

# ***TracPipe*<sup>®</sup> Design and Installation Specification**

*March 2012 EDITION*

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***For Corrugated Stainless Steel Semi-Rigid  
Pipe and Associated Fittings***



ISO 9001  
FM 517165



BS 7838  
KM 52508

**OMEGAFLEX<sup>®</sup> LIMITED - ISO 9001 Certified**

**Manufactured and Kitemarked to British Standard BS 7838**  
***Specification for Corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50.***

FGP-027 Rev. 03/12



## WARNING

When installing, servicing, maintaining or repairing gas appliances and other gas fittings in Great Britain, (including Northern Ireland and the Isle of Man), there are a number of statutory requirements with which to comply. When working on gas, compliance should be achieved by carrying out work in accordance with the relevant standards and the following manufacturer's instructions.

Gas operatives must be competent and hold a valid certificate of competence for each work activity that they wish to undertake. The valid certificate must have been issued under either the Approved Code of Practice (ACoP) or the Nationally Accredited Certification Scheme (ACS) for individual gas fitting operatives or an aligned qualification. For further information please visit [www.euskills.co.uk/gas](http://www.euskills.co.uk/gas).

All businesses and individuals undertaking gas work on installations supplied with Natural gas or LPG must be registered with a body approved by the Health and Safety Executive (HSE). (In Great Britain it is The Gas Safe Register. In Northern Ireland, the Channel Islands and the Isle of Man consult the relevant authorities for up to date guidance.)

All gas appliances and other gas fittings must be installed in accordance with The Gas Safety (Installation and Use) Regulations 1998, Building Regulations and Manufacturers installation instructions. Installations should also comply with British Standards. (Our Design and Installation Guide revisions will follow any amendments to the Regulations or British Standards, and thus in the event of any conflict the Regulations and/or British Standards will take precedence over this Design and Installation Guide).

Only the components provided or specified by OMEGAFLEX® as part of the approved piping system are to be used in the installation. The use of TracPipe® piping or fittings with piping or fittings from other flexible gas piping manufacturers is strictly prohibited and may result in serious bodily injury or property damage.

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

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## **Forward.**

### **Relevant Installation Standards**

#### **EN 15266:2007 and its current relevance to BS 7838.**

When British Gas had a monopoly on all gas matters in the UK they developed a number of in-house procedures and product standards to ensure the safety of installations. As the gas installation market opened to more registered installers, the majority of the in-house documents formed the basis either of British Standards or of Institution of Gas Engineers & Managers (IGEM) Standards.

The design and installation of low-pressure gas pipework in domestic premises is specified in BS 6891 (2<sup>nd</sup> family gas) and BS 5482-1 (3<sup>rd</sup> family gases), whilst pipework with larger bore sizes and higher operating pressures is covered in IGEM/UP/2 Latest Edition. Strength testing, tightness testing and purging of installation pipework are covered in the IGE/UP/1 standards.

As natural gas was being introduced as a fuel gas in the UK, British Gas had concerns about the reaction of sulphur compounds with the existing installation pipework (generally referred to “black dust”). As a consequence, they researched alternative, resistant pipework materials and conducted trial installations with stainless steel semi-rigid pipework. This resulted in an in-house standard that formed the basis for BS 7838, first published in 1996 and incorporated into the design and installation standards in 1998. Also in 1998, the Gas Safety Regulations were adopted and provided for a uniform set of rules regarding the safe installation of gas piping.

EN 15266 has been written in response to a CEN work item under the Construction Products Directive (CPD) to permit the use of stainless steel pliable tubing kits in fuel gas installations across the European Member States. The installation standards for fuel gases tend to be unique to each Member State, as is the case in the UK.

BS EN 15266:2007 is the UK implementation of EN 15266:2007. The UK participation in the preparation of EN 15266 was entrusted to Technical Committee PSE/12, Metal hoses, hose assemblies, bellows and expansion joints. The only European countries represented on this committee with CSST market experience and CSST technical experience were the UK and Ireland. In addition the UK is the only country with a national standard, BS 7838. However, the resulting draft standard proposed by the European committee CEN/TC 342/WG did not include or reference that guidance. It soon became evident that EN 15266 was deeply flawed and inadequate in many regards, and that for the UK a detailed forward was needed to note the deficiencies and deviations of EN 15266 to current British codes and standards. The installation standards BS 6891 and BS 5482 are currently being revised with the intention of having the design and installation specification for all domestic fuel gas pipework systems under one standard.

BSI formed a joint committee combining GSE/1 and PSE/12 to review both documents with the specific purpose of producing a UK foreword to BS EN 15266. This work was extensive and took several years. BSI is still considering how best to proceed. Recently the responsibility has passed to a new committee GSE/42 combining both GSE/1 and PSE/12.

**In the meantime TracPipe retains kite mark licences to both BS 7838 and BS EN 15266.**

**EN 15266 has not been harmonized; it has not been published in the Official Journal of the European Union (OJEU). Therefore it is not possible to “CE” mark product.**

For these reasons we have not referenced EN 15266 in this D&I Guide. Once the amendments have been satisfactorily addressed by CEN, and the relevant BS and IGEN design and installation specifications revised, only then may it be possible for BS 7838 to be withdrawn.

For general reference purposes, we have included the sizing tables for BS EN 15266 in Annex G. Persons designing gas piping systems must use the relevant sizing methods in IGEN/UP/2 Latest Edition with the tables in Annex G.

## **SUMMARY**

CSST systems tested to BS 7838 (such as TracPipe) will almost certainly meet the test requirements of BS EN 15266.

CSST systems tested to meet the test requirements of EN 15266 don't necessarily meet the full test requirements of BS 7838, and may not comply with the requirements of the Gas Safety Regulations.

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# TracPipe® by OMEGAFLEX®

## Design and Installation Specification

### **1 SCOPE**

British Standards Institution has granted Kitemark Licence Number KM 52508 to OmegaFlex. This Kitemark can be affixed to all sizes of TracPipe® which are in conformity with BS 7838: 1996 *Corrugated stainless steel semi-rigid pipe and associated fittings for low pressure gas pipework of up to DN 50*.

This Kitemark Licence covers TracPipe® sizes DN 12, 15, 22, 28, 32, 40 and 50 and their associated fittings.

BS 7838 specifies requirements for semi-rigid (bendable) corrugated stainless steel pipe and associated fittings in the nominal size range DN 10 to DN 50 and intended for use as installation pipework for the supply of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> family gases in permanent buildings. It applies to corrugated pipe and fittings that are suitable for a maximum working pressure of 75 mbar when installed in accordance with BS 6891 or BS 5482 Part 1 in domestic premises, or in accordance with the Institution of Gas Engineers and Managers publication IGEM/UP/2 Latest Edition in other premises.

This document contains portions of BS 6891 language where appropriate, (for which we are grateful to British Standards Institution), which is the installation specification for low pressure natural gas pipework of up to 35 mm (R1.1/4") in domestic premises. This standard applies to gas installation pipework where the nominal working pressure is 21 mbar.

BS 5482 Part 1 specifies requirements for the installation at permanent dwellings of domestic systems using liquefied petroleum gases (LPG), whether from cylinders or bulk supply, at a pressure of 28 mbar for commercial butane and of 37 mbar for commercial propane.

TracPipe® is Kitemarked to BS 7838, in all sizes. The installation of pipework in sizes above DN 32 and for working pressures above 21 mbar falls under the Institution of Gas Engineers and Managers Utilization Procedures IGEM/UP/2 Latest Edition.

TracPipe® has North American approvals for working pressures to 125 psi and we would be pleased to discuss potential applications for working pressures in excess of 75 mbar outside the scope of this Design and Installation Specification.

Sound engineering principles and practices must be exercised for the proper design of fuel gas piping systems, in addition to compliance with Gas Safety, Building Regulations and with British Standards requirements. The installation instructions and procedures contained in this Specification must be strictly followed in order to provide a safe and effective fuel gas piping system or system modification.

This Specification is intended to aid the Gas Safe registered gas pipe installer in the design, installation and testing of the TracPipe® semi-rigid gas piping system.

It is not possible for this specification to anticipate every variation in construction style, building configuration, appliance requirement, or local restriction. This document will not therefore cover every application. The user should contact us, exercise his/her own engineering judgment on system design and installation, or seek technical input from other qualified sources. Additional information pertaining to gas piping systems is available from IGEM, Gas Safe and your local gas utility.

## **2 REFERENCES**

**BS 7838** – *Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50.*

**BS 6891** – *Installation of low pressure gas pipework of up to 35 mm (R1.1/4) in domestic premises (2nd family gas). - Specification*

**BS 5482** – *Code of practice for domestic butane and propane-gas burning installations Part 1: Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding DN25 for steel and DN28 for corrugated stainless steel or copper.*

**IGEM/UP/2 Latest Edition.** The Institution of Gas Engineers and Managers Communication 1729, Installation pipework on industrial and commercial Premises.

## **3 DEFINITIONS**

See Annex C.

## **4 EXCHANGE OF INFORMATION AND TIME SCHEDULE.**

See BS 6891.

## **5 PIPE SIZING**

**5.1** When designing an installation, the sizes of all installation piping shall be determined from the maximum gas rate of the appliances to be connected. **The method of calculating pipe sizes in Annex B must be used in conjunction with sizing Table 1.** Allowance should also be made for the possibility of future extensions, especially if the piping is to be buried.

**5.2** For natural gas at 21 mbar the pressure drop between the outlet of the meter and the points to be connected shall not exceed 1 mbar at maximum flow conditions. Table 1 should be used when sizing natural gas piping systems in accordance with BS 6891.

**5.3** Low pressure 3<sup>rd</sup> family gas supplies should be regulated at 37 mbar (propane), or 28 mbar (butane) with a pressure drop not exceeding 2.5 mbar in accordance with the prescribed sizing methods in BS 5482-1, latest edition.

**5.4** For general reference purposes, we have included the sizing tables for BS EN 15266 in Annex G. Persons designing gas piping systems must use the relevant sizing methods in IGEM/UP/2 Latest Edition with the tables in Annex G.

**Table 1 –Sizing Table: BS 6891.** Discharge in cubic metres per hour in a straight horizontal pipe with a 1.0 mbar differential pressure between the ends for the gas of relative density 0.6 (air =1).

DN	Length of pipe in metres							
	3	6	9	12	15	20	25	30
12	1.5	1.0	0.85	0.82	0.69	0.52	0.41	0.34
15	2.9	1.9	1.5	1.3	1.1	0.95	0.92	0.88
22	8.7	5.8	4.6	3.9	3.4	2.9	2.5	2.3
28	18	12	9.4	8.0	7.0	5.9	5.2	4.7
32	29	20	15	13	12	10	8.5	7.6
Note: When using this Table to estimate gas flow rate in pipework of known length, this length should be increased by 0.5 m for each elbow and 0.3 m for each 90° bend fitted.								

## **Altitude effect on pressure**

Compensation for the effects of altitude should be made for pipes in high-rise buildings. Lighter than air gases will show an increase in pressure due to altitude whereas for heavier than air gas the reverse is true. The following formula may be used:

$$h = 0.123(1-s)H$$

Where: h = pressure change due to altitude (mbar)

H = altitude change (m)

s = density of gas relative to air (dimensionless)

## **6 MATERIALS**

### **6.1 General**

Materials used for gas installation pipes and fittings shall conform to the British Standards listed in 6.2 to 6.6, where appropriate.

### **6.2 Corrugated stainless steel pipes**

Corrugated stainless steel pipe shall conform to BS 7838.

**TracPipe®** with **AutoFlare®** fittings are tested and Kitemarked to British Standard BS 7838. *SEE SECTION 6.7 FOR DETAILS OF THE TracPipe® CORRUGATED STAINLESS STEEL PIPING SYSTEM.*

### **6.3 Steel**

Steel pipe nipples may be used in TracPipe® installations for attachment to appliances, valves and other accessories. All steel pipe material shall conform to BS EN 10255 or BS EN 10216-1 and BS EN 10217-1.

### **6.4 Malleable iron**

Malleable iron fittings may be used in TracPipe® installations for attachment to appliances, valves and other accessories. Malleable iron fittings shall conform to BS 143 & BS 1256.

### **6.5 Valves**

Ball valves shall conform to BS EN 331.

**6.6 Thread sealing.** Sealing materials shall conform to BS EN 751 Parts 1-3 or BS 6956 Part 5, as appropriate. Sealing materials must not be applied to the AutoFlare® metal to metal sealing face.

### **6.7 TracPipe® Corrugated stainless steel pipe.**

**6.7.1** The TracPipe® gas piping system consists of corrugated, semi-rigid stainless steel piping with AutoFlare® brass mechanical attachment fittings terminating in either a male BSP taper thread, a female BSP thread, a copper compression or a meter connection to BS746 for easy attachment to traditional steel or copper pipe systems and connections to gas appliances. The tubing is jacketed with a yellow polyethylene cover, with a smoke and fire retardant, which provides ease of running through building components. The cover is marked at one-metre intervals with the amount of tubing left on the reel, for quick measurement.

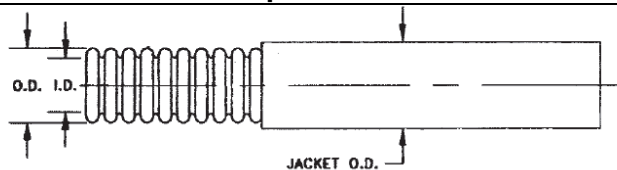


The yellow ochre colour is the international designation for fuel gas.

TracPipe® is designed to replace or use as an alternative to traditional rigid copper or steel pipework between meter and appliance. It is not intended for applications in which during installation, or subsequent to installation, it can be subjected to repeated bending. TracPipe® must not be used as a flexible connector to a movable appliance (see Annex A).

