
International Standard



2758

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

Paper — Determination of bursting strength

Papier — Détermination de la résistance à l'éclatement

Second edition — 1983-11-01

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 2758:1983](#)

<https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-6a3a49b72218/iso-2758-1983>

UDC 676.017.42 : 539.42

Ref. No. ISO 2758-1983 (E)

Descriptors : papers, tests, mechanical tests, determination, bursting strength, burst tests.

Price based on 9 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (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 authorized 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 2758 was developed by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This second edition was submitted directly to the ISO Council, in accordance with clause 6.11.2 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 2758-1974), which had been approved by the member bodies of the following countries:

Australia	Iran	Spain
Austria	Ireland	Sweden
Czechoslovakia	Israel	Switzerland
Egypt, Arab Rep. of	Netherlands	Thailand
Finland	New Zealand	Turkey
France	Norway	United Kingdom
Germany, F.R.	Poland	USA
Hungary	Romania	
India	South Africa, Rep. of	

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

Belgium

Paper — Determination of bursting strength

0 Introduction

This International Standard is applicable to papers with bursting strengths of up to 1 100 kPa.

For materials with bursting strengths greater than 350 kPa (or 250 kPa for the components of combined materials), an alternative method, based on similar principles, is specified in ISO 2759.

The scales of many instruments in use for determining this property are at present graduated in kilograms-force per square centimetre, or pounds-force per square inch. For the purpose of this International Standard, the following conversion factors are to be used:

$$1 \text{ kgf/cm}^2 = 98,1 \text{ kPa}$$

$$1 \text{ lbf/in}^2 = 6,89 \text{ kPa}$$

1 Scope

This International Standard specifies a method for measuring the bursting strength of paper submitted to increasing hydraulic pressure.

2 Field of application

This International Standard is applicable to paper having bursting strengths within the range 70 to 1 100 kPa. It is not however generally intended to be used for the components (such as fluting medium or linerboard) of a combined board, for which the method given in ISO 2759 is more suitable. Papers having bursting strengths less than 70 kPa may also be tested by bursting a number of sheets simultaneously.

NOTE — Because of the interaction between the plies, tests on multiple sheets will result in single-sheet bursting strength values that can be significantly higher.

3 References

- ISO 186, *Paper and board — Sampling for testing.*
- ISO 187, *Paper and board — Conditioning of samples.*
- ISO 536, *Paper and board — Determination of grammage.*
- ISO 2759, *Board — Determination of bursting strength.*

4 Definitions

For the purpose of this International Standard, the following definitions apply.

4.1 bursting strength: The maximum uniformly distributed pressure, applied at right angles to its surface, that a single sheet of paper can withstand under the test conditions.

4.2 burst index: The bursting strength of the paper divided by the grammage of the conditioned paper determined by the standard method of test.

5 Principle

A test piece, placed over a circular elastic diaphragm, is rigidly clamped at the periphery but free to bulge with the diaphragm. Hydraulic fluid is pumped at a constant rate, bulging the diaphragm until the test piece ruptures. The bursting strength of the test piece is the maximum value of the applied hydraulic pressure.

6 Apparatus

The apparatus shall be installed on a reasonably horizontal surface and shall be free from externally induced vibrations.

All air shall be removed from the hydraulic system by bleeding. The whole apparatus shall be checked for expansion and for leaks using the methods described in annex E.

6.1 Clamping system, for clamping the test piece firmly and uniformly between two annular plane, parallel surfaces, which shall be smooth (but not polished) and grooved as described in annex A, which also gives the dimensions of the clamping system.

The upper clamping plate shall be held in a swivel joint or similar device so as to ensure that the clamping pressure is distributed evenly.

During tests, the apertures in the two clamping plates shall be concentric to within 0,25 mm and the clamping surfaces shall be flat and parallel. The method of checking the clamps is given in annex B.

