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Entwurf

**Erdöl- und Erdgasindustrie –
Umhüllungen für erd- und wasserverlegte Rohrleitungen in
Transportsystemen –
Teil 3: Nachumhüllung der Schweißverbindungen
(ISO/DIS 21809-3:2014);
Englische Fassung prEN ISO 21809-3:2014**

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

Part 3: Field joint coatings (ISO/DIS 21809-3:2014);
English version prEN ISO 21809-3:2014

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 (ISO/DIS 21809-3:2014);
Version anglaise prEN ISO 21809-3:2014

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2014-07-04 wird der Öffentlichkeit zur Prüfung und
Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses
Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise online im Norm-Entwurfs-Portal des DIN unter www.entwuerfe.din.de bzw. für Norm-Entwürfe der DKE auch im Norm-Entwurfs-Portal der DKE unter www.entwuerfe.normenbibliothek.de, sofern dort wiedergegeben;
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- oder in Papierform an den Normenausschuss Gastechnik (NAGas) im DIN, 53058 Bonn, Postfach 14 03 62 (Hausanschrift: Josef-Wirmer-Str. 1 - 3, 53123 Bonn).

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten
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Gesamtumfang 139 Seiten

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Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN
Normenausschuss Materialprüfung (NMP) im DIN
Normenausschuss Wasserwesen (NAW) im DIN

Nationales Vorwort

Dieser Norm-Entwurf (prEN ISO 21809-3:2014) wurde vom ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“ in Zusammenarbeit mit dem Technischen Komitee ECISS/TC 110 „Stahlrohre und Fittings für Eisen- und Stahlrohre“ (Sekretariat: UNI, Italien) erarbeitet.

Das zuständige deutsche Gremium ist der Arbeitsausschuss NA 032-02-09 AA „Außenkorrosion“ im Normenausschuss Gastechnik (NAGas). Der Arbeitsausschuss NA 109-00-02 AA „Fernleitungssysteme“ im Normenausschuss Erdöl- und Ergasgewinnung (NÖG) hat an diesem Dokument mitgearbeitet.

Dieses Dokument enthält unter Berücksichtigung des Präsidialbeschlusses 1/2004 nur die englische Originalfassung des Entwurfes prEN ISO 21809-3:2014. Nur der Abschnitt Begriffe wurde übersetzt.

3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

3.1

Spezifikation des Umhüllungsverfahrens

Dokument, welches das Verfahren, die Methode, Ausrüstung und Werkzeuge zum Aufbringen der Umhüllung beschreibt

3.2

Beschichter

Unternehmen, welches Umhüllungen nach diesem Teil der ISO 21809 herstellt

3.3

Charge

Menge des Materials in einem kontinuierlichen Fertigungsprozess mit Rohstoffen aus gleicher Herkunft und gleichbleibender Qualität

3.4

Chargenzeugnis

Analysenzertifikat der Charge des Herstellers

3.5

Haftvermittler

Material, welches als ein Film auf die grundierte Metalloberfläche aufgebracht wird, um die Haftung der nachfolgenden Umhüllung zu gewährleisten

3.6

Prüfbescheinigung

Dokument nach ISO 10474:2013 (EN 10204:2004 oder), welches die Einhaltung der Anforderungen der Bestellung bestätigt

3.7

Umhüller

Person, welche die Oberflächenvorbereitung und Aufbringung der Umhüllung ausführt

3.8

Rückschnitt

Zu Verbindungszwecken (z. B. Schweißen) verbleibende unbeschichtete/nicht umhüllte Rohrenden

3.9

Kunde

Unternehmen als Auftraggeber oder als Rohrleitungsbetreiber

3.10

Nachumhüllungsbereich

(Schweißnahtbereich) nicht umhüllter Verbindungsbereich durch Rohrkürzungen, Rückschnitte oder Schweißnähte

3.11

Umhüllungsfehlstelle

Fehler in der Umhüllung, die elektrische Leitfähigkeit aufweist, wenn sie einer bestimmte Spannung ausgesetzt wird

3.12**Prüf- und Testplan****ITP**

(en: inspection and testing plan)

Dokument, welches die Abfolge der Prüfungen und Tests, einschließlich Prüfmittel und Verfahren zusammenfasst

3.13**Prüfer**

Endbenutzer und/oder Käufer für einen oder mehrere der in diesem Teil der ISO 21809 festgelegten Prüfungen

3.14**Bandlage**

Einzelbandwicklung ohne Überlappung

Anmerkung Wicklungen eines Bandes mit 50% Überdeckung bilden eine zweilagige Umhüllung

3.15**Hersteller**

Unternehmen, welches das Umhüllungsmaterial herstellt

3.16**Maximale Einsatztemperatur der Nachumhüllung** **$T_{\max}$**

Maximale dauerhafte Temperatur, welche die Nachumhüllung verkraftet

3.17**Maximale der Planung zugrunde gelegte Temperatur der Rohrleitung**

Maximale Temperatur, für welche die Rohrleitungen geplant worden ist

3.18**Minimale Einsatztemperatur der Nachumhüllung**

Minimale Temperatur, welche die Nachumhüllung während des Betriebs und Aufbringung verkraftet

3.19**Überlappung**

Bereich, in dem sich Nachumhüllung und Werksumhüllung überschneiden

3.20**Rohrleitung**

Einrichtung zum Durchleiten von flüssigen Medien einschließlich Rohr, Molchschleusen, Komponenten und Zubehör und Absperrarmaturen

[ISO 13623]

3.21**Rohrleitungssystem**

Rohrleitungen mit dazugehörigen Anlagenteilen wie Verdichter- oder Pumpstationen, Leitstellen, Mess- und Regelstationen, Speichersysteme, Überwachungs- und Datenverarbeitungssysteme (SCADA), Sicherheitssysteme, Korrosionsschutz-Systeme sowie weitere Einrichtungen oder Gebäude, welche zum Transport von Flüssigkeiten verwendet werden

[ISO 13623]

3.22

Vorfertigungs-Prozess

PPT

(en: pre-production-trial)

Aufbringung der Nachumhüllung und Inspektion/Prüfung ihrer Eigenschaften, um zu bestätigen, dass der APS die Fähigkeit hat, die Nachumhüllung mit der geforderten Qualität auf der Baustelle unmittelbar vor Ausführungsbeginn auszuführen.

3.23

Grundierung

Material, welches als ein Film auf den Untergrund (Metall-und / oder Werksumhüllung) aufgebracht wird, um die Haftung der nachfolgenden Umhüllung zu gewährleisten

3.24

Vorfertigungs-Qualitätssicherungsprüfung

PQT

(en: procedure qualification trial)

Aufbringen einer Nachumhüllung und anschließende Inspektion/Prüfung der geforderten Eigenschaften, um sicherzustellen, dass die APS erfüllt werden, durchgeführt nach den Vorgaben des Herstellers oder einer abgestimmten Ausführung/Lokalität

3.25

Besteller

Unternehmen, welches für die Festlegung der Bestellanforderungen verantwortlich ist

3.26

Wickelschlauch, Schrumpfschlauch

Hülle, welcher die Nachumhüllungsstelle des Stahlrohrs umschließt

— Leerseite —

Contents

Page

Foreword	xi
Introduction.....	xii
1 Scope	1
2 Normative references	1
3 Terms and definitions	4
4 Symbols and abbreviated terms	6
4.1 Symbols.....	6
4.2 Abbreviated terms	7
5 General requirements	8
5.1 Rounding	8
5.2 Compliance to standard.....	8
6 Information to be supplied by the purchaser	8
6.1 General information	8
6.2 Additional information	9
7 Application procedures and qualification.....	9
7.1 Application procedure specification (APS)	9
7.2 Coating materials	10
7.3 Procedure qualification trial (PQT)	11
7.4 Pre-production trial (PPT).....	11
7.5 Qualification of coating and inspection personnel.....	12
7.6 Production testing and inspection	12
7.7 Inspection documents and traceability	12
8 Classification of field joint coatings.....	13
9 General requirements for surface preparation, coating application, testing and repair	14
9.1 Surface preparation.....	14
9.1.1 General	14
9.1.2 Preparation of the steel substrate	14
9.1.3 Preparation of the adjacent plant-applied coating.....	15
9.2 Application of the coating	15
9.3 Visual inspection of the applied coating.....	16
9.4 Testing of the field joint coating	16
9.5 Repairs	16
9.6 Verification, handling and storage of coating materials	16
10 Hot-applied bituminous tape coatings	16
10.1 Coating identification.....	16
10.2 Description of the coatings	16
10.3 Surface preparation.....	16
10.4 Coating application	17
10.4.1 General	17
10.4.2 Application of the primer	17
10.4.3 Application of the bituminous tapes	17
10.4.4 Overlap	17
10.5 Testing of the applied coatings	18
10.5.1 General	18
10.5.2 Thickness	18
10.5.3 Holiday detection.....	18

