VILLAGE OF HAMILTON

NATURAL GAS CONSTRUCTION STANDARDS

VILLAGE OF HAMILTON

This manual has been reviewed and approved by:

_____ _____
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SECTION 1.00 SCOPE

1.1 SCOPE

This Gas Construction Standards Manual has been developed in accordance with gas industry standards, state and federal laws, codes and regulations. It is intended to act as a standard in the engineering and construction of gas facilities for the Village of Hamilton.

These standards were developed to satisfy the minimum requirements for the construction of natural gas distribution and transmission facilities.

SECTION 2.00 CODES / PIPE DESIGN

- Codes
- References
- Steel Pipe Design
- References
- Design Formula
- Calculations
- Plastic Pipe Design
- References
- Calculations

1.1 CODES

1.2 The following list of codes was used as reference to develop the Gas Construction Standards Manual. A brief description of each is included.

2.1 REFERENCES

2.2 Title 16 New York Code, Rules and Regulation (NYCRR)
(Part 255 referring to the transmission and distribution of gas)
This is the New York State minimum standard that governs the design, construction, operation and maintenance of natural gas transmission and distribution facilities in New York State.
Title 16 NYCRR Part 255 meets or exceeds the requirements contained in Federal Code 192 and reflects practices contained in the ASME Guide for Gas Transmission and Distribution (ANSI Code B 31.8), both are described below.

Other parts of this regulation that govern the gas business are:

Part 131 - Utilities Within State Highway Limits
Part 226 – Gas Meters and Accessories, Testing and Reporting
Part 232 - Interruption of Service
Part 261 - Piping Downstream of the Meter

2.3 D.O.T. Part 192 (Transportation of Natural Gas and Other By Pipeline; Minimum Federal Safety Standards)

These are the federal regulations administrated by the U.S.D.O.T.'s Pipeline and Hazardous Material Safety Administration (PHMSA). This code is administered by the Office of Pipeline Safety Operations. This code sets minimum standards for materials, design, welding, joining of materials other than by welding, construction requirements, meters, regulators, lines, test requirements, uprating, operations and maintenance procedures.

2.4 ASME Guide for Gas Transmission and Distribution (ANSI Code B 31.8)

This Guide includes the Federal Gas Pipeline Safety Standards, together with the design recommendations, material reference and recommended practices of the ASME Gas Piping Standards Committee. The function of the Committee's "Guide" material is to provide "how to" supplementary recommendations related to the Federal Safety Standards.

This Guide was formerly the ANSI B31.8 Code.

2.5 D.O.T. Part 191 (Transportation of Natural Gas and Other By Pipeline; Annual Reports, Incident Reports, and Safety Related Condition Reports)

These are the federal regulations administrated by the U.S.D.O.T.'s Pipeline and Hazardous Material Safety Administration (PHMSA). This code is administered by the Office of Pipeline Safety Operations. This code prescribes requirements for the reporting of incidents, safety related conditions, and annual pipeline summary data by operators of gas pipeline facilities.

2.6 AGA Purging Principles and Practices

This is a guide consisting of background information and descriptions of various methods and procedures found by experienced operators to be effective in minimizing or controlling combustible mixtures and maintaining safe atmospheres inside pipes, holders, tanks and other facilities being placed in service or taken out of service.

2.7 AGA Plastic Pipe Manual

This is a collection of information, data, specifications, and recommendations on the use of plastic pipe for the distribution of natural gas. It is intended to be a prime reference source on the subject of the plastic piping.

2.8 New York State Department of Education Regulations (Manual of Planning Standards)

Gas installations made on public school property, colleges and universities must be in compliance with the New York State Department of Education Regulations.

2.9 Codes and Regulations of the State New York, (NYCRR) Public Safety Title 16, Part 753 , which are the procedures for the protection of underground facilities required by the General Business Law Article 36 and Public Service Law Section 119-b.

2.10 Fuel Gas Code of New York State-NYS Department of State Division of Code Enforcement and Administration

This code offers general criteria for the installation and operation of gas piping and gas equipment on consumers' premises.

2.11 National Electric Safety Code

This code covers supply and communication lines, equipment, and associated

work practices employed by a utility in the delivery of electricity from the point of generation or purchase to the point of delivery to the customer's facilities.

2.12 National Electric Code

This code offers general criteria for the installation of electric wiring and electric equipment on consumer's premises.

2.13 Code of Federal Regulations - 29 (OSHA)

This section of the code includes parts 1900-1910, or the Occupational Health and Safety Administration (OSHA). OSHA Regulations cover many safety concerns relating to personnel and their work environment.

2.14 National Fire Prevention Association

#54 - included in National Fuel Gas code
#54A - standard for the installation of gas piping and gas equipment on industrial premises and certain other premises.

2.15 C.P. Chem., Performance Pipe, Piping Publication April 2002.

2.16 Village of Hamilton Natural Gas Operating and Maintenance Procedures Manual

2.17 American Society for Testing and Materials (ASTM) F1962-99, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene pipe or Conduit Under Obstacles, Including River Crossings.

2.18 Trenchless Technology Technical Note No. 1, Plexco, Chevron, Horizontal Directional Drilling (Guided Boring) with Plexco Pipe, revision 1.

2.19 North American Society for Trenchless Technology (NASTT), First Edition, September 1995, Mini-Horizontal Directional Drilling Manual

3.1 STEEL PIPE DESIGN

3.2 This specification describes the design of steel pipe (bare and coated) for aboveground and underground use. Included in this specification is the design formula and calculation.

4.1 REFERENCES

4.2 Code of Federal Regulations, Transportation Title 49, Part 192.

4.3 Codes, Rules and Regulations of the State of New York (NYCRR), Public Safety Title 16, Part 255.101 to 255.115

4.4 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition, section 841 Steel Pipe.

5.1 DESIGN FORMULA

5.2 The maximum allowed operating pressure for steel pipelines is determined by using the following formula.

$$P= (2St/D) \times F \times E \times T$$

Where:

P = Design pressure in pounds per square inch gauge (psig).

S = Yield strength in pounds per square inch.

D = Nominal outside diameter of the pipe in inches.

t = Nominal wall thickness of pipe in inches.

F = Design factor; as specified in 16 NYCRR Part 255 for steel pipe.

E = Longitudinal joint factor; as specified in 16 NYCRR Part 255 for seamless or electric resistance welded steel pipe manufactured under API specification 5L the longitudinal joint factor is: E = 1.00

T = Temperature derating factor; as specified in 16 NYCRR Part 255 for steel pipe that operates at a gas temperature of 250 degrees Fahrenheit or less, the temperature derating factor is: T = 1.00

6.1 CALCULATIONS

6.2 All Village operated pipelines are designed to a Class 3 location.

6.2.1 In a class 3 location the design Factor is: F = 0.50.

6.3 The design formula must be used to determine what percent of SMYS the proposed pipeline will operate.

6.4 Application of design formula to 2" Village of Hamilton station piping:

$$P = (2st/D) \times F \times E \times T$$

Where:

F= Design Factor = 0.5 for Class 3
E = 1.0
T = 1.0
s = 52,000 psi
P = 4773 psi
t = .218”
D = 2.375”

SMYS = 1440/4773 = 30%, since it exceeds 20% therefore it’s classified as transmission piping per NYCRR Title 16 Part 255.

7.1 PLASTIC PIPE DESIGN

7.2 REFERENCES

Code of Federal Regulations, Transportation Title 49, Part 192.

Codes, Rules and Regulations of the State of New York (NYCRR), Public Safety Title 16, Part 255.121 and 255.123

American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition, section 841 Steel Pipe.

Plastic Pipe Institute, Handbook of PE Pipe, Chapter 6, Design of Polyethylene Piping Systems.

7.3 CALCULATIONS

The maximum allowable operating pressure of plastic pipe is determined in accordance with the following formula.

$$P = \frac{2St \times DF}{(SDR - 1)}$$

Where:

P = Design Pressure, PSIG
S = the long term hydrostatic strength, 11,000 psig)
t = Specified wall thickness, inches
SDR = Standard Dimension Ratio, the ratio of the average outside diameter to the minimum specified wall thickness
DF= .32 = Environmental Design Factor
= .40 = Nominal pipe size (IPS or CTS) 4 inch or less, SDR 11 or greater (i.e. thicker pipe wall), PA-11 pipe produced after January 23, 2009.

7.4 Note: All plastic distribution pipe for the Village of Hamilton system will utilize HDPE pipe 3408 SDR 11 except for ½" which will be SDR 7 at a maximum operating pressure of 100psi.

SECTION 3.00 NOTIFICATIONS

- References
- PSC
- Excavation
- Highway
- Special
- Rights Of Way
- Miscellaneous

1.1 NOTIFICATIONS

1.2 This section pertains to notifications required before construction activity is undertaken.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255.4, 255.302, 255.505, 255.552

2.3 NYCRR, Public Safety Title 16, Part 753.

2.4 NYSDOT Part 131.

3.1 CONSTRUCTION RELATED PSC NOTIFICATION

3.2 The Village must notify the PSC of the intent to perform construction on the gas system for several situations.

3.3 **At least 30 days prior to** the start of construction or reconstruction of any main designed to operate at 125 psig or more, the Village is required to file with the Albany office of the New York State Public Service Commission (PSC) a letter of intent and a report of specifications.
Note: If there is no response from the PSC within 30 days, the project may proceed.

3.4 The intent to pressure test a pipeline designed to operate at greater than 125 psig must be reported to the Albany office of the PSC at least 5 business days prior to the start of the test.
Note: Testing will not be considered satisfactory unless certified by an inspector from the Gas division of the PSC. Part 255.505 (h), (i) 3.1.3

3.5 According to 16 NYCRR Part 255.302(b), before any pipeline designed to operate at or above 125 psig is put into operation, a report shall be filed with the Albany Office of the PSC certifying the Maximum Operating pressure to which the line is intended to be subjected and also certifying that the line has been constructed and tested according to the requirements stated in part 255. This report will include copies of all the tests required by these rules.

3.6 The Maximum Allowable Operating Pressure (MAOP) of systems at or above 125 psig cannot be raised or lowered without submitting a letter of intent to the Albany office of the PSC **at least 60 days prior** to the proposed change of the said certified pressure according to NYCRR Part 255.552(a). This requirement is also in effect for pressure increases above 125 psig in pipelines designed to operate at less than 125 psig. Pressure increases in pipelines operating at or above 125 psig must be explained in writing to the Albany office of the PSC. A public hearing may also be required according to NYCRR Part 255.552(b).

3.7 The MAOP of systems operating below 125 psig cannot be raised without a letter of intent to the Albany office of the PSC **at least 60 days prior** to the proposed change of the said certified pressure according to NYCRR Part 255.552(c) for the following situations.

1. Any system operating between 1/2 and 60 PSIG and the final difference is greater than 6 psig.
2. Any system operating between 60 and 124 psig and the final difference is greater than 10% of the new MAOP.
3. Any system being converted from low pressure to any pressure less than 124 psig.

Note: In the event of an emergency, verbal permission may be obtained but written notification must be filed promptly.

3.8 Unless otherwise indicated all submissions to the New York State Public Service Commission, written or telephonic, should be directed to:

Department of Public Service

Gas and Water Division

3 Empire State Plaza

Albany, New York 12223-1350

(518) 474-5453

4.1 CONSTRUCTION RELATED EXCAVATION NOTIFICATION

4.2 The Village construction departments are required to contact the central one call notification system Dig Safely New York for the protection of underground facilities prior to undertaking excavation work.

4.3 Dig Safely New York **(one call system)** must be notified at least **two working days but not more than 10 working days** before construction begins.
The Dig Safely New York number for New York State (Outside of New York City and Long Island) is: 1- 800- 962-7962.
In the event of a gas emergency requiring excavation, Dig Safe New York shall be notified as soon as possible that the excavation is commencing or is underway.

5.1 HIGHWAY PERMITS

5.2 Whenever planning to dig within the established highway limits, a highway permit must be obtained from the local, county, state or governing authority that has jurisdiction over the road.
In the event of an emergency, the permit can be obtained by contacting the proper authority as soon as practicable during business hours.
An annual permit is obtained from the state on a regional basis for common O&M procedures. A copy of this permit must be available on all construction trucks.

6.1 SPECIAL PERMITS

6.1 Special permits must be obtained from the governing authorities when it is necessary to cross-navigable waterways, railroads or designated wetlands.

7.1 RIGHTS OF WAY

7.2 Rights of Way are required when main is installed on private property or when portions of a gas service cross-lands other than the customers.

7.3 Main - Right of way or an easement is required for all main that is located on **private** property.

7.4 Services - Right of way or an easement is only required for a service line if the line or part of it crosses **private** property that does not belong to the customer. An easement would then be required for that portion of the service that was not on the customers property.

8.1 MISCELLANEOUS

8.2 General notifications should be made to our customers prior to commencing construction and maintenance activity that may interrupt the customer's normal schedule or cause undue hardship or delay.

8.3 Long Side Service – a Foreman shall contact the customer on the opposite side of the road where the gas main is located.

8.4 Survey Permission – Prior to fieldwork beginning for the layout of system replacements or extensions on private property survey permission shall be obtained from the property owner.

8.5 Emergencies – The Foreman shall attempt to contact the customer or landowner prior to starting any work if possible.

8.6 Inside – If work performed involves any part of the customer's service pipe, regulator, meter, fuel lines, or appliances, then a check of all appliances must be made after the work is completed. The check is to be sure that pilots have not been affected on any of the appliances. If it is not possible to enter the building to make such a check, the service will be shut off or isolated until arrangements can be made to enter the premises.

SECTION 4.00 MAINS GENERAL

- Installation Requirements
- References
- Description Of Distribution Mains
- Description of Transmission Mains
- Backfill – General
- Bedding/Padding Of Trench
- Backfill Of Trench
- Cover Distribution Mains
- Clearances Distribution Mains
- Cover Mains Operating Above 124 PSIG
- Clearances Mains Operating Above 124PSIG

1.1 INSTALLATION REQUIREMENTS

1.2 This section provides a brief description and an overview of general pipe joining, and installation clearance requirements for Distribution and Transmission Mains.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255 various sections

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1995 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR.

3.1 DESCRIPTION OF DISTRIBUTION MAINS

3.2 Distribution Mains (0 – 124 PSIG) - may be constructed of (coated and wrapped steel for underground use or bare for above ground use) API 5L Grade B pipe or plastic HDPE 3408.

3.2.1 The joints may be welded or in the case of plastic pipe, using heat fusion, mechanical or compression type couplings.

4.1 DESCRIPTION OF TRANSMISSION MAINS

4.2 Transmission Mains (125 PSIG & ABOVE) - may be constructed of (coated and wrapped steel for underground use or bare for above ground use) API 5L Grade B or stronger pipe with welded joints.

4.3 All transmission lines are to be constructed to a minimum of Class 3 construction (high pressure distribution as defined in part 255 will be referred to as transmission).

5.1 BACKFILL - GENERAL

5.2 Backfill operations should follow placement operations as close as practicable so a minimum amount of ditch is open at any time.

5.3 Backfilling shall be completed in a manner sufficient to prevent soil settlement at a later date. Trenches in any roadway or driveway using loose backfill material shall be backfilled and mechanically tamped in 12 inch lifts until the trench is filled.

5.4 The authority having jurisdiction over any trench, shall also approve backfill material, the number compaction lifts, and surface restoration method.

5.5 Prior to installing the pipe into the ditch, the ditch shall be inspected to insure that it is free of any material that would damage the pipe or coating during the backfill process.

6.1 BEDDING/PADDING OF TRENCH

6.2 The bedding refers to the layer of backfill material the pipe lays on. This layer is installed in the trench bottom and is a minimum of 3 inches deep.

6.3 The padding refers to the area of the trench from the pipe to 6 inches above the pipe.

6.4 Refer to the trench detail drawing in this section for reference (page 21).

6.5 For plastic or steel installations, the bedding shall be used to provide firm uniform support along the entire length of the pipe compacted to eliminate voids and to avoid possible shear points.

6.6 Topsoil or organic material shall not be used for bedding or padding around the pipe due to settlement of ditch line and gasses releases. As the organic material decomposes it can produce false indications of leakage when using a Flame Ionization (FI) unit or the Combustible Gas Indicator (CGI).

6.7 Rock or frozen materials shall not be placed directly adjacent to the pipe or padding layer.

6.8 Native spoil may be utilized as bedding/padding only if the particle size is no greater than 2 inch and the particles are smooth, rounded, and non-angular.

6.9 When the native spoil is not suitable for bedding/padding, suitable backfill or sand padding shall be hauled in and used. Rockshield may also be an alternative if it is uneconomical to haul in backfill material.

7.1 BACKFILL OF TRENCH

7.2 The backfill layer refers to the area of the trench above the bedding/padding layer to within 2 inches of final grade.

7.3 Refer to the trench detail drawing in this section for reference (page 23).

7.4 Backfill may contain rocks up to approximately 6 inches in diameter for areas maintained as mowed turf, and up to approximately 12 inches for all other areas unless specified. Frozen lumps of soil shall be broken up and pulverized prior to backfilling.

8.1 COVER DISTRIBUTION MAINS

8.2 All distribution mains shall be installed with a minimum of 24 inches of cover unless specified differently on specific job plans or as noted below.

8.3 If an underground structure prevents installation with the minimum cover, the main may be installed at a lesser depth provided it is adequately protected from anticipated external loads.

8.4 Mains installed in agricultural areas cultivated for at least two of the past five years shall have a minimum cover of 48 inches.

8.5 Mains installed in a navigable river, stream or harbor must have a minimum cover of 48 inches in soil or minimum 24 inches in consolidated rock. If an underground structure prevents said cover, the main may be installed at a lesser depth provided it is adequately protected from anticipated external loads.

9.1 CLEARANCES DISTRIBUTION MAINS

9.2 Distribution Mains shall be installed with a minimum of 6 inches of clearance from any underground structure when possible.

9.3 If this clearance **cannot** be attained, a minimum clearance of 2 inches is permissible providing the main is suitably protected from damage that might result from the proximity of the other structure.

10.1 COVER MAINS OPERATING AT OR ABOVE 125 PSIG

10.2 Shall be installed with a minimum cover as follows, unless specified differently on specific job plans or as noted below.

Location	Normal Soil	Consolidated Rock
Class 1 Locations	30 inches	18 inches
Class 2, 3 and 4 Locations	36 inches	24 inches
Drainage ditches of public roads and railroad crossings	36 inches	24 inches

10.3 The following exceptions apply:

10.4 When an underground structure prevents the installation with minimum cover, the main may be installed at a lesser depth with adequate protection from anticipated external loads.

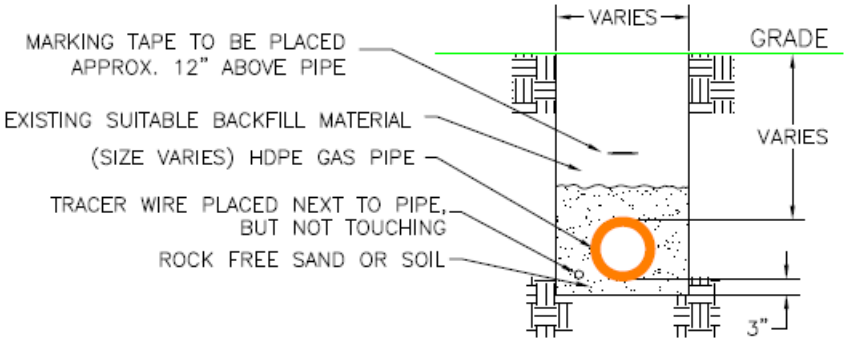
10.5 Mains installed in agricultural areas cultivated for at least two of the past five years shall have a minimum cover of 48 inches.

10.6 Mains installed in a navigable river, stream or harbor must have minimum cover of 48 inches in soil or 24 inches in consolidated rock. If an underground structure prevents the installation with minimum cover, a lesser depth will be permitted provided adequate protection from anticipated external loads.

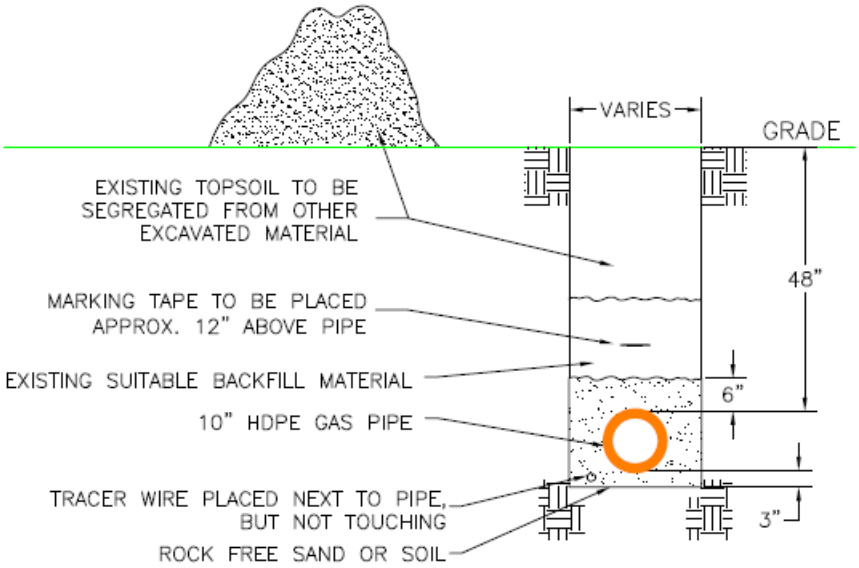
11.1 CLEARANCES MAINS OPERATING AT OR ABOVE 125 PSIG

11.2 Shall be installed with a minimum of 12 inches of clearance from any underground structure not associated with the main. If this clearance cannot be attained, a minimum clearance of 2 inches is permissible, provided the main is **suitably protected** from damage that may result from the proximity of the other structure.

11.3 Suitably Protected - includes but is not limited to at least 1/2 inch of non-conducting permanent material, such as a section of fiberglass shield.



GAS TRENCH DETAIL



TYPICAL GAS TRENCH DETAIL
AGRICULTURAL AREAS

SECTION 5.00 SERVICES GENERAL

- Installation Requirements
- References
- Definition Of A Service
- Materials
- Backfill – General
- Bedding/Padding Layer Of Trench
- Backfill Layer Of Trench
- Cover Services
- Clearances Services
- Prohibited Installations
- Installation Considerations
- Excess Flow Device

1.1 INSTALLATION REQUIREMENTS

1.2 This section provides a brief description and an overview of general requirements for the installation of Gas Services.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255 various sections

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR.

3.1 DEFINITION OF A SERVICE

3.2 Service is defined as the pipe between the main and the meter bar. A gas service may serve 2 separate dwellings before it is considered a gas main.

4.1 MATERIALS

4.1.1 All gas services on mains operating from 0 psig to 124 psig shall be constructed using High Density PE 3408.

4.2 The joints may be made using heat fusion, mechanical and compression type couplings.

5.1 BACKFILL - GENERAL

5.2 Backfill operations should follow placement operations as close as practicable so a minimum amount of ditch is open at any time.

5.3 Backfilling shall be completed in a manner sufficient to prevent soil settlement at a later date. Trenches in any roadway or driveway using loose backfill material shall be backfilled and mechanically tamped in 12 inch lifts until the trench is filled.

5.4 The authority having jurisdiction over any trench, shall also approve backfill material, the number compaction lifts, and surface restoration method.

5.5 Prior to installing the pipe into the ditch, the ditch shall be inspected to insure that

it is free of any material that would damage the pipe or coating during the backfill process.

6.1 BEDDING/PADDING LAYER OF TRENCH

6.2 The bedding refers to the layer of backfill material the pipe lays on. This layer is installed in the trench bottom and is 3 inches deep.

6.3 The padding refers to the area of the trench from the pipe to 6 inches above the pipe.

6.4 For plastic installations, the bedding shall be used to provide firm uniform support along the entire length of the pipe.

6.5 Topsoil or organic material shall not be used for bedding or padding around the pipe due to settlement of ditch line and gasses released as the organic material deteriorates can produce false indications leakage using the Flame Ionization (FI) unit or the Combustible Gas Indicator (CGI).

6.7 Rock or frozen materials shall not be placed directly adjacent to the pipe or padding layer.

6.8 Native spoil may be utilized as bedding/padding only if the particle size is no greater than 2 inch particles that are smooth, rounded, and non angular.

6.9 When the native spoil is not suitable for bedding/padding material, suitable backfill or sand padding may be hauled in and used. Rockshield may also be used if it is uneconomical to haul in backfill material.

7.1 BACKFILL LAYER OF TRENCH

7.2 The backfill layer refers to the area of the trench above the bedding and padding layers to within 2 inches of final grade.

7.3 Backfill may contain rocks up to approximately 6 inches in diameter for areas maintained as mowed turf, and up to approximately 12 inches for all other areas unless specified. Frozen lumps of soil shall be broken up and pulverized prior to backfilling.

8.1 COVER SERVICES

8.2 All services shall be installed with a minimum of 18 inches of cover unless an underground structure prevents installation with the minimum cover. The service may be installed at a lesser depth provided it is adequately protected from anticipated external loads. Measures to protect the plastic pipe include bridging or sleeving.

9.1 CLEARANCES SERVICES

9.2 Shall be installed with a minimum of 6 inches of clearance from all parallel underground facilities when possible and a minimum of 4 inches clearance when crossing facilities at right angles.

9.3 If this clearance **cannot** be attained, a minimum clearance of 2 inches is permissible providing the service is suitably protected from damage that might result from the proximity of the other structure.

9.4 Joint Trench - Clearances for joint trench are more stringent. Refer to Joint Trench Section of this manual.

10.1 PROHIBITED INSTALLATIONS

10.2 Gas services shall not be located under floors, porches, garages, mobile home slabs, or any other permanent structure. Threaded pipe or fittings shall not be below grade on medium pressure services.

10.3 Never drive carrier pipe, use a casing or other method for installing the service pipe such as pneumatic boring or directional drilling.

10.4 Plastic piping shall not be installed above ground.

10.5 Avoid installing gas piping above or through leach fields or other corrosive areas.

11.1 INSTALLATION CONSIDERATIONS

11.2 It is not good practice to install a service line to house or building before earth fill has been placed around the foundation walls. Gas services should not be installed until the site is within 6 inches of final grade to alleviate problems associated with insufficient cover or excess depth.

11.3 Plastic piping shall be installed in such a manner that shear and tensile stresses

are minimized. The piping shall be laid on undisturbed or well-compacted soil and not supported by blocking.

11.4 The material used for backfill shall be free of rocks, building materials, etc., that might damage the pipe.

12.1 EXCESS FLOW DEVICES

12.2 All one and two family residences (including mobile homes) served from a medium pressure line normally operating at over 10 psig shall be equipped with an excess flow device incorporated near or at the main. Refer to manufacturers flow limiter information for flow capacity and maximum service length recommendations.

SECTION 6.00 HANDLING PLASTIC PIPE

- Handling Plastic Pipe
- References
- General Handling
- Transporting Plastic Pipe
- Storage Of Plastic Pipe
- Shelf Life Of Plastic Pipe

1.1 HANDLING PLASTIC PIPE

1.2 This section describes the handling and storage of plastic pipe.

2.1 REFERENCES

2.2 C.P. Chem., Performance Pipe, Piping Publication April 2002.

3.1 GENERAL HANDLING

3.2 Care should be exercised when handling plastic pipe to avoid dropping the pipe.

3.1.1 Pipe may be lifted using an approved pipe-lifting device, utilizing fabric or nylon slings, or by hand. **Wire rope or chain slings, chains, cables, or other metallic equipment shall not be used on the pipe**.

4.1 TRANSPORTING PLASTIC PIPE

4.2 During transportation of the plastic pipe from the storage area to the jobsite by Village or contractor crews, care should be exercised to avoid damage. The following precautions will apply:

4.2.1 The vehicle bed, racks or stanchions shall be covered with padding and shall be free of all sharp projections that could damage the pipe.

4.2.2 Plastic pipe shall not overhang the vehicle more than 3 feet. A red flag shall be secured to any length of pipe that overhangs the vehicle. The stacking height shall be such that no overhanging pipe bends.

4.2.3 The piping should be fastened tightly (to avoid movement) to the vehicle with cloth or nylon straps, **not with chains**.

5.1 STORAGE OF PLASTIC PIPE

5.2 Plastic pipe should be stored so as to minimize the possibility of the material being damaged by crushing or piercing. No temporary covering (tarps or black plastic sheets, etc.) shall be placed over this material.

5.2.1 The exact height to which plastic pipe can be stacked depends on many factors such as material, size, wall thickness, and ambient temperatures. At no time should the loading cause the pipe section to be forced out of round. Regardless of the method used to stack the sticks or coils, it must be stressed that adequate support be maintained to prevent damage to the plastic.

5.3 Stick Pipe

5.3.1 Bundles of Sticks: Bundles shall have a maximum stack of 90 inches.

5.3.2 Loose Sticks: Loose sticks shall be stacked in a pyramid pile with the following height limitations:

Pipe Sizes	Tiers High
2”	12
3”	12
4”	8
6”	7
8”	6
10”	5

5.4 Coil Pipe

5.4.1 When stored in horizontal stacks, the stack height shall be a maximum of 86 inches high.

5.4.2 Vertical storage of coils is permitted with the following cautions:

1. The coil should be stored on a surface that will not damage the pipe.
2. The coil should be properly blocked with tapered blocks to keep the coil from rolling.
3. The coil should be lifted to avoid cuts and scratches that may occur when sliding or rolling.

6.1 SHELF LIFE OF PLASTIC PIPE

6.2 The shelf life of all high-density plastic pipe shall not exceed 24 months from the extrusion date marked on the pipe surface.

6.2.1 No High Density (PE3408) plastic pipe or tubing older than 24 months (2 years) from date of extrusion shall be installed.

SECTION 7.00 HANDLING STEEL PIPE

- Handling
- References
- General Handling
- Transporting
- Storage

1.1 HANDLING STEEL PIPE

1.2 This section describes the handling and storage of steel gas pipe.

2.1 REFERENCES

2.2 NONE

3.1 GENERAL HANDLING

3.2 Care should be exercised when handling coated steel pipe to avoid damage to the pipe or coating.

3.2.1 Pipe shall be lifted with either slings, pipe calipers, or end-hooks only.

3.2.2 Pipe shall not be dumped on the ground.

3.2.3 Pipe shall be lifted from the truck by means of fabric or leather slings or using an approved pipe-lifting device. **Wire rope or chain slings, chains, cables, or other metallic equipment shall not be used on the coating of the pipe**.

4.1 TRANSPORTING STEEL PIPE

4.2 Care should be exercised when transporting coated steel pipe to avoid damage to the pipe or coating.

4.2.1 Vehicles and trailers used to haul pipe should have padded surfaces free of any appurtenances.

4.2.2 The piping should be fastened tightly (to avoid movement) to the vehicle with cloth or nylon straps, **not with chains**.

4.2.3 If the pipe is to be handled with a forklift, each level including the bottom row must be blocked on padded supports with sufficient space to allow the forklift device to be placed between pipe levels without striking an adjacent layer of piping.

5.1 STORAGE OF STEEL PIPE

5.2 Pipe must be stored on padded blocks and stacked to height limits to insure that the coating is not crushed by the pipe's weight when stacked too high.

5.3 The base for pipe storage is recommended to be at least 6 inches off the ground to minimize debris being thrown into the pipe.

SECTION 8.00 INSPECTION AND REPAIR OF DAMAGED PIPE NEW CONSTRUCTION

- Inspection And Repair Of Damaged Pipe
- References
- Plastic
- Steel

1.1 INSPECTION

1.2 All pipe shall be inspected for visible physical damage before it is lowered into the trench.

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Part 192, Subpart E and F.

2.3 NYCRR, Public Safety Title 16, Parts 255.307, 255.309, 255.311

3.1 PLASTIC

3.2 Any major imperfection in plastic pipe shall be removed.

3.3 Major imperfections include: a gouge or groove deeper than 10% of the wall thickness; a kink, or buckle.

3.4 If a bad fusion joint is suspected, the joint shall be removed and the pipe rejoined.

4.1 STEEL

4.2 Any imperfection in steel pipe shall be removed as a section.

4.3 An imperfection includes; A gouge or groove, a kink, buckle, arc burn, split seam, a shallow nick, or scratch.

4.4 All steel mains shall be jeeped while the pipe is blocked and again before it is lowered into the ditch.

SECTION 9.00 SQUEEZE OFFS

- Squeeze Offs
- References
- General
- Plastic Squeeze Off
- Notes

1.1 SQUEEZE OFFS

1.2 This section pertains to the use of approved squeeze off tools for use during emergency situations or when making a plastic tie in.

2.1 REFERENCES

2.2 Section 11.00 Bonding and Grounding

2.3 NYCRR, Public Safety Title 16, Parts 255.321

3.1 GENERAL

3.2 All squeeze-off tools shall be used in accordance with the manufacturer's instructions and recommendations.

3.3 Squeeze-off tools may be either Mechanical or Hydraulic. When hydraulic tools are used, they shall be provided with a mechanical lock-off device to prevent the tool from opening in the event that the hydraulic system fails.

3.4 During a squeeze-off, the velocity of the gas will increase as does the possibility of a static charge. Therefore, all cutting tools and squeeze-off tools shall be grounded accordingly.

4.1 PLASTIC SQUEEZE-OFF

4.2 All squeeze-off tools for plastic pipe shall be approved for use and have stops of the appropriate Standard Dimension Ratio (SDR) or (DR) for the pipe being squeezed or a torque-limiting device to prevent pipe damage during the procedure.

4.3 **The squeeze-off site must be at least (3) pipe diameters or 12",** whichever is greater, away from a prior squeeze location, fusion site, or mechanical fitting.

4.4 Whenever plastic pipe is squeezed-off, care must be taken to identify the squeeze-off location to prevent a second squeeze-off at the same location.

5.1 NOTES

5.2 If damage has occurred or may have occurred to plastic pipe during the squeeze-off operation, the affected area will be replaced.

5.3 The rate of squeeze or release shall be the same. A one-minute pause is required at wall contact, ¼ open, and at ½ open for pipe larger than 3 inches.

5.4 During freezing temperatures, closure rates should be halved and pauses should be doubled.

5.5 It is not necessary or advisable to "re-round" the plastic pipe by squeezing at a 90^{o} rotation of the initial squeeze.

