



External field joint coatings for steel pipelines



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-

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Australian Standard®

External field joint coatings for steel pipelines

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PREFACE

This Standard was prepared by the Australian members of the Standards Australia/Standards New Zealand Committee ME-038, Petroleum Pipelines, to supersede AS 4822—2008.

The objective of this Standard is to provide manufacturers, suppliers, specifiers and users of oil and gas pipelines information on the application of and testing requirements for external field joint coatings (FJCs) of seamless or welded steel pipelines for onshore steel pipelines.

This revision updates requirements taking into account the latest version of ISO 21809-3, *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems*, Part 3: *Field joint coatings*, and includes a new joint coating type, Amorphous low viscosity polyolefin coating.

The performance of field joint coatings is a critical part of the corrosion protection of steel pipelines. This Standard makes no appraisal of the relative performance of the coating systems that are covered herein. There should be careful selection of the field joint coating chosen for each application, taking into account its importance in providing satisfactory corrosion protection for the service life under the construction and operating conditions of the pipeline.

Statements expressed in mandatory terms in notes to figures and tables are deemed to be requirements of this Standard. All other notes are for information and guidance only.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard**External field joint coatings for steel pipelines**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out minimum requirements for the field joint coating (FJC) of seamless and welded steel buried onshore pipelines. It specifies the application and testing of corrosion protection coatings applied to steel surfaces left bare after the pipes and fittings (components) are joined by welding.

NOTES:

- 1 Field joints and other specific points are coated on site.
- 2 Information to be supplied at the time of order is given in Appendix A.
- 3 Coatings detailed in this Standard are suitable for use with cathodic protection systems.

1.2 NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

- 1145 Determination of tensile properties of plastics materials
- 1145.3 Part 3: Test conditions for films and sheets
- 1391 Metallic materials—Tensile testing at ambient temperature
- 1627 Metal finishing—Preparation and pretreatment of surfaces
- 1627.2 Part 2: Power tool cleaning
- 1627.4 Part 4: Abrasive blast cleaning of steel
- 1627.9 Part 9: Pictorial surface preparation standards for painting steel surfaces
- 2706 Numerical values—Rounding and interpretation of limiting values
- 3862 External fusion-bonded epoxy coating for steel pipes
- 3894 Site testing of protective coatings
- 3894.1 Part 1: Non-conductive coatings—Continuity testing—High voltage ('brush') method
- 3894.3 Part 3: Determination of dry film thickness
- 3894.4 Part 4: Assessment of degree of cure
- 3894.5 Part 5: Determination of surface profile
- 3894.6 Part 6: Determination of residual contaminants
- 3894.9 Part 9: Determination of adhesion
- 4352 Tests for coating resistance to cathodic disbanding
- ISO
- 868 Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)
- 4624 Paints and varnishes — Pull-off test for adhesion

- ISO
8502 Preparation of steel substrates before application of paint and related products —
Tests for the assessment of surface cleanliness
8502-3 Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-
sensitive tape method)

- ASTM
D2240 Standard Test Method for Rubber Property—Durometer Hardness
SSPC Steel Structures Paint Council
SP 1 Solvent Cleaning

1.3 TERMS AND DEFINITIONS

For the purposes of this Standard, the terms and definitions below apply.

1.3.1 Application procedure specification (APS)

Procedure describing coating materials and all the steps for surface preparation, coating application, inspection and testing, stripping and repair (if allowed) for the application of an FJC.

1.3.2 Applicator

Person who undertakes the coating application.

1.3.3 Applicator company

Company that undertakes the coating application.

1.3.4 Batch

Discrete and continuous identified manufacturing run using product of the same source.

1.3.5 Batch certificate

Certificate of conformance of a batch issued by the manufacturer.

1.3.6 Bonding primer

Material applied as a film to the primed metal surface in order to ensure adhesion of the subsequent protective layer.

1.3.7 Coating defect

Any deleterious imperfection in the coating, including disbonded areas, areas of low film thickness and holidays.

1.3.8 Cutback

Length of pipe left uncoated at each end for joining purposes (e.g. welding).

1.3.9 End user

The company operating the pipeline system.

1.3.10 Holiday

A discontinuity of protective coating that exposes the steel to the outside environment.

1.3.11 Inspector

The person who carries out inspection of materials or phases of coating application.

1.3.12 Manufacturer

Company responsible for the manufacture of a coating material.

1.3.13 Maximum operating temperature ($T_{\max}$)

Maximum temperature for which the pipeline system has been designed when handling the specified fluid.

1.3.14 Pre-production trial (PPT)

Series of tests carried out before start of coating operations, aimed at verifying the conformity of a FJC system, including materials used, surface preparation, application process and equipment, qualification of application and inspection personnel.

1.3.15 Primer

Material applied as a film on substrate (metal and/or factory-applied coating) to ensure adhesion of the subsequent protective coating.

