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भारतीय मानक मसौदा

Draft Indian Standard

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डोरी रीले - विशीष्टि

Draft *Indian Standard*

CORD RELAYS – SPECIFICATION

ICS 71.100.30

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B U R E A U O F I N D I A N S T A N D A R D S
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Explosives and Pyrotechnics Sectional Committee, CHD 26

FOREWORD

(Formal clauses shall be added later)

A detonator is a device used to trigger an explosive. Detonators are usually initiated by mechanical or electrical means.

Cord relays are used along with detonating cords in opencast metal and coal mines, quarrying and in civil construction and in underground metal mines. Cord relays provide accurate delay between blast holes in a row or cross in a multiple row blast.

In the formulation of this standard, assistance has been derived from the EN 13763 Series 'Explosives for civil uses — Detonators and relays'.

There is no ISO specification for the product.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values *(second revision)*'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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CORD RELAYS - SPECIFICATION

1 SCOPE

This standard prescribes the requirements, methods of sampling and test for cord relays.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of and necessary adjuncts to this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated.

IS No.	*Title*
IS 1260 (Part 1): 1973	Pictorial Marking for Handling and Label ling of Goods: Part 1 Dangerous Goods (*first revision*)
IS 4905: 2015	Random Sampling and Randomization Procedures (*first revision*)
IS 6609 (part 3): 1973	Methods of Test for Commercial Blasting Explosives and Accessories Part 3 Detonators, General and Permitted
IS 10081: 1981	Terms Relating to Commercial Explosives, Pyrotechnics and Blasting Practices
IS/IEC 60529: 2001	Degrees of protection provided by enclosures (IP Code)

3 TERMINOLOGY

For the purpose of this standard, the terms and definitions given in IS 10081 shall apply.

4 REQUIREMENTS

4.1 Drop Test

When subjected to drop test as laid down in **2.2** of IS 6609 (Part 3), none of the detonators shall detonate nor there shall be any loose composition inside the tubes. At the end of drop test, all the test samples shall fire in the functioning test.

4.2 Strength of Detonators

4.2.1 By sand bomb method - When the detonators are tested in sand bomb as prescribed in **2.5** of IS 6609 (Part 3), the percentage of crushed sand passing through 500-micron and 250-micron IS Sieves shall be as follows:

Strength of detonator	Percentage of sand passing through	
	500 micron IS sieve	250 micron IS sieve
No.6	≥ 35	≥ 30
No.8	≥ 50	≥ 45

4.2.2 By lead plate method - When the detonators are subjected to the test as prescribed in **2.6** of IS 6609 (Part 3), they shall produce dent on the lead plate corresponding to at least C-3 class [2.6.2.2 of IS 6609 (Part 3)].

4.3 Water Resistance

When the detonators are subjected to water resistance test as prescribed in **2.1** of IS 6609 (Part 3), all the test samples shall fire.

4.4 Delay Time Measurement

The manufacturer shall declare the nominal delay interval for each delay of the different types of delay detonators.

Delay time shall be measured as prescribed in **2.10.3.1** of IS 6609 (Part 3). In delay time measurement, the scatter of any particular delay number of any type shall be such that not more than 5 percent of the detonators tested shall have delay timing overlapping with the delay timing of the adjacent numbers.

4.5 Impact test

When tested as per the method prescribed in **Annex A**, the mean height and the minimum height at which explosion is observed shall be greater than 7 m and 5 m respectively.

4.6 Determination of transfer capability of surface connectors, relays and coupling accessories

Transfer capability shall be determined as per the method prescribed in **Annex B**. In case of surface connectors, all the test specimen shall pass. In case of coupling accessories, requirements specified in the manufacturer's manual shall be satisfied.

5 PACKING AND MARKING

5.1 Packing

The cord relays shall be packed as agreed to between the purchaser and the supplier. The packing shall conform to the provisions of *Explosives (Amendment) Rules*, 2019.

5.2 Marking

5.2.1 Each package shall be marked with the following information:

a) Name, grade, type and strength of the material;

b) Number of pieces in the package;

c) Manufacturer's name and/or his recognized trade-mark, if any; and

d) Date of manufacture and lot number to enable the batch of manufacture to be traced from records.

5.2.2 The package shall also be marked with the appropriate symbol specified in IS 1260 (Part 1).

5.2.3 The marking shall further be in conformity to the provisions of *Explosives (Amendment) Rules*, 2019.

5.2.4 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the BIS Act, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

6 SAMPLING

6.1 Lot

6.1.1 Cases of detonators of same grade, same type and belonging to the same batch of manufacture shall be grouped together to constitute a lot.

6.1.2 Detonators constituting the sample shall be drawn from each lot separately for deciding the conformity of the lot to the requirements of the specification.

6.2 Scale of Sampling

Number of detonators to be selected at random from the lot shall depend on the lot size and shall be in accordance with co1 2 of Table 1. In order to ensure randomness of selection, procedures given in IS 4905 may be followed.