10.5.4	Impact resistance.....	18
10.5.5	Indentation resistance.....	18
10.5.6	Specific electrical insulation resistance	18
10.5.7	Cathodic disbondment.....	18
10.5.8	Peel strength to pipe surface and plant coating	19
10.5.9	Hot-water immersion test.....	19
10.5.10	Lap shear strength.....	19
11	Petrolatum and wax-based tape coatings	22
11.1	Coating identification	22
11.2	Description of the coatings	22
11.2.1	Petrolatum tapes (Type 1B)	22
11.2.2	Wax-based tapes (Type 1C)	22
11.3	Surface preparation	22
11.4	Coating application.....	23
11.4.1	General.....	23
11.4.2	Application of the primer	23
11.4.3	Application of petrolatum or wax-based tapes.....	23
11.4.4	Overlap.....	23
11.5	Testing of the applied coatings	23
11.5.1	General.....	23
11.5.2	Thickness	23
11.5.3	Holiday detection	24
11.5.4	Impact resistance.....	24
11.5.5	Indentation resistance.....	24
11.5.6	Specific electrical insulation resistance	24
11.5.7	Cathodic disbondment.....	24
11.5.8	Peel strength to pipe surface and plant coating	24
11.5.9	Hot-water immersion test.....	24
11.5.10	Drip resistance	24
12	Cold-applied polymeric tape coatings.....	26
12.1	Coating identification	26
12.2	Description of the coatings	26
12.3	Surface preparation	26
12.4	Coating application.....	27
12.4.1	General.....	27
12.4.2	Application of the primer	27
12.4.3	Application of polymeric tapes	27
12.4.4	Overlap.....	27
12.5	Testing of the applied coatings.....	27
12.5.1	General.....	27
12.5.2	Thickness	27
12.5.3	Holiday detection	28
12.5.4	Impact resistance.....	28
12.5.5	Indentation resistance.....	28
12.5.6	Cathodic disbondment.....	28
12.5.7	Peel strength between tape layers of polymeric tapes.....	28
12.5.8	Peel strength to pipe surface and plant coating	28
12.5.9	Hot-water immersion test.....	28
12.5.10	Lap shear strength.....	29
12.5.11	Thermal ageing resistance	29
13	Non-crystalline low-viscosity polyolefin based coatings.....	30
13.1	Coating identification	30
13.2	Description of the coatings	30
13.3	Surface preparation	31
13.4	Application of the coatings.....	31
13.4.1	General.....	31
13.4.2	Overlap.....	31
13.5	Testing of the applied coating.....	31

13.5.1	General	31
13.5.2	Thickness	32
13.5.3	Holiday detection	32
13.5.4	Impact resistance	32
13.5.5	Indentation resistance	32
13.5.6	Cathodic disbondment resistance	32
13.5.7	Peel strength between outer wrap and compound and between layers of outer wrap	32
13.5.8	Adhesion to pipe surface and plant coating	33
13.5.9	Thermal ageing resistance	33
13.5.10	Lap shear strength	33
13.5.11	Hot-water immersion test	33
13.5.12	Glass transition temperature	34
13.5.13	Drip resistance	34
14	Coatings based on heat-shrinkable materials	37
14.1	Coating identification	37
14.2	Description of the coatings	37
14.2.1	General	37
14.2.2	Type 2A	37
14.2.3	Types 2B, 2C and 2D	38
14.3	Surface preparation	38
14.4	Application of the coatings	38
14.4.1	General	38
14.4.2	Application of the primer	38
14.4.3	Application of heat-shrinkable materials	39
14.4.4	Overlap	39
14.5	Testing of the applied coatings	39
14.5.1	General	39
14.5.2	Thickness	39
14.5.3	Holiday detection	40
14.5.4	Peel strength	40
14.5.5	Cathodic disbondment	40
14.5.6	Hot-water immersion test	40
14.5.7	Impact resistance	40
14.5.8	Indentation resistance	40
14.5.9	Lap shear strength	41
14.5.10	Thermal ageing resistance and thermal stability	41
14.5.11	Bursting strength	41
14.5.12	Oxidation induction time	41
15	Hot-applied microcrystalline wax coatings	45
15.1	Coating identification	45
15.2	Description of the coating	45
15.3	Surface preparation	45
15.4	Application of the coating	46
15.4.1	General	46
15.4.2	Application of the microcrystalline wax	46
15.4.3	Application of the outer wrap	46
15.4.4	Application of wax top coat	46
15.5	Testing of the applied coatings	46
15.5.1	General	46
15.5.2	Thickness	46
15.5.3	Holiday detection	46
15.5.4	Adhesion	47
15.5.5	Hardness	47
16	Elastomeric coatings	48
16.1	Coating identification	48
16.2	Description of the coatings	48
16.3	Surface preparation	48

16.4	Application of the coatings.....	49
16.4.1	General.....	49
16.4.2	<i>In situ</i> vulcanization method	49
16.4.3	Ambient-cure adhesive method	49
16.5	Testing of the applied coatings.....	49
16.5.1	General.....	49
16.5.2	Visual appearance	49
16.5.3	Coating thickness	49
16.5.4	Holiday detection	50
16.5.5	Hardness.....	50
16.5.6	Adhesion.....	50
16.5.7	Hot-water immersion test.....	50
16.5.8	Cathodic disbondment.....	50
16.5.9	Density	50
16.5.10	Rheometer curve — Oscillating disc	50
16.5.11	Tensile strength	51
16.5.12	Elongation at break.....	51
16.5.13	Tear strength	51
16.5.14	Electrical volume resistivity	51
16.5.15	Ozone resistance	51
16.5.16	Resistance to seawater	51
17	Fusion-bonded epoxy (FBE) powder coatings	53
17.1	Coating identification	53
17.2	Description of the coatings	53
17.3	Surface preparation	54
17.4	Application of the coatings.....	54
17.4.1	General.....	54
17.4.2	Transport and storage of epoxy powder	54
17.4.3	Heating.....	54
17.4.4	Application of epoxy powder.....	55
17.5	Testing of the applied coatings.....	55
17.5.1	General.....	55
17.5.2	Visual appearance	55
17.5.3	Thickness	55
17.5.4	Holiday detection	55
17.5.5	Adhesion.....	55
17.5.6	Degree of cure.....	56
17.5.7	Impact resistance.....	56
17.5.8	Cathodic disbondment.....	56
17.5.9	Hot-water immersion test.....	56
17.5.10	Flexibility	56
18	Liquid-applied coatings	56
18.1	Coating identification	56
18.2	Description of the coatings	57
18.2.1	Liquid epoxy — 6A.....	57
18.2.2	Liquid polyurethane — 6B	57
18.2.3	Fibre reinforced epoxy — 6C.....	57
18.2.4	Fibre reinforced vinyl ester — 6D	57
18.2.5	Cast polyurethane — 6E	57
18.3	Surface preparation	57
18.4	Application of the coatings.....	57
18.4.1	General.....	57
18.4.2	Heating.....	57
18.4.3	Liquid coatings application	58
18.5	Testing of the applied coatings.....	58
18.5.1	General.....	58
18.5.2	Thickness	58
18.5.3	Holiday detection	58

