BS EN 1555-2:2010

BSI Standards Publication

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

Part 2: Pipes

National foreword

This British Standard is the UK implementation of EN 1555-2:2010. It supersedes BS EN 1555-2:2002 which is withdrawn. Together with BS EN 1555-1:2010 and BS EN 1555-5:2010, it supersedes BS 7281:1990 which is withdrawn.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 subcommittee can be obtained on request to its secretary.

NOTE 1 There is no Part 6 in the EN 1555 series. Instead users of BS EN 1555 should refer to EN 12007-2, *Gas supply systems – Pipelines for maximum operating pressure up to and including 16 bar – Part 2: Specific functional recommendations for polyethylene (MOP up to and including 10 Bar). Users of this standard are also referred to the guidance issued by National Grid, for example T/PR/ML/4 - Work procedure for pipe system construction.*

NOTE 2 Part 7 of the EN 1555 series has been prepared as a CEN/TS to allow further development. CEN/TS 1555-7 is not mandatory under the Public Procurement Directives (2004/18/EC and 2004/17/EC).

Users should be aware of any appropriate safety precautions relating to pipework for combustable gas, such as the National Grid Gas document T/PR/ML/4, *Work procedure for pipe system construction Module 4 – PE main laying up to an including 630 mm diameter at pressures up to and including 2 bar*. It is assumed in the drafting of a standard that the execution of its provisions is entrusted to appropriately qualified and competent people.

National Annex NA provides additional information on the selection and installation of piping systems and components in the UK.

Attention is drawn to the following statutory regulation: Health & Safety at Work etc. Act 1974, and subsequent regulations.

The UK Committee would like to emphasize that compliance with this British Standard does not necessarily mean that products are fit for the purpose of conveying gaseous fuels in the UK. The EN 1555 series of standards are not fully compatible with existing UK practice in terms of applicable pressure tiers, preferred colours for gas pipe recognition, jointing and installation methods.

The requirements contained in the EN 1555 series of standards are not necessarily indicative of all the performance requirements, or the suitability of pipework for the service conditions, likely to be encountered in the UK.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 64872 4

ICS 23.040.20; 91.140.40

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2010.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1555-2

September 2010

ICS 23.040.20; 91.140.40

Supersedes EN 1555-2:2002

English Version

Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 2: Pipes

Systèmes de canalisations en plastique pour la distribution de combustibles gazeux - Polyéthylène (PE) - Partie 2 : Tubes

Kunststoff-Rohrleitungssysteme für die Gasversorgung Polyethylen (PE) - Teil 2: Rohre

This European Standard was approved by CEN on 30 July 2010.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 1555-2:2010: E

Contents

Page

Foreword

This document (EN 1555-2:2010) has been prepared by Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

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 EN 1555-2:2002.

It has been prepared in liaison with Technical Committee CEN/TC 234 "Gas infrastructure".

System Standards are based on the results of the work being undertaken in ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids", which is a Technical Committee of the International Organization for Standardization (ISO).

They are supported by separate standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with general standards on functional requirements and on recommended practice for installation.

EN 1555 consists 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* (this standard);

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

— prEN 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 assessment of conformity*.

NOTE EN 12007-2:2000 [1] prepared by CEN/TC 234 “Gas infrastructure” deals with the recommended practice for installation of plastics pipes system in accordance with EN 1555 (all parts).

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

Introduction

The System Standard, of which this is Part 2, specifies the requirements for a piping system and its components made from polyethylene (PE) and which is intended to be used for the supply of gaseous fuels.

Requirements and test methods for material and components, other than pipes, are specified in EN 1555-1, EN 1555-3 [7] and prEN 1555-4 [8].

Characteristics for fitness for purpose are covered in EN 1555-5. CEN/TS 1555-7 [2] gives guidance for assessment of conformity. Recommended practice for installation is given in EN 12007-2:2000 [1] prepared by CEN/TC 234.

This part of EN 1555 covers the characteristics of pipes.

1 Scope

This part of EN 1555 specifies the characteristics of pipes made from polyethylene (PE) for piping systems in the field of the supply of gaseous fuels.

It also specifies the test parameters for the test methods referred to in this standard.

In conjunction with Parts 1 and 3 to 5 of EN 1555, it is applicable to PE pipes, their joints and to joints with components of PE and other materials intended to be used under the following conditions:

a) a maximum operating pressure, MOP, up to and including 10 bar [1)];

b) an operating temperature of 20 °C as reference temperature.

NOTE 1 For other operating temperatures, derating coefficients should be used, see EN 1555-5.

