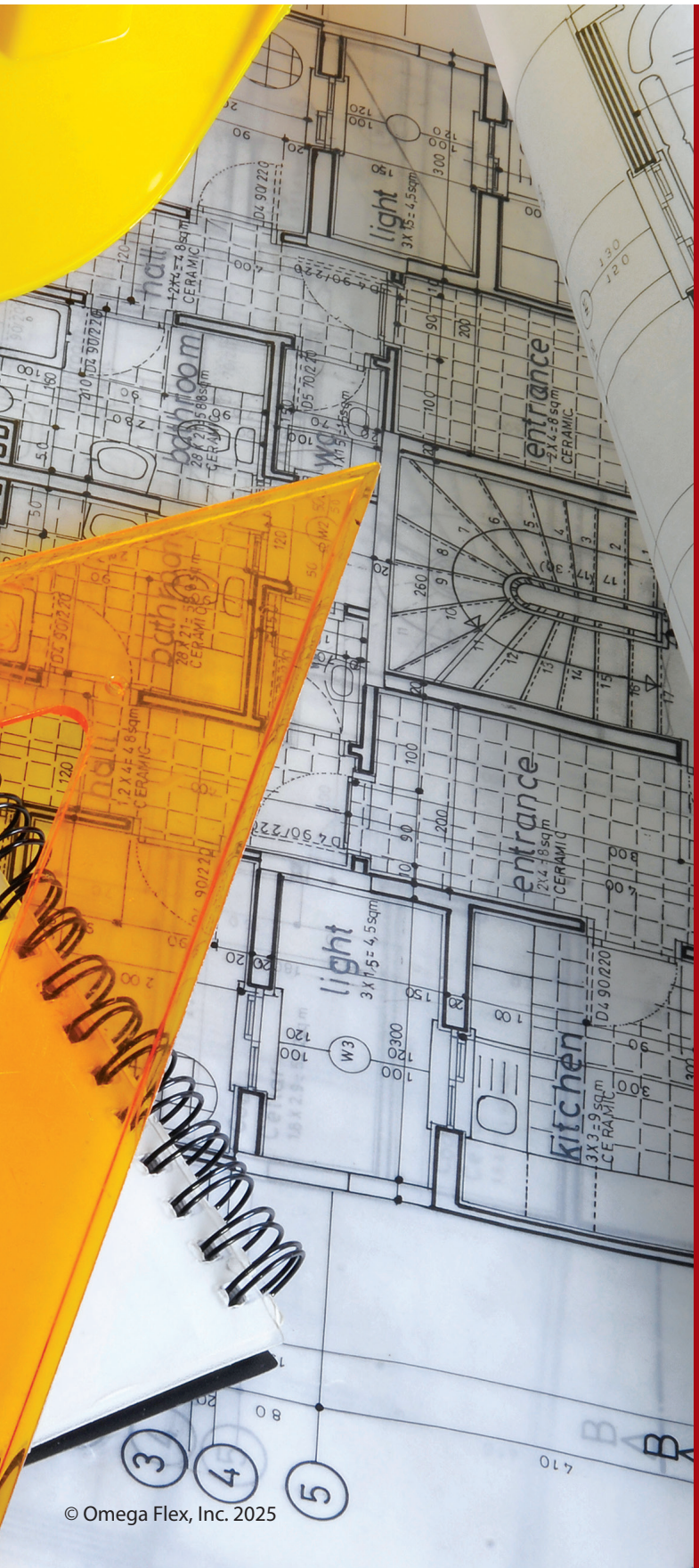
Commercial • Industrial • Residential

TracPipe® CounterStrike®

Flexible Gas Piping by OmegaFlex®



Canadian Flexible Gas Piping Design Guide & Installation Instructions

April 2025

FGP-001CAN 04/25


xible stainless steel piping product for natural gas and propane
tions. AutoFlare is the self-piloting fitting that attaches TracPipe
to traditional gas fittings and appliances. No special
tools or additional parts are required.
TracPipe
Flexible Gas Piping by OmegaFlex
AutoFlare
The Self-Flaring Fitting for TracPipe
AutoFlare

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CHAPTER 1 INTRODUCTION

⚠ WARNINGS

Section 1.0 - USER WARNINGS/ DANGERS

Each installer must meet applicable qualifications in accordance with state and/or local requirements as established by the administrative authority which enforces the plumbing or mechanical codes where gas piping is installed.

The TracPipe and TracPipeCounterStrike CSST (corrugated stainless steel tubing) flexible gas piping material must only be installed by a qualified person who has been sucessfully trained through the TracPipe gas piping installation program.

This guide is updated periodically. Installers must use the most current version of the guide. Copies of updated guides are available for free at locations where the **TracPipe** and **TracPipeCounterStrike** CSST is sold or online at www.tracpipe.ca.

The guide must be used in conjunction with territorial, provincial, 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 the National Standard of Canada, Natural Gas and Propane Installation Code, CSA B149.1.

Warranty Information

All sales are subject to our Limited Warranty, which is available at https://omegaflexcorp.com/legal/information and

The jacket on the **TracPipe** and **TracPipeCounterStrike** CSST shall not be removed, altered, or modified in any fashion, including full or partial painting or coating of the surface and the mounting of adhesively attached plastic or paper labels without the express consent of Omega Flex, Inc.

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. All installations must pass inspections by the local authority having jurisdiction prior to having the gas service turned on.

Only the components provided or specified by Omega Flex, Inc. as part of the approved piping system may be used in the installation.

⚠ DANGER

The interconnection of TracPipe and TracPipeCounterStrike tubing or AutoFlare and AutoSnap fittings directly with or on tubing or fittings from other CSST manufacturers is strictly prohibited and may result in a hazardous condition leading to serious bodily injury or property damage.

Omega Flex, Inc.
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610-524-7272 Fax: 610-524-7282

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SECTION 1.1 — APPLICABLE MODEL CODES, STANDARDS AND LISTINGS

MODEL CODES:
A. CSA B149.1 Natural Gas and Propane
B. CSA C22.1 Canadian Electrical Code Part 1

STANDARDS:
A. CSA/ANSI LC-1•CSA 6.26
B. UL Through Penetration Firestop Systems Classification
C. Tested for flame spread and smoke density per ASTME84.
D. IAPMO IGC 201 Polyethylene Sleeved-Corrugated Stainless Steel Tubing for use in Fuel Gas Piping Systems
E. ICC AC156 Acceptance criteria for seismic qualification by shake table texting of non-structural components.

LISTINGS:
CSA Certificate of Compliance #1082441
ICC-PMG-1046
ICC-PMG-1052
ICC-PMG-1058
IAPMO-ES-4665
ICC-ESR-4565 Seismic Resistance

NOTICE:

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).

NOTICE:

TracPipe CSST is the original yellow jacketed CSST gas piping system manufactured by **Omega Flex, Inc**.
TracPipeCounterStrike CSST is the next generation of CSST which includes an arc resistant black jacket.
TracPipeCounterStrike CSST is completely interchangeable with the existing **TracPipe** CSST installations. The installation must be in compliance with the electrical protection requirements included in Section 4.10 and the fuel gas code.

NOTICE:

While every effort has been made to prepare this document in accordance with the most current model codes in effect at its printing, **Omega Flex, Inc**. cannot guarantee that the local administrative authority adopts or accepts the most recent edition of these codes. The installer must use the current edition of the **TracPipeCounterStrike** Design Guide and Installation Instructions. The installer is ultimately responsible to determine suitability and acceptance of any building component, including gas piping. **Omega Flex, Inc**. assumes no responsibilty for materials or labor for installations made without prior determination of local code authority acceptance.

NOTICE:

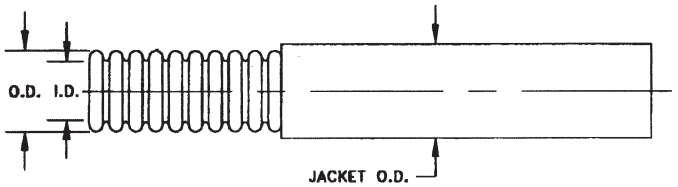
Installations of **TracPipe** and **TracPipeCounterStrike** CSST in Food Trucks, RV's or any other vehicle is not covered by these installation instructions and any such use of the piping system is not permitted by **Omega Flex, Inc**.

NOTICE:

For more information on the above referenced codes, standards, and listings pertaining to TracPipe products, contact the Omega Flex, Inc. Engineering Department.

TracPipe and TracPipeCounterStrike
SPECIFICATION DATA SHEET

FGP-CS-CHART



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	39	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

Figure: 1-1

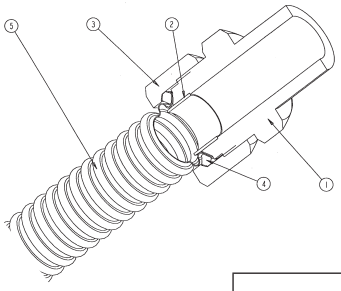
TracPipeCounterStrike

Part No.	FGP-CS-375	FGP-CS-500	FGP-CS-750	FGP-CS-1000	FGP-CS-1250	FGP-CS-1500	FGP-CS-2000
Size (inch)	3/8”	1/2”	3/4”	1”	1-1/4”	1-1/2”	2”
EHD* (AGA size)	15	19	25	31	39	46	62
Jacket O.D. (max.)	.700	.888	1.140	1.415	1.700	1.940	2.515
Inside Diameter (nom)	.440	.597	.820	1.040	1.290	1.525	2.060
Wall Thickness (in.)	.01	.01	.01	.01	.012	.012	.012

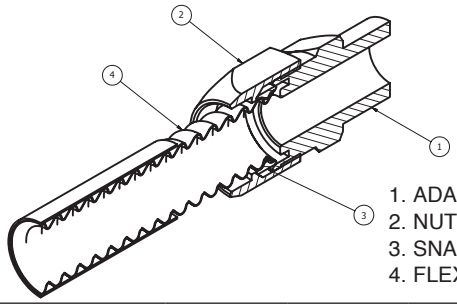
*EHD (Equivalent Hydraulic Diameter) A relative measure of Flow Capacity; This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

Figure: 1-2

Straight AutoFlare/AutoSnap Fittings



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

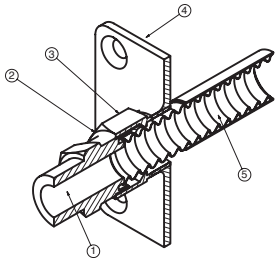


1. ADAPTER – Brass
2. NUT – Brass
3. SNAP RING – Brass
4. FLEXIBLE PIPE – Stainless Steel

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"

Figure: 1-3

Flange Mount AutoFlare/AutoSnap 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"

Figure: 1-4

CONSULT FACTORY FOR OTHER TERMINATION METHODS

CHAPTER 2
DESCRIPTION of SYSTEM and COMPONENTS

SECTION 2.0 — *TracPipe* and *TracPipeCounterStrike* CSST FLEXIBLE GAS PIPING MATERIAL DESCRIPTION

1. TUBING
The **TracPipe** and **TracPipeCounterStrike** CSST fuel gas piping systems consist of corrugated, flexible, semi-rigid stainless-steel tubing with brass mechanical attachment fittings terminating in NPT pipe threads 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 inches.

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 intervals with the amount of tubing left on the reel for quick measurement **(Figure 2-1)**.

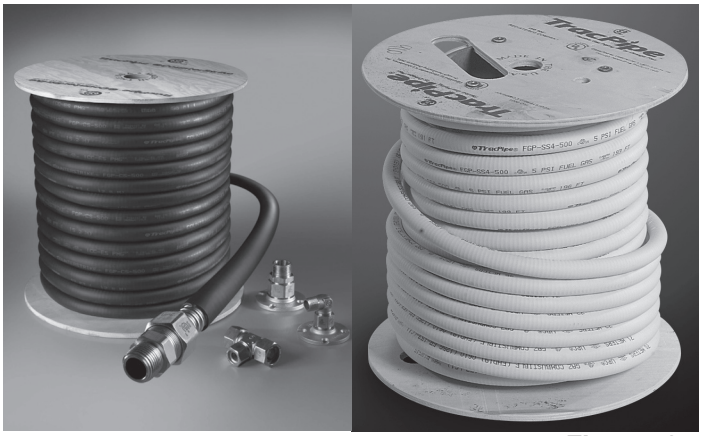


Figure: 2-1

2. FITTINGS
Straight NPT pipe fittings are standard and are available in sizes shown above to fit all tubing. Additional fittings including flange mounts with straight or 90-degree elbow fittings for termination of gas lines near movable appliances, and meter termination accessories for support of **TracPipe** and **TracPipeCounterStrike** CSST 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 termination 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:** Allows 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 **TracPipeCounterStrike CSST (Figure 2-2)**.

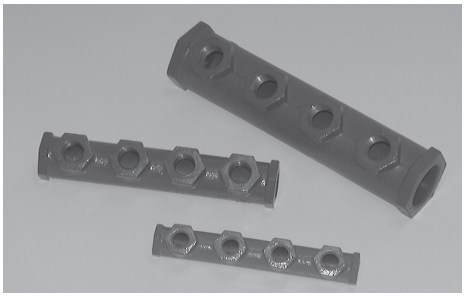


Figure: 2-2

B. **Pressure Regulators:** Pounds to inches - for use in elevated pressure system installations (over 14-inch water column- one-half PSI) to reduce pressure to standard low pressure for appliances. Regulators are available for use with natural and propane gas **(Figure 2-3)**.

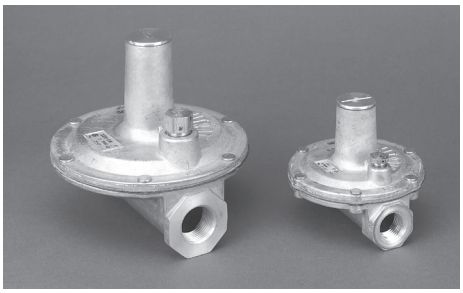


Figure: 2-3

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 five striker plate configurations made from stamped steel and specially hardened to resist penetration from screws and pneumatic nail guns. These are a quarter-striker, half-striker, three-quarter striker, full-striker, and 6-inch x 17-inch flat plate striker. Spiral wound galvanized steel "floppy" conduit is available for additional protection **(Figure 2-4)**.

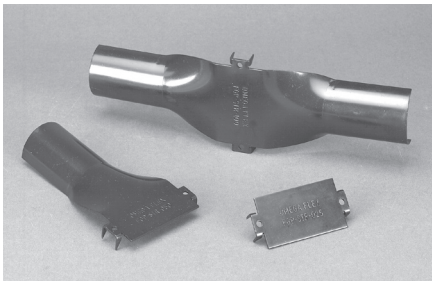


Figure: 2-4

D. **Shut-off Valves:** for use in elevated pressure installations: 2 PSI up to 5 PSI. (Standard gascocks 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 **(Figure 2-5)**.

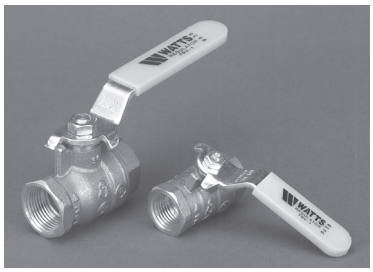


Figure: 2-5

SECTION 2.1 — MATERIAL USE AND LIMITATIONS

NOTICE:

For additional specifications see submittal sheets on the website at www.tracpipe.ca

NOTE: This Design and Installation guide was written using 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 designing, installing, and testing flexible fuel gas piping systems for residential, commercial, and industrial buildings. It is not possible for this guide to anticipate every variation of construction style, building configuration, appliance requirement, or local restriction. This document will not, therefore, cover every application. The user should exercise his/her engineering judgment on system design and installation or seek technical input from other qualified sources. Additional information about gas piping systems is available from your local gas utility or propane supplier. Some of the special usage features of **TracPipe** and **TracPipeCounterStrike** CSST gas piping are as follows.

1. Flexible gas piping is used to provide safe, efficient, and timely installation of fuel gas piping within residential, commercial, and industrial buildings or for outdoor connections to appliances attached to 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 rooftops or along soffits, or in chases outside of buildings. **TracPipe** and **TracPipeCounterStrike** CSST gas piping has been tested and listed by CSA International for outdoor and indoor use.

3. CSA International lists **TracPipe** and **TracPipeCounterStrike** CSST for fuel gas use in Canada and rates it for pressures up to 25 PSI. It has been tested for use up to 125 PSI for sizes 3/8 inch up to 1-1/4 inch for local gas utility-approved use only.

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 contruction. 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 CAN/CSA B149.1. Natural gas and propane installation code.

6. **TracPipe** and **TracPipeCounterStrike** CSST comes in two variations, one with a yellow polyethylene jacket (**TracPipe**) and the other (**TracPipeCounterStrike**) with a black polyethylene jacket. Both have been rigorously tested by Underwriters Laboratory to ASTM E84 (UL723) Surface Burning Characteristics and have received favorable flame spread and smoke density ratings enabling both to be installed in return air plenums. It is important to note, however, that adherence to fire and building code requirements is mandatory for all installations. If you require more detailed information regarding flame spread and smoke density tests, please reach out to **TracPipe** and **TracPipeCounterStrike** CSST Engineering.

7. If you plan to install **TracPipe** and **TracPipeCounterStrike** CSST underground or in solid flooring, you must encase the tubing in a duct made of polyethylene or another approved water-resistant material. The duct should provide free airspace around the tube and be ventilated. You can easily accomplish this by using pre-sleeved **TracPipe PS-II** piping.

8. Flexible gas piping can be utilized along with steel pipes (black iron or galvanized) or copper tubing in new constructions, renovations, and replacement piping installations. All **TracPipe** and **TracPipeCounterStrike** CSST fittings come with standard NPT male or female pipe threads, making it easy to interface with appliances, valves, unions, and couplings.

9. **TracPipe** and **TracPipeCounterStrike** CSST is a flexible piping solution that is ideal for retrofit installations. It can be easily snaked through hollow wall cavities without the need for major restoration work, which is typically required when running rigid pipes through existing construction.

10. **TracPipe** and **TracPipeCounterStrike** CSST can be run directly to the shut-off valves of fixed appliances without requiring an appliance connector. However, an approved flexible appliance connector is essential in most jurisdictions for moveable appliances such as ranges or dryers. It is important to note that **TracPipe** and **TracPipeCounterStrike** CSST cannot be used as a substitute for a connector in this case, especially if the appliance is free to move for cleaning or any other purpose.

11. **TracPipe** and **TracPipeCounterStrike AutoFlare/ AutoSnap** fittings have been tested by CSA International and are listed for use in concealed locations. Concealed fittings facilitate the installation of the critical valves required for gas fireplaces in many jurisdictions. They are also desirable when adding tees for branch runs in series configurations and in other installation situations where locating a **TracPipe** and **TracPipeCounterStrike** CSST fitting in an accessible location is impractical **(Figure 2-6)**.

12. **TracPipe** and **TracPipeCounterStrike** CSST have been evaluated for resistance to damage imposed by shifting appliances and damage to structural framing caused by earthquakes. Seismic Performance can be referenced under listing ICC-ESR-4565.

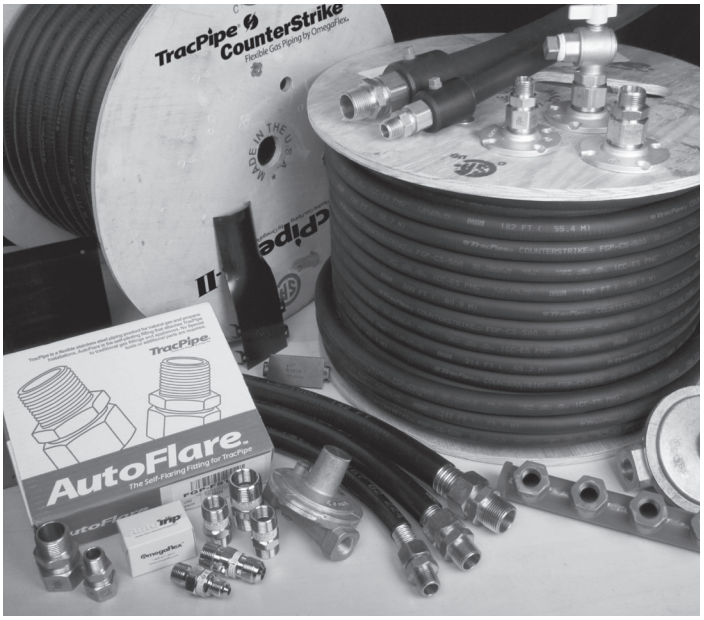
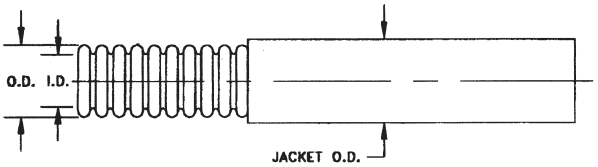


Figure: 2-6

SECTION 2.2 — SYSTEM COMPONENTS *TracPipe* Flexible Gas Piping

Component	Material	Description/Dimensions
TracPipe Flexible Gas Piping	Corrugated Stainless Steel (300 Series) with Polyethylene Jacket	

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	39	46	62
Jacket O.D. (max.)	.700	.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

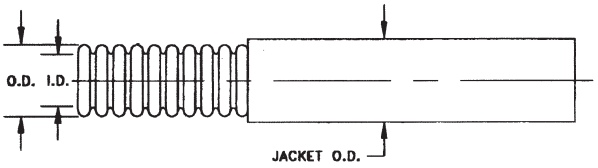
*EHD (Equivalent Hydraulic Diameter) A relative measure of Flow Capacity; This number is used to compare individual sizes between different manufacturers. The higher the EHD number the greater flow capacity of the piping.

TracPipe on Reels	Plywood Reels for packaging	

Pipe Size	Standard Reel Length	Weight Long Reel
3/8″	250', 100'	29 lbs
1/2″	500', 250', 100', 50'*, 25'*	87 lbs
3/4″	250', 100', 50'*, 25'*	55 lbs
1″	180', 100', 50'*, 25'*	60 lbs
1-1/4″	250', 150'	115 lbs
1-1/2″	250', 150'	125 lbs
2″	150'	92 lbs

Note: other reel lengths available upon request.
Note: Reel length followed by an * indicates a coil.

TracPipeCounterStrike Flexible Gas Piping

TracPipe CounterStrike Flexible Gas Piping	Corrugated Stainless Steel (300 Series) with Polyethylene Jacket	

Part No.	FGP-CS-375	FGP-CS-500	FGP-CS-750	FGP-CS-1000	FGP-CS-1250	FGP-CS-1500	FGP-CS-2000
Size (inch)	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
EHD (AGA size)	15	19	25	31	39	46	62
Jacket O.D. (max.)	.700	.888	1.140	1.415	1.700	1.940	2.515
Inside Dia. (nom)	.440	.597	.820	1.040	1.290	1.525	2.060

*EHD (Equivalent 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.

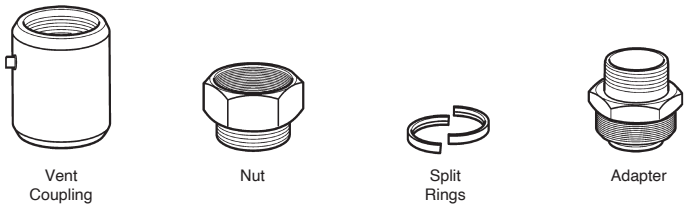
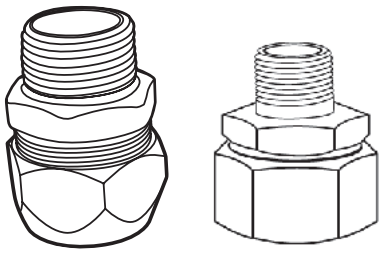
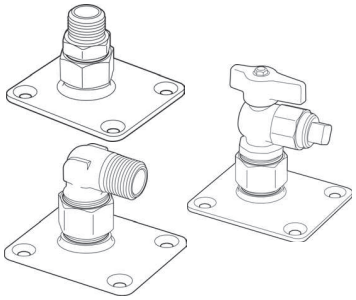
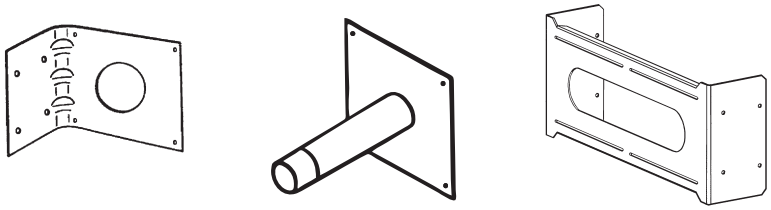
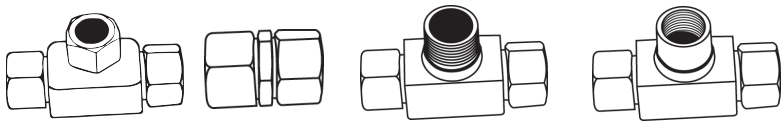
TracPipe CounterStrike on Reels	Plywood Reels and Banded Coils for Packaging	

Pipe Size	Standard Reel Length	Maximum Reel Weight
3/8″	250', 100'	37 lbs
1/2″	500', 250', 100', 50'*, 25'*	98 lbs
3/4″	250', 100', 50'*, 25'*	70 lbs
1″	180', 100', 50'*, 25'*	70 lbs
1-1/4″	250', 150'	129 lbs
1-1/2″	250', 150'	182 lbs
2″	150'	137 lbs

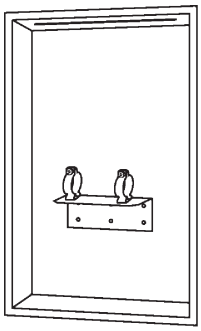
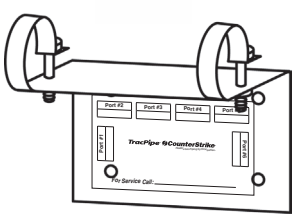
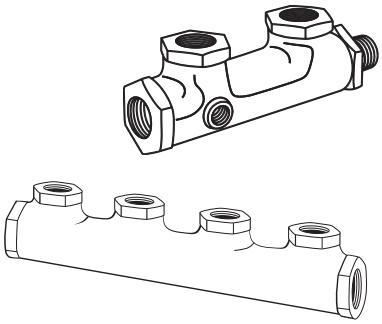
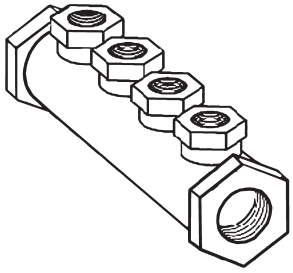
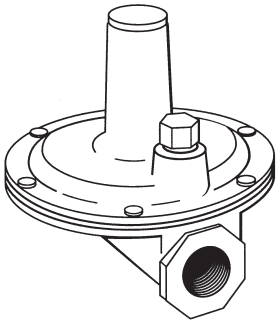
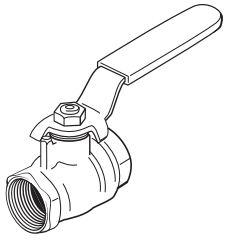
Note: other reel lengths available upon request.
1/2", 3/4" and 1" tubing available in a 25 ft. coil
Note: Reel length followed by an * indicates a coil.

TracPipe AutoFlare/AutoSnap Fittings

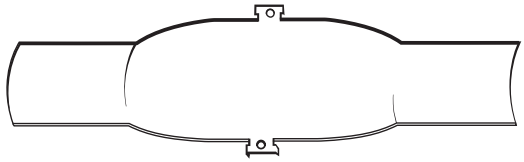
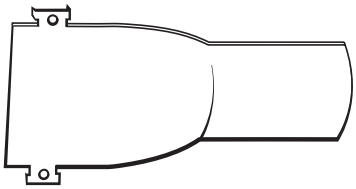
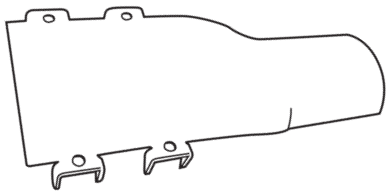
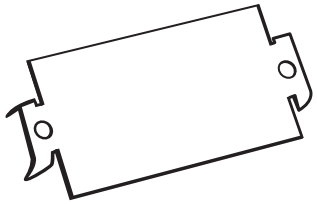
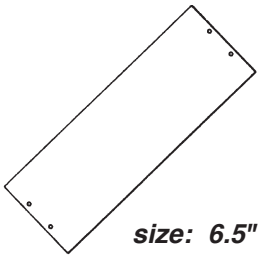
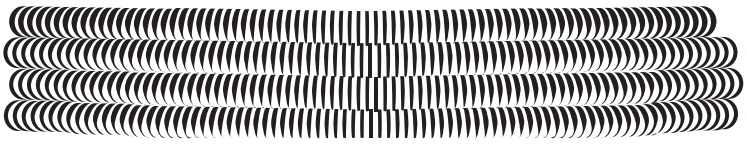
The fittings and accessories pictured on the following pages are representative of the range of products available from **TracPipe** CSST. Refer to the latest **TracPipe** Price Sheet for a complete listing of part numbers.

Component	Material	Description/Dimensions
TracPipe PS-II Accessories		 Vent Coupling; Nut; Split Rings; Adapter
Straight Mechanical Fitting Reducer Fitting	Brass Fitting ***AutoSnap Autoflare***	 ***Sizes: 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2" and 2"*** ***Note size 3/8" fitting has either 1/2" NPT or 3/8" NPT Thread***
Termination and Flange Mount Fittings- Straight and 90 Elbow	Brass Fitting ***AutoSnap AutoFlare***	 ***Sizes: 3/8", 1/2", 3/4", 1", and 1-1/4"*** ***Note size 3/8" fitting has either 1/2" NPT or 3/8" NPT Thread*** ***Elbow Sizes: 3/8" and 1/2"***
Meter Termination Bracket Stub Out Stud Bracket	Galvanized Steel Mounting Bracket	***BIP Stub-out with Mounting Plate*** 
Tee Fitting and Coupling	Brass Tee Fitting & Coupling ***Autoflare***	 ***Sizes: 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2", and 2"*** ***Reducer tees available for 1/2", 3/4", 1", 1-1/4", 1-1/2", and 2" sizes***

TracPipe Accessories

Component	Material	Description/Dimensions
Load Center Manifold Bracket	Painted Steel Galvanized Steel	 
Multi-Port Manifolds	Malleable Iron Poly Coated	 
Pressure Regulators	Cast Housing Suitable for Outdoor Use	 ***Sizes: 1/2", 3/4", 1"*** ***Regulator includes approved vent limiting device for REG-3 (1/2 inch), REG-5A (3/4 inch) and REG-7L (1").*** ***Note: Stainless steel high pressure tags are available for use where required by code***
Shut Off Valves	Brass Housing with Stainless Steel Ball	 ***Sizes: 1/2" and 3/4"***

TracPipe Accessories

Component	Material	Description/Dimensions
Full Striker Plate	Carbon Steel Hardened	 ***size: 3" x 12"***
Half Striker Plate & Three Quarter Striker Plate	Carbon Steel Hardened	 ***size: 3" x 7"***  ***size: 3" x 8"***
Quarter Striker Plate	Carbon Steel Hardened	 ***size: 3" x 2"***
6.5 x 17 Striker Plate	Carbon Steel Hardened	 ***size: 6.5" x 17"***
Floppy Strip Wound Conduit	Type RW Galvanized Steel	 Fits sizes ***3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2", and 2" TracPipe***

CHAPTER 3
SYSTEM CONFIGURATIONS AND SIZING

SECTION 3.1 — SYSTEM CONFIGURATIONS

Using **TracPipe** and **TracPipeCounterStrike** CSST flexible gas piping material, the installer has several piping system options. This design flexibility is one of CSST's major benefits.