The clamping pressure shall be sufficient to prevent slippage during the test (see clause 9), but not so great as to damage the test piece in such a way that rupture could occur around the periphery of the test area. Normally, the clamping pressure shall not be less than 430 kPa (see annex C). For some papers, clamps of larger area than the minimum specified may be required to prevent slippage.

A maximum clamping pressure and also a minimum, differing from that stated above, may be agreed between the parties concerned, in which case the agreed limit or limits of clamping pressure shall be stated in the test report.

6.2 Diaphragm, circular, of elastic material, clamped securely with its upper surface about 3,5 mm below the top plane of the lower clamping plate. The material and construction of the diaphragm shall be such that the pressure required to bulge the diaphragm 9 mm above the top face of the lower clamping plate is 30 ± 10 kPa.

A new diaphragm will frequently require a higher pressure for a given bulge height than one that has been used. Diaphragms shall be checked at frequent intervals and changed if the bulge height requirements are not met. Care shall be taken during the fitting of the diaphragm to eliminate all air trapped under the diaphragm.

6.3 Hydraulic system, to apply a controlled hydraulic pressure to the underside of the diaphragm until the test piece bursts. The pressure shall be generated by a piston forcing a suitable liquid (chemically pure glycerol, ethylene glycol containing a corrosion inhibitor, or a low viscosity silicone oil) against the lower surface of the diaphragm. The hydraulic system and liquid used shall be free from air bubbles. The pumping rate shall be 95 ± 15 ml/min (see annex E).

A motor-operated piston should preferably be used; if a hand-operated instrument is used, this fact shall be clearly stated in the test report.

6.4 Pressure gauges.

6.4.1 Bourdon gauge, maximum reading type, of appropriate capacity.

This instrument should preferably be used within the range 25 to 75 % and, in no case, outside the range 15 to 85 % of the capacity of the scale.¹⁾ The scale shall have a minimum diameter of 95 mm and graduations extending over a minimum arc of 270°. At any point within the working range it shall be accurate to within 0,5 % of the maximum capacity of the scale. The scale shall be subdivided into at least 70 divisions.

The expansibility of the gauge shall be constant to within 20 % over its full working range and shall be such that the volume of hydraulic fluid required to give a full scale reading does not exceed 0,4 ml (see annex E). The gauge shall be fitted with a scale adjustment device for fine setting.

The maximum reading pointer shall not introduce errors into the scale readings during use. This can only be confirmed by dynamic calibration of the gauge. Gauges with pointers having a frictional couple of about 0,3 mN·m and a moment of inertia of between 1 and 10 g·cm² have been found to be satisfactory (see annex D).

The gauge shall be provided with a bleed hole or other device to facilitate the complete filling of the gauge with the hydraulic fluid.

The total measuring range of the instrument may be divided by the use of two gauges, independent of each other in use; by checking the expansibility of the system with the selector valve in each appropriate position, the suitability of the selector valve can be confirmed (see annex E).

6.4.2 Transducer type gauge.

An example of suitable equipment is a pressure transducer which operates with negligible inertia and expansion and a pressure recorder accurate to within 0,2 %. If a digital read-out device is fitted, the reading shall not change by more than 1 unit after the test piece has ruptured.

7 Calibration

Each gauge shall be calibrated before initial use and afterwards at sufficiently frequent intervals to maintain the specified accuracy. A deadweight tester may be used (see annex D). Calibration shall be carried out with the gauge mounted in the same position as it occupies on the instrument and preferably when mounted on the instrument. If the gauge is accidentally used beyond its capacity it shall be recalibrated before being used again.

Routine calibration checks on the instrument may be carried out using standardized foil test pieces for pressures up to about 1 000 kPa.

