Gas Industry Standard

GIS/CM2: 2025

Specification for

Internal Coating Materials for Steel Line Pipe and Fittings

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Contents

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 (GT) 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 issued	November 1977
Amendment No1 published	February 1989
Amended issue published	February 1993
Editorial update to reflect demerger	June 2001
Editorial update to reflect merger	November 2002
Amended and reissued	March 2003
Editorial Update to comply with GRM	August 2004
Rebranded	March 2006
Update to GIS	March 2025

1. Scope

1.1 This Gas Industry Standard (GIS) specifies the general conditions, including basic paint and paint film properties, and the physical performance requirements for materials for the internal coating of new steel line pipe and fittings.

1.2 Methods of surface preparation and coating application are briefly described in Annex C and D respectively, however reference should be made to **/SP/CM/1 for more complete details.

2. Related Documents

2.1 This Standard makes references to the documents listed in Annex A. Unless otherwise specified, the latest editions of the documents apply, including all amendments.

3. Definitions

3.1 The definitions applying to this Standard are listed in Annex B.

4. Approval of Materials

4.1 Although epoxy based paints are suggested as most likely to produce the best overall performance, it is not intended to preclude the use of other materials which may be proposed as variants for consideration by the GT in formulating paints to meet the requirements of this GIS.

4.2 The Contractor shall be responsible for complying with all the provisions of this specification and the GT may make any investigation including testing, batch sampling and manufacturing inspection necessary to ensure compliance by the Contractor.

4.3 Any material composition which meets the requirements of this specification shall be considered as constituting an approved coating. Use of such material however, shall not be adopted until satisfactory experience has been gained of application at a coating mill.

4.4 The method of approval of materials shall be by evaluation in accordance with Annex I. Failure, in any respect, to meet the requirements of this specification or evidence showing inconsistency of product shall be considered sufficient grounds for rejection of material and possibly for withdrawal of approval.

4.5 Any point of dispute which arises in respect of interpretation of test results shall be considered by the GT in collaboration with the Contractor and may be referred to an independent authority.

5. Certification

5.1 Batch records should be kept by the painting manufacturer but need not be provided on every order, only for:

a) Initial qualification purposes.

b) Requalification due to change in formula.

c) When requested by the purchaser for quality assurance or investigation purposes.

5.2 Each batch of paint shall be tested by the Contractor for the following attributes. A typical batch record card is shown in Annex E:

d) Relative density.

e) Viscosity (mixed).

f) Pigment dispersion.

g) Non-volatile content.

h) Drying test.

i) Flow properties (mixed).

j) Curing properties (mixed).

6. Basic Physical Properties Data

6.1 When required, the Contractor shall, in confidence, furnish details of formulation together with the typical physical constants and manufacturing tolerances associated with materials submitted.

6.2 Any change of formulation of material may be proposed for consideration as a variant by the GT and supply of the modified material shall not be implemented until such time as the modification has been approved. Details of the physical constants specified in clause 7 shall be submitted to the GT and shall be applicable to all materials supplied.

7. Type of Approval

7.1 Basic paint properties

7.1.1 The Contractor shall supply the information given in Table 1 in respect of the components of the paint as supplied and when mixed and thinned to application viscosity, as required.

7.2 Basic film properties

7.2.1 The tests given in Table 2 shall be carried out on 1 mm thick steel panels (BS 1449: Part 1, CR 1/FF) polished to 0.5µm (see Annex E, clause E2) and glass panels. The paint shall be applied by spray to give a minimum dry film thickness between 50µm and 75µm in one coat and allowed to dry for 24 h unless specified otherwise.

7.3 Basic performance requirements

7.3.1 Physical performance requirements

7.3.1.1 The tests given in Table 3 shall be carried out on standard surfaces as described in Annex G, clause G3 unless specified otherwise. The coatings shall be applied to give a minimum dry film thickness of 50µm and shall be allowed to dry at 20°C to 25°C and 60% to 70% relative humidity for the time specified under each test.

7.3.2 Environmental resistance requirements

7.3.2.1 The tests given in Table 4 shall be carried out on standard surfaces as described in Annex G, clause G3 unless specified otherwise. The coatings shall be applied to give a minimum dry film thickness of 50µm and shall be allowed to dry at 20 °C to 25 °C and 60% to 70% relative humidity for the time specified under each test.

7.3.3 Chemical resistance requirements

7.3.3.1 After a drying period of seven days at 20°C to 25°C, test panels described in Annex G, clause G3 and prepared in accordance with 7.2 shall be subjected to partial immersion under the conditions given in Table 5. After removal from the test liquid, the coating shall show no signs of damage or breakdown and no corrosion of the substrate.

8. Variants

8.1 A Contractor shall only propose variants to this specification where the text indicates that variants would be considered by the GT.

