

Fibre-cement pipes for sewers and drains

Part 1. Pipes, joints and fittings for gravity systems

The European Standard EN 588-1 : 1996 has the status of a British Standard

ICS 91.040.80

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- Association of Consulting Engineers
- British Plastics Federation
- Chartered Institution of Water and Environmental Management
- Clay Pipe Development Association Limited
- Concrete Pipe Association
- Department of the Environment
- Department of the Environment (Property and Buildings Directorate)
- Fibre Cement Manufacturers' Association Limited
- Institute of British Foundrymen
- Institution of Civil Engineers
- London Technical Advisors' Group (Lotag)
- METCOM
- Water Services Association of England and Wales

The following body was also represented in the drafting of the standard, through subcommittees and panels:

- Water Companies Association

This British Standard, having been prepared under the direction of the Sector Board for Building and Civil Engineering, was published under the authority of the Standards Board and comes into effect on 15 April 1997

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Amendments issued since publication

Amd. No.	Date	Text affected

The following BSI references relate to the work on this standard:
Committee reference B/505
Draft for comment 91/18757 DC

ISBN 0 580 26892 6

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National foreword

This British Standard has been prepared by Technical Committee B/505 and is the English language version of EN 588-1 : 1996 *Fibre-cement pipes for sewers and drains — Part 1: Pipes, joints and fittings for gravity systems* published by the European Committee for Standardization (CEN).

EN 588-1 was published as a result of international discussion in which the UK took an active part.

This standard supersedes BS 3656 : 1990 which is withdrawn.

This standard together with a number of other ENs will form a comprehensive series of standards in the field of cement pressure pipes.

The manufacture of all asbestos products is covered by the requirements of The Control of Asbestos at Work Regulations 1987, introduced on 1 March 1988. These set out comprehensive provisions covering work activities involving exposure to asbestos. Advice on how to comply with these regulations can be obtained from the manufacturers of the material, from the Asbestos Information Centre Ltd., Derby Road, Cheshire WH8 9ND, from the local area office of the Health and Safety Executive or from the Environmental Health Department of the Local Authority.

WARNING. Breathing asbestos dust is dangerous to health and precautions have to be taken during the manufacture and use of these products.

Particular note has to be taken of the Asbestos Products (Safety) Regulations 1985, made under the Consumer Safety Act 1978, and of the Asbestos (Prohibitions) (Amendment) Regulations 1988, made under the Health and Safety at Work etc. Act 1974, which prohibit the supply of products containing amosite or crocidolite and set out requirements for the labelling of all products containing amosite or crocidolite and set out requirements for the labelling of all products containing asbestos.

All the above legislation implements EEC Directives.

Cross-references

Publication referred to	Corresponding British Standard
ENV 197-1 : 1992	DD ENV 197 <i>Cement. Composition, specifications and conformity criteria</i> Part 1 : 1995 <i>Common cements</i>
EN 512 : 1994	BS EN 512 : 1995 <i>Fibre-cement products. Pressure pipes and joints</i>
EN ISO 9001 : 1994	BS EN ISO 9001 : 1994 <i>Quality systems. Model for quality assurance in design, development, production, installation and servicing</i>
EN ISO 9002 : 1994	BS EN ISO 9002 : 1994 <i>Quality systems. Model for quality assurance in production, installation and servicing</i>
ISO 2859-1 : 1989	BS 6001 <i>Sampling procedures for inspection by attributes</i> Part 1 : 1991 <i>Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i>
ISO 3951 : 1989	BS 6002 <i>Sampling procedures for inspection by variables</i> Part 1 : 1993 <i>Specification for single sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i>

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 32, and inside back cover and a back cover.

