International Standard 4483

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Asbestos-cement pipelines — Field pressure testing

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Foreword

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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 4483 was developed by Technical Committee ISO/TC 77, *Products in fibre reinforced cement*, and was circulated to the member bodies in September 1977.

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

Australia	Germany, F.R.	Romania
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Norway
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Asbestos-cement pipelines — Field pressure testing

1 Scope and field of application

This International Standard applies to the field pressure testing of asbestos-cement pipelines, above or below ground, conveying fluids, with or without internal hydraulic pressure and consisting of pipes referred to in ISO 160[1] and ISO 881[1].

It outlines the basic methods of pressure testing these types of asbestos-cement pipelines.

2 References

ISO 160, *Asbestos-cement pressure pipes and joints.*[1]

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.*

3 General

For pressure pipelines, two main types of tests are specified :

— **Type 1** : Pressure testing carried out as a single operation on individual test sections.

— **Type 2** : Testing of each coupling carried out progressively with pipe laying, followed by pressure testing of the completed pipeline as a whole (applicable only to diameters 900 mm and above).

4 Type 1 method for testing pressure pipelines in trench

4.1 Length of test section

The length of the section shall be indicated by the pipeline designer, taking into account local factors such as contour of the pipeline, weather conditions, traffic, time available before completion of the trench backfill, location of permanent concrete anchorage, availability of test water and of suitable anchorage for temporary end-closures, etc.

The length of the test section should normally be from 500 to 1 000 m. Longer sections may be permitted, always provided that, during the test, the pressure at the highest point of the section is not less than 0,8 times the pressure at the lowest point.

4.2 Preparation of the section to be tested

4.2.1 Backfilling before the test

4.2.1.1 Partial backfill

The pipes comprising the test section shall be anchored by partially backfilling the trench, according to the procedure of ISO 4482, to at least 300 mm above the crown of pipes not exceeding 200 mm diameter, and to about 500 mm for pipes of larger diameter.

The backfill shall be placed and compacted so that the internal pressure will not give rise to any transverse or vertical displacement of the pipes. The joints should remain uncovered for visual inspection during the test.

4.2.1.2 Complete backfill

As an alternative to partial backfill before testing, the pipeline installer, in agreement with the pipeline designer, may backfill the pipeline completely before pressure testing, provided that the pipeline installer undertakes to locate and uncover leakage indicated by testing.

4.2.2 Anchorage

The pressure test shall be carried out after all permanent anchor blocks have been placed (as required by ISO 4482 or specified by the pipeline designer) and, if of concrete, have developed adequate strength. Temporary anchorage for closure caps on test sections shall be designed to suit the magnitude of the test pressure and the load-bearing capacity of the supporting soil, as in the case of permanent anchorage.

1) At present at the stage of draft.

4.2.3 Filling of the test section[1)]

The section of the pipeline to be tested shall be filled with water at a rate sufficiently slow to ensure that all air is expelled. The water should preferably be introduced at the lowest point of the section under test. Air vents shall be kept open during filling until there is no further escape of air.

Consideration may additionally be given to the removal of air by passing a suitable swab through the test section, provided that it has been constructed to allow the passage of such a plug.

4.3 Test equipment

The hydraulic pressure in the test section shall be raised by means of a suitable pump. The water tank of the pump shall incorporate a gauge for measuring the quantities of water added to maintain the specified test pressure. The gauge shall have an accuracy of ± 1 litre. A calibrated pressure gauge (preferably a recording one) shall be connected to the pipeline (preferably at its lowest point) and shall be capable of being read to an accuracy of 0,01 MPa.

4.4 Procedure

4.4.1 Preliminary test

After having been filled with water, the test section shall stand for an initial period of at least 24 h under a static pressure of up to the intended working pressure in the section.

Should a failure occur and some or all of the water be lost, the procedure of filling and of raising the pressure shall be repeated after remedial work has been carried out.

The standing period shall commence from the time at which the working pressure was reached successfully, i.e. without failure.

If the pipeline is partially backfilled, the exposed parts of the test section shall be visually inspected after the 24 h standing period.

If the pipeline is fully backfilled prior to testing, acceptance must be based solely on the measured make-up water (see 4.4.2.2).

4.4.2 Pressure test

If neither appreciable movement of the pipeline nor any leakage has been found during the aforementioned visual inspection, the section shall be subjected to the pressure test proper.

