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Method of spark test for steels

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS G 0566** : 1980), which has been technically revised.

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Method of spark test for steels

1 Scope

This Japanese Industrial Standard specifies the method of spark test using a grinder (hereafter referred to as the test) on steel ingots, steel billets, steel products and other products made of steel (hereafter referred to as the test specimens) to estimate the steel grades or to discriminate foreign materials.

2 Normative references

Part or all of the provisions of the following standards, 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 0202 *Glossary of terms used in iron and steel (Testing)*

JIS G 0203 *Glossary of terms used in iron and steel (Products and quality)*

JIS G 0320 *Standard test method for heat analysis of steel products*

JIS G 0321 *Product analysis and its tolerance for wrought steel*

JIS R 6210 *Vitrified grinding wheels*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS G 0202** and **JIS G 0203** apply.

4 Form and designations of spark

The form and designations of spark shall be as shown in Figure 1.

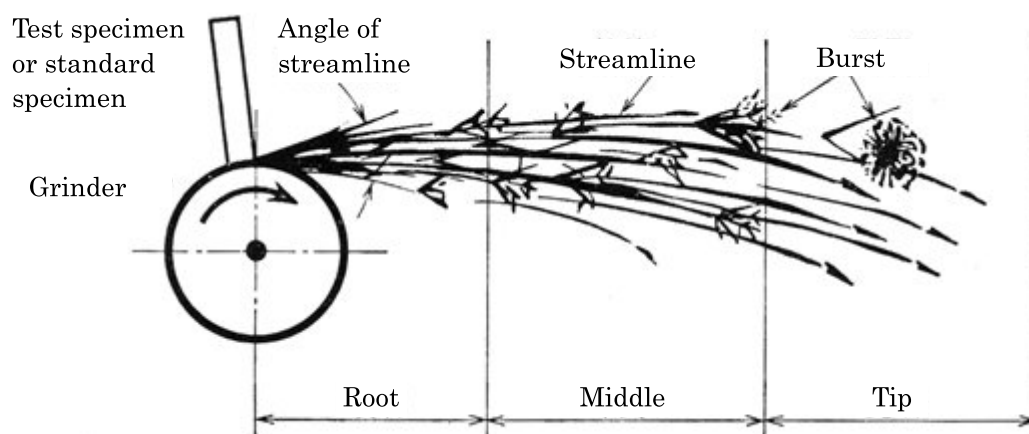


Figure 1 Form and designations of spark

5 Instruments for test

The instruments for test shall be as follows. In order to keep consistency of the test conditions, the same instruments should always be used.

- a) **Grinder** Either an electric or a pneumatic type and either a fixed or a portable type is permissible, provided that the grinder can produce sparks sufficient for observation and can conduct safe grinding and observation.
- b) **Grinding wheel**, of F36 or F46 in grain size and of P or Q in bonding degree specified in **JIS R 6210** shall be used. Generally, the grinding wheel shall be used with a peripheral speed of at least 20 m/s.
- c) **Auxiliary instruments** If it is necessary to prevent the influence of wind, avoid direct light, and/or regulate the ambient brightness for the spark observation, a blackout curtain, screen, movable dark box, etc. should be used.

6 Standard specimens

The standard specimens shall be as follows.

- a) It is preferable to prepare several steel bars and the like of known chemical composition as the standard specimens.
- b) Determination of the chemical composition of standard specimens shall be in accordance with **JIS G 0320** or **JIS G 0321**.
- c) The standard specimens shall be capable of producing the representative sparks of their steel grades after the removal of decarburized layer, carburized layer, nitrided layer, gas cut zone, scales etc.
- d) The standard specimens should have the same heat history as that of the test specimen.

7 Test method

7.1 Test method general

General matter on the test method shall be as follows.

- a) The test should always be carried out under the same conditions using the same instruments.
- b) The test shall generally be carried out in a properly dimmed room. When the test is carried out outdoors or in a bright site, auxiliary instruments shall be used to prevent the direct light from striking the spark, and the background brightness shall be adjusted so that it does not affect the colour or the brightness of spark.
- c) During the test, wind effects shall be avoided. Particularly, sparks shall not be produced upwind.
- d) The test specimen shall be ground at the portion from which the spark representing the chemical composition of base metal is produced. The decarburized layer, carburized layer, nitrided layer, gas cut zone, scales etc. on the surface of the steel

product may give different sparks from those of the base metal; therefore, these portions shall not be ground for the test. Figure C.1 and Figure C.2 show the charts of sparks produced from carburized layer and nitrided layer.

