International Standard

ISO 881

Asbestos-cement pipes, joints and fittings for sewerage and drainage

Tuyaux, joints et accessoires en amiante-ciment pour canalisations d'assainissement

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 881 was developed by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*, and was circulated to the member bodies in March 1979.

It has been approved by the member bodies of the following countries :

Australia	Israel	Romania
Austria	Italy	South Africa, Rep. of
Brazil	Korea, Rep. of	Spain
Colombia	Libyan Arab Jamahiriya	Switzerland
Czechoslovakia	Mexico	Thailand
Egypt, Arab Rep. of	Morocco	Turkey
France	Netherlands	United Kingdom
Greece	New Zealand	USSR
India	Poland	Yugoslavia
Ireland	Portugal	

The member body of the following country expressed disapproval of the document on technical grounds :

Belgium

This International Standard cancels and replaces ISO Recommendation R 881-1968, of which it constitutes a technical revision.

Contents

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Asbestos-cement pipes, joints and fittings for sewerage and drainage

1 Scope and field of application

This International Standard gives specifications relating to asbestos-cement pipes, joints and fittings suitable for use with gravity flow at atmospheric pressure[1], intended for sewerage and drainage applications; it defines certain conditions of manufacture, classification, characteristics and acceptance tests applicable to these products.

NOTE — Asbestos-cement pressure pipes and joints are covered by ISO 160[2]. Building and sanitary pipes in asbestos-cement are covered by ISO 391[2]. Asbestos-cement pipe fittings for building and sanitary purposes are covered by ISO 392[2].

2 References

ISO 390, *Asbestos-cement products — Sampling and inspection.*

ISO 2785, *Guide to the selection of asbestos-cement pipes subject to external loads with or without internal pressure.*

ISO 4482, *Asbestos-cement pipelines — Guide for laying.*

3 Pipes

3.1 Composition

The pipes shall be made from a close and homogeneous mixture essentially consisting of a suitable inorganic hydraulic binder[3], asbestos fibre and water, excluding any materials liable to cause ultimate deterioration in the quality of the pipes.[4]

3.2 Classification

The pipes are classified according to their crushing strength. The ultimate loads (see table 4) of the four[5] following series are based on a load per unit area[6] of

— 40 kN/m² for series 1

— 60 kN/m² for series 2

— 90 kN/m² for series 3

— 120 kN/m² for series 4

provided that no crushing load at rupture (see 3.6.1) is less than 15 kN/m.

The choice of the class of the pipes is determined by the purchaser's engineer, who is qualified to judge the conditions of laying and using the pipes. However, it is recommended that a class be selected such that, taking into account all the loads and the method of laying adopted, the pipes used give a safety factor against crushing of at least 1,3 for diameters up to 1 000 and of 1,5 for diameters above 1 000 (see also ISO 2785).

3.3 Types

The pipes may be either of the type with both ends plain or of the type with socket at one end.

3.4 General appearance and finish

The internal surface shall be regular and smooth. If necessary, the pipes may be coated internally and/or externally, but their internal surface shall remain regular and smooth (see 6.4).

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1) Accidental overpressures are admitted provided that a safety factor of 2,0 be maintained in relation to the hydraulic test pressure provided for in 3.6.2.

2) At present at the stage of draft. (Revisions of ISO/R 160, ISO/R 391 and ISO/R 392.)

3) National standards may specify the binder to be used.

4) This International Standard applies both to water-cured pipes and to autoclaved pipes in which the binder is partially replaced by ground silica.

5) National standards may include different series than the four mentioned above, but not lower than series 1.

6) The load per unit area is the crushing load per metre length of pipe divided by the nominal diameter of the pipe in metres.

3.5 Characteristics

3.5.1 Geometrical characteristics

3.5.1.1 Nominal diameter

The nominal diameter of the pipe corresponds to the internal diameter expressed in millimetres, tolerances excluded.

The series of nominal diameters is given in table 1. Nominal diameters not shown within parentheses are preferable.

