# MATERIAL STANDARD

# FOR

# STEEL WIRE ROPES

# FOR

# GENERAL SERVICES

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PAGE No.



## APPENDICES:

## 0. INTRODUCTION

This Standard covers the minimum requirement for wire ropes for general lifting applications. Wire ropes for other applications such as elevators, cranes and etc. shall be in accordance to the appropriate standard as indicated in the following Table:

| APPLICATION | STANDARD NUMBER |
|---|---|
| Mobile cranes | IPS-M-GM-340 |
| Overhead and gantry cranes | IPS-M-GM-350 |
| Elevators | IPS-M-GM-370 |
| Drilling and oil field service | API-SPEC-9A |

## 1. SCOPE

**1.1** This IPS Standard specifies the minimum requirements for most commonly used wire ropes for general purposes. They are grouped by the number of strands and the number of outer wires in the strands.

In the absence of a precise indication by the purchaser, the choice of construction within a group is left to the discretion of the supplier.

The following types of wire ropes are not covered by this Standard:

- ropes for cranes;
- ropes for aircraft controls;
- ropes for drilling equipment;
- ropes for aerial ropeways;
- ropes for lifts and elevators;
- ropes for prestressed concrete;

**1.2** Compliance by the rope vendor with the requirements of this Standard specification does not relieve him of the responsibility of furnishing ropes of proper design mechanically suited to meet operating guarantees.

## 2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor.

**IPS (IRANIAN PETROLEUM STANDARDS)**

M-GM-340 "Mobile Cranes"
M-GM-350 "Overhead and Gantry Cranes"
M-GM-370 "Elevators"

**API (AMERICAN PETROLEUM INSTITUTE)**

Spec. 9A "Wire Rope"

## 3. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry, purchaser this Standard the following priority of documents shall apply;

- First priority: Purchase order and variations there to
- Second priority: This Standard specification

## 4. UNITS

This Standard is based on International System of Units (SI), except where otherwise is specified.

## 5. DEFINITIONS AND TERMINOLOGY

### 5.1 Wire

The individual single filament

### 5.2 Stranding

Spinning wires together to form a strand.

### 5.3 Strand

An assembly of wires which are of appropriate shape and dimensions, spun helically in one or more layers around a core.

### 5.4 Core

The central member of a strand or rope.

### 5.5 Rope

An assembly of strands spun helically in one or more layers around a core.

### 5.6 Round Strand Rope

A stranded rope in which the strands are made of wires disposed in such a manner that the perpendicular cross section of the strand is approximately circular in shape.

### 5.7 Multi Strand Rope (or Non-Rotating Rope)

A stranded rope in which two or more layers of strand are spun helically around the main core. The layers of strands are so disposed that, when under tension, the rope will have the minimum obtainable torque or rotational tendency.

### 5.8 Class

The nominal grouping of basically similar wire ropes having approximate the same number of wires in the strand and the same number of strands per rope.

### 5.9 Layer

A group of strands in a rope or a group of wires in a strand spun concentrically around the core.

### 5.10 Core of Strands

The core of a strand may be of fibre, a single wire (king wire) or a number of wires.

### 5.11 King Wire

A single wire forming the core of a strand.

### 5.12 Main Core of Rope

The core of the rope around which the strands are spun.

### 5.13 Independent Wire Rope Core (I.W.R.C)

A main core which is itself an independent wire rope.

### 5.14 Covering Wires

All the main wires which are spun around the core of the strand.

### 5.15 Tensile Grade of Wire

The minimum value of tensile strength use to designate the tensile strength range.

### 5.16 Galvanised Wire

Wire which has been zinc coated by one of the permissible processes. The quality of the galvanized coating is defined by its weight, evenness and adherence. Different classes are designated conventionally by a letter E.G. Class A.

### 5.17 R.H. (Right Hand) or L.H. (Left Hand) Lay Rope

The designation of the direction in which the strands are spun in the rope.

### 5.18 Ordinary or Regular Lay Rope

Ropes in which the direction of lay of the outer layer of wires in the strands, is opposite to the direction of lay of the strands in the rope.

### 5.19 Lang's Lay Rope

Ropes in which the direction of lay of the outer layer of wires in the strand is the same as the direction of lay of the strands in the rope.

### 5.20 Lay Length

The distance in a strand or rope, measured parallel to the longitudinal axis, in which the wire in the strand or the strand in the rope makes one complete turn (or helix) about the axis of the strand or rope.

### 5.21 Nominal Diameter

The value by which the diameter of the wire or rope is designated.

### 5.22 Minimum Breaking Force

The breaking force below which a sample of the rope will not fracture when tested to destruction in the prescribed manner. The value is calculated from the product of the square of the square of the nominal diameter of the rope, the tensile grade of the wire and a coefficient appropriate to the construction of the rope.

## 6. CLASSIFICATION OF WIRE ROPES

**6.1** Wire ropes are classified as shown in Table 1.

**TABLE 1**

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Group | Class | Description | Diameter Range mm |
| 1 | 6 × 7 | Up to 7 outer wires in a strand, one layer of wire over a king wire | 2 to 9 |
| 2 | 6 × 19 | 8 to 12 outer wires in a strand, two or three layers over a king wire. Wires equal laid | 8 to 52 |
| 3 | 6 × 37 | 14 to 18 outer wires in a strand, three or more layers of wire over a king wire. Wires equal laid | 9 to 60 |
| 4 | 8 × 19 | 8 to 12 outer wires in a strand, two or three layers over a king wire. Wires equal laid | 22 to 60 |
| 5 | 8 × 37 | 14 to 18 outer wires in a strand, three or more layers over a king wire. Wires equal laid | 22 to 60 |
| 6 | 17 × 7 | 17 or 18 strands in rope. Two layers of strand over fibre or steel core | 8 to 26 |
| 7 | 34 × 7 | 34 or 36 strands in rope. Three layers of strand over fibre or steel core | 16 to 40 |
| 8 | 6 × 24 | 12 to 15 outer wires in a strand. Two layers of wire over fibre strand core | 8 to 40 |

**6.2** Ropes in Groups 1, 2, 3, 4, 5, 8 can be manufactured in right and left hand, ordinary, or langs lay.

The lays of multistrand ropes (Groups 6 and 7) shall be at the discretion of the manufacturer.

