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W1604

\*\*\*\*This document supercedes BECo WMS 2.9-1.1\*\*\*\*

## CABLE PULLING OPERATIONS

### 1.0 Purpose

- 1.1 This Work Method Standard prescribes the preferred methods of removing and installing cables between manholes.
- 1.2 This standard can be used to remove or install more than one cable at the same time in a single duct. Throughout this standard the word “cable” can refer to one three-conductor cable or many single-conductor cables.
- 1.3 This standard is divided into four major sections as follows:
  - A. GENERAL
  - B. CABLE REMOVAL
  - C. CABLE INSTALLATION
  - D. COMBINED CABLE REMOVAL AND INSTALLATION

### 2.0 Safety Rules

- 2.1 The following safety measures shall be observed:
  - A. WMS1.1-2.2 “Installation and Maintenance of Temporary Traffic Controls for Protection of the Public and Employees.
  - B. WMS2.10-4.1 “Gas Detection in Manholes”.
  - C. OP1.1-2C “Accident Prevention: Protective Headgear”.
  - D. OP1.1-2CC “Accident Prevention: Ear and Hearing Protection”.
  - E. OP1.1-2D “Entering and Working in Underground Locations”.
  - F. OP1.1-2S “Accident Prevention: Protection Against Eye Injury”.
- 2.2 Wheel Clocks must be used on all trucks and trailers.
- 2.3 All personnel will maintain a safe and reasonable distance from the winch during pulling operations to prevent injury in the event of a breakage of the winch rope.
- 2.4 Personnel will not remain in the manhole during the pulling operation. Personnel will exit the manhole after the cable has been guided into the proper duct.

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### 3.0 General Information

#### 3.1 Vehicle Equipment Operations

- A. Refer to the Service Department's Manual of Operating Procedures No. TT-510 "Single Reel Cable Transporting-Puller-Tensioner Truck Operating Instructions" for the proper operation of the Transporting-PullerTruck.
- B. Refer to the Service Department's Manual of Operating Procedures No. TT-500 "Arm-Driven, Self Propelled Cable Handler Operating Instructions" for the proper operation of the Power Reel Trailer.

#### 3.2 Pulling and Feeding Manholes

- A. Unless previously instructed, the leader will decide which manhole is to be the pulling manhole and which is to be the feeding manhole. The leader should consider the following:
  - 1) Pulling cable from the manhole that is farthest from any offsets or bends is preferable for a long or difficult pull.
  - 2) It is preferable to pull from the least congested manhole.
  - 3) A "downhill" pull is preferable.
  - 4) When removing cable, it is preferable to pull cable from the duct closed to the manhole roof.
  - 5) When removing cable, if a burn is visible , it is preferable to pull from the manhole that is farthest from the burn.
- B. The means of communication between the workers at the two manholes will be radio, voice signals, or the following hand signals:
  - 1) One hand extended over the head and rotating slowly means "go ahead"
  - 2) Both hands extended over the head and palms forward means "stop".
  - 3) Both hands extended over the head and moving side-to-side means "all equipment off".
- C. The leader will inspect the manhole and report any unusual conditions to the supervisor.

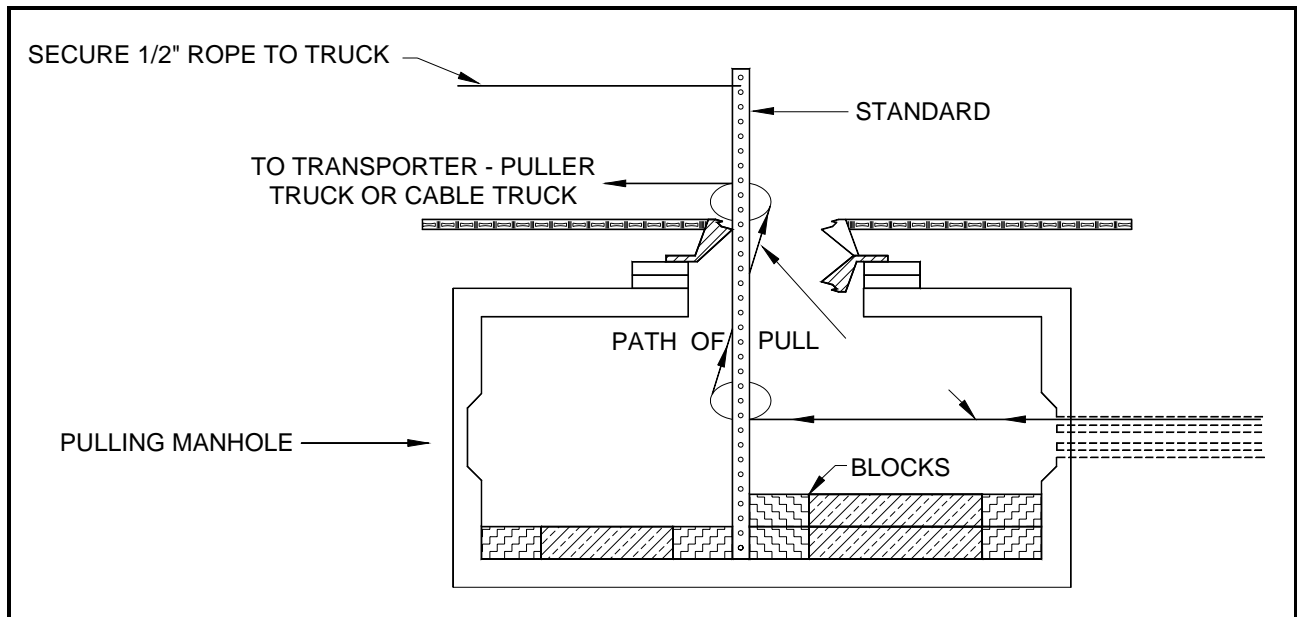
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3.0 General Information – Cont'd

