



GAS DESIGN STANDARD POLYETHYLENE GAS DISTRIBUTION SYSTEM DESIGN

A-90

Publication Date: 02-26-14 Rev. #06

This document also appears in the following manuals:

- Electric & Gas Service Requirements (Greenbook)
- Gas Applicant Design Manual

Purpose and Scope

This Gas Design Standard (GDS) provides design requirements for the Pacific Gas and Electric Company (Company) polyethylene (PE) gas distribution system. Company PE installations meet the [Code of Federal Regulations 49 \(CFR\) 192.321, "Installation of plastic pipe."](#)

Areas covered in this GDS include:

- General Information
- Materials: pipe, fittings, risers, valves and locating wire
- Polyethylene Pipe Placement
- Construction Methods: preferred PE joining methods, direct-burial plastic main and service installation, mechanical insertion of polyethylene main and service and plastic service renewal.
- Records

General Information

1. Connections within the PE system may be made with the following:

- Heat iron socket and butt fusion (reference Gas Design Standard B-90, "Plastic System Socket and Butt Fusion Fittings")
- Heat iron saddle fusion (reference Gas Design Standard B-90.1, "Plastic System Saddle Fittings")
- Electrofusion (reference Gas Design Standard B-90.3, "Electrofusion Fittings and Tapping Tees")
- Mechanical fittings (reference Gas Design Standard B-91, "Transition Fittings for Polyethylene Pipe" and Gas Design Standard, B-91.1, "Polyethylene (PE) System Mechanical Fittings").

NOTE: Any connection to Aldyl-A pipe requires mechanical or electrofusion fittings ONLY. Heat iron fusion is NOT allowed on Aldyl-A pipe.

- IF the SDR (wall thickness) of an Aldyl-A pipe is unknown,
THEN electrofusion must be used.
- #### **2. Evaluate cathodic protection impacts of the design:** Utility Standard S0470, "Design and Construction of Gas Distribution Facilities" requires a corrosion mechanic or gas operating supervisor to evaluate the cathodic protection impacts and needs associated with a project during the design stage of the project.
- a. All isolated steel pipe, risers, valves, and/or fittings within a PE pipe system must be cathodically protected. Prefabricated risers, metallic components on plastic valves, tapping tees, and/or metallic bolts on plastic fittings do NOT need to be protected. Refer to *Gas Transmission and Distribution Manual - Corrosion Control Volume*.
- #### **3. Ensure plastic mains or services are not subjected to temperatures greater than 140°F as described in Gas Design Standard A-93, "Polyethylene Pipe Specifications and Design Considerations."**
- #### **4. To deactivate a plastic service see Gas Design Standard A-93.2, "Deactivation of Plastic Services."**

Materials

Only pipeline components listed in the Company's Gas Standards and Specifications, Gas Information Bulletins and Flash emails are allowed in construction of the gas system.

1. Pipe

a. Pipe sizing:

- 2", 4", 6" or 8" PE main is preferred.
- New services and fully replaced services are to be 1" CTS or larger.

Exceptions: Existing 3/4" steel services may be replaced with inserted 1/2" CTS polyethylene, if the 1/2" CTS polyethylene has the capacity to support current customer loads and is consistent with Gas Design Standard A-93.3, "Plastic Excess Flow Valves," when an excess flow valve (EFV) is required.

Existing 1/2" CTS PE service may be replaced by pipe splitting with 1/2" CTS as described in Utility Procedure TD-4634P-01, "Polyethylene Service Splitting."

Note: 1/2" CTS may ONLY be used for inserting, 1/2" CTS pipe splitting, partial service alterations, and leak repairs to existing 1/2" CTS services.

- On applicant installed jobs, the Company may accept previously installed 1/2" CTS services and 1/2" CTS service stubs installed prior to May 1, 2010, if those services and stubs have the capacity to support the current customer loads, as approved by the local area engineer. See Appendix 1 for the requirements that must be met to approve previously installed applicant installations.

2. Fittings

- Heat Iron Fusion Fittings are listed in Gas Design Standard B-90 and Gas Design Standard B-90.1.
- Electrofusion Fittings are listed in Gas Design Standard B-90.3.
- Approved PE-to-PE mechanical connections are listed in Gas Design Standard B-90.1, Gas Design Standard [B-91](#), and Gas Design Standard B-91.1.
- Make PE-to-steel, PE-to-copper, or PE-to-cast-iron transition joints using the approved transition fittings shown in:
 - Gas Design Standard B-54, "Compression Couplings"
 - Gas Design Standard B-91, "Transition Fittings for Polyethylene Pipe"
 - Gas Design Standard, B-91.1, "Polyethylene (PE) System Mechanical Fittings"
 - Gas Design Standard B-91.4, "Cast Iron to Steel Insulated Transition Couplings"
 - Gas Design Standard B-91.5, "Cast Iron to Polyethylene Transition Fittings"

3. Risers

- Pre-fabricated risers are listed in Gas Design Standard A-91, "Prefabricated Risers."

4. Valves

- Excess Flow Valves (EFVs) are listed in Gas Design Standard A-93.3.
- PE valves are listed in Gas Design Standard F-90, "Polyethylene (PE) Valves."
- Contact the local area engineer to determine requirements when using steel valves within a PE system. For example: when installing fire/emergency valves upstream and downstream of regulator stations.

