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Steel wire ropes — Determination of the transverse rigidity of steel wire ropes under no axial load condition

Câbles en acier — Détermination de le rigidité transversale des câbles en acier sans charge axiale

Reference number
ISO 16839:2013(E)

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Foreword

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The committee responsible for this document is ISO/TC 105, *Steel wire ropes*.

This corrected version of ISO 16839:2013 incorporates the modification of Formula (1) in 7.2.

Introduction

In a multilayer spooling, wire ropes are subjected to lateral pressure as shown in Figure 1.

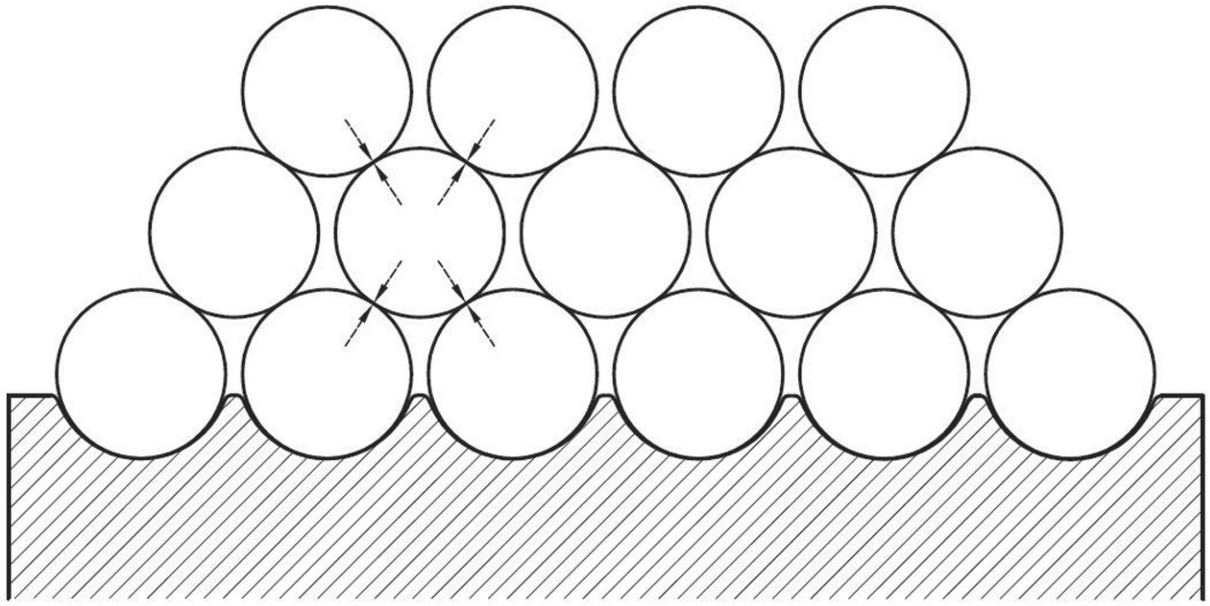

Figure 1 — Schematic presentation of the pyramidal form of layers in a multilayer spooling

The cross-section shows the pyramidal form of layers (parallel sections) with the contact points of the rope to its surrounding turns. The lateral pressure is induced to the rope at four contact points. These working and stress conditions can be simulated with the test set-up shown in this International Standard.

This International Standard is intended to provide manufacturers, suppliers and independent testing bodies with a uniform testing method for determining the resistance against lateral deformation of steel wire rope without axial load.

Lateral deformation values depend on the condition of the rope, and it is thus necessary to know the actual condition under which the deformation is to be, or has been, determined.

The three usual conditions are

— initial (as manufactured),

— partially bedded, or

— final bedded.

Steel wire ropes — Determination of the transverse rigidity of steel wire ropes under no axial load condition

1 Scope

This International Standard specifies a method for determining, by test and calculation, the resistance against lateral deformation of steel wire ropes without axial load. It provides a system of testing in order to qualify wire ropes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 463, *Geometrical Product Specifications (GPS) — Dimensional measuring equipment — Design and metrological characteristics of mechanical dial gauges*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
notional rope diameter in the direction of the lateral force
dy
notional diameter of the rope in the Y-axis as determined from the following:

$$dy = d - \Delta dy_{\mathrm{m}}$$

3.2
notional rope diameter perpendicular to the direction of the lateral force
dx
notional diameter of the rope in the X-axis as determined from the following:

$$dx = d + \Delta dx_{1\mathrm{m}} + \Delta dx_{2\mathrm{m}}$$

3.3
horizontal differential diameter value
$\Delta dx_{1\mathrm{m}}$, $\Delta dx_{2\mathrm{m}}$
reading of the dial gauges perpendicular to the direction of the lateral force

Note 1 to entry: The zero position is the initial position when starting the test on the initial actual rope diameter.

3.4
vertical differential jaw movement
Δdy_{m}
reading of the dial gauge in the direction of the lateral force

Note 1 to entry: The zero position is the initial position when starting the test on the initial actual rope diameter.

