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Coated steel pipes for water
service—Part 3: Long-life external
plastic coatings

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Water Steel Pipe Association (WSP)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS G 3443-3:2014**), which has been technically revised.

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JIS G 3443 series consists of the following 4 parts under the general title *Coated steel pipes for water service*—

Part 1: Pipes

Part 2: Fittings

Part 3: Long-life external plastic coatings

Part 4: Internal epoxy coatings

Blank

Coated steel pipes for water service— Part 3: Long-life external plastic coatings

1 Scope

This Japanese Industrial Standard specifies the requirements for long-life plastic coatings applied on the external surface of mother pipes used mainly for water works, sewage works, industrial water works and agricultural water works.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

- JIS B 0601 *Geometrical Product Specifications (GPS)—Surface texture: Profile method—Terms, definitions and surface texture parameters*
- JIS B 7503 *Mechanical dial gauges*
- JIS B 7512 *Steel tape measures*
- JIS G 3101 *Rolled steels for general structure*
- JIS G 3141 *Cold-reduced carbon steel sheet and strip*
- JIS G 3443-1 *Coated steel pipes for water service—Part 1: Pipes*
- JIS G 3443-2 *Coated steel pipes for water service—Part 2: Fittings*
- JIS G 3477-1 *Polyethylene coated steel pipes—Part 1: External 3 layer extruded polyethylene coated steel pipes*
- JIS H 8300 *Thermal spraying—Zinc, aluminium and their alloys*
- JIS K 5500 *Glossary of terms for coating materials*
- JIS K 5600-1-1 *Testing methods for paints—Part 1: General rule—Section 1: General test methods (conditions and methods)*
- JIS K 5600-1-2 *Testing methods for paints—Part 1: General rules—Section 2: Sampling*
- JIS K 5600-1-4 *Testing methods for paints—Part 1: General rule—Section 4: Standard panels for testing*
- JIS K 5600-3-4 *Testing methods for paints—Part 3: Film formability—Section 4: Evaluation of the compatibility of product with a surface to be painted*
- JIS K 5600-5-7 *Testing methods for paints—Part 5: Mechanical property of film—Section 7: Adhesion test (Pull-off method)*
- JIS K 5601-1-2 *Testing methods for paint components—Part 1: General rule—Section 2: Determination of non-volatile matter content*
- JIS K 6761 *Polyethylene pipes for general purposes*

- JIS K 6900 *Plastics—Vocabulary*
- JIS K 6922-2 *Plastics—Vocabulary Plastics—Polyethylene (PE) moulding and extrusion materials—Part 2: Preparation of test specimens and determination of properties*
- JIS K 7112 *Plastics—Methods of determining the density and relative density of non-cellular plastics*
- JIS K 7120 *Testing methods of plastics by thermogravimetry*
- JIS K 7161-1 *Plastics—Determination of tensile properties—Part 1: General principles*
- JIS K 7161-2 *Plastics—Determination of tensile properties—Part 2: Test conditions for moulding and extrusion plastics*
- JIS K 7206 *Plastics—Thermoplastic materials—Determination of Vicat softening temperature (VST)*
- JIS K 7209 *Plastics—Determination of water absorption*
- JIS K 7210-1 *Plastics—Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics—Part 1: Standard method*
- JIS K 7215 *Testing methods for durometer hardness of plastics*
- JIS K 7350-2 *Plastics—Methods of exposure to laboratory light sources—Part 2: Xenon-arc lamps*
- JIS K 7350-4 *Plastics—Methods of exposure to laboratory light sources—Part 4: Open-flame carbon-arc lamps*
- JIS Z 0103 *Glossary of terms used in rust and corrosion preventive technology*
- JIS Z 0313 *Test and assessment of abrasive blast-cleaned substrates before application of paints*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS G 3443-1**, **JIS G 3443-2**, **JIS K 5500**, **JIS K 6900**, **JIS K 7210-1** and **JIS Z 0103**, and the following apply.

3.1

long-life

improvement in long-period durability of coating, such as high-temperature oxidation degradation and weathering resistance, by adding a deterioration inhibitor, an oxidation inhibitor etc.

