

PD CEN/TS 1555-7:2013



BSI Standards Publication

Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE)

Part 7: Guidance for the assessment of conformity

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National foreword

This Published Document is the UK implementation of CEN/TS 1555-7:2013. It supersedes DD CEN/TS 1555-7:2003 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PRI/88, Plastics piping systems, to Subcommittee PRI/88/2, Plastics piping for pressure applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Plastics piping systems for the supply of gaseous fuels -
Polyethylene (PE) - Part 7: Guidance for the assessment of
conformity

Systèmes de canalisations en plastique pour la distribution
de combustibles gazeux - Polyéthylène (PE) - Partie 7:
Guide pour l'évaluation de la conformité

Kunststoff-Rohrleitungssysteme für die Gasversorgung -
Polyethylen (PE) - Teil 7 : Empfehlungen für die
Beurteilung der Konformität

This Technical Specification (CEN/TS) was approved by CEN on 11 September 2012 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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Foreword

This document (CEN/TS 1555-7:2013) has been prepared by Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems”, the secretariat of which is held by NEN.

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

This document supersedes CEN/TS 1555-7:2003.

EN 1555 is composed of the following parts:

- EN 1555-1, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*;
- EN 1555-2, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*;
- EN 1555-3, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*;
- EN 1555-4, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 4: Valves*;
- EN 1555-5, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 5: Fitness for purpose of the system*;
- CEN/TS 1555-7, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 7: Guidance for the assessment of conformity* (the present Technical Specification).

This issue of CEN/TS 1555-7 takes into account the technical changes made in the revision of EN 1555-1, -2, -3, -5 and -4, published in 2010 and respectively in 2011. Guidance for the assessment of conformity given in this document has been revised to reflect the changes made to test methods and requirements given in EN 1555-1, -2, -3, -4 and -5. Two new types of pipe have been introduced, i.e. coextruded pipes and peelable layer pipes. The sampling procedures and sampling frequencies for these types of pipes have been introduced into the tables for TT, BRT, PVT and AT tests for pipes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Figures 1 and 2 are intended to provide general information on the concept of testing and organisation of those tests used for the purpose of the assessment of conformity. For each type of test, i.e. type testing (TT), batch release test (BRT), process verification test (PVT), and audit test (AT), this part of EN 1555 details the applicable characteristics to be assessed as well as the frequency and sampling of testing.

A typical scheme for the assessment of conformity of compounds, pipes, fittings, valves, joints or assemblies by manufacturers is given in Figure 1.

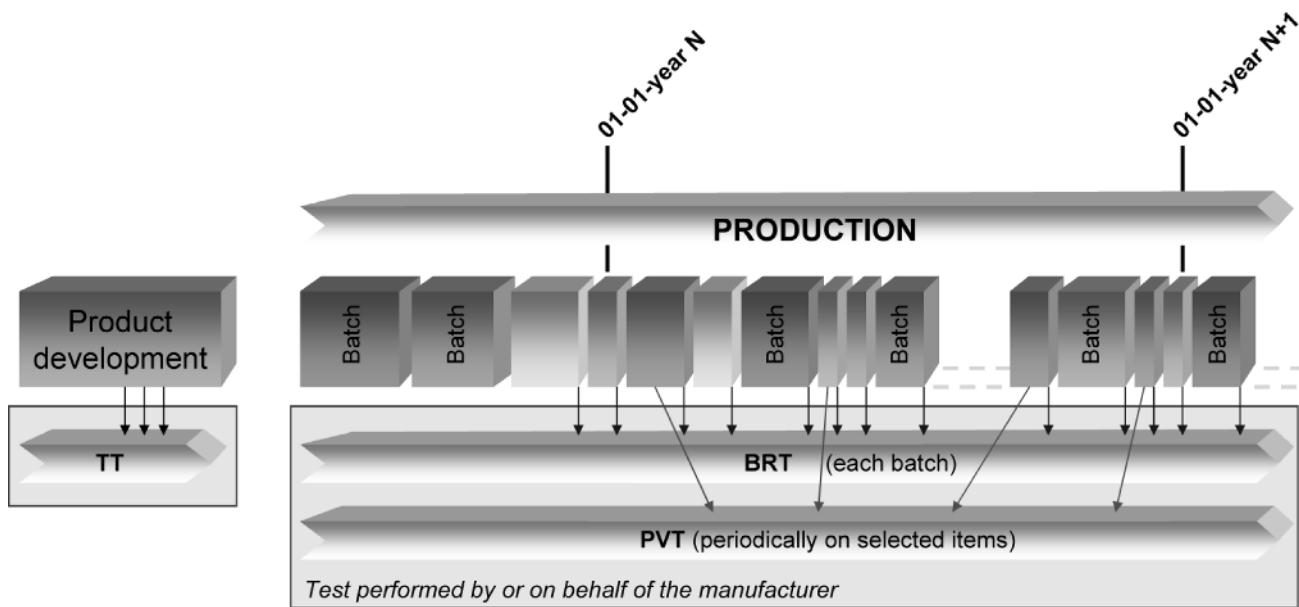


Figure 1 — Typical scheme for the assessment of conformity by a manufacturer

A typical scheme for the assessment of conformity of compounds, pipes, fittings, valves, joints or assemblies by manufacturers, including certification, is given in Figure 2.

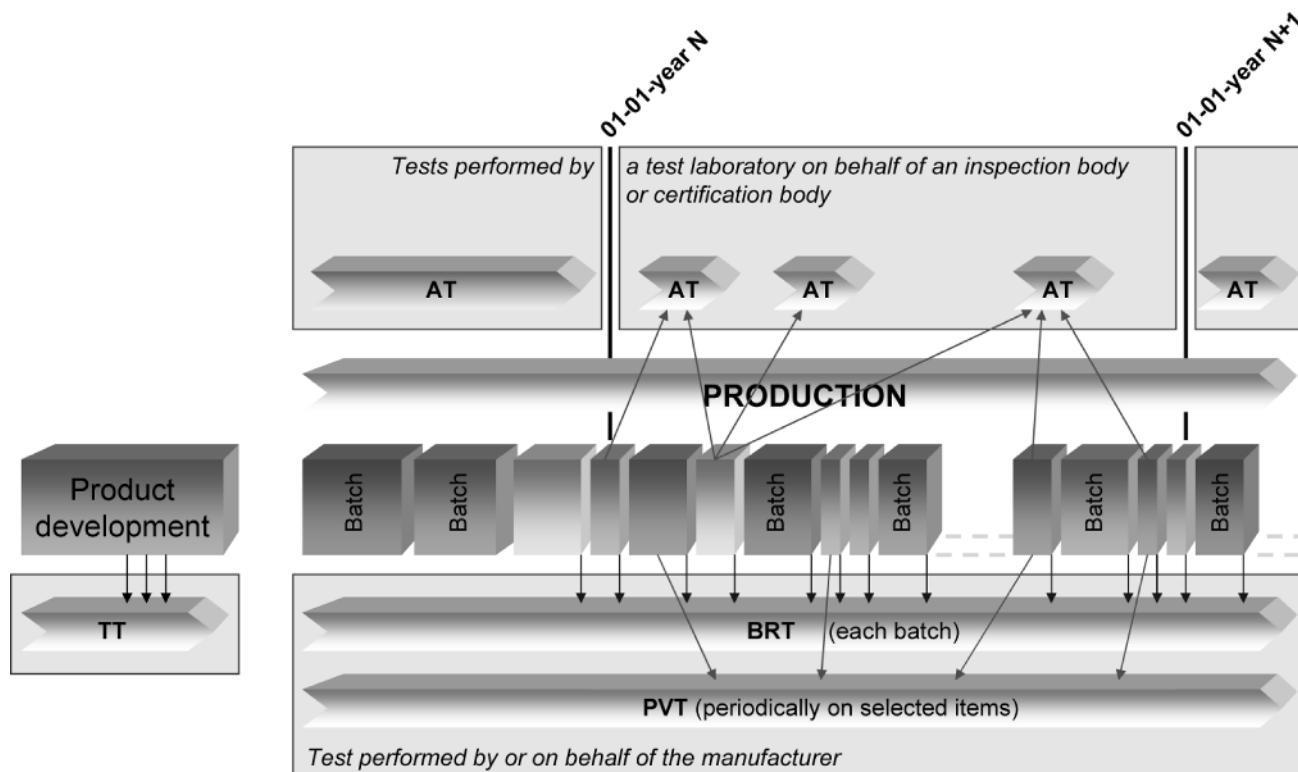


Figure 2 — Typical scheme for the assessment of conformity by a manufacturer, including certification

1 Scope

This Technical Specification gives guidance for the assessment of conformity of compounds, products, joints and assemblies in accordance with the applicable part(s) of EN 1555 intended to be included in the manufacturer's quality plan as part of the quality management system and for the establishment of certification procedures.

