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JAPANESE INDUSTRIAL STANDARD

Test Methods on Electrical
Apparatus for Explosive
Gas Atmospheres in
General Industry

JIS C 0904—1983

Translated and Published

by

Japanese Standards Association

Printed in Japan

Translation without guarantee
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standard in Japanese is to be evidence

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Test Methods on Electrical Apparatus
for Explosive Gas Atmospheres
in General Industry

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1. Scope

This Japanese Industrial Standard specifies test methods for the explosion-protected construction of the electrical machinery and appliances, hereinafter referred to as the "electrical apparatus", specified in JIS C 0903.

Remark: The units and numerical values in { } in this standard are based on the International System of Units (SI) and are appended for reference.

2. Classification of Tests

The tests are classified as follows:

- (1) Construction test
- (2) Explosion test
- (3) Ignition test
- (4) Pressurization test
- (5) Spark (ignition) test
- (6) Temperature test
- (7) Electric strength test
- (8) Functional test of safety barrier assembly
- (9) Impact test (by falling steel ball)
- (10) Drop test
- (11) Tensile test

3. Application of Tests

The tests for explosion-protected electrical apparatus shall be carried out as follows:

- (1) The tests which are indicated by the mark ○ in Table 1, in correlation with the classification of explosion-protected constructions, shall be carried out on explosion-protected electrical apparatus.

For an electrical apparatus in which two or more types of explosion-protective construction are employed, the tests shall be carried out on each type of the construction employed.

Applicable Standards and Corresponding International Standard and Reference Standards: See page 23.

Table 1. Application of Test to Each Type of Explosion-Protected Construction

Classification of explosion-protected construction	Flameproof type	Oil-immersed type	Pressurized type	Increased safety type	Intrinsically-safe type
Classification of tests					
Construction test	○	○	○	○	○
Explosion test	○				
Ignition test		○			
Pressurization test			○		
Spark test					○
Temperature test	○	○	○	○	○
Electrical strength test					○
Functional test of safety barrier assembly					○
Impact test	○		○	○	
Drop test	○				
Tensile test	○			○	

- (2) The tests shall, as a rule, be carried out on the same apparatus to be tested. However, such test as the impact test that might remarkably decrease the strength of enclosure may be carried out on a separate sample apparatus.
- (3) The tests required by the appropriate authority shall be carried out on an explosion-protected electrical apparatus of special type.

4. Test Methods

4.1 Test of Flameproof Electrical Apparatus

4.1.1 Construction Test The flameproof electrical apparatus shall be tested on its each part whether the materials, construction, dimensions, etc. comply with the appropriate provisions specified in 6. and 7. of JIS C 0903 or not.

4.1.2 Explosion Test For flameproof electrical apparatus, the mechanical strength test against explosion which verifies the mechanical strength against the internal explosion, and the flame transmission test which verifies the explosion-protective performance against flame transmission shall be carried out.

When the enclosure is divided by a partition like the combination of the electrical apparatus body and the terminal box, each of the compartments shall be tested separately.

(1) Mechanical Strength Test against Explosion

(a) Conditions of the apparatus under test shall be as follows:

- (i) All the components which are indispensable for service as an electrical apparatus shall, as a rule, be mounted as in normal use. However, the test may be carried out under such state that the contents whose removal will not mitigate the test conditions are removed, and the components necessary for enclosing (through rod, conductor entry, etc.) only are attached.
 - (ii) When it is difficult to perform the test due to the gaps in the enclosure, such gaps may be temporarily closed.
 - (iii) When the apparatus under test is mounted or tightly fastened, such procedure shall not reduce the effect of test pressure.
- (b) The apparatus under test shall be filled with a mixture of explosive gas and air which will produce the appropriate test pressure for the internal volume and explosion grade given in Table 2., and then the gas mixture shall be ignited to cause explosion.

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Table 2. Test Pressure in Mechanical Strength Test against Explosion

Explosion grade	Test pressure kgf/cm ² {kPa}	
	Apparatus with internal volume over 2 cm ³ up to 100 cm ³	Apparatus with internal volume over 100 cm ³
1	8 {785}	10 {981}
2		
3	1.5 times the explosion pressure measured in the preliminary explosion test ⁽¹⁾ [8 {785} min.]	1.5 times the explosion pressure measured in the preliminary explosion test ⁽¹⁾ [10 {981} min.]