18.5.4	Adhesion	58
18.5.5	Impact resistance	58
18.5.6	Hardness	59
18.5.7	Cathodic disbondment.....	59
18.5.8	Hot-water immersion test	59
18.5.9	Flexibility	59
18.5.10	Indentation resistance	59
18.5.11	Specific electrical insulation resistance	59
18.5.12	Compressive strength.....	59
18.5.13	Electrical volume resistivity	60
18.5.14	Water absorption	60
19	Hot-applied polyolefin-based coatings	62
19.1	Coating identification	62
19.2	Description of the coatings	63
19.2.1	Flame-sprayed polypropylene — Type 7A.....	63
19.2.2	Hot-applied polypropylene tapes/sheets — Type 7B	63
19.2.3	Injection-moulded polypropylene — Type 7C	63
19.2.4	Flame-sprayed polyethylene — Type 7D	63
19.2.5	Hot-applied polyethylene tapes/sheets — Type 7E	64
19.3	Surface preparation.....	64
19.4	Application of the coating	64
19.4.1	General	64
19.4.2	Heating	64
19.4.3	Application of the epoxy layer	65
19.4.4	Application of the chemically modified PP or PE	65
19.4.5	Application of the polyolefin top coat	65
19.5	Testing of the applied coatings	66
19.5.1	General	66
19.5.2	Thickness	66
19.5.3	Holiday detection.....	66
19.5.4	Peel strength.....	66
19.5.5	Adhesion to plant coating	67
19.5.6	Hot-water immersion test	67
19.5.7	Degree of cure	67
19.5.8	Cathodic disbondment.....	67
19.5.9	Impact resistance	67
19.5.10	Indentation resistance	67
19.5.11	Oxidation induction time	67
19.5.12	Flexibility	67
20	Thermal spray aluminium (TSA) coatings	71
20.1	Coating identification	71
20.2	Description of the coating	71
20.3	Qualification	71
20.4	Surface preparation.....	71
20.5	Application of the coating	71
20.5.1	General	71
20.5.2	Aluminium	71
20.5.3	Sealer	72
20.6	Testing of the applied coating	72
20.6.1	General	72
20.6.2	Visual inspection	72
20.6.3	TSA porosity	72
20.6.4	Coating thickness.....	72
20.6.5	Bend test	72
20.6.6	Pull-off adhesion test	73
20.6.7	Sealer penetration	73
Annex A	(normative) Test programmes for procedure for qualification trails, pre-production trails or production testing	74

A.1	General.....	74
A.2	Inspections, tests and frequencies.....	74
A.3	Retest.....	74
Annex B	(normative) Inspection of thickness.....	79
B.1	General.....	79
B.2	Equipment.....	79
B.3	Procedure.....	79
B.4	Results.....	79
Annex C	(normative) Holiday detection test.....	80
C.1	General.....	80
C.2	Equipment.....	80
C.3	Procedure.....	80
C.4	Results.....	80
Annex D	(normative) Impact test.....	81
D.1	General.....	81
D.2	Equipment.....	81
D.3	Procedure.....	81
D.4	Results.....	82
Annex E	(normative) Indentation test.....	83
E.1	General.....	83
E.2	Equipment.....	83
E.3	Procedure.....	83
E.4	Results.....	84
Annex F	(normative) Specific electrical insulation resistance.....	85
F.1	General.....	85
F.2	Equipment.....	85
F.3	Preparation of the test samples.....	85
F.4	Procedure.....	85
F.5	Results.....	86
Annex G	(normative) Cathodic disbondment test.....	87
G.1	General.....	87
G.2	Equipment.....	87
G.3	Sampling.....	88
G.4	Procedure.....	88
G.5	Investigation procedure.....	88
G.6	Results.....	89
Annex H	(normative) Peel-strength test.....	93
H.1	Measurement of the peel strength with a tensile testing machine.....	93
H.1.1	General.....	93
H.1.2	Equipment.....	93
H.1.3	Procedure.....	94
H.1.4	Results.....	95
H.2	Measurement of the peel strength with a spring balance or digital load cell.....	95
H.2.1	General.....	95
H.2.2	Equipment.....	95
H.2.3	Procedure.....	95
H.2.4	Results.....	96
Annex I	(normative) Hot water immersion test.....	98
I.1	General.....	98
I.2	Equipment.....	98
I.3	Sample preparation.....	98
I.3.1	Laboratory prepared samples.....	98
I.3.2	Samples from qualification trials.....	99
I.4	Preparation of test area.....	99
I.5	Test procedure.....	99

I.6	Results	100
Annex J	(normative) Lap shear strength	101
J.1	Lap shear strength of tape coatings	101
J.1.1	General	101
J.1.2	Equipment	101
J.1.3	Preparation of the test samples	101
J.1.4	Procedure	101
J.1.5	Results	102
J.2	Lap shear strength of shrinkable material coatings	102
J.2.1	General	102
J.2.2	Apparatus	102
J.2.3	Preparation of the test samples	103
J.2.4	Procedure	103
J.2.5	Results	104
Annex K	(normative) Drip resistance	105
K.1	General	105
K.2	Equipment	105
K.3	Preparation of the test sample	105
K.4	Procedure	105
K.5	Results	105
Annex L	(normative) Peel strength between layers	106
L.1	General	106
L.2	Equipment	106
L.3	Preparation of the test sample	106
L.3.1	General	106
L.3.2	Tapes	106
L.3.3	Shrinkable materials	107
L.4	Procedure	107
L.4.1	General	107
L.4.2	Tapes	107
L.4.3	Shrinkable materials	108
L.4.4	Results	108
Annex M	(normative) Thermal ageing resistance	109
M.1	Elongation at break	109
M.1.1	General	109
M.1.2	Equipment	109
M.1.3	Preparation of the test samples	109
M.1.4	Procedure	109
M.1.5	Results	109
M.2	Peel strength between layers	110
M.2.1	General	110
M.2.2	Equipment	110
M.2.3	Preparation of the test samples	110
M.2.4	Procedure	110
M.2.5	Results	110
M.3	Peel strength to pipe surface	111
M.3.1	General	111
M.3.2	Apparatus	111
M.3.3	Preparation of the test samples	111
M.3.4	Procedure	111
M.3.5	Results	111
M.4	Bursting strength of reinforced backing	112
M.4.1	General	112
M.4.2	Equipment	112
M.4.3	Preparation of the test samples	112
M.4.4	Procedure	112
M.4.5	Results	112

Annex N (normative) Thermal stability test (Hot air ageing)	114
N.1 General	114
N.2 Equipment	114
N.3 Preparation of the test samples	114
N.4 Procedure	114
N.5 Results	114
Annex O (normative) Bursting strength of reinforced backing	115
O.1 General	115
O.2 Equipment	115
O.3 Preparation of the test samples	115
O.4 Procedure	115
O.5 Results	115
Annex P (normative) Thermal analysis of epoxy powder and cured coating film (FBE)	116
P.1 General	116
P.2 Equipment	116
P.3 Procedures and measurement for epoxy powder	116
P.3.1 Measurement	116
P.3.2 Evaluation of results	116
P.4 Procedures and measurement for coating sample	117
P.4.1 General	117
P.4.2 Measurement	117
P.4.3 Evaluation of results	118
P.4.4 Results	119
Annex Q (normative) Adhesion test - Resistance to removal	120
Q.1 General	120
Q.2 Equipment	120
Q.3 Procedure	120
Q.4 Results	120
Bibliography	122

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

ISO 21809-3 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*.

This second edition cancels and replaces the first edition (ISO 21809-3:2008), which has been technically revised.

ISO 21809 consists of the following parts, under the general title *Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems*:

- *Part 1: Polyolefin coatings (3- layer PE and 3- layer PP)*
- *Part 2: Fusion-bonded epoxy coatings*
- *Part 3: Field joint coatings*
- *Part 4: Polyethylene coatings (2-layer PE)*
- *Part 5: External concrete coatings*

Multilayer fusion bonded epoxy coatings is to form the subject of future part 6.

Introduction

Users of this part of ISO 21809 should be aware that further or differing requirements can be needed for individual applications. This part of ISO 21809 is not intended to inhibit a vendor from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this part of ISO 21809 and provide details.

Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems — Part 3: Field joint coatings

1 Scope

This part of ISO 21809 specifies requirements for field joint coating of seamless or welded steel pipes for pipeline transportation systems in the petroleum, petrochemical and natural gas industries as defined in ISO 13623. This part of ISO 21809 specifies the qualification, application and testing of the corrosion protection coatings applied to steel surfaces left bare after the pipes and fittings (components) are joined by welding.

This part of ISO 21809 defines and codifies in Table 1 the different types of field joint coatings for pipelines.

This part of ISO 21809 does not address additional mechanical protection, thermal insulation or joint infills for concrete weight-coated pipes.

