

***IGEM/GM/8 Part 1 Edition 2
Communication 1795***

***Meter installations of flow exceeding
6 m³ per hour***

Part 1: Design



*Founded 1863
Royal Charter 1929
Patron: Her Majesty the Queen*

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SECTION 1 : INTRODUCTION

- 1.1 This Standard supersedes IGE/GM/8 Part 1 Edition 1, Communication 1706, which is obsolete.
- 1.2 This Standard has been drafted by an Institution of Gas Engineers and Managers (IGEM) Panel, appointed by IGEM's Gas Measurement Committee, subsequently approved by that Committee and has been approved by IGEM's Technical Co-ordinating Committee on behalf of the Council of IGEM.
- 1.3 IGEM/GM/8 is published in 5 parts:
- Part 1 covering design
 - Part 2 covering locations, housings and compounds
 - Part 3 covering installation and commissioning
 - Part 4 covering operation and maintenance
 - Part 5 covering notices and labels.
- 1.4 This Standard covers the design of gas supply meter installations (see Sub-Section 2.1) of capacity greater than $6 \text{ m}^3 \text{ h}^{-1}$ and maximum operating pressure (upstream) (MOP_u) not exceeding 38 bar.

With the exception of the few installations of MOP_u exceeding 38 bar, the majority of industrial and commercial meter installations can be designed by following IGEM/GM/6 (for MOP_u not exceeding 75 mbar only) and/or IGEM/GM/8.

It is the intention that IGEM/GM/6 be used for the largest proportion of installations that can be covered by "standard designs" for MOP_u not exceeding 75 mbar.

For $75 \text{ mbar} < \text{MOP}_u \leq 38 \text{ bar}$ or where an installation is not a "standard design" as specified in IGEM/GM/6, IGEM/GM/8 applies (see also Note 4 to Sub-Section 2.1).

For a turbine meter installation of MOP_u not exceeding 75-mbar, there are no recognised standard designs i.e. IGEM/GM/6 does not apply. It is recommended that IGEM/GM/8 be used for all such installations.

For any meter installation of MOP_u exceeding 38 bar, IGE/GM/4 applies.

- 1.5 This Standard applies to new, onshore, gas supply meter installations only. It is not retrospective. However, where work needs to be undertaken on a meter installation, it is recommended that such an installation be brought into line with this Standard. In particular, any unregulated by-pass needs to be removed or a regulator installed in the by-pass.

When re-engineering or replacing legacy meter installations, consideration is to be given to bringing them in line with the standard arrangements within IGEM/G/1. Unless all involved parties are in agreement to continue the legacy arrangement, it is expected that if reasonably practicable such existing systems will be modified to meet the recommended approach.

Irrespective of whether an emergency control valve (ECV) is fitted to the inlet of the meter installation, it is recommended that modification work be undertaken in line with this Standard.

Over recent years, ownership and responsibility for new installations covered by this Standard has been liberalised from gas transporters (GTs) to Meter Asset

Managers (MAMs) and consumers. The regulation authority, the Office of Gas Supply (OFGAS), and later the Office of Gas and Electricity Markets (Ofgem) have required that MAMs and installers are separately accredited for the work they carry out. Approved MAMs have operational and management responsibility while Approved Meter Installers (currently OAMI) carry out meter work, installation, modification, repair, maintenance and removal activities, both work to the relevant Supply Point Administration Agreement (SPAA)/Ofgem Codes of Practice:

- SPAA Meter Asset Managers Code of Practice (MAMCOP)
- Ofgem Codes of Practice for Meter Installations (CoP/1a, CoP/1b and CoP/1c).

At the same time, new licence conditions have made gas suppliers responsible for coordinating the provision of metering services and have placed responsibilities on GTs to underpin the overall safety of the gas supply system from the distribution main to the outlet of the consumer's appliances.

Note: Under these arrangements, a SPAA approved MAM does not have to be an OAMI, but has an obligation to use an OAMI to carry out work on a meter installation.

Notwithstanding Sub-Section 1.11, total compliance with IGEN/GM/8 is necessary for installations and modules where the meter installation has to comply with the MAMCoP.

1.6 This Standard does not detail the management processes required for compliance with the Pressure Systems Safety Regulations (PSSR); such guidance is provided by IGEN/GL/5. It is intended that work carried out in accordance with this Standard and IGEN/GL/5 will conform to the requirements of PSSR.

1.7 Terms such as "maximum operating pressure" (MOP), "maximum incidental pressure" (MIP) and "operating pressure" (OP) are used to reflect gas pressure terminology used in European standards. These terms are used in all relevant IGEN standards and, possibly, in other standards. Other terms have been introduced to assist in recognition of design information to be transferred between interested parties.

Note: Appendix 11 shows an explanation of the terms used by setting out the definitions of the terms, explaining the suffixes, the relationship between the terms, and their significance. It is strongly recommended that Appendix 11 be read immediately.

1.8 This Standard makes use of the terms "must", "shall" and "should" when prescribing particular requirements. Notwithstanding Sub-Section 1.11:

- the term "must" identifies a requirement by law in Great Britain (GB) at the time of publication
- the term "shall" prescribes a procedure which, it is intended, will be complied with in full and without deviation
- the term "should" prescribes a procedure which, 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 Code of Practice (ACoPs) or guidance, and reference needs to be made to such statutory legislation or official guidance for information on legal obligations.

1.9 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 primary responsibilities. Employers must:

- have done everything to ensure, so far as it 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 not within 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 which deviate from this, they should refer the matter for higher review.

1.10 It is now widely accepted that the majority of accidents in industry 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 in a more appropriate manner 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 regard be paid to HSG48.

1.11 Notwithstanding Sub-Section 1.8, 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 are to 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.

1.12 Requests for interpretation of this Standard in relation to matters within their scope, but not precisely covered by the current text, need to be addressed in writing to Technical Services, The Institution of Gas Engineers and Managers, Igem House, High Street, Kegworth, Derbyshire DE74 2DA, or emailed to technical@igem.org.uk, 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.

1.13 This Standard was published in October 2016.

SECTION 2 : SCOPE

- 2.1 This Standard applies to all new, onshore, Natural Gas (NG) supply meter installations (hereafter referred to as "installations") (and defined in IGE/G/1) of flow rate (capacity) exceeding $6 \text{ m}^3 \text{ h}^{-1}$ and MOP upstream (MOP_u) not exceeding 38 bar.

Installations with the following types of meter are covered:

- diaphragm
- rotary displacement (RD)
- turbine
- ultrasonic (USM).

Note 1: For installations of capacity not exceeding $6 \text{ m}^3 \text{ h}^{-1}$, intended to carry NG, BS 6400-1 or BS 6400-2 apply, as appropriate for MOP_u . For non-domestic premises, there are additional legal requirements that may have to be met, e.g. DSEAR.

The requirements of this document may be applied to installations of capacity not exceeding $6 \text{ m}^3 \text{ h}^{-1}$ and MOP_u exceeding 2 bar.

Note 2: For installations of MOP_u exceeding 38 bar, IGE/GM/4 applies and IGE/TD/13 may be used for the regulation of pressure, however, where the metering pressure is not exceeding 38 bar, this Standard applies. Where IGE/TD/13 is used, the control and fault pressure ranges have to be acceptable to the consumer; it may be necessary to apply tolerances required by IGE/GM/8 to IGE/TD/13 control philosophy.

Note 3: Primarily, IGE/GM/8 has been produced for primary meters and other meters used for billing purposes. However, its principles may be applied for other meters, for example appliance check meters or departmental charging meters, when certain procedures may not apply.

Note 4: IGE/GM/6 provides requirements for "standard" installations of MOP_u not exceeding 100 mbar. For other, "non-standard", installations of MOP_u not exceeding 100 mbar, IGE/GM/8 applies. See also the note within Sub-Section 1.4.

Note 5: For turbine meters and USMs, in addition to IGE/GM/8, some of the principles of IGE/GM/4 may apply and further useful information is also included.

Note 6: IGE/GM/8 does not address the Network pipeline (see IGE/TD/1, IGE/TD/3, IGE/TD/4 and IGE/G/5, as appropriate). IGE/GM/8 does not address requirements for a pressure regulating installation (PRI) installed in a Network pipeline that is not part of the meter installation, when IGE/TD/13 applies.

- 2.2 This Standard covers installations that are wholly downstream of the outlet of the ECV as recommended in IGE/G/1, in which case the installation is not part of the Network. The owner or user of the installation would not, therefore, be a conveyor of gas on the Network and would not be subject to the general duties of the Gas Safety (Management) Regulations (GS(M)R). Similarly, the owner or user of the installation would not be an operator of a pipeline and, therefore, would not be subject to the requirements of the Pipelines Safety Regulations (PSR). However, the installation may be subject to the requirements of PSSR.

Notwithstanding the above paragraph, IGE/GM/8 may be applied when undertaking work on legacy meter installations that do not have an ECV located on their inlet, but have a valve within the meter installation nominated as the ECV. In such installations the section of the installation upstream of the ECV will be subject to the requirements of GS(M)R which will have to be complied with in addition to IGE/GM/8.

- 2.3 This Standard applies to installations intended to carry NG (a 2nd family gas as defined by BS EN 437).

Note: The Gas Safety (Installation and Use) Regulations (GS(I&U)R) define "gas" to include 1st, 2nd and 3rd family gases as well as other gases. The principles of IGEN/GM/8 may be used for gases other than NG but suitable adjustments to parameters and procedures will need to be considered by a competent person.

- 2.4 This Part 1 of IGEN/GM/8 deals with the design of relevant installations.

- 2.5 All pressures are gauge pressures unless otherwise stated.

- 2.6 Italicised text is informative and does not represent formal requirements.

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

SECTION 3 : LEGAL AND ALLIED CONSIDERATIONS

3.1 GENERAL

- 3.1.1 This Standard is set out against a background of legislation in force in GB at the time of publication. The devolution of power to the Scottish, Welsh and Northern Ireland Assemblies means that there may be variations to the legislation described below for each of them and consideration of their particular requirements must be made. Similar considerations are likely to apply in other countries, where reference to appropriate national legislation is necessary.

All relevant legislation must be applied and relevant ACoPs, official Guidance and referenced CoPs, standards, etc. shall be taken into account.

Note: Appendix 2 is relevant in this respect.

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

- 3.1.2 Persons who design meter installations must have a knowledge and understanding of the standards and regulations that apply to ensure that the completed plans will produce a safe and satisfactory installation.

Persons who install or maintain meter installations must be competent to do so and compliance with GS(I&U)R must be achieved where those Regulations apply (see IGEN/GM/8 Parts 3 and 4, respectively).

At the time of publication, the body with HSE approval to operate and maintain a register of businesses who are "members of a class of persons" is Gas Safe Register. Therefore, all businesses or self-employed gas fitters working on meter installations must be registered with Gas Safe Register where GS(I&U)R apply.

Persons deemed competent to carry out gas work are those who hold a current certificate of competence in the type of activity to be conducted issued by a certification body accredited by the United Kingdom Accreditation Service (UKAS), to issue certificates of competence under the Nationally Accredited Certification Scheme for Individual Gas Fitting Operatives (ACS).

- 3.1.3 Any meter installation used by a gas supplier for the purpose of billing shall be designed, installed, commissioned and maintained in accordance with the MAMCoP.
- 3.1.4 Any meter of capacity not exceeding $1600 \text{ m}^3 \text{ h}^{-1}$ used to render a charge must be approved and stamped, as required by the Gas Act, under the Gas (Meters) Regulations 1983 and the Measuring Instruments (Gas Meters) Regulations 2006 (see clause 12.1.2).
- 3.1.5 Some GTs operate an approval scheme under their Safety Case arrangements as a pre-requisite for authorising an OAMI to set any meter regulator or to break a regulator seal. Therefore, an OAMI must seek advice from the relevant GT before carrying out such procedures.

3.2 BUILDING REGULATIONS

3.2.1 England and Wales (As Amended)

Building Regulations are Statutory Instruments that are required to be followed when engaged in any building work. They are written in a format of broad Regulations, setting out simple requirements in a Separate Schedule. Suggested

ways of complying with these Regulations are contained in Approved Documents.

The Approved Documents that apply to gas work are:

- A (Structure)
- B (Safety in Fire)
- F (Ventilation).

