International Standard 4482

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

Asbestos-cement pipelines — Guide for laying

Canalisations en amiante-ciment — Guide de pose

First edition — 1979-09-01

UDC 691.328.5-462 : 628.24 **Ref. No. ISO 4482-1979 (E)**

Descriptors : asbestos-cement products, pipelines, buried pipes, installing, mounting surfaces, assembly.

Price based on 6 pages

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 4482 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 :

Austria	Germany, F. R.	Romania
Belgium	Greece	South Africa, Rep. of
Brazil	India	Spain
Bulgaria	Ireland	Sweden
Canada	Israel	Switzerland
Chile	Italy	Turkey
Colombia	Korea, Rep. of	United Kingdom
Czechoslovakia	Mexico	USSR
Denmark	Netherlands	Venezuela
Egypt, Arab Rep. of	New Zealand	Yugoslavia
France	Portugal	

The member body of the following country expressed disapproval of the document on technical grounds :

Norway

Asbestos-cement pipelines — Guide for laying

1 Scope and field of application

This International Standard specifies the recommended procedure for the installation of asbestos-cement pipelines for both pressure and non-pressure applications. It covers the types of laying conditions most commonly encountered in practice. Where special or exceptional conditions apply, it is the responsibility of the pipeline designer and the site engineer to give suitable instructions to supplement this International Standard.

Reference should be made to ISO 160 (sub-clause 3.2 and clause A.7) for pressure pipes; ISO 881 (sub-clause 3.2) for sewerage and drainage pipes; ISO 2785 and ISO 4483.

This International Standard does not cover those aspects which affect the owner or occupier of the land through which the pipeline passes. The requirements of national statutory regulations and code of practice standards which deal with these aspects must be observed both prior to and in the course of installation and reinstatement.

This International Standard does not contradict other similar documents either already existing or which may exist in different countries. Its aim is to unify the principles of laying asbestos-cement pipes.

Installation by thrust boring and pipe jacking methods which require the use of highly specialized techniques are not covered by this International Standard.

2 References

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

ISO 881, *Asbestos-cement pipes, joints and fittings for sewerage and drainage.*[1)]

ISO 2785, *Guide to the selection of asbestos-cement pipes subject to external loads with or without internal pressure.*

ISO 4483, *Asbestos-cement pipelines — Field pressure testing.*

3 Handling and storage

3.1 General recommendations

Throughout the operations covered by this International Standard, safety of the public and the site personnel shall be taken into account.

Care shall be taken in handling pipes, joints and fittings to avoid severe impact or other damage. In particular, they should not be dropped or, when slung, be allowed to collide with solid objects. The pipes may be rolled under control on a surface free from protuberances.

The pipeline installer shall provide, at the outset, suitable equipment for unloading pipes and fittings at the agreed delivery point and also for stacking and stringing out.

3.2 Off-loading

Heavy pipes and bulky fittings shall be lifted by suitable mechanical means.

The whole sequence of operations shall be carried out without snatch, taking care to ensure that any hooks used are of the flattened type suitably padded to prevent damage at the pipe ends.

If, for pipes in sizes up to 600 mm diameter, mechanical equipment is not available, the pipes may be unloaded laterally down planks under the manual restraint of at least two suitably anchored ropes. The planks shall have ample beam strength and be of sufficient length to ensure that the gradient does not exceed 45°. The planks should be placed at about 1/5 of the pipe length from each end. Each rope should be looped once around the pipe (or twice for heavier pipes) and have one end securely attached to the vehicle. The free ends should be fed out simultaneously and slowly by men standing on the vehicle.

For pipes in sizes over 600 mm diameter, mechanical equipment should be used.

1) At present at the stage of draft. (Revision of ISO/R 160 and ISO/R 881.)

3.3 Stacking of pipes

The first layer of pipes should be placed on two timber runners set on a firm foundation and situated about 1/5 of the pipe length from each end. The width of the runner is a function of the mass of the stack. Wedges should be firmly nailed in position at the ends of each runner. Where the pipes are delivered to site in bundles, they may remain bundled until commencement of laying.

Subsequent layers should be placed either by nesting in pyramid fashion or by placing on additional runners (prismatic stacking). The latter method is recommended for small diameter pipes or where space is limited. Wedges should be nailed to the ends of each runner.

The height of the stack should be limited to suit the handling facilities available on site but should not exceed that recommended by the manufacturers.