NOTE Pipes coated in accordance with this part of ISO 21809 are considered suitable for further protection by means of cathodic protection.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 34-1, Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces

ISO 37, Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties

ISO 62, Plastics — Determination of water absorption

ISO 188, Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests

ISO 527-2, Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics

ISO 527-3, Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets

ISO 868, Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)

ISO 1431-1, Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing

ISO 1523, Determination of flash point — Closed cup equilibrium method

ISO 1817, Rubber, vulcanized — Determination of the effect of liquids

ISO 2178, Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method

ISO 2781, Rubber, vulcanized or thermoplastic — Determination of density

ISO 2808, Paints and varnishes — Determination of film thickness

ISO 2811-1, Paints and varnishes — Determination of density — Part 1: Pyknometer method

ISO 3251, Paints, varnishes and plastics — Determination of non-volatile-matter content

ISO 3303-1, Rubber or plastics coated fabrics – Determination of bursting strength – Part 1: Steel-ball method

ISO 3417, Rubber — Measurement of vulcanization characteristics with the oscillating disc curemeter

ISO 3801, Textiles — Woven fabrics — Determination of mass per unit length and mass per unit area

ISO 4591, Plastics — Film and sheeting — Determination of average thickness of a sample, and average thickness and yield of a roll, by gravimetric techniques (gravimetric thickness)

ISO 4593, Plastics — Film and sheeting — Determination of thickness by mechanical scanning

ISO 4624, Paint and varnishes — Pull-off test for adhesion

ISO 4625-1, Binders for paints and varnishes — Determination of softening point — Part 1: Ring-and-ball method

ISO 5893, Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification

ISO 7619-1, Rubber, vulcanized or thermoplastic — Determination of indentation hardness - Part 1: Durometer method (Shore hardness)

ISO 8501-1, Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings

ISO 8501-3, Preparation of steel substrates before application of paints and related products. - Visual assessment of surface cleanliness – Part 3: Preparation grades of welds, edges and other areas with surface imperfections.

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

ISO 8502-6, Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 6: Extraction of soluble contaminants for analysis — The Bresle method

ISO 8502-9, Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 9: Field method for conductometric determination of water-soluble salts

ISO 8503-1, Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces

ISO 8503-2, Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel — Comparator procedure

ISO 8503-4, Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile — Stylus instrument procedure

ISO 8503-5, Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 5: Replica tape method for the determination of the surface profile

ISO 8504-2, Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 2: Abrasive blast-cleaning

ISO 8504-3, Preparation of steel substrates before application of paints and related products — Surface preparation methods — Part 3: Hand- and power-tool cleaning

ISO 10474:2013, Steel and steel products — Inspection documents

ISO 11124 (all parts), Preparation of steel substrates before application of paints and related products — Specifications for metallic blast-cleaning abrasives

ISO 11126 (all parts), Preparation of steel substrates before application of paints and related products — Specifications for non-metallic blast-cleaning abrasives

ISO 11357-2, Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and glass transition step height

ISO 11357-6, Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)

ISO 13623, Petroleum and natural gas industries — Pipeline transportation systems

ISO 21809-2, Petroleum and natural gas industries — External coatings for buried submerged pipelines used in pipeline transportation systems — Part 2: Fusion-bonded epoxy coatings

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

EN 10204:2004, Metallic products - Types of inspection documents

ASTM D 70 ¹⁾, Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)

ASTM D 92, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D 127, Standard Test Method for Drop Melting Point of Petroleum Wax, Including Petrolatum

ASTM D 149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

ASTM D 257, Standard Test Methods for DC Resistance or Conductance of Insulating Materials

ASTM D 695, Standard Test Method for Compressive Properties of Rigid Plastics

ASTM D 937, Standard Test Method for Cone Penetration of Petrolatum

¹⁾ American Society for Testing and Materials, 100 Harbour Drive, West Conshohocken, PA 19428-2959, USA.

ASTM D 938, Standard Test Method for Congealing Point of Petroleum Waxes, Including Petrolatum

ASTM D 1000, Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

ASTM D 1141, Standard Practice for the Preparation of Substitute Ocean Water

ASTM D 1321, Standard Test Method for Needle Penetration of Petroleum Waxes

ASTM D 2084, Standard Test Method for Rubber Property — Vulcanization Using Oscillating Disk Cure Meter

ASTM D 4285, Standard Test Method for Indicating Oil or Water in Compressed Air

ASTM D 4541, Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers

SSPC-SP1 ²⁾, Surface preparation specification No.1 — Solvent cleaning

SSPC CS 23.00, Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc and Their Alloys and Composites for the Corrosion Protection of Steel

AWS C2.25/C2.25M ³⁾, Specification for Thermal Spray Feedstock Solid and Composite Wire and Ceramic Rods

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 application procedure specification

APS

document describing procedures, methods, equipment and tools used for coating application

3.2 applicator

company that undertakes the coating application in accordance with the provisions of this part of ISO 21809

3.3 batch

quantity of material produced in a continuous manufacturing operation using raw materials of the same source and grade

3.4 batch certificate

certificate of analysis issued by the manufacturer for a given batch

3.5 bonding agent

material applied as a film to the primed metal surface in order to ensure adhesion of the subsequent protective coating

²⁾ The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656, USA.

³⁾ America Welding Society, 550 N.W. Le Jeune Road, Miami, Florida 33126, USA.

3.6

inspection document

document issued in accordance with ISO 10474:2013 (or EN 10204:2004) stating compliance with the requirements given in the purchase order

3.7

coating operative

individual undertaking coating activity on the work site, including surface preparation

3.8

cutback

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

3.9

end user

company that owns and/or operates the pipeline system

3.10

field joint area

⟨weld zone⟩ uncoated area that results when two pipe sections or a pipe section and a fitting with coating cutbacks are assembled, by welding, in the field

3.11

holiday

coating discontinuity that exhibits electrical conductivity when exposed to a specific voltage

3.12

inspection and testing plan

ITP

document providing an overview of the sequence of inspections and tests, including resources and procedures

3.13

inspector

end user and/or purchaser's representative responsible for one or more of the inspections specified in this part of ISO 21809

3.14

layer of tape

single wrap of tape without overlap

Note to entry

Wrapping of a tape with 50 % overlap constitutes a two-layer coating

3.15

manufacturer

company responsible for the manufacture of coating material

3.16

maximum service temperature of field joint coating

T_{max}

maximum continuous temperature that the field joint coating can resist

3.17

maximum design temperature of pipeline

maximum operating temperature for which the pipeline has been designed

3.18

minimum service temperature of field joint coating

minimum temperature that the field joint coating can resist during operation and installation

3.19

overlap

length of the field joint coating over the plant-applied coating including the coating bevel

3.20

pipeline

those facilities through which fluids are conveyed, including pipe, pig traps, components and appurtenances, up to and including the isolating valves

[ISO 13623]

3.21

pipeline system

pipeline with compressor or pump stations, pressure control stations, flow control stations, metering, tankage, supervisory control and data acquisition system (SCADA), safety systems, corrosion protection systems, and any other equipment, facility or building used in the transportation of fluids

[ISO 13623]

3.22

pre-production trial

PPT

application of coating and inspection/testing of its properties, to confirm that the APS is able to produce a field joint coating with the specified properties, carried out in the field immediately prior to start of production

3.23

primer

material applied as a film on substrate (metal and/or plant coating) to ensure adhesion of the subsequent protective coating

3.24

procedure qualification trial

PQT

application of a field joint coating and subsequent inspection/testing of its properties, to confirm that the APS is able to produce a coating with the specified properties, carried out at the premises of the applicator or any other agreed location

3.25

purchaser

company responsible for providing the product order requirements

3.26

wraparound sleeve

sleeve that is wrapped, circumferentially, around the steel pipe area being coated

4 Symbols and abbreviated terms

4.1 Symbols

B_0	bursting strength without heat ageing
B_{70}	bursting strength after heat ageing for 70 days
B_{100}	bursting strength after heat ageing for 100 days

C	percentage of conversion of FBE coating
ΔH	exothermic heat of reaction
ΔT_g	variation of glass transition temperature between two or more successive thermal analysis scans
E_0	elongation at break without heat ageing
E_{70}	elongation at break after heat ageing for 70 days
E_{100}	elongation at break after heat ageing for 100 days
P_0	peel strength to pipe surface without heat ageing
P_{70}	peel strength to pipe surface after heat ageing for 70 days
P_{100}	peel strength to pipe surface after heat ageing for 100 days
P'_0	peel strength between layers without heat ageing
P'_{70}	peel strength between layers after heat ageing for 70 days
P'_{100}	peel strength between layers after heat ageing for 100 days
R_S	specific electrical resistance of a coating
R_{S70}	specific electrical resistance after 70 days
R_{S100}	specific electrical resistance after 100 days
t	thickness
$T_{\max}$	maximum service temperature of field joint coating

4.2 Abbreviated terms

APS	application procedure specification
DFT	dry film thickness
DSC	differential scanning calorimetry
EP	epoxy
EPDM	ethylene propylene diene monomer
FBE	fusion-bonded epoxy
FJC	field joint coating
HSS	heat-shrink sleeve
ITP	inspection and testing plan
MSDS	material safety data sheet
PE	polyethylene
PP	polypropylene
PPT	pre-production trial
PQT	procedure qualification trial
PU	polyurethane
PVC	polyvinylchloride
TSA	thermal spray aluminium

2LPE	two-layer polyethylene coating
3LPE	three-layer polyethylene coating
3LPP	three-layer polypropylene coating

5 General requirements

5.1 Rounding

Unless otherwise stated in this part of ISO 21809, to determine conformance with the specified requirements, observed or calculated values shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with ISO 80000-1:2009, Annex B, Rule A.

