

IAPMO IGC 345-

2020a2024



PUBLIC REVIEW DRAFT

Industry Standard for

**Polypropylene (PP) DWV Pipe with or
without a Mineral Filled Core and PP
Fittings**



IAPMO Standard

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Contents

Preface

IAPMO Standards Review Committee

1 Scope

- 1.1 General
- 1.2 Alternative Materials
- 1.3 Terminology
- 1.4 Units of Measurement

2 Reference Publications

3 Definitions and Abbreviations

- 3.1 Definitions
- 3.2 Abbreviations

4 General Requirements

- 4.1 Materials
- 4.2 Dimensions
- 4.3 Workmanship
- 4.4 Elastomeric Joints

5 Testing Requirements for PP Pipe

- 5.1 Melt Flow Rate Index Test
- 5.2 Impact Strength Test
- 5.3 Pipe Stiffness Test
- 5.4 Pipe Flattening Test

6 Testing Requirements for PP Fittings

- 6.1 Melt Flow Rate Index Test for Fittings
- 6.2 Impact Strength Test
- 6.3 Heat Reversion Test
- 6.4 Fitting Stiffness Test

7 Markings and Accompanying Literature

Preface

This is the ~~fourth~~fifth edition of IAPMO IGC 345, Polypropylene (PP) DWV Pipe with or without a Mineral Filled Core and PP Fittings. This Standard supersedes IAPMO 345-2020a, Polypropylene (PP) DWV Pipe with or without a Mineral Filled Core and PP Fittings. The previous editions of this standard are: September 2018, July 2019, ~~and~~ April 2020, and August 2020.

This Standard was developed by the IAPMO Standards Review Committee (SRC) in accordance with the policies and procedures regulating IAPMO industry standards development, Policy S-001, Standards Development Process. This Standard was approved as an IAPMO Industry Standard on August 10, 2020~~2024~~.

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 - (c) *an explanation of circumstances surrounding the actual field conditions; and*
 - (d) *the request for interpretation phrased in such a way that a "yes" or "no" answer will address the issue.*

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IAPMO IGC 345-~~2020a~~2024

Polypropylene (PP) DWV Pipe with or without a Mineral Filled Core and PP Fittings

1 Scope

1.1 General

1.1.1 This Standard covers DN 40 to DN 200 or 1-1/2 to 8 NPS polypropylene drain, waste and vent (DWV) pipe with or without a mineral filled core and polypropylene fittings intended for use in commercial and residential applications and specifies requirements for materials, physical characteristics, performance testing, and markings.

1.1.2 PP pipe and fittings covered by this standard include:

- (a) Joints
 - i. integral elastomeric ring seal socket; and
 - ii. butt fusion;
- (b) PP pipes and fittings joined with components of other plastic and non-plastic materials;
- (c) Soil and waste discharge pipework for the conveyance of domestic waste waters (low and high temperature);
- (d) ventilation pipework associated with; and
- (e) rainwater pipework within the building structure.

1.2 Alternative Materials

The requirements of this Standard are not intended to prevent the use of alternative materials or methods of construction provided such alternatives meet the intent and requirements of this Standard.

1.3 Terminology

In this Standard,

- (a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
- (b) “should” is used to express a recommendation, but not a requirement;
- (c) “may” is used to express an option or something permissible within the scope of the Standard; and
- (d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.4 Units of Measurement

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

2 Reference Publications

This Standard refers to the following publications and, where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

ASTM International

ASTM D792

Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

ASTM D1238

Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

ASTM D2122

Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM D2444

Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

ASTM D2412

Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

ASTM D3212

Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3311

Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns

ASTM F477

Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F610/F610M

Standard Practice for Evaluating the Quality of Molded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fitting by the Heat Reversion Technique

ASTM F2389

Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

3 Definitions and Abbreviations

3.1 Definitions

The following definitions shall apply in this Standard:

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

Homopolymer — A polymer derived from one species of monomer.

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 reprocessible or recyclable material has been added.

Own Reprocessable Material — Material prepared from rejected unused pipes or fittings, including trimmings from the production of pipes and fittings, that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as molding or extrusion, and for which the complete formulation is known.

External Reprocessable Material — Material comprising either one of the following forms:

- (a) material from rejected unused pipes or fittings or trimmings therefrom, that will be reprocessed and that were originally processed by another manufacturer;
- (b) material from the production of unused PP-products other than pipes and fittings, regardless of where they are manufactured.

Recyclable Material — Material comprising either one of the following forms:

- (a) material from used pipes or fittings which have been cleaned and crushed or ground;
- (b) material from used PP-products other than pipes or fittings which have been cleaned and crushed or ground.

3.2 Abbreviations

The following abbreviations apply in this Standard:

MFR	—	Melt Flow Rate
PP	—	Polypropylene
PP-C	—	Polypropylene Copolymer
PP-H	—	Polypropylene Homopolymer
PP-M	—	Polypropylene Mineral Filled

4 General Requirements

4.1 Materials

4.1.1 Compound

The compound for pipes and fittings covered by this standard shall be a polypropylene base material (homopolymer or copolymer) to which is included additives to facilitate the manufacturing process and mineral filling for use in the core.

4.1.2 Reprocessable and Recyclable Material

In addition to virgin material, the use of the manufacturers own reprocessible material obtained during the production and testing of products conforming to this standard shall be permitted. Reprocessible or recyclable material from external sources (i.e. external reprocessible material) shall not be used.

4.1.3 Class and Melt Flow Rate (MFR)

4.1.3.1 The base material of the pipe and fittings shall be tested and categorized in accordance with the intended use and/or class specified in Sections 5.1, 6.1 and Table 1.

4.1.3.2 Pipes and fittings intended for mechanical joining, (e.g. with integral elastomeric ring seal socket) shall only be joined together with pipe and fittings that are similarly classed for mechanical joining.

4.1.3.3 Pipe and fittings intended to be assembled using butt fusion joints shall only be joined with similarly classed pipe and fittings as found through the results of the MFR test specified in Section 5.1 and Table 1.

4.1.4 Density

The density of the compound of the pipe and fittings shall be a minimum of 1.5 g/cc (94 lb/ft³) when measured in accordance with ASTM D792.

4.2 Dimensions

PP Pipe and fitting dimensions shall comply with Appendix A, ASTM F2389, ASTM D3311 or other applicable national standards.

4.3 Workmanship

4.3.1 Appearance

When viewed without magnification the internal and external surfaces of pipes and fittings shall be smooth, clean and free from grooving, blistering, impurities, pores and any other surface irregularities.

4.3.2 Pipe Ends

Pipe ends shall be cleanly cut and the ends of pipes and fittings shall be square to each axis.

4.3.3 Color

PP pipes and fittings covered by this standard shall be uniformly colored throughout their entire thickness.

4.4 Elastomeric Joints

Elastomeric joints shall comply with the applicable testing requirements specified in ASTM D3212.

5 Testing Requirements for PP Pipe

5.1 Melt Flow Rate Index Test

5.1.1 Test Procedure

The melt flow rate (MFR) index test shall be conducted in accordance with ASTM D1238, Test method A, under the following conditions:

- (a) Test temperature of 230°C (446°F); and
- (b) Loading mass of 2.16 kg (4.762 lbs).

