

Australian/New Zealand Standard™

**External extruded high-density
polyethylene coating system for pipes**



AS/NZS 1518:2002

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Australian Institute of Petroleum
Australian Petroleum Production and Exploration Association
Australian Pipeline Industry Association
Bureau of Steel Manufacturers
Co-operative Research Centre for Materials Welding and Joining
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Australian/New Zealand Standard™

External extruded high-density polyethylene coating system for pipes

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PREFACE

This Standard was prepared by Standards Australia/Standards New Zealand Committee, ME-038, Petroleum pipelines, to supersede AS 1518—1979, Extruded high-density polyethylene protective coating for pipes.

This objective of this Standard is to provide the manufacturers, suppliers, specifiers and users of oil and gas pipelines with a set of requirements for external protection against corrosion, using high-density polyethylene.

This Standard incorporates Amendment No. 1 (May 2006). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

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.

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.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**External extruded high-density polyethylene coating system for pipes****1 SCOPE**

This Standard specifies requirements for external protection against corrosion of pipeline systems, whereby a sealant layer is interposed between the pipe and the extrudate of high-density polyethylene, applied using annular or lateral extrusion techniques, to comprise the external coating.

Materials complying with this Standard are intended for use where the pipe temperature during operation is in the range of -20°C to $+55^{\circ}\text{C}$. Guidance is provided on selection and testing of the coating where elevated temperatures may be encountered during storage, stockpiling or construction. The performance of the coating at high and low temperatures may not be as reflected by tests carried out at ambient temperatures. For example, mastic creep and penetration, and coating system peel strength and cathodic disbanding resistance may not be as at ambient temperatures.

The coating is intended for use in applications where it is not subject to weather or ultra-violet light exposure. A safe period of 12 months of weather exposure after manufacture is allowed for completion of the installation of the pipeline system.

NOTES:

- 1 Guidelines for purchasers on information that should be supplied by the purchaser and those variables that should or may be agreed upon at the time of inquiry or order are given in Appendix A.
- 2 For submerged are welded pipe, additional consideration should be given to air entrapment along the length of the weld and localised stress on the polyethylene coating.

Methods for demonstrating compliance with this Standard are given in Appendix B.

Coatings applied over galvanized pipe shall comply with the requirements of Appendix C.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

A1	1145	Determination of tensile properties of plastics materials
	1145.3	Part 3: Determination of tensile properties of plastic materials—Test conditions for films and sheets
	1199	Sampling procedures and tables for inspection by attributes
	1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes
	1627	Metal finishing—Preparation and pre-treatment of surfaces
	1627.2	Part 2: Power tool cleaning
	1627.4	Part 4: Abrasive blast cleaning
	1627.9	Part 9: Pictorial surface preparation standards for painting steel surfaces
	3894	Site testing of protective coatings
	3894.1	Part 1: Non-conductive coatings—Continuity testing—High voltage ‘brush’ method
	3894.4	Part 4: Determination of dry film thickness
	3894.5	Part 5: Determination of surface profile

AS/NZS	
4352	Tests for coating resistance to cathodic disbonding
ISO	
ISO 9000	Quality management systems—Fundamentals and vocabulary
ISO 9001	Quality management systems—Requirements
ISO 9004	Quality management systems—Guidelines for performance improvement
ISO 10013	Guidelines for developing quality manuals
SAI	
HB 18	Guidelines for third party certification and accreditation
HB 18.28	Guide 28: General rules for a model third-party certification scheme for products
HB 18.44	Guide 44: General rules for ISO or IEC international third-party certification schemes for products
ASTM	
D36	Softening point of bitumen (Ring-and-ball-apparatus)
D638	Tensile properties of plastics
D1238	Flow rates of thermoplastics by extrusion plastomer
D1505	Density of plastics by the density-gradient technique
D1693	Environmental stress-cracking of ethylene plastics
APIRP	
5LI	Recommended practice for railroad transportation of linepipe
5LW	Recommended practice for transportation of line pipe on barges and marine vessels
CSAZ	
245.21	External polyethylene coating for pipe

3 DEFINITIONS

For the purpose of this Standard the definitions given in AS 3500.0 and those below apply.

3.1 Batch

A discrete and continuous manufacturing run.