Table 1 Scale of sampling of Cord Relays

No. of detonators in the lot	**Sample size**
(1)	(2)
Up to 10 000	50
10 001 to 25 000	100
25 001 and above	125

6.3 Number of Tests - The number of detonators taken for the determination of each characteristic shall be as given below:

Sl No.	**Test/ Characteristic**	**No. of detonators to be tested**
i)	Water resistance	5
ii)	Drop test	5
iii)	Strength test	5
iv)	Delay timing test	20

6.4 Criteria for conformity - For deciding the conformity of the lot to the requirements of this specification, the test results of each characteristic shall meet the corresponding requirements specified in the relevant clauses.

Annex A

(*Clause* 4.5)

DETERMINATION OF SENSITIVENESS TO IMPACT

A-1 General

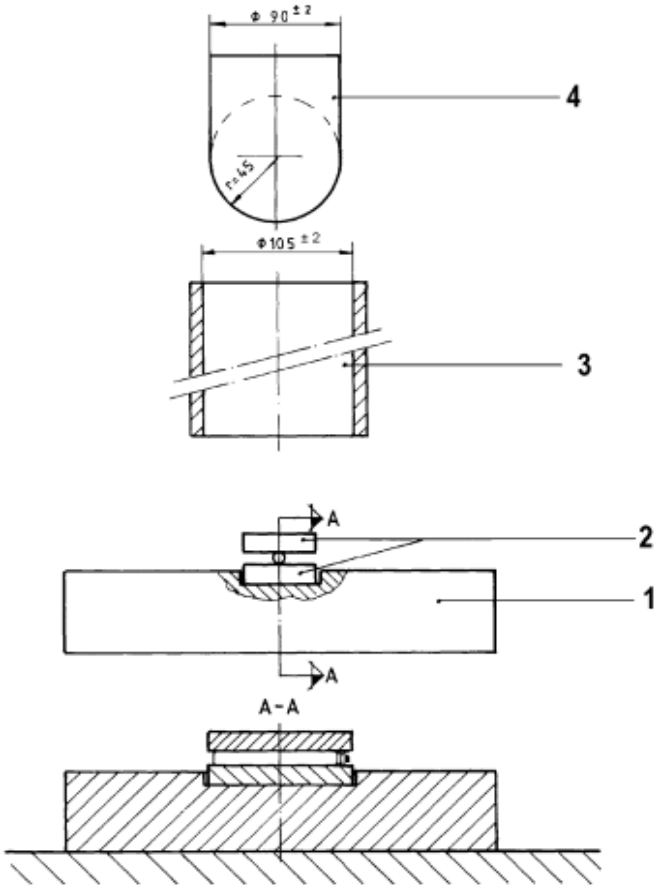
The resistance of a detonator to initiation or damage by impact gives an indication of its safety in handling, transportation and use.

A-2 Apparatus

Impact testing apparatus, consisting of a (5.0 ± 0.01) kg steel hammer which can be dropped freely from a set height, inside a guide tube onto a steel plate and anvil containing the device to be tested. The anvil shall rest on a concrete floor.

NOTE: Figure 1 shows the arrangement of the impact testing apparatus.

The hammer is made of steel of type B1 100Cr6 as defined by ISO 683-17:1999. The plates are made of steel of type FE 490-2 as defined by ISO 1052:1982. The anvil is made of steel of type 46 S 20 as defined by ISO 683- 9:1988.



Key

1 Anvil
2 Plates
3 Guide tube
4 Hammer

Figure 1 – Impact testing apparatus for cord relays

A-3 Test pieces

Select 25 relays or surface connectors of the same design. If the relays or surface connectors form part of a series with different delay times, select 50 relays or surface connectors with delay times distributed as evenly as possible throughout the series.

A-4 Procedure

A-4.1 Place the relay, in the most sensitive horizontal position, between the two parallel steel plates and secure it by putting a thin paper tape around the plates. Place the whole assembly on the anvil so that the bottom plate fits into the recess (see Fig 5). Drop the hammer from the specified height and observe whether the relay explodes. The mean height is calculated using the Bruceton method which is based on determining the level of stimulus at which there is a 50% probability of obtaining a positive result.

A-4.2 the Bruceton method involves the application of different levels of stimulus and determining whether or not a positive reaction occurs. The performance of the trials is concentrated around the critical region. It takes place by decreasing the stimulus in one level at the next trial if a positive result is obtained and by increasing the stimulus in one level if a negative result is obtained. Usually about five preliminary trials are performed to find a starting level in approximately the right region and then at least 25 trials are performed to provide the data for the calculations.

Note: *If no explosion occurs at the maximum height of the apparatus (12 m), test the next piece at the same height. Continue the procedure until all test pieces have been tested.*

A-5 Calculation

In determining the level at which the probability of obtaining a positive result is 50% (H_{50}), only the positive results (+) or only the negative results (-) are used, depending on which has the smaller amount. If the numbers are equal, either may be used. The data are recorded in a Table (e.g. as in Table 1) and summarized as shown in Table 2. Column 1 of Table 2 contains the drop heights, in ascending order, starting with the lowest level for which a test result is recorded. In column 2, 'i' is a number corresponding to the number of equal increments above the base or zero line. Column 3 contains the number of positive results (n (-)) for each drop height. The fourth column tabulates the result of multiplying 'i' times 'n' and the fifth column tabulates the results of multiplying the square of 'i' times 'n'. A mean is calculated from the following equation:

$H_{50} = c + d \times [(A/N_S) \pm 0.5]$ (1)

Where

$N_s = \Sigma n_i$,

$A = \Sigma (i \times n_i)$,

c is the lowest drop height

d is the height interval.