When steel valves are installed in a PE system, vertical or horizontal steel legs must be welded to the steel pipe or transition fittings to prevent the valve body from rotating (see examples in A-90 Attachment 1, "[Illustration of a Direct Burial Main and Service Installation](#)"). Gas Design Standards and Specifications, Section F provides information on steel valves.

5. PE Pipe Locating

- For locating wire requirements see Gas Design Standard A-90.2, "Locating Wire Installation for Direct Burial Plastic Mains and Services" and Gas Design Standard A-90.3, "Locating Wire Installation for Inserted Plastic Mains and Services."

Polyethylene Pipe System Design

1. Polyethylene Pipe Placement:

Horizontal distance:

- a. Polyethylene distribution gas main must be installed a minimum horizontal distance of 10' from the face or foundation of any building.
 - IF the main must be installed closer than 10' to a foundation or building,
THEN contact the local area gas engineer to determine if additional protection for the gas main is required.

Burial depth:

- a. Place gas only facilities in the distribution trench per GS Interim Standard 463-4, "Cover and Clearance Requirements for Transmission Lines, Mains and Service Lines."
- b. Place joint trench gas facilities in the distribution trench per Utility Standard S5453, "Joint Trench." Placement in a Public Utility Easement (PUE) is preferred.
- c. Plastic pipe is susceptible to buckling and crushing at specified depths due to the effects of soil stresses. Plastic pipe may NOT be installed at a depth greater than 10' unless the installation is evaluated for fill-stress effects and is approved by the area senior gas distribution engineer.

Gas service placement:

- a. Gas service is normally installed in a straight line at a right angle to the main, traversing from the main to the meter.
 - Offsets, diagonal runs, and bends should be avoided wherever possible.
 - Where avoidable, service should NOT be installed under driveways or customer-paved areas.
- b. When an applicant changes the service-point location (flop lots), take one of the following actions:
 - i. For short-side service stubs, cut off the service stub at the main per Gas Design Standard A-93.2. Install a new service.
 - ii. For long-side service stubs:
 - IF the street is not yet paved,
THEN cut off the service stub at the main per Gas Design Standard A-93.2. Install a new service.
 - IF the street is paved and the walls of the new building are still opened,
THEN use the existing service-point location and have the applicant re-plumb the houseline to the original service-point location.
 - IF the street is paved and the walls of the new building are closed,
THEN consult the local area engineer to determine the change in service lay-out.
- c. The final grade level for a pre-fabricated riser must be at or below the red burial line indicated on the riser as described in Gas Design Standard A-91.

2. Typical Subdivision Design for PE Pipe

Figure 1 shows a "Typical Subdivision Design - Infill" and Figure 2 shows a "Typical Subdivision Design - End of System Growth"

- a. The local gas distribution engineer must specify main-line rib sizes and tie-in locations.
- b. Do NOT terminate gas distribution facilities at the end of a development to clear paving or other improvements unless the applicant requests an extension to serve adjacent future development. Terminate these facilities approximately 5' past the last service or to the next property line within the project area, unless approved by the area senior gas distribution engineer.
- c. To make sharp turns or offsets (smaller than the minimum bend radius in Table 2), install full-opening heat fusion fittings per Gas Design Standard B-90 or electrofusion fittings per Gas Design Standard B-90.3.