## 7. MATERIALS

### 7.1 Wire Ropes

**7.1.1** Wire used in the manufacture of wire rope shall be made from (1) acid or basic open-hearth steel, (2) basic oxygen steel or (3) electric furnace steel.

The tensile grades and surface finish of wires, excluding filler and king wires shall be :

- 1770 N/mm$^2$*, bright or B-galvanized for all groups except group 8,
- 1570 N/mm$^2$, A-galvanized for group 8

*** 1N/mm$^2$ = 1MPa**

**7.1.2** For galvanized wire, galvanizing may, at the request of the purchaser, be

- Of quality B, for all wire diameters from 0.20 mm inclusive up to 3.7 mm exclusive.
- Of quality AB, for all wire diameters from 0.40 mm inclusive up to 1.9 mm exclusive.
- Of quality A, for all wire diameters from 0.40 mm inclusive up to 3.7 mm exclusive.

These quality grades correspond to the different minimum requirements indicated in Table 2.

**TABLE 2**

| DIAMETER OF GALVANIZED WIRE, mm | | MINIMUM MASS OF ZINC g/m$^2$ | | |
|---|---|---|---|---|
| From (Incl.) | To (Exct.) | Quality B Galvanizing | Quality AB Galvanizing | Quality A Galvanizing |
| 0,20 | 0,25 | 20 | — | — |
| 0,25 | 0,40 | 30 | — | — |
| 0,40 | 0,50 | 40 | 60 | 75 |
| 0,50 | 0,60 | 50 | 70 | 90 |
| 0,60 | 0,70 | 60 | 85 | 110 |
| 0,70 | 0,80 | 60 | 85 | 110 |
| 0,80 | 1,00 | 70 | 95 | 130 |
| 1,00 | 1,20 | 80 | 110 | 150 |
| 1,20 | 1,30 | 90 | 120 | 165 |
| 1,30 | 1,50 | 90 | 120 | 165 |
| 1,50 | 1,60 | 100 | 130 | 180 |
| 1,60 | 1,80 | 100 | 130 | 180 |
| 1,80 | 1,90 | 100 | 130 | 180 |
| 1,90 | 2,00 | 110 | — | 205 |
| 2,00 | 2,30 | 110 | — | 205 |
| 2,30 | 2,40 | 110 | — | 205 |
| 2,40 | 2,50 | 110 | — | 205 |
| 2,50 | 3,00 | 125 | — | 230 |
| 3,00 | 3,20 | 125 | — | 230 |
| 3,20 | 3,50 | 135 | — | 250 |
| 3,50 | 3,70 | 135 | — | 250 |

## 7.2 Cores

### 7.2.1 Fiber cores

For all wire ropes, all fiber cores shall be hard-twisted, best quality, natural fiber, polypropylene, or equivalent. For wire ropes of uniform diameter, the cores shall be of uniform diameter and hardness, effectively supporting the strands. Manila and sisal cores shall be thoroughly impregnated with a suitable lubricating compound free from acid.

### 7.2.2 Steel main cores

The steel core shall normally be an independent wire rope (IWR), complying Clause 7.1.1.

## 8. ROPE CHARACTERISTICS

## 8.1 Strand

**8.1.1** The strand shall be uniformly made and be free from slack wires.

**8.1.2** In equal lay construction, all wires of the strand should be stranded in one operation . When the king wire of the strand becomes so large that it is considered undesirable, it is permissible (at the manufacturer's discretion) to replace it with a multi-wire strand manufactured in a separate stranding operation.

**8.1.3** King wires and fiber cores of strand shall be of a size to provide sufficient support to enable the covering wires to be evenly laid.

## 8.2 Rope

**8.2.1** The rope shall be uniformly made and the strands shall lie tightly on the core or the underlying strands. When uncoiled and under no load the rope shall not be wavy.

**8.2.2** All strands in a given layer shall be of the same construction and lay. The length of lay of the strands in a rope shall not vary significantly.

**8.2.3** The core shall be of a size to provide sufficient support to enable the covering strands to be evenly laid.

**8.2.4** In galvanized ropes, all the wires shall be galvanized, including those of the steel core, where applicable.

**8.2.5** Wires over 0,4 mm diameter shall be joined by brazing or welding. Wires up to and including 0,4 mm diameter may be joined by brazing, welding or twisting.

**8.2.6** The free ends of all wire ropes shall be secured against untwisting if necessary.

## 8.3 Lubrication

All wire rope, shall be lubricated and impregnated in the manufacturing process with a suitable compound. This lubricant should thoroughly protect the ropes both internally and externally to minimize rust or corrosion until the rope is put in service.

## 8.4 Rope Diameter

### 8.4.1 Nominal diameter, d

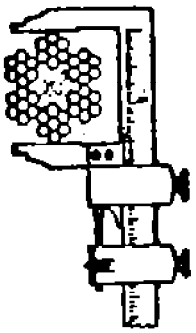
The nominal rope diameter, expressed in millimeters, shall be that by which the rope is designated.

### 8.4.2 Measured (actual) diameter

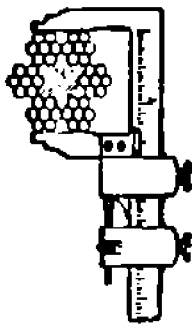
The measured (actual) rope diameter shall be that obtained by measuring the rope by the method shown in Figure 1.

