

Gas Industry Standard

GIS/E6:2013

Specification for

**Specification for vaporizers and foggers for joint
sealing on gas mains**



Contents

	Page
Foreword	iii
Mandatory and non-mandatory requirements	iii
Disclaimer	iii
Brief history	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 General requirements	3
5 Materials	7
6 Design	8
7 Inspection	8
8 Testing	9
9 Documentation	10
10 Marking	10
Bibliography	10
Table 1 — Rubber swellants	3
Table 2 — Jute swellants	4
Table 3 — Surface temperature classification	6

Foreword

Gas Industry Standards (GIS) are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition. Contractors and other users external to Gas Transporters should direct their requests for copies of a GIS to the department or group responsible for the initial issue of their contract documentation.

Comments and queries regarding the technical content of this document should be directed in the first instance to the contract department of the Gas Transporter responsible for the initial issue of their contract documentation.

This standard calls for the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

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

Mandatory and non-mandatory requirements

For the purposes of a GIS the following auxiliary verbs have the meanings indicated:

- can** indicates a physical possibility;
- may** indicates an option that is not mandatory;
- shall** indicates a GIS requirement;
- should** indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment needs to be completed to show that the alternative method delivers the same, or better, level of protection.

Disclaimer

This engineering document is provided for use by Gas Transporters and such of their contractors as are obliged by the terms of their contracts to comply with this engineering document. Where this engineering document is used by any other party, it is the responsibility of that party to ensure that the engineering document is correctly applied.

Brief history

First published as BGC/PS/E6 Amendment No. 1 published Editorial update to reflect demerger November 2000 Editorial update to reflect merger October 2002 Editorial update to comply with GRM Edited by BSI in accordance with BS 0-3:1997 Reviewed on behalf of the Gas Distribution Networks' Technical Standard Forum by BSI Reviewed by TSF	October 1977 March 1978 June 2001 November 2002 August 2004 August 2006 September 2013 June 2018
---	---

© Energy Networks Association on behalf of Cadent Gas Limited, Northern Gas Networks, SGN and Wales & West Utilities Ltd.

This Gas Industry Standard is copyright and must not be reproduced in whole or in part by any means without the approval in writing of Energy Networks Association.

1 Scope

This Gas Industry Standard (GIS) specifies the performance and manufacturing requirements for vaporizers and foggers designed for operation up to 4 bar, which can be used on gas mains operating at pressures of 2 bar and below, to:

- a) condition distributed gas with suitable liquid sealants in the vapour phase by evaporating controlled amounts of liquid; or
- b) evaporate the sealant then condense the resultant vapour to produce a fine aerosol.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Formal standards

BS EN 10365, *Hot rolled steel channels, I and H sections. Dimensions and masses.*

BS EN 1993-1-3:2006, *Design of steel structures. General rules. Supplementary rules for cold-formed members and sheeting*

BS EN 10255:2004, *Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions*

BS 1600, *Specification for dimensions of steel pipe for the petroleum industry.*

BS 1640-1, *Steel butt-welding pipe fittings for the petroleum industry — Part 1: Wrought carbon and ferritic alloy steel fittings.*

BS 1640-3, *Steel butt-welding pipe fittings for the petroleum industry — Part 3: Wrought carbon and ferritic alloy steel fittings — Metric units.*

BS EN 10253-1:1999, *Butt-welding pipe fittings. Wrought carbon steel for general use and without specific inspection requirements*

BS EN 10253-2:2007, *Butt-welding pipe fittings. Non alloy and ferritic alloy steels with specific inspection requirements*

BS 2051-1, *Tube and pipe fittings for engineering purposes — Part 1: Copper and copper alloy capillary and compression tube fittings for engineering purposes.*

BS EN ISO 2560, *Welding consumables — Covered electrodes for manual metal arc welding of non-alloy and fine grain steels — Classification.*

BS EN 1011-2, *Welding — Recommendations for welding of metallic materials — Part 2: Arc welding of ferritic steels.*