ICS 23.040.30; 23.040.50

Descriptors: Sanitation, sewage, gravity flow, piping tubes, pipe joints, accessories, asbestos cement products, designation, classifications, geometric characteristics, mechanical properties, physical properties, tests, corrosion resistance, acceptability, marking

English version

Fibre-cement pipes for sewers and drains — Part 1 : Pipes, joints and fittings for gravity systems

Tuyaux en fibres-ciment pour réseaux
d'assainissement et branchements — Partie 1:
Tuyaux, joints et accessoires à écoulement libre

Faserzementrohre für Abwasserleitungen und
Abwasserkanäle — Teil 1: Rohre, Rohrverbindungen
und Formstücke für Freispiegelleitungen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This has been prepared by Technical Committee CEN/TC 165, Waste water engineering, the Secretariat of which is held by DIN.

A distinction has been made between product appraisal (type tests) and routine quality control requirements (acceptance tests).

Attention is drawn to the need for observance of EU and/or EFTA Directives transposed into national legal requirements restricting the use of certain materials and to the related marking and labelling requirements.

The performance of a sewage network constructed with these products depends not only on the properties of the product as required by this standard but also on the design and construction of the network as a whole in relation to the environment and conditions of use.

This standard will be updated with the standard EN 476 *General requirements for components used in discharge pipes, drains and sewers for gravity systems* established by TC 165 WG 1 and the other functional standards as soon as these are available.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 1997, and conflicting national standards shall be withdrawn at the latest by February 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1 Scope

This Part 1 of EN 588 specifies requirements for fibre-cement pipes, joints and fittings suitable for gravity systems at atmospheric pressure intended for sewerage and drainage applications. It is applicable only to the more commonly used fittings i.e. angled branches or tees and bends.

It defines general composition, classification, geometrical, mechanical and physical characteristics, acceptance tests, type tests and quality control.

For pressurized sewers, fibre-cement pipes and joints in accordance with EN 512 will be used with additional consideration relevant to sewerage transport.

NOTE 1. EN 588-2 specifies requirements for fibre-cement manholes and inspection chambers.

NOTE 2. Occasional momentary overpressures of no more than 100 kPa are acceptable.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. Dated references, subsequent amendments to or revisions of any of these publications will apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ENV 197-1 : 1992	<i>Cement — Composition, specifications and conformity criteria — Part 1: Common cements</i>
EN 512	<i>Fibre-cement products — Pressure pipes and joints</i>
prEN 681-1	<i>Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber</i>
EN ISO 9001	<i>Quality systems — Model for quality assurance in design/development, production, installation and servicing (ISO 9001 : 1994)</i>
EN ISO 9002	<i>Quality systems — Model for quality assurance in production, installation and servicing (ISO 9002 : 1994)</i>
ISO 390 : 1993	<i>Products in fibre reinforced cement — Sampling and inspection</i>
ISO 2859-1 : 1989	<i>Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection</i>
ISO 3951	<i>Sampling procedures and charts for inspection by variables for percent nonconforming</i>

3 Definitions

For the purposes of this standard the following definitions apply.

3.1 nominal diameter (DN)

Numerical denomination of size of a component, which is a convenient round number approximately equal to the manufacturing dimension in millimetres of the internal diameter.

3.2 acceptance test

Test to establish whether a batch of products conforms to a specification of the standard. The tests are performed on samples drawn either from continuous production or from a consignment (ISO 390 : 1993).

NOTE. Tests methods, specifications and limit values are specified in this standard. Sampling levels and acceptance criteria are specified in ISO 390.

3.3 type test

Test for approval of a new product and/or a fundamental change in formulation or method of manufacture, or both. The test is performed on the as delivered product.

The type test is not to be taken as evidence of the conformity to specification of products subsequently produced in quantity (ISO 390 : 1993).

3.4 acceptable quality level (AQL)

When a continuous series of batches is considered, the quality level which for the purposes of sampling inspection is the limit of a satisfactory process average (ISO 2859-1 : 1989).

NOTE. A sampling scheme with an AQL of 4 % means that batches containing up to 4 % defective items have a high probability of acceptance.

3.5 pipe barrel

Cylindrical part of the pipe with a uniform cross-section excluding socket and spigot.

