ES PIPELINES

ESP/PM/MP4

SPECIFICATIONS FOR

INDUSTRIAL AND COMMERCIAL METERING INSTALLATIONS (INLET PRESSURES NOT EXCEEDING 7 BAR GAUGE)

October 2022

Document and version control

Date	By	Notes	Version number (after changes)
May 2006	Alan Smith	Document created & approved	V1.0
August 2008	Alan Smith	Document reviewed with minor format changes and approved	V1.1
January 2012	Safety & Compliance Manager	Minor updates to text.	V1.2
April 2014	Safety & Compliance Manager	No changes made following review.	V 1.3
April 2016	Safety & Compliance Manager	Minor changes to text.	V 1.4
June 2018	Safety & Compliance Manager	Minor changes to text.	V 1.5
Nov 2020	Safety & Compliance Engineer	Document reviewed without change; review frequency now annual (was 2-yearly)	V1.6
Sep 2021	Compliance Manager	Reviewed in line with MCoP & updated BS.	V1.7
Oct 2022	Compliance Officer	Reviewed (annual review) minor edits	V1.8

Audience

ESP staff and Service Providers who have responsibility for the design, installation, and commissioning of I & C gas meter installations.

Prepared by:	**Geoff Ansell – Compliance Officer**
Approved by:	**Rhodri Hughes – Safety & Compliance Engineer**
Date Approved:	**October 2022**
Review Date:	**October 2023**

CONTENTS **Page**

FOREWORD

ES Pipelines Limited's documents are reviewed and revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition by referring to the ES Pipelines Limited Register of Engineering Documents.

Compliance with this document does not confer immunity from prosecution for breach of statutory or other legal obligations.

This document is in four main sections; Parts A, B, C and D. Part A, General and Part D, Commissioning and Maintenance, apply to all installations. Parts B and C both cover System Design but for different installation inlet pressures and although they are similar in content there are many detailed differences and only the appropriate Part will apply to any given installation.

The most recent issue of IGEM/GM/8 'Non-Domestic Meter Installations, Flow rate exceeding 6m^3/h and inlet pressure not exceeding 38 bar'. Part1: Design; Part 2: Location, housings and compounds and Part 5: Notices and Labels has supplemented this document and reference should also be made to this suite of IGEM documents before finalising the design of a meter installation that falls within the parameters of ESP/PM/MP4.

At the end of the Requirements there is a Supplement which is not a part of the Requirements itself but consists of explanatory notes and further general information relating to certain clauses in the Requirements. The Clause references are set out in numerical order.

BRIEF HISTORY

Approved by ES Pipelines Limited as ESP MP4 May 2006
First published as ESP MP4 Version 1.0 May 2006
Reviewed and minor updates to format ESP/PM/MP4 Version 1.1 August 2008
Reviewed and minor updates to format ESP/PM/MP4 Version 1.2 January 2012
Reviewed no changes required ESP/PM/MP4 V 1.3 April 2014.
Reviewed with minor changes made to text ESP/PM/MP4 V 1.4 April 2016.
Reviewed with minor changes made to text ESP/PM/MP4 V 1.5 July 2018
Reviewed without change ESP/PM/MP4 V 1.6 November 2020
Reviewed in line with new MCoP, ESP/PM/MP4 V1.7 September 2021
Reviewed (annual review) minor edits, October 2022, ESP/PM/MP4 V1.8

DISCLAIMER

This Safety and Engineering document is provided for use by ES Pipelines Limited and such of its contractors as are obliged by the terms and conditions of their contracts to comply with this document. Where this document is used by any other party it is the responsibility of that party to ensure that this document is correctly applied.

PART A

GENERAL

1. INTRODUCTION

1.1 These Requirements have been prepared to provide an ES Pipelines Limited (ESP) standard covering the design and installation of meter installations, including their associated filters and regulators, serving Industrial and Commercial end users where the meters are used for billing purposes.

1.2 These Requirements specify the minimum standards which shall be applied such that installations will operate safely and reliably whilst ensuring that the gas consumption is metered as accurately as possible commensurate with the costs and practicable means of achieving that accuracy.

1.3 At the time of publication, it is believed that these procedures when competently carried out satisfy those Industry requirements currently in force relating to metering/pressure regulating installations.

1.4 It is recognised that, in particular circumstances, it may be necessary to use materials, systems and procedures which differ from those specifically defined in these Requirements but which, nevertheless, comply with its intent. Similarly, new materials, systems and procedures resulting from advances in technology may be applied to give equal or improved safety and metering accuracy. It is not intended that these Requirements should prohibit their development or use, but any departure should be made only on the basis of sound engineering judgement and experience.

1.5 Throughout this document the use of "**shall**" indicates a mandatory requirement, whereas "**should**" indicates a recommendation.

2. SCOPE

2.1 These Requirements apply to all metering installations in industrial and commercial premises, except those described in 2.2, where the inlet pressure is less than 7barg and the meter reading is used to render an account for gas used.

2.2 When a domestic sized meter supplied from a low-pressure system is fitted in industrial and commercial premises, the design and commissioning of the installation need not comply with all the detailed requirements of Parts B and D of this document but should be in accordance with established procedures for domestic meter installations and ES Pipelines Limited's Procedure ESP/PM/MP3. Such installations are the subject of BS 6400:1 2016 'Specification for the installation, exchange, relocation, and removal of domestic-sized gas meters (2nd and 3rd family gases). Part 1: Low Pressure 2nd family gases' which covers meters up to 6m^3/h rating.

2.3 These Requirements embrace the design, location, housing and construction of the meter installation and its subsequent commissioning and maintenance.

2.4 The requirements and recommendations contained in this document apply both to end users supplied under published tariffs and to end users whose gas is supplied under the terms of a Special Agreement, sometimes referred to as Contract End Users.

3. PHILOSOPHY

3.1 The prime objectives when designing a metering installation are to ensure, as far as is reasonably practicable:

3.1.1 Continuous accurate measurement, including the reduction of both random and systematic metering errors, where this can be justified economically.

3.1.2 Reliability of operation, including the required level of security of the gas supply, integrity of meter installation, and consideration of future maintenance and eventual disposal.

3.1.3 The safety of persons and plant, including impact on escape routes

3.2 The meter installation and its pressure regulating installation should be designed not in isolation, but as a single unit. Both should be sized for the same load, and consideration must be given to the effect that each may have on the other.

3.3 The meter selected should be capable of matching the characteristics of the load with the required degree of accuracy.

3.4 The pressure regulating equipment should be selected so as to provide the necessary performances required by the meter and by the load being supplied.

3.5 The standard of filtration provided for the pressure regulating equipment shall be selected so as to provide suitable filtration standards for metering and other associated equipment and with consideration given to the requirements of appliances and plant controls.

3.6 The requirements for any housing of the equipment will depend upon the supply pressure, the location, the equipment being installed, the need for safety, security, and similar considerations.

4. RESPONSIBILITIES

4.1 Installation Housing and Security

4.1.1 It is the responsibility of ES Pipelines Limited to procure and install the installation housing (and to subsequently re-charge all associated costs in full to the end user) unless it is specifically agreed that the end user shall provide the housing. Where the end user is responsible for the provision of the housing then the location, design and specification shall be approved by ES Pipelines Limited prior to it's procurement/ construction. The approval of the design of all meter housings shall be in accordance with the Company's procedure ESP/PM/GT6. It is the end users' responsibility to maintain any housing or security compound that may be required, including the provision and maintenance of any other specified services, e.g., water, drainage, electricity. All such housings and compounds shall be compliant with current industry standards and requirements.

4.1.2 It is the responsibility of ES Pipelines Limited to advise the end user if any part of

the installed equipment could be affected by the end user's own maintenance work and that the end user shall advise ES Pipelines Limited before any such work is commenced.

4.1.3 It is the responsibility of ES Pipelines Limited to provide the end user with an operating key to any emergency meter installation isolation valve fitted together with instructions and any necessary notices as to its use and to advise the end user that any key should be kept in a safe and accessible place.

4.2 Meter By-Passes

4.2.1 It is the responsibility of ES Pipelines Limited to agree the circumstances in which a meter by-pass may be installed before this is done in accordance with the Company's management procedure ESP/PM/GT3. This include agreeing this with the gas supplier.

4.2.2 After the commissioning of an installation including a meter by-pass has been completed the by-pass shall been labelled and properly sealed in a closed position.

5. LEGAL, ES PIPELINES LIMITED, AND OTHER REQUIREMENTS

5.1 Legal Requirements

The following documents have been taken into account in the preparation of these Requirements:

Gas Act 1985, and where relevant as amended by Gas Act 1995
Gas Meter Regulations (and Amendments) 1983
Gas Safety (Installation and Use) Regulations 1998
Gas (Calculation of Thermal Energy) Regulations 1996
European Measuring Instruments Directive (2004/22/EC)
Pressure Equipment Directive 1997
Pressure Equipment Regulations 1999
Pipeline Safety Regulations 1999
Pressure Systems Safety Regulations 2000
Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)

5.2 ES Pipelines Limited Requirements

5.2.1 Metering Pressure

The pressure at the meter inlet shall be set at 21 mbar gauge unless ES Pipelines Limited have contracted to supply at a higher pressure and by agreement with the end user.

5.2.2 Badged Meters

Only badged/stamped meters registering in cubic metres shall be used for billing purposes.

It is an offence under the Gas Act to supply gas to tariff end users through a badged/stamped meter if the seal has been broken or for the seals on such

badged/stamped meters to be broken by anyone other than an Authorised Gas Meter Examiner.

5.2.3 Meter Correction

Correction for the effects of pressure, temperature and compressibility will be applied as follows:

5.2.3.1 Special Agreements

Correction shall be applied in accordance with the Company's Procedure ESP/PM/ME6.

5.2.3.2 Tariffs

The Gas Act does not permit tariff supplies to be corrected.

5.2.4 Special Agreement End users

When a supply to a non-tariff end user is being considered reference should be made to the conditions specified in the standard ES Pipelines Limited form "Special Agreement for the Supply of Gas".

5.2.5 Where the consumer is to use a compressor, engine, or any associated compressed air or extraneous gases, ESP shall instruct them to advise the GT of this. The GT may then become involved in the Design process for any protective devices etc. it deems necessary.

5.3 **Technical Requirements**

The following publications have been taken into account in the preparation of these Requirements:

Publication	**Title**
IGEM/GM/5	Selection, installation and use of electronic gas meter volume conversion systems
IGEM/GM/6	Specification for low pressure diaphragm and Rotary Displacement meter installations with badged meter capacities exceeding 6m^3/h. (212 ft^3/h) but not exceeding 1076m^3/h (38000 ft^3/h)
IGEM/GM/7 A & B	Electrical connections and hazardous area classification for gas metering equipment
IGEM/GM/8	Non-domestic meter installations. Flow rate exceeding 6m^3/h. and inlet pressure not exceeding 38bar
Part 1	Design
Part 2	Locations, housings and compounds
Part 3	Installation and commissioning
Part 4	Operation and maintenance
Part 5	Notices and Labels
IGEM/TD/13	Pressure regulating installations for transmission and distribution
IGEM/G/1	Defining the end of the Network, a meter installation and installation pipework
IGEM/UP/1	Strength and tightness testing and direct purging of industrial and commercial gas installations
IGEM/UP/1A	Strength and tightness testing and direct purging of small low pressure industrial and commercial Natural Gas installations

IGEM/UP/1C	Strength and tightness testing and direct purging of industrial and commercial Natural Gas meter installations
IGEM/SR/25	Hazardous area classification of Natural Gas installations
GIS/L2	Steel pipe 21.3mm to 1219mm outside diameter for operating pressures up to 7 bar (supplementary to BS EN ISO 3183 PSL 2).
GIS/F7	Specification for steel welding pipe fittings 15mm to 450mm inclusive nominal size for operating pressures not greater than 7 bar.
BS EN 60079-14:2014	Electrical apparatus for explosive gas atmospheres. Electrical installations in hazardous areas (other than mines)
BS EN 60079-17:2014	Electrical apparatus for explosive gas atmospheres. Inspection and maintenance of electrical installations in hazardous areas (other than mines)
BS 6400 2016 and 2018	Specification for the installation, exchange, relocation and removal of domestic-sized gas meters (2nd and 3rd family gases). Part 1. Low Pressure 2nd family gases Part 2. Medium Pressure 2nd family gases
BS EN 1359:2017	Gas meters. Diaphragm gas meters
BS EN 12480:2018	Gas meters. Rotary displacement gas meters
BS EN 12261:2018	Gas meters. Turbine gas meters
BS EN 12405-1:2021	Gas meters. Conversion devices. Volume Conversion
BS EN 1759-1:2004	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, class-designated. Steel flanges, NPS 1/2 to 24
BS 6956-5:1992	Jointing materials and compounds. Specification for jointing compounds for use with water, low pressure saturated steam, 1st family gases (excluding coal gas) and 2nd family gases
BS EN 1092-1:2018	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
BS EN 1515-1:2000	Flanges and their joints. Bolting. Selection of bolting
BS EN 1515-3:2005	Flanges and their joints. Bolting. Classification of bolt materials for steel flanges, class designated
BS 10:2009	Specification for flanges and bolting for pipes, valves, and fittings
BS EN 10255:2004	Non alloy steel tubes suitable for welding or threading
BS 143 and 1256:2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 1560-3.2:1989	Circular flanges for pipes, valves and fittings (Class designated). Steel, cast iron and copper alloy flanges. Specification for cast iron flanges
BS EN 10253-1:1999	Butt-weld pipe fittings. Wrought carbon steel for general use and without specific inspection requirements
BS 1965-1:2011	Specification for butt-welding pipe fittings for pressure purposes.
BS 4800:2011	Schedule of paint colours for building purposes
BS 1640-3:1968	Specification for steel butt-welding pipe fittings for the petroleum industry. Wrought carbon and ferritic alloy steel fittings. Metric units
BS 3799:1974	Specification for steel pipe fittings, screwed and socket-welding for the petroleum industry
BS 2971:1991	Specification for class II arc welding of carbon steel pipework for carrying fluids
BS EN 334:2019	Gas pressure regulators for inlet pressures up to 100 bar
BS EN 10241:2000	Steel threaded pipe fittings
BS EN 10216-1:2013	Seamless steel tubes for pressure purposes. Technical delivery conditions
BS 4368-1:1998	Metallic tube connectors for fluid power and general use. Split collet compression fittings
BS EN 1514-1:1997	Flanges and their joints. Dimensions of gaskets for PN-designated flanges. Non-metallic flat gaskets with or without inserts

BS EN 1514-2:2014+A1 2021	Flanges and their joints. Dimensions of gaskets for PN-designated flanges. Spiral wound gaskets for use with steel flanges
BS EN 682:2002	Elastomeric seals. Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids
BS EN 1057:2006 +A1 2020	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1254-2:2021	Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
BS 476-20:1987	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction
BS 476-21:1987	Fire tests on building materials and structures. Methods for determination of the fire resistance of load bearing elements of construction
BS 476-22:1987	Fire tests on building materials and structures. Methods for determination of the fire resistance of non-load bearing elements of construction
BS 476-23:1987	Fire tests on building materials and structures. Methods for determination of the contribution of components to the fire resistance of a structure
BS EN 14382:2019	Safety devices for gas pressure regulating stations and installations. Gas safety shut-off devices for inlet pressures up to 100 bar
BS EN 10216-5:2021	Seamless steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes

6. METER INSTALLATION DESIGN - LOAD CHARACTERISTICS AND PRESSURE REQUIREMENTS

6.1 Reliable information relating to the nature of a load and the anticipated rate of flow (present and future) is important. Pressure requirements downstream of the meter installation are also of importance when designing the meter installation. A typical form which may be used when necessary for collating the required information is given in Appendix 3.

6.2 It is the responsibility of both ES Pipelines Limited and the end user or the end users nominated Gas Supplier/Shipper to provide a reliable assessment of the load requirements for a particular meter installation on the end users site and also to establish the nature of the load and the anticipated rates of flow and pressure requirements which should include:

6.2.1 The estimated maximum flow rate, which is not necessarily a summation of the total connected load (but shall be this value unless an agreed load factor can be established which shall ensure that adequate supply is provided at all times for the safe and efficient operation of the plant and equipment installed downstream of the meter installation), and the minimum flow rate (which shall not be zero) to be anticipated.

6.2.2 The number and type of each unit of plant, and the anticipated load pattern for each.

6.2.3 The best possible estimate concerning the anticipated future growth of load.

6.2.4 Details of any special features of the plant which may affect the nature of the load, e.g., fast-fluctuating loads, snap-acting control valves creating rapid on - off load conditions, boosters and compressors, and associated start-up characteristics (‘black start’ conditions etc.).

6.2.5 The pressure requirements downstream of the meter installation to ensure safe and efficient operation of all plant and equipment installed/ to be installed by the end user. This will determine the metering pressure to be provided by ES Pipelines Limited at the outlet of the metering installation.

PART B

SYSTEM DESIGN FOR INSTALLATIONS WITH INLET PRESSURES NOT EXCEEDING 75MBAR GAUGE

7. GENERAL

7.1 The meter and pressure regulating equipment should be designed not in isolation, but as a single installation. Normally both should be sized for the same load and consideration must be given to the effect that each may have on the other.

7.2 Continuity of supply, whilst not always an essential requirement, may be desirable in some circumstances, e.g., to enable an end user to take gas during regulator maintenance or in the event of a fault in the system. When designing a pressure regulating installation which the end user will be asked to contribute towards, the end user may be given the option of a twin-stream rather than single-stream regulator installation.

7.3 Where two or more regulator streams are installed, (other than any small parallel stream to cope with low flow rates) the main stream shall be capable of providing 100% of the normal load capacity, with the standby streams also being capable of providing 100% of the normal load capacity in the event of a failure of the main stream. Alternatively, each stream may be equally sized to supply part of the total normal load capacity requirement e.g., 60-70% through either stream with one stream having sufficient capacity for the essential load *(this is the non-preferred option of ES Pipelines Limited and will only be considered in exceptional circumstances).*

Where two or more regulator streams are necessary to provide the essential load capacity (i.e., the combined capacity of the regulator streams equates to the total essential load capacity requirement of the installation) then individual stream isolation valves may not be fitted (this will ensure that the capacity of the installation is not reduced should one of the streams be isolated inadvertently). Where each of the regulator streams is capable of meeting 100% of the normal load capacity requirement then each stream shall have stream isolation valves fitted.

7.4 It is permissible to use meters in parallel from a single regulator system, provided the meter outlets are not connected. The design of parallel meters with common outlet connections shall only be considered in exceptional circumstances.

7.5 Where the distribution system operates at pressures not exceeding 50 mbar gauge arrangements as shown in Figs.1, 2 & 3 in Section 8.3 should be used and it is not normally necessary to provide over-pressure protection or creep relief facilities. However, where over-pressure protection is necessary reference shall be made to Part C, Sections 18.2.1 and 18.3.1.

7.6 The maximum designed flow rate for which the installation is sized should take account of a suitable load factor where appropriate (see section 6.2).

7.7 The installation should be designed to pass the maximum designed gas flow rate at the lowest expected inlet pressure and the designed outlet pressure.

7.8 The minimum installation inlet pressure will not normally exceed 25 mbar gauge. However, in exceptional circumstances a different pressure at the installation inlet may be permitted by the Company and this should be taken as the lowest expected inlet pressure.

7.9 The meter inlet pressure to which the pressure regulators should control shall be e stablished. This will normally be 21mbar gauge unless it has been agreed to meter at an elevated pressure (see 5.2.1) in which case the set pressure shall be marked on a notice at the installation.

7.10 Gas velocities in pipework must not exceed 20 m/s on the inlet side of filters (unless the upstream system is classified as 'dust free' or is itself filtered in which case inlet velocities of 40m/s will be permitted) and 40 m/s downstream of filters when the maximum flow rate occurs at the lowest expected inlet pressure.

7.11 Once the meter position is agreed, the service pipe and the first above-ground valve (normally the meter control valve) will be installed.

7.12 At selected installations, provision should be made to monitor load characteristics once the plant is operational.

7.13 On single-stream pressure regulator installations consideration should be given to the provision of suitably sized plugged and sealed valves either side of the installation to enable the downstream pipework to be kept pressurised during maintenance via a temporary rider incorporating a pressure regulator *(generally a 15mm connection should be adequate but consideration should be given to the load requirements when sizing a temporary rider)*.