- e) The pressure to hold the test specimen against the grinding wheel or the force to hold the grinding wheel against the test specimen shall be equal as far as possible. The holding pressure shall be so adjusted that the spark length for carbon steel of about 0.2 % in carbon content becomes about 500 mm.
- f) The spark shall be projected horizontally or in obliquely upward direction, and generally observed from behind the streamlines toward the front, or from the sideways.
- g) On the observation of sparks, the streamlines, bursts etc. shall be carefully observed on each of the root, middle and tip, based on the following items.
 - 1) Streamline (colour, brightness, length, thickness and number)
 - 2) Bursts [shape, size, number and dusts (see Figure 3)]
 - 3) Resistance

7.2 Steel grade estimation test

The steel grade estimation test shall be as follows.

- a) On the estimation of the steel grade, carry out the test in accordance with 7.1, observe the characteristics of streamlines and bursts, and estimate the steel grade by the presumption of the carbon content and the type and quantity of alloy elements in accordance with Clause 8.
- b) The steel grade should be estimated according to the procedure of 8.2.
- c) After the rough estimation of steel grade in accordance with b), if necessary, confirm the estimation result by the comparison of the spark of the test specimen and the spark of the standard specimen of the estimated steel grade.

7.3 Foreign materials discrimination test

The foreign materials discrimination test shall be as follows.

- a) Carry out the test on the standard specimen corresponding to the test specimen, and verify the spark.
- b) Carry out the test in accordance with 7.1 on the whole number of test specimens, observe the sparks in accordance with Clause 8, and treat the results as follows.
 - 1) When no dissimilarity with the standard specimen on all observation items is found, the estimation shall be no contamination of foreign materials.
 - 2) When obvious dissimilarities with the standard specimen are recognized on one or more of the observation items, the test specimens presenting these dissimilarities shall be discriminated as those containing foreign materials.
 - 3) When some observation items are recognized as not necessarily be completely identical with those of standard specimen, verification shall be made by addition-

ally performing chemical analysis or other tests.

8 Criteria for steel grade estimation

8.1 Steel grade estimation method

The steel grade shall be estimated by the comparison of spark with that of the standard specimen, referring to the spark characteristics and chart examples of spark shown below.

a) Carbon steels

- 1) **Spark characteristics** Table 1, Figure 2 and Figure 3 show the spark characteristics of carbon steels ¹⁾.

Note ¹⁾ Unless otherwise described, the chart examples of spark are those of killed steels.

- 2) **Chart examples of spark** Figure A.1 to Figure A.8 show the chart examples of spark produced from carbon steels.

Figure A.9 and Figure A.10 show the chart examples of spark produced from rimmed steels.

Table 1 Table of spark characteristics of carbon steels

Carbon content (%)	Streamline					Burst				Resistance		
	Colour	Brightness	Length	Thickness	Number	Shape	Largeness	Number	Dust			
Under 0.05		Dark	Long	Thick	Few	No burst ^{a)}						
0.05						2-bursts			No			
0.1						3-bursts			No			
0.15						Multiple-bursts			No			
0.2						3-bursts in 2 steps			No			
0.3						Multiple-bursts in 2 steps			Commence dusting			
0.4						Multiple-bursts in 3 steps	Yes					
0.5												
0.6												
0.7												
0.8												
Over 0.8	Red	Dark	Short	Thin	Many	Complex	Small	Many	Much	Hard		

Note ^{a)} No burst is observed but spikes are observed.

Note ^{a)} No burst is observed but spikes are observed.