Note ⁽¹⁾ The preliminary explosion test described here means an explosion test carried out to determine the test pressure, this explosion test is carried out under ordinary pressure on the enclosure of apparatus to be tested using an explosive gas for which the enclosure is designed, and the maximum explosion pressure occurred at the time shall be measured.

(c) The number of times of tests shall be 10.

(2) Flame Transmission Test

(a) Conditions of the apparatus under test shall be as follows:

- (i) Every part of the enclosure shall be assembled as in normal use. However, packings which are additionally attached to the joint for the purpose of dust-proof or waterproof may be removed.
- (ii) The components which are indispensable for service as an electrical apparatus shall, as a rule, be mounted as in normal use. However, the components whose removal will not affect the explosion-protective performance may be removed.

(b) The apparatus under test shall be tested on its flame transmission in such a manner that the apparatus is placed in a test chamber, the test gas mixture which is specified below corresponding to the explosion grade is filled inside and outside the apparatus enclosure, and then the gas mixture is ignited in the enclosure to cause explosion.

- (i) Explosion grade 1 The explosive gas-air mixture having flame-transmission characteristic which can prove the explosion-protective performance against every explosive gas included in explosion grade 1.

- (ii) Explosion grade 2 The explosive gas-air mixture having flame-transmission characteristic which can prove the explosion-protective performance against every explosive gas included in explosion grade 2.
- (iii) Explosion grade 3 The intended explosive gas-air mixture having the concentration which will cause flame transmission most easily. However, the electrical apparatus intended for all explosive gases included in explosion grade 3 shall be tested using hydrogen-air mixture and acetylene-air mixture each having a concentration which will cause flame transmission most easily.

(c) The test shall be made 15 times.

- (3) Amalgamation of Mechanical Strength Test against Explosion and Flame Transmission Test If the purposes of mechanical strength test against explosion and flame transmission test can be achieved at the same time, the both tests may be amalgamated and carried out at the same time.

In this case, conditions of the apparatus under test, composition of test gas and number of test times shall be as specified in the flame transmission test of (2), but a explosion pressure not less than the appropriate test pressure given in Table 2. shall be generated at least 10 times out of 15 times test.

4.1.3 Temperature Test The temperature test of explosion-protected electrical apparatus shall be carried out as follows:

- (1) The temperature test of an electrical apparatus shall be carried out with the apparatus being mounted as in normal use, at the rated frequency, rated voltage and rated load, and it shall be verified that the temperature rise at the outer surface of enclosure is not exceeding the appropriate value given in Table 3.

If the apparatus under test is an integrated one consisting of various kinds of electrical apparatus, the above requirement shall be complied with in a sense of an integrated apparatus.

Table 3. Limit of Temperature Rise for Flameproof
Electrical Apparatus

Unit: °C

Place of measurement	Limit of temperature rise					
	G1	G2	G3	G4	G5	G6
Outside surface of enclosure	320	200	120	70	40	30

Remark: The symbols G 1 to G 6 indicate ignition categories as specified in 3 (1) of JIS C 0903, and these symbols are used in Table 5., Table 6., Table 8., Table 9. and Table 13.

- (2) The temperature test shall, as a rule, be carried out in accordance with the method specified in the relevant standard to the kind of electrical apparatus.

4.1.4 Impact Test The impact test of flameproof electrical apparatus shall be carried out as follows:

- (1) The transparent plate of transparent window and lamp protective cover are mounted on the electrical apparatus, the face on which the impact is applied is held horizontally, a steel ball is allowed to fall in accordance with the details specified in Table 4. on a place considered as weakest, and then no formation of cracks and/or damages to such a degree that will impair the explosion-protection is verified. For pilot lamps and the like, however, if the specified steel ball does not pass through the lattice of guard, the specified steel ball is dropped onto the guard attached and a largest steel ball which can pass through the lattice of guard is dropped from the same height directly onto the lamp protective cover.

The steel balls specified in JIS B 1501 or those at least equivalent in quality shall be used.

Table 4. Mass of Steel Ball and Height of Fall in Impact Test

Application		Mass of steel ball g	Height of fall cm
Transparent plate of window		200 (36.5 mm dia.)	200
Lamp protective cover	Glass globe	95 (28.6 mm dia.)	100
	Cylindrical glass	50 (23.0 mm dia.)	100
	Tempered globe	200 (36.5 mm dia.)	200
	Tempered plate glass		

- (2) This test shall, as a rule, be carried out on three specimens.