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**Aerospace — Preformed flexible steel wire
rope for aircraft controls —**

**Part 2:
Technical specification**

*Aéronautique et espace — Câbles en acier souples préformés pour
commandes d'aéronefs —*

Partie 2: Spécifications techniques



Reference number
ISO 2020-2:1997(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

International Standard ISO 2020-2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 12, *Mechanical system parts*.

This first edition of ISO 2020-2 together with ISO 2020-1 cancels and replaces ISO 2020:1984.

ISO 2020 consists of the following parts, under the general title *Aerospace — Preformed flexible steel wire rope for aircraft controls*:

- *Part 1: Dimensions and loads*
- *Part 2: Technical specification*

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Aerospace — Preformed flexible steel wire rope for aircraft controls —

Part 2: Technical specification

1 Scope

This part of ISO 2020, in conjunction with ISO 2020-1, specifies the inspections and tests as well as acceptance and qualification conditions for preformed flexible steel wire ropes for aircraft controls.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 2020. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 2020 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2020-1:1997, *Aerospace — Preformed flexible steel wire rope for aircraft controls — Part 1: Dimensions and loads.*

ISO 2408:1985, *Steel wire ropes for general purposes — Characteristics.*

ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*

ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing.*

3 General requirements

Manufacture and workmanship shall be in accordance with the best practice for high quality aircraft wire ropes consistent with the requirements of this part of ISO 2020. The finished cable shall be uniform in construction and securely laid, free from kinks, loose wires, loose strands or other defects. A maximum of one broken wire is permissible on a rope length of 300 mm.

Tucked joints may be in wires of diameter equal to or less than 0,2 mm. For wires of diameter greater than 0,2 mm the joints shall be made by brazing or electric welding. In the same strand, joints shall be not less than 6 m apart.

4 General inspections and tests

All wire rope shall be examined for workmanship and finish to determine compliance. For this purpose, the wire rope shall travel no faster than 30 m/min and shall be stopped for closer inspection when necessary. This inspection shall take place at the time the wire rope is wound on shipping reels. Any discard from the head or starting end of the manufacturing reel shall be removed prior to winding of the shipping reel.

The manufacturer shall make available the necessary equipment for testing a rope to the conditions of this part of ISO 2020.

Before every inspection and test the inspector shall be satisfied that the measuring instruments are correctly calibrated. Inspections and tests referred to in 5.1 to 5.10 shall be carried out on each lot produced.

5 Specific requirements, inspections and test methods

Specific requirements, inspections and test methods are given in 5.1 to 5.10.

No.	Characteristics	Requirements	Inspections and test methods	Q ¹⁾	A ¹⁾
5.1	Materials	In accordance with ISO 2020-1.	Chemical analysis or certificate of conformity of the manufacturer of the semi-finished product.	×	×
5.2	Dimensions	In accordance with ISO 2020-1.	The actual diameter of the rope shall be measured after production with a measuring device with jaws broad enough to cover not less than two adjacent strands. At each of three points spaced at least 1 m apart, two measurements shall be taken at right angles to each other. The average of these six measurements shall fall within the specified maximum and minimum diameters. Each end of each manufactured length shall be measured in this manner. These measurements shall be made on a straight portion of the rope under no tension.	×	×
5.3	Masses	In accordance with ISO 2020-1.	Using a suitable method.	×	
5.4	Lubrication	During rope manufacture a suitable lubricant shall be applied so that each wire is coated. The lubricant shall reduce internal friction and inhibit corrosion. It shall be resistant in the service temperature range and shall have good lubrication properties.	Visual examination and certificate of conformity of the grease manufacturer.	×	×
5.5	Surfaces	Flattening of wire surfaces of the rope due to manufacture are permissible as long as the requirements of ISO 2020-1 are met.	Visual examination.	×	×

No.	Characteristics	Requirements	Inspections and test methods	Q ¹⁾	A ¹⁾
5.5.1	Surface treatment of zinc coated ropes	The requirements of ISO 2020-1 shall be met.	Testing according to the Keller-Bohaczek method.	×	×
5.6	Preforming	The increase in the diameter of the wire rope after cutting shall not exceed the value indicated in table 1.	<p>It shall be possible to lead the cut end through a bore with the maximum permissible diameter.</p> <p>Other suitable measuring methods, e.g. profile projectors or measuring magnifiers, are permissible.</p> <p>To avoid distorting the cable ends, it is recommended that cutting be carried out electrically or using cutters with constricting jaws.</p>	×	×
5.7	Actual breaking load	The minimum breaking load according to ISO 2020-1 shall be met.	The actual breaking load of the wire rope shall be determined in accordance with ISO 3108.	×	×
5.8	Elongation	The requirements of ISO 2020-1 shall be met.	<p>From each wire rope of the 7 × 7 and 7 × 19 constructions a sufficient length shall be selected to provide an unobstructed minimum test length of 500 mm between the jaws of the test machine. This test length shall be progressively loaded (max. 10 mm/min) until 60 % of the minimum breaking load is reached. This load shall be maintained for 1 min. It shall then be released to 2 % of the minimum breaking load. Under this initial load a gauge length of 250 mm shall be marked or another suitable measuring device with a minimum distance of 100 mm between cutting edges shall be applied. The rope shall then be progressively loaded (max. 10 mm/min) until 60 % of its minimum breaking load is reached and its elongation determined when 5 %, 10 %, 25 %, 40 % and 60 % of the minimum breaking load are reached.</p>	×	×