It is recommended that the quality management system conforms to or is no less stringent than the relevant requirements to EN ISO 9001 [2].

NOTE 1 If certification is involved, the certification and inspection body is preferably compliant with EN 45011 [3], EN 45012 [4] or EN ISO/IEC 17020 [5], as applicable.

In conjunction with Parts 1 to 5 of EN 1555 (see Foreword), this Technical Specification is applicable to polyethylene (PE) plastics piping systems for the supply of gaseous fuels. It is applicable to PE pipes, fittings, and valves, their joints and to joints with components of other materials intended to be used under the following conditions:

- a) a maximum operating pressure, MOP, up to and including 10 bar¹⁾;
- b) an operating temperature of 20 °C as reference temperature.

NOTE 2 For other operating temperatures, derating coefficients can be used; see EN 1555-5.

For mechanical fittings conforming to ISO 10838-1 [6], ISO 10838-2 [7] or ISO 10838-3 [8], as applicable, guidance for assessment of conformity is not given in this part of EN 1555. When requested, a quality plan based on the tests mentioned in ISO 10838-1 [6], ISO 10838-2 [7] or ISO 10838-3 [8], as applicable, should be set up in agreement between user and manufacturer.

EN 1555 covers a range of maximum operating pressures and gives requirements concerning colours and additives.

NOTE 3 It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

2 Normative references

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

EN 1555-1:2010, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*

EN 1555-2:2010, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*

EN 1555-3:2010, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*

EN 1555-4:2011, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 4: Valves*

EN 1555-5:2010, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 5: Fitness for purpose of the system*

1) 1 bar = 0,1 MPa.

EN ISO 6259-1, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method (ISO 6259-1)*

EN ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient (ISO 12162)*

EN ISO 13477, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test) (ISO 13477)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions given in EN 1555-1:2010, EN 1555-2:2010, EN 1555-3:2010, EN 1555-4:2011 and EN 1555-5:2010 and the following apply.

3.1

certification body

impartial body, governmental or non-governmental, possessing the necessary competence and responsibility to carry out certification of conformity according to given rules of procedure and management

Note 1 to entry: A certification body is preferably compliant with EN 45011 [3].

3.2

inspection body

body that performs inspection

Note 1 to entry: A body can be an organisation or part of an organisation.

Note 2 to entry: An inspection body is accredited to EN ISO/IEC 17020 [5].

3.3

testing laboratory

laboratory which measures, tests, calibrates or otherwise determines the characteristics of the performance of materials and products

Note 1 to entry: In the context of this part of EN 1555, the materials and products can be subjected to type testing, batch release testing, process verification testing, audit testing, and witness testing, as applicable.

Note 2 to entry: A testing laboratory is preferably compliant with EN ISO/IEC 17025[9].

3.4

quality management system

management system to direct and control an organisation with regard to quality

Note 1 to entry: Requirements for quality management systems are given in EN ISO 9001 [2].

3.5

quality plan

document setting out the specific quality practices, resources and sequence of activities relevant to a particular product or range of products

3.6

type testing

TT

testing performed to prove that the material, product, joint or assembly is capable of conforming to the requirements given in the relevant standard

Note 1 to entry: The type test results remain valid until there is a change in the material or product or assembly provided that the process verification tests are done regularly.

3.7
batch release test
BRT
test performed by or on behalf of the manufacturer on a batch of compound or products, which needs to be satisfactorily completed before the batch can be released

3.8
process verification test
PVT
test performed by or on behalf of the manufacturer on compound or products or joints or assemblies at specific intervals to confirm that type tests originally performed on the compound or products or joints or assemblies continue to be valid and the process continues to be capable of producing products which conform to the requirements given in the relevant standard

Note 1 to entry: Such tests are carried out as a measure of process control and are not related to release of batches of compound or products.

3.9
audit test
AT
test performed by a test laboratory on behalf of an inspection body or certification body to confirm that the compound, product, joint or assembly continues to conform to the requirements given in the relevant standard and to provide information to assess the effectiveness of the quality management system

3.10
indirect test
IT
test performed by or on behalf of the manufacturer, different from that specified test for that particular characteristic, having previously verified its correlation with the specified test

3.11
witness test
WT
test accepted by an inspection or a certification body for type testing and/or audit testing, which is carried out by or on behalf of the manufacturer and supervised by a representative of the inspection or certification body, qualified in testing

3.12
material
composition grouped by families, expressed by generic names, e.g. polypropylene, stainless steel, brass or EPDM

Note 1 to entry: Definition from European Commission, Directorate-General for Enterprise and Industry, Sub-group on Product Testing Procedures (EC, DG ENT and IND, SG PTP).

3.13
compound
clearly defined homogenous mixture of base polymer with additives, i.e. antioxidants, pigments, stabilisers and others, at a dosage level necessary for the processing and the intended use of the final product

3.14
material batch
clearly identified quantity of a given homogeneous compound manufactured continuously under uniform conditions and defined and identified by the compound manufacturer

3.15
product
pipe, fitting, or valve of a clearly identified type intended to be a part of a piping system which the manufacturer puts on the market

3.16

product batch

clearly identified collection of products, manufactured consecutively or continuously under the same conditions, using the same compound conforming to the same specification

Note 1 to entry: The product batch is defined and identified by the product manufacturer.

3.17

lot

clearly identifiable sub-division of a batch for inspection purposes

3.18

sample

one or more products drawn from the same production batch or lot, selected at random without regard to their quality

Note 1 to entry: The number of products in the sample is the sample size.

Note 2 to entry: The number of test pieces required for each test are taken from the sample. This information is given in this document, in the product standard, or in the relevant test method standard.

3.19

group

collection of similar products from which samples are selected for testing purposes

3.20

component

product manufactured out of a specific composition or compound, brought to the market as part of another product or as a spare part

Note 1 to entry: Components are considered as products and are individually approved (e.g. o-rings and gaskets), or they are tested as integral part of a finished product (e.g. in a valve).

3.21

joint

connection between two or more products

3.22

assembled product

assembled final product using two or more single parts

3.23

assembly

unit of two or more products assembled for testing purposes

3.24

sampling plan

specification of the type of sampling to be used combined with the operational specification of the entities or increments to be taken, the samples to be constituted and the measurements to be made

EXAMPLE A specific plan which indicates the type of test, the number of units of products or assemblies to be inspected.

3.25

product type

generic description of a product

EXAMPLE A pipe or fitting or valve or their main parts, of the same design.

3.26

body type

generic description of a body

EXAMPLE A valve body of a particular design, which can have different end connections.

3.27

cavity

space within a mould to be filled to form the moulded product

EXAMPLE That part of an injection mould which gives the form to the injection-moulded product.

4 Abbreviated terms

To avoid misunderstanding, the abbreviations in this Clause are defined as being the same in each language. For the same reason, the terms are given in the three languages, English, French and German.

AT en : audit test
fr : essai d'audit
de : Überwachungsprüfung

BRT en : batch release test
fr : essai de libération de campagne de fabrication
de : Freigabeprüfung einer Charge

IT en : indirect test
fr : essai indirect
de : indirekte Prüfung

PVT en : process verification test
fr : essai de vérification du procédé de fabrication
de : Prozessüberprüfung

TT en : type test
fr : essai de type
de : Typprüfung

WT en : witness test
fr : essai témoin
de : Prüfung unter Aufsicht

5 General

5.1 Compounds, products, joints and assemblies shall conform to the requirements given in EN 1555-1, EN 1555-2, EN 1555-3, EN 1555-4, and EN 1555-5.

5.2 Products and assemblies shall be produced by the manufacturer under a quality management system which includes a quality plan.

6 Testing and inspection

6.1 Grouping

6.1.1 General

For the purposes of this Technical Specification, the groups specified in 6.1.2 and 6.1.3 apply.

6.1.2 Size groups

Three size groups are defined for pipes and fittings, as given in Table 1. For testing purposes, one individual nominal diameter, d_n , shall be selected from each group.

Table 1 — Size groups

Size group	Nominal diameter, d_n mm
1	$d_n < 75$
2	$75 \leq d_n < 250$
3	$250 \leq d_n \leq 630$

6.1.3 Fitting groups

Three groups of fittings each having a similar design are defined, as given in Table 2.

For testing purposes, one individual fitting shall be selected from each group.

