INTERNATIONAL STANDARD

ISO 4437

Second edition
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Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications

Canalisations enterrées en polyéthylène (PE) pour réseaux de distribution de combustibles gazeux —Série métrique — Spécifications

Reference number
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CONTENTS

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Foreword

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

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

International Standard ISO 4437 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids,* Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels.*

This second edition cancels and replaces the first edition (ISO 4437:1988), in which substantial changes have been made in the specifications for the characteristics of the PE compound as well as for the mechanical properties of the PE pipe. Also, references are made to test methods which are laid down in ISO Standards and in Technical Reports which were not ready at the time the first edition was issued.

Annexes A to D form an integral part of this International Standard. Annex E is for information only.

Buried polyethylene (PE) pipes for the supply of gaseous fuels – Metric series – Specifications

1. SCOPE

This International Standard specifies the physical properties of buried polyethylene (PE) pipes intended to be used for the supply of gaseous fuels. In addition, it specifies some general properties of the material from which these pipes are made, including a classification scheme.

This International Standard also lays down dimensional requirements and maximum allowable operating pressure ratings related to overall service (design) coefficients and operating temperatures.

2. NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3: 1973, *Preferred numbers — Series of preferred numbers.*

ISO 161-1:1996, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series.*

ISO 1133:1997, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics.*

ISO 1167:1996, *Thermoplastics pipes for the conveyance of fluids — Resistance to internal pressure — Test method.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

ISO 1872-1:1993, *Plastics — Polyethylene (PE) moulding and extrusion materials — Part 1: Designation system and basis for specifications.*

ISO 2505-1:1994, *Thermoplastics pipes — Longitudinal reversion — Part 1: Determination methods.*

ISO 2505-2:1994, *Thermoplastics pipes — Longitudinal reversion — Part 2: Determination parameters.*

ISO 3126:1974, *Plastics pipes — Measurement of dimensions.*

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

ISO 4440-1:1994, *Thermoplastics pipes and fittings — Determination of melt mass-flow rate — Part 1: Test method.*

ISO 6259-3:—[1], *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes.*

ISO 6964:1986, *Polyolefin pipes and fittings — Determination of carbon black content by calcination and pyrolysis — Test method and basic specification.*

ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*

ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing.*

ISO/TR 9080:1992, *Thermoplastics pipes for the transport of fluids — Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials.*

ISO/TR 10837:1991, *Determination of the thermal stability of polyethylene (PE) for use in gas pipes and fittings.*

ISO 11420:1996, *Method for the assessment of the degree of carbon black dispersion in polyolefin pipes, fittings and compounds.*

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

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient.*

1) To be published.

ISO 13477: — [1], *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test).*

ISO 13478:1997, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full-scale test (FST).*

ISO 13479:1997, *Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes (notch test).*

ISO 13949:— [1], *Method for the assessment of the degree of pigment dispersion in polyolefin pipes, fittings and compounds.*

ASTM D 4019: 1994a, *Test method for moisture in plastics by coulometric regeneration of phosphorus pentoxide.*

3. DEFINITIONS

For the purposes of this International Standard, the following definitions apply.

3.1 Geometrical definitions

3.1.1 **nominal outside diameter, d_n:** A numerical designation of size which is common to all components in a thermoplastics piping system other than flanges and components designated by thread size. It is a convenient round number for reference purposes.

NOTE — For metric pipes conforming to ISO 161-1, the nominal outside diameter, expressed in millimetres, is the minimum mean outside diameter $d_{em,min}$.

3.1.2 **mean outside diameter d_{em}:** The measured length of the outer circumference of the pipe divided by π[2], rounded up to the nearest 0,1 mm.

3.1.3 **minimum mean outside diameter, $d_{em,min}$:** The minimum value of the mean outside diameter specified in this International Standard. It is equal to the nominal outside diameter d_n, expressed in millimetres.

