INTERNATIONAL

Designation: E877 – 21

Standard Practice for Sampling and Sample Preparation of Iron Ores and Related Materials for Determination of Chemical Composition and Physical Properties[1]

This standard is issued under the fixed designation E877; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers procedures for mechanical sampling of iron ores and related materials in a falling stream or stopped-belt sampling and preparing the gross sample to the various test samples required for each characteristic to be measured. Included as Annexes are (*1*) design criteria to prevent bias, (*2*) statistical methods to determine quality variation and precisions of sampling and division, and (*3*) a method for comparing two sampling procedures for possible systematic differences.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Section 8.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials

E276 Test Method for Particle Size or Screen Analysis at 4.75 mm (No. 4) Sieve and Finer for Metal-Bearing Ores and Related Materials

E279 Test Method for Determination of Abrasion Resistance of Iron Ore Pellets, Lump, and Sinter by the Tumbler Test

E389 Test Method for Particle Size or Screen Analysis at 4.75 mm (No.4) Sieve and Coarser for Metal-Bearing Ores and Related Materials

E882 Guide for Accountability and Quality Control in the Chemical Analysis Laboratory

E1072 Test Method for Low Temperature Breakdown of Iron Ores (Withdrawn 1995)[3]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology E135.

3.1.1 *nominal topsize, n—in sampling,* the opening of the screen of the standard series that would pass 95 % of a representative sample.

3.1.2 *precision, n*—a measure of reproducibility of test results, using the same equipment and method, statistically derived from multiple data expressed at 95 % confidence level.

4. Summary of Practice

4.1 The precision required for the sampling and sample preparation steps is calculated based on the objectives of the testing, resulting in a sampling plan specifying the minimum masses and number of increments required for each step in the procedure. Samples are then collected, dried, blended, divided, crushed, pulverized, and ground as required by the test methods to be utilized.

5. Significance and Use

5.1 This practice is to be used for sampling and sample preparation of iron ores and related materials, prior to use of a referee method for testing for compliance with compositional specifications for metal content or physical properties. It is assumed that all who use this procedure will be trained analysts capable of performing common laboratory practices skillfully and safely. It is expected that work will be performed in a properly equipped laboratory and that proper waste disposal

[1] This practice is under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.02 on Ores, Concentrates, and Related Metallurgical Materials.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

procedures will be followed. Appropriate quality control practices must be followed, such as those described in Guide E882.

5.2 Adequate methods for obtaining representative samples for testing the chemical and physical properties of a consignment of iron ore are essential. The sale and use are dependent on the chemical or physical properties, or both, of an ore.

5.3 The criteria to prevent bias may be used for both design of a sampling system and in checking the design of an existing system.

6. Apparatus

6.1 Any mechanical sampler is acceptable that either by design or comparison, or both (as defined in Annex A1 and Annex A4) can be shown to take nonbiased increments of at least minimum mass and number required and can handle these increments in accordance with the practice.

6.2 *Templates and Related Equipment,* to obtain increments from a stopped belt, with bias protection in accordance with Annex A2, are acceptable.

6.3 *Riffle*—A stationary sampler comprising an even number of equally-sized, adjacent chutes discharging in opposite directions. For use with this practice, there must be a minimum of twelve chutes with an opening width of at least 3 times the nominal topsize.

NOTE 1—For fine ores (< 3 mm), the 3 times nominal topsize should be increased to the point where the plugging of chutes is eliminated. For coarse ores (> 12.5 mm) it is recommended not to exceed 3½ times nominal topsize as it is required that the full width of the riffle be used since the accuracy of the split increases with the number of chutes. For free-flowing ores such as pellets, the 3 times the nominal topsize may be reduced to 1½ times provided it is ascertained that there is no chute plugging for a particular ore type.

6.4 *Crushers*—Crushers may be jaw, cone, rotary, or other type that can reduce the particle size to the desired level without significant loss of mass (less than 0.5 %) and not contaminate the sample.

