INTERNATIONAL STANDARD

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AMENDMENT 1
2011-11-15

Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems —

Part 3: Field joint coatings

AMENDMENT 1

Industries du pétrole et du gaz naturel — Revêtements externes des conduites enterrées ou immergées utilisées dans les systèmes de transport par conduites —

Partie 3: Revêtements des joints soudés sur site

AMENDEMENT 1

Reference number
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to ISO 21809-3:2008 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

Amendment 1 to ISO 21809-3:2008 adds field joint coatings based on non-crystalline low-viscosity polyolefin tapes and makes corrections to the technical requirements of ISO 21809-3:2008.

Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems —

Part 3:
Field joint coatings

AMENDMENT 1

Page 1, Clause 2

In the list of normative references, replace

"ISO 31-0:1992, *Quantities and units — Part 0: General principles*"

with

"ISO 80000-1:2009, *Quantities and units — Part 1: General*"

Page 7, 5.1

Replace both instances of "ISO 31-0:1992" with "ISO 80000-1:2009".

Page 9, 7.2.1; page 13, 9.1.2.1 and 9.1.2.2; page 14, 9.1.3 and 9.4; page 64, D.1.1; page 65, D.1.3.1; page 66, D.1.4 and D.2.1; page 83, I.5

Replace the cross-reference to "Clauses 10 to 17" with one to "Clauses 10 to 18".

Page 12, Clause 8

Add the following new rows in Table 1:

Code	Clause	Type of field joint coating
1E-a	18	Coatings based on non-crystalline low-viscosity polyolefin tapes with polymeric tape outer wrap
1E-b		Coatings based on non-crystalline low-viscosity polyolefin tapes with heat shrinkable sleeve outer wrap

Page 14, 9.1.2.2, seventh paragraph

Replace "1A, 1B, 1C, 1D, 2A and 7" with "1A, 1B, 1C, 1D, 1E-a, 1E-b, 2A, and 7".

Page 15, 10.2.2

Replace the first sentence with the following:

"Petrolatum tape coatings consist of a single layer or multiple layers of petrolatum tapes, with or without a primer."

Page 17, 10.4.4

Replace the third bullet with the following:

— Apply a thin coat of compatible primer (if any) by brush, by hand or using other applicable tools.

Page 21, Table 5

Replace Table 5 with the one given below.

Table 5 — Requirements for Type 1C — Wax tape and primer

Property		Test temperature °C	Units	Requirements	Test method
Primer					
Congeal point		—	°C	55 to 70	ASTM D 938
Flash point		—	°C	≥ 65	ASTM D 92
Specific gravity		25	g/cm^3	0,9 to 1,25	ASTM D 70
Cone penetration		25	0,1 mm	75 to 225	ASTM D 937
Dielectric strength		—	V/µm	≥ 4	ASTM D 149
Tape					
Congeal point of saturant		—	°C	65 to 70	ASTM D 938
Flash point of saturant		—	°C	≥ 60	ASTM D 92
Thickness		—	mm	> 1,75	ASTM D 1000
Dielectric strength		—	V/µm	> 6,7	ASTM D 149
Complete coating					
Impact resistance		20	J/mm	≥ 0,8	Annex G
Indentation resistance	Test pressure	23	N/mm^2	0,1	Annex H
	Holiday detection		—	No holiday	
	Residual thickness		mm	≥ 0,6	
Specific electrical insulation resistance	R_{S100}	—	Ω·m^2	≥ 10^6	Annex K
	R_{S100}/R_{S70}		—	≥ 0,8[a]	
Cathodic disbondment resistance at 28 days		23	mm	< 12	Annex F
Peel strength to pipe surface and plant coating		23	—	Leave a film of compound on the substrate	—
Peel strength to steel and plant coating before and after 28-day hot-water immersion test at 30 °C		23	—	Leave a film of compound on the substrate	Annex I
Drip resistance		45	—	No dripping of compound	Annex J
Holiday detection at 5 kV/mm + 5 kV		—	—	No holiday	Annex B

[a] This requirement ($R_{S100}/R_{S70} \geq 0,8$) need be fulfilled only if the specific electrical insulation resistance after 70 days is less than 10 times the requirement of the specific electrical insulation resistance after 100 days.