3.1.4 **maximum mean outside diameter, $d_{em,max}$:** The maximum value of the mean outside diameter specified in this International Standard.

3.1.5 **outside diameter at any point, d_{ey}:** The measured outside diameter through the cross-section at any point of the pipe, rounded up to the nearest 0,1 mm.

1) To be published.

2) The value for π is taken to be 3,142.

3.1.6 **out-of-roundness**: The difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of the pipe.

3.1.7 **nominal wall thickness, e_n**: The wall thickness, in millimetres, tabulated in ISO 4065, corresponding to the minimum wall thickness at any point $e_{y,min}$.

3.1.8 **mean wall thickness, e_m**: The arithmetic mean of at least four measurements regularly spaced around the same cross-sectional plane of the pipe, including the measured minimum and maximum values obtained, rounded up to the nearest 0,1 mm.

3.1.9 **wall thickness at any point, e_y**: The measured wall thickness at any point around the circumference of the pipe, rounded up to the nearest 0,1 mm.

3.1.10 **minimum wall thickness, $e_{y,min}$**: The minimum wall thickness for the pipe specified in this International Standard.

3.1.11 **maximum wall thickness, $e_{y,max}$**: The maximum wall thickness for the pipe, not specified in this International Standard but which can be determined from the tolerance on $e_{y,min}$ given in ISO 11922-1.

3.1.12 **standard dimension ratio, SDR**: The ratio of the nominal outside diameter of a pipe to its nominal wall thickness.

$$\mathrm{SDR} = \frac{d_n}{e_n}$$

3.2 Material definitions

3.2.1 **lower confidence limit, σ_{LCL}**: A quantity with the dimensions of stress, in megapascals, which can be considered as a property of the material under consideration and represents the 97,5 % lower confidence limit of the predicted long-term hydrostatic strength at a temperature of 20 °C for 50 years with internal water pressure.

3.2.2 **overall service (design) coefficient, *C***: An overall coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit.

NOTE — For gas applications, C can have any value $\geqslant$ 2,0.

3.2.3 **minimum required strength, MRS**: The value of the lower confidence limit σ_{LCL} rounded down to the next value in the R 10 series as defined in ISO 3 when σ_{LCL} is less than 10 MPa or down to the next value in the R 20 series as defined in ISO 3 when σ_{LCL} is greater than or equal to 10 MPa. The MRS is expressed as a hoop stress in megapascals.

3.2.4 **melt mass flow rate, MFR**: A value relating to the viscosity of the molten material at a specified temperature and rate of shear.

3.3 Definitions related to service conditions

3.3.1 gaseous fuel: Any fuel which is in the gaseous state at a temperature of +15 °C and a pressure of 1 bar.

3.3.2 maximum operating pressure, MOP: The maximum effective pressure of the gas in a piping system, expressed in bars, which is allowed in continuous use. It takes into account the physical and the mechanical characteristics of the components of the piping system.

NOTE: It is given by the equation

$$\mathrm{MOP} = \frac{20 \times \mathrm{MRS}}{C \times (\mathrm{SDR} - 1)}$$

4. MATERIAL

4.1 Technical data

The technical data concerning the materials used shall be made available to the purchaser by the pipe manufacturer. Any change in the choice of materials affecting the quality shall require a new qualification of the pipe according to table 6.

4.2 Compound

The compound from which the pipe is produced shall be polyethylene which shall be made by adding only those additives necessary for the manufacture and end use of pipes conforming to this specification.

All additives shall be uniformly dispersed.

4.3 Identification compound

Where applicable the compound used for identification stripes shall be manufactured from the same type of polyethylene as used in the compound for pipe production.

4.4 Reprocessable material

Clean reprocessable material generated from a manufacturer's own production of pipe to this specification, may be used, if it is derived from the same resin as used for the relevant production.