BS EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications.*

BS EN 1254-2, *Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes.*

BS EN 1775, *Gas supply — Gas pipework in buildings — Maximum operating pressure up to and including 5 bar — Functional recommendations.*

BS EN 10025-1, *Hot rolled products of non-alloy structural steels — Part 1: General delivery conditions.*

BS EN 10025-2, *Hot rolled products of non-alloy structural steels — Part 2: Technical delivery conditions for flat products.*

BS EN 10028-1, *Specification for flat products made of steels for pressure purposes — General requirements.*

BS EN 10028-2, *Specification for flat products made of steels for pressure purposes — Non-alloy and alloy steels with specified elevated temperature properties.*

BS EN 10028-3, *Specification for flat products made of steels for pressure purposes — Weldable fine grain steels, normalized.*

BS EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties.*

BS EN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties.*

BS EN 10217-1, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties.*

BS EN 10217-2 *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties.*

BS EN 10222-1, *Steel forgings for pressure purposes — Part 1: General requirements for open die forgings.*

BS EN 10222-2, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties.*

BS EN 10222-3, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low-temperature properties.*

BS EN 10222-4, *Steel forgings for pressure purposes — Part 4: Weldable fine-grain steels with high proof strength.*

BS EN 10222-5, *Steel forgings for pressure purposes — Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels.*

BS EN 10241, *Steel threaded pipe fittings.*

BS EN 10272, *Stainless steel bars for pressure purposes.*

BS EN 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas.*

BS ISO 15649, *Petroleum and natural gas industries — Piping.*

PD 5500, *Specification for unfired fusion welded pressure vessels.*

Individual Gas Distribution Network Standards

**/SP/P1, Specification for the welding of steel pipe for distribution systems and installations operating at pressures below 7 bar.*

**/SP/PA/10, Specification for new and maintenance painting at works and site for above ground pipeline and plant installations.*

* = Denotes each gas distribution network reference

3 Terms and definitions

For the purposes of this standard the following definitions apply.

3.1 fine aerosol

dispersion of liquid droplets having mass median size equivalent to 2µm or less

3.2

fogger

device used to introduce gas conditioning agent into gas mains by producing a fog of tiny droplets

3.3

vaporizer

device used to introduce gas conditioning agent into gas mains by producing a vapour

4 General requirements

4.1 General

4.1.1 The equipment shall be capable of generating a fog or vapour from one or more of the gas conditioning liquids listed in Tables 1 and 2.

NOTE It would be advantageous if the equipment could vaporize single components or mixtures of the various rubber swellants in Table 1 and single components or mixtures of the various jute swellants in Table 2.

Table 1 — Rubber swellants

Characteristics	Mineral spirit ^{a)}		Mineral oil ^{a)}	
	Shell distillate	Esso white spirit	Shell Carnea 21	Ironside lubricants GMO 60
Viscosity (cP)	1.2 at 21 °C	0.9 at 25 °C	50 at 20 °C	20 at 15.5 °C
Surface tension at 20 °C (N/m)	29×10^{-3}	27×10^{-3}	31×10^{-3}	30×10^{-3}
Vapour pressure at 20 °C (mbar)	1.1	3.9	1.3×10^{-4}	1.3×10^{-4}
Specific gravity	0.79 at 20 °C	0.78 at 15.5 °C	0.92 at 15.5 °C	0.87 at 15.5 °C
Boiling range (°C)	165 to 233	150 to 195	300 to 400	300 to 400
^{a)} Or equivalent fluids supplied by other manufacturers and accepted by the gas transporter.				

Table 2 — Jute swellants

Characteristics	MEG (Monoethylene glycol)	DEG (Diethylene glycol)	TEG (Triethylene glycol)
Viscosity (cP)	21 at 20 °C	35.7 at 20 °C	48 at 20 °C
Surface tension at 20°C (N/m)	48.4×10^{-3}	47×10^{-3}	45.2×10^{-3}
Vapour pressure at 20°C (mbar)	0.08	< 0.013	< 0.013
Specific gravity	1.115 at 20 °C	1.118 at 15.5 °C	1.125 at 15.5 °C
Boiling point at 1013.25 mbar (°C)	197.6	245	287.4

4.1.2 Monoethylene glycol (MEG) and Diethylene glycol (DEG) may be used separately or in the form of a mixture, which may include Triethylene glycol (TEG).