4 Pipes

4.1 General composition

Fibre-cement pipes shall consist essentially of cement or a calcium silicate formed by chemical reaction of a siliceous and a calcareous material, reinforced by fibres. The cement shall comply with relevant national standards of CEN members and/or ENV 197-1.

NOTE. Other components which are compatible with the composite and have no negative influence on the performance in use of the product, can be added.

Two types of fibre-reinforced cement products (pipes, joints and fittings) are included in this standard:

- type AT (Asbestos Technology) for products the formulation of which contains chrysotile asbestos;
- type NT (Non-asbestos Technology) for products the formulation of which does not contain asbestos.

For products of type AT and NT all the requirements of this standard shall be fulfilled.



4.2 Classification

The pipes shall be classified in accordance with their minimum crushing strength in three classes based on load per unit internal area: 60 kN/m², 90 kN/m², 120 kN/m². The load per unit area is the breaking load in kilonewtons per metre length of pipe divided by the nominal diameter of the pipe in metres (1/1000 of the nominal diameter values).

4.3 Pipe ends

Pipes shall either have plain ends or with one end plain and the other end with a fixed socket. Plain ends may be machined or un-machined (see figure 1).

4.4 General appearance and finish

The pipes shall be straight, uniform and regular. The shape of the finished end shall be fixed by the manufacturer to suit the type of joint used.

The end faces shall be free from breakout and machining burrs. The parts of the pipe where the rubber jointing rings are located shall be free from irregularities which could affect the watertightness of the joint.

NOTE. If necessary, the pipes can be impregnated and/or coated internally and/or externally to meet special working conditions as agreed between manufacturer and customer. The coating and finish should comply with the relevant national standards (transposing the European Standard), if existing.

