International Standard ISO 3271

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Iron ores — Determination of tumbler strength

Minerais de fer — Essai au tambour

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3271 was prepared by Technical Committee ISO/TC 102, *Iron ores*.

ISO 3271 was first published in 1975. This second edition cancels and replaces the first edition, clauses 3, 5, 6, 7 and 8 of the previous edition having been technically revised.

Iron ores — Determination of tumbler strength

1 Scope and field of application

This International Standard specifies a method for evaluating the tumbler strength of iron ores (resistance to degradation by impact and abrasion) by determining the tumbler index and the abrasion index.

This method is applicable to sized iron ores and to such iron ore agglomerates as pellets or sinters.

2 References

ISO 3081, *Iron ores — Increment sampling — Manual method.*[1]

ISO 3082, *Iron ores — Increment sampling and sample preparation — Mechanical method.*[2]

ISO 3083, *Iron ores — Preparation of samples — Manual method.*[3]

3 Definitions

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

3.1 tumbler index: A relative measure of the resistance of the material to breakage or degradation by impact and abrasion, which is expressed as the percentage of +6,30 mm fraction.

3.2 abrasion index: A relative measure of the degradation of the material by abrasion, which is expressed as the percentage of −500 µm fraction.

3.3 sample for the tumbler test: The sample taken for the determination of tumbler strength of a lot or part of a lot.

4 Principle

Tumbling of a 15 kg test portion by using a circular drum (internal diameter 1 000 mm, internal length 500 mm) for a total of 200 revolutions.

Sieving with test sieves including square mesh apertures of 6,30 mm and 500 µm. Weighing of the appropriate size fractions and calculation of tumbler index and abrasion index.

5 Apparatus

5.1 Tumbler test apparatus, as shown in the figure, consisting of a circular drum of internal diameter 1 000 mm and internal length 500 mm, constructed of steel plate at least 5 mm in thickness. The drum shall be replaced whenever the thickness of the plate is reduced by wear to 3 mm in any area.

Two equally spaced steel angle lifters, of section 50 mm × 50 mm × 5 mm, of length 500 mm (*i.e.* equal to the internal length of the drum) shall be solidly attached longitudinally inside the drum by welding in such a manner as to prevent accumulation of material between lifter and drum. One of the lifters shall be attached to the door for ease of sample removal. The other shall be positioned at 180° from the first. Each lifter shall be fastened so that it points toward the axis of the drum, with its attached leg pointing away from the direction of rotation, thus providing a clear unobstructed shelf for lifting the sample. The lifters shall be replaced in any case when the width of the shelf is reduced by wear to less than 47 mm.

The door shall be so constructed as to fit into the drum to form a smooth inner surface. During the test it shall be capable of being rigidly fastened and sealed to prevent loss of the sample.

1) At present at the stage of draft. (Revision of ISO 3081-1973.)

2) At present at the stage of draft.

3) At present at the stage of draft. (Revision of ISO 3083-1973.)

The drum shall be rotated on stub axles attached to its ends by means of flanges welded so as to provide smooth inner surfaces.

The apparatus shall be fitted with a revolution counter and with an automatic device for stopping the drum after a predetermined number of revolutions. The apparatus shall operate on a power supply of a minimum of 1,5 kW to ensure that the drum attains full speed in one revolution, rotates uniformly, and stops within one revolution.

5.2 Test sieves, having square apertures of the following nominal sizes, and conforming to test sieve standard specifications:

40,0 mm, 25,0 mm, 16,0 mm, 10,0 mm, 6,30 mm and 500 µm

5.3 Weighing devices, having appropriate capacities, each having a sensitivity of 1/1 000 or better.

6 Preparation of test samples

6.1 General

The sample for tumbler test shall be prepared according to ISO 3082 or ISO 3083 from the sample for physical testing which has been taken in accordance with ISO 3081 or ISO 3082.

NOTE — The tumbler and abrasion indices are influenced by the amount of handling to which the material is subjected. It is therefore recommended that the sampling point be reported with the test results.

The sample for tumbler test shall be dried at 105 ± 5 °C and then allowed to cool to room temperature. From the dried sample, test portions as specified in table 1 shall be prepared.