3.3 Manhole Equipment

- A. The leader will decide the type of approved equipment to be used in the pulling manhole, keeping in mind the conditions in the manhole and on the street.
- B. The types of approved equipment set-ups are as follows:
  - 1) Cable Pulling Standards.
  - 2) Snatch Block and Portable Sheave
  - 3) Leathers.
- C. Arrange the equipment so that the pull from the duct will be in as straight a line as possible with a minimum of directional changes.
- D. The following is a list of instructions on how to use the cable pulling standards (refer to Figure 1):
  - 1) Lower the standard into the manhole as vertical as possible.
  - 2) Position the bottom of the standard on the manhole floor and wedge into place with wood blocks.
  - 3) Secure the top of the standard to a fixed object with a ½" rope.
  - 4) Install the lower sheave or shoe so that the pull from the duct will be as straight as possible.
  - 5) Install the upper sheave or shoe as close as possible to the manhole frame.
  - 6) Use shoes if the cable is to be re-used. Use sheaves if the cable is to be junked.

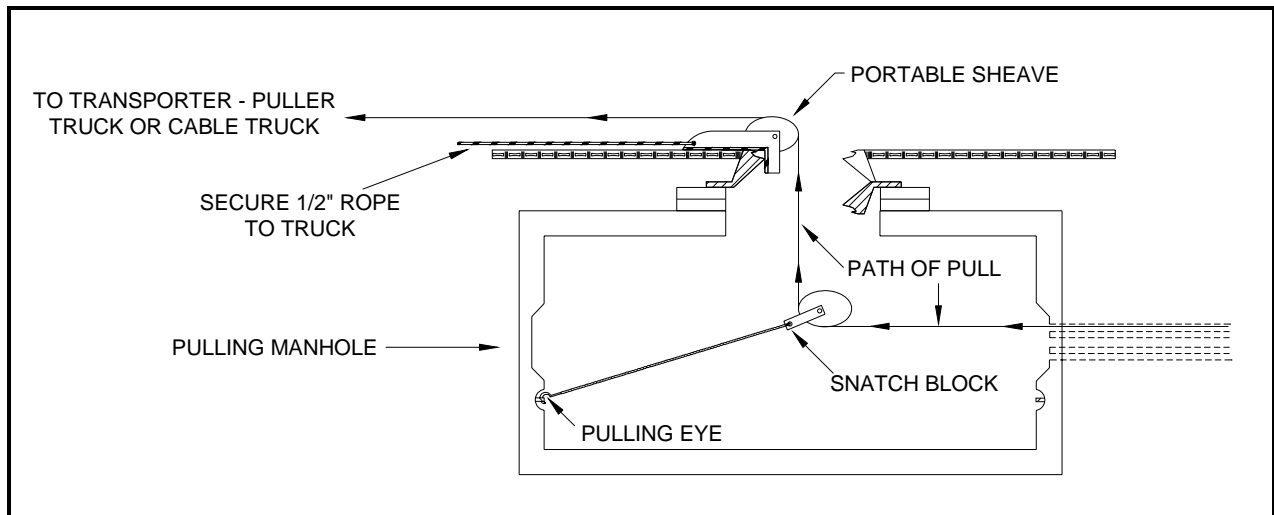
3.0 General Information – Cont'd



**Figure 1 - "Standards" Set-Up**

- E. In concrete manholes equipped with a pulling eye, the snatch block and portable sheave can be used to remove cable that is to be junked. Refer to Figure 2.
- F. If the cable is to be saved, then only use the snatch block to "break" the cable loose from the duct. Pull the wire rope through the snatch block but do not pull the cable through the snatch block. When installing cable, replace the snatch block with a shoe if cable must be pulled through to leave enough slack for racking and splicing.

