*भारतीय मानक* **IS 1855 : 2024**

***Indian Standard***

# खानों में वेष्टन द्वारा और व्यक्ति-रोहन द्वारा ढुलाई के लिए लड़दार इस्पात के तार के रस्से — विशिष्टि

*( चौथा पुनरीक्षण )*

# Stranded Steel Wire Ropes for Winding and Man-Riding Haulages in Mines — Specification

*( Fourth Revision )*

ICS 73.100.40; 77.140.65



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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Wire Ropes and Wire Products Sectional Committee, MED 10

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wire Ropes and Wire Products Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1961 and was revised in 1977, 2003 and 2022. The standard is being revised again for incorporating the modifications found necessary as a result of experience gained with the use of this standard. Also, the major changes in the standard with this revision are given below:

a) The scope of the standard has been modified;

b) Provision for minimum breaking force has been modified; and

c) Requirements for wire rope core has been modified in **6.2**.

All the necessary information regarding the conditions, under which the rope is to be used together with other particulars, laid down in Annex A, shall be supplied with the enquiry and order.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

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*

# STRANDED STEEL WIRE ROPES FOR WINDING AND MAN-RIDING HAULAGES IN MINES — SPECIFICATION

*( Fourth Revision )*

## 1 SCOPE

This standard covers general requirements for stranded steel wire ropes for winding and man-riding haulages in mines. Most common rope constructions and rope types are given in following table. Common rope grades, cores and size ranges are identified by x mark. Specially developed constructions including compacted ropes, cushion core rope and plastic valley filled ropes may be used to fulfill specific requirement of the installation if agreed between manufacturer and purchaser.

| *Sl No.* | *Construction* | *Type* | *Rope Grade* | | | | | *Core* | | *Rope Size* (Diameter, in mm) | *Table* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1230 | 1420 | 1570 | 1770 | 1960 | Fibre | Steel | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| i) | 6 × 7 (6 – 1) | Round strand | – | – | × | × | × | × | × | 13 to 29 | 1 |
| ii) | 6 × 15 S (7 – 7 –1) | | – | – | × | × | × | × | × | 13 to 32 | 2 |
| iii) | 6 × 17 S (8 – 8 –1) | | | | × | × | × | × | × | 13 to 35 | |
| iv) | 6 × 19 S (9 – 9 – 1) | | | | × | × | × | × | × | 13 to 38 | |
| v) | 6 × 26 SW (10 –5 + 5 – 5 – 1) | | – | – | × | × | × | × | × | 25 to 41 | 3 |
| vi) | 6 × 31 SW (12 –6 + 6 – 6 – 1) | | | | × | × | × | × | × | 29 to 44 | |
| vii) | 6 × 36 SW (14 – 7 + 7 – 7 – 1) | | | | × | × | × | × | × | 35 to 51 | |
| viii) | 6 × 41 SW (16 – 8 + 8 – 8 – 1) | | | | × | × | × | × | × | 38 to 60 | |
| ix) | 6 × 49 SWS (16 – 8 + 8 – 8 – 8 – 1) | | | | × | × | × | × | × | 51 to 64 | |
| x) | 6 × 46 SW (18 – 9 + 9 – 9 - 1) | | | | × | × | × | × | × | 51 to 64 | |
| xi) | 6 × 52 SW (18 - 9 + 9 - 9/6 - 1) | | | | × | × | × | × | × | 51 to 64 | |
| xii) | 17 × 7 [11 × 7 (6 – 1) : 6 × 7(6 – 1)] | Multi strand | × | × | × | × | × | × | × | 16 to 35 | 4 |
| xiii) | 18 × 7 [12 × 7 (6 – 1) : 6 × 7 (6 – 1)] | | × | × | × | × | × | × | × | 16 to 35 | |

| *Sl No.* | *Construction* | *Type* | *Rope Grade* | | | | | *Core* | | *Rope Size* (Diameter, in mm) | *Table* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1230 | 1420 | 1570 | 1770 | 1960 | Fibre | Steel | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| xiv) | 34 × 7 [17 × 7 (6 – 1) : 11 × 7(6 – l)/6 × 7 (6 – 1)] | rotation resistant | × | × | × | × | × | × | × | 19 to 60 | 5 |
| xv) | 36 × 7 [18 × 7(6 – 1) : 12 × 7 (6 – 1)/6 × 7(6 – 1)] | | × | × | × | × | × | × | × | 19 to 60 | |
| xvi) | 35 × 7 [16 × 7 (6 – 1) : 6 × 7 (6 – 1) + 6 × 7 (6 – 1) – 6 × 7 (6 – 1) – 1×7(6-1) | | | | × | × | × | | × | 19 to 60 | 8 |
| xvii) | 40 × 7 [18 × 7 (6 – 1) : 7 × 7 (6 – 1) + 7 × 7 (6 – 1) – 7 × 7 (6 – 1) – 1 × 7 (6 – 1)] | | | | × | × | × | | × | 19 to 60 | 8 |
| xviii) | 35 × 19 S [16 × 19S (9 – 9 – 1) : 6 × 19 S (9 – 9 – 1) + 6 × 19S (9 – 9 – 1) – 6 × 19 S (9 – 9 – 1) – 1 × 19S (9 – 9 – 1) | | | | × | × | × | | × | 19 to 60 | 8 |
| xix) | * 15 × 7 | | | | × | × | × | | × | 19 to 60 | 8 |
| xx) | * 16 × 7 | | | | × | × | × | | × | 19 to 60 | 8 |
| xxi) | 6 × V 8 (7 – Δ) | Flattened strand | – | – | × | × | × | × | × | 16 to 32 | 6 |
| xxii) | 6 × V 9 (8 – Δ) | | | | × | × | × | × | × | 16 to 32 | |
| xxiii) | 6 × V 22 (9/12 – Δ) | | – | – | × | × | × | × | × | 25 to 36 | 7 |
| xxiv) | 6 × V 25 (12/12 – Δ) | | | | × | × | × | × | × | 25 to 44 | |
| xxv) | 6 × V 28 (15/12 – Δ) | | | | × | × | × | × | × | 32 to 56 | |
| xxvi) | 6 × V 31 (18/12 – Δ) | | | | × | × | × | × | × | 36 to 64 | |

*15 × 7 and 16 × 7 construction rope shall have IWRC having more than 7 strands for flexibility and lay direction shall be opposite to rope lay direction for rotational resistance property.

