

Wireline Engineering Method and Procedure

OSP Handbook Buried and Underground (UG) Plant

Purpose	The purpose of this document is to provide guidance to Engineering, Operations (where applicable), and Vendors on the design and construction of buried and underground (UG) facilities and the associated carrying plant.
Personnel Affected	This method affects all Outside Plant Engineering, Construction and Vendor personnel.
Effective Date	This document is effective upon receipt.
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**Regulatory
Compliance**

Not Applicable

**Related
Documents**

[OSP Handbook General Guidelines](#)
[OSP Handbook Aerial Plant](#)
[OSP Handbook Project Design and As-Built Procedures](#)
[OSP Handbook Splicing Preparations](#)
[OSP Handbook Cable/Equipment/Material Specifications](#)
[OSP Handbook Safety Regulations](#)
[OSP Handbook Subaqueous Plant / Bridge and Fixed Structure Attachments](#)
[OSP Handbook Invoicing](#)
[OSP Handbook Project Design and As-Built Procedures](#)

**Related
Training**

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1.0 Verizon Employee Compliance

1.1 Verizon Code of Conduct and Company Policy Compliance

All Verizon employees are required to understand and adhere to the Verizon Code of Conduct and all Company policies.

The Code of Conduct and Company policies are in place to govern the conduct of employees and the conduct between employees, customers, competitors and the numerous business providers, including suppliers, vendors, contractors and agents.

Employees may never violate the Verizon Code of Conduct or any Company policy.

1.2 Customer Proprietary Network Information (CPNI) Compliance Policy

The CPNI policy describes and governs the permissible uses and disclosures of Customer Proprietary Network Information (CPNI).

The policy is applicable to customers of all Verizon Wireline organizations, consumer, small business, medium business, large business, government and online accounts. The policy governs activities where CPNI data is used internally, provided to a Customer, shared among affiliates or disclosed to a third party.

It is each employee's responsibility to understand and comply with the CPNI policy along with the Verizon Code of Conduct and all other Company policies.

2.0 Defining Buried and Underground (UG) Construction

This document describes two methods of outside plant construction, buried and underground. The Verizon employee is responsible for coordinating and communicating among the various parties with respect to design guidelines. Creativity and persuasiveness is often required of the Design Engineer to bring about the agreement. Any differences between Verizon guidelines and those of the ROW owner/maintainer should be pointed out immediately in writing, to the assigned Verizon employee.

It is the responsibility of the Verizon employee to place orders for all the Verizon furnished materials, based on the quantities specified on the construction plans. Let's distinguish between them before we go any further.

BURIED - cables or wires are buried directly into the ground without a conduit.

UNDERGROUND (UG) - cables are pulled through conduits that are buried in the ground.

Reasons for using direct buried or underground as opposed to aerial construction may include:

Aesthetics

Local Procedures

Municipal regulations

Some specific scenarios could involve:

The placement of conduit beneath driveways, roadways and other soon to be paved areas, in an effort to minimize future costs associated with digging up and replacing these surfaces when a cable needs to be placed or maintained.

Placement of a conduit system in a rocky or ledgy area to avoid a need for any future access into the area.

3.0 Verizon General Buried Construction Requirements

1. Construction of cable systems through adverse terrain such as ditches, canals, roadways, marshes, or across or under other obstructions may be required during inclement weather.
2. The depth shown on the work plans will be adhered to in all operations.
3. The Contractor should take before and after photos and or a video of work areas. Restoration of the Right-Of-Way (ROW) to their original condition or better as construction progresses after placing cable or conduit as dictated by the municipality.

4. Plow trenches will be tamped, making as many passes as required over the plowed area to accomplish sufficient compaction.
5. Test pits will be dug, utilizing non-invasive methods of excavation (i.e., hand digging, vacuum excavation, etc.) every 25 feet (or as required) to expose other buried utilities when trenching or plowing within 5 feet (or as required) of a parallel existing line. These tests will be supported by the use of cable locating devices. The location and safe crossing of all foreign utilities is the responsibility of the Contractor.
6. All conduit and innerduct will be capped immediately after placement (See section 3.2).
7. At any time, Verizon and/or representatives of the railroad or appropriate permit agency may require a Department of Transportation standard compaction test of tamped areas. Such tests will be performed at Contractor's expense. If the compacted soil fails the test, the Contractor is responsible for correcting the deficiency.
8. The Contractor will provide and place barricades around open pits and trenches. No excavation will be permitted to remain open overnight. Barricades will have flashing lights. Barricade tape (not Verizon marker tape) will be used to rope off the excavation area.
9. The transmission quality and characteristics of the fiber optic cable are degraded if the cable is subjected to excessive pulling tensions or excessively short bending radii. The manufacturer's specifications concerning maximum pulling tension and minimum bending radius shall not be exceeded. Generally the standard for maximum tension during installation of fiber optic cable is 600 pounds. The minimum bending radius of fiber optic cable under tension will not be less than 20 times the cable diameter.
10. Employees involved in burying fiber optic cable will be familiar with standard placement practices and precautions and with manufacturers' specifications
11. Buried plant will be placed in as straight and level condition as possible, at the depth specified.
12. The minimum area required for figure-eighting cable is 25-feet x 50-feet. Figure-eight cable will be barricaded and attended at all times. The figure-eight method of handling cable will be used when a reel cannot be placed in one continuous pull.
13. Care will be taken to avoid cable damage during handling and placement. Avoid sharp bends, do not exceed cable manufacture's specification, and take precautions to prevent crushing the cable during placement. Such damage may alter the transmission characteristics to the extent the cable section will have to be replaced.

14. Cable reels will be transported in an upright position. Fiber storage must be protected from extreme weather while on cable reel.
15. Security should be provided by the Contractor for all cable reels or exposed cable not completely placed in one day. Reels will be protected with a steel cage or an attendant security guard.
16. If it is necessary to lay the cable on the ground to bypass obstacles, the area will be enclosed with barricades. Where the cable crosses locations such as private entrances, the cable will be bridged with 2-inch x 8-inch planks.
17. All cable ends will be temporarily grounded.
18. All cables placed through duct will be sealed immediately after installation. All sealant materials will be in accordance with section 3.2.
19. To reduce friction during the placing operation, lubricate the cable using a Verizon approved lubricant. Application will conform to the manufacturer's directions and section 3.1.
20. Dependable radio communications will be established between the pull, feed, and monitor locations before starting any pull. If radio communications fail during pulling operations, cable pulling will stop immediately.
21. Never enter a handhole/manhole without first testing it for the presence of gas. If gas is detected, the handhole/manhole shall be ventilated. Never enter a handhole/manhole unless tests indicate that the atmosphere is safe.
22. Do not bring open flames, torches, or lighted cigars, cigarettes, or pipes into a handhole/manhole even though tests may indicate that the atmosphere is satisfactory.
23. Lighting, heating and other equipment used inside manhole/handhole must be operated and meet all local, state, and federal safety requirements. Never connect or disconnect electric lighting or heating equipment in the handholes/manholes. Making or breaking an electric circuit may cause an arc.
24. Pull-through handholes/manholes will be entered only after the pulling attachments have gone through the manhole and entered the upstream conduit.
25. If the pulling truck and associated equipment are not equipped with overhead exhaust systems and they are stationed near the handhole/manhole, exhaust gases will be directed away from the handhole/manhole opening.

26. Generators, blowers, and pumps will be located so the exhaust fumes will not blow into the handhole/manhole. Manhole setup package with ventilation is a must when working in Manholes.
27. When working in a handhole/manhole, exercise care to prevent damage to cables while setting up the pulling equipment or while using tools of any kind. A ladder will always be used to enter or leave manholes. **(Do not step on the cables)**
28. Do not place hands on a moving pull line, especially in the vicinity of a sheave.
29. All open manholes will be protected with a Telco-type manhole guard.
30. Never enter a non-Verizon owned manhole without obtaining the prior consent of the owner.
31. Buried dielectric fiber cable will be placed with a trace-wire either: (1) twelve inches above the conduit or HDPE containing the dielectric cable, or (2) inside the conduit (pulled in WITH and outside the innerducts).
32. All fiber cable will be tested with OTDR before and after being placed. Record the test results and provide a copy to the Verizon Manager.

3.1 Lubricants

The following is a list of recommended lubricants, utilized in conjunction with pulling cable into innerduct or when re-entering previously installed HDPE. When utilized in conjunction with new HDPE installation efforts, supplemental applications will be of the same material as applied by the vendor in the pre-lubricated HDPE. Summer grades of lubricants are effective to 32 degrees Fahrenheit; winter grades to 0 degrees Fahrenheit. Both water-based and silicone based materials clean up with water. See Table 3-1.

Table 3-1 Lubricants

MANUFACTURER	DESCRIPTION
Integral Corp. Dallas, Texas	Lubaduk Silicone oil with microspheres in suspension
American Polywater Corp. Stillwater, Minnesota	Polywater F Slow drying water based gel
ARNCO Corp. Elyria, Ohio	Hydra-Lube F-100 Water Based Hydra-Lube F-150 Silicone spheres

Note: *Soap lubricants or lubricants containing soap are harmful to the polyethylene cable sheath and will not be used.*

3.2 Duct/Conduit Sealants

The temporary sealing or capping of the conduit(s) and sealing around the innerduct(s) will be with foam. Approved foams are, Dow Corning 3-6548 RTV or Semco PR-855 RTV or equivalent, meeting UL 94 HF-1 and ASTM E84 Class 1 standards. Permanent sealing will be with JackMoon style plugs and sleeves. All ducts entering a building shall be sealed both at the point of entry (first MH/HH outside) and at the point of emergence (first exposed location outside) with JackMoon plugs or equivalent.

3.3 Anti-Freeze Gel

Accepted temperature range of use for anti-freeze gel is -40 degrees to 120 degrees Fahrenheit. The gel should be tested to ensure it is not harmful to the cable jacket. Fiber cable manufacture's recommended anti-freeze gel may be used with approval of OSPE.

4.0 Planning and Design Considerations

Selecting a Location

Several factors must be considered while selecting a permanent location for buried plant:

- Profiles and curves
- Access to cable
- Bending radii
- Environmental conditions
- Existing structures (e.g., bridges)
- Joint protection
- Pulling tensions
- Future needs
- Maintenance
- Existing and proposed utilities
- Work space requirements
- Boring equipment space requirements.
- ROW issues / Ordinances / Permit requirements
- Soil conditions
- Existing and future obstacles / Obstructions (i.e. trees, rocks, fences, signposts, etc.)
- Future excavation potential (i.e. road widening)

- Location of other utilities

Location of other utilities

- Know what currently exists in the area. There are plant locating resources for this. Before any underground work is done, you must be aware of what exists in the area. Gather information on existing and proposed underground facilities of other utilities and agencies.
- It is a legal requirement that no digging be performed before notifying all utilities and allowing them the timely opportunity as required by law, to mark the location of their facilities in the affected area. **Know what's below before you dig.** It's the law.
- Most all localities have established a clearinghouse to notify the utilities of proposed construction. The clearinghouse is variously called Dig-Safe, Dig-Safely, One-Call, Miss Utility or Utility Notification Center in different parts of the country. It should be known in your office or can be easily found on the World Wide Web. **Be mindful of regional differences at the municipal, city, state and federal level.**
- The FCC has established 811 as a national call-before-you-dig telephone number. It is to be implemented by April 2007. Verizon wireless implemented 811 in March 2006. Verizon wireless customers dialing 811 will be connected to the appropriate call center for their location.

4.1 Design Guidelines

1. Long Distance buried plant will be installed with a minimum cover of 42 inches, 36 inches for Local, or at depth specified by the ROW owner/maintainer, whichever is greater. Conduit depths will be shown on the construction drawings. Depths shown will be considered as the depth of cover on top of the conduit, not trench depth.

The following guidelines will be followed when the specified minimum cover cannot be attained:

DEPTH	METHOD OF PLACEMENT
42'-36'	Buried Conduit or HDPE
	Concrete Encapsulated Conduit/HDPE or Concrete Capped Conduit/HDPE or
36' - 24'	BSP Conduit
24' OR LESS	Concrete Encapsulated BCP/HDPE

2. Where extensive rock conditions make buried placement with sufficient cover uneconomical, alternate installation methods such as aerial, existing conduit, rock saw, etc., should be considered.
3. Compaction and backfill requirements will be provided for trench or plow operations. This information will be included in the Typical Drawings located in the front section of the EWO / Project. With this arrangement, these Typical Drawings can be referenced to as needed on other drawings in the package. Special ROW requirements will be identified on the construction drawings.
4. All foreign utilities within five feet of the proposed running line will be physically located by either the utility owner or the design firm. ALL foreign utilities within the ROW will be posted onto the drawings.

Additional protection may sometimes be required at locations crossing above gas, petrochemical, utility, sewer, or other pipelines. Install BSP conduit at these locations for HDPE or innerduct to be pulled through (refer to above item 2 for minimum separation).

BSP conduit shall be considered where obstructions such as buried utilities or other facilities run parallel to the proposed running line and have less than two feet of separation or as dictated by the owner of the affected facility.

5. Cable installation operations should be planned to minimize the need to figure-eight, however, if it is necessary to figure-eight, the cable sufficient space (25 feet long by 50 feet wide minimum for a 5-6 km reel) must be available for figure-eighting operations.
6. Sufficient space must be available for different types of construction equipment to operate. As a guide, typical space requirements are given below:
 - Typical plow train width: 10 feet
 - Typical small trenching machine: 15 feet
 - Recommended area of a bore pit: 20 feet by 40 feet (includes 5' x 15' bore pit and space for equipment and spoils)
 - Recommended area of a receive pit: 5 feet by 10 feet (includes space for equipment and spoils)

Along public road ROW, construction corridors will be shown on the plans. A construction corridor is that area that will likely be disturbed by the proposed construction.

If a construction corridor encumbers an area outside the ROW and a temporary construction permit is required, a temporary Check List form symbol should be placed on the plans. Temporary Check List symbols are simply standard Check List symbols with a "T" appended to them. To aid in the acquisition

process, the area requiring a temporary construction easement will be dimensioned and referenced to known visible points in the field (See Figure 4-2)

Construction activities may occur as close as one foot to the ROW line in flat terrain. In sloped areas, this separation may require acquisition of a temporary construction easement.

If longitudinal agreement exists, follow terms of agreement.