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

It covers three types of pipe:

— PE pipes (outside diameter d_n) including any identification stripes;

— PE pipes with co-extruded layers on either or both the outside and/or inside of the pipe (total outside diameter d_n) as specified in Annex A, where all layers have the same MRS rating;

— PE pipes (outside diameter d_n) with a peelable, contiguous thermoplastics additional layer on the outside of the pipe ('coated pipe') as specified in Annex B.

NOTE 2 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 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.

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

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

EN 12106, *Plastics piping systems — Polyethylene (PE) pipes — Test method for the resistance to internal pressure after application of squeeze-off*

EN ISO 1133:2005, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics (ISO 1133:2005)*

EN ISO 1167-1:2006, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method (ISO 1167-1:2006)*

1) 1 bar = 0,1 MPa.

EN ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces (ISO 1167-2:2006)*

EN ISO 2505, *Thermoplastics pipes — Longitudinal reversion — Test method and parameters (ISO 2505:2005)*

EN ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions (ISO 3126:2005)*

EN ISO 6259-1, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method (ISO 6259-1:1997)*

EN ISO 9969, *Thermoplastics pipes — Determination of ring stiffness (ISO 9969:2007)*

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 13477:2008)*

EN ISO 13478, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full scale test (FST) (ISO 13478:2007)*

EN ISO 13479:2009, *Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes (ISO 13479:2009)*

EN ISO 13968, *Plastics piping and ducting systems —Thermoplastics pipes — Determination of ring flexibility (ISO 13968:2008)*

ISO 4065:1996, *Thermoplastics pipes — Universal wall thickness table*

ISO 6259-3, *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes*

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

ISO 13480, *Polyethylene pipes — Resistance to slow crack growth — Cone test method*

3 Terms and definitions, symbols and abbreviations

For the purposes of this document the terms and definitions, symbols and abbreviations given in EN 1555-1:2010 apply.

4 Material

4.1 Compound for pipes

The pipes shall be made from virgin material or own reprocessable material from the same PE compound or a mixture of both materials. Reprocessable material from coextruded pipes or from pipes reprocessed with the peelable layer attached shall not be used. Own reprocessed material from the base pipe of peelable layer pipes can be used.

The compound(s) from which the pipes are made shall conform to EN 1555-1.

4.2 Compound for identification stripes

For black pipe with yellow or orange identifications stripes (see also 5.2), the compound used for these identification stripes shall be made from the same base polymer (PE) as one of the pipe compounds for which fusion compatibility has been proven.

4.3 External reprocessable and recyclable material

Reprocessable material obtained from external sources and recyclable material shall not be used.

5 General characteristics

5.1 Appearance

When viewed without magnification, the internal and external surfaces of pipes shall be smooth and clean and shall have no scoring, cavities and other surface defects to an extent that would prevent conformity to this standard.

The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

5.2 Colour

Pipes shall be black (PE 80 or PE 100), yellow (PE 80) or orange (PE 100). In addition black PE 80 pipes may be identified by yellow stripes and black PE 100 pipes may be identified by yellow or orange stripes, according to national preference.

The outer coextruded layer of coextruded pipes (see Annex A) or the outer peelable layer of peelable layer pipes (see Annex B) shall be either black, yellow or orange. In addition identification stripes may be used according to national preference.

NOTE 1 In some countries pipes made out of non-pigmented compound in conjunction with an external peelable layer are permitted, providing the compound conforms to the requirements of this document. If this is allowed in a country, this should be clearly stated in the national foreword.

NOTE 2 National preference for colour should be stated in the national foreword.

6 Geometrical characteristics

6.1 Measurement of dimensions

The dimensions of the pipe shall be measured in accordance with EN ISO 3126, and rounded to the next 0.1 mm. In case of dispute the measurement shall not be made less than 24 h after manufacture after being conditioned for at least 4 h at (23 ± 2) °C.

NOTE Indirect measurement at the stage of production is allowed at shorter time periods providing evidence is shown of correlation.

6.2 Mean outside diameters, out-of-roundness (ovality) and tolerances

The mean outside diameters of the pipe, d_{em} shall conform to Table 1.

For straight pipes, the maximum out-of-roundness shall conform to Table 1. For coiled pipes, the maximum out-of-roundness shall be specified by agreement between the manufacturer and the end-user.