### 8.4.3 Tolerance

The actual rope diameter shall be within the tolerance of the nominal diameter specified in Table 3.



*Correct way to measure the diameter of wire rope.*



*Incorrect way to measure the diameter of wire rope.*

**MEASUREMENT OF DIAMETER**
**Fig. 1**

**TABLE 3**

| NOMINAL DIAMETER d mm | TOLERANCE OF THE NOMINAL DIAMETER, % | |
|---|---|---|
| | Ropes with strands exclusively of wire | Ropes with fiber strand cores |
| 2 and 3 | +7<br>-1 | — |
| 4 and 5 | +6<br>-1 | -8<br>-1 |
| 6 and 7 | +5<br>-1 | +7<br>-1 |
| 8 and more | +4<br>-1 | +6 |

**Note:**

**For ropes with diameters from 2 to 5 mm the permitted tolerance shall be rounded up to the nearest 0,05 mm.**

## 8.5 Length

The length of rope supplied, expressed in meters, shall be that given on the order subject to the following tolerances:

$$\text{-} \leq 400 \text{ m} : {}^{+5}_{-0} \%$$

$$\text{-} > 400 \text{ m} : {}^{+20}_{-0} \text{ m for each 1000 m or part thereof}$$

The rope length shall be measured under no load. Ropes required with smaller tolerance, for example ropes fitted with a terminal at each end, shall be the subject of special agreement between the purchaser and the manufacturer.

## 8.6 Mass, M

The approximate rope mass, expressed in kilograms per 100 m, is calculated as follows:

$$M = kd^2$$

**where:**

**K** is the empirical factor for the mass per unit length for a given rope construction in kilograms per 100 meter square millimeters [kg/(100 m. mm$^2$)].

The values for K shown in Table 4 are for fully lubricated ropes. Ropes which are not fully lubricated may be lighter.

**In Table 4:**

$K_{1n}$ is the mass factor for natural fiber cored ropes;
$K_{1p}$ is the mass factor polypropylene fiber cored ropes;
$K_2$ is the mass factor for steel cored ropes.

**In Tables 5 to 10:**

$M_{1n}$ is the approximate mass for natural fiber cored ropes;
$M_2$ is the approximate mass for steel cored ropes.

## 8.7 Minimum Breaking Force, $F_o$

The minimum breaking force, expressed in kilo-newtons, is the force which shall be reached at least in the tensile test to destruction carried out in accordance with section 7.

It is calculated as follows:

$$F_o = \frac{K' d^2 R_o}{1000}$$

**where:**

$F_o$ is the minimum breaking force, in kilo-newtons;
$d$ is the nominal diameter of the rope, in millimeters;
$R_o$ is the tensile grade of wire, in newtons per square millimeter;
$K'$ is the empirical factor for the minimum breaking force for a given construction.

The values of K' are given in Table 4.

**In Table 4:**

$K'_1$ is the empirical factor for fiber cored ropes;
$K'_2$ is the empirical factor for steel cored ropes.

**In Tables 5 to 8:**

$F_{o1}$ is the minimum breaking force for fiber cored ropes;
$F_{o2}$ is the minimum breaking force for steel cored ropes.

The breaking force values for ropes with steel cores shown in the tables are calculated on the assumption that the steel core has a tensile strength similar to that of the wires of the other strands.

**Note:**

**In cases where the tensile grade of wires in steel cores is different from that of the wires in the other strands, the minimum breaking force of the rope will need to be agreed between the manufacturer and the purchaser.**

## TABLE 4 - NUMERICAL VALUES OF FACTORS K AND K' AND MINIMUM BREAKING FORCE FACTOR

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| Group | Class | ROPE MASS FACTOR | | | $\frac{K_2}{K_{1n}}$ | $\frac{K_2}{K_{1p}}$ | MINIMUM BREAKING FORCE FACTOR ROPES WITH | | $\frac{K'_2}{K'_1}$ |
| | | Natural Fibre Core | Ropes with man-made fibre core | Steel Core | | | Fiber Core | Steel Core | |
| | | $K_{1n}$ | $K_{1p}$** | $K_2$ | | | $K'_1$ | $K'_2$ | |
| | | kg/(100 m.mm²) | | | | | | | |
| 1 | 6 × 7 | 0.346 | 0.340 | 0.381 | 1.10 | 1.12 | 0.332 | 0.359 | 1.08 |
| 2<br>3* | 6 × 19 and 6 × 37 | 0.361 | 0.352 | 0.398 | 1.10 | 1.13 | 0.330 | 0.356 | 1.08 |
| 4<br>5 | 8 × 19 and 8 × 37 | 0.347 | 0.339 | 0.417 | 1.20 | 1.23 | 0.293 | 0.346 | 1.18 |
| 6 | 17 × 7 | 0.390 | | | - | - | 0.328 | | - |
| 7 | 34 × 7 | 0.390 | | | - | - | 0.318 | | - |
| 8 | 6 × 24 | 0.308 | 0.295 | | - | - | 0.280 | -- | - |

*** When ropes with strands of 19 wires or fewer are supplied in these groups, mass factors 3% lower than those given in the tables shall be used.**

