International Standard 160

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Asbestos-cement pressure pipes and joints

Tuyaux et joints en amiante-ciment pour canalisations avec pression

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

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Belgium
China
USSR

This International Standard cancels and replaces ISO Recommendation R 160-1971, of which it constitutes a technical revision.

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Asbestos-cement pressure pipes and joints

1 SCOPE AND FIELD OF APPLICATION

This International Standard gives specifications relating to asbestos-cement pipes and joints intended for use under pressure; it defines certain conditions of manufacture, classification, characteristics and acceptance tests applicable to these products.

NOTE – Building and sanitary pipes in asbestos-cement are covered by ISO 391.[1)] Asbestos-cement pipe fittings for building and sanitary purposes are covered by ISO 392[1)]. Asbestos-cement pipes, joints and fittings for sewerage and drainage are covered by ISO 881[1)].

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.*

ISO 4483, *Asbestos-cement pipelines – Field pressure testing.*

3 PIPES

3.1 Composition

The pipes shall be made from a close and homogeneous mixture essentially consisting of a suitable inorganic hydraulic binder[2)], asbestos fibre and water, excluding any materials liable to cause ultimate deterioration in the quality of the pipes.[3)]

3.2 Classification

3.2.1 *Pipes of nominal diameter up to 1 000*

Pipes of nominal diameter up to 1 000 are classified according to the works hydraulic test pressures given in table 1.

TABLE 1 – **Classification**

Classes	Works hydraulic test pressure, TP	
	MPa	bar
5	0,5	5
6	0,6	6
10	1,0	10
12	1,2	12
15	1,5	15
18	1,8	18
20	2,0	20
24	2,4	24
25	2,5	25
30	3,0	30
35	3,5	35
36	3,6	36

NOTE – For pipes of nominal diameter from 600 to 1 000, the procedure given in 3.2.2 may also be used.

The purchaser's engineer; who is qualified to judge the conditions of laying and operational suitability of the pipes, must decide the class of pipe to be used, in relation to the hydraulic working pressure and other conditions of laying and of operation he has determined.

For choosing the class of pressure pipes subject to external loads, see ISO 2785.

1) At present at the stage of draft. (Revisions of ISO/R 391, ISO/R 392 and ISO/R 881.)

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

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

The relationship between the bursting pressure BP and the works hydraulic test pressure TP, and the relationship between the bursting pressure BP and the hydraulic working pressure WP* shall not be less than the values indicated in table 2.

3.2.2 *Pipes of nominal diameter exceeding 1 000*

Pipes of nominal diameter exceeding 1 000 are not classified in the same way as defined in 3.2.1. They are designed to suit the specific requirements of any particular pipeline.

The purchaser's engineer, who is qualified to judge the conditions of laying and operational suitability of the pipes, shall provide the manufacturer with all required data for the design of a suitable pipe. The design shall take into account the crushing loads for pipes of nominal diameter > 600 in accordance with the recommendations given in ISO 2785 or other relevant International Standard for asbestos-cement pipes and shall be subject to the approval of the purchaser's engineer.

The relationship between the bursting pressure BP and the works hydraulic test pressure TP, and the relationship between the bursting pressure BP and the hydraulic working pressure WP* shall not be less than the values indicated in table 2.

TABLE 2 — **Pressure relationships**

Nominal diameters	$\frac{BP}{TP}$	$\frac{BP}{WP^*}$
from 50 to 100	2	4
from 125 to 200	1,75	3,5
from 250 to 500	1,5	3
from 600 to 1 000	1,5	2,5
from 1 100 to 2 500	1,5	2,5

*WP includes unavoidable surpressures

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. The pipes may be coated internally and/or externally with a suitable coating if required by the purchaser's engineer.

The part of the pipe where the rubber jointing rings are located shall satisfy the tolerances on the external diameter as defined in 3.5.1.4 a), for a length appropriate to the type of joint adopted, and shall be free from irregularities which could affect the water tightness.

The shape of the finished ends shall be fixed by the manufacturer to suit the type of joint used.

3.5 Characteristics

3.5.1 *Geometrical characteristics*

3.5.1.1 NOMINAL DIAMETER

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

The series of nominal diameters is given in table 3. Nominal diameters not shown within parentheses are preferable.

TABLE 3 — **Nominal diameters**

50	900
60	1 000
75 or 80	(1 100)
100	1 200
125	(1 300)
150	1 400
175	1 500
200	1 600
250	(1 700)
300	1 800
350	(1 900)
400	2 000
450	(2 100)
500	2 200
600	(2 300)
700	2 400
800	2 500

NOTES

1 For sizes not exceeding 1 000, national standards may continue to permit manufacturing internal diameters which differ from the nominal diameters given in table 3 by more than allowed by the application of the relevant tolerances (see 3.5.1.4), provided that such manufacturing internal diameters are shown in the manufacturer's literature and in tenders.