3.2 Bolster

Support for coated pipes during transport and storage.

3.3 Coating

The total coating system comprising a covering of polyethylene extruded over a previously applied sealant layer.

3.4 Compounded polyethylene

Ethylene homopolymers or copolymers containing anti-oxidants, pigments and ultra-violet light stabilisers.

NOTE: The material can be compounded before or during application.

3.5 Cut-back

The region at each end of a pipe where the polyethylene has been removed, and the steel surface is substantially free from sealant, excepting a region immediately adjacent to the polyethylene coating, due to shrinkage of the polyethylene.

3.6 HDPE

High density polyethylene.

3.7 Holiday

A discontinuity in the protective coating, which exposes the steel to the outside environment.

3.8 Lot

A batch or number of batches manufactured within a limited period of time, typically 24 h or less.

3.9 Nesting

The stacking of pipe without separation.

3.10 Polyethylene

See compounded polyethylene.

3.11 Ring sample

A short length of pipe cut from the original sample pipe and used for laboratory tests.

3.12 Rust blooming

Visual detectable colour change on the surface of the pipe due to oxidation.

3.13 Sealant

The adhesive compound interposed between the pipe and the polyethylene sheath.

3.14 Substrate

The steel pipe surface to which the coating is to be applied.

3.15 Surface preparation

Treatment of the pipe surface to receive the coating.

3.16 Weather exposure

Continuously exposed without protection from direct sunlight and weathering elements.

3.17 Wind row

Row of sand or soil, free of material that may damage pipe or pipe coating, used for supporting pipes.

4 MATERIAL REQUIREMENTS

4.1 Sealant

The sealant shall be a bituminous rubber blend, or a material having similar properties. The sealant properties shall be in accordance with requirements of Appendix B.

4.2 Polyethylene

The high-density polyethylene properties shall be in accordance with the requirements of Appendix B.

4.3 Repair materials

Materials used for repair shall be a two-layer heat shrink sleeve or laminate tape, in accordance with Clause 6.

4.4 Material documentation and marking

4.4.1 Documentation

The manufacturers of the sealant and polyethylene shall provide certificates of compliance for each batch or lot with this Standard. Results of compliance tests shall be provided on request. Where applicable, density measurement shall be taken on virgin polyethylene resin, and the melt flow index shall be taken on either virgin or compounded polyethylene. All other tests shall be conducted on compounded polyethylene.

4.4.2 Marking

Each batch or lot shall be identified with the following information:

- (a) Manufacturer's name.
- (b) Product description and grade.
- (c) Batch or lot number.
- (d) Container number, when specified.

NOTE: Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, or on packaging or promotional material related to that product, are advised to ensure that such compliance is capable of being verified.

5 PIPE SURFACE PREPARATION AND COATING APPLICATION

5.1 Surface preparation

Prior to blast cleaning, or to sealant coating, the pipe surface shall be maintained at a temperature at least 3°C above the dew point. If required, this may be achieved by preheating the pipe.

Surface preparation for bare steel pipe shall be as follows:

- (a) Pipe shall be free from visible oil grease, soil, organise and other contaminants prior to abrasive cleaning, in accordance with AS 1627.4.
- (b) Cleaning of exterior of pipe shall be by dry blasting in accordance with AS 1627.4, Class ½.
- (c) The surface profile shall be between 40 µm and 100 µm measured in accordance with AS 1627.4.
- (d) The cleaned exterior of pipe shall be inspected for sliver, scabs, lamination, burns or bristles of steel after blast cleaning.

NOTE: Some steel pipes can exhibit surface imperfections in the form of slivers, burrs and laminations, which may require removal prior to coating. The remaining pipe wall thickness after repair by grinding or filing shall comply with the requirements of the specification for the supply of steel pipe.

- (e) Pipe surface shall be visually inspected to determine that it is not contaminated with grit, dust, metal particles, oil, or any other foreign material from any source, including pipe-conveying systems.
- (f) All pipes shall be coated within 4 h of blast cleaning. Any pipe, which is not coated within 4 h or where rust blooming has occurred, shall be completely re-blasted.

For steel pipe that has been galvanized, see Appendix C.

