

ORDINANCE NO. 2022-10-52

AN ORDINANCE CREATING SECTION 17.5.135 OF THE AMERICAN FORK CITY MUNICIPAL CODE RELATING TO INSTALLATION OF COMMUNICATION INFRASTRUCTURE DESIGN STANDARDS AND PROVIDING AN EFFECTIVE DATE FOR THE ORDINANCE.

WHEREAS, American Fork City seeks to promote the health, safety, morals, convenience, order, prosperity, and general welfare of American Fork City;

WHEREAS, the American Fork City Council finds it in the best interest of the City to adopt design standards for the installation of communication infrastructure;

WHEREAS, the American Fork City Council finds that the adoption of this ordinance would promote the health, safety and welfare of the City and its residents.

NOW THEREFORE, be it ordained by the city council of American Fork, Utah, that:

**PART I
TEXT OF ORDINANCE**

SECTION 1. Chapter 17.5.135 of the Municipal Code of American Fork City, relating to installation of communication infrastructure design standards, shall read as follows:

17.5.135 Installation of Communication Infrastructure Design Standards

The publication known as the American Fork City Developer Installed Communications Infrastructure Design Standards, adopted October 25, 2022, and as amended by motion of the city council, one copy of which is filed in the office of the city recorder, is adopted by reference, in its entirety, as presently constituted and shall be known as Section 17.5.135 of the American Fork Municipal Code.

**PART II
CONFLICTING ORDINANCES, SEVERABILITY, AND ADOPTION**

SECTION 1. Conflicting Provisions. Whenever the provisions of this Ordinance conflict with the provisions of any other ordinance, resolution, or part thereof, the more stringent shall prevail.

SECTION 2. Provisions Severable. This Ordinance and the various sections, clauses and paragraphs are hereby declared to be severable. If any part, sentence, clause, or phrase is

adjudged to be unconstitutional or invalid, it is hereby declared that the remainder of the ordinance shall not be affected thereby.
This amended ordinance shall take effect immediately upon its passage and publication as prescribed by law.

Passed by the American Fork City Council this 25 day of October, 2022.



Bradley J. Frost
American Fork City Mayor

ATTEST:



Terilyn Lurker
City Recorder





**American Fork City
Developer Installed Communications
Infrastructure Design Standards**



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SECTION 1

GENERAL AFFN REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all American Fork Fiber-Optic Network (hereinafter “AFFN”) components as defined on the plans, specifications, details, and special provisions.
- B. It is the developer’s responsibility to purchase, install, and provide all components and materials, at the developer’s expense.
- C. Provide all documentation required for the installation and testing of AFFN infrastructure.
- D. Developer Design Requirements
- E. Once installed and approved by AFFN, American Fork City (hereinafter “AFC”) will have full ownership of the infrastructure placed by the developer.

1.2 RELATED SECTIONS

- A. SECTION 1 AFFN GENERAL REQUIREMENTS
- B. SECTION 2 AFFN CONDUIT REQUIREMENTS
- C. SECTION 3 AFFN HANDHOLE ENCLOSURE REQUIREMENTS

1.3 REFERENCES

- A. American Wire Gauge (AWG)
- B. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications
- C. National Electric Code (NEC)
- D. Underwriters Laboratory (UL)
- E. National Electric Safety Code (NESC)

1.4 DEFINITIONS

- A. AFFN – American Fork Fiber Network
- B. CFE – City Fiber-Optic Engineer
- C. AFC – American Fork City

1.5 SUBMITTALS

- A. Provide all required submittals as described in this section, part 2.1, paragraph A.

1.6 WARRANTY

- A. Provide to AFFN any warranty documents from the manufacturer for each of its components. The workmanship performed by the developer and its sub-contractors must be warrantied for the duration of one year (the “Warranty Period”) from the date of final acceptance of the entire project by AFFN.
- B. Warranties are not required for AFFN furnished components (if any).
- C. Take any corrective action necessary during the Warranty Period, within 72 hours after written notification by the CFE to restore any identified deficiency caused by defective workmanship or materials. Developer is required to repair or replace defective components at their expense. Notify the CFE when corrective action has been completed for approval inspection by CFE.

1.7 DEVELOPER DESIGN REQUIREMENTS

- A. Developer will need to schedule a design meeting with the CFE to go over the common trench design layout to ensure that AFFN Infrastructure will be designed and placed as decided between the developer and the CFE.
 - a. Developer will ensure that all road crossings have sleeves with adequate room for AFFN 4-Way conduit to be placed as decided in the design meeting with CFE.
 - b. Design meeting is intended to be a kick-off point to make sure developer understands the design placement of handhole enclosures and 4-Way conduit throughout the entire development.

1.8 OWNERSHIP OF AFFN INFRASTRUCTURE

- A. All AFFN Infrastructure placed by developer will be fully owned by AFC.

PART 2 PRODUCTS

2.1 DOCUMENTATION

A. Submittals

1. Provide one copy of all documentation, including all manufactures documents, configuration data, and developer provided as-built drawings to the City Fiber-Optic Engineer (hereinafter “CFE”) before final acceptance by AFC.
2. The general purpose and content of all required submittals is described in the following list. The details of the submittal requirements for each AFFN component type can be found in the appropriate Standard Specification, Supplemental Specification, or Special Provision for the AFFN component.
 - a. Developer Furnished Material and Component Lists: The lists will include the name of the manufacturer, size, and identification number.
 - b. Test Reports: After the completion of a successful locate wire continuity test of each conduit placed, provide a test report to certify end-to-end conduit/locate wire continuity. This test should be performed before and after backfilling of the common trench. Provide test report to the CFE in either digital format or a printed format. The test reports will include the following items:
 - 1) All test results (including failed tests)
 - 2) Description of any observed discrepancies
 - 3) Description of required corrective action
 - 4) Estimated time to complete corrective action and re-test
 - 5) Results of any corrective action
 - c. Completion Notice: Provide a Completion Notice to the CFE after all components have successfully passed AFFN component tests. The Completion Notice consists of the certification that all AFFN components are compliant with all project requirements.
 - d. Manufacturer’s component documentation for all developer furnished components, provide all factory issued manuals, warranties, instruction sheets, and parts lists to the CFE.
 - e. As-Built Drawings.

B. Documentation Timeline

1. The following list describes the conditions under which submittals must be provided:
 - a. Developer Furnished Material and Component Lists: Submit within fifteen business days prior to ordering. All developer furnished components must be approved by the CFE prior to ordering.
 - b. Test Reports: Submit within five business days from the completion of a successful test of the components.
 - c. Completion Notice: Submit within five business days prior to the final walkthrough of project with the CFE.

- d. Manufacturer's component documentation and As-Built Drawings must be received no later than fifteen business days prior to Final Acceptance.
 2. The CFE accepts or rejects submittals within ten business days. If rejected, the developer must rectify and resubmit rejected submittals within five business days, or as specified by the CFE.
- C. Factory Issued Manuals
 1. Acceptable factory manuals must contain technical, diagnostic, and maintenance (preventative and troubleshooting) information. Advertising brochures and catalog cuts not accepted.

PART 3 EXECUTION

3.1 TESTING AND ACCEPTANCE

- A. The following test procedures will be required for all AFFN locations:
 - 1. Perform Locate Wire Continuity Test according to specifications.

3.2 DEVELOPER INSTALLED COMPONENTS

- A. Until final acceptance, repair any damage to AFFN developer placed components including but not limited to conduit, junction boxes, pedestals, or underground utilities that are caused by the developers' activities. Request a meeting with the CFE to verify that all installed components are in working order at the project site as requested by the developer, if needed.
- B. Developer must coordinate the locating and marking of all utilities prior to initiation of construction. Developer must contact Blue Stakes of Utah, utilities or government agencies not participating in either of the above-mentioned notification agencies, then schedule the locating of underground utilities. Developer must determine the exact location of all existing utilities before commencing work and be fully responsible for any damage that might result from the failure to locate and preserve any underground utilities.
- C. Do not proceed on work occurring outside designated right-of-way until the required permits, environmental clearances and approvals are obtained from all local entities.
- D. Perform all digging using hand tools if any construction is to take place within two feet either side of existing facilities.

3.3 LOCATION OF INSTALLED COMPONENTS

- A. Proposed component locations may be modified to avoid conflict with underground utilities or other obstructions. Consult CFE for approval.
- B. Install all above ground components the maximum practical distance from traffic, behind barrier or other approved protection.

3.4 INSTALL GROUND WIRING

- A. Ground wire:
 - 1. All ground wire must be 10 AWG.
 - 2. Bond each ground wire to the ground rod in each handhole enclosure with removable clamp.
- B. Neatly arrange wiring within cabinets, handhole enclosures, fixtures, etc.

3.5 MAINTENANCE

- A. Repair, replace, maintain, and operate all installed AFFN components as defined in Section 3.2. Includes but is not limited to:
 - 1. Repair or replacement of damaged conduit and handhole enclosures.
- B. Repair installation or replace components due to any damage.

- C. During the Warranty period defined in Section 1.6, failure to provide adequate routine or emergency maintenance will result in AFC or its designated contractor performing the necessary maintenance. AFC will provide written notice to the developer and developer will have 5 business days from receipt of notice to complete the maintenance. If the maintenance is not performed within the allotted time, the developer will be charged for all costs incurred by AFC to perform the work.

END OF SECTION 1

SECTION 2

AFFN CONDUIT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install conduit as shown on the plans and details. Unless otherwise specified, install conduit in the common trench where power conduit and communications conduits reside.
- B. Install all materials, labor, workmanship, components, and incidental items required for a complete system of conduit.

1.2 RELATED SECTIONS

- A. SECTION 1 AFFN GENERAL REQUIREMENTS
- B. SECTION 2 AFFN CONDUIT REQUIREMENTS
- C. SECTION 3 AFFN HANDHOLE ENCLOSURE REQUIREMENTS

1.3 REFERENCES

- A. Standard Specification for Dura-line 4-Way Future Path micro-conduit
- B. American National Standards Institutes (ANSI)
- C. American Wire Gauge (AWG)
- D. National Electric Code (NEC)
- E. National Electrical Manufacturers Association (NEMA)
- F. Underwriters Laboratory (UL)

PART 2 PRODUCTS

2.1 MATERIALS

- A. Conduit and Fittings:
 - 1. Orange Sheath Dura-line 4-Way Future Path bundled 18/14mm Micro-Conduits with locate wire included.
 - 2. Microtechnology Accessories 18/14mm Straight Couplers
- B. Provide all materials used in the installation of conduits such as couplings, plugs, and fittings to meet or exceed all the recommendations of the conduit manufacturer for suitable installation.
- D. In the rare case splicing of the micro-conduits are necessary, use Microtechnology Accessories 18/14mm Straight Couplers installed as recommended by the conduit manufacturer for suitable installation. Splicing of micro-conduit should be avoided and must be approved by the CFE prior to splicing.
- E. Provide fiber optic and electrical buried cable marker warning tape that meets the following requirements:
 - 1. Material: Composite reinforced thermoplastic.
 - 2. Tape Color: Orange (fiber optic).
 - 3. Length: 5 feet minimum.
 - 4. Text: Caution Buried Fiber Optic Cable (front and back).
 - 5. Text Color: Black.
 - 6. Width: 3 inch minimum (face or diameter).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conduit must be placed in the common trench a minimum depth of 30 inches and a maximum depth of 48 inches.
- B. When installing Dura-Line 4-Way Future Path conduit, please refer to the charts located in Section 4 of this document for bend radius specifications.
- C. Obtain appropriate permits before work commences.
- D. Conduit Stub
 - 1. Install conduit into handholes brought up from underneath the open bottom handhole enclosure.
 - 2. A minimum 12 inches of conduit must be stubbed into handhole.
- E. Install compatible conduit plug at each end of the conduit.
- F. Fill all new and existing conduit to less than 40 percent as per NEC.

3.2 AFFN CONDUIT IN COMMON TRENCH

- A. Place all conduit in the common trench as straight as possible. Refer to Section 4 for details and recommendations on the placement of conduit in the common trench.

END OF SECTION 2

SECTION 3

AFFN HANDHOLE ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install handholes as shown in Section 4.
- B. Includes all materials, labor, workmanship, components, and incidental items required for a complete conduit system.

1.2 RELATED SECTIONS

- A. SECTION 1 AFFN GENERAL REQUIREMENTS
- B. SECTION 2 AFFN CONDUIT REQUIREMENTS
- C. SECTION 3 AFFN HANDHOLE ENCLOSURE REQUIREMENTS

1.3 REFERENCES

- A. American National Standards Institutes (ANSI)
- B. National Electric Code (NEC)
- C. National Electrical Manufacturers Association (NEMA)
- D. Underwriters Laboratory (UL)
- E. National Electric Security Code (NESC)

PART 2 PRODUCTS

2.1 MATERIALS

A. Handholes:

1. AFFN standard handhole enclosures are 30" (w)x48" (l)x36" (d), open bottom, T22 load rated box and T22 load rated lids. Lids may be 1-piece or 2-piece, but the weight of a single lid section may not be greater than 230 lbs. Handhole enclosures shall be straight wall with minimal wall flaring. Handhole enclosure construction may be Polymer Blend, Polymer Concrete, or Plastic. Fiberglass handhole enclosures and lids are not permitted.
2. Acceptable manufactures and models include Hubbell-Pencell or Quazite, Channell-Bulk Series, or Oldcastle-Carson, Duralite, or PC.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Handhole enclosures shall be placed with top of handhole at ground level. Handhole must be placed level unless approved by CFE prior to installation. Lip of handhole must be flush with the ground to prevent any potential tripping hazards.
- B. Place a minimum 6 inches of small gravel in the bottom of each handhole for drainage.
- C. Conduit entering handhole must be placed as follows:
 - 1. All conduits must be brought up from underneath an open bottom handhole enclosure.
 - 2. A minimum 12 inches of conduit must be stubbed into the handhole enclosure,
- D. Install a 3/8" x 3' ground rod with no more than 6 inches protruding above gravel base in each handhole enclosure. Ground rods should be placed in a corner closest to the nearest roadway of handhole enclosure.
 - 1. Install two 10 AWG, stranded, green jacketed ground wires, no less than 5 feet in length. On each wire, attach one end to the ground rod with a removable clamp and install a "Ring Terminal" on the opposite end.
- E. AFFN handhole enclosures must be placed at all junction points where all other utilities pedestal/vaults/handhole enclosures are placed.

END OF SECTION 3

SECTION 4
DRAWINGS AND SPECIFICATIONS

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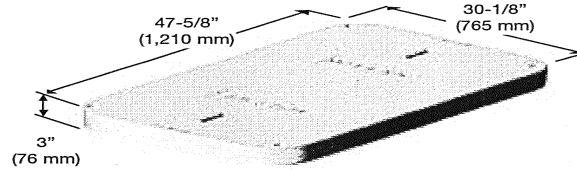


Glendora, California
 Toll-Free: 800.735.5566
 Phone: 909.592.6272
 Fax: 909.592.7971

Roscommon, Ireland
 Phone: 35.39.03.25922
 Fax: 35.39.03.25921

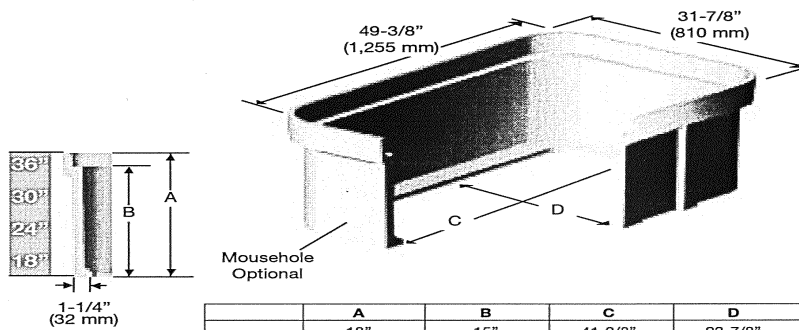
H Series H3048

Heavy Duty



Cover¹ (2 piece)

Material: Polymer Concrete
 Weight: 144.0 lbs. (65.3 kgs) per half cover
 Model: H3048-P1
 Skid Resistant Surface²
 (Material and cover dimensions compliant with WUC, Guide 3.6³)



Bodies (18", 24", 30", 36")

Material: Polymer Concrete

- 18" Weight: 165 lbs. (75 kg) Model: H3048-18
- 24" Weight: 220 lbs. (100 kg) Model: H3048-24
- 30" Weight: 271 lbs. (122 kg) Model: H3048-30
- 36" Weight: 314 lbs. (141 kg) Model: H3048-36

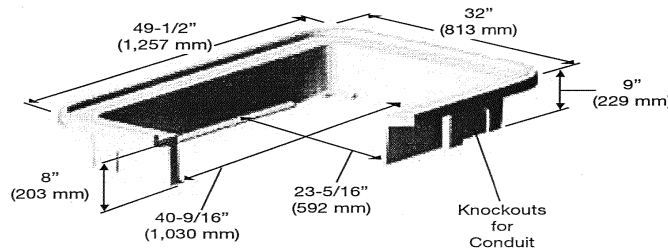
| | A | B | C | D |
|-----------------|-----------------|-----------------|-----------------------|-----------------------|
| H3048-18 | 18" (457 mm) | 15" (381 mm) | 41-3/8" (1051 mm) | 23-7/8" (606 mm) |
| H3048-24 | 24" (610 mm) | 21" (533 mm) | 41-5/16" (1049 mm) | 23-13/16" (605 mm) |
| H3048-30 | 30" (762 mm) | 27" (686 mm) | 41-3/16" (1045 mm) | 23-11/16" (601 mm) |
| H3048-36 | 36" (914 mm) | 33" (838 mm) | 41" (1041 mm) | 23-1/2" (597 mm) |

Bottom Extension

Material: Polymer Concrete
 Model: H3048-9X (99.0 lbs. /45 kgs)

Tolerances

Cover $\pm 1/8"$ (3 mm); Body $\pm 1/8"$ (3 mm)
 Foot $\pm 1/16"$ (2 mm); Height $\pm 1/4"$ (6 mm)



Fasteners: 2 each (optional 4 ea) 1/2-13 UNC, Stainless Steel, Hex Head with Washer; Options: Captive bolt and floating nut, size, quantity, type head are available.
Cover Identification is blank unless specified
Pull Slot 1/2" x 4" (13 mm x 102 mm)
Steel Covers Optional

Boxes are stackable. 24" deep shall be used as the lower box only. Vertical load ratings are stated for single boxes. For units with MOLDED OPENINGS, subtract 2 lbs from Unit Weight. Weights may vary slightly. Dimensions in inches with metric equivalents.

Revision Date 4/2003

H Series H3048

Heavy Duty

Carson Industries, LLC

Glendora, California
Toll-Free: 800.735.5566
Phone: 909.592.6272
Fax: 909.592.7971

Roscommon, Ireland
Phone: 35.39.03.25922
Fax: 35.39.03.25921

Vertical and Lateral Load Rating

Heavy Duty Covers

- Compliant with AASHTO, Design Load of H-10; ASTM C 857-95, Design Load of A-8, 8,000 lbs. Capable of withstanding a Static Load of >22,880 lbf transferred through a 10" x 10" steel plate centered on the cover and body.
- Compliant with AASHTO, Design Load of H-20; ASTM C 857-95, Design Load of A-16, 16,000 lbs. Capable of withstanding a Static Load of >45,760 lbf transferred through a 10" x 20" steel plate centered on the cover and body.
- This product is designed to withstand H-10 and H-20 loading in incidental or non-deliberate traffic areas. Not intended to be installed in roadways.

Shipping Configuration

- Single Bodies – 18":**
Unit, 2 assemblies, = 47.8 cu. ft.; 906.0 lbs.
- Single Bodies – 24":**
Unit, 2 assemblies, = 61.8 cu. ft.; 1,016.0 lbs.

| Standard Test Method | Properties of Raw Material | ASTM Designation | Test Results |
|---|--|------------------|----------------------------|
| Compressive Strength of Polymer Concretes | Compressive Strength | C 579-96 | 11,000 psi |
| Flexural Strength and Modulus of Elasticity of Polymer Concretes | Flexural Strength Modulus of Elasticity | C 580-93 | 1,800 psi 2,900,000 psi |
| Chemical Resistance of Polymer Concretes | Chemical Resistance | C 267-97 | Pass ⁴ |
| Determination of Impact Resistance by means of a Tup (falling weight) | Impact Resistance | D 2444-93 | Pass ⁵ |

¹AASHTO H-10, ASTM C 857, A-8, 8,000 lbs Design Load. Static Vertical Load Rating >22,880 lbf.
AASHTO H-20, ASTM C 857 A-16, 16,000 lbs Design Load. Static Vertical Load Rating > 45,760 lbf

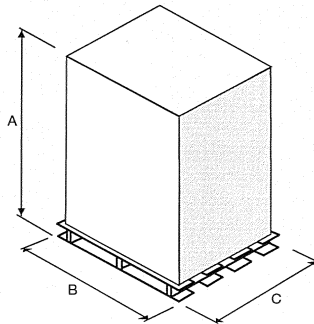
²Coefficient of Friction (ASTM C1028) >0.5

³Western Underground Committee, Guide 3.6

⁴Specimens exposed to ten reagents (alkalis, acids and petroleum distillates) experience <2% weight and dimensional change and retain >75% of average Compressive Strength. Listing of reagents and test reports available upon request.

⁵Capable of withstanding 70 ft lbs impact with a type "C" Tup.