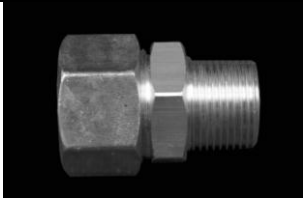

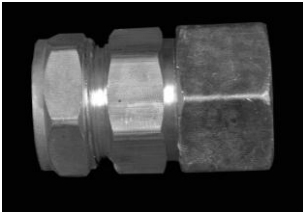

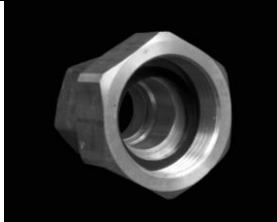
TracPipe® meets all test requirements of BS 7838 including the Bend Test (Clause 8.2). This stipulates 12 repeat bends through 180 degrees around a cylindrical former. The cylindrical former radius is equivalent to the Minimum Bend radius for that size of TracPipe®. (See Table 2).



**Figure 1: TracPipe® System Components  
Corrugated Stainless Steel Pipe**

Component	Material	Description/Dimensions																																						
TracPipe® Flexible Gas Piping	Corrugated Stainless Steel (1.4306) with Polyethylene Jacket																																							
		<table><tr><td>DN</td><td>12</td><td>15</td><td>22</td><td>28</td><td>32</td><td>40</td><td>50</td></tr><tr><td>Inch</td><td>3/8</td><td>1/2</td><td>3/4</td><td>1</td><td>1 1/4</td><td>1 1/2</td><td>2</td></tr><tr><td>Jacket O.D. (max) mm</td><td>17</td><td>22</td><td>28</td><td>35</td><td>42</td><td>49</td><td>66</td></tr><tr><td>Inside Dia. (nom) mm</td><td>11</td><td>15</td><td>21</td><td>27</td><td>33</td><td>40</td><td>52</td></tr></table>	DN	12	15	22	28	32	40	50	Inch	3/8	1/2	3/4	1	1 1/4	1 1/2	2	Jacket O.D. (max) mm	17	22	28	35	42	49	66	Inside Dia. (nom) mm	11	15	21	27	33	40	52						
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TracPipe® on Reels	Plywood Reels for Packaging																																							
		<table><tr><td>DN)</td><td>Reel Length (Mtrs)</td><td>Approx Weight (kg)</td></tr><tr><td rowspan="2">12</td><td>30 metres</td><td>6.4</td></tr><tr><td>75 metres</td><td>13.2</td></tr><tr><td rowspan="2">15</td><td>30 metres</td><td>10.5</td></tr><tr><td>75 metres</td><td>22.5</td></tr><tr><td rowspan="2">22</td><td>30 metres</td><td>12.5</td></tr><tr><td>75 metres</td><td>30.0</td></tr><tr><td rowspan="3">28</td><td>30 metres</td><td>18.0</td></tr><tr><td>55 metres</td><td>30.0</td></tr><tr><td>90 metres</td><td>48.0</td></tr><tr><td rowspan="2">32</td><td>45 metres</td><td>36.0</td></tr><tr><td>75 metres</td><td>48.0</td></tr><tr><td rowspan="2">40</td><td>45 metres</td><td>38.0</td></tr><tr><td>75 metres</td><td>60.0</td></tr><tr><td>50</td><td>45 metres</td><td>55.0</td></tr></table>	DN)	Reel Length (Mtrs)	Approx Weight (kg)	12	30 metres	6.4	75 metres	13.2	15	30 metres	10.5	75 metres	22.5	22	30 metres	12.5	75 metres	30.0	28	30 metres	18.0	55 metres	30.0	90 metres	48.0	32	45 metres	36.0	75 metres	48.0	40	45 metres	38.0	75 metres	60.0	50	45 metres	55.0
		DN)	Reel Length (Mtrs)	Approx Weight (kg)																																				
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	75 metres	48.0																																						
40	45 metres	38.0																																						
	75 metres	60.0																																						
50	45 metres	55.0																																						
TracPipe® KITS	Boxed in a cardboard box. Complete with fitting instructions and a roll of silicone tape.																																							
		<table><tr><td>Part No.</td><td>FGP-15-05 (kit)</td><td>FGP-22-05 (kit)</td><td>FGP-28-05 (kit)</td><td>FGP-32-05 (kit)</td></tr><tr><td></td><td>FGP-15-10 (kit)</td><td>FGP-22-10 (kit)</td><td>FGP-28-10 (kit)</td><td>FGP-32-10 (kit)</td></tr><tr><td></td><td>FGP-15-15 (kit)</td><td>FGP-22-15 (kit)</td><td>FGP-28-15 (kit)</td><td>FGP-32-15 (kit)</td></tr><tr><td>DN</td><td>15mm</td><td>21mm</td><td>26mm</td><td>33mm</td></tr><tr><td>DN</td><td>22mm</td><td>28mm</td><td>35mm</td><td>42mm</td></tr></table>	Part No.	FGP-15-05 (kit)	FGP-22-05 (kit)	FGP-28-05 (kit)	FGP-32-05 (kit)		FGP-15-10 (kit)	FGP-22-10 (kit)	FGP-28-10 (kit)	FGP-32-10 (kit)		FGP-15-15 (kit)	FGP-22-15 (kit)	FGP-28-15 (kit)	FGP-32-15 (kit)	DN	15mm	21mm	26mm	33mm	DN	22mm	28mm	35mm	42mm													
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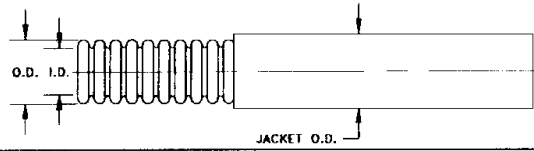
**Figure 1: (contd)TracPipe® System Components  
AutoFlare® Fittings**

Component	Material	Description/Dimensions	
Straight Mechanical Fitting	Brass Fitting		
	AutoFlare® Insert	Sizes DN 10, 15, 20, 25, 32, 40 and 50	
Tee Fitting and Coupling	Brass Fitting		
	AutoFlare® Insert	Sizes DN 10, 15, 20, 25, 32, 40 and 50	
TracPipe® to Copper Compression	Brass Fitting		
	AutoFlare® Insert		
	Copper Olive		
		Part No.	Part Description
		FGP-15x15mm	15mm Compression for DN15 TracPipe®
		FGP-22x15mm	15mm Compression for DN22 TracPipe®
		FGP-22x22mm	22mm Compression for DN22 TracPipe®
		FGP-28x22mm	22mm Compression for DN28 TracPipe®
TracPipe® to BSP Female BSP Thread	Brass Fitting		
	AutoFlare® Insert		
		Part No.	Part Description
		FGP-22-500BSP	1/2" BSP female for DN22 TracPipe®
		FGP-22-750BSP	3/4" BSP female for DN22 TracPipe®
		FGP-28-500BSP	1/2" BSP female for DN28 TracPipe®
		FGP-28-750BSP	3/4" BSP female for DN28 TracPipe®
		FGP-32-750BSP	3/4" BSP female for DN32 TracPipe®
TracPipe® to 1" BS746 Meter Connection	Brass Fitting		
	AutoFlare® Insert Rubber washer	DN22 DN28 and DN32	

# TracPipe®

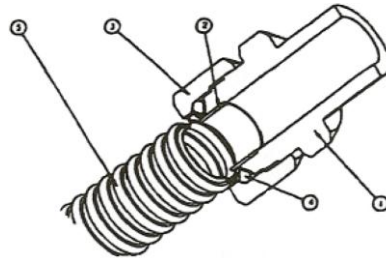
## SPECIFICATION DATA SHEET

### FGP-SS4-CHART



TracPipe® part No	FGP-SS4-12	FGP-SS4-15	FGP-SS4-22	FGP-SS4-28	FGP-SS4-35	FGP-SS4-40	FGP-SS4-50
DN	12	15	22	28	32	40	50
Size (inch)	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Jacket O.D. (Max)	17	22	28	35	42	49	66
Inside Dia. (nom)	11	15	21	26	33	40	52
Wall Thk. (min)	0.25	0.25	0.25	0.25	0.30	0.30	0.30

### STRAIGHT AUTO-FLARE FITTINGS



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

Available sizes							
DN	12	15	22	28	32	40	50
Tube Size (in)	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
BSPT Thread	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"

**6.7.2** Additional fittings include flange mount straight and 90-degree elbows for termination of gas lines near appliances and at meter boxes on building exteriors. Tee fittings are available for addition of branch lines into tubing runs.

**6.7.3** Protection Devices are used where flexible piping passes through building materials and is restricted from moving to avoid nails, screws, drills and other puncture threats. There are four striker plate configurations made from stamped steel and specially hardened to resist penetration from screws and pneumatic nail guns. In addition, spiral wound steel “floppy” conduit is available for additional protection in areas where striker plates cannot be used.

**6.7.4** Bending TracPipe® is one feature that contributes to the speed of installation. The recommended bend radius for general routing is listed in Table 2.

Multiple tight bends can restrict the gas flow and increase pressure drop.

The tightest bend allowed for each size of TracPipe® is shown in Table 2.

Typical locations requiring tight bends are the terminations in walls, particularly for gas taps at fireplaces.

The bend radius should be measured at the inside of the bend.

<b>Table 2. Bend radii for TracPipe®</b>		
<b>TracPipe® Size</b>	<b>Bend radius</b>	
	<b>Recommended</b>	<b>Minimum</b>
mm	mm	mm
12	76	15
15	76	20
22	76	25
28	125	76
32	125	76
40	125	76
50	150	102



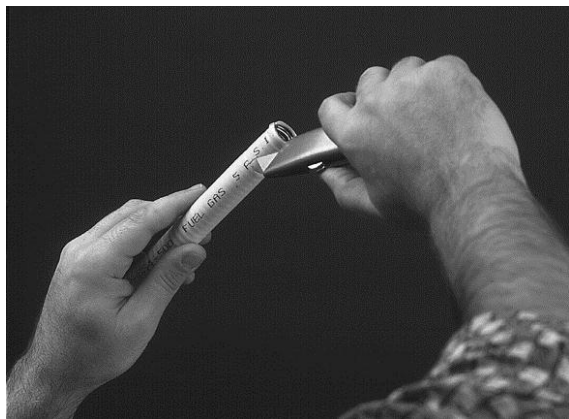
## **7. AUTOFLARE® FITTINGS**

### **7.1 HOW TO ASSEMBLE FITTINGS TO TracPipe®**



**7.1.1 CUT-TO-LENGTH:** Determine proper length. Cut through plastic cover and stainless pipe using a tube cutter with a sharp wheel. Cut must be centred 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 pipe.

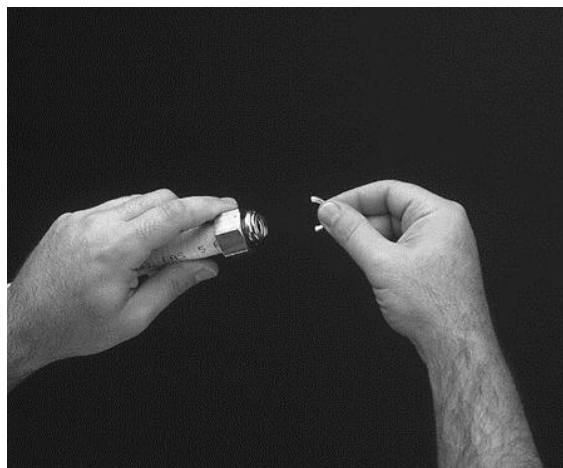
**7.1.2 STRIP COVER:** Using a utility knife, strip back the plastic cover about 25 mm back from the cut end to allow assembly of fittings. **Caution: Knife blade and cut pipe**



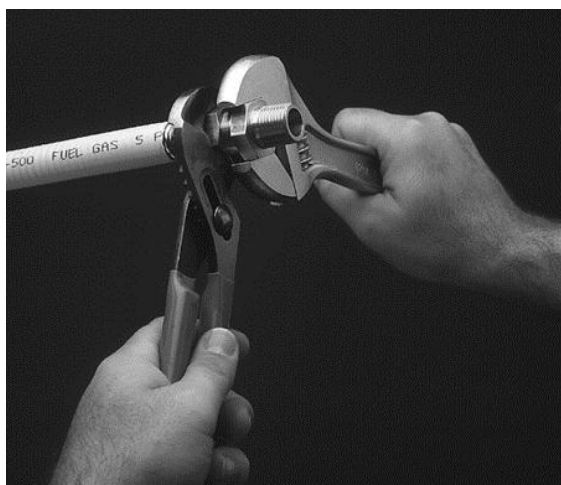
**ends are both sharp. Use care when cutting the cover and handling the pipe.**



**7.1.3 INSTALL BACK NUT:** Slide the back nut over the cut end; place the two split rings into the first corrugation next to the pipe cut. Slide the back nut forward to trap the rings.



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



**7.1.5 FINAL TORQUE :** Tighten nut and body as though you were making up a flared tubing joint. Note the relation between hex flats at this point and continue to tighten for two additional hex flats (one-third turn) to obtain required torque and final leak- tight metal-to-metal seal.

Maximum torques for sealing are :

DN	Torque N.m	Ft.lbs
12	54	40
15	57	42
22	61	45
28	100	75
32	200 - 270	150 - 200
40	270 - 340	200 - 250
50	340 - 405	250 - 300

**7.1.6 TAPE WRAP: AFTER GAS TIGHTNESS TEST - Care must be taken after pressure test to ensure that no stainless steel pipe is visible.**

Any portions of exposed stainless steel behind the fitting nut shall be wrapped with self-bonding silicone tape TracPipe® P/N FGP-915-10H-12, (25 mm wide), or FGP-915-20H12PO, (50 mm wide). This will reduce the possibility of later external corrosive attack.

## **7.2 Screwed joints**

Malleable cast iron and cast copper alloy fittings can be used in conjunction with the TracPipe® system, in which case they shall conform to BS 143 & BS 1256. All threads shall be clean prior to the application of any thread sealing material.