Table 1 – Information to be supplied by the Contractor

Information required	Method of test
Mixing ratio of base and curing agent Nature of thinner and quantity required for adjustment to application viscosity Cure time	Annex F, clause F.1
Stability	Annex F, clause F.2
Pot-life	Annex F, clause F.3
Relative density	Annex F, clause F.4
Drying times	ISO 3251
Total non-volatile content (by weight and volume)	BS 3900: Part B2
Viscosity	BS EN 535 (Break point procedure) BS 3900:Part A7*
Pigment dispersion	BS 3900:Part C6
Flash point	BS 3900:Part A9
Wet film thickness to give dry film thickness of 50 µm. in one coat	BS 3900:Part C5
*BS 3900: Part A7 shall be used for non-newtonian materials having a high rate of shear where the flow cup method is not appropriate.	

Table 2 – Test conditions and required results for basic film property tests

Property	Panel reference	Method of test	Result required
Cissing	300mm x 100mm steel 150mm x 100mm glass (blast cleaned)	Viewed over bright light source	No cissing
Blistering and flow	As for cissing	----------	No blistering and uniform flow
Sagging	300mm x 100mm steel	Panel dried vertically	No sagging
Drying	Steel	Drying at 20 °C to 25 °C, 60% to 70% relative humidity	Surface dry < 2h, hard dry < 16h

Table 3 – Test conditions and required results for physical performance tests

Property	Panel reference	Method of test	Result required
Flexibility (bend test)	Annex G, clause G1 Dried 7 days and 28 days	ASTM D522 – 60	No damage to coating
Reverse impact (falling weight)	Annex G, clause G2 Dried 7 days and 28 days	BS 3900 Part E3 Indentation depth 2.5mm	No damage to coating
Scratch resistance	Annex G, clause G2 Dried 7 days and 28 days	BS 3900 Part E2	Pass at 2000 g
Adhesion (cross-cut test)	Annex G, clause G2 Dried 7 days and 28 days	BS 3900 Part E6 Spacing of cuts 1.5mm	Classification 0 No lifting other than cuttings

Table 4 – Test conditions and required results for environmental resistance tests

Property	Panel reference	Method of test	Result required
Salt spray	Annex G clause G3 Dried 7 days	BS 3900 : Part F4	No breakdown after 500 h
Humidity	Annex G clause G3 Dried 7 days	ISO 6270	No breakdown after 10 days
Pressure blistering	Annex G clause G3 Dried 7 days	Annex D, clauses D.6 and D.7	No blistering or detachment

Table 5 – Test conditions and recovery time for chemical resistance test

Medium	Temperature ° C	Pressure bar	Immersion time h	Recovery time h
Distilled water in equilibrium with carbon dioxide (pH 4) (all surfaces in Annex E)	20 to 25	7	1000	-
Distilled water (all surfaces in Annex E)		Atmospheric	1000	-
Triethylene glycol			500	4
Lubricating oil *			168	4
Benzene			168	4
Xylene			168	4
n-Hexane			168	4
Iso–Octane			168	4
Methyl alcohol			168	4
Odorizing agents **			168	4
Dialkyl sulphide / mercaptan odorant			168	4
* GIS 07 – turbine oil – heavy grade. ** Information concerning odorants at present in use may be obtained from the GT				

Annex - A References

	GT Specifications
**/SP/CM/1	Procedure for internal coating operations for steel line pipe and fittings
	European Standards
BS EN 535	Method for determination of flow time of paints by use of flow cups
	British Standards
BS 1449	Steel plate, sheet and strip: Part 1 - Carbon and carbon-manganese plate, sheet and strip
BS 3900	Methods of test for paints: Part A7 - Determination of the viscosity of paint at a high rate of shear Part A9 - Determination of flashpoint (closed cup equilibrium method) Part C2 - Surface drying test (ballotini method) Part C3 - Through dry test Part C5 - Determination of film thickness Part C6 - Determination of fineness of grind Part E2 - Scratch test Part E3 - Impact (falling weight) resistance Part E6 - Cross-cut test Part F4 - Resistance to continuous salt spray
	International Standards
ISO 8501	Preparation of steel substrates before application of paints and related products
ISO 3251	Paints, varnishes and plastics - Determination of volatile matter and non-volatile matter
ISO 6270	Determination of resistance to humidity (cyclic condensation)
	American Society for Testing and Materials (ASTM) Document
ASTM D522 – 60	Test for the elongation of attached organic coatings with conical mandrel apparatus

Note: Gas Transporters will each have their own procedures & specifications normally in the referenced format **/SP/XX/No, where ** is replaced by the Gas Transporters reference e.g. T for National Gas Transmission, or SGN, WWU etc. followed by the specification initials and number reference.

