IGEM
Institution of
Gas Engineers & Managers

IGEM/UP/1B Edition 3 (with Amendments October 2012)
Communication 1759

Tightness testing and direct purging of small Liquefied Petroleum Gas/Air, Natural Gas and Liquefied Petroleum Gas installations

Founded 1863
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Patron: Her Majesty the Queen

IGEM
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IGEM STANDARDS

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SECTION 1 : INTRODUCTION

1.1 This Standard supersedes IGE/UP/1B Edition 2, Communication 1714, which is obsolete and BS 5482-1, which is partially superseded.

1.2 This Standard has been drafted by a Panel appointed by the Institution of Gas Engineers and Managers' (IGEM's) Gas Utilization Committee, subsequently approved by that Committee and published by the authority of the Council of the Institution.

1.3 IGE/UP/1 Edition 2 deals with all aspects of strength and tightness testing and direct purging of selected 1st, 2nd and 3rd family gases within its wide scope and at a maximum operating pressure (MOP) not exceeding 16 bar.

IGE/UP/1A Edition 2 deals with the special case of strength and tightness testing and direct purging of volumes not exceeding 1 m^3 and operating pressure (OP) not exceeding 40 mbar and using Natural Gas (NG).

IGEM/UP/1B Edition 3 deals with all aspects of tightness testing and direct purging of small Liquefied Petroleum Gas/Air (LPG/Air), NG and Liquefied Petroleum Gas (LPG) installations with or without a meter of maximum badged capacity not exceeding 16 $m^3\ h^{-1}$ and supply MOP (MOP_u) not exceeding 2 bar.

Note: In the United Kingdom LPG/Air is typically 1st family gas, NG is 2nd family gas and LPG is a 3rd family gas. NG is lighter than air and LPG/Air and LPG are both heavier than air.

IGEM/UP/1B Edition 3 does cover installations on Caravan and Leisure Accommodation Vehicles (LAVs). For tightness testing of small LPG installations in boats, yachts, crafts and other vessels, PD 5482-3 or BS EN ISO 10239 apply, as appropriate. For volumes exceeding 0.035 m^3, IGE/UP/1 Edition 2 applies.

IGEM/UP/1C deals with strength testing, tightness testing and direct purging of meter installations (as defined in IGEM/G/1), containing either NG or LPG, of volume not exceeding 1 m^3 and MOP not exceeding 7 bar.

Note: IGEM/UP/1C is most useful for those NG or LPG meter installations that have a means of isolation on the outlet, are out of scope of IGEM/UP/1B and where there is no desire to test the installation pipework downstream of the meter installation.

Figure 1 will assist in selecting the appropriate standard.

Note: For a new system of installation pipework, the onus is on the designer to establish both the maximum incidental pressure (MIP) and MOP. For an existing system of installation pipework, the onus is on the designer/owner of the installation to ensure that any increase in pressure within the installation will not result in OP exceeding MOP of the system and on the gas transporter/meter asset manager (GT/MAM) to ensure that any change in their pressure regimes due to fault conditions will not jeopardise the safety of the downstream installation. This involves effective communication between the GTs/MAMs and installation designers/owners.

1.4 This Standard makes use of the terms "must", "shall" and "should" when prescribing particular requirements. Notwithstanding Sub-Section 1.7:

- the term "must" identifies a requirement by law in Great Britain (GB) at the time of publication
- the term "shall" prescribes a requirement that, it is intended, will be complied with in full and without deviation
- the term "should" prescribes a requirement that, it is intended, will be complied with unless, after prior consideration, deviation is considered to be acceptable.

Such terms may have different meanings when used in legislation, or Health and Safety Executive (HSE) Approved Codes of Practice (ACoPs) or guidance, and

reference needs to be made to such statutory legislation or official guidance for information on legal obligations.

1.5 The primary responsibility for compliance with legal duties rests with the employer. The fact that certain employees, for example "responsible engineers", are allowed to exercise their professional judgement does not allow employers to abrogate their professional responsibilities. Employers must:

- have done everything to ensure, so far as is reasonably practicable, that there are no better protective measures that can be taken other than relying on exercise of professional judgement by "responsible engineers"
- have done everything to ensure, so far as is reasonably practicable, that "responsible engineers" have the skills, training, experience and personal qualities necessary for the proper exercise of professional judgement
- have systems and procedures in place to ensure that the exercise of professional judgement by "responsible engineers" is subject to appropriate monitoring and review
- not require "responsible engineers" to undertake tasks which would necessitate the exercise of professional judgement that is beyond their competence. There should be written procedures defining the extent to which "responsible engineers" can exercise their professional judgement. When "responsible engineers" are asked to undertake tasks that deviate from this, they should refer the matter for higher review.

1.6 It is widely accepted that the majority of accidents at work generally are in some measure attributable to human as well as technical factors in the sense that actions by people initiated or contributed to the accidents, or people might have acted better to avert them.

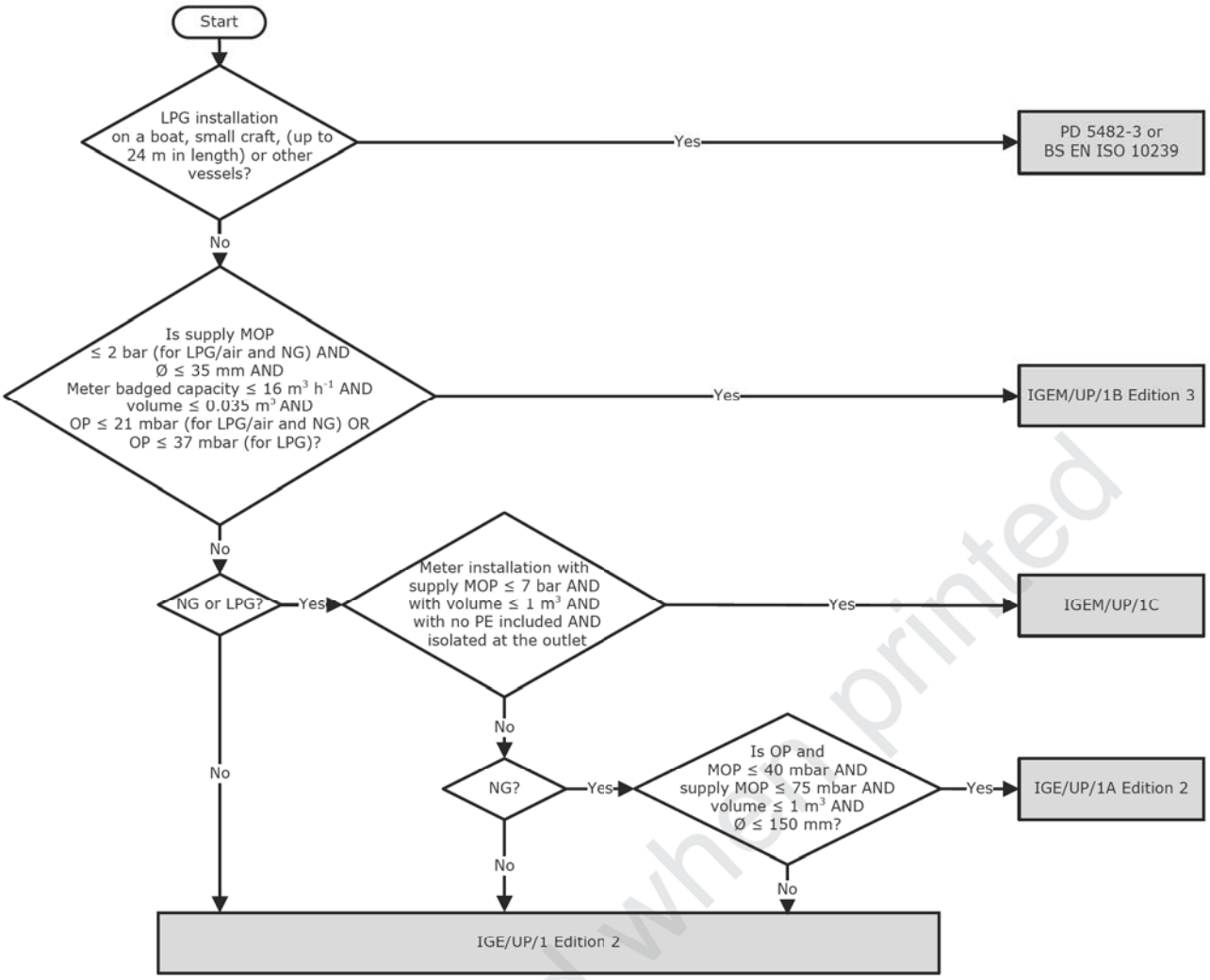
It is therefore necessary to give proper consideration to the management of these human factors and the control of risk. To assist in this, it is recommended that due cognisance be taken of HSG48 and HSG65.

1.7 Notwithstanding Sub-Section 1.4, this Standard does not attempt to make the use of any method or specification obligatory against the judgement of the responsible engineer. Where new and better techniques are developed and proved, they should be adopted without waiting for modification to this Standard. Amendments to this Standard will be issued when necessary, and their publication will be announced in the Journal of the Institution and other publications as appropriate.

1.8 Requests for interpretation of this Standard in relation to matters within their scope, but not precisely covered by the current text, should be addressed in writing to Technical Services, IGEM, IGEM House, High Street, Kegworth, Derbyshire, DE74 2DA and will be submitted to the relevant Committee for consideration and advice, but in the context that the final responsibility is that of the engineer concerned. If any advice is given by or on behalf of IGEM, this does not relieve the responsible engineer of any of his or her obligations.

1.9 This Standard was published in March 2012.

1.10 The Amendments issued in October 2012 are incorporated within this electronic version. The start and finish of additional or substituted text is given by the symbols ➢➣.

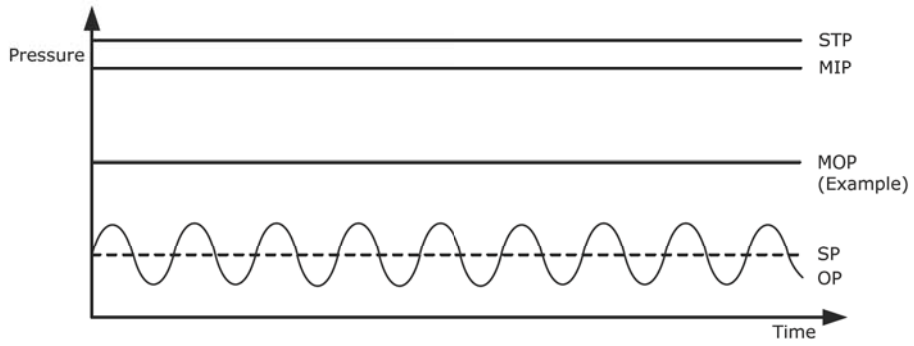


≤	less than or equal to	MOP	Maximum Operating Pressure	mbar	millibar
∅	nominal diameter	NG	Natural Gas	mm	millimetre
V	volume	OP	Operating pressure	m^3	cubic metre
		LPG	Liquefied petroleum gas		

Note 1: If it is preferred IGE/UP/1 Edition 2 can be used rather than IGE/UP/1A Edition 2, IGEM/UP/1B Edition 3 or IGEM/UP/1C or PD 5482-3 or BS EN ISO 10239. It is necessary to check the scope of referenced Standards before proceeding.

Note 2: Operating pressures listed are nominal for the installations and will vary around the regulator set point (see Figure 2).

FIGURE 1 - ALGORITHM TO SELECT TESTING AND PURGING STANDARDS



STP	=	Strength test pressure
MIP	=	Maximum incidental pressure (e.g., as declared by the GT/MAM/Supplier)
OP	=	Operating pressure
MOP	=	Maximum operating pressure
SP	=	Set point of the regulator.

Note: This is extracted from IGEM/TD/13 and simplified for the purposes of IGEM/UP/1B.

FIGURE 2 - RELATIVE PRESSURE LEVELS

SECTION 2 : SCOPE

2.1 This Standard applies to LPG/Air, NG, and LPG installations as illustrated in Figure 3.

2.2 This Standard applies to any section of installation pipework, including meters, having the following:

- MOP at the outlet of the emergency control valve (ECV) not exceeding 2 bar for NG and LPG/Air and
- a nominal bore of not greater than 35 mm (DN32, R1¼) and
- a maximum badged capacity through the primary meter of not exceeding 16 $m^3 h^{-1}$ and
- a maximum installation volume (IV) supplying an individual dwelling or non domestic premises of 0.035 m^3 and
- LPG/Air Installations - OP at the outlet of the primary meter and any point in the section to be tested not exceeding 21 mbar or
- NG Installations - OP at the outlet of the primary meter and any point in the section to be tested not exceeding 21 mbar or
- LPG Installations - OP at the outlet of the final stage regulator and any point in the section to be tested not exceeding 37 mbar.

Note 1: There are some existing NG installations, where MOP_u exceeds 75 mbar that have been installed without the facility of a meter inlet valve (MIV). These installations are not within the scope of IGEM/UP/1B but advice on testing and purging is given in Appendix 4.

Note 2: Installations of larger volume are rare in domestic premises. However, if there is any doubt, it is advisable to calculate IV in accordance with Appendix 7 before using this Standard.

Note 3: LPG service pipework is not within scope of this Standard and is covered by UKLPG Code of Practice 22.

Note 4: Propane and Butane installations typically operate at 37 mbar and 28 mbar.

Note 5: The scope of this Standard limits the IV to 0.035 m^3. For example, the following installations have a volume less than 0.035 m^3:

- *25 m of 35 mm copper pipework (assuming U6 fitted)*
- *10 m of 35 mm copper pipework (assuming U16 fitted)*
- *20 m of 32 mm corrugated stainless steel tube (CSST) pipework (assuming U6 fitted)*
- *8 m of 32 mm CSST pipework (assuming U16 fitted).*

2.3 This Standard covers tightness testing and direct purging of pipework containing either LPG/Air, NG, or LPG.

Note 1: There are Standards for other installation locations which are not individual dwellings – PD 5482-3, or BS EN ISO 10239 or IGE/UP/1 apply, as appropriate (see Figure 1).

Note 2: Historically, BS 6891 (which preceded IGE/UP/1B Edition 1 for "soundness testing") and IGE/UP/1B Edition 1 and 2 have not required strength testing. This philosophy continues for IGEM/UP/1B Edition 3 (for components of MOP ≤ 75 mbar) as there is no significant case evidence for introducing strength testing, the risk associated with failure of integrity is comparatively low (due to low energy contained) and the available materials and methods of construction are such as to give confidence that integrity will be assured. Steps are given in the tightness test section to check that jointing has been correctly carried out.

2.4 This Standard applies to tightness testing in the following circumstances:

- new installations
- alteration to, replacement of, or re-use of, existing installations
- new extensions to existing pipework
- prior to any work on existing installations
- where there is a known or suspected gas escape
- where there has been a complete loss of supply pressure i.e. upstream of the ECV, or of installation pressure
- routine testing of existing installations
- immediately before purging of installations (except when taking components permanently out of service).

Note: This Standard may not need to be applied when carrying out routine maintenance, such as servicing.

2.5 This Standard applies to direct purging in the following circumstances:

- new installations
- alteration to, replacement of, or re-use of, existing installations
- new extensions to existing installations
- where there has been a complete loss of installation pressure
- where there is the possibility of air being present in an installation.

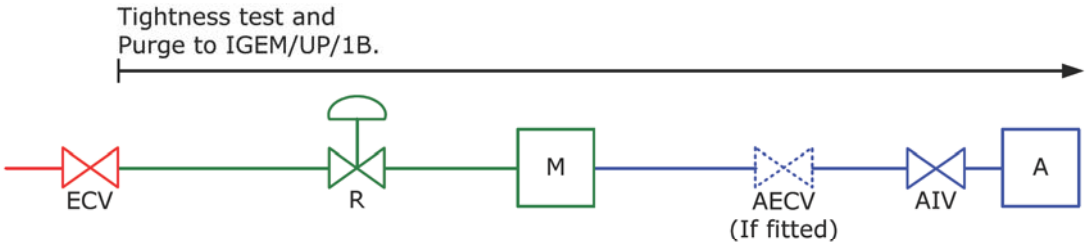
Note 1: This Standard may not need to be applied when carrying out routine maintenance, such as servicing.