5.1.2 Performance Requirement

The MFR of pipe shall be:

- (a) ≤ 3.0 g/10 min (0.007 lbs/10 min) for pipe and fittings used with integral elastomeric ring seal socket or mechanical joints; and
- (b) as specified in Table 1 for pipe and fittings used for butt fusion joints.

5.2 Impact Strength Test

5.2.1 Test Apparatus

The test apparatus shall consist of a:

- (a) Tup impact tester;
- (b) 5 Kg (12 lb) mass for testing sizes ≤ 4 NPS;
- (c) 10 Kg (20 lb) mass for testing sizes > 4 NPS;
- (d) Tup A; and
- (e) Holder B

5.2.2 Test Procedure

The impact resistance test shall be conducted in accordance with ASTM D2444 and as follows:

- (a) Condition the test specimens at 0°C (32°F) for at least 1 hr prior to testing;
- (b) Conduct the impact test under ambient laboratory conditions as soon as possible or within 60 s of removing the test specimen from the conditioning environment;
- (c) Secure the test specimen in the holder;
- (d) Apply an impact force as specified in Table 2, using a:
 - (i) 5 Kg (12 lb) mass for testing pipe sizes ≤ 100 DN or 4 NPS;
 - (ii) 10 Kg (20 lb) mass for testing sizes > 100 DN or 4 NPS.
- (e) Test 10 specimens.
 - (i) When 9 or 10 specimens pass, accept the lot.
 - (ii) When 4 or more specimens fail, reject the lot.
- (f) When 2 or more specimens of 10 fail, test 10 additional specimens.
 - (i) When 17 of 20 specimens tested pass, accept the lot.
 - (ii) When 7 or more of 20 fail, reject the lot.
- (g) When 4, 5 or 6 of 20 fail, test 20 additional specimens.
 - (i) When 32 of 40 specimen pass, accept the lot.
 - (ii) When 9 or more of 40 specimens fail, reject the lot.

5.2.3 Performance Requirement

The pipe shall not shatter or have any cracks or breaks extending entirely through the pipe wall visible to the unaided eye.

5.3 Pipe Stiffness Test

5.3.1 Test Procedure

The pipe stiffness test procedure shall be conducted in accordance with ASTM D2412 except the rate of cross head motion shall be 5.1 to 6.3 mm/min (0.20 to 0.25 in/min). Deform the pipe to 5 + 0.5% deflection.

5.3.2 Performance Requirements

The minimum stiffness values at 5% deflection shall equal or exceed the requirements specified in Table 3.

5.4 Pipe Flattening Test

5.4.1 Test Procedure

The pipe flattening test shall be conducted in accordance with ASTM D2412 except the rate of cross head motion shall be 5.1 to 6.3 mm/min (0.20 to 0.25 in/min). Deform the pipe to 25+0.5% deflection.

5.4.2 Performance Requirement

The test specimen shall not shatter, or have any cracks or breaks extending entirely through the pipe wall visible to the unaided eye when deflected 25%.

6 Testing Requirements for PP Fittings

6.1 Melt Flow Rate Index Test for Fittings

6.1.1 Test Procedure

The melt flow rate (MFR) index test shall be conducted in accordance with ASTM D1238, Test method A, under the following conditions:

- (a) Test temperature of 230°C (446°F); and
- (b) Loading mass of 2.16 kg (4.762 lbs).

6.1.2 Performance Requirement

The MFR of fittings shall be:

- (a) 3.0 g/10 min (0.007 lbs/10 min) for pipe and fittings used with integral elastomeric ring seal socket or mechanical joints; and
- (b) as specified in Table 1 for pipe and fittings used for butt fusion joints.

6.2 Impact Strength Test

6.2.1 Test Apparatus

The test apparatus shall consist of a:

- (a) Tup impact tester
- (b) 5 Kg (12 lb) mass;
- (c) Tup C; and
- (d) Holder B

6.2.2 Test Procedure

The impact resistance test shall be conducted in accordance with ASTM D2444 and as follows:

- (a) Subject three fittings to a minimum impact of 27 J (20 ft•lbf) under ambient laboratory conditions; and
- (b) Bushings, increasers and closet flanges are exempt from this requirement.

6.2.3 Performance Requirement

The fittings shall not shatter, develop any cracks or breaks which extend entirely through the pipe wall and visible to the unaided eye.

6.3 Heat Reversion Test

6.3.1 Test Procedure

The heat reversion test shall be conducted in accordance with ASTM F610/F610M under the following conditions:

- (a) Test temperature of $150 \pm 3^{\circ}\text{C}$ ($302 \pm 5.4^{\circ}\text{F}$); and
- (b) Exposure time of 30 min.

6.3.2 Performance Requirement

The effect of heating shall not cause the following:

- (a) Penetration of the wall resulting from weld line separation, gate flaw or surface peeling such that the combined penetration of the two sides exceeds 25% of the original thickness; and
- (b) Delamination or peeling over more than 25% of the fitting surface area.

Note: Moldings that are used for fabricated fittings may be tested separately.

6.4 Fitting Stiffness Test

6.4.1 Test Procedure

The fitting stiffness test procedure shall be conducted in accordance with ASTM D2412 except the rate of cross head motion shall be 5.1 to 6.3 mm/min (0.20 to 0.25 in/min). Apply a minimum load of 11 kN/m (750 lbf/ft) of centerline length to the fitting.

6.4.2 Performance Requirements

There shall be no visible evidence of cracking or failure.

7 Markings and Accompanying Literature

- 7.1** PP pipe and fittings complying with this Standard shall be marked with the:
- Manufacturer's name and/or trademark;
 - Nominal size;
 - IAPMO standard designation (i.e., "IAPMO IGC 345");
 - Material (e.g., "PP" "PP-H", "PP-M", "PP-C")
 - Intended application (i.e., "DWV");
 - For pipe and fittings intended for butt fusion the MFR Class; and
 - Date or date code of manufacture
- 7.2** PP pipe complying with this standard shall be marked in letters not less than 5 mm (3/16 in) high, in a contrasting color, spaced at intervals of not more than 1.5 m (5 ft).
- 7.3** Markings shall be permanent, legible, and visible after installation.