5.6 After removal of the squeeze-off tool, a soap test shall be performed on the squeeze site.

5.7 **From the start of a squeeze-off on plastic pipe to the removal, the total time should not exceed 8 hours. Excessive time may damage the pipe.**

SECTION 10.00 INSTALLATION CONSIDERATIONS

- Installation Methods
- References
- Direct Burial Plastic Mains
- Direct Burial Steel Main
- Trenchless Construction General
- Horizontal Directional Drilling
- Bore Path Planning & Profiles – Directional Drilling
- Exploratory Soil Bores – Directional Drilling
- Rights Of Way - Directional Drilling
- Entry & Exit Angles – Directional Drilling
- Minimum Bend Radius – Directional Drilling
- Plastic Pipe Material Selection – Directional Drilling
- Quality Assurance – Directional Drilling
- Weak Link – Directional Drilling
- Weak Link Usage Table – Directional Drilling
- Tracer Wire Connection – Directional Drilling
- Pulling Head – Directional Drilling
- Back Reaming – Directional Drilling
- Pull Back – Directional Drilling
- Gauge Pigging – Directional Drilling

1.1 INSTALLATION METHODS

1.2 This section describes considerations and the various methods of installing gas pipelines.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255.321 Installation of Plastic Pipe.

2.3 NYCRR, Public Safety Title 16, Part 753, Protection of Underground Facilities.

2.4 American Society for Testing and Materials (ASTM) F1962-99, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene pipe or Conduit Under Obstacles, Including River Crossings.

2.5 Trenchless Technology Technical Note No. 1, Plexco, Chevron, Horizontal Directional Drilling (Guided Boring) with Plexco Pipe, revision 1.

2.6 North American Society for Trenchless Technology (NASTT), First Edition, September 1995, Mini-Horizontal Directional Drilling Manual

3.1 DIRECT BURIAL PLASTIC MAINS

3.2 The direct burial of plastic mains shall be in accordance with all procedures and cautions stated in this Section.

3.3 Plastic pipe shall be installed with sufficient slack to provide for possible contraction. Normal uncoiling and placing in the trench will usually provide the necessary slack.

3.4 The bottom of the trench must continuously support plastic pipe with no pipe spans bridging low spots.

4.1 DIRECT BURIAL STEEL MAINS

4.2 Steel pipe installed below grade must conform to the bottom of the trench for continuous support or be supported by sandbags at intervals not to exceed 6 feet to minimize stress on the pipe.

4.3 Clean backfill or bedding material may be used to fill low spots to provide continuous support to the pipe.

5.1 TRENCHLESS CONSTRUCTION GENERAL

5.2 Whenever trenchless technology is used for installing mains, extreme caution must be exercised. It is important that all foreign facilities (e.g. telephone, sewer, water, etc.) be accurately located.

5.3 Test pits are required per Code Rule 753 to determine the location of all foreign facilities.

6.1 HORIZONTAL DIRECTIONAL DRILLING – PLASTIC PIPE

6.2 The following guide has been developed as an aid for the layout, design, and installation of plastic Horizontal Directional Drilling (HDD) installations where conventional pipe installations are not an option.

7.1 BORE PATH PLANNING AND PROFILES – DIRECTIONAL DRILLING

7.2 When a location has been chosen for the directional drill, the area should be profile surveyed and detailed drawings prepared. The accuracy of the drill profile and alignment is dependent on the accuracy of the profile survey information.

7.3 The alignment of the bore path has much to do with the forces acting on the pipe during the pullback operation; the straighter the alignment, the less force acting on the pipe. The pullback forces applied to the pipe will depend upon the following; the buoyant forces acting on the pipe cause frictional drag between the pipe and the top of the borehole, resistance due to stiffness at curves along the bore path, the lubricity and viscosity of the drilling fluid referred to as "hydrokinetic drag", the cutting mixture, weight of groundwater, and soil conditions.

8.1 EXPLORATORY SOIL BORES – DIRECTIONAL DRILLING

8.2 It is generally recommended to have exploratory soil bores performed in locations where directional drilling is contemplated to determine subsurface soil conditions.

8.3 The number of exploration holes is a function of the length of the proposed crossing and complexity of subsurface soils. There should be at least 2 bores performed for a 1000-foot directional drill, and it is important to note that the exploratory drill must extend to the depth of the directional drill. The exploration holes shall not be located exactly over the profile of the proposed drill. All drill hole shall be filled with grout or other approved material.

8.4 The state DOT or other agencies may already have this information. The Regional DOT Engineering offices should be contacted to determine if this information is available.

8.5 If rock is encountered during the soil bores, it is important to determine the type, hardness, and strength. The type of rock can be obtained during the soil bore procedure, and a geologist can determine the rock quality designation, the hardness designation, and compressive strength. It is important to provide this information to the directional-drilling contractors so that they can determine their equipment requirements and accurately price the installation.

8.6 The soil conditions found during the exploratory soil bore process will allow the driller to determine the proper drilling fluid and additives required to provide stability to the bore hole and to transport the cuttings from the bore hole to the containment pit. The exploratory soil bores will also provide the driller with information needed to select the drilling head and back reamer.

9.1 RIGHTS OF WAY – DIRECTIONAL DRILLING

9.2 There should be enough permanent or temporary ROW obtained to provide room for construction equipment and reclamation pits. There should also be sufficient temporary right-of-way obtained for the entire drill string to lay prior to the pullback operation. There should not be a time delay between the back reaming operation and the pullback. Any interruptions could be cause for collapse of the back- reamed hole or damage to the pull string.

10.1 ENTRY AND EXIT ANGLES – DIRECTIONAL DRILLING

10.2 The preferred entry and exit angles are between 14 and 20 degrees. The entry angles are generally greater due to difficulties encountered starting the head of the drill into the ground.

10.3 The entry and exit angles have a direct effect on the estimated average arc curvature radius of the pipe and the estimated horizontal distance required achieving depth or rising from entry or exit locations.

11.1 MINIMUM BEND RADIUS – DIRECTIONAL DRILLING

11.2 The minimum bending radius of a HDD crossing should not be less than 100 feet to reduce frictional forces and to avoid possible kinking or egging the pipe.

11.3 A tight bend radius has a direct effect on the required pullback force acting on

the drill string. As a rule of thumb, the steel drill rod is limited to a 100-foot radius for each 1" diameter of drill rod.

12.1 PLASTIC PIPE MATERIAL SELECTION – DIRECTIONAL DRILLING

12.2 High Density pipe is recommended for all Directional Drilling applications. High Density pipe has roughly double the short term safe pull strength and has a higher resistance to abrasion.

13.1 QUALITY ASSURANCE – DIRECTIONAL DRILLING

13.2 Pipeline fusions for long distance bores should be ultrasonically tested to assure the joints are of the best possible quality to withstand the potential stresses of the directional bore.

14.1 WEAK LINK – DIRECTIONAL DRILLING

14.2 A weak link should be utilized to assure the pipe string is protected from exceeding the Short Term Safe Pull Strength. The Weak Link Usage Table below provides the proper weak link selection based on temperature and duration of pullback.

14.3 An adjustable Borzall Breakaway Connector should be used to set the proper breakaway value to assure the short term safe pull strength is not exceeded. The Borzall Connector has an interchangeable selection of pins to provide breakaway values from 750 LBS up to 13500 LBS in 250-LB increments by selective usage of the Breakaway Pins.

14.4 Refer to the Weak Link Usage Table to determine proper values for directional drilling.

HORIZONTAL DIRECTIONAL DRILLING WEAK LINK USAGE TABLE

Pipe Size	SDR	HDPE Weak Link Value
2	11	1250#
4	11	5000#
6	11	12000#
8	11	20000#
10	11	25000#

Weak Link Values have been derated for pipe temperatures of 100ºF and for pull durations over one hour.

15.1 TRACER WIRE CONNECTION – DIRECTIONAL DRILLING

15.2 The standard 49 strand stainless steel #10 wire should be used.

15.3 The wire should be connected to the pulling head with cable clamps.

16.1 PULLING HEAD – DIRECTIONAL DRILLING

16.2 A transition fitting should be utilized for the transition from the steel back reamer to the plastic pull string. The open end will be fabricated shut with a pipe cap and an eyebolt installed to attach the back reamer.

17.1 BACK REAMING – DIRECTIONAL DRILLING

The back reamer is used to enlarge the drilled hole to facilitate the installation of the drill string. The back ream must be at least 1½ times the size of the drill string to allow for an annular space for return of drilling fluid and cuttings (spoil) to the containment pit. Refer to the Back Reamer Sizing Table below for proper sizing.

Back Reamer Sizing Table	
Pipe Size Nominal, Inch	**Back Reamer Size, Minimum, Inch**
2	5
4	6
6	8
8	10
10	12
12	16

17.2 There are a variety of back reamers for different soil conditions encountered; these are, a blade reamer for soft soil, a barrel reamer for mixed soil, and a carbide tipped back reamer for rock formations.

17.3The back reamer must have a swivel head to avoid twisting the pipe string.

18.1 PULLBACK - DIRECTIONAL DRILLING

18.2 There should not be a time delay between the back reaming operation and the pullback. Any interruptions could be cause for collapse of the back reamed hole and damage to the pull string.

18.3 After the pullback, the pipe should be allowed to recover from the stress effects of directional drilling. A relaxation period is required and should range from 8 to 24 hours.

19.1 GAUGE PIGGING – DIRECTIONAL DRILLING

19.2 The final acceptance of a HDD crossing is to pig the pipeline to assure the pipeline inside diameter is constant and without obstruction.

19.3 A “T.D. Williamson Option All Pig” fitted with a slotted aluminum gauging flange installed on the leading edge should be used. The gauging flange and Option All pig is available for pipe sizes larger than 2”.

19.4 The Option All pig must have the cups machined to match the ID of the plastic pipe.

19.5 The gauging flange must be machined to 93% of the pipe ID after subtracting for the size of the fusion beads.

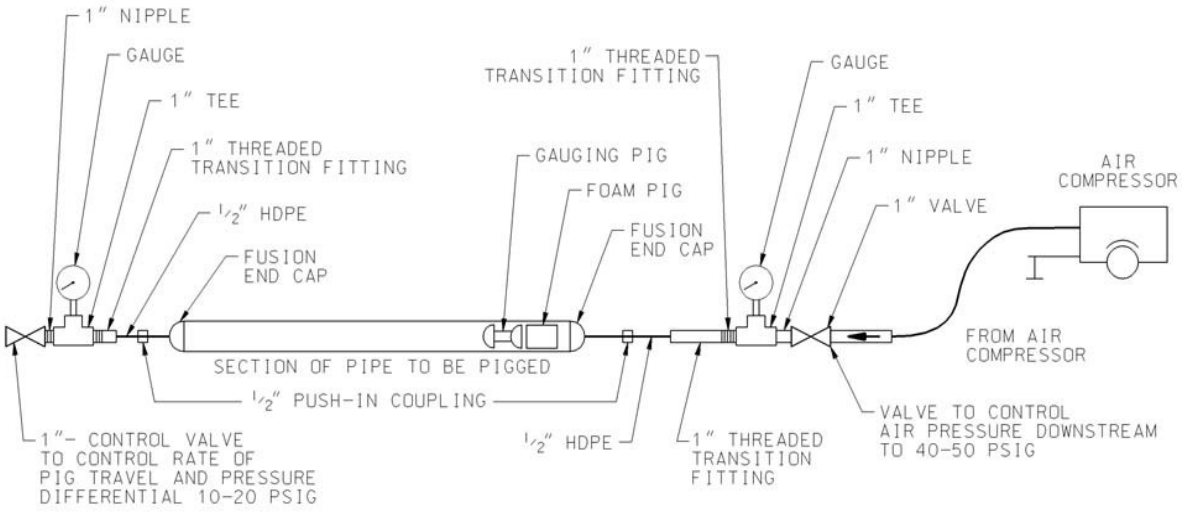
19.6 Special consideration should be made to limit the speed at which the pig travels during this operation. Refer to the Directional Drilled Pipeline Gauge Pig Process Detail Diagram No. PD-1 to set up for gauge pigging.

19.7 If, after pigging, the leading edge of the plate is bent, it may be an indication of a possible bend or kink of the drill string. In any case, further investigation should be undertaken to investigate the cause.

19.8 The condition of the sizing plate will be used to determine if the directional-drilled pipeline is acceptable to the Village and justify payment to the drilling contractor for performance under the contract.

PD-1

DIRECTIONAL DRILLED PIPELINE GAUGING PIG PROCESS DETAIL



NOTE: 1. 1" CONTROL VALVE TO BE ADJUSTED TO MAINTAIN APPROX 30# PRESSURE DIFFERENTIAL TO REDUCE VELOCITY OF GAUGING PIG.
2. GAUGING FLANGE. OPTION ALL BATCH PIG AND FOAM PIG ARE AVAILABLE THRU KERR ENGINEERED SALES CO.

T.D.W OPTION ALL BATCHING PIG WITH CUPS MACHINED FOR MDPE AND HDPE APPLICATIONS. USED IN CONJUNCTION WITH PROPER SLOTTED ALUMINUM GAUGING FLANGE.

PIPE SIZE	MDPE	HDPE
4"	3.794"	3.5"
6"	5.463"	5.153"
8"	8.625"	6.709"

T.D.W SLOTTED ALUMINUM GAUGING FLANGE

PIPE SIZE	MDPE	HDPE
4"	3.30"	3.02"
6"	4.73"	4.44"
8"	6.30"	5.77"

SECTION 11.00 BONDING AND GROUNDING

- Bonding And Grounding
- References
- Bonding Steel Pipe
- Grounding Plastic Pipe

1.1 BONDING AND GROUNDING

1.2 This section describes the requirement of bonding steel pipe and grounding plastic pipe prior to separating when it is necessary to make repairs or completing tie ins.

2.1 REFERENCES

2.2 National Electric Safety Code

3.1 BONDING STEEL PIPE

3.2 Whenever separating steel mains temporary bonding clamps shall be installed around the point of separation to provide a path for any current that might be on the main. **Magnetic Bonding Clamps shall not be used because they do not provide a reliable means of electrical conductivity.**

3.3 A #8 AWG copper flexible wire is the minimum size bonding wire to be used for bonding. A #2 AWG flexible wire is the minimum size wire to be used when bonding in stray current areas, or in proximity of high voltage power lines.

4.1 GROUNDING PLASTIC PIPE

4.2 Plastic pipe is not an electrical conductor, but it is easily charged with static electricity. This charge may accumulate on the inside or the outside of the pipe as a result of handling or internal turbulence and friction due to flowing gas.

4.3 Whenever plastic pipe is placed in contact with a foreign object, it is possible to discharge in the form of a spark. For this reason it is important to provide a ground path when making repairs or handling pipe in situations where live gas could be present.

4.4 Static grounding must be applied prior to joining two separated pieces of plastic piping together, separating a piece of existing plastic piping, or making repairs to damaged plastic pipe. The antistatic kit is applied to the ends of the existing pipe prior to separating and making repairs. The Anti- Static Kit shall be used for all situations needing static preventative measures. Burlap soaked in a soap/water solution is acceptable in an emergency.

SECTION 12.00 BENDS

- Bends
- References
- Plastic Pipe
- Minimum Bend Radius of Plastic Pipe
- Steel Pipe
- Location of Longitudinal Weld Seam
- Location of Circumferential Weld

1.1 BENDS

1.2 This section pertains to bends in plastic pipe that can be achieved during open trench construction. If directional drilling, pulling or plowing plastic pipe refer to Directional Drilling Installation methods for minimum bend radius.

1.3 The intent of this section is to produce bends which shall minimize distortion of the pipe and which in no way impair the strength of the pipe.

1.4 A change in direction that will exceed the minimum bend radius as detailed in this section must use manufactured fittings to achieve the desired direction change.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255.313

3.1 PLASTIC PIPE

3.2 Plastic pipe may be bent, with a minimum bend radius of twenty times the pipe diameter during open trench construction.

3.3 All bends should be inspected for possible damage; any damaged section shall be removed and replaced with a new section of pipe.

3.4 Only factory built, prefabricated mitered joints are permitted.

4.1 MINIMUM BEND RADIUS OF PLASTIC PIPE & TUBING

4.2 Bends are to be used wherever possible. If a bend will exceed the minimum bend radius an elbow shall be used.

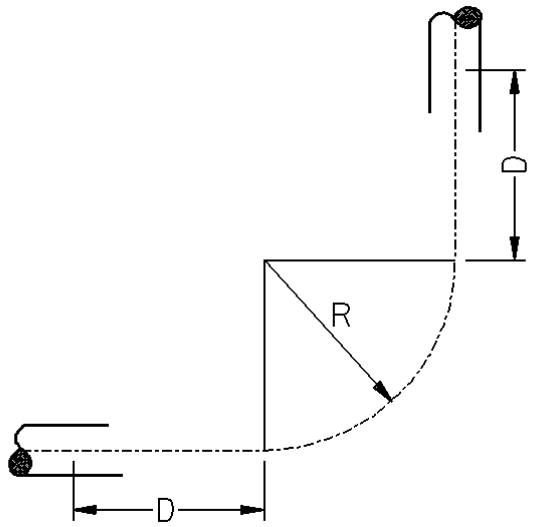
4.3 Straight runs of plastic pipe without fittings or fusions can accommodate a minimum bend radius no less than 20 times the pipe diameter. See Table 1 and Figure 1.

4.4 When the pipe is bent, there shall be no fusion or mechanical joints within the bend or within 20 pipe diameters on either side of the bend.

4.5 Care shall be taken so as to not damage or kink the plastic pipe or to reduce flow. If the plastic pipe becomes kinked, the kinked section must be cut out.

TABLE 1

MINIMUM BENDING RADIUS FOR PLASTIC PIPE WITHOUT FITTINGS	
Plastic Pipe Size	**Minimum Bend Radius R & Minimum Distance From Bend Distance For Fitting Installation (D)**
.5” CTS	1’ 1”
1” CTS	2’
1.25” IPS	2’ 10”
2” IPS	4’
4” IPS	6’ 8”
6” IPS	10’
8” IPS	13’ 4”



R = THE MINIMUM BENDING RADIUS IS 20 PIPE DIAMETERS.
D = THE MINIMUM DISTANCE FROM THE BEND TO THE NEAREST FITTING OR FUSION IS 20 PIPE DIAMETERS.

FIGURE 1

5.1 STEEL PIPE

5.2 All bends shall be done cold producing a smooth bend. No hot or wrinkle bends will be allowed. Bends shall be made using a type of bending machine approved by the Village, and if necessary an internal bending mandrel may be used.

5.3 All over-bends shall be made in such a manner so that the midpoint of the bend when installed shall clear the high point of the trench bottom. All sag bends shall be fitted snug to the bottom of the ditch.

5.4 The distance between centerlines of bending points shall be such that there shall be no distortion of the pipe or of any previously made bend and the distance shall not in any case be closer than one (1) pipe diameter.

5.5 When bending is required, the recommended bending radius for pipe smaller than 12 inch is 18 pipe diameters.

5.6 No bend shall produce wall thickness thinning exceeding 10% of the pipe wall as measured through the use of an ultra-sonic thickness gauge.

5.7 All bends shall be measured for ovality using a caliper. If the bend has produced an ovality that exceeds 2.5% of the pipe OD it shall be cut out.

5.8 All over-bends, sag-bends, or side-bends shall be made before any cleaning, priming, or wrapping operations, and shall be installed in such a manner so that an adequate amount of slack is provided in the line.

5.9 Any pipe that has been buckled or gouged as a result of the bending process shall be cut out and replaced.

5.10 After bending, the coating integrity shall be checked using a high voltage short locater (Jeep).

6.1 LOCATION OF LONGITUDINAL WELD SEAM

6.2 The longitudinal weld (seam) of the pipe should be located as near as possible to the neutral axis of the bend unless.

A) The bend is made with an internal bending mandrel

OR

B) The pipe OD is less than 12”

OR

C) The diameter to wall ratio is less than 70.

R=D/W
R is the ratio
D is the pipe outside diameter
W is the wall thickness in inches

6.3 The longitudinal seam is the location on the pipe that is not in tension or compression relative to the completed bend.

7.1 LOCATION OF CIRCUMFERENTIAL WELD

7.2 No bends shall be made within 4 feet of a circumferential weld or open end of the pipe joint in a pipe having a diameter of less than 16 inches.

7.3 If because of unusual circumstances this limitation may be waived, provided that any circumferential weld closer to a bend segment than permitted is subjected to an X-ray inspection.

7.4 Bends in which a circumferential weld is located within the bend shall not be permitted.

SECTION 13.00 JOINING OF PIPE - DISTRIBUTION

- Joining of Pipe
- References
- Couplings
- Welding

1.1 JOINING OF PIPE

1.2 This section details alternate joining methods for steel pipe such as mechanical couplings.

2.1 REFERENCES

2.2 Village of Hamilton Welding Procedures Manual

3.1 COUPLINGS

3.2 Mechanical couplings may be used for joining steel to steel, steel to plastic, and plastic to plastic.

3.3 All mechanical couplings shall be seal and restraint where available

4.1 WELDING

4.2 Welding is the preferred method of joining steel for main construction in all pressure ranges. All welding will be done according to the guidelines established in the Village of Hamilton Welding Procedures Manual.

4.2 Any main located in unstable soils should be constructed with steel pipe.

SECTION 14.00 JOINING OF PLASTIC PIPE

- Joining Of Plastic Pipe
- References
- Plastic Joining Tasks- Preferred and Alternate Joining Methods

1.1 JOINING OF PLASTIC PIPE

1.2 This section details preferred and alternative joining methods for plastic pipe that encompasses leak repairs, tie ins, service tee connections, and joining of coil and stick pipe ends for open trench installation, pipe pulling, and directional drilling.

2.1 REFERENCES

2.3 NYCRR, Public Safety Title 16, Part 255.281
2.4 Village of Hamilton Gas Operating and Maintenance Procedures Manual
2.5 Section 22.00 Plastic Batch Numbers

3.1 PLASTIC JOINING TASKS – PREFERRED AND ALTERNATE METHODS

3.2 See attached Joining Table. For joining procedures and qualification requirements refer to Village of Hamilton Gas O&M Manual.

3.3 It is preferable to install plastic service pipe as one continuous length. Where it is necessary to use more than one length of pipe, the lengths shall be joined by one of the methods in the Plastic Joining Tasks – Preferred & Alternate Methods table.

Plastic Joining Tasks – Preferred & Alternate Methods			
Task	**Material**	**Preferred Method**	**Alternate Method(s)**
Leak Repair ½" – 2"	HDPE	Stab Coupling	
Tie-In	HDPE	Electrofusion	Mechanical Butt Fusion
Hi-Volume Tee	HDPE	Electrofusion	None
Service Tee 8" & 10"	HDPE	Electrofusion	None
Service Tee 2" – 6" Main	HDPE	Mechanical	Electrofusion
Join Coil Pipe for Open Trench Install	HDPE	Electrofusion	Butt Fusion Mechanical
Join Coil Pipe for Directional Pull	HDPE	Butt Fusion	None
Join Stick Pipe	HDPE	Butt Fusion	Electrofusion Mechanical
Directional Bore - Tie-In With MDPE	HDPE	Electrofusion	Mechanical
Directional Bore - Tie-In With HDPE	HDPE	Butt Fusion	Electrofusion Mechanical
Cross Join Materials		Electrofusion	Mechanical

SECTION 15.00 SERVICE CONNECTIONS

- Service Connections
- References
- General
- Service Matrix
- Drawings

1.1 SERVICE CONNECTIONS

1.2 This section provides detailed illustrations of approved materials for service connections at the main (main end) and riser connections at the house (house end).

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255.367, 255.375

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR.

3.1 GENERAL

3.2 Refer to manufacturers Flow Limiter information to determine the proper selection of flow limiters for the anticipated connected load.

3.3 The Perfection Mechanical Tees used are equipped with integral flow limiters and have been standardized to include a Powell 400 CFH EFV with a .5” outlet and a Powell 800 CFH EFV with a 1” outlet.

3.4 There are additional stab end flow limiters available in .5”, 800 CFH and 1.25”, 1800 CFH sizes if needed. Please note the limiter ratings are based on 10 PSIG inlet, the capacity of the flow limiter increases with main pressure.

3.5 All HDPE services operating over 60 psig installed without a flow limiter shall be equipped with a curb valve located as close to the service connection as practical.

4.0 SERVICE CONNECTION MATRIX

Service Connection Matrix

Main Pressure	Main Material	Service Material	Main Size	Main Wall Thickness	Service Size	Flow Limiter Equipped	Service Connection Type
Medium Pressure 61 to 124 psig	HDPE	HDPE	2” & 4”	SDR 11.0	.5” - 1"	Y	Mechanical
			6" only			*	
			8" & 10”			*	Electrofusion
			2" -10"		2”	N	

*See drawing notes for flow limiter and valving requirements.

5.0 Drawings

Detail drawings to be added.

SECTION 16.00 PIGGING

- Pigging
- References
- General Cleaning

1.1 PIGGING

1.2 This section describes the requirements for pigging gas mains to remove foreign materials from new lines prior to energizing. The operation of pigging will remove construction debris such as; paper, mud, water, etc.

2.1 REFERENCES

2.2 None.

3.1 GENERAL CLEANING

3.2 All pipelines two inches in diameter and larger shall be pigged prior to tie-in. Compressed air may be used for all other pipelines.

3.2.1 Short sections less than 100 feet and tie in sections do not require pigging but due to construction conditions may be pigged if needed.

3.3 All plastic pipelines shall be cleaned with a squeegee type pig of suitable size.

3.3.1 Pigs shall be supplied by the Contractor and approved by the Construction Inspector.

3.4 The pigging operation may require numerous passes to properly clean the pipeline. The Construction Inspector shall witness final pigging operations.

SECTION 17.00 VALVES

- Valve Requirements
- Main Valves
- Installations

1.1 VALVE REQUIREMENTS

The primary purpose of main line valves in distribution systems is to shut off the flow of gas in the event of an emergency. However they may also be installed for future anticipated main extensions.

Main line valves can represent a significant capital investment, and a long term O&M commitment, requiring careful consideration of the effectiveness and necessity of each valve installation.

Items to consider include, but are not limited to:

- Number of customers which can be isolated.
- Significance of the main being protected.
- Ease of employing alternative measure such as squeeze-off.
- Relative risk of blowing gas on main to be isolated.
- Potential benefits to system maintenance.
- Potential of future construction or system up-grades.

2.1 REFERENCES:

2.2 NYCRR, Public Safety Title 16, Part 255.181

3.1 Main Valves:

Design: Ball valves, lubricated plug valves, and gate valves with internal stem screws are all acceptable designs. Gear operators should be considered in metal plug and ball valves larger than 6", and are required in valves larger than 10". Valves with full port openings must be used in pipelines designed to be pigged.

Material: Valves should be predominantly of the same material as the pipe, i.e., plastic valves in plastic systems. Polyethylene bodied valves are preferred in PE systems, and steel bodied valves are preferred in steel mains.

Pipe End Connections: The preferred method to install valves is to weld or fuse them into place based on the system type. Flanged ends are acceptable, but not preferred.

Valve Boxes: The operator of all buried valves must be accessible through a valve box. Valve boxes must be installed in a manner that will not transfer surface or highway loads to the valve or main. Valve boxes with rigid or fixed extensions must not be supported by, or rest on the main. Valve boxes with metal extensions cannot come in contact with the plastic main.

Valve boxes in roadways, or a road box, should have a heavy collar at least 5" deep. Valve boxes outside of the highway, or curb boxes, may utilize shallower collars.

4.1 Installations:

As a general guideline, valves should be installed to allow efficient isolation of blocks of customers in the event of a failure or 3rd party damage.

Valves should be installed on the downstream side of all branches or intersections of belt lines and/or major trunk mains. Valves are also required on lateral extensions off trunk mains if a break on the extension would require shutting down the trunk main. Valves are also required for some bridge and railroad crossings.

Valves should be installed on well compacted soil with voids around the valve filled with well compacted soil or sand. Blocking under plastic valves is not permitted. Where applicable, appropriate lengths of stick pipe rather than coiled pipe shall be fused to the valve outlets so as to protect the pipe material against excessive torsional or shearing loads when the valve is operated and from any other secondary stresses which might be exerted through the valve or valve box.

SECTION 18.00 VALVE REQUIREMENTS- SERVICE LINES

- Valve Requirements
- References
- When To Install
- Where To Install
- How To Install
- Curb Boxes

1.1 VALVE REQUIREMENTS

1.2 This section details the requirements of installing service line valves on Village owned services.

1.3 Exposed service line valves must be tamper proof and have a method for locking in the closed position.

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Parts 192.363 and 192.365, Subpart H, Customer Meters, Service Regulators and Service Lines.

2.3 NYCRR, Public Safety Title 16, Part 255.363, 255.365

3.1 WHEN TO INSTALL SERVICE LINE VALVES

3.2 An outside service line valve must be installed on all service lines. A valve that is an integral part of the meter set will qualify as the service line valve.

3.3 HDPE services installed without flow limiters shall have a valve installed as close as possible to the service tee.

4.1 WHERE TO INSTALL

4.2 Service line valves must be readily accessible.

4.3 Valves shall be located upstream of the regulator the operator of the valve facing away from the building to enable shut off with an extended tool in the event of an emergency.

4.4 If the service is to a building of public assembly as defined in the Operations and Maintenance Manual, the valve must be located outside of the building.

5.1 HOW TO INSTALL

5.2 Service line valves should be locked in the closed position with a barrel lock at the time of installation.

5.3 Buried service line valve commonly referred to as curb valves or curb cocks should be located as close as practicable to the property line as possible.

5.4 Buried service line valves may be marked with a line marker if the service has no other shut off valve or if the building is a building of public assembly.

6.1 CURB BOXES

6.2 Curb boxes shall be installed on each curb valve.

6.3 The curb box is to be centered over the head of the valve and the height will be adjusted to be flush with the finished grade

SECTION 19.00 TRACER WIRE

- Objectives
- References
- Tracer Wire Installation
- Test Station Boxes Damage Prevention
- Test Station Box Installation
- Test Station Construction Continuity Test

1.1 OBJECTIVES

1.2 This section details the requirement for installing tracer wire and test stations for locating PE mains and services.

1.3 A protected and locatable tracer wire box will improve the safety of the infrastructure, the safety of the public and the employee.

1.4 This process protects newly installed underground facilities from being damaged by third party work in the same general area. The underground facility shall be flagged and/or marked (Ref. 2.4 below).

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Part 192.

2.3 NYCRR, Public Safety Title 16, Part 255.321

2.4 Codes and Regulations of the State of New York, Public Safety Title 16, Part 753, Subchapter F – Miscellaneous, Protection of Underground Facilities.

3.1 TRACER WIRE INSTALLATION

3.2 A tracer wire shall be installed alongside (6-12 inches) but not touching plastic pipe to locate its position.

3.3 Copper (Solid) #12 wire with a tensile strength of approximately 198 # or steel core copper clad wire with a tensile strength of 370 # shall be used for all open trench main installations. Stainless steel (stranded) #10 wire with a tensile strength of approximately 1,400 # shall be used for Horizontal directional drilling installations.

3.4 Specified tracer wire is jacketed with high molecular weight polyethylene (HMW-PE). No other wire or material shall be used as tracer wire except those specified herein.

3.4 Copper tracer wire end connections shall be made with silicone filled wire nuts/connector or split bolt connectors.

3.5 Copper and stainless steel tracer wires shall be connected in a test box using a split bolt connector, silicone filled wire nuts/connector, or using the test connections provided with a test box.

3.6 Copper to stainless steel tracer wire connections shall not be subjected to any tensile loads (i.e. pullback during horizontal directional drilling).

3.7 All tracer wire connections shall be protected from moisture by thoroughly wrapping the connection with H-35 grey tape, or equivalent.

3.8 Tracer wire shall be installed alongside PE pipe beyond any joint trench for location purposes.

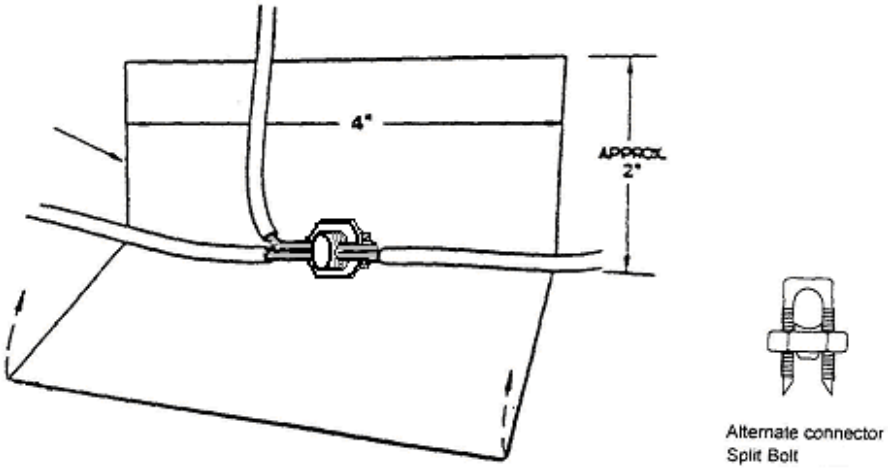
3.9 There shall be a sufficient amount of tracer wire installed to extend 4 – 5 feet from tracer wire box. The excess tracer wire shall be coiled and left in the tracer wire box.

3.10 Service tracer wire connections to the main tracer wire shall be made with split bolt connectors only. The split bolt connector must also be protected from moisture by thoroughly wrapping the connection with H-35 grey tape.

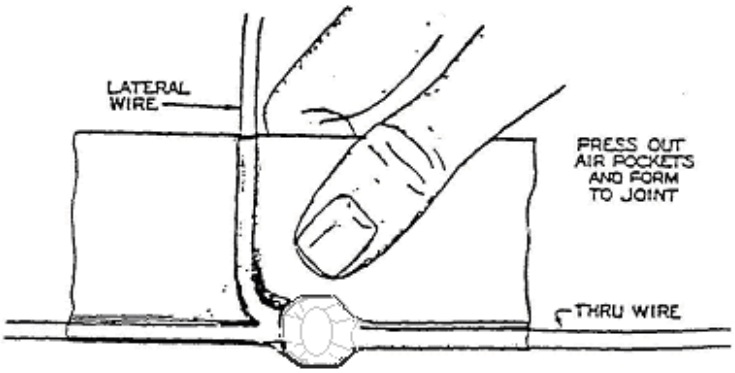
3.11 The tracer wire shall be wrapped around the service riser or clipped to the riser using a tracer wire clip.

DRAWINGS

Refer to the following detail drawing for correct installation (main tracer wire to service tracer wire connections) of tracer wire for typical service installations.



Bring pad adhesive surfaces together and using thumb forefinger, form the tape around the joint to work out any air pockets.