Table 1 — Mean outside diameters and out-of-roundness

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter		Maximum out-of-roundness for straight pipes [b] [c]
		$d_{em,min}$	$d_{em,max}$ [a]	
16	16	16,0	16,3	1,2
20	20	20,0	20,3	1,2
25	25	25,0	25,3	1,2
32	32	32,0	32,3	1,3
40	40	40,0	40,4	1,4
50	50	50,0	50,4	1,4
63	63	63,0	63,4	1,5
75	75	75,0	75,5	1,6
90	90	90,0	90,6	1,8
110	110	110,0	110,7	2,2
125	125	125,0	125,8	2,5
140	140	140,0	140,9	2,8
160	160	160,0	161,0	3,2
180	180	180,0	181,1	3,6
200	200	200,0	201,2	4,0
225	225	225,0	226,4	4,5
250	250	250,0	251,5	5,0
280	280	280,0	281,7	9,8
315	315	315,0	316,9	11,1
355	355	355,0	357,2	12,5
400	400	400,0	402,4	14,0
450	450	450,0	452,7	15,6
500	500	500,0	503,0	17,5
560	560	560,0	563,4	19,6
630	630	630,0	633,8	22,1

a Grade B according to ISO 11922-1:1997 [3].
b Measurement of out-of-roundness shall be made at the point of manufacturing.
c If other values for the out-of-roundness than those given in this table are necessary (eg coiled pipes), they shall be agreed between the manufacturer and the end-user.

6.3 Wall thicknesses and related tolerances

6.3.1 Minimum wall thicknesses

The use of any SDR derived from the pipe series S given according to ISO 4065:1996 is permitted.

The minimum wall thickness, e_{min}, of pipes with SDR 17,6, SDR 17 and SDR 11 shall conform to Table 2.

Table 2 — Minimum wall thicknesses for pipes of SDR 17,6, SDR 17 and SDR 11

Dimensions in millimetres

Nominal size DN/OD	Minimum wall thickness e_{min} [a]		
	SDR 17,6 [b]	SDR 17	SDR 11
16	2,3 [c]	2,3 [c]	3,0 [c]
20	2,3 [c]	2,3 [c]	3,0 [c]
25	2,3 [c]	2,3 [c]	3,0 [c]
32	2,3 [c]	2,3 [c]	3,0
40	2,3	2,4	3,7
50	2,9	3,0	4,6
63	3,6	3,8	5,8
75	4,3	4,5	6,8
90	5,2	5,4	8,2
110	6,3	6,6	10,0
125	7,1	7,4	11,4
140	8,0	8,3	12,7
160	9,1	9,5	14,6
180	10,3	10,7	16,4
200	11,4	11,9	18,2
225	12,8	13,4	20,5
250	14,2	14,8	22,7
280	15,9	16,6	25,4
315	17,9	18,7	28,6
355	20,2	21,1	32,2
400	22,8	23,7	36,3
450	25,6	26,7	40,9
500	28,4	29,7	45,4
560	31,9	33,2	50,8
630	35,8	37,4	57,2

a $e_{min} = e_n$.
b The SDR 17,6 series will be removed at the next revision of this standard.
c The calculated values of e_{min} have been rounded up to 2,3 mm for SDR 17,6 and SDR 17 and 3,0 mm for SDR 11, respectively.

6.3.2 Tolerance on the wall thicknesses

The tolerance on the wall thickness at any point shall conform to Table 3 footnote a, which is derived from grade V of ISO 11922-1:1997 [3].

Table 3 — Tolerance on wall thicknesses

Dimensions in millimetres

Nominal wall thickness e_n [a]		Plus tolerance t_y [b]	Nominal wall thickness e_n [a]		Plus tolerance t_y [b]
>	≤		>	≤	
–	2,0	0,3	30,0	31,0	3,2
2,0	3,0	0,4	31,0	32,0	3,3
3,0	4,0	0,5	32,0	33,0	3,4
4,0	5,0	0,6	33,0	34,0	3,5
5,0	6,0	0,7	34,0	35,0	3,6
6,0	7,0	0,8	35,0	36,0	3,7
7,0	8,0	0,9	36,0	37,0	3,8
8,0	9,0	1,0	37,0	38,0	3,9
9,0	10,0	1,1	38,0	39,0	4,0
10,0	11,0	1,2	39,0	40,0	4,1
11,0	12,0	1,3	40,0	41,0	4,2
12,0	13,0	1,4	41,0	42,0	4,3
13,0	14,0	1,5	42,0	43,0	4,4
14,0	15,0	1,6	43,0	44,0	4,5
15,0	16,0	1,7	44,0	45,0	4,6
16,0	17,0	1,8	45,0	46,0	4,7
17,0	18,0	1,9	46,0	47,0	4,8
18,0	19,0	2,0	47,0	48,0	4,9
19,0	20,0	2,1	48,0	49,0	5,0
20,0	21,0	2,2	49,0	50,0	5,1
21,0	22,0	2,3	50,0	51,0	5,2
22,0	23,0	2,4	51,0	52,0	5,3
23,0	24,0	2,5	52,0	53,0	5,4
24,0	25,0	2,6	53,0	54,0	5,5
25,0	26,0	2,7	54,0	55,0	5,6
26,0	27,0	2,8	55,0	56,0	5,7
27,0	28,0	2,9	56,0	57,0	5,8
28,0	29,0	3,0	57,0	58,0	5,9
29,0	30,0	3,1			