8. INSTALLATION ARRANGEMENTS

8.1 General

8.1.1 Irrespective of whether a service isolation valve is fitted, a meter control valve shall be installed.

8.1.2 Where there is more than one regulator stream, there shall be an inlet and outlet valve on each stream *except* where two regulator streams are needed to meet the essential load capacity requirement of the installation as described in 7.3.

8.1.3 There shall be no ungoverned by-pass around any regulator.

8.1.4 The regulators shall have internal valves which are open at rest.

8.1.5 A meter shall be positioned in such a way that the index can be read conveniently when the meter is installed, without the use of mirrors, etc. Where site conditions permit, gas flow through the meter from left to right, when viewing the index, is preferred.

8.1.6 Pressure test points (see 14.2) and purge and vent points (see 14.3) shall be fitted as indicated in 8.3.1, 8.3.2, and 8.3.3 Figs. 1, 2 & 3. Where a pressure test point is not provided on an item of equipment a point shall be provided on the adjacent pipework.

8.2 Meter Connections

Meters shall be installed in a manner that minimises strain being placed upon the meter connections and allows easy removal and re-fixing of the meter.

Where flexible connections # are used they shall be fitted in accordance with 8.2.1, 8.2.2 or 8.2.3.

See Appendix 1.

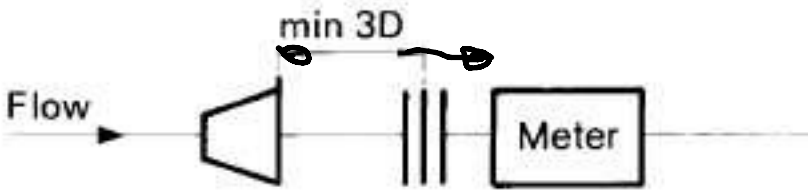
8.2.1 with diaphragm meters of tin-plate construction at least one flexible connection#, on the meter inlet, shall be used. Steel-case types may be fixed with rigid connections, but any flexible connection used shall be on the inlet as a minimum.

8.2.2 With Rotary Displacement meters flexible connections# shall be on both the inlet and outlet to facilitate levelling and may accommodate the open-ended top-hat or skirt-type strainer at the meter inlet (see 9.5) *except* where factory made pre-assembled Rotary Displacement meter modules are utilised and then only one flex connection shall be required

See Appendix 1

8.2.3 With Turbine meters a flexible connection# that **does not disturb the flow pattern** shall be on the meter inlet at least. This connection may be accommodated within the 3D spacing required between the strainer and meter inlet (see Section 9), however this should only be considered where as stated the flexible connection does not disturb the flow pattern.

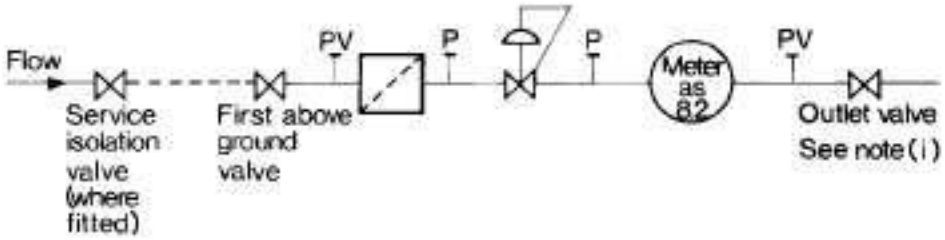
See Appendix 1.



8.3 **Complete Systems**

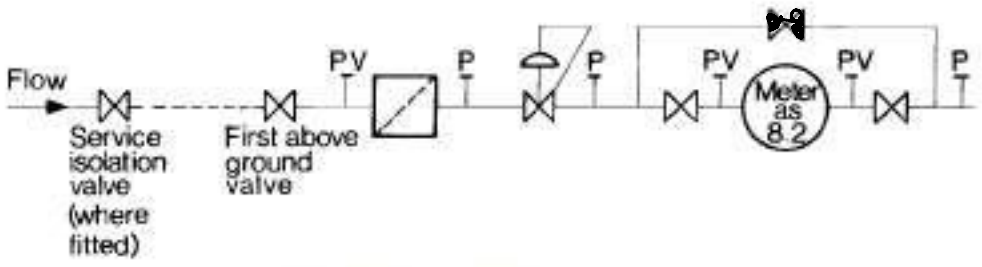
The system should comply with one of the arrangements detailed in 8.3.1, 8.
. 3.2 or 8.3.3 but subject to the requirements of 7.5.

8.3.1 Single-stream regulator and meter - Figure 1.



*Note (i) Other than in exceptional circumstances a meter outlet valve shall be fitted if the meter capacity is in excess of 25 m^3/h

8.3.2 Single-stream regulator and meter (with optional by-pass) - Figure 2.



Notes (i) Where meters are fitted with a by-pass (see Section13.6) then the meter by-pass shall be connected downstream of the regulator.

8.3.3 Twin or multi-stream regulators and meter (with optional by-pass) -

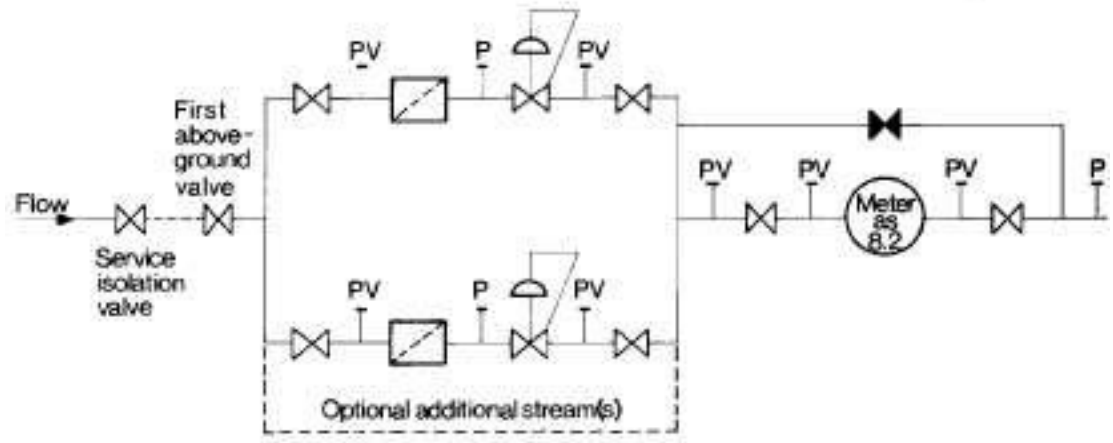


Figure 3.

Notes (i) Where meters are fitted with a by-pass (see Section 13.6) then the meter by-pass shall be connected downstream of the regulators.

(ii) Where continuity of supply is important, a meter with a by-pass should be supplied from a twin or multi-stream regulator installation.

(iii) The meter run and meter by-pass shall both be supplied via the outlet header of the Regulator installation.

(iv) Where two or more regulator streams are needed to meet the essential load capacity requirement of the installation (as described in 7.3) then stream isolation valves may not be fitted.

9. FILTRATION

9.1 Meters, regulators, and instrumentation systems should be protected from gas-borne dust by the inclusion of suitable filters.

9.2 All filters and strainers should be sized such that the pressure drop at the maximum required flow rate does not exceed 1.25mbar measured on gas. In certain circumstances a lesser pressure drop may be essential.

9.3 The filter, which should normally be positioned upstream of the regulator, shall have a cut-off not greater than 200 microns except that a cut-off of not greater than 50 microns shall be specified where a Rotary Displacement meter without scraper tips is to be installed. In certain circumstances it may be desirable to install finer filters.

9.4 All Turbine and Rotary Displacement meters should in addition be fitted with an open-ended top-hat or skirt-type strainer inserted in horizontal pipework between the regulators and the meter *except* where factory made pre-assembled Rotary Displacement or Turbine meter modules are utilised and then this is not a requirement. The strainer mesh size shall not be finer than that of the main filters nor should it be coarser than 250 microns (50 microns for Rotary Displacement meters without scraper tips). Provision should be made in the design of the pipework to enable removal of the strainer for

cleaning and inspection or following commissioning should the strainer be fitted purely for this purpose. For Rotary Displacement meters the strainers should be fitted as near as practicable to the meter inlet. For Turbine meters the strainer shall be at least 3D upstream of the meter inlet.

9.5 The presence of a filter or strainer should be identifiable from the outside of the pipework.

10. REGULATORS

10.1 Regulator Sizing

Unless otherwise specified a regulator should be selected to pass the maximum flow rate at a minimum inlet pressure of 23.5 mbar gauge whilst maintaining an outlet pressure of 21 mbar gauge

Where less than 2% of its maximum flows can be anticipated it is possible that hunting will occur. Under these circumstances consideration should be given to installing either a smaller parallel stream to cope with the low flow rates or multiple identical streams.

Instability can also occur where two or more parallel streams are operating with insufficient differential(s) between their set points.

10.2 Steady State Control

Each regulator should be capable of controlling the outlet pressure over its designed flow range and over the anticipated range of inlet pressure. The preferred accuracy is ± 7.5% of set point gauge (with a limit of ± 10%) between the maximum design flow and 2% of that flow.

10.3 Lock Up

As the flow through a regulator is slowly reduced from 2% of maximum flow to zero, the regulator should not allow the outlet pressure to rise by more than 5 mbar above the value at 2% of maximum flow.

10.4 Response Time

The response time of a regulator is a measure of the time in which a regulator opens or shuts in response to an abrupt change in outlet pressure.

It is essential that the response time should be sufficiently short to follow the variation in outlet pressure caused by change in demand flow rate. Wherever possible response time should not exceed one second. Where a major part of the load (10% or more) is operating in the on/off mode, a regulator with a response time that is significantly shorter may be required.

10.5 Regulator By-passes

There shall be no un-governed by-pass around a regulator.

10.6 Sealing

The regulator shall be capable of being sealed to prevent unauthorised adjustment of its set pressure.

11. METERS

11.1 Meter Selection

The meter should be selected to ensure correct matching to the load. The

standard direction of flow through a meter is ‘left-to-right’ when viewing the index: non-standard arrangements should not be used.

11.1.1 Pressure Ranges

Meters shall only be used within their designed and badged/stamped pressure range.

Steel-case diaphragm meters meeting BS EN 1359:2017 shall be used.

Aluminium-cased diaphragm meters are also available in various pressure ranges.

All Rotary Displacement and Turbine meters are suitable for pressures in excess of 75 mbar gauge.

11.1.2 Flow Range

The flow being measured should lie, as far as possible, within the turn-down range of the meter. Where relatively small quantities of gas are passed at the lowest flows, it will be uneconomic to measure accurately over the complete flow range. The integrated flow accuracy should be estimated for a period of 1 year in order to achieve an economic installation design.

11.1.3 Diaphragm Meters

Diaphragm meters have a turn-down range in excess of 50: 1 and may be used for all normal loads where the flow is less than 170 m^3/h.

11.1.4 Rotary Displacement Meters

Rotary Displacement meters have a turn-down range of at least 30: 1 but this varies according to the make and size and the maker's data should be consulted. This type of meter is therefore more suitable than a Turbine meter for general metering purposes. The meter should not be oversized to accommodate maximum flow rates which may only occur very infrequently, but consideration must be given to possible over-speed effects due to under-sizing. However, the pressure absorption limitations (see 11.2) may result in some over-sizing of the meter being necessary.

Where large step load changes are anticipated, or where boosters or compressors are installed, or where small burners e.g., permanent pilots are also supplied, Rotary Displacement meters should be used with caution. In extreme cases a sudden load increase may cause a temporary low pressure at the meter outlet resulting in pilot outage or burner system lock-out, whereas a sudden load decrease may cause the meter to over-run resulting in a temporary over-pressure condition with consequences similar to the low pressure condition.

These problems due to meter inertia may be minimised by the inclusion of a large reservoir of gas between the meter and the appliances, or in some cases by the installation of a non-return valve at the meter outlet, but such installations should be referred to the meter manufacturer for advice. Wherever possible the use of these meters on such loads should be avoided, using a Diaphragm meter or, in some cases, a Turbine meter as an alternative.

11.1.5 Turbine Meters

Turbine meters have a turn-down range of approximately 15: 1 but this varies according to the manufacturer and size and the manufacturers' data should be consulted.

Badged Turbine meters must have a flow-straightening device which may be either integral with the meter, or a bolt-on attachment, which must always be used with the meter.

Because of the limited turndown range, over-sizing of the meter should be avoided although the pressure absorption limitations (see 11.2) may result in some over-sizing being necessary.

Turbine meters should not be used to measure loads which operate at less than 1.5 times their minimum badged flow rate (Q min) for long periods.

Turbine meters should not be used to measure flows which are rapidly pulsating, nor should they be used where the total metered gas flow is on/off unless the on-time is greater than 30 minutes, as the turbine wheel continues to rotate for some time after the flow through the meter has ceased. The necessary on-time can be reduced to 2 minutes if a continuous base load flows through the meter equal to at least 10% of the maximum metered flow. With certain Turbine meters the above requirements may be relaxed, and shorter on-times would be acceptable, provided the meter manufacturer gives an assurance that metering errors due to non-steady flow will not exceed 1%.

11.1.6 Ancillary Equipment

All Rotary Displacement and Turbine meters shall be fitted with a low frequency transmitter. In addition, they may be fitted with high frequency transmitters, mechanical drives and, on some, a temperature-and/or pressure-corrected index.

The need for these attachments should be taken into consideration when specifying the meter to be used.

Any attachment to the meter must not invalidate the Certificate of Approval for that badged meter.

11.2 Pressure Absorption Across a Meter

11.2.1 At the required maximum flow rate the pressure loss across the meter should not exceed 1.25mbar on gas unless it is known that a higher pressure absorption is acceptable.

11.2.2 It may be necessary to operate the meter at less than its badged rating in order not to exceed the permitted pressure drop. In such cases the usable turn-down will be reduced. This is of particular relevance when using Rotary Displacement or Turbine meters.

11.3 Pipework in Vicinity of Meters

11.3.1 Pipework sizing and configuration upstream and downstream should be in accordance with the meter manufacturer's recommendations.

11.3.2 The pipework configuration upstream and downstream of Diaphragm and Rotary Displacement meters is not critical with respect to registration accuracy.

11.3.3 A Turbine meter requires straight unobstructed lengths of pipe equal to at least 10D upstream and 4D downstream of the meter. Where a taper is required to match the pipe size then there is a requirement for an ***additional*** straight length of pipe of 3D upstream of the meter, where D is the nominal bore of the meter connection. Any taper-piece shall be concentric and have a 15° included angle. Where the manufacturer states that shorter pipe lengths are acceptable a certificate shall be obtained from the manufacturer that pipework and equipment effects shall not affect the accuracy curve of the meter by more than 0.3%.

11.4 Methods of Correction

11.4.1 Correction may be applied by one of the following methods.

11.4.1.1 Fixed-factor correction.

11.4.1.2 Automatic temperature corrector together with fixed-factor pressure correction.

11.4.1.3 Automatic pressure/temperature corrector.

12. VALVES

12.1 Manually Operated Valves

12.1.1 Manual valves shall be fitted in the positions indicated in Figures 1, 2 & 3 of Section 8.3.

12.1.2 The valves selected should be of a type that minimises pressure drop.

12.1.3 All valves shall close in a clockwise direction and have clear indication of valve position. It is also preferable that they have clear indication of direction of operation to open or close.

12.1.4 Where a service isolation valve is fitted it is not essential that the first above-ground valve is a fire-safe type. Where no service isolation valve is fitted the first above-ground valve shall be of a fire-safe type.

12.1.5 The valve designated as the 'meter control valve' (MCV) shall be clearly identified and shall have a handle or wheel which is securely attached to the operating spindle. Where this valve has a handle or lever which does not move horizontally, the valve shall be closed when the handle or lever has been moved as far as possible in the downwards direction.

12.1.6 Installations with a meter capacity greater than 25 m^3/h shall have a meter outlet valve save for in exceptional circumstances.

12.1.7 Where there is more than one regulator stream there should be inlet and outlet valves on every stream so that each may be independently isolated *except* where two or more regulator streams are needed to meet the

essential load capacity requirement of the installation (as described in 7.3) then stream isolation valves may not be fitted.

On single-stream regulator installations, the installation inlet isolation valve may be used as one of an inlet pair and the outlet isolation valve, where fitted, may be similarly used.

12.1.8 Stream isolation valves need not be fitted with a permanent means of actuation.

12.1.9 Line valves immediately upstream of the meter must not be of the forced lubrication type.

12.1.10 Meter by-pass valves shall be fitted with a permanent means of actuation (e.g. handle or wheel) and must be capable of being sealed in the closed position.

12.2 Non-Return Valves

12.2.1 Under the Gas Act it is a requirement for an end user using (in conjunction with the consumption of natural gas) a compressor or air at higher pressure or any extraneous gas not supplied from the upstream distribution network of ES Pipelines Limited to install and use an appliance to prevent the high pressure air or extraneous gas from entering the service pipe or any of ES Pipelines Limited's upstream distribution system. Such an appliance is the **non-return valve**.

12.2.2 Non-return valves shall comply with the requirements of IGEM/GM/8 Part 1.

12.2.3 It is preferable for non-return valves to be fitted to each compressor or item of plant or equipment using compressed air or extraneous gas, thus protecting the end user's equipment and pipework installation in addition to protecting ES Pipelines Limited's meter equipment and upstream distribution system.

In certain cases, particularly in large or complex installations, it may be necessary to fit an additional non- return valve on the outlet of the primary meter.

12.2.4 Where oxygen is being used, special care should be exercised in the choice of non-return valves.

13. PIPEWORK

13.1 Materials and Jointing

13.1.1 Pipework other than for auxiliary and impulse systems should be steel with screwed or welded joints. Flanges may be used in conjunction with either screwed or welded pipework however, the number of such joints should be kept to a minimum.

13.1.2 Grey and ductile iron pipe and pipe fittings shall not be used on metering installations.

13.1.3 Non-metallic pipe and pipe fittings shall not be used except for instrumentation connections or purpose designed insulating joints.

13.2 System Specification

13.2.1 Screwed Pipework

13.2.1.1 Pipe should conform to BS EN 10255:2004 (medium or heavy) with fittings to BS 143:2000 or BS EN 10241: 2000.

13.2.1.2 Screwed pipework and pipe fittings should only be used up to and including 50mm nominal bore and screwed connections to valves, filters and regulators should also not exceed 50mm nominal bore for MOB of 2barg. Between 2barg and 7barg only welded joints are allowed for 50mm and above diameter pipes.

13.2.1.3 Threads shall be in accordance with BS EN 10226, BS 746, BS EN 10806, or BS 5200 as appropriate, but parallel/ parallel threaded joints shall not be used (except for the limited use of longscrews/ connectors). If taper external/parallel internal options are proposed consideration should be given to the possibility of cracking of the internally threaded fitting or component.

13.2.1.4 Joints should be sealed with an approved jointing material applied to male threads only. Joints should not be turned back for alignment purposes, but dismantled and remade. Jointing paste shall not be used as sealant on screwed meter connections to RD meters.

13.2.2 Welded Pipework

13.2.2.1 Pipe should conform to BS EN 10216:2002 or as supplemented by L2/E In addition pipe to BS EN 10255:2004 (medium or heavy plain ended) may be welded. Fittings to BS 1640-3:1968: should be used, and fittings meeting those standards detailed in IGEM/GM/8: Part 1 Materials and Pipework may also be specified and used.

13.2.2.2 Welding should be carried out to BS 2971:1991 for up to 7barg MOP.

13.2.2.3 Welds shall not be closer to each other than 150mm or one pipe diameter, whichever is the smaller, excepting connections provided for impulse and instrumentation purposes and excluding the welds of fittings fabricated off-site, e.g., ‘lobster-back’ bends.

13.2.3 Flanged Joints

13.2.3.1 Flanges shall conform to BS EN 1092-1:2018 Table PN16. Other flanges (e.g., BS 10:2009 or BS 1560-3.2:1989) may be used where necessary to match meter connections.

13.2.3.2 Flanged joints shall be made incorporating the appropriate gasket. Jointing paste or compounds shall not be used.