Table 2 — Fitting groups

Fitting groups	Fitting type
(A)	Electrofusion socket fitting
(B)	Electrofusion saddle fitting
(C)	Spigot end fitting

6.1.4 Fitting types

Fitting groups are divided in fitting types.

Fitting group (A) includes the following fitting types: Electrofusion couplers, electrofusion 45° elbows, electrofusion 90° elbows, electrofusion tees, electrofusion reducers, electrofusion end caps, etc.

Fitting group (B) includes the following fitting types: Electrofusion tapping saddles, electrofusion branch saddles, etc.

Fitting group (C) includes the following fitting types: 45° elbows, 90° elbows, tees, reducers, end caps, etc.

6.2 Type testing

Relevant TTs shall be carried out whenever there is a change in design, in compound or production method, other than routine in-process adjustments, and/or whenever there is an extension of the product range or change of production site.

Relevant tests selected from the type testing tables for the product concerned to be carried out when a change of the production site occurs should be defined by the manufacturer. If certification is involved the scheme should be agreed between the parties concerned.

Type tests shall demonstrate that the products conform to all requirements for the characteristics given in Tables 3 to 6, as applicable.

In case of change in compound as defined in A.2, relevant type testing requirements as defined in A.3, and in Tables 3 to 6 as applicable, shall apply.

For the purposes of a change in design, the following characteristics are relevant:

- a) dimensions and geometry (see column D1 of Tables 5 and 6), as: change of visual and functional optimisations, change of overall dimensions, change of a non-PE part;
- b) joint affected part (see column D2 of Tables 5 and 6), as: change of the dimensions of the fusion zone (e.g. wire pitch, wire depth), the electrical characteristics (e.g. wire, resistance), the fusion parameters (e.g. time, voltage).

For the extension of the production range, the relevant characteristics given in Table 5 and Table 6, column E, as applicable, shall be retested. If third party certification is involved, retesting shall be agreed between the certification body and the manufacturer.

Table 3 — Characteristics of compounds that require type testing (TT) by the compound manufacturer

Characteristic	Reference to part, clause or subclause of EN 1555	Sampling procedure
Compound density	-1:2010-4.2.3.1	3 samples/ compound
Oxidation induction time (thermal stability)	-1:2010-4.2.3.1	3 samples/ compound
Melt mass-flow rate (MFR)	-1:2010-4.2.3.1	3 samples/ compound
Volatile content	-1:2010-4.2.3.1	1 sample/ compound
Water content ^a	-1:2010-4.2.3.1	1 sample/ compound
Carbon black content ^b	-1:2010-4.2.3.1	3 samples/ compound
Carbon black dispersion ^b	-1:2010-4.2.3.1	1 sample/ compound
Pigment dispersion ^c	-1:2010-4.2.3.1	1 sample/ compound
Resistance to gas condensate	-1:2010-4.2.3.2	1 sample/ compound
Resistance to weathering	-1:2010-4.2.3.2	Once/compound ^d
Resistance to rapid crack propagation (critical pressure, p_c) ($e \geq 15$ mm)	-1:2010-4.2.3.2	Number of test pieces shall conform to EN ISO 13477, Once/compound ^e
	-5:2010-5	Number of pieces shall conform to EN ISO 13477, Once/compound
Resistance to slow crack growth (d_n : 110 mm SDR 11)	-1:2010-4.2.3.2	3 test pieces/ compound ^e
Determination of the failure mode in a tensile test on a buttfusion weld (d_n : 110 mm SDR 11)	-1:2010-4.3.1	3 samples/ compound
	-1:2010-4.3.2	3 samples/ compound
Classification	-1:2010-4.4	Shall conform to EN ISO 12162, Once/compound
^a Only applicable if the requirement for volatile content is not conformed to. In case of dispute the requirement for water content shall apply. ^b Only applicable for black compound. ^c Only applicable for non black compound. ^d Three pieces for elongation at break/ Three pieces for hydrostatic strength / One sample for decohesion of an electrofusion joint. ^e Resistance to RCP and slow crack growth shall be measured on pipe made from the same compound batch.		

Table 4 — Characteristics of pipes, including coextruded pipes and peelable layer pipes that require type testing (TT) (1 of 2)

Characteristic ^j	Reference to part, clause or subclause of EN 1555	Conditions requiring test ^a				Sampling procedure	
		N	D	M	E	Manufacturer ^b	Certification body ^{b c}
Appearance	-2:2010-5.1	+	+	+	+	1 test piece of each diameter	1 test piece of one diameter/ size group
Colour	-2:2010-5.2	+	+	+	+	1 test piece of each diameter	1 test piece of one diameter/ size group
Geometrical characteristics	-2:2010-6	+	-	+	+	1 test piece of each diameter	1 test piece of one diameter/ size group
Circumferential reversion	-2:2010-6.4	+	-	+ g	+	1 test piece of each diameter/ size group 3	1 test piece of one diameter/ size group 3
Hydrostatic strength (20 °C, 100 h)	-2:2010-7.2	+	-	+ g	+	3 test pieces of one diameter/size group	3 test pieces of one diameter/ size group
Hydrostatic strength (80 °C, 1 000 h)	-2:2010-7.2	+	-	+ g	+	3 test pieces of one diameter/size group	3 test pieces of one diameter/ size group
Elongation at break	-2:2010-7.2	+	-	+ g	+	Number of samples shall conform to EN ISO 6259-1, One diameter/size group	Number of samples shall conform to EN ISO 6259-1, One diameter/ size group
Resistance to slow crack growth $e \leq 5$ mm (Cone test)	-2:2010-7.2	+	-	+ g	+	3 test pieces of one diameter/size group	3 test pieces of one diameter/ size group
Resistance to slow crack growth $e > 5$ mm (Notch test)	-2:2010-7.2	+	-	+ g	+	3 test pieces of one diameter/size group	3 test pieces of one diameter/ size group
Resistance to rapid crack propagation (critical pressure, p_c) ^{e f}	-2:2010-7.2	+	+	+	+	Number of samples shall conform to EN ISO 13477 of one diameter	Number of samples shall confirm EN ISO 13477 of one diameter
Oxidation induction time (Thermal stability) ⁱ	-2:2010-8.2	+	-	+	-	1 sample of one diameter/ size group	1 sample of one diameter/ size group
Melt mass-flow rate (MFR) ⁱ	-2:2010-8.2	+	-	+	-	1 sample of one diameter/ size group	1 sample of one diameter/ size group
Longitudinal reversion ^d	-2:2010-8.2	+	-	+	+	1 sample of one diameter/ size group	1 sample of one diameter/ size group
Marking	-2:2010-10.2	+	-	+	-	1 sample of each diameter	By checking the test result of the manufacturer
Resistance to weathering	-2:2010-8.2	Tested on the compound in the form of pipe by the compound supplier					
Tensile strength for butt fusion	-5:2010-4.2.2.1	+	-	+	-	1 sample of one diameter/ size group 2	By checking the test results of the manufacturer

Table 4 (2 of 2)

Characteristic ^j	Reference to part, clause or subclause of EN 1555	Conditions requiring test ^a				Sampling procedure	
		N	D	M	E	Manufacturer ^b	Certification body ^{b c}
Tensile strength for buttfusion	-5:2010-4.2.2.2	+	-	+	-	1 sample of one diameter/ size group 2	By checking the test results of the manufacturer
Squeeze off	-2:2010-Annex C	+	-	+	-	1 sample of one diameter ^{g h}	By checking the test results of the manufacturer
Additional tests for coextruded pipes							
Integrity of the structure after deflection	-2:2010-A.7	+	-	+	+	1 sample of each diameter	1 sample of one diameter/ size group
Additional tests for peelable layer pipes							
Resistance to weathering ^k	-2:2010-B.3	+	+	+	-	1 sample of one diameter/ peelable layer formulation	1 sample of one diameter/ peelable layer formulation
^a N : new system; D : only applicable for change of thickness of peelable layer, and change of material type or adhesive (if used) for the peelable layer; M : change of compound; E : extension of the product range (except the products already covered by the scheme of sampling procedure); + : test to be carried out; - : test not to be carried out. ^b Successful testing will validate pipe with the same d_n and a higher SDR, i.e. thinner wall thickness. Where a manufacturer extends his production beyond his approval, additional relevant type testing shall be carried out. ^c Recommended sampling procedure for a testing laboratory working on behalf of a certification body. Testing undertaken in manufacturer's laboratory shall be taken into account, by prior agreement with the certification body. ^d Longitudinal reversion is applicable to wall thickness ≤ 16 mm. ^e For pipes and the base pipe of peelable layer pipes, if applicable (see Table 4 of EN 1555-2:2010). ^f Applicable for coextruded pipes, and for peelable layer pipes tested with the external layer. ^g Sampling procedure of one diameter. ^h To be performed preferably on d_n 63 SDR 11. ⁱ Applicable for each layer of coextruded pipe. ^j All characteristics except marking are applicable for the base pipe of peelable layer pipe without the layer. Appearance, colour, resistance to rapid crack propagation, resistance to weathering, and marking are also applicable to peelable layer pipes including the layer. ^k Weathering of the base pipe is assessed in accordance with EN 1555-1:2010. The weathering of peelable layer pipe with the layer is assessed by testing three test pieces for elongation at break/ three test pieces for hydrostatic strength / one sample for decohesion of an electrofusion joint.							