4.1.3 The equipment shall be capable of continuous operation throughout its designed output range for a minimum period of 30 days without major maintenance. Any uncontrolled reduction in fog or vapour output over this period shall not exceed 10 %.

4.1.4 The equipment shall incorporate the means for obtaining measurements of liquid throughput, gas flow (if any) and vaporizer operating temperature.

4.1.5 Gas and liquid shall be filtered, to a nominal particle size of 10 µm.

4.1.6 The sealant storage vessel shall have a large enough capacity to allow the equipment to operate for at least 200 h without re-filling.

4.1.7 The sealant storage vessel shall incorporate a safety valve, a calibrated and protected liquid level indicator and facilities for filling, cleaning, draining and purging.

4.1.8 If an atmospheric tank is used with a pumped feed, cut-out devices shall be fitted to switch the equipment off should the liquid fall to a predetermined level.

4.1.9 If an atmospheric tank is used with a pumped feed, the pump shall be fitted with a pressure relief valve.

4.1.10 The control system shall be stable over:

- a) variations in gas mains gas temperature of 5 °C to 14 °C and a rate of change in mains gas temperature of 30 °C in 30 days;
- b) gas mains gas velocities ranging from 0.15 m/s to 12.2 m/s and a rate of change in mains gas velocity of 3 m per h.

4.1.11 The equipment shall also maintain the required production rate of fog or vapour within a tolerance of ± 10 % over a minimum period of 30 days.

4.1.12 The equipment shall incorporate means for controlling liquid throughput by one or both of following:

- a) operating at a pre-set flow rate for a specified time (a constant rate of liquid throughput shall be maintained with a tolerance of ± 10 % irrespective of ambient temperature variations);
- b) controlling the output in relation to gas flow and temperature (a constant

concentration of fog in the gas mains, measured at a minimum distance of 40 pipe diameters from the fog injection point, shall be maintained with a tolerance of $\pm 10\%$ irrespective of gas flow variations).

4.1.13 The concentration of vapour in the gas mains, measured at a minimum distance of 200 pipe diameters from the fog injection point, shall be maintained at the required level within a tolerance of $\pm 10\%$ of gas flow and gas and ambient temperature variations.

4.1.14 If thermal decomposition of the liquid occurs, the resultant formation of solids shall not affect the fog or vapour output of the equipment.

4.2 Foggers

4.2.1 When fogging low vapour pressure mineral oils (e.g. Shell Carnea 21, Ironside lubricants GMO 60) the output shall be adjustable.

4.2.2 When fogging low vapour pressure mineral oils the maximum throughput shall be 10 l/h.

4.2.3 When fogging glycols, the maximum adjustable throughput shall be 10 l/h.

4.3 Vaporizers

4.3.1 Vaporization may be achieved directly by heating the liquid, indirectly by heating a side stream flow of natural gas, or by a combination of both methods.

4.3.2 When vaporizing distillate or white spirit the maximum throughput shall be 70 l/h.

4.3.3 When vaporizing glycols, the maximum adjustable output shall be 5 l/h when vaporizing MEG and 0.5 l/h when vaporizing DEG.

4.3.4 Any solid deposits shall be readily removable using hand tools during routine maintenance, which shall be capable of being carried out on site.

4.3.5 Hot external surfaces shall be marked as such and fitted with covers.

4.3.6 Protective devices shall be incorporated to prevent hazards resulting from the following:

- a) over pressurization of evaporator vessel and storage vessel;
- b) excessive temperatures occurring within vessels;
- c) air entering the evaporator vessel.

Protective devices to prevent flooding of the gas mains with liquid sealant may also be incorporated.