Table 1 — Nominal diameters

100	(1 100)
125	1 200
150	(1 300)
200	1 400
250	1 500
300	1 600
350	(1 700)
400	1 800
450	(1 900)
500	2 000
600	(2 100)
700	2 200
800	(2 300)
900	2 400
1 000	2 500

NOTE — National standards may continue to provide for nominal diameters from the following range of approximately corresponding metric/inch sizes : 100/4 in, 125/5 in, 150/6 in, 175/7 in, 200/8 in, 225/9 in, 250/10 in, 300/12 in, 350/14 in, 375/15 in, 400/16 in, 450/18 in, 500/20 in, 525/21 in, 600/24 in, 675/27 in, 700/28 in, 750/30 in, 800/32 in, 825/33 in, 900/36 in, 975/39 in, 1 000/40 in, 1 050/42 in.

3.5.1.2 Thickness of wall

The nominal thickness of the pipes is the thickness of the barrel of the pipe, excluding the machined ends.

The nominal thickness and the method of measurement shall be specified by the manufacturer, taking into consideration all the requirements provided in this International Standard.

3.5.1.3 Length

The nominal length of the pipes refers to the length measured between the extremities for pipes with plain ends and to the effective length for socketed pipes. It should preferably be not less than

— 3 m for pipes with a nominal diameter equal to or less than 200,

— 4 m for pipes with a nominal diameter exceeding 200.

In special cases shorter pipes may be specified. The nominal length should preferably be a multiple of 0,5 m (see also 6.3).

3.5.1.4 Tolerances

a) External diameter of finished ends

The tolerances on the external diameter of the pipe ends where jointing rings are located (plain ends), as well as a suitable method of measuring, shall be established by the manufacturer according to the type of joint used and taking into account the tolerances acceptable in respect of jointing rings.

b) Regularity of the internal diameter (Roundness — Optional test)

If required, the regularity of the internal diameter of pipes of nominal diameter up to 500 may be checked by means of a sphere or a disk, of a material unaffected by water, passing freely in the pipe.

The disk shall be kept perpendicular to the axis of the pipe. The diameter of the sphere or the disk shall be less than the nominal diameter of the pipe by the following value, expressed in millimetres (rounded to the nearest millimetre) :

$$2,5 + 0,01\ d$$

d being the nominal diameter, expressed in millimetres.

If required, the regularity of the internal diameter of pipes of nominal diameter exceeding 500 shall be checked by measuring at each end of the pipe three diameters at an angle of about 60° between them, with an accuracy of $\pm$ 1 mm. None of the six measured diameters shall be smaller than that allowed by application of the above formula.

c) Nominal thickness of the wall (excluding machined ends)

The lower deviations of the tolerances are as follows for the nominal thicknesses shown :

—	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

NOTE — Upper deviations are free.

d) Nominal length

For all lengths : $^{+\ 5}_{-\ 20}$ mm

e) Straightness (Optional test)

The straightness may be checked by either of the following two methods :

— by rolling the pipe on two parallel runners placed at a distance apart equal to two-thirds of the nominal length l of the pipe [see figure 1a)], or

— by rolling the pipe on an even, flat floor until one or both ends of the pipe reach the maximum elevation from the floor [see figure 1b)].

The maximum deviations, f, according to the method in figure 1a) and measured on the external surface at mid-span, or j, according to the method in figure 1b) and measured from the floor to the outer surface at the ends of the pipe, shall not exceed the values in table 2.

Table 2 — Maximum deviations from straightness

Nominal diameter	f mm	j mm
from 100 to 150	5,5 l	6,5 l
from 200 to 400	4,5 l	5,5 l
from 450 to 2 500	3,0 l	4,0 l

l being the length of the pipe, in metres.

3.5.2 Physical characteristics

Tested as prescribed in 3.6.2 (optional test), the pipes shall show no fissure, leakage or sweating.

3.5.3 Mechanical characteristics

3.5.3.1 Crushing

Tested as prescribed in 3.6.1 (compulsory test), the pipes shall indicate

— a minimum total transverse crushing load at rupture at least equal to that defining the series to which they belong [see 3.6.1 a)];

— a minimum transverse crushing strength of 33 N/mm^2*.

3.5.3.2 Bending

Tested as prescribed in 3.6.3 (optional test), pipes with nominal diameters of 100, 125 or 150, irrespective of their series, shall indicate minimum total bending loads at rupture of 2,8, 4,2 and 6,0 kN respectively.

