



Standard Practice for Sampling Steel and Iron for Determination of Chemical Composition¹

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1. Scope

1.1 This practice covers the sampling of all grades of steel, both cast and wrought, and all types (grades) of cast irons and blast furnace iron for chemical and spectrochemical determination of composition. This practice is similar to ISO 14284.

1.2 This practice is divided into the following sections.

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1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.* For specific statements, see 6.4.3.5, 9.4.4.3, and 12.5.1 as well as Section 5.

2. Referenced Documents

2.1 ASTM Standards:²

- A48/A48M Specification for Gray Iron Castings
- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials
- E415 Test Method for Analysis of Carbon and Low-Alloy Steel by Spark Atomic Emission Spectrometry
- E1010 Practice for Preparation of Disk Specimens of Steel

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 E01.01 on Iron, Steel, and Ferroalloys.

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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.

and Iron by Remelting for Spectrochemical Analysis

2.2 *ISO Documents:*

ISO 9147 Pig irons—Definition and classification³

ISO 14284 Steel and iron—Sampling and preparation of samples for the determination of chemical composition³

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cast product, n*—item of iron or steel which has not been subject to deformation, for example, an ingot, a semi finished product obtained by continuous casting, or a shaped casting.

3.2.2 *consignment, n*—quantity of metal delivered at one time.

3.2.3 *grinding, n*—method of preparing a sample of metal for a spectrochemical method of analysis in which the surface of the sample for analysis is abraded using an abrasive wheel.

3.2.4 *increment, n*—in sampling, a portion of material removed from a lot by a single operation.

3.2.5 *linishing, n*—method of preparing a sample of metal for a spectrochemical method of analysis in which the surface of the sample for analysis is abraded using a rotating disk or continuous belt coated with an abrasive substance.

3.2.6 *lot, n—in sampling*, a collection of material regarded as a unit (see Specification A48/A48M).

3.2.7 *melt, n*—liquid metal from which a sample is removed.

3.2.8 *sample, probe, n*—sample taken from the melt using a sampling probe.

3.2.9 *sample, product, n*—specific item of iron or steel selected from a supplied quantity for the purpose of obtaining a sample.

3.2.10 *sample, spoon, n*—sample taken from the melt using a spoon and cast into a small mold.

3.2.11 *sampling, immersion, n*—method of probe sampling in which the probe is immersed in the melt where the sample chamber in the probe fills by ferrostatic pressure or gravity.

3.2.12 *sampling, probe, n*—method in which the sample is taken using a sampling probe inserted into the melt.

3.2.13 *sampling, spoon, n*—method in which the sample is taken from the melt, or during the pouring of the melt, using a long-handled spoon and cast into a small mold.

3.2.14 *sampling, stream, n*—method of probe sampling in which the probe is inserted into a stream of liquid metal where the sample chamber in the probe fills by force of metal flow.

3.2.15 *sampling, suction, n*—method of probe sampling in which the probe is inserted into the melt where the sample chamber in the probe fills by aspiration.

3.2.16 *test portion, n*—part of the sample for analysis, or part of the sample taken from the melt, actually analyzed.

3.2.16.1 *Discussion*—In certain cases, the test portion may be selected from the sample product itself.

3.2.17 *thermal method of analysis, n*—method for the determination of chemical composition in which the sample is submitted to a process of heating, combustion, or fusion.

3.2.18 *wrought product, n*—item of steel which has been subject to deformation by rolling, drawing, forging, or some other method, for example, a bar, billet, plate, strip, tube, or wire.

4. Significance and Use

4.1 This practice covers all aspects of sampling and preparing steel and iron for chemical analysis as defined in Test Methods, Practices, and Definitions A751 and Specification A48/A48M. Such subjects as sampling location and the sampling of lots are defined.

4.2 It is intended that this practice include most requirements for sampling steel and iron for analysis. Standard analytical methods that reference this practice need contain only special modifications and exceptions.

4.3 It is assumed that all who use these procedures will be trained samplers capable of performing common sampling operations skillfully and safely. It is expected that only proper sampling equipment will be used.

5. Hazards and Safety Precautions

5.1 Provide personal protective equipment to minimize the risk of injury during sampling and sample preparation methods. Provisions shall include protective clothing, hand protection, and face visors resistant to splashes of liquid metal for use during the sampling of liquid metal; protective clothing and hand, eye, and hearing protection for use during the sampling and sample preparation of solid metal; and respiratory protection for use where necessary.

5.2 The use of machinery for sampling and sample preparation shall be in accordance with appropriate national standards. Grinding operations used for surface preparation may be covered by national legislation.

5.3 Reference should be made to appropriate national regulations with respect to the use of solvents for the cleaning and drying of samples and test portions.

6. Requirements for Sampling and Sample Preparation

6.1 *General:*

6.1.1 This section describes the general requirements for the sample and for the sampling and sample preparation of iron and steel. Special requirements apply to each category of liquid and solid metal, and these requirements are described in the relevant section.

6.1.2 The sequence of sampling and sample preparation of liquid iron and steel and cast iron and steel products is shown in Fig. 1. Special considerations apply to pig irons (see Section 10).