4.4.2.1 Magnitude of test pressure

The field test pressure (FTP) shall normally not be less than 1,5 times the actual working pressure in the pipeline where this does not exceed 1,0 MPa but shall not exceed FTP given by the following expressions :

$$FTP = 1{,}5\ WP^{*} \text{ for } WP \leqslant 1{,}0\ MPa$$

$$FTP = WP + 0{,}5\ MPa \text{ for } WP > 1{,}0\ MPa$$

The field test pressure shall never be less than 0,4 MPa irrespective of the magnitude of the actual working pressure.

While the pressure is being raised, care shall be taken to permit the release of further quantities of air.

NOTES

1 The maximum field test pressure corresponding to working pressures exceeding 1,0 MPa is limited to avoid anchorage problems, particularly with large diameter pipes.

2 Consideration shall be given to any limitations that may be supported by fittings incorporated in the pipelines.

4.4.2.2 Duration of pressure test and water absorption

When an asbestos-cement pipeline is filled with water, some water is absorbed by the pipes. The rate of absorption is dependent upon the initial water content, diameter, and length of the test section, magnitude of the hydrostatic test pressure, and duration of the test. Although after a short period of service this absorption becomes practically negligible, the effect of absorption shall be considered in relation to the pressure test.

The test pressure specified in 4.4.2.1 shall be maintained in the test section for at least 1 h. A longer dwell may, however, be specified by the pipeline designer up to a maximum of 6 h.

As a result of water absorption by the pipes, the pressure initially applied will drop. Additional quantities of water shall be pumped into the test section to restore the required test pressure. It is recommended that restoration of the test pressure be carried out at half-hourly intervals.

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1) The recommended rate of filling should be based on a flow velocity of 0,05 m/s, and calculated by the following formula :

$$Q = 0{,}05 \times \frac{\pi}{4} \times \frac{d^2}{1\,000}$$

where

Q is the rate of filling, in litres per second;

d is the internal diameter of the pipe, in millimetres.

* WP is the rated working pressure equal to the half of the class of pipes or the designed working pressure according to ISO 160 (3.2.2) for pipes specially designed (large diameter pipes).

The quantity of water added each time, referred to later as make-up water, shall be measured, recorded and totalled up at the end of the test. The total amount of water added to maintain the pressure during the whole period of the test shall not exceed the volume indicated in the table (presented graphically in the figure), and any successive measurements shall always show a decreasing trend.

NOTES

1 The table shows the maximum permissible quantities of the required make-up water corresponding to various combinations of time (t) (between 0,25 h and 6 h) and field test pressure (FTP).

2 Taking into account local conditions, different durations of pressure tests and/or lower permissible quantities of make-up water than given in the table may be specified. Also in this case successive measurements taken at regular intervals shall always show a decreasing trend.

4.4.2.3 Repetition of pressure test

If the quantity of water added to maintain the test pressure does not meet the requirements of 4.4.2.2, the section shall again be inspected visually for leakages. If leakages are found, the required remedial work shall be carried out and the pressure test repeated in the manner described above. If no leakage is found and the quantities of water added to maintain the test pressure still exceed the amount permitted, steps shall be taken to permit release of any air still trapped in the pipeline, before repeating the pressure test.

4.4.3 Final test

After the successfully tested sections of the pipeline have been coupled together and backfilling completed, except at the closure joints, the pipeline shall be subjected to a pressure equal to the working pressure of the pipeline.

The duration of this test will be determined by the time required to carry out a visual inspection of the closure joints between the previously tested individual sections of the pipeline.

5 Type 2 method for testing pressure pipelines in trench

Field testing method type 2 is applicable only to diameters 900 mm and above. It is especially recommended for use where unstable ground conditions or non-availability of a suitable water supply would create special problems if the type 1 method were used, or where backfilling and reinstatement is required to be carried out immediately after pipes are laid and jointed. The tightness of each individual coupling is proven, as soon as possible after mounting in the trench, by application of an internal hydrostatic pressure.

The requirements for the Type 2 method are as follows :

a) Each coupling shall be tested for water tightness as laying proceeds, by application of an internal hydrostatic pressure through a movable apparatus fitted internally and designed to straddle the pipe ends. The test pressure FTP shall be chosen in accordance with the recommendations given in 4.4.2.1 and maintained for at least 5 min (see A.2.1).

b) On completion of the hydrostatic testing of each individual joint and after all backfilling has been carried out, a final hydrostatic test shall be applied to the whole length of the pipeline. The test pressure shall be the pipeline working pressure.