Note 2: This Standard refers throughout to purging when there is the possibility air may be present in the gas installation. The principles may be used when there could be other gases in the installation other than the gas with which the installation is currently supplied, for example when an installation is converted from one fuel gas to another, but suitable adjustments to stated parameters and procedures will need to be considered by a competent person.

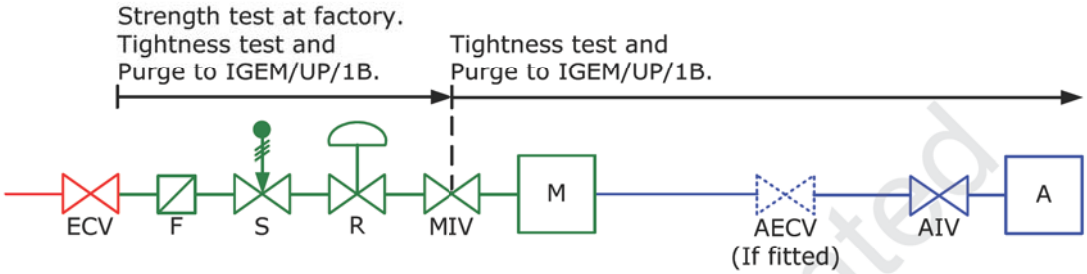
2.6 All pressures quoted are gauge pressures unless otherwise stated.

2.7 Italicised text is informative and does not represent formal requirements.

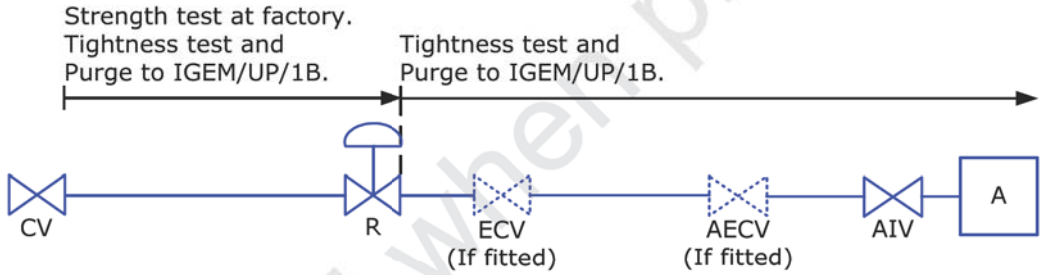
2.8 Appendices are informative and do not represent formal requirements unless specifically referenced in the main sections via the prescriptive terms "must", "shall" or "should".



(a) **Typical installation. $MOP_u \leq 75$ mbar**



(b) **Typical installation. 75 mbar < $MOP_u \leq 2$ bar**



(c) **Typical LPG cylinder installation**

ECV	emergency control valve		Network
CV	cylinder valve		meter installation
F	filter		installation pipework
R	regulator	<	less than
MIV	meter inlet valve	≤	less than or equal to
M	meter		
A	appliance		
AECV	additional emergency control valve		
AIV	appliance isolation valve		
MOP_u	supply MOP		
S	safety device (see BS 6400).		

Note 1: Certain installations will incorporate an under pressure shut-off device.

Note 2: A meter installation may not be fitted on LPG installations.

Note 3: Where a component or sub-assembly (meter installation component, meter "skid" unit, etc.) has been pre-tested and not subsequently modified (such as by cutting threads or welding) and has appropriate certificates of conformity available, the strength testing of such a component/assembly need not be undertaken but a visual examination of joints, general condition, suitability, etc. is recommended prior to installing and subsequent tightness testing as for a new installation. Permanent marking, for example by manufacturer's badging/stamping, may be deemed as certification of conformity.

FIGURE 3 - TYPICAL INSTALLATIONS

SECTION 3 : LEGAL AND ALLIED CONSIDERATIONS

3.1 This Standard is set out against a background of legislation in force in the GB at the time of publication. Similar considerations are likely to apply in other countries and reference to appropriate national legislation will be necessary.

Note: For example, in Northern Ireland there is a different version of the Gas Safety (Installation and Use) Regulations (GS(I&U)R), see Appendix 2.

Appendix 2 lists legislation, guidance notes and Standards etc. which are identified within this Standard as well as further items of legislation that may be applicable.

Where Standards are quoted, equivalent national or international Standards, etc. equally may be appropriate.

Unless otherwise stated, the latest version of the referenced document should be used.

3.2 Health and safety legislation must be observed, including those requirements concerned with the duties of employers towards both their employees and other persons, including members of the public whose safety may be affected.

In the absence of specific legislation, it is essential that installations are designed, constructed, installed, operated and maintained so as to be safe.

3.3 Any person engaged in tightness testing or purging of pipework must be a competent person.

Note: Any person carrying out the installation of gas pipework and associated fittings has to be competent to do so. Competence requires enough knowledge, practical skill and experience to carry out the job in hand safely with due regard to good working practice.

Where gas installation work is carried out in properties covered by the current GS(I&U)R, the person carrying out that work must be a "member of a class of persons" as specified by these Regulations.

At the time of publication of this Standard, the body with approval to operate, and which maintains, a register of businesses in the United Kingdom (UK), Isle of Man and Guernsey who are "members of a class of persons" is the Gas Safe Register. Thus, it is essential that all businesses or self-employed gas installers be registered with Gas Safe Register if GS(I&U)R apply.

Where MOP_u exceeds 75 mbar, the requirements for competency to do work are set at a higher level than for installations where MOP_u does not exceed 75 mbar.

3.4 Consideration shall be given to the environmental impact of methane and other hydrocarbons in the atmosphere. Releases should be minimised to levels required to achieve prescribed purge end points.

SECTION 4 : TEST EQUIPMENT AND CRITERIA

4.1 TEST EQUIPMENT

4.1.1 Any gauge or gas detector shall:

- be suitably ranged
- if appropriate, be zeroed at atmospheric pressure at the start of each test
- be appropriate for the gas under test
- be suitable for the atmosphere in which they are to be used
- be calibrated for the gas on which it will be used in accordance with the manufacturer's instructions.

Any electronic gauge or gas detector shall be calibrated at least every 12 months, or otherwise as specified by the manufacturer, and a calibration certificate should be available.

Note: Fluid (water) gauges do not require calibration but do need to be kept well maintained.

4.1.2 Fluid (water) gauges shall be capable of being read to 0.5 mbar and any electronic gauge shall be capable of being read to 0.1 mbar.

Note: The scale on the gauge is not indicative of gauge accuracy.

Electronic gauges shall register to at least one decimal place.

4.1.3 Any electronic gauge shall:

- be operated within the manufacturer's specification for ambient temperature
- be stabilized at the ambient temperature as specified by the gauge manufacturer, prior to the test being carried out.

Note: Electronic gauges may be prone to drifting due to changes in ambient temperature.

4.1.4 In the following situations, electronic test equipment shall be certified for use in a hazardous area (intrinsically safe):

- when seeking the source of a known or suspected gas escape, using a gas detector
- where it is known or suspected that the location in which the equipment is to be used could contain a flammable atmosphere that may be ignited by the use of equipment that is not certified for use in hazardous areas
- when a hazardous area is imposed by the gas installation or other installations / situations that require the use of such certified equipment and the equipment is to be used within the designated zone of that hazardous area
- when it is anticipated that the area in which the equipment will be located will be left unattended at any time during the test/purge
- when a risk assessment indicates that the use of certified equipment is essential.

Note: Fluid (water) gauges can always be used if there is any doubt about the use of electronic pressure gauges that are not certified for use in hazardous areas.

Use of electronic pressure gauges that are not certified for use in hazardous areas, placed in the open air or in well ventilated environments and located in a position that will not cause the ignition of any flammable atmospheres may be acceptable for a number of the above situations, subject to a suitable risk assessment.

A hazardous area is an area in which explosive mixtures are, or may be expected to be, in quantities such as to require special precautions for the construction, installation and use of electrical apparatus or other sources of ignition. Detailed guidance on hazardous areas relating to gas installations can be found in IGEM/SR/25 and IGEM/UP/16.

4.1.5 Any equipment, including the sample line, shall be checked for integrity immediately prior to measurement.

Only proprietary leak detection fluids (LDFs) shall be used that comply with BS EN 14291 and should be compatible with the materials to which it is to be applied. LDFs containing more than 30 parts per million of halogens shall not be used on stainless steel components. LDFs containing ammonia shall not be used on copper or brass components.

To avoid subsequent corrosion, care shall be taken to ensure that LDF is wiped off pipe and fittings after use.

Note 1: A pH value of 7.0 or less indicates absence of ammonia.

Note 2: Detergents and soap solutions such as "washing-up" liquids are not suitable.

Note 3: Certain chemicals (for example, ammonia and chlorides) used in some LDFs can cause unwanted effects such as stress corrosion cracking.

4.2 TEST CRITERIA

The tightness testing procedures listed in this Standard vary depending on the type of fuel.

The test criteria for each type of fuel is dependent on a number of factors including whether the installation is new or existing.

4.2.1 For "new" installations and for all "let-by tests", the pass criteria shall be "no perceptible movement" during the test period.

Note: A movement of 0.25 mbar or less on a fluid (water) gauge is considered to be "not perceptible". Therefore, if the gauge is seen to move, it can be inferred that the pressure within the installation has altered by more than 0.25 mbar.

It follows that, where a gauge that can register perceptible movement of less than 0.25 mbar i.e. an electronic gauge, is used, the pass criteria of "no perceptible movement" has to be considered to be a maximum of 0.25 mbar except for those gauges that read to one decimal place when "no perceptible movement" is considered a maximum of 0.2 mbar.

4.2.2 For "existing" installations, the pass criteria is based on a number of factors including, but not necessarily limited to, fuel type, meter designation and pipe diameter. For each fuel, consideration shall be given to the appropriate values listing the maximum permissible pressure drop allowed during the tightness test period taking into account the parameters of the installation being tested.

SECTION 5 : TIGHTNESS TESTING

5.1 STRENGTH TESTING

For any part of an installation of MOP not exceeding 75 mbar, there is no requirement to carry out strength testing on site provided it can be isolated from an upstream installation of MOP_u exceeding 75 mbar.

For any part of an installation upstream of either a MIV (where a meter is fitted) or final stage regulator (where no meter is fitted), and downstream of an ECV, of MOP exceeding 75 mbar, the components shall be:

- pre-assembled and strength tested by the manufacturer; or
- strength tested in accordance with IGE/UP/1.

5.2 GENERAL

Tightness testing is carried out to ensure that an installation has a leak rate below a level which could ever be considered to form a hazard caused by the size of the escape, assuming adequate ventilation has been provided.

On a new installation, the test is to verify that, within tolerances caused by the finite time for testing and the accuracy of instruments, pipework is, nominally, gas tight i.e. has, nominally, zero leakage.

For existing installations, the test is to verify that pipework is, nominally, gas tight within acceptable limits as the test may be against isolation valves that may be relatively old and worn, so a defined maximum level of leakage is permitted.

After a tightness test, a smell of gas or indication of gas on a gas detector is not acceptable.

5.2.1 MOP_u shall be determined. If it exceeds 75 mbar, it shall be verified that the relevant components have been pre-assembled by the manufacturer and strength tested in accordance with IGE/UP/1 (see clause 5.1).

Note: See Appendix 5 for guidance on recognising typical medium pressure installations.

5.2.2 Upon completion of any work that may have affected the gas tightness of an installation, the installation must be tightness tested. Fuel gas or air shall be used as the test medium. If a section of pipework contains fuel gas, it shall be pressurised with fuel gas.

Note: Where a new installation is connected to a gas supply, it is recommended that the installation is pressurised via the fuel gas supply.

5.2.3 Before testing, and as far as is reasonably practicable, all newly-made joints shall be inspected visually to ensure that they have been made correctly.

Note: Where a protective coating is to be applied to joints or pipework on site, it is essential that this is not applied until the pipework has been tested and deemed to be gas tight.

5.2.4 Checks shall be made to ensure that there are no open ends on the installation. If any are found, they must be sealed with an appropriate fitting.

5.3 TIGHTNESS TESTING PROCEDURES

5.3.1 LPG/Air mixtures

5.3.1.1 *New and existing installations*

The following procedure assumes that the installation is connected to a live gas supply (see Figure 4 for a summary of the procedure). Where the installation is not connected to a live gas supply the installation shall be tightness tested with air (see Appendix 3).

The following test procedure shall be carried out:

(a) Visually inspect the installation and ensure all sections to be tested are connected, all joints are correctly made and any exposed gas ways (for example, open ends) on the installation are sealed with an appropriate fitting. Check any appliance(s) and ensure the appliance isolation valve (AIV) is open and all burner control taps and any pilot burner supplies are turned off. On a cooker with a fold down lid, lift the lid to the fully open position to ensure that any safety shut-off valve (SSOV) on the gas installation is in the open position.

(b) Turn off the gas installation at the appropriate valve as follows:

- for $MOP_u \leq 75$ mbar, the ECV/AECV
- for $MOP_U > 75$ mbar, the MIV, in which case ensure the ECV is open.

Note: Unless stated otherwise throughout the remainder of this LPG/Air testing procedure the ECV, AECV or MIV that is immediately upstream of the section being tested and is being turned on/off during testing will be referred to as the 'supply control valve'.

For installations with a $MOP_U > 75$ mbar where work involves a new meter installation, a replacement meter installation, a replacement regulator or where the work may have affected the gas tightness of the installation between the ECV and the MIV ensure that all connections between these points have been tightness tested with LDF immediately on opening the ECV.

For installations with a $MOP_U > 75$ mbar where an MIV is not fitted see Appendix 4.

(c) Connect the pressure gauge to a suitable pressure test point on the installation.

(d) Carry out a let-by test of the closed supply control valve as follows:

- adjust the pressure to between 7 and 10 mbar
- for $MOP_u > 75$ mbar, ensure the regulator on the inlet of the MIV is activated
- close the valve, and note the gauge reading.

Note: If there is an under pressure shut off (UPSO) valve on the outlet of the supply control valve, this may close at these test pressures. In this case, once the pressure has been adjusted to the chosen pressure, operate the UPSO reset to release any trapped upstream pressure, balancing the pressures either side of the device, then allow it to re-shut. There may be a small sudden rise in the gauge reading as the upstream pressure is released into the downstream pipework. If the gauge reading rises and remains higher than 10 mbar then this process will need to be repeated until the gauge reads and remains at the chosen test pressure.

If the pressure requires reducing to achieve the required test pressure at this stage or any stage in the tightness testing process then any potential LPG/air mixtures that are to be released will need to be vented to a safe area. See clause 6.3.1 (a) for guidance on the necessary safety precautions to be taken.

Check for any perceptible movement (rise) of the gauge reading (see clause 4.2.2) over the next 1 minute period.

Note: If the action documented above in relation to any UPSO was necessary, then the UPSO reset will need to be operated again at the end of the 1 minute let-by period, before the final reading taken is considered. A momentary movement of the gauge while operating the UPSO may be observed due to the diaphragm moving.

If there is no perceptible movement of the gauge reading the valve shall be deemed to have passed the test. Otherwise, the valve shall be deemed to have failed the test.

If the valve fails the test the cause shall be investigated and rectified.

In this situation the valve shall be checked for let-by by disconnecting its outlet union and applying LDF to the valve barrel or ball.

If let-by is confirmed on an ECV connected to the end of a LPG/Air service pipe or a MIV the gas supplier shall be immediately notified to enable them to arrange an effective repair. On no account shall anyone other than an authorised operative working on behalf of the gas supplier attempt to remove, repair or dismantle the ECV or MIV.

In any event, if let-by is confirmed, the valve shall be repaired/replaced before repeating this let-by test and proceeding with the tightness test.

If the repair cannot be completed, the installation must be made safe by disconnecting the installation, as appropriate, and sealing all open ends with an appropriate fitting and suspending further tests.

Note: If the valve appears satisfactory but there is still an increase in the pressure reading on the gauge during this period, the pressure and/or temperature within the installation may be stabilising. Time will need to be allowed until a stable reading is obtained. Once a stable reading is obtained this stage in the test procedure will have to be repeated. A major decrease in pressure is probably attributable to an escape on the installation that will need to be rectified before restarting the test.

(e) Slowly raise the pressure in the installation to the tightness test pressure (TTP) indicated in Table 1 by opening the appropriate supply control valve(s) then turn off the valve(s).