Page 31, Table 16

In row 5, column 3, delete the cross-reference to “Table 1”.

Page 37, 13.5.4

Replace the text of the entire subclause with the following:

The adhesion to the steel surface shall be tested in accordance with ISO 4624 (pull-off test) and shall meet the requirements of Table 19 or 20. For production testing, the method defined in Annex C may be used for Types 4A and 4B, unless otherwise agreed. The results shall meet the requirements of Table 19.

The adhesion to plant-applied coating shall be tested in accordance with Annex C for Types 4A and 4B and ISO 4624 for Types 4C, 4D and 4E, and shall meet the requirements of Table 19 or 20. Alternatively, the adhesion test may be carried out using ISO 4624 for Types 4A and 4B for PQT and PPT, and shall meet the requirements of Table 19 or 20.

Page 37, 13.5.8

Replace the text of the entire subclause with the following:

A hot water immersion test shall be carried out in accordance with Annex I, the test temperature being the maximum design temperature of the joint coating, limited as specified in Annex I.

The adhesion to the steel surface shall be tested in accordance with ISO 4624 (pull-off test) during PQT and PPT and shall meet the requirements of Table 19 or 20.

The adhesion to plant-applied coating shall be tested in accordance with Annex C during PQT and PPT for Types 4A and 4B and in accordance with ISO 4624 for Types 4C, 4D and 4E, and shall meet the requirements of Table 19 or 20. Alternatively, the adhesion test may be carried out using ISO 4624 (pull-off test) and shall meet the requirements of Table 19 or 20 for Types 4A and 4B.

Page 39, Table 19

In row 10, column 2, replace “2 °C” by “20 °C”.

In row 15, column 8, replace “ISO 4624” by “Annex I plus ISO 4624”.

Page 40, Table 20

Delete row 6 (Cathodic disbondment at 48 h).

In row 11, column 2, replace “23 °C” by “20 °C”.

Page 59

Add the following Clause 18 before Annex A.

18 Coatings based on non-crystalline low-viscosity polyolefin tapes

18.1 Coating identification

Coatings based on non-crystalline low-viscosity polyolefin tapes shall be identified in the APS in accordance with Table 40 and shall meet the requirements of Table 41.

Data sheets for the non-crystalline low-viscosity polyolefin compound tapes used as the base of the coatings shall be in accordance with Table 42.

Application instructions shall be provided by the manufacturer in accordance with Table 43.

18.2 Description of the coatings

The coatings consist of the following:

— a coat comprising one or several layers of a non-crystalline low-viscosity (fully amorphous, non-crosslinked) polyolefin (e.g. polyisobutylene) compound tape applied without any primer or adhesive; this material may be reinforced by fabrics; a backing film may cover this compound tape;

— an outer wrap, which shall be a polymeric tape (FJC type 1E-a) or a heat-shrinkable sleeve (FJC type 1E-b) or any other agreed material, provided that the requirements of Table 41 are fulfilled for the complete coating.

NOTE The purposes of the outer wrap are to provide additional pressure in order to support cold flow of the compound tape and self-healing properties of the complete coating system and to give mechanical protection.

Maximum design temperature is 50 °C to 80 °C, depending on the composition of the non-crystalline low-viscosity polyolefin compound tape and on the choice of outer wrap.

Specific configurations allowing higher maximum design temperature may be used subject to qualification.

The maximum design temperature shall be precisely defined in the APS and for the coating identification (see Table 40). Requirements given in Table 41 are applicable whatever the maximum design temperature.