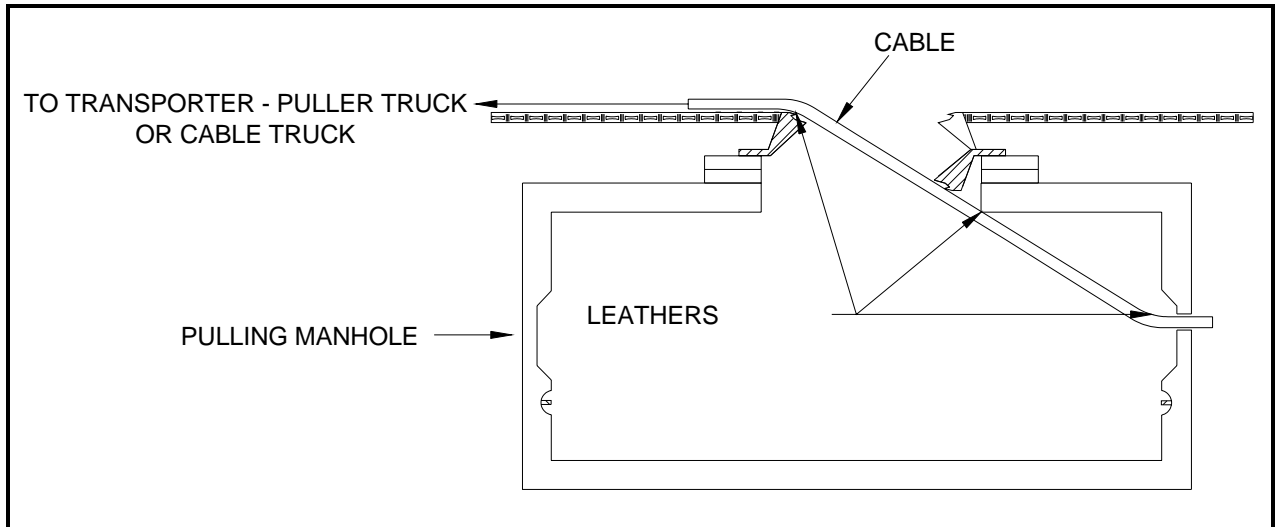
3.0 General Information – Cont'd



**Figure 2 - Snatch Block Set-Up**

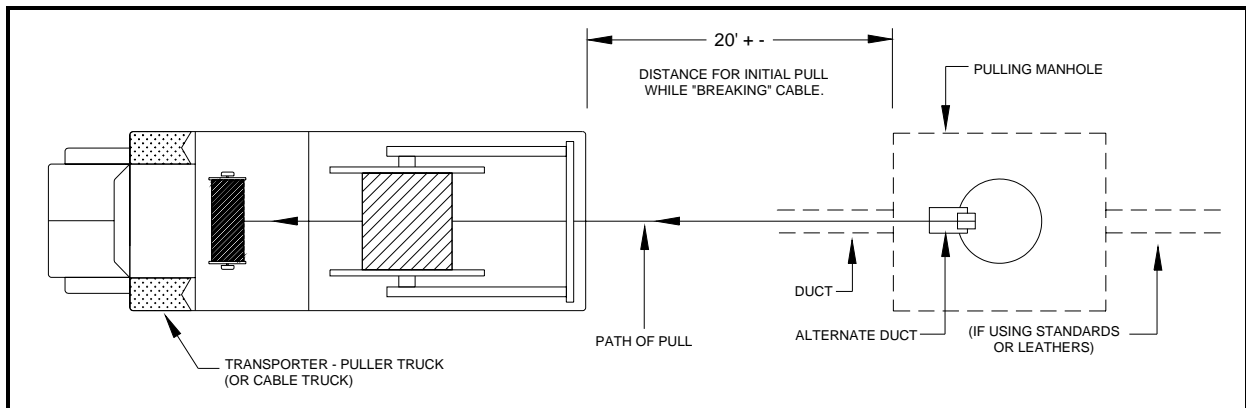
- G. Leathers should only be used on cable that is in a high duct where there is a clear path from the duct to the manhole chimney. Only install cable with leathers if the other methods cannot be used. Refer to Figure 3 and proceed with the following:
- 1) Install Leathers at any point where the cable will rub against a fixed object.
  - 2) Hold the leathers in position until tension is put on the cable. If the leather moves out of position, then release the tension and put the leather back into position.
  - 3) Lubricate the leathers with cable pulling lubricant.
  - 4) If the leather will not fit in the duct or if the strain is very heavy, install a steel fairleader in the duct from which cable is to be removed. If installing cable the steel fairleader should only be used with the winch wire, not with the cable.

3.0 General Information – Cont'd



**Figure 3 - Placement of Leathers**

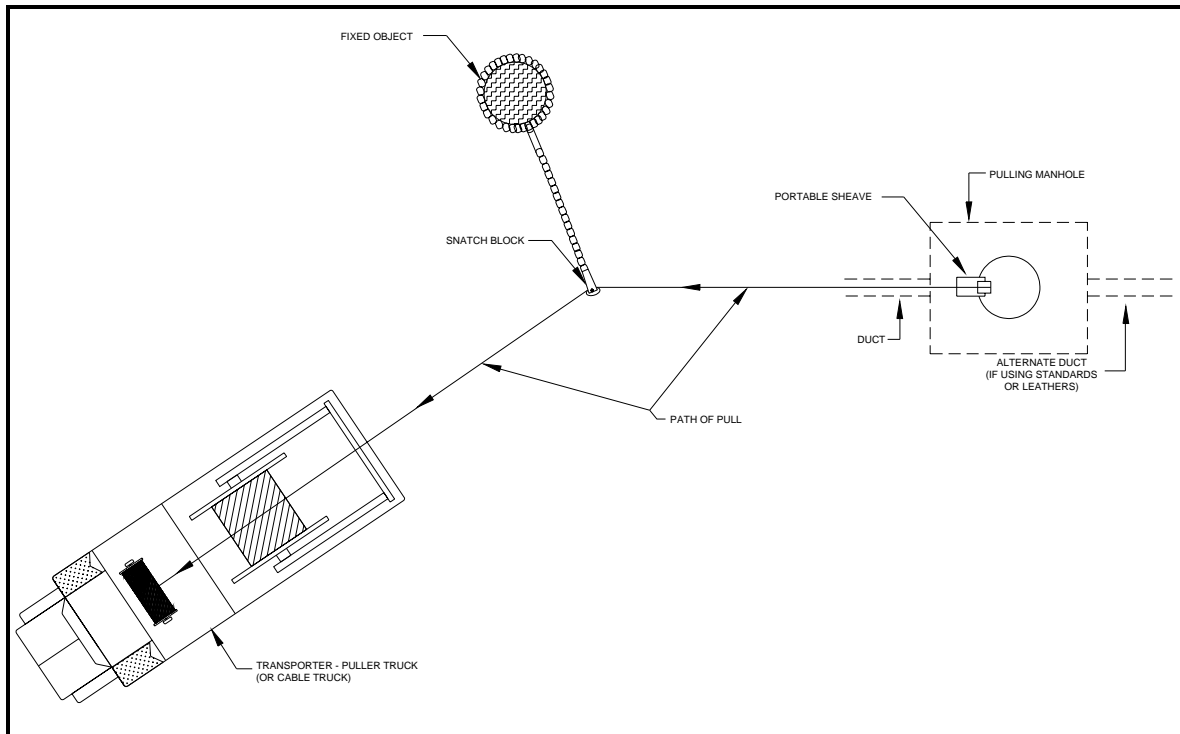
- H. Use a Cable Truck and a Power Reel Trailer in combination or use a Transporting-Puller Truck. The Power Reel Trailer or Transporting-Puller should be equipped with an empty steel reel.
- I. Position the Cable Truck or Transporter-Puller Truck at the pulling manhole so that the path of the pull, as viewed from above, from the duct to the truck is in a straight line as showing in Figure 4.



**Figure 4 - Job Set-Up**

- J. If it is possible to line the truck up straight with the duct, then park the truck at an angle. In this case it is preferable to use a snatch block as shown in Figure 5.