6.2 *Sample:*

6.2.1 *Quality:*

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

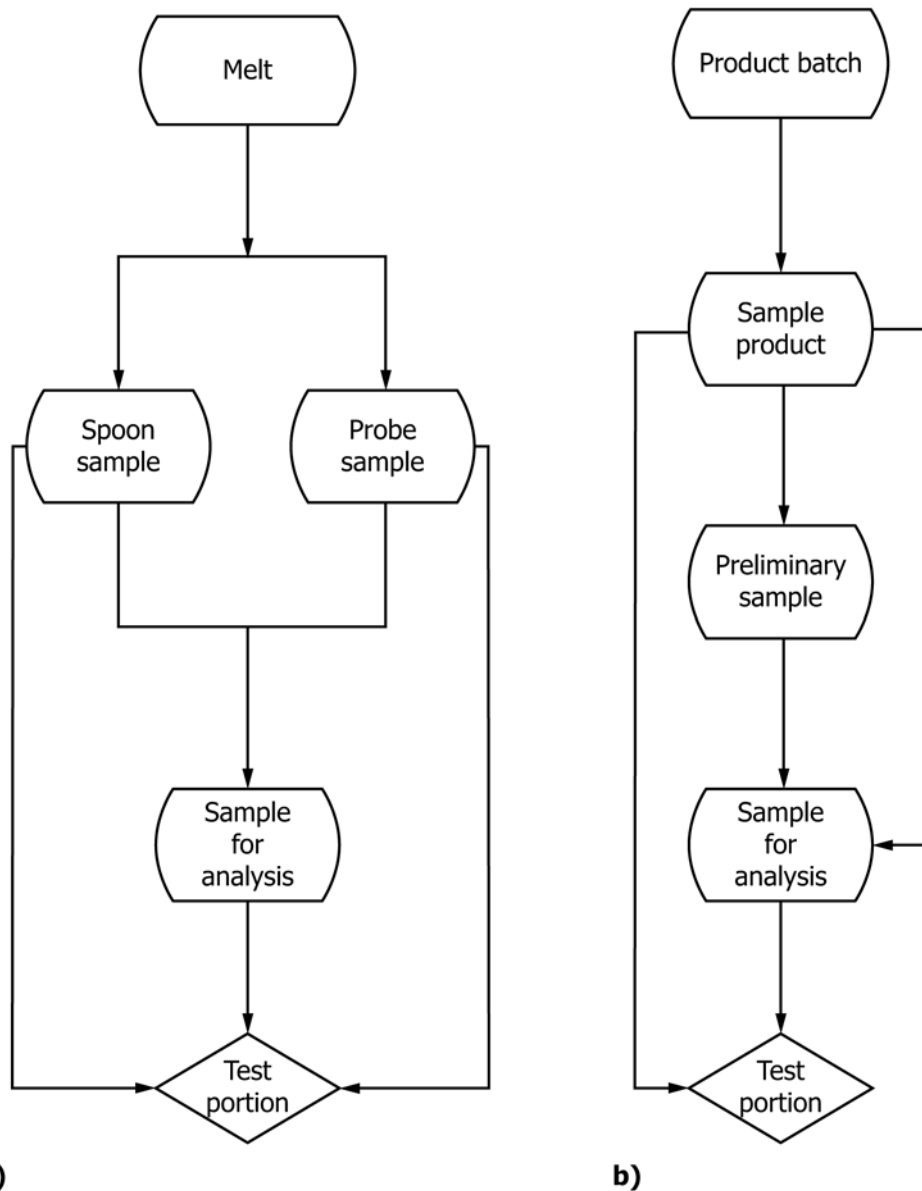


FIG. 1 Sequence of Sampling and Sample Preparation of (a) Liquid Iron and Steel and (b) Cast Iron and Steel Products

6.2.1.1 Sampling practices shall be designed to provide an analytical sample that is representative of the mean chemical composition of the melt or of the sample product.

6.2.1.2 Ensure that the sample is sufficiently homogeneous with respect to chemical composition so that inhomogeneity does not appreciably contribute to the error variability of the method of analysis. In the case of a sample taken from a melt, however, some variability in analysis, both within and between samples for analysis, may be unavoidable. This variability will form an inherent part of the repeatability and reproducibility of the analysis.

6.2.1.3 Ensure that the sample is free from surface coatings and from moisture, dirt, or other forms of contamination.

6.2.1.4 The sample should be free from voids, cracks, and porosity and from fins, laps, or other surface defects.

6.2.1.5 Take particular care when selecting and preparing the sample where a sample taken from a melt is expected to be heterogeneous or contaminated in any way.

6.2.1.6 A sample taken from a melt shall be cooled in such a manner that the chemical composition and metallurgical structure of the sample is consistent from sample to sample.

6.2.1.7 It is important to recognize that analysis by some spectrochemical methods may be influenced by the metallurgical structure of the sample, particularly in the case of irons with white and grey iron structures, and steels in the as-cast and wrought conditions.