3.5.4 Chemical characteristics

Tested as prescribed in 3.6.4 (optional test), the pipes shall not show a neutralization of acetic acid exceeding 0,100 g per square centimetre.

3.6 Tests

The acceptance tests shall be carried out at the manufacturer's works on pipes, coated or otherwise, sufficiently matured. The number of tests shall be as specified in ISO 390.

a) Compulsory test (see 3.5.3.1)

Transverse crushing test (method as specified in 3.6.1).

b) Optional tests at purchaser's request

1) Hydraulic pressure test (method as specified in 3.6.2).

2) Longitudinal bending test (method as specified in 3.6.3) (see 3.5.3.2).

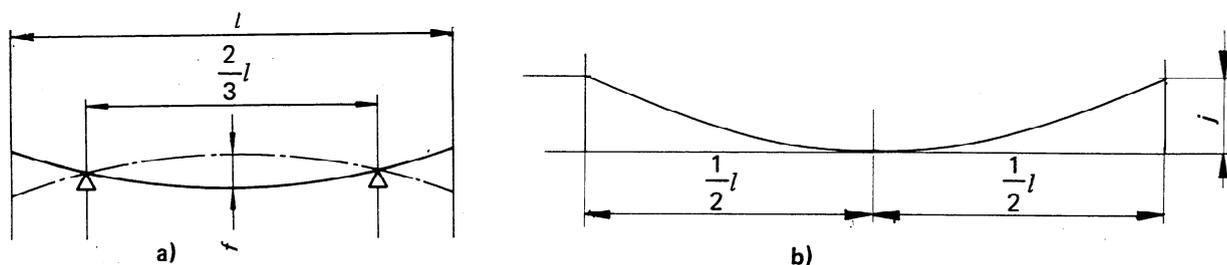3) Chemical resistance test (method as specified in 3.6.4) (see 3.5.4).

Figure 1 — Measurement of straightness

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* When dry specimens are tested, the minimum transverse crushing strength shall be 36 N/mm^2.

3.6.1 Transverse crushing test

The test shall be carried out on a piece of pipe, taken from a part not accommodating the joint, of a length cut to

— 200 mm for pipes of nominal diameters up to and including 300,

— 300 mm for pipes of nominal diameters from 350 to 2 500,

after immersion for 48 h in water (see footnote to 3.5.3.1).

The load shall be applied through press-blocks as shown in figure 2, at a constant rate regulated so that the rupture occurs after at least 15 s and not more than 30 s, according to the diameter.

The lower press-block consists of a V-shaped support having an included angle of 150°, made of metal or hard wood; the flat upper press-block, made of the same material, has a width b varying with the nominal diameter of the pipe. The values of b are given in table 3.

The load may be applied either horizontally or vertically.

Strips of rubber of suitable width and length shall be interposed between the press-blocks and the test piece. The rubber strips shall be 15 mm thick and of a hardness of 60 ± 5 Shore A degrees.

Table 3 — Width of upper press-block

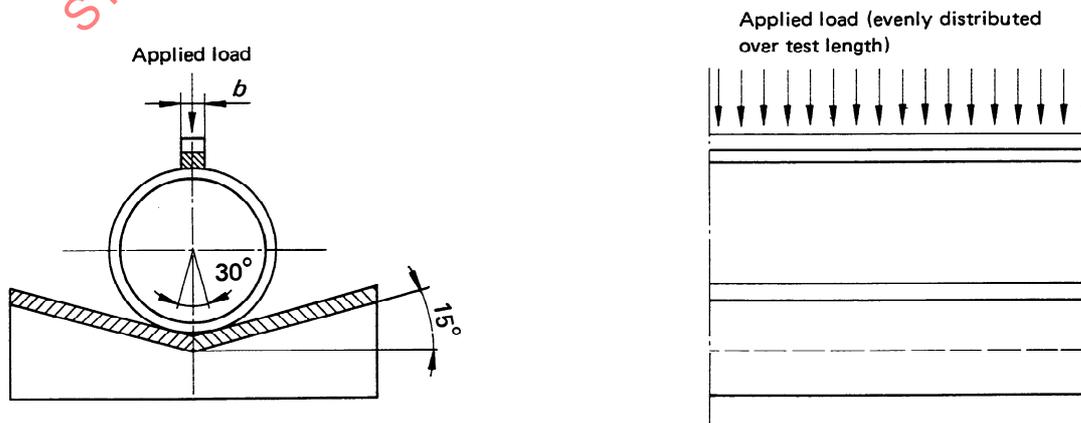| Nominal diameter	Width b mm
up to 250	25
300 to 350	35
400 to 450	50
500 to 600	60
700 to 800	85
900 to 1 000	105
1 100 to 1 200	130
1 300 to 1 400	150
1 500 to 1 600	175
1 700 to 1 800	195
1 900 to 2 000	220
2 100 to 2 200	240
2 300 to 2 400	265
2 500	290