Table 1
Class and Melt Flow Rate Performance Requirements
(See Sections 4.1.3.1, 4.1.3.3, 5.1.2 and 6.1.2)

Class	MFR g/10 min (lbs/10 min)
A	≤ 0.3 g/10 min (0.0007 lbs/10 min)
B	≤ 0.6 g/10 min (0.0013 lbs/10 min)
C	≤ 0.9 g/10 min (0.0020 lbs/10 min)
D	≤ 1.5 g/10 min (0.0033 lbs/10 min)

Table 2
Impact Resistance
(See Section 5.2.2)

DN	NPS	Minimum Impact Resistance J (ft·lbf)
		At 32°F (0°C)
40	1.5	27 (20)
50	2.0	41 (30)
58	2.3	54 (40)
63	2.5	54 (40)
75	3.0	54 (40)
90	3.5	54 (40)
110	4.0	54 (40)
125	5.0	54 (40)
160	6.0	54 (40)
200	8.0	54 (40)

Table 3
Pipe Stiffness
 (See Section 5.3.2)

DN	NPS	Minimum Pipe Stiffness at 5% Deflection	
		Lbf/in ²	N/mm ²
40 (1.575)	1.5	80	0.55
50 (1.969)	2.0	280	1.93
58 (2.283)	2.3	230	1.59
63 (2.480)	2.5	200	1.38
75 (2.953)	3.0	160	1.10
90 (3.543)	3.5	140	0.965
110 (4.331)	4.0	100	0.69
125 (4.921)	5.0	50	0.34
160 (6.299)	6.0	30	0.21
200 (7.874)	8.0	20	0.14

Appendix A (Normative)

Geometric Characteristics of PP DWV Pipe and Fittings with a Mineral Filled Core

A.1 General

Dimensions shall be measured in accordance with ASTM D2122. The figures indicated in this Appendix are schematic sketches only, to indicate the relevant dimensions. They do not necessarily represent the manufactured components.

A.2 Definitions and Symbols

A.2.1 Definitions

The following definitions shall apply in this Annex:

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.

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 (0.004 inch)

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.

nominal outside diameter (d_n) — The specified outside diameter, in millimeters, assigned to a nominal size DN/OD.

nominal size DN — A numerical designation of the size of a component, which is approximately equal to the manufacturing dimension, in millimeters.

nominal size DN/OD — Nominal size, related to the outside diameter.

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 (0.004 inch)

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

A.2.2 Symbols

A	length of engagement
B	lead of lead-in
C	depth of sealing zone
DN	nominal size
DN/OD	nominal size, outside diameter related
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
e_2	wall thickness of a socket
e_3	wall thickness in the groove area
l	effective length of a pipe
l_1	length of spigot
R	radius of swept fittings
z	z-lengths of fitting
α	nominal angle of a fitting

A.3 Dimensions of pipes

A.3.1 Outside Diameters

The mean outside diameter, d_{em} , shall conform to Table A.1 as applicable.

A.3.2 Effective Length

The effective length of a pipes l shall not be less than that declared by the manufacturer and shall be measured as shown in Figure A.1.

A.3.3 Chamfering

If a chamfer is required, the angle of chamfering shall be between 15° and 45° to the axis of the pipe (see Figure A.3). When pipes without chamfer are used, the pipe ends shall be deburred.

The remaining wall thickness of the end of the pipe shall be at least 1/3 of e_{min} .

A.3.4 Wall Thickness

The wall thickness e shall conform to Table A.2, as applicable, where for metric series a maximum wall thickness at any point up to $1.25e_{min}$ is permitted, provided that the mean wall thickness e_m is less than or equal to the specified $e_{m, max}$

Table A.1
Mean Outside Diameters of Pipes
Dimensions in mm (in)
 (See Sections A.3.1, A.4.1)

Nominal Size DN/OD	Nominal outside diameter d_n	Mean outside diameter	
		$d_{em, min}$	$d_{em, max}$
40 (1.575)	40 (1.575)	40.0 (1.575)	40.3 (1.587)
50 (1.969)	50 (1.969)	50.0 (1.969)	50.3 (1.980)
58 (2.283)	58 (2.283)	58.0 (2.283)	58.3 (2.295)
63 (2.480)	63 (2.480)	63.0 (2.480)	63.3 (2.492)
75 (2.953)	75 (2.953)	75.0 (2.953)	75.4 (2.968)
90 (3.543)	90 (3.543)	90.0 (3.543)	90.4 (3.559)
110 (4.331)	110 (4.331)	110.0 (4.331)	110.4 (4.346)
125 (4.921)	125 (4.921)	125.0 (4.921)	125.4 (4.937)
160 (6.299)	160 (6.299)	160.0 (6.299)	160.5 (6.319)
200 (7.874)	200 (7.874)	200.0 (7.874)	200.6 (7.898)

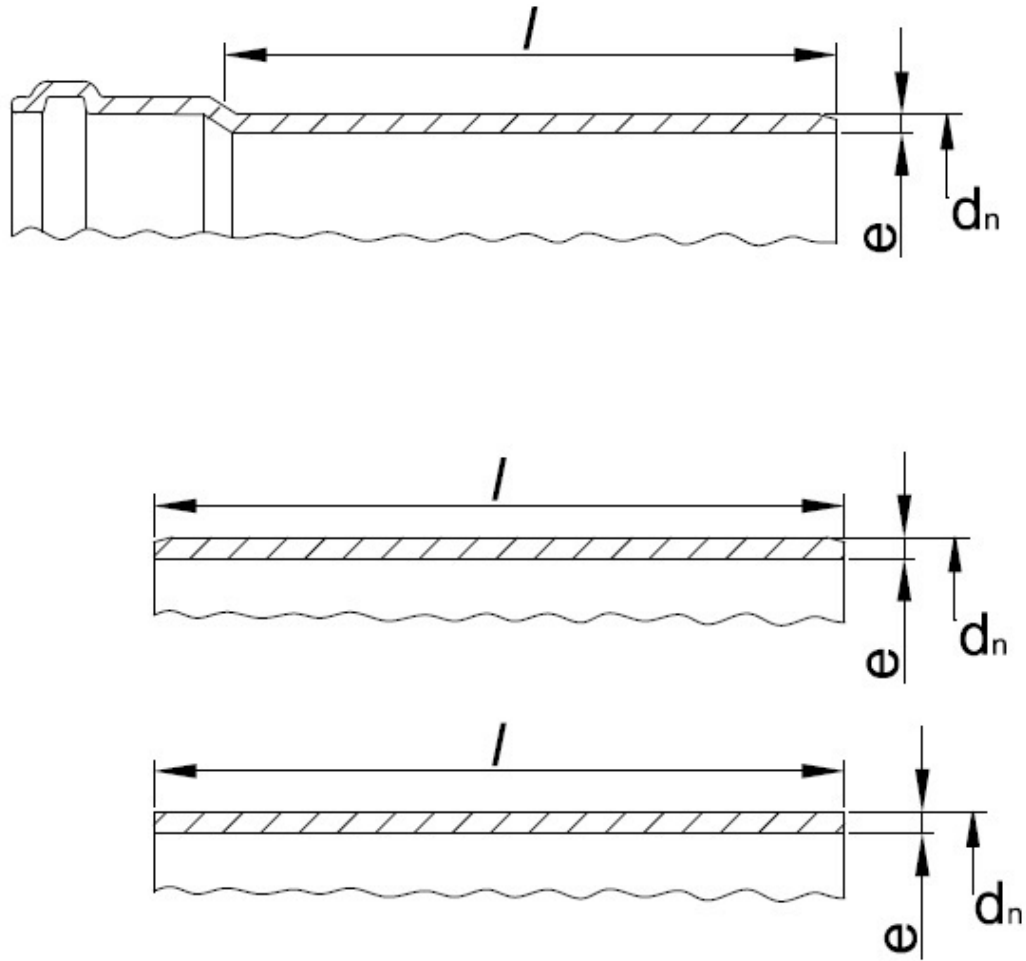


Figure A.1
Effective Length of Pipes
(See Section A.3.2)

