

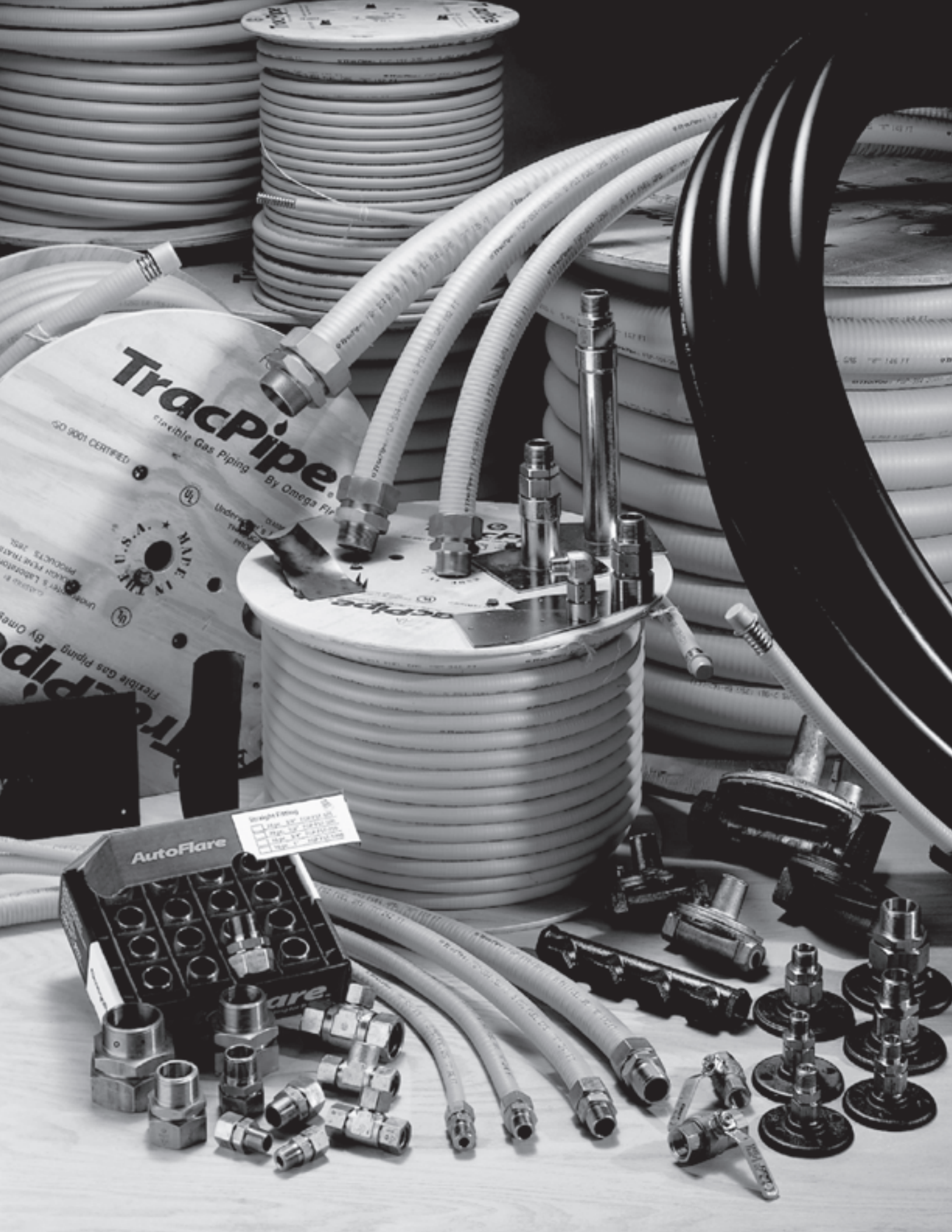
TracPipe®

Flexible Gas Piping by Omega Flex®

FLEXIBLE GAS PIPING DESIGN GUIDE and INSTALLATION INSTRUCTIONS December 2005



RESIDENTIAL • COMMERCIAL • INDUSTRIAL



TracPipe
Flexible Gas Piping
By Omega Fire

ISO 9001 CERTIFIED

MADE IN U.S.A.

AutoFlare

Weight Chart

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3/4" Dia. for 3/4" O.D.	2.50
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100" Dia. for 100" O.D.	18512.00
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CHAPTER 1 INTRODUCTION

WARNINGS

SECTION 1.0 — USER WARNINGS

The *TracPipe*[®] gas piping material (CSST-Corrugated Stainless Steel Tubing) must only be installed by a qualified person who has been trained or otherwise qualified through the *TracPipe* Gas Piping Installation Program. Any installer must also meet qualifications in accordance with state and/or local requirements as established by the administrative authority which enforces the plumbing or mechanical code where the gas piping is installed.

This document provides general instructions for the design and installation of fuel gas piping systems using gas piping material CSST. The guide must be used in conjunction with state and local building codes. Local codes will take precedence in the event of a conflict between this guide and the local code. In the absence of local codes, installation must be in accordance with the current edition of *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, the National Standard of Canada, *Natural Gas and Propane Installation Code, CSA B149.1*, the *International Fuel Gas Code, the Federal Manufactured Home Construction and Safety Standards, ICC/ANSI 2.0* or the *Standard on Manufactured Housing, NFPA 501, as applicable*

Sound engineering principles and practices must be exercised for the proper design of fuel gas piping systems, in addition to compliance with local codes. The installation instructions and procedures contained in this Design Guide must be strictly followed in order to provide a safe and effective fuel gas piping system or system modification. All installations must pass customary inspections by the local official having authority prior to having the gas service turned on. All requirements of the local natural gas utility or propane supplier must also be met.

Only the components provided or specified by *OMEGAFLEX* as part of the approved piping system are to be used in the installation.

The use of *TracPipe* tubing or fittings with tubing or fittings from other flexible gas piping manufacturers is strictly prohibited and may result in serious bodily injury or property damage.

WARNING !

If this system is used or installed improperly, fire, explosion or asphyxiation may result. The installation instructions and applicable local codes must be strictly followed.



OMEGAFLEX[®]

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SECTION 1.1 — APPLICABLE
CODES AND STANDARDS
REGIONAL /MODEL CODES LISTING CSST
AS AN ACCEPTABLE GAS PIPING
MATERIAL AS OF JULY 2005:

- a. ANSI/IAS LC-1 • CSA 6.26 Standard
- b. CANADA-CSA B149.1 Natural Gas and Propane Installation Code
- c. NFPA 54/ANSI Z 223.1 National Fuel Gas Code
- d. ICBO-Uniform Mechanical Code
- e. BOCA-National Mechanical Code
- f. CABO-1 and 2 Family Dwelling Code
- g. SBCCI-Standard Gas Code
- h. ICC-International Mechanical Code
- i. IAPMO Listing FILE 3682
- j. IAPMO Listing FILE 4665 *TracPipe PS-II*

- k. ICBO Evaluation Services ER-5412.
- l. Factory Mutual "Flexible Piping Systems for Flammable Gases."
- m. California Mechanical and Plumbing Codes
- n. ICC-International Fuel Gas Code
- o. NFPA 58 LP-Gas Code
- p. UPC-Uniform Plumbing Code 2003
- q. UL Through Penetration Firestop Systems Classified (see Appendix A)
- r. Tested to Code Requirements per ASTM E84 (UL 723)

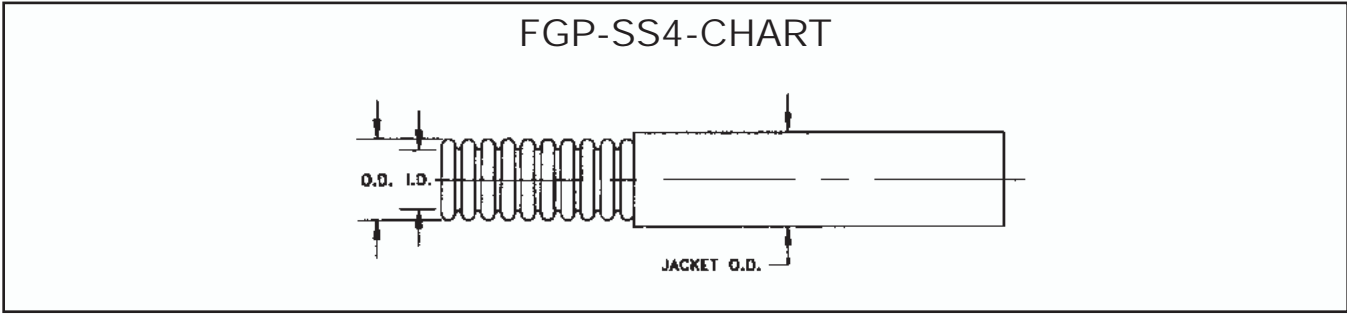
This Design and Installation Guide has been written in accordance with the most current edition of ANSI LC1 CSA 6.26, Fuel Gas Piping Systems using Corrugated Stainless Steel Tubing (CSST).

WHILE EVERY EFFORT HAS BEEN MADE TO PREPARE THIS DOCUMENT IN ACCORDANCE WITH THE REGIONAL MODEL CODES IN EFFECT AT ITS PRINTING, OMEGAFLEX CANNOT GUARANTEE THAT THE LOCAL ADMINISTRATIVE AUTHORITY WILL ACCEPT THE MOST RECENT VERSION OF THESE CODES.

THE INSTALLER IS ULTIMATELY RESPONSIBLE TO DETERMINE SUITABILITY AND ACCEPTANCE OF ANY BUILDING COMPONENT, INCLUDING GAS PIPING. OMEGAFLEX ASSUMES NO RESPONSIBILITY FOR MATERIALS OR LABOR FOR INSTALLATIONS MADE WITHOUT PRIOR DETERMINATION OF LOCAL CODE AUTHORITY ACCEPTANCE.

TracPipe®

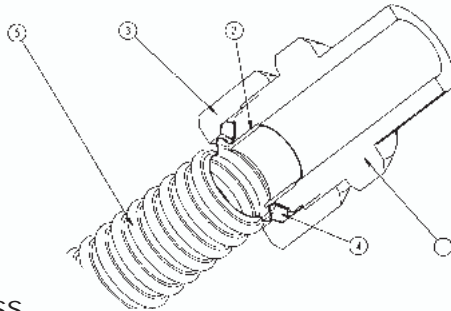
SPECIFICATION DATA SHEET



TracPipe® part no.	FGP-SS4-375	FGP-SS4-500	FGP-SS4-750	FGP-SS4-1000	FGP-SS4-1250	FGP-SS4-1500	FGP-SS4-2000
Size (inch)	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
EHD (AGA size)	15	19	25	31	37	46	62
Jacket O.D. (max.)	.668	.868	1.108	1.383	1.665	1.920	2.590
Inside Diameter (nom)	.440	.597	.820	1.040	1.290	1.525	2.060
Wall Thickness (in.)	.01	.01	.01	.01	.012	.012	.012

*EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity; This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

STRAIGHT AUTO-FLARE FITTINGS

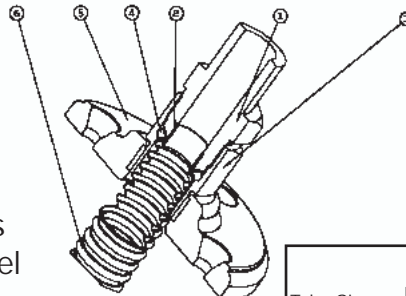


1. ADAPTER – Brass
2. INSERT – Stainless Steel
3. NUT—Brass
4. SPLIT-RINGS – Brass or Stainless Steel
5. FLEXIBLE PIPE – Stainless Steel

AVAILABLE IN SIZES							
Tube size	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
NPT Thread	1/2" or 3/8"	1/2" or 3/4"	3/4" or 1/2"	1" or 3/4"	1-1/4"	1-1/2"	2"

FLANGE MOUNT AUTO-FLARE FITTINGS

1. ADAPTER – Brass
2. INSERT – Stainless Steel
3. FLANGE NUT – Brass
4. SPLIT-RINGS – Brass or Stainless Steel
5. FLANGE – Malleable Iron/Brass
6. FLEXIBLE PIPE – Stainless Steel



AVAILABLE IN SIZES					
Tube Size	3/8"	1/2"	3/4"	1"	1-1/4"
NPT Thread	1/2" or 3/8"	1/2"	3/4"	1"	1-1/4"

CONSULT FACTORY FOR OTHER TERMINATION METHODS

CHAPTER 2

DESCRIPTION of SYSTEM and COMPONENTS

SECTION 2.0 — *TracPipe* FLEXIBLE GAS PIPING MATERIAL DESCRIPTION

1. TUBING

The *TracPipe* fuel gas piping system consists of corrugated, semi-rigid stainless steel tubing with brass mechanical attachment fittings terminating in NPT pipe fittings for easy attachment to traditional black iron pipe systems and direct connections to gas appliances.

Tubing is available in sizes 3/8 inch, 1/2 inch, 3/4 inch, 1 inch, 1-1/4 inch, 1-1/2 inch, and 2 inch.

The 300 series stainless steel tubing is jacketed, with a non-metallic cover which provides ease of running through joists, studs, and other building components. The jacket is marked at one foot intervals with the amount of tubing left on the reel, for quick measurement.



2. FITTINGS

Straight NPT pipe fittings are standard and are available in sizes shown above to fit all tubing. Additional fittings include termination mount and flange-mount straight and 90 degree elbow fittings for termination of gas lines near movable appliances; and meter termination accessories for support of *TracPipe* at utility meter sets on building exteriors and roof penetrations. Tee fittings are available for addition of branch lines into tubing runs; reducer tees are available in popular sizes and pipe outlet tees terminate in pipe threads on the outlet leg for size changes utilizing available black iron reducer fittings.

3. ACCESSORIES

Accessories are available for expansion of the flexible piping material and additions to existing fuel gas piping systems. These accessories include:

- A. Manifolds — allow parallel installations with “home runs” to each appliance. 1/2 inch female NPT outlets and 3/4 inch and 1/2 inch female NPT inlets. Large size manifolds are also available for use with commercial size *TracPipe*.



- B. Pressure Regulators: pounds to inches - for use in elevated pressure system installations (over 14 inches water column - one half psi) to reduce pressure to standard low pressure for appliances.



Available regulators include 1/2 and 3/4 inch sizes for natural and propane use and 1-1/4 inch size for natural gas. Regulators include approved vent limiters except 1-1/4" size.

- C. Protection Devices-for use where flexible piping passes through studs, joists and other building materials and is restricted from moving to avoid nails, screws and other puncture threats.



There are four striker plate configurations made from stamped steel and specially hardened to resist penetration from screws and pneumatic nail guns. These are quarter-striker, half striker full-striker and 6" X 17" flat plate striker. Spiral wound galvanized steel "floppy" conduit is available for use as additional protection.

D. Shut-off Valves-for use in elevated pressure installations: 2 psi up to 5 psi.

(Standard gas-cocks should be used at appliance stub outs and other low pressure areas of the piping system.) Brass



lever-handle ball valves supplied by *OmegaFlex* are rated for 5 psi use and are available in 1/2 inch and 3/4 inch sizes.

SECTION 2.1 — MATERIAL USE AND LIMITATIONS

This Design and Installation Guide has been written in accordance with the most current edition of ANSI LC 1 CSA 6.26, *FUEL GAS PIPING SYSTEMS USING CORRUGATED STAINLESS STEEL TUBING (CSST)*.

This Design Guide is intended to aid the professional gas pipe installer in the design, installation and testing of flexible fuel gas piping systems for residential, commercial and industrial buildings. It is not possible for this guide to anticipate every variation in construction style, building configuration, appliance requirement, or local restriction. This document will not therefore cover every application. The user should either exercise his own engineering judgment on system design and installation, or seek technical input from other qualified sources. Additional information pertaining to gas piping systems is available from your local gas utility or propane supplier.

Some of the special usage features of *TracPipe* gas piping are outlined below:

1. Flexible gas piping is used to provide safe, efficient, timely installation of fuel gas piping within buildings, residential, commercial, and industrial, or for outdoor connections to appliances that are attached or in close proximity to the building.
2. Flexible gas piping can be routed in most locations where traditional gas piping materials are installed: inside hollow wall cavities, along or through floor joists in basements, on top of the joists in attics, on roof tops or along soffits or in chases outside of buildings. *TracPipe* gas piping has been tested and is listed by CSA International for both outdoor and indoor use.
3. *TracPipe* is listed by CSA International for fuel gas use in the USA and Canada for pressures up to 25 psi. For local gas utility approved use only, *TracPipe* has been tested for use up to 125 PSI for sizes 3/8" up to 1-1/4", and for use up to 25 psi for sizes 1-1/2" and 2".
4. In North America, the most common pressure for Natural Gas is 6-7 inches water column, standard low pressure. Elevated pressures of either 2 psi or one half psi are also available from utilities in most areas for new residential construction. 5 PSI systems are commonly installed in commercial or industrial buildings. Elevated pressures allow the use of smaller diameter piping, while providing for increased loads and longer length runs.
5. Flexible gas piping can be used for Natural gas and propane (Liquefied Petroleum gas) and other fuel gases recognized in NFPA 54 National Fuel Gas Code.
6. *TracPipe* CSST with the yellow polyethylene jacket has been tested by Underwriters Laboratory to UL723 (ASTM E84) Surface Burning Characteristics with flame spread and smoke density ratings meeting the

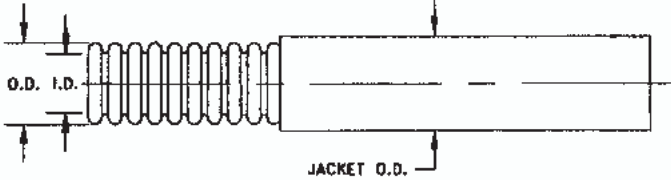
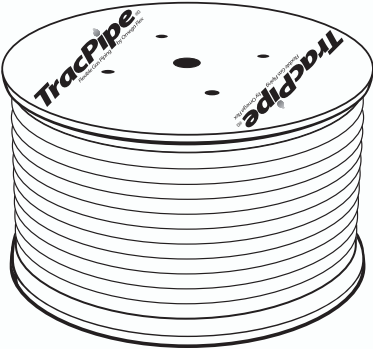
requirements of ANSI/CSA LC-1 for use in air ducts and plenums. It is mandatory, however, to follow fire and building code requirements in all installations. CounterStrike with black jacket requires removal of the jacket for use in air ducts or plenums.

7. For underground or under slab burial the flexible gas piping run must be encased in a sleeve of polyethylene, or other approved water resistant material. See Section 4.9, Underground Installations. Sleeved runs under concrete slabs beneath buildings must be installed as required by local codes. Most codes require venting of the sleeves under buildings to the outdoors. This can be accomplished using Pre-sleeved *TracPipe PS* or *PS-II with available accessories*.
8. Flexible gas piping can be used in conjunction with steel pipe (black iron or galvanized) in either new construction or renovation and replacement piping installations. All *TracPipe* fittings terminate in standard NPT male or female pipe threads to interface with appliances, valves, unions and couplings.
9. For retrofit installations, *TracPipe* can be snaked through hollow wall cavities without major restoration as is typical when running rigid pipe through existing construction. The replacement or addition of gas appliances, fireplaces, and gas logs is greatly facilitated with flexible piping on reels requiring no special tooling or oily threading equipment.
10. *TracPipe* gas piping can be run directly to the shut off valves of most fixed appliances without installing an appliance connector. For moveable appliances such as ranges or dryers, the use of an approved flexible appliance connector is required in most jurisdictions. *TracPipe* cannot be substituted as a connector for

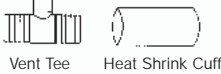
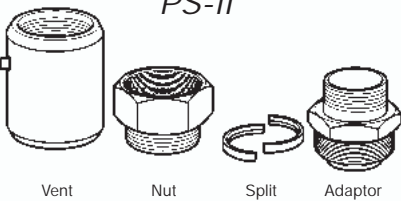
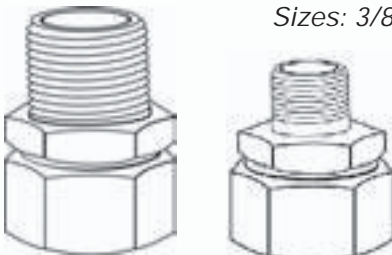
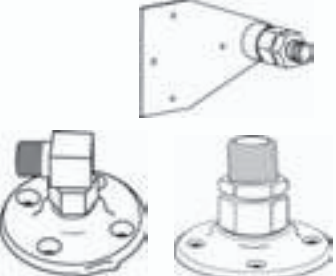
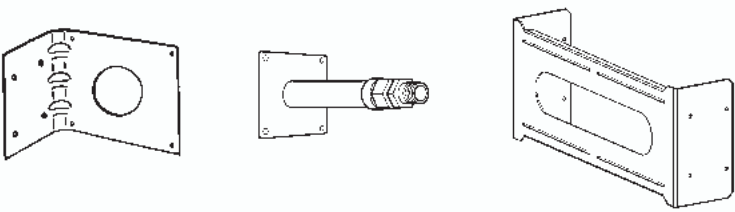
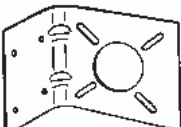

this use when the appliance is free to move for cleaning, etc.

11. *TracPipe AutoFlare*[®] fittings have been tested by CSA International (formerly the American Gas Association Laboratories) and are listed for use in concealed locations as defined in NFPA 54 National Fuel Gas Code, The Uniform Plumbing Code, and The International Fuel Gas Code. This facilitates installation of the key valves required for gas fireplaces in many jurisdictions. Concealed fittings are also desirable when adding tees for branch runs in series configurations and in other installation situations where locating a *TracPipe* fitting in an accessible location is not practical.

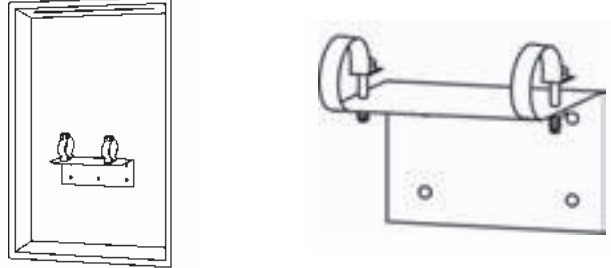
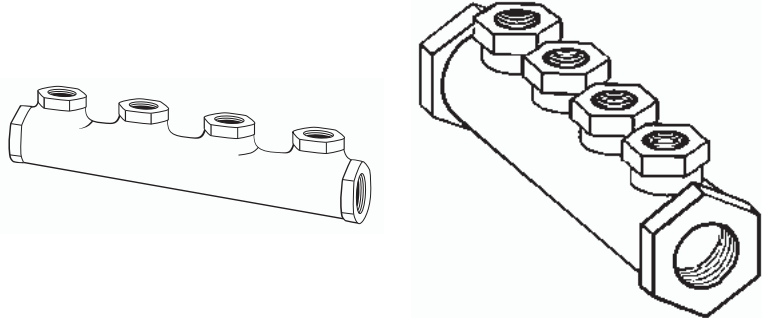
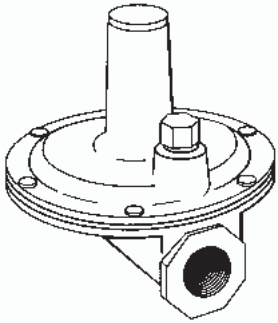
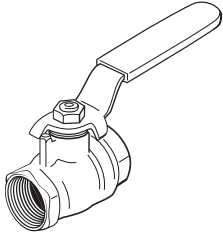
SECTION 2.2 — SYSTEM COMPONENTS
TracPipe Flexible Gas Piping

Component	Material	Description/Dimensions																																								
<p><i>TracPipe</i> Flexible Gas Piping</p>	<p>Corrugated Stainless Steel (300 Series) with Polyethylene Jacket</p>	<div style="text-align: center;">  </div> <table border="1" data-bbox="625 600 1469 808"> <thead> <tr> <th>part no.</th> <th>FGP-SS4-375</th> <th>FGP-SS4-500</th> <th>FGP-SS4-750</th> <th>FGP-SS4-1000</th> <th>FGP-SS4-1250</th> <th>FGP-SS4-1500</th> <th>FGP-SS4-2000</th> </tr> </thead> <tbody> <tr> <td>Size (inch)</td> <td>3/8"</td> <td>1/2"</td> <td>3/4"</td> <td>1"</td> <td>1-1/4"</td> <td>1-1/2"</td> <td>2"</td> </tr> <tr> <td>EHD (AGA size)</td> <td>15</td> <td>19</td> <td>25</td> <td>31</td> <td>37</td> <td>46</td> <td>62</td> </tr> <tr> <td>Jacket O.D. (max.)</td> <td>.668</td> <td>.868</td> <td>1.108</td> <td>1.38</td> <td>1.665</td> <td>1.920</td> <td>2.590</td> </tr> <tr> <td>Inside Dia. (nom)</td> <td>.440</td> <td>.597</td> <td>.820</td> <td>1.040</td> <td>1.290</td> <td>1.525</td> <td>2.060</td> </tr> </tbody> </table> <p>*EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity; This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.</p>	part no.	FGP-SS4-375	FGP-SS4-500	FGP-SS4-750	FGP-SS4-1000	FGP-SS4-1250	FGP-SS4-1500	FGP-SS4-2000	Size (inch)	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	EHD (AGA size)	15	19	25	31	37	46	62	Jacket O.D. (max.)	.668	.868	1.108	1.38	1.665	1.920	2.590	Inside Dia. (nom)	.440	.597	.820	1.040	1.290	1.525	2.060
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<p><i>TracPipe</i> on Reels</p>	<p>Plywood Reels for packaging</p>	<div style="text-align: center;">  </div> <p style="text-align: center;"><i>Note: other reel lengths available upon request.</i></p> <table border="1" data-bbox="657 1423 1437 1906"> <thead> <tr> <th>Pipe Size</th> <th>Standard Reel Length</th> <th>Weight Long Reel</th> </tr> </thead> <tbody> <tr> <td>3/8 inch</td> <td>250 feet 100 feet</td> <td>29 pounds</td> </tr> <tr> <td>1/2 inch</td> <td>500 feet 250 feet 100 feet 50 feet</td> <td>87 pounds</td> </tr> <tr> <td>3/4 inch</td> <td>250 feet 100 feet</td> <td>55 pounds</td> </tr> <tr> <td>1 inch</td> <td>180 feet 100 feet</td> <td>60 pounds</td> </tr> <tr> <td>1-1/4 inch</td> <td>250 feet 150 feet</td> <td>115 pounds</td> </tr> <tr> <td>1-1/2 inch</td> <td>250 feet 150 feet</td> <td>125 pounds</td> </tr> <tr> <td>2 inch</td> <td>150 feet</td> <td>92 pounds</td> </tr> </tbody> </table>	Pipe Size	Standard Reel Length	Weight Long Reel	3/8 inch	250 feet 100 feet	29 pounds	1/2 inch	500 feet 250 feet 100 feet 50 feet	87 pounds	3/4 inch	250 feet 100 feet	55 pounds	1 inch	180 feet 100 feet	60 pounds	1-1/4 inch	250 feet 150 feet	115 pounds	1-1/2 inch	250 feet 150 feet	125 pounds	2 inch	150 feet	92 pounds																
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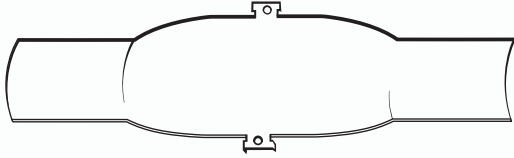
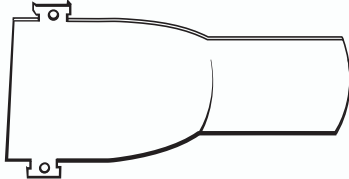
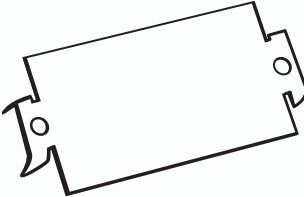
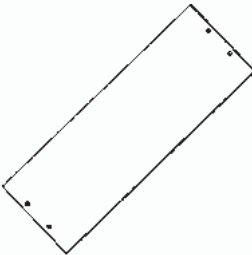
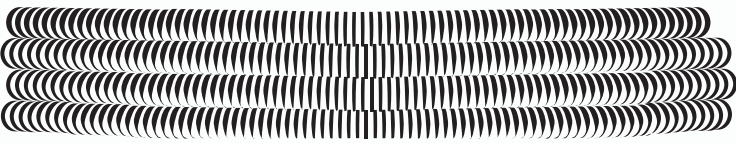
AutoFlare® Fittings

Component	Material	Description/Dimensions	
TracPipe PS & PS-II Accessories	Black Polyethylene Sleeved TracPipe	<p style="text-align: center;"><i>PS</i></p>  <p style="text-align: center;">Vent Tee Heat Shrink Cuff</p>	<p style="text-align: center;"><i>PS-II</i></p>  <p style="text-align: center;">Vent Coupling Nut Split Rings Adaptor</p>
Straight Mechanical Fitting Reducer Fitting	Brass Fitting Autoflare Insert	 <p style="text-align: right;"><i>Sizes: 3/8, 1/2, 3/4, 1, 1-1/4, 1-1/2 and 2 inch</i></p> <p style="text-align: right;"><i>Note size 3/8 fitting has either 1/2" NPT or 3/8" NPT Thread</i></p>	
Termination and Flange Mount Fittings Straight and 90 Elbow	Brass Fitting Autoflare Insert Malleable Iron or Brass Flange	 <p style="text-align: right;"><i>Sizes: 3/8, 1/2, 3/4, 1 inch and 1-1/4 inches</i></p> <p style="text-align: right;"><i>Note size 3/8 fitting has either 1/2" NPT or 3/8" NPT Thread</i></p> <p style="text-align: right;"><i>Elbow Sizes: 3/8 in. and 1/2 in.</i></p>	
Meter Termination Fitting Stud Bracket	Brass Fitting Autoflare Insert Galv. steel Mounting Bracket		
Flange Mounting Bracket	Galv. Steel	 <p style="text-align: right;"><i>One size fits all: Size 3/8 through 1-1/4 inches</i></p>	
Tee Fitting & Coupling	Brass Tee Fitting & Coupling Autoflare Insert	 <p style="text-align: center;"><i>Sizes: 3/8, 1/2, 3/4 and 1 inch</i></p> <p style="text-align: center;"><i>Reducer tees available for 1/2, 3/4 and 1 inch sizes</i></p>	

TracPipe Accessories

<i>Component</i>	<i>Material</i>	<i>Description/Dimensions</i>
<p>Load Center</p> <p>Manifold Bracket</p>	<p>Painted Steel</p> <p>Galvanized Steel</p>	
<p>Multi-Port Manifolds</p>	<p>Malleable Iron</p> <p>Poly Coated</p>	
<p>Pressure Regulators</p>	<p>Cast Housing</p> <p>Suitable for Outdoor Use</p>	 <p>Sizes: 1/2 inch & 3/4 inch & 1-1/4 inch Regulator includes approved vent limiting device for REG 3 (1/2 in.) and REG 5A (3/4 in.).</p> <p>Note: Stainless steel High Pressure tags are available for use where required by code</p>
<p>Shut Off Valves</p>	<p>Brass Housing with Stainless Steel Ball</p>	 <p>Sizes: 1/2 inch & 3/4 inch</p>

TracPipe Accessories

<i>Component</i>	<i>Material</i>	<i>Description/Dimensions</i>
Full Striker Plate	Carbon Steel Hardened	 <p>size: 3" x 12"</p>
Half Striker Plate	Carbon Steel Hardened	 <p>size: 3" x 7"</p>
Quarter Striker Plate	Carbon Steel Hardened	 <p>size: 3" x 2"</p>
6 x 17 Striker Plate	Carbon Steel Hardened	 <p>size: 6" x 17"</p>
Floppy Strip Wound Conduit	Type RW Galvanized Steel	 <p>sizes: Fits 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2" and 2" TracPipe</p>

CHAPTER 3

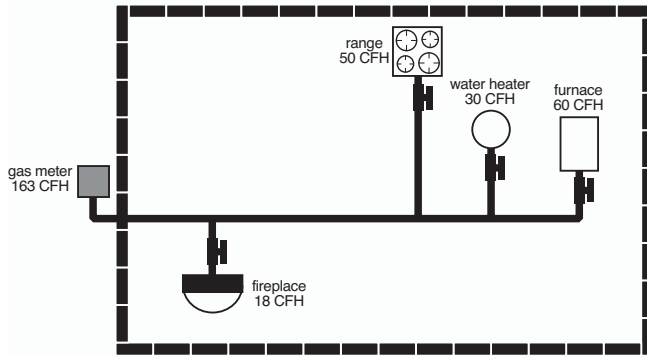
SYSTEM CONFIGURATIONS AND SIZING

SECTION 3.1 — SYSTEM CONFIGURATIONS

There are several piping system options available to the installer using *TracPipe* gas piping material. This flexibility of design is one of the major benefits of CSST.

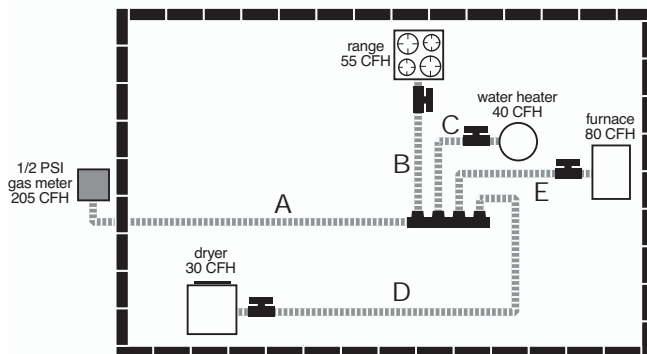
3.1A — LOW PRESSURE SYSTEMS

1. SERIES: A series layout is the most common arrangement utilized for black iron pipe. This consists of a main run with tees branching off to each appliance.



Series Layout

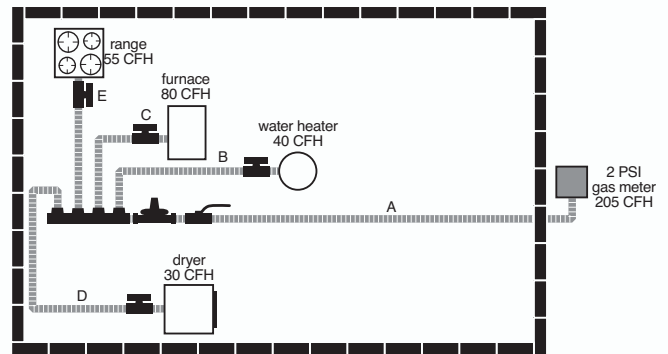
2. PARALLEL: A parallel system consists of a central distribution manifold with branch runs to the appliances. This is usually accomplished by providing a main supply line to a manifold and installing “home runs” to each appliance location. In the parallel system shown below the pressure is not elevated above 1/2 pound and no regulator is required.