NOTE For the purposes of this provision, the rounding method of ASTM E 29 is equivalent to ISO 80000-1:2009, Annex B, Rule A.

5.2 Compliance to standard

A quality system should be applied to assist compliance with the requirements of this part of ISO 21809.

NOTE ISO/TS 29001 gives sector-specific guidance on quality management systems.

The applicator shall be responsible for complying with the requirements of this part of ISO 21809. It shall be permissible for the purchaser to make any investigation necessary in order to be assured of compliance by the applicator and to reject any material that does not comply.

6 Information to be supplied by the purchaser

6.1 General information

The purchase order shall include the following information:

- designation of this part of ISO 21809 and year of publication (ISO 21809-3:2015);
- type of field joint coating system in accordance with Table 1;
- minimum and maximum thickness of the field joint coating (if applicable);
- minimum and maximum design temperature of the pipeline;
- cutback length (or length of the field joint being coated), including tolerances;
- pipe material/grade;
- pipe nominal outer diameter and wall thickness;
- plant-applied coating system, including thickness;
- number of field joints to be coated;
- type and frequency of inspection document in accordance with ISO 10474:2013 (or EN 10204:2004) (see 7.7).

6.2 Additional information

The purchase order shall specify which of the following provisions apply for the specific order item:

- permissible field joint coating repairs (see 9.5);
- acceptable level of soluble salts (see 9.1.2.2);
- any special requirement with regard to FJC overall thickness and/or thickness of individual layers (see 10.5.2, 11.2.2, 12.5.2, 13.5.2, 16.5.3, 17.5.3, 18.5.2, 19.5.2);
- overlap on the parent (i.e. “plant-applied”) coating or detailed drawing of the field joint coating with dimensional tolerances (see 17.5.3);
- requirements for traceability and marking;
- requirements for documentation and schedule of supply of documentation (see 7.7);
- qualification of the applicator's personnel who apply and/or inspect the coating (see 7.5);
- purchaser's approval of the application procedure specification (APS) (see 7.1);
- use of specific proprietary coating materials (see 7.2);
- procedure qualification trial (PQT) (see 7.3);
- pre-production trial (PPT) (see 7.4);
- subsequent coating (or infill) being applied;
- temperature range during installation;
- method of installation of the pipeline;
- time constraints for application and number and dimensions of working stations, if relevant;
- specific testing conditions and minimum requirements when applicable (e.g. cathodic disbondment or flexibility) (see 17.5.8, 17.5.10, ect.).

7 Application procedures and qualification

7.1 Application procedure specification (APS)

The applicator shall prepare an APS to be approved by the end user and/or purchaser prior to the start of production and prior to any agreed PQT and/or PPT (see 7.3 and 7.4). The responsibilities shall be clearly defined between all parties. Once approved, the APS shall not be changed without prior written authorization of the parties.

The APS shall include:

- identification of the coating;
- manufacturer's instructions for application;
- preparation of steel surface and plant-applied coating, including inspection (see 9.1);

- data sheets defining coating and abrasive blasting material properties, including all health and safety data (see 7.2 and 9.1.2.2);
- maximum service temperature, $T_{\max}$, of field joint coating;
- receipt, handling and storage of coating and abrasive blasting materials (see 7.2 and 9.1.2.2);
- coating application procedure, tools and equipment;
- overlap (with tolerances) of FJC over plant coating (a drawing should be considered for certain types of FJC);
- time required for coating application;
- inspection and testing of applied FJC;
- repair and testing of defective FJC;
- stripping of defective FJC;
- marking, traceability and documentation.

The APS shall cover all items associated with quality control as defined in this part of ISO 21809 and any agreed options for the specific FJC.

All coating work, testing and inspection shall be carried out according to the APS.

7.2 Coating materials

The applicator shall provide the data sheets specified in Clauses 10 to 20 for each coating material from the manufacturer.

In addition to the coating-material data sheets, the applicator shall provide the following information from the manufacturer:

- batch certificates certifying that the coating materials delivered meet the coating characteristics as set forth in the coating data sheets, and any agreed optional requirements, if applied according to the manufacturer's instructions;
- packaging, transport and storage requirements of coating materials;
- range of application conditions including minimum and maximum application temperatures (for materials and substrate) and relative humidity;
- material safety data sheet (MSDS).

Marking on each shipment of coating materials shall contain the following information:

- manufacturer's name;
- name and complete identification of material, including plant of origin;
- reference to applicable coating-material standards, if any;
- production batch number;
- mass/size;
- date of production;
- expiry date.

7.3 Procedure qualification trial (PQT)

If specified by the purchaser or otherwise required by this part of ISO 21809, the APS shall be qualified by a PQT. Test methods and frequencies for PQT are specified in Annex A. Acceptance criteria are given in the relevant clauses referred to in Annex A.

The applicator may request the manufacturer(s) to assist during the PQT to ensure the correct use of the coating material(s) and to train applicator personnel.

Qualification tests shall be carried out on representative pipes having the diameter and thickness as agreed upon between applicator and end user or purchaser.

Tests shall be carried out on test zones distributed along a pipe coated with the actual parent (plant-applied) coating. The length of the test zones shall be equivalent to the field joint coating length.

If not present, a circumferential cap weld shall be added at the centre of each of the test zones to simulate the field weld.

If heating of the area to be coated is specified in the APS, it shall be demonstrated that there is no visual detrimental effect such as blistering or disbondment of the plant-applied coating.

All tools and equipment (e.g. for induction heating, abrasive blasting, coating application and inspection) being used for PQT shall be of the same type as those being used for the actual field joint coating.

Unless otherwise specified, at least three test zones shall be coated.

Coating repairs and stripping of defective FJC shall be included in PQT (except if coating repairs are not allowed).

The time for coating application during PQT shall be consistent with the estimated field joint coating time in the field. Any significant differences in the PQT environment compared to actual production conditions should be considered, e.g. number of work stations, similarity of, or differences in, lifting equipment.

For pipelines that experience deformations above 0,3 % during handling or installation (e.g. reeling), the PQT shall include relevant tests carried out after pipe deformation. The test temperature shall be at least 5 °C below minimum deformation temperature.

The applicator shall submit a complete report of the qualification test results to the purchaser for approval.

7.4 Pre-production trial (PPT)

If specified by the purchaser or otherwise required by this part of ISO 21809, a PPT shall be performed on site to verify the:

- surface condition and adhesion of the plant-applied coating on steel in the vicinity of the cut-backs;
- field joint coating materials;
- application procedure;
- equipment being used for surface preparation and coating application;
- heating equipment and results when used;
- application of the coating system;
- qualification of the coating operatives and purchaser's inspectors that will actually be used in the field;
- properties of the applied FJC.

The above shall comply with the requirements of this part of ISO 21809 and the results of any previous PQT.

Test methods and frequencies for PPT are specified in Annex A. Acceptance criteria are given in the relevant clauses to which reference is made in Annex A.

The PPT shall be carried out in presence of the end user and/or purchaser (or their representative) at the start of operations when equipment and personnel are mobilized on site. The PPT shall be performed on the first joints to be coated (or, if agreed, on a dummy pipe).