Details of testing procedure and equipment are given in the annex.

6 Testing of pressure pipelines laid on or above ground level

Pressure pipelines laid on or above ground level shall be tested by the type 1 method described in clause 4, but disregarding 4.2.1, which is not applicable to this laying condition.

The pipes shall be fixed to their supports in accordance with the recommendations given in ISO 4482. Care shall be taken to ensure that the pipes and fittings are securely anchored in order to prevent displacement of the pipeline.

7 Testing of non-pressure pipelines for sewerage and drainage applications

The testing methods described in this clause apply to pipelines conveying fluids flowing in the pipeline with a free surface at the ambient barometric pressure, if such testing is required.

7.1 Length of test section

If manholes are incorporated in the pipeline, the length of the test section shall be from manhole to manhole. Otherwise, the length of the test section shall be specified by the pipeline designer, having regard to the gradient.

NOTE — Testing may be restricted to random sections if so specified.

7.2 Preparation of the pipeline for the test

7.2.1 Backfilling before the test

The trench shall be backfilled according to 4.2.1.

7.2.2 Sealing the ends of the test section

All ends of the test section shall be sealed off with means for introducing water into, and for expelling air from, the section.

7.3 Water test

7.3.1 Filling of the section

The test section shall be filled in accordance with 4.2.3.

7.3.2 Procedure

After the section has been filled with water and the air expelled, the hydrostatic pressure inside the section shall be raised by applying 0,04 MPa (4 m head of water) at the higher end of the section. This pressure shall be maintained for 30 min, during which time there should be no leakage at any of the couplings. If inspection of the joints is impossible, then the make-up water shall be measured and shall not exceed 0,1 litre per square metre of internal pipe surface after 30 min.

7.4 Air test (Optional)

Where local conditions (for example sub-zero temperatures) give rise to difficulty in carrying out the water test (7.3), consideration may be given to testing by means of internal air pressure. The test length shall be effectively plugged as described in 7.2.2 and the air pumped in by suitable means (for example a hand-pump) until a pressure of not more than 0,01 MPa[1)] is indicated by a suitable calibrated measuring device connected to the system. The air pressure should not fall by an amount more than specified during periods of time corresponding to the diameter of the section under test and the pressure applied.

Air pressure can be affected by temperature changes or by defects in the testing apparatus. Consequently, failure to pass this test is not conclusive and, if failure does occur and no leakage can be traced by external application of soapy water to all sealing areas, the water test described in 7.3 shall be carried out before rejection is made.

1) If the pipeline is n metres below the ground-water level, measured from the centre of the pipe, the air pressure may be increased by n times 0,01 MPa, provided that the total pressure will never exceed 0,03 MPa.

TABLE — **Maximum permissible make-up water (in litres) for various combinations of test pressures and durations of test per 100 m of pipeline of internal diameter 100 mm**

Time from start of pressure test h	Field test pressure (FTP), MPa																			
	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	2,0	2,1	2,2	2,3
0,25	0,18	0,20	0,22	0,24	0,26	0,27	0,29	0,30	0,31	0,33	0,34	0,35	0,36	0,37	0,38	0,40	0,41	0,42	0,43	0,44
0,5	0,35	0,39	0,43	0,47	0,50	0,53	0,56	0,58	0,61	0,64	0,66	0,68	0,70	0,73	0,75	0,77	0,79	0,81	0,83	0,85
1,0	0,66	0,74	0,81	0,88	0,94	0,99	1,05	1,10	1,15	1,20	1,24	1,28	1,33	1,37	1,41	1,45	1,48	1,52	1,56	1,59
1,5	0,94	1,05	1,15	1,24	1,33	1,41	1,48	1,55	1,62	1,69	1,75	1,82	1,88	1,93	1,99	2,04	2,10	2,15	2,20	2,25
2,0	1,18	1,32	1,44	1,56	1,67	1,77	1,87	1,96	2,04	2,13	2,21	2,29	2,36	2,43	2,50	2,57	2,64	2,70	2,77	2,83
2,5	1,39	1,56	1,71	1,84	1,97	2,09	2,20	2,31	2,41	2,51	2,61	2,70	2,79	2,87	2,96	3,04	3,12	3,19	3,27	3,34
3,0	1,58	1,77	1,94	2,09	2,24	2,37	2,50	2,62	2,74	2,85	2,96	3,06	3,16	3,26	3,36	3,45	3,54	3,63	3,71	3,79
3,5	1,75	1,96	2,14	2,31	2,47	2,62	2,77	2,90	3,03	3,15	3,27	3,39	3,50	3,61	3,71	3,81	3,91	4,01	4,10	4,19
4,0	1,90	2,12	2,32	2,51	2,68	2,84	3,00	3,14	3,28	3,42	3,55	3,67	3,79	3,91	4,02	4,13	4,24	4,34	4,45	4,55
4,5	2,03	2,26	2,48	2,68	2,86	3,04	3,20	3,36	3,51	3,65	3,79	3,92	4,05	4,18	4,30	4,41	4,53	4,64	4,75	4,86
5,0	2,14	2,39	2,62	2,83	3,03	3,21	3,38	3,55	3,71	3,86	4,00	4,14	4,28	4,41	4,54	4,66	4,79	4,90	5,02	5,13
5,5	2,24	2,51	2,74	2,96	3,17	3,36	3,54	3,72	3,88	4,04	4,19	4,34	4,48	4,62	4,75	4,88	5,01	5,14	5,26	5,37
6,0	2,33	2,60	2,85	3,08	3,29	3,49	3,68	3,86	4,04	4,20	4,36	4,51	4,66	4,80	4,94	5,08	5,21	5,34	5,46	5,59