**** These factors are for polypropylene cored ropes.**

TABLE 5 - PHYSICAL PROPERTIES OF ROPES-GROUP 1

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| ROPE NOMINAL DIAMETER | | APPROXIMATE MASS OF ROPES | | MINIMUM BREAKING FORCE OF ROPES CORRESPONDING TO NOMINAL TENSILE GRADE Ro OF 1770 N/mm² | |
| d | | Ropes with | | Ropes with | |
| | Tol. | Natural fibre core $M_{1n}$ | Steel core $M_2$ | Fibre core $F_{o1}$ | Steel core $F_{o2}$ |
| mm | % | kg/100m | kg/100m | kN | kN |
| 2 | +7 | 1,38 | 1,52 | 2,35 | 2,54 |
| 3 | -1 | 3,11 | 3,43 | 5,29 | 5,72 |
| 4 | +6 | 5,54 | 6,10 | 9,40 | 10,17 |
| 5 | -1 | 8,65 | 9,53 | 14,69 | 15,89 |
| 6 | +5 | 12,46 | 13,72 | 21,16 | 22,88 |
| 7 | -1 | 16,95 | 18,67 | 28,79 | 31,14 |
| 8 | -4 | 22,14 | 24,38 | 37,61 | 40,67 |
| 9 | -1 | 28,03 | 30,86 | 47,60 | 51,47 |

TABLE 6 - PHYSICAL PROPERTIES OF ROPES-GROUP 2 AND 3

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| ROPE NOMINAL DIAMETER | | APPROXIMATE MASS OF ROPES | | MINIMUM BREAKING FORCE OF ROPES CORRESPONDING TO NOMINAL TENSILE GRADE Ro OF 1770 N/mm² | |
| d | | Ropes with | | Ropes with | |
| | Tol. | Natural fibre core $M_{1n}$ | Steel core $M_2$ | Fibre core $F_{o1}$ | Steel core $F_{o2}$ |
| mm | % | kg/100m | kg/100m | kN | kN |
| 8* | | 23,1 | 25,5 | 37,4 | 40,3 |
| 9 | | 29,2 | 32,2 | 47,3 | 51,0 |
| 10 | | 36,1 | 39,8 | 58,4 | 63,0 |
| 11 | | 43,7 | 48,2 | 70,7 | 76,2 |
| 12 | | 52,0 | 57,3 | 84,1 | 90,7 |
| 13 | | 61,0 | 67,3 | 98,7 | 106,5 |
| 14 | | 70,8 | 78,0 | 114,5 | 123,5 |
| 16 | | 92,4 | 101,9 | 149,5 | 161,3 |
| 18 | | 117,0 | 129,0 | 189,2 | 204,2 |
| 20 | | 144,4 | 159,2 | 233,6 | 252,0 |
| 22 | +4 | 174,7 | 192,6 | 282,7 | 305,0 |
| 24 | -1 | 207,9 | 299,2 | 336,4 | 362,9 |
| 26 | | 244,0 | 269,0 | 394,9 | 426,0 |
| 28 | | 283,0 | 312,0 | 457,9 | 494,0 |
| 32 | | 369,7 | 407,6 | 598,1 | 645,2 |
| 36 | | 467,9 | 515,8 | 757,0 | 816,6 |
| 40 | | 577,6 | 636,8 | 934,6 | 1 008,2 |
| 44 | | 698,9 | 770,5 | 1 130,8 | 1 219,2 |
| 48 | | 831,7 | 917,0 | 1 345,8 | 1 451,8 |
| 52 | | 976,1 | 1 076,2 | 1 579,4 | 1 703,8 |
| 56** | | 1 132,1 | 1 248,1 | 1 831,7 | 1 976,1 |
| 60** | | 1 299,6 | 1 432,8 | 2 102,8 | 2 268,4 |

TABLE 7 - PHYSICAL PROPERTIES OF ROPES-GROUP 4 AND 5

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| ROPE NOMINAL DIAMETER | | APPROXIMATE MASS OF ROPES | | MINIMUM BREAKING FORCE OF ROPES CORRESPONDING TO NOMINAL TENSILE GRADE Ro OF 1770 N/mm² | |
| d | | Ropes with | | Ropes with | |
| | Tol. | Natural fibre core $M_{1n}$ | Steel core $M_2$ | Fibre core $F_{o1}$ | Steel core $F_{o2}$ |
| mm | % | kg/100m | kg/100m | kN | kN |
| 22 | | 167,9 | 201,8 | 251,0 | 296,4 |
| 24 | | 199,9 | 240,2 | 298,7 | 352,8 |
| 26 | | 234,6 | 281,9 | 350,6 | 414,0 |
| 28 | | 272,0 | 326,9 | 406,6 | 480,1 |
| 32 | | 355,3 | 427,0 | 531,1 | 627,1 |
| 36 | +4 | 449,7 | 540,4 | 672,1 | 793,7 |
| 40 | -1 | 555,2 | 667,2 | 829,8 | 979,9 |
| 44 | | 671,8 | 807,3 | 1 004,0 | 1 185,6 |
| 48 | | 799,5 | 960,8 | 1 194,9 | 1 411,0 |
| 52 | | 938,3 | 1 127,6 | 1 402,3 | 1 656,0 |
| 56 | | 1 088,2 | 1 307,7 | 1 626,4 | 1 920,5 |
| 60 | | 1 249,9 | 1 501,2 | 1 867,0 | 2 204,7 |

TABLE 8 - PHYSICAL PROPERTIES OF ROPES-GROUP 6

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ROPE NOMINAL DIAMETER d | | APPROXIMATE MASS OF ROPES | MINIMUM BREAKING FORCE OF ROPES CORRESPONDING TO NOMINAL TENSILE GRADE Ro OF 1770 N/mm² |
| | Tol. | m | $F_o$ |
| mm | % | kg/100 m | kN |
| 8 | | 25.0 | 37.2 |
| 9 | | 31.6 | 47.0 |
| 10 | | 39.0 | 58.1 |
| 11 | | 47.2 | 70.2 |
| 12 | | 56.2 | 83.6 |
| 13 | | 65.9 | 98.1 |
| 14 | +4 | 76.4 | 113.8 |
| 16 | -1 | 99.8 | 148.6 |
| 18 | | 126.4 | 188.1 |
| 20 | | 156.0 | 232.2 |
| 22 | | 188.8 | 281.0 |
| 24 | | 224.6 | 334.4 |
| 26 | | 263.6 | 392.5 |