Tracer Wire Installation Drawing

4.1 TEST STATION BOXES DAMAGE PREVENTION

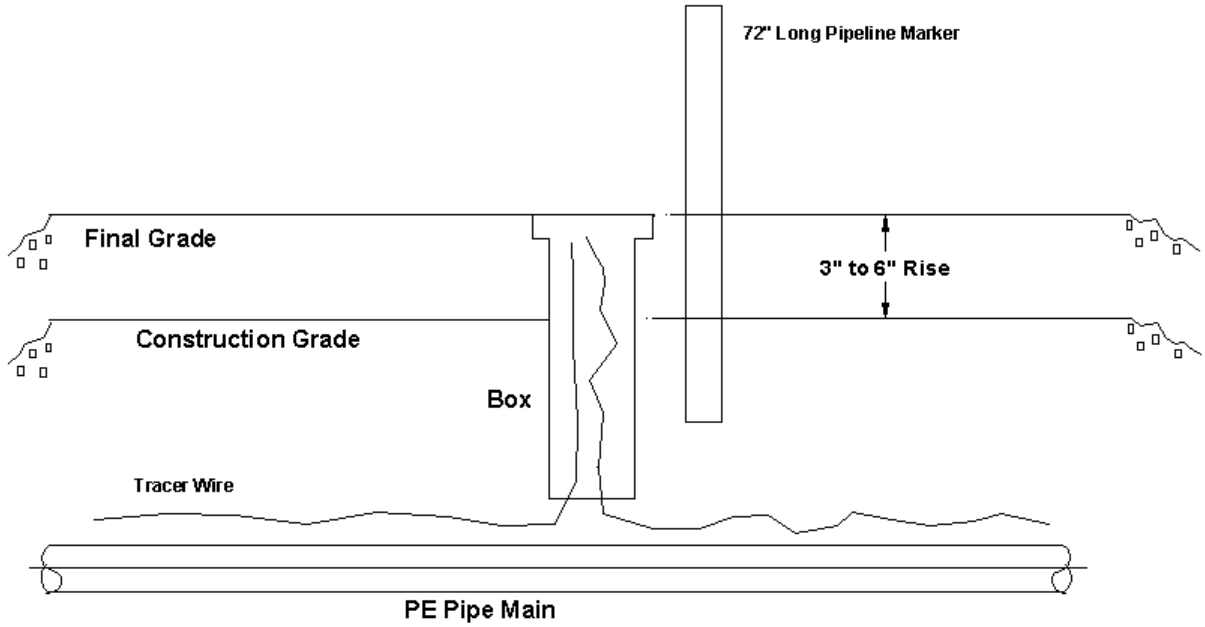
4.2 Test Stations shall be installed at tracer wire and gas main termination points to provide either a connection point to connect sections of tracer wire together or provide connection points for locating purposes. Protecting tracer wire boxes from being damaged after initial installation is essential.

4.3 To prevent tracer wire box damage during construction and to raise the level of awareness that underground facilities are present:

4.3.1 Install a pipeline marker post at tracer wire box locations.

4.3.2 Leave plastic box 6” above grade.

4.3.3 After final grade is completed, if possible leave pipeline markers and position valve box to final grade position.



Typical Test Station Installation

5.1 TEST STATION BOX INSTALLATION

5.2 There are two types of tracer wire boxes, the flush grade box and the above grade box. In most cases the flush grade box is sufficient, but depending on location a round yellow above grade plastic box can be used. The above ground box shall be utilized in rural applications for ease of locating.

5.3 Locate all tracer wire boxes behind the curb, not in the road or paved surface.

5.4 A tracer wire box shall be installed at 1,000-foot (maximum) intervals and at the end of every PE gas main.

6.1 AFTER INSTALLATION - TRACER WIRE CONTINUITY TEST

6.2 Test the post construction tracer wire. This is the responsibility of the installation crew and shall be performed by a qualified individual (s) to verify the tracer wire is continuous from given point-to-point.

6.3 Continuity test of all tracer wire shall be successful. All unsuccessful continuity tests shall be repaired and retested until 100% continuity is achieved.

SECTION 20.00 WARNING TAPE

- Warning Tape
- General
- Location
- Specification

1.1 WARNING TAPE

1.2 This section describes the general requirement to install warning tape for all new direct buried gas main and service installations.

2.1 GENERAL

2.2 Warning tape shall be installed directly above all new direct buried gas main and service installations and is not required over trenchless installations.

3.1 LOCATION

3.2 The tape shall be installed approximately 12 inches deep to insure it will be exposed by the excavator before reaching the depth of the pipe.

3.2.1 The backfilling operation will tend to push the tape to the side of the ditch, therefore, care should be taken to position the tape as close to the centerline of the pipe as possible.

3.2.2 When the main or service is located in agricultural areas that may be plowed etc, the warning tape should be located at a depth that would not be reached by the cultivating equipment.

4.1 SPECIFICATION

4.2 The marking tape will be yellow ribbon approximately 3 inches wide with the words:

"CAUTION NATURAL GAS PIPELINE BELOW"

SECTION 21.00 INSTALLATION OF LINE MARKERS

- Line Markers
- References
- Materials
- Placement

1.1 LINE MARKERS

1.2 This section details the requirement for the placement of line markers. The installation of line markers provides added protection from third party damage and assists the crews in determining the location of Village facilities.

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Part 192.707, Line Markers.

2.3 NYCRR, Public Safety Title 16, Part 255.707

3.1 MATERIALS FOR LINE MARKERS

3.2 Both round and flat line markers shall be utilized to mark the underground gas facilities, in addition to these line markers an above ground cathodic protection test station or a casing vent can be used as a line marker.

4.1 PLACEMENT OF PIPELINE MARKERS

4.2 Pipeline markers should be installed in such areas as property lines, hedge rows, creek crossings, road crossings, and other points of intersection along the pipeline to maintain a visual site reference along the pipeline.

SECTION 22.00 PLASTIC BATCH NUMBERS

- Plastic Batch Numbers
- References
- Recording Plastic Batch Numbers

1.1 PLASTIC BATCH NUMBERS

1.2 This section details the requirement to record plastic batch numbers that are stenciled on all plastic pipe used in the natural gas industry.

2.1 REFERENCES

2.2 ASTM Code D2513

3.1 RECORDING PLASTIC BATCH NUMBERS

3.2 The plastic batch numbers identify the manufacturer, plant, date, shift, extrusion machine, operator, and in some cases the coil number of the pipe as it is manufactured.

3.3 By recording the batch numbers the operator has a method of identifying where specific batches of pipe have been installed in case of a recall.

3.4 The batch numbers shall be recorded on the as-built sketch. The batch numbers will also be recorded as part of the final mapping record.

SECTION 23.00 Joint Trench Installations

- Joint Trench Installations
- References
- Excavation
- Backfill
- Clearance
- Facility Location
- Customer Provided Trench – Customer Responsibilities

1.1 JOINT TRENCH INSTALLATIONS

1.2 This section pertains to the installation of gas lines in the same trench with electric cables (buried directly or within duct), telephone cables (buried directly or within duct), and television cables. Joint trenching of gas lines with sewers and water lines must be approved by the Village.
As always, good coordination between all of the joint trench parties (electric, gas, cable television (CATV), telephone, and the customer or contractor is essential if cost savings associated with joint trenching are to be maximized.

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Part 192, Subpart E and F.

2.3 NYCRR, Public Safety Title 16, Part 255 various sections.

2.4 Fuel Gas Code of New York State and ANSI Z223.1-1996, Part 3, Gas Piping Installation, 3.1.3.

2.5 NFPA 54

3.1 EXCAVATION

3.2 Trench Width - The trench must be wide enough to allow a minimum of twelve (12) inch of horizontal separation between gas lines and any other utility. The gas lines shall be located on the side of the trench that is closest to the house.

3.3 Trench Depth - The normal cover directly over the pipe is to be at least twenty four (24) inches. The final grade over the pipeline is determined from the subdivision maps and the installation depth is shown on the gas proposal.

3.4 Trench Bottom (Bedding) - The trench bottom shall be reasonably level and free of all rock and other sharp objects. If the facilities are to be installed in either a rock excavation or soil that may damage it, a bedding of three inches of small particle-size soil shall be placed in the trench prior to the installation of the facilities. As a rule, small particle-size material shall be considered as material that is either rounded and contains particles ¾ of an inch in diameter or sand.

3.5 Trench Walls - Trench walls will be as vertical as possible.

3.6 Trench Obstructions - The Contractor is responsible for obtaining the location of all underground pipe, ducts and obstructions from the owner of the facility before excavation of a trench. He is responsible for making certain that no damage is incurred because of his excavation.

3.7 No tree roots shall be cut without permission of the governing authorities of the right of way (State, County, City, Town) or, on private property, the property owner.

3.8 Excavation location changes are made only with permission of authorized representatives of those utilities involved.

3.9 Trench (Padding) – Refers to the area in the trench above the facilities. Small particle sized soil shall be placed over the facilities for a depth of six (6) inches. Care should be taken not to pierce the sand layer with stones and other sharp objects.

4.1 BACKFILL

4.2 Refers to the area six inches above the facilities to grade. No rocks larger than approximately four (4) inches in any dimension will be allowed Backfill trench with clean backfill material, until the compacted backfill is twelve (12) inches over all utilities. Clumps of frozen material shall be broken up and pulverized prior to backfill.

4.3 Method - The contractor will backfill all excavations to the satisfaction of the property owners, and all involved utility agencies.

5.1 CLEARANCE

5.2 Construct the trench to provide twelve (12) inches clearance from any existing or proposed underground structure such as sewers or water lines. No utility should be installed above the horizontal plane of the gas line. It is preferred that all utilities be installed at the same depth (Horizontal Construction).

5.3 Electric lines should be installed below gas facilities at crossings. Vertical separation between electric and gas facilities shall be as follows:

6-inch minimum for gas main or service.

5.4 If gas services are installed in a joint trench the gas facilities should be installed to the right side (as facing the house) of pad-mounted equipment. A 12-inch separation should be maintained between gas facilities and the concrete foundation for pad-mount equipment.

5.5 If gas services are installed in a joint trench, the electric meter shall be installed on the front corner on the end of the house. The gas meter shall be installed near the electric meter, but sufficiently toward the rear of the house to: 1) maintain a 12-inch minimum horizontal separation between the gas regulator and the electric meter cabinet, and 2) maintain a 6-inch minimum horizontal separation between any gas piping and the electric meter cabinet.

5.6 The gas regulator vent shall be located at least 18 inches away from any opening into the structure. Where practical, the gas regulator should not be located under a window capable of being opened.

6.1 FACILITY LOCATION

6.2 Facility location is preferred to be on private property. Installation on highway right of way can be an alternate location as conditions dictate.

7.1 CUSTOMER PROVIDED TRENCH – CUSTOMER RESPONSIBILITIES

7.2 The customer will be required to coordinate the installation with other utilities (electric, gas, cable television (CATV), telephone).

7.3 Provide easements as required.

7.4 Provide a clear path for utilities, graded within six (6) inches of final grade.

7.5 Request and schedule coordinating meeting with all utilities prior to construction.

7.6 Provide the Village five (5) working days' notice to schedule the installation.

7.7 Call Dig Safe New York at 1-800-962-7962 for utility stake out at least 48 hours but not more than 10 days prior to the anticipated start of excavating (some utilities may not belong to Dig Safe and will need to be notified individually)

NOTES:

1. The trench shall be dug one day prior to installation of all utilities.
2. The Village will inspect and approve the trench the day before installation.
3. The Village will install any road crossings as necessary.
4. The Village will witness the bedding/padding of utilities when conduit is not used.

SECTION 24.00 BYPASSING

- Bypassing
- References
- General

1.1 BYPASSING

1.2 This section is written to provide a guideline for personnel when bypassing and tying in gas mains. Also included in this section is the need and proper placement of pressure indicating gauge locations for safely and expeditiously completing a bypass.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255.

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR.

3.1 GENERAL

3.2 The bypass shall be modeled with expected pressure drops and conveyed to the field as details on construction drawings or through written procedural steps.

3.3 There are other manufacturer's fittings that can be used for bypassing such as mechanical service tees without flow limiter and high volume electrofusion tees.

3.4 All bypass and stopping operations shall be performed using pressure indicating gauges to determine both upstream and downstream pressures. The gauges shall be monitored during the operation to verify the pressure and any abnormal operating condition that may occur due to the procedure.

3.5 The pressures shall be monitored the entire time the bypass is being used.

3.6 The pressure indicating gauges shall be installed as close as possible to the work location and within the line of site of the work. Radio or telephone communication may also be used if needed. The indicating gauges may be installed in the following locations:

- service tee connections installed for the bypass operation
- house meter set
- terminal gauges
- or station chart recorders.

3.7 The placement and usage of gauge locations shall be documented on the construction drawings or in the written procedure.

SECTION 25.00 TAPPING GAS SERVICES

- Tapping
- References
- General

1.1 TAPPING GAS SERVICES

1.2 This section details the requirements of tapping gas services and proper installation location for service tees for plastic.

2.1 REFERENCES

2.2 NYCRR, Public Safety Title 16, Part 255.367

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR.

3.1 GENERAL

3.2 Self -Tapping tees are the primary service connection for gas services. Only qualified employees shall perform the installation/tapping operation.

3.2.1 Self-tapping mechanical tees are available for high density plastic mains in main sizes 2", 4", and 6" and outlet sizes from 1/2" & 1". Outlet sizes greater than 1 ¼" require the use of electrofusion high volume tapping tees.

3.3 Each service line connection to a main must be located at the top of the main between the 315˚ and 45˚ or between 10 and 2 positions. Installation angles greater than this may produce difficulty in proper operation of the flow - limiting device if so equipped. Side tap connections are not recommended due to the possibility of moisture or other liquids being carried from the main to service line.

SECTION 26.00 PIPELINE TEST REQUIREMENTS

- Scope
- References
- Acronyms
- Definitions
- Responsibilities
- General
- Testing Steel and Plastic Pipelines Operating at Less than 125PSIG.
- Pressure Testing Steel Pipelines Operating at 125 PSIG or Above
- Test Requirements for Steel and Plastic Service Lines Operating at Less Than 125 PSIG
- Test Requirements For Reinstating Service Lines

1.1 SCOPE

1.2 This section covers the pressure test requirements for distribution and transmission main and service pipelines. This procedure shall be used to verify system integrity and establish the maximum allowable operating pressure (MAOP) prior to placing in service.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Parts 255.505, 255.507, 255.511, 255.725

3.1 ACRONYMS

3.2 Maximum Allowable Operating Pressure (MAOP)

3.3 Pounds per Square Inch Gauge (psig)

3.4 Public Service Commission (PSC)

3.5 Specified Minimum Yield Strength (SMYS)

3.6 Combustible Gas Indicator (CGI)

3.7 Flame Ionization (FI)

4.1 DEFINITIONS

4.2 Stabilization: The point in time when the test pressure will not drop below the minimum required test pressure at any time during a test.

4.3 Time Off: The time at which the pressure recording gauge or pressure indicating gauge is removed and the pressure test officially ends.

4.4 Time On: The time at which the test pressure has stabilized, the pressure recording gauge or pressure indicating gauge is installed and the pressure test officially begins.

4.5 Disconnect: To physically separate a service line at the main or any location along its entire length.

4.6 Reinstating: Reconnecting a service line that has been disconnected. When a service line is reinstated, a pressure test is required.

5.1 RESPONSIBILITIES

5.2 Gas Operator is responsible for:

5.2.1 Providing the PSC with the required five days verbal notice prior to pressure testing pipelines operating at 125 psig or above.

5.2.2 Performing the pressure tests and recording the results.

5.2.3 Ensuring all gauges are calibrated.

5.2.4 Providing the PSC with a signed copy of the completed pressure test chart for pipelines operating at 125 psig or above.

6.1 GENERAL

6.2 When performing a pressure test, the following information shall be included on the recording chart or the as-built sketch (if a pressure indicating gauge is used):

6.2.1 Signature of employee and employee number

6.2.2 Time On

6.2.3 Date On

6.2.4 Time Off

6.2.5 Date Off

6.2.6 Test duration, if a pressure indicating gauge is used

6.2.7 Test medium (water, inert gas, air)

6.2.8 Description of the project or section of the project

7.1 TESTING STEEL AND PLASTIC PIPELINES OPERATING AT LESS THAN125 PSIG

The test pressure shall be 90 psig or 1.5 times the MAOP, whichever is greater

7.1 **The test pressure for plastic shall never exceed 3 times the design pressure**.

7.2 The test duration shall be at least one hour after stabilization.

7.4 The test medium shall be air, inert gas, or water. During the test, the temperature of the plastic pipe shall not exceed the temperature at which the material's long-term hydrostatic strength has been determined, or 100ºF, whichever is greater.

7.5 A calibrated indicating gauge or pressure recording gauge that will indicate increments of two psig or less shall be attached to the test section.

7.5 For tests on short sections (100 feet or less) of plastic pipe and tie-in sections where all joints, and/or fittings are exposed, a soap test is acceptable at line pressure.

The entire pipe length must be soap tested. Natural gas may be used as the test medium at the maximum pressure available in the distribution system at the time of the test.

8.1 PRESSURE TESTING STEEL PIPELINES OPERATING AT 125 PSIG OR ABOVE

8.2 The test pressure shall be 90 percent of the SMYS or 1.5 times the MAOP, whichever is less.

8.1 The test medium shall be air, inert gas, or water. If the pipeline will operate above 20 percent SMYS in any location or operate at 125 psig or above in a Class 4 location, the medium must be water unless there are no buildings intended for human occupancy within 300 feet of the pipeline facilities being tested. Prior approval must be granted by the PSC to use air or inert gas.

8.2 The test duration shall be 12 hours after the pressure has stabilized.

8.2.1 The duration of the test may be reduced to four hours, following stabilization, for short lengths of pipe (including tie-in sections) which have not been backfilled and the entire circumference can be examined

visually for leakage.

8.2.2 For safety reasons it is preferable to conduct these tests hydrostatically. However, an inert gas may be used in situations where hydrostatic testing is not practicable.

8.3 A pressure recording gauge, calibrated in accordance with procedure for (Calibration of Pressure Indicating Gauges, Recording Gauges and RTUs), with increments of five psig or less, where practicable, shall be attached to the test section.

8.3.1 The pressure recording gauge must be calibrated hourly for the first and last two hours of the test. Calibration shall be performed using a dead weight tester, or electronic pressure recording gauge. All data shall be documented on the Pressure Test Data Sheet

8.3.2 In addition, readings for pressure and temperature shall also be observed and documented every hour on the Pressure Test Data Sheet.

8.4 Flanged joints and fittings may be subjected to system hydrostatic tests at pressures not to exceed the following:

8.4.1 150# Class – 450 psig
8.4.2 300# Class – 1125 psig
8.4.3 400# Class – 1510 psig
8.4.4 600# Class – 2225 psig

8.5 A copy of the completed Pressure Test Data Sheet and pressure recording charts shall be maintained in the project.

9.1 TEST REQUIREMENTS FOR STEEL AND PLASTIC SERVICE LINES OPERATING AT LESS THAN 125 PSIG

9.2 Test requirements:

9.1

Pipe Material	Pipe Size	Test Pressure	Test Duration
Steel or Plastic	2” and smaller	90 psig or 1.5 X MAOP (whichever is greater)	15 minutes

Steel or Plastic	Greater than 2”	90 psig or 1.5 X MAOP (whichever is greater)	30 minutes

9.3 The test medium shall be air. During the test, the temperature of the plastic pipe shall not exceed 100ºF.

9.4 A calibrated pressure indicating gauge shall be attached to the test section that will indicate:

9.4.1 Increments of five psig or less for services operating at 100 psig or greater; or

9.4.2 That any loss of pressure is readily detected for services operating less than 100 psig.

9.5 The limits of the test shall be from the main to the service line valve immediately upstream of the meter or regulator for both inside and outside sets.

9.6 The service line connection to the main does not need to be included in these tests if it is not practical. However, the main connection shall be leak tested at operating pressure when placed into service.

9.6.1 If a service tee is not removed or a new service tee is installed over an existing tap hole as a result of a service replacement, a soap test is required for each connection and tie in piece that is not subjected to a pressure test.

10.1 TEST REQUIREMENTS FOR REINSTATING SERVICE LINES

10.2 All service lines operating at pressures less than 125 psig that have been disconnected as a result of third party damage shall be air tested from the point of disconnect to the house end as described in section 9.1 of this section.

10.2.1 All final connections shall be soap tested at line pressure. The point of disconnect to the main shall be evaluated for leakage by surveying with a FI unit or CGI after repair. If the ground is saturated with natural gas, it shall be surveyed daily until zero percent gas in air readings are obtained.

10.3 Service lines disconnected from the source of supply for any length of time shall be tested in accordance with the following steps prior to reinstatement. The test limits shall be from the main or point of disconnect to the service line valve immediately upstream of the meter or regulator.

10.3.1 If the MAOP is less than or equal to 20 psig, the test pressure shall be three psig or three times the MAOP, whichever is greater.

10.3.2 If the MAOP is more than 20 psig up to and including 60 psig, the test

pressure shall be 90 psig.

10.3.3 If the MAOP is greater than 60 psig, the test pressure shall be 1.5 times the MAOP.

10.3.4 The test duration for steps 10.3.1, 10.3.2 and 10.3.3 shall be 15 minutes.

10.3.4.1 **For services larger than two inches to be operated at pressures less than 125 psig refer to the table in section 9 of this procedure.**

10.3.5 The test medium shall be inert gas or air.

10.3.6 The test shall be conducted with a calibrated pressure indicating gauge.

SECTION 27.00 PURGING MAINS AND SERVICES

- Scope
- Reference
- General Guidelines
- Purging Services Lines
- Purging Mains

1.1 PURGING OF MAINS AND SERVICES

2.1 SCOPE: This section covers proper purging methods of service lines and mains. Purge is the act of removing the content of pipe and displacing it with another gas.

3.1 REFERENCE:

3.2 NYCRR Public Safety Title 16 Parts Part 255.629, 255.727, 255.751,
3.3 AGA Purging Principles and Practices.

4.1 GENERAL GUIDELINES

4.2 New gas mains, services, extensions, and tie-ins shall be purged of all air before being placed in service. All mains and services to be abandoned shall be disconnected from all sources of gas, completely purged of natural gas.

4.3 New gas mains and services shall only be purged after successfully completing a pressure leak test. Only a qualified person may perform purging operations.

4.4 A minimum of two people shall be present during the purging of a main or service; one to control the flow of the purging gas at the source and the other to control the flow where the purging gas enters the atmosphere.

4.5 New or replacement gas mains shall be tied into the system prior to purging operations. Sources of ignition shall be eliminated in the area of the purging operation. Plastic pipe shall not be used for purging transitions to steel risers and precautions to eliminate static electricity at squeeze locations shall be utilized.

4.6 When using air to purge a main or service to be cut dead, no combustible gas mixture shall be present in the gas main or service following the purging operation.

4.7 Avoid the public's presence in the area of the purging operation.

5.1 PURGING SERVICE LINES

5.2 Requirements for purging lines to initiate or restore service are as follows:

5.2.1 An inert gas (nitrogen or carbon dioxide) purge is not required for service lines.

5.2.2 The service line valve should be operated before purging to ensure that it works properly and it can be closed.

5.2.3 Precautions shall be taken to ensure that natural gas is not being vented into a building or closed environment.

5.2.4 Any pipe or fittings being used to direct purging gas either “out of” or “away from” a closed environment shall be gas tight mechanical fittings.

5.2.5 Check for 100% gas using a calibrated Combustible Gas indicator (CGI) at a point where the purging gas enters the atmosphere.

5.2.6 Upon completion of the purge and closing of the service line valve any exposed pipe or fittings shall be checked for leakage.

5.2.7 After a new service purge is completed and the meter is not going to be installed immediately, the exposed service line valve shall be plugged and locked to prevent unauthorized use.

5.2.8 When purging service lines that will be abandoned, the hose or piping can be connected to either end of the service. Check for 0% gas using a calibrated CGI.

6.1 PURGING MAINS

6.2 Purging of gas mains shall be conducted through properly sized metallic piping constructed to extend 7 feet above grade. The minimum size vent shall be 1-inch nominal diameter.

6.3 All vent piping shall be grounded to dissipate any static charges developed during the purge.

6.4 Only one purge point shall be open at a time.

6.5 For activation of new mains, check for 100% gas using a calibrated Combustible Gas Indicator (CGI) at a point where the purging gas enters the atmosphere.

6.6 For abandoning of mains, check for 0% gas using a calibrated Combustible Gas Indicator (CGI) at a point where the purging gas enters the atmosphere. If after using the required amount of nitrogen, the gas is still not a 0%, air may be used to complete the purge.

6.7 Purging mains less than 6 inches in diameter.

6.7.1 Gas mains less than 6” do not require an inert gas (nitrogen or

carbon dioxide) purge.

6.8 Purging 6 inch mains and greater in diameter.

6.8.1 Short sections of gas mains 6 inch or greater in diameter and less than 40 cubic feet, may not require an inert gas purge at the discretion of the Gas Foreman.

6.8.2 All other gas mains 6 inch or greater in diameter shall be purged with an inert gas (nitrogen or carbon dioxide) when activating or abandoning in place.

6.9 Refer to Table 1 below for the required amount of inert gas to purge by completely filling the volume with an inert gas.

Table 1 - Required Inert Gas Amount

Nominal Pipe Size	Volume of Inert Gas Required per 100 ft of Pipe Length
6 inch	30 cubic feet
8 inch	55 cubic feet
10 inch	90 cubic feet
12 inch	120 cubic feet
16 inch	190 cubic feet
20 inch	310 cubic feet
24 inch	450 cubic feet
30 inch	700 cubic feet
36 inch	1020 cubic feet

6.10 When it is impractical to completely fill the pipeline with an inert gas due to the pipelines length, a slug purge may be performed. This reduces the amount of nitrogen required to safely purge the line.

SECTION 28.00 CASINGS

- Casings
- Reference
- General Information for Casings

1.1 CASINGS

1.2 This section describes the general installation requirements for casings. Refer to specific design for installation details.

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Part 192.323, Casing.

2.3 NYCRR Public Safety Title 16 Part 255.323.

3.1 GENERAL INFORMATION FOR CASINGS

3.2 Casing Pipe – The casing shall be two pipe sizes larger than the carrier pipe

3.3 Place a casing insulator within six inches of the casing ends and space casing insulators evenly every 8 to 10 feet for plastic carrier pipe. Insulators should be adequately tightened to prevent slippage when inserting pipe into casing.

3.4 Center and insert carrier pipe through casing.

3.5 Clean ends of casing and carrier pipe in preparation of link seal installation. The link seals provide an end seal at the casing ends that protect the casing from debris.

3.6 Install end seals at both ends of the casing.

SECTION 29.00 TERMINAL GAUGE AND REMOTE RTU INSTALLATION

- Terminal Gauge & Remote RTU Installation
- References
- Requirements
- Design, Material, Fabrication, Installation
- Terminal Gauge Installation

1.1 TERMINAL GAUGE & REMOTE RTU INSTALLATION

1.2 This section describes in detail the materials required for a Terminal Gauge and a Remote Transmitting Unit (RTU) installation. This includes design, materials, fabrication and installation.

1.3 Pressure sensing Terminal Gauges and Remote RTU are used throughout the distribution system to measure and record gas system pressure fluctuations.

1.4 The Terminal Gauge records the pressure on a circular paper chart that is changed on predetermined schedule either weekly or monthly. The charts are reviewed to determine operating conditions and make pressure changes on a month by month basis.

1.5 The RTU continually transmits the measured pressure electronically to the gas SCADA where a dispatcher can control and/or observe the system pressures.

1.6 The recorded readings for both types of monitoring gauges are used to determine possible system problems or to verify system node maps for accuracy.

2.1 REFERENCES

2.2 Code of Federal Regulations, Transportation Title 49, Part 192.51, Subpart B-Materials.

2.3 NYCRR Public Safety Title 16 Part 255.203

2.4 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition, section 848.

3.1 REQUIREMENTS

3.2 For all Low Pressure Systems a Terminal Gauge or Remote RTU is required at or near all probable locations of minimum pressures in each part of the system as determined through network analysis.

3.3 On Distribution Systems greater than 12 inches water column pressure, the Design Engineer will determine the necessity of installing a Terminal Gauge or Remote RTU.

4.1 DESIGN, MATERIAL, FABRICATION, INSTALLATION

4.2 Fabrication shall be consistent with normal gas construction requirements.

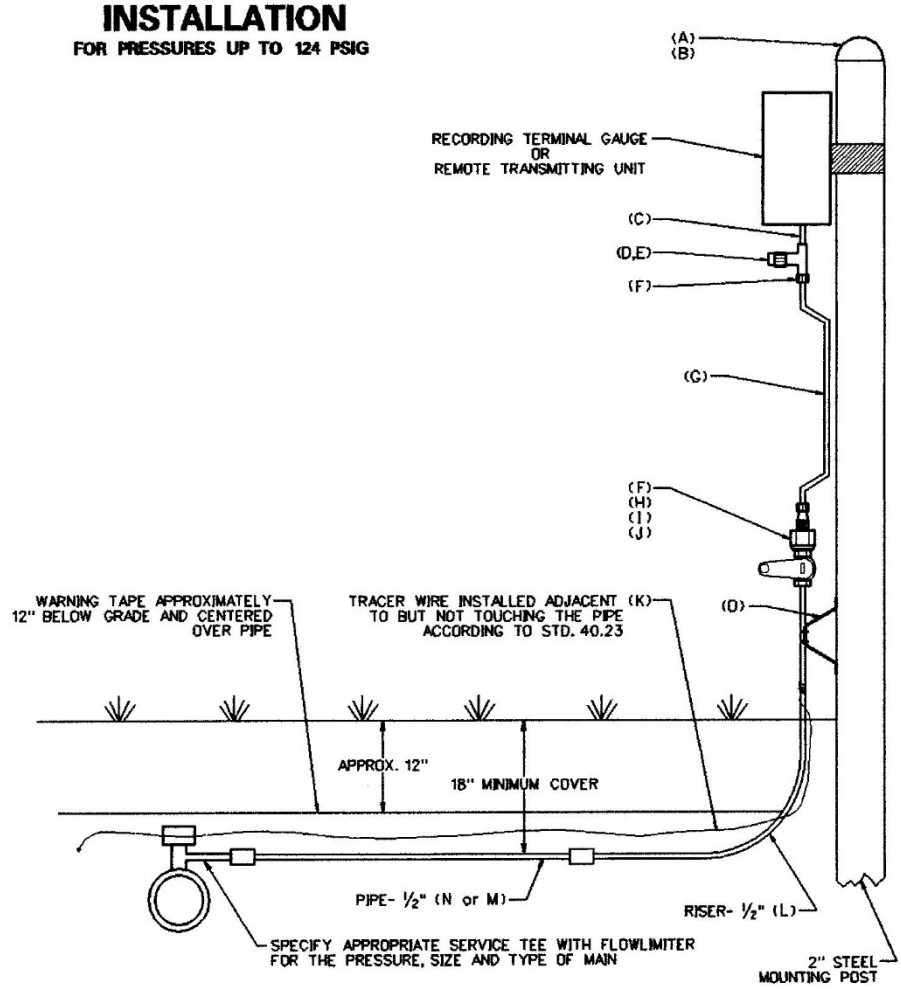
4.3 Connection to gas main shall be similar to that of a service. Installation shall be performed per the appropriate specification main material and pressures.

Item	Quantity	Description		
A	1	Cap, Weld, 2 “		
B	1	Pipe, Bare 2”		
C	1	Nipple, Thread, Black, ¼” x 3”		
D	1	Tee, thread, Black ¼”		
E	1	Plug, Threaded, Black, ¼”		
F	2	Adaptor, ¼” Pipe x 3/8” Tube		
G	**	Tubing, Stainless, 3/8”		
H	1	Nipple, Threaded, Black, ¾” x 2”		
I	1	Coupling, Threaded, Black, Reducing, ¾” x ¼”		
J	1	Valve, Lock wing, ¾”		
K	**	Wire, Tracer, #12 Solid		
L	1	Riser, ½” MDPE x ¾” IPS For Pressures Up To 124 PSIG		
M	***	Pipe, MDPE For Pressures Up To 60 PSIG		
N	***	Pipe, HDPE For Pressures Up To 124 PSIG		
O	1	Bracket , Service Riser, Adjustable ½” – 2”		

NOTES
* - Swagelok Part # SS-600-1-4, Parker Part # 6-4-FBZ-SS
** - Quantity as needed
*** - As required to meet pressure requirements

TERMINAL GAUGE INSTALLATION

FOR PRESSURES UP TO 124 PSIG



INSTALLATION GUIDELINES:

1) IF POSSIBLE, POSITION INSTALLATION OFF THE ROAD IN AN INCONSPICUOUS LOCATION, PROTECTED FROM TRAFFIC AND NOT ANNOYING THE CUSTOMER BY IT'S LOCATION.

2) ALWAYS USE SERVICE TEES WITH FLOW LIMITERS FOR MEDIUM PRESSURE APPLICATIONS.

3) ORDER CHART GAUGE WITH EITHER THE 8" OR 12" CHART, 31 DAY CLOCK, SOLID FRONT DOOR, WITH LOCKING HASP, PAINTED FOREST GREEN, 2" POST MOUNT AND BLUE PEN. THE PRESSURE RANGE MUST BE SPECIFIED. THE CHART SHOULD OPERATE IN THE MIDDLE OF THE RANGE. EXAMPLE: 45# SYSTEM ORDER 0-75# RECORDER, 60# SYSTEM ORDER 0-150# RECORDER 124# SYSTEM ORDER 0-150# RECORDER.

4) THE GAUGE SHALL BE INSTALLED AT APPROXIMATELY AVERAGE EYE LEVEL OR CENTERED AT ABOUT 5'6".

5) THE MOUNTING POST SHALL BE SET AT A DEPTH BELOW THE ANTICIPATED FROST LEVEL.

6) THE TAP CONNECTION FOR THE TERMINAL GAUGE SHOULD BE LOCATED AT THE MAIN LINE ONLY. THE TAP SHOULD NOT BE OFF CUSTOMERS SERVICE LINES DUE TO PRESSURE DROP ON SERVICE LINE THAT WILL RESULT IN INACCURATE PRESSURE READINGS.

SECTION 30.0 METERS – GENERAL

- General
- References
- Piping
- Outside Installations
- Meter Protection
- Load Diversification – Medium Pressure Mains
- Meter Swivels
- Meter Bypass Installation
- Special Regulations Governing Schools

1.1 GENERAL

1.2 This section provides general information to be used for gas meter set details, load diversification standards for low pressure delivery from medium pressure gas mains, and details the requirements for piping, piping components, and meter protection of various meter settings.