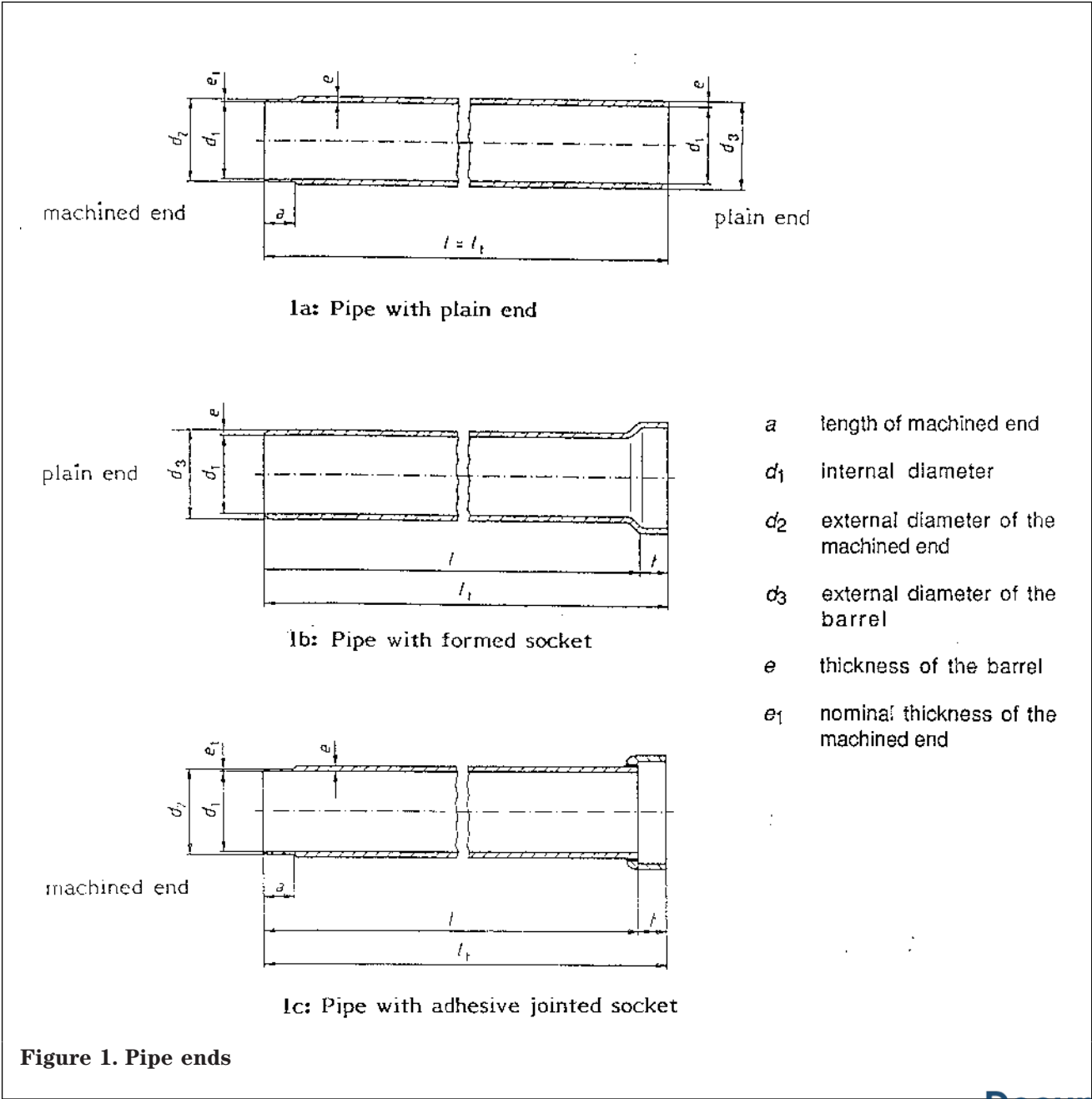


Figure 1. Pipe ends

4.5 Smoothness of bore

The internal surface of the pipe shall be regular and smooth. Slight scratches, indentations or small protrusions that do not affect the intended use or efficiency shall be acceptable.

4.6 Geometrical characteristics

4.6.1 Nominal diameter (DN)

Nominal diameters shall be as given in table 1. Nominal diameters without brackets are preferred.

Table 1. Nominal diameters (DN)	
100	(1100)
125	1200
150	(1300)
200	1400
250	(1500)
300	1600
(350)	(1700)
400	1800
(450)	(1900)
500	2000
600	(2100)
(700)	2200
800	(2300)
(900)	(2400)
1000	2500

4.6.2 Internal diameter

When measured in accordance with 4.10.2.1 the internal diameter d_1 (see figure 1), expressed in millimetres, of the pipe shall be equal to the nominal diameter, limit deviations excluded.

4.6.3 Thickness of wall

When measured in accordance with 4.10.2.3 the nominal thickness of the wall of the pipe shall be the thickness of the barrel e , expressed in millimetres, (see figure 1) of the pipe, excluding the machined end.

This nominal thickness shall be stated by the manufacturer in his literature.

If the extremity of the pipe is machined, the nominal thickness e_1 of the machined end shall be at least 3,3 % of the nominal diameter but not less than 6 mm.

4.6.4 External diameter

When measured in accordance with 4.10.2.2 the external diameter d_2 (see figure 1) of the pipe at the finished end where the rubber ring is located, expressed in millimetres, shall be stated by the manufacturer in his literature.

4.6.5 Length of pipes

When measured in accordance with 4.10.2.4 the nominal length l (see figure 1) of the pipe shall be the length measured between the extremities for pipes with plain ends and the total length l_t less the depth of the socket t for socketed pipes.

The nominal length shall be stated by the manufacturer in its literature in accordance with table 2.

Table 2. Nominal length of pipes	
DN	Nominal length m
100	2,0
	2,5
to	3,0
	4,0
	5,0
2 500	6,0

Other pipe lengths than those stated in table 2 can be agreed on between purchaser and manufacturer by dividing the nominal length of table 2 by round numbers (1/2, 1/3, 1/4 length pipes).