5.2 Sealant application

The following applies to sealant application:

- (a) The sealant shall be uniformly applied to the pipe surface to a minimum thickness of 0.15 mm over the profile with no voids in the sealant layer.

- (b) A cut-back length, as specified in Rows 9 & 10, Table B1 of Appendix B or as otherwise specified, at each end of each pipe length, shall be retained free from sealant as an aid to subsequent pipe joining operations.

5.3 Polyethylene application

The following applies to polyethylene application:

- (a) Immediately following application of the sealant layer to the pipe and without any surface contamination occurring, a covering of polyethylene of uniform thickness shall be extruded on to the surface of the pipe. When lateral extrusion processes are used, a circumferential spiral effect may be observed along the length of the coating as a result of the overlapping of the HDPE sheath.
- (b) The polyethylene coating shall be a continuous process with controlled cooling such as to provide a smooth other sheath, free from mechanical damage and with minimum voids between the mastic and the polyethylene.

No single void shall be greater than 20 mm in maximum linear extent with a maximum area of 10 mm². The number of voids with linear extent greater than 10.0 mm shall not be exceed 5 voids per square metre of coated surface.

The sheath shall be in accordance with requirements specified in Table 1. The maximum polyethylene layer thickness shall not exceed twice the minimum polyethylene layer thickness. However, for pipes of diameter less than 60.5 mm, the maximum polyethylene layer thickness shall not exceed twice the minimum applied polyethylene layer thickness.

- (c) The ends of the pipe shall be trimmed to provide a cut-back region from polyethylene and essentially free from sealant.

NOTE: It is normal for some shrink-back of the polyethylene subsequent to the coating application, the magnitude of which is dependent upon application conditions and ambient temperatures. Cutback measurements are made at the time of cutting (see Row 9, Table B1 of Appendix B).

TABLE 1
THICKNESS OF POLYETHYLENE COATING

Outside diameter of pipe (mm)	Polyethylene thickness minimum, (mm)
Over 60.3	1.0
48.3 to 60.3	0.75
Under 48.3	0.60

NOTE: Where additional mechanical protection is required, a thicker layer of polyethylene may be specified, or a double coating may be specified.

5.4 Double coating

Where a double coating is required it shall be carried out by applying the first coat in accordance with Clauses 5.1, 5.2 and 5.3 and the second coat as follows:

- (a) The first coating shall be maintained free from contaminants prior to the application of the second coat.
- (b) The second coating shall be carried out by a further application of sealant and polyethylene in accordance with Clauses 5.2(a), 5.2(c) and 5.3.
- (c) The minimum sealant layer thickness for the second coating shall be 0.12 mm.

- (d) The cutback area of the initial coat may be extended to a nominal 150 mm, with the option of application of additional sealant at the end of the HDPE coating. This is to reduce the possibility of voids between the layers and to reduce the possibility of cracking where the two HDPE layers may be fuse together.

6 COATING REPAIRS AND FIELD JOINT COATINGS

6.1 General

Factory coating repairs shall be effected by application of a heat-shrink sleeve.

Field joint coating, and repairs to damaged areas of coating, shall be effected by the application of heat shrink sleeves or by wrapping with laminate tape. Applicators of field joint coatings and coating repairs shall have appropriate training and accreditation.

6.2 Repair method

6.2.1 Repairs by recoating

Recoating of pipes shall be carried out when the initial HDPE coating has any one of the following:

- (a) Three or more cut-outs at separate locations, along the length of the pipe.
- (b) Areas of mechanical damage that preclude the possibility of repair by heat-shrink sleeves.
- (c) An original HDPE layer thickness less than 50% of the specified minimum thickness.

Heat-shrink sleeve repairs shall not be permitted within 200 mm of the pipe ends, unless agreed by the purchaser.

Where required, recoating shall be in accordance with the coating procedure, commencing with the application of the sealant in accordance with Clause 5.2.

6.2.2 Repairs by overcoating

Subject to appropriate identification as an overcoated pipe, all defects not described in Clause 6.2.1 may be repaired by overcoating, without the removal of the residual, undamaged, initial HDPE coating.

Pipes repaired by overcoating shall not exceed 5% of the number of pipes coated per days of production.

6.3 Preparation

6.3.1 General

Unless otherwise specified in this Standard, surface preparation shall be carried out in accordance with written instructions from the coating manufacturer.