13.2.3.3 Gaskets for use with flat-face flanges should conform to the dimensions given in BS EN 1092-1:2018, BS 10:2009or BS 1560-3.2:1989 as relevant and to the materials in BS 6956-5:1992.

13.2.3.4 Gaskets for use with raised-face flanges should conform to the dimensions given in BS EN 1092-1:2018, BS EN 1759-1:2004 or BS EN 1514-1 & 2:1997 and 2014 and to the materials in BS 6956-5:1992.

13.2.3.5 Bolting materials and dimensions should comply with BS EN 1515-1:2000 & 1515-

3:2005.

13.2.4 Flexible Connections and Joints

Flexible connections and joints shall not be used except for the connections onto the meter. Such joints shall be capable of being dismantled and shall incorporate elastomeric seals to BS EN 682:2002.

13.2.5 Impulse and Instrumentation Pipework

13.2.5.1 Impulse and Instrumentation pipework may be steel screwed (see 13.2.1) or welded (see 13.2.2), or stainless steel to BS EN 10216-5:2021 with couplings to BS 4368-1:1998, or copper to BS EN 1057:2006 + A1:2010 with couplings to either BS EN 1254-1, 4 and 5:2021

13.2.5.2 Pipework to pressure recorders and correctors may alternatively be run in small-bore flexible tube.

13.3 **Headers**

Each header of multi-stream installations should be sized such that the header is of a size at least equal to that of the off-take pipework from that header.

13.4 **Supports**

13.4.1 Supports should be designed with due consideration to avoiding corrosion between pipe and pipework supports.

13.4.2 Allowance should be made for the weight of the pipes, components supported by the pipe, wind, and snow loadings.

13.4.3 Supports intended to anchor the installation rather than merely supporting, apart from needing sufficient strength to withstand anticipated loads, should also be able to withstand a reversal of half this load.

13.4.4 Supports not intended to anchor the pipe should not inhibit thermal expansion of the pipe.

13.4.5 All meters shall be adequately supported. Line-mounted meters may be pipe supported. Flexible meter connections shall not be relied upon to provide such support.

13.5 **Pipework Protection**

13.5.1 The exterior of pipework and fittings shall be adequately protected. In normal indoor atmospheres the application of suitable paints may provide the necessary degree of protection.

13.5.2 In corrosive or damp atmospheres protection may be afforded by bituminous paint or wrapping.

13.5.3 After completion of the installation, all gas pipes shall be easily identifiable. Where there is no other flammable gas, it is sufficient to colour code the pipe yellow ochre (BS 4800:1989 standard colour 08C35) or Primrose Yellow (BS 4800:1989

standard colour 10E53). In the case of large complex installations, for example chemical works, it is desirable to identify pipe contents more precisely and the base colour should be supplemented with its name or chemical symbol, normally “Gas” marker tape at frequent intervals.

13.6 Meter By-passes

13.6.1 Where a meter by-pass is installed, a valve shall be fitted in the by-pass and separate meter inlet and outlet valves shall also be provided.

13.6.2 Sizing

Where it is unacceptable for the end user to be subjected to reduced flow when operating on the by-pass, the meter by-pass should have a pressure drop no greater than the meter line. In all other cases a smaller bypass providing a restricted supply should be adequate.

13.6.3 Sealing

All by-pass valves shall be labelled and sealed in the closed position and a warning notice shall be fitted adjacent to the by-pass valve giving instruction to the end user as to its use. The seal shall be identifiable and irreparable.

13.6.4 Regulated Supply

Where a regulator installation is fitted on the inlet of the meter, it is preferable for the inlet of the meter by-pass to be connected downstream of the regulator installation. In those instances where the meter by-pass is connected upstream of the regulator installation, the by-pass itself shall incorporate a regulator in accordance with the Gas Safety (Installation and Use) Regulations 1998.

13.7 Lightning Conductors

Consideration should be given to the possible need to protect exposed installations against lightning by suitably-positioned lightning conductors. Lightning conductor systems shall not be bonded to gas service pipework on the inlet side of any insulating joint.

14. ANCILLARY CONNECTIONS

14.1 Impulse Points

14.1.1 Where a regulator is externally impulsed, the connection should normally be made between the regulator and the meter inlet valve at a point where the flow is reasonably free from turbulence and velocity change effects. The point of connection should be above the horizontal centre line of the pipe.

14.1.2 Impulse pipework should be as short as possible and should not be manifolded.

14.1.3 Impulse pipework should be larger than 8mm diameter and should not include any restrictions other than those required for control purposes.

14.1.4 The design of impulse pipework should be such as not to cause a hazard in an otherwise safe zone, nor should it impact on cathodic protection systems, nor

cause a diversion of electric currents which may be travelling through the main pipework.

14.1.5 Valves on impulse pipes shall be fitted close to the line connection point.

14.2 Pressure Test Points

14.2.1 Pressure test points shall be provided to enable the pressure losses across various components to be measured, regulators to be correctly set and the metered pressure determined.

14.2.2 Required positions are shown in Figs.1, 2 & 3 in Section 8.3.

14.3 Purge or Vent Points

14.3.1 Points should be provided to enable pipework, and individual or groups of items of equipment, to be safely purged or vented.

14.3.2 Connections for such points shall be suitably sized to facilitate purging or venting within a reasonable time and shall be securely capped or plugged. It is not normally necessary for such points to be larger than 20mm. If required, the purge or vent points may incorporate a valve.

14.3.3 Suggested positions are shown in Figs. 1, 2 & 3 in Section 8.3.

15. INSTRUMENTATION

15.1 Any meter-driven mechanical device must not put a torque or resistance on the meter which would invalidate its badging. Only a device which is listed in the Schedule on the Certificate of Approval may be used.

15.2 On Rotary Displacement meters fitted with correctors the pressure connection should be made to the pressure tapping on the inlet flange of the meter.

On Turbine meters fitted with correctors the pressure connection should, where specified by the manufacturers, be to the specially-provided body tapping on the meter; otherwise, it should be to the inlet flange tapping.

In each case the pressure pipe connection to the corrector or pressure transducer should incorporate a valve which can be sealed in the open position.

15.3 Thermo-wells shall be installed whenever temperature-correcting or recording equipment is used which requires the insertion of a temperature probe. Thermo-wells should be located within three pipe diameters of the meter outlet; they should protrude into the pipework by approximately one third of the nominal bore and should be oil-filled.

15.4 If pressure recorders, loggers or gauges are to be fitted permanently to indicate the regulator set pressure, the pressure connection shall be made immediately upstream of the meter inlet valve. The pressure connection pipe should incorporate a valve which can be sealed in the open position.

15.5 Chart recorders, automatic correctors and telemetry equipment shall be sealed to prevent unauthorised adjustment.

15.6 Telemetry equipment, correctors, pressure, temperature, and volume recorders, if supplied in weather-proofed casings, may be fitted in the open air adjacent to the meter with provision made to screen pressure transducers and electronic equipment from direct sunlight. However, whenever possible and convenient electrical equipment should be located indoors.

15.7 Where electrical equipment is fitted with a re-chargeable battery pack stand-by power supply, a permanent automatic re-charging system shall be installed. All such equipment shall be suitably protected from the weather.

15.8 Instrument mounting brackets shall not be welded to the line or impulse pipework.

16. HOUSING

16.1 Security of Meter Installations

16.1.1 Consideration should be given at the design stage to the degree of security required to prevent unauthorised persons having unrestricted access to the installation.

16.1.2 When meter compounds, houses, or compartments are locked, a set of keys shall be kept in a secure position or under the control of a responsible person. Wherever site security personnel are on continuous duty such authorised officers should control the key or keys, but it is desirable for ES Pipelines Limited personnel to have a means of access to the meter installation at all times.

16.2 Location

16.2.1 Meters shall be installed in a position which meets the requirements of the Gas Safety (Installation & Use) Regulations 1998.

16.2.2 The meter installation should be located as close as is sensibly practicable to the site boundary or just within the main building or a suitable subsidiary building.

16.2.3 It is generally preferable for an installation to be located in a separate purpose-built structure or compound. In certain circumstances it may however become necessary for it to be located in an existing building provided ventilation is adequate (see 16.3.8), the equipment is not in close proximity to heating, process equipment or electrical switch gear, it does not impact on escape routes, and it is protected against accidental damage. Meter/regulator installations should not be located in pits unless there is no practicable alternative (see 16.5).

16.2.4 The installation's location should not be subject to extremes in temperature or vibration, nor to moist, corrosive, chemical-laden or dirty atmospheres, nor to accidental damage.

16.2.5 Where a purpose-designed enclosure is provided, including those within the main building, it shall not be used for purposes other than pressure regulating and metering the gas supply except as detailed in Section 16.6.1.3.

16.2.6 Installations should be on well-drained sites which are not liable to flooding, and away from overhead high tension cables and trees.

16.2.7 Suitable unobstructed access shall be provided to facilitate construction of the

installation and its subsequent maintenance. The site must also be freely accessible to authorised personnel at all reasonable times.

16.2.8 Permanent safe working access shall be provided, whether the installation is at high or low level.

16.2.9 Sufficient clearances shall be provided for safe working on the equipment.

16.3 All Housed Installations

16.3.1 Purpose-built external housings shall comply with any relevant statutory regulations and be approved by the Gas Transporter.

16.3.2 The materials used on the construction of housings shall be durable, weather resistant, waterproof, and fire-resistant.

16.3.3 Where a new, purpose-built room or building is provided to house the installation, the walls shall be solid without cavity and shall not include openings other than those required for access or for ventilation. Where the new room makes use of existing walls of cavity construction, those parts of the wall bounding the new room shall have a screed or plaster finish applied to minimise gas leakage through the wall or into the cavity.

16.3.4 The roof of any purpose-built external housing should be of light-weight construction but should provide the same level of security as the rest of the structure unless other overall site security measures are taken.

The whole or part of the roof may be removable in order to facilitate access to the installation.

16.3.5 Floors and duct coverings must be strong enough to take the required point weight loadings of the installation and any additional loadings imposed during construction and maintenance.

16.3.6 The covers for pipe ducts shall not create unventilated voids.

16.3.7 Doors must be of a sufficient size to afford access to people and equipment, and where the installation is in a separate room large enough for a person to enter, consideration shall be given to a means of exit in an emergency. A means should be provided to hold the doors in the open position once opened.

16.3.7.1 For cupboards and compartments the whole front should be in the form of a door or an easily-removable panel.

16.3.7.2 For a separate room attached to the outside of a building, at least one set of standard width outward-opening double doors shall be fitted in the outside wall of the meter room. The doors shall not be capable of being locked or fastened in such a manner that they cannot be easily and immediately opened from the inside.

16.3.7.3 For a separate purpose-built structure, more substantial than in 16.3.7.1, at least one set of standard width outward-opening double doors shall be fitted. Two sets of doors are preferred and should be mounted in opposite walls of the house for rapid exit in case of emergency and shall be of the type specified in 16.3.7.2.

16.3.8 The total effective ventilation area should not be less than 2% of the floor area of the installation housing or its notional equivalent and should be equally distributed and disposed at high and low levels between the outside walls. Ventilators shall be of the non-adjustable type. Where the installation is ventilated directly or indirectly via the main building, the above ventilation requirements are additional to any other ventilation requirements of that building.

16.4 Outdoor Installations

16.4.1 The installation should be securely fenced-off and shall provide adequate access to the equipment for repair, maintenance, and fire-fighting. Wherever possible, an emergency exit should be provided in addition to the normal access gateway.

16.4.2 Consideration should be given to the provision of vehicle diversion barriers to protect the installation from vehicular traffic and the fitting of protective covers to vulnerable equipment where it is necessary to guard against vandalism.

16.4.3 Floodlighting from positions situated at a safe distance from the metering compound should be considered.

16.5 Installations in Pits

16.5.1 Only as a last resort should equipment be located in an external pit below ground level.

16.5.2 Pits should be of robust construction and designed to withstand foreseeable superimposed loads and forces exerted by ground water. They should be watertight and provide adequate security against vandalism.

16.5.3 Pipes and conduits passing through the walls of the pit should be sleeved and the annulus sealed to maintain a gas and watertight seal.

16.5.4 A pit should not connect, by an open duct or pipe, with a drain or other enclosed space.

16.5.5 The dimensions of a pit should be such that operatives can carry out maintenance work effectively.

Wherever possible an operative undertaking maintenance work shall be able to have his head and shoulders above the level of the surrounding ground.

16.5.6 Access to a pit should be by means of a permanent ladder or steps.

16.5.7 Where appropriate a sump should be constructed in the base of the pit.

16.5.8 Where practicable the whole roof of the pit shall be able to be removed during maintenance work.

16.5.9 The arrangement for raising and lowering covers shall be such as to protect the installed equipment from damage due to a handling error.

16.5.10 The ventilation area should be not less than 0.5% of the floor area of the pit but in small installations it may be necessary to increase the ventilation area to 3% of the floor area.

16.5.11 A two-pipe ventilation system is preferred with vent pipes starting at both high and low levels within the pit and terminating more than 3 metres above ground level.

Where this level of ventilation cannot be achieved and/or where a vent stack terminates at less than 3 metres above ground level, flame arrestors should be fitted. Such flame arrestors should not restrict the design capacity of the vents and should be protected from blockage.

16.6 **Electrical Safety Standards**

16.6.1 General

16.6.1.1 All electrical equipment associated with meter installations should be designed, constructed, and installed in accordance with the recommendations issued by the Institution of Electrical Engineers and any relevant British Standards, ES Pipelines Limited Electrical Standards, Codes of Practice and local or statutory requirements.

16.6.1.2 Equipment mounted in or on meters to provide an electrical output shall comply with the requirements of IGEM/GM/7 Edition 2.

16.6.1.3 Compressors, boosters, and premix machines should not be installed in meter houses. If they do have to be fitted in the meter house then all electrical equipment in the meter house must be installed to Zone 2 Group II standards.

16.6.1.4 Pipes shall be cross bonded with other services by the end user's electrical engineer or contractor in accordance with the Institution of Electrical Engineers' Regulations.

Separate bonding straps shall be fitted across flexible couplings unless they incorporate integral continuity devices.

16.6.1.5 Where insulated joints are deliberately incorporated anywhere in the installation, for example PME insulators or cathodic protection insulators, it is essential that cross bonding does not produce a bond around any such insulating joint.

16.6.1.6 In general, the cross bonding of other services to the gas supply should only be to the pipework on the outlet side of the meter.

16.6.2 Adjacent Electric Services

16.6.2.1 Gas meters shall not be installed in rooms specifically intended for electrical meters or switchgear.

16.6.2.2 All parts of the gas meter installation should be located as far as is practicably possible from any adjacent electrical meters or switchgear and in no circumstances should the distance be less than 150 mm. This is not intended to preclude the use of suitably-protected and certificated electrical instrumentation in connection with the meter (see 16.6.1.2).

16.7 **Warning Notices and Line Diagrams**

16.7.1 To comply with Gas Safety (Installation & Use) Regulations 1998 (GS(I&U)R 1998) and ES Pipelines Limited requirements, warning notices shall be located adjacent to the meter and shall be in accordance with IGEM/GM/8 Part 5.

Where applicable the following notices are required (see Appendix 2).

Statutory Notices

Escapes
Joint Services
Secondary Meters

ES Pipelines Limited Notices

By-Passes
Non-Return Valve
Gas Compressors and Engines
(a) Near the Meter Inlet Valve
(b) Near the Gas Compressor or Engine
High Pressure Gas
Meter Control Valve (where more than one valve) Metering Pressure (when above 21 mbar gauge)

Composite Notice

Where a number of notices are required, consideration should be given to the provision of a composite notice fitted in a prominent position.

16.7.2 Line Diagram

The GS(I&U)R 1998 requires that under certain circumstances a line diagram of the gas installation be provided adjacent to the meter.

PART C

SYSTEM DESIGN FOR INSTALLATIONS WITH INLET PRESSURES BETWEEN 75MBAR AND 7BAR GAUGE

17. GENERAL

17.1 The meter and pressure regulating components should be designed not in isolation, but as a single installation. Normally both should be sized for the same load and consideration must be given to the effect that each may have on the other.

17.2 Regulator installations should protect the downstream system against the effects of both over-pressure and under-pressure. The minimum degree of safety provided in any one stream should be such that failure of any one device (75 mbar to 2 bar gauge) or any two devices (2bar to 7bar gauge) should not create a hazard.

17.3 Continuity of supply, whilst not always an essential requirement, may be desirable in some circumstances, e.g., to enable a end user to take gas during regulator maintenance or in the event of a fault in the system. When designing a regulator installation which the end user will be asked to contribute towards, the end user may be given the option of a twin-stream rather than a single-stream installation. Above 2 bar gauge the single stream option is only applicable to small installations as detailed in 18.3; in all other circumstances duplicate streams shall be installed.

17.4 Where two regulator streams are installed, (other than any small parallel stream to cope with low flow rates) the main stream must have 100% of normal load capacity, although the standby stream may have either 100% of normal load capacity or a lower capacity equivalent to the essential load to be maintained to the premises in the event of a failure of the main stream.

Where three or more streams of small regulators are installed in parallel the total load capacity should be shared equally between the regulators although an additional stream may be included to provide an element of standby *(this is a non-preferred option of ES Pipelines Limited and will only be considered in exceptional circumstances).*

17.5 It is permissible to use meters in parallel, from a single regulator system, provided the meter outlets are not connected. The design of parallel meters with common outlet connections shall only be considered in exceptional circumstances.

17.6 The maximum design flow rate for which the installation is sized should take account of a suitable load factor where appropriate (see Section 6.2).

17.7 The installation should be designed to pass the maximum designed gas flow rate at the lowest expected inlet pressure and the designed outlet pressure.

17.8 The minimum installation inlet pressure will normally be 75mbar gauge where the inlet pressure is in the range 75mbar - 2bar gauge, or 2bar gauge where the inlet pressure is in the range 2bar - 7bar gauge.

17.9 The meter inlet pressure to which the regulators must control shall be established.

This will normally be 21mbar gauge unless it has been agreed to meter at an elevated pressure (see 5.2.1) in which case the set pressure shall be marked on a notice at the installation.

17.10 Gas velocities in pipework must not exceed 20 m/s on the inlet side of filters (unless the upstream system is classified as 'dust free' or is itself filtered in which case inlet velocities of 40m/s will be permitted) and 40 m/s downstream of filters when the maximum flow rate occurs at the lowest expected inlet pressure.

17.11 Whilst the following sections indicate that the meter is positioned downstream of the regulator(s), under certain circumstances it may be appropriate to install the meter upstream of, or between, the regulator(s). As correction will be necessary, this type of installation arrangement may only be used for Special Agreement supplies.

17.12 All pipework and equipment downstream of the upstream regulator(s) must be capable of withstanding the maximum incidental pressure (MIP) resulting from a fault condition. This maximum pressure should be the set pressure of the final safety device taking its accuracy into account.

17.13 Consideration should be given to the provision of thermal and acoustic insulation for kiosks and for buildings.

17.14 Consideration should be given to the need for appropriate heating to protect installations against the effects of internal and external ice formation. Such heating should not create a fire or explosion hazard.

17.15 At selected installations, provision should be made to monitor load characteristics once the plant is operational.

17.16 On single -stream regulator installations consideration should be given to the provision of suitably sized plugged and sealed valves either side of the installation to enable the downstream pipework to be kept pressurised during maintenance via a temporary rider incorporating a regulator. *(Generally, a 15mm connection should be adequate but consideration should be given to the load requirements when sizing a temporary rider)*.

18. INSTALLATION ARRANGEMENTS

18.1 General

18.1.1 A valve shall be provided to isolate the installation from the distribution mains system. This valve shall normally be situated at least 4 metres, and in no case less than 2 metres, from the installation. Generally, this valve will be the service isolation valve, sometimes referred to as the installation 'inlet Fire Valve'.

18.1.2 There shall be an inlet and an outlet valve on every regulator stream. Each valve shall be designed to seal on both upstream and downstream faces and the space between the faces shall be fitted with a vent *(known as a 'block and bleed 'facility)*. Alternatively, two valves may be used on the inlet with a vent fitted to the space between them, and a second pair of valves, similarly vented, used on the outlet. *This requirement only applies to valves having a nominal bore in excess of 25mm*.