## 2 REFERENCES

The standards given below contain provisions, which through reference in this text constitute provisions of 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 edition of these standards:

| *IS No.* | *Title* |
|---|---|
| IS 1804 : 2004 | Steel wire ropes — Fibre main cores — Specification (*fourth revision*) |
| IS 1835 : 1976 | Specification for round steel wire for ropes (*third revision*) |
| IS 2363 : 2022 | Glossary of terms relating to wire ropes (*second revision*) |
| IS 9182 (Part 1) : 1993 | Lubricants for wire ropes and fire cores — Specification: Part 1 Lubricants for fibre core of wire ropes (*first revision*) |
| IS 13917 : 2003 | Stranded wire ropes for mine hoisting — Technical delivery requirements (*first revision*) |

## 3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2363 shall apply.

## 4 ROPE SIZE AND TOLERANCE

Most common size of rope, designated, as 'nominal diameter' are given in Table 1 to Table 7; however other size may be given as agreed between the manufacturer and purchaser. The actual diameter of the rope as supplied shall be within + 4, - 1 percent of the nominal diameter.

## 5 MINIMUM BREAKING FORCE

Minimum breaking force shall be as given in Table 1 to Table 8 or higher values as agreed between manufacturer and purchaser. Minimum breaking force for compacted ropes and specially developed ropes may be as agreed between manufacturer and purchaser.

NOTE — The actual breaking force shall not fall below the minimum breaking force values and may be obtained through Method A or B (including foot notes) as specified in IS 13917.

## 6 GENERAL REQUIREMENTS

The wire rope shall conform to IS 13917 in addition to the requirements given below:

### 6.1 Wire

The chemical composition of the raw material for producing wires to be used in the rope shall conform to any of the Grades 1, 2 and 3 of IS 1835.

### 6.2 Core

Core shall be fibre core or steel core as per **6.2.1** and **6.2.2**.

**6.2.1** *Fibre Core*

The core shall be made from natural hard fibre, either manila (abaca) or sisal, and shall conform to the requirements laid down in IS 1804.

**6.2.2** *Steel Core*

Whenever steel main core is specified, it shall be an independent wire rope core (CWR), except for multi-strand rotation resistant ropes where wire strand cores (CWS) shall be used. In case of inner core of multi-strand rotation resistant rope is having 3 or 4 number of strands in first inner layer, there may not have essentially a central core. The tensile designation of the wires for steel core and core wires in the strands of the rope shall not exceed the tensile grade of the main rope wires, however, it can be up to one grade lower than the main rope wires. In case of shaped wires from strand core, **4.3** of IS 13917 shall be referred.

NOTE — The use of steel core has certain advantages in adverse conditions, such as corrosive atmosphere, multi-layer winding leading to crushing of rope, and deep shaft winding leading to considerable stretch in the rope.

### 6.3 Joints

**6.3.1** Joints in wires at the final stage shall be avoided as far as possible, but where necessary, those shall be spread as widely as possible in the strand and in no case more than one wire shall be joined in a strand length of every 1 000 m or part. Total number of such joints shall not be more than 3 in any length of rope.

**6.3.2** The joints shall be as far as possible electrically welded or brazed.

**6.3.3** Tucked joints shall not be permitted.

### 6.4 Lay

**6.4.1** *Direction of Lay*

The rope shall be of Lang's lay unless otherwise specified by the purchaser (zZ or sS).

**6.4.2** *Length of Lay*

The length of lay of ropes shall not exceed 8 times the nominal diameter.

### 6.5 Mass

**6.5.1** The rope mass values shown in Table 1 to Table 8 are of fully lubricated ropes. The ropes, which are not lubricated, may be lighter.

**6.5.2** The actual rope mass shall meet the requirements of IS 13917.

NOTE — Rope mass values for the rope not covered in the Table 1 to Table 8 shall be as agreed between manufacturer and supplier.

## 7 GALVANIZING

Galvanizing shall meet the requirement of IS 13917.

## 8 LUBRICATION

**8.1** The ropes shall be thoroughly lubricated with an appropriate lubricant specified in IS 13917 unless otherwise requested by the purchaser specifically.

**8.2** Galvanized ropes for friction winder shall be lubricated with a lubricant, which will be resistant to slippage.

**8.3** Fibre core shall be lubricated with a suitable lubricant as specified in IS 9182 (Part 1) and shall have retention of lubricant after rope making (in new condition):

a) to an extent of minimum 12 percent by mass of dry fire core for general winding ropes; and

b) to an extent of minimum 8 percent by mass of dry fire core for friction winder ropes.

## 9 FREEDOM FROM DEFECTS

The completed ropes shall be free from defects like loose wires and strands, kink, protrusion of core and other irregularities that can be detected visually. The ropes shall be evenly laid and shall remain in condition when properly unwound from the reel.

## 10 SAMPLING PLAN

### 10.1 Lot

Steel wire rope of same size manufactured using the same set of strands and same type of core under identical condition of production, shall constitute a lot.

NOTE — Manufacturer shall provide evidence for the tractability of the individual rope lengths to the parent rope to establish that those represent the lot as defied above.

**10.2** For ascertaining the conformity of a lot, the following sampling plan shall be made:

a) Dimensional checking — 100 percent; or

b) Breaking force test — one sample from a lot

## 11 PREFORMING

Round and flattened strand ropes shall be preformed unless otherwise agreed upon. Multi-strand rotation resistant ropes may at the option of the manufacturer be supplied as non-preformed. Manufacturer shall provide at least one seizing at the rope ends for all round and flattened strand ropes and two to three seizing's of appropriate length and distance in case of rotation resistant ropes.

## 12 TEST

The wire ropes shall meet the test requirements and compliance criteria as laid down in IS 13917.

## 13 PACKING AND MARKING

### 3.1 Packing

Packing shall be done as per IS 13917.

### 13.2 Marking

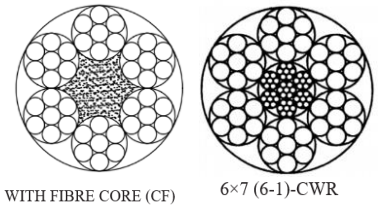
The reel number, nominal rope size, construction, rope grade, direction of lay, core, coating, length, purchaser's order reference and any other marking which may be specified by the purchaser shall be legibly displayed on both sides of reel flanges through suitable tags or stenciling.