NOMINAL OPERATING PRESSURE	**TTP** (See Note 1)
14 mbar	13 to 14 mbar (See Note 2)
21 mbar	20 to 21 mbar (See Note 3)

Note 1: Avoid higher pressures to prevent regulator lock-up.

Note 2: If whilst raising the pressure to the test pressure it were to exceed 14 mbar but not exceed 16 mbar re-adjust the pressure to between 13 and 14 mbar. If the pressure were to exceed 16 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before raising the pressure to between 13 and 14 mbar. This helps to ensure that the regulator is not locked-up during the tightness test.

Note 3: If whilst raising the pressure to the test pressure it were to exceed 21 mbar but not exceed 23 mbar re-adjust the pressure to between 20 and 21 mbar. If the pressure were to exceed 23 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before raising the pressure to between 20 and 21 mbar. This helps to ensure that the regulator is not locked-up during the tightness test.

TABLE 1 - TTP FOR LPG/AIR INSTALLATIONS

(f) Allow 1 minute for the pressure and temperature within the installation to stabilise, if necessary, at the end of the stabilisation period re-adjust the pressure to the appropriate TTP. If the supply control valve has been turned on to re-adjust the pressure then turn off the valve.

The test procedure shall not proceed until a stable reading is obtained.

Note: There may still be a slight increase or decrease in the pressure reading on the gauge during this period as the installation stabilises. Further time may need to be allowed until a stable reading is obtained.

(g) Check for any perceptible movement (fall) of the gauge reading (see clause 4.2.2) over the next 2 minute period.

For all new installations (with or without appliances connected) or existing installations where no appliances are connected, if there is no perceptible movement (fall) of the gauge reading and there is no smell of gas the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

For existing installations where appliances are connected, if the pressure drop does not exceed the values given in Table 2 and there is no smell of gas, the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

TYPE OF INSTALLATION		
METER DESIGNATION	**PIPEWORK DIAMETER**	**MAXIMUM PERMISSIBLE PRESSURE DROP**
No Meter ECV/AECV Only *(e.g. flat)*	≤ 35 mm	1.5 mbar
Diaphragm ≤ 6 $m^3 h^{-1}$ (e.g. U6, G4)	≤ 35 mm	1.5 mbar
Diaphragm > 6 $m^3 h^{-1}$ ≤ 16 $m^3 h^{-1}$ (e.g. U16, G10)	≤ 35 mm	0.5 mbar
Key: ≤ less than or equal to > greater than		

TABLE 2 - MAXIMUM PERMISSIBLE PRESSURE DROPS FOR AN INDIVIDUAL DWELLING WITH APPLIANCES CONNECTED (LPG/Air)

Note: The maximum permissible pressure drops given relate to the average volume of pipework in a domestic-sized installation. The drops reflect the differing internal volumes of the different meter types.

For new installations incorporating existing appliances, the new part(s) of the installation will need to be gas tight to the tolerance, no perceptible movement of the gauge and no smell of gas, the pressure drops given in Table 2 may be allowed on an existing appliance(s).

Where multiple dwellings exist on a premises and each dwelling includes an ECV/AECV, for example in a flat, wherever possible, it is advisable to test the entire installation.

(h) If the installation fails the test, either:

- trace and repair the escapes(s) and re-test the installation, or
- the installation must be made safe by disconnecting appliance(s) or the relevant section of the installation, as appropriate, and sealing all open ends with an appropriate fitting.

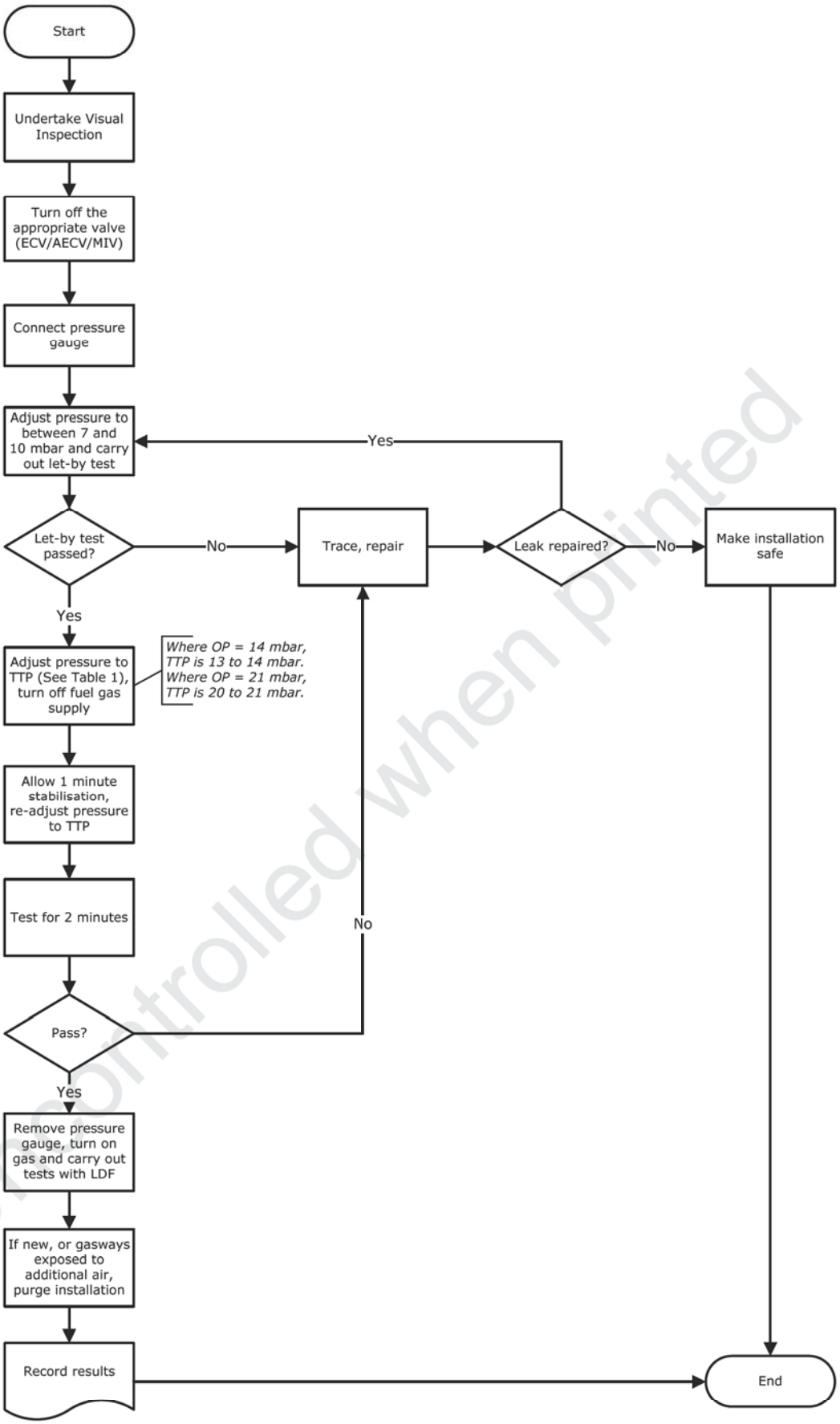
(i) Remove the pressure gauge and re-seal the test point. Slowly turn on the gas supply. Test the pressure test point, ECV/AECV outlet connection, regulator connections and, where appropriate, the MIV connections with LDF.

Note: Ensure that all connections between the ECV and regulator in the section that has been tightness tested are tested with LDF. These connections may be operating at higher pressures than the test pressure to which they have been subjected during the test and escapes may only become apparent at the higher pressures.

(j) Upon completion of the test:

- if the installation is new, or if any gas ways have been exposed to any additional air, or the work may have allowed additional air into the installation by any other means purge the installation in accordance with Section 6 and then proceed to step (k); or
- if the installation is existing and there is no possibility that any additional air may have been allowed into the installation then proceed to step (k).

(k) Record the test results and, where appropriate, inform the responsible person.



Note: This flow diagram does not show all the necessary steps and the full procedure in Section 5 applies.

FIGURE 4 - FLOW DIAGRAM FOR TIGHTNESS TESTING LPG/AIR INSTALLATIONS

5.3.2 **Natural Gas**

5.3.2.1 *New and existing installations*

The following procedure assumes that the installation is connected to a live gas supply (see Figure 5 for a summary of the procedure). Where the installation is not connected to a live gas supply the installation shall be tightness tested with air (see Appendix 3).

The following test procedure shall be carried out:

(a) Visually inspect the installation and ensure all sections to be tested are connected, all joints are correctly made and any exposed gas ways (for example, open ends) on the installation are sealed with an appropriate fitting. Check any appliance(s) and ensure the AIV is open and all burner control taps and any pilot burner supplies are turned off. On a cooker with a fold down lid, lift the lid to the fully open position to ensure that any SSOV on the gas installation is in the open position.

(b) Turn off the gas installation at the appropriate valve as follows:

- for $MOP_u \leq 75$ mbar, the ECV/AECV
- for $MOP_U > 75$ mbar, the MIV, in which case ensure the ECV is open.

Note: Unless stated otherwise throughout the remainder of this NG testing procedure the ECV, AECV or MIV that is immediately upstream of the section being tested and is being turned on/off during testing will be referred to as the 'supply control valve'.

For installations with a $MOP_U > 75$ mbar where work involves a new meter installation, a replacement meter installation, a replacement regulator or where the work may have affected the gas tightness of the installation between the ECV and the MIV ensure that all connections between these points have been tightness tested with LDF immediately on opening the ECV.

For installations with a $MOP_U > 75$ mbar where an MIV is not fitted see Appendix 4.

(c) Connect the pressure gauge to a suitable pressure test point on the installation.

(d) Carry out a let-by test of the closed supply control valve as follows:

- adjust the pressure to between 7 and 10 mbar
- for $MOP_u > 75$ mbar, ensure the regulator on the inlet of the MIV is activated
- close the valve, and note the gauge reading.

Note: If the pressure requires reducing to achieve the required test pressure at this stage or any stage in the tightness testing process then any potential NG or NG/air mixtures that are to be released will need to be vented to a safe area. See clause 6.3.2 (a) for guidance on the necessary safety precautions to be taken.

Check for any perceptible movement (rise) of the gauge reading (see clause 4.2.2) over the next 1 minute period.

If there is no perceptible movement of the gauge reading the valve shall be deemed to have passed the test. Otherwise, the valve shall be deemed to have failed the test.

If the valve fails the test the cause shall be investigated and rectified.

In this situation the valve shall be checked for let-by by disconnecting its outlet union and applying LDF to the valve barrel or ball.

If let-by is confirmed on an ECV connected to the end of a NG service pipe, the appropriate Gas Emergency Service Call Centre shall be immediately notified to enable them to arrange an effective repair. On no account shall anyone other than an authorised operative working on behalf of the Gas Emergency Service Provider (ESP) attempt to remove, repair or dismantle the valve.

If let-by is confirmed on a MIV, the MAM shall be immediately notified to enable them to arrange an effective repair. On no account shall anyone other than an authorised operative working on behalf of the MAM attempt to remove, repair or dismantle the valve.

In any event, if let-by is confirmed, the valve shall be repaired/replaced before repeating this let-by test and proceeding with the tightness test.

If the repair cannot be completed, the installation must be made safe by disconnecting the installation, as appropriate, and sealing all open ends with an appropriate fitting and suspending further tests.

Note: If the valve appears satisfactory but there is still an increase in the pressure reading on the gauge during this period, the pressure and/or temperature within the installation may be stabilising. Time will need to be allowed until a stable reading is obtained. Once a stable reading is obtained this stage in the test procedure will have to be repeated. A major decrease in pressure is probably attributable to an escape on the installation that will need to be rectified before restarting the test.

(e) Slowly raise the pressure in the installation to between 20 and 21 mbar by opening the appropriate supply control valve, then turn off the valve.

Note: Avoid higher pressures to prevent regulator lock-up.

If whilst raising the pressure to the test pressure it were to exceed 21 mbar but not exceed 23 mbar re-adjust the pressure to between 20 and 21 mbar. If the pressure were to exceed 23 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before raising the pressure to between 20 and 21 mbar. This helps to ensure that the regulator is not locked-up during the tightness test.

(f) Allow 1 minute for the pressure and temperature within the installation to stabilise, if necessary, at the end of the stabilisation period re-adjust the pressure to between 20 and 21 mbar. If the supply control valve has been turned on to re-adjust the pressure then turn off the valve.

The test procedure shall not proceed until a stable reading is obtained.

Note: There may still be a slight increase or decrease in the pressure reading on the gauge during this period as the installation stabilises. Further time may need to be allowed until a stable reading is obtained.

(g) Check for any perceptible movement (fall) of the gauge reading (see clause 4.2.2) over the next 2 minute period.

For all new installations (with or without appliances connected) or existing installations where no appliances are connected, if there is no perceptible movement (fall) of the gauge reading and there is no smell of gas the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

For existing installations where appliances are connected, if the pressure drop does not exceed the values given in Table 3 and there is no smell of gas, the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

TYPE OF INSTALLATION		
METER DESIGNATION	**PIPEWORK DIAMETER**	**MAXIMUM PERMISSIBLE PRESSURE DROP**
No Meter AECV Only (e.g. flat)	≤ 28 mm	8 mbar
	> 28 mm ≤ 35 mm	4 mbar
Ultrasonic ≤ 6 $m^3 h^{-1}$ (e.g. E6)	≤ 28 mm	8 mbar
	> 28 mm ≤ 35 mm	4 mbar
Diaphragm ≤ 6 $m^3 h^{-1}$ (e.g. U6, G4)	≤ 28 mm	4 mbar
	> 28 mm ≤ 35 mm	2.5 mbar
Diaphragm > 6 $m^3 h^{-1}$ ≤ 16 $m^3 h^{-1}$ (e.g. U16, G10)	≤ 35 mm	1 mbar
Key: ≤ less than or equal to > greater than		

TABLE 3 - MAXIMUM PERMISSIBLE PRESSURE DROPS FOR AN INDIVIDUAL DWELLING WITH APPLIANCES CONNECTED (NG)

Note: The maximum permissible pressure drops given relate to the average volume of pipework in a domestic-sized installation. The drops reflect the differing internal volumes of the different meter types.

For new installations incorporating existing appliances, the new part(s) of the installation need to be gas tight to the tolerance, no perceptible movement of the gauge and no smell of gas, the pressure drops given in Table 3 may be allowed on an existing appliance(s).

Where an installation to be tested includes an AECV, but there is no meter, for example in a flat where the gas supply is not individually metered, the pressure drop value is appropriate to the small volume of installation. However, wherever possible, it is advisable to test the entire installation.

(h) If the installation fails the test, either:

- trace and repair the escapes(s) and re-test the installation, or
- the installation must be made safe by disconnecting appliance(s) or the relevant section of the installation, as appropriate, and sealing all open ends with an appropriate fitting.