3.4 Storage of joints and fittings

Until required for use, joints, rubber rings, fittings and lubricant should be stored in a compound and the rubber rings kept in the bags or cartons in which they have been delivered to site. Rubber rings should be protected from sunlight, oils and greases and sources of heat. If the rubber rings have been tied, they should be separated a few days before required for use in order to eliminate minor impressions which the ties may have caused. Ties should be of a type which, during normal handling and separating, will not cut the rings.

4 Stringing out

Stringing consists of placing pipes on the ground in line ready for laying. Care should be taken to prevent damage during this operation.

Suitable vehicles with protrusion-free platforms and side walls should be used. Where protrusion cannot be eliminated, wooden planks should be provided at about 1/5 of the pipe length from each end.

Prismatic stacking (see 3.3) is recommended for on-site transport. The load must be secured by ropes and tensioners. In the case of very large diameter pipes it is advisable to use the same wooden blocks as those used for transport between factory and site. Pipes should not protrude more than 1 m beyond the rear of the vehicle.

Unloading should take place as near as possible to the point of installation, care being taken to ensure that all pipes are in a stable position clear of traffic. Where necessary, steps should be taken to prevent surface water accumulations or any foreign material from entering the bores of the pipes, joints and fittings.

5 Excavation and preparation of the trench

5.1 General recommendations

The trench should be dug so that the line, gradient, dimensions and type of bedding indicated on the drawings or in the specifications, or as agreed with the site engineer, are observed.

If there is any risk of the trench collecting water (ground water, seepage, rain) or if the soil is unstable, excavation of the trench should be geared to the rate of laying, but should preferably not be more than a few pipe lengths in advance. During excavation, all large stones which could fall and damage the pipes should be removed from the brink of the trench.

The installer should take all precautions required by statutory regulations or dictated by actual circumstances to ensure the safety of the public and the pipelayers and to avoid interrupting or damaging public or private utilities which may be encountered during the course of the work.

5.2 Trench width

The net trench width inside any shuttering which may be used should be sufficient to permit the pipe and joints to be properly bedded and to facilitate adequate compaction of the initial fill, particularly around the underside of the pipe. The recommended net width at bedding level is $D + 0{,}4$ m for pipes of nominal diameter up to 500 mm, and $D + 0{,}6$ m for pipes of nominal diameter exceeding 500 mm, D being the external diameter of the pipe in metres. The minimum width of the trench at bedding level should be 0,6 m for trench depths up to 1,5 m, and 0,8 m for greater depths. If special equipment is required to mount the joints, it may be necessary to widen the trench at these points.

Where the flexibility of the joint is used to give a slight curve to the pipeline, the base of excavation should be widened to enable the pipes to be jointed in good alignment before the deflection is made (see 7.1.1 and 7.2.4).

The actual trench width is a factor considered when designing the pipeline (see ISO 2785) and the gross width should therefore not exceed the stipulated maximum.

5.3 Trench depth

The trench depth and/or invert level should be specified by the pipeline designer taking into account the calculations given in ISO 2785 and any special requirements on minimum depth of cover due to gradient, superimposed loading or climatic conditions.

5.4 Preparation of trench bottom

The trench bottom should be uniform, and if possible dry, to ensure that individual pipes, and the pipeline as a whole, will be evenly supported. Joint holes of ample size must be provided to prevent the pipes from resting on the joints. The length and depth of the joint holes depend upon the dimensions of the joints and the method of assembly.

The bottom of the trench shall follow strictly the gradient of the longitudinal elevation. When levelling the trench bottom, any local hard high spots such as projecting stones or nibs of rock must be trimmed well back and the resulting irregularities or holes filled in with suitable material, properly compacted.

Where it is not possible to level the bottom of the trench properly using mechanical/hand trim methods, the bottom of the trench should be covered by a layer of granular material or selected fine earth which is readily compactible, to a depth of at least 10 + (D/10) cm, where D is the external diameter of the pipe in centimetres. When pipes are to be laid in rocky ground, the depth of the layer should be 20 + (D/10) cm. Consequently, when excavating the trench, the depth specified or shown in the drawings must be increased over the full width of the trench to allow for such additional depths of bedding.

The bedding shall be of uniform compaction over the whole length of the trench and, in conjunction with the initial back-fill (see 11.1) shall envelop the pipe to the angle appropriate to the bedding condition (see ISO 2785) specified by the pipeline designer.

If the soil is sandy or of an otherwise uniform nature free from large lumps and stones and the bottom of the trench properly levelled as described above, the pipes may, at the discretion of the pipeline designer, be laid directly on the bottom of the trench. Where pipes exceeding 600 mm nominal diameter are to be laid in this way, it is recommended that the bottom of the trench be uniformly loosened so as to ensure that the pipes have an adequate bearing surface (bedding angle) appropriate to the condition specified by the pipeline designer (see ISO 2785).