### 13.3 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.

**Table 1 Breaking Force and Mass for 6 × 7 (6-1) Construction Ropes**

(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)

| Typical Cross Section | Typical Construction | |
|---|---|---|
| | Rope Construction | Strand Construction |
|  WITH FIBRE CORE (CF) 6×7 (6-1)-CWR | 6 × 7 | 6-1 |

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| i) | 13 | 60.4 | 66.4 | 88.1 | 95.2 | 99.4 | 107 | 110 | 119 |
| ii) | 14 | 70.1 | 77.0 | 102 | 110 | 115 | 124 | 128 | 138 |
| iii) | 16 | 91.5 | 101 | 134 | 144 | 151 | 163 | 167 | 180 |
| iv) | 18 | 116 | 127 | 169 | 183 | 191 | 206 | 211 | 228 |
| v) | 19 | 129 | 142 | 188 | 203 | 212 | 229 | 235 | 254 |
| vi) | 20 | 143 | 157 | 209 | 225 | 235 | 254 | 260 | 281 |
| vii) | 21 | 158 | 173 | 230 | 248 | 259 | 280 | 287 | 310 |

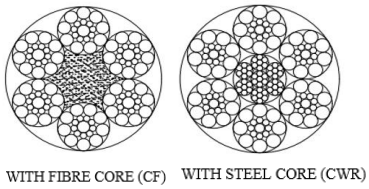
**Table 1** (*Concluded*)

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| viii) | 22 | 173 | 190 | 252 | 273 | 285 | 307 | 315 | 340 |
| ix) | 24 | 206 | 226 | 300 | 324 | 339 | 366 | 375 | 405 |
| x) | 25 | 223 | 246 | 326 | 352 | 367 | 397 | 407 | 440 |
| xi) | 26 | 242 | 266 | 353 | 381 | 397 | 429 | 440 | 475 |
| xii) | 27 | 261 | 287 | 380 | 411 | 429 | 463 | 475 | 513 |
| xiii) | 28 | 280 | 308 | 409 | 442 | 461 | 498 | 510 | 551 |
| xiv) | 29 | 301 | 331 | 439 | 474 | 495 | 534 | 548 | 591 |

NOTE — To calculate the aggregate breaking force, multiply the figures given in col (4), (6) and (8) by 1.111 and in col (5), (7) and (9) by 1.193.

**Table 2 Breaking Force and Mass for 6 × 15 S (7 –7 –1), 6 × 17 S (8 –8 –1) and 6 × 19 S (9 –9 –1) Construction Ropes**

(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)

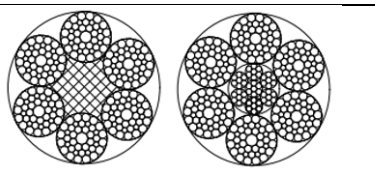
| Typical Cross Section | Typical Construction | |
|---|---|---|
|  WITH FIBRE CORE (CF) WITH STEEL CORE (CWR) | Rope Construction | Strand Construction |
| | 6 × 15S | 7-7-1 |
| | 6 × 17S | 8-8-1 |
| | 6 × 19S | 9-9-1 |

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| i) | 13 | 63.0 | 69.3 | 87.8 | 94.8 | 99.0 | 107 | 110 | 118 |
| ii) | 14 | 73.0 | 80.3 | 102 | 110 | 115 | 124 | 127 | 137 |
| iii) | 16 | 95.4 | 105 | 133 | 144 | 150 | 162 | 166 | 179 |
| iv) | 18 | 121 | 133 | 168 | 182 | 190 | 205 | 210 | 227 |
| v) | 19 | 135 | 148 | 188 | 203 | 211 | 228 | 234 | 253 |
| vi) | 20 | 149 | 164 | 208 | 224 | 234 | 253 | 260 | 280 |
| vii) | 21 | 164 | 181 | 229 | 247 | 258 | 279 | 286 | 309 |
| viii) | 22 | 180 | 198 | 252 | 272 | 284 | 306 | 314 | 339 |
| ix) | 24 | 215 | 236 | 299 | 323 | 337 | 364 | 374 | 403 |
| x) | 25 | 233 | 256 | 325 | 351 | 366 | 395 | 405 | 438 |
| xi) | 26 | 252 | 277 | 351 | 379 | 396 | 428 | 439 | 474 |
| xii) | 27 | 272 | 299 | 379 | 409 | 427 | 461 | 473 | 511 |
| xiii) | 28 | 292 | 321 | 407 | 440 | 459 | 496 | 509 | 549 |
| xiv) | 29 | 313 | 345 | 437 | 472 | 493 | 532 | 546 | 589 |
| xv) | 32 | 382 | 420 | 532 | 575 | 600 | 648 | 664 | 717 |
| xvi) | 35 | 456 | 502 | 637 | 687 | 718 | 775 | 795 | 858 |
| xvii) | 38 | 538 | 592 | 750 | 810 | 846 | 913 | 937 | 1012 |

NOTE — To calculate the aggregate breaking force, multiply the figures given in col (4), (6) and (8) by 1.163 and in col (5), (7) and (9) by 1.25.

**Table 3 Breaking Force and Mass for 6 × 26 SW (10 – 5 + 5 – 5 – 1), 6 × 31 SW (12 – 6 + 6 – 6 – 1), 6 × 36 SW (14 – 7 + 7 – 7 – 1), 6 × 41 SW (16 – 8 + 8 – 8 – 1) and 6 × 49 SWS (16 – 8 + 8 – 8 – 8 – 1) Construction Ropes**

(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)

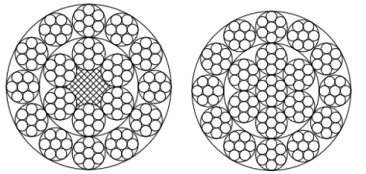
| Typical Cross Section | Typical Construction | |
|---|---|---|
|  WITH FIBRE CORE (CF) WITH STEEL CORE (CWR) | Rope Construction | Strand Construction |
| | 6 × 26SW | 10 – 5 + 5 – 5 – 1 |
| | 6 × 31 SW | 12 – 6 + 6 – 6 – 1 |
| | 6 × 36 SW | 14 – 7 + 7 – 7 – 1 |
| | 6 × 41 SW | 16 – 8 + 8 – 8 – 1 |
| | 6 × 49SWS | 16 – 8 + 8 – 8 – 8 – 1 |
| | 6 × 46SW | 18 – 9 + 9 – 9 – 1 |
| | 6 × 52SW | 18 – 9 + 9 – 9/6 – 1 |