Shipping Information

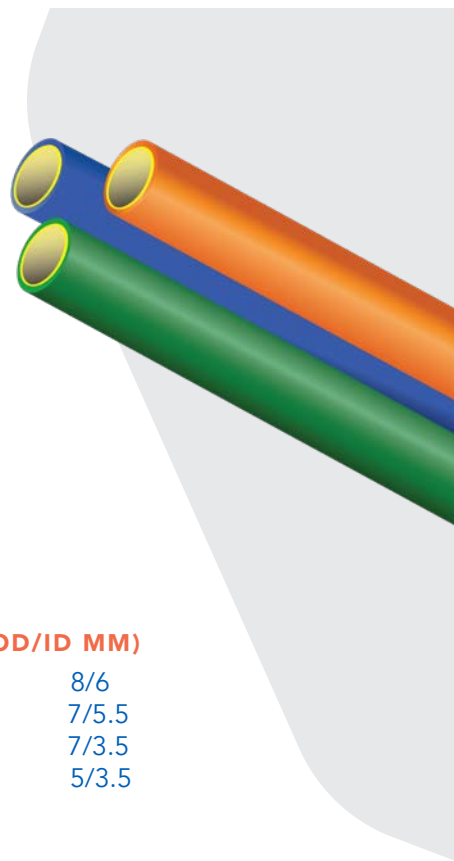


| UNIT 3048-18 | | | UNIT 3048-24 | | | UNIT 3048-30 | | | UNIT 3048-36 | | |
|--|-------------|-------|--|-------------|-------|---|-------------|-------|--|-------------|-------|
| Dim. | Description | Value | Dim. | Description | Value | Dim. | Description | Value | Dim. | Description | Value |
| A | Height | 42" | A | Height | 54" | A | Height | 36" | A | Height | 42" |
| B | Length | 42" | B | Length | 42" | B | Length | 42" | B | Length | 42" |
| C | Width | 54" | C | Width | 54" | C | Width | 54" | C | Width | 54" |
| Units: 2 per pallet Weight: 961 lbs. per pallet | | | Units: 2 per pallet Weight: 1,071 lbs. per pallet | | | Units: 2 per pallet Weight: 1,173 lbs. per pallet | | | Units: 2 per pallet Weight: 1,259 lbs. per pallet | | |
| BODY 3048-18 | | | BODY 3048-24 | | | BODY 3048-30 | | | BODY 3048-36 | | |
| Dim. | Description | Value | Dim. | Description | Value | Dim. | Description | Value | Dim. | Description | Value |
| A | Height | 42" | A | Height | 54" | A | Height | 36" | A | Height | 42" |
| B | Length | 42" | B | Length | 42" | B | Length | 42" | B | Length | 42" |
| C | Width | 54" | C | Width | 54" | C | Width | 54" | C | Width | 54" |
| Units: 4 per pallet Weight: 715 lbs. per pallet | | | Units: 4 per pallet Weight: 935 lbs. per pallet | | | Units: 2 per pallet Weight: 597 lbs. per pallet | | | Units: 2 per pallet Weight: 683 lbs. per pallet | | |
| COVER | | | BOTTOM EXTENSION | | | All information contained in this brochure was current at the time of printing. Because of Carson Industries' policy of ongoing research and development, the Company reserves the right to discontinue or update product information without notice. | | | | | |
| Dim. | Description | Value | Dim. | Description | Value | | | | | | |
| A | Height | 21" | A | Height | 47" | | | | | | |
| B | Length | 42" | B | Length | 42" | | | | | | |
| Units: 15 sets per pallet Weight: 1,485 lbs. per pallet | | | Units: 5 per pallet Weight: 540 lbs. per pallet | | | | | | | | |

MICROTECHNOLOGY

MICRODUCTS HDPE

- HDPE MicroDucts are small starting at a 5 mm diameter
- Co-extruded with SuperSilicore™ permanent lining to reduce friction on cable installs
- Utilize space in an occupied duct
- Revitalize existing networks with Over-Rides
- Substantially reduce construction costs & deployment time
- Install up to 432 count fiber MicroCables
- Check specifications below



INSTALLATION TYPES

Subdivided Conduit, tional Bore, Micro-
 Overrides, Plow Trench, Tray Instal-
 Installations, Trench lations
 Installations, Direc-

SIZE RANGE AVAILABLE (OD/ID MM)

| | | |
|-------|---------|-------|
| 27/20 | 14/10 | 8/6 |
| 22/16 | 12.7/10 | 7/5.5 |
| 18/14 | 12.7/8 | 7/3.5 |
| 18/10 | 12/10 | 5/3.5 |
| 16/13 | 10/8 | |
| 16/12 | 8.5/6 | |

STANDARD COLORS

Oversheath 
 MicroDucts  
 Custom Colors Available            

FEATURES

STANDARD

SEQUENTIAL FOOT OR METERZ MARKINGS Custom print streams available

SUPER SILICORE is co-extruded with the tough HDPE wall creating a permanent, super slippery interior lining. It has the lowest co-efficient of friction compared to other options, no performance loss in all temperature conditions and functions without additional wet lubricants

INTERNAL RIBS standard on most MicroDucts (3.5mm ID are designed with a standard smooth interior)

OPTIONS

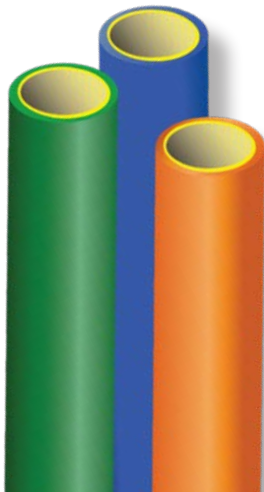
FIRE RETARDANT Available in Riser, Plenum or Low Smoke Zero Halogen (LSZH)

PRE-INSTALLED FIBER OR PULL-STRING OPTION Fiber cable or cordage can be factory preinstalled; alternatively, MicroDuct can be supplied with a factory pre-installed pull string for pulling in fiber optic cable



+1 800 847 7661
 WWW.DURALINE.COM





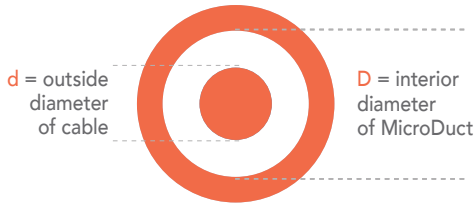
PRODUCT RECOMMENDATIONS:

Dura-Line manufactures many different sizes and configurations of MicroDucts for a variety of applications, such as: Backbone, Back-haul, Direct Buried, Directional Drilling, Over-Rides, and populating existing conduits. In order to get the best product performance, please follow the suggested guidelines for choosing the best MicroDuct size.

DIRECT BURIED (DB): In applications where the MicroDucts will be directly buried, or bundled into FuturePath configurations, we recommend using a thicker walled MicroDuct to maintain the optimum fill ratios and have faster, easier installations.

DIRECT INSTALL (DI): In applications where the MicroDuct or FuturePath configuration will be placed inside an existing conduit, like an Over-Ride or populating an existing conduit, we recommend using a thinner walled product where protection is provided by the existing conduit and space is more sensitive.

| MICRODUCT-SIZE (MM) | APPLICATION DB/DI | NOM OD (MM/IN) | MIN ID (MM/IN) | WEIGHT (LB/FT) | BEND RADIUS SUP* (IN) | BEND RADIUS UNSUP* (IN) | SWPS † (LBS) |
|---------------------|-------------------|----------------|----------------|----------------|-----------------------|-------------------------|--------------|
| 22/16 | DB | 22/0.87 | 15.4 / 0.61 | 0.116 | 9 | 18 | 615 |
| 18/14 | DB | 18/0.71 | 13.6 / 0.54 | 0.066 | 7 | 14 | 352 |
| 12.7/10 | DB, DI | 12.7/0.5 | 9.8 / 0.39 | 0.032 | 5 | 10 | 167 |
| 5/3.5 | DI | 5/0.2 | 3.4 / 0.13 | 0.006 | 2 | 4 | 33 |
| 27/20 | DB | 26.7/1.05 | 20.7 / 0.81 | 0.132 | 11 | 21 | 701 |
| 7/3.5 | DB | 7/0.28 | 3.7 / 0.15 | 0.018 | 3 | 6 | 97 |
| 7/5.5 | DI | 7/0.28 | 5.6 / 0.22 | 0.009 | 3 | 6 | 49 |
| 8/6 | DI | 8/0.31 | 5.8 / 0.23 | 0.014 | 3 | 6 | 76 |
| 8.5/6 | DI, DB | 8.5/0.34 | 5.9 / 0.23 | 0.018 | 3 | 7 | 96 |
| 10/8 | DI | 10/0.39 | 8.1 / 0.32 | 0.018 | 4 | 8 | 93 |
| 12/10 | DI | 12/0.47 | 9.9 / 0.39 | 0.021 | 5 | 9 | 114 |
| 12.7/8 | DB | 12.7/0.5 | 7.9 / 0.31 | 0.05 | 5 | 10 | 268 |
| 14/10 | DB | 14/0.55 | 9.8 / 0.39 | 0.05 | 6 | 11 | 264 |
| 16/12 | DB | 15.9/0.63 | 11.6 / 0.46 | 0.058 | 6 | 13 | 305 |
| 16/13 | DI | 16/0.63 | 12.8 / 0.5 | 0.043 | 6 | 13 | 229 |
| 18/10 | DB | 18/0.71 | 10 0.39 | 0.11 | 7 | 14 | 581 |



(D/D)*100 = % FILL RATIO

To calculate the fill ratio, divide the cable diameter (d) by the interior dimension (D) of the MicroDuct. To achieve maximum jetting performances, Dura-Line recommends a fill ratio between 50% and 75%. Several factors impact jetting performance, including the condition of route, bends and equipment.

RECOMMENDED FIBER FILL RATIOS

| MICRODUCT SIZE* (MM) | FIBER COUNT† | FIBER CABLE OD RANGE (MM) |
|----------------------|--------------|---------------------------|
| 5/3.5 | up to 12 | 1.8 – 2.6 |
| 7/5.5 | up to 48 | 2.8 – 4.1 |
| 8.5/6 | up to 96 | 3.0 – 4.5 |
| 10/8 | up to 96 | 4.0 – 6.0 |
| 12.7/10 | up to 144 | 5.0 – 7.5 |
| 14/10 | up to 144 | 5.0 – 7.5 |
| 16/12 | up to 192 | 6.0 – 9.0 |
| 16/13 | up to 288 | 6.5 – 9.8 |
| 18/10 | up to 144 | 5.0 – 7.5 |
| 18/14 | up to 288 | 7.0 – 10.5 |
| 22/16 | up to 432 | 8.0 – 12.0 |
| 27/20 | up to 432 | 10.0 – 15.0 |

*Other sizes available, please contact Customer Service for details
 †Fiber count subject to change

RECOMMENDED MICRODUCT FILL RATIOS (# OF MICRODUCTS PER STANDARD DUCT SIZE SDR11 OR SDR13.5)

| DUCT SIZE | 16MM/13MM | 12.7MM/10 MM | 12MM/10MM | 10MM/8MM |
|-----------|-----------|--------------|-----------|----------|
| 1" | N/A | 2 | 2 | 3 |
| 1.25" | N/A | 3 | 4 | 5 |
| 1.5" | 2 | 4 | 6 | 8 |
| 2" | 5 | 7 | 8 | 10 |

Numbers can vary based on the path of the existing conduit, bend radii, elevation changes, distances, and installation method.



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MICROTECHNOLOGY

FUTUREPATH

- Multiple pathways for one installation cost, allows flexibility and future growth
- No special tools or equipment needed; installation uses the same as traditional conduit or innerduct
- Choose the correct MicroDuct size based on the Outer Diameter (OD) of desired MicroCable. Dura-Line recommends a fill ratio of 50% to 75% for optimal cable placement performance. Several factors impact jetting distance, including the condition of route, bends, and equipment.

INSTALLATION TYPES

| | |
|--------------|------------------|
| Plow | Directional Bore |
| Micro-Trench | Tray |

CONFIGURATIONS

| | |
|-------|--------|
| 2-way | 12-way |
| 3-way | 19-way |
| 4-way | 24-way |
| 7-way | |

OVERSHEATH & MICRODUCT COLORS



custom colors available for MicroDucts and Oversheath



FEATURES

STANDARD

SEQUENTIAL FOOT OR METER MARKINGS Custom print streams available

MATERIAL Available in HDPE, Plenum, Riser, or LSZH and factory bundled in an oversheath

RIP CORD(S) for easy opening of the sheath

SILICORE® ULF (Ultra-Low Friction) is co-extruded inside the HDPE wall creating a slick, permanent, interior lining. With a coefficient of friction 60% lower than standard HDPE conduit without the aid of wet lubricants, SILICORE ULF exhibits no loss in performance over time or in extreme temperature conditions

SHIPS ON STANDARD REEL

INTERNAL RIBS standard (except 3.5mm ID are designed with a standard smooth interior)

OPTIONS

LOCATE WIRE Available with or without a 20 AWG insulated copper wire

THICKER OVERSHEATH Available in most configurations to meet your needs for more rugged projects

UV PROTECTION Available with carbon black and antioxidants for maximum UV protection

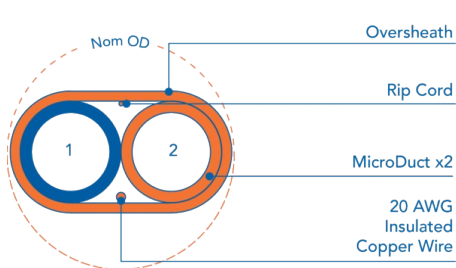
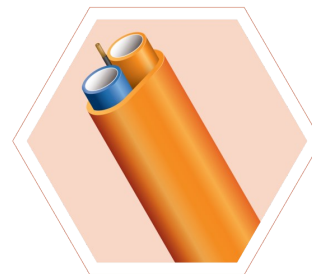


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FUTUREPATH

2-way 18/14 mm



| | |
|--------------------------|-------------|
| MicroDuct OD/ID | 18/14 mm |
| Nominal OD | 1.56 in |
| MicroDuct Min ID | 14 mm |
| Oversheath | 0.07 in |
| Weight | 0.244 lb/ft |
| Bend Radius Sup | 16 in |
| Bend Radius UnSup | 31 in |
| Conduit SWPS | 1316 lbs |

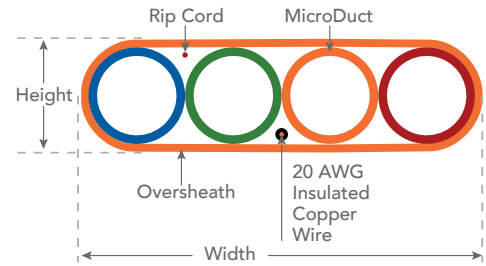
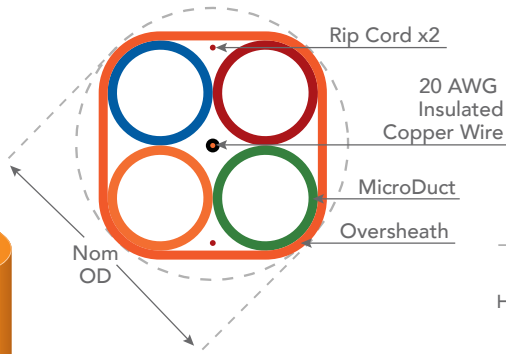
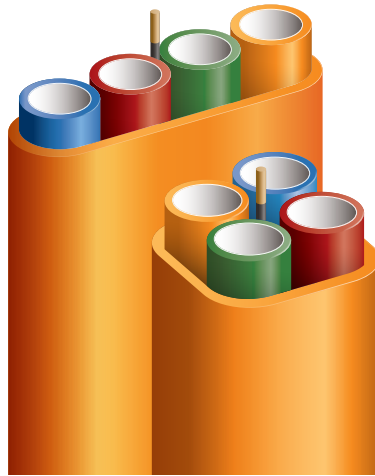
| STANDARD DETAILS | |
|---------------------------|--|
| DETAILS | FuturePath is a unit of bundled MicroDucts. Manufactured from flexible HDPE (High Density Polyethylene) |
| INSTALLATION TYPES | Subdivided Conduit, Overrides, Plow, Trench, Directional Bore, MicroTrench, Tray |
| FILL RATIO | Choose the correct MicroDuct size based on the Outer Diameter (OD) of desired MicroCable. Dura-Line recommends a fill ratio of 50% to 75% for optimal cable placement performance. Several factors impact jetting distance including the condition of route, bends, and equipment. |
| COLORS | Oversheath: Orange MicroDucts: (1) Blue, (2) Orange |
| CONDUIT MARKINGS | Permanent marking along FuturePath includes: material, relevant standards, production info, and sequential feet or meter markings. Custom options available. |
| CO-EXTRUDED LINING | SILICORE® ULF (Ultra-Low Friction) is co-extruded inside the HDPE wall creating a slick, permanent, interior lining. SILICORE® ULF exhibits no loss in performance over time or in extreme temperature conditions. |
| INTERNAL RIBS | Standard (except 3.5mm ID MicroDucts which are designed with a standard smooth interior) |
| LOCATE WIRE | Includes a 20 AWG insulated copper wire |
| RIP CORD(S) | For easy opening of the oversheath |
| OPTIONS | |
| THICKER OVERSHEATH | Available in most configurations to meet your needs for more rugged projects |

† Safe working pull strength is calculated at 80% of tensile or breaking strength

* Unsupported Bend Radius guidelines should be followed during the installation process. The Supported Bend Radius are post-installation measurements.

MICROTECHNOLOGY

FUTUREPATH 4-WAY



FUTUREPATH 4-WAY TECHNICAL SPECIFICATIONS

| MICRODUCT OD/ID (MM) | NOM OD (IN) | MICRODUCT MIN ID (MM) | MICRODUCT MIN ID (IN) | OVERSHEATH (IN) | WEIGHT (LB/FT) | BEND RADIUS SUP* (IN) | BEND RADIUS UNSUP* (IN) | SWPS† (LBS) |
|----------------------|-------------|-----------------------|-----------------------|-----------------|----------------|-----------------------|-------------------------|-------------|
| 5/3.5 | 0.56 | 3.4 | 0.13 | 0.04 | 0.050 | 7 | 12 | 276 |
| 8.5/6 | 0.93 | 5.9 | 0.23 | 0.06 | 0.136 | 12 | 20 | 733 |
| 10/8 | 1.04 | 8.1 | 0.32 | 0.04 | 0.120 | 11 | 17 | 635 |
| 12.7/10 | 1.34 | 9.8 | 0.39 | 0.07 | 0.236 | 13 | 27 | 1,260 |
| 12.7/10 (FLAT) | 2.14 | 9.8 | 0.39 | 0.05 | 0.223 | 21 | 42 | 1,189 |
| 14/10 | 1.47 | 9.8 | 0.39 | 0.07 | 0.320 | 13 | 25 | 1,709 |
| 16/12 | 1.66 | 11.6 | 0.46 | 0.07 | 0.368 | 17 | 33 | 1,963 |
| 16/13 | 1.65 | 12.8 | 0.50 | 0.07 | 0.308 | 25 | 41 | 1,658 |
| 16/13 (FLAT) | 2.67 | 12.8 | 0.50 | 0.05 | 0.290 | 39 | 66 | 1,516 |
| 18/14 | 1.86 | 13.6 | 0.54 | 0.07 | 0.417 | 19 | 37 | 2,243 |
| 22/16 | 2.23 | 15.4 | 0.61 | 0.07 | 0.613 | 28 | 47 | 2,840 |
| 27/20 | 2.68 | 20.7 | 0.81 | 0.07 | 0.751 | 40 | 67 | 4,024 |

* Unsupported Bend Radius guidelines should be followed during the installation process. The Supported Bend Radius are post-installation measurements.

† Safe working pull strength is calculated at 80% of tensile or breaking strength

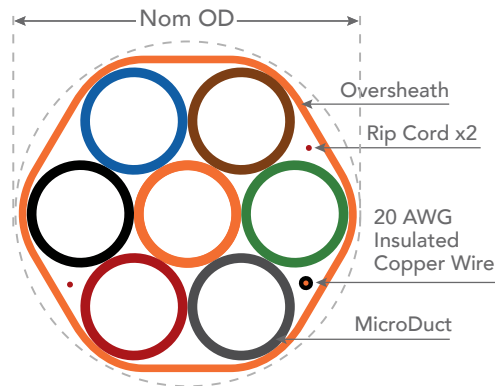
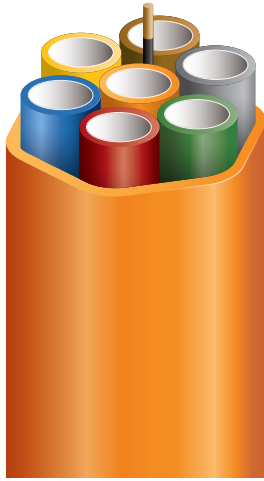


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MICROTECHNOLOGY

FUTUREPATH 7-WAY



FUTUREPATH 7-WAY TECHNICAL SPECIFICATIONS

| MICRODUCT OD/ID (MM) | NOM OD (IN) | MICRODUCT MIN ID (MM) | MICRODUCT MIN ID (IN) | OVERSHEATH (IN) | WEIGHT (LB/FT) | BEND RADIUS SUP* (IN) | BEND RADIUS UNSUP* (IN) | SWPS† (LBS) |
|-----------------------|-------------|-----------------------|-----------------------|-----------------|----------------|-----------------------|-------------------------|-------------|
| 5/3.5 | 0.67 | 3.4 | 0.13 | 0.04 | 0.075 | 7 | 13 | 409 |
| 7/5.5 | 0.93 | 5.6 | 0.22 | 0.05 | 0.116 | 9 | 19 | 633 |
| 8.5/6 | 1.13 | 5.9 | 0.23 | 0.06 | 0.207 | 16 | 26 | 1,112 |
| 10/8 | 1.29 | 8.1 | 0.32 | 0.05 | 0.204 | 13 | 26 | 1,080 |
| 12.7/10 | 1.64 | 9.8 | 0.39 | 0.07 | 0.360 | 16 | 33 | 1,926 |
| 14/10 | 1.77 | 9.8 | 0.39 | 0.05 | 0.465 | 18 | 35 | 2,474 |
| 16/12 | 2.03 | 11.6 | 0.46 | 0.07 | 0.579 | 20 | 40 | 3,079 |
| 16/13 | 2.03 | 12.8 | 0.50 | 0.07 | 0.471 | 20 | 41 | 2,530 |
| 18/14 | 2.27 | 13.6 | 0.54 | 0.07 | 0.656 | 31 | 52 | 3,522 |
| 22/16 | 2.74 | 15.4 | 0.61 | 0.07 | 1.047 | 38 | 63 | 5,588 |
| 27/20 | 2.97 | 20.7 | 0.81 | 0.05 | 1.126 | 49 | 81 | 6,013 |

* Unsupported Bend Radius guidelines should be followed during the installation process. The Supported Bend Radius are post-installation measurements.
 † Safe working pull strength is calculated at 80% of tensile or breaking strength



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MICROTECHNOLOGY ACCESSORIES

STRAIGHT COUPLERS

- Easy assembly/disassembly, no tools required, low profile design
- Provide an air and water tight connection
- Designed and tested to meet or exceed industry standards
- Color coded to easily identify by size
- Available for all Microduct sizes 5mm–27mm
- Specially designed to ensure a smooth interior transition
- Withstand chemical and harsh environment conditions
- "HD" or "Heavy Duty" denotes enhanced pull-out and pressure characteristics (currently size 18/10 next page)



5/3.5mm (OD/ID)
Straight Coupler

PART #
20001462



6/4mm (OD/ID)
Straight Coupler

PART #
20004725



7mm (OD/ID)
Straight Coupler

PART #
20001463



8/6mm (OD/ID)
Straight Coupler

PART #
20003948



8.5/6mm (OD/ID)
Straight Coupler

PART #
20001834



10/8mm (OD/ID)
Straight Coupler

PART #
20001831



12/8mm (OD/ID)
Straight Coupler

PART #
20001833



12/10mm (OD/ID)
Straight Coupler

PART #
20005069

MICROTECHNOLOGY ACCESSORIES

STRAIGHT COUPLERS

- Easy assembly/disassembly, no tools required, low profile design
- Provide an air and water tight connection
- Designed and tested to meet or exceed industry standards
- Color coded to easily identify by size
- Available for all Microduct sizes 5mm–27mm
- Specially designed to ensure a smooth interior transition
- Withstand chemical and harsh environment conditions
- "HD" or "Heavy Duty" denotes enhanced pull-out and pressure characteristics (currently size 18/10 below)



12.7/10mm (OD/ID)
Straight Coupler

PART #

20001832



14/10mm (OD/ID)
Straight Coupler

PART #

20003430



16mm (OD/ID)
Straight Coupler

PART #

20001517



18/10mm (OD/ID)
HD Straight Coupler

PART #

20005217



18/14mm (OD/ID)
Straight Coupler

PART #

20001518



22/16mm (OD/ID)
Straight Coupler

PART #

20003137



27mm (OD/ID)
Straight Coupler

PART #

20001491

MICROTECHNOLOGY ACCESSORIES

TRANSITION COUPLERS

- Easy assembly/disassembly, no tools required
- Provide an air and water tight connection
- Transition couplers available to provide coupling of different diameters
- Designed and tested to meet or exceed industry standards
- Color coded to easily identify by size
- Specially designed to ensure a smooth interior transition
- Withstand chemical and harsh environment conditions



7mm x 5mm
Transition Coupler

PART #

20001882



8mm x 5mm
Transition Coupler

PART #

20003016



8.5mm x 5mm
Transition Coupler

PART #

20001883



8.5mm x 8mm
Transition Coupler

PART #

20001884



10mm x 8.5mm
Transition Coupler

PART #

20001881



12mm x 10mm
Transition Coupler

PART #

20003262



12.7mm x 8.5mm
Transition Coupler

PART #

20004736



12.7mm x 10mm
Transition Coupler

PART #

20003498



12.7mm x 12mm
Transition Coupler

PART #

20001939



14mm x 12.7mm
Transition Coupler

PART #

20003658



16mm x 12mm
Transition Coupler

PART #

20003708



16mm x 12.7mm
Transition Coupler

PART #

20003207



16mm x 14mm
Transition Coupler

PART #

20003915

MICROTECHNOLOGY ACCESSORIES

TRANSITION COUPLERS

- Easy assembly/disassembly, no tools required
- Provide an air and water tight connection
- Transition couplers available to provide coupling of different diameters
- Designed and tested to meet or exceed industry standards
- Color coded to easily identify by size
- Specially designed to ensure a smooth interior transition
- Withstand chemical and harsh environment conditions
- Low profile design



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TECHNICAL BULLETIN



Conduit Handling Procedures for Field Forces

CONTENTS:

- 1.0 General Information
- 2.0 Recommendations
- 3.0 Contact Information

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Technical Bulletin: DCEB-17004
Issue: A
Date: April 6, 2017
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1.0 GENERAL INFORMATION

- 1.1 HDPE (High Density Polyethylene) conduit is the preferred product when building a cable pathway, in both inside and outside environments. The flexibility and scalability allows a wide variety of installations to be performed smoothly, without time consuming joints placed every 20 feet, such as in stick conduit.
- 1.2 HDPE conduit is typically shipped on reels which can accommodate extended continuous lengths. Standard SDR, SIDR, Schedules 40 & 80, single MicroDuct, and FuturePath® are all shipped this way, and Dura-line has developed suggested guidelines for handling HDPE conduit when shipped on a reel, and used in the outside or inside environments.
- 1.3 HDPE is a plastic pipe, and will form a memory when placed on a reel. While not exactly spring-like, it will exhibit coiling once pulled from a reel. Following recommendations will help to curb some of the issues due to coil memory. Larger diameter conduit will take some care to uncoil, as the more plastic material in the product, the more memory will be observed. Technical Bulletin DCEB-17002 can provide additional information on these procedures.

