SLOVENSKI STANDARD
SIST ISO 1167:1996

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Plastične cevi za transport tekočin - Določanje odpornosti na notranji pritisk

Plastics pipes for the transport of fluids -- Determination of the resistance to internal pressure

Tubes en matières plastiques pour le transport des fluides -- Détermination de la résistance à la pression intérieure

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23.040.20 Cevi iz polimernih materialov Plastics pipes

SIST ISO 1167:1996 **en**

INTERNATIONAL STANDARD 1167

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Plastics pipes for the transport of fluids — Determination of the resistance to internal pressure

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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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, International Standard ISO 1167 replaces ISO Recommendation R 1167-1970 drawn up by Technical Committee ISO/TC 5, *Pipes and fittings.* Technical Committee ISO/TC 138, *Plastics pipes and fittings for the transport of fluids*, set up in 1970, took over the responsibility for this document.

The Member Bodies of the following countries approved the Recommendation :

Australia	Greece	Poland
Belgium	India	South Africa, Rep. of
Canada	Ireland	Spain
Chile	Israel	Sweden
Czechoslovakia	Italy	Switzerland
Denmark	Japan	Turkey
Egypt, Arab Rep. of	Korea, Dem.P.Rep. of	United Kingdom
France	Netherlands	U.S.S.R.
Germany	Norway	Yugoslavia

The Member Body of the following country expressed disapproval of the Recommendation on technical grounds :

New Zealand*

* Subsequently, this Member Body approved the Recommendation.

Printed in Switzerland

Plastics pipes for the transport of fluids — Determination of the resistance to internal pressure

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the testing apparatus and the test procedure to be applied for determining the resistance of plastics pipes to a constant internal pressure and the bursting time of these pipes.

The test requirements are given in the specifications concerning the types of pipes under test.

2 PRINCIPLE

The method consists in subjecting specified lengths of pipe to a specified constant internal pressure for a specified period of time, or until the test piece bursts.

The test pieces are conditioned before testing, and throughout the test they are kept at a specified constant temperature equal to the conditioning temperature. The tests are carried out "with water under water" (see 7.6).

NOTE — The method is based on the correlation between the circumferential stress exerted on the pipe and the time after which bursting is observed.

Consequently, it is based also on the shape of the circumferential stress/bursting time curve, which can be obtained by submitting a number of test pieces to various pressures. The shape of this curve depends on

- the nature of the product used (PVC; PE, high-density; PE, low-density; etc.);
- the processing conditions of the material.

If the tests are performed at elevated temperature, the circumferential stresses required to produce bursting decrease, but the shape of the curve is maintained.

At elevated temperatures, singularities in this curve — in particular, points of flexion — develop sooner. This circumstance is utilized to facilitate extrapolation.

The extrapolation, by suitable methods, of the circumferential stress/bursting time curve, determined at 20 °C in accordance with the test conditions fixed by this method, allows approximate estimation of the maximum circumferential stress which the pipe can withstand, without bursting, over a reasonably long period, say 50 years.

The ratio between this maximum circumferential stress obtained by extrapolation and the circumferential stress to which the pipe will be subjected in continuous service defines what is called a "factor of safety", which is only applicable when water under pressure at a temperature of 20 °C is transported. It makes allowance for the service conditions of the pipe, its handling qualities, etc.

For applications where higher temperatures and/or higher aggressiveness of the fluids to be transported are to be expected, special tests can be considered.

Two types of test are provided for :

- **Acceptance tests**, carried out at a temperature of 20 °C. These allow a fast verification of the conformity of a batch of pipes to a specified type.
- **Quality tests**, carried out at an elevated temperature as a function of the nature of the pipe tested. These allow evaluation of the standard of the production and the pipe material used.

The first type of test may be applied by the manufacturer for the continuous inspection of his products and/or by the consumer for the acceptance of a batch of pipes.

3 APPARATUS

The essential parts of the apparatus are as follows :

3.1 Fittings, to be mounted at the ends of the test piece.

The fittings shall be designed to make a pressure-tight connection to the test piece and to the pressure appliance.

Three types of fittings are allowed, as follows :

3.1.1 Fittings rigidly connected to the test piece so that the lower end of the test piece carries the weight of one of the fittings and the thrust of the pressure (see figure 1a).

3.1.2 Caps, provided with ring joints sealing onto the *external* surface of the test piece, and connected to one another by a metal rod allowing some longitudinal movement at the ends of the test piece. Pressure is applied through one cap end, or through the connecting rod (see figure 1b).

3.1.3 Metal plugs provided with ring joints sealing onto the *inner* surface of the test piece, and connected to one another by a metal rod with a central bore allowing some longitudinal movement at the ends of the test piece (see figure 1c).

3.2 Tank filled with water at the required temperature and provided with a thermostat allowing the temperature to be maintained within ± 1 °C.

NOTE — Provision shall be made for effective stirring.

