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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

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R 160

ASBESTOS-CEMENT PRESSURE PIPES

2nd EDITION

April 1971

This second edition supersedes the first edition

For each individual country the only valid standard is the national standard of that country.

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BRIEF HISTORY

The ISO Recommendation R 160, *Asbestos cement pressure pipes*, was drawn up by Technical Committee ISO/TC 77, *Products in asbestos-cement*, the Secretariat of which is held by the Association Suisse de Normalisation (SNV).

Work on this question led to the adoption of Draft ISO Recommendation No. 149, which was circulated to all the ISO Member Bodies for enquiry in October 1956. The results of this consultation having been deemed unsatisfactory, a second Draft ISO Recommendation No. 149 was submitted to all ISO Member Bodies in June 1959. It was approved by 26 Member Bodies. Three Member Bodies opposed the approval of the second Draft (Brazil, India, Mexico).

This second Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in 1960, to accept it as an ISO RECOMMENDATION.

BRIEF HISTORY RELATING TO THE SECOND EDITION

Technical Committee ISO/TC 77 decided to undertake the revision of ISO Recommendation R 160-1960 in 1963. Work on this question led to the adoption of Draft ISO Recommendation No. 1895, which was circulated to all the ISO Member Bodies for enquiry in June 1970. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	Italy	South Africa, Rep. of
Austria	Japan	Spain
Belgium	Korea, Rep. of	Switzerland
Czechoslovakia	Netherlands	Thailand
Denmark	New Zealand	Turkey
France	Norway	U.A.R.
Germany	Poland	United Kingdom
Ireland	Portugal	
Israel	Romania	

The following Member Bodies opposed the approval of the Draft :

India	Sweden
Mexico	U.S.A.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as the second edition of ISO Recommendation R 160.

This edition (second edition) cancels and replaces the first edition of ISO Recommendation R 160.

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ASBESTOS-CEMENT PRESSURE PIPES*

1. SCOPE

This ISO Recommendation applies to asbestos-cement pipes, and their joints, intended for use under pressure.

It defines certain conditions of manufacture, the classification, the characteristics and acceptance tests applicable to these products.

2. PIPES

2.1 Composition

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

2.2 Classification

2.2.1 *Classes.* The pipes are classified according to the hydraulic test pressure as shown in Table 1.

TABLE 1

SERIES I

Classes (in ft H_2O)	Hydraulic test pressure (TP)		
	MN/m^2	kgf/cm^2	lbf/in^2
Class 200	0.6	6	85
Class 400	1.2	12	170
Class 600	1.8	18	255
Class 800	2.4	24	340
Class 1000	3	30	425

SERIES II

Classes (in kgf/cm^2)	Hydraulic test pressure (TP)		
	MN/m^2	ft H_2O	lbf/in^2
Class 5	0.5	165	70
Class 10	1	330	140
Class 15	1.5	495	215
Class 20	2	660	285
Class 25	2.5	825	355
Class 30	3	1000	425

* See also ISO Recommendation R 391, *Building and sanitary pipes in asbestos-cement,* and ISO Recommendation R 881, *Asbestos-cement pipes, joints and fittings for sewerage and drainage.*

** This ISO Recommendation also applies to autoclaved pipes, when the binder is partially replaced by ground silica.

2.2.2 *Choice of the class.* This classification being based on the hydraulic test pressure, the pipe must be chosen in such a way that the hydraulic working pressure (WP) does not normally exceed one half (50 %) of the pressure defining the class.

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

The relationship between the bursting pressure BP and the hydraulic test pressure TP and the relationship between the bursting pressure BP and the normal hydraulic working pressure WP should be not less than the values indicated in Table 2.

TABLE 2

Nominal diameters mm	$\frac{BP}{TP}$	$\frac{BP}{WP}$
from 50 to 100	2	4
from 125 to 200	1.75	3.5
from 250 to 1000	1.5	3

NOTE. – For nominal diameters of 600 to 1000 mm, excluding the two first classes, the relations of 1.5 and 3 may be reduced to 1.25 and 2.5 respectively, provided that the resistance necessary to the crushing loads in the trench does not justify the choice of a higher class.

2.3 Types

The pipes may be either of the type with socket, or of the type with plain ends.

2.4 General appearance and finish

The internal surface of the pipes should be regular and smooth.

Since the pipes are to be laid with rubber jointing rings, the part of the pipe where the rings are located should satisfy the tolerances of the external diameter, set out in clause 2.5.1.4 (*a*), for a length appropriate to the type of joint adopted, and should be free from any local irregularity which could affect the tightness.