No.	Characteristics	Requirements	Inspections and test methods	Q ¹⁾	A ¹⁾
5.9	Shear proof test	After testing no single wire shall be broken.	<p>Using the same test piece as for the elongation test the load shall be progressively increased until a value of 80 % of the minimum breaking load is reached and maintained for a minimum period of 5 s. This load shall then be released and the test piece completely separated into its constituent wires and each wire shall be examined.</p> <p>NOTE — The manufacturer may use, at his discretion, electronic devices which have been developed to detect the breaking of wires while the test is being carried out. However in the event of any conflict of evidence, the test method described shall be used as the reference method.</p>	×	×
5.10	Endurance test	After endurance testing and the subsequent test according to subclause 4.5 the values of the minimum breaking load shall be met.	<p>An endurance test shall be carried out for each lot of wire rope. The number of reversals and the wire rope test load shall be as indicated in table 1. The test apparatus shall conform to figure 1. The total travel of the cable in one direction shall be 343 mm. The test pulleys shall be made of steel and shall conform to the dimensions of figure 2 and table 2. The application of lubricant to the endurance test sample, in addition to the lubricant applied during the manufacture of wire rope, shall not be permitted either before or during the endurance test. After endurance testing the breaking load of the wire rope shall be rechecked in accordance with 4.7 as follows:</p> <p>a) the test length shall be that portion of the wire rope that passes over the test pulley during the endurance test;</p> <p>b) the breaking load shall, as a minimum, conform to the values specified in table 1.</p>	×	×

1) A = Acceptance test, Q = Qualification test

6 Re-test

If the requirements of an inspection or test method are not met, a re-test may be carried out taking two further test lengths from the end of the same production length. If both test lengths conform to the requirements of this part of ISO 2020, the relevant lot of wire rope shall be deemed to comply with requirements of this part of ISO 2020. A complete report of the tests shall be prepared and supplied with the dispatch documents for each test lot.

Table 1 — Breaking load after endurance test and permissible increase in diameter

Nominal diameter of wire rope mm	Construction	Wire rope test load ¹⁾ min. N	Number of reversals ²⁾	Minimum breaking load		Maximum rope diameter after performing test mm
				for carbon steel ³⁾ kN	for corrosion-resisting steel ⁴⁾ kN	
1,2	7 × 7	13,5	70 000	0,60	0,70	1,60
1,6		22		1,07	1,28	2,10
2,4		40		2,05	2,45	2,95
3,2		80		2,25		
4,0	7 × 19	107	130 000	4,45	4,7	3,85
4,8		165		6,25	6,4	4,85
5,6		225		9,30	9,9	5,75
6,4		285		12,45	13,4	6,55
7,2		350		15,60	17,0	7,40
8,0		400		17,80	20,8	8,30
9,5		535		21,80	24,0	9,15
				32,05	32,0	10,85

1) The wire rope test load is equal to one half the weight which includes idler pulley and hanger.
 2) 1 cycle = 2 reversals.
 3) Minimum breaking load equal to 50 % of the original minimum breaking load, prior to the endurance test.
 4) Minimum breaking load equal to 60 % of the original minimum breaking load, prior to the endurance test.

7 Quality assurance

7.1 Quality assurance and management system

The manufacturer shall proceed on the basis of a quality assurance and management system in accordance with ISO 9001 or ISO 9002 which has been certified by an approved authority. The certification has to be presented to the airworthiness authority of the receiving country or to the appointed representatives on their request.

7.2 Product qualification testing approval

The qualification approval test shall consist of all the tests specified in clause 5.

7.3 Certificate of conformity

Each lot of wire rope supplied in conformity with this part of ISO 2020 shall be accompanied by a certificate of conformity.

8 Delivery, packing and marking

8.1 Delivery

Each consignment shall consist of a maximum of 6 000 m wire rope of the same construction and the same diameter produced in one production run on one or a series of successive machines.

Ropes shall be delivered in minimum lengths of 300 m, except that up to 20 % of the rope ordered may be supplied in lengths between 150 m and 300 m.