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| i) | 25 | 238 | 261 | 324 | 350 | 365 | 394 | 404 | 436 |
| ii) | 26 | 257 | 283 | 350 | 378 | 395 | 426 | 437 | 472 |
| iii) | 28 | 298 | 328 | 406 | 439 | 458 | 494 | 507 | 548 |
| iv) | 29 | 320 | 352 | 436 | 470 | 491 | 530 | 544 | 587 |
| v) | 32 | 389 | 428 | 530 | 573 | 598 | 646 | 662 | 715 |
| vi) | 35 | 466 | 512 | 634 | 685 | 715 | 773 | 792 | 855 |
| vii) | 36 | 493 | 542 | 671 | 725 | 757 | 817 | 838 | 905 |
| viii) | 38 | 549 | 604 | 748 | 808 | 843 | 911 | 934 | 1 008 |
| ix) | 40 | 608 | 669 | 829 | 895 | 934 | 1 009 | 1 035 | 1 117 |
| x) | 41 | 639 | 703 | 871 | 940 | 982 | 1 060 | 1 087 | 1 174 |
| xi) | 42 | 671 | 738 | 914 | 987 | 1 030 | 1 112 | 1 141 | 1 232 |
| xii) | 44 | 736 | 810 | 1 003 | 1 083 | 1 130 | 1 221 | 1 252 | 1 352 |
| xiii) | 48 | 876 | 964 | 1 193 | 1 289 | 1 345 | 1 453 | 1 490 | 1 609 |
| xiv) | 51 | 989 | 1 088 | 1 347 | 1 455 | 1 519 | 1 640 | 1 682 | 1 816 |
| xv) | 52 | 1 028 | 1 131 | 1 401 | 1 513 | 1 579 | 1 705 | 1 748 | 1 888 |
| xvi) | 56 | 1 192 | 1 311 | 1 624 | 1 754 | 1 831 | 1 978 | 2 028 | 2 190 |
| xvii) | 60 | 1 369 | 1 506 | 1 856 | 2 014 | 2 102 | 2 270 | 2 328 | 2 514 |
| xviii) | 64 | 1 557 | 1 713 | 2 121 | 2 291 | 2 392 | 2 583 | 2 648 | 2 860 |

NOTE — To calculate the aggregate breaking force, multiply the figures given in col (4), (6) and (8) by 1.19 and in col (5), (7) and (9) by 1.28.

**Table 4 Breaking Force and Mass for 17 × 7 (6 –1) and 18 × 7 (6 –1) Construction Ropes**

(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)

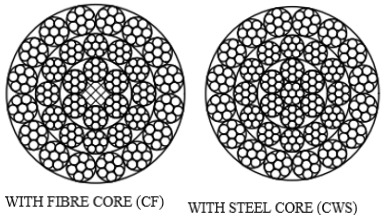
| Typical Cross Section | Typical Construction | |
|---|---|---|
| | Rope Construction | Strand Construction |
|  WITH FIBRE CORE (CF) WITH STEEL CORE (CWS) | 17 × 7 (11 × 7 : 6 × 7 - FC) | 6-1 |
| | 17 × 7 (11 × 7 : 6 × 7 - 1 × 7) | 6-1 |
| | 18 × 7 (12 × 7 : 6 × 7 - FC) | 6-1 |
| | 18 × 7 (12 × 7 : 6 × 7 - 1 × 7) | 6-1 |

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1230 | | 1420 | | 1570 | | 1770 | | 1960 | |
| | | Fibre core (CF) | Steel core (CWS) | Fibre core (CF) | Steel core (CWS) | Fibre core (CF) | Steel core (CWS) | Fibre core (CF) | Steel core (CWS) | Fibre core (CF) | Steel core (CWS) | Fibre core (CF) | Steel core (CWS) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| i) | 16 | 98 | 103 | 100 | 103 | 116 | 119 | 128 | 132 | 144 | 149 | 160 | 165 |
| ii) | 19 | 138 | 145 | 141 | 146 | 163 | 168 | 181 | 186 | 204 | 210 | 225 | 232 |
| iii) | 20 | 153 | 161 | 226 | 161 | 181 | 186 | 200 | 206 | 226 | 232 | 250 | 257 |
| iv) | 22 | 185 | 195 | 190 | 195 | 219 | 225 | 242 | 249 | 273 | 281 | 302 | 311 |
| v) | 24 | 220 | 232 | 226 | 232 | 261 | 268 | 288 | 297 | 325 | 335 | 360 | 370 |
| vi) | 25 | 239 | 251 | 245 | 252 | 283 | 291 | 313 | 322 | 352 | 363 | 390 | 402 |
| vii) | 26 | 259 | 272 | 265 | 273 | 306 | 315 | 338 | 348 | 381 | 393 | 422 | 435 |
| viii) | 27 | 279 | 293 | 286 | 294 | 330 | 340 | 365 | 376 | 411 | 423 | 455 | 469 |
| ix) | 28 | 300 | 315 | 307 | 316 | 355 | 365 | 392 | 404 | 442 | 455 | 490 | 504 |
| x) | 32 | 392 | 412 | 401 | 413 | 463 | 477 | 512 | 527 | 577 | 595 | 639 | 659 |
| xi) | 35 | 469 | 492 | 480 | 494 | 554 | 571 | 613 | 631 | 691 | 711 | 765 | 788 |

NOTE — To calculate the aggregate breaking force, multiply the figures given in col (4), (6), (8), (10) and (12) by 1.28 and in col (5), (7), (9), (11) and (13) by 1.32.

**Table 5 Breaking Force and Mass for 34 × 7 (6 – 1) and 36 × 7 (6 – 1) Construction Ropes**

(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)

| Typical Cross Section | Typical Construction | |
|---|---|---|
|   | Rope Construction | Strand Construction |
| | 34 × 7 (17 × 7 : 11 × 7/6 × 7 – FC) | 6-1 |
| | 34 × 7 (17 × 7 : 11 × 7/6 × 7 – 1 × 7) | 6-1 |
| | 36 × 7 (18 × 7 : 12 × 7/6 × 7 – FC) | 6-1 |
| | 36 × 7 (18 × 7 : 12 × 7/6 × 7 – 1 × 7) | 6-1 |
| | 60 × 7 (24 × 7 : 18 × 7 : 12 × 7 : 6 × 7 – FC) | 6-1 |

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1230 | | 1420 | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| i) | 19 | 141 | 145 | 139 | 141 | 160 | 163 | 177 | 180 | 199 | 203 | 221 | 225 |
| ii) | 22 | 189 | 195 | 186 | 190 | 215 | 219 | 237 | 242 | 267 | 273 | 296 | 302 |
| iii) | 25 | 244 | 251 | 240 | 245 | 277 | 283 | 306 | 312 | 345 | 352 | 382 | 390 |
| iv) | 26 | 264 | 272 | 260 | 265 | 300 | 306 | 331 | 338 | 374 | 381 | 414 | 422 |
| v) | 28 | 306 | 315 | 301 | 307 | 348 | 354 | 384 | 392 | 433 | 442 | 480 | 489 |
| vi) | 30 | 351 | 362 | 346 | 352 | 399 | 407 | 441 | 450 | 497 | 507 | 551 | 562 |
| vii) | 32 | 400 | 412 | 393 | 401 | 454 | 463 | 502 | 512 | 566 | 577 | 627 | 639 |
| viii) | 34 | 451 | 465 | 444 | 453 | 512 | 523 | 567 | 578 | 639 | 651 | 707 | 721 |
| ix) | 36 | 506 | 521 | 498 | 508 | 575 | 586 | 635 | 648 | 716 | 730 | 793 | 809 |