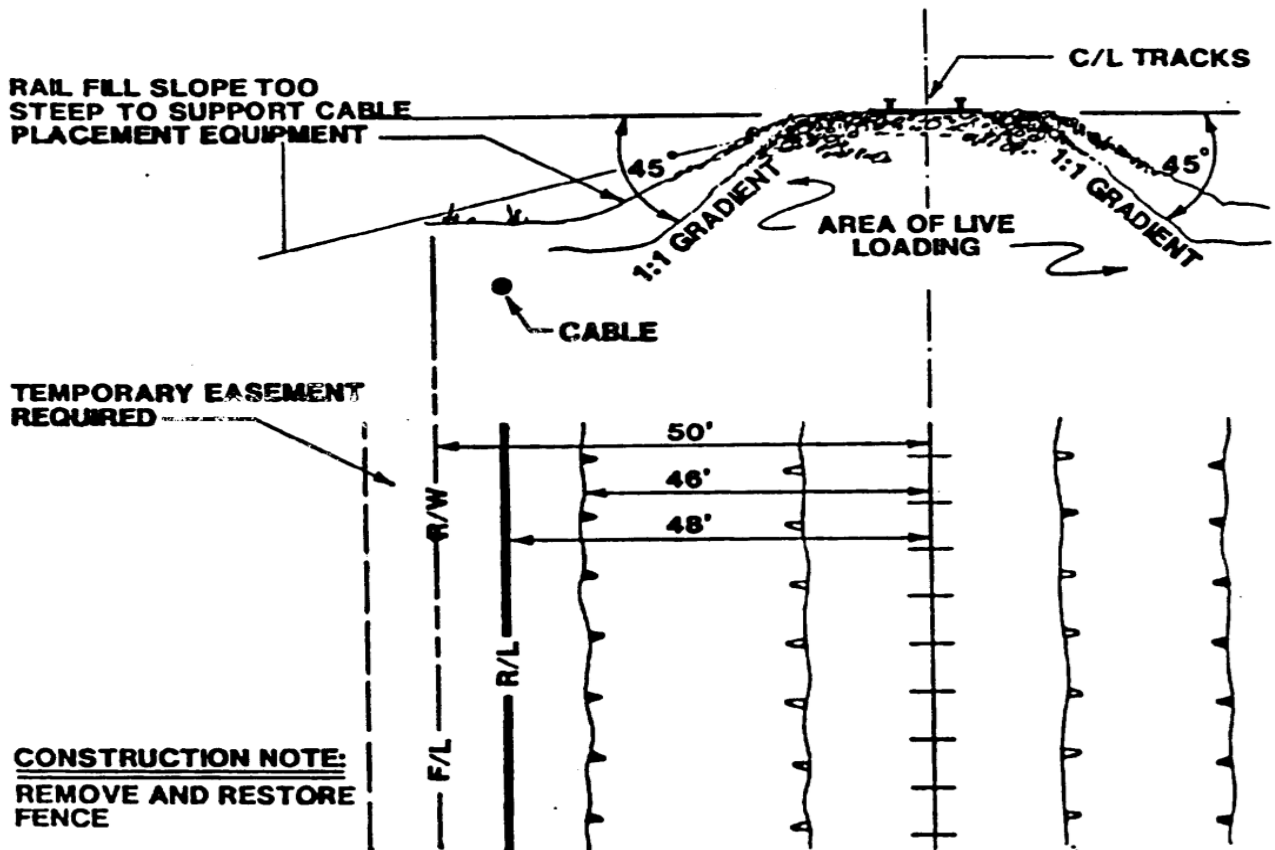


Figure 4-1 Railroad Area of Safe Gradient

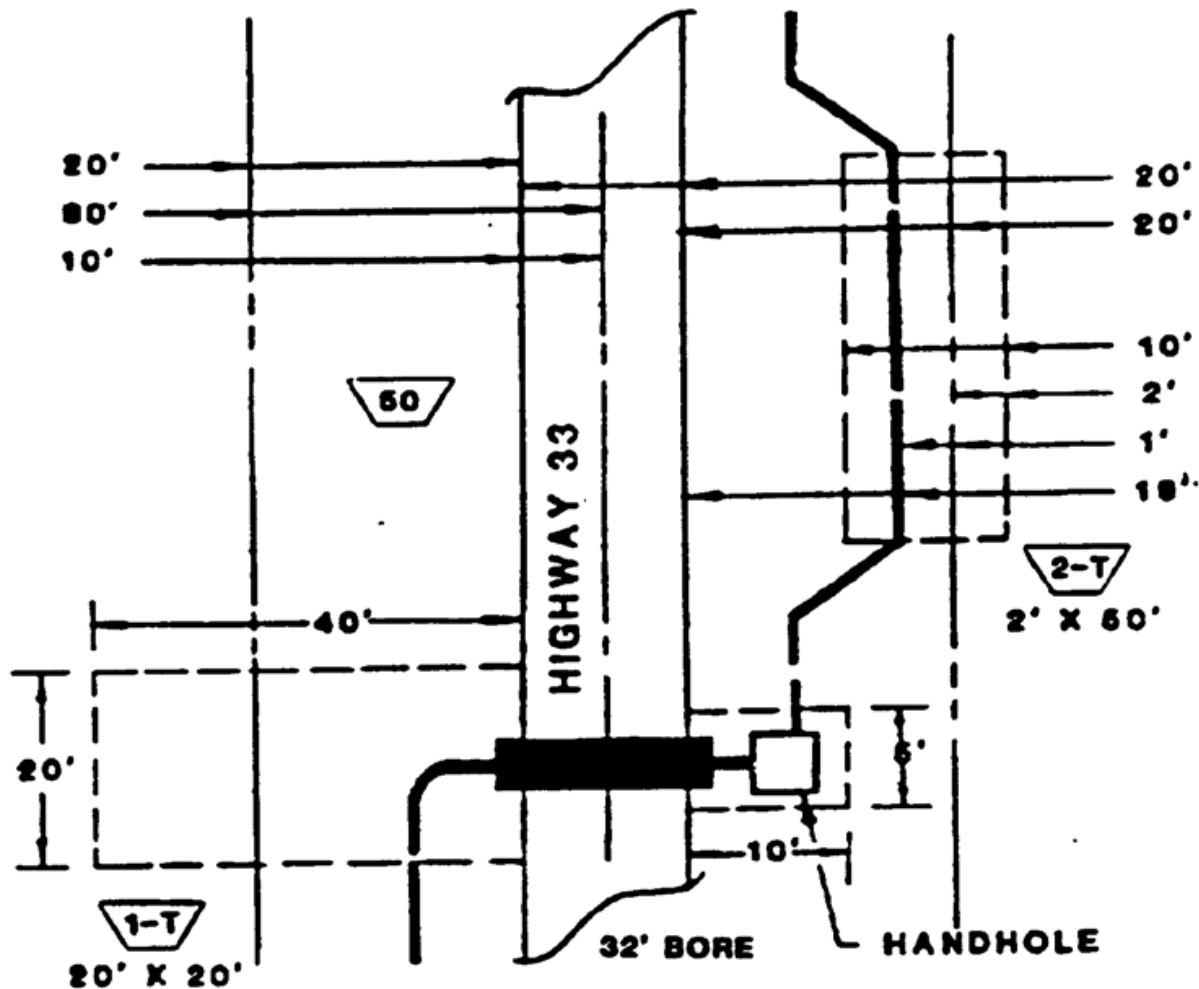


Figure 4-2 Line List Form Numbers

7. Topography is a key factor when formulating buried designs. As railroads are frequently constructed in fill or slope areas, the following guidelines should be useful:
A maximum safe gradient in stable soil conditions is considered to be 15 degrees or a ratio of 1:4 (See Figure 4-1). Facilities should not be proposed in steeper slope areas.

In certain instances where it is necessary to design in steeper slopes, the following requirements will be adhered to:

- a) A cross section depicting the slope gradient must be prepared.

- b) Earthwork volume estimates must be calculated. Written approval from the railroad Chief Engineer must be obtained.
 - c) Written approval from the Verizon Manager must be obtained.
 - d) A comprehensive plan to control slope erosion such as fabric under rip-rap, re-vegetation mat, etc., must be prepared.
 - e) An important consideration when designing in slopes is the live-loading area. Live-loading area is that portion of the slope that directly bears the weight of the structure being supported. Generally, the live loading area is defined as the area between 1:1 gradients from the edge of pavement or edge of railroad tie (see Figure 4-1).
- 8. Avoid designing cable on fire and equestrian trails. Offset the running line to avoid damage during subsequent trail maintenance.
 - 9. Avoid designing cable in railroad track ballast. Exceptions to this will require written approval from the Railroad Chief Engineer and the assigned Verizon OSP Engineer.
 - 10. Design cable routes on the field side of railroad equipment.
 - 11. Design cable routes on the land side of ROW that parallels bodies of water. Exceptions to this will require written approval from the assigned Verizon OSP Engineer.
 - 12. In addition to the above guidelines, the following should be considered when presenting buried designs:
 - a) Existing and planned sub-surface structures and plant will be identified on the plans. The depths of these structures and plant will be expressed in inches, not feet, for clarity.
 - b) Existing and planned above-ground obstructions (including pole lines) will be shown on the plans. These locations will be shown using offset measurements from the centerline of track on railroad or from the edge of pavement or face of curb on roads. Pole lines within the ROW will be shown on the plans with their station, pole number (tag number), and ownership.
 - c) Required ROW clearing will be shown on the plans.
 - d) All utilities, to include overhead electric lines that cross the proposed cable route will be shown on the plans.

- e) Whenever a change of running line is proposed, a brief explanatory note will be shown on the plans with new ties as required for construction and permitting.
- f) When designing main track bores, consideration should be given to equipment access. For example, if there is not a nearby grade crossing to move equipment across the tracks, then more time may be lost in equipment relocation than would be gained by a preferable running line on the other side. Main track bores should end with steel extensions to a BSP sweep (on both ends). This provides support during pulling operations, preventing the pull rope burning through.

13. General cable vault sizing guide:

4'x 4' x 4' primarily for through hand holes or pull boxes.

4'x 6'x 4' primarily for splice points where connecting to a lateral cable -supporting node.

4'x 8'x 4' primarily installed along local loop sections that overlap the backbone network.

12'x 6'x 8' primarily used as a "zero" vault.

Design Engineering must take into consideration future expansion when sizing a vault.

5.0 Direct Buried Facilities

In Urban and Suburban areas, buried plant placement is generally along the ROW or granted utility easement on the property

In cases involving Mobile home Parks, cable should be buried along the rear lot lines with distribution terminals located to conveniently service the homes (a joint pedestal with power service may be used in these cases).

Compound filled plastic insulated conductor cable is required for direct buried construction.

Sizing Cable

Urban/Suburban Areas

Feeder should be sized for an economical period of time, as set by the Network Facility Planner.

Buried distribution cables should be sized for the ultimate requirements per living unit and business.

A minimum of 2 pairs per living unit is standard (consult local practice). Sizing per living unit is dependent upon the local requirements and trends o Requirements per business are dependent upon the type of business being served, if unknown, 1 line per 100 sq. ft. of office space.

FDH Size	F1 Cable Stub	F2 Cable Stub	Maximum Splitters	Minimum Engineered Units (80%)	Engineered Maximum Units (90%)
Small	24	144	5	116	130
Medium	48	288	9	230	260
Large	48	432	14	346	390

NOTE: for MxU locations greater than 75 units, an FDH should be placed (preferably inside the building) to serve ONLY that property. In these instances the FDA polygon will be aligned with the property and all associated units.

In such scenarios, distribution facilities should not be extended off of the property to adjacent or nearby locations in the area.

FDHs can be placed on poles, in hand holes, mounted on concrete pads, or inside/outside wall mount.

NOTE: In OOF areas, avoid placing FDHs directly on poles to minimize additional pole attachment costs

5.1 Splitter

All required FDHs must be deployed on the initial build. Commscope and Corning are the vendors approved to provide FDH Cabinets to Verizon. The cabinets will come in (3) three sizes 144, 288 and 432, and (2) two splitter sizes, 1x32 and 1x16 (Corning splitter modules contain (2) two 1X16 splitters and occupy the same slot as (1) one 1X32 splitter. Commscope does not have this option). All FDHs are to be fed with enough feeder fibers to provide for all possible splitters and at least (2) two spare fibers. The ultimate number of feeder fibers plus (2) two spares should be spliced into the FDH, initially.

NOTE: The recommended splitter sizing per FDH upon initial placement is as follows:

144 – 1
288 – 2
432 - 2

Max PON distances must be observed for 1x32 and 1x16 splitter deployments. Current architecture guidelines will employ a 2x2 coupler with N1 optics, future will include N2 optics enabling greater splits,

the Max. PON distances vary based on various network configurations which can limit network designs by great than 10kft from configuration to configuration, always refer to NP-GL-2016-0024 - NGPON Deployment Distances Guidelines for most recent information.

Areas of Lower Population Density Sizing distribution becomes a challenge due to:

- Unknowns of the ultimate service requirements
- Frequently, feeder and distribution are housed in the same cable
- Loading issues, often these areas are located more than 18KF from the Central Office (CO)

NOTE: *The labels for 1F in VzWest (formerly known as VzB or OOF) areas will all be MCI regardless of whether we had a FiOS or VzEast (formerly known as VzT or IF) network there.*

6.0 Joint Buried Construction

Generally, when both power and telephone facilities are to be buried, a joint trench is arranged, which may include:

Telephone distribution cabling
Power service Wires
Cable Television facilities
Municipal wires (fire alarm)

Separation of Utilities

Existing power and telephone facilities may be buried in the same trench as dictated by NESC standards. See Telcordia Bluebook link below:

https://knowledge.verizon.com/vzknowledge/documentUrl.portal?docName=VZK_2207751

Placing Buried (Jelly Filled) Copper Cable

Work prints should include:

A representation of cable placement with reference to a permanent location such as the curb or roadway centerline

Detailed contact information of the developer or individual responsible for trench opening

Representation of closure locations which should be staked in the field

Detail of objects in close proximity to cable path (i.e. power transformer, guard rail, etc.)

Cable measurements:

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approved contractors.

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- include ample cable to allow for small obstructions
- allocate enough cable to loop up through closures

Caution should be given to reel lengths so that there will be a minimum of buried splices or splices in poor locations (i.e. road crossings)

7.0 Placing Fiber Cable

The placing of buried fiber cable is similar to the placement of buried copper with a few exceptions:

Fiber must be placed a minimum of 24-36 inches below final grade

In places where other facilities will cross the fiber, there is to be a minimum of 12 inches vertical separation between the two (fiber on the bottom)

At road crossings and permanent surface obstacles (railroads, streams, etc.), a spare duct should also be placed. Duct should extend 10 feet on either side of the crossing

Before plowing fiber cables (as applicable), a ripping pass should be made first to remove all obstacles

If non-metallic fiber cable is used, some type of metal tracer cable needs to be placed as well for the purposes of plant location.

Before designing the fiber placement, the engineer and line foreman should perform a joint field survey to ensure the best location for cable and splice placement as well as determining whether it would be best to place the cable by plowing or trench.

Service Wire

Whenever possible, buried service wire should be placed at the same time as distribution cable.

8.0 Conduit

Conduit is a pipe, tube or compartmentalized structure placed underground to form duct work through which cables can be pulled. Conduit may also be used inside building walls or beneath floors for the same purposes.

8.1 Planning and Design Guidelines

Before any detailed planning of a conduit system:

Know what currently exists in the area

Before any underground work is done, you must be aware of what exists in the area. Gather information on existing and proposed underground facilities of other utilities and agencies. There are plant locating resources for this.

The location records of other underground utilities should be maintained in municipal or state offices. It is imperative that this information be known during the planning phase and even more critically during the construction phase of a job.

Check with construction forces

Collect information on possible special construction problems (such as existing collapsed ducts and known duct obstructions.)

Conduct field survey of proposed route(s)

8.2 Underground Site Location

When selecting an underground site, some considerations should be made. Many of these are similar to the considerations that go into planning buried construction. Avoid construction impact on public, for example events, movement, safety agencies, hospitals... etc.

- Consult with your planner to ensure that your design fits into the long range plans for the area.
- Plan for future growth / excavations.
- Be aware of the location of other utilities.
- Be aware of obstructions such as bridges, railways, wetlands and submarine crossings.
- Avoid ledge, rock, unstable soil conditions, foreign underground structures, and liquid and gas storage facilities.
- Consider having Test Pits dug to determine if there are obstructions or poor soil conditions.
- Keep safety and convenience of workers and general public in mind.
- Right of way requirements / permits, etc.
- Avoid drainage patterns that could physically expose underground structure by soil erosion. Avoid interference with present drainage patterns.
- Schedule job to avoid cold weather and periods of peak demand on contractors.

8.3 Handhole/Manhole Verizon Standard

Verizon Handholes vary in size and applications, (See Table 8-1) Handhole will be properly sized to accommodate all planned conduits, fiber service loops, and minimum bend radii.

Handholes will be placed at the following locations:

- Every 2200 to 3000 feet in a continuous straight run on Long-Haul projects. If this length must be exceeded, additional cable slack must be placed in the handholes.
- At a maximum of 1000 to 1500 feet on Metropolitan projects.
- At main railroad track bores if a handhole is not positioned within 1500 feet in either direction.
- On each side of a river or lake crossing.
- HH/MH spacing must be approved to meet service demands and field conditions.
- HH/MH location must be a minimum of 50 feet from the beginning / end of a curb radius when in a main arterial road way.
- At all riser locations.
- At all buried splice locations associated with aerial builds.
- At each end of a tunnel.
- One at all bridge attachment crossings. One at each end if the bridge is over 100 feet long.
- At repeater and terminal locations. One handhole is required at the intersection of the backbone cable running line and the running line leading into the repeater/terminal site. One handhole is required within 10 feet of the repeater/terminal, only if the site is more than 500 feet from the first handhole.
- All Verizon hand-holes, unless otherwise stipulated by the ROW will be buried with 12 to 18 inches of cover at grade level. These Verizon handholes must be a minimum of 20K load bearing capability and manufacturer will be required to stamp 20K designation.
- All Verizon handholes that will be surface mounted will be 30K rated.
- Handholes should never be placed in streets, highways, or driveways, etc.
- 50ft minimum of slack is recommended for every 1000 to 1500 feet of cable placement in a Manhole.
- 15ft minimum of slack is recommended for terminal tails in a Handhole.

8.4 Handhole bedding

Pea Stone and Gravel

Disturbed soil beneath and surrounding hand holes, pull boxes, pedestals, and light prefabricated pads placed for mounting equipment housings require construction backfill material be used as a base to stabilize them and prevent subsidence (sinking/settling/shifting) caused by inadequate drainage beneath and around the site. This backfill base is also intended to provide a suitable porous base and ground barrier that prevents rodents and other pests from burrowing.

This document provides a description of each of the backfill materials used when placing pedestals, pull boxes, handholes, and light equipment pads and the usage limitations and requirements of each product. The backfill materials include:

- A processed pea gravel mix (cleaned and bagged 3/8" to 1")
- Crushed rock

Processed Pea Gravel Mix

The selected standard, processed pea gravel mix approved and required for pedestal applications only is described as a 3/8- to 1-inch smoothed surface, non-angular stone free of dirt, dust, sand, and other porous materials.

Because processed and bagged pea gravel, unlike bulk pea gravel, has been washed three times and dried to eliminate porous materials that normally create clogging and retain moisture, it absorbs and dissipates heat thereby reducing condensation and allowing moisture to evaporate rapidly. It also allows any source of water to quickly drain into the soil beneath the base without accumulating.

The standard processed pea gravel is available according to the following:

Product Description: Unit of Measure	Ordering Info	SSI#	IID#
Pea gravel 3/8" pre-washed	100, 15lb bags per pallet	87017313	87017313
Pea gravel 3/8" pre-washed	50, 15lb bags per pallet	11037175	11037175

NOTE: *Bagged pre-washed and cleaned pea gravel is not to be used for any applications other than pedestal installations. Crushed rock is to be used for other construction applications that require the use of backfill material.*

Locally Purchased Peal Gravel

Locally purchased (bulk) pea gravel is not acceptable for use in pedestals. This gravel, unlike the standard bagged processed pea gravel, is not cleaned and washed and contains porous materials such as dirt, sand, and other organic material that retains moisture. Unprocessed pea gravel is typically used in other construction uses such as an aggregate material for various concrete mixes.