In special cases, specified length can be agreed on between purchaser and manufacturer.

At least 90 % of the pipes supplied shall be of the nominal length agreed upon (subject to limit deviation given in 4.6.7.4). The remainder can be shorter by no more than 1 m. However, the total length of the pipes supplied shall not be less than the length ordered.

4.6.6 Length of machined end

The length of the machined end a (see figure 1) shall not exceed the length of the coupling (or socket in case of socketed pipes) + 10 mm.

NOTE. Longer machined end pipes can be supplied. In this case the manufacturer will indicate the minimum breaking load.

4.6.7 Limit deviations

4.6.7.1 Internal diameter

The limit deviation on the internal diameter shall be as given in table 3.

Table 3. Limit deviation on internal diameter	
DN	Limit deviation mm
$\leq 1\ 200$	$\pm (2,5\text{ mm} + 0,01d)$
$> 1\ 200$	$\pm 15\text{ mm}$
NOTE. d being the nominal diameter, expressed in millimetres.	

4.6.7.2 Thickness

The lower deviation on the thickness of the barrel and machined ends shall be as given in table 4.

Table 4. Lower deviation on barrel thickness	
Thickness	Lower deviation
Up to 10 mm	−1,5 mm
Over 10 mm up to 20 mm	−2,0 mm
Over 20 mm up to 30 mm	−2,5 mm
Over 30 mm up to 60 mm	−3,0 mm
Over 60 mm up to 90 mm	−3,5 mm
Over 90 mm	−4,0 mm

The upper deviations on the pipe end thickness shall be such as the maximum thickness is as follows:

Table 5. Upper deviation on the pipe end thickness	
DN	Upper deviation mm
≤ 300	$e_{\max} = e_{\min} + 6$
300 < DN ≤ 1000	$e_{\max} = e_{\min} + 0,02 \times \text{DN}$
> 1000	$e_{\max} = e_{\min} + 20$

where:

- $e_{\max}$ is the maximum thickness at the end of the pipe (machined end or barrel) in millimetres;
- $e_{\min}$ is the minimum thickness at the end of the pipe (machined end or barrel) equal to the nominal thickness stated by the manufacturer less the lower deviation of table 4, in millimetres.

4.6.7.3 External diameter at finished end covered by the coupling

The limit deviations on the external diameter d_2 of the pipe ends where jointing rings are located (plain ends), shall be established by the manufacturer in accordance with the type of joint used and taking into account the limit deviations acceptable in respect of the design of the joint and of the performance defined in 5.2 (see figure 1).

4.6.7.4 Length l (figure 1)

The limit deviation on the measurement shall be:

- + 5 mm;
- −20 mm.

NOTE. Larger limit deviations can be agreed between customer and manufacturer.

4.6.7.5 Straightness

The maximum deviation f on straightness in accordance with the test method of 4.10.2.6 shall not exceed the following values given in table 6.

Table 6. Limit deviation on straightness	
DN	Maximum deviation f mm
100 to 150	$3,0l_t$
200 to 1 000	$2,5l_t$
1 100 to 2 500	$1,5l_t$

NOTE. l_t is the length of the pipe in metres (see figure 1).

4.6.8 Interchangeability

Interconnection between pipes of the same nominal diameter and class of different pipe end dimensions can be achieved by special couplings or special machining of the pipe ends.

4.7 Mechanical characteristics

4.7.1 Crushing strength

When tested in accordance with 4.10.3.1 the minimum breaking loads for pipes of nominal diameter up to DN 1 000 shall be as given in table 7.