Where the trench bottom is unstable, for example in marshy ground or in running sand, special measures are necessary to ensure proper bedding (see also 7.2).

6 Lowering pipes, joints and fittings into the trench

6.1 General recommendations

Before being lowered into the trench, pipes, joints and fittings should be inspected carefully to detect any damage which may have occurred during transport, handling and storage on site. Suspect areas should be wetted thoroughly to detect end cracks, crushed laminations, etc. Any damaged pipe should be marked clearly to avoid its laying before appropriate action is taken.

Minor irregularities or scoring on the jointing surfaces at the pipe ends which could affect the watertightness of the joint shall be smoothed away by careful rasping in such a way as to avoid a "flat". Where the irregularities or scoring are too pronounced to be smoothed away by such treatment, the pipe end shall be trimmed back and, if necessary, re-machined.

Where impact damage has been detected, the manufacturer's opinion should be sought if required. Consideration may be given to reclaiming the sound portion of the pipe. In the case of crushed ends or hair cracks, a sound pipe will usually remain if a suitable length is cut off. Pipes which have been reclaimed on site should be suitably marked so that at the time of laying their actual position in the pipeline can be known when pressure tests are subsequently carried out.

Pipes, joints and fittings shall be lowered carefully into the trench with tackle suitable for their weight and for the depth of the trench.

6.2 Lowering by hand

Where the pipes and accessories are not too heavy, lowering may be carried out by hand provided that the trench depth does not exceed 1,5 m and that the edge of the trench is sufficiently stable.

6.3 Lowering with ropes

If the trench is deeper than 1,5 m, or if the trench edges are inaccessible or if the pipes and accessories are too heavy to be lowered by hand, the method is generally as described in 3.2 except that planks are not normally required. The fixed ends of the ropes shall be properly anchored.

6.4 Lowering with mechanical equipment

Where the use of mechanical equipment is necessary (i.e when pipes, joints and accessories are very heavy or the trench is very deep) or preferred, a wide sling positioned at the point of balance shall be used.

7 Pipe laying

7.1 General recommendations

Careful site organization shall precede the laying of pipes. The pipeline installer should have available, at the required time, all material and equipment necessary for carrying out the work in accordance with this guide.

To prevent the entry of foreign material during laying, the ends of pipelines for potable water should be closed temporarily. Care should also be taken to ensure that there is adequate backfill or temporary strutting to prevent flotation.

The pipeline installer should ensure that the class of pipes, joints, fittings and rubber rings corresponds to the project specifications.

A distinction may be made between the following three types of laying :

1) continuous supports (see 7.1.1);

2) intermittent supports (see 7.1.2);

3) suspended installation (see 7.1.3).

7.1.1 Laying on continuous supports

7.1.1.1 Normal gradients

This is the normal type for pipelines laid in trench or in embankment conditions. The pipes should be in contact with the bedding over their whole length and under no circumstances should their weight be carried by the joints. Adequate joint holes must therefore be provided.

The pipes should be laid and assembled in good alignment. If,

in order to curve the run, it is necessary to deflect the pipes at the joints, the deflection shall be applied only after the joint has been mounted (see 5.2 and 7.2.4).

As laying progresses, any necessary permanent anchorages (see clause 9) shall be installed and backfilling carried out (see clause 11).

7.1.1.2 Steep gradients

In the case of steeply inclined runs, it is necessary to provide transverse anchors to prevent movement of the pipeline. The choice of type and spacing of anchorages and any necessary additional requirements shall be determined by the pipeline designer.

Precautions shall also be taken to ensure, as far as possible, that any surface water flow, capable of undermining the pipes, is prevented from entering the open trench.

In addition, it is advisable, before backfilling the trench, to install water-stops perpendicular to the pipeline axis at suitable intervals in the trench to prevent the bedding and backfill being washed down the slope. In extreme cases it may even be necessary to fill the trench completely with gravel, excluding stones larger than about 3 cm.

7.1.2 Laying on intermittent supports

This is the type required when a pipeline is laid on cradles or saddles (for example in tunnels) or on piles (for example crossing rivers or cuttings). Special precautions in design and construction should be taken when a pipeline supported in this way is subject to external load (for example backfill, traffic, etc.).

7.1.2.1 Number and location of supports

The number and the spacing of the supports shall be determined by the pipeline designer taking into account the diameter and the strength of the pipes and the anticipated external load on the pipeline.