Figure 2 — Loading in transverse crushing test

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a) Total transverse crushing loads on test length

The total transverse crushing loads at rupture, expressed in kilonewtons, shall be not less than the values given in table 4.

Table 4 — Transverse crushing loads

Nominal diameter	Length of test piece mm	Crushing load, kN			
		Series 1	Series 2	Series 3	Series 4
100	200	—	—	—	3,0
125	200	—	—	—	3,0
150	200	—	—	3,0	3,5
200	200	—	3,0	3,5	5,0
250	200	—	3,0	4,5	6,0
300	200	3,0	3,5	5,5	7,0
350	300	4,5	6,5	9,5	12,5
400	300	5,0	7,0	11,0	14,5
450	300	5,5	8,0	12,0	16,0
500	300	6,0	9,0	13,5	18,0
600	300	7,0	11,0	16,0	21,5
700	300	8,5	12,5	19,0	25,0
800	300	9,5	14,5	21,5	29,0
900	300	11,0	16,0	24,5	32,5
1 000	300	12,0	18,0	27,0	36,0
1 100	300	13,5	20,0	29,5	39,5
1 200	300	14,5	21,5	32,5	43,0
1 300	300	15,5	23,5	35,0	47,0
1 400	300	17,0	25,0	38,0	50,5
1 500	300	18,0	27,0	40,5	54,0
1 600	300	19,0	29,0	43,0	57,5
1 700	300	20,5	30,5	46,0	61,0
1 800	300	21,5	32,5	48,5	65,0
1 900	300	23,0	34,0	51,5	68,5
2 000	300	24,0	36,0	54,0	72,0
2 100	300	25,0	38,0	56,5	75,5
2 200	300	26,5	39,5	59,5	79,0
2 300	300	27,5	41,5	62,0	83,0
2 400	300	29,0	43,0	65,0	86,5
2 500	300	30,0	45,0	67,5	90,0

NOTE — For the diameters shown in the note to 3.5.1.1, the width of the upper press-block and the total transverse crushing load at rupture shall be specified in accordance with 3.2 and with table 3.

b) Unit stress (see 3.5.3.1)

The unit transverse crushing strength R_e, expressed in newtons per square millimetre, is given by the formula

$$R_e = K \frac{M_e}{W_e}$$

where

$K = \dfrac{3d + 5e}{3d + 3e}$ is a factor resulting from the curvature of the pipe,

d being the actual internal diameter of the test piece, in millimetres, taken as the average of two perpendicular measurements, and

e being the actual thickness of the wall of the test piece in the broken section, in millimetres, taken as the average of three measurements made along the line of fracture at the top of the ring;

$M_e = nP_e \dfrac{(d + e)}{2}$ is the maximum ring bending moment,

n being equal to 0,26 for 100 diameter pipes and to 0,30 for diameters exceeding 100;

P_e being the breaking load, in newtons;

$W_e = \dfrac{1}{6} le^2$ is the modulus of resistance of the wall of the pipe,

l being the actual length of the test piece, in millimetres.

NOTE — The value of R_e may be derived directly from the formula

$$R_e = 0,3 \frac{P_e}{l} \frac{(3d + 5e)}{e^2}$$

the terms being expressed in the same units as above.

3.6.2 Internal hydraulic pressure test

This test shall be carried out on whole pipes, including the sockets if the pipes are socketed.

The pipes shall be placed on a hydraulic press, the tightness at the ends being ensured by an appropriate device. The hydraulic pressure shall be measured by a pressure gauge calibrated to give accurate readings [a manometer graduated to at least 0,05 MPa (0,5 bar) is recommended].