Parallel Layout

3.1B — DUAL PRESSURE SYSTEMS

Elevated pressure systems (2 psi for residential and up to 5 psi for commercial installations) are usually piped with one or more house line regulators (pounds-to-inches) followed by a manifold and runs to each of the appliances. It is possible that these runs to appliances may contain tees branching off to an additional appliance where gas loads permit.



Dual Pressure System Layout

NOTE:
HYBRID SYSTEMS – FLEXIBLE GAS PIPE and RIGID BLACK PIPE COMBINATIONS. In low or medium pressure systems, it is often advantageous to use both corrugated stainless steel tubing and rigid pipe in the same system. This is the case when a larger diameter main branch is required to provide for the total appliance load in a parallel system. *TracPipe* is certified for use in combination with black iron pipe and copper tube gas piping systems. For additional information on Hybrid Systems see examples showing the method for sizing hybrid systems using both *TracPipe* and black iron pipe. These are included in the SIZING EXAMPLES section of this manual. Refer to Section 3.2C

SECTION 3.1C — SYSTEM DESIGN

1. Prepare a sketch or layout of the gas piping system you are about to install. The information you will need is the location of each appliance, the point of delivery (location of utility meter or second stage LP regulator), appliance load demands, and possible pipe routing locations. The load demand data is usually available on the appliance manufacturer's nameplate, or can be provided by the builder.
2. Determine local piping restrictions prior to installing flexible gas piping. The major code bodies in North America have written Corrugated Stainless Steel Tubing into the latest revisions of their mechanical codes, but local and state adoption of these codes often lags behind. CONFIRM THAT THE LOCAL CODE AUTHORITY HAS ACCEPTED THE USE OF FLEXIBLE GAS PIPING. Your *TracPipe* distributor should be able to provide that information but confirmation by the installer should be made where there is a question.

SECTION 3.1D — SYSTEM PRESSURE CHOICES

1. NATURAL GAS-Determine the delivery pressure provided by the Local Distribution Utility where the piping will be installed.
 - a. LOW PRESSURE-6 to 7 inches water column-equivalent to 4 ounces or 1/4 pound is the standard pressure supplied by natural gas utilities in the USA and Canada.
 - b. MEDIUM PRESSURE-1/2 POUND-12 to 14 inches water column-Is available from many natural gas utilities as an enhanced pressure supply. The increase in pressure provides for reductions in pipe size and does not require a pressure regulator. Most natural gas appli-

ances manufactured for use in the US and Canada are designed to operate up to a maximum of 14 inches water column.

- c. ELEVATED PRESSURE-2 PSI -Is the highest natural gas pressure usually supplied within residential buildings in North America. This pressure always requires the installation of a pounds-to-inches house line regulator between the utility meter set and the appliances.
2. PROPANE (LP GAS)-Is typically supplied within residential buildings at 11 inches water column, set at the second stage regulator mounted outside the building. Propane can also be utilized at medium-pressure, with the use of a 13-14 inch setting. For 2 PSI Propane elevated pressure the Maxitrol regulator used is FGP-REG-3P.(which is factory set at 11 inches water column.) A second stage regulator which reduces 10 psi from the tank to 2 psi must be used. (e.g. Fisher model R312E).

NOTE: *TracPipe* has been tested by CSA International (formerly AGA Laboratories) for a working pressure of 125 PSI for sizes 3/8" through 1-1/4" and 25 PSI for sizes 1-1/2 & 2".

PRESSURE CONVERSION CHART

1/4 PSI	=	7" w.c.	=	4 oz.
1/2 PSI	=	14" w.c.	=	8 oz.
1 PSI	=	28" w.c.	=	16 oz.
2 PSI	=	56" w.c.	=	32 oz.

SECTION 3.2 SIZING METHODS and EXAMPLES

SECTION 3.2A — USE OF SIZING TABLES

This Chapter includes flexible gas piping sizing procedures for both low pressure and elevated pressure systems. Every piping system introduces pressure loss to the fluid flowing within. The amount of loss depends on the piping size and the gas flow, expressed in cubic feet per hour (and converted to BTU's). The object of the sizing exercise is to determine the smallest size piping which will introduce the allowed pressure loss or drop within the length of piping required. Sizing Tables (Capacity Charts) provide the maximum flow capacity for a given length of run for each pipe size. A different sizing table is used for each system pressure and pressure drop combination.

1. The low pressure series system (standard arrangement) is sized in the same way as a conventional low pressure black iron pipe system using *TracPipe* sizing tables or tables found in National Fuel Gas Code NFPA 54. This method is known as the "Branch Length Method". Pressure drop in a low pressure system is usually limited to 1/2 inch water column over the system.
2. Elevated pressure systems incorporate two operating pressures downstream of the utility meter set. The first pressure, set by the service regulator at the meter, is usually 2 PSI. This part of the system is sized separately and ends at the pounds-to-inches regulator. The allowable pressure loss for this part of the system must be added to the effect of the regulator to determine the available pressure at the regulator outlet. The chart in Section 4.8B shows pressure losses for maximum loads through the regulator.
3. For a 2 PSI system, the proper drop is usually 1 PSI for this part of the system; this allows for the approximate 3/4 PSI regulator drop downstream and provides the 1/4 PSI (6-7 inches w.c.) necessary for appliances. The regulator reduces the pressure from pounds to 8 inches water column.

This part of the system is sized the same as a low pressure system, except that a special table N-3 is used allowing 3 inches of water column drop. These lines are typically sized for only one appliance load installed as a "home run" from the manifold.

SECTION 3.2B — SIZING EXAMPLES BRANCH LENGTH METHOD

To size each of the following systems, determine the required size for each section and outlet. To size each section of the system, determine both the total gas load for all appliances and the maximum distance (longest length) in which a particular section delivers gas.

EXAMPLE 1 LOW PRESSURE SYSTEM SERIES ARRANGEMENT

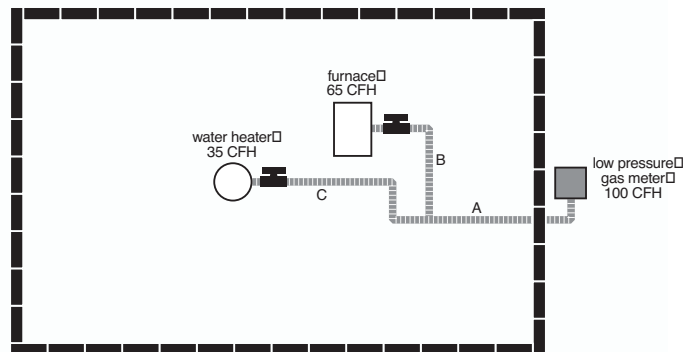
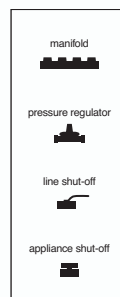


Figure 3-1



LENGTH OF RUNS

- A = 10 Feet
- B = 10 Feet
- C = 15 Feet

Supply pressure 6 inches w.c.
Allowable drop 0.5 inches w.c.

1. The system presented in figure 3-1 is typical of a single family installation in which there are a limited number of appliances located in one general area. The supply pressure is 6 inches water column and the allowable drop is 1/2 inch.

2. To size section A, determine the longest run from the meter that includes section A and the total gas load it must deliver:

- Meter to Furnace is 20 ft. (A+B)
- Meter to Water Heater is 25 ft. (A+C). This is the longest run.
- Determine the maximum load transported by Section A
- Furnace plus Water Heater = 100 cfh (100,000 BTU)
- Select Table N-1 "Low Pressure 6 inches- 1/2 inch w.c. drop"
- Using the longest run method, select the column showing the measured length, or the next longest length if the table does not give the exact length. Referring to table N-1 the column for 25 feet of piping shows that sizes 3/8 and 1/2 are too small and the next available size is 3/4 supplying 132 cfh.
- The correct size is 3/4".

3. To size Section B, determine the length of run from the meter to the Furnace and the load delivered:

- Length is 20 ft (A+B) and load is 65 cfh (65,000 BTU)
- Table N-1 shows that size 1/2" supplies 67 cfh
- The correct size is 1/2".

4. To size Section C, determine the length of run from the meter to the Water Heater and the load delivered:

- Length is 25 ft (A+C) and load is 35 cfh (35,000 BTU)
- Table N-1 shows that size 1/2" is required, because size 3/8" only supplies 27 cfh (27,000 BTU)
- The correct size is 1/2"

EXAMPLE 2 MEDIUM PRESSURE 12-14 INCHES W.C. (1/2 PSI)

1. The system shown in Figure 3-2 is typical of a single family installation with several appliances. The arrangement chosen is

parallel. The MEDIUM PRESSURE SYSTEM (1/2 PSI) allows a higher pressure drop (6 inches Water column) than is available with low pressure systems.

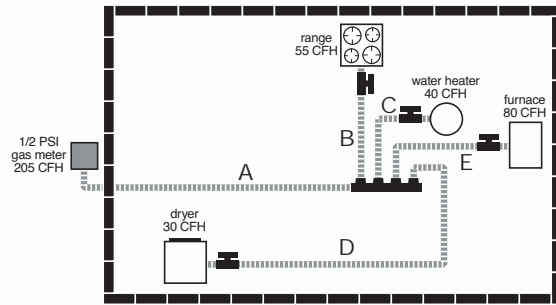
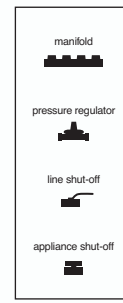


Figure 3-2

LENGTH OF RUNS



- A = 10 Feet
- B = 20 Feet
- C = 10 Feet
- D = 40 Feet
- E = 10 Feet

Supply pressure 1/2 PSI (12"-14" w.c.)
Allowable drop: 6" w.c.

2. To size SECTION A, determine the LONGEST RUN from the meter to the furthest appliance.

- Meter to dryer is 50 feet (10+40) A+D
- Determine maximum load transported by section A
- Dryer + Range + Water heater + Furnace = 205 cfh (205,000 BTU)
- Select table N-4 "Medium Pressure 1/2 PSI with 6 inch drop". Table N-4 shows that 1/2" size is too small for 205 cfh at 50 ft. but 3/4" can handle 315 cfh.
- The correct size is 3/4"

3. To size SECTION B, the distance from the meter to the range is 30 ft (10+20) A+B

- Load is 55 cfh (55,000 BTU)
- Table N-4 shows that 3/8" size can handle 90cfh
- The correct size for section B is 3/8"

4. To size SECTION C, the distance from the meter to the water heater is 20 ft (10+10) A+C

- Load is 40 cfh (40,000 BTU)
- Table N-4 shows that that 3/8" size

- can handle 112cfh
 - The correct size for section C is 3/8"
- To size SECTION D, the distance from the meter to the dryer is 50 ft (10+40) A+D
 - Load is 30 cfh (30,000 BTU)
 - Table N-4 shows that that 3/8" size can handle 69cfh at 50 feet
 - The correct size for section D is 3/8"
 - To size SECTION E, the distance from the meter to the furnace is 20 ft (10+10) A+E
 - Load is 80 cfh (80,000 BTU)
 - Table N-4 shows that that 3/8" size can handle 112cfh at 20 feet
 - The correct size for section E is 3/8"

EXAMPLE 3 ELEVATED
PRESSURE 2 PSI SYSTEM
PARALLEL ARRANGEMENT

- The system shown in figure 3-3 is adapted for multifamily or single family application with an extended (100 feet) tubing run from the meter to the regulator. The 2 PSI system is well adapted to handle the long runs required in multifamily buildings with centralized meter banks.
- To size section A determine the entire gas load it will deliver

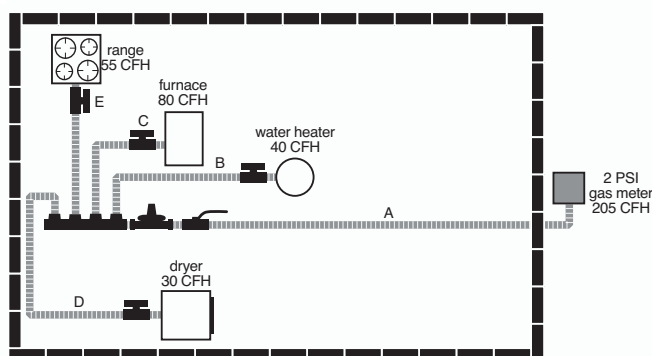
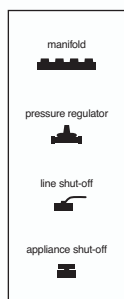


Figure 3-3



LENGTH OF RUNS

- A = 100 Feet
- B = 15 Feet
- C = 10 Feet
- D = 25 Feet
- E = 20 Feet

Supply pressure 2 PSI
Allowable drop: 1 PSI up to reg.
3 inches w.c.-reg. to appliance

- furnace + water heater + dryer + range = 80 cfh + 40 cfh + 30 cfh + 55cfh = 205 cfh (205,000 BTUH) Select Table N-5 "Elevated Pressure 2 PSI with 1 PSI drop" This is the standard table chosen to stay within the Maxitrol 325-3 regulator capacity. See note below.
 - Length is 100 ft.
 - Table N-5 shows that 3/8" size is too small for 205 cfh but 1/2" can handle 222cfh.
 - The correct size is 1/2"
- To size each of the other sections:

Select Table N-3 " Regulator Outlet 8.0 inches w.c with a drop of 3.0 inches w.c

- Section B is 15 feet with a 40 cfh load 3/8" has a capacity of 90 cfh
- Section C is 10 feet with a 80 cfh load 3/8" has a capacity of 112 cfh
- Section D is 25 feet with a 30 cfh load 3/8" has a capacity of 69 cfh
- Section E is 20 feet with a 55 cfh load 3/8" has a capacity of 78 cfh
- The correct size for all these runs is 3/8"

NOTE: at 250 cfh gas flow the FGP-REG-3 regulator contributes 3/4 PSI drop to the system. (see chart below). The low pressure part of the system downstream of the regulator requires the standard 1/4 PSI to power appliances. Deducting the 3/4 psi drop and the 1/4 psi load the maximum allowable drop for the meter run is 1 psi. Start with 2 PSI - 3/4 drop for regulator - 1/4 left for Appliance = 1 PSI drop for section A.

Capacities and Pressure Drop

Pressure Drop through Regulator
Based on flow in cubic feet per hour

P/N	7" w.c.	1/2 psi	3/4 psi	1 psi
FGP-REG-3	145	204	250	289
FGP-REG-5A	338	476	583	673
FGP-REG-7L	690	972	1191	1375

EXAMPLE 4 MEDIUM
 PRESSURE 12-14 INCHES W.C. 1/2 PSI)
 PARALLEL SYSTEM WITH A SERIES BRANCH

1. The system shown in Figure 3-4 has a barbeque installed nearby the range. A parallel arrangement was chosen for the medium pressure system (12 inch W.C. with 6 inches W.C. drop) with a single run feeding both range and barbeque in series.

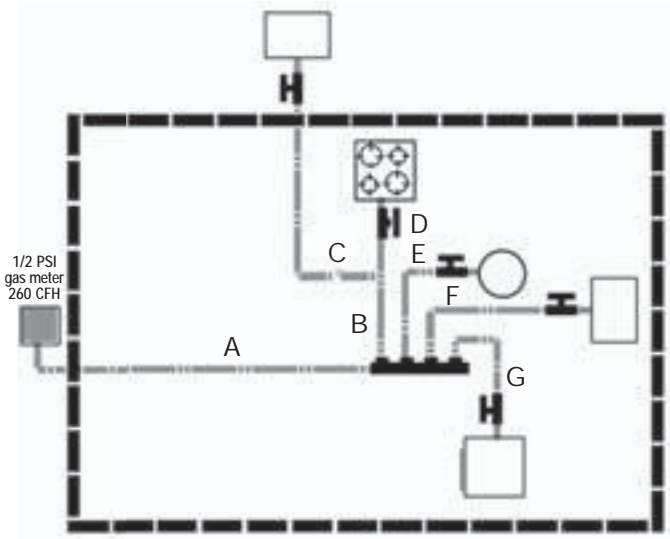


Figure 3-4

LENGTH OF RUNS

- A = 20 Feet
- B = 35 Feet
- C = 20 Feet
- D = 10 Feet
- E = 10 Feet
- F = 10 Feet
- G = 15 Feet

2. To size SECTION A, determine the length of the longest run from the meter and the entire gas load it must deliver:

- Range + Barbeque + Water heater + Furnace +Dryer = 260 CFH (260,000 BTUH).
- Meter to barbeque is 75 ft (A+B+C) This is the longest length
- Select Table N-4 Medium Pressure. Table N-4 shows that 1" is required for 260 CFH at 75 ft (using next longer distance 80 ft column)
- The correct size is 1"

3. To size SECTION B, the line from the manifold serves both the range and the barbeque.

- Total load is 105 CFH (105,000 BTUH)
- Longest length is 75 feet (A+B+C) from the meter to the barbeque
- Table N-4 shows that size 1/2" can handle 116 CFH at 80 ft
- The correct size is 1/2"

4. To size SECTION C, the distance from the meter to the barbeque is 75 ft (A+B+C)

- Load is 55 CFH (55,000 BTUH).
- Table N-4 shows that size 3/8" can only handle 54 CFH at 80 ft
- The correct size is 1/2"

5. To size SECTION D, the distance from the meter to the range is 65 ft (A+B+D)

- Load is 50 CFH (50,000 BTUH).
- Table N-4 shows that size 3/8" can handle 58 CFH at 70 ft
- The correct size is 3/8"

6. To size SECTION E, the distance from the meter to the water heater is 30 ft (A+F)

- Load is 40 CFH (40,000 BTUH).
- Table N-4 shows that size 3/8" can handle 81 CFH at 70 ft
- The correct size is 3/8"

7. To size SECTION F, the distance from the meter to the furnace is 30 ft (A+E)

- Load is 80 CFH (80,000 BTUH).
- Table N-4 shows that size 3/8" can handle 81 CFH at 30 ft
- The correct size is 3/8"

8. To size SECTION G, the distance from the meter to the dryer is 35 ft (A+G)

- Load is 35 CFH (35,000 BTUH).
- Table N-4 shows that size 3/8" can handle 78 CFH at 40 ft
- The correct size is 3/8"

SECTION 3.2C — SIZING HYBRID SYSTEMS

(Black Iron and *TracPipe* Combination)

To size a commercial or a residential system with a rigid black iron trunk line and flexible *TracPipe* branches feeding the appliances, you will need both the standard gas piping capacity tables for black iron printed in many plumbing and mechanical codes (and contained in both National and International Fuel Gas Code) and the *TracPipe* Capacity Tables printed later in this manual.

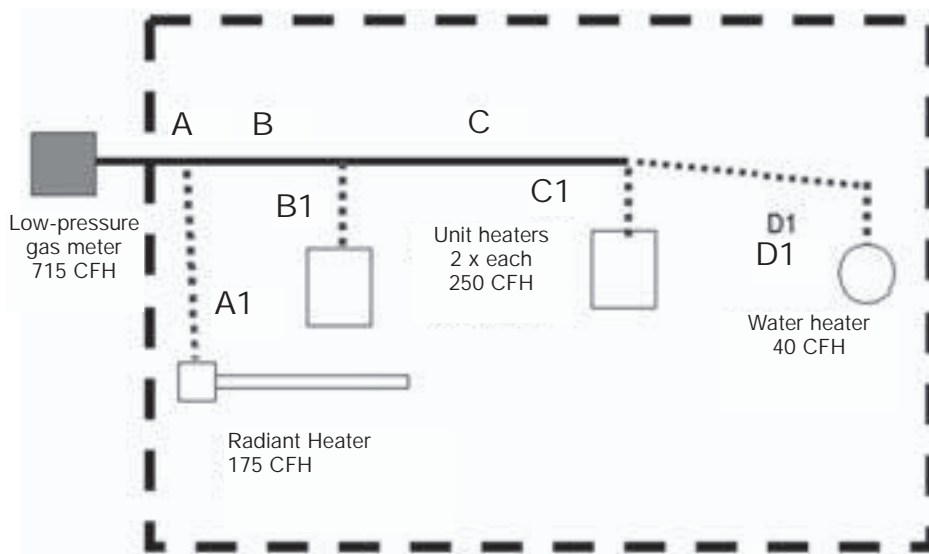


Figure 3-5

LENGTH OF RUNS

A = 15 Feet C = 20 Feet
 A1 = 45 Feet C1 = 5 Feet
 B = 15 Feet D1 = 20 Feet
 B1 = 10 Feet

EXAMPLE 5 LOW PRESSURE HYBRID SYSTEM (Black Iron and *TracPipe* Combination) SERIES ARRANGEMENT

- The system shown in figure 3-5 is a typical commercial building with 4 appliances. The gas pressure for this example is standard low pressure with 6-inch supply pressure and 0.5-inch pressure drop.
- To determine rigid pipe size (section A) determine the longest run from the meter to the furthest appliance:
 Meter to Water Heater Add A + B + C + D1 = 70 ft.
 Total Load is 715 CFH (715,000 BTU)

Section A correct size is 1 1/2 inch black pipe

- To determine rigid pipe size (section B) reduce load by the load carried in section A1 to Radiant Heater (175 CFH). Use same number for length: 70 ft. is longest run. Load for this section is 540 CFH
 Section B correct size is 1 1/2 inch black pipe

- To determine rigid pipe size (section C) reduce load further by the load carried in section B1 to first unit heater (250 CFH). Use same number for length: 70 ft. is longest run. Load for this section is 290 CFH

Section C correct size is 1 1/4 inch black pipe

- To determine *TracPipe* sizing for the branch runs the length to be used is the total length of black pipe plus *TracPipe* from the meter to that appliance. The load used is the load of the individual piece of equipment.

- To determine the size of *TracPipe* (section D1) the length is 70 ft and the load is 40 CFH. Using Table N-1:
 Section D correct size is 3/4 inch

- To determine the size of *TracPipe* (section C1) the length is 55 ft and the load is 250 CFH. Using Table N-1:
 Section C1 correct size is 1 1/2 inch

- To determine the size of *TracPipe* (section B1) the length is 40 ft and the load is 250 CFH. Using Table N-1:
 Section B1 correct size is 1 1/4 inch

- To determine the size of *TracPipe* (section A1) the length is 60 ft and the load is 175 CFH. Using Table N-1:
 Section A1 correct size is 1 1/4 inch

EXAMPLE 6 LOW PRESSURE HYBRID SYSTEM (Black Iron and *TracPipe* Combination) SERIES ARRANGEMENT

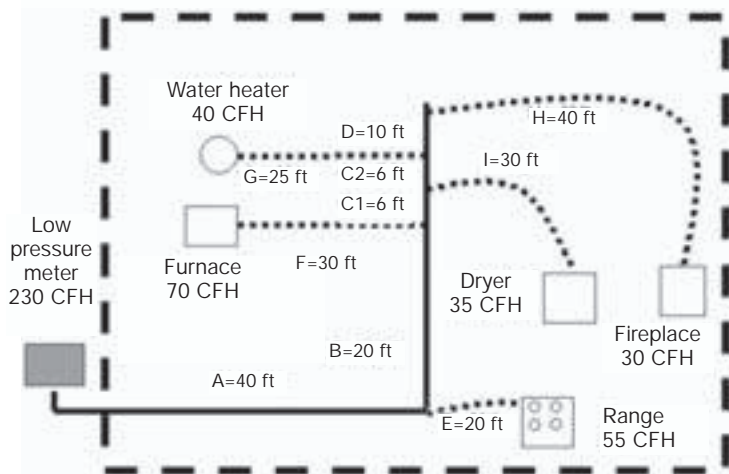


Figure 3-6

1. The system presented in figure 3-6 is a typical residence with 5 appliances. The supply pressure is 7 inches w.c. The allowable drop is 1-inch w.c. total. (black iron drop is 0.5 in. w.c. and *TracPipe* drop is 0.5 in. w.c.) Note: Check with your local inspection department and/or gas utility before sizing any low-pressure system with a total drop of more than 0.5 in. w.c.
2. The black iron trunk line (A+B+C1+C2+D) will first be sized for a drop of 0.5 in., w.c. in accordance with the standard method (longest total run) and each *TracPipe* branch run to an appliance will then be sized for 1.0 in w.c. drop based on the length from that appliance back to the meter. The maximum pressure drop to each appliance will be 1.0-inch w.c.
3. The longest total run is 120 ft. (total length of all black iron sections and *TracPipe* section to the furthest appliance). The total load is 70+40+55+35+30=230 CFH. Correct size for A is 1-1/4"
4. Section B, the longest run remains 120 ft but the load is reduced to 175 CFH. Correct size is 1".

5. Section C1, the longest run is 120 ft and load is reduced to 105. Correct size is 1".
6. Section C2, the longest run is 120 ft and load is reduced to 70. Correct size is 3/4".
7. Section D, the longest run is 120 ft and load is reduced to 30. Correct size is 1/2".
8. Section E, length is 60 ft and the load is 55 CFH. From Table N-1 the correct size is 3/4".
9. Section F, length is 90 ft and the load is 70 CFH. From Table N-1 the correct size is 3/4".
10. Section G, length is 95 ft and the load is 40 CFH. From Table N-1 the correct size is 3/4".
11. Section H, length is 120 ft and the load is 30 CFH. From Table N-1 the correct size is 3/4".
12. Section I, length is 95 ft and the load is 35 CFH. From Table N-1 the correct size is 3/4".

EXAMPLE 7 LOW PRESSURE HYBRID STEEL PIPE AND *TRACPIPE*-PARALLEL ARRANGEMENT-MANIFOLD-USING THE LONGEST RUN METHOD

1. The system presented in figure 3-7 is typical of a residential installation with four appliances. The supply pressure is 7-8 inches water column. The system will be sized with 0.5 inches w. c. drop for the steel pipe trunk line and 1 inch w.c. drop for the *TracPipe* branches. (Note: confirm that pressure drops larger than 0.5 inches water column are permitted in your jurisdiction)

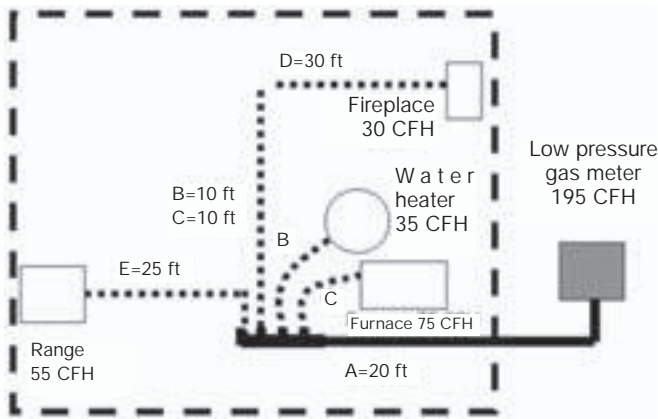


Figure 3-7

2. To size the steel pipe trunk line, determine the longest run from the meter to any appliance and the total load. The longest run is to the fireplace.
 - Meter to fireplace is 50 ft (A + D)
 - Total load is 195 CFH (75 + 35 + 30 + 55)
 Using steel pipe Table SP-1 (page 77) following the 50 ft column down, the correct size for the steel pipe is 1".
3. To determine the size of the *TracPipe* run "C" to the furnace use the load through that branch (75 CFH) and calculate the length from the meter to the furnace.
 - Meter to furnace is 30 ft (A + B)
 - Furnace load is 75 CFH
 Using Table N-2A the 1.0-inch w.c. pressure drop chart for *TracPipe*. Follow the 30 ft column down, the correct size for the furnace branch line "C" is 1/2".
4. To determine the size of the *TracPipe* run "B" to the water heater use the load through that branch (35 CFH) and calculate the length from the meter to the water heater.
 - Meter to water heater is 30 ft (A + C)
 - Water heater load is 35 CFH
 Using Table N-2A the 1.0-inch w.c. pressure drop chart for *TracPipe*. Follow the 30 ft column down, the correct size for the water heater branch line "B" is 1/2".
5. To determine the size of the *TracPipe* run "D" to the fireplace use the load through that branch (30 CFH) and calculate the length from the meter to the fireplace.
 - Meter to fireplace is 50 ft (A + D)
 - Fireplace load is 30 CFH
 Using Table N-2A the 1.0-inch w.c. pressure drop chart for *TracPipe*. Follow the 50 ft column down, the correct size for the fireplace branch line "D" is 1/2".

6. To determine the size of the *TracPipe* run "E" to the range use the load through that branch (55 CFH) and calculate the length from the meter to the range.
 - Meter to range is 45 ft (A + E)
 - Range load is 55 CFH
 Using Table N-2A the 1.0-inch w.c. pressure drop chart for *TracPipe*. Follow the 50 ft column down, the correct size for the range branch line "E" is 1/2".

6. To determine the size of the *TracPipe* run "E" to the range use the load through that branch (30 CFH) and calculate the length from the meter to the range.
 - Meter to range is 45 ft (A + E)
 - Range load is 55 CFH
 Using Table N-2A the 1.0-inch w.c. pressure drop chart for *TracPipe*. Follow the 50 ft column down, the correct size for the range branch line "D" is 1/2".

SECTION 3.2D — ALTERNATE SIZING METHOD: SUM OF PRESSURE LOSS CALCULATIONS

1. In addition to the longest run sizing method, there is another approach to pipe sizing, which yields results closer to the actual friction loss results (obtained from testing) for each section of an installed gas piping system. This engineered approach "Sum of Pressure Loss Calculations" avoids the simplified, conservative approximations of the longest run method. Mechanical engineers who design piping systems understand that placing a building's entire load (theoretically) at the farthest equipment outlet is not only inaccurate but will often yield pipe sizes which are larger than necessary. The longest run method was devised at a time when gas utilities could not always guarantee a constant pressure at every meter during times of high demands; it is a conservative approach and, although it is the customary sizing approach in North America, other engineered calculations are permitted by most codes.

2. Pressure Loss Calculations which sum up friction losses in each section of a gas piping system can provide a system design with more accurate and possibly smaller piping diameters than the traditional longest run method. These calculations utilize pressure loss charts for each size of CSST, which have been developed from actual test results. The maximum flow capacity is predicted with more precision than with the longest run method. The Sum of Pressure Loss method is described below with tables providing pressure loss per foot based upon the total load supplied by that length of pipe with all appliances operating.

3. The system designer has simply to determine the load and the length for each run. A tentative size is chosen and pressure loss in that leg is determined by multiplying the loss per foot (inches w.c. from the chart) by the length. Starting at the meter and working outward the pressure loss for each leg is then summed up until the farthest appliance is reached. The total calculated loss is then compared with the allowable loss, which must not be exceeded from the meter to the farthest appliance. The allowable pressure loss for each system is the responsibility of the system designer, based on model codes and on the available pressure at the meter set (or second stage regulator) and the pressure required for each appliance (usually found on the manufacturer's data plate.) Current language in many model codes states: The allowable loss under maximum probable flow conditions, from the point of delivery to the inlet connection of the appliance, shall be such that the supply pressure at the appliance is greater than the "minimum inlet pressure" as stated on the appliance manufacturer's data plate. If the initial proposed design calculation yields a total pressure loss, which is higher than allowed, simply go back and calculate again with larger sizes, starting from the meter.

USING SUM OF PRESSURE LOSS METHOD

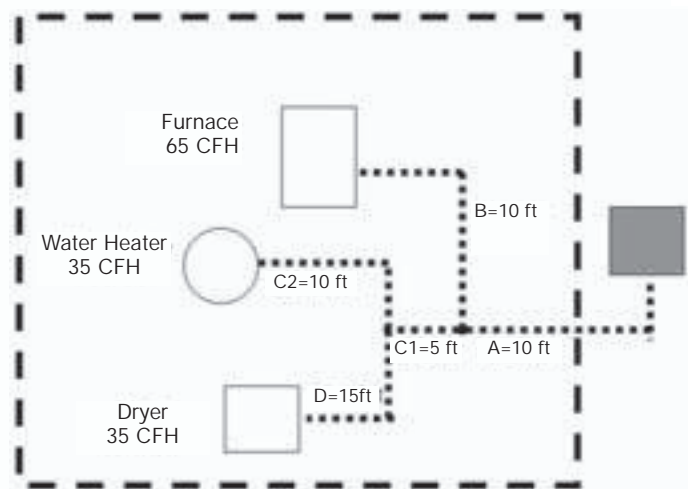


Figure 3-8

EXAMPLE 8 LOW PRESSURE SYSTEM SERIES ARRANGEMENT

- The system presented in figure 3-8 is similar to that in 3-1, a single-family installation with the addition of one more appliance, a dryer. The supply pressure is 6 inches water column and the allowable pressure drop is 1/2 inch.
- To size section A, calculate the load carried by that section:
 - Furnace plus Water Heater plus Dryer = 135 CFH (135,000 BTU)
 Using Table PD-1 find pressure loss at 135 MBTU load through 3/4" *TracPipe* Average of .019 and .022 is .021. Drop per foot is 0.021; multiply by length 10 feet = 0.21 drop
- To size section B find the drop per foot for the load carried by that section:
 - 65 CFH (MBTU)
 Using Table PD-1 find pressure loss at 65 MBTU through 1/2" *TracPipe* Use the average of loss between 60 and 70 MBTU: Average of .019 and .027 is .023 ; Drop per foot is 0.023 Multiply by length 10 feet = 0.23 drop
 Sum pressure loss meter to Furnace 0.21 + 0.23 = .44 inches w.c
 This leg is sized properly at 1/2" because sum of loss is less than .5 in. w.c.

4. To size section C1 find the drop per foot for the load carried by that section:
70 CFH (MBTU)
Using Table PD-1 find pressure loss at 70 MBTU load through 1/2" *TracPipe*
Drop per foot is .027; length is 5 ft; 5 X .027 is .135

5. To size section C2 find the drop per foot for the load carried by that section:
35 CFH (MBTU)
Using Table PD-1 find pressure loss at 35 CFH load through 1/2" *TracPipe*
Average of .008 and .004 is .006; length is 10 ft; 10X .006 is .06
Sum pressure loss to water heater 0.21 + .135 + .06 = .405 inches w.c
This leg is sized properly at 1/2" because sum of loss is less than .5 in. w.c.

6. To size section D find the drop per foot for the load carried by that section:
35 CFH (MBTU)
Using Table PD-1 find pressure loss at 35 MBTU through 1/2" *TracPipe*
Drop per foot is .006 (see number 4 above); Multiply by length 15 feet = .09
Sum pressure loss to dryer 0.21 + 0.135 + .09 = .435 inches w.c.
This leg is sized properly at 1/2" because sum of loss is less than .5 in. w.c.

The sum of pressure loss method allows the addition of an appliance without increasing trunk line size.

EXAMPLE 9 LOW PRESSURE HYBRID SYSTEM (Steel Pipe and *TracPipe* Combination) SERIES ARRANGEMENT USING SUM OF PRESSURE LOSS METHOD

1. The system presented in figure 3-9 is identical to that in Figure 3-6: a single-family installation with 5 appliances. Low pressure 6-7 inches and a pressure drop of 0.5 inches water column. NOTE: in

Example 6 this system was sized using the longest run method. Here we will use the sum of pressure loss method discussed in section 3.2D.

