भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
BUREAU OF INDIAN STANDARDS
(Ministry of Consumer Affairs, Food & Public Distribution, Govt. of India)

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व्यापक परिचालन मसौदा

हमारा संदर्भ : सीईडी 50/टी-95 **10 जनवरी 2025**

तकनीकी समिति : प्लास्टिक पाइपिंग पद्धति विषय समिति, सीईडी 50

प्राप्तकर्ता :

1. **सिविल अभियांत्रिकी विभाग परिषद, सीईडीसी के सभी सदस्य**
2. **अग्नि शमन विषय समिति, सीईडी 50 और इसकी उपसमितियों के सभी सदस्य**
3. **रुचि रखने वाले अन्य निकाय।**

महोदय/महोदया,

निम्नलिखित मानक का मसौदा संलग्न हैं:

प्रलेख संख्या	शीर्षक
सीईडी 50 (27261)WC	**इमारत संरचना के भीतर मल और अपशिष्ट निर्वहन (कम और उच्च तापमान) के लिए पॉलीप्रोपाइलीन (पीपी) प्लास्टिक पाइपिंग सिस्टम भाग 2 संरचित दीवार/मल्टी लेयर पॉलीप्रोपाइलीन (पीपी) पाइपिंग प्रणाली** (ICS No. 91.140.80)

कृपया इस मसौदे का अवलोकन करें और अपनी सम्मतियाँ यह बताते हुए भेजे कि यह मसौदा प्रकाशित हो तो इन पर अमल करने में आपको व्यवसाय अथवा कारोबार में क्या कठिनाइयां आ सकती हैं।

सम्मतियाँ भेजने की अंतिम तिथि: 09 फ़रवरी 2025

सम्मति यदि कोई हो तो कृपया अधोहस्ताक्षरी को ई-मेल द्वा **ced50@bis.gov.in** पर या उपरलिखित पते पर, संलग्न फोर्मेट में भेजें। सम्मतियाँ बीआईएस ई-गवर्नेंस पोर्टल, **www.manakonline.in** के माध्यम से ऑनलाइन भी भेजी जा सकती हैं।

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यह प्रालेख भारतीय मानक ब्यूरो की वेबसाइट **www.bis.gov.in** पर भी उपलब्ध हैं।

धन्यवाद।

भवदीय
ह/-
द्वैपायन भद्र
वैज्ञानिक ई एवं प्रमुख
सिविल अभियांत्रिकी विभाग
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संलग्न: उपरलिखित

भारतीय मानक ब्यूरो
(उपभोक्ता मामले, खाद्य एवं सार्वजनिक वितरण मंत्रालय, भारत सरकार)
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WIDE CIRCULATION DRAFT

Our Reference: CED 50/T-95 **10 January 2025**

TECHNICAL COMMITTEE: PLASTIC PIPING SYSTEM SECTIONAL COMMITTEE, CED 50

ADDRESSED TO:

1. All Members of Civil Engineering Division Council, CEDC
2. All Members of Plastic Piping System Sectional Committee, CED 50 and its Subcommittees
3. All others interested.

Dear Sir/Madam,

Please find enclosed the following draft:

Doc No.	Title
CED 50 (27261)WC	**Polypropylene (PP) Plastic Piping System For Soil and Waste Discharge (Low and High Temperature) Within the building structure Part 2 Structured Wall/ Multi Layer Polypropylene (PP) Piping System (ICS No. 91.140.80)**

Kindly examine the attached draft and forward your views stating any difficulties which you are likely to experience in your business or profession, if this is finally adopted as National Standard.

Last Date for comments: 09 February 2025

Comments if any, may please be made in the enclosed format and emailed at ced50@bis.gov.in or sent at the above address. Additionally, comments may be sent online through the BIS e-governance portal, www.manakonline.in.

In case no comments are received or comments received are of editorial nature, kindly permit us to presume your approval for the above document as finalized. However, in case comments, technical in nature are received, then it may be finalized either in consultation with the Chairman, Sectional Committee or referred to the Sectional Committee for further necessary action if so desired by the Chairman, Sectional Committee.

The document is also hosted on BIS website www.bis.gov.in.

Thanking you,

Yours faithfully,

Sd/-

Dwaipayan Bhadra
Scientist 'E' & Head
Civil Engineering Department
Email: ced50@bis.gov.in

Encl: As above

FORMAT FOR SENDING COMMENTS ON THE DOCUMENT

[Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub-clause/ table/figure, etc, be stated on a fresh row. Information/comments should include reasons for comments, technical references and suggestions for modified wordings of the clause. **Comments through e-mail to ced50@bis.gov.in shall be appreciated**.]

Doc. No.: CED 50 (27261)WC **BIS Letter Ref**: CED 50/T-95

Title: POLYPROPYLENE (PP) PLASTIC PIPING SYSTEM FOR SOIL AND WASTE DISCHARGE (LOW AND HIGH TEMPERATURE) WITHIN THE BUILDING STRUCTURE

Part 2 Structured Wall/ Multi Layer Polypropylene (PP) Piping System

(ICS No. 91.140.80)

Last date of comments: 09 February 2025

Name of the Commentator/ Organization: _____

Sl No.	Clause/ Para/ Table/ Figure No. commented	Type of Comment (General/ Technical/ Editorial)	Comments/ Modified Wordings	Justification of Proposed Change

NOTE- Kindly insert more rows as necessary for each clause/table, etc

BUREAU OF INDIAN STANDARDS

DRAFT FOR COMMENTS ONLY

Draft Indian Standard

POLYPROPYLENE (PP) PLASTIC PIPING SYSTEMS FOR SOIL AND WASTE DISCHARGE (LOW AND HIGH TEMPERATURE) WITHIN THE BUILDING STRUCTURE

Part 2 Structured Wall/ Multi Layer Polypropylene (PP) Piping System

(ICS No. 91.140.80)

Plastic Piping System Sectional Committee, CED 50	Last Date of Comments: **09 February 2025**

FOREWORD

(*Formal clauses to be added later*.)

The PP piping application for soil and waste discharge is comparatively new in Indian context, however it is quite established in other parts of the world. The standard covers both single layer and multilayer PP pipes as well as such fittings. The scope of the standard has been restricted for application of such pipes within the building structure. The types and dimensions have been kept as per the manufacturing practices prevailing in the country.

During preparation of standard, initial draft was made by combining all test requirements and construction of pipe together however committee realize that it is better to separate pipes based on application, construction and testing.

Hence the standard has been formulated to cover polypropylene (PP) plastic piping system as Part 1 and Part 2 for soil and waste discharge with and without noise control for both low and high temperature applications within the building structure as per scope below.

Single layer Polypropylene (PP) pipes covered under Part 1 are intended for use in soil and waste discharge system, ventilation pipe work and rainwater discharge, and rainwater harvesting application.

Structured wall / multilayer layer polypropylene (PP) pipes covered under Part 2 are intended for use in:

a) Soil and waste discharge system, ventilation pipe work and rainwater

discharge, and rainwater harvesting application, and

b) Soil and wastage discharge system with noise control (Acoustic) application.

Formulation of new Indian Standard is based on ISO 7671:2003 ‘Plastic piping systems for soil and waste discharge (low and high temperature) inside buildings – Polypropylene (PP) and EN 1451- Polypropylene (PP) plastics piping systems for soil and waste discharge - Dimensions within the building structure, with and without including acoustic test requirements.

Assistance has been derived from the following International Standards in the formulation of this standard:

ISO 7671:2003	Plastic piping systems for soil and waste discharge (low and high temperature) inside buildings – Polypropylene (PP)
EN 1451	Polypropylene (PP) plastics piping systems for soil and waste discharge – Dimensions

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2:1960 ‘Rules for rounding off numerical value (revised)’. The number of significant places retained in the rounded off value should be the as that of the specified value in this standard.

BUREAU OF INDIAN STANDARDS

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Draft Indian Standard

POLYPROPYLENE (PP) PLASTIC PIPING SYSTEM FOR SOIL AND WASTE DISCHARGE (LOW AND HIGH TEMPERATURE) WITHIN THE BUILDING STRUCTURE

Part 2 Structured Wall/ Multi Layer Polypropylene (PP) Piping System

(ICS No. 91.140.80)

Plastic Piping System	**Last Date for Comments:**
Sectional Committee, CED 50	**09 February 2025**

1 SCOPE

1.1 Structured wall / multilayer layer polypropylene (PP) pipes covered under Part 2 are intended for use in:

a) Soil and waste discharge system, ventilation pipe work and rainwater discharge, and rainwater harvesting application, and

b) soil and wastage discharge system with noise control (Acoustic) application

1.2 This standard Part-2 covers requirement for plain and socket end structured wall / multilayer Polypropylene (PP) pipes with nominal outside diameter 32mm to 315mm of the following types:

a) Class 1 – Multilayer Polypropylene (PP) pipe for use in soil and waste discharge systems, ventilation pipe work, rainwater discharge and rainwater harvesting application and

b) Class 2 – Multilayer polypropylene (PP) pipe with intermediate layer of mineral filled polypropylene (PP-MD) between outer and inner polypropylene (PP) layers, for use in soil and waste discharge system, ventilation pipe work, rainwater discharge and rain water harvesting application. These pipes additionally can be used for soil and wastage discharge system with noise control (Acoustic) application.

1.3 This standard also covers fittings for Class 1 and Class 2 PP multilayer Pipes which can be injection moulded with PP for Class 1 & PP-MD for Class 2. Fabricated fittings manufactured from Class 1 and Class 2 PP Pipes are also covered in the standard. PP-MD fittings are used for soil and waste discharge systems with noise control (Acoustic).

1.4 Pipes and fittings of Pipe series S20 shall be used for rainwater discharge and ventilation pipe work whereas S16 & S14 Series pipes and fittings shall be used for soil and waste discharge system. The pipe size DN 32mm & above in S20 Series can be used in waste discharge system.

1.5 The standard also covers the requirement for joining system of PP Pipes and fittings; and also for their connections with components of other plastic materials intended to be used for the above purpose.

1.6 The fittings with integral elastomeric sealing ring have been considered. Components to be used with pipe and fittings for which the specification has not been covered in this standard, shall be as agreed between the manufacturer and the purchaser. However, they shall conform to the requirements of joint dimension and functional requirement given in this standard.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No	*Title*
IS 4984:2022	Polyethylene pipes for water supply - Specification (*fifth revision*)
IS 5382:2018	Rubber seals - Joint rings for water supply, drainage and sewerage pipelines - Specification for materials (*second revision*)
IS 10951:2020	Specification for polypropylene (PP) materials for moulding and extrusion (*second revision*)
IS 12235	Thermoplastic pipes and fittings – Methods of test
Part 6:2004	Stress relief test.
Part 9:2004	Resistance to external blows (impact resistance) at O°C (round-the-clock method)
IS 16098	Structured-wall plastics piping systems for non-pressure drainage and sewerage
Part 1:2013	Part 1 Pipes and fittings with smooth external surface, Type A

Part 2:2013	Part 2 Pipes and fittings with non-smooth external surface, Type B

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply:

3.1 Copolymer — A polymer derived from more than one species of monomer.

3.2 Homopolymer — A polymer derived from one species of monomer.

3.3 Mean Inside Diameter of a Socket (d_{sm}) — The arithmetical mean of a number of measurements of the inside diameter of a socket in the same cross-section.

3.4 Mean Outside Diameter (d_{em}) — The measured outer circumference of a pipe or spigot end of a fitting in any cross-section square to the pipe axis, divided by π (= 3.142), rounded to the next greater 0.1 mm.

3.5 Mean Wall Thickness (e_m) — The arithmetical mean of a number of measurements of the wall thickness, regularly spaced around the circumference and in the same cross-section of a component, including the measured minimum and the measured maximum values of the wall thickness in that cross-section.

3.6 Nominal Size (DN) — A numerical designation of the size of a component which is approximately equal to the manufacturing dimension, in millimeter.

3.7 Nominal Size (*DN/OD*) — Nominal size related to the outside diameter.

3.8 Nominal Outside Diameter (d_n) The specified outside diameter in millilitre, assigned to a nominal size *DN*/*OD*.

3.9 Nominal Ring Stiffness (SN) — A numerical designation of the ring stiffness of a pipe or fitting, which is a convenient round number relative to the determined stiffness in kilo-newton per square meter (kN/m^2), indicating the minimum ring stiffness of a pipe or fitting.

3.10 Noise

3.10.1 *Definition* — Noise is defined as 'sound not desired by the recipient' that is, unwanted sound. This unwanted sound may be of single frequency and of constant or varying intensities or it may be a combination of various frequencies of different intensities. The annoyance effect of noise depends not only on the frequency but also on the intensity and waveform of the noise. Thus, the noise may be due to either of the factors, frequency and intensity, or both; high frequency sounds are more annoying and harmful than low frequency sounds

3.10.2 *Indoor and Outdoor Noise* — Noises may be of outdoor or indoor origin. Outdoor noises are caused by road traffic, railways, aeroplane, lifts, blaring loudspeakers and various types of moving machinery ' in the neighbourhood or in

adjacent buildings. As far as indoor noise is concerned, conversation of the occupants, footsteps, banging of doors, shifting of' the furniture. operation of the cistern and water-closets, playing of radios, gramophones, etc, contribute most of the noise emanating from an adjacent room or an adjacent building.
Noise conditions vary from time to time; a noise which may not be objectionable during the day may assume annoying proportions in the silence of the night when quiet conditions are essential

3.11 Outside Diameter (d_e) — The measured outside diameter through its cross-section at any point of a pipe or spigot end of a fitting, rounded to the next greater 0.1 mm.

3.12 Own Re-processable Material — Material prepared from rejected unused pipes or fittings, including trimmings from the production of pipes or fittings ((class 1 or class 2 as the case may be), that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion, and for which the complete formulation is known.

3.13 Pipe Series (S) — A dimensionless number for pipe designation.

3.14 Tests

3.14.1 *Type Tests* — Tests carried out whenever a change is made in the composition or in the size/series in order to establish the suitability and the performance capability of the pipes and fittings.

3.14.2 *Acceptance Tests* — Tests are carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.15 Virgin Material — Material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no re-processable or recyclable material has been added.

3.16 Wall Thickness (*e*) — The measured wall thickness at any point around the circumference of a component.

4 SYMBOLS AND ABBREVIATIONS

A	=	length of engagement, or maximum pull-out whilst maintaining tightness
B	=	length of lead-in
C	=	depth of sealing zone
D_i	=	socket inside diameter
DN	=	Nominal size
DN/OD	=	Nominal size, outside diameter related
$D_{im,min}$	=	minimum mean inside diameter of a socket

d_e	=	outside diameter
d_{em}	=	Mean outside diameter
d_n	=	Nominal outside diameter
d_s	=	Inside diameter of a socket
d_{sm}	=	Mean inside diameter of a socket
e	=	Wall thickness
e_m	=	Mean wall thickness
S	=	Pipe series
SN	=	Nominal ring stiffness
e_2	=	wall thickness of a socket
e_3	=	wall thickness in the groove area
l	=	effective length of a pipe
$L_{1,min}$	=	minimum length of a spigot
R	=	radius of swept fittings
Z	=	Z-lengths of a fitting
α	=	nominal angle of a fitting

MFR	=	melt mass-flow rate
OIT	=	oxidation induction time
PP	=	polypropylene
PP-H	=	Polypropylene homo polymer
PP-B	=	polypropylene block copolymer
TIR	=	true impact rate
PP-MD	=	Mineral filled Polypropylene

5 SIZES AND DESIGNATION

5.1 Sizes

Nominal outside diameter, *DN* of pipes/fittings as covered in the standard are 32, 40, 50, 63, 75, 90, 110, 125, 160, 200, 250 and 315 mm.