The hydraulic pressure shall be raised gradually up to 0,25 MPa (2,5 bar), irrespective of the class of the pipe. This pressure shall be maintained for 60 s to check that there is no fissure, leakage or sweating.

The testing time may be reduced to 20 s, provided that the pressure is increased to 0,3 MPa (3,0 bar).

For nominal diameters exceeding 1 000, the hydraulic pressure test may be replaced by a suitable method of inspection agreed between the customer and the manufacturer.

3.6.3 Longitudinal bending test

Taking into account the practical possibilities of carrying out the test and the nature of the bending stresses, this test should be called for only on pipes of diameter 150 and less.

The test shall be carried out on a pipe or part of a pipe at least 2,2 m long, taken from the pipe having already provided the test pieces for the transverse crushing test.

The test piece shall be placed on two metal V-shaped supports having an included angle of 120°, presenting a face 50 mm wide to the pipe and free to move in the plane of bending on two horizontal axes 2 000 mm apart (see figure 3).
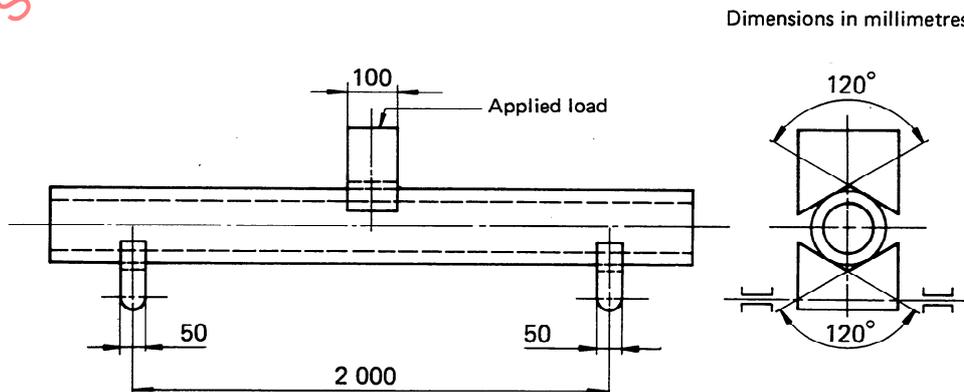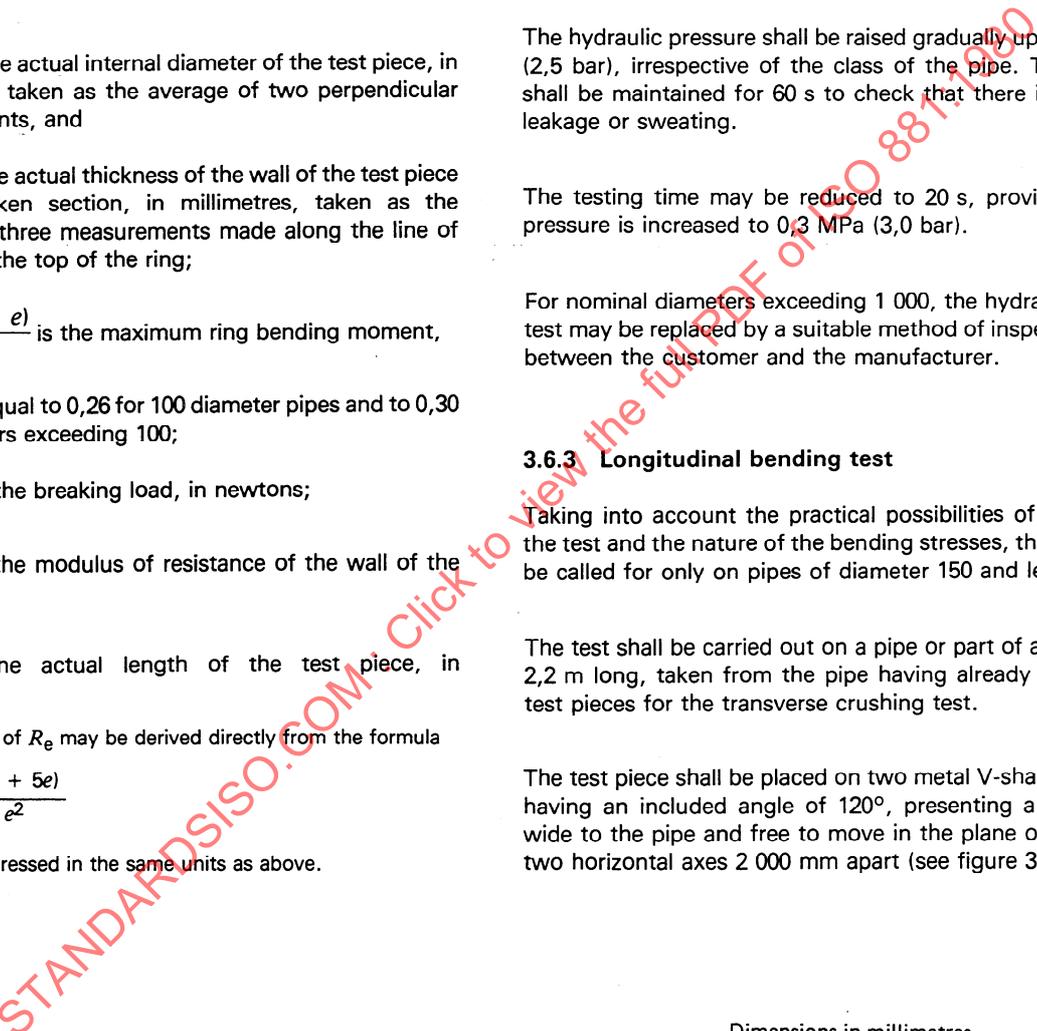
Dimensions in millimetres