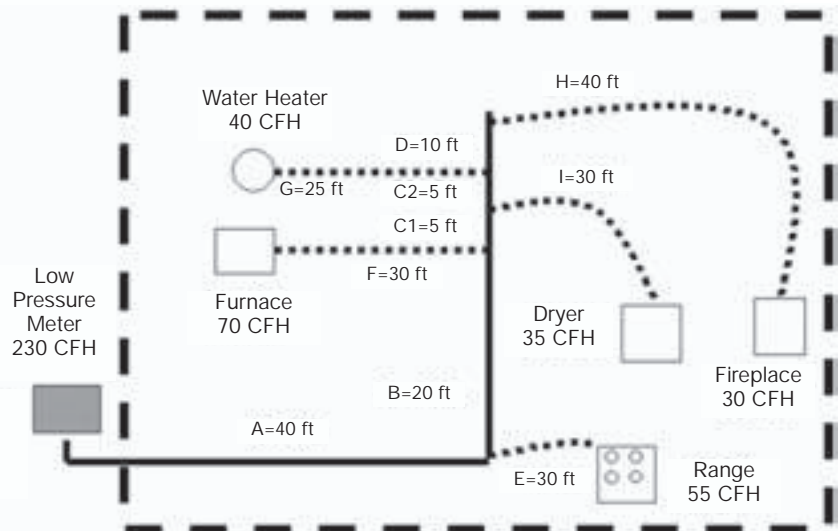


Figure 3-9

2. Begin by using pipe sizes determined in Example 6 and determine if these are correct with this method. It is possible that smaller pipe sizes may be sufficient; this will be determined by calculating the sum of pressure losses from the meter to each appliance. To use this method a tentative size will be assigned to each run and this size will be confirmed or revised by the calculation. The sum total loss of a run from the meter to the appliance cannot exceed the allowable pressure loss.
3. To determine pressure loss through section A (steel pipe trunk), use the load through that section (230 CFH) and find pressure loss per foot from the steel pipe Schedule 40 Pressure Drop Curves Graph Table SP-1. The 1 1/4 inch pipe diameter line intersects the 230 CFH line at a pressure drop of .18 inches w.c. per 100 feet of length. Multiply the length: 40 feet by the loss per foot: 0.0018. The pressure loss for this section is 0.072.
4. To determine pressure loss through section B we use the load through that section (175 CFH). Find pressure loss for 1" size from the steel pipe graph in Table SP-1 - 0.6 per 100 feet. Multiply the length: 20 feet by the loss per foot: 0.006. The pressure loss for this section is 0.12.

5. To determine pressure loss through section C1 we use the load through that section (105 CFH). Find pressure loss for 1" size from the steel pipe graph - 0.2 per 100 feet. Multiply the length: 5 feet by the loss per foot: 0.002. The pressure loss for this section is 0.01.
6. To determine pressure loss through section C2 we use the load through that section (70 CFH). Find pressure loss for 3/4" size from the steel pipe graph - 0.38 per 100 feet. Multiply the length: 5 feet by the loss per foot: 0.0038. The pressure loss for this section is 0.019.
7. To determine pressure loss through section D we use the load through that section (30 CFH). Find pressure loss for 1/2" size from the steel pipe graph - 0.31 per 100 feet. Multiply the length: 10 feet by the loss per foot: 0.0031. The pressure loss for this section is 0.031.
8. To determine pressure loss through section E (*TracPipe* drop to the range), use the load through that section (55 CFH) and find pressure loss from Table PD-1 Pressure Drop per Foot for *TracPipe*. Trying the 3/4 inch column we find .004 inches per foot length (there is no 55 CFH load listed, so we use 60 CFH). Multiply the length: 30 feet by the loss per foot .004. The pressure loss for this section is 0.12. Add the loss of section A to the loss of section E for total loss from the meter to range. $0.072 + 0.12 = 0.192$. Since this is less than the 0.5 allowable drop the correct size for section E is 3/4".
9. To determine pressure loss through section F (*TracPipe* drop to the furnace), use the load (70 CFH) and find pressure loss from Table PD-1. In the 3/4" column we find 0.005. Multiply the length: 30 feet by 0.005. The pressure loss for this section is 0.15.
Add the loss of sections A + B to the loss of section F for total loss from meter to furnace. $0.072 + 0.12 + 0.15 = 0.342$. The correct size for section F is 3/4".
10. To determine pressure loss through section G (*TracPipe* drop to the water heater), use the load (40 CFH) and find pressure loss from Table PD-1. In the 1/2" column we find 0.008. Multiply the length: 25 feet by 0.008. The pressure loss for this section is 0.20. Add the loss of sections A + B + C1 + C2 to the loss of section G for total loss from meter to furnace. $0.072 + 0.12 + 0.01 + 0.019 + 0.20 = 0.421$. The correct size for section G is 1/2".
11. To determine pressure loss through section H (*TracPipe* drop to the fireplace), use the load (30 CFH) and find pressure loss from Table PD-1. In the 1/2" column we find 0.004. Multiply the length: 40 feet by 0.004. The pressure loss for this section is 0.16. Add the loss of sections A + B + C1 + C2 + D to the loss of section H for total loss from meter to furnace. $0.072 + 0.12 + 0.01 + 0.019 + 0.031 + 0.16 = 0.412$. The correct size for section H is 1/2".
12. To determine pressure loss through section I (*TracPipe* drop to the dryer), use the load (35 CFH) and find pressure loss from Table PD-1. In the 1/2" column we find 0.006. Multiply the length: 30 feet by 0.006. The pressure loss for this section is 0.18. Add the loss of sections A + B + C1 to the loss of section I for total loss from meter to dryer. $0.072 + 0.12 + 0.01 + 0.18 = 0.382$. The correct size for section I is 1/2". Using the Sum of Pressure Loss Method we calculate that three of the five *TracPipe* sections (when compared with the longest length method) can utilize reduced sizes to deliver the necessary load with a pressure loss equal to or less than the allowable 0.5 inches water column. This enables the installer to use 1/2" *TracPipe* on all but the furnace and range drops, which remain 3/4".

SECTION 3.3 — GASBREAKER® EXCESS FLOW DEVICES FOR CSST AND STEEL PIPE GAS SYSTEMS

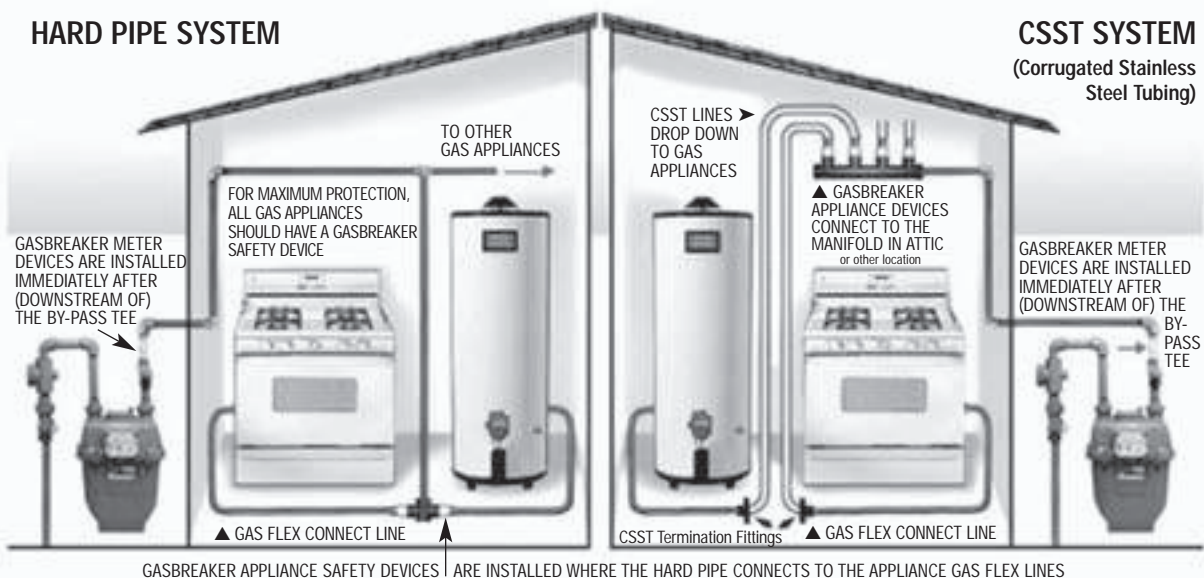
GasBreaker excess flow devices protect against residential and commercial gas line breaks. GasBreakers work in conjunction with *TracPipe* and other brands of CSST at the gas meter as well as at the appliance manifold. GasBreakers should be connected directly to the manifold at the point between the manifold and the appliance gas lines, which will offer increased safety for the building occupants. The charts used to size CSST systems below are for use with TracPipe flexible gas piping only. (For other CSST brands, size the piping by assuming that the load for that section of pipe is the maximum load of the excess flow device chosen).

1. **GASBREAKER LOW PRESSURE EXCESS FLOW DEVICES FOR PROPANE AND NATURAL GAS SERVICE.** An excess flow device is a protective device to help control the discharge of fuel gas in the event of a complete breakage of pipe lines or flex connector rupture. Excess Flow Devices have been of help in limiting gas loss in many incidents involving breakage of piping. Thus, they do provide a useful safety function in gas systems. This section explains

what protection Excess Flow Devices can offer, points out conditions which can interfere with that protection, and offers suggestions for effective Excess Flow Device installation.

2. **INSTALLATION OF GASBREAKER DEVICES ON GAS METERS.** The GasBreaker device can be installed downstream of the gas company meter and bypass tee outlet using standard pipe fittings and procedures. GasBreaker Meter Devices must be installed within 5 degrees of the vertical position with the flow arrow pointing upward in the direction of flow.

3. **INSTALLATION OF GASBREAKER APPLIANCE DEVICES.** GasBreaker devices should be connected directly to the manifold at the point between the manifold and the gas appliance lines. If there is no manifold, the devices could be located at the tee or fitting where the appliance drop attaches to the trunk line. All GasBreaker devices except series 120 appliance device must be installed in the vertical position (within 5 degrees) with the flow arrow pointing upward in the direction of flow. The series 120 appliance device can be installed in a vertical or horizontal position with the flow arrow pointing in the direction of flow.



SECTION 3.4 — SIZING INSTRUCTIONS FOR GASBREAKER DEVICES USED WITH CSST/TRACPIPE SYSTEMS

SECTION 3.4A — METER DEVICES (SERIES FGP-GB300, FGP-GB400, FGP-GB600)

1. Choose the GasBreaker Meter Device from Table 3.1 based on the total capacity of the gas piping system served by that meter.
2. Using the appropriate GasBreaker Capacity Chart “Table N-1GB GasBreaker Low Pressure” or “Table N-5GB GasBreaker (2-psi system)” based upon system pressure; determine the size of CSST, which will supply the necessary total capacity of that meter. This size of CSST is designed to allow the GasBreaker device to act as a safety shut-off device in the event of a complete breakage of the main downstream trunk line piping. Note: GasBreakers installed at the meter are not designed to protect against breakage of piping downstream that has been reduced from the initial size or appliance branch piping.

SECTION 3.4B — APPLIANCE DEVICES (SERIES FGP-GB090, FGP-GB120, FGP-GB150)

1. Elevated Pressure 2 PSI system (Manifold with parallel arrangement)
 - a. Choose the appropriate size device (“Max. Load Capacity (BTU/hr)” column) for each manifold outlet from Table 3.1. Select a device with sufficient capacity to supply the appliance(s) connected to the outlet.
 - b. Using GasBreaker Capacity Chart “Table N-3GB GasBreaker Dual Pressure System” determine size of TracPipe CSST which will carry the required load for the distance from the manifold to the appliance(s). This size of CSST is designed to allow the GasBreaker device to act as a safety shut-off device in the event of a complete breakage of downstream pipe lines or flex connector rupture.

2. Series System Low Pressure
 - a. When there is no manifold, the devices should be located at the tee or fitting where the appliance drop attaches to the trunk line. If this is a concealed location, follow local codes.
 - b. Choose the appropriate size device (“Max. Load Capacity (BTU/hr)” column) for each appliance from Table 3.1. Select a device with sufficient capacity to supply the appliance(s) connected to that drop.
 - c. Using GasBreaker Capacity Chart “Table N-1GB GasBreaker Low Pressure” determine size of TracPipe CSST which will carry the required load for the distance from the meter to the appliance(s). This size of CSST is designed to allow the GasBreaker device to act as a safety shut-off device in the event of a complete downstream breakage of pipe lines or flex connector rupture.

SECTION 3.4C — SIZING INSTRUCTIONS FOR GASBREAKER DEVICES WITH STEEL PIPE SYSTEMS

1. Choose the GasBreaker Device (Appliance or Meter) from Table 3.1, based upon either the capacity of the appliance or the total capacity of the gas piping system served by the meter.
2. Using GasBreaker Capacity Chart “Table SP-1GB GasBreaker Steel Pipe Low Pressure” determine the size of CSST, which will supply the necessary capacity of that appliance or meter. This size of CSST will allow the GasBreaker device to act as a safety shut-off device in the event of a complete downstream breakage of pipe lines or flex connector rupture.

Gas Breaker’s published limitations, based upon black pipe sizing (*Pipe break open to atmosphere*) are:

- Series 300: For up to 60' of 3/4" and 190' of 1" pipe.
Series 400: For up to 200' of 1 1/4" pipe and 500' of 1 1/2" pipe.
Series 600

TABLE 3.1
Low Pressure Excess Flow Devices
GasBreaker Models

Product Name	TracPipe Part #	Valve Inlet x Outlet Male - NPT	Max. Load Capacity (BTU/hr)	Maximum Device Closure Flow Rate (SCFH)
GasBreaker	FGP-GB090-075	3/4 x 3/4	70,000	100
GasBreaker	FGP-GB120-050	1/2 x 1/2" Flare	90,000	125
GasBreaker	FGP-GB120-075	3/4 x 5/8" Flare	90,000	125
GasBreaker	FGP-GB150-075	3/4 x 3/4	125,000	160
GasBreaker	FGP-GB300-075	3/4 x 3/4	275,000	320
GasBreaker	FGP-GB300-100	1 X 1	275,000	320
GasBreaker	FGP-GB400-100	1 X 1	375,000	450
GasBreaker	FGP-GB600-100	1 X 1	500,000	660

Notes:

- 1) Flow Rates given for 0.6 Specific Gravity Natural Gas with an avg. heating value of 1000 BTU / cu. ft.
- 2) Abbreviations: "w.c. = inches water column
SCFH = Standard Cubic Feet per Hour
- 3) Equivalent length pipe calculations MUST use the Maximum ΔP across device at Trip AND the Maximum Device Closure Flow Rate to insure that the GasBreaker EFD will act as a safety shut-off device ("Trip" or "Close") under a given set of design conditions. Other ΔP values may be found in TABLE 3.2.

TABLE 3.2
Low Pressure Excess Flow Devices
Pressure drop ΔP ("w.c.) at Flow Rates*

FLOW (SCFH)	GasBreaker MODEL				
	GB090	GB150	GB300	GB400	GB600
50	0.1				
60	0.2	0.1			
70	0.4	0.2			
80	0.6	0.3			
90	0.7	0.4			
100		0.5	0.2		
110		0.7			
120		0.8			
130		1.0			
140		1.2			
150		1.3	0.4		
200			0.7	0.1	0.1
250			1.1	0.3	
300			1.7	0.5	0.5
350				0.8	
400				1.3	1.0
500					1.8
600					2.7

*Note: When calculating pipe lengths use TABLE 3.1 to insure that the EFD will operate as a safety shut-off device.

GasBreaker Capacity Charts

Table N-1 1GB GasBreaker-TracPipe (Low Pressure System 6-7 in w.c.)

Determine CSST size based upon the GasBreaker Device Chosen and Length of CSST Run
Standard Low Pressure (6-7 in w.c.)—Pressure Drop 0.5 in w.c.

TracPipe P/N Appliance Series	Max. Capacity BTU	Distance Range – Length in Feet													
		0-10 Feet	<15	<20	<25	<40	<50	<60	<90	<100	<150	<200	<250	<300	
FGP-GB090	70,000	1/2"CSST	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1 1/4"
FGP-GB120	90,000	1/2"CSST	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"
FGP-GB150	125,000	3/4"CSST	3/4"	3/4"	3/4"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
Meter Series															
FGP-GB300	275,000	1"CSST	1"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"
FGP-GB400	375,000	1"CSST	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"	2"	2"	2"
FGP-GB600	500,000	1 1/4"CSST	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"	2"	2"	2"	2"	2"

NOTE: If you are installing a brand of CSST other than TracPipe, size each run to supply the Max Capacity of the GasBreaker device instead of the capacity of appliances on that run.

Table N-3 3GB GasBreaker-TracPipe (Dual Pressure System-8 in w.c. -Regulator outlet @ manifold)

Determine CSST size based upon the GasBreaker Device Chosen and Length of CSST Run
Regulator Outlet for 2-psi system (8 in w.c. with a Pressure Drop of 3 in w.c.)

TracPipe P/N Appliance Series	Max. Capacity BTU	Distance Range – Length in Feet															
		0-10 Feet	<15	<20	<25	<30	<40	<50	<60	<80	<90	<100	<150	<200	<250	<300	
FGP-GB090	70,000	3/8"CSST	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"
FGP-GB120	90,000	3/8"CSST	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
FGP-GB150	125,000	1/2"CSST	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"
Meter Series																	
FGP-GB300	275,000	3/4"CSST	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/2"
FGP-GB400	375,000	3/4"CSST	3/4"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
FGP-GB600	500,000	1"CSST	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"

NOTE: If you are installing a brand of CSST other than TracPipe, size each run to supply the Max Capacity of the GasBreaker device instead of the capacity of appliances on that run.

GasBreaker Capacity Charts

Table N-5GB GasBreaker-TracPipe (2-psi system)

Determine CSST size based upon the GasBreaker Device Chosen and Length of CSST Run
 Meter Outlet for 2-psi system (Elevated Pressure) – Pressure Drop 1-psi

TracPipe P/N	Max. Capacity BTU	Distance Range – Length in Feet															
		0-10 Feet	<25	<30	<40	<50	<75	<80	<100	<150	<200	<250	<300	<400	<500		
Meter Series																	
FGP-GB300	275,000	3/8"CSST	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"
FGP-GB400	375,000	1/2"CSST	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	1"
FGP-GB600	500,000	1/2"CSST	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"

NOTE: If you are installing a brand of CSST other than TracPipe, size each run to supply the Max Capacity of the GasBreaker device instead of the capacity of appliances on that run.

Table SP-1GB GasBreaker Steel Pipe Low Pressure

Determine pipe size based upon the GasBreaker Device Chosen and Length of Run
 Standard Low Pressure 0.5 psi or less (6-7 in w.c.)—Pressure Drop 0.5 in w.c.

TracPipe P/N	Max. Capacity BTU	Distance Range – Length in Feet															
		0-10 Feet	<20	<30	<40	<50	<60	<70	<90	<100	<125	<150	<200	<250	<300		
Appliance Series																	
FGP-GB090	70,000	1/2"Pipe	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"
FGP-GB120	90,000	1/2"Pipe	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"
FGP-GB150	125,000	1/2"Pipe	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"
Meter Series																	
FGP-GB300	275,000	3/4"CSST	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"
FGP-GB400	375,000	1"CSST	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"
FGP-GB600	500,000	1"CSST	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"	2"	2"

Propane GasBreaker Charts

Table A PROPANE — GasBreaker Low Pressure Excess Flow Devices

GasBreaker Flow Rates in 1.55 S.G./2520 BTU/cu.ft. PROPANE										
TracPipe P/N	Appliance Device	Btu/hr			SCFH			Typ. Load	Nom. Closing	Nom. Closing
		Typ. Load	Max Load	Nom. Closing	Typ. Load	Max Load	Nom. Closing			
FGP-GB090	FGP-GB090	108,880	108,880	139,988	44	44	44	56		
FGP-GB150	FGP-GB150	155,543	194,428	233,314	62	78	78	93		
	Meter Devices									
FGP-GB300	FGP-GB300	272,200	427,743	466,628	109	171	171	187		
FGP-GB400	FGP-GB400	388,857	583,285	622,171	156	233	233	249		
FGP-GB600	FGP-GB600	466,628	777,714	933,257	187	311	311	373		

Table P-1GB GasBreaker (Propane Low Pressure System 11 in w.c.)-TracPipe

Determine CSST size based upon the GasBreaker Device Chosen and Length of CSST Run
Standard Propane Low Pressure (11 in w.c.)—Pressure Drop 0.5 in w.c.

TracPipe P/N	Max. Capacity BTU	Distance Range – Length in Feet															
		0-10 Feet	<15	<20	<25	<40	<50	<60	<90	<100	<150	<200	<250	<300			
Appliance Series																	
FGP-GB090	108,880	1/2"CSST	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	3/4"	1"	1"	1"	1"	1"	1 1/4"
FGP-GB150	194,428	3/4"CSST	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"
Meter Series																	
FGP-GB300	427,743	1"CSST	1"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"
FGP-GB400	583,285	1"CSST	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"	2"	2"
FGP-GB600	777,714	1 1/4"CSST	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	2"	2"	2"	2"	2"	2"

CHAPTER 4 INSTALLATION PRACTICES

SECTION 4.1 — GENERAL INSTALLATION PRACTICES

Precautions must be taken to ensure that any exposed flexible piping is not damaged or abused during building construction. All system hardware should be stored in a secure, dry location prior to installation.

1. The piping system is for use with fuel gas at operating pressures up to 25 PSI (USA and Canada restriction). *TracPipe* gas piping (3/8" up to 1-1/4" sizes) has been tested and is approved for pressures up to 125 PSI, and may ONLY be used at this pressure with the consent of the local gas utility and code authority. 1-1/2" & 2" size *TracPipe* gas piping has been tested and are approved for pressures up to 25 PSI. Pressure tests up to 125 PSI are permitted on sizes up to 1-1/4".
2. Only components provided by OMEGA FLEX or specified as part of the *TracPipe* piping system are to be used in the installation.

DO NOT USE *TRACPIPE* TUBING OR FITTINGS WITH TUBING OR FITTINGS OF ANY OTHER MANUFACTURER. INTERMIXING OF CSST TUBING OR FITTING COMPONENTS BETWEEN CSST MANUFACTURERS IS PROHIBITED. CONNECTIONS BETWEEN TWO DIFFERENT BRANDS OF CSST MAY

BE ACCOMPLISHED USING STANDARD MALLEABLE IRON FITTINGS.

3. Ends of the piping are to be temporarily capped, plugged or taped closed prior to installation and pulling through structure to prevent entrance of dirt, or other debris.
4. Contact with sharp objects or harmful substances is to be avoided. Contact with any chemicals containing chlorides or ammonia must be followed by thorough rinse and wipe dry. Typical chloride based chemicals include fluxes used for soldering copper tubes and acid based cleaners such as muriatic acid used for cleaning brickwork. Use only non-corrosive leak detection fluids.

5. **BENDING *TRACPIPE*** Undue stress or strain on the tubing or fittings is to be avoided. Bending flexible gas piping is one feature which contributes to the speed of installation. The recommended bend radius for general routing of tubing is listed in Table 4-1. Multiple tight bends can restrict the gas flow and increase pressure drop. The tightest bend allowed for each size of *TracPipe* is shown in the chart below. Typical locations

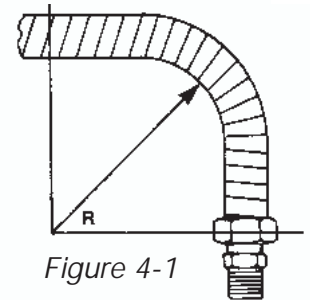


Figure 4-1

RECOMMENDED MINIMUM BENDING RADIUS FOR FLEXIBLE GAS PIPING

Table 4-1

TUBING SIZE	ABSOLUTE MINIMUM BEND RADIUS R	RECOMMENDED MINIMUM BEND RADIUS R
3/8 inch	9/16 inch	3 inches
1/2 inch	3/4 inch	3 inches
3/4 inch	1 inch	3 inches
1 inch	3 inches	5 inches
1-1/4 inch	3 inches	5 inches
1-1/2 inch	3 inches	5 inches
2 inch	4 inches	6 inches

requiring tight bends are termination mount installations in hollow stud walls.

6. SUPPORTING *TRACPIPE*

Piping shall be supported in a workman-like manner with pipe straps, bands, brackets or hangers suitable for the size and weight of the piping. *TracPipe* which passes over or through a structural member is considered to be supported by that member.

6A. VERTICAL RUNS

Spacing of supports is not to exceed 10 feet, requiring hangers only where the height of each floor is greater than 10 feet.

6B. HORIZONTAL RUNS

Spacing of supports Hangers, supports and anchors-Piping shall be supported at intervals not to exceed those shown in Table 4-2. It is acceptable to use standard pipe straps or tubing clips available in metal or plastic materials, OMEGAFLEX has found that the use of two-attachment point plastic clips or metal EMT pipe straps is advisable.

Some plastic clips, especially the "J-clips" designed to support plastic tubing are susceptible to breakage upon subsequent handling by other trades.

HORIZONTAL OR INCLINED RUNS

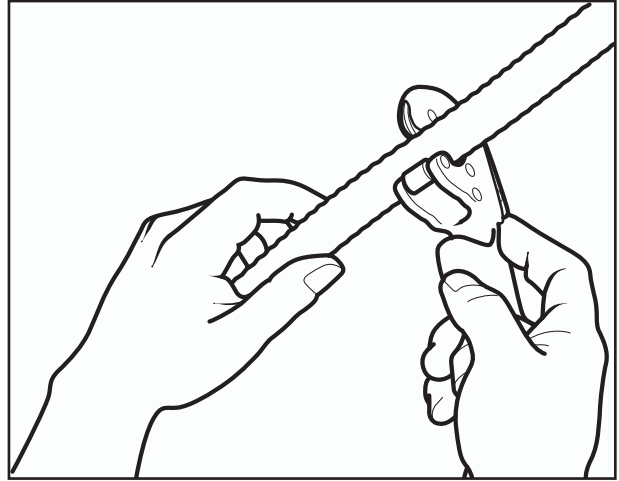
Table 4-2

PIPING SIZE	SPACING OF SUPPORTS
3/8 inch	4 FEET
1/2 inch	6 FEET
3/4 inch	8 FT. (USA) 6 FT. (CANADA)
1 inch	8 FT. (USA) 6 FT. (CANADA)
1-1/4 inch	8 FT. (USA) 6 FT. (CANADA)
1-1/2 inch	8 FT. (USA) 6 FT. (CANADA)
2 inch	8 FT. (USA) 6 FT. (CANADA)

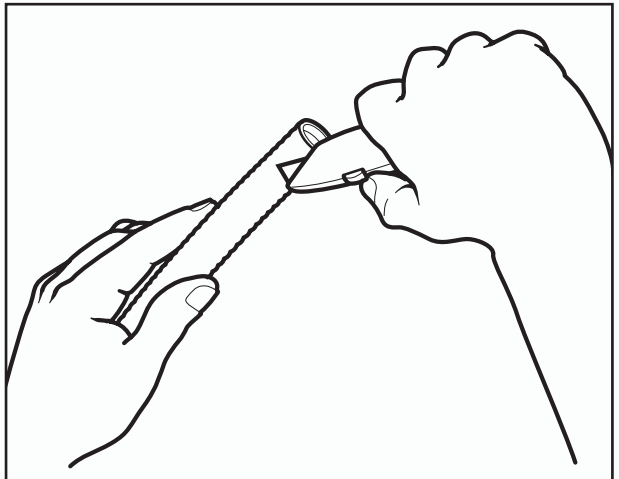
SECTION 4.2 HOW TO ASSEMBLE *TracPipe* AUTO-FLARE FITTINGS

INSTRUCTIONS for making Fitting Connections to Flexible Gas Piping

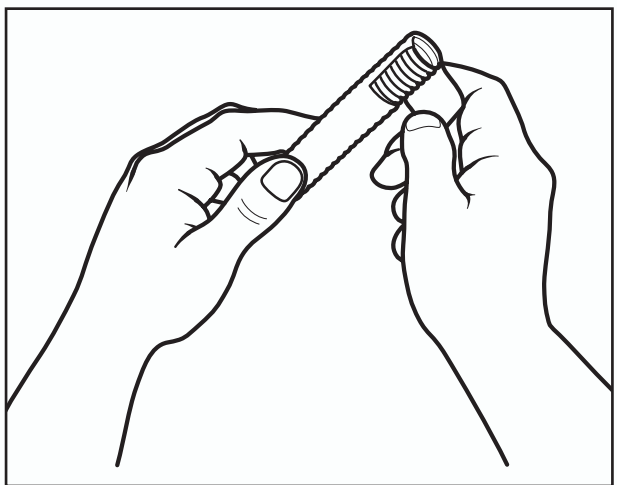
1. CUT-TO-LENGTH: Determine proper length. Cut through plastic jacket and stainless tube using a tube cutter with a sharp wheel. Cut must be centered between two corrugations. Use full circular strokes in one direction and tighten roller pressure slightly (a quarter turn) after each revolution. **DO NOT OVERTIGHTEN ROLLER**, which may flatten tube.



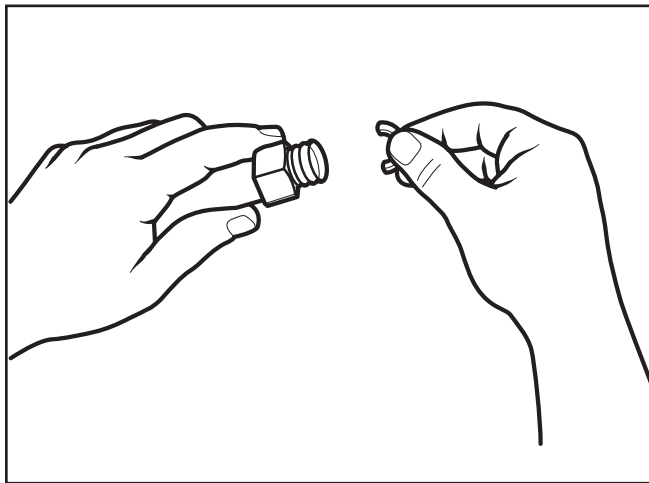
NOTE: Due to the large diameter and depth of corrugation on sizes over 1", tubing must be cut with a standard tubing cutter RIDGID™ 152 or equal using a *TracPipe* cutting wheel no. FGP-E-5272 (P/N E-5272 or equal). **CAUTION:** Use of a small cutting wheel may flatten the first corrugation and make cutting and/or sealing of fittings difficult.



2. STRIP JACKET: Using a utility knife, strip back the jacket approximately one inch to allow assembly of fittings. **Caution: For your personal safety--Knife blade and cut tube ends are both sharp. Use care when cutting the jacket and handling the tube.**

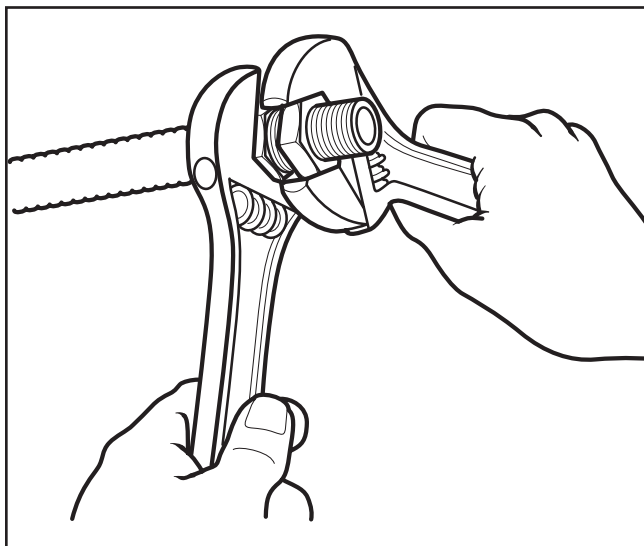


INSTRUCTIONS for making Fitting Connections to Flexible Gas Piping (Continued)



3. **INSTALL FITTING NUT:** Slide nut over cut end: place two split-rings into the first corrugation next to the tube cut. Slide nut forward to trap the rings.

4. **WRENCH FITTING:** Place the adapter into the nut and engage threads. Note that the AutoFlare® fitting is designed to form a leak tight seat on the stainless tubing as you tighten the fitting. (The piloting feature of the adapter will not always enter the bore of the tubing before the tightening operation, but will center the fitting when tightened). Using appropriate wrenches, tighten the fitting until adapter bottoms and the resistance to wrenching increases greatly. The flare has now been created on the tubing end.



CAUTION- DO NOT USE ANY THREAD SEALANTS FOR THIS CONNECTION. SEALANTS ARE TO BE USED ON THE PIPE THREAD ONLY.

Table 4-3

Flexible Pipe Size	Fitting	Torque Value
3/8" FGP-SS4-375	FGP-FST-375	40 ft.-lb.
1/2" FGP-SS4-500	FGP-FST-500	42 ft.-lb.
3/4" FGP-SS4-750	FGP-FST-750	45 ft.-lb.
1" FGP-SS4-1000	FGP-FST-1000	75 ft.-lb.
1-1/4" FGP-SS4-1250	FGP-FST-1250	150-200 ft.-lb.
1-1/2" FGP-SS4-1500	FGP-FST-1500	200-250 ft.-lb.
2" FGP-SS4-2000	FGP-FST-2000	250-300 ft.-lb.

5. **FINAL TORQUE:** Tighten nut and adapter to the torque values shown in Table 4-3. For field installations use the following method: Tighten nut and adaptor as though you were making up a flared tubing joint. Note relation between hex flats at this point and continue to tighten for two additional hex flats (one-third turn) to obtain required torque and final leak-tight seal.



AutoFlare® (Patented) – The Fitting is the Flaring Tool

SECTION 4.2A — TROUBLE SHOOTING FITTING CONNECTIONS

1. The tubing cut is the critical step in the fitup procedure. Always cut in a straight section of piping, rather than an area you have bent. Use light roller pressure applied on every revolution to cut tube evenly around its surface. Remember that this tube has a thinner wall than the copper tube you are accustomed to cutting. A sharp blade is very important, and it will be helpful to reserve one cutter for stainless steel only.
2. If the fitting connection cannot be made to seal upon applying torque per the instructions in Section 4.2, continue to tighten an additional quarter to a half turn. If leakage continues, do not continue to apply torque. Disassemble the fitting and inspect the sealing surfaces. The most likely cause of leakage is foreign material on the sealing surfaces. Wipe both fitting and tubing flare with a clean cloth. Inspect the formed flare on the tubing end, which should appear round when compared with the split ring washers and the nut in place. If any deformation is noted, the tubing can be recut and the fitting re-attached. The patented Autoflare fitting has an insert which is self piloting and **does not require special tooling to make a leak proof fitting.**
3. REASSEMBLY - When reattaching the AutoFlare fitting, it is only necessary to re-insert the split rings into the space between the first two corrugations and to pull the nut back over the rings into position. The adapter can then be conveniently re-threaded into the nut and torqued as before. If the nut cannot be pulled into place, examine the split-rings, which may have been "coined" by the first torque operation. If this is the case, simply reverse the split-rings positioning to align with the nut and continue the assembly process. If the fitting is reattached more than three times, or if the nut cannot be pulled over the rings in any position, then the split-rings must be replaced. Packets of spare split-rings are available (P/N FGP-RING-SIZE) and the remaining fitting parts can be re-used.