Annex - B Definitions

Contractor	The person, firm or company with whom the GT enters into a contract to which this specification applies, including the Contractor's personal representatives, successors and permitted assigns.

Annex - C Surface Preparation of Test Panels by Blast Cleaning

C.1 Preliminary Operations

C.1.1 It is essential that all oil, grease, etc., and all loosely adherent surface contaminants, are completely removed from pipes before internal coating is commenced.

C.2 Surface Preparation

C.2.1 The method of surface preparation shall be by blast cleaning, after removal of oil, grease, etc., with suitable solvents or detergents. Pipe surfaces shall be blast cleaned to a metal finish complying with ISO 8501, Sa 2 1/2 quality and shall have a profile amplitude not greater than 50µm.

C.3 Post Cleaning Operations

C.3.1 The prepared surface shall not be allowed to deteriorate prior to the coating application.

Annex - D Coating Application to Test Panels

D.1 Application of Coating

D.1.1 Application of the coating by airless spraying is the preferred method and shall be used whenever possible.

D.1.2 Paint spraying equipment shall be kept in good working condition during the coating operation.

D.1.3 Adequate filters shall be present in the equipment to ensure that the air supply to the spraying and cleaning apparatus is free from oil and other contaminants.

D.2 Use of Lambs-Wool Rollers

D.2.1 The use of lambs-wool rollers is acceptable provided that the use of this method results in a coating of uniform thickness free from sags, runs, holidays, etc.

Annex - E Typical Batch Record Card for Test Results

Batch record card		No.
Contractor:	Supplied to:	
Product ref. No.	Batch ref. No.	
Date supplied:	Date tested:	Quantity:
Basic physical properties		
	Base	Hardener
1. Relative density		
2. Viscosity (mixed)		
3. Pigment dispersion		
4. Non-volatile content		
5. Drying test		
6. Flow properties (mixed)		
7. Curing properties (mixed)		

Tested by …….. Date …….

Approved	
Rejected	

Annex - F Methods of Test

F.1 Cure Time

F.1.1 Panel(s) shall be prepared to Annex G and coated to the agreed procedure.

F.1.2 The panel shall be immersed for 1 h in methyl ethyl ketone and then removed. After a 2 h recovery period the panel shall show no signs of deterioration.

F.2 Stability

F.2.1 The separate materials, when stored at 20 °C to 25 °C for a period of 12 months, shall:

a) Show no sign of hard settlement.

b) Show no excessive increase in viscosities.

c) Show no deterioration of drying properties.

F.2.2 The separate materials, when stored in closed containers 75 mm diameter x 75 mm high, approximately two-thirds full at 20 °C to 25°C for 24 h, shall show no sign of skinning.

F.3 Pot-Life

F.3.1 When the materials are mixed, and the mixture allowed to age for a period of 4 h at 20 °C to 25 °C, any change in viscosity shall be insufficient to impair the spraying properties.

F.4 Relative Density

F.4.1 Apparatus

F.4.1.1 The following apparatus will be required to determine the relative density:

a) A standard weight per gallon cup of 100 cm^3 capacity.

b) Laboratory balance.

F.4.2 Procedure

F.4.2.1 The following procedure shall be used to determine the relative density of the paint:

a) Weigh the cup empty and record the weight in grams(1).

b) Fill the cup with paint and wipe the exterior clean of residual paint.

c) Weigh the cup of paint and record the weight in grams(2).

F.4.2.2 The relative density of the paint can be determined from the following equation:

Relative density = [Weight(2) minus Weight(1)]/100

F.5 Pneumatic Pressure Testing

F.5.1 The coated panel shall be placed in a suitable pressure vessel and subjected to a pressure of 85 bar using nitrogen gas as the pressure medium.

F.5.2 After periods of 24 h and 72 h under these conditions at 20 °C to 25 °C the pressure shall be released over a period of 30 s and the coated panel examined as soon as possible.

F.5.3 There shall be no sign of blistering or detachment of the coating.

F.6 Hydrostatic Pressure Testing

F.6.1 The coated panel shall be placed in a suitable pressure vessel and subjected to a pressure of 140 bar using distilled water as the pressure medium.

F.6.2 After a period of 24 h under this condition at 20 °C to 25 °C, the pressure shall be quickly released, and the coated panel examined as soon as possible.

F.6.3 There shall be no sign of blistering or detachment of the coating.

Annex - G Surface Preparation of Test Panels

G.1 General

G.1.1 The standard test panels specified in clauses G.2 or G.3 shall be used as required in this specification.

G.2 Standard Polished, Degreased Steel Panels

G.2.1 Steel panels to BS 1449: Part 1, CR 1/FF of 1 mm thickness and appropriate surface dimensions, surface finished to a centre line average of 0.5µm.