1.3.16 Procedure qualification trial (PQT)

Coating application and testing activity carried out for the qualification of the FJC system, including materials used, surface preparation, application process, equipment and inspection/testing procedures.

NOTE: The PQT qualifies the coating system and application process. The PPT is carried out prior to start of coating operations and includes qualification of application and inspection personnel who would carry out field application process.

1.3.17 Purchaser

Company responsible for providing the FJC order requirements.

1.3.18 Quality plan

Document specifying which procedures and associated resources are applied by whom and when to a specific project, product, process or contract.

1.4 SYMBOLS AND ABBREVIATED TERMS

1.4.1 Symbols

Symbol	Definition
E_0	elongation at break without heat ageing (arithmetic mean of five results)
E_{70}	elongation at break after heat ageing for 70 days (arithmetic mean of five results)
E_{100}	elongation at break after heat ageing for 100 days (arithmetic mean of five results)
P_0	peel strength between layers at 23°C without heat ageing
P_{70}	peel strength between layers at 23°C after heat ageing for 70 days
P_{100}	peel strength between layers at 23°C after heat ageing for 100 days
A_0	peel strength to pipe surface at 23°C without heat ageing
A_{70}	peel strength to pipe surface at 23°C after heat ageing for 70 days
A_{100}	peel strength to pipe surface at 23°C after heat ageing for 100 days
ε	specified strain expressed as a percentage
C	test piece thickness, in millimetres (see Figure J1)
D	diameter of required mandrel, in millimetres
ΔT_g	change in the glass transition temperature between two or more successive thermal analysis scans

1.4.2 Abbreviated terms

ALVPC	amorphous low viscosity polyolefin coatings
APS	application procedure specification
DFT	dry film thickness
DSC	differential scanning calorimetry
EP	liquid applied epoxy
FBE	fusion-bonded epoxy powder coating
FJC	field joint coating
MEK	methyl ethyl ketone
SDS	safety data sheet
PE	polyethylene
PPT	pre-production trial
PQT	procedure qualification trial
PU	liquid applied polyurethane
SDS	safety data sheet

1.5 GENERAL REQUIREMENTS—FIELD JOINT COATINGS (FJCs)

General industry practice is that external pipeline coatings be factory-applied except for field joints and other specific items, which are coated on site.

Field joints shall be protected with a coating system that is compatible with the factory-applied pipe coating. The FJC shall provide similar performance to the factory-applied pipe coating and allow satisfactory application under the predicted field conditions.

The performance of field joint coatings is a critical part of the corrosion protection of steel pipelines. The field joint coating shall be carefully selected for each application, taking into account its importance in providing satisfactory corrosion protection for the service life under the construction and operating conditions of the pipeline.

Rounding of numerical values shall be in accordance with AS 2706.

NOTES:

- 1 The FJCs described herein have different performance characteristics. The end user should decide on the FJC taking into consideration the factory-applied coating, the desired application and performance characteristics, including resistance to impact, creep, indentation, cathodic disbondment, loss of adhesion, operating temperature and ageing.
- 2 Depending upon the type and complexity of FJC and size of project, the end user should consider the use of specialist FJC applicator companies to ensure consistent quality and production rates. Specialist applicators should be selected based on a verifiable successful record of the same FJC in a similar project environment.

SECTION 2 SELECTION OF FJCS

2.1 GENERAL

The FJC shall be selected to be—

- (a) compatible with the factory-applied pipe coating;
- (b) suitable for service under the operating conditions of the pipeline;
- (c) suitable for service in the environment in which the pipeline is laid;
- (d) fit to perform for the anticipated life of the factory-applied coating or the design life of the pipeline, as applicable; and
- (e) suitable for the intended construction handling and installation technique.

NOTES:

- 1 Selection of the FJC should be made by, or approved by, the designer or owner of the pipeline.
- 2 For guidance on FJC selection, see Appendix K.

2.2 TYPES OF FJCS

The FJC coatings covered by this Standard are listed in Table 2.1.

TABLE 2.1
CLASSIFICATION OF FJC TYPES

Code	Section	Type of FJC
1A	5	Petrolatum tapes
1B	5	Cold-applied polymeric tapes
2A	6	Heat-shrinkable materials, polyethylene based
2B	6	Heat-shrinkable materials, polyethylene based, applied over a liquid applied epoxy (EP) layer
3A	7	Fusion-bonded epoxy—single layer
3B	7	Fusion-bonded epoxy—dual layer
4A	8	Liquid applied epoxy (EP)
4B	8	Liquid applied polyurethane
4C	8	Fibre-reinforced epoxy
5A	9	Amorphous low viscosity polyolefin with tape outer wrap
5B	9	Amorphous low viscosity polyolefin with sleeve outer wrap

SECTION 3 APPLICATION

3.1 APPLICATION PROCEDURE SPECIFICATION (APS)

Prior to start of application and any agreed PQT and/or PPT (see Clauses 3.3 and 3.5), the APS shall be prepared (that is a compilation of documents related to the project-specific control of FJC), including the following:

- (a) A list of all PPE and detailed safe working procedures.
- (b) A list of tools, testing and inspection equipment, and coating supplies to be used.
- (c) Preparation of the steel surface and factory-applied coating, including inspection prior to application (see Clause 4.1).
- (d) Coating and abrasive blasting material properties (see Clauses 3.2 and 4.1.2.2).
- (e) Receipt, handling and storage of coating and abrasive blasting materials (see Clauses 3.2 and 4.1.2.2).
- (f) Coating application procedure.
- (g) Inspection and testing of applied FJC (see Clause 3.6).
- (h) Repair and testing of defective FJC.
- (i) Marking, traceability and documentation.