1.2 Any preliminary load over 5 MCFH on a medium pressure distribution system shall be reviewed for impact to service or main capacity.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Parts 255.351 to 255.359

2.3 National Fuel Gas Code (National Fire Protection Association, NFPA-54 and Z223.1-1996).

2.4 New York State Fuel Gas Code. NYS Department of State Division of Code Enforcement and Administration

2.5 New York State Education Department, Manual of Planning Standards, 1998 edition, Sections S409, S709, &. S710.

2.6 ASME Code for Pressure Piping, ASME B31.3-2002, Sec 304.3 Branch Connection.

3.1 PIPING

3.2 All meter and regulator installations shall be constructed from steel pipe using threaded, welded, flanged or compression connections. Only approved pipe and fittings may be used.

3.3 Threaded connections will be limited to 2” and smaller. However, rebuilds may require threaded fittings larger than 2”.

3.4 Outside sets shall be painted ASA#49 gray, equivalent (dark machinery gray) or thermally sprayed aluminum (TSA). Meters, regulators, overpressure protection and flange faces are not to be painted. Aluminum piping may be used only for vent stacks.

3.5 Copper piping may be used only for vent lines on regulators or overpressure protection. Plastic pipe shall not be used for vent piping.

4.1 OUTSIDE INSTALLATIONS

4.2 All meter and regulator sets shall be installed outside.

4.3 All purchased meters must be tested to 10psig minimum.

5.1 METER PROTECTION

5.2 Meters should be located in the safest possible location to minimize physical damage. Physical damage includes but is not limited to vehicular traffic, possibility of vandalism, and exposure to snow, ice or water runoff from roofs, etc. In cases where no hazards exist protection is not necessary.

5.3 Any meter or regulator set located within three feet of any driven surface, paved or unpaved, requires barricades. This includes installations perpendicular to the driven surface as well as those that are parallel. Installations beyond the three foot rule may have barricades when considered necessary.

5.4 Any commercial, industrial or fixed factor set where the possibility of vandalism could occur and no temperature and/or pressure corrector is used shall be, at a minimum, installed within a chain link fence. The chain link fence shall be paid for and maintained by the customer.

5.5 All meter sets with temperature and/or pressure correctors shall be installed in a building to protect the large capital investment and electronic equipment. A building may be employed around any set to enhance aesthetics or provide a greater level of protection when deemed necessary. All meter buildings will be constructed to Village standards and shall be paid for and maintained by the customer.

6.1 LOAD DIVERSIFICATION – MEDIUM PRESSURE MAINS

6.2 When providing gas service to customers served from medium pressure gas mains, the customer's total connected loads may be diversified based on type of load or load usage.

7.1 METER SWIVELS

7.6 The standard residential meter swivel for a prefab meter set is an offset (20 LT)

7.7 The same meter bar is used for 250, 425 and 630 meters.

7.4 When the gas load for a residential or small commercial customer exceeds the capacity of the standard 250 style meter. The offset swivels are needed due to the wider connection spacing of the 425 and 630 style meters.

8.1 METER BYPASS INSTALLATION

8.2 A meter bypass may be required when a customer's service can NOT be interrupted. A meter bypass would allow exchange of the meter as required by the mandated meter exchange program while providing continuous, albeit short term unmetered gas to the customer.

8.3 Include a bypass on the meter set to accommodate customers involved in:
- Critical manufacturing heating operation (i.e. - glass, heat treating)
- Critical care facilities (i.e. - Hospitals, nursing or group homes)
- Large load customers.

9.1 SPECIAL REGULATIONS GOVERNING SCHOOLS

9.2 Meters, regulators, and over pressure relief devices shall be protected by either being located within a separate meter building/room or fenced area adjacent to the school building.

9.3 The maximum delivery pressure into a boiler room shall be limited to 2 PSIG.

9.4 The maximum delivery pressure directly into any other school area shall be a maximum of ½ PSIG.

9.5 Piping after Village owned metering and regulating equipment owned by the school, located inside and larger than 3 inches must be welded construction.

9.6 Pressure testing (required by school's contractor) must comply with the following:

9.6.1 Piping with a working pressure up to 12 inches water column is to be tested with air or inert gas for a minimum of 1 hour at 15 PSIG.

9.6.2 Piping with a working pressure above 12 inches water column is to be tested with air or inert gas for a minimum of 1 hour at ½ times the working pressure or a minimum of 50 PSIG.

9.6.3 Pressure tests must be made in the presence of the architect, engineer, or their representative.

SECTION 31.00 RESIDENTIAL METER SETS

- Residential Sets
- References
- Meters
- Regulators
- Drawings of Residential Sets

1.1 RESIDENTIAL SETS

1.2 This section details the requirements of residential meter sets.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Parts 255.351 to 255.359.

2.3 National Fuel Gas Code (National Fire Protection Association, NFPA-54 and Z223.1-1996).

2.5 New York State Fuel Gas Code. NYS Department of State Division of Code Enforcement and Administration

3.1 METERS

3.2 All new meter sets will be installed outside of the building being served and located to minimize exposure to snow, ice, or water runoff from roofs, including locations where snow is piled when practicable. All meter and regulator sets shall be installed outside. Under some circumstances a meter may be installed inside. All inside sets shall have outside shutoff valves.

3.3 Gas meters must have a minimum separation of 3 feet from sources of ignition. Electric meters are not considered sources of ignition.

3.4 All new meter installations must be insulated at the inlet and outlet of the Villages' metering/regulating facilities. In most cases, this will be accomplished by the use of an insulating union service valve and an insulating union on the outlet of the meter bar.

3.5 If the customer wishes to install some type of meter cover, it should be constructed so company work can be accomplished without hindrance.

3.6 Corrugated stainless steel tubing (CSST).

3.6.1 Single meter sets. CSST shall be located on the building interior only. An approved CSST wall flange or black iron pipe shall be used through the exterior wall and hard piped to the meter set to provide adequate support.

3.6.2 Multiple meter sets. CSST may be used on the exterior of the building (between ground and a height of 6') in an exposed condition provided the CSST is protected inside a conduit and a wall flange or black iron pipe is used for the wall penetration.

3.6.3 CSST requires manufacturer's qualified installers, specific guidelines apply to these installations such as grounding details, refer to manufacturer's instructions.

4.1 REGULATORS

4.2 For each installation, operating personnel will decide on the location of the vent terminus and the vent size considering customer safety, aesthetics, and economics. **In all cases the regulator diaphragm vent shall be located 18 inches above anticipated final grade.** The bottom of the meter shall not be in contact with the ground. In areas subject to flooding the vent opening should be raised up to 10 feet. Vent extensions over 10 feet must be properly sized for adequate relief capacity.

4.3 Internal relief regulators should be located outside on the riser. If for some reason the service termination must be inside, an internal relief regulator can be located inside if the vent is piped to terminate outside.

4.4 The vent terminus for both the inside and outside locations shall have the vent opening pointing toward the ground, be covered with an insect-proof cap, be at least 18” above the finished grade, be 18” from any building opening and be placed where the vent cannot create a hazard.

4.5 If the customer installs an enclosure, any vents shall terminate outside the enclosure.

4.6 Inspection of all residential regulators shall be done in accordance with the Gas Operating and Maintenance Procedures Manual.

4.7 Customers that require service pressure greater than 7” (1/4psig) will require Meter and regulator sets designed to the specific application.

5.1 DRAWINGS OF RESIDENTIAL SETS

Pre-Fab Meter Set – MP
(¾” x 1”) and (1” x 1”)

Pre-Fab Two Meter Manifold – MP
(3/4”x1”) and (1”x1”)

Pre-Fab Three Meter Manifold – MP
(3/4”x1”) and (1”x1”)

Pre-Fab Four Meter Manifold – MP
(3/4”x1”) and (1”x1”)

DETAIL DRAWINGS TO BE ADDED

SECTION 32.00 FIXED FACTOR METER MEASUREMENT

- Fixed Factor Measurement
- References
- Delivery Pressure for Fixed Factor Installations
- Meters
- Regulators – Village Owned
- Relief Valves – Village Owned
- Back Flow Protection
- Drawing Details of Fixed Factor Installations

1.1 FIXED FACTOR MEASUREMENT

1.2 This section details the requirements for fixed factor installations.

2.1 REFERENCES

2.2 Codes and Regulations of the State of New York, Public Safety Title 16, Part 226.11.

2.3 NYCRR Public Safety Title 16 Parts 255.351 to 255.359.

2.4 National Fuel Gas Code (National Fire Protection Association, NFPA-54 and Z223.1-1996).

2.5 New York State Fuel Gas Code. NYS Department of State Division of Code Enforcement and Administration

3.1 DELIVERY PRESSURE FOR FIXED FACTOR INSTALLATIONS

3.2 If elevated delivery pressure (14" water column or greater) is to be served, the following shall apply when utilizing fixed factor measurement:

1. **Available Delivery Pressures** - 1/2 PSIG, 1 PSIG, 2 PSIG, 3 PSIG, 5 PSIG. In certain applications, e.g. grain dryer, 10 PSIG may be made available.

As with any installation, system capacity and pressure availability must be checked. Any preliminary load over 5.0 MCFH on a medium pressure distribution system or elevated pressure requests of 2 psig and greater must be reviewed also.

2. **Capacity Ranges** – Load Capacity for Fixed Factor regulators must be Confirmed.

3. **Customer Equipment and Piping** - Customers served gas in excess of 14" W.C. (1/2 PSIG) must comply with the Gas O&M Procedures. Customers receiving this service will be required to properly install devices for the sole purpose of controlling the downstream pressure. This equipment must prevent the gas pressure on internal piping from exceeding 5 psig, except inside boiler rooms or mechanical rooms where the general public has no access.
Doors and rooms must meet a 2-hour fire-rating requirement.

4. **Requirements -** Delivery pressures of 14" wc or higher will be supplied after the customer's request has been approved and the customer has signed the letter of understanding that explains the requirements (Fuel Gas Code of New York State) associated with the elevated delivery pressure.

4.1 METERS

4.2 All meter installations must be insulated at the inlet and the outlet of the metering/regulating facilities.

4.3 All meters will be operated at (6.5" +-.5") of water column (WC) unless the billing registration is compensated for the higher pressure. A fixed factor billing constant tag should be attached to the index of the meter at time of installation.

5.1 REGULATORS – VILLAGE OWNED

5.2 If the customer demand is small enough to permit the use of a regulator with internal relief, the following rules apply:

- Regulators without internal relief must be used in conjunction with a separate relief valve.
- For each installation, operating personnel will decide on the location of the vent terminus and the vent size considering customer safety, aesthetics, and economics.
- Internal relief regulators should be located outside on the riser. The vent terminus locations shall have the vent opening pointing toward the ground, be covered with a bug-proof cap, be at least 18" above the finished grade, be 18" from any building opening and be placed where the vent cannot create a hazard.
- If the customer installs an enclosure, any vents must terminate outside the enclosure.

6.1 RELIEF VALVES – VILLAGE OWNED

6.2 Steel, aluminum, or copper piping must be used to construct relief valve vents. For each installation, operating personnel will decide on the location of the vent termination and vent size considering customer safety, aesthetics, and economics. The vent termination will be at least 8' above final grade.

6.3 Weather resistant protective caps will be installed on all relief valve vents.

6.4 All relief valve vents will have weep holes drilled through the lower elbow or cap for water to drain (per attached drawings).

6.5 Relief valves will be installed except where internal relief regulators or monitor regulators may be used.

6.6 Relief valves used on individual services will be installed above ground only. Any isolation valve installed ahead of a relief valve must be locked in the open position except for maintenance or testing.

6.7 Inspection of all relief valves will be done as required in the Gas O&M Manual.

7.1 BACK FLOW PROTECTION

7.2 A suitable protective device shall be installed and maintained by the customer downstream of our regulator and metering facilities under the following conditions:

(a) If the gas utilization equipment might induce a vacuum at the meter, install a backpressure regulator downstream of our facilities.

(b) If the gas utilization equipment might induce a backpressure, or if it is connected to a source of oxygen or compressed air, install a check valve. If liquefied petroleum gas or other supplementary gas is used as a standby and might flow back into our facilities, a three-way valve, installed to admit the standby supply

8.1 DRAWING DETAILS OF FIXED FACTOR INSTALLATIONS

Fixed Factor – Rotary bypass– RM 8C/11C/15C

Fixed Factor - Rotary bypass– RM 15C/2M/3M

Fixed Factor - Rotary bypass- RM 5M/7M

DETAIL DRAWINGS TO BE ADDED

SECTION 33.00 COMMERCIAL AND INDUSTRIAL MEASUREMENT

- Line Pressure Measurement
- References
- Elevated Delivery Pressures
- Meters
- Regulators – Company Owned
- Relief Valves – Company Owned
- Back Flow Protection
- Drawings: Industrial and Commercial Sets

1.1 LINE PRESSURE MEASUREMENT

1.2 This section details requirements for Line Pressure Measurement such as industrial and commercial meter sets.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Parts 255.351 to 255.359

2.3 National Fuel Gas Code (National Fire Protection Association, NFPA-54 and Z223.1-1996).

2.4 New York State Fuel Gas Code. NYS Department of State Division of Code Enforcement and Administration

3.1 ELEVATED DELIVERY PRESSURES

3.2 If elevated delivery pressure (greater than 6.5 +/- 0.5" WC) is to be served, the following shall apply:

1. **Customer Equipment and Piping** - Customers receiving this service will be required to properly install approved over pressure protection devices for the sole purpose of controlling the downstream pressure. This equipment must prevent the gas pressure on internal piping from exceeding 5 psig except inside boiler rooms or mechanical rooms where the general public has no access. Doors and rooms must meet a 2-hour fire-rating requirement.

2. **Requirements -** Delivery pressures of 14" wc or higher will be supplied after the customers request has been approved and the customer has signed the letter of understanding that explains the requirements (Fuel Gas Code of New York State) associated with the elevated delivery pressure.

4.1 METERS

4.2 All new or rebuilt meter installations must be insulated at the inlet and the outlet of Village's metering/regulating facilities.

4.3 All meters will be operated at 6.5 + .5" of water column (WC) unless the billing registration is compensated for the higher pressure.

4.4 All installations using temperature and/or pressure compensating instruments must be enclosed within a building.

4.5 Rotary meters should be used on as many installations as possible.

5.1 REGULATORS – VILLAGE OWNED

5.2 If the customer demand is small enough to permit the use of a regulator with internal relief, the following rules apply:

- Regulators without internal relief must be used in conjunction with a separate relief valve.
- For each installation, operating personnel will decide on the location of the vent terminus and the vent size considering customer safety, aesthetics, and economics.
- Internal relief regulators should be located outside on the riser. The vent terminus locations shall have the vent opening pointing toward the ground, be covered with an insect-proof cap, be at least 18” above the finished grade, be 18” from any building opening and be placed where the vent cannot create a hazard.
- If the customer installs an enclosure, any vents must terminate outside the enclosure.

6.1 RELIEF VALVES – VILLAGE OWNED

6.2 Steel, aluminum, or copper piping must be used to construct relief valve vents.

6.3 For each installation, operating personnel will decide on the location of the vent termination and vent size considering customer safety, aesthetics, and economics.

6.4 All relief valve vents will have weep holes drained through the lower elbow or cap for water to drain.

6.5 Weather resistant protective caps will be installed on all relief valve vents.

6.6 Relief valves will be installed except where internal relief or monitor regulators may be used.

6.7 Relief valves used on individual services will be installed above ground only. Any isolation valve installed ahead of a relief valve must be locked in the open position except for maintenance or testing.
Inspection of all relief valves will be done as required in the Gas O&M Manual.

7.1 BACK FLOW PROTECTION

7.2 A suitable protective device shall be installed and maintained by the customer downstream of our regulator and metering facilities under the following conditions:

(a) If the gas utilization equipment might induce a vacuum at the meter, install a backpressure regulator downstream of our facilities.

(b) If the gas utilization equipment might induce a backpressure, or if it is connected to a source of oxygen or compressed air, install a check valve. If liquefied petroleum gas or other supplementary gas is used as a standby and might flow back into our facilities, a three-way valve, installed to admit the standby supply.

8.1 DRAWINGS: INDUSTRIAL AND COMMERCIAL SETS

MP - Rotary - RM-8C/11C/15C

MP - Rotary - RM-15C/2M/3M

MP - Rotary - RM-5M/7M

DETAIL DRAWINGS TO BE ADDED

SECTION 34.00 CORROSION

- General Requirements
- References
- General
- Anode
- Surveys

1.1 CORROSION: GENERAL REQUIRMENTS

1.2 This section describes the general requirements for corrosion control.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Parts 255.455 to 255.359
255.455 Chapter III Gas Utilities.

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1995 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR, Subpart J, Requirements of Corrosion Control.

2.5 National Association of Corrosion Engineers (NACE).

3.1 GENERAL

3.2 All steel pipe, valves, and fittings (distribution and transmission) shall be coated or wrapped entirely for new construction jobs. The manufacturer's installation procedures shall be followed when installing all materials.

3.3 Careful consideration shall be given to the placement of insulating devices.

3.4 Compression couplings, sleeves, and valves should be ordered with factory applied epoxy coating or equivalent. Couplings not previously coated, are to be wrapped with an approved material in order to protect the fitting and/or pipe.

3.5 Bolts on buried couplings, valves, and flanges shall be coated in the field to eliminate the possibility of corrosion. In all above ground installations these appurtenances shall be coated with an epoxy coating.

4.1 ANODES

4.2 Anodes shall be installed for cathodic protection of mains. The common sizes of anodes used for corrosion control are the 1# ingot, and cloth bagged anodes with backfill in 3#, 17#, and 50#.

4.3 Anodes shall be installed with a minimum separation between other anodes by 3' and installed a minimum of 3' to the side of the main and 1' below.

4.4 Anodes may be installed perpendicular or parallel along the pipeline.

5.1 SURVEYS

5.2 New steel pipelines should have a cathodic protection system installed at the time of construction and shall be cathodically protected within 1 year of installation. A close interval survey not exceeding 5 feet may be completed to establish a baseline for cathodic protection potential measurements.

5.3 One-time pipe to soil potential readings on isolated fittings will be taken at the time of installation by field personnel and documented on the as built print.

5.3.1 Acceptable minimum pipe to soil potential reading (greater than 1.0 MV) must be obtained.

SECTION 35.00 CORROSION COATINGS

- References
- Pipe Coatings - General
- Tape/Wrapping
- Tape/Shrink Sleeves
- Ground Coatings

1.1 REFERENCES

1.2 NYCRR Public Safety Title 16 Part 255.461

1.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

1.4 Department of Transportation (DOT), Part 192, 49 CFR, Subpart J, Requirements of Corrosion Control.

1.5 National Association of Corrosion Engineers (NACE).

2.1 PIPE COATINGS - GENERAL

2.2 Repairs and field coating during construction and maintenance is accomplished using approved hot and cold applied tapes, shrink sleeves, and paints.

3.1 TAPE/WRAPPING

3.2 Tapes and wrapping wherever applied is part of the pipe coating and is important part of the piping system's coating integrity. Tapes are effective only when applied properly, on clean, dry, primer coated pipe in accordance with manufacturers recommended procedures. All bare areas along a coated steel pipe including fittings, valves, and drips should be coated.

3.3 Cleaning and priming shall extend onto the existing pipe's coating (2 inch minimum overlap). This overlap shall ensure better overall corrosion protection.

3.4 Any time primer is used it shall be allowed to dry to a tacky condition before coating application (except in the application of wax tape primers).

3.5 Care should be used during the backfilling process as improperly placed or compacted backfill can create significant soil stresses that tend to pull off the applied coating.

3.6 Coating applications shall be over lapped 2-inch minimum onto existing undisturbed mill applied coatings.

3.7 Ensure the tape ends and edges are properly bonded and sealed to eliminate slippage of tape due to settlement.

3.7.1 Risers should be coated with Tapecoat H35 Grey Tape, or equivalent, no wax tapes shall be used.

3.7.2 Buried pipes should always be wrapped from the left side counterclockwise while

standing over the pipeline, final end taping shall be terminated in the 3 – 6 o' clock position to prohibit unwrapping caused by settlement

4.1 APPROVED TAPE/SHRINK SLEEVES

4.2 **Trenton #1 Wax Tape Buried Piping Only**
Color: Brown
Petroleum based wax tape 70-90 mils thickness
4" and 6" width

Vendor: McJunkin

This tape may be used on any below ground installation, but will perform most effectively when coating an irregular shaped component such as fittings, tees, flanges, or valves and anode connections. When used, **the pipe shall not be moved** after the wax tape is applied. The wax tape may lose its bond if the pipe is dragged or handled.

4.3 **Trenton #2A Wax Tape Above Grade Piping**
Color: Aluminum
Petroleum based wax tape 70-90 mils thickness
4" and 6" width

Vendor: McJunkin

This tape shall be used on above grade installations and may be used on below grade installations. It conforms well to any irregular shaped components such as valves and fittings and has ultraviolet inhibitors.

4.3 **Trenton Wax Primer**
Color: White
Petroleum wax, plasticizer, and corrosion inhibitor
Paste like substance applied by hand
1 gallon cans

Vendor: McJunkin

4.4 **Poly Ply Wrapper**
Clear plastic membrane used to provide mechanical protection against backfill stress when using wax tape products and Graycoat coating.
6" width

Vendor: Trenton

4.5 **Tapecoat 20**

Hot Applied Tape
Fabric saturated in coal tar pitch, 58 mils thickness
3, 4", and 6" width
Primer: Omniprime

Vendor: The Tapecoat Company

The preferred use of this tape is on below grade transmission mains.

4.6 **Tapecoat Grey H35**

Cold applied tape
Flexible polymer film and synthetic elastomeric
35 mils thickness
2", 4" and 6" width
Primer shall be used at temperatures below 40 deg. F (Omniprime)

Vendor: The Tapecoat Company

This tape may be used on any below grade installation. This product will be used instead of cold applied Royston Greenline Tape. The preferred use of this product is on welded joints on pipe less than and equal to 2 inches and repair of coating defects (holidays) on all pipe sizes.

4.7 **Graycoat Wax**

Wax Coating
No primer required
24" lb cans
Apply to 1/8" thickness
Poly Ply Wrap

Vendor: McJunkin

This wax may be used on any below ground installation. This will replace Roscote Mastic. The preferred use of this product is on fittings on 2 inch and larger pipe and on replacing coating through keyhole technologies. An additional use of Graycoat is for coating of bolts on buried couplings. Graycoat may be used in addition to any of the other field-applied coatings. Gray coat must always be used with Poly Ply wrapper.

4.8 **Shrink Sleeves**

Heat shrink application
LDPE/EVA Polyolefin sheeting
70% lateral strength
15 inches in length

Vendor: Canusa, Stuart Steel Corp., Umac

These products may be used below as well as above grade; their preferred use is on butt-welded joints greater than 2" in size during pipeline construction.

4.9 **J – Kits**
Epoxy coating
No primer required
Available in multi sized cans or drums

Vendor: Dura-Bond

A Manually applied liquid epoxy coating for coating weld joints on FBE, but primarily used on Powerecrete coated pipelines used for directional drilling applications. This product exhibits excellent cathodic disbondment resistance, adhesion to bare steel and mechanical properties.

5.1 ABOVE GROUND COATINGS

5.2 The preferred method of coating an above ground pipe installation is with an approved paint and primer combination that is specified for atmospheric corrosion resistance and good weathering properties.

5.3 **Sherwin Williams**
System 4000 Tile Clad, High Solids 2 Part A & B product.

This approved coating is a 2-package, epoxy polyamide high gloss coating for use in marine and industrial maintenance environments. The primer to be used is the Sherwin Williams Steel Recoatable epoxy primer. This product should be used for all large exterior meter sets, interior station piping, and bridge crossings.

SECTION 36.00 COATING INSPECTION

- Inspection
- References
- Inspection

1.1 COATING INSPECTION

1.2 This section describes the requirement to perform both a visual inspection of the coated steel pipe upon delivery and a visual or electrical coating inspection prior to installation.

1.3 The electrical inspection is not a specific code requirement but has been adopted as an acceptable construction practice to assure best possible coating integrity at the time of installation.

1.4 The electrical coating inspection is not required for tie in or short section replacements less than a length of pipe.

1.5 A Holiday Detector (Jeep) is used to perform the electrical coating inspection.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Part 255.461

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

2.4 Department of Transportation (DOT), Part 192, 49 CFR, Subpart J, Requirements of Corrosion Control.

2.5 National Association of Corrosion Engineers (NACE).

3.1 INSPECTION

3.2 All pipe mill applied coating shall be inspected for defects (holidays) either visually or electrically. Visual inspection shall begin when the pipe is delivered. The coating shall be checked for damage during transit from the factory, and if excessive damage is observed, the pipe shall be rejected and returned to the supplier.

3.3 Visual inspection of the pipe shall be conducted from delivery to burial.

3.4 Coating may be damaged during transportation and handling.

3.5 All coated pipe shall be inspected visually and/or electrically either 1) prior to lowering the pipe into the ditch or 2) while in the ditch and prior to backfilling. Any identified damage to the coating which exposes the metal shall be repaired.

3.6 Electrical tests appropriate for the type of coating shall be used to detect defects in the coating which may not be revealed by a visual inspection. Where such tests are not practical, aboveground electrical tests, after installation, shall be conducted.

3.6.1 Electrical inspection prior to installation is conducted using a calibrated Holiday Detector also referred to as a Jeep. Each piece of pipe shall be tested above the trench using the Holiday Detector. The Holiday Detector shall be set to the required voltage necessary to effectively test the coating applied to the piping. If the manufacturer does not supply the voltage level for testing, the following formula from NACE RP-02-74 "High Voltage Electrical Inspection of Pipeline Coating Prior to Installation" may be used to acquire the required Holiday Detector setting:

Polyethylene Coating
Test Voltage=1250 x (Sq. Rt.) of T
T=coating thickness in mils

Fusion Bonded Epoxy Coating
Test Voltage=525 x (Sq. Rt.) of T
T=coating thickness in mils

NOTE: The thickness of "T" includes primer and coating combined.

- The Holiday Detector shall be grounded but when soil is dry or pipe is elevated, a direct connection to the pipe may be necessary. To check the Holiday Detector after the required voltage is set, first run the coil spring (electrode) over the coating and on to the bare cutback on either end of the pipe segment and notice the characteristic sound made when the coil spring contacts the bare pipe. Then make a small nick (holiday) in the coating. Run the coil spring over the area where the nick was created to see if the Holiday Detector would find it. If the Holiday Detector will not locate the nick, it must be sent out for repair and/or calibration, and another Holiday Detector shall be tested using the same procedure.

SECTION 37.00 CORROSION TEST STATIONS INSTALLATIONS

- Corrosion Test Stations
- References
- General
- Test Station Wires
- To Install Test Stations
- Test Station Installation Documentation

1.1 CORROSION TEST STATIONS

1.2 This section details the requirement to install corrosion control test stations, the specified wire size, color requirements, and typical test station diagrams to be followed for installation.

2.1 REFERENCES

2.2 NYCRR Public Safety Title 16 Part 255.469, 255.471

2.3 American Society of Mechanical Engineering (ASME), Gas Transmission and Distribution Piping Systems, ASME B31.8 - 1999 Edition.

2.4 Department of Transportation (DOT), Part 192, 49CFR, Subpart J, Requirements of Corrosion Control.

2.5 National Association of Corrosion Engineers (NACE).

3.1 GENERAL

3.2 All cathodically protected pipelines must have sufficient cathodic protection test stations necessary to obtain electrical measurements to determine adequacy of the cathodic protection.

3.3 Cathodic protection test stations may include: risers at meter sets and regulator stations, drips, above ground valves, above ground test station boxes and at grade boxes regulator vent lines.

3.4 Test stations should be installed in locations where they will not be damaged, and may be located near valve boxes, line markers, casing vents, pole lines, property lines, hedge rows, or fence lines.

4.1 TEST STATION WIRES

4.2 Test Station wire color-coding shall be followed to provide precise detailed information for new installations. The chart below details the type of test station installation, wire size and color-coding. Additional color combinations may be necessary to satisfy other installations

TEST STATION WIRE INFORMATION				
Wire Color	**Wire Size**	**Attach to**	**Test Station Type**	
Blue	12 AWG CU	Casing, Bare Pipe, Upstream Piping, & Foreign Facilities	2 WTS*	
White	12 AWG CU	Coated/Downstream Pipe	4WTS*	
Black	12 AWG CU	Anode Wire		
Yellow	12 AWG CU	Tracer Wire		

***** 2 WTS – 2 Wire Test Station

4.3 Test Stations already in service shall be upgraded as they are repaired or replaced.

4.4 Sufficient slack wire shall be provided to make connections and in case of future breakage. The wires should be looped around the buried gas facilities to relieve strain at test station and cad weld. The additional wire necessary for each test station is detailed below:

4.4.1 Flush Test Stations – allow additional 3 feet of wire above grade.

4.4.2 Above Grade Stations – allow additional 6 feet of wire above grade.

5.1 WHERE TO INSTALL TEST STATIONS

5.2 Across buried (and designated aboveground) insulated fittings on magnesium anode and rectifier protected pipelines.

5.3 Periodically along cathodically protected pipelines, such as highway crossings, water crossings, midpoint along right-of-ways, main offsets, or at any location where fieldwork removes an existing test station.

6.1 CORROSION TEST STATION INSTALLATION DOCUMENTATION

6.2 A recorded record of installation must accompany each test station installation.

SECTION 38.00 CONVERSION FACTORS

1.0 CONVERSION FACTORS

1 CF Natural Gas = 1,000 BTU

1 Therm = 100,000 BTU = 1 CCF Natural Gas

1 MSCF Natural Gas = 10 CCF = 1,000 CFH = 1 DTH = 10 Therms = 1,000,000 BTU

1 KWH = 3,412 BTU = .03412 Therms = .003412 MSCF Natural Gas

1Gal. Propane = 91,600 BTU = .916 Therms = .0196 MSCF

Natural Gas 1 CF Propane = 2,500 BTU

1 Gal. #2 Fuel Oil = 139,000 BTU = 1.39 Therms = .139 MSCF Natural Gas

1 Gal. #6 Fuel Oil = 150,000 BTU = 1.5 Therms = .15 MSCF Natural Gas

1 BHP = 33,475 BTU/hr.
= 34.5 lbs. Steam/hr. (from and at 212º F)
= 139.5 sq. ft. EDR steam
= 223 sq. ft. EDR water

1 lb. steam from and at 212º F = 970 BTU

1 sq. ft. EDR steam = 240 BTU/hr.

1 Sq. ft. EDR water = 150 BTU/hr.

SECTION 39.00 SIZING TABLES

Pipe Sizing Tables

- For Pressures Less than 1 psig
- For 1 psig
- For 2 psig
- For 5 psig
- For 10 psig
- For 20 psig
- For 50 psig

1.1 PIPE SIZING TABLE

1.2 For Pressures Less than 1 psig

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	284	195	157	134	119	108	92	82	56	45	39
1.25	1.380	583	400	322	275	244	221	189	168	115	93	79
1.50	1.610	873	600	482	412	366	331	283	251	173	139	119
2.00	2.067	1681	1156	928	794	704	638	546	484	333	267	229
2.50	2.469	2680	1842	1479	1266	1122	1017	870	771	530	426	364
3.00	3.068	4738	3256	2615	2238	1983	1797	1538	1363	937	752	644
3.50	3.548	6937	4767	3828	3277	2904	2631	2252	1996	1372	1102	943
4.00	4.026	9663	6641	5333	4565	4046	3666	3137	2780	1911	1535	1313
5.00	5.047	17482	12015	9649	8258	7319	6632	5676	5030	3457	2776	2376
6.00	6.065	28308	19456	15624	13372	11851	10738	9190	8145	5598	4496	3848
8.00	7.981	58161	39974	32100	27474	24350	22062	18883	16735	11502	9237	7905
10.00	10.020	105636	72603	58303	49900	44225	40071	34296	30396	20891	16776	14358
12.00	11.938	167236	114940	92301	78998	70014	63438	54295	48120	33073	26559	22731

For pressures under one pound approximate capacity of pipes of different diameters and lengths in cubic feet per hour with pressure drop of 0.5 inch water column and 0.6 specific gravity.

1.3 For 1 psig

For 1 pound pressure capacity of pipes of different diameters and lengths in cubic feet per hour for an initial pressure of 1.0 psig with a 10% pressure drop and a gas of 0.6 specific gravity.

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	717	493	396	338	300	272	233	206	142	114	97
1.25	1.380	1471	1011	812	695	616	558	478	423	291	234	200
1.50	1.610	2204	1515	1217	1041	923	836	716	634	436	350	
2.00	2.067	4245	2918	2343	2005	1777	1610	1378	1222	840	674	577
2.50	2.469	6766	4651	3735	3196	2833	2567	2197	1947	1338	1075	920
3.00	3.068	11962	8221	6602	5650	5008	4538	3864	3442	2366	1900	1626
3.50	3.548	17514	12037	9666	8273	7332	6644	5686	5039	3464	2781	2381
4.00	4.026	24398	16769	13466	11525	10214	9255	7921	7020	4825	3875	3316
5.00	5.047	44140	30337	24362	20851	18479	16744	14330	12701	8729	7010	6000
6.00	6.065	71473	49123	39447	33762	29923	27112	23204	20566	14135	11351	9715
8.00	7.981	146849	100929	81049	69368	61479	55705	47676	42254	29041	23321	19960
10.00	10.020	266718	183314	147207	125990	111663	101175	86592	76745	52747	42357	36252
12.00	11.938	422248	290209	233048	199459	176777	160172	137087	121498	83505	67057	57392

1.4 For 2 psig

For 2 pound pressure capacity of pipes of different diameters and lengths in cubic feet per hour for an initial pressure of 2.0 psig with a 10% pressure drop and a gas of 0.6 specific gravity.

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1112	764	614	525	466	422	361	320	220	177	151
1.25	1.380	2283	1569	1260	1079	956	866	741	657	452	363	310
1.50	1.610	3421	2351	1888	1616	1432	1298	1111	984	677	543	465
2.00	2.067	6589	4528	3636	3112	2758	2499	2139	1896	1303	1046	896
2.50	2.469	10501	7217	5796	4961	4396	3983	3409	3022	2077	1668	1427
3.00	3.068	18564	12759	10246	8769	7772	7042	6027	5342	3671	2948	2523
3.50	3.548	27181	18681	15002	12840	11379	10311	8825	7821	5375	4317	3694
4.00	4.026	37865	26025	20899	17887	15853	14364	12293	10895	7488	6013	5147
5.00	5.047	68504	47082	37809	32359	28680	25986	22240	19711	13547	10879	9311
6.00	6.065	110924	76237	61221	52397	46439	42077	36012	31917	21936	17616	15077
8.00	7.981	227906	156638	125786	107657	95414	86452	73992	65578	45071	36194	30977
10.00	10.020	413937	284497	228461	195533	173297	157020	134389	119106	81861	65737	56263
12.00	11.938	655315	450394	361682	309553	274351	248582	212754	188560	129596	104070	89071

1.5 For 5 psig

For 5 pound pressure capacity of pipes of different diameters and lengths in cubic feet per hour for an initial pressure of 5.0 psig with a 10% pressure drop and a gas of 0.6 specific gravity.