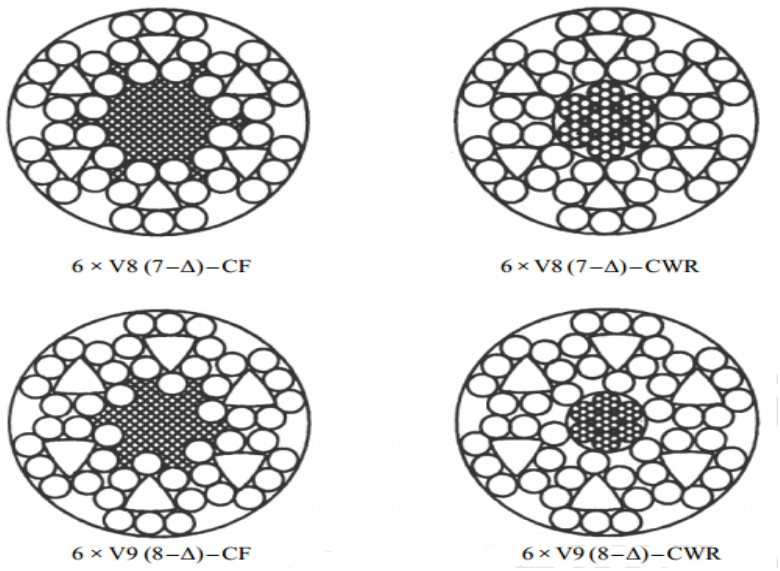
**Table 5** (*Concluded*)

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1230 | | 1420 | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) | Fibre Core (CF) | Steel Core (CWS) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| x) | 38 | 563 | 580 | 555 | 566 | 640 | 653 | 708 | 722 | 798 | 814 | 884 | 901 |
| xi) | 40 | 624 | 643 | 614 | 627 | 709 | 723 | 784 | 800 | 884 | 902 | 979 | 999 |
| xii) | 41 | 656 | 676 | 646 | 658 | 745 | 760 | 824 | 840 | 929 | 947 | 1 029 | 1 049 |
| xiii) | 44 | 755 | 778 | 743 | 758 | 858 | 875 | 949 | 968 | 1 070 | 1 091 | 1 185 | 1 208 |
| xiv) | 48 | 899 | 926 | 885 | 902 | 1 021 | 1 042 | 1 129 | 1 152 | 1 273 | 1 298 | 1 410 | 1 438 |
| xv) | 51 | 1 015 | 1 046 | 999 | 1 019 | 1 153 | 1 176 | 1 275 | 1 300 | 1 437 | 1 466 | 1 592 | 1 623 |
| xvi) | 52 | 1 055 | 1 087 | 1 038 | 1 059 | 1 199 | 1 223 | 1 325 | 1 352 | 1 494 | 1 524 | 1 655 | 1 687 |
| xvii) | 55 | 1 180 | 1 216 | 1 162 | 1 185 | 1 341 | 1 368 | 1 483 | 1 512 | 1 672 | 1 705 | 1 851 | 1 888 |
| xviii) | 56 | 1 224 | 1 261 | 1 204 | 1 228 | 1 390 | 1 418 | 1 537 | 1 568 | 1 733 | 1 767 | 1 919 | 1 957 |
| xix) | 60 | 1 405 | 1 447 | 1 382 | 1 410 | 1 596 | 1 628 | 1 765 | 1 800 | 1 989 | 2 029 | 2 203 | 2 247 |

NOTE — To calculate the aggregate breaking force, multiply the figures given in col (4), (6), (8), (10) and (12) by 1.33 and in col (5), (7), (9), (11) and (13) by 1.346.

**Table 6 Breaking Force and Mass for 6 × V 8 (7 –Δ) and 6 × V 9 (8 –Δ) Construction Ropes**

(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)



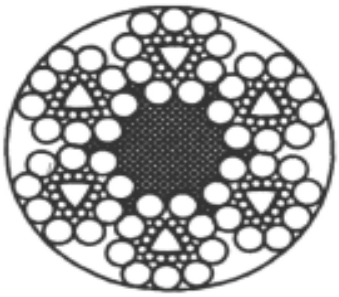

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| i) | 16 | 105 | 114 | 145 | 154 | 164 | 174 | 182 | 193 |
| ii) | 19 | 148 | 161 | 205 | 218 | 231 | 245 | 256 | 272 |
| iii) | 20 | 164 | 179 | 227 | 241 | 256 | 272 | 284 | 301 |
| iv) | 21 | 181 | 197 | 251 | 266 | 283 | 300 | 313 | 332 |
| v) | 22 | 198 | 216 | 275 | 292 | 310 | 329 | 343 | 364 |
| vi) | 24 | 236 | 257 | 327 | 347 | 369 | 391 | 409 | 434 |
| vii) | 25 | 256 | 279 | 355 | 377 | 400 | 425 | 443 | 470 |
| viii) | 26 | 277 | 302 | 384 | 408 | 433 | 459 | 480 | 509 |
| ix) | 29 | 345 | 376 | 478 | 507 | 539 | 572 | 597 | 633 |
| x) | 32 | 420 | 458 | 582 | 617 | 656 | 696 | 727 | 771 |

NOTES

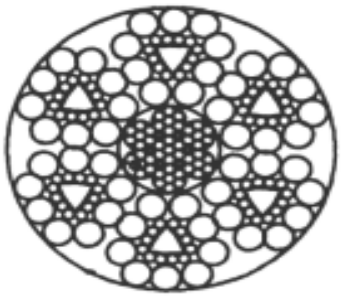
**1** To calculate the aggregate breaking force, multiply the figures given in col (4), (6) and (8) by 1.137 and in col (5), (7) and (9) by 1.21.
**2** In case of Δ wire, 3 or more round wires may also be used.

