

JIS

JAPANESE INDUSTRIAL STANDARD

Iron Ores—Preparation of
Samples—Manual Method

JIS M 8703—1985

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Iron Ores - Preparation of Samples -
Manual Method

M 8703-1985

1. Outline of the Items Stipulated

This standard gives:

- (1) the underlying theory,
- (2) the basic principle, and
- (3) the basic requirements for the device and operation

for the manual method of preparation of samples taken from a consignment of iron ore by JIS M 8701 or JIS M 8702, for the purpose of determining the quality characteristics of the consignment.

Reference: This standard corresponds to ISO/DP 3083.

2. Scope

The methods prescribed below are applicable to all iron ores, whether natural processed (e.g. concentrates and agglomerates such as pellets, sinters or briquettes). Samples are prepared for the determination of size distribution, moisture content and chemical composition.

3. Applicable Standards

JIS M 8100-General Rules for Methods of Sampling of Bulk Materials

JIS M 8701-Iron Ores-Increment Sampling-Manual Method

JIS M 8702-Iron Ores-Increment Sampling and Sample Preparation-Mechanical Method

JIS M 8705-Iron Ores-Determination of Moisture Content

JIS M 8706-Iron Ores-Determination of Size Distribution by Sieving

4. Definitions

For the purpose of this standard, the following definitions apply:

- (1) lot A definite quantity of an ore, processed or produced under conditions which are presumed uniform.
- (2) consignment A quantity of an ore delivered at one time.

Remark: The consignment may consist of one or more lots or parts of lots.

Corresponding International Standard:

ISO/DP 3083 Iron ores-Preparation of samples-Manual method

- (3) increment A quantity of an ore obtained by a sampling device at one time from a consignment; also a quantity taken by the increment division method.
- (4) sub-sample A quantity of an ore consisting of two or more increments taken from a consignment; or a composite of two or more increments each of which individually having been optionally crushed and/or optionally divided as necessary.
- (5) gross sample The quantity of an ore consisting of all the increments taken from a consignment; or the composite of all the increments or all the sub-samples each of which individually having been optionally crushed and/or optionally divided as necessary.
- (6) divided sample A sample obtained by a method of division.
- (7) test sample Any sample, for the determination of size distribution, moisture content, or chemical composition, which is prepared from each increment, each subsample, or from the gross sample in accordance with the method specified in this standard for that type of sample. A representative part of a test sample which is actually subjected to the test mentioned above is designated "test portion". If the entire quantity of a test sample is subjected to the test, the test sample may also be called "test portion".
- (8) size sample The sample taken for the determination of size distribution of the consignment.
- (9) moisture sample The sample taken for the determination of moisture content of the consignment.
- (10) sample for chemical analysis The sample taken for the determination of chemical composition of the consignment.
- (11) maximum particle size Particle size expressed in terms of the size of aperture of the sieve on which approximately 5 % in mass of iron ore is retained.

Remark: The maximum particle size of the consignment may be ascertained either by past experience or by experiment. However, if no information is available, visual estimation is acceptable.

- (12) whole-through sieve size Particle size expressed by the size of the smallest sieve aperture size through which all of a sample pass.
- (13) sample preparation The process of bringing the sample ready for the determination of quality characteristics. It covers sample division, crushing, mixing and sometimes pre-drying and may be performed at several stages.
- (14) sample division The process in sample preparation whereby the mass of a sample is reduced by partition or extraction without crushing.

- (15) constant-mass division A type of division for obtaining divided samples having almost uniform mass ⁽¹⁾ regardless of the variation in mass of samples to be divided.

Note ⁽¹⁾ Almost uniform mass means that the variation in mass shall be less than 20 % in terms of the coefficient of variation (CV) .

- (16) fixed-rate division A type of division for obtaining divided samples having such masses as to be proportional to the varied masses of samples to be divided.
- (17) split-use of sample The sample is split into two or more parts, which are used individually for the determination of their two or more quality characteristics.
- (18) multiple-use of sample The sample in its entirety is used for the determination of one quality characteristic, then the same sample in its entirety or part is used for the determination of other quality characteristics.