SECTION 4.3 — ROUTING

Depending on local building codes and construction practice, Flexible gas piping can be routed:

1. Beneath floor joists, through floor and ceiling joists, along side of floor and ceiling joists. This is the typical location for residences and commercial buildings with basements and for multi-floor systems.
2. Inside hollow interior wall cavities. This is the preferred location for vertical sections of piping, rather than horizontal sections.
3. Through approved conduit under ground or under building slabs. When piping runs are located below grade or under a concrete slab, the *TracPipe* shall be routed within a non-metallic water-tight conduit. No tubing joints are permitted within the conduit. Gas piping runs beneath building slabs must be both sleeved and vented to the atmosphere. See Underground Installations Section 4.9 for underground use of *TracPipe PS* and *TracPipePS-II*. *TracPipe PS* and *TracPipePS-II* meet code requirements for underground and under building slab installation.
4. Clearance holes for routing the piping through studs, joists, plates etc. shall have a diameter at least 1/2 inch larger than the outside diameter of the piping. When a structural member must be drilled, conformance to building codes must be followed. No structural member shall be seriously weakened or impaired by cutting, notching or otherwise altering the member. Minimum drill hole sizes are listed in Table 4-4.

Table 4-4

TUBING SIZE	DRILL HOLE SIZE
3/8 inch	1-1/8 inch
1/2 inch	1-3/8 inch
3/4 inch	1-1/2 inch
1 inch	1-3/4 inch
1-1/4 inch	2-1/4 inch
1-1/2 inch	2-1/2 inch
2 inch	3 inch

5. METAL STUDS

For installations involving horizontal runs through galvanized steel studs, the use of plastic grommets supplied by the stud manufacturer is recommended. The use of these grommets will reduce the likelihood of damage to the tubing non-metallic jacket.

SECTION 4.3A — CONCEALED LOCATIONS FOR FITTINGS — GENERAL PROVISIONS

The *AutoFlare*® mechanical attachment fittings have been tested and are listed per the requirements of ANSI LC1 and CSA 6.26 Standard (USA and CANADA) This specification provides test requirements which certify fittings for concealed installations and connections to appliances where concealing the fittings is the only practical alternative.

These guidelines address some of the known situations which may require the use of a concealed fitting. While accessibility of fittings may be desirable there are often situations where concealing the fittings is the only practical option. This guide cannot address all applications of concealed fittings but provides instead typical instructions to demonstrate the principles which apply to fittings listed for installation in concealed locations (Ref National Fuel Gas Code NFPA54 Chapter 6).

EXCLUSIONS:

1. Manifold Stations (for 2 PSI systems) which include the multiport manifold, shut off valve, and pressure regulator shall not be installed in concealed locations regardless of the qualifications of tubing fittings.

NEW INSTALLATIONS:

1. CSST may be connected to steel piping systems through threaded pipe connections. This can be a stub-out to an appliance connection or outdoors to a meter, etc.
2. Flexible piping connections to fireplace "key valves" can be located in a concealed location, when accessibility is not readily

provided. See Illustrations 1 & 2 for typical key valve mountings.

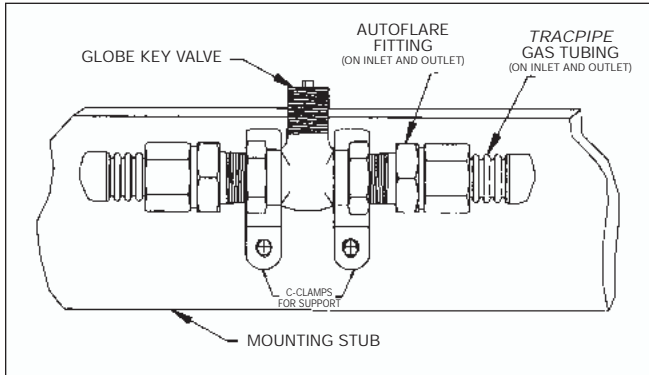


Illustration 1

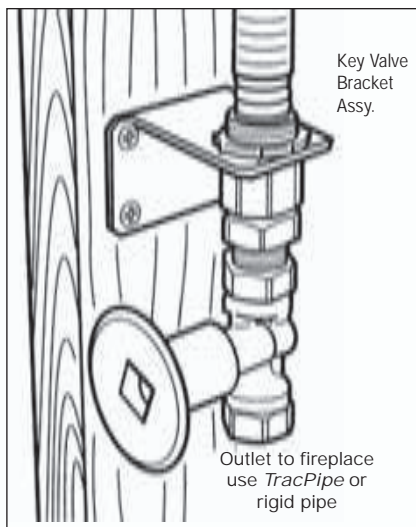


Illustration 2

- Multiple gas outlets – when multiple outlets are supplied from a single run of piping, each downstream outlet branch can be connected to the main run using a tee fitting which can be located in a concealed location.

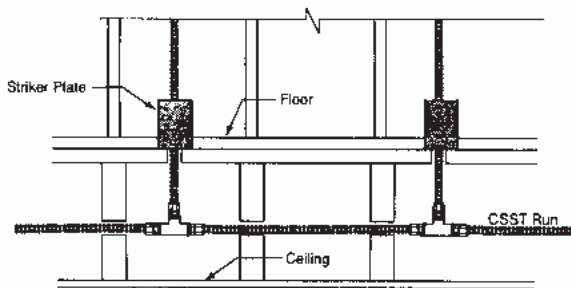


Figure 4-2 Multiple outlets along main tubing run

MODIFICATIONS TO INSTALLED SYSTEMS:

- New ceilings in unfinished rooms/basements-**

Flexible piping fittings originally installed in accessible ceiling locations can be concealed at a later date in the event that a ceiling is installed. Precautions shall be taken to ensure that the newly concealed piping and fittings are adequately protected from accidental puncture in accordance with the instructions in this guideline.

- Extensions to existing tubing runs-**A tubing run can be modified to permit an extension to another appliance location provided there is sufficient capacity to supply both appliances at the same time. If an accessible location for the modification is not available, the existing tubing run can be modified with a tee fitting, resulting in a concealed fitting.
- Repairs to existing tubing runs-**Damaged tubing runs shall be repaired in accordance with instructions in this guide (Section 5.2). The repair can result in a line splice which may ultimately be located in a concealed location.

SECTION 4.3B — OUTDOOR INSTALLATION ISSUES

The following section provides instructions for the use of *TracPipe* in systems in which portions of the piping are exposed to the outdoors as required to make connections to gas meters or appliances which are attached to, mounted on, or located in close proximity to the building structure. ANSI/IAS LCI-CSA 6-26-1997 contains test requirements determining suitability for exposure of CSST piping systems to outdoor environments. *TracPipe* is certified to this standard and is fully qualified for outdoor installations. The *TracPipe* yellow jacket contains UV inhibitors to retard jacket degradation when exposed to long periods of sunlight.

- When installed outdoors, the plastic jacketing shall remain intact as much as practical for the given installation. Any portions of exposed stainless steel shall be wrapped with self bonding silicone tape sealing the fitting connection to prevent later corrosive attack by acid wash or chloride based compounds. (See Figures 4-3A & 4-3B)

- When *TracPipe* is installed in a swimming pool mechanical room or exposed to a corrosive environment which may be harmful to the tubing, all exposed portions of the stainless steel tubing shall be wrapped with self-bonding tape. (See Figures 4-3A & 4-3B)
- When installed along the side of a structure (between the ground and a height of 6 feet) in an exposed condition, the *TracPipe* shall be installed in a location which will not subject the piping to mechanical damage or be protected inside a conduit.

NOTE: For support and protection, OmegaFlex recommends that outside runs along the side of a building be clipped securely to the wall or other structural component.

- TracPipe* shall not be buried directly in the ground or embedded in concrete unless it is sleeved inside of a non-metallic (PVC or *TracPipe PS* or *PS-II* Polyethylene) water tight conduit. The conduit shall be sealed at any exposed end to prevent water from entering. See instructions for underground installations Section 4.9.
- When installed underneath mobile homes or in crawl spaces, *TracPipe* shall be installed in accordance with these standard outdoor instructions.

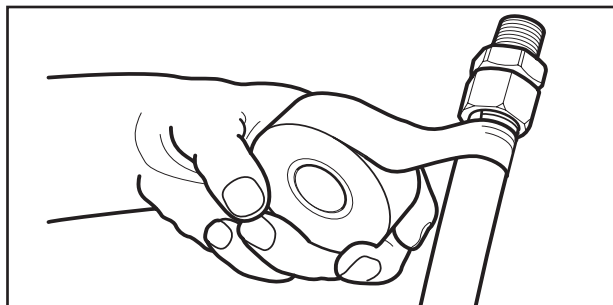


Figure 4-3A Wrapping with self bonding silicone tape - begin on jacket.

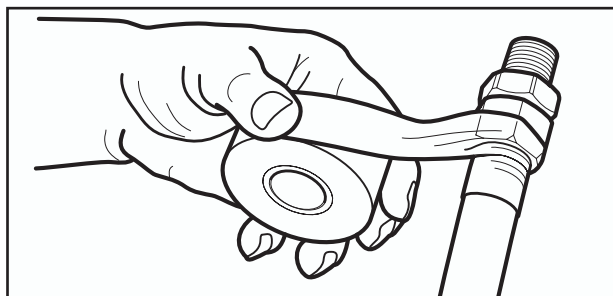


Figure 4-3B Wrapping with self bonding silicone tape - end on nut.

SECTION 4.4 — PROTECTION

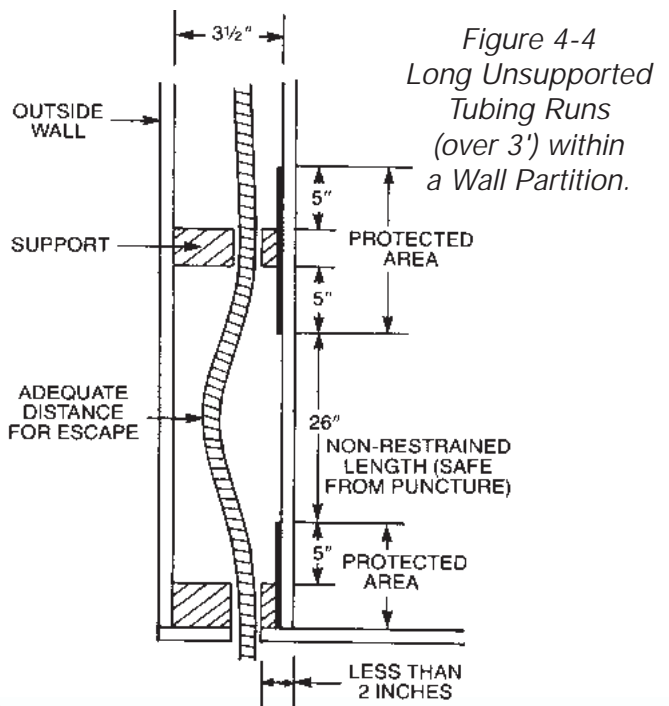
The flexible gas piping must be adequately protected from puncture, shear, crush or other physical damage threats. The tubing shall be protected at points of support and when passing through structural members such as studs, joists and plates in accordance with this section. PROTECTION IS REQUIRED WHENEVER THE TUBING IS CONCEALED, RESTRAINED, AND WITHIN 3 INCHES OF A POTENTIAL THREAT. If the tubing requires protection, the following measures should be taken.

SECTION 4.4A — STRIKER PLATE REQUIREMENTS

- Install shielding devices i.e. striker plates to protect the tubing from penetration by drill bits, nails, screws, etc. in those areas where the tubing will be concealed and will not be free to move to avoid such puncture threats.

NOTE: Only CSA approved hardened striker plates listed for CSST systems may be used.

- At support points and points of penetration less than 2 inches away from any edge of a stud, joist, plate, etc. shielding is required at the area of support and within 5 inches of each side (if appropriate). Use a half striker or a full striker plate in these locations. (Figure 4-4)



b. At support points and points of penetration 2 to 3 inches from any edge of stud, joist, plate, etc. shielding is required throughout area of support. Use a quarter striker plate in these locations. (Figure 4-5)

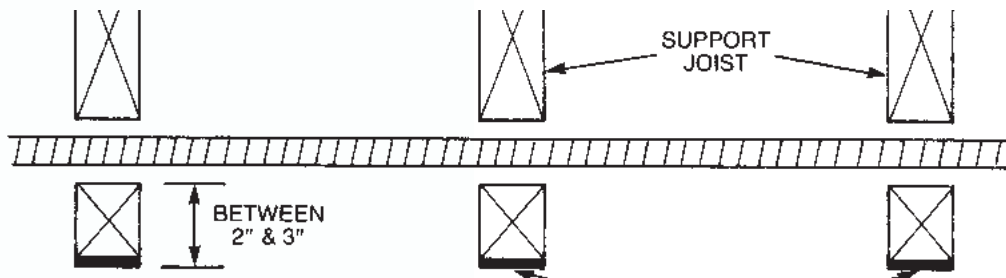


Figure 4-5
Shielding Requirements at Support Area when Points of Penetration are 2-3 inches from any Edge of a Stud, Joist, Plate, etc.

c. Hardened steel striker plates provide the required protection through building structures as described above. Type RW Floppy steel conduit shall be installed as additional protection at termination points. (Figure 4-7)

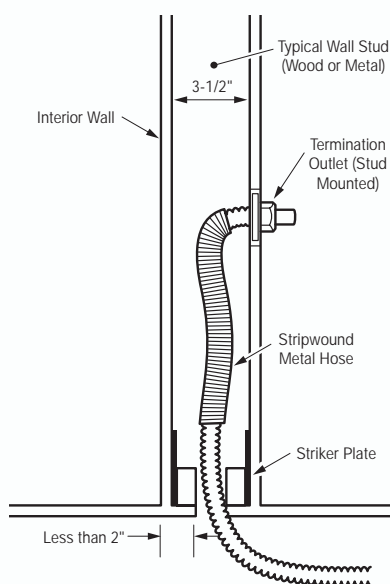


Figure 4-7

d. When tubing is routed horizontally between studs, install quarter striker plates at each stud and floppy galvanized steel conduit (spiral metal hose) along the entire length.

e. Schedule 40 steel pipe has been tested by CSA International and found acceptable for puncture protection. Steel pipe can be used where standard striker plates cannot reasonably be installed. Examples of this type of use

include: (but are not limited to) outside walls of buildings with sheathing in place, between floors with enclosed joist areas, and retrofits in existing buildings with walls in place. Steel pipe having an inner diameter at least one-

half inch larger than the *TracPipe* O.D. is approved by CSA International for this use as an alternate to striker plates. Protection must extend 5 inches beyond the penetration of the structural member(s). A 12 inch pipe length is appropriate for penetration of a single stud. Omegaflex recommends the use of standard striker plates where the building construction permits their installation. See Chart for pipe sizes.

<i>TracPipe</i> Size	Steel Pipe Size
3/8 inch	1-1/4 inch
1/2 inch	1-1/4 inch
3/4 inch	1-1/2 inch
1 inch	2 inch
1-1/4 inch	2-1/2 inch
1-1/2 inch	2-1/2 inch
2 inch	3-1/2 inch

2. The best protection is to install the tubing in those out of the way areas where testing has shown no protection is necessary, for example:

a. Where the tubing is supported more than 3 inches from any outside edge of a stud, joist, plate, etc. or wall surface. (Figure 4-6)

b. Where any non-restrained tubing can be displaced from the direction of potential penetration at least 3 inches.

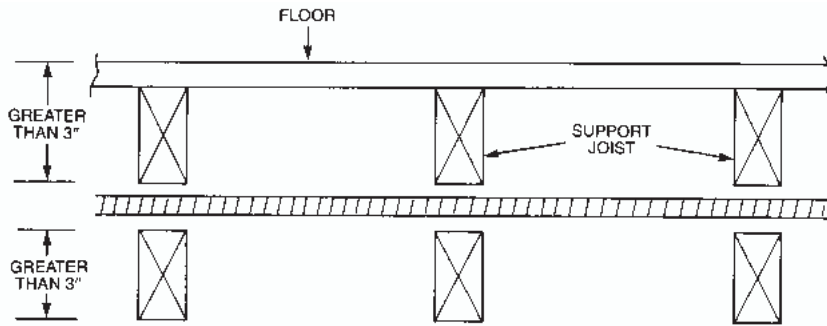


Figure 4-6

No Shielding Requirement at Support Area when Points of Penetration are greater than 3 inches from any Edge of a Stud, Joist, Plate, etc.

- c. When tubing is supported under the joists in basements or crawl spaces and is not concealed by wallboard or ceilings.
3. *TracPipe* with its specially formulated yellow polyethylene jacket has been tested to the flame spread and smoke density requirements of ASTM E84 and meets ANSI LC-1 limits imposed for this criteria.

NOTE: For *TracPipe* tubing version with Black outer jacket, the installer shall meet local building codes with respect to flame spread and smoke density regulations for non-metallic materials. Omegaflex recommends either removing the black jacket or transitioning to the standard yellow jacketed product when passing through areas such as drop ceiling return plenums.

4. For through-penetration fire stop instructions refer to the UL classification requirements shown in appendix A. When passing through a fire stop (2hr. wall) the YELLOW jacket does not have to be removed. Seal between building and *TracPipe* with an approved 3M type CP-25 or equivalent caulk. The BLACK jacket shall be removed for 2 ft. on each side of the penetration when passing through a fire stop.
5. *TracPipe* has thru-penetration UL Classifications for 1,2,3 and 4 hour requirements depending on materials and type of construction. See Appendix A.

SECTION 4.5 — METER CONNECTIONS

1. Meters which depend on the service and house piping for support shall not be directly connected to the flexible piping. Instead, use a meter termination fitting or termination mount fitting with steel pipe for the outdoor portion of the connection. For mounting of meters, all fastener locations should be used when installing the flange or mounting plate. (Figure 4-8)
2. Meters which are independently supported with a bracket can be directly connected outdoors with *TracPipe*. If practical, direct connections shall include a 3 to 6 inch additional length of tubing to accommodate differential settling and meter movement. No mechanical protection of the tubing is required for outdoor connections. **PRIOR TO INSTALLING *TracPipe* DIRECTLY TO A METER, ENSURE THAT THE LOCAL UTILITY ALLOWS THIS PRACTICE** as some utilities have regulations specifying meter attachments. Any exposed sections of stainless steel piping must be wrapped with a silicone self-bonding tape. This is especially important with masonry construction. (Figure 4-9) A PVC Sleeve is recommended for *TracPipe* penetration of both masonry and wood frame construction.

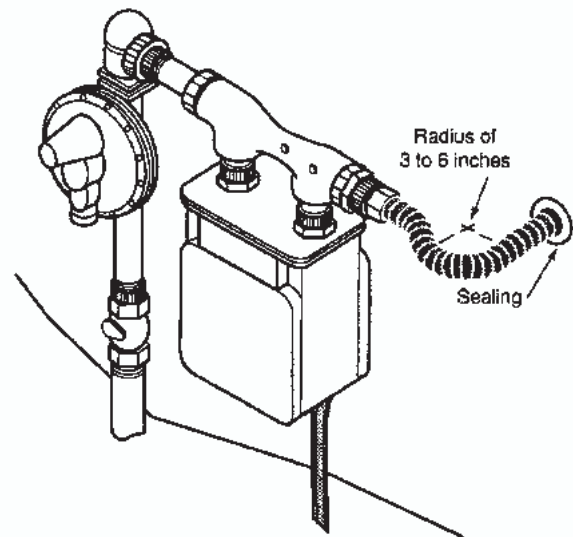


Figure 4-9

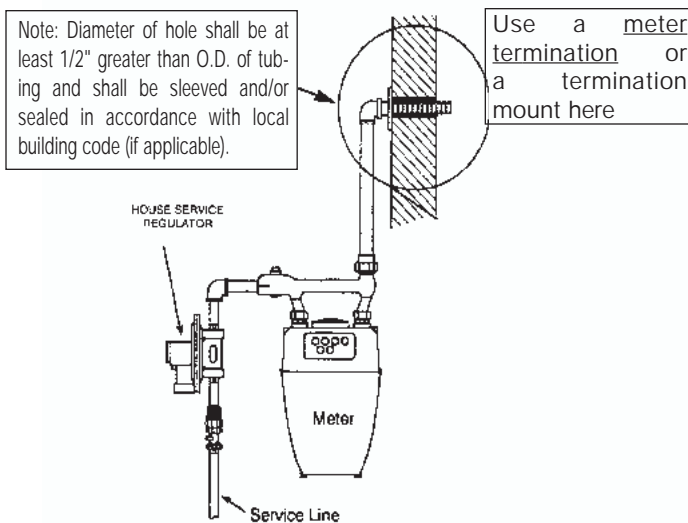
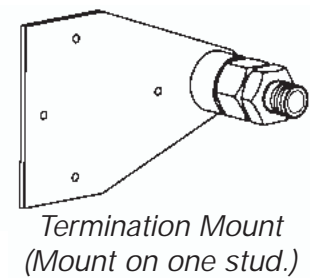
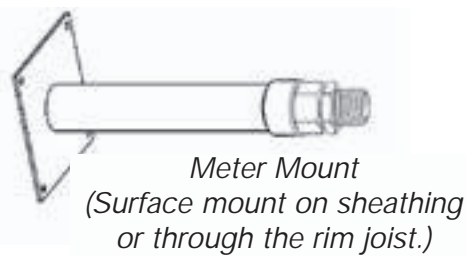


Figure 4-8

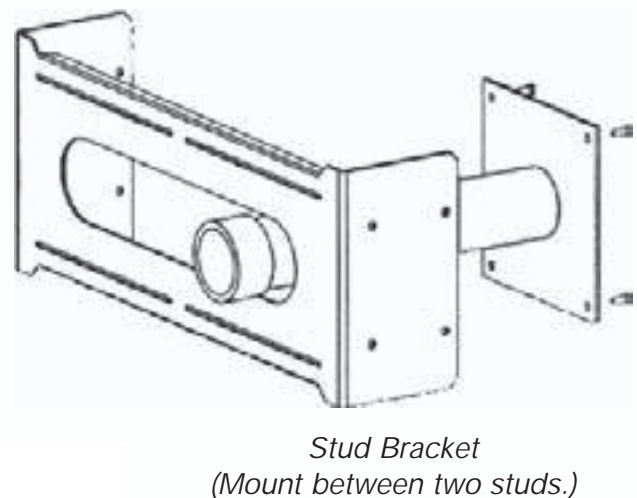


Figure 4-10
Meter Mounting Accessories

SECTION 4.6 — APPLIANCE CONNECTIONS

A listed termination outlet (termination mount or flange fitting) shall be installed and secured to the structure at all floor & hollow wall piping outlets used for moveable appliances and quick disconnect devices. The termination outlets are designed to simplify the installation of gas connections for moveable appliances and minimize the need for concealed fittings. The flange fitting or plate shall be securely fastened in place during rough-in. It may be attached to a brace spanning between studs for a wall location, or directly to the floor. (Figure 4-11) The flange may also be mounted with a flange L- bracket, which is nailed or screwed to the stud.

When a moveable appliance is in a location where a termination outlet cannot be readily installed through the structure, the *TracPipe* can be transitioned to black pipe at a suitable location and

the black iron pipe fastened to the block walls or concrete. Another option is to use termination mounting bracket fastened to the block wall and make the drop with *TracPipe*. Final connection is with a flexible appliance connector.

1. MOVABLE APPLIANCE CONNECTIONS (SUCH AS RANGES AND DRYERS) SHALL BE MADE USING APPROVED FLEXIBLE APPLIANCE CONNECTORS.

(Figure 4-12)

See also recessed wall box Section 4.6-3.

2. FIXED APPLIANCE CONNECTIONS MAY BE DIRECTLY CONNECTED TO THE FLEXIBLE GAS PIPING SYSTEMS (in most jurisdictions). When the fixed appliance is located in a secure, dedicated space, such as a basement, attic, garage or utility closet, the flexible piping may be directly connected to the appliance shut-off valve without installation of a flange fitting or flexible appliance connector.

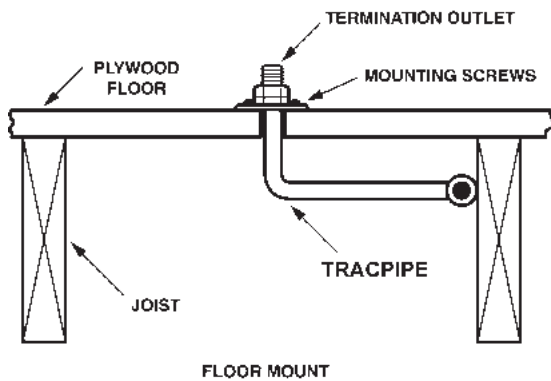


Figure 4-11
Support Device Flange Termination Outlet

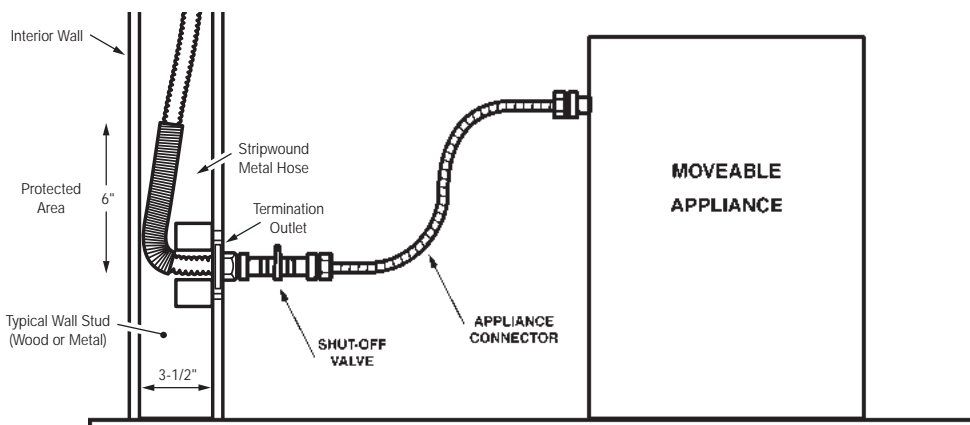
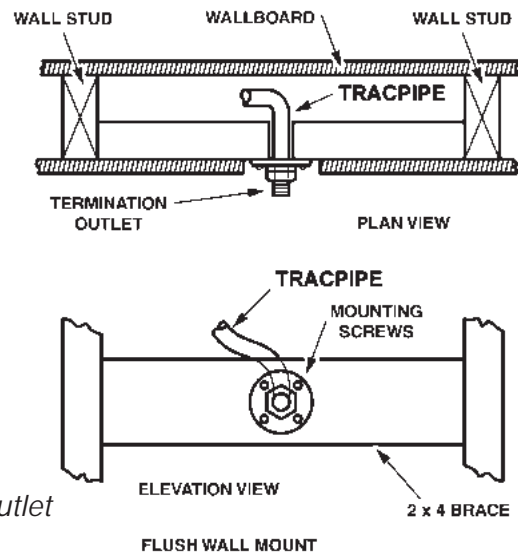
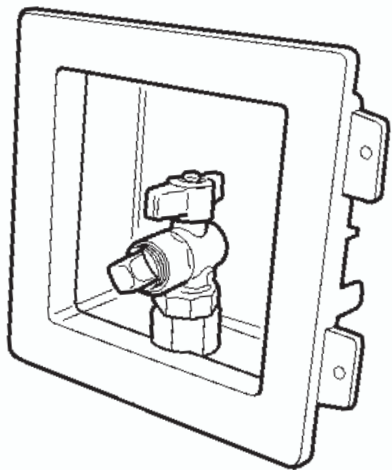


Figure 4-12
Stainless Steel Gas Connector Connection to a Movable Gas Appliance

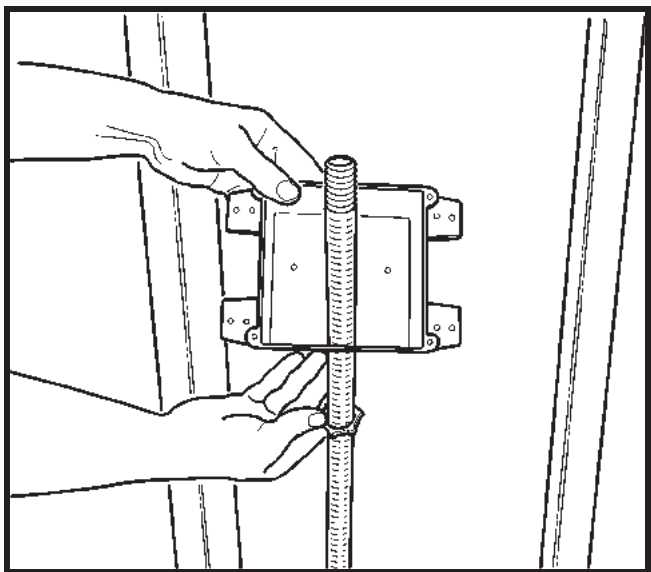
3. RECESSED WALL BOX TracPipe Part Number FGP-WBT-500

Product Description: TracPipe Recessed Wall Box makes possible appliance stub outs with zero clearance for a finished appearance in laundry rooms, kitchens and mechanical rooms. This accessory provides a rigid attachment point for appliance connectors serving movable appliances.



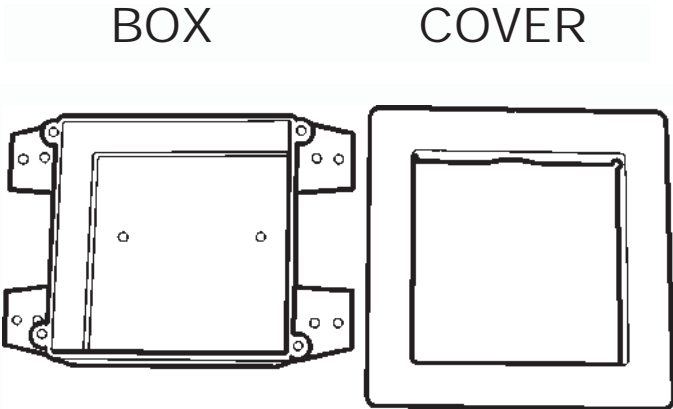
3A. Wall Box Installation Instructions

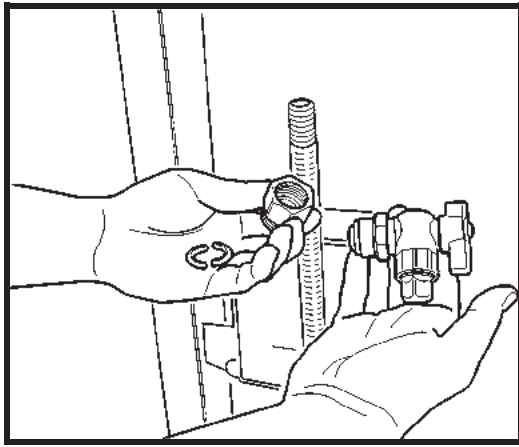
1. Install *TracPipe* gas pipe and cut to desired length using a tubing cutter with sharp wheel. Strip yellow jacket back approximately 2". Inspect pipe for a clean cut without tears.



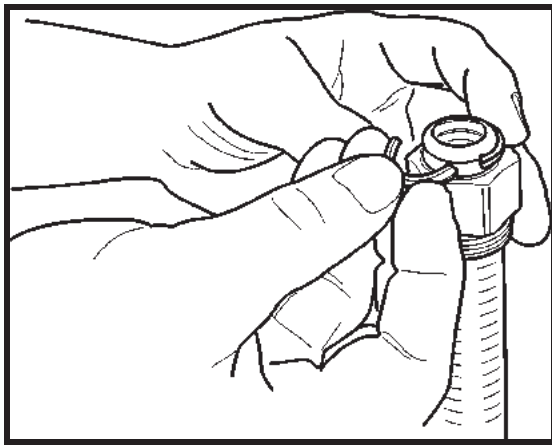
2. Remove box cover and slip locknut and box over end of pipe.

Caution: This is not a fire rated box. Before installing on a fire wall, consult your local code authority for acceptable installation practices. This box has been designed for use with *TracPipe* Flexible Gas Piping as an appliance termination and is not suitable for connection to any other CSST brand or black iron pipe. Installers must be trained on *TracPipe* before installing this product.

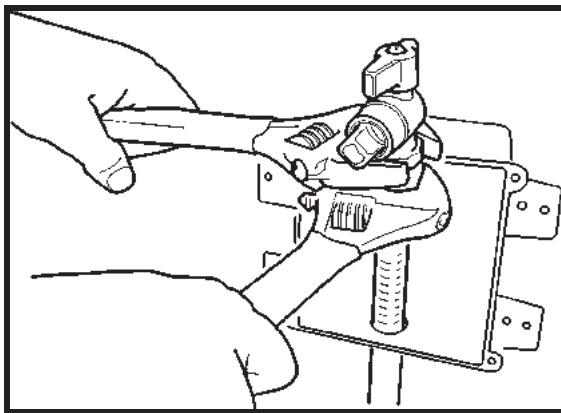




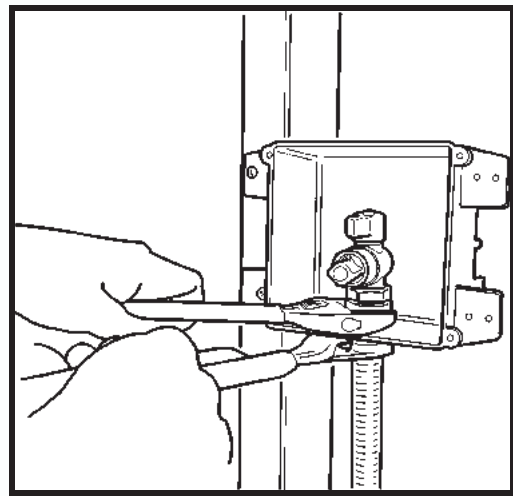
3. Disassemble valve and split rings from nut.



4. Slip nut over end of pipe and insert split rings into valley of the first corrugation.

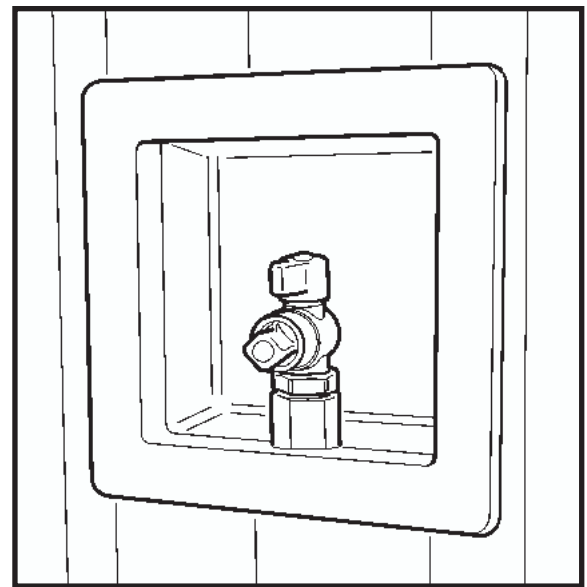


5. Thread 90 degree ball valve onto nut and tighten so valve outlet faces forward. It is recommended that crescent wrenches be used to avoid damaging valve or nut. Do not use thread sealants on this connection.