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1989	1367	1098	940	833	755	646	572	393	316	270
1.25	1.380	4084	2807	2254	1929	1710	1549	1326	1175	808	649	555
1.50	1.610	6120	4206	3378	2891	2562	2321	1987	1761	1210	972	
2.00	2.067	11786	8101	6505	5567	4934	4471	3827	3391	2331	1872	1602
2.50	2.469	18785	12911	10368	8874	7865	7126	6099	5405	3715	2983	2553
3.00	3.068	33209	22824	18329	15687	13903	12597	10782	9556	6568	5274	4514
3.50	3.548	48623	33418	26836	22968	20356	18444	15786	13991	9616	7722	6609
4.00	4.026	67736	46555	37385	31997	28358	25694	21991	19490	13396	10757	9207
5.00	5.047	122544	84224	67635	57887	51304	46485	39785	35261	24235	19461	16656
6.00	6.065	198427	136378	109516	93732	83073	75270	64421	57095	39241	31512	26970
8.00	7.981	407692	280204	225014	192583	170683	154651	132361	117309	80626	64745	55414
10.00	10.020	740477	508926	408686	349782	310005	280887	240403	213065	146438	117595	100646
12.00	11.938	1172269	805694	647001	553749	490777	444680	380588	337309	231830	186168	159336

1.6 For 10 psig

For 10 pound pressures approximate capacity of pipes of different diameters and lengths in cubic feet per hour for an initial pressure of 10 psig with a 10% pressure drop and a gas of 0.6 specific gravity.

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	2000	3000
1.00	1.049	3259	2240	1798	1539	1364	1236	1058	938	644	517	443
1.25	1.380	6690	4598	3692	3160	2801	2538	2172	1925	1323	1062	909
1.50	1.610	10024	6889	5532	4735	4197	3802	3254	2884	1982	1592	1362
2.00	2.067	19305	13268	10655	9119	8082	7323	6268	5555	3818	3066	2624
2.50	2.469	30769	21148	16982	14535	12882	11672	9990	8854	6085	4886	4182
3.00	3.068	54395	37385	30022	25695	22773	20634	17660	15652	10757	8638	7393
3.50	3.548	79642	54737	43956	37621	33343	30211	25857	22916	15750	12648	10825
4.00	4.026	110948	76254	61235	52409	46449	42086	36020	31924	21941	17620	15080
5.00	5.047	200720	137954	110782	94815	84033	76140	65166	57755	39695	31876	27282
6.00	6.065	325013	223379	179382	153527	136068	123288	105518	93519	64275	51615	44176
8.00	7.981	667777	458959	368561	315440	279569	253310	216800	192146	132061	106050	90765
10.00	10.020	1212861	833593	669404	572924	507772	460078	393767	348988	239858	192614	164853
12.00	11.938	1920112	1319682	1059751	907010	803866	728361	623383	552493	379725	304933	260983

1.7 For 20 psig

Approximate capacity of pipes of different diameters and lengths in cubic feet per hour for an initial pressure of 20 psig with a 10% pressure drop and a gas of 0.6 specific gravity.

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	2000	3000
1.00	1.049	5674	3900	3132	2680	2375	2152	1842	1633	1122	901	771
1.25	1.380	11649	8006	6429	5503	4877	4419	3782	3352	2304	1850	1583
1.50	1.610	17454	11996	9633	8245	7307	6621	5667	5022	3452	2772	2372
2.00	2.067	33615	23103	18553	15879	14073	12751	10913	9672	6648	5338	4569
2.50	2.469	53577	36823	29570	25308	22430	20323	17934	15416	10595	8509	7282
3.00	3.068	94714	65097	52275	44741	39653	35928	30750	27253	18731	15042	12874
3.50	3.548	138676	95311	76538	65507	58058	52604	45023	39903	27425	22023	18849
4.00	4.026	193187	132777	106624	91257	80879	73282	62720	55538	38205	30680	26258
5.00	5.047	349503	240211	192898	165096	146322	132578	113470	100566	69118	55505	47505
6.00	6.065	565926	388958	312347	267329	236928	214674	183733	162840	111919	89875	76921
8.00	7.981	1162762	799160	641754	549258	486797	441074	377502	334573	229950	184658	158043
10.00	10.020	2111887	1451488	1165596	997600	884154	801108	685645	607674	417651	335388	287049
12.00	11.938	3343383	2297888	1845285	1579326	1399727	1268254	1085462	962025	661194	530962	454435

1.8 For 50 psig

For 50 pounds pressure approximate capacity of pipes of different diameters and lengths in cubic feet per hour for an initial pressure of 50 psig with a 10% pressure drop and a gas of 0.6 specific gravity.

Pipe Size of Schedule 40 Standard Pipe (in.)	Internal Diameter (in.)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	2000	3000
1.00	1.049	12993	8930	7171	6138	5440	4929	4218	3739	2570	2063	1766
1.25	1.380	26676	18335	14723	12601	11168	10119	8661	7676	5276	4236	3626
1.50	1.610	39970	27471	22060	18881	16733	15162	12976	11501	7904	6348	5433
2.00	2.067	76977	52906	42845	36362	32227	29200	24991	22149	15223	12225	10463
2.50	2.469	122690	84324	67715	57955	51365	46540	39832	35303	24263	19484	16676
3.00	3.068	216893	149070	119708	102455	90804	82275	70417	62409	42893	34445	29480
3.50	3.548	317564	218260	175271	150009	132950	120463	103100	91376	62802	50432	43164
4.00	4.026	442393	304054	244166	208975	185211	167814	143627	127294	87849	70256	60130
5.00	5.047	800352	550077	441732	378065	335072	303600	259842	230293	158279	127104	108784
6.00	6.065	1295955	890703	715266	612175	542559	491598	420744	372898	256291	205810	176147
8.00	7.981	2662693	1830054	1469598	1257785	1114752	1010046	864469	766163	526579	422862	361915
10.00	10.020	4836161	3323866	2669182	2284474	2024687	1834514	1570106	1391556	956409	768030	657334
12.00	11.938	7656252	5262099	4225651	3616611	3205335	2904266	2485676	2203009	1514115	1215888	1040643

SECTION 40.00 STANDARD PIPE DATA

Standard Pipe Data

- Steel Pipe
- Plastic Pipe

1.1 STANDARD PIPE DATA

1.2 Steel Pipe

Nominal Size-Inches	Rating	Diameter O.D.	Diameter I.D.	Wall Thicknes	Lgth Req'd 1 cu ft vol	Weight lbs. / ft.	Circumference OD
3/4	xh	1.050	0.742	0.1540	332.60	1.47	3.30
3/4	std	1.050	0.824	0.113	270.03	1.130	3.30
1	xh	1.315	0.957	0.1790	200.30	2.17	4.13
1	std	1.315	1.049	0.1330	166.60	1.68	4.13
1 1/4	std	1.660	1.380	0.1400	96.28	2.27	5.22
1 1/2	std	1.900	1.610	0.1450	70.73	2.72	5.97
2	std	2.375	2.067	0.1540	42.91	3.65	7.46
3	st	3.500	3.068	0.2160	19.48	7.58	11.00
4	tw	4.500	4.124	0.1880	10.76	8.64	14.14
4	std	4.500	4.026	0.2370	11.31	10.79	14.14
6	tw	6.625	6.187	0.2190	4.58	14.97	20.81
6	std	6.625	6.065	0.2800	4.98	18.97	20.81
8	tw	8.625	8.187	0.2190	2.73	22.36	27.10
8	sch-30	8.625	8.071	0.2770	2.81	24.70	27.10
8	std	8.625	7.981	0.3220	2.88	28.55	27.10
10	tw	10.750	10.310	0.2190	1.72	23.60	33.77
10	sch-30	10.750	10.190	0.2790	1.76	31.20	33.77
10	std	10.750	10.020	0.3650	1.83	40.48	33.77
12	tw	12.750	12.250	0.2500	1.22	33.38	40.06
12	std	12.750	12.000	0.3750	1.27	49.56	40.06
14	std	14.000	13.250	0.3750	1.04	54.57	43.98
16	tw	16.000	15.500	0.2500	0.76	42.05	43.98
16	std	16.000	15.250	0.3750	0.79	62.58	50.27

1.3 Plastic Pipe

1.3.1 PE3408 High Density (HDPE)

Nominal	Type	SDR	Diameter		Wall Thickness	Weight lb/ft	Coil Length	Stick Length
size-inches			OD	AVG ID				
1/2	cts	7	.625	0.439	0.090	0.07	500/1000	na
1	cts	9	1.125	0.875	0.125	0.170	500	na
1	cts	11	1.125	0.915	0.099	0.140	500	na
1 1/4	ips	11	1.660	1.358	0.155	0.310	500	na
2	ips	9	2.375	1.847	0.264	0.759	500	40
2	ips	11	2.375	1.943	0.216	0.640	500	40
3	Ips	11	3.500	2.864	0.318	1.39	500	40
4	ips	9	4.500	3.500	0.500	2.724	500	40
4	Ips	11.0	4.500	3.682	0.409	2.300	500	40
6	ips	9	6.625	5.153	0.736	5.903	500/1500	40
6	Ips	11	6.625	5.421	.602	4.91	500/1500	40
6	Ips	13.5	6.625	5.585	.491	4.130	500/1500	40
8	ips	9	8.625	6.709	0.958	10.00	500/1500	40
8	ips	11	8.625	7.057	.784	8.30	500/1500	40
8	Ips	13.5	8.625	7.271	.639	7.00	500/1500	40
10	Ips	11	10.750	8.679	.977	13.154	500	40

SECTION 41.00 MANUFACTURERS PLASTIC JOINING REFERENCE MATERIAL

- Central Plastics Electrofusion Procedure Manual
- Central Plastics Electrofusion Cooling Times Chart
- Perfection Permalock Mechanical Tees
- Perfection Permasert Mechanical Couplings Installation Procedures
- Polypipe Fusion Procedures
- Performance Pipe Fusion Procedures

Information provided as reference only, Gas Construction Standards and Gas Operating and Maintenance Manual specify required procedures.

Electrofusion Installation Procedure Manual

It is important to read and understand all instructions before attempting a fusion. Permanent field installations should be done only by operators who have been properly trained and certified as qualified. Should you have any questions or need installation training, please contact

Central Plastics Company at 1-800-654-3872
or
Your Local Central Plastics Representative.

The following procedures were written to assist trained field personnel in the use of the Central Plastics Electrofusion system and Central Electrofusion Fittings. While technical data and advice contained herein is based upon tests and information believed to be reliable, user should not rely upon it absolutely for specific applications. All data is given and accepted at user's risk and confirmation of its validity and stability in particular cases should be obtained independently. Central Plastics makes no guarantee of results and assumes no obligation or liability in connection with its advice. The integrity of the piping system is the ultimate responsibility of the installer. This publication is not to be taken as a license to operate under, or recommendation to infringe any patents.

REV 5/03rp

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Before You Start

The following is an installation guide for the purpose of assisting the installer in adequately preparing an electrofusion fitting and pipe for fusion. This document is a guide only, and should not be used in place of training by an authorized electrofusion instructor. The recommended joining procedures for the Central Electrofusion System detailed in this manual have been qualified in accordance with D.O.T. 192.283

Central Plastics Company strongly recommends that electrofusion fittings be installed only by persons that have received training from an authorized instructor, that have a strong working knowledge of polyethylene and heat fusion, and have qualified electrofusion joints through destructive testing. Persons responsible for the joining of polyethylene pipe by fusion methods must qualify according to the requirement of the Title 49 Code of Federal Regulations, Section 192.285.

The installer of the electrofusion fittings for pressure applications should have knowledge of the intended application and is responsible for any fitting that is installed into a system that is not suitable for electrofusion fittings. Central Plastics electrofusion fittings are designed for use on pipe conforming to ASTM standard D2513 & F714 dimensions and with fittings conforming to D3261. All pipe to which these fittings are installed should meet the dimensional requirements of these standards.

Whether the installer is in a controlled environment or in the field making electrofusion fitting joints, Central Plastics recommends that you have the following equipment:

1. PIPE PREPARATION EQUIPMENT
   - Pipe Cutting Tools
   - Pipe Scraping Tools
   - Pipe Cleaning Material
   - Pipe re-rounding tools (on larger pipe sizes)

2. PIPE RESTRAINT EQUIPMENT

3. FUSION EQUIPMENT
   - Fusion Processor with correct leads and/or tips
   - Adequate power supply

IMPORTANT NOTE:

Pipe preparation and contamination are very important considerations in the electrofusion process. Careful attention must be given to proper scraping and cleaning procedures.

ELECTROFUSION POWER REQUIREMENTS

GENERATORS

For the installation of electrofusion fittings in field applications, it will be necessary to have a reliable source of AC power for the Electrofusion Processor to work properly in supplying the fitting with the right amount of energy. Generators used as an AC power source should conform to the following;

- **Be well maintained and subjected to a periodic maintenance schedule;**
- **Provide an output voltage in the range that meets the specifications of the applicable processor model;**
- **Operate within a frequency range of 45 Hertz minimum to 75 Hertz maximum;**
- **A minimum wattage capacity of;**

Minimum KVA	Fitting Range
5.0 KVA	Will fuse all Central Plastics fittings including 24" DIPS / 630 mm couplings
3.5 KVA	Will fuse Couplings up to 8"/ 225 mm and all Tapping Tees, High Volume Tapping Tees, Branch Saddles and Reducers
2.0 KVA	Will fuse Couplings up to 1 1/4", and all Tapping Tees, High Volume Tapping Tees, Branch Saddles and Reducers

A matching outlet is needed to mate with the plug equipped with the unit by Central:
120V models — 30 Amp, 125 Volt, NEMA L5, twist-lock;

INVERTERS

Inverters can be used as an acceptable AC power source but with the continuing changes in inverter technologies, earlier processor models may not be compatible to the quasi-sine waveform produced by some inverters. Central recommends performing compatibility tests using the lightest and heaviest anticipated loads before approving an inverter system. Feel free to contact Central to discuss issues regarding the use of inverters.

EXTENSION CORDS

Due to the amperage draw of electrofusion fittings, use of extension cords are not encouraged but in the event it becomes necessary to use one the following lengths and wire gages are recommended:

Cord Length	Wire Gage
25 ft.	#10/3 wire (6 mm^2)
50 ft.	# 8/3 wire (10 mm^2)

NO EXTENTION CORDS SHOULD BE USED ON 14" IPS & LARGER COUPLINGS

PIGTAILS - (30 Amp Twist Lock to 15 Amp Standard Plug Adapter)

The use of pigtails for in field applications of electrofusion fittings is not recommended except on fitting sizes 2" and smaller.

POWERING UP

Prior to beginning the electrofusion sequence, it is important that you ensure the following:

- **The generator has enough fuel to complete the electrofusion cycle**
- **The throttle is opened all the way (in anticipation of power draw)**

IMPORTANT NOTE FOR COLD WEATHER INSTALLATIONS:

Cold weather affects both fittings and equipment. Electrofusion fittings require more energy at the beginning of the fusion cycle, this requirement is increased in cold weather situations. Make sure that your generator is in good mechanical condition and that it meets the minimum wattage output.

Proper Pipe Preparation for Electrofusion Fittings

For a pipe surface to be properly prepared for electrofusion the outer layer or "skin" of the pipe should be removed to expose a clean, virgin pipe material. This can be achieved by using one of several types of approved scraping tools. "Approved" scraping tools can vary widely between electrofusion manufacturers and they may not necessarily be a tool that is manufactured by the fitting manufacturer. A few examples of scraping tools that Central Plastics classifies as "approved" are; a rasp type tool (Stanley Surform Model 21-296 or equivalent), a metal blade paint scraper, or tools manufactured specifically for electrofusion scraping. "Approved" simply indicates that the tool has been qualified by the manufacturer and has been found to perform in a satisfactory manner under the joining conditions established by the manufacturer. **Wood rasps or metal files are not considered acceptable.**

It is very important to note that abrasive materials, such as sandpaper or emory cloth, should never be used in place of a scraping tool. Abrasive materials have been proven to be ineffective in the removal of sufficient amounts of surface material needed to achieve an electrofusion bond and in fact, they have actually been shown to impede the electrofusion process. This is due to the grit or grit like residue they imbed into the pipe area being scraped, which in turn acts as a barrier between the pipe and fitting. The electrofusion process significantly differs from conventional heat fusion. In the electrofusion process there is very little material movement or melt displacement (i.e. melt beads). For this reason, any contaminant that is present on the surface of the pipe will remain sandwiched between the pipe and fitting interface and will ultimately prevent the two materials from joining. It is also recommended that the "Metal File" type of rasp not be used as a pipe scraper; as the pipe material is removed with this type of tool, tends to ball up and roll around on the pipe surface instead of being cleanly removed and directed away.

Central Plastics Company recommends that a minimum of .007" to .010" of the pipe's surface material be removed during the scraping process in order to expose a clean virgin material. This is approximately the thickness of two sheets of paper. It is important that the pipe surface be clean and free from any type of contaminants that may be spread before scraping begins. Should the pipe surface be contaminated with dirt, mud or drilling fluids before scraping, plain water may be used to remove the surface level of these contaminates. It should be noted however, that water cannot be used to clean the pipe surfaces once the virgin material has been exposed. In those instances a **minimum 70%** isopropyl alcohol concentration, **with no additional additives**, has been found to be highly effective in removing these type of contaminates and is recommended by Central Plastics as a cleaning agent that can be used before and after scraping. For applications where a fitting will be moved around on the pipe, such as a repair application where a coupling will be pushed completely over one end of the pipe, it is recommended that pipe be scraped for the entire length of the coupling to prevent a clean fitting from being contaminated by unscraped pipe.

Markers

Marks can be made on the outer surface of the pipe as a visual aid to help indicate the required scraper coverage. Marks made on the pipe should not be made with a "grease pencil" or other type of petroleum based marker that will leave a contaminate behind. **Central Plastics Company's only requirement for markers used on PE pipe during electrofusion preparation is that the marker be non-petroleum based.** Grease pencils are generally petroleum based and therefore should not be used on PE pipe prior to electrofusion joining.

We have found many different types and brands of markers to be acceptable and recommend that any permanent marker of a color that will show on the pipe material can be used. The permanent type markers, such as the, "Sharpie", "Marks-A-Lot" and "Magic Marker" by Avery are adequate for marking yellow or light colored pipe. Fast drying paint pens, such as those manufactured by PENTEL and Faber Castell, also work well and are available in colors that will show well on black pipe; it is sometimes necessary to allow for drying when using paint type pens. We have also found that a wax based "China Marker", although not permanent, works well for marking black pipe. We have found no advantage of one type of marker, permanent or paint, over the other.

Re-Rounding

The non-brittle and flexible material characteristic of polyethylene makes it ideal for many pressure and non-pressure applications. But this material characteristic alone brings with it an important consideration that must be taken into account when using polyethylene pipe.

"Care must be taken to ensure that the polyethylene pipe is not out-of-round before attempting the electrofusion process."

HOW DOES POLYETHYLENE PIPE BECOME OUT- OF- ROUND?

1. **FROM THE MANUFACTURER:** It is important for the installer to confirm that the polyethylene pipe meets all dimensional requirements of ASTM 2513 and F714 and that the pipe does not exceed 5% ovality. If ovality is greater than 5% (see chart below), the installer must take steps to re-round the pipe.

IPS SIZES			
PIPE SIZE	NOMINAL DIAMETER	MINIMUM DIAMETER	MAXIMUM DIAMETER
4	4.500	4.480	4.520
5	5.563	5.538	5.588
6	6.625	6.595	6.655
7	7.125	7.091	7.159
8	8.625	8.586	8.664
10	10.750	10.702	10.798
12	12.750	12.693	12.807
14	14.000	13.937	14.063
16	16.000	15.928	16.072
18	18.000	17.919	18.081
20	20.000	19.910	20.090
22	22.000	21.901	22.099
24	24.000	23.892	24.108
26	26.000	25.883	26.117
28	28.000	27.874	28.126
30	30.000	29.865	30.135
32	32.000	31.865	32.144
34	34.000	33.347	34.153
36	36.000	35.838	36.162
42	42.000	41.811	42.189
48	48.000	47.784	48.216

DIPS SIZES			
PIPE SIZE	NOMINAL DIAMETER	MINIMUM DIAMETER	MAXIMUM DIAMETER
4	4.800	4.778	4.822
6	6.900	6.869	6.931
8	9.050	9.009	9.091
10	11.100	11.050	11.150
12	13.200	13.141	13.259
14	15.300	15.231	15.369
16	17.400	17.322	17.478
18	19.500	19.412	19.588
20	21.600	21.503	21.697
24	25.800	25.684	25.916
30	32.000	31.886	32.114
36	38.300	38.128	38.472
42	44.500	44.300	44.700
48	50.800	50.571	51.029

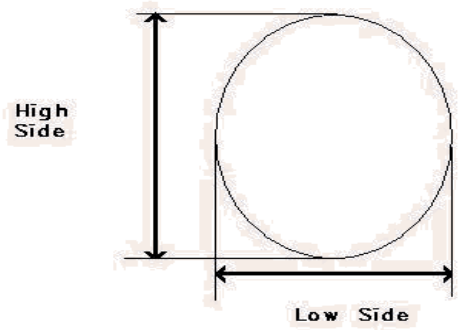
2. **IN THE WAREHOUSE:** Polyethylene pipe that is warehoused for a period of time or stacked on top of each other can experience ovality related issues (this is more pronounced with large diameter pipe).
3. **OVER TIME:** Large Diameter Polyethylene pipe will tend to relax a little during storage due to a combination of its weight and its natural flexibility.
4. **DURING INSTALLATION:** Mechanical forces experienced during some trenchless installation techniques such as Pipe Bursting or Directional Drilling can temporarily leave the Polyethylene pipe elongated and out-of-round.
5. **PREVIOUSLY INSTALLED:** Polyethylene pipe that has been underground for awhile is subjected to earth loads. These earth loads can cause the pipe to sag and/ or become out-of-round.

WHY IS IT IMPORTANT TO ADDRESS THE OUT-OF-ROUND ISSUE FOR ELECTROFUSION INSTALLATIONS?

One of the most critical functions of the electrofusion process is to close the gap between the pipe and the fitting and to build up interfacial pressures for the fusion process to take place. If this gap is not closed and the interfacial pressures cannot be built up, there is no way for the electrofusion joint to effectively achieve the high level of fusion integrity for which it was designed. If a pipe is out-of-round the initial concern is that the surface area of the pipe may not adequately come in contact with the fusion zone of the electrofusion fitting. This could result in the electrofusion fittings cold zones, that are designed to contain the material generated in the melt pool, to simply allow the molten material to escape out of the fusion area without producing any melt penetration. This is a particularly important concern when installing tapping tees and branch saddles since they do not fully encircle the pipe as will an electrofusion coupling.

HOW DO YOU CORRECT AN OUT-OF ROUND CONDITION?

First, determine if out-of-round conditions exists. This can be done visually for the more extreme cases or it can be done by measuring the pipe diameter with tape measure to determine the High/Low points of the pipe (see Figure A). If the High/Low measurements exceed the maximum pipe O.D. tolerance, a re-rounding clamp or device must be used to bring the pipe back to a round condition. (see Table1 for equipment examples)



Product Specific Clamping Devices (e.g. saddle clamps, t-clamps, etc)
Clamp Kits (multi-clamp kit for 4" and under)
Pipe Clamps from butt-fusion machines
Full-encirclement clamps (i.e. Victaulic Clamps)
Porta-Power Tools

Table 1

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FITTING RESTRAINT

ELECTROFUSION COUPLINGS

Important Note:

> **All Electrofusion Couplings (regardless of manufacturer) require the pipe to be restrained or sufficiently supported on each side of the pipe to; *a) restrict movement during the fusion and cooling process*, and *b) alleviate or eliminate sources of stress and/or strain* until both the fusion cycle and the cooling cycle are completed.**

Central Plastics recommends the use of some form of pipe restraint and/or support for the primary purpose of controlling and eliminating any movement of the fitting due to fusion pressures generated during the fusion process and/or any external forces exerted on the pipe or the fitting. The basis for using pipe restraint and/or support when joining two pieces of PE pipe with an electrofusion coupling is to:

- **Minimize potential short-stab, mis-stab or binding situations**
- **Ensure proper cold-zone contact with the prepared fusion area so that sufficient interfacial pressure is built up.**
- **Eliminate unwanted loss of molten material from the fusion zone *(resulting loss of interfacial pressure can be a source of voiding or a defective and unsatisfactory joint)***

A properly prepared and assembled joint that is kept stationary and free from stresses and strains during the fusion process and recommended cooling time should have good joint integrity.

ELECTROFUSION SADDLES

Electrofusion Saddle fittings *(Tapping Tees, Branch Saddles, Corp Saddles, etc.)* Installation of an electrofusion saddle requires the use of recommended restraint systems for the purpose of;

- **Holding the fitting in place during the fusion process**
- **Eliminating fitting movement due to material expansion**
- **Ensuring proper cold-zone contact with the prepared fusion area so that sufficient interfacial pressure is built up.**

Note: Barcode Scanning Instructions

Be sure the processor is ready and the display is reading "Read Data". It is critical that the tip of the barcode reader be touching the barcode label. While holding the reader at a 15 to 30 degree angle start the scan beginning in the white area on one side of the label and move the reader evenly across the barcode into the white area on the opposite side. Move the reader in a smooth quick motion, without stopping, all the way across the label. The label can be read in either direction, front to back or back to front. The processor should make an audible signal when the barcode has been accepted.

Most difficulties experienced in barcode scanning are simple problems involving technique. Ensure that the display reads "Read Data" before attempting to scan a barcode label. Make sure the tip light is illuminated on the reader. If not, check cable connections. Be sure the reader tip is clean and free from dirt and debris. Move the reader pen across the barcode from white area to white area without stopping.

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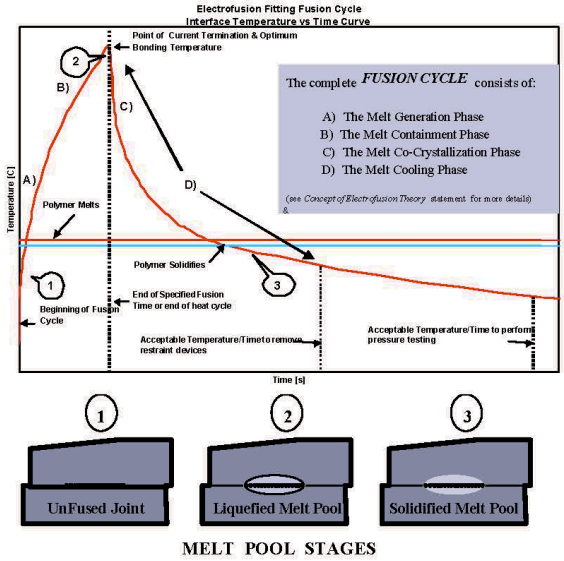
Electrofusion Fitting Cooling

One of the most misunderstood and often ignored components of the entire electrofusion process is the *cooling phase*. It is often assumed that if the fitting is cool enough to touch it must be cool enough to remove the restraint device or even pressure test the connections. The cooling phase is critical to the success of the electrofusion process and careful attention should be given to insure that the stated cooling times are properly adhered to.

The importance of the cooling phase can be illustrated in the actions of the *melt pool.* Using the following Figure we will look closer at the melt pool stages created during the electrofusion process.



MELT POOL STAGES

When current is applied to the fitting, the plastic in the fitting and on the pipe surface begins to melt and form a melt pool (A & B). With continued application of current, the melt pool deepens at the pipe and fitting interface which in turn forces internal pressures to build up. This process is known as co-crystallization between the melted pipe and fitting material (C). The cooling phase (D) (combined with the design of the fitting) provides a controlled environment between the pipe and the fitting where resolidification can effectively take place. This cooling phase begins immediately following the termination of current being supplied to the fitting and continues for a period of time beyond the point where the PE polymer resolidifies (also known as clamping time). This allows ample time for the fusion area to regain the strength and flexibility it exhibited prior to fusion. Any movement or external stresses (binding, pulling, etc.) applied to the fused area during this cooling phase may result in a compromised fusion joint.

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Re-Fusion of Electrofusion Fittings

Central Plastics electrofusion fittings can be re-fused only in the event of an input power interruption, i.e. fusion leads were detached during fusion, generator runs out of gas, processor malfunction, or other circumstance that results in processor input power interruption.

The recommended procedure for re-fusing fittings is:

Fitting should remain in clamped position and be allowed to cool to ambient temperature. The fitting should be reconnected to the processor and fused for the entire fusion time. This re-fusion procedure should be used for fusions that terminated due to input power reasons only.

Fittings that fault for any other reason should be cut out and replaced.

Hydrostatic Testing of Electrofusion Fittings

This technical note deals with the procedures and requirements for pressure testing Central Plastics Company's electrofusion fittings prior to placing the fitting in service.

Unless otherwise noted, all fittings subject to this technical note are pressure rated to an SDR 11 equivalent of 160 psi for water at 73°F (PE3408) or 125 psi for water at 73°F (PE2406). Pressure ratings for electrofusion fittings, as with pipe, are a function of wall thickness and operating temperature combined with a design safety factor specific to the media, in this case water.

Pressure testing of Central Electrofusion fittings is recommended to conform to guidelines set forth by the pipe manufacturer to include pressure ratings equal to or less than SDR 11. It is the responsibility of the installer to ensure that appropriate safety precautions are observed during pressure tests. Pneumatic pressure testing, due to safety reasons, is not recommended.

Most pipe manufacturers have adopted the hydrostatic pressure test recommendations listed in Plastics Pipe Institute (PPI) Technical Report TR 31. Test pressures should not exceed 1.5 times the rated operating pressure of the pipe or lowest rated component of the system for an average of 1 to 3 hours. The total time under test should not exceed 8 hours. Retests should not be performed within 8 hours of the prior test.

Under these guidelines the recommended maximum test pressure for an electrofusion fitting is 240 psig (PE3408) or 187.5 psig (PE2406) for an average duration of 1 to 3 hours, not to exceed 8 hours. The fitting should be visually examined for leakage when possible; if pressure monitoring is used to determine if leakage exists, allowances should be made for pipe expansion by adding water until equilibrium is established. Allowable amounts of "make up" water are shown in PPI Technical Report TR 31.

Electrofusion Joining Procedures for Couplings

1.) Clean the pipe ends, or the area to be fused, by removing dirt, mud, and other debris from pipe ends. Clean water can be used for initial cleaning of pipe surfaces prior to scraping and isopropyl alcohol is recommended after scraping.

2.) Check pipe for out-of-round condition. If fusion area is found to be out-of-round, take appropriate steps to bring fusion area back within required tolerances.

3.) When installing a coupling it is necessary for the pipe ends to have a square and even cut. This can be accomplished by various methods. (e.g. a blade type of pipe cutter, a wood saw and a clamp to use as a guide, a tubing cutter, or a chain saw without bar oil for larger pipe sizes)

4.) Identify the location of the fitting to be installed on the pipe and mark the area with a non-greasy marker. (See "Markers" page 4)

If installing a coupler, measure the total length of the coupler to be installed. Make a mark (with a non-grease marker) from the pipe end that is 1/2 the total length of the coupler. This mark is for stab depth purposes and will ensure that the pipe end is inserted to the center of the coupler.

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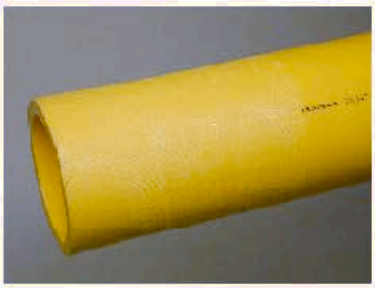
5.) Check the pipe surface for any embedded debris that may cause damage to scraping tools, and once more make sure that the outer pipe surface is clean and free of any dirt or mud that could recontaminate the scraped pipe surfaces.

6.) Scrape the outside of the pipe surface to remove oxidation and other contaminates. Use an appropriate scraping tool as recommended by Central Plastics. Scrape the pipe surface until the outer layer or "skin" of the pipe has been removed to expose a clean, virgin pipe material. Inspect the entire scraped area to ensure total scraping coverage. If a coupling is to be pushed completely over one pipe end, scrape the pipe end for the entire length of the coupler to prevent contamination of the coupler by sliding over un-scraped pipe. **Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.**

NOTE: The purpose of scraping is to remove material from the pipe surface. Simply roughing the fusion area will not allow an acceptable bond to take place.

7.) Avoid touching the scraped pipe surface or the inside of the coupler as body oils and other contaminates can affect fusion joint performance. If the surfaces become contaminated, clean thoroughly with a clean, lint free towel and a **minimum 70%** concentration of isopropyl alcohol and allow to dry before assembling. **Do not use alcohol with any additives other than water.** **CAUTION: AVOID ALL POSSIBLE RE-CONTAMINATION OF THE PREPARED SURFACE.**



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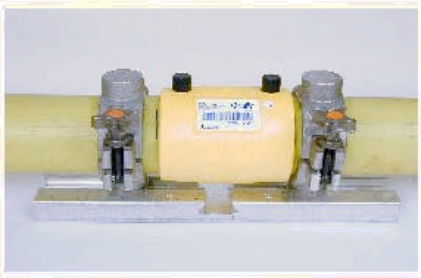
8.) Place the fitting on the area to be fused and restrain using an approved restraint device (See "Restraint" page 7)



Use rubber mallet (or metal hammer and wood blocks) to move coupler onto pipe, if necessary. Ensure that stab depth marks are properly located and visible.

9.) Attach processor leads to the fitting and proceed with fusion as described for standard joining. (If using a Bar-Code Processor see "Scanning Instructions" page 8)

10.) Disconnect and remove processor leads when fusion cycle is complete. It is a good practice to note the time required before clamp removal and mark it on the fitting if necessary.

11.) Allow fitting to cool in accordance with recommended cooling time before pressure testing or rough handling. (See "Electrofusion Cooling" page 9)

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Electrofusion Joining Procedures for Sidewall/Saddle Fittings
(for use with under-clamp on 1-1/4" - 6" fitting bases)

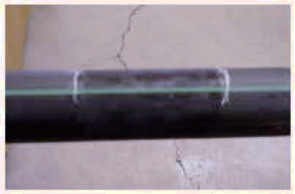
1.) Identify the location of the fitting to be installed on the pipe and mark the area with a non-greasy marker.