Table 7. Minimum breaking load in kilonewtons per metre (kN/m)			
DN	Class 60	Class 90	Class 120
100	—	—	20 ¹⁾
125	—	—	21 ¹⁾
150	—	—	22 ¹⁾
200	15 ¹⁾	18	24
250	15	22,5	30
300	18	27	36
350	21	31,5	42
400	24	36	48
450	27	40,5	54
500	30	45	60
600	36	54	72
700	42	63	84
800	48	72	96
900	54	81	108
1000	60	90	120

¹⁾ Minimum breaking loads exceed the calculated minimum requirement to satisfy other design criteria.

For DN > 1 000 the minimum breaking loads in kilonewtons per metre are given by multiplying the class in kilonewtons per square metre by 1/1000 the nominal diameter (diameter in metres).

e.g. when DN = 1 500 and pipe class is 90 kN/m² the minimum breaking load shall be:

$$90 \text{ kN/m}^2 \times 1,5 \text{ m} = 135 \text{ kN/m}$$

4.7.2 Bending loads

Breaking bending loads in accordance with 4.10.3.2 shall be as given in table 8.

Table 8. Minimum breaking bending loads	
DN	Breaking bending load min. N
100	2 800
125	4 200
150	6 000
200	12 000
NOTE. When site circumstances require pipes to have higher bending strengths than those given, pipes of series S with a minimum breaking load 25 % higher than given in the table, or short length pipes can be specified.	

4.8 Physical characteristics

4.8.1 Long term vertical loading

When tested in accordance with 4.10.4.1, no test specimens shall fail (see annex C).

4.8.2 Warm water test

When tested in accordance with 4.10.4.2, the lower confidence limit L calculated for the test specimens shall be not less than 0,75.

4.8.3 Watertightness

When tested in accordance with 4.10.4.3, the pipe shall exhibit no fissure, leakage or sweating.

4.8.4 Modulus of elasticity

If necessary (e.g. for structural analysis), the modulus of elasticity shall be determined as a type test in accordance with the test method given in annex D.

4.9 Resistance to domestic sewage media

When tested in accordance with 4.10.5, the lower confidence limit L calculated for the test specimens shall be not less than 0,75.

4.10 Test methods

4.10.1 General

4.10.1.1 Acceptance tests

Acceptance tests shall be carried out at the manufacturer's works on pipes as delivered whenever possible, or on test specimens cut from the pipes.

NOTE. The manufacturer can carry out the test as part of the routine quality control system at an earlier stage of maturity.

Acceptance tests consist of the following:

- visual inspection of appearance, finish and of marking;
- geometrical characteristics;
- crushing strength;
- bending loads.

4.10.1.2 Type tests

The following type tests shall be carried out on pipes as delivered:

- long term loading test;
- warm water test;
- watertightness test;
- resistance to domestic sewerage media.

When type tests are carried out the product shall also be subjected to the acceptance tests to ensure it complies with the requirements of this standard.

4.10.2 Geometrical characteristics

4.10.2.1 Internal diameter

The minimum and maximum internal diameter shall be measured at both ends of the element with an accuracy of 0,5 mm. The values obtained shall comply with the specifications of 4.6.2 and 4.6.7.1.

4.10.2.2 External diameter

These measurements shall be carried out only at the plain or machined end of the pipe. The values obtained shall comply with the specifications of 4.6.4 and 4.6.7.3.

For pipes of $DN \leq 400$ two measurements of the external diameter shall be made and carried out at 90° to each other with an accuracy of 0,1 mm approximately where the rubber rings are located.

For pipes of $DN > 1\,500$, determine the outer diameter by measuring the circumference with an accuracy of 0,5 mm taking into account the thickness of measuring tape.

For pipes of $400 < DN \leq 1\,500$, one or the other of the above methods may be used; if the measurement of the circumference is carried out, the measurement of internal diameter (see 4.10.2.1) shall be carried out on the same pipe.

4.10.2.3 Thicknesses

For pipes with plain or machined ends measure the thickness at each end and for socketed pipes measure the thickness at the plain end to an accuracy of 0,1 mm as follows:

- either at four points displaced at 90°;
- or the minimum and the maximum thickness.