[a] See Table 2 footnote a.

[b] The tolerance is expressed in the form $^{+t_y}_{0}$ mm.

6.4 Circumferential reversion of pipes with a d_n equal to or greater than 250 mm

The circumferential reversion of pipes with a d_n equal to or greater than 250 mm shall be determined between 24 h and 48 h after manufacture and after conditioning in water at 80 °C. The conditioning shall be in accordance with EN ISO 1167-1. The pipe test pieces shall be $3d_n$ in length. With the test piece at (23 ± 2) °C, circumferential measurement shall be made to establish d_{em}. made at distance of $0.1d_n$ and $1{,}0d_n$ respectively from the end of the test piece. The difference between these d_{em} measurements shall not be greater than the d_{em} tolerance range specified in Table 1.

6.5 Coiled pipe

During production the pipe shall be coiled such that localised deformation, e.g. buckling and kinking, is prevented.

The minimum internal diameter of the coil shall be not less than $18d_n$.

6.6 Lengths

No requirements have been set concerning particular lengths of coiled or straight pipe or the tolerance thereon; hence it is necessary for lengths of pipe to be supplied by agreement between purchaser and manufacturer.

7 Mechanical characteristics

7.1 Conditioning

Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing in accordance with Table 4.

7.2 Requirements

When tested in accordance with the test methods as specified in Table 4 using the indicated parameters, the pipe shall have mechanical characteristics conforming to the requirements given in Table 4. The requirements for squeeze-off pipe are given in Annex C.

Table 4 — Mechanical characteristics

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Hydrostatic strength (20 °C, 100 h)	No failure during the test period of any test piece	End caps Orientation Conditioning time at test temperature Number of test pieces [a] Type of test Circumferential (hoop) stress for: PE 80 PE 100 Test period Test temperature	Type A of EN ISO 1167-1:2006 Free Shall conform to EN ISO 1167-1 3 Water-in-water 10 MPa 12,0 MPa 100 h 20 °C	EN ISO 1167-1 and EN ISO 1167-2
Hydrostatic strength (80 °C, 165 h)	No failure during the test period of any test piece [b]	End caps Orientation Conditioning time at test temperature Number of test pieces [a] Type of test Circumferential (hoop) stress for: PE 80 PE 100 Test period Test temperature	Type A of EN ISO 1167-1:2006 Free Shall conform to EN ISO 1167-1 3 Water-in-water 4,5 MPa 5,4 MPa 165 h 80 °C	EN ISO 1167-1 and EN ISO 1167-2

(continued)

Table 4 *(continued)*

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Hydrostatic strength (80 °C, 1000 h)	No failure during the test period of any test piece	End caps Orientation Conditioning time at test temperature Number of test pieces [a] Type of test Circumferential (hoop) stress for: PE 80 PE 100 Test period Test temperature	Type A of EN ISO 1167-1:2006 Free Shall conform to EN ISO 1167-1 3 Water-in-water 4 MPa 5 MPa 1000 h 80 °C	EN ISO 1167-1 and EN ISO 1167-2
Elongation at break for $e \leq 5$ mm	≥ 350 % [c d]	Test piece shape Speed of test Number of test pieces [a]	Type 2 100 mm/min Shall conform to EN ISO 6259-1	EN ISO 6259-1 and ISO 6259-3
Elongation at break for 5 mm < $e \leq$ 12 mm	≥ 350 % [c d]	Test piece shape Speed of test Number of test pieces [a]	Type 1 [e] 50 mm/min Shall conform to EN ISO 6259-1	EN ISO 6259-1 and ISO 6259-3
Elongation at break for $e >$ 12 mm	≥ 350 % [c d]	Test piece shape Speed of test Number of test pieces [a]	Type 1 [e] 25 mm/min Shall conform to EN ISO 6259-1	EN ISO 6259-1 and ISO 6259-3
		OR		
		Test piece shape Speed of test Number of test pieces [a]	Type 3 [e] 10 mm/min Shall conform to EN ISO 6259-1	
Resistance to slow crack growth for $e \leq 5$ mm (Cone test)	≤ 10 mm/day	Number of test pieces [a]	Shall conform to ISO 13480	ISO 13480
Resistance to slow crack growth for $e >$ 5 mm (Notch test)	No failure during the test period	Test temperature Internal test pressure for: PE 80, SDR 11 PE 100, SDR 11 Test period Type of test Number of test pieces [a]	80 °C 8 bar [f] 9,2 bar [f] 500 h Water-in-water Shall conform to EN ISO 13479	EN ISO 13479
Resistance to rapid crack propagation (Critical pressure, p_c) [g]	$p_c \geq 1{,}5$ MOP with $P_c = 3{,}6\ p_{c,s4} + 2{,}6$ [h]	Test temperature Number of test pieces [a]	0 °C Shall conform to EN ISO 13477	EN ISO 13477