Table 5 — Characteristics of fittings that require type testing (TT) (1 of 2)

Characteristic ^c	Reference to part, clause or subclause of EN 1555	Conditions requiring test ^a					Sampling procedure	
		N	D1	D2	M	E	Manufacturer	Certification body ^b
Appearance	-3:2010-5.1	+	-	-	+	+	5 test pieces/ size/fitting type ^g	5 test pieces of one diameter/ size group/ fitting type
Colour	-3:2010-5.2	+	-	-	+	+	5 test pieces/ size/fitting type ^g	5 test pieces of one diameter/ size group/ fitting type
Electrical characteristics (A) (B)	-3:2010-5.5	+	-	+	-	+	5 test pieces/ size/fitting type ^g	5 test pieces of one diameter/ size group/ fitting type
Geometrical characteristics	-3:2010-6	+	+	+	+	+	5 test pieces/ size/fitting type ^g	5 test pieces of one diameter/ size group/ fitting type
Hydrostatic strength (20°C, 100 h)	-3:2010-7.2	+	-	-	+ f	+	3 test pieces/ size/ fitting type ^{g i j k}	3 test pieces of one diameter/ size group/ fitting type ^{i j k}
Hydrostatic strength (80 °C, 165 h) ^h (C)	-5:2010-4.2.2	+	-	+	+	-	1 test piece/ size group/ fitting type	By checking the test results of the manufacturer
Hydrostatic strength (80°C, 1 000 h)	-3:2010-7.2	+	-	+	+ f	+	3 test pieces/ size/ fitting type ^{g i j k}	3 test pieces of one diameter/ size group/ fitting type ^{i j k}
Decohesive resistance (A)	-3:2010-7.2	+	-	+	+ f	+	1 test piece/ size/ fitting type/ condition ^g	1 test piece of one diameter/size group/ fitting type/ condition
	-5:2010-4.2.3.1	+	-	+	+ f	+	1 test piece/ size/ fitting type/ condition ^g	1 test piece of one diameter/size group/ fitting type/ condition
Evaluation of ductility of fusion joint interface (B)	-3:2010-7.2	+	-	+	+ f	+	1 test piece/ size/ fitting type/ condition ^{g l}	1 test piece of one diameter/size group/ fitting type/ condition ^l
	-5:2010-4.2.3.1	+	-	+	+ f	+	1 test piece/ size/ fitting type/ condition ^{g l}	1 test piece of one diameter/size group/ fitting type/ condition ^l
Tensile strength for butt fusion ^h (C)	-3:2010-7.2	+	-	-	+	+	1 test piece/ size group / fitting group/ condition	By checking the test results of the manufacturer
	-5:2010-4.2.2.1	+	-	-	-	-	1 test piece/ size group / fitting group/ condition	By checking the test results of the manufacturer
Impact resistance (B)	-3:2010-7.2	+	-	+	+ f	+	1 test piece/ size/ fitting type	1 test piece/ size group/ fitting type
Pressure drop (B)	-3:2010-7.2	+	+	-	-	+	1 test piece/ size/ fitting type	By checking the test results of the manufacturer
Short-term internal pressure resistance (A) ^d	-3:2010-7.3	+	-	+	+ f	+	3 test pieces/ size/ fitting type ^{g i}	3 test pieces of one diameter/ size group/ fitting type ⁱ
Resistance to tensile load (A) ^d	-3:2010-7.3	+	-	+	+ f	+	3 test pieces/ size/ fitting type ^{g i}	3 test pieces of one diameter/ size group/ fitting type ⁱ

Table 5 (2 of 2)

Characteristic ^c	Reference to part, clause or subclause of EN 1555	Conditions requiring test ^a					Sampling procedure	
		N	D1	D2	M	E	Manufacturer	Certification body ^b
Oxidation induction time (Thermal stability) ^e	-3:2010-8.2	+	-	-	+	-	1 sample/ size group/ fitting type	1 sample/ fitting group
Melt mass-flow rate (MFR)	-3:2010-8.2	+	-	-	+	-	1 sample/ size group/ fitting type	1 sample/ fitting group
Marking	-3:2010-10.2	+	-	-	+	+	5 test pieces/ size/ fitting type ^g	5 test piece of one diameter/ size group/ fitting type
Fusion system recognition (A) (B)	-3:2010-10.4	+	-	+	-	+	5 test pieces/ size/ fitting type	-

^a N : new system;
D1 : change of dimensions and geometry as: change of visual and functional optimisation, change of overall dimensions, change of a non-PE part;
D2 : change of joint affected part as: change of the dimension of the fusion zone (e.g. wire pitch, wire depth), the electrical characteristics (e.g. wire, resistance), the fusion parameters (e.g. time, voltage);
M : change of compound of the same MRS. In case of change of the MRS, type tests according column (N) shall apply;
E : extension of the fitting range;
+ : test to be carried out;
- : test not to be carried out.

^b Recommended sampling procedure for a testing laboratory working on behalf of a certification body. Testing undertaken in a manufacturer laboratory shall be taken into account, provided prior acceptance by the certification body.

^c (A): Electrofusion socket fitting;
(B): Electrofusion saddle fitting;
(C): Spigot end fitting.

^d Only applicable if EN 1555-3:2010, 6.2.2 b) applies.

^e Test pieces should be taken from surfaces, especially those forming part of a fusion joint.

^f Manufacturer sampling procedure changed from "size/fitting type" to "2 dimensions/size group/fitting type".

^g Shall contain fittings from each cavity. The minimum number of samples shall be at least one from each cavity.

^h Only applicable to size group 2 and 3.

ⁱ One test piece for size group 3.

^j Alternatively for $d_n > 450$ mm, the test can be performed water-in-air. In case of dispute, water-in-water shall be used.

^k For fitting type (B), $dn > 450$ mm alternative testing (eg pressurisation through saddle outlet) allowed.

^l Alternatively for fitting type (B) $dn > 450$ mm may be checked by the strip bend test according to ISO 21751.

Table 6 — Characteristics of valves that require type testing (TT) (1 of 2)

Characteristic	Reference to part, clause or subclause of EN 1555	Conditions requiring test ^a					Sampling procedure	
		N	D1	D2	M	E	Manufacturer	Certification body ^b
Appearance	-4:2011-5.1	+	+ 1/2/ 6	-	+ 1/2/6	+	5 test pieces/ size/ product type ^c	5 test pieces of one diameter/ size group/ product type
Colour	-4:2011-5.2	+	+ 1/2	-	+ 1/2	+	5 test pieces/ size/ product type ^c	5 test pieces of one diameter/ size group/ product type
Geometrical characteristics	-4:2011-6	+	+ 2/6	+ 2/6	+ 2/6	+	5 test pieces/ size/ product type ^c	5 test pieces of one diameter/ size group/ product type
Hydrostatic strength (20°C, 100 h)	-4:2011-7.2	+	-	+ 1/2	+ 1/2	+	3 test pieces/ size/ product type ^c	3 test pieces of one diameter/ size group/ product type
Hydrostatic strength (80°C, 1 000 h)	-4:2011-7.2	+	-	+ 1/2/4	+ 1/2/4	+	3 test pieces/ size/ product type ^c	3 test pieces of one diameter/ size group/ product type
Leaktightness of seat and packing	-4:2011-7.2	+	-	+	+	+	1 test piece/ body type	1 test piece/ body type
Pressure drop	-4:2011-7.2	+	-	+ 1/2/3/ 4	-	+	1 test piece/ size/ product type	1 test piece/ size/product type
Operating torque	-4:2011-7.2	+	-	+	+	+	1 test piece/ body type	1 test piece/ body type
Stop resistance	-4:2011-7.2	+	-	+ 1/3/5/ 6	+ 1/3/5/ 6	+	1 test piece/ body type	1 test piece/ body type
Actuation mechanism resistance	-4:2011-7.2	+	-	+ 3/5/6	+ 3/5/6	-	1 test piece/ body type	1 test piece/ body type
Resistance to bending between supports	-4:2011-7.2	+	-	+ 1/2/3/ 4	+ 1/2/3/ 4	+	1 test piece/ size/ product type ^c	1 test piece/ size/product type
Thermal cycling resistance dn > 63 mm	-4:2011-7.2	+	-	+	+	+	1 test piece/ body type	1 test piece/ body type
Leaktightness under bending with thermal cycling, dn ≤ 63 mm	-4:2011-7.2	+	-	+	+	+	1 test piece/ body type	1 test piece/ body type
Leaktightness under tensile loading	-4:2011-7.2	+	-	+ 1/2/3/ 4	+ 1/2/3/ 4	+	1 test piece/ body type	1 test piece/ body type
Leaktightness under and after bending applied to the operating mechanism	-4:2011-7.2	+	-	+	+	+	1 test piece/ body type	1 test piece/ body type