2 National standards may continue to permit, for an interim period, nominal diameters of 375, 525, 750, 825 and 975.

In both cases (notes 1 and 2) the ultimate aim shall be towards conformity between the manufactured internal diameters and the nominal diameters given in table 3.

3.5.1.2 THICKNESS OF WALL

The nominal thickness and the method and point 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 5.2.4).

3.5.1.4 TOLERANCES

a) External diameter of finished ends

The tolerances on the external diameter of the finished 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 diameter $\leqslant$ 500 shall 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[1] 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[1] diameter, in millimetres.

If required, the regularity of the internal diameter of pipes $>$ 500 mm 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 ± 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

On jointing surfaces at the pipe ends, the lower deviations of the tolerances are as follows :

— 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

NOTES

1 Upper deviations are free.

2 For pipes of 50 and 60 mm diameter, the above tolerances are allowable provided that the variation of the internal diameter resulting from their application does not exceed — 5 mm.

3 The thickness at any point along the barrel of the pipe should be not less than that obtained by application of the tolerances given in 3.5.1.4 c) to the nominal thickness.

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, to be chosen by the manufacturer :

— 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 [see figure 1b)].

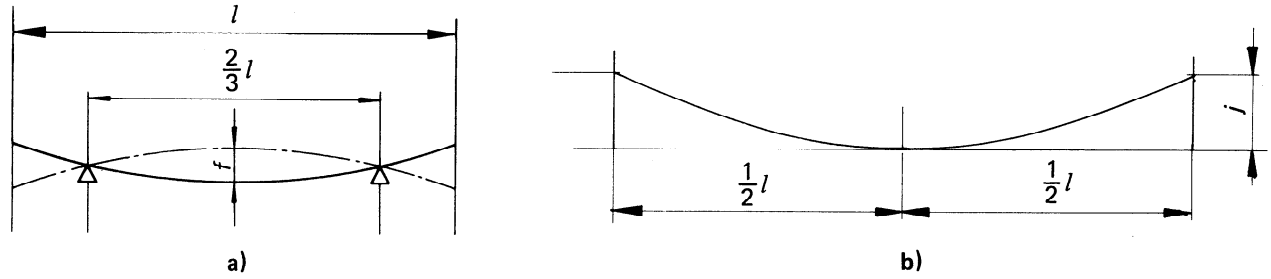

FIGURE 1 — **Measurement of straightness**

1) Or the manufacturing diameter, if different from the nominal diameter (see 3.5.1.1).

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 4.

TABLE 4 — **Maximum deviations from straightness**

Nominal diameter	f mm	j mm
from 50 to 150	5,5 l	6,5 l
from 175 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 3.6.1 (compulsory test for all pipes), the pipes shall show no fissure, leakage or sweating.

3.5.3 *Mechanical characteristics*

3.5.3.1 BURSTING

Tested as prescribed in 3.6.2, the pipes shall have a minimum unit bursting strength of 22 N/mm^2 except that for diameters exceeding 1 200 mm this strength may be reduced by not more than 20 % by agreement between manufacturer and purchaser provided that the safety factors specified in ISO 2785 for large diameter pipes are maintained (see 3.2.2).

3.5.3.2 CRUSHING

Tested as prescribed in 3.6.3, the pipes shall have a minimum unit transverse crushing strength of 44 N/mm^2, except that for diameters exceeding 1 200 mm this strength may be reduced by not more than 20 % by agreement between manufacturer and purchaser provided that the safety factors specified in ISO 2785 for large diameter pipes are maintained.

3.5.3.3 BENDING

Tested as prescribed in 3.6.4 (test limited to pipes with a nominal diameter less than or equal to 150 mm), the pipes shall have a minimum unit bending strength of 24,5 N/mm^2.

NOTES

1 Mechanical characteristics may be expressed in ultimate loads; however, the unit strengths determined by the tests prescribed in 3.6.2, 3.6.3 and 3.6.4 should be not less than those indicated in 3.5.3.1, 3.5.3.2 and 3.5.3.3 respectively.

2 Tests on non-immersed specimens may be specified, in which case the following values shall apply :

- minimum unit bursting strength[1)] : 24 N/mm^2
- minimum unit transverse crushing strength[1)] : 48,5 N/mm^2
- minimum unit bending strength : 27 N/mm^2

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 tests

1 Works hydraulic pressure tightness test on all pipes (method as specified in 3.6.1).

When nominal diameters exceed 1 000, this test may be replaced by a suitable method of control agreed between the purchaser and manufacturer.

2 Hydraulic pressure bursting test (methods as specified in 3.6.2; number of tests as specified in ISO 390).

3 Transverse crushing test for diameters equal to or greater than 600 mm (method as specified in 3.6.3; number of tests as specified in ISO 390).

b) Optional tests at purchaser's request

4 Transverse crushing test for diameters smaller than 600 mm (method as specified in 3.6.3; number of tests as specified in ISO 390).