Table A.2
Wall Thickness of Pipes
(See Section A.3.4)

Nominal Size DN (in)	Nominal outside diameter d_n	e_{min}	$e_{m,max}$
40 (1.575)	40 (1.575)	2.20 (0.086)	2.50 (0.098)
50 (1.969)	50 (1.969)	4.00 (0.157)	4.60 (0.181)
58 (2.283)	58 (2.283)	4.00 (0.157)	4.60 (0.181)
63 (2.480)	63 (2.480)	4.00 (0.157)	4.60 (0.181)
90 (3.543)	90 (3.543)	4.50 (0.177)	5.15 (0.203)
75 (2.953)	75 (2.953)	4.50 (0.177)	5.15 (0.203)
110 (4.331)	110 (4.331)	5.30 (0.209)	6.05 (0.238)
125 (4.921)	125 (4.921)	5.30 (0.208)	6.05 (0.238)
160 (6.299)	160 (6.299)	5.30 (0.209)	6.05 (0.238)
200 (7.874)	200 (7.874)	6.20 (0.244)	7.00 (0.276)

A.4 Dimensions of Fittings

A.4.1 Outside Diameters

The mean outside diameter d_{em} of the spigot end shall conform to Table A.1, as applicable.

A.4.2 z-lengths

The z-length(s) of fittings (see Figures A.6 to A.19) shall be given 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.

A.4.3 Wall Thickness

The minimum wall thickness e_{min} , of the body or the spigot end of a fitting shall conform to Table A.3, as applicable, except that a reduction of 5% 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 A.3, as applicable.

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 Figure A.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 $e_{3\text{ min}}$ as given in Table A.7, as appropriate for the pipe.

Table A.3
Wall Thickness of Fittings
Dimensions in Millimeters (inches)
(See Sections A.4.3)

Nominal Size DN/OD	Nominal outside diameter d_n	Wall Thickness	
		e_{min}	$e_{\text{n,max}}$
40 (1.575)	40 (1.575)	2.00 (0.078)	2.50 (0.098)
50 (1.969)	50 (1.969)	4.00 (0.157)	4.60 (0.181)
58 (2.283)	58 (2.283)	4.00 (0.157)	4.60 (0.181)
63 (2.480)	63 (2.480)	4.00 (0.157)	4.60 (0.181)
75 (2.953)	75 (2.953)	4.50 (0.177)	5.15 (0.203)
90 (3.543)	90 (3.543)	4.50 (0.177)	5.15 (0.203)
110 (4.331)	110 (4.331)	5.30 (0.209)	6.05 (0.238)
125 (4.921)	125 (4.921)	5.30 (0.208)	6.05 (0.238)
160 (6.299)	160 (6.299)	5.30 (0.209)	6.05 (0.238)
200 (7.874)	200 (7.874)	6.20 (0.244)	7.00 (0.276)

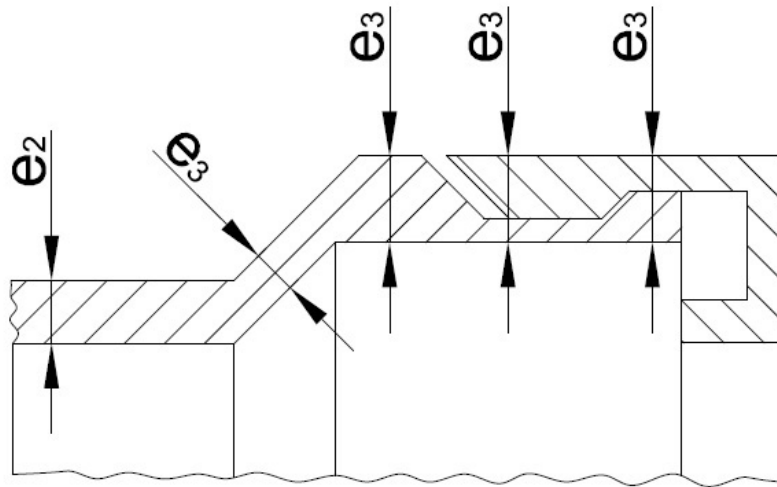


Figure A.2
Example for Calculation of the Wall Thickness of Socket with Retaining Cap
(See Section A.4.3)

A.5 Dimensions of Sockets and Pipe Ends

A.5.1 Dimensions of Ring Seal Sockets and Spigot Ends

A.5.1.1 Diameters and Lengths

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

- 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 Figure A.5 as an example). This point shall give a full sealing action.
- Where sealing rings are firmly retained, requirements for dimension B (see Figure A.4) do not apply.

Different designs of ring seal sockets (see Figure A.4) are permitted, provided the joints conforms to the requirements given in Section A.5.1.

A.5.1.2 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 A.6 and Table A.7 as applicable.

A.5.2 Dimensions of Pipe Ends for Butt Fusion Joints

The mean outside diameter d_{em} and the wall thickness e of pipes with plain ends intended to be used for butt fusion joints shall conform.

Table A.4
Dimension of Ring Seal Sockets and Spigot Ends of Pipes
Dimensions in Millimeters (inches)

(See Section A.5.1.1)

Nominal Size DN/OD	Nominal outside diameter d_n	Socket				
		$d_{sm, min}$	$d_{sm, max}$	A_{min}	B_{min}	C_{max}
40 (1.575)	40 (1.575)	40.30 (1.587)	41.10 (1.618)	28.50 (1.122)	5.00 (0.197)	14.50 (0.571)
50 (1.969)	50 (1.969)	50.50 (1.988)	51.30 (2.020)	30.50 (1.201)	6.00 (0.236)	20.00 (0.787)
58 (2.283)	58 (2.283)	58.30 (2.295)	59.10 (2.327)	31.00 (1.220)	6.00 (0.236)	20.00 (0.787)
63 (2.480)	63 (2.480)	63.40 (2.500)	64.20 (2.528)	31.50 (1.240)	7.70 (0.303)	19.70 (0.776)
75 (2.953)	75 (2.953)	75.50 (2.972)	76.40 (3.008)	33.00 (1.299)	6.00 (0.236)	20.00 (0.787)
90 (3.543)	90 (3.543)	90.50 (3.563)	91.4 (3.598)	34.00 (1.338)	6.00 (0.236)	20.00 (0.787)
110 (4.331)	110 (4.331)	110.50 (4.350)	111.40 (4.386)	35.50 (1.398)	7.50 (0.295)	23.00 (0.906)
125 (4.921)	125 (4.921)	125.40 (4.937)	126.40 (4.976)	38.40 (1.512)	8.90 (0.350)	50.10 (1.972)
160 (6.299)	160 (6.299)	160.80 (6.331)	161.80 (6.370)	43.50 (1.713)	10.00 (0.394)	35.00 (1.378)
200 (7.874)	200 (7.874)	200.80 (7.905)	201.80 (7.945)	51.00 (2.008)	12.00 (0.472)	40.00 (1.575)

Table A.5
Dimension of Ring Seal Sockets and Spigot Ends of Fittings
Dimensions in Millimeters (inches)

(See Section A.5.1.1)