On single-stream installations, the installation inlet isolation valve may be used as

one of an inlet pair and the outlet isolation valve, where fitted, may be similarly used.

18.1.3 An exception to 18.1.2 is permitted on individual service installations with flow rates less than 15 std m^3/h. These installations shall have an inlet isolation valve and if the installation is remote from occupied premises, a separate valve on the meter outlet may be necessary in addition to the meter control. Both the inlet valve and this outlet valve (if fitted) should be of a type that does not require maintenance.

18.1.4 There shall be no un-regulated by-pass around any regulator.

18.1.5 Any auxiliary system shall have inlet and outlet valves and a filter. In addition, on regulator streams not fitted with slam shut valves, the auxiliary system shall include a pressure relief valve positioned upstream of any inspirator or jet. The maximum capacity of this pressure relief valve should not exceed 1% of the maximum capacity of the installation

18.1.6 A meter shall be positioned in such a way that the index can be read conveniently when the meter is installed, without the use of mirrors, etc. Where site conditions permit, gas flow through the meter from left to right, when viewing the index, is preferred.

18.1.7 Consideration should be given to the inclusion of other features, for example stream selection devices, remote warning systems, etc, as agreed with the end user.

When two or more regulator streams are installed and continuity of supply is required, the slam shut system shall be so designed that it is unlikely to be operated by a regulator failure in another stream.

18.1.8 Pressure test points (see 24.2) and purge and vent points (see 24.3) shall be fitted as indicated in Figures. 4 - 10. Where a test point is not provided on an item of equipment, a point shall be provided on the adjacent pipework.

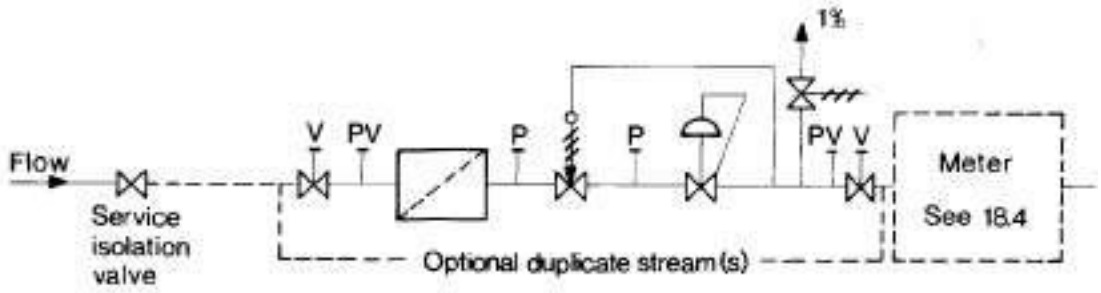
18.2 Regulator arrangements with regulators greater than 50mm nominal bore or with stream fault flow rates greater than 300sm^3/h

Regulator arrangements should comprise one or more streams as described below.

18.2.1 Regulator arrangements for inlet pressures from 75mbar to 2bar gauge.

Acceptable arrangements within this range of inlet pressures are described in 18.2.1.1 and 18.2.1.2

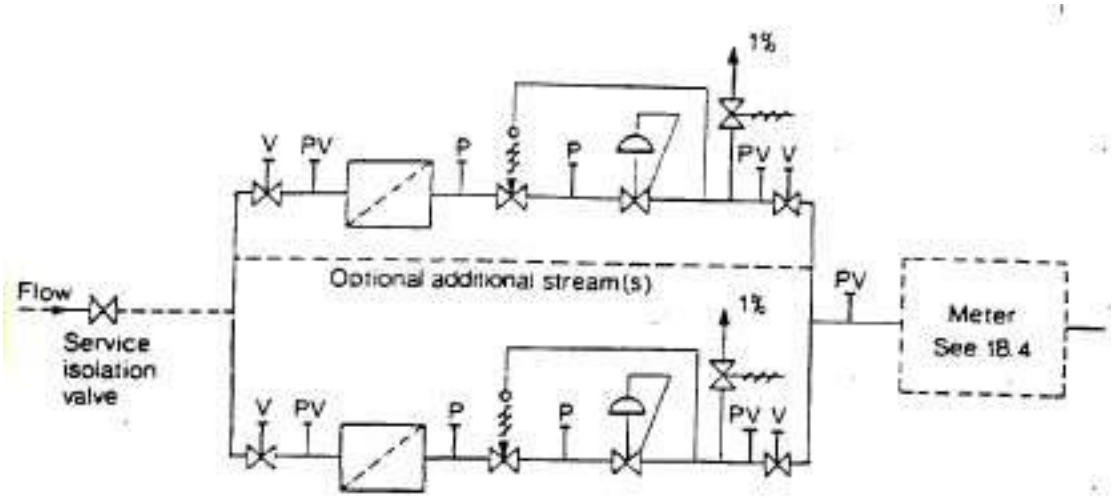
18.2.1.1 Single stage regulator with a slam shut valve – Figure 4.



Notes (i) The regulator shall have internal valves which are open at rest.

(ii) The capacity of the relief valve shall not be more than 1% of the stream fault capacity.

18.2.1.2 Two or more identical small regulators in parallel, each valved independently - Figure 5.



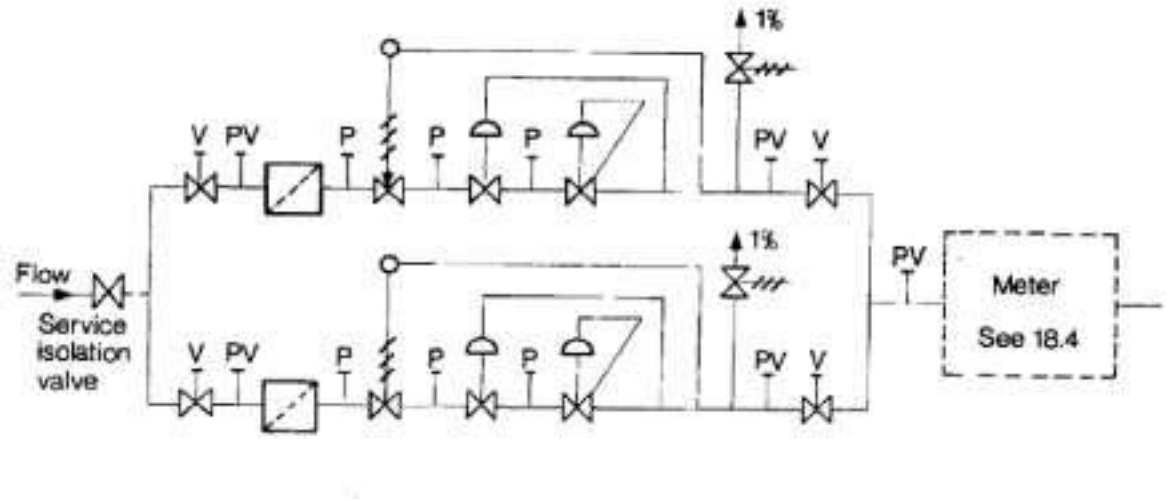
Notes (i) The regulators shall have Internal valves which are open at rest

(ii) Each stream shall comprise a regulator, slam shut valve and a relief valve of not more than 1% of the stream fault capacity fitted on the outlet of each stream

18.2.2 Regulator arrangements for inlet pressures from 2 bar to 7 bar gauge.

Acceptable arrangements within this range of inlet pressures are described in 18.2.2.1 and 18.2.2.2.

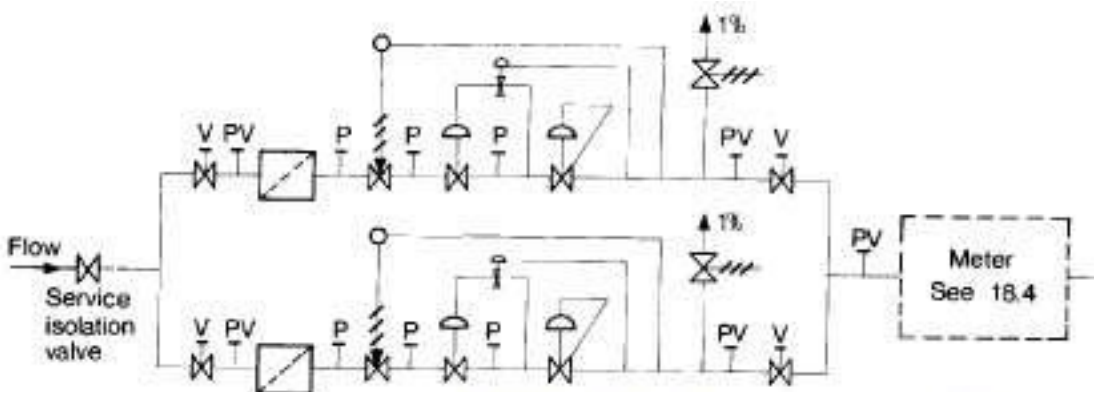
18.2.2.1 Duplicate streams each having a monitor and active regulators and a slam shut valve - Figure 6.



Notes (i) The monitor regulator shall be upstream of the active regulator in each stream.

(ii) The capacity of the relief valve shall be not more than 1% of the stream fault capacity.

18.2.2.2 Duplicate streams, each having two stage pressure regulating and a slam-shut valve - Figure 7.



Notes (i) A monitor override pilot regulator shall be fitted to the first stage regulator and shall be impulsed from the outlet of the second stage regulator.

(ii) The capacity of the relief valve shall be not more than 1% of the stream fault capacity

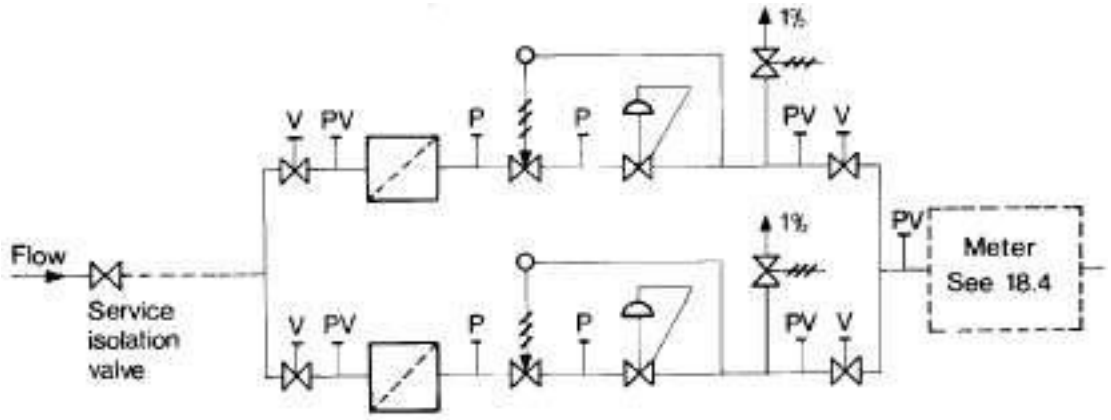
18.3 **Regulator arrangements with regulators of 50mm nominal bore or less and stream fault flow rates less than 300sm³/h**

Regulator arrangements should comprise one or more streams as described below

18.3.1 The arrangement shall be as described in 18.2.1.1 and 18.2.1.2.

18.3.2 Inlet pressures from 2 bar to 7 bar gauge

The arrangement shall consist of one or more streams as in Figure 7 above or Figure 8 below.



Note (i) The capacity of the relief valve shall be not more than 1% of the stream fault capacity.

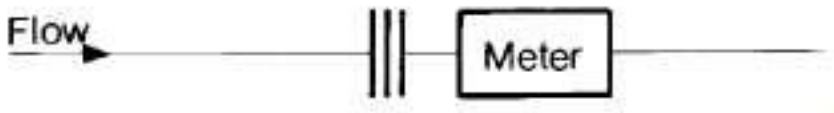
18.4 **Meter and meter by-pass arrangements**

18.4.1 Meter connections.

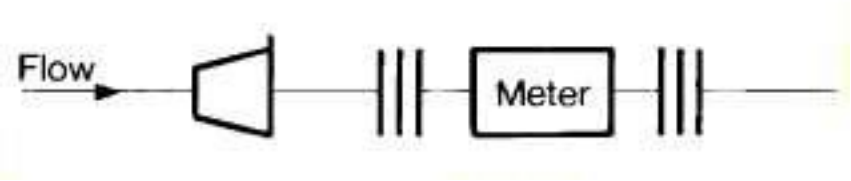
Meters shall be installed in a manner that minimises strain being placed upon the meter connections and allows easy removal and re-fixing of the meter.

Where flexible connections are used they shall be fitted in accordance with 18.4.1.1, 18.4.1.2 or 18.4.1.3.

18.4.1.1 With Diaphragm meters of tin-plate construction at least one flexible connection[#] on the meter inlet, shall be used. Steel-case types may be fixed with rigid connections, but any flexible connection shall be on the inlet as a minimum.

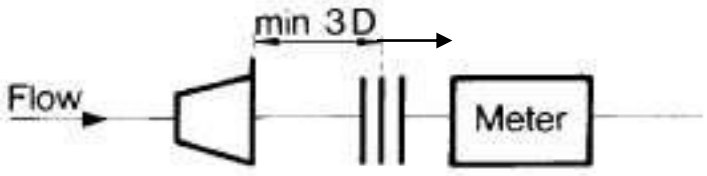


18.4.1.2 With Rotary Displacement meters flexible connections[#] shall be on both the inlet and outlet to facilitate levelling and may accommodate the open-ended top-hat or skirt-type strainer at the meter inlet (see 19.4) *except* where factory made pre-assembled Rotary Displacement meter modules are utilised and then only one flex connection shall be required.



18.4.1.3 With Turbine meters a flexible connection[#] that **does not disturb the flow pattern** shall be on the meter inlet at least. This connection may be accommodated within the 3D spacing required between the strainer and meter inlet (see Section 9), however this should only be considered where as stated the flexible connection does not disturb the flow pattern. (see 19.4).

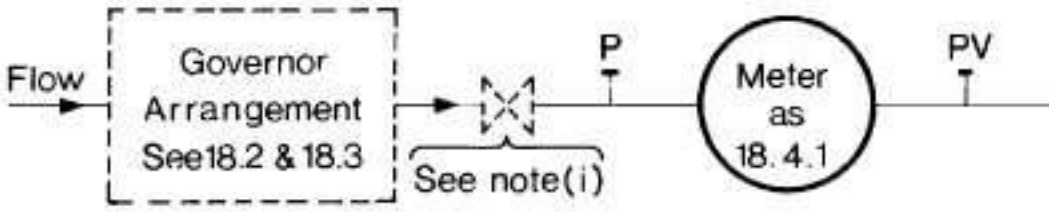
[#]See Appendix 1.



18.4.2 Meter arrangements.

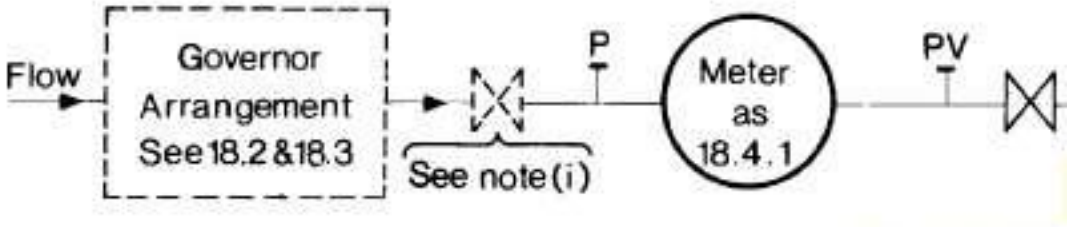
The meter and its immediate connections as detailed in 18.4.1 may be installed on the outlet of the regulator arrangements detailed in 18.2 and 18.3 subject to the requirements of 18.4.2.1 to 18.4.2.3.

18.4.2.1 Meters with a capacity 25m^3/h or less in conjunction with a single or multi-stream regulator installation - Figure 9.

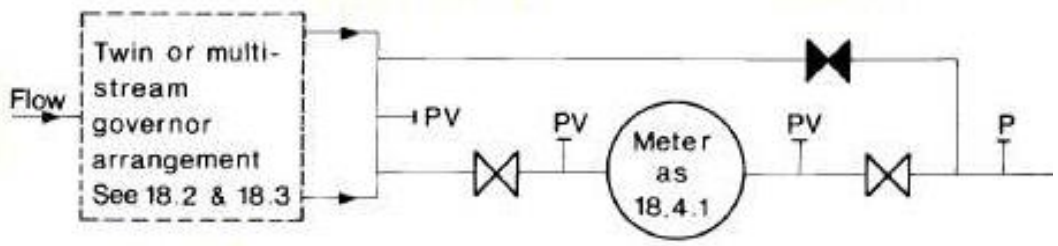


Note (i) Where a multi-stream regulator installation is fitted this additional valve shall be installed as the meter control valve.

18.4.2.2 Meters with a capacity greater than 25 m^3/h in conjunction with a single or multi-stream regulator installation - Figure 10.



Note (i) Where a multi-stream regulator installation is fitted this additional valve shall be installed as the meter control valve.



Notes (i) It is recommended that meters with a capacity greater than 42.5 m^3/h should be fitted with a by-pass (see 23.6).

(ii) A meter with a by-pass should always be supplied from a twin or multi-stream regulator installation.

(iii) The meter run and meter by-pass shall both be supplied via the outlet header of the regulator installation.

19. FILTRATION

19.1 Meters, regulators, and instrumentation systems shall be protected from gas-borne dust by the inclusion of suitable filters. The standard of filtration should not be more stringent than is necessary to protect these systems.

19.2 For installations having an inlet pressure in the range 75 mbar - 2 bar gauge the primary filter positioned upstream of the regulator shall have a cut-off not greater than 200 microns, except that a cut-off of not greater than 50 microns shall be specified where a Rotary Displacement meter without scraper tips is installed.

For installations having an inlet pressure in the range 2bar - 7 bar gauge the primary filter shall have a cut-off not greater than 50 microns. In certain instances, it may be desirable to install finer filters which may also provide protection to downstream appliances.

19.3 Filters should be of a type that enables the element to be withdrawn from its housing without having to break the main pipe. Filters of 100 mm nominal bore and larger should have quick-release covers.

19.4 All Turbine and Rotary Displacement meters shall in addition be protected by a top-hat strainer inserted in horizontal pipework between the regulators and the meter. The strainer mesh size shall not be finer than that of the main filters. For Rotary Displacement meters the top-hat strainer should be fitted as near as practicable to the meter inlet

. For Turbine meters the top-hat shall be at least 3D upstream of the meter inlet.

Provision should be made in the pipework to enable removal of this filter for cleaning and inspection or following commissioning should the strainer be fitted purely for this purpose.

19.5 Gas supplies to pilot regulators, auxiliary systems and instrumentation shall incorporate an auxiliary filter with a cut-off not greater than 50 microns.

19.6 Means shall be provided to register the maximum differential pressure which occurs across each primary filter.

19.7 Connections shall be provided for venting and/or purging primary filters prior to changing elements.

19.8 The presence of a filter should be identifiable from the outside of the pipework.

20. REGULATORS

20.1 Regulator Sizing

A regulator should be selected to pass the maximum flow rate at the minimum inlet pressure whilst maintaining the set outlet pressure.

Where flows of less than 2% of its maximum can be anticipated it is possible that hunting will occur. Under these circumstances consideration

should be given to installing either a smaller parallel stream to cope with the low flow rates or multiple identical streams.

Instability can also occur where two or more parallel streams are operating with insufficient differential(s) between their set points.

20.2 Steady State Control

Each regulator must be capable of controlling the outlet pressure over its designed flow range and over the anticipated range of inlet pressure. The preferred accuracy is indicated in the table below.

Set Pressure Range	Accuracy
21 mbar – 75 mbar gauge	+/- 5% gauge preferred +/- 10% gauge limit (see note (b))
75 mbar – 350 mbar gauge	+/- 3% gauge
350 mbar – 7 bar gauge	+/- 1% absolute

Notes (a) The flow range of the above table is from maximum rated flow to 2% of maximum rated flow.

(b) When the set pressure is between 21mbar and 75mbar gauge and the 10% gauge limit applies, due regard must be given to the minimum pressure supplied to the downstream appliance(s).

(c) Where a multi-stream regulator system is used the set points must be as close together as practicable and the pressure at the meter must not vary by more than 1% of the absolute pressure. This does not apply to purely standby streams.