4.5 Characteristics of the PE compound

The pipes shall be made of virgin material, of reprocessable material or of a combination of virgin and reprocessable material. The PE compound from which the pipe is manufactured shall conform to the requirements given in table 1

Table 1: Characteristics of the PE compound[1)]

Characteristics		Units	Requirements	Test parameters	Test method
Conventional density		kg/m^3	≥ 930 (base polymer)	23 °C	ISO 1183 ISO 1872/1
Melt mass-flow rate			± 20 % of value nominated by compound producer	190 °C	ISO 1133
Thermal stability		min	> 20	200 °C	ISO/TR 10837
Volatile content at extrusion		mg/kg	≤ 350		Annex A
Water content[2)]		mg/kg	≤ 300		ASTM D 4019
Carbon black content		% (m/m)	2,0% ≤ ... ≤ 2,5%		ISO 6964
Carbon black dispersion[3)]		grade	≤ 3		ISO 11420
Pigment dispersion[4)]		grade	≤ 3		ISO 13949
Resistance to gas constituents		h	≥ 20	80 °C 2 MPa	Annex B
Resistance to rapid crack propagation (RCP)					
Full scale (FS) test:	$d_n \geq 250$ mm	MPa	The critical pressure in the FS test shall be greater than or equal to the value of the MOP of the system multiplied by 1,5.	0 °C	ISO 13478
or					
S4 test:	Shall be performed on pipe with a wall thickness of ≥15 mm	MPa	The critical pressure in the S4 test shall be equal to or greater than the value of the MOP of the system divided by 2,4[5)].	0 °C	ISO 13477

Table 1: Characteristics of the PE compound *(concluded)*

Characteristics	Units	Requirements	Test parameters	Test method
Resistance to slow crack growth $e_n > 5$ mm	h	165	80 °C, 0,8 MPa[6]	ISO 13479
			80 °C, 0,92 MPa[7]	

1) Non-black compounds shall conform to the weathering requirements given in table 6.
2) Only applicable if the compound does not conform to the requirement for volatile content. In case of dispute the requirement for water content shall be acceptable.
3) Carbon black dispersion for black compounds only.
4) Pigment dispersion method for non-black compounds only.
5) This factor 2,4 is still under study and may be subject to change. If the requirement is not met, then retesting by using the full scale (FS) test will be performed.
6) Test parameter for PE 80, SDR 11.
7) Test parameter for PE 100, SDR 11.

4.6 Classification

PE compounds shall be classified by MRS as given in table 2.

Table 2: Classification of PE compounds

Designation	σ_{LCL} (20 °C, 50 years, 97, 5 %) MPa	MRS MPa
PE 80	8,00 ≤ ... ≤ 9,99	8,0
PE 100	10,00 ≤ ... ≤ 11,19	10,0

The classification in accordance with ISO 12162 shall be given and demonstrated by the compound producer.

5. APPEARANCE

When viewed without magnification, the internal and external surfaces shall be smooth, clean and free from scoring, cavities, and other surface defects which may affect pipe performance. The pipe ends shall be cut cleanly and square to the axis of the pipe.

6. GEOMETRICAL CHARACTERISTICS

6.1 General

The dimensions of the pipes shall be measured not less than 24 h after manufacture in accordance with ISO 3126 after being conditioned for at least 4 h.

6.2 Mean outside diameter and out-of-roundness (ovality) and their tolerances

The mean outside diameter, d_{em}, and the out-of-roundness (ovality) and their tolerances shall conform to table 3.

For close-tolerance pipes Grade B tolerances shall apply, and for other pipes Grade A tolerances, where these tolerance grades shall conform to ISO 11922/1.