2.) Check the pipe surface for any embedded debris that may cause damage to scraping tools making sure that the outer pipe surface is clean and free of any dirt or mud that could recontaminate the scraped pipe surfaces.

3.) Scrape the area to be fused with an approved scraping tool. Make sure that the appropriate amount of material is removed approx. .007" to .0010".

Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.

NOTE: The purpose of scraping is to remove material from the pipe surface. Simply roughing up the fusion area will not allow an acceptable bond to take place. (see "Proper Pipe Preparation" page 3)



4.) Avoid touching the scraped pipe surface or the inside of the fitting as body oils and other contaminates can affect fusion joint performance. If the surfaces become contaminated, clean thoroughly with a clean, lint free towel and a **minimum 70%** concentration of isopropyl alcohol and allow to dry before assembling. **Do not use alcohol with any additives other than water.**

CAUTION:

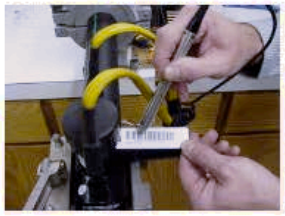
AVOID ALL POSSIBLE RECONTAMINATION OF THE PREPARED SURFACE.

5.) Remove the fitting from the bag and place it on the area to be fused

6.) Without moving the fitting, slide the Under-Clamp onto the base of the fitting.

7.) Make sure the fitting is centered in the Under-Clamp and then pivot the handle into the secured position.

8.) Attach processor leads to the fitting and proceed with fusion as described for standard joining. (If using a Bar-Code Processor see "Scanning Instructions" page 8)



IMPORTANT NOTE:

Proper installation of an electrofusion side-wall fitting requires the fitting to remain secured in the clamp until the clamping time shown on the fitting label has been completed! Outlets may be prepared prior to the Tapping Tee installation or at least 10 minutes after the Tapping Tee has been fused to the pipe.

Page 16

Electrofusion Joining Procedures for Sidewall /Saddle Fittings
(for use with Top-Load Clamp on 8", 10" & 12" fitting bases)

1) Equipment Needed:

1. Top Load Clamp
2. Top Load Clamp Fitting Adapters
3. Electrofusion Processor
4. Sure-Form Scraper
5. 8", 10" or 12" Electrofusion Saddle Fitting
6. Permanent Marker
7. Re-Rounding Clamps (if necessary)

2) Place fitting on pipe and mark area to be scraped. If the pipe iis out-of-round use re-rounding devices on both sides of the area to be fused before proceeding.

3) Using a scraping tool, remove the outer layer of pipe in order to reach virgin material.

4) If installing a Tapping Tee, remove the cap from fitting.

5) Taking care not to contaminate the scraped pipe surface, attach the Top Load Clamp and Fitting to the pipe. Hold the fitting in place and lower the cross bar. Then lock in place.
NOTE: Clamp weight may need to be supported if fusing to areas other than the 12 o'clock position on the pipe.

6) Begin applying pressure to the fitting by turning the handle clockwise.

7) Tighten until indicator post located in the center of the handle is flush with the top of the handle.
CAUTION: Over/Under tightening could result in defective joints.

8) Attach leads and verify fusion time.

9) Press Start button on Electrofusion Processor

10) Upon completion of the fusion cycle, allow the fitting to cool for recommended cooling time. DO NOT remove the clamp until the fusion cycle and the cooling cycle are complete.

NOTE: Tapping Tees must remain immobile until it has properly cooled. Outlets may be prepared prior to the Tapping Tee installation or at least 10 minutes after the Tapping Tee has been fused to the pipe.

NOTE: Procedures for installing 8", 10" and 12" Electrofusion Saddle Fittings can be accomplished at a temperature range of -10°F to 120°F

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Electrofusion Joining Procedures for Branch Saddle Fittings
(for use with T-Clamp)

1.) Clean the area to be fused by removing dirt, mud, and other debris from pipe ends (pay close attention to the drill mud residue in trenchless applications). Clean water can be used for initial cleaning prior to scraping and isopropyl alcohol is recommended after scraping if necessary.

2.) Check the pipe for out-of-round condition. If the area to be fused is found to be out -of -round, take the appropriate steps to bring the fusion area **back within the required tolerances. Use a .015" feeler gauge to check interface gap**

3.) Before placing the fitting use a hole saw and cut an entrance hole that is smaller than the inside diameter of the branch saddle for the T-Clamp to be inserted through.

4.) Identify the location of the fitting to be installed on the pipe and mark the area with a non-greasy marker.

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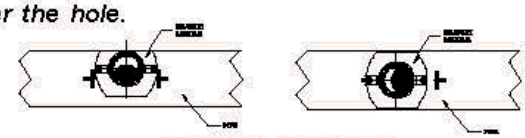
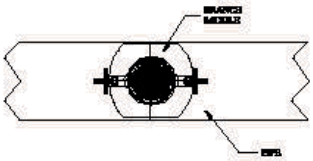
5.) Use your marks to make sure the alignment of the fitting is correct.
CAUTION: Fusion zone cannot be located over the hole.



Incorrect Alignment



Correct Alignment

6.) Check the pipe surface for any embedded debris that may cause damage to scraping tools making sure that the outer pipe surface is clean and free of any dirt or mud that could recontaminate the scraped pipe surfaces.

7.) Scrape the area to be fused with an approved scraping tool. Make sure that the appropriate amount of material is removed (approx. .007" to .010")

Sure Form Rasp
(Stanley Model #21-296
or equivalent)

Paint Scraper

Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.

NOTE: The purpose of scraping is to remove material from the pipe surface. Simply roughing up the fusion area will not allow an acceptable bond to take place. (see "Proper Pipe Preparation" page 3)

8.) Avoid touching the scraped pipe surface or the inside of the fitting as body oils and other contaminates can affect fusion joint performance. If the surfaces become contaminated, clean thoroughly with a clean, lint free towel and a **minimum 70%** concentration of isopropyl alcohol and allow to dry before assembling. **Do not use alcohol with any additives other than water.**

CAUTION:
AVOID ALL POSSIBLE RECONTAMINATION OF THE PREPARED SURFACE.

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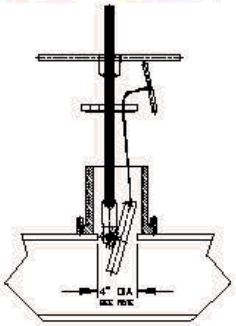
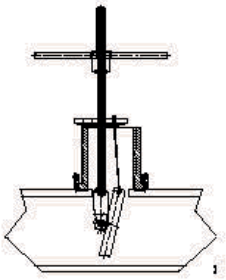
9.) Place the fitting on the area to be fused and restrain using the T-Clamp.

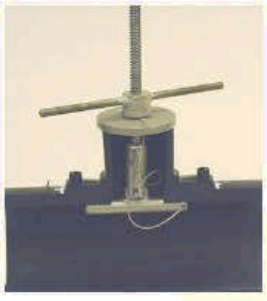
10.) Insert the T-Clamp through the top of the Branch Saddle and into entrance hole.

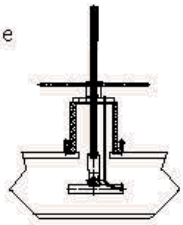


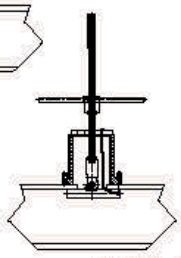
NOTE:
CUT A 4" DIA. HOLE FOR SIZES LARGER THAN 4" TO MAKE AN EASIER FIT.



11.) Tighten T-Clamp down until it is snug on the pipe surface then turn handle 1/4 turn more.







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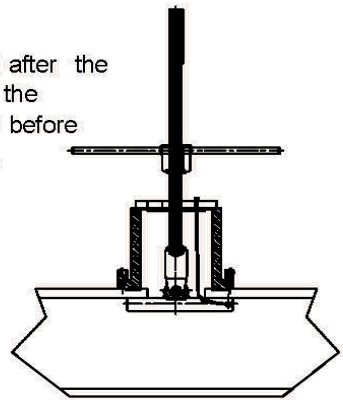
12.) Check to make sure there is no excessive gap between the pipe and the fitting. Use a .015" feeler gauge to check interface gap

13.) Attach processor leads to the fitting and proceed with fusion as described for standard joining. (If using a Bar-Code Processor see "Scanning Instructions" page 8)

14.) Disconnect and remove the processor leads when the fusion cycle has been completed.

15.) Keep the pipe and the fitting restrained until after the fitting has completed the entire fusion cycle and the recommended cooling time. Note the time required before clamp removal and mark it on the fitting if necessary.



16.) Reverse the installation process to remove T-Clamp.

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Electrofusion Joining Procedures for Flex Restraints
(for use with Ratchet Strap Clamp)

(1) Identify the desired location for the Flex Restraints

(2) Pipe must be clean. Remove all sources of contamination. A **minimum 70%** concentration of Isopropyl Alcohol and a lint free rag should be used to clean the surface area to be fused.

(3) For the purpose of insuring a good scrape of the fusion area, use an appropriate marker to randomly mark over the outlined fusion area. This will provide a visual gage while scraping.

(4) A thin layer of the pipe surface area must be removed in the area that is to be fused in order to assure a quality fusion joint. **(Do not use emory cloth - see "Proper Pipe Preparation" page 3)** Scrape the fusion area until all of the marks have been removed.

NOTE:

Make sure the fusion area remains clean and free of moisture during the installation of the saddle. If contamination of the area occurs after scraping, Isopropyl alcohol should be used to removed contamination. Re-scrape if necessary

(5) The Flex Restraint must be secured to the scraped area of the pipe surface. This can be accomplished in a variety of ways (i.e. wormgear clamps, c-clamps or nylon ratchet straps), ratchet straps are the recommended application tool due to the ease of use.

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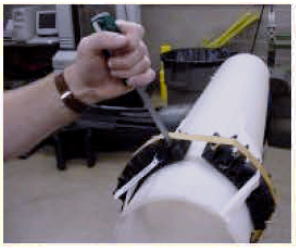
(6) Tighten the strap until the restraints are conformed to the pipe wall. Make sure the Flex Restraint makes contact with the pipe over the entire fusion area. If more than one restraint is to be used, make sure that all fittings are in place before fully tightening the ratchet straps.



NOTE:
If multiple restraints are to be used, it is helpful to place the fitting over the scraped area and to secure it in place with masking tape or duct tape until the strap can be applied.

(7) Connect the processor leads to the Flex Restraint. The fusion data is entered into the processor in either manual mode or bar-code mode. The Flex Restraint is a temperature compensated fitting. If the data is entered in manual mode, make sure to set the fusion time as stated on the card insert provide with each fitting. The bar-code entry of data automatically sets the fusion parameters

NOTE:
If using a Model C or a Model U Processor fusion times should be manually set using the fusion time card packaged with the fitting.

(8) After the fusion cycle is complete, the restraint and clamping device being used must remain in place and be allowed to cool for 15 minutes. The Flex Restraint should be completely cool before it is subjected to any forces.

CAUTION: ***The fusion zone of the Flex Restraint gets very hot and it is also a potential shock hazard! DO NOT TOUCH THE WIRES DURING THE FUSION OR THE COOLING TIME!***

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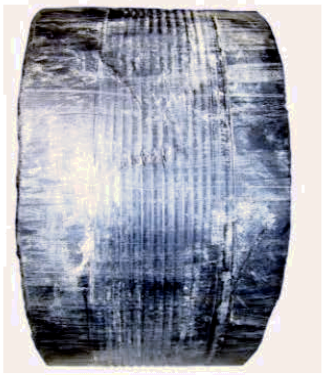
Examples of Incorrect Electrofusion Joints

The most common cause of joint failure for an electrofusion fitting falls into a category of failure classified as *improper pipe preparation*. Most issues associated with improper pipe preparation can be controlled by the installer and with adherence to proper installation techniques. Improper pipe preparation is avoidable .

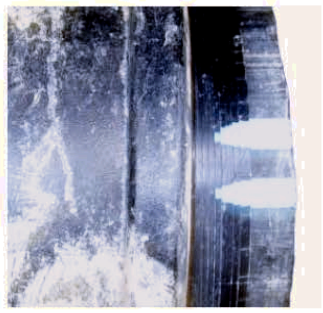
NO PIPE SCRAPING

The radial depressions are created by the wire-heating element of the fitting and indicate that the fitting achieved the proper temperature for fusion. This pipe section has many grooves and scratches from its insertion into a steel main. These defects along with the dirt that has been melted into the surface make it apparent that no scraping or other pipe preparation was done.



PIPE OVER-SCRAPED

The complete removal of the co-extruded stripes on this pipe indicates that more than .060 of an inch was removed from the out-side diameter of the pipe. This required 12 – 15 passes with a rotary scraper. Remov-ing this much material from the pipe cre-ates a gap between the pipe and fitting that is too great to seal during the fusion pro-cess.

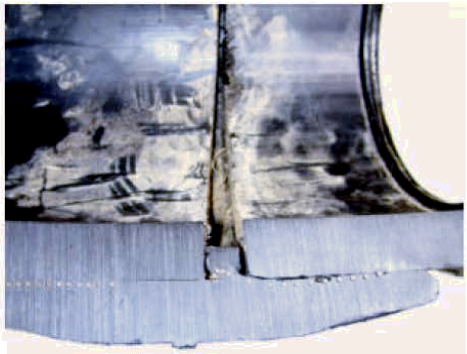


Examples of Incorrect Electrofusion Joints

PIPE UNDER-SCRAPED

The visible tool marks show that some effort was made to scrape the pipe. Unfortunately there was not enough material removed to allow a proper fusion. While most of the fitting did not fuse to the pipe, a small section did. When the joint failed, the stress on the section that did fuse was too great, causing the coupling to break.

PIPE MIS-STAB



The combination of a crooked cut on the end of the pipe, and the pipe ends not being centered in the pipe, have created a condition known as a Mis-stab or a short-stab. When this occurs the pipe does not create a adequate seal in the center cold zone. This causes molten material to flow toward the center of the fitting. The loss of material and pressure at the joint interface result in poor joint integrity.

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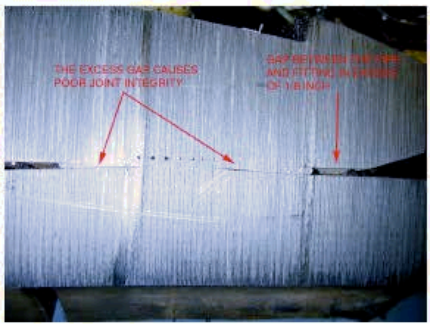
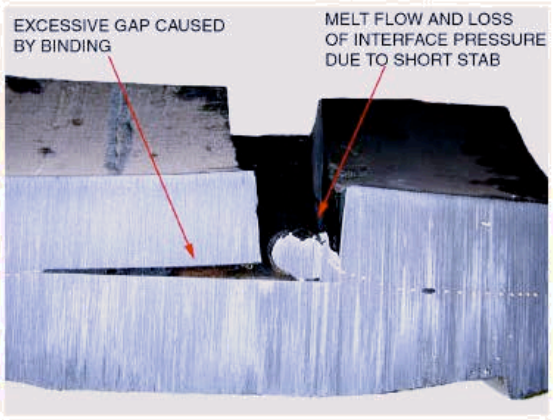
Examples of Incorrect Electrofusion Joints

EXCESS GAP



When the gap between the pipe and fitting is excessive the expansion of molten polyethylene cannot completely fill the space for a successful fusion. This can be caused by undersized pipe, over scraping, or severely out of round pipe.

SHORT-STAB / BINDING



A short-stab is the result of not centering the pipe ends in the fitting. Binding is caused by a severe mis-alignment or excessive lateral forces on the joint. The result of either of these situations is excess flow of molten material, loss of pressure at the fusion interface, and poor joint integrity.

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DESTRUCTIVE TESTING PROCEDURES FOR ELECTROFUSION FITTING QUALIFICATION

The following test methods are useful as an evaluation of bonding strength and quality between the pipe and fitting. Similar tests can be used as user qualification criteria. As these methods are destructive, they are only useful in determining joint quality of a fusion to verify that proper procedures were followed.

The following steps should be used only as a guide for cursory analysis of suspect fittings or fusions, this guide should not be considered as proof of long-term performance of pipe and fitting fusions.

General information regarding a suspect fusion or fitting failure that should be obtained whenever possible:

1. Heating coil ohmic value
2. ID resistor ohmic value
3. Label fuse time information
4. Barcode label information
5. Fusion download (if possible)
6. Visible indications of malfunction or preparation errors
7. Field conditions/Site conditions (weather factors, generator size, etc.)
8. Fitting Lot number
9. Fitting production date

1. COUPLINGS:

After all relevant information is gathered, the fitting should be cut and subjected to joint evaluation tests. Bend tests, peel tests, and crush tests are helpful in locating fusion weaknesses. It is desirable to obtain x-ray photographs of the fitting before dissection to locate any possible contact points of the fusion coil.

To prepare a specimen for crush testing, it is necessary to cut the pipe and coupling longitudinally in half as near to the centerline of the pipe and coupling as possible. It is desirable to leave at least 3"(75mm) to 5"(125mm) of pipe length at each end of the coupler.

Place a specimen half in a vise so that the outermost wire of the fusion zone is approximately 1 1/4" (32mm) from the vise jaws, (**Figure 1)**

Close the vise jaws until the pipe walls meet, (**Figure 2)** Repeat this process for each end of both halves of the coupling.

Inspect the crushed specimens for separation of the pipe and fitting in the fusion zone. Some minor separation (up to 15%) may be seen at the outermost region of the fusion zone, this does not constitute failure. Ductile failure of the pipe, fitting, or PE insulation around the wires is acceptable. There should be no separation at the fusion interface of the pipe and fitting.

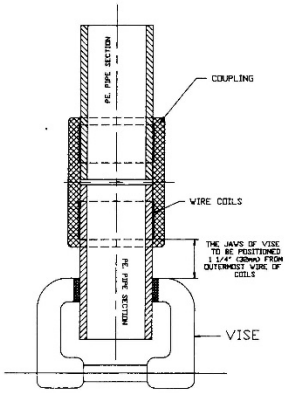


Figure 1

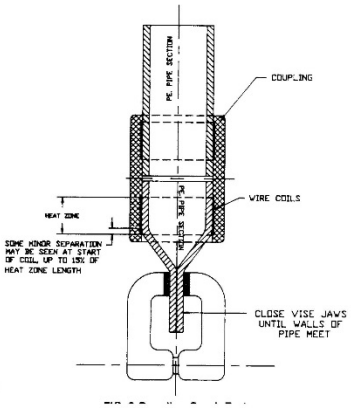


Figure 2

1. TAPPING TEES

Tapping tees should be left intact for crush testing. Pipe lengths can be cut to the edges of the fitting base.

Place the pipe and fitting into a vise so that the jaws are within 1/2" (13mm) of the bottom of the saddle, (**Figure 3).** Close the vise until the pipe walls meet, (**Figure 4).**

Inspect the crushed specimens for separation of the pipe and fitting in the fusion zone. Some minor separation (up to 15%) may be seen at the outermost region of the fusion zone, this does not constitute failure. Ductile failure of the pipe, fitting, or PE insulation around the wires is acceptable. There should be no separation at the fusion interface of the pipe and fitting.

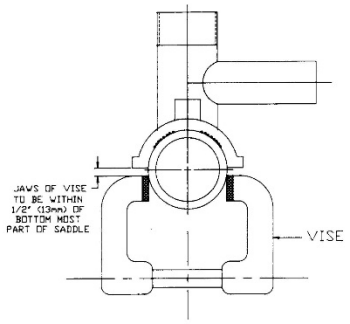


Figure 3

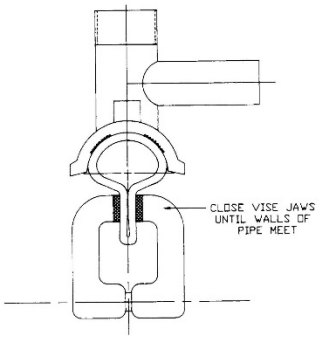
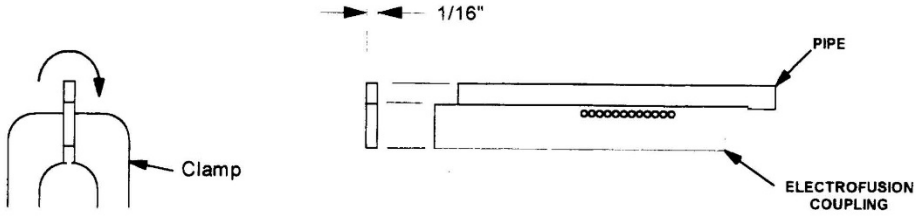


Figure 4

Further evaluations are possible by cutting the fusion area and surrounding pipe and fitting materials in thin strips for bend tests. The strips are then placed into a vise and bent directly on the fusion interface and evaluated for separation. The same visual criteria are used for fusion evaluation tests as is used for crush tests.



Couplings should have four strips cut from the fusion interface at 90° intervals as shown in figure 5. The strips should be approximately 1/16"(1.5mm) to 1/8"(3mm) in thickness.

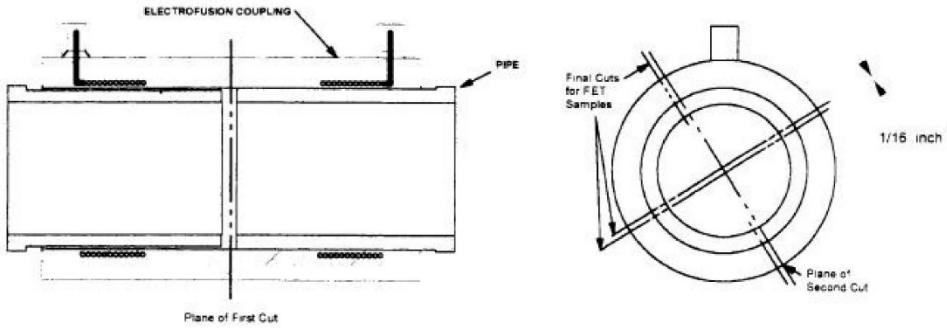
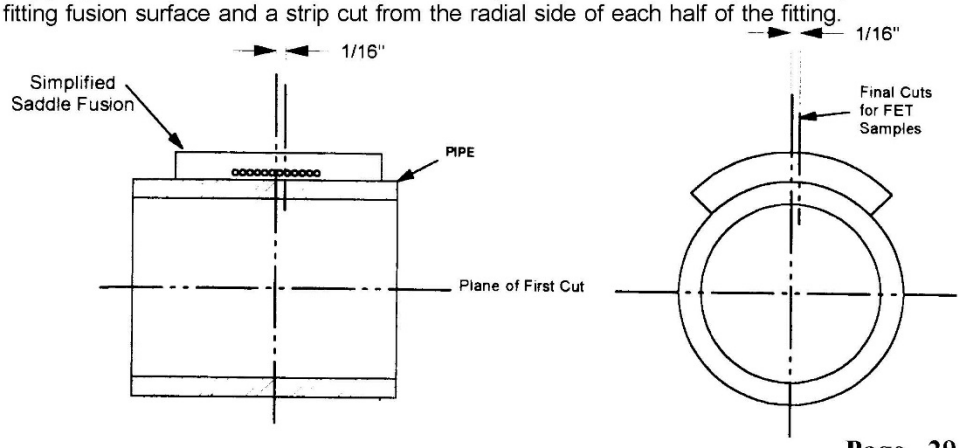


Figure 5

Tapping Tees should have four strips cut along the center line of the pipe through the fitting fusion surface and a strip cut from the radial side of each half of the fitting.



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TECHNICAL NOTE

Central Plastics Electrofusion
Fusion and Cooling Time Chart

FAMILY:	Electrofusion
PRODUCT:	All Through 12"
TYPE:	TECHNICAL NOTE
DOC:	TN-013
REV:	1
FILE:	
DATE:	11/16/2010
PAGES:	2

Tapping Tees are listed by saddle size. Times will apply to all outlet sizes.	Connection	Fusion Time (Seconds)	Cooling Time in Clamped Position (minutes)	Total Cooling Time Before Pressure/Tap (minutes)	Total Cooling Time Before Rough Handling (minutes)	Minimum KVA*	Generator Breaker Minimum	Extension Cord Size 25ft	Extension Cord Size 50ft
Tapping Tees:									
1-1/4"	4.7 R	45	10	20	30	1.5	10	#12/3	#10/3
1-1/2" IPS	4.7 R	50	10	20	30	1.5	10	#12/3	#10/3
2" IPS	4.7 R	90	10	20	30	1.5	10	#12/3	#10/3
2" CTS	4.7 R	60	10	20	30	1.5	10	#12/3	#10/3
3" IPS	4.7 R	90	10	20	30	1.5	10	#12/3	#10/3
4" IPS / DIPS	4.7 R	90	10	20	30	1.5	10	#12/3	#10/3
6" IPS / DIPS	4.7 R	90	10	20	30	1.5	10	#12/3	#10/3
8" - 10" IPS / DIPS	4.7 R	60	10	20	30	1.5	10	#12/3	#10/3
** These fittings require temperature compensation									
Reducers:									
3/4" x 1/2" CTS	4.7 R	20	5	15	30	1.5	10	#12/3	#10/3
1" x 1/2" CTS	4.7 R	25	5	15	30	1.5	10	#12/3	#10/3
1" x 1/2"	4.7 R	30	5	15	30	1.5	10	#12/3	#10/3
1" x 3/4"	4.7 R	30	5	15	30	1.5	10	#12/3	#10/3
1"x 1" CTS	4.7 R	30	5	15	30	1.5	10	#12/3	#10/3
1"x 1-1/4" CTS	4.7 R	30	5	15	30	1.5	10	#12/3	#10/3
1"x1-1/4"	4.7 R	45	10	20	30	1.5	10	#12/3	#10/3
Couplings:									
1/2 CTS	4.7 R	20	5	15	30	1.5	10	#12/3	#10/3
1/2 IPS	4.7 R	20	5	15	30	1.5	10	#12/3	#10/3
3/4 CTS	4.7 R	25	5	15	30	1.5	10	#12/3	#10/3
3/4 IPS	4.7 R	35	5	15	30	1.5	10	#12/3	#10/3
1 CTS	4.7 R	40	5	15	30	1.5	10	#12/3	#10/3
1 IPS	4.7 R	45	10	15	30	1.5	10	#12/3	#10/3
1 1/4 CTS	4.7 R	50	10	20	30	2	10	#12/3	#10/3
1 1/4 IPS	4.7 R	75	10	20	30	2	10	#12/3	#10/3
1 1/2 IPS	4.7 R	60	10	20	30	1.5	10	#12/3	#10/3
2 CTS	4.7 S	40	5	20	30	2.5	20	#12/3	#10/3
2 IPS	4.7 R	60	10	20	30	2.5	20	#12/3	#10/3
3 IPS	4.7 R	180	15	30	35	2.5	20	#12/3	#10/3
4 IPS	4.7 R	200	15	30	35	3.5	30	#12/3	#10/3
4 DIPS	4.7 S	200	15	30	35	3.5	30	#12/3	#10/3
6 IPS SDR 11	4.7 R	500	20	40	45	3.5	30	#12/3	#10/3
6 IPS SDR 21	4.7 R	360	20	40	45	3.5	30	#12/3	#10/3
6 DIPS	4.7 S	500	20	40	45	3.5	30	#12/3	#10/3
8 IPS	4.7 R	500	20	40	45	3.5	30	#12/3	#10/3
8 DIPS	4.7 S	500	20	40	45	3.5	30	#12/3	#10/3
10 IPS FM 150	4.7 R	750	30	60	60	3.5	30	#12/3	#10/3
10 IPS FM 200	4.7 S	TC**	45	60	60	3.5	30	#12/3	#10/3
10 DIPS	4.7 S	750	30	60	60	3.5	30	#12/3	#10/3
12 IPS FM 150	4.7 R	750	30	60	60	3.5	30	#12/3	#10/3
12 IPS FM 200	4.7 S	TC**	45	60	60	3.5	30	#12/3	#10/3
12 DIPS	4.7 S	750	45	60	60	3.5	30	#12/3	#10/3
** These fittings require temperature compensation									

HV Tapping Tees, Branch Saddles with 2" and 1 1/4 Outlets and Transition Saddles with Threaded Outlets	Connection	Fusion Time (Seconds)	Cooling Time in Clamped Position (minutes)	Total Cooling Time Before Pressure Test / Tap (minutes)	Total Cooling Time Before Rough Handling (minutes)	Minimum KVA*	Generator Breaker Minimum	Extension Cord Size 25ft	Extension Cord Size 50ft
2"	4.7 R	90	10	25	30	1.5	10	#12/3	#10/3
3"	4.7 R	60	10	25	30	1.5	10	#12/3	#10/3
4"	4.7 R	60	10	25	30	1.5	10	#12/3	#10/3
6"	4.7 R	60	10	25	30	1.5	10	#12/3	#10/3
8" IPS PE 2406	4.7 R	80	10	25	30	1.5	10	#12/3	#10/3
8" IPS PE 3408/4710	4.7 R	240	20	30	40	1.5	10	#12/3	#10/3
8" DIPS	4.7 S	240**	20	30	40	1.5	10	#12/3	#10/3
10"	4.7 S	240**	20	30	40	1.5	10	#12/3	#10/3
12"	4.7 S	240**	20	30	40	1.5	10	#12/3	#10/3
Large Pressure Rated Molded Branch Saddles IPS									
4" x 4"	4.7 R	50	10	20	30	2.5	20	#12/3	#10/3
6" x 4" PE 2406	4.7 R	150	15	30	45	2.5	20	#12/3	#10/3
6" x 4" PE 3408 / PE 4710	4.7 R	200	15	30	45	2.5	20	#12/3	#10/3
8" IPS x 4" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
8" IPS x 6" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
10" IPS x 4" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
10" IPS x 6" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
10" IPS x 8" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
12" IPS x 4" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
12" IPS x 6" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
12" IPS x 8" IPS	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
Large Pressure Rated Molded Branch Saddles DIPS									
8 x 4	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
8 x 6	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
10 x 4	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
10 x 6	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
12 x 4	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3
12 x 6	4.7S	TC**	20	40	60	2.5	20	#12/3	#10/3

** These fittings require temperature compensation

	Clamped Time	Testing / Tapping	Rough Handling
Example 4" IPS coupling fusion cycle ends at 12:04	+15 = 12:19	+30 = 12:34	+35 = 12:39

Clamped cooling time: The minimum time the fitting must remain clamped after the fusion cycle is complete.

Time before pressure test & Tapping: The minimum time before the joint can be pressurized to 150% of MOAP and the main can be tapped.

Time before rough handling: The minimum time before the joint can be subjected to forces such as pulling, or back filling.

CAUTIONS/WARNINGS:

Fusions should not be performed by any persons who have not been trained and qualified by an authorized electrofusion instructor. The installer should demonstrate their ability to make electrofusion joints through destructive testing. In addition to this Technical Note, the installer should have a full understanding of and available access to the Central Plastics Electrofusin Installation Procedure Manual. To obtain a copy of the Electrofusion Installation Procedure Manual, please contact Central Plastics Company at 1-800-654-3872.

Note: This document supercedes all previous Technical Notes and is subject to change without notice. Check for the current revision at www.centralplastics.com

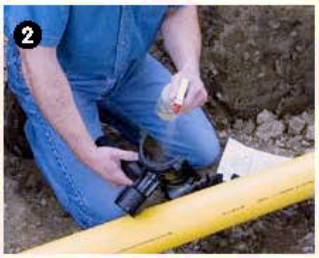
Approved By:

Rick Over
Product Manager

PermaLock® Mechanical Tapping Tees

Installation Guide

Clean surface of main.



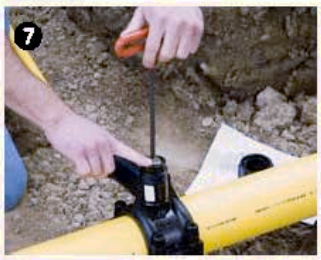
Lubricate tower o-ring and surface of main where tee is to be installed.

Bolt tee onto main until tee tower/base corners touch. The bolt should be flush with the bottom of the base. Stop, do not tighten further.

Connect service piping to PermaLock tee outlet.

Place depth tube on top of cutter assembly.

Thread cutter downward until the cutter bottoms in the tower. The depth tube is a visual guide and will be approximately flush with the top of the tower when the cutter is engaged.



Thread cutter upward until cutter is flush with top of tee tower. Discard depth tube.

Install PMTT PermaTite® cap, hand tightening until cap comes in contact with built in stop on tower.

elster
Perfection

Permasert® Mechanical Couplings

Installation Guide

1. Cut the PE piping so that the end is square.

2. Wipe with a clean dry cloth. Inspect the last several inches of PE piping for damage. If any, cut again to remove damaged area.

3. Use the Elster Perfection chamfering tool for a proper O.D. chamfer. This chamfer permits the PE piping to be completely stabbed without affecting the internal seals.

4. Use a soft felt tip pen, crayon or grease pencil to mark the stab depth as indicated on your Permasert package instructions. The stab depth is the approximate distance from the edge of the fusion bead to the end of the fitting body.

5. Stab the PE piping into the Permasert fitting so that the stab depth mark is visible:

   - Within 1/8" of moisture seal on 1/2" CTS and 1" CTS sizes
   - Within 1/4" on all other sizes through 1-1/4" CTS
   - Approximately 3/8" on 1-1/4" IPS and 2" IPS sizes

The PE piping must bottom out in the fitting. Pressure test the joint in accordance with your standard procedures. The reference mark can move outward up to an additional 3/8" during pressure testing.

