



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS G 1211-3 : 2011

(JISF)

**Iron and steel—Determination of
carbon content—Part 3: Infrared
absorption method after combustion**

ICS 77.040.30;77.080.01

Reference number : JIS G 1211-3 : 2011 (E)

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Date of Establishment: 2011-03-22

Date of Public Notice in Official Gazette: 2011-03-22

Investigated by: Japanese Industrial Standards Committee
Standards Board
Technical Committee on Iron and Steel

JIS G 1211-3:2011, First English edition published in 2012-11

Translated and published by: Japanese Standards Association
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Printed in Japan

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by the Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Consequently, **JIS G 1211:1995** has been withdrawn and partially replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public or utility model right. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public or the utility model right.

JIS G 1211 series consists of the following 5 parts under the general title “*Iron and steel—Determination of carbon content*”:

Part 1: Combustion gravimetric method

Part 2: Gas volumetric method after combustion

Part 3: Infrared absorption method after combustion

Part 4: Infrared absorption method after combustion in a furnace with preheating or peak separating

Part 5: Determination of non-combined carbon

Iron and steel—Determination of carbon content—Part 3: Infrared absorption method after combustion

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 9556** published in 1989 and the first edition of **ISO 15350** published in 2000 with some modification of the technical contents for the purpose of incorporating the technical contents of the above-mentioned two standards as one standard and updating the technical contents and tolerances determined from the latest results of cooperative experiment of the infrared absorption method after combustion specified in Annex 4 of **JIS G 1211** : 1995.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with explanations is given in Annex JA.

1 Scope

This Standard specifies the infrared absorption method after combustion among the determination methods of carbon content of iron and steel. This method is applicable to the determination of carbon content (mass fraction) in iron and steel in the range of 0.001 % or over to and including 5.0 %. When using the working curve of reagent or reference solution, it is applicable to the determination in the range of 0.003 % or over to and including 4.5 % in mass fraction.

NOTE 1 When the carbon content is determined according to the method specified in this Standard, there is the possibility that the higher value than the carbon content of the test portion itself is reported because the carbon adhered or adsorbed to the surface of the test portion may be determined together. However, the difference is usually about 0.000 2 % in mass fraction and less than 0.000 5 % at most. For the method of determination excluding the influence of the carbon adhered or adsorbed to the surface of the test portion in the determination of carbon in micro range, **JIS G 1211-4** is specified. In case of doubt in the analytical value of 0.001 % to 0.010 % in carbon content (mass fraction), it is recommended that the analytical value according to **JIS G 1211-4** be adopted.

NOTE 2 The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows:

ISO 9556:1989 *Steel and iron—Determination of total carbon content—Infrared absorption method after combustion in an induction furnace*

ISO 15350:2000 *Steel and iron—Determination of total carbon and sulfur content—Infrared absorption method after combustion in an induction furnace (routine method)* (overall evaluation: MOD)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 1201 *Iron and steel—General rules for analytical methods*

JIS K 0050 *General rules for chemical analysis*

JIS Z 2615 *General rules for determination of carbon in metallic materials*

JIS Z 8402-6 *Accuracy (trueness and precision) of measurement methods and results—Part 6: Use in practice of accuracy values*

3 General matters

General matters common to the determination method shall be in accordance with **JIS G 1201**.

4 Summary

Combustion of a sample at a high temperature in a current of oxygen and oxidation of carbon into carbon dioxide.

This is sent to an infrared absorption cell together with oxygen, the infrared absorption amount thereof is measured, and the absorption amount is converted to the carbon amount according to the working curve prepared beforehand.

For the furnace, a tubular electrical resistance furnace or a high frequency induction furnace is used, and for the measurement of infrared absorption, only the integral method is adopted.

The working curve is prepared by using the iron and steel certified reference material in the case of a tubular electrical resistance furnace, and is prepared by using reagent or reference solution or by using the iron and steel certified reference material in the case of a high frequency induction furnace.

5 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

5.1 Water free from carbon dioxide

Water free from carbon dioxide shall be prepared immediately before the use according to either of the following.

- a) Boil water for 30 min by heating, cool it down to the room temperature as introducing oxygen (5.2), and furthermore introduce oxygen (5.2) for 15 min.
- b) In accordance with E.2 of **JIS K 0050**.

5.2 Oxygen

That of 99.5 % or more in volume fraction.

An oxidation catalyst [copper (II) oxide or platinum] tube heated to a temperature at 450 °C or higher shall be used in front of the purifying unit (6.5), when the presence of organic contaminants is suspected in the oxygen.

5.3 Iron

That of high purity and of low carbon content (mass fraction) known of not more than 0.001 0 %.

5.4 Magnesium perchlorate [Mg(ClO₄)₂]

That for the analysis of element whose particle size is 0.7 mm to 1.2 mm.

5.5 Barium carbonate

That (99.5 % or more in mass fraction) dried at 105 °C to 110 °C for about 3 h and cooled in a desiccator not coated with grease, etc. before use.

5.6 Sodium carbonate

That (99.9 % or more in mass fraction) dried at about 300 °C for about 2 h and cooled in a desiccator not coated with grease, etc. before use.

5.7 Accelerator

Copper, tin, tungsten or a mixture of tungsten and tin of not more than 0.001 0 % in carbon content (mass fraction).

For the accelerator used for the combustion in a tubular electrical resistance furnace, copper or tin is preferable. For the accelerator used for the combustion in a high-frequency induction furnace, tungsten, a mixture of tungsten and tin or copper is preferable. For the amount to be used, an optimum amount for the apparatus to be used shall be investigated beforehand.

For the accelerator, it is preferable to use the shape indicated in 8.13 of JIS Z 2615.

5.8 Carbon reference solution A (sucrose solution) (C 25 g/L)

Dry sucrose (C₁₂H₂₂O₁₁) at 100 °C to 105 °C for about 2.5 h beforehand and leave it cool in a desiccator not coated with grease, etc. Weigh out 14.843 g from it, dissolve it by adding about 100 ml of water free from carbon dioxide (5.1), transfer it in a 250 ml volumetric flask by using water free from carbon dioxide (5.1), and dilute it up to the marked line with water free from carbon dioxide (5.1).

25 mg of carbon is contained in 1 ml of this reference solution.

5.9 Carbon reference solution B (sodium carbonate solution) (C 25 g/L)

Weigh out 55.152 g of sodium carbonate (5.6), dissolve it by adding about 200 ml of water free from carbon dioxide (5.1), transfer it in a 250 ml volumetric flask by using water free from carbon dioxide (5.1), and dilute it up to the marked line with water free from carbon dioxide (5.1).

25 mg of carbon is contained in 1 ml of this reference solution.