International Standard 391

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Building and sanitary pipes in asbestos-cement

Tuyaux de bâtiment et tuyaux sanitaires en amiante-ciment

First edition — 1982-07-15

UDC 691.328.5-462 **Ref. No. ISO 391-1982 (E)**

Descriptors : asbestos-cement product, pipes (tubes), pipe joints, classifications, characteristics, dimensions, dimensional tolerances, tests, crushing tests, pressure tests, bend tests, marking, acceptance testing.

Price based on 8 pages

Preisgr. IE

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

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

Austria	Ireland	Romania
Belgium	Israel	South Africa, Rep. of
Brazil	Italy	Spain
China	Mexico	Switzerland
Colombia	Netherlands	Thailand
Czechoslovakia	New Zealand	USSR
France	Poland	Venezuela
India	Portugal	Yugoslavia

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

Australia
United Kingdom

This International Standard cancels and replaces ISO Recommendation R 391-1964, of which it constitutes a technical revision.

Contents

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Building and sanitary pipes in asbestos-cement

1 Scope and field of application

This International Standard defines dimensions, characteristics and acceptance tests for asbestos-cement pipes and jointing pieces used in building, such as rainwater, sanitary and sewer connections up to the connection with main or common sewer.[1)]

2 References

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

ISO 392, *Asbestos-cement pipe fittings for building and sanitary purposes*[2)].

3 Pipes

3.1 Composition

The pipes to which this International Standard relates consist essentially of an inorganic hydraulic binder[3)] reinforced by asbestos fibres to which other fibres may be added[4)].

Fillers and pigments may be added.

3.2 Types

The pipes may be of two types :

— pipes with socket;

— pipes with plain ends.

3.3 General appearance and finish

The external surface of the pipes shall be regular and the internal surface shall be regular and smooth. If necessary, the pipes may be coated internally and/or externally with a suitable coating.

3.4 Characteristics

3.4.1 Geometrical characteristics

3.4.1.1 Nominal diameter

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

The series of the nominal diameters[5)] is as shown in table 1.

Table 1

50/60*
70/80*
100
125
150
200
250
300

* The choice in each group being that of the national standards institution.

3.4.1.2 Ovality

The ovality is defined by

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

1) Pressure pipes are covered by ISO 160; sewerage and drainage pipes for main and common sewer are covered by ISO 881.

2) At present at the stage of draft.

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

4) Asbestos-cement silica pipes to which this International Standard also relates consist essentially of an inorganic hydraulic binder and silica in chemical combination (calcium silicate reaction) reinforced by asbestos fibres to which other fibres may be added.

5) Manufacturers' catalogues should state actual dimensions available. When national standards provide for other diameters, these should be chosen from preferred numbers of R 10 series.

where

Dr is the value corresponding to the maximum or minimum effective internal diameter, in millimetres, of the spigot end of the pipe or their socket;

Dt is the value of the specified internal diameter, in millimetres, of the spigot end of the pipe or the socket.[1)]

The ovality shall be within the following limits according to the nominal diameter :

	Ovality
— for nominal diameters less than 100 :	0,975 to 1,025
— for nominal diameters from 100 to 300 :	0,98 to 1,02

3.4.1.3 Nominal thicknesses

The nominal wall thicknesses and their tolerances are given in table 2.

Table 2

Nominal diameter	Nominal wall thickness mm	Tolerance mm
50 60 70 80 100 125 150*	7 7 7 7 7 8 8	+ 1,5 − 1,0
200* 250* 300*	9 10 11	+ 2,0 − 1,5

* Where pipes larger than or equal to 150 diameter are to be used underground without additional protection against ground pressure and external loads, the strength of the pipe should be verified and if inadequate a pipe conforming with ISO 881 should be selected.

The thickness shall be measured at the unmachined end of the pipe.

3.4.1.4 Nominal length

For pipes with plain ends, the nominal length corresponds to the length measured between the ends of the pipes. For pipes with socket, see figure 1 in the case of applied socket and figure 2 in the case of a monolithic pipe.

The series of the nominal lengths, expressed in metres, is

0,50 — 1,00 — 1,50 — 2,00 — 2,50 — 3,00 — 4,00 — 5,00

The nominal length of 5,00 m only applies to pipes of nominal diameter equal to or greater than 150.

3.4.1.5 Tolerance on the nominal length

Upper deviation : + 10 mm
Lower deviation : − 20 mm

3.4.2 Physical characteristics

When tested as provided for in 3.5.2 (optional test), the pipes shall have no fissure, leakage or sweating.

3.4.3 Mechanical characteristics

3.4.3.1 Crushing

When tested as provided for in 3.5.1 (compulsory test), the pipes shall indicate a minimum unit crushing strength of 25 N/mm^2.

3.4.3.2 Bending

When tested as provided for in 3.5.3 (optional test, limited to pipes with a nominal diameter less than or equal to 150) the pipes shall indicate a minimum unit bending strength of 16 N/mm^2.