2.0 RECOMMENDATIONS

- 2.1 Dura-Line HDPE products are shipped via private trucking companies, and may be subject to damage once the reels leave the manufacturing facility. Inspect reels prior to removal from the truck, if possible, for damage. Damage can occur due to improper forklift use, or poorly secured reels which cause damage to the HDPE. Lift reels by supporting the flanges, or sides of the reel. Do not put the weight of the HDPE and reel against the bottom layer of the conduit, to avoid flattening or crushing (Figure 1).



Figure 1

- 2.2 Reels should arrive shipped upon flat bed trailers in a vertical position. Reels

shipped or stored flat may exhibit entanglement of the conduit. Inspect for forklift or other damage before removal from truck (Figure 2).



Figure 2

- 2.3** Dura-Line ships various size reels depending upon the type of product and length ordered (Figure 3). Order acknowledgements include reel dimensions of each shipment. Installers can plan their installations to determine which reel-handling trailer or device is needed for the pending job. Steel, wooden, or plastic reels are utilized by Dura-Line. Reels should be loaded on trailers, trucks, or stands equipped with locking collars for the spindle used, to keep reels from travelling side-to-side.

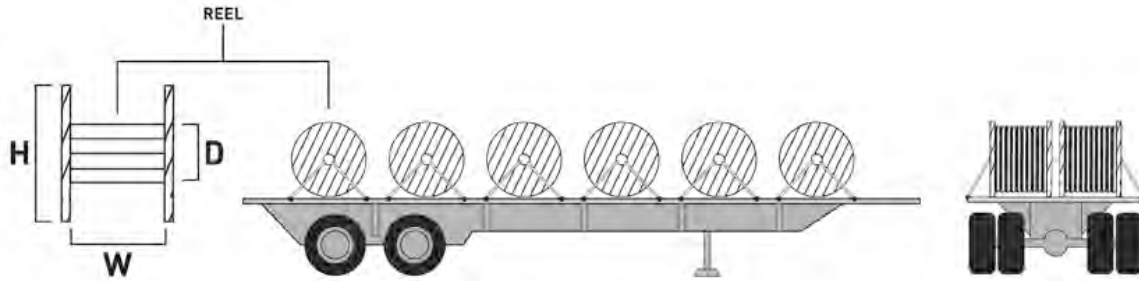


Figure 3

- 2.4** When pulling conduit from a reel, ensure the inner wraps of product remain tightly turned. Over-pulling, or spinning the reel too quickly can result in excess slack, which can equate to twisting or tangling of the conduit during pull off operations. Tangling can lead to kinking of the conduit, which should be cut at that point and the kink discarded. To form a bend in conduit, slowly push the conduit into a tight bend without exceeding the minimum or supported bend radius, or static bend radius published. When pulling out product, or installing into position, maintain the dynamic or unsupported bend radius. Tighter supported bend radii may be formed prior to final positioning of the conduit (Figure 4).

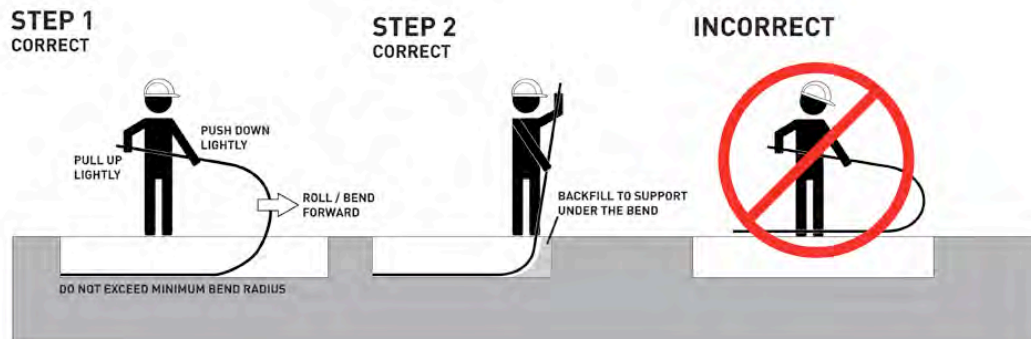


Figure 4

- 2.5** Excess bends during installation can increase friction or drag, and will affect cable installations. Before back-filling any trench, pull the HDPE tight and push to one side of the trench bottom, anchoring it with soil (Figure 5). Make sure backfill is clean and free of large rocks. Rocks should be no larger than half the diameter of the product being installed. This should be maintained as a layer surrounding the HDPE for several inches. After about 12 inches of back-fill have been placed, larger rocks can be re-introduced into the trench.

ANCHOR THE DUCT PERIODICALLY
TO KEEP IT AS STRAIGHT AS
POSSIBLE IN THE TRENCH

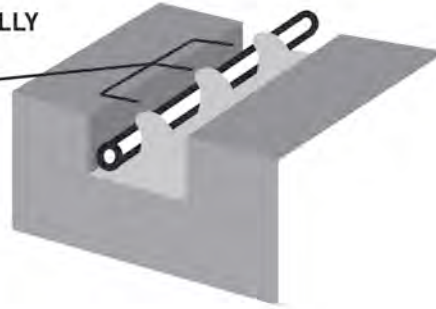


Figure 5

- 2.6 At times or in colder temperatures, HDPE may be more difficult to work with, showing more reel set or memory. Pull the HDPE straight into a trench, which has been graded or flattened on the bottom, and after the removal of large or jagged rocks (Figures 6-8).

INCORRECT



CORRECT



Figures 6-8

- 2.7** Load reels so that the HDPE follows the natural bend into the trench or outer conduit. This will be where the conduit feeds from the bottom of the reel. For reverse bend installation, load the reel so that the HDPE feeds off the top of the reel, again, following the natural bend of the conduit. Line up the reel prior to pullout so that it feeds directly into the trench, avoiding any rubbing or entanglements. It is recommended to station an installer at the reel during pullout, to watch for entanglements or overspin of the reel (Figure 9).

Derailments can occur as well, especially when a reel is nearly full, which is where the HDPE loop jumps over the reel side or flange, and can then kink on the spindle or other reel handling structure.

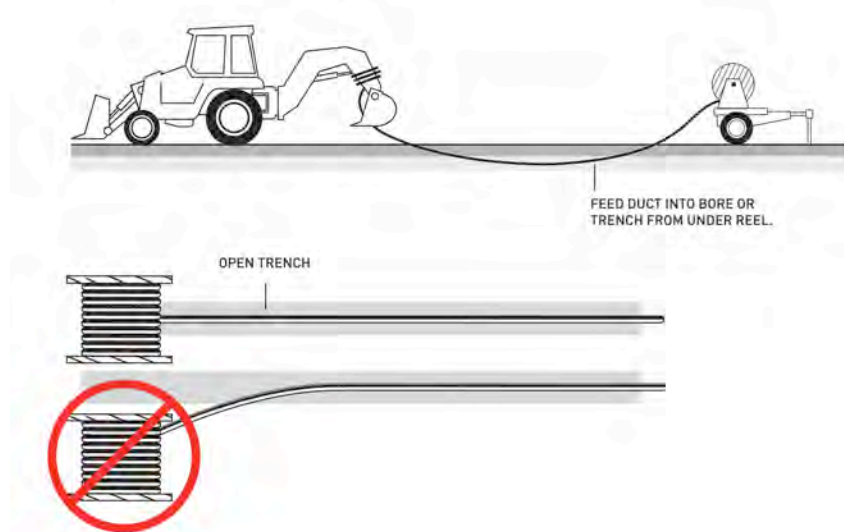


Figure 9

- 2.7** When pulling out conduit around obstructions, avoid twisting or kinking the HDPE. Utilize a swivel to keep twists out, and maintain tension during the pull-out so the HDPE does not recoil and allow kinking to occur. Maintain recommended bend radii during movement around obstructions, to avoid kinking (Figures 10 & 11).



Figure 10



Figure 11

- 2.8** Crushed HDPE may affect the cable placement by minimizing the ID (Inside Diameter) of the product. Avoid this by always keeping the HDPE tight on the reel, especially during transport from one location to another. Take a short section (10-15) feet of Bull-line® and half hitch a knot onto the end of the conduit. Use tape to secure the Bull-line to the conduit wall. Work the slack out of the HDPE towards the outer end, and secure the tail to the reel flange (Figure 12).



Figure 12

While HDPE is very robust and flexible, it is easy to become overconfident in the conduit's ability to withstand abuse. Even HDPE can become damaged or unusable if care is not taken during installation. It is hoped these guidelines are helpful to any installer of HDPE. The following chart describes some typical Dura-Line products and the recommended minimum bend radii during installation, and post installation (Table A).

| DESCRIPTION | NOMINAL DIMENSIONS | BEND RADIUS UNSUPPORTED | BEND RADIUS SUPPORTED * |
|--------------------------------|--------------------|-------------------------|-------------------------|
| 12.7mm x 10mm 7-way FuturePath | 1.64" O.D. | 30" | 15" |
| 18mm x 14mm 4-way FuturePath | 1.86" O.D. | 32" | 16" |
| 22mm x 16mm 7-way FuturePath | 2.62" O.D. | 52" | 26" |
| 1.25" SDR-11 | 1.660" O.D. | 34" | 17" |
| 1.50" SDR-11 | 1.900" O.D. | 38" | 19" |
| 2" SDR-13.5 | 2.375" O.D. | 58" | 29" |
| 3" SCHED 80 | 3.500" O.D. | 78" | 39" |
| 4" SDR-11 | 4.500" O.D. | 100" | 50" |
| 6" SDR-11 | 6.625" O.D. | 146" | 73" |
| 8" SDR-13.5 | 8.625" O.D. | 233" | 155" |
| 16mm x 12mm MicroDuct | 0.63" (16mm) | 12" | 6" |
| 12.7mm x 10mm MicroDuct | 0.050" (12.7mm) | 10" | 5" |
| 8.5mm x 6mm MicroDuct | 0.33" (8.5mm) | 6" | 3" |

*SUPPORTED; after installation has occurred, and conduit is in its final position

Table A

3.0 CONTACT INFORMATION

- 3.1 Dura-Line Customer Service 1-800-847-7661 or 1-865-218-3460
Fax 1-865-218-3461
- 3.2 Web: www.duraline.com
- 3.3 Email: moreinfo@duraline.com
- 3.4 For further information on this product, contact Customer Service who can arrange for a Field Support Engineer to contact you directly.
- 3.5 Dura-Line has a library of Technical Bulletins that are for use by our customers and their placing crews.



STANDARD TERMS AND CONDITIONS

1. CONTRACT FORMATION: These Terms and Conditions ("Terms") govern this Sales Order and any agreement, order, sale or lease is expressly limited to and made conditional upon these Terms becoming a part of the agreement between Dura-Line Corporation ("Seller") and Buyer.

2. ACCEPTANCE: This transaction is expressly limited to and made conditional upon the Terms on the face and reverse side hereof. Any of Buyer's terms in addition to or different from those contained herein, whether contained on a request for quotation, purchase order, acknowledgement or other document, are hereby objected to and shall be of no effect. No course of prior dealings between the parties and no usage of the trade shall be relevant to supplement or explain any term used in this agreement. Acceptance or acquiescence in a course of performance rendered under this agreement shall not be relevant to determine the meaning of this agreement even though the accepting or acquiescing party has knowledge of the nature of the performance and the opportunity for objection. No waiver or alteration of terms shall be binding unless in writing, signed by an executive officer of Seller. Acceptance of this contract is expressly limited to the exact terms contained in the offer and any attempt to alter or omit any such terms shall be deemed a rejection and counteroffer.

3. PRICE: All prices are F.O.B. Seller's plant unless otherwise specifically set forth on the face of this Sales Order. Prices stated are subject to change without notice in the event of (i) alterations in specifications, quantities, designs, or delivery schedules; (ii) increases in the cost of fuel, power, material, supplies, or labor, and/or (iii) foreign or domestic legislation enacted by any level of government, including tax legislation, which increases the cost of producing, leasing, or selling the Goods. No discount will be permitted unless specifically set forth on the face of this Sales Order. Prices set forth in any proposal sent to Buyer shall be firm for thirty (30) days following the date of such proposal unless otherwise set forth in any proposal. Payment terms of sale are net thirty (30) days unless Seller agrees otherwise in writing. In the event payment is not made within terms, Buyer shall be charged a late payment fee of one and one-half (1.5%) percent per month for each month in which payment is delayed, or the maximum lawful rate, whichever is lower, until payment is made in full. Until the purchase price and any late fees have been paid in full, Seller retains a security interest in the goods sold, consigned or leased ("Goods") and in all proceeds of said Goods. Buyer hereby irrevocably authorizes Seller to execute and file UCC financing statements in support of a purchase money security interest. All orders are subject to the approval by Seller at its offices in Knoxville, Tennessee.

4. DISPUTES: All disputes hereunder shall be made, in writing to the following: Dura-Line Attention: Controller, 11400 Parkside Drive Suite 300, Knoxville, TN 37934. Payments which are intended by Buyer to represent "payment in full" for the Goods sold, and which are less than the amount shown on Seller's invoice as being due, shall be sent to the above address. If said "payment in full" check is not made to the above address then, pursuant to Tennessee Code Ann. Section 47-3-11 the acceptance of said check will not act as a discharge of the remaining balance due under this Seller's invoice.

5. Dura-Line warrants that the following goods manufactured will be free from defects in material and workmanship for the following periods:

1. Conduit, CIC and pipe products for one year following the date of original shipment.
2. Placing equipment and accessories for 90 days following the date of original shipment.
3. With respect to lubricants, chemicals, pull tapes and specialty products, Dura-Line warrants only that such goods will conform to Dura-Line's standards as specified.

If any products are found by Dura-Line to be defective, such products, at Dura-Line's option, will be replaced or repaired at Dura-Line's cost. The Purchaser's sole remedy for a defective product, and for any and all claims arising out of the purchase and use of the product, shall be limited to the repair and replacement of the product at Dura-Line's cost.

The foregoing warranties are in lieu of all other warranties, expressed or implied, including those of merchantability or fitness for any purpose.

Goods which may be sold by Dura-Line but which are not manufactured by Dura-Line are not warranted by Dura-Line, but are sold only with the warranties, if any, of the manufacturers thereof.



STANDARD TERMS AND CONDITIONS

This warranty does not cover labor or other costs or expenses to remove or install any defective, repaired or replaced product. Warranty does not apply to any product which has been subjected to misuse, mishandling, misapplication, neglect (including but not limited to improper maintenance), accident, improper installation or modification.

6. LIMITATION OF LIABILITY: SELLER'S LIABILITY (WHETHER UNDER THE THEORIES OF BREACH OF CONTRACT OR WARRANTY, NEGLIGENCE, OR STRICT LIABILITY) FOR ITS GOODS SHALL BE LIMITED TO REPAIRING OR REPLACING PARTS FOUND BY SELLER TO BE DEFECTIVE OR AT SELLER'S OPTION, TO REFUNDING THE PURCHASE PRICE OF SUCH GOODS OR PARTS THEREOF. AT SELLER'S REQUEST, BUYER WILL SEND, AT BUYER'S SOLE EXPENSE, ANY ALLEGEDLY DEFECTIVE PARTS TO THE PLANT OF SELLER WHICH MANUFACTURED THEM FOR INSPECTION AND WARRANTY ADJUSTMENT.

7. DISCLAIMER OF CONSEQUENTIAL DAMAGES: IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE PURCHASE AND SALE OR LEASING OF SELLER'S GOODS, INCLUDING WITHOUT LIMITATION BREACH OF ANY OBLIGATION IMPOSED ON SELLER HEREUNDER OR IN CONNECTION HEREWITH. CONSEQUENTIAL DAMAGES FOR PURPOSES HEREOF SHALL INCLUDE WITHOUT LIMITATION LOSS OF USE, INCOME OR PROFIT, OR LOSSES SUSTAINED AS THE RESULT OF INJURY (INCLUDING DEATH TO ANY PERSON, OR LOSS OF OR DAMAGE TO PROPERTY (INCLUDING WITHOUT LIMITATION PROPERTY HANDLED OR PROCESSED BY THE USE OF THE GOODS)). BUYER SHALL INDEMNIFY SELLER AGAINST ALL LIABILITY, COST OR EXPENSE WHICH MAY BE SUSTAINED BY SELLER ON ACCOUNT OF ANY SUCH LOSS, DAMAGE OR INJURY.

8. ACCEPTANCE AND TRANSPORTATION: Upon Buyer's receipt of shipment, Buyer shall immediately inspect the Goods. Unless Buyer provides Seller with written notice of any claim for shortages of or defects in the Goods within forty-eight (48) hours after receipt of shipment, such Goods shall be deemed finally inspected, checked and accepted by Buyer. In absence of shipping and packing instructions, Seller shall use its own discretion in choice of carrier and method of packing. Seller shall not be responsible for insuring shipments unless specifically requested by Buyer and any insurance so requested shall be at Buyer's expenses and valuation.

9. TITLE AND RISK OF LOSS: Title to any Goods sold and risk of loss of such Goods passes to Buyer upon delivery by Seller to carrier, and any claims for losses or damage shall be made by Buyer directly with carrier.

10. CREDIT TERMS: All orders and shipments shall at all times be subject to the credit approval of the Seller. Seller reserves the right of declining to make shipment whenever, for any reason, there is doubt as to Buyer's financial responsibility and Seller shall not in such event be liable for breach or nonperformance of contract, in whole or in part.

11. TAXES: Unless otherwise specifically provided on the face hereof; the price for the Goods purchased is net and does not include sales, use, excise or similar taxes, whether federal, state or local. The amount of any such taxes applicable to the Goods shall be paid by Buyer in the same manner and with the same effect as if originally included in the purchase.

12. PACKAGING: Prices stated are based on Seller's standard packaging. Special customer packaging will be furnished only when specified and so stated herein, and the cost thereof shall be borne by Buyer.

13. DELIVERY AND DELAYS: Unless expressly specified to the contrary, Goods in stock will be shipped promptly, and Goods not in stock will be shipped as soon as commercially reasonable. However, all shipping dates are approximate, and are based upon current availability of material, present production schedules, and prompt receipt of all necessary information. Seller will not be liable for any damage, loss, fault, or expenses arising out of delays in shipment or other nonperformance, of this agreement caused by or imposed by (a) strikes, fires, disasters, acts of terrorists, riots, acts of God, (b) acts of Buyer, (c) shortages of labor, fuel, power, materials, supplies, transportation, or manufacturing facilities



STANDARD TERMS AND CONDITIONS

(d) government action; (e) subcontractor delay, or (f) any other cause or condition beyond Seller's reasonable control. In the event of any such delay or nonperformance, Seller may, at its option, and without liability, cancel all or any portion of this agreement and/or extend any date upon which any performance hereunder is due. Any delivery not in dispute shall be paid for regardless of other controversies relating to other delivered or undelivered merchandise. Orders will be considered complete upon shipment of a reasonable quantity over or under the amount specified in the Sales Order when it is impracticable to produce the exact quantity ordered.

14. TERMINATION, CANCELLATION, CHANGES, AND RETURNED MATERIAL: Orders cannot be terminated, modified, shipment deferred or returned after acceptance of Buyer's order by Seller, except with Seller's written consent and subject to a minimum \$25.00 or 25% restocking charge, whichever is greater. Goods shipped to Buyer approved for return must be shipped freight prepaid. Buyer shall indemnify Seller against liability and expense incurred and commitments made by Seller and shall provide for profit on work in process and contract value of products or parts completed and ready for shipment.

15. PATENTS: The purchase of the Goods shall not entitle Buyer to employ the Goods with any patented process owned by Seller or others. Seller makes no warranty that the Goods or method or process of using them, are free of the claim of any third party by way of patent infringement or the like. Buyer, by its acceptance of the goods or equipment agrees that there is no indemnification by the Seller of any claims of patent infringement, regardless of any rights under the Uniform Commercial Code or other similar regulations, and any such rights are hereby waived. Seller has no obligation to defend or pay damages, settlements, attorneys' fees or any other ancillary damages from such a claim of patent infringement brought against Buyer. Buyer shall hold Seller harmless from, and release and not make claim or suit against Seller because of, any suits, claims, losses, or other liability made against, or suffered by, Buyer arising from any claim of, or infringement of, patent, copyright, trademark, or other proprietary right at common law, or claim of unfair trade or unfair competition, resulting from, or occasioned by, Buyer's use, possession, sale, or delivery of the Goods sold to Buyer by Seller. Buyer agrees to defend and indemnify Seller against any claims or liabilities for, or by reason of the infringement of any United States Patent arising from the manufacture of any of the Goods in accordance with specifications furnished by Buyer or from the sale thereof.

16. GENERAL CONDITIONS: No agent, salesman or other party is authorized to bind Seller by any agreement, warranty, statement, promise or understanding not herein expressed. The sale of Goods pursuant to this contract, shall be governed by the internal laws of the State of Tennessee without regard to conflict principles. In addition to the rights and remedies conferred upon Seller by law, Seller shall not be required to proceed with the performance of any order or contract, if Buyer is in default in the performance of any order or contract with Seller and in case of doubt as to Buyer's financial responsibility, shipments under this order may be suspended or sent sight draft with bill of lading attached by Seller. Any clerical errors are subject to correction. No delay or omission by Seller in exercising any right or remedy provided for herein shall constitute a waiver of such right or remedy and shall not be constituted as a bar to or a waiver of any such right or remedy on any future occasion. Any provision hereof prohibited by law shall be ineffective to the extent of such prohibition and without invalidating the remaining provision hereof.

17. ARBITRATION: Any dispute arising between Buyer and Seller based upon this agreement or the Goods purchased pursuant hereto will be heard in the Chancery Court for Knox County, Tennessee by a Chancellor sitting without a jury and the award of the Chancellor shall be final and binding upon the parties.

18. ENTIRE CONTRACT: The Terms set forth herein and on the face side hereof constitute the entire agreement between Buyer and Seller on these issues. Any representations, promises, warranties or statements by any agent or employee of Seller that differ in any way from these Terms shall be given no effect or force.



TECHNICAL BULLETIN

SPECIFICATIONS FOR MICRODUCT AND FUTUREPATH®

CONTENTS:

- 1.0 General Information
- 2.0 Quality
- 3.0 Product Design
- 4.0 Material Requirements
- 5.0 Dimensions and Tolerances
- 6.0 Performance Requirements
- 7.0 Packaging Requirements
- 8.0 Contact Information

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1.0 GENERAL INFORMATION

- 1.1** This Technical Bulletin, DCEB-00009, describes the minimum material and performance requirements for individual MicroDuct and FuturePath®. MicroDuct is an HDPE (High Density Polyethylene) product typically used for placing reduced diameter fiber optic communications cables. FuturePath® is Dura-Line's bundled MicroDuct product, formed by combining multiple MicroDucts and extruding an oversheath onto the MicroDucts, forming a single unit of various MicroDuct in order to increase capacity and to ease placement of multiple MicroDuct pathways. FuturePath® configurations vary from two MicroDucts to 25 MicroDucts, all manufactured with the protective oversheath, adding to the robustness of the MicroDucts. An optional copper-coated locate wire may be added to the construction for meeting locatable requirements.
- 1.2** Individual MicroDuct can be placed into external conduit singly or in multiple groupings by either jetting (blowing) the MicroDuct, or by pulling in short sections into the conduit. Multiple reels of duct are required for this installation, depending on the number of pathways required. MicroDuct may also be placed as an override solution, being placed into an occupied conduit where the existing cable or conduit (innerduct) allows room for one or more MicroDuct to be placed alongside.
- 1.3** FuturePath® may be pulled into conduit, horizontally directional drilled (bored), plowed, or placed into open trench installations, without the need for any special tools or equipment. Multiple pathways can then be installed using a single pass and handling procedures reduced through the need for only a single reel of duct.