NOTE: *Pea gravel, regardless of type, and other expensed material is NOT to be used as backfill when placing or removing utility poles.*

Crushed Rock

The selected standard backfill material used for establishing a foundation when placing hand holes and pull boxes is 3/4-inch or smaller crushed rock that is free of soil and other organic material. The same crushed rock is used as the backfill material for a foundation when placing light and medium prefabricated concrete equipment pads.

Crushed rock must be purchased locally through a rock/stone supplier and is not available through Verizon Logistics.

NOTE: *River rock and pea gravel are NOT to be used as backfill when placing hand holes, pull boxes, or pads.*

Table 8-1 Handhold sizes

Size	Description
9"x10"x18" Tier 8	Small Flower Pot - Greenway applications only
11"x11"x 16" Tier 8	Large Flower Pot - Greenway applications only
17"x30"x24" Tier 15	Complete Handhole Assembly 17x30x24 Box & Cover Tier 15 Includes 18" Long Cable Racks in 2 Places and Solid cover. Mouseholes one centered each end (4-3/4" x 9-3/4") and one centered each end on each side (5-1/2" x 14")
17"x30"x24" Tier 15	Complete Handhole Assembly 17x30x24 Tier 15
24"x36"x24" Tier 15	Complete Handhole Assembly 24x36x24 Box & Cover Tier 15 Includes 12" Long Cable Racks in 2 Places and Solid cover. Mouseholes two on each end (5-1/2" x 4-3/8") and one centered each end on each side (5-1/2" x 14")
24"x36"x24" Tier 15	Complete Handhole Assembly 24x36x24 Tier 15
30"x48"x24" Tier 15	Complete Handhole Assembly 30x48x24 Tier 15
36"x60"x36" Tier 22	36x60x36 Grade level vault with torsion assisted lid Tier 22
30"x60"x30" Tier 22	30x60x30 handhole assembly with 2 cover, struts, Mouseholes and separate bottom
36"x60"x36" Tier 22	Complete Handhole assembly with split lid, struts and Mouseholes
36"x60"x48" Tier 22	Complete Handhole assembly with split lid, struts and Mouseholes
36"x60"x36" Tier 22	Complete Handhole assembly with split lid for pad mount Commscope FDH applications, struts and Mouseholes
36"x60"x36" Tier 22	Complete Handhole assembly with split lid for pad mount Corning FDH applications, struts and Mouseholes
36"x60"x48" Tier 22	Complete Handhole assembly with split lid for pad mount Commscope FDH applications, struts and Mouseholes
36"x60"x48" Tier 22	Complete Handhole assembly with split lid for pad mount Corning FDH applications, struts and Mouseholes
Flat Pad	Throat and Mounting inserts for Corning Gen III 144, 216 and 432
Flat Pad	Throat and Mounting inserts for Commscope 432

For addition information, please refer to link below:

[http://gnp.vzbi.com/ine/library/plannerlibrary.nsf/0/82291F64FE3E3367862581D8005FB8C8/\\$File/2017-025854-NETWORK One Fiber OSP Bonding Grounding Standards 20V2](http://gnp.vzbi.com/ine/library/plannerlibrary.nsf/0/82291F64FE3E3367862581D8005FB8C8/$File/2017-025854-NETWORK One Fiber OSP Bonding Grounding Standards 20V2)

8.5 Conduit

Conduit material associated with Directional Bores may consist of Black Steel Pipe (BSP) or HDPE, depending upon the radii, depth, and conduit flexibility requirements dictated by the directional bore Cross Section Study.

Verizon preferred materials will be used unless otherwise required by the permitting agency as follows:

CODE	DISCRIPTION
GSP	Galvanized steel pipe
GRC	Galvanized rigid conduit
BSP	Black steel pipe
PVC	Polyvinyl chloride
SPL BSP	Split black steel pipe
SPL GSP	Split galvanized steel pipe
SPL PVC	Split polyvinyl chloride
STL	Steel Casing
HDPE	High Density Polyethylene

Note: All above ground steel pipe should be galvanized.

Unless otherwise specified by the owner of the structure, Verizon conduit should be separated from foreign structures according to the following minimum spacing schedule:

FOREIGN STRUCTURE	MINIMUM SPACING
Buried Cables	24 inches
Conduits/Pipes (all)	24 inches
Railroads	Parallel: Refer to railroad agreement

8.6 Conduit Costs

Conduit is an expensive cabling structure. There are several factors that contribute to this expense, including:

Engineering time

Actual materials

Preparing (before) and restoring (upon closing) trench for conduit run

Contract work and inspection costs

Permits

Police/traffic control details

8.7 High Density Polyethylene (HDPE) Conduit

The minimum inside diameter of buried HDPE conduit is 2-inches. A 1.5-inch inside diameter must be approved by the Verizon Manager.

HDPE may be direct buried, plowed, rail-plowed, trenched, or directionally bored.

The HDPE running line will be designed to minimize changes of direction to facilitate construction and maintenance operations.

8.8 Sweeps and Bends

All sweeps and field bends will be either Schedule 40 PVC or Schedule 40 BSP, with a minimum radius of 36 inches. Only the screw type of BSP to PVC adapters shall be used. Approved prefabricated sweeps:

- 22-1/2 degree curved segment (solid and split)
- 30 degree long sweep (solid and split)
- 45 degree long sweep (solid and split)
- 90 degree long sweep (solid and split)

8.9 Curve Design

Curves should be designed with the greatest radius possible (i.e., 15 feet or greater) and with a single continuous arc wherever possible, as shown in Figure 8-8.1.

If environmental conditions (obstructions, ROW restraints, etc.) prevent single arc design, apply). In either case all sweeps and bends will be Schedule 40 PVC or steel.

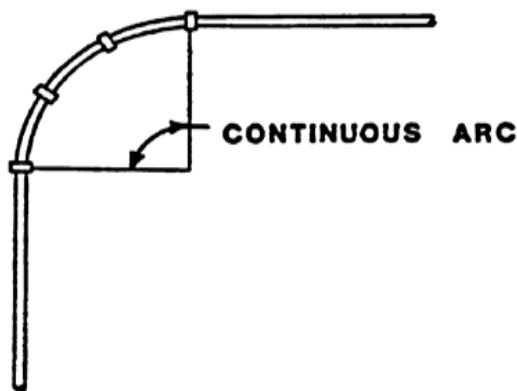


Figure 8-8.1 Continuous Arc

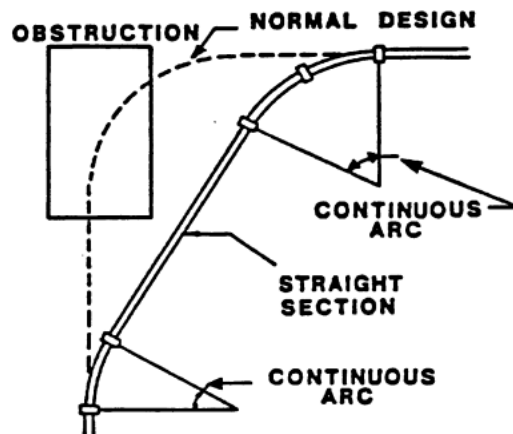


Figure 8-8.2 Continuous Bend

8.10 Sizing Conduit

To avoid additional construction costs, it is essential that an adequate number of ducts are placed. Factors dictating duct usage / need include:

Number, size, type, gauge of cables utilizing the proposed ductwork

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Timing of future conduit projects

Retirement and removal plans for existing cable (i.e. freeing up duct space)

Long range (20-50 year) forecasts figures should be used for sizing conduit structures. Short term economic structures (2 to 3 years) should be disregarded.

9.0 Types of Conduit, Pipe and Formations

There are different kinds of existing conduit runs for various situations. Each has their advantages and disadvantages. Factors to consider in selecting the type of conduit include:

- Material cost and local availability.
- Ease of handling and joining.
- Ease of joining.
- Encasement and backfill requirements.
- Soil conditions.
- Material breakage.
- Special conditions such as heat, gas, heavy loads, limited cover.
- Construction locations (i.e. bridges)

A conduit system design objective is to remain serviceable for sixty or more years. The engineer should specify the conduit material that can best combine favorable first costs and long term serviceability for each specific job.

Duct material is available as either single bore meaning conduit that has single duct design or multiple bore signifying conduit that is designed with more than one duct such as compartmentalized duct, better known as MPC (Multiple plastic conduit) for fiber cables.

Some situations like construction on bridges require steel, fiberglass or schedule D plastic conduit.

9.1 Single Bore Conduit

Single bore conduit can be made of plastic. Advantages of plastic single bore conduit include:

- Lightweight: mechanical handling equipment not required.
- Good joint integrity.
- Strong, stable structure (if concrete-encased).
- Easily rearranged to avoid obstacles.
- Can be pneumatically rodded.
- Less susceptible to silting.

Multiple formations of single duct can be arranged to avoid obstructions more readily than can be done with multiple bore type conduit. Concrete encased single bore plastic conduit offers the most benefits and, with the exception of special applications, is all that is being used today.

Single Bore Plastic Conduit is available in three types:

- Type B - thin wall, requires concrete encasement
- Type C - thick wall, may be buried with selected backfill in straight runs
- Type D - thick wall, it is both ultraviolet (sunlight) and flame resistant

9.2 B Plastic Conduit

Plastic conduit is a single bore conduit made from polyvinyl chloride (PVC.) This conduit is round bored and has an inside diameter of 4" and a nominal length of twenty feet. Special cement is used to join each section. The thickness of the wall varies with the manufacturer but is typically 1/4". It is available in long lengths, has a relatively low coefficient of friction and has good bending characteristics.

The low coefficient of friction contributes to reduced cable tension during cable placing operations. This permits longer section lengths between splice chambers consistent with maximum cable reel lengths. Because of the bending characteristics of B plastic conduit, straight sections can be bent to allow for minor variations in trench alignment. Straight sections of single bore conduit can be used to construct horizontal and vertical curves up to 90° as long as adequate anchoring and a minimum radius of curvature of 40' or more can be utilized. With less of a radius, a combination of cut segments and bends must be used.

B Plastic conduit can also be incorporated in structures such as viaducts, bridges, etc. where it can be encased in concrete within the structure.

9.3 C Plastic Conduit

C Plastic Conduit should be specified for main line conduit as well as for road crossings and connections between manholes and poles, buildings and interfaces. It is sand encased in most applications but must be concrete encased when sweeps with 80' radii are encountered.

9.4 D Plastic Conduit

D Plastic Conduit is designed for special exposed installation. The duct is flame resistant and immune to ultraviolet rays from the sun. It can be suspended from bridge frameworks without

concrete encasement. Expansion couplings are available for joining the length and providing a sealed movable joint to compensate for temperature variations.

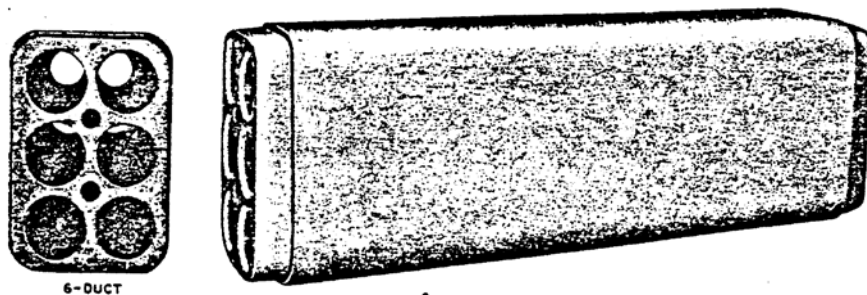
9.5 Steel Pipe

Steel pipe is used where conduit must be pushed or jacked, where environment is too severe for other conduit and for submarine crossings. Steel pipe, threaded with a half inch wall thickness, can be used when adequate depth of cover cannot be obtained because of subsurface structures. Steel pipe, due to its inherent strength, requires very little cover. This type of conduit material is very expensive and should only be used where other materials cannot be used.

9.6 Multiple Bore Conduit

Advantages of multiple bore conduits include:

- Long trench openings are not required. Conduits are available in lengths from 12" to 48". 4-Duct, 6-Duct, 8-Duct and 12-Duct configurations are standard.
- Select backfill not required.
- Ready-mixed concrete not required.
- Multiple bore conduits are constructed of concrete or clay (tile).



Typical 6-duct B and C Multiple Bore Concrete Conduit

9.7 Conduit Formations

There are a variety of possible conduit formations that may be used dependent upon the required the number of ducts and conduit type. It is important for the Engineer to design the appropriate formation for each individual conduit job

10.0 Lateral Connections

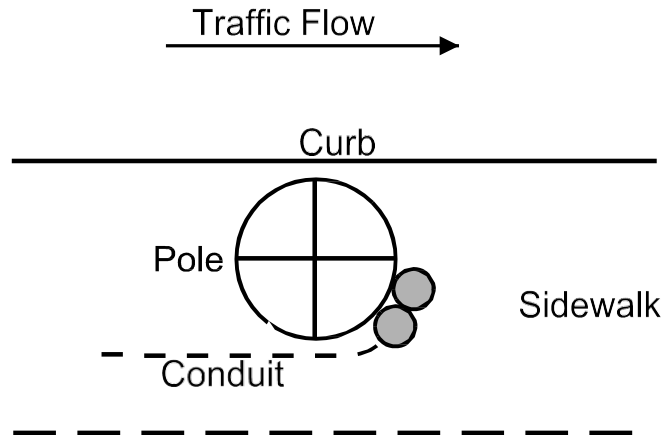
One of the most common work operations involving conduit that a design engineer will become involved with is the placing of lateral connections. Lateral connections are also referred to as “dips,” “siphons,” “subsidiary,” “underground connections,” “risers” and many other names. It is that section of conduit that is placed from a splice chamber to a pole, building, interface or electronic closure.

In most cases a lateral connection is our access to the underground feeder network, and as such, it should be sized for the ultimate needs. Main line conduit is sized on an economic basis as is feeder cable but in the case of lateral connections and distribution cables; they should be sized for the ultimate use. Therefore, a minimum of two ducts should be placed for reasons such as to avoid frozen connections and the width of trench necessary to place one duct as opposed to two ducts.

10.1 Lateral Connections from Splice Chambers to Poles

When placing a connection from a splice chamber to a pole, remember that the purpose for the connection is to allow the placement of cable in the connection and up the pole. The piece of cable which runs up the pole is vulnerable to damage by both motor vehicles and vandals.

Always place a lateral connection to a pole so that the cable will be placed on the back side of the pole away from the flow of vehicular traffic and always call for a “U” guard to be placed over the cable as it comes out of the connection. (10’ for copper and 20’ for fiber)



Each unoccupied bend should be capped at the pole to avoid being filled with stones, trash, etc.

Laterals to a pole can be either “B” or “C” wall conduit.

Grommets of various styles can be ordered to fit/seal smaller fiber conduits leaving the 4” PVC and rising up the pole.

10.2 Laterals to a Building

When service to a building is going to be placed in conduit, a minimum of 2 - 4" conduits should be called for. These conduits are generally placed by the customer.

10.3 Laterals to Cross Connect Facilities and Electronics Enclosures

When placing conduits to or between cross connect facilities or electronics equipment enclosures, the ultimate amount of conduit required should be placed with the initial job. Usually these jobs require site excavation and preparation that should be coordinated with the conduit placement. It is conceivable that you may place some conduit that you will not use, but it is better to do that, then to have to be involved in a situation where you have to dig around working cables.

11.0 Supplying Information to the Developer

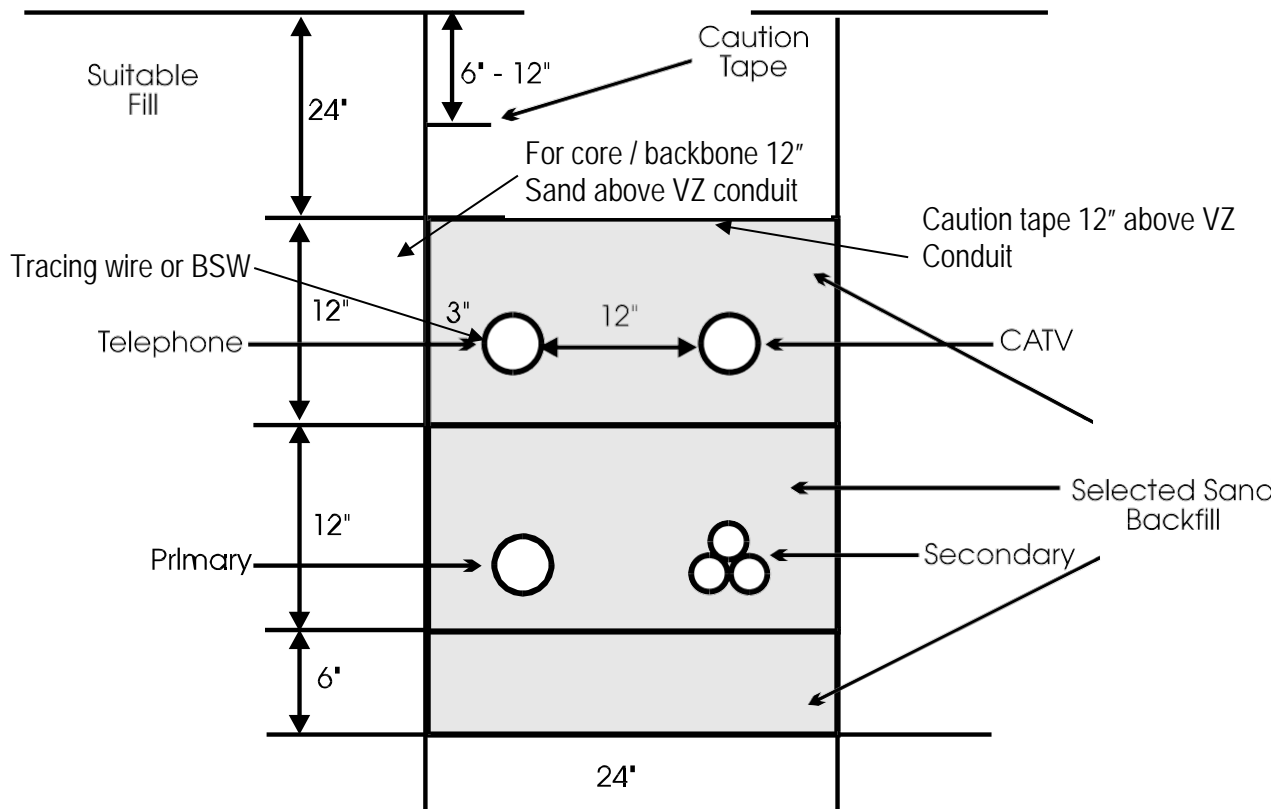
Supply the developer responsible for the worksite with the following guidelines:

- Typically, conduit should be:
 - * 4" (white) "C" Plastic on main runs and road crossings
 - * 1 1/2" - 2" schedule 40 (NESC approved) from the protector to the hand hole (or serving terminal) for service wires (provided by Developer)
 - * There may be cases where random lay or horizontal separation is applicable.
- All elbows are to be long sweeps
- Conduit is to be equipped with a pull string capable of a 200 to 300 pound pull
- Closure locations are to be trenched to and located at least 3 feet from the main trench
- Conduit closure locations should come up 6" above final grade and abut one another
- Verizon will inspect trench and conduits prior to the developer backfilling

11.1 Trench Detail

The following trench design is recommended for joint trench construction.