5.2 Designation

Pipes/Fittings shall be designated by their nominal outside diameter, pipe series, stiffness class and class of the material (*see* **7.1.5**).

6 GENERAL CHARACTERISTICS

6.1 Appearance

When viewed without magnification, the pipes and fittings shall meet the following requirements:

a) The internal & external surfaces of pipes and fittings shall be smooth clean and free from grooving, blistering, impurities, pores or other surface irregularity likely to prevent performance of pipes and fittings as per this standard;
b) Each end of a pipe or a fitting shall be cleanly cut, if applicable, and shall be square to its axis.

6.2 Colour

Surface colour of pipes/fittings shall be white or black or grey or blue shade. Inside layer of the pipes/fittings shall be white or black or grey or blue shade. The individual layer and multilayer pipes/fittings shall be uniformly coloured throughout their entire thickness.

Note: Other colours as agreed between the manufacturer and the purchaser may also be supplied

7 MATERIALS

7.1 Pipes and Fittings

7.1.1 The materials from which pipes and injection moulded fittings are produced shall essentially consist of polypropylene to which may be added only those additives that are needed to facilitate the manufacture of sound and durable pipes of good surface finish, mechanical strength, and opacity under condition of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard, impair the fabrication, welding, chemical and physical properties of the pipes. The material should also consist of sufficient quantity of stabilizer to help the pipe/fitting withstand thermal ageing and exposure to ultra-violet light conditions inside building. The base material (homopolymer or copolymer) with or without minerals additives and filler shall conform to the requirements given in Table 1 and Table 2.

Table 1 Material Characteristics for Base PP Material in Granules Form

(*Clause* 7.1.1)

Sl No.	Characteristics	Requirements	Test Parameters		Test Method
(1)	(2)	(3)	(4)		(5)
i)	Melt Flow Rate (MFR)	≤ 3 g/10 min	Temperature	230 °C	IS 13360 (Part 4/ Sec 1)
			Loading Mass	2.16 kg	
ii)	Thermal stability (OIT)[1)]	≥ 8 minutes	Temperature	200 °C	As per Annex B of IS 4984

Table 2 Material Characteristics for PP Material in Pipe Form For Class 1 & Class 2

(*Clause* 7.1.1)

Sl No.	Characteristics	Requirements	Test Parameter		Test Method
(1)	(2)	(3)	(4)		(5)
i)	Resistance to internal pressure	No Failure during the test period	Material Type	PP-H	As Per IS 4984
			Test Temperature	80 ± 1° C	
			Test Period	140 h	
			Orientation	Free	
			Number of test pieces	3	
			Circumferential (Hoop) stress	6.0 MPa	
			Conditioning Period	1 h	
			Type of Test	Water-in-water	
ii)	Resistance to internal pressure	No Failure during the test period	Material Type	PP-H	As Per IS 4984
			Test Temperature	95 ± 1° C	
			Test Period	1000 h	
			Orientation	Free	
			Number of test pieces	3	
			Circumferential (Hoop) stress	3.5 MPa	
			Conditioning Period	1 h	
			Type of Test	Water-in-water	
iii)	Resistance to internal pressure	No Failure during the test period	Material Type	PP-B	
			Test Temperature	80 ± 1° C	
			Test Period	140 h	

			Orientation	Free	
			Number of test pieces	3	
			Circumferential (Hoop) stress	4.2 MPa	
			Conditioning Period	1 h	
			Type of Test	Water-in-water	
iv)	Resistance to internal pressure	No Failure during the test period	Material Type	PP-B	
			Test Temperature	95 ± 1^{o} C	
			Test Period	1000 h	
			Orientation	Free	
			Number of test pieces	3	
			Circumferential (Hoop) stress	2.5 MPa	
			Conditioning Period	1 h	
			Type of Test	Water-in-water	
	[1)] For checking this requirement for PP base materials, the test shall be carried out on the solid wall pipe made from that particular PP Base material. This required is for Pipe & Fittings both				

7.1.4 Fabricated fittings or parts of fabricated fitting (for assembly with injection moulded fitting) shall be made from pipes and/or moulding conforming to all the requirements of this standard.

7.1.5 *Requirement for Fusion Welding*

Materials for pipes and fittings suitable for fusion welding shall be classified as below based on their melt flow rate (MFR):

a) Class A : MFR ≤ 0.3 g/10 min;
b) Class B : 0.3 g/10 min < MFR ≤ 0.6 g/10 min;
c) Class C : 0.6 g/10 min < MFR ≤ 0.9 g/10 min; and
d) Class D : 0.9 g/10 min < MFR ≤ 1.5 g/10 min.

Only pipes and fittings made from materials of the same or adjacent MFR classes shall be fused together.

7.2 Sealing Ring

7.2.1 Rubber sealing rings shall be of any of the six hardness classes as per IS 5382. The manufacturer has to however specify the hardness class and application type of sealing ring that is being offered. Rubber sealing rings shall be free from substances that can have a detrimental effect on the performance of the pipes or fittings.

NOTE — A test report or conformity certificate may be obtained from the manufacturer of the sealing ring for conformity to IS 5382. The frequency of this test report or conformity certificate shall be once in three months.

7.2.2 The design of the profile and dimensions of the sealing ring is left to the manufacturer, as long as the pipe with the sealing ring meets the requirements of this standard. Where the design of the socket is such that the ring is not firmly fixed in position, the housing for the ring shall be so designed as to minimize the possibility of the ring being dislodged during insertion of the pipe (or spigot or fitting) to complete the joint.

7.3 Ring Stiffness — The ring stiffness of pipes conforming to this standard determined in accordance to IS16098-2 and is as:

SN ≥ 4 kN/m² for S16

SN ≥ 6.0 kN/m² for S14

7.4 Noise Levels — The NBC 2016 (Part 8 , section 4 : Acoustics , sound insulation , and Noise control) provide guidelines for controlling noise within buildings , particularly focusing on maximum permissible noise levels in various spaces , including residential building. The reference to IS 1950 & IS 4954 acoustic is considered **maximum of 25 dB (A)**.

Notes

1. The optimal decibel (dB) level for a given site configuration depends on several factors, including the velocity and volume of external sources. Designers should select the appropriate size subject to the site conditions to achieve the desired dB level.
2. The methodology and details for measuring noise levels, as well as the applicability of acoustic properties, are provided in Annex - A, B, C & D.

8 DIMENSIONS

8.1 Dimensions of Pipes

8.1.1 *Outside Diameters* — The mean outside diameter of pipes shall be as per Table 3.

Table 3 Mean Outside Diameters

(*Clauses* 8.1.1 and 8.3.1)

All dimensions are in millimetres

Sl No.	Nominal Size,	Nominal Outside Diameter,	Mean Outside Diameter	
	DN/OD	d_n	d_{em}, *Min*	d_{em}, *Max*
(1)	(2)	(3)	(4)	(5)
i)	32	32	32.0	32.3
ii)	40	40	40.0	40.3
iii)	50	50	50.0	50.3
iv)	63	63	63.0	63.3
v)	75	75	75.0	75.4
vi)	90	90	90.0	90.4
vii)	110	110	110.0	110.4
viii)	125	125	125.0	125.4
ix)	160	160	160.0	160.5
x)	200	200	200.0	200.6
xi)	250	250	250.0	250.8
xii)	315	315	315.0	316.0

8.1.2 *Effective Length*

The effective length of a pipe shall not be less than that declared by the manufacturer and shall be measured as shown in Fig. 1.

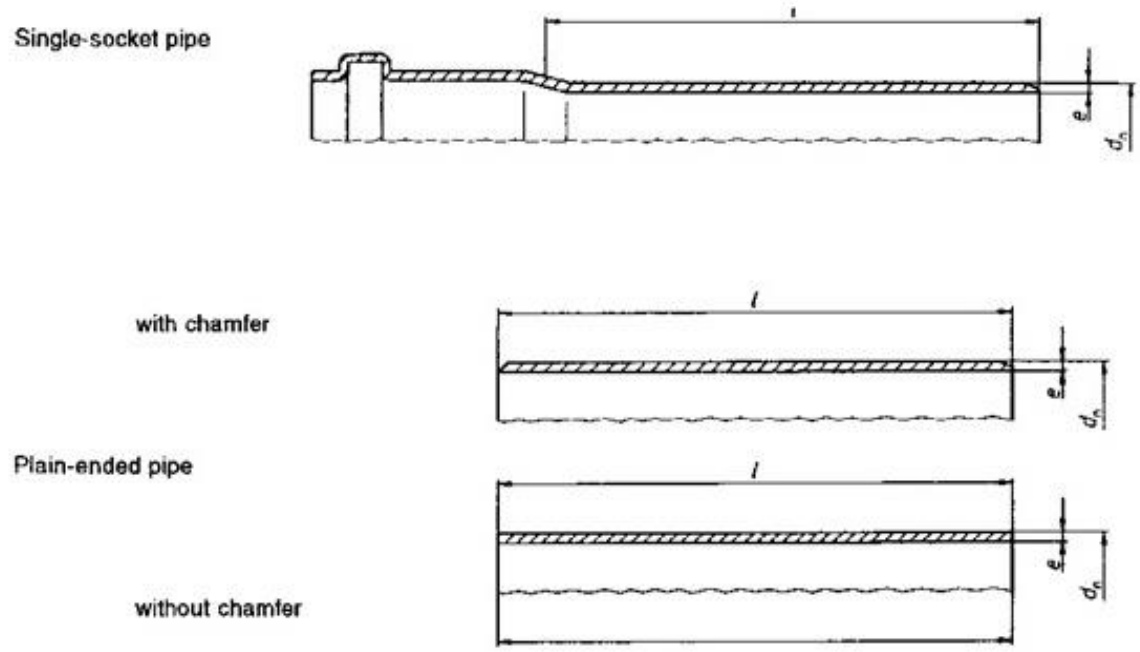


FIG. 1 EFFECTIVE LENGTH OF PIPES (CLASS 1 AND CLASS 2)

8.1.3 *Chamfering*

If a chamfer is required, the angle of chamfering shall be between 15° and 45° to the axis of the pipe (*see* Fig 1). When pipes without chamfer are used, the pipe ends shall be de-burred.
The remaining wall thickness of the end of the pipe shall be at least ⅓ of $e_{min.}$

8.2 *Wall Thickness*

8.2.1 *CLASS 1/ CLASS 2 Pipes*

The wall thickness, *e* shall conform to Table 4.

Table 4 Wall Thicknesses for Pipes

(*Clauses* 8.2.1 and 8.3.3)

All dimensions are in millimetres.

Sl No.	**Nominal Size,** *DN/OD*	**Nominal Outside Diameter,** d_n	**Pipe Series**					
			S20[1)]		S16		S14	
			Wall Thickness					
			e, *Min*	e_m, *Max*	*e*, *Min*	e_m, *Max*	*e*, *Min*	e_m, *Max*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	32	32	1.8	2.2	1.8	2.2	1.8	3.0
ii)	40	40	1.8	2.2	1.8	2.2	1.8	3.0
iii)	50	50	1.8	2.2	1.8	2.2	1.8	3.0
iv)	63	63	1.8	2.2	2.0	2.4	2.2	3.1
v)	75	75	1.9	2.3	2.3	2.8	2.6	3.1
vi)	90	90	2.2	2.7	2.8	3.3	3.1	3.7
vii)	110	110	2.7	3.2	3.4	4.0	3.8	4.4
viii)	125	125	3.1	3.7	3.9	4.5	4.3	5.0
ix)	160	160	3.9	4.5	4.9	5.6	5.5	6.3
x)	200	200	4.9	5.6	6.2	7.1	6.9	7.7
xi)	250	250	6.2	7.1	7.7	8.7	8.6	9.7
xii)	315	315	7.7	8.7	9.7	10.9	10.8	12.1
	[1)] Pipes are suitable for use of rain water discharge and ventilation pipe work only and The pipe sizes DN 32mm & above in S20 Series can be used in waste discharge system.							

8.2.2 *Layer Thickness of Pipe* CLASS 1 / *CLASS 2 Pipes*

Structure wall (layer thicknesses) for CLASS 1 and CLASS 2 pipes shall be as given in Table 5.

Table 5 Layer Thickness (Class 1 & Class 2)

(*Clause* 8.2.2)

All dimensions are in millimetres.

Sl No.	**Nominal Size,** DN/OD	**Nominal Outside Diameter,** DN	**S20**[1)]		**S16**		**S14**	
			Total Thickness of Pipe *Min*	**Individual Thickness of Inner and Outer Layers** *Min*	**Total Thickness of Pipe,** *Min*	**Individual Thickness of Inner and Outer Layers** *Min*	**Total Thickness of Pipe,** *Min*	**Individual Thickness of Inner and Outer Layers,** *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	32	32	1.8	0.2	1.8	0.2	1.8	0.2
ii)	40	40	1.8	0.2	1.8	0.2	1.8	0.2
iii)	50	50	1.8	0.2	1.8	0.2	1.8	0.2
iv)	63	63	1.8	0.25	2.0	0.3	2.2	0.3
v)	75	75	1.9	0.3	2.3	0.3	2.6	0.4
vi)	90	90	2.2	0.3	2.8	0.3	3.1	0.4
vii)	110	110	2.7	0.3	3.4	0.4	3.8	0.5
viii)	125	125	3.1	0.4	3.9	0.4	4.3	0.5
ix)	160	160	3.9	0.4	4.9	0.5	5.5	0.7
x)	200	200	4.9	0.5	6.2	0.6	6.9	0.7
xi)	250	250	6.2	0.6	7.7	0.7	8.6	0.9
xii)	315	315	7.7	0.7	9.7	0.8	10.8	1

8.3 Dimensions of Fittings

8.3.1 *Outside Diameters*

The mean outside diameter, d_{em} of the spigot end shall conform to Table 3.

8.3.2 *Z-lengths*

The z-length of fittings (*see* figure 6 to figure 19) shall be declared by the manufacturer.

NOTE — The Z-length of a fitting is intended to assist in the design of moulds and is not intended to be used for quality control purposes.

8.3.3 *Wall Thicknesses*

The minimum wall thickness, e_{min} of the body or the spigot end of a fitting shall conform to Table 5, except that a reduction of 5 percent resulting from core shifting is permitted. In such a case the average of two opposite wall thicknesses shall be equal to or exceed the values given in Table 5.

Where a fitting or adaptor provides for a transition between two nominal sizes, the wall thickness of each connecting part shall conform to the requirements for the applicable nominal size. In such a case, the wall thickness of the fitting body is permitted to change gradually from the one wall thickness to the other.

Where a sealing ring is located by means of a retaining cap or ring (*see* Fig. 2) the wall thickness in this area shall be calculated by addition of the wall thickness of the socket and the wall thickness of the retaining cap or ring at the corresponding places in the same cross-section.

The wall thickness of fabricated fittings, except for spigot end and socket may be changed locally by the fabrication process, provided that the minimum wall thickness of the body conforms to $e_{3, Min}$, as given in Table 7, as appropriate for the concerned pipe series.