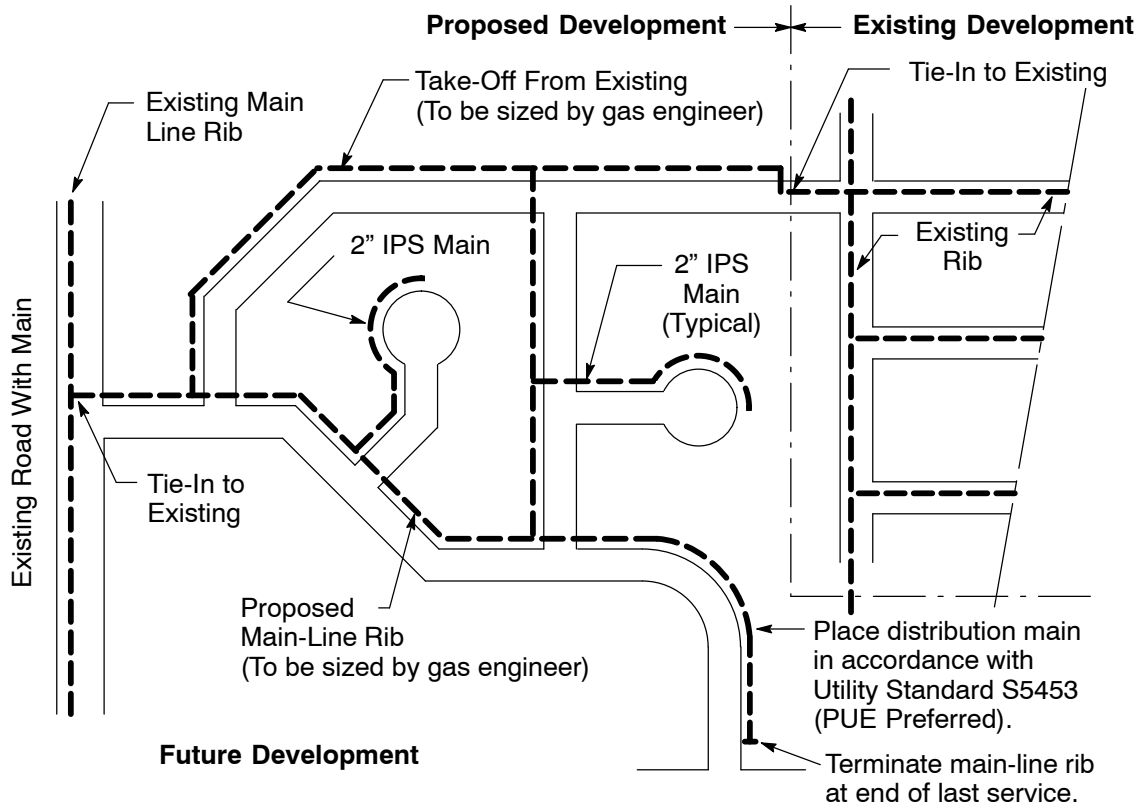


Figure 1
Typical Subdivision Design - Infill

d. Place the gas facilities in the distribution trench per Utility Standard S5453. Placement in a PUE is preferred.

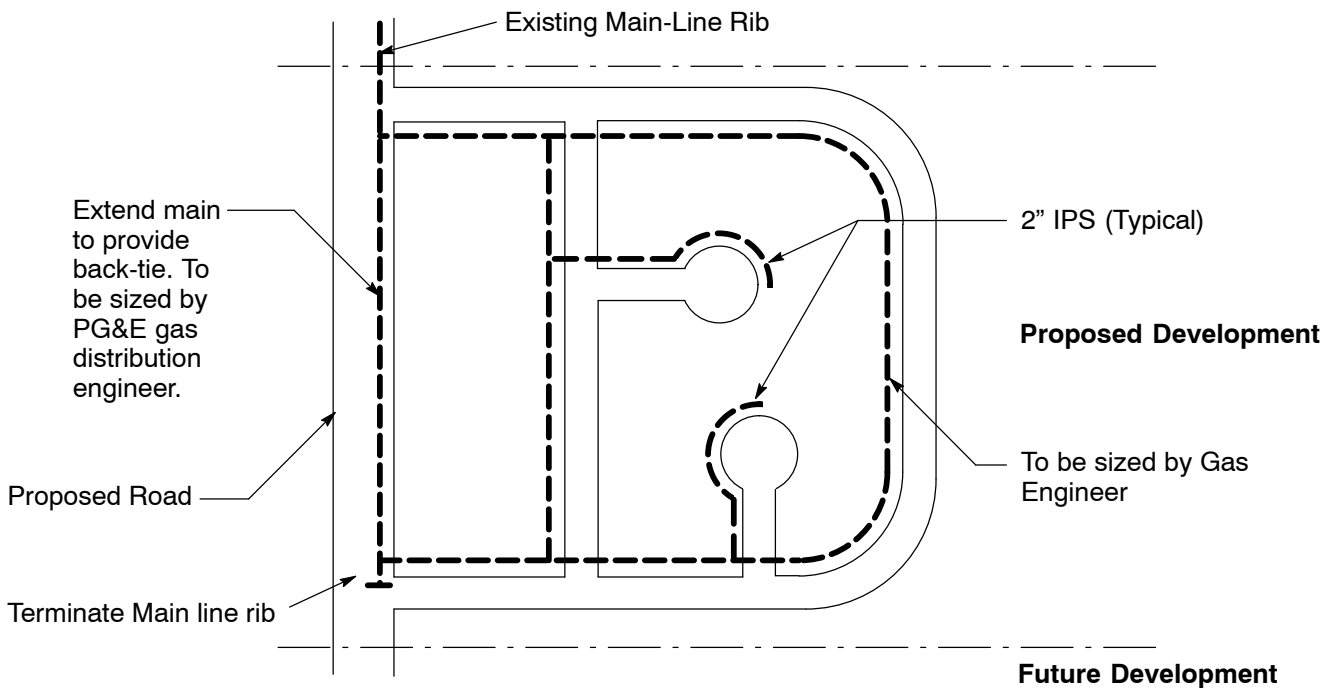


Figure 2
Typical Subdivision Design - End of System Growth

e. A subdivision design for end of system growth is shown in Figure 2. Extend the distribution main along the proposed road to provide a back-tie to the proposed development.

3. Branch Services

- a. Branch services must be designed and installed as outlined in Gas Design Standard A-42, "Standard Branch Service Installation."
- b. Branching may be used to provide service to NO more than two buildings. The meter installations must be located on the adjacent sides of the two buildings served. Where a branch-service installation is justified, a separate location for the gas meter and electric meter is permissible, if necessary.

Construction Methods

1. PE Joining Methods

- a. The preferred joining methods for each size pipe are shown in Table 1.