NOTE — Standardized aluminium foils for routine calibration of burst testers may be obtained from:

Pulp and Paper Research Institute of Canada
570 St. John's Boulevard,
Pointe Claire, P.Q. Canada H9R 3J9

The Research Association for the Paper and Board, Printing and Packaging Industries (PIRA)
Randalls Road
LEATHERHEAD
Surrey
England

8 Sampling and preparation of test pieces

The paper to be tested shall be sampled in accordance with ISO 186. Test pieces shall be larger in area than the clamps of the burst tester and no area covered by the clamp in one test shall be included in subsequent test areas.

1) If the capacity of the gauge is known to exceed the graduated scale reading by 20 %, the upper limit of scale reading may be increased to 90 % and 100 %, respectively.

Test pieces shall not include areas containing watermarks, creases, or visible damage.

Test pieces shall be conditioned in accordance with ISO 187.

The number of test pieces required depends on whether or not separate results are required for burst tests carried out with each surface in contact with the diaphragm.

NOTE — When laboratory sheets are being tested and when only narrow samples are available for testing, it may not be possible to avoid the clamped area overlapping the edges of the test piece or an adjacent clamped area. In such instances, the overlap should be carefully minimized and the test piece inspected after use to ensure that the overlap has not caused the clamped paper to slip. If clamping is not in accordance with the stated procedure, this fact should be stated in the test report.

9 Procedure

Tests shall be carried out in the standard atmosphere, defined in ISO 187, used for the conditioning of test pieces in accordance with clause 8.

Where alternative gauges are available, select the most suitable gauge, if necessary by carrying out a preliminary test using the gauge with the greatest range, and isolate the other gauges.

Raise the clamp and insert the test piece in a position enabling the full clamping area to be used (see the note to clause 8); then firmly apply the clamp to the test piece at the clamping pressure specified in 6.1.

Apply hydraulic pressure at the correct rate until the test piece bursts. Retract the piston until the diaphragm is below the level of the lower clamping plate. Read the pressure indicated on the gauge to three significant figures. Then release the clamp and return the maximum reading pointer to its starting position for the next test. Readings shall be rejected when visible slippage of the test piece (as shown by movement of the test piece area outside the clamps or by creasing of the test piece in the clamped area) has occurred. In cases of doubt, the use of a larger test piece will frequently establish whether slippage is occurring. Readings shall also be rejected if the type of failure (for example severance at the periphery of the test zone) indicates that the test piece was damaged by excessive clamping pressure or by rotation of the clamps during clamping.

If the reading is less than 70 kPa, burst the minimum number of sheets simultaneously to give a reading above 70 kPa. These sheets shall be arranged top side to wire side with machine directions parallel.

NOTE — Care should be taken when returning the pointer to the starting position. On some instruments, if it is returned too rapidly, the pointer may be damaged.

If separate results are required for each surface of the paper in contact with the diaphragm, twenty tests shall be carried out to obtain each result. If separate results are not required for the two surfaces of the paper, ten tests shall be carried out with the wire side uppermost and ten tests with the top side uppermost.

NOTE — The surface in contact with the diaphragm is considered to be the surface under test.

10 Expression of results

The mean bursting strength, P , expressed in kilopascals, is given by the formula

$$P = \frac{B}{N}$$

where

B is the mean value of the maximum hydraulic pressure, in kilopascals;

N is the number of sheets tested simultaneously.

The burst index, X , expressed in kilopascal square metres per gram, may be calculated from the bursting strength by the formula

$$X = \frac{P}{W}$$

where

P is the mean bursting strength, in kilopascals;

W is the grammage of the paper, in grams per square metre, determined in accordance with ISO 536.

11 Precision

The precision depends to a great extent on the variability of the material tested, and the accuracy of the mean on a large number of factors, the most important possibly being the efficiency of clamping.

It is difficult, under practical circumstances, to separate these factors, but some typical results will illustrate the variations likely to be encountered.

Within laboratory (15 papers):

Coefficient of variation of individual results: 3,6 to 13,2 %;

95 % confidence limits of mean result: $\pm 1,7$ to 6,1 %.

Between laboratories (randomized test pieces):

Coefficient of variation of mean results: 2,1 to 9,7 %.