3.1.1 — LOW PRESSURE SYSTEMS

1. The most common arrangement for black iron pipe is a series layout. It consists of a primary pipeline with tees branching off to each appliance **(Figure 3-1)**.

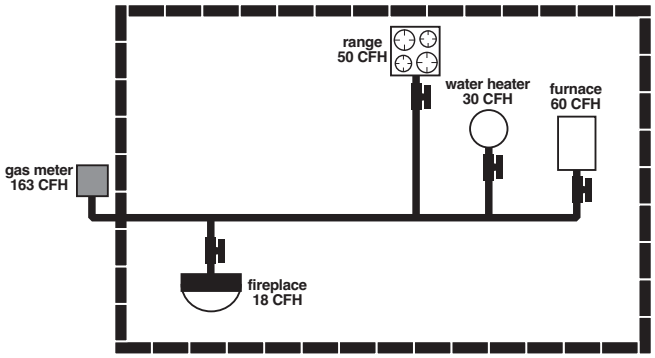


Figure: 3-1
Series Layout

2. PARALLEL: A parallel system consists of a main supply line connected to a central distribution manifold. From there, individual branch runs are installed to supply gas to each appliance location. This is achieved by providing a dedicated supply line, known as a "home run," to each appliance. The pressure in the parallel system is not elevated above 1/2 pound, which means that no regulator is needed **(Figure 3-2)**.

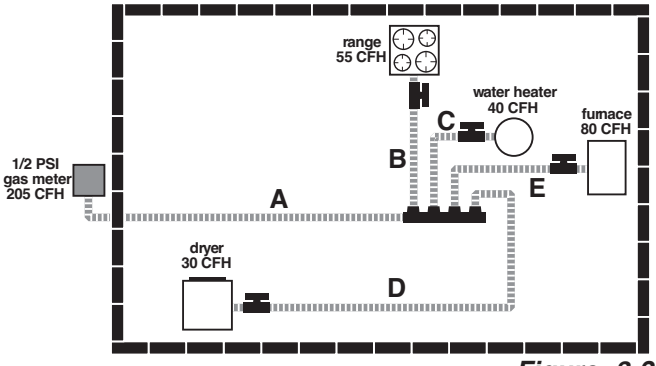


Figure: 3-2
Parallel Layout

3.1.2 — DUAL PRESSURE SYSTEMS

Elevated pressure systems are commonly installed in residential installations with 2 PSI and up to 5 PSI for commercial installations. These systems are usually equipped with one or more line pressure (LP) regulators, which convert pounds of pressure to inches. Line pressure regulators are followed by a manifold, and runs are then connected to each appliance. It is possible that these runs may contain tees branching off to an additional appliance where gas loads permit **(Figure 3-3)**.

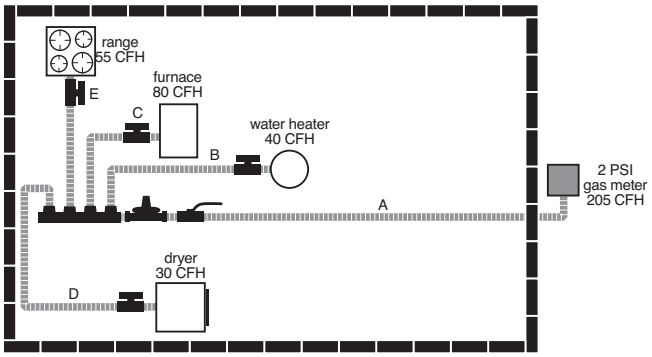


Figure: 3-3
Dual Pressure System Layout

NOTICE:

HYBRID SYSTEMS - FLEXIBLE GAS PIPE and RIGID BLACK PIPE COMBINATIONS.
When setting up low or medium-pressure gas systems, using both corrugated stainless-steel tubing and rigid pipe in the same system can be beneficial. This is especially true when a larger diameter main branch is needed to support the total appliance load in a parallel system. **TracPipe** and **TracPipeCounterStrike** CSST are certified for use in combination with black iron pipe and copper tube gas piping systems. You can find examples of how to size hybrid systems using **TracPipe**, **TracPipeCounterStrike** CSST, and black iron pipe in the SIZING EXAMPLES section of this guide under Section 3.2.3.

SECTION 3.1.3 — SYSTEM DESIGN

1. Create a sketch or design of the gas piping system you intend to install. You will need to know each appliance's location, the delivery point (where the utility meter or second-stage LP regulator is located), the appliance load demands, and possible pipe routing locations. You can find the load demand data on the appliance manufacturer's nameplate or request it from the builder.

2. Before installation, determine any local piping restrictions. The Natural Gas and Propane Installation Code B149.1 recognizes corrugated stainless-steel tubing, but regional and provincial adoption of the most recent edition of this code may be delayed. MAKE SURE THAT THE LOCAL CODE AUTHORITY HAS APPROVED THE USE OF FLEXIBLE GAS PIPING. Your **TracPipe** and **TracPipeCounterStrike** distributor should be able to provide this information, but if you have any questions, please confirm them with the installer.

SECTION 3.1.4 — 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 - The standard pressure supplied by natural gas utilities in Canada is 6 to 7 inches of water column, which is equivalent to 4 ounces or ¼ pounds.

   b. MEDIUM PRESSURE - Many natural gas utilities offer an enhanced pressure supply of 1/2 pound or 12 to 14 inches water column, allowing for pipe size reductions and not requiring a pressure regulator. Most natural gas appliances designed for use in Canada can operate at a maximum of 14 inches of water column.

   c. ELEVATED PRESSURE - In Canada, 2PSI is the maximum natural gas pressure generally provided to single-family residential buildings. However, a pound-to-inches house line regulator must be installed between the utility meter and the appliances to regulate this pressure and ensure safe usage. Elevated pressures make it possible to use smaller diameter piping while accommodating heavier loads and longer length runs.

2. PROPANE (LP GAS) is typically supplied within residential buildings at 11 inches water column which is 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 use, use a line gas pressure regulator that is set for 11 inches water column outlet pressure.

NOTICE:

TracPipe and **TracPipeCounterStrike** CSST have been tested by CSA International for a working pressure of 125 PSI for sizes 3/8" through 1-1/4".

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 3.2.1 — USE OF SIZING TABLES

This chapter provides guidance for determining the appropriate size of piping required for both low-pressure and elevated-pressure systems. When designing a piping system, it is crucial to consider the pressure loss that occurs within the system. The amount of pressure loss is dependent on the size of the piping and the gas flow rate expressed in cubic' per hour (and converted to BTUs). The goal of the sizing exercise is to determine the smallest size of piping that will ensure adequate volume and pressure of gas to each other appliance while accounting for piping system pressure loss. To accomplish this, sizing tables (also known as capacity charts) are used to provide the capacity for a given length of piping for each pipe size. It is important to note that each system pressure and pressure drop combination requires a different sizing table **(For all Capacity Tables Refer to Chapter 7)**.

1. The low-pressure series system (standard arrangement) is sized like a conventional low-pressure black iron pipe system using **TracPipe** and **TracPipeCounterStrike** CSST sizing tables. This method is known as the “Longest Length Method”. Pressure drop in a low-pressure system is traditionally limited to 0.5- or 1.0-inch water column over the system based on supply pressure and appliance requirements.

2. Elevated pressure systems have two pressure settings downstream of the utility meter. The first pressure, which is typically 2 PSI, is set by the service regulator at the meter. This part of the system is sized separately and ends at the pounds-to-inches regulator. The maximum loads through the regulator are shown in the chart in Section 4.8C.

3. For a 2PSI system, it's usually recommended to have a pressure drop of 1 PSI. This drop is necessary to provide the required inlet pressure into the regulator and provide 1/4 PSI (6-7 inches w.c.) outlet pressure for appliances. The regulator reduces the pressure from pounds to 8 inches of water column. The portion of the system downstream from the regulator is sized the same as a low-pressure system and is typically designed for only one appliance load per manifold port.

SECTION 3.2.2— SIZING EXAMPLES - Branch Length METHOD

To determine the appropriate size for each section and outlet of the system, you need to calculate the required size. To do that, you need to determine the total gas load for all appliances and find out the longest distance in the system. This will help you size each section of the system appropriately.

EXAMPLE 1: LOW PRESSURE SYSTEM SERIES ARRANGEMENT

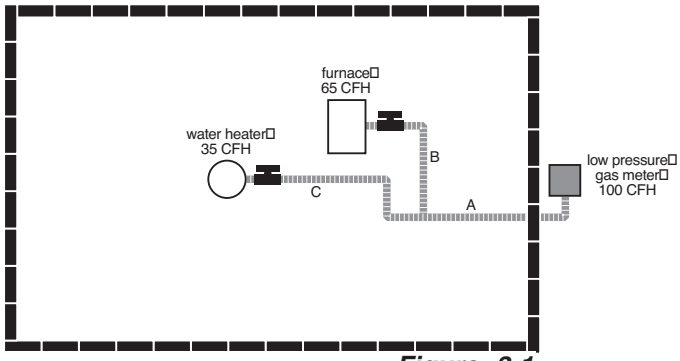
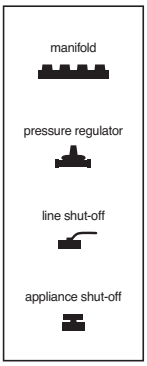


Figure: 3-1



LENGTH OF RUNS
A = 10'
B = 10'
C = 15'

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

1. The diagram depicted in **Figure 3-1** is an example of a single-family setup, where a few appliances are placed together in a specific area. The supply pressure for this setup is 6 inches of water column, and the permissible drop is 1/2 inch.

2. To size Section A, determine the longest run from the gas meter that includes it and the total gas load it must deliver.
   - Meter to Furnace is 20' (A+B).
   - Meter to Water Heater is 25' (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 inch-1/2 inch w.c. drop".
   - To determine the appropriate pipe size, use the longest length method and select the column displaying the measured length. If the table does not show the exact length, choose the next longest length. Refer to **Table N-1** and locate the column for 25' of piping. The sizes 3/8 and 1/2 are too small, and the next available size is 3/4, which will supply 157 CFH.
   - The correct size for Section A is 3/4 inch.

3. To size SECTION B, use the same column identified above and the load delivered:
   - Length is 25' (A+C) and load is 65 CFH (65,000 BTU).
   - **Table N-1** shows that size 3/4 inch supplies 157 CFH.
   - The correct size for Section B is 3/4 inch.

4. To size SECTION C, use the 25' length and determine the required load:
   - Length is 25' (A+C) and load is 35 CFH (35,000 BTU).
   - **Table N-1** shows that size 1/2 inch is required, because size 3/8 inch only supplies 29 CFH (29,000 BTU).

5. The correct size for Section C is 1/2 inch.

EXAMPLE 2: MEDIUM PRESSURE 7-14 INCHES W.C. (1/2 PSI)

1. **Figure 3-2** shows the system 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 (1-inch water column) than with low-pressure systems.

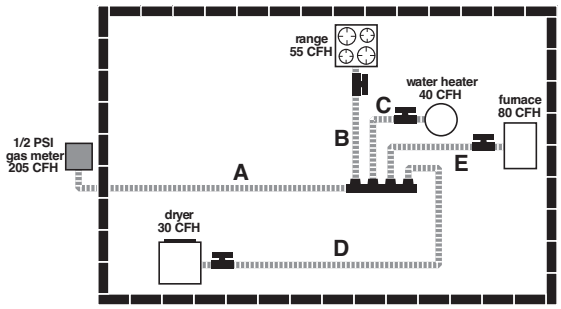
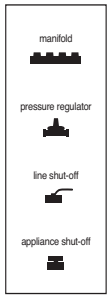


Figure: 3-2



LENGTH OF RUNS
A = 10'
B = 20'
C = 10'
D = 40'
E = 10'

Supply pressure 1/2 PSI
(7 inch-14 inch w.c.)
Allowable drop: 1 inch w.c.

2. To size **SECTION A**, determine the LONGEST RUN from the meter to the furthest appliance:
   - Meter to dryer is 50' (10+40) A+D.
   - Determine maximum load transported by section A.
   - Dryer + Range + Water heater + Furnace = 205 CFH (205,000 BTU).
   - Select **Table N-2** "Medium Pressure 1/2 PSI with 1 inch drop". **Table N-2** shows that 3/4 inch size is too small for 205 CFH at 50' but 1 inch can handle 267 CFH.
   - The correct size for Section A is 1 inch.

3. To size **SECTION B**, the distance remains 50':
   - Load is 55 CFH (55,000 BTU).
   - **Table N-2** shows that 1/2 inch size can handle 63 CFH.
   - The correct size for Section B is 1/2 inch.

4. To size **SECTION C**, the distance is 50':
   - Load is 40 CFH (40,000 BTU).
   - **Table N-2** shows that 1/2 inch size can handle 63 CFH.
   - The correct size for section C is 1/2 inch.

5. To size **SECTION D**, the distance is 50':
   - Load is 30 CFH (30,000 BTU).
   - **Table N-2** shows that 1/2 inch size can handle 63 CFH at 50'.
   - The correct size for section D is 1/2 inch.

6. To size **SECTION E**, the distance is 50':
   - Load is 80 CFH (80,000 BTU).
   - **Table N-2** shows that 3/4 inch size can handle 157 CFH at 50'.
   - The correct size for SECTION E is 3/4 inch.

EXAMPLE 3: ELEVATED PRESSURE 2 PSI SYSTEM-PARALLEL ARRANGEMENT

1. The system shown in **Figure 3-3** is adapted for multifamily or single-family applications with an extended (100') 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.

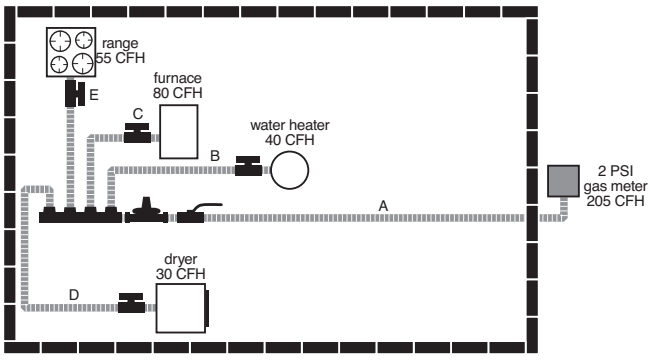
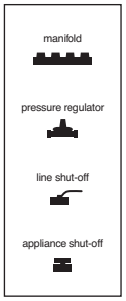


Figure: 3-3



LENGTH OF RUNS
A = 100'
B = 15'
C = 10'
D = 25'
E = 20'

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

2. To size **SECTION A** determine the entire gas load it will deliver:
   - Furnace + Water Heater + Dryer + Range = 80 CFH + 40 CFH + 30 CFH + 55 CFH = 205 CFH(205,000 BTUH) Select **Table N-3**

   "Elevated Pressure 2 PSI with 1 PSI drop'' This is the standard table chosen to stay within the FGP-REG-3 regulator capacity. See NOTICE below.
   - Length is 100 ft.
   - **Table N-3** shows that 3/8 inch size is too small for 205 CFH but 1/2 inch can handle 226 CFH..
   - The correct size for Section A is 1/2 inch.

3. To size each of the other sections:
   Select **Table N-2** "Regulator Outlet 8.0 inches w.c with a drop of 1.0 inches w.c:
   - **Section B** is 15' with a 40 CFH load 3/8 inch has a capacity of 52 CFH.
   - **SECTION C** is 10' with a 80 CFH load 1/2 inch has a capacity of 138 CFH.
   - **SECTION D** is 25' with a 30 CFH load 3/8 inch has a capacity of 41 CFH.
   - **SECTION E** is 20' with a 55 CFH load 1/2 inch has a capacity of 99 CFH.

Supply Pressure and Capacities

Based on flow in cubic' per hour

P/N	1/2 PSI (34 mbar)	3/4 PSI (52 mbar)	1 PSI (69 mbar)	1-1/2 PSI (103 mbar)
FGP-REG-3	145 (4.1)	200 (5.7)	250 (7.1)	250 (7.1)
FGP-REG-5A	335 (9.5)	475 (13.5)	550 (15.6)	500 (15.6)
FGP-REG-7L	690 (19.5)	970 (27.5)	1000 (28.3)	1000 (28.3)

EXAMPLE 4: MEDIUM PRESSURE 7-14 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 (7-14 inch W.C. with 1-inch W.C. drop), with a single run feeding both the range and barbecue in series.

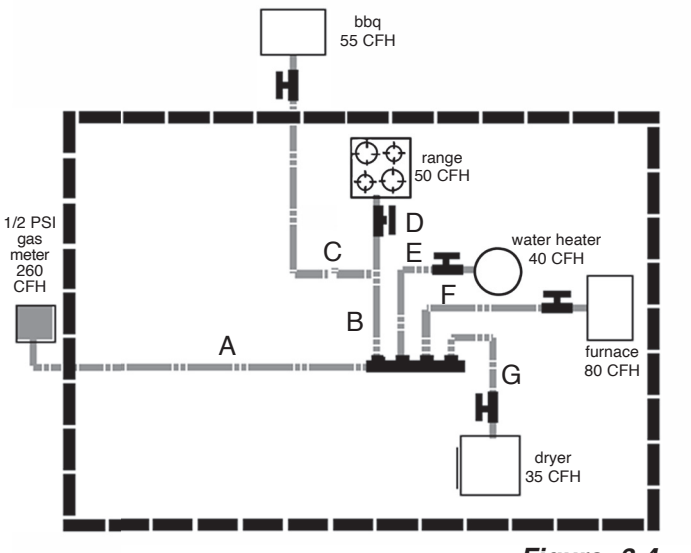


Figure: 3-4

LENGTH OF RUNS

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

2. To size **SECTION A**, determine the length of the longest run from the meter and the entire gas load it must deliver:
   - Range + Barbecue + Water Heater + Furnace + Dryer = 260 CFH (260,000 BTUH).
   - The meter to Barbecue is 75' (A+B+C), is the longest length.
   - Select **Table N-2** Medium Pressure. **Table N-2** shows that 1-1/4 inch is required for 260 CFH at 75'
   - The correct size is 1-1/4 inch.
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).
   - The longest length is 75' (A+B+C) from the meter to the Barbecue.
   - **Table N-2** shows that size 3/4 inch can handle 129 CFH at 75'.
   - The correct size is 3/4 inch.
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-2** shows that size 3/4 inch can handle 129 CFH at 80'
   - The correct size is 3/4 inch.
5. To size **SECTION D**, the distance is 75 ft.
   - Load is 50 CFH (50,000 BTUH).
   - **Table N-2** shows that size 1/2 inch can handle 52 CFH at 75'..
   - The correct size is 1/2 inch.
6. To size **SECTION E**, the distance is 75 ft.
   - Load is 40 CFH (40,000 BTUH).
   - **Table N-2** shows that size 1/2 inch can handle 52 CFH at 30'.
   - The correct size is 1/2 inch.
7. To size **SECTION F**, the distance is 75 ft.
   - Load is 80 CFH (80,000 BTUH).
   - **Table N-2** shows that size 3/4 inch can handle 129 CFH at 30'.
   - The correct size is 3/4 inch.
8. To size **SECTION G**, the distance is 75 ft.
   - Load is 35 CFH (35,000 BTUH).
   - **Table N-2** shows that size 1/2 inch can handle 52 CFH at 40'.
   - The correct size is 1/2 inch.
   - **Table N-2** shows that size 1/2 inch can handle 52 CFH at 40'.
   - The correct size is 1/2 inch.

Section 3.2.3 — SIZING HYBRID SYSTEMS - Black Iron, *TracPipe* and *TracPipeCounterstrike* Combination

To size a commercial or a residential system with a rigid black iron trunk line and flexible **TracPipe** and **TracPipeCounterStrike** CSST branches feeding the appliances, you will need both the standard gas piping capacity tables for black iron printed in the B149 Natural Gas and Propane Installation Code and the **TracPipe** and **TracPipeCounterStrike** CSST Capacity Tables printed later in this guide.

NOTICE:

Black iron pipe Capacity Table is provided in this Design Guide **Section 7.2**.

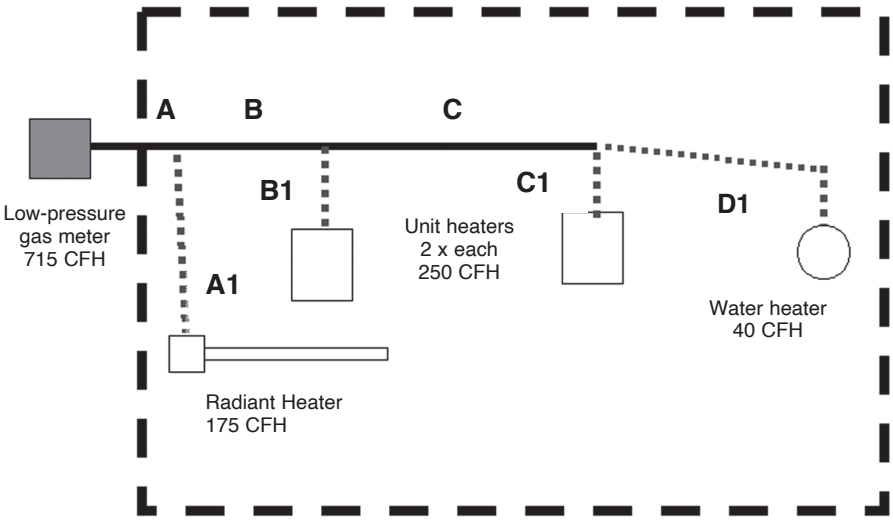


Figure: 3-5

LENGTH OF RUNS
A = 15' C = 20'
A1 = 45' C1 = 5'
B = 15' D1 = 20'
B1 = 10'

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

1. 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.
2. 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'**. Total Load is 715 CFH). Section A correct size is 2 inch black pipe.
3. To determine rigid pipe size **(SECTION B)**, reduce load by the load carried in section A1 to the Radiant Heater (175 CFH). Use the same number for length: 70' is the longest run. The load for this section is 540 CFH **SECTION B**. The correct size is 1-1/2-inch black pipe..
4. To determine rigid pipe size **(SECTION C)** reduce load further by the load carried in **SECTION B1** to the first unit heater (250 CFH). Use the same number for the length: 70' is the longest run. The load for this section is 290 CFH. **SECTION C**, The correct size is 1-1/4-inch black pipe.
5. To calculate the appropriate size of **TracPipe** and **TracPipeCounterstrike** CSST required for the branch runs, you need to add up the total length of black pipe and **TracPipe** CSST starting from the meter to the furthest appliance. The load taken into account is the load of each individual piece of equipment.
6. To determine the size of **TracPipe** and **TracPipeCounterstrike** CSST (Section D1) the length is 70' and the load is 40 CFH. Using **Table N-1 SECTION D** correct size is 3/4 inch.
7. To determine the size of **TracPipe** and **TracPipeCounterstrike** CSST (Section C1) the length is 70' and the load is 250 CFH. Using **Table N-1 SECTION C1** correct size is 1-1/4 inch.
8. To determine the size of **TracPipe** and **TracPipeCounterstrike** CSST (Section B1) the length is 70' and the load is 250 CFH. Using **Table N-1 SECTION B1** correct size is 1-1/4 inch.
9. To determine the size of **TracPipe** and **TracPipeCounterstrike** CSST (Section A1) the length is 70' 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

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.

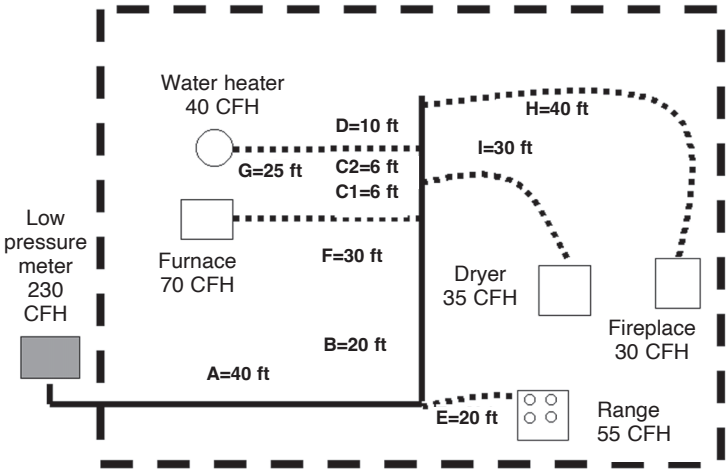


Figure: 3-6

2. The black iron trunk line (A+B+C1+C2+D) will be initially sized for a drop of 0.5-inch w.c. using **Table SP-1** in accordance with the standard method (longest run).

NOTE:
Table SP-1 is used as the available chart from this guide, The user may opt to use a 1.0 inch w.c. drop black iron steel pipe table from the code if available.

   Then, every **TracPipe** and **TracPipeCounterstrike** CSST branch run leading to an appliance will be sized for 1.0-inch w.c. pressure drop based on the longest total run. The maximum pressure drop to each appliance will be 1.0-inch w.c.

3. The longest total run is 122', which includes the total length of all black iron sections and the **TracPipe** and **TracPipeCounterstrike** CSST section to the furthest appliance. The total load is **70+40+55+35+30=230** CFH. The correct size for
   A is 1-1/4 inch.

4. **SECTION B** has the longest run remains at 122', but the load is now reduced to 175 CFH. The correct size for B is 1-1/4 inch.

5. **SECTION C1**, the longest run is 122' and load is reduced to 105. Correct size is 1 inch

6. **SECTION C2**, the longest run is 122' and load is reduced to 70. Correct size is 3/4 inch.

7. **SECTION D**, the longest run is 122' and load is reduced to 30. Correct size is 1/2 inch.

8. **SECTION E**, length is 122' and the load is 55 CFH. From **Table N-2** the correct size is 3/4 inch.

9. **SECTION F**, length is 122' and the load is 70 CFH. From **Table N-2** the correct size is 3/4 inch.

10. **SECTION G**, length is 122' and the load is 40 CFH. From **Table N-2** the correct size

11. **SECTION H**, length is 122' and the load is 30 CFH. From **Table N-2** the correct size is 1/2 inch.

12. **SECTION I**, length is 122' and the load is 35 CFH. From **Table N-2** the correct size is 1/2 inch.

SECTION 3.2.4 — ALTERNATE SIZING METHOD: SUM OF PRESSURE LOSS CALCULATIONS

1. There are two methods for pipe sizing: the longest-run sizing method and the Sum of Pressure Loss Calculations method. The Sum of Pressure Loss Calculations method is more accurate as it provides results closer to the actual friction loss results obtained from testing each section of an installed gas piping system. Contrary to the longest-run method, this approach avoids the simplified, conservative approximations. In the engineering world, it is understood that placing a building's entire load at the farthest equipment outlet is inaccurate and often yields larger pipe sizes than necessary. The longest-run method was created when gas utilities could not guarantee constant pressure at every meter during high demand. While it is customary in Canada, the code permits other engineered calculations.

2. Calculating the pressure loss in each section of a gas piping system can result in more precise system designs and potentially smaller piping diameters compared to the traditional longest-run method. These calculations use pressure loss charts for each size of CSST, developed from actual test results. The Sum of the Pressure Loss method is explained below with tables that show pressure loss per foot based on the total load supplied by that length of pipe with all appliances operating. This method predicts the maximum flow capacity more accurately than the longest-run method.

3. The system designer needs to determine the load and length for each run. They select a tentative size and determine the pressure loss in that leg by multiplying the loss per foot (inches w.c. from the chart) by the length. Starting from the meter and moving outward, the pressure loss for each leg is 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 permissible pressure loss for each system is the system designer's responsibility. It is based on model codes, 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.) If the initial proposed design calculation results in a higher total pressure loss than allowed, the designer should recalculate with larger sizes, starting from the meter.

USING SUM OF PRESSURE LOSS METHOD EXAMPLE: 7 LOW-PRESSURE SYSTEM SERIES ARRANGEMENT

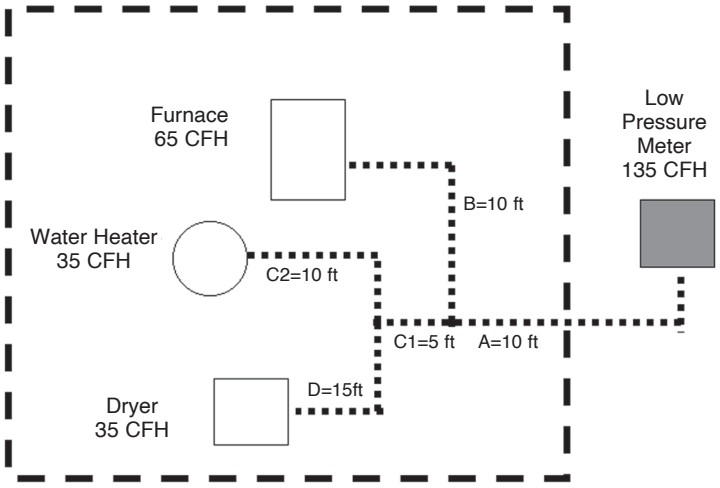


Figure: 3-7

1. The system shown in **Figure 3-7** is similar to the one in **Figure 3-1,** which is a single-family installation with an additional appliance, a dryer. The supply pressure is 6 inches of water column, and the allowable pressure drop is 0.5 inches.

2. To determine the appropriate size for SECTION A, you need to calculate the load that it will carry. This load is the sum of the Furnace, Water Heater, and Dryer, which equals 135 CFH (135,000 BTU). Using **Table PD-1A**, you can find the pressure loss at 135 MBTU load through ¾ inch **TracPipe** and **TracPipeCounterStrike** CSST. The average of 0.0135 and 0.0158 is 0.0147. The drop per foot is 0.0147, which you need to multiply by the length of 10' to get a drop of 0.147.

3. To determine the appropriate size for SECTION B, you need to find the drop per foot for the load carried by that section, which is the Furnace Load 65 CFH (MBTU). Using **Table PD-1A**, you can find the pressure loss at 65 MBTU through 1/2-inch **TracPipe** and **TracPipeCounterStrike** CSST. Use the average pressure loss between 60 and 70 MBTU, which is 0.0177 and 0.0244, respectively. The average of these is 0.0211. The drop per foot is 0.0211, which you need to multiply by the length of 10' to get a drop of 0.211. Sum pressure loss meter to Furnace 0.147 + 0.211 = .358-inch w.c. This leg is sized properly at 1/2 inch because the 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-1A** find pressure loss at 70 MBTU load through ½ inch **TracPipe** CSST. Drop per foot is .0244; length is 5'; 5 X .0244 is .122.