Table 1 PE Pipe Joining Methods

Pipe/Tubing Size (Inches)	Joining Method
1/2 CTS, 1 CTS, and 1-1/4 IPS	Electrofusion, Heat Iron Socket Fusion or Mechanical Fittings
2 IPS	Electrofusion, Heat Iron Socket Fusion, Heat Iron Butt Fusion or Mechanical Fittings
3 IPS and Larger	Heat Iron Butt Fusion and Electrofusion

2. Typical Direct-Burial Plastic Main and Service Installation

- a. Do NOT install direct-buried plastic pipe beneath retaining structures, walls or footings, or adjacent to pile or other structures subject to settlement.
- b. Do NOT install direct-buried plastic pipe in unpaved areas where substantial wheel or equipment loading may damage the pipe, unless approved by the local area gas engineer.
- c. A warning tape is to be installed in direct-burial installations per Gas Design Standard L-16, "Gas Pipeline Underground Warning Tape."

Directional Changes

- d. Changes in pipe direction must be made with elbows or tee fittings at street intersections (as illustrated in A-90 Attachment 1). Roping may be used for directional changes at other locations, when necessary.
- e. Bends in roped PE pipe must be installed in the trench with a radius greater than the minimum recommended radius (Table 2). All bends must have a radius greater than: 20 times the pipe diameter for SDR 7 and 9 and 25 times the pipe diameter for SDR 10, 11, 11.5 and 13.5.
- f. There must be NO fusion or mechanical joints within 3' of any bend.

Table 2 PE Pipe Minimum Bend Radius

Nominal Pipe Size (Inches)	Minimum Bend Radius for PE Pipe Unsupported by Casing
1/2 CTS	1-1/4'
1 CTS	2-1/4'
1-1/4 IPS	3-1/2'
2 IPS	5'
3 IPS	7'
4 IPS	9-1/2'
6 IPS	14'
8 IPS	18'

- g. Ensure that plastic pipe containing fusions or mechanical joints is installed in a straight alignment. Plastic pipe installations are in a straight alignment if the bend radius of the pipe is greater than 150 times the pipe diameter.

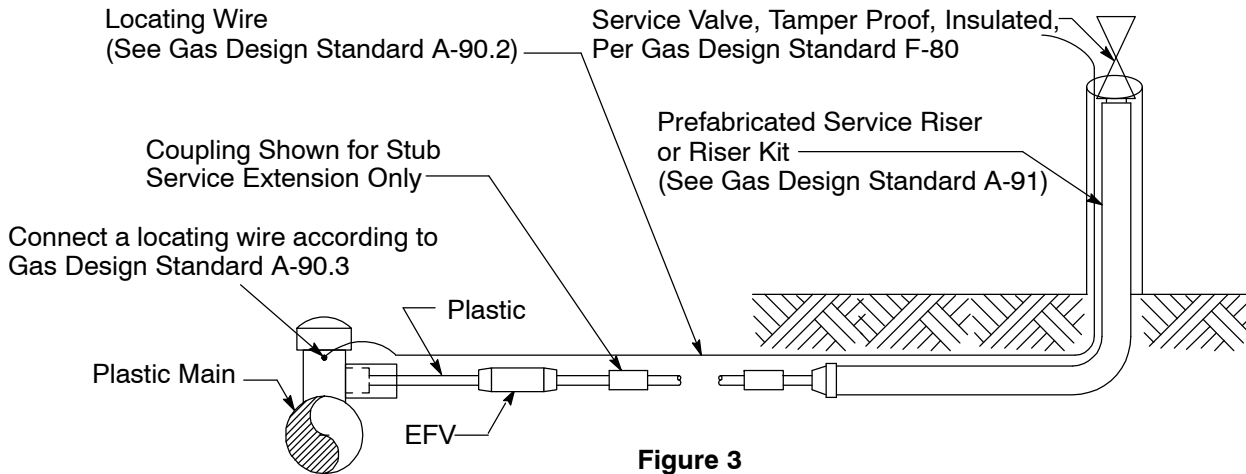


Figure 3
Plastic Service Installation

Figure 3 represents a typical lateral connection. See Gas Design Standard B-90.1 and Gas Design Standard B-90.3 for saddle fittings.

- h. For future lateral lines, install a minimum 3' stub with locating wire attached to an anode as described in Gas Design Standard A-90.2

3. Mechanical Insertion of Polyethylene Main and Service

- a. Refer to the documents below for information on specific casing applications and installations:
- Refer to Gas Design Standard A-75, "Gas Service and Mains in Plastic Casing" for the specific installation requirements for plastic pipe in a plastic casing.
 - Refer to Gas Design Standard A-33.1, "Plastic Gas Lines on Bridge Structures" for the specific installation requirements for plastic lines on bridge structures.
 - Casing size and other requirements for highway crossings are provided in Gas Design Standard A-70, "Casings for Highway and Railroad Crossings."
- b. Do not transfer copper services to a new main or alter copper services (see Utility Standard TD-4801S, "Service Replacement Criteria"). Replace copper services with 1" CTS or larger PE tubing. Install an excess flow valve (EFV) per Gas Design Standard A-93.3. (see illustration in A-90 Attachment 1)
- c. Plastic pipe is approved for double inserting into existing mains and services. This application is approved provided the following conditions are met:
- Removing the previously inserted pipe is not practical or economical.
 - Installation is made in accordance with Gas Design Standard A-75 or Gas Design Standard A-93.1, "Plastic Gas Distribution System Construction and Maintenance," as applicable, particularly with respect to protecting and supporting the entry and exit points.
 - Installation is mapped with both the casing size and casing material identified. An example is shown in the mechanical insertion section of Gas Design Standard A-93.1.
- d. Ensure that the minimum bend radius of PE pipe listed in Table 2 is not exceeded during insertion into a casing.
- e. Provide for future laterals by installing stubs or opening up the casing at appropriate locations (see Figure 4, "Laterals Off Plastic Main Insert" and Figure 6, "Service Connections Off Plastic Main Insert").
- f. Plug the space between the plastic and the casing pipe (see Figure 5, "Tie-In to Steel") with casing plugs or cable protectors (see Gas Design Standard A-70, "Casings for Highway and Railroad Crossings" and Gas Design Standard A-73, "Casing Insulator and End Seals Selection Chart"), duct seal, or other suitable means not detrimental to PE pipe. See Gas Design Standard A-75 for the plastic casing/sleeve sealing requirements.