These measurements shall be carried out:

- a) on machined pipes:
 - at 30 mm from the pipe end;
 - at 30 mm beyond the machined part for the barrel;
- b) on non-machined ends:
 - at a distance of 30 mm approximately from the end.

These measurements shall comply with the specifications of 4.6.3 and 4.6.7.2.

4.10.2.4 Length of pipe

Take the single values of two diametrically opposed measurements of the pipe length with an accuracy of 1 mm. The average shall comply with the specification of 4.6.5 and 4.6.7.4.

4.10.2.5 Length of machined ends

Measure the length of the machined end *a* axially with an accuracy of 1 mm (see figures 1a and 1c). The values shall comply with the specification of 4.6.6.

4.10.2.6 Straightness

4.10.2.6.1 Test specimen

The test specimen shall be a complete pipe.

4.10.2.6.2 Apparatus

The apparatus shall consist of:

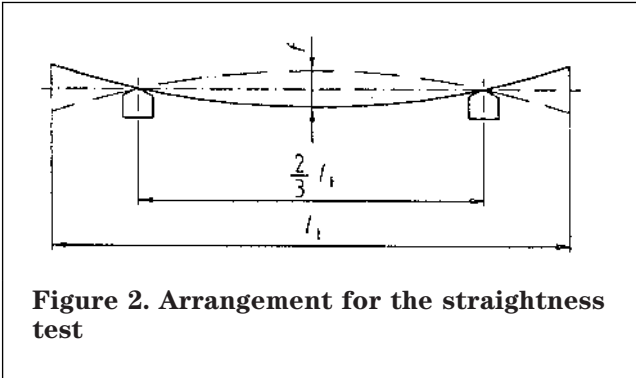
4.10.2.6.2.1 Two supports, the distance between the centres of which is equal to 2/3 of the total length of the pipe to be checked.

Each support shall be equipped with a roller system which makes it possible to rotate the pipe around its axis without longitudinal or lateral movement.

4.10.2.6.2.2 A dial gauge, with semi-spherical shaped measuring faces or with rounded tips accurate to 0,1 mm and fixed on a stable base.

4.10.2.6.3 Procedure

Lay the pipe horizontally on the two supports. Place the dial gauge at an equal distance, from the supports, in such a way that the sliding spindle of the gauge is in radial contact with the pipe. Turn the pipe at least one complete rotation. Note the maximum deviation *f* obtained, rounded to the nearest millimetre (see figure 2).



4.10.2.6.4 Expression and interpretation of result

Record the maximum deviation *f*. It shall comply with the specification of 4.6.7.5.

4.10.3 Mechanical characteristics

4.10.3.1 Crushing test

4.10.3.1.1 Test specimen

The test specimen shall be a piece of pipe cut from the barrel (excluding the machined end), length of which shall be:

- 200 mm for pipes ≤ DN 300;
- 300 mm for pipes > DN 300.

4.10.3.1.2 Apparatus

The apparatus shall consist of:

4.10.3.1.2.1 A press, with a loading error of ± 3 % maximum and a loading reproducibility error of ± 2 % maximum.

4.10.3.1.2.2 A lower press block,, formed by a V-shaped support having an included angle of 170° made of metal or hard wood, and a flat upper press block made of the same material. The length of these blocks shall be equal to the length of the test specimen (figure 3). The width of the upper press block shall not be more than the value given in table 9.

Table 9. Width of upper press blocks	
DN	Width <i>b</i> mm
up to 450	50
500 to 600	60
700 to 800	85
900 to 1 000	105
1 100 to 1 200	130
1 300 to 1 400	150
1 500 to 1 600	175
1 700 to 1 800	195
1 900 to 2 000	220
2 100 to 2 200	240
2 300 to 2 400	265
2 500	290

Strips of rubber of suitable width and length shall be interposed between the press blocks and the test specimen¹⁾. The rubber strips shall be 25 mm ± 5 mm thick and a shore hardness of 60 ± 5 IRHD.