3.2

plastic coating

polyurethane coating or polyethylene coating applied on the external surface of mother pipe

3.3

two-component inner-mixing coating machine

airless coating machine which force-feeds the base compound and the hardener by separate pumps and mixes the two by the mixer or the like attached to the end of the coating hose

3.4

free-film

single coating substance of hardened polyurethane

3.5

cathodic disbonding

disbondment of coating from the steel surface occurring adjacent to defects of coating due to alkali, hydrogen etc. generated by protection current, when electrolytic protection is applied on a coated steel pipe and the steel surface at the defects serves as a cathode

3.6

delivery test

test to confirm that the products have been manufactured properly, performed on every delivery of products

3.7

type test

test performed not upon every delivery but at the time of initial manufacture, at regular intervals, and at the time when manufacturing conditions are given changes which can affect performances, intended to determine if the product quality conforms to all performances specified in designs

3.8

joint coat

generic term for heat shrinkable coating materials applied on the external surface of field weld

It includes heat shrinkable tubes and heat shrinkable sheets.

3.9

heat shrinkable tube

tube manufactured by moulding, crosslinking and stretching polyethylene containing an antioxidant into a tubular-shape heat shrinkable base material, and applying on it a uniform coat of the adhesive materials composed mainly of synthetic rubber and other components such as a tackifier, softener and filler

3.10

heat shrinkable sheet

sheet manufactured by moulding, crosslinking and stretching polyethylene containing an antioxidant into a sheet-shape heat shrinkable base material, and applying on it a uniform coat of the adhesive materials composed mainly of synthetic rubber and other components such as a tackifier, softener and filler

4 Classification and grade symbols of long-life plastic coatings

Classification and grade symbols of long-life plastic coatings shall be as given in Table 1. As for coatings, Type I shall be the standard, and Type II can be applied only to the case where the impact resistance of coating is especially required from the applying condition, etc. Polyurethane coating is applied to the pipes and fittings of nominal diameters 80 A to 3 000 A. Polyethylene coating is applied to the pipes of nominal diameters 80 A to 1 600 A.

Table 1 Classification and grade symbols of long-life plastic coatings

Grade	Type	Grade symbol
Polyurethane coating	Type I	JISPUX-I
	Type II	JISPUX-II
Polyethylene coating	Type I	JISPEX-I
	Type II	JISPEX-II
NOTE Old grade symbols “JISPU” and “JISPE” were specified as “normal type” before the revision in 2014, and as “long-life type” after the revision in 2014 until the revision at this time.		

5 Materials of long-life plastic coatings

The materials used for long-life plastic coatings shall be in accordance with Annex A, Annex B or Annex C.

6 Long-life plastic coating method

6.1 Polyurethane coating method

6.1.1 Substrate treatment

Oil adhered to the mother pipe shall be degreased with a solvent. Foreign matter such as mill scale and rust shall be removed by abrasive blast-cleaning to Grade Sa 2^{1/2} specified in 4 b) of JIS Z 0313 or better.

6.1.2 Primer coating

Primer shall be applied by airless spray, air spray, brush, roller or the like to the thickness specified by the primer manufacturer without any coating imperfections. Sufficient dry curing is required for primer coating; therefore, dry curing shall be performed for a period specified by the primer manufacturer until cured to set-to touch.

6.1.3 Polyurethane coating

Polyurethane shall be coated within the period specified by the primer manufacturer after primer coating. In case of overdue coating, the primer shall be recoated, or polyurethane shall be coated after roughening the primer surface with a disc sander or other devices. The coating shall be performed using a two-component inner-mixing coating machine which can mix a base compound and a hardener at a specified mixing ratio in such a way as to avoid foreign matter, pinholes, coating irregularities, coating imperfections etc.

When required, recoating shall be performed within the period specified by the polyurethane coating material manufacturer. In case of overdue recoating, it shall be performed after roughening the undercoated surface with a disc sander or other devices.

6.1.4 Treatment of uncoated part of pipe end

Primary anti-rust coating material shall be applied on the uncoated part of pipe end as shown in Figure 1.

In order to prevent the weld degradation by rust, a groove anti-rust agent may be applied on the uncoated part at the workshop, and removed in the field before welding.