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

- minimum unit crushing strength : 27,5 N/mm^2
- minimum unit bending strength : 17,6 N/mm^2

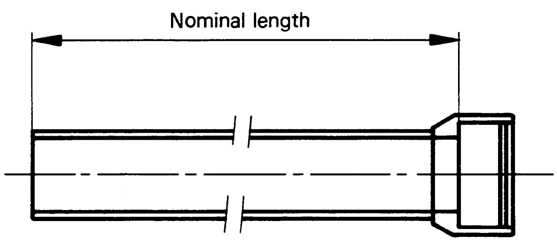


Figure 1

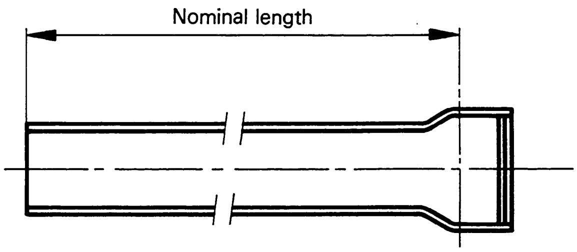


Figure 2

1) The theoretical diameter of the pipes is equal to the nominal diameter of the pipes. The theoretical diameter of the sockets is defined by the national standards or, failing this, in the manufacturers' catalogues.

3.5 Tests

The acceptance tests shall be carried out at the manufacturer's works on pipes and test pieces cut from sufficiently matured pipes.

The conditions and methods of test shall apply equally to pipes coated or uncoated.

a) **Compulsory test**

1) Transverse crushing test (method as defined in 3.5.1, number of tests as indicated in the extract of the table in annex B).

b) **Optional tests**

2) Internal hydraulic pressure tightness test (method as defined in 3.5.2, number of tests as indicated in the extract of the table in annex B)[1].

3) Longitudinal bending test (method as defined in 3.5.3, number of tests as indicated in the extract of the table in annex B)[1].

3.5.1 Transverse crushing test

3.5.1.1 Test procedure

The test shall be carried out on a piece of pipe, cut from a section not including any joint, after immersion for 24 h in water.

The nominal length[2] of the test piece shall be 200 mm.

The load shall be applied through press-blocks shown in figure 3 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[3].

The lower press-block consists of a V-shaped support having an included angle of 150° made of metal or hard wood whereas the flat upper press-block, made of the same material, has a width b = 25 mm for all nominal pipe diameters.

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.

3.5.1.2 Calculation of the strength (see 3.4.3.1)

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

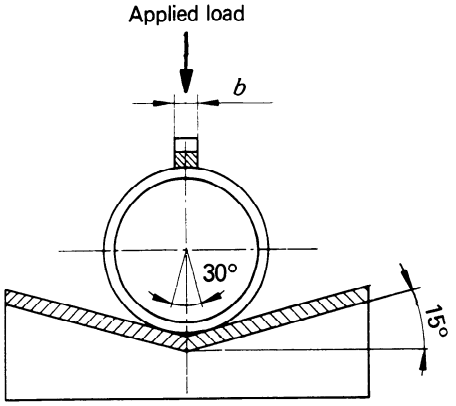
$K = \frac{3d + 5e}{3d + 3e}$ is a factor resulting from the curvature of the test piece;

$M_e = n P_e \frac{d + e}{2}$ is the maximum ring bending moment;

n being equal to 0,26 for diameters up to 100;

n being equal to 0,30 for diameters exceeding 100;

$W_e = \frac{1}{6} l e^2$ is the modulus of resistance of the test piece;



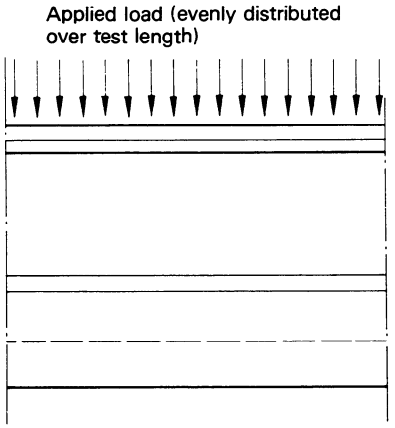


Figure 3

1) The test pieces required for all tests should be taken from the same pipe, if its length permits it.

2) National standards may specify a length of 300 mm for all nominal diameters.

3) For pipes with seam, the load should be applied to the seam via the upper press-block.

P_e is the breaking load, expressed in newtons;

d is the effective internal diameter of the test piece, in millimetres, taken as the average of two perpendicular measurements, at the broken cross sections;

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

l is the effective length of the test piece, in millimetres.

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

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

the terms being expressed in the same units as above.

3.5.2 Internal hydraulic pressure tightness test

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

The pipes shall be placed on an hydraulic press, the water 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 0,01 MPa is recommended.

The hydraulic pressure shall be raised gradually up to 0,05 MPa. This pressure is maintained for 60 s to check that there is no fissure, leakage or sweating.

No reduction of the testing time is permitted.

3.5.3 Longitudinal bending test

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

The test shall be carried out on a whole or part of a pipe at least 2,20 m long, which has been immersed in water for 24 h. The test piece shall be placed on two metal supports which are V-shaped, 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 4).