3.3 Suitable appliance allowing the required pressure to be built up gradually and without shock and to be subsequently maintained within ± 2 % throughout the test.

NOTE – It is recommended that the pressure be applied to each test piece individually, by means of a cylinder of compressed gas connected to the water-filled test pieces. A device which allows the pressure to be applied to several test pieces at the same time should not be used, because at the moment of bursting of one of the test pieces the pressure will also fall to zero in the others. It is not permitted to raise the pressure again to its initial value and continue the test, since the requirements of 3.3 would then not be complied with.

3.4 Pressure gauges, equal in number to the number of test pieces, with suitable scales to check the pressure in the pipes.

NOTE – The pressure gauges shall permit reading within ± 1 %. It is recommended that the pressure gauges be checked regularly, for example once a week, and in the case of short-duration tests every day.

3.5 Appliance designed to register the duration of the pressure application till the moment of bursting, or the first pressure fall.

NOTE – It is recommended that an apparatus be used which is sensitive to the pressure variations caused by rupture and which can stop the time counter and, eventually, close the pressure circuit.

A pressure gauge with electrical contacts or similar systems can be used for this purpose.

4 SAMPLING

4.1 From a batch of pipes, take at random a sample of sufficient length.

4.2 From this sample cut lengths of pipe, or test pieces, one after another. The ends of the test pieces shall be flat and perpendicular to the axis of the pipe.

4.3 The free length of each test piece between the connecting caps shall be L mm as determined by equation 1, but not less than 250 mm.

$$L = 3\,d_e \qquad \ldots \quad (1)$$

where d_e is the outside diameter of the pipe in millimetres.

4.4 Number of test pieces

4.4.1 *Acceptance test* : five test pieces.

4.4.2 *Quality test* : five test pieces for each required test condition.

5 CONDITIONING

Test pieces shall not be tested within a period of 15 h after production of the pipe.

Test pieces shall be brought to the specified temperature and conditioned at that temperature for 1 h.

They may be, for example, immersed in the tank to be used in the burst tests.

6 CALCULATION OF THE PRESSURE

6.1 Acceptance test

The pressure p, in newtons per square metre (or kilograms-force per square centimetre), shall be calculated to three significant figures by means of equation 2 :

$$p = \sigma \frac{2e}{d_e - e} \qquad \ldots \quad (2)$$

where

σ is the circumferential stress, in newtons per square metre (or kilograms-force per square centimetre). For each material the value of σ to be applied to the test pieces is laid down in the particular specification applicable to the pipes under test;

d_e is the nominal outside diameter of the pipe, in millimetres;

e is the nominal wall thickness of the pipe, in millimetres.

6.2 Quality test

The pressure p, in newtons per square metre (or kilograms-force per square centimetre), shall be calculated to three significant figures for each test piece by means of equation 3 :

$$p = \sigma \frac{2e_{min}}{d_{m,\,max} - e_{min}} \qquad \ldots \quad (3)$$

where

σ is the circumferential stress, in newtons per square metre (or kilograms-force per square centimetre) (see 6.1);

$d_{m,\,max}$ is the maximum mean outside diameter, in millimetres, measured on each test piece;

e_{min} is the minimum wall thickness, in millimetres, measured on each test piece to within 0,01 mm by means of a micrometer.

NOTE – It is essential to have available a micrometer designed to measure the wall thickness of a test piece at all points along its length.

7 PROCEDURE

7.1 Cut the test pieces according to clause 4.

7.2 Wipe the test pieces free from any trace of dirt, oil or wax, etc.

7.3 Measure the dimensions of the test pieces (quality test only) and calculate the test pressure (see clause 6) corresponding to the specified circumferential stress.

7.4 Put the fittings on the ends of the test pieces.

7.5 Fill the test pieces with water and condition them (see clause 5).

7.6 Connect the test pieces to the apparatus, release the air from the test pieces and within 60 s apply the specified pressure with an accuracy of ± 2 %.

Throughout the test, the test pieces shall be immersed in the tank, the temperature of which is maintained within ± 1 °C (see 3.2).

7.6.1 *Acceptance test*

Five test pieces shall be subjected to the pressure corresponding to the circumferential stress laid down in the particular specification applicable to the pipes under test.

7.6.2 *Quality test*

Five test pieces shall be subjected to the pressure corresponding to the higher circumferential stress.

Five test pieces shall be subjected to the pressure corresponding to the lower circumferential stress.

These stresses are laid down in the particular specification applicable to the pipes under test.

7.7 The requirements of this test have been complied with if, after the period of time given in the particular specification applicable to the pipes under test, no test piece has burst.

7.8 Retests in case of bursting

7.8.1 *Acceptance test*

If any one of the five test pieces bursts before the specified period of time has elapsed, the test shall be stopped and repeated with a second set of five test pieces taken at random from the batch.

7.8.2 *Quality test*

If any one of the five test pieces in a required test condition bursts before the specified period of time has elapsed, the test shall be stopped and repeated with a second set of five test pieces taken at random from the batch.