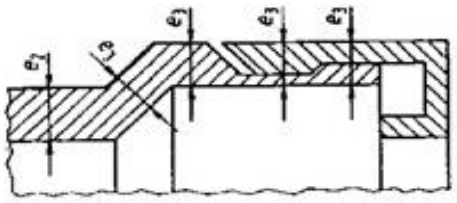


FIG. 2 EXAMPLE FOR CALCULATION OF THE WALL THICKNESS OF SOCKETS WITH RETAINING CAP

8.3.4 *Dimensions of Sockets and Pipe Ends*

8.3.4.1 *Diameters and lengths*

The diameters and lengths of ring seal sockets and spigot ends (*see* Fig. 3, Fig. 4 or Fig. 5) shall conform to Table 6 as applicable, and shall be in accordance with the following conditions:

a) Where sealing rings are firmly retained, the dimensions for the minimum value for A and the maximum value for C shall be measured to the effective sealing point (*see* Fig. 5 as an example). This point shall give a full sealing action.

b) Where sealing rings are firmly retained, requirements for dimension B (*see* Fig. 4) do not apply.

Different designs of ring seal sockets (*see* Fig. 4) are permitted provided the joints conform to the requirements given in Table 14.

Table 6 Diameters and Lengths of Ring Seal Sockets and Spigot Ends

(*Clause* 8.3.4.1)

All dimensions are in millimetres.

Sl No.	**Nominal Size,**	**Nominal Outside Diameter,**	**Socket**				**Spigot End**
	DN/*OD*	d_n	d_{sm}, *Min*	*A*, *Min*	*B*, *Min*	*C*, *Max*	l_1, *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	32	32	32.3	24	5	18	42
ii)	40	40	40.3	26	5	18	44
iii)	50	50	50.3	28	5	18	46
iv)	63	63	63.3	31	5	18	49
v)	75	75	75.4	33	5	18	51
vi)	90	90	90.4	34	5	20	54
vii)	110	110	110.4	36	6	22	58
viii)	125	125	125.4	38	7	26	64
ix)	160	160	160.5	41	9	32	73
x)	200	200	200.6	45	12	40	85
xi)	250	250	250.8	68	15	50	118
xii)	315	315	316.0	81	19	63	144

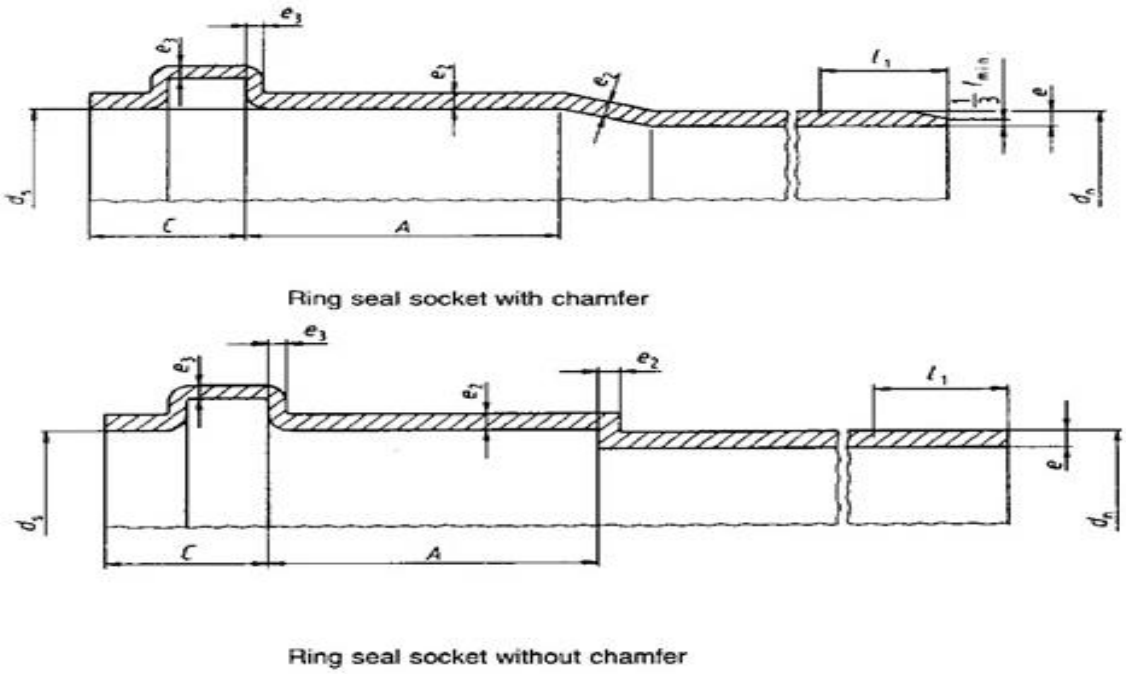


FIG. 3 DIMENSIONS OF SOCKETS AND SPIGOT ENDS FOR RING SEAL JOINTS

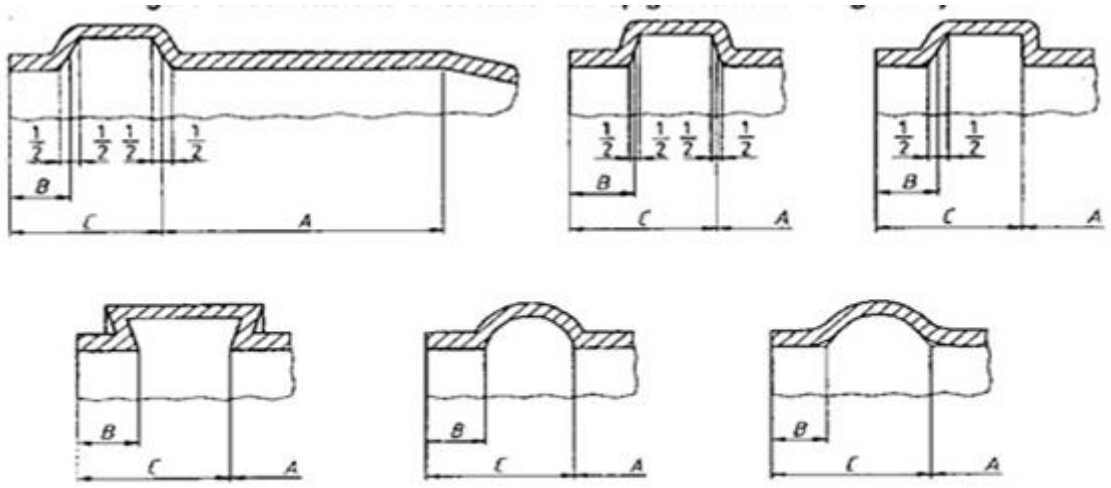


FIG. 4 TYPICAL GROOVE DESIGNS FOR RING SEAL SOCKETS

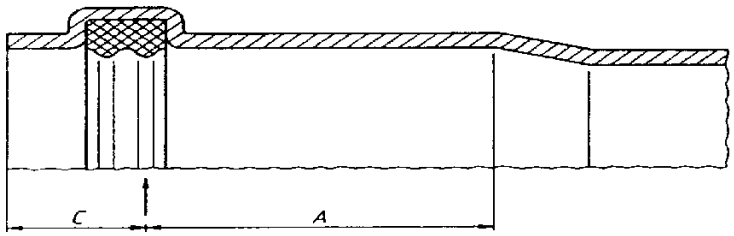


FIG. 5 EFFECTIVE SEALING POINT

8.3.4.2 *Wall Thickness of Ring Seal Sockets*

The wall thickness of the socket, e_2 and the wall thickness in the groove area, e_3 shall conform to Table 7, as applicable in 8.3.4.2

Table 7 Wall Thickness of Sockets

(*Clauses* 8.3.4.2)

All dimensions are in millimetres.

Sl No.	**Nominal Size** DN/OD	**Nominal Outside Diameter** d_n	**Pipe Series**					
			S 20[1)]		**S 16**		**S 14**	
			Wall thickness					
			e_2	e_3	e_2	e_3	e_2	e_3
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	32	32	1.6	1.0	1.6	1.0	1.6	1.0
ii)	40	40	1.6	1.0	1.6	1.0	1.6	1.0
iii)	50	50	1.6	1.0	1.6	1.0	1.6	1.0
iv)	63	63	1.6	1.0	1.7	1.1	2.0	1.3
v)	75	75	1.7	1.1	2.1	1.3	2.4	1.5
vi)	90	90	2.0	1.3	2.6	2.1	2.8	2.4
vii)	110	110	2.4	1.5	3.1	2.6	3.5	2.9
viii)	125	125	2.8	1.8	3.6	3.0	3.9	3.3
ix)	160	160	3.5	2.2	4.5	3.7	5.0	4.2
x)	200	200	4.4	2.7	5.6	4.7	6.3	5.2
xi)	250	250	5.6	4.7	7.0	5.8	7.8	6.5
xii)	315	315	6.9	5.8	8.8	7.3	9.7	8.1

8.3.5 *Dimensions of Pipe Ends for Fusion Joints*

The mean outside diameter, d_{em} and the wall thickness, *e* of pipes with plain ends intended to be used for fusion joints shall conform to the same pipe series S, as specified in this standard.

8.3.6 *Types of Fittings*

8.3.6.1 This standard is applicable for the following types of fittings. Other designs of fittings are also permitted.

a) Bends (*see* Figs. 6, 7, 8, 9, 10 and 11);
   1) upswept or swept angle.
   2) spigot/socket or socket/socket; and
   3) butt fused from segments.

   The fixed nominal angle, *α* of bends shall be as follows:

   15°, 22.5°, 30°, 45°, 67.5°, 80° or 87.5° and 90°.

b) Branches and reducing branches (branching single or multiple) (*see* Fig. 12, 13, 14, 15, 16 and 17)

   1) upswept or swept angle; and
   2) spigot/socket or socket/socket.

   The fixed nominal angle, *α* of branches and reducing branches should be 45°, 67.5° or 87.5° to 90°. If other angles are required, they shall be agreed between the manufacturer and purchaser and be identified accordingly.

c) Reducers (*see* Fig. 18);

d) Access fittings (*see* Fig. 19);

   The inside diameter of the cleaning hole shall be as specified by the Manufacturer

e) Couplers
   1) Double socket (*see* Fig. 20);
   2) Repair collar (*see* Fig. 21);

f) Push-fit socket for fusion for pipe ends (*see* Fig. 22)

g) Plugs (*see* Fig. 23).

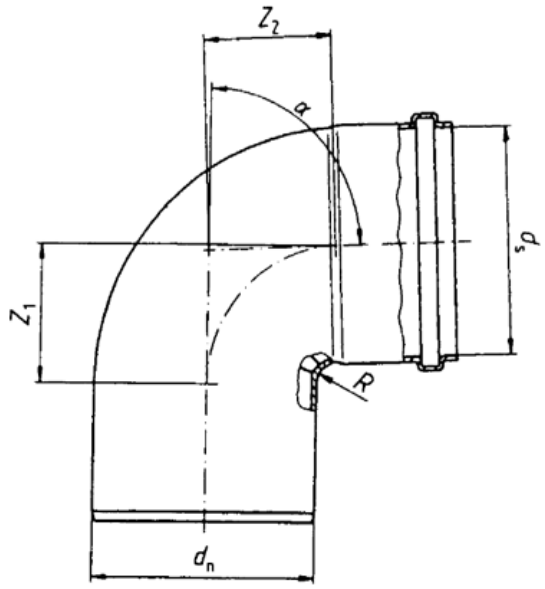


FIG. 6 BEND WITH SINGLE SOCKET

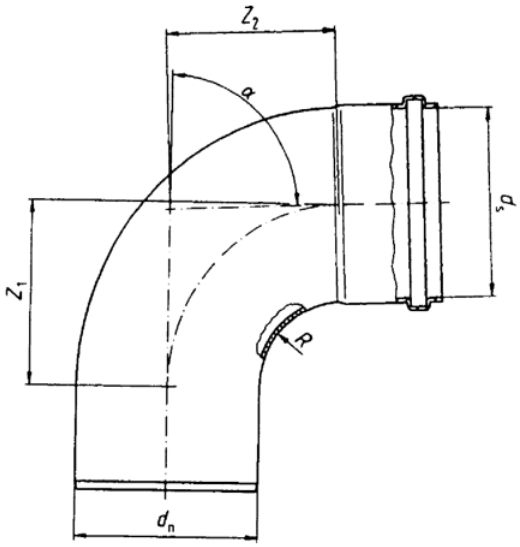


FIG. 7 BEND WITH SINGLE SOCKET (SWEPT)

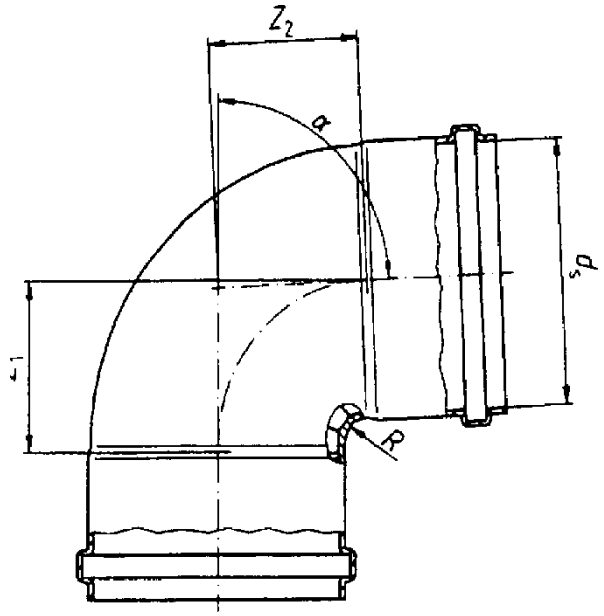


FIG. 8 BEND WITH ALL SOCKETS (UNSWEPT)

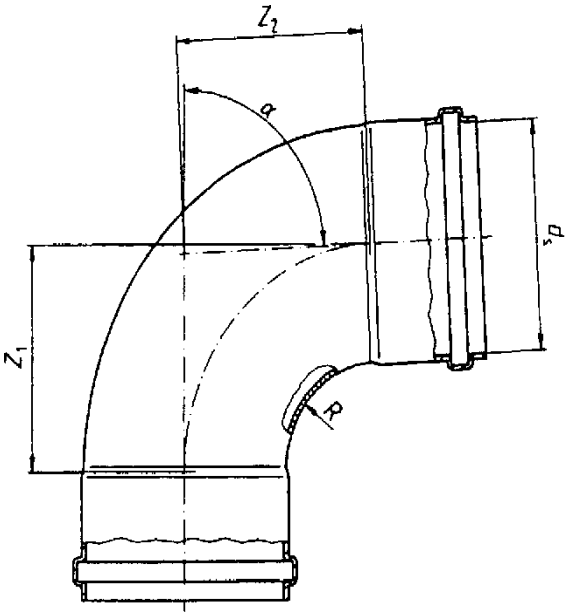


FIG. 9 BEND WITH ALL SOCKETS (SWEPT)