TABLE 9 - PHYSICAL PROPERTIES OF ROPES-GROUP 7

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ROPE NOMINAL DIAMETER d | | APPROXIMATE MASS OF ROPES | MINIMUM BREAKING FORCE OF ROPES CORRESPONDING TO NOMINAL TENSILE GRADE Ro OF 1770 N/mm² |
| | Tol. | m | $F_o$ |
| mm | % | kg/100 m | kN |
| 16 | | 99.8 | 144.1 |
| 18 | | 126.4 | 182.4 |
| 20 | | 156.0 | 225.1 |
| 22 | | 188.8 | 272.4 |
| 24 | +4 | 224.6 | 324.2 |
| 26 | -1 | 263.6 | 380.5 |
| 28 | | 305.8 | 441.3 |
| 32 | | 399.4 | 576.4 |
| 36 | | 505.4 | 729.5 |
| 40 | | 624.0 | 900.6 |

TABLE 10 - PHYSICAL PROPERTIES OF ROPES-GROUP 8

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ROPE NOMINAL DIAMETER d | | APPROXIMATE MASS OF ROPES | MINIMUM BREAKING FORCE OF ROPES CORRESPONDING TO NOMINAL TENSILE GRADE Ro OF 1570 N/mm² |
| | Tol. | M1n | $F_o$ |
| mm | % | kg/100 m | kN |
| 8 | | 19.7 | 28.1 |
| 9 | | 24.9 | 35.6 |
| 10 | | 30.8 | 44.0 |
| 11 | | 37.3 | 53.2 |
| 12 | | 44.4 | 63.3 |
| 13 | | 52.1 | 74.3 |
| 14 | | 60.4 | 86.2 |
| 16 | | 78.8 | 112.5 |
| 18 | +6 | 99.8 | 142.4 |
| 20 | -1 | 123.2 | 175.8 |
| 22 | | 149.1 | 212.8 |
| 24 | | 177.4 | 253.2 |
| 26 | | 208.2 | 297.2 |
| 28 | | 241.5 | 344.6 |
| 32 | | 315.4 | 450.2 |
| 36 | | 399.2 | 569.7 |
| 40 | | 492.8 | 703.4 |

# 9. INSPECTION, TESTING AND TERMS OF ACCEPTANCE

## 9.1 Determination of Actual Breaking Load

### 9.1.1 General

Following Clauses specifies the method of tensile test to destruction for determining the actual breaking load of steel wire ropes.

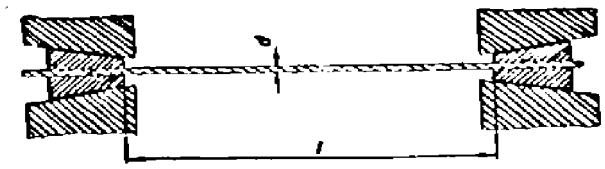
### 9.1.2 Test length

The test length (distance between the grips) shall be in accordance with Table 11 and Fig. 2.

**TABLE 11 - MINIMUM TEST LENGTH**

**Dimensions in millimeters**

| ROPE DIAMETER d | MINIMUM TEST LENGTH 1 |
|---|---|
| $d \leq 6$ | 300 |
| $6 < d \leq 20$ | 600 |
| $d > 20$ | $30 \times d$ |



**ROPE TEST LENGTH**
**Fig. 2**

### 9.1.3 Test piece

The minimum length of the test piece is made up of the test length plus an allowance for gripping.

The test piece shall be representative of the rope as a whole and free from defects. Prior to selection, the ends of the test piece shall be secured to prevent turn being put into or taken out of the test piece. In the same way, the rope from which the test piece is taken shall be secured. When cutting the test piece from the rope, neither the test piece nor the rope shall be damaged.

During testing, the test piece shall be gripped in such a way that all wires in the rope take part in the acceptance of the load. It may be useful to provide the test piece with conical sockets. If such sockets are used, care has to be taken that the casting material penetrates well to ensure intimate cohesion with the untwisted wires.

### 9.1.4 Testing

**9.1.4.1** Not more than 80% of the minimum breaking load given in Clause 8.7 may be applied quickly; the remaining load shall be applied slowly, at a rate of application of stress of approximately 10 MPa per second.

**9.1.4.2** The actual breaking load is reached when no further increase of the load is possible.

**9.1.4.3** Tests in which breaking occurs inside or adjacent to the grips may be discarded at the option of the manufacturer in cases where the minimum breaking load is not reached.

### 9.1.5 Test report

The test report shall include the following particulars:

**a)** the reference to the method used, that is, this IPS Standard;
**b)** the results (in terms of magnitude and unit);
**c)** any unusual features noted during the test;
**d)** any operation not included in this IPS Standard.

## 9.2 Torsion Test

Depending on its diameter and tensile strength, the wire shall be capable of withstanding before fracture the minimum number of turns indicated in Table 12.

The test relates only to wire having a diameter of 0,5 mm and over. The length 100 d of the test piece between grips is preferable. When this length is impracticable the alternative length is at the discretion of the wire manufacturer and then the minimum of twists which the wire shall withstand shall be in direct ratio to the number specified in Table 12 for a test length of 100 $d_1$.