The APS shall cover all items associated with quality control as defined in this Standard and any agreed options for the specific FJC system.

The APS shall be approved by the purchaser. The approved APS shall not be changed by the applicator without prior written authorization of the purchaser and all coating work, testing and inspection shall be carried out according to the APS.

The time necessary for the various operations related to surface preparation, heating, coating application and testing shall be defined by the applicator and approved by the purchaser (e.g. during PQT and/or PPT) in order not to delay the pipeline construction operations.

NOTE: The purchaser may specify that the APS be approved prior to the start of production and prior to any agreed PQT and/or PPT.

3.2 COATING MATERIALS

3.2.1 Information to be supplied

The coating material shall include the following information:

- (a) In the case of coatings proposed by the coating applicator company, information that provides evidence of suitability of the proposed coating for the required application.
- (b) Production test certificates (batch certificates), as specified in this Standard, for the actual coating material, and any agreed optional requirements.
- (c) Conditions for application of the coating materials (field joint and repair of FJC).
- (d) Packaging, storage and safety requirements of coating materials.

3.2.2 Marking on shipment of coating materials

Marking on each shipment of coating materials shall include, as a minimum, the following information:

- (a) Manufacturer's name.
- (b) Name and complete identification of material, including origin.
- (c) Reference to applicable coating material Standards, if any.
- (d) Reference to material safety data sheet (SDS).
- (e) Production batch number.
- (f) Weight/size.
- (g) Date of production.
- (h) Shelf life.

3.3 PROCEDURE QUALIFICATION TRIAL (PQT)

Test methods, frequencies and acceptance criteria shall conform to the Sections of this Standard relating to the FJC system, and any agreed optional requirements.

The PQT shall be performed in a timely manner to ensure the PPT is fully implemented prior to the commencement of construction.

NOTES:

- 1 End user or purchaser and applicator company may also agree to carry out a PQT independent of any specific project. By agreement, this may include use of data from previous or independent testing.
- 2 The manufacturer/supplier should be requested to provide assistance during the PQT to ensure the correct use of the coating material(s) and to train the applicator's personnel.

The following applies to PQT:

- (a) The APS to be used shall be submitted to the purchaser for approval.
NOTE: Sufficient time should be allowed for review prior to conducting the PQT.
- (b) Qualification tests for pipe requiring heating as part of the application process shall be carried out on pipes having the same diameter and the same thickness as that of the actual pipes. Qualification tests for other FJCs shall be carried out on pipes having a similar diameter to that of the actual pipes.
- (c) Tests shall be carried out on actual joints or test zones distributed along an actual pipe coated with the actual factory-applied coating. The length of the test zones shall be equivalent to the FJC length.
- (d) A girth cap weld shall be added at the centre of each of the test zones in order to simulate the field weld.
- (e) All tools and equipment (e.g. for induction heating, abrasive blasting, coating application and inspection) to be used for the PQT of a specific FJC system shall be of the same type as those to be used for the actual FJC.
- (f) Unless otherwise specified by the purchaser and/or end user, at least three tests shall be conducted.
- (g) Coating repairs shall be included in the PQT (except if they are not allowed).
- (h) The method of stripping of defective FJC shall be included in the PQT.
- (i) A complete report of the qualification test results shall be submitted to the purchaser for approval.

3.4 QUALIFICATION OF COATING AND INSPECTION PERSONNEL

All coating applicators shall be qualified to undertake the coating application procedure and repair work. The applicator shall be trained, qualified and certified as being competent in the application and repair of the FJC. In addition, all coating applicators shall have successfully passed the PPT qualification test.

Coating inspectors shall be trained and qualified in the inspection of the specific coating being applied.

3.5 PRE-PRODUCTION TRIAL (PPT)

The purpose of the PPT is to verify that the following are in conformance with the requirements of this Standard, any project specification and the result of any relevant PQT:

- (a) The coating system.
- (b) Materials.
- (c) Application procedure.
- (d) Equipment to be used for surface preparation.
- (e) Application and repair of the coating system.
- (f) Qualification of the coating applicator and inspectors.

NOTES:

- 1 Tests and acceptance criteria are specified for the different FJC systems.
- 2 Recommendations for the PPT for each FJC type are given in the inspection and test plan tables of this Standard.
- 3 The PPT should be carried out at the start of the operations when equipment and personnel are mobilized on site for the FJC project and as required during the project.