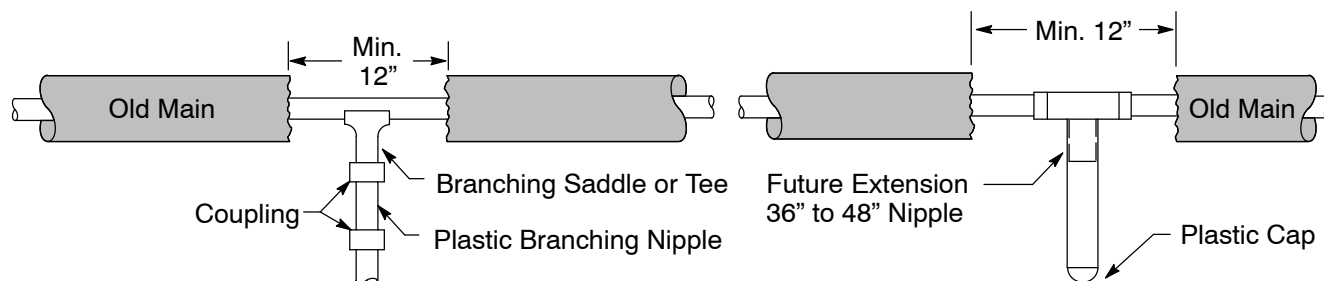


Figure 4
Laterals Off Plastic Main Insert

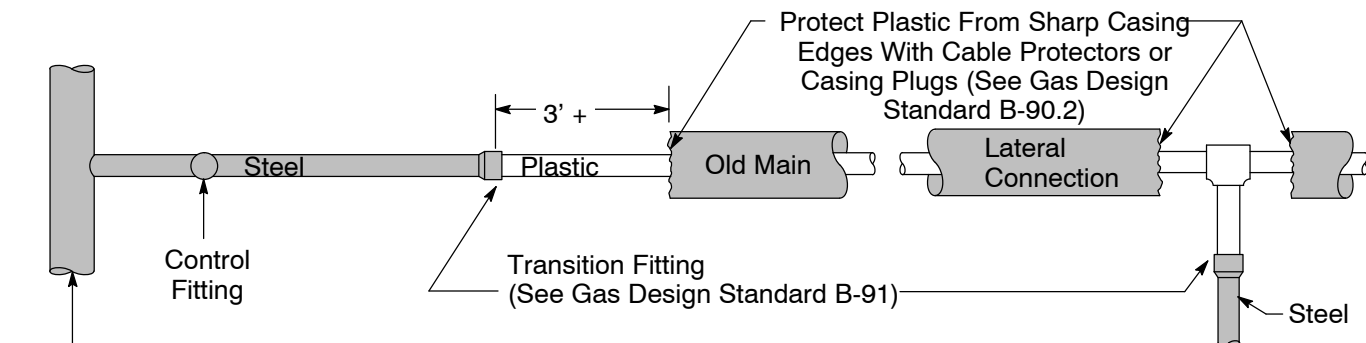


Figure 5
Tie-In to Steel

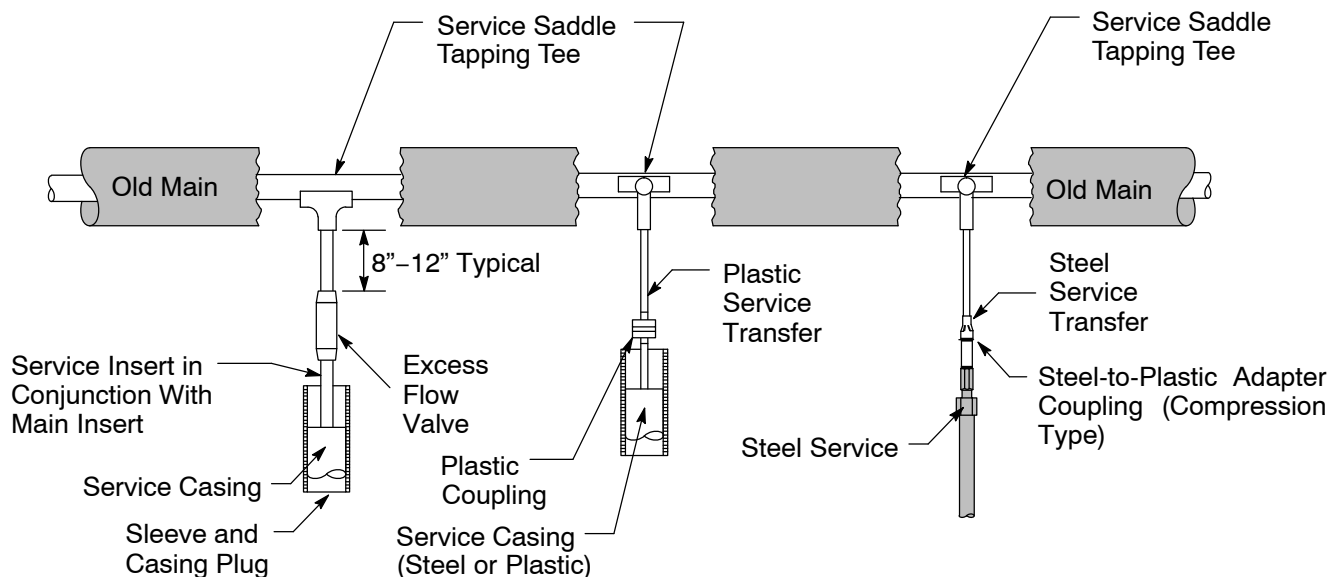


Figure 6
Service Connections Off Plastic Main Insert

4. Riser Insertion

- a. Details for service head adapter installation are provided in Gas Design Standard B-91.
- b. Whenever possible, the service riser must be relocated outside of the building (see Gas Design Standard A-91). This section of Gas Design Standard A-90, "Plastic Main and Service Installation," Figure 7, "Typical Insert into Basement or Meter Box," is intended for use on service renewals where a new service riser cannot be relocated outside of the building.