Table 6 (2 of 2)

Characteristic	Reference to part, clause or subclause of EN 1555	Conditions requiring test ^a					Sampling procedure	
		N	D1	D2	M	E	Manufacturer	Certification body ^b
Impact loading resistance	-4:2011-7.2	+	-	+ 1/3/ 5/6	+ 1/3/ 5/6	-	1 test piece/ body type	1 test piece/ body type
Multiple test after the internal pressure test ^{f g} 1) Long term resistance 2) Leaktightness of seat and packing 25 mbar 3) Leaktightness of seat and packing 1,5 MOP 4) Operating torque 5) Impact loading resistance	-4:2011-7.2	+	-	+	+	+	1 test piece/ body type/ size group	1 test piece/ body type/ size group
Oxidation induction time (thermal stability) ^d	-4:2011-8.2	+	-	-	+ 1/2	-	1 sample/ size group	1 sample/ size group
Melt mass-flow rate (MFR)	-4:2011-8.2	+	-	-	+ 1/2	-	1 sample/ size group	1 sample/ size group
Marking	-4:2011-10.2	+	+ 1/2	+ 1/2	-	+	1 test piece/ size/ product type	1 test piece/ size/ product type
Tensile strength for butt fusion ^e	-5:2010-4.2.1.1	+	-	+ 2	+ 2	+	1 test piece/ size group/ product type	By checking the test results of the manufacturer
Tensile strength for butt fusion ^e	-5:2010-4.2.1.2	+	-	+ 2	+ 2	+	1 test piece/ size group/ product type	By checking the test results of the manufacturer
Hydrostatic strength (80 °C, 165 h) ^e	-5:2010-4.2.2	+	-	+ 2	+ 2	-	1 test piece/ size group/ product type ^c	By checking the test results of the manufacturer

^a N : new system;
D1 : change in design with no effect on valve performance;
D2 : change in design with effect on valve performance;
M : change of compound of the same MRS. In case of change of the MRS, type tests according column (N) shall apply;
E : extension of the valve range;
+ : test to be carried out;
- : test not to be carried out.
The code numbers following the + indicate which modified component of the valve initiate testing:
Code 1 : body
Code 2 : outlets
Code 3 : obturator
Code 4 : sealing element
Code 5 : spindle / drive
Code 6 : actuator

^b Recommended sampling procedure for a testing laboratory working on behalf of a certification body. Testing undertaken in a manufacturer laboratory shall be taken into account, provided prior acceptance by the certification body.

^c Valves shall contain components from each PE cavity. The minimum number of samples shall be at least one from each cavity.

^d Test pieces should be taken from surfaces, especially those forming part of a fusion joint.

^e Only applicable for valves with a spigot end of size groups 2 and 3.

^f If agreed between the manufacturer and the end-user an additional test can be carried out to check the initiating torque after a specified time in a closed position under pressure.

^g The multiple tests shall be carried out at least 24 h after completion of the pressure test, if not otherwise specified by the manufacturer.

6.3 Batch release tests

Those characteristics specified in EN 1555-1:2010, EN 1555-2:2010, EN 1555-3:2010, EN 1555-4:2011 or EN 1555-5:2010 and listed in Tables 7 to 10 shall be subject to BRTs with the minimum sampling frequency as given in Tables 7 to 10, as applicable.

All tests shall be carried out for each start up of the production facility of a product. A restart after production has been suspended shall not be considered as an interruption of a continuous production, provided this period of interruption does not exceed a maximum period to be defined in the manufacturer's quality plan.

Table 7 — Characteristics of compounds and minimum sampling frequencies for BRTs by the compound manufacturer

Characteristic	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^a
Compound density	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Oxidation induction time (thermal stability)	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Melt mass-flow rate (MFR)	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Volatile content	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Water content ^b	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Carbon black content ^c	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Carbon black dispersion ^c	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
Pigment dispersion ^d	-1:2010-4.2.3.1	1 sample/ batch/ 7 days
^a The number of samples given in the table is the minimum. All samples shall pass the relevant test(s). ^b Only applicable if the requirement for volatile content is not conformed to. In case of dispute the requirement for water content shall apply. ^c Only applicable for black compound. ^d Only applicable for non black compound.		

Table 8 — Characteristics of pipes, including coextruded pipes and peelable layer pipes, and minimum sampling frequencies for BRTs by the pipe manufacturer

Characteristic ^f	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^a
Appearance	-2:2010-5.1	At start up and at least every 8 h.
Colour	-2:2010-5.2	At start up and at least every 8 h.
Geometrical characteristics	-2:2010-6	At start up and continuously ^c or at least every 8 h.
Hydrostatic strength (80 °C, 165 h)	-2:2010-7.2	1 test piece/ batch/ 7 days (size groups 1 and 2), 1 test piece/ batch (size group 3)
Elongation at break ^d	-2:2010-7.2	1 sample/ batch/ 7 days (size groups 1 and 2), 1 sample/ batch (size group 3)
Oxidation induction time (thermal stability) ^b	-2:2010-8.2	1 sample/ batch/ 7 days (size groups 1 and 2), 1 sample/ batch (size group 3)
Melt mass-flow rate (MFR) ^d	-2:2010-8.2	1 sample/ batch/ 7 days (size groups 1 and 2), 1 sample/ batch (size group 3)
Marking	-2:2010-10.2	At start up and every 8 h
Additional tests for coextruded pipes		
Delamination	-2:2010-A.6	After each relevant test ^e
^a Batch refers to pipe batch but an alternative approach could be considered based on compound batch if agreed by the certification body. ^b Test carried out on the inner surface. For coextruded pipes test inner/outer and each mid layer. Tests may be carried out at higher temperatures by indirect testing; see Table 6, Note b of EN 1555-2:2010. ^c By indirect testing. ^d Tests to be carried out where own reprocessed materials of the same compound are used. The test is not applicable in case of use of 100% of virgin material. Applicable for all layers of coextruded pipes. ^e Test samples from the hydrostatic strength and elongation at break tests shall be examined after testing for any signs of delamination; see EN 1555-2:2010, A.6. ^f For peelable layer pipes all characteristics are assessed on the base pipe without the layer except for marking, appearance, and colour which are also assessed on the peelable layer pipe with the layer.		

Table 9 — Characteristics of fittings and minimum sampling frequencies for BRTs by the fitting manufacturer

Characteristic ^a	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency
Appearance	-3:2010-5.1	1 test piece/ cavity at start-up, then 1 test piece per shift, but at least every 8 h ^c
Colour	-3:2010-5.2	1 test piece/ cavity at start-up, then 1 test piece per shift, but at least every 8 h ^c
Electrical characteristics (A) (B)	-3:2010-5.5	1 test piece/ cavity at start-up, then: a) 1 sample per shift (quantitative), but at least every 8 h ^c b) Each fitting during production ^d
Geometrical characteristics	-3:2010-6	1 test piece/ cavity at start-up, then 1 test piece per shift, but at least every 8 h ^c
Hydrostatic strength (80 °C, 165 h) ^{g h}	-3:2010-7.2	1 test piece/ batch/ cavity, but at least every 10 days ^f
Evaluation of ductility of fusion joint interface ^{b i} (B)	-3:2010-7.2	1 test piece/ batch/ cavity, but at least every 10 days ^f
Marking	-3:2010-10.2	1 test piece/ cavity at start-up, then 1 test piece per shift, but at least every 8 h ^c
Fusion system recognition (A) (B)	-3:2010-10.4	1 test piece/ batch, but at least every 10 days ^{c e f}
^a (A): Electrofusion socket fitting; (B): Electrofusion saddle fitting. ^b Only to be performed if requested by the end-user. ^c For multiple cavity moulds, a rotating sampling procedure between the cavities for testing during the shifts shall be considered. The manufacturer shall give details in his quality plan accordingly. ^d May be checked on a qualitative basis (pass – do not pass). ^e To be checked when welding the hydrostatic strength test sample. ^f For fittings in size group 3, test to be performed either every 10 days or alternatively every 1000 fittings. ^g Alternatively, for $d_n > 450$ mm, the test can also be performed in water-in-air. In case of dispute, water-in-water shall be used. ^h For fitting type (B), $d_n > 450$ mm alternative testing (eg pressurisation through saddle outlet) allowed. ⁱ Alternatively for fitting type (B) $d_n > 450$ mm may be checked by the strip-bend test according to ISO 21751.		