7.5 Qualification of coating and inspection personnel

The coating operatives shall be qualified to undertake the coating application procedure and repair work. The qualification may be obtained by demonstration at a PQT, during PPT, via a certification organization or as agreed with the end user.

The applicator shall request the manufacturer of the coating material(s) and equipment to provide technical assistance to the coating operatives if necessary.

Inspectors and applicator personnel carrying out the coating inspection shall be trained and qualified.

7.6 Production testing and inspection

The applicator shall perform inspection and testing during production in accordance with an ITP to verify the surface preparation, coating application and the specified properties of the applied FJC.

The ITP shall be prepared by the applicator and shall be approved by the purchaser prior to the start of the coating work and prior to the start of any PQT and/or PPT. The ITP shall identify all inspection activities and tests, their frequency and the relevant inspection authorities.

Test methods and frequencies are specified in Annex A. Acceptance criteria are given in the relevant clauses to which reference is made in Annex A.

7.7 Inspection documents and traceability

The inspection documents shall be in accordance with ISO 10474:2013 (or EN 10204:2004). The type of certificate of compliance shall be defined in the purchase order.

FJC reports shall identify each field joint by a unique number for identification purposes and shall record the material batch number for traceability. Test results shall be linked to the field joint number or repair on which they were performed. Records shall be maintained on a shift and daily basis and shall be available for inspection by the purchaser and/or end user.

The Inspection documents signed by the applicator (and the inspector, if applicable) shall be transmitted to the purchaser at a frequency defined in the purchase order. Cumulative production records shall be maintained daily.

8 Classification of field joint coatings

The FJC types covered by this part of ISO 21809 are classified in Table 1.

Table 1 — FJC types

Code	Clause	Type of field joint coating
1A	10	Hot-applied bituminous tape coatings
1B	11	Petrolatum tape coatings
1C		Wax-based tape coatings
1D	12	Cold-applied polymeric tape coatings
1E	13	Non-crystalline low-viscosity polyolefin based coatings with polymeric tape outer wrap
1F		Non-crystalline low-viscosity polyolefin based coatings with heat shrinkable sleeve outer wrap
2A	14	Coatings based on heat-shrinkable materials, polyethylene-base, applied without primer
2B		Coatings based on heat-shrinkable materials, polyethylene-based, applied over a liquid epoxy, fusion-bonded epoxy, or other approved primer layer
2C		Coatings based on heat-shrinkable materials, polyolefin-based, with reinforced backing (hybrid), applied over a liquid epoxy, fusion-bonded epoxy, or other approved primer layer
2D		Coatings based on heat-shrinkable materials, polypropylene-based, applied over a liquid epoxy, fusion-bonded epoxy, or other approved primer layer
3	15	Hot-applied microcrystalline wax coatings
4A	16	Elastomeric coatings, polychloroprene-based
4B		Elastomeric coatings, EPDM-based
5A	17	Single-layer fusion-bonded epoxy powder coatings
5B		Two-layer fusion-bonded epoxy powder coatings
6A	18	Liquid applied epoxy based coatings
6B		Liquid applied polyurethane based coatings
6C		Fibre-reinforced epoxy based coatings
6D		Fibre-reinforced vinylester based coatings
6E		Cast solid polyurethane based coatings
7A	19	Coatings based on flame-sprayed polypropylene powder applied over an epoxy layer
7B		Coatings based on polypropylene tapes/sheets hot-applied over an epoxy layer
7C		Coatings based on injection-moulded polypropylene over an epoxy layer
7D		Coatings based on flame-sprayed polyethylene powder applied over an epoxy layer
7E		Coatings based on polyethylene tapes/sheets hot-applied over an epoxy layer
8	20	Thermal spray aluminium (TSA) coatings

The FJC shall be compatible with the plant-applied coating and ensure continuity of corrosion protection.

The weld geometry and structure shall be taken into consideration during the selection of the FJC system.

The maximum service temperature, $T_{\max}$, of the FJC shall be equal or greater than the maximum design temperature of the pipeline.

The FJC shall be compatible with the minimum operating temperature of the pipeline, the ambient temperature during transportation and handling, and during the construction of the pipeline.

9 General requirements for surface preparation, coating application, testing and repair

9.1 Surface preparation

9.1.1 General

Surface preparation shall be carried out in accordance with the APS and as detailed below.

9.1.2 Preparation of the steel substrate

9.1.2.1 General

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

Oil, grease and wax shall be removed by solvent cleaning in accordance with SSPC-SP1.

All visible surface imperfections of substrate caused by the girth welding operation, such as welding slag and spatter, sharp edges or burrs that could damage the coating, detected before or during surface preparation shall be removed by an approved grinding method or filing techniques according to the following grades:

- P3 of standard ISO 8501-3 for components and fittings to be used in submerged conditions (permanent or intermittent);
- P2 of standard ISO 8501-3 for components and fittings to be used in buried conditions.

Grinding of steel defects shall not reduce the wall thickness below the specified minimum wall thickness of the pipe.

Areas of rust or scaling shall be removed by spot abrasive blast-cleaning or wire brushing as specified in the APS.

Dust contamination shall be measured in accordance with ISO 8502-3. Acceptance criteria are given for each FJC type in Clauses 10 to 20.

Chemical treatment of the steel may be used by agreement between the applicator and the purchaser and/or end user, subject to the manufacturer's recommendation.

9.1.2.2 Abrasive blast-cleaning

Abrasives used in the preparation of field joints shall comply with ISO 11124 or ISO 11126.

Compressed air for blast-cleaning shall be free of oil, condensed moisture and any other contaminants, and shall conform to the requirements of ASTM D 4285.

Reclaimed abrasive blast materials shall not be used unless automatic reclaiming equipment is used. Blasting equipment that includes devices to recycle abrasives shall have equipment that ensures removal of dust, fines, corrosion products and other contaminants.

The cleanliness shall be checked in accordance with the requirements of ISO 8501-1. Acceptance criteria are given for each system in Clauses 10 to 20.

NOTE

- Sa 3 is approximately equivalent to NACE No.1/SSPC-SP5 (White metal blast cleaning)

- Sa 2½ is approximately equivalent to NACE No.2/SSPC-SP10 (Near-white metal blast cleaning)
- Sa 2 is approximately equivalent to NACE No.3/SSPC-SP6 (Commercial blast cleaning)

The profile/roughness shall be checked in accordance with the requirements of ISO 8503-5. Acceptance criteria are given for each system in Clauses 10 to 20. Other methods (see ISO 8503-1, ISO 8503-2, ISO 8503-3 and ISO 8503-4) may be used if correlated with ISO 8503-5. The profile shall be of an angular and dense nature.

In areas where the roughness of the profile does not meet these requirements, the surface shall be reblasted.

The level of soluble salts measured in accordance with the requirements of ISO 8502-6 or ISO 8502-9 shall be $\leq 20 \text{ mg/m}^2$ for coating types 2B, 2C, 2D, 4, 5, 6, 7 and 8. It is not necessary to measure the level of soluble salts on the steel surface for the other coating types.

Testing of the soluble-salt level during production may be reduced or omitted by agreement between applicator and end user or purchaser, if a PPT has demonstrated that the application procedure ensures a salt level below these requirements.

9.1.2.3 Wire-brush cleaning

If wire-brush cleaning is permissible (see 9.1.1), it shall be performed in accordance with ISO 8504-3. The surface preparation shall be in accordance with ISO 8501-1 grade St 3 using a power tool.

Manual wire-brush cleaning shall be allowed only if the manufacturer of the FJC requires a degree of cleanliness of ISO 8501-1 grade St 2 and if defined in the APS.

NOTE

- St 2 is approximately equivalent to SSPC-SP2 (Hand tool cleaning)
- St 3 is approximately equivalent to SSPC-SP3 (Power tool cleaning) or SSPC-SP11 (Power tool cleaning down to bare metal)

9.1.3 Preparation of the adjacent plant-applied coating

The plant-coated area adjacent to the cutback shall be prepared to ensure the adhesion of the field joint coating in accordance with Clauses 10 to 20 for each of the different FJC types.

9.2 Application of the coating

The temperature of the substrate shall be at least 3 °C above the dew point.

The coating shall be applied by qualified personnel and in accordance with the APS. The coating shall be applied symmetrically and with approximately equal overlaps onto the plant-applied coating on either side.

Following surface preparation, the surface being coated shall not be exposed for a length of time that can result in flash rust detrimental to the quality of the coating.

