
International Standard



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Pulps — Laboratory beating — Part 1 : Valley beater method

Pâtes — Raffinage de laboratoire — Partie 1 : Méthode à pile Valley

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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.

International Standard ISO 5264/1 was developed by Technical Committee ISO/TC 6, *Paper, board and pulps*, and was circulated to the member bodies in December 1977.

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

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No member body expressed disapproval of the document.

Pulps — Laboratory beating — Part 1 : Valley beater method

0 Introduction

It has been agreed that the ultimate aim of standardization of laboratory beating should be to develop one test method which is internationally acceptable and which, if possible, allows the energy consumption during beating to be measured. For practical reasons it has not proved possible to achieve this at present. Therefore, as an interim measure, in view of the widespread use of the following methods

- Valley beater,
- PFI mill,
- Jokro mill,

it has been decided to provide agreed guidance on the use of these equipments in order to achieve consistency of results with each instrument. While all three methods will show a similar trend in respect of the pulp tested, the actual results cannot be correlated between different types of beater¹⁾. The position will be kept under review, and the methods will be replaced by a single method as soon as practicable.

1 Scope

This International Standard specifies a method, using a Valley beater, for the laboratory beating of pulp. The description is limited to the furnishing and beating of the stock, the withdrawal and distribution of samples, and the beating equipment.

The beating is a preliminary step in testing the physical properties of pulp.

Part 2 specifies a method of laboratory beating using a PFI mill and Part 3 a method using a Jokro mill.

2 Field of application

In principle, this method is applicable to all kinds of pulp.

NOTE — In practice, the method may not give satisfactory results with certain extremely long-fibred pulps, such as cotton linters.

3 References

- ISO 638, *Pulps — Determination of dry matter content*.
- ISO 4119, *Pulps — Determination of stock concentration (Rapid method)*.
- ISO 5263, *Pulps — Laboratory wet disintegration*.

4 Principle

A measured amount of pulp of specified stock concentration is beaten between the bars of the roll and the bedplate of a Valley beater. Samples of beaten pulp are taken at intervals during the beating.

5 Apparatus and auxiliary materials

Ordinary laboratory equipment and

5.1 Valley beater, as described in annex A.

5.2 Timer.

5.3 Balance, capable of weighing the sample to an error of less than 1 g.

5.4 Distilled water, or deionized water, or water of similar quality.

NOTE — Distilled water, or water of similar quality, is particularly recommended with a view to obviating any difficulties that might arise from the use of different qualities of water by the interested parties.

6 Preparation of sample

If the pulp is wet or air-dry, weigh out a sample for dry matter determination in accordance with ISO 638. If the pulp is in slush form, determine the dry matter content in accordance with ISO 4119.

1) Should one of the three methods listed become the future standard method, that one of the methods should be chosen which works in the most economical way and yields the highest reproducibility of results obtained in different laboratories.

At present, some countries are of the opinion that the PFI mill described in ISO 5264/2 meets these requirements best of all.

Take an amount of the pulp corresponding to 360 ± 5 g of oven-dry pulp (do not cut the pulp, and avoid the use of cut edges). If the sample is in the form of machine-dried sheets or flash-dried slabs, soak the pulp thoroughly in 5 litres of water (see 5.4) at room temperature for not less than 4 h. Tear the soaked pulp into pieces approximately $25 \text{ mm} \times 25 \text{ mm}$ in size. It is essential that the pulp be thoroughly softened by soaking, to ensure that the preliminary disintegration results in a minimal beating effect. Wet pulps may be disintegrated without soaking.

7 Procedure

7.1 Disintegration

The preliminary disintegration is effected in the Valley beater (5.1) itself.

Lower the bedplate, and clamp it in the lowered position, so that the clearance between the roll and bedplate bars is at least 10 mm. Close the outlet of the beater tub with a stopper. Fill the tub with 18 litres of water (5.4) at 20 ± 5 °C, and start the motor. Slowly add, over a period of 3 to 5 min, the pulp and the water used for wetting it. The total volume of pulp and water should be $23,0 \pm 0,2$ litres, to give a pulp concentration of approximately 1,57 % (m/m).

Disintegrate the pulp with the bedplate still fixed in its lowered position. Free any pieces of pulp caught behind the roll or the adjacent shield, by moving the lever arm of the bedplate rapidly once or twice up and down during the course of disintegration.