5. To size **SECTION C2** find the drop per foot for the load carried by that section:
   • 35 CFH (MBTU)
   Using **Table PD-1A** find pressure loss at 35 CFH load through ½ inch **TracPipe** CSST. Average of .0077 and .0042 is .0060; length is 10'; 10 X .006 is .06. Sum of pressure loss to water heater 0.147 + .122 +.06 = .329 inches w.c. This leg is sized properly at ½ inch 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-1A** find pressure loss at 35 MBTU through ½ inch **TracPipe** CSST. Drop per foot is .006 (See number 4 above); multiply by length 15' = .09. Sum of pressure loss to dryer 0.147 + 0.122 + .09 = .359 inch w.c. This leg is sized properly at ½ inch because the 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: 8 LOW PRESSURE HYBRID SYSTEM (Steel Pipe and *TracPipe* Combination) SERIES ARRANGEMENT USING SUM OF PRESSURE LOSS METHOD

1. The system presented in **Figure 3-8** 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 inch water column..

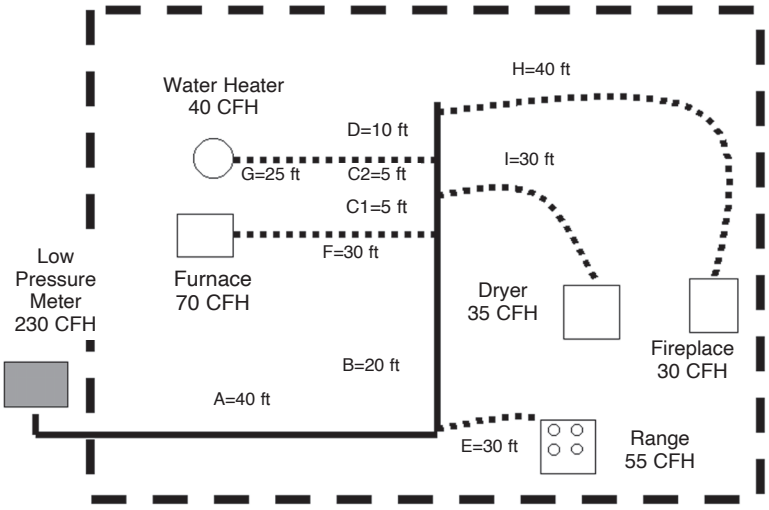


Figure: 3-9

NOTICE:

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 3.2.

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 calculate the pressure loss in **SECTION A** (steel pipe trunk), you must use the load that passes through this section (230 CFH). For 1-¼ inch steel pipe, consult **Table PD-2A** to find the pressure loss per foot. Suppose 230 CFH is not listed in the chart. In that case, you must estimate the pressure drop using the two flow rates above and below the desired capacity. The estimated pressure drop per foot is approximately 0.0018-inch w.c. Multiply the pressure drop per foot by 40' to get the total pressure loss for this section, which is 0.072.

4. To calculate the pressure loss in **SECTION B**, we need to know the load passing through it, which is 175 CFH. We can find the loss for a 1-inch size using **Table PD-2A**, which amounts to approximately 0.0041 inches w.c. Per foot. We then multiply this value by the length of the section, which is 20', to get the pressure loss for this section, which is 0.0820.

5. We can determine the pressure loss through **SECTION C1** by using the load through that section, 105 CFH. To find the pressure loss for 1 inch, we can refer to **Table PD-2A**, which gives us an approximate value of 0.0016-inch w.c. After that, we need to multiply the length of 5' by the loss per foot of 0.0016, indicating a pressure loss of 0.0080-inch w.c. for this section.

6. To calculate the pressure loss in **SECTION C2**, we need to determine the load that goes through that section (which is identified by 70 CFH). We can find the pressure loss for a ¾ inch unit using **Table PD-2A**, which comes to 0.0024' w.c. Next, we multiply the section length (5') by the loss per foot: 0.0024, indicating a pressure loss of 0.0120 inches w.c. for this section.

7. We use the load through **SECTION D** (30 CFH) to determine the pressure loss through the section. For a ½ inch diameter, find the pressure loss using **Table PD-2A**, which is 0.0020-inch w.c. Then, multiply this loss per foot by the length of 10' to get the pressure loss for this section, which is 0.0200-inch w.c.

8. To calculate the pressure loss in **SECTION E** (**TracPipe** and **TracPipeCounterStrike** CSST drop to range), determine the load through that section (55 CFH) and extrapolate the pressure loss using **Table PD-1A**. Assuming the ¾ inch column, the pressure loss is around 0.0029- inch w.c. Multiply the length of 30' by the loss per foot of 0.0029 to get the pressure loss for **SECTION E**, which is 0.0870. Add the pressure loss of **SECTION A** (0.072) to the loss of **SECTION E** (0.0870) to get the total loss from the meter to the range of 0.159, as this is less than the allowable.

9. To calculate the pressure loss through SECTION F (**TracPipe** and **TracPipeCounterStrike** CSST drop to the furnace), use the load (70 CFH) and refer to **Table PD-1A** to find the pressure loss. In the ¾ inch column, the pressure loss is 0.0038. Multiply the section length (30') by 0.0038 to obtain the pressure loss for this section, which is 0.1140. Add the loss of **SECTIONS A + B** to the loss of **SECTION F** to get the total loss from the meter to the furnace, which is 0.072 + 0.082 + 0.114 = 0.2680. The correct size for **SECTION F** is ¾ inch.

10. To calculate the pressure loss through **SECTION G**, i.e., **TracPipe** and **TracPipeCounterStrike** CSST drop to the water heater, use the load (plate number 1) and refer to **Table PD-1** to find the pressure loss. In the ½ inch column of the table, you will find the value 0.0077. Multiply this value with the length of 25', giving you a pressure loss of 0.1925 for this section. Add the loss of **SECTIONS A, B, C1**, and **C2** to the loss of **SECTION G** to get the total loss from the meter to the furnace. **SECTIONS A, B, C1**, and **C2** loss are 0.072, 0.0820, 0.0080, and 0.0120, respectively. Adding them to the loss of **SECTION G**, we get a total loss of 0.1740. Based on this calculation, the correct size for **SECTION G** is ½ inch.

11. To determine the pressure loss through **SECTION H**, the **TracPipe** and **TracPipeCounterStrike** CSST drop to the fireplace, you need to use the load (30 CFH) and find the pressure loss from **Table PD-1**. In the ½ inch column, you will find 0.0042. Then, multiply the length, which is 40', by 0.0042. This will give you the pressure loss for this section, which is 0.1680. To get the total loss from the meter to the furnace, add the loss of **SECTIONS A, B, C1, C2**, and **D** to the loss of **SECTION H**, which we calculated earlier. The total loss will be 0.072 + 0.0820+ 0.0080 + 0.0120 + 0.1680 = 0.3420. The correct size for **SECTION H** is ½ inch.

12. To calculate the pressure loss through **SECTION I** (**TracPipe** and **TracPipeCounterStrike** CSST drop to the Dryer), use the load (plate number 1) and refer to **Table PD-1**. In the ½ inch column, you will find 0.006. Multiply the length (30') by 0.006. The resulting value, 0.18, is the pressure loss for this section. Add the loss of **SECTIONS A, B**, and **C1** to the loss of **SECTION I** for the total loss from the meter to the Dryer. The total loss is obtained by adding 0.072, 0.0820, 0.0080, and 0.18, which equals 0.3420. The correct size for **SECTION I** is ½ inch. By using the Sum of Pressure Loss Method, you can determine that three of the five **TracPipe** and **TracPipeCounterStrike** CSST sections (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-inch water column. The Sum of Pressure loss Method enables the installer to use ½ inch **TracPipe** and **TracPipeCounterStrike** CSST on all sections except the furnace and range drops, which remain ¾ inch.

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** and **TracPipeCounterStrike** CSST gas piping (3/8 inch up to 1-1/4 inch 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. Pressure tests up to 125 PSI are permitted on sizes up to 1-1/4 inch.

2. Only components provided by **Omega Flex, Inc.** or specified as part of the **TracPipe** and **TracPipeCounterStrike** CSST piping system are to be used in the installation.

Do not use **TracPipe** and **TracPipeCounterStrike** CSST tubing or fittings with tubing or fittings of any other manufacturer. Itermixing 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.

⚠ WARNING

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. (Available: TracPipe Leak Check Solution P/N FGP-LCS). Call customer Service.

5. BENDING **TracPipe** and **TracPipeCounterStrike** CSST 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. Multiple tight bends can restrict the gas flow and increase pressure drop. The tightest bend allowed for each size of **TracPipe** and **TracPipeCounterStrike** CSST is shown in **Table: 4-1**.

RECOMMENDED MINIMUM BENDING RADIUS FOR FLEXIBLE GAS PIPING

Table: 4-1

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

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

6. **SUPPORTING**
TracPipe and **TracPipeCounterStrike** CSST Piping shall be supported in a workmanlike manner with pipe straps, bands, brackets or hangers suitable for the size and weight of the piping. **TracPipe** and **TracPipeCounter-Strike** CSST 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**.

NOTICE:

The B149.1 Natural gas and propane installation code requires the use of supports that are metallic and installed so as to prevent galvanic action between the tubing and the supports.

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	6 feet
1 inch	6 feet
1-1/4 inch	6 feet
1-1/2 inch	6 feet
2 inch	6 feet

SECTION 4.2

Section 4.2.1 — HOW TO ASSEMBLE TRACPIPE AUTOFLARE FITTINGS

1. CUT-TO-LENGTH: Determine proper length plus approx. three inches. Make a rough 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. **Figure 4-1**

NOTICE:

Due to the large diameter and depth of corrugations on sizes over ¾ inch, tubing must be cut with a **TracPipe** and **TracPipeCounterStrike** CSST cutting wheel P/N FGP-E-5272 installed in a standard tubing cutter RIGID 152 (remove standard RIGID 152 wheel and replace with FGP-E-5272). For use of the P/N FGP-E-5272 cutting wheel with other tubing cutters contact the **TracPipe** engineering department.

⚠ CAUTION

The use of a small cutting wheel may flatten the first corrugation and make cutting and/or sealing fittings difficult.

2. **STRIP JACKET and FINAL CUT:** Using a utility knife, strip back the jacket three inches. From the jacket, count out the required number of corrugations (6 for standard FST fittings, 9 for Termination type fittings) and make a final cut on the bare stainless steel between corrugations ensuring the maximum strip lengths in **Table 4-3** are maintained. Care should be taken to minimize the amount of jacket material removed.

⚠ CAUTION

For your personal safety, the Knife blade and cut tube ends are both sharp. Use care when cutting the jacket and handling the tube.

MAXIMUM STRIP LENGTH
Table: 4-3

Tubing Size	P/N Suffix	FST Fittings	Termination Type And PS-II Fittings
3/8"	-375	1-1/8"	1-1/2"
1/2"	-500	1-3/16"	1-1/2"
3/4"	-750	1-1/4"	1-3/4"
1"	-1000	1-3/8"	2"
1-1/4"	-1250	1-5/8"	2-1/4"
1-1/2"	-1500	1-5/8"	2-1/2"
2"	-2000	2"	2-3/4"

The Maximum exposed stainless steel tubing at the fitting joint before or after assembly is equal to or less than the Maximum Strip Lengths provided.

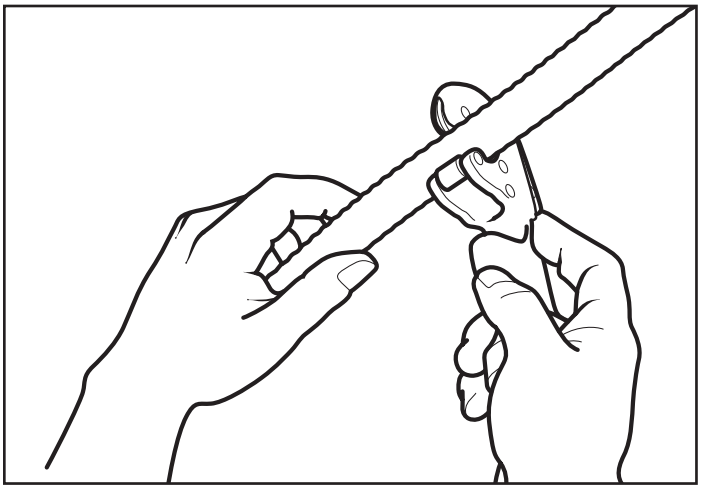


Figure: 4-1

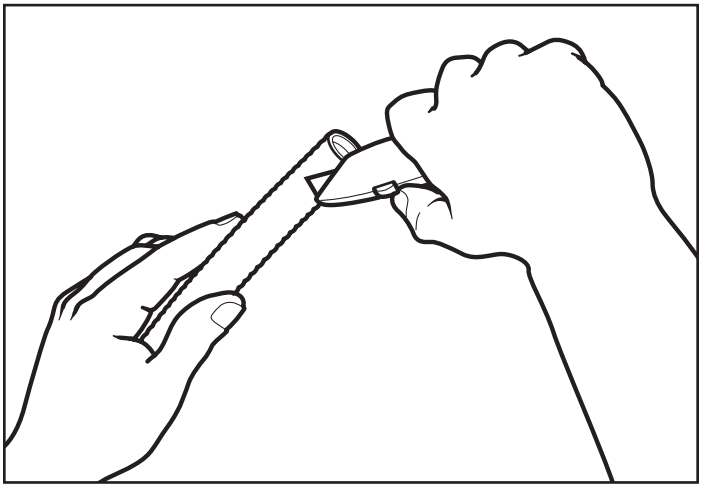


Figure: 4-2

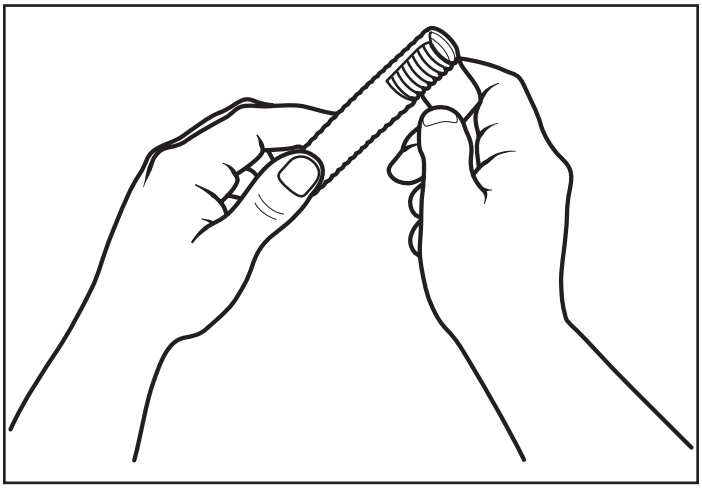


Figure: 4-3

Table: 4-4

FLEXIBLE PIPE SIZE	FITTING	TORQUE VALUE
3/8" FGP-SS4-375	FGP-FST-375	40' lb-ft
1/2" FGP-SS4-500	FGP-FST-500	42' lb-ft
3/4" FGP-SS4-750	FGP-FST-750	45' lb-ft
1" FGP-SS4-1000	FGP-FST-1000	75' lb-ft
1-1/4" FGP-SS4-1250	FGP-FST-1250	150'-200' lb-ft
1-1/2" FGP-SS4-1500	FGP-FST-1500	200'-250' lb-ft
2" FGP-SS4-2000	FGP-FST-2000	250'-300' lb-ft

3. **INSTALL FITTING NUT:** Slide the nut over the cut end: place two split rings into the first corrugation next to the tube cut. Slide the nut forward to trap the rings **(Figure 4-4)**.

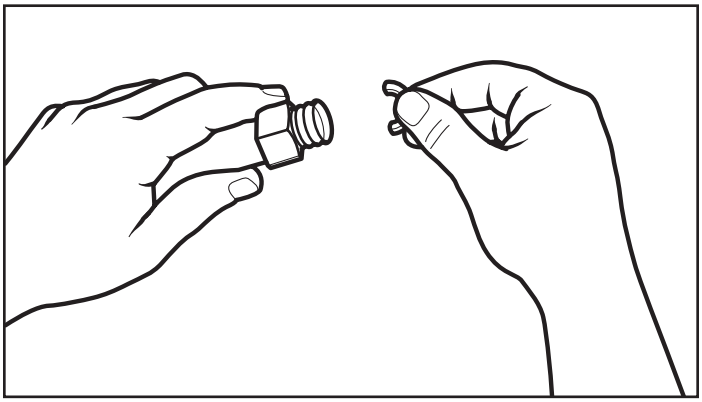


Figure: 4-4

4. **WRENCH FITTING:** Place the adapter into the nut and engage the threads. Note that the **TracPipe** and **TracPipeCounterStrike AutoFlare** fitting is designed to form a leak-tight seal on the stainless tubing as you tighten it. (The adapter's piloting feature 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 the adapter bottoms and the resistance to wrenching increases greatly. The flare has now been created on the tubing end.

⚠ WARNING

Do not use any thread sealants for this connection. Sealants are to be used on the pipe thread only.

5. **FINAL TORQUE:** To ensure a proper and leak-tight connection, please follow the torque values mentioned in **Table 4-4** while tightening the nut and adapter. If you are installing the field version, please use the following method: Tighten the nut and adapter as if you were tightening a flared tubing joint. Observe the relationship between the hex flats at this point and continue tightening for two more hex flats (one-third turn) to achieve the required torque and a final leak-tight seal **(Figure 4-5)**.

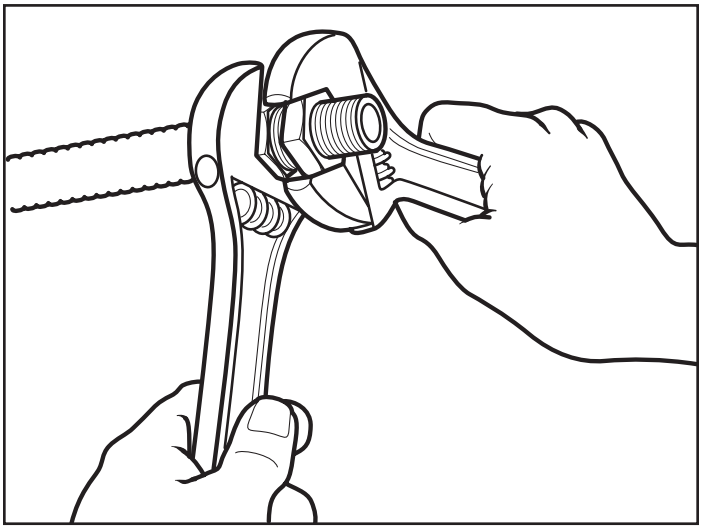


Figure: 4-5

Section 4.2.2 — HOW TO ASSEMBLE TracPipe Autosnap FITTINGS

⚠ WARNING

These instructions must be followed for installing TracPipe and TracPipeCounterStrike AutoSnap fittings to TracPipe and TracPipe CounterStrike CSST flexible gas piping.

⚠ CAUTION

Do not use pipe sealants on any part of these fittings except the NPT threads. Pipe wrenches are not recommended and may damage the fittings. Use adjustable or open-end wrenches whenever possible.

⚠ CAUTION

The knife blade and pipe ends are very sharp. Use care when stripping the jacket and handling tubing.

1. **CUT PIPE:** Determine proper pipe length and cut through the plastic jacket and stainless steel pipe using a tubing cutter with a sharp wheel. Cut the tubing approx. 3-4 corrugations longer than you need. The finished length will require THREE corrugations exposed for straight fittings and couplings and FIVE corrugations exposed for termination fittings.

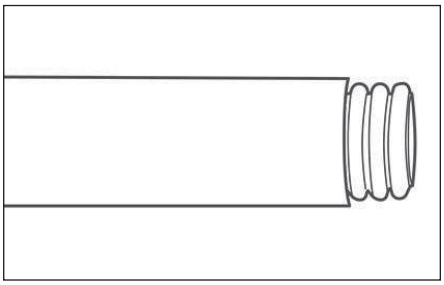


Figure: 4-6

NOTICE:

Due to the large diameter and depth of corrugations on sizes over ¾ inch, tubing must be cut with a **TracPipe** and **TracPipeCounterStrike** CSST cutting wheel P/N FGP-E-5272 installed in a standard tubing cutter RIGID 152 (remove standard RIGID 152 wheel and replace with FGP-E-5272). For use of the P/N FGP-E-5272 cutting wheel with other tubing cutters contact the **TracPipe** and **TracPipeCounterStrike** CSST engineering department.

2. **STRIP JACKET:** Using a utility knife with a sharp blade, strip back the jacket so that after making the final cut you will have THREE corrugation peaks left exposed for straight fittings and couplings and FIVE corrugations are left exposed for termination fittings. This is critical for the proper insertion of pipe into the fitting **(Figure 4-6)**. Make a final cut using full circular rotations in one direction, gradually tightening roller pressure after each revolution until a clean cut is obtained. Avoid overtightening roller as this may flatten the crowns of the corrugations and interfere with a gas tight seal. Inspect the pipe for a clean cut without tears or distortion.

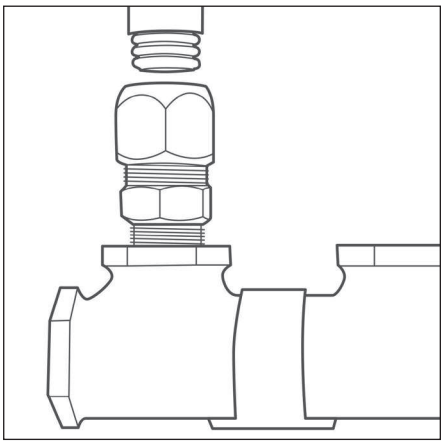


Figure: 4-7

INSTALLING STRAIGHT FITTINGS AND COUPLINGS

3. **NPT CONNECTION:** For couplings, skip this step. For straight fittings, connect the NPT threaded end to the termination point, i.e., manifold or appliance, using thread sealant. Tighten fitting to the termination point using an adjustable wrench on the body hex only **(Figure 4-7)**. **Do not make this connection by tightening the nut, or the assembly of the fitting to the pipe will not be possible without disassembly and reassembly of the fitting components.**

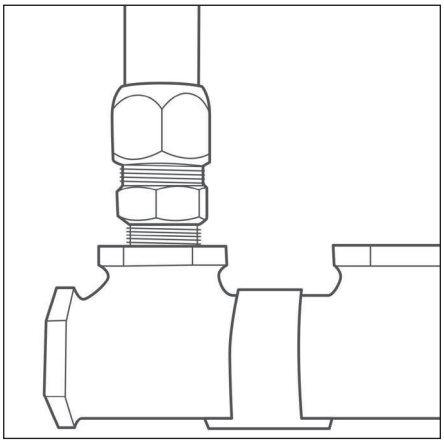


Figure: 4-8

4. **PIPE TO FITTING CONNECTION:** This step applies to straight and coupling fittings. Loosen the nut on the fitting 1 to 1-1/2 turns. Straighten the pipe end and insert it into the back of the fitting until it snaps into place **(Figure 4-8)**. While holding the tubing firmly into the fitting, tighten the nut by hand to capture the first corrugation. A gradual resistance to tightening by hand will be felt if inserted correctly. If a dead stop is felt, the pipe is not inserted properly, back off the nut, make sure the pipe is in completely, straighten and re-tighten by hand to confirm proper fit. Check to make sure the tubing is captured by pulling on the tubing. If the tubing has been captured, use adjustable wrenches and continue to tighten the nut to the specified torque value or until resistance has greatly increased. **Table 4-5** When the nut is fully tightened leak tight, there should be no more than ½ to 1 thread showing behind the nut.

5. Use a second adjustable end wrench on the fitting body as a backup while tightening the nut. Holding the nut and tightening it by turning the body may cause the pipe to twist. Over-tightening the nut may cause deformation that will not allow the fitting to be reused.

Table: 4-5

SIZE	MIN. TORQUE (LB-FT)
3/8"	25
1/2"	30
3/4"	40
1"	45
1-1/4"	55
1-1/2"	75
2"	90

INSTALLING FLANGE TERMINATION FITTINGS

A. MOUNT FLANGE: Mount flange to the desired location on a wall stud or floor using appropriate size screws to provide a firm mount (**Figure 4-9**). Do not attach the fitting to the flange at this point. This will be done after the fitting to the pipe connection has been completed. Insert pipe through the back of the flange after preparing pipe in accordance with steps 1 through 3, **making sure to strip the jacket to expose FIVE corrugations.**

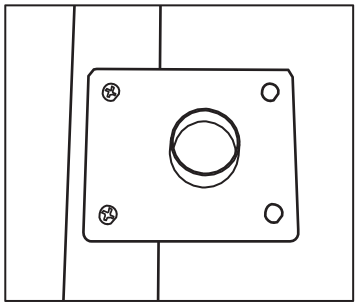


Figure: 4-9

B. PIPE TO FITTING CONNECTION: Attach fitting to pipe following all instructions in step 5. **Figure 4-10** Once the fitting has been tightened to the pipe, slightly loosen this connection until the fitting can be rotated on the pipe. **Figure 4-11** Screw the fitting onto the flange and tighten. Holding the flange fitting nut, re-tighten the body. **Figure 4-12**

⚠ CAUTION

This step must be followed to avoid excessive twisting of the pipe when tightened.

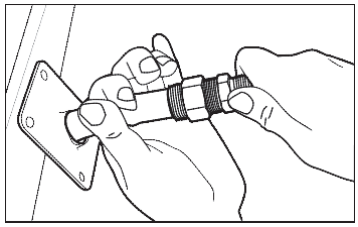


Figure: 4-10

INSTRUCTIONS FOR RE-USING FITTINGS

If there is a leak in the fitting, the most probable cause is that the pipe was not properly prepared and has a tear or excessive deformation in the last corrugation that interferes with proper sealing. To remove the pipe from the fitting, strip the jacket back behind the fitting nut/ flange about 1". Disassemble the fitting completely and push the pipe through the nut to expose the snap ring. Gently pry the ring off of the pipe and remove the pipe from the fitting. Inspect the ring for damage and replace it if necessary. Since the ring has been compressed into the back of the body, it must be re-sized before reusing. This is achieved by carefully spreading the ring open by hand or using small pliers. After opening up the ring, insert it into the fitting nut. If it inserts without resistance, it must be opened further. Once the ring has been installed, thread the nut and body back together loosely. Re-cut the tubing, prepare steps 1 through 3, and assemble to fitting.

If it inserts without resistance, it must be opened further. Once the ring has been installed, thread the nut and body back together loosely. Re-cut the tubing and prepare per steps 1 thru 3, and assemble to fitting.

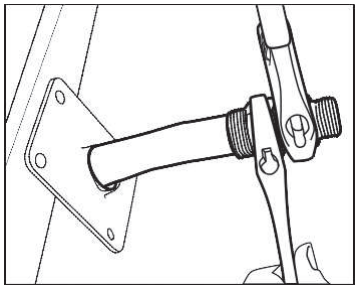


Figure: 4-11

⚠ CAUTION

The knife blade and pipe ends are very sharp. Use care when stripping jacket and handling tubing.

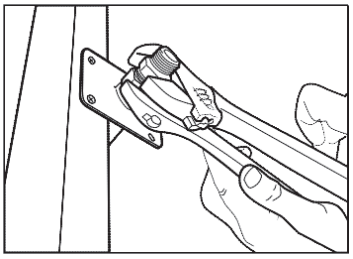
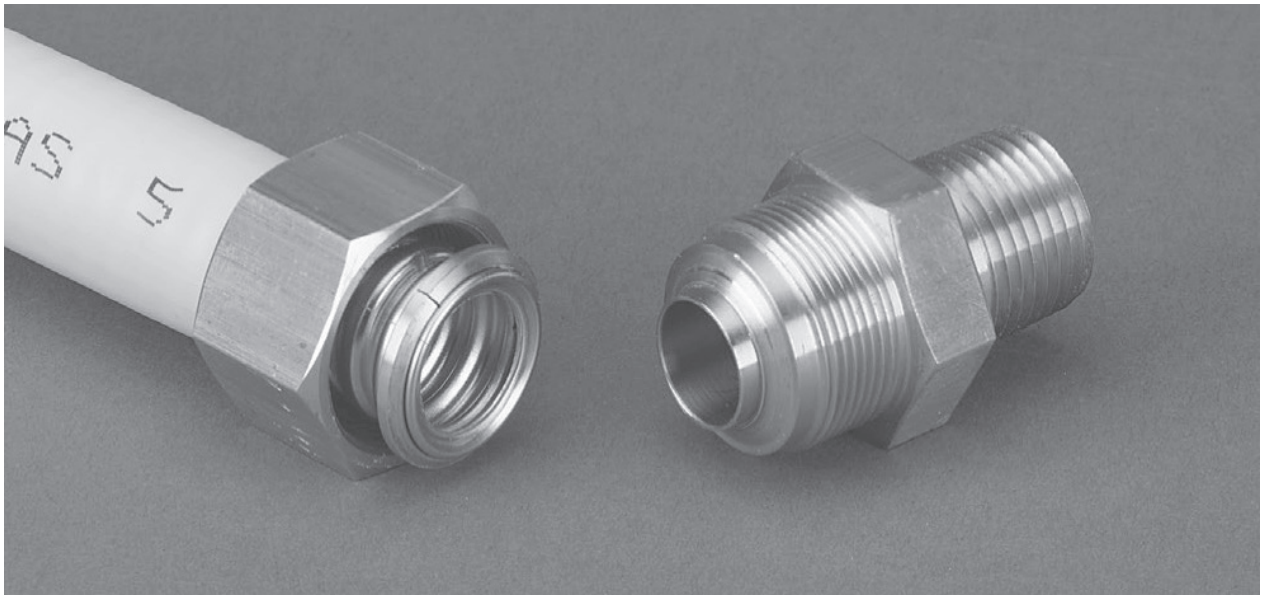


Figure: 4-12

DO NOT USE THREAD SEALANTS WITHIN THE FITTING. USE THREAD SEALANTS ONLY ON THE NPT THREADS



AutoFlare (Patented) – The Fitting is the Flaring Tool

Figure: 4-13

SECTION 4.2.3 — 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 the 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, loosen the nut and then retighten the fitting. 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. Apply a thin coating of a petroleum wax type lubricant to the fitting flare, split rings and machine threads, then reattach the 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 practices, Flexible gas piping can be routed:

1. **Beneath floor joists, through floor and ceiling joists, alongside floor and ceiling joists:** This is the typical location for residences and commercial buildings with basements and multi-floor systems. Multiple tubing runs may be bundled.

⚠ CAUTION

Exposed stainless steel, may contact spray foam installation and must be wrapped in self-bonding tape, per Section 4.3.2.

2. **Exterior/interior wall cavities:** Hollow interior wall cavities are the preferred location for vertical runs of tubing. Piping runs may be installed in insulated walls. For bat type insulation the piping may be placed within or in front of the insulation facing sheet. Piping restrained by rigid foam-type insulation shall be protected along the entire run in accordance with Section 4.4.1.

3. **Through an approved duct underground or encased in a solid floor**: When piping runs are located below grade or within solid floors, the **TracPipe** and **TracPipeCounterStrike** CSST shall be routed within a nonmetallic water-tight duct. No tubing joints are permitted within the floor. Gas piping runs encased within a solid floor shall be ventilated. See Underground Installation, Section 4.9, for underground use of **TracPipe PS-II** CSST. **TracPipe PS-II** CSST meets code requirements for direct burial underground and encasement in solid floor installations.

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 it. Minimum drill hole sizes are listed in **Table 4-6**.

Table: 4-6

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:** When installing tubing horizontally through galvanized steel studs, it is recommended to use plastic grommets provided by the stud manufacturer. This will help prevent damage to the tubing's non-metallic jacket. Additionally, when routing the tubing, it's important to avoid potential threats as much as possible. For flexible gas piping larger than 1-inch internal diameter installed within hollow cavity walls of 2 x 4 construction, it should be protected along the entire concealed length.