All personnel involved in the PQT-PPT shall be those who will undertake the actual FJC. In the event of change of personnel, the PPT shall be carried out again.

NOTE: The PPT should be performed on the first joints to be coated (or if agreed on a separate pipe) sufficiently in advance so as not to delay the project.

If required, a PPT shall be performed at the actual site of FJC application.

3.6 PRODUCTION TESTING AND INSPECTION

An inspection and testing procedure shall be documented in a quality plan (or 'inspection and testing plan'), which shall be carried out during production to verify the—

- (a) surface preparation;
- (b) coating application; and
- (c) specified properties of the applied FJC.

Test methods and acceptance criteria shall conform to the FJC system and agreed options as specified in this Standard.

NOTE: The results of PQT, PPT and production testing should be fully recorded and documented and provided to the purchaser in accordance with Clauses 3.3 and 3.4 (also see Paragraph A5, Appendix A).

SECTION 4 SURFACE PREPARATION, APPLICATION, INSPECTION, TESTING, REPAIR AND SAFETY

4.1 SURFACE PREPARATION

4.1.1 General

Surface preparation shall be carried out in accordance with the specification of the manufacturer, and as specified in this Section.

All the welds that are to be coated shall have the height and profile confirmed as being suitable for the FJC system selected.

4.1.2 Preparation of the steel substrate

4.1.2.1 General

At the time of application of the coating, the surface to be coated shall be dry and free of any contamination detrimental to surface preparation (such as detritus, dust, non-adhering particles, grease, oil, soluble salts, etc.) or to adhesion of the coating on the steel.

If necessary, extra cleaning shall be carried out to remove the following:

- (a) Greasy and waxy substances (using a totally volatile solvent, as required), or other contamination, as specified in SSPC SP1.
- (b) Weld spatter, slag, and burrs that can pierce the coating (using approved grinding or filing techniques).
- (c) Areas of rust or scaling by spot abrasive blast cleaning or wire brushing, as specified in the appropriate application procedure.

4.1.2.2 Abrasive blast cleaning

The method of preparation of the substrate shall be abrasive blast cleaning unless otherwise agreed. Recycling of abrasive may be acceptable, provided suitable abrasive material is used. The minimum cleanliness of the surface after abrasive blast cleaning shall be in accordance with AS 1627.4 and be a minimum class of surface preparation of Class Sa 2½.

Abrasive materials shall be silica free non-metallic or metallic, and shall conform to AS 1627.4. They shall be free from contamination and contain less than 100 mg/kg chlorides and less than 0.3% copper.

All surface imperfections that are detrimental to the performance of the FJC shall be removed. The residual thickness of the pipe wall shall be not less than the specified minimum thickness for the pipe. The profile/roughness shall be checked in accordance with the requirements of AS 3894.5 or other method approved by the purchaser.

The profile shall be of an angular and dense nature over the entire joint surface to be coated.

Compressed air for blast cleaning shall be free of oil, condensed moisture, and any other contaminants. Blasting equipment that includes devices to recycle abrasives shall have equipment that ensures removal of dust, fines, corrosion materials, and other contaminants.

At the beginning of the surface preparation procedure, it shall be demonstrated that the blasting procedure will provide the specified surface cleanliness and anchor profile.

Dust and detritus shall be removed from the substrate following the surface preparation procedure.

The level of chloride ions shall be measured in accordance with the requirements of AS 3894.6 and shall be equal to or less than 25 mg/m², unless otherwise agreed.

4.1.2.3 *Wire brush cleaning*

Dust and detritus shall be removed from the field joint following the preparation of the substrate and the surrounding factory-applied coating. Where specified, wire brush cleaning shall be undertaken in accordance with AS 1627.2.

4.1.2.4 *Reconditioning*

If, after joint surface preparation the substrate is contaminated or corrodes, the joint shall undergo further partial or total surface preparation to ensure the coating is applied to a surface that has been cleaned and prepared in accordance with the manufacturer's specification and Clauses 4.1.2.1 to 4.1.2.3.

4.1.2.5 *Preparation of the adjoining factory-applied coating*

The factory-applied coated area on either side of the exposed substrate shall be prepared to facilitate the adhesion of the FJC. The factory-applied coating shall be chamfered to an angle not greater than 30° to the pipe surface. The method of preparation shall not cause damage outside the FJC area.

NOTE: Additional requirements for each of the FJC materials are given in Clauses 5.3, 6.3, 7.6 and 8.3.

4.2 PRELIMINARY QUALITY INSPECTION

The preliminary quality inspection shall ascertain that—

- (a) the materials used for surface preparation and the FJC conform to the material specification; and
- (b) the storage conditions are in accordance with the manufacturer's instructions.

