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IS 7071-4 (1986): Methods of physical test for ropes and cordages, Part 4: Breaking load and elongation at break [TXD 1: Physical Methods of Tests]



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IS 7071 ( Part 4 ) : 1986

*Indian Standard*

METHODS OF  
PHYSICAL TEST FOR ROPES AND CORDAGES  
**PART 4 BREAKING LOAD AND ELONGATION AT BREAK**

( Second Reprint SEPTEMBER 1996 )

UDC 677 072 68 677 017 424 5

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

**Gr 3**

*February 1987*

**AMENDMENT NO. 1 MAY 1988**  
**TO**  
**IS : 7071 ( Part 4 ) - 1986 METHODS OF PHYSICAL**  
**TEST FOR ROPES AND CORDAGES**

**PART 4 BREAKING LOAD AND ELONGATION AT BREAK**

( Page 9, Table 2, col 8 and 9, against nominal diameter 40 and 44 mm under col 1)—Delete the existing values.

( Page 9, Table 2, col 8 and 9, against nominal diameter 48 to 80 mm under col 1)—Substitute the following for the existing values:

(1)	(8)	(9)
48	0.890	0.871 9
52	0.880	0.864 6
56	0.875	0.858 3
60	0.870	0.853 1
64	0.865	0.848 3
68	—	—
72	0.855	0.839 5
76	—	—
80	0.845	0.833 2

( Page 9, Table 2, col 8 and 9 against nominal diameter 88 and 96 mm under col 1)—Add the following values:

(1)	(8)	(9)
88	0.840	0.828 6
96	0.835	0.824 2

( TDC 1)

## Indian Standard

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## *Indian Standard*

### METHODS OF PHYSICAL TEST FOR ROPES AND CORDAGES

#### PART 4 BREAKING LOAD AND ELONGATION AT BREAK

#### 0. FOREWORD

**0.1** This Indian Standard ( Part 4 ) was adopted by the Indian Standards Institution on 30 April 1986, after the draft finalized by the Physical Methods of Test Sectional Committee had been approved by the Textile Division Council

**0.2** This standard forms a part of a series of standard under the title 'Methods of physical test for ropes and cordage'.

**0.3** This standard is based on methods in use for testing ropes and cordage in the industry and trade. Considerable assistance has also been derived from ISO 2307-1972 'Ropes — Determination of certain physical and mechanical properties' and BS 5053 : 1985 'Methods of test for cordage and webbing slings and fibre cores for wire ropes', issued by International Organization for Standardization and British Standards Institution, respectively

**0.4** For general information like definitions, atmospheric conditions for conditioning and testing and sampling, IS 7071 ( Part 1 )-1974\* may be referred.

**0.5** In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960†.

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#### 1. SCOPE

**1.1** This standard ( Part 4 ) prescribes methods of test for determination of breaking load and elongation at break of ropes and cordage made from natural and man-made fibres.

\*Methods of physical test for ropes and cordages: Part 1 General.

†Rules for rounding off numerical values ( revised )



**IS : 7071 ( Part 4 ) - 1986**

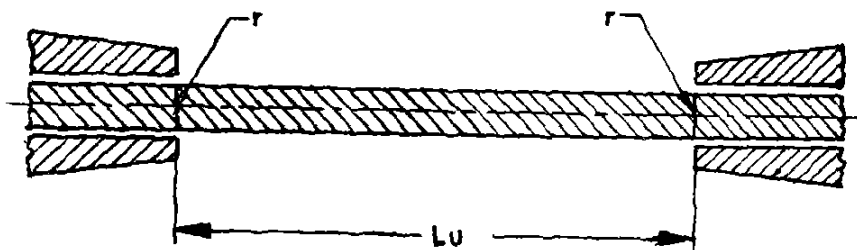
**2. PRINCIPLE**

**2.1** The specimen is gripped between two clamps of a tensile testing machine and continually increasing load is applied by moving one of the clamps until the specimen ruptures. Values of breaking strength and elongation of the test specimen are read directly or from a chart attached. In case of ropes having very high breaking strength, the yarns taken from rope are tested and then strength of rope is calculated from these.