## **7.3 Jointing compound.**

Jointing compound must not be used on the internal sealing components of the TracPipe® fitting. These components are designed for metal-to-metal sealing without the aid of jointing paste. The use of paste on flared sealing faces of this fitting can interfere with proper fit up and cause leakage.

*When jointing paste is used it should only be applied to the external pipe threads and any excess paste should be removed on completion of the joint. Jointing compound should not be used in conjunction with PTFE tape.*

*PTFE tape should be wound with a 50% overlap starting from the thread runout in a direction counter to the thread form.*

## **8. INSTALLATION**

### **8.1 General**

Installation pipework shall be physically protected or located where it is not liable to mechanical damage. The bore of an installation pipe shall not be restricted by kinks, burrs, or foreign matter or in any other way.

### **8.2 Safety precautions**

**8.2.1** While installation work is in progress, care shall be taken to prevent the ingress of dirt, water, etc., into installation pipes.

**8.2.2** Where work is in progress on pipes already connected to a meter either:

- a) the meter shall be temporarily disconnected and both the open ends of the pipework sealed and dust caps fitted to the meter; or
- b) all open ends of the pipework shall be plugged, capped or terminated with a self sealing appliance connector conforming to BS 669: Part 1 or BS 669: Part 2 as appropriate, before the work is left unattended.

*Installers need to consider the risk of persons restoring the gas supply at the primary meter should they leave the general location where the work is in progress.*

**8.2.3** When work has been completed, open ends of pipe shall be plugged, capped or terminated with a self-sealing appliance connector conforming to BS 669: Part 1 or BS 669: Part 2, as appropriate.

**8.2.4** Before any work is commenced with a naked flame, e.g. a blowlamp, on pipework that contains or has contained gas, the gas supply to that part of the pipework shall be isolated and disconnected. The open ends of pipework connected to the gas supply and of any gas meter shall be plugged or capped.

Naked flames shall be kept away from the open ends of pipework.

In no case shall oxy-gas flame cutting equipment be applied to any meter, pipe or fitting containing gas.

#### **8.2.5 Connection and disconnection of pipes and fittings**

Where any installation pipe is no longer required, the pipe(s) shall be disconnected as close to the point of supply as practicable. All pipe ends shall be sealed, e.g. with a plug or cap.

During any work that necessitates connection or disconnection of any installation pipework, a temporary continuity bond shall be fixed where production of a spark or shock could cause a hazard, whether or not permanent equipotential bonding has been established.

*The recommended disconnection procedure is as follows.*

*a) Isolate the electrical connection of associated gas appliances from the mains supply.*

*b) Clip or clamp a temporary continuity bond to each side of the union, fittings or complete section that is to be removed or connected ensuring that good metallic contact is made.*

*c) Leave the bond in position until after the work is completed and metallic continuity re-established.*

*A recommended temporary continuity bond comprises of at least 1.2 m of single-core insulated flexible cable or equivalent of at*

*least 250 V rating. The cable should have a cross-sectional area of not less than 10 mm<sup>2</sup> and multi-strand flexible construction generally in accordance with BS 6004, BS 6007 or BS 6231 with a robust clip or clamp firmly attached at each end.*

#### **8.3 TracPipe® laid in wooden joisted floors**

**8.3.1** Where pipes are installed between floor joists or roof spaces, they shall be correctly supported. BS 6891 specifies a maximum interval between pipe supports of 2.0m for a vertical run and 1.5m for a horizontal run for sizes to 15 mm, and of 2.5m for a vertical run and 2.0m for a horizontal run for larger sizes. These maximum intervals for pipe support also apply to surface mount pipework.

*TracPipe® is not annealed after forming, to ensure maximum hoop strength and resistance to external damage. As such it has a lower tendency to sag than annealed product. Further, provided fixings are not too close TracPipe® has a tendency to deflect away from penetrating objects such as nails, drills and screws.*

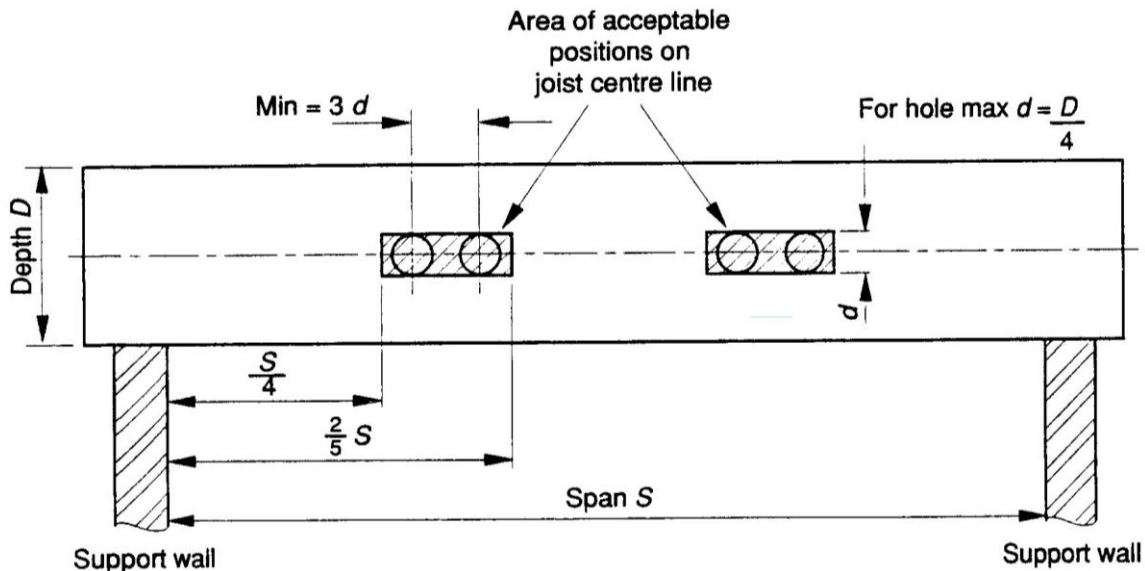


Figure 3: Pipes in Joists

**b) Timber joist drilling**

NOTE 1. Notches should have rounded corners and it is essential that they do not extend across the joint between floorboards.

NOTE 2. Notches and drillings in the same joist should be at least 100 mm apart horizontally.

NOTE 3. Rules are for joist depth up to 250 mm; for deeper joists assume  $D = 250$ .

**8.3.2** Where pipes are laid across the joists in ceiling or roof spaces fitted with flooring they shall be located in purpose-made notches or circular holes. (Figure 3). Notches shall not be made in joists less than 100 mm deep.

*There are now available specialist joist systems constructed of wood that are similar in appearance to rolled steel joists (RSJ's), which cannot be notched for structural reasons. However, these joists can be drilled or are supplied with 'Knock out' holes, which are pre-drilled during the manufacturing process. Where this type of joist is to be drilled, it is essential that the recommendations of the joist manufacturer be followed at all times.*

*TracPipe® is particularly suitable for this system of joists as it can be threaded between joists with ease. Prior to running pipework below suspended floors a visual inspection should be carried out to note the position of any electrical cables, junction boxes and ancillary equipment, in order that accidental damage or injury does not occur when inserting pipework.*

*Care should be taken when refixing flooring to prevent damage to the pipe by nails or screws. Where possible, the flooring should be appropriately marked to warn others.*

Table 3. Drill hole sizes for TracPipe®	
TracPipe® Size Mm	Drill hole size mm
12	28
15	35
22	38
28	45
32	57
40	63.5
50	76

**8.4 Pipes laid in concrete floors**

**8.4.1** TracPipe® corrugated stainless steel pipe **may be buried directly in concrete floors.** Pipe laid in concrete shall be installed in accordance with Figure 4. After piping is laid and prior to pouring screed, the entire run of TracPipe® must be examined visually and manually. The installer must closely inspect the cover over the entire length to check for any damage or



voids in the yellow plastic cover, which could affect corrosion resistance. Repair any damage by wrapping with tape. Tape wrapping must be done with self-bonding silicone tape TracPipe® P/N FGP-915-10H-12, (25 mm wide), or FGP-915-20H12PO, (50 mm wide).

**8.4.2** Pipes laid in concrete floors shall be protected against failure caused by movement.

TracPipe® is suitable to withstand seismic movement and settlement.

TracPipe® is fitted with a polyethylene covering material, which is soft yet thick enough to provide movement and resilient enough to support the concrete cover while it is setting.

**8.4.3** Pipes passing vertically through solid floors shall take the shortest practicable route and shall be sleeved (see **8.6**).

**8.4.4 TracPipe® fittings shall not be buried in the structure or below ground.**

*Boxes, with removable plywood covers and suitable for accessing TracPipe® fittings within floor screed are available from Hepworth and others, described as 'Conduit junction boxes'.*

## **8.5 Pipes in walls**

### **8.5.1 Pipe runs**

TracPipe® runs shall, where possible, be vertical and shall be placed in ducts with convenient access points or placed in pipe chases. Typical methods of installing TracPipe® in walls are shown in Figure 5. TracPipe® should be secured at each floor. In plaster walls, (see Figure 5) examine the entire run of TracPipe® visually and manually to check for any damage or voids in the yellow plastic cover. Repair any damage as shown in Paragraph **8.4.1** with self-bonding silicone tape.

### **8.5.2 Cavity walls**

TracPipe® shall not be placed within the structural cavities of cavity walls. Every pipe passing through a cavity wall shall take the shortest practicable route and shall be sleeved (see **8.6**).

### **8.5.3 Dry lined walls.**

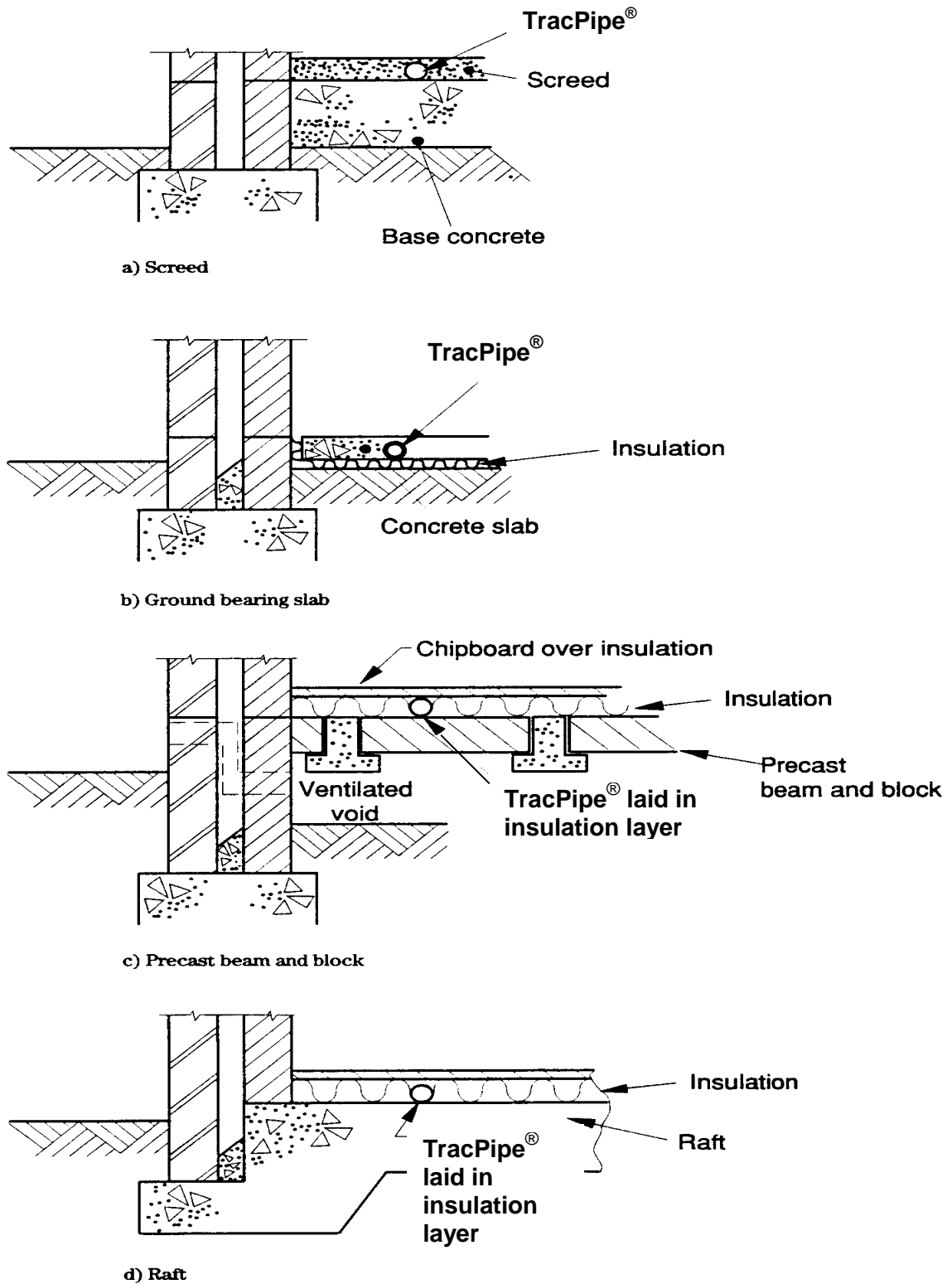
TracPipe® installed behind dry lining shall be encased by building material. For typical examples see Figure 5. Examine the entire run of TracPipe® visually and manually to check for any damage or voids in the yellow plastic cover. Repair any damage as shown in Paragraph **8.4.1** with self-bonding silicone tape.