2.0 QUALITY

- 2.1** MicroDuct and FuturePath® are manufactured under the control of ISO 9000 with full quality records and traceability. Dura-Line is independently audited and certified to ISO 9001: 2008. Dura-Line shall provide a quality plan, if requested, upon receipt of a formal contract/order.

3.0 PRODUCT DESIGN

- 3.1** MicroDuct and FuturePath® are designed to be flexible, lightweight, durable, easy to install and are available in multiple configurations. 7mm OD and above MicroDucts are smooth on the outside, internally longitudinally ribbed on the inside, and have a co-extruded permanent lubrication layer of SuperSilicore®. 5mm OD and smaller MicroDucts are smooth on the outside, smooth on the inside and have a co-extruded permanent lubrication layer of SuperSilicore®. The FuturePath® oversheath is smooth on the outside.

- 3.2 SuperSilicore® is co-extruded with the tough HDPE wall creating a permanent, super slippery interior lining. It has the lowest co-efficient of friction compared to other options, no performance loss in all temperature conditions and functions without additional wet lubricants. All FuturePath® containing 7mm OD MicroDucts and above will be equipped with a Super Silicore® slick permanent liner.
- 3.3 The anticipated product life of MicroDuct and FuturePath® shall be considered 15 years after installation, allowing for jetting (blowing) operations for cable installations and replacements.
- 3.4 The workmanship of MicroDuct and FuturePath® will display free from holes, blisters, inclusions, cracks, or other imperfections that would affect the performance or serviceability of the product. Options available with FuturePath® include an integral copper-coated steel insulated locate wire, and ripcord(s) for aiding in access to the MicroDucts.

4.0 MATERIAL REQUIREMENTS

- 4.1 The MicroDuct and FuturePath® shall be constructed of polymeric materials, which are lightweight, flexible, corrosion resistant and nonconductive. The base material shall be clean virgin grade high-density polyethylene (HDPE), which conforms to ASTM D3350-98a, Type III, Category 5, Class B or C and Grade P-34 per ASTM D1248-84 or equivalent.
- 4.2 The base HDPE material shall conform to the minimum mechanical properties as listed (Table 1).

| MINIMUM OR RANGE | PROPERTY | ASTM STANDARD |
|------------------------|----------|---|
| Density | D 1505 | 0.940-0.950 g/cm ³ |
| Melt Index (E) | D 1238 | 0.10 - 0.35 g/ 10 Minute |
| ESCR | D 1693 | 192.0 hrs. (per ASTM D3350) |
| Tensile @ Yield (min) | D 638 | 2500 psi to 3200 psi (1,700 – 2,200N/cm ²) |
| % Elongation | D 638 | 300% |
| Flexural Modulus (min) | D 790 | 115,000 psi (790,000 kPa) |
| Hardness | D 2240 | 60 Shore D |
| VICAT Softening Pt. | D 1525 | 248 ° F (120 ° C) |
| Brittleness Temp. | D 746 | -94 ° F (-70 ° C) |

Table 1

- 4.3 Standard available colors shall be black, terracotta, red, orange, gray, green, blue, brown, and white. FuturePath® MicroDucts will be individually colored or will be of a single color and be sequentially numbered every two feet. The oversheath of FuturePath® will be available in different colors, although aerial versions of individual MicroDucts and FuturePath® will be available in black only.

Colors shall be protected from ultra-violet (UV) degradation by the incorporation of Hindered Amine Light Stabilizers (HALS). This will allow for one (1) years of outside storage UV protection. Aerial products shall incorporate a higher level of finely divided carbon black and HALS additives, which provides a twenty (20) plus year usable life expectancy. The duct material shall be compounded with antioxidant additives to prevent thermal degradation.

- 4.4** Fire retardant MicroDucts are typically required for inside buildings and must comply with local fire codes. Both Riser rated and Plenum rated MicroDucts must comply with the applicable requirements of the *Standard for Safety for Optical Fiber and Communication Cable Raceway*, UL-2024. The Riser-rated MicroDucts must comply with UL-1666, and the Plenum-rated MicroDucts must comply with NFPA-262 (Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, Edition 2011).

Fire retardant MicroDucts shall be tested to the UL Standard by UL, ETL or another approved testing facility, and will be printed with the approval number and fire rating every two feet.

5.0 DIMENSIONS AND TOLERANCES

- 5.1** HDPE MicroDucts should be circular in form with the following dimensions (Table 2). MicroDuct dimensions are listed in millimeters (mm).

| SIZE (OD X ID) | OUTSIDE DIAMETER (OD) | WALL THICKNESS | ID MINIMUM | MIN BEND RADIUS | TENSILE STRENGTH (LBS) |
|----------------|-----------------------|-----------------|------------|-----------------|------------------------|
| 27/20mm | 27 ± 0.10 | 2.67 + 0.0/0.25 | 20.7 | 11 in. | 701 |
| 22/16mm | 22 ± 0.10 | 2.94 + 0.0/0.25 | 15.4 | 8 in. | 615 |
| 18/14mm | 18 ± 0.10 | 2.16 + 0.0/0.13 | 13.9 | 7 in. | 328 |
| 18/15mm | 18 ± 0.10 | 1.37 + 0.0/0.13 | 14.9 | 8 in. | 300 |
| 16/13mm | 16 ± 0.10 | 1.50 + 0.0/0.1 | 12.9 | 6 in. | 263 |
| 16/12mm | 16 ± 0.10 | 2.00 + 0.0/0.05 | 11.6 | 6 in. | 305 |
| 12.7/10mm | 12.7 ± 0.10 | 1.29 + 0.0/0.1 | 9.8 | 5 in. | 195 |
| 12/10mm | 12 ± 0.10 | 0.939 + 0.0/0.1 | 9.8 | 5 in. | 139 |
| 10/8mm | 10 ± 0.10 | 1 + 0.0/0.1 | 7.9 | 4 in. | 107 |
| 8.5/6mm | 8.5 ± 0.10 | 1.25 + 0.0/0.1 | 5.9 | 4 in. | 115 |
| 7/5.5mm | 7 ± 0.10 | 0.75 + 0.0/0.1 | 5.4 | 4 in. | 55 |
| 5/3.5mm | 5 ± 0.10 | 0.75 + 0.0/0.1 | 3.4 | 4 in. | 50 |

Table 2

5.2 Riser rated MicroDucts shall be V-2 rated with the following dimensions (Table 3).

| Size (OD x ID) | Outside Diameter (OD) | Wall | ID Min |
|----------------|-----------------------|-----------------|--------|
| 18mm | 18.01 ± 0.10 | 2.01 + 0.0/0.15 | 13.6 |
| 16mm | 15.88 ± 0.10 | 1.50 + 0.0/0.1 | 12.8 |
| 12.7mm | 12.7 ± 0.1 | 1.55 + 0.0/0.1 | 9.6 |
| 8.5mm | 8.5 ± 0.1 | 1.25 + 0.0/0.1 | 5.9 |

Table 3

5.3 Plenum rated MicroDucts shall be V-0 rated with the following dimensions (Table 4).

| Size (OD x ID) | Outside Diameter (OD) | Wall | ID Min |
|----------------|-----------------------|-----------------|--------|
| 18mm | 18.01 ± 0.10 | 2.01 + 0.0/0.15 | 13.6 |
| 16mm | 15.9 ± 0.10 | 1.42 + 0.0/0.05 | 12.8 |
| 12.7mm | 12.7 ± 0.1 | 1.14 + 0.0/0.1 | 10.4 |
| 8.5mm | 8.5 ± 0.1 | 0.81 + 0.0/0.1 | 6.68 |

Table 4

5.4 FuturePath® is a bundled MicroDuct configuration that is available in various sizes and styles. The outside plant versions can be direct buried or trenched, pulled into conduit, horizontally directional drilled (HDD) or plowed. Aerial versions include a lashed and self-support Figure-8 style. An armored version is available for extreme conditions where ground heave or rodents may be a factor. FuturePath® is available in material designed for interior spaces where fire protection is a requirement. These are referred to as Dura-Line Enterprise Products, and are available in HDPE, Riser, Plenum, and LSHF materials. The following list is the FuturePath® specifications for versions available at the time of this Technical Bulletin Issue (Table 5). Note: where material description is not noted in column 1, assume the material to be HDPE.

| Size (mm) | # DUCTS | Nom OD (in.) | Over Sheath (in) | Weight (#/ft) | Bend Radii SUP (in.) | Bend Radii UNSUP (in.) | SWPS (lbs) |
|------------------------------|--------------|--------------|------------------|---------------|----------------------|------------------------|-------------|
| 27 / 20 Min ID 20.7mm | | | | | | | |
| 27/20 | 2-Way | 2.200 | 0.050 | 0.374 | 17 | 29 | 2042 |
| 27/20 | 3-Way | 2.370 | 0.050 | 0.532 | 31 | 52 | 2847 |
| 27/20 | 4-Way | 2.640 | 0.050 | 0.686 | 33 | 55 | 3669 |
| 27/20 | 7-Way | 2.970 | 0.050 | 1.126 | 49 | 81 | 6013 |

| 22 / 16 Min ID 15.5mm | | | | | | | |
|-----------------------|-------|-------|-------|-------|----|----|------|
| 22/16 | 2-Way | 1.790 | 0.050 | 0.295 | 10 | 20 | 1581 |
| 22/16 | 3-Way | 1.790 | 0.050 | 0.413 | 17 | 34 | 2211 |
| 22/16 | 4-Way | 2.130 | 0.050 | 0.531 | 18 | 36 | 2840 |
| 22/16 | 7-Way | 2.620 | 0.050 | 0.869 | 26 | 52 | 5001 |

| 18 / 14 Min ID 13.6mm | | | | | | | |
|-----------------------|-------|-------|-------|-------|----|----|------|
| 18/14 | 2-Way | 1.560 | 0.070 | 0.244 | 9 | 18 | 1316 |
| 18/14 | 3-Way | 1.670 | 0.070 | 0.330 | 15 | 30 | 1776 |
| 18/14 | 4-Way | 1.860 | 0.070 | 0.417 | 16 | 32 | 2243 |
| 18/14 | 7-Way | 2.270 | 0.070 | 0.656 | 21 | 42 | 3522 |
| 18/14 (Thicker OS) | 2-Way | 1.620 | 0.100 | 0.292 | 9 | 18 | 1578 |
| 18/14 (Thicker OS) | 3-Way | 1.730 | 0.100 | 0.387 | 18 | 36 | 2087 |
| 18/14 (Thicker OS) | 4-Way | 1.910 | 0.100 | 0.482 | 16 | 32 | 2598 |
| 18/14 (Thicker OS) | 7-Way | 2.330 | 0.100 | 0.743 | 22 | 44 | 3998 |
| 18/14 (Flat) | 3-Way | 2.230 | 0.050 | 0.306 | 8 | 16 | 1645 |

| 16 / 13 Min ID 12.8mm | | | | | | | |
|-----------------------|-------|-------|-------|-------|----|----|------|
| 16 / 13 | 2-Way | 1.350 | 0.050 | 0.153 | 7 | 14 | 824 |
| 16 / 13 | 3-Way | 1.490 | 0.070 | 0.247 | 13 | 26 | 1331 |
| 16 / 13 | 4-Way | 1.650 | 0.070 | 0.308 | 14 | 28 | 1658 |
| 16 / 13 | 7-Way | 2.030 | 0.070 | 0.471 | 19 | 38 | 2530 |
| 16 / 13 (Thicker OS) | 4-Way | 1.710 | 0.100 | 0.370 | 15 | 30 | 1996 |
| 16 / 13 (Thicker OS) | 7-Way | 2.080 | 0.100 | 0.550 | 19 | 38 | 2962 |
| 16 / 13 (Flat) | 3-Way | 1.980 | 0.050 | 0.220 | 8 | 16 | 1184 |
| 16 / 13 (Flat) | 4-Way | 2.620 | 0.050 | 0.290 | 8 | 16 | 1516 |

| 16 / 12 Min ID 11.6mm | | | | | | | |
|-----------------------|-------|-------|-------|-------|----|----|------|
| 16 / 12 | 2-Way | 1.350 | 0.050 | 0.18 | 8 | 16 | 976 |
| 16 / 12 | 3-Way | 1.490 | 0.070 | 0.292 | 13 | 26 | 1559 |
| 16 / 12 | 4-Way | 1.660 | 0.070 | 0.368 | 14 | 28 | 1963 |
| 16 / 12 | 7-Way | 2.030 | 0.070 | 0.579 | 19 | 38 | 3079 |
| 16 / 12 (Thicker OS) | 2-Way | 1.450 | 0.100 | 0.260 | 8 | 16 | 1396 |
| 16 / 12 (Thicker OS) | 4-Way | 1.720 | 0.100 | 0.431 | 15 | 30 | 2307 |
| 16 / 12 (Thicker OS) | 7-Way | 2.090 | 0.100 | 0.657 | 19 | 38 | 3505 |
| 16 / 12 (Flat) | 3-Way | 1.980 | 0.050 | 0.265 | 8 | 16 | 1412 |

| 14 / 10 Min ID 9.8mm | | | | | | | |
|----------------------|-------|-------|-------|-------|----|----|------|
| 14 / 10 | 2-Way | 1.190 | 0.040 | 0.149 | 7 | 14 | 795 |
| 14 / 10 | 3-Way | 1.740 | 0.040 | 0.217 | 7 | 14 | 1157 |
| 14 / 10 | 4-Way | 1.470 | 0.070 | 0.320 | 12 | 24 | 1709 |
| 14 / 10 | 7-Way | 1.770 | 0.050 | 0.465 | 16 | 32 | 2474 |
| 14 / 10 (Thicker OS) | 2-Way | 0.121 | 0.050 | 0.162 | 7 | 14 | 866 |
| 14 / 10 (Thicker OS) | 2-Way | 1.240 | 0.070 | 0.189 | 7 | 14 | 1013 |
| 14 / 10 (Thicker OS) | 7-Way | 1.870 | 0.100 | 0.579 | 17 | 34 | 3096 |

| 12.7 / 10 Min ID 9.8mm | | | | | | | |
|------------------------|--------|-------|-------|-------|----|----|------|
| 12.7 / 10 | 2-Way | 1.100 | 0.050 | 0.119 | 6 | 12 | 635 |
| 12.7 / 10 | 3-Way | 1.140 | 0.070 | 0.191 | 11 | 22 | 1021 |
| 12.7 / 10 | 4-Way | 1.340 | 0.070 | 0.236 | 12 | 24 | 1260 |
| 12.7 / 10 | 7-Way | 1.640 | 0.070 | 0.360 | 15 | 30 | 1926 |
| 12.7 / 10 | 12-Way | 2.140 | 0.070 | 0.566 | 20 | 40 | 3004 |
| 12.7 / 10 | 19-Way | 2.640 | 0.070 | 0.826 | 24 | 48 | 4373 |
| 12.7 / 10 (Thicker | 2-Way | 1.140 | 0.070 | 0.143 | 7 | 14 | 766 |
| 12.7 / 10 (Thicker | 4-Way | 1.410 | 0.100 | 0.289 | 12 | 24 | 1549 |
| 12.7 / 10 (Thicker | 7-Way | 1.700 | 0.100 | 0.424 | 16 | 32 | 2264 |
| 12.7 / 10 (Flat) | 4-Way | 2.090 | 0.050 | 0.223 | 6 | 12 | 1189 |
| 12.7 / 10 x 7 + 16/13 | 8-Way | 1.790 | 0.070 | 0.416 | 18 | 36 | 2215 |

| 10 / 8 Min ID 7.9mm | | | | | | | |
|---------------------|--------|-------|-----------|-------|----|----|------|
| 10 / 8 | 2-Way | 0.870 | 0.040 | 0.070 | 5 | 10 | 373 |
| 10 / 8 | 3-Way | 0.990 | 0.070 | 0.128 | 9 | 18 | 684 |
| 10 / 8 | 4-Way | 1.040 | 0.040 | 0.120 | 9 | 18 | 635 |
| 10 / 8 | 7-Way | 1.290 | 0.050 | 0.204 | 12 | 24 | 1080 |
| 10 / 8 | 9-Way | 1.610 | 0.050 | 0.252 | 13 | 26 | 1332 |
| 10 / 8 | 12-Way | 1.700 | 0.050 | 0.314 | 15 | 30 | 1655 |
| 10 / 8 | 19-Way | 2.090 | 0.060 | 0.489 | 19 | 38 | 2577 |
| 10 / 8 (Flat) | 3-Way | 1.29 | 0.050 | 0.116 | 5 | 10 | 619 |
| 10 / 8 (Flat/Double | 3-Way | 1.34 | 0.040/0.0 | 0.154 | 6 | 12 | 826 |
| 10 / 8 | 2-Way | 0.890 | 0.050 | 0.081 | 5 | 10 | 433 |
| 10 / 8 | 4-Way | 1.090 | 0.070 | 0.157 | 10 | 20 | 837 |

| 8.5 / 6 Min ID 5.9mm | | | | | | | |
|----------------------|--------|-------|-------|-------|----|----|------|
| 8.5 / 6 (No Locate) | 2-Way | 0.770 | 0.050 | 0.075 | 5 | 10 | 404 |
| 8.5 / 6 (No Locate) | 3-Way | 0.850 | 0.060 | 0.110 | 8 | 16 | 593 |
| 8.5 / 6 (No Locate) | 4-Way | 0.930 | 0.060 | 0.136 | 8 | 16 | 733 |
| 8.5 / 6 (No Locate) | 7-Way | 1.130 | 0.060 | 0.207 | 11 | 22 | 1112 |
| 8.5 / 6 (No Locate) | 12-Way | 1.480 | 0.060 | 0.322 | 13 | 26 | 1727 |
| 8.5 / 6 (No Locate) | 19-Way | 1.800 | 0.060 | 0.472 | 16 | 32 | 2528 |
| 8.5 / 6 (No Locate) | 24-Way | 2.130 | 0.060 | 0.579 | 16 | 32 | 3099 |

| 7 / 5.5 Min ID 5.6mm | | | | | | | |
|----------------------|-------|-------|-------|-------|---|----|-----|
| 7 / 5.5 (No Locate) | 2-Way | 0.063 | 0.040 | 0.044 | 4 | 8 | 240 |
| 7 / 5.5 (No Locate) | 7-way | 0.930 | 0.050 | 0.116 | 9 | 80 | 633 |

| 5/3.5 Min ID 3.4mm | | | | | | | |
|---------------------|--------|-------|-------|-------|----|----|------|
| 5 / 3.5 (No Locate) | 2-Way | 0.460 | 0.030 | 0.026 | 3 | 6 | 143 |
| 5 / 3.5 (No Locate) | 3-way | 0.480 | 0.040 | 0.040 | 5 | 10 | 220 |
| 5 / 3.5 (No Locate) | 4-Way | 0.560 | 0.040 | 0.050 | 5 | 10 | 276 |
| 5 / 3.5 (No Locate) | 7-Way | 0.670 | 0.040 | 0.075 | 6 | 12 | 409 |
| 5 / 3.5 (No Locate) | 12-Way | 0.870 | 0.040 | 0.115 | 8 | 16 | 630 |
| 5 / 3.5 (No Locate) | 19-Way | 1.070 | 0.040 | 0.168 | 10 | 20 | 920 |
| 5 / 3.5 (No Locate) | 24-Way | 1.270 | 0.040 | 0.202 | 10 | 20 | 1120 |

Table 5

- 5.5** FuturePath® Flex is an array of MicroDucts connected by an oversheath and a tangential partitioned web. Its flat configuration and ease of duct segregation make it ideal for MicroTrenching and FTTX applications (Figure 1).



Figure 1

Duct separation is easily performed with nearly any knife, and it is available in Fire-Retardant versions for use inside buildings. The inside versions can be easily connected to the OSP FuturePath® Flex by using push-on air and watertight couplers (Figure 2), eliminating the need for a splice cabinet.



Figure 2

In this manner, a single, uninterrupted pathway is created for the fiber cable. The 18/15mm version is large enough to accommodate a pre-connectorized fiber drop with an SC-style connector and nylon pulling-sock, should that be the application requirements. Specifications for FuturePath® Flex are located in Figure 3 and Table 6.

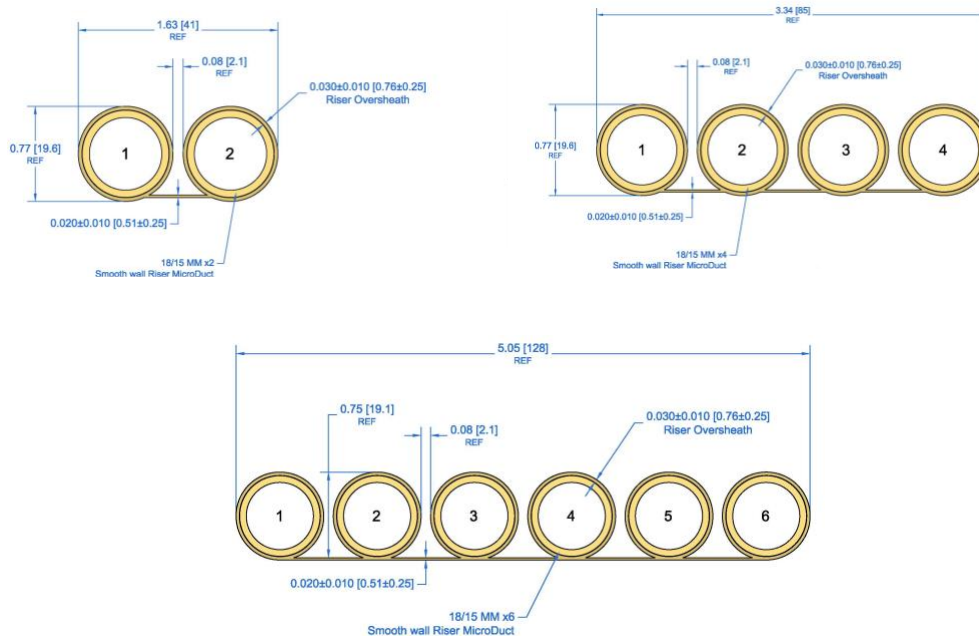


Figure 3

| FUTUREPATH® FLEX | | | | | | |
|---------------------|----------------------|------------------------|---------------------------------|-----------------------------|-------------------------------|--------------------------|
| MicroDuct Size (mm) | Number of MicroDucts | Outside Diameter (in.) | MDPE Oversheath Thickness (in.) | Supported Bend Radius (in.) | Unsupported Bend Radius (in.) | Safe Working Load (lbs.) |
| 18/14 | 6 | 0.779/5.365 | 0.020 | 12 | 19 | 3890 |
| 18/14 | 4 | 0.779/3.649 | 0.020 | 12 | 19 | 2580 |
| 18/14 | 2 | 0.779/1.637 | 0.020 | 12 | 19 | 1260 |
| 18/15 | 6 | 0.770/5.050 | 0.020 | 11 | 19 | 2900 |
| 18/15 | 4 | 0.770/3.340 | 0.020 | 11 | 19 | 1900 |
| 18/15 | 2 | 0.770/1.630 | 0.020 | 11 | 19 | 930 |

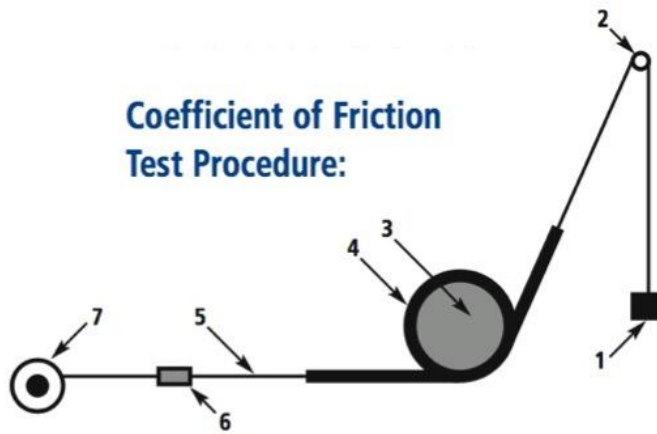
Table 6

6.0 PERFORMANCE REQUIREMENTS

The MicroDucts and FuturePath® can be jetted (blown) inside an outer duct. Typically, individual MicroDucts are jetted either into an empty outer conduit or as an override next to existing cable or duct. Limited pulling force can be applied to the individual MicroDuct for installing into short sections of conduit (Table 7). FuturePath® is generally pulled into conduit or Horizontally Directional Drilled (bored) utilizing a wire mesh-pulling grip installed onto the end of the conduit bundle. The fiber optic cable should be installed inside the MicroDuct or FuturePath® by the jetting (blowing) method. The MicroDucts manufactured by Dura-Line will meet or exceed the following performance requirements. When FuturePath® is placed aerially or buried, fiber optic cables should be installed by the jetting (blowing) method. MicroDucts are not designed for pulling MicroCables into them, primarily because reduced diameter fiber optic cables (MicroCables) have limited pulling force (usually between 90-300 lbs., depending upon the fiber cable selected).