Table 10 — Characteristics of valves and minimum sampling frequencies for BRTs by the valve manufacturer

Characteristic	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency
Appearance	-4:2011-5.1	1 test piece at start-up, then 1 test piece per shift, but at least every 8 h
Colour	-4:2011-5.2	1 test piece at start-up, then 1 test piece per shift, but at least every 8 h
Geometrical Characteristics	-4:2011-6	1 test piece at start-up, then 1 test piece per shift, but at least every 8 h
Hydrostatic Strength (80°C-165 h)	-4:2011-7.2	1 test piece/ batch, but at least every 10 days
Operating Torque	-4:2011-7.2	Every valve
Leaktightness of seat packing at 1.5 MOP (see safety precautions) ^a	-4:2011-7.2	Every valve
Leaktightness of seat packing at 25 mbar	-4:2011-7.2	1 test piece/ batch, but at least every 10 days
Marking	-4:2011-10	1 test piece at start-up, then 1 test piece per shift, but at least every 8 h
^a SAFETY PRECAUTIONS — Safety precautions need to be taken when testing with air or nitrogen up to 1,5 MOP. For testing with air or nitrogen a pressure of a maximum of 6 bar should be used. For MOP > 4 bar, testing with water should be considered, and the test conditions shall be agreed between the manufacturer and end user.		

The manufacturer shall specify a batch in his quality plan.

A batch or lot shall only be released for supply when all the relevant tests and inspections have been carried out at the specified frequencies and the requirements have been met.

If a product fails in respect of any characteristic given in Tables 7 to 10, as applicable, the batch or lot shall be rejected or the retest procedures shall be performed for the characteristic on which the product failed.

The retest procedure shall be given in the manufacturer's quality plan.

6.4 Process verification tests

Those characteristics specified in EN 1555-1:2010, EN 1555-2:2010, EN 1555-3:2010, EN 1555-4:2011 or EN 1555-5:2010 and listed in Table 11 to Table 14 shall be subject to PVTs with the minimum sampling frequency given in Table 11 to Table 14, as applicable.

Table 11 — Characteristics and minimum sampling frequencies for PVTs by the compound manufacturer

Characteristic ^a	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency
Classification ^b	-1:2010-4.4	1 sample/ two years/ compound/ production site
Resistance to rapid crack propagation (critical pressure, p_c , $e \geq 15$ mm)	-1:2010-4.2.3.2 -5:2010-5 Annex B	1 sample/ two years/ compound/ production site
Resistance to slow crack growth (d_n : 110 mm SDR 11)	-1:2010-4.2.3.2	3 test pieces/ year/ compound/ production site
^a Only to be performed if no AT is performed during the same period. ^b Check two stress levels at 20 °C as follows: PE 80 at 10,0 MPa/ 100 h, 9,1 MPa/ 2 500 h; PE 100 at 12,0 MPa/ 100 h, 11,1 MPa/ 2 500 h In addition every 8 years a test at 80 °C for PE 80 at 3,8 MPa/ 5 000 h and for PE 100 at 4,8 MPa/ 5 000 h shall be carried out. Test three test pieces on 1 diameter of size group 1 pipe. The corresponding time shall be exceeded without failure.		

Table 12 — Characteristics of pipes including coextruded pipes and peelable layer pipes, and minimum sampling frequencies for PVTs by the pipe manufacturer

Characteristic ^d	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^{a b}
Hydrostatic strength (80 °C, 1 000 h)	-2:2010-7.2	One diameter/ year/ compound designation/ size group/ production site 3 test pieces of size group 1 or 2, 1 test piece size group 3
Elongation at break ^e	-2:2010-7.2	1 sample of one diameter/ size group/ year/ compound designation/ production site
Longitudinal reversion ^c	-2:2010-8.2	1 sample of one diameter/ size group/ year/ compound designation/ production site
Circumferential reversion	-2:2010-6.4	1 sample of one diameter/ size group 3/ year/ compound designation/ production site
Additional tests for coextruded pipes		
Integrity of the structure after deflection	-2:2010-A.7	1 sample of one diameter/size group/ year/ compound designation/ production site
Delamination	2-A.6	After the elongation at break test
^a Only to be performed if no AT is performed during the same period. ^b Rotate sizes, SDR and compound, as applicable. ^c Longitudinal reversion applicable to wall thickness ≤ 16 mm. ^d For peelable layer pipes all tests are performed on the base pipe without the layer. ^e Only to be performed if not carried out in BRT. Test samples from the elongation at break test on coextruded pipes shall be examined after testing for any signs of delamination, see EN 1555-2:2010, Clause A.6.		

Table 13 — Characteristics of fittings and minimum sampling frequencies for PVTs by the fitting manufacturer

Characteristic ^a	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^{b c}
Hydrostatic strength (80°C, 1 000 h) ^{f g}	-3:2010-7.2	1 test piece per cavity of one diameter from one fitting type/ fitting group/ size group/ year/ compound/ production site
Decohesive resistance (A)	-3:2010-7.2	1 test piece per cavity of one diameter from one fitting type/ size group/ year/ compound/ production site
Evaluation of ductility of fusion joint interface (B) ^{d h}	-3:2010-7.2	1 test piece per cavity of one diameter from one fitting type/ size group/ year/ compound/ production site
Tensile strength for butt fusion (C)	-3:2010-7.2	1 test piece per cavity of one diameter from one fitting type/ size group 2/ year/ compound/ production site
Impact resistance (B)	-3:2010-7.2	1 test piece per cavity of one diameter from one fitting type/ size group/ year/ compound/ production site
Short-term internal pressure resistance (A) ^e	-3:2010-7.3	1 test piece per cavity of one diameter from one fitting type/ size group/ year/ compound/ production site
Resistance to tensile load (A) ^e	-3:2010-7.3	1 test piece per cavity of one diameter from one fitting type/ size group/ year/ compound/ production site

^a (A): Electrofusion socket fitting;
(B): Electrofusion saddle fitting;
(C): Spigot end fitting.

^b Change of product type, diameter and SDR every year to grant that all fittings are tested over a certain time period. Details shall be given in the manufacturer's quality plan.

^c Results from audit tests should be regarded as PVTs.

^d Only to be performed if not tested in the BRT.

^e Only applicable if EN 1555-3:2010, 6.2.2 b) applies.

^f Alternatively, for $d_n > 450$ mm, the test can also be performed in water-in-air. In case of dispute, water-in-water shall be used.

^g For fitting type (B), $d_n > 450$ mm alternative testing (eg pressurisation through saddle outlet) allowed.

^h Alternatively for fitting type (B) $d_n > 450$ mm may be checked by the strip-bend test according to ISO 21751.

Table 14 — Characteristics and minimum sampling frequencies for PVTs by the valve manufacturer

Characteristic	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^{a b}
Hydrostatic strength (80°C, 1 000h)	-4:2011-7.2	3 test pieces/ body type/ year/ compound/ production site
Stop Resistance	-4:2011-7.2	1 test piece/ body type/ year/ compound/ production site
Actuation Mechanism resistance	-4:2011-7.2	1 test piece/ body type/ year/ compound/ production site
Resistance to bending between supports	-4:2011-7.2	1 test piece/ body type/ year/ compound/ production site
Leaktightness under tensile loading	-4:2011-7.2	1 test piece/ body type/ year/ compound/ production site
Impact loading resistance	-4:2011-7.2	1 test piece/ body type/ year/ compound/ production site
^a Change of product type, diameter and SDR every year to grant that all valves are tested over a certain time period. Details shall be given in the manufacturer's quality plan. ^b Results from audit tests should be regarded as PVTs.		

If the product does not conform to the requirements in respect of any characteristic given in Tables 11 to 14, as applicable, the retest procedure detailed in the manufacturer's quality plan shall be performed. If third-party certification is involved, the certification body shall be informed.