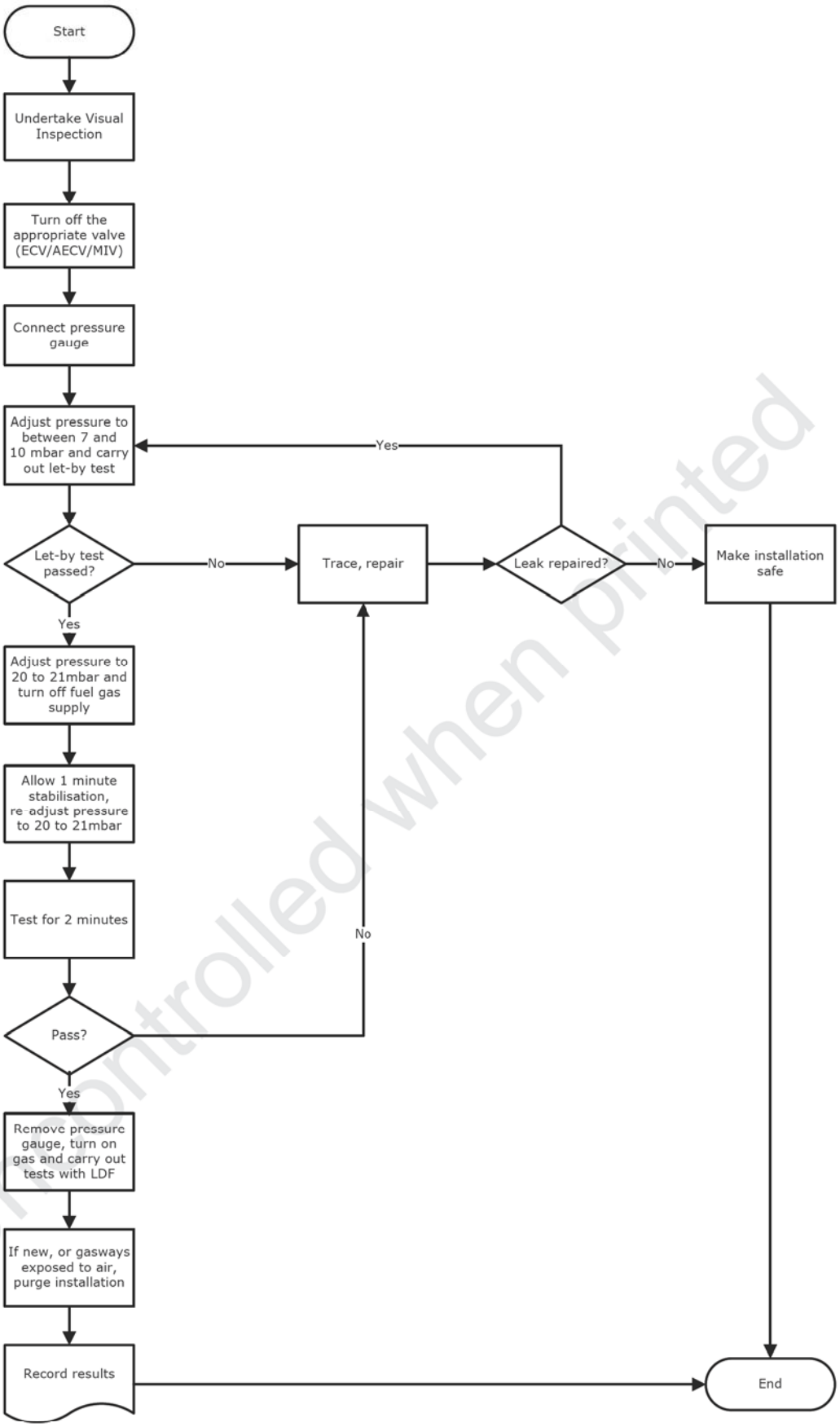
(i) Remove the pressure gauge and re-seal the test point. Slowly turn on the gas supply. Test the pressure test point, ECV/AECV outlet connection, regulator connections and, where appropriate, the MIV connections with LDF.

Note: Ensure that all connections between the ECV and regulator in the section that has been tightness tested are tested with LDF. These connections may be operating at higher pressures than the test pressure to which they have been subjected during the test and escapes may only become apparent at the higher pressures.

(j) Upon completion of the test:

- if the installation is new, or if any gas ways have been exposed to air, or the work may have allowed air into the installation by any other means purge the installation in accordance with Section 6 and then proceed to step (k); or
- if the installation is existing and there is no possibility that air may have been allowed into the installation then proceed to step (k).

(k) Record the test results and, where appropriate, inform the responsible person.



Note: This flow diagram does not show all the necessary steps and the full procedure in Section 5 applies.

FIGURE 5 - FLOW DIAGRAM FOR TIGHTNESS TESTING NG INSTALLATIONS

5.3.3 **LPG**

5.3.3.1 *New and existing installations*

The following procedure assumes that the installation is connected to a live gas supply (see Figure 6 for a summary of the procedure). Where the installation is not connected to a live gas supply the installation shall be tightness tested with air (see Appendix 3).

Note: Typical LPG installations are shown in Appendix 6.

The following test procedure shall be carried out:

(a) Visually inspect the installation and ensure all sections to be tested are connected, all joints are correctly made and any exposed gas ways (for example, open ends) on the installation are sealed with an appropriate fitting. Check any appliance(s) and ensure the AIV is open and all burner control taps and any pilot burner supplies are turned off. On a cooker with a fold down lid, lift the lid to the fully open position to ensure that any SSOV on the gas installation is in the open position.

(b) Turn off the gas installation at the appropriate supply control valve that is situated on the inlet of the section to be tested.

Note: Unless stated otherwise throughout the remainder of this LPG testing procedure the cylinder valve, ECV, AECV or MIV that is immediately upstream of the section being tested and is being turned on/off during testing will be referred to as the 'supply control valve'.

For installations that incorporate a regulator in the section to be tightness tested where work involves a new installation, a replacement regulator or where the work may have affected the gas tightness of the installation between the supply control valve and regulator ensure that all connections between these points have been tightness tested with LDF immediately on opening the supply control valve.

(c) Connect the pressure gauge to a suitable pressure test point on the installation in the section of pipework on the outlet of the supply control valve and the final stage regulator.

Note: The final stage regulator is typically the last regulator controlling the supply pressure to the installation pipework. It is often referred to as the 1st or 2nd stage regulator.

(d) Carry out a let-by test of the closed supply control valve as follows:

- adjust the pressure to between 7 and 10 mbar
- ensure any regulator on the inlet of the supply control valve is activated
- close the valve, and note the gauge reading.

Note: If there is an UPSO valve on the outlet of the supply control valve, this will close at these test pressures. In this case, once the pressure has been adjusted to the chosen pressure, operate the UPSO reset to release any trapped upstream pressure, balancing the pressures either side of the device, then allow it to re-shut. There may be a small sudden rise in the gauge reading as the upstream pressure is released into the downstream pipework. If the gauge reading rises and remains higher than 10 mbar then this process will need to be repeated until the gauge reads and remains at the chosen test pressure.

If the pressure requires reducing to achieve the required test pressure at this stage or any stage in the tightness testing process then any potential LPG or LPG/air mixtures that are to be released will need to be vented to a safe area, preferably outside. See clause 6.3.3 (a) for guidance on the necessary safety precautions to be taken.

Check for any perceptible movement (rise) of the gauge reading (see clause 4.2.2) over the next 1 minute period.

Note: If the action documented above in relation to any UPSO was necessary, then the UPSO reset will need to be operated again at the end of the 1 minute let-by period, before the final reading taken is considered. A momentary movement of the gauge while operating the UPSO may be observed due to the diaphragm moving.

If there is no perceptible movement of the gauge reading the valve shall be deemed to have passed the test. Otherwise, the valve(s) shall be deemed to have failed the test.

If the valve fails the test the cause shall be investigated and rectified.

In this situation the valve shall be checked for let-by by disconnecting its outlet union and applying LDF to the valve barrel or ball.

If let-by is confirmed on a cylinder valve, the cylinder shall be changed, if safe to do so, and the faulty cylinder valve shall be sealed off with an appropriate fitting to prevent a further escape of gas. The gas supplier shall be immediately notified of the fault so necessary arrangements can be made for the collection of the cylinder and rectification of the fault. On no account shall anyone other than the gas supplier attempt to remove, repair or dismantle a cylinder valve.

In any event, if let-by is confirmed, the valve shall be replaced before repeating this let-by test and proceeding with the tightness test.

If the repair cannot be completed, the installation must be made safe by disconnecting the installation, as appropriate, and sealing all open ends with an appropriate fitting and suspending further tests.

Note: If the valve appears satisfactory but there is still an increase in the pressure reading on the gauge during this period, the pressure and/or temperature within the installation may be stabilising. Time will need to be allowed until a stable reading is obtained. Once a stable reading is obtained this stage in the test procedure will have to be repeated. A major decrease in pressure is probably attributable to an escape on the installation that will need to be rectified before restarting the test.

Alternatively, for cylinder installations using high pressure hoses between the cylinder valve and regulator where the cylinder valve is the only form of supply control valve, a rise in pressure may be due to hose relaxation. In this situation it may be necessary to install an additional supply control valve downstream of the regulator. This valve may be either left in place once the let-by and tightness tests are completed or removed and any joints made after the tightness test checked with LDF.

Installation's fed from two or more cylinders may be tested for let-by through all the cylinder valves simultaneously i.e. all valves turned off. If let-by is detected check each cylinder valve individually with LDF.

(e) Slowly raise the pressure in the installation to TTP indicated in Table 4 by opening the appropriate supply control valve(s) then turn off the valve(s).

TYPE OF INSTALLATION (See Note 1)	OPERATING PRESSURE	TTP (See Note 2)	
		PROPANE	BUTANE
Installations with a regulator in the section to be tested (see Figures 13 and 14)	28 mbar		20 to 21 mbar (See Note 4)
	30 mbar (See Note 3)	28 to 29 mbar (See Note 4)	28 to 29 mbar (See Note 4)
	37 mbar	30 to 31 mbar (See Note 4)	
Installations without a regulator in the section to be tested (see Figures 15 and 16)	28 mbar		27 to 28 mbar
	30 mbar (See Note 3)	29 to 30 mbar	29 to 30 mbar
	37 mbar	36 to 37 mbar	

Note 1: Typical installation layouts are given in Appendix 6.

Note 2: Avoid higher pressures to prevent regulator lock-up.

Note 3: These OPs are found on caravans designed for use on the road, where the gas installation has been installed in accordance with BS EN 1949 and the regulator complies with BS EN 12864 or BS EN 13786.

Note 4: A lower TTP is necessary to ensure that the regulator is open and any potential locked up high pressure in the installation upstream of the regulator is released into the downstream installation and this high pressure section is then included in the test. High pressure trapped upstream of a regulator could mask a gas escape if the locked up regulator is letting by.

➢For Butane installations with an OP of 28 mbar, if whilst raising the pressure to the test pressure it were to exceed 21 mbar but not exceed 23 mbar re-adjust the pressure to between 20 and 21 mbar. If the pressure were to exceed 23 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before re-raising the pressure to between 20 and 21 mbar. This helps to ensure that the regulator in not locked-up during the tightness test.

For Butane/Propane installations with an OP of 30 mbar, if whilst raising the pressure to the test pressure it were to exceed 29 mbar but not exceed 31 mbar re-adjust the pressure to between 28 and 29 mbar. If the pressure were to exceed 31 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before re-raising the pressure to between 28 and 29 mbar. This helps to ensure that the regulator in not locked-up during the tightness test.➢

For Propane installations with an OP of 37 mbar, if whilst raising the pressure to the test pressure it were to exceed 31 mbar but not exceed 33 mbar re-adjust the pressure to between 30 and 31 mbar. If the pressure were to exceed 33 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before re-raising the pressure to between 30 and 31 mbar. This helps to ensure that the regulator is not locked-up during the tightness test

TABLE 4 - TTP FOR LPG INSTALLATIONS

(f) Allow 1 minute for the pressure and temperature within the installation to stabilise, if necessary, at the end of the stabilisation period re-adjust the pressure to the appropriate TTP. If a supply control valve has been turned on to re-adjust the pressure then turn off the valve.

The test procedure shall not proceed until a stable reading is obtained.

Note: There may still be a slight increase or decrease in the pressure reading on the gauge during this period as the installation stabilises. Further time may need to be allowed until a stable reading is obtained.

(g) Check for any perceptible movement (fall) of the gauge reading (see clause 4.2.2) over the next 2 minute period.

For all installations (with or without appliances connected) if there is no perceptible movement (fall) of the gauge reading and there is no smell of gas the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

Note: Higher leakage rates may be allowed for existing installations where appliances are connected, but this will require the installation volume to be calculated to determine the allowed maximum permissible pressure drop (see Appendix 8).

Where multiple dwellings exist on a premises and each dwelling includes an ECV/AECV, for example in a flat, wherever possible, it is advisable to test the entire installation.

(h) If the installation fails the test, either:

- trace and repair the escapes(s) and re-test the installation, or
- the installation must be made safe by disconnecting appliance(s) or the relevant section of the installation, as appropriate, and sealing all open ends with an appropriate fitting.

(i) Upon completion of the test:

- if the installation is new, or if any gas ways have been exposed to air, or the work may have allowed air into the installation by any other means purge the installation in accordance with Section 6 and then repeat steps (e) to (h) and then proceed to step (j); or
- if the installation is existing and there is no possibility that air may have been allowed into the installation then proceed to step (j).

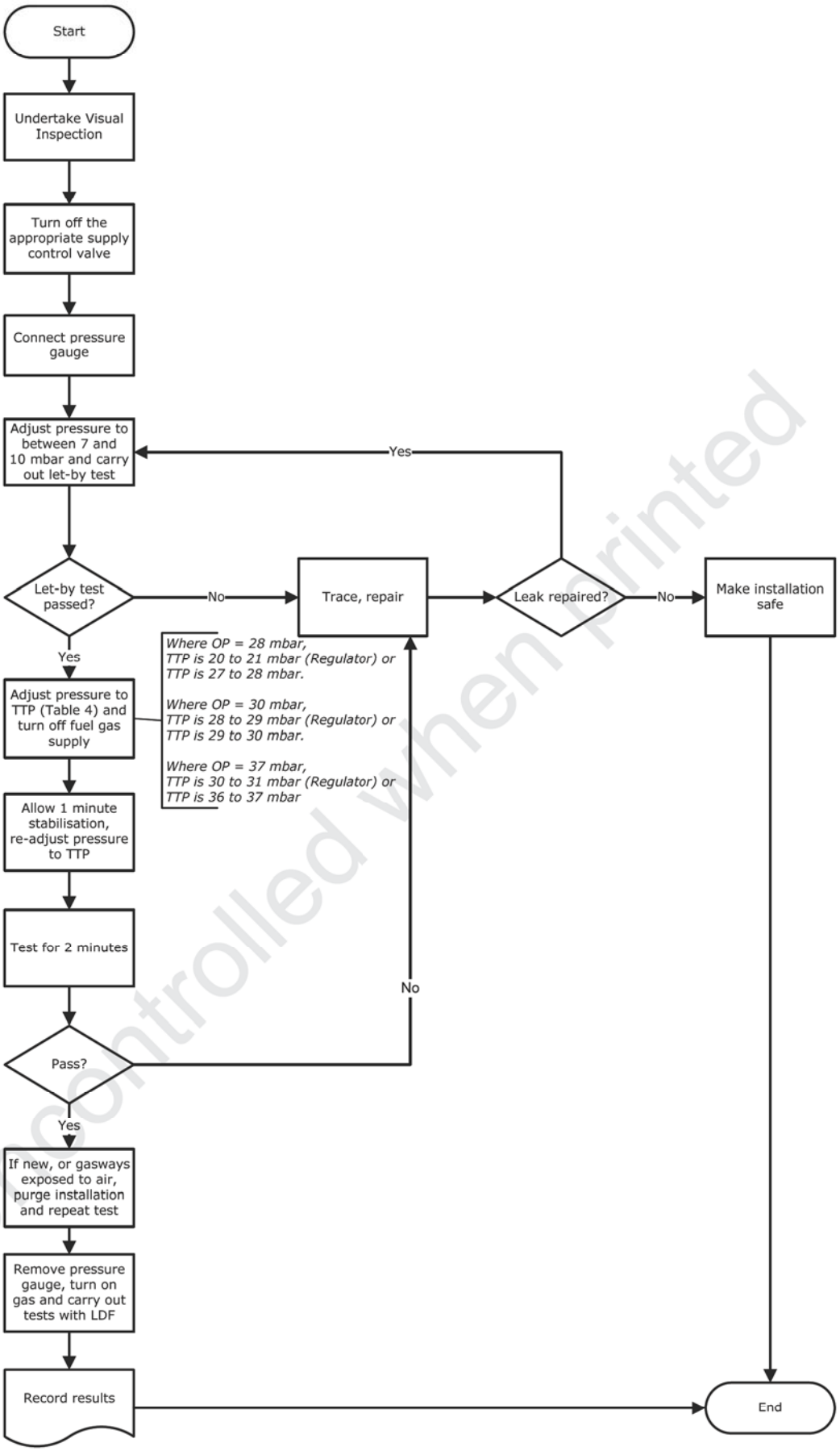
Note: Due to the differences in the viscosity of air and LPG certain levels of escape will not be detected on the initial tightness test where the installation contains air. It is therefore essential to repeat the tightness test after purging to ensure the installation is gas tight.

Consideration needs to be given to the risks involved in leaving a gauge that is connected to the installation unattended during the purging operation, in particular the risk of the pressure gauge tube becoming detached from the test point.

(j) Remove the pressure gauge and re-seal the test point. Slowly turn on the gas supply. Test the pressure test point, supply control valve outlet connection and regulator connections with LDF.

