

# INTERNATIONAL STANDARD

# ISO 8458-3

Second edition  
2002-10-15

Corrected version  
2003-02-01

---

---

## Steel wire for mechanical springs — Part 3: Oil-hardened and tempered wire

*Fils en acier pour ressorts mécaniques —  
Partie 3: Fils trempés à l'huile et revenus*



Reference number  
ISO 8458-3:2002(E)

© ISO 2002

**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

© ISO 2002

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.ch](mailto:copyright@iso.ch)  
Web [www.iso.ch](http://www.iso.ch)

Printed in Switzerland

## 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.

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 part of ISO 8458 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8458-3 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 17, *Steel wire rod and wire products*.

This second edition cancels and replaces the first edition (ISO 8458-3:1992), which has been technically revised.

ISO 8458 consists of the following parts, under the general title *Steel wire for mechanical springs*:

- *Part 1: General requirements*
- *Part 2: Patented cold-drawn non-alloy steel wire*
- *Part 3: Oil-hardened and tempered wire*

This corrected version of ISO 8458-3 has been necessitated by the omission of paragraph 6 above.

.....

# Steel wire for mechanical springs —

## Part 3: Oil-hardened and tempered wire

### 1 Scope

This part of ISO 8458 specifies requirements for oil-hardened and tempered carbon and low alloy steel wire, for the manufacture of mechanical springs for static duty and dynamic duty applications, complying with the general requirements of ISO 8458-1.

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 8458. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 8458 are encouraged to investigate the possibility of applying the most recent editions of the normative documents 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 4967:1998, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams*

ISO 8458-1, *Steel wire for mechanical springs — Part 1: General requirements*

### 3 Classification and designation

The various spring wire grades and the relevant diameters are shown in Table 1.

Table 1 — Spring wire grades and diameter ranges

Tensile strength	Static	Medium fatigue	High fatigue
Low tensile strength	FDC	TDC	VDC
Medium tensile strength	FDCrV(A.B)	TDCrV(A.B)	VDCrV(A.B)
High tensile strength	FDSiCr	TDSiCr	VDSiCr
Diameter range (mm)	0,50 to 17,00	0,50 to 10,00	0,50 to 10,00
FD grade is intended for static applications, required for normal springs.			
TD grade is intended for medium fatigue levels.			
VD grade is intended for use under severe dynamic duty such as for valve springs.			

## 4 Dimensional tolerances

The permissible dimensional tolerances on wire in coils and cut lengths shall be in accordance with those specified in ISO 8458-1.

When the required tolerance level is different from those mentioned above, it shall be agreed at the time of ordering.

## 5 Requirements

### 5.1 Chemical composition

The steel is characterized by the heat analysis, which shall be in accordance with the values listed in Table 2. The permissible deviation of the product analysis from the heat analysis shall be in accordance with Table 3.

**Table 2 — Chemical composition, mass fraction**

Values in percent

Grade	C	Si	Mn	P max.	S max.	Cr	V	Cu max.
FDC	0,60 to 0,75	0,10 to 0,35	0,50 to 1,20	0,030	0,030	—	—	0,20
TDC	0,60 to 0,75	0,10 to 0,35	0,50 to 1,20	0,020	0,025	—	—	0,12
VDC	0,60 to 0,75	0,15 to 0,30	0,50 to 1,00	0,020	0,025	—	—	0,12
FDCrV-A	0,47 to 0,55	0,10 to 0,40	0,60 to 1,20	0,030	0,030	0,80 to 1,10	0,15 to 0,25	0,20
TDCrV-A				0,025	0,025			0,12
VDCrV-A				0,025	0,025			0,12
FDCrV-B	0,62 to 0,72	0,15 to 0,30	0,50 to 0,90	0,030	0,030	0,40 to 0,60	0,15 to 0,25	0,20
TDCrV-B				0,025	0,025			0,12
VDCrV-B				0,025	0,025			0,12
FDSiCr	0,50 to 0,60	1,20 to 1,60	0,50 to 0,90	0,030	0,030	0,50 to 0,80	—	0,20
TDSiCr				0,025	0,025			0,12
VDSiCr				0,025	0,025			0,12