If the retest procedure does not confirm conformity of the product to the requirements, then the process shall be investigated and corrected in accordance with the procedures given in the manufacturer's quality plan, as well as to verify the characteristics given in Tables 11 to 14, as applicable.

6.5 Audit tests

Audit Tests are only performed if certification is involved.

Those characteristics specified in EN 1555-1:2010, EN 1555-2:2010, EN 1555-3:2010, EN 1555-4:2011 or EN 1555-5:2010 and listed in Tables 15 to 18 are intended to be audit tested with the minimum sampling frequency as given in Tables 15 to 18, as applicable.

Table 15 — Characteristics and minimum sampling frequencies for ATs for the compound

Characteristic	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency
Classification	-1:2010-4.4	1 sample/ two years/ compound/ production site ^a
Resistance to rapid crack propagation (critical pressure, p_c) ($e \geq 15$ mm)	-1:2010-4.2.3.2 -5:2010-Annex B	1 sample/ two years/ compound/ production site
Resistance to slow crack growth (d_n : 110 mm - SDR 11)	-1:2010-4.2.3.2	3 test pieces/ year/ compound/ production site
^a Check two stress levels at 20 °C as follows: PE 80 at 10,0 MPa/ 100 h, 9,1 MPa/ 2 500 h; PE 100 at 12,0 MPa/ 100 h, 11,1 MPa/ 2 500 h. In addition every 8 years a test at 80 °C for PE 80 at 3,8 MPa/ 5 000 h and for PE 100 at 4,8 MPa/ 5 000 h shall be carried out. Test three test pieces at each stress level on 1 diameter of size group 1 pipe. The corresponding times shall be exceeded without failure.		

Table 16 — Characteristics and minimum sampling frequencies for ATs for pipes, including coextruded pipes and peelable layer pipes

Characteristic ^g	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^a
Appearance	-2:2010-5.1	1 test piece of one diameter/ year/ size group/ production site
Colour	-2:2010-5.2	1 test piece of one diameter/ year/ size group/ production site
Geometrical characteristics	-2:2010-6	1 test piece of one diameter/ year/ size group/ production site
Hydrostatic strength (80 °C, 1 000 h) ^c	-2:2010-7.2	One diameter/ year/ one size group/ production site 3 test pieces of size group 1 or 2, 1 test piece size group 3
Resistance to slow crack growth e < 5 mm (Cone test) e > 5 mm (Notch test)	-2:2010-7.2	One diameter/ year/ one size group/ production site 3 test pieces of size group 1 or 2, 1 test piece size group 3
Resistance to rapid crack propagation (critical pressure, p_c) ^{d e}	-2:2010-7.2	1 sample, Once/ two years/ production site
Elongation at break ^c	-2:2010-7.2	Number of samples shall conform to EN ISO 6259-1, one diameter/ year/ size group/ production site
Oxidation induction time (thermal stability) ^f	-2:2010-8.2	1 sample of one diameter/ year/ size group/ production site
Melt mass-flow rate (MFR) ^f	-2:2010-8.2	1 sample of one diameter/ year/ size group/ production site
Longitudinal reversion ^b	-2:2010-8.2	1 test piece of one diameter/ year/ size group/ production site
Circumferential reversion	-2:2010-6.4	1 test piece of one diameter/ year/ size group 3/ production site
Marking	-2:2010-10.2	1 test piece of one diameter/ year/ size group/ production site
^a Rotate sizes and SDR every year. ^b Longitudinal reversion is applicable to wall thickness ≤ 16 mm. ^c For coextruded pipes test samples from the hydrostatic strength and elongation at break tests shall be examined after testing for any signs of delamination, see EN 1555-2:2010, A.6. ^d For pipes and the base pipe of peelable layer pipes, if applicable (see Table 4 of EN 1555-2:2010). ^e Applicable for coextruded pipes, and for peelable layer pipes tested with the external layer. ^f For coextruded pipes, to be carried out on each layer. ^g All tests except marking are applied to the base pipe of peelable layer pipes. Appearance, colour, RCP and marking are also assessed for peelable layer pipes with the layer included.		

Table 17 — Characteristics and minimum sampling frequencies for ATs for fittings

Characteristic ^a	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^b
Appearance	-3:2010-5.1	1 test piece of one diameter from one fitting type/ fitting group/ size group/ 2 years/ compound/ production site
Colour	-3:2010-5.2	1 test piece of one diameter from one fitting type/ fitting group/ size group/ 2 years/ compound/ production site
Electrical characteristics (A) (B)	-3:2010-5.5	1 test piece of one diameter from one fitting type/ fitting group/ size group/ 2 years/ compound/ production site
Geometrical characteristics	-3:2010-6	1 test piece of one diameter from one fitting type/ fitting group/ size group/ 2 years/ compound/ production site
Hydrostatic strength (80°C, 1000 h) ^{d e}	-3:2010-7.2	3 test pieces of one diameter from one fitting type/ fitting group/ 2 years/ compound/ production site
Decohesive resistance (A)	-3:2010-7.2	1 test piece of one diameter from one fitting type/ 2 years/ compound/ production site
Evaluation of ductility of fusion joint interface (B) ^{c f}	-3:2010-7.2	1 test piece of one diameter from one fitting type/ 2 years/ compound/ production site
Tensile strength for butt fusion (C)	-3:2010-7.2	1 test piece of one diameter from one fitting type of size group 3/ 2 years/ compound/ production site
Impact resistance (B)	-3:2010-7.2	1 test piece of one diameter from one fitting type/ 2 years/ compound/ production site
^a (A): Electrofusion socket fitting; (B): Electrofusion saddle fitting; (C): Spigot end fitting. ^b Change of fitting type, diameter and SDR every visit to grant that all fittings are tested over a certain time period. ^c If tested in BRT this may be carried out by checking the test results of the manufacturer. ^d Alternatively, for $d_n > 450$ mm, the test can also be performed in water-in-air. In case of dispute, water-in-water shall be used. ^e For fitting type (B), $d_n > 450$ mm alternative testing (eg pressurisation through saddle outlet) allowed. ^f Alternatively for fitting type (B) $d_n > 450$ mm may be checked by the strip-bend test according to ISO 21751.		

Table 18 — Characteristics and minimum sampling frequencies for ATs for valves

Characteristic	Reference to part, clause or subclause of EN 1555	Minimum sampling frequency ^a
Appearance	-4:2011-5.1	1 test piece/ 2 years/ compound/ production site
Colour	-4:2011-5.2	1 test piece/ 2 years/ compound/ production site
Geometrical characteristics	-4:2011-6	1 test piece/ 2 years/ compound/ production site
Hydrostatic strength (80°C, 1000 h)	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Stop resistance	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Actuation mechanism resistance	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Resistance to bending between supports	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Thermal cycling resistance $d_n > 63$ mm	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Leaktightness under bending with thermal cycling, $d_n \leq 63$ mm	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Leaktightness under tensile loading	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
Impact loading resistance	-4:2011-7.2	1 test piece/ 2 years/ compound/ production site
^a Change of product type, diameter and SDR every visit to grant that all valves are tested over a certain time period.		

6.6 Indirect tests

Generally, testing shall be performed using the test methods referred to EN 1555-1:2010, EN 1555-2:2010, EN 1555-3:2010, EN 1555-4:2011 or EN 1555-5:2010.

Indirect testing may be used for BRT characteristics as given in Table 7 and Table 10. Indirect testing shall not be used for TTs, PVTs or ATs.

The indirect test method used and the correlation or safe relationship of the indirect testing to the specified testing shall be documented in the manufacturer's quality plan. The continuing validity of the indirect testing shall be checked at regular intervals.

In cases of dispute, the BRTs as specified in Table 7 to Table 10, as applicable, shall be used.

If third-party certification is involved, the IT shall be accepted by certification body.

6.7 One-off products and products produced in very low quantity

For fittings and valves produced one-off or in a very low quantity, testing shall be agreed between the manufacturer and end user.

6.8 Large diameter products

For testing of pipes and fittings $d_n > 630$ mm it is recommended to follow the tables as given in this document. Testing shall be agreed between manufacturer and end user.

6.9 Documentation

6.9.1 Type test results

All Type Tests and their results shall be documented in test reports.

All test reports shall be retained by the manufacturer for at least until the last date of production of the pipes, fittings or valves to which they relate.

6.9.2 Test records

Unless otherwise specified all records shall be maintained for a minimum of 10 years in accordance with the information given in the quality management system.