Finish Grade



12.0 Underground Structures

12.1 Manholes - Subterranean Splice Chambers

The purpose of manholes is to provide a readily accessible space in the conduit system to perform cable pulling operations and to house cable splices, load coils and apparatus cases. All subterranean splice chambers should be constructed to provide sufficient space for cables, equipment and craft persons.

Subterranean splice chambers should be situated so that the optimum use can be made of the connecting conduit structure on subsequent cable placing operations.

There are two types of subterranean splice chambers, Precast and Cast-In-Place.

Precast are ordered from the factory in specified size and type.

When circumstances require, a more expensive, "custom made" chamber is built and poured, Cast - In - Place, on the site.

The standard manhole recommended for Verizon use is available in 4' x 4' x 4' and constructed of concrete or fiberglass. Manholes are drop ship items and must be requisitioned through the Materials Management organization. The ordering description is Manhole 4' x 4' x 4', two sections w/Iron Ring and cover with 12-inch neck Extension. Selection of manufactured material to be in accordance with the ROW Owner/Maintainer. The minimum size lid for manholes is 30-inches in diameter.

Manholes will be specified under the following conditions:

Whenever required by property owner/maintainer.

In streets, highways, driveways, etc., where the Verizon facility is exposed to heavy traffic loads.

In sidewalks and pedestrian walkways where public safety and welfare dictate.

Manholes to be placed at 500 feet to 1500 feet (maximum) spacing in city streets.

Verizon manholes surface mounted or placed in sidewalks must be a minimum of 30K load bearing capability and manufacturer will be required to stamp 30K designation on the flush mounted lid.

Note: HH/MH spacing must be approved to meet service demand and field conditions.

13.0 Controlled Environment Vaults (CEVs)

A Controlled Environment Vault (CEV) is designed to provide an underground facility suitable to house electronic equipment such as subscriber loop carrier systems or light wave digital transmission system regenerators. The CEV is neither intended nor equipped to support "through" cable as do splice chambers. They are generally placed in proximity to splice chambers on a main underground route.

The CEV is a precast concrete structure consisting of a top and a bottom section. They are available in 10', 16' and 24' length sizes depending on the amount of electronics equipment to be housed. They have an inside dimension of six feet wide and nine feet of headroom. The entry portion of the CEV is above ground in order to enter the subterranean structure. This visible element is also often landscaped to be hidden from public view.

14.0 Buried Cable Markers Location and Numbering

14.1 General

Verizon standard cable markers will be placed at locations noted on the construction drawings and at locations described below. When cable is being placed in open trenches or conduits, cable markers, and properly marked signs will be positioned simultaneously with trench backfill. Upon conclusion of cable placement, cable markers will be placed along the cable route. Engineering judgment is to be exercised in the placement of the tubular marking. One tubular marker may suffice in an area where a handhole, bore or running line change may exist.

Verizon employs five types of buried cable warning devices, which will be outlined in this section. They are:

- Flat Marker
- Steel Marker Post and Tubular Markers
- Aluminum/Brass Hub Marker
- Water Crossing Sign
- Buried Cable Warning Tape
- Verizon standard marking devices will be placed at all locations described below:
- Minimum 500-foot intervals in urban areas.
- Minimum 1000-foot intervals in rural areas.
- Each side of all major roads, railroads, rivers, or stream crossings (if not within 200 feet).
- All handhole/manhole locations.
- Underground obstructions (if one not within 200 feet).
- Any location subjected to future dredging, i.e., culvert or drainage ditch crossings.
- At each end of all bores.
- "Line of Sight" so that from any point along a route, at least one marker post is visible in both directions.

14.2 Steel Marker Post and Tubular Markers

Whenever possible, the Verizon cable marker should be placed on the field side. All steel marker posts will be securely placed at a minimum depth of 4 feet. The one call number will be included for the state or area of the state where the markers will be installed.

14.3 Aluminum/Brass HUB Marker

Aluminum hub markers (See Figure 14-1) are intended for use in pavement areas where it is not appropriate or possible to use flat markers. Placement guidelines for these markers are the same as for flat composite markers.

ALUMINUM "HUB" STYLE MARKER DETAILSROUTE MARKER DETAILS

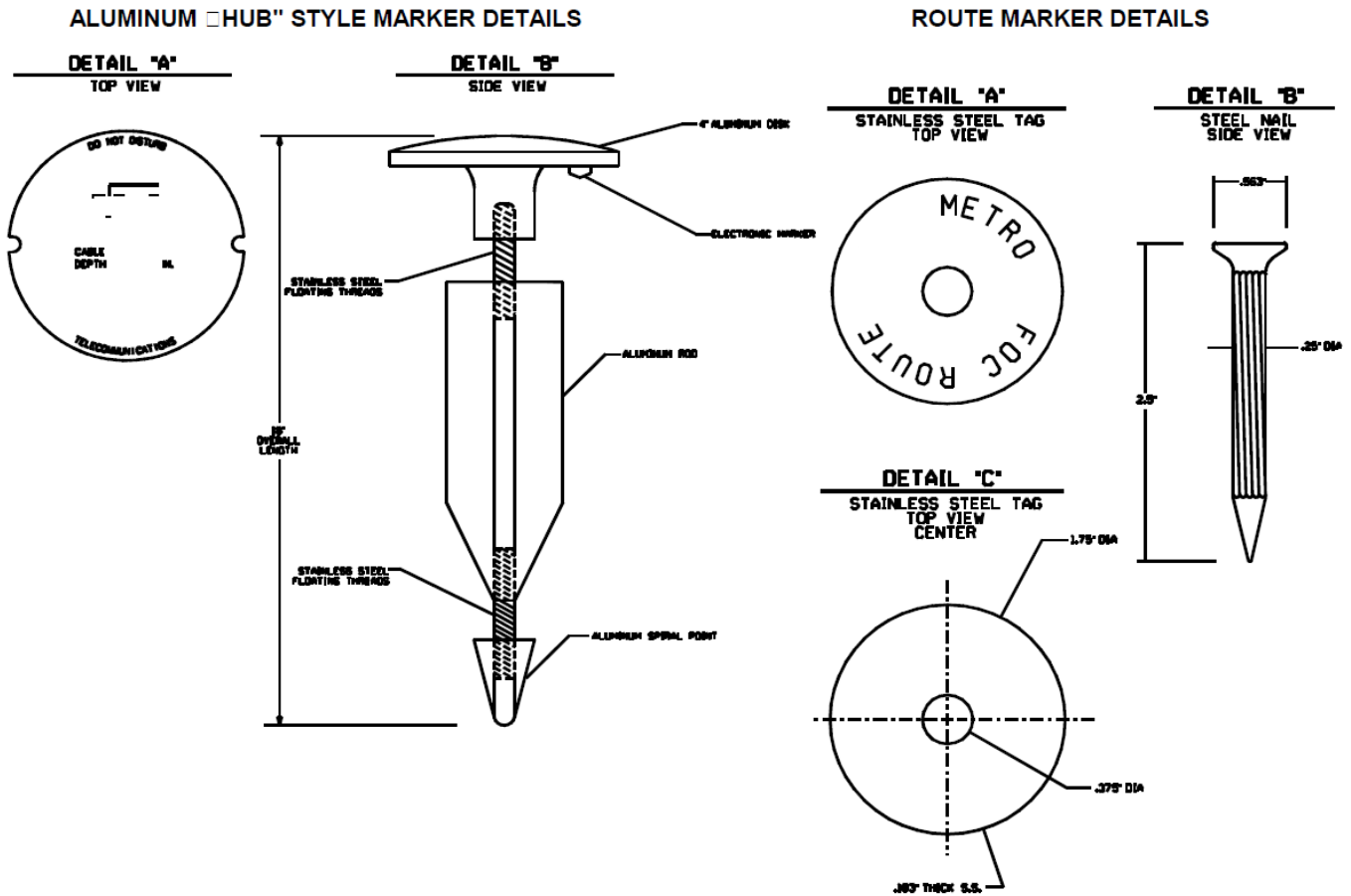


Figure 14-1 Aluminum "Hub" Type Marker

Note: Aluminum "Hub" Type Marker can be used for HH/MH ID number located on top of curb.

14.4 Water Crossing Signs

Large cable warning signs (See Figure 14-2) will be placed at each side of all navigable waterways.

1. Water crossing signs consist of:
 - a) 1 large 4 foot x 6 foot factory stenciled sign
 - b) 8 lag bolts with washers
 - c) 2 creosote 4-inch x 4-inch x 10-foot pressure treated support posts
2. The creosote support posts are to be placed 4 feet in depth and are to be concrete encased. The signs are to be placed in areas on land adjacent to the Verizon buried cable and must be facing and visible from the waterway

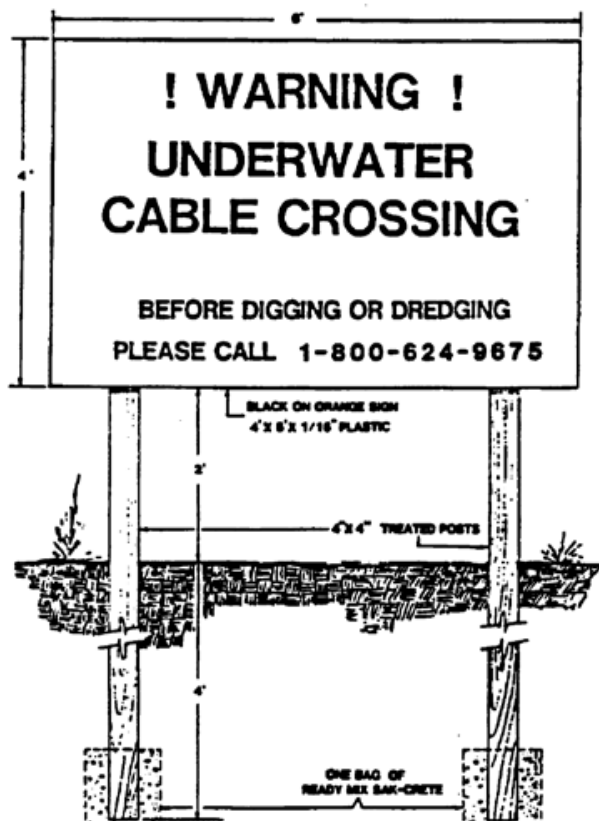


Figure 14-2 Underwater Cable Crossing Sign

Note: See Subaqueous Plant

14.5 Buried Cable Warning Tape

A continuous ribbon of Buried Cable Warning Tape will be placed above and parallel to buried facilities. The tape will be placed 12 inches above buried facilities.

Buried Cable Warning Tape is a standard material item and is provided by Verizon. The Verizon Manager is responsible for ordering warning tape.

14.6 Tubular Marker Numbering System

Tubular marker signs will be numbered as follows:

- Marker signs will be labeled with a 5-digit number reflecting the cable marker location in relation to the railroad milepost marker while on the RR ROW.
- Cable marker signs will be numbered from the lowest numbered milepost to the higher number milepost.

Example: Marker Sign

| 062 | 43
| |--Distance From Lowest MP in hundreds of feet (4,300)
| |
| |
|--Lowest Railroad Milepost Number (MP#62)

Where the route leaves the railroad ROW, cable marker placement procedures are unchanged. Zero-out the marker number when leaving the railroad ROW or at the new route origin point. Example: If the first marker post off railroad ROW is 100 feet, the 5-digit sign number should read:

00001

Continue cable marker placements per Verizon specifications until the first mile point is reached. *Example:* the first mile (approximately 5,300 feet) should indicate a five-digit number of 00100 or theoretical MP#1.

00100

Continue marker placement per Verizon specifications, assigning a theoretical milepost number at each milepost in numerical order, i.e., MP#2, MP#3, etc.

If the cable placement should re-enter the railroad ROW, revert to the railroad milepost numbering system.

Take all measurements parallel to the railroad or road centerline.

14.7 Manhole/Handhole Numbering in a Local Carrier Network (LCN) Environment

1. Numbering manholes will start at the LCN Hub site, at the first manhole outside of the Hub and will be numbered consecutively clockwise along the ring back to the Hub site. Example: manholes #1 to #18. See Figure 14-3.
2. Manholes intersecting between two manholes will be numbered with an alpha/numeric number. (Example: a manhole set between manholes #5 and #6 will be manhole #5A). Manholes placed as an extension from #5A will be numbered #5A1, #5A2, #5A3, etc.

3. Manholes extending from an originally numbered manhole will be numbered as follows: (If a manhole system is being built from manhole #5, the manholes will be numbered #501, #502, #503 etc., or in the case of manhole #16, the manholes will be numbered #1601, #1602, #1603, etc.). Manhole extensions from those are numbered #501.1, #501.2, #501.3, etc., or #1601.1, #1601.2, #1601.3, etc.)
4. Manholes extending from an existing manhole will be numbered consecutively from the manhole it exits. Example: leaving manhole #12, manholes will be numbered #1201, #1202, #1203, etc., to the point of contact of that LCN. That LCN will have its own number system starting with #1.
5. Manholes leaving the Hub site transporting to another LCN will start with an alpha numeric number. Example: #A001, #A002, #A003, etc., to the point of contact of the other LCN. A second manhole run from the Hub would start with the alpha numeric #B001, #B002, #B003, etc., and so on.
6. Manholes leaving an existing manhole to serve a remote site will be numbered as follows: A manhole being placed from manhole #1201 to serve a remote site will be #1201.1, #1201.2, #1201.3, etc.

In numbering manholes all extensions should be numbered so that the extensions refer to the original manhole number. Example: manhole #501 comes from manhole #5 or manhole #1601 comes from manhole #16. This will help in identifying the original location of the conduit run.

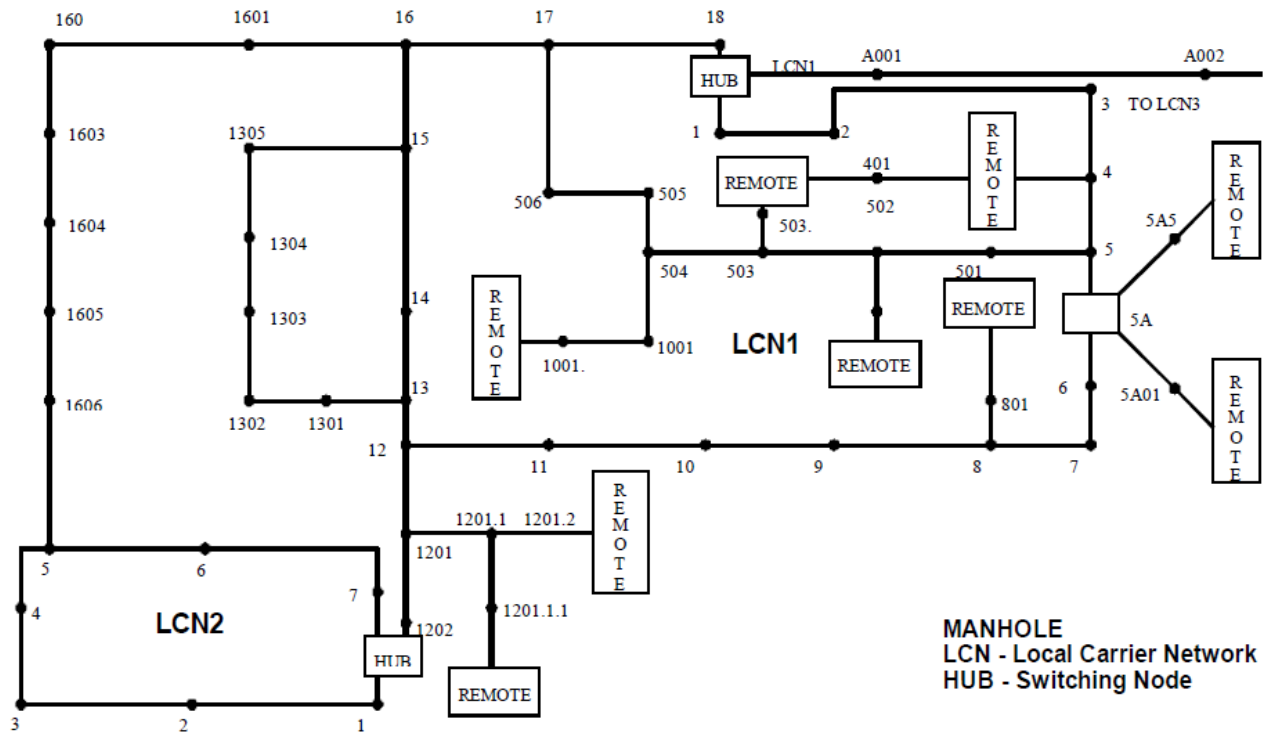


Figure 14-3 Typical Manhole Numbering Example in an LCN Environment

15.0 Handhole/Manhole Grounding

All splice handholes/manholes will be grounded to conform to the Verizon typical Engineering drawings. Verizon-furnished materials:

- One 5/8-inch x 8-foot copper-clad steel ground rod equipped with a 15-foot #6 AWG pigtail
- One surge arrestor handhole
- One isolator/protector system with 30 foot harness for use on a straight splice, or one isolator/protector system with 30-foot harness system for use at splices with a spur cable.