G.2.2 Pyrene Gold Seal panels or panels of an equivalent quality are satisfactory.

G.3 Blast Cleaned Steel Panels

G.3.1 Millscaled steel panels shall be degreased and the surface prepared by blast cleaning in accordance with Annex C.

Annex - H Adhesion Test of Epoxy Coatings on Steel Line Pipe

H.1 Introduction

H.1.1 General

H.1.1.1 The tests specified in clause H.2 shall be carried out as a 'type test' to establish cure conditions and as a regular 'control test' to validate control of cure conditions during production (see H.1.2 and H.1.3 respectively).

H.1.2 Type tests

H.1.2.1 Type testing shall be carried out:

a) On a range of line pipe sizes.

b) Whenever a change is made:

i. To a material.

ii. To process conditions.

H.1.3 Control tests

H.1.3.1 Control testing shall be carried out on a weekly basis, rotating sizes.

H.1.4 Type and control tests

H.1.4.1 For both type testing and control testing, the coated pipe shall be immersed in tap water for 24 h and then subjected to a V-notch adhesion test in accordance with clause H.2.

H.2 Test Procedure

H.2.1 Preparation of coated pipe

H.2.1.1 Using tissue or clean rag moistened with potable water, clean an area of approximately 40 cm^2 of internal pipe coating at a point sufficiently far into the pipe to ensure that the coating is apparently sound and unaffected by damage or undercut corrosion. This area shall be on the bottom (upward facing) surface of the pipe.

H.2.1.2 Using plasticine or an equivalent material, construct a 'pond' having minimum dimensions 100 mm along the pipe axis and 50 mm circumferentially and deep enough to contain water to a minimum depth of 15 mm. Fill the 'pond' with water and note the time.

Note: In conditions under which rapid evaporation of the water could result, this should be prevented by covering the 'pond' with aluminium foil or cling film.

H.2.1.3 After a period of 24 h has elapsed, remove the water, dry the surface and, within 10 minutes, carry out the adhesion test specified in H.2.2.

H.2.2 Adhesion test

H.2.2.1The adhesion test shall be carried out as follows:

a) Using a sharp knife having a pointed blade (e.g.Stanley knife) inscribe a V-cut having arms approximately 50 mm long and at an angle of approximately 30°. The cut shall penetrate to the steel at all points.

b) By applying a levering motion with the knife, attempt to lift the coating at the 'point' of the V-cut.

c) Ascertain the results of the test as follows:

   i. Cohesive failure within the coating without detachment of greater than 2.5 mm constitutes a 'pass'.

   ii. Adhesive failure of the coating (i.e. extensive detachment from the pipe surface) constitutes a 'fail'.

d) Record the results of the test on the test report (see clause H.3).

e) Repeat a), b) and c) above on a 'dry' area of coating and record the results on the test report (see clause H.3).

H.3 Test Report

The results of the adhesion tests specified in H.2.2 shall be reported in the following format:

Test Condition	Result of Tests*	Remarks
After immersion		
Dry		
* The result of the tests should be reported as ‘Pass’ or ‘Fail’ with supplementary information on mode of failure		

Annex - I Scheme of Approval & Testing of Internal Coating Material to GIS/CM2

I.1 General

I.1.1 This Annex provides a scheme of approval and testing of internal coating materials for steel line pipe and fittings to GIS/CM2 together with the current list of approved suppliers of coating materials.

I.2 Initial Evaluation

I.2.1 Evaluation of coatings against the requirements of GIS/CM2 shall be carried out by the manufacturer and submitted to the GT.

I.3 Approved List of Suppliers

I.3.1 An approved list of prospective suppliers of coatings to the GT is given in the coatings register prepared by the GT.

I.4 Quality Control

I.4.1 Basic parameters required for the quality control of approved (see clause 3) paint shall be declared by the coating's manufacturer to the GT. It should be noted that approval refers to coating performance, therefore final acceptance will be dependent to some extent on practical application properties. Consequently, practical experience will be complementary to the evaluation work.

I.5 Ordering Coatings

I.5.1 On receipt of instructions from the GT the applicator (who is the pipe or fitting manufacturer or coating contractor) shall order coatings from an approved supplier (see clause 3). Only approved coatings shall be used by the applicator.

I.6 Suitable Coatings and Suppliers – Responsibilities

I.6.1 The Gas Transporter (GT)

I.6.1.1 The recommendation of suitable coatings and suppliers will be the responsibility of the GT.

I.6.2 The Applicator

I.6.2.1 Although the GT may wish to check that materials purchased by the applicator conform to their requirements, it is the responsibility of the applicator to provide a suitable coating which complies with **/SP/CM/1 and GIS/CM2.

I.7 Batch Record Card

I.7.1 Batch record cards shall be supplied according to section 5.