### **8.5.4 Timber construction walls**

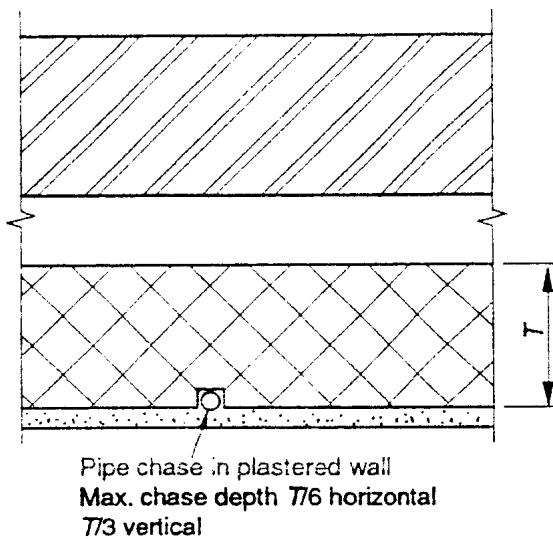
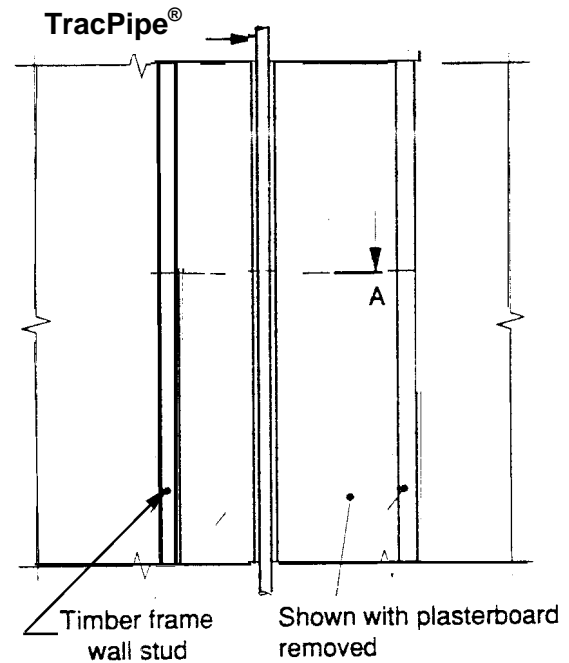
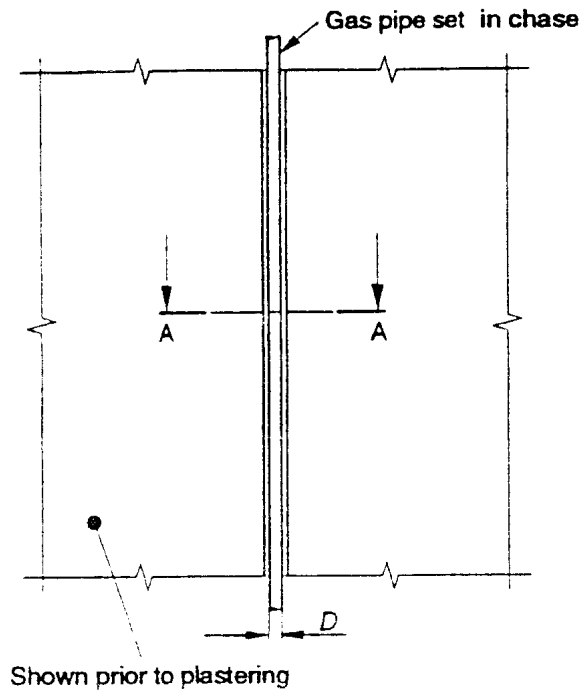
Installation pipes installed within timber construction walls shall either:

- a) Be run within purpose designed channels or ducts; or
- b) Be free to move away from potential puncture threats behind the plasterboard; have no fittings behind the wallboard; and be protected where appropriate from mechanical damage. Protection consists of striker plates, which are required where TracPipe® passes through structural members and movement is restrained.

Typical methods of installing TracPipe® in timber construction walls are shown in Figure 5. TracPipe® should be secured at each floor, but be free to move away from potential puncture threats behind plasterboard and other wall surfaces.



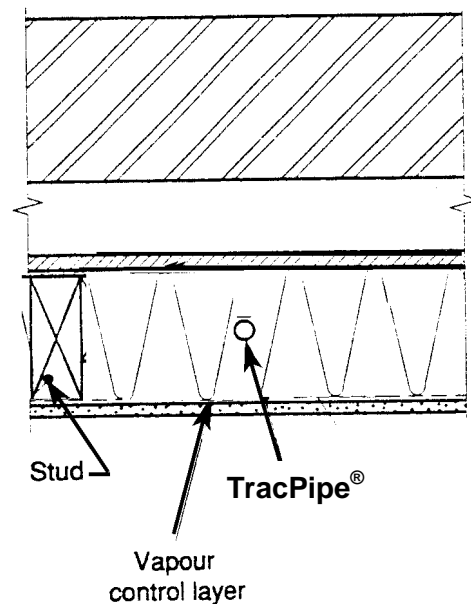
**Figure 4 : Typical examples of buried pipes**



Enlarged section A-A  
(shown after plastering)

a) Brick and block plastered

Dimensions in millimetres



Enlarged section A-A  
(shown with plasterboard in place)

d) Timber constructions

**Figure 5 : Typical examples of TracPipe® in masonry and timber frame walls**

### **8.5.5 Solid walls**

Every pipe, including TracPipe®, passing through a solid wall shall be sleeved.

### **8.6 Sleeves**

**8.6.1** Sleeves shall be of a material capable of containing or distributing gas, e.g. copper, steel, polyethylene, or other suitable plastic material.

*Care should be taken to ensure that PVC does not come into contact with stainless steel owing to the risk of corrosion.*

**8.6.2** Sleeves shall pass through the full width of the wall and be sealed at one end between the pipe and the sleeve with a flexible fire resistant compound. Sleeves shall not impair the fire resistance of a building.

*The internal diameter of any sleeve should allow for an annular space around the pipe to enable satisfactory insertion of the pipe into it and be of sufficient diameter to allow adequate sealing between the pipe and the sleeve.*

*The sleeve should be sealed at one end only, the other end being ventilated, preferably to open air. In the case of a sleeve within a gas meter box, this will not be possible, as the sleeve should be sealed at the point of entry into the building to prevent an accumulation of gas entering the building.*

**8.6.3** Sleeves shall be sealed at each end to the structure with a suitable building material, e.g. cement mortar.

**8.6.4** TracPipe® fittings shall not be located within the sealed section of a sleeve.

## **8.7 Pipework in ducts**

### **8.7.1 Ventilation**

Wherever possible, vertical and horizontal ducts containing TracPipe® Corrugated Stainless Steel piping shall be ventilated to ensure that minor gas leakage does not cause the atmosphere within the duct to become unsafe.

*Vertical ducts may run freely through a number of storeys or take the form of an enclosure at each storey level. Where ducts are continuous, ventilation can normally be achieved by the provision of openings sized in accordance with Table 4 (see Figure 6a). Where the duct takes the form of an enclosure at each storey level, ventilation is normally required at high level only in each storey (see Figure 6b).*

<b>Table 4. Free area of ventilation openings</b>	
<b>Cross sectional area of duct (m<sup>2</sup>)</b>	<b>Minimum free area of each opening (m<sup>2</sup>)</b>
Not Exceeding 0.01	0
0.01 and not exceeding 0.05	Cross sectional area of duct
0.05 and not exceeding 7.5	0.05
Exceeding 7.5	1/150 of the cross sectional area of duct

*Ducts having a small cross sectional area and volume (i.e. 0.01 m<sup>2</sup> or less and 0.1 m<sup>3</sup> or less, respectively) are considered to be adequately ventilated by adventitious means and no additional openings are required.*

*Additional information is given in BS 8313.*

*Minor gas leakage is that which would remain undetected by normal tightness testing techniques. The level of ventilation is not intended to clear a major gas escape arising from damage or failure of a gas pipe.*

*The normal minimum period of fire resistance of the duct is 30 min for buildings of not more than three storeys. Further guidance on the fire resistance of buildings is given in the appropriate Building Regulations.*

### **8.7.2 Fire stopping**

For buildings containing flats and maisonettes, installation pipes shall be fire stopped as they pass from one floor to another unless in their own protected shaft which is ventilated top and bottom to outside atmosphere. When installation pipes from a continuous duct enter a flat or maisonette they shall be fire stopped at the point of entry. (See Figure 6a).

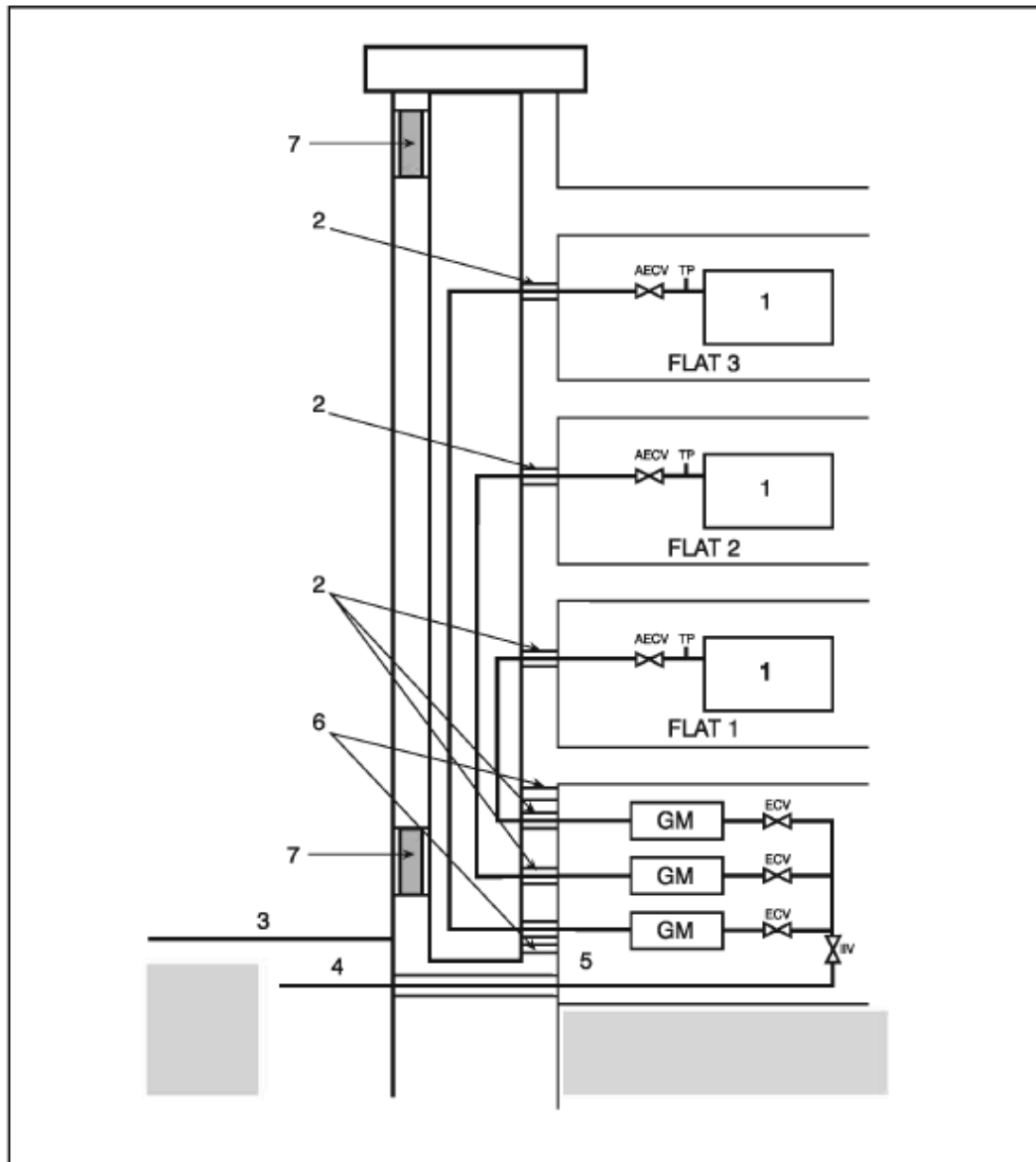
*When pipes pass through the protecting structure (i.e. compartment walls or floors) all openings should be kept as small, and as few in number as practicable, and should be suitably fire stopped in such a manner as to allow thermal movement of the pipe and ensure the fire resistance is not impaired.*

*To prevent displacement, materials used for fire stopping should be supported by, or reinforced with, materials of limited combustibility.*

*Any proprietary fire stopping should, when tested in accordance with the appropriate part of BS 476, achieve the relevant periods of fire resistance for the structure in respect of load bearing capacity, integrity and insulation.*

**Figure 6A**

Typical installation pipework in multi-storey buildings containing flats or maisonettes – Ventilated duct.