Pulps with an initial dry matter content of 20 % (m/m) or more normally disintegrate within 30 min after addition of all the pulp to the beater tub. Pulps with less than 20 % (m/m) dry matter content should disintegrate within 5 min.

NOTES

- 1 Where necessary for climatic reasons, a temperature of 25 ± 5 °C may be applied, provided that this is noted in the test report.
- 2 Ensure that the pulp is completely disintegrated. Pulps that are difficult to disintegrate, such as unbleached sulphate pulp, may require a time exceeding 30 min for disintegration.
- 3 A sample disintegrated as described above may not be regarded as a sample of unbeaten pulp disintegrated in accordance with ISO 5263.
- 4 Hands must not be placed inside the beater while it is running.

7.2 Beating

Beating conditions : Load on the lever arm : $54 \pm 1 \text{ N}$
 Rotational frequency of the roll :
 $8,3 \pm 0,2 \text{ s}^{-1}$

Check that the load on the bedplate lever is as specified, release the lever, and start the timer (5.2). Without interruption of the beating process, and without removal of the bedplate load, withdraw a total of five stock samples of 1 200 ml (18,8 g of fibres, oven-dry basis), distributed over the range of beating required.

The following is an example of a schedule for sample removal :

Bleached and unbleached sulphite pulps, straw pulps and hardwood alkaline pulps : 5, 10, 15, 20, 30 min

Bleached softwood alkaline pulps : 5, 15, 30, 45, 60 min

Unbleached softwood alkaline and other slow-beating pulps 5, 15, 30, 60, 90 min

NOTES

- 1 Even if the quantity of pulp withdrawn is not necessarily all used for testing, it is necessary that the stated quantity of pulp be withdrawn at the periods adopted. It can be expected that a change in the volume removed will change the rate of beating.
- 2 After beating, clean the beater thoroughly with water and, if necessary, with a pitch solvent, with due consideration being given to the rubber diaphragm.
- 3 If pulps are normally beaten to "Canadian Standard" freeness number values below 300, or to Schopper-Riegler number values above 40, frequent checks should be made of the calibration of the beater.
- 4 If the drainability is measured, this should be done with a minimum of delay.

8 Test report

The test report shall include the following particulars :

- a) the reference to this International Standard;
- b) all the indications necessary for complete identification of the sample;
- c) the time used for preliminary disintegration;
- d) the time used for beating;
- e) the results obtained in the drainability test, if made (see note 4 to 7.2);
- f) any unusual features observed in the course of the procedure;
- g) any operations not specified in this International Standard or in the International Standards to which reference is made, or regarded as optional, which might have affected the results.

Annex A

Valley Beater (see the figure)

The bars of the roll and bedplate are made of stainless steel. The bedplate has a Brinell hardness of 325 to 375 HB, and the roll flybars 350 to 400 HB. The diameter of the roll is 168 mm; with the 32 flybars inserted, it is 190 to 194 mm. The thickness of each flybar is 4,7 mm, and the width of the roll 152 mm.

The bedplate has 7 bars set in lead, each 3,2 mm thick and 2,4 mm apart. The grooves between the bars are filled with strips of kiln-dried white oak. The bars are rectangular in cross-section and bent in the shape of a V with the apex of the V pointing in the flow direction of the stock, and the arms of the V forming an angle of 5° with the direction of the roll axis. The width of the bedplate is 159 mm; it is ground to the same curvature as the roll.

The bedplate and the bottom of the beater tub are connected by a diaphragm of soft, elastic rubber, of thickness approximately 1,5 mm, installed in such a way that there is no tension in the diaphragm when the bedplate and beater roll are in contact.

The bedplate is pressed against the roll by means of a lever; the ratio between the lever arms is 1,94 to 1; a load of 5 500 gf, obtained by using suitable weights applied to the longer arm then produces a force of 105 N on the bedplate. The roll is run at a rotational frequency of $8.3 \pm 0,2 \text{ s}^{-1}$ and may convey

niently be driven by a motor of approximately 400 W by a belt drive. The beater tub is provided with bolts for fixing the bedplate lever during grinding.

The bedplate is balanced so that it is in equilibrium with 23,0 litres of water in the beater when the beater is running. An extremely small force will then bring the roll and bedplate into contact.