**3. APPARATUS**

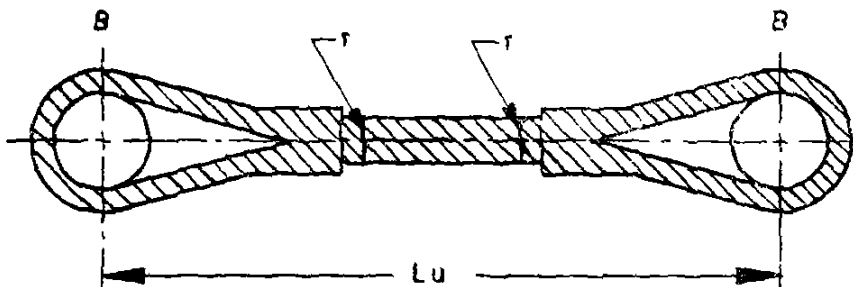
**3.1 Testing Machine** — A constant rate traverse type tensile testing machine of appropriate capacity. The load range of the machine shall be such that the observed values would be between 10 and 90 percent of the full scale load. The permissible error in the machine at any point in this range shall not exceed  $\pm 1$  percent. The machine shall be provided with the following arrangements:

- a) Clamps for holding the specimen which may be any of the following types:
  - 1) Ordinary or wedge grips ( *see* Fig. 1 ),
  - 2) Bollard grips for use with eye spliced test specimens ( *see* Fig. 2 ),
  - 3) Pulleys commonly called 'Cor-de-chasse' grips ( *see* Fig. 3 ), and
  - 4) Ram horn grips ( *see* Fig. 4 ).
- b) Each clamp shall be provided with a mechanical or pneumatic device so constructed that through its means a specimen can be secured firmly between the jaws of the clamps so that it does not slip during the test. Also the edge of the surface of each clamp shall be such that it would not cut or damage the specimen during testing.
- c) Means for applying pre-tension of 2 percent breaking load to the specimen when clamped ( the tension device may be dead-weight, a spring or an air-actuated mechanism ).
- d) Means for adjusting the distance between the clamps.
- e) A scale or dial or autograph recording chart graduated so as to give load in kilograms and elongation in millimetres.



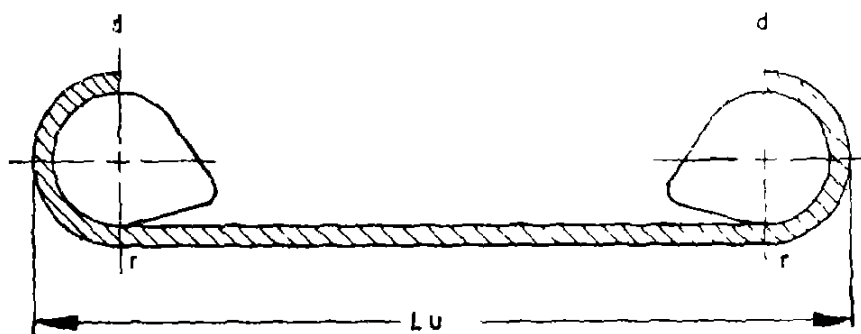
The limiting marks 'r' on the test piece shall be positioned in line with the grips

FIG. 1 TEST PIECE MOUNTED BETWEEN WEDGE GRIPS



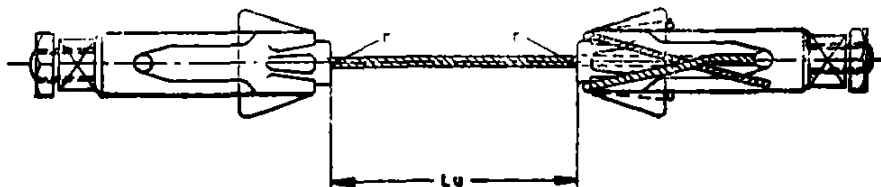
The limiting marks 'r' shall be 150 mm from the last turn of the splice.

FIG. 2 EYE SPLICED TEST PIECE BETWEEN TWO BOLLARDS



The limiting marks 'r' shall be positioned where the rope leaves the Cor-de-chasse.

FIG. 3 TEST PIECE MOUNTED ON PULLEYS ( Cor-de-chasse )



The limiting marks 'r' on the test piece shall be positioned in line with the grips.