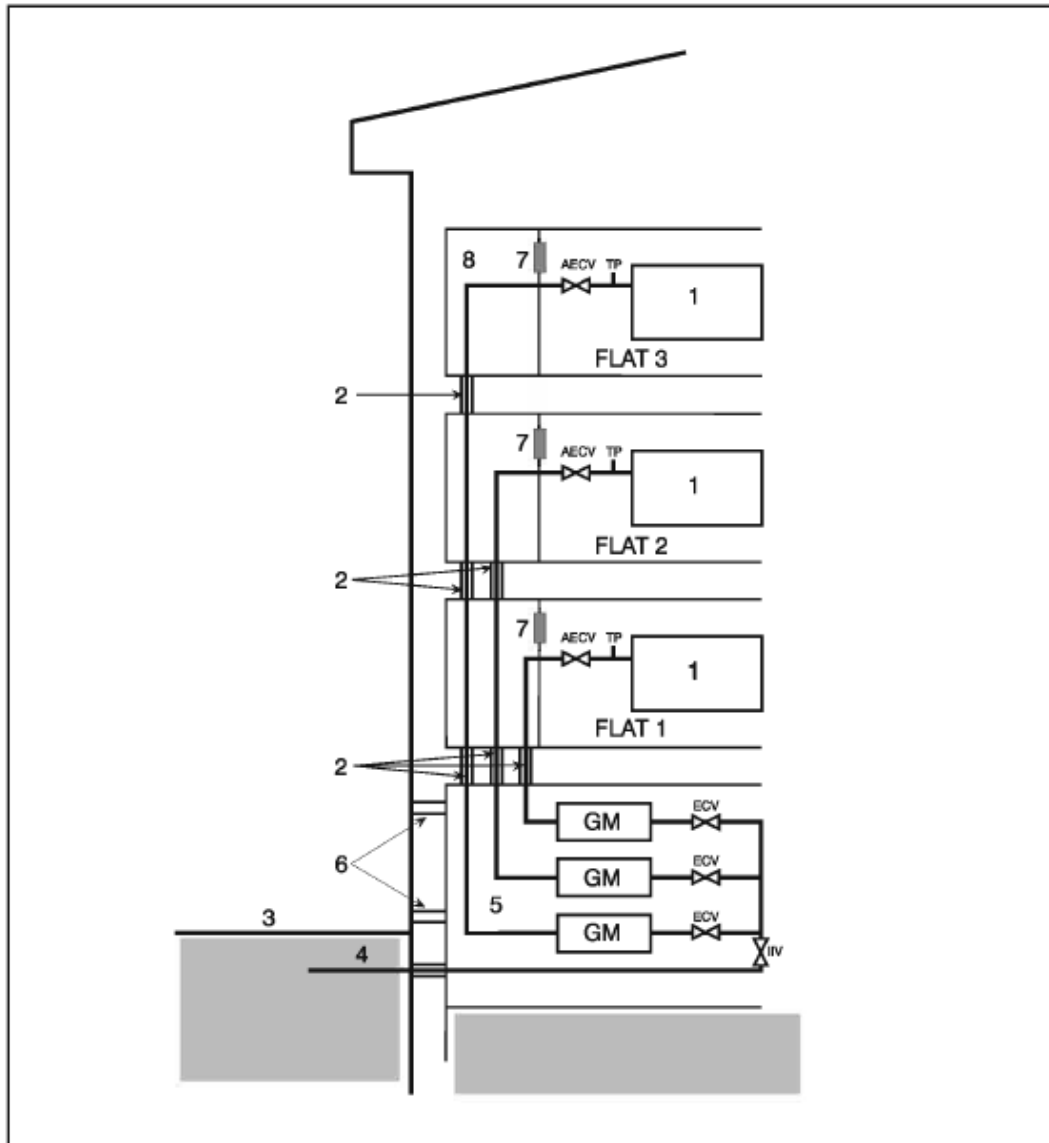
**KEY**

GM Gas Meter  
ECV Emergency Control Valve  
AECV Additional Emergency Control Valve  
IIV Incoming Isolation Valve  
TP Test Point

1 Appliance  
2 Fire Stop  
3 Ground Level  
4 Gas Service  
5 Meter Room  
6 Meter Room Vent  
7 Vent

**Figure 6B**

Typical installation pipework in multi-storey buildings containing flats or maisonettes – Fire stopped pipework and ventilated enclosed area,



**KEY**

GM Gas Meter  
ECV Emergency Control Valve  
AECV Additional Emergency Control Valve  
IIV Incoming Isolation Valve  
TP Test Point

1 Appliance  
2 Fire Stop  
3 Ground Level  
4 Gas Service  
5 Meter Room  
6 Meter Room Vent  
7 Vent  
8 Enclosure

### **8.8 Gas pipework inside a protected shaft containing a stair and/or lift or other protected fire escape route.**

In addition to the requirements for fire resistance (see 8.7.1) and fire stopping (see 8.7.2) any pipe carrying gas installed in, or passing through, a protecting structure shall be of screwed steel or of an all welded steel construction – or of a continuous length of corrugated stainless steel.

*TracPipe® can therefore be installed in a stairwell but it must then be a continuous length (without joins).*

*However, Note that a pipe is not considered to be within a protected shaft if it is contained within a fire resistant duct that is itself ventilated direct to outside air. (See Table 4).*

*The requirement given in 8.8 does not normally apply to one or two storey domestic dwellings.*

### **8.9 Pipe Supports and Fittings**

BS 6891 specifies a maximum interval between pipe supports:

for all sizes to DN15 – 2.0 metres for vertical runs and 1.5 metres for horizontal runs;

for sizes DN22 and above – 2.5 metres for vertical runs and 2.0 metres for horizontal runs.

### **8.10 Exterior pipework**

TracPipe® is suitable for exterior, exposed use. The yellow polyethylene cover has been tested for ultraviolet attack and colour fade. The cover should be checked for damage, and repaired if necessary as outlined in 8.4.1. Unlike traditional rigid pipe, further painting and labelling is not necessary. Any exposed stainless steel should be covered with self adhesive silicone tape, (see 7.1.6 ).

Although it is more common to use polyethylene pipe for exterior underground pipe, TracPipe® is suitable, provided the cover and exposed stainless steel are treated as outlined above.

For Natural Gas (*Domestic Installation to BS 6891*).

Buried pipework in open soil and below vehicular traffic shall have at least 375mm of cover.

Buried pipework in or below concrete, which has only pedestrian traffic, shall have at least 40mm of cover.

For LPG (*Domestic Installation to BS5482-1*).

Buried pipework in open soil shall have at least 375mm of cover.

Buried pipework below vehicular traffic shall have at least 600mm of cover.

Buried pipework below concrete with only pedestrian access shall have at least 100mm of cover.

For Natural gas and LPG; (*Commercial Installation to IGEM/UP/2 Latest Edition*).

Buried pipework under carriageways shall have at least 450mm of cover.

Buried pipework under path footways, verges and private ground shall have at least 375mm of cover.

Buried pipework under fields and agricultural land shall have at least 1100mm of cover.

UKLPG COP22 requires that LPG service pipework operating at less than 500mbar be buried with a minimum depth of cover of 350mm where there is negligible risk of interference/mechanical damage or at 600mm where there is a greater risk of damage. This dimension can however be reduced if the service pipework is protected against possible damage e.g. by laying concrete slabs approximately 100mm above the service pipework.

For LPG installations, buried metallic pipework (other than proprietary systems intended for underground use) should only be used when an appropriate:

- Risk Assessment has been carried out;
- Inspection and Maintenance Strategy has been developed and implemented

Where this is proven acceptable then TracPipe® should be installed in either:



- a) a trench backfilled with inert, non-corrosive material free of abrasive material likely to damage its corrosion protection; or
- b) inside a buried outer pipe or covered channel which terminates either above ground or in a suitable inspection pit. The design should be such as to prevent the accumulation of water in the outer pipe or duct, while enabling periodic inspection

In all cases, TracPipe® AutoFlare® fittings shall not be buried below ground.

## **8.11 Interrelation with other services**

### **8.11.1 General**

TracPipe® Corrugated Stainless Steel Piping shall be located so that it does not touch metallic fittings, which can give rise to electrolytic corrosion.

*The polyethylene cover should provide adequate protection where spacing is impracticable.*

*Care is essential when installing gas pipework in buildings containing electrical damp-proof protection systems to prevent accelerated pipe corrosion from occurring.*

### **8.11.2 Spacing**

Ideally TracPipe® should be spaced at least 25 mm away from electricity supply and distribution cables, and other metallic services.

Where spacing requirements are impracticable the polyethylene cover will provide adequate protection.

### **8.11.3 Electrical services**

Care shall be taken not to damage any electrical conductor when installing pipework.

TracPipe® shall not be buried in floors where electrical underfloor heating is installed, unless it has been physically and permanently disconnected.

## **8.11.4 Main equipotential bonding (cross bonding)**

**8.11.4.1** All domestic gas installations shall have main equipotential bonding of the gas installation pipework conforming to BS 7671 (IEE Wiring Regulations).

*The purpose of electrical bonding is to create a zone in which voltage differences, and therefore hazards from electric shocks, are minimized. This is achieved by connecting separate conductive components together with earthing cable or metal pipework. If an electrical fault occurs, either inside or outside of a building, it is possible for stray currents to be transmitted through the gas installation pipework. With a PME (protective multiple earth) system, a small current may pass along the pipework under normal conditions. Therefore, to avoid electric shock, or a spark, which could ignite the gas, it is important to maintain electrical continuity in the pipework at all times.*

**8.11.4.2** Main equipotential bonding shall be connected:

- a) on the customer's side of the meter;
- b) as close as practicable to the meter before any branch in the installation pipework;
- c) in a position where it can be visually observed, with a warning label stating 'Safety electrical connection. Do not remove';
- d) by a mechanically and electrically sound connection which is not subject to corrosion (i.e. not exposed to the weather).
- e) at the point of entry into the property, especially apartments.

*Main equipotential bonding of the gas installation pipework should be a minimum of 10 mm<sup>2</sup> cable with green and yellow insulation, construction reference 6491X conforming to BS 6004.*

*For internal meters, for verification purposes the bonding connection should be within 600 mm of the meter outlet.*

*For meters in outside meter boxes/compartments, the bonding connection should be preferably inside the building and as near as practicable to the*

*point of entry of the installation pipework into the building. Alternatively, the connection may be made within the box/compartment, but it is essential that the bonding cable does not interfere with the integrity of the box/compartment and the sealing of any sleeve.*

*When relocating a meter, an existing main equipotential bond may be satisfactory as found, or it may need to be either lengthened or shortened or, in some cases, completely re-run. The bond connection is satisfactory if the conditions of **8.11.4.1** are met.*

**8.11.4.3** When a gas installation pipe is connected to a primary meter installation, the installer of the installation pipe shall, in the case where main equipotential bonding may be necessary, inform the responsible person that such bonding should be carried out by a competent person.

*For new gas installations the responsibility for the main equipotential bond lies with the installer to preferably carry out the bonding directly, where competent to do so, or, alternatively, pass notification (e.g. a letter or card, see Figure 7) to the responsible person (e.g. house owner, tenant, landlord or builder).*

### **ELECTRICAL BONDING**

Most types of electrical installations are fitted with main protection bonding conductors, which is the connection of the internal gas and water pipes to the installation's earth terminal. In particular, those installations with PME (protective multiple earth) must, by law, be fitted with protection equipotential bonding (PEB).

The gas installation pipe fitted in your premises does not appear to be fitted with a protection bonding conductor.

I am required by The Gas Safety (Installation and Use) Regulations, to inform you that any necessary PEB work should be carried out by a competent person. I advise you to have the installation checked by an electrically competent person.

No electrical installation work should be undertaken until the lack of protective bonding is checked by an electrically competent person.

If you are the tenant of this property, would you please bring this requirement to the attention of the owner/landlord or their managing agent.

**Figure 7. Typical notification of main equipotential bonding**

## **8.12 Valves**

**8.12.1** An emergency control valve (ECV) shall always be fitted.

*The ECV is not part of the installation pipework system. It is usually installed at the end of the service main at the inlet of the primary meter. The ECV is not an "additional emergency control valve" (AECV), see 8.12.2.*

**8.12.2** An additional emergency control valve (AECV) is not an ECV (see 8.12.1). An AECV is intended to allow the consumer of gas to shut off the gas supply in an emergency, and is located downstream of the meter. An AECV may not isolate all the installation pipework or meter installation.

An AECV shall be fitted:

a) If the meter is 6 m or more away from the building, an AECV shall be installed where the installation pipe enters the building. See *also 8.12.4.*

b) When multiple meters serving individual flats are located in remote or communal areas, an AECV shall be fitted inside each individual flat. See *also 8.12.4*

**8.12.3** Every additional emergency control valve shall:

a) be labelled or marked to show its open and closed positions;

b) be fitted in an accessible position;

c) be easy to operate;

d) be fitted with a suitable handle, which is securely attached, or other permanent means of operation;

e) where the lever moves in the vertical plane the move to the 'off' position shall be in a downward direction.

There shall be a permanent notice attached to the valve indicating that the valve is an 'Emergency Control for customers' use', giving the telephone number of the Gas Emergency Service, and advising the consumer on actions to be taken in the event of a suspected escape of gas.

**8.12.4** A pressure test point shall be installed no more than 300mm downstream of each emergency control valve.

**8.12.5** A valve shall be fitted in an accessible position at the point of exit from a dwelling where the installation pipe leaves the dwelling to supply remote appliances.

*It is preferable that the valve be fitted externally. Appliances such as greenhouse heaters, barbecues and lighting are fitted external to the premises.*

## **9 CORROSION**

### **9.1 General**

**9.1.1** A gas pipe or pipe fitting shall not be installed in a position where it is likely to be exposed to a corrosive environment. Gas pipes or fittings that are considered to be at risk shall either be manufactured from materials that are inherently resistant to corrosion or shall be protected against corrosion.

*TracPipe® is supplied with a polyethylene cover, which provides suitable corrosion resistance for a majority of installations. Care must be taken when assembling AutoFlare® fittings to assure that no stainless steel pipe is visible. Exposed stainless steel behind the fitting nut shall be wrapped with self-bonding silicone tape TracPipe® P/N FGP-915-10H-12, (25 mm wide), or FGP-915-20H12PO, (50 mm wide). This will reduce the possibility of later external corrosive attack.*

#### **9.1.2 Pipework in fireplace openings**

**Do not install TracPipe® in the openings of all-fuel fireplaces.** Soot and debris can be highly corrosive. TracPipe® feeding this type of fireplace must be terminated outside of the firebox and the final fit up made with suitably protected pipe. The flexibility of TracPipe® can be utilized to carry out this type of installation.

**9.1.3** Assembled pipework shall be tested for soundness in accordance with Paragraph **10** before any additional protection against corrosion is applied on site.

## **9.2 Buried pipework**

### **9.2.1 Internal environment**

**9.2.1.1** Pipework that is buried in a solid floor or wall shall be factory sheathed, or protected on site by wrapping or with suitable bituminous paint protection.

The entire section of pipe and fittings to be buried shall be protected.