6. **Hollow Cavity Walls**: Care shall be taken to route the tubing in areas that are least susceptible to potential threats wherever possible. Flexible gas piping sizes 1-1/4 inch and larger installed within hollow cavity of 2x4 construction shall be protected along the entire concealed length.

SECTION 4.3.1 — CONCEALED LOCATIONS FOR FITTINGS — GENERAL PROVISIONS

The **TracPipe, AutoFlare/AutoSnap** mechanical attachment fittings have been tested and are listed per the requirements of CSA/ANSI LC 1 CSA 6.26 Standard (USA and CANADA). This standard provides test requirements which certify fittings for concealed installations and connections to appliances.

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 NPT threaded pipe connections. This can be a stub out to an appliance connection, 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 **Figure 4-14** and **Figure 4-15** for typical key valve mountings.

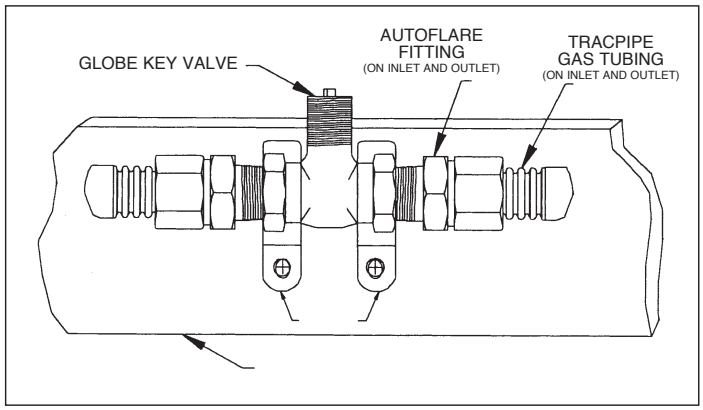


Figure: 4-14

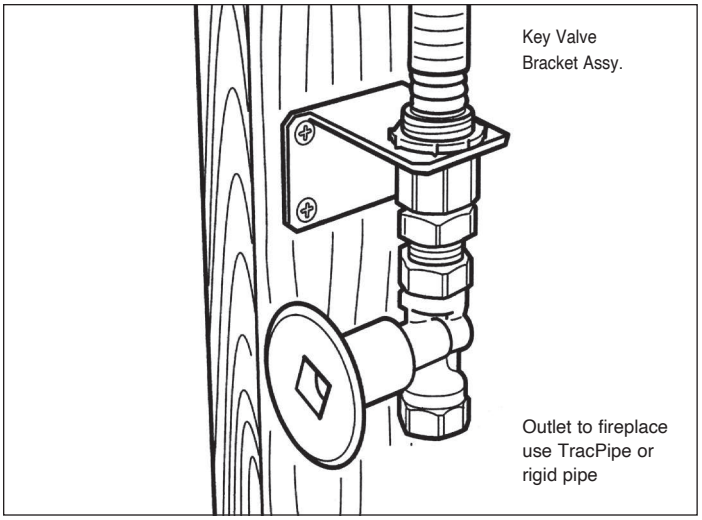


Figure: 4-15

3. 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 concealed (See **Figure 4-16**).

MODIFICATIONS TO INSTALLED SYSTEMS:

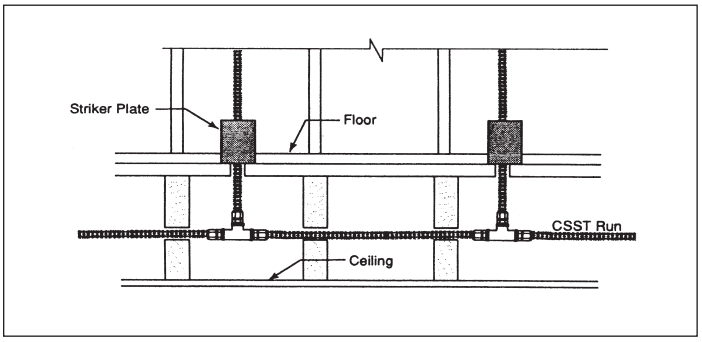


Figure: 4-16 Multiple outlets along main tubing run

1. **New ceilings in unfinished rooms/basements** - Flexible piping fittings originally installed in accessible ceiling locations can be concealed at a later date if 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.

2. **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.

3. **Repairs to existing tubing runs** - Damaged tubing runs shall be repaired per 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 4.3.2 — TRACPIPE AND TRACPIPECOUNTERSTRIKE CSST OUTDOOR INSTALLATION ISSUES

The following section provides instructions for the use of **TracPipe** and **TracPipeCounterStrike** CSST in systems in which portions of the piping are exposed to the outdoors as required to make connections to gas meters or appliances that are attached to, mounted on, or located in close proximity to the building structure. ANSI LC1 CSA 6.26 contains test requirements determining suitability for exposure of CSST piping systems to outdoor environments. **TracPipe** and **TracPipeCounterStrike** CSST is certified to this standard and is fully qualified for outdoor installations. The **TracPipe** and **TracPipeCounterStrike** CSST jackets contain UV inhibitors to retard jacket degradation when exposed to long periods of sunlight.

1. 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 4-17** and **4-18).**

2. When **TracPipe** and **TracPipeCounterStrike** CSST is installed in a swimming pool mechanical room or exposed to a pool, exposed portions of the stainless-steel tubing shall be wrapped with self-bonding silicone tape. (See **Figures 4-17** and **4-18).**

3. When installed along the side of a structure (between the ground and a height of 6 feet) in an exposed condition, the **TracPipe** and **TracPipeCounterStrike** CSST shall be installed in a location that will not subject the piping to mechanical damage or be protected inside a conduit or protective cover. (See **Figures 4-17** and **4-18**).

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

4. **TracPipeCounterStrike** CSST SHALL NOT BE BURIED DIRECTLY IN THE GROUND OR PENETRATE CONCRETE UNLESS IT IS SLEEVED INSIDE OF A NON-METALLIC (PVC) WATER TIGHT CONDUIT or use **TracPipe® PS-II** piping. The conduit shall be sealed at any exposed end to prevent water from entering. See instructions for underground installations Section 4.9.

5. When installed underneath mobile homes or in crawl spaces, **TracPipe** and **TracPipeCounterStrike** shall be installed in accordance with these standard outdoor instructions.

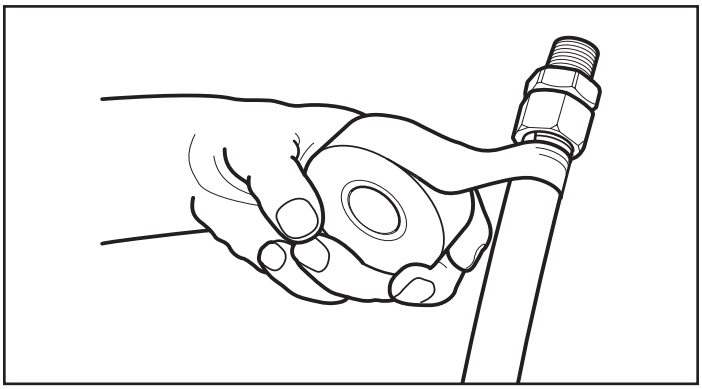


Figure: 4-17 *Wrapping with self bonding silicone tape - begin on jacket.*

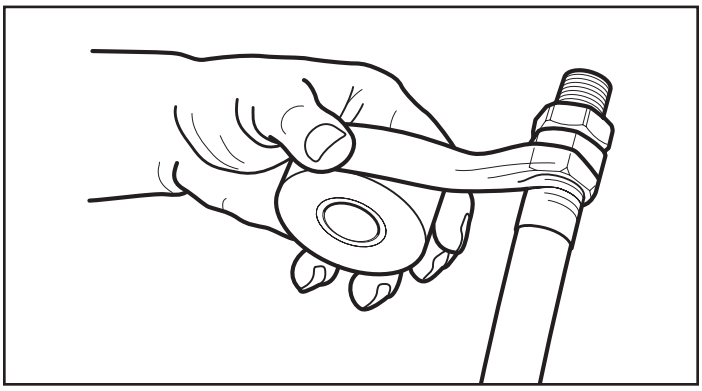


Figure: 4-18 *Wrapping with self bonding silicone tape - end on nut.*

SECTION 4.4 - PROTECTION

Flexible gas piping must be adequately safeguarded against puncture, shear, crush, or other physical damage. As per the regulations, the tubing should be protected at points of support and when passing through structural members such as studs, joists, and plates. Protection is mandatory 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 4.4.1 - STRIKER PLATE REQUIREMENTS

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

NOTICE:

Only CSA approved hardened striker plates listed for CSST systems may be used. CSST runs of sizes 1-1/4" and larger installed in 2x4" wall cavities must be protected for the entire concealed length. For walls that remain open on one side the tubing is not required to be protected.

a. 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 4-19)**

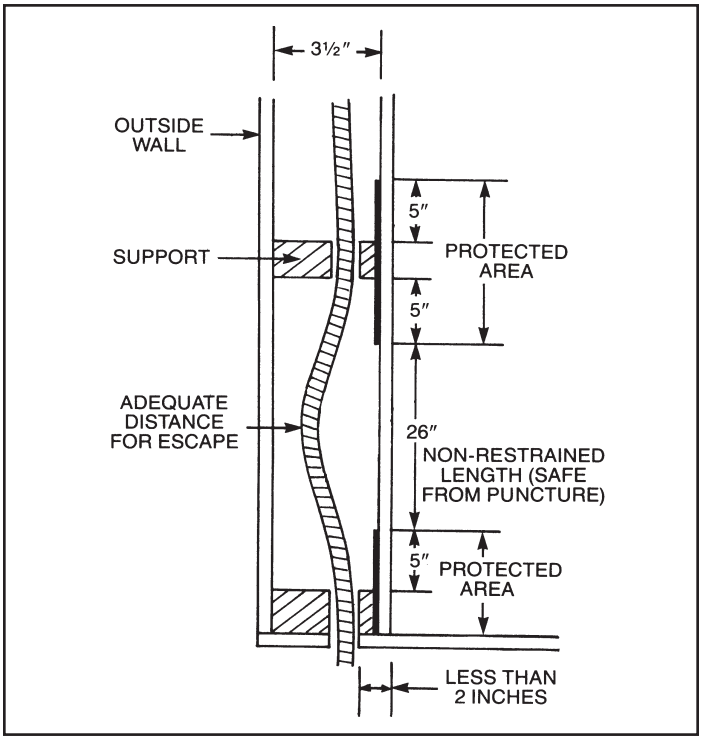


Figure: 4-19 *Long Unsupported Tubing Runs (over 3') within a Wall Partition.*

b. Shielding is required at support points and points of penetration located 2 to 3 inches away from any edge of the stud, joist plate, etc. A quarter striker plate should be used in these locations. (See **Figure 4-20**).

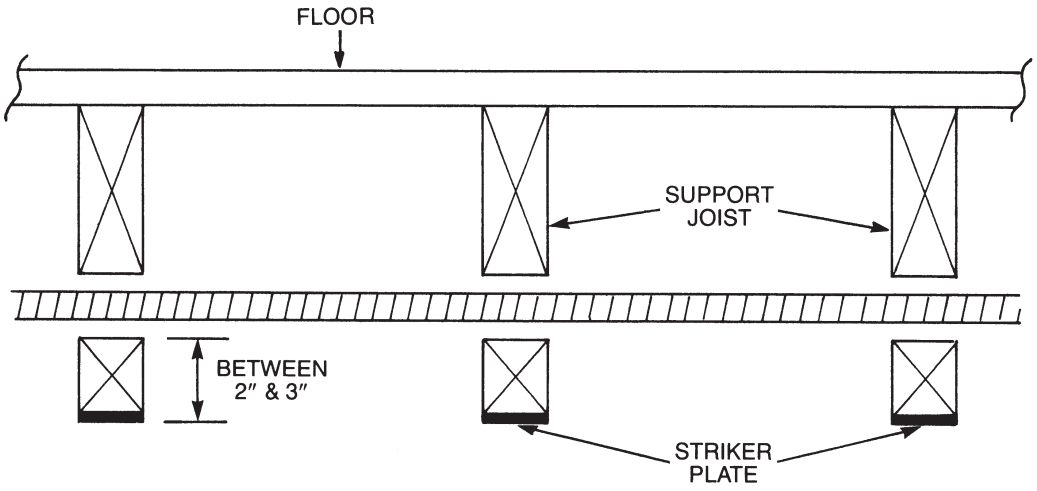


Figure: 4-20

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. Additional protection shall be provided by installing Type RW Floppy steel conduit at termination points to reinforce the required protection of hardened steel striker plates through building structures as described above. (**Figure 4-21**)

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

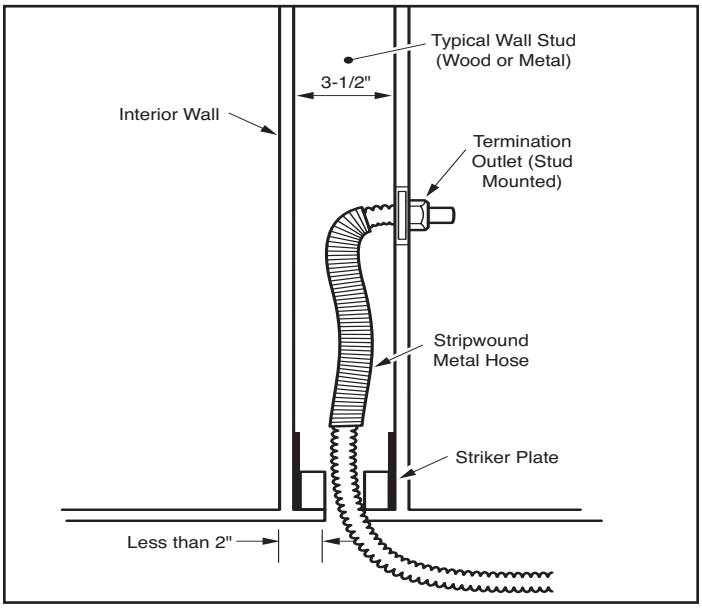


Figure: 4-21

e. Schedule 40 steel pipe has been tested and approved by CSA International for use as puncture protection. It can be used in situations where standard striker plates cannot be installed, such as outside walls of buildings with sheathing in place, between floors with enclosed joist areas, or in retrofits of existing buildings with walls in place. Steel pipe with an inner diameter of at least one-half inch larger than the **TracPipe** and **TracPipeCounterStrike** CSST outside diameter is an approved alternative to striker plates. For this use, the protection must extend 5 inches beyond the penetration of the structural member(s). A 12-inch pipe length is appropriate for the penetration of a single stud. Although steel pipe can be used, Omega Flex, inc. recommends the use of standard striker plates wherever possible. **Table 4-7** provides pipe sizes for your reference.

Table: 4-7

TracPipe 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 tubing in areas where testing has shown there is no need for protection, such as out of the way places.

a. Where the tubing is supported more than 3 inches from any outside edge of a stud, joist, plate, etc., or wall surface. (**Figure 4-22**)

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

c. When tubing is supported under the joists in basements or crawl spaces and is not concealed by wallboard or ceilings.

d. In unfinished garage walls where tubing is exposed.

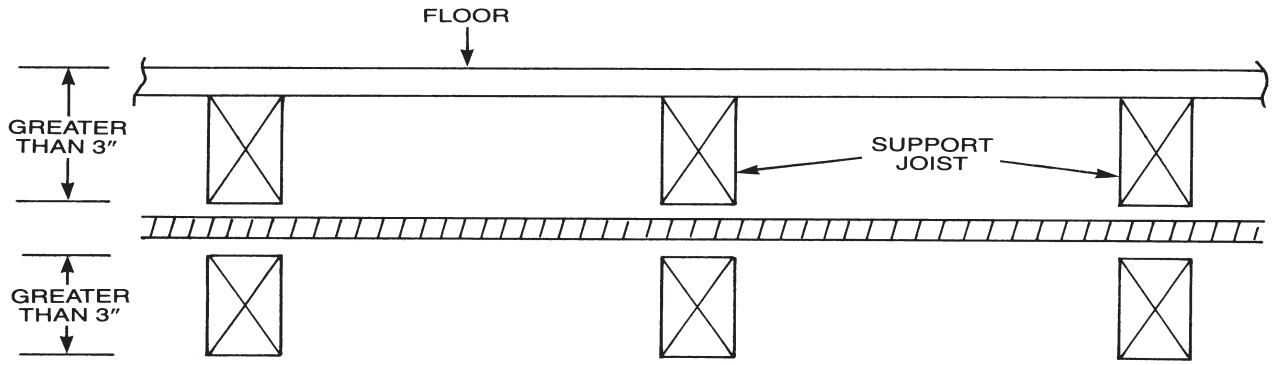


Figure: 4-22

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

SECTION - 4.4.2 - THROUGH WALL PENETRATIONS

1. **TracPipe** and **TracPipeCounterStrike** CSST, with their specially formulated polyethylene jacket and the yellow polyethylene jacket, have been tested to the flame spread and smoke density requirements of ASTM E84, meeting ANSI LC-1 reporting criteria.

2. For through-penetration fire-stop instructions, refer to the UL classification requirements shown in Appendix A. When passing through a fire stop, the jacket does not have to be removed. Seal the area between the building and **TracPipe** and **TracPipeCounterStrike** CSST with an approved 3M type CP-25 or equivalent caulk.

NOTICE:

For more information regarding flame spread and smoke density tests contact **TracPipe** piping Engineering.

3. **TracPipe** and **TracPipeCounterStrike** have thru-penetration UL Classifications for 1, 2, and 4 hour requirements, depending on the materials and type of construction. See Appendix A.

NOTICE:

For **TracPipe PS-II** tubing with black outer jacket, the installer shall address local building codes with respect to flame spread and smoke density regulations for non-metallic materials. **Omega Flex, Inc.** recommends either removing the black jacket or transitioning to the **TracPipe** and **TracPipeCounterStrike** product when passing through areas such as drop ceiling return plenums.

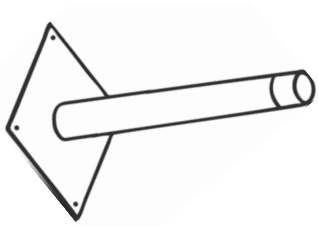
SECTION 4.5 — METER CONNECTIONS

1. Meters that depend on the service and house piping for support shall not be directly connected to the flexible piping. Instead, use a meter Stub-out fitting or steel pipe for the outdoor portion of the connection. For mounting meters, all fastener locations should be used when installing the flange or mounting plate. **(Figures 4-23** and **4-24)**.

2. Meters independently supported with a bracket can be directly connected outdoors with **TracPipe** and **TracPipeCounterStrike** CSST (See **Figure 4-25**). 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.

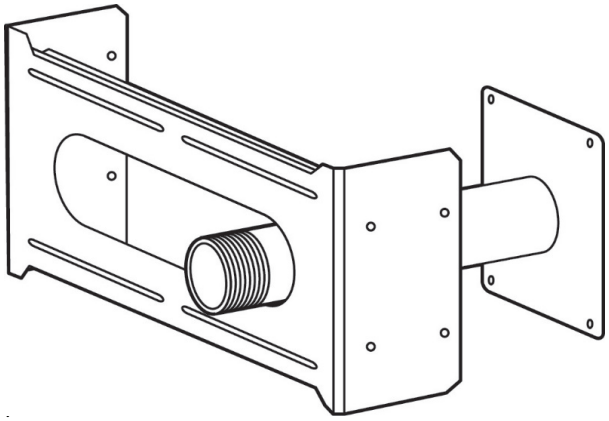
NOTICE:

Prior to installing **TracPipe** and **TracPipeCounterStrike** CSST directly to a meter, ensure that the local utility allows this practice, and the meter is independently supported. Any exposed sections of stainless-steel piping must be wrapped with silicone self-bonding tape. This is especially important with masonry construction (See **Figure 4-23**). A sleeve is required for **TracPipe** and **TracPipeCounterStrike** CSST penetration of masonry and recommended for wood frame construction.



Meter Stub-out Mount

(Surface mount on sheathing or through the rim joist.)



Stud Bracket

(Mount between two studs.)

Figure: 4-24 Meter Mounting Accessories

NOTICE:

Diameter of hole shall be at least 1/2" greater than O.D. of tubing and shall be sleeved and/or sealed in accordance with local building code (if applicable).

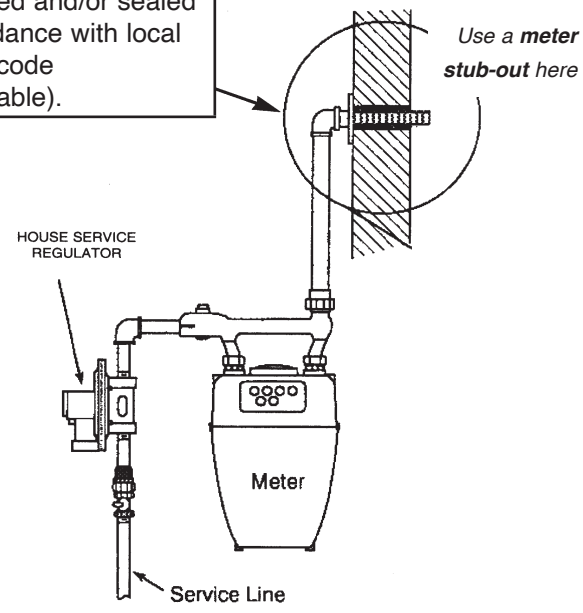


Figure: 4-23

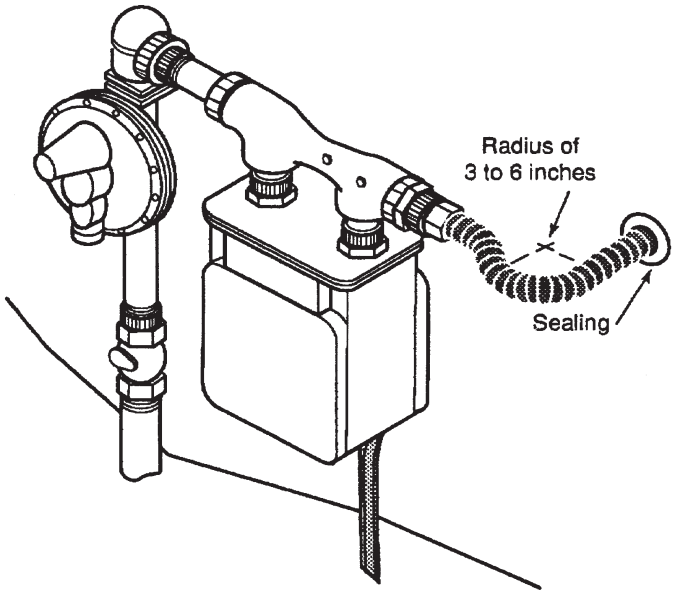


Figure: 4-25

SECTION 4.5.1 — CSST Connection to Outdoor Propane Tanks (Located in Close Proximity to the Building)

To provide for vertical or horizontal movement that may be experienced with outdoor propane tanks due to freeze/thaw ground conditions, **TracPipe** and **TracPipeCounterStrike** CSST Flexible Gas Piping may be installed in a loop configuration as shown in **Figure 4-26**. Use **Table 4.8** to determine loop diameter based on size used.

The tank shall be in a fixed condition on a level pad and not subject to tipping or other movement other than that covered in this section.

The tank shall be of the fill in place type (not the exchange type) and located in close proximity to the building. **TracPipe** and **TracPipeCounterStrike** CSST used for this application is to be downstream of 2nd stage pressure reduction only. Movement of the tank shall not exceed 15cm.

Installation shall be done by trade professionals trained to install **TracPipe** and **TracPipeCounterStrike** CSST products, and be in compliance with the **TracPipe** and **TracPipeCounterStrike** CSST Design and Installation Guide and all applicable codes and standards. **TracPipe** and **TracPipeCounterStrike** CSST are not listed for propane in the liquid state.

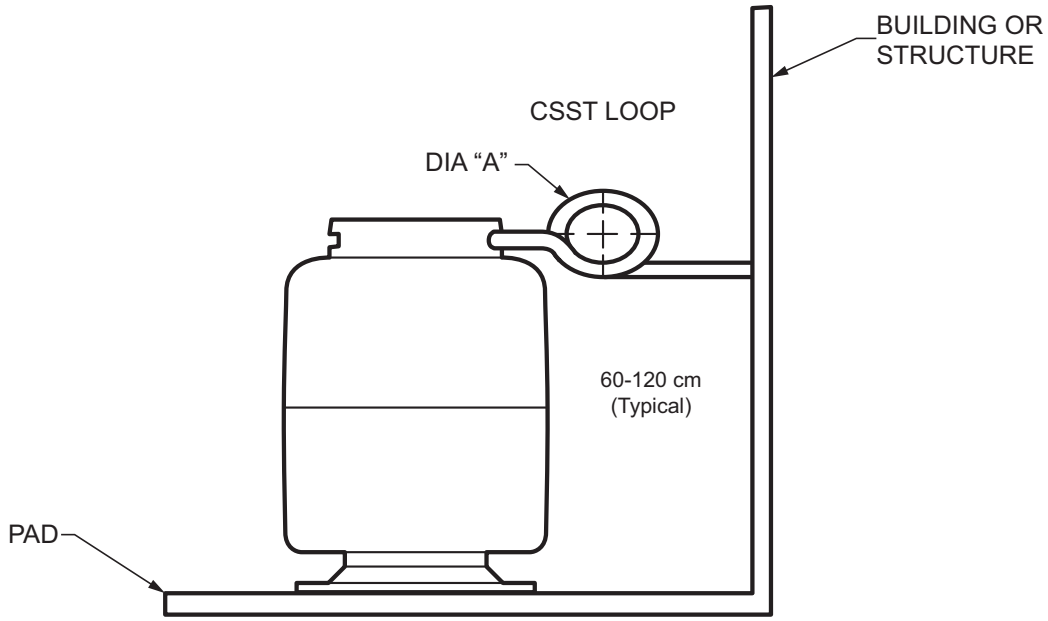


Figure: 4-26

Table: 4-8

Size	Dia. "A" Min	Max: Movement
3/8" (12 mm)	33 cm	15 cm
1/2" (15 mm)	38 cm	15 cm
3/4" (22 mm)	46 cm	15 cm
1" (28 mm)	56 cm	15 cm

SECTION 4.6 - APPLIANCE CONNECTIONS

For all floor and hollow wall piping outlets used for movable appliances and quick disconnect devices, a listed termination outlet (flange fitting) should be installed and secured to the structure. These termination outlets are designed to simplify gas connection installation for movable appliances and minimize the need for concealed fittings. The flange fitting or plate must be securely fastened in place during the rough-in process. It can be attached to a brace spanning between studs for a wall location or directly to the floor **(see Figure 4-27)**. In cases where a termination outlet cannot be readily installed through the structure and transitioned to black pipe at a suitable location. The black iron pipe can then be fastened to block walls or concrete and the final connection can be made with a flexible appliance connector **(refer to Figure 4-27)**.

1. MOVABLE APPLIANCE CONNECTIONS (SUCH AS RANGES AND DRYERS) SHOULD BE MADE USING APPROVED FLEXIBLE APPLIANCE CONNECTORS. **(See Figure 4-28)**. See also recessed wall box next page.
2. FIXED APPLIANCE CONNECTIONS MAY BE DIRECTLY CONNECTED TO THE FLEXIBLE GAS PIPING SYSTEMS

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.

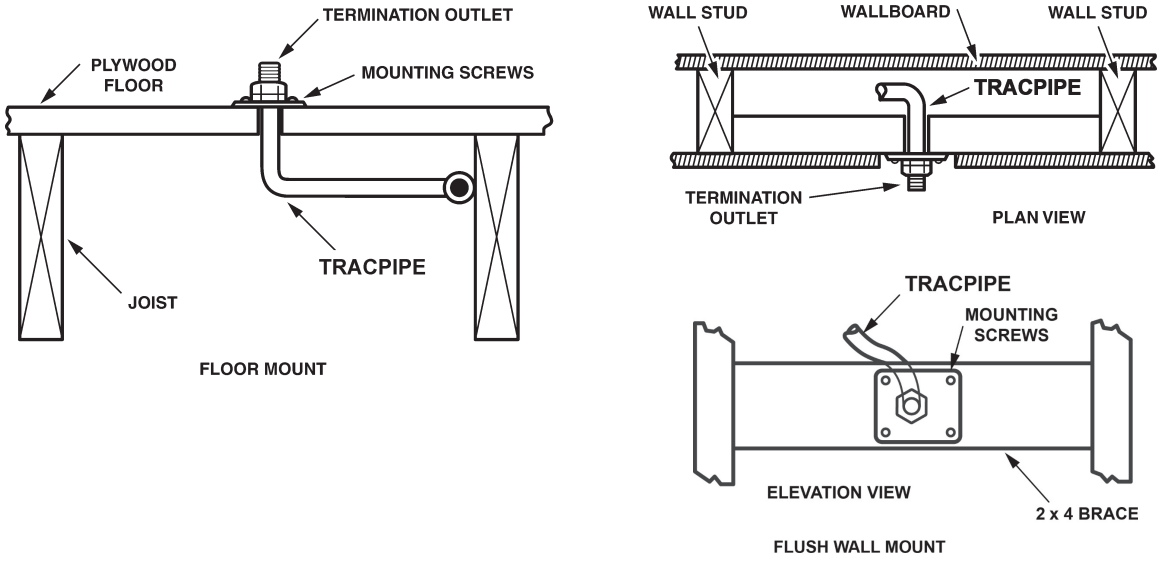


Figure: 4-27
Support Device Flange Termination Outlet

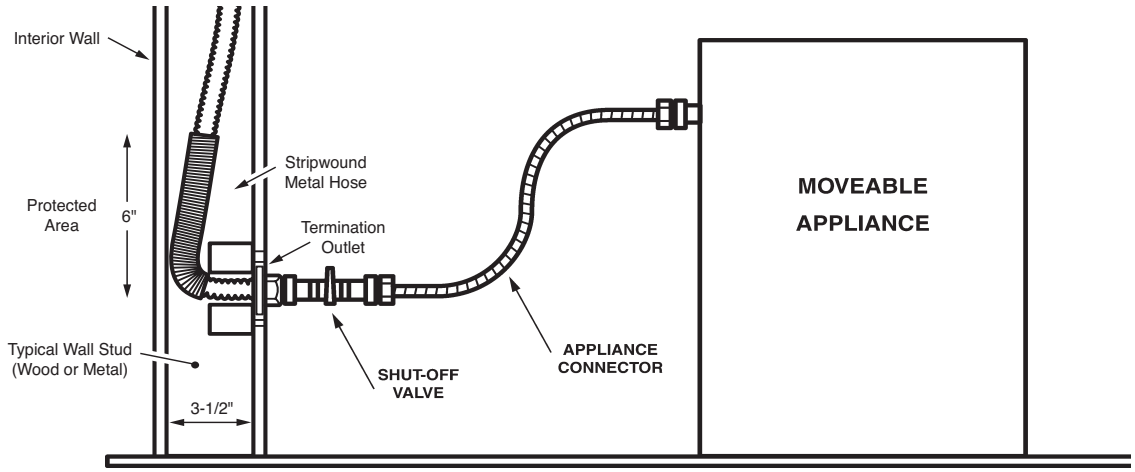


Figure: 4-28
Stainless Steel Gas Connector Connection to a Movable Gas Appliance

SECTION 4.6.1 — RECESSED FIRE RATED METAL GAS OUTLET WALL BOX

Fire resistant accessory for gas outlet terminations

All wallboxes measure 7" x 7" x 3"

PRODUCT DESCRIPTION

1. The **TracPipe** and **TracPipeCounterStrike** Gas Outlet Wall Box **(Figure 4-29)** has been tested and approved for 1 hr and 2 hr Fire Stop Systems in accordance with UL 1479.