**Table 7 Breaking Force and Mass for 6 × V 22 (9/12 – Δ), 6 × V 25 (12/12 – Δ), 6 × V 28 (15/12 – Δ) and 6 × V 31 (18/12 – Δ) Construction Ropes**

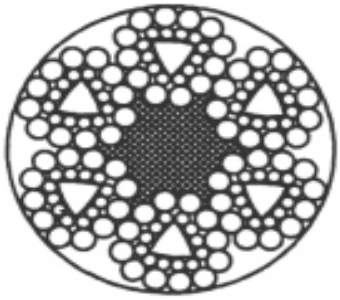
(*Clauses* 4, 5, 6.5.1 *and* 6.5.2)



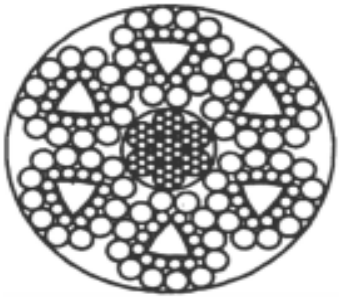
6×V 22(9/12-Δ)-CF



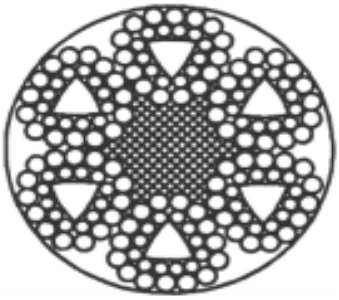
6×V 22(9/12-Δ)-CWR



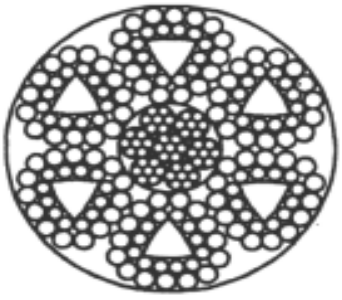
6×V 25(12/12-Δ)-CF



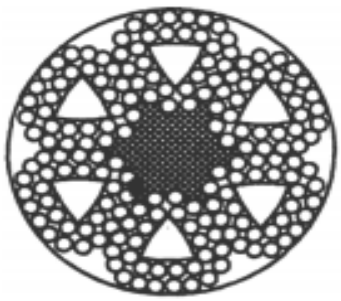
6×V 25(12/12-Δ)-CWR



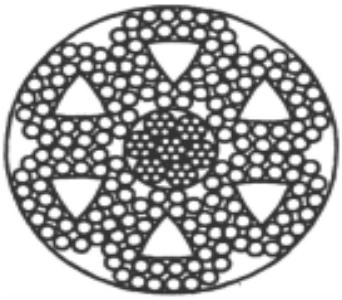
6×V 28(15/12-Δ)-CF



6×V 28(15/12-Δ)-CWR



6×V 31(18/12-Δ)-CF



6×V 31(18/12-Δ)-CWR

| Sl No. | Nominal Diameter | Nominal Mass | | Minimum Breaking Force Corresponding to Rope Grade of | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1570 | | 1770 | | 1960 | |
| | | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) | Fibre Core (CF) | Steel Core (CWR) |
| | mm | kg/100 | | kN | kN | kN | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| i) | 25 | 256 | 279 | 344 | 365 | 388 | 412 | 430 | 456 |
| ii) | 26 | 277 | 302 | 373 | 395 | 420 | 445 | 465 | 493 |
| iii) | 28 | 321 | 350 | 432 | 458 | 487 | 516 | 539 | 572 |
| iv) | 29 | 345 | 376 | 463 | 491 | 522 | 554 | 579 | 613 |
| v) | 32 | 420 | 458 | 564 | 598 | 636 | 674 | 704 | 747 |
| vi) | 35 | 502 | 548 | 675 | 715 | 761 | 807 | 843 | 893 |
| vii) | 36 | 531 | 579 | 714 | 757 | 805 | 853 | 892 | 945 |
| viii) | 40 | 656 | 715 | 882 | 934 | 994 | 1 054 | 1 110 | 1 167 |
| ix) | 44 | 794 | 865 | 1 067 | 1 131 | 1 203 | 1 275 | 1 332 | 1 412 |
| x) | 48 | 945 | 1 030 | 1 270 | 1 346 | 1 431 | 1 571 | 1 585 | 1 680 |
| xi) | 51 | 1 066 | 1 163 | 1 433 | 1 519 | 1 616 | 1 713 | 1 789 | 1 896 |
| xii) | 52 | 1 109 | 1 209 | 1 490 | 1 579 | 1 680 | 1 780 | 1 860 | 1 972 |
| xiii) | 56 | 1 286 | 1 402 | 1 728 | 1 832 | 1 948 | 2 065 | 2 157 | 2 287 |
| xiv) | 60 | 1 476 | 1 609 | 1 984 | 2 103 | 2 237 | 2 370 | 2 477 | 2 625 |
| xv) | 64 | 1 679 | 1 831 | 2 257 | 2 392 | 2 545 | 2 697 | 2 818 | 2 986 |

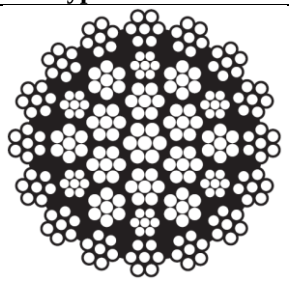
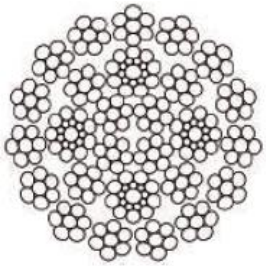
NOTES

**1** To calculate the aggregate breaking force, multiply the figures given in col (4), (6) and (8) by 1.177 and in col (5), (7) and (9) by 1.25.

**2** In case of Δ wire, 3 or more round wires may also be used.

**Table 8 Breaking Force and Mass for 35 × 7 (6 – 1) and 35 × 19S (9 – 9 - 1) Construction 35(W) × 7 Class and 15 × 7 Class Ropes**

(*Clauses* 5, 6.5.1 *and* 6.5.2)

| Typical Cross Section | Typical Construction | |
|---|---|---|
|  WITH STEEL CORE (CWS)  WITH STEEL CORE (CWR) | Rope Construction | Strand Construction |
| | 35 × 7 (16 × 7 : 6 × 7 + 6 × 7 – 6 × 7 – 1 × 7) | 6-1 |
| | 40 × 7 [18 × 7 : 7 × 7 + 7 × 7 - 7 × 7 – 1 × 7) | 6-1 |
| | 35 × 19S (16 × 19S : 6 × 19S + 6 × 19S – 6 × 19S – 1 × 19S) | 9-9-1 |
| | 15 × 7 : IWRC | 6-1 |
| | 16 × 7 : IWRC | 6-1 |

| Sl No. | Nominal Diameter | Approximate Mass | Minimum Breaking Force Corresponding to Rope Grade of | | |
|---|---|---|---|---|---|
| | | | 1570 | 1770 | 1960 |
| | | Steel Core | Steel Core | Steel Core | Steel Core |
| | | (CWR) | (CWR) | (CWR) | (CWR) |
| | mm | kg/100 m | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) |
| i) | 19 | 164 | 204 | 230 | 255 |
| ii) | 20 | 182 | 226 | 255 | 282 |
| iii) | 22 | 220 | 274 | 308 | 342 |
| iv) | 24 | 262 | 326 | 367 | 406 |
| v) | 25 | 284 | 353 | 398 | 441 |
| vi) | 26 | 307 | 382 | 431 | 477 |
| vii) | 28 | 356 | 443 | 500 | 553 |
| viii) | 29 | 382 | 475 | 536 | 593 |
| ix) | 30 | 409 | 509 | 573 | 635 |
| x) | 32 | 465 | 579 | 652 | 723 |
| xi) | 34 | 525 | 653 | 737 | 816 |
| xii) | 35 | 556 | 692 | 781 | 864 |
| xiii) | 36 | 588 | 732 | 826 | 914 |
| xiv) | 38 | 656 | 816 | 920 | 1019 |