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

2.5 Characteristics

2.5.1 *Geometrical characteristics*

2.5.1.1 NOMINAL DIAMETER. The nominal diameter of the pipes corresponds to their internal diameter (bore), tolerances not being taken into account.

The series of nominal diameters is given in Table 3. The dimensions in millimetres and in inches are considered to be "corresponding values", although they are only approximate.

TABLE 3

Nominal diameters	
millimetres	inches (approx.)
50	2
60	–
80 (75)*	3
100	4
125	5
150	6
175	7
200	8
250	10
300	12
350	14 (15)*
400	16
450	18
500	20 (21)*
600	24
700	28 (27)*
800	32 (33)*
900	36
1000	40 (39)*

* For national standards, either of the sizes may be chosen.

2.5.1.2 THICKNESS OF WALL. The nominal thicknesses, as well as the points of measurement, should be specified in the national standards or in the manufacturer's catalogues, taking into consideration all the requirements provided for in this ISO Recommendation. The actual thickness should be at least 8 mm.

2.5.1.3 LENGTH. The nominal length of the pipes corresponds to the length measured between the extremities for pipes with plain ends and to the useful length for socketed pipes. It should normally be not less than

– 3 m for pipes with a nominal diameter equal to or less than 100 mm ;
– 4 m for pipes with a nominal diameter exceeding 100 mm.

The nominal length should preferably be a multiple of 0.50 m.

2.5.1.4 TOLERANCES ON THE DIMENSIONS

(*a*) *External diameter of finished ends*

The tolerances on the external diameter of the finished ends where jointing rings are located (plain ends) should be established by the manufacturer according to the type of joint used and taking into account the tolerances acceptable in respect of jointing rings.

However, they should be not greater than the following values :

– from 50 to 300 mm : ± 0.6 mm
– from 350 to 500 mm : ± 0.8 mm
– from 600 to 700 mm : ± 1.0 mm
– from 800 to 1000 mm : ± 1.2 mm

(*b*) *Regularity of the internal diameter (Roundness)* (optional test)

The regularity of the internal diameter may be checked by means of a sphere or a disk, of a material unaffected by water, passing freely in the pipe.

The disk should be kept perpendicular to the axis of the pipe. The diameter of the sphere or the disk should be less than the nominal internal diameter of the pipe by the following value, expressed in millimetres :

$$2.5 + 0.01\,d$$

d being the nominal diameter, expressed in millimetres.

NOTE. – In the acceptance conditions it should be made clear that this test will only be applied on the special request of the purchaser, to whose attention the mention of "optional test" in the title is called.

(*c*) *Nominal thickness of the walls*

(1) *at finished ends*

for nominal thicknesses

- 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 : ± 3.0 mm

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

(2) *on the barrel of the pipe*

The thickness at any point should be not less than that obtained by the application of the tolerances given in 2.5.1.4 (*c*) (1).

NOTE. – The wall thickness should be not less than 8 mm after application of the tolerance in order to comply with clause 2.5.1.2.

(*d*) *Nominal length*

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

(*e*) *Straightness* (optional test)

The straightness may be checked 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 Fig.1).

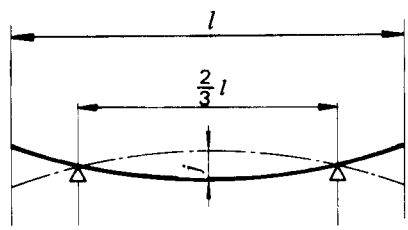

FIG. 1

The deviation j, expressed in millimetres, measured on the external surface at mid-span should not exceed the following values :

for nominal diameters

- from 50 to 60 mm : 5.5 l
- from 80 to 200 mm : 4.5 l
- from 250 to 500 mm : 3.5 l
- from 600 to 1000 mm : 2.5 l

where l is the nominal length of the pipe, expressed in metres.

2.5.2 *Physical characteristics*

Tested as prescribed in clause 2.6.1 (compulsory test for all pipes), the pipes should have no fissure, leaking or visible sweating on their outside surface.

2.5.3 *Mechanical characteristics*

2.5.3.1 BURSTING. Tested as prescribed in clause 2.6.2 (compulsory test), the pipes should have a minimum unit bursting strength of 22 MN/m^2 (225 kgf/cm^2)

2.5.3.2 CRUSHING. Tested as prescribed in clause 2.6.3 (optional test), the pipes should have a minimum unit transverse crushing strength of 44 MN/m^2 (450 kgf/cm^2).

2.5.3.3 BENDING. Tested as prescribed in clause 2.6.4 (optional test, limited to pipes with a nominal diameter less than or equal to 150 mm), the pipes should have a minimum unit bending strength of 24.5 MN/m^2 (250 kgf/cm^2).