(continued)

Table 4 *(continued)*

a The numbers of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance see CEN/TS 1555-7 [2].
b Only brittle failures shall be taken into account. If a ductile failure occurs before 165 h, the test may be repeated at a lower stress, see 7.3. The stress and the associated test period shall be selected from Table 5 or from a line based on the stress/time points given in Table 5.
c Where the rupture takes place outside the gauge marks, the test is accepted if the value conforms to the requirements.
d The test can be terminated when the requirement is met, without necessarily carrying out the test up to the rupture of the test piece.
e Where practical, machine or die cut type 2 test pieces may be used for pipe wall thickness equal to or less than 25 mm.
f For other SDR classes values are given in Annex B of EN ISO 13479:2009.
g Rapid crack propagation testing is only required when the wall thickness of the pipe is greater than the wall thickness of the pipe used in the rapid crack propagation PE compound test (see Table 2 of EN 1555-1:2010). For coextruded and peelable layer pipes refer to Annex A and Annex B. Rapid crack propagation testing is required at sub-zero temperatures for applications at such temperatures.
h Full scale/S4 correlation factor is equal to 3,6 and is defined as the full scale/S4 critical absolute pressures ratio: $(p_{c,full\ scale} + 1) = 3,6(p_{c,s4} + 1)$.
If the requirement is not met or S4 test equipment not available, then (re)testing by using the full scale test shall be performed in accordance with EN ISO 13478. In this case : $p_c = p_{c,full\ scale}$.

7.3 Retest in case of failure at 80 °C

A fracture in a brittle mode in less than 165 h shall constitute a failure; however if a sample in the 165 h test fails in a ductile mode in less than 165 h, a retest shall be performed at a selected lower stress in order to achieve the minimum required time for the selected stress obtained from the line through the stress/time points given in Table 5.

Table 5 — Test parameters for the retest of the hydrostatic strength at 80 °C

PE 80		PE 100	
Stress	**Test period**	**Stress**	**Test period**
MPa	h	MPa	h
4,5	165	5,4	165
4,4	233	5,3	256
4,3	331	5,2	399
4,2	474	5,1	629
4,1	685	5,0	1 000
4,0	1 000	—	—

8 Physical characteristics

8.1 Conditioning

Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing in accordance with Table 6.

8.2 Requirements

When tested in accordance with the test methods as specified in Table 6 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 6.

Table 6 — Physical characteristics

Characteristic	Requirements	Test parameters		Test method
		Parameter	Value	
Oxidation induction time (Thermal stability)	≥20 min	Test temperature Number of test pieces [a c] Test environment Specimen weight	200 °C [b] 3 Oxygen 15 mg ± 2 mg	ISO 11357-6
Melt mass-flow rate (MFR)	After processing maximum deviation of ± 20 % of the value measured on the batch used to manufacture the pipe	Loading mass Test temperature Time Number of test pieces [a]	5 kg 190 °C 10 min Shall conform to EN ISO 1133:2005	EN ISO 1133:2005
Longitudinal reversion	≤ 3 % original appearance of the pipe shall remain	Test temperature Length of test piece Immersion time Test method Number of test pieces [a]	110 °C 200 mm 1 h Free Shall conform to EN ISO 2505	EN ISO 2505

a The numbers of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance see CEN/TS 1555-7 [2].

b Test may be carried out as an indirect test at 210 °C or 220 °C providing clear correlation has been established. with the results at 200 °C. In case of dispute the reference temperature shall be 200 °C.

c Samples shall be taken from the outer and inner pipe surfaces.