**Table 8** (*Concluded*)

| Sl No. | Nominal Diameter | Approximate Mass | Minimum Breaking Force Corresponding to Rope Grade of | | |
|---|---|---|---|---|---|
| | | | 1570 | 1770 | 1960 |
| | | Steel Core | Steel Core | Steel Core | Steel Core |
| | | (CWR) | (CWR) | (CWR) | (CWR) |
| | mm | kg/100 m | kN | kN | kN |
| (1) | (2) | (3) | (4) | (5) | (6) |
| xv) | 40 | 726 | 904 | 1020 | 1129 |
| xvi) | 42 | 801 | 997 | 1124 | 1245 |
| xvii) | 44 | 879 | 1094 | 1234 | 1366 |
| xviii) | 45 | 919 | 1145 | 1290 | 1429 |
| xix) | 46 | 961 | 1196 | 1348 | 1493 |
| xx) | 48 | 1046 | 1302 | 1468 | 1626 |
| xxi) | 50 | 1135 | 1413 | 1593 | 1764 |
| xxii) | 51 | 1181 | 1470 | 1657 | 1835 |
| xxiii) | 52 | 1228 | 1528 | 1723 | 1908 |
| xxiv) | 54 | 1324 | 1648 | 1858 | 2058 |
| xxv) | 55 | 1373 | 1710 | 1928 | 2134 |
| xxvi) | 56 | 1424 | 1772 | 1998 | 2213 |
| xxvii) | 58 | 1527 | 1901 | 2144 | 2374 |
| xxviii) | 60 | 1634 | 2035 | 2294 | 2540 |

## ANNEX A

(*Foreword*)

## INFORMATION TO BE GIVEN WITH THE ENQUIRY OR ORDER

The information to be given with the enquiry or order is detailed below. It is recommended that the information should be supplied in the tabular form illustrated on page 15 and 16.

### A-1 PARTICULARS OF SHAFT

a) Depth — From lowest working level in shaft to bank, vertical distance from bank to center of head pulley;

b) Whether up cast, downcast, or both;

c) Whether wet or dry, and approximate range of temperature variation;

d) Whether shaft water is known to be of an injurious nature; its *p*H value and chloride content, if available; and

e) Whether steam is exhausted into the shaft, and whether there are any other special circumstances likely to affect the rope.

### A-2 PARTICULARS OF WINDING ENGINE DRUM

a) *Type of drum*:

1) If parallel type, give diameter, width and distance of fist and last live turns from centerline of drum;

2) If conical type, give minimum and maximum diameters, width and distance of fist and last working turns from centerline of drum; and

3) If cylindro-conical type, give maximum and minimum diameters, distance of fist and last live turns from centre-line of drum, number of working turns on the minimum diameter, number of turns on the scroll, width of drum, width of scroll and width of parallel portion of drum:

b) Nature and arrangement of drum lagging or cladding material and particulars of any grooving; and

c) Whether rope is wound on itself; if so, number of layers.

### A-3 PARTICULARS OF DRIVING SHEAVE

a) Diameter; and

b) Rope groove lining.

### A-4 PARTICULARS OF PITHEAD PULLEYS AND POSITION WITH RESPECT TO WINDING ENGINE

a) Horizontal and vertical distance between centres of pithead pulleys and whether the vertical centreline of or between the pulleys coincides with the centreline of the drum or sheave;

b) Diameter of pithead pulley at the bottom of groove;

c) Diameter of any guide sheave and its position with respect to the pithead pulley or driving sheave;

d) Height of centre of head pulley above centre of drum or ground type driving sheave;

e) Horizontal distance between centre of drum or ground type driving sheave and rope hanging in shaft; and

f) Inside and outside fleet angles.

### A-5 MAXIMUM WINDING SPEED IN METRES PER SECOND

### A-6 MAXIMUM ACCELERATION IN METRES PER SECOND PER SECOND OF ROPE WHEN RAISING FULL LOAD

### A-7 MAXIMUM LOAD AND NORMAL LOAD SUSPENDED FROM THE WINDING ROPE CAPPING INCLUDING THE MASS OF ANY BALANCE ROPE AND ITS ATTACHMENTS

### A-8 TYPE OF CAGE GUIDES

### A-9 PARTICULARS OF ROPE REQUIRED OR PROPOSED

a) Length, in m;

b) Nominal diameter, in mm;

c) Construction;

d) Minimum breaking force, in kN;

e) Round strand or flattened strand Lang's lay or ordinary lay, right hand or left hand, preformed or non-preformed;

f) Rope grade;

g) If the wire is to be galvanized, state type; and

h) Material of main core, fibre or wire.