**Table 3 — Permissible deviation of the product analysis from the limiting values for the heat analysis**

Chemical element	Wire grade	Permissible deviation, % by mass
C	All	± 0,03
Si	SiCr	± 0,05
	other grades	± 0,03
Mn	All	± 0,04
P	All	+ 0,005
S	All	+ 0,005
Cu	All	+ 0,02
Cr	All	± 0,05
V	All	± 0,02

## 5.2 Surface quality

5.2.1 The surface of the wire shall be smooth. The permissible maximum depth of surface discontinuities measured on samples as defined in ISO 8458-1 shall be in accordance with Table 4.

**Table 4 — Permissible maximum depth of surface discontinuities**

Dimensions in millimetres

Wire diameter, $d$	VD	TD		FD
		Class 1	Class 2 <sup>a</sup>	
$2,00 \leq d \leq 6,00$	$0,005d$	$0,008d$	$0,013d$	$0,01d^b$
$6,00 < d \leq 10,00$	$0,007d$	$0,01d$	$0,013d$	$0,014d$
<sup>a</sup> Only for SiCr grades. <sup>b</sup> For SiCr grades, 1,4 %.				

5.2.2 Eddy current inline testing shall be performed for VD grades and is optional for TD grades. The method of testing and the evaluation of test results shall be agreed upon between the parties. Eddy current testing is normally applied for sizes 2,50 mm to 6,00 mm.

5.2.3 The cross-section of wire of VD and TD shall be free from complete decarburization. The permissible maximum average depths of partial decarburized layer are shown in Table 5.

**Table 5 — Permissible maximum average depth of surface decarburization**

Dimensions in millimetres

Wire grade	Diameter, $d$	
	$d \leq 4,00$	$d > 4,00$
VD	0,04	$0,01d$
TD	0,05	$0,013d$
FD	$0,015d$	

## 5.3 Non-metallic inclusions

The VD grades shall be checked for maximum size of inclusion in accordance with ISO 4967. The permissible level of inclusions shall be agreed upon between the parties at the inquiry and order.

## 5.4 Mechanical properties

For tensile strength and reduction in area after rupture, the wire grades shall satisfy the values listed in Table 6 and Table 7. Reduction of area shall be measured only for sizes 1,00 mm and above. The range of tensile strength values within a coil/reel shall not exceed 50 N/mm<sup>2</sup> for the grades VD, 60 N/mm<sup>2</sup> for the grades TD and 70 N/mm<sup>2</sup> for the grades FD.

## 5.5 Technological properties

### 5.5.1 Wrapping test

5.5.1.1 The wrapping test may be applied to wires with nominal diameter less than 3,00 mm.

5.5.1.2 The wire shall not show any sign of fracture when closely coiled for at least four turns around a mandrel of diameter equal to that of the wire.