4.3 PRIOR TO THE APPLICATION OF THE COATING

Prior to the application of the coating, the following shall apply:

- (a) The temperature of the joint substrate shall be at least 3°C above the dewpoint, and the joint shall be dry.
- (b) Dust contamination shall be determined in accordance with ISO 8502-3 and shall be ≤ Class 3 for FJC Types 1A, 5A and 5B and ≤ Class 2 for FJC Types 1B, 2A, 2B, 3A, 3B, 4A, 4B, and 4C.
- (c) The coating shall be applied by qualified personnel in accordance with the specified procedure, which shall have been qualified by the purchaser.
- (d) The joint shall not be exposed for a length of time that could result in oxidation of its surface, detrimental to the quality and adhesion of the coating.
- (e) At the time of application of the coating, the temperature of the substrate shall be within the temperature range specified by the manufacturer.
- (f) FJCs that require heating, as part of the application process, shall employ heating methods that raise the temperature sufficiently, and sufficiently uniformly, to ensure correct application over the entire FJC.

NOTES:

- 1 During bad weather (rain, wind, airborne dust, etc.), cleaning and coating operations may only continue, provided effective protective enclosures are installed.
- 2 Chemical treatment of the steel may be used to supplement the surface preparation, by agreement between the manufacturer, purchaser and the applicator.

4.4 VISUAL INSPECTION OF THE APPLIED COATING

When inspected visually, the applied coating shall be homogenous across the entire field joint. In particular, no surface imperfections detrimental to the quality of the coating (embedded grit, foreign particles, pitting, blisters, etc.) shall be allowed.

4.5 TESTING OF THE FJC AND REPAIRS

Regular inspection and testing procedures during production shall be carried out in accordance with the quality plan.

NOTES:

- 1 Test procedures and acceptance criteria are given in Clauses 5.5, 6.5, 7.8 and 8.5, and Appendices B to J.
- 2 Recommendations for frequencies are given in the relevant Section for each of the FJC materials.

4.6 SAFETY CONSIDERATIONS

Potential hazards include exposure to vapours, dust, fumes, gases, and noise (from blasting or a spray gun).

Applicators shall conform to the procedures in the safety regulations, the manufacturer's technical manuals, and the FJC SDS.

Where required, the steel substrate shall be electrically grounded to eliminate static charges associated with surface preparation and coating operations.

SECTION 5 PETROLATUM AND POLYMERIC TAPE COATINGS

5.1 GENERAL

Identification of coatings made from tapes shall be in accordance with Table 5.1 and shall meet the requirements of Table 5.2, 5.3(A) or 5.3(B), as applicable.

Information concerning the coating materials shall be given as data sheets by the manufacturer to the applicator in accordance with Table 5.4 for primer and Table 5.5 for tapes, as a minimum.

Application instructions shall be provided by the manufacturer as set out in Table 5.6 (as minimum).

5.2 DESCRIPTION OF THE COATINGS

5.2.1 Petrolatum tapes (Type 1A)

Petrolatum tape coatings can consist of a primer plus single or multiple layers of fabric fully impregnated with a neutral petroleum wax compound. The maximum operating temperature is 30°C or 50°C for high temperature tapes.

The primer for Type 1A tapes shall contain at least 1.0% of corrosion inhibitor (e.g. mimosa tannin).

5.2.2 Polymeric tapes (Type 1B)

Cold-applied polymeric tape coatings can consist of a bonding primer and multiple layers of one or several polymeric tapes. Maximum operating temperature is 50°C to 80°C depending on the material.

Specific polymeric tapes allowing higher maximum operating temperature may be used. Where such tapes are used, requirements shall be agreed after qualification.

5.3 SURFACE PREPARATION

Surface preparation shall be carried out in accordance with Section 4 and the specification of the manufacturer.

For petrolatum coatings (Type 1A), as a minimum requirement, the area to be coated shall be cleaned with a powered steel wire brush. The degree of cleanliness shall conform to AS 1627.2 and shall be such that, when viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering rust, paint coating and foreign matter. The surface shall have a metallic sheen arising from the metallic substrate. All mill scale shall be removed from the steel.

For polymeric tapes (Type 1B), as minimum, the substrate to be coated shall be abrasive blast cleaned in accordance with AS 1627.4 to a minimum class of surface preparation of Class Sa 2½ or mechanical rotary bristle cleaning to produce a cleanliness in accordance with AS 1627.4 to a minimum class of surface preparation of Class Sa 2½.

The edges of the factory-applied coating shall be suitably roughened beyond the required FJC overlap onto the factory-applied coating (see also Clause 5.4.4). The profile on the pipe steel for coating type 1B shall be angular, between 50 µm and 110 µm, or as specified by the manufacturer.

5.4 APPLICATION OF THE COATINGS

5.4.1 General

Application of the coating shall be carried out in accordance with Clause 4.2 and the written application instructions of the manufacturer.

5.4.2 Application of the primer

The primer shall be applied in accordance with the written application instructions of the manufacturer, as set out in Table 5.6.

Some primers require that the tape be applied when the primer is still tacky, whilst others require that the primer be dry. The manufacturer's instructions shall apply in terms of the condition of the primer at the time of wrapping.