18.3 Surface preparation

Surface preparation shall be carried out in accordance with the APS. The edges of the plant coating shall be bevelled and the plant coating shall be roughened over the minimum length specified for the overlap on the plant coating (see 18.4.2).

Surface preparation shall be carried out either by means of wire-brush cleaning in accordance with 9.1.2.1 and 9.1.2.3 to a minimum degree of cleanliness of ISO 8501-1:2007, grade St 2, or by means of abrasive blast cleaning in accordance with 9.1.2.1 and 9.1.2.2 to a minimum degree of cleanliness of ISO 8501-1:2007, grade Sa 2 ½.

Alternative surface preparation methods may be used by agreement.

Dust contamination shall be a maximum of grade 3 measured in accordance with ISO 8502-3:1992.

18.4 Application of the coatings

18.4.1 General

Application of the coatings shall be carried out in accordance with the APS.

The non-crystalline low-viscosity polyolefin compound tape shall be applied without tension by means of lay-up techniques, using prefabricated shapes and sizes which are wrapped in a wrap-around method. Alternatively, spiral wrapping may be used for small-diameter pipes.

The outer wrap shall be applied directly on the compound tape in accordance with 10.4.5 for polymeric tape or 11.4.3 for heat-shrinkable sleeves, or in accordance with the manufacturer's recommendations for other agreed materials.

The minimum application temperature shall be 20 °C above the glass transition temperature of the low-viscosity polymer.

18.4.2 Overlap

The overlap of the compound tape on the plant-applied coating shall be in accordance with the manufacturer's application instructions (see Table 43) and shall be a minimum of 50 mm.

The outer wrap shall cover the compound tape.

When a polymeric tape is used for the outer wrap (Type 1E-a), it may overlap the plant coating.

When a heat-shrinkable sleeve (Type 1E-b) is used, it shall overlap the plant coating by at least 50 mm on both sides, excluding bevels.

The overlap of any other agreed outer wrap material shall be in accordance with the manufacturer's recommendations.

A double thickness of the compound tape shall be applied in an area extending 25 mm either side of the weld cap.

The overlap of the spirally wrapped outer wrap tape shall be 50 %.

18.5 Testing of the applied coating

18.5.1 General

The tests in 18.5.2 to 18.5.14, summarized in Table 41, shall be carried out for production quality control and for PQT and PPT if required.

18.5.2 Thickness

The minimum thicknesses of the compound tape and of the complete coating shall be agreed between the end user and/or purchaser and the applicator, based on the data sheets and recommendations of the manufacturers. The minimum thickness shall be specified in the APS.

Unless otherwise agreed with the purchaser, the minimum thickness of the complete coating on the weld cap shall be not less than 0,6 mm.

NOTE The coating thickness on the weld cap is normally less than on the body because some of the coating material flows from the weld cap to the body, both during and after application. This is necessary to prevent voids in the coating and is not detrimental to the corrosion protection.

The coating thickness shall be measured using the method given in Annex A.

18.5.3 Holiday detection

The entire surface of the coated joint shall be checked for holidays or other discontinuities at a voltage of 5 kV/mm + 5 kV at a maximum of 25 kV, in accordance with the method defined in Annex B. This test shall be carried out after application of the compound tape and may be repeated after completion of the coating where so required by the purchaser.

Holidays shall be repaired in accordance with the APS.

18.5.4 Impact resistance

The impact resistance shall be measured on the complete coating, using the method given in Annex G, and shall meet the requirements of Table 41.

18.5.5 Indentation resistance

The indentation resistance shall be measured on the complete coating at 23 °C and at maximum design temperature, using the method given in Annex H, and shall meet the requirements of Table 41.

18.5.6 Specific electrical insulation resistance

The specific electrical insulation resistance shall be measured on the compound tape, using the method given in Annex K, and shall meet the requirements of Table 41.