Table 3: Mean outside diameters and out-of-roundness

Dimensions in millimetres

Nominal outside diameter		$d_{em,max.}$		Maximum of absolute out-of-roundness (ovality)[1)]	
d_n	$d_{em,min.}$	Grade A	Grade B	Grade K[2)]	Grade N
16	16,0	-	16,3	1,2	1,2
20	20,0	-	20,3	1,2	1,2
25	25,0	-	25,3	1,5	1,2
32	32,0	-	32,3	2,0	1,3
40	40,0	-	40,4	2,4	1,4
50	50,0	-	50,4	3,0	1,4
63	63,0	-	63,4	3,8	1,5
75	75,0	-	75,5	-	1,6
90	90,0	-	90,6	-	1,8
110	110,0	-	110,7	-	2,2
125	125,0	-	125,8	-	2,5
140	140,0	-	140,9	-	2,8
160	160,0	-	161,0	-	3,2
180	180,0	-	181,1	-	3,6
200	200,0	-	201,2	-	4,0
225	225,0	-	226,4	-	4,5
250	250,0	-	251,5	-	5,0
280	280,0	282,6	281,7	-	9,8
315	315,0	317,9	316,9	-	11,1
355	355,0	358,2	357,2	-	12,5
400	400,0	403,6	402,4	-	14,0
450	450,0	454,1	452,7	-	15,6
500	500,0	504,5	503,0	-	17,5
560	560,0	565,0	563,4	-	19,6
630	630,0	635,7	633,8	-	22,1

1) Measurement of out-of-roundness shall be made at the point of manufacture according to ISO 3126.
2) For coiled pipe with $d_n \leq 63$ grade K applies, for pipe with $d_n \geq 75$ the maximum out-of-roundness shall be specified by agreement.

6.3 Wall thicknesses and tolerance

6.3.1 Minimum wall thickness

The most commonly used SDR values are 17,6 and 11. For specific applications other SDR values can be used taken from all series stated in ISO 4065 and ISO 161/1. Table 4 gives these two series (pipe SDR's) for minimum wall thicknesses $e_{y,min.}$ which are most commonly used for gas.

Table 4: Minimum wall thicknesses for pipe SDR's most commonly used for gas
Pipe diameters < 40 mm, SDR 17,6, and < 32 mm, SDR 11, are characterized by wall thickness.
Pipe diameters ≥ 40 mm, SDR 17,6, and ≥ 32 mm, SDR 11, are characterized by SDR.

Dimensions in millimetres

Nominal outside diameter d_n	Minimum wall thickness $e_{y,min.}$	
	SDR 17,6	SDR 11
16	2,3	3,0
20	2,3	3,0
25	2,3	3,0
32	2,3	3,0
40	2,3	3,7
50	2,9	4,6
63	3,6	5,8
75	4,3	6,8
90	5,2	8,2
110	6,3	10,0
125	7,1	11,4
140	8,0	12,7
160	9,1	14,6
180	10,3	16,4
200	11,4	18,2
225	12,8	20,5
250	14,2	22,7
280	15,9	25,4
315	17,9	28,6
355	20,2	32,3
400	22,8	36,4
450	25,6	40,9
500	28,4	45,5
560	31,9	50,9
630	35,8	57,3

6.3.2 Tolerances on the wall thickness at any point

The tolerances on the wall thickness at any point shall be conform to grade V of ISO 11922-1. The maximum permissible variation between the nominal wall thickness, e_n, and the wall thickness at any point, e_y, shall conform to table 5.

