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R 391

BUILDING AND SANITARY PIPES IN ASBESTOS-CEMENT

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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 391, *Building and sanitary pipes in asbestos-cement*, 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 by the Technical Committee began in 1956 and led, in 1963, to the adoption of a Draft ISO Recommendation.

In December 1963, this Draft ISO Recommendation (No. 689) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Australia	Israel	Republic of South Africa
Austria	Italy	Romania
Belgium	Japan	Spain
Colombia	Lebanon	Sweden
Denmark	Morocco	Switzerland
Finland	Netherlands	Turkey
France	New Zealand	U.A.R.
Germany	Norway	United Kingdom
Greece	Poland	U.S.A.
Hungary	Portugal	U.S.S.R.
Ireland	Republic of Korea	Venezuela
		Yugoslavia.

Three Member Bodies opposed the approval of Draft:

Brazil, Mexico, Peru.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1964, to accept it as an ISO RECOMMENDATION.

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ISO Recommendation R 391 November 1964

ASBESTOS-CEMENT BUILDING AND SANITARY PIPES [1]

1. SCOPE

This Recommendation applies to asbestos-cement pipes and jointing pieces used in building, such as rainwater, sanitary and sewer connections.

It defines certain conditions of manufacture, dimensions and acceptance tests for these products.

2. PIPES

2.1 Composition

The pipes should be seamless and made by the application of 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]

2.2 Types

The pipes may be of two types:

— A — light — for pipes not used under pressure,
— B — heavy — for pipes which may be subject to accidental pressure in service.

The types A and B may be of two kinds:

— pipes with socket,
— pipes with plain ends.

2.3 General appearance and finish

The interior surface of the pipes should be regular and smooth. If required, they may be coated internally and externally with a suitable coating which should comply with the requirements of the national standards of the producing country.

2.4 Characteristics

2.4.1 *Geometrical characteristics*

2.4.1.1 NOMINAL DIAMETER

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

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[1] Pressure pipes are covered by ISO Recommendation R 160, sewerage and drainage pipes by ISO Recommendation (at present Draft ISO Recommendation No. 786).

[2] This Recommendation also applies to autoclaved pipes, when the binder is partially replaced by ground silica.

The series of the nominal diameters is as follows:

Millimetres	Inches (approximately)
50	2
60	2½
80	3
100	4
125	5
150	6
200	8
250	10
300	12
400	16
500	20 or 21

When national standards provide for other diameters, these should be chosen from preferred numbers of the R 10 series. [3]

2.4.1.2 THICKNESSES

The nominal thicknesses of the pipes should conform to those in the national standards of the producing country or, failing this, should be as specified in the manufacturers' catalogues.

The actual thicknesses should however be not less than the following: [4]

DIMENSIONS IN MILLIMETRES

Nominal diameter	Thickness
50	6
60	6
80	7
100	7
125	7
150	8
200	8
250	10
300	10
400	11
500	12

2.4.1.3 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, not taking the tolerances into account.

[3] The manufacturers' catalogues should state the dimensions which they normally keep in stock.

[4] For special orders, the thicknesses of the pipes may be less than those indicated in the above table provided that the internal hydraulic pressure bursting strength (2.5.2), the crushing strength (2.5.3) and the bending strength (2.5.4) be increased in proportion so that the test or breaking loads be at least as high as the loads calculated for the minimum thicknesses indicated in the table.

The series of the nominal or useful lengths is of:

0.50 — 1.00 — 2.00 — 3.00 — 4.00 m. [5]

The pipes of diameter equal to or exceeding 250 mm may also be made in 5.00 m length.

2.4.1.4 TOLERANCES ON THE DIMENSIONS

(a) on the internal diameter of the pipes and sockets (tolerance of ovality)

The diametral variation O as defined by the ratio of the actual diameter Dr (maximum or minimum bore of pipes or sockets measured over a given section) and the nominal diameter Dt (bore of pipes or sockets) expressed by the formula:

$$O = \frac{Dr}{Dt}$$

should lie within the following limits according to the nominal diameters.

	Type A O	Type B O
for diameters less than 80 mm	0.96-1.04	0.975-1.025
for diameters from 80 to 150 mm . . .	0.97-1.03	0.98 -1.02
for diameters from 200 to 500 mm . .	0.98-1.02	0.985-1.015

(b) on the nominal thicknesses

— for nominal diameter less than or equal to 125 mm
upper deviation: + 1.5 mm
lower deviation: — 1 mm

— for nominal diameters equal to or exceeding 150 mm
upper deviation: + 2 mm
lower deviation: — 1.5 mm.

(c) on the nominal length

Upper deviation: + 10 mm
Lower deviation: — 10 mm.

2.4.2 *Physical characteristics*

Tested as provided for in 2.5.1 (compulsory test), the pipes should not indicate any fissure, loss or visible sweating on their outside surface.