**Table 6 — Mechanical properties for oil-hardened and tempered spring steel wire of static duty**

Diameter range mm	Tensile strength, N/mm <sup>2</sup>				Reduction in area min. %
	FDC <sup>a,b</sup>	FDCrV-A <sup>c</sup>	FDCrV-B <sup>d,e</sup>	FDSiCr <sup>f,g</sup>	
$d \leq 0,50$	1 800 to 2 100	1 800 to 2 100	1 900 to 2 200	2 000 to 2 250	—
$0,50 < d \leq 0,80$	1 800 to 2 100	1 800 to 2 100	1 900 to 2 200	2 000 to 2 250	—
$0,80 < d \leq 1,00$	1 800 to 2 060	1 780 to 2 080	1 860 to 2 160	2 000 to 2 250	—
$1,00 < d \leq 1,30$	1 800 to 2 010	1 750 to 2 010	1 850 to 2 100	2 000 to 2 250	45
$1,30 < d \leq 1,40$	1 750 to 1 950	1 750 to 1 990	1 840 to 2 070	2 000 to 2 250	45
$1,40 < d \leq 1,60$	1 740 to 1 890	1 710 to 1 950	1 820 to 2 030	2 000 to 2 250	45
$1,60 < d \leq 2,00$	1 720 to 1 890	1 710 to 1 890	1 790 to 1 970	2 000 to 2 250	45
$2,00 < d \leq 2,50$	1 670 to 1 820	1 670 to 1 830	1 750 to 1 900	1 970 to 2 140	45
$2,50 < d \leq 2,70$	1 640 to 1 790	1 660 to 1 820	1 720 to 1 870	1 950 to 2 120	45
$2,70 < d \leq 3,00$	1 620 to 1 770	1 630 to 1 780	1 700 to 1 850	1 930 to 2 100	45
$3,00 < d \leq 3,20$	1 600 to 1 750	1 610 to 1 760	1 680 to 1 830	1 910 to 2 080	40
$3,20 < d \leq 3,50$	1 580 to 1 730	1 600 to 1 750	1 660 to 1 810	1 900 to 2 060	40
$3,50 < d \leq 4,00$	1 550 to 1 700	1 560 to 1 710	1 620 to 1 770	1 870 to 2 030	40
$4,00 < d \leq 4,20$	1 540 to 1 690	1 540 to 1 690	1 610 to 1 760	1 860 to 2 020	40
$4,20 < d \leq 4,50$	1 520 to 1 670	1 520 to 1 670	1 590 to 1 740	1 850 to 2 000	40
$4,50 < d \leq 4,70$	1 510 to 1 660	1 510 to 1 660	1 580 to 1 730	1 840 to 1 990	40
$4,70 < d \leq 5,00$	1 500 to 1 650	1 500 to 1 650	1 560 to 1 710	1 830 to 1 980	40
$5,00 < d \leq 5,60$	1 470 to 1 620	1 460 to 1 610	1 540 to 1 690	1 800 to 1 950	35
$5,60 < d \leq 6,00$	1 460 to 1 610	1 440 to 1 590	1 520 to 1 670	1 780 to 1 930	35
$6,00 < d \leq 6,50$	1 440 to 1 590	1 420 to 1 570	1 510 to 1 660	1 760 to 1 910	35
$6,50 < d \leq 7,00$	1 430 to 1 580	1 400 to 1 550	1 500 to 1 650	1 740 to 1 890	35
$7,00 < d \leq 8,00$	1 400 to 1 550	1 380 to 1 530	1 480 to 1 630	1 710 to 1 860	35
$8,00 < d \leq 8,50$	1 380 to 1 530	1 370 to 1 520	1 470 to 1 620	1 700 to 1 850	30
$8,50 < d \leq 10,00$	1 360 to 1 510	1 350 to 1 500	1 450 to 1 600	1 660 to 1 810	30
$10,00 < d \leq 12,00$	1 320 to 1 470	1 320 to 1 470	1 430 to 1 580	1 620 to 1 770	30
$12,00 < d \leq 14,00$	1 280 to 1 430	1 300 to 1 450	1 420 to 1 570	1 580 to 1 730	30
$14,00 < d \leq 15,00$	1 270 to 1 420	1 290 to 1 440	1 410 to 1 560	1 570 to 1 720	—
$15,00 < d \leq 17,00$	1 250 to 1 400	1 270 to 1 420	1 400 to 1 550	1 550 to 1 700	—