Figure 3 — Loading in longitudinal bending test

The pipe shall be loaded at the centre of the distance between the supports by means of a metal pad having the same shape as the supports, but with a width of 100 mm. Strips of felt or soft fibre boards not more than 10 mm thick shall be interposed between the supports and the pipe, and between the pad and the pipe. The applied load shall be raised gradually to breaking point at a rate of 400 to 600 N per second.

3.6.4 Chemical resistance test

The test shall be carried out on an uncoated test piece cut from the central part of each item selected. The test piece shall be 65 mm in length and 65 mm in width (following the curve), its total surface area (edges inclusive) being approximately 100 cm^2.

3.6.4.1 Reagents

3.6.4.1.1 Acetic acid, 5 % solution.

Standardize this solution as follows :

Take 10 ml of the solution, add 10 drops of the thymol blue solution (3.6.4.1.3), and dilute to 100 ml, while stirring. Titrate with the sodium hydroxide solution (3.6.4.1.2) until the colour changes from yellow to blue, corresponding to a modification of the pH of 8,0 to 9,5. Record the volume V_1, in millilitres, of the sodium hydroxide solution used for the titration.

3.6.4.1.2 Sodium hydroxide, 0,5 N standard volumetric solution.

1 ml of this solution corresponds to 0,030 g of acetic acid.

3.6.4.1.3 Thymol blue solution

Dissolve 0,040 g of thymol blue in 100 ml of 95 % (V/V) ethanol.

3.6.4.2 Procedure

Immerse the test piece in 270 ml of the acetic acid solution (3.6.4.1.1) at a temperature between 14 and 18 °C, in a container permitting the complete vertical immersion of the test piece. Use a different container for each test piece.

After 24 h, remove the test piece, and mix the solution well. Take 10 ml of the solution, add 10 drops of the thymol blue solution (3.6.4.1.3), and dilute to 100 ml, while stirring. Titrate as described in 3.6.4.1.1. Record the volume V_2, in millilitres, of the sodium hydroxide solution (3.6.4.1.2) used. The small amount of gelatinous precipitate which may be formed during the titration may be ignored.

3.6.4.3 Expression of results

The number of grams of acetic acid neutralized per square centimetre of area of the test piece is given by the formula

$$0,03 \, \frac{270 \, (V_1 - V_2)}{10A}$$

$$= 0,81 \, \frac{V_1 - V_2}{A}$$

where

V_1 is the volume, in millilitres, of the sodium hydroxide solution (3.6.4.1.2) used in the standardization of the acetic acid solution (3.6.4.1.1);

V_2 is the volume, in millilitres, of the sodium hydroxide solution (3.6.4.1.2) used in the titration of the acetic acid solution after immersion of the test piece;

A is the total surface area of the test piece, in square centimetres.