### 3.0 General Information – Cont'd



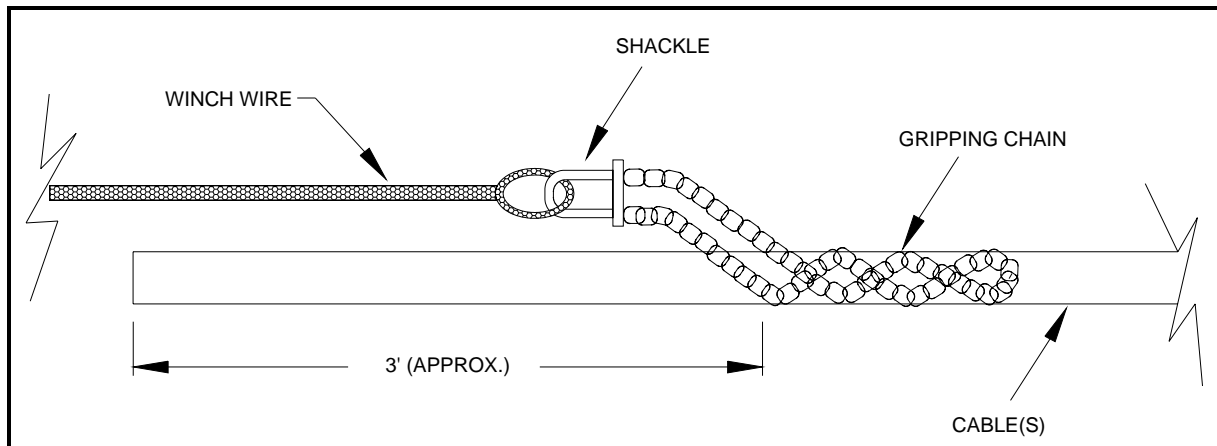
**Figure 5 - Alternate Set-Up**

- K. When the Power Reel Trailer is used with the Cable Truck, it should be moved into position after the cable has been “broken” loose from the duct by the Cable Truck winch.

### 3.4 Cable Preparation Prior to Removal

- A. The cable to be removed must be cut clear in both manholes.
- B. The joints in the pulling manhole do not have to be cut clear. These joints can be used to provide a stronger grip when pulling.
- C. Cable will be removed one section at a time. Do not attempt to pull any joints through a duct.
- D. In both manholes, remove arc proofing, bonds, and fairleaders from the cable to be pulled.
- E. In the pulling manhole, attach a ½” gripping chain to the cable to be removed. Refer to Figure 6. Make a “figure eight” hitch at a point about three feet from the cable end. Wrap each end of the chain around the cable two or three times.

3.0 General Information – Cont'd

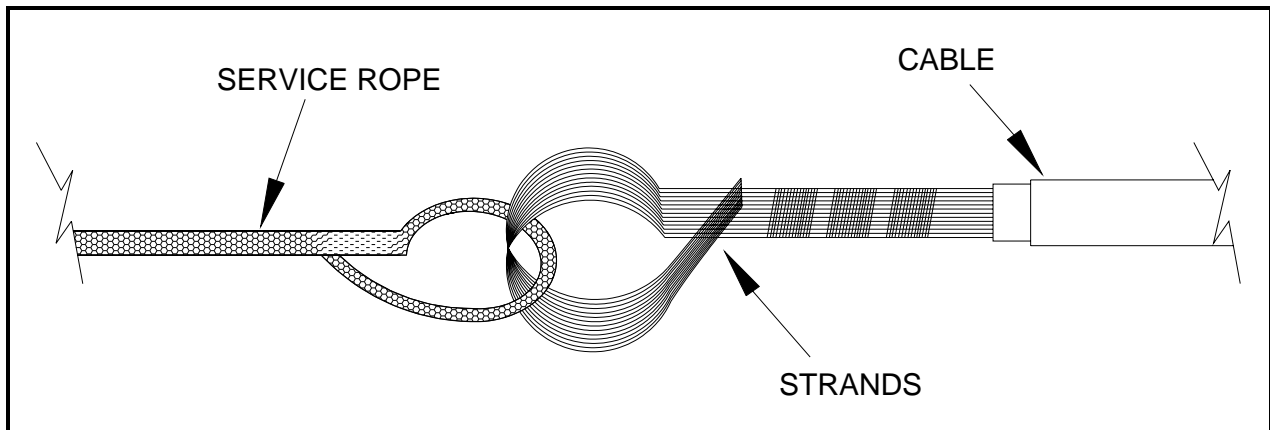


**Figure 6 - Chain Grip**

- F. Thread the wire winch rope from the truck over the manhole equipment (sheaves or shoes, leathers, etc.) and attach it to both ends of the chain using a shackle.
- G. In the feeding manhole, attach a nylon service rope to the cable to be removed. Use a single or a multiple hitch.
- H. If the cable has not faulted in the duct, then use a single hitch. Refer to Figure 7 and proceed with the following:
  - 1) Strip approximately three feet of the sheath and insulation from one conductor, exposing the strands.
  - 2) Spread the strands apart and cut off all but fifteen strands.
  - 3) Pass the strands through the loop of the service rope and fold them back.
  - 4) Wrap each strand, one at a time, tightly around the conductor forming a loop which inter-locks with the service rope. Wrap all strands in the same direction.
  - 5) Cover the hitch with friction tape.