3.2.2 **Building Standards (Scotland) Regulations and Amendments**

The Building Standards (Scotland) are written directly as Regulations within the Statutory Instrument. The Regulations can be satisfied:

- by compliance with Technical Standards published by the Scottish Government
- conforming with the provisions of "deemed to satisfy" documents, for example British Standards
- other equivalent means.

3.3 **CONFINED SPACES REGULATIONS**

These Regulations apply to a whole range of confined spaces. The supplier or designer of an enclosure and equipment within it is required to perform a risk assessment of the enclosure with respect to safe access and egress and to give clear instructions to operators on access/egress as well as to what actions to take in the event of a gas alarm occurring. Employers and the self employed are required to prevent entry into confined spaces unless avoidance is not reasonably practicable and unless there is a system of work which renders the work safe. They are also required to have specific emergency arrangements in place.

3.4 **CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS (CDM)**

These Regulations impose duties on designers, clients (and their agents), developers, principal designer and principal contractors.

Further information is given in L153, which sets out the principles duty holders are required to use in their approach to identifying the measures they need to take to control the risks to health and safety in a particular project.

The general principles of prevention are to:

- avoid risks where possible
- evaluate those risks that cannot be avoided, and
- put in place proportionate measures that control them at source.

Construction includes the alterations, repair, re-decoration, maintenance, de-commissioning or demolition of a structure. It also covers installation, commissioning, maintenance or removal of gas services.

3.5 **CONTROL OF ASBESTOS AT WORK REGULATIONS**

3.5.1 These Regulations set out standards for the identification, monitoring and assessment of work that may expose workers to asbestos and the measures needed to control the risk.

3.5.2 Employers cannot carry out any work that exposes, or is likely to expose, employees to asbestos unless an assessment of that exposure has been made. Employers have to set out steps to be taken to prevent, or reduce to the lowest

level reasonably practicable, that exposure. Employers have to carry out medical surveillance of employees if they work over a certain time limit.

3.5.3 The Regulations impose a duty on those with responsibilities for the repair and maintenance of non-domestic premises to find out if there are, or may be, asbestos containing materials within them; to record the location and condition of such materials and assess and manage any risk from them, including passing of any information about their location and condition to anyone likely to disturb them.

3.5.4 Further information is available in HSG227. Other HSE documents associated with these Regulations are L143 and INDG 223.

3.6 **CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH REGULATIONS (COSHH)**

3.6.1 These Regulations, which reinforce existing statutory obligations under HSWA, impose a duty on employers to protect employees against risks to health, whether immediate or delayed, arising from exposure to substances hazardous to health, either used or encountered, as a result of a work activity. They also impose certain duties on employees.

3.6.2 Under COSHH, work is not be carried out which is liable to expose employees to hazardous substances unless the employer has made a suitable and sufficient assessment of the risk created by the work and the steps that need to be taken to comply with the Regulations. After assessing the risk, it is necessary to inform employees of the risks and to carry out the appropriate training and instruction to ensure the risks are minimised. In certain cases, control measures such as ventilation or personal protective equipment may be necessary and, where provided, they are required to be used.

3.7 **DANGEROUS SUBSTANCES AND EXPLOSIVE ATMOSPHERES REGULATIONS (DSEAR)**

These Regulations are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. The Regulations require that risks from dangerous substances are assessed, eliminated or reduced. They contain specific requirements to be applied where an explosive atmosphere may be present and require the provision of arrangements to deal with accidents, emergencies etc. and provision of information, training and use of dangerous substances. The Regulations also require the identification of pipelines and containers containing hazardous substances.

The following publications contain details of the Regulations and their application:

- L138
- INDG 370.

3.8 **ELECTRICITY AT WORK REGULATIONS**

These Regulations apply to a wide range of electrical work, from overhead power lines to the use of office computers and batteries and include work on gas equipment using electrical energy.

They are concerned with the prevention of danger from electric shock, electric burn, electrical explosion or arcing, or from fire or explosion initiated by electrical energy.

3.9 **GAS (CALCULATION OF THERMAL ENERGY) REGULATIONS**

3.9.1 These regulations provide for the calculation of thermal energy of gas conveyed by GTs to premises, or to pipelines operated by other GTs, on the basis of the calorific values and volumes of gas conveyed. The calorific values of the gas may be either determined by, or declared by, the GT in accordance with the regulations. The metered gas volumes may be adjusted for the temperature, pressure and compressibility factor of the gas.

3.9.2 Information on converting the actual volume measured into the volume at standard conditions, the methods of determining daily calorific values, and the calculation of thermal energy, is given in Appendix 12.

3.9.3 They impose duties on every employer, employee and self-employed person and require that persons engaged in electrical work be competent or be supervised by competent persons.

Note: A "Memorandum of Guidance on the Electricity at Work Regulations, 1989" is available from HMSO and gives useful information on the Regulations. Further advice is contained in HSR25.

3.10 **GAS (METERS) REGULATIONS**

3.10.1 **Legislation**

3.10.1.1 In GB, The Gas Act 1986, as amended, requires that certain gas meters (within the scope of IGEM/GM/8) used for measuring the quantity of gas supplied be stamped.

3.10.1.2 The Gas Act 1986, as amended, defines that a meter exceeding a capacity of 1600 cubic metres per hour, at standard conditions, need not be stamped.

3.10.1.3 There are three different regulations covering the approval of gas meters in Great Britain which sit under the Gas Act 1986, as amended. These are:

a) New meters approved prior to the 30 October 2006

- i. The Gas (Meters) Regulations 1983, SI 1983/684, as amended
- ii. The Measuring Instruments (EEC Requirements) Regulations, as amended, SI 1988/296 – for meters applicable to European requirements.

b) New meters approved post 30th October 2006

- i. The Measuring Instruments (Gas Meters) Regulations 2006, SI 2006/2647.

3.10.1.4 The requirements in the Measuring Instruments (Gas Meters) Regulations is subtly different from that of the Gas Act as these regulations have effectively amended the Act, in that the 1600 m³ h⁻¹ limit is applied to the quantity of gas supplied (when measured at standard conditions) to the consumer and is not related to the meter's design capabilities.

3.10.2 **MID meter designs**

Under the Measuring Instruments (Gas Meters) Regulations all new meter designs (and any subsequent production of that type) are required to undertake a conformity assessment by a notified body, designated by an EU Member state, to ensure that they meet the essential requirements of MID. All meters conforming to MID have to bear the "CE" markings and the "M" marking followed by the year of manufacture (for example a meter manufactured in 2013

would have the following MID marking M13) and a four-digit code representing the Notified Body that undertook the conformity assessment. The manufacturer will be issued with a certificate from the assessing notified body proving that the meter design meets the requirements of the conformity assessment. A copy of this may be provided by the manufacturer on request.

Where a gas meter is placed on the market and put into use in accordance with the Measuring Instruments (Gas Meters) Regulations, and bears the appropriate markings, it is then deemed to be stamped and therefore compliant with The Gas Act.

3.10.3 **Pre-MID meter designs**

New meter designs cannot now be submitted for type approval under pre-MID arrangements. However, MID does allow manufacturers to continue to stamp meters already approved under the pre-MID regulations without having to have them reassessed under the Measuring Instruments (Gas Meters) Regulations. This is permitted until 30th October 2016 whereupon all meters placed on the market will be required to conform to MID.

3.10.4 **Meters already in service**

A gas meter, once put into use, is permitted to stay in-service until its performance no longer meets the requirements of the regulations applicable to that meter when it first went into service (MID or pre-MID). There are no specific requirements for the in-service limits for meters under the Gas (Meters) Regulations; however the National Measurement and Regulation Office would expect such meters to meet their initial requirement. The Measuring Instruments (Gas Meters) Regulations do include specific limits.

Only meters that meet the in-service limits are deemed stamped and therefore comply with the Gas Act 1986, as amended.

3.10.5 **Disputed meters**

The Gas (Meters) Regulations deal with the re-examination of disputed meters whereas the Measuring Instruments (Gas Meters) Regulations amend those regulations to reflect the different in-service accuracy requirements of MID meters.

Requirements for those meters stamped under previous arrangements are maintained and are not modified by the MID accuracy requirements.

3.11 **GAS SAFETY (INSTALLATION AND USE) REGULATIONS (GS(I&U)R)**

3.11.1 GS(I&U)R are relevant statutory provisions of HSWA setting out general and detailed requirements dealing with the safe installation, maintenance and use of gas systems, including gas fittings, appliances and flues.

3.11.2 GS(I&U)R define the type of work that requires persons carrying out such work, or their employers, to be an "approved class of person", i.e. Gas Safe registered.

3.11.3 GS(I&U)R requires all those undertaking gas work to be competent. L56 provides guidance as those allowed to undertaking gas work and the training that needs to be provided. The requirements for training in gas work are set out in IGEN/IG/1.

3.11.4 The installer is required to check the safety of any meter installation they install or work on and take appropriate action where they find faults. Where the premises are let or hired out, the landlord or hirer has special responsibilities to

ensure that any installer they use for the gas fitting, service or maintenance or safety is a member of an approved class of persons (see clause 3.4.2) and is competent to carry out such work. If any serious fault is found, the installer is required to inform both the landlord/hirer, as well as the user, so that such faults can be rectified before further use.

3.12 **GAS SAFETY (MANAGEMENT) REGULATIONS (GS(M)R)**

3.12.1 GS(M)R place specific duties on GTs, or their emergency service providers (ESPs), for dealing with gas escapes from pipes on their network. Their primary duty is to make the situation safe. They are responsible not only for dealing with escapes from their own pipes, but also for dealing with escapes from gas fittings supplied with gas from pipes on their network. In GS(M)R, the term "gas escapes" includes escapes or emissions of carbon monoxide (CO) from gas fittings.

3.12.2 The ESP has specific duties to:

- provide a continuously staffed and free telephone service to enable persons to report gas escapes and
- pass such reports on to the person who has the responsibility for dealing with the escape.

In addition, there are duties imposed on gas suppliers and GTs to notify the ESP should they, rather than the ESP, receive a report of an escape from the consumer.

3.12.3 GS(M)R require GTs to investigate fire and explosion incidents upstream of the ECV and to send a report of the investigation to HSE. GTs are also required to investigate fire and explosion incidents downstream of the ECV but this is limited to establishing whether the seat of the fire or explosion was in an appliance (and if so, which one) or in the installation pipework.

3.12.4 Responsibility for investigating RIDDOR reportable incidents (see Sub-Section 3.9) as a result of an escape of CO from incomplete combustion of gas from a gas fitting, is placed on gas suppliers. HSE is required to be notified before such investigations commence.

Note: Advice on dealing with gas escapes is contained in IGEM/SR/29.

3.13 **HEALTH AND SAFETY AT WORK ETC. ACT (HSAW)**

HSAW applies to all persons involved with work activities, including employers, the self-employed, employees, designers, manufacturers, suppliers etc. as well as the owners of premises. It places general duties on such people to ensure, so far as is reasonably practicable, the health, safety and welfare of employees and the health and safety of other persons such as members of the public who may be affected by the work activity.

3.14 **MANAGEMENT OF HEALTH AND SAFETY AT WORK REGULATIONS (MHSWR)**

In addition to specific duties under GS(I&U)R (see Sub-Section 3.4) MHSWR impose a duty on employers and the self-employed to make assessments of risks to the health and safety of employees, and non-employees affected by their work. They also require effective planning and review of protective measures.

3.15 **PRESSURE EQUIPMENT REGULATIONS (PER)**

- 3.15.1 These Regulations cover pressure equipment manufactured and sold throughout the European Community with a maximum allowable pressure greater than 0.5 bar. The Regulations deal with the manufacture, design and supply of pressure equipment. They impose duties on the responsible person.

Note: A "responsible person" is defined as "the manufacturer or his authorised representative established within the Community; or where neither the manufacturer nor his authorised representative is established within the Community, the person who places the pressure equipment or assembly on the market or puts it into service as the case may be."

- 3.15.2 "Pressure equipment" is defined as "vessels, piping, safety accessories and pressure accessories; where applicable, pressure equipment includes elements attached to pressurised parts, such as flanges, nozzles, couplings, supports, lifting lugs and similar."