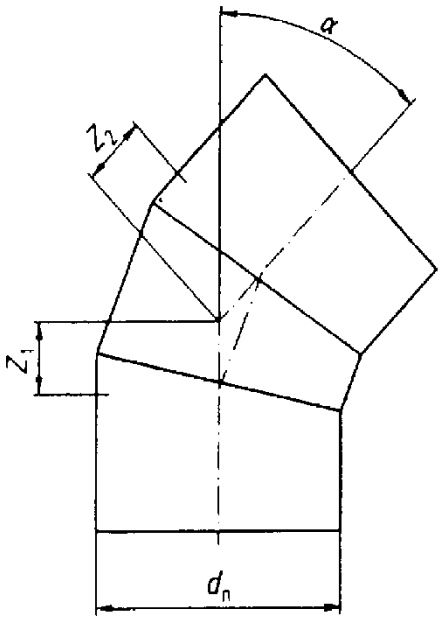


FIG. 10 BEND, FUSED FROM

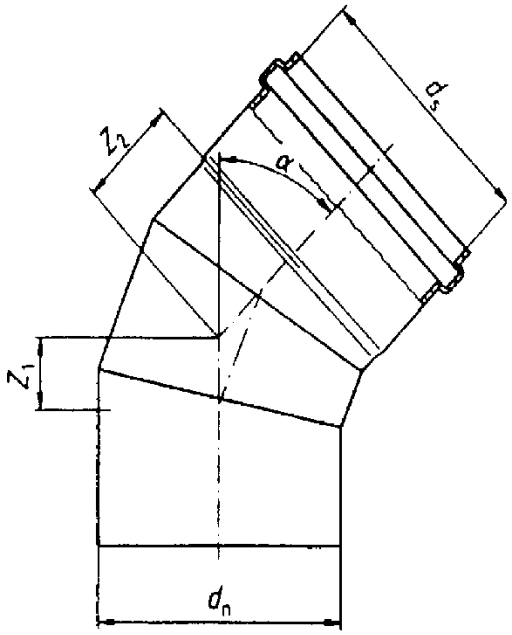


FIG. 11 BEND WITH SINGLE

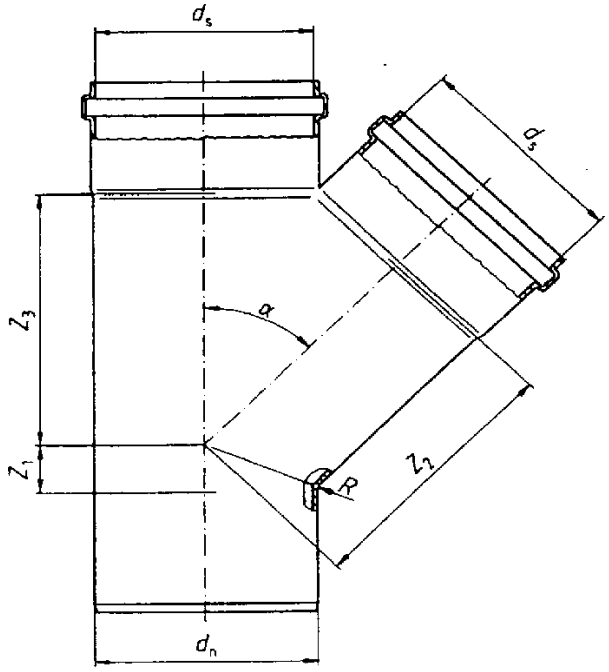


FIG. 12 BRANCH (UNSWEPT)

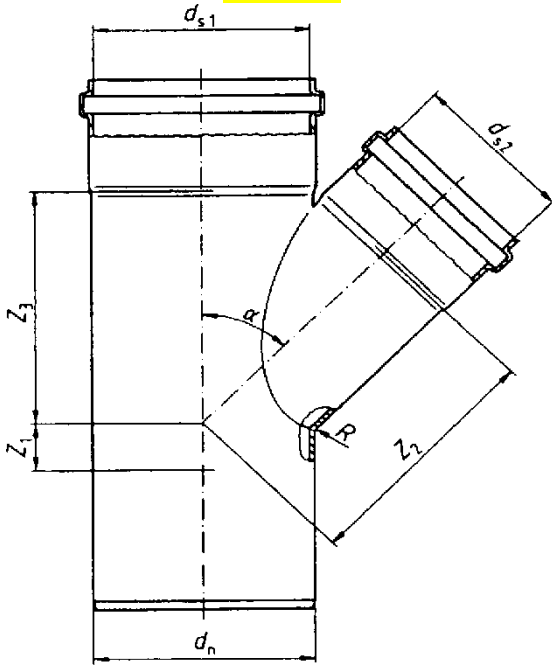


FIG. 13 REDUCING BRANCH (UNSWEPT)

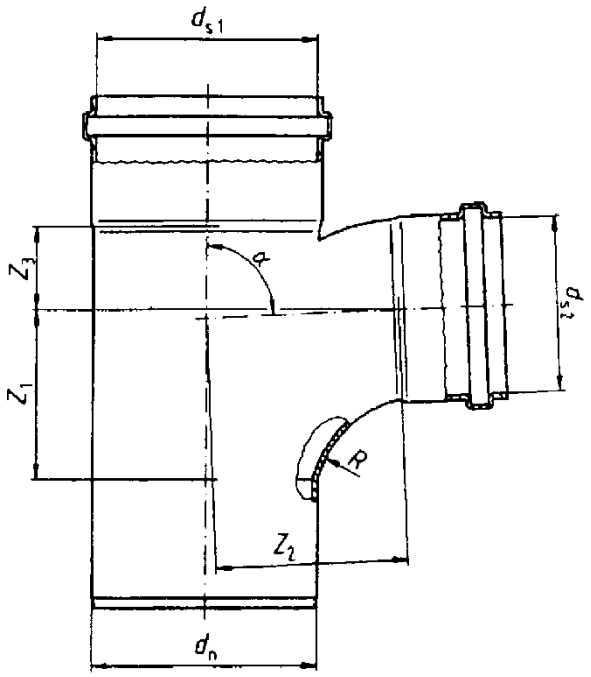


FIG. 14 REDUCING BRANCH (SWEPT)

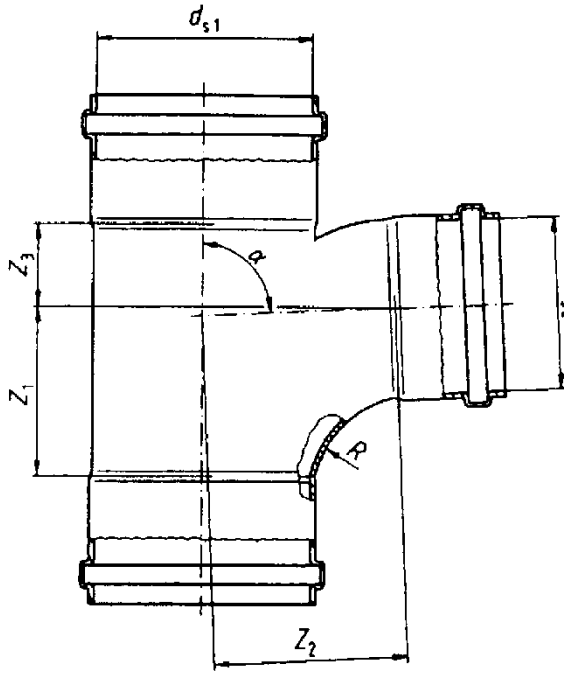


FIG. 15 REDUCING BRANCHWITH ALL SOCKETS (SWEPT)

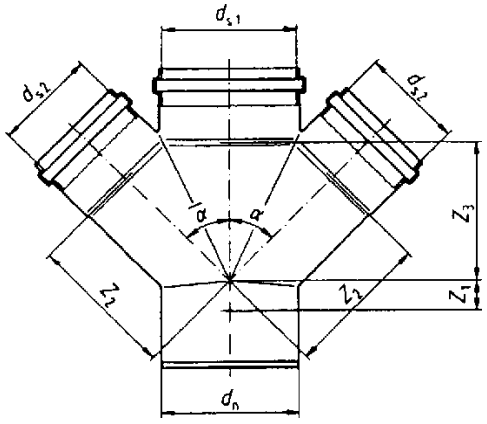


FIG. 16 DOUBLE BRANCH

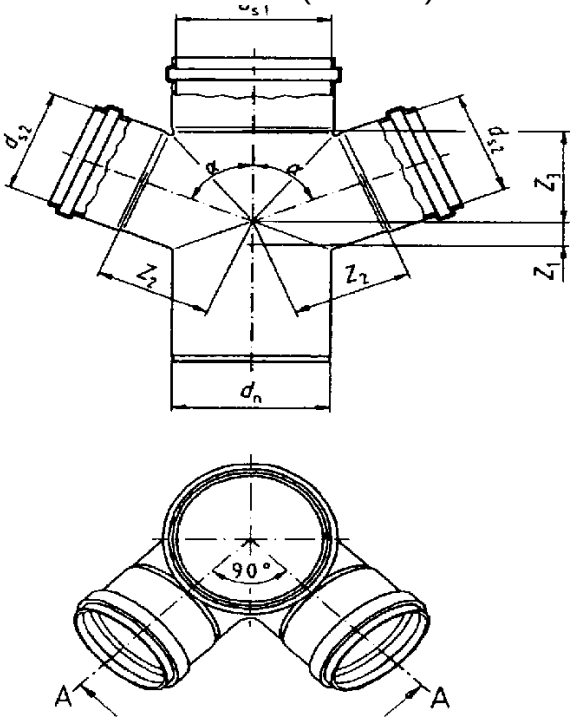


FIG. 17 ANGULAR DOUBLE BRANCH

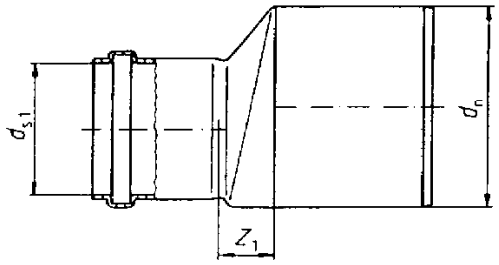


FIG. 18 REDUCER

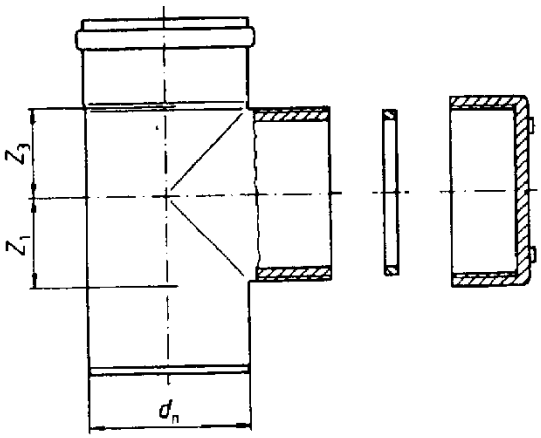


FIG. 19 ACCESS FITTING WITHROUND CLEANING HOLE

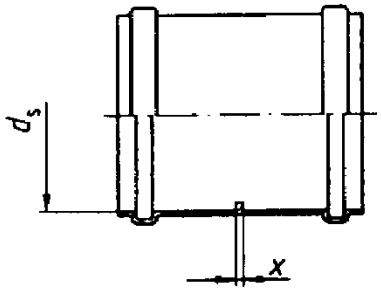


FIG. 20 DOUBLE SOCKET

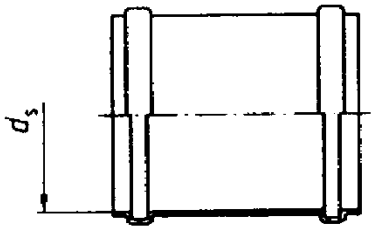


FIG. 21 REPAIR COLLAR

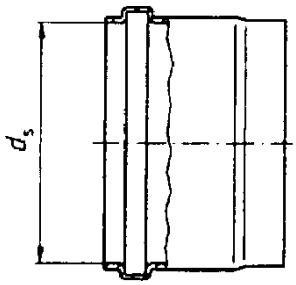


FIG. 22 PUSH-FIT SOCKET FOR FUSION OF PIPE ENDS

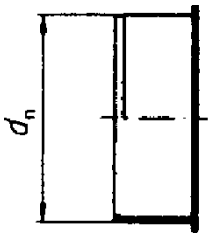


FIG. 23 PLUG

9 OTHER 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 (Class 1 and Class 2)

(*Clauses* 8.3.3 *and* 9)

Sl No.	Characteristics	Requirements	Test Parameters	Test Methods

(1)	(2)	(3)	(4)		(5)
i)	Longitudinal Reversion [1)]	≤ 2 % The pipe shall exhibit no bubbles or cracks	Test temperature	(150 ± 2)°C	IS 12235 (Part 5)
			Immersion time in liquid	30 min	
			Or		
			Test temperature	(150 ± 2)°C	IS 12235 (Part 5)
			Immersion time Air	60 min	
ii)	Melt mass-flow rate (MFR-value)	Permitted max. deviation when processing the compound into a pipe: 0.2 g/10 min	Test temperature	230 °C	IS 13360 (Part 4/ Sec 1)
			Reference time	10 min	
			Loading mass	2.16 kg	
iii)	Density [2)]	Class 1 Pipe Class 2 Pipe	> 0.88 > 1.1	27 °C	IS 13360 (Part 3/ Sec 1)
	[1)] The choice of Immersion in liquid or Immersion in Air is the responsibility of the manufacturer. However, the method adopted shall be reported. [2)] The manufacturer has to declare the base density for the material which comply the requirement of above table, however the variation of ± 10 percent is allowed on declared value when tested on the finished pipe sample. The declare value of density for pipe and fittings material should be the same.				

9.1 Other Physical Characteristics of Fittings

When tested in accordance with the test methods as specified in Table 9 using the indicated parameters, the fittings shall have physical characteristics conforming to the requirements given in Table 9.

Table 9 Physical Characteristics of Fittings

(*Clause* 9.1)

Sl No.	**Characteristics**	**Requirements**	**Test Parameters**		**Test Methods**
(1)	(2)	(3)	(4)		(5)
i)	Effects of heating	1) 2) 3)	Test Temperature	(150 ± 2)°C	Annex D of IS 16098 (Part 2)
			Heating time	30 min	
ii)	Density[4)]	(Class 1 Fittings)	> 0.88	27 °C	IS 13360 (Part 3/ Sec 1)
		(Class 2 Fittings)	> 1.1		

	1) The depth of cracks, delamination or blisters shall not be more than 20 percent of the wall thickness around the injection point(s). No part of the weld line shall be open to a depth of more than 20 percent of the wall thickness. 2) When fittings are manufactured from Pipes (Class 1 or Class 2), the Pipes shall conform to the requirements given in Table 6 and Table 9. 3) Mouldings that are used for fabricated fittings may be tested separately. 4) The manufacturer shall declare the base density for the material which comply the requirement of above table, however the variation of ± 10percent is allowed on declared value on finished fitting sample. The declare value of density for pipe and fittings material should be same.

10 MECHANICAL CHARACTERISTICS OF PIPES

10.1 General Mechanical Characteristics of Pipes

When tested in accordance with the test method as specified in Table 10 using the indicated parameters, the pipe shall have general mechanical characteristics conforming to the requirements given in Table 10.

The mass and fall height of striker for determining the impact resistance (round-the-clock method) as specified in Table 10 shall be as given in Table 11.