NOTES

1 The figures above, based, in principle, on theoretical considerations and on actual field observations, are, however, a compromise corresponding to various climatic conditions and to different curing methods of pipes.

2 The figures above apply to pipes of 100 mm internal diameter. To obtain the maximum permissible make-up water applicable to pipes of any other internal diameter (*d*, mm) multiply the figure given in the table for the required time and test pressure by a factor *n*, where : $n = d/100$;

3 The figures above are given for test pressures from 0,4 to 2,3 in steps of 0,1 MPa. To obtain the permissible make-up water corresponding to a test pressure FTP not indicated in the table, proceed according to the following example : FTP = 1,35 MPa, time : 2 h; the maximum permissible make-up water for 1,35 MPa is :

$$1{,}87 \sqrt{\frac{1{,}35\ \text{MPa}}{1{,}0\ \text{MPa}}} = 2{,}17 \text{ litres per 100 m of 100 mm diameter pipeline,}$$

where 1,87 litres corresponds to 1,0 MPa test pressure.

4 If the pipeline is backfilled completely prior to pressure testing, so that the joints are not visible for inspection, the permissible make-up water shall be at least 10 % less than given in the table above.

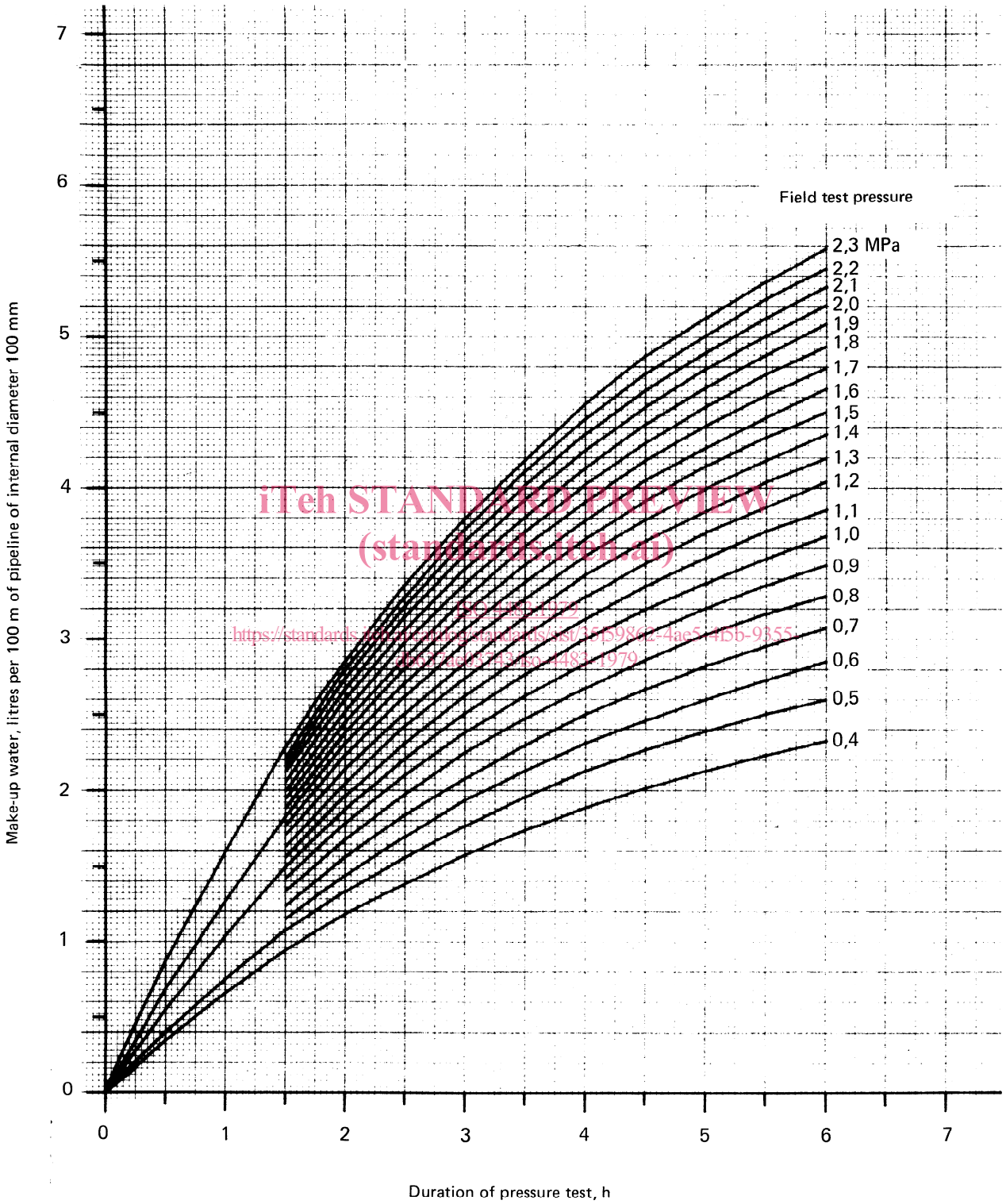

FIGURE — **Maximum permissible make-up water versus duration and height of field test pressure**

Annex

Type 2 testing — General guidance on equipment and methods

(see clause 5)

A.1 Testing equipment

A.1.1 Apparatus for testing tightness of couplings

The apparatus should consist, in principle, of a short steel tube of external diameter somewhat smaller than the internal diameter of the pipeline. A separate apparatus is required for each nominal diameter.

The steel tube should be equipped with the following :

A.1.1.1 Two rubber tyres, of a flat and wide cross-section, to be filled with water under pressure up to 2,5 MPa, fixed to both ends of the tube.