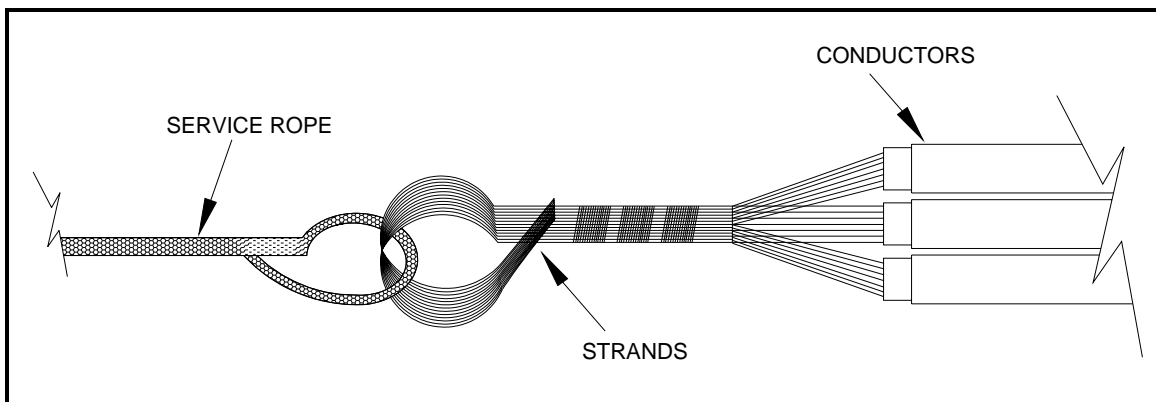


3.0 General Information – Cont'd



**Figure 7 - Single Hitch**

- I. If a three-conductor cable that has faulted in the duct is to be removed, then use a multiple hitch. Refer to Figure 8 and proceed with the following:
  - 1) Strip about two or three feet of the sheath and insulation from each conductor, exposing the strands.
  - 2) Separate the strands and cut off all but eight strands from each conductor.
  - 3) Bring all of the strands together and pass them through the loop of the service rope. Fold the strands back.
  - 4) Wrap each strand, one at a time, tightly around the conductor forming a loop that inter-locks with the service rope. Wrap all strands in the same direction.
  - 5) Cover the hitch with friction tape.



**Figure 8 - Multiple Hitch**

|                    |                                                                                                                                            |                                           |
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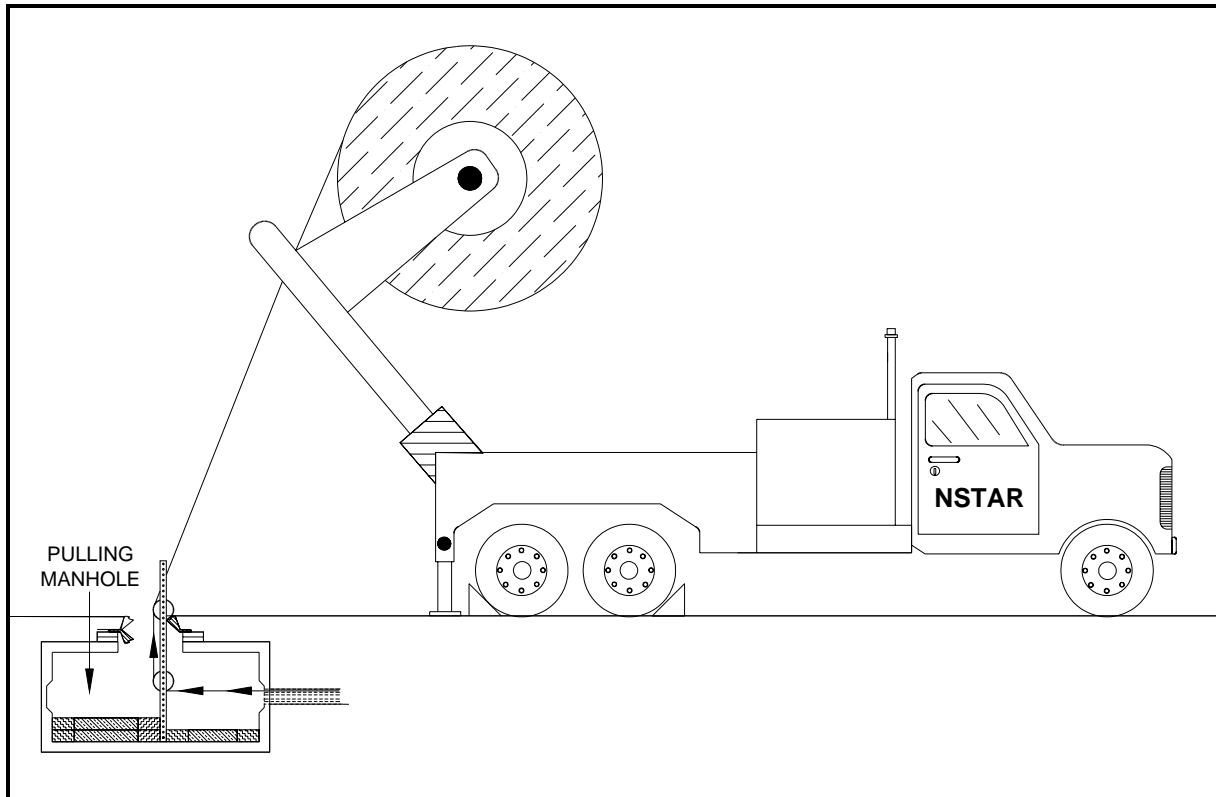
### 3.0 General Information – Cont'd

- J. If single conductor cables that have faulted in the duct are to be removed, then take a very short pull on the cables at the pulling manhole and note which cables move.
  - 1) Make a multiple hitch, as described in paragraph I, on the conductors that move.
  - 2) The conductors that did not move will have to be pulled from the feeding hole.