- 6.1** The typical values for sliding coefficient of friction (μ) of Dura-Line MicroDucts with SuperSilicore® permanent lining and internal longitudinal ribs used for cables with polyethylene jackets is <10 . The test procedure for coefficient of friction is shown (Figure 4).

**Coefficient of Friction
Test Procedure:**



| Indicator # | Description |
|-------------|---|
| 1 | Tail Weight (15 lbs.) |
| 2 | Pulley |
| 3 | 36" Diameter Wheel - Restrained (no rotation) |
| 4 | MicroDuct wrapped 420° around wheel |
| 5 | Armored MDPE Jacketed Fiber Optic Cable |
| 6 | Load Cell (Load Indicator) & Chart Recorder |
| 7 | Variable Speed Winch |

Figure 4

6.2 The pull strength for MicroDucts and FuturePath® is the tensile force that can be used to pull it during the installation. The following (Table 7) lists the safe pull strength for MicroDucts.

| MicroDuct Size (OD x ID) mm | Safe Pull Strength (lbs.) | Safe Pull Strength (Newtons) |
|-----------------------------|---------------------------|------------------------------|
| 18 x 15 | 300 | 1,334 |
| 18 x 14 | 328 | 1,459 |
| 16 x 13 | 263 | 1,170 |
| 16 x 12 | 305 | 1,357 |
| 12.7 x 10 (9.8) | 227 | 1,010 |
| 12 x 10 (9.8) | 179 | 796 |
| 10 x 8 | 107 | 476 |
| 8.5 x 6 | 115 | 512 |
| 7 x 5.5 | 55 | 245 |
| 5 x 3.5 | 38 | 169 |

Table 7

Note 1: Individual MicroDucts are designed for jetting installations (blown in with air), not pulled in the traditional sense, as noted by the low pull strength.

Note 2: The pull and crush strength of a FuturePath® 7 x 12.7mm MicroDucts with an oversheath of 0.070 is the same as 1-1/4" SDR-11 duct.

6.3 The MicroDuct and FuturePath® crush strength (Compression) is a measurement of how the HDPE reacts to a bearing load. The MicroDucts should recover their circular shape upon removal of a transverse compression load. MicroDuct 250mm in length, when placed between two flat plates 100mm x 100mm, is loaded with 150 lbs. (68 kg) for MicroDuct sizes 10mm OD and larger. For MicroDuct sizes 8.5mm OD and smaller, 100 lbs. (45 kg) is used. Applying the force for 60 seconds shall not show deformation of the MicroDuct greater than 15 % (of the original OD), splitting or permanent damage. The test procedure is per Bell Core GR-356-CORE.

$$\% \text{ Deformation} = \frac{(\text{original O.D.} - \text{compressed O.D.})}{\text{original O.D.}} \times 100$$

6.4 The burst strength is exceeded when there is a break in the MicroDuct with a loss of air and it retains no pressure holding capability. Sustained (holding the air under pressure for 1000 hours) pressure rating for MicroDuct is shown below (Table 8). The test procedure is per Bell Core GR-356-CORE, with the exception of taking the pressure from 125 psi to 175psi. Testing is conducted using 175 psi (1,206 kPa) at 23° C ±5° C (73° F ±9° F) for duration of 5 minutes with no air loss due to failure of the MicroDuct.

| MicroDuct Size (OD x ID) mm | Sustained Pressure PSI (BAR) | Burst Pressure PSI (BAR) |
|-----------------------------|------------------------------|--------------------------|
| 18 x 15 | 291 (20) | 458 (32) |
| 18 x 14 | 400 (28) | 630 (43) |
| 16 x 13 | 306 (21) | 482 (33) |
| 16 x 12 | 489 (34) | 770 (53) |
| 12.7 x 10 (9.8) | 445 (31) | 700 (48) |
| 12 x 10 (9.8) | 388 (27) | 611 (42) |
| 10 x 8 | 316 (22) | 498 (34) |
| 8.5 x 6 | 523 (36) | 824 (57) |
| 7 x 5.5 | 328 (23) | 516 (36) |
| 5 x 3.5 | 479 (33) | 754 (52) |

Table 8

6.5 MicroDuct is subjected to flexibility testing, otherwise known as a bend test. The MicroDuct and FuturePath® shall be capable of being bent at least 180 degrees over a mandrel (mandrel diameter is equal to or less than 20 times the diameter of MicroDuct) and then straightened without cracking, splitting, breaking or permanent reduction in diameter.

- 6.6** An environmental stress crack resistance test (ESCR) is performed on Dura-Line MicroDucts. Stresses can be imposed on duct during installation and the MicroDuct and FuturePath® can be subjected to chemical attack from the environment. If the duct is manufactured from a poor-quality polymer, then the induced stress, together with the chemical attack can cause the duct to crack. In the ESCR test, the MicroDuct is pre-stressed and exposed to a chemical solution at an elevated temperature for a given time. Dura-Line Corporation requires zero (0) failure in 192 hours per ASTM D1693, Condition B.
- 6.7** Each finished reel of MicroDuct and FuturePath® will be subjected to proprietary testing to validate the integrity of the ID.
- 6.8** A general appearance test is performed as well. The external and internal surfaces of the MicroDucts shall be free from irregularities such as cracks, pinholes, joints, water splash marks, and die marks, repairs and other defects per standard Dura-Line procedure. This does not include internally ribbed product that is extruded with internal longitudinal ribs.

7.0 PACKAGING REQUIREMENTS

- 7.1** MicroDuct and FuturePath® shall be shipped on wooden or metal reels or in coils. The MicroDuct reel drum size is a minimum of 452mm (18”), flange 609mm (24”) up to 1.22 meters (48”), and a reel width outside to outside maximum of 686mm (27”). The MicroDuct ends are sealed to prevent the ingress of water or dirt. The inside end of the MicroDuct must be accessible for pressurization and testing. The FuturePath® reels will be sized to meet the requirement of the FuturePath®.
- 7.2** Each reel shall be identified in a weather resistant manner with the following information:
- MANUFACTURERS NAME & LOCATION
 - PRODUCT SIZE
 - PRODUCT LENGTH
 - SPECIFIED CUSTOMER NUMBERS
- 7.3** The MicroDuct and FuturePath® shall be continuously marked and identified along its length in contrasting color and with print of at least 0.118-inch (3mm) height. The print interval shall not exceed 10 feet (3 m), unless specified and shall include the following information:
- MANUFACTURERS NAME
 - PRODUCT NAME/NUMBER
 - PRODUCTION CODE (Date, Location, Lot)
 - LENGTH OF DUCT (in feet) on reel

Note: (For fire retardant MicroDucts only, print either Riser or Plenum and the approval code every two feet)

- 7.4** MicroDuct and FuturePath® should be handled by lifting or cradling the reel flanges as shown (Figure 5). Never lift reels while making contact with the HDPE duct material. The weight of the reel may compress or damage the MicroDucts.

Loading Reels

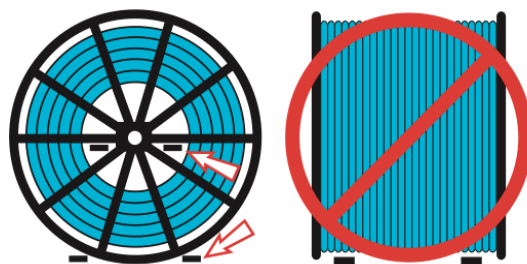


Figure 5

BULK1730241B0110

Description: BULK 17" x 30" x 24"
HDPE body and cover

FEATURES:

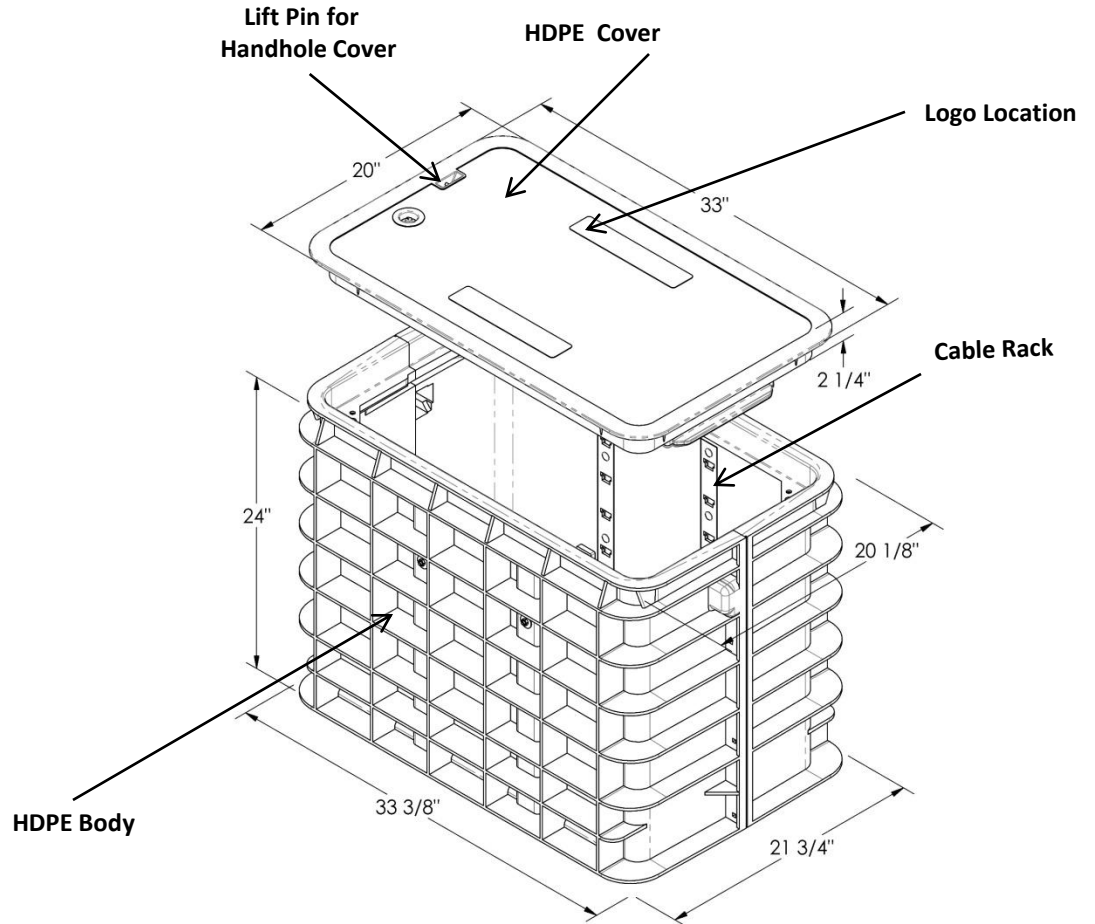
- 17 X 30 X 24 inches (Open Floor)
- HDPE Body – HDPE Cover - Load Rated: Light Duty (ANSI/SCTE 77 2010)
- Cover meets or exceeds ADA requirements for slip
- BULK vault body is upgradeable to Tier 22 load ratings by changing the cover

WEIGHT & SHIPPING:

- Cover Weight: 14 lbs
- Box Weight: 34 lbs
- Assembly Weight: 148 lbs
- Loaded Pallet Weight: 205 lbs
- Per Pallet #: 4
- Pallet Dimensions: 34" L x 49" W x 31½" H

LOAD RATINGS:

- ANSI/SCTE 77 LIGHT DUTY



| Inside Dimensions | | |
|-------------------|-------|-------|
| Length | Width | Depth |
| 29.5" | 16.5" | 24" |

SGLBU243624

BULK VAULT HDPE STRUCTURAL FOAM

HDPE PLASTIC COVER



FEATURES:

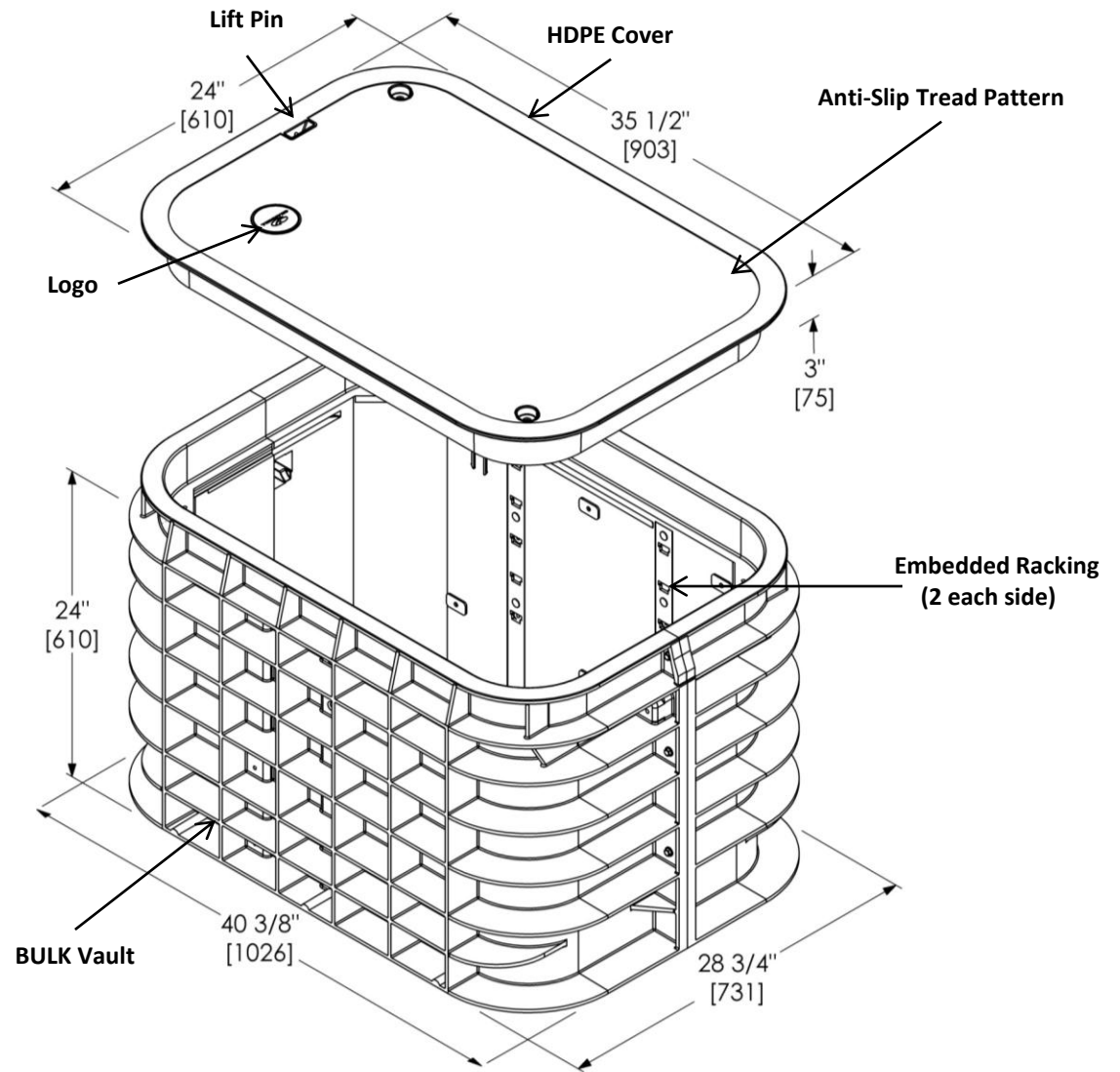
- 24" X 36" X 24" (open floor) (actual dimensions on drawing)
- BULK VAULT – HDPE PLASTIC COVER - Light Duty Load Rated (ANSI/SCTE 77: 2013)
- (2) Cover locking Auger bolts, Hex (9/16") or Penta (7/8") head with washer
- (2) Non-Seizing Fastening System, Field Replaceable
- (4) Embedded Composite Rack Support
- (1) Lifting slot equipped with stainless steel pin (slot is approximately 2 3/4" x 3/4")
- (2) Winterized Cable Drop slide (1 1/4" X 1 1/4")
- (1) Logo Disk

WEIGHT & SHIPPING:

- Cover Weight: 23 lbs
- Box Weight: 55 lbs
- Assembly Weight : 78 lbs

PERFORMANCE TESTING:

- ANSI/SCTE 77: 2013 – Light Duty Rated (3,000 lbs)
- Bulk Vault Rated up to 60,000 lbs. (upgradable lid)



| Inside Dimensions | | |
|-------------------|------------------|--------------|
| Length | Width | Depth |
| 34 3/8" [873] | 22 3/4" [578] | 21" [533] |

BULKU304824

BULK VAULT HDPE STRUCTURAL FOAM SHIELD X COMPOSITE COVER



FEATURES:

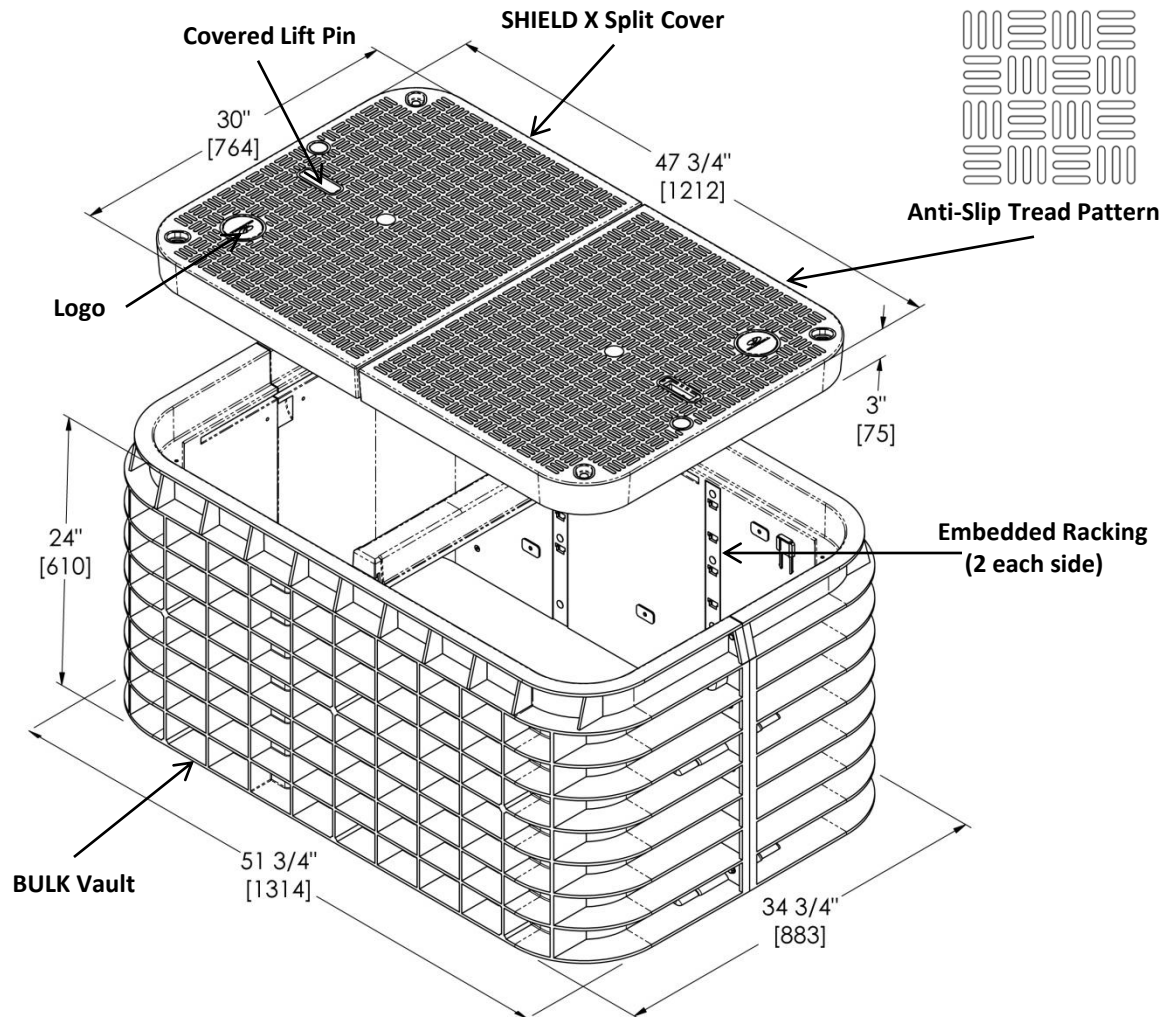
- 30" X 48" X 24" (open floor) (actual dimensions on drawing)
- BULK VAULT – SHIELD X Split COVER- Tier 22 Load Rated (ANSI/SCTE 77: 2016)
- (4) Cover fastener auger bolts, Hex (9/16") or Penta (7/8") head with washer (304 stainless steel)
- (4) Non-Seizing Fastening System, Field Replaceable
- (4) Embedded Composite Rack Support
- (1) Lifting slot equipped with stainless steel pin (slot is approximately 2 3/4" x 3/4")
- (1) Galvanized Center Beam
- (2) Logo Disk
- Stainless steel hardware is 300 series.