Table 1 — Test portion for the tumbler test

Sample	Size range of test portion mm	Mass of test portion kg	Number of test portions
Iron ore pellets	−40 + 6,30	15 ± 0,15	at least 4
Sinters, sized iron ores	−40 + 10,0		

6.2 Pellets

The sample for tumbler test shall be sufficient to provide at least 60 kg of pellets that will pass a 40,0 mm sieve and be retained on a 6,30 mm sieve. From this sample, at least four test portions shall be prepared.

6.3 Sinters and sized iron ores

The sample for tumbler test shall be sufficient to provide at least 60 kg of sinter or sized iron ore that will pass a 40,0 mm sieve and be retained on a 10,0 mm sieve. This sample shall be separated into four fractions by sieving through 25,0, 16,0 and 10,0 mm sieves. From the material on the three sieves, at least four test portions shall be reconstituted by taking a proportionate mass of material from each of the three fractions. The mass of the individual fractions shall be recorded.

7 Procedure[1)]

7.1 Number of determinations

Carry out the test in duplicate on one ore sample.

7.2 Test portion

Use a test portion of 15 ± 0,15 kg, prepared according to clause 6.

7.3 Tumbling

Place the test portion (7.2) carefully in the tumbler drum (5.1). Tightly fasten the door and rotate the drum at 25 ± 1 r/min for a total of 200 revolutions.

NOTE — It is recommended that, after tumbling, the tumbler drum should be kept at rest, for at least 2 min.

Remove all the material from the drum.

7.4 Sieving

Place the material on a nest of four sieves which shall include a 6,30 mm and a 500 µm sieve and shake for 1 min by hand. Mechanical sieving may be used provided that preliminary tests give results similar to those obtained by hand sieving, within the permissible tolerance of 2 % absolute.

NOTE — It is considered that the set of sieves used for sieving after tumbling should include a sieve of suitable aperture size between 6,30 mm and 500 µm (for example 2,00 mm or 1,00 mm) in order to improve the efficiency of the 500 µm sieve by decreasing the sample mass retained on it. It could also be claimed to be advantageous for works control and ease of sieving to include an aperture size above 6,30 mm, for example either 10,0 mm or 8,00 mm.

Determine and record the mass of +6,30 mm fraction, −6,30 mm + 500 µm fraction, and the −500 µm fraction.

7.5 Permissible loss of mass

The difference between the initial mass of the test portion and the total mass of the fractions shall not exceed 1,0 % of the initial mass of the test portion. If this difference exceeds 1,0 % the test shall be rejected.

1) Schematic representation of the procedure is given in annex B.

8 Expression of results

8.1 Calculation of the tumbler and abrasion indices

The tumbler index T and the abrasion index A, expressed as percentages by mass, are calculated from the following formulae:

$$T = \frac{m_1}{m_0} \times 100$$

$$A = \frac{m_0 - (m_1 + m_2)}{m_0} \times 100$$

where

m_0 is the mass, in grams, of the test portion as weighed out and placed in the tumbler drum;

m_1 is the mass of +6,30 mm fraction of the tumbled test portion;

m_2 is the mass of −6,30 mm + 500 µm fraction of the tumbled test portion.

Express each index to two decimal places.

8.2 Repeatability and acceptance of test results

The difference between the results of duplicate tests (in the same laboratory using the same apparatus) shall not differ by more than the value given in table 2 [1].

If the difference between the results of duplicate tests does not exceed the repeatability given in table 2, the mean value shall be reported to one decimal place.

Table 2 — Repeatability

Tumbler strength	Repeatability (relating to 95 % probability)
Tumbler index T (+6,30 mm)	r_T = 1,4 % absolute
Abrasion index A (−500 µm)	r_A = 0,8 % absolute

If the difference between the results of duplicate tests exceeds the repeatability given in table 2, further duplicate test(s) shall be carried out in accordance with the flowsheet presented in annex A.

9 Test report

The test report shall include the following information:

a) reference to this International Standard;

b) details necessary for the identification of the sample and sampling point position;

c) results of the test;

d) reference number of the results;

e) any characteristics noticed during the test and any operations which may have had an influence on the results, for example scalping sieves used, method of sieving, loss of mass during the test.