### 3.5 Cable Pulling

- A. Lubricate the sheaves, shoes, and/or leathers.
- B. All personnel must now exit the manholes. Workers shall not remain in either manhole during the pulling operation.
- C. Using the winch on the Transporting-Puller or the Cable Truck, take up a strain on the wire rope.
- D. Increase the strain in steps, and hold until the cable moves. On hard pulls, hold each heavy strain for several minutes.
- E. When the cable begins moving, be sure to pay out the service rope at the feeding manhole.
- F. If using the Transporting-Puller Refer to Figure 9 and proceed with the following:

3.0 General Information – Cont'd

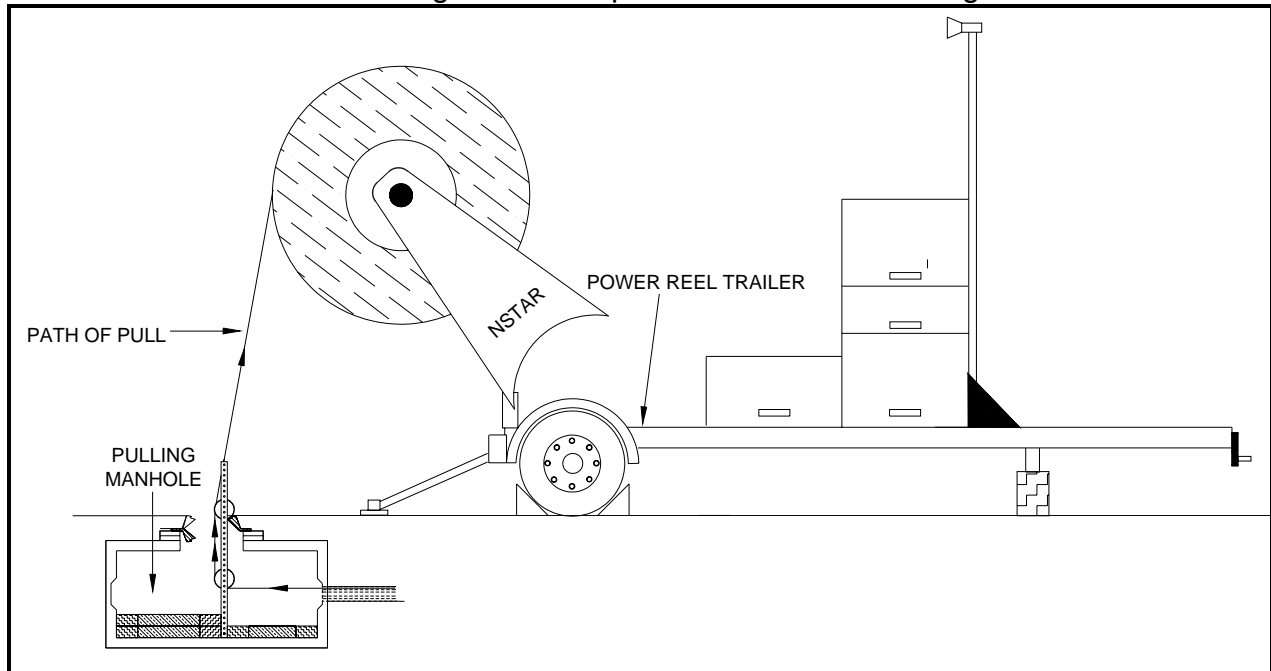


**Figure 9 - Position of the Transporter - Puller Truck**

- 1) Pull out the cable until it reaches the rear of the Transporting-Puller Truck.
- 2) Remove the wire rope and chain grips from the cable.
- 3) Lower the lifting arms until the empty reel is just off the ground.
- 4) Lift the cable onto the empty reel. Pass a piece of wire rope through one of the holes in the reel, and use it to lash the cable to the reel.
- 5) Back up the Transporting-Puller Truck until the reel is at the edge of the manhole. Operate the reel and remove the slack from the cable.
- 6) Position the lifting arms so that the cable is angled onto the self-winding sheave on the reel-lifting arms.
- 7) Resume pulling the cable onto the reel. Be sure that the cable is tight against the self-winding sheave on the reel-lifting arms.

3.0 General Information – Cont'd

- G. If using the Cable Truck in combination with the Power Reel Trailer refer to Figure 10 and proceed with the following:



**Figure 10 - Position of the Power Reel Trailer**

- 1) Pull the cable out until it reaches the back of the Cable truck. Be sure that approximately 20 feet of the cable is pulled out of the manhole.
- 2) Remove the wire rope and grips from the cable.
- 3) Move the Cable Truck away from the manhole.
- 4) Position the self-driving Power Reel Trailer in line with the removed cable. The stabilizer jacks must be lowered when the trailer is disconnected from the truck.
- 5) Lower the lifting arms until the empty reel is just off the ground.
- 6) Lift the cable onto the empty reel. Pass a piece of wire rope through one of the holes in the reel, and use it to lash the cable to the reel.
- 7) Back up the Power Reel Trailer until the reel is just at the manhole edge. Reel in any slack. Turn the front tire at a 90° angle to the path of pull.
- 8) Position the lifting arms to obtain a better angle of pull if necessary.

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### 3.0 General Information – Cont'd

- 9) Resume pulling the cable onto the arm-driven reel. Move the front tire back and forth slightly when necessary to guide the cable across the reel evenly.
- H. If the cable is known to have faulted in the duct, then do not back the Power Reel Trailer or Transporting-Puller up to the manhole edge. Leave the vehicle in its initial pulling position and continue winding the cable onto the reel until the fault is spotted. Proceed with the following:
  - 1) Pull the cable until the fault is near the rear of the Transporting-Puller Truck or Power Reel Trailer.
  - 2) Cut the fault clear approximately one foot on either side of the damaged area. Fill out and attach a yellow "Fault Specimen" tag and submit the fault to the Fault Analysis Room in Building "B" at the Mass. Ave. Service Center.
  - 3) Re-attach the cable to the reel, and position the Transporting-Puller Truck or Power Reel Trailer at the manhole edge. Resume pulling the cable.
- I. When the cable is completely removed from the duct, stop pulling and cut off the service hitch and detach the service rope. Leave the nylon service rope in the duct for future cable installations.
- J. Resume pulling until the cable is completely wound on the reel. Secure the end by tying it down. If the cable is to be re-used at a later date, then seal the end with a heat shrink or lead cap.
- K. Leave the work area in a safe and clean condition.
- L. Return the reel of cable to the Stores Department for salvage or storage.