Note: Ensure that all connections between the supply control valve and any regulator in the section that has been tightness tested are tested with LDF or a gas detector. These connections will be operating at considerably higher pressures than the test pressure to which they have been subjected during the test and escapes may only become apparent at the higher pressures.

(k) Record the test results and, where appropriate, inform the responsible person.



Note: This flow diagram does not show all the necessary steps and the full procedure in Section 5 applies.

FIGURE 6 - FLOW DIAGRAM FOR TIGHTNESS TESTING LPG INSTALLATIONS

5.4 NEW EXTENSIONS/ALTERATIONS TO EXISTING INSTALLATIONS

Before commencing the new work, the existing installation shall be tightness tested in accordance with clause 5.3 for the appropriate fuel gas and any permissible pressure drop over the 2 minute test period noted (see also Sub-Section 4.2).

Upon completion of the work to the existing installation, the tightness test shall be repeated and the pressure drop after the 2 minute test period shall be no greater than that previously measured and there shall be no smell of gas.

5.5 DEALING WITH SUSPECTED GAS ESCAPES

When responding to the following situations, the gas installation shall be tightness tested in accordance with Sub-Section 5.3 for the appropriate fuel gas.

However, to successfully pass the test, there shall be no perceptible movement of the gauge reading and there shall be no smell of gas:

- when investigating a gas installation that has been isolated by the emergency service provider (ESP) or gas supplier following a reported escape of gas or a suspected smell of gas
- when the gas user or gas operative smells gas or suspects a gas escape.

If a smell of gas persists, a report shall be made to the ESP or gas supplier.

SECTION 6 : DIRECT PURGING

6.1 GENERAL

6.1.1 A tightness test of pipework must be carried out immediately prior to any purge.

6.1.2 When an installation is connected to a live gas supply, is new or if any gas ways have been exposed to air, or the work may have allowed air into the installation by any other means the installation must be purged after passing the tightness test.

6.1.3 The pressure created during purging shall not exceed MOP of any pipework being purged.

6.2 INSTALLATION VOLUME AND PURGE VOLUME

6.2.1 The IV is the total volume of the installation being purged.

The purge volume (PV) is the total volume of gas that should be passed through the installation to ensure a safe air to gas ratio in the pipe.

Note: When it is considered necessary to purge the installation of any fuel gas, see clause 6.4, then the PV is also the total volume of air that needs to be passed through the installation to ensure a safe air to gas ratio in the pipe.

6.2.2 PV shall be as given in Table 5.

TYPE OF INSTALLATION		PURGE VOLUME (PV)
METER DESIGNATION	PIPEWORK DIAMETER	
U6, G4, E6	≤ 28 mm	0.01 m^3 (0.35 ft^3)
U6, G4, E6, U16, G10	> 28 mm ≤ 35 mm	1.5 IV
Key: ≤ less than or equal to > greater than		

Note 1: The pipework diameter limits apply for the maximum diameter pipework of any length within the section being tested.

Note 2: IV is the sum of the volumes of the meter, pipework and fittings. For methods of calculating the IV and PV of installations see Appendix 7.

TABLE 5 - PURGE VOLUME

6.3 PURGING PROCEDURES

6.3.1 LPG/Air mixtures

The following procedure shall be carried out:

(a) Within the vicinity of the purging activity ensure the following safety precautions are taken throughout the purging process:

- avoid any accumulation of gas within confined spaces
- prevent inadvertent operation of any electrical switch or other appliance
- extinguish all potential sources of ignition
- ensure that there is no smoking or naked lights
- ensure good ventilation by opening doors, windows, passive stack ventilation systems, etc.
- advise the responsible person for the premises or other persons in the area of the above of the intent to purge and that there may be a smell of gas.

Note: These precautions are applicable even if a source of ignition is held adjacent to the purged gas, as a mixture of un-ignited gas/air may be released until a suitable mixture is achieved.

(b) Ensure that all appliances are turned off before commencing with the purge.

(c) Slowly turn on the gas supply and note the position of the test dial or test drum on diaphragm meters.

(d) From a suitable purge point on the installation turn on a burner control tap on an appliance with an open burner. The purge gas mixture shall be ignited at the burner as soon as possible, by holding a source of ignition adjacent to the burner head or by continually operating the appliances ignition system.

Note: It may be necessary, in certain situations, to connect a temporarily installed burner to a suitable point on the installation, for example, on installations with no appliances fitted, where the appliance(s) is fitted with a flame supervision device or where there are no open burners.

Confirm the presence of gas, for example, by observation of the burner igniting. Turn off the appliance burner control tap.

During the purging operation, the area in which the purge gas is being released shall not be left unattended.

(e) Return to the meter and note the volume of gas that has passed.

(f) Continue steps (d) and (e) until the correct PV has been passed (see Table 5).

(g) Ensure every branch of pipework is purged.

(h) Establish a stable flame picture at each appliance.

Where an appliance is identified which has not been commissioned, either it must be:

- disconnected from the gas supply or sealed off with an appropriate fitting with an appropriate label attached indicating the appliance is not commissioned, or
- the appliance commissioned.

6.3.2 **Natural Gas**

The following procedure shall be carried out:

(a) Within the vicinity of the purging activity ensure the following safety precautions are taken throughout the purging process:

- avoid any accumulation of gas within confined spaces
- prevent inadvertent operation of any electrical switch or other appliance
- extinguish all potential sources of ignition
- ensure that there is no smoking or naked lights
- ensure good ventilation by opening doors, windows, passive stack ventilation systems, etc.
- advise the responsible person for the premises or other persons in the area of the above of the intent to purge and that there may be a smell of gas.

Note: These precautions are applicable even if a source of ignition is held adjacent to the purged gas, as a mixture of un-ignited gas/air may be released until a suitable mixture is achieved.

(b) Ensure that all appliances are turned off before commencing with the purge.

(c) Slowly turn on the gas supply and note the position of the test dial or test drum on diaphragm meters or the meter reading on ultrasonic meters.

(d) Select the appropriate purge activity based on the installation volume:

- **Installation Volumes ≤ 0.02 m^3**

  From a suitable purge point on the installation either turn on a burner control tap on an appliance with an open burner or loosen the appropriate fitting sealing the gas way. If purging by opening a burner control tap, it is permissible to hold a source of ignition adjacent to the burner head or to continually operate the appliances ignition system to attempt to ignite the purged gas/air mixture.

  Note: This not only serves to assist the operative in determining whether the PV has been passed but will limit the amount of un-ignited purge gas that will be released.

  Confirm the presence of gas, for example, by observation of the burner igniting and/or by smell. Turn off the appliance burner control tap or tighten the appropriate fitting, testing with LDF as required.

  During the purging operation, the area in which the purge gas is being released shall not be left unattended.

- **Installation Volumes > 0.02 m^3 ≤ 0.035 m^3**

  Note: Such domestic installations are uncommon when connected to E6, G4 and U6 meters but all installations that include a U16/G10 meter have an IV exceeding 0.02 m^3.

  From a suitable purge point on the installation turn on a burner control tap on an appliance with an open burner. The purge gas mixture shall be ignited at the burner as soon as possible, by holding a source of ignition adjacent to the burner head or by continually operating the appliances ignition system.

  Note: It may be necessary, in certain situations, to connect a temporarily installed burner to a suitable point on the installation, for example, on installations with no appliances fitted, where the appliance(s) is fitted with a flame supervision device or where there are no open burners.

Confirm the presence of gas, for example, by observation of the burner igniting and/or by smell. Turn off the appliance burner control tap.

During the purging operation, the area in which the purge gas is being released shall not be left unattended.

(e) Return to the meter and note the volume of gas that has passed.

(f) Continue steps (d) and (e) until the correct PV has been passed (see Table 5). Unless appliance burners are lit during purging, avoid exceeding the PV to minimise the amount of un-ignited gas that is released.

(g) Ensure every branch of pipework is purged.

(h) Establish a stable flame picture at each appliance.

Where an appliance is identified which has not been commissioned, either it must be:

- disconnected from the gas supply or sealed off with an appropriate fitting with an appropriate label attached indicating the appliance is not commissioned, or
- the appliance commissioned.

6.3.3 **LPG**

The following procedure shall be carried out:

(a) Within the vicinity of the purging activity ensure the following safety precautions are taken throughout the purging process:

- avoid any accumulation of gas within confined spaces
- prevent inadvertent operation of any electrical switch or other appliance
- extinguish all potential sources of ignition
- ensure that there is no smoking or naked lights
- ensure good ventilation by opening doors, windows, passive stack ventilation systems, etc.
- advise the responsible person for the premises or other persons in the area of the above of the intent to purge and that there may be a smell of gas.

Note: These precautions are applicable even if a source of ignition is held adjacent to the purged gas, as a mixture of un-ignited gas/air may be released until a suitable mixture is achieved.

(b) Ensure that all appliances are turned off before commencing with the purge.

(c) Slowly turn on the gas supply and when a meter is installed note the position of the test dial or test drum on diaphragm meters or the meter reading on ultrasonic meters.

(d) From a suitable purge point on the installation turn on a burner control tap on an appliance with an open burner. The purge gas mixture shall be ignited at the burner as soon as possible, by holding a source of ignition adjacent to the burner head or by continually operating the appliances ignition system.

Note: It may be necessary, in certain situations, to connect a temporarily installed burner to a suitable point on the installation, for example, on installations with no appliances fitted, where the appliance(s) is fitted with a flame supervision device or where there are no open burners.

Confirm the presence of gas, for example, by observation of the burner igniting. Turn off the appliance burner control tap.

During the purging operation, the area in which the purge gas is being released shall not be left unattended.

(e) Upon establishing the presence of gas:

- if the installation includes a meter, return to the meter and note the volume of gas that has passed continuing steps (d) and (e) until the correct PV has been passed (see Table 5).
- if the installation does not include a meter proceed to step (f).

(f) Ensure every branch of pipework is purged following the aforementioned procedure.

(g) Establish a stable flame picture at each appliance.

Where an appliance is identified which has not been commissioned, either it must be:

- disconnected from the gas supply or sealed off with an appropriate fitting with an appropriate label attached indicating the appliance is not commissioned, or
- the appliance commissioned.

6.4 SAFETY PRECAUTIONS

6.4.1 Where an installation is temporarily isolated to allow work to be undertaken on it, consideration shall be given to the risks involved in working on installations that contain fuel gas.

6.4.2 Before any work is commenced on an installation, or section of an installation, where there is a risk of any fuel gas within the installation being ignited and constituting a danger (for example, when using a blowlamp) the following precautions shall be taken:

- undertake a tightness test in accordance with Section 5 on the installation, or section of the installation, in particular to verify there is no let-by from the valve used to isolate the gas supply; and
- disconnect the gas supply to the installation, or section of the installation; and
- remove any meter, where fitted, from the installation, or section of the installation; and
- immediately seal all exposed gas ways (for example, open ends on the pipework and/or meter) with an appropriate fitting.

Note: These are long standing safety precautions that will reduce the risk of any fuel gas being inadvertently ignited and constituting a danger. Where it is considered that even when taking these measures there may still be a danger posed from the fuel gas igniting, the gas operative may choose to purge the installation of any fuel gas. Additional guidance on purging installations of any fuel gas (decommissioning) can be found in IGE/UP/1 and IGE/UP/1A.

It is difficult to specify an exact set of parameters that state when an installation is or is not to be decommissioned prior to working on it due to the diversity of installations that may be encountered.

6.4.3 When any installation is to be decommissioned (for example, prior to the installations removal, property demolition, etc.), consideration shall be given to purging out any fuel gas within the installation.

In all circumstances any exposed gas ways must be sealed with an appropriate fitting and any part of the installation that may contain fuel gas shall be labelled as such.

Note: It is difficult to specify an exact set of parameters that state when an installation is or is not to be decommissioned due to the diversity of installations that may be encountered.

6.4.4 Where a meter with badged capacity not exceeding 6 $m^3 h^{-1}$ is permanently removed from an installation (for example, on a meter exchange or on the termination of the gas supply) the exposed gas ways on the meter shall be immediately sealed with an appropriate fitting.

Where a meter with badged capacity exceeding 6 $m^3 h^{-1}$ is permanently removed from an installation it shall be purged of any fuel gas.

Note: Additional guidance on purging meters of any fuel gas (decommissioning) can be found in IGE/UP/1 and IGE/UP/1A.

APPENDIX 1 : GLOSSARY, ACRONYMS, UNITS, SYMBOLS AND SUBSCRIPTS

GLOSSARY

All definitions are given in IGEM/G/4 which is freely available by downloading a printable version from IGEM's website, www.igem.org.uk.

Recommended and legacy gas metering arrangements are given in IGEM/G/1 which is freely available by downloading a printable version from IGEM's website, www.igem.org.uk.

ACRONYMS

ACoP	Approved Code of Practice
AECV	additional emergency control valve
AIV	Appliance isolation valve
CSST	corrugated stainless steel tube
CV	cylinder valve
ECV	emergency control valve
ESP	emergency service provider
GB	Great Britain
GS(I&U)R	Gas Safety (Installation and Use) Regulations
GT	gas transporter
HSE	Health and Safety Executive
IGEM	Institution of Gas Engineers and Managers
IV	installation volume
LDF	leak detection fluid
LPG	Liquefied Petroleum Gas
MAM	meter asset manager
MIP	maximum incidental pressure
MIV	meter inlet valve
MOP	maximum operating pressure
NG	Natural Gas
OP	operating pressure
PV	purge volume
SG	specific gravity
SP	set point
SSOV	safety shut-off valve
STP	strength test pressure
TTP	tightness test pressure
UK	United Kingdom
UPSO	under pressure shut off.

UNITS

bar	bar
ft^3	cubic foot
in	inch
mbar	millibar
m	metre
m^3	cubic metre
mm	millimetre
$m^3 h^{-1}$	cubic metre per hour
pH	acidity/alkalinity value.

SYMBOLS

>	greater than
<	less than
≤	less than or equal to
Ø	nominal diameter
A	gas appliance
F	filter
M	meter
R	regulator
S	safety device
V	volume.

SUBSCRIPTS

f	fittings
m	meter
p	pipe
t	total
u	upstream.

APPENDIX 2 : REFERENCES

This Standard is set out against a background of legislation in force in the GB at the time of publication. Similar considerations are likely to apply in other countries and reference to the appropriate national legislation will be necessary. The following list is not exhaustive.

All relevant legislation must be complied with and relevant ACoPs, official Guidance Notes and referenced codes, standards, etc. shall be taken into account.

Where British Standards, etc. are quoted, equivalent national or international standards, etc. equally may be appropriate.

Care shall be taken to ensure that the latest editions of the relevant documents are used.

A2.1 STATUTORY INSTRUMENTS

- Gas Act 1986, as amended
- Health and Safety at Work etc. Act 1974

  Note: This applies to all work activities. It places general duties on employers to ensure, so far as is reasonably practicable, the health, safety and welfare of their employees and the health and safety of members of the public who may be affected by the activity.

- Confined Spaces Regulations 1997
- Control of Substances Hazardous to Health Regulations 1995, as amended
- Dangerous Substances and Explosive Atmospheres Regulations 2002
- Electricity at Work Regulations 1989
- Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Isle of Man Gas Safety (Application) Order 1996
- Gas Safety (Installation and Use) Regulations 1998

  Note: These apply to domestic and commercial premises. For industrial premises, the requirements of these Regulations could be considered relevant in an investigation under the Health and Safety at Work etc. Act. The Regulations set out detailed requirements for gas installation work. In particular, they require that anyone carrying out such work must be competent to do so. They also prescribe circumstances in which a tightness test and purge must be carried out.

- Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004
- Health and Safety (Gas)(Guernsey) Ordnance 2006
- Management of Health and Safety at Work Regulations 1999
- Provision and Use of Work Equipment Regulations 1999
- Personal Protective Equipment at Work Regulations 1992
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995
- Workplace (Health, Safety and Welfare) Regulations 1992.