6.3.2 Environment

The pipe shall not be exposed to adverse weather conditions, such as dusty conditions or rain, during surface preparation and before application of the coating.

6.3.3 Linepipe coating preparation

Coating defects shall be removed by full smooth circumferential cuts with no offsets, discontinuities or notches into the remaining coating. The cut edge of coating defect cut outs, and the edge of linepipe coating at field welds, shall be chamfered to an angle of not more than 30° to the pipe surface. The chamfering may be achieved by cutting at the angle, power wire brushing or by blast cleaning.

6.3.4 Drying

If the pipe surface temperature is less than 3°C above the dew point then the pipe shall be heated using a method, which will not damage the pipe or coating, prior to the commencement of surface preparation. The area shall be maintained continuously at not less than 3°C above the dew point until coating application is complete.

6.3.5 Surface preparation

Prior to preparing the surface, the steel shall be free of weld spatter, sharp edges, and burrs. If the weld cap is over 1.5 mm high, or if the weld has irregularities, it shall be ground smooth.

Adjacent linepipe coating shall be fully adherent to the pipe without any loose coating flaps or other areas of inadequate adhesion.

All oil, grease, dirt, and moisture shall be removed from the pipe surface.

The exposed steel shall be blast cleaned to AS 1627.4 Class 2¹/₂, and a minimum of 50 mm of adjacent linepipe coating shall be blast cleaned to remove all gloss from its surface. The edge of the existing coating shall be chamfered by the blast cleaning to provide a smooth profile for the overcoating.

If the coating is to be applied over a coating defect and all steel not coated with linepipe coating is either coated with uncontaminated mastic, or has exposed steel of condition of at least to AS 1627.4 Class 2¹/₂, then additional blast cleaning of the steel is not required. The linepipe coating shall then be provided with the 30° chamfer, and the surface of the linepipe coating shall be abraded by other techniques.

The surfaces to be coated, which includes all exposed steel and a minimum of 50 mm overlap onto existing coating, shall be blown free of all dust and contaminants before applying the coating. The coating shall be applied within 4 h of surface preparation providing there has been no contamination of the pipe surface.

6.4 Heat-shrink sleeve repairs

6.4.1 Material requirements

The heat-shrink sleeves selected shall be tested and confirmed, or certified by the manufacturer, to have the following properties:

- (a) Sufficiently high temperature resistance for its performance to comply with the requirements of this Section, at the maximum operating temperature of the pipeline, and at the temperatures that may be encountered during construction.
- (b) Sufficiently high creep resistance of the mastic so that mastic will remain between the polyethylene of the heat-shrink-sleeve and the steel, under all conditions of pipeline construction and operation.
- (c) Cathodic disbanding resistance of not less than that of the linepipe coating.
- (d) Integrity of the closure to be maintained during application and service.
- (e) The polyethylene to resist impact and creep forces that may occur during application and service.
- (f) The mastic to be of sufficient thickness to prevent any voids between the steel and the polyethylene, particularly at submerged arc longitudinal welds, field welds, interfaces with linepipe coating, and at any laps in the heat-shrink sleeve and its closure.
- (g) Adhesion shall pass the test detailed in Clause 6.6.

6.4.2 Application

Application shall be carried out in accordance with written instructions from the sleeve manufacturer, except where they are modified herein.

The sleeve shall be applied so that it covers all of the exposed steel and 50 mm of the linepipe coating on both sides. All equipment used shall be as recommended by the sleeve manufacturer.

The pipe shall be preheated. The temperature at the time of sleeve application shall be in accordance with the sleeve manufacturer's instructions and shall be checked with a contact thermometer at four positions around the pipe circumference immediately prior to heat shrink leave application.

The closure patch area, and the linepipe coating shoulder shall be lightly rolled whilst the mastic is hot to remove voids and air pockets and to ensure that there is intimate contact between the sleeve and the substrate. After application the sleeve shall be free of cold spots, air bubbles, lack of adhesion, lamination and any other defects.

The sleeve shall be allowed to cool for a period of at least 2 h before applying stress to the sleeve such as supporting the weight of the pipe on the sleeved section of pipe.

6.5 Laminate tape repairs

6.5.1 General

Application shall be carried out in accordance with written instructions from the tape manufacturer, except where they are modified herein.