6. Slide box up and over the threads on the bottom of the nut and mount box to stud.

7. Secure valve assembly to box with lock-nut.



8. Install box cover after completion of dry-wall.

SECTION 4.6A — PAD MOUNTED EQUIPMENT, ROOF TOP EQUIPMENT

1. Gas appliances mounted on concrete pads or blocks, such as gas air conditioners heat pumps, pool heaters and NGV refueling stations, shall be connected to the *TracPipe* system at a termination fitting using either rigid pipe or an approved outdoor appliance connector. Direct connection of *TracPipe* to pad mounted equipment is permitted when the CSST is securely supported and located where it will be protected from physical damage. Follow local and state codes.

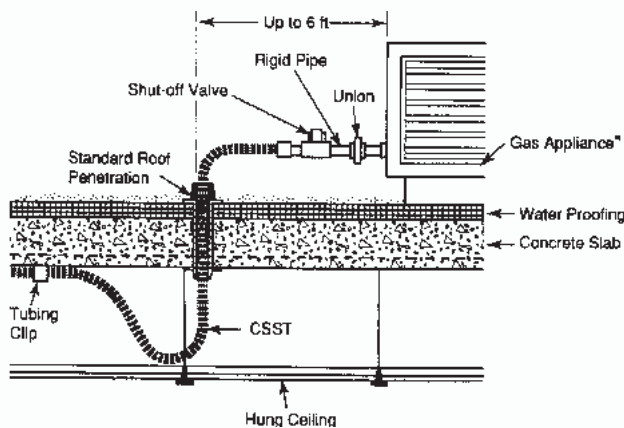


Figure 4-13 Short (1-6 foot) outdoor connection to roof mounted equipment

2. No special mechanical protection of the piping is required for connection to roof top equipment. Whenever possible, roof penetrations shall be located within 6 feet of the equipment to be connected as shown in figure 4-13. Long runs of tubing shall be supported with non-metallic blocks at the support interval listed in

Table 4-2, and raised above the roof a distance determined by local code/practice.

3. *TracPipe* may be supported with strut/channel running from block to block beneath the flexible gas pipe. Galvanized shallow channel (13/16") with splice plates at joints and bends provides a secure, damage resistant "track". With metallic strut support, blocks can be reduced to every 8 feet. The *TracPipe* should be firmly attached to each block with metallic clamps designed for the strut or appropriate fastening mechanism. (See Figure 4-15) Black cable ties (UV resistant) at intermediate points facilitate rolling out the *TracPipe*. The blocks are to be attached to the roof surface in accordance with the roofing manufacturer's instructions.

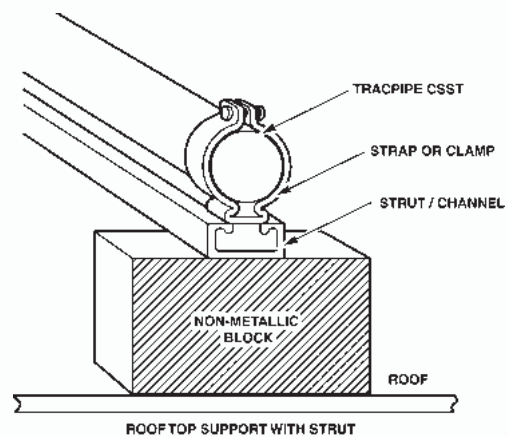


Figure 4-15

4. Piping run vertically up the side of the building shall be protected in accordance with the General Provisions section of the outdoor use guidelines (section 4.3B).

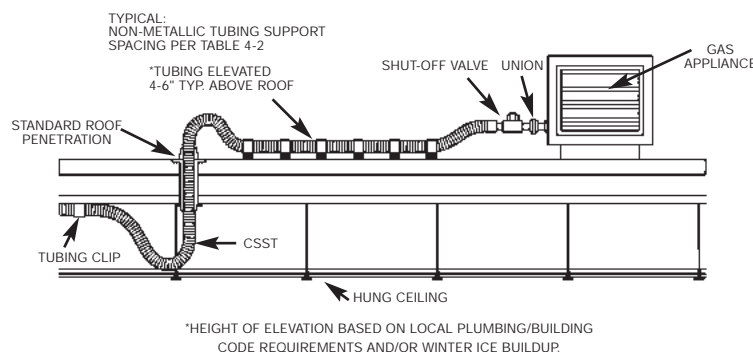


Figure 4-14

SECTION 4.6B — OUTDOOR APPLIANCES — BARBEQUE GRILL AND GAS LIGHT CONNECTIONS

1. Movable Grills shall be connected using an approved outdoor appliance connector which shall be attached to the flexible piping system at either a termination mount fitting, a transition to a steel nipple, or a quick-connect device such as the M. B. Sturgis Model 3/375 shown in figure 4-16. The quick-connect outlet shall be installed in accordance with manufacturer's instructions.
2. Permanently mounted grills located on decks shall be connected with the *TracPipe* system as shown in figure 4-17 and in accordance with this guide. The outdoor portion of the piping shall be supported against the side of any of the inside deck joists. If the elevation of the deck is below the top of the foundation, any exposed piping shall be protected using water-tight non-metallic conduit.

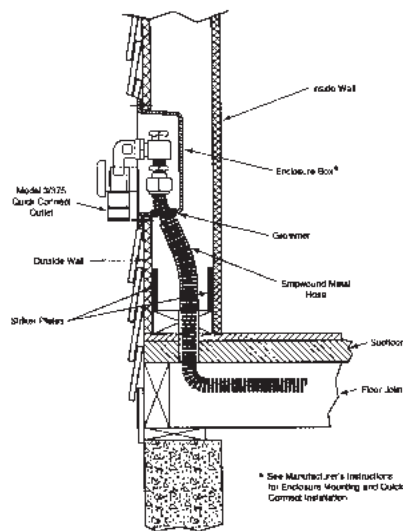


Figure 4-16

3. Permanently mounted lights located on decks shall be connected to the piping system the same as permanently mounted grills shown in figure 4-17 and in accordance with the manufacturer's instructions.

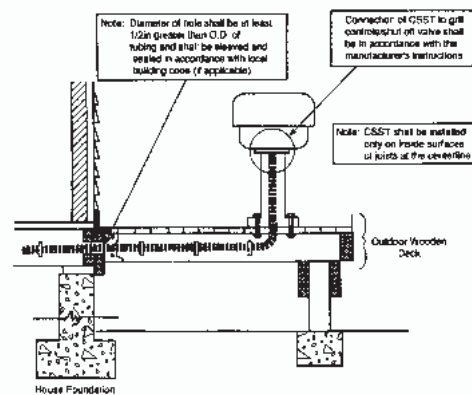


Figure 4-17

4. Yard mounted lights shall be connected to the *TracPipe* system as shown in figure 4-18. All piping installed below grade shall be protected by non-metallic, water-tight conduit or *TracPipe PS* or *TracPipe PS-II* for underground use. Exposed ends of the conduit shall be sealed against water entry.

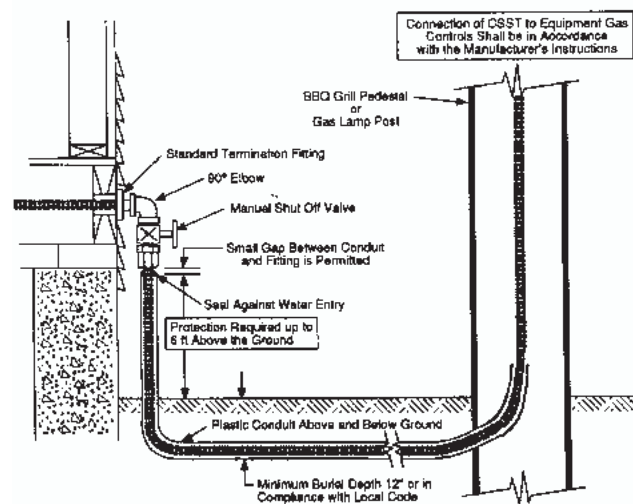


Figure 4-18

Section 4.6C — FIREPLACE INSTALLATIONS

1. *TracPipe* may be used to deliver gas directly to the valve for a gas fireplace. This is approved for decorative and heat generating fireplaces and for gas logs used in masonry and pre-fabricated fireplaces. DO NOT use *TracPipe* to connect gas log lighters or gas wands for use in all-fuel (woodburning) fireplaces.
2. Most gas fireplaces and gas logs (Refer to ANSI Z24.60) fall into the definition of fixed appliances which can be directly connected to *TracPipe* without the use of a flange mount fitting. The attachment is generally to the shut-off valve which may be located in the control area beneath the burner unit or at the side of the log set. *TracPipe* can be run into the lower control area for attachment without removal of the polyethylene jacket. In vented fireplaces, attachment to gas logs is best accomplished by removal of the jacket inside the fire box. This precludes direct flame contact with the polyethylene jacket. Stainless Steel melting temperatures (2000° F) are consistent with black iron.
3. For gas log lighter installations in all-fuel fireplaces, the *TracPipe* run MUST be terminated at the key valve or another location outside the fireplace. The final attachment should be made using black iron pipe.
4. When it is necessary to install *TracPipe* through sheet metal enclosures, such as those commonly used in decorative gas fireplaces, the manufacturer's recommendation is to leave the protective yellow polyethylene jacket in place through the sheet metal penetration. The *TracPipe* should be clipped to the building structure at a suitable location outside the fireplace to limit the amount of motion after installation. If additional protection is required, such as an installation with a source of vibration (fan, etc.) which may cause abrasion, then a short piece of floppy conduit or PVC pipe may be used between the jacket and the enclosure.
5. In masonry fireplace installations of decorative gas appliances (log sets) it is recommended to leave the polyethylene jacket in place throughout the masonry penetration providing a non-metallic sleeve for the flexible stainless steel. Caulking can then take place between the jacket and the penetration at interior and/or exterior locations. Remove the jacket inside the firebox. If additional protection is required, the *TracPipe* may be sleeved using PVC pipe in addition to the included jacket.
6. The FGP-FPT may be used in all applications where it is desirable not to penetrate the enclosure with tubing. (See figure 4-24)

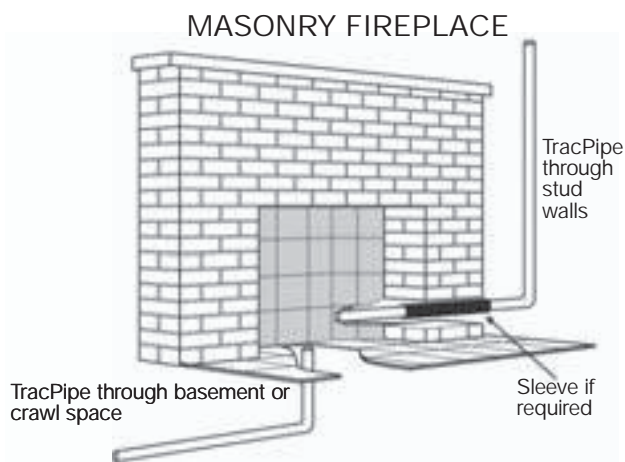


Figure 4-23

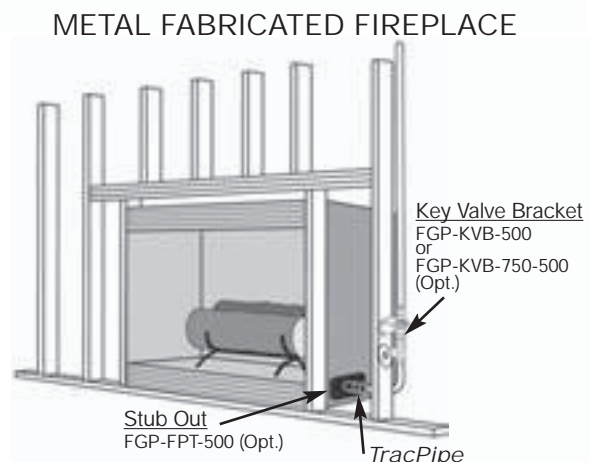
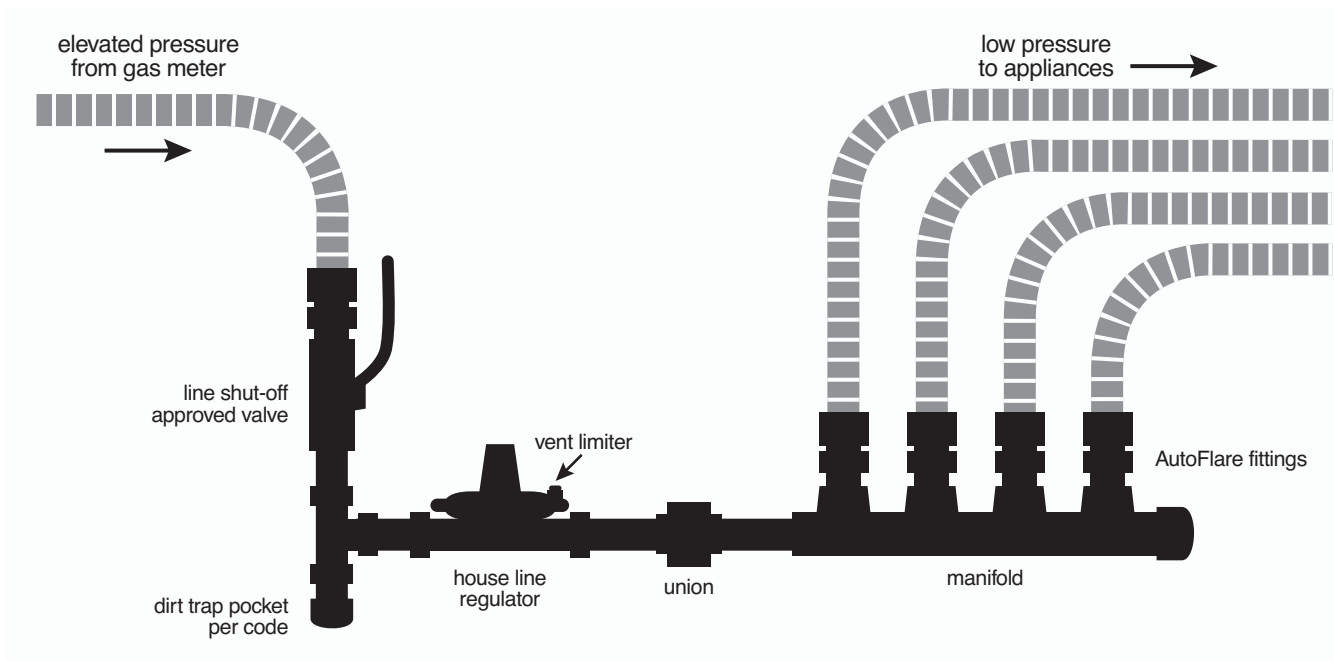


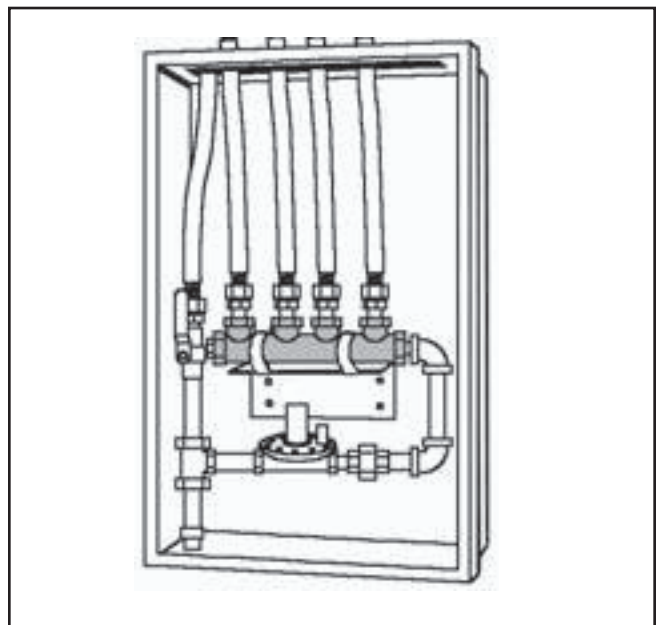
Figure 4-24



SECTION 4.7 — MANIFOLD & REGULATOR STATION

The use of a central manifold and regulator station is recommended for elevated pressure systems which are typically installed in a parallel arrangement to take advantage of the capacity of the regulator, which is sufficient for several appliances. Manifolds are available with the *TracPipe* system, or the use of black iron pipe and tee fabricated manifolds is permitted with this system. The manifold/regulator station should be located near by the largest gas consuming appliances, typically the furnace or boiler and the water heater in order to allow short runs to these units.

The manifold station **MUST** be located in an accessible location because of the shut-off valve(s) and regulator it contains. The manifold station may be contained in an enclosure box called a gas load center. Optional gas shut-off valves may be mounted on the manifold for each appliance run.



Gas Load Center

SECTION 4.8— REGULATORS AND ELEVATED PRESSURE SYSTEMS

A tubing system used at gas pressures exceeding 1/2 PSI but serving appliances rated for 1/2 PSI maximum, shall contain a pounds-to-inches regulator to limit the downstream pressure to no more than 1/2 PSI. The regulator must incorporate a lock-up feature limiting downstream pressure to 1/2 PSI under no flow conditions. The regulator shall comply with the applicable provisions of ANSI Z21.18 or CAN 1-6.3-M82.-ANSI Z21.80

Regulators used to reduce elevated system pressures for use by appliances must also conform to the following:

1. Must be sized to supply the required appliance load.(see chart below)

Capacities and Pressure Drop
Nat. Gas 0.64 Specific Gravity
Pressure Drop through Regulator

P/N	7" w.c.	1/2 psi	3/4 psi	1psi
FGP-REG-3	145	204	250	289
FGP-REG-5A	338	476	583	673
FGP-REG-7L	690	972	1191	1375

2. Must be equipped with an acceptable vent limiting device, supplied by the manufacturer, or be capable of being vented to the outdoors. The vent-limiting device can be used when the regulator is installed in a ventilated area. OMEGAFLEX ships all REG-3 & REG-5A regulators with vent-limiters installed. Vent-limiters are not available for REG-7 series regulators.

NOTE: For outdoor venting, the line must be at least the same size as the regulator vent connection, and cannot exceed a length of 30 feet. The vent shall be designed to prevent entry of water, insects or other foreign materials that could cause blockage of the line. DO NOT VENT TO APPLIANCE FLUE OR BUILDING EXHAUST SYSTEM. DO NOT VENT TO PILOT LIGHT.

3. MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.

WHEN A VENT-LIMITER IS USED THE REGULATOR MUST BE MOUNTED IN AN UPRIGHT POSITION. INSTALL THE REGULATOR PROPERLY WITH GAS FLOWING AS INDICATED BY THE ARROW ON THE CASTING.

4. Must be installed in a fully accessible area with an approved shut off valve ahead of regulator. An optional union will enable removal of the regulator if the location does not otherwise permit removal for servicing. The ability of the autoflare fitting to allow dissassembly and reattachment provides for regulator removal in most instances.
5. Line regulators do not vent gas under normal operating conditions. Any regulator found to be venting gas should be replaced immediately. Vent-limiters are required to limit venting in the event of a diaphragm failure, within the regulator, to limits identical to those imposed on a gas appliance control valve.
6. An area is considered to be ventilated if the combustion, ventilation or dilution air is obtained from the occupied areas of the building, or from outside, or from both, into the common areas of the appliance locations. Reference applicable codebook for details.
7. For outdoor installations remove the vent limiter and mount regulator with the vent outlet pointing down to prevent the entrance of water. A plastic cap FGP-CAP-3 is available for outdoor installations permitting regulator to be mounted in an upright position.

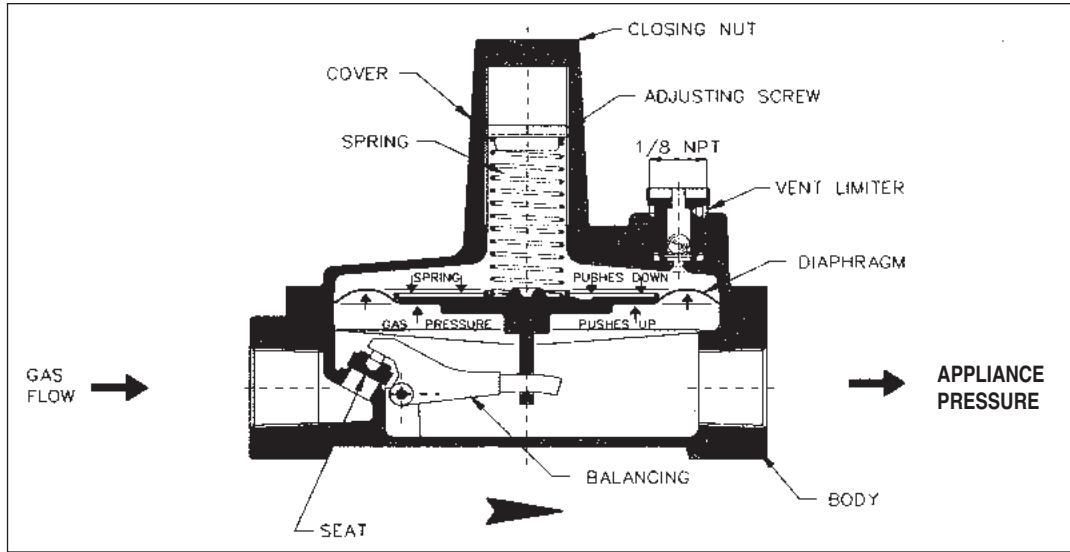
SECTION 4.8A REGULATOR ADJUSTMENTS

1. Regulators can be adjusted to deliver different outlet pressures within a limited range. The range is determined by the spring installed.
2. Adjustment can be accomplished by first removing the regulator seal cap to expose the adjusting screw. Turning the screw clock-

wise will increase outlet pressure, turning it counter-clockwise will decrease pressure.

- If spring adjustment will not produce desired outlet pressure, check to make sure supply pressure is at least equal to desired outlet pressure plus pressure drop of the regulator. If supply pressure is ade-

quate, consult factory if adjustment still can not be made. Do not continue to turn regulator adjusting screw clockwise if outlet pressure readings do not continue to increase. THIS MAY RESULT IN OVER-FIRING DUE TO LOSS OF PRESSURE CONTROL, SHOULD THERE BE A SUBSEQUENT INCREASE IN INLET PRESSURE.



SECTION 4.8B — REGULATOR CAPACITIES AND PRESSURE DROP FOR MULTIPLE APPLIANCES

Natural Gas 0.64 Specific Gravity

1. PRESSURE DROP ACROSS 2 PSI REGULATOR: expressed in CFH (m³/h) (0.64 Specific Gravity Gas)

Part Number	NPT SIZE	7.0" w.c. (17 mbar)	1/2 psi (34 mbar)	3/4 psi (52 mbar)	1 psi (69 mbar)
FGP-REG-3 FGP-REG-3P	1/2"	145 (4.0)	204 (5.8)	250 (7.0)	289 (8.2)
FGP-REG-5A FGP-REG-5P	3/4"	338 (9.6)	476 (13.5)	583 (16.5)	673 (19.1)
FGP-REG-7L	1-1/4"	690 (19.5)	972 (27.6)	1191 (33.8)	1375 (39.0)

Maximum Individual Load:
 FGP-REG-3 OR -3P OR -3X 140 CFH
 FGP-REG-5A OR -5P OR -5AX 300 CFH
 FGP-REG-7L 900 CFH

Recommended column for
 TracPipe installations
 Refer to table N-5 page 68

2. PRESSURE DROP ACROSS 5 PSI REGULATOR: expressed in CFH (m³/h) (0.64 Specific Gravity Gas)

Part Number	NPT SIZE	7.0" w.c. (17 mbar)	1/2 psi (34 mbar)	3/4 psi (52 mbar)
FGP-REG-3X	1/2"	145 (4.0)	204 (5.8)	250 (7.0)
FGP-REG-5AX	3/4"	338 (9.6)	476 (13.5)	583 (16.5)

Consult factory or regulator manufacturer for the capacities and pressure drop for a combination of 5 psi regulator and OPD.

Propane 1.53 Specific Gravity

3. PRESSURE DROP ACROSS 2 PSIG REGULATOR: expressed in CFH (m³/h) PROPANE (1.53 Specific Gravity Gas)

Part Number	NPT SIZE	7.0" w.c. (17 mbar)	1/2 psi (34 mbar)	3/4 psi (52 mbar)	1 psi (69 mbar)
FGP-REG-3P	1/2"	94 (2.6) (237 MBTUH)	132 (3.8) (333 MBTUH)	161 (4.5) (406 MBTUH)	186 (5.3) (469 MBTUH)
FGP-REG-5P	3/4"	218 (6.2) (549 MBTUH)	307 (8.7) (774 MBTUH)	376 (10.7) (948 MBTUH)	434 (12.4) (1094 MBTUH)
FGP-REG-7L	1-1/4"	445 (12.6) (1121 MBTUH)	627 (17.9) (1580 MBTUH)	768 (21.9) (1935 MBTUH)	887 (24.2) (2235 MBTUH)

Maximum Individual Load:
 FGP-REG-3P OR -3X 90 CFH
 FGP-REG-5P OR -5X 194 CFH
 FGP-REG-7L 581 CFH

Recommended column for
TracPipe installations
 Refer to table P-3 page 70

4. PRESSURE DROP ACROSS 5 PSIG REGULATOR: expressed in CFH (m³/h) PROPANE (1.53 Specific Gravity Gas)

Part Number	NPT SIZE	7.0" w.c. (17 mbar)	1/2 psi (34 mbar)	3/4 psi (52 mbar)
FGP-REG-3X	1/2"	94 (2.6) (237 MBTUH)	132 (3.8) (333 MBTUH)	161 (4.5) (406 MBTUH)
FGP-REG-5AX	3/4"	218 (6.2) (549 MBTUH)	307 (8.7) (774 MBTUH)	376 (10.7) (948 MBTUH)

CAUTION: RECENT CODE CHANGES REQUIRE the use of 5 PSI LABELED REGULATORS IN 5 PSI SYSTEMS. REGULATORS LABELED 2 PSI ARE NOT APPROVED FOR 5 PSI USE.

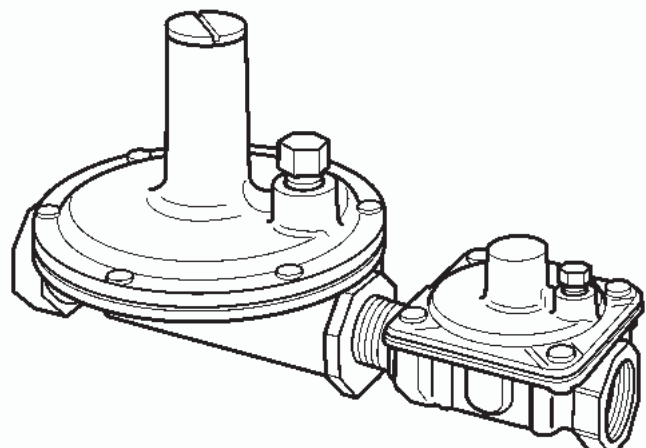
NOTE: At supply pressures in excess of 2 PSI, the new ANSI Z21.80 Line Regulator Standard requires a means (an Over-Pressure protection Device / OPD) - approved and tested with 5-PSI or 2-5 PSI Labeled regulator - to limit the downstream pressure to 2-PSI maximum, in the event of regulator failure. CONSULT THE FACTORY OR THE REGULATOR MANUFACTURER FOR THE CAPACITIES & PRESSURE DROP FOR A COMBINATION OF 5-PSI REGULATOR & OPD.

SECTION 4.8C — OVER-PRESSURE PROTECTION

At supply pressures in excess of 2-psi the ANSI Z21.80 line regulator standard requires a means - an over-pressure protection device (OPD)-approved and tested with the regulator- to limit the downstream pressure to 2-psi maximum, in the event of regulator failure.

To comply with the ANSI Standard and with all codes adopted in the US and Canada, all installations exceeding 2-psi (primarily 5-psi systems, but including all other elevated pressure installations higher than 2-psi nominal) require a tested and approved overpressure protection device for use with the pounds-to-inches regulator. This requirement applies to line regulators but not to appliance regulators.

Regulators for 5 PSI Systems must be shipped as an assembled unit from our factory, regulator with OPD attached. Consult the current *TracPipe* Price List for information regarding part numbers and capacity.



regulator with OPD attached

SECTION 4.9 — UNDERGROUND INSTALLATIONS

1. CODE REQUIREMENTS

When gas piping runs are located below grade in contact with earth or other material that could corrode the piping, codes require that the gas piping shall be protected against corrosion.

When piping is installed underground beneath buildings, codes require that the piping shall be encased in a conduit sealed inside of the building and vented above grade to the outside. The conduit shall be designed to withstand the superimposed loads. **NO FITTINGS OR COUPLINGS ARE PERMITTED BENEATH BUILDINGS.**

2. REGIONAL/MODEL CODES

TracPipe PS (patented) and *PS-II (patent-pending)* installations conform to the underground fuel gas installation requirements of:

The National Fuel Gas Code NFPA 54

The International Fuel Gas Code

The Uniform Plumbing Code 2003 UPC®

SECTION 4.9A — GUIDELINES FOR UNDERGROUND INSTALLATIONS

1. Lay *TracPipe PS/PS-II* in a trench. Install the gas piping on a continuous solid surface per code to the appropriate burial depth as defined in Table 4-6.

WARNING: *TracPipe PS and PS-II Systems must only be installed by a qualified person who has been trained through the TracPipe Gas Piping Installation Program. All installations must comply with local code requirements and the instructions contained in the TracPipe Design and Installation Guide.*

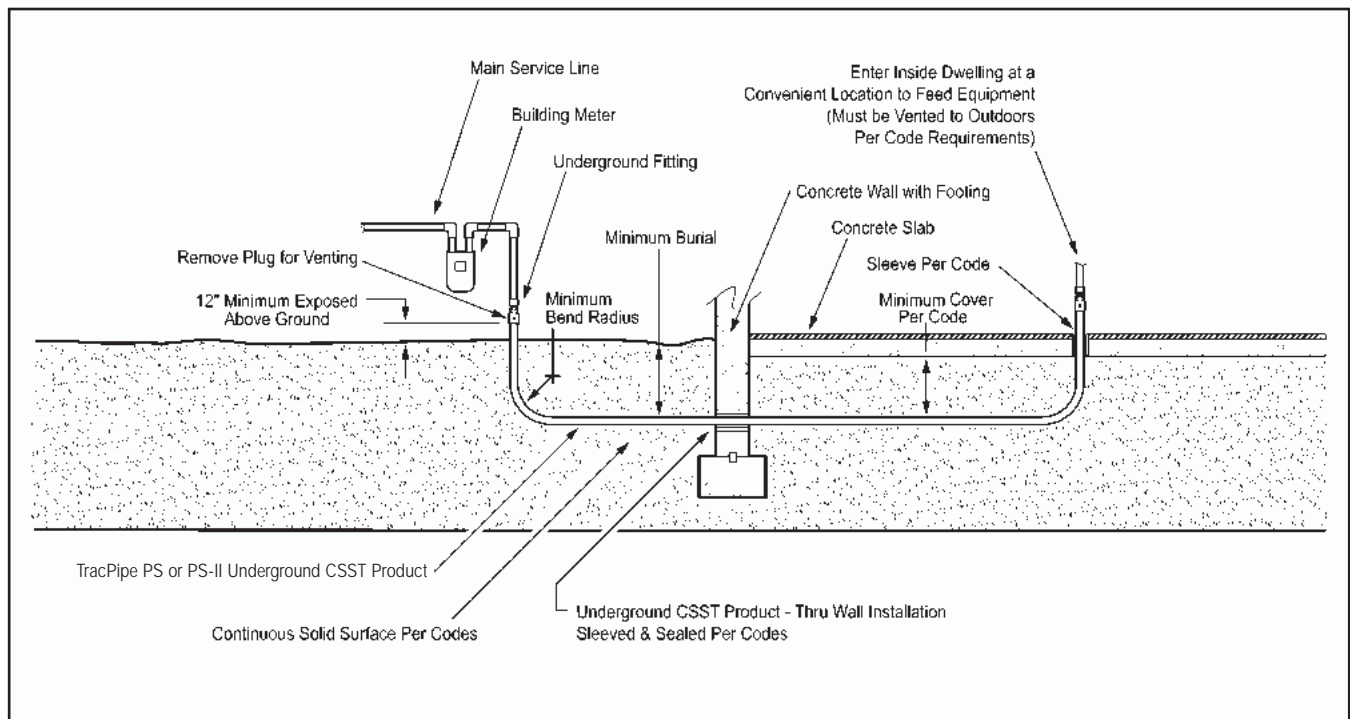


Figure 4-19

- When transitioning *TracPipe PS/PS-II* from below grade or under slab to above grade, use the recommended minimum bend radius as shown in Figure 1 and depicted in Table 4.7 below.

TABLE 4.7

RECOMMENDED MINIMUM BENDING RADIUS FOR <i>TracPipe PS/PS-II</i>		
Tubing Size	Minimum Bend Radius R	
	PS	PS-II
3/8 inch	18 inches	6 inches
1/2 inch	18 inches	6 inches
3/4 inch	24 inches	8 inches
1 inch	30 inches	10 inches
1-1/4 inch	36 inches	12 inches
1-1/2 inch	48 inches	16 inches
2 inch	54 inches	18 inches

Note: For *TracPipe PS* Installations requiring a tighter bend radius than shown above, Flexible Poly Tubing is available. See Flexible Poly Tubing Instructions later in this document.

- Recommended exposed clearance height (height to the *TracPipe* fitting above grade) is 24 inches minimum when terminating at this point. For vertical runs up the outside of a building in traffic areas, protect the *TracPipe* as explained in Section 4.3B.
- Avoid bending the above grade vertical

portion of the *TracPipe PS/PS-II* piping beyond the Minimum Bend radius in Table 2. To make a tighter bend in order to line up for a wall penetration, use a rigid fitting such as a malleable iron 90.

- TracPipe PS/PS-II* is suitable for above ground installations and is resistant to U.V. exposure. Portions rising above grade should be rigidly supported by direct attachment to a wall or independent support, (e.g. metallic strut) or by connection to rigid downstream piping or fittings (e.g. at a meter or Propane second stage regulator)
- When installing *TracPipe PS-II* through a foundation wall the space between the gas piping and the building shall be sealed to prevent entry of gas or water.
- TracPipe PS-II* can penetrate directly through a concrete slab unless other requirements are established by local codes concerning slab penetrations and firestop requirements.
- TracPipe PS-II* can be transitioned to standard *TracPipe* piping above grade using *TracPipe AutoFlare*® fittings with a *TracPipe PS-II* Coupling P/N FGP-UGC-SIZE. Remove the black plastic vent coupling on the standard *TracPipe* side.