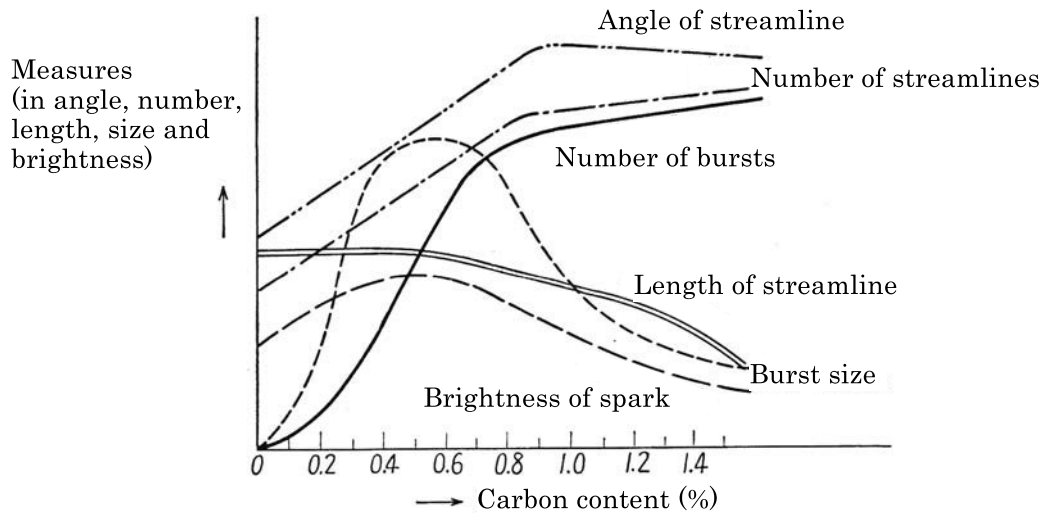


Figure 2 Spark characteristics curves of carbon steels

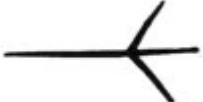
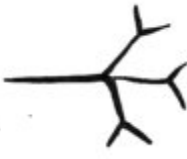
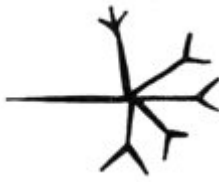
 a) Spike (Under 0.05 % in C content)	 b) 2-bursts (Approx. 0.05 % in C content)	 c) 3-bursts (Approx. 0.1 % in C content)
 d) 4-bursts (Approx. 0.1 % in C content)	 e) Multiple-bursts (Approx. 0.15 % in C content)	 f) Star-bursts (Approx. 0.15 % in C content)
 g) 3-bursts in 2 steps (Approx. 0.2 % in C content)	 h) Multiple-bursts in 2 steps (Approx. 0.3 % in C content)	 i) Multiple-bursts in 3 steps (Approx. 0.4 % in C content)
 j) Multiple-bursts in 3 steps with dusts (Approx. 0.5 % in C content)	 k) Feathery flower (rimmed steel)	

Figure 3 Spark characteristics of carbon steels (carbon bursts)

b) **Alloy elements**

- 1) **Spark characteristics** Table 2 and Figure 4 show the spark characteristics of alloy elements.
- 2) **Chart examples of spark** Figure B.1 to Figure B.30 show the chart examples of spark produced from alloy steels.

Table 2 Effects of alloy elements on spark characteristics

Classification of effects	Alloy element	Streamline				Burst				Resistance	Characteristics	
		Colour	Brightness	Length	Thickness	Colour	Shape	Number	Dust		Shape	Position
Promotion of carbon burst	Mn	Yellowish white	Bright	Short	Thick	White	Complex, fine dendritic	Many	Yes	Soft	Dust	Middle
	Cr	Orange	Dark	Short	Thin	Orange	Chrysanthemum flower	Constant	Yes	Hard	Flower	Tip
	V	Less variation				Less variation	Fine	Many	—	—	—	—
Suppression of carbon burst	W	Dark red	Dark	Short	Thin, wavy and intermittent	Red	Droplet Foxtail	Few	No	Hard	Foxtail	Tip
	Si	Yellow	Dark	Short	Thick	White	White bead	Few	No	—	White bead	Middle
	Ni	Reddish yellow	Dark	Short	Thin	Reddish yellow	Flash with blob	Few	No	Hard	Flash with blob	Middle
	Mo	Reddish orange	Dark	Short	Thin	Reddish orange	Spearhead	Few	No	Hard	Spearhead	Tip