WEIGHT & SHIPPING:

- Cover Weight: 50 lbs (Per Half)
- Box Weight: 88 lbs
- Assembly Weight : 188 lbs

PERFORMANCE TESTING:

- ANSI/SCTE 77: 2016 - TIER 22 Rated (33,750 lbs)
- AS3996 – Class C
- EN124 Class B125
- ASTM C1028-07 & AS-4586 (Slip Resistance)
- 10,000 Hour Xenon-Arc Exposure (No fiber-bloom)
- ASTM D635-06 (Flammability)



| Inside Dimensions | | |
|-------------------|------------------|--------------|
| Length | Width | Depth |
| 46 1/2" [1180] | 28 3/4" [730] | 21" [533] |



BULKU304836

BULK VAULT HDPE STRUCTURAL FOAM SHIELD X COMPOSITE COVER



FEATURES:

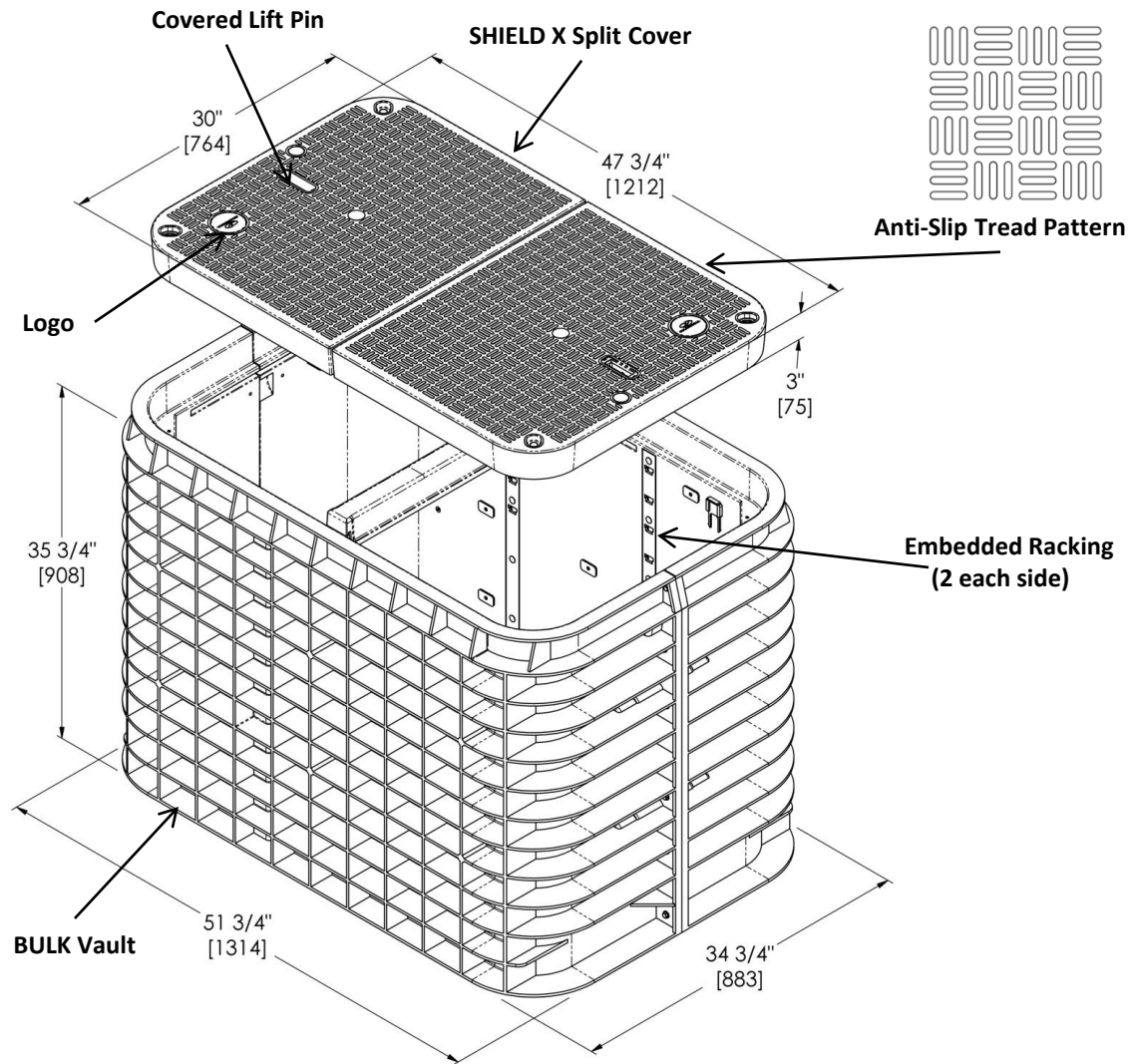
- 30" X 48" X 36" (open floor) (actual dimensions on drawing)
- BULK VAULT – SHIELD X Split COVER- Tier 22 Load Rated (ANSI/SCTE 77: 2016)
- (4) Cover fastener auger bolts, Hex (9/16") or Penta (7/8") head with washer (304 stainless steel)
- (4) Non-Seizing Fastening System, Field Replaceable
- (4) Embedded Composite Rack Support
- (1) Lifting slot equipped with stainless steel pin (slot is approximately 2 3/4" x 3/4")
- (1) Galvanized Center Beam
- (2) Logo Disk
- Stainless steel hardware is 300 series.

WEIGHT & SHIPPING:

- Cover Weight: 50 lbs (Per Half)
- Box Weight: 129 lbs
- Assembly Weight : 229 lbs

PERFORMANCE TESTING:

- ANSI/SCTE 77: 2016 - TIER 22 Rated (33,750 lbs)
- AS3996 – Class C
- EN124 Class B125
- ASTM C1028-07 & AS-4586 (Slip Resistance)
- 10,000 Hour Xenon-Arc Exposure (No fiber-bloom)
- ASTM D635-06 (Flammability)



| Inside Dimensions | | |
|-------------------|------------------|------------------|
| Length | Width | Depth |
| 46 1/2" [1180] | 28 3/4" [730] | 32 3/4" [832] |



BULKU366036

BULK VAULT HDPE STRUCTURAL FOAM SHIELD X COMPOSITE COVER



FEATURES:

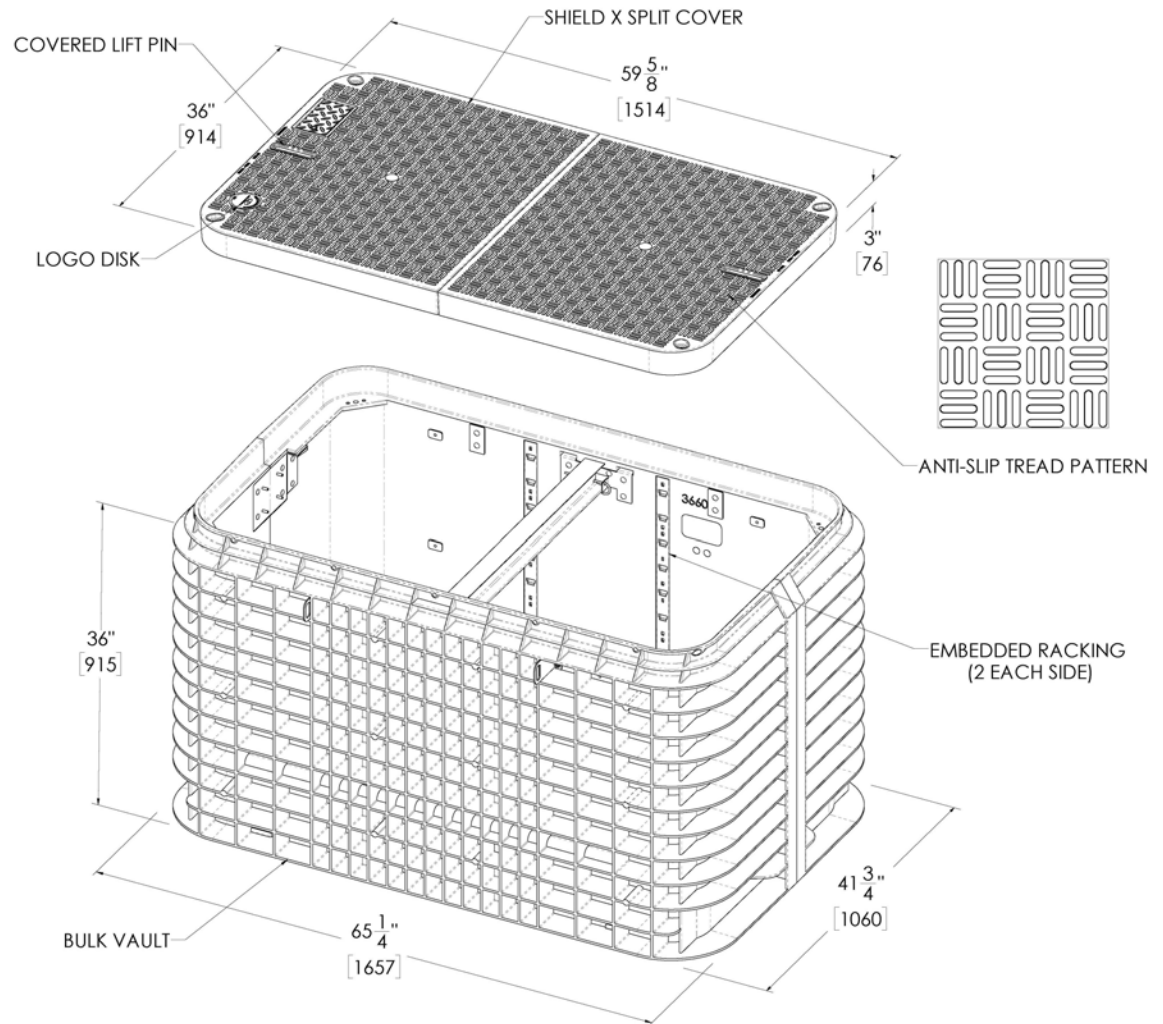
- 36" X 60" X 36" (open floor) (actual dimensions on drawing)
- BULK Vault – SHIELD X Split cover- Tier 22 Load Rated (ANSI/SCTE 77: 2016)
- (4) Cover fastener auger bolts, Hex (9/16") or Penta (7/8") head with washer (304 stainless steel)
- (4) Non-Seizing Fastening System, Field Replaceable
- (4) Embedded Composite Rack Support
- (1) Lifting slot, per cover, equipped with stainless steel pin (slot is approximately 4 1/2"x 3/4")
- (1) Galvanized Center Beam
- (1) Logo Disk
- Stainless steel hardware is 300 series.
- Available with flush to surface pad lock box.

WEIGHT & SHIPPING:

- Cover Weight:
 - Fixed Half 76 lbs.
 - Lock Half: 80 lbs.
- Box Weight: 209 lbs
- Assembly Weight : 365 lbs

PERFORMANCE TESTING:

- ANSI/SCTE 77: 2016 - TIER 22 Rated (33,750 lbs)
- AS3996 – Class C
- EN124 Class B125
- ASTM C1028-07 & AS-4586 (Slip Resistance)
- 10,000 Hour Xenon-Arc Exposure (No fiber-bloom)
- ASTM D635-06 (Flammability)



| Inside Dimensions | | |
|-------------------|------------------|------------------|
| Length | Width | Depth |
| 58 1/4" [1480] | 34 3/4" [883] | 32 5/8" [829] |



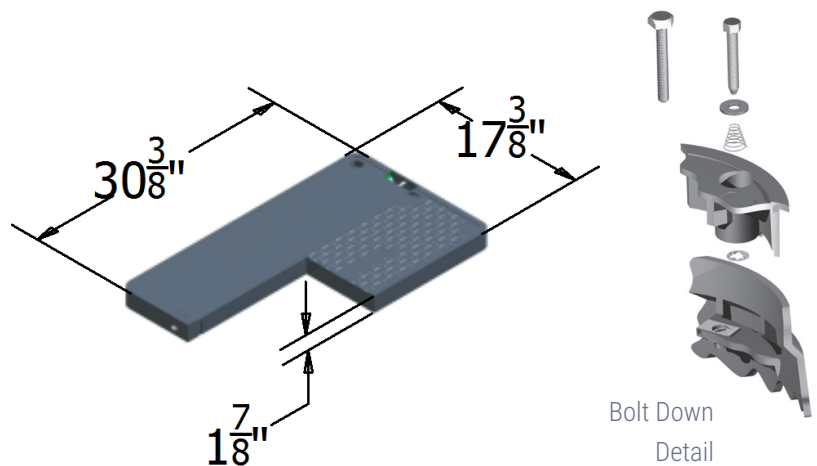
1730-24

CARSON[®] *Spec Grade*

COVER

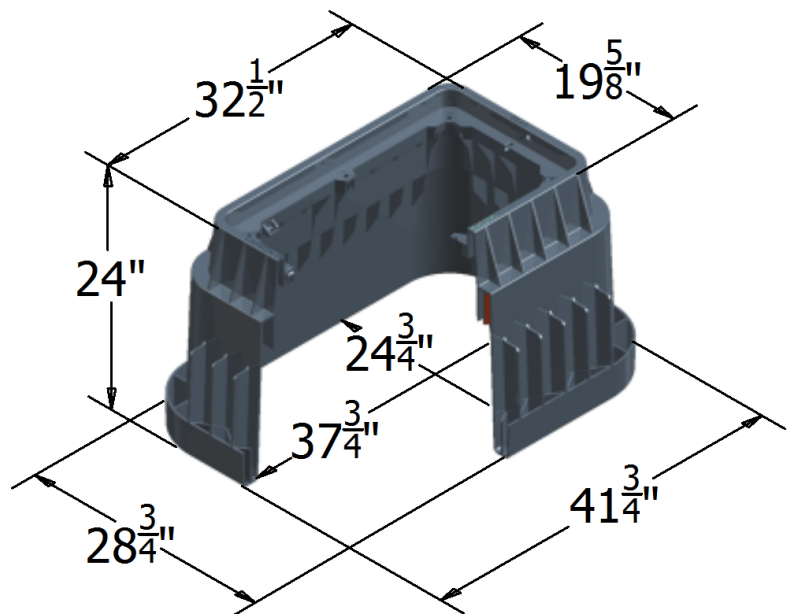
| | |
|-----------------|--------------------------------|
| Style: | Flush |
| Material: | HDPE |
| Model: | 17" x 30" |
| Weight: | 10 lbs |
| Std. Fasteners: | 3/8" Hex Bolt |
| Options: | Logos and Special Markings |
| Surface: | Skid Resistant & Marked |
| Performance: | Pedestrian, ASTM C857, WUC 3.6 |

Cover comes standard with permanent markings for manufacturer and model size.



BODY

| | |
|--------------|--------------------------------|
| Material: | HDPE |
| Model: | 17" x 30" |
| Weight: | 24" Depth: 52 lbs |
| Wall Type: | Flared |
| Mouseholes: | 0 |
| Performance: | Pedestrian, ASTM C857, WUC 3.6 |



LOAD RATING / NOTES



LIGHT DUTY
PEDESTRIAN / GREENBELT

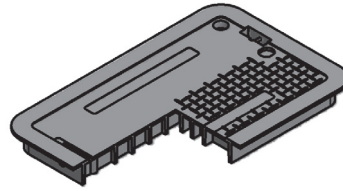
For use in non-vehicular traffic situations only.
Weights and dimensions may vary slightly.
Actual load rating is determined by the box
and cover combination.

1730-24

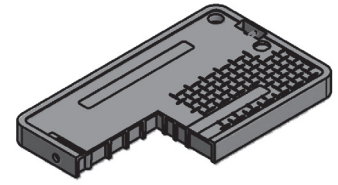
CARSON[®] *Spec Grade*

COVER OPTIONS

- HDPE, T-Cover Solid
- HDPE, Flush Solid
- HDPE, Flush with Plastic Reader Door
- HDPE, Flush with Cast Iron Reader Door



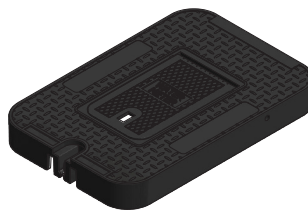
T-Cover Solid



Flush Solid

COLOR OPTIONS

- Cover: Black, Green, Gray, Tan, Purple
- Body: Black, Green, Gray, Tan, Purple



Reader Door Detail

FASTENER OPTIONS

- Hex Head Bolt (A)
- Penta Head Bolt (B)
- Penta Head Coil Thread Bolt (B)
- Oldcastle Vandal Resistant Bolt (C)
- Captive Bolt Retainer
- Drop-N-Lock™



Standard Thread



A



B



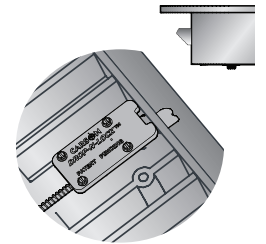
C



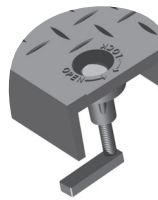
Coil Thread



Bolt Retainer
(for standard thread)



Drop-N-Lock
(T-Cover only)



L Bolt Detail



EMS Marker

ADD ON OPTIONS

- AMR Friendly Solutions
- Touch Read Hole
- EMS Marker
- Racking Provision

⚠ WARNING: Cancer - www.P65Warnings.ca.gov

All information contained on this sheet is current at the time of publication.
Oldcastle reserves the right to discontinue or update product information without notice.

Revision 11/30/18
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2436

CARSON® Spec Grade

COVER

| | |
|-----------------|--------------------------------|
| Style: | T-Cover |
| Material: | HDPE |
| Model: | 24" x 36" |
| Weight: | 37 lbs |
| Std. Fasteners: | 3/8" Hex Bolt |
| Options: | Logos and Special Markings |
| Surface: | Skid Resistant & Marked |
| Performance: | Pedestrian, ASTM C857, WUC 3.6 |

Cover comes standard with permanent markings for manufacturer and model size.

BODY

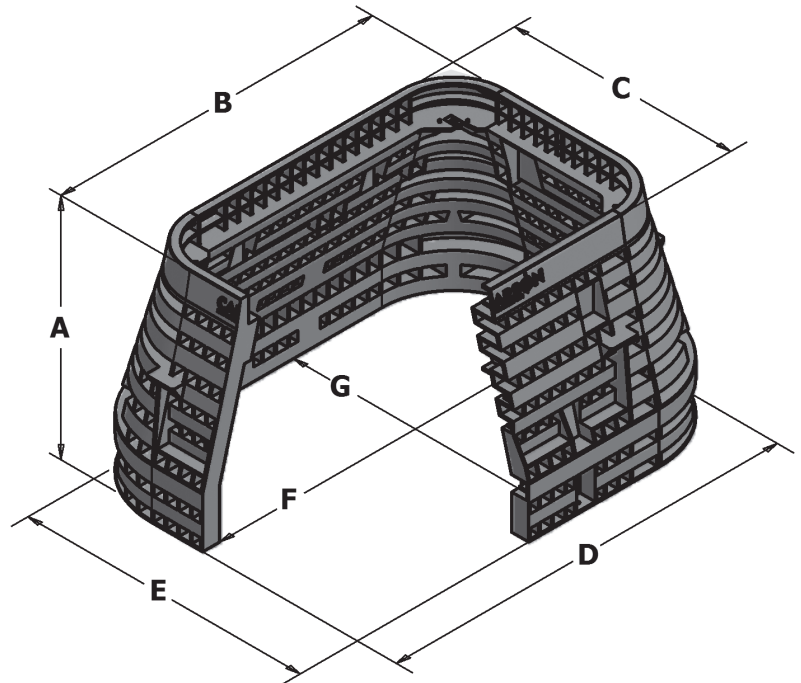
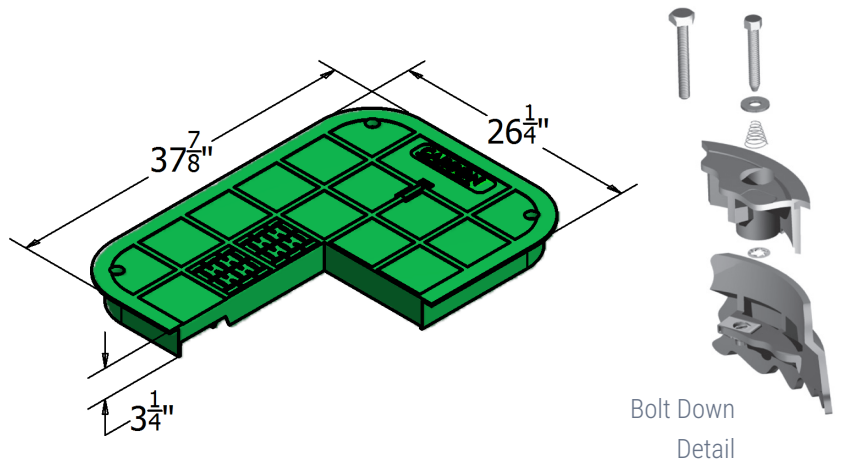
| | |
|--------------|--|
| Material: | HDPE |
| Model: | 24" x 36" |
| Weight: | 18" Depth: 47 lbs 24" Depth: 62 lbs |
| Wall Type: | Flared |
| Mouseholes: | 0 |
| Performance: | Pedestrian, ASTM C857, WUC 3.6 |

LOAD RATING / NOTES



LIGHT DUTY
PEDESTRIAN / GREENBELT

For use in non-vehicular traffic situations only.
Weights and dimensions may vary slightly.
Actual load rating is determined by the box
and cover combination.



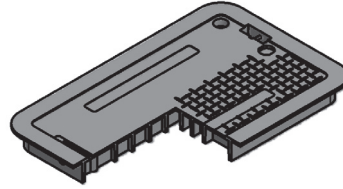
| A | B | C | D | E | F | G |
|-----|---------|---------|-----|---------|---------|---------|
| 18" | 37-3/4" | 26-1/4" | 47" | 35-3/8" | 42-7/8" | 31-1/4" |
| 24" | 37-3/4" | 26-1/4" | 47" | 35-3/8" | 42-7/8" | 31-1/4" |

2436

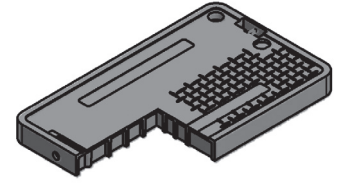
CARSON[®] *Spec Grade*

COVER OPTIONS

HDPE, T-Cover Solid
HDPE, Flush Solid



T-Cover Solid



Flush Solid

COLOR OPTIONS

Cover: Green, Gray
Body: Black, Gray

FASTENER OPTIONS

Hex Head Bolt (A)
Penta Head Bolt (B)
Penta Head Coil Thread Bolt (B)
Oldcastle Vandal Resistant Bolt (C)
Captive Bolt Retainer
Drop-N-Lock™



Standard Thread



A



B



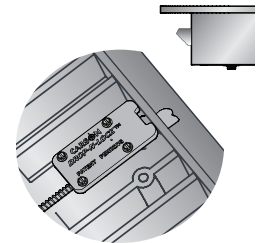
C



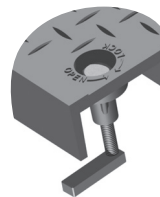
Coil Thread



Bolt Retainer
(for standard thread)



Drop-N-Lock
(T-Cover only)



L Bolt Detail

⚠ WARNING: Cancer - www.P65Warnings.ca.gov

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Revision 11/30/18
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Plastic & Polymer Grade Level Enclosure Installation Procedure

1 SCOPE

Installation instructions provide general information useful for *parkway installation* in both ‘grass surround’ and ‘sidewalk’ locations. This guide cannot anticipate all situations that could develop in the field. Rather, it presents information applicable to common installation conditions.

1.1 Installation Location

Location alone should not dictate product selection. Oldcastle Precast Enclosure Solutions divide their product offerings into performance classifications based on Design Load, the maximum load that may repeatedly be applied safely.

1.1.1 Light Duty (Carson/L Series brands)

‘Pedestrian Loading’, sometimes referred to as ‘greenbelt’ defines our all HDPE body and cover vaults intended for installation in landscape or grass surround areas where they will not be exposed to vehicular traffic. Exceptions to this rule include residential or light commercial mowers but do not include tractor/ mowers in highway easements.

1.1.2 Medium Duty (Fibrelyte/Carson Hybrid and Heavy Wall brands)

‘Incidental/ Non-deliberate Light Vehicular Loading’ category includes HDPE and glass filled HDPE bodies with polymer concrete covers and rings (for some sizes). This product range can be installed in sidewalks or in grass surround (between curb and sidewalk) where *it is reasonable to expect that some light vehicular traffic may occur*.

1.1.3 Heavy Duty (Synertech/H-Series brands)

‘Incidental/ Non-deliberate Medium and Heavy Vehicular Loading’ category is limited to all polymer concrete assemblies of body and cover. These products, while intended for installation in non-traffic areas of sidewalks and other asphalt or concrete surround are also installed in grass surround where governing organizations mandate. It is recommended that when installed in grass or soil surround a three to four-inch (3” – 4”) thick concrete collar may be poured around the enclosure.

1.2 Cover Selection

- 1.2.1 It is entirely appropriate and responsible to specify the use of a cover surface exhibiting a coefficient of friction greater than 0.5 whenever a vault and cover assembly are installed in a designated “walkway”. The following coefficient of frictions have been determined using ASTM C-1028 and are typical for Carson brand material and texture patterns:

| <u>Cover</u> | <u>Neolite Test Specimen</u> | | <u>Leather Test Specimen</u> | |
|------------------|------------------------------|------------|------------------------------|------------|
| | <u>Dry</u> | <u>Wet</u> | <u>Dry</u> | <u>Wet</u> |
| HDPE | 0.29 | 0.27 | 0.28 | 0.43 |
| Polymer Concrete | 0.84 | 0.67 | 0.60 | 0.64 |

- 1.2.2 Installation of product in a sidewalk (alone) does not specify a mandatory loading requirement. It is reasonable to assume there will be foot traffic.
- 1.2.3 HDPE covers receive a "vertical load rating" of "pedestrian traffic" (ASTM, C-857, A-0.3). The rating does not address coefficient of friction requirements that may be proper for installation in a dedicated walkway.

2 PROCEDURE

2.1 Site Preparation

- 2.1.1 Ensure that national - local electrical and building codes, OSHA and Company safety work rules are observed and provisions made for street flags, barricades and cones.
- 2.1.2 Secure permits as required by city and Company.