The duties on the "responsible person" are to ensure that pressure equipment:

- satisfies the relevant essential requirements
- has undergone the relevant conformity assessment procedure, if applicable
- has had the CE mark affixed by the manufacturer, if applicable
- has had the declaration of conformity drawn up by the manufacturer that the equipment is, in fact, safe.

Note: Not all pressure equipment is covered by PER. There are 21 categories of exceptions, detailed in Schedule 1 of PER.

- 3.15.3 The relevant conformity assessment procedure is determined by the classification of the pressure equipment according to criteria laid down in the Regulations. The classification system results in equipment being placed in one of five categories depending on the inherent level of hazard within the system.

The category then determines the range of conformity assessment modules relevant to that equipment. The modules are designed to allow the manufacturer to choose between a quality assurance route or type testing.

3.16 **PRESSURE SYSTEMS SAFETY REGULATIONS (PSSR)**

- 3.16.1 These Regulations impose duties on designers, importers, suppliers, installers and users or owners to ensure that pressure systems do not give rise to danger. This is done by the correct design installation and maintenance, provision of information, operation within safe operating limits and, where applicable, examination in accordance with a written scheme of examination drawn up or approved by a competent person (as defined by PSSR).

- 3.16.2 Relevant fluids referred to in the Regulations for the purpose of this document would be natural gas at a pressure greater than 0.5 bar above atmospheric pressure. A pressure system would include bulk storage tanks, pressure vessels, pipelines or protective devices. Once the pressure in the pipework drops below 0.5 barg, and the user/owner can show clear evidence that the system does not contain, and is not liable to contain, a relevant fluid under foreseeable operating conditions, then that part of the system is no longer covered by the Regulations. This is likely to be the case after the isolation valve downstream of a pressure reducing valve which takes the pressure to below 0.5 barg.

Note the special requirements placed on protective devices in such systems (see para 110b of L122). The regulations also apply to pipelines and their protective devices in which the pressure exceeds 2 barg (see Sch 1 part 1 item 5 of L122).

- 3.16.3 More information is available in L122 and some information is presented in INDG 261 and INDG 178.

3.17 **PROVISION AND USE OF WORK EQUIPMENT REGULATIONS (PUWER)**

- 3.17.1 Work equipment has a wide meaning and includes tools such as hammers, laboratory apparatus, for example Bunsen burners, ladders, photocopiers, lifting equipment and machinery for use at work.
- 3.17.2 The Regulations place duties on employers in relation to selection, suitability, maintenance, inspection, installation, instruction and training, prevention of danger and control of equipment.
- 3.17.3 More information on the Regulations can be found in L22. Free leaflets include INDG 291 and INDG 229.

3.18 **REPORTING OF INJURIES, DISEASES AND DANGEROUS OCCURRENCES REGULATIONS (RIDDOR)**

- 3.18.1 RIDDOR require employers, self employed people or those in control of work premises to report certain work related accidents, diseases and dangerous occurrences.

- 3.18.2 Other people have duties to report certain gas incidents which may not appear to be work related:

- death, major injury, lost consciousness, or been taken to hospital for treatment to an injury arising out of the distribution, filling, import or supply of NG or LPG are to be reported by the conveyor for NG and the filler, importer or supplier for LPG
- dangerous gas fittings (as defined in RIDDOR) are required to be reported by a "member of a class of persons". Gas Safe registered engineers are to provide details of any gas appliances or fittings that they consider to be dangerous, to such an extent that people could die, lose consciousness or require hospital treatment. The danger could be due to the design, construction, installation, modification or servicing of that appliance or fitting, which could cause:
 - an accidental leakage of gas
 - incomplete combustion of gas or
 - inadequate removal of products of the combustion of gas.

- 3.18.3 Major injuries, death and dangerous occurrences are to be notified immediately, for example by telephone, to the enforcing authority by the "responsible person" as defined by RIDDOR. Report can be made to the Incident Contact Centre:

- for fatal and major injuries only, telephone on 0845 300 9923 (opening hours Monday to Friday 8.30 am to 5 pm) and complete appropriate on-line form
- all other reports at HSE website www.hse.gov.uk

Complete the appropriate online report form listed below.

- report of an injury
- report of a dangerous occurrence
- report of an injury offshore
- report of a dangerous occurrence offshore
- report of a case of disease
- report of flammable gas incident
- report of a dangerous gas fitting.

- 3.18.4 The form will then be submitted directly to the RIDDOR database and a copy issued to the person making the report.

- 3.18.5 On-line written reports are to be submitted within the required timescale (10 days, or 14 days for dangerous gas fittings). Other reports need to be made as soon as practicable and within 10 days of the incident.
- 3.18.6 INDG 453 contains detailed guidance on RIDDOR, including a full list of injuries etc. that need reporting.
- 3.18.7 IGEN/GL/8 provides guidance on the reporting and investigation of gas-related incidents.

SECTION 4 : DESIGN OBJECTIVES AND PRINCIPLES

4.1 DESIGN OBJECTIVES

The primary objectives shall be to ensure, as far as possible:

- that pressure is managed, to deliver a suitable pressure to consumers' appliances
- continuous accurate measurement, including the reduction of both random and systematic metering errors where this can be justified economically

Note: The overall accuracy of a meter installation will depend upon the type of meter installed, the method of any volume conversion being used and the configuration of the installation.

- reliability of operation, including the required level of security of the gas supply
- safety of persons and plant.

4.2 DESIGN PRINCIPLES (see also Appendix 11)

4.2.1 General

4.2.1.1 At the outset, the designer shall consider the requirement conforms to the PSSR and, where relevant, should adopt a design management system such as IGEM/GL/5.

4.2.1.2 Any meter and its PRI/regulator should be designed not in isolation, but as a single unit. Both should be sized for the same load and consideration shall be given to the effect that each may have on the other.

4.2.1.3 The selected meter should be capable of matching the characteristics of the load with the required degree of accuracy. Consideration shall also be given to those future demand changes that can reasonably be foreseen.

An estimate concerning any anticipated growth of load over the following 12 months should be made and included in the overall calculations for meter selection. However, for larger loads, for example exceeding $160 \text{ m}^3 \text{ h}^{-1}$, such allowance should not extend beyond 12 months unless there is certainty of the growth.

Note 1: Oversizing a meter for the initial load in anticipation of a significant later increase in load can adversely affect the meter accuracy until such additional load is taken.

Note 2: Where there is an anticipated additional future load beyond 12 months, it may be prudent to design the installation such that additional capacity can be accommodated at a later date without the need to renew the complete installation.

4.2.1.4 The PRI/regulator should, normally, be located upstream of the meter.

Note: In some cases, it may be economically sound and technically acceptable to locate the PRI/regulator downstream of the meter and, in other cases, to provide an unregulated supply (see clauses 7.6.7 and 7.6.8).

4.2.1.5 The standard of filtration provided shall give adequate protection for the PRI/regulator, the meter and any associated equipment.

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4.2.2 Accuracy

4.2.2.1 The meter shall be selected to ensure that its error on the actual volume of gas used per annum does not fall outside:

- $\pm 3\%$ for $Q_{\text{imax}} \leq 160 \text{ m}^3 \text{ h}^{-1}$
- $\pm 2\%$ for $Q_{\text{imax}} > 160 \text{ m}^3 \text{ h}^{-1}$.

Note: This error will be affected by both the accuracy of the meter and the range of flows over which the meter will be within the manufacturer's specification.

4.2.2.2 Any volume conversion system shall comply with IGEN/GM/5, with particular respect to the accuracy of the converted volume.

Note: IGEN/GM/5 specifies an error on conversion of no greater than 1%.

4.2.2.3 Pipework and components within the installation shall be selected and designed so as to ensure the meter reading will not be influenced by greater than 0.3% of the actual reading.

4.2.2.4 The meter accuracy can be affected by certain types of loads. The effect of load on the meter accuracy should be limited to $\pm 1\%$.

It is the consumer's responsibility to protect the meter installation from excessive load changes, pulsations, etc. As such, the meter installer shall draw the attention of the consumer to any restrictions that need to be imposed on the downstream system in order to achieve this.

4.2.3 Pressure

4.2.3.1 The installation must be designed to maintain a suitable pressure at downstream appliances to ensure their safe operation under all foreseeable conditions.

Note 1: Information concerning the performance of a downstream system will have to be obtained from the consumer, identifying an acceptable range of outlet pressures (or make assumptions in the absence of firm information – see Sub-Section 5.4) and the installation will need to be designed to maintain its outlet pressure within this envelope.

Note 2: GS(M)R state "The gas shall be at a suitable pressure to ensure the safe operation of any appliance which a consumer could reasonably be expected to operate".

Note 3: Where the metering pressure is a nominal 21 mbar, both BS 6891 and IGEN/UP/2 specify a maximum pressure drop of 1 mbar across a gas consumer's pipework.

BS EN 1775 requires gas pipework to be sized such that the pressure at the inlet of all appliances is compatible with their safe and effective operation.

4.2.3.2 The installation shall be capable of withstanding any MIP to which it may be subjected (by either the upstream supply network or the consumer's downstream installation) without jeopardising the integrity of any connected gas fittings (see also IGEN/UP/2, IGE/UP/3, IGEN/UP/6 and IGE/UP/9).

Future uprating of the Network shall be taken into account when designing and specifying the meter installation and components. When a design maximum incidental pressure (DMIP) is specified by a GT, it shall be used in the design.

SECTION 5 : EXCHANGE OF INFORMATION

5.1 GENERAL

The effective design, installation, commissioning and operation of a meter installation are dependent upon all parties involved adequately exchanging appropriate information. The designer of any meter installation shall obtain the required information from the GT, Utility Infrastructure Provider (UIP), shipper, supplier and consumer, as necessary.

Note: The exchange of information will, in most cases, be a two-way exercise in order to arrive at a workable solution to which all parties agree.

5.2 INFORMATION CONCERNING THE NETWORK (see also Appendix 11)

5.2.1 In order to provide the required information, the GT will require key identification information to establish the correct supply meter point. The request should include, as a minimum, the following information to allow the GT to identify the pipeline/ECV to which the meter installer is planning to connect:

- meter installer contact details and address
- site contact, name and address, including post code/map reference
- whether the information is for an existing or new pipeline/ECV
- GT reference number, i.e.
 - the meter point reference number (MPRN) for an existing pipeline (where known) or
 - GT connection reference number for a planned but yet-to-be-installed pipeline.

Note: In particular, the latter two are important for any site that has more than one primary meter.

5.2.2 Information pertaining to the Network shall be obtained. Such information should include:

- confirmation of a live gas pipeline (for an existing installation)
- Network design minimum pressure (= DmP_u)
- Network lowest operating pressure (= LOP_u)
- Network maximum operating pressure (= MOP_u)
- Network maximum incidental pressure (= MIP_u) or Network DMIP (= $DMIP_u$) whichever is provided
- Network design pressure (= DP_u)
- planned, actual or nominated energy value of the pipeline capacity
- size and design of the ECV and its outlet connection detail
- dimensions indicating the approximate position of the ECV
- any constraints that the GT has imposed on the pipeline, meter installation, or use of any meter installation housing.

Note 1: Often, much of the above information is standard across a GT's Network. Appendix 5 provides guidance on Gas Distribution Networks' standard Network operating conditions. The guidance may not apply for another GT.

Note 2: Most GTs will require information requests to be made in accordance with a set procedure. An example GDN/PM/GT/1 form is included in Appendix 4.

If any information pertaining to the size, design, outlet connection detail, position of the ECV etc., on an existing pipeline, is not available from the GT, the designer of the meter installation shall establish the detail by other means, for example by visiting the site.

Where a meter installation exchange is planned and the ECV is not upstream of the whole meter installation, the MAM shall contact the GT prior to exchange, to advise the GT of the need to relocate the ECV (see clause 1.5).

Note: Such legacy installations are to be brought in line with the standard arrangements in IGEN/G/1, unless all parties involved agree to the continued use of such an arrangement, and provided the MAM can comply with all relevant legislation.

5.3 **METER INSTALLATION DESIGNER CONSTRAINTS IMPOSED ON THE OPERATION OF GAS CONSUMERS' PLANT**

5.3.1 In the case of a new gas supply to a premises, the consumer may have no idea of the requirements of his plant and equipment. In such circumstances, and in the absence of any other information being available, the meter installation designer has to assume that the installation will be supplying "standard appliances" (see clause 5.4.1). Where the meter installer has made assumptions about the connected load, size, operation, pressure requirements, lack of special features, etc., these assumptions shall be passed to the consumer in writing (via the contractual chain).