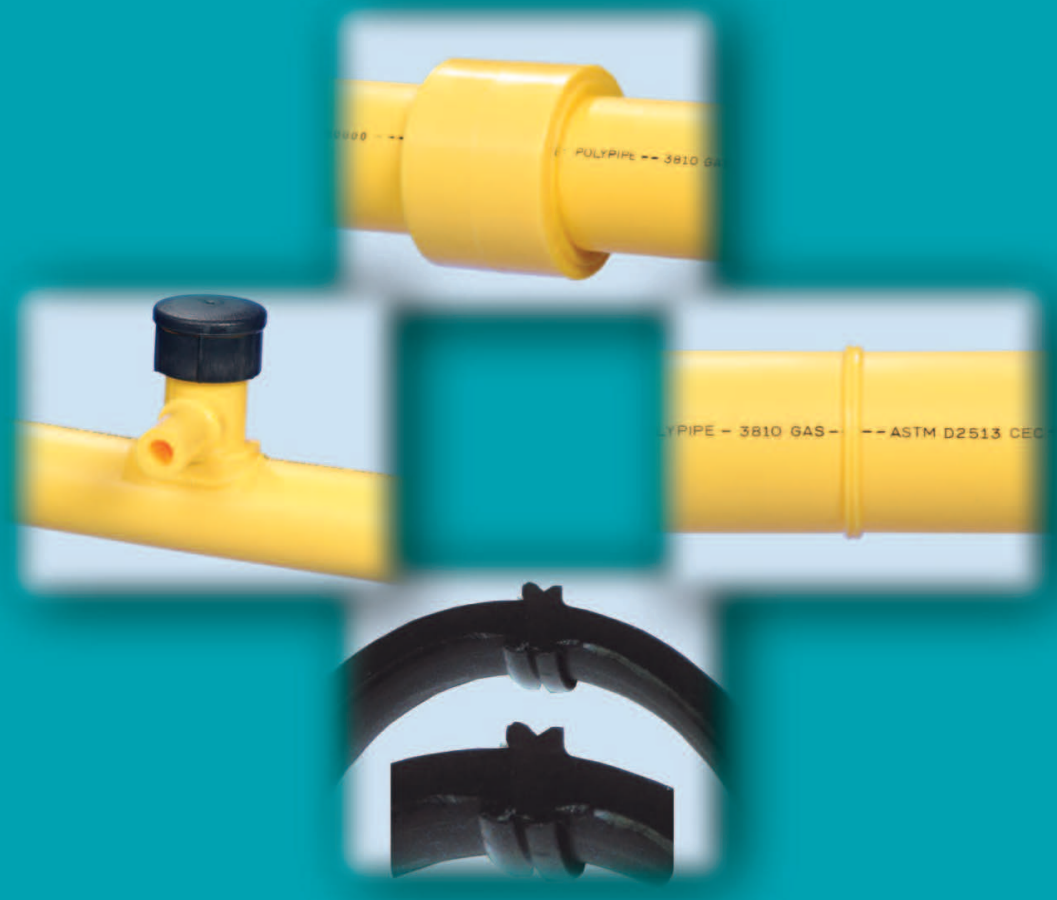
www.elster-perfection.com

elster Perfection

PolyPipe®

RECOMMENDED

Heat Fusion Joining Procedures



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INTRODUCTION

An integral part of any pipe system is the method used to join the system components. Proper engineering design of a system will take into consideration the type and effectiveness of the techniques used to join the piping components and appurtenances, as well as, the durability of the resulting joints. The integrity and versatility of the joining techniques used for polyethylene pipe allow the designer to take advantage of the performance benefits of polyethylene in a wide variety of applications.

There are three types of heat fusion joints currently used in the industry: Butt, Saddle and Socket Fusion. Additionally, there are two methods for producing the socket and saddle fusion joints. In addition to the fusion procedures that follow, electrofusion is recognized as an acceptable method of producing socket and saddle fusions but is not addressed in this document.

The fusion procedures that follow have been proven to consistently produce sound fusion joints when used correctly and are recommended for the joining of PolyPipe® products. The recommended procedures for butt and saddle fusions are consistent with the Plastic Pipe Institute (PPI) TR-33, Generic Butt Fusion Procedures and TR-41, Generic Saddle Fusion Procedures.

POLYPIPE® PRODUCTS	
GAS DISTRIBUTION	**M&I, WATER AND SPECIALTY**
POLYPIPE® GDB50 (GB50) POLYPIPE® GDB40 (GB40) POLYPIPE® GDB30 (GB30) POLYPIPE® GDY20	POLYPLUS™ POLYPIPE® EHMW PLUS POLYPIPE® EHMW POLYPIPE® PW POLYPIPE® DUCT POLYPIPE® LIGHTVIEW™

FEDERAL REGULATIONS

Individuals who are involved in joining gas piping systems must note certain qualification requirements of the U.S. Department of Transportation Pipeline Safety Regulations. The U.S. Department of Transportation, D.O.T., requires that all persons who make fusion joints in polyethylene gas piping systems must be qualified under the operator's written procedures (49 CFR, Part 192, §192.293(a)), and require that gas system operators ensure that all persons who make fusion joints are qualified (49 CFR, Part 192, §192.285(d)).

These fusion joining procedures, when used to join PolyPipe® gas pipe and fittings, are qualified in accordance with U.S. Department of Transportation Regulations.

- D.O.T. regulations require that written procedures for butt fusion, saddle fusion and socket fusion joining of polyethylene gas piping must be qualified before use by subjecting specimen joints to required test procedures (CFR 49, Part 192, §192.283(a)).

- D.O.T. regulations require that each joint in a gas piping system must be made in accordance with written procedures that have been proved by testing to produce strong gastight joints (CFR 49, Part 192, §192.273(b)).

- D.O.T. regulations require that all persons who make joints in polyethylene gas piping must be qualified under the operator's written procedures (CFR 49, Part 192, §192.285(a)).

- D.O.T. regulations require that the gas system operator must ensure that all persons who make or inspect joints are qualified (CFR 49, Part 192, §192.285(d) & §192.287).

Where an operator is already using qualified procedures that are in compliance with the D.O.T., these recommended procedures do not constitute a requirement for that operator to change to these fusion procedures.

Qualification Procedure

Due to the requirements of the U.S. Department of Transportation, any person joining polyethylene gas pipe must receive training in each of the fusion procedures (49 CFR, Part 192). Each operator should make a sample joint for each procedure used. Each sample joint must pass the following inspections and tests:

1. Pressure and tensile testing as described in §192.283, CFR,
2. Ultrasonically inspected and found to contain no flaws, or
3. Cut into at least three (3) strips, each of which is:

   (a) Visually examined and found free of voids or discontinuity on the cut surface of the joint.
   (b) Deformed by bending, torque or impact, and if failure occurs, must not initiate in the joint area.

A person must be re-qualified under an applicable procedure during a 12-month period for the following conditions:

1. The individual does not make any joints under the procedure.
2. The individual has three (3) joints or 3% of the joints made, whichever is greater, that are found to be unacceptable by §192.513, CFR.

Each operator shall establish a method to determine that each person making a joint in plastic pipelines in his/her system is qualified in accordance with this section.

HEAT FUSION

The principle behind heat fusion is to heat two surfaces to a designated temperature, and then fuse them together by application of a sufficient force. This applied force causes the melted materials to flow and mix, resulting in a permanent, monolithic fusion joint. When fused according to the recommended procedures, the fusion or joint becomes as strong as or stronger than the pipe itself in both tensile and pressure properties. PolyPipe® fusion procedures require specific tools and equipment for the fusion type and for the sizes of pipe and fittings to be joined.

- ***Butt Fusion*** – This technique consists of heating the squared ends of two pipes, a pipe and fitting, or two fittings by holding them against a heated plate, removing the plate when the proper melt is obtained, promptly bringing the ends together and allowing the joint to cool while maintaining the appropriate applied force.

- ***Saddle Fusion*** – This technique involves melting the concave surface of the base of a saddle fitting, while simultaneously melting a matching pattern on the surface of the pipe, bringing the two melted surfaces together and allowing the joint to cool while maintaining the appropriate applied force.

- ***Socket Fusion*** – This technique involves simultaneously heating the outside surface of a pipe end and the inside of a fitting socket, which is sized to be smaller than the smallest outside diameter of the pipe. After the proper melt has been generated at each face to be mated, the two components are joined by inserting one component into the other. The fusion is formed at the interface resulting from the interference fit. The melts from the two components flow together and fuse as the joint cools.

Properly fused polyethylene joints do not leak. If a leak is detected during hydrostatic testing, it is possible for a system failure to occur. Caution should be exercised in approaching a pressurized pipeline and any attempts to correct the leak should not be made until the system has been depressurized.

Note: Polyethylene cannot be joined by solvent bonding or threading. Extrusion welding or hot air welding is not recommended for pressure applications.

INCLEMENT WEATHER

Polyethylene has reduced impact resistance in sub-freezing conditions. Additional care should be exercised while handling in sub-freezing conditions. In addition, polyethylene pipe will be harder to bend or uncoil.

In inclement weather and especially in windy conditions, the fusion operation should be shielded to avoid precipitation or blowing snow and excessive heat loss from wind chill. The heating tool should also be stored in an insulated container to prevent excessive heat loss. Remove all frost, snow or ice from the OD and ID of the pipe; all surfaces must be clean and dry prior to fusing.

The time required to obtain the proper melt may increase when fusing in cold weather. The following recommendations should be followed:

1. Maintain the specified heating tool surface temperature. ***Do not increase the tool surface temperature.***
2. Do not apply pressure during zero pressure butt fusion heating steps.
3. Do not increase the butt fusion joining pressure.

In butt fusion, melt bead size determines heating time; therefore, the procedure automatically compensates when cold pipe requires longer time to form the proper melt size.

The outside diameter of polyethylene pipe and fittings will contract in cold weather conditions. This can result in loose or slipping cold rings. For best results, clamp one cold ring in its normal position adjacent to the depth gage. Shim around the pipe behind the clamp with paper, tape, etc., and place a second cold ring over this area. This cold ring will prevent slippage while the inner cold ring will allow for the pipe to expand during the heating cycle of the fusion process.

The proper cycle time for any particular condition can be determined by making a melt pattern on a piece of scrap pipe using the recommended standard heating time. If the melt pattern is incomplete, increase the heating time by three (3) second intervals until a complete melt pattern is established. Each time the procedure is repeated, a new piece of scrap pipe should be used.

For additional information concerning cold weather procedures, refer to ASTM D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings, Annex A1.

NOTES ON FUSION CONFIDENCE

Reliable fusion joints of polyethylene piping systems can be accomplished under reasonable latitude of conditions. The following is a listing of general notes to help ensure proper equipment and techniques are utilized:

1. ***The fusion operator must have adequate training and understanding of the equipment and tools and the fusion procedure***

   Improper understanding of the operation of the equipment and tools can produce a fusion of poor quality. The operator must understand thoroughly how to use the equipment and tools, their function and operation. The operator should adhere to the equipment manufacturer's instructions.

   Contact pressures and heating/cooling cycles may vary dramatically according to pipe size and wall thickness. Operators should not rely exclusively on automated fusion equipment for joint qualification. In addition, visual inspection and qualification should always be made. If necessary, test fusions should be made to determine correct pressures and heat/cool cycle times. Destructive test methods, such as bend back tests, may be necessary to formulate correct pressures and heat/cool cycle times *(refer to Qualification Procedures)*.

2. ***Pipe and fitting surfaces must be clean and properly prepared***

   Any contaminants present on the surfaces or poor preparation of the surfaces cannot produce a quality fusion joint. Ensure that all pipe and fitting surfaces are clean. If surfaces are reintroduced to contaminants, they should be cleaned again.

3. ***Heater plates must be clean, undamaged and the correct surface temperature***

   Heater surfaces are usually coated with a non-stick material. Cleaning techniques should be used accordingly. If a solvent is deemed necessary, do not use gasoline or other petroleum products. Refer to the equipment manufacturer's instructions for proper cleaning products.

   Recommended heating tool temperatures are specified for each procedure. This temperature is indicative of the surface temperature, not the heating tool thermometer. The surface temperature should be verified daily by using a surface pyrometer. If a crayon indicator (melt stick) is used, it should not be used in an area that will be in contact with the pipe or fitting.

   If the heater plate is not in use, it is recommended that it be stored in an insulated holder. This not only protects the heater surfaces from contaminants, but it can also prevent inadvertent contact, which can result in serious injuries.

4. ***Proper equipment and condition of tools and equipment for the job***
   Each type of fusion requires special tools and equipment. Fusions performed with the incorrect fusion equipment, materials or tools can result in a poor fusion.

Fusion Checklist

- ❒ Inspect pipe lengths and fittings for unacceptable cuts, gouges, deep scratches or other defects. Damaged products should not be used. Refer to PolyPipe® InfoBrief No. 17 for allowable surface damage according to the Plastics Pipe Institute (PPI) and the American Gas Association (AGA).

- ❒ Any surface damage at pipe ends that could compromise the joining surfaces or interfere with fusion tools and equipment should be removed.

- ❒ Be sure all required tools and equipment are on site and in proper working order.

- ❒ Pipe and fitting surfaces where tools and equipment are fitted must be clean and dry. Use ***clean***, dry, non-synthetic (cotton) cloths or paper towels to remove dirt, snow, water and other contaminants.

- ❒ Shield heated fusion equipment and surfaces from inclement weather and winds. A temporary shelter over fusion equipment and the operation may be required.

- ❒ Relieve tension in the line before making connections.

  When joining coiled pipe, making an S-curve between pipe coils can relieve tension. In some cases, it may be necessary to allow pipe to equalize to the temperature of its surroundings. Allow pulled-in pipes to relax for several hours to recover from tensile stresses.

- ❒ Pipes must be correctly aligned before making connections.

- ❒ Trial fusions.

  A trial fusion, preferably at the beginning of the day, can verify the fusion procedure and equipment settings for the actual jobsite conditions. Refer to Qualification Procedures for detailed information on the bend back test procedure.

BUTT FUSION

- **Heater Surface Temperature:** Minimum 400°F – Maximum 450°F (204 – 232°C)

  Heating tool surfaces must be to temperature before you begin. All points on both heating tool surfaces where the heating tool surfaces will contact the pipe or fitting ends must be within the prescribed minimum and maximum temperatures and the maximum temperature difference between any two points on the heating tool fusion surfaces must not exceed 20°F (11°C) for equipment for pipe smaller than 18" diameter, or 35°F (19°C) for larger equipment. Heating tool surfaces must be clean.

- **Interface pressure:** Minimum 60 psi – Maximum 90 psi (414 – 621 kPa; 4.16 – 6.21 bar)

  Interface pressure is used to calculate a fusion joining pressure value for hydraulic butt fusion machines or manual machines equipped with force reading capability. The interface pressure is constant for all pipe sizes and all butt fusion machines. However, fusion joining pressure settings are calculated for each butt fusion machine, which are dependent upon the OD and DR (Dimension Ratio).

  For hydraulic machines, the interface pressure, the fusion surface area, the machine's effective piston area and frictional resistance, and if necessary, the pressure needed to overcome external drag resistance, are used to calculate hydraulic fusion joining pressure gauge settings (refer to Appendix A). The equipment manufacturer's instructions are used to calculate this value. The proper amount of force should be verified by visual inspection of the joint.

NOTE: The interface pressure and the hydraulic gauge pressure are not the same.

  For manual machines without force reading capability, the correct fusion joining force is the force required to roll the melt beads over to the pipe surface during joining.

Procedure

1. ***Secure***
   Clean the inside and outside of the component, pipe or fitting ends by wiping with a clean, dry, lint-free cloth or paper towel. Remove all foreign matter. Align the components of the machine, place them in the clamps, and then close the clamps. ***Do not force pipes into alignment against open fusion clamps.*** Component ends should protrude past the clamps enough so that facing will be complete. Bring the ends together and check high-low alignment. Adjust alignment as necessary by tightening the high side down.

2. ***Face***
   Place the facing tool between the component ends, and face them to establish smooth, clean, parallel mating surfaces. Complete facing produces continuous circumferential shavings from both ends. Face until there is minimal distance between the fixed and moveable clamps. If the machine is equipped with facing stops, face down to the stops. Stop the facer before moving the pipe ends away from the facer. Remove the facing tool, and clear all shavings and pipe chips from the component ends. ***Do not touch the component ends with your hands after facing.***

3. ***Align***
Bring the component ends together, check alignment and check for slippage against fusion pressure. Look for complete contact all around both ends with no detectable gaps, and outside diameters in high-low alignment. If necessary, adjust the high side by tightening the high side clamp. Do not loosen the low side clamp because components may slip during fusion. Re-face if high-low alignment is adjusted.

4. ***Melt***
Verify that the contact surface of the heating tool is maintaining the correct temperature. Place the heating tool between the component ends, and move the ends against the heating tool. Bring the component ends together under pressure to ensure full contact. The initial contact pressure should be held *very briefly* and released without breaking contact. Pressure should be reduced when evidence of melt appears on the circumference of the pipe. Hold the ends against the heating tool ***without force*** (drag force may be necessary to ensure contact). Beads of melted polyethylene will form against the heating tool at the component ends. When the proper melt bead size is formed, quickly separate the ends, and remove the heating tool. The proper bead size is dependent upon the size of the component. Approximate values are shown in Table I.

Table I
Approximate Melt Bead Size

Approximate Wall Thickness, inches		**Melt Bead Size* (Approximate)**	
≤ 0.15	3.8 mm and smaller	1/32" – 1/16"	1 – 2 mm
0.15 – 0.30	3.8 mm – 7.6 mm	1/16"	2 mm
Above 0.30 – 0.75	Above 7.6 mm – 19 mm	1/8" – 3/16"	3 – 5 mm
Above 0.75 – 1.15	Above 19 mm – 29.2 mm	3/16" – 1/4"	5 – 6 mm
Above 1.15 – 1.60	Above 29.2 mm – 40.6 mm	1/4" – 5/16"	6 – 8 mm
Above 1.60 – 2.20	Above 40.6 mm – 55.9 mm	5/16" – 7/16"	8 – 11 mm
Above 2.20 – 3.00	Above 55.9 mm – 76.2 mm	7/16" – 9/16"	11 mm
The appearance of the melt swell zone may vary depending on the pipe material. The melt bead width is to be determined by measuring the distance from the heater plate to the melt swell origin.			

During heating, the melt bead will expand out flush to the heating tool surface, or may curl slightly away from the surface. If the melt bead curls significantly away from the heating tool surface, unacceptable pressure during heating may have occurred.

5. ***Join***
Immediately after the heating tool is removed, ***quickly*** inspect the melted ends, which should be flat, smooth and completely melted. If the melt surfaces are acceptable, immediately and in a continuous motion, bring the ends together and apply the correct joining force (or fusion pressure). The correct fusion pressure will form a double bead that is rolled over to the surface on both ends.

A concave melt surface is unacceptable; it indicates pressure during heating. Do not continue. Allow the component ends to cool and start over with Step 1.

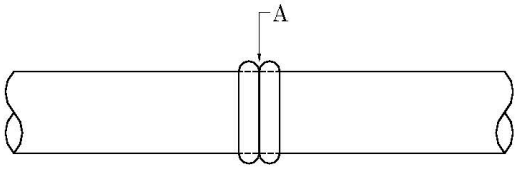
6. ***Hold***
Hold joining force against the ends until the joint is cool. The joint is cool enough for ***gentle*** handling when the double bead is cool to the touch. Cool for about 30 – 90 seconds per inch of pipe diameter. *Do not try to decrease the cooling time by applying water, wet cloths or the like.*

- ❒ Avoid pulling, installation, pressure testing and rough handling for at least an additional 30 minutes.

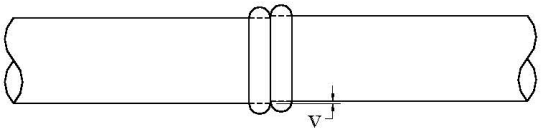
- ❒ Heavier wall thickness pipes require longer cooling times.

7. ***Inspection***
On both sides, the double bead should be rolled over to the surface, and be uniformly rounded and consistent in size all around the joint.

1. The gap (A) between the two single beads must not be below the fusion surface throughout the entire circumference of the butt joint.



2. The displacement (V) between the fused ends must not exceed 10% of the pipe/fitting minimum wall thickness.



3. Refer to Table II for general guidelines for bead width, B, for each respective wall thickness.

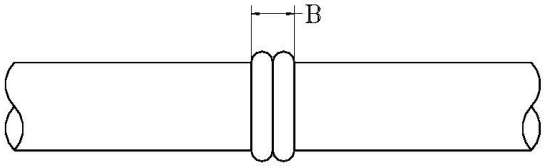


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Table II
Bead Widths per Wall Thickness

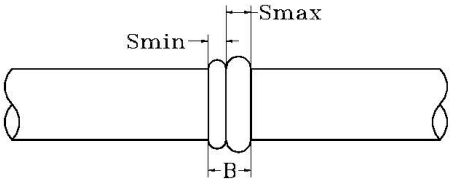
Minimum Wall Thickness, in.	Approximate Bead Width (B), in.		Minimum Wall Thickness, in.	Approximate Bead Width (B), in.	
	Minimum	Maximum		Minimum	Maximum
.118	5/32	1/4	1.06	19/32	25/32
.157	5/32	9/32	1.18	5/8	13/16
.197	3/16	5/16	1.34	21/32	7/8
.246	1/4	11/32	1.57	11/16	29/32
.315	9/32	3/8	1.77	25/32	1
.354	5/16	7/16	1.97	7/8	1-1/16
.433	11/32	1/2	2.16	15/16	1-3/16
.512	3/8	9/16	2.36	1	1-1/4
.630	7/16	19/32	2.56	1-1/8	1-7/16
.710	1/2	5/8	2.76	1-3/16	1-1/2
.750	1/2	11/16	2.95	1-1/4	1-9/16
.870	1/2	11/16	3.15	1-5/16	1-11/16
.940	9/16	3/4	3.35	1-3/8	1-3/4
			3.54	1-1/2	1-13/16

Instructions:
Determine the wall thickness of the pipe/fitting. Find the wall thickness above. If the exact wall thickness is not shown, use the next lowest wall thickness for determination of bead width.

4. The size differential (S_{max} – S_{min}) between two single beads shall not exceed X% of the actual bead width (B).

$$X = \frac{S}{B} \times 100$$

Where
X = Percent difference of bead width, %
Pipe to pipe, maximum X = 10%
Pipe to fitting, maximum X = 20%
Fitting to fitting, maximum X = 20%
S = S_{max} - S_{min}, inches
B = Width of bead, inches



NOTE: When butt fusing to molded fittings, the fitting side bead may have an irregular appearance. This is acceptable provided the pipe side bead is correct.

Qualification

1. Prepare a sample joint. Sample lengths should be at least 6" or 15 times the minimum wall thickness (see Figure I).

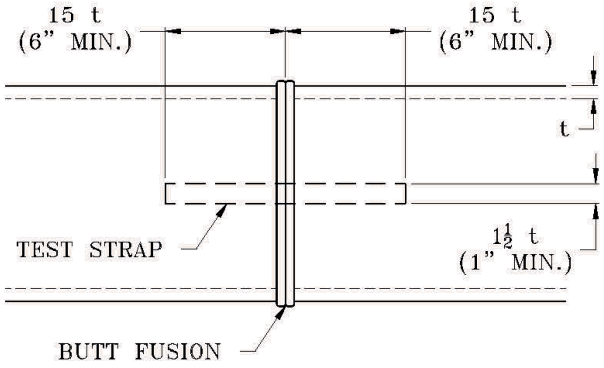
2. Observe the fusion process and verify the recommended procedure for butt fusion is being followed.

3. Visually inspect the sample joint for quality.

4. Allow the joint to cool completely (minimum of one hour).

5. Prepare the sample as shown in Figure I. The sample should be cut lengthwise into at least three longitudinal straps with a minimum of 1" or 1.5 times the wall thickness in width.

Figure I
Butt Fusion Bent Strap Test Specimen
(Reference ASTM D2657)



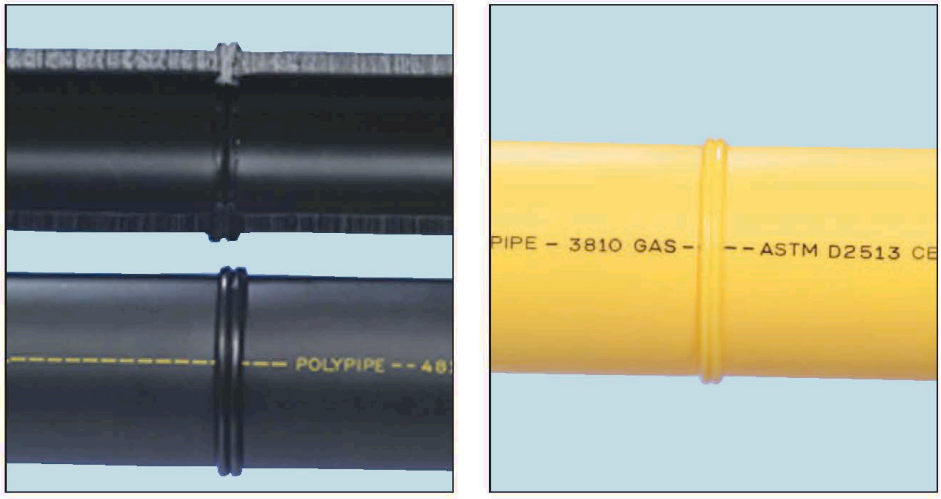
6. Visually inspect the cut joint for any indications of voids, gaps, misalignment or surfaces that have not been properly bonded.

7. Bend each sample at the weld with the inside of the pipe facing out until the ends touch. The inside bend radius should be less than the minimum wall thickness of the pipe. In order to successfully complete the bend back, a vise may be needed. For thick wall pipe, a hydraulic assist may be required.

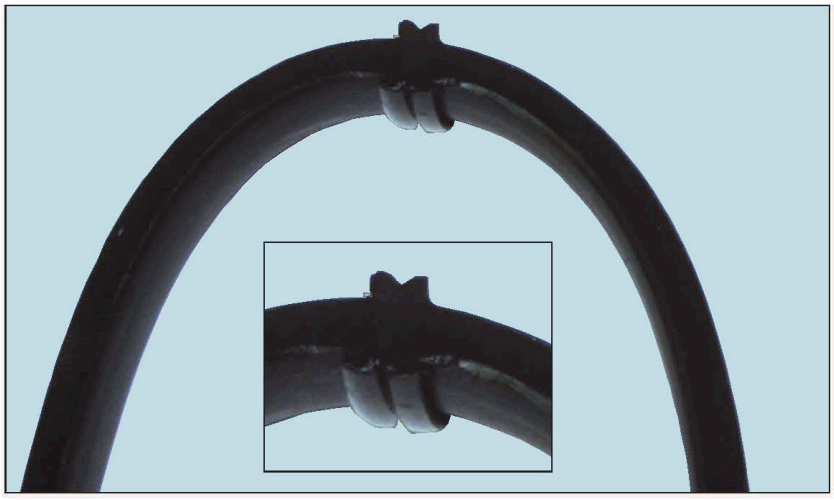
8. The sample must be free of cracks and separations within the weld location. If failure does occur at the weld in any of the samples, then the fusion procedure should be reviewed and corrected. After correction, another sample weld should be made per the new procedure and re-tested.

Butt Fusion

ACCEPTABLE FUSIONS



Proper alignment and double roll-back bead.



Bend back testing. No gaps or voids. (See Figure I)

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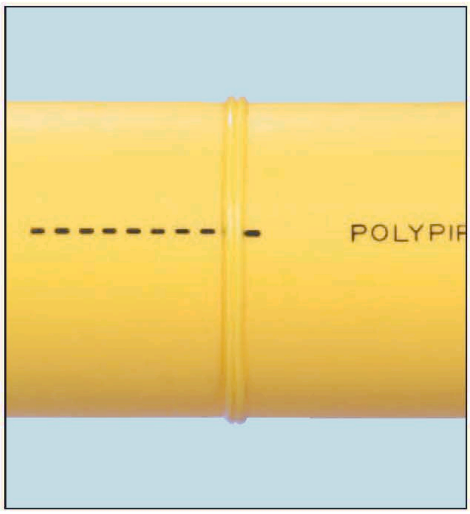
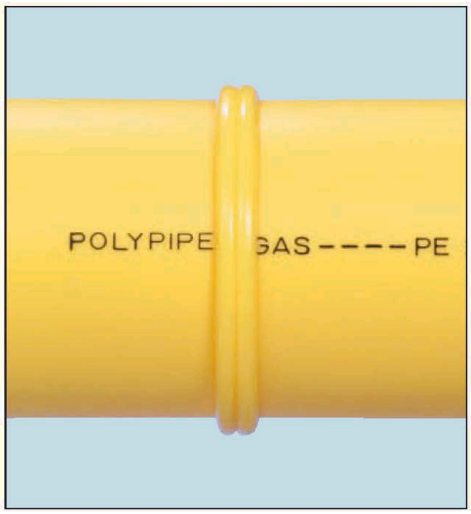
Butt Fusion

UNACCEPTABLE FUSIONS

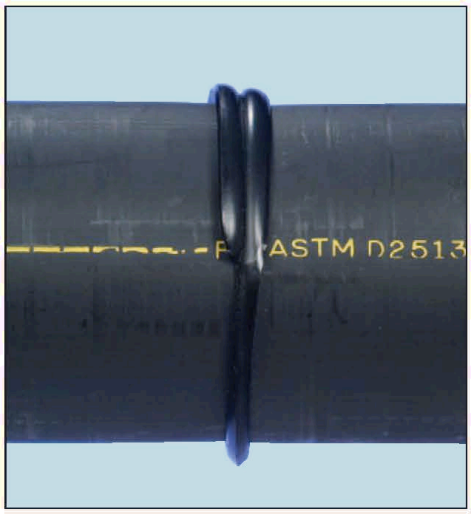


Melt bead too small due to insufficient heat time.



Melt bead too large due to excessive heating and/or over-pressurizing of joint.

Misalignment.



Incomplete facing.

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Table III
Butt Fusion Troubleshooting Guide

Observed Condition	Possible Cause
▪ Excessive double bead width	▪ Overheating ▪ Excessive joining force
▪ Double bead v-groove too deep	▪ Excessive joining force ▪ Insufficient heating ▪ Pressure during heating
▪ Flat top on bead	▪ Excessive joining force ▪ Overheating
▪ Non-uniform bead size around pipe	▪ Misalignment ▪ Defective heating tool ▪ Worn equipment ▪ Incomplete facing
▪ One bead larger than the other	▪ Misalignment ▪ Component slipped in clamp ▪ Worn equipment ▪ Heating iron does not move freely in the axial direction ▪ Defective heating tool ▪ Incomplete facing
▪ Beads too small	▪ Insufficient heating ▪ Insufficient joining force
▪ Bead not rolled over to surface	▪ Shallow v-groove – Insufficient heating & insufficient joining force ▪ Deep v-groove – Insufficient heating & excessive joining force
▪ Beads too large	▪ Excessive heating time
▪ Square type outer bead edge	▪ Pressure during heating
▪ Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	▪ Hydrocarbon (gasoline vapors, spray paint fumes, etc.) contamination

APPENDIX A

HYDRAULIC FUSION MACHINE GAUGE PRESSURE

The manufacturer of the fusion machine should be consulted for guidance in determining the proper conversion of PolyPipe®'s recommended interfacial pressure to the gauge pressure. The effective hydraulic piston area must be available in order to calculate the required hydraulic gauge pressure. The calculation for hydraulic gauge pressure is as follows:

$$P_G = \frac{0.785 \times \left(OD^2 - ID^2\right) \times P_I}{A_P} + DF^*$$

Where
- P_G = Hydraulic Gauge Pressure, psi
- OD = Pipe outside diameter, inches
- ID = Pipe inside diameter, inches
- P_I = Required interfacial pressure, psi
- A_P = Total hydraulic piston area, in^2
- DF = Hydraulic fusion pressure required to move the carriage holding the pipe (generally accepted minimum is 30 psi).

*The drag factor is an important parameter easily overlooked. If two long pieces of pipe are being fused, the drag factor can easily reach several hundred pounds per square inch (psi).

REFERENCES

1. Plastics Pipe Institute Technical Report-33. Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe, 2001.

2. Plastics Pipe Institute Technical Report-41. Generic Saddle Fusion Joining Procedure for Polyethylene Gas Pipe, 2002.

3. Plastics Pipe Institute. Polyethylene Joining Procedures, March 1998.

4. ASTM D2657-97. Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings. Volume 8.04. American Society of Testing and Materials. Baltimore, 2002.

5. ASTM F1056-97. Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings. Volume 8.04. American Society of Testing and Materials. Baltimore, 2002.

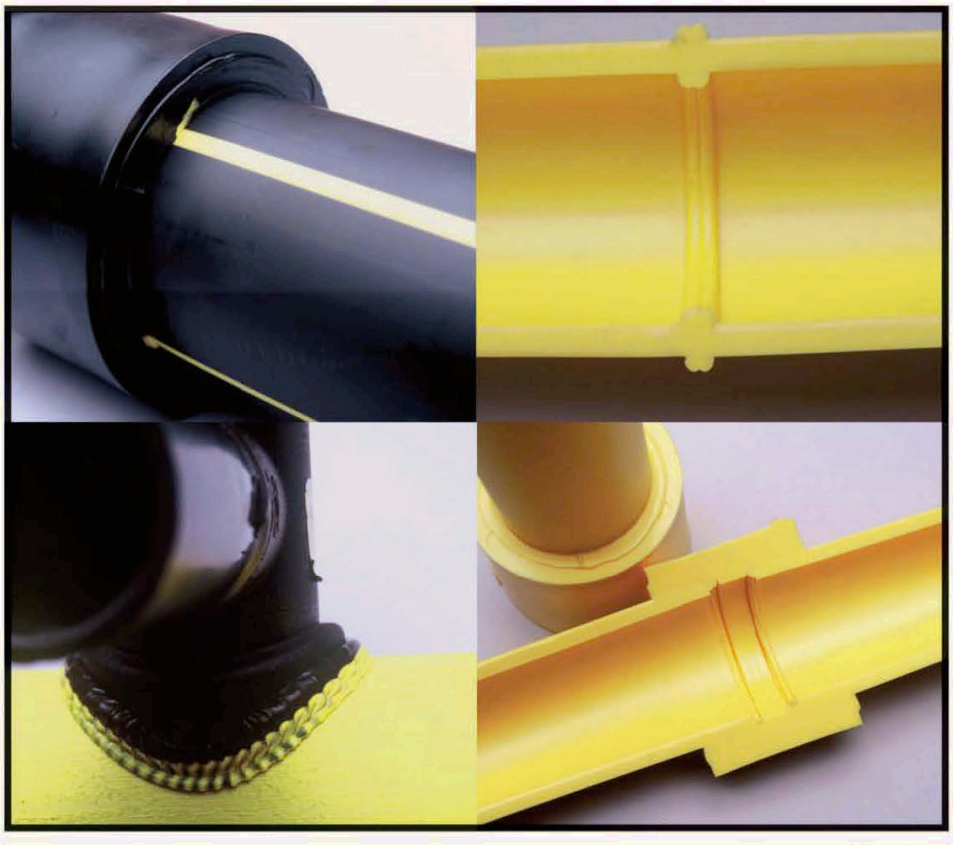
6. Pipeline Safety Regulations. U.S. Department of Transportation. CFR 49. Washington, 2002.