5 Longitudinal bending test (method as specified in 3.6.4; number of tests as specified in ISO 390). Test limited to pipes of 150 mm diameter and less.

3.6.1 *Works hydraulic pressure tightness test*

The pipes shall be placed in a testing apparatus, the tightness of the ends being ensured by an appropriate device. The internal pressure shall be measured by a pressure gauge calibrated to give accurate readings within 0,05 MPa (0.5 bar).

The hydraulic pressure shall be raised gradually until the gauge registers a figure corresponding to the class. This pressure shall be maintained for 30 s to check that there is no fissure, leakage or sweating.

The duration of the test may be reduced to 5 s for pipes of 350 mm diameter or less, without changing the class, provided that the internal pressure is increased by 10 %.

3.6.2 *Hydraulic pressure bursting test*

The test shall be carried out on a test piece after immersion in water for 48 h (see 3.5.3, note 2), using either internal or external sealing arrangements, according to the choice of the manufacturer. Pipes of nominal diameters exceeding 2 000 shall be tested with internal sealing only. The length of the test piece depends on the method of sealing when put under pressure and shall be as follows :

a) if the test piece is sealed internally, its length shall be not less than 500 mm and not more than 1 000 mm for all diameters;

1) The bursting and crushing strengths may be reduced by not more than 20 % in the case of diameters exceeding 1 200 mm (see 3.5.3.1 and 3.5.3.2).

b) if the test piece is sealed externally, its minimum length shall be as indicated in table 5 or calculated from the formula

$$l = 500 + 2a + 6{,}5d\sqrt{\frac{e}{d}}$$

where

l is length of the test piece, in millimetres;

a is the distance between the plain end of the test piece and the sealing rubber ring, in millimetres;

e is the nominal wall thickness, in millimetres;

d is the diameter, in millimetres.

TABLE 5 — **Test piece lengths**

Nominal diameter	Minimum length of bursting test piece mm
from 50 to 100	750
from 125 to 250	1 000
from 300 to 500	1 500
from 600 to 700	2 000
from 800 to 1 000	2 500
from 1 100 to 1 300	3 000
from 1 400 to 1 600	3 500
from 1 700 to 2 500	4 000

NOTE — In case a), the test piece shall be cut from the barrel of the pipe without machining.

In case b), the ends of the test piece may be machined to not less than the nominal wall thickness, including tolerances.

The test piece shall be put under pressure in a suitable device designed to avoid any axial compression of the pipe when the pressure approaches its ultimate value.

The hydraulic pressure shall be applied at a constant rate and shall be regulated so that the rupture occurs after at least 15 s and more than 30 s.

The unit bursting strength R_t, expressed in newtons per square millimetre, is given by the formula

$$R_t = \frac{p\,(d + e)}{2\,e}$$

where

p is the internal pressure at rupture, in megapascals;

d is the actual internal diameter of the test piece, in millimetres, taken as the average of two perpendicular measurements made at both ends of the test piece;

e is the actual thickness of the wall of the test piece in the broken section, in millimetres, taken as the average of three equidistant measurements along the whole line of fracture.

NOTE — When agreed between purchaser and manufacturer, the tensile tangential strength of the material may be determined by another acceptable method which does not involve application of internal hydraulic pressure.

3.6.3 *Transverse crushing test*

The test shall be carried out on a piece of pipe of a length cut to

— 200 mm for pipes of nominal diameters from 50 to 300,

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

after immersion for 48 h in water (see 3.5.3, note 2).

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.

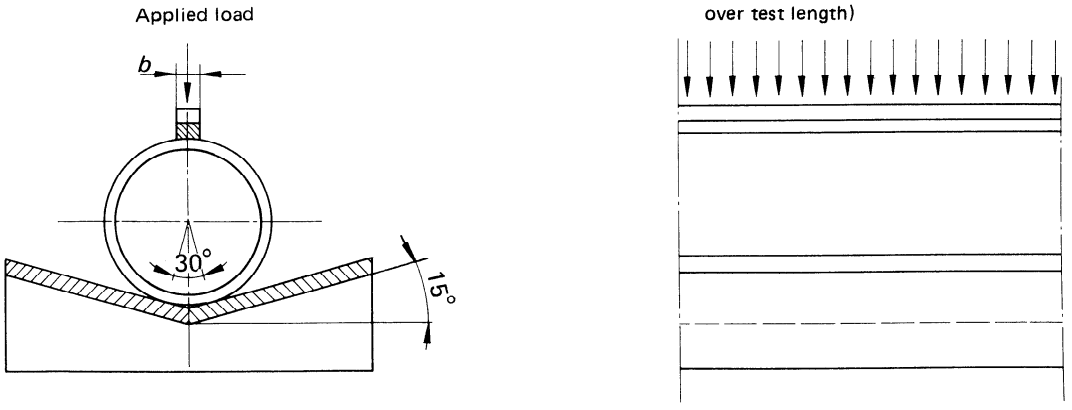

FIGURE 2 — **Loading in transverse crushing test**