

# General Specification for the Replacement of Mainline Water Distribution Pipe by Pipe Bursting

The following specifications are common to the industry. They are general in nature. Each job has its unique circumstances. These specifications are not complete for any job and cannot be used as such. Earth Tool Company LLC makes no claim as to the specifications' accuracy or completeness and does not represent or warrant them as such. The project engineer, city, or the contractor must provide the final specifications.

## **DESCRIPTION:**

This specification shall cover the rehabilitation of existing water lines using On-Line, Pneumatic, Hydraulic or Static pipe bursting systems (See Appendix 1). Pipe Bursting is a process by which the bursting tool splits the existing pipe while simultaneously installing a new Polyethylene Pipe of the same size or larger where the old pipe existed. Reconnect existing service connections, pressure test the Polyethylene Pipe and complete the installation in accordance with the contract documents

## **QUALIFICATIONS:**

- A. The contractor shall be fully trained in the operation of the Pipe Bursting Equipment by the particular Pipe Bursting System manufacturer in the use of pipe bursting equipment.
- B. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Personnel trained in the use of butt-fusion/electrofusion equipment shall perform polyethylene pipe joining. A qualified representative shall perform training.
- C. The contractor shall hold the city and engineering firm whole harmless in any legal action resulting from patent infringements.

## **SUBMITTALS:**

Submit the following contractor's drawings:

- A. Shop drawings, catalog data and manufacturer's technical data showing complete information on material composition, physical properties and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage and repair of pipe.
- B. Method of construction with detailed drawings and written descriptions of the entire construction procedure to insert the pipe, pipe fusion techniques, non-fusion pipe joining techniques and connections to water services, fire fireplugs and intersecting water mains. Drawings shall show, but are not limited to, excavation locations, access pits, dimensions, shoring, method of de-watering, adjacent utilities and traffic control.
- C. If required, plans and procedures for supplying temporary water service during pipe bursting operation.

## **METHODS FOR NEW PIPE INSTALLATION:**

The method approved for rehabilitation of existing water lines by pipe bursting and installation of new polyethylene pipe is the Vermeer On-Line, Pneumatic or Static pipe bursting system or approved equals.

## **MATERIALS:**

Polyethylene Plastic Pipe shall be AWWA C906 high-density polyethylene pipe.

- A. Sizes of the insertions to be used shall be such to renew the water line to its original or greater than flow capacity.
- B. All pipe shall be made of virgin material. No rework except that obtained from the manufacturers own production of the same formulation shall be used.
- C. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters or other deleterious faults.

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- D. Prior to construction, contractor shall submit for approval, the manufacturer's specific technical data with complete information on resin, physical properties of pipe and pipe dimensions pertinent to this job. A certificate of "Compliance with Specification" shall be furnished for all materials to be supplied.
- E. Dimension Ratios: The minimum wall thickness of the polyethylene pipe shall meet pipe manufacturers recommendations.
- F. Check for damage on the pipe prior to installation. If there is any abrasion, cuts or gouges deeper than 10% of the wall thickness of the pipe, it will need to be cut out and repaired. This is according to ASTM specification F585.

## **BURSTING EQUIPMENT:**

The pipe bursting unit shall be designed and manufactured to force its way through existing line by fragmenting the pipe and compressing the broken pieces into the surrounding soil as it progresses. The bursting unit shall generate sufficient force to burst and compact the existing pipeline. See manufacturer specifications for what size unit should be used in what diameter of pipe, as well as parameters of what size unit for percentage of upsize allowed.

An on-line system pipe bursting system utilizes a 24,000, 33,000 or 50,000 class Horizontal Directional Drill (HDD) to provide continuous tension to assist the tool. If using a pneumatic system, the pipe bursting tool shall be assisted by a continuous tension winch through the old line. In each case the bursting unit shall pull the polyethylene pipe with it as it moves forward.

If the pipe bursting tool is pneumatic or mechanical the bursting action of the tool shall increase the external dimensions sufficiently, causing breakage of the pipe at the same time expanding the surrounding ground. This action shall not only break the pipe but also create the void into which the bursting tool can be winched and enables forward progress to be made. At the time the polyethylene pipe, directly attached to the burst head shall also move forward. The bursting tool shall have its own forward momentum while being assisted by HDD rod pullback or winching. A hydraulic or hydrostatic winch shall give the bursting tool friction by which it can be moved forward. To form a complete operating system, the pneumatic or mechanical tool must be matched to an HDD or a continuous tension hydraulic or hydrostatic winching system and be able to maintain the continuous tension throughout the burst. The HDD or winch should be fitted with a direct reading load gauge to measure the pullback force or winching load.