5.3.2 In addition to any assumptions made by the designer, the consumer shall be advised (via the contractual chain) of any restrictions that the designer of the installation has to impose on the operation of the consumer's plant in order to ensure the safe operation of the installation, and to enable it to accurately record the quantity of gas.

5.3.3 Depending on the pressure supplied to the consumer's system, the downstream pipework and equipment may be captured under PSSR. In such cases, the designer shall inform the consumer of this and cooperate with determining Safe Operating Limits (SOL) and formally identifying the demarcation between the meter installation and the installation pipework. Reference can be made to IGEN/G/1 for guidance.

5.3.4 Where relevant to the design of the consumers system, the meter installation designer shall advise the consumer of the requirements of Section 13.7.3, and draw their attention to the need to comply with IGEN/UP/2 and IGEN/UP/6 as appropriate.

5.4 **THE NATURE AND SIZE OF THE LOAD (see also Appendix 11)**

5.4.1 Reliable information relating to the nature of the load and the anticipated flow rate (present and anticipated in the future) shall be obtained from the gas supplier or from the consumer (via the contractual chain) as appropriate, and should include:

- the estimated maximum flow rate (which is not necessarily a summation of the total connected load)
- the minimum flow rate anticipated (a realistic assessment and not a zero flow rate)
- the number and type of each unit of plant and, where available, the anticipated load pattern for each
- the best possible estimate concerning the anticipated growth of load over the next 12 months
- where necessary, peak flow likely to occur for a short period, infrequently, possibly in excess of Q_{max}
- establishment of the metering pressure to which the PRI/regulator(s) is/are required to control

Note: Normally, this will be 21 mbar, unless it has been agreed between the supplier, shipper, GT and consumer to meter at an elevated pressure.

- strength test pressure (STP) (for the downstream system and all connected plant)
- DP_c if higher than MOP_c
- SOL_c
- MIP_c (to which the meter installation could be subjected by the gas consumer's plant and equipment)
- MOP_c (for which the downstream system has been designed to ensure that all connected plant will operate with an inlet pressure not exceeding P_{max})
- OP_c
- LOP_c (for which the downstream system has been designed to ensure that all connected plant will operate with an inlet pressure exceeding P_{min})
- DmP_c (for which the downstream system has been designed to ensure that all connected plant will operate safely and which may have to be obtained from other sources).

Note 1: For an existing downstream system, information on the plant/appliance type is essential as it cannot be assumed that downstream appliances comply with current standards.

Note 2: On an installation with a metering pressure of 21 mbar, the designer has to assume that "standard" appliances will be connected at some stage, unless the consumer specifically advises otherwise. It has been established that standard appliances have the following characteristics (see also Appendix 11):

STP	=	50 mbar
P_{max}	=	25 mbar
OP	=	20 mbar
P_{min}	=	17 mbar
P_{ign}	=	14 mbar (70% OP).

Note 3: Where the metering pressure is a nominal 21 mbar, both BS 6891 and IGEN/UP/2 specify a maximum pressure drop of 1 mbar across a gas consumer's pipework.

Note 4: On the majority of lower pressure, simple systems, DP_c will not be known and can be assumed to be MOP_c .

5.4.2 Details of any special features of gas plant which may affect the nature of the load, for example fast-fluctuating loads, snap-acting control valves creating rapid on/off load conditions, engines, turbines, gas boosters and compressors, shall be obtained from appropriate sources.

Note 1: Such special features require specialist analysis to determine the significance of possible interactions with the meter installation. Appendices 3 and 7 are typical forms that provide guidance on the information required.

Note 2: The Gas Act allows a GT to insist on the fitting of an anti-fluctuator, to avoid excessive pulsations being present in the Network and, hence, at the meter installation. The fitting and maintenance of such a device is the responsibility of the consumer.

5.4.3 An appropriate record shall be made of the information obtained.

Note: A typical form that may be used for collecting the information is shown in Appendix 3.

5.5 GAS CONSUMER-IMPOSED CONSTRAINTS AND SPECIAL REQUIREMENTS

5.5.1 Any constraints imposed by the consumer, which may affect safety, shall be determined.

Note: Examples include any hazardous area identified by the consumer that may affect the location of the meter installation, or restrict the range of equipment to be installed, or any restrictions on the venting of gas.

- 5.5.2 Any special requirements for a consumer-stated measurement uncertainty, tighter than those stipulated in this Standard, for example to account for the EU Emissions Trading Scheme (see Appendix 12), shall be taken into account when planning the validation of the performance of the meter installation.

Note: Provision of this information will be the responsibility of the consumer.

5.6 **PROVISION OF INFORMATION TO THE MAM/METER ASSET OWNER (see also Appendix 11)**

Following design, the MAM/meter asset owner shall be advised by the designer/installer, of the following details of the meter installation:

- maximum capacity of the installation (Q_{imax})
- $DMIP_u$ for which the installation has been designed
- DP_u for which the installation has been designed
- MIP_u (where known)
- MOP_u
- LOP_u
- DmP_u
- STP for different sections of the meter installation
- SOL for different sections of the meter installation
- DP_c (where known by the consumer)
- MOP_c
- LOP_c
- DmP_c
- MIP_c (if applicable)
- SOL_c (if applicable)
- MIP to which the downstream system may be subject ($= MIP_{mi}$)

Note: For any installation not incorporating a safety device, the consumer needs to be advised that, in the event of a regulator failure, the installation may subject the downstream system to MOP_u which has to be considered by the consumer to equal MIP_{mi} .

- outlet temporary operating pressure ($= TOP_{mi}$)
- outlet peak level operating pressure (peak level OP_{mi})
- meter installation outlet maximum operating pressure ($= MOP_{mi}$)
- metering pressure used for any conversion factor (P_m) (normally the meter inlet pressure)
- outlet lowest operating pressure ($= LOP_{mi}$)
- outlet design minimum pressure ($= DmP_{mi}$)
- set points of all pressure regulators, safety devices and reliefs
- the extent and classification of any hazardous area

Note: This information will also need to be made available to the consumer.

- any assumptions that have been made concerning the downstream load
- any restrictions that have been imposed on the operation of the downstream plant and equipment
- where a meter by-pass has been installed, the justification for the by-pass and a copy of the GT and gas supplier authorisations.

SECTION 6 : GT AUTHORISATIONS

6.1 METER INSTALLATIONS

- 6.1.1 Prior to, and to permit, connection of any meter installation to the Network, the responsible person shall submit a warrant in accordance with appropriate GT procedures and obtain written authorisation from the GT to break any seal, set and seal any meter regulator and any associated pressure control and protection device(s). This warrant shall specify the agreed pressure rating and pressure control performance envelope (that will ensure a suitable pressure is available at any appliance under all foreseeable conditions) for the installation and shall represent the installation as it is designed and installed.

Note 1: GTs may grant generic authorisation for meter installations within their Safety Case.

Note 2: The majority of GTs operate an authorisation scheme for unregulated installations (see GDN/PM/GT2 available through the Energy Networks Association (ENA)).

Note 3: Each appraisal (including generic appraisals) will, normally, be given a unique appraisal reference number, together with authorisation, where appropriate, for the meter installer (OAMI) to break any regulator seal and set and adjust any meter regulator and any associated pressure protection device (see also Note 4 below).

Note 4: A typical GT appraisal procedure is based on the following principles:

- *the GT will make available, on request, the necessary information relating to any pipeline connected to its network (see Appendix 5 for the GDNs' standard conditions)*
- *any person installing a meter installation being competent for the category of work they are undertaking*
- *while the GT will carry out appraisals for any competent meter installer, the GT will only authorise OAMIs to act on their behalf with respect to the breaking of a seal, the initial setting and any subsequent adjustment of a meter regulator or associated pressure protection devices*
- *the GT will require meter installers to give a warranty that any meter installation that they install, which will be connected to the Network, will meet specified criteria, which will ensure that a suitable pressure is available for the safe operation of any appliance supplied through that meter installation.*

Note 5: Prior to giving any authorisation, the GT probably will require the applicant to warrant that any meter installation to be installed under that application will meet the criteria set out in clause 6.1.2 and its Note. The basis of such a warrant would be the completion of an appropriate form.

- 6.1.2 Any installed meter installation shall meet all of the following criteria:

- the pressure control philosophy meets industry-accepted practice
- the construction of any meter regulator and any associated pressure control or protection device(s) is suitable for all pressures and flow rates to which they may be subjected
- the organisation warranting the performance of the installation is in possession of technical evidence to demonstrate that performance
- the gas is maintained at a suitable pressure to ensure the safe operation of any connected appliance
- any meter regulator will adequately lock up at zero flow and, in conjunction with any protection device, limit the downstream pressure to an acceptable level when gas is supplied at either MOP_u under normal conditions or MIP_u under fault conditions
- the meter and its installation meet the requirements of Schedule 2B of the Gas Act with respect to compliance with its Section 17 (see clause 12.1.2).

Note: Any authorisation by a GT will be subject to the following conditions:

- *the authorisation is only valid for the meter installation described in the letter of authorisation*
- *the organisation undertaking the adjustment is competent to do so*
- *any regulator and any associated pressure control or protection device(s) are set to the values stated in the request and these pressures do not subject the*

installation pipework and any connected appliance to a pressure greater than that for which they were designed. Such values and any associated conditions are to be clearly labelled on the installation and

- *the regulator and any pressure control protection device(s) is/are, subsequently, sealed to prevent unauthorised adjustment with a seal marked with the OAMI registration number or, for pre-set equipment, the manufacturer's mark.*

6.2 ABNORMAL LOADS

6.2.1 Abnormally large and rapid changes of flow in the Network or installation pipework can be caused by a compressor as defined in IGEN/UP/2 and IGEN/UP/6. Any such change is not permitted to create a pressure fluctuation sufficient to compromise the proper operation of the Network or of other plant/appliances connected to the installation pipework. A GT must be notified of the intention to install a gas compressor and of the following technical details:

- receiver volume
- over and under pressure protection devices on the inlet of a compressor
- performance specification for pulsation damping
- a diagram illustrating any safety device and its logic of operation.

A typical form for submission to a GT is shown in Appendix 7.

6.2.2 A GT will, normally, require analysis to estimate the worst case effect of the compressor load on the Network, paying attention to steady, static and dynamic situations and, in particular, the effect of short term dynamic pressure fluctuations in Networks of MOP not exceeding 0.5 bar. If such an analysis indicates that pressure fluctuations could be excessive, the installation shall comply with any restrictions imposed by the GT, including:

- safeguards to prevent simultaneous start up of compressors that operate in parallel
- the specification of particular start up modes for any compressor
- the specification of a number of low and high pressure safeguards on the inlet to any compressor.

Note: Further guidance is provided in IGEN/UP/6.

6.3 METER BY-PASSES

6.3.1 A meter by-pass shall not be installed without the provision and use of the by-pass being approved by the gas supplier.

6.3.2 Where the GT operates an approval process, a meter by-pass shall not be installed without the approval of the GT.

Note: In most cases, the GT's Network Code requires that the GT approves the provision and use of a meter by-pass (see GDN/PM/GT/2 in Appendix 4).

6.3.3 Once approval has been granted, the meter by-pass shall be installed in accordance with this Standard. The meter by-pass valve (MBV) shall be sealed in the closed position in accordance with IGEN/GM/8 Part 3, and be labelled in accordance with IGEN/GM/8 Part 5.

SECTION 7 : DESIGN CONSIDERATIONS

7.1 GENERAL

Reference should be made to Appendix 10 for an explanation of all pressure terms used in this sub-section.

7.1.1 Consideration shall be given, at the design stage, to the following:

- the intended location of the meter installation (see IGEN/GM/8 Part 2)
- appropriate means of access (see IGEN/GM/8 Part 2)
- the method of handling and construction on site (see IGEN/GM/8 Part 3)
- maintenance (see IGEN/GM/8 Part 4)
- the requirements under the PSSR (see IGEN/GL/5).

7.1.2 Any meter installation shall include a regulator unless:

- the installation complies with clause 7.6.8 and
- the appropriate GT's policy for unregulated supplies and
- has been authorised by the appropriate GT (see Section 6).