FIG. 4 TEST PIECE MOUNTED BETWEEN RAM HORN GRIPS

### 3.2 Measuring Tape

## 4. MOUNTING OF TEST SPECIMENS

4.1 Fix the ends of the test piece between the wedge grips on the pulleys or on the bollards, or by its eye splices on the bollards or between 'Ram horn grips' according to the type of grips used ( see Fig. 1, 2, 3 and 4 ) in such a way as to obtain the effective test length,  $L_u$ , of test specimen specified in Table 1

TABLE 1 EFFECTIVE TEST LENGTHS

ROPE DIA	TEST LENGTH
Greater than 10 mm	1 m
10 mm and less	250 mm

4.1.1 The effective test length,  $L_u$ , shall be measured under zero tension, the test specimen being simply held straight for each of the four principal types of grips.

4.1.2 The separation of strands by untwisting or unplaiting the ends of the test piece when the testing is carried out as indicated by Fig. 1 and 3, shall not be done before testing

4.1.3 In the case of pulleys, ropes of diameter above 12 mm can be untwisted or unplaited beyond point  $d$  on the circumference of the pulleys for the purpose of fixing the ends ( see Fig. 3 ).

NOTE — It is recommended as far as possible wedge grips should not be used as rope is likely to slip or fibres getting damaged during testing resulting in erroneous results. However, if these grips are used, enough care should be taken to see that the slippage or the damage does not occur

4.1.4 In case of eye splicing, the eyes shall have an internal length between 250 and 300 mm when measured closed and splices shall be made to the manufacturers discretion. In the case of man-made fibre ropes, it is recommended that the end of the splices be tapered to finish.

**4.1.5** The bollard diameter ( $B$ ) shall be at least 100 mm for ropes of a nominal diameter of 40 mm or less, and 150 mm for ropes with a nominal diameter above 40 mm.

**4.2** With the test piece mounted on the testing machine apply the marks  $r$  limiting the portion of the test piece within which the rope is normally expected to break during the course of the breaking test.

**4.3** The rate of traverse of the straining head of the testing machine shall be constant. The applicable rates of traverse shall be as given below:

<i>Man-Made Fibre Ropes</i>	<i>Natural Fibre Ropes</i>
Within 75-250 mm/min	Within 150-305 mm/min

## 5. PROCEDURE

**5.0** Condition the test specimen as per the procedure laid down in IS : 7071 ( Part 1 )-1974\*.

### 5.1 Method A — by Rope Test.

**5.1.1** Take the conditioned test specimen and mount it on the machine as given in 4 depending upon the type of rope and the type of clamps used. Set the machine to the required rate of traverse ( see 4.3 ). Start the machine and carry the test to rupture.

**5.1.2** Record the breaking load and elongation at break of the specimen. Observe the location of the break, on the test piece on completion of the test in order to establish whether or not the test results represent the true strength of the rope ( see Note ). Damage to the test piece caused by the holding devices seriously affect the test results. The breakage should occur between two marks put on the test piece ( see 4.2 ).

NOTE — In case of eye spliced test, the ropes shall be deemed to conform to the requirements of the specification provided that the breaking load for the specimen is a minimum of 90 percent of the specified breaking load when the rupture occurs beyond  $r$  ( see Fig. 2 ).

**5.1.3** If the breakage takes place beyond the marks and below the specified breaking strength the test piece shall be considered to be conforming to the tensile strength requirement of the specification if the load recorded is not less than 90 percent of the specified breaking strength. If not, the test shall be discarded and new test carried out.

**5.1.4** Similarly test the other test specimens.

**5.1.5 Calculations** — Calculate the average breaking strength and elongation at break of all the observations made.

### 5.2 Method B —by Rope Yarn Test.

**5.2.1** The breaking load of rope is calculated from average breaking load of the single rope yarn in this method by unstranding sufficient length of rope in order to obtain rope yarns required for testing.

\*Methods of physical test for ropes and cordages: Part 1 General.

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**5.2.2** For calculating breaking load, realization factors have been provided in Table 2. For this method conditions given below shall be applicable:

- a) Where the rope is made from one size, type and construction of rope yarn, test at least 15 rope yarns of which 3 in every 15 are selected from the centre of the strands.
- b) For ropes made from more than one size, type and construction of yarn, test at least 15 rope yarns, but find out first the number of each size, type and construction of the rope yarn. Select a proportionate number of each size and type for test.
- c) Ensure that selected rope yarns are long enough to provide a minimum length of 250 mm between the grips of the testing machine.