6.9.3 Technical file for certification purposes

A technical file shall be made available to the certification body by the pipe, fitting and/or valve manufacturer for product certification purposes, containing:

- description of product range concerned
- technical product specification

NOTE 1 This specification needs to contain, depending on the product for example:

- dimensions and tolerances for each geometrical characteristic in according with EN 1555-1, -2, -3 or -4;
- components and materials list with characteristics;
- for electrofusion fittings: electrical characteristics (wire material, diameter and length of the resistive wire, nominal value of the electrical resistance, material and dimensions of terminal connection);
- welding parameters and/or cooling time.

NOTE 2 Spigot ended fittings are covered by ISO/TS 19911 [11].

- Type Test results of the products concerned
- quality plan of the products concerned

Annex A (normative)

Change of compound

A.1 General

For the purposes of this Technical Specification the following definitions of the change of compound shall apply in the determination of type tests re-evaluation requirements for compound.

A.2 Change

A.2.1 Change of base polymer

Change of polymer manufacture, polymerisation process or chemical nature of the comonomer.

A.2.2 Change of grade

A.2.2.1 Any change of nominated density and/or MFR outside of the following limits:

- increase MFR (190 °C, 5 kg) > 20 % or 0,1 g/10 min;
- change of density > 3 kg/m³.

If a decrease of MFR is greater than 20 %, the processing conditions (e.g. injection-moulding) of the compound could be influenced and it should be verified with the product manufacturer.

If the changes are within the above-mentioned limits, only PVT testing as Table 11 is required.

A.2.2.2 Production of the same base polymer at a different site.

A.2.2.3 Production of the same base polymer with a new production line at the same site.

A.2.3 Change of pigment

A.2.3.1 Change of chemical nature or colour of pigment.

A.2.3.2 Increase of pigment level by > 30 %.

A.2.4 Change of additives other than pigments

A.2.4.1 Change of chemical nature or addition or deletion of any additive.

A.2.4.2 Change of any additive (other than UV-stabilisers) level by > 30 %.

A.2.4.3 Decrease of UV-stabilisers by > 30 % or increase by > 50 %.

A.3 Type testing required for re-evaluation

A.3.1 Changes A.2.1 and A.2.3.1

Changes conforming to A.2.1 and/or A.2.3.1 shall require the compound to be regarded as a new compound, for which all type tests shall be required and carried out according to Table 3.

A.3.2 Changes A.2.2.1, A.2.2.2, A.2.2.3, A.2.3.2, A.2.4.1, A.2.4.2 and A.2.4.3

These changes are considered as "minor changes".

Type tests shall be carried out as shown in Table A.1, taken from Table 3 of this Technical Specification.

Failure of the specified requirements is not acceptable.

Table A.1 — Type testing required for re-evaluation

Characteristic	Change ^a						
	A.2.2.1	A.2.2.2	A.2.2.3	A.2.3.2	A.2.4.1	A.2.4.2	A.2.4.3
Physical ^{a b}	+	+	+	+	+	+	+
Resistance to slow crack growth	+	+	+	+	+	+	+
Resistance to rapid crack propagation	+	+	+	+	+	–	–
Tensile strength for butt fusion	+	–	–	+	+	+	+
Resistance to weathering	–	–	–	–	+	–	+
Hydrostatic strength ^c (20°C)	+	+	+	–	+	–	–
Hydrostatic strength ^d (80°C)	+	+	+	+	+	+	+

^a " + " denotes test to be carried out.
" – " denotes test not to be carried out.

^b As defined in Table 3 of this Technical Specification (Conventional density, Oxidation induction time, Water content, Carbon black content and dispersion, Pigment dispersion, MFR).

^c Check two stress levels at 20 °C as follows: PE 80 at 10 MPa/ 100 h, 9,1 MPa/ 2 500 h; PE 100 at 12 MPa/ 100 h, 11,1 MPa/ 2 500 h. Test three test pieces at each stress level on size group 1 pipe. The corresponding times shall be exceeded without failure.

^d Check two stress levels at 80 °C as follows: PE 80 at 4,5 MPa/ 165 h, 3,9 MPa/ 2 500 h; PE 100 at 5,4 MPa/ 165 h, 4,9 MPa/ 2 500 h. Test three test pieces at each stress level on size group 1 pipe. The corresponding times shall be exceeded without failure.

Annex B
(informative)

Basic test matrix for PE compounds and piping products

Table B.1 — Basic test matrix for PE compounds and piping products (1 of 2)

Requirements for		compound formulation (by producer)				Pipes				fittings				Valves			
		TT	BRT	PVT	AT	TT	BRT	PVT	AT	TT	BRT	PVT	AT	TT	BRT	PVT	AT
1	Compound density	X	X														
2	Oxidation induction time	X	X			X	X		X	X				X			
3	Melt mass flow (MFR)	X	X			X	X		X	X				X			
4	Volatile content	X	X														
5	Water content	X	X														
6	Carbon black content	X	X														
7	Carbon black/pigment dispersion	X	X														
8	Resistance to gas condensate	X															
9	Resistance to weathering	X															
10	Resistance to rapid crack propagation	X		X	X	X (1)			X (1)								
11	Resistance to slow crack growth	X		X	X	X			X								
12	Tensile test on a buttfusion weld	X								X (7)		X (7)	X (7)				
13	Classification	X		X	X												
14	Appearance					X	X		X	X	X		X	X	X		X
15	Colour					X	X		X	X	X		X	X	X		X
16	Geometric characteristics					X	X		X	X	X		X	X	X		X
17	Circumferential reversion					X		X	X								
18	Hydrostatic strength (20 °C, 100 h)					X				X				X			
19	Hydrostatic strength (80 °C, 165 h) (2)						X				X				X		
20	Hydrostatic strength (80 °C, 1 000 h)					X		X	X	X		X	X	X		X	X
21	Elongation at break					X	X	X	X								
22	Longitudinal reversion					X	X	X	X								
23	Marking					X			X	X	X			X	X		
24	Squeeze off					X											
25	Coextruded pipes – Integrity of the structure					X		X									
26	Coextruded pipes – Delamination						X										
27	Peelable layer pipes – Weathering					X											
28	Electrical Characteristics (3)									X	X		X				
29	Decohesive resistance (4)									X		X	X				
30	Ductility of fusion joint interface (5)									X	X	X	X				

Table B.1 (2 of 2)

Requirements for		compound formulation (by producer)				Pipes				fittings				Valves			
Characteristic		TT	BRT	PVT	AT	TT	BRT	PVT	AT	TT	BRT	PVT	AT	TT	BRT	PVT	AT
31	Impact resistance (5)									X		X	X				
32	Pressure drop (5)									X							
33	Short term internal pressure (6)									X		X					
34	Resistance to tensile load (6)									X		X					
35	Fusion system recognition									X	X						
36	Leaktightness of seat and packing													X	X		
37	Pressure drop													X			
38	Operating torqueX													X	X		
39	Stop resistance													X		X	X
40	Actuation mechanism resistance													X		X	X
41	Resistance to bending between supports													X		X	X
42	Thermal cycling resistance dn > 63 mm													X			X
43	Leaktightness under bending with thermal cycling , dn ≤ 63 mm													X			X
44	Leaktightness under tensile loading													X		X	X
45	Leaktightness under and after bending applied to the operating mechanism													X			
46	Impact loading resistance													X		X	X
47	Multiple test after the internal pressure test													X			
Requirements for assemblies		compound formulation (by producer)				Pipes				fittings				Valves			
Characteristic		TT	BRT	PVT	AT	TT	BRT	PVT	AT	TT	BRT	PVT	AT	TT	BRT	PVT	AT
48	Tensile strength for butt fusion (8)					X				X				X			
49	Decohesive resistance (4)									X							
50	Ductility of fusion joint interface (5)									X							
51	Hydrostatic strength 80°C 165 h (8)									X				X			

(1) Only applicable for the pipe manufacturer if the wall thickness of the pipe is greater than for pipe tested by the compound supplier. For RCP requirements of coextruded and peelable layer pipes see EN 1555-2:2010, Annexes A and B.
(2) Applicable for pipes and spigot end fittings (3) Applicable for electrofusion socket and saddle fusion fittings. (4) Applicable for electrofusion socket fittings.
(5) Applicable for electrofusion saddle fittings. (6) Only applicable if the wall thickness does not conform with EN 1555-3:2010, 6.2.2 a). (7) Applicable for spigot end fittings. (8) Applicable for pipes and spigot end fittings.

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- [11] ISO/TS 19911, *Plastics pipes and fittings — Format of a technical file for characterizing PE spigot end fittings*
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2) Under revision and to be replaced by ISO 17885 in the future.

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