7.1.3 Any meter and associated PRI/regulator should be designed not in isolation but as a single unit. Both should be sized for the same load and consideration shall be given to the effect that each may have on the other.

7.1.4 Any meter installation (as a whole item) should be designed to minimize the pressure drop between any regulator impulse point and the inlet of the meter (see clause 16.6.13).

Note: In particular, this is important where fixed factor conversion is being employed, but is less critical when electronic volume conversion is fitted (see clause 9.3.2).

7.1.5 DP and STP of all pipework and equipment upstream of any PRI/regulator (including the regulator) shall be selected such that the pipework and equipment are capable of withstanding MIP_u or, where stated by the GT, $DMIP_u$ (see Figure 1).

DP of the part of the installation upstream of the PRI/ regulator (including the regulator) shall be greater than or equal to DP_u .

7.1.6 DP and STP of all pipework and equipment downstream of the inlet of the PRI/regulator and safety devices shall be selected such that the pipework and equipment are capable of withstanding MIP_{mi} or the highest pressure that could be caused by the downstream equipment (MIP_c) whichever is the greater (see Figure 1).

7.1.7 DP and STP of all pipework and equipment downstream of any PRI/regulator but upstream of the first valve fitted downstream of any regulator (including the valve itself) should be such that the pipework and equipment are capable of withstanding MIP_u or, where specified by the GT, $DMIP_u$. However, an exception is where a meter is incorporated in this section of pipework, when DP and STP shall be selected such that the meter is capable of withstanding DP_u (see Figure 1).

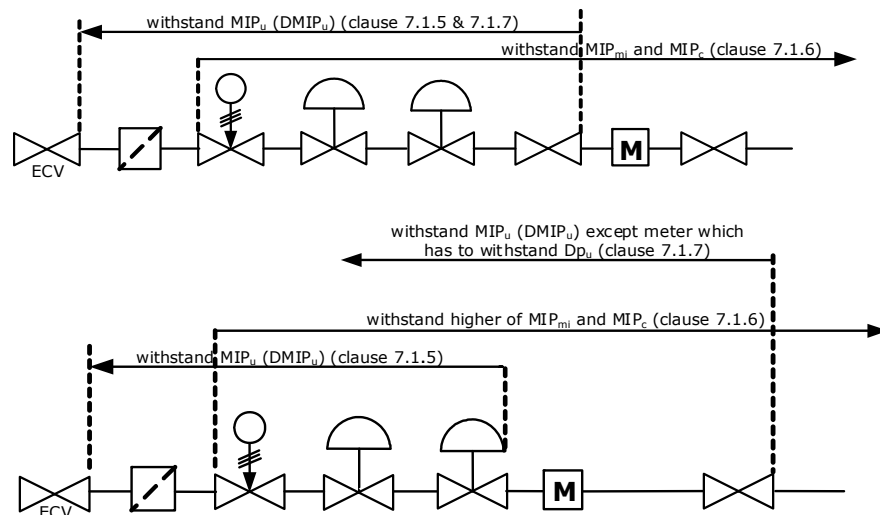


FIGURE 1 - PRESSURE RATING OF EQUIPMENT

7.1.8 The limit of any pressure system shall be determined, and the safe operating limit (SOL) must be established for all gas equipment that forms part of a pressure system as defined by PSSR.

SOLs must be established by the Pressure System User and agreed with the Competent Person as defined in PSSR.

Where the meter installation incorporates a pressure break, the SOL must be determined for each section of the meter installation within the scope of PSSR.

The SOL should be declared as being equal to the MIP that is used when calculating the strength test pressure for a given section of the meter installation. The SOL shall not be declared as a value lower than the MIP that a section of the installation may be subjected to. SOL must not exceed the minimum STP applied to a section of installation.

Note: The change of SOL will normally occur at the pressure break. However, if:

- a) the outlet of the meter installation is at 2 barg or less and*
- b) the protective device set at 2.7 barg or less, and*
- c) the meter installation is not feeding a 3rd party pressure system,*

then the boundary of the Pressure System will be at the outlet of the first valve downstream of the active regulator. The upstream SOL will apply up to the outlet flange of the active regulator, and equipment downstream of the active regulator can be considered to be exempt from PSSR. This can be marked as such on the PSSR drawing and the outlet SOL marked as "N/A".

7.1.9 Where MOP of any part of a meter installation is 0.5 bar or greater, any new component that will operate at such a pressure must comply, where appropriate, with PER.

7.1.10 All parts of an installation shall be designed to withstand the maximum range of temperature to which the installation may be subjected under test and operating conditions.

7.1.11 For MOP_u exceeding 7 bar, consideration shall be given to conducting a stress analysis of the installation, in which case reference should be made to IGE/TD/12 which gives detailed guidance and a method of comprehensive analysis.

7.2 PROTECTION OF THE DOWNSTREAM SYSTEM

Reference should be made to Appendix 10 for an explanation of all pressure terms used in this sub-section.

- 7.2.1 The meter installation shall be designed to pass the maximum designed flow rate at DmP_u and to maintain DmP_{mi} at or above DmP_c .

Note: DmP_c has to be sufficient to ensure that P_{ign} is maintained at connected appliances, noting that, where the metering pressure is a nominal 21 mbar, both BS 6891 and IGE/UP/2 require a maximum pressure drop of 1 mbar across installation pipework. For higher metering pressures, IGE/UP/2 requires a maximum drop of 10% of the metering pressure.

"Standard" appliances are required to adequately cross light at 70% of their operating pressure, i.e. 70% of 20 = 14 mbar (see Note 2 to clause 5.4.1).

- 7.2.2 The meter installation shall be designed to ensure that, for inlet pressures in the range of LOP_u to MOP_u and flow rates of 5% Q_{imax} to Q_{imax} , OP at the outlet of the installation is maintained within the pressure range LOP_c to MOP_c .

Note: This is intended to ensure that the pressure at appliances is maintained within the limits P_{min} to P_{max} .

- 7.2.3 For a meter installation incorporating a monitor regulator, that regulator shall be designed, sized and set so as to ensure that, when the monitor regulator is operating, OP at the outlet of the installation is maintained within the pressure range LOP_c to MOP_c .

Note: This is intended to ensure that the pressure to appliances is maintained within the limits P_{min} to P_{max} .

- 7.2.4 For a meter installation incorporating a slam-shut valve (SSV), the SSV shall be designed, sized and set to ensure that, under all foreseeable circumstances, MIP_{mi} will not exceed STP of any section of the installation or the downstream system except for any connected appliances that are otherwise protected, i.e. by a downstream pressure regulator.

Note: IGE/UP/1 requires STP to be the greater of $1.1 \times MIP$ and a value that is related to the MOP.

7.3 VELOCITY

- 7.3.1 Subject to the exceptions given in Note 2 below, gas velocity within a meter installation shall not exceed:

- 20 m s⁻¹ upstream of any filter(s) and
- 40 m s⁻¹ downstream of any filter(s).

Note 1: Where the inlet pressure to an installation is as low as 25 mbar, the effects of pressure loss across the installation will become prohibitively large before the velocity of 40 m s⁻¹ is attained.

Note 2: Where it is essential to the design of an installation, gas velocities within any regulator installation stream may exceed the filtered gas velocity limit, subject to the system design capability, acceptable noise level and good engineering practice.

Note 3: Immediately downstream of a regulator, velocities can be much higher than 40 m s⁻¹. The design of the installation has to take this into account to ensure metering accuracy continues to comply with clause 4.2.2.3.

- 7.3.2 When high velocities are anticipated, consideration shall be given to the possibility of noise effects and overspeeding of any meter.

Note: Most meters are designed to run at lower gas velocities than those specified.

7.4 NOISE

- 7.4.1 Due account shall be taken of possible noise emission at all flow and pressure conditions.

Note: In particular, this is relevant for MOP_d exceeding 75 mbar.

- 7.4.2 Further guidance on the control of noise is given in Appendix 6 which should be referenced if noise may be a problem.

Note: Appendix 6 recommends a survey of ambient noise levels be taken before and after a meter installation becomes operational.

Consideration shall be given to:

- burying pipework
- installing silencing measures on any PRI/regulator or selecting quieter equipment

Note: In-line silencers are not recommended.

- installing acoustic cladding
- providing an acoustic enclosure
- effects of meters.

Note: Large diaphragm meters and, in particular, RD meters, produce mechanical noise which, although not particularly loud, can prove disturbing in quiet surroundings such as offices.

- 7.4.3 In addition to assessing noise within the context of noise nuisance and compliance with prescribed limitations, consideration shall be given to noise exposure for operational personnel (in terms of the noise levels likely to be experienced while on site) and to the proximity of noise sources to the area in which operational personnel will be expected to work. Reference shall be made to the Noise at Work Regulations.

7.5 HEATING

- 7.5.1 Consideration shall be given to the need for appropriate heating to protect installations against the effects of internal and external ice formation caused by ambient conditions or by a reduction in pressure which results in a reduction in temperature. Such heating shall not create a fire or explosion hazard.

Where gas pre-heating is to be installed, it shall be in accordance with a suitable standard.

Note: Normally, heating is only required where a large pressure reduction occurs, typically in excess of 15 bar. In general, a temperature drop of 1°C will occur for every 2 bar pressure reduction.

- 7.5.2 In establishing a requirement for the provision of pre-heating, regard should be paid to the:

- ability of the downstream pipe material to retain satisfactory physical characteristics at any reduced temperature of operation
- possibility of frost heave due to frozen ground around buried outlet pipework
- possibility of hydrate or liquid formation which could influence the operation of any PRI/regulator and downstream equipment
- need to prevent icing-up of regulators, auxiliary equipment, etc.

Note 1: Consideration may be given to the provision of pre-heating to improve the operating condition of equipment by reducing the likelihood of condensation occurring and, hence, reducing corrosion.

Note 2: Electrical tape heating, or some other form of low heat input, may be sufficient to meet these requirements.

7.5.3 Where the effects of low temperature operation could have a detrimental effect on pilot control systems, consideration shall be given to the provision of an independent pilot heating system.

Note 1: This may be provided by methods such as trace heating, vortex heating, small capacity electric heaters or secondary heat exchanger loops in the main heating system.

Note 2: Consideration may be given to the provision of pre-heating to improve the operating condition of equipment by reducing the likelihood of condensation occurring and, hence, reducing corrosion.

7.5.4 The number of heaters and their capacity should be determined having regard to the probability of failure of a unit occurring simultaneously with a period of extreme demand.

Note: If this possibility is low, the provision of standby heater capacity to meet the extreme condition may not be necessary.

7.5.5 Consideration shall be given to the reliability of any heating system in operation, taking into account its dependence on other services.

Note: It may be necessary to provide standby water and electricity supplies where continuous operation under all fault conditions is essential.

7.5.6 Where waterbath heaters are utilised, the heater air intake and flue stack shall be sited in a safe area of the PRI, as determined in accordance with IGEN/SR/25 or IGEN/GM/7B. Particular care should be taken with the siting of the heater control system to ensure that any hazardous areas associated with it do not encroach into the vicinity of the heater air intake and flue stack.

7.5.7 Package/modular boiler installations shall be sited in a safe area of the PRI as determined in accordance with IGEN/SR/25 or IGEN/GM/7 and installed to comply with the requirements of BS 6644 and IGEN/UP/10.

7.5.8 Measures should be taken to protect water-based heating systems from freezing and internal corrosion.

7.5.9 Measures shall be taken to prevent, or to detect, ingress of gas at high pressure into water-based heating systems.

7.5.10 Any material used in a meter installation, in particular polymeric and elastomeric types, shall be capable of withstanding the maximum temperature that any pre-heating source can attain.

Note: In order to avoid exceeding the safe operating temperature of such materials in any meter or regulator valve seat, it may be necessary to limit the maximum temperature of the pre-heating source.

7.5.11 Any heater installation should be equipped with a meter for measuring its fuel consumption and a control system which minimises the energy consumed by the pre-heaters.

7.5.12 The fuel gas supply for heating installations should, wherever possible, be taken from the point of lowest pressure within the PRI consistent with the requirements of the heater burner system and, in the case of waterbath heaters, downstream of the waterbath heater.

7.5.13 The supply for any gas fired pre-heater should be upstream of the customer's meter and be registered with a gas supplier. Sub-deduct arrangements shall be avoided.