9 Performance requirements

When pipes conforming to this standard are assembled to each other or to components conforming to other parts of EN 1555, the joints shall conform to EN 1555-5.

10 Marking

10.1 General

10.1.1 The marking elements shall be printed or formed directly on the pipe in such a way that after storage, weathering, handling and installation legibility is maintained during the use of the pipe.

NOTE The manufacturer is not responsible for marking being illegible, due to actions caused during installation and use such as painting, scratching, covering of the components or by use of detergents etc. on the components unless agreed or specified by the manufacturer.

10.1.2 Marking shall not initiate cracks or other types of defects, which adversely influence the performance of the pipe.

10.1.3 If printing is used, the colour of the printed information shall differ from the basic colour of the pipe.

10.1.4 The size of the marking shall be such that it is legible without magnification.

10.1.5 In case of pipes made from own reprocessable material, the use of appropriate marking should be subject to agreement between the manufacturer and the end-user.

10.2 Minimum required marking

The minimum required marking shall conform to Table 7.

Table 7 — Minimum required marking

Aspects	Mark or symbol
Number of the System Standard	EN 1555
Manufacturer's name and/or trademark	Name or symbol
For pipes $d_n \leq 32$ mm:	
Nominal outside diameter × nominal wall thickness ($d_n \times e_n$)	e.g. 32 × 3,0
For pipes $d_n > 32$ mm:	
– Nominal outside diameter, d_n	e.g. 200
– SDR	e.g. SDR 11
Type of pipe if applicable	e.g. co-extruded or peelable layer
Material and designation	e.g. PE 100
Manufacturer's information	[a]
Intended use [b]	GAS

[a] For providing traceability the following details shall be given:
- the production period, year and month, in figures or in code;
- name or code for the production site, if the manufacturer is producing in different sites;
- materials used by name or code.

b Information on abbreviations may be found in CEN/TR 15438 [4] and/or in national rules.

The frequency of the marking shall not be less than once per metre.

The length of coiled pipes is permitted to be indicated on the coil; the remaining length of pipe on drums is permitted to be indicated on the pipe.

Coextruded and peelable pipe shall be marked accordingly including any specific instructions related to these types of pipe.

10.3 Additional marking

Pipes conforming to this standard, which are third party certified, may be marked accordingly.

Annex A
(normative)

Pipes with co-extruded layers

A.1 General

This annex specifies the additional geometrical, mechanical and physical properties of polyethylene (PE) pipes with co-extruded layer(s), intended to be used for the supply of gaseous fuels. Additional marking requirements are given. The outside diameter, d_e, is defined as the total outside diameter, including the coextruded black or pigmented layer(s) at the outside of the pipe (see 5.2), and the wall thickness (e_n) is defined as the total wall thickness including all layers, on either or both the outside and/or inside of the pipe. The PE compounds used for the layer(s) of the pipe shall be in accordance with EN 1555-1 and of the same MRS rating. Reprocessed material from coextruded pipes shall not be used for these products.

NOTE Other types of layered pipes are covered by other standards, e.g. ISO 17484-1:2006 [5] or ISO 18225:2007 [6].

A.2 Geometrical characteristics

The geometrical characteristics of the pipe, inclusive of the co-extruded layer(s), shall be in accordance with Clause 6. The manufacturer shall declare the thickness of each layer and tolerance in the technical file.

A.3 Mechanical characteristics

The mechanical characteristics of the pipe, inclusive of the co-extruded layer(s), shall be in accordance with Clause 7.

In addition the requirements for RCP and Slow Crack Growth in accordance with Table 2 of EN 1555-1:2010 shall be fulfilled by the manufactured pipe.

A.4 Physical characteristics

The physical characteristics shall be in accordance with Clause 8. The requirements for thermal stability and for melt flow rate shall apply to the individual layers respectively. Heat reversion shall be applicable to the pipe, inclusive of the co-extruded layer(s).

A.5 Marking

The marking of pipes with co-extruded layer(s) shall be in accordance with Clause 10.

A.6 Delamination

No delamination shall occur during all tests of the co-extruded pipe.

A.7 Integrity of the structure

When tested in accordance with the test methods as specified in Table A.1, using the indicated parameters, the pipe shall have the structural performance conforming to the requirements given in Table A.1.