Where laid in the open, the stability of the completed structure shall also be considered and allowance made for wind, impact, subsidence, etc.

Normally two supports are required for each length of pipe. The supports should be located clear of the joints and at a distance from the pipe ends not exceeding 1/5 of the length of the pipe.

7.1.2.2 Types of support

Concrete, brick and mortar, or metal cradles shall be so shaped as to envelop not less than 60° (120° on heavily loaded pipes) of the external circumference of the pipe. The dimensions of the supporting cradle depend on the external diameter of the pipe, the enveloping angle and the bearing capacity of the soil, and should be determined by the pipeline designer. The design should allow sufficient space for the joint and its assembly.

To ensure that the pipe is uniformly supported by the cradle, it is advisable to insert between the pipe and the cradle a layer of bitumen-impregnated felt or other durable flexible material having a thickness of approximately 5 mm. It is also advisable to fix the pipes to the supports by means of a flat steel strap protected against corrosion. This is an essential precaution if the pipeline does not follow a perfectly straight run or if internal pressure is involved.

7.1.3 Suspended installation

This is the type of installation required when a pipeline is suspended from a structure (for example bridges, walls, ceilings, etc.). The pipes are supported by straps at specified intervals (7.1.2.1). The straps should be made of flat steel, at least 50 mm wide, protected against corrosion, and under no circumstances should they compress the pipe. Round-section straps should not be used.

7.2 Special laying conditions

7.2.1 Unstable ground

In the case of unstable ground, the pipeline designer should consider all the factors in order to determine the appropriate laying method. The following possibilities should be taken into account :

- use of short lengths;
- use of long or locked joints;
- special preparation of trench bottom and pipe foundation.

7.2.2 Passing under highways or railways

Backfill above the crown of the pipes should have a height of at least 1 m. The pipe bedding, side backfill and the first 30 cm of material covering the pipe should be selected non-cohesive soil or granular material. The laying bed should be of a depth at least 20 + (D/10) cm, D being the external diameter of the pipe in centimetres, and should fill the whole width of the trench.

Flexible joints should be positioned at both extremities of the crossing.

Care should be taken to comply strictly with the provisions laid down in the statutory regulations as applicable in each country.

7.2.3 Passing through rigid structures

If the pipeline has to pass through walls or manholes, or concrete blocks, it is essential to ensure that the pipes are not rigidly held. Where pipes are connected to manholes, a short length of pipe should be built into the wall of the manhole and a further short length of pipe should be laid immediately adjacent so that full flexibility can be ensured in the event of differential settlement.

If the structure is not thick, the length of pipe may be replaced by building in an asbestos-cement joint.

7.2.4 Changing of direction

Changes in direction, either horizontal or vertical, may be achieved by using

a) bends or angled couplings;

b) the inherent flexibility of the joints;

c) manholes.

Where method b) is used, the angular deflection between two consecutive pipes should not exceed that recommended by the manufacturer. The pipes must be jointed, in the first instance, in a straight line, and the trench must be widened towards the outside of the curve (see 5.2 and 7.1.1). The required curve is obtained by successively moving the ends of each last pipe thus laid. The deflection shall be equally distributed from joint to joint.

Bends subject to internal pressure should be adequately anchored (see clause 9).

8 Jointing

Jointing should be carried out in accordance with the pipe manufactuer's instructions. In general, the pipeline installer should ensure that

— the rubber rings used correspond to the size and class (or wall thickness) of the pipes;

— the rubber rings and the jointing surfaces of both pipe and joint are clean;

— the rubber rings are correctly positioned in the grooves of the joint or on the pipe ends, as applicable;

— where the use of lubricant is specified, the pipeline designer shall verify that the instructions of the manufacturer are perfectly followed;

— care is taken to prevent the entry of bedding material into the joint;

— a suitable gap is provided between pipe ends after jointing.

9 Anchorages

At points in a pipe run where there are horizontal or vertical changes in direction, reduction in pipe size, valves, branches or capped ends, it is necessary to construct permanent anchorages where movement may occur due to thrust generated by internal pressure.

Temporary anchorages are those which serve only to hold the temporary end closures installed for progressive testing of sections of the pipeline.

Permanent anchorages are intended to form an integral part of the pipeline and consist usually of blocks of concrete. The shape of the concrete blocks depends on the type of the fittings which have to be anchored, while the size of the blocks depends on the thrust to be withstood due to internal pressure, the resistance of the soil and any other local loads.