2.4.3 *Mechanical characteristics*

2.4.3.1 BURSTING

Tested as provided for in 2.5.2 (compulsory test), the pipes should indicate a minimum unit bursting stress of

(a) pipes of type A 100 kgf/cm²
(b) pipes of type B 130 kgf/cm².

[5] The manufacturers' catalogues should state the dimensions which they normally keep in stock.

2.4.3.2 CRUSHING

Tested as provided for in 2.5.3 (optional test), the pipes should indicate a minimum unit crushing stress of:

(a) pipes of type A 225 kgf/cm²
(b) pipes of type B 295 kgf/cm².

2.4.3.3 BENDING

Tested as provided for in 2.5.4 (optional test), the pipes should indicate a minimum unit bending stress of:

(a) pipes of type A 150 kgf/cm²
(b) pipes of type B 165 kgf/cm².

2.5 Tests

The acceptance tests are carried out at the manufacturer's work on pipes and test pieces cut off the pipes which the manufacturer guarantees to be sufficiently matured.

(a) Compulsory tests

1. Internal hydraulic pressure tightness test (method as defined in 2.5.1, number of tests as indicated in the extract of the table in Appendix B).
2. Internal hydraulic pressure bursting test (method as defined in 2.5.2, number of tests as indicated in the extract of the table in Appendix B).

(b) Optional tests at purchaser's request

3. Transverse crushing test (method as defined in 2.5.3, number of tests as indicated in the extract of the table in Appendix B).
4. Longitudinal bending test (method as defined in 2.5.4, number of tests as indicated in the extract of the table in Appendix B).

NOTE: The test pieces required for the tests should be taken from the same pipe, if its length allows it.

2.5.1 *Internal hydraulic pressure tightness test*

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

The pipes are placed on a hydraulic press, the tightness of the ends being ensured by a device avoiding as far as possible any axial compression of the pipe. The internal hydraulic pressure is measured by a pressure gauge calibrated to give accurate readings.

The internal hydraulic pressure is raised gradually to 1 kgf/cm² for pipes of type A and 2.5 kgf/cm² for pipes of type B. This pressure is maintained for at least 30 seconds to check that there is no fissure loss or visible sweating on the outside surface of the pipe.

2.5.2 *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 test piece is submitted to a press which is raised gradually and regularly to breaking point. The rate of increase of the pressure is 1 to 2 kgf/cm² s.

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

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

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 thickness considered is the average of three measurements taken along the line of fracture.

The unit bursting stress R_t should be not less than:

(a) pipes of type A 100 kgf/cm²

(b) pipes of type B 130 kgf/cm². [6]

2.5.3 *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 10 to 20 kgf/cm² s up to breaking point.

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

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

where

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

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

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; the thickness considered is the average of three measurements taken along the line of fracture

L = actual length of the loaded specimen depending on the section of rupture, expressed in centimetres.

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

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

The values are expressed in the same units.

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[6] Any tolerances on a bursting stress when specified by national standards should not lead to the acceptance of values lower than the minimum indicated in this Recommendation.

Also when these national standards specify tests on non-immersed pipes, this modification of the testing conditions is only acceptable on the condition that the unit bursting stress so determined be not less than:

(a) pipes of type A 110 kgf/cm²

(b) pipes of type B 145 kgf/cm².

The unit transverse crushing stress R_e should be not less than:

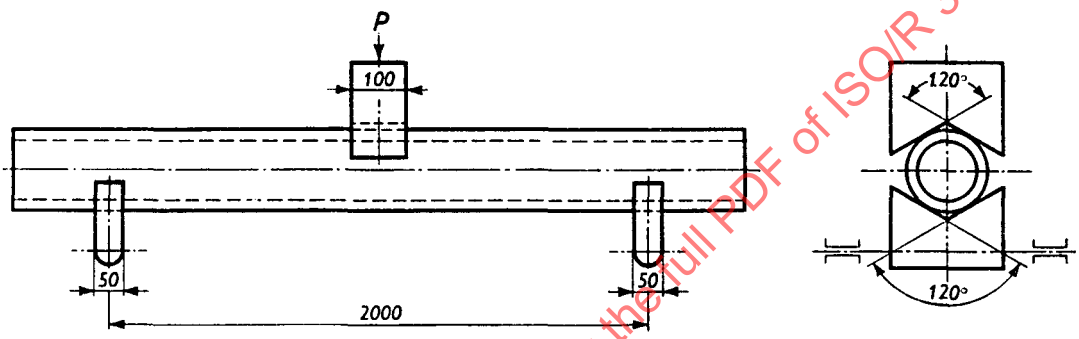
(a) pipes of type A 225 kgf/cm²
(b) pipes of type B 295 kgf/cm². [7]

2.5.4 *Longitudinal bending test*

Taking into account the practical possibilities of carrying out the test and the nature of the bending stresses, this test may be called for on pipes not exceeding 150 mm diameter.

