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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 160

ASBESTOS CEMENT PRESSURE PIPES

1st EDITION

June 1960

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

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Also issued in French and Russian. Copies to be obtained through the national standards organizations.

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).

The ISO/TC 77 Secretariat prepared the first draft proposal, which it circulated, in July 1952, to the Members of the Technical Committee. In the light of the results of this consultation, the Secretariat set up a second draft proposal, which was discussed during the first meeting of ISO/TC 77, held in Zurich, in May 1954. Pursuant to decisions adopted during that meeting, the Secretariat prepared a third draft proposal, which was circulated in December 1954.

The observations sent in by various Members of the Technical Committee induced the ISO/TC 77 Secretariat to put forward a fourth draft proposal, which the Technical Committee accepted by correspondence as a Draft ISO Recommendation, in June 1956.

This Draft ISO Recommendation (No. 149) was submitted on 31 October 1956 to all the ISO Member Bodies for enquiry. The results of this consultation having been deemed unsatisfactory, the Technical Committee presented a second Draft ISO Recommendation, which was submitted to all the ISO Member Bodies on 26 June 1959, and which was approved, subject to a few editorial modifications, by the following 26 Member Bodies:

Australia	Ireland	Romania
Austria	Israel	Spain
Belgium	Italy	Sweden
Burma	Japan	Switzerland
Chile	Netherlands	Union of South Africa
Czechoslovakia	New Zealand	United Kingdom
Denmark	Norway	U.S.S.R.
France	Poland	Yugoslavia
Germany	Portugal	

Three Member Bodies opposed the approval of the Draft:

Brazil India Mexico

The Draft ISO Recommendation was then submitted to the ISO Council, which decided, during its meeting of June 1960, to accept it as an ISO RECOMMENDATION.

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ISO Recommendation R 160 June 1960

ASBESTOS CEMENT PRESSURE PIPES

1. PURPOSE AND SCOPE

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

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

2. PIPES

2.1 Composition

Pipes should be made from a close and homogeneous mixture essentially consisting of cement, conforming to the national standards of the producing country, asbestos fibre and water, and excluding material liable to cause ultimate deterioration in the quality of the pipes.

2.2 Finish

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

Since pipes are to be laid with rubber ring joints, the surface on which the rings rest should satisfy the tolerances for the exterior diameters, set out in clause 2.5.1, for a sufficient length to suit the type of joint adopted.

2.3 Marking

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.

2.4 Classification and dimensions

2.4.1 *Classification.* Pipes are classed according to the tightness test pressure. Either of the following series of classes * may be chosen:

Classes: Series I

Feet head	kgf/cm² (approximately)
200	6
400	12
600	18
800	24

Classes: Series II

kgf/cm²	Feet head (approximately)
5	165
10	330
15	495
20	660
25	825

* The choice of the class of the pipes is determined by the purchaser's engineer, who alone is qualified to judge the conditions of laying and using the pipes. Nevertheless, it is recommended that a class be selected such that the working pressure does not exceed half the tightness test pressure (see clause 2.6.1) given for that class.

2.4.2 *Nominal diameters.* The nominal diameter of asbestos cement pipes corresponds to the internal diameter (bore), tolerances not being taken into account.

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

Series of nominal diameters

Millimetres	Inches (approximately)	Millimetres	Inches (approximately)
50	2	350	14 or 15
60	—	400	16
80	3	450	18
100	4	500	20 or 21
125	—	600	24
150	6	700	—
200	8	800	—
250	10	900	—
300	12	1 000	—

2.4.3 *Thickness.* The actual thickness should be at least 8 mm and be such that the tightness test pressure defining the class gives, in relation to the bursting pressure (see clause 2.6.2), a safety factor of not less than

2 for pipes up to 100 mm diameter,
1.75 for pipes from 125 to 200 mm diameter,
1.5 for pipes of 250 mm diameter and over.

NOTE: The bursting pressure (see clause 2.6.2) should be not less than the working pressure (equal to a maximum of 50 per cent of the tightness test pressure), multiplied by the coefficients 4, 3.5 and 3 respectively.