Thus it can be seen that, generally, depending on the value of the bursting strength, differences in the mean results for two papers of less than about 5 % on a single instrument or about 10 % on instruments in different laboratories cannot be taken as proof of a real difference in bursting strength.

12 Sources of error

The main sources of error are as follows:

— testing several sheets simultaneously (see the note to clause 2);

- faulty calibration of the pressure gauge (see annex D);
- incorrect rate of increase in pressure (increased rates lead to an apparent increase in bursting strength) (see annex E);
- defective diaphragm (see 6.2);
- inadequate or uneven clamping (which generally leads to an apparent increase in bursting strength) (see annexes B and C);
- presence of air in the system (which generally leads to an apparent decrease in bursting strength) (see annex E).

13 Test report

The test report shall include the following particulars:

- a) a reference to this International Standard;
- b) the date and place of testing, the make of instrument and the model number;
- c) whether the instrument used was hand-operated;
- d) the standard conditioning atmosphere used;
- e) the mean value of the bursting strength to three significant figures (if required, for each surface of the paper);
- f) if required, the burst index to three significant figures;
- g) the 95 % confidence limits of the mean bursting strength;
- h) in the case of multiple sheet testing, the number of sheets used;
- i) any deviations (including clamping pressure limits) from the specified clamping conditions;
- j) any deviations (not mentioned above) from the method specified.

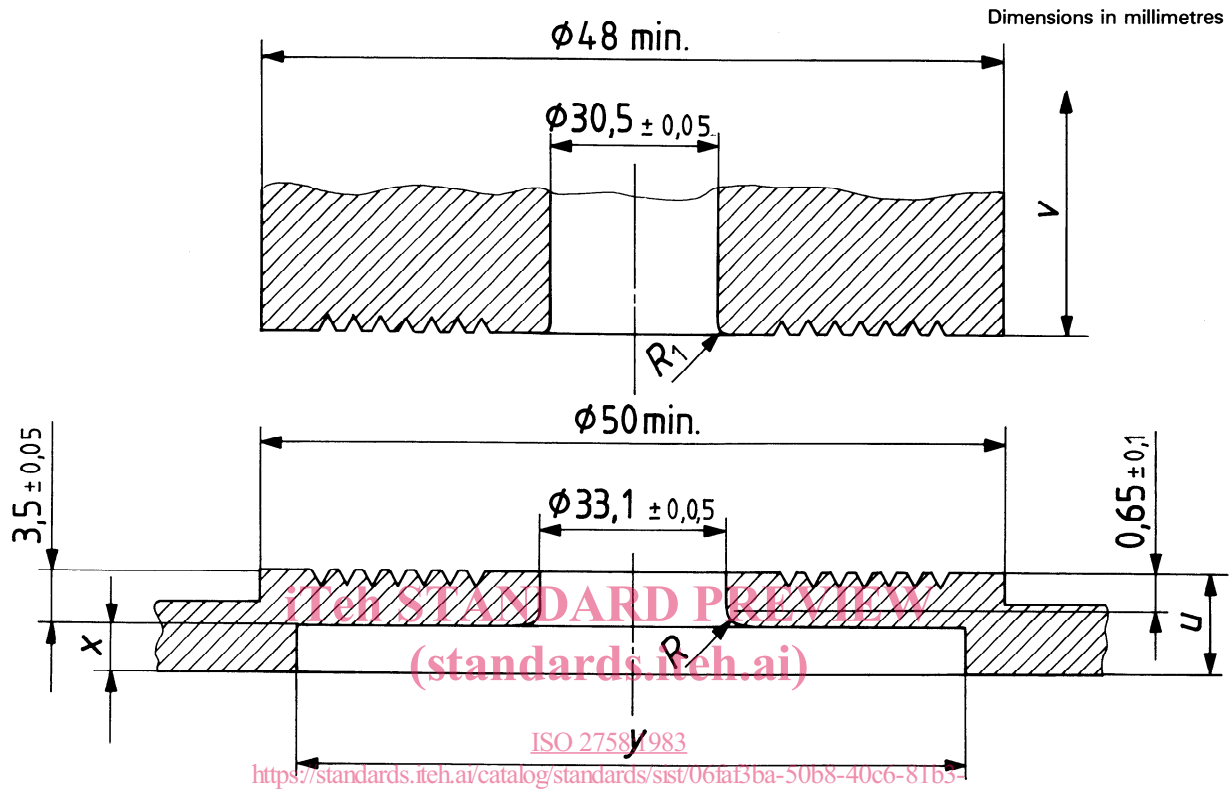
iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 2758:1983](https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-6a3a49b72218/iso-2758-1983)