To ensure reproducible beating, the following conditions shall be fulfilled :

- a) The beater roll shall run smoothly, without irregular vibrations.
- b) All the roll and bedplate bars shall make contact throughout their width.
- c) The threshold formed by the first bar of the bedplate, and the depth of grooves between the bedplate bars, shall be $1,0 \pm 0,2 \text{ mm}$.
- d) The leading edge of the flybars shall be rounded to a radius of approximately 0,2 to 0,3 mm.
- e) All the bars shall be clean, undamaged and free from deposits and corrosion.

Annex B

Calibration of the Valley beater

The following calibration procedure is designed to bring the beater to a condition which will remain stable during repeated use, and maintain reproducible laboratory sheet properties at a given beating degree, within a narrow range of beating times.

This alignment and stabilization procedure shall be applied

- a) when a new beater is taken into use;
- b) when a carbon paper impression indicates a serious misalignment between the bedplate bars and the beater roll;
- c) after the installation of a new bedplate assembly, rubber diaphragm, beater roll or roll bearing.

B.1 Auxiliary materials

B.1.1 Pulp, suitable for grinding purposes.

B.1.2 Silicon carbide powder, 125 μm and 45 μm .

B.1.3 Carbon paper, placed between two paper sheets to give a total thickness of 0,15 mm.

B.1.4 Suitable hone.¹⁾

B.1.5 Light machine oil.

B.1.6 Reference pulp, kept for checking purposes and stored sufficiently long to avoid further changes in the pulp. The reference pulp should preferably be of the same type as that normally beaten in the beating equipment concerned.

B.2 Alignment grinding

Before calibration, check the beater roll and flybars to ensure that they are not loose. The beater roll shall be checked; if out of round, it shall be ground on a grinder or lathe. By reason of the change in beater geometry, flybars shall be replaced if they have worn down by more than 2 mm, i.e. if the diameter of the roll is less than 190 mm.

New bedplate bar assemblies, and beaters which have been dried out, shall be soaked with water for at least 24 h, to permit the wooden spacers to swell. Bedplate bars shall be replaced when they have worn below 3,2 mm.

Before calibration, the bedplate and diaphragm shall be removed and inspected. Scrape the excess mounting metal from the leading edge of the bedplate bars, to a depth of $1,0 \pm 0,2$ mm, thus producing a $1,0 \pm 0,2$ mm threshold. The depth of each groove between the bars shall also be adjusted to $1,0 \pm 0,2$ mm. Scrape or hone the burred edges of each bedplate bar, and clean the areas between them. Grind or file off the raised shoulders at the ends of the bedplate bars below the level of the contact area. Remount the bedplate assembly and diaphragm by means of the bolts on the lever-arm.

NOTE — Both the 1,0 mm threshold and the depth of the groove shall be extended horizontally along the full width of the bedplate.

Attach the lever-arm clamp to the beater body by means of the bolts. The lever-arm extends through the slot in the clamp, and its position can be regulated and maintained by the two set screws bearing on the upper and lower surfaces of the lever-arm. Before grinding commences, the clamp should be adjusted to prevent contact between the bedplate and the beater roll.

Prepare a standard 360 g (oven-dry basis) beater charge of pulp (B.1.1) in the normal way. Operate the beater without load for a few minutes and add 120 g (approximately 80 ml) of the 125 μm silicone carbide powder (B.1.2) to form a homogeneous mixture.

With the beater running, adjust the setscrews on the lever-arm clamp to bring the bedplate into contact with the beater roll. Continue grinding with occasional adjustment to maintain bedplate contact, until a smooth, vibration-free operation is achieved, and a shiny, ground surface is obtained evenly across the flybars on the beater roll. With proper alignment, this condition should be attained in approximately 30 min if the bedplate bars and the beater roll are completely new. If they have already been in use, a few minutes should be satisfactory.

Empty the pulp and abrasive from the beater, and retain this mixture for further grinding. Wash the beater thoroughly, and dry the area around the bedplate with blotters.

Take a carbon-paper impression of the condition of the bedplate as follows :

Place a sheet of the carbon paper (B.1.3) between two paper sheets to give a total thickness of 0,15 mm. Cut this to 160 mm $\times$ 250 mm. Place the prepared carbon paper between the bedplate and the beater roll, and apply pressure to the lever-arm. Hold the paper firmly, to prevent slippage, and rotate the roll by hand. Repeat the procedure in a few other

1) For example, a Carborundum hone No. 149.

positions of the roll until a complete impression of the bedplate is obtained.

NOTE — A similar impression is attainable by the use of a sheet of aluminium foil covered with paper to a total thickness of 0,15 mm.