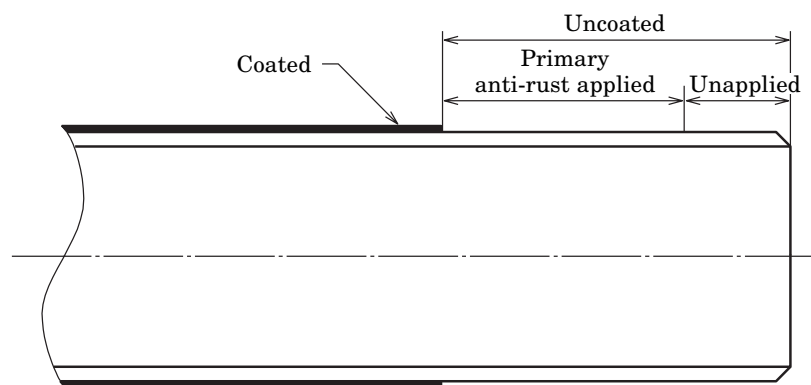


Figure 1 Treatment of uncoated part of pipe end

Examples of field weld coating (joint coat) treatment on uncoated part of pipe end after field welding are shown in Annex E.

6.1.5 Curing of polyurethane coating

Coating shall be cured naturally to a hard-dry state.

Coating shall be free from dust and water until cured to set-to touch.

6.2 Polyethylene coating method

Polyethylene coating method shall be in accordance with Clause 6 of JIS G 3477-1. Primary anti-rust coating material shall be coated at the uncoated part of pipe end as shown in Figure 1.

Examples for treatment method of the uncoated part of pipe end after field welding are shown in Annex E.

7 Requirements for long-life plastic coatings

7.1 Appearance

The appearance of coating shall be free from cracks, blistering, foreign matter etc. when tested in accordance with 8.2.

7.2 Coating thickness

The coating thickness shall satisfy Table 2, when tested in accordance with 8.3. Other coating thicknesses, when required, shall be as agreed between the manufacturer and the purchaser.

Table 2 Coating thickness

Unit: mm

Type	Coating thickness
Type I	1.5 min.
Type II	2.5 min.

7.3 Length of uncoated part of pipe end

The length of uncoated part of pipe end shall satisfy Table 3, when tested in accordance with 8.4. Other lengths, when required, shall be as agreed between the manufacturer and the purchaser.

Table 3 Length of uncoated part of pipe end

Unit: mm

Nominal diameter	Length of uncoated part	Length of unapplied part (reference)
Under 1 600 A	100 to 150	Approx. 30
1 600 A or over	150 to 200	

7.4 Coating performances

The coating performance shall be as given in Table 4.

Delivery test and type test of the performance of coating shall be performed by the coating dealer who performs the coating on the external surface of steel pipe.

Table 4 Coating performances

Test type	Item	Performance		Test condition ^{a) b)}	Subclause to be referred to
		Polyurethane coating	Polyethylene coating		
Delivery test	Pinhole	Not detected.	Not detected.	—	8.5
	Adhesion MPa	3 min. (average)	—	—	8.6
	Adhesive property N/mm	—	No peeling shall occur when a test force of 15 N/mm width is applied.	23 °C to 38 °C	8.7
Type test	Pull-off adhesive strength MPa	3 min. (average)	—	23 °C	8.8
		1 min. (average)	—	60 °C	
	Peeling strength N/mm	—	15 min. (average)	23 °C	8.9
		—	3 min. (average)	60 °C	
	Impact resistance	No pinhole detected.	No pinhole detected.	Type I: 23 °C, 11 J	8.10
				Type II: 23 °C, 18 J	
	Indentation depth mm	0.4 max. (average)	0.2 max. (average)	23 °C, 25 N	8.11
		0.6 max. (average)	0.4 max. (average)	60 °C, 25 N	
	Nominal tensile strain at break %	—	400 min. (average)	23 °C	8.12
	Bending resistance	No crack	No crack	Type I: 0 °C, angle 2°	8.13
				Type II: 0 °C, angle 2°	
	Cathodic disbonding resistance mm	7 max. (average)	7 max. (average)	23 °C × 28 days	8.14
		20 max. (average)	—	40 °C × 28 days	
		—	20 max. (average)	60 °C × 28 days	
	Hot water immersion resistance mm	2 max. (average) 3 max. (maximum)	2 max. (average) 3 max. (maximum)	80 °C × 48 h	8.15
Notes ^{a)} The tolerance on the temperature of test conditions shall be ± 3 °C.					
^{b)} Unless otherwise specified, the temperature shall be 20 °C ± 15 °C.					

8 Test methods

8.1 General

Test conditions for each test shall be as given in Table 4. Unless otherwise specified in Table 4, the test temperature shall be 20 °C ± 15 °C.