A.1.1.2 A water tank containing enough water for filling both the tyres and the annular space between the outer surface of the steel tube, the rubber tyres and the exposed surfaces of the coupling and pipe ends.

A.1.1.3 Three small hand-pumps (or at least two) for

a) filling the tyres and the annular space with water,

b) applying the necessary internal pressure to the tyres and to the annular space,

c) returning the water to the water tank;

also, the necessary piping system and manometers.

A.1.1.4 Eight small wheels (four at each end of the steel tube) spaced at approximately 90° around the tube and fixed so that the tube, with all its equipment, can move in an axial direction inside the pipeline being tested.

NOTE — All the equipment shall be built into the steel tube in such a way that a man will be able to pass inside the pipeline from one side of the testing apparatus to the other.

A.1.2 Equipment for the final testing of the whole pipeline

For final testing of the completed pipeline, the same equipment as mentioned in 4.3 will be required.

A.2 Procedure

A.2.1 Tightness testing of the couplings

The coupling tightness tests shall not commence until at least two full-length pipes on each side of the coupling to be tested have been backfilled.

The testing apparatus shall be entered into the pipeline and rolled towards the first coupling to be tested. The apparatus shall be centrally positioned across the gapped adjacent ends of the pipes on which the coupling to be tested is mounted. The tyres shall be filled with water and the pressure raised until its magnitude is 0,1 to 0,2 MPa greater than the pressure required to be applied to the annular space beneath the coupling and between the pipe ends. Before the latter pressure is applied, two flat steel wedges of appropriate width shall be inserted into the gaps at the other end of both pipes in order to prevent axial movement of these pipes when pressure is applied. (By this method, the friction between the backfill soil and the barrels of the two pipes on each side of the coupling under test is utilised.)