(d) Where automatic pressure correction is fitted to the meter, the regulator accuracy limits specified above may be relaxed.

20.3 Lock Up

As the flow through a regulator is slowly reduced from 2% of maximum flow to zero the regulator must not allow the outlet pressure to rise by more than 5 mbar or 5% of the set pressure (gauge), whichever is the greater, above the value at 2% of maximum flow.

20.4 Response Time

The response time of a regulator is a measure of the time in which a regulator opens or shuts in response to an abrupt change in outlet pressure.

In general, a regulator with a fast response time should be selected to be the monitor regulator on each stream so that it will be able to react quickly to failure of the active regulator; for example, a direct acting regulator could be

used as the monitor whilst a pilot-operated regulator could be the active (for performance).

It is essential that the response time shall be sufficiently short to follow the variation in outlet pressure caused by changes in demand flow rate. Wherever possible response time should not exceed one second. Where a major part of the load (10% or more) is operating in the on/off mode, a regulator with a response time that is significantly shorter may be required.

20.5 Regulator By-passes

There shall be no un-regulated by-pass around a regulator.

20.6 Sealing

The regulator shall be capable of being sealed to prevent unauthorised adjustment of its set pressure.

21. METERS

21.1 Meter Selection

The meter should be selected to ensure correct matching to the load and for its ability to withstand the maximum pressure likely under fault conditions. The standard direction of flow through meters is 'left-to- right' when viewing the index end: non-standard arrangements should not be used.

21.1.1 Pressure Ranges

Meters shall only be used within their designed and badged pressure range.

Steel-case meters to BS EN 1359:2017 are leak tested to at least 50mbar gauge but may be obtained suitable for pressures up to 7bar gauge

Aluminium-cased Diaphragm meters are also available in various pressure ranges. Rotary Displacement and Turbine meters are available for pressures in excess of 7bar gauge.

21.1.2 Flow Range

The flow being measured should lie as far as possible within the range of the meter. Where relatively small quantities of gas are passed at the lowest flows, it will be uneconomic to measure accurately over the complete flow range. The integrated flow accuracy should be estimated for a period of 1 year in order to achieve an economic installation design.

21.1.3 Diaphragm Meters

Diaphragm meters have a turndown range in excess of 50:1 and may be used for all normal loads where the flow is less than 170 m^3/h.

21.1.4 Rotary Displacement Meters

Rotary displacement meters have a turndown range of at least 30: 1 but this varies according to the make and size and the maker's data should be consulted. This type of meter is therefore more suitable than a Turbine meter for general metering purposes. The meter should not be oversized to

accommodate maximum flow rates which may only occur very infrequently, and consideration must be given to possible over-speed effects due to under-sizing.

Where large step load changes are anticipated, or where boosters or compressors are installed or where small burners, e.g., permanent pilots, are also supplied, Rotary Displacement meters should be used with caution. In extreme cases a sudden load increase may cause a temporary low pressure at the meter outlet resulting in pilot outage or burner system lock-out, whereas a sudden load decrease may cause the meter to over-run resulting in a temporary over-pressure condition with consequences similar to the low pressure condition.

These problems due to meter inertia may be minimised by the inclusion of a large reservoir of gas between the meter and the appliances, or in some cases by the installation of a non-return valve at the meter outlet, but such installations should be referred to the meter manufacturer for advice. Wherever possible the use of these meters on such loads should be avoided, using a diaphragm meter or, in some cases, a Turbine meter as an alternative.

21.1.5 Turbine Meters

Turbine meters have a turndown range of approximately 15:1 at low pressure but this varies according to the make and size and the manufacturer's data should be consulted. At higher gas pressures the increase in gas density causes the turndown range of a turbine meter to increase in proportion to the square root of the density to approximately 100:1 at 7bar gauge.

Badged Turbine meters must have a flow-straightening device which may be either integral with the meter or a bolt-on attachment which must always be used with the meter.

At low metering pressures over-sizing of the meter should be avoided because of the limited turn-down range.

Turbine meters should not be used to measure loads which operate at less than 1.5 times their minimum badged flow rate (Q min) for long periods except that at higher pressures the turn-down range is increased (see first paragraph). Turbine meters should not be used to measure flows which are rapidly pulsating, nor should they be used where the total metered gas flow is on/off unless the on-time is greater than 30 minutes, as the turbine wheel continues to rotate for some time after the flow through the meter has ceased. The necessary on-time can be reduced to 2 minutes if a continuous base load flows through the meter equal to at least 10% of the maximum metered flow. With certain Turbine meters the above requirements may be relaxed and shorter on-times would be acceptable provided the meter manufacturer gives an assurance that metering errors due to non-steady flow will not exceed 1%.

21.1.6 Ancillary Equipment

All Rotary Displacement and Turbine meters shall be fitted with low frequency transmitters. In addition, they may be fitted with high frequency transmitters, mechanical drives and, on some, a temperature- and/or

pressure-corrected index.

The need for these attachments should be taken into consideration when specifying the meter to be used.

Any attachment to the meter must not invalidate the Certificate of Approval for that badged meter.

21.2 Pipework in Vicinity of Meters

21.2.1 Pipework sizing and configuration upstream and downstream of the meter should be in accordance with the meter manufacturers' recommendations.

21.2.2 The pipework configuration upstream and downstream of Diaphragm and Rotary Displacement meters is not critical at low metering pressures below 75 mbar gauge, but at higher pressures straight lengths of pipe are required each side of the meter as follows (where D is the nominal bore of the meter connection).

Diaphragm meters	-	no specific requirement
Rotary Displacement meters	-	straight lengths of up to 4D upstream and 2D downstream of the meter but see 21.2.1.
Turbine meter	-	straight lengths of up to 10D (see 21.2.3) upstream and 5D downstream of the meter but see 21.2.1.

21.2.3 A Turbine meter which requires a taper to match the pipe size will generally require an **additional** straight pipe of length 3D on the inlet to the meter. Any taper-piece shall be concentric and have a 15° included angle.

21.3 Methods of Correction

21.3.1 Correction may be applied by one of the following methods subject to the ES Pipelines Limited Policy in force at the time (see 5.2.3.1).

21.3.1.1 Fixed-factor correction.

21.3.1.2 Automatic temperature corrector together with fixed-factor pressure correction.

21.3.1.3 Automatic pressure/temperature corrector including compressibility correction where required.

22. VALVES

22.1 Manually Operated Valves

22.1.1 Manual valves shall be fitted in the positions indicated in Figures. 4 - 10 of Sections 18.2, 18.3 and 18.4.

22.1.2 Valves which are subject to pressures not exceeding 75 mbar gauge should be of a type that minimises pressure drop.

22.1.3 All valves shall carry clear indication of the direction of operation to open and close the valves which should be 'clockwise to close'. Valves shall be fitted with a device to indicate the position of the closing member.

22.1.4 It is not essential that above-ground valves be fire-resistant.

22.1.5 The valve designated as the 'meter control valve' (MCV) shall be clearly identified and shall have a handle or wheel which is securely attached to the operating spindle. Where this valve has a handle or lever which does not move horizontally then the valve shall be closed when the handle or lever has been moved as far as possible in a downwards direction.

22.1.6 Installations having a meter capacity greater than 25 m^3/h shall have at meter outlet valve.

22.1.7 Where there is more than one regulator stream there shall be inlet and outlet valves on every stream so that each may be independently isolated.

22.1.8 Regulator stream isolation valves shall be, and meter inlet and outlet valves should be, designed to seal on both upstream and downstream faces and the space between the faces shall be fitted with a vent *(known as a 'block and bleed 'facility)* .

Alternatively, two valves may be used on the inlet with a vent fitted to the space between them, and a second pair of valves, similarly vented, used on the outlet.

On single stream installations, the installation inlet isolation valve may be used as one of an inlet pair and the outlet isolation valve, where fitted, may be similarly used.

22.1.9 Stream isolation valves need not be fitted with a permanent means of actuation.

22.1.10 Line valves immediately upstream of the meter should not be of the forced lubrication type.

22.1.11 A meter by-pass valve shall be fitted with a permanent means of actuation (e.g., handle or wheel), and must be capable of being sealed in the closed position.

22.1.12 On impulse line valves the means of actuation must be capable of being removed.

22.2 Non-Return Valves

22.2.1 Under the Gas Act it is a requirement that an end user using (in conjunction with the consumption of natural gas) a compressor or air at higher pressure or any extraneous gas not supplied from the upstream distribution network of ES Pipelines Limited to install and use an appliance to prevent the high pressure air or extraneous gas from entering the service pipe or any of ES Pipelines Limited's upstream distribution system. Such an appliance is the **non-return valve**.

22.2.2 Non-return valves shall comply with the relevant industry standards.

22.2.3 It is preferable for non-return valves to be fitted to each compressor or item of plant or equipment using compressed air or extraneous gas, thus protecting the end user's pipework installation in addition to protecting ES Pipelines Limited's meter and distribution system.

In certain cases, particularly large or complex installations, it may be necessary to fit an additional non-return valve on the outlet of the primary meter.

22.2.4 Where oxygen is being used, special care should be exercised in the choice of non-return valves.

22.3 Relief Valves

22.3.1 Creep due to partially-worn or dirty regulator seats may be catered for by the installation of suitably-sized relief valves.

22.3.2 Creep relief valves shall not have a capacity larger than 1% of the stream fault capacity.

22.3.3 Relief valves provided for main regulator creep may be located remote from the installation provided that the interlinking pipework is adequately sized.

22.3.4 Vents shall be provided to discharge gas from relief valves to a safe place and shall conform with the requirements given in Section 2

.23. PIPEWORK

23.1 Materials and Jointing

23.1.1 Pipework other than that for auxiliary and impulse systems should be steel with screwed or welded joints. Flanges may be used in conjunction with either screwed or welded pipework, however the number of such joints should be kept to a minimum.

23.1.2 Grey and ductile iron pipe and pipe fittings shall not be used on metering installations.

23.1.3 Non-metallic pipe and pipe fittings shall not be used on metering installations except for instrumentation connections or purpose designed insulating joints.

23.2 Systems Specification

23.2.1 Screwed Pipework

23.2.1.1 Pipe should conform to BS EN 10255:2004 (medium or heavy) with fittings to BS 143:2000 or BS EN 10241:2000. Pipe to BS EN 10255:2004 (medium) shall not be used at pressures in excess of2 bar gauge.

23.2.1.2 Where the operating pressure does not exceed 75mbar gauge screwed pipework and pipe fittings may be used up to and including 100mm nominal bore but screwed connections to valves, filters and regulators should not exceed 80mm nominal bore. Where the operating pressure is above 75mbar gauge screwed connections greater than 50mm nominal bore should not be used.

23.2.1.3 Threads shall be in accordance with BS EN 10226, BS 746, BS EN 10806, or BS 5200 as appropriate, but parallel/parallel threaded joints shall not be used (except for the limited use of longscrews/ connectors). If taper external/parallel internal options are proposed, consideration should be given to the possibility of cracking of the internally threaded fitting or component.

23.2.1.4 Joints should be sealed with an approved jointing material applied to male threads only. Joints should not be turned back for alignment purposes, but dismantled and remade. Jointing paste shall not be used as sealant on screwed meter connections to RD meters.

23.2.2 Welded Pipework Pipe should conform to BS EN 10216-1:2002 or as

supplemented by L2/E: In addition, pipe to BS EN 10255:2004 (medium or heavy plain ended) may be welded, although the medium grade shall not be used at pressures in excess of 2barg. Fittings to BS 1640-3:1968: should be used, and fittings meeting those standards detailed in IGEM/GM/8: Part 1 Materials and Pipework may also be specified and used. Welding should be carried out to BS 2971:1991.

23.2.2.1 Welds shall not be closer to each other than 150mm or one pipe diameter, whichever is the smaller, excepting connections provided for impulse and instrumentation purposes.

23.2.3 Flanged Joints

23.2.3.1 Flanges shall conform to BS EN 1092-1:2018 Table PN16. Other flanges (e.g., BS 10:2009 or BS 1560- 3.2:1989) may be used where necessary to match meter connections.

23.2.3.2 Flanged joints shall be made incorporating the appropriate gasket. Jointing paste or compounds shall not be used.

23.2.3.3 Gaskets for use with flat-face flanges should conform to the dimensions given in BS EN 1092-1:2018, BS 10:1985 or BS 1560-3.2:1989 as relevant and to the materials in BS 6956-5:1992.

23.2.3.4 Gaskets for use with raised-face flanges should conform to the dimensions given in BS EN 1092-1:2018, BS 1560-3.2:1989 or BS EN 1514-1:1997 & 1514-2:2014+A1:2021 and to the materials in BS 6956-5:1992.

23.2.3.5 Bolting materials and dimensions should comply with BS EN 1515-1:2000 & 1515-3:2005.

23.2.4 Flexible Connections and Joints

23.2.4.1 Flexible connections and joints shall not be used except for the connections onto the meter. Flexible joints shall be capable of being dismantled and shall incorporate elastomeric seals to BS EN 682:2002.

23.2.4.2 Consideration shall be given to the possibility of pipes pulling out of compression-type joints and to the measures which may need to be taken to prevent it.

23.2.5 Impulse and Instrumentation Pipework

23.2.5.1 Auxiliary pipes, impulse pipes and fittings associated with regulators and slam shuts should be suitably sized, adequately supported and shall be of an approved grade of steel which may be screwed (see 23.2.1) or welded (see 23.2.2) or stainless steel to BS EN 10216-5:2021 with couplings to BS 4368- 1:1998+A1:2014.

Other pipework may be of an approved grade of steel or copper to BS EN 1057:2006+A1:2010 with couplings to either BS EN 1254-2:2021.

Other approved metallic or plastics materials may be used for instrumentation and non-critical control pipe. Where these are used they shall be enclosed within a protective material if installed in a position where damage might occur. Wherever possible impulse lines external to buildings, kiosks, pits, etc., should be avoided, but if unavoidable special protective measures should be undertaken.

23.2.5.2 Pipework to pressure recorders and correctors may alternatively be run in small-bore flexible tube.

23.3 Headers

23.3.1 Each header of multi-stream installations should be sized such that the header is of a size at least equal to that of the off-take pipework from that header

23.3.2 Noise is not normally a problem but, if necessary, at least the discharge header can be buried.

23.4 Supports

23.4.1 Supports should be designed with due consideration to avoiding corrosion between pipe and pipework supports.

23.4.2 Allowance should be made for the weight of the pipes, components supported by the pipe, wind and snow loadings.

23.4.3 Supports intended to anchor the installation rather than merely supporting, apart from needing sufficient strength to withstand anticipated loads, should also be able to withstand a reversal of half this load.

23 4 4 Supports not intended to anchor the pipe should not inhibit thermal expansion of the pipe.

23.4.5 All meters shall be adequately supported. Line-mount meters may be pipe supported. Flexible meter connections shall not be relied upon to provide such support.

23.5 Pipework Protection

23.5.1 The exterior of pipework and fittings shall be adequately protected. In normal indoor atmospheres the application of suitable paints may provide the necessary degree of protection.

23.5.2 In corrosive or damp atmospheres protection may be afforded by bituminous paint or wrapping.

23.5.3 After completion of the installation, all gas pipes shall be easily identifiable. In buildings where there is no other piped flammable gas it is sufficient to colour code the pipe yellow ochre (BS 4800:1989 standard colour 08C 35) or Primrose Yellow (BS 4800:1989 standard colour 10E53). In the case of large complex installations, for example chemical works, it is desirable to identify pipe contents more precisely with its name or chemical symbol, normally “Gas” marker tape at frequent intervals.

Where the normal operating pressure exceeds 75 mbar gauge the pipe should be labelled with the operating pressure.

23.6 Meter By-passes

23.6.1 In line with current practice and where it is considered necessary, a meter by-pass should be fitted to meters with a capacity greater than 42.5m^3/h.

23.6.2 Where a meter by-pass is installed, a valve shall be fitted in the by-pass and

separate meter inlet and outlet valves shall also be provided.

23.6.3 Sizing

Where it is unacceptable for the end user to be subjected to reduced flow when operating on the by-pass, the meter by-pass should have a pressure drop no greater than the meter line. In all other cases a smaller bypass providing a restricted supply may be adequate.

23.6.4 Sealing

All by-pass valves shall be labelled and sealed in the closed position and a warning notice shall be fitted adjacent to the by-pass valve giving instructions to the end user as to its use. The seal shall be identifiable and irreparable.

23.6.5 Governed Supply

Where a regulator installation is fitted on the inlet of the meter, it is preferable for the meter by-pass to be connected downstream of the regulator installation. In those instances where the meter by-pass is connected upstream of the regulator installation, then it shall itself incorporate a regulator in accordance with GS(I&U)R 1998.

23.7 Lightning Conductors

Consideration should be given to the possible need to protect exposed installations against lightning by suitably positioned lightning conductors.

Lightning conductor systems shall not be bonded to gas service pipework on the inlet side of any insulating joint.

24 ANCILLARY CONNECTIONS

24.1 Impulse Points

24.1.1 Where a regulator is externally impulsed the connection should be made between the regulator and the meter inlet valve and where the flow is reasonably free from turbulence and velocity change effects. The point of connection should be above the horizontal centre line of the pipe.

24.1.2 Impulse pipework should be as short as possible and should not be manifolded.

24.1.3 Impulse pipework should be larger than 8mm diameter and should not include any restriction other than those required for control purposes.

24.1.4 The design of impulse pipework should be such so as not to cause a hazard in an otherwise safe zone, nor should it earth cathodic protection systems, nor cause a diversion of electric currents which may be travelling through the main pipework.

24.1.5 Valves on impulse pipes shall be fitted close to the line connection point.

24.2 Pressure Test Points

24.2.1 Pressure test points shall be provided to enable the pressure losses across various components to be measured, regulators to be correctly set and the metered

pressure determined.

24.2.2 Required positions are shown in Figures 4 - 10 of Sections 18.2, 18.3 and 18.4.

24.3 Purge or Vent Points

24.3.1 Points should be provided to enable pipework and individual or groups of items of equipment to be purged or vented.

24.3.2 Connections for such points shall be suitably-sized to facilitate purging or venting in a reasonable time, shall incorporate a valve and shall be securely capped or plugged. It is not normally necessary for such points to be larger than 20mm.

24.3.3 Suggested positions are shown in Figures 4 - 10 of Sections 18.2, 18.3 and 18.4.

25 VENT PIPEWORK

25.1 Where the installation incorporates either a full bore relief, a creep relief regulator or regulator with integral relief, the relief outlet shall be fitted with a vent pipe sized to cope with the maximum designed relief flow.

25.2 Consideration should be given to the fitting of vents to the breather holes of regulators without integral relief valves if they are installed in confined spaces, for example, sub-basement areas. The design of the vent pipes shall be sized so as not to impair regulator performance.

25.3 Creep, auxiliary and similar small relief valves may be connected to a common vent stack provided that the vent is designed to avoid any interaction between the relief valves.

25.4 Vents from regulator breathers and larger relief valves shall not be manifolded together or to any other vent.

25.5 Vents shall terminate in a safe place, preferably above roof level. If it is impractical to terminate above roof level, great care shall be taken to vent into a safe area. Consideration shall be given to the topography of the surrounding area, for example, the effects of downwash.

25.6 Vent pipes shall not pass through electrical intake rooms, transformer rooms, lift shafts, refrigerator chambers; neither shall they be installed in any other position which may be prejudicial to their safety.

25.7 Vent pipes shall be of permanent construction, should be as straight and as short as possible and shall be designed to prevent undue back-pressure upon the relief valve. If vents exceed a length of 20 metres or an unusual number of bends is necessary, then an increase in vent pipe size may be required to minimise back-pressure effects.

25.8 Vents need not be fitted with flame arrestors unless the pipe-length exceeds 20 metres, or an increased vent pipe size has been used. When flame arrestors are fitted, they should preferably be of the in line type and be protected by a vent terminal. The design should ensure that the flow capacity of the vent is not significantly reduced.

25.9 Care shall be taken in the design of vent terminals to minimise the risk of blockage by foreign matter and the ingress of water. Where terminal caps or flaps are used they shall be light in weight, firmly attached to the pipe, self-closing, of non-sparking construction or material and such that they will operate even after long periods of in-operation.