When grounding the fiber optic cable system, a 5/8 x 8 feet copper clad ground rod with 15-foot pigtail and splice connector assembly is required at each splice hole.

1. OSP Contractor will install the following material:
 - a. Warning sign post
 - b. Tubular warning marker with hardware
 - c. Ground rod with pigtail and butt splice connector

- d. Surge arrestor handhole and appropriate ACT unit
2. All Verizon and contractor furnished material will be in place prior to placement of the fiber optic cable at which time the temporary ground connection will be made.

15.1 Buried HDPE Placement

1. When placing HDPE in an open trench, HDPE will be placed under tension to facilitate a straight line prior to placement of backfill. The first 12 inches of backfill will be free of large or sharp stones or sticks or other large materials that may cause damage. The trench shall be mechanically tamped and compacted in 6-inch lifts, as required by the Verizon Manager, railroad, or local permit agency requirements.
2. All cables placed in HDPE will be sealed immediately after installation.
3. All conduit, HDPE, and innerduct will be sealed immediately after placement. All ducts entering a building shall be sealed both at the point of entry (first MH/HH outside) and at point of emergence (first exposed location inside) with Jack Moon plugs or equivalent.
4. All conduit runs will be proved and a pull line will be left in place upon completion. The pull line must be approved for Verizon use.
5. All conduits will be capped during placement as well as after placement to prevent the entry of foreign objects or substances into the conduit.
6. All HDPE within the same ditch will be colored or identified in accordance with ASTM D-3035.
7. All HDPE will meet the specifications outlined in the latest Verizon HDPE Spec. When multiple HDPE conduits are installed in the same ditch, they will have different colored strips for identification.
8. **Note:** *Products manufactured in accordance with ASTM D-2239 are not acceptable.*

15.2 Innerduct Placement

Standard innerduct shall be used. A swivel will be used to prevent innerduct twisting during placement.

Care will be taken to pull additional footage of innerduct during placement to compensate for the natural stretch of the innerduct being pulled. Shrinkage will vary with temperature and pulling tension. Care will be taken to avoid a bending radius less than 10-25 times the normal diameter of the innerduct being placed.

15.3 Materials Needed for Placing

- Swivel
- Wire Grip
- Dowel (Wooden Pin)
- End Cap or Sealant
- Lubricant
- Leader Guard
- Verizon-Approved Connector (for splicing ends).

16.0 Preparation for Pulling

1. Remove the first 20 feet of innerduct. Be careful to avoid severing the pull line.
2. The 20 feet of pull line extending from the innerduct should then be inserted (stuffed) back into the innerduct. This will compensate for innerduct stretch during pulling operations.
3. Dowel pins will be placed in the innerduct to be pulled to avoid innerduct collapse where the wire grip is attached. The ends will be sealed with tape.
4. When more than one innerduct is to be placed or when duct is placed in conjunction with cable, the reels will be placed in line with one feeding over the other to minimize twisting and the friction of pull.
5. The cable reel will be in the lead, after the ends are ready, the wire grip will be placed over the ends of the innerducts only and a swivel will be attached to the wire grip to prevent twisting during the pulling operation.
6. When cable is to be placed at the same time as the innerduct, the cable will be equipped with a pulling eye arrangement, break-away (600 lb. max.) and swivel.
7. The cable and innerduct will be attached to a third swivel before attaching the winch line to prevent twisting during pulling operations. Cables and innerduct will be fed through a cable chute (cable feeder) or leader guard to protect them from scraping edge of the duct or conduit.

16.1 Pulling the Innerduct

1. Dependable communications will be established with two-way radios or comparable communication methods between the feed location and the pull location.

2. After dependable communications have been established and the duct or conduit has been verified as clear for pulling, attach the winch line to the swivel.
3. When pulling commences, Verizon-approved lubricant will be applied to the cable and innerduct to ease friction at the feeder end. Sufficient employees will be posted to watch the reels and feed the cable/innerduct simultaneously during pulling operations.

16.2 Duct and Sub-duct Proving

All Duct(s)/Sub-duct(s)/Innerduct(s) shall be proofed (test mandrel), when placed under hard surface area(s) or at any location requested by Verizon Manager.

16.3 Existing Conduit/Innerduct Verification

1. Determine whether the selected duct, as indicated on the running line sheet or plan, has a mule tape or pull rope within it.
2. Pull a properly sized test mandrel through the duct to determine whether the conduit section is acceptable for use. If an obstruction is found, clean the duct using Verizon approved duct cleaning and rodding tools (Figure 16-3)

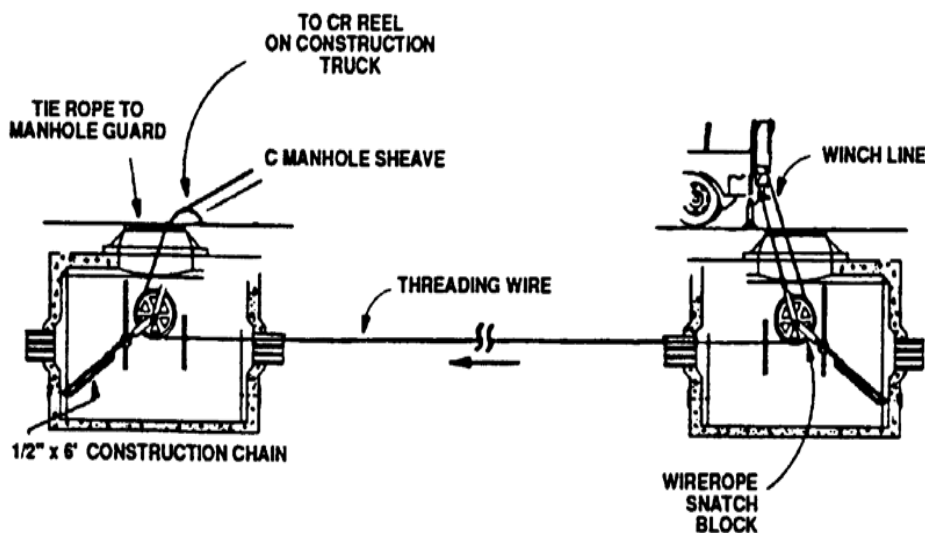


Figure 16-1 Placing Winch Line in Duct

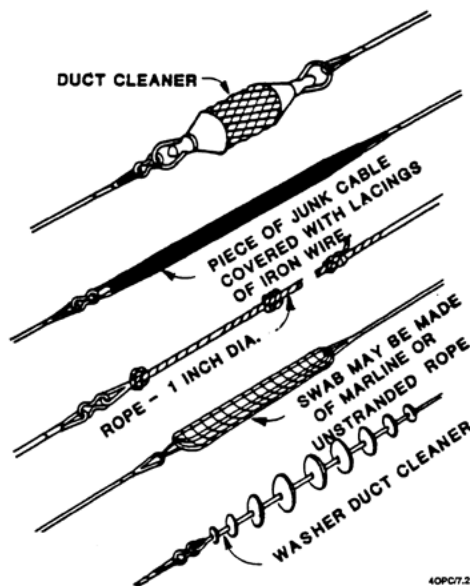


Figure 16-2 Cleaning Tools

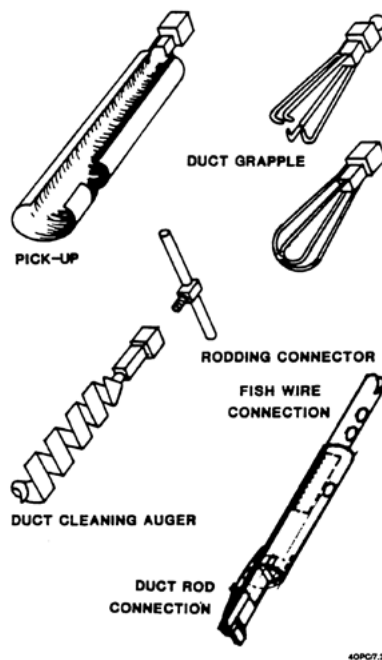


Figure 16-3 Rodding Tools

16.4 Checking Cable and Reel Markings

1. Inspect the reel and cable for possible damage caused during transportation or handling. Watch for protruding nails or damaged reel flanges. All damage to reels or cable will be reported to the Verizon Manager for inspection before pulling.
2. If it is necessary to roll the reel to the desired location, roll it in the direction of the arrow on the reel. When handling a heavy cable reel, maintain careful control of its movement. Never permit a reel to tilt. Where uneven ground conditions are encountered, provide a substantial runway of heavy planks, leveled with blocking, to prevent tilting.
3. Prior to setting up a reel, verify the reel number, size, and length of the cable with the information given on the reel assignment sheet.

16.5 Setting up the Cable Reel

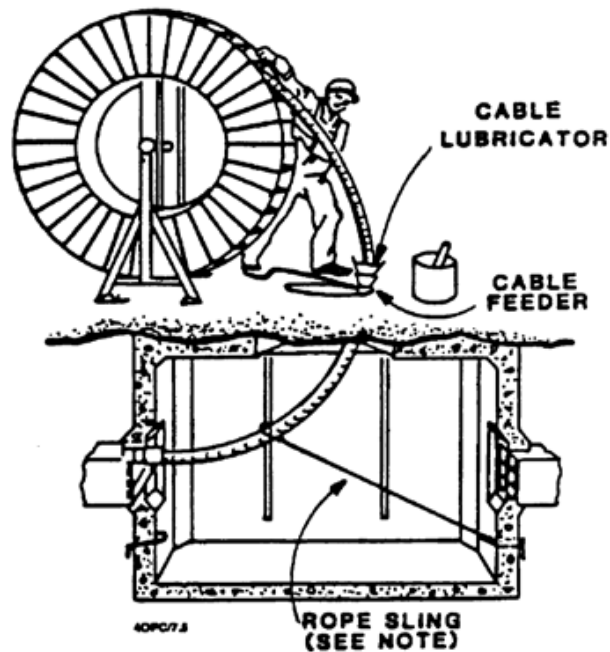
Set up the reel at the handhole/manhole at the conduit section in which the cable is to be placed. The reel should be aligned with the duct and in such a position that the cable can be passed from the top of the reel in a long, smooth bend into the duct without twisting. Never leave a rotating reel unattended (See Figure 16-4 and Figure 16-5).

It is essential that the reel be in proper alignment and level during the placing operations, as incorrect positioning of the reel will cause unnecessary binding which will result in uneven cable feed. A cable reel trailer will be used, if possible (See Figure 16-5).

When a cable reel trailer is not available or cannot be used, cable reel jacks may be used. However, stability and proper installation are very important when using jacks. Make sure spacers are placed on the shaft in both cases to prevent binding. See Figure 16-4.

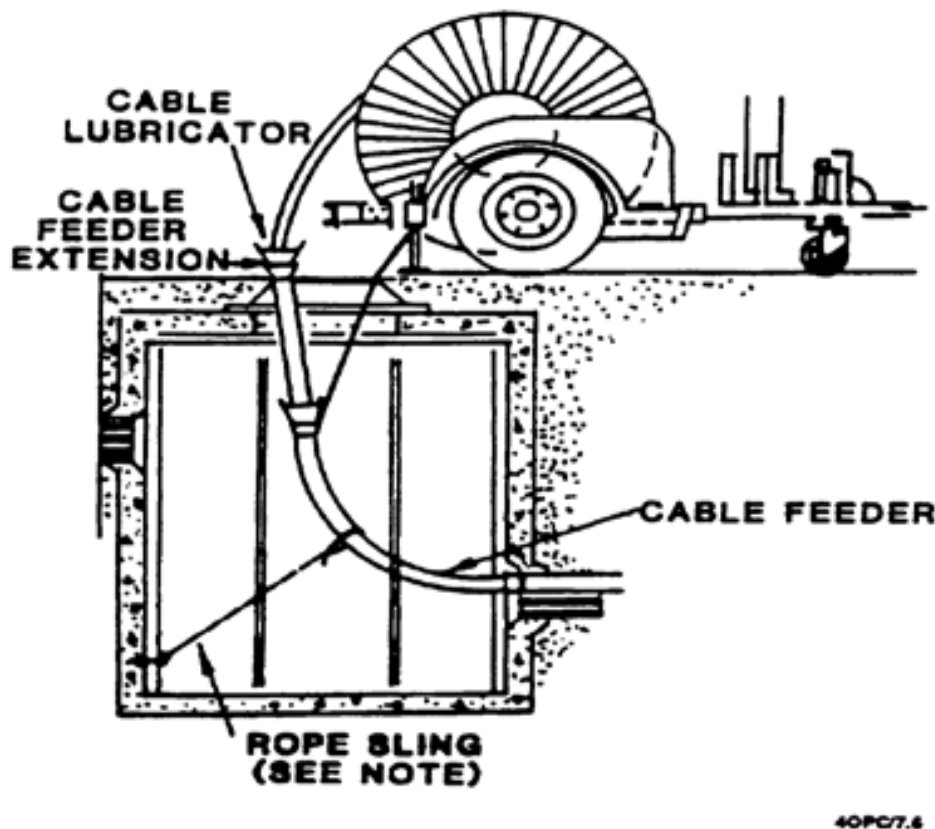
Ensure there is adequate space for figure-eighting the cable. The minimum space required is approximately 25-feet x 50-feet.

If the duct line in which the cable will be pulled contains a curve or bend, set-up the reel at the handhole/manhole nearer to the curve if conditions permit.



NOTE: ATTACH 3/4" ROPE SLING OR EQUIVALENT FROM CABLE FEEDER TO PULLING IRON TO MAINTAIN PROPER CURVATURE.

Figure 16.4 Supporting Cable Reel with Cable Jacks



NOTE: ATTACH 3/4" ROPE SLING OR EQUIVALENT FROM CABLE FEEDER TO PULLING IRON TO MAINTAIN PROPER CURVATURE

Figure 16-5 Supporting Cable Reel with Cable Reel Trailer

16.6 Feeding and Pulling Arrangements

1. When figure-eighting is performed in more than one location on one cable end, the complete figure eight will be flipped. However, a hydraulic cable pick-up reel or bull wheel may be used to pull cable at intermediate manholes instead of making a second figure eight, providing the reel has a 28-inch diameter or greater drum (Figure 16-6)

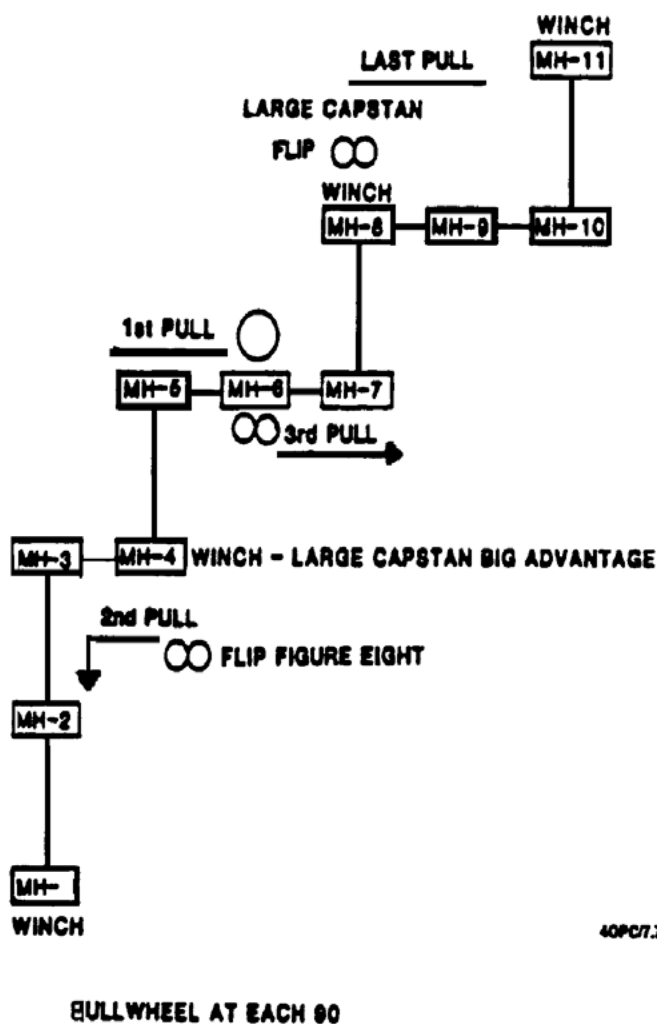


Figure 16-6 Typical Duct System

1. If the handhole/manhole is equipped with pulling-in irons, use a cable sheave and shackle as illustrated in Figure 16-7.
2. When pulling cable from two directions, always set up to pull the longest section first to minimize figure-eighting Figure 16-8
3. When it is not possible to locate the pulling apparatus adjacent to the manhole, the C manhole sheave illustrated in Figure 16-9 should be used.

