***भारतीय मानक***

***Indian Standard***

**IS XXXX : 2024**

**Doc. No. CHD 26 (16101) F**

***डोरी रीले — विशिष्टि***

**Cord Relays — Specification**

ICS 71.100.30

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भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

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**December 2024 Price Group**

Explosives and Pyrotechnics Sectional Committee, CHD 26

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Explosives and Pyrotechnics Sectional Committee had been approved by the Chemical Division Council.

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.

The composition of the Committee responsible for development of this standard is given in Annex C.

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.

*Indian Standard*

CORD RELAYS — SPECIFICATION

**1 SCOPE**

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

**2 REFERENCES**

The Indian standards given 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 given at below:

|  |  |
| --- | --- |
| *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/ISO 24153 : 2009 | Random sampling and randomization procedures (*first revision*) |
| IS 6609 (Part 3) : 2023 | Commercial blasting explosives and accessories — Methods of test Part 3 Detonators, general and permitted (*first revision*) |
| IS 10081 : 1981 | Terms relating to commercial explosives, pyrotechnics and blasting practices |

**3 TERMINOLOGY**

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

**4** **REQUIREMENTS**

**4.1 Drop test**

This test is carried out on the filled shells (which will be used in cord relays subsequently) as laid down in **4.2** of IS 6609 (Part 3). None of the shell tested shall detonate nor there do any loose composition inside the shell.

**4.2** **Delay time measurement**

**4.2.1** Themanufacturer shall declare the nominal delay interval for each delay of the different types of delay detonators.

**4.2.2** Delay time shall be measured as prescribed in **4.10.3.1** of IS 6609 (Part 3). In delay time measurement, the scatterof any particular delay 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 delay.

**4.3 Determination of transfer capability of relays**

All the test specimen shall pass the test for transfer capability when tested as per the procedure specified in **Annex A**.

**5 TYPE TESTS**

**5.1 Impact test**

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

**6 PACKING AND MARKING**

**6.1 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.

**6.2** **Marking**

**6.2.1** Eachpackage shall be marked with the followinginformation:

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.

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

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

**6.2.4** *BIS Certification Marking*

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

**7 SAMPLING**

**7.1 Lot**

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

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

**7.2** **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 3 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**

(*Clause* 7.2)

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **No. of detonators in the lot** | **Sample size** |
| (1) | (2) | (3) |
|  | Up to 10 000 | 50 |
|  | 10 001 to 25 000 | 100 |
|  | 25 001 and above | 125 |

**7.3 Number of Tests**

The number of detonators to be selected from the sample size for the determination of each characteristic shall be as given in the Table 2.

**Table 2 Number of tests**

(*Clause* 7.3)

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Test/Characteristic** | **No. of detonators to be tested** |
| (1) | (2) | (3) |
|  | Transfer capability | 5 |
|  | Drop test | 5 |
|  | Delay timing test | 10 |

**7.4 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* 4.3)

**DETERMINATION OF TRANSFER CAPABILITY OF RELAYS**

**A-1 GENERAL**

When using initiation systems using detonating cords, there is a need to transfer the detonation from one length of detonating cord to another length of detonating cord with designated delay. This can be done by means of relays.

**A-2 APPARATUS**

Initiating device for the donors, Detonating cords (for use as receptors or donors).

**A-3 TEST PIECES**

Make a selection of 5 items of similar type with similar construction and materials

**A-4 PROCEDURE**

**A-4.1** Condition the relay by submerging the assembly for 2 h at a depth of 0.5 m ± 0.05 m in water. The temperature should be kept at 25 ℃ ± 5 ℃.

**A-4.2** After the conditioning step, remove the relay from the water.

**A-4.3** Connect the donor (detonating cord) and receptor (detonating cord) to the relay as per the instructions given by the manufacturer.

**A-4.4** Now initiate the donor by making use of an appropriate initiating device and then check that the receptor has fired.

**A-4.5** Record if detonation has successfully transferred to the receptor or not.

**A-5 TEST REPORT**

It shall clearly indicate the following information:

1. Whether the receptor initiated successfully or not.

**Annex B**

(*Clause* 5.1)

**DETERMINATION OF SENSITIVENESS TO IMPACT**

**B-1 GENERAL**

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

**B-2 APPARATUS**

Impact testing apparatus, consisting of a 5.0 kg ± 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. Fig. 1 shows the arrangement of the impact testing apparatus.

NOTE

It is recommended that the hammer should made of steel of type 100Cr6 as defined by IS 17111 (identical adoption of ISO 683-17). 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. However, if these grades are not available, other appropriate type of steel may also be used.

****

*Key*

1 Anvil

2 Plates

3 Guide tube

4 Hammer

FIG. 1 IMPACT TESTING APPARATUS FOR CORD RELAYS

**B-3 TEST PIECES**

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

**B-4 PROCEDURE**

**B-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. 1). 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.

**B-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.

**B-5 CALCULATION**

In determining the level at which the probability of obtaining a positive result is 50 % (H50), 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 3) and summarized as shown in Table 4. Column 2 of Table 3 contains the drop heights, in ascending order, starting with the lowest level for which a test result is recorded. In column 3 of Table 4, ‘i’ is a number corresponding to the number of equal increments above the base or zero line. Column 4 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:

$H\_{50}=c+d×\left[\left(\frac{A}{N\_{s}}\right)\pm 0.5\right]$ (1)

where,

*Ns*= $\sum\_{}^{}n\_{i}$,

*A* = $\sum\_{}^{}\left(i×n\_{i}\right)$,

*c* is the lowest drop height, and

*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:

$s=1.62×d×\left[\left(\frac{\left(N\_{s}×B-A^{2}\right)}{N\_{s}^{2}}\right)+0.029\right]$ (2)

where,

*B* = $\sum\_{}^{}\left(i^{2}×n\_{i}\right)$.

EXAMPLE

Using the following data from Tables 3 and 4: 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:

H50 = 10 + 5 × [(16 / 12) + 0.5] = 19.2 cm

And the standard deviation by equation (2) as:

s = [((12 × 30 - 162) / 122) + 0.029] = 6.1

The minimum height at which explosion occurred = 15 cm

**Table 3 Recording Data**

(*Clause* B-5)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 4 Summarizing data**

(*Clause* B-5)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl No.** | **Height****(cm)** | **i(-)** | **n(-)** | **i(-).n(-)** | **i2(-).n(-)** |
| (1) | (2) | (3) | (4) | (5) | (6) |
|  | 25 | 3 | 1 | 3 | 9 |
|  | 20 | 2 | 4 | 8 | 16 |
|  | 15 | 1 | 5 | 5 | 5 |
|  | 10 | 0 | 2 | 0 | 0 |
| Totals | Ns = 12 | A = 16 | B = 30 |

**B-6 TEST REPORT**

It shall clearly indicate the following information:

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

**ANNEX C**

( *Foreword* )

**COMMITTEE COMPOSITION**

Explosives and Pyrotechnics Sectional Committee, CHD 26

|  |  |
| --- | --- |
| *Organization* | *Representative(s)* |
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| Central Pollution Control Board, New Delhi | SHRI ABHIJIT PATHAK |
| Centre for Fire and Explosive Environment Safety, Defence Institute of Fire Research, Delhi | SHRIMATI HEMLATA GAUTAMSHRI GULSHAN KUMAR SINGLA (*Alternate*) |
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| The Coronation Fireworks Factory, Sivakasi | SHRI K JEYAKUMAR (*Alternate*) |
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Explosives Panel, CHD 26: P4

|  |  |
| --- | --- |
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