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 wooden fibre boards not more than 10 mm thick shall be interposed between the supports and the pipe, and the pad and the pipe. The load shall be applied at a constant speed and should be regulated so that the rupture occurs after at least 15 s and not more than 30 s.

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

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

where

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

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

P_f being the breaking load, in newtons;

l being the distance between centres of supports, in millimetres;

d being the effective internal diameter of the test piece, in millimetres, taken as the average of two perpendicular measurements at the broken cross section;

e being the effective thickness of the wall of the test piece in the broken section, in millimetres, to be taken as

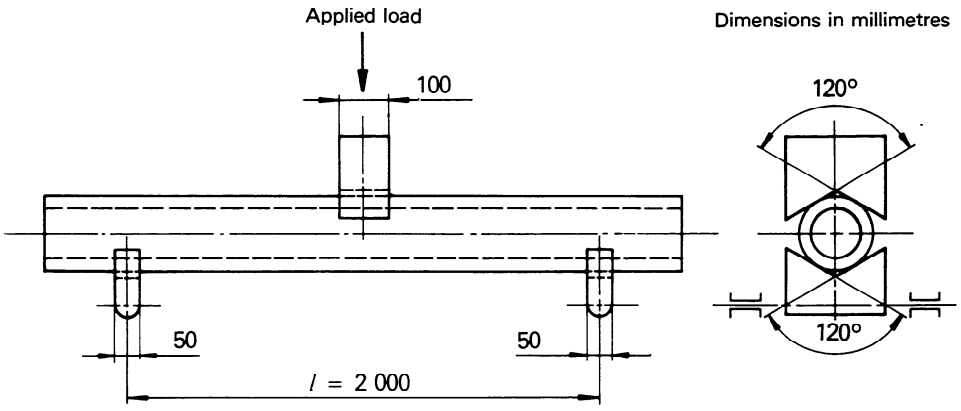


Figure 4

the average of three measurements made along the line of fracture at the top of the ring.

NOTE — The value R_f may be derived directly from the formula

$$R_f = 2{,}547\frac{P_f\, l\, (d + 2e)}{(d + 2e)^4 - d^4}$$

the terms being expressed in the same units as above.

3.6 Marking

The pipes shall be marked legibly and indelibly to show at least

— manufacturer's mark;

— date of manufacture.

The method of marking shall conform to the national standards. Additional marks, in particular the nominal diameter, may be applied.

4 Joints

4.1 Types of assembly

The tightness of the conduct is realized by assembling the spigot ends on the socket of the pipes, or separate sleeves.

In the traditional system, the tightness of the spigot and socket joint is realized by caulking or stuffing suitable soft material into the free space of the socket.

Other systems are realized by elastomeric gaskets which shall ensure tightness of socket and spigot joints, or separate sleeves.

4.2 Assembly by caulking or stuffing

4.2.1 Profile and internal diameter of sockets

The profile and the internal diameter of sockets shall be such that, taking into account the tolerances on the thickness of the pipe (see 3.4.1.3) and the ovalization (see 3.4.1.2), there is an annular space sufficient to ensure tightness depending on the nature of the material used for the manufacturing of the joint and the application technique.

4.2.2 Thickness

The average wall thickness of the socket shall be not less than that of the pipe.

4.2.3 Depth

The depth of the socket shall be at least 50 mm and shall allow a clearance of approximately 5 mm between the base of the socket and the spigot end of the mating pipe.

4.3 Assembly by elastomeric gaskets

Dimensions and tolerances of all elements of the joint shall be such that permanent tightness at the internal hydraulic pressure of 0,05 MPa at the maximum permitted angular deviation is assured. The test shall be carried out according to 3.5.2 for the internal hydraulic pressure and the testing time.

5 Sampling, inspection and acceptance

Enquiries and orders shall specify whether or not acceptance tests are required and if so, which tests. Otherwise, the purchaser is presumed not to require acceptance tests.

5.1 Inspection by sampling

5.1.1 All requirements of the pipes shall be verified, if requested, by sampling.

5.1.2 The procedure in ISO 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 respectively :

— for diameters less than or equal to 200 : 800 and 200 pipes respectively;

— for diameters exceeding 200 : 400 and 100 pipes respectively.

5.1.3 If the sample is not satisfactory the customer or manufacturer may request inspection of each item for the failing characteristic in accordance with 5.2.

5.2 Inspection of each item of the consignment

5.2.1 The requirements concerning the general appearance and finish (3.3), the geometrical characteristics (3.4.1) and the marking (3.6) of the pipes may be verified on each item of the consignment.

5.2.2 The pipes which do not satisfy the requirements when submitted to inspection of each item of the consignment (5.2.1) may be rejected.

5.3 Length — Delivery tolerances

In any one consignment, 5 % of the pipes delivered may have a shorter nominal length than the length ordered. However, all the pipes delivered shall have a nominal length as specified in 3.4.1.4 (subject to the limits of the tolerances given in 3.4.1.5) and the total length of the pipes supplied shall be not less than the length ordered.