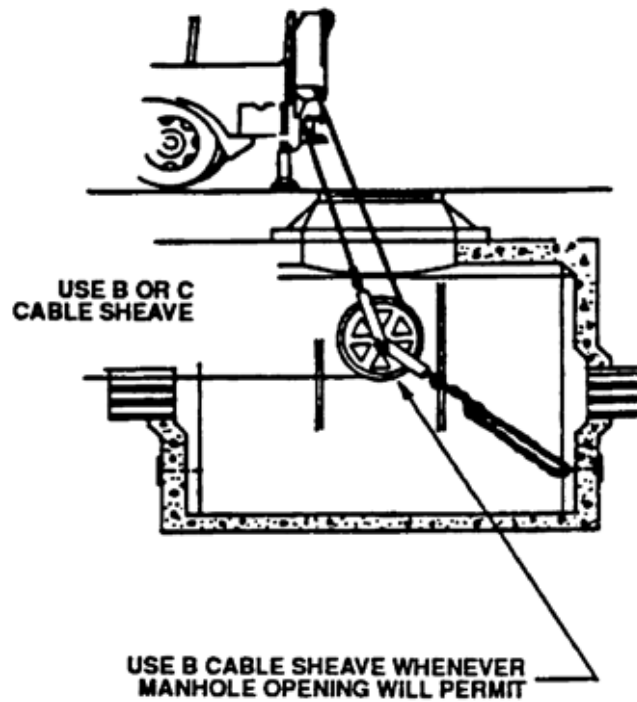


Figure 16-7 Pulling Arrangement Using B Cable Sheave Shackle and Winch Truck

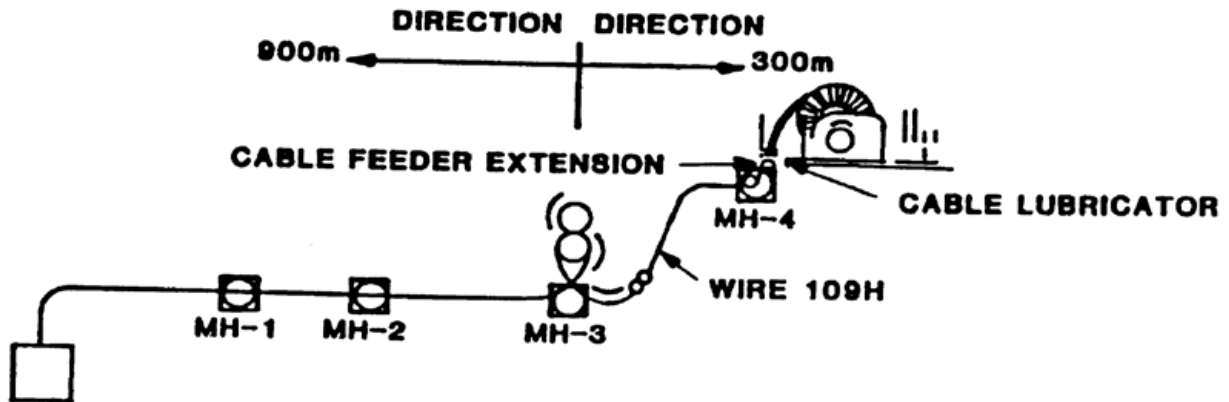


Figure 16-8 Bi-directional Cable Placing Method from Pull-through Manhole

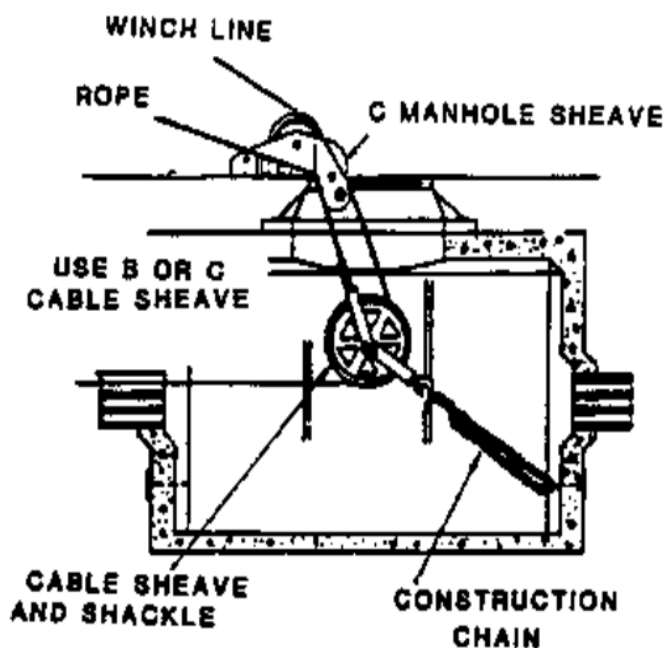


Figure 16-9 Pulling Arrangement Using C Manhole Sheave and B Cable Sheave and Shackle

4. Where the handhole/manhole opening does not permit the use of 28-inch diameter sheaves, the quadrant blocks illustrated in Figure 16-10, Figure 16-11, Figure 16-12, and Figure 16-13 will be used to ensure a dynamic bending radius of at least 20 inches.

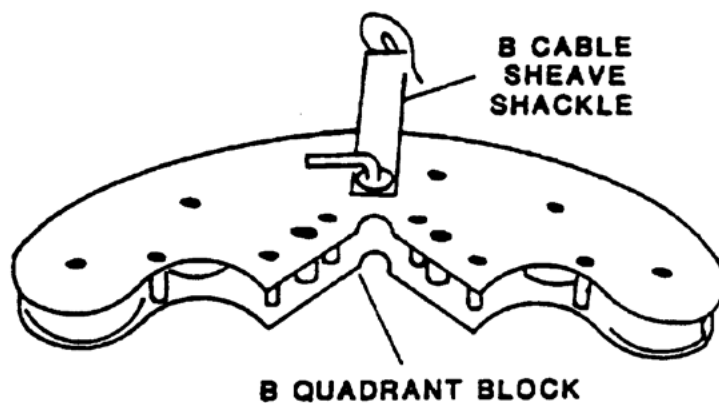


Figure 16-10 B Quadrant Block Attached to B Cable

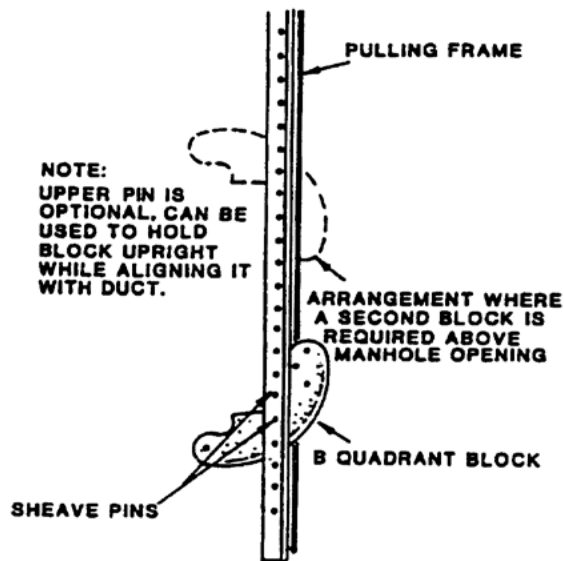


Figure 16-11 B Quadrant Block Installed in C Pulling Frame

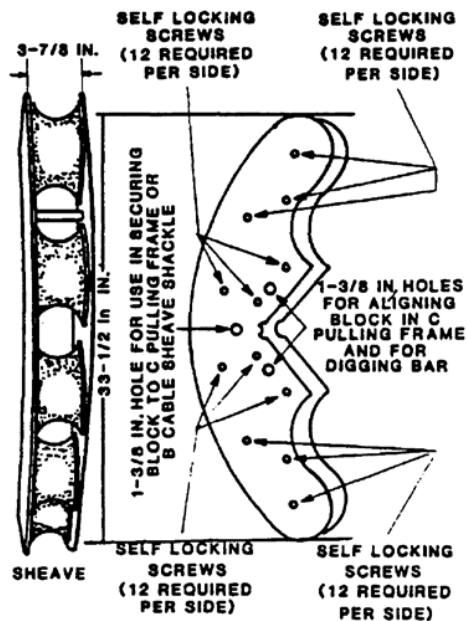


Figure 16-12 B Quadrant Block

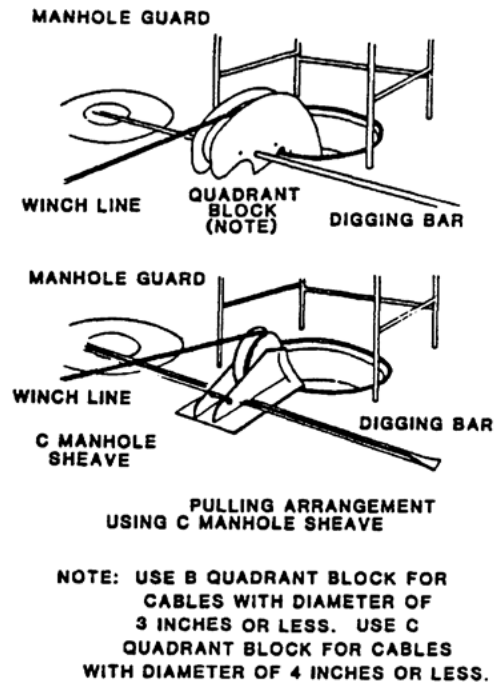


Figure 16-13 Pulling Arrangement Using Quadrant Block

5. A cable feeder will be used to protect and guide the cable into the duct, where an extension section is required, its nozzle end will be placed in the bell end of the main section. The cable feeder also will be used to feed lubricant onto the moving cable (Figure 16-4 and Figure 16-5).
6. In sections where the cable will be pulled in two directions, the flexible conduit used for cable protection will serve as the cable feeder.
7. Feed the pull line from the duct through the cable feeder before the connection is made between the line and the cable. Always place the appropriate fusible link and swivel between the cable pulling eye and the pull line. Place a marker consisting of several turns of friction tape on the pull line, 20 feet from the cable end. This will be used to indicate when the cable is about to enter the manhole (Figure 16-14).
8. Before starting the pull, check the equipment carefully to minimize the chance of interruption once pulling has started. Inspect the cable reel to ensure there are no factory reel defects, exposed nails, splinters, or similar hazards that could cause cable damage. A pulling speed of 80 feet to 100 feet per minute is required.

9. Watch the cable carefully as it unreels, continually inspecting it for sheath defects or damage. Verify that the cable was wrapped properly at the factory. If a defect or damage is noticed, stop the pull and have the Verizon Manager inspect the cable before resuming the pull

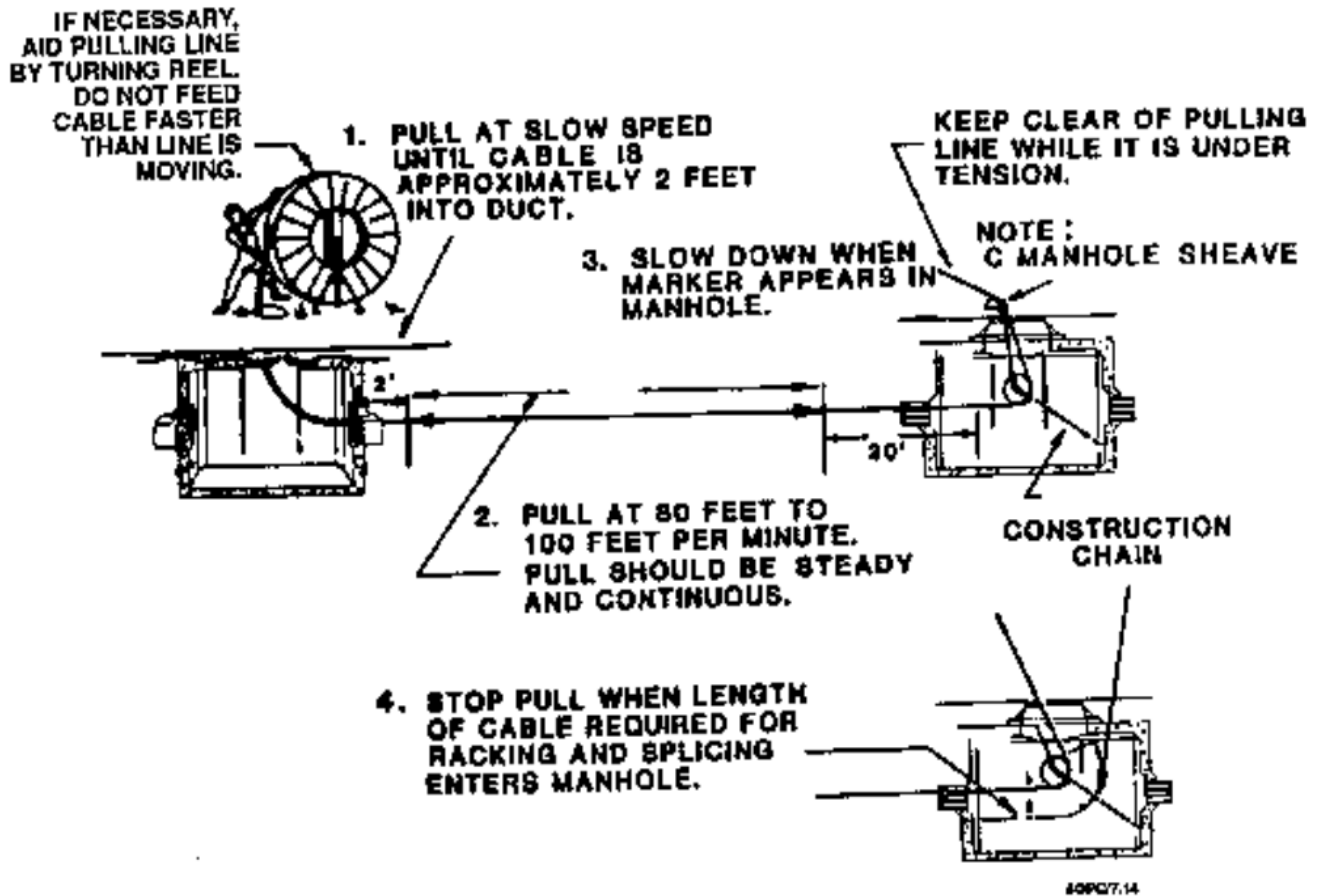


Figure 16-14 Placing Cable in Underground Conduit

10. When stops are necessary, the pull line operator will stop the pulling operation, but will not release tension unless signaled to do so. In starting up again, the inertia of the cable will be overcome by gradually increasing the tension in steps a few seconds apart until the cable starts to move. A dynamometer will be used for all pulling operations.

11. When the cable goes through intermediate handholes/manholes where ducts are out of line or offset, place protective flexible conduit so the ends extend in the conduit at each end of the handhole/manhole to prevent sheath abrasion. This operation will be done after the cable end is passed through the handhole/manhole.
12. Flexible conduit shall be placed in every handhole/manhole as the pull line is pulled with the mule tape or pull rope. The flexible conduit will be long enough to cover the exposed cable in the handhole/manhole plus 2 feet into the duct in each direction. It will be inserted in the upstream duct and tied in place.
13. Record meter markings at all handhole/manhole locations.
14. Alternate methods of cable placement in handholes/manholes are illustrated in Figure 16-15, Figure 16-16, and Figure 16-17.