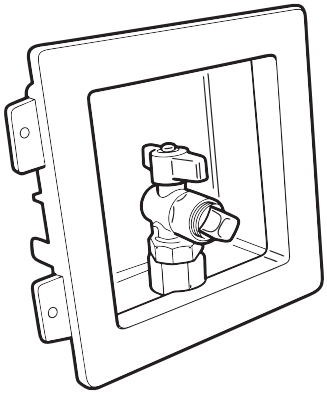


Figure: 4-29

2. The wall box installs with zero clearance for a finished appearance in laundry rooms, kitchens and mechanical rooms, and provides a rigid attachment point for appliance connectors serving movable appliances.

This box is not suitable for use with black iron pipe or any CSST brand other than TracPipe or TracPipeCounterStrike.

INSTALLATION INSTRUCTIONS

1. Remove Knockout for appropriate size valve. The 3/8" and 1/2" size use the small knockout and the 3/4" size uses the the large knockout. Install **TracPipe** and **TracPipeCounterStrike** gas piping and cut to the desired length, using a standard tubing cutter with a sharp wheel. Using the strip length in the chart below **(Figure 4-30)**, strip the jacket back and inspect the pipe for a clean cut without tears.

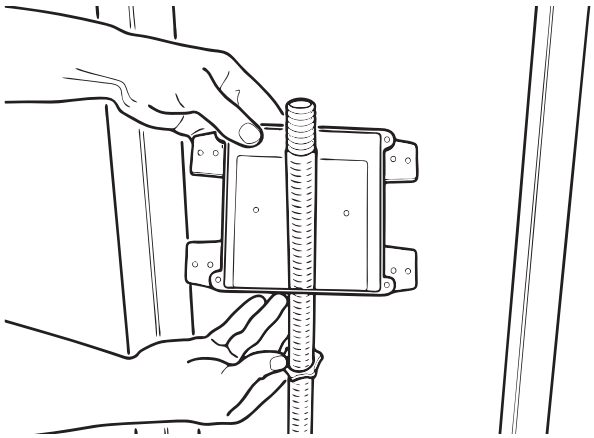


Figure: 4-31

NOTICE:

Mounting tabs are oriented for a single layer of drywall. When two layers are used for some 2-HR rated walls, remove screws on tabs and invert mounting tabs.

2. Remove the box cover and slip the locknut and box over the end of the pipe **(Figure 4-31)**.

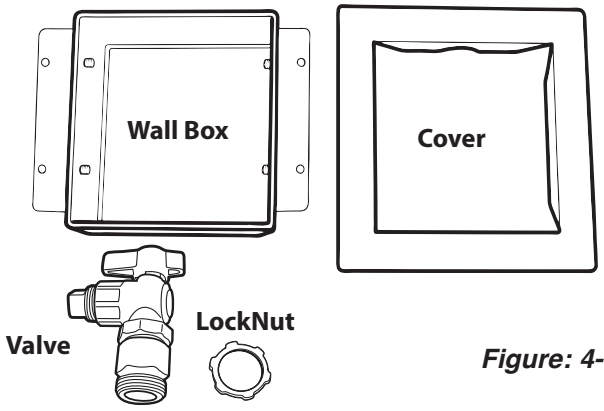
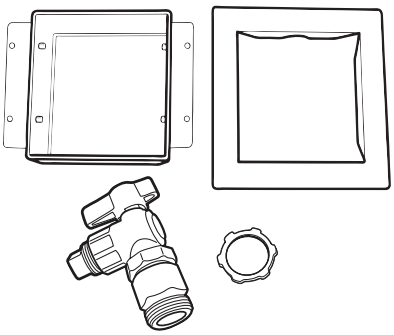


Figure: 4-32



Part Description	Part Number	Size	Pkg. Qty	Strip Length
Metal Wall Box with Valve	FGP-WBTM-375	3/8"	24 per box	1-1/2"
Metal Wall Box with Valve	FGP-WBTM-500	1/2"	24 per box	1-1/2"
Metal Wall Box with Valve	FGP-WBTM-750	3/4"	24 per box	1-3/4"

Figure: 4-30

3. Disassemble the nut and split rings from the valve **(Figure 4-33)**.

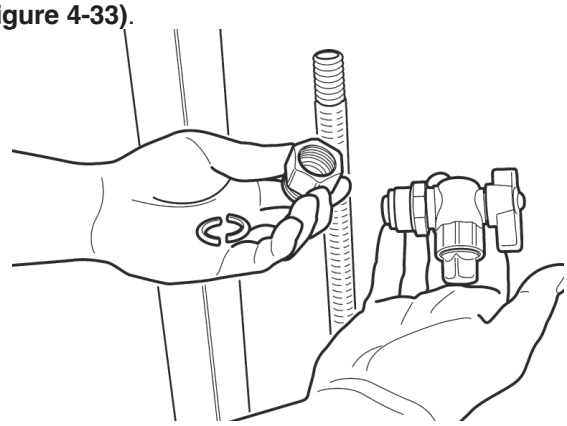


Figure: 4-33

4. Slip nut over end of pipe and insert split rings into the valley of the first corrugation **(Figure 4-34)**.

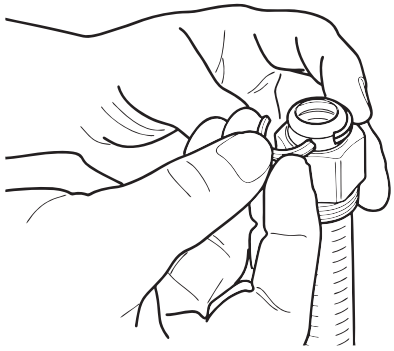


Figure: 4-34

5. Thread 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 **(Figure 4-35)**. **Do not use thread sealants on this connection.**

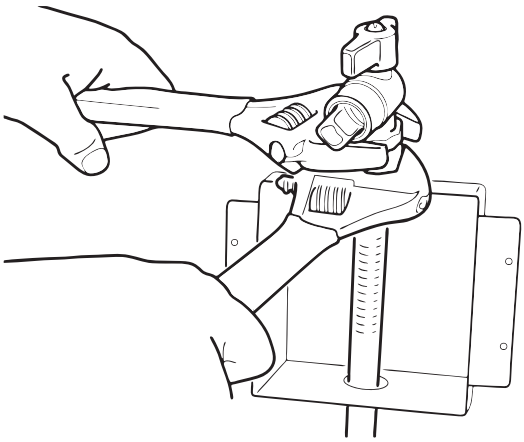


Figure: 4-35

6. Slide box up and over the threads on the bottom of the nut and mount box firmly to stud. Provide full support by fastening both mounting tabs to structure where required by local codes.
7. Secure valve assembly to box with locknut **(Figure 4-36)**.

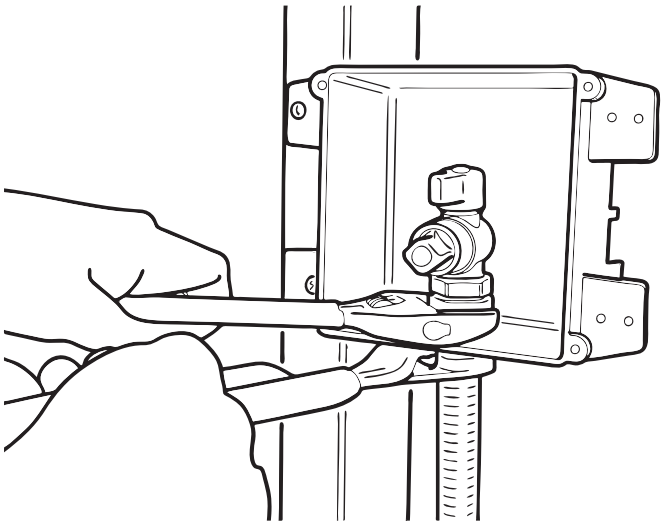


Figure: 4-36

8. Install box cover after completion of drywall. If the gap between the edges of the box and the drywall is less than ¼", no fire caulking is required **(Figure 4-37)**.

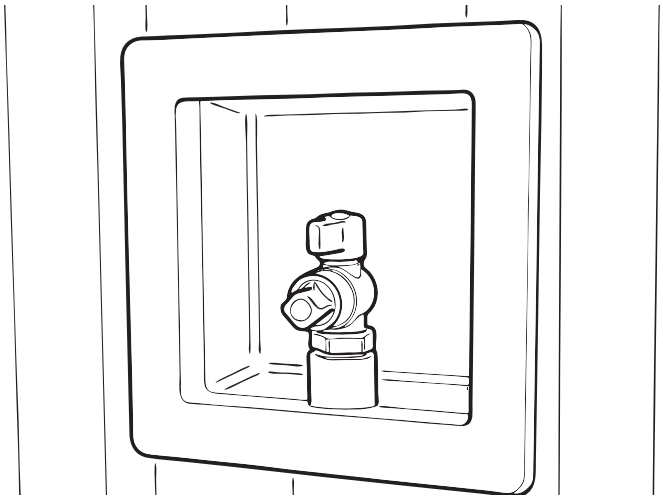


Figure: 4-37

NOTICE:

These instructions must be used in conjunction with the **TracPipe** and **TracPipeCounterStrike** Design and Installation Guide. **TracPipe** and **TracPipeCounterStrike** flexible gas piping material must only be installed by a qualified person who has been trained through the **TracPipe** Gas Piping Installation Program.

SECTION 4.6.2 — PAD MOUNTED EQUIPMENT, ROOF TOP EQUIPMENT

1. Gas appliances that are installed on concrete pads or blocks, such as gas air conditioners, heat pumps, pool heaters, and NGV refueling stations, must be connected to the **TracPipe** and **TracPipeCounterStrike** CSST system at a termination fitting using either rigid pipe or an approved outdoor appliance connector. You can directly connect **TracPipe** and **TracPipeCounterStrike** CSST to pad-mounted equipment only if the CSST is securely supported and located where it will be protected from physical damage. It is important to always follow the local and provincial codes when dealing with gas appliances.

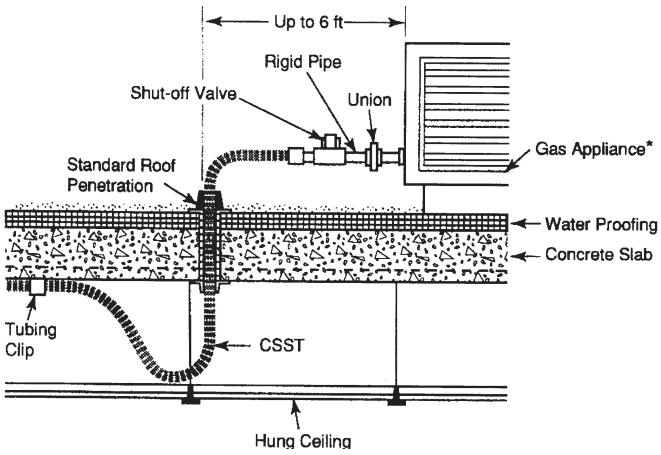


Figure: 4-38 Short (1-6 foot) outdoor connection to roof mounted equipment

2. No additional mechanical protection for the piping is necessary when connecting to rooftop equipment. Whenever possible, roof penetrations should be positioned within 6 feet of the equipment that needs to be connected, as illustrated in **Figure 4-38**. Long tubing runs should be supported by non-metallic blocks at the intervals specified in **Table 4-2** and raised above the roof at a certain distance determined by local code/practice.

3. **TracPipe** and **TracPipeCounterStrike** CSST can be supported using a galvanized shallow channel (13/16 inch) with splice plates at joints and bends. This provides a secure and damage-resistant track for the flexible gas pipe, which can be attached to each block with metallic clamps designed for the strut or appropriate fastening mechanism. With metallic strut support, blocks can be reduced to every 8 feet. Black cable ties (UV resistant) at intermediate points facilitate rolling out the **TracPipe** and **TracPipeCounterStrike** CSST. The blocks should be attached to the roof surface according to the roofing manufacturer's instructions. Please refer to **Figure 4-40** for more details.

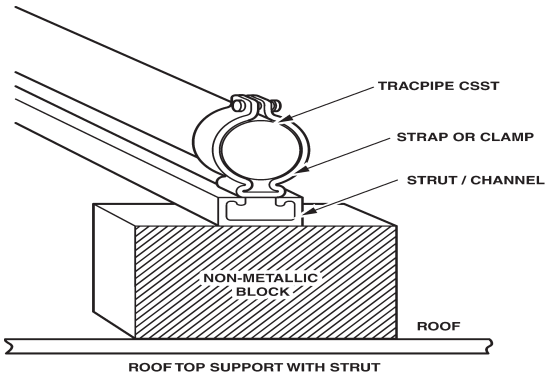


Figure: 4-40

4. Piping running vertically up the building must be protected per **Section 4.3** of outdoor use guidelines.

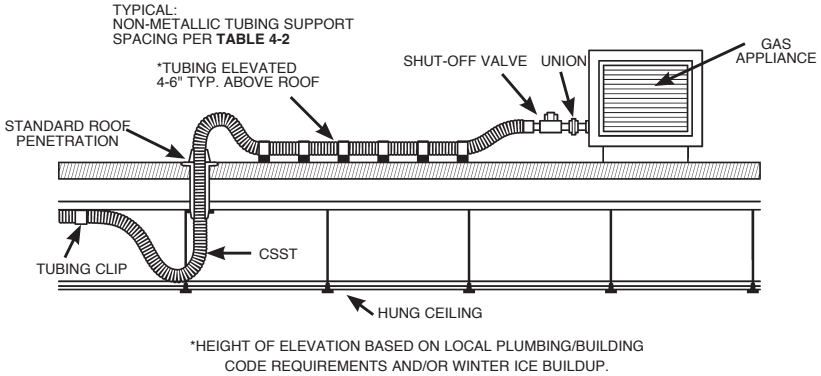


Figure: 4-39

SECTION 4.6.3 — OUTDOOR APPLIANCES — BARBECUE 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 4-41**. 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** and **TracPipeCounterStrike** CSST System as shown in **Figure 4-42** 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 watertight non-metallic conduit.

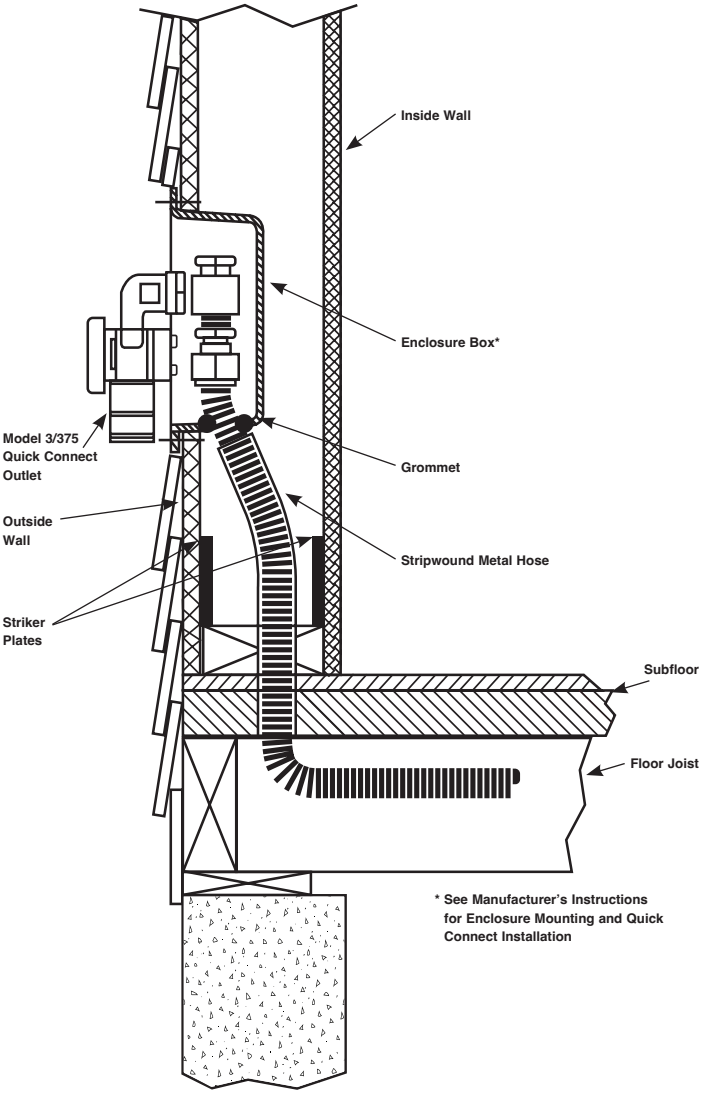


Figure: 4-41

3. Permanently mounted lights located on decks shall be connected to the piping system the same as permanently mounted grills shown in **Figure 4-42** and in accordance with the manufacturer's instructions.

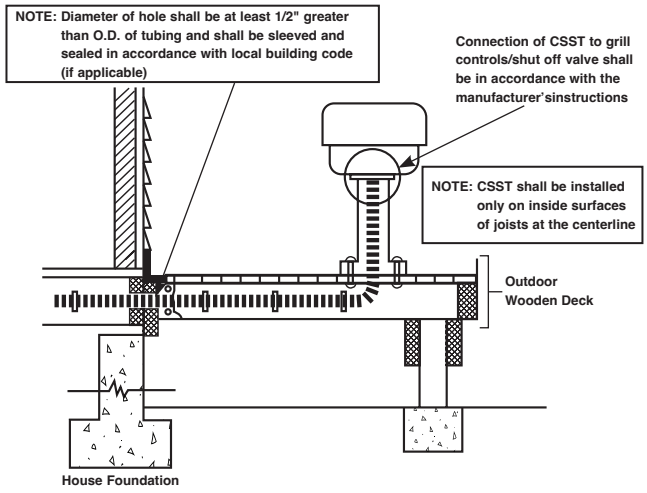


Figure: 4-42

4. Yard mounted lights shall be connected to the **TracPipe** and **TracPipeCounterStrike** CSST system as shown in **Figure 4-43**. All piping installed below grade shall be protected by non-metallic, water-tight conduit or **TracPipe PS-II** for underground use. Exposed ends of the conduit shall be sealed against water entry.

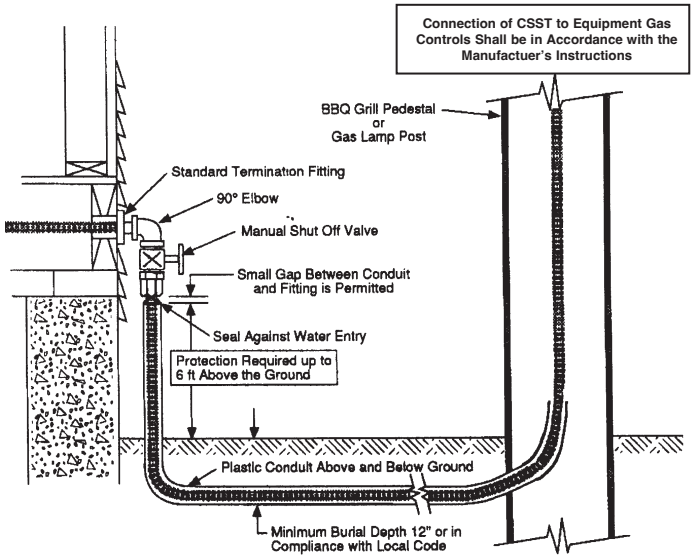


Figure: 4-43

Section 4.6.4— FIREPLACE INSTALLATIONS

1. **TracPipe** and **TracPipeCounterStrike** CSST shall not be directly routed into a metallic gas appliance enclosure utilizing a metallic vent which penetrates a roofline. The **TracPipe** and **TracPipeCounterStrike** CSST connection shall be made outside of the metallic gas appliance enclosure to a segment of rigid metallic pipe, a stub-out or a termination fitting **(Figure 4-44)**.

2. **TracPipe** and **TracPipeCounterStrike** CSST may be used to deliver gas directly to the control valve for approved unvented appliances, heat generating fireplaces with side-wall venting, gas logs used in masonry fireplaces, and pre-fabricated fireplace inserts with non-metallic venting.

3. **TracPipe** and **TracPipeCounterStrike** CSST connections to approved unvented appliances and sidewall vented fireplaces may be made to the shut-off valve located in the control area beneath the burner unit without removal of the polyethylene jacket. When connecting to decorative gas logs the jacket shall be removed inside the fire box. Stainless steel melting temperatures (2000º F) are consistent with black iron.

⚠ CAUTION

For gas log lighter installations in all-fuel fireplaces, the TracPipe and TracPipeCounterStrike CSST run MUST be terminated at the key valve or another location outside the fireplace.

4. When it is permitted (see Item 1) to install **TracPipe** and **TracPipeCounterStrike** CSST through sheet metal enclosures, such as those commonly used in decorative gas fireplaces, the manufacturer's recommendation is to leave the protective polyethylene jacket in place through the sheet metal penetration. The **TracPipe** and **TracPipeCounterStrike** CSST 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, 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** and **TracPipeCounterStrike** CSST 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 **(Figure 4-45)**.

METAL FABRICATED FIREPLACE

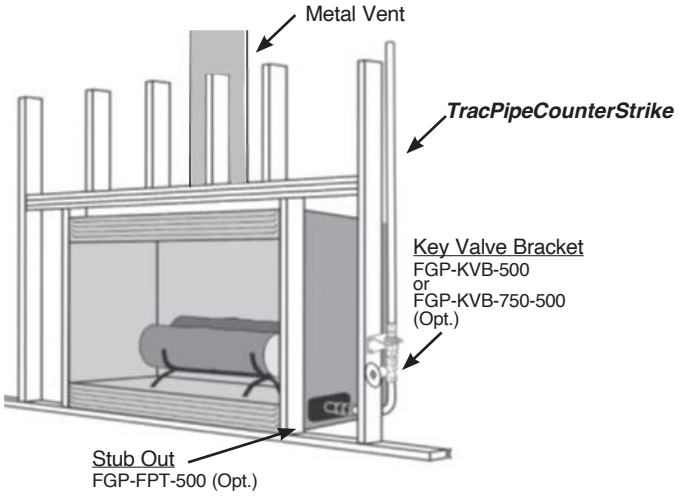


Figure: 4-44

MASONRY FIREPLACE

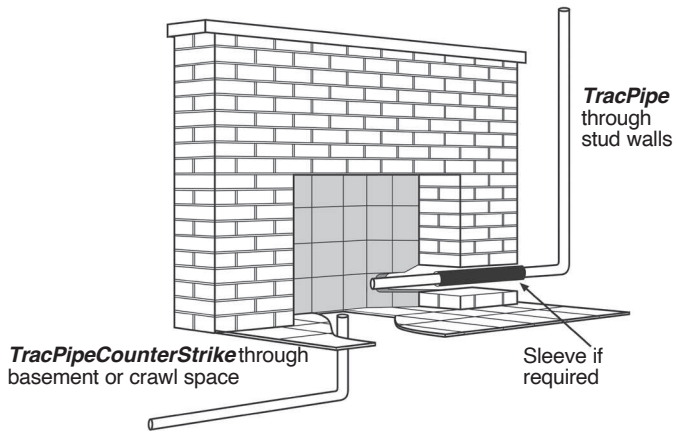


Figure: 4-45

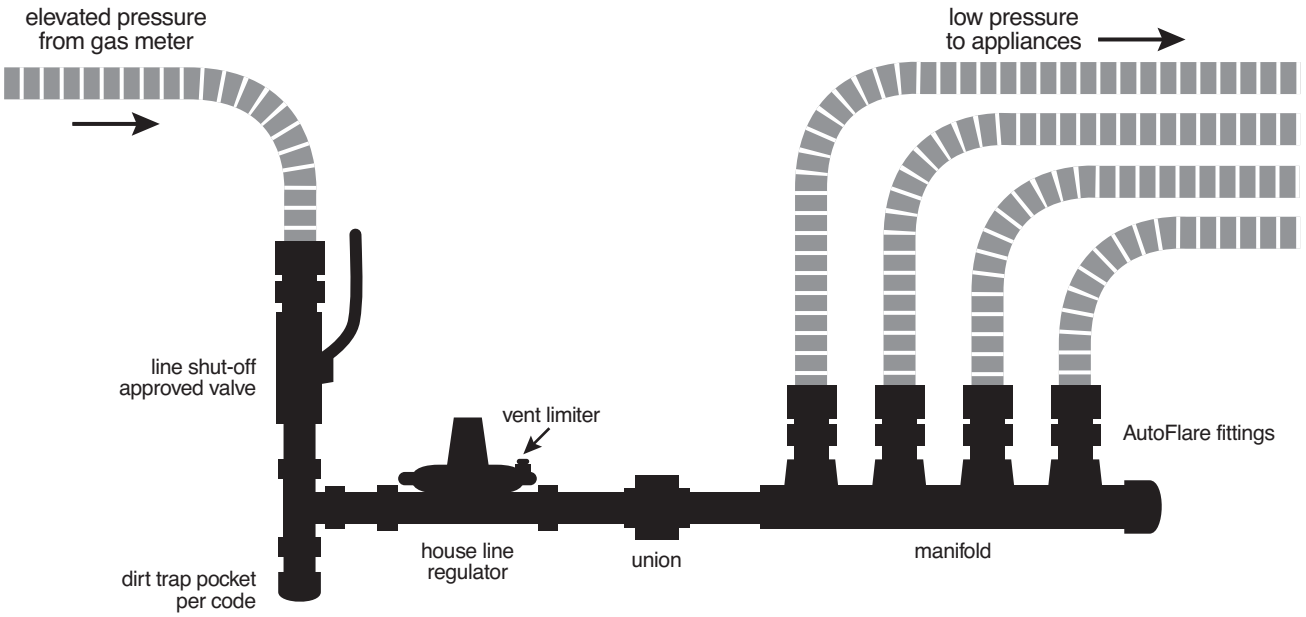


Figure: 4-46

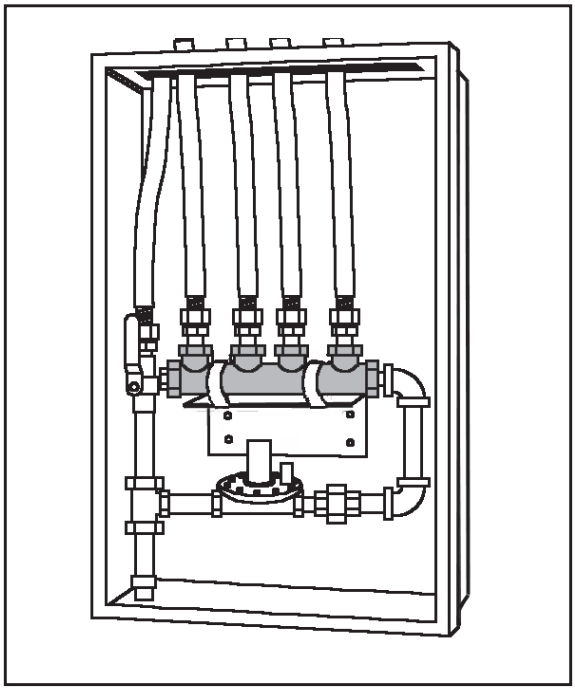
SECTION 4.7 — MANIFOLD & REGULATOR STATION

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 **(Figure 4-46)**. Manifolds are available with the **TracPipe** and **TracPipeCounterStrike** CSST system, or the use of black iron pipe and tee fabricated manifolds is permitted with this system. The manifold/regulator station should be located nearby the largest gas consuming appliances, typically the furnace, 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 **(Figure 4-43)**. Optional gas shut-off valves may be mounted on the manifold for each appliance run **(Figure 4-46)**.

Fuel gas codes may have additional installation requirements for manifold stations that include a line pressure regulator.

Manifolds installed on low pressure systems or in locations removed from the regulator may be concealed. Additional line pressure regulators may be installed in new or existing piping systems to accommodate the installation of large-capacity appliances such as tankless water heaters.



Gas Load Center

Figure: 4-47

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. Gas pressure regulators shall comply with a nationally recognized standard for pressure regulators.

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. Section 4.8.2

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. Omega Flex, Inc. ships all regulators with vent limiters installed.

⚠ CAUTION

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. A union shall be installed either upstream or downstream of the regulator to enable the removal of the regulator.

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 the discharge of fuel gas in the event of a diaphragm failure, within the regulator, to limits identical to those imposed on a gas appliance control valve.

6. 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 the applicable codebook for details.

7. For outdoor installations, remove the vent limiter and mount the regulator with the vent outlet pointing down to prevent water from entering. Plastic Caps, FGP-CAP-3 and FGP-CAP-5A, are available for outdoor installations, permitting the regulator to be mounted in an upright position.

SECTION 4.8.1 — 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 clockwise will increase outlet pressure, turning it counter-clockwise will decrease pressure.