At the time of application of the coating, the temperature of the substrate shall be within the temperature range specified in the APS. The temperature of the field joint shall be monitored to ensure that the application conditions are fully satisfied and are uniform across the steel substrate and the plant-applied coating. The methods of monitoring and recording shall be defined in the APS.

During adverse weather conditions, cleaning and coating operations shall be stopped unless protective enclosures are installed that maintain the field joint area in a clean and dry condition as specified in the APS throughout the surface preparation and coating application and curing.

9.3 Visual inspection of the applied coating

The applied coating shall be free of anomalies, contain no surface defects detrimental to the quality of the coating (grit, foreign particles, fish eyes, blisters, etc.) and have approximately equal overlaps onto the plant coating on either side.

9.4 Testing of the field joint coating

Inspection and testing shall be carried out during production in accordance with the agreed ITP. Test procedures and acceptance criteria are defined in Clauses 10 to 20 for different FJC types. Testing frequencies are given in Annex A.

Damaged areas created by testing shall be repaired in accordance with 9.5.

9.5 Repairs

The acceptable size and frequency of field joint coating repairs and the repair procedures shall be subject to agreement between the purchaser and the applicator.

FJC materials and repair procedures shall be included in the APS.

9.6 Verification, handling and storage of coating materials

The applicator shall ensure that the materials used for surface preparation and the coating(s) comply with the material specification and that the manufacturer's handling and storage instructions are followed.

10 Hot-applied bituminous tape coatings

10.1 Coating identification

Hot-applied bituminous tape coatings (FJC Type 1A) shall be identified in the APS in accordance with Table 2 and shall meet the requirements of Table 3.

Data sheets for the coating materials shall be in accordance with Table 4 (primer) and Table 5 (tape).

Application instructions shall be provided by the manufacturer in accordance with Table 6.

10.2 Description of the coatings

Bituminous tape coatings consist of a single layer or multiple layers of fusible bituminous tape, hot-applied, with or without a primer. Maximum service temperature is 30 °C.

10.3 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 for the minimum length according to the overlap on the plant coating (10.4.4).

The area being coated shall be cleaned by mechanical rotary wire brush to a minimum of grade St 3 as defined in ISO 8501-1:2007. Alternatively, surface preparation can be achieved by abrasive blast-cleaning to a minimum grade of Sa 2 as defined in ISO 8501-1:2007.

Dust contamination shall be grade 3 or better, measured in accordance with ISO 8502-3.

10.4 Coating application

10.4.1 General

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

10.4.2 Application of the primer

If applicable, application of the primer shall be carried out in accordance with the APS.

10.4.3 Application of the bituminous tapes

Application shall be carried out in accordance with the APS. As a general guideline, the following procedure shall be followed.

- Clean the area being coated with the approved cleaning method.
- Preheat it to a temperature recommended by the manufacturer.
- Verify the temperature of the substrate using a temperature-measuring device (e.g. hand-held thermocouple).
- Apply a thin coat of compatible primer; allow the primer to dry.
- Cut a sufficient length of bituminous tape (circumference plus 50 mm for overlap).
- If necessary, preheat again the surface being coated.
- Heat the bituminous side of the tape until the bitumen becomes liquid and put it with this side down on the surface being coated.
- Heat additionally the outer side and smooth the overlap.
- Install all stripes necessary side by side and follow the right overlap to the plant-applied coating.
- If it is necessary to install a second layer of bituminous tape, heat the surface of the first layer and smooth it until the anti-adhesive coat is incorporated.
- Install the second layer of bituminous tape.

10.4.4 Overlap

The minimum tape overlap shall be in accordance with Table 7, or the manufacturer's required overlap (Table 6) if greater.

The overlap of tape on plant-applied coating shall be in accordance with the manufacturer's application instructions (Table 6) and shall be at least 50 mm.

The width of the tape used depends on the diameter of the pipes. For all types of manual application, an appropriate width shall be chosen to avoid wrinkling of the tape, which can occur if the tape is too wide.

10.5 Testing of the applied coatings

10.5.1 General

The tests in 10.5.2 to 10.5.10 shall be carried out for production quality control, and for PQT and PPT if required.

10.5.2 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 0,6 mm.

NOTE The coating thickness on the weld cap is normally less than on the body because some of the polymeric adhesive flows 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.

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

10.5.3 Holiday detection

The entire surface of the coated joint shall be checked for holidays or other discontinuities according to the method defined in Annex C at a voltage of 5 kV/mm + 5 kV to a maximum of 25 kV. The voltage shall never exceed the acceptable voltage for the plant-applied coating.

Holidays shall be repaired in accordance with the APS.

10.5.4 Impact resistance

The impact resistance shall be measured using the method given in Annex D and shall meet the requirements of Table 3.

10.5.5 Indentation resistance

The indentation resistance shall be measured using the method given in Annex E and shall meet the requirements of Table 3.

10.5.6 Specific electrical insulation resistance

The specific electrical insulation resistance shall be measured using the method given in Annex F and shall meet the requirements of Table 3.

Alternatively, resistivity of the FJC at high humidity measured in accordance with ASTM D1000 can be used by agreement provided that acceptable values are agreed upon.

10.5.7 Cathodic disbondment

The cathodic disbondment shall be measured using the method given in Annex G.

The cathodic disbondment after 28 days at 23 °C shall meet the requirements of Table 3.

10.5.8 Peel strength to pipe surface and plant coating

The minimum waiting period between application of the coating and the peel strength test shall be 24 h, unless specified otherwise by the coating manufacturer.

The peel strength shall be measured using the methods given in Annex H and shall meet the requirements of Table 3. The method given in Clause H.1 shall be used for PQT. The method given in Clause H.2 may be used for PPT and production testing.

Failure shall not occur at the interface between steel and adhesive, except for a peeling strength 50 % higher than the values listed in Table 3.

10.5.9 Hot-water immersion test

A hot-water immersion test shall be carried out in accordance with Annex I with a duration of 28 days, the test temperature being the maximum service temperature of the joint coating, limited as specified in Annex I.

The peel strength after the hot-water immersion test shall be measured using the method given in Clause H.1 and shall meet the requirements of Table 3.

10.5.10 Lap shear strength

The lap shear strength resistance shall be measured using the method given in Annex J and shall meet the requirements of Table 3.

Table 2 — Coating identification

Property
Coating trade name
FJC Type and code as per Table 1
Maximum and minimum service temperature
Primer trade name
Number of layers ^a
Trade names of all layers
Nominal thickness of the coating system
Compatible plant coatings ^b
^a Excluding primer.
^b State all types of plant coatings that have been tested successfully with the coating.

Table 3 — Requirements for Type 1A — Hot-applied bituminous tape

Property	Test temperature °C	Unit	Requirements	Test method
Thickness	—	mm	≥ 0,9 × nominal value	Annex B
Holiday detection at 5 kV/mm + 5 kV, max. 25 kV	—	—	no holiday	Annex C
Impact resistance	20	J/mm	≥ 2	Annex D

Indentation resistance, pressure – Residual thickness	23	N/mm ² mm	1,0 ≥ 0,6	Annex E
Specific electrical insulation resistance – R_{S100} – R_{S100}/R_{S70}	23	$\Omega \cdot m^2$ —	≥ 10 ⁶ ≥ 0,8 ^a	Annex F
Cathodic disbondment resistance, 28 days	23	mm	≤ 20	Annex G
Peel strength – to steel surface ^b – to plant coating – plant coating after 28-day hot-water immersion test at 30 °C – steel surface after 28-day hot-water immersion test at 30 °C	23 23 23 23	N/mm N/mm N/mm N/mm	≥ 0,4 ≥ 0,2 ≥ 0,1 ≥ 0,2	Annex H Annex I
Lap shear strength	23	N/mm ²	≥ 0,05	Annex J

^a This requirement is only applicable 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.

^b If the result is less than 0,4 N/mm, residual thickness of bituminous compound on the pipe surface or plant coating shall be ≥ 0,25 mm.