NOTE This test temperature is obtained by adopting 20 °C for the standard atmospheric condition specified in **JIS Z 8703**, and by adopting temperature Class 15 (± 15 °C) for the tolerance specified in **3.1** of **JIS Z 8703**.

The test pieces for type test of polyurethane coating shall be steel plates coated by the same coating machine as the one used for coating steel pipes. The method shall be in accordance with Annex D.

8.2 Appearance test

The appearance shall be examined in delivery test, and cracks, blistering, foreign matter etc. shall be visually inspected.

8.3 Coating thickness test

The coating thickness shall be examined by delivery test, and measured by a thickness measuring device of an accuracy within $\pm 10\%$.

8.4 Length test of uncoated part of pipe end

The length of uncoated part of pipe end shall be examined by delivery test, and measured by a steel tape measure specified in **JIS B 7512** or a measuring device of an accuracy at least equivalent thereto.

8.5 Pinhole test

Pinholes shall be examined in delivery test, and examined with a pinhole detector as moving the brush electrode on the coated surface. The test voltage applied between the brush electrode and the steel surface shall be as follows: 8 kV to 10 kV for Type I of polyurethane coating; 12 kV to 15 kV for Type II of polyurethane coating; 15 kV to 18 kV for Type I of polyethylene coating; and 25 kV for Type II of polyethylene coating.

8.6 Adhesion test

The adhesion of polyurethane coating shall be examined in acceptance test, in accordance with **A.2.2** of **JIS H 8300**. The polyurethane coated surface to be tested shall be roughened by sand-paper before bonding a test jig.

The prevention of adhesive permeation shall not be performed.

8.7 Adhesive property test

The adhesive property of polyethylene coating shall be examined in delivery test in accordance with **8.4** of **JIS G 3477-1**.

8.8 Pull-off adhesive strength test

The pull-off adhesive strength shall be examined in type test applicable to polyurethane coating, and the test method shall be in accordance with **D.2**.

8.9 Peeling strength test

The peeling strength shall be examined in type test applicable to polyethylene coating, and the test method shall be in accordance with Annex E of **JIS G 3477-1**.

8.10 Impact resistance test

The impact resistance shall be examined in type test applicable to polyurethane and polyethylene coatings. The test method for polyurethane coating shall be in accordance with **D.3**, and that for polyethylene coating shall be in accordance with Annex F of **JIS G 3477-1**.

8.11 Indentation depth test

The indentation depth shall be examined in type test applicable to polyurethane and polyethylene coatings. The test method for polyurethane coating shall be in accordance with **D.4**, and that for polyethylene coating shall be in accordance with Annex G of **JIS G 3477-1**.

8.12 Nominal tensile strain test at break

The nominal tensile strain at break shall be examined in type test applicable to polyethylene coating. The test method shall be in accordance with **8.8** of **JIS G 3477-1**.

8.13 Bending resistance test

The bending resistance shall be examined in type test applicable to polyurethane and polyethylene coatings. The test method for polyurethane coating shall be in accordance with **D.5**, and that for polyethylene coating shall be in accordance with Annex H of **JIS G 3477-1**.

8.14 Cathodic disbonding resistance test

The cathodic disbonding resistance shall be examined in type test applicable to polyurethane and polyethylene coatings. The test method for polyurethane coating shall be in accordance with **D.6**, and that for polyethylene coating shall be in accordance with Annex I of **JIS G 3477-1**.

8.15 Hot water immersion resistance test

The hot water immersion resistance shall be examined in type test applicable to polyurethane and polyethylene coatings. The test method on polyurethane coatings shall be in accordance with **D.7**, and that for polyethylene coatings shall be in accordance with Annex J of **JIS G 3477-1**.

9 Inspection

9.1 Appearance inspection

The appearance shall be inspected for each coated steel pipe over the whole coated surface by the method specified in **8.2**, and the result shall conform to the requirements of **7.1**.

The appearance inspection shall be performed on 100 % of coated steel pipes.

9.2 Coating thickness inspection

The coating thickness shall be inspected at both ends and centre of coated steel pipe, each at any four points on orthogonal axes in the circumferential direction of the coated steel pipe by the method specified in **8.3**, and the result shall conform to the requirements of **7.2**.

The coating thickness inspection shall be performed on 100 % of coated steel pipes for polyurethane coating, and on two coated steel pipes sampled from the same manufacturing lot for polyethylene coating. The same manufacturing lot for polyethylene coating in this case shall be equivalent to the quantity of adhesives and polyethylene extruded and coated continuously.