18.5.7 Cathodic disbondment resistance

The cathodic disbondment resistance shall be measured on the complete coating, using the method given in Annex F carried out on a pipe section. The resistance to cathodic disbondment shall meet the requirements of Table 41. The cathodic disbondment test shall be carried out over a period of 28 days at 23 °C. A test duration of 48 h instead of 28 days may be used for PPT or production testing if the test temperature is increased to 65 °C and provided that comparison of results is performed during PQT.

The cathodic disbondment after 28 days at maximum design temperature (subject to an upper limit of 95 °C) shall meet the requirements of Table 41.

At the end of the test, the thickness of the compound tape at the location of the artificial defect shall be as a minimum the thickness specified in the APS and no holiday shall be detected.

18.5.8 Peel strength between outer wrap and compound tape and between layers of outer wrap

The peel strength between outer wrap and compound tape (with or without backing) shall be measured at 23 °C and at maximum design temperature, using the method given in Annex M, and shall meet the requirements of Table 41.

If the outer wrap consists of multiple layers, the peel strength between outer wrap layers shall also be measured at 23 °C and at maximum design temperature, using the method given in Annex M, and shall meet the requirements of Table 41.

18.5.9 Adhesion to pipe surface and plant coating

18.5.9.1 General

The adhesion test shall be carried out after application of the outer wrap and after cooling where heat has been applied.

18.5.9.2 Testing

The peel strength with respect to steel and plant coating of compound tape containing reinforcement shall be tested at 23 °C and at maximum design temperature, using the methods given in Annex D, and the results concerning failure mode and substrate coverage shall meet the requirements given in Table 41, unless otherwise agreed by all parties including the manufacturer. The method given in D.1 shall be used for PQT. The method given in D.2 may be used for PPT and production testing.

The adhesion to steel and plant coating of compound tape containing no reinforcement shall be measured as follows. Adhesion testing shall be carried out at the 6 o'clock and 12 o'clock positions of the FJC by using a utility knife to attempt to lift the coating material from the steel surface. The coating material shall leave a film of corrosion protective coating material on the substrate. There shall be no evidence of adhesive failure.

Adhesion to the plant coating of the outer wrap polymeric tape (Type 1E-a) when applicable or of the outer wrap shrinkable sleeve (Type 1E-b) shall be measured using the peel strength method given in Annex D and shall meet the requirements given in Table 41.

18.5.10 Thermal ageing resistance

18.5.10.1 Compound tape

The thermal ageing resistance for the compound tape shall be measured using the method given in N.3 for 100 days at T_{max} + 20 °C. The adhesion of the compound tape to the pipe surface and the plant coating shall be measured as specified in 18.5.9.2 and shall meet the requirements of Table 41.

18.5.10.2 Outer wrap

For Type 1E-a, the thermal ageing resistance for the outer wrap polymeric tape shall be measured using the method given in N.1 and N.2 for 100 days at T_{max} + 20 °C and shall meet the requirements of Table 41.

For Type 1E-b, the thermal ageing resistance for the outer wrap shrinkable material shall be measured using the method given in N.1 and N.3 for 100 days at T_{max} + 20 °C and shall meet the requirements of Table 41.

18.5.11 Lap shear strength

The lap shear strength of the compound tape shall be measured at 23 °C and at maximum design temperature, using the method given in L.2, and shall meet the requirements of Table 41. The coating thickness shall be 2 mm, instead of 1 mm as specified in L.2.

18.5.12 Hot-water immersion test

The hot-water immersion test of the compound tape shall be carried out in accordance with Annex I for 100 days at T_{max} + 20 °C, limited as specified in Annex I. The adhesion of the compound tape to the pipe surface and the plant coating shall be measured as specified in 18.5.9.2 and shall meet the requirements of Table 41.

The hot-water immersion test of the outer wrap shall be carried out in accordance with Annex I for 100 days at T_{max} + 20 °C, limited as specified in Annex I. The adhesion of the outer wrap to the plant coating shall be measured as specified in 18.5.9.2 and shall meet the requirements of Table 41.