5.4.3 Application of petrolatum tapes

The application of petrolatum or wax tapes shall be in accordance with the manufacturer's instructions (see Table 5.6). As a minimum, the following application procedure shall apply:

- (a) If visible moisture is present, wipe the surface to be free from moisture.
- (b) Prepare the surface as specified.
- (c) Apply a thin coat of compatible primer (if any) by brush or by hand.
- (d) Wrap the area to be coated spirally with tapes of recommended width, employing the correct overlap.
- (e) Use sufficient means to ensure complete conformability of the coating to the pipe surface.
- (f) Apply any outer wrap (if specified by the manufacturer or if specified by the purchaser).
- (g) The overlap of tapes onto factory-applied coating shall be at least 75 mm. The over-wrap shall overlap the tape by at least 25 mm.

NOTE: The application of a compatible mastic to the weld should be considered to prevent tenting.

5.4.4 Application of polymeric tape

The application of polymeric tapes shall be in accordance with the manufacturer's instructions (see Table 5.6). As a minimum, the following application procedure shall apply:

- (a) Prepare the surface according to Clause 5.3.
- (b) Apply a coat of compatible primer in accordance with the manufacturer's instruction.
- (c) Wrap the area to be coated spirally with tapes of an adequate width, employing the right overlap and using sufficient tension to ensure a complete conformability of the coating.

The tape shall be applied with an overlap of not less than 55% and not less than 25 mm, whichever is the greater. In a two-tape system, the over-wrap shall be applied with an overlap of not less than 25 mm.

The tape wrap shall start and finish at the horizontal axis of the pipe, pointing in the downward direction.

The overlap of tapes onto factory-applied coating shall be at least 75 mm. The over-wrap shall overlap the tape by at least 25 mm.

NOTES:

- 1 Hand-wrapping machines may be of assistance in ensuring correct application of the tape.
- 2 The height of weld beads at field joints should be low enough so that the tape remains in intimate contact with the steel substrate on either side of the weld bead. Alternatively, bituminous/butyl filler mastic may be used to provide a smooth contour to prevent voids beneath the tape.
- 3 The width of the tape that is used depends on the diameter of the pipes. For all types of application, an appropriate width should be chosen to avoid wrinkling, which can occur if the material is too wide.

5.5 INSPECTION AND TESTING OF THE APPLIED COATINGS

5.5.1 General

The tests specified in Clauses 5.5.3 to 5.5.12 shall be carried out either for qualification and/or for production quality control.

5.5.2 General inspection

After application, the tape coating shall be smooth, have uniform overlap, be free of wrinkles, air bubbles, lack of adhesion, laminations and any other coating defects. The tape wrap shall start and finish at the horizontal axis of the pipe, pointing in the downward direction.

5.5.3 Thickness

The nominal thickness is the calculated sum of the thickness of all the layers of the coating before application.

The minimum thickness of the coating on the body of the joint shall be not less than 90% of the nominal value, or as otherwise agreed to by the purchaser.

Unless otherwise agreed with the purchaser, the minimum thickness on the weld cap shall be not less than 80% of the nominal value or as otherwise agreed with the purchaser.

NOTES:

- 1 The coating thickness on the weld cap is normally less than on the body because some of the polymeric adhesive will flow from the weld cap to the body, both during and after the application. This is necessary to prevent voids in the coating and is not detrimental to the corrosion protection.
- 2 The coating thickness should be measured using the method given in AS 3894.3.

5.5.4 Holiday detection

The entire surface of the coated joint shall be checked for holidays or other discontinuities according to the method and test voltages specified in AS 3894.1.

Holidays shall be repaired applying a new tape wrap unless otherwise agreed.

5.5.5 Impact resistance

The impact resistance shall be measured using the method given in Appendix C. The impact resistance shall meet the values given in Tables 5.3(A) and 5.3(B).

5.5.6 Indentation resistance

The indentation resistance shall be measured using the method given in Appendix D. The indentation resistance shall meet the values given in Table 5.2(A).

5.5.7 Drip resistance

The drip resistance of petrolatum tapes shall be measured using the method given in Appendix F. The drip resistance shall meet the requirements given in Table 5.1.

5.5.8 Cathodic disbondment

The cathodic disbondment shall be measured using the method given in AS 4352 and shall meet the values given in Tables 5.2(A) and 5.2(B).

5.5.9 Peel strength between tape layers of polymeric tapes

The peel strength between tape layers of polymeric tapes shall be measured using the method given in Appendix H. The peel strength between layers of polymeric tapes shall meet the values given in Table 5.2(A).

5.5.10 Peel strength to pipe surface and factory-applied coating

5.5.10.1 General

The minimal waiting period between application of the coating and the peel strength test shall be as given in Table 5.7, unless specified otherwise by the coating manufacturer.

5.5.10.2 Petrolatum tapes (Type 1A)

Petrolatum tapes shall leave a film of compound on the substrate when peeled off.

