



Designation: E159 – 22

## Standard Test Method for Loss of Mass in a Reducing Gas Atmosphere for Cobalt, Copper, Tungsten, and Iron Powders (Hydrogen Loss)<sup>1</sup>

This standard is issued under the fixed designation E159; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This test method covers the determination of the mass of hydrogen-reducible constituents in the following metal powders: cobalt, copper, iron, and tungsten.

1.2 This test method is useful for cobalt, copper, and iron powders in the range from 0.05 to 3.0 % oxygen, and for tungsten powder in the range from 0.01 to 0.50 % oxygen.

1.3 This test method does not measure the oxygen contained in oxides such as silicon oxide ( $\text{SiO}_2$ ), aluminum oxide ( $\text{Al}_2\text{O}_3$ ), magnesium oxide ( $\text{MgO}$ ), calcium oxide ( $\text{CaO}$ ), titanium dioxide ( $\text{TiO}_2$ ), etc. that are not reduced by hydrogen at the test temperatures.

1.4 For total oxygen content, vacuum or inert gas fusion methods are available (see Test Methods [E1019](#)).

1.5 *Units*—The values stated in SI units are to be regarded as the standard.

1.6 *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.*

1.7 *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*:<sup>2</sup>

[B215](#) Practices for Sampling Metal Powders

[B243](#) Terminology of Powder Metallurgy

[E177](#) Practice for Use of the Terms Precision and Bias in ASTM Test Methods

[E691](#) Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

[E1019](#) Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques

### 3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology [B243](#). Additional descriptive information on powder metallurgy is available under “General Information on PM” on the ASTM B09 web page.

### 4. Summary of Test Method

4.1 This test method consists of subjecting a test portion of powder to the action of a hydrogen-containing gas under standard conditions of temperature and time and measuring the resulting loss of mass.

### 5. Significance and Use

5.1 The oxygen content of a powder affects both its green and sintered properties.

5.2 Hydrogen loss is a term widely used in the powder metallurgy industry even though the measurement represents an approximate oxygen content of the powder.

5.3 Oxygen is the most common hydrogen-reducible constituent of metal powders, and this procedure may be used as a measure of oxygen, reducible under the test conditions, if other interfering elements are absent.

### 6. Interferences

6.1 If carbon or sulfur is present, or both are present, they will be largely removed in the test. Their loss in mass is included in the total loss in mass measurement and must be subtracted from the total mass loss.

6.2 If metals or compounds are present that vaporize at the test temperature (such as cadmium, lead, zinc, etc.), their effect is included in the loss of mass measurement and must be subtracted from the total mass loss.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [B09](#) on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee [B09.02](#) on Base Metal Powders.

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

\*A Summary of Changes section appears at the end of this standard