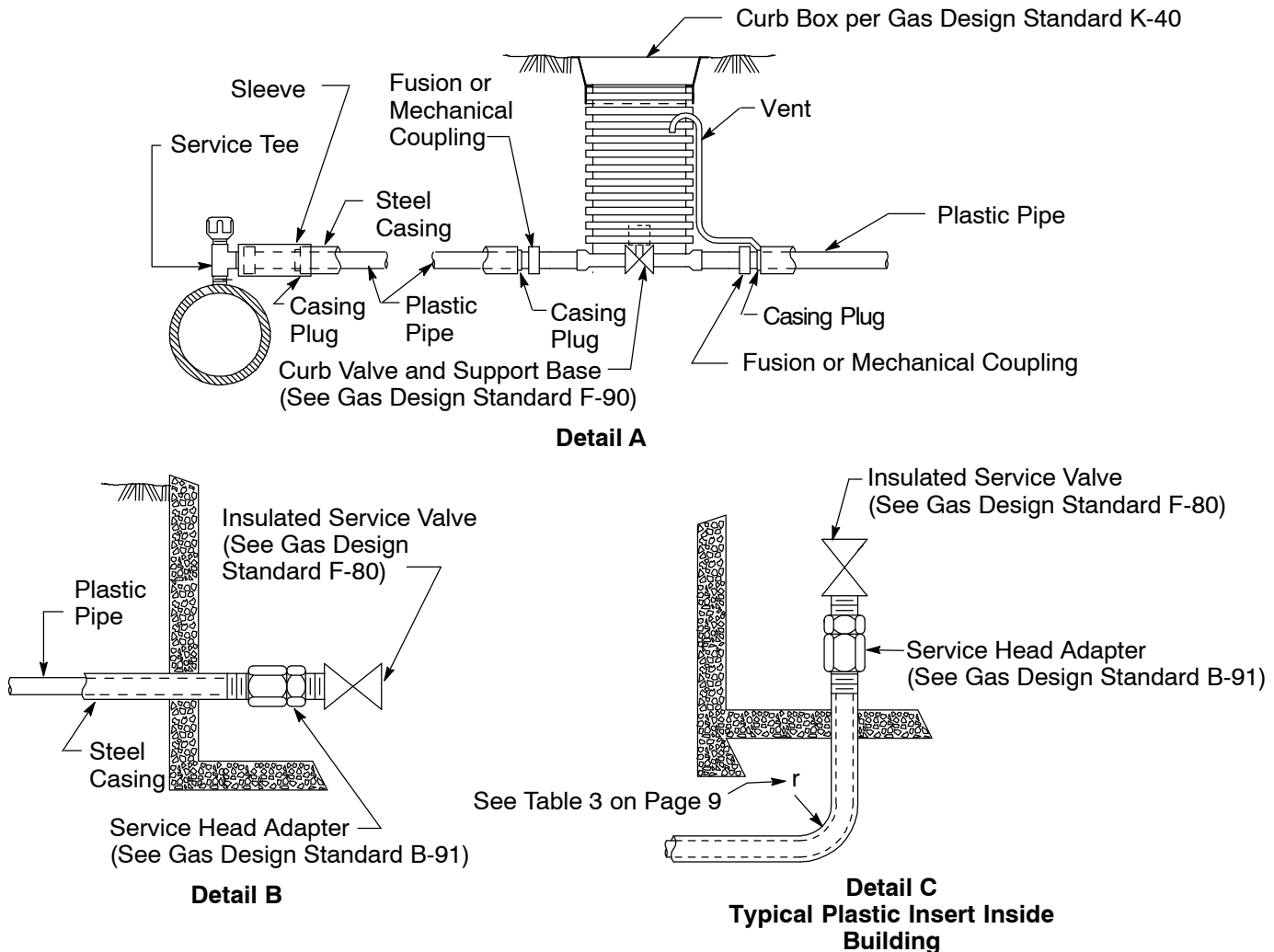


Figure 7
Typical Plastic Insert Into Basement or Meter Box

- c. Where possible, the sleeve should bridge the gap between the service tee and the casing pipe. The plastic pipe must be supported by well-compacted sand or fine soil.
- d. Use 1/2" CTS copper or stainless steel tubing as a vent pipe.
 - The vent pipe must be inserted approximately 6" into the annulus between the casing pipe and plastic pipe (see vent in Figure 7).
 - The tubing may be slightly oval to fit into the annulus.
 - Use care to avoid restricting the carrying capacity of the tubing.
 - Insulate the tubing from the steel casing by wrapping the tubing with tape.
 - Drill a 3/8" hole into the plastic extension of the curb valve box and insert the tubing with a slight gooseneck to prevent dirt from clogging the vent.
- e. Do NOT insert plastic pipe into a casing if the casing pipe radius is less than that shown in Table 3.
 - IF the radius is less than Table 3,
THEN install a new riser with the proper bend radius.
- f. Install the curb box so that external loads are not transmitted to the service. The valve box must NOT rest on the service pipe or casing.

Table 3 Minimum Bend Radius in a Riser Casing for Specified Pipe Sizes

Pipe Size (Inches)	Minimum Radius (Inches)
1/2 CTS	18
1 CTS	28
1-1/4 IPS	41-1/2

- g. See Gas Design Standard A-44, "Service Connections to Cast Iron Main" for information on connecting plastic to cast iron.

5. Records

- a. The brand name of all plastic pipe lots installed at each location and the date it was manufactured must be recorded in the permanent records. This may require multiple plastic stamps for construction drawings. Figure 8 depicts a sample plastic stamp for construction drawings.
- Note the pipe's brand and manufacturing date (MM/DD/YY format) on the foreman's copy of the completed estimate.
 - Transcribe this information to the file copy.
 - Record the brand and manufacturing date (MM/DD/YY format) of pipe used for service installations in the "Remarks" section of the Form F5458-1, "Gas Service Record," or the Form TD-4110P-03-F01, "Leak Repair, Inspection, and Gas Quarterly Incident Report," as appropriate.
 - See A-93 Attachment B, "Approved PE Pipe/Tubing Manufacturers and Plants" for a description of print line information.

TEST AT 100–110 PSI FOR MINIMUM OF 5 MIN			
Pressure	Duration	Initials	Date of Test
Plastic Pipe Data			
Footage and Size		_____ / _____	
SDR / Wall Thickness		_____	
Pipe Manufacture		_____	
Date Manufactured		_____	
<input type="checkbox"/> PE 2406/2708		<input type="checkbox"/> Other PE:	
Footage and Size		_____ / _____	
SDR / Wall Thickness		_____	
Pipe Manufacture		_____	
Date Manufactured		_____	