Note: Where the supply for the gas fired pre-heaters is downstream of the customer's meter any additional metering is to be for energy monitoring purposes only.

7.5.14 The MAM shall be responsible for arranging for the metering of preheat fuel and any commercial arrangements.

7.5.15 The heat input of any heater installation should be calculated to meet the particular duty. The full calculation should take into account the composition of the gas to be heated and the influence of pressure on the specific heats of its various constituents.

7.5.16 Precautions shall be taken to prevent interchange of the gas with any heating medium.

7.5.17 Consideration shall be given to the effects of thermal stress which may occur in heat exchangers due to the cyclic nature of some heating control systems.

7.6 PROVISION AND ARRANGEMENT OF COMPONENTS

7.6.1 General

7.6.1.1 Any meter should be positioned in such a way that the index can be read conveniently, without the use of mirrors, etc.

7.6.1.2 The gas flow through the meter installation should be from left to right, when viewing the index of the meter (see clause 12.1.3).

Note: It may be possible to take advantage of adjustable index positions.

7.6.1.3 Pipework and equipment shall be arranged such as to:

- facilitate easy access to all components for maintenance, particularly meters, regulators, filters and the ECV
- avoid over-stressing pipework and plant
- allow for expansion and contraction due to temperature and system loading
- minimise adverse deflections and displacements during normal operation or hydrostatic testing
- provide a minimum cover for buried pipework as given in Table 1
- minimise the number of pipe cross-overs
- provide adequate separation from other pipework to facilitate maintenance. In any event, the minimum separation should be 600 mm.

Note: Small bore impulse pipework may be installed with less separation.

LOCATION OF PIPE UNDER	MINIMUM DEPTH OF COVER (m)			
	MOP $\leq$ 75 mbar and $\varnothing \leq$ 63 mm	75 mbar $<$ MOP $\leq$ 7 bar or $\varnothing >$ 63 mm	7 $<$ MOP $\leq$ 16 bar	MOP $>$ 16 bar
Carriageways	0.45	0.75	1.1	1.2
Path footways	0.375	0.6	1.1	1.1
Verges	0.6	0.75	1.1	1.1
Other fields and agricultural land	1.1	1.1	1.1	1.1
Other private ground	0.6	0.6	1.1	1.1
Water courses, rivers and canals*	0.6	1.2	1.2	1.2
Railways**	1.4	1.4	1.4	1.4

*Note 1: Reference to be made to the appropriate environment agency for permission to cross these features.

**Note 2: Refer to the appropriate authority.

TABLE 1 - MINIMUM COVER FOR BURIED PIPEWORK

- 7.6.1.4 There shall not be more than one flexible connection or joint incorporated within any one stream of a meter installation.

Note: Flexible connections and joints are those that are able to move while in service to allow for expansion and contraction.

- 7.6.1.5 A meter installation inlet valve (MIIV) shall be fitted at the inlet of the meter installation.

Note: The ECV may fulfil this purpose.

- 7.6.1.6 If Q_{imax} exceeds $25 \text{ m}^3 \text{ h}^{-1}$, a meter outlet valve (MOV) shall be fitted.

Note: The fitting of a MOV on installations with a lower flow rate will simplify tightness testing and purging operations.

- 7.6.1.7 On a meter installation having a single stream PRI for MOP_u not exceeding 75 mbar, consideration shall be given to the provision of a PRI inlet and outlet valve (PRIIV and PRIOV) along with suitably sized, plugged and sealed valves either side of the PRI.

Similarly, on a meter installation that does not incorporate a meter by-pass, consideration shall be given to the provision of appropriately sized, suitably plugged and sealed, valves (see Figure 8).

Note 1: These provisions are to enable the downstream pipework to be kept pressurised during maintenance via a temporary by-pass incorporating a regulator and protective device(s).

Generally, for installations of MOP_u not exceeding 7 bar, a 22 mm ($\frac{3}{4}$ in) connection will be adequate.

Note 2: Where the downstream pipework is not extensive, it may be possible to maintain pressure by installing a temporary gas cylinder on a tapping downstream of the installation.

Note 3: These provisions will not permit continuity of supply, for which a suitably sized second stream containing regulators and safety devices have to be fitted (see clause 7.6.4).

7.6.1.8 Any required filter(s) (see Section 8) shall protect the whole meter installation and, hence, shall be installed on the inlet to the installation.

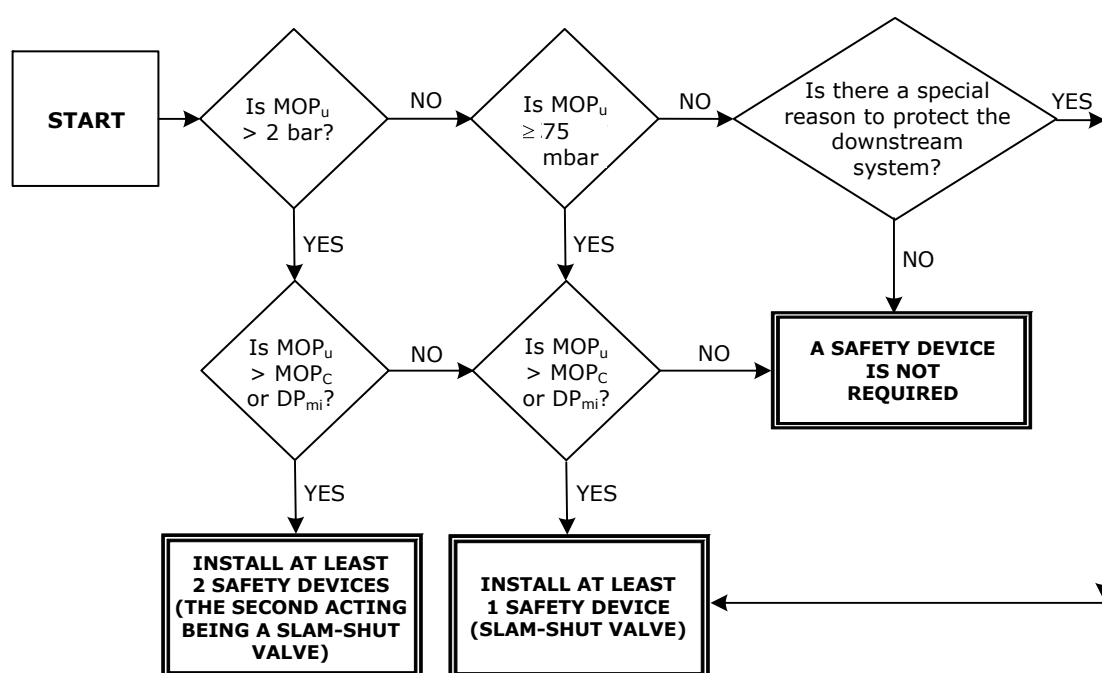
7.6.1.9 For MOP_u not exceeding 75 mbar, arrangements as shown in Figures 8 to 13 should be used.

Note: Normally, it is not necessary to provide over-pressure protection or creep relief facilities. However, where over-pressure protection is necessary, refer to clause 7.6.2.

7.6.2 Regulators and safety devices protecting the downstream system

Note: Acceptable regulator installation arrangements are shown in Figures 8 to 25.

7.6.2.1 Where a regulator is required (a regulator will, normally, be required - see clause 7.1.2), it shall protect downstream elements of the meter installation and the downstream system (up to any further regulator) against the effects of over-pressure. The operation and control philosophy of regulator streams shall be established at an early stage in the design process. The minimum degree of safety provided in any one stream shall be in accordance with Figure 2.



Note 1: A typical reason to protect the downstream system when not, normally, required would be when appliances are not "standard" (see Note 2 to clause 5.4.1).

Note 2: For MOP_u exceeding 7 bar, it may be beneficial to install a two stage pressure breakdown with first stage monitor override. In this configuration, both regulators are active, with the 1st regulator fitted with an override pilot monitoring the 2nd stage outlet pressure. The 1st stage regulator takes control if a failure of the 2nd stage regulator is detected by the pressure downstream of the 2nd stage regulator reaching the set point of the monitor pilot.

FIGURE 2 - DECISION ALGORITHM FOR MINIMUM NUMBER OF SAFETY DEVICES

7.6.2.2 Any diaphragm-operated regulator should be installed with the diaphragm in the horizontal plane unless specifically permitted or recommended by the manufacturer (see clause 9.3.1).

Note: Certain diaphragm regulators of nominal bore not exceeding 80 mm can be installed with their diaphragm in the vertical plane, but this will result in impaired performance and, consequently, a reduced capacity.

7.6.2.3 A relief valve shall not be used as a primary safety device.

Note: The use of relief valves is limited to providing protection against regulator let-by and nuisance slam-shut firing.

7.6.2.4 For MOP_u exceeding 7 bar, consideration shall be given to providing a suitably-sized by-pass around the PRIIV, together with a commissioning vent downstream of any regulator and upstream of any regulator/stream outlet isolation valve (ROV/SOIV) to allow the regulator(s) to be commissioned statically.

7.6.3 **Pipework in the vicinity of meters**

7.6.3.1 Normally, a meter and associated pipework should be installed on the outlet side of the PRI/regulator (see also clause 7.6.7).

7.6.3.2 Pipework shall be designed such that the meter orientation will be acceptable to the manufacturer.

7.6.3.3 The pipework should be designed such that significant jetting or swirling does not occur at the inlet to a meter (see also clause 4.2.2.3).

Note 1: Partially open valves and regulators are a common cause of jetting.

Note 2: Jetting and swirling are a cause of meter registration errors.

Note 3: For diaphragm meters, there is no significant loss of accuracy provided correct installation attitude is maintained. For RD meters, significant errors may result at low flows if the impeller/rotor axis alignment is outside the manufacturer's tolerances (pressure loss across the meter will also be increased).

7.6.3.4 Pipework configuration shall incorporate straight lengths of pipe each side of a meter as detailed in Table 2, or as detailed in the manufacturer's installation instructions for fiscal type applications. Further guidance should be sought from the manufacturers on their specific installation requirements for the meter installation to perform in accordance with clause 4.2.2.3.

The straight lengths specified in Table 2 may be reduced by fitting a flow conditioner upstream of the meter (additional to any conditioner within the meter). Where such a flow conditioning device is fitted, it shall be of a type recommended by the meter manufacturer and shall be installed in accordance with their instructions.

Note: Normally, flow conditioning devices have a significant pressure loss and, as such, they may not be suitable for installations of MOP_{mi} not exceeding 75 mbar.

Where the meter is installed in accordance with the manufacturer's instructions, and these are less onerous than the values given in Table 2, such instructions shall be obtained in writing from the manufacturer and retained with the site records.

METER TYPE	MOP _{mi} ≤ 7 bar		MOP _{mi} > 7 bar	
	Pipe upstream	Pipe downstream	Pipe upstream	Pipe downstream
Diaphragm	Not critical	Not critical	Not critical	Not critical
RD	Not critical	Not critical	4D	2D
Turbine	10D	5D	10D	5D
Multipath USM	10D	5D	10D	5D

TABLE 2 - MINIMUM STRAIGHT LENGTH OF PIPE OF SIMILAR NOMINAL BORE

Note: Reductions from the recommended inlet and outlet pipework configuration may produce increasing and significant error levels as OP increases above 7 bar, particularly as the flow rate approaches Q_{max}.

7.6.3.5 Any protrusion into the gas stream, upstream of the meter, for example a thermowell, shall not be installed within the upstream pipe length given in Table 2 or the length advised by the manufacturer (see clause 7.6.3.4).

7.6.3.6 For a turbine meter where a reducer, for example to BS 1640, is used to match the pipe size to the meter, a length of straight pipe in excess of 3D shall be installed on the inlet to the meter in addition to the length provided under clause 7.6.3.4. The meter manufacturer's advice should be sought regarding the exact length of additional pipe required.

Note: Where a fabricated reducer of included angle of 15° or less is used, an additional 3D length of pipe is, normally, adequate.

7.6.3.7 Any reducer shall be concentric.

7.6.3.8 The strain placed upon any meter connection shall be minimised and the installation method should allow easy removal and re-fitting of the meter. This shall be achieved by:

- for a diaphragm meter, connecting using a maximum of one flexible connection

Note: Usually, this is located on the inlet of the regulator.