2.2 Excavation

- 2.2.1 Plan excavation approximately twelve to sixteen inches (12" – 16") longer and wider than the actual dimensions of the vault to be installed. Similarly, excavate six to eight inches (6" – 8") deeper than the overall dimensions of the vault with cover in place.

CAUTION: Vault size is generally defined by the approximate cover dimensions. The vault actual measurements will differ. Refer to the Oldcastle Precast Enclosure Solutions catalog or measure the vault overall maximum dimensions for computing the excavation hole size.

NOTE: The dimensions above for determining the size of excavation provide sufficient volume for accommodating the maximum recommended select backfill. The volume of the excavation would be reduced if a lesser volume of backfill material were chosen.

- 2.2.2 Installation can be in a 'grass surround' or in a 'concrete surround' (sidewalk) as required. The installation procedure is similar. Differences exist primarily in backfill material.
- 2.2.3 If installation is to be within a sidewalk, it is generally more practical to use a masonry saw and remove the entire sidewalk width to facilitate soil removal.
- 2.2.4 Excavate hole to appropriate dimension with mechanical excavator or hand dig as appropriate. Confirm the excavation floor is level.

2.3 Installation

- 2.3.1 While it is a common practice to install Pedestrian Rated vaults in grass surround without select backfill, Oldcastle Precast Enclosure Solutions recommends the use of a minimum two to three-inches (2" – 4") crushed rock to prevent subsidence over time. Subsidence is a familiar example of neglecting this step.

2.3.2 Vaults designed to withstand incidental/ non-deliberate traffic must be installed on a crushed rock base. A minimum thickness for light traffic (Fibrelyte/Carson Hybrid and Heavy Wall brands 'Medium Duty' classification) should be a minimum of four inches (4"). A thicker base of six to eight inches (6" – 8") is required for vaults designed for medium and heavy incidental traffic (Synertech/H-Series brands 'Heavy Duty' classification) or where shallow ground water is common.

NOTE: Base material shall be crushed rock $\frac{3}{4}$ " and smaller, angular stone, not '*river rock* or *round stone*'. Desired compaction and equivalent resistance to lateral loading will not be achieved with round stone. The rock should be free of soil and organic material.

ALTERNATE: A '*dry lean mix*' may be prepared for backfill using Portland cement and crushed rock in a ratio of 1:10. This higher strength alternative is useful where severe surcharge loading (lateral live load) is anticipated and the more flexible HDPE body is chosen.

2.3.3 Set vault into excavation on top of backfill material and adjust height to grade. Tamp base material to level with a mechanical tamper or hand tamper. It is generally desirable to install vault level. When a vault must be installed on a hill, a retaining wall provision shall be made.

2.3.4 The cover of the enclosure shall not be lower than nor more than two-inches (2") higher than the grade as specified by the Owner/ Operator. Soil in the immediate vicinity shall be tamped and sloped away from the enclosure.

2.3.5 Center the vault in the excavation parallel with sidewalk or curb. Mark the vault for duct/ pipe entry locations. The HDPE vault may be cut with a hole saw and drill motor. Provide adequate clearance for ovality in ducts. Small clearance between duct and vault may be sealed with expanding polyurethane foam.

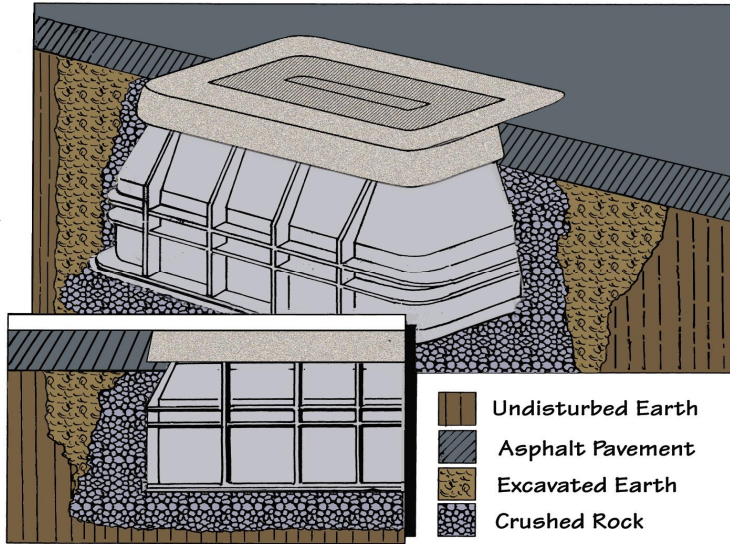
2.3.6 Backfill material can vary based on product and installation location. It is customary and acceptable in landscape installations where vehicles are prevented from traffic on or around a Pedestrian Rated vault to use the spoils removed during excavation for backfill. Remove stones three-inches (3") and larger.

2.3.7 For all product categories, begin the backfilling operation by adding soil, crushed rock or dry lean mix in eight-inch (8") *lifts* or layers.

2.3.8 Oldcastle Precast Enclosure Solutions recommends not using a mechanical tamper with a HDPE vault body, it may be desirable to use internal bracing during the backfill and tamping operation to prevent excessive deflection the sidewalls.

NOTE: The cover should be installed and bolted into the vault body prior to backfilling. This prevents debris from entering the vault or its' cover fasteners and ensures cover fit on completion of installation.

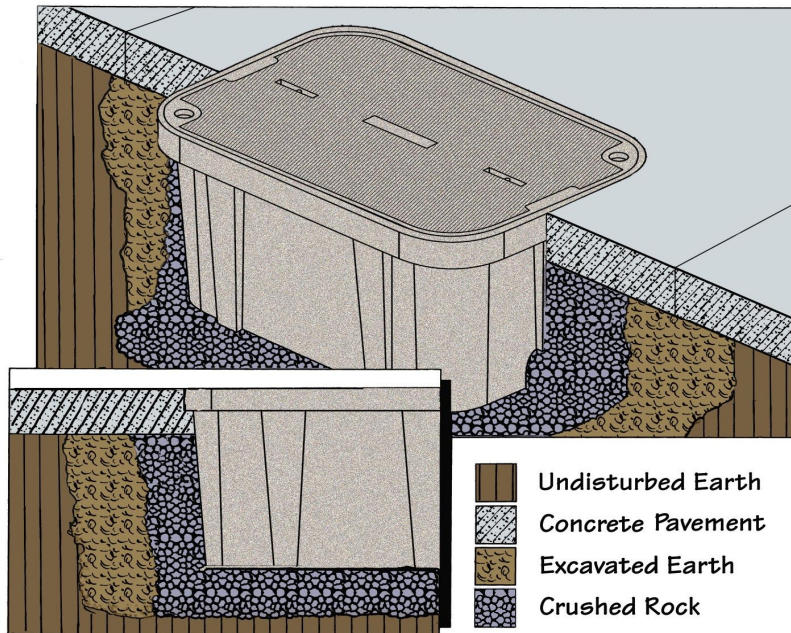
All information contained in this document was current at the time of printing. Because of Oldcastle Precast Enclosure Solutions policy of ongoing research and development, the Company reserves the right to discontinue or update product information without notice.



Medium Duty Product (Fibrelyte/Carson Hybrid and Heavy Wall brands)
Concrete or Asphalt Surround (shown)

Note compacted crushed rock surround. Dry mix could be added to crushed rock under "Ring" to improve vertical load bearing capacity.

.....



Heavy Duty Product (Synertech/H-Series brands)
Concrete or Asphalt Surround (shown)

Note compacted crushed rock surround and concrete under vault collar. Not shown but also applicable for this type enclosure is a 'greenbelt' installation. Many DOT's require a four-inch (4") concrete ring poured around vault collar.

End



MATERIAL & STYLE

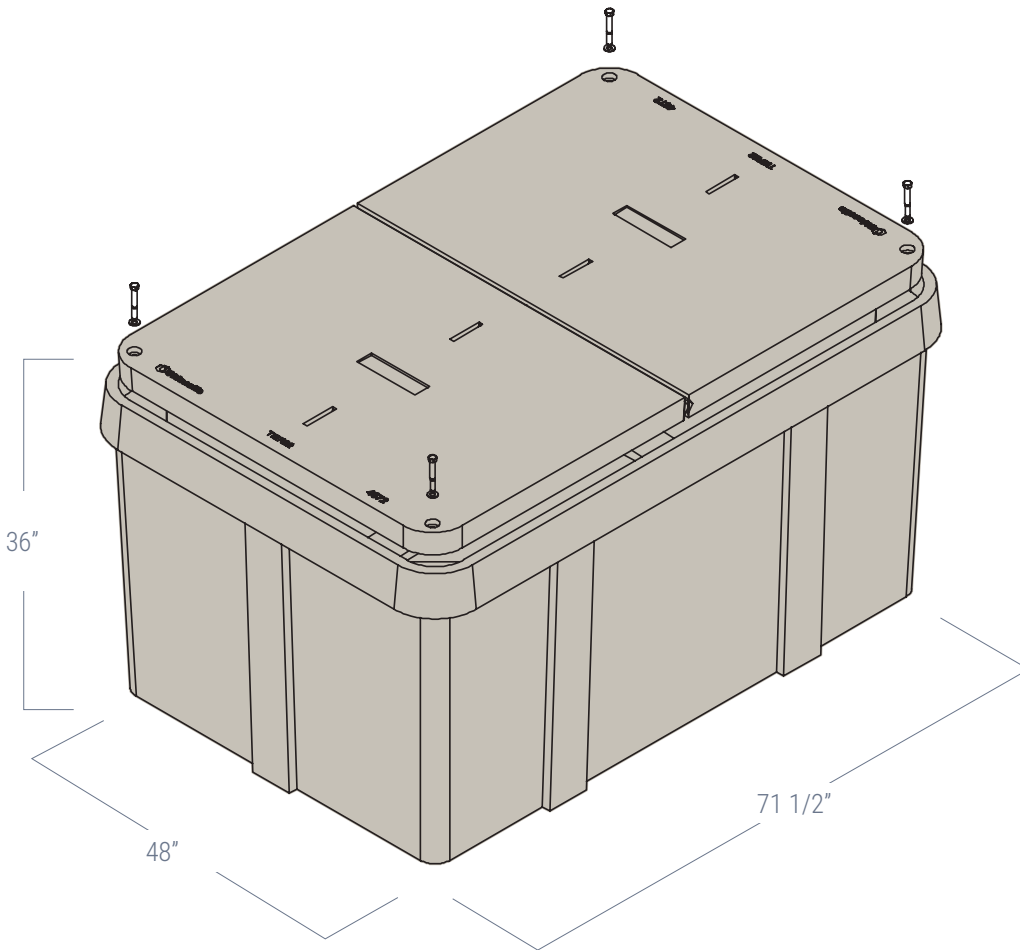
Polymer Concrete
Straight Wall

4872-36

ANSI/SCTE-77, Tier 22
734 lbs

OPTIONS

Mouseholes/Knockouts
Solid Bottom



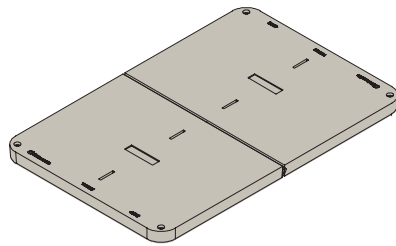
HEAVY DUTY
ANSI/SCTE TIER 22

For use in non-vehicular traffic situations only. Weights and dimensions may vary slightly. Actual load rating is determined by the box and cover combination.

Cover comes standard with permanent markings for manufacturer, load rating, model size and manufacturing location. Based upon lid and body combination, this unit can be Tier 15 or Tier 22. T22 rating when paired with T22 Cover.

Revision 04/19/21

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OPTIONS

Available Covers: • Polymer Concrete, Flush Split Cover

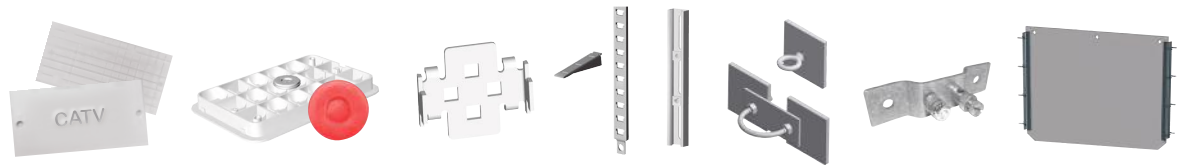


Detail: Lifting Strap



Fasteners:

- Hex Head Bolt
- Penta Head Bolt
- Penta Head Coil Thread Bolt
- Vandal Resistant Bolt
- Captive Bolt Retainer



Add On Options:

- Logos and Special Markings
- Marking Plate
- EMS Marker
- Rack Mount / Cable Rack
- Cable Arms
- Unistrut
- Pulling Eye
- Ground Buss
- Dividers
- Lid Gaskets*

RAW MATERIAL SPECIFICATION

| BODY : Material Property | Test Method | Typical Value ¹ |
|--------------------------|-------------|----------------------------|
| COMPRESSIVE STRENGTH | ASTM C 579 | > 12,500 PSI |
| FLEXURAL STRENGTH | ASTM D 790 | > 3,000 PSI |
| MODULAS OF RUPTURE | ASTM C 99 | ≥ 3,000 PSI |
| WATER ABSORPTION | ASTM C 97 | ≤ 0.25% |
| IMPACT RESISTANCE | ASTM D 2444 | > 70 FT-LB |
| FRICTION COEFFICIENT | ASTM C 1028 | > 0.5 |
| CHEMICAL RESISTANCE | ASTM D 543 | RESISTANT, > 75% RETENTION |

¹ The values listed for physical property measurements are nominal values only. Certain physical property measurements are subject to variations consistent with the test methods and are within a generally accepted range for such values.

WARNING: Cancer - www.P65Warnings.ca.gov

* Lid Gaskets inhibit water flow into the box, they do not make enclosure fully waterproof.

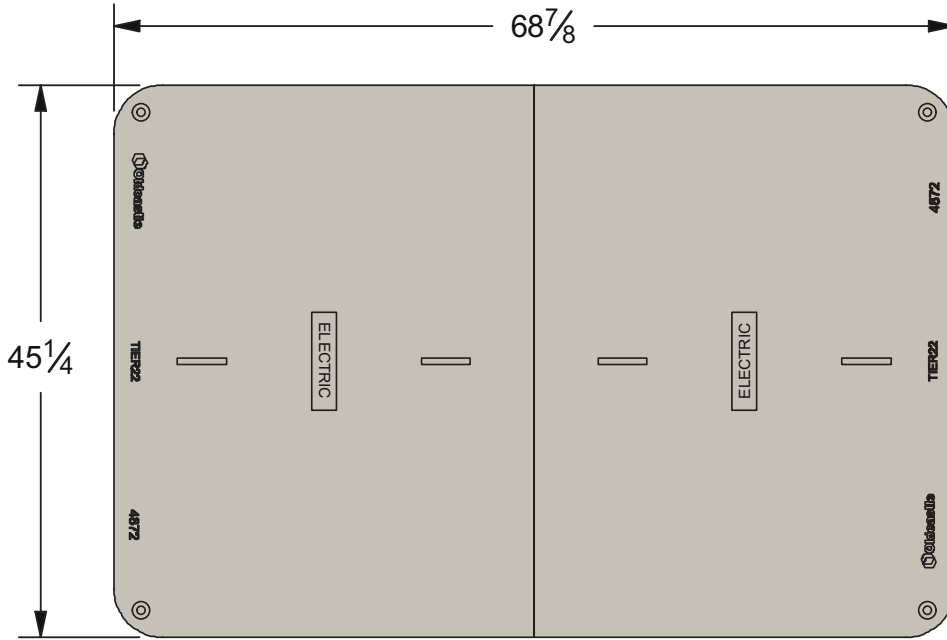
Product modifications, including but not limited to, cutting for conduit access, or "mouseholes" may alter ratings and product performance listed within this document unless stated otherwise.

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MATERIAL & STYLE

Polymer Concrete
Flush Split Cover
Non-skid texture

HARDWARE

1/2-13 Stainless Steel Hex
Head Bolt, Washer and
Floating Nut

**PERFORMANCE &
WEIGHT**

ANSI/SCTE-77, Tier 22
337 lbs / Half

OPTIONS

- Marking Plate
- Hex Head Bolt
- Penta Head Bolt
- Penta Head Coil Thread Bolt
- Vandal Resistant Bolt
- Logos and Special Markings
- EMS Marker

Cover comes standard with permanent markings for manufacturer, load rating, model size and manufacturing location.

RAW MATERIAL SPECIFICATION

| COVER : Material Property | Test Method | Typical Value ¹ |
|---------------------------|-------------|---|
| COMPRESSIVE STRENGTH | ASTM C 579 | > 12,500 PSI |
| FLEXURAL STRENGTH | ASTM D 790 | > 3,000 PSI |
| MODULAS OF RUPTURE | ASTM C 99 | ≥ 3,000 PSI |
| WATER ABSORPTION | ASTM C 97 | ≤ 0.25% |
| IMPACT RESISTANCE | ASTM D 2444 | > 70 FT-LB |
| FRICTION COEFFICIENT | ASTM C 1028 | > 0.5 |
| CHEMICAL RESISTANCE | ASTM D 543 | RESISTANT, > 75% RETENTION PHYSICAL PROPERTIES |

¹ The values listed for physical property measurements are nominal values only. Certain physical property measurements are subject to variations consistent with the test methods and are within a generally accepted range for such values.

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HEAVY DUTY
ANSI/SCTE TIER 22

For use in non-vehicular traffic situations only. Weights and dimensions may vary slightly. Actual load rating is determined by the box and cover combination.

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UNDERGROUND MARKING TAPE

PREMIUM SUPERSTRETCH™

| <u>Property</u> | <u>Test Method</u> | <u>U.S. Value</u> | <u>Metric Value</u> |
|-------------------|--------------------|--------------------------------|----------------------------|
| Overall Thickness | ASTM D-2103 | 6.0 Mil (Nominal) | 0.15 mm |
| Weight | ASTM D-2103 | 27.3 lbs /1000 ft ² | 13.3 kg/100 m ² |
| Tensile Strength | ASTM D-882 | 6050 PSI 32.7 lbs/in width | 41.7 MPa 145.5 N |
| Elongation | ASTM D-882 | 950% | 950% |
| Printability | ASTM D-2578 | > 40 dynes | > 40 dynes |

Key Features and Benefits

- * Specially formulated plastic film with super-enhanced tensile and elongation characteristics
- * Identifies and protects buried lines
- * Suitable for both plow and open trench applications
- * Lead-free pigments maintain color vibrancy in the soil
- * Environmentally safe ink ensures a long lasting warning message
- * Acid and alkali resistance enhances long term integrity in the ground
- * Meets American Public Works Association (APWA) National Color Code
- * Available in orange with black lettering. Other film colors may be available upon request.

Approvals

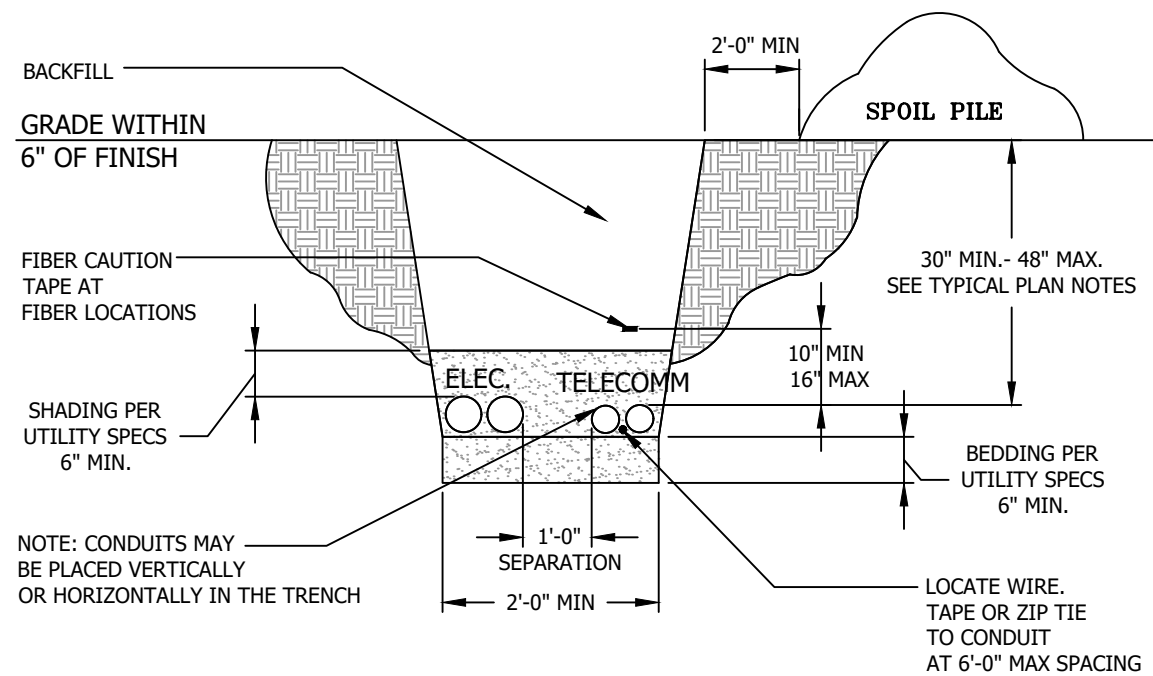
- * U.S. DOT, Office of Pipeline Safety
- * NTSB, Prevention of Damage to Pipeline Study
- * OSHA, Location of Underground Utility Lines Regulation
- * API, Recommended Practice For Marking Buried Petroleum Pipelines
- * GSA, Public Buildings Mechanical & Electrical Equipment Specification
- * REA, National Electrical Safety Code for Underground Construction

TYPICAL PLAN NOTES

SEE THE TYPICAL DETAILS FOR MORE INFORMATION.

BURIED TELECOMMUNICATION FACILITIES

1. TYPICAL TRENCH DEPTHS:
 - A. ALL TRENCH DEPTHS ARE THE MINIMUM REQUIRED FROM FINAL FINISH GRADE TO TOP OF CONDUIT.
 - I. RESIDENTIAL 30".
 - II. COUNTY AND CITY ROW 36".
2. ALL PEDESTALS AND VAULTS TO BE PLACED NEXT TO GROUND TRANSFORMERS, SWITCHES, AND OTHER GROUND INSTALLED POWER FACILITIES SHALL MEET MINIMUM CLEARANCE REQUIREMENTS REQUIRED BY THE POWER COMPANY.
3. ALL PEDESTALS AND VAULTS TO BE PLACED A MINIMUM OF 4'-0" CLEAR OF POWER POLES.
4. CONDUIT AND RUNS TO MAINTAIN 4'-0" MINIMUM FROM POWER POLE RUNNING LINE.
5. NOTIFY THE INSPECTOR IF MINIMUM CLEARANCES TO POWER POLES OR POWER RUNNING LINES ARE NOT ABLE TO BE MET.
6. ALL CONDUITS PLACED IN AN OPEN TRENCH TO BE LOCATED SUCH THAT THEY MINIMIZE SNAKING AND MAINTAIN AS STRAIGHT A PROFILE AS POSSIBLE.
7. ALL CONDUIT PATHWAYS SHALL BE PROOFED FOR FUTURE CABLE INSTALLATION PRIOR TO THE COMPLETION OF CONSTRUCTION.