<input type="checkbox"/> PE 2406/2708		<input type="checkbox"/> Other PE:	
Foreman LAN ID: _____		Date: ____/____/____	
Foreman Signature: _____			
List all plastic pipe by footage, size, manufacture and date manufactured per Gas Design Standard A-93.1			

**Figure 8
Plastic Pipe Stamp**

Target Audience

Gas planners, estimators, new business inspectors, gas distribution engineers, maintenance and construction, general construction, materials inspectors, and personnel involved in PE pipe connection training and qualification.

Definitions

NA

Acronyms and Abbreviations

NA

Compliance Requirement/Regulatory Commitment

[Installation of plastic pipe](#) [49 CFR 192.321](#)

References

Code Numbers for Steel Pipe	A-15
Plastic Gas Lines on Bridge Structures	A-33.1
Piping Design and Test Requirements	A-34
Standard Branch Service Installation	A-42
Service Connections to Cast Iron Main	A-44
Copper Pipeline Defects	A-67
Casings for Highway and Railroad Crossings	A-70
Casing Insulator and End Seals Selection Chart	A-73
Gas Service and Mains in Plastic Casing	A-75
Plastic Main and Service Installation	A-90
Locating Wire Installation for Direct Burial Plastic Mains and Services	A-90.2
Locating Wire Installation for Inserted Plastic Mains and Services	A-90.3
Prefabricated Risers	A-91
Polyethylene Pipe Specifications and Design Considerations	A-93
Plastic Gas Distribution System Construction and Maintenance	A-93.1
Deactivation of Plastic Services	A-93.2
Plastic Excess Flow Valves	A-93.3
Compression Couplings	B-54
Plastic System Socket and Butt Fusion Fittings	B-90
Plastic System Saddle Fittings	B-90.1
Polyethylene (PE) System Accessories	B-90.2
Electrofusion Fittings and Tapping Tees	B-90.3
Transition Fittings for Polyethylene Pipe	B-91
Polyethylene (PE) System Mechanical Fittings	B-91.1
Cast Iron to Steel Insulated Transition Couplings	B-91.4
Meter Valves	F-80
Polyethylene (PE) Valves	F-90
Gas Meter Locations	J-15
Gas Meter Room	J-16
Plastic Valve Box for 3/4" - 4" Valves	K-40
Gas Pipeline Underground Warning Tape	L-16
Gas Service Record	F5458-1
Cover and Clearance Requirements for Transmission Lines, Mains and Service Lines	GS I.S. 463-4
Design and Construction of Gas Distribution Facilities	S0470
Joint Trench	S5453
Leak Repair, Inspection, and Gas Quarterly Incident Report	TD-4110P-03-F01
Polyethylene Service Splitting	TD-4634P-01
Service Replacement Criteria	TD-4801S
Squeezing Polyethylene (PE) pipe	WP4170-02
Gas Design Standards and Specifications, Section F	
<i>Gas Transmission and Distribution Manual - Corrosion Control Volume</i>	
Plastic Pipe Institute (PPI) Handbook, Chapter 7, Underground Installation of PE Piping	
ASTM F1973-08, Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems	