26. INSTRUMENTATION

26.1 Any meter-driven mechanical device must not put a torque or resistance on the meter which would invalidate its badging. Only a device which is listed in the Schedule on the Certificate of Approval may be used.

26.2 On Rotary Displacement meters fitted with correctors the pressure connection should be made to the pressure tapping on the inlet flange of the meter.

On Turbine meters fitted with correctors the pressure connection should, where specified by the manufacturers, be to the specially-provided body tapping on the meter; otherwise, it should be to the inlet flange tapping.

In each case the pressure pipe connection to the corrector or pressure transducer should incorporate a valve which can be sealed in the open position.

26.3 Thermo-wells shall be installed whenever temperature correcting or recording equipment is used which requires the insertion of a temperature probe. Thermo-wells should be located within three pipe diameters of the meter outlet; they should protrude into the pipework by approximately one third of the nominal bore and should be oil-filled. Where more than one thermo-well is fitted on an installation, they should not be fitted in line but should be staggered radially.

26.4 If pressure recorders or gauges are to be fitted permanently to indicate the regulator set pressure, the pressure connection shall be made immediately upstream of the meter inlet valve. The pressure connection pipe should incorporate a valve which can be sealed in the open position.

26.5 Chart recorders, automatic correctors and telemetry equipment shall be sealed to prevent unauthorised adjustment.

26.6 Telemetry equipment, correctors, pressure, temperature, and volume recorders, if supplied in weather-proofed casings, may be fitted in the open air adjacent to the meter with provision made to screen pressure transducers and electronic equipment from direct sunlight. However, whenever convenient electrical equipment should be located indoors.

26.7 Where electrical equipment is fitted with a re-chargeable battery pack stand-by power supply a permanent automatic re-charging system shall be installed. All such equipment shall be suitably protected from the weather.

26.8 Electrical instrumentation and equipment shall be constructed and installed in accordance with the published parts of BS EN 60079-14:2014as they become available.

26.9 Instrument mounting brackets shall not be welded to the line or impulse pipework.

27. HOUSING

27.1 Security of Meter Installations

27.1.1 Consideration should be given at the design stage to the degree of security required to prevent unauthorised persons having unrestricted access to the installation.

27.1.2 When meter compounds, houses or compartments are locked, a set of keys shall be kept in a secure position or under the control of a responsible person. Wherever site security personnel are on continuous duty such authorised officers should control the key or keys, but it is desirable for ES Pipelines Limited personnel to have a means of access to the meter installation at all times.

27.2 Location

27.2.1 Meters shall be installed in a position which meets the requirements of the GS(I&U)R 1998.

27.2.2 The meter installation should be located as close as is sensibly practicable to the site boundary adjacent to the main, but it may be desirable to locate the installation in such a position as will minimise the length of outlet pipework operating at pressures in excess of 75mbar gauge.

27.2.3 It is generally preferable for an installation to be located in a separate purpose-built structure or compound but installations may be located within main buildings provided the following additional requirements are met:-

27.2.3.1 The inlet pressure to the installation must be less than 2 bar gauge.

27.2.3.2 The installation must be completely isolated from the rest of the building in such a manner so that any gas escaping from the installation cannot enter the main building, and any floor, wall or ceiling separating the installation from the rest of the building shall be of fire-resistant construction finished with a screed or plaster finish to minimise the leakage of gas through cracks or into any wall cavity. In addition, particular attention shall be paid to the sealing of ventilation openings, pipes, etc., which cross any cavity to prevent gas ingress.

27.2.3.3 The only access to the installation shall be from outside the main building through outward-opening doors.

27.2.3.4 An explosion relief shall be provided, either within the doors, or by the doors, or on an outside wall or the roof of the housing (providing that adequate restraining devices are fitted to prevent complete lift-off of the roof structure in the event of an explosion). The explosion relief should be capable of relieving the effects of an explosion and preventing any damage being caused to that part of the housing which segregates the installation from the main building.

27.2.4 Meter/regulator installations should not be located in pits unless there is no practicable alternative.

27.2.5 Whenever possible installations should be located away from the main buildings. Installations shall not be located in the immediate vicinity of hazardous installations, for example fuel, paint or chemical stores, etc.

27.2.6 The installation location should not be subject to extremes in temperature or vibration, nor to moist, corrosive, chemical-laden or dirty atmospheres, nor to accidental damage.

27.2.7 Where a purpose-designed enclosure is provided, including those within the main building, it shall not be used for purposes other than pressure regulating and metering the gas supply except as detailed in 27.6.1.4.

27.2.8 Consideration should be given to the suitability of the location for the routing and termination of vents.

27.2.9 Consideration should be given to the measures necessary to reduce any nuisance due to noise which may be emitted by the installation.

27.2.10 Installations should be on well-drained sites which are not liable to flooding, and away from overhead high tension cables and trees.

27.2.11 Suitable unobstructed access shall be provided to facilitate construction of the installation and its subsequent maintenance. The site must also be freely accessible to authorised personnel at all reasonable times.

27.2.12 Permanent safe working access shall be provided with sufficient clearance for safe working on the equipment installed.

27.3 All Housed Installations

27.3.1 Purpose-built external housings shall comply with any relevant statutory regulations.

27.3.2 The materials used on the construction of housings shall be durable, weather-resistant, waterproof and fire- resistant.

27.3.3 Where a new, purpose-built room or building is provided to house the installation, the walls shall be solid without cavity and shall not include openings other than those required for access or for ventilation.

27.3.4 The roof of any purpose built external housing should be of light-weight construction, or so constructed to minimise damage to installed equipment in the event of a roof fall but should provide the same level of security as the rest of the structure unless other overall site security measures are taken.

The whole or part of the roof may be removable in order to facilitate access to the installation.

27.3.5 Floors and duct coverings must be strong enough to take the required point weight loadings of the installation, and any additional loadings imposed during construction and maintenance.

27.3.6 The covers for pipe ducts shall not create unventilated voids.

27.3.7 Doors must be of sufficient size to afford access to people and equipment, and

where the installation is in a separate room large enough for a person to enter, consideration shall be given to a means of exit in an emergency. A means should be provided to hold the doors in the open position once opened.

27.3.7.1 For a compartment or a room within a building access shall only be from the outside of that building and the whole front should be in the form of an easily-removable panel or outward-opening door(s).

27.3.7.2 For a separate room attached to a building, at least one set of standard width outward- opening double doors shall be fitted in the outside wall of the building. The doors shall not be capable of being locked or fastened in such a manner that they cannot be easily and immediately opened from the inside.

27.3.7.3 For a separate purpose-built structure, at least one set of standard width outward-opening double doors shall be fitted. Two sets of doors are preferred and should be mounted in opposite walls of the house for rapid exit in case of emergency and shall be of the type specified in 27.3.7.2.

27.3.8 The total effective ventilation area should not be less than 2% of the floor area of the installation housing and should be equally distributed and disposed at high and low levels between the outside walls. Ventilators shall be of the non-adjustable type. Where minimisation of noise is important consideration should be given to providing ventilation through purpose-designed acoustic ventilators.

Where the housing is attached to or is substantially within the main building, ventilation shall not be into the main building. If ventilation is via ducting through the main building such ductwork shall be gas-tight and fire resistant.

27.4 Outdoor Installations

27.4.1 The installation should be securely fenced off and shall provide adequate safe access to the equipment for repair, maintenance, and fire-fighting. Wherever possible, an emergency exit should be provided in addition to the normal access gateway.

27.4.2 Consideration should be given to the provision of vehicle diversion barriers to protect the installation from vehicular traffic and the fitting of protective covers to vulnerable equipment where it is necessary to guard against vandalism.

27.4.3 Floodlighting from positions situated at a safe distance from the metering compound should be considered.

27.5 Installations in Pits

27.5.1 Only as a last resort should equipment be located in an external pit below ground level.

27.5.2 Pits should be of robust construction and designed to withstand foreseeable superimposed loads and forces exerted by ground water. They should be water tight and provide adequate security against vandalism.

27.5.3 Pipes and conduits passing through the walls of the pit should be sleeved and the annulus sealed to maintain a gas and watertight seal.

27.5.4 A pit should not connect, by an open duct or pipe, with a drain or other enclosed space.

27.5.5 The dimensions of a pit should be such that operatives can carry out maintenance work effectively.

Wherever possible an operative undertaking maintenance work shall be able to have his head and shoulders above the level of the surrounding ground.

27.5.6 Access to a pit should be by means of a permanent ladder or steps.

27.5.7 Where appropriate a sump should be constructed in the base of the pit.

27.5.8 Where practicable the whole roof of the pit shall be able to be removed during maintenance work.

27.5.9 The arrangement for raising and lowering covers shall be such as to protect the installed equipment from damage due to a handling error.

27.5.10 The ventilation area should be not less than 0.5% of the floor area of the pit but in small installations it may be necessary to increase the ventilation area to 3% of the floor area.

27.5.11 A two-pipe ventilation system is preferred with vent pipes starting at both high and low levels within the pit and terminating more than 3 metres above ground level.

Where this level of ventilation cannot be achieved and/or where a vent stack terminates at less than 3 metres above ground level, flame arrestors should be fitted. Such flame arrestors should not restrict the design capacity of the vents and should be protected from blockage.

27.6 Electrical Safety Standards

27.6.1 General

27.6.1.1 All electrical equipment associated with meter installations should be designed, constructed and installed in accordance with the recommendations issued by the Institution of Electrical Engineers and any relevant British Standards, ES Pipelines Limited Electrical Standards, Codes of Practice and local or statutory requirements.

27.6.1.2 Precautions covering the use of electricity other than for metering purposes must be related to the hazards involved. Where there is any likelihood of gas being present in the atmosphere all electrical equipment and instrumentation should be constructed and installed in accordance with BS EN 60079-14:2014.

27.6.1.3 The degree of protection required will depend upon the zone classification. It may be possible in some cases to avoid using flameproof equipment by siting switches, isolators and switchgear outside the hazardous areas.

27.6.1.4 Compressors, boosters and premix machines should not be installed in meter houses unless there is no practicable alternative. If they do have to be fitted in the meter house then all electrical equipment in the meter house must be installed to Zone 2 Group II standards.

27.6.1.5 Pipes shall be cross bonded with other services by the end user's electrical

engineer or contractor in accordance with the Institution of Electrical Engineers' Regulations.

Separate bonding straps shall be fitted across flexible couplings unless they incorporate integral continuity devices.

27.6.1.6 Where insulated joints are deliberately incorporated anywhere in the installation, for example PME insulators or cathodic protection insulators, it is essential that cross bonding does not produce a bond around any such insulating joint.

27.6.1.7 In general the cross bonding of other services to the gas supply should only be connected to the pipework on the outlet side of the meter.

27.6.2 Adjacent Electric Services

27.6.2.1 Gas meters shall not be installed in rooms specifically intended for electrical meters or switchgear.

27.6.2.2 All parts of the gas meter installation should be located as far as is practicably possible from any adjacent electrical meters or switchgear and in no circumstances should the distance be less than 150 mm. This is not intended to preclude the use of suitably-protected and certificated electrical instrumentation in connection with the meter (see 27.6.1.2).

27.7 Warning Notices and Line Diagrams

27.7.1 To comply with GS(I&U)R 1998 and ES Pipelines Limited requirements, warning notices shall be located adjacent to the meter and shall be in accordance with IGEM/GM/8 Part 5.

Where applicable the following notices are required (see Appendix 2).

Statutory Notices

Escapes
Joint Services
Secondary Meters

ES Pipelines Limited Notices

By-Passes
Non-Return Valve
Gas Compressors and Engines
(a) Near the Meter Inlet Valve
(b) Near the Gas Compressor or Engine
High Pressure Gas
Meter Control Valve (where more than one valve) Metering Pressure (when above 21 mbar gauge)

Composite Notice

* Where a number of notices are required, consideration should be given to the provision of a composite notice fitted in a prominent position.

27.7.2 Line Diagram

The GS(I&U)R 1998 require that under certain circumstances a line diagram of the gas installation be provided adjacent to the meter.

PART D

COMMISSIONING AND MAINTENANCE

28. COMMISSIONING

28.1 General

28.1.1 To ensure safe and efficient commissioning a competent person should be nominated to take overall control.

28.1.2 Meter/ regulator installations shall be commissioned according to the following procedure: -

(i) hydrostatic testing (if appropriate)

(ii) pre-commissioning check

(iii) soundness test

(iv) purging

(v) commissioning

(vi) post-commissioning check.

28.1.3 It is preferable for commissioning to be a continuous operation but it is recognised that in many instances this may not be practicable. If it is necessary to suspend operations before commissioning is completed the installation shall be left in a safe condition and sealed off by means of caps, plugs, spades or blind flanges as appropriate.

28.1.4 It is preferable to use an inert gas for the soundness testing and for purging the installation. However, on low pressure installations of small capacity it is acceptable to use air for the soundness testing and to purge direct to gas.

28.1.5 Manufacturers' instructions concerning the proper commissioning of specific items of equipment should be observed in all cases.

28.2 Hydrostatic Testing

28.2.1 Hydrostatic testing is the normally accepted method of strength testing. However, for working pressures of 7bar gauge or less, a pneumatic test to the appropriate pressure may be substituted for the hydrostatic test.

28.2.2 Where a pneumatic or hydrostatic test is applied, the test pressure shall be 1.5 times the maximum working pressure under fault conditions.

28.2.3 Strength testing of meters, regulators, filters, valves and other equipment should normally have been carried out by the manufacturers and the maximum test pressure will be marked on the equipment.

28.2.4 As the meter, regulators, reliefs, slam-shut valves, filter elements and strainers must be removed from the line before applying a hydrostatic test to a

metering installation, consideration should be given to hydrostatically testing pipework components and fabrications prior to final assembly on site.

28.2.5 Before hydrostatic pressurisation care should be taken to ensure that there is no air or gas in the system.

28.2.6 After hydrostatic testing, each part shall be thoroughly dried before the meter, regulators, etc. are bolted in place, and particular care shall be taken to drain any low points where water could accumulate.

28.2.7 Where hydrostatic testing is carried out on individual sections which are subsequently assembled together with only flanged or screwed joints, a hydrostatic test of the complete installation is not required.

28.2.8 It is not necessary to re-check the system for strength after dismantling and re-assembly providing there have been no mechanical changes likely to affect strength, e.g., welding or fitting of untested parts.

28.3 Pre-commissioning Check

28.3.1 The installation should be checked visually to ensure that it is complete in accordance with the design, but with the instrumentation disconnected.

28.3.2 Prior to testing for soundness, it may be necessary to fit a temporary by-pass around the regulator and isolate the meter or any other component which may not withstand the test pressure.

28.3.3 The installation to be tested shall be isolated from those parts of the service and outlet supply pipework which are not to be subject to the test at this time. The closing of valves does not in this context constitute isolation.

28.4 Soundness Testing

28.4.1 All installations shall be pneumatically checked for leakage using air or an inert gas. Reference should be made to IGEM/UP/1C.

28.4.2 Installations operating at pressures in excess of 75 mbar gauge shall be subjected to a soundness test, initially at 15 mbar gauge for 2 minutes, during which time there shall be no apparent leakage, and then continuing by subjecting the installation to a test pressure of 1.5 times the maximum pressure under fault conditions. Once the test pressure has stabilised, there shall be no loss in pressure over a period of at least 10 minutes. Dependent upon the duration of the test it may be necessary to take account of temperature variations and its effect upon the test pressure. Joints shall be tested with a leak-detection fluid; there shall be no leakage.

28.4.3 Once these parts of the soundness test have been completed, temporary regulator by-passes shall be removed and isolated components shall be reconnected, except for instrumentation which shall remain isolated.

28.5.2 Before proceeding, the following checks shall be carried out:-

28.5.3 That the main filter element is installed.

28.5.4 That strainers have been fitted in front of Turbine and Rotary Displacement meters.

28.5.5 That the alignment of inlet and outlet pipework is satisfactory and does not transfer load to the meter.

28.4.4.1 That the rotational axis of Rotary Displacement meters is level within the tolerances specified by the manufacturers.

28.5.6 That lubricant of the correct type and quantity is added in accordance with the manufacturer's instructions.

28.5.7 That Rotary Displacement meters have been shown to rotate freely.

28.4.5 The complete installation shall then be tested for soundness at a pressure equal to the nominal working pressure, and the re-made joints tested using a leak detection fluid. There shall be no leakage.

28.5 Purging

28.5.1 Reference should also be made to IGEM/UP/1C.

Immediately prior to starting any purging a soundness test shall be carried out.

28.5.8 The connection between the gas service and the meter/ regulator installation shall be re-established.

28.5.9 Where soundness testing was carried out using air, or where the re-establishment of the connection involved the replacement of pipework rather than the removal of a spade, consideration should be given to carrying out an inert gas purge.

28.5.10 The procedure shall ensure that all pipework is purged, and that wherever possible sequential purging is employed. On more complex installations, it is recommended that with the meter inlet and by-pass valves closed, each regulator stream is purged through the outlet header.

28.5.5 Where a meter by-pass is not fitted, the meter should be purged slowly through the inlet valve to the outlet valve.

Where a meter by-pass is fitted, the downstream pipework should be purged through the by-pass with the meter inlet and outlet valves closed. The meter should be purged **slowly** through the inlet valve, and out through the purge point between the meter outlet and meter outlet valve. The meter inlet and by-pass valves should then be closed.

28.5.6 The completion of each stage of purging shall be determined using a suitable instrument. Purging shall not be considered complete until a 90% gas concentration is registered.

28.6 Commissioning

28.6.1 A facility shall be established for a flow of gas which should preferably not pass through the meter.

28.6.2 The regulator in each stream shall be adjusted to the desired set-point. Each stream shall be set in turn. Any reliefs or slam-shuts incorporated in the system

should be set immediately prior to the final adjustment of the regulator. It may be necessary to wait until the end user's gas consuming equipment is operable before final adjustments can be completed. It is essential that pressures are set accurately especially where fixed factor correction is to be applied.

28.6.3 Where gas is not already passing through the meter, the meter inlet valve shall be opened slowly, followed by the meter outlet valve. The meter by-pass valve, where fitted, shall be closed and sealed.

28.6.4 When the meter is operating it should be observed carefully for external signs of faulty operations such as excessive noise, jerky movements of the index, or high differential pressure.

28.6.5 The set pressures of the regulators, reliefs, slam-shut valves, and the metering pressures shall be marked on, or at, the installation.

28.7 Instrument Commissioning

28.7.1 Prior to connecting and commissioning instrumentation the following checks should be carried out as appropriate, and reference made to manufacturers' instructions.

28.7.1.1 Check that all instruments have been located in a suitable environment and are not subjected to vibration and similar effects.

28.7.1.2 Check that all necessary test points and proving facilities have been provided and are operable.

28.7.1.3 Check that all electronic equipment satisfies the relevant safety requirements for the particular location. The appropriate certificates should be examined.

28.7.1.4 Check power supplies, fuses and cabling to ensure that they are appropriate for the required duty.

28.7.1.5 Check instruments for free movement of all moving parts.

28.7.1.6 Check that the instrument is securely mounted.

28.7.1.7 Check that any driven parts rotate in the correct direction.

28.7.1.8 Check that adjustable gearing is correctly set.

28.7.1.9 Check that all impulse lines are clear before connection to the instrument. Instrument impulse lines shall not be vented through the instrument. As soon as pipework is pressurised, it should be tested for soundness.

28.7.1.10 Check that temperature-sensing elements are correctly installed and thermo-wells are oil-filled.

28.7.1.11 Check that instrumentation is adequately protected against the effects of weather, including sunlight.

28.7.2 Pressure-sensing instruments shall be pressurised slowly, and equalisation valves should always be used where they are provided.

28.7.3 Electrical supplies to the instruments shall be connected.

28.7.4 The calibration of each instrument shall be checked to ensure that it has not drifted.

28.7.5 With the meter and instrumentation operating, instruments should be carefully observed for signs of faulty operation such as excessive noise, mechanical binding, slipping, overheating and effects of vibration.

28.7.6 Chart recorders, automatic correctors, the meter by-pass valve, meter regulators, telemetry equipment and pressure connections to instruments used for correction, shall be sealed.