Nominal Size DN/OD	Nominal outside diameter d_n	Socket				
		$d_{sm, min}$	$d_{sm, max}$	A_{min}	B_{min}	C_{max}
40 (1.575)	40 (1.575)	40.30 (1.587)	41.10 (1.618)	29.00 (1.142)	5.00 (0.197)	15.00 (0.591)
50 (1.969)	50 (1.969)	50.30 (1.980)	51.10 (2.012)	30.50 (1.201)	6.00 (0.236)	19.50 (0.768)
58 (2.283)	58 (2.283)	58.30 (2.295)	59.10 (2.327)	31.00 (1.220)	6.00 (0.236)	20.00 (0.787)
63 (2.480)	63 (2.480)	63.30 (2.500)	64.30 (2.528)	31.50 (1.240)	7.70 (0.303)	20.00 (0.787)
75 (2.953)	75 (2.953)	75.30 (2.965)	76.40 (3.008)	33.00 (1.299)	6.00 (0.236)	20.00 (0.787)
90 (3.543)	90 (3.543)	90.30 (3.555)	91.4 (3.598)	33.00 (1.299)	6.00 (0.236)	21.0 (0.827)
110 (4.331)	110 (4.331)	110.30 (4.343)	111.60 (4.394)	35.50 (1.402)	7.50 (0.295)	23.00 (0.906)
125 (4.921)	125 (4.921)	125.40 (4.937)	126.40 (4.957)	38.50 (1.516)	8.90 (0.350)	30.00 (1.181)
160 (6.299)	160 (6.299)	160.50 (6.319)	161.50 (6.358)	43.10 (1.697)	10.00 (0.394)	35.00 (1.378)
200 (7.874)	200 (7.874)	200.50 (7.894)	201.80 (7.945)	50.70 (1.996)	12.00 (0.472)	40.00 (1.575)

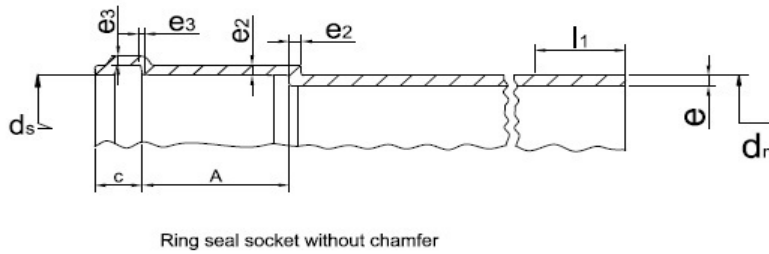
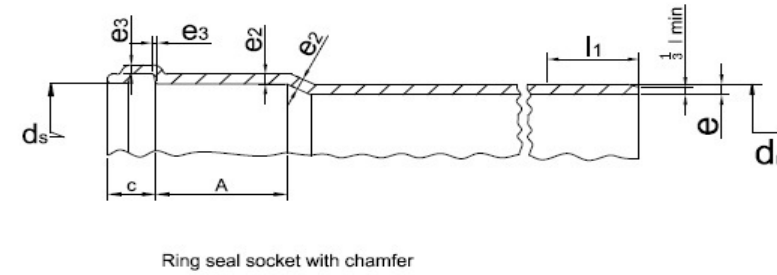


Figure A.3
Dimension of Socket and Spigot Ends for Ring Seal Joints
 (See Sections A.3.3, and A.5.1.1)

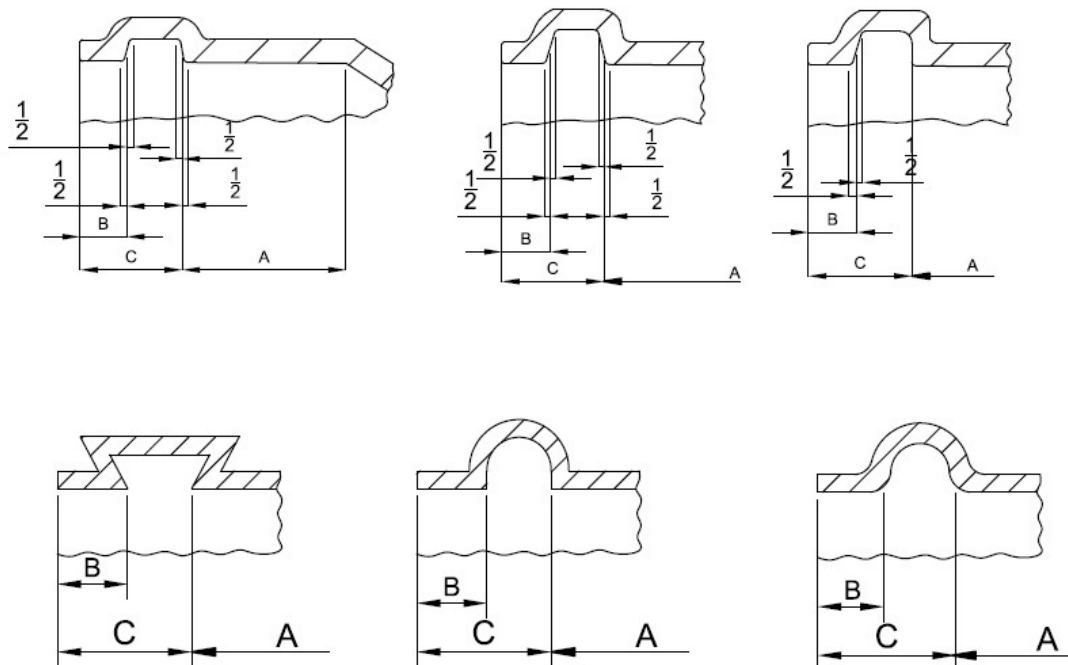


Figure A.4
Typical Groove Designs for Ring Seal Sockets
 (See Section A.5.1.1)

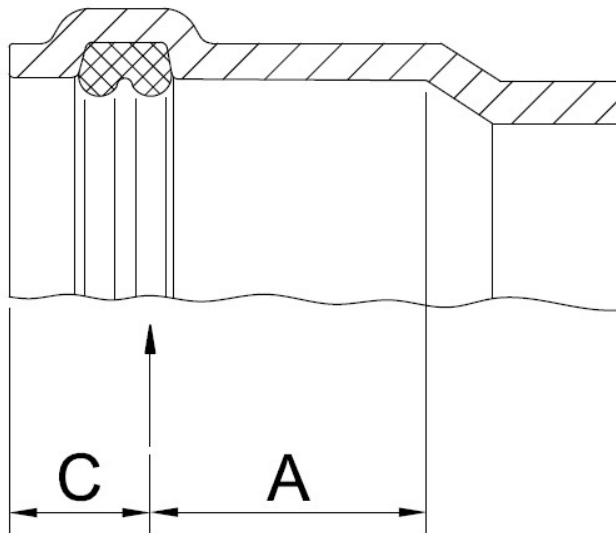


Figure A.5
Effective Sealing Point
 (See Section A.5.1.1)

Table A.6
Wall Thickness of Sockets of Pipes
Dimensions in Millimeters (inches)
 (See Section A.5.1.2)