<https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-6a3a49b72218/iso-2758-1983>

Annex A

Dimensions of the clamping system



R , R_1 , u , v , x and y are specified in the text.

Figure 1 – Clamps

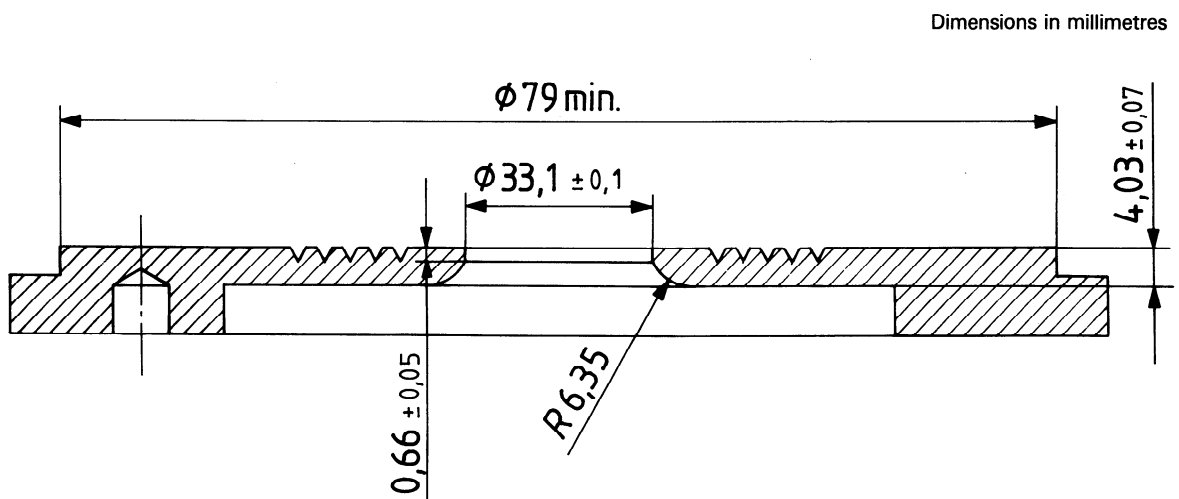


Figure 2 – Alternative lower clamp¹⁾

1) This clamp may sometimes be found on instruments of North American manufacture. When this clamp is provided, the radius R_1 on the upper clamping plate is about 0,4 mm.

Dimensions u and v (see figure 1) are not critical but shall be large enough to ensure that the clamps do not distort during use. For the top clamp, a minimum thickness of 6,35 mm has been found satisfactory in use.

Dimensions x and y depend on the burst tester and on the diaphragm used but shall be such that the diaphragm is securely clamped.

Radius R is set by the limits imposed by the dimensions $3,5 \pm 0,05$ mm and $0,65 \pm 0,1$ mm. The arc shall be tangential to the vertical face of the orifice and to the horizontal bottom surface of the lower clamp. The radius shall be about 3 mm.

To reduce the danger of damage to the test piece or the diaphragm, R_1 shall be very slightly rounded but not sufficiently to affect the bore of the upper clamping plate. (A radius of curvature of about 0,2 mm is recommended.)