A2.2 OFFICIAL APPROVED CODES OF PRACTICE AND GUIDANCE

- HSG48 Human factors in industrial safety
- HSG65 Successful health and safety management
- HSL56 Safety in the installation and use of gas systems and appliances

A2.3 **BRITISH STANDARDS (ABBREVIATED TITLES)**

• BS 4250	Commercial butane and commercial propane
• BS 5482-1	Domestic butane and propane gas burning installations – Permanent dwellings
• PD 5482-3	Domestic butane and propane gas burning installations – Boats, yachts and other vessels
• BS 6400-1	Installation of domestic-sized meters. Low pressure supply (2nd family gases)
• BS 6400-2	Installation of domestic-sized meters. Medium pressure supply (2nd family gases)
• BS 6400-3	Installation of domestic-sized meters. Low and medium pressure (3rd family gases)
• BS 6891	Installation pipework in domestic premises
• BS EN 1949	Installation of LPG systems for habitation purposes in leisure accommodation vehicles
• BS EN 12864	Low pressure LPG regulators
• BS EN 13786	Automatic LPG change over valves
• BS EN 14291	Foam producing solutions for leak detection
• BS EN ISO 10239	Small craft. LPG systems.

A2.4 **IGEM**

• IGE/UP/1 Edition 2	Strength testing, tightness testing and direct purging of industrial and commercial gas installations
• IGE/UP/1A Edition 2	Strength testing, tightness testing and direct purging of small low pressure industrial and commercial Natural Gas installations
• IGEM/UP/1C	Strength testing, tightness testing and direct purging of industrial and commercial gas installations
• IGEM/UP/16	Design for Natural Gas installations on industrial and commercial premises with respect to hazardous area classification and preparation of risk assessments
• IGE/GM/8	Non-domestic meter installations. Flow rate exceeding 6 $m^3 h^{-1}$ and inlet pressure not exceeding 38 bar
• IGEM/TD/13 Edition 2	Pressure regulating installations for Natural Gas, Liquefied Petroleum Gas and Liquefied Petroleum Gas/Air
• IGEM/SR/25 Edition 2	Hazardous area classification of natural gas installations
• IGEM/G/1	Defining the end of the Network, a meter installation and installation pipework
• IGEM/G/4	Definitions for the gas industry.

A2.5 **UKLPG**

• Code of Practice 22	Design, Installation and testing of LPG piping systems.

A2.6 **GAS SAFE REGISTER**

- Gas Industry Unsafe Situations Procedure.

APPENDIX 3 : TIGHTNESS TESTING NEW INSTALLATIONS WITH AIR

A3.1 NEW INSTALLATIONS - TEST WITH AIR

Note: The tightness test detailed in this section may be undertaken before the installation is connected to a live gas supply and tightness tested and purged with fuel gas.

The following test procedure shall be carried out:

(a) Visually inspect the installation and ensure all sections to be tested are connected, all joints are correctly made and any exposed gas ways (for example, open ends) on the installation are sealed with an appropriate fitting. Check any appliance(s) and ensure the AIV is open and all burner control taps and any pilot burner supplies are turned off. On a cooker with a fold down lid, lift the lid to the fully open position to ensure that any SSOV on the gas installation is in the open position.

(b) Connect the pressure gauge to the installation via a branch of a test T-piece which is valved on the other branch for air to be pumped into the installation.

(c) Slowly raise the pressure in the installation with air to the appropriate value given in Table 6 then turn off the pressure source.

FUEL	NOMINAL OP (mbar)	TTP (mbar)
LPG/Air	14	13-14
LPG/Air	21	20-21
NG	21	20-21
Butane	28	45-46
Propane	37	45-46

Note 1: It is assumed for air testing there is no regulator in the section to be tested. However if a regulator is fitted in the section to be tested, avoid higher pressures to prevent regulator lock-up. Additional guidance can be found in Sub-Section 5.3.

Note 2: For OPs of 30 mbar found on caravans designed for use on the road, where the gas installation has been installed in accordance with BS EN 1949, the installation will have been tightness tested with air by the manufacturer.

TABLE 6 - TTP FOR AIR TESTS ON NEW INSTALLATIONS

(d) Allow 1 minute for the pressure and temperature within the installation to stabilise, if necessary, at the end of the stabilisation period re-adjust the pressure to the TTP then turn off the pressure source.

Note: There may be a slight increase or decrease in the pressure reading on the gauge during this period, this may be due the pressure and/or temperature within the installation stabilising. A major decrease in pressure is probably attributable to an escape on the installation that will need to be rectified before restarting the test.

(e) Check for any perceptible movement (fall) of the gauge reading (see clause 4.2.2) over the next 2 minute period.

If there is no perceptible movement of the gauge reading the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

Note: If there is an increase in the pressure reading on the gauge during this period the installation may still be stabilising and further time will need to be allowed until a stable reading is obtained. Once a stable reading is obtained this stage in the test procedure will have to be repeated.

(f) If the installation fails the test, either:

- trace and repair the escapes(s) and re-test the installation, or
- the installation must be made safe by disconnecting appliance(s) or the relevant section of the installation, as appropriate, and sealing all open ends with an appropriate fitting.

(g) Upon completion of the test, remove the pressure gauge and re-seal the test point/test T-piece connection.

(h) Record the test results and, where appropriate, inform the responsible person.

Once the installation has been connected to a live gas supply the installation shall be tightness tested following the appropriate procedure in Section 5 before the installation may be purged with fuel gas (see Section 6).

APPENDIX 4 : TIGHTNESS TESTING EXISTING NG INSTALLATIONS FOR 75 mbar < MOP_u ≤ 2 bar WITHOUT A METER INLET VALVE (MIV)

Current NG meter designs are specified in BS 6400-2 and require a MIV to be fitted.

However, on some older designs, a MIV is not fitted and the installation will not be capable of being tightness tested to IGEM/UP/1B. The following guidance does not constitute a formal Procedure but is provided to enable the majority of such installations to be tested.

Note: As outlined, this Appendix deals with legacy meter installations that were installed without a MIV and having a $MOP_u \leq 2$ bar. The principles may be used for similar meter installations without a MIV having a $MOP_u \leq 4$ bar, but suitable adjustments to stated parameters and steps in this Appendix will need to be considered by a competent person. Many of these types of installation are to be found in Northern Ireland.

A4.1 Carry out the Procedures in Sub-Sections 5.1 and 5.2

A4.2 If the meter regulator is found to be faulty, this warrants upgrading the entire meter installation to BS 6400-2 or IGE/GM/8 as appropriate, do not simply replace/repair the regulator.

A4.3 The following procedure assumes that the installation is connected to a live gas supply.

Carry out the following test procedure:

(a) Visually inspect the installation and ensure all sections to be tested are connected, all joints are correctly made and any exposed gas ways (for example, open ends) on the installation are sealed with an appropriate fitting. Check any appliance(s) and ensure the AIV is open and all burner control taps and any pilot burner supplies are turned off. On a cooker with a fold down lid, lift the lid to the fully open position to ensure that any SSOV on the gas installation is in the open position.

(b) Turn off the gas installation at the ECV.

(c) Connect the pressure gauge to a suitable pressure test point on the installation.

(d) Carry out a let-by test of the closed ECV as follows:

- adjust the pressure to between 7 and 10 mbar
- operate the UPSO or excess flow valve reset to balance the pressures either side of the device, then allow it to re-shut
- close the ECV, and note the gauge reading.

Note: Any UPSO or excess flow valve incorporated in the regulator assembly on the outlet of the ECV will close at these test pressures. In this case, once the pressure has been adjusted to the chosen pressure, operating the UPSO or excess flow valve reset will release any trapped upstream pressure balancing the pressures either side of the device. There may be a small sudden rise in the gauge reading as the upstream pressure is released into the downstream pipework. If the gauge reading rises and remains higher than 10 mbar then this process will need to be repeated until the gauge reads and remains at the chosen test pressure.

If the pressure requires reducing to achieve the required test pressure at this stage or any stage in the tightness testing process then any potential NG or NG/air mixtures that are to be released will need to be vented to a safe area. See Clause 6.3.2 (a) for guidance on the necessary safety precautions to be taken.

Check for any perceptible movement (rise) of the gauge reading (see clause 4.2.2) over the next 1 minute period.

Note: If the action documented above in relation to any UPSO or excess flow valve was necessary, then the UPSO or excess flow valve reset will need to be operated again at the end of the 1 minute let-by period, before the final reading taken is considered. A momentary movement of the gauge while operating the UPSO may be observed due to the diaphragm moving.

If there is no perceptible movement of the gauge reading the valve shall be deemed to have passed the test. Otherwise, the ECV shall be deemed to have failed the test.

If the valve fails the test the cause shall be investigated and rectified.

In this situation the valve shall be checked for let-by by disconnecting its outlet union and applying LDF to the valve barrel or ball.

If let-by is confirmed on an ECV connected to the end of a NG service pipe, the appropriate Gas Emergency Service Call Centre shall be immediately notified to enable them to arrange an effective repair. On no account shall anyone other than an authorised operative working on behalf of the ESP attempt to remove, repair or dismantle the valve.

In any event, if let-by is confirmed, the valve shall be repaired/replaced before repeating this let-by test and proceeding with the tightness test.

If the repair cannot be completed, the installation must be made safe by disconnecting the installation, as appropriate, and sealing all open ends with an appropriate fitting and suspending further tests.

Note: If the valve appears satisfactory but there is still an increase in the pressure reading on the gauge during this period, the pressure and/or temperature within the installation may be stabilising. Time will need to be allowed until a stable reading is obtained. Once a stable reading is obtained this stage in the test procedure will have to be repeated. A major decrease in pressure is probably attributable to an escape on the installation that will need to be rectified before restarting the test.

(e) Slowly raise the pressure in the installation to between 18 and 19 mbar by opening the ECV valve, then turn off the valve.

Note: ➢Avoid higher pressures to prevent regulator lock-up. If whilst raising the pressure to the test pressure it were to exceed 19 mbar but not exceed 21 mbar re-adjust the pressure to between 18 and 19 mbar. If the pressure were to exceed 21 mbar it is necessary to drop the pressure back to between 7 and 10 mbar before raising the pressure to between 18 and 19 mbar. This helps to ensure that the regulator is not locked-up during the tightness test.➢

(f) Allow 1 minute for the pressure and temperature within the installation to stabilise, if necessary, at the end of the stabilisation period re-adjust the pressure to between 18 and 19 mbar. If an ECV has been turned on to re-adjust the pressure then turn off the valve.

The test procedure shall not proceed until a stable reading is obtained.

Note: There may still be a slight increase or decrease in the pressure reading on the gauge during this period as the installation stabilises. Further time may need to be allowed until a stable reading is obtained.

(g) Check for any perceptible movement (fall) of the gauge reading (see clause 4.2.2) over the next 2 minute period.

For all new installations (with or without appliances connected) or existing installations where no appliances are connected, if there is no perceptible movement (fall) of the gauge reading and there is no smell of gas the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

For existing installations where appliances are connected, if the pressure drop does not exceed the values given in Table 3 and there is no smell of gas, the installation shall be deemed to have passed the test. Otherwise, the installation shall be deemed to have failed the test.

(h) If the installation fails the test, either:

- trace and repair the escapes(s) and re-test the installation, or
- the installation must be made safe by disconnecting appliance(s) or the relevant section of the installation, as appropriate, and sealing all open ends with an appropriate fitting.

(i) Remove the pressure gauge and re-seal the test point. Slowly turn on the gas supply. Test the pressure test point, ECV outlet connection and regulator connections with LDF.

Note: Ensure that all connections between the ECV and regulator in the section that has been tightness tested are tested with LDF. These connections may be operating at higher pressures than the test pressure to which they have been subjected during the test and escapes may only become apparent at the higher pressures

(j) Upon completion of the test:

- if the installation is new, or if any gas ways have been exposed to air, or the work may have allowed air into the installation by any other means purge the installation in accordance with Section 6 and then proceed to step (k); or
- if the installation is existing and there is no possibility that air may have been allowed into the installation then proceed to step (k).

(k) Record the test results and, where appropriate, inform the responsible person.

APPENDIX 5 : RECOGNISING REGULATOR SETS

A5.1 NATURAL GAS - 75 mbar < MOP_u ≤ 2 bar

The vast majority of domestic meter installations in the GB are supplied from services of MOP_u less than 75 mbar. Increasingly, the pressure is between 75 mbar and 2 bar. To reduce the gas pressure to 21 mbar, it was normal practice in most areas to place a small MP/LP (medium pressure/low pressure) regulator in a kiosk at the boundary of the property and then continuing the service to a meter box at the property.

From the early 1980s, in some parts of the country such as Scotland and the South West, MP/LP regulators have been mounted directly in a meter box. GS(I&U)R require MP supplies to have regulators which have an additional safety device. These regulators fall into two basic categories. One type is fitted with a small relief valve and a slam shut valve. This device detects the gas pressure on the outlet of the regulator and, if the pressure rises above the set point, the slam shut valve will shut off the gas supply to the premises. When this happens, the MAM has to be called out to reset the regulator (see Figure 7).

In the late 1990's the second type of MP/LP regulator was introduced from Europe. This regulator operates on a different principle from the MP/LP regulator in use at that time. They are compact devices that reduce the gas pressure to 21 mbar in two stages. The initial pressure reduction is to around 350 mbar with the second stage dropping the pressure to 21 mbar. The safety devices on the regulator are also different. A relief valve operates if the pressure on the outlet rises above a set point. The regulators are fitted with an excess flow shut-off device which operates if a combination of flow and pressure on the outlet reach a particular level. If this happens, the regulator requires re-setting. Re-setting procedures are relatively simple and instructions are usually provided with the installation (see Figure 8).

If a regulator is encountered that is not recognised, seek further advice before carrying out any work.

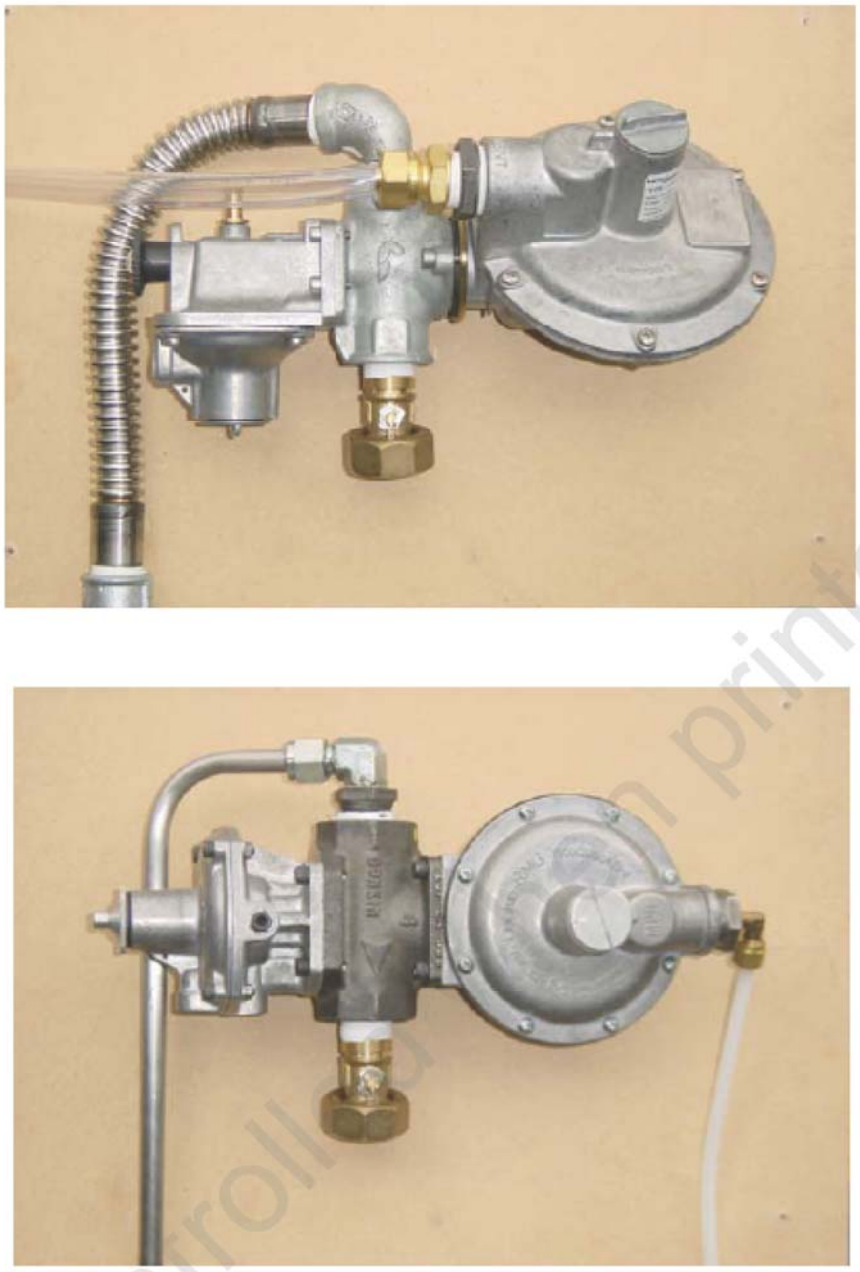


FIGURE 7 - TYPICAL MP/LP REGULATOR SETS (SINGLE STAGE RELIEF VALVE PLUS SLAM-SHUT VALVE)