Nominal Size DN/OD	Nominal outside diameter d_n	$e_{2,min}$	$e_{3,min}$
40 (1.575)	40 (1.575)	2.00 (0.079)	1.60 (0.063)
50 (1.969)	50 (1.969)	3.60 (0.142)	2.90 (0.114)
58 (2.283)	58 (2.283)	3.60 (0.142)	2.90 (0.114)
63 (2.480)	63 (2.480)	3.60 (0.142)	2.90 (0.114)
75 (2.953)	75 (2.953)	4.10 (0.161)	3.20 (0.126)
90 (3.543)	90 (3.543)	4.10 (0.161)	3.20 (0.126)
110 (4.331)	110 (4.331)	4.80 (0.189)	3.80 (0.150)
125 (4.921)	125 (4.921)	4.80 (0.189)	3.80 (0.150)
160 (6.299)	160 (6.299)	4.80 (0.189)	3.80 (0.150)
200 (7.874)	200 (7.874)	5.60 (0.220)	4.50 (0.177)

Table A.7
Wall Thickness of Sockets of Fittings
Dimensions in Millimeters (inches)
(See Sections A.4.3, A.5.1.2)

Nominal Size DN/OD	Nominal outside diameter d_n	$e_{2(\min)}$	$e_{3(\min)}$
40 (1.575)	40 (1.575)	1.90 (0.074)	1.80 (0.070)
50 (1.969)	50 (1.969)	3.60 (0.142)	2.90 (0.114)
58 (2.283)	58 (2.283)	3.60 (0.142)	2.90 (0.114)
63 (2.480)	63 (2.480)	3.60 (0.142)	2.90 (0.114)
75 (2.953)	75 (2.953)	4.10 (0.161)	3.20 (0.126)
90 (3.543)	90 (3.543)	4.10 (0.161)	3.20 (0.126)
110 (4.331)	110 (4.331)	4.80 (0.189)	3.80 (0.150)
125 (4.921)	125 (4.921)	4.80 (0.189)	3.80 (0.150)
160 (6.299)	160 (6.299)	4.80 (0.189)	3.80 (0.150)
200 (7.874)	200 (7.874)	5.60 (0.220)	4.50 (0.177)

A.6 Types of Fittings

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

- (a) Bends (see Figures A.6, A.7, A.8, A.9, A.10 or A.11)
 - (i) Unswept or swept angle;
 - (ii) Spigot/socket or socket/socket;
 - (iii) Butt fused from segments.

The fixed nominal angle α should be as follows: 15°, 22.5°, 30°, 45°, 67.5°, 80° or 87.5° to 90°.

- (b) Branches and reducing branches (branching single or multiple)
(See Figures A.12, A.13, A.14, A.15, A.16 or A.17)
 - (i) Unswept or swept angle;
 - (ii) Spigot/socket or socket/socket.

The fixed nominal angle α should be as follows: 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.

- (a) Reducers (see Figure A.18);
- (b) Access fittings (see Figure A.19);

The inside diameter of the cleaning hold shall be as specified by the manufacturer.

- (a) Couplers
 - (i) Double socket (see Figure A.20); Repair collar (see Figure A.21);
- (b) Push-fit socket for butt fusion for pipe ends (see Figure A.22)
 - (i) Plugs (see Figure A.23)

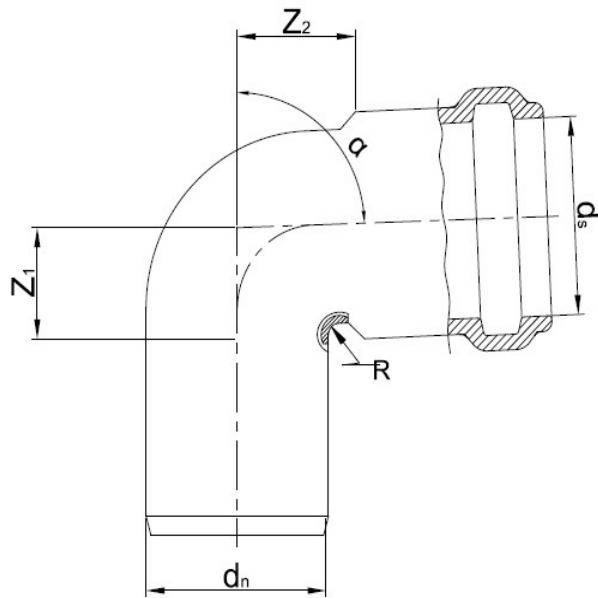


Figure A.6
Bend with Single Socket (unswept)
(See Sections A.4.2, A.6)

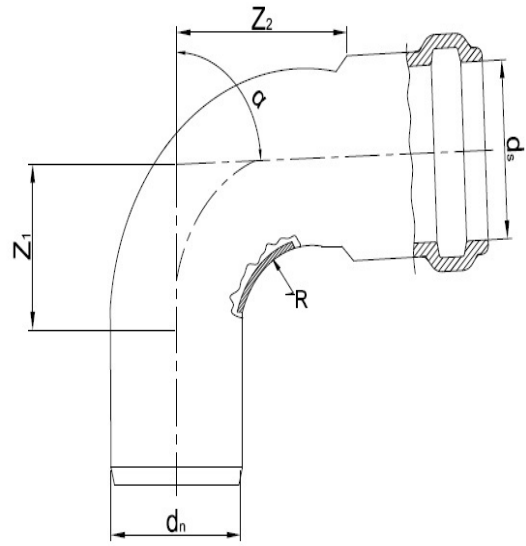


Figure A.7
Bend with Single Socket (swept)
(See Sections A.4.2, A.6)

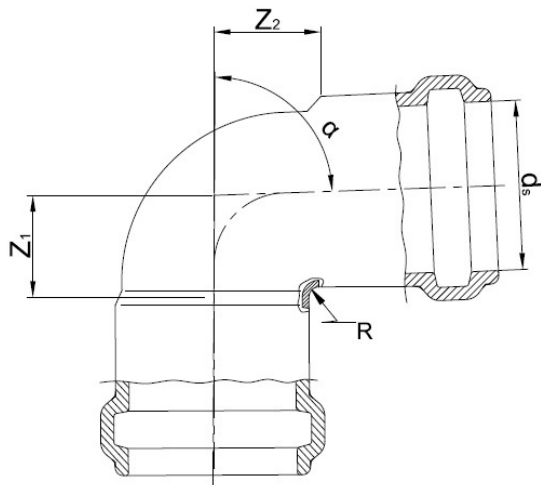


Figure A.8
Bend with All Socket (unswept)
(See Sections A.4.2, A.6)

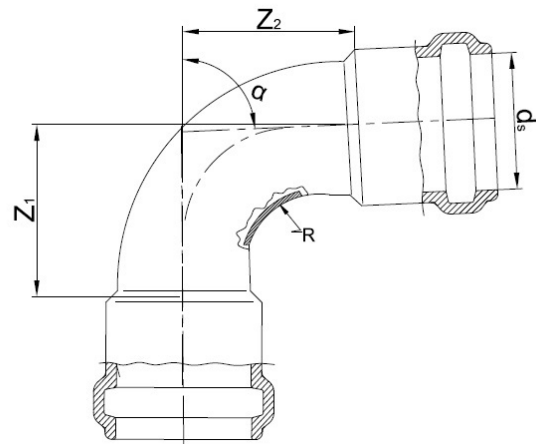


Figure A.9
Bend with All Socket (swept)
(See Sections A.4.2, A.6)