Table A.1 — Integrity of the structure

Characteristic	Requirement	Test parameters		Test method
Integrity of the structure after deflection	> 80% of the initial stiffness value	Deflection Position of test piece	30% of d_{em} When applicable, at 0, 45 and 90 from the upper plate	EN ISO 13968

For the determination of the integrity of the structure after deflection of coextruded pipes, the following procedure shall be applied:

a) determine the initial ring stiffness of the pipe according to EN ISO 9969;

b) carry out the ring flexibility test according to EN ISO 13968;

c) after a 1 h period for recovery, determine again the ring stiffness according to EN ISO 9969.

The ring stiffness of the coextruded pipe shall be at least 80% of the initial ring stiffness.

Annex B
(normative)

Pipes with peelable layer

B.1 General

This annex specifies the geometrical, mechanical and physical properties of those polyethylene (PE) pipes (outside diameter d_n) having a peelable, contiguous, thermoplastics layer on the outside of the pipe ("coated pipe"), intended to be used for the supply of gaseous fuels. Marking requirements are also given.

The PE-material used for the production of the base pipe shall be in accordance with EN 1555-1 and the base pipe shall fulfil all the requirements of EN 1555-2:2010 after removal of the peelable layer with the exception of appearance, colour and marking.

The external coating shall be manufactured from a thermoplastic material. When attached, the coating shall not affect the ability of the PE pipe to meet the performance requirements of this European standard.

If an adhesive layer is used to attach the peelable layer, it shall be easily removed, and without affecting the jointing process. The preparation for the joining process shall follow normal procedures.

NOTE Other types of layered pipes are covered by other standards e.g. ISO 17484-1:2006 [5] or ISO 18225:2007 [6].

B.2 Geometrical characteristics

The geometrical characteristics of the pipe, with the coating removed, shall be in accordance with Clause 6.

B.3 Mechanical characteristics

The coating shall not have a detrimental effect on the pipe or vice versa. The mechanical characteristics of the pipe, with the coating removed shall be in accordance with Clause 7, and the attachment of the coating shall not affect the ability of the pipe to conform with those requirements. Requirements for colour are given in 5.2.

When the pipe is tested with the coating attached, conformity with Clause 7 before and after weathering according to Table 2 of EN 1555-1:2010 shall be assessed with the exception of black pipe. The conditions selected shall ensure that pipe is subjected to the specified test stresses.

B.4 Physical characteristics

The physical characteristics of the pipe, with the coating removed, shall be in accordance with Clause 8. The coating shall not have a detrimental effect on the pipe or vice versa.

B.5 Coating adhesion

The coating shall be resistant to detachment during storage and installation.

The coating shall be manually removable prior to jointing using simple tools.

B.6 Marking

Marking shall be applied to the coating and shall be in accordance with Clause 10.

In addition, the coating shall be provided with marking clearly distinguishing the pipe from non-coated pipe in service, for example identification stripes may be used for this purpose.

The coating shall also carry marking that warns that the coating must be removed prior to electrofusion, buttfusion and mechanical jointing.

NOTE When possible, the base pipe should be marked in accordance with Clause 10.

Annex C
(normative)

Squeeze-off technique

C.1 General Squeeze-off technique

In certain countries the technique of squeeze-off is used to restrict the flow of gas in PE piping systems whilst effecting maintenance and repair operations.

If the end-user desires to employ the technique, evidence shall be provided to the end-user that after squeeze-off in accordance with the method recommended by the manufacturer of pipes or a method using a reinforcement sleeve, all the requirements for hydrostatic strength of the pipe according to Table 4 shall be fulfilled.

C.2 Terms and definitions

For the purposes of this annex the following terms and definitions apply.

C.2.1
squeeze-off
gas flow stopped by squeezing the pipe when compressed between two clamps in such a way that the distance between both clamps is less than twice the nominal wall thickness

C.3 Test method

The evidence in accordance with C.1 shall be obtained using the test method specified in EN 12106.

Bibliography

[1] EN 12007-2:2000, *Gas supply systems — Gas pipelines for maximum operating pressure up to and including 16 bar — Part 2: Specific functional recommendations for polyethylene (MOP up to and including 10 bar)*

[2] CEN/TS 1555-7, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 7: Guidance for assessment of conformity*

[3] ISO 11922-1:1997, *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series*

[4] CEN/TR 15438, *Plastics piping systems – Guidance for coding of products and their intended uses*

[5] ISO 17484-1:2006, *Plastics piping systems — Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 bar (500 kPa) — Part 1: Specifications for systems*

[6] ISO 18225:2007, *Plastics piping systems — Multilayer piping systems for outdoor gas installations — Specifications for systems*

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

[8] prEN 1555-4, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 4: Valves*

National Annex (informative)

Additional information on the selection and installation of piping systems and components in the UK