5. General Procedures for Sample Preparation

The increments taken in accordance with JIS M 8701 or JIS M 8702 for the required determinations shall be prepared into test samples according to the following general procedures:

- (1) Determine whether the test sample is to be prepared from each increment, from each sub-sample or from the gross sample according to the requirements for the determination of quality characteristics.
- (2) Determine whether the sample be in split-use or in multiple-use.
- (3) Select the method and type of sample division at each stage.
- (4) Establish the flow of sample preparation including the processes of division, crushing, mixing and pre-drying (if necessary).
- (5) Prepare the test sample according to the procedures mentioned above.

6. Fundamentals of Sample Preparation

6.1 Precision of Sample Preparation and Overall Precision The precision of sample preparation (β_P) shall be within ± 0.3 % in total iron or moisture content with a 95 % probability. However, if sample preparation is carried out first on individual increments or sub-samples at an appropriate stage of the sample preparation and then those divided increments or sub-samples are combined into the gross sample, the precision of sample preparation will be further improved [see (2) and (3) below].

The precision of sample preparation (β_{PM}) for size fraction shall be within the values specified for the type of ore (see Table 8).

Variations from the other tables in this standard may be made, provided it can be demonstrated that the precision of sample preparation given above can be met.

The precision should be confirmed in accordance with Appendix 5 of JIS M 8100.

The overall precision in terms of standard deviation (σ_{SPM}) for the cases where division and measurement are carried out on the gross sample, on each of the sub-samples or on each of the increments may be expressed as follows:

- (1) When the gross sample is composed for a consignment and "l" determinations (chemical analyses) are carried out on the gross sample, the overall precision will be:

$$\sigma_{SPM}^2 = \sigma_S^2 + \sigma_{P_1}^2 + \frac{\sigma_M^2}{l} \dots\dots\dots(1)$$

where

σ_S : the precision of sampling in terms of standard deviation

σ_{P_1} : the precision of sample preparation in terms of standard deviation comprising the processes from the gross sample to the test sample

σ_M : the precision of measurement in terms of standard deviation

- (2) When "k" sub-samples, whereby each sub-sample consists of an equal number of increments are composed and "l" determinations are carried out on each sub-sample, the overall precision will be:

$$\sigma_{SPM}^2 = \sigma_S^2 + \frac{\sigma_{P_2}^2 + \sigma_M^2/l}{k} \dots\dots\dots(2)$$

where

σ_{P_2} : the precision of sample preparation in terms of standard deviation comprising the processes from the sub-sample to the test sample

Further, when the above "k" sub-samples are combined into the gross sample at an appropriate stage (e.g. not more than 10 mm) after individual sample preparation, and "l" determinations are carried out on the gross sample, the overall precision will be:

$$\sigma_{SPM}^2 = \sigma_S^2 + \frac{\sigma_{P_3}^2}{k} + \sigma_{P_4}^2 + \frac{\sigma_M^2}{l} \dots\dots\dots(3)$$

where

σ_{P_3} : the precision of sample preparation in terms of standard deviation comprising the processes from the sub-sample to the divided sub-sample at an appropriate stage.

σ_{P_4} : the precision of sample preparation in terms of standard deviation covering the processes from the gross sample at an appropriate stage to the test sample

- (3) When "l" determinations are carried out on each increment, the overall precision will be:

$$\sigma_{SPM}^2 = \sigma_s^2 + \frac{\sigma_{P_s}^2 + \sigma_M^2 / l}{n} \dots\dots\dots (4)$$

where σ_{P_s} : the precision of sample preparation in terms of standard deviation covering the processes from the increment to the test sample

n : the number of increments

Further, when all the increments are combined into the gross sample at an appropriate stage (e.g. not more than 10 mm) after individual sample preparation, and "l" determinations are carried out on the gross sample, the overall precision will be:

$$\sigma_{SPM}^2 = \sigma_s^2 + \frac{\sigma_{P_s}^2}{n} + \sigma_{P_t}^2 + \frac{\sigma_M^2}{l} \dots\dots\dots (5)$$

where σ_{P_s} : the precision of sample preparation in terms of standard deviation covering the processes from the increment to the divided increment at an appropriate stage

σ_{P_t} : the precision of sample preparation in terms of standard deviation covering the processes from the gross sample at an appropriate stage to the test sample

6.2 Composition of Samples When samples are to be composed of the increments, the following shall be taken into consideration:

- (1) quality characteristics to be determined,
- (2) overall precision to be performed,
- (3) coefficient of variation (CV) in mass of increments taken by mass-basis sampling.