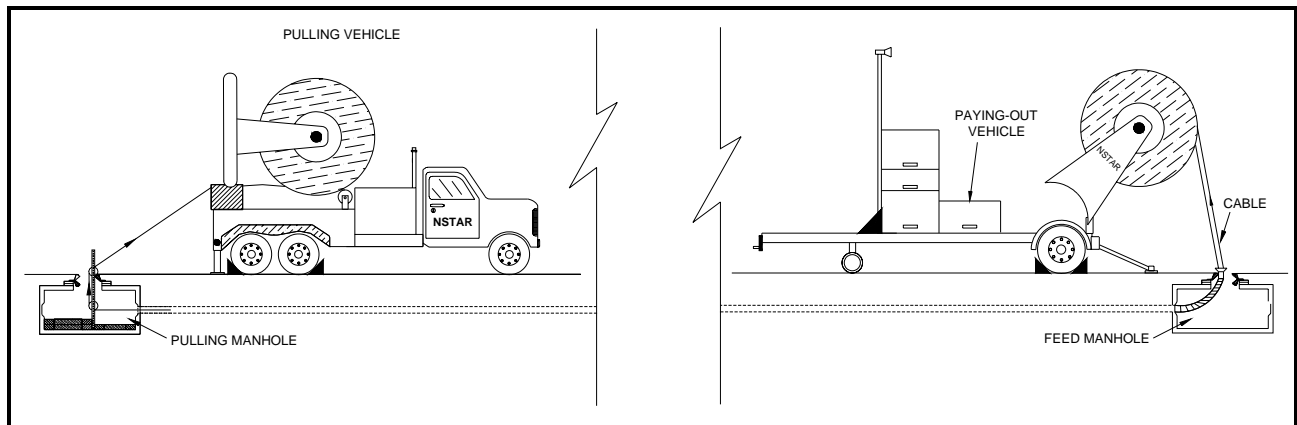
### 4.0 Cable Installation

#### 4.1 Job Set-Up

- A. Two cable-pulling vehicles are needed for cable installation, one vehicle at the pulling manhole and one vehicle at the feeding manhole.
- B. At the pulling manhole use either of the following vehicles:

4.0 Cable Installation – Cont'd

- 1) Transporting-Puller Truck
  - 2) Cable Truck
  - 3) For the remainder of this standard these will be referred to as the "Pulling Vehicle."
- C. At the feed manhole use either of the following vehicles:
- 1) Transporting-Puller Truck
  - 2) Power Reel Trailer
  - 3) For the remainder of this standard these will be referred to as the "Paying-Out Vehicle."
- D. Load the cable to be installed onto the Paying-Out Vehicle to be used at the feed manhole.
- E. Refer to Figure 11 and position the vehicles as shown.



**Figure 11 - Cable Installation**

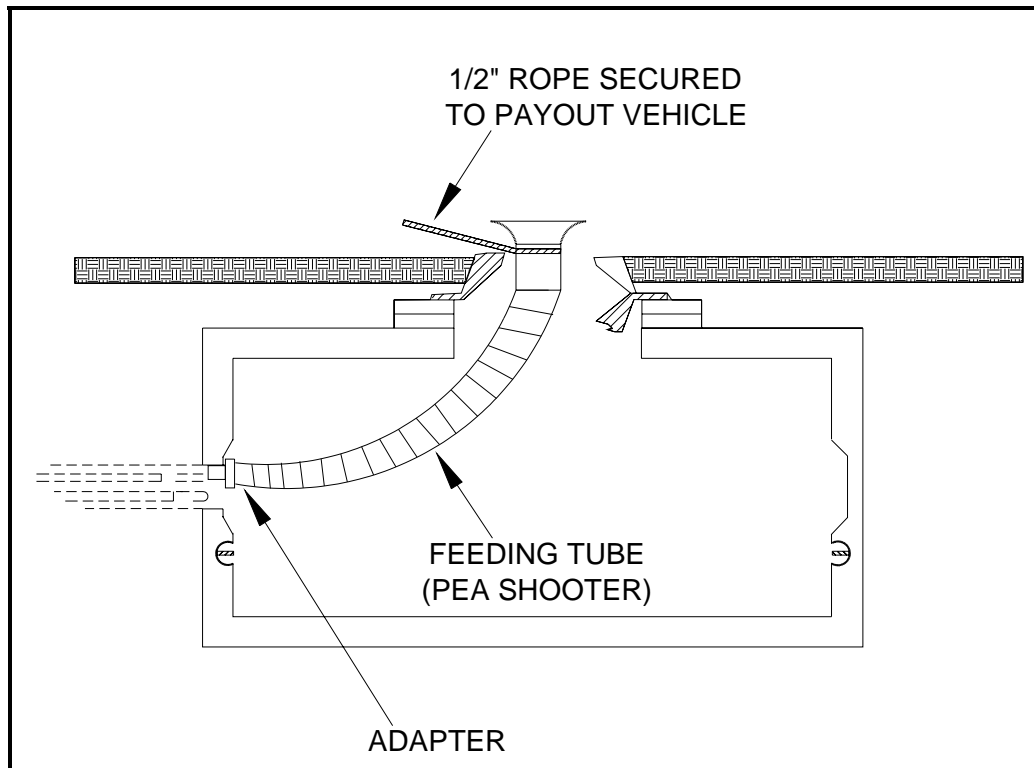
- F. If the duct in which the cable is to be installed is empty, push duct rods or thread a snake from the pulling manhole to the feeding manhole.
- 1) Duct rods are to be used for long pulls or if the duct is very dirty.
  - 2) A snake is used for short runs if the duct is relatively clean.
  - 3) If the duct is new or very clean, use a conduit air blower to shoot a jet line through.