Table 10 General Mechanical Characteristics of Pipes (Class 1 or Class 2)

(*Clause* 10.1)

Sl No.	Characteristic	Require-ment	Test Parameters		Test Method
(1)	(2)	(3)	(4)		(5)
i)	PP-copolymer: Impact resistance 1) (round-the-clock method)	TIR≤10%	Mass of striker Fall height of striker Type of striker for: d < 110 mm dn≥110 mm Conditioning medium Conditioning temperature Conditioning period Sampling procedure	Tables 11 Tables 11 d25 d90 Water or air (0 ± 1) °C 60 min As per plan	IS 12235 : 2004 (Part 9)
ii)	PP-H: Impact resistance (round-the-clock method)	TIR≤10%t	Mass of striker Fall height of striker Type of striker for: dn < 110 mm dn ≥ 110 mm Conditioning medium Conditioning temperature	Tables 11 Tables 11 d25 d90 Water or air (26 ±3) °C	Same as Above

			Conditioning period Sampling procedure	60 min As per plan	
iii)	Ring stiffness	≥ 4.0 kN/m^2 [f] For S16 & ≥ 6.0 kN/m^2 For S14	Test temperature Deflection Deflection speed for: 75 mm ≤ dn ≤ 110 mm 110 mm < dn ≤ 200 mm 200 mm < d ≤ 315 mm	(23 ± 2) °C, 3 percent (2 ± 0.4) mm/min (5 ± 1.0) mm/min (10 ± 2.0) mm/min	As per IS 16098 (Part 1) and IS 12235 (Part 9)

Table 11 Masses and Fall Heights of Striker for Impact Resistance (Round-the-Clock Method)

(*Clause* 10.1)

All Dimensions in millimetres

Sl No.	**Nominal Size**, (DN/OD)	**Nominal Outside Diameter**, (dn)	**Mass of Striker**, (kg)	**Fall Height of Striker,** (mm)
(1)	(2)	(3)	(4)	(5)
i)	32	32	0.5	600
ii)	40	40	0.5	800
iii)	50	50	0.5	1 000
iv)	63	63	0.8	1 000
v)	75	75	0.8	1 000
vi)	90	90	0.8	1 200
vii)	110	110	1.0	1 600
viii)	125	125	1.25	2 000
ix)	160	160	1.6	2 000
x)	200	200	2.0	2 000
xi)	250	250	2.5	2 000
xii)	315	315	3.2	2 000

10.2 Additional Mechanical Characteristics of Pipes

Pipes (Class 1 and Class 2) made from PP-copolymers intended to be used in areas where installation is usually carried out at temperatures below -10 °C, shall additionally conform to the requirements of an impact test (staircase method) as specified in Table 12. such pipes shall be marked in accordance with Table 11.

10.3 Mechanical Characteristics of Fittings

When tested for mechanical characteristics, The fittings shall have mechanical characteristics conforming to the requirements given in Table 13. Assembled fittings are not submitted to this requirement.

Table 12 Additional Mechanical Characteristics of Pipes (Class 1 and Class 2)

(*Clause* 10.2)

Sl No.	Characteristics	Requirements	Test parameters		Test method
(1)	(2)	(3)	(4)		(5)
i)	Impact resistance[1)&2)] (staircase method)	H 50 ≥ 1m maximum one break below 0.5 m	Conditioning Period	1 hour	As per Annex C
			Conditioning temperature	(-10 ± 1) °C	
			Type of striker	d 90	
			Mass of striker		
			75 mm ≤ dn < 90mm	2.5 kg	
			90 mm ≤ dn ≤ 110mm	3.2 kg	
			dn = 110mm	4.0 kg	
			dn = 125mm	5.0 kg	
			dn = 160mm	8.0 kg	
			dn = 200mm	10.0 kg	
			dn = 250mm	12.5 kg	
	[1)] For PP-copolymer only. [2)] Applicable for > 75 mm				

Table 13 Mechanical Characteristics of Fittings

(*Clause* 10.3)

Sl No.	Characteristics	Requirements	Test parameters		Test method
(1)	(2)	(3)	(4)		(5)
i)	Impact Strength (Drop test)	No damage	Conditioning Temperature	0 ± 1°C	As per Annex D

			Conditioning Period	30 min	
			Falling Height for:		
			dn = 75 mm	1000 mm	
			dn = 90 mm	1000 mm	
			dn = 110 mm	1000 mm	
			dn = 125 mm	1000 mm	
			dn = 160 mm	500 mm	
			dn = 200 mm	500 mm	
			dn = 250 mm	500 mm	
			dn = 315 mm	500 mm	
			Point of impact	Mouth of the socket	

10.4 Performance Requirements

When tested in accordance with the test methods as specified in Table 14 using the indicated parameters, the joints and the system shall have fitness for purpose characteristics conforming to the requirements given in Table 14

Table 14 Fitness for Purpose Characteristics of the System

(*Clause* 10.4)

Sl No.	Characteristics	Requirements	Test parameters		Test method
(1)	(2)	(3)	(4)		(5)
i)	Water tightness	No leakage	—		IS 16098 (Part 2)
ii)	Elevated temperature cycling	No leakage before and after the test; Sagging:	—		IS 16098 (Part 2)
		DN ≤ 50: ≤ 3 mm			
		DN > 50: 0.05 dn			
iii)	Tightness of elastomeric ring seal joints	No leakage No leakage ≤ – 0.27 bar	Test temperature	(23 ± 5) °C	EN ISO 13259
			Spigot deflection	≥ 10 percent	
			Socket deflection	≥ 5 percent	
			Water pressure	0.05 bar	
			Water pressure	0.5 bar	
			Air pressure	- 0.3 bar	
		No leakage	Test temperature	(23 ± 5) °C	EN ISO 13259

		No leakage ≤ - 0.27 bar	Angular deflection	2°	
			Water pressure	0.05 bar	
			Air pressure	- 0.3 bar	

10.5 For Fusion joints the pipe & fittings to be fused together shall be of same class.

11 MARKING

11.1 General

Marking elements shall be labelled, printed or formed directly on the component in such a way that after storage, weathering, handling and installation, the required legibility is maintained.

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.

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

If printing is used, the coloring of the printed information shall differ from the basic coloring of the pipe or fitting.

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

11.2 Minimum Required Marking of Pipes (Class 1 and Class 2)

The minimum required marking of Pipes (Class 1 and Class 2) shall conform to Table 15. Pipes (Class 1 and Class 2) shall be marked at intervals of maximum 1 m, at least once per pipe. Pipes (Class 1 and Class 2) with a length less than 1 m may be marked with a label at least once per pipe.

Table 15 Minimum Required Marking of Pipes (Class 1 and Class 2)

(*Clauses* 10.1 and 11.2)

Sl No.	Aspects	Marking or Symbol	Minimum Durability of legibility of Marking
(1)	(2)	(3)	(4)
i)	Number of the standard	IS XXXX/ IS Logo	A
ii)	a) Manufacturer's name and/or trade mark	XXX	a
	b) Nominal size	e.g. DN 110	a

	c) Class	e.g. 1 or 2	a
	d) Material [1)]	PP OR PP H OR PP-MD	a
	e) Pipe series	e.g. S 16	a
	f) Manufacturer's information	[3)]	a
	[1)] Pipes (Class 1 and Class 2) which are marked "PP" are made from PP-copolymer. Pipes (Class 1 and Class 2) made from PP-Homopolymer shall be marked "PP-H".		
	[2)] For Pipes (Class 1 and Class 2) intended for fusion.		
	[3)] For providing traceability the following details shall be given:		
	a) the production period (year and month) in Fig or in code;		
	b) a name or code for the production site if the manufacturer is producing at different sites.		
	c) a name or code for the production site if the manufacturer is producing at different sites. Note : The symbols for the legibility mean the following - : a) : Durable in use b) : Legible until the system is installed.		

11.3 Minimum Required Marking of Fittings

The minimum required marking of fittings shall conform to Table 16, whereby the manufacturer's information can be either on the fitting or on the packaging. If the manufacturer's information is on the packaging it shall be determined by national requirements.

Table 16 Minimum Required Marking of Fittings

(*Clause* 11.3)

Sl No.	Aspects	Marking or Symbol	Minimum Durability of legibility of Marking
(1)	(2)	(3)	(4)
i)	a) Number of the standard	IS XXXX/ IS Logo	b
	b) Manufacturer's name and/or trade mark	XXX	a
	c) Nominal size	e.g. DN 110	a
	d) Nominal angle	e.g. 67.5°	b
	e) Material [1)]	PP or PP H OR PP-MD	a
	f) Class:	1 or 2	a

	g) Pipe series	e.g. S 16	a
	h) Manufacturer's information	[3)]	b
	1) Fittings which are marked "PP" are made from PP-copolymer;		
	2) Fittings made from PP-homopolymer shall be marked "PP-H";		
	3) For fittings intended for fusion;		
	4) For providing traceability the following details shall be given;		
	a) the production period (year) in Fig or in code; and		
	b) a name or code for the production site if the manufacturer is producing at different sites. Note : The symbols for the legibility mean the following - : a) : Durable in use b) : Legible until the system is installed.		

12 INSTALLATION OF PIPING SYSTEMS

For the installation of Pipes (Class 1 and Class 2) and fittings conforming to this standard, national and/or local requirements and relevant codes of practice apply.

In addition, the pipe manufacturer shall give a recommended practice for installation which refers to transport, storage and handling of the pipes and fittings as well as to the installation in accordance with the applicable national and/or local instructions.

For external above ground application additional requirements depending on the climate shall be agreed between the manufacturer and the user.

Due to the limited impact strength at low temperatures, pipes (Class 1 and Class 2) and fittings made from PP-Homopolymer are not intended to be installed at temperatures below +5 °C.

13 SAMPLING, FREQUENCY OF TESTS AND CRITERIA FOR CONFORMITY

13.1 Acceptance Test

13.1.1 Acceptance tests are carried out on sample selected from a lot for the purpose of acceptance of the lot in accordance with Table 17 (for pipes) and Table 18 (for fittings).

13.2 Type Test

13.2.1 Type tests are intended to prove the suitability and performance of a new technique or a new size of a pipe &fittings. Type testing shall be in accordance with Tables 19 to 20, as applicable. All tests are required to be carried out either in an in-house laboratory or at an authorized third party laboratory.

13.3 Sampling

All pipes of the same size, same grade and manufactured essentially under similar conditions shall constitute a lot. These pipes shall be selected at random from the lot

and in order to ensure the randomness of selection, a random number table shall be used. For guidance and use of random number tables, IS 4905 may be referred. In the absence of a random number table, the procedure given in Table 21and table 22 may be adopted.

13.3.1 Starting from any pipe in the lot, count them as 1, 2, 3, 4, etc, up to *r* and so on where *r* is an integral part of *N*/*n*, *N* being the number of pipes in the lot and *n* is the number of pipes in the sample. Every *r* th pipe so counted shall be drawn so as to constitute the required sample size.

The number of pipes given for the first sample in col 4 of Table 21 shall be examined for dimensional and visual requirements. A pipe failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements if the number of detectives found in the first sample are less than or equal to the corresponding acceptance number given in col 6 of Table 21. The lot shall be deemed not to have met these requirements if the number of detectives found in the first sample is greater than or equal to the corresponding rejection numbers given in col 7 of Table 21.

If, however, the number of detectives found in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and col 7 of Table 21.

Table 17 Acceptance Tests for Pipes

(*Clause* 8, 9 *and* 10)

Sl No.	Description of Test	Requirement, Ref to Clause	Sample Size
(1)	(2)	(3)	(4)
i)	Visual appearance, finish and colour	6.1 & 6.2	See table 21
ii)	Dimensions	8 &8.1	See table 21
iii)	Density	9.2	See table 22
iv)	Impact resistance	10 &10.1	See table 22
v)	Ring stiffness	10	See table 22
vi)	Longitudinal reversion	9.2	See table 22
vii)	Water tightness	10.2	See table 22

Table 18 Acceptance Tests for Fittings

Sl No.	Description of Test	Requirement, Ref to Clause	Sample Size
(1)	(2)	(3)	(4)
i)	Visual appearance, finish and colour	6.1 & 6.2	See Table 21
ii)	Dimensions	8.3	See Table 22
iii)	Density	9.3	See Table 22

iv)	Effect of heating	9.3	See Table 22
v)	Water Tightness	10.2	See Table 22
vi)	Impact Strength (Drop Test)	10.11	See Table 22

Table 19 Type Test for PP Pipes

(Clause 7.1.1 ,10.2)

Sl No.	Tests	Requirement, Ref to Clause	Sample Size
(1)	(2)	(3)	(4)
i)	Resistance to Internal Hydrostatic Pressure For 140 h at 6.0 MPa (for PP-H only)	7.1.1	2
ii)	Resistance to Internal Hydrostatic Pressure For 1000 h at 3.5 MPa (for PP-H only)	7.1.1	2
iii)	Resistance to Internal Hydrostatic Pressure For 140 h at 4.2 MPa (for PP-Copolymer only)	7.1.1	2
iv)	Resistance to Internal Hydrostatic Pressure For 1000 h at 2.5 MPa (for PP-Copolymer only)	7.1.1	2
v)	Tightness Of Rubber Sealing Rings Joint	10.2	2
vi)	Elevated Temperature cycling	10.2	2

Table 20 Type Test for PP Fittings

(Clause 7.1.1 & 9.3)

Sl No.	Description of Test	Requirement, Ref to Clause	Sample Size
(1)	(2)	(3)	(4)
i)	Thermal Stability (Oxidation induction test)	7.1.1	3
ii)	Melt Flow Rate	7.1.1 and 9.2	3
Note: The requirement is only valid for pipes intended to be jointed in field by fusing or welding.			

Table 21 Scale of Sampling for Dimensional and Visual Requirements

(*Clause* 6,6.1, 6.2.8 & 8.3)

Sl No.	No. of pipes in the Lot	Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.
i)	Up to 1 000	First	13	13	0	2
		Second	13	26	1	2
ii)	1 001 to 3 000	First	20	20	0	2
		Second	20	40	1	2

iii)	3 001 to 10 000	First	32	32	0	3
		Second	32	64	3	4
iv)	10 001 and above	First	50	50	1	4
		Second	50	100	4	5

The second sample of the size given in col 4 of Table 21 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these, requirements, if the number of detectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in col 6 of Table 21; otherwise not.

12.4 Conformance

The lot having satisfied dimensional and visual requirements shall be tested for other requirements with the sample size selected as per Table 21 from the lot. If the first sample drawn fails the tests, re-sampling should be done from the lot which has satisfied the dimensional and visual requirements. The lot shall be considered to have met the requirements of these tests, if none of these samples tested fails.

Table 22 Scale of Sampling for Acceptance Tests Other thanVisual and Dimensional Requirements

Sl No.	No. of Pipes in Lot	Sample Size for sizes Less than or Equal to DN 315 mm
(1)	(2)	(3)
i)	Up to 1 000	2
ii)	1 001 to 3 000	3
iii)	3 001 and above	4

ANNEX A

(*Reference Clause no*. 8.4)

A-1 INTRODUCTION

Noise from wastewater installations is generated by the flow and fall of water in the piping system. There are many different ways to install such systems in building codes. They may be firmly cemented in to walls and floors, fixed by clips in walls and covered slabs, or hung exposed in the plenum above a suspended ceiling. It seems advisable, therefor, to define measuring methods for both structure-borne and airborne sound

Important noise sources are bends after vertical sections, but also discontinuities e.g. inlets, couplings and sleeves. Apart from that noise impact on the inhabitants of the building strongly depends on the material properties of the pipes, on the methods used in joining and fastening them and on the local building practice.

A-2 SCOPE

This document specifies methods for the measurement of airborne and structure-borne sound produced in waste water and rain water installations under laboratory conditions.

The defines expression of the results.

It is applicable to waste water piping system and parts thereof, but not to the actual sources of the wastewater, e.g. lavatories, toilets and bathtubs or any active units. It applies to pipes with natural ventilation and made of any common material in commonly used diameters (up to 150 mm).

A-3 TERMS AND DEFINITIONS

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

A-3.1 Waste Water

Any type of water including rainwater evacuated from buildings into the sewer system.

A-3.2 Waste Water Installation

The total of pipes and all fixing components, used to evacuate waste water, but excluding the actual sources of the waste water, e.g. sinks, toilets, bathtubs, gutter or any active units (pumps).

