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NO. : TSG1000G

TITLE : GENERAL RULES FOR CHEMICAL ANALYSIS OF STEEL MATERIALS

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This standard has been revised in consequence of the partial modification of its terms and expressions.

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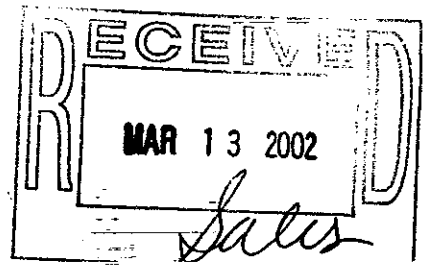

GENERAL RULES FOR CHEMICAL ANALYSIS OF STEEL MATERIALS

1. Scope

This standard covers the method of sampling for the chemical analysis of steel materials (bars, sheets, tubes and wires) used for the manufacture of the automotive parts (hereinafter referred to as "steel material analysis") and other particulars common to steel material analysis.

2. Test Sample Preparation

Test sample shall be prepared in the following manner:

2.1 Location

Test sample shall be randomly cut off from an arbitrary location of the steel material.

2.2 Number

The number of samples to be prepared shall be one for each type of steel, as a rule.

3. Sample Preparation

3.1 General Rules for Sample Preparation

(1) Prior to sample preparation, the surface of the test sample (both inner and outer surfaces, in the case of a tube) should be cleaned of scales, rust, paint, metal coating, chemical coating, decarbonized layer, carbonized layer and any other degenerated layers as well as contaminants such as fats, oils and dirt.

(2) Sample shall be collected from a location of the steel sample representing the transverse average of its chemical composition. Do not collect sample from the center of a steel bar.

(3) A drilling machine or a lathe shall normally be used, though another appropriate machine tool may be used for sampling from a stock of special shape or material, to obtain a pile of chips under 1 mm in thickness as sample for analysis. In this case, water or antifriction oil shall be not used and must be carefull to prevent the chips from discoloring due to the cutting heat. A test sample may be crushed into small particles or pieces by using a crusher or a saw, if it is hard to cut.

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3.2 Methods of Sample Preparation

3.2.1 Steel Bar

(1) Thick steel bar

Sampling from a steel bar 28 mm or more in diameter or in side-to-side distance (nominal size) shall be made by drilling in the axial direction from a transverse section, as shown in Fig. 1-(a), taking care to avoid the central axis. Drilling may be performed in perpendicular to the axis from the side into a depth of approximately 1/3 of the diameter or of the side-to-side distance, as shown in Fig. 1-(b). However, chips from the superficial part shall not be used. In both cases, a drill 10 mm or more in diameter shall be used.

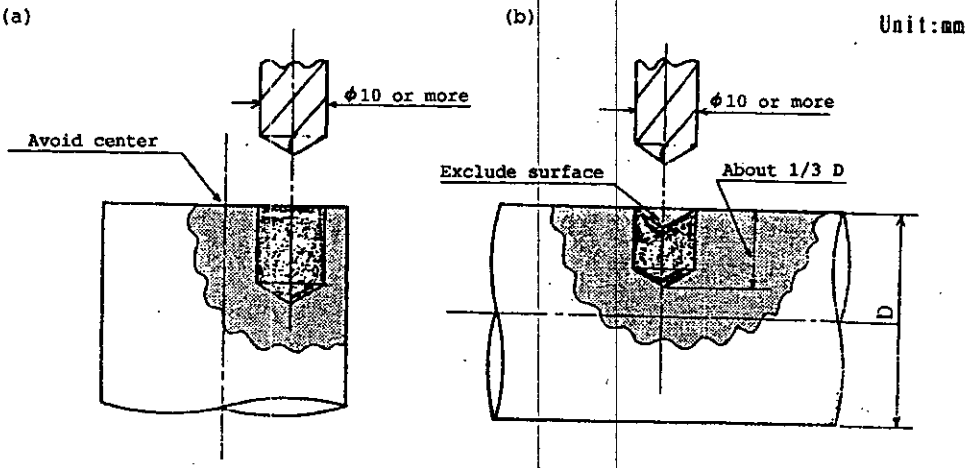

Fig. 1

(2) Thin steel bar

Sampling from a steel bar or coil stock under 28 mm in diameter or in side-to-side distance (nominal size) shall be made by lathing until a core approximately 1/3 of the diameter is left, as shown in Fig. 2. However, chips from the superficial part shall not be used.