FIGURE 8 - TYPICAL MP/LP REGULATOR SETS (TWO STAGE PRESSURE REDUCTION)

A5.2 LPG REGULATOR SETS

FIGURE 9 – TYPICAL 2nd STAGE REGULATOR INCLUDING UPSO/OPSO

FIGURE 10 – TYPICAL 3rd STAGE REGULATOR INCLUDING UPSO

FIGURE 11 - TYPICAL 2nd STAGE REGULATOR INCLUDING UPSO/OPSO ON A METER INSTALLATION

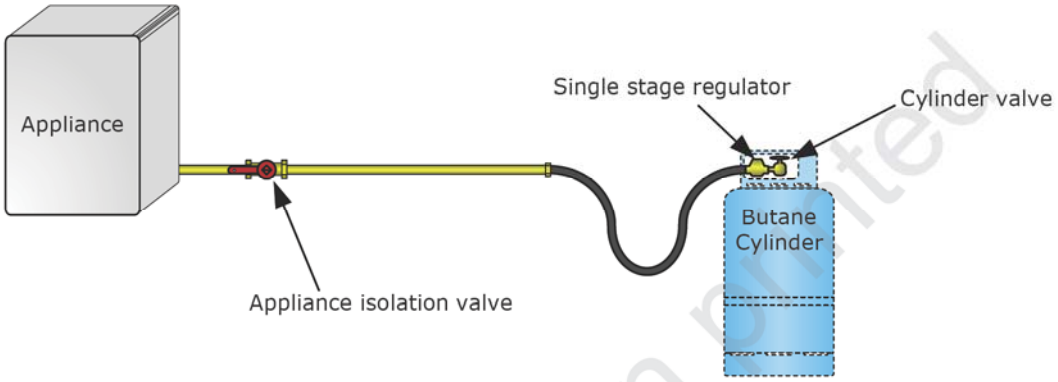
FIGURE 12 - TYPICAL 3rd STAGE REGULATOR INCLUDING UPSO ON A METER INSTALLATION

APPENDIX 6 : LPG INSTALLATION TYPES

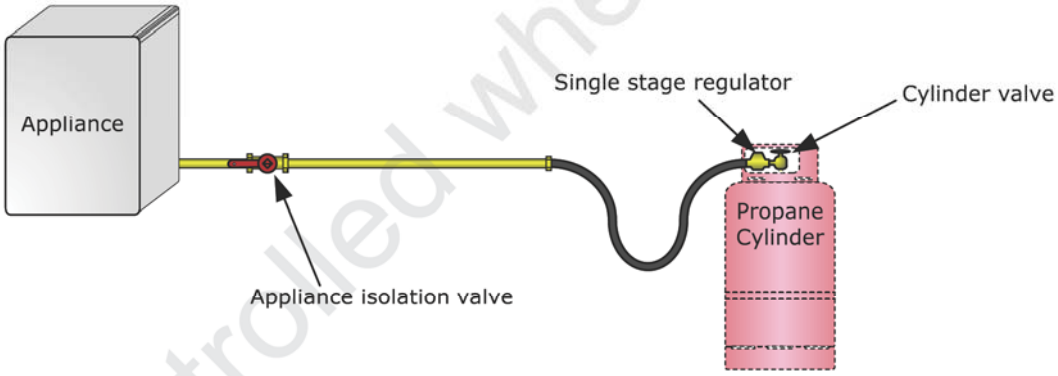
A6.1 TYPICAL LPG INSTALLATIONS WITH A REGULATOR IN THE SECTION TO BE TESTED

- Cylinder fed installations, using propane or butane (see Figure 13)
- Installation pipework fed by a bulk storage vessel, using propane, where the final stage regulator is wall mounted and connected to the outlet of the premises emergency control valve (see Figure 14).

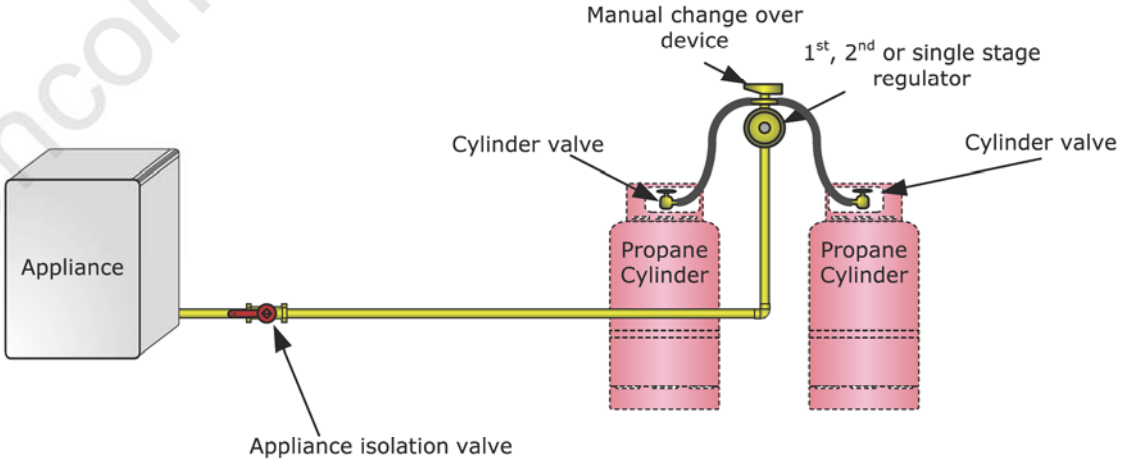
Note: The extent of the installations that the tightness test procedure covers in these situations is illustrated by the solid lines in Figures 13 and 14.



(a) Single cylinder butane installation

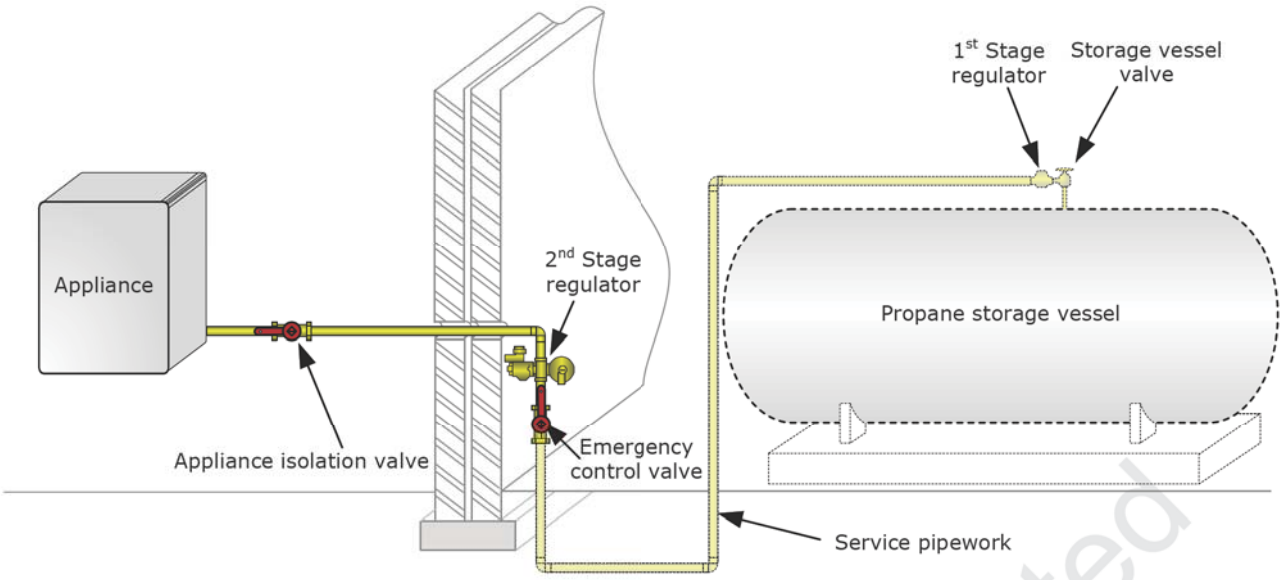


(b) Single cylinder propane installation

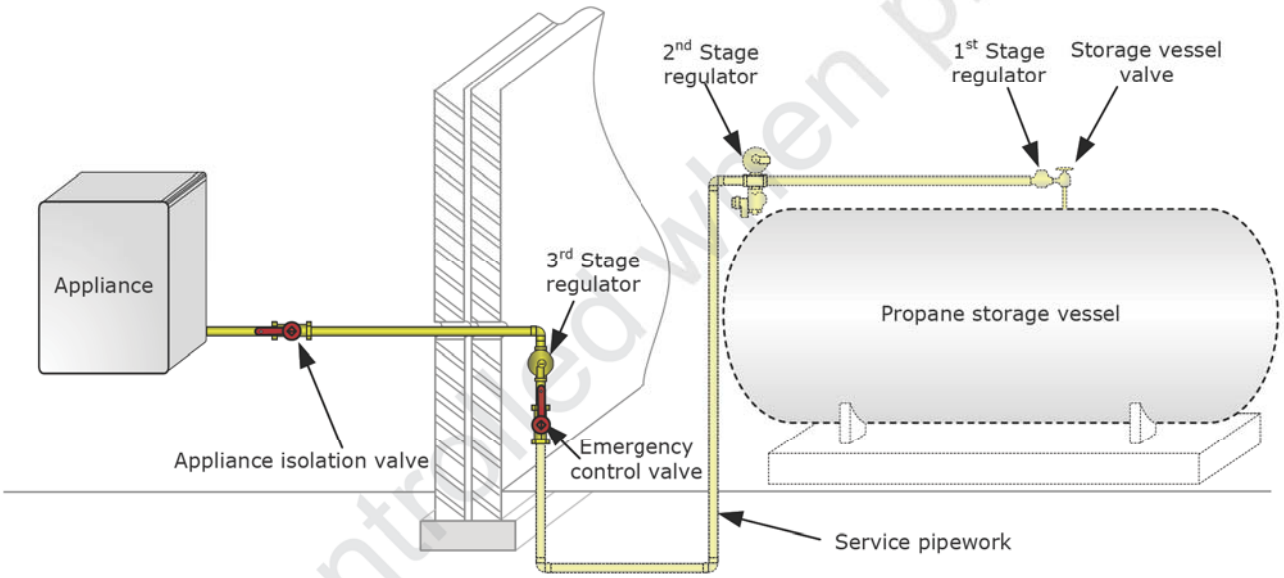


(c) Multiple cylinder installations

FIGURE 13 - CYLINDER INSTALLATIONS (WITH REGULATORS IN THE SECTION TO BE TESTED)



(a) Wall mounted second stage regulator



(b) Wall mounted third stage regulator

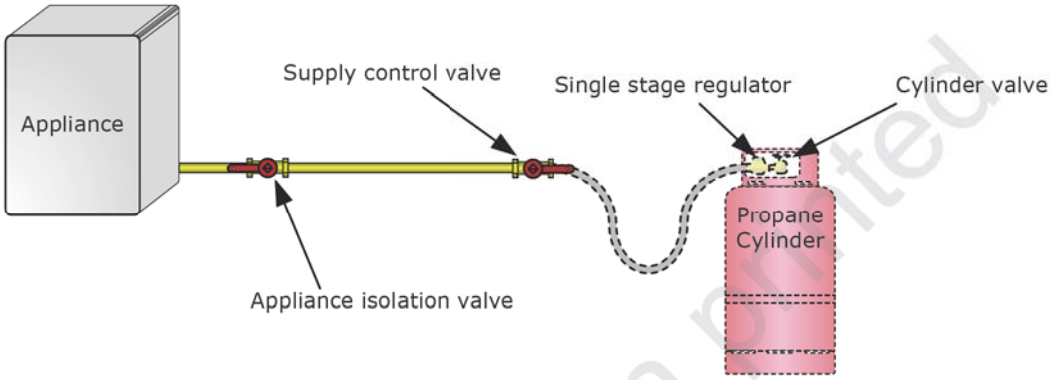
FIGURE 14 - BULK STORAGE VESSEL INSTALLATIONS (WITH REGULATORS IN THE SECTION TO BE TESTED)

A6.2 TYPICAL LPG INSTALLATIONS WITHOUT A REGULATOR IN THE SECTION TO BE TESTED

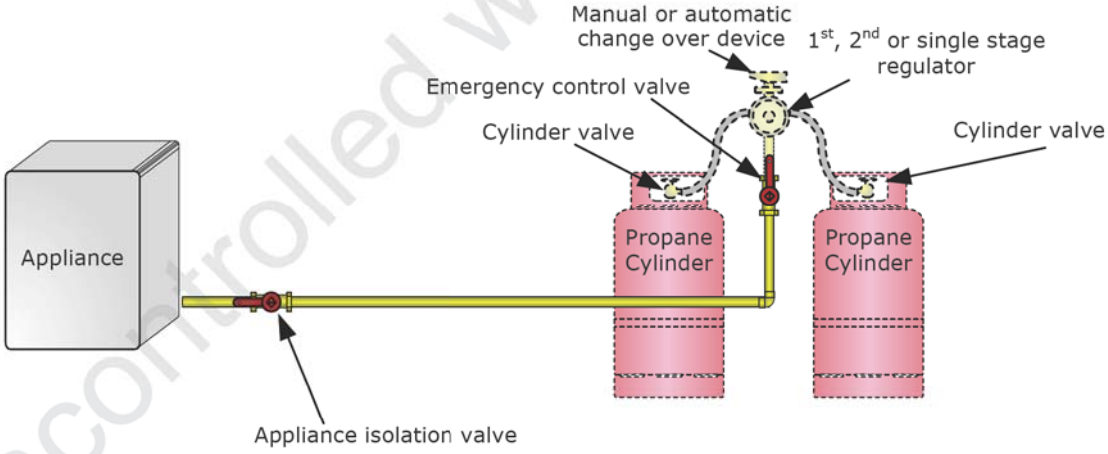
Propane installations fitted with a supply control valve on the outlet of the final stage regulator (set at 37 mbar). Testing from the supply control valve for:

- cylinder fed installations (see Figure 15)
- bulk storage vessel fed installations (see Figure 16).

Note: The extent of the installations that the tightness test procedure covers in these situations is illustrated by the solid lines in Figures 15 and 16.