A-3.3 Specimen

Object of tests according to this standard. Specimens are simple wastewater installation systems with a single path of water flow. Any combination of commercial elements may be assembled to form a specimen.

A-3.4 Source Room

Test room used for airborne sound measurement; the specimen is mounted inside the test room.

A-3.5 Receiving Room

Test room used for structure-borne sound measurement; the specimen is mounted outside the test room.

A-3.6 Standard Configuration

A mandatory form of specimen used for comparison.

A-3.7 Standard Mounting

Mandatory mounting conditions for the standard configuration.

A-3.8 Standard Test Wall

Mandatory test wall used for comparison.

A-3.9 Wall Structural Sensitivity

Normalised ratio between a point force exciting the test wall and the sound power radiated by the test wall. The wall structural sensitivity is measured according to a reciprocity method described in Annex B.

A-3.10 Reference Wall

Standardized wall of 250 kg/m^2 used for normalisation of the measurement results and described by a reference structural sensitivity spectrum (given in Clause **A-9**)

A-3.11 Frequency Range of Measurement

Range in 1/3 octave bands over which measurements are carried out.

A-4 NOTATIONS

- f — Frequency in Hz
- T_e — Reverberation time measured in the source (emission) room, in seconds (According to EN ISO 354) reverberation.
- T_r — Time measured in the receiving room, in seconds
- V_e — Volume in the source room in cubic metres volume in
- V_r — The receiving room in cubic metres
- L'_s — Average sound pressure level due to structure-borne sound measured in The receiving room (according to EN ISO 140-3) before correction for Background noise, in decibels

L'_t — Average total sound pressure level measured in the source room (according To EN ISO 140-3) including airborne and structure-borne sound, before Correction for background noise, in decibels

L_B — Measured background sound pressure level, in decibels

L_S — Structure-borne sound pressure level after correction for background noise, in decibels

L_t — Total sound pressure level after correction for background noise, in decibels

L_{sn} — Structure-borne sound pressure level normalized to an equivalent absorption Area of 10 m^2, in decibels

L_{tn} — Total sound pressure level normalized to an equivalent absorption area of 10 m^2, in decibels

L_{an} — Airborne sound pressure level normalized to an equivalent absorption area of 10 m^2, in decibels

$L_{s,A}$ — A-weighted structure-borne pressure level, in decibels

$L_{a,A}$ — A-weighted airborne sound pressure level, in decibels

D_A — Attenuation values of the A-weighted filter, in decibels

T_m — Measuring time, in seconds

L_{SS} — Wall structural sensitivity level, in decibels

L_{SSR} — Structural sensitivity level of the reference wall, in decibels

ΔL_{SS} — Sensitivity correction in decibels: $\Delta L_{SS} = L_{SS} - L_{SSR}$

L_{sc} — Structure-borne sound characteristic level, in decibels $L_{sc} = L_{sn} - \Delta L_{SS}$

L_W — Sound power level (ref 10^{-12} watts) of the sound reference source, in decibels

L'_V — Vibration velocity level (ref 10^{-9} m/s) at the clamp fixing, in decibels, Before correction for background vibration

L_V — Vibration velocity level (ref 10^{-9} m/s) at the clamp fixing, in decibels, After correction for background vibration

A-5 PRINCIPLE OF THE TEST METHOD

A-5.1 Structure-borne Sound Measurements (Index S)

The specimen is mounted outside the test room (receiving room), connected as in practice to the test wall using the fixing material specified by the manufacturer of the system. A steady flow of tap water is applied and the total sound transmitted into the test room is measured (L'_S). The specimen is then disconnected from the test wall and the water system operated in order to measure the background noise. The values L'_S are then corrected for background noise giving the values L_S. These values are then normalized (*see* A-9.5) to an equivalent absorption area of 10 m^2 using the measured reverberation time T_r of the receiving room giving the values L_{sn}.

After the last step, the results are corrected for the difference in structural sensitivity between the test wall used and the reference wall (correction given in Clause A-9).

A-5.2 Airborne Sound Measurement (Index A)

The specimen is mounted on a test wall inside the test room (source room). Appropriate openings in the ceiling and in the floor are provided. A steady flow of tap water is applied. The sound in the test room, produced as airborne sound radiated directly from the object but also as structure-borne sound radiated by the wall is measured (L'_t). The water flow is stopped to measure the background noise. The values L'_t are then corrected for background noise giving the values L_t and normalized to an equivalent absorption area of 10 m^2 using the measured reverberation time T_e of the source room giving the values L_{tn}. Later in the progress of calculation the structure-borne contribution is subtracted giving the values L_{an}.

A-6 EQUIPMENT

A-6.1 Requirements for the Frequency Range of Measurement

Throughout this standard the frequency range is limited to the eighteen 1/3 octave bands with mid-frequencies from 100 Hz to 5 000 Hz. If Additional information is required in the low frequency range, measurements at 1/3 octaves 50 Hz, 63 Hz and 80Hz can be made, guidance for such additional measurements is given in EN ISO 140-3:1995 Annex F.

A-6.2 Requirements for the Acoustic Equipment

The equipment shall comply with the requirements of EN ISO 140-3:1995 Clause 4**.**

A-6.3 Requirements for the Hydraulic Equipment

The hydraulic equipment shall be able to generate flow rates between 0.5 l/s and an upper limit depending on the inner diameter of the tested specimen (given in **A-9.2**). The equipment shall be able to measure the flow with an accuracy of 5 percent.

A-6.4 Requirements for the Wall Structural Sensitivity Measuring Equipment

The reciprocity method requires the use of a reference sound source calibrated according to EN ISO 6926. The vibration transducer used shall be calibrated according to ISO 16063-21 and fixed according to ISO 5348**.**

A-7 TEST FACILITIES

A-7.1 Construction Requirements

A-7.1.1 *Test Room*

The test room shall have a volume of at least 50 m^3 and an interior height of (3.0 ± 0.5) m. The test wall shall not be less than 3.5 m wide. Openings in the ceiling and in

the floor are provided for the installation of the test objects. A combination of two adjacent test rooms may be advantageous, allowing the simultaneous measurement of the airborne and the structure-borne sound. Additional space above and below the test room is required to ensure the standardised falling height of the measured system of about 6 m (*see* A-8.1.2.).

A-7.1.2 *Test Wall*

A single wall built of bricks, blocks or poured concrete shall be defined as the standard test wall; hollow bricks or blocks are not allowed. Its mass per unit area, including a coat of mineral based plaster on both sides, shall be (200 ± 50) kg/m^2.

Any other mass per unit area can be used, long as the applicability condition define in Annex B.2 is fulfilled.

A-7.2 Acoustic Requirements

According to EN ISO 140-3, the reverberation time shall be in the range 1s - 2s.

A-8 TEST SPECIMEN

A-8.1 Geometry

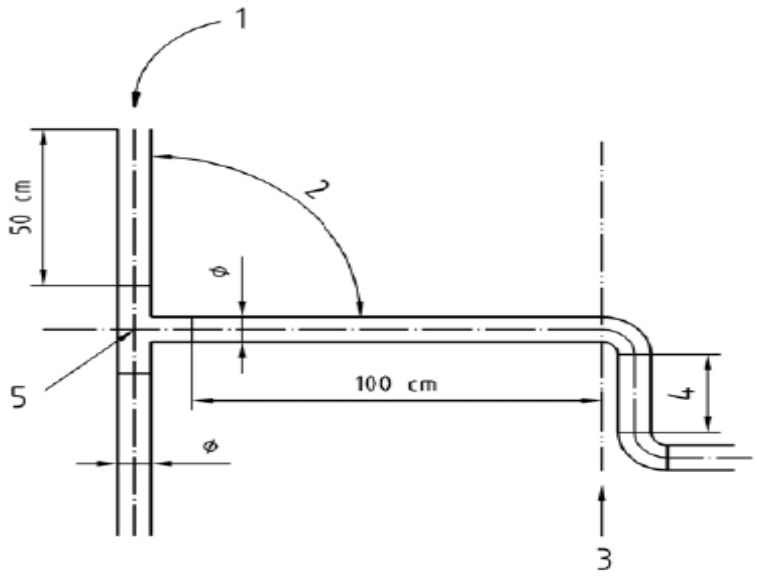
A-8.1.1 *Components*

The objects tested according to this standard consist of systems of wastewater installations with a single path of the water flow. They consist of:

a) an inlet, part of the test object according to Fig. 24;
b) any combination of straight pipes with tees, bends, joints and inlets, mounted on the test wall; and
c) A basement bend of totally approximately 90 °C angle, being part of the specimen.

A-8.1.2 *Falling Height, h*

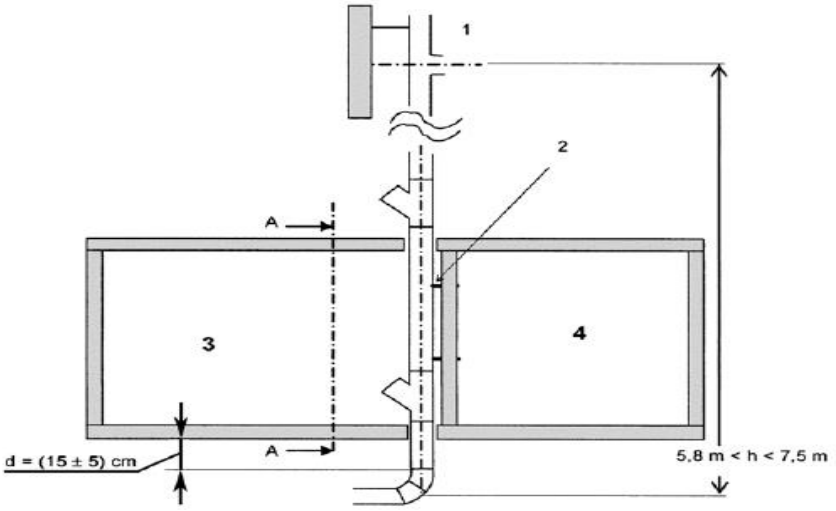
The falling height h shall be in the range 5.8 m – 7.5 m, measured between the inlet point and the impact point (Fig. 25). The inlet point is given as the intersection of the axis of the inlet tube with the axis of the vertical pipe; the impact point is defined by the intersection of the vertical pipe axis with the wall of the basement bend.



Key

1 Silencer when required as part of the test installation
2 Close to 90° (depending on product)
3 Limit of the system
4 25 cm minimum
5 Inlet point

FIG. 24 INLET CONFIGURATION



Key
1 Inlet
2 Fixing device
3 Source room
4 Receiving room

FIG. 25 STANDARD CONFIGURATION

A-8.1.3 *Standard Configuration*

For comparison purposes a standard configuration is used, consisting of a straight vertical pipe with an inlet tee within the measuring room and an inlet tee above the test room, both closed by an accessory of the manufacturer. In the standard configuration the basement bend is made of two 45 degree bends of the same material as the test object.

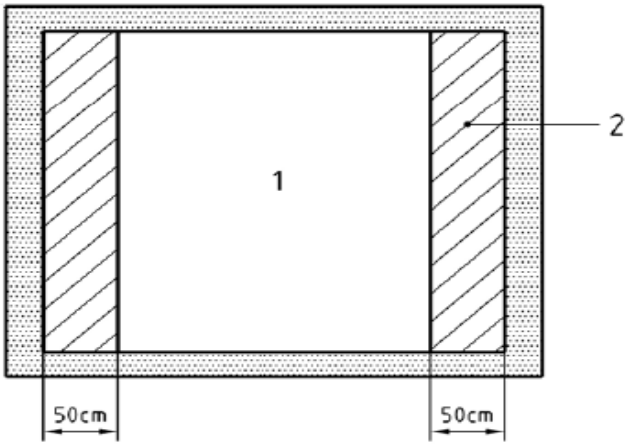
A-8.2 Mounting of the Specimen

A-8.2.1 *General*

The mounting is performed exactly according to the instructions given by the manufacturer or distributor of the pipe system. It shall be described in full detail in the test report.

A restricted area of the test wall, as defined by Fig. 26, is provided for mounting of the test object. At least one fixing point shall be used to fasten the system to the test wall. No further restrictions are made concerning the location of clamps, clips and other fixing devices.

The mandatory basement bend shall be mounted below the floor of the test room, at a distance of (15 ± 5) cm from the floor (*see* Fig. 25). It shall be fixed rigidly, but avoiding any direct transmission of structure-borne sound to the test room. Above the test room, the upper system is fixed, avoiding also any direct transmission of structure-borne sound to the test room.



Key
1 Test wall
2 Restricted area

FIG. 26 RESTRICTED AREA FOR MOUNTING THE TEST OBJECT ON THE TEST WALL (AA VIEW IN FIG. 2)

A-8.2.2 *Requirements for Airborne Sound Measurement*

The air gaps between tube and floor in the entrance and exit openings have to be carefully filled with porous absorbent material and covered with plastic sealant in order to prevent any airborne sound from the outside influencing the measurement. The seal shall remain sufficiently flexible to avoid mechanical clamping of the pipe.

A-8.2.3 *Requirements for the Standard Configuration*

Two clamps shall be used to fasten the system to the test wall. If not otherwise specified by the manufacturer, metal plugs shall be used.

A-9 TEST PROCEDURE AND EVALUATION

A-9.1 Wall structural Sensitivity Measurement

The wall structural sensitivity level shall be measured, according to the procedure described in Annex B, at each fixing location (L_{SS1} and L_{SS2}) with the pipe in place and then averaged energetically for each frequency band:

$$L_{SS} = 10\lg [[10^{LSS1/10}+10^{LSS2/10}]/2] \quad (1)$$

A wall structural sensitivity correction is then calculated from the difference:

$$\Delta L_{SS} = L_{SS} - L_{SSR} \quad (2)$$

where

L_{SSR} is the structural sensitivity level of the reference wall, given in Fig. 27, in decibels and calculated from;

$$L_{SSR} = [28\lg f + 11.2] \text{ rounded to nearest integer} \quad (3)$$

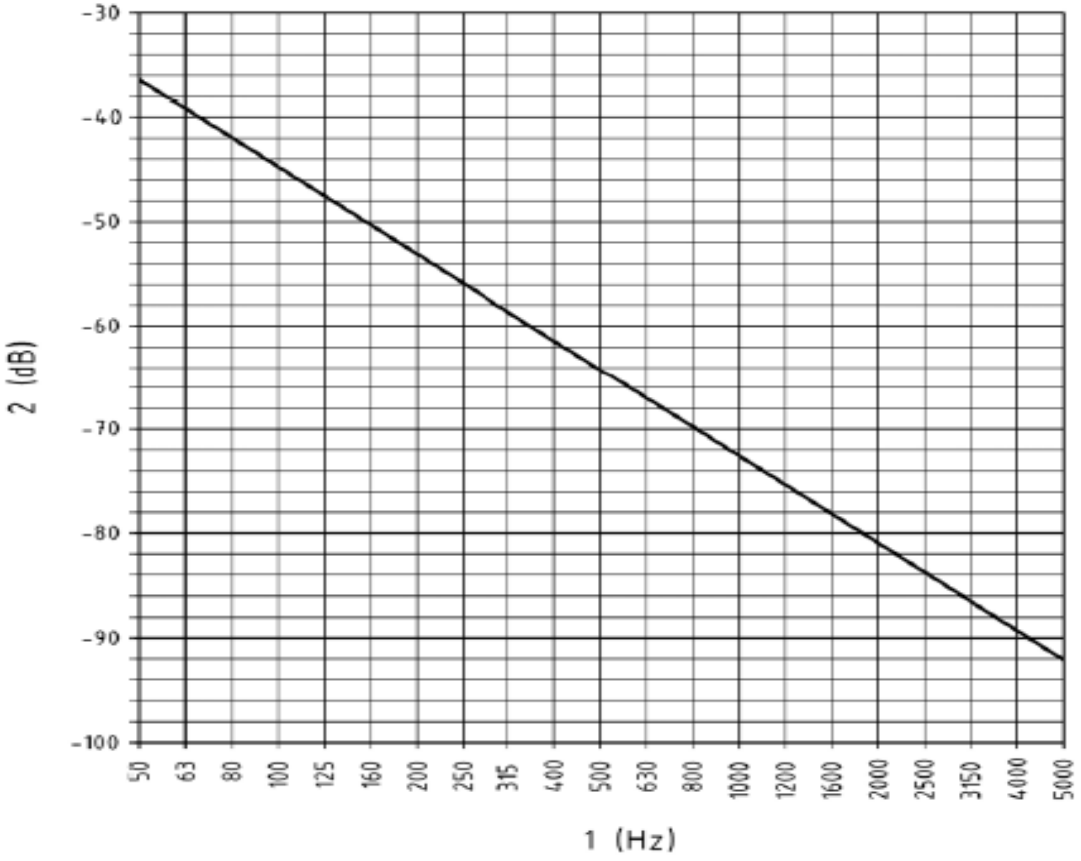


FIG. 27 REFERENCE STRUCTURAL SENSITIVITY SPECTRUM

A-9.2 Flow Rate

The test shall be performed at the following constant flow rates: 0.5 l/s, 1l/s , 2 l/s , 4 l/s and 8 l/s, up to a limit depending on the pipe internal diameter and given in Table 18. The flow rate shall be controlled and kept within ± 5 percent of the stated value during measuring time T_m.