1) Derived from the results of the international test which are reported in the document ISO/TC 102/SC 3 N 487E.

Dimensions in millimetres

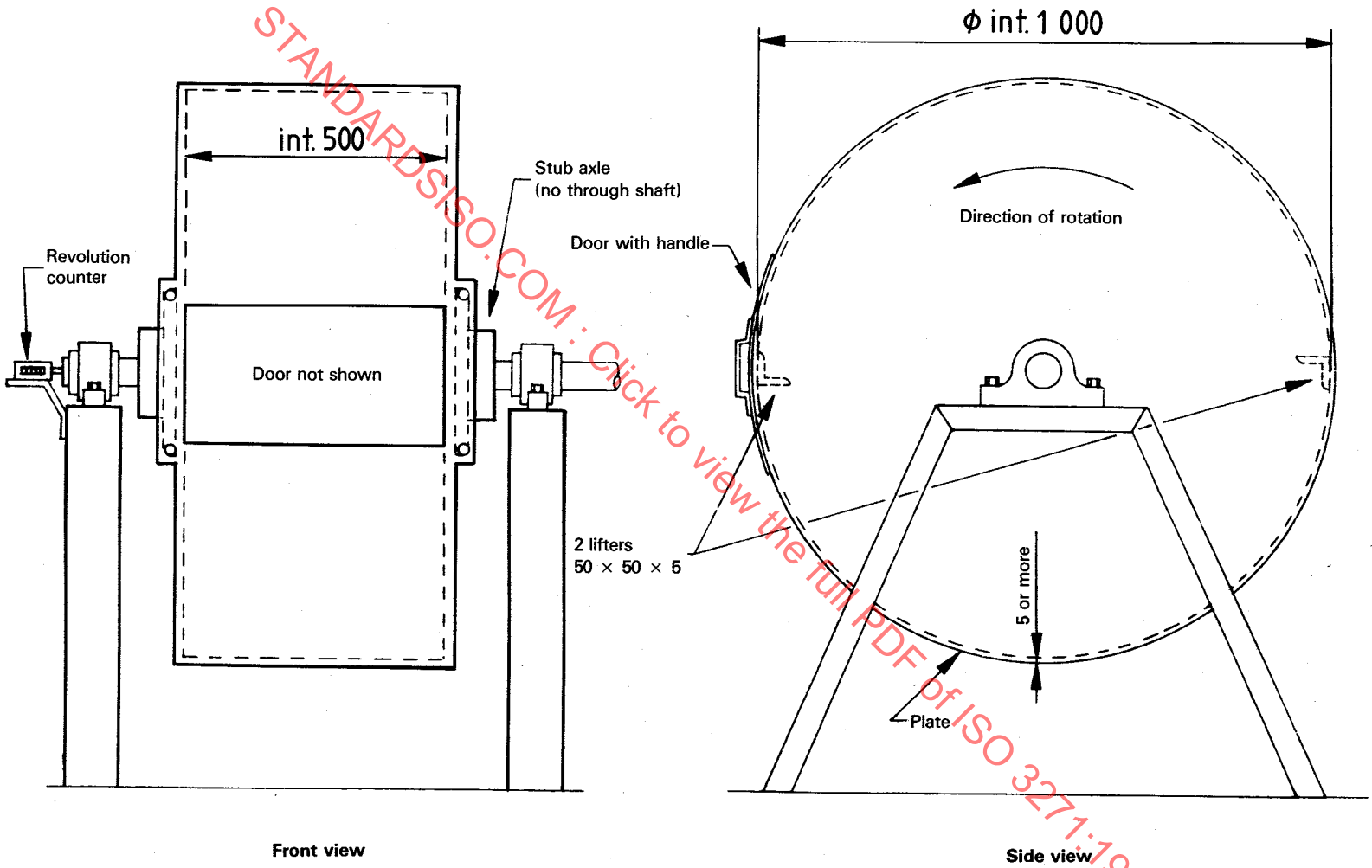

Figure — Example of tumbler test apparatus