When utilizing a winch the winch, cable and cable drum must be provided enclosed so that it may be operated safely without injury to persons or property. The contractor shall provide a system of guide pulleys and bracing at the exit pit to minimize cable contact with the existing line between launch and exit pits. The winch cable, burst head and polyethylene pipe cannot come into contact with the supports of the trench shoring in the insertion pit.

## **CONSTRUCTION METHOD**

### **PIPE HANDLING AND JOINING:**

The contractor is required to transport, handle and store pipe and fittings as recommended by the manufacturer.

If new pipe and fittings become damaged before or during installation it shall be repaired as recommended by the manufacturer or replaced as required by the engineer at the contractor's expense, before proceeding further.

The polyethylene pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

The butt-fused joint shall be in true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. The fused joint shall be water-tight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the engineer and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the city. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent of the wall thickness shall

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not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the engineer and/or his representative shall be discarded and not used.

Terminal sections of pipe that are joined shall be connected with Central Plastics Electrofusion Couplings, or approved equal, or connectors with tensile strength equivalent to that of the pipe being joined.

Service connections with the polyethylene pipe shall be accomplished by the sidewall fusion method in accordance with the manufacturer's printed instructions.

Where the polyethylene pipe is connected with ductile iron fittings or valves, an HDPE flange adapter shall be fused to the end of the pipe and the connection made with bolted flange components.

All joints shall be inspected by the city before insertion. The pipe shall be joined on site in appropriate working lengths near the launching pit.

## LAUNCHING AND RECEIVING PITS:

- A. The location and number of launching and receiving pits shall be proposed by the contractor and approved by the city prior to excavation. The pits shall be located such that their number shall be minimized.
- B. Before any excavation is done for any purpose, the contractor shall contact the various utility companies for determining field location of existing utilities.
- C. All work is to be completed within existing street right-of-ways or easements.
- D. Any damage to adjacent properties that are not part of this work shall be repaired and restored to its original condition at the contractor's expense.
- E. Where it is necessary to excavate, the contractor shall furnish and install trench shoring or bracing in compliance with OSHA standards.

## INSERTION OF POLYETHYLENE PIPE:

- A. If required, the contractor shall develop a temporary water system to supply water service to area residents and businesses during pipe bursting operations. It is anticipated that the system will be fed from existing fire fireplugs. The temporary system and fireplugs shall be disinfected according to engineering specifications.
- B. All buried utilities adjacent to the pipe bursting operation shall be reviewed and where necessary be excavated to relieve transient loading during the insertion operation. If any utilities are within 24" of the pipe to be burst, the contractor shall excavate a pit at the location to check clearance. The amount of clearance will be affected by the soil type, the amount of up-sizing and the location of the existing utility in relation to the line being burst. If adequate separation does not exist between the existing water line and the subject utility, the contractor shall employ substitute means to rehabilitate the existing water line.
- C. Any concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head. All in-line valves and fittings shall be removed prior to the bursting operation.
- D. The new polyethylene pipe shall be inserted immediately behind the bursting head in accordance with the manufacturer's recommended procedures. The bursting equipment shall be specifically designed and manufactured for the type of insertion process being used.

## TESTING / DISINFECTION:

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The polyethylene pipe shall be pressure tested after the line and all fittings and valves have been installed. Connections may be left exposed for visual leak inspection.

The line shall be pressurized to 160 psi, and allowed to stand for a period of 4 hours to allow for the expansion of the pipe. The pressure shall be checked every 30 minutes. If the pressure drops below 155 psi, it shall be restored to 160 psi. At the end of the 4-hour period, the pressure shall be dropped or restored to 150 psi. If during the initial 4-hour pressurization period the pressure remains above 155 psi, (5 psi below the initial pressure) to the end of one 30-minute cycle and above 152 psi, (5 % below the initial pressure) to the end of the next 30-minute cycle, without the addition of water, the line shall have passed the pressure test.

## **SERVICE CONNECTIONS:**

- A. All service connections on the existing water main that is to be burst or will be taken out of service, shall be connected to the temporary water system during bursting, disinfection, testing and service reconnection operations.
- B. Terminal sections of pipe that are joined shall be connected with Central Plastics Electrofusion Couplings, or approved equal, or connectors with tensile strength equivalent to that of the pipe being joined.
- D. After the new polyethylene pipe has been installed, disinfected and tested, each existing service shall be connected to the new pipe in accordance with manufacturer's recommendations for sidewall fusion.
- E. Accepted quantities for service connections will be paid for at the contract unit price which will be per each water service connection made.
- F. Work necessary to excavate and backfill service connections will not be paid for separately, but will be included in the contract unit price for this item. The surface repair of the excavation will be paid for separately under the appropriate bid item.