NOTES

1. National standards may provide for mechanical characteristics expressed in absolute values; however, the unit strengths determined by the tests prescribed in clauses 2.6.2, 2.6.3 and 2.6.4, should be not less than those indicated in clauses 2.5.3.1, 2.5.3.2 and 2.5.3.3 respectively.
2. When national standards specify tests on non-immersed pipes, the following values should apply :
   - minimum unit bursting strength : 23.5 MN/m^2 (240 kgf/cm^2);
   - minimum unit transverse crushing strength : 49 MN/m^2 (500 kgf/cm^2);
   - minimum unit bending strength : 27 MN/m^2 (275 kgf/cm^2).

2.6 Tests

The acceptance tests should be carried out at the manufacturer's works on pipes which the manufacturer guarantees to be sufficiently matured.

(*a*) COMPULSORY TESTS

1. Internal hydraulic pressure tightness test on all pipes (method as specified in clause 2.6.1).
2. Internal hydraulic pressure bursting test (method as specified in clause 2.6.2; number of tests as specified in ISO Recommendation R 390, *Sampling and inspection of asbestos-cement products*).

(*b*) OPTIONAL TESTS AT PURCHASER'S REQUEST

3. Transverse crushing test (method as specified in clause 2.6.3; number of tests as specified in ISO Recommendation R 390).
4. Longitudinal bending test (method as specified in clause 2.6.4; number of tests as specified in ISO Recommendation R 390).

2.6.1 *Internal hydraulic pressure tightness test.* The pipes should be placed on a hydraulic press, the tightness of the ends being ensured by an appropriate device. The internal pressure should be measured by a pressure gauge calibrated to give accurate readings.

The internal hydraulic pressure should be raised gradually until the gauge registers a figure corresponding to the class. This pressure should be maintained for 30 seconds to check that there is no fissure, leakage or visible sweating on the outside surface.

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

2.6.2 *Internal hydraulic pressure bursting test.* The test should be carried out on a test piece after immersion in water for 48 hours. The length of the test piece should be such that the distance between the sealing rings is

- 500 mm for pipes of diameter from 50 to 500 mm;
- 1000 mm for pipes of diameter from 600 to 1000 mm.

The test piece should be taken from the end of a pipe and partly machined, if necessary, to the external diameter corresponding to the nominal thickness. It should be put under pressure by a device based on the method of jointing used in actual practice and avoiding as far as possible any axial compression of the pipe.

The load should be applied at a constant speed and should be regulated so that the rupture occurs after at least 25 seconds.

The unit bursting strength R_t, expressed in meganewtons per square metre, is given by the formula

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

where

p is the internal hydraulic pressure at rupture, expressed in meganewtons per square metre;

d is the actual internal diameter of the test piece, expressed in millimetres;

e is the actual thickness of the wall of the test piece in the broken section, expressed in millimetres; take as the thickness the average of three measurements made along the line of fracture in the unmachined part.

2.6.3 *Transverse crushing test.* The test should be carried out on a piece of pipe

- 200 mm long for pipes of diameter from 50 to 250 mm.
- 300 mm long for pipes of diameter from 300 to 1000 mm.

after immersion for 48 hours in water.

Strips of felt or soft wooden fibre boards not more than 10 mm thick should be interposed between the press plates and the test piece. The load should be applied at a constant speed and should be regulated so that the rupture occurs after at least 25 seconds.

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

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

where

$$M_e = \frac{1}{2\pi} P_e\,(d+e)$$

$$W_e = \frac{1}{6} l_1\, e^2$$

P_e being the breaking load, expressed in newtons;

d being the actual internal diameter of the test piece, expressed in millimetres;

e being the actual thickness of the wall of the test piece in the broken section, expressed in millimetres; take as the thickness the average of three measurements made along the line of fracture;

l_1 being the actual length of the test piece, expressed in millimetres.

NOTE. – The value R_e may be derived directly from the formula

$$R_e = 0.955\,\frac{P_e\,(d+e)}{l_1\, e^2}$$

the terms being expressed in the same units as above.

2.6.4 *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 150 mm diameter and less.