TABLE 4.6

Minimum cover requirements for TRACPIPE PS/PS-II, Burial in inches (cover is defined as the shortest distance measured between a point on top surface of the outer sleeve and the top surface of finished grade, concrete or similar cover)	
Location of buried <i>TracPipe PS/PS-II</i>	Minimum cover for direct burial without concrete encasement
All locations not specified below	18 inches
In trench below 2-in thick concrete or equivalent	12 inches
Under a building with interior slab	4 inches
Under minimum of 4-in. thick concrete exterior slab with no vehicular traffic and the slab extending not less than 6-in beyond the underground installation	4 inches
Under streets, highways, roads, alleys, driveways, and parking lots	24 inches
One and two family dwelling driveways and parking lots and used only for dwelling-related purposes	18 inches
In or under airport runways, including adjacent areas where trespassing prohibited	18 inches

Note: When encased in concrete, the concrete envelope shall not be less than 2 inches thick.

Alternatively use a malleable iron coupling for the transition.

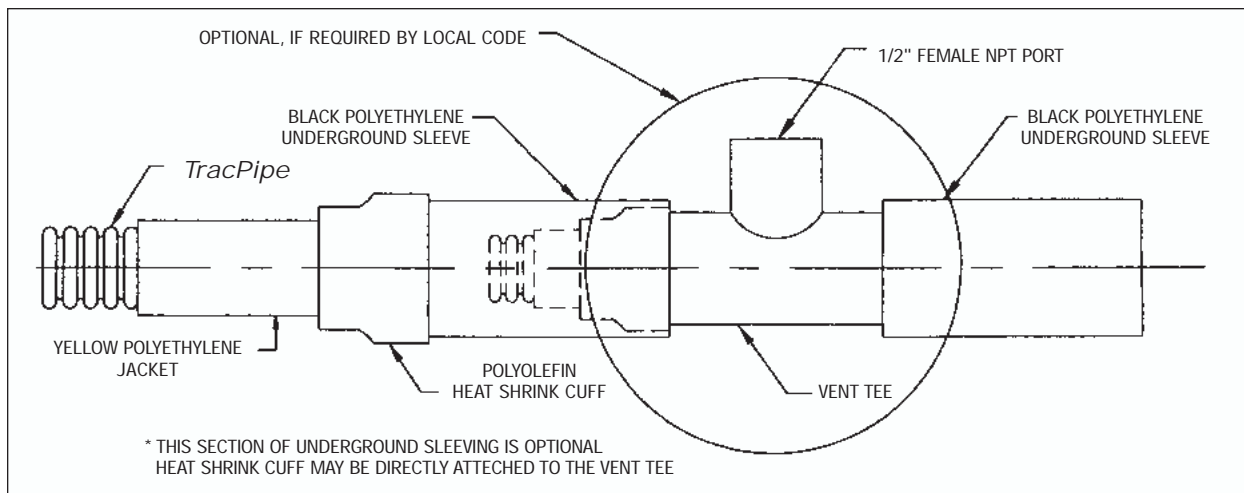
9. *TracPipe PS-II* must be transitioned above ground to standard *TracPipe* when routing through plenums or through penetration firestop installations. The black sleeve is not qualified for these locations.
10. Venting of *TracPipe PS/PS-II* shall be designed per local codes to prevent the entrance of water, insects or foreign materials.
11. Typical underground installations for Corrugated Stainless Steel tubing include, but are not limited to:
 - Pool and Spa Heaters
 - School Science Laboratories
 - Gas service to Outbuildings
 - Gas Lampposts and Grills

SECTION 4.9B — *TracPipe PS* FITTING ATTACHMENT INSTRUCTIONS

1. *TracPipe PS* uses standard *AutoFlare* fittings. To assemble fittings follow instructions found in the *TracPipe* Design Guide and Installation Instructions Section 4.2.
2. To install *TracPipe PS* for underground service, cut the black polyethylene sleeve in the same manner you would cut the 1-1/4" thru 2" size *TracPipe* product, with a standard tubing cutter Ridgid™ 152 or equal,

and a cutting wheel Ridgid™ catalog no. 33195 (Poly Wheel) (P/N E:5272). Note: For the 1-1/4" thru 2" size black polyethylene sleeving, the larger tubing cutter Ridgid™ no. 152 must be used due to the diameter of the sleeving. CAUTION: Do NOT use a hacksaw or other sawing device to cut the black polyethylene sleeving as it may damage the inner *TracPipe* gas piping.

3. Cut the *TracPipe* gas piping using the same tubing cutter per standard instructions in the Design and Installation Guide.
4. Slip the required heat shrink polyolefin cuff over the *TracPipe* gas piping to each end of the black polyethylene sleeving and heat shrink the polyolefin cuff to the gas piping and the black polyethylene using a heat gun or other suitable heat source. NOTE: Omegaflex®, Inc. recommends the use of a heat gun. Extreme care should be taken when applying heat to the polyolefin cuff as not to damage the *TracPipe* gas piping yellow jacket.
5. Where local codes require venting, slide plastic tee (P/N: FGP-VT-SIZE) over end of *TracPipe* and insert into end of the black polyethylene sleeve on the end of the run which is nearest to the outside wall of the building. Heat shrink the polyolefin tubing to the vent tee and to the *TracPipe* gas pipe.



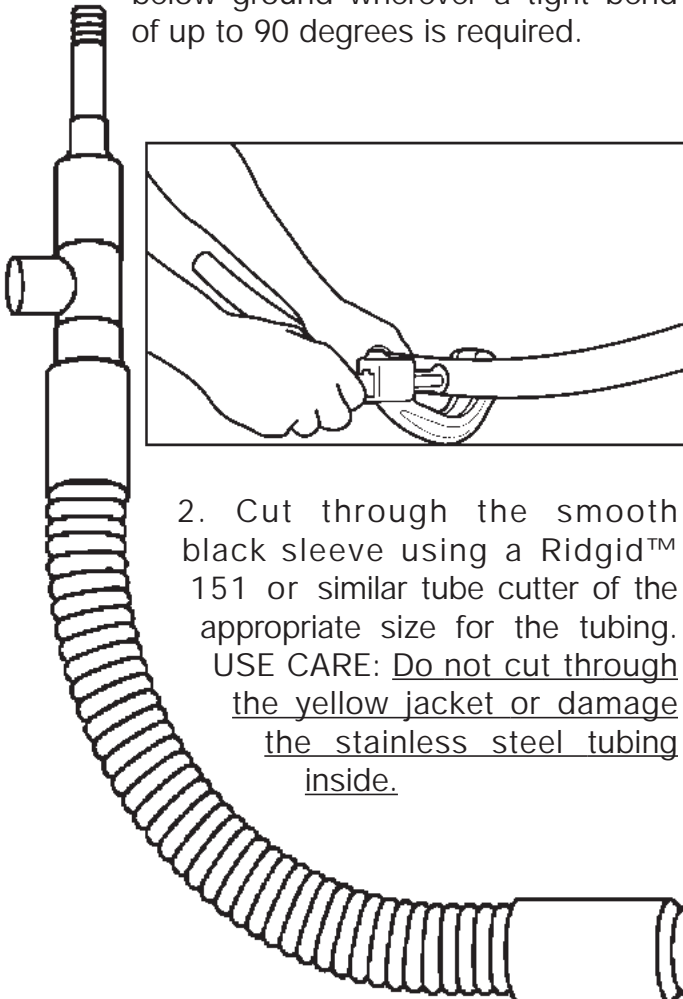
TracPipe PS with Vent Tee Installed
Figure 4-20

SECTION 4.9C — UNDERGROUND PS WITH FLEXIBLE POLY TUBING

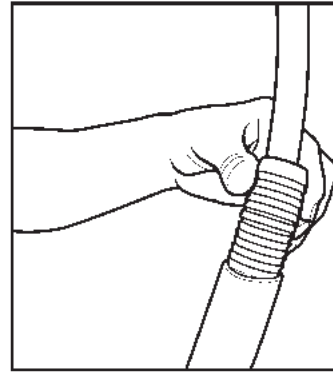
Product Description: Flexible, corrugated polyethylene tubing in sizes to fit *TracPipe PS* (patented) underground gas piping. Poly tubing is easy to bend, providing flexibility at the ends of a length of *TracPipe PS* to facilitate transition to above ground. Use with available heat shrink cuffs and couplings to provide a completely sleeved underground gas piping system that can be easily vented when required by codes.

Installation Instructions

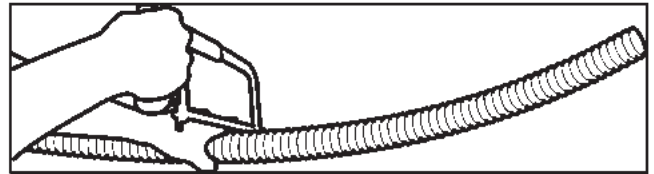
1. Determine the location where the smooth black sleeve will make the transition to flexible poly tubing. This is typically the transition point from below ground to above ground but can also occur above or below ground wherever a tight bend of up to 90 degrees is required.



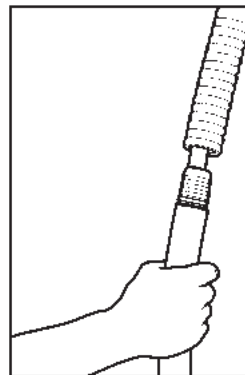
2. Cut through the smooth black sleeve using a Ridgid™ 151 or similar tube cutter of the appropriate size for the tubing. USE CARE: Do not cut through the yellow jacket or damage the stainless steel tubing inside.



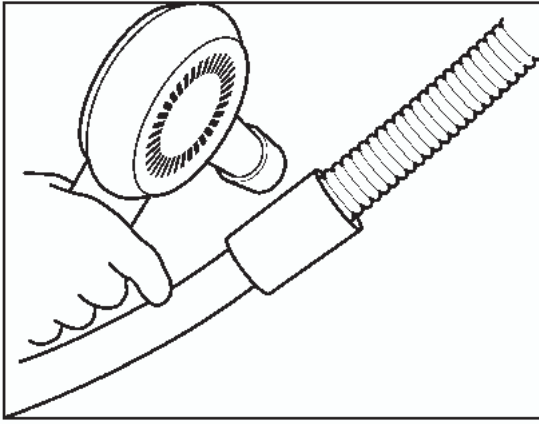
3. Insert a barbed coupling by sliding it over the exposed length of TracPipe and pushing firmly into the smooth black sleeve until all barbs are covered up to the coupling's center.



4. Cut flexible poly tube with a hack saw to approximately 1-1/2 times the trench depth. This will leave about one foot exposed above ground after backfill.



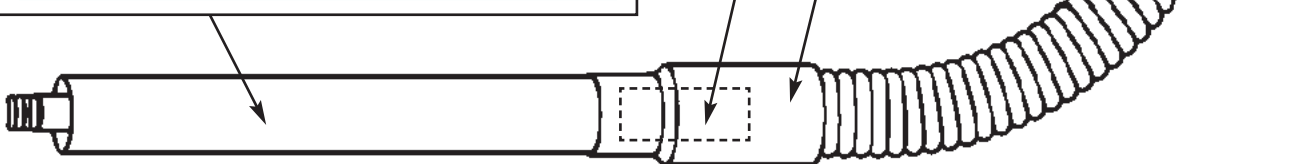
5. Slide cut section of flexible poly tube over the remaining barbs on the coupling.



6. Position a section of heat shrink cuff material to cover the coupled smooth sleeve and corrugated sleeve. This cuff should be centered over the plastic barbed coupling and cover roughly two (2) inches of each black sleeve. NOTE: This cuff is internally treated with a thermal adhesive and cannot be removed without damage after the heat shrink operation.
7. Carefully shrink the cuff using a heat gun. As cuff is heated it will conform to the diameters of the sleeves and the thermal adhesive will set to lock the combined materials.
8. Above Ground, follow the preceding steps to install a plastic barbed tee for vented systems, or shrink a cuff directly onto the exposed *TracPipe* for non-vented installations. (Most codes require underground sleeving to be vented for under building slab installations such as island ranges).

TracPipe PS

Please read and follow all instructions and precautions in this document and *TracPipe* Design and Installation Guide (latest version) relative to installing the pre-sleeved version of OMEGAFLEX® *TracPipe*. The instructions contained on this sheet apply to the flexible poly tubing available as an optional accessory to facilitate tight bends.

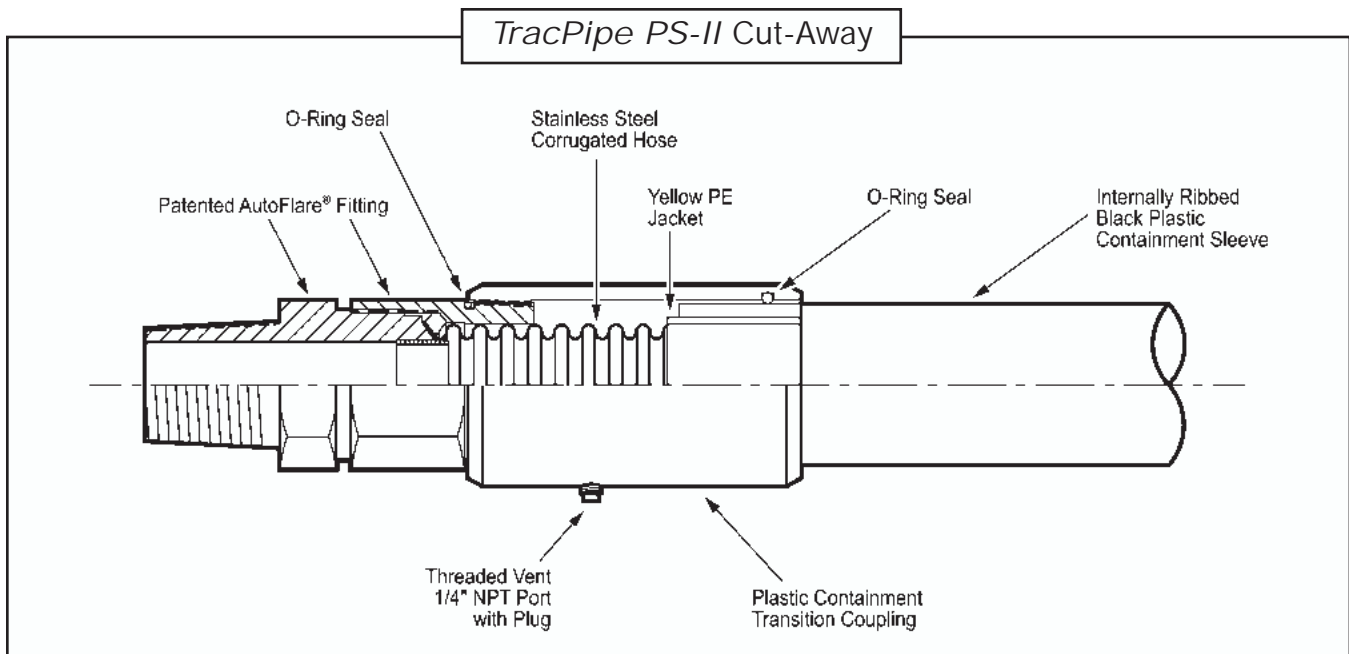


Sizing Chart for Flexible Poly Tubing

Part #	Description	Used In Con-junction With
FGP-UGFX-1.25	1-1/4" Flexible Poly Tubing	3/8" & 1/2" TracPipePS
FGP-UGFX-1.50	1 1/2" Flexible Poly Tubing	3/4" & 1" TracPipePS
FGP-UGFX-2.00	2" Flexible Poly Tubing	1 1/4" TracPipePS
FGP-UGFX-3.00	3" Flexible Poly Tubing	1-1/2" & 2" TracPipePS

All sizes available in maximum 100 foot coils

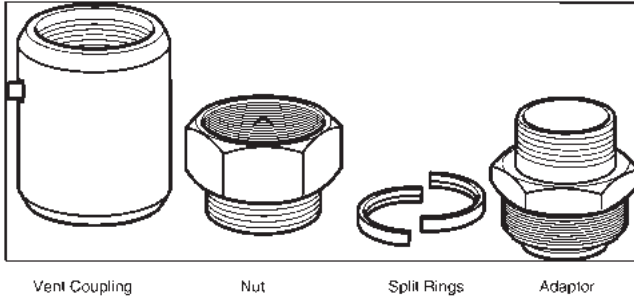
Typical Underground Installation using Flexible Poly Tubing



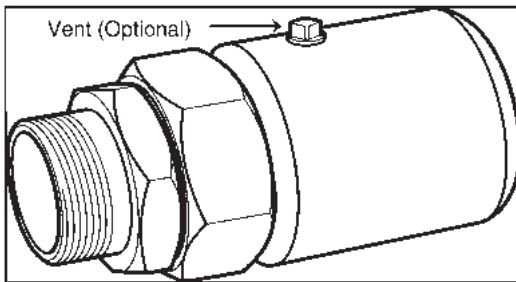
SECTION 4.9D — TRACPIPE PS-II

1. *TracPipe PS-II* uses plastic containment transition fittings specifically designed to provide vent capability at either end of a piping run where required by code.
2. *TracPipe PS-II* is supplied in standard lengths on reels or custom cut lengths. Standard reel lengths are 250 and 150 feet.
3. *TracPipe PS-II* lengths can be spliced together by using available couplings. All metallic portions of the fittings underground shall be mastic-wrapped to conform to local codes for underground piping. Be certain prior to back-filling that no metallic portions of the piping system will be exposed to earth. No fittings or couplings are permitted under building slabs.
4. **NOTE:** When pressure testing *TracPipe PS-II*, it is necessary to remove at least one fitting vent plug to insure proper test results on the stainless steel tubing.

SECTION 4.9E — TRACPIPE PS-II FITTING ATTACHMENT



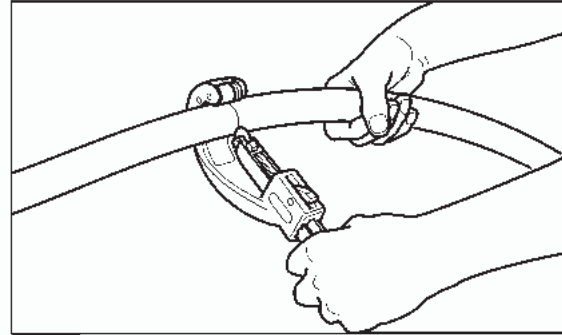
1. *TracPipe PS-II* is constructed from Omegaflex standard TracPipe Stainless Steel Flexible Gas Pipe sleeved in a fully vent-capable polyethylene sleeve.



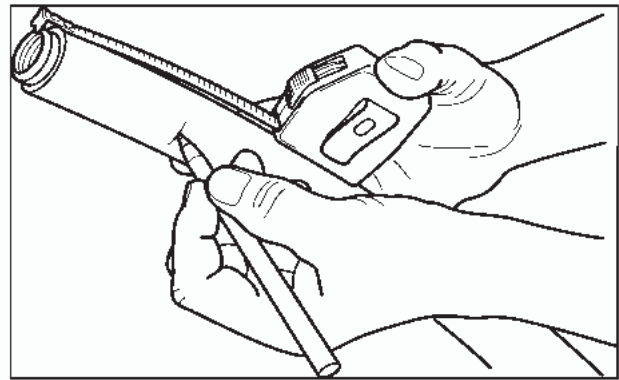
2. *TracPipe PS-II* fittings are constructed from TracPipe patented AutoFlare fittings with a plastic containment coupling and 1/4" NPT vent port. Fittings assemble without special tools.
3. **NOTE:** When pressure testing *TracPipe PS-II*, it is necessary to remove at least one fitting vent plug to insure proper test results on the stainless steel tubing.

Tools Required for Assembly

- * Utility knife with sharp blade
- * Appropriate size Adjustable or Monkey Wrenches
- * Tubing Cutter:
 - For up to 3/4" -#151 Ridgid® Tubing Cutter (FGP-TC-151) w/TracPipe Cutting Wheel (FGP-E-5272)
 - For 1" and up -#152 Ridgid® Tubing Cutter (FGP-TC-152) w/TracPipe Cutting Wheel (FGP-E-5272)
- * Reciprocating Saw or Hacksaw



1. Unreel pipe into trench or on the ground and cut to desired length-plus one foot. Cutting up to 1" size can be done with a large tubing cutter. For 1-1/4" - 2" sizes, a reciprocating saw is recommended.

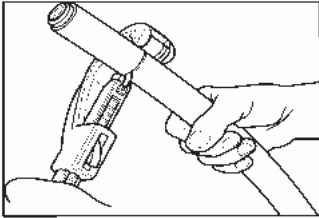


2. Mark the sleeve at specified length on the Strip Length Chart (below) - plus 2".

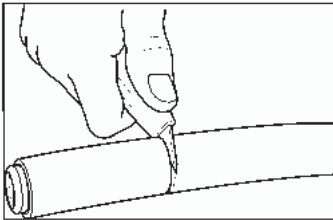
Table 4-8
Jacket Strip Length / Fitting Torque / Superimposed Loading Chart

Size	3/8	1/2	3/4	1	1-1/4	1-1/2	2
Jacket Strip Length	1-1/2"	1-1/2"	1-3/4"	2"	2-1/4"	2-1/2"	2-3/4"
Fitting Torque Value	40 ft-lb	42 ft-lb	45 ft-lb	75 ft-lb	150 ft-lb	200 ft-lb	250 ft-lb
Max. Superimposed Loading <i>psf</i>	9640	7254	5409	4203	3390	2901	2124

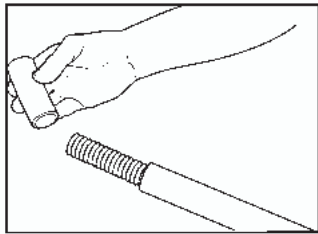
Notes: 1. Super-imposed loading includes all dead load and live load combinations.
2. Maximum buried depth of 36"; 3. Soil Density : 120 pcf; 4. Factor of safety used: 4.



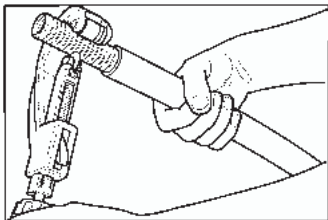
- Using the appropriate tubing cutter with TracPipe #FGP-E-5272 cutting wheel, score the black sleeve approximately half of the way through. Use extreme care not to cut or score the stainless corrugated pipe! Typically, no more than two turns in on the cutter is sufficient.



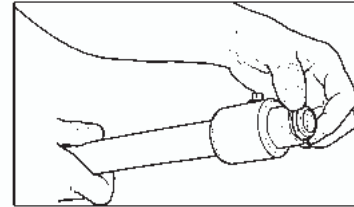
- Finish cutting through the sleeve down to the stainless corrugated pipe using a sharp utility knife.



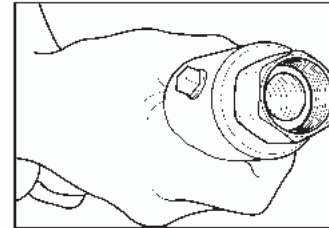
- Using a twisting motion, remove the black sleeve and yellow jacket from the pipe. It may be necessary to cut sleeve longitudinally and peel off for larger sizes. Inspect stainless pipe for scoring from the tubing cutter.



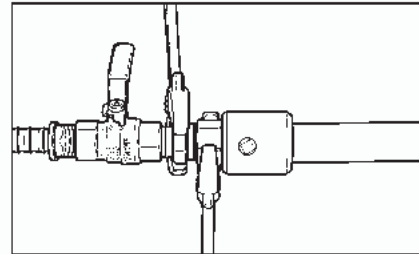
- Using the tubing cutter, trim corrugated pipe to strip length specified on chart. Cut slowly in the root of the corrugation in the same manner you would cut copper tubing. Inspect end of pipe for a clean cut without tears in corrugation.



- Remove adapter and split rings from fitting. Attach adapter to equipment. Slip coupling and nut over end of pipe all the way to expose first corrugations of pipe. Insert split rings into first corrugation as shown.



- Holding the black coupling, slide fitting up to capture split rings into nut. Be sure split rings slip all the way to the base of the internal threads. Assembly is now ready to be attached to the adapter on the equipment.



- Thread nut onto adapter previously installed on the equipment. Using appropriate wrenches, hold adapter and tighten nut to proper torque specified. Do not over tighten or use any pipe dope or thread sealants on this connection. This is a metal-to-metal seat and will not seal if pipe dope or thread sealants are used. Sealants are to be used on the NPT connection to the equipment only!

NOTE: When installing coupling FGP-UGC-SIZE the same instructions apply, except metallic parts of the fitting must be wrapped in a code approved manner (e.g. mastic used for wrapping metallic pipe).

SECTION 4.10 — ELECTRICAL BONDING/GROUNDING

1. The piping system is not to be used as a grounding conductor or electrode for an electrical system. In accordance with The National Fuel Gas Code NFPA 54/ANSI Z223, "each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be electrically continuous and bonded to any grounding electrode, as defined by the *National Electrical Code*, ANSI/NFPA 70 1999 Edition."
2. For bonding of the *TracPipe* system, a bonding clamp must be attached to the brass AutoFlare fitting adapter (adjacent to the pipe thread area — see Figure 4-21) or to a black pipe component connected to an AutoFlare fitting. The corrugated stainless steel portion of the gas piping system SHALL NOT be used as the bonding attachment point under any circumstances. Bonding electrode conductor sizing shall be in accordance with Article 250 (Table 250-66) of ANSI/NFPA 70 1999 Edition. The bonding is a requirement of the National Electrical Code.

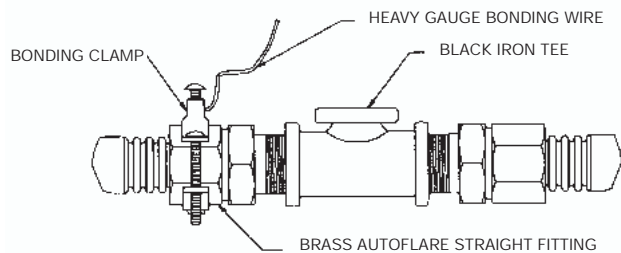


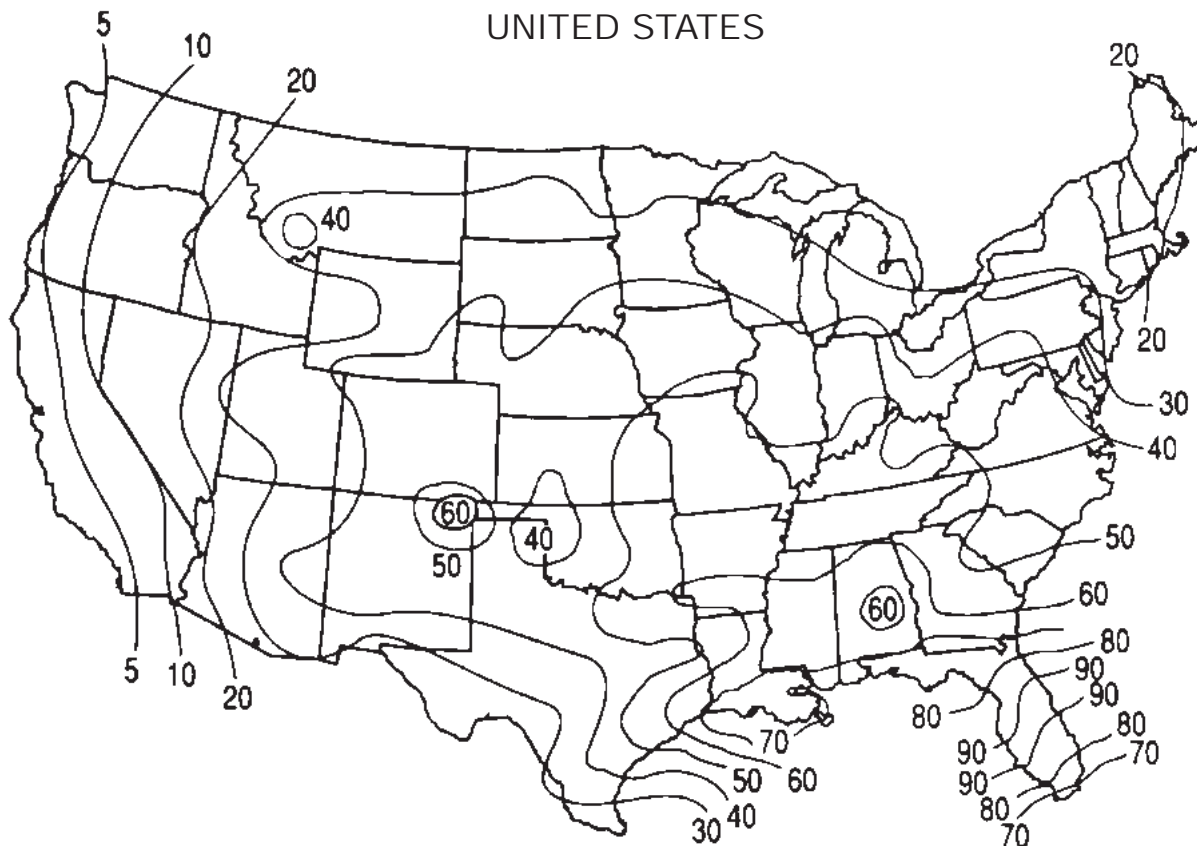
Figure 4-21

BRASS BONDING CLAMPS

<i>TracPipe</i> AutoFlare FITTING SIZE RANGE	BONDING CLAMP SIZE	PART NO. OR EQUAL (Bridge Port)
3/8" & 1/2" & 3/4"	1/2" & 3/4"	1309-B
1"	1-1/4"	1313-B
1-1/4"	2"	1314-B
1-1/2"	2-1/2"	1314-B
2"	3"	1315-B

3. Definitions:

- a. Grounding: The process of making an electrical connection to the general mass of the earth. This is most often accomplished with ground rods, ground mats or some other grounding system. Low resistance grounding is critical to the operation of lightning protection techniques.
 - b. Bonding: The process of making an electrical connection between the grounding electrode and any equipment, appliance, or metal conductor: pipes, plumbing, flues, etc. Equipment bonding serves to protect people and equipment in the event of an electrical fault.
 - c. Equipotential Bonding: The process of making an electrical connection between the grounding electrode and any metal conductor: pipes, plumbing, flues, etc., which may be exposed to a lightning strike and can be a conductive path for lightning energy towards or away from the grounding electrode.
4. Lightning strike density varies considerably around the United States. The highest density is experienced in the Gulf Coast and Florida. The lowest lightning strike density is the Pacific Coast states. See map of the United States (Figure 4.22) for the average number of thunderstorm days per year for a specific region or state.



Average Number of Thunderstorm Days per Year

Figure 4-22

Section 4.10A — CounterStrike® Installation Instructions

1. Equipotential Bonding of the gas piping system is recommended using shortest distance possible.
2. An equipotential bonding/grounding connection shall be made between the fuel gas piping system and the electrical service grounding electrode. The bonding jumper should be sized in accordance with NEC Table 250.66 (based on the main service conductor size), or in accordance with NFPA 780 Paragraphs 4.14.1.2 thru 4.14.1.4 (main-size lightning conductors) Tables 4.1.1.1(A) and (B): Class I and Class II wire size. Bonding and grounding connections are to be made by a qualified technician.

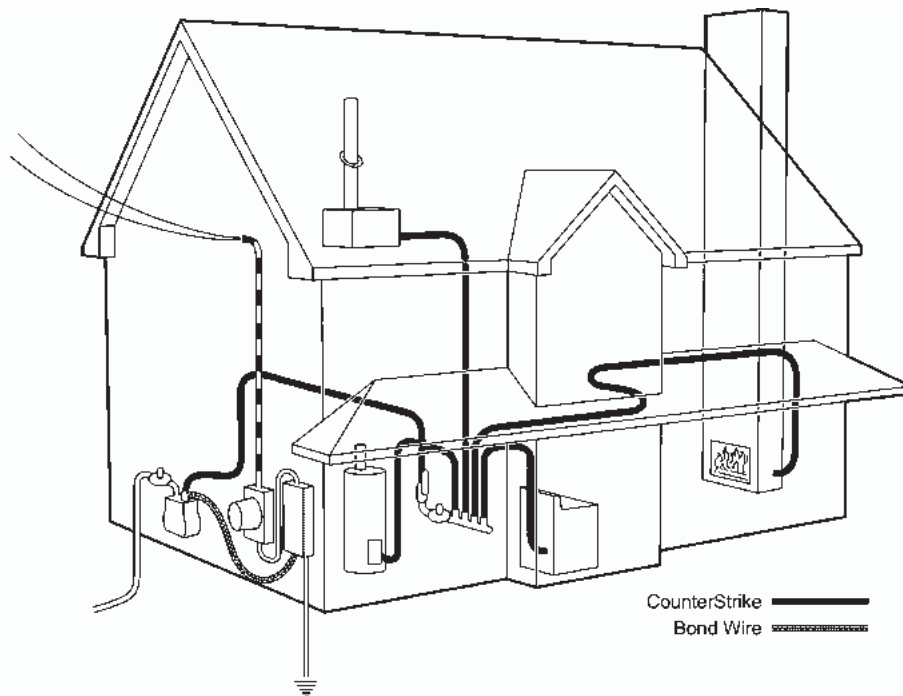
If the building to be piped is in a high lightning flash density area or a region with a high number of thunderstorm days per year, consideration should be given to uti-

lizing the Lightning Risk Assessment method given in Annex L of NFPA 780 for a determination of the need for a lightning protection system.

Notes:

- a. If possible, avoid running the bonding jumper a long distance through the building. The connection should be as short as possible. Gas meter should be near the electrical service if possible. If not, the bond can be connected at any point in the system per (Figure 4-21).
- b. Lightning induced voltages seeking ground are subject to impedance; utilize a braided or stranded bonding jumper for greater surface area, rather than solid wire.
- c. Upon completion of the *TracPipe* CounterStrike Gas Piping System installation and prior to gas service initiation, check to see if the bonding has been completed.

3. Routing of gas piping should be as low in the structure as reasonably possible for best performance.
4. *TracPipe* CSST runs, including CounterStrike, should be installed with a bend radius of 8 inches or more whenever possible; this will reduce the possibility that energy will jump from the piping to other conductive surfaces.
5. For CounterStrike with BLACK outer jacket installations, the installer shall meet local building codes with respect to flame spread and smoke density regulations for non-metallic materials. If run through return air plenums, black jacket shall be removed.
6. For through penetration fire stop systems per UL classification requirements, remove the BLACK outer jacket when passing through a fire stop.
7. The instructions for cutting the tubing and for making fitting connections to CounterStrike are identical to those for the standard yellow-jacketed *TracPipe*.
8. The use of *TracPipe PS-II* should be considered for use as the trunk line under the building slab from the meter set to the manifold station. This practice routes the elevated pressure portion of a 2 PSI system completely away from any potential contact with other building metallic systems which can become energized in the event of a nearby lightning strike.
9. Optional: Install GasBreaker excess flow devices at the meter and appliance locations. See *TracPipe* design and Installation Guide Section 3.3. (Mandatory where required by code.)