2.4.4 *Length.* The nominal length (length between extremities for pipes with plain ends, effective length for pipes with sockets) should be not less than

3 m for pipes of nominal diameter of 100 mm or less,
4 m for pipes of nominal diameter greater than 100 mm.

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

2.5 Tolerances on the dimensions

2.5.1 *Tolerances on the external diameter at finished ends*

DIMENSIONS IN MILLIMETRES

Nominal diameters		Tolerances
equal to and over	equal to and under	
50	300	± 0.6
350	500	± 0.8
600	700	± 1.0
700	1 000	± 1.2

NOTE: Should the tightness of certain types of joints necessitate more severe tolerances, these tolerances should be specified, when ordering, by agreement between the manufacturer and the purchaser.

2.5.2 *Tolerances on the internal diameter (bore) (tolerances of ovality)*, (optional test). The regularity of the internal diameter should be checked by means of a sphere or a disc, of a material unaffected by water, which should pass freely along the pipe.

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

$$2.5 + 0.01\ d$$

d being the internal diameter, 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 which attention is called in the title by the mention of "optional test".

2.5.3 *Tolerances on the thickness of the wall*

2.5.3.1 TOLERANCES AT FINISHED ENDS

DIMENSIONS IN MILLIMETRES

Nominal thickness *		Tolerances
over	under or equal to	
—	10	± 1.5
10	20	± 2.0
20	30	± 2.5
30	—	± 3.0

* Indicated by the manufacturer.

The above tolerances are also subject to the provision that the difference between any two internal diameters should never be greater than 10 per cent of the nominal internal diameter.

2.5.3.2 TOLERANCES ON THE BARREL OF THE PIPE. The thickness at any point should be not less than that laid down by the application of the tolerances given in clause 2.5.3.1.

NOTE: The wall thickness of a pipe should be not less than 8 mm after application of the tolerance in order to comply with clause 2.4.3.

2.5.4 *Tolerances on the nominal length*

Upper deviation: + 5 mm
Lower deviation: − 20 mm
for all lengths.

2.5.5 *Tolerances on the straightness.* The deviation j is determined by rolling the pipe under examination on two parallel runners placed at a distance apart equal to two thirds of its length l (see Fig. 1, page 7). The deviation should not exceed the following values:

DIMENSIONS IN MILLIMETRES

Nominal diameter		Maximum deviation j
equal to or over	equal to or under	
50	60	5.5 l *
80	200	4.5 l *
250	500	3.5 l *
600	1 000	2.5 l *

* l = length of the pipe, expressed in metres.

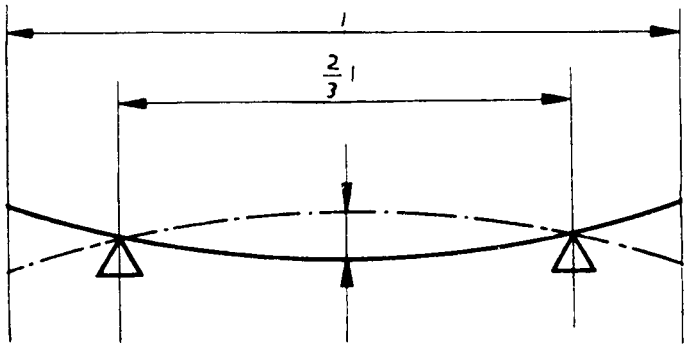

Fig. 1

2.6 Tests

Any acceptance tests are carried out at the manufacturer's works on pipes which the manufacturer guarantees to be sufficiently matured. There are two sorts of tests:

(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 clause 4.2.2).

(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 clause 4.2.2).
4. Longitudinal bending test (method as specified in clause 2.6.4; number of tests as specified in clause 4.2.2).

2.6.1 *Internal hydraulic pressure tightness test.* The pipes are placed in a hydraulic press, the tightness of the ends being ensured by an appropriate device.