## **MEASUREMENT AND PAYMENT:**

- A. The inserted pipe shall be paid for per linear foot of the size pipe specified and shall include all pipe bedding, backfill material, annulus sealing material and launching pits. Locating and reconstruction of services and all reconnections of services shall be paid for per each connection made, including fittings and pipe.
- B. The work performed as prescribed by this item will be paid in the following manner: The main line work, the unit price per linear foot of water line for the specified pipe diameter, and a unit price for each service connection (locate, cut and reconnect) for the specified pipe diameter. The price shall be full compensation for the installation of the new pipe, furnishing and placing of all materials, labor, tools, equipment, cleaning, and preparation of the existing pipe to receive the replacement pipe.
- C. The cost of any temporary water services shall be paid as a separate pay item.
- D. Accepted quantities of polyethylene pipe installed by pipe bursting will be paid for at the contract unit price, which will be the lineal foot of pipe installed, including the length through the launching/receiving pits.
- E. Work necessary to excavate and backfill potholes at utility crossings will not be paid for separately, but will be included in the contract unit price for this item. The surface repair of the potholes will be paid for separately under the appropriate bid item.
- F. Accepted quantities for valves and fittings will be paid for at the contract unit price that will be per each appurtenance installed.
- G. Work necessary to excavate and backfill appurtenances will not be paid for separately, but will be included in the contract unit price for this item.

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## APPENDIX 1 TYPES OF PIPE BURSTING EQUIPMENT

### General

Various types of specialized equipment are utilized in pipe bursting projects and the types are generally unique to each of the generic methods Static Pull, Pneumatic and Hydraulic. The primary difference between methods is the manner in which the force is generated and transferred to the host pipe during bursting operations.

### On-line Pipe Bursting

On-Line Pipe Bursting is done by creating an impact load in the pipe by applying a "hoop" stress into the pipe causing it to burst in tension. The Dynamic Bursting system consists of a 24,000, 33,000, 50,000 class Horizontal Directional Drill and a Pneumatic (Air Impactor™) or Mechanical (Rotary Impactor™) bursting tool. Both the Air and Mechanical Impactor rely on percussive hammering action to break out the old pipe in which the tool travels. Simultaneously the new replacement pipe is installed into the space created by the bursting tool. The Horizontal Directional Drill is used to drill from the surface down to and through the section(s) of pipe to be replaced then back up to the surface where the appropriate bursting tool is attached to the drill rod. The Horizontal Directional Drill then pulls the bursting tool into the old pipe providing a constant tension pulling force and maintaining correct line and grade while the tool bursts the pipe. This technique is aimed at the replacement of gravity pipes as well as pressure pipes and is suitable for diameters of from 6 inches to 12 inches.

### Pneumatic Pipe Bursting

Pneumatic Pipe Bursting is done by creating an impact load in the pipe by applying a "hoop" stress into the pipe causing it to burst in tension. This technique uses a pneumatic bursting head with a properly sized expander, and relies on percussive hammering action to break out the old pipe in which the tool travels. Simultaneously the new replacement pipe is installed into the space created by the pneumatic bursting head and expander. A winch cable is attached to the nose of the bursting head to maintain correct line and grade by providing constant pulling tension and enhancing the percussive force. Winching forces up to 20 tons are typical for this method. This technique is primarily aimed at the replacement of gravity pipes as well as pressure pipes, and has been used in diameters ranging from 4-inches to 54-inches or larger.

### Hydraulic Pipe Bursting

Rather than the pipe being burst from the transfer of a pulling or hammering radial force into the plane of the pipe diameter, the bursting head diameter expands, fragmenting the pipe from the inside.

The bursting head is equipped with "petals" which open and close under hydraulic pressure. Using hydraulic cylinders, the bursting head first expands to crack the host pipe, then contracts to allow the winch to pull the pipe string forward, while tension is applied to the nose of the head using a winch cable to maintain directional stability. Hydraulic bursting is primarily used for on-line replacement of sewers and gravity pipelines 6-inches to 20-inches in diameter or larger.

### Static Pipe Bursting

In Static Pipe Bursting a pulling force is applied to a tapered or blunt nosed bursting head through steel rods, chain or cable and new pipe is simply pulled behind the burst head through the old pipe. In this process the old pipe fails in tension created by the radial force applied to the pipe wall from by the bursting head. As the bursting head advances, the old pipe is fragmented and compressed into the adjacent soil and the new pipe line is simultaneously installed in the void. The static pipe bursting winch equipment is modeled after high-powered hydraulic jacks, mounted horizontally, or a high tension drum type of winch. Pulling forces of up to 225 tons are typical for this method. This method is used in pipes 4-inches to 40-inches in diameter or larger.