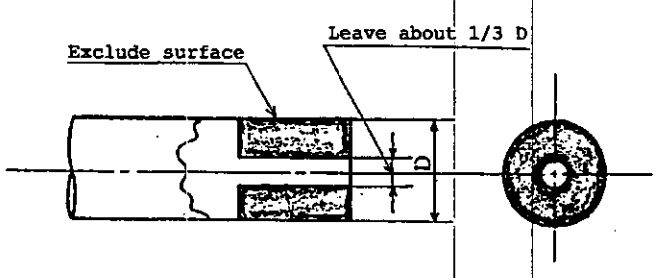

Fig. 2

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3.2.2 Flat Steel and Steel Sheet

A punching machine may replace a drilling machine for sampling from a flat steel or steel sheet. When a drilling machine is used, drill through the stock in perpendicular to the surface, as shown in Fig. 3-(a). Collect sample from as many spots as possible distributed uniformly in perpendicular to the rolling direction (i.e., in the transverse direction). A steel sheet may be folded over several times to make a pile before drilling, as shown in Fig. 3-(b). In both cases, a drill 6 mm or more in diameter shall be used. The locations for sampling with a punching machine shall conform to those with a drilling machine. However, the steel sheet need not be folded over before punching.

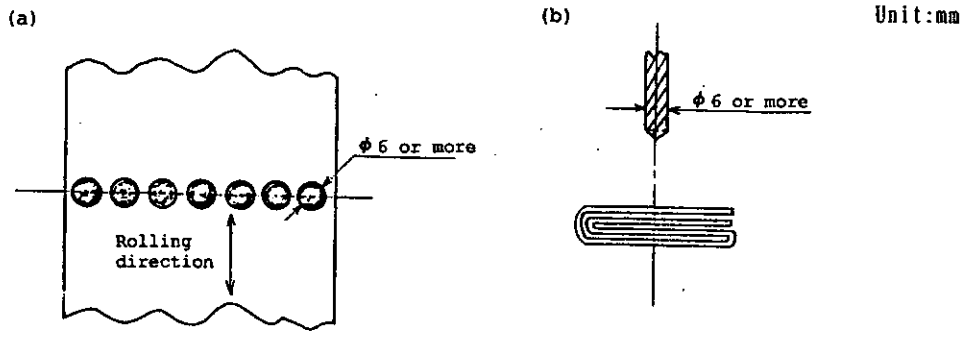

Fig. 3

3.2.3 Steel Tube

(1) Sampling chips from a seamless tube shall be performed by lathing in the axial direction from the edge, as shown in Fig. 4-(a). However, the sampling method for seamed tubes described in (2) below may also be employed for seamless tube.

(2) Sampling chips from a seamed tube shall be performed by drilling through from the side perpendicular to the axis, as shown in Fig. 4-(b). Take care not to drill through the seam. Drilling spots shall be uniformly distributed on the circumference. Use a proper size of drill depending on the tube diameter.

Established/ 4 Revised:
Feb.2002

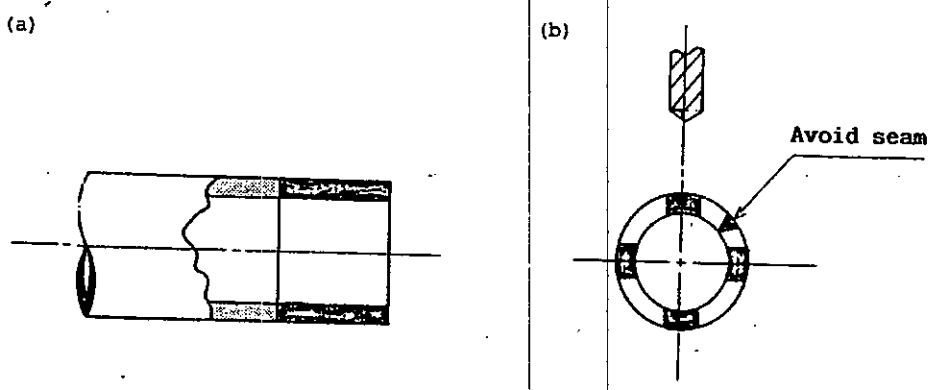

Fig. 4

3.2.4 Steel Wire

Sample from a steel wire shall be collected with cut lengths of 2 to 15 mm, as shown in Fig. 5.

Unit:mm

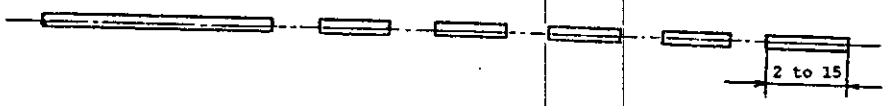

Fig. 5

4. Handling of Samples

4.1 Cleaning

Generally, samples shall be cleaned with pure alcohol and ether to remove oil on the surface and dried with due precaution against fire.