8.2 Packing

8.2.1 Ordinary packing

The rope shall be wound on a suitable reel. The diameter of the barrel of the reel shall exceed 40 times the diameter of the rope. The flanges and the barrel of the reel shall be covered with waterproof material before the rope is wound onto the reel. When it is fully wound, the exposed surface shall be covered with a layer of waterproof material held down by appropriate means.

8.2.2 Special packing

Any special packing shall be specified in the order.

8.3 Marking

A label shall be fixed on the reel bearing the following information:

- a) the designation in accordance with ISO 2020-1;
- b) the name of the manufacturer;
- c) the order number;
- d) the number of manufacture;
- e) the date of manufacture;
- f) the inspection note.

9 Test equipment for endurance test

The test equipment for the endurance test is shown in figure 1. The test pulleys are shown in figure 2 and their dimensions are given in table 2.

Dimensions in millimetres

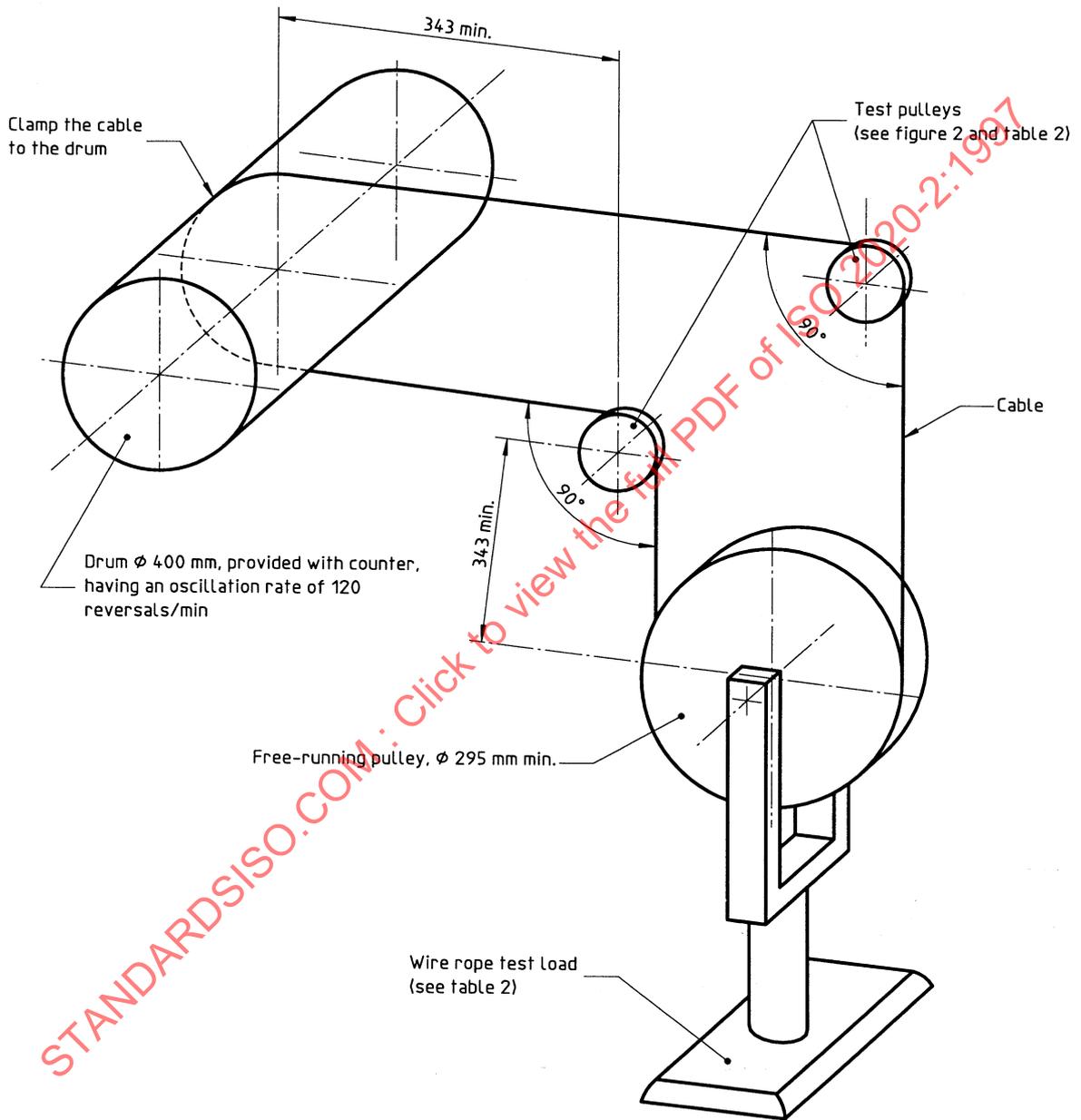


Figure 1 — Apparatus for endurance test