3.5
lateral force
F_Q
force applied laterally during the test

Note 1 to entry: It is expressed in kilo newton (kN).

3.6
maximum lateral force
$F_{Q,max}$
most concentrated lateral force applied during the test

Note 1 to entry: It is expressed in kilo newton (kN).

3.7
degree of deformation
V
compliance characteristics of steel wire ropes subjected to lateral load, expressed by the degree of deformation

Note 1 to entry: The degree of deformation is expressed in per cent (%).

3.8
final bedded condition
condition in which repeated readings of the dial gauges are consistent at both ends of the force range

3.9
partially bedded condition
condition where force cycles have been applied, but the dial gauge readings at both ends of the force range are not yet consistent

4 Test piece

The test piece shall be representative of the rope as a whole and be free from defects. The surfaces of the rope sections shall be thoroughly wiped clean. Its length shall be such that the free length between end servings is at least equivalent to three lay lengths. The rope shall be served with a permanent serving. The material used for the permanent serving shall be tinned or galvanized soft wire or strand for zinc/zinc alloy coated wire rope, and uncoated (bright), tinned or galvanized soft wire or strand for uncoated (bright) wire rope. The wire rope shall be cut by abrasive wheel, percussive or shearing methods, paying particular attention not to disturb the position of wires and/or strands below and between the permanent servings.

Fused and tapered ends may be used as an alternative to serving, but the sample length shall be increased to avoid any effects, e.g. shortening of the lay length associated with fused ends.

The sample beyond the jaws shall be supported to avoid any bending of the rope sample.

5 Jaws

A set of two jaws is necessary for the test method described in this particular procedure. The length of the jaws, l_{jaws}, shall be at least as long as one lay length of the rope. The width of the jaws, *b*, shall be at least equivalent to three nominal rope diameters. For the case in which the jaws are fully supported by the interface of the compression testing machine, the thickness of the jaws, *t*, shall be at least equivalent to one nominal rope diameter. Otherwise, the thickness shall be chosen in such a way that the deformation in either direction is smaller than 1 %. The depth of the V-shaped groove, *g*, with angle of aperture of

120° shall be equivalent as a minimum to 0,34 nominal rope diameter. The jaws shall be made out of hardened steel and the groove shall have a minimum hardness of 60 HRC.

NOTE An angle of 120° provides more advanced conditions than in a multilayer spooling, where the contact angle is between 116° anda 117°.

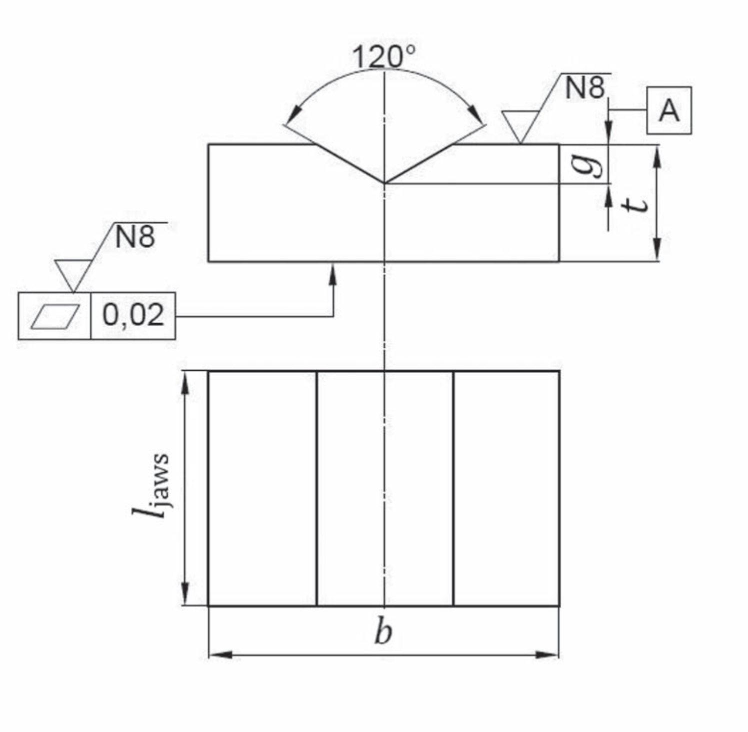

Figure 2 — Jaw dimensions

6 Test equipment

The compression testing machine shall be in accordance with ISO 7500-1 class 1.

The dial gauges shall be in accordance with ISO 463. The accuracy of the dial gauges shall be equal to or less than than 1 %.

7 Test method

7.1 General

See Figure 3.