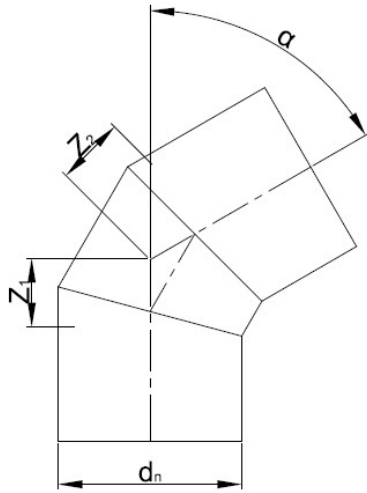


Figure A.10
Bend, Butt Fused from Segments
(See Sections A.4.2, A.6)

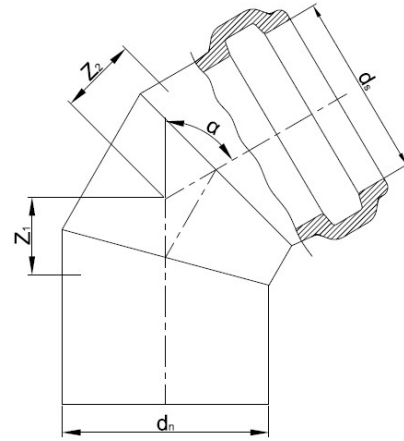


Figure A.11
Bend with Single Socket, Butt used from Segments
(See Sections A.4.2, A.6)

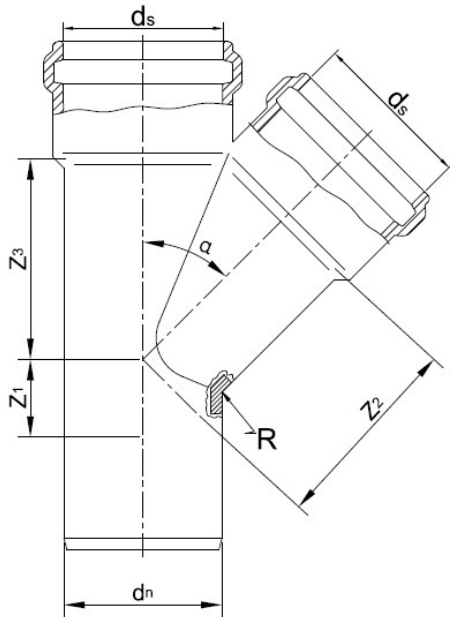


Figure A.12
Branch (unswept)
(See Sections A.4.2, A.6)

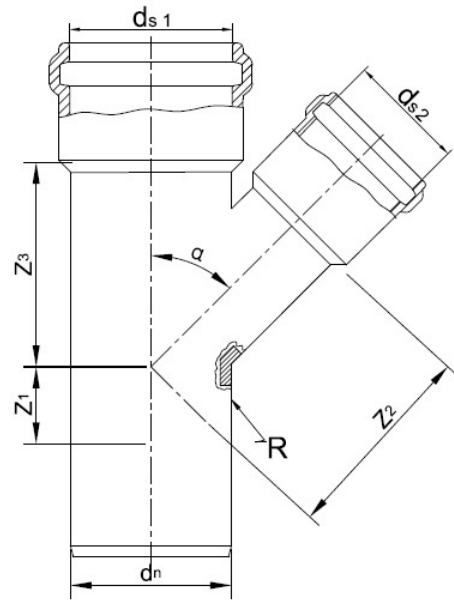


Figure A.13
Reducing Branch (unswept)
(See Sections A.4.2, A.6)

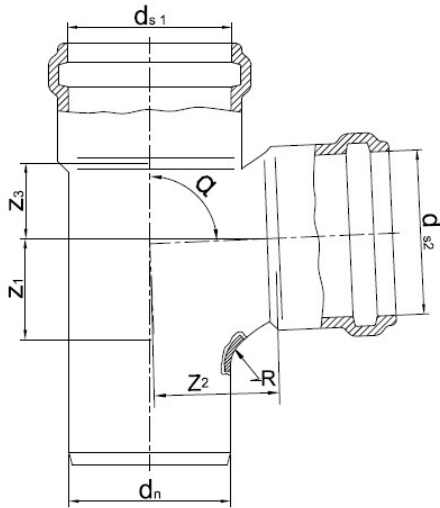


Figure A.14
Reducing Branch (swept)
(See Sections A.4.2, A.6)

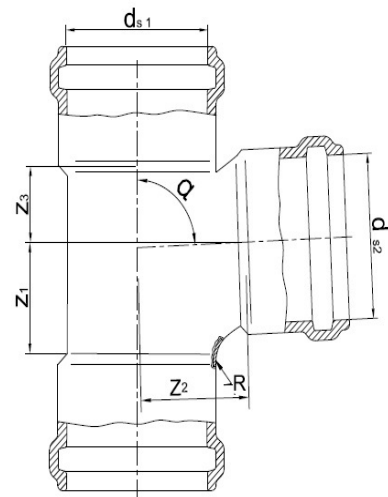


Figure A.15
Reducing Branch with All Socket (swept)
(See Sections A.4.2, A.6)

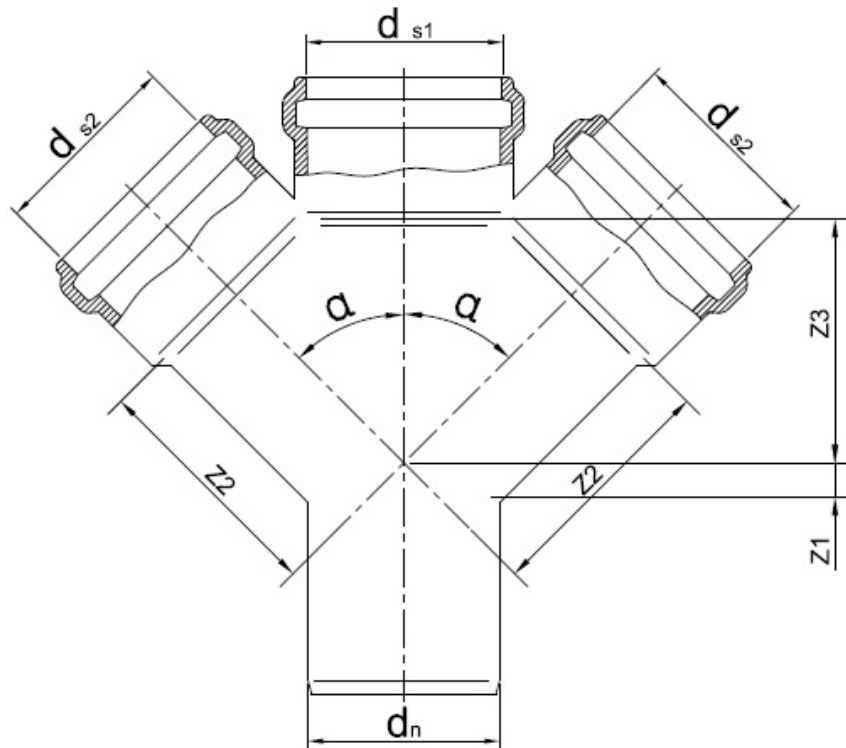


Figure A.16
Double Branch
(See Sections A.4.2, A.6)