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

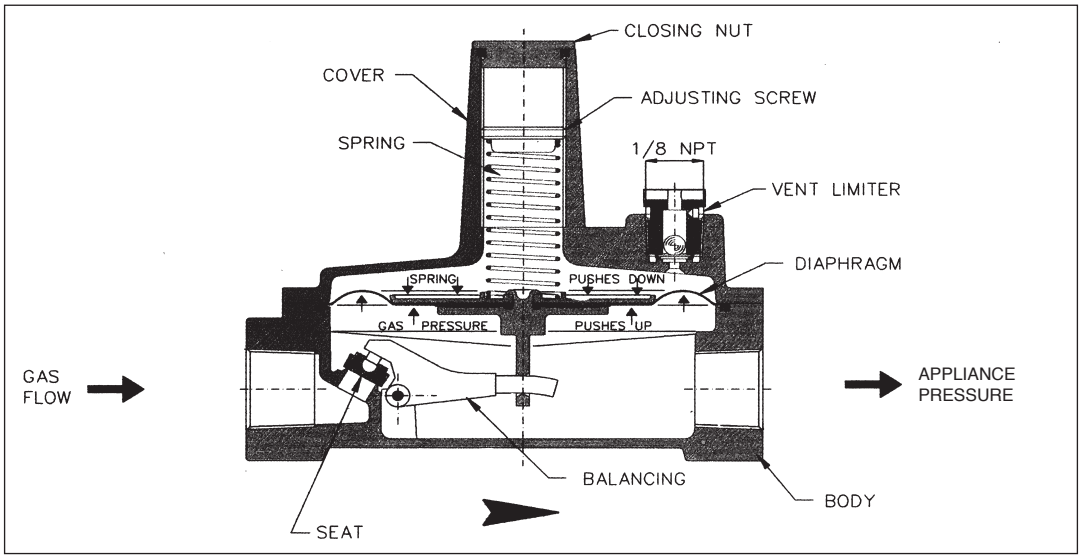


Figure: 4-48

Section 4.8.2 — REGULATOR SUPPLY PRESSURE AND CAPACITIES DROP FOR SINGLE AND MULTIPLE APPLIANCES

NATURAL GAS 0.64 SPECIFIC GRAVITY

REGULATOR CAPACITIES expressed in CFH (m3/h) 0.64 Speci ic Gravity Gas

					Operating Inlet Pressure			
Regulator Application	**Part Number**	**NPT SIZE**	**Maximum Single Appliance Load**	**Outlet Pressure Set Point**	**1/2 psi (34 mbar)**	**3/4 psi (52 mbar)**	****1 psi (69 mbar)**	*****1-1/2 psi (103 mbar)**
2 psig	**FGP-REG-3**	1/2”	140 (4.0)	8” w.c.	145 (4.1)	200 (5.7)	250 (7.1)	250 (7.1)
2 psig	**FGP-REG-3P**	1/2”	140 (4.0)	11” w.c.	93 (2.6)	172 (4.9)	225 (6.4)	250 (7.1)
2 psig	**FGP-REG-5A**	3/4”	300 (8.5)	8” w.c.	335 (9.5)	475 (13.5)	550 (15.6)	550 (15.6)
2 psig	**FGP-REG-5P**	3/4”	300 (8.5)	11” w.c.	211 (6.0)	391 (11.1)	511 (14.5)	550 (15.6)
2 psig	**FGP-REG-7L**	1”	900 (25.5)	8” w.c.	690 (19.5)	970 (27.5)	1000 (28.3)	1000 (28.3)
2 psig	**FGP-REG-7L**	1”	900 (25.5)	*11” w.c.	441 (12.5)	816 (23.1)	1000 (28.3)	1000 (28.3)
								***
5 psig w/ OPD	**FGP-REG-3L47**	1/2”	125 (3.5)	8” w.c.	125 (3.5)	125 (3.5)	125 (3.5)	125 (3.5)
5 psig w/ OPD	**FGP-REG-3L47**	1/2”	125 (3.5)	*11” w.c.	105 (3.0)	125 (3.5)	125 (3.5)	125 (3.5)
5 psig w/ OPD	**FGP-REG-3L48**	1/2”	200 (5.7)	8” w.c.	160 (4.5)	200 (5.7)	200 (5.7)	200 (5.7)
5 psig w/ OPD	**FGP-REG-3L48**	1/2”	200 (5.7)	*11” w.c.	120 (3.4)	200 (5.7)	200 (5.7)	200 (5.7)
5 psig w/ OPD	**FGP-REG-5AL48**	3/4”	320 (9.1)	8” w.c.	320 (9.1)	320 (9.1)	320 (9.1)	320 (9.1)
5 psig w/ OPD	**FGP-REG-5AL48**	3/4”	320 (9.1)	*11” w.c.	245 (6.9)	320 (9.1)	320 (9.1)	320 (9.1)
5 psig w/ OPD	**FGP-REG-5AL600**	3/4”	425 (12.0)	8” w.c.	345 (9.8)	425 (12.0)	425 (12.0)	425 (12.0)
5 psig w/ OPD	**FGP-REG-5AL600**	3/4”	425 (12.0)	*11” w.c.	260 (7.3)	425 (12.0)	425 (12.0)	425 (12.0)
5 psig w/ OPD	**FGP-REG-5AL601**	1”	465 (13.2)	8” w.c.	375 (10.6)	465 (13.2)	465 (13.2)	465 (13.2)
5 psig w/ OPD	**FGP-REG-5AL601**	1”	465 (13.2)	*11” w.c.	285 (8.1)	465 (13.2)	465 (13.2)	465 (13.2)

*** Requires manual field adjustment of regulator to obtain 11” w.c. outlet pressure**

**** Recommended sizing column for 2 psig Natural Gas TracPipe CounterStrike installations refer to Table N-5 Section 7.0.**

***** Recommended sizing column for 5 psig Natural Gas TracPipe CounterStrike installations refer to Table N-6 Section 7.0.**

PROPANE 1.53 SPECIFIC GRAVITY
REGULATOR CAPACITIES expressed in CFH (m3/h) 1.53 Gravity Gas

(MBTUh values based on Gas with a heating value of 2520 BTU per cubic foot)

					Operating Inlet Pressure			
Regulator Application	**Part Number**	**NPT SIZE**	**Maximum Single Appliance Load**	**Outlet Pressure Set Point**	**1/2 psi (34 mbar)**	**3/4 psi (52 mbar)**	****1 psi (69 mbar)**	**1-1/2 psi (103 mbar)**
2 psig	**FGP-REG-3P**	1/2"	91 (2.6) [229 MBTUh]	11" w.c.	60 (1.7) [152 MBTUh]	112 (3.2) [281 MBTUh]	146 (4.1) [368 MBTUh]	162 (4.6) [409 MBTUh]
2 psig	**FGP-REG-5P**	3/4"	195 (5.5) [491 MBTUh]	11" w.c.	137 (3.9) [345 MBTUh]	254 (7.2) [639 MBTUh]	332 (9.4) [836 MBTUh]	357 (10.1) [899 MBTUh]
2 psig	**FGP-REG-7L**	1"	584 (16.5) [1472 MBTUh]	*11" w.c.	286 (8.1) [721 MBTUh]	529 (15.0) [1334 MBTUh]	649 (18.4) [1635 MBTUh]	649 (18.4) [1635 MBTUh]

*** Requires manual field adjustment of regulator to obtain 11" w.c. outlet pressure**

**** Recommended sizing column for 2 psig Propane TracPipe CounterStrike installations refer to Table P-3 Section 7.0.**

⚠ 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.

NOTICE:

Please note that according to the new ANSI Z21.80 Line Regulator Standard, any supply pressures exceeding 2 PSI require an Over-Pressure Protection Device (OPD) that has been approved and tested with 5-PSI or a 2-5 PSI labeled regulator. This device is necessary to limit the downstream pressure to a maximum of 2-PSI in the event of regulator failure. Please note that 5 PSIG regulators with OPD are CSA Design certified for Natural Gas ONLY and come with vent limiters. If you plan to use these regulators on Propane systems above 2-PSIG, you will need to remove the vent limiters and follow local codes for venting of regulators.

SECTION 4.8.3 — OVER-PRESSURE PROTECTION

At supply pressures in excess of 2-PSI the **CSA/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 **CSA/ANSI Standard** and **B149.1 Natural Gas and Propane Installation code**, 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.

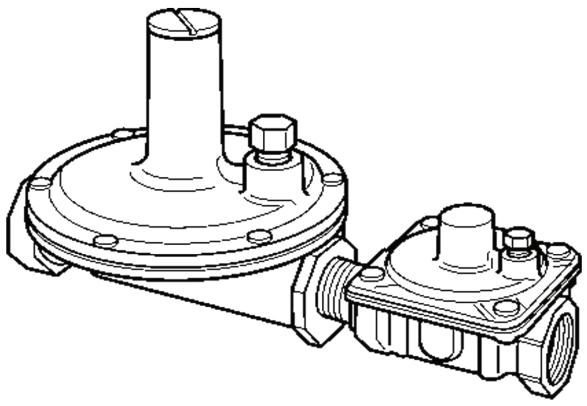


Figure: 4-49

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

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 is protected against corrosion. When piping is installed in solid floors, codes allow the piping to be encased in a duct and the duct ventilated. The duct shall be designed to withstand the superimposed loads. **TRACPIPE DOES NOT PERMIT THE INSTALLATION OF COUPLINGS OR FITTINGS WITHIN THE FLOOR**.

2. **REGIONAL/MODEL CODES**
   PS-II (patented) installations conform to the underground fuel gas installation requirements of B149.1 Natural Gas and Propane Installation Code.

SECTION 4.9.1 — GUIDELINES FOR UNDERGROUND INSTALLATIONS

1. Lay **TracPipe PS-II** piping in a trench. Install the gas piping on a continuous solid surface and to the appropriate burial depth, per code.

2. When transitioning **TracPipe PS-II** piping from below grade, use the recommended minimum bend radius shown in **Table 4.9**.

Table 4-9

RECOMMENDED MINIMUM BENDING RADIUS FOR *TracPipe PS-II*	
Tubing Size	**Minimum Bend Radius R PS-II**
3/8 inch	6 inch
1/2 inch	6 inch
3/4 inch	8 inch
1 inch	10 inch
1-1/4 inch	12 inch
1-1/2 inch	16 inch
2 inch	18 inch

3. When terminating at this point, the recommended exposed clearance height (the height to the **TracPipe** and **TracPipeCounterStrike** CSST fitting above grade) is 12 inches minimum. For vertical runs up the outside of a building in traffic areas, protect the **TracPipe** and **TracPipeCounterStrike** CSST as explained in Section 4.3.

4. Avoid bending the above-grade vertical portion of the **TracPipe PS-II** piping beyond the Minimum Bend radius in **Table 4-9**. To make a tighter bend to line up for a wall penetration, use a rigid fitting such as a malleable iron 90.

5. **TracPipe PS-II** piping 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).

6. The **B149.1** Natural Gas and Propane installation code expressly prohibits under-foundation or under-building gas piping.

7. **TracPipe PS-II** piping can penetrate directly through concrete slab unless other requirements are established by local codes concerning slab penetrations and firestop requirements. **TracPipe PS-II** shall not be installed less than 15 in (400mm) underground nor less than 24 in (610mm) under a commercial driveway or parking lot, except when is rises at the point of supply for either a building or an outdoor appliance. (**B149.1**)

8. **TracPipe PS-II** piping can be transitioned to standard **TracPipe** piping above grade using **TracPipe** and **TracPipeCounterStrike/AutoFlare/AutoSnap** fittings with a Coupling P/N FGP-UGC-SIZE. Remove the black plastic vent coupling on the standard **TracPipe** and **TracPipeCounterStrike** CSST side. Alternatively use a malleable iron coupling for the transition.

9. **TracPipe PS-II** piping must be transitioned above ground to standard **TracPipe** and **TracPipeCounterStrike** CSST when routing through plenums or through firestop penetrations. The black **TracPipe PS-II** piping sleeve is not qualified for these locations.

10. The venting of **TracPipe PS-II** piping shall be designed according to 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
    - Gas service to outbuildings
    - Gas lampposts and grills
    - Outdoor fire features

NOTICE:

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

NOTICE:

No Tracer wire is required for underground installations of TracPipe or TracPipeCounterStrike CSST in a duct or TracPipe PS-II.

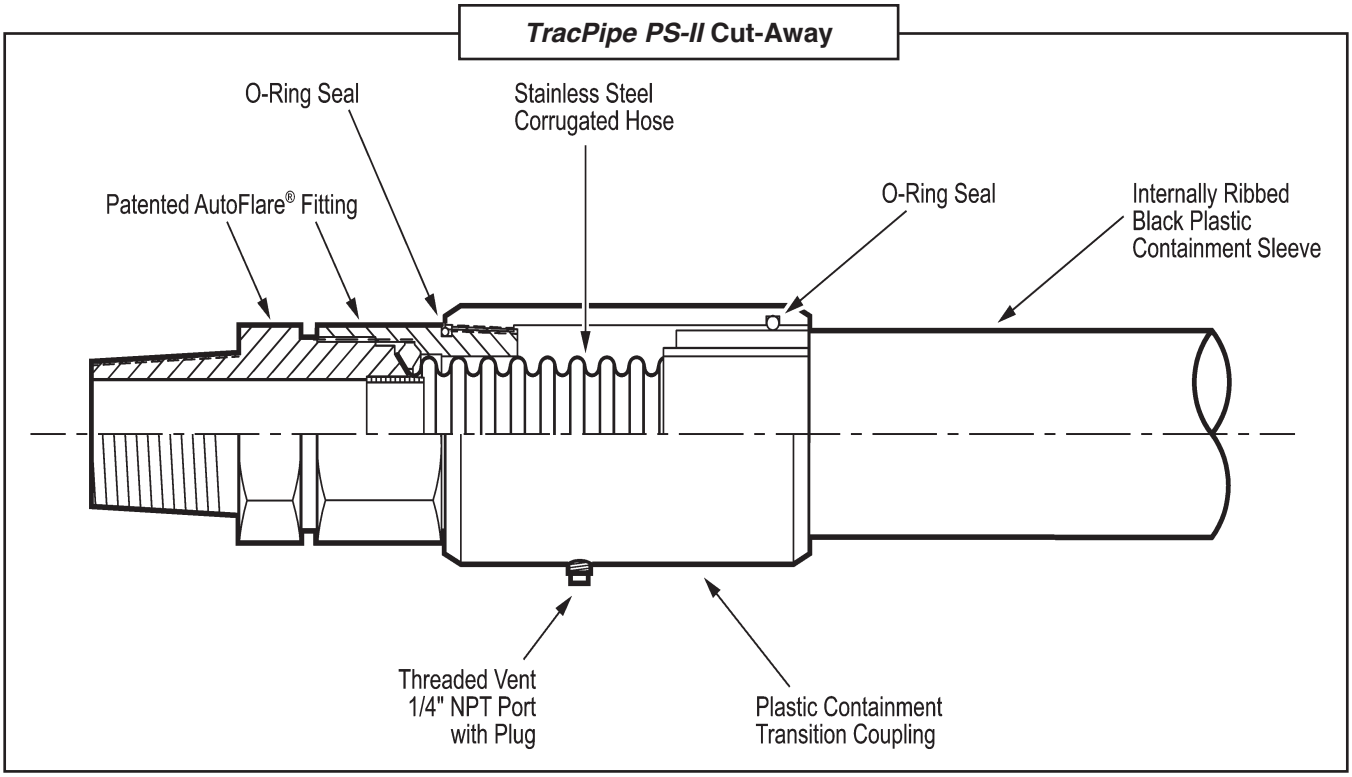


Figure: 4-50

SECTION 4.9.2 — TRACPIPE PS-II

1. **TracPipe PS-II** piping is a patented system suitable for above-ground and underground use. It is designed with our standard CSST tubing and incorporates an internally ribbed sleeve (duct), and specially designed end fittings that provide vent capability at either end of a piping run in the event of a leak in the CSST. **Figure 4-50**

2. **TracPipe PS-II** piping is IAPMO tested and UPC listed for underground use per IGC 201-2018. It complies with all model code requirements for underground/under-slab burial and is CSA-listed for above-ground use.

NOTICE:

The CSA / ANSI LC 1 - CSA 6.26 Standard has no provisions for evaluating CSST for direct burial.

3. For above-ground **TracPipe PS-II** piping installations, the installer shall meet local building codes regarding flame spread and smoke density regulations for nonmetallic materials. Per UL classification requirements, **TracPipe PS-II** piping is not suitable for use in return air plenums or through penetration fire stop systems.

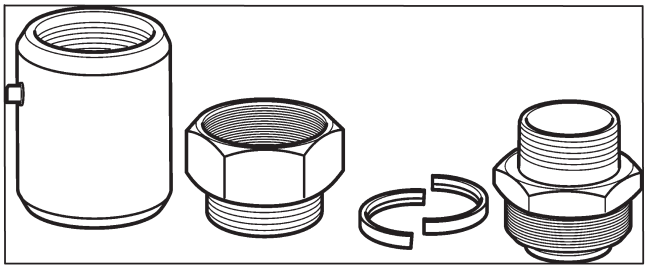
4. **TracPipe PS-II** piping is supplied in standard lengths on reels or custom-cut lengths. Standard reel lengths are 100, 150, and 250 feet (100-foot lengths for sizes up to 1 inch.)

5. **TracPipe PS-II** piping 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.**

NOTICE:

When pressure testing **TracPipe PS-II** piping, it is necessary to remove at least one fitting vent plug to ensure proper test results on the stainless-steel tubing. Codes do not require pressure testing of the sleeve. If local jurisdictions require the sleeve to be tested, do not exceed the pressure of the pipe (25 PSI maximum).

SECTION 4.9.3 — *TRACPIPE PS-II* FITTING ATTACHMENT



- **TracPipe PS-II** piping is constructed from Omegaflex standard **Tracpipe** and **TracPipeCounterStrike** CSST flexible gas pipe sleeved in a fully vent-capable polyethylene sleeve.

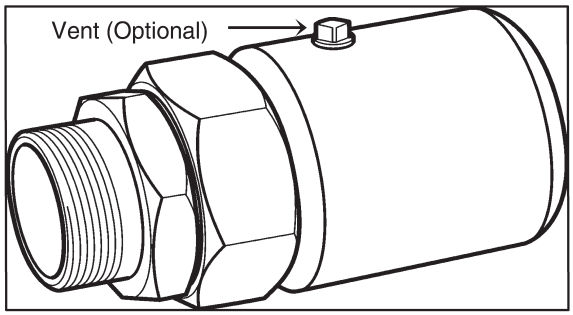


Figure: 4-51

- **TracPipe PS-II** fittings are constructed from **TracPipe** and **TracPipeCounterStrike** CSST patented **AutoFlare** fittings with a plastic containment coupling and a 1/4-inch NPT vent port. Fittings are assembled without special tools **(Figure 4-51)**.

NOTICE:

When pressure testing **TracPipe PS-II** piping, 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

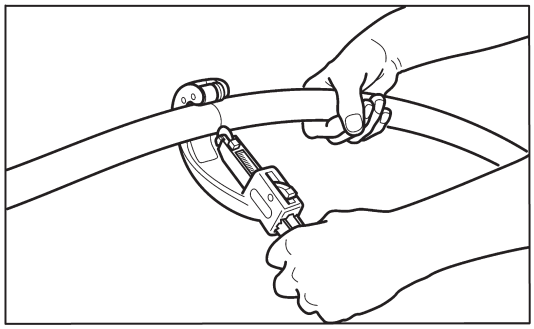


Figure: 4-52

1. Unreel pipe into a trench or on the ground and cut to the desired length plus one foot. Cutting up to 1-inch size can be done with a large tubing cutter. For 1-1/4 inch to 2-inch sizes, a reciprocating saw is recommended **(Figure 4-52)**.

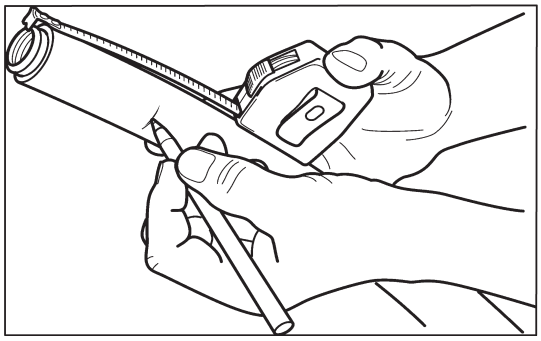


Figure: 4-53

2. Mark the sleeve at the specified length on the Strip Length Chart **Table 4-10** - plus 2 inches **(Figure 4-53)**.

Table: 4-10
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 inch	1-1/2 inch	1-3/4 inch	2 inch	2-1/4 inch	2-1/2 inch	2-3/4 inch
Fitting Torque Value	40 lb-ft	42 lb-ft	45 lb-ft	75 lb-ft	150 lb-ft	200 lb-ft	250 lb-ft
OD for Core Hole Sizing	.820	1.08	1.32	1.6	1.96	2.18	2.8
Max. Superimposed Loading *psf*	9640	7254	5409	4203	3390	2901	2124

NOTICE:

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.

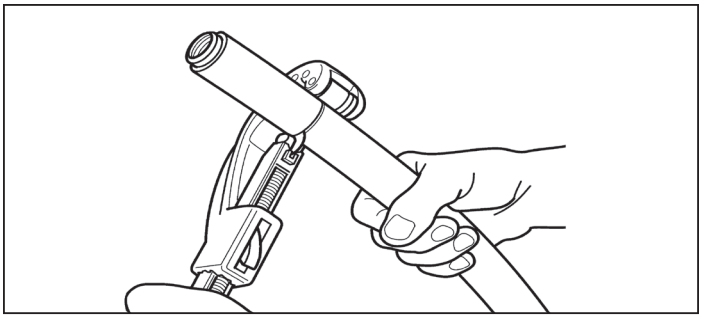


Figure: 4-54

3. 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 **(Figure 4-54)**.

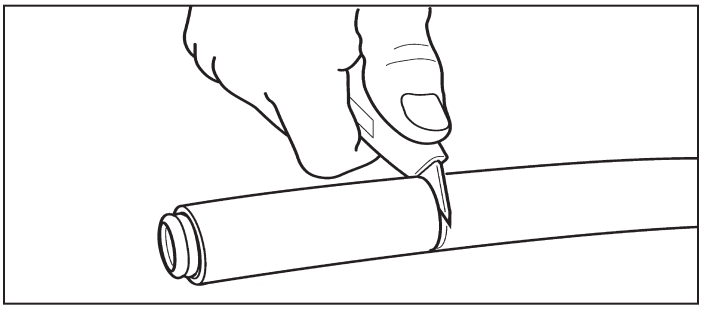


Figure: 4-55

4. Finish cutting through the sleeve down to the stainless corrugated pipe using a sharp utility knife **(Figure 4-55)**.

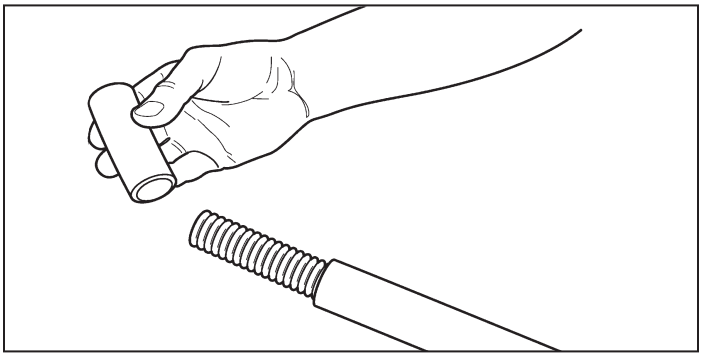


Figure: 4-56

5. Using a twisting motion, remove the black sleeve from the pipe. It may be necessary to cut sleeves longitudinally and peel off for larger sizes. Inspect stainless pipe for scoring from the tubing cutter **(Figure 4-56)**.

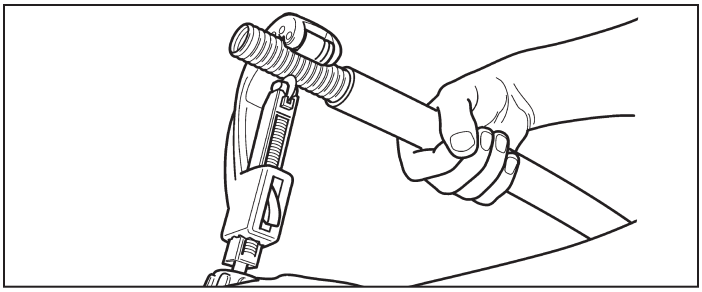


Figure: 4-57

6. Using the tubing cutter, trim the corrugated pipe to the strip length specified in **Table 4.8**. Cut slowly in the root of the corrugation in the same manner you would cut copper tubing. Inspect the end of the pipe for a clean cut without tears in the corrugation **(Figure 4-57)**.

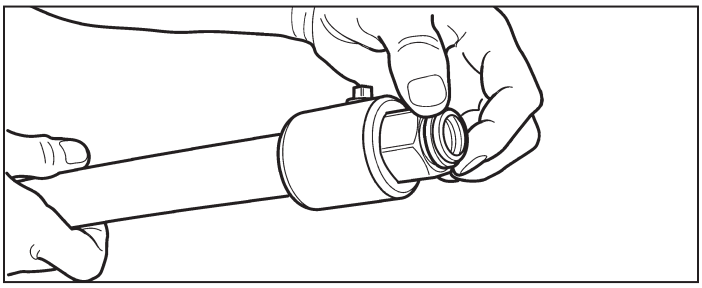


Figure: 4-58

7. Remove the adapter and split rings from the fitting. Attach the adapter to the equipment. Slip the coupling and nut over the end of the pipe all the way to expose the first corrugations of the pipe. Insert split rings into the first corrugation as shown **(Figure 4-58)**.

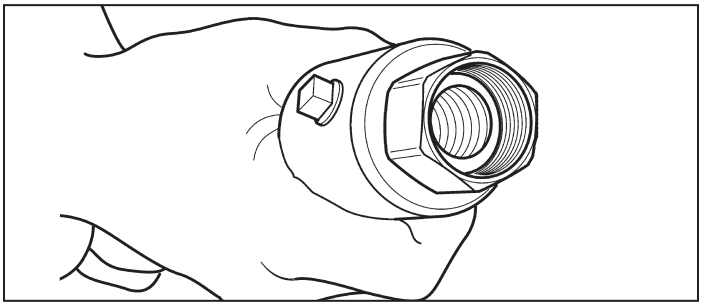


Figure: 4-59

8. Hold the black coupling and slide the fitting up to capture the split rings into the nut. Make sure that the split rings slip all the way to the base of the internal threads. Your assembly is now ready to be attached to the adapter on the equipment **(Figure 4-59)**.

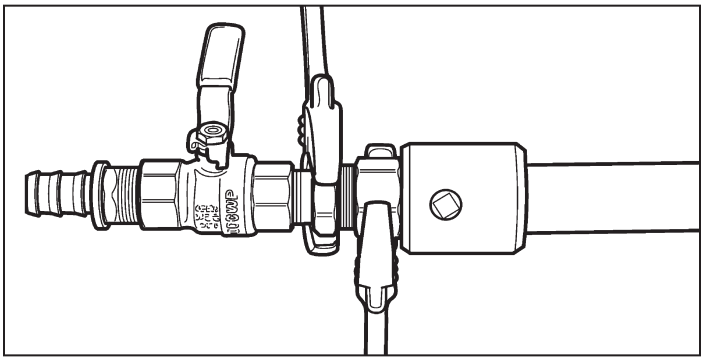


Figure: 4-60

9. Thread the nut onto the adapter. Use the appropriate wrenches to hold the adapter and tighten the nut to the proper torque specified. It's important not to overtighten or use any pipe dope or thread sealants on this connection. The connection is a metal-to-metal seat and will not seal if pipe dope or thread sealants are used. Remember, sealants are only meant to be used on the NPT connection to the equipment **(Figure 4-60)**.

NOTICE:
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

⚠ WARNING FIRE / FUEL GAS PIPING

The TracPipe and TracPipeCounterStrike flexible gas piping MUST be bonded to an effective ground-fault current path per the Canadian Electrical Code (CEC) and in accordance with the instructions contained in this section. It is HIGHLY RECOMMENDED to equipotential bond all mechanical systems to the building's grounding electrode system.

1. Definitions:
   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.
   Bonding: The process of making an electrical connection between the grounding electrode and any equipment, appliance, or metal conductor, such as pipes, plumbing, flues, etc. Equipment bonding protects people and equipment in the event of an electrical fault.

   Equipotential Bonding: The process of making an electrical connection between the grounding electrode system 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.

2. **TracPipe**, and **TracPipeCounterStrike** gas piping systems shall be bonded per the locally adopted electrical code, fuel gas code, and these instructions. In the event of a conflict, the most restrictive practice shall apply.

SECTION 4.10.1 - *TracpipeCounterStrike* Bonding Instructions

For all products date coded 0731 and higher (manufactured after July 30, 2007)

1. The instructions for cutting tubing, removing the jacket, and making fitting connections to **TracPipe** piping and **TracPipeCounterStrike** CSST are located in Section 4.2 of this guide. The maximum strip length when assembling the fitting to the tubing is shown in **Table 4-3** of this guide.

2. There are no additional bonding requirements for **TracPipeCounterStrike** CSST and underground **TracPipe PS-II** piping imposed by the manufacturer's installation instructions.

3. Do not apply any non-metallic labels or paint to **TracPipeCounterStrike** CSST. If non-metallic labels or paint are applied, the system must be bonded in accordance with section 4.10.2.

SECTION 4.10.2— BONDING CONVENTIONAL YELLOW-JACKETED *TracPipe*

1. For bonding of the **TracPipe** system, a bonding clamp must be attached to the brass **AutoFlare/AutoSnap** fitting adapter (adjacent to the pipe thread area - See **Figure 4-61**) or to a black or copper pipe component (pipe or fitting) located in the same electrically continuous gas piping system. The corrugated stainless-steel portion of the gas piping system SHALL NOT be used as the bonding attachment point **under any circumstances**. The bonding conductor shall be at least #6 AWG copper or equivalent and connected to the grounding electrode system per the Canadian Electrical Code (C22.1) or the locally adopted electrical code.

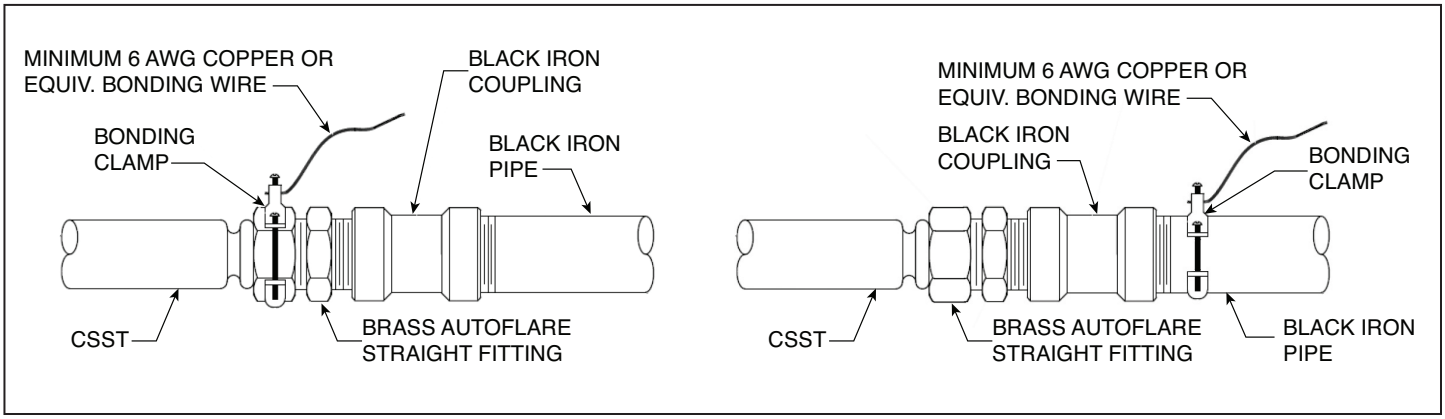


Figure: 4-61

NOTICE:

Under no circumstances shall the corrugated stainless-steel tubing be used as the bonding attachment point.

Brass Bonding Clamps

Part No.	Fits TracPipe AutoFlare Fitting	Fits Iron Pipe Size
FGP-GC-1	3/8", 1/2"	1/2", 3/4", 1"
FGP-GC-2	3/4", 1", 1-1/4"	1-1/4", 1-1/2", 2"
FGP-GC-3	1-1/2", 2"	2-1/2", 3", 4"

NOTICE:

TracPipe Bonding clamps have been tested and approved by CSA per UL 467 / CSA C22.2 No. 41-07 when installed on Black Iron /Galvanized steel pipe and **TracPipe AutoFlare/AutoSnap** brass hex fittings (report #3000657, 5/2/08).

⚠ WARNING FIRE / FUEL GAS PIPING

- **Failure to properly bond the TracPipe flexible gas piping may damage the CSST system in the event of a lightning strike.**
- **A lightning-induced fire in the building could lead to serious personal injury and/or significant property damage.**

2. The bonding conductor should be as short as practical. The bonding conductor shall be attached to the grounding electrode system per the locally adopted electrical code.

CHAPTER 5
INSPECTION, REPAIR AND REPLACEMENT

SECTION 5.1 — MINIMUM INSPECTION REQUIREMENTS

TracPipe Inspection Checklist

All installations shall be inspected by the jurisdiction having authority in accordance with provincial and local mechanical/plumbing codes and the Canadian CSA B149.1 Natural gas and propane installation code.