Continue grinding with the pulp-abrasive mixture, until the carbon-paper impression shows complete contact between the bedplate bars and the beater roll.

Once complete contact is achieved, empty the beater, and retain the pulp-abrasive mixture. Remove the bedplate and diaphragm as a unit, and repeat the removal of any excess mounting metal from the leading edge of the bedplate bars, to a amount of $1,0 \pm 0,2$ mm.

Scrape or hone the burred edges of each bedplate bar, and clean the areas between each bar. Grind or file the raised shoulders at the end of the bedplates, and replace the bedplate.

Pour the pulp-abrasive mixture into the beater, and grind for approximately 5 min with the standard 54 N load on the lever-arm to correct any misalignment resulting from the removal of the bedplate assembly.

Empty the beater, dry the bedplate area, and check the bedplate contact with a carbon-paper impression. If contact is complete, remove the splash cover from the beater roll. Rotate the beater roll by hand, and check that each flybar is straight with a precision straight edge. Carefully hone the metal burr from each flybar trailing edge, using the hone (B.1.4) and the light machine oil (B.1.5).

Carefully hone the leading edge of each flybar to a radius of approximately 0,2 to 0,3 mm. At this stage, do not attempt to modify the grooved surfaces of the flybar.

Check the operation of the beater by beating a reference pulp (B.1.6). For a hardwood reference pulp, beating for the time normally required to reach about 50 Schopper-Riegler number or 200 "Canadian Standard" freeness number shall give a Schopper-Riegler number about 10 % higher or a "Canadian Standard" freeness number about 10 % lower than the normal value for that pulp. If checking is made with a softwood reference pulp, the drainage values obtained shall be at the level normal for the pulp concerned.

If this is not the case, proceed as follows :

If the beater develops drainage properties too slowly, condition it with 420 g (approximately 300 ml) of the 45 μ m silicon carbide powder (B.1.2) in a well-beaten pulp, using the standard load on the lever-arm. Continue the treatment for 15 to 30 s. This treatment shall be followed by the stabilization step (clause B.3), before checking with the reference pulp (B.1.6).

If the beater develops drainage properties too quickly, continue the alignment grinding described above, but with a small load (5 to 10 N) on the lever-arm. This treatment shall be continued for 10 to 30 min, depending on the effect needed. It shall be followed by the stabilization step (B.3) before checking with the reference pulp (B.1.6).

B.3 Stabilization

This step is required to stabilize the condition of the roll bars and bedplate bar assembly.

Remove the lever-arm clamp from the beater. Prepare a standard 360 g beater charge in the normal way

NOTE — The use of a pulp sample which represents the type of pulp regularly under evaluation will help condition the beater at a bedplate-beater roll gap normal for that type of pulp.

Add 50 g (approximately 35 ml) of the 45 μ m silicon carbide powder to the beater charge, and circulate until a uniform mixture is obtained with no load on the beater arm.

Place the standard 5 500 gf load on the beater arm, and run the pulp-abrasive mixture for 2 to 3 min. Discharge the mixture, and wash all traces of pulp and abrasive from the beater. Loosen the diaphragm bolts, and flush all traces of abrasive from diaphragm area.

Beat at least three standard charges of the reference pulp (B.1.6) to approximately 200 "Canadian Standard" freeness number or 50 Schopper-Riegler. Discard these runs, unless a freeness time-check is required.

The stabilization can also be effected by repeated beatings of a slow beating pulp.

Check the beater calibration by making a complete beater run, using the reference pulp (B.1.6).

If the drainage values within ± 5 % of those normal for the reference pulp are arrived at, the beater is ready for use.

B.4 Touch-up grinding

The touch-up procedure shall be applied whenever

- the bedplate assembly chatters or vibrates excessively during the later stages of beating;
- the beater gives test results that fall outside the normal control limit.

Inspect both the bedplate bars and beater roll for excessive wear, misalignment or looseness. Replace the bedplate bars if they are worn more than 3,2 mm, and the beater roll flybars, if worn more than 1,6 mm from their original specifications. Check the clearance between the mounting metal and the leading edge of the bedplate bars, and adjust to provide a clearance of 1,0 mm.

If the beater develops drainage properties too slowly, condition it with 420 g (approximately 300 ml) of 45 μ m silicon carbide powder (B.1.2) in a well-beaten hardwood pulp, using the standard load on the lever-arm. Continue the treatment for 15 to 30 s. This treatment shall be followed by the stabilization step (clause B.3) before checking with the reference pulp (B.1.6).