Table 4 — Data sheet — Primer

Property	Unit	Test method
Primer trade name	—	—
Generic type	—	—
Solid content	%	ISO 3251
Type of solvent	—	—
Flash point	°C	ISO 1523
Density	g/cm ³	ISO 2811-1
Coverage area	m ² /l	—
Dry film thickness	µm	ISO 2808
Storage conditions – temperature, minimum – temperature, maximum	°C °C	— —
Shelf life at storage temperature	month	—

Table 5 — Data sheet^a — Tape

Property	Unit	Test method
Trade name	—	—
Description of coating material	—	—
Colour	—	—
Minimum total thickness or Surface density ^b	mm g/m ²	ISO 4591 and ISO 4593 ISO 3801

Polymeric film/reinforcement – generic type of polymeric film – generic type of reinforcement material – nominal thickness, or – surface density	— — mm g/m ²	— — ISO 4591 and ISO 4593 ISO 3801
Adhesive – generic type – nominal thickness or – surface density – softening point ring and ball ^c	— mm g/m ² °C	— ISO 4591 and ISO 4593 ISO 3801 ISO 4625-1
Mechanical properties – tape strength – modulus at 10 % elongation ^c – elongation at break ^c	N/mm N/mm %	ISO 527-3
Storage conditions – temperature, minimum – temperature, maximum	°C °C	— —
Shelf life at storage temperature	month	—
^a Data according to this data sheet shall be supplied for each coating component. ^b Also called “mass per unit area,” a deprecated designation. ^c If applicable.		

Table 6 — Application instructions

Property	Unit
Ambient conditions – minimum temperature – maximum temperature – relative humidity	°C °C %
Surface preparation — metal surface – cleanliness (ISO 8501-1) – profile in case of abrasive blast-cleaning (ISO 8503-2) Surface preparation — plant coating	— — —
Application of primer – method – minimum surface temperature – maximum surface temperature – pot life – minimum overcoating time – maximum overcoating time – curing temperature	— °C °C h h or min days or h °C
Application of tape – method – minimum material temperature – minimum overlap of tape	— °C % or mm

General	
– minimum overlap on plant coating ^a	mm
– specific application instructions	—
– holiday detection voltage	kV
– repair procedure	—
^a It is necessary that this be given for each compatible plant coating.	

Table 7 — Overlap of tape

Tape width	Overlap
< 50 mm	≥ 50 %
≥ 50 mm	≥ 25 mm

11 Petrolatum and wax-based tape coatings

11.1 Coating identification

Petrolatum and wax-based tape coatings (FJC Types 1B and 1C) shall be identified in the APS in accordance with Table 2 and shall meet the requirements of Table 8 for petrolatum tape coatings (Type 1B) or Table 9 for wax tape coatings (Type 1C).

Data sheets for the coating materials shall be in accordance with Table 4 (primer) and Table 5 (tape).

Application instructions shall be provided by the manufacturer in accordance with Table 6.

11.2 Description of the coatings

11.2.1 Petrolatum tapes (Type 1B)

Petrolatum tape coatings consist of a single layer or multiple layers of petrolatum tapes, with or without a primer. Maximum service temperature is 30 °C.

11.2.2 Wax-based tapes (Type 1C)

Wax-based tape coatings consist of a primer and a single layer or multiple layers of wax-based tapes. Maximum service temperature is 30 °C.

11.3 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 for the minimum length according to the overlap on the plant coating (11.4.4).

The area being coated shall be cleaned according to ISO 8501-1:2007, grade St 2, by hand-tool cleaning as described in ISO 8504-3.

Alternatively, surface preparation can be achieved by abrasive blast-cleaning to a minimum grade of Sa 1 as defined in ISO 8501-1:2007.

Dust contamination shall be grade 3 or better, measured in accordance with ISO 8502-3:1992.

11.4 Coating application

11.4.1 General

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

11.4.2 Application of the primer

If applicable, application of the primer shall be carried out in accordance with the APS.

11.4.3 Application of petrolatum or wax-based tapes

Application shall be carried out in accordance with the APS. As a general guideline, the following application procedure shall be followed.

- Wipe the surface to remove visible moisture.
- Prepare the surface.
- Apply a thin coat of compatible primer (if any) by brush, by hand or using other applicable tools.
- Spirally wrap the area being coated with tapes of recommended width, employing the correct overlap and ensuring the complete coverage and adherence of the coating to the pipe surface.
- Apply any outerwrap if recommended by the manufacturer or specified by the purchaser.

11.4.4 Overlap

The minimum tape overlap shall be in accordance with Table 7, or the manufacturer's required overlap (Table 6) if greater.

The overlap of tapes on plant-applied coating shall be in accordance with the manufacturer's application instructions (Table 6) and shall be at least 50 mm.

The width of the tape used depends on the diameter of the pipes. For all types of manual application, an appropriate width shall be chosen to avoid wrinkling of the tape, which can occur if the tape is too wide.

11.5 Testing of the applied coatings

11.5.1 General

The tests in 11.5.2 to 11.5.10 shall be carried out for production quality control, and for PQT and PPT if required.

11.5.2 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 0,6 mm.

NOTE The coating thickness on the weld cap is normally less than on the body because some of the polymeric adhesive flows 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.

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

11.5.3 Holiday detection

The entire surface of the coated joint shall be checked for holidays or other discontinuities at a voltage of 5 kV/mm to a maximum of 25 kV according to the method defined in Annex C.

Holidays shall be repaired in accordance with the APS.

11.5.4 Impact resistance

The impact resistance shall be measured using the method given in Annex D and shall meet the requirements of Table 8 or 9.

11.5.5 Indentation resistance

The indentation resistance shall be measured using the method given in Annex E and shall meet the requirements of Table 8 or 9.

11.5.6 Specific electrical insulation resistance

The specific electrical insulation resistance shall be measured using the method given in Annex F and shall meet the requirements of Table 8 or 9.

Alternatively, resistivity of the FJC at high humidity measured in accordance with ASTM D1000 can be used by agreement provided that acceptable values are agreed upon.

11.5.7 Cathodic disbondment

The cathodic disbondment shall be measured using the method given in Annex G.

The cathodic disbondment after 28 days at 23 °C shall meet the requirements of Table 8 or 9.

11.5.8 Peel strength to pipe surface and plant coating

The minimum waiting period between application of the coating and the peel strength test shall be 1 h, unless specified otherwise by the coating manufacturer.

Petrolatum and wax-based tapes shall leave a film of compound, visible without magnification, on the entire surface of the substrate when the coating is peeled off.

11.5.9 Hot-water immersion test

A hot-water immersion test shall be carried out in accordance with Annex I with a duration of 28 days, the test temperature being the maximum service temperature of the joint coating, limited as specified in Annex I.

Petrolatum and wax-based tapes shall leave a film of compound on the substrate when peeled off after the hot-water immersion test.

11.5.10 Drip resistance

No dripping of the compound shall occur when the tape is tested in accordance with Annex K for types 1B and 1C as listed in Tables 8 or 9.

Table 8 — Requirements for Type 1B — Petrolatum tape

Property	Test temperature °C	Unit	Requirements	Test method
Thickness	—	mm	$\geq 0,9 \times \text{nominal value}$	Annex B
Holiday detection at 5 kV/mm, max. 25 kV	—	—	no holiday	Annex C
Impact resistance	20	J/mm	$\geq 0,8$	Annex D
Indentation resistance, test pressure	23	N/mm ²	0,1	Annex E
– Residual thickness		mm	$\geq 0,6$	
Specific electrical insulation resistance	23	$\Omega \cdot \text{m}^2$	$\geq 10^6$	Annex F
– R_{S100} – R_{S100}/R_{S70}		—	$\geq 0,8^a$	
Cathodic disbondment resistance at 28 days	23	mm	≤ 20	Annex G
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 K

^a This requirement is only applicable 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 9 — Requirements for Type 1C — Wax-based tape and primer

Property	Test temperature °C	Units	Requirements	Test method
Primer				
Congeval point	—	°C	> 55	ASTM D 938
Flash point	—	°C	≥ 65	ASTM D 92
Density	25	g/cm ³	< 1	ASTM D 70
Cone penetration	25	mm	7,5 to 25	ASTM D 937
Dielectric strength	—	V/μm	≥ 4	ASTM D 149
Tape				
Congeval point of saturant	—	° C	> 65	ASTM D 938
Flash point of saturant	—	° C	≥ 60	ASTM D 92
Thickness	—	mm	> 1,75	ASTM D 1000
Dielectric strength	—	V/μm	> 6,6	ASTM D 149
Complete coating				
Holiday detection at 5 kV/mm, max. 25 kV	—	—	no holiday	Annex C
Impact resistance	20	J/mm	$\geq 0,8$	Annex D