6.5 *Pulverizers and Grinders*—Pulverizers and grinders may be of plate, cylinder, or other type that can reduce the particle size to the desired level. They should be made of sufficiently hardened material to prevent contamination of the sample. Also, the loss of total mass during pulverizing should not exceed 2.5 %.

7. Design of Sampling Operations

7.1 *Basic Requirements:*

7.1.1 The characteristics to be determined and precisions desired must be known.

7.1.2 The mass and special requirements for each test sample must be known.

7.2 *Overall Precision* (β_{SDM})*:*

7.2.1 Overall precision for determining the mean values of the iron content, moisture content, and percentage passing the specified size sieve (in accordance with Test Methods E276 and E389), at 95 % confidence in absolute percentages are as in Table 1.

7.2.2 Overall precisions for other characteristics shall be agreed upon between the parties concerned.

TABLE 1 Overall Precision

Consignment, tons	Iron and Moisture Content, %	Specification Size, Cumulative Percent Passing			
		< 10 %	10 % – 50 %[A]	> 50 % – 90 %[A]	> 90 %
> 100 000	± 0.3	± 0.75 %	± 0.075*C*	± 0.075 (100-*C*)	± 0.75 %
20 000 to 100 000	± 0.4	± 1.0 %	± 0.1*C*	± 0.1 (100-*C*)	± 1.0 %
< 20 000	± 0.5	± 2.0 %	± 0.2*C*	± 0.2 (100-*C*)	± 2.0 %

[A] In the formulae for calculating the precision estimates within this column, *C* = cumulative percent passing.

NOTE 2—Nationally or internationally accepted measurement methods should be used to determine the characteristics desired.

7.3 *Equations:*

7.3.1 Calculate overall precision as follows:

$$\beta_{SDM} = 2\sqrt{\frac{\sigma_w^{\ 2}}{n}\left(1+\frac{1}{c}\right)+\frac{\sigma^2{}_{DM}}{\nu}} \tag{1}$$

or

$$\beta_{SDM} = 2\sqrt{\frac{\sigma_w^{\ 2}}{n}\left(1+\frac{1}{\sigma}\right)+\frac{\sigma_D{}^2}{\nu}+\frac{\sigma_{M^2}}{\nu m}} \tag{2}$$

where:

β_{SDM}	=	overall precision for any characteristic,
σ_w	=	estimated within-strata standard deviation of a characteristic,
σ_D	=	estimated standard deviation of division,
σ_M	=	estimated standard deviation of measurement,
σ_{DM}	=	estimated standard deviation of division and measurement combined,
n	=	number of primary increments,
v	=	number of final samples taken for measurement,
m	=	number of measurements taken on each final sample, and
c	=	average number of secondary increments taken per primary increment.

NOTE 3—Factor (1 + 1 ⁄*c*) is omitted from the equation if only primary increments are used.

7.3.2 σ_w and σ_{DM} or σ_w, σ_D, and σ_M are estimated in accordance with Annex A3.

7.3.3 When designing a new sampling installation, refer to Annex A1 for estimating σ_w and σ_{DM}.

7.4 *Selection of Sampling Parameters*—Using the estimated values of σ_w and σ_{DM} or σ_w, σ_D, and σ_M and Eq 1 or Eq 2, choose a combination of *n, c, v,* and *m* to obtain the required precision. It is recommended in routine sampling to use the same value of *c* used in the determination of σ_w.

7.5 *Minimum Mass of Increment*—The minimum mass of an increment is calculated by the following formula to ensure that a particle the shape of a cube of the nominal topsize shall not represent more than 10 % of its mass, to avoid bias by larger particles:

$$W = (S^3/20) \times (\text{sp gr}/5) \tag{3}$$

where:

W	=	minimum mass of increment, kg,
S	=	nominal size of the ore, cm, and