8 INTERPRETATION OF RESULTS

A batch or a manufacture shall be deemed to comply with the requirements

— if no test piece bursts before the specified period of time has elapsed,

or

— if a test piece has burst during the first series of tests but no bursting occurs during the second set of tests.

If a rupture occurs within a distance of 0,1 L from the clamp, it shall be disregarded. Such a failed test piece shall be replaced by another test piece.

9 TEST REPORT

The test report shall contain the following particulars :

a) the type of test (acceptance or quality test);

b) the nominal pipe identification;

c) the dimensions of the pipe;

d) the type of end fittings used;

e) the test temperature, with degree of accuracy;

f) the circumferential stress, or stresses, and test pressure, or pressures, with degree of accuracy;

g) the number of pieces tested;

h) the test results, and the time to rupture (if bursting occurs before the specified period of time has elapsed);

i) any characteristics noted during the test;

j) any operation not laid down in this International Standard, or regarded as optional, which might have affected the results.

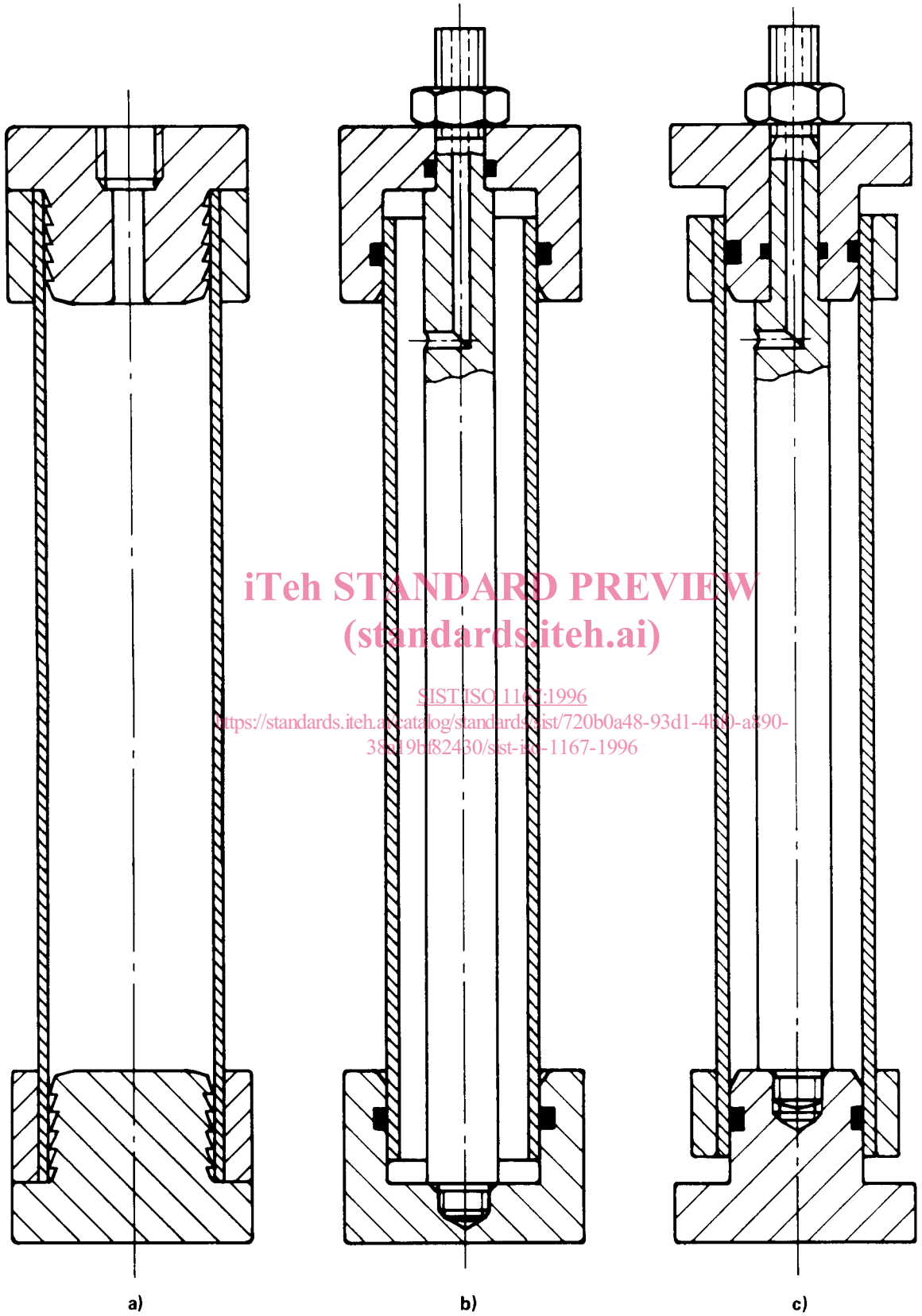

FIGURE 1 — **Arrangement for pressure testing of pipes**