Table 5: Tolerances on wall thickness at any point

Dimensions in millimetres

Minimum wall thickness $e_{y,min.}$		Permitted positive deviation	Minimum wall thickness $e_{y,min.}$		Permitted positive deviation
>	≤		>	≤	
2,0	3,0	0,4	30,0	31,0	3,2
3,0	4,0	0,5	31,0	32,0	3,3
4,0	5,0	0,6	32,0	33,0	3,4
5,0	6,0	0,7	33,0	34,0	3,5
6,0	7,0	0,8	34,0	35,0	3,6
7,0	8,0	0,9	35,0	36,0	3,7
8,0	9,0	1,0	36,0	37,0	3,8
9,0	10,0	1,1	37,0	38,0	3,9
10,0	11,0	1,2	38,0	39,0	4,0
11,0	12,0	1,3	39,0	40,0	4,1
12,0	13,0	1,4	40,0	41,0	4,2
13,0	14,0	1,5	41,0	42,0	4,3
14,0	15,0	1,6	42,0	43,0	4,4
15,0	16,0	1,7	43,0	44,0	4,5
16,0	17,0	1,8	44,0	45,0	4,6
17,0	18,0	1,9	45,0	46,0	4,7
18,0	19,0	2,0	46,0	47,0	4,8
19,0	20,0	2,1	47,0	48,0	4,9
20,0	21,0	2,2	48,0	49,0	5,0
21,0	22,0	2,3	49,0	50,0	5,1
22,0	23,0	2,4	50,0	51,0	5,2
23,0	24,0	2,5	51,0	52,0	5,3
24,0	25,0	2,6	52,0	53,0	5,4
25,0	26,0	2,7	53,0	54,0	5,5
26,0	27,0	2,8	54,0	55,0	5,6
27,0	28,0	2,9	55,0	56,0	5,7
28,0	29,0	3,0	56,0	57,0	5,8
29,0	30,0	3,1	57,0	58,0	5,9

7. MECHANICAL CHARACTERISTICS

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

Table 6: Mechanical characteristics of pipes

Characteristics	Units	Requirements	Test parameters		Test method
Hydrostatic strength (HS)	h		20 °C		
		Failure time ≥ 100 h	PE 80 9,0 MPa	PE 100 12,4 MPa	ISO 1167
			80 °C		
		Failure time ≥ 165 h	PE 80 4,6 MPa[1)]	PE 100 5,5 MPa[1)]	
		Failure time ≥ 1000 h	4,0 MPa	5,0 MPa	
Elongation at break	%	≥ 350			ISO 6259/3
Resistance to weathering (for non-black pipes only)		After weathering the requirements for thermal stability[2)], HS (165 h/80°C) and elongation at break shall be met.	$E \geq 3{,}5$ GJ/m²		ISO 1167 ISO 6259/3 ISO/TR 10837 Annex C

[1)] Only brittle failures shall be taken into account. If a ductile failure occurs before the required minimum time, a lower stress may be selected and the minimum test time shall be obtained from the line through the recommended stress/time points (see table 7).

[2)] For the thermal stability test the pipe shall be scraped as for welding prior to testing. The scraped layer shall be discarded.

Table 6 (concluded)

Characteristics		Units	Requirements	Test parameters	Test method
Resistance to rapid crack propagation (RCP)[1]					
Full-scale test (FST):	$d_n \geq 250$ mm	MPa	The critical pressure in the FS test shall be greater than or equal to the value of the MOP of the system multiplied by 1,5	0 °C	ISO 13478
or					
S4 test:	In principle for all diameters	MPa	The critical pressure in the S4 test shall be equal to or greater than the value of the MOP of the system divided by 2,4[2].	0 °C	ISO 13477
Resistance to slow crack growth	$e_n > 5$ mm	h	165	80 °C, 0,8 MPa[3] 80 °C, 0,92 MPa[4]	ISO 13479

[1] RCP tests are applicable to PE pipes intended to be used under the following conditions:

- In distribution systems with an MOP > 0,1 bar and $d_n \geq 250$ mm
- In distribution systems with an MOP > 4 bar and $d_n \geq 90$ mm

For severe working conditions (e.g. sub-zero temperatures) RCP testing is also recommended.

[2] This factor 2,4 is still under study and may be subject to change. If the requirement is not met, then retesting by using the full-scale test (FST) will be performed.

[3] Test parameter for PE 80, SDR 11.

[4] Test parameter for PE 100, SDR 11.