**TABLE 12 - MINIMUM NUMBER OF TURNS**

| DIAMETER mm | | BRIGHT AND GALVANIZED WIRE QUALITY B | | GALVANIZED WIRE QUALITY AB | | GALVANIZED WIRE QUALITY A |
|---|---|---|---|---|---|---|
| From (incl.) | To (excl.) | Nominal strength | | Nominal strength | | Nominal strength |
| | | 1570 N/mm² | 1770 N/mm² | 1570/N/mm² | 1770 N/mm² | 1570 N/mm² |
| 0,20<br>0,25<br>0,40 | 0,25<br>0,40<br>0,50 | | | | | |
| 0,50<br>0,60<br>0,70<br>0,80 | 0,60<br>0,70<br>0,80<br>1,00 | 30 | 28 | 28 | 26 | 19 |
| 1,00<br>1,20 | 1,20<br>1,30 | 29 | 26 | 26 | 23 | 18 |
| 1,30<br>1,50<br>1,60 | 1,50<br>1,60<br>1,80 | 28 | 25 | 25 | 22 | 17 |
| 1,80<br>1,90<br>2,00 | 1,90<br>2,00<br>2,30 | 26 | 24 | 24 | 21 | 17 |
| 2,30<br>2,40<br>2,50 | 2,40<br>2,50<br>3,00 | 24 | 22 | | | 14 |
| 3,00<br>3,20 | 3,20<br>3,50 | 22 | 20 | | | 12 |
| 3,50 | 3,70 | 20 | 18 | | 12 | 10 |

## 9.3 Reverse Bend Test

Depending on its diameter and nominal tensile strength, the wire shall be capable of withstanding the minimum number of reverse bends indicated in Table 13 without fracture. The bending rail for different wire diameters are also given in Table 13.

The test relates only to wire having a diameter of 0,5 mm and over.

**TABLE 13 - MINIMUM NUMBER OF REVERSE BENDS**

| DIAMETER mm | RADIUS OF CURVATURE OF THE SUPPORTS mm | BRIGHT WIRE AND GALVANIZED WIRE QUALITY B | | GALVANIZED WIRE QUALITY AB | | GALVANIZED WIRE QUALITY A |
|---|---|---|---|---|---|---|
| | | Nominal strength | | Nominal strength | | Nominal strength |
| | | 1570 N/mm² | 1770 N/mm² | 1570 N/mm² | 1770N/mm² | 1570 N/mm² |
| 0,50 | 1,25 | 7 | 6 | 6 | 5 | 5 |
| 0,55 | 1,75 | 13 | 12 | 12 | 11 | 10 |
| 0,60 | | 11 | 10 | 10 | 9 | 8 |
| 0,65 | | 9 | 8 | 8 | 7 | 7 |
| 0,70 | | 8 | 7 | 7 | 6 | 6 |
| 0,75 | 2,5 | 15 | 14 | 14 | 13 | 12 |
| 0,80 | | 14 | 13 | 13 | 12 | 11 |
| 0,85 | | 13 | 12 | 12 | 11 | 10 |
| 0,90 | | 12 | 11 | 11 | 10 | 9 |
| 0,95 | | 11 | 10 | 10 | 9 | 8 |
| 1,00 | | 10 | 9 | 9 | 8 | 8 |
| 1,10 | 3,75 | 17 | 16 | 16 | 15 | 14 |
| 1,20 | | 15 | 14 | 14 | 13 | 12 |
| 1,30 | | 13 | 12 | 12 | 11 | 10 |
| 1,40 | | 11 | 10 | 10 | 9 | 8 |
| 1,50 | | 10 | 9 | 9 | 8 | 7 |
| 1,60 | 5 | 13 | 12 | 12 | 11 | 10 |
| 1,70 | | 12 | 11 | 11 | 10 | 9 |
| 1,80 | | 11 | 10 | 10 | 9 | 8 |
| 1,90 | | 10 | 9 | 9 | 8 | 7 |
| 2,00 | | 9 | 8 | | | 7 |
| 2,10 | 7,5 | 13 | 12 | | | 10 |
| 2,20 | | 12 | 11 | | | 9 |
| 2,30 | | 11 | 10 | | | 8 |
| 2,40 | | 10 | 9 | | | 7 |
| 2,50 | | 9 | 8 | | | 7 |
| 2,60 | | 9 | 8 | | | 6 |
| 2,70 | | 8 | 7 | | | 6 |
| 2,80 | | 8 | 7 | | | 5 |
| 2,90 | | 7 | 6 | | | 4 |
| 3,00 | | 6 | 5 | | | 3 |
| 3,10 | 10 | 9 | 8 | | | 6 |
| 3,20 | | 8 | 7 | | | 6 |
| 3,30 | | 8 | 7 | | | 5 |
| 3,40 | | 7 | 6 | | | 5 |
| 3,50 | | 7 | 6 | | | 5 |
| 3,60 | | 7 | 6 | | | 5 |
| 3,70 | | 7 | 6 | | | 5 |

**Note:**

**If the diameter of the wire is between two consecutive diameters of the table, the number of bends corresponding to the next larger diameter shall be taken.**

## 9.4 Inspection

### 9.4.1 General

The manufacturer shall give the purchaser or his representative all reasonable facilities to carry out the tests in order to ensure that rope and its components are in accordance with this IPS Standard.

### 9.4.2 Inspection of zinc coating

The coating of the wire shall comply with the requirements indicated in Table 2, relating to the minimum mass of zinc deposited per unit of surface area, the continuity and uniformity of the deposit.

## 9.5 Acceptance Level

### 9.5.1 Diameter and tolerances

The nominal diameter of the rope shall be one of those specified in Tables 5 through 10 and the actual diameter of the rope shall be within the tolerances specified in Table 3.

### 9.5.2 Ovality

The maximum variation between any of the four measurements shall not exceed the values given in Table 14.

**TABLE 14 - PERMISSIBLE OVALITY**

| ROPE NOMINAL DIAMETER d mm | PERMISSIBLE OVALITY ON NOMINAL DIAMETER % | |
|---|---|---|
| | Ropes with strands exclusively of wires | Ropes with fiber strand cores |
| 2 and 3 | 7 | — |
| 4 and 5 | 6 | 8 |
| 6 and 7 | 5 | 7 |
| 8 and over | 4 | 6 |

### 9.5.3 Breaking force

The actual breaking force of the rope shall be not less than the minimum breaking force specified in Clause 8.7.