- for an RD meter, connecting using one flexible connection, located on the inlet or outlet of the meter, positioned so as to protect the meter from any stresses that may be imposed by the upstream or downstream pipework.

Note: If the flexible connection is on the meter inlet, it can be used to accommodate the open-ended top hat or skirt-type strainer (used for commissioning purposes – see Sub-Section 8.4) at that inlet.

For MOP_{mi} exceeding 7 bar, the meter may be rigidly piped, but the pipework either side of the meter shall be so designed as to protect the meter from any stresses that may be imposed by the upstream or downstream pipework.

- for a turbine meter, connecting with a maximum of one flexible connection, located either on the inlet or outlet of the meter. Alternatively, the meter should be rigidly piped with the pipework either side of the meter so designed to protect the meter from any stresses that may be imposed by the upstream or downstream pipework.

If the flexible connection is on the inlet of the meter it should be located at least 3D upstream of the meter.

- for a USM, installing in accordance with the manufacturer's instructions. Upstream and downstream pipe supports should be designed to prevent movement of connecting pipework in the event of the meter being removed.
- Any USM shall be rigidly piped, with pipe supports located on both the inlet and outlet of the meter.

Note: Further guidance on the installation of multipath USMs is given in BS 7965.

Acceptable arrangements are shown in Figures 21 to 24.

7.6.4

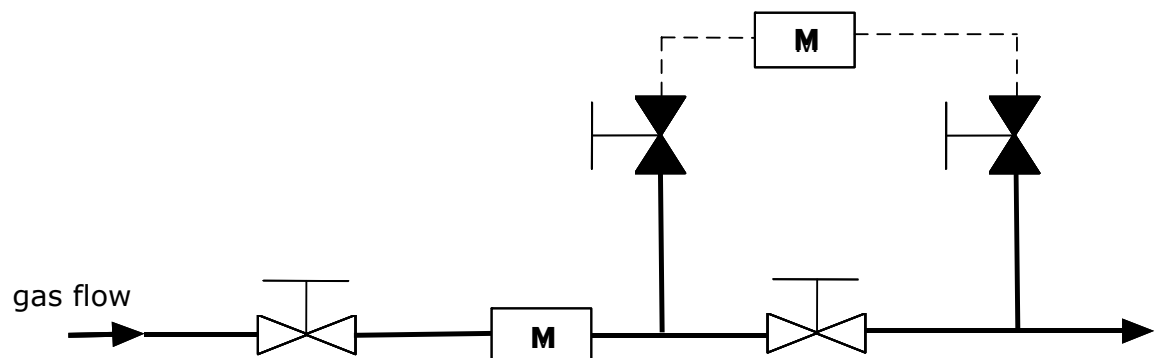
Multi-stream systems

Multi-stream systems may be installed for a variety of commercial and technical reasons, including:

- continuity of supply
- partial continuity of supply for essential loads
- improved pressure control over the required flow range
- achieving the required capacity
- provision of standby metering
- provision of reference metering

and these arrangements should be in accordance with Figure 26.

Note: In order to meet requirements for provision of standby or reference metering, the combinations shown in Figures 3 to 7 are often used.



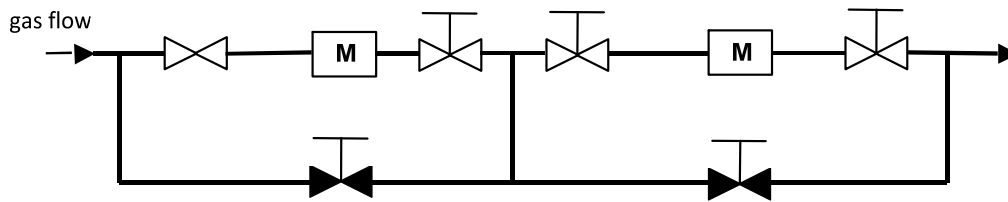
Note: With this option, valves are installed to enable a check meter or calibration test rig to be temporarily installed in series with the main meter being used for billing. On completion of any tests or calibration, the check meter is removed for use on other installations.

**FIGURE 3 - ARRANGEMENT OF A SINGLE METER.
WITH PROVISION FOR A TEMPORARY CHECK METER TO BE
INSTALLED IN SERIES**



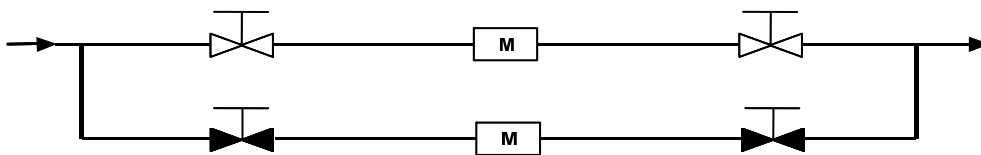
Note: In this case, a second meter is installed in series. Both meters are on line at all times and readings from each meter can be used to cross check each other's performance and is of value in particular if the meters are of different types for example a turbine meter and a USM. However, this arrangement may mask the effects of any deterioration of the meter through general wear and tear.

**FIGURE 4 - ARRANGEMENT OF TWIN METERS.
SERIES CONFIGURATION WITHOUT A BY-PASS**



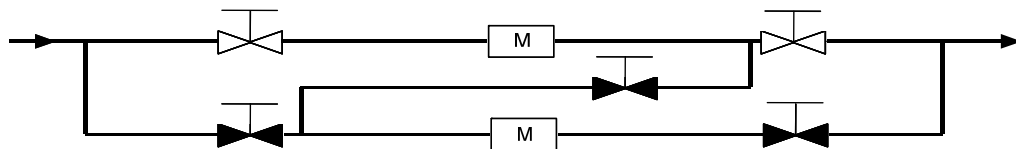
Note: This configuration is identical to Figure 4 with the addition of by-pass valves around each meter. This combination allows each meter to be removed from service for maintenance or fault finding and also allows for the second or check meter to be isolated and only used during check or calibration procedures. This configuration is, normally, recommended.

**FIGURE 5 - ARRANGEMENT OF TWIN METERS.
SERIES CONFIGURATION WITH A BY-PASS**



Note: This arrangement is useful only as a standby arrangement and not as check metering.

**FIGURE 6 - ARRANGEMENT OF TWIN METERS.
PARALLEL CONFIGURATION**



Note: In this arrangement, meters are installed in parallel, but an internal cross over is provided to enable the meters to be run in series for check and calibration purposes. This combination gives the best flexibility and ease of operation. It is often considered on larger installations where an economic justification can be made against loss of accuracy or meter failure. This is considered to be a preferred configuration and is, normally, recommended.

**FIGURE 7 - ARRANGEMENT OF TWIN METERS.
SERIES/PARALLEL CONFIGURATION WITH CROSS-OVER**

7.6.4.1

Continuity of supply, while not always an essential requirement, may be desirable in some circumstances, for example to enable a customer to take gas during PRI/regulator maintenance or in the event of a fault in the system/meter. Where continuity of supply is important, consideration shall be given to installing a multi-stream PRI/regulator and, possibly, a meter by-pass.

Where two major PRI/regulator streams are installed (other than any small parallel stream to cope with low flow rates) the main stream should have 100% of normal load capacity, with the standby having either 100% capacity or a lower capacity equivalent to the essential load to be maintained to the premises. Alternatively, each stream should be equally sized to supply the essential load, provided that the two streams in parallel can supply the installation design capacity.

- 7.6.4.2 When two or more PRI/regulator streams are installed and continuity of supply is required, a stream discrimination system should be fitted so that a slam-shut valve in a "healthy" stream is unlikely to be fired by a regulator failure in another stream.

Note: This can be achieved by selecting the set points of the sensing elements in the slam-shut system, so that they are properly sequenced and with sufficient separation to maintain the downstream supply at a safe pressure level and withstand any pressure surge that may occur. In practice, this is only viable on installations where OP_{mi} exceeds 7 bar. On other installations, consideration will need to be given to the inclusion of other features, for example stream discrimination devices, remote warning systems, etc.

- 7.6.4.3 Any stream discrimination device should be a swinging plate check valve fitted between the regulator outlet and the SOIV, or another system that complies with clause 7.6.4.2.

Note: For OP_{mi} not exceeding 7 bar, stream discrimination has, traditionally, been provided by such check valves. For OP_{mi} exceeding 7 bar, both check valves and pilot-operated systems have been used. The latter are also available for lower pressures.

- 7.6.4.4 Where a swinging plate check valve stream discrimination device is fitted:

- the valve shall be installed in horizontal pipework and have sufficient straight pipe immediately upstream to accommodate the slam-shut impulse points and creep relief
- the valve shall be positioned such that its operation is not affected by downstream equipment, pipework or fittings
- the valve differential pressure should not be so large as to cause nuisance movement of the slam-shut mechanism at flow rates up to 120% Q_{max} (see Sub-Section 10.7)
- a valved tapping shall be provided in the stream pipework between the valve and stream outlet isolation valve:
 - for MOP_{mi} not exceeding 7 bar of minimum diameter 20 mm
 - for MOP_{mi} exceeding 7 bar of minimum diameter 25 mm.

- 7.6.4.5 Wherever possible, a meter installation that incorporates more than one meter should be designed to avoid common outlet connections from the meters.

Note 1: This is to avoid problems with over-speeding and interaction between meters. The preferred arrangement is to split the load, i.e. to use separate meters for different parts of the load. The meters may be fed from a single regulator installation or be individually regulated.

Note 2: It may be necessary to split the load to ensure that low flow rates are recorded accurately, for example factory catering loads.

Where two meters, connected to a common PRI/regulator, supply independent systems comprising substantial volumes of downstream pipework, particularly for MOP_u exceeding 75 mbar, consideration shall be given to fitting a positive sealing non-return valve (NRV) on the outlet of each meter stream.

Note: Where an NRV has not been installed, the downstream pressure in one of the systems may affect the pressure in the other system at times of substantial load change. This is partly due to the response time of the regulator. The equalising of pressure between the two systems can cause a meter to rotate, either forwards or backwards, potentially causing metering errors particularly where a conversion device is installed.

- 7.6.4.6 Where it is necessary to use meters in parallel and with a common outlet connection (see Figure 27), each meter should be regulated independently at a slightly different pressure. The difference in regulator set points should not be large enough to cause meter over-speeding.

Where meters of different size are installed, provision shall be made to prevent the smaller meter over-speeding.

Where it is unavoidable to use meters in parallel and with a common inlet and outlet manifold connections, supplied from a common regulator system, for example on very large loads:

- the meters used shall be of the same make and size
- the installation shall be designed such that the pressure loss characteristics of each stream are sensibly identical and, thus, the flow down each measuring stream is the same under all flow conditions.

7.6.4.7 On large loads, it may be desirable to install either a standby meter or a reference meter, in which case the two meters can be installed with common inlet and outlet connections (see Figure 7). In the case of a reference meter, the pipework should include a facility to enable the two meters to be run in series as well as in parallel (see Figure 8).

7.6.4.8 On installations with MOP_u not exceeding 75 mbar, where parallel regulator streams are installed for the purpose of providing sufficient flow capacity, each regulator stream shall be equipped with a stream inlet valve.

In all other instances of parallel regulator streams, meter streams or filter streams, there shall be inlet and outlet valves fitted on each stream.

7.6.5 **PRI/regulator by-passes**

7.6.5.1 Any PRI/regulator stream shall not be capable of being by-passed unless a means of pressure control is incorporated and safety systems are included in the by-pass. Such safety systems shall be at least equivalent to the main stream safety system.

7.6.5.2 For a single stream module, adequate provision should be made to ensure that a positive pressure can be maintained in the downstream system during maintenance (see clause 7.6.1.7).

7.6.5.3 Any temporary by-pass that by-passes the main stream regulator(s) or safety system(s) shall have regulating and safety systems, as appropriate, fitted to protect the downstream system as outlined in clause 7.6.2.

7.6.5.4 Where an auxiliary system by-passes the main stream regulator(s) and the safety system(s), it shall also be fitted with regulating and safety systems to protect the downstream system, as outlined in clause 7.6.2.

7.6.6 **Meter by-passes**

7.6.6.1 A meter by-pass is not preferred and shall only be installed with the approval of all the relevant parties in the contractual chain (see Sub-Section 6.2).