The test should be carried out on a whole pipe or part of a pipe at least 2.20 m long, which has been immersed in water for 48 hours. The test piece should be placed on two metal supports which are V-shaped with an opening of 120°, presenting a face 50 mm wide to the pipe and free to move in the plane of bending on two horizontal axes 2000 mm apart (see Fig. 2)

Dimensions in millimetres

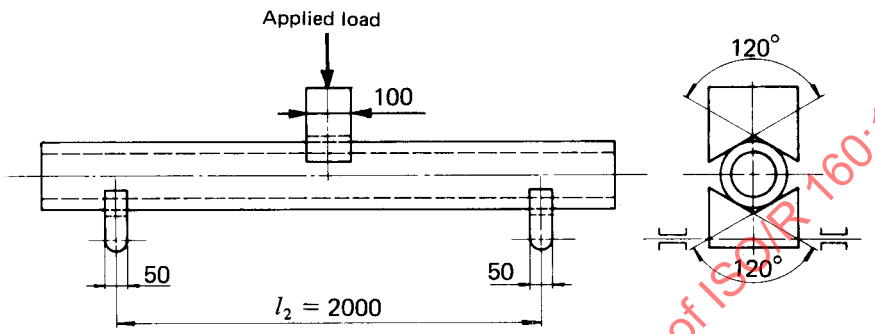

FIG. 2

The pipe should 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 wooden fibre boards not more than 10 mm thick should be interposed between the supports and the pipe, and the pad and the pipe. The load should be applied at a constant speed and should be regulated so that rupture occurs after at least 25 seconds.

The unit longitudinal bending strength R_f, expressed in meganewtons per square metre, is given by the formula

$$R_f = \frac{M_f}{W_f}$$

where

$$M_f = \frac{P_f l_2}{4}$$

$$W_f = \frac{\pi}{32} \times \frac{(d + 2e)^4 - d^4}{d + 2e}$$

P_f being the breaking load, expressed in newtons;

l_2 being the distance between centres of supports, expressed in millimetres;

d being the actual internal diameter of the pipe, expressed in millimetres;

e being the actual thickness of the wall of the pipe in the broken section, expressed in millimetres; take as the thickness the average of three measurements made along the line of fracture.

NOTE. – The value R_f may be derived directly from the formula

$$R_f = 2.547 \frac{P_f l_2 (d + 2e)}{(d + 2e)^4 - d^4}$$

the terms being expressed in the same units as above.

2.7 Marking

The pipes should be marked legibly and indelibly as follows :

- manufacturer's mark;
- date of manufacture;
- nominal diameter;
- class.

The method of marking should conform to the national standards of the producing country.

3. JOINTS

3.1 Jointing

The pipes are jointed by means of natural or synthetic rubber rings held in place by a suitable device.

3.2 Jointing rings

The jointing rings should be suitable for the type of joint selected. If the pipes are to be used to convey potable water, the rings should not affect the organoleptic properties of the water.

3.3 Parts of the joints

The parts of the joints, other than those made in asbestos-cement, should conform to the national standards of the producing country for the materials.

3.4 Characteristics

3.4.1 *Geometrical characteristics*

3.4.1.1 DIMENSIONS. The dimensions and the shape of all parts of the joints should be indicated by the manufacturer.

3.4.1.2 TOLERANCES. The tolerance on all dimensions of the joints or sockets should be established by the manufacturer, taking into account the tolerances of the rubber rings and the tolerances permitted by clause 2.5.1.4 (*a*) for the external diameter of the pipe.

3.4.2 *Physical characteristics.* The assembled joints, when tested at the factory, should be capable of withstanding the specified hydraulic test pressure (see clause 2.6.1) of the pipes on which they are to be used, even when the pipes are set at the maximum angular deviation indicated by the manufacturer of the joint.

4. INSPECTION AND ACCEPTANCE

Enquiries and orders should specify whether the consignment is to be delivered with or without acceptance tests. Failing this specification in the order, it is presumed to be with acceptance tests if agreements on the date of the tests or the nature of the optional tests have been made between the manufacturer and the purchaser. Otherwise, the consignment is presumed to be without acceptance tests.

4.1 Inspection of each item of the consignment

4.1.1 The required physical characteristics (see clause 2.5.2) of the pipes should be verified on each item of the consignment. The internal hydraulic pressure tightness test (see clause 2.6.1) should be carried out by the manufacturer; the purchaser, if he so desires, may be present while the tests are being carried out (see also clause 4.2.1).

4.1.2 The required general appearance and finish (see clause 2.4), the geometrical characteristics (see clauses 2.5.1* and 3.4.1, for the joints) and the marking (see clause 2.7) of the pipes may be verified on each item of the consignment.

4.1.3 The pipes and joints which do not satisfy the requirements when inspected as in clause 4.1.2 may be rejected.

* The checks on the regularity of the internal diameter and on the straightness (see clause 2.5.1.4 (*b*) and (*e*)) should be carried out only when specified in the order.