Table 23 Flow Rate Limits

(*Clause* A-9.2)

Pipe Internal Diameter D mm	70 ≤ D < 100	100 ≤ D ≤125	125 < D ≤ 150
Upper Flow Rate l/s	1	4	8

A-9.3 Measurements

Both the sound pressure levels L'_t and L'_S and the reverberation times T_e and T_r are measured in 1/3-octave bands according to EN ISO 140-3.

A complete set of primary quantities comprises the levels L'_t and L'_S for each flow rate, the reverberation times T_e and T_r of the source and receiving room respectively and the wall structural sensitivity correction ΔL_{SS}.

A-9.4 Correction for Background Noise

The measured levels L'_t and L'_S are corrected for background noise according to EN ISO 140-3 giving the values L_t and L_s respectively. Levels at the limit of measurement shall be clearly indicated in the test report.

A-9.5 Normalisation

The value L_t and L_s are normalized to an equivalent absorption area of 10 m^2 using

$$L_{tn} = L_t - 10\lg(T_e) + 10\lg(0.16V_e/10) \quad (4)$$

$$L_{sn} = L_s - 10\lg(T_r) + 10\lg(0.16V_r/10) \quad (5)$$

where

V_e and V_r are the volume of the source and receiving room respectively, in cubic meters

A-9.6 Calculation of Structure-borne Sound Level L_{sn} and Normalisation with Respect to the Acoustic Properties of the Wall

The structure-borne sound level L_{sn} is calculated and the wall structural sensitivity correction ΔL_{SS} is subtracted from L_{sn} with respect to the acoustic properties of the wall compared with the properties of a reference wall:

$$L_{sc} = L_{sn} - \Delta L_{SS} \quad (6)$$

The level L_{sc} is characteristic of the pipe system tested.

> Note — The level obtained in any configuration (laboratory or field) can then be calculated by adding L_{sn} to the correction $\Delta L_{SS,\,situ}$ corresponding to the configuration considered.

A-9.7 Calculation of the Airborne Level L_{an}

The airborne sound is calculated from L_{tn} by energetically subtracting the structure-borne sound for each frequency band:

$$L_{an} = 10\lg(10^{L_{tn}/10} - 10^{L_{sn}/10}) \quad (7)$$

A-10 Calculation of Single Number Quantities

A-10.1 Single Number Descriptor for Structure-borne Sound

The A-weighted single number descriptor is calculated by:

$$L_{sc,\,A} = 10\lg\left(\sum_{i=1}^{18} 10^{(L_{sci}+D_{Ai}/10)}\right) \quad (8)$$

where,

D_{Ai} are the attenuation values of the A-weighting filter in the frequency range used (EN 61672-1).

A-10.2 Single Number Descriptor for Airborne Sound

The A-weighted single number descriptor is calculated by:

$$L_{a,\,A} = 10\lg\left(\sum_{i=1}^{18} 10^{(L_{ani}+D_{Ai}/10)}\right) \quad (9)$$

A-11 PRECISION

A-11.1 Repeatability

NOTE — It is not currently possible to define repeatability. This will be added once experience with this test method has been gained.

A-11.2 Reproducibility

NOTE — It is not currently possible to define reproducibility. This will be added once experience with this test method has been gained.

A-12 EXPRESSION OF RESULTS

The 1/3 octave spectra L_{sc} and L_{an} obtained for the different flow rates shall be given in the table where the flow rates are clearly stated. Levels at the limit of measurement (*see* **A-9.4**) shall be clearly indicates.

A-13 TEST REPORT

The test report shall include:

a) Reference to this document.
b) Name and address of the testing laboratory.
c) Identification number of the test report.
d) Name and address of the organization or the person who ordered the test.
e) Name and address of manufacturer or supplier of the tested object.
f) A description of the tested object stating the material and size of the parts, the methods used for joining and sealing the parts and the detailed plan of the mounting configuration.
g) Identification of the test equipment and instruments used.
h) A description of the test facility, especially of the test wall.
i) Environmental data (temperature, static pressure, background noise).

j) Test results: the main page of the report shall include a table giving the single number descriptors $L_{sc, A}$ and $L_{a, A}$ obtained for the different flow rates. The report shall include the noise spectra L_{sn} and L_{an} obtained for the different flow rates and the test wall structural sensitivity spectrum L_{SS}; and

k) Date of the test and signature of the person responsible.

ANNEX B

(*Reference Clause no*. 8.4)

(Normative)

B-1 WALL STRUCTURAL SENSITIVITY MEASUREMENT

B.1.1 Measurement Procedure:

The sound reference source shall be located in the receiving room as described in EN ISO 140-3 for loudspeakers, not close to the test wall (minimum distance: 2 m from the test wall and 1 m from other walls) and at a minimum of 3 positions.

B.1.2 Accelerometers shall be located as close as possible to the clamp fixing points (maximum distance: 5 cm).

B.1.3 The sound reference source (of sound power level L_W) is operated and the velocity levels at the clamp fixing points shall be measured (L_v) · the sound reference source shall be stopped in order to measure the background vibration level. The values, L_V are then corrected for background vibration with the same procedure as for sound pressure level giving the values L_V. Levels at the limit of measurement shall be clearly indicated in the test report. The wall structural sensitivity level L_{SS} is then calculated for each clamp fixing point using the following equation in decibels:

$$L_{SS} = L_V - L_W + 10\log V_r / T_r - 59 \text{ dB}$$

where,

V_r = the volume of the receiving room in cubic metres and

T_r = the reverberation time of the receiving room in seconds.

B-2 APPLICABILITY OF THE METHOD

The vibration levels at the specimen fixing points shall be measured with and without the pipe in place; The method is applicable if the difference between the two levels obtained at each fixing point is less than 3 dB. This condition shows that the internal mobility of the pipe is much higher than the input mobility of the wall and that the pipe is a force source.

ANNEX C

(*Reference* Clause no. 8.4)

C-1 SCOPE

This standard specifies a method for determining the resistance to external Blows of thermoplastics pipes by using the staircase method. This method is not applicable to perforated pipes.

The method is intended to be applied for pipe testing at 0 °C.

C-2 DEFINITIONS

For the purposes of this standard, the following definitions apply.

C-2.1 H 50 Value

The height of fall (drop height) of a striker of specified mass which provokes failure of 50 percent of test pieces from samples of pipe taken to represent a batch.

> NOTE — In practice, test pieces are drawn at random from a batch and the result is only an estimate of the H50 for that batch.

C-2.2 Production Batch

A clearly identifiable collection of units, manufactured consecutively or continuously under the same conditions, using material or compound conforming to the same specification.

C-3 PRINCIPLE

Test pieces, comprising cut lengths of pipe, are subjected to a single blow by a falling striker of specified mass and shape dropped from one of a sequence of different heights onto either a random position around the circumference of the pipe or on to a specified generatrix of the pipe.

If a test piece fails (*see* d) of **C-7.1**), the drop height for the next blow is decreased by a predetermined amount. If a test piece does not fail, the drop height for the blow on the subsequent test piece is increased accordingly. If sufficient test pieces are used, the H50 value of a batch, or a production run from an extruder, can be calculated.

A preliminary test procedure (*see* **C-7.2**) is carried out to obtain a rough indication of the H50 value and to identify the first test piece from which the result will be used in a main test procedure (*see* **C-7.3**).

The severity of this test method can be adjusted to suit different specification needs by changing the mass of the striker and/or the test temperature.

NOTE — It is assumed that the following test parameters are set by the standard making reference to this standard:

a) The type of striker and striker mass [*see* b) of **C-4.1** and a) of **C-7.1**];
b) The test and conditioning temperatures and the conditioning medium (*see* **C-4.2** and Clause **C-6**);
c) The method of sampling (*see* **C-5.1**);
d) If appropriate, the number of test pieces to be used (*see* **C-5.2** and Clause **C-7**);
e) If applicable, the position of impact on the test piece and/or any alternative or additional criteria [*see* b), c) and d) of **C-7.1**];
f) If applicable, the initial drop height to be used in place of the preliminary test procedure [*see* e) of **C-7.1**]; and
g) The required H50 value for the pipe [*see* a) of **C-7.2.1**].

C-4 APPARATUS

C-4.1 A falling weight impact testing machine incorporating the following basic components (*see* Fig. 28):

a) Main Frame with guide rails or a guiding tube rigidly fixed in the vertical position, to accommodate a striker [*see* b)] and release it to fall vertically and freely such that the speed of the striker at the moment of hitting the pipe is not less than 95 percent of the theoretical speed;

b) Striker having a nose comprising all or part of a hemispherical form combined with a cylindrical stem at least 10 mm long and having dimensions conforming to Table 19 and Fig. 2, depending upon the mass of the striker. The mass of the striker, including any associated weights, shall be selected from Table 20. Below the stem, the nose shall be of steel with a minimum wall thickness of 5 mm and the striking surface shall be free from imperfections that could influence the results.

Table 24 Dimensions for the Nose of the Striker (*see* Fig. 2)

(*Clause* C-4.1)

Dimensions in millimetres

Sl No.	**Type**	**R_s,** mm	**D,** mm	**D_s**	**α**
(1)	(2)	(3)	(4)	(5)	(6)
i)	d25	50	25 ± 1	*)	*)
ii)	d90	50	90 ± 1	*)	*)
	*) Not Specified				

Table 25 Masses of Strikers

(*Clauses* C-4.1, C-7.1, C-7.2.4 and C-7.2.5)

Masses in kilograms

Sl No.	**Mass of Striker (± 0.005 kg)**					
	Type d25			**Type d90**		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	0.25	1.00	2.00	4.0	8.0	16.0
ii)	0.5	1.25	2.5	5.0	10.0	
iii)	0.8	1.6	3.2	6.3	12.5	

c) Rigid Test Piece Support having one of the following forms as applicable.

1) For pipes having a circular external cross section, consisting of a 120° V-block of steel at least 200 mm long, positioned so that the axis of the line of fall of the nose of the striker shall intersect the axes of the V to within ± 2.5 mm (*see* Fig. 28).
2) For pipes with a flat bottom, a horizontal support of flat steel together with guides to ensure that the line of fall of the striker shall intercept to within ± 2.5 mm the striking point specified on the test piece by the referring standard.

The support construction shall be sufficiently rigid not to cushion the effect of the impact.

d) Release Mechanism such that the striker can fall from a variable height which can be adjusted up to 2 m, as measured from the top surface of the test piece with an accuracy of 10 mm. The drop height shall be a multiple of 100 mm.

C-4.2 A Liquid Bath or Air Cabinet, capable of maintaining one of the following conditioning temperatures for testing at the temperature as specified in the referring standard.

For testing at 0°C, the conditioning temperature shall be (0 ± 1) °C.
For testing at -20 °C the conditioning temperature shall be (-20 ± 2) °C.
For testing at +23°C, the conditioning temperature shall be (+23 ± 2) °C.

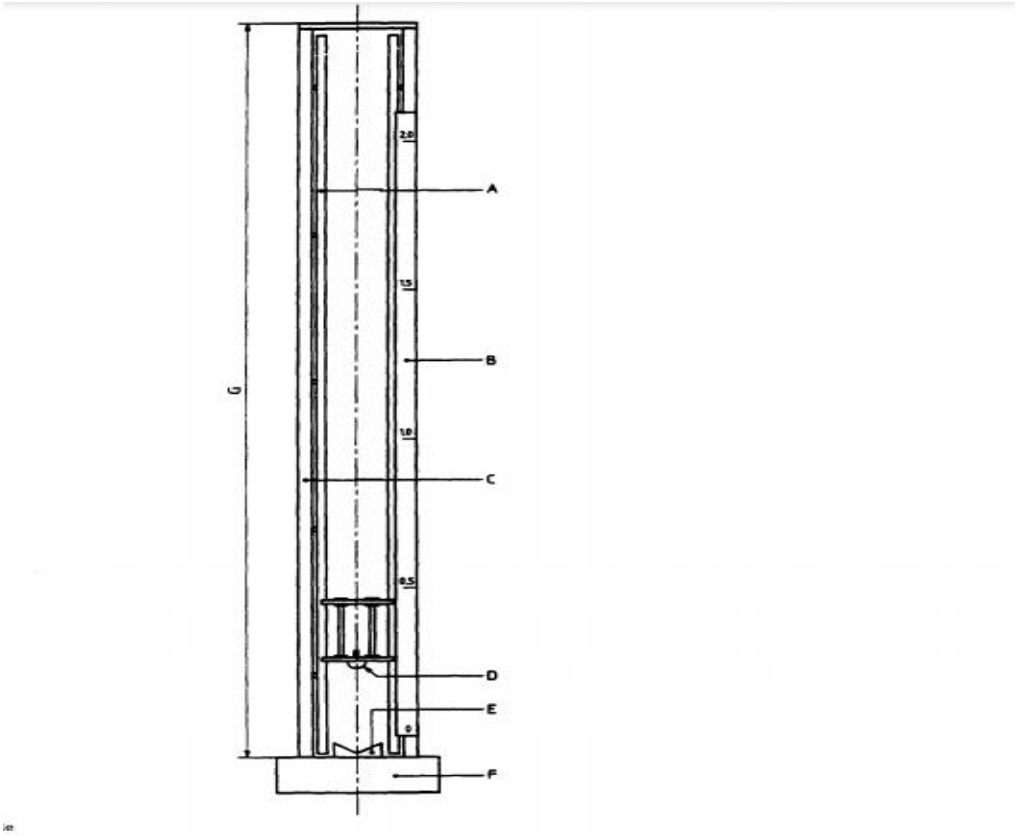


FIG. 28 TYPICAL IMPACT TESTING MACHINE

A-Guide
B-Graduated scale, vertically adjustable for different sizes of pipe
C-Main frame
D-Striker
E-Steel block 120·, V-shaped or flat [*see* c) of **C-4.1**]
F-Solid base
G-Sufficient to give a clear height from striker to pipe of at least 2 m

C-5 TEST PIECES

C-5.1 Preparation

The test pieces shall be cut from pipes selected at random. In the case of pipes having longitudinal seam lines, the seam lines (*see* Note) shall be marked, e.g. with different colors, before the pipe is cut as follows.