**TYPICAL TELECOMMUNICATIONS
AND POWER SHARED TRENCH
DETAIL**

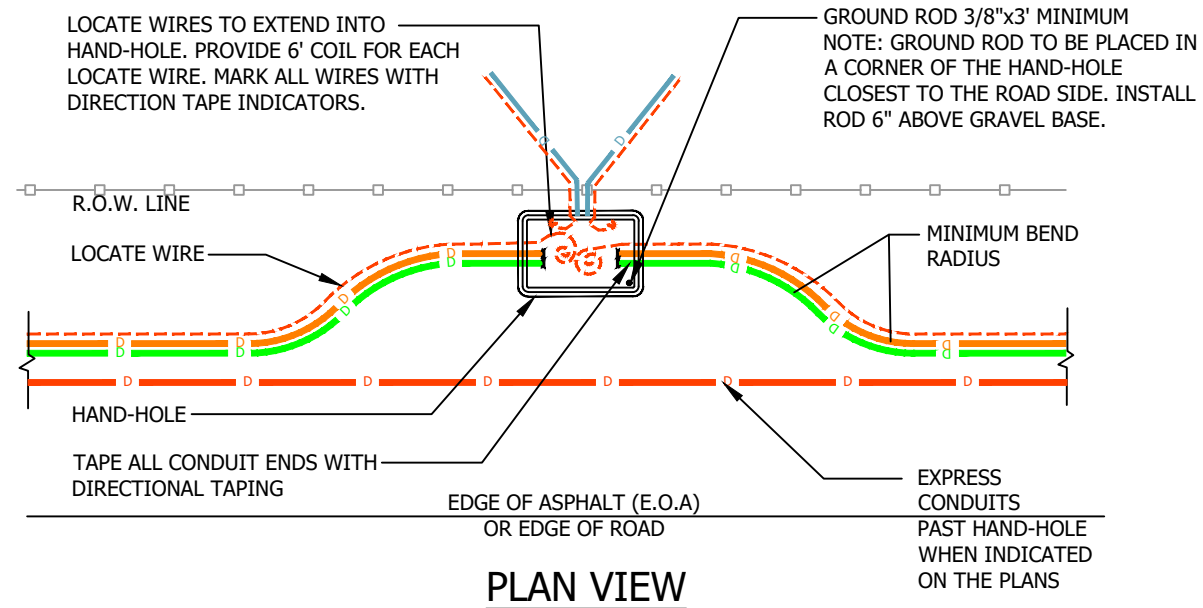
NOTES:

1. PLACE HAND-HOLE AGAINST R.O.W. LINE UNLESS NOTED OTHERWISE (U.N.O.) ON THE PLANS. SWEEP DUCTS AND TRACER LOCATE WIRE INTO HAND-HOLE WHILE MAINTAINING MINIMUM BEND RADIUS AT ALL CONDUIT BENDS. PLUG OR CAP ALL CONDUIT ENDS. MARK ALL CONDUIT ENDS WITH DIRECTIONAL TAPE INDICATORS.

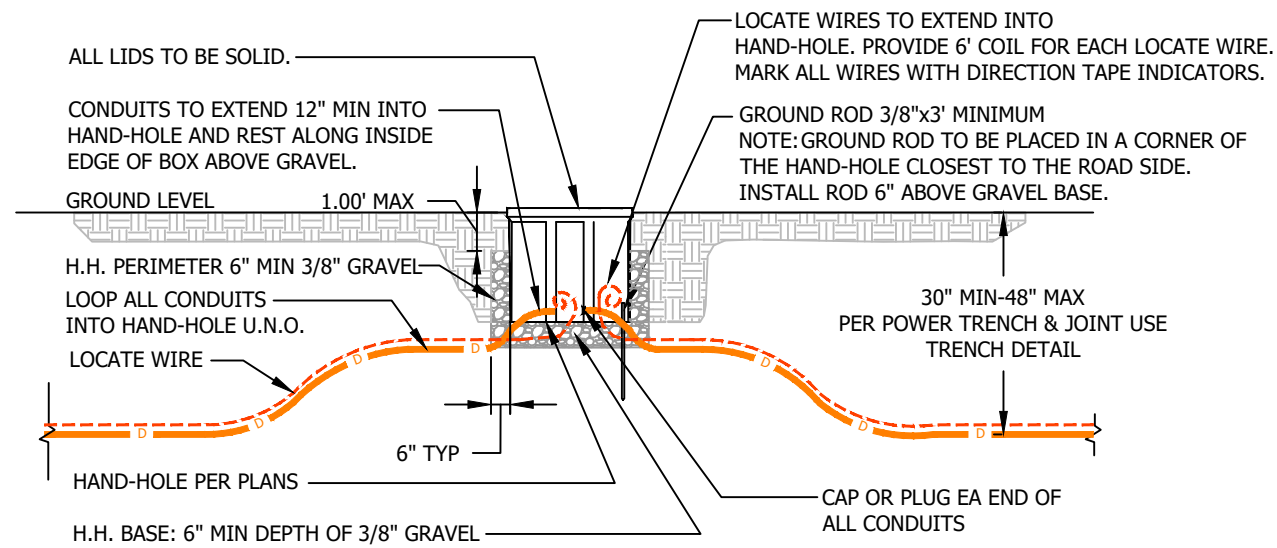
2. SWEEP DUCTS AND LOCATE WIRE INTO HAND-HOLE WHILE MAINTAINING MIN. BENDING RADIUS AT ALL CONDUIT BENDS.

MIN. BEND RADIUS: 18/14 MICRO-DUCT = 7"
4 WAY OR 7 WAY FUTURE PATH MICRO-CONDUITS = 4'

3. DETAIL IS REPRESENTATIVE OF TYPICAL FIELD CONDITIONS. ACTUAL CONDITIONS MAY VARY AND ARE SUSCEPTIBLE TO ALTERATIONS AS WARRANTED BY FIELD INSPECTORS.



PLAN VIEW



PROFILE VIEW

PREFERRED HAND-HOLE PLACEMENT DETAIL

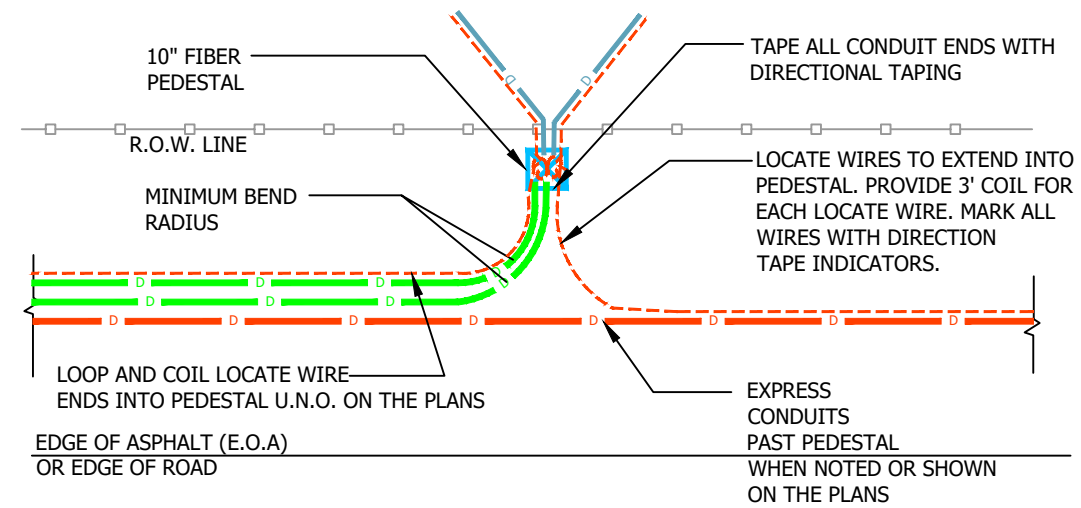
NOTES:

1. PLACE PEDESTAL AGAINST R.O.W. LINE UNLESS NOTED OTHERWISE (U.N.O.) ON THE PLANS. LOOP ALL DUCTS INTO PEDESTAL WHILE MAINTAINING A RADIUS/SWEEP AT ALL BENDS. PLUG OR CAP ALL CONDUIT ENDS FOR CONDUITS NOT IN USE. MARK ALL CONDUIT ENDS WITH DIRECTIONAL TAPE INDICATORS.

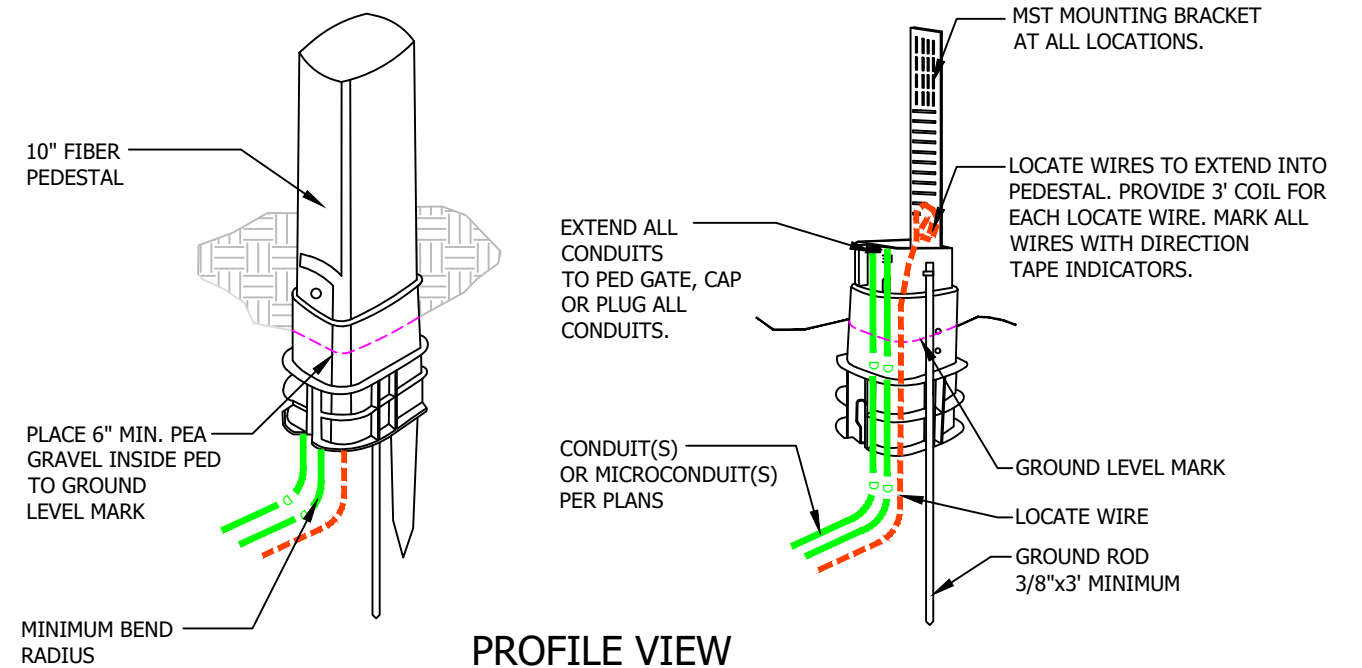
2. DETAIL IS REPRESENTATIVE OF TYPICAL FIELD CONDITIONS. ACTUAL CONDITIONS MAY VARY AND ARE SUSCEPTIBLE TO ALTERATIONS AS WARRANTED BY STRATA NETWORKS FIELD INSPECTORS.

3. SWEEP DUCTS AND LOCATE WIRE INTO HAND-HOLE WHILE MAINTAINING MIN. BENDING RADIUS AT ALL CONDUIT BENDS.

MIN. BEND RADIUS: 18/14 MICRO-DUCT = 7"
4 WAY OR 7 WAY FUTURE PATH MICRO-CONDUITS = 4'



PLAN VIEW

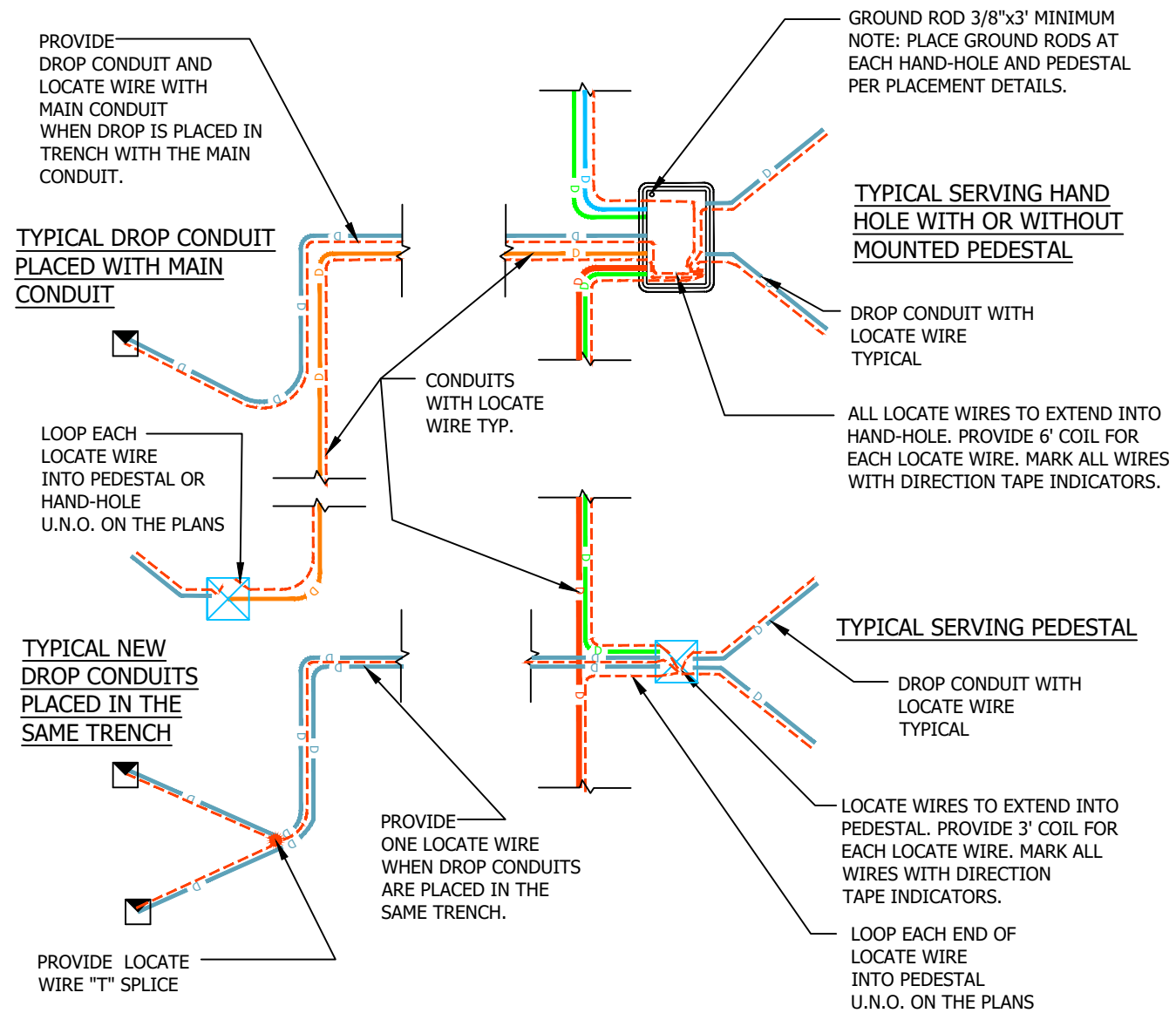


PROFILE VIEW

PEDESTAL PLACEMENT DETAIL

NOTES:

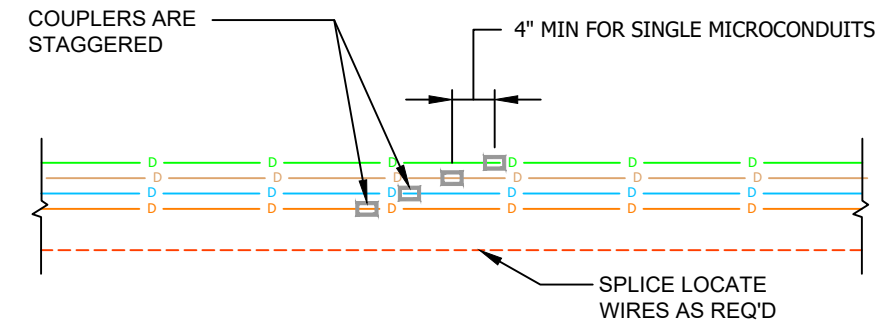
1. LOCATE WIRE TO RUN CONTINUOUS FROM HAND-HOLE/PEDESTAL TO ADJACENT HAND-HOLE/PEDESTAL. MID-SPAN SPLICING OF LOCATE WIRE IS NOT PERMITTED UNLESS PRIOR APPROVAL IS OBTAINED FROM THE INSPECTOR. ALL MAIN LINE LOCATE WIRES CONTAINING AN INTERMEDIATE SPLICE WILL BE SUBJECT TO PRE-APPROVAL, LOCATION VERIFICATION, AND LOCATE TESTING PRIOR TO ACCEPTANCE.
2. ATTACH ALL LOCATE WIRE TO CONDUIT AT 6'-0" MAX SPACING WITH TAPE OR ZIP TIES PRIOR TO PLACING CONDUIT INTO THE TRENCH.



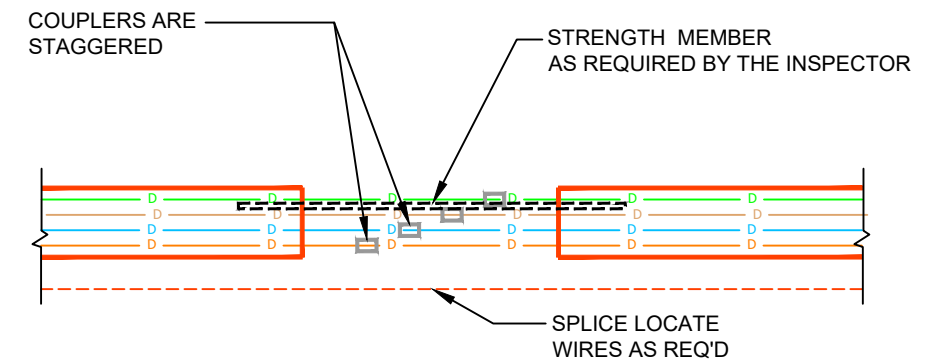
TYPICAL LOCATE SYSTEM DETAIL

NOTES:

1. LOCATE WIRE MAY BE LOCATED INSIDE OF AN EXISTING CONDUIT OR FASTENED TO THE EXTERIOR OF A NEW CONDUIT.
2. ALL CONDUIT COUPLERS ARE TO BE SUPPLIED OR APPROVED BY THE CONDUIT MANUFACTURER.
2. DETAIL IS REPRESENTATIVE OF TYPICAL FIELD CONDITIONS. ACTUAL CONDITIONS MAY VARY AND ARE SUSCEPTIBLE TO ALTERATIONS AS WARRANTED BY STRATA NETWORKS FIELD INSPECTORS.



SINGLE MICROCONDUIT COUPLE DETAIL



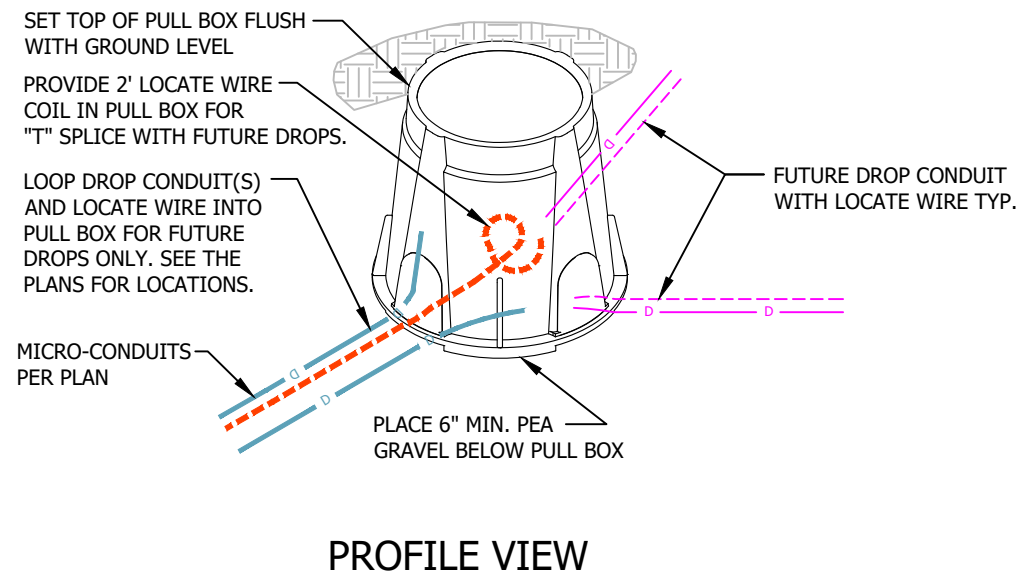
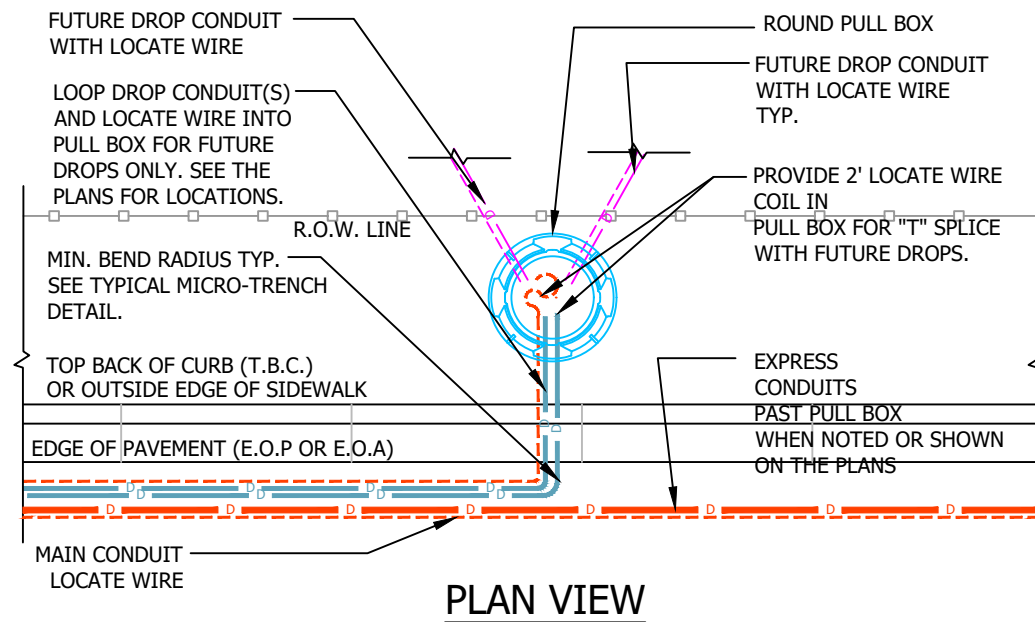
4 WAY FUTURE PATH MICROCONDUITS COUPLE DETAIL

CONDUIT COUPLE DETAILS

NOTES:

1. PLACE PULL BOX AGAINST R.O.W. LINE WHERE POSSIBLE. PULL BOXES ARE NOT TO BE PLACED IN LOCATIONS WHERE POTENTIAL VEHICLE TRAFFIC MAY OCCUR. LOOP ALL UNUSED DROP MICRO-CONDUITS INTO PULL BOX WHILE MAINTAINING A RADIUS/SWEEP AT ALL BENDS. PLUG OR CAP ALL MICRO-CONDUIT ENDS INSIDE PULL BOX. PULL BOX IS INTENDED TO BE REMOVED ONCE THE FUTURE DROP CONDUIT HAS BEEN INSTALLED.

2. DETAIL IS REPRESENTATIVE OF TYPICAL FIELD CONDITIONS. ACTUAL CONDITIONS MAY VARY AND ARE SUSCEPTIBLE TO ALTERATIONS AS WARRANTED BY STRATA NETWORKS FIELD INSPECTORS.



PULL BOX PLACEMENT DETAIL

KEY FOR COLOR CODING CABLES, CONDUITS, & LOCATE WIRE:

TAPE THE ENDS OF THE CABLES, CONDUITS, AND LOCATE WIRE IN PEDS AND HAND-HOLES, DEPENDING ON WHICH DIRECTION THEY ARE LEAVING THE PEDESTAL OR HAND-HOLE. COLORS MAY BE COMBINED TO DELINEATE ADDITIONAL DIRECTIONS, I.E. SOUTH-WEST, NORTH-WEST, ETC. USE ONLY SOLID COLORED TAPE.

- CENTRAL OFFICE/NETWORK FEED-BLUE**
(USE BLUE ONLY WHEN DIRECTED BY THE INSPECTOR)
- NORTH-ORANGE**
- EAST-GREEN**
- SOUTH-BROWN**
- WEST-SLATE**