The internal pressure is measured by a pressure gauge calibrated to give accurate readings. The internal hydraulic pressure is raised gradually until the gauge registers a figure corresponding to the class. This pressure is maintained for 30 seconds to check that there is no loss or visible sweating on the outside surface of the pipe.

The test time may be reduced to 10 seconds without modification of the class, provided that the internal pressure is increased by 10 per cent.

2.6.2 *Internal hydraulic pressure bursting test.* A piece not less than 50 cm long is taken from the end of a pipe and immersed in water for 48 hours. It is 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 distance between the sealing rings being not less than 45 cm, measured between the centres of the rings.

The piece is submitted to a pressure which is raised gradually and regularly to breaking point. The rate of increase of the pressure is 1 to 2 kgf/cm² per second.

The unit bursting stress R_t, expressed in kilogrammes-force per square centimetre, is given by the conventional formula:

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

where

p = internal hydraulic pressure, expressed in kilogrammes-force per square centimetre,
d = actual internal diameter of the pipe, expressed in centimetres,
e = actual thickness of the pipe in the broken section, expressed in centimetres.

The unit bursting stress R_t should be not less than 200 kgf/cm². *

2.6.3 *Transverse crushing test.* The test is carried out on a piece of pipe 20 cm long after immersion for 48 hours in water. Strips of felt or soft fibre not more than 1 cm thick are interposed between the press plates and the test piece. The load transmitted by the press is raised gradually so as to increase the stresses at the rate of 40 to 60 kgf/cm² per second up to breaking point.

The unit transverse crushing stress R_e, expressed in kilogrammes-force per square centimetre, is given by the conventional formula:

$$R_e = \frac{M}{W}$$

where

$$M = \frac{1}{2\pi} P (d + e)$$

$$W = \frac{1}{6} g e^2$$

P = breaking load, expressed in kilogrammes-force,
d = actual internal diameter of the pipe, expressed in centimetres,
e = actual thickness of the pipe in the broken section, expressed in centimetres,
g = actual length of the loaded specimen depending on the section of potential rupture, expressed in centimetres.

The unit transverse crushing stress R_e should be not less than 450 kgf/cm².**

NOTE: The value R_e may be derived from the formula:

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

the values being expressed in the same units.

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 is carried out on a pipe or part of a pipe (test piece) at least 2.20 m long which has been immersed in water for 48 hours. The test piece is placed on two metal supports. The supports are V-shaped with an opening of 120°, presenting a face 5 cm wide to the pipe and are free to move in the plane of bending on two horizontal axes 2 m apart (see Fig. 2, page 9).

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* Any tolerances on a similar bursting stress requirement, when specified by national standards, should not lead to the acceptance of values lower than the minimum indicated in this ISO Recommendation.

When national standards specify tests on non-immersed pipes, the unit bursting stress should be not less than 225 kgf/cm².

** Any tolerances on a crushing stress, when specified by national standards, should not lead to the acceptance of values lower than the minimum indicated in this ISO Recommendation.

When national standards specify tests on non-immersed pipes, the unit crushing stress should be not less than 500 kgf/cm².

Dimensions in millimetres

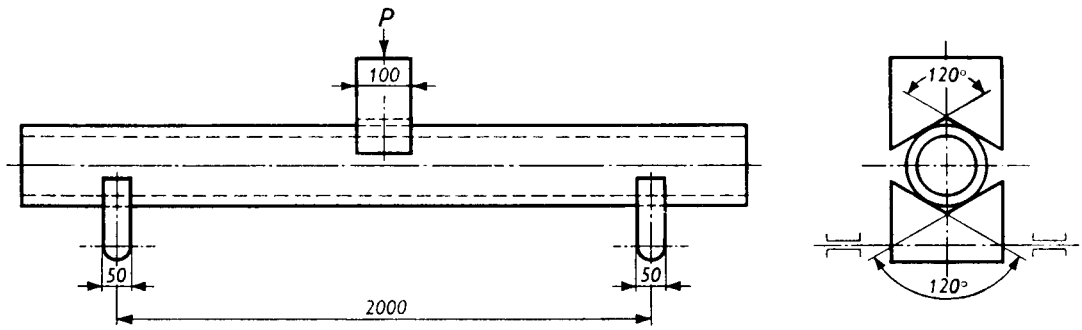

Fig. 2

The pipe is 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 10 cm. Strips of felt or soft fibre not more than 1 cm thick are interposed between the supports and the pipe, and the pad and the pipe. The applied load is raised gradually so as to increase the maximum stresses at the rate of 8 to 12 kgf/cm² per second up to breaking point.