4.2 Weighing

A necessary quantity of sample shall be weighed out to the order of 0.1 mg after sufficient stirring. The quantity to be taken shall be decided for the applicable analysis method, on the basis of the analytical tolerance and the number of digits necessary for the analytical curve.

4.3 Storage

It is advisable that the sample be stored in a desiccator with silica gel in it, unless this method interferes with the analysis.

Established/ 4 Revised:
Feb.2002

5. Methods of Chemical Analysis

Table 1 shows the usual methods of chemical analysis. However, the methods in Table 2 are available when the methods in Table 1 are unusable due to device failure or other reasons. To validate the analysis of an actual sample, it is necessary to make parallel analysis for a standard sample similar to the tested sample in composition.

Table 1

Element	Toyota Engineering Standard No.	Analytical methods	
C, S	TSG1126G	Method for determination of carbon and sulfur in iron and steel	Infrared spectrometry
Si, Mn, Cr, Mo, Cu, Pb, Mg, Ca, V, Co, Ti, As, Ce, Aℓ, Sn, Zr, Sb, P	TSG1128G	Method for chemical analysis of iron and steel by inductively coupled plasma spectrometry	---
B	TSG1116G	Method for determination of boron in iron and steel	Methylene blue extraction absorptiometry
N, O	TSG1125G	Method for determination of oxygen and nitrogen in iron and steel (thermal conductivity method)	Thermal conductivity method

Established/ 4 Revised: Feb.2002

Table 2

Element	Toyota Engineering Standard No.	Analytical methods	
Si	TSG1101G	Method for determination of silicon in iron and steel	Silicon dioxide gravimetric method
	---		Method for atomic absorption spectrometry
Mn	TSG1127G	Method for atomic absorption spectrochemical analysis of iron and steel	
P	TSG1103G	Method for determination of phosphorus in iron and steel	Molybdenum blue absorption spectrophotometry
Ni Mo Cu V Co Ti Aℓ	TSG1127G	Method for atomic absorption spectrochemical analysis of iron and steel	Method for atomic absorption spectrometry
As	TSG1114G	Method for determination of arsenic in iron and steel	Arsenic iodide extraction molybdenum blue absorption spectrophotometry
Sn	TSG1127G	Method for atomic absorption spectrochemical analysis of iron and steel	Method for atomic absorption spectrometry
B	TSG1116G	Method for determination of boron in iron and steel	Methylene blue extraction absorptiometry
Pb Hg Zn Ca Sb Bi	TSG1127G	Method for atomic absorption spectrochemical analysis of iron and steel	Method for atomic absorption spectrometry
Total rare earth	TSG1124G	Method for determination of total rare earths in iron and steel	Neo-Thorin complex absorption spectrophotometry

6. Analytical Results

6.1 Expression of Analytical Values

The analytical values shall be expressed in mass percentage. Numerical values shall be sought to one place lower than the significant figures for the specific values given in the respective standards covering individual steel types, and rounded to the nearest whole numbers.

6.2 Discussions of Analytical Results

The analytical values for the standard sample subjected to parallel analysis should fall within the specified range of tolerance (TSG1004G). If the range is exceeded, the analysis shall be repeated for a second time.

Established/ 4 Revised: Feb.2002

6.3 Treatment of Analytical Results

The mean value shall preferably be calculated from the original unrounded values and the results rounded according to section 6.1. In addition, analytical values from the same test stock shall be treated as one group of steel analysis data (and averaged, for example). And analytical values for different test sample in a single steel blook shall be treated distinctively.

Applicable Standards

TSG1004G	General Rules for The Standard Control of Errors in Metal Analysis
TSG1101G	Method for Determination of Silicon in Iron and Steel
TSG1103G	Method for Determination of Phosphorus in Iron and Steel
TSG1114G	Method for Determination of Arsenic in Iron and Steel
TSG1116G	Method for Determination of Boron in Iron and Steel
TSG1124G	Method for Determination of Total Rare Earths in Iron and Steel
TSG1125G	Method for Determination of Oxygen and Nitrogen in Iron and Steel
TSG1126G	Method for Determination of Carbon and Sulfur in Iron and Steel
TSG1127G	Method for Absorption Spectrochemical Analysis of Iron and Steel
TSG1128G	Method for Chemical Analysis of Iron and Steel by Inductively Coupled Plasma Spectrometry

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