NOTE — When pipes are continuously molded between two running molds, lines are formed in the longitudinal direction of the pipe which are called seam lines.

For each test piece, the length shall be (200 ± 10) mm. The cut ends shall be square to the axis of the pipe, clean and free from damage. For helically ribbed pipes the cut end of the helical rib shall be rounded off in order to eliminate any sharp edges.

C-5.2 Number

Unless otherwise specified by the referring standard, up to 50 test pieces shall be used as follows:

a) for a given striker mass, up to 10 test pieces may be used for the preliminary test procedure (*see* **C-7.2**) to determine the drop height which provokes the first failure;
b) At least 20 test pieces are used for the main test procedure (*see* **C-7. 3**).

NOTE — Only one blow is made per test piece.

C-6 CONDITIONING

Condition the test pieces in a liquid bath or air for not less than the applicable period given in Table 26 where that period shall commence when the temperature of the conditioning medium has returned to the specified temperature if disturbed by the introduction of the test piece. The wall thickness et shall be determined as follows:

a) For pipes with smooth inside and outside surfaces the wall thickness et of the pipe shall be the total wall thickness through the pipe section.
b) For pipes which are corrugated or ribbed externally the wall thickness et shall be the minimum wall thickness between inside and outside surfaces both in contact with the conditioning fluid.

Table 26 Conditioning Periods

(*Clause* C-6)

Sl No.	Wall Thickness, e_t mm	Conditioning Period (min)	
		Liquid Bath	Air
(1)	(2)	(3)	(4)
i)	$e_t \leq 8.6$	15	60
ii)	$8.6 < e_t \leq 14.1$	30	120
iii)	$14.1 < e_t$	60	240

In the case of dispute over results a liquid bath shall be used.

C-7 PROCEDURE

C-7.1 General

Conduct the procedures given in **C-7.2** and **C-7.3** in accordance with the following criteria, as applicable:

a) The striker shall have a mass selected from Table 25, either as specified in the referring standard or, if not thus specified, such that the H50 value is between 0.5 m and 2.0 m;

b) Each test piece shall be struck only once, either at random or on a generatrix, as specified by the referring standard (*see* Clause 3). Unless the ambient

temperature is in the same range as the specified conditioning temperature, the impact shall occur within 10 s of the removal of the test piece from the conditioning environment.

If that 10 s interval is exceeded, the test piece shall be returned to the conditioning environment within a further 10 s for a minimum period of 5 min or shall otherwise be discarded or fully reconditioned.

c) Unless otherwise specified by the referring standard, the circumferential orientation of the test piece in the V-shaped support shall be random. For corrugated or ribbed pipe, if the pitch of the corrugation or ribs is more than 0.25 times the diameter d of the stem of the striker nose (*see* Fig. 29), the test piece shall be positioned so that the impact of the striker will be on the top of a corrugation or a rib.

NOTE — The referring standard may specify testing along one or more generatrices.

d) Unless otherwise specified by the referring standard, failure of a test piece shall comprise shattering or any crack or split on the inside of the pipe that was caused by the impact and that can be *see*n without magnification. Lighting devices may be used to assist in examining the test pieces. Indentation of the test piece or a crease on the surface shall not be taken as a failure;

e) For routine testing (e.g. batch release testing) of a product for which the H50 value is found to be at least 80 percent higher than the required minimum level, the preliminary test procedure (*see* **C-7.2**) may be omitted. The drop height for the first impact in the main test procedure shall be that corresponding to the H50 value obtained from a preceding batch from the same production run, rounded down to the next smaller 0.1 m.

NOTE — A convenient format for summarizing the procedure followed and results obtained is given in Fig. 30.

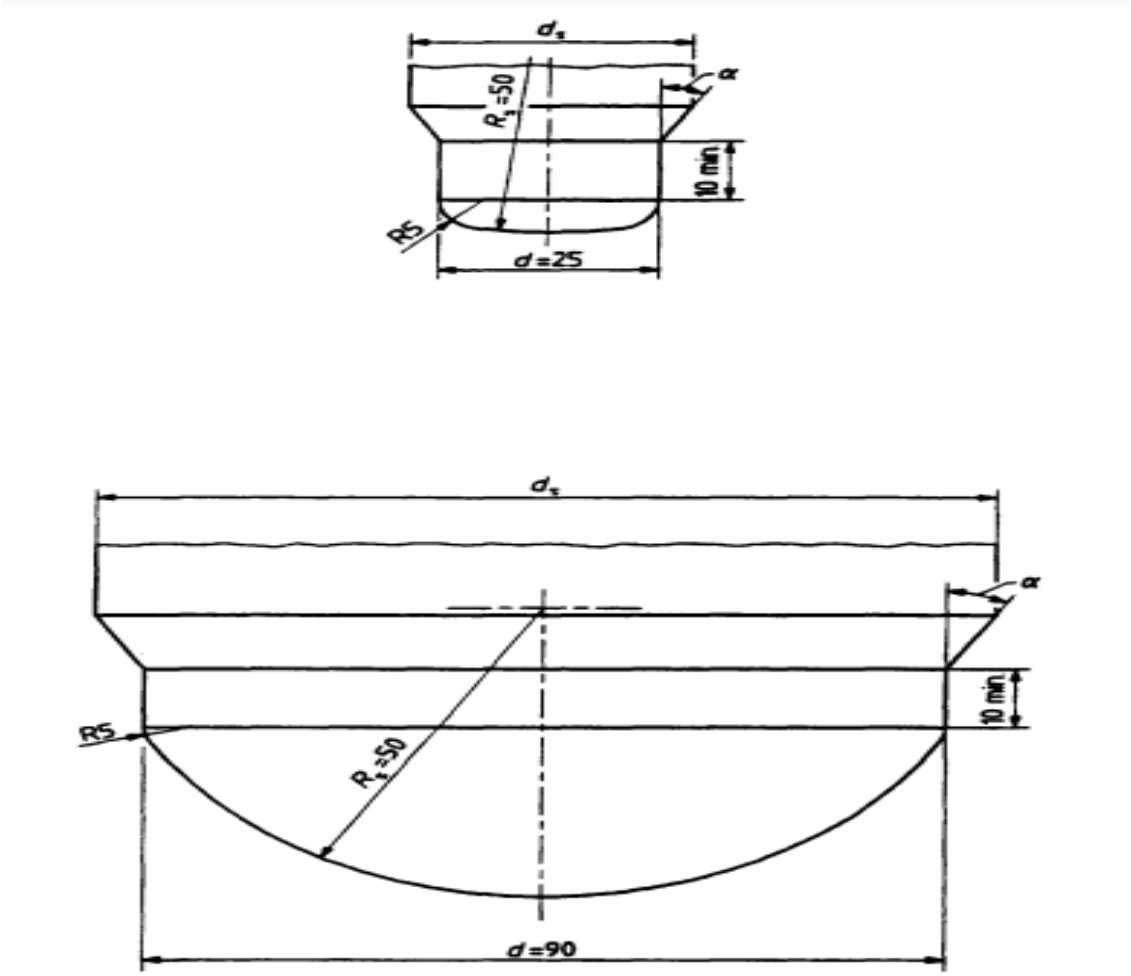
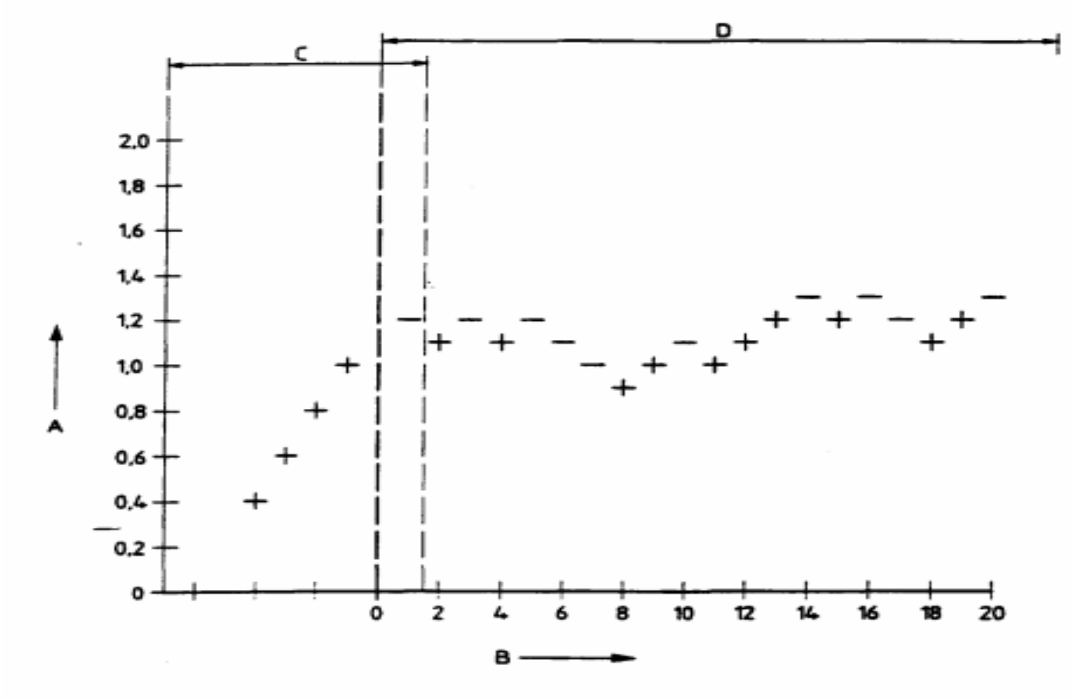


FIG. 29 DIMENSIONS OF STRIKER

C-7.2 Preliminary Test Procedure

NOTE — The purpose of the preliminary test procedure is to obtain a rough indication of the H50 value and to identify the first test piece from which the result will be used in the main test procedure (*see* C-7.3).



A Height in metres
B Number of blows
C Preliminary test procedure
D Main test procedure
+ Indicates a pass
- Indicates a failure

FIG. 30 TYPICAL RECORD FOR IMPACT TEST DATA, OBTAINED USING THE STAIRCASE METHOD (IN THIS EXAMPLE, THE H50 VALUE = L, 14 M.)

C-7.2.1 Set a drop height for the striker (*see* Clause 4) in accordance with one of the following criteria:

a) 50 percent of the specified H_{50} value for the pipe, if known, otherwise;
b) 0.5 m.

C-7.2.2 Remove a test piece from the conditioning environment and within 10 s position it on the appropriate support and subject the test piece to one impact by the striker.

Determine and record whether the test piece failed [*see* (d) of **C-7.1**]. If it did not fail, proceed in accordance with **C-7.2.5**. Otherwise, record the type of failure and proceed in accordance with **C-7.2.3** or **C-7.2.4**, as applicable.

C-7.2.3 If testing in accordance with a) of **C-7.2.1** and the first result is a failure, repeat **C-7.2.2** using the same drop height and another test piece.

If the second result is a pass proceed in accordance with **C-7.2.5**.

If the second result is a failure record the sample as not conforming to the specified value and proceed to Clause 9.

C-7.2.4 If testing in accordance with b) of **C-7.2.1** and the first result obtained is a failure, repeat **C-7.2.2** using a drop height of 0.30 m and another test piece.

If the second result is a pass proceed in accordance with **C-7.2.5**.

If the second result is a failure, if possible select a striker having the next lighter mass in accordance with Table 25 and recommence testing in accordance with **C-7.2.1**.

Otherwise, if already using a striker mass of 0.25 kg record the result and proceed to Clause 9.

C-7.2.5 Reset the striker drop height 0.2 m higher and test another test piece in accordance with **C-7.2.2**. If necessary, repeat this step until the first failure occurs.

Record the drop height for the first test piece that fails for use as the first test piece result for the main test procedure (*see* **C-7.3**)

If the drop height has reached 2 m without failure, select the striker having the next greater mass in accordance with Table 25 and recommence testing in accordance with **C-7.2.1** (*see* a) of **C-5.2**).

C-7.3 Main Test Procedure

C-7.3.1 Record as the striker drop height for the first result that height obtained in accordance with e) of **C-7.1** or with **C-7.2**, as applicable.

Set the striker drop height 0.1 m lower than that thus recorded.

C-7.3.2 Remove a test piece from the conditioning environment and within 10 s position it on the appropriate support and subject the test piece to one impact by the striker. Determine and record whether and how the test piece failed [*see* d) of **C-7.1**] and proceed to **C-7.3.3**.

C-7.3.3 If the result obtained in accordance with **C-7.3.2** was a failure, reset the striker drop height 0.1 m lower, otherwise reset it 0.1 m higher, and test another test piece in accordance with **C-7.3.2**.

C-7.3.4 Repeat the procedure given in **C-7.3.3** until one of the following conditions is satisfied, as applicable.

a) For routine testing of a product in accordance with e) of **C-7.1**, proceed until ten test pieces have been tested. If six or more failures have been found, test a further ten test pieces and proceed in accordance with c) as follows. Otherwise stop testing and proceed to Clause 8.
b) If following preliminary testing in accordance with **C-7.2**, proceed until 20 test pieces have been tested, including the first failure in accordance

with **C-7.2.5**. and proceed in accordance with c) as follows. c) If less than eight failures or less than eight passes are found, extend the test to a total of 40 test pieces by striking a further 20 test pieces in accordance with **C-7.3.2**. Otherwise stop testing. Proceed to Clause 8.

C-8 CALCULATIONS

Calculate to the nearest 0.01 m the arithmetic mean of the drop heights recorded during the main test procedure.

NOTE — The confidence limits of the calculated mean value H_{50} may be obtained by calculation in accordance with C-7.3.3 of ISO 6603-1:1985.

If more than three passes are obtained using the maximum height and striker mass of the testing apparatus, the H_{50} value is greater than the average so calculated.

C-9 TEST REPORT

The test report shall include the following information:

a) A reference to this standard and to the referring standard;
b) The full identification of the pipe under test, including application, material, dimensions;
c) The method of sampling;
d) The numbers of test pieces used for the preliminary and main test procedures, respectively;
e) The conditioning medium and its temperature, in degrees Celsius;
f) The type of striker and its mass, in kilograms;
g) If applicable, details of other failure criteria [*see* (e) of **C-7.1**];
h) The minimum and the maximum drop heights found during the main test procedure or the drop height used if testing was stopped in accordance with **C-7.2.3** and **C-7.2.4**;
j) The H50 value;
k) Any factors which may have affected the results, such as any incidents or any operating details not specified in this standard; and
m) The date of test.

ANNEX D

(Reference Clause no. 8.4)

D-1 The fitting specimen shall be conditioned for a least 30 min at a temperature of 0±1°C.The specimen shall be dropped freely in random position, from height of 1m for DN 75mm to 125 mm and 500 mm for DN above 125mm onto a flat concrete floor, within 10 s of being removed from the conditioning chamber.

D-2 The specimen shall be examined for breaks or cracks.

Note: In the context of this test ‘damage’ means any visible split or any complete breakage in the body of the fitting. Surface scratches, scuffing or chipping of edges which may occur in the test does not constitute damage.