6.3 Division Rules In order to obtain the specified precision of sample preparation the following aspects of division shall be considered:

- (1) minimum mass of the sample after division, specified for each quality characteristic to be determined,
- (2) method and type of division to be adopted,
- (3) whole-through sieve size of the sample to be divided.

6.4 Method and Type of Division There are two types of division, constant-mass division and fixed-rate division, to obtain divided samples from each increment or each sub-sample. Irrespective of these methods of division, any one of the following methods of sample division may be applied to the gross sample:

- (1) manual increment division method [see 9.(1)],
- (2) manual riffle division method [see 9.(2)],
- (3) coning and quartering method [see 9.(3)],
- (4) mechanical division method (see JIS M 8702).

This standard specifies three methods of manual division (1),(2) and (3) above, which shall be applied to increments or sub-samples on the basis of taking increments and division type as shown in Table 1. In this case, one or several methods of sample division described above may be used individually or jointly.

Combining of increments taken on time-basis sampling and mass-basis sampling shall incorporate the procedures specified in clause 8.

Table 1. Application of Manual Division Method

Division of	Conditions of increment				Manual division method to be applied	
	Sampling		Number of increments composed	CV %	Constant-mass division	Fixed-rate division
	Method	Type			Increment division method, etc.	Riffle division and C/Q, etc.
Increment	Manual	Mass-basis	—	<20	○	○
				≥20	○	×
	Mechanical	<20		○	○	
				≥20	○	×
		Time-basis		—	×	○
Sub-sample	Manual	Mass-basis	Equal	<20	○	○
	Mechanical		<20	○	○	
		Unequal	<20	×	○	
		Time-basis	—	—	×	○

○ : Applicable × : Not applicable

6.5 Split-Use and Multiple-Use of Sample When a sample taken from the consignment meets the respective requirements for the determination of quality characteristics, the sample may be either in split-use or in multiple-use for obtaining the test samples for moisture determination, size determination and chemical analysis.

6.6 Crushing and Grinding The crushing and grinding shall be conducted with such a crusher and a grinder as suitable for the size and hardness of the ore particles. The crusher and grinder should be purged with material from the same source.

6.7 Mixing By mixing the sample thoroughly, it may be made homogeneous and consequently the errors in sample division can be lessened.

The mixing may be conducted either by a mechanical mixer or by hand. The mixer shall be selected to suit the mass and particle size of the sample.

6.8 Pre-drying When the sample is very wet or sticky and the sample preparation cannot be conducted, the sample may be pre-dried by air- or over-drying, or the like, below the temperature where there is likely to be change in quality so as to the sample preparation being carried out without trouble.

Remark: If necessary, the pre-drying shall be carried out in accordance with Appendix 1 of JIS M 8705.

6.9 Requirements for Sample Preparation

- (1) Sample preparation shall be carried out in such a manner that there shall be no contamination or introduction of materials other than the sample and no change of the quality of it. In particular, the moisture sample shall be kept in an airtight, non-absorbent container in order to avoid any change in its moisture.
- (2) Check experiments for precision and bias shall be carried out from time to time on the sample preparation process, so that significant errors in the results caused by the process may be detected.

7. Apparatus

- (1) The following apparatus shall be provided for sample preparation:
 - (a) crushers and grinders,
 - (b) drying ovens, capable of regulating the temperature (see JIS M 8705),
 - (c) mixers,
 - (d) riffle dividers (see Appendix 1)
 - (e) shovel for increment division (see Fig. 1.).