*TracPipe® cover or wrapping shall be examined for cuts or other defects and made good prior to use. Any portions of exposed stainless steel or cut cover shall be wrapped with self-bonding silicone tape TracPipe® P/N FGP-915-10H-12, (25 mm wide), or FGP-915-20H12PO, (50 mm wide). This will reduce the possibility of later external corrosive attack.*

*Protective measures are applied as a precaution against electrolytic and/or chemical corrosion.*

**9.2.1.2** If TracPipe® is to be used for installation piping to be buried in magnesium-oxy-chloride cement or magnesite flooring, please consult us before installation.

### **9.2.2 External environment**

**9.2.2.1** TracPipe® is suitable for external applications, including burial. The integrity of the polyethylene cover should be checked and rectified if necessary. (See **8.4.1**). Fittings shall not be buried.

*Further information on the correct procedures for laying buried pipes is given in the Institution of Gas Engineers and Managers Recommendations IGE/TD/4.*

**9.2.2.2** TracPipe® run above ground is protected from corrosion by the polyethylene cover. Ensure any exposed stainless steel is suitably covered (see **7.1.6** and **8.4.1**).

## **10 TESTING FOR GAS TIGHTNESS, AND PURGING.**

Domestic installations, apart from those below, should be tested and purged in accordance with IGE/UP/1B – *Tightness testing and direct purging of small Liquefied Petroleum Gas/Air, Natural Gas and Liquefied Petroleum Gas installations.*

Domestic installations with a pipework size in excess of TracPipe® DN 32, or installations greater in volume than 0.035m<sup>3</sup>, or with a gas meter larger in volume than a U16/G10, should be tested to the requirements of the Institution of Gas Engineers and Managers (IGEM) document IGE/UP/1 or IGE/UP/1A – *Soundness Testing & Purging of Industrial and Commercial Gas Installations.*

It is important to note that some leak detection fluids (LDF) contain compounds that can be corrosive, either to stainless steel or to brass. Should the use of LDF's be necessary the operator must ensure that all traces are removed by washing with clean water. Household or 'washing up' liquid should NOT be used as leak detection fluid, as the high chloride content is corrosive to metals.

TracPipe® self adhesive silicon tape should be used to cover exposed stainless steel; it is essential that this is not applied until the pipework has been tested and deemed to be gas tight, (and any traces of LDF, if used, washed away and the pipe and fitting dried).

The tape should run onto the back nut, leaving sufficient space to apply an earthing connection to the back nut or fitting body.

## **11. DAMAGE AND REPAIR.**

### **11.1 General.**

Although TracPipe® is very light, it has considerable hoop strength and will generally resist external damage better than copper. Further, provided it is not fixed too

closely TracPipe® has the natural ability to deflect away from nails, screws, drills and other implements of puncture.

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

### **11.2 Assessment.**

Repairs to the cover can be effected by the use of self-adhesive silicon tape, as described earlier (see 8.4.1).

No repairs or replacement of the tubing is necessary if the tubing is only slightly dented due to impact or crushing where the outside diameter is reduced by under 1/3.

The tubing must be replaced under the following circumstances :

- A. The tubing has been significantly crushed or dented, where the outside diameter is reduced by more than 1/3.
- 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.

### **11.3 Repair.**

A line splice can be made using two straight AutoFlare® fittings and a female malleable iron socket, or by using a TracPipe® coupling. However, if the tubing run is short and easily accessible, the preferred repair is to replace the entire length. A tubing run can often be replaced faster than repairing the damaged section with a splice, and this does not add any additional fitting joints into the system.

The AutoFlare® fittings from the removed section can be reattached to the new tubing run.

# ANNEX A

## (Normative)

### **A.1 Installation procedures**

The installation pipework should be installed and tested in accordance with BS 6891, BS5482-1 or the Institution of Gas Engineers and Managers publications IGEM/UP/2 Latest Edition, IGE/UP/1, IGE/UP/1A or IGE/UP/1B as appropriate, supplemented by the manufacturer's instructions.

When designing and planning the installation, consideration should be given to the possibility of restricted access on site and the forces and torques required for assembly, particularly for the larger diameters.

### **A.2 Compatible products**

Corrugated pipe from a particular manufacturer must be assembled only using fittings supplied or specified by the same manufacturer and must not be assembled using fittings from other sources.

### **A.3 Pipe sizes**

Sizing of installation pipework can be carried out in accordance with BS6891, BS5482-1 or IGEM/UP/2 Latest Edition as appropriate. Alternatively sizing can be carried out in accordance with our specific data contained in Annex G.

### **A.4 Seals**

Care should be taken to avoid damaging seals. Any damaged seals should be discarded.

### **A.5 Pipe supports and appliance connection**

Corrugated stainless steel semi-rigid pipe to BS 7838 should not be used where during installation, or subsequent to installation, it can be subjected to repeated bending. Corrugated stainless steel semi-rigid pipe to BS 7838 is an alternative to traditional rigid pipe systems, not a replacement for flexible connections.

Installation pipework must be adequately supported in accordance with the requirements of BS 6891, and the manufacturer's instructions.

A movable appliance (e.g. cooker, tumble dryer) must not be connected directly to corrugated stainless steel piping. Connection should be made using a flexible connector in accordance with BS 669-1 or BS 669-2 as appropriate.

*Some types of overhead heaters are not considered as moveable appliances and TracPipe® can be connected directly to these units. However, where the heater manufacturer specifies that a flexible connection must be used, TracPipe® is NOT a replacement for a flexible hose.*

The length of unsupported corrugated pipe connected directly to any fixed appliance should not exceed 500 mm. Where the final connection is made indirectly by using a length of rigid pipe, the end fittings or adaptor should be permanently fixed. If the appliance is normally moved for servicing, an isolation valve and a union coupling or other suitable means of disconnection should be fitted at the appliance inlet.

During assembly or disassembly, manifolds if used, should be adequately supported by wrenches or other means, to avoid excessive strain on fittings or attached pipework.

### **A.6 Connections to copper pipe**

**It is important that TracPipe® is not contaminated in any way with flux or solder, either internally or externally.**

**Any soldering on adjacent copper pipework must be completed, and the soldered component thoroughly cleaned of flux, before any connection to TracPipe® is made.**

## ANNEX B

### (Normative)

#### **GUIDE TO SIZING GAS SUPPLIES.**

When deciding on the correct size of gas pipes for an internal installation, it is recommended practice to allow a maximum pressure loss of 1 mbar between the meter outlet and the appliance connection points.

The size of the pipe selected should be of sufficient diameter to supply all the appliances on the installation when they are used at the maximum gas rate.

Figure B.1 gives an example of a typical TracPipe® Stainless Steel Piping installation showing the lengths of pipes and the gas rates of the appliances. The pipes have been sized using Tables 1, and the results are shown in Table B.1. When sizing pipes, it is essential that consideration is given to the permissible pressure loss in each section of the installation. For example, the pressure loss between A and H in figure B.1 should not exceed 1 mbar.

A to H is made up of four sections of pipe, A-B, B-D, D-F and F-H. Each section carries a different gas rate and needs to be sized separately

If A to H is to have a pressure loss of not more than 1 mbar, then the pressure losses in each of the four sections should be approximately 0.25 mbar. So A-B, B-D, D-F and F-H should each be sized to give a pressure loss of approximately 0.25 mbar.

The table of discharges in a straight horizontal pipe given in Table 1 only allows for pressure losses of 1 mbar.

However pressure loss is proportional to length, so if the pipe size selected in Table

1 is four times longer than required, the pressure loss on the actual length will be 0.25 mbar.

#### *Example*

Considering length D-F as given in figure B.1 :

D-F has a length of 1.5 m and is to carry a gas rate of 1.5 m<sup>3</sup>/h; it should have a pressure loss of 0.25 mbar maximum.

However, a pressure loss of 0.25 mbar in a length of 1.5 m equals

$$(4 \times 0.25) = 1 \text{ mbar in } (4 \times 1.5 \text{ m}) = 6 \text{ m.}$$

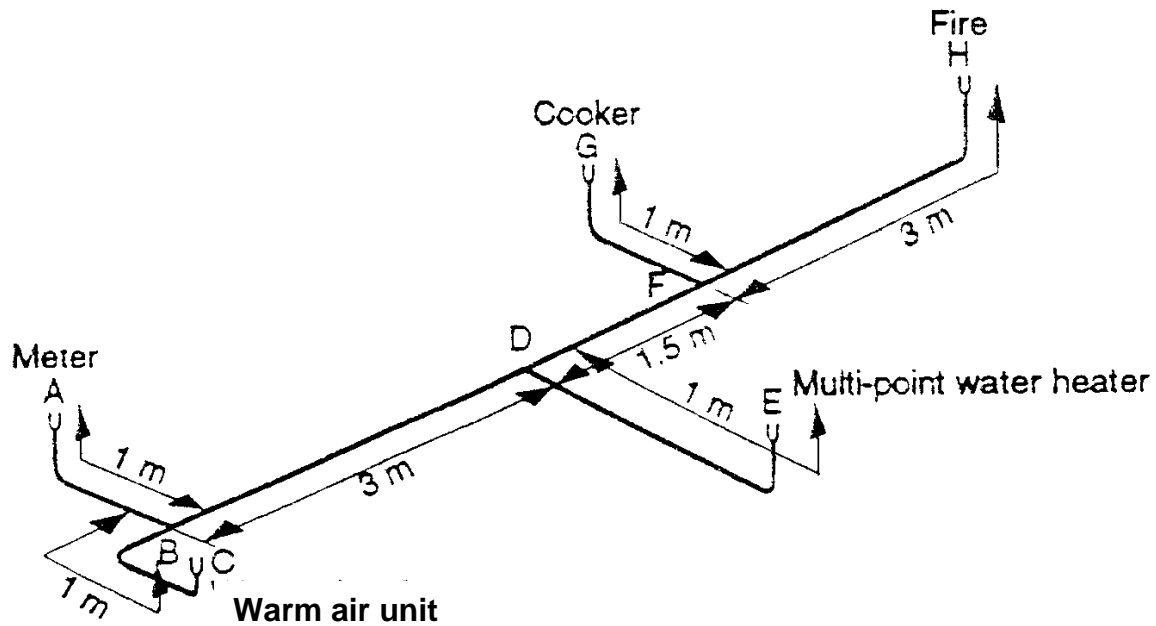
In Table 1, look up the column under 6m, for a discharge of 1.5 m<sup>3</sup>/h and find: 12 mm = 1.0 m<sup>3</sup>/h

$$15 \text{ mm} = 1.9 \text{ m}^3/\text{h}$$

The first size, 12 mm, would give a lower flow rate than is required.

The larger size, 15 mm, would carry the 1.5 m<sup>3</sup>/h of gas with little pressure loss and could allow for appliances to be added to the installation at a later date, if required. This is the size to be used.

NOTE. If the same calculations as above are used for sizing the pipework for properties which are supplied with liquefied petroleum gas (LPG), the property could be converted to natural gas in the future and no problems would be found with the pipe sizes (as LPG normally only requires smaller diameter pipes than natural gas.)



Appliance	Gas rate (typical) M <sup>3</sup> /h
Warm air unit	1.0
Multi-point water heater	2.5
Cooker	1.0
Gas fire	0.5
Central heating boiler	1.5
Combination boiler	2.5

Table B1. Sizing Results						
			Equivalent length of fitting from Table 1			
Pipe section	Gas rate M <sup>3</sup> /h	Pipe length m	Type	Equivalent length m	Total length m	Pipe diameter DN
A-B	5	1	Elbow tee	0.3 0.5	1.8	22
B-C	1	1	Two elbows	0.6	1.6	15
B-D	4	3	---	---	3	22
D-E	2.5	1	Tee elbow	0.5 0.3	1.8	22
D-F	1.5	1.5	---	---	1.5	15
F-G	1	1	Tee elbow	0.5 0.3	1.8	15
F-H	0.5	3	elbow	0.3	3.3	12
1) Most appliances have horizontal connections, so in practice an additional elbow is required at each point						

**Figure B.1 Example - calculation**



## **ANNEX C**

### **(Informative)**

#### **3 DEFINITIONS**

**For the purposes of this Document the definitions given in BS 1179: Part 6: 1980 apply, together with the following.**

##### **3.1 installation pipework**

Any pipework or fitting from the first fitting or joint after the primary meter outlet union connection to points at which appliances are to be connected. *This definition varies from that given in the Gas Safety (Installation and Use) Regulations 1994.*

##### **3.2 duct**

A purpose designed enclosure to contain gas pipes.

##### **3.3 emergency control valve (ECV)**

A valve, not being an additional emergency control valve (AECV), for shutting off the supply of gas in an emergency, intended for use by a consumer of gas, and being installed at the end of a service or distribution main. *Note. The ECV is not part of the installation pipework.*

##### **3.4 additional emergency control valve (AECV)**

A valve, not being the ECV, for shutting off the supply of gas in an emergency, intended for use by a consumer of gas. *Note: An AECV may be located within the installation pipework or meter installation, and may not isolate all the consumer's pipework or meter installation.*

##### **3.5 primary meter**

The meter nearest to and downstream of a service pipe for ascertaining the quantity of gas supplied through that pipe.

##### **3.6 protected shaft**

A shaft which enables persons, air or objects to pass from one compartment to another, and which is enclosed with fire-resisting construction.

##### **3.7 service pipe**

A pipe connected to a distribution main to provide a supply of gas to one or more consumers and terminating at and including the emergency control valve at a primary meter.

##### **3.8 sleeve**

A tubular case inserted in a prepared hole in a structure for the reception of an installation pipe.

## **ANNEX D**

### **(Informative)**

*TracPipe® corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework – SAMPLE SPECIFICATION.*

#### **GAS PIPING**

The gas piping material shall be Corrugated Stainless Steel Semi-rigid pipe Kitemarked to British Standard BS 7838 and installed in accordance with British Standards BS 6891, (2<sup>nd</sup> family gases), or BS 5482:Part 1, (3<sup>rd</sup> family gases), in domestic premises, or in accordance with the Institution of Gas Engineers and Managers publication IGEM/UP/2 Latest Edition in other premises.