### 9.5.4 Torsion test

At least 95% of the wires tested shall comply with the requirement of Clause 9.2.

### 9.5.5 Reverse bend test

At least 95% of the wires tested shall comply with the requirement of Clause 9.3.

#### 9.5.6 Galvanized test

At least 95% of the wires tested shall comply with the requirement of Table 2 in respect of the tests for mass of coating.

### 9.6 Certificates

Vendor shall provide the requested certificates regarding materials and testes as specified by this Standard and the Purchaser requisition.

## 10. PACKAGING

Unless specified otherwise, ropes shall be supplied in coils or on reels at the discretion of the Manufacturer.

The rope shall be protected in transit against moisture, dust, and dirt.

## 11. GUARANTEE AND WARRANTY

During a period of 18 months after the date of shipment the vendor shall with all possible speed and without cost to the purchaser, replace the goods found to be defective due to faulty material, workmanship or to any act or omission of the vendor. In the particular the vendor shall reimburse any transportation and other charges incured by the purchaser in effecting such replacement or repair at the point of use.

## APPENDICES

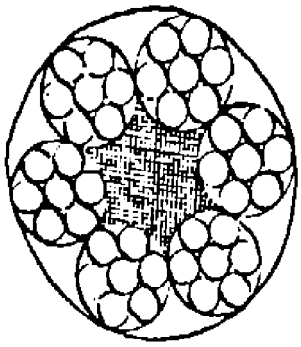
## APPENDIX A
## TYPICAL ROPE CONSTRUCTIONS

This Appendix gives typical rope constructions for the respective wire rope groups and wire rope classes laid down in Table 1.