If negative results are used, the sign inside the brackets is positive; it is negative if positive results are used. The standard deviation, s, may be estimated using:

$s = 1.62 \times d \times [((NS \times B - A^2) / N_S^2) + 0.029]$ (2)

Where

$B = \Sigma (I^2 \times n_i)$.

EXAMPLE

Using the following data from Tables 1 and 2: lowest drop height 10 cm; height interval 5 cm; sum of i.n(-) 16; sum of i^2.n(-) 12,

The mean height is given by equation (1) as:

$H_{50} = 10 + 5 \times [(16 / 12) + 0.5] = 19.2$ cm

And the standard deviation by equation (2) as:

$s = [((12 \times 30 - 162) / 122) + 0.029] = 6.1$

The minimum height at which explosion occurred = 15 cm

Table 1 Recording Data

Drop Height																									

(cm)																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	+	-
30								+																		1	
25							-		+				+				+		+							4	1
20				+		-				+		-		+		-		-		+		+				5	4
15	+		-		-						-				-						-		+		+	3	5
10		-																						-			2
																										13	12

Table 2 Summarizing data

Height (cm)		**Calculations using negatives**		
	i(-)	n(-)	i(-).n(-)	i^2(-).n(-)
25	3	1	3	9
20	2	4	8	16
15	1	5	5	5
10	0	2	0	0
Totals		N_s = 12	A = 16	B = 30

A-6 Test Report

It shall clearly indicate the following information:

i. The mean height and standard deviation as calculated from the above procedure
ii. The minimum height at which the explosion occurred in at least 1 out of 25 trials.

ANNEX B
(*Clause* 4.6)

DETERMINATION OF TRANSFER CAPABILITY OF SURFACE CONNECTORS, RELAYS AND COUPLING ACCESSORIES

B-1 General

When using non-electric initiation systems there is a need to transfer the shock-wave from one unit to another and/or to delay the signal. This can be done by means of surface connectors, relays and coupling accessories.

B-2 Apparatus

Witness papers, initiating device for the donors, Detonating cords or shock tubes (for use as receptors or donors)

B-3 Test Pieces

Make a selection of 25 items of similar type with similar construction and materials

B-4 Procedure

B-4.1 Relays or surface connectors other than the ones which are designed to be hung from vertical rock faces

Connect the maximum number of receptors that are claimed by the manufacturer to the surface connector or to the relay as per the instructions given by the manufacturer.

Condition the entire assembly by submerging the assembly for 48 h at a depth of (0.5 ± 0.1) m in water. The temperature should be kept at (20±5) ^{o}C and make sure that the ends of the receptors are kept out of the water.

Unless specified by the manufacturer ensure that the surface connectors free end or relay shall remain submerged during conditioning.

After the conditioning step, remove the relay or connector from the water.

Witness papers are placed at each of the receptor's end. Now initiate the donor by making use of the initiating device and then check the witness paper at each receptor's end.

Record if shockwave has successfully transferred to all receptors or not.

B-4.2 Relays or surface connectors that are designed to be hung from near vertical rock faces

If the relay or surface connector is of a type that is designed to be hung to a near vertical rock face and is not laid on the ground, from the place where it can be exposed to the puddles of water, as mentioned by the manufacturer, the procedure given in the clause **B-4.1** should be performed with the relay or connector subjected to the ingress of the water test for IPX4as given in IS/IEC 60529, instead of the complete immersion in water.

B-4.3 Coupling accessories other than the ones that are designed to be hung to a near vertical rock faces

Maximum number of receptors as claimed by the manufacturer are connected to the coupling accessory as per the instructions given by the manufacturer.

Condition the entire assembly by submerging it in water at a depth of (0.5±0.1) m for a period of 48 hours at a temperature of 20±5 ^{o}C, thereby assuming that the receptors ends are kept out of water.

After the conditioning is done, the coupling accessory is removed from water.

Witness paper is placed at the end of each receptor.

Initiate the donor by making use of initiating device and the witness paper is checked at the end of each receptor.

Record if the shock wave has successfully transferred to all the receptors or not.

B-4.4 Coupling accessories that are designed to hung from the near vertical rock faces

In case the coupling accessory is of such a type that it is designed just to hung from a near vertical rock face and is not laid on the ground, where it could be exposed to puddles of water, as described by the manufacturer, the procedure given in the clause **B-4.3** shall be used with the coupling accessory to undergo the ingress of the water test for IPX4as given in IS/IEC 60529, in place of the total immersion in water.

B-5 Test Report

It shall clearly indicate the following information:

i. Number of receptors that did no initiate during the test