The responsible UK committee gives the following advice concerning the selection and installation of piping systems and components conforming to this British Standard.

a) Gas supply companies and other entities deemed to be within the scope of the Public Procurement Directives (PPD) are obliged to use EN 1555-1, EN 1555-2, EN 1555-3, EN 1555-4 and EN 1555-5, produced under EC/U mandate, if they wish to purchase PE pipe systems or components within the PPD scope.

b) CE marking against the Construction Products Directive and the Pressure Equipment Directive does not apply to pipes and fittings within the scope of EN 1555-1, EN 1555-2 and EN 1555-3. However, CE marking may apply to valves within the scope of EN 1555-4.

c) Where there are options, care should be taken to ensure that agreement is established between suppliers and purchasers, e.g. in terms of colour, size, physical characteristics and Quality Assurance.

d) For colour, it is the practice of UK gas companies to use yellow PE pipes to facilitate identification of buried gas pipelines, in accordance with the recommendations of the National Joint Utilities Group (NJUG) concerning the colour coding of pipelines and other services. For UK public gas supply applications, the pipes should also be marked in accordance with the relevant standards of the national network distributors[1] (i.e. GIS/PL2 Part 2 and GIS/PL2 Part 8).

e) To comply with health and safety requirements for safe handling of PE pipes supplies as coils or on drums, guidance should be sought from the national network distributors.

f) This British Standard requires pipes in the diameter range 16 mm to 25 mm to have, according to BS EN 1555-2, Table 2, a minimum wall thickness of either 2,3 or 3,0 mm. It is established practice in the UK for distribution pipes to have a minimum wall thickness of 2,3 mm for that size range, and for the pipes to be designated SDR11.

g) This British Standard requires the critical pressure for rapid crack propagation (RCP) as measured in accordance with ISO 13477 to be equal to or greater than 1,50 maximum operation pressure (MOP) in BS EN 1555-2, Table 4. It is current practice of UK gas companies to use a value of 2.0 instead of 1.5 times MOP.

h) Requirements for slow crack growth (SCG) are specified in BS EN 1555-2, Table 4. The PE pipe compound is to be tested in pipe form in accordance with EN ISO 13479, with a test period of 500 h. It is established practice in the UK to use a test period of 1000 h.

[1] The national network distributers are a group of companies that operate the pipelines in the UK. There are 5 companies that make up this group: National Grid; Wales and West Utilities; Northern Gas Networks; Scotia Gas South; and Scotia Gas North.

i) Attention is drawn to the normative Annex C of BS EN 1555-2, to the assessment of the effect of squeeze-off on the strength of PE gas pipes using the test method specified in EN 12106. It is the responsibility of the manufacturer to ensure that pipes fulfil the specified requirements. It is recommended that the end-user confirm with the manufacturer that the product has been proven to meet the requirements for hydrostatic strength of pipe according to BS EN 1555-2, Table 4. The relevant specifications of the national network distributors should be consulted for information on squeeze-off requirements. This is particularly important in the case of coextruded pipes and pipes with a peelable outer layer.

j) Attention is drawn to the necessity of following manufacturer's instructions on correct jointing procedure. Butt-welding parameters for welding pipe to pipe are the responsibility of the pipe manufacturer. Butt-welding parameters for welding pipes to spigot fittings are the responsibility of the fitting manufacturer. Electrofusion welding parameters are the responsibility of the fitting manufacturer. In particular, the need, (or otherwise) to scrape the pipe prior to electrofusion jointing should be established with the manufacturer of the electrofusion fittings. This is even more important in the case of coextruded pipes and pipes with a peelable outer layer.

MAHCO

MAHCO

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards and other standards-related publications, information and services.
It presents the UK view on standards in Europe and at the international level.

It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001

BSI offers Members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Tel: +44 (0)20 8996 7669 Fax: +44 (0)20 8996 7001
Email: plus@bsigroup.com

Buying standards

You may buy PDF and hard copy versions of standards directly using a credit card from the BSI Shop on the website **www.bsigroup.com/shop.** In addition all orders for BSI, international and foreign standards publications can be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Knowledge Centre.

Tel: +44 (0)20 8996 7004 Fax: +44 (0)20 8996 7005
Email: knowledgecentre@bsigroup.com

Various BSI electronic information services are also available which give details on all its products and services.

Tel: +44 (0)20 8996 7111 Fax: +44 (0)20 8996 7048
Email: info@bsigroup.com

BSI Subscribing Members are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about BSI is available on the BSI website at **www.bsigroup.com/standards**

Copyright

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™