Table 7: Hydrostatic strength (80 °C) - Stress/minimum failure time correlation

PE 80		PE 100	
Stress MPa	Minimum failure time h	Stress MPa	Minimum failure time h
4,6	165	5,5	165
4,5	219	5,4	233
4,4	293	5,3	332
4,3	394	5,2	476
4,2	533	5,1	688
4,1	727	5,0	1000
4,0	1000	-	-

8. PHYSICAL CHARACTERISTICS

When tested in accordance with the test methods as specified in table 8 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in table 8.

Table 8: Physical characteristics of pipes

Characteristics	Units	Requirements	Test parameters	Test method
Conventional density	kg/m^3	≥ 930 (base polymer)	23 °C	ISO 1183 ISO 1872/1
Thermal stability	min	> 20	200 °C	ISO/TR 10837
Melt flow rate (MFR)		1) Change in MFR by processing < 20%[1)] 2) ± 30% of the value nominated by the pipe manufacturer	190 °C	ISO 4440/1
Heat reversion	%	≤ 3, no effect on surface	110 °C	ISO 2505/1 ISO 2505/2

1) Value as measured by pipe manufacturer relative to the value measured on the compound.

9. MARKING

9.1 Marking details shall be printed or formed directly on the pipe in such a way that the marking does not initiate cracks or other types of failure and in such a way that with normal storage, weathering and processing, and the permissible method of installation and use, legibility shall be maintained for the life of the pipes.

9.2 If printing is used, the colouring of the printed information shall differ from the basic colouring of the product.

9.3 The quality and size of the marking shall be such that it is easily legible without magnification.

9.4 All pipes shall be marked visibly and indelibly with the minimum data given in table 9:

Table 9: Minimum data for marking

Aspects	Marking or symbol
Manufacturer or trademark	Name or symbol
Internal fluid	Gas
Dimensions	d_n x e_n
SDR (d_n ≥ 40 mm)	SDR (Ref. table 4)
Material and designation	e.g. PE 80
Production period (date, code)[1]	
Reference to number of standard	ISO 4437

[1] Marking for traceability purposes is under study.

9.5 The marking shall not weaken the pipe.

9.6 The length of coiled pipes may be indicated on the coil.

9.7 The frequency of the printing shall be at intervals of not greater than 1 m.

ANNEX A

(normative)

Volatile content

A.1. Principle of the method

The volatile content is determined as the loss of mass of a sample which has been put in a drying oven.

A.2. Equipment

- Non-ventilated drying oven with thermostat
- Weighing cup with a diameter of 35 mm
- Desiccator
- Analytical balance accurate to ± 0,1 mg

A.3. Procedure

Tare the weighing cup and its lid which have been in a desiccator for at least half a hour.
Fill the cup with about 25 g sample weighed to the nearest 0,1 mg.
Put the weighing cup in the non-ventilated drying oven which is kept at 105 °C ± 2°C.
Take the weighing cup out of the drying oven after 1 h and put it in a dessicator for 1 h.
Cover the cup and weigh it to the nearest 0,1 mg.

A.4. Calculation of the results

Calculate the volatile matter content using the following equation:

$$V = \left\{ \frac{P1 - P2}{P1 - P0} \right\} x\ 10^6$$

Where :

V is the volatile matter content in mg/kg at 105 °C

p_0 is the weight in g of the empty weighing cup

p_1 is the weight in g of the weighing cup plus sample

p_2 is the weight in g of the weighing cup plus sample after 1 h at 105 °C

ANNEX B

(normative)

Resistance to gas constituents

The test shall be carried out on 32 mm x 3 mm pipe.

The test may be carried out on other pipe sizes provided that there is a clear correlation to the results on the 32 mm x 3 mm pipe.

Prepare a synthetic condensate comprising a mixture of 50 % (m/m) n-decane (99 %) and 50 % (m/m) 1-3-5-trimethylbenzene.

Condition the pipe by filling it with condensate and allowing it to stand in air for 1500 h at (23 ± 2) °C. Carry out the test in accordance with ISO 1167 but using the synthetic condensate inside the pipe at a temperature of 80 °C.