**5.2.3** Mount each rope yarn in turn in the testing machine and observe the breaking load. Ensure that the twist in yarn is not disturbed prior to test.

**5.2.4 Calculations** — Find out the average of all the observed results and calculate from these the breaking load of the rope in accordance with the following formula:

- a) When the rope is made from one size, type and construction of yarns

$$BL = y \times n \times r$$

where

- $BL$  = calculated breaking load, in kg,  
 $y$  = average strength of the yarns, in kg;  
 $n$  = number of yarns in the rope, and  
 $r$  = realization factor as given in Table 2

- b) When ropes are made from more than one size, type and construction of rope yarns

$$BL = y \times r$$

where

- $BL$  = calculated breaking load, in kg,  
 $y$  = aggregate strength of rope yarns in the rope (this aggregate is obtained by adding together the overall strength of each size, type of construction of yarn multiplied by the number of such yarns in the rope), and  
 $r$  = realization factor as given in Table 2.

**TABLE 2 REALIZATION FACTORS**  
( Clause 5.2.2 and 5.2.4 )

NOMINAL DIAMETER OF REFERENCE NUMBER mm	REALIZATION FACTOR FOR									
	Manila and Sisal Ropes			Synthetic Fibre Ropes			3 or 8-Strand polypropylene monofilament or staple fibre			
	3-Strand	4-Strand	4-Strand	3 or 8-Strand polyamide	3-Strand polyester	3-Strand polyethylene	3 or 8-Strand polypropylene fibrillated filit*	(7)	(8)	(9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		
24	0.608	0.547	0.511	0.750 0	0.622 2	0.786	—	—	—	—
28	0.602	0.541	0.502	0.737 6	0.604 2	0.765	—	—	—	—
32	0.597	0.537	0.494	0.727 0	0.592 5	0.752	—	—	—	—
36	—	—	—	0.717 7	0.584 0	0.741	—	—	—	—
40	—	—	—	0.709 5	0.576 8	0.731	0.890	0.871 9	—	—
44	—	—	—	0.702 2	0.570 5	0.723	0.880	0.864 6	—	—
48	0.608	0.547	0.511	0.695 8	0.565 5	0.715	0.870	0.858 3	—	—
52	0.602	0.541	0.502	0.690 0	0.561 0	0.708	0.865	0.848 3	—	—
56	0.597	0.537	0.494	0.685 0	0.557 2	0.702	—	—	—	—
60	0.592	0.533	0.487	0.680 8	0.553 6	0.697	0.855	0.839 5	—	—
64	0.589	0.530	0.480	0.677 0	0.550 2	0.692	—	—	—	—
68	0.585	0.527	—	—	—	—	—	—	—	—
72	0.582	0.524	0.469	0.670 0	0.544 6	0.684	0.845	0.833 2	—	—
76	0.579	0.521	—	—	—	—	0.840	0.828 6	—	—
80	0.577	0.519	0.461	0.665 0	0.540 0	—	0.835	0.824 2	—	—
88	0.574	0.517	0.456	0.661 3	0.536 7	—	—	—	—	—
96	0.572	0.515	0.452	0.657 8	0.533 3	—	—	—	—	—
104	0.570	0.513	0.433	—	—	—	—	—	—	—
112	0.568	0.511	0.431	—	—	—	—	—	—	—
120	0.567	0.509	0.429	—	—	—	—	—	—	—
128	0.566	0.507	0.428	—	—	—	—	—	—	—
136	0.564	0.505	0.426	—	—	—	—	—	—	—
144	0.563	0.503	0.424	—	—	—	—	—	—	—

\*These values are only applicable when the fibrillated num rope yarns have an elongation at break of at least 7 percent. The method should not be used when the elongation value is less.

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**6. REPORT**

**6.1** The report shall include the following information:

- a) Type of material,
- b) Method used,
- c) Type of grips used,
- d) Number of test specimens tested,
- e) Test length,
- f) Breaking load, and
- g) Elongation.

**6.2** If the breaking strength has been calculated, mention shall be made of this fact in the test report, in commercial documents, and in dealings with the purchaser

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