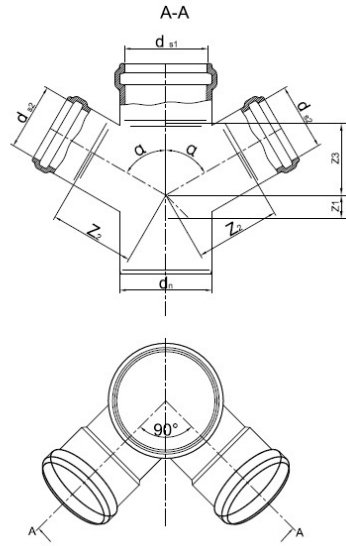


Figure A.17
Angular Double Branch
(See Sections A.4.2, A.6)

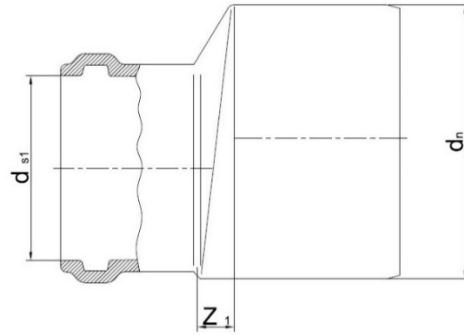


Figure A.18
Reducer
(See Sections A.4.2, A.6)

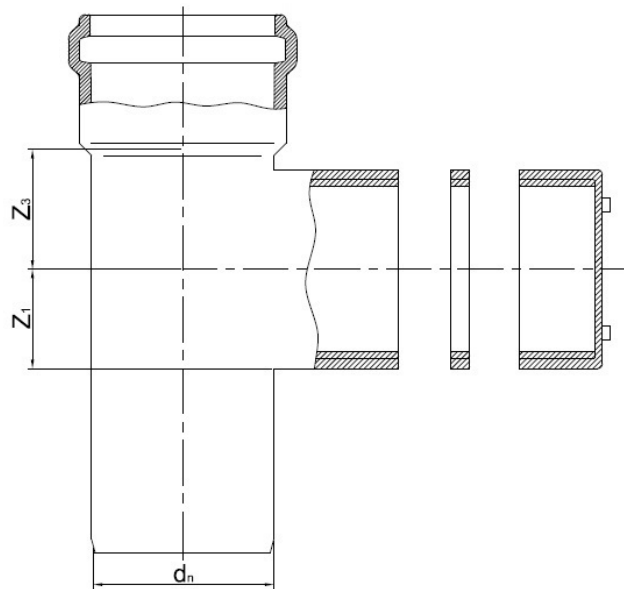


Figure A.19
Access Fitting with Round Cleaning Hole
(See Sections A.4.2, A.6)

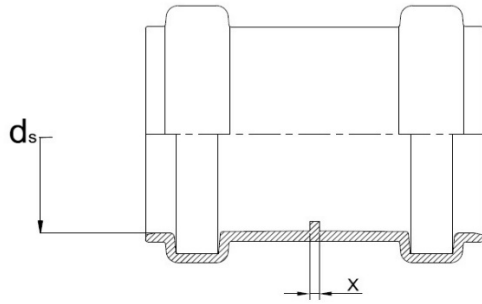


Figure A.20
Double Socket
(See Section A.6)

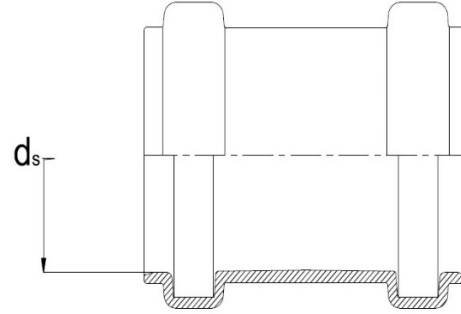


Figure A.21
Repair Collar
(See Section A.6)

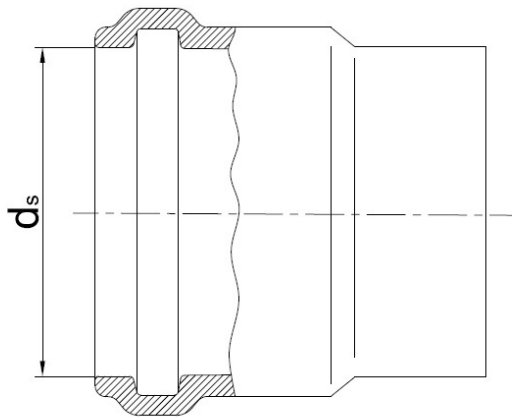


Figure A.22
Push Fit Socket for Butt Fusion of Pipe Ends
(See Section A.6)

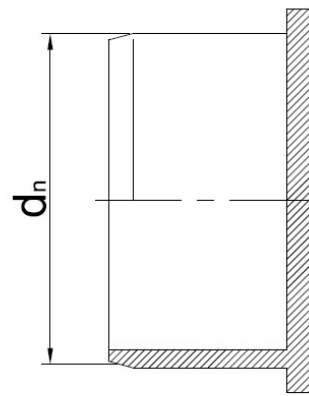


Figure A.23
Plug
(See Section A.6)

Appendix B (Informative)

General characteristics of PP pipes and fittings

B.1 General

This Standard specifies the general requirements for components used in discharge pipes, drains and sewers for gravity systems. Pipes and fittings conforming to this standard fully meet these requirements. Further the following information is given.

B.2 Definitions

The following definition shall apply in this Annex:

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 kilonewtons per square meter (kN/m^2), indicating the minimum ring stiffness of a pipe or fitting.

B.3 Material Characteristics

Pipes and fittings conforming to this standard have generally these characteristics:

Modulus of elasticity	$E_{(1 \text{ min})} \geq 1200 \text{ Mpa (174045.3 psi)}$
Average density	$\approx 1.80 - 1.90 \text{ g/cm}^3$
Average coefficient of linear	
Thermal expansion	$\approx 0.14 \text{ mm/m.K;}$
Thermal conductivity	$\approx 0.20 \text{ W/m.K;}$
Specific heat capacity	$\approx 2000 \text{ J/Kg.K;}$
Surface resistance	$> 10^{13} \Omega$

B.4 Ring Stiffness

The ring stiffness of pipes conforming to this standard is determined in accordance with ASTM F477 and is as follows:

$$\geq 4 \text{ kN/m}^2 \quad (\geq 899 \text{ lbs/m}^2)$$

When a fitting conforming to this standard has the same wall thickness as the corresponding pipe, the stiffness of this fitting because of its geometry, is equal to or greater than the stiffness of that pipe.

B.5 Chemical Resistance

PP giving systems conforming to this standard are resistant to corrosion by water with a wide range of pH-value such as soil and waste water, rain water, surface water and ground water.

If piping systems conforming to this standard are to be used for chemical contaminated waste water, such as industrial discharges, chemical and temperature resistance have to be taken into account.



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