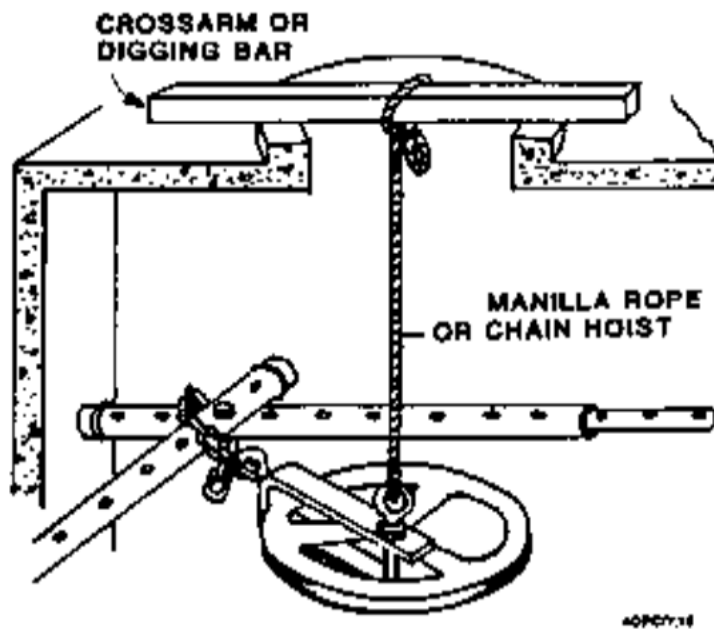


Figure 16-15 Alternate Cable Placement Methods

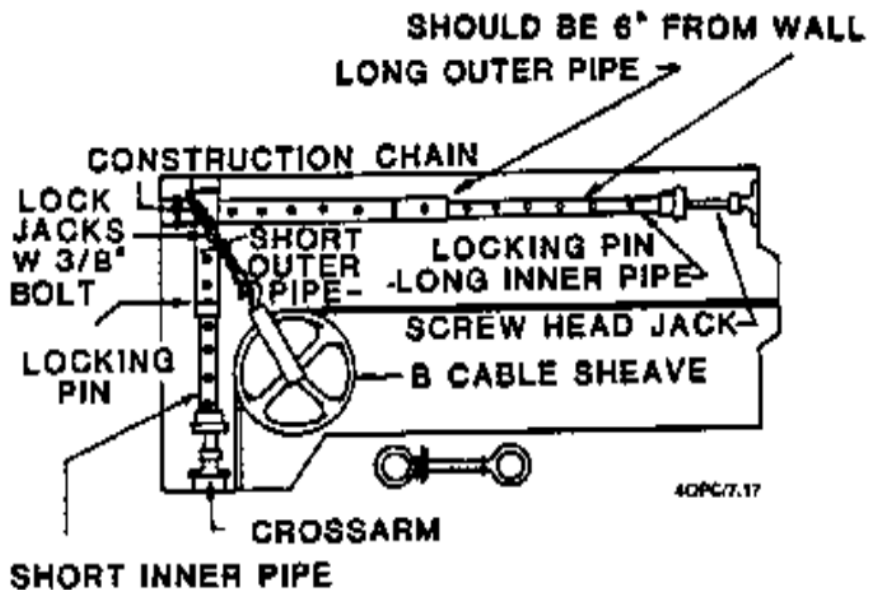


Figure 16-16 Alternate Cable Placement Methods

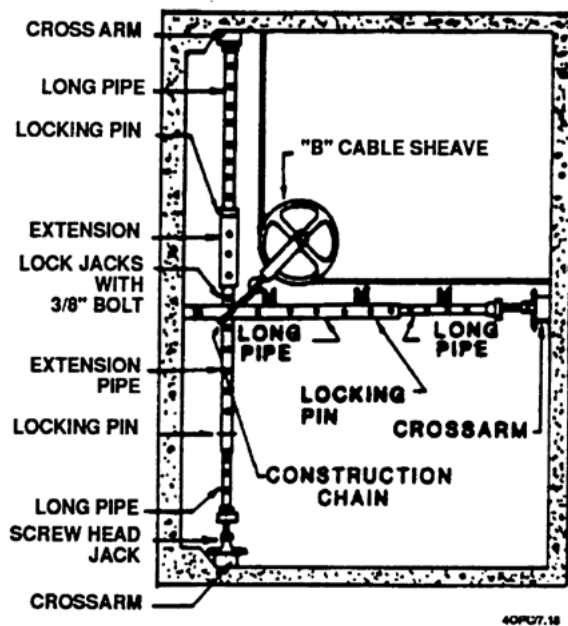


Figure 16-17 Alternate Cable Placement Methods

16.7 Cable Blowing

Standard outside plant fiber cable is not to be placed using any blowing techniques. Micro cable products may be placed using blowing techniques, but only in accordance with the specification outlined below.

Micro cable products, including micro fiber cables and micro ducts, have been specifically designed by the manufacturer to be installed using blowing techniques, thus requiring different treatment from standard Outside Plant Fiber Cable. Special procedures and handling instructions must be applied for these products. In all cases the handling and installation procedures supplied by the product manufacturer need to be followed. Some general guidelines and industry standard procedures for micro cable products are listed below.

1. The micro duct should be proofed or tested by blowing a sphere through the duct run.
2. Approved duct lubricant should be applied to ease cable installation.
3. Pre cable installation testing and reel handling instructions are the same as stated in section 4.9 and 4.10.
4. Micro cable is to be installed according to the cable manufacturer's installation specifications for distances over 700 feet. For distances under 700 feet, the micro cable can be hand pushed or pulled with a 300-pound breakaway device.
5. Specific blowing machine settings such as air pressure, flow rates, speed, and grip wheel tension, etc., when not specifically supplied by the product manufacturer, should be obtained from the blowing equipment manufacturer for the specific micro cable product to be installed.
6. Micro cable may be installed in lengths greater than 1 mile and at speeds of 200 – 300 feet per minute. Cascading may be used to achieve greater installation distances.

16.8 Racking Cable

1. Cable placed in Verizon handholes will not be racked. At all handholes, the cable will be neatly coiled per the detailed drawings in the walleye holders supplied with the handhole. Special attention and handling of the cable must be afforded to avoid micro bending. At no time will the minimum bending radius be exceeded.

Note: All Verizon-approved manholes are to be equipped with racking.

2. For cable placed in existing conduit owned by companies other than Verizon, leave sufficient cable pulled inside the handhole/manhole for racking. Flexible conduit will be placed over the exposed

cable so two feet enters the conduit at each end of the handhole/manhole. The cable will then be racked and attached with plastic ties to the vertical racks.

3. At each handhole/manhole with multiple cable in a single duct, the cable end will be tagged to indicate the direction. All Verizon cable placed in a foreign handhole/manhole must be identified by tagging. The tagging will be done as soon as the cable pull/placement is completed.
4. For LCN environment, cable shall be tagged beginning at Hub, to continue in a clockwise direction back to Hub.

Note: HH/MH spacing must be approved to meet service demands and field conditions

16.9 Handholes

1. All Verizon splice handholes will be grounded.
2. Handholes will be placed in accordance with standard industry practice following the specifications provided in the construction plans, typical drawings, and detail drawings. Special attention and planning must be exercised to ensure accessibility by other Verizon functional groups after construction has been completed.
3. All due caution will be exercised in transporting and off-loading handholes to prevent any damage during shipping or placement. Any damage to handholes after their initial receipt and inspection by the Contractor will be the sole responsibility of the Contractor, who will replace such damaged handholes at no additional expense to Verizon.
4. All Verizon handholes unless otherwise stipulated by the drawings will be buried with 12 to 24 inches of cover at final grade.
5. All buried handholes will be equipped with an EMS (Electronic Marker System) location device. In most instances, the EMS marker is mounted in the lid of the handhole, while in isolated cases the EMS marker is a separate unit. In either case, the EMS marker will be tested to ensure proper functioning immediately upon placement of the handhole and marker.
6. Cable markers and signs will be placed and numbered per the construction drawings and Verizon specifications immediately following placement of the Verizon handhole/ manhole.
7. Immediately after placement, the soil around and over the handhole will be tamped and compacted. The compaction will be performed using a mechanical tamping/compacting machine to avoid washouts. Should any washouts occur, the Contractor will be responsible for correcting the problem immediately without additional cost to Verizon!

8. After cable placement all ducts will be sealed. The temporary sealing or capping of the conduit(s) and sealing around the innerduct(s) will be with foam. Approved foams are, Dow Corning 3-6548 RTV or Semco PR-855 RTV or equivalent, meeting UL 94 HF-1 and ASTM E84 Class 1 standards. Permanent sealing will be with JackMoon style plugs and sleeves. All ducts entering a building shall be sealed both at the point of entry (first MH/HH outside) and at the point of emergence (first exposed location outside) with JackMoon plugs or equivalent.
9. Surge protection is to be installed at all splice point locations, per Verizon specifications.

17.0 Micro Trench Placement

17.1 General Engineering & Construction Guidelines

Micro Trenching should only be used as a “last mile/ building add” solution, and only deployed in a ring configuration with or as a diverse lateral. Micro Trenching is not recommended for use in a backbone type application. Micro Trench Duct runs cannot exceed 500’ without an interruption (Handhole, Manhole, 90 degree turn, etc.).

Micro Trench Technology can only be used in a concrete or asphalt surface. No landscaped areas or isolated sidewalks can be utilized. If possible, when engineering, in city streets, the running line should utilize existing grooves between the street panels or curb line and road surface. If you cannot utilize an existing groove, the running line should be as close to the curb line as possible. No running line will be placed in high tire traffic areas. In parking lots, take the above into consideration as well as the markings on the parking lot, avoid trenching through the parking stripes. The exact methods for cutting the trench, installing the duct, backer rod, sealer, and cable are all listed below. Deviations are not allowed without written approval from the Verizon OSP representative.

17.2 Cutting the Trench

1. Surface area must be free of debris (dirt, oil, etc.) prior to cutting. Cleaning the running line with high-pressure water or air is acceptable.
2. Straight line cuts are required, therefore, the trench-line should be marked with a chalk-line.
3. When possible all trenches should be cut parallel or perpendicular to other pavement attributes (expansion joints, striping, etc.)
4. Standard ½ inch concrete saw blades, turned so that the blade cuts backwards (up-cuts) should be used. The cutting machine is used without water, dry cut, with a dust collection and containment

system attached to the back of the blade area to catch the debris and dust. For safety reasons, a collection and containment system must be in place during operation.

5. Ninety-degree turns should be achieved by sawing almost to each of the running line. T, then cutting a forty-five-degree angle between the two lines. (See Figure 16-18)
6. The trench depth should be between 3.5 and 4 inches. The trench should be inspected after cutting to ensure gradual transitions are maintained. Transitions in depth at the bottom of the trench should be smooth. This can be achieved with a hand/cut-off saw.
7. The trench width should be ½ inch or equal to the size of the duct.
8. Once the trench is cut, it should be cleaned with a blower or compressed air with sufficient pressure to remove all dust and debris from the trench.
9. See Typical's A thru F for entering manholes, handholes, or building walls.

17.3 Micro Duct Placement

1. A thorough inspection of the trench should be done prior to the duct placement to ensure no debris has entered the trench. It is critical that all dirt and debris is removed from the trench and six inches each side of the trench prior to placement, including surface dirt, and moisture.
2. The duct should be inspected to make sure it is made of HDPE, has a .375" lineside diameter and a .5" outside diameter, and is HD20 load rated.
3. The duct should be placed unidirectional, Never start duct from two different directions.
4. The duct must be placed at the bottom of the groove. T, this should be achieved by pressing it into the trench using a steel wheel with sufficient weight to ensure slack is removed and there is no space between the duct and the bottom of the trench.
5. If the Duct or cable does not contain a locate wire, then a Tracer Wire must be installed for locate purposes. The Tracer wire should be a coated 14 gauge copper wire installed on top of the duct and under the spacer.
6. See Typical's A thru F for entering manholes, handholes, or building walls

17.4 Spacer (Backer Rod) Placement

1. A thorough inspection of the trench should be done prior to the spacer placement to ensure no debris has entered the trench.

2. The spacer should be water impermeable, heat resistant to 400 degrees, and at least 5/8 inches in diameter (for a ½ inch trench). The spacer should always be substantially (25 %) larger than the trench to ensure a tight seal between the duct and the bitumen.
3. The Spacer should be place unidirectional. N, never place spacer from two different directions. Spacers cannot be spliced, however, they can be overlaid to begin a new piece or a repair, and the overlay must be at least six inches.
4. At ninety-degree turns the spacers should be placed around the first forty-five degree turn then across the next turn into the over-cut trench. , The same should be done with a new piece to finish the running or continue to the next turn. (See Figure 16-19.)
5. The spacer must be placed on the top of the duct. T, this should be achieved by pressing it into the trench using a steel wheel with sufficient weight to ensure slack is removed and there is no space between the duct and the bottom of the spacer.
6. Once all the spacers are in place, sand should be added to all areas where the spacer does not protect the duct from the HOT sealer. The sand should be the same height as the top of the spacer. Sand should be fine grade and dry. (See figure 16-20)
7. After installation, the trench should be inspected to ensure that the top of the spacer or sand is at least 2" but no more than 3" from the surface.

17.4 Trench Sealer Placement

1. Bitumen sealer is to be used as the top layer for all trenches
2. The preferred temperature for placement of the bitumen sealer is 325 degrees with a maximum of 375 degrees. No exceptions.
3. The sealer thickness should be between 2 and 3 inches. No more than three inches should be used, if the trench requires more than 3 inches, a backer rod or sand should be used to fill the void.
4. The sealer should be placed unidirectional in multiple passes. The final pass should only be made after the trench has had time to cool and contract.
5. The sealer should overlap the edge of the trench by 2 inches. Therefore, the total sealer width on the surface should be 4.5 inches. The sealer should be no more than ¼ above road surface.

17.5 Micro Cable Placement

1. When using the pulling method, pulling tensions should not exceed 300lbs. A 300lbs breakaway must be used.

2. Cable blowing or jetting equipment designed for use with standard outside plant fiber cable should not be used to place micro cable. Micro cable requires specialized equipment.

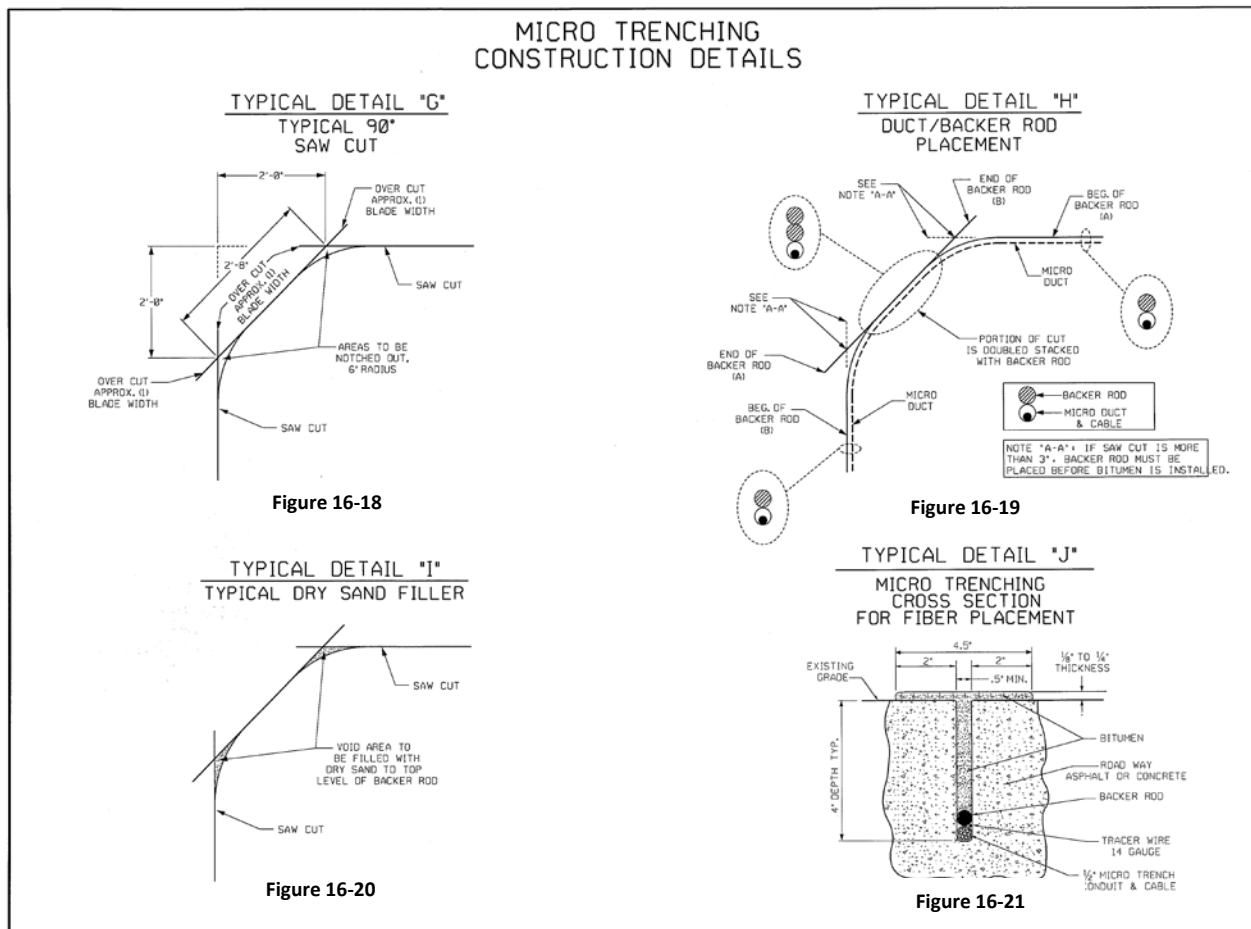


Figure 16-18, Figure 16-19, Figure 16-20 and, Figure 16-21

18.0 Micro Duct Placement Override Applications

18.1 General Engineering and Construction Guidelines

One or more micro ducts can be placed inside an existing conduit, already occupied by an existing cable, to allow the installation of micro cables inside the micro ducts. The existing duct and cable must be examined to determine if a micro duct override is possible. The inside diameter of the existing duct and

the outside diameter of the existing cable must be known. There has to be a sufficient amount of space available inside the duct to allow the micro duct(s) to move during installation.