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5.0 Combined Cable Removal & Installation – cont'd

- 4) When duct rods or snakes are used, they shall be installed in a direction to minimize hazards to the workers. An employee shall be stationed at the far end of the duct line, for safety of personnel and equipment.
  
  - G. At the feed manhole, connect the pilot line (from the pilot winder on the Paying-Out Vehicle) to the duct rod, snake, jet line, or service rope. Set the pilot winder to the “freewheel” mode.
  
  - H. At the pulling manhole, pull the duct rods, snake, jet line, or service rope until the pilot line appears in the manhole.
  
  - I. At the pulling manhole, connect a brush or mandrel and the winch wire to the pilot line. Always clean and prove the duct with a brush or mandrel. If a mandrel is used it should be at least as large in diameter as the cable to be installed. Set the winch to the “freewheel” mode.
  
  - J. At the feed manhole, use the pilot winder to pull the winch wire and brush or mandrel into the feed manhole.
  
  - K. Remove the brush or mandrel from the winch wire, and snake the wire through a “Pea Shooter” feeding tube.
  
  - L. Insert the lower end of the “Pea Shooter” into the duct using an adapter and secure the top of the shooter to a fixed object. Refer to Figure 12.
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5.0 Combined Cable Removal & Installation – cont'd



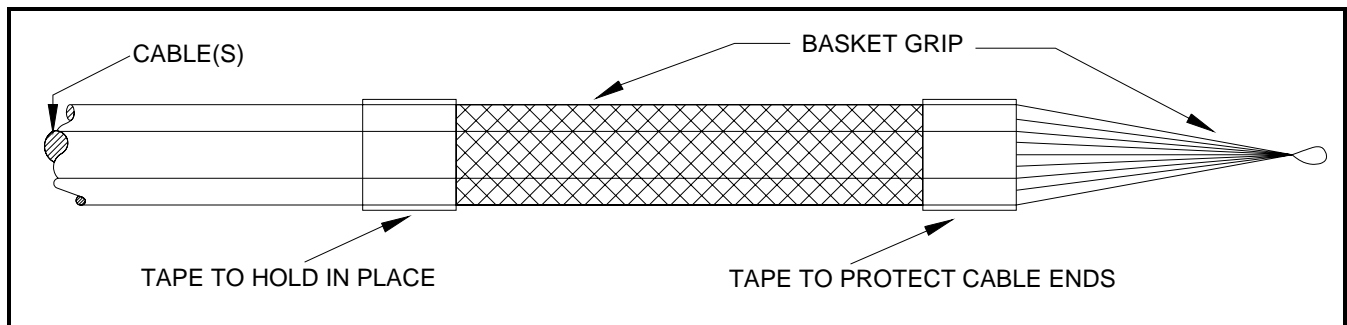
**Figure 12 - Feeding Tube**

- M. Set up the cable pulling equipment within the designated pulling manhole.
- N. Pulling eyes are required on all paper and lead cable over 200 feet long. Pulling eyes are also required on all cable 500 kcmil and larger regardless of length. Refer to WMS2.1-1.1 "Pulling Eyes and End Seals".
- O. Paper and lead cable, which will be exposed to moisture while passing through the duct, must be lead capped. Rubber and lead or non-leaded cable can be capped with a heat shrink cap or taped.
- P. If a pulling eye has not been installed and is not necessary, then feed the cable end into a basket grip.



5.0 Combined Cable Removal & Installation – cont'd

- 1) Refer to Figure 13. The basket grip can be used with multiple cables.



**Figure 13 – Basket Grip**

- 2) Tape both ends of the basket grip to hold in place and protect the cable.
- 3) If there is a bare conductor being installed along with jacketed conductors, then tape the bare conductor securely to one of the other conductors.

Q. Connect the winch wire rope to the pulling eye or basket grip. Use a swivel shackle for the connection to prevent the cable from twisting in the duct.

4.2 Cable Pulling

- A. Communications become especially important at this point. The workers at the pulling manhole must be very alert to the signals of the workers at the feed manhole and vice versa. If the pulling and feeding manholes are not within sight of each other, than radios must be used.
- B. Begin pulling with the winch of the Pulling Vehicle and paying out with the arm-driven reel of the Paying-out Vehicle. The initial pulling speed should be very slow.
- C. As soon as the cable has entered the duct, stop the pull and have all personnel exit the manholes. If it becomes necessary to enter either manhole to adjust equipment while pulling, then stop the pull. Workers shall not remain in either manhole during the pulling operation.

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- D. Lower the arm-driven reel of the Paying-Out Vehicle until the cable is paying off the reel directly above the manhole.
- E. Resume pulling the cable. Lubricate the cable as it enters the feeding tube. Use cable pulling lubricant, and apply plenty of lubrication at the rate of one gallon per 100 feet of cable applied evenly throughout the pull.
- F. Match the pay-off speed to the pulling speed by careful observation of the cable as it enters the feed manhole.
- G. Pull the cable until it emerges from the duct in the pulling manhole.
  - 1) Pull a sufficient amount to allow for splicing and racking in the pulling manhole.
  - 2) Do not pull the new cable over the sheave in the pulling manhole. Replace the sheave with a shoe when the cable reaches this point.
- H. At the feed manhole, cut the cable. Be sure to leave a sufficient amount for splicing and racking.
- I. Seal both ends of the cable and rack as high as possible.
  - 1) Wipe off any lubricant and/or dirt on the new cable.
  - 2) Inspect the pulling eyes or seals for any signs of damage during the pull. Repair if necessary.
  - 3) Seal with a heat shrink cap or lead cap.
- J. Install plastic fairleaders in each end of the duct.
- K. If any cable is left on the reel, then seal with a heat shrink or lead cap. Tie down the end.
- L. Return the reel to the Stores Department. Fill out a credit requisition if any cable is left on the reel.
- M. Pick up all equipment and leave the work area in a safe and clean condition.

5.0 Combined Cable Removal and Installation

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