Note: Illustration may not represent actual installation and is for reference only.



CHAPTER 5

INSPECTION, REPAIR AND REPLACEMENT

SECTION 5.1 — MINIMUM INSPECTION REQUIREMENTS

TracPipe[®] Inspection Checklist Corrugated Stainless Steel Tubing CSST

All installations shall be inspected by the jurisdiction having authority in accordance with state and local mechanical/plumbing codes and the National Fuel Gas Code NFPA 54 (ANSI Z 223.1).

- Installer Qualified per state and/or local requirements.
- Installer has *TracPipe* Training Certification card.
- Inspection and pressure test completed at rough in.
- Strike protection in place where required.

TracPipe Flexible Gas Piping
OMEGAFLEX[®] INC.
451 Creamery Way, Exton, PA 19341-2509
1-800-671-8622, (610) 524-7272, Fax: (610) 524-7282

SECTION 5.2 — REPAIR OF DAMAGED PIPING

If the tubing is damaged, refer to the following sections to determine the severity of damage and, if necessary, the method of repair.

1. No repairs or replacement of the tubing is necessary if the tubing is only slightly dented due to impact or crushing as indicated in Figure 5-1.
2. The tubing must be replaced under the following circumstances:
 - a. The tubing has been significantly crushed or dented (Figure 5-2)
 - b. The tubing has been damaged by puncture of any kind, i.e., nails, screws, drill bits, etc.
 - c. The tubing has been bent beyond its minimum bend radius so that a crease or kink remains. (Figure 5-3)

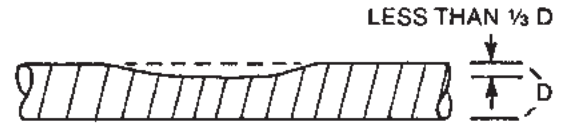


Figure 5-1 – Repair Unnecessary. No Significant Damage to the Tubing Due to Impact or Crushing

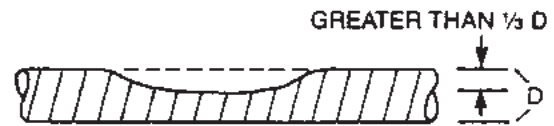


Figure 5-2 – Repair Necessary. Significant Damage to the Tubing Due to Impact or Crushing

METHOD OF REPAIR

A line splice can be made using an autoflare coupling, but if the tubing run is short and easily accessible, the preferred repair method is to replace the entire length. Tubing run can often be replaced faster than repairing the damaged section with a splice and this does not add any additional fitting joints to the system. The Auto Flare fittings can be re-attached to the new tubing run

1. Where repairs or replacements involve Corrugated Stainless Steel Tubing systems of different manufacturers, the systems can be joined again through standard pipe couplings and the appropriate CSST fittings.

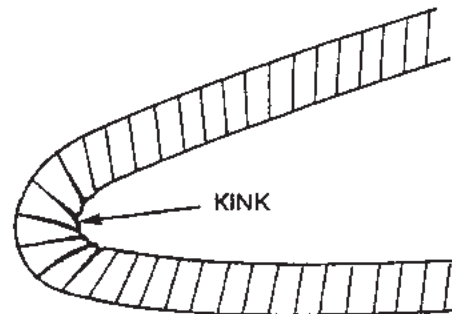


Figure 5-3 – Repair Necessary. Damage Due to Bending Beyond Minimum Bend Radius

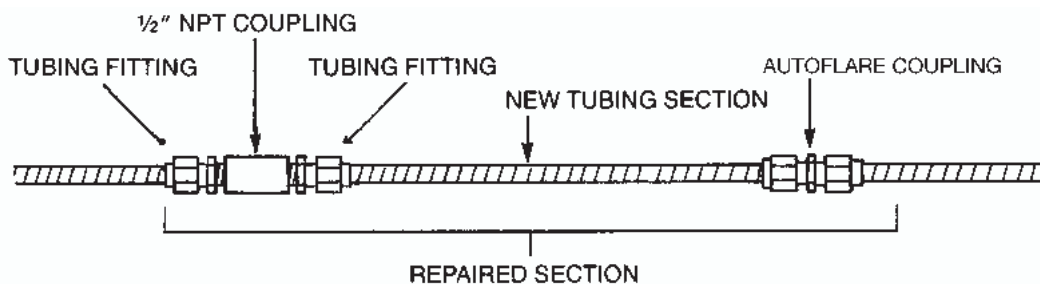


Figure 5-4 – Repair of Damaged Tubing with a New Section of Tubing and a joint splice or an AutoFlare Coupling

CHAPTER 6

PRESSURE/LEAKAGE TESTING

SECTION 6.0 — PRESSURE TEST PROCEDURE

The final installation must be inspected and tested for leaks at 1 1/2 times the maximum working pressure, but not less than 3 PSI, using the procedures specified in Part 4 "Inspection, Testing and Purging" of the National Fuel Gas Code*, NFPA 54/ANSI Z223. 1-1996* or subsequent editions of this code in effect at the time of the test. Pressure test according to these guidelines or to local codes. When local codes are more stringent, local codes must be followed. If no local codes apply, test according to the National Fuel Gas Code. The installer should never pressure test above 10 PSI with the pounds-to-inches regulator installed. This may damage the regulator.

1. Pressure testing should be performed during rough construction of the facility before interior walls are finished. This will permit a more complete inspection of the piping system during the pressure testing, and save costly rework in the event of leaks or other problems. *TracPipe* is not responsible for repairs necessary to correct defects discovered after interior walls are finished.
2. Do not connect appliances or pressurize the system with fuel gas until after the pressure test is completed.
3. All gas outlets for appliance connections should be capped during pressure testing.
4. **USE ONLY NON-CORROSIVE LEAK CHECK SOLUTIONS.** Rinse with water and dry the tubing thoroughly after leak detection.

*To obtain a copy of the National Fuel Gas Code write to: National Fire Protection Association, Battery March Park, Quincy, MA 02269-9904 or call: 1-800-344-3555

5. Most utilities perform a leak test after setting the gas meter and prior to turning on the gas. This test is performed after the final construction is complete and finished interior walls are in place. This test is performed to assure no damage was done to the tubing during the closing-in construction process.
6. **NOTE:** When pressure testing *TracPipe PS-II*, it is necessary to remove at least one fitting vent plug to insure proper test results on the stainless steel tubing.

SECTION 6.1 — Pressure Test for Elevated Pressure Systems

NOTE: DO NOT SUBJECT *TracPipe* SIZES 1-1/2" OR 2 INCH TO EXCESSIVE PRESSURE.

Pressure Test 1-1/2" and 2" sizes to local code requirements but not to exceed 40 psi. In the absence of code requirements, test to 1-1/2 times actual working pressure, not to exceed 40 psi.

The 2-5 PSI system requires a two-part pressure test. (See Figure 6-1) The first part is performed on the elevated pressure section, between the meter connection and the pounds-to-inches house line regulator.

The second part is performed on the low pressure section, between the pounds-to-inches house line regulator and the gas appliance outlet. If a steel pipe "jumper" is inserted in place of the house line regulator the entire system can be pressure tested in one step.

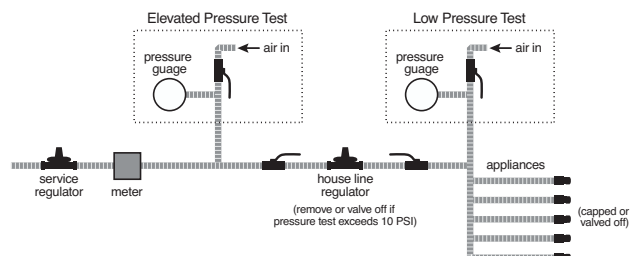


Figure 6-1 – Pressure Test Requirement for a 2 PSI System

SECTION 6.1A — APPLIANCE CONNECTION LEAKAGE CHECK PROCEDURE

1. After the final pressure test, inspection and final construction is complete (finished interior walls) connect the appliances to the tubing system.
2. This final connection can be accomplished by a stainless steel flexible connector, direct connection with CSST tubing or with rigid black pipe. See section 4.6 for installation details and guidelines.
3. Turn the gas on at the meter and inspect for leakage before operating the appliances.
4. Connections made at the appliances should be leak checked with a bubble solution. Before placing the appliances in operation the tubing system should be purged. This displaces the air in the system with fuel gas. Be sure to bleed tubing system into a well ventilated area.

NOTE: Leak test solutions may cause corrosion to some types of material in the gas tubing system. Be sure to water rinse after the test and thoroughly dry all contacted material. Also, the vent limiter should not be leak tested with a liquid test solution. This will contaminate the internal ball check mechanism or plug the breathing hole, resulting in erratic regulator operation.

SECTION 6.1B — REGULATOR PERFORMANCE

A. Load Response

1. A performance test should be conducted while operating all appliances at full load.

This will insure adequate pressure to each appliance under full-load conditions. To accomplish this, measure the line pressure at the appliance connection while operating the appliance.

2. The inlet pressure for typical natural gas appliances should measure between 4 and 6 inches water column under full-load conditions. If this pressure can not be obtained a slight adjustment to the pounds-to-inches regulator may be necessary to increase the line pressure. Do not set any system regulator over the system design pressure (2 PSI).

B. Spring Adjustment

1. The 2 PSI system pounds-to-inches house line regulator can be adjusted with an outlet pressure ranging between 7 and 11 inches of water column. The regulator must be adjusted according to the manufacturer's recommended procedure. A pressure gauge mounted just downstream of the regulator can monitor the set pressure under various loads.
2. The regulator is typically set when the system is operating at approximately 75 percent of maximum load.
3. The average natural gas appliance is designed to operate at 3 to 4 inches water column manifold pressure, and a pressure difference of 1 to 2 inches of water column across the appliance regulator which will prevent slow regulator response. Thus, the appliance regulator will operate best at 5 to 6 inches water column inlet pressure. In this case, the 2 PSI house line regulator should be reset to deliver approximately 8 to 10 inches of water column outlet pressure under load to allow for 3 inches of water column pressure drop in the tubing. Some appliances may have different inlet pressure requirements.

CHAPTER 7

CAPACITY TABLES

SECTION 7.0 — SIZING TABLES

for *TracPipe* Flexible Gas Piping

STANDARD TABLES

Natural Gas	6-7 in. w.c. / 0.5 in. w.c. drop
	8 in. w.c. / 3 in. w.c. drop
	12-14 in. w.c. / 6 in. w.c. drop
	2 psi / 1 psi drop
	5 psi / 3.5 psi drop
Propane	11 in. w.c. / 0.5 in.w.c. drop
	2 psi / 1 psi drop
	5 psi / 3.5 psi drop

ADDITIONAL TABLES

Natural Gas	6-7 in. w.c. / 1 in. w.c. drop
	8 in. w.c. / 2 in. w.c. drop
	11 in. w.c. / 5 in. w.c. drop
	2 psi / 1.5 psi drop
Propane	12-14 in. w.c. / 2.5 in. w.c. drop
	2 psi / 1.5 psi drop

SECTION 7.1 — PRESSURE DROP PER FOOT TABLES

for *TracPipe* Flexible Gas Piping - Natural Gas*

*Note: For propane (LP) gas applications:

1. Convert propane BTU load to CFH propane (divide by 2520 BTU per cubic foot).
2. Multiply CFH propane (1.52 SG) value by 1.5916 to obtain equivalent CFH Natural Gas (0.6 SG) value.
3. Find pressure drop per foot using CFH Natural Gas value from Step 2. This is the pressure drop per foot for Propane at the given BTU load.
4. Follow Sum of Pressure Loss instructions.

Convert 1,000 BTU values to CFH (Propane) using the formula:

$$\text{Propane} = 2520 \text{ BTU/Cu.Ft.}$$

SECTION 7.2 — SIZING TABLE FOR STEEL PIPE

Natural Gas 0.5 PSI or less / 0.5 in. w.c. drop

SECTION 7.2A — PRESSURE DROP PER 100 FOOT OF STEEL PIPE

Table N-1 Low Pressure (Standard)

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas (1,000 BTU approx)

Gas Pressure: 6-7 in. W.C. Pressure Drop: 0.5 in. W.C. (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	15	42	34	30	27	24	21	19	17	16	15	14	13	11	9	8	8
1/2"	19	94	78	68	61	56	48	44	40	37	35	33	31	26	22	20	18
3/4"	25	288	206	147	132	121	105	94	86	80	75	71	67	55	48	43	39
1"	31	518	366	299	259	231	183	163	149	138	129	121	115	94	81	73	66
1-1/4"	37	901	639	524	456	409	374	325	292	267	248	232	219	171	148	133	95
1-1/2"	46	1790	1261	1027	888	793	723	625	509	471	440	415	393	320	277	247	226
2"	62	4142	2934	2398	2078	1860	1698	1472	1203	1114	1042	983	933	762	661	591	540

see notes below*

EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity: This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Table N-2A Low Pressure (Canada & USA 1 inch drop)

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas (1,000 BTU approx)

Gas Pressure: 6-7 in. W.C. Pressure Drop: 1.0 in. W.C. (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	15	82	58	48	42	37	34	30	27	24	23	21	20	19	15	13	11
1/2"	19	182	131	108	94	85	78	68	61	56	52	48	46	44	31	28	26
3/4"	25	403	288	237	206	185	169	147	132	121	112	105	99	94	67	60	55
1"	31	734	518	423	366	327	299	259	231	211	195	183	172	163	115	103	94
1-1/4"	37	1324	901	720	614	542	490	418	369	334	306	284	266	251	171	151	137
1-1/2"	46	2541	1790	1458	1261	1126	1027	888	793	723	669	625	589	559	393	351	320
2"	62	5848	4142	3386	2934	2626	2398	2078	1860	1698	1573	1472	1388	1317	933	835	762

* NOTES: Tables above include losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: L = 1.3n where L is additional length of tubing and n is the number of additional fittings and/or bends.

Table N-2B Low Pressure (Canada & USA 2 inch drop)

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas (1,000 BTU approx)

Gas Pressure: 7 in. W.C. Pressure Drop: 2 in. W.C. (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	115	82	67	58	52	48	42	37	34	32	30	28	27	22	19	17	15
1/2"	254	182	150	131	118	108	94	85	78	72	68	64	61	50	44	39	36
3/4"	564	403	331	288	258	237	206	185	169	157	147	139	132	108	94	84	77
1"	1038	734	599	518	463	423	366	327	299	276	259	244	231	189	163	146	133
1-1/4"	1944	1324	1057	901	797	720	614	542	490	450	418	391	369	295	251	222	201
1-1/2"	3607	2541	2070	1790	1599	1458	1261	1126	1027	950	888	837	793	646	559	499	455
2"	8257	5848	4780	4142	3707	3386	2934	2626	2398	2221	2078	1960	1860	1520	1317	1179	1076

see notes below*

EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity: This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Table N-3 Regulator Outlet (8 inches W.C.)

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas (1,000 BTU approx)

Gas Pressure: 8 in. W.C. Pressure Drop: 3 in. W.C. (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	160	112	90	78	69	63	54	48	44	41	38	36	34	27	23	21	19
1/2"	327	231	189	164	147	134	116	104	95	88	82	77	73	60	52	46	42
3/4"	687	491	403	351	315	288	250	225	206	191	179	169	160	132	115	103	94
1"	1365	958	778	672	599	546	471	421	383	355	331	311	295	240	207	184	168
1-1/4"	2433	1657	1324	1129	997	901	769	679	614	564	523	490	462	369	315	278	251
1-1/2"	4428	3119	2541	2197	1963	1790	1548	1383	1261	1166	1090	1027	974	793	686	613	559
2"	10103	7156	5848	5069	4536	4142	3590	3213	2934	2717	2543	2398	2276	1860	1612	1442	1317

see notes below*

EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity: This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Table N-3A 3P Regulator Outlet (11 inches W.C.)

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas

Gas Pressure: 11 in. W.C. Pressure Drop: 5 in. W.C. (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	207	144	116	100	89	81	70	62	56	52	48	45	43	35	30	26	24
1/2"	419	297	242	210	188	172	149	133	122	113	105	99	94	77	67	60	54
3/4"	878	627	515	448	402	368	320	287	263	244	228	216	205	168	146	131	120
1"	1766	1237	1005	867	773	704	607	542	493	456	425	400	379	308	266	237	216
1-1/4"	3229	2199	1757	1498	1324	1196	1020	901	815	748	695	651	614	490	418	369	334
1-1/2"	5732	4038	3290	2844	2541	2317	2004	1790	1632	1510	1411	1330	1261	1027	888	793	723
2"	13026	9227	7541	6535	5858	5341	4629	4142	3783	3504	3279	3092	2934	2398	2078	1860	1698

see notes below*

EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity: This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Table N-4 Medium Pressure

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas (1,000 BTU approx)

Gas Pressure: 1/2 PSI (12-14 inches W.C.) Pressure Drop: 6 in. W.C. (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	229	160	130	112	99	90	78	69	63	58	54	51	48	39	34	30	27
1/2"	461	327	267	231	207	189	164	147	134	124	116	109	104	85	73	66	60
3/4"	962	687	564	491	441	403	351	315	288	267	250	237	225	185	160	144	132
1"	1946	1365	1110	958	855	778	672	599	546	505	471	444	421	342	295	263	240
1-1/4"	3573	2433	1944	1657	1464	1324	1129	997	901	828	769	720	679	542	462	409	369
1-1/2"	6286	4428	3607	3119	2786	2541	2197	1963	1790	1656	1548	1458	1383	1126	974	870	793
2"	14263	10103	8257	7156	6404	5848	5069	4536	4142	3837	3590	3386	3213	2626	2276	2036	1860

* NOTES: Tables above include losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: L = 1.3n where L is additional length of tubing and n is the number of additional fittings and/or bends.

Table N-6 Elevated Pressure 5psi

Maximum Capacity of OmegaFlex TracPipe
in Cubic Feet per Hour Natural Gas (1,000 BTU approx)

Gas Pressure: 5 psi Pressure Drop: 3.5 psi (based on a 0.6 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)													
	10	25	30	40	50	75	80	100	150	200	250	300	400	500
3/8"	672	420	382	329	293	238	230	205	166	143	128	116	100	89
1/2"	1304	827	755	654	586	479	463	415	339	294	263	240	208	186
3/4"	2650	1699	1556	1353	1214	998	967	868	713	620	556	509	443	397
1"	5659	3543	3228	2786	2486	2021	1955	1744	1418	1224	1092	955	858	766
1-1/4"	11376	6847	6189	5277	4664	3725	3594	3176	2537	2163	1912	1728	1473	1302
1-1/2"	18080	11378	10377	8972	8015	6530	6320	5646	4600	3977	3553	3240	2802	2503
2"	40353	25580	23361	20246	18119	14809	14341	12834	10489	9090	8135	7430	6439	5762

* NOTES: Table does not include effect of pressure drop across the line regulator. If regulator loss exceeds 3/4 PSI (based on 8 inch outlet pressure) Do not use this chart. Pressure drops across a regulator vary with flow rate. FGP-REG-5 has a 1 PSI pressure drop at a flow of 673 cubic feet per hour. CAUTION: Capacities shown in table may exceed maximum capacity for a selected regulator.

Table P-1 Propane Low Pressure (Standard)

Maximum Capacity of OmegaFlex TracPipe™
in Thousands of BTU per Hour Propane Gas

Gas Pressure: 11 in. W.C.

Pressure Drop: 0.5 in. W.C. (based on a 1.52 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	99	69	55	49	42	39	33	30	26	25	23	22	20	15	14	12	11
1/2"	211	150	121	106	94	87	74	66	60	57	52	50	47	36	33	30	26
3/4"	456	325	267	232	209	191	166	149	136	126	118	112	106	87	76	68	62
1"	863	605	490	425	379	344	297	265	241	222	208	197	186	143	129	117	107
1-1/4"	1424	971	775	661	583	528	449	397	359	330	307	286	270	217	183	163	147
1-1/2"	2830	1993	1623	1404	1254	1143	988	884	805	745	696	656	621	506	438	390	357
2"	6547	4638	3791	3285	2940	2684	2327	2082	1902	1761	1647	1554	1475	1205	1045	934	854

see notes below*

EHD (Effective Hydraulic Diameter) A relative measure of Low Capacity. This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Table P-2 Propane Medium Pressure

Maximum Capacity of OmegaFlex TracPipe
in Thousands of BTU per Hour Propane Gas

Gas Pressure: 1/2 psi (12-14 in. W. C.) Pressure Drop: 2.5 in. W. C. (based on a 1.52 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)																
	5	10	15	20	25	30	40	50	60	70	80	90	100	150	200	250	300
3/8"	222	159	131	114	102	93	81	73	67	62	58	55	52	43	37	33	30
1/2"	491	353	290	254	228	209	182	164	150	140	131	124	118	97	85	76	70
3/4"	1094	782	642	559	501	459	399	358	328	304	285	269	256	210	183	164	136
1"	2512	1863	1720	1343	1106	976	883	825	771	719	673	632	596	470	398	352	320
1-1/4"	3476	2368	1891	1612	1424	1288	1099	971	877	805	748	700	661	528	449	397	359
1-1/2"	6383	4496	3663	3168	2830	2580	2230	1993	1818	1682	1571	1481	1404	1143	988	884	805
2"	14586	10330	8443	7317	6547	5980	5183	4638	4236	3923	3671	3462	3285	2684	2327	2082	1902

NOTES: Tables above include losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends and/or fittings shall be increased by an equivalent length of tubing to the following equation: $L=1.3n$ where L is additional length of tubing and n is the number of additional fittings and/or bends.



Table P-3 Propane Elevated Pressure 2psi

Maximum Capacity of OmegaFlex TracPipe™
in Thousands of BTU per Hour Propane Gas

Gas Pressure: 2 psi Pressure Drop: 1 psi (based on a 1.52 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)															
	10	25	30	40	50	75	80	100	150	200	250	300	400	500		
3/8"	558	347	316	271	243	196	189	169	137	118	105	96	82	72	3/8"	
1/2"	1106	701	640	554	496	406	393	350	287	248	222	203	175	158	1/2"	
3/4"	2282	1464	1340	1165	1046	859	833	713	614	534	479	439	381	342	3/4"	
1"	4720	2954	2692	2323	2072	1685	1629	1454	1182	1019	910	829	716	638	1"	
1-1/4"	8983	5406	4888	4167	3682	2942	2837	2507	2003	1707	1510	1364	1163	1027	1-1/4"	
1-1/2"	15174	9549	8708	7529	6726	5480	5303	4738	3860	3337	2981	2719	2351	2101	1-1/2"	
2"	34203	21680	19801	17159	15357	12551	12154	10877	8890	7705	6895	6296	5457	4883	2"	

* NOTES: Table does not include effect of pressure drop across the line regulator. If regulator loss exceeds 3/4 PSI (based on 8 inch outlet pressure) Do not use this chart. Pressure drops across a regulator vary with flow rate. FGP-REG-3P has a 3/4 PSI pressure drop at a flow of 161 cubic feet per hour. CAUTION: Capacities shown in table may exceed maximum capacity for a selected regulator. EHD (Effective Hydraulic Diameter) A relative measure of Flow Capacity. This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Table P-3A Propane Elevated Pressure 2 psi

Maximum Capacity of OmegaFlex TracPipe™
in Thousands of BTU per Hour Propane Gas

Gas Pressure: 2 psi

Pressure Drop: 1.5 psi (based on a 1.52 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)														
	10	25	30	40	50	75	80	100	150	200	250	300	400	500	
3/8"	817	525	481	419	376	310	300	269	222	193	173	159	138	124	3/8"
1/2"	1588	1041	957	839	757	628	609	550	456	399	360	331	290	262	1/2"
3/4"	3237	2147	1978	1739	1574	1312	1275	1153	962	845	765	705	619	560	3/4"
1"	6838	4436	4070	3553	3198	2641	2561	2305	1903	1661	1495	1372	1198	1078	1"
1-1/4"	11245	6769	6118	5216	4609	3682	3554	3139	2507	2139	1889	1707	1456	1287	1-1/4"
1-1/2"	18624	11721	10689	9243	8256	6726	6511	5816	4738	4097	3659	3337	2886	2578	1-1/2"
2"	41847	26527	24227	20996	18789	15357	14872	13308	10877	9426	8436	7705	6677	5975	2"

Table P-4 Propane Elevated Pressure 5psi

Maximum Capacity of OmegaFlex TracPipe™
in Thousands of BTU per Hour Propane Gas

Gas Pressure: 5 psi

Pressure Drop: 3.5 psi (based on a 1.52 Specific Gravity Gas)

Size (EHD)	TUBING LENGTH (FEET)														
	10	25	30	40	50	75	80	100	150	200	250	300	400	500	
3/8"	1065	664	603	520	463	376	363	324	262	226	202	183	158	140	3/8"
1/2"	2061	1307	1193	1033	926	757	731	656	535	464	416	379	328	294	1/2"
3/4"	4189	2686	2459	2139	1920	1577	1529	1310	1127	980	880	805	700	629	3/4"
1"	8945	5600	5102	4404	3929	3194	3090	2756	2241	1934	1726	1572	1356	1210	1"
1-1/4"	17983	10823	9783	8342	7373	5888	5681	5020	4010	3419	3022	2732	2328	2058	1-1/4"
1-1/2"	28580	17986	16403	14183	12670	10322	9990	8925	7271	6287	5616	5122	4429	3957	1-1/2"
2"	63788	40436	36928	32004	28642	23409	22670	20287	16581	14369	12859	11745	10178	9108	2"

* NOTES: Table does not include effect of pressure drop across the line regulator. If regulator loss exceeds 3/4 PSI (based on 8 inch outlet pressure) Do not use this chart. Pressure drops across a regulator vary with flow rate. Maxitrol FGP-REG-5 has a 1 PSI pressure drop at a flow of 434 cubic feet per hour. CAUTION: Capacities shown in table may exceed maximum capacity for a selected regulator.

Section 7.1 — Table PD-1
 Pressure Drop per foot for *TracPipe* (Natural Gas) (For Propane See Below)

3/8" CSST		1/2" CSST		3/4" CSST		1" CSST	
CFH	"W.C.	CFH	"W.C.	CFH	"W.C.	CFH	"W.C.
20	0.011	20	0.002	30	0.001	50	0.001
30	0.025	30	0.004	40	0.002	60	0.001
40	0.045	40	0.008	50	0.003	70	0.002
50	0.071	50	0.013	60	0.004	80	0.002
60	0.104	60	0.019	70	0.005	90	0.003
70	0.143	70	0.027	80	0.007	100	0.004
80	0.188	80	0.035	90	0.009	110	0.005
90	0.240	90	0.045	100	0.011	120	0.005
100	0.299	100	0.056	110	0.014	130	0.006
110	0.364	110	0.069	120	0.016	140	0.007
120	0.436	120	0.082	130	0.019	150	0.008
130	0.515	130	0.098	140	0.022	160	0.010
140	0.600	140	0.114	150	0.026	170	0.011
150	0.693	150	0.132	160	0.030	180	0.012
160	0.792	160	0.151	170	0.034	190	0.013
170	0.897	170	0.172	180	0.038	200	0.015
180	1.010	180	0.194	190	0.042	210	0.016
190	1.130	190	0.217	200	0.047	220	0.018
200	1.257	200	0.242	210	0.052	230	0.020
210	1.390	210	0.268	220	0.057	240	0.021
220	1.531	220	0.295	230	0.063	250	0.023
230	1.678	230	0.324	240	0.068	260	0.025
240	1.833	240	0.355	250	0.074	270	0.027
250	1.995	250	0.387	260	0.081	280	0.029
260	2.163	260	0.420	270	0.087	290	0.031
270	2.339	270	0.455	280	0.094	300	0.034
280	2.522	280	0.491	290	0.101	310	0.036
290	2.712	290	0.529	300	0.108	320	0.038
300	2.910	300	0.568	310	0.116	330	0.041
310	3.114	310	0.608	320	0.124	340	0.043
320	3.326	320	0.650	330	0.132	350	0.046
330	3.544	330	0.694	340	0.140	360	0.048
340	3.770	340	0.739	350	0.149	370	0.051
350	4.004	350	0.785	360	0.158	380	0.054
360	4.244	360	0.833	370	0.167	390	0.057
370	4.492	370	0.883	380	0.176	400	0.060
380	4.747	380	0.934	390	0.186	410	0.063
390	5.009	390	0.986	400	0.196	420	0.066
400	5.279	400	1.040	410	0.206	430	0.069
410	5.556	410	1.096	420	0.217	440	0.072
420	5.840	420	1.153	430	0.228	450	0.075
430	6.132	430	1.211	440	0.239	460	0.079
440	6.431	440	1.271	450	0.250	470	0.082
450	6.737	450	1.333	460	0.262	480	0.086
460	7.051	460	1.396	470	0.274	490	0.089
470	7.372	470	1.461	480	0.286	500	0.093
480	7.701	480	1.527	490	0.298	510	0.097
490	8.037	490	1.595	500	0.311	520	0.100
500	8.380	500	1.664	510	0.324	530	0.104

* NOTE: For Propane (LP) Gas applications, obtain Pressure drop per foot values for Propane by following the Propane conversion method detailed in Section 7.1.

Table PD-1
 Pressure Drop per foot for *TracPipe* (Natural Gas) (For Propane See Below)

1 1/4" CSST		1 1/2" CSST		2" CSST	
CFH	"W.C.	CFH	"W.C.	CFH	"W.C.
80	0.001	210	0.001	510	0.001
90	0.002	220	0.002	520	0.002
100	0.002	230	0.002	530	0.002
110	0.002	240	0.002	540	0.002
120	0.003	250	0.002	560	0.002
130	0.003	260	0.002	570	0.002
140	0.003	270	0.002	580	0.002
150	0.004	280	0.003	590	0.002
160	0.004	290	0.003	600	0.002
170	0.005	300	0.003	610	0.002
180	0.005	310	0.003	620	0.002
190	0.006	320	0.003	630	0.002
200	0.007	330	0.004	640	0.002
210	0.007	340	0.004	650	0.002
220	0.008	350	0.004	660	0.002
230	0.008	360	0.004	670	0.003
240	0.009	370	0.004	680	0.003
250	0.010	380	0.005	690	0.003
260	0.011	390	0.005	700	0.003
270	0.011	400	0.005	710	0.003
280	0.012	410	0.005	720	0.003
290	0.013	420	0.006	730	0.003
300	0.014	430	0.006	740	0.003
310	0.015	440	0.006	750	0.003
320	0.015	450	0.007	760	0.003
330	0.016	460	0.007	770	0.003
340	0.017	470	0.007	780	0.003
350	0.018	480	0.007	790	0.004
360	0.019	490	0.008	800	0.004
370	0.020	500	0.008	810	0.004
380	0.021	510	0.008	820	0.004
390	0.022	520	0.009	830	0.004
400	0.023	530	0.009	840	0.004
410	0.024	540	0.009	850	0.004
420	0.025	560	0.010	860	0.004
430	0.026	570	0.010	870	0.004
440	0.027	580	0.011	880	0.004
450	0.029	590	0.011	890	0.005
460	0.030	600	0.011	900	0.005
470	0.031	610	0.012	910	0.005
480	0.032	620	0.012	920	0.005
490	0.033	630	0.013	930	0.005
500	0.034	640	0.013	940	0.005
510	0.036	650	0.013	950	0.005
520	0.037	660	0.014	960	0.005
530	0.038	670	0.014	970	0.005
540	0.040	680	0.015	980	0.006
560	0.042	690	0.015	990	0.006
570	0.044	700	0.016	1000	0.006

* NOTE: For Propane (LP) Gas applications, obtain Pressure drop per foot values for Propane by following the Propane conversion method detailed in Section 7.1.

Pressure Drop per foot for *TracPipe* (Natural Gas) (For Propane See Below)

1/2" CSST		3/4" CSST		1" CSST	
CFH	"W.C.	CFH	"W.C.	CFH	"W.C.
510	1.735	520	0.337	540	0.108
520	1.807	530	0.351	560	0.117
530	1.881	540	0.364	570	0.121
540	1.957	560	0.393	580	0.125
560	2.113	570	0.407	590	0.129
570	2.193	580	0.422	600	0.134
580	2.275	590	0.437	610	0.138
590	2.358	600	0.453	620	0.143
600	2.443	610	0.469	630	0.147
610	2.529	620	0.485	640	0.152
620	2.618	630	0.501	650	0.157
630	2.707	640	0.517	660	0.162
640	2.798	650	0.534	670	0.167
650	2.891	660	0.551	680	0.172
660	2.986	670	0.569	690	0.177
670	3.082	680	0.586	700	0.182
680	3.180	690	0.604	710	0.187
690	3.279	700	0.622	720	0.192
700	3.380	710	0.641	730	0.198
710	3.482	720	0.660	740	0.203
720	3.586	730	0.679	750	0.209
730	3.692	740	0.698	760	0.214
740	3.799	750	0.718	770	0.220
750	3.908	760	0.738	780	0.226
760	4.019	770	0.758	790	0.232
780	4.244	780	0.778	800	0.237
790	4.360	790	0.799	810	0.243
800	4.477	800	0.820	820	0.249
810	4.596	810	0.841	830	0.256
		820	0.863	840	0.262
		830	0.885	850	0.268
		840	0.907	860	0.274
		850	0.929	870	0.281
		860	0.952	880	0.287
		870	0.975	890	0.294
		880	0.998	900	0.300
		890	1.022	910	0.307
		900	1.045	920	0.314
		910	1.070	930	0.321
		920	1.094	940	0.328
		930	1.119	950	0.335
		940	1.144	960	0.342
		950	1.169	970	0.349
		960	1.194	980	0.356
		970	1.220	990	0.363
		980	1.246	1000	0.371
		990	1.273	1010	0.378
		1000	1.299	1020	0.386
		1010	1.326	1030	0.393

* NOTE: For Propane (LP) Gas applications, obtain Pressure drop per foot values for Propane by following the Propane conversion method detailed in Section 7.1.