To minimize slippage, the clamp surfaces which come into contact with the paper during test shall have spiral or concentric tool marks in the surface.

The following have been found very satisfactory:

- a) a continuous spiral 60° V-groove not less than 0,25 mm deep, with a pitch of $0,9 \pm 0,1$ mm, the groove starting at $3,2 \pm 0,1$ mm from the edge of the circular opening;
- b) a series of concentric 60° V-grooves not less than 0,25 mm deep and $0,9 \pm 0,1$ mm apart, the centre of the innermost groove being $3,2 \pm 0,1$ mm from the edge of the circular opening.

The space above the orifice in the upper clamp shall be of sufficient size to allow free bulging of the test piece and shall be connected to the atmosphere by an orifice of sufficient size to allow air trapped above the test piece to escape. An orifice of diameter about 4 mm has been found to be suitable.

iTeh STANDARD PREVIEW (standards.iteh.ai)

Annex B

[https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-](https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-6a3a49b72218/iso-2758-1983)

Testing the clamps

Place a piece of pencil carbon paper, together with a piece of thin white paper, between the clamps and apply the normal clamping pressure. If the clamps are satisfactory, the impression transferred from the carbon paper to the white paper will be clear, uniform and well defined over the whole clamping area. If the upper clamp can be rotated, the clamping impression shall be repeated at right angles to the original impression.

The concentricity of the clamps may be checked either by checking that the clamps line up correctly on a plate fitted with discs on each side corresponding in diameter with the dimensions of the orifice, or by taking a clamping impression using two sheets of carbon paper with a sheet of thin white paper between them and checking that the clamping impressions are symmetrical and correspond.

Annex C

Clamping pressure

Some testers are fitted with a hydraulic or pneumatic clamping device, incorporating a pressure gauge, and can be readily adjusted to give any required clamping pressure. In such cases, it must be stressed that the pressure in the hydraulic or pneumatic system is not necessarily identical with the pressure between the clamps. The areas of the piston and of the clamp faces must be taken into account.

Testers fitted with a hand-operated clamping wheel can be suitably modified by attaching to the wheel a square socket adapter which will accept a standard adjustable torque wrench.

Testers so modified shall be individually calibrated with a load cell to determine the torque wrench settings corresponding to the specified clamping pressure. It is important, however, that the top clamp screw be maintained undamaged, clean and lightly oiled to minimize friction.

Lever-operated clamps are normally spring-loaded. If the compression spring is calibrated, the compression of the spring will give an indication of the clamping pressure. The calculated values shall be confirmed using a load cell or other suitable method.

iTeh STANDARD PREVIEW (standards.iteh.ai)

Annex D

ISO 2758-1983

[https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-](https://standards.iteh.ai/catalog/standards/sist/06faf3ba-50b8-40c6-81b3-6a10b7221415/iso-2758-1983)

Calibration of pressure gauge

D.0 Introduction

The pressure gauge may be calibrated statically by means of a deadweight tester of the piston type or by means of a column of mercury. Such calibration shall be carried out with the gauge in the same position as in the bursting tester.

Pressure gauges are subject to dynamic, in addition to static, calibration errors; dynamic calibration is therefore advisable. For references to methods, see bibliography.

D.1 Pointer inertia and friction

The moment of inertia of the maximum reading pointer may be calculated from the geometry and mass of the pointer.

The friction of the pointer can be determined by resting a small loop of wire on the pointer when placed horizontally with the gauge mounted vertically. A torque of between 0,2 and 0,4 mN·m, calculated from the mass of the wire loop and its distance from the pointer shaft, shall be required to cause the pointer to move slowly and smoothly when the gauge is rotated or lightly tapped.

D.2 Gauge expansibility

The expansibility of the gauge may be determined by a calibrated plunger or dilatometer. With the system free of air, the plunger shall be moved forward by known amounts and the pressure developed in the gauge noted.