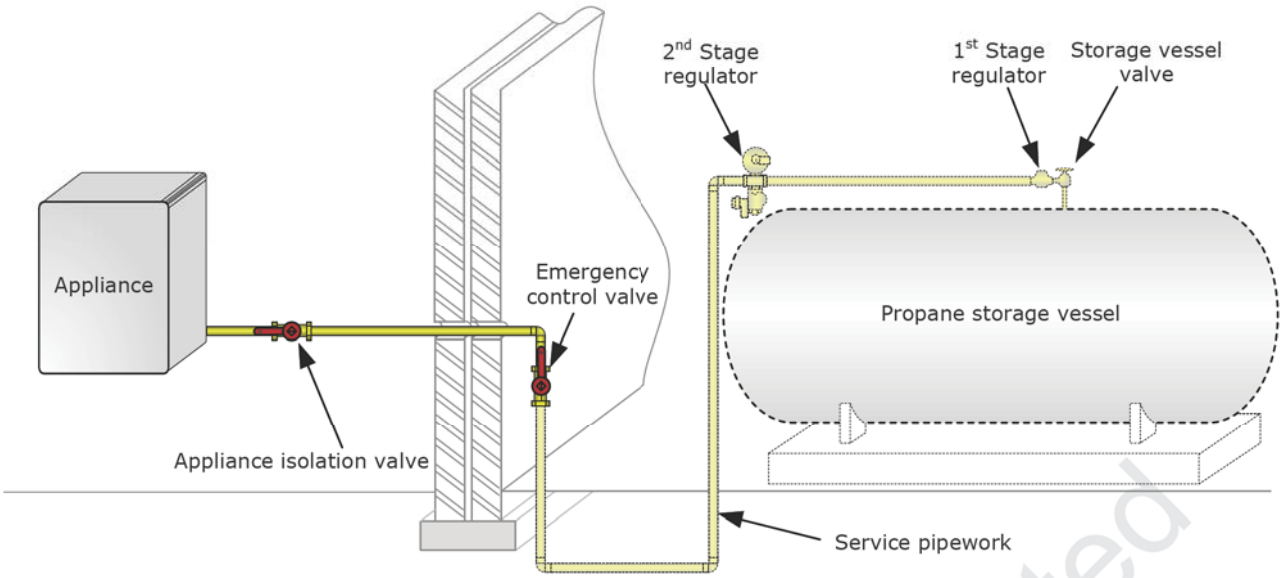


(a) Single cylinder (Propane) installation

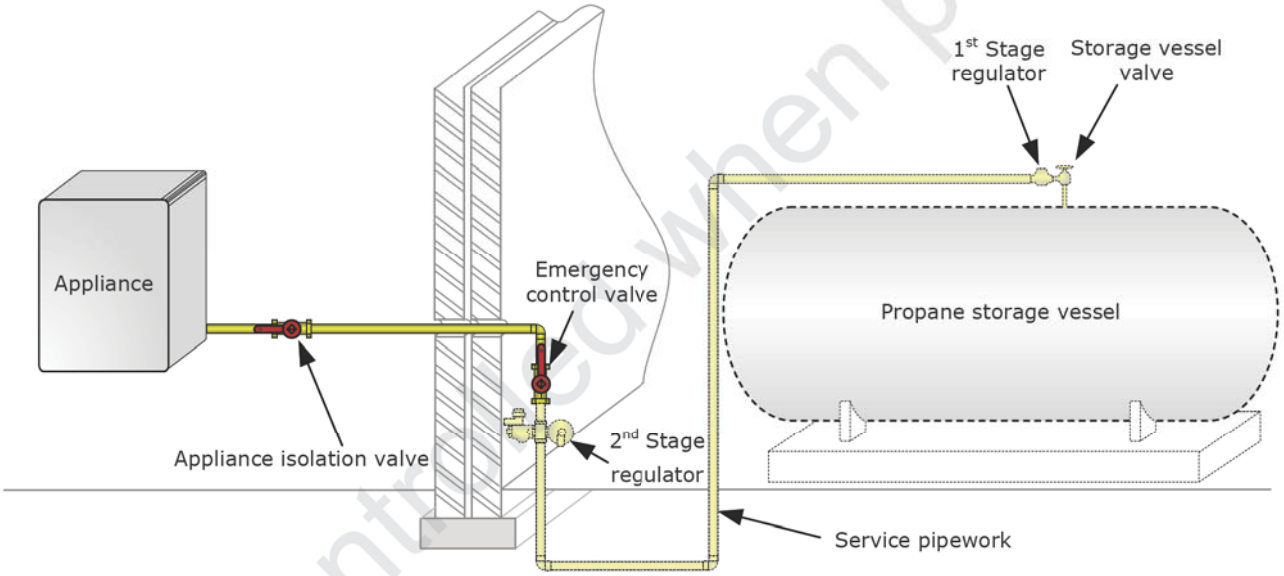


(b) Multiple cylinder installation

FIGURE 15 - CYLINDER INSTALLATIONS



(a) Storage vessel mounted second stage regulator



(b) Wall mounted second stage regulator

FIGURE 16 - BULK STORAGE VESSEL INSTALLATIONS

APPENDIX 7 : ESTIMATING INSTALLATION VOLUME (IV) AND PURGE VOLUME (PV)

A7.1 IV

The estimation of IV involves surveying the whole of the pipework section to be tested, unless it is a very simple section (for example, one straight length of pipe).

Note: The IV and PV values are always different. IV is used for determining whether the installations can be tightness tested and purged to IGEM/UP/1B.

Take note of the relevant dimensions of all components including any:

- meter
- pipe
- fitting, including any regulator, bend, tee, etc
- inaccessible section of pipework.

Note: For inaccessible pipework where there are different sizes of pipework of unknown length, always assume the largest size for the maximum length.

When existing pipework is to be extended, the total volume of the new and existing sections has to be less than 0.035 m^3 (see Sub-Section 2.2).

A7.2 PV

PV is calculated using the installation volume.

A7.3 CALCULATIONS

Calculate the total IV (IV_t) (m^3).

$IV_{total\ (t)} = IV_{meter\ (m)} + IV_{pipe\ (p)} + IV_{fittings\ (f)}$.

(a) IV of meters (IV_m)

Use Table 7 or consult the meter manufacturer for any other meter.

METER DESIGNATION	IV_m (m^3)
E6	0.0024
U6, G4	0.008
U16, G10	0.025

Note: For diaphragm meters, previously the cyclic volume has been used to calculate the PV.

TABLE 7 - IV OF METERS

(b) **IV of pipe (IV_p)**

For a 1 m length of pipe, obtain the volume of the particular pipe as given in Table 8. Multiply the value given by the length of the pipe in the section.

MATERIAL AND NOMINAL SIZE OF PIPE (mm)	(in)	VOLUME OF 1 m LENGTH OF PIPE (m^3)
Steel/stainless steel/CSST		
15	1/2	.00024
20	3/4	.00046
25	1	.00064
32	1 1/4	.0011
Copper		
15		.00014
22		.00032
28		.00054
35		.00084
PE SDR 11		
20		.00019
25		.00033
32		.00053

TABLE 8 - VOLUME OF 1 m LENGTH OF PIPE

(c) **IV of valves, fittings, pressure vessels, accumulators, etc. (IV_f)**

Add any additional volume caused by such components.

In the event that IV_f cannot be calculated, add an additional 10% of IV_p.

(d) **Total IV (IV_t)**

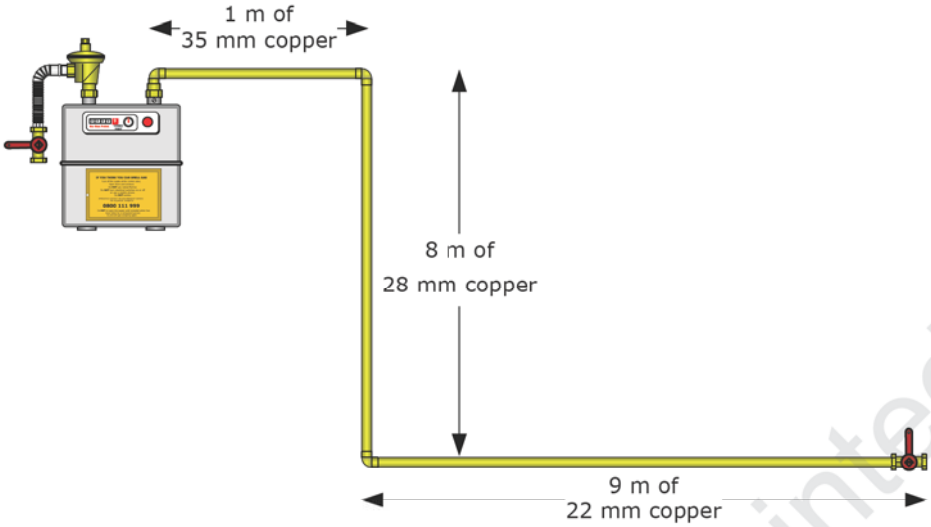
$IV_t = IV_m + IV_p + IV_f$

(e) **PV**

$PV = 1.5 \times IV_t$

A7.4 **EXAMPLES**

Example 1: A U6 meter, but with unusually long pipe runs.

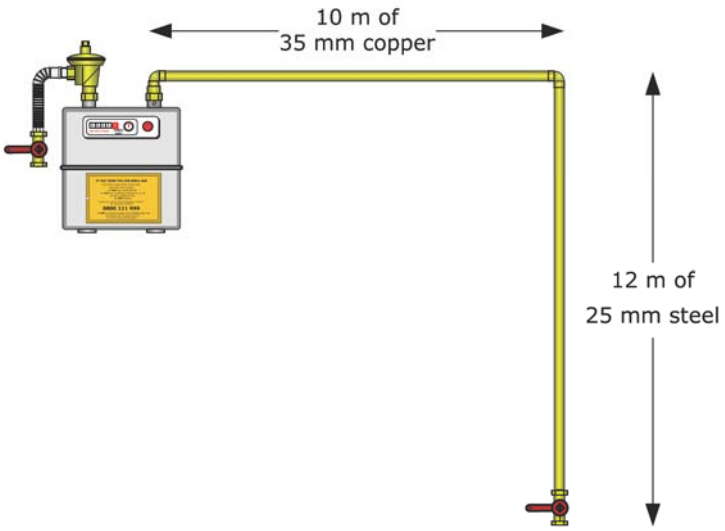


INSTALLATION VOLUME (IV)		
Meter (IV_m)		
U6 Diaphragm Meter	IV_m =	0.008 m^3
Pipework (IV_p)		
1 m of 25 mm (Copper)	1 x 0.00084 =	0.00084 m^3
8 m of 28 mm (Copper)	8 x 0.00054 =	0.00432 m^3
9 m of 22 mm (Copper)	9 x 0.00032 =	0.00288 m^3
	IV_p =	0.00804 m^3
Fittings (IV_f)		
0.1 x IV_p	IV_f =	0.000804 m^3
Total volume (IV_t)		
IV_m+ IV_p + IV_f	IV_t =	**0.017 m^3**
PURGE VOLUME (PV)		
1.5 x IV_t	PV =	**0.026 m^3**

This can be purged in accordance with IGEM/UP/1B (because installation volume is less than 0.035 m^3).

The purged fuel gas/air mixture can either be vented to atmosphere (because installation volume is less than 0.02 m^3) or ignited at a burner.

Example 2: A U6 meter, but with unusually long pipe runs.

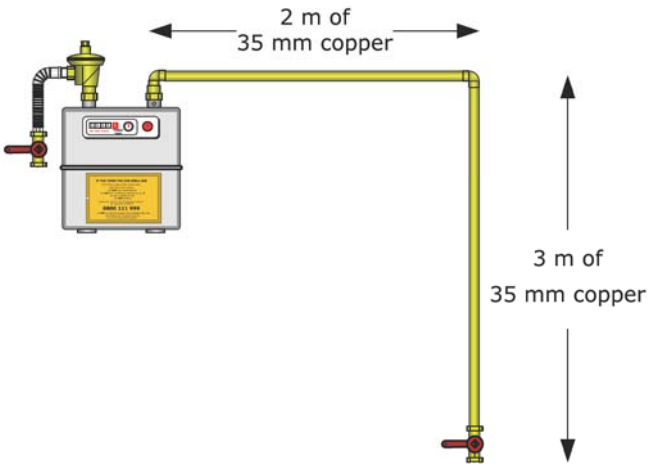


INSTALLATION VOLUME (IV)		
Meter (IV_m)		
U6 Diaphragm Meter	IV_m =	0.008 m^3
Pipework (IV_p)		
10 m of 35 mm (Copper)	10 x 0.00084 =	0.00840 m^3
12 m of 25 mm (Steel)	12 x 0.00064 =	0.00768 m^3
	IV_p =	0.01608 m^3
Fittings (IV_f)		
0.1 x IV_p	IV_f =	0.001608 m^3
Total volume (IV_t)		
IV_m+ IV_p + IV_f	IV_t =	**0.026 m^3**
PURGE VOLUME (PV)		
1.5 x IV_t	PV =	**0.039 m^3**

This can be purged in accordance with IGEM/UP/1B (because installation volume is less than 0.035 m^3).

The purged fuel gas/air mixture has to be ignited at a burner and as soon as possible (because installation volume is greater than 0.02 m^3).

Example 3: A U16 meter with short pipe runs of large diameter.

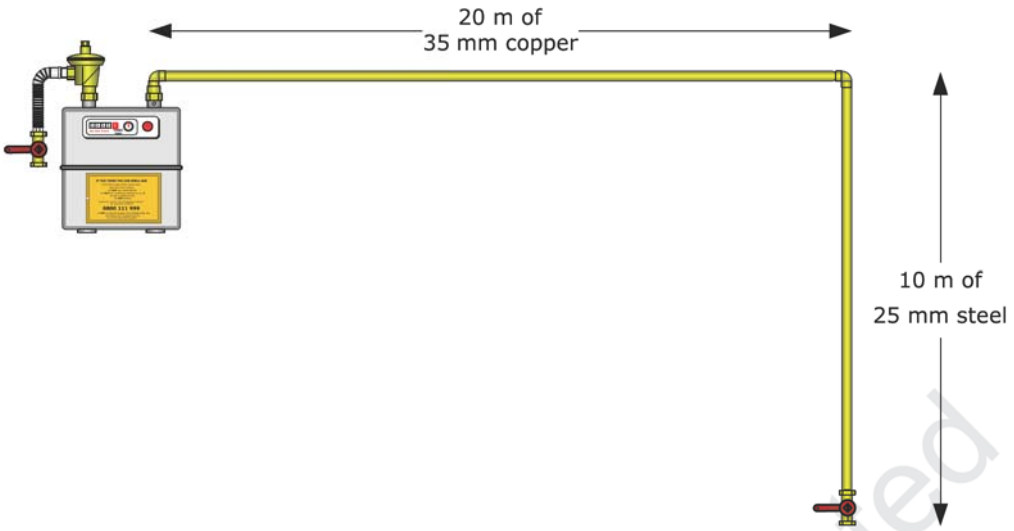


INSTALLATION VOLUME (IV)		
Meter (IV_m)		
U16 Diaphragm Meter	IV_m =	0.025 m^3
Pipework (IV_p)		
2 m of 35 mm (Copper)	2 x 0.00084 =	0.00168 m^3
3 m of 35 mm (Copper)	3 x 0.00084 =	0.00252 m^3
	IV_p =	0.0042 m^3
Fittings (IV_f)		
0.1 x IV_p	IV_f =	0.00042 m^3
Total volume (IV_t)		
IV_m+ IV_p + IV_f	IV_t =	**0.03 m^3**
PURGE VOLUME (PV)		
1.5 x IV_t	PV =	**0.045 m^3**

This can be purged in accordance with IGEM/UP/1B (because installation volume is less than 0.035 m^3).

The purged fuel gas/air mixture has to be ignited at a burner and as soon as possible (because installation volume is greater than 0.02 m^3).

Example 4: A U16 meter with longer pipe runs of mixed diameters.



INSTALLATION VOLUME		
Meter (IV_m)		
U16 Diaphragm Meter	IV_m =	0.025 m^3
Pipework (IV_p)		
20 m of 35 mm (Copper)	20 x 0.00084 =	0.00168 m^3
10 m of 25 mm (Steel)	10 x 0.00064 =	0.0064 m^3
	IV_p =	0.0232 m^3
Fittings (IV_f)		
0.1 x IV_p	IV_f =	0.00232 m^3
Total volume (IV_t)		
IV_m+ IV_p + IV_f	IV_t =	**0.051 m^3**

This can neither be tested nor purged in accordance with IGEM/UP/1B (see Sub-Section 2.2).

APPENDIX 8 : MAXIMUM PERMISSABLE PRESSURE DROPS FOR EXISTING LPG INSTALLATIONS WITH APPLIANCES CONNECTED

A8.1 The IV needs to be calculated to utilise the permissible pressure drops in this Appendix.

For existing installations where appliances are connected, if the pressure drop does not exceed the values given in Tables 9 and there is no smell of gas, the installation may be deemed to have passed the test. Otherwise, the installation has failed the test.

INSTALLATION VOLUME	MAXIMUM PERMISSIBLE PRESSURE DROP
$\leq 0.0025\ m^3$	2 mbar
$> 0.0025\ m^3 \leq 0.005\ m^3$	1 mbar
$> 0.005\ m^3 \leq 0.01\ m^3$	0.5 mbar
$> 0.01\ m^3 \leq 0.035\ m^3$	No perceptible movement (Fall)

TABLE 9 - MAXIMUM PERMISSIBLE PRESSURE DROP FOR EXISTING INSTALLATIONS WITH APPLIANCES CONNECTED (PROPANE OR BUTANE INSTALLATIONS)