5.5.10.3 Polymeric tapes (Type 1B)

The peel strength shall be measured using the method given in Appendix B. The peel strength of polymeric tapes (Type 1B) shall meet the values given in Tables 5.3(A) and 5.3(B).

5.5.10.4 Peel strength after immersion in water

The peel strength shall be measured after immersion in water for 24 h, the test temperature being 50°C or 80°C for Type 1B, in accordance with the maximum operating temperature of the coating, and 30°C or 50°C for Type 1A.

Petrolatum tapes shall leave a continuous film of compound on the substrate when peeled off after immersion in water.

For polymeric tapes, the peel strength after immersion in water shall be measured using the method given in Appendix B. The peel strength after immersion in water shall meet the values given in Tables 5.3(A) and 5.3(B).

5.5.11 Lap shear strength of bituminous and polymeric tapes

The lap shear strength resistance of bituminous and polymeric tapes shall be measured using the method given in Appendix H. The lap shear strength of bituminous and polymeric tapes shall meet the values given in Tables 5.3(A) and 5.3(B).

5.5.12 Thermal ageing resistance of polymeric tapes

The thermal ageing resistance shall be measured using the method given in Appendix H. The thermal ageing resistance shall meet the values given in Table 5.3(A).

TABLE 5.1
COATING IDENTIFICATION

Coating trade name	
Basic type of coating material (1A or 1B)	
Primer trade name	
Number of layers (Note 1)	
Trade names of all layers	
Nominal thickness of coating system	
Compatible factory-applied coatings (Note 2)	

NOTES:

- 1 Excluding primer.
- 2 State all types of factory-applied coating that have been tested successfully with the coating.

TABLE 5.2
INSPECTION AND TEST PLAN AND MINIMUM
REQUIREMENTS FOR TYPE 1A (PETROLATUM TAPES,
MAXIMUM OPERATING TEMPERATURE OF 30°C AND 50°C)

Property	Test method	Number of PQT joints	Number of PPT joints	Production frequency	Requirement
Surface cleanliness	AS 1627.4	3	3	Every joint	Clause 5.3
Thickness	AS 3894.3	3	3	Nil	Clause 5.5.3
Holiday detection	AS 3894.1	3	3	Nil	No holiday
Impact resistance	Appendix C	3	Nil	Nil	≥0.8 J/mm
Cathodic disbondment at 23°C 28 days (see Note)	AS 4352	3	Nil	Nil	≤20 mm
Cathodic disbondment at 50°C 28 days (for high temperature tape) (see Note)	AS 4352	3	Nil	Nil	≤20 mm
Peel strength to pipe surface and factory-applied coating	Manually peel strip 25 × 100 mm	3	3	Nil	Leave continuous film of compound on the substrate
Peel strength to pipe surface and factory-applied coating before and after 28 day hot water immersion test at 30°C	Manually peel strip 25 × 100 mm	3	3	Nil	Leave continuous film of compound on the substrate
Peel strength to pipe surface and factory-applied coating before and after 28 day hot water immersion test at 50°C (for high temperature tape)	Manually peel strip 25 × 100 mm	3	3	Nil	Leave continuous film of compound on the substrate
Drip resistance at 50°C	Appendix F	3	Nil	Nil	No dripping of compound
Drip resistance at 70°C (for high temperature tape)	Appendix F	3	Nil	Nil	No dripping of compound

NOTE: During CD testing if material exudes to significantly reduce the size of the intentional holiday, the surplus material shall be removed to maintain the current constant.

TABLE 5.3(A)
MINIMUM REQUIREMENTS FOR TYPE 1B (POLYMERIC TAPES,
MAXIMUM OPERATING TEMPERATURE UP TO 50°C OR 80°C)

Property	Test temperature	Unit	Requirement (up to 50°C)	Requirement (up to 80°C)	Test method
Thickness		mm	≥0.9 × nominal value		AS 3894.3
Holiday detection		kV	250√T T = thickness (μm)		AS 3894.1
Impact resistance	23°C	J/mm	≥4		Appendix C
Indentation resistance:					Appendix D
—applied stress	20°C	N/mm ²	10.0	1.0	
—residual thickness	T _{max}	mm	≥0.6	≥0.6	
Cathodic disbondment resistance (see Note)	23°C	mm	≤15	≤15	AS 4352
	T _{max}	mm	≤20	≤20	
Peel strength between tape layers:					Appendix H
—inner/inner, inner/outer	23°C	N/mm	≥2.0	≥2.0	
—inner/inner, inner/outer	T _{max}	N/mm	≥1.0	≥1.0	
—outer/outer	23°C	N/mm	≥2.0	≥2.0	
—outer/outer	T _{max}	N/mm	≥1.0	≥1.0	
Peel strength:					Appendix B
—to steel surface	23°C	N/mm	≥2.0	≥2.0	
—to steel surface	T _{max}	N/mm	≥1.00	≥1.00	
—to factory-applied coating	23°C	N/mm	≥2.0	≥2.0	
—to factory-applied coating	T _{max}	N/mm	≥1.00	≥1.00	
—to factory-applied coating after 28 days immersion in water at 50°C	23°C	N/mm	≥2.0	≥2.0	
—to steel surface after 28 days immersion in water at 50°C or 80°C	23°C	N/mm	≥2.0	≥2.0	
Lap shear strength	23°C T _{max}	N/mm ² N/mm ²	≥0.1 ≥0.1	≥0.1 ≥0.1	Appendix G
Thermal ageing resistance					Appendix I
Ratio of:					
—elongation at break		—	1.25 ≥E ₁₀₀ /E ₀ ≥0.75 E ₁₀₀ /E ₇₀ ≥0.8		
—peel strength between tape layers		—	P ₁₀₀ /P ₀ ≥0.75 P ₁₀₀ /P ₇₀ ≥0.8		
—peel strength to pipe surface		—	A ₁₀₀ /A ₀ ≥0.75 A ₁₀₀ /A ₇₀ ≥0.8		