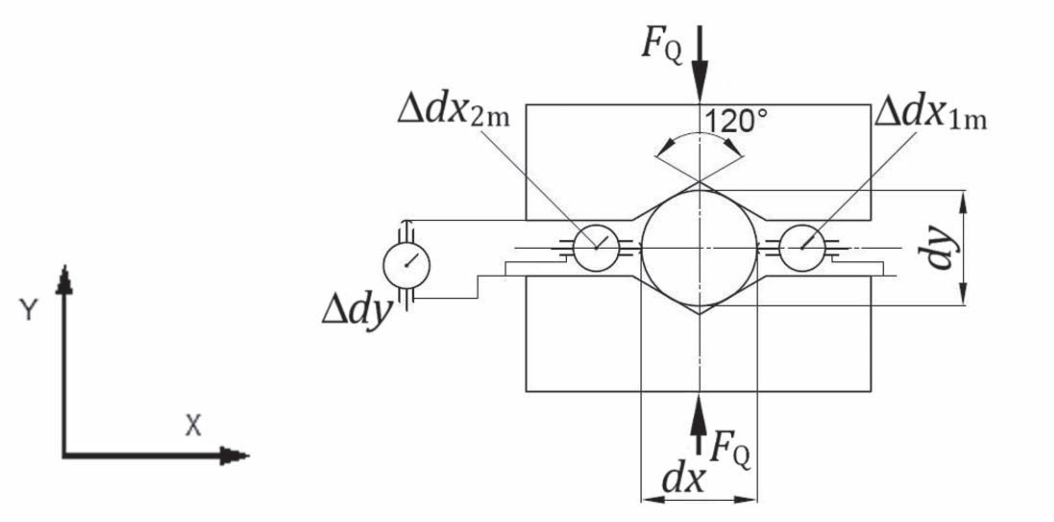

Figure 3 — Test set-up

It is important that the dial gauges be directly attached to the jaws. Any connection of the dial gauge to the other parts of the compression testing machine would include objectionable deformations at the interfaces in the test result. The attachment of the gauges shall be secure, so that the test results are not affected.

7.2 Calculation of maximum lateral force $F_{Q,max}$

Based on experience, the lateral pressure, P, on a steel wire rope in a multilayer spooling may be up to 60 N/mm^2.

The maximum lateral force, $F_{Q,max}$, applied during the test is calculated as given by Formula (1):

$$F_{Q,max} = \frac{P \times d_{nom} \times l_{jaws}}{1\,000} \tag{1}$$

where

$F_{Q,max}$ is the maximum lateral force, applied at the test, in kilo newton (kN);

P is the lateral pressure: 60 N/mm^2;

d_{nom} is the nominal diameter of the rope, in millimetres (mm);

l_{jaws} is the length of the jaws (see Figure 2), in millimetres (mm).

The loading tests on the ropes shall be carried out at room temperature. The actual rope diameter and lay length shall be taken from the unloaded rope sections. The compression jaws shall be mounted in a compression testing machine.

The test piece shall be put into the test set-up and positioned in the corresponding grooves of the compression jaws and loaded to a preload of 0,5 % of $F_{Q,max}$., where all dial gauges are set to zero. This reference setting shall be kept throughout all subsequent loading tests.

Starting at the preload, the ropes shall be loaded step-by-step to $F_{Q,max}$. It is recommended to carry out at least 10 steps. Changes in the actual rope diameter perpendicular to the direction of force at individual load steps at load, F_Q, shall be recorded with the dial gauges (Δdx_{1m}; Δdx_{2m}), which were horizontally opposed connected to the rope sections via adaptors of a width suitable to bridge the gap between adjacent strands in the centre of the compression jaws. Changes in the actual rope diameter in the direction of force shall be recorded via the displacement of the compression jaws with the dial gauge (Δdy_m). During the first force cycle, values for the initial condition of the rope shall be recorded.

Decrease the force to the preload.

Continue applying and reducing the force in a cyclical manner until the test piece is bedded, either partially or fully, as required.

If cycling is stopped before the rope reaches its bedded condition, i.e. the rope is only partially bedded, the number of cycles shall be recorded [see 9 i)].

8 Calculation of the degree of deformation

Using the test results (readings) from Clause 7, the degree of deformation, V (%), as an index of the compliance characteristics of the steel wire rope subjected to lateral load shall be calculated as given by Formula (2):

$$V = \left(\frac{dx}{dy} - 1 \right) \times 100 \qquad (2)$$

where

dy is the actual rope diameter in the direction of force at load F_Q;

dx is the actual rope diameter perpendicular to the direction of force at load F_Q (see Clause 3).

9 Test report

The test report shall contain at least the following information:

a) a reference to this International Standard, i.e. ISO 16839;

b) the test number;

c) the rope identification;

d) the resulting of the degree of deformation at $F_{Q,max}$, and a statement as to whether the value was determined in initial, partially or final bedded condition;

e) the resulting of the degree of deformation per load step;

f) the forces per load steps at which the readings were taken;

g) the readings of the dial gauges (Δdx_{1m}, Δdx_{2m}, Δdy_m) per load step;

h) the calculated actual diameters, dx and dy, per load step;

i) the number of cycles completed;

j) the jaw dimensions.

Bibliography

ISO 2768-2, *General tolerances — Part 2: Geometrical tolerances for features without individual tolerance indications*

ISO 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 17893, *Steel wire ropes — Vocabulary, designation and classification*

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