6.5.2 Material requirements

The laminate tapes selected shall be tested and confirmed, or certified by the manufacturer, to have the following properties:

- (a) Sufficient high-temperature resistance for its performance to comply with the requirements of this Section, at the maximum operating temperature of the pipeline, and at the temperatures that may be encountered during construction.
- (b) Sufficient high-creep resistance of the adhesive so that it will remain between the plastic tape backing and the steel under all conditions of pipeline construction and operation.
- (c) Cathodic disbanding resistance of not less than that of the linepipe coating.
- (d) Excellent adhesion to itself at overlaps in the tape wrapping.
- (e) The plastic backing to resist impact and creep forces that may occur during application and service.
- (f) The adhesive to be of sufficient thickness and ability to flow under application pressure to prevent any voids between the steel and the plastic backing, particularly at submerged arc longitudinal welds, field welds, interfaces with linepipe coating, and at tape overlaps in the spiral wrapping.
- (g) Adhesion shall pass the test detailed in Clause 6.6.

6.5.3 Priming

A coat of primer shall be applied over the areas to be coated. It shall be brushed in an even wet coat over the entire surface. Brushes shall not shed any bristles onto the work. It should be applied to a dry film thickness of 50 µm to 75 µm and shall be free of runs and sags.

Determine whether the primer is an 'alive' or 'dead' type. Live primers shall be allowed to dry to a tacky surface prior to application of the mastic and the tape. If the primer is allowed to completely dry and becomes non-tacky, an additional coat of primer shall be applied. It shall be allowed to dry to a tacky surface prior to application of the wrapping tape. Drying time varies with temperature, wind and humidity; however, the minimum drying time is typically 10 min and the maximum drying time is typically 2 h. Dead primers require full drying prior to tape application.

A layer of butyl rubber mastic strip shall be applied to areas such as welding irregularities, or sharp changes in profile. The mastic shall be applied to ensure that there are no voids between the substrate and the tape and to provide a smooth profile before the tape is applied. The mastic shall be cut to size and inserted with firm pressure into the appropriate area and moulded to form a smooth contour as well as an air/moisture tight seal.

6.5.4 Tape application

The tape shall be applied to the primed or mastic-coated surface providing there has been no rain, moisture, dust or other contamination of the surface. The wrapping shall be applied as a spiral with a minimum 55% overlap.

The overwrap tape, if a part of the manufacturer's recommended system, shall be applied as a spiral with a minimum 25 mm overlap, providing there has been no rain, moisture, dust or other contamination of the surface.

Tape shall be applied free of wrinkles, air bubbles and other defects. Sufficient pressure shall be applied on the tape to ensure that there is no gap at the spiral overlap.

The end of the wrap shall always finish in a downward direction at either the 3 o'clock or 9 o'clock position, dependent upon the direction of wrapping. When a new roll of tape is required the new roll shall be tied in by inserting the start of the roll a minimum of 100 mm underneath the previous roll.

6.6 Bond adhesion tests

Adhesion testing is a destructive test. As the correct application of field coatings can not be determined by other techniques, and as a significant number of such coatings have had adhesion failures, applicator testing shall be carried out at regular intervals.

The testing shall be carried out at locations where poor application may typically be anticipated; for example, at overlaps and at circumferential welds, on the bottom of the pipe.

A minimum of 3 tests shall be carried out on each joint coating selected for testing. Each test should comprise two parallel cuts 20 mm apart and not less than 200 mm long. The full length of the cut strip should be peeled back from the pipe at an angle of approximately 90°, at a rate of not more than 5 mm/sec.

The test result is acceptable only if—

- (a) the tape fails cohesively, that is, if the tape remains with the mastic adhering both to the steel and the backing; or
- (b) if the sum of the dimension of adhesive failure to the steel is less than 10 mm in one line.

NOTES:

- 1 Heat-shrink sleeves should not be tested until they have been completely cooled, preferably to ground temperature.
- 2 Laminate tapes continue to develop adhesion over a period of several days and maximum adhesion may not be developed for a week. As a result, adhesion testing of laminate tapes should not be carried out within 24 h of the tape application. Preferably, testing should be carried out when the pipe is cool.