The test is carried out on a pipe or part of a pipe at least 2.20 m long, after immersion in water for 48 hours. The test piece is placed on two metal supports V — shaped and with an opening of 120°. They present a face 5 cm wide to the pipe and are free to oscillate in the plane of bending on two horizontal axes 2 m apart.

DIMENSIONS IN MILLIMETRES



The pipe is loaded at the centre of the distance between the supports by means of a metal plate having the same shape as the supports, but with a width of 10 cm. Strips of felt or soft fibre boards not more than 1 cm thick are interposed between the supports and the pipe, and the plate and the pipe. The applied load is raised gradually so as to increase the stresses at the rate of about 8 kgf/cm² s up to breaking point.

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

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

where

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

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

P = breaking load, expressed in kilogrammes-force
l = distance between the centres of the supports, expressed in centimetres

[7] 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 Recommendation.

Also when these national standards specify tests on non-immersed pipes, this modification of the testing conditions is only acceptable on the condition that the unit crushing stress so determined be not less than

(a) pipes of type A 250 kgf/cm²
(b) pipes of type B 325 kgf/cm².

d = actual internal diameter of the pipe, expressed in centimetres

e = actual thickness of the pipe in the broken part, expressed in centimetres; the thickness considered is the average of three measurements taken along the line of fracture.

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

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

the values being expressed in the same units.

The unit longitudinal bending stress R_f should be not less than:

(a) pipes of type A 150 kgf/cm²
(b) pipes of type B 165 kgf/cm². [8]

2.6 Marking

The pipes should be marked legibly and indelibly so as to show:

— the origin of manufacture,
— the date of manufacture,
— the type (if necessary).

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

3. JOINTING

3.1 Pipes with socket

The national standards of the producing country or, failing this, the manufacturers' catalogues, should indicate for which nature and type of joint the socket is suitable. [9]

3.1.1 *Profile and diameter*

The profile and the diameter of the socket should be such that, taking into account the tolerances on the thickness of the pipe (2.4.1.4 *b*) and on the ovality (2.4.1.4 *a*), there is a suitable annular space allowing the correct jointing.

In the case of caulked or poured joints, this space should be not less than 6 mm.

3.1.2 *Thickness*

The actual average thickness of the socket taking into account grooves, if any, should be at least equal to that of the barrel of the pipe.

The average thickness is obtained by taking the area of the cross section of the wall of the socket on the axis of the pipe and dividing this area by the depth of the socket.

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[8] 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 Recommendation.

Also when these national standards specify tests on non-immersed pipes, this modification of the testing conditions is only acceptable on the condition that the unit bending stress so determined be not less than

(a) pipes of type A 165 kgf/cm²
(b) pipes of type B 180 kgf/cm².

[9] As an example, but not restrictive, the joints for the pipes with socket may be made by caulking, stuffing, rubber rings, etc.

3.1.3 *Depth*

The depth of the socket, i.e. the difference between the total length of the pipe and the effective length, should be determined by the type of joint to be made. It should allow a clearance of approximately 5 mm between the base of the socket and the spigot end of the socketed pipe.

3.2 Pipes with plain ends

The ends of pipes should be finished to suit the joints with which they are to be used. [10]

4. SAMPLING, INSPECTION AND ACCEPTANCE

Enquiries and orders should specify whether the consignment is to be delivered with or without acceptance tests. Failing this, 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 requirements concerning the general appearance and finish (2.3), the geometrical characteristics (2.4.1) and the marking (2.6) of the pipes may be verified on each item of the consignment.

4.1.2 The pipes which do not satisfy the requirements when submitted to inspection of each item of the consignment (4.1.1) may be rejected.

4.2 Inspection by sampling

4.2.1 The requirements concerning the physical characteristics (2.4.2) and the mechanical characteristics (2.4.3) of the pipes should be verified, if requested, by sampling.

4.2.2 The procedure in ISO Recommendation R 390 applies for the sampling, inspection and acceptance. Each inspection lot should include only items of the same diameter and of the same type. The maximum and minimum inspection lots are agreed between the manufacturer and the purchaser; failing such an agreement these should be:

— for diameters less than or equal to 200 mm: 800 and 200 pipes respectively,
— for diameters exceeding 200 mm: 400 and 100 pipes respectively.

4.3 Length — Delivery tolerances

The pipes delivered should have a nominal length as specified in 2.4.1.3 subject to the limits of the tolerances given in 2.4.1.4 *c)*. However, the total length of the pipes supplied should be not less than the length ordered.

[10] This requirement is applicable to short lengths of pipe.