28.7.7 Hand wheels shall be removed from valves, or locked and sealed, as appropriate.

28.8 Post-commissioning Check

28.8.1 After a volume of gas significant in relation to the capacity of the installation has been supplied, the following checks and adjustment shall be carried out.

28.8.1.1 Ensure that noise is not excessive when the installation is working at least 20% of its maximum flow rate.

28.8.1.2 With a similar flow rate, check and adjust the set point of each regulator. Where fixed factor correction is applied ensure that the set pressure is accurate.

28.8.1.3 The oil in Rotary Displacement meters should be changed in accordance with the manufacturers' instructions.

28.8.1.4 Check that the meter index is still operational.

28.8.1.5 Check that the uncorrected volume of gas recorded on any instrument agrees with the volume registered by the meter to within the tolerance stated by the instrument manufacturer.

28.8.1.6 Check all instruments for signs of undue wear, slippage or overheating. Check the calibration of all instruments and sensors.

28.8.2 Check the integrity of all seals and ensure that the meter by-pass valve is sealed in the closed position.

28.8.3 Ensure that all appropriate Notices are correctly sited.

29 MAINTENANCE

29.1 To ensure a continued high level of reliability and that no degradation in acceptable measurement accuracy occurs with time, it is desirable to establish a procedure for inspection and maintenance of meter/ regulator installations.

29.2 The following points, over and above the normal regulator and meter maintenance schedules should be considered when drafting such a procedure.

29.2.1 The corrected flow index reading should be compared with the corrected flow calculated from the uncorrected meter index reading and the nominal gas pressure and temperature as appropriate.

29.2.2 Pressure recorders should be installed for at least one working week every year to check regulator, meter, and installation performance.

29.2.3 Meter oil levels should be checked and all instruments, meters etc. lubricated annually.

29.2.4 Regulator set points, instruments and recorders should be checked and reset or recalibrated at least once every year. It is particularly important to ensure that the set pressure is accurately maintained where fixed factor correction is applied.

29.2.5 The flow rate should be checked periodically to ensure that the installation is operating within the design constraints.

29.2.6 Checking of pressure relief valve set point and the associated vent pipework system to ensure that its operational capabilities are unimpaired.

29.2.7 Check that ventilators and ventilation ductwork are not obstructed.

29.2.8 Top-up as necessary the oil level in thermo-wells.

29.3 Regular visits should be made to site to inspect all equipment and instruments for signs of faulty operation such as excessive noise, jerky index movements, mechanical binding, slipping, or overheating and for the effects of vibration. The integrity of all seals shall be checked, and seals replaced as necessary.

29.4 If there is any doubt about the performance of a Rotary Displacement or Turbine meter, the differential pressure or spin-down time respectively should be checked against that obtained when the meter was new. Any significant variation should be investigated.

29.5 A record of all inspections and work programmes should be maintained and filed in date order.

29.6 For more specific details of both ES Pipelines Limited's Policy for the Management of the Maintenance of Gas Supply Metering Installations and its Procedure for the Maintenance of Gas Supply Metering Installations making up its portfolio of such installations reference should be made to the Company's documents ESP/PL/MM1 and ESP/PM/MM9 respectively.

APPENDIX 1 DEFINITIONS

A.1.1 **Agreement**

When written with a capital 'A' the Agreement may be embodied in the document 'Special Agreement for the Supply of Gas' (sometimes referred to as a contract), or it may take the form of a formal exchange of letters between ES Pipelines Limited and the gas supplier and/ or end user. When written with a little 'a' the word has the normal dictionary meaning and no legal significance.

A.1.2 **Filter**

A device to collect any dust, debris, etc. which may be present in the flowing gas stream. It consists of a body housing fitted into the gas pipework which contains an element which may be replaced without removing the filter body from the pipework.

A.1.3 **Fire-Safe (as applied to valves)**

For a valve to be considered fire-safe it shall be capable of withstanding a half-hour standard when tested by a method based upon the standard time/temperature curve specified in BS 476-21 TO 23:1987. At the end of the test period the external leakage from the valve shall not exceed 0.14 m^3 h and, with the valve in the closed position, the internal through leakage shall not exceed 0.14 m^3/h when tested on air at 75 mbar gauge.

A.1.4 **Flexible Connection**

A pipe fitting which is designed to permit limited movement. Typical examples are flange adaptors and couplings (flexible joints) and flexible metallic tube.

A.1.5 **Housed Installation**

This term is taken to include the following :-

(i) a cupboard or compartment within a building;

(ii) a separate room within or attached to a building;

(iii) a separate purpose-built structure.

A.1.6 **Hunting (also referred to as 'Chattering')**

(a) Regulator instability when the flow rate is very low and the regulator is on the verge of lock up.

(b) Interaction between two or more regulators in parallel which are set very close to, or at, the same outlet pressure.

Hunting will always result in fluctuations of the regulator outlet pressure.

A.1.7 **Instrumentation**

This term includes all devices and attachments used in conjunction with a meter for correction purposes. The term also embraces any other permanently-installed

pressure gauges, recorders, thermometers, telemetry equipment, etc. not used in connection with the rendering of accounts.

A. 1.8 **Load Factor**

Is the ratio of the total connected gas load to the likely maximum consumption taking account of the diversity of usage of the installed equipment.

A.1.9 **Meter Control Valve**

The valve adjacent to and on the inlet side of a meter controlling the gas supply to the end user. Where the installation incorporates more than one valve which could control the gas supply the LDZ may nominate any one of them as the meter control.

A.1.10 **Meter Regulator**

An outlet pressure regulator fitted between the meter control valve and the meter which is designed to operate at an inlet pressure not exceeding 75 mbar gauge.

A.1.11 **Outdoor Installation**

This term is taken to mean an installation in the open air which may, or may not, have a light-weight weather shield to protect the equipment and/or personnel working upon the installation.

A.1.12 **Seal**

A means of indicating that equipment has remained as originally fitted and set and of deterring unauthorised tampering. Sealing may take the form of wiring with a seal, padlocking the equipment or locking the doors of instruments.

A.1.13 **Service Regulator**

A pressure regulator installed in a service pipe.

A.1.14 **Service Isolation Valve**

A valve inserted in the service pipe outside a building for shutting off the supply of gas.

A.1.15 **Spade**

A plate, having a tell-tale handle, which is inserted between two flanges to block the flow of gas.

A.1.16 **Strainer**

A metal mesh type of sieve fitted into the pipework to collect debris, dust, etc. in the gas stream. It is clamped between two flanges and requires removal of a pipe section for its withdrawal. Both open-ended (skirt-type) and closed-ended (top-hat type) exist.

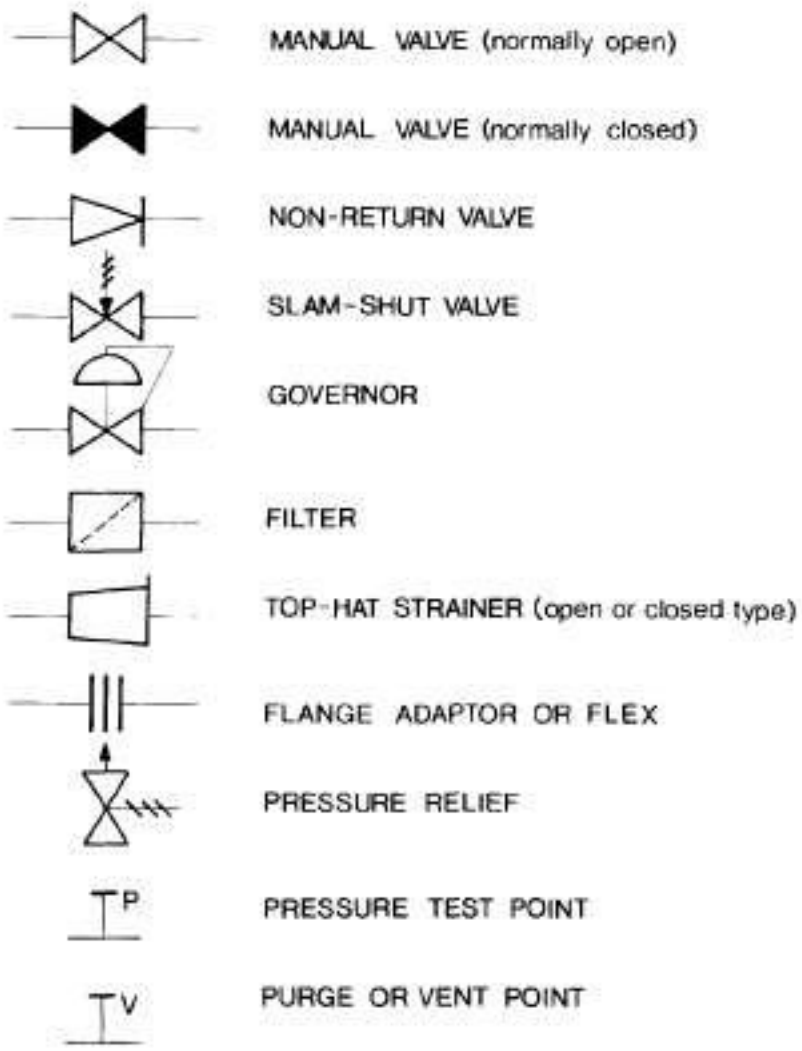
A.1.17 **Stream Fault Flow-rate**

The quantity of gas which a stream will discharge when the regulator fails in the open position with the inlet pressure at its maximum. It should be noted that the restrictive effect of the pipework and other equipment within the stream may mean that the stream fault flow rate is less than the regulator fault capacity.

A.1.18 **Standard Symbols**

The symbols used in the figures included in Sections 8 and 18 are as depicted in Figure A. 1.1.

Figure A.1.1 Standard Symbols



APPENDIX 2

A.2 NOTICES AND LABELS

IGEM/GM/8 Part 5 deals with the provision of notices and labels for Industrial and Commercial metering installations.

Section 5 of IGEM/GM/8 Part 5 specifically details the use of Composite Notices and it is ES Pipelines Limited's preference that a Composite Notice should be used wherever possible in order to comply with the requirements of these recommendations.

Where a Composite Notice does not provide compliance with the recommendations then the use of Individual Notices as detailed in IGEM/GM/8 Part 5 will be implemented as required. Consideration will also be given to the use of the Optional Notices detailed in IGEM/GM/8 Part 5 where applicable.

General Health and Safety Notices will be provided at all installations as detailed in IGEM/GM/8 Part 5.

APPENDIX 3

ES PIPELINES LIMITED – METER MODULE/INSTALLATION DESIGN QUESTIONAIRE – page 1 of 2

LOAD INFORMATION REQUIRED AT METER INSTALLATION DESIGN STAGE *(Information to be supplied to ES Pipelines Limited by the gas supplier or end user)*			
To enable a design to be completed by ES Pipelines Limited, and where applicable a quotation to be provided, for a meter module/installation, the completed form must be returned to the ES Pipelines Limited. ***NOTE*****:** *Where information is unavailable, the ES Pipelines Limited may have to make assumptions during the design stage of the meter installation. These assumptions may impose restrictions on the operation of the end users plant and could affect plant operability.*			
Gas supplier contact details:			
Company:		Address:	
Engineer:			
Tel No:			
Fax No:		E-mail	
End User contact details:			
Company:		Address:	
Engineer:			
Tel No:			
Fax No:		E-mail	
Housing/location requirements/details **NOTE:** Housings must have a minimum free ventilation area of 2% floor area.			
IGEM/GM/8 Part 2 Housing Required? ☐ No ☐ Yes	Finish: ☐ Green ☐ Textured ☐ Brick Effect		
Please provide details of the proposed location of the housing and installation, indicating proximity to the site boundary, other buildings, plant, etc. A scale site plan showing the precise meter location required should be provided wherever possible *(Scale 1:500 or greater if possible)*			
Preferred outlet pipe orientation:			
Outlet orientation: ☐ Vertical down ☐ Vertical up ☐ Horizontal			
Plant and downstream system pressure details (safety and performance):			
	Non-standard appliances ☐	Standard appliances ☐	
Metering pressure requested:	mbar/bar gauge	mbar/bar gauge	
Strength test pressure STP?	mbar/bar gauge	mbar/bar gauge	
Design pressure DP?	mbar/bar gauge	mbar/bar gauge	
Maximum operating pressure MOP?	mbar/bar gauge	mbar/bar gauge	
Normal operating pressure?	mbar/bar gauge	mbar/bar gauge	
Lowest operating pressure LOP?	mbar/bar gauge	mbar/bar gauge	
Design minimum pressure DmP?	mbar/bar gauge	mbar/bar gauge	
Load details:			
Minimum flow rate std m^3/h	Note: Should not be zero.	Maximum flow rate std m^3/h:	
Estimate Q_{max} in 12 months in std m^3/h::		Peak load std m^3/h:	
Is continuity of supply required?	☐ No ☐ Yes. If yes specify reason		

Details of downstream plant/equipment:	Number, type and size of unit of plant and, where available, usage patterns: (including any inter-dependencies) Other comments sheet attached?: ☐ No ☐ Yes Sheets
Special features of the load:	
Special features present downstream:	
Initial overview of special features where present:	☐ Engine ☐ Turbine ☐ Compressor ☐ Booster ☐ Modulating ☐ Pulsating Load Frequency of pulsations Hz Amplitude of pulsations % ☐ On-Off Frequency on-off loads e.g. 20min on, 30min off. ☐ Other possible sources of pulsations/step load changes specify: and provide details on a separate sheet. ☐ Other possible sources of extraneous gases specify and provide details on a separate sheet. Other comments attached? ☐ No ☐ Yes Sheets
Maximum incidental pressure (fault pressure) to which the meter installation may be subjected by the consumer's system	mbar/bar gauge
Other requirements/restrictions: e.g. hazardous areas	
Other comments attached? ☐ No ☐ Yes Sheets	

SUPPLEMENT - EXPLANATORY NOTES AND COMMENTARY

This section does not constitute part of the Requirements itself but represents explanatory notes and further general information on specific clauses for the benefit of the reader. The contents of this section should therefore be considered only in conjunction with the clauses to which they refer.

Clause 4.1.1 Planning approval from the local authority might be required for any external housing and it would be the end user's responsibility to obtain any such approval.

Clause 4.1.2 The type of work which the end user might carry out and which could affect the pressure regulating/ meter installation includes alterations to the building housing the installation, painting the housing or the installation itself (which could block regulator breathers, clog operating stems of valves and obliterate markings).

The end user should also be advised that, if he wishes to shut-off the gas supply to his installation to facilitate pipework alterations or plant maintenance, the gas supply should be shut-off at the meter inlet, regulator outlet and not at the inlet to the complete installation. This is particularly relevant to higher pressure installations as regulators, safety devices, etc. could require resetting if they are turned off.

Clause 5.2.2 Whenever the installation or repair of a meter index, corrector drive or pulse generator involves the breaking of any official seals it will be necessary for a Gas Meter Examiner to be in attendance throughout to officially break the seals and reseal the meter after the work has been completed to his satisfaction. ES Pipelines Limited employees shall not break the seals of any badged meter without a Gas Meter Examiner being present.

Clause 5.2.3 Ofgem will allow the use of equipment provided the additional torque caused by its attachment to the meter does not cause the meter's legal accuracy limits to be exceeded. Gas Standards will not, however, badge such instruments for accuracy.

Clause 5.2.3.2 Under the Gas Act, no meter correction may be applied to any gas supplied and charged in accordance with a published tariff. If, by exchange of letters with a end user, it is agreed to apply correction and then charge at the same rate as a published tariff, it is no longer a tariff supply but a Special Agreement.

Clause 5.2.4 The standard form of 'Special Agreement for the Supply of Gas' contains several conditions relevant to metering and the meter installation namely:

(i) Calculation of volume of gas supplied.

(ii) Supply and Metering Equipment.

(iii) ES Pipelines Limited Equipment.

(iv) Delivery Point.

(v) Indemnity.

(vi) Access.

(vii) Gas Act 1985.

Clause 7.3 Whenever an installation is designed to have more than one regulator in operation at any given time it will be necessary to have a differential between the set points, to prevent instability. The result of such an arrangement is that at the peak flow rates through the whole regulator installation the total pressure differential between the service pipe and the meter inlet pressure of 21 mbar gauge will be at a maximum. Also, at lower flow rates with only one regulator operating the set pressure will have to be in excess of 21 mbar gauge. The minimum differential between the set points of any two regulators is 0.5 mbar.

Clause 7.4 To avoid over-speeding and interaction between meters, the use of meters in parallel with common outlet connections should be avoided wherever possible.

Where, because of the wide turn down in load, it is necessary to use meters in parallel with a

common outlet connection, each meter shall be independently governed at a slightly different pressure. The difference in regulator set points should not be large enough to cause meter over-speeding.

Where, because of the size of the load, it is necessary to use meters in parallel with common inlet and outlet manifold connections and supplied from a common regulator system

(i) the meters used shall be of the same make and size;

(ii) 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. This latter comment is particularly relevant to diaphragm and Rotary Displacement meters.

Clause 7.5 Where the operating pressure of the distribution system exceeds 50 mbar gauge but not 75 mbar gauge it may be necessary to consider overpressure protection. It should be noted that the standard diaphragm meters are only tested to 50 mbar gauge although higher test pressures may be requested for specific installations. Alternatively a meter regulator which will accept the maximum inlet pressure may be adequate.

Clause 7.9 The regulator set pressure must take into account the pressure required at the appliances, the pressure loss across the pipework between the meter and the appliances and the pressure drop across the meter installation. Every attempt should be made to minimise the pressure loss across the filter, valves, pipework and meter.

Clause 7.10 Where the inlet pressure to the installation is no higher than 25 mbar gauge the effects of pressure loss across the installation will become critical before the velocity of 40 m/s is attained. At such high velocities consideration should be given to noise effects and possible meter over-speeding.

Clause 7.12 Suitable arrangements should be made at the design stage of selected installations to collect information about the load characteristics, including flow rate profile.

Whilst information relating to load characteristics may be collected manually, advantage should be taken of the benefits to be derived from the use of data-logging systems whose use will necessitate the purchase of meters fitted with an LF or HF transmitter. In addition, it would be an advantage if corresponding data could be obtained concerning the operation of the plant. Careful study and analysis of such data might reveal evidence to be used for a variety of purposes including :-

(i) checking actual operation conditions against the assumed operating conditions;

(ii) checking the rate of growth of the load;

(iii) production of *typical flow rate profiles* for types of plant and/or operations. This could be used to determine realistic 'load factors' for application in future non-domestic flow metering installation designs.

Clause 8.3.1 The meter outlet valve is provided so that it is not necessary to purge the downstream pipework when maintaining the installation. Where the downstream pipework is short, is simple to purge efficiently and supplies not more than two appliances, the appliance isolating valves may be considered sufficient and the meter outlet valve omitted.

Clause 9.5 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 regulator filter and the meter, which might otherwise damage the meter.

The open-ended variety specified is considered adequate as there is unlikely to be any gas-borne dust due to the low gas pressures and velocity in such installations. They have the added advantage of a relatively low pressure differential.

The reason for the strainer being at least 3D upstream of Turbine meters is that, if positioned directly on the meter inlet, significant metering errors may occur.

Clause 9.6 Box filters are generally self-evident but top-hat strainers should incorporate

some form of external identification such as a handle or identification plate or label.

Clause 10.4 The response time is the time to restore the pressure to 63% of the set pressure following a step increase in flow demand from zero to 30% of the regulator capacity**. This step shall be applied with the regulator set to maintain an outlet pressure of 21 mbar gauge with an inlet pressure of 23.5 mbar gauge and with a small pipe volume (approximately 10 diameters) between the regulator and the fast acting demand control valve. If the regulator has a capacity of less than 30 m^3/h the step applied shall be 100% of the regulator capacity.

** *For the purpose of this test, carried out on air, 100% regulator capacity is defined as the flow rate at 10% droop from an initial outlet pressure of 21 mbar gauge and differential of 2.5 mbar where the initial outlet pressure is that pressure which exists when a small flow has been established through the regulator, i.e. when the regulator is not locked up.*

Clause 11.1 Careful consideration should be given to the load profile of any further load (see Section 6). Experience suggests that there is a general tendency to oversize meters, which can result in the volume of gas supplied being under-registered. It is also important to ensure that the meter operates within its badged rating although brief and infrequent flows in excess of the badged rating are not usually deleterious providing the higher pressure drop across the meter is acceptable.