❑ Installer qualified per province 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** is bonded to the grounding electrode system.

❑ **TracPipe** tubing is supported at proper interval.

❑ No damaged tubing dents or defects. (See 5.3, 5.4)

RECOMMENDED

❑ Installation of equipotential bonding between grounding electrode and all mechanical systems.

TracPipe CounterStrike Flexible Gas Piping

Omega Flex, Inc.
451 Creamery Way, Exton, PA 19341-2509
Toll free: (800) 671-8622
Tel: (610) 524-7272
Fax: (610) 524-7282Fax: (610) 524-7282

INSPECTION, REPAIR AND REPLACEMENT

SECTION 5.2 — MINIMUM INSPECTION REQUIREMENTS

TracPipe®*CounterStrike*® Inspection Checklist

All installations shall be inspected by the jurisdiction having authority in accordance with provincial and local mechanical/plumbing codes and the Canadian CSA B149.1 Natural gas and propane installation code.

- ❑ Installer qualified per province and/or local requirements.
- ❑ Installer has ***TracPipe*®*CounterStrike*®** Training Certification card.
- ❑ Inspection and pressure test completed at rough in.
- ❑ Strike protection in place where required.
- ❑ ***TracPipe*®*CounterStrike*®** tubing is supported at proper interval.
- ❑ No damaged tubing dents or defects. (See 5.3, 5.4)
- ❑ Inspect for elecrical bonding where required.

RECOMMENDED

- ❑ Installation of equipotential bonding between grounding electrode and all mechanical systems.

TracPipe CounterStrike Flexible Gas Piping

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Tel: (610) 524-7272
Fax: (610) 524-7282Fax: (610) 524-7282

SECTION 5.3 — 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 are necessary if it 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**).

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. The 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 **AutoFlare** 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 5-4**

SECTION 5.4 REPAIR OF DAMAGED JACKET

1. If the **TracPipe** and **TracPipeCounterStrike** CSST jacket has been ripped, torn, cut or exposed to an electrical arc, a repair is required. The jacket shall be wrapped using self-bonding silicone tape over the damaged area insuring that the damaged jacket is fully covered and fully wrapped around the jacket circumference.

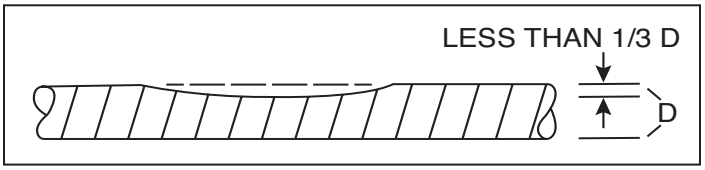


Figure: 5-1

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

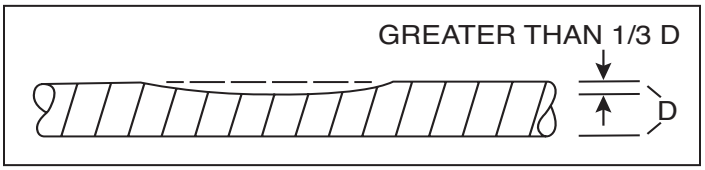


Figure: 5-2

Figure: 5-2 Repair Necessary.
Significant Damage to the Tubing Due to Impact or Crushing.No Significant Damage to the Tubing Due to Impact or crushing.

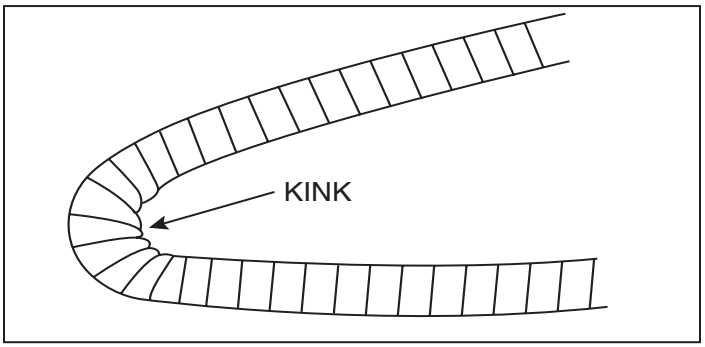


Figure: 5-3

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

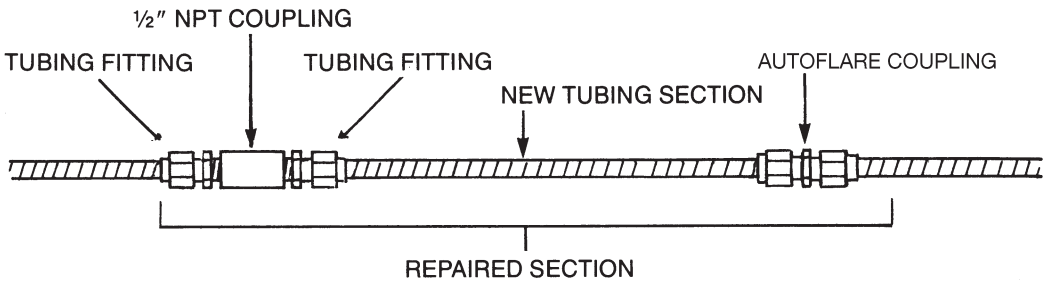


Figure: 5-4

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 6.22 “Testing of Piping” of the CSA B149.1 Natural gas and propane installation code. Pressure test according to these guidelines or local codes. When local codes are more stringent, local codes must be followed. If no local codes apply, test according to the CSA B149.1 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 is recommended during the rough construction phase of a facility before the interior walls are finished. This will allow for a thorough inspection of the piping system during the pressure testing, which can help identify leaks or other issues early on. If defects or problems are discovered after the interior walls are finished, **TracPipe** will not be responsible for any repairs needed to correct them.

2. Do not connect appliances or pressurize the system with fuel gas until 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. After leak detection, rinse with water and dry the tubing thoroughly. (**TracPipe** Leak Check Solution P/N FGP-LCS is available.)

5. Utilities typically conduct a leak test after setting up the gas meter but before turning on the gas. This test is performed once the final construction is complete and the finished interior walls are in place. The primary purpose of this test is to ensure that the tubing was not damaged during the closing-in construction process.

SECTION 6.1 — PRESSURE TEST FOR ELEVATED PRESSURE SYSTEMS

NOTICE:

When pressure testing **TracPipe PS-II**, removing at least one fitting vent plug is necessary to ensure proper test results on the stainless-steel tubing. Codes do not require pressure testing of the sleeve. If local jurisdictions require the sleeve to be tested, do not exceed the pressure of the pipe (25 PSI maximum).

NOTICE:

Do not subject **TracPipe** and **TracPipeCounterStrike** sizes 1-1/2 inch or 2 inch to excessive pressure. Pressure test 1-1/2 inch and 2 inch sizes to local code requirements but not to exceed 40 PSI. In the absence of code requirements, test 1-1/2 times actual working pressure, not to exceed 40 PSI.

Pressure test 1-1/2 inch and 2-inch 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.

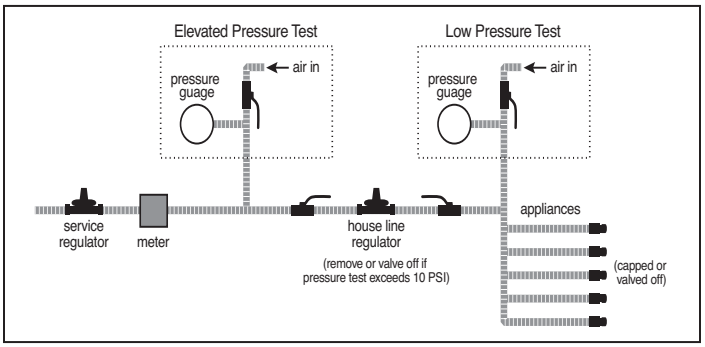


Figure: 6-1

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

SECTION 6.1.1 — APPLIANCE CONNECTION LEAKAGE CHECK PROCEDURE

1. After the final pressure test, inspection, and construction (finished interior walls) are complete, 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. The tubing system should be purged before the appliances are placed in operation. This displaces the air in the system with fuel gas. Be sure to bleed the tubing system into a well-ventilated area.

NOTICE:

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 6.1.2 — REGULATOR PERFORMANCE

A. Load Response

1. A performance test should be conducted while operating all appliances at full load. This will ensure adequate pressure on 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 of water column under full-load conditions. If this pressure cannot 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 maximum allowable delivery pressure of the appliance(s).

B. Spring Adjustment

1. The 2 PSI system pounds-to-inch house line regulator can be adjusted with an outlet pressure ranging between 7 and 11 inches or 14 inches of water column. The regulator must be adjusted according to the manufacturer's recommended procedure. A pressure gauge mounted 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 the maximum load.

3. The average natural gas appliance is designed to operate at 3 to 4 inches of 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 of 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
<7 in. w.c. / 0.5 in. w.c. drop-**Table N-1**: Low Pressure (Standard)
=> 7-14 in. w.c. / 1 in. w.c. drop-**Table N-2**: Medium Pressure (1 inch drop)
2 PSI / 1 PSI drop-**Table N-3**: Elevated Pressure (2 PSI)
5 PSI / 3.5 PSI drop-**Table N-4**: Elevated Pressure (5 PSI)
20 PSI / 10 PSI drop-**Table N-5**: Elevated Pressure (20 PSI)

Propane
11-12 in. w.c. / 1.0 in w.c. drop-**Table P-1**: Propane Low Pressure
2 PSI / 1 PSI drop-**Table P-2**: Propane Elevated Pressure (2 PSI)
20 PSI / 10 PSI drop-**Table P-3**: Propane Elevated Pressure (20 PSI)

Table N-1 Low Pressure (Standard)

Maximum Capacity of OmegaFlex TracPipe CSST in Cubic Feet per Hour (CFH) of Natural Gas (1000 BTU per cubic foot approx)

Min. Gas Pressure: < 7 in w.c.
Pressure Drop: 0.5 in w.c.
(Based on a 0.60 Specific Gravity Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	63	45	37	33	29	27	23	21	19	18	17	17	16	15	14	12	11	10	9	8	7	6	6	5	5	5	5	4	4	4	4
1/2″	19	138	99	81	70	63	58	50	45	41	38	37	36	34	32	29	26	23	20	19	16	14	13	12	11	11	10	10	9	9	9	8
3/4″	25	344	245	201	175	157	143	125	112	102	95	92	89	84	80	71	65	57	51	46	40	36	33	31	29	27	26	24	23	22	22	21
1″	31	589	419	343	298	267	244	212	190	174	161	156	151	142	135	121	111	96	86	79	68	61	56	52	48	46	43	41	40	38	37	35
1 1/4″	37	1109	789	646	561	503	460	399	358	327	303	293	284	268	254	228	208	181	162	148	128	115	105	97	91	86	82	78	75	72	69	67
1 1/2″	46	1790	1261	1027	888	793	723	625	559	509	471	455	440	415	393	351	320	277	247	226	195	174	159	147	137	129	123	117	112	107	103	100
2″	62	4142	2934	2398	2078	1860	1698	1472	1317	1203	1114	1076	1042	983	933	835	762	661	591	540	468	419	382	354	331	312	296	283	271	260	251	242

see notes below*
EHD (Equivalent Hydraulic Diameter) A theoretical size which reflects the hydraulic performance of the tubing. It is not a true physical measure. This number is used to compare individual sizes between different manufactures. The higher the EHD number the greater the flow capacity of the piping.

Table N-2 Medium Pressure (1 in drop)

Maximum Capacity of OmegaFlex TracPipe CSST in Cubic Feet per Hour (CFH) of Natural Gas (1000 BTU per cubic foot approx)

Min. Gas Pressure: < 7-14 in w.c.
Pressure Drop: 1.0 in w.c.
(Based on a 0.60 Specific Gravity Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	87	63	52	45	41	37	33	29	27	25	24	23	22	21	19	17	15	14	12	11	10	9	8	8	7	7	7	6	6	6	6
1/2″	19	193	138	113	99	88	81	70	63	58	54	52	50	47	45	40	37	32	29	26	23	20	19	17	16	15	14	14	13	13	12	12
3/4″	25	482	344	282	245	220	201	175	157	143	133	129	125	118	112	100	92	80	71	65	57	51	46	43	40	38	36	34	33	32	31	30
1″	31	827	589	483	419	376	343	298	267	244	227	219	212	200	190	170	156	135	121	111	96	86	79	73	68	64	61	58	56	54	52	50
1 1/4″	37	1558	1109	908	789	707	646	561	503	460	426	412	399	377	358	320	293	254	228	208	181	162	148	137	128	121	115	110	105	101	97	94
1 1/2″	46	2541	1790	1458	1261	1126	1027	888	793	723	669	646	625	589	559	499	455	393	351	320	277	247	226	209	195	184	174	166	159	152	147	142
2″	62	5848	4142	3386	2934	2626	2398	2078	1860	1698	1573	1520	1472	1388	1317	1179	1076	933	835	762	661	591	540	500	468	441	419	399	382	367	354	342

*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 the equivalent length of tubing to the following equation: L=1.3n where L is the additional length of tubing and n is the number of additional fittings and/or bends.

Table N-3 Elevated Pressure 2 psig

Maximum Capacity of OmegaFlex TracPipe CSST in Cubic Feet per Hour (CFH) of Natural Gas (1000 BTU per cubic foot approx)

Gas Pressure: 2 psig
Pressure Drop: 1.0 psi

(Based on a 0.60 Specific Gravity Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	410	353	286	246	220	200	172	154	139	128	124	120	112	107	94	87	75	67	61	53	47	43	40	38	36	34	33	31	30	29	28
1/2″	19	965	700	567	493	444	406	353	317	290	269	260	252	238	226	203	186	162	145	133	116	104	95	88	83	78	74	71	68	65	63	61
3/4″	25	2430	1734	1423	1237	1110	1015	883	792	724	672	650	630	595	565	507	464	403	361	331	287	258	236	219	205	193	184	175	168	162	156	151
1″	31	4220	3004	2463	2139	1917	1753	1522	1365	1248	1157	1118	1084	1023	971	871	796	691	620	567	492	441	403	374	350	330	314	299	287	276	266	257
1 1/4″	37	7969	5670	4646	4034	3615	3305	2870	2572	2352	2180	2108	2042	1927	1830	1640	1499	1302	1167	1067	926	830	759	703	659	622	590	563	540	519	500	484
1 1/2″	46	13626	9599	7820	6762	6041	5509	4763	4255	3881	3590	3467	3355	3161	2997	2678	2442	2111	1886	1720	1487	1329	1212	1121	1048	987	936	892	853	820	789	762
2″	62	30546	21637	17684	15326	13715	12526	10855	9715	8872	8217	7940	7689	7251	6881	6158	5624	4874	4362	3983	3452	3089	2821	2613	2445	2306	2188	2087	1998	1920	1851	1788

see notes below*
EHD (Equivalent Hydraulic Diameter) A theoretical size which reflects the hydraulic performance of the tubing. It is not a true physical measure. This number is used to compare individual sizes between different manufactures. Pressure drop across a regulator will vary with flow rate. FGP-REG-3 has a 3/4 PSI pressure drop at a flow of 250 cubic feet per hour. regulator. The higher the EHD number the greater the flow capacity of the piping.
Table does not include effect of pressure drop across the line regulator. CAUTION: Capacities shown in table may exceed the maximum capacity for a slected regulator.

Table N-4 Elevated Pressure 5 psig

Maximum Capacity of OmegaFlex TracPipe CSST in Cubic Feet per Hour (CFH) of Natural Gas (1000 BTU per cubic foot approx)

Gas Pressure: 5 psig
Pressure Drop: 3.5 psi

(Based on a 0.60 Specific Gravity Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	736	672	552	475	420	382	329	293	267	246	238	230	216	205	182	166	143	128	116	100	89	78	73	68	65	62	59	57	54	53	51
1/2″	19	1769	1304	1040	905	827	755	654	586	532	493	479	463	437	415	373	341	297	266	244	212	190	174	162	152	143	136	130	125	120	116	112
3/4″	25	4472	3191	2619	2277	2042	1869	1625	1457	1333	1237	1196	1159	1095	1040	933	853	742	665	609	529	475	434	403	378	356	339	323	310	298	287	278
1″	31	7800	5659	4552	3953	3543	3240	2814	2522	2307	2139	2067	2003	1891	1795	1609	1472	1278	1146	1048	910	815	746	691	647	611	580	554	531	510	492	476
1 1/4″	37	14743	10489	8595	7463	6688	6116	5310	4759	4351	4034	3899	3778	3565	3386	3034	2774	2409	2159	1974	1714	1536	1404	1302	1219	1151	1093	1043	999	960	926	895
1 1/2″	46	25665	18080	14730	12737	11378	10377	8972	8015	7310	6762	6530	6320	5955	5646	5044	4600	3977	3553	3240	2802	2503	2283	2111	1974	1860	1763	1680	1608	1544	1487	1436
2″	62	56970	40353	32981	28583	25580	23361	20246	18119	16547	15326	14809	14341	13524	12834	11485	10489	9090	8135	7430	6439	5762	5262	4874	4561	4301	4081	3892	3727	3582	3452	3336

*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 the equivalent length of tubing to the following equation: L=1.3n where L is the additional length of tubing and n is the number of additional fittings and/or bends.

Table N-5 Elevated Pressure 20 psig

Maximum Capacity of OmegaFlex TracPipe CSST in Cubic Feet per Hour (CFH) of Natural Gas (1000 BTU per cubic foot approx)

Gas Pressure: 20 psig
Pressure Drop: 10.0 psi

(Based on a 0.60 Specific Gravity Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	1315	958	796	698	630	580	508	459	422	393	381	370	351	334	302	278	243	220	202	177	160	147	137	129	122	116	111	107	103	100	97
1/2″	19	3044	2214	1838	1610	1453	1336	1171	1057	972	905	877	851	807	768	693	638	559	504	464	406	367	337	314	295	280	266	255	245	236	228	221
3/4″	25	7190	5268	4391	3859	3491	3217	2827	2558	2357	2199	2132	2071	1965	1874	1695	1562	1373	1242	1144	1006	910	838	782	737	699	666	639	614	592	573	555
1″	31	12131	8910	7439	6545	5926	5464	4807	4353	4014	3747	3634	3531	3351	3197	2895	2669	2348	2126	1961	1725	1562	1440	1344	1267	1202	1147	1099	1058	1021	987	958
1 1/4″	37	18598	13773	11553	10199	9259	8556	7553	6857	6336	5926	5752	5593	5315	5078	4610	4259	3760	3414	3154	2784	2528	2336	2185	2062	1959	1872	1796	1730	1671	1618	1570
1 1/2″	46	35539	25802	21395	18733	16898	15533	13600	12268	11277	10502	10173	9874	9351	8907	8034	7385	6466	5833	5362	4695	4235	3893	3625	3408	3228	3074	2942	2826	2723	2632	2549
2″	62	65326	48577	40848	36123	32837	30375	26861	24418	22588	21147	20533	19974	18994	18158	16506	15269	13502	12274	11354	10040	9127	8443	7904	7466	7099	6787	6516	6278	6067	5878	5707

see notes below*
EHD (Equivalent Hydraulic Diameter) A theoretical size which reflects the hydraulic performance of the tubing. It is not a true physical measure. This number is used to compare individual sizes between different manufactures.
The higher the EHD number the greater the flow capacity of the piping. Table does not include effect of pressure drop across the regulator. User must size the regulator based on an inlet pressure between 10 and 20 psig with the desired outlet pressure range and capacity required.

Table P-1 Propane Low Pressure

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

Min. Gas Pressure: 11-12 in w.c.
Pressure Drop: 1.0 in w.c.

(Based on a 1.52 Specific Gravity / 2520 BTU per cubic foot Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	138	100	82	71	65	59	52	46	43	40	38	36	35	33	30	27	24	22	19	17	16	14	13	13	11	11	11	9	9	9	9
1/2″	19	306	218	179	157	139	128	111	100	92	85	82	79	74	71	63	59	51	46	41	36	32	30	27	25	24	22	22	21	21	19	19
3/4″	25	763	545	446	388	348	318	277	249	226	211	204	198	187	177	158	146	127	112	103	90	81	73	68	63	60	57	54	52	51	49	47
1″	31	1309	933	765	663	595	543	472	423	386	359	347	336	317	301	269	247	214	192	176	152	136	125	116	108	101	97	92	89	85	82	79
1 1/4″	37	2467	1756	1438	1249	1119	1023	888	796	728	674	652	632	597	567	507	464	402	361	329	287	256	234	217	203	192	182	174	166	160	154	149
1 1/2″	46	4023	2834	2308	1997	1783	1626	1406	1256	1145	1059	1023	990	933	885	790	720	622	556	507	439	391	358	331	309	291	275	263	252	241	233	225
2″	62	9259	6558	5361	4645	4158	3797	3290	2945	2688	2490	2407	2331	2198	2085	1867	1704	1477	1322	1206	1047	936	855	792	741	698	663	632	605	581	560	541

*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 the equivalent length of tubing to the following equation: L=1.3n where L is the additional length of tubing and n is the number of additional fittings and/or bends.

Table P-2 Propane Elevated Pressure 2 psig

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

Min. Gas Pressure: 2 psig
Pressure Drop: 1.0 psi

(Based on a 1.52 Specific Gravity / 2520 BTU per cubic foot Gas)

Tubing Length (feet)

Size	EHD	5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	649	558	453	389	347	316	271	243	220	203	196	189	177	169	144	137	118	105	96	84	74	68	63	60	57	54	52	49	47	46	44
1/2″	19	1528	1106	898	781	701	643	559	502	459	426	412	399	377	358	321	294	256	230	211	184	165	150	139	131	123	117	112	108	103	100	97
3/4″	25	3847	2745	2253	1959	1757	1607	1398	1254	1146	1064	1029	997	942	895	803	735	638	572	524	454	408	374	347	325	306	291	277	266	256	247	239
1″	31	6681	4756	3900	3387	3035	2775	2410	2161	1976	1832	1770	1716	1620	1537	1379	1260	1094	982	898	779	698	638	592	554	522	497	473	454	437	421	407
1 1/4″	37	12617	8977	7356	6387	5724	5233	4544	4072	3724	3452	3338	3233	3051	2897	2597	2373	2061	1848	1689	1466	1314	1202	1113	1043	985	934	891	855	822	792	766
1 1/2″	46	21574	15198	12381	10706	9565	8722	7541	6737	6145	5684	5489	5312	5005	4745	4240	3866	3342	2986	2723	2354	2104	1919	1775	1659	1563	1482	1412	1351	1298	1249	1206
2″	62	48362	34257	27999	24265	21715	19832	17186	15381	14047	13010	12571	12174	11480	10894	9750	8904	7717	6906	6306	5465	4891	4466	4137	3871	3651	3464	3304	3163	3040	2931	2831

Notes:
EHD (Equivalent Hydraulic Diameter) A theoretical size which reflects the hydraulic performance of the tubing. It is not a true physical measure. This number is used to compare individual sizes between different manufactures. The higher the EHD number the greater the flow capacity of the piping. Table does not include effect of pressure drop across the line regulator. If the regulator loss exceeds 1/2 PSI (based on 11 inch outlet pressure) Do not use this chart. Pressure drops across a regulator will vary with flow rate. FGP-REG-5P has a 1/2 PSI pressure drop at a flow of 307 cubic feet per hour (774 MBTUh). CAUTION: Capacities shown in the table may exceed the maximum capacity for a selectedregulator.

Table P-3 Elevated Pressure 20 psig

Maximum Capacity of OmegaFlex TracPipe CSST in Thousands of BTU per hour Propane

Gas Gas Pressure: 20 psig
Pressure Drop: 10.0 psi

(Based on a 1.52 Specific Gravity / 2520 BTU per cubic foot Gas)

Tubing Length (feet)

		5	10	15	20	25	30	40	50	60	70	75	80	90	100	125	150	200	250	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
3/8″	15	2082	1517	1260	1105	997	918	804	727	668	622	603	586	556	529	478	440	385	348	320	280	253	233	217	204	193	184	176	169	163	158	154
1/2″	19	4819	3505	2910	2549	2300	2115	1854	1674	1539	1433	1389	1347	1278	1216	1097	1010	885	798	735	643	581	534	497	467	443	421	404	388	374	361	350
3/4″	25	11384	8341	6952	6110	5527	5093	4476	4050	3732	3482	3376	3279	3111	2967	2684	2473	2174	1966	1811	1593	1441	1327	1238	1167	1107	1054	1012	972	937	907	879
1″	31	19207	14107	11778	10362	9382	8651	7611	6892	6355	5933	5754	5591	5306	5062	4584	4226	3718	3366	3105	2731	2473	2280	2128	2006	1903	1816	1740	1675	1617	1563	1517
1 1/4″	37	29446	21806	18291	16148	14659	13546	11958	10856	10032	9382	9107	8855	8415	8040	7299	6743	5953	5405	4994	4408	4003	3699	3459	3265	3102	2964	2844	2739	2646	2562	2486
1 1/2″	46	56268	40851	33874	29659	26754	24593	21532	19424	17855	16627	16107	15633	14805	14102	12720	11692	10237	9235	8489	7433	6705	6164	5739	5396	5111	4867	4658	4474	4311	4167	4036
2″	62	103429	76910	64673	57192	51990	48092	42528	38660	35763	33481	32509	31624	30073	28749	26133	24175	21377	19433	17976	15896	14450	13368	12514	11821	11240	10746	10317	9940	9606	9306	9036

*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 the equivalent length of tubing to the following equation: L=1.3n where L is the additional length of tubing and n is the number of additional fittings and/or bends.

Section 7.1 — PRESSURE DROP PER FOOT TABLES-NATURAL GAS for TracPipe Flexible Gas Piping and Black Iron - Natural Gas Steel Pipe

For propane (LP) gas applications:

1. Convert propane BTU load into CFH propane and divide it by 2520 BTU per cubic foot.

2. Multiply the obtained CFH propane (1.52 SG) value by 1.5916 to get the equivalent CFH natural gas (0.6 SG) value.

3. Find the pressure drop per foot using the CFH natural gas value obtained from the previous step. This pressure drop per foot will be for propane at the given BTU load.

4. Follow the instructions for the sum of pressure loss. If you need to convert 1,000 BTU values to CFH propane, you can use the formula: **Propane = 2520 BTU/cubic feet**.

Section 7.1 - Table PD-1A

Pressure drop (inch wc per foot) for TracPipe based on a given CFH Flow (Natural Gas SG = 0.60 Gas) at Inlet Pressures up to 5 PSI

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the TracPipeCounterStrike D&I Guide.

CFH	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
10	0.0019	0.0004	0.0001				
20	0.0085	0.0018	0.0003	0.0001			
30	0.0204	0.0042	0.0007	0.0002	0.0001		
40	0.0377	0.0077	0.0012	0.0004	0.0001	0.0001	
50	0.0609	0.0121	0.0019	0.0007	0.0002	0.0001	
60	0.0900	0.0177	0.0028	0.0009	0.0003	0.0001	
70	0.1253	0.0244	0.0038	0.0013	0.0004	0.0002	
80	0.1668	0.0321	0.0050	0.0017	0.0005	0.0002	
90	0.2146	0.0410	0.0064	0.0022	0.0006	0.0003	
100	0.2690	0.0509	0.0079	0.0027	0.0007	0.0003	0.0001
110	0.3300	0.0620	0.0096	0.0033	0.0009	0.0004	0.0001
120	0.3976	0.0743	0.0115	0.0039	0.0011	0.0005	0.0001
130	0.4721	0.0876	0.0135	0.0046	0.0013	0.0006	0.0001
140	0.5533	0.1022	0.0158	0.0053	0.0015	0.0006	0.0001
150	0.6415	0.1178	0.0182	0.0061	0.0017	0.0007	0.0001
160	0.7367	0.1347	0.0207	0.0070	0.0019	0.0008	0.0001
170	0.8389	0.1526	0.0235	0.0079	0.0022	0.0009	0.0002
180	0.9482	0.1718	0.0264	0.0089	0.0025	0.0011	0.0002
190	1.0647	0.1921	0.0295	0.0099	0.0028	0.0012	0.0002
200	1.1884	0.2136	0.0328	0.0110	0.0031	0.0013	0.0002
225	1.5297	0.2726	0.0418	0.0140	0.0039	0.0017	0.0003
250	1.9172	0.3390	0.0519	0.0174	0.0048	0.0020	0.0004
275	2.3517	0.4128	0.0631	0.0211	0.0058	0.0025	0.0004
300	2.8338	0.4943	0.0755	0.0252	0.0070	0.0029	0.0005
325	3.3642	0.5833	0.0890	0.0297	0.0082	0.0034	0.0006
350	3.9433	0.6799	0.1036	0.0345	0.0095	0.0040	0.0007
375	4.5717	0.7842	0.1193	0.0398	0.0110	0.0045	0.0008
400	5.2499	0.8962	0.1363	0.0454	0.0125	0.0052	0.0009
425	5.9783	1.0159	0.1543	0.0513	0.0142	0.0058	0.0010
450	6.7575	1.1434	0.1736	0.0577	0.0159	0.0065	0.0012
475	7.5877	1.2788	0.1940	0.0644	0.0178	0.0072	0.0013
500	8.4694	1.4219	0.2155	0.0715	0.0197	0.0080	0.0014
525	9.4030	1.5729	0.2382	0.0790	0.0218	0.0088	0.0016
550		1.7318	0.2621	0.0868	0.0240	0.0097	0.0017
575		1.8986	0.2872	0.0951	0.0262	0.0106	0.0019
600		2.0733	0.3134	0.1037	0.0286	0.0115	0.0021
625		2.2560	0.3408	0.1127	0.0311	0.0125	0.0022
650		2.4467	0.3694	0.1221	0.0337	0.0135	0.0024
675		2.6453	0.3992	0.1319	0.0364	0.0145	0.0026

Section 7.1 - Table PD-1A

Pressure drop (inch wc per foot) for TracPipe based on a given CFH Flow (Natural Gas SG = 0.60 Gas) at Inlet Pressures up to 5 PSI

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the TracPipeCounterStrike D&I Guide.