18.5.13 Glass transition temperature

The glass transition temperature of the compound tape shall be determined by differential thermal analysis (Annex E) of a sample of the material and shall meet the requirements of Table 41.

18.5.14 Drip resistance

No dripping of the compound tape shall be allowed, as specified in Table 41, when performing the test in accordance with Annex J with a modified test temperature of maximum design temperature +15 °C and in any case a minimum of 80 °C.

Table 40 — Coating identification

Property	Reference
Coating trade name	—
Type of FJC	Table 1
Maximum and minimum design temperature	—
Form of non-crystalline low-viscosity polyolefin compound	—
Types, number and thicknesses of layers	—
Trade names of all layers	—
Nominal thickness of complete coating	—
Compatible plant coatings[a]	—

[a] State all types of plant coating that have been tested sucessfully with the coating.

Table 41 — Requirements for non-crystalline low-viscosity polyolefin-based coatings (Types 1E-a and 1E-b)

Property		Test temp.	Units	Requirements		Test method
Non-crystalline low-viscosity polyolefin compound tape						
Minimum thickness		23 °C	mm	By agreement		Annex A
Glass transition temperature		—	°C	< min. design temp. minus 20		Annex E
Holiday detection at 5 kV/mm + 5 kV		—	—	No holiday		Annex B
Drip resistance		T_{max} + 15 °C (in any case > 80 °C)	—	No dripping of compound		Annex J
Specific electrical insulation resistance	R_{S100}	23 °C	Ω·m²	≥ 10^8		Annex K
	R_{S100}/R_{S70}		—	≥ 0,8[a]		
Peel strength test with respect to steel and to plant coating before and after thermal ageing resistance and before and after hot-water immersion test, both for 100 days at T_{max} + 20 °C (if reinforcement in the compound tape)		23 °C	N/mm	≥ 0,2	Cohesive failure Coverage ≥ 95 %	Annex D (and Annex I)
		T_{max}		≥ 0,02		
Adhesion test with respect to steel and to plant coating before and after thermal ageing resistance and before and after hot-water immersion test, both for 100 days at T_{max} + 20 °C (if no reinforcement in the compound tape)		23 °C	—	The coating shall leave a film of corrosion protective coating material on the substrate. There shall be no evidence of adhesive failure.		18.5.9.2 (and N.3 and Annex I)
		T_{max}				
Lap shear strength		23 °C	N/mm²	≥ 0,02	Cohesive failure Coverage ≥ 95 %	Annex L
		T_{max}		≥ 0,002		
Complete coating						
Impact resistance		20 °C	J	≥ 15		Annex G
Indentation resistance	Test pressure	23 °C and T_{max}	N/mm²	10,0		Annex H
	Holiday detection at 5 kV/mm + 5 kV		—	No holiday		
	Residual thickness		mm	≥ 0,6		