Clause 11.1.2 Gas flow rates which are lower than the meter's minimum flow rate will invariably be under-registered and in the extreme case they will not register at all. It is therefore necessary to consider the total quantity of gas likely to flow under such conditions during the period of a year, in order to determine a realistic overall metering accuracy for the installation.

Clauses 11.1.3, 11.1.4 and 11.1.5 - General

The Gas Meter Regulations 1983 specify the accuracy limits required for badged meters. For Diaphragm meters the accuracy has to be within ± 2% over a flow range from Q max. to 0.02 Q max. For Rotary Displacement and Turbine meters the accuracy required is ± 1% over the range Qmax. to 0.2 Q max. and ± 2% over the range 0.2 Q max. to Q min.

Clause 11.1.5 Pulsating flows may be caused by cycling loads having on/off control or even by some high/low controls. In addition, reciprocating gas compressors and engines will give rise to flow pulsations which would affect the metering accuracy.

Where it is not possible to use an alternative type of meter steps must be taken to ensure that flow oscillations at the meter are reduced to below 10% of the mean flow.

Clause 11.1.6 If any doubt exists the meter manufacturers should be consulted, and their advice sought.

Clause 11.2 The Gas Meter Regulations 1983 specify a maximum pressure drop allowable across the various sizes of Diaphragm meter. The maximum pressure drop allowed is 4 mbar but in practice meters currently available and used by ES Pipelines Limited have a pressure drop much less than this; generally, 1.25 mbar measured on natural gas.

There is no legal limit to the pressure drop allowed across a Rotary Displacement or Turbine meter. This means that meter manufacturers may design their meters to pass the maximum flow at any pressure drop they choose. In practice the pressure drop at maximum flow when passing gas at near atmospheric pressure is unlikely to be more than 5 mbar. For metering of low pressure supplies however, this pressure drop may be unacceptable as it could result in insufficient pressure at the appliance. Where gas is being metered at 21 mbar gauge the meter shall be sized such that the pressure drop across the meter does not exceed 1.25 mbar. To minimise the pressure loss across the meter a larger meter may have to be used. However, in these cases it must be remembered that the turndown range for ± 1% accuracy applies to the badged maximum flow rate and that using an oversized meter will effectively reduce the turndown range. It is therefore even more important than normal to establish realistic actual maximum and minimum flow rates.

As an alternative to using an oversized meter it may be possible to meter at higher pressure than normal and to apply appropriate pressure correction. This solution is preferable to using an oversize meter but is not usually possible from low pressure supplies.

Clause 11.3.3 The pipework should be designed such that jetting or swirling does not occur at the meter inlet as meter registration errors will be caused. Partially-open valves are a common cause of jetting

Clause 11.4.1 Fixed Factor Correction

In the case of those installations having a Diaphragm meter without the facility to drive correcting equipment, or where suitable correction equipment is not available, or small loads where automatic correction is not economically justified, correction by means of a fixed factor may be the only practical method.

Clause 11.4.1.2 Automatic Temperature Correctors

Correctors that automatically correct for the effect of temperature may be obtained either integral with the meter, or as separate mechanical or electronic correctors.

(i) Temperature-compensated meters are meters in which the index mechanism incorporates a mechanical temperature corrector. Badged Rotary Displacement meters are available that incorporate an additional temperature-corrected index and on new installations they should be used together with a fixed factor pressure correction.

(ii) Mechanical temperature correctors are available which are in effect the temperature half of the combined pressure/ temperature correctors. They may be used with any meter capable of providing the necessary mechanical uncorrected volume drive.

(iii) Electronic temperature correctors utilise an electrical pulse signal from the meter index to provide the uncorrected flow data, and an electric signal from a suitable transducer provides the data on the temperature of the metered gas flow.

Any electrical connections from the pulse generator on the meter index and on the corrector itself (including test connections) must be sealed to guard against unauthorised interference.

Clause 11.4.1.3 Automatic Pressure/Temperature Correctors

Correctors that automatically correct for pressure (P) and temperature (T) are available and may be obtained to take account of the effects of compressibility (Z).

(i) Mechanical automatic correctors may be of the continuous or intermittent (step) integration type. Where the effects of compressibility (Z) need to be taken into account, mechanical correctors may have a factor built-in for the pressure at which the device is designed to operate. All mechanical correctors utilise a mechanical drive input related to the uncorrected metered flow which is obtained either via a direct mechanical drive from the meter index mechanism, or via an electro-mechanical drive unit.

When selecting mechanical correctors it is essential to ensure that the required driving torque from the meter does not exceed the maximum permitted for the badged meter. This is particularly relevant to Turbine meters.

(ii) Electronic automatic correctors are available with, or without compressibility correction. Electronic correctors utilise an electrical pulse signal from the meter index to provide the uncorrected flow data, and electrical signals from transducers to provide the pressure and temperature data of the metered gas flow.

Where the corrector is to be installed in an environment considered to be a hazardous area, it will be necessary either for the whole corrector installation to be certificated as intrinsically safe, or for an intrinsically safe corrector to be used, or for the corrector to be mounted outside the hazardous area with suitable barriers in all the electrical connections to the meter and sensors. Any electrical connections from the pulse generator on the meter index and on the corrector itself (including test connections) must be sealed to guard against unauthorised interference.

(iii) Density correction is not worth considering except for the largest of loads due to the expense and complexity of the system.

Density correction automatically corrects for pressure, temperature and compressibility.

If there are variations in the composition of the flowing gas, errors in correction will occur because of the variations of base reference density due to the variations of composition. It is therefore necessary to measure the specific gravity of the gas at regular intervals to monitor the base reference density.

Density correction utilises a density cell connected to the flowing gas stream and an electric signal from a meter in the gas flow which provides the uncorrected flow data.

Special care is needed in the installation of density cells, particularly on low pressure supplies, to ensure that the gas density measured by the cell is representative of that in the line.

Clause 12.1.6 See supplement to Clause 8.3.1.

Clause 12.2.4 Special care is essential wherever oxygen is being used in conjunction with natural gas. A spontaneous explosion will occur when oxygen is in contact with oil or grease and it is imperative that any non-return valves used to provide protection against reverse flow of oxygen are suitable for use with oxygen.

It is particularly important that suitable non-return valves are fitted to each item of plant or equipment using oxygen so that these valves also protect any other non-return valves installed on the outlet of the meter.

Clause 13.2.4 Flexible connections may take the form of either flange adaptors or couplings (flexible joints) or flexible metallic tube.

The flexible connection on the inlet side of the meter may be used to facilitate the removal of the top-hat strainer on the inlet of Rotary Displacement and Turbine meters.

Flange adaptors and couplings (typically Viking Johnson) are basically a mechanical compression type of joint to be used on plain-ended pipe, which whilst providing a gas seal, does not prevent the pipe from pulling out.

The adaptor allows up to 3° angular movement and for 5 mm longitudinal expansion and contraction, and a coupling twice these amounts. However, the adaptor should not be used as an expansion joint.

The following constraints also apply to their use:

(i) care must be taken to ensure that this type of joint is not subjected to pressures or temperatures in excess of those specified by the manufacturer.

(ii) the joint must be protected against damage and the effects of heat.

(iii) the pipework must be restrained to prevent separation of the pipes, for example, by tie rods or chains. This is however not necessary for an isolated coupling in firmly-supported pipework otherwise rigidly jointed. Where tie rods are used, the angular deflection in the plane of the ties is restricted.

(iv) the pipework should also be laterally restrained to prevent angularity which can result in resolved side thrusts due to internal pressure.

Flexible metallic tubes are constructed of convoluted stainless steel and, if required, may be sheathed. A variety of end connections are available; male or female; screwed and with or without integral unions; flanges or plain ends for welding.

The following constraints also apply to their use:

(i) flexible tubes should be rates for three times the maximum working pressure or 350 mbar gauge (whichever is the greater) taking into account the temperature extremes of the application.

(ii) the length of the tubing should be the minimum practicable and in any case shall not exceed 1 metre.

(iii) the pipework either side of the tubing should be separately supported so that the flexible tube is not supporting the weight of any of the pipework.

(iv) flexible tubes should not pass through walls or similar rigid structures.

(v) tubes should be protected against damage and the effects of heat and be located in an accessible position.

Clause 13.2.5.2 Small bore flexible tube may be copper, stainless steel or a suitable nylon subject to the pressure requirements of the system.

Clause 13.5 Steel pipework and fittings shall be adequately protected against internal corrosion which may occur prior to delivery to site and during storage and handling. Grease films, primer paint coatings or plastic end caps could satisfy this requirement.

Clause 13.6.1 There are four main reasons for recommending the installation of meter by-passes.

(i) To allow the meter to be serviced or exchanged during the normal working hours of ES Pipelines Limited and at ES Pipelines Limited's convenience without interrupting the supply to the end user. It is also important to remember that, if ES Pipelines Limited were to shut-off the gas supply to work upon the meter, the end user's installation pipework would have to be tested for soundness and purged at ES Pipelines Limited's expense prior to re-establishing the gas supply.

(ii) To permit the controlled pressurisation of the downstream installation when bringing the meter into service. This is particularly important with Rotary Displacement and Turbine meters if damage to the meter is to be avoided.

(iii) To provide continuity of supply in the event of a meter failure, recognising that it would take a finite time for ES Pipelines Limited to respond to a report from the end user of a meter failure and to effect the necessary replacement.

(iv) To enable the meter accuracy to be checked without interrupting or restricting the gas supply to the end user.

Clause 14.1.1 The regulator is intended to control the pressure supplied to the meter and it is therefore necessary for the impulse connection to be on the inlet side of the meter. In addition, an impulse connection on the outlet side of the meter could give rise to unsafe conditions, for example:

(i) a blockage at the meter outlet would lead to possible over-pressurisation of the meter.

(ii) servicing one regulator on a multi-stream regulator installation whilst the other stream(s) maintain the supply could result in a dangerous gas escape unless the impulse pipework was shut-off.

Clause 15.1 See supplement to Clause 11.1.6.

Clauses 15.2 and 15.4

The inclusion of a valve in the pressure pipe connection will permit maintenance of the instrument without the need to shut-down the whole installation. It should be capable of being sealed in the open position to prevent unauthorised isolation which could affect the accuracy of subsequent billing of the end user.

Clause 15.3 Whenever a thermo-well is installed consideration should be given to fitting a spare thermo-well for use when calibrating the attached instruments.

The oil-filling of thermo-wells improves their thermal conductivity and also minimises the possible ingress of water.

Clause 15.6 Pressure transducers and electronic equipment generally is susceptible to high ambient temperatures which may be experienced if the instrument is exposed to direct sunlight. All such equipment should be shaded from the sun.

Clause 16.1.2 The use of a combination padlock is the preferred means of providing security to ES Pipelines Limited’s meter installations.

Clause 16.2 The location of the meter will depend upon the following primary considerations :

(i) security

(ii) the type of property

(iii) the relationship between the area covered by the building and the total site area

(iv) the area, whether built-up, congested, or open

(v) the size of the meter installation

(vi) the proximity of other underground services, storage tanks, or voids

(vii) the requirements of the end user

(viii) the preservation of natural amenities including the avoidance of noise.

Clause 16.2.2 This will minimise the length of service pipe containing relatively uncontrolled gas which is on private property but which is the responsibility of ES Pipelines Limited.

Clause 16.2.7 The provision of roadways and hard standing will be required for vehicle access where such access is not readily available on the end users site.

The site chosen for the meter installation must be freely accessible for authorised personnel at all times for: -

(i) reading the meter and, when fitted, the correction equipment.

(ii) maintenance.

(iii) exchanging the meter.

(iv) operation of the meter control valve for emergency use.

Consideration must be given to preventing other parties from impeding access to the site by such acts as the parking of vehicles, storage of goods, dumping of equipment, etc.

Clause 16.2.9 The clearance should allow for the withdrawal of components and the erection and safe use of lifting equipment.

Clause 16.3.1 Any purpose-built external housings may have to comply with, for example, the Building Regulations, or local bye-laws. See also Clause 4.3.1 and its Supplement.

Clause16.3.7.2Where only one set of doors is provided into a meter room or housing, the meter installation shall be positioned such that it is accessible for maintenance, meter reading, etc. from the side adjacent to the doors.

Clause 16.3.8 The natural ventilation requirements for an above-ground housing would normally be satisfied by the provision of ventilators to the outside atmosphere located at both high and low levels. The inlet openings should be positioned approximately 150 mm above the floor. The outlet openings should be situated as close as possible beneath, but not more than 10% of the total height below, the roof or ceiling level. The total ventilation area should not be less than 2% of the floor area, being equally distributed and disposed between the outside walls to ensure that good through ventilation is achieved.

The notional equivalent floor area is the floor area of an imaginary meter housing to enclose a meter installation which is in fact in part of a larger open area such as, for example, in the corner of a factory workshop, wall mounted in a shop, in a school boiler house, etc.

Clauses 16.6.1.2 and 16.6.2.2

BS EN 60079-14:2014 specifies Hazardous Areas by making reference to three sets of conditions which are recognised and defined. These may be summarised as follows:-

Zone 0	An area in which an explosive gas/air mixture is continuously present, or present for long periods

Zone 1	An area in which an explosive gas/air mixture is likely to occur in normal operation.
Zone 2	An area in which an explosive gas/air mixture is not likely to occur in normal operation, and if it occurs it will only exist for a short time.

By implication an area which is not classified as Zone 0, Zone 1, or Zone 2 is deemed to be non-hazardous or a safe area. The conditions envisaged in Zones 0 and 1 would not normally be encountered in meter/regulator installations.

If necessary, electrical equipment used on meter/regulator installations should be appropriately certificated for safety. Detailed guidance on equipment certification standards and information on the authorities administering them is given in BS EN 60079-14:2014. If the required equipment is not certificated or suitable for use in the designated area, it should be fitted outside, or in a separate compartment having outside access and gas-tight divisions or walls.

Clause 16.7.1 The composite notice should be mounted on the internal wall or door of the

meter house: alternatively where there is no separate meter house, or adjacent wall, the notice could be suspended from the gas piping.

Clause 16.7.2 The line diagram should show the features which would, in the judgement of the

engineer responsible, enable anyone to locate the valves necessary to isolate each section of the gas installation in the event of an emergency. This means that on large installations it will generally be unnecessary to show pipes of 50 mm nominal bore and smaller. It is the responsibility of both the installer and end user to ensure that the line diagram is provided.

Clause 17.5 See supplement to Clause 7.4.

Clause 17.9 The regulator set pressure must take into account the pressure required at the appliances, the pressure loss across the pipework between the meter and the appliances and the pressure drop across the meter installation. The pressure loss across the filter, valves, pipework, and meter should not exceed 25% of the minimum pressure loss across the whole installation, (ie. the lowest expected inlet pressure less the maximum design outlet pressure).

Clause 17.15 See supplement to Clause 7.12.

Clause 19.4 This additional 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 regulator filter and the meter, which might otherwise damage the meter.

As gas-borne dust is possible at the higher pressures and velocities, a closed-end top-hat strainer is specified and, as there is a higher supply pressure available, the pressure differential across the top-hat is of no consequence.

The reason for this strainer being at least 3D upstream of Turbine meters is that if positioned directly on the meter inlet, significant metering errors may occur.

Clause 19.8 See supplement to Clause 9.6.

Clause 20.4 See supplement to Clause 10.4.

Clause 21.1 See supplement to Clause 11.1Clause 21.1.2 See supplement to Clause 11.1.2.

Clauses 21.1.3, 21.1.4 and 21.1.5

See supplement to Clauses 11.1.3, 11.1.4 and 11.1.5

Clause 21.1.5 See supplement to Clause 11.1.5.

Clause 21.1.6 See supplement to Clause 11.1.6

Clause 21.2.3 See supplement to Clause 11.3.3.

Clause 21.3.1.1 See supplement to Clause 11.4.1.1.

Clause 21.3.1.2 See supplement to Clause 11.4.1.2

Clause 21.3.1.3 See supplement to Clause 11.4.1.3.

Clause 22.1.6 See supplement to Clause 8.3.1.

Clause 22.2.4 See supplement to Clause 12.2.4.

Clause 23.2.4.1 See supplement to Clause 13.2.4.

Clause 23.2.5.2 See supplement to Clause 13.2.5.2.

Clause 23.5 See supplement to Clause 13.5

Clause 23.5.2. See supplement to Clause 13.5.2.

Clause 23.6.1 See supplement to Clause 13.6.1.

Clause 24.1.1 See supplement to Clause 14.1.1.

Clause 25 Further data on vent design is contained in IGEM/SR/25

Clause 25.5 A safe area in which to terminate a vent is in the open air, remote from potential ignition sources and where there is no risk of vented gases entering buildings or other plant through windows, air intakes, etc.

Clause 25.7 To ensure that vent pipes do not cause undue back-pressure onto relief valves, the vent pipework should normally be of a larger diameter than the outlet connection of the relief valve.

Clauses 26.2 and Clause 26.4

See supplement to Clause 15.2 and 15.4.

Clause 26.3 See supplement to Clause 15.3.

Clause 27.1.2 See supplement to Clause 16.1.2

Clause 27.2 . See supplement to Clause 16.2.

Clause 27.2.1 See supplement to Clause 16.2.1.

Clause 27.2.2 Although it is desirable to minimise the length of service pipe containing relatively uncontrolled gas which is on private property, it may be more desirable to minimise the length of outlet supply pipework operating at pressures in excess of 75mbar gauge. In such cases the location will have to be subject to discussions between ES Pipelines Limited and the end user.

Clause 27.2.7 See supplement to Clause 16.2.5.

Clause 27.2.11 See supplement to Clause 16.2.7.

Clause 27.2.12 See supplement to Clause 16.2.9.

Clause 27.3.1 See supplement to Clause 16.3.1.

Clause 27.3.7.2 See supplement to Clause 16.3.7.2.

Clause 27.3.8 See supplement to Clause 16.3.8 but the paragraph on notional equivalent floor area does not apply.

Clauses 27.6.1.2 and 27.6.2.2

See supplement to Clauses 16.6.1.2 and 16.6.2.2.

Clause 27.7.1 See supplement to Clause 16.7.1.

Clause 27.7.2 See supplement to Clause 16.7.2.

Clause 28.1.5 It is imperative during the commissioning process to protect the meter from mechanical damage caused by either over-speeding while pressure is being built-up, or by excessive pressure drop across the meter. Both conditions are avoidable by pressurising the downstream system through the meter by-pass before opening the meter inlet and outlet valves.

Clause 28.4.2 The maximum pressure under fault conditions should be determined assuming only one failure mode in the system at any one time.

When testing joints with a leak-sensitive solution it is essential that pure soap, not detergent, is used on joints incorporating an elastomeric seal; detergents will attack elastomers.

Clause 28.5.5 On large installations and/or those where the inlet pressure exceeds 2 bar gauge, there may be real advantages to be gained from the use of a temporary small bore by-pass around the meter. It is however very important that this type of facility be removed when commissioning is complete.

Clause 28.6.1 To protect the meter against sudden surges of pressure the initial regulator setting should be carried out without the gas flowing through the meter. Either the meter by-pass should be used, or a temporary purge connection between the regulator and meter inlet valve should be used with the gas safely vented to atmosphere.

The use of such a facility is particularly important with all rotary and Turbine meters and with all higher pressure installations.

Clause 28.7.1.9 It is important that impulse lines are not vented through instruments as debris carry-over into the instrument working chambers can cause severe damage. Instruments should be disconnected before venting any impulse line.

The soundness testing of instrument lines is very important as even small leaks can give rise to large errors in measurement.

Clause 28.7.6 All meter by-pass valves shall be sealed in the closed position and a warning notice shall be fitted adjacent to the by-pass valve giving the end user instructions as to its use. The form of seal used shall be readily identifiable and irreparable. The preferred method consists of wiring the valve handle or wheel in the closed position in such a way that the valve cannot be operated even slightly without breaking the wire or the lead seal used to seal the knot. The lead seal itself should be formed using sealing pliers which imprint an identification mark upon the completed seal. Pressed steel snap-fix seals are not considered adequate for this duty.

One of the reasons for using an identifiable seal on the meter by-pass is to assist in the monitoring of the state of the by-pass: such regular monitoring by, for example meter readers, is considered essential

.