3.7 Marking

The pipes shall be marked legibly and indelibly as follows :

— manufacturer's mark (indicating company of origin);

— date of manufacture;

— nominal diameter;

— series, followed by a word or symbol indicating that these pipes are for sewerage use.

4 Joints

4.1 Materials

4.1.1 Asbestos-cement sleeves intended for the jointing of pipes or fittings shall comply with the requirements of 3.1. Where jointing devices of other materials are used, such materials shall comply with the relevant International Standards, unless otherwise agreed between purchaser and manufacturer.

4.1.2 Sealing rings shall be of rubber of a type suitable for use with the liquid to be conveyed and shall conform to the relevant International Standards, unless otherwise agreed between purchaser and manufacturer. They shall also be suitable for use with the type of jointing device selected.

4.2 Characteristics

4.2.1 Geometrical characteristics

4.2.1.1 Dimensions

The dimensions and the shape of all parts of the sleeves or sockets, including the rubber rings, shall be determined by the manufacturer of the pipes.

The joints, when mounted, shall ensure the permanent tightness of the pipeline against both leakage and infiltration.

4.2.1.2 Tolerances

The tolerances on all dimensions of the sleeves or sockets shall be established by the manufacturer, taking into account the tolerances on the sealing rings and on the external diameters of the pipe ends.

4.2.2 Sealing characteristics

Where mounted on the pipes and fittings with which they are to be used, the joints shall withstand an internal pressure of 0,1 MPa (1 bar), even when the pipes are set at the maximum angular deviation recommended by the manufacturer.

4.3 Marking

As for the corresponding pipes (see 3.7) with the exception of the date of manufacture.

5 Fittings

5.1 Composition

The fittings shall comply with the composition requirement of 3.1.

Epoxy resin or other suitable material may be used for jointing the individual pieces of fabricated fittings.

5.2 Classification and types

The fittings when installed in the pipeline and, if necessary, surrounded with lean concrete, shall be of equivalent strength to that of the adjacent pipes. The basic types of fittings are bends, angle junctions, equal or unequal tees, double sockets, sleeves and saddles.

5.3 Characteristics

5.3.1 General appearance and finish

The fittings shall comply with the requirements of 3.4.

5.3.2 Geometrical characteristics

The main dimensions shall conform to those in the national standards or, failing this, shall be as specified in the manufacturers' catalogues.

5.3.2.1 Nominal diameter

The series of nominal diameters of the fittings shall correspond to the nominal diameters of the pipes as given in 3.5.1.1.

5.3.2.2 Thickness

The thickness in the barrel of the fitting shall be at least equal to that specified by the manufacturer for the corresponding pipe.

5.3.2.3 Tolerances

a) Variation of the internal diameter (tolerance of ovality) : as for the corresponding pipes [see 3.5.1.4 a)].

b) Nominal thickness of the walls (barrel of the fitting) :

— upper deviation : free;

— lower deviation : − 1,5 mm.

NOTE — The tolerances on fittings manufactured from pipes should correspond to those of the pipes of the same wall thickness [see 3.5.1.4 c)].

5.3.3 Physical characteristics

Tested as prescribed in 5.4.1 (optional test), the fittings shall not show any damage, leakage or sweating.

5.3.4 Mechanical characteristics

Tested as prescribed in 5.4.2 (optional test), the fittings shall not fracture or show any crack under a load less than 90 % of the total load stated for the pipes of corresponding series and diameter [3.6.1 a)], this load being calculated in relation to the length of the axis of the fitting actually loaded.

No minimum transverse crushing stress is required for fittings.

5.3.5 Chemical characteristics

Tested as prescribed in 5.4.3 (optional test), the fittings shall not show a neutralization of acetic acid exceeding 0,100 g per square centimetre.

5.4 Optional tests at purchaser's request

These tests are carried out on dry fittings.

a) Internal hydraulic pressure test (methods as specified in 5.4.1).

b) Crushing test (method as specified in 5.4.2).

c) Chemical resistance test (method as specified in 5.4.3).