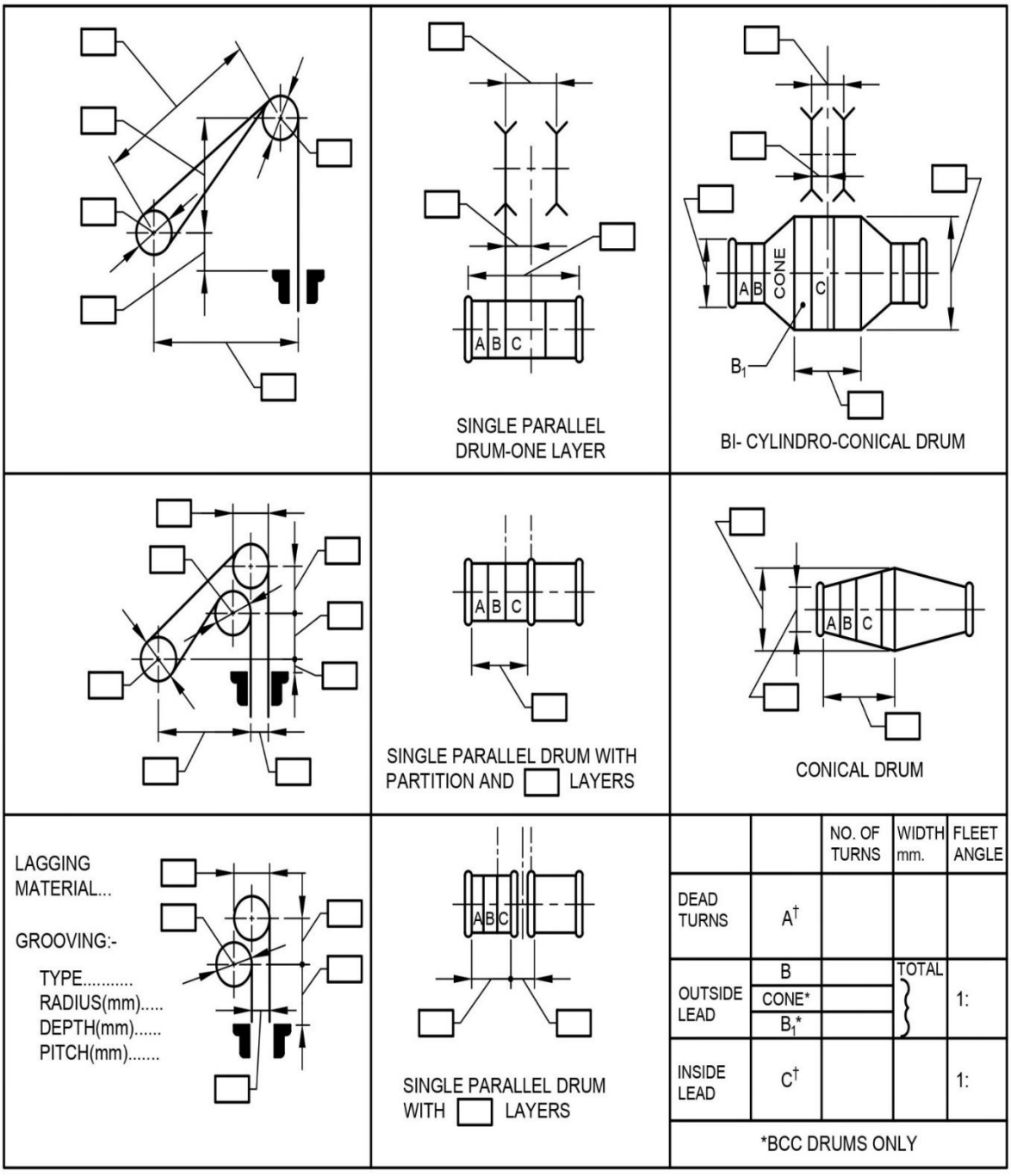
## A-10 PARTICULARS OF INSPECTION AND TESTING REQUIRED

## A-11 WHETHER TO BE DELIVERED ON REEL HAVING LIMITING DIMENSIONS

enquiry or order form for winding rope round strand or flattened strand only

| *Mine* | *Engine* |
|---|---|
| **1 Shaft Data** | a) Up cast or downcast<br>b) Wet or dry<br>c) Approximate working temperature range (°C)<br>d) Approximate analysis of shaft water if<br><br>$\text{injurious} = \frac{\text{pH value}}{\text{Chloride (as } Cl_2\text{) parts per million}}$ |
| a) *Depth* — lowest working level to bank (m)<br>b) Type of cage guides<br>c) Any special circumstances in shaft (for example, exhaust steam) | |
| **2 Rope Loading** | |
| a) Maximum working load, excluding rope, but including cage, balance rope, etc (kg) | |
| **3 Data of Rope Required or Proposed** | a) Maximum winding speed (m/s)<br>b) Maximum acceleration or retardation under full load conditions ($m/s^2$) |
| a) Length (m)<br>b) Diameter (mm)<br>c) Lay (Lang's or ordinary, right hand or left hand)<br>d) Whether preformed<br>e) Construction<br>f) Rope grade<br>g) Minimum breaking force (kN)<br>h) Whether galvanized and type required<br>j) Material and construction of main core<br>k) To be delivered on reel having limiting dimensions, if any<br>m) Details of special tests and inspection | |

**4 Drum and head gear, type of drum or driving sheave**




NOTE — All diameters are to bottom of rope groove.

† If the rope coil is from right to left, *A* and *C* are reversed.

## ANNEX B

(*Foreword*)

## COMMITTEE COMPOSITION

Wire Ropes and Wire Products Sectional Committee, MED 10

| *Organization* | *Representative(s)* |
|---|---|
| Directorate General of Mines Safety, Dhanbad | SHRI D. B. NAIK **(*Chairperson*)**<br>SHRI VIJAY BARAPATRE (*Alternate*) |
| Bharat Heavy Electrical Limited, New Delhi | SHRI BHASKARJIT BARUA<br>SHRI RAMAN BHARIHOKE (*Alternate*) |
| Bharat Wire Ropes Limited, Mumbai | SHRI MAHENDER SINGH ARORA<br>SHRI MAYANK MITTAL (*Alternate*) |
| Central Institute of Mining and Fuel Research, Dhanbad | DR MANOJ KUMAR SINGH,<br>DR DEBASISH BSSAK (*Alternate*) |
| Directorate General Factory Advice Service and Labour Institutes, Mumbai | SHRI SAMIR PANDEY<br>SHRI N. VARADHARAJAN (*Alternate*) |
| Maccaferri Environment Solutions Pvt. Limited, Navi Mumbai | SHRIMATI MINIMOL KORULLA<br>SHRI RUDRA BUDDHABHATTI (*Alternate*) |
| Ministry of Ports, Shipping and Waterways, New Delhi | SHRI ANIL PRUTHI<br>SHRI RAMJI SINGH (*Alternate*) |
| Nanda and Miller Co, Kolkata | SHRI J. P. GOENKA |
| National Test House, Kolkata | SHRI SURESH PARWAL<br>SHRI ANGAD VERMA (*Alternate*) |
| Oil and Natural Gas Corporation Limited, New Delhi | SHRI RITUJIT HAZARIKA<br>SHRI RAKESH KUMAR SRIVASTAVA (*Alternate*) |
| Orient Wire Ropes, Indore | SHRI RUSHIKESH AKARTE |
| Otis Elevator Company (India) Limited, Bengaluru | SHRI SHRIHARI VISPUTE |
| Schindler India Private Limited, Mumbai | SHRI NITIN VITHAL KADAM<br>SHRI KETAN KSHIRSAGAR (*Alternate*) |
| TK Elevator India Private Limited, Navi Mumbai | SHRI VISHNU PARASHAR<br>SHRI DEEPAK BALANI (*Alternate*) |
| Usha Martin Industries Limited, Ranchi | SHRI SUBRATA DUTTA<br>SHRI SANDEEP JAISWAL (*Alternate*) |
| Vedanta Limited, Mumbai | SHRI RAKESH SINGHIV |
| BIS Directorate General | SHRI K. V. RAO, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (MECHANICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)] |

*Member Secretary*
SHRI SANDEEP KESHAV
SCIENTIST 'C'/ DEPUTY DIRECTOR
(MECHANICAL ENGINEERING), BIS

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