The unit longitudinal breaking stress R_f, expressed in kilogrammes-force per square centimetre, is given by the conventional formula:

$$R_f = \frac{M}{W}$$

where

$$M = \frac{P\,l}{4}$$

$$W = \frac{\pi}{32}\,\frac{(d+2e)^4 - d^4}{d+2e}$$, expressed in cubic centimetres,

P = breaking load, expressed in kilogrammes-force,
l = distance between centres of supports, expressed in centimetres,
d = actual internal diameter of the pipe, expressed in centimetres,
e = actual thickness of the pipe in the broken part, expressed in centimetres.

The unit longitudinal breaking stress R_f should be not less than 250 kgf/cm².*

NOTE: The value R_f may be derived from the formula:

$$R_f = 2.547\,\frac{P\,l \cdot (d+2e)}{(d+2e)^4 - d^4},$$

the values being expressed in the same units.

3. JOINTS

3.1 Jointing

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 drinking water, the rings should not affect the quality 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 for the materials of the producing country.

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* Any tolerances on a bending stress, when specified by national standards, should not lead to the acceptance of values lower than the minimum indicated in this ISO Recommendation.
When national standards specify tests on non-immersed pipes, the unit bending stress should be not less than 275 kgf/cm².

3.4 Dimensions

The dimensions of all parts of the joints are those indicated by the manufacturer.

3.5 Tolerances

The tolerances on the internal diameter of the joints should be agreed with the manufacturer, taking account of the tolerances of the rubber rings and the tolerances permitted by clause 2.5.1 for the external diameter of the pipes.

3.6 Internal hydraulic pressure tightness test

The assembled joints should be capable of withstanding the specified tightness test pressure (see clause 2.6.1) of the pipes on which they are to be used, when the pipes are set at the maximum angular deviation indicated by the manufacturer of the joints.

4. ACCEPTANCE TESTS

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

4.1 Checking on each item of the consignment

4.1.1 *Finish–Marking–Dimensions*

4.1.1.1 The finish (see clause 2.2), the marking (see clause 2.3), the dimensions (see clauses 2.4.2, 2.4.3 and 2.4.4) and the tolerances on pipes and joints (see clauses 2.5.1, 2.5.3, 2.5.4, 2.5.5 and 3.5) may be verified on each item of the consignment.

4.1.1.2 The test on the regularity of the internal diameter (see clause 2.5.2) should be carried out only when required by the order.

4.1.2 *Length–Delivery tolerances.* At least 95 per cent of the pipes supplied should be of the nominal length (subject to the tolerances given in clause 2.5.4), and the remainder may be shorter by not more than one metre. However, the total length of the pipes supplied should be not less than the length ordered.

4.1.3 *Internal hydraulic pressure tightness test.* The internal hydraulic pressure tightness test (see clause 2.6.1) should be carried out by the manufacturer on all pipes. The purchaser, if he so desires, may be present while the tests are being carried out.

4.2 Checking on samples

4.2.1 *Batching.* The consignment is divided by the manufacturer before testing into batches. A batch should include only items of the same diameter and class.

The batches are of 200 units.

Any homogeneous consignment smaller than this number or any remaining fraction form a batch when they are greater than 100 units.

4.2.2 *Sampling.* The purchaser selects at random the pipes or joints for testing in the ratio of one unit for each batch constituted according to clause 4.2.1.

For fractions of batches smaller than 100 units, no sampling is carried out.