NOTE: During cathodic disbondment testing if material exudes to significantly reduce the size of the intentional holiday, the surplus material shall be removed to maintain the current constant.

TABLE 5.3(B)
INSPECTION AND TEST PLAN—POLYMERIC TAPES COATING

Properties	Test method	Number of PQT joints	Number of PPT joints	Production frequency	Requirement for operating temp. (up to 50°C)	Requirement for operating temp. (up to 80°C)
Coating conditions	As per test equipment manufacturer's instruction	1/PQT or 1/day*	1/PPT or 1/day*	Daily before coating commences and when change of weather condition may cause non-compliance	—	—
Surface cleanliness	AS 1627.4	3	3	1/day or 1/30 joints*	Class Sa 2½	Class Sa 2½
Surface profile—Steel surfaces	AS 3894.5	3	3	1/day or 1/30 joints*	As specified by manufacturer	As specified by manufacturer
Surface profile—Factory-applied coating	AS 3894.5	3	3	1/day or 1/30 joints*	As specified by manufacturer	As specified by manufacturer
General inspection of the coating	Clause 5.5.2	3	3	Every joint	As specified in Clause 5.5.2	As specified in Clause 5.5.2
Thickness	AS 3894.3	3	3	1/day or 1/30 joints*	As specified in Clause 5.5.3	As specified in Clause 5.5.3
Holiday detection	AS 3894.1	3	3	Every joint	No coating defects	No coating defects
Impact resistance	Appendix C	3	Nil	Nil	≥4 J/mm	≥4 J/mm
Cathodic disbondment at 23°C, 28 days (see Note)	AS 4352	3	Nil	Nil	≤15 mm	≤15 mm
Cathodic disbondment at pipeline maximum operating temperature, 28 days (see Note)		3	Nil	Nil	≤20 mm	≤20 mm
Peel strength:	Appendix B					
To pipe surface at 23°C		3	3	— 1/day or once/100 joints**†	— ≥2.0 N/mm	— ≥2.0 N/mm
To pipe surface at pipeline maximum operating temperature		3	Nil	Nil	≥1.0 N/mm	≥1.0 N/mm
To factory-applied coating at 23°C		3	3	1/day or once/100 joints**†	≥2.0 N/mm	≥2.0 N/mm
To factory-applied coating at pipeline maximum operating temperature		3	Nil	Nil	≥1.0 N/mm	≥1.0 N/mm

* Whichever is least frequent.

† When permitted by the purchaser, the manufacturer's data may be used to calculate the peel strength relative to the requirements at 23°C.

NOTE: During cathodic disbondment testing if material exudes to significantly reduce the size of the intentional holiday, the surplus material shall be removed to maintain the current constant.

TABLE 5.4
DATA SHEET—PRIMER—TAPES

Property	Value	Test method
Primer trade name		
Generic type		
Solid content		
Type of solvent		
Flashpoint		
Density		
Spreading rate (coverage); or dry film thickness		
Storage conditions		
—temperature minimum		—
—temperature maximum		—
Shelf life at storage temperature		—

TABLE 5.5
DATA SHEET—TAPES

Property	Values	Test method
Trade name	—	—
Description of coating material	—	—
Colour	—	—
Minimum total thickness; or mass per unit area		
Polymeric film/reinforcement		
—generic type of polymeric film	—	—
—generic type of reinforcement material	—	—
—nominal thickness; or mass per unit area	—	—
Adhesive		
—generic type	—	—
—nominal thickness; or mass per unit area		
—softening point ring and ball (see Note 2)		
Mechanical properties		
—tape strength		
—modulus at 10% elongation (see Note 2)		
—elongation at break (see Note 2)		
Storage conditions		
—temperature minimum		—
—temperature maximum		—
Shelf life at storage temperature		—

NOTES:

- 1 Data according to this data sheet shall be supplied with each coating component.
- 2 If applicable.