Property		Test temp.	Units	Requirements	Test method
Cathodic disbondment resistance at 28 days		23 °C and T_{max}	mm	0 mm, no holiday	Annex F (and Annex B and 18.5.7)
Type 1E-a (Outer wrap — Polymeric tape)					
Peel strength	Outer wrap layer to outer wrap layer	23 °C	N/mm	≥ 0,40	Annex M
		T_{max}		≥ 0,04	
	Outer wrap to backing of compound	23 °C		≥ 0,40	
		T_{max}		≥ 0,04	
Peel strength of outer wrap to compound tape without backing		23 °C	N/mm	≥ 0,20	Annex M
		T_{max}		≥ 0,02	
Peel strength at 10 mm/min with respect to plant coating		23 °C	N/mm	≥ 1,0	Annex D (and Annex I)
		T_{max}		≥ 0,1	
Peel strength at 10 mm/min to plant coating after hot water immersion test		23 °C	N/mm	≥ 1,0	Annex D (and Annex I)
Elongation at break (E_{100}/E_0) after thermal ageing test for 100 days at T_{max} + 20 °C		23 °C	—	≥ 0,75	N.1
Peel strength (P'_{100}/P'_0) after thermal ageing test for 100 days at T_{max} + 20 °C.	Outer wrap layer to outer wrap layer	23 °C	—	≥ 0,75	N.2 and Annex D
	Outer wrap layer to compound tape (or its backing if any)				
Type 1E-b (Outer wrap — Heat-shrinkable sleeve)					
Peel strength at 10 mm/min with respect to plant coating		23 °C	N/mm	≥ 1,0	Annex D (and Annex I)
		T_{max}		≥ 0,1	
Peel strength at 10 mm/min with respect to plant coating after hot water immersion test		23 °C	N/mm	≥ 1,0	Annex D (and Annex I)
Elongation at break (E_{100}/E_0) after thermal ageing test for 100 days at T_{max} + 20 °C.		23 °C	—	≥ 0,75	N.1
Peel strength of outer wrap with respect to compound tape (or its backing if any)		23 °C	N/mm	≥ 0,40	Annex M
		T_{max}		≥ 0,04	
Peel strength with respect to plant coating (P''_{100}/P''_0) after thermal ageing test for 100 days at T_{max} + 20 °C.		23 °C	—	≥ 0,75	N.3 and Annex D

[a] This requirement ($R_{S100}/R_{S70} \geq 0,8$) need be fulfilled only if the specific electrical insulation resistance after 70 days is less than 10 times the requirement of the specific electrical insulation resistance after 100 days.

Table 42 — Data sheets of non-crystalline low-viscosity polyolefin compound tapes

Property	Units	Test method
Trade name	—	—
Prefabricated compound tape[a] — generic type of non-crystalline low-viscosity polyolefin — generic type of reinforcement material	—	—
Colour	—	—
Nominal thickness of prefabricated compound tape	mm	ISO 4591/ ISO 4593
Density	g/cm^3	—
Minimum design temperature Maximum design temperature	°C	—
Storage conditions — temperature range (minimum/maximum)	°C	—
Shelf life at storage temperature	month	—
Data according to this data sheet shall be supplied for each coating component.		
[a] If applicable.		

Table 43 — Application instructions

Property	Units
Ambient conditions	
— minimum temperature	°C
— maximum temperature	°C
— maximum relative humidity	%
Surface preparation of steel surface — surface cleanliness (ISO 8501-1)	—
Surface preparation of plant coating	—
Application of coating	
— method of application	—
— surface temperature/dewpoint	°C
— material temperature	°C
General	
— minimum thickness	mm
— overlap on plant coating (minimum and maximum)[a]	mm
— specific application instructions	—
— repair procedures	—
[a] To be given for each compatible plant coating.	

Page 83, Annex I.3.2.1

Delete "× 6 mm".

Page 83, Annex I.3.2.2

Delete "× WT".

Page 96, O.2, first paragraph

Replace the sentence "Any other test required in this part of ISO 21809 and not mentioned in Table O.1 shall be considered as required only for PQT." with the following text:

> Any other test required in this part of ISO 21809 and not mentioned in Table O.1 shall be considered as required only for PQT, except for some long-term tests related to the material itself (i.e. specific electrical insulation resistance and thermal ageing). In application of 7.2.1, these material properties shall be verified by laboratories that comply with ISO/IEC 17025 and reported in a test report.

Page 96, Table O.1

Replace Table O.1 with the one given below.