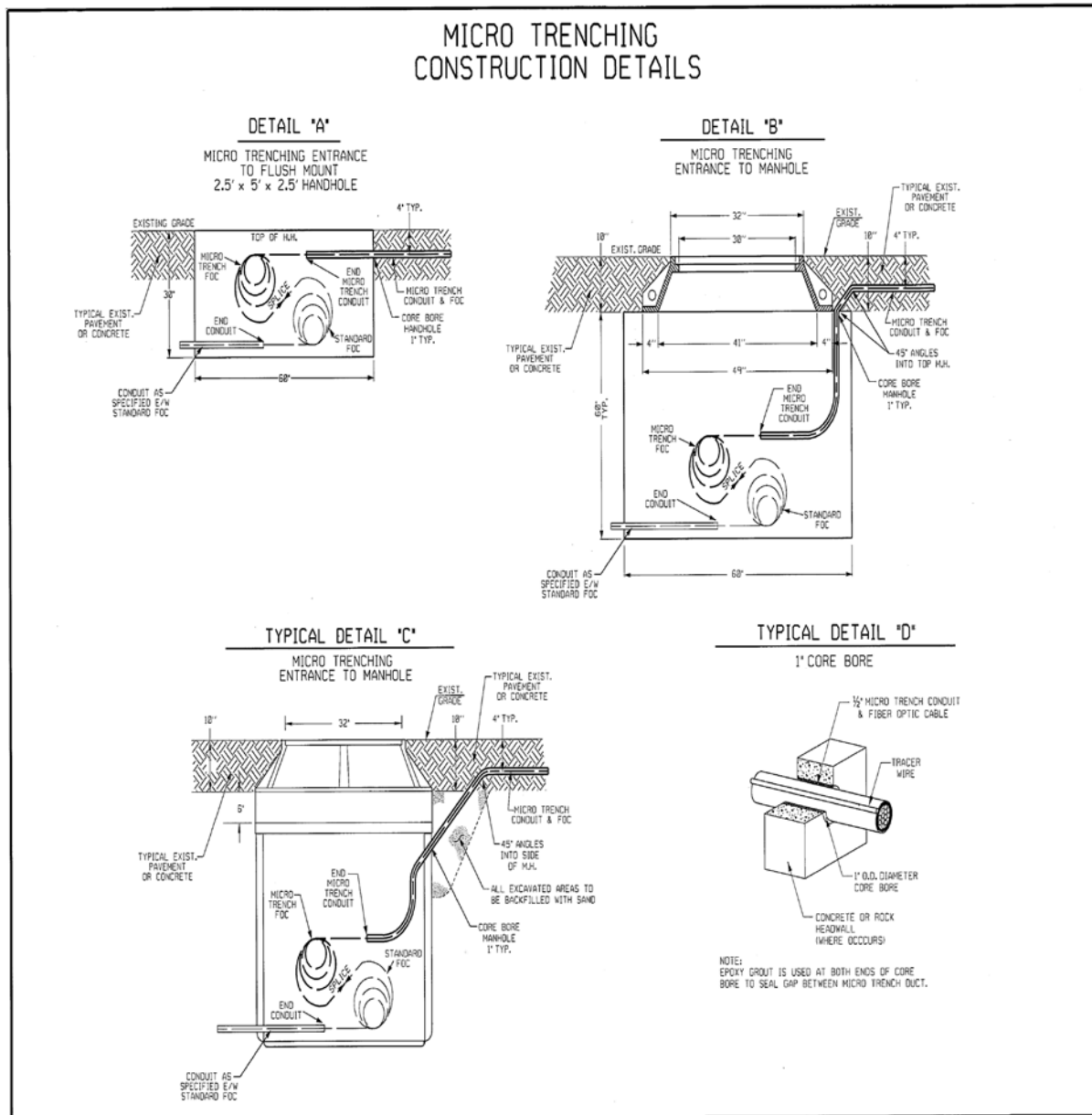
18.2 Micro Duct Installation

Micro duct products have been specifically designed by the manufacturer to be installed using blowing techniques, riding a cushion of air over the existing cable. In all cases, the handling and installation procedures supplied by the product manufacturer need to be followed.

1. Some general guidelines and industry standard procedures for micro duct products are listed below. When they are installed using manufacturer-supplied blowing techniques, micro ducts can only be installed from the beginning opening to the next opening in the existing duct. Once the micro ducts are installed from opening to opening, individual micro ducts can be spliced together with an airtight fitting, for a longer installation of micro cable(s).
2. The micro ducts must be pressurized during installation to keep them from imploding. A cap must be placed on the end of the micro duct that allows for an airtight seal and is designed to help the micro duct maneuver through the existing duct. The opposite end of the micro duct (on the reel) must be fitted with a valve that allows the micro duct to be pressurized to 125 PSI.
3. If installation of more than one micro duct is necessary, then the ends of the micro ducts should be staggered at least 6ft apart. This helps the micro ducts traverse through the couplers and bends more easily.
4. As you will be using air for the installation, a “Y” adapter must be used to make an airtight seal around the existing duct and cable while allowing the placement of the micro duct. The “Y” adapter has changeable inserts, which allow it to seal to a wide variety of cable and duct sizes. Follow the guidelines from the “Y” adapter manufacturer to determine the proper inserts for any particular installation.
5. Prior to closing the “Y” adapter, hand push the micro ducts 10 – 15 ft. into the existing duct to make sure the micro duct(s) have free movement. Then assemble the top half of the “Y” adapter.
6. Depending on the number and size of micro ducts, a special track system may be required on the installation equipment.
7. Once everything is setup, a small amount of air should be applied and the hydraulics should be started slowly. When the micro duct(s) start moving, make sure the reel(s) are moving freely. Upon evaluation that all is working properly, increase the air and hydraulic pressure slowly. Keep increasing

the pressure as more micro duct is installed. Note: if you apply too much air pressure too early, before enough micro duct is installed, backpressure will impede the process.

8. When the micro duct reaches the next opening, be sure to allow enough slack to work with before stopping the pressure. Also remember the micro duct is under pressure and care must be taken when removing the end cap.
9. The contractor will design and utilize an impregnable shield with padded facing to fit around the active fiber inside of the receiving handhole to intercept and shield the active cable from sustaining damage from foreign objects entering the handhole pressure. The shield will be removed and placed in next receiving handhole prior to duct proofing and micro duct placement. This approved design will be used in every receiving handhole. Any person or persons monitoring the receiving handhole shall wear proper protective gear to avoid injury from deflected debris.
10. All micro duct couplers supplied by the contractor must conform to all micro duct ratings and meet or exceed manufactures tolerances and must be able to be pressurized after installation.



18.3 Directional Boring

Directional boring is the preferred method of placing sub-aqueous plant.

Due to economic considerations, directional boring should be considered for sub-aqueous crossings as follows:

- Crossings exceeding 100 feet in length.

- Depth of waterway.
- Subsurface conditions.
- Availability of work space to accommodate drilling and receiving equipment.
- Permitting agency and environmental impact.
- Availability of alternate crossings or crossing methods.

18.4 Description

Directional bore is a cost effective alternative to open cut or tunneled installations. This no-dig technology is used to cross under obstructions such as river crossings, runways, lakes, canals, archaeological, and ecological sites.

Present techniques employed in directional boring consist of drilling a pilot hole, enlarging the pilot hole sufficiently to accommodate the conduit and pullback for installation of the conduit.

Directional boring may be utilized in the installation of HDPE ranging from Verizon standard 1-1/2 inch to 4 inch HDPE, as well as 4 inch Black Steel Pipe (BSP) conduit, or the 5 inch drill stem pipe.

Specifications for materials employed in directional boring are shown in Table 18-1 and Table 18-2.

Table 18-1 High Density Polyethylene Material (HDPE)

NOMINAL SIZE (INCHES)	DIMENSIONS		ASTM D-3035 MIN WALL	SDR	APPROX WEIGHT P/100 FT. (LBS.)
	OD	ID			
1-1/2	1.900	1.644	0.173	11	41
2	2.375	1.943	0.216	11	64
4	4.500	3.800	0.333	13.5	190

Table 18-2 Black Steel Pipe (BSP), ASTM Designation: 1-20, Schedule 40

NOMINAL SIZE (INCHES)	DIMENSIONS		MIN WALL	APPROX WEIGHT P/100 FT. (LBS.)
	OD	ID		
4	4.500	4.026	0.237	1089

18.5 Design and Layout

Profile Design: A cross section reflecting distances from drilling point to receiving area, including entry and exit angles, the allowable sag, bend radius and depth of cover. The cross section drawing will furnish sufficient information to the construction contractor for developing costs.

Geo-technical Survey: Sufficient soil borings should be taken to describe the subsurface conditions along the planned running line. Standard penetration testing in unconsolidated soils and unconfined compressive testing of rock samples are extremely important in evaluating drilling performance, hence project construction costs. Installations through strata which contain an excess of 75 percent by weight of gravel or larger material are very difficult to execute.

Site Survey: Inspection of the work site is important to determine accessibility. Sufficient workspace will be required on the rig site to contain the drilling and auxiliary equipment.

18.6 Directional Bore Plan

Prior to all directional boring operations the Contractor will review the plan with the Verizon Manager and complete the Bore Plan Sketch Form, Figure 18-1, and the On-Site Bore Plan Checklist, Figure 18-2. Forty-eight hours prior to construction the Contractor will complete the Pre-Bore Checklist, Figure 18-3a/b, and provide a copy to the Verizon Manager.

Figure 18-1 Bore Plan Sketch Form



		PROFILE														SITE PLAN														
		13	12	11	10	9	8	7	6	5	4	3	2	1	0	5	4	3	2	1	0	-1	-2	-3	-4	-5				
<div>PROJECT #: PROJECT LOCATION: PRIME CONTRACTOR: DRILLING CONTRACTOR: BORE LOCATION: OPERATOR: LOCATOR: INSPECTOR:</div>																0'														
																50'														
																100'														
																150'														
																200'														
																250'														
																300'														
															350'															

HDD CONTRACTOR ON-SITE BORE PLAN CHECKLIST



PROJECT NAME AND NUMBER: _____
PRIME CONTRACTOR: _____
HDD CONTRACTOR: _____
BORE LOCATION: _____
BORING CREW: _____
LOCATOR NAME: _____
OPERATOR NAME: _____
INSPECTOR NAME: _____
DATE BORING STARTED: _____
TOPOGRAPHY INFORMATION

- _____ R.O.W. and permit requirements reviewed
_____ examined site for any natural or man-made obstructions (reference on bore plan)
_____ examined site for signs of unidentified utilities (reference on bore plan)

EXISTING UTILITIES

_____ verified that all known utilities (identified on bore plan and drawings) have been physically located and marked

BORE PREPARATION

- _____ physically staked bore path and reviewed against Bore Plan
_____ Entry and exit bore pit locations reviewed for sufficient size of the planned bore and recorded on _____ bore site plan
_____ locating equipment (pilot and back ream) calibrated and documented in daily log

REVIEW BORE PLAN

- _____ reviewed bore plan with operators, locators and inspectors
_____ discussed in detail all utilities in conflict
_____ addressed unidentified issues or concerns

* ALL OSHA AND COMPANY SAFETY REGULATIONS MUST BE FOLLOWED WITHOUT EXCEPTION

ADDITIONAL INFORMATION AND COMMENTS:

*** KEEP THIS CHECKLIST AND BORE PLAN IN THE BORE FOLDER ***

Figure 18-2 On-Site Bore Plan Checklist

HDD CONTRACTOR PRE-BORE CHECKLIST

(To be completed at least 48 hrs. prior to commencement of boring)

PROJECT NAME AND NUMBER: _____
PRIME CONTRACTOR: _____
BORE LOCATION: _____
BORING CREW: _____
LOCATOR NAME: _____
OPERATOR NAME: _____
INSPECTOR NAME: _____
CHECKLIST COMPLETED DATE: _____

A. INFORMATION AND PLANNING

- _____ Construction approval received
- _____ Emergency contact list with escalation numbers for all known utilities and permitting agencies compiled
- _____ Environmental and cultural restrictions or controls considered
- _____ Confirmed availability of required resources and schedule
- _____ Proposed alignment, design, and specifications
- _____ Verified information, drawings, and permits

B. UTILITIES

_____ One Call, www.digsafely.com or other locating company contacted

• Confirmation / Ticket # _____

- _____ Existing utility as-builts and plans reviewed for potential conflict
- _____ identified and met with all utility representatives on location (including those not participating in the One Call system)

Conflicting Utilities

Utility Name & Representative	Name Meeting Date / Time	Type of Facility
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____

5. _____

Figure 18-3a Contractor Pre-Bore Checklist

HDD CONTRACTOR PRE-BORE CHECKLIST (continued)

REQUIRED RESOURCES

_____ Bore Plan completed

- survey any significant surface elevations and evidence of any past excavation activity or grade changes (such as fill brought in/removed)
- examine site for any natural or man-made obstructions (reference on bore plan)
- examine site for signs of unidentified utilities
- expose (pothole) all the existing utilities, both identified and unidentified, and verified depth through vacuum excavation or hand digging
- identify all existing utilities encountered and document actual location on redlines (As-Built)
- plot surface elevations on profile
- record the surface distance from entry to exit pits
- walk bore path with receiver for any abnormal signal readings and chart location
- chart locations of all utilities in proximity of bore path, recording distance and depth on the site plan and profile
- dimension both length and depth of the planned bore

_____ Safety plan/hazard analysis and trained personnel have reviewed

_____ Traffic control plan developed

_____ drilling fluid plan developed

_____ Site constraints and other requirements investigated

_____ verified drill pipe and product cam meet bend radius requirements of proposed bore

_____ Mobilization and production schedule completed

***ALL OSHA AND COMPANY SAFETY REGULATIONS MUST BE FOLLOWED WITHOUT EXCEPTION**

ADDITION INFORMATION OR COMMENTS:

***KEEP THIS CHECKLIST AND ANY ABOVE INFORMATION IN THE BORE FOLDER**

Note: Before and after photos and or video should be taken of all work areas.

Figure 18-3b Contractor Pre-Bore Checklist

19.0 Jetting

19.1 General

The design engineer will, on occasion, encounter projects that involve crossing numerous, small, slow moving, and penetrable bottom water courses. The use of hydraulic jetting as a means of negotiating these crossings will be considered if the permitting agency's concerns about turbidity and shellfish habitat disturbance can be alleviated. The two types of hydraulic jetting available are:

19.2 Wand and Hydraulic Jetting

Current velocity: Divers experience difficulty in maintaining a straight conduit run to pull through if the current velocity exceeds 3-1/2 knots.

Water Turbidity: Divers generally wear jet wearing KM-B-10 hard hats served with air by hose. Sight is not necessary to jet the trench. However, the need to visually inspect the BSP, PVC, or HDPE and rip-rap weight remains an issue.

Depth of Placement: Generally divers will not jet trench above diaphragm height as a guard against cave-ins or hidden pockets in the bottom. The conduit must have a minimum of 48-inch cover with rip-rap cribbing or special concrete mix being placed on 5-foot centers in the trench.

The sequence of events during construction are:

- Cutting bottom cover with water pressure wand.
- Placement of conduit (4-inch PVC or BSP) or HDPE in formed trench.
- Undercutting of both sides to provide cover.
- Flooding of placed material with water pressure to check for connectivity and install slick line pull rope for cable pulling.

19.3 Sled Hydraulic Jetting (Jet Plow)

The use of the hydraulic sled to place conduit or HDPE is an option for negotiating water crossings.

The sequence of events is not totally unlike those that occur during wand jetting, however, the divers accompanying the plow are there to ensure the safety and integrity of the conduit as the plow is winched to the surface vessel (barge with spuds or anchors).

The entry and exit of the plow blade (stinger) into the bottom cover is very critical to cable integrity. The Design Engineer will pay particular attention to the degree of slope at the ingress and egress points as well as the amount of right-of-way available to support equipment.

19.4 Dredging

Dredging is accomplished either from the shoreline or a barge, depending on the distance of the crossing. The depth of dredge will be determined by the appropriate permit agency. Dredging spoils will be placed beside the trench or on a barge, as specified by the permit.

After the trench has been dredged, diver inspection is required to determine that the proper depth has been obtained. The conduit or HDPE reel will be anchored on a barge or shoreline depending on the length of the crossing and the location. A winch vehicle will be set up on another barge or on the opposite shoreline. The winch line will be across the channel and will pull the conduit or HDPE across the channel to the winch setup.

Diver inspection is required to determine that the conduit or HDPE is in the trench and backfill operations may be performed.

A final inspection dive will be performed to assure that backfill is complete.

19.5 Embedment Plowing

Embedment plowing is defined by the Florida Department of Energy Resources (Permit Sta. 17-4.02) as the placement of lines to the bottom of waters "by minimal displacement of bottom material and without the creation of trench or trough, through the use of techniques such as plowing in, weighing in, or non-trenching jets."

The sequence of construction events to be considered when designing a water crossing for this type of installation is identical to those that occur during jet plow with the exclusion of the low pressure surfaces on the leading edge of the plow (stinger).

The positive aspects are:

- Straight line crossings can be achieved, unless extreme current velocities are encountered, due to the weight of the plow and the fixed point reference system (winch line) used to retrieve the equipment.
- The depth can be increased to 9 feet (twice that of wand jetting).
- Multiple innerducts/conduits can be placed simultaneously for longer distances at lower depths.

The design engineer will pay particular attention to the right-of-way requirements as well as the degree of slope at the ingress and egress points.

20.0 Damaged Cable Sheath

If the cable sheath is damaged, the Verizon Supervisor will be notified immediately and the cable will be inspected.

Warning: *DO NOT CUT THE CABLE! The Verizon Supervisor is the only person who may authorize cutting a cable.*

21.0 Acronyms

A list of acronyms and their associated definitions can be found on the VzKnowledge website located here: <https://knowledge.verizon.com/vzknowledge/glossary.portal>