4.4 Electrical

4.4.1 Equipment shall be suitable for use in Zone 1 as defined in BS EN 60079-10.

NOTE Attention is drawn to European Directive 94/9/EC [1], also known as "ATEX 100a" and "ATEX 95", and the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) [2]. DSEAR implements Directive 94/9/EC with minor deviations and together they provide the technical requirements to be applied to equipment intended for use in potentially explosive atmospheres.

4.4.2 The maximum surface temperature of any system component in contact with the surrounding atmosphere shall not exceed the appropriate maximum surface temperature given in Table 3.

Table 3 — Surface temperature classification

Characteristics	Glycols			Mineral Spirits ^{a)}		Mineral Oils ^{a)}	
	MEG	DEG	TEG	Distillate (heptane)	White spirit	Shell Carnea 21	Ironside lubricants GMO 60
Auto-ignition temperature (°C)	413	229	371	223	245	371	371
Maximum allowable surface temperature with ambient temperature 40 °C (°C)	300	200	300	200	200	300	300
Temperature classification	T2	T3	T2	T3	T3	T2	T2

^{a)} Or equivalent fluids supplied by other manufacturers and accepted by the gas transporter.

4.4.3 The surface temperatures are related to the liquid vaporised as in 4.1.1 and shall not be exceeded under worst fault conditions:

- a) without thermal protection: failure of liquid supply and operating gas supply (if used), and a continuous 10 % over-voltage at the terminals of the heating element;
- b) with thermal protection: failure of liquid supply and gas supply and a 10 % over-voltage at the terminals of the heating element; causing the system temperature to rise to the operating temperature of the thermal cut-out.

4.4.4 The normal operating life for the heating elements shall be proposed by the contractor and approved by the gas transporter.

4.4.5 All electronic system control elements shall be capable of operating within their specification over the temperature range –10 °C to 40 °C.

4.4.6 A visual indication of the control temperature shall be provided.

4.4.7 Flameproof equipment shall be weatherproof or protected by suitable covers.

4.5 Welding procedures

4.5.1 All welding procedures and welders shall be proposed by the contractor and approved by the gas transporter.

4.5.2 Welding procedures for pipework shall be approved by the gas transporter in accordance with GIS/P1.

4.5.3 Welding procedures for elements other than pipework shall conform to BS EN 1011-2.

4.5.4 All pipework welding shall conform to BS ISO 15649.

4.6 Fabrication

4.6.1 All vessels shall be fabricated in conformance to PD 5500.

4.6.2 Support structures shall be fabricated conforming to the general requirements of BS 449-2, using electrodes conforming to BS EN ISO 2560.

4.7 Protective painting

4.7.1 Internal surfaces of the sealant storage vessel shall be wire brushed to remove all scale and loose material. Painting of the internal surfaces is not required.

4.7.2 Painting of the external surfaces of the equipment at the contractor's works shall be in accordance with */SP/PA/10.

4.7.3 Exposed surfaces of flanges, pads, etc. shall be coated with fluid for the prevention of rust and corrosion, suitable for the protection of both ferrous and non ferrous metal surfaces.

5 Materials

5.1 General

New material shall be used throughout the manufacture of vaporizer and fogger equipment.

5.2 Sealant storage vessel

5.2.1 Materials for sealant storage vessels shall conform to BS EN 10028-1, BS EN 10028-2 and BS EN 10028-3 or PD 5500.

5.2.2 Materials for associated plate and sections shall conform to BS EN 10028-1, BS EN 10028-2 and BS EN 10028-3

5.2.3 Materials for associated bars shall conform to BS EN 10272.

5.2.4 Materials for associated forgings shall conform to BS EN 10222-1, BS EN 10222-2, BS EN 10222-3, BS EN 10222-4 and BS EN 10222-5.

5.2.5 Only if the sealant storage vessel is for use at atmospheric pressure may the tank be constructed of GRP (glass reinforced plastics).