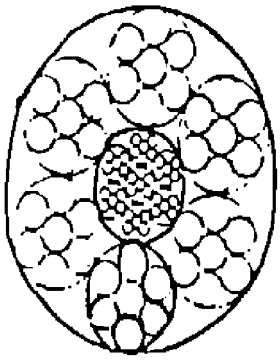
### A.1 Group 1, class 6 × 7

#### A.1.1 Wire rope 6 × 7

Construction of the strand : 6 + 1



**with fiber core (FC)**

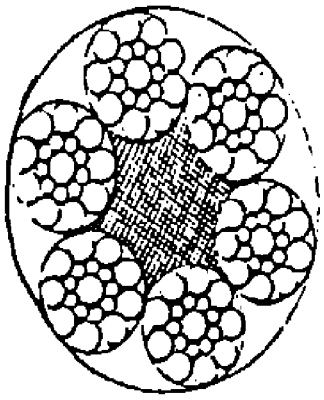


**with steel core (IWR)**

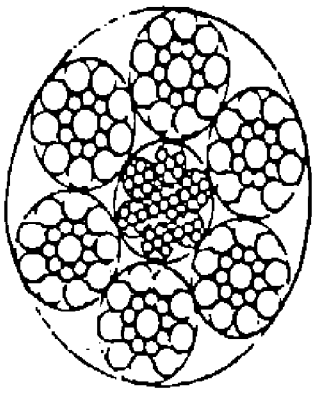
### A.2 Group 2, class 6 × 19

#### A.2.1 Wire rope 6 × 19 Seals

Construction of the strand: 9 + 9 + 1



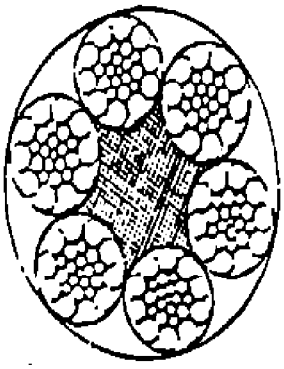
**with fiber core (FC)**



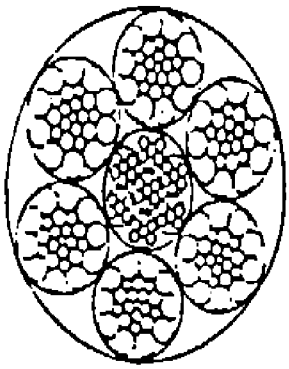
**with steel core (IWR)**

### A.2.2 Wire rope 6 × 26 Warrington-Seals

Construction of the strand: 10 + 5/5 + 5 +1



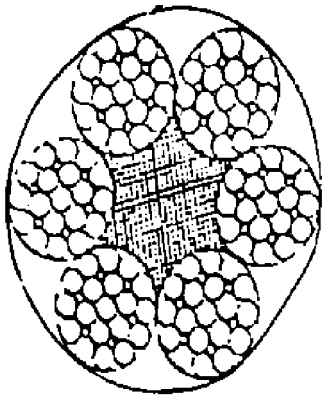
**with fiber core (FC)**



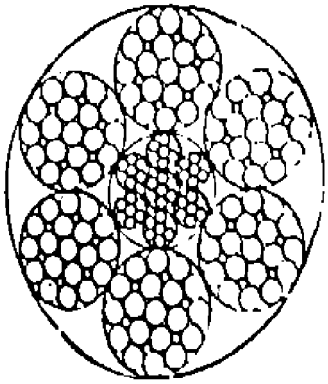
**with steel core (IWR)**

### A.2.3 Wire rope 6 × 19 Filler

Construction of the strand: 12 + 6F + 6 +1



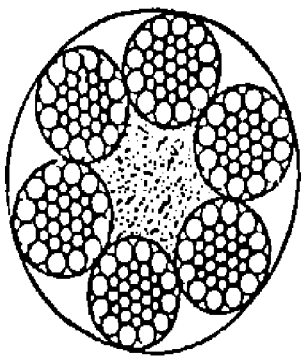
**with fiber core (FC)**



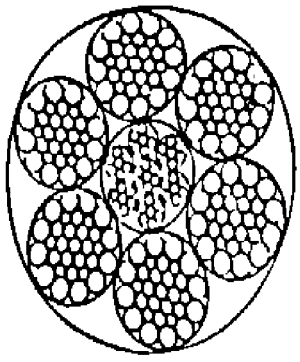
**with steel core (IWR)**

### A.2.4 Wire rope 6 × 31 Warrington-Seals

Construction of the strand: 12 + 6/6 + 6 + 1



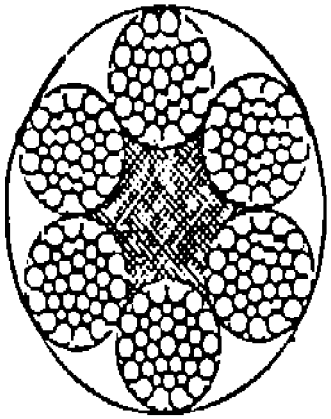
**with fiber core (FC)**



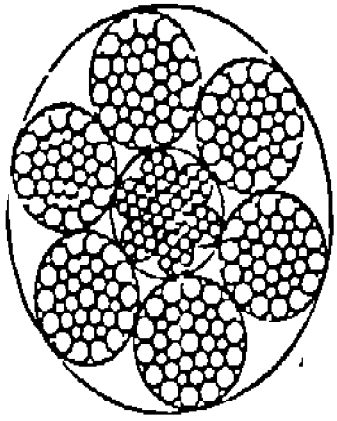
**with steel core (IWR)**

### A.3 Group 3, class 6 × 37

#### A.3.1 Wire rope 6 × 36 Warrington-Seals



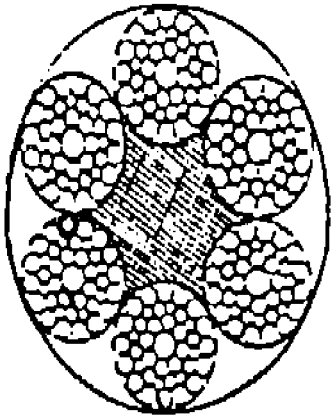
**with fiber core (FC)**



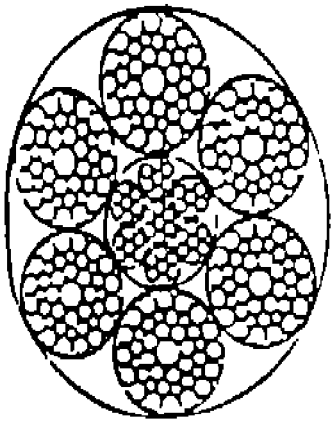
**with steel core(IWR)**

#### A.3.2 Wire rope 6 × 41 Warrington-Seals

Construction of the strand: 16 + 8/8 + 1



**with fibre core (FC)**

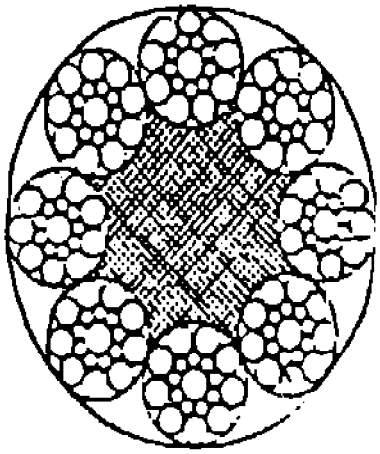


**with steel core (IWR)**

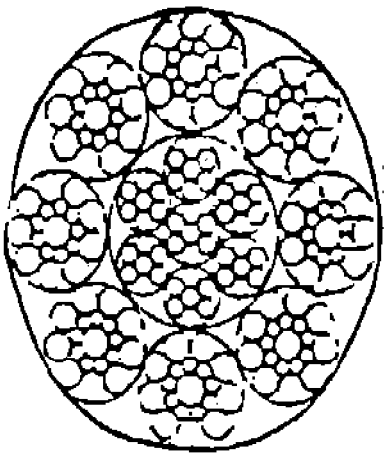
### A.4 Group 4, class 8 × 19

#### A.4.1 Wire rope 8 × 19 Seals

Construction of the strand: 9 + 9 + 1



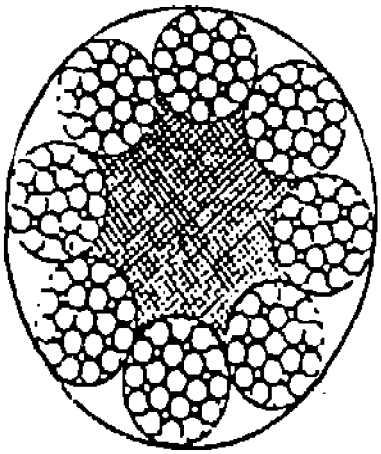
**with fiber core (FC)**



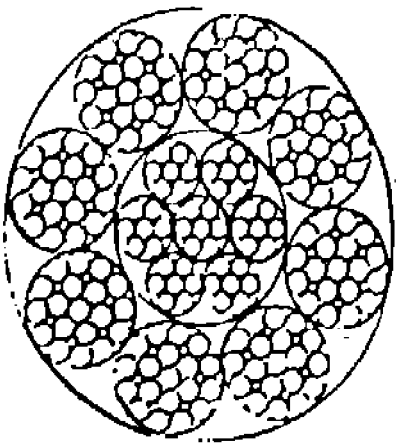
**with steel core (IWR)**

#### A.4.2 Wire rope 8 × 19 Filler

Construction of the strand : 12 + 6F + 6 +1



**with fiber core (FC)**



**with steel core (IWR)**