CFH	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
700	2.8520	0.4301	0.1420	0.0392	0.0156	0.0028
725	3.0668	0.4623	0.1526	0.0421	0.0167	0.0030
750	3.2895	0.4956	0.1635	0.0451	0.0179	0.0032
775	3.5204	0.5302	0.1748	0.0482	0.0191	0.0034
800	3.7594	0.5659	0.1865	0.0514	0.0203	0.0037
825	4.0065	0.6028	0.1986	0.0547	0.0216	0.0039
850	4.2617	0.6410	0.2110	0.0582	0.0229	0.0041
875	4.5250	0.6803	0.2239	0.0617	0.0243	0.0044
900	4.7966	0.7208	0.2371	0.0653	0.0256	0.0046
925	5.0763	0.7625	0.2507	0.0691	0.0271	0.0049
950	5.3642	0.8055	0.2648	0.0729	0.0285	0.0052
975	5.6603	0.8496	0.2792	0.0769	0.0300	0.0055
1000	5.9647	0.8950	0.2940	0.0810	0.0316	0.0057
1100	7.2646	1.0885	0.3571	0.0983	0.0381	0.0070
1200	8.6972	1.3015	0.4264	0.1174	0.0453	0.0083
1300		1.5341	0.5020	0.1382	0.0531	0.0097
1400		1.7864	0.5839	0.1607	0.0615	0.0113
1500		2.0584	0.6722	0.1849	0.0705	0.0130
1600		2.3502	0.7668	0.2109	0.0801	0.0148
1700		2.6619	0.8677	0.2386	0.0903	0.0167
1800		2.9935	0.9750	0.2680	0.1011	0.0187
1900		3.3451	1.0887	0.2992	0.1125	0.0209
2000		3.7168	1.2088	0.3322	0.1245	0.0231
2100		4.1086	1.3353	0.3669	0.1371	0.0255
2200		4.5206	1.4682	0.4033	0.1503	0.0280
2300		4.9528	1.6075	0.4415	0.1641	0.0306
2400		5.4053	1.7533	0.4815	0.1786	0.0334
2500		5.8781	1.9056	0.5233	0.1936	0.0362
2600		6.3713	2.0643	0.5668	0.2092	0.0392
2700		6.8848	2.2295	0.6120	0.2254	0.0423
2800		7.4189	2.4011	0.6591	0.2422	0.0455
2900		7.9734	2.5793	0.7079	0.2597	0.0488
3000		8.5484	2.7640	0.7585	0.2777	0.0523
3100		9.1441	2.9552	0.8109	0.2963	0.0558
3200		9.7603	3.1529	0.8650	0.3155	0.0595
3300			3.3571	0.9210	0.3353	0.0633
3400			3.5679	0.9787	0.3557	0.0672
3500			3.7853	1.0382	0.3767	0.0712
3600			4.0091	1.0995	0.3983	0.0754
3700			4.2396	1.1626	0.4205	0.0797

Section 7.1 - Table PD-1A

Pressure drop (inch wc per foot) for TracPipe based on a given CFH Flow (Natural Gas SG = 0.60 Gas) at Inlet Pressures up to 5 PSI

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the **TracPipeCounterStrike** D&I Guide.

CFH	1"	1-1/4"	1-1/2"	2"
3800	4.4766	1.2275	0.4433	0.0841
3900	4.7202	1.2941	0.4666	0.0886
4000	4.9704	1.3626	0.4906	0.0932
4100	5.2271	1.4329	0.5152	0.0979
4200	5.4905	1.5050	0.5403	0.1028
4300	5.7604	1.5788	0.5661	0.1078
4400	6.0370	1.6545	0.5924	0.1129
4500	6.3202	1.7320	0.6194	0.1181
4600	6.6100	1.8112	0.6469	0.1234
4700	6.9064	1.8923	0.6750	0.1289
4800	7.2094	1.9752	0.7037	0.1344
4900	7.5191	2.0599	0.7330	0.1401
5000	7.8355	2.1464	0.7629	0.1459
5250	8.6554	2.3706	0.8402	0.1610
5500	9.5170	2.6062	0.9212	0.1767
5750		2.8531	1.0059	0.1933
6000		3.1114	1.0943	0.2105
6250		3.3811	1.1864	0.2285
6500		3.6623	1.2821	0.2473
6750		3.9548	1.3815	0.2667
7000		4.2588	1.4846	0.2870
7250		4.5743	1.5913	0.3079
7500		4.9012	1.7017	0.3297
7750		5.2397	1.8158	0.3521
8000		5.5896	1.9335	0.3753
8250		5.9511	2.0549	0.3993
8500		6.3241	2.1799	0.4240
8750		6.7086	2.3086	0.4494
9000		7.1047	2.4409	0.4756
9250		7.5124	2.5769	0.5025
9500		7.9316	2.7166	0.5302
9750		8.3625	2.8598	0.5586
10000		8.8049	3.0067	0.5878
10500		9.7247	3.3115	0.6483

CFH	1-1/2"	2"
11000	3.6307	0.7119
11500	3.9645	0.7784
12000	4.3128	0.8479
12500	4.6756	0.9204
13000	5.0529	0.9959
13500	5.4447	1.0744
14000	5.8509	1.1559
14500	6.2716	1.2404
15000	6.7067	1.3278
16000	7.6202	1.5117
17000	8.5913	1.7077
18000	9.6200	1.9156
19000		2.1355
20000		2.3674
21000		2.6113
22000		2.8673
23000		3.1352
24000		3.4152
25000		3.7073
26000		4.0114
27000		4.3275
28000		4.6557
29000		4.9959
30000		5.3482
31000		5.7126
32000		6.0890
33000		6.4775
34000		6.8781
35000		7.2908
36000		7.7155
37000		8.1523
38000		8.6013
39000		9.0623
40000		9.5354

Section 7.1 - Table PD-2A

Pressure drop (inch wc per foot) for Black Iron based on a given CFH Flow (Natural Gas SG = 0.60 Gas)

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the **TracPipe** D&I Guide.

CFH	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
10	0.0003	0.0001						
20	0.0009	0.0002	0.0001					
30	0.0020	0.0005	0.0002					
40	0.0033	0.0009	0.0003	0.0001				
50	0.0050	0.0013	0.0004	0.0001				
60	0.0071	0.0018	0.0006	0.0001	0.0001			
70	0.0094	0.0024	0.0007	0.0002	0.0001			
80	0.0120	0.0031	0.0009	0.0003	0.0001			
90	0.0149	0.0038	0.0012	0.0003	0.0001			
100	0.0181	0.0046	0.0014	0.0004	0.0002	0.0001		
110	0.0216	0.0055	0.0017	0.0005	0.0002	0.0001		
120	0.0254	0.0065	0.0020	0.0005	0.0003	0.0001		
130	0.0295	0.0075	0.0023	0.0006	0.0003	0.0001		
140	0.0338	0.0086	0.0027	0.0007	0.0003	0.0001		
150	0.0384	0.0098	0.0030	0.0008	0.0004	0.0001		
160	0.0433	0.0110	0.0034	0.0009	0.0004	0.0001	0.0001	
170	0.0484	0.0124	0.0038	0.0010	0.0005	0.0001	0.0001	
180	0.0538	0.0137	0.0043	0.0011	0.0005	0.0002	0.0001	
190	0.0595	0.0152	0.0047	0.0012	0.0006	0.0002	0.0001	
200	0.0654	0.0167	0.0052	0.0014	0.0006	0.0002	0.0001	
225	0.0813	0.0208	0.0064	0.0017	0.0008	0.0002	0.0001	
250	0.0988	0.0252	0.0078	0.0021	0.0010	0.0003	0.0001	
275	0.1178	0.0301	0.0093	0.0025	0.0012	0.0003	0.0001	0.0001
300	0.1384	0.0353	0.0109	0.0029	0.0014	0.0004	0.0002	0.0001
325	0.1605	0.0410	0.0127	0.0034	0.0016	0.0005	0.0002	0.0001
350	0.1840	0.0470	0.0146	0.0038	0.0018	0.0005	0.0002	0.0001
375	0.2091	0.0534	0.0165	0.0044	0.0021	0.0006	0.0003	0.0001
400	0.2356	0.0602	0.0186	0.0049	0.0023	0.0007	0.0003	0.0001
425	0.2635	0.0673	0.0208	0.0055	0.0026	0.0008	0.0003	0.0001
450	0.2929	0.0748	0.0232	0.0061	0.0029	0.0009	0.0004	0.0001
475	0.3237	0.0827	0.0256	0.0068	0.0032	0.0010	0.0004	0.0001
500	0.3559	0.0909	0.0282	0.0074	0.0035	0.0010	0.0004	0.0002
525	0.3896	0.0995	0.0308	0.0081	0.0039	0.0011	0.0005	0.0002
550	0.4246	0.1084	0.0336	0.0089	0.0042	0.0012	0.0005	0.0002
575	0.4609	0.1177	0.0365	0.0096	0.0046	0.0014	0.0006	0.0002
600	0.4987	0.1273	0.0394	0.0104	0.0049	0.0015	0.0006	0.0002
625	0.5378	0.1373	0.0425	0.0112	0.0053	0.0016	0.0007	0.0002
650	0.5783	0.1476	0.0457	0.0121	0.0057	0.0017	0.0007	0.0002
675	0.6201	0.1583	0.0490	0.0130	0.0061	0.0018	0.0008	0.0003

Tables calculated from Low-Pressure Gas Formula in NFPA -54

Section 7.1 - Table PD-2A

Pressure drop (inch wc per foot) for Black Iron based on a given CFH Flow
(Natural Gas SG = 0.60 Gas)

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the **TracPipe** D&I Guide.

CFH	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
700	0.6632	0.1693	0.0525	0.0139	0.0066	0.0019	0.0008	0.0003
725	0.7077	0.1807	0.0560	0.0148	0.0070	0.0021	0.0009	0.0003
750	0.7535	0.1924	0.0596	0.0157	0.0074	0.0022	0.0009	0.0003
775	0.8006	0.2044	0.0633	0.0167	0.0079	0.0024	0.0010	0.0003
800	0.8490	0.2168	0.0671	0.0177	0.0084	0.0025	0.0011	0.0004
825	0.8987	0.2295	0.0711	0.0188	0.0089	0.0026	0.0011	0.0004
850	0.9497	0.2425	0.0751	0.0198	0.0094	0.0028	0.0012	0.0004
875	1.0020	0.2559	0.0793	0.0209	0.0099	0.0029	0.0012	0.0004
900	1.0556	0.2695	0.0835	0.0221	0.0104	0.0031	0.0013	0.0005
925	1.1105	0.2835	0.0878	0.0232	0.0110	0.0033	0.0014	0.0005
950	1.1667	0.2979	0.0923	0.0244	0.0115	0.0034	0.0014	0.0005
975	1.2241	0.3125	0.0968	0.0256	0.0121	0.0036	0.0015	0.0005
1000	1.2828	0.3275	0.1015	0.0268	0.0127	0.0038	0.0016	0.0006
1100	1.5300	0.3907	0.1210	0.0320	0.0151	0.0045	0.0019	0.0007
1200	1.7972	0.4589	0.1421	0.0375	0.0178	0.0053	0.0022	0.0008
1300	2.0839	0.5321	0.1648	0.0435	0.0206	0.0061	0.0026	0.0009
1400	2.3901	0.6103	0.1890	0.0499	0.0236	0.0070	0.0030	0.0010
1500	2.7154	0.6933	0.2148	0.0567	0.0268	0.0080	0.0034	0.0012
1600	3.0596	0.7812	0.2420	0.0639	0.0302	0.0090	0.0038	0.0013
1700	3.4226	0.8739	0.2707	0.0715	0.0338	0.0101	0.0042	0.0015
1800	3.8043	0.9714	0.3009	0.0795	0.0376	0.0112	0.0047	0.0016
1900	4.2044	1.0735	0.3325	0.0878	0.0416	0.0124	0.0052	0.0018
2000	4.6228	1.1803	0.3656	0.0966	0.0457	0.0136	0.0057	0.0020
2100	5.0593	1.2918	0.4001	0.1057	0.0500	0.0149	0.0063	0.0022
2200	5.5139	1.4079	0.4361	0.1152	0.0545	0.0162	0.0068	0.0024
2300	5.9864	1.5285	0.4735	0.1251	0.0592	0.0176	0.0074	0.0026
2400	6.4766	1.6537	0.5122	0.1353	0.0640	0.0190	0.0080	0.0028
2500	6.9846	1.7834	0.5524	0.1459	0.0690	0.0205	0.0087	0.0030
2600	7.5100	1.9175	0.5940	0.1569	0.0742	0.0221	0.0093	0.0032
2700	8.0530	2.0562	0.6369	0.1682	0.0796	0.0237	0.0100	0.0035
2800	8.6133	2.1992	0.6812	0.1799	0.0851	0.0253	0.0107	0.0037
2900	9.1908	2.3467	0.7269	0.1920	0.0909	0.0270	0.0114	0.0040
3000	9.7856	2.4986	0.7740	0.2044	0.0967	0.0288	0.0121	0.0042
3100		2.6548	0.8223	0.2172	0.1028	0.0306	0.0129	0.0045
3200		2.8153	0.8721	0.2303	0.1090	0.0324	0.0137	0.0048
3300		2.9802	0.9232	0.2438	0.1154	0.0343	0.0145	0.0050
3400		3.1494	0.9756	0.2577	0.1219	0.0363	0.0153	0.0053
3500		3.3228	1.0293	0.2719	0.1286	0.0382	0.0161	0.0056
3600		3.5005	1.0843	0.2864	0.1355	0.0403	0.0170	0.0059
3700		3.6825	1.1407	0.3013	0.1426	0.0424	0.0179	0.0062
3800		3.8687	1.1984	0.3165	0.1498	0.0445	0.0188	0.0065
3900		4.0591	1.2573	0.3321	0.1571	0.0467	0.0197	0.0069

Tables calculated from Low-Pressure Gas Formula in NFPA -54

Section 7.1 - Table PD-2A

Pressure drop (inch wc per foot) for Black Iron based on a given CFH Flow
(Natural Gas SG = 0.60 Gas)

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the **TracPipe** D&I Guide.

CFH	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
4000	4.2537	1.3176	0.3480	0.1647	0.0490	0.0207	0.0072
4100	4.4524	1.3792	0.3643	0.1724	0.0513	0.0216	0.0075
4200	4.6554	1.4421	0.3809	0.1802	0.0536	0.0226	0.0079
4300	4.8624	1.5062	0.3978	0.1882	0.0560	0.0236	0.0082
4400	5.0737	1.5716	0.4151	0.1964	0.0584	0.0246	0.0086
4500	5.2890	1.6383	0.4327	0.2048	0.0609	0.0257	0.0090
4600	5.5084	1.7063	0.4507	0.2133	0.0634	0.0268	0.0093
4700	5.7319	1.7755	0.4690	0.2219	0.0660	0.0278	0.0097
4800	5.9595	1.8460	0.4876	0.2307	0.0686	0.0290	0.0101
4900	6.1912	1.9178	0.5066	0.2397	0.0713	0.0301	0.0105
5000	6.4269	1.9908	0.5258	0.2488	0.0740	0.0312	0.0109
5250	7.0338	2.1788	0.5755	0.2723	0.0810	0.0342	0.0119
5500	7.6658	2.3746	0.6272	0.2968	0.0882	0.0372	0.0130
5750	8.3227	2.5780	0.6810	0.3222	0.0958	0.0404	0.0141
6000	9.0043	2.7892	0.7367	0.3486	0.1036	0.0437	0.0152
6250	9.7104	3.0079	0.7945	0.3759	0.1118	0.0472	0.0164
6500		3.2342	0.8543	0.4042	0.1202	0.0507	0.0177
6750		3.4680	0.9160	0.4334	0.1289	0.0544	0.0189
7000		3.7093	0.9798	0.4636	0.1378	0.0582	0.0203
7250		3.9580	1.0455	0.4947	0.1471	0.0621	0.0216
7500		4.2142	1.1131	0.5267	0.1566	0.0661	0.0230
7750		4.4776	1.1827	0.5596	0.1664	0.0702	0.0245
8000		4.7484	1.2542	0.5935	0.1765	0.0745	0.0259
8250		5.0265	1.3277	0.6282	0.1868	0.0788	0.0275
8500		5.3119	1.4031	0.6639	0.1974	0.0833	0.0290
8750		5.6044	1.4803	0.7004	0.2083	0.0879	0.0306
9000		5.9042	1.5595	0.7379	0.2194	0.0926	0.0323
9250		6.2111	1.6406	0.7763	0.2308	0.0974	0.0339
9500		6.5251	1.7235	0.8155	0.2425	0.1023	0.0357
9750		6.8462	1.8083	0.8556	0.2544	0.1074	0.0374
10000		7.1744	1.8950	0.8967	0.2666	0.1125	0.0392
10500		7.8520	2.0740	0.9813	0.2918	0.1231	0.0429
11000		8.5574	2.2603	1.0695	0.3180	0.1342	0.0468
11500		9.2907	2.4540	1.1612	0.3452	0.1457	0.0508
12000			2.6550	1.2563	0.3735	0.1576	0.0549
12500			2.8632	1.3548	0.4028	0.1700	0.0592
13000			3.0786	1.4567	0.4331	0.1828	0.0637
13500			3.3012	1.5620	0.4644	0.1960	0.0683
14000			3.5309	1.6707	0.4967	0.2096	0.0730
14500			3.7676	1.7827	0.5300	0.2237	0.0779
15000			4.0114	1.8981	0.5643	0.2382	0.0830

Tables calculated from Low-Pressure Gas Formula in NFPA -54

Section 7.1 - Table PD-2A

Pressure drop (inch wc per foot) for Black Iron based on a given CFH Flow (Natural Gas SG = 0.60 Gas)

Note: For Propane (LP) Gas applications, obtain Pressure Drop per foot values by following the Propane conversion method detailed in Section 7.1 of the **TracPipe** D&I Guide.

CFH	1-1/4"	1-1/2"	2"	2-1/2"	3"
16000	4.5200	2.1387	0.6359	0.2684	0.0935
17000	5.0563	2.3925	0.7113	0.3002	0.1046
18000	5.6201	2.6593	0.7907	0.3337	0.1163
19000	6.2112	2.9389	0.8738	0.3688	0.1285
20000	6.8293	3.2314	0.9608	0.4055	0.1413
21000	7.4742	3.5366	1.0515	0.4438	0.1546
22000	8.1457	3.8543	1.1460	0.4836	0.1685
23000	8.8437	4.1846	1.2442	0.5251	0.1829
24000	9.5680	4.5273	1.3461	0.5681	0.1979
25000		4.8823	1.4516	0.6126	0.2134
26000		5.2496	1.5608	0.6587	0.2295
27000		5.6292	1.6737	0.7063	0.2461
28000		6.0208	1.7901	0.7555	0.2632
29000		6.4245	1.9102	0.8061	0.2809
30000		6.8403	2.0338	0.8583	0.2990
31000		7.2679	2.1609	0.9120	0.3177
32000		7.7075	2.2916	0.9671	0.3369
33000		8.1589	2.4258	1.0238	0.3567
34000		8.6220	2.5635	1.0819	0.3769
35000		9.0969	2.7047	1.1415	0.3977
36000		9.5834	2.8494	1.2025	0.4189
37000			2.9975	1.2650	0.4407
38000			3.1490	1.3290	0.4630
39000			3.3040	1.3944	0.4858
40000			3.4624	1.4612	0.5091
41000			3.6242	1.5295	0.5329
42000			3.7894	1.5992	0.5572
43000			3.9579	1.6703	0.5819
44000			4.1299	1.7429	0.6072
45000			4.3051	1.8169	0.6330

SECTION 7.2 — SIZING TABLE FOR STEEL PIPE

Table: SP-1

Capacity of SCH 40 Metallic Pipe in Cubic Feet of Gas per Hour
(0.60 Specific Gravity Gas)
Based on an Inlet Pressure of 2 psi or less and a Pressure Drop of 0.5 inches water column

Nominal IronPipe Size (inches)	Internal Diameter (inches)	Length of Pipe (Feet)													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/2	0.622	172	118	95	81	72	65	60	56	52	50	44	40	37	34
3/4	0.824	360	247	199	170	151	137	126	117	110	104	92	83	77	71
1	1.049	678	466	374	320	284	257	237	220	207	195	173	157	144	134
1 1/4	1.380	1390	957	768	657	583	528	486	452	424	400	355	322	296	275
1 1/2	1.610	2090	1430	1150	985	873	791	728	677	635	600	532	482	443	412
2	2.067	4020	2760	2220	1900	1680	1520	1400	1300	1220	1160	1020	928	854	794
2 1/2	2.469	6400	4400	3530	3020	2680	2430	2230	2080	1950	1840	1630	1480	1360	1270
3	3.068	11300	7780	6250	5350	4740	4290	3950	3670	3450	3260	2890	2610	2410	2240
4	4.026	23100	15900	12700	10900	9660	8760	8050	7490	7030	6640	5890	5330	4910	4560
5	5.047	41800	28700	23000	19700	17500	15800	14600	13600	12700	12000	10600	9650	8880	8260
6	6.065	67600	46500	37300	31900	28300	25600	23600	22000	20600	19500	17200	15600	14400	13400
8	7.981	139,000	95,500	76,700	65,600	58,200	52,700	48,500	45,100	42,300	40,000	35,400	32,100	29,500	27,500

Note: Table values taken from 2021 NFPA 54 (National Fuel Gas Code) Table 6.2.1(b)

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 inch W.C. approximately
1/2 PSI = 14 inch W.C.
1/4 PSI = 7 inch 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 duct of iron, steel, copper, brass or aluminum.

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

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

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

Pressure Regulator – A device that 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 is read from a measurement gauge or device. Gauge pressure is the 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-inch w.c. to the manifold pressure in the appliance. (approximately 3.5-inch 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-inch w.c.).

Regulator, Service (PSI – PSI or inches w.c.) – A pressure reducing valve (PRV) is installed by the gas supplier to reduce and control service line gas pressure upstream of the meter.

Regulator Vent – The regulator housing has an opening on its atmospheric side that allows air in and out to balance the regulator diaphragm's movement.

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 – "Two pounds per square inch gauge pressure" is an abbreviated form of expression. It is also the name of a piping system that supplies gas at the specified pressure to a house line regulator. This regulator then reduces the pressure to inches W.C. upstream of the appliance regulator.

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

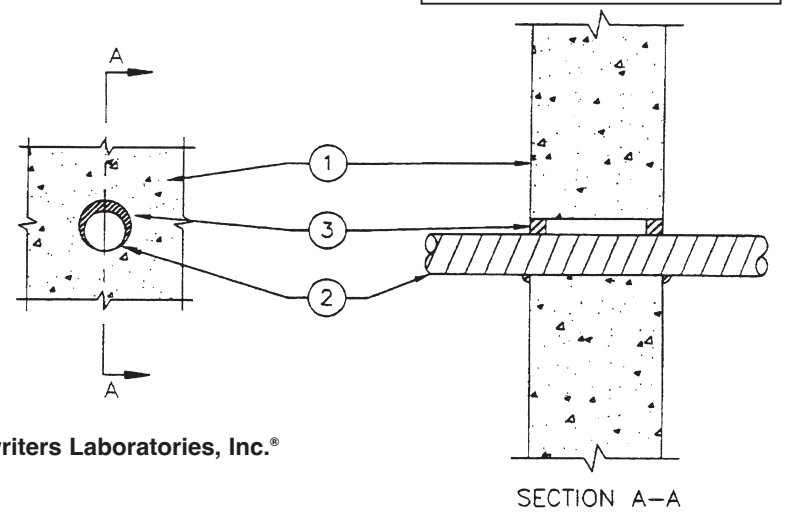
Vent Limiter Device – There is a restriction/orifice type device in the vent outlet of a pressure regulator that controls or limits leakage in the event of a diaphragm leak. It also allows the diaphragm to move freely for pressure control.

APPENDIX A
UL CLASSIFICATION

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

SYSTEM NO. W-J-1106

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



Underwriters Laboratories, Inc.®

1. **Wall Assembly -** For walls requiring a 1 or 2-hour fire rating, use lightweight or normal-weight concrete with a thickness of at least 4'-7/8" or 6'-1/8", respectively. Alternatively, UL Classified Concrete Blocks can be used. The maximum opening diameter allowed in the wall is 3'-1/2". For a list of manufacturers, please refer to the Fire Resistance Directory under the Concrete Blocks (CAZT) category.

2. **"Through Penetrating Products"** - refers to flexible metallic piping made of steel with a nominal diameter of 2 inches or smaller. Only one flexible metal piping can be installed, either concentrically or eccentrically within an opening. The annular space between the piping and periphery of the opening should be between 0 (point contact) and 1 inch maximum. The piping must be rigidly supported on both sides of the wall assembly. The plastic covering on piping may or may not be removed on both sides of the wall assembly. Omega Flex, Inc. provides **TracPipe** Flexible Gas Piping.

3. **Fill, Void, or Cavity Material***- A sealant of a minimum 5/8 inches thickness should be used for 1-hour fire-rated wall assemblies, while 2-hour fire-rated wall assemblies require a thickness of 1 inch. The sealant should be applied within the annulus and must be flush with both wall surfaces. Additionally, an extra 1/2-inch diameter of fill material must be applied at the point of contact between the gypsum board and the penetrant interface on both wall surfaces. Johns Manville International, Inc. — Firetemp™ CI
   * Bearing the UL Classification Marking Johns Manville International, Inc. — Firetemp™ CI

SYSTEM NO. C-AJ-1340

The firestop system requires a floor or wall assembly with a minimum thickness of 4-1/2 inches, constructed of lightweight or normal-weight concrete or UL Classified Concrete Blocks. The opening in the assembly should be between 3/4 inch to 4 inches in diameter, depending on the size of the flexible metal piping. Flexible gas piping with a diameter of 2 inches or smaller should be installed concentrically or eccentrically within the opening and should be rigidly supported on both sides of the assembly.

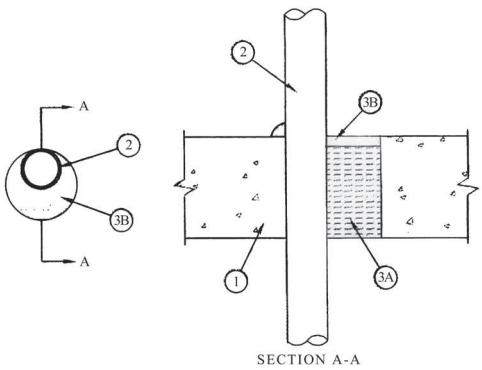
A. Packing Material - Min 3-3/4 in. thickness of min 4 pcf mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces wall as required to accommodate the required thickness of fill material.

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

1. Wall Assembly - The gypsum wallboard/stud wall assembly must have a fire rating of either 1 or and methods specified in either U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory. The assembly should include the following construction features:

A. Studs - Wall framing may consist of wood or steel channel studs. Wood studs will 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* - For each wall and partition design, use gypsum wallboard with the appropriate thickness, type, and number of layers. Openings should have a maximum diameter of 3-1/2 inches.

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*- Please note the following requirements for installing flexible metal piping with a nominal 2-inch diameter or smaller steel. Only one flexible metal piping can be installed either concentrically or eccentrically within the opening. The annular space between the pipe and the periphery of the opening should be a minimum of 0 inches (point contact) and a maximum of 1 inch. The piping must be rigidly supported on both sides of the wall assembly. The plastic covering on the piping may or may not be removed for a distance of 2 feet on both sides of the wall assembly. The specific brand for the flexible gas piping is **TracPipe** and it is manufactured by **Omega Flex, Inc**.

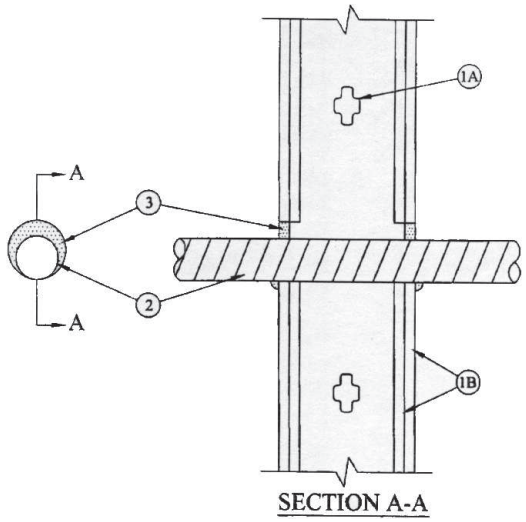
3. Fill, Void, or Cavity Material* - Sealant - To create a fire-rated wall assembly, you need to fill any void or cavity with sealant. For 1 hour-rated walls, the fill material should be at least 5/8 inches thick, while for 2 hour-rated walls, it should be 1 inch thick. Apply the fill material within the annulus and make sure it is flush with both surfaces of the wall. Additionally, apply an extra 1/2 inch diameter of fill material at the point of contact between the gypsum board and penetrant on both wall surfaces. Johns Manville International, Inc. - Firetemp TMCI

* Bearing the UL Classification Marking

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

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)



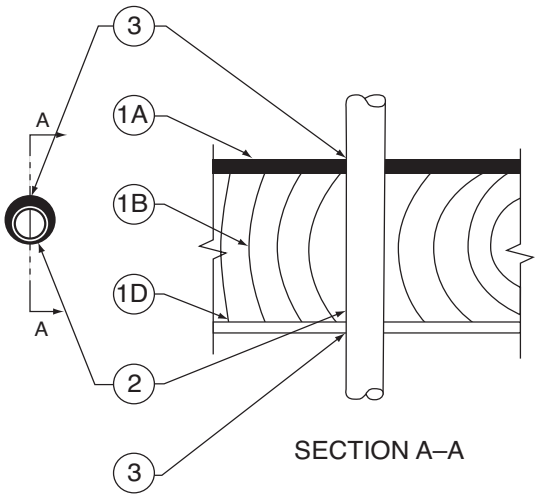
Underwriters Laboratories inc.®

NOTICE:

To access the complete UL Through Penetration Firestop Systems go to **www.ul.com**

For instructions regarding a specified Through Penetration Firestop System consult with the project fire protection company.

C UL US	**F Rating - 1 and 2 Hr (See Item 1)** **T Rating - I Hr**	**F-C-1111**



SECTION A–A

1. **Floor-Ceiling Assembly** - With a 1- or 2-hour fire rating can be constructed using wood joists, wood trusses, or a combination of wood and steel trusses. The specific materials and construction methods should follow the guidelines outlined in the L500 Series Design as listed in the UL Fire Resistance Directory. The firestop system should have an F Rating that matches the rating of the floor-ceiling and wall assemblies. Below are some general features of the floor-ceiling.

   A. Flooring System - Lumber or plywood subfloor with a finished floor of lumber, plywood, or a floor topping mixture, as specified in the individual ceiling design. The maximum diameter of the opening is 3 inches (76 mm).

   B. Joists - Use nominal 2 by 10 inch (51 by 254 mm) deep lumber joists, steel, or a combination of both, spaced 16 inches (406 millimeters) on center. Ensure that the joists have proper bridging as required by building codes and that their ends are fire-stopped to prevent the spread of fire. Alternatively, you may use trusses or Structural Wood Members*.

   C. Furring Channels - Galvanized steel furring installed as per L500 Series Designs in the Fire Resistance Directory.

   D. Gypsum Board* - The thickness, type, number of layers, and fasteners shall be as specified in the individual ceiling design. The maximum diameter of the opening is 3 in. (76 mm).

2. **Through Penetrating Products*** - Flexible Metal Piping-Use 2 inches (51 mm) diameter or smaller steel flexible metal piping with or without a plastic covering on the piping. Only one flexible metal piping can be installed near the center of the circular through the opening in the floor assembly. The annular space between the piping and the periphery of the opening should be a minimum of 0 inches (0 mm) (point contact) and a maximum of 1/2 inches (13 mm). The piping must be rigidly supported on both sides of the floor assembly.

3. **Fill, Void, or Cavity Material*** - Sealant - A sealant of minimum 3/4 in. (19 mm) thickness should be applied within the annulus on the top surface of the floor. Similarly, a minimum of 5/8 in. (16 mm) thickness of sealant should be applied within the annulus on the bottom surface of the ceiling. At the point of contact, a minimum of 1/2 in. (13 mm) bead of sealant must be applied to the interface between the penetrant and the gypsum board on the bottom surface of the ceiling and at the interface of the penetrant and the flooring on the top surface of the floor. Passive Fire Protection Partners** - 3600EX, 41GONS or 4800DW

* Bearing the UL Classification Marking
**Formerly Firestop Systems Inc.

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