In the case of vertical curves, the anchorage may comprise flat steel straps held in place by embedding in concrete blocks and suitably protected against corrosion. Such anchorage must not hold the piping rigid and should be constructed merely to withstand the thrust generated in a given direction by the internal pressure. Wherever possible, the adjacent joints should remain accessible.

To determine the size of each anchorage, it is necessary to calculate the thrust resulting from the maximum internal pressure which will be attained at the anchorage point during testing and to consider the resistance of the soil and/or local conditions.

Before a pressure test is carried out, all permanent and temporary concrete anchor blocks shall have developed adequate strength. Rapid hardening cement may be used.

10 House service connections

10.1 Potable water connections

Tappings for service connections may be carried out directly or indirectly. In the first case (10.1.1), the connection is made directly to the pipe; in the second case (10.1.2), the connection is made by interposing a suitable adaptor.

Drilling and tapping should be carried out in accordance with the pipe manufacturer's instructions. Suitable precautions should be taken during installation of the service pipe to ensure that the length adjacent to the ferrule can accommodate any minor settlements in order to prevent undue loading on the ferrule.

10.1.1 Direct connection

Drilling, with subsequent tapping if threaded ferrules are to be employed, may be used with 100 and 150 mm diameter pipes provided that the ferrule does not exceed 20 mm diameter; and with pipes of larger diameter provided that the ferrule does not exceed 25 mm diameter. The type of device used should be compatible with the thickness of the pipe.

10.1.2 Indirect connection

In this type of connection, a suitable fitting is inserted between the main pipe and the ferrule. Typical fittings are tees, collars, saddles and special asbestos-cement connection joints.

10.2 Sewerage connections

Connections may be of the direct type (10.2.1) or the indirect type (10.2.2).

10.2.1 Direct connection

Direct connection is carried out by cutting a hole in the main pipe into which a branch pipe is fixed, with or without a saddle,

and sealed by means of rubber jointing or suitable adhesive. The manufacturer's instructions should be followed.

10.2.2 Indirect connection

In this type of connection, a prefabricated asbestos-cement junction is inserted.

10.2.3 Manholes and inspection chambers

Manholes and inspection chambers may serve as the point of connection in the appropriate circumstances.

11 Backfilling

Backfilling of piping may be carried out in two phases :

— phase 1 involves partial backfilling before pressure testing;

— phase 2 involves completion of backfilling after pressure testing.

Complete backfilling may be carried out in a single operation prior to field pressure testing if so agreed between the pipeline installer and the pipeline designer.

In either case, backfill should be placed in a manner which ensures compaction.

Where mechanical equipment is employed on the site, care must be taken to avoid damage to the pipeline.

The site engineer must approve the material used for backfilling. It is necessary to use selected material (see ISO 2785). Material containing large stones or frozen lumps or harmful industrial wastes must not be used.

11.1 Partial backfilling

Material used for partial backfilling should be placed in the trench in a uniform manner, on each side of the pipe and over the whole width of the trench, in layers approximately 15 cm thick, carefully compacted under the pipe and at the sides in order to provide a good bedding free from cavities, and in conformity with the designer's specification (see ISO 2785).

Partial backfilling should leave the joints exposed and rise at least 30 cm above pipes of diameters up to 200 mm and about 50 cm for larger diameters. In order to ensure good partial backfilling, mechanical shovels should not be used for placing the partial backfill in the trench. In general, if the excavated material is being used for backfill, the density and the moisture content of the compacted fill should be as near equal as possible to that of the existing undisturbed soil it supports. If replacement materials are being used for backfill, they should be compacted at their optimum moisture content to give the maximum density to the satisfaction of the site engineer.

11.2 Backfilling after pressure testing

When the tests have been completed satisfactorily, it is first necessary to backfill the joints which have been left exposed and then to complete the backfilling of the piping as a whole. For backfilling the joints, the instructions given in 11.1 should be followed. To complete the backfilling, use should be made of ordinary materials from which large stones have been removed. The trench must on no account be used as a dump for waste and rubbish.

In completing the backfilling, the material should be placed in layers approximately 30 cm thick, levelled and carefully compacted similar to the instructions given 11.1 or in conformity with the designer's specification.

12 Commissioning

Cleaning and, in the case of potable water pipelines, disinfection should be carried out before the pipeline is commissioned. Filling of pressure pipelines should take place from the lowest point, if practicable, and always with a flow considerably less than that used in normal service.[1] During filling, all drain cocks should be closed and all air vents kept open until there is no further escape of air.

---

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.