Table O.1 — Frequency of testing and inspection for specific FJC types

Property	FJC types	Reference subclause[a]	Method of testing	Frequency		
				PQT	PPT	Production
Surface condition of the area to be coated before preparation	All	9.1.2.1	Visual	3 joints	3 joints	Each joint
Visual inspection of the cleaned surface	All	9.1.2	ISO 8501-1	3 joints	3 joints	Each joint
Roughness of the cleaned surface	All	9.1.2	ISO 8503-1	3 joints	3 joints	3 times per shift
Level of soluble salts on cleaned surface	All except 1A, 1B, 1C, 1D, 1E-a, 1E-b, 2A and 7	9.1.2.2	ISO 8502-6 and ISO 8502-9	3 joints	3 joints	3 times per shift[b]
Dust contamination	All	9.1.2.1	ISO 8502-3	3 joints	3 joints	3 times per shift
Examination of the dulled plant-applied coating	All except 6	9.1.3	Visual	3 joints	3 joints	Each joint
Temperature of the surface to be coated	All	9.2	—	3 joints	3 joints	Each joint
Application criteria	All	—	—	3 joints	3 joints	Continuously
Degree of cure of epoxy	2B, 2C, 3A, 3B, 5	—	Annex E	3 joints	3 joints	—
Oxidation induction time (intercept in the tangent method)	5A, 5C, 5D	14.5.11	ISO 11357-6	3 joints	3 joints	By agreement
Visual inspection of the coating	All	9.3	—	3 joints	3 joints	Each joint
Inspection of thickness	All	—	Annex A	3 joints	3 joints	By agreement
Holiday detection test	All except 6	—	Annex B	3 joints	3 joints	Each joint
Impact resistance test	All except 6	—	Annex G	3 joints	3 joints	—

Property	FJC types	Reference subclause[a]	Method of testing	Frequency		
				PQT	PPT	Production
Indentation resistance test	All except 6	—	Annex H	3 joints	—	—
Shore hardness	4	13.5.6	ISO 868	3 joints	3 joints	—
Peel strength between layers at ambient temperature	1D	10.5.8	Annex M	3 joints	3 joints	—
Peel strength between layers at maximum design temperature	1D	10.5.8	Annex M	3 joints	By agreement	—
Peel strength on steel surface and plant coating at ambient temperature	1A, 1D, 2A, 2B, 2C	10.5.9.3 11.5.4	Annex D	3 joints	3 joints	Once per shift
Peel strength on steel surface and plant coating at T_{max}	1D, 2A, 2B, 2C	10.5.9.3 11.5.4	Annex D	3 joints	—	—
Peel strength on steel surface and plant coating at ambient temperature	1B, 1C	10.5.9.2	—	3 joints	3 joints	Once per shift
Adhesion to steel surface at ambient temperature	3	12.5.5	Annex C	3 joints	3 joints	Once per shift
Adhesion to steel surface at ambient temperature	4	13.5.4	ISO 4624	3 joints	3 joints	Once per shift[c]
Adhesion to plant coating at ambient temperature	4A, 4B	13.5.4	Annex C	3 joints[d]	3 joints[d]	Once per shift
Adhesion to plant coating at ambient temperature	4C, 4D, 4E	13.5.4	ISO 4624	3 joints	3 joints	Once per shift
Peel strength on steel surface and plant coating at T_{max}	5A, 5B, 5C, 5D, 5E	14.5.4 14.5.5	Annex D	3 joints	3 joints	—
Peel strength on steel surface and plant coating at 90 °C	5A, 5B, 5C	14.5.4 14.5.5	Annex D	3 joints	3 joints	—
Adhesion to steel surface at ambient temperature	6	15.6.6	ISO 4624	3 joints	—	—
Adhesion to steel surface at ambient temperature	6	15.6.6	ASTM D 4541	—	3 joints	Once per shift
Adhesion to steel surface and plant coating at 50 °C	7	16.5.4	—	3 joints	3 joints	—
Peel strength on steel surface and plant coating at ambient temperature	8	17.5.6	Annex D	3 joints	3 joints	Once per shift
Hot-water immersion test	All except 6 and 7	—	Annex I	3 joints	By agreement	—