Pressure Drop per foot for *TracPipe* (Natural Gas) (For Propane See Below)

1 1/4" CSST		1 1/2" CSST		2" CSST	
CFH	"W.C.	CFH	"W.C.	CFH	"W.C.
580	0.045	710	0.016	1010	0.006
590	0.046	720	0.016	1020	0.006
600	0.048	730	0.017	1030	0.006
610	0.049	740	0.017	1040	0.006
620	0.051	750	0.018	1050	0.006
630	0.052	760	0.018	1060	0.006
640	0.054	770	0.019	1070	0.007
650	0.055	780	0.019	1080	0.007
660	0.057	790	0.020	1090	0.007
670	0.058	800	0.020	1100	0.007
680	0.060	810	0.021	1200	0.008
690	0.062	820	0.021	1300	0.010
700	0.063	830	0.022	1400	0.011
710	0.065	840	0.022	1500	0.013
720	0.067	850	0.023	1600	0.015
730	0.068	860	0.023	1700	0.017
740	0.070	870	0.024	1800	0.019
750	0.072	880	0.025	1900	0.021
760	0.073	890	0.025	2000	0.023
770	0.075	900	0.026	3000	0.052
780	0.077	910	0.026	4000	0.093
790	0.079	920	0.027	5000	0.146
800	0.081	930	0.027	6000	0.210
810	0.082	940	0.028	7000	0.287
820	0.084	950	0.029	8000	0.375
830	0.086	960	0.029	9000	0.476
840	0.088	970	0.030	10000	0.588
850	0.090	980	0.030	11000	0.712
860	0.092	990	0.031	12000	0.848
870	0.094	1000	0.032	13000	0.996
880	0.096	1010	0.032	14000	1.156
890	0.098	1020	0.033	15000	1.328
900	0.100	1030	0.033	16000	1.512
910	0.102	1040	0.034	17000	1.708
920	0.104	1050	0.035	18000	1.915
930	0.106	1060	0.035	19000	2.135
940	0.108	1070	0.036	20000	2.367
950	0.110	1080	0.037	21000	2.611
960	0.112	1090	0.037	22000	2.867
970	0.114	1100	0.038	25000	3.707
980	0.116	1200	0.045	28000	4.655
990	0.118	1300	0.053	30000	5.348
1000	0.120	1400	0.061	32000	6.089
1010	0.123	1500	0.070	35000	7.290
1020	0.125	1600	0.080	38000	8.601
1030	0.127	1700	0.090	40000	9.535
1040	0.129	1800	0.101	42000	10.517
1050	0.132	1900	0.112		
1060	0.134	2000	0.124		

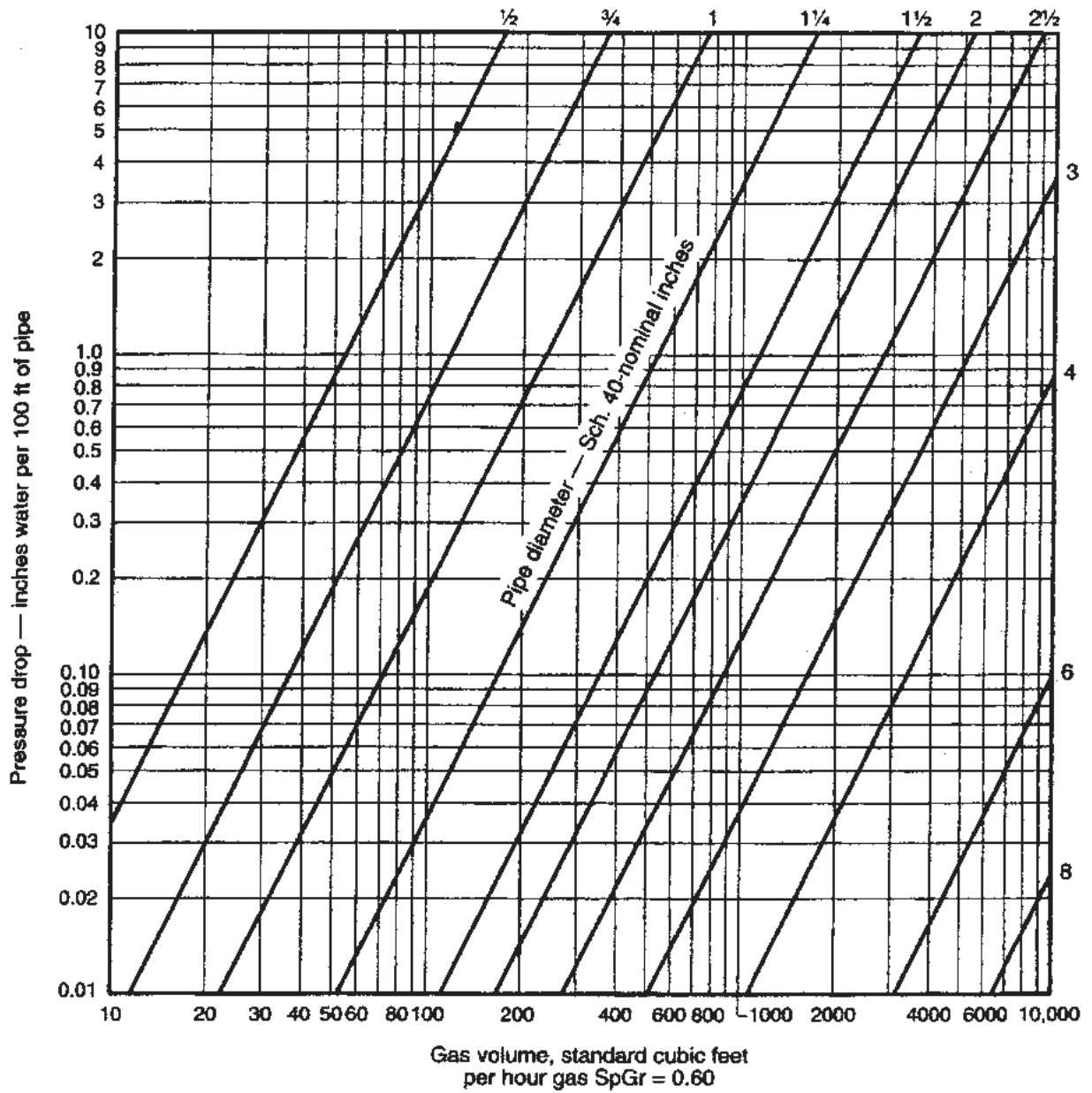
* NOTE: For Propane (LP) Gas applications, obtain Pressure drop per foot values for Propane by following the Propane conversion method detailed in Section 7.1.

SECTION 7.2

Table SP-1
 Maximum Capacity of Pipe in Cubic Feet of Gas per Hour for Gas Pressures
 of 0.5 psi or Less and a Pressure Drop of 0.5 Inch Water Column (Based on a 0.6 Specific Gravity)

Normal Iron Pipe Size (Inches)	Internal Diameter (Inches)	Length of Pipe (Feet)															
		10	20	30	40	50	60	70	80	90	100	125	150	175	200		
1/4	.364	43	29	24	20	18	16	15	14	13	12	11	10	9	8		
3/8	.493	95	65	52	45	40	36	33	31	29	27	24	22	20	19		
1/2	.622	175	120	97	82	73	66	61	57	53	50	44	40	37	35		
3/4	.824	360	250	200	170	151	138	125	118	110	103	93	84	77	72		
1	1.049	680	465	375	320	285	260	240	220	205	195	175	160	145	135		
1 1/4	1.380	1,400	950	770	660	580	530	490	460	430	400	360	325	300	280		
1 1/2	1.610	2,100	1,460	1,180	990	900	810	750	690	650	620	550	500	460	430		
2	2.067	3,950	2,750	2,200	1,900	1,680	1,520	1,400	1,300	1,220	1,150	1,020	950	850	800		
2 1/2	2.469	6,300	4,350	3,520	3,000	2,650	2,400	2,250	2,050	1,950	1,850	1,650	1,500	1,370	1,280		
3	3.068	11,000	7,700	6,250	5,300	4,750	4,300	3,900	3,700	3,450	3,250	2,950	2,650	2,450	2,280		
4	4.026	23,000	15,800	12,800	10,900	9,700	8,800	8,100	7,500	7,200	6,700	6,000	5,500	5,000	4,600		

SECTION 7.2A



* Reprinted from The National Fuel Gas Code Handbook, 1996 Edition

CHAPTER 8

DEFINITION OF TERMINOLOGY

A.G.A. – American Gas Association

ANSI Z223.1 1988 – 1988 edition of the National Fuel Gas Code published by American National Standard Institute. Also known as NFPA 54 (National Fire Protection Association).

Appliance (Equipment) – Any device which utilizes natural gas or propane as a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

Approved – Acceptable to the authorities having jurisdiction.

Authority Having Jurisdiction – The organization, office or individual responsible for “approving” equipment, an installation or a procedure.

Btu – Abbreviation for British Thermal Unit, which is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit .

Cfh – Gas flow rate stated in cubic feet per hour.

Clothes Dryer – A device used to dry wet laundry by means of heat derived from the combustion of natural gases.

Design Pressure – The maximum operating pressure permitted by this document, as determined by the design procedures applicable to the materials involved.

Drip Leg – The container (dirt trap pocket) placed at a low point in a system of piping to collect foreign material or condensate and from which it may be removed.

EHD (Effective Hydraulic Diameter) – A relative measure of Flow Capacity; This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Full Lockup – The capability of totally stopping the flow of gas if the load goes to zero, thus preventing the downstream pressure from increasing

more than a certain upper limit pressure above the set point.

Header (manifold) – A pipe or fitting to which a number of branch lines are connected.

ID – Inside diameter of pipe or tubing.

Inches (") W.C. – Method of stating pressure measured in inches of water column by a manometer or pressure gauge. Commonly used in the gas industry when the pressure is less than one (1) PSI.

1 PSI = 28 in. W.C. approximately

1/2 PSI = 14 in. W.C.

1/4 PSI = 7 in. W.C.

Load – The amount of gas in Cfh required by an appliance, or group of appliances, per their rating plate.

L. P. Gas – Fuel gas that is stored and transported in a liquid state, i.e., propane, butane, and mixtures of these and other heavier hydrocarbons.

Meter – An instrument installed to measure the volume of gas delivered through a piping system.

Manometer – A “U” shaped tube filled with water, or mercury where the pressure applied to one leg of the “U” will push the liquid column a measurable distance. Also known as a “U” gauge.

OD – Outside Diameter of pipe or tubing.

1/2 PSI – A shortened way of stating 1/2 pounds per square inch gauge. Also the name of a low pressure piping system supplying gas from the meter at 1/2 PSI to each appliance pressure regulator.

Piping – As used in this document, either pipe or tubing, or both.

a. pipe – Rigid conduit of iron, steel, copper, brass or aluminum.

b. tubing – Semi rigid conduit of corrugated stainless steel.

Pressure – Unless otherwise stated, is expressed in pounds per square inch above atmospheric pressure, i.e. gage pressure (PSI).

Pressure Drop – The loss in static pressure of gas due to friction or obstruction in tubing, valves, fittings, regulators and burners.

Pressure Regulator – A valve which reduces and controls pressure. It automatically opens and closes in response to changing pressure conditions in the downstream piping.

PSI – Pounds per square inch gauge. The pressure, as read from a measurement gage or device. Gauge pressure is pressure above atmospheric pressure.

Purge – To displace the original air, or gas, or a mixture of gas and air in a gas conduit with a new air/gas mixture.

Regulator, Appliance (inches w.c. – inches w.c.) – A device for controlling and maintaining a uniform pressure to the manifold of gas burning equipment. This valve is typically part of the appliance. It reduces the pressure from 5.5" w.c. to the manifold pressure in the appliance. (approximately 3.5" w.c.).

Regulator, House Line (PSI – inches w.c.) – A device placed in a gas line between the service regulator and the appliance regulator for controlling, maintaining or reducing the pressure in that portion of the piping system downstream of the device. This valve reduces the house line pressure (Typically 2 PSI) to the regulator manifold pressure (Typically 8-10" w.c.).

Regulator, Service (PSI – PSI or inches w.c.) – A device installed by the serving gas supplier to reduce and limit the service line gas pressure. This valve reduces the service pressure to the metering pressure. It is located upstream of the gas meter.

Regulator Vent – The opening in the atmospheric side of the regulator housing permitting the in and out movement of air to compensate for the movement of the regulator diaphragm.

Specific Gravity – As applied to gas, the ratio of the weight of a given volume to that of the same volume of air, both measured under the same conditions.

2 PSI – A shortened way of stating 2 pounds per square inch gauge pressure. Also the name of a piping system supplying gas at 2 PSI to a house line regulator which then reduces the pressure to inches W.C. upstream of the appliance regulator.

Valve, Manual Shut-off – A valve (located in the piping system and readily accessible and operable by the consumer) used to shut off individual equipment.

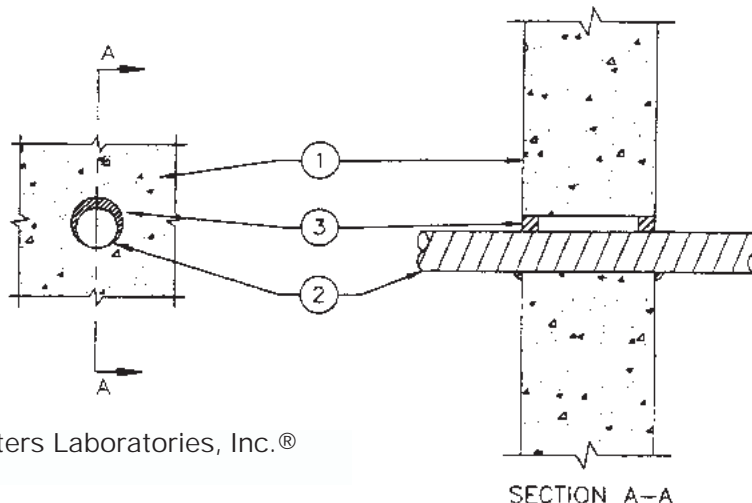
Vent Limiter Device – Restriction/orifice type device in the vent outlet of a pressure regulator that controls or limits leakage, in the event of a diaphragm leak. It also allows the diaphragm to move freely to control pressure.

APPENDIX A UL CLASSIFICATION

The UL Through Penetration Firestop Systems in Appendix A are only a sample of the complete UL database. See NOTE on Page 82

System No. W-J-1106

F-Rating - 1 & 2 Hr
T-Rating - 3/4 and 1-1/4 Hr



Underwriters Laboratories, Inc.®

SECTION A-A

1. Wall Assembly- Min 4-7/8 in. or 6-1/8 in. thick lightweight or normal weight (100-150 pcf) concrete for 1 or 2 hr rated assemblies, respectively. Wall may also be constructed of any UL Classified Concrete Blocks*. Max diam of opening is 3-1/2 in.
See Concrete Blocks (CAZT) category in the Fire Resistance Directory for names of manufacturers.
2. Through Penetrating Products*-Flexible Metal Piping-Nom. 2 in. diam (or smaller) steel flexible metallic piping. Max one flexible metal piping to be installed either concentrically or eccentrically within opening. The annular space between piping and periphery of opening shall be min 0 (point contact) in. to max 1 in. Piping to be rigidly supported on both sides of wall assembly. Plastic covering on piping may or may not be removed on both sides of wall assembly.
Omegaflex Inc.—*TracPipe* Flexible Gas Piping.
3. Fill, Void, or Cavity Material*-Sealant -Min. 5/8 and 1 in. thickness of fill material for 1 and 2 hr fire-rated wall assemblies, respectively, applied within the annulus, flush with both surfaces of wall. An additional 1/2 in. diam of fill material applied at gypsum board/penetrant interface at point contact location on both surfaces of wall.
Johns Manville International, Inc. — Firetemp™ CI

*Bearing the UL Classification Marking

SYSTEM No. C-AJ-1340

Floor or Wall Assembly-Min 4-1/2 in. thick lightweight or normal weight (100 to 150 pcf) concrete. Wall may also be constructed of any UL Classified Concrete Blocks*. Diam of opening in floor or wall assembly to be min 3/4 in. to max 1-1/2 in. Larger than diam of flexible metal piping (Item 2) installed in through opening. Max diam of opening is 4 in. See Concrete Block (CAZT) category in the Fire Resistance Directory for names of manufacturers.

Through-Penetrant*-Omegaflex Gas Piping-Nom 2 in. diam (or smaller) flexible gas piping. One flexible gas piping to be installed either cocentrically or eccentrically within the firestop system. The annular space between gas piping and periphery of opening shall be min 0 in. (point contact) to max. 1-1/2 in. Gas piping to be rigidly supported on both sides of floor or wall assembly. Plastic covering on piping may or may not be removed on both sides of floor or wall assembly. OmegaFlex, Inc.-*TracPipe* Flexible Gas Piping

Firestop System The firestop system shall consist of the following:

A. Packing Material-Min 3-3/4 in. thickness of min 4 pcf mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces wall as required to accommodate the required thickness of fill material.

B. Fill, Void or Cavity Material* -Sealant Min 3/4 in. thickness of fill material applied within the annulus, flush with top surface of floor or both surfaces of wall. Min 1/2 in. diam bead of caulk applied to the penetrant/concrete or penetrant/concrete interface at the point contact location between penetrant and periphery of opening.

Passive Fire Protection Partners--4800DW

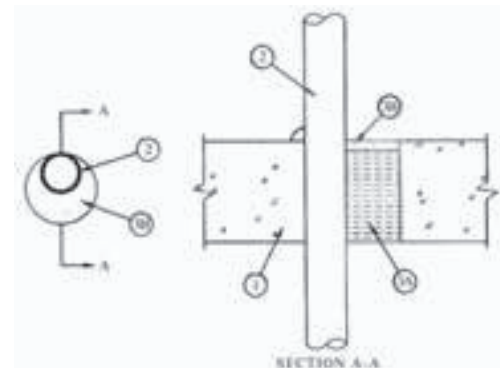
* Bearing the UL Classification Marking

XHEZ

Through Penetration Firestop systems

System No. C-AJ-1340

F-Rating - 4 Hr
T-Rating - 2 1/4 Hr



Underwriters Laboratories, Inc.®

UL CLASSIFICATION

SYSTEM NO. W-L-1195

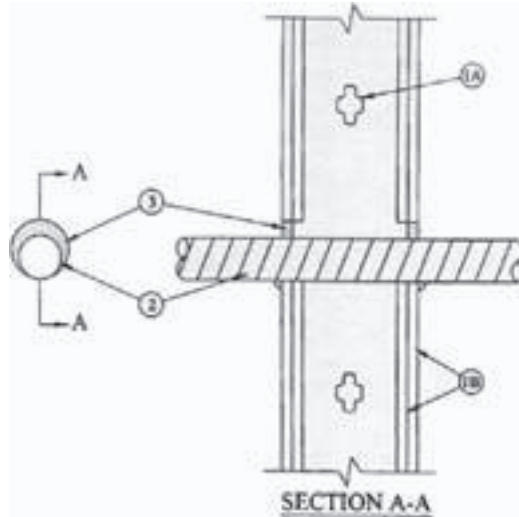
The UL Through Penetration Firestop Systems in Appendix A are only a sample of the complete UL database. See NOTE below.

1. Wall Assembly- The 1 or 2 hr fire rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. Studs- Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC with nom 2 by 4 in. Lumber end plates and cross braces. Steel studs to be min 3-5/8 in. wide by 1-3/8 in. deep channels spaced max 24 in. OC.

B. Wallboard, Gypsum*-Thickness, type, number of layers and fasteners as required in the individual Wall and Partition Design. Max diam of opening is 3-1/2 in.

XXEZ
Through-Penetration Firestop Systems
System No. W-L-1195
F Rating - 1 & 2 hr (See Item 1)
T Rating - 3/4 & 1-1/4 hr(See Item 1)



Underwriters Laboratories inc.®

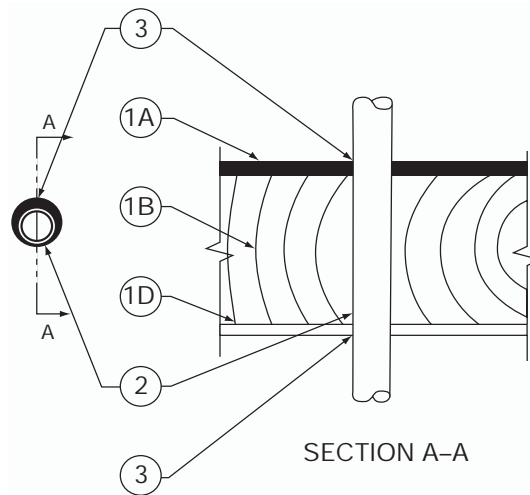
1. The hourly F rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed. The hourly T rating is 3/4 hr and 1-1/4 hr for 1 and 2 hr rated assemblies, respectively.
2. Through-Penetrating Product*-Flexible Metal Piping-Nom 2 in. diam (or smaller) steel Flexible Metal Piping. Max one flexible metal piping to be installed either concentrically or eccentrically within opening. The annular space between pipe and periphery of opening shall be min 0 in. (point contact)to max 1 in. Piping to be rigidly supported on both sides of wall assembly. Plastic covering on piping may or may not be removed for a distance of 2 ft. on both sides of wall assembly. OmegaFlex, Inc.- *TracPipe* Flexible Gas Piping
3. Fill, Void, or Cavity Material*-Sealant - Min 5/8 and 1 in. thickness of fill material for 1 and 2 hr fire-rated wall assemblies, respectively, applied within the annulus, flush with both surfaces of wall. An additional 1/2 in diameter of fill material applied at gypsum board/penetrant interface at point contact location on both surfaces of wall.

Johns Manville International, Inc - Firetemp™CI

*Bearing the UL Classification Marking

NOTE: to access the complete UL Through Penetration Firestop Systems database online:

1. Go to website www.ul.com
2. Click on : "CERTIFICATIONS" in left hand panel
3. Click on : "Company name/location" under General Search
4. Fill in OmegaFlex inc (3 words) in "Company Name" box
5. All approved systems are shown



1. Floor Assembly - The 1 or 2 hr fire-rated wood joist, wood truss or combination wood and steel truss Floor-Ceiling assembly shall be constructed of the materials and in the manner described in the individual L500 Series Design in the UL Fire Resistance Directory. The F Rating of the firestop system is equal to the rating of the floor-ceiling and wall assemblies. The general construction features of the floor-ceiling assembly are summarized below:
 - A. Flooring System - Lumber or plywood subfloor with finish floor of lumber, plywood or Floor Topping Mixture* as specified in the individual Floor-Ceiling Design. Max diam of opening is 3 in. (76 mm).
 - B. Joists - Nom 2 by 10 in. (51 by 254 mm) deep (or deeper) lumber joists spaced 16 in. (406 mm) OC or steel or combination lumber and steel joists, trusses or Structural Wood Members* with bridging as required and with ends firestopped.
 - C. Furring Channels (Not Shown) (As required) Resilient galvanized steel furring installed in accordance with the manner specified in the individual L500 Series Designs in the Fire Resistance Directory.
 - D. Gypsum Board* - Thickness, type, number of layers and fasteners shall be as specified in the individual Floor-Ceiling Design. Max diam of opening is 3 in. (76 mm).
2. Through Penetrating Products* - Flexible Metal Piping-Nom 2 in. (51 mm) diam (or smaller) steel Flexible Metal Piping with or without plastic covering on piping. Max one flexible metal piping to be installed near center of circular through opening in floor assembly. The annular space between the piping and periphery of opening shall be min 0 in. (0 mm) (point contact) to max 1/2 in. (13 mm). Piping to be rigidly supported on both sides of floor assembly.
OmegaFlex INC
3. Fill, Void or Cavity Material* - Sealant - Min 3/4 in. (19 mm) thickness of sealant applied within annulus on top surface of floor. Min 5/8 in. (16 mm) thickness of sealant applied within annulus on bottom surface of ceiling. At point contact location, a min 1/2 in. (13 mm) bead of sealant shall be applied to the penetrant/gypsum board interface on bottom surface of ceiling and at penetrant/flooring interface on top surface of floor.
Passive Fire Protection Partners** - 3600EX, 41GONS or 4800DW

*Bearing the UL Classification Marking

**Formerly Firestop Systems Inc.

APPENDIX B MANUFACTURED HOUSING GUIDELINES

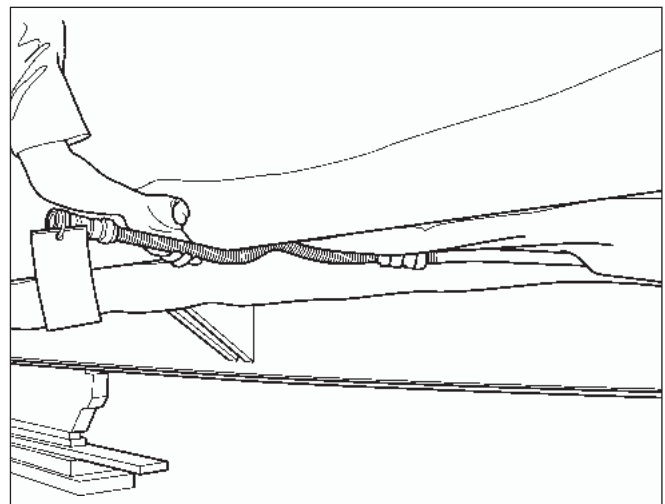
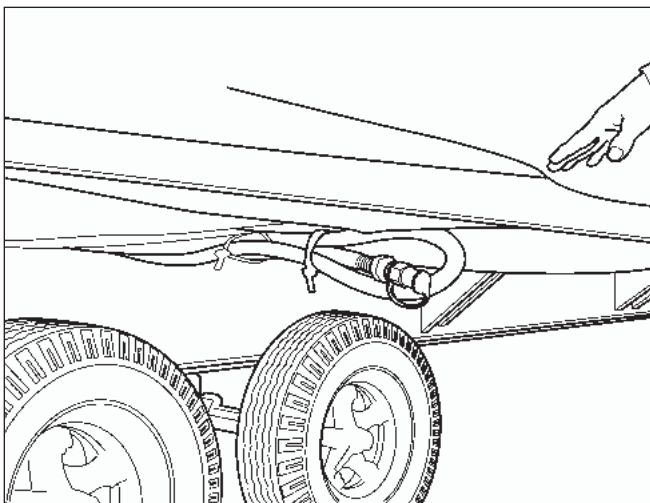
A. CODE AND ADMINISTRATIVE REQUIREMENTS

1. Manufactured homes and mobile homes bearing an insignia or required to bear an insignia must comply with Title VI 24 Code of Federal Regulations, The National Manufactured Housing Act of 1974 Part 3280. In most jurisdictions this requirement remains in force *when the structural, electrical plumbing or mechanical systems are altered*. The Code of Federal Regulations, Housing and Urban Development, Part 3280 *Manufactured Home Construction and Safety Standards* is applicable throughout the USA for manufactured housing construction (also known as “HUD code” housing).
2. There are other types of factory-built housing that do not fall directly under the classification “HUD code” which must also be reviewed for special installation considerations when designing a CSST gas piping system or appliance retrofit. Some examples of this type of housing are Assembly Buildings, Panelized, Modular, and Production Build. *TracPipe* should not be considered for RVs, which are subject to over the road use and not just initial placement or repositioning.
3. Part 3280 *Manufactured Home Construction and Safety Standards 1994* has not been revised or updated for several years. There has been an effort by both NFPA and CABO (now a part of the ICC) to have the US Congress adopt a new Manufactured Housing Code. The latest version of the CABO Code *ICC/ANSI 2.0 Manufactured Housing Construction Safety Standards* is available but has not been adopted by Congress.
4. Omegaflex has obtained a written opinion from the U.S. Department of Housing and Urban Development regarding the use of *TracPipe* CSST. This HUD decision states “CSST, such as *TracPipe*, is allowed to be used in HUD manufactured homes (based upon incorporation of *NFPA 54-1992 ANSI 223.1 The National Fuel Gas Code* into Section 3280.703 Minimum Standards).” This opinion shall be confirmed with State authorities responsible for inspections of HUD Code buildings prior to installing *TracPipe* after the home has left the factory. For factory installations, approval by the DAPIA (Manufacturer’s Design Approval Primary Inspection Agency) is normally required for the piping system design. Contact Omegaflex for specification data and a copy of the HUD decision letter.

B. PIPING SYSTEM DESIGN REQUIREMENTS

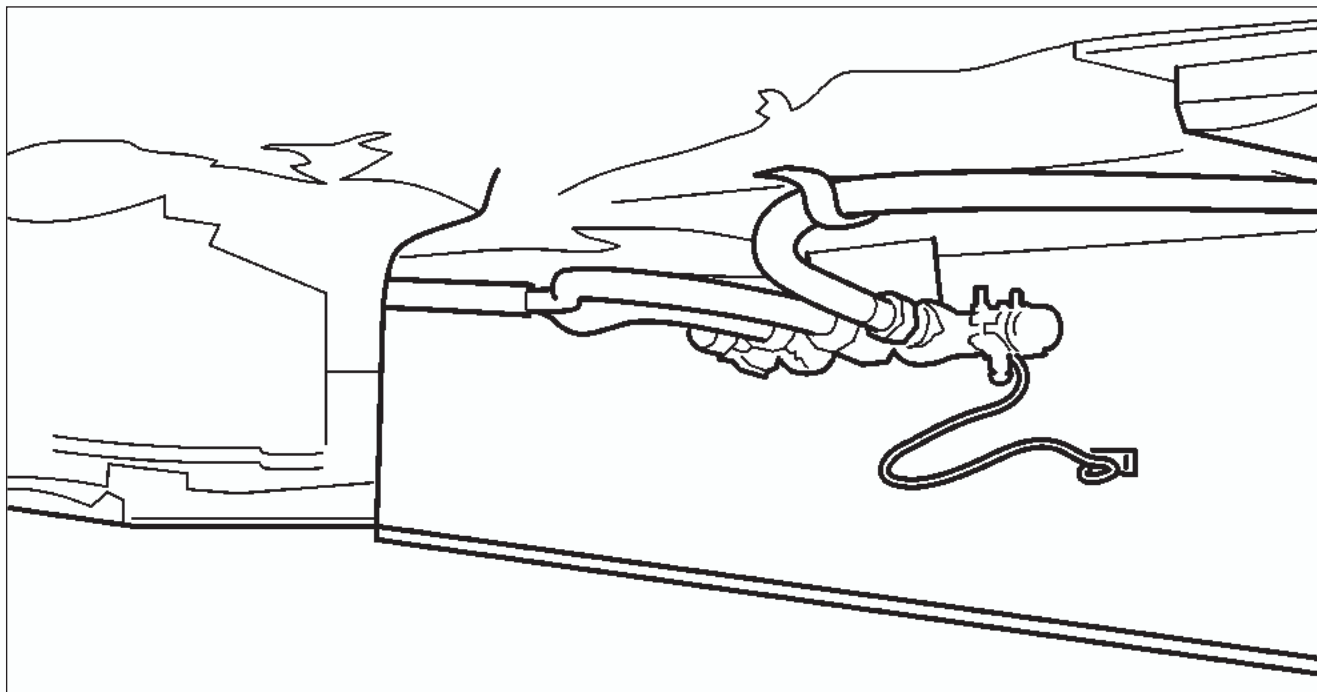
1. The primary information for any *TracPipe* installation is contained in the *TracPipe Design Guide and Installation Instructions* (latest edition). This guide provides manufacturer’s instructions that are a requirement of the ANSI/CSA LC-1 Standard governing certification and test requirements for Corrugated Stainless Steel Tubing. Manufacturer’s instructions must be followed.

2. Sizing for gas piping systems in HUD Code homes must be performed in accordance with Part 3280 (Natural Gas piping system acceptable for LP-gas). System sizing is to be done with Low Pressure Capacity Charts utilizing 0.5-inch water column drop. (see Chart N-1 in the *TracPipe* Design Guide)
3. The natural gas supply connections shall not be less than the size of the gas piping but shall not be smaller than 3/4-inch nominal pipe size. Gas supply connection shall not be beneath an exit door. Gas supply connection shall be rigidly anchored to a structural member within 6 inches of supply connection. All exterior openings around piping shall be sealed to resist the entrance of rodents.
4. Where fuel gas piping is to be installed in more than one section of an expandable or multiple-unit home, crossover connections between sections of the home shall be constructed by one of the following methods:
 - A. Listed quick disconnect device, designed to provide a positive seal of the supply side of the gas piping system when such device is separated.
 - B. Flexible connectors listed for exterior use and a shutoff valve of the non-displaceable rotor type conforming to ANSI Z21.15, installed on supply side.
 - C. Direct plumbing (CSST) sized in accordance with Natural Gas Low Pressure Capacity Chart N-1 (see above).
5. The flexible connector, direct plumbing pipe or "quick-disconnect" device shall be provided with protection from mechanical and impact damage and located to minimize the possibility of tampering. For gas line crossover connections made with CSST or flexible connectors, the crossover points shall be capped on the supply side to provide a positive seal and covered on the other side with a suitable protective covering.
6. All points of crossover shall be accessible from the exterior of the home.



C. INSTALLATION REQUIREMENTS

1. The preferred location for CSST flexible gas piping is beneath the floor and inside or above the I-beam flange. This location will provide the best protection from transit damage. Appliance stub-outs are easily made utilizing termination mounts or flange mounts rigidly attached to the floor. Final connections can be made with approved flexible appliance connectors downstream from the appliance shut-off valve. All floor penetrations shall be sealed to resist the entrance of rodents. All CSST should be within the envelope or rigidly attached to the I-beam flange.
2. Where CSST must cross an I-beam flange, the piping shall be securely attached to the house flange to protect the CSST. Angle iron, C-channel or a wooden block are recommended means of attachment. It is preferred to drill through a wooden structural member if possible to avoid crossing the flange.
3. In open joist construction, routing should be within the open web portion of the fabricated joist wherever possible. This location provides necessary support points at each joist location.
4. In all locations, CSST must be supported in accordance with the manufacturer's instructions (every 4 feet-3/8 size, 6 feet-1/2 size, 8 feet-3/4 size and 1 inch size) Support should be with metal EMT conduit straps or two-point attachment plastic clips suitable for the size of the tubing.



5. If a manifold is used, it shall be rigidly mounted to the I-beam flange. This applies to parallel system layouts. Gas pressure in HUD Code homes is limited to 14 inches water column maximum. Line pressure regulators are not necessary for this pressure and should not be used.

6. The gas piping shall be bonded to the frame of the home by the use of:
 - a. Solderless type grounding terminal with a star washer bolted to the chassis;
 - b. Grounding clamp attached to a gas piping fitting. (For attachment of clamp to *TracPipe* fitting, refer to Section 4.10 – Electrical Bonding/Grounding. Do not clamp to the stainless steel portion under any circumstances.); and
 - c. A bonding conductor of #8 copper wire.
7. Concealed tubing: CSST shall not be run inside walls, partitions or roofs. Where tubing passes through walls, floors, partitions, roofs, or similar installations, such tubing shall be protected by the use of weather resistant grommets that shall snugly fit both the tubing and the hole through which the tubing passes. DO NOT remove the yellow polyethylene jacket in any penetrations.
8. All CSST tubing joints shall have any exposed sections of stainless steel piping wrapped with silicone self-bonding tape. The under-floor portion of the manufactured home is considered an outdoor location. Proper support (per item 4 above) is required under the floor.
9. Retrofit of appliances:
 - a. The gas supply connection shall be rigidly anchored to a structural member within 6 inches of supply connection.
 - b. CSST shall be supported and protected per manufacturer's instructions. (See items 4 and 7 above.)
 - c. Pressure test gas piping per Item D 1 below before operating appliance.

D. INSPECTION AND TEST REQUIREMENTS

1. Pressure test in accordance with Part 3280.705k (8) testing for leakage (8 i) before appliances are connected and (8 ii) after appliances are connected.



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