The stainless steel tubing should not be annealed after forming to ensure maximum crush resistance, and the attachment fittings must have a metal-to-metal seat to accomplish gas sealing. Elastomer seal rings or fibre gaskets are not permitted in the tubing attachment fittings.

A non-metallic jacket, coloured yellow ochre, and marked 'GAS', of non-halogenated, fire and smoke retardant polyethylene shall be used. Polyvinyl chloride (PVC) is not permitted as a jacket material.

Where piping penetrates floor slabs evidence of a minimum 2-hour fire rating is required for the gas piping material.

The gas piping material shall satisfy the requirements in BS 6891 or IGEM/UP/2 Latest Edition for sleeved pipe, such that the piping can pass through unventilated voids, without joins, whilst maintaining its sleeved integrity.

For timber frame housing, (refer to IGE/UP/7), the sleeving must be maintained, as above, without joins, where the pipework passes through unventilated voids in the construction.

(Type *TracPipe*® semi-rigid gas piping is available from OmegaFlex Limited, Kildare House, Wildmere Road, Banbury, Oxfordshire OX16 3JU – U.K.

Tel: 01295 676670 (Int + 44 1295 67 66 70.)

Fax: 01295 267302 (Int + 44 1295 26 73 02.)

## ANNEX E

### (Informative)

#### **PIPE CUTTER**

When TracPipe® is being cut to permit the attachment of end fittings, all sizes must always be cut with a wheeled pipe cutter. For sizes up to DN28, many different makes and models of pipe cutter are suitable. For larger sizes, some makes and models of pipe cutter may be unsuitable. For sizes up to DN32, we recommend a cutter made by Monument Tools, their product reference 275Q (and replacement wheels 311U). For all sizes up to DN50, we recommend Ridgid Tool Company model 152, using their cutting wheel catalogue number 33195, part number E-5272.

**CAUTION:** Use of a small cutting wheel may flatten the first corrugation and make sealing of fittings difficult.

#### **PIPE-IN-PIPE**

We are sometimes asked for recommendations for additional piping to enclose TracPipe®, to provide an enhanced pipe-in-pipe solution, for example in timber framed buildings.

The material of the exterior surrounding pipe, (which is often vented to atmosphere), is sometimes specified, in which case either follow the specification or contact our technical department.

When the material is not specified we recommend Plastiflex GF, which is a flexible corrugated polyethylene tubing, manufactured by Plastiflex (UK) Ltd., tel: 01924 829024.

Suitable sizes are:

<u>TracPipe® DN</u>	<u>Description</u>
12, and 15	GF 28, 28 mm i.d. Flexible Polyethylene Tubing
22	GF 32, 32 mm i.d. Flexible Polyethylene Tubing
28	GF 38, 38 mm i.d. Flexible Polyethylene Tubing
32	GF 51, 51 mm i.d. Flexible Polyethylene Tubing
40	GF 63, 63 mm i.d. Flexible Polyethylene Tubing
50	GF 76, 76 mm i.d. Flexible Polyethylene Tubing

Where a TracPipe® coupling is to be used on TracPipe® and incorporated within a surrounding pipe, please note the following “across corner” dimensions for the couplings. The exterior, surrounding pipe will need to have an internal diameter larger than these dimensions:

<u>TracPipe® DN</u>	<u>Across Corner dimension – mm</u>
12	29.3
15	33.0
22	40.3
28	47.7
32	62.3
40	73.3
50	95.3

## ANNEX F

### *TracPipe® stainless steel semi-rigid gas piping to BS 7838* Statement on the installation of gas pipes in false ceilings and suspended or floating floors.

There is some confusion among Consulting Engineers, Contractors and registered installers about where and how gas piping can be installed in false ceilings and floating/ suspended floors – associated with the requirements for ventilation.

The Gas Safety (Installation and Use) Regulations 1998 has an Approved Code of Practice, drawn up by the Health and Safety Commission<sup>1</sup> and effective from 31<sup>st</sup> October 1998, which gives practical advice.

Regulation 19(2) states:

*(2) No person shall install any installation pipework so as to pass through a wall or a floor or standing of solid construction (whether or not it contains any cavity) from one side to another unless –*

*(a) any part of the pipe within such wall, floor or standing as the case may be takes the shortest practicable route; and*

*(b) adequate means are provided to prevent, so far as is reasonably practicable, any escape of gas from the pipework passing through the wall, floor or standing from entering any cavity in the wall, floor or standing.*

The Guidance states:

*Regulation 19(2)(b) addresses the potential risk of gas leaking from pipework within a cavity in a wall, floor or standing; such leakage may be difficult to detect and readily lead to the accumulation of an explosive gas/air mixture in the cavity, presenting a considerable hazard to building occupants and others. The protective measures required may include enclosing that part of the pipe which passes through the wall, floor or standing in a gastight sleeve which is itself ventilated to a safe position, preferably to open air. This approach also provides some protection against mechanical damage to pipework, arising from structural movement (see also regulation 19(5); any gap between the pipe and sleeve should be sealed (with flexible sealant), but at one end only so as to ensure any leak cannot accumulate in the gap space.*

Clause 4.3.3 of BS EN 1775:2007 Gas supply – Gas pipework for buildings – Maximum operating pressure up to and including 5 bar – Functional recommendations states:-

*The route of pipework in buildings shall preferably be located in ventilated spaces. The ventilation shall be adequate to safely dilute any small gas leak taking due account of the density of the gas (heavier than air e.g. LPG, or lighter than air e.g. natural gas). Where it is not possible to achieve adequate ventilation, other solutions shall be applied, e.g. ventilated sleeves or ducts, pipes which are all welded, all brazed or joint free or the filling of the space around the pipe with inert materials etc.*

IGEM/UP/2 Latest Edition installation pipework on industrial and commercial premises states in Clause 10.4. Pipework must not be installed in an unventilated duct or void. However, if creating a ventilated enclosure or filling void;

The pipework is sleeved continuously through the unventilated duct or void, with the sleeve ventilated at one or both ends into a safe place: or

the unventilated duct or void is filled with a crushed inert infill to reduce to a minimum the volume of any gas which may accumulate. The infill material should be of a dry, chemically neutral and fire resistant nature, for example crushed slate chippings or dry washed sand.

TracPipe® is a continuously welded stainless steel semi-rigid gas pipe. It also has a gas tight cover, which extends over the whole length of the pipe (up to the end fittings). TracPipe®'s cover has been independently tested by BSI at pressures from 20 mbar to 2 bar to demonstrate that it performs satisfactorily as a sleeve, allowing free passage for gas flow between the stainless steel pipe and the outer cover to the end fittings, throughout this pressure range

This gas tight cover makes TracPipe®, in effect, a sleeved pipe. Therefore, being a sleeved pipe, TracPipe® can pass through unventilated ceilings or floors, meeting the requirements of the GS(IU)R, BS EN 1775 and IGEM/UP/2 Latest Edition, provided that the route is the shortest practicable, the integrity of the cover is maintained, and the end fittings (where the gas tight cover ends) are in a ventilated area. TracPipe® could for instance run from a gas meter, through an unventilated false ceiling, to a gas boiler. At the boiler the sleeve on the TracPipe® ends, but the room in which the boiler is installed is ventilated. Any minor gas leakage in the TracPipe®, undetected by normal testing means, would be conducted along the inside of the cover to the end fittings.

Unfortunately, BS 6891:2005 does not address how to pass pipework through an unventilated void. Clause 8.11.1 of BS6891:2005 deals with ventilation, and if the cover on TracPipe® is regarded as a duct, since it has a cross sectional area less than 0.01 m<sup>2</sup>, no additional ventilation openings are required.

Five practical points to note:

1. Where TracPipe® passes through holes in walls or floors we still recommend an additional sleeve inside the hole, suitably fire stopped at one end with a flexible (non-setting) fire resistant material, as for traditional rigid copper and steel pipework.
2. At the meter box TracPipe® should still pass through the sleeving provided for copper or steel, being sealed within the sleeve as usual.
3. In case of damage to the cover which would affect its properties as a sleeve, if the TracPipe® is visible during installation, repair any damage to the cover made using our yellow part cured silicon rubber tape – as for TracPipe® being used in concrete floors. Where TracPipe® would not be visible during installation, for instance in threading TracPipe® under floors when the floor is already laid, to avoid the risk of unseen damage to the cover we recommend running TracPipe® inside flexible polyethylene ducting (see Annex E). Both ends of the ducting should open into ventilated areas.
4. TracPipe® must not be joined or teed in any unventilated space, unless the cross sectional area and volume of the space meet the requirements stated in Table 3 of BS 6891:2005, (CORGI *Essential Gas Safety, Domestic*, 5<sup>th</sup> edition, Table 5.8), for nil ventilation.

5. Where the sleeve feature of the TracPipe® cover is used through unventilated ceilings or floor cavities, the yellow part-cured silicon tape should only be applied at one end of the run, the other end being left without tape so that the sleeve can ventilate into a safe area. Ideally the tape should be applied at the end at most at risk to external corrosion, e.g. in kitchen areas, where bleach may come into contact with the TracPipe®.

Notes:

1. 'Sleeve' is defined in BS 6891 as – A tubular case inserted in a prepared hole in a structure for the reception of an installation pipe. Further, 'sleeves shall be made of a material capable of containing or distributing gas, e.g. copper, steel, polyethylene, polyvinyl chloride (PVC), or other suitable plastics material. *(However, PVC should not come into contact with stainless steel owing to the risk of corrosion.)*
2. 'Duct' is defined in BS 6891 as – A purpose designed enclosure to contain gas pipes. This definition is in accordance with BS 8313.
3. Gas Safe Technical Bulletins TB113 and TB120 give relevant information on the installation of pipework in voids.

# **Annex G**

## **Informative**

### **Sizing tables for BS EN 15266**

Persons designing gas installation pipework systems with the data contained in this Annex will need to use the appropriate sizing method specified in IGEM/UP/2 Latest Edition.

**TABLE G1 – Approximate discharge through TracPipe® CSST in cubic metres per hour for NATURAL GAS (relative density 0.60)**

		Inlet Pressure: 21 mbar Pressure Drop: 1 mbar Specific Gravity (Relative Density) of Gas: 0.60																			
		Tubing Length (metres)																			
DN	EHD	3	6	9	12	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150
10	15	1.18	0.85	0.70	0.62	0.55	0.49	0.44	0.40	0.35	0.32	0.29	0.27	0.25	0.24	0.23	0.22	0.21	0.20	0.20	0.19
15	19	2.55	1.82	1.50	1.30	1.17	1.02	0.91	0.84	0.73	0.65	0.60	0.56	0.52	0.49	0.47	0.45	0.43	0.41	0.40	0.38
20	25	6.30	4.50	3.69	3.21	2.88	2.50	2.25	2.05	1.79	1.60	1.47	1.36	1.27	1.20	1.14	1.09	1.05	1.01	0.97	0.94
25	31	10.76	7.66	6.28	5.46	4.89	4.25	3.81	3.48	3.02	2.71	2.48	2.30	2.15	2.03	1.93	1.84	1.76	1.70	1.64	1.58
32	37	20.24	14.40	11.80	10.25	9.18	7.97	7.14	6.53	5.67	5.08	4.65	4.31	4.04	3.81	3.62	3.45	3.31	3.18	3.07	2.96
40	46	32.25	22.72	18.51	16.01	14.30	12.37	11.05	10.08	8.71	7.78	7.10	6.57	6.14	5.78	5.48	5.23	5.00	4.80	4.63	4.47
50	62	75.14	53.23	43.51	37.71	33.75	29.25	26.18	23.91	20.72	18.55	16.94	15.69	14.68	13.85	13.14	12.53	12.00	11.53	11.11	10.74
Notes:		1) Flow rates based on Standard Conditions of 21C and 1 bar. 2) Flow rates above include losses for four 90-degree bends and two end fittings. For tubing runs with additional bends or fittings, increase pipe length by the values given in Table G7.																			

**TABLE G2 – Approximate discharge through TracPipe® CSST in cubic metres per hour for PROPANE (relative density 1.52)**

		Inlet Pressure: 37 mbar Pressure Drop: 2.5 mabr Specific Gravity (Relative Density) of Gas: 1.52																			
		Tubing Length (metres)																			
DN	EHD	3	6	9	12	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150
10	15	1.13	0.82	0.68	0.59	0.53	0.47	0.42	0.39	0.34	0.30	0.28	0.26	0.24	0.23	0.22	0.21	0.20	0.20	0.19	0.18
15	19	2.49	1.78	1.46	1.27	1.14	1.00	0.89	0.82	0.71	0.64	0.59	0.54	0.51	0.48	0.46	0.44	0.42	0.40	0.39	0.38
20	25	6.19	4.41	3.62	3.15	2.83	2.46	2.20	2.02	1.75	1.57	1.44	1.33	1.25	1.18	1.12	1.07	1.03	0.99	0.95	0.92
25	31	10.60	7.54	6.18	5.37	4.81	4.18	3.75	3.43	2.98	2.67	2.44	2.26	2.12	2.00	1.90	1.81	1.74	1.67	1.61	1.56
32	37	19.94	14.19	11.63	10.09	9.05	7.86	7.04	6.44	5.59	5.01	4.58	4.25	3.98	3.75	3.56	3.40	3.26	3.13	3.02	2.92
40	46	32.19	22.68	18.48	15.98	14.27	12.34	11.03	10.06	8.70	7.77	7.09	6.55	6.13	5.77	5.47	5.22	4.99	4.79	4.62	4.46
50	62	74.47	52.75	43.12	37.37	33.45	28.99	25.94	23.69	20.54	18.38	16.79	15.55	14.55	13.72	13.02	12.42	11.89	11.43	11.01	10.64
Notes:		1) Flow rates based on Standard Conditions of 21C and 1 bar. 2) Flow rates above include losses for four 90-degree bends and two end fittings. For tubing runs with additional bends or fittings, increase pipe length by the values given in Table G7.																			



