INTERNATIONAL STANDARD

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Steel wire ropes — Determination of the actual modulus of elasticity

Câbles en acier — Détermination du module effectif d'élasticité

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12076 was prepared by Technical Committee ISO/TC 105, *Steel wire ropes*.

Introduction

This International Standard is intended to provide manufacturers, suppliers and independent testing bodies with a uniform testing method for determining the modulus of steel wire rope.

Modulus values depend on the condition of the rope, and it is thus necessary to know the actual condition under which the modulus is to be, or has been, determined. The three usual conditions are

— initial (as manufactured),

— partially-bedded, or

— final bedded.

It is important, too, to recognize that steel wire ropes do not possess a normal modulus of elasticity, but an “apparent” one, which can be determined between fixed loads. This is referred to as the *rope modulus*.

Steel wire ropes — Determination of the actual modulus of elasticity

1 Scope

This International Standard specifies a method for determining, by test and calculation, the actual modulus of steel wire ropes within a specified load range.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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*

3 Terms and definitions

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

3.1
initial rope modulus
E_i
constant in the relationship between stress and strain when measured during the first (initial) loading of the rope following manufacture

3.2
partially-bedded rope modulus
$E_{p\text{-}b}$
constant in the relationship between stress and strain when measured with the rope in a partially-bedded condition

3.3
final rope modulus
E_f
constant in the relationship between stress and strain when measured with the rope in its bedded condition

3.4
bedded condition
condition at which repeated extension readings are consistent at both ends of the force range

4 Test piece

The test piece shall be representative of the rope as a whole and be free from defects.

Its length shall be such that the free length between grips or end termination is at least equivalent to 30 × nominal rope diameter.

5 Gauge length

The gauge length of the extensometer, when employed, shall be at least equivalent to 15 × nominal rope diameter for ropes up to 60 mm in diameter. For rope sizes of more than 60 mm diameter, the gauge length shall be a minimum of one lay length or a minimum of 900 mm, whichever is the greater.

6 Tensile testing machine

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

7 Test method

When an extensometer is used to measure extension, apply a force equivalent to 10 % of the minimum breaking force or nominal breaking strength of the rope, attach and zero the extensometer, then measure the gauge length (l_i).

When the modulus is to be determined with the rope in its initial condition, increase the force to a value of no greater than 30 % of the minimum breaking force, or nominal breaking strength, of the rope. Note the extensometer readings (x_1 and x_2) at forces equivalent to 10 % and 30 % ($F_{10\,\%}$ and $F_{30\,\%}$), respectively, of the minimum breaking force of the rope.

When the modulus is to be determined with the rope in a partially-bedded or fully-bedded condition increase the force to a value no greater than 50 % of the minimum breaking force of the rope.

Decrease the force to a value equivalent to 5 % of the minimum breaking force of the rope.

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, h)].

If other minimum and maximum values of force are used, the difference between them should be not greater than 20 % of the minimum breaking force of the rope.

NOTE During loading and unloading of the rope a hysteresis effect will be observed. To avoid confusion, the readings of extensions for the purpose of the calculation are taken when the load is increasing.

Then, unless other values (e.g. for lift ropes) of force are agreed between the purchaser and the manufacturer, apply a force equivalent to 10 % of the minimum breaking force, and note the force ($F_{10\,\%}$) and the extensometer reading (x_1). Increase the force until it is equivalent to 30 % of the minimum breaking force, and note the force ($F_{30\,\%}$) and the extensometer reading (x_2).

8 Calculation of modulus

The rope modulus, $E_{10–30}$, using the test results (readings) from clause 7, shall be calculated as follows:

$$E_{10-30} = l_i \frac{F_{30\%} - F_{10\%}}{A_c(x_2 - x_1)}$$

where A_c is the calculated metallic cross-sectional area, the area normally used to determine the stress, a design value obtained from the sum of the metallic cross-sectional areas of the individual wires in the rope based on their nominal diameters.

Alternatively, for forces and masses given in the tables in other International Standards appropriate to the rope application and duty, the nominal metallic cross-sectional area value, A, may be used; if so, this shall be stated in the test report.

9 Test report

The test report shall contain at least the following information:

a) test number;

b) the reference to the procedure used, i.e. this International Standard;

c) rope identification;

d) the resulting modulus value and a statement as to whether the value is E_i, $E_{p\text{-}b}$ or E_f;

e) the range of forces used during cycling;

f) the forces at which the final readings were taken, if different from 10 % and 30 %;

g) the area on which the modulus has been determined (i.e. A_c or, alternatively, A) ;

h) the number of cycles completed if the rope has been only partially bedded;

i) gauge length.

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