7.6.6.2 Any meter by-pass shall be connected around the meter stream, and shall not by-pass the PRI/regulator. On an installation incorporating a twin stream PRI, the meter by-pass and meter stream should be supplied from the PRI outlet header and shall terminate at a header or tee connected to the outlet of the meter stream.

7.6.6.3 An MIV and MOV shall be fitted in each stream to allow meter removal.

7.6.6.4 The meter by-pass shall by-pass the meter and its isolation valves and shall also be fitted with a meter by-pass valve (MBV) (see Sub-Section 13.4).

- 7.6.6.5 Where it is unacceptable for the consumer to be subject to reduced flow when operating on a by-pass, the meter by-pass should have a pressure loss no greater than the pressure loss in the meter stream.

7.6.7 Upstream metering

While the foregoing requirements indicate that the meter is positioned downstream of the regulator(s), under certain circumstances it may be appropriate to install the meter upstream of the PRI/regulator.

In such installations, volume conversion equipment (see IGEN/GM/5) shall be installed and consideration shall be given to the effects that the expected variations in the metering pressure will have on the effective turndown of the meter.

Note: When metering upstream of a PRI/regulator, any variation in supply pressure will have a significant impact on the turndown of the meter selected, as the meter would have to cope with the maximum flow at the minimum pressure, and with the minimum flow at the maximum pressure. For example, a 2 to 1 variation in absolute pressure will result in the usable turn down of the meter being halved.

7.6.8 Unregulated supplies

- 7.6.8.1 While the foregoing requirements indicate that the installation incorporates a regulator, under certain circumstances it may be appropriate to install an unregulated supply.

- 7.6.8.2 Unregulated supplies shall only be installed when the installation fulfils the following criteria:

- when the installation is within the scope of the GS(I&U)R, an exemption has been granted by HSE

Note 1: This has, usually, only been given for a dedicated supply to a CHP installation requiring gas compression.

Note 2: The scope of the GS(I&U)R does not include certain types of industrial and commercial premises, e.g. factories.

- the upstream conveyor (usually the GT) has given its permission, in writing, for the installation to be connected to its network and that compliance with any requirements specified by the conveyor has been, and will continue to be, achieved, and the requirements of the Gas Act, Schedule 2B have been fulfilled
- an appropriate volume conversion system has been installed (see IGEN/GM/5)
- consideration has been given to the effects that the expected variations in the supply pressure will have on the effective turndown of the meter (see clause 7.6.7)
- suitable over-pressure protection devices (in accordance with IGEN/UP/6) have been installed and set correctly
- both the GT and the consumer agree to notify the other if any circumstance arises that would invalidate previously approved designs
- when MIP_u not exceeding MOP_c and DP_{mi}
- the installation is fed from a dedicated pipeline
- for OP_u exceeding 2 bar, a dedicated housing/compound for the meter installation will be provided (see IGEN/GM/8 Part 2).

SECTION 8 : GAS CLEANING (inc. filtration)

8.1 GENERAL

- 8.1.1 Any meter, PRI/regulator and instrumentation system shall be protected adequately against gas-borne dust and liquids that may be present in the upstream system, by incorporating a suitable extraction system on the inlet of the installation.

Note: A diaphragm or USM installation of MOP_u not exceeding 75 mbar does not, normally, require an extraction system.

- 8.1.2 The extraction system shall be sized for the maximum volumetric flow at minimum system inlet pressure, with an inlet gas velocity not exceeding 20 m s^{-1} .

- 8.1.3 The extraction system shall be designed to produce an acceptable pressure loss when clean to ensure satisfactory operation of downstream equipment. Unless it is known that a higher pressure loss is acceptable, the pressure loss across a clean extracting system should not exceed those given in Table 3.

MOP	MAXIMUM PRESSURE LOSS
$\leq 75 \text{ mbar}$	0.6 mbar
$> 75 \text{ mbar} \leq 2 \text{ bar}$	20 mbar
$> 2 \text{ bar} \leq 7 \text{ bar}$	100 mbar
$> 7 \text{ bar} \leq 38 \text{ bar}$	100 mbar or as manufacturer's instructions.

Note: In certain circumstances, a lower pressure loss than indicated may be essential.

TABLE 3 - MAXIMUM PRESSURE LOSS ACROSS EXTRACTION SYSTEMS

- 8.1.4 The chosen form of protection shall be installed at the inlet of the meter installation. As a minimum, it shall be a closed end in-line strainer (top/witches hat for OP_u not exceeding 75 mbar) mounted in the pipe and, for OP_u exceeding 75 mbar where maintenance will need to be undertaken, a box type design where elements can be withdrawn from the housing without breaking the main pipe.
- 8.1.5 Any in-line type strainer should incorporate some form of external indication of its type, presence and correct installation, such as a handle or label. Other extraction systems should have an identifying plate showing the type and method of operation of release mechanisms.
- 8.1.6 Where filters are classified as pressure vessels, any associated extraction system should meet an acceptable minimum standard such as PD 5500.
- 8.1.7 Any box-type extraction system should have its closure constructed such that it can be opened safely and be fitted with a safety blow down system.
- 8.1.8 Any extraction system shall have a clear indication of the direction of flow.

8.2 INSTALLATION FILTRATION

8.2.1 Any body of an extraction system of diameter 80 mm (3 in) and larger should incorporate quick-release closures.

8.2.2 Suitable pipework connections shall be provided to enable venting and/or purging and, where necessary, draining of primary cleaning components, prior to changing elements. Extraction systems should be vented using a downstream connection.

Note: This is to ensure that dirt and debris is not dislodged from the filter elements and brought back into the pipework and the filter unit itself.

8.2.3 It shall be ensured, by appropriate configuration or component design, that debris cannot fall into pipework when removing any cleaning element.

8.2.4 Tappings should be provided across any primary cleaning element to enable the differential pressure reading devices to be fitted if required.

Note 1: The tapping may be plugged or comprise a pressure test nipple with sealing screw.

For MOP_u exceeding 75 mbar, any tappings shall be valved. Where a differential pressure gauge is provided, it shall incorporate a slave pointer to record the maximum differential pressure reached between inspections, highlighting any need for the element to be renewed.

Note 2: If the meter installation incorporates a telemetry link, a differential pressure transducer may be considered.

Note 3: Remote indication of the differential pressure may be desirable.

On a large installation, provision should be made to enable the pressure drop across any filter to be monitored.

Note 4: This can be applied to each individual filter, or across the filter installation as a whole.

8.2.5 For MOP_u not exceeding 7 bar, cleaning element cut offs shall be $\leq 250 \mu\text{m}$ except:

- $\leq 50 \mu\text{m}$ for an RD meter without scraper tips
- $\leq 50 \mu\text{m}$ for any meter installation at $2 \text{ bar} < MOP_u \leq 7 \text{ bar}$.

Note: Notwithstanding these limits, it may be desirable to install a finer mesh/strainer size.

8.2.6 For MOP_u exceeding 7 bar, the following apply:

- any filter/strainer shall be to a suitable recognized standard
- any filter/strainer element should be of a disposable glass fibre type which shall achieve a filtration level of between $2 \mu\text{m}$ and $50 \mu\text{m}$ dependent on the sensitivity of the downstream system to contamination

Note: Elements with mesh or gauze construction are not recommended.

- cyclic pressure conditions shall be considered and specified in the filter/strainer design
- at least two filters/strainers shall be incorporated, one active, one on standby
- a pressure-balancing bridle shall be fitted around each filter/strainer inlet valve (FIV). Connections should be of such size to be resistant to mechanical damage
- if the meter installation has a telemetry link, a differential pressure transducer should be installed for each filter/strainer.

8.3 **AUXILIARY LINE FILTRATION**

- 8.3.1 The general principles of Sub-Section 8.1 shall be applied for gas supplies to slam-shut actuators, valve actuators, pilot regulators, other auxiliary systems and instrumentation which shall incorporate a filter/strainer with a cut-off $\leq 50 \mu\text{m}$ or finer if specified by the manufacturer.

Note: Single, low-capacity, filters are acceptable.

- 8.3.2 Removal of any element shall be possible without disconnection of pipework.

8.4 **TEMPORARY FILTERS/STRAINERS FOR COMMISSIONING**

- 8.4.1 Any turbine or RD meter should be fitted with a strainer for commissioning, unless the complete meter installation has been manufactured and assembled under workshop-controlled conditions when it may be deemed unnecessary.

For MOP at the filter/strainer not exceeding 75 mbar, the element shall be an open-ended, in-line, mesh type or skirt-type strainer inserted in horizontal pipework between any meter regulator and the meter. For MOP exceeding 75 mbar, this element shall be a closed end, in-line, mesh type strainer.

Note 1: This strainer is required to protect the meter from any welding slag, pipe scale, rust or other debris existing or occurring in the pipework between the meter and regulator(s), which might otherwise damage the meter.

Note 2: The open-ended strainer is considered to be adequate at low pressures as there is unlikely to be any gas borne dust/debris due to low gas pressure and velocity. They have the added advantage of a relatively low pressure drop, which is important when metering at low pressures. However, at higher pressures, gas-borne dust is more likely and the pressure drop is less critical.

- 8.4.2 The strainer mesh size shall not be finer than that of the main installation filtration and should not be coarser than $250 \mu\text{m}$ or $50 \mu\text{m}$ for RD meters without scraper tips.

- 8.4.3 Provision shall be made in the design of the pipework to enable removal of the strainer following commissioning of the installation.

- 8.4.4 For an RD meter, the strainer should be fitted as near as practicable to the inlet of the meter.

- 8.4.5 For a turbine meter, the strainer should be at least 3D (or other distance as recommended by the meter manufacturer) upstream of the inlet of the meter. Where the meter is installed in accordance with the manufacturer's requirements for fiscal type metering applications, and these allow the strainer to be installed within 3D of the meter, this information shall be obtained in writing from the manufacturer and retained with the site records.

Note: It is likely that installing the strainer any closer than 3D will result in significant metering errors.

- 8.4.6 Where the main installation filters/separators and regulators are installed separately (with interconnecting pipework) provision should also be made for a temporary strainer to be installed upstream of each PRI/regulator stream, including a suitable means of removal.

SECTION 9 : PRESSURE CONTROL

9.1 GENERAL

- 9.1.1 For MOP_u not exceeding 75 mbar, any valve within a regulator shall be open at rest.
- 9.1.2 Any regulator shall conform to BS EN 88, BS EN 334 or IGEM/GM/PRS/33, as appropriate, or shall comply with the general principles of such standards.
- 9.1.3 Any breather shall be resistant to water ingress and shall enable a pipe to be fitted via a screwed connection to BS EN 10226.
- 9.1.4 Any pressure-controlling spring supplied as part of a regulator shall be colour coded to enable identification of its pressure range.

9.2 SIZING A PRI/REGULATOR

- 9.2.1 The PRI/regulator should be selected so as to provide the necessary performance required by the meter and by the load being supplied through the meter under all foreseeable operating conditions at the inlet to the meter installation.

Any PRI/regulator shall be able to pass the required load with the installation inlet pressure at DmP_u while maintaining the required outlet pressure above DmP_c .

When a meter is installed downstream of a regulator, the regulator shall be able to maintain the required meter inlet pressure within the tolerances given in Sub-Section 9.3.

When sizing a regulator, due consideration shall be taken of the pressure loss across filters, inlet valves and pipework which will reduce the inlet pressure to the regulator at high flows.

Note: In particular, this is important when the inlet pressure is as low as DmP_u .

- 9.2.2 Where significant volumes of gas are expected to flow at less than 2% of the maximum capacity of a regulator, consideration shall be given to the installation of either a smaller parallel stream to cope with those low flow rates or identical stream(s).

Note: Hunting could occur when the regulator operates at a flow of less than 2% of its maximum capacity. This could, in turn, affect the accuracy of any meter and the operation of the consumer's appliances.

9.3 CONTROL OF METER INLET PRESSURE

The following assumes that a meter is installed downstream (not upstream) of a regulator.

- 9.3.1 The regulator shall be capable of controlling, in a stable manner, the meter inlet pressure over its designed flow range and over the anticipated range of installation inlet pressures.

Note: To achieve the control accuracy specified in clause 9.3.2 over the anticipated range of inlet pressures, a regulator that is balanced against the effects of inlet pressure will normally be required. A two stage regulator may also provide an enhanced level of control.