Appendices

Appendix 1 – Application of New Installation and Design Requirements to Qualified Delayed Applicant-Installed Work

Attachments

Illustration of a Direct Burial Main and Service Installation A-90 Attachment 1

Revision Notes

Revision 06 has the following changes:

1. Gas Design Standard A-93.1 and Gas Design Standard A-90 have been revised to organize all design information for the plastic pipe system in Gas Design Standard A-90 and construction information into Gas Design Standard A-93.1. Several items were moved from Gas Design Standard A-93.1 into the Gas Design Standard A-90 design document including preferred joining methods and the minimum bend radius for pipe.
2. The title of the document has been changed from “Plastic Main and Service Installation” to “Polyethylene Gas Distribution System Design”.
3. The document formatting has changed to clarify wording and group subjects. References have been updated and some new references added to direct document users to additional information.
4. Incorporated 1” service requirements and installation information from TD-A-90B-001 to Appendix 1.
5. The instruction for inserting 1/4” CTS PE tubing for service replacement has been removed. 1/4” CTS PE pipe and fittings are no longer approved for installation.
6. Removed detail for locating wire requirements. These requirements are now detailed in Gas Design Standard A-90.2 and Gas Design Standard A-90.3.
7. Removed branch service installation information covered in Gas Design Standard A-42 and added Gas Design Standard A-42 as a reference.
8. Added the requirement that any new gas main must be installed at the minimum horizontal distance of 10’ from the nearest structure.
9. The preferred joining methods in Table 1 have been revised.
10. Added requirement for warning tape in direct burial installations per Gas Design Standard L-16.
11. Revised the bending radius for installed PE pipe in a typical direct-burial plastic main and service installation.
12. Revised Plastic Pipe Stamp in Figure 8 to add SDR/wall thickness.

Asset Type: Distribution

Function: Design, Construction and Maintenance

Gas Design Standard Contact: Gas Design Standard Responsibility List

Appendix 1 – Application of New Installation and Design Requirements to Qualified Delayed Applicant Installed Work

This appendix clarifies how to apply various new installation and design requirements to qualified delayed applicant-installed gas projects, where the gas distribution main backbone and service stubs were installed and inspected, but the service completions have not been completed for many months or years.

NOTE: This does NOT apply to any “At-risk” projects.

The Company has encountered “delayed” applicant-installed projects (e.g. subdivisions) where the gas distribution main backbone and service stubs were installed and inspected, but the service completions have not been completed for many months or years and the system has not been pressurized, energized and accepted by the Company. These projects must meet the criteria:

- Job designs were previously approved by Company.
- Contracts were executed by the applicant with Company for the project.
- Company has inspected the work to date on the project.

Current installation and design requirements must be applied when a delayed project is actually pressurized and placed in service.

This appendix addresses the following new requirements:

- Pipe locating requirements
- One-inch diameter services
- 1000-foot maximum spacing between Electrolysis Test Stations (ETS)
- Locating wire gauge requirements for plastic pipe installations
- Pressure testing

1. Locating Requirements

Applicant Installers are required to mark dead end gas mains and gas service stubs as described in Gas Design Standard A-90.2 and Gas Design Standard A-90.3.

2. One inch services

The Company will accept previously-installed 1/2” services and 1/2” service stubs installed prior to May 1, 2010, if those services and stubs have the capacity to support the current customer loads.

The gas service stub must be at least 1” in diameter if any of the following conditions exists:

- Customer gas load conditions require a larger size gas service. For example, 1” Excess Flow Valves (EFVs) and services are required for service lengths of 122 feet or longer, per Gas Design Standard A-93.3. Please note that Gas Design Standard A-93.3. also directs that EFVs are not to be installed on stub completions.
- Branch services
- Changed or new customer gas loads that exceed the capacity of the previously designed service.

3. 1,000-ft. maximum spacing between ETS boxes

Applicant Installers are required to install ETS boxes every 1,000 feet (or closer) in accordance with Gas Design Standard A-90.2.

4. Locating wire gauge requirements for plastic pipe installations

The Company will accept 14-gauge locating wire on existing plastic pipe service installations, installed prior to August 1, 2009, as long as the wire passes continuity tests. Applicant installers are not required to replace existing 14-gauge wire (that pass continuity tests) with 10-gauge on plastic services and service stubs that have already been installed. However, all new plastic services and service stubs must be installed with 10-gauge wire in accordance with Gas Design Standard A-90.2 and Gas Design Standard A-90.3.

5. Pressure Test

Main and stubs are required to be tested per Gas Design Standard A-34.