PERFORMANCE PIPE

A DIVISION OF CHEVRON PHILLIPS CHEMICAL COMPANY LP

Heat Fusion Joining Procedures and Qualification Guide

Gas Distribution (MDPE & HDPE) Products
Water, M&I and Specialty Products
Energy Products



Bulletin: PP 750

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PERFORMANCE PIPE

HEAT FUSION JOINING PROCEDURES

INTRODUCTION

Performance Pipe, a Division of Chevron Phillips Chemical Company LP, is the functional successor to the operations of PLEXCO® and DRISCOPIPE®. Performance Pipe began operations on July 1, 2000, and effective July 1, 2000, the products of the former PLEXCO and DRISCOPIPE companies became the products of Performance Pipe. Performance Pipe products may have the markings of the former and current companies, that is, "PLEXCO", "DRISCOPIPE" or "DRISCOPLEX" markings.

Material performance characteristics and product fusion characteristics have not changed as a result of the joint venture and creation of Performance Pipe. Modifications to the content of the print-line on the product do not affect fusion procedures. Therefore, joining procedures that are qualified for PLEXCO products and for DRISCOPIPE products are joining procedures that are qualified for Performance Pipe products. Furthermore, operator (utility) specific joining procedures, which are already qualified, continue to be qualified for use with products from Performance Pipe. Department of Transportation regulations require that all persons who make fusion joints in polyethylene gas piping systems must be qualified under the operator's written procedures (49 CFR Part 192, 192.293(a)), and require that gas system operators ensure that all persons who make fusion joints are qualified (49 CFR, Part 192, 192.285(d)). (See below: **Federal Regulations for Gas Pipe Joining**.)

Where qualified procedures are already in-use by an operator in compliance with Department of Transportation regulations, these recommended fusion procedures do not constitute a requirement for that operator to change to these recommended fusion procedures.

This Bulletin describes recommended procedures and guidelines for joining Performance Pipe polyethylene pipe and fittings using butt fusion, saddle fusion and socket fusion joining techniques. Butt fusion procedures are consistent with PPI TR-33 *Generic Butt Fusion Procedures.*

USE THESE PROCEDURES WITH THESE PRODUCTS

The procedures in this bulletin are recommended for joining the following Performance Pipe products to themselves or to each other:

GAS DISTRIBUTION PRODUCTS:

DriscoPlex® 6500† Piping	DriscoPlex® 6800 Piping	DRISCOPIPE® 8100 Piping
Plexco® Yellowpipe PE 2406† Piping	DRISCOPIPE® 6800 Piping	Plexco® Yellowstripe PE 3408 Piping
DRISCOPIPE® 6500 Piping	Plexco Plexstripe II PE 3408 Piping	YELLOWSTRIPE® 8300 Piping

† Includes fusing DriscoPlex® 6500 or Plexco Yellowpipe PE 2406 installed within DriscoPlex® 6600 (formerly Plexco Plexshield). **Do not join Driscopipe® 7000 or 8000 using these procedures.**

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Water, M&I and Specialty Product Piping Systems:

DriscoPlex® 1700	DriscoPlex® 1000	DriscoPlex® 8700	DriscoPlex® 6400
DriscoPlex® 1500	DriscoPlex® 5100	DriscoPlex® 4000	DriscoPlex® 4100
DriscoPlex® 4200	DriscoPlex® 4300	DriscoPlex® 4600	DriscoPlex® 4700
DriscoPlex® 1200	DriscoPlex® 1400	DriscoPlex® 4400	DriscoPlex® 4500
DriscoPlex® 4800	DriscoPlex® 6400	DriscoPlex® 5300	DriscoPlex® 9200
Plexco® EHMW PE 3408	Driscopipe® 1000	Driscopipe® 5300	Driscopipe® 6400
Plexco® Bluestripe PE 3408	Driscopipe® 4000	Driscopipe® 4100	Driscopipe® 4400
Plexco® Greenstripe PE 3408	Driscopipe® 4200	Plexco® Purplestripe PE 3408	Plexco® Plexvue
Driscopipe® 4300	Driscopipe® 8700	Driscopipe® 4500	Driscopipe® 1000 FM
	Driscopipe® 1200	Driscopipe® 1400	
Plexco® Redstripe FM PE 3408	Plexco® PE 3408 Oil & Gas Gathering Pipe		Plexco® Bluestripe FM PE 3408

Do not join Driscopipe® 7600 or 8600 using these procedures.

OVERVIEW

In heat fusion joining, mating surfaces are prepared, simultaneously melted with a hot-plate heater, the heater is removed, and the melted surfaces are pressed together and held under pressure. As the molten materials cool, they mix and fuse into a permanent, monolithic joint. Performance Pipe fusion procedures require specific tools and equipment for the fusion type and for the sizes of pipe and fittings being joined.

- Butt fusion is used to make end-to-end joints between "butt" or plain end pipes and fittings that have the same outside diameter and like wall thickness[1].
- Saddle (sidewall) fusion is used to install a branch outlet fitting to the top or side of a main pipe. Tapping tee fittings are usually installed on top of the main, and branch or service saddle fittings on the side of the main. After the joint has cooled, the main pipe wall is pierced (tapped) to enable flow through the branch. "Hot tapping" is saddle fusion to a "live" or pressurized main.
- Socket fusion is used to join 4" IPS and smaller tubing and pipe to socket fittings. Socket fittings are available for certain Performance Pipe PE materials.

FEDERAL REGULATIONS FOR GAS PIPE JOINING

When used to join Performance Pipe polyethylene gas pipe and fittings, Performance Pipe fusion joining procedures are qualified in accordance with U.S. Department of Transportation Regulations.

✓ D.O.T. Regulations require that each joint in a gas piping system must be made in accordance with written procedures that have been proved by test or experience to produce strong gastight joints (49 CFR, Part 192, §192.273(b)).

[1] *"Like wall thickness"* means that the pipe or fitting ends being butt fused do not exceed one SDR difference, for example, SDR 9.0 to SDR 11.0. Per ASTM, standard dimension ratio, SDR, value is when the outside diameter divided by the minimum wall thickness equals one of the following values: 6.0, 7.3, 9.0, 11.0, 13.5, 17.0, 21.0, 26.0, 32.5 or 41.0. Between adjacent SDR's, the difference in minimum wall thickness varies from about 21.7% to about 26%.

- ✓ D.O.T. Regulations require that written procedures for butt fusion, saddle fusion, and socket fusion joining of polyethylene gas piping must be qualified before use by subjecting specimen joints to required test procedures (CFR 49, Part 192, §192.283(a)).
- ✓ D.O.T. Regulations require that all persons who make joints in polyethylene gas piping must be qualified under the operator's written procedures (CFR 49, Part 192, & §192.285(a)).
- ✓ D.O.T. Regulations require that the gas system operator must ensure that all persons who make or inspect joints are qualified (CFR 49, Part 192, §192.285(d) & §192.287).

CAUTION — Performance Pipe polyethylene piping products cannot be joined with adhesives or solvent cement. Joining by hot air (hot gas) welding or extrusion welding techniques and joining by pipe threading are not recommended for pressure service.

PRECAUTIONS

STATIC ELECTRICITY

Polyethylene plastic pipe does not readily conduct electricity. A static electricity charge can buildup on inside and outside surfaces, and stay on the pipe surface until some grounding device such as a tool or a person comes close enough for the static electricity to discharge to the grounding device.

Discharging one part of the pipe surface will not affect other charged areas because static electricity does not flow readily from one area to another. Polyethylene pipe cannot be discharged by attaching grounding wires to the pipe.

WARNING – Fire or Explosion – Static electricity discharge can ignite a flammable gas or combustible dust atmosphere.

A static electricity discharge to a person, a tool, or a grounded object close to the pipe surface can cause an electric shock or a spark that can ignite a flammable gas or combustible dust atmosphere causing fire or explosion.

- In gas utility applications, static electricity can be a potential safety hazard. ***Where a flammable gas-air mixture may be encountered and static charges may be present, such as when repairing a leak, squeezing-off an open pipe, purging, making a connection, etc., arc preventing safety precautions are necessary.[2] Observe all Company (pipeline operator, utility, contractor, etc.) procedures for static electricity safety and control, including procedures for discharging static electricity and requirements for personal protection.***
- Take steps to discharge static electricity from the surface of a polyethylene gas pipe. Such steps include wetting the entire exposed pipe surface with a conductive anti-static liquid or a dilute soap and water solution, then covering or wrapping the entire wetted, exposed pipe surface with grounded wet burlap, conductive poly film, or wet tape conductor. The external covering should be kept wet by occasional re-wetting with anti-static solution. The covering or tape should be suitably grounded such as to a metal pin driven into the ground.
- Steps that discharge the outer surface do not discharge the inner surface of the pipe. Squeeze-off, purging, venting, cutting, etc., can still result in a static electricity discharge. When appropriate, ground tools and remove all potential sources of ignition.

[2] See the *AGA Plastic Pipe Manual For Gas Service 2000*, American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209.

- Appropriate safety equipment should be used.
- ***Do not use polyethylene pipe for handling dry grain or coal where a static electricity discharge may ignite a combustible dust atmosphere and cause an explosion or fire.***

Polyethylene pipe is not recommended for pneumatic slurry applications.

Electric Tools

WARNING – Fire or Explosion – Electric tools or fusion equipment may not be explosion-proof and may ignite a flammable gas or flammable dust atmosphere.

DO NOT operate electrical devices that are not explosion proof in a flammable gas or flammable dust atmosphere. When a flammable gas-air mixture may be present, observe all gas system operator (pipeline or utility company, and contractor) safety procedures for the use of electric tools and equipment.

Protection Against Shear and Bending Loads

Protective measures such as protective sleeves and properly placed, compacted backfill are necessary at a connection where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle or tapping tee on a main pipe. Protective measures are necessary for all types of plastic and non-plastic branch connections including heat fusion, mechanical, and electrofusion types. A protective sleeve and properly placed, compacted backfill are generally used together, but whether or not a protective sleeve is installed, the area surrounding the connection must be embedded in properly placed, compacted backfill to protect the polyethylene pipe against shear and bending loads.

For additional information on protection against shear and bending loads, at branch connections and where PE pipe penetrates a structure or enters or exits a casing, see the *Performance Pipe Engineering Manual*, and ASTM D 2774, *Underground Installation of Thermoplastic Pressure Piping*.

Liquid Hydrocarbon Permeation

When present, liquid hydrocarbons may permeate (solvate) polyethylene pipe. Liquid hydrocarbon permeation may occur when liquid hydrocarbons are present in the pipe, or where soil surrounding the pipe is contaminated with liquid hydrocarbons, or where liquid hydrocarbon condensates can form in gas pipelines. All types of liquid hydrocarbons (aromatic, paraffinic, etc.) have a similar effect, and the relative effect on different polyethylene pipe resins is essentially the same. Heat fusion joining to liquid hydrocarbon permeated pipes may result in a low strength joint.

CAUTION — Once polyethylene pipe has been permeated with liquid hydrocarbons, heat fusion or electrofusion joining is not recommended because liquid hydrocarbons will leach out during heating and contaminate the joint. Liquid hydrocarbon permeated polyethylene pipe should be joined using suitable mechanical connection methods.

Liquid hydrocarbon contamination is indicated by a rough, sandpaper-like, bubbly, or pockmarked surface when a fusion heating iron is removed from the pipe surface, and may be indicated by discoloration or by a hydrocarbon fuel odor. See the *Performance Pipe Engineering Manual* for additional information on permeation and chemical resistance.

Mechanical joining products (fittings, components, etc.) must be installed in accordance with the instructions of the mechanical joining product manufacturer. Obtain these instructions from the

mechanical joining product manufacturer. **The mechanical joining product manufacturer determines the capabilities of his product and its suitability for use with polyethylene pipe.**

Leakage at Fusion Joints

WARNING – Correctly made fusion joints do not leak. When pressurized, leakage at a faulty fusion joint may immediately precede catastrophic separation and result in violent and dangerous movement of piping or parts and the release of pipeline contents under pressure. Never approach or attempt to repair or stop leaks while the pipeline is pressurized. Always depressurize the pipeline before making corrections.

Faulty fusion joints must be cut out and redone.

Handling

Polyethylene piping is a tough, robust material, but it is not immune to damage. ***Improper handling or abuse can damage piping, compromise system performance and result in injury or property damage.*** Polyethylene piping should be unloaded and moved with proper handling and lifting equipment. Use fabric slings. Do not use chains or wire ropes. Do not roll or drop pipe off the truck, or drag piping over sharp rocks or other abrasive objects. Store piping so that the possibility of mechanical damage is minimized. See the *Performance Pipe Engineering Manual* for additional information on handling and storage.

Fusion in Cold Weather

In cold weather, polyethylene becomes more sensitive to impact and less flexible. Use additional care in handling. When temperatures are very cold, avoid sharp impact such as dropping the pipe from moderate heights. Cold pipes will be harder to bend or uncoil. In inclement weather and especially in windy conditions, the fusion operation should be shielded to avoid precipitation or blowing snow and excessive heat loss from wind chill.

Remove all frost, ice, or snow from the OD and ID surfaces of areas to be fused. Surfaces must be clean and dry before fusing.

Polyethylene pipe and fittings will contract slightly in the cold. Most butt and saddle fusion equipment will accommodate the slightly reduced diameter of cold pipe. In socket fusion, it will be more difficult to fit a cold socket fitting on the heating tool socket face. One way to compensate is to warm socket fittings in the cab of the service truck before using them.

In some cases, socket fusion cold ring clamps may fit loosely on cold pipe. Using two cold ring clamps, set the first cold ring clamp to proper distance with the depth gauge. Shim around the pipe behind the clamp with tape, and place a second, backup cold ring clamp over the tape. The backup cold ring clamp prevents slippage, and the inner cold ring clamp allows the pipe to expand to normal dimensions when heated.

When fusing in cold weather, the time required to obtain the proper melt may increase.

- *Maintain the specified heating tool surface temperature.* ***Do not increase heating tool surface temperature.***
- *Do not apply pressure during zero pressure butt or saddle fusion heating steps.*
- *Do not increase butt or saddle fusion joining pressure.*

In butt fusion, melt bead size determines heating time; so the procedure automatically compensates when cold pipe requires longer time to form the proper melt bead size.

For saddle fusion, establish the necessary cold weather heating time by making trial melt patterns in the field on non-pressurized, excess pipe that is at field temperature. Use the standard heating time plus additional heating time in 3-second increments until the proper melt pattern is established on the pipe. A clean wood board or heat shield ("flyswatter") should be used between the saddle fitting and the heater to avoid heating the fitting when making trial melt patterns.

- *Use only the cold weather heating time required to obtain the proper melt. Avoid excessive heating time.*
- *Do not make saddle fusion trial melt patterns on pressurized pipe.*

In cold weather socket fusion, it takes more time to push a cold socket fitting onto the male socket heater face so trials to develop a heating time for the fitting are not needed. For the pipe, establish the necessary heating time by making trial patterns on excess pipe that is at field temperature. Use the recommended heating time plus additional heating time in three-second increments until the proper melt pattern is established.

Additional information on fusion in cold weather can be found in ASTM D 2657 *Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings*, Annex A1.

KEY FACTORS FOR QUALITY FUSIONS

Quality fusion requires using all of the required tools and equipment, and following all of the steps in the procedure in the correct sequence. The fusion procedure prepares and aligns the surfaces, heats the mating surfaces to the proper melt consistency, joins the surfaces together under pressure, then cools the joint under pressure. Faulty fusion is caused by improper or defective equipment, omitting steps or doing things out of sequence. Faulty fusion may be hazardous.

Training and experience provide knowledge and proficiency in what to do, what to expect, and recognizing potential problems in advance. Inadequately trained or inexperienced persons can produce poor quality fusions, and may expose themselves or others to hazards. Federal safety regulations require that persons making joints in gas systems must be qualified in the pipeline operator's qualified fusion procedures. (See Federal Regulations for Gas Pipe Joining above.)

The key factors below are necessary for quality fusion.

- *Fusion tools and equipment must be correct for the job, and in proper working order;*

Each fusion procedure requires specific tools and equipment to do the job properly. Incorrect or poorly maintained or damaged fusion tools or equipment or using the wrong tools or equipment can cause a poor fusion, and may be hazardous. Use only the correct tools and equipment for the job. Do not use defective or improper tools or equipment. Follow the equipment manufacturer's procedures for equipment maintenance.

- *The fusion operator must be proficient in tool and equipment use and operation, and proficient in fusion procedure;*

The operator should be thoroughly familiar with the tools and equipment and follow the manufacturer's instructions on their use and operation. Improper use or an incorrect operating sequence can cause a poor fusion, and may be hazardous. If possible, a data logging device can be used with hydraulic joining equipment to record the critical fusion parameters.

- *Pipe and fitting surfaces must be clean and properly prepared;*

Dirty, or contaminated, or poorly prepared surfaces that do not mate together properly cannot produce a quality fusion. Clean and prepare the surfaces before joining. If contamination is reintroduced, clean the surfaces again.

- *Heating tool surfaces must be clean, undamaged and at the correct surface temperature;*

Heating tool faces have non-stick coatings for quick, complete release from melted polyethylene. Dirty or contaminated heating tool faces can cause poor fusion, and damaged coatings may not release properly from the melt. Use only wooden implements, and clean, dry non-synthetic (cotton) cloths or paper towels to clean heating tool faces. Never use spray chemicals or metal tools on heating tool faces.

Heating tool temperatures are specified for each procedure. (Butt fusion and saddle fusion heating tool temperatures are different.) *The specified temperature is the temperature on the surfaces that contact the pipe or fitting being joined, not the heating tool thermometer temperature.* Use a pyrometer or infrared thermometer to check for uniform temperature across both of the component contact surfaces. *(Temperature indication crayons are not preferred. If used, temperature-indicating crayons must never be applied to a surface that contacts a pipe or fitting.)* Uneven temperature may indicate a faulty heater. The heater thermometer measures the internal temperature, which is usually higher than surface temperature, however, heating tool temperature can be verified by checking the thermometer to ensure that the heating tool is maintaining temperature. When checking surface temperature with a pyrometer or infrared thermometer, note the heating tool thermometer reading. Check the heating tool thermometer reading before each fusion to verify that the heating tool is maintaining temperature properly. Incorrect or non-uniform temperature can cause poor fusion; ***low heating tool temperature can lead to a blowout during hot tap saddle fusion.***

BEFORE YOU START:

- ✓ *Inspect pipe lengths and fittings for unacceptable cuts, gouges, deep scratches or other deleterious defects.* Damaged products should not be used.
- ✓ *Toe-in or necking down is normal at pipe ends, but may need to be removed for socket fusion, or butt fusion to fittings.*
- ✓ *Remove surface damage at pipe ends that could compromise the joining surfaces or interfere with fusion tools or equipment.*
- ✓ *Be sure all required tools and equipment are on site, in proper working order and fueled up.*
- ✓ *The pipe and fitting surfaces where tools and equipment are fitted must be clean and dry.* Use CLEAN, dry, non-synthetic (cotton) cloths or paper towels to remove dirt, snow, water and other contamination.
- ✓ *Shield heated fusion equipment and surfaces from inclement weather and winds.* A temporary shelter over fusion equipment and the fusion operation may be required.
- ✓ *Relieve tension in the line before making connections.*

When joining coiled pipe, making an s-curve between pipe coils can relieve tension. In some cases, it may be necessary to allow pipe to equalize to the temperature of its surroundings. Allow pulled-in pipes to relax for several hours to recover from tensile stresses.

- ✓ *Pipes must be correctly aligned before making connections.*

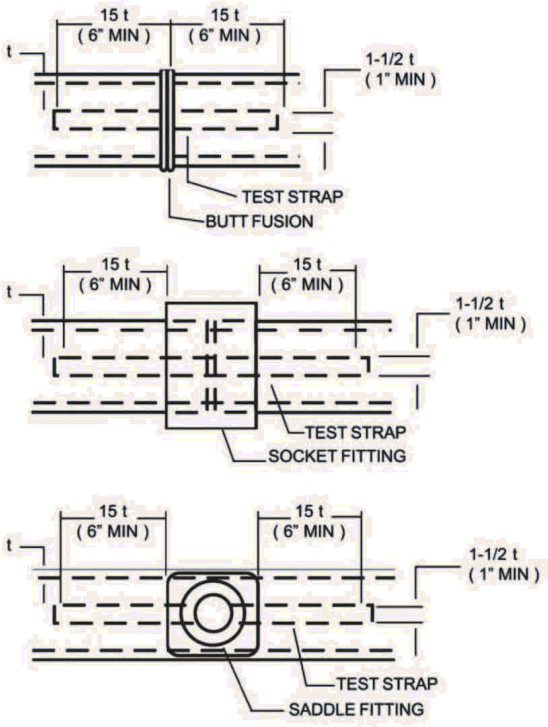
CAUTION – Impact Hazard – Do not bend pipe into alignment against open butt fusion clamps. The pipe may spring out and cause injury or damage. *Pipe must be aligned before placing it into butt fusion equipment.*

✓ *Trial fusions.*

It is possible to evaluate sample joints in order to verify the skill and knowledge of the fusion operator. Cut joints into straps (Fig. 1) and visually examine and test for bond continuity and strength. Bending, peeling, and elongation tests are useful for this purpose. These tests are generally conducted on smaller pipe sizes

Testing of large diameter fusions (≥ 12") may require special equipment and safety precautions.

Figure 1 ASTM D 2620 Specimens for Bent Strap Tests



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BUTT FUSION

SET-UP PARAMETERS

HEATING TOOL SURFACE TEMPERATURE — MINIMUM 400°F – MAXIMUM 450°F (204 – 232°C)

Heating tool surfaces must be up to temperature before you begin. Before you begin, all points on both heating tool surfaces where the heating tool surfaces will contact the pipe or fitting ends must be within the prescribed minimum and maximum temperatures and the maximum temperature difference between any two points on the heating tool fusion surfaces must not exceed 20°F (11°C) for equipment for pipe smaller than 18-in. (450 mm) diameter, or 35°F (19°C) for larger equipment. Heating tool surfaces must be clean.

- Interface pressure — **minimum 60 psi – maximum 90 psi (414 – 621 kPa; 4.14 – 6.21 bar)**

When the properly heated mating surfaces are brought together, the force required to make the joint is the force that is necessary to roll the fusion melt beads over to the pipe surface. This is a visual determination.

Interface pressure is used to calculate a fusion joining pressure value for hydraulic butt fusion machines or manual machines equipped with a torque wrench. The same interface pressure is used for all pipe sizes and all butt fusion machines. However, fusion joining pressure settings for the butt fusion machine are calculated for each pipe OD and DR.

For hydraulic machines, the interface pressure, the fusion surface area, the machine's carriage cylinder size and internal drag pressure, and if necessary, the pressure needed to overcome external drag resistance, are used to calculate hydraulic fusion joining pressure gauge settings. The equipment manufacturer's instructions are used to calculate this value.

Interface pressure and fusion machine hydraulic fusion joining pressure gauge settings are not the same!

Procedure

1. ***Secure.*** Clean the inside and outside of the component (pipe or fitting) ends by wiping with a clean, dry, lint-free cloth or paper towel. Remove all foreign matter. Align the components with the machine, place them in the clamps and then close the clamps. *Do not force pipes into alignment against open fusion machine clamps.* (When working with coiled pipe, if possible "S" the pipes on each side of the machine to compensate for coil curvature and make it easier to join.) Component ends should protrude past the clamps enough so that facing will be complete. Bring the ends together and check high-low alignment. Adjust alignment as necessary by tightening the high side down.
2. ***Face.*** Place the facing tool between the component ends, and face them to establish smooth, clean, parallel mating surfaces. Complete facing produces continuous circumferential shavings from both ends. Face until there is a minimal distance between the fixed and moveable clamps. Some machines have facing stops. If stops are present, face down to the stops. Remove the facing tool, and clear all shavings and pipe chips from the component ends. *Do not touch the component ends with your hands after facing.*
3. ***Align.*** Bring the component ends together, check alignment and check for slippage against fusion pressure. Look for complete contact all around both ends with no detectable gaps, and outside diameters in high-low alignment. If necessary, adjust the high side by tightening the high side clamp. Do not loosen the low side clamp because components may slip during fusion. Re-face if high-low alignment is adjusted.

4. ***Melt.*** Verify that the heating tool is maintaining the correct temperature. Place the heating tool between the component ends, and move the ends against the heating tool. The initial contact should be under moderate pressure to ensure full contact. Hold contact pressure *very briefly* then release pressure without breaking contact. Pressure must be reduced to contact pressure at the first indication of melt around the pipe ends. Hold the ends against the heating tool ***without force***. Beads of melted polyethylene will form against the heating tool at the component ends. When the proper melt bead size is formed, quickly separate the ends, and remove the heating tool.

   - During heating, the melt bead will expand out flush to the heating tool surface, or may curl slightly away from the surface. If the melt bead curls significantly away from the heating tool surface, unacceptable pressure during heating may be indicated.

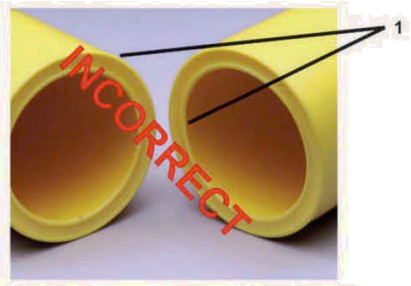
Table 1 Approximate Melt Bead Size

Pipe Size	*Approximate Melt Bead Size*
1-1/4" and smaller (40 mm and smaller)	1/32" – 1/16" (1 – 2 mm)
Above 1-1/4" through 3" (above 40 mm through 90 mm)	About 1/16" (2 mm)
Above 3" through 8" (above 90 mm through 225 mm)	1/8" – 3/16" (3 – 5 mm)
Above 8" through 12" (above 225 mm through 315 mm)	3/16" – 1/4" (5 – 6 mm)
Above 12" through 24" (above 315 mm through 630 mm)	1/4" – 7/16" (6 – 11 mm)
Above 24" through 36" (above 630 mm through 915 mm)	About 7/16"
Above 36" through 54" (above 915 mm through 1300 mm)	About 9/16"

5. ***Join.*** Immediately after heating tool removal, *QUICKLY* inspect the melted ends, which should be flat, smooth, and completely melted. If the melt surfaces are acceptable, immediately and in a continuous motion, bring the ends together and apply the correct joining force. *Do not slam. Apply enough joining force to roll both melt beads over to the pipe surface.*

   A concave melt surface is unacceptable; it indicates pressure during heating. (See Figure 2). Do not continue. Allow the component ends to cool and start over at Step 1.

Figure 2 Unacceptable Concave Melt Appearance

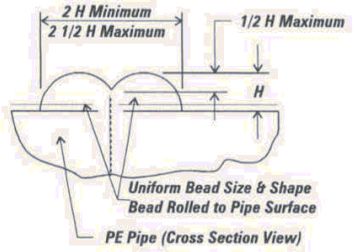


1. Unacceptable concave melt appearance.

   - The correct joining force will form a double bead that is rolled over to the surface on both ends.

6. ***Hold.*** Hold joining force against the ends until the joint is cool. The joint is cool enough for *GENTLE* handling when the double bead is cool to the touch. Cool for about 30-90 seconds per inch of pipe diameter. *Do not try to shorten cooling time by applying water, wet cloths or the like.*
   - Avoid pulling, installation, pressure testing and rough handling for at least an additional 30 minutes.
   - Heavier wall thickness pipes require longer cooling times.
7. ***Inspect.*** On both sides, the double bead should be rolled over to the surface, and be uniformly rounded and consistent in size all around the joint. As illustrated in Figure 3, the double bead width should be 2 to 2-1/2 times its height above the surface, and the v-groove depth between the beads should not be more than half the bead height.

Figure 3 Butt Fusion Bead Proportions



- When butt fusing to molded fittings, the fitting side bead may have an irregular appearance. This is acceptable provided the pipe side bead is correct.
- It is not necessary for the internal bead to roll over to the inside surface of the pipe.

Table 2 Butt Fusion Bead Troubleshooting Guide

Observed Condition	*Possible Cause*
Excessive double bead width	Overheating; Excessive joining force
Double bead v-groove too deep	Excessive joining force: Insufficient heating; Pressure during heating
Flat top on bead	Excessive joining force; Overheating
Non-uniform bead size around pipe	Misalignment; Defective heating tool; Worn equipment; Incomplete facing
One bead larger than the other	Misalignment; Component slipped in clamp; Worn equipment; Defective heating tool; Incomplete facing; Dissimilar material – see note above
Beads too small	Insufficient heating; Insufficient joining force
Bead not rolled over to surface	*Shallow v-groove* – Insufficient heating & insufficient joining force; *Deep v-groove* – Insufficient heating & excessive joining force
Beads too large	Excessive heating time
Squared outer bead edge	Pressure during heating
Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	Hydrocarbon contamination

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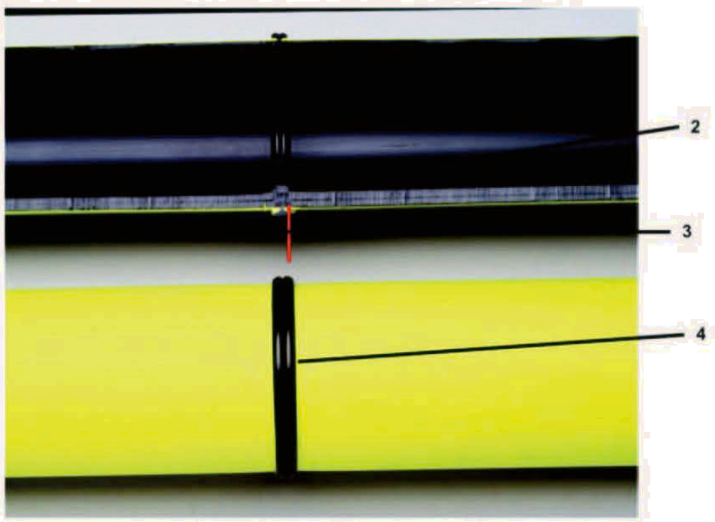
Butt Fusion Qualifying Procedure

1. Prepare a sample joint. Pipes on either side of the joint should be at least 6" (150 mm) or 15 times the wall thickness in length. Observe the joining process to determine that the correct procedure is being followed.
2. Visually inspect the sample joint and compare it to a sample or picture of an acceptable joint.
3. Allow the sample joint to cool completely – for no less than one hour.
4. Cut the sample joint lengthwise along the pipe into at least three straps that are at least 1" (25 mm) or 1.5 wall thicknesses wide. See Figure 1. For sizes less than 2" where this is not possible, the sample may be cut into at least 3 straps with no width requirement.
5. Visually inspect the cut surface at the joint and compare to a sample or picture of an acceptable joint. There should be no gaps, voids, misalignment, or unbonded areas.
6. Bend the straps until the ends of the strap touch.
7. If flaws are observed in the joint, compare appearance with pictures of unacceptable joints. Prepare a new sample joint using correct joining procedure, and repeat the qualifying procedure.

Acceptable Appearance



2. Proper alignment - no gaps or voids
3. Proper melt, pressure and alignment
4. Proper double roll-back bead

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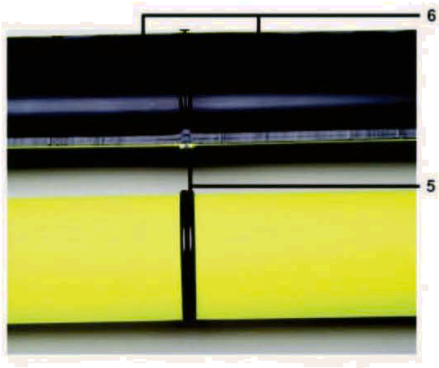
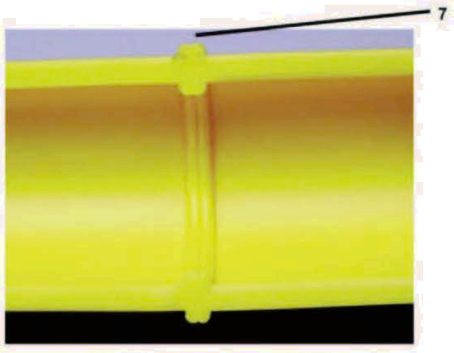
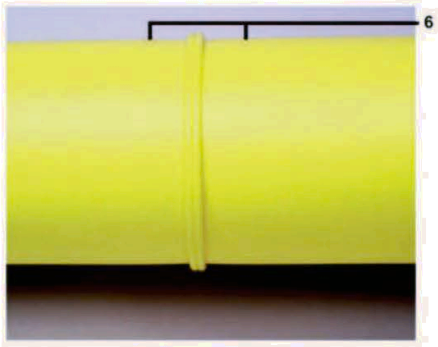
ACCEPTABLE FUSIONS



5. Proper double roll-back bead
6. Proper alignment



7. Proper double roll-back bead



6. Proper alignment

8. No gaps or voids when bent

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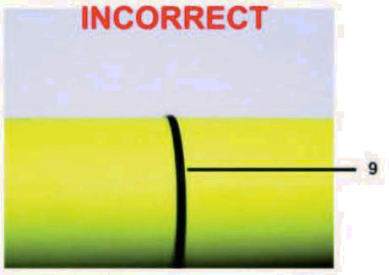
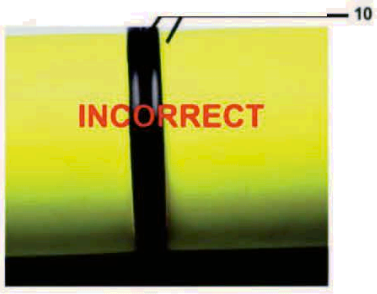
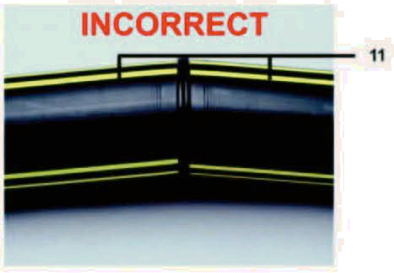
UNACCEPTABLE FUSIONS



9. Insufficient heat time; melt bead too small

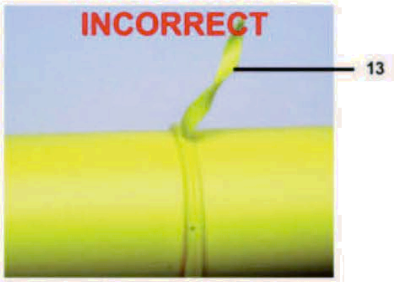


10. Excessive heat time or pressure applied during heating; melt bead too large

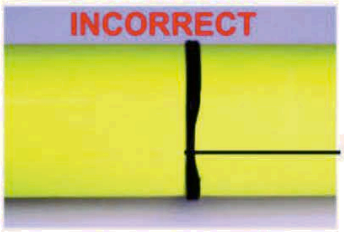


11. Pipe angled into fusion unit

12. Improper "High-Low" alignment



13. Incomplete face off or failure to remove faced off ribbons



14. Incomplete face off

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