If the beater develops drainage properties too quickly, continue the alignment grinding described above, but with a small load (5 to 10 N) on the lever-arm. This treatment shall be continued

for 10 to 30 min, depending on the effect needed, and shall be followed by the stabilization step (B.3) before checking with the reference pulp (B.1.6).

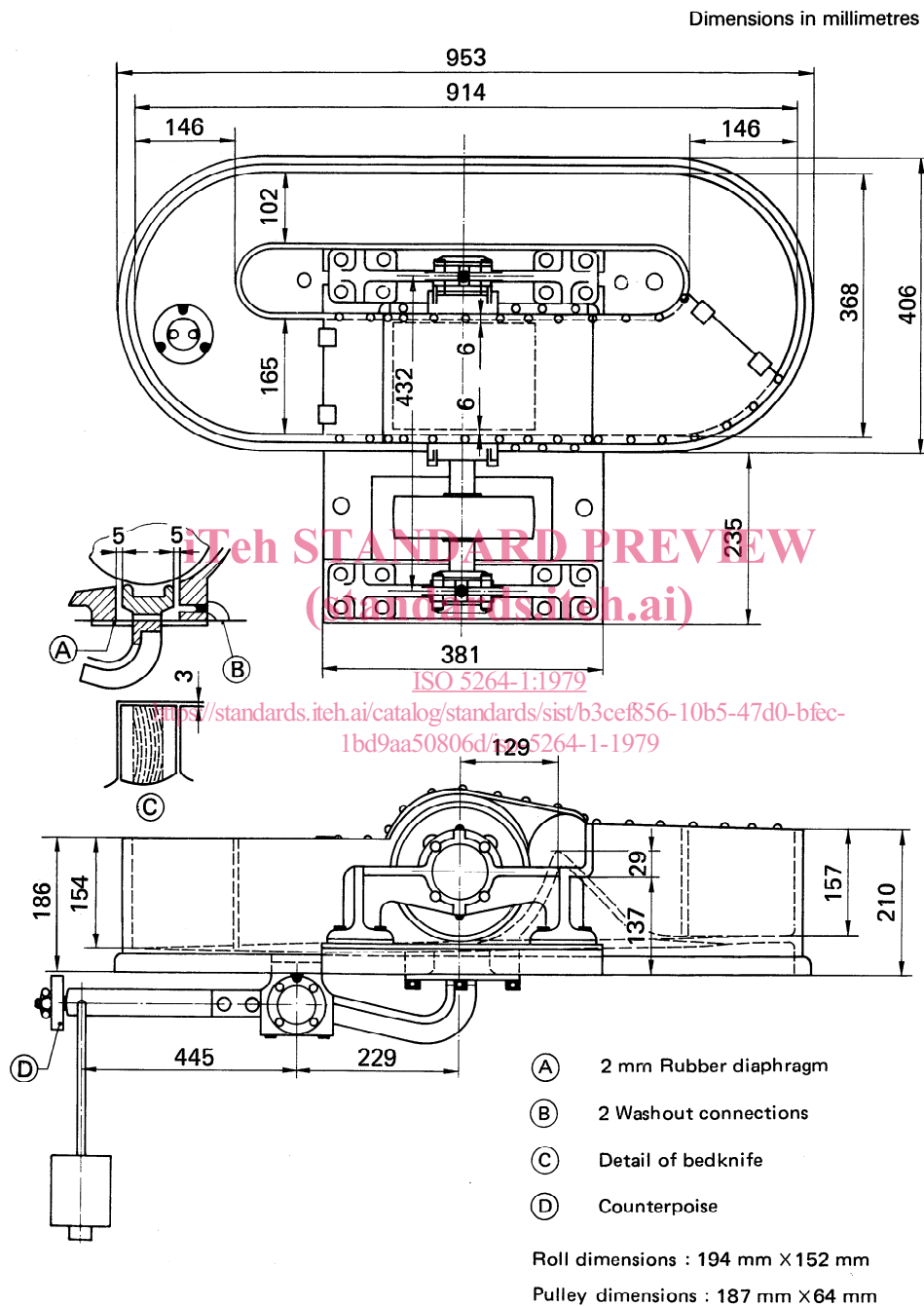


Figure — Valley beater