5.3 Pipework

The system pipework shall be fabricated from any of the following elements:

- a) compression type tube fittings conforming to BS EN 1254-2 and tubing conforming to BS EN 1057;
- b) fittings conforming to BS EN 10241 and tubing conforming to BS 1387;
- c) fittings conforming to BS 1640-1 and BS 1640-3 and tubing conforming to BS 1600;
- d) fittings conforming to BS 1965-1 and tubing conforming to BS EN 10216-1, BS EN 10216-2, BS EN 10217-1 and BS EN 10217-2.

5.4 Support structures

Support structures shall be fabricated from plates and sections conforming to BS EN 10025-1 and BS EN 10025-2 and tubes conforming to BS EN 1775.

5.5 Sections

The dimensions and properties of rolled steel sections, if used, shall conform to BS EN 10365 and BS 449-2.

6 Design

6.1 The design of sealant storage pressure vessels shall comply with PD 5500 Class III or Category 3.

6.2 The maximum working pressure shall be 2 bar greater than the maximum operating pressure of the fogging or vaporizing system.

6.3 Stress relief is not required.

6.4 The design of all vessels shall conform to PD 5500 Class III or Category 3.

6.5 The maximum design temperature shall be 450°C.

6.6 The design of fabricated support structures shall conform to BS 449-2.

6.7 The design of associated system pipework shall conform to BS ISO 15649.

6.8 The whole unit shall be designed so that it can be completely purged prior to both operation and maintenance.

7 Inspection

7.1.1 The gas transporter shall have the right to undertake inspection or testing of the goods or services during any stage of manufacture at which the quality of the finished goods might be affected and to undertake inspection or testing of raw materials or purchased components.

7.1.2 Inspection procedures covering pressure vessels and piping shall be submitted to the gas transporter and approved prior to commencement of work.

7.1.3 The gas transporter might, at their discretion, implement inspection conforming to PD 5500 Class III or Category 3, during assembly and manufacture. Associated piping shall be subject to visual examination. Dye penetrant and magnetic particle inspection may be used as a guide to visual inspection.

8 Testing

8.1 General

8.1.1 Pressure vessels and associated piping shall be hydraulically tested, in conformance with PD 5500, to one and a half times the design pressure.

8.1.2 The complete vaporizer or fogger system shall be leak tested, in conformance with PD 5500, using nitrogen to a test procedure agreed with the gas transporter. This test shall take place before the equipment leaves the contractor's premises, can be witnessed by the gas transporter and shall include:

- a) checks on the settings and operation of relief and/or safety valves, regulators, flowmeters and flow control valves;
- b) checks on the integrity of all pipework and joints.

8.2 Electrical control systems

8.2.1 The complete vaporizer or fogger equipment shall be operated under "no-flow" conditions for a minimum of 24 h at normal working temperatures.

8.2.2 At the end of the test period the working temperature shall be increased until the thermal cut-out operates. The temperature at which the cut-out operates shall be recorded.

9 Documentation

The documentation detailed below shall be supplied to the gas transporter by the contractor:

- a) A description of the equipment including its operating procedure.
- b) Maintenance and servicing instructions.
- c) Drawings showing all electrical, pneumatic (gas), etc., control circuits.
- d) All equipment assembly and subassembly drawings including parts lists.
- e) Component test certificates and material approval certificates.

10 Marking

Products conforming to GIS/E6 shall be permanently marked with the following:

- a) the number and date of this standard, i.e. GIS/E6:2013 ¹⁾;
- b) the name or trademark of the manufacturer or their appointed agent;
- c) the manufacturer's contact details;
- d) where authorized, the product conformity mark of a third party certification body, e.g. BSI Kitemark.

NOTE Attention is drawn to the advantages of using third party certification of conformance to a standard."

Bibliography

- [1] EUROPEAN COMMUNITIES. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Luxembourg: Office for Official Publications of the European Communities.
- [2] GREAT BRITAIN. The Dangerous Substances and Explosive Atmospheres Regulations 2002. London: The Stationery Office. SI 2002 No. 2776.

¹⁾ Marking GIS/E6:2013 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.