**TABLE G3 – Approximate discharge through TracPipe® CSST in cubic metres per hour for BUTANE (relative density 2.07)**

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**TABLE G4 - Approximate pressure drop (mbar per metre) through TracPipe CSST at a given flow rate (cubic metres per hour), for NATURAL GAS (relative density 0.60)**

m <sup>3</sup> /hr	DN10	DN15	DN20	DN25	DN32	DN40	DN50
0.25	0.0121	0.0027	0.0004	0.0002	-	-	-
0.50	0.0534	0.0115	0.0018	0.0006	0.0002	0.0001	-
0.75	0.1272	0.0266	0.0042	0.0015	0.0004	0.0002	-
1.00	0.2357	0.0482	0.0076	0.0026	0.0007	0.0003	0.0001
1.25	0.3803	0.0765	0.0120	0.0041	0.0011	0.0005	0.0001
1.50	0.5621	0.1116	0.0175	0.0060	0.0017	0.0008	0.0001
1.75	0.7821	0.1535	0.0240	0.0082	0.0023	0.0010	0.0002
2.00	1.0413	0.2023	0.0315	0.0108	0.0030	0.0014	0.0002
2.25		0.2581	0.0402	0.0137	0.0038	0.0017	0.0003
2.50		0.3210	0.0499	0.0170	0.0047	0.0021	0.0004
2.75		0.3910	0.0607	0.0206	0.0057	0.0026	0.0004
3.00		0.4681	0.0725	0.0246	0.0068	0.0030	0.0005
3.25		0.5523	0.0855	0.0290	0.0080	0.0035	0.0006
3.50		0.6438	0.0996	0.0337	0.0094	0.0041	0.0007
3.75		0.7426	0.1147	0.0388	0.0108	0.0047	0.0008
4.00		0.8487	0.1310	0.0443	0.0123	0.0054	0.0009
4.25		0.9621	0.1484	0.0501	0.0139	0.0060	0.0010
4.50		1.0828	0.1669	0.0563	0.0156	0.0068	0.0012
4.75			0.1865	0.0628	0.0174	0.0075	0.0013
5.00			0.2072	0.0698	0.0193	0.0083	0.0014
5.25			0.2290	0.0771	0.0214	0.0092	0.0016
5.50			0.2520	0.0847	0.0235	0.0101	0.0017
5.75			0.2761	0.0928	0.0257	0.0110	0.0019
6.00			0.3013	0.1012	0.0280	0.0119	0.0021
6.25			0.3276	0.1100	0.0305	0.0130	0.0022
6.50			0.3551	0.1191	0.0330	0.0140	0.0024
6.75			0.3838	0.1287	0.0356	0.0151	0.0026
7.00			0.4135	0.1386	0.0384	0.0162	0.0028
7.25			0.4444	0.1489	0.0412	0.0174	0.0030
7.50			0.4765	0.1595	0.0442	0.0186	0.0032
7.75			0.5097	0.1706	0.0472	0.0198	0.0035
8.00			0.5440	0.1820	0.0504	0.0211	0.0037
8.25			0.5795	0.1938	0.0536	0.0224	0.0039
8.50			0.6162	0.2059	0.0570	0.0238	0.0042
8.75			0.6540	0.2185	0.0604	0.0252	0.0044
9.00			0.6929	0.2314	0.0640	0.0267	0.0047
9.25			0.7331	0.2447	0.0677	0.0281	0.0049
9.50			0.7743	0.2584	0.0715	0.0297	0.0052
9.75			0.8168	0.2724	0.0753	0.0312	0.0055
10.00			0.8604	0.2869	0.0793	0.0328	0.0058
12.00			1.2512	0.4161	0.1150	0.0471	0.0083
14.00				0.5699	0.1574	0.0639	0.0114
16.00				0.7483	0.2066	0.0833	0.0149
18.00				0.9515	0.2626	0.1051	0.0188
20.00				1.1796	0.3254	0.1295	0.0233
25.00					0.5125	0.2014	0.0365
30.00					0.7430	0.2889	0.0526
35.00					1.0170	0.3920	0.0717
40.00						0.5106	0.0938
45.00						0.6447	0.1189
50.00						0.7942	0.1469
55.00						0.9591	0.1780
60.00						1.1393	0.2120
65.00							0.2490
70.00							0.2890
75.00							0.3320
80.00							0.3781
85.00							0.4271
90.00							0.4791
95.00							0.5341
100.00							0.5921

Notes: 1) Pressure drop information based on Standard Conditions of 21°C and 1 bar.  
2) Flow rates / pressure drop information above include losses for four 90-degree bends and two end fittings. For tubing runs with additional bends or fittings, increase pipe length by the values given in Table G7.

**TABLE G5 – Approximate pressure drop (mbar per metre) through TracPipe® CSST at a given flow rate (cubic metres per hour), for PROPANE (relative density 1.52)**

m <sup>3</sup> /hr	DN10	DN15	DN20	DN25	DN32	DN40	DN50
0.25	0.0327	0.0072	0.0011	0.0004	0.0001	0.0001	-
0.50	0.1445	0.0301	0.0048	0.0016	0.0005	0.0002	-
0.75	0.3445	0.0696	0.0109	0.0038	0.0010	0.0005	0.0001
1.00	0.6382	0.1261	0.0197	0.0068	0.0019	0.0009	0.0001
1.25	1.0297	0.2001	0.0312	0.0106	0.0030	0.0013	0.0002
1.50	1.5219	0.2918	0.0454	0.0154	0.0043	0.0019	0.0003
1.75	2.1178	0.4014	0.0623	0.0212	0.0059	0.0026	0.0004
2.00	2.8195	0.5291	0.0819	0.0278	0.0077	0.0034	0.0006
2.25		0.6751	0.1044	0.0353	0.0098	0.0043	0.0007
2.50		0.8395	0.1296	0.0438	0.0121	0.0053	0.0009
2.75		1.0225	0.1576	0.0532	0.0147	0.0064	0.0011
3.00		1.2242	0.1885	0.0635	0.0176	0.0076	0.0013
3.25		1.4446	0.2221	0.0748	0.0207	0.0089	0.0015
3.50		1.6839	0.2587	0.0870	0.0241	0.0103	0.0018
3.75		1.9423	0.2981	0.1001	0.0277	0.0118	0.0020
4.00		2.2197	0.3403	0.1142	0.0316	0.0134	0.0023
4.25		2.5162	0.3854	0.1292	0.0358	0.0151	0.0026
4.50		2.8321	0.4335	0.1452	0.0402	0.0170	0.0030
4.75			0.4844	0.1622	0.0449	0.0189	0.0033
5.00			0.5382	0.1800	0.0498	0.0209	0.0036
5.25			0.5949	0.1989	0.0550	0.0230	0.0040
5.50			0.6546	0.2187	0.0605	0.0252	0.0044
5.75			0.7172	0.2394	0.0662	0.0276	0.0048
6.00			0.7827	0.2612	0.0722	0.0300	0.0053
6.25			0.8512	0.2838	0.0785	0.0325	0.0057
6.50			0.9226	0.3075	0.0850	0.0351	0.0062
6.75			0.9970	0.3321	0.0918	0.0378	0.0067
7.00			1.0743	0.3577	0.0989	0.0407	0.0072
7.25			1.1546	0.3842	0.1062	0.0436	0.0077
7.50			1.2378	0.4117	0.1138	0.0466	0.0082
7.75			1.3241	0.4402	0.1216	0.0498	0.0088
8.00			1.4133	0.4696	0.1297	0.0530	0.0094
8.25			1.5055	0.5000	0.1381	0.0563	0.0100
8.50			1.6008	0.5314	0.1468	0.0597	0.0106
8.75			1.6990	0.5638	0.1557	0.0633	0.0112
9.00			1.8002	0.5972	0.1649	0.0669	0.0119
9.25			1.9044	0.6315	0.1744	0.0706	0.0126
9.50			2.0116	0.6668	0.1841	0.0744	0.0133
9.75			2.1219	0.7031	0.1941	0.0784	0.0140
10.00			2.2352	0.7403	0.2044	0.0824	0.0147
12.00			3.2506	1.0738	0.2963	0.1182	0.0212
14.00				1.4706	0.4055	0.1604	0.0289
16.00				1.9311	0.5322	0.2089	0.0378
18.00				2.4555	0.6765	0.2638	0.0480
20.00				3.0442	0.8383	0.3249	0.0593
25.00					1.3206	0.5053	0.0928
30.00					1.9143	0.7250	0.1339
35.00					2.6202	0.9836	0.1826
40.00						1.2812	0.2388
45.00						1.6176	0.3027
50.00						1.9927	0.3741
55.00						2.4064	0.4531
60.00						2.8587	0.5398
65.00							0.6340
70.00							0.7359
75.00							0.8454
80.00							0.9626
85.00							1.0873
90.00							1.2198
95.00							1.3599
100.00							1.5076
Notes:	1) Pressure drop information based on Standard Conditions of 21°C and 1 bar. 2) Flow rates / pressure drop information above include losses for four 90-degree bends and two end fittings. For tubing runs with additional bends or fittings, increase pipe length by the values given in Table G7.						

**TABLE G6 – Approximate pressure drop (mbar per metre) through TracPipe® CSST at a given flow rate (cubic metres per hour), for BUTANE (relative density 2.07)**

m <sup>3</sup> /hr	DN10	DN15	DN20	DN25	DN32	DN40	DN50
0.25	0.0455	0.0099	0.0016	0.0005	0.0002	0.0001	0.0000
0.50	0.2012	0.0414	0.0065	0.0023	0.0006	0.0003	0.0000
0.75	0.4797	0.0957	0.0150	0.0051	0.0014	0.0007	0.0001
1.00	0.8886	0.1736	0.0271	0.0093	0.0026	0.0012	0.0002
1.25	1.4336	0.2755	0.0429	0.0146	0.0041	0.0018	0.0003
1.50	2.1190	0.4017	0.0623	0.0212	0.0059	0.0026	0.0004
1.75	2.9486	0.5525	0.0855	0.0290	0.0080	0.0036	0.0006
2.00		0.7283	0.1125	0.0381	0.0106	0.0046	0.0008
2.25		0.9292	0.1433	0.0484	0.0134	0.0058	0.0010
2.50		1.1555	0.1780	0.0600	0.0166	0.0072	0.0012
2.75		1.4073	0.2165	0.0729	0.0202	0.0087	0.0015
3.00		1.6849	0.2588	0.0870	0.0241	0.0103	0.0018
3.25		1.9883	0.3051	0.1025	0.0284	0.0121	0.0021
3.50		2.3177	0.3552	0.1192	0.0330	0.0140	0.0024
3.75		2.6732	0.4093	0.1372	0.0380	0.0161	0.0028
4.00			0.4673	0.1565	0.0433	0.0182	0.0032
4.25			0.5293	0.1771	0.0490	0.0206	0.0036
4.50			0.5953	0.1990	0.0551	0.0230	0.0040
4.75			0.6652	0.2222	0.0615	0.0256	0.0045
5.00			0.7391	0.2467	0.0682	0.0284	0.0050
5.25			0.8170	0.2725	0.0754	0.0312	0.0055
5.50			0.8989	0.2997	0.0828	0.0343	0.0060
5.75			0.9849	0.3281	0.0907	0.0374	0.0066
6.00			1.0749	0.3578	0.0989	0.0407	0.0072
6.25			1.1689	0.3889	0.1075	0.0441	0.0078
6.50			1.2670	0.4213	0.1164	0.0477	0.0084
6.75			1.3691	0.4550	0.1257	0.0514	0.0091
7.00			1.4753	0.4901	0.1354	0.0552	0.0098
7.25			1.5856	0.5264	0.1454	0.0592	0.0105
7.50			1.6999	0.5641	0.1558	0.0633	0.0112
7.75			1.8183	0.6031	0.1666	0.0675	0.0120
8.00			1.9409	0.6435	0.1777	0.0719	0.0128
8.25			2.0675	0.6852	0.1892	0.0764	0.0136
8.50			2.1983	0.7282	0.2010	0.0811	0.0145
8.75			2.3331	0.7726	0.2133	0.0859	0.0153
9.00			2.4721	0.8183	0.2258	0.0908	0.0162
9.25			2.6153	0.8653	0.2388	0.0959	0.0171
9.50				0.9137	0.2521	0.1011	0.0181
9.75				0.9634	0.2658	0.1064	0.0191
10.00				1.0144	0.2799	0.1119	0.0201
12.00				1.4714	0.4057	0.1605	0.0289
14.00				2.0151	0.5553	0.2177	0.0395
16.00				2.6460	0.7289	0.2836	0.0516
18.00					0.9264	0.3580	0.0654
20.00					1.1481	0.4411	0.0808
25.00					1.8086	0.6860	0.1266
30.00					2.6217	0.9842	0.1827
35.00						1.3353	0.2491
40.00						1.7393	0.3258
45.00						2.1959	0.4129
50.00						2.7051	0.5103
55.00							0.6181
60.00							0.7363
65.00							0.8649
70.00							1.0038
75.00							1.1532
80.00							1.3130
85.00							1.4833
90.00							1.6639
95.00							1.8550
100.00							2.0566
Notes:	1) Pressure drop information based on Standard Conditions of 21°C and 1 bar.						
	2) Flow rates / pressure drop information above include losses for four 90-degree bends and two end fittings. For tubing runs with additional bends or fittings, increase pipe length by the values given in Table G7.						

<b>TABLE G7. Equivalent length of pipe (in metres) to be added to a pipe run for additional 90 degree bends and tees</b>		
<b>TracPipe size</b>	<b>90 Degree Bend</b>	<b>Tee</b>
<b>DN</b>	<b>metres</b>	<b>metres</b>
10	0.3	0.5
15	0.3	0.5
20	0.3	0.5
25	0.3	0.5
32	0.5	1.0
40	0.5	1.0
50	0.65	1.5

[illegible]