1 N/mm<sup>2</sup> = 1 MPa.

- a For diameters  $\leq 2,00$  mm, a tensile strength range of 1 720 to 1 920 N/mm<sup>2</sup> may be agreed.
- b A lower limit value of 1 900 N/mm<sup>2</sup> may be agreed for diameter  $\leq 1,00$  mm.
- c For diameters  $\leq 3,00$  mm, a tensile strength range of 1 620 to 1 820 N/mm<sup>2</sup> may be agreed.
- d For diameters  $\leq 3,00$  mm, a tensile strength range of 1 660 to 1 860 N/mm<sup>2</sup> may be agreed.
- e A lower limit value of 2 000 N/mm<sup>2</sup> may be agreed for diameter  $\leq 1,00$  mm.
- f A lower limit value of 2060 N/mm<sup>2</sup> may be agreed for diameter  $\leq 2,00$  mm.
- g For diameter above 2 mm, the lower limit for tensile strength may be reduced by 30 N/mm<sup>2</sup> if agreed upon.



Table 7 — Mechanical properties for oil-hardened and tempered spring steel wire of dynamic duty <sup>a</sup>

Diameter range mm	Tensile strength, N/mm <sup>2</sup>				Reduction in area min. %
	TDC VDC	TDCrV-A VDCrV-A <sup>b</sup>	TDCrV-B VDCrV-B <sup>c</sup>	TDSiCr VDSiCr	
$d \leq 0,50$	1 700 to 2 000	1 750 to 1 950	1 910 to 2 060	1 960 to 2 230	—
$0,50 < d \leq 0,80$	1 700 to 2 000	1 750 to 1 950	1 910 to 2 060	1 960 to 2 230	—
$0,80 < d \leq 1,00$	1 700 to 1 950	1 750 to 1 950	1 910 to 2 060	1 960 to 2 230	—
$1,00 < d \leq 1,30$	1 700 to 1 850	1 700 to 1 900	1 860 to 2 010	1 960 to 2 230	45
$1,30 < d \leq 1,40$	1 700 to 1 850	1 670 to 1 860	1 820 to 1 970	1 960 to 2 230	45
$1,40 < d \leq 1,60$	1 700 to 1 850	1 670 to 1 860	1 820 to 1 970	1 960 to 2 210	45
$1,60 < d \leq 2,00$	1 650 to 1 800	1 620 to 1 800	1 770 to 1 920	1 960 to 2 160	45
$2,00 < d \leq 2,50$	1 600 to 1 750	1 620 to 1 770	1 720 to 1 860	1 900 to 2 060	45
$2,50 < d \leq 2,70$	1 600 to 1 750	1 620 to 1 770	1 660 to 1 810	1 860 to 2 010	45
$2,70 < d \leq 3,00$	1 600 to 1 750	1 620 to 1 770	1 660 to 1 810	1 860 to 2 010	45
$3,00 < d \leq 3,20$	1 570 to 1 720	1 570 to 1 720	1 620 to 1 770	1 860 to 2 010	45
$3,20 < d \leq 3,50$	1 550 to 1 700	1 570 to 1 720	1 620 to 1 770	1 860 to 2 010	45
$3,50 < d \leq 4,00$	1 500 to 1 650	1 520 to 1 670	1 570 to 1 720	1 810 to 1 960	45
$4,00 < d \leq 4,20$	1 500 to 1 650	1 520 to 1 670	1 520 to 1 670	1 810 to 1 960	45
$4,20 < d \leq 4,50$	1 500 to 1 650	1 520 to 1 670	1 520 to 1 670	1 810 to 1 960	45
$4,50 < d \leq 4,70$	1 490 to 1 640	1 470 to 1 620	1 520 to 1 670	1 760 to 1 910	45
$4,70 < d \leq 5,00$	1 490 to 1 640	1 470 to 1 620	1 520 to 1 670	1 760 to 1 910	45
$5,00 < d \leq 5,60$	1 470 to 1 620	1 470 to 1 620	1 470 to 1 620	1 760 to 1 910	40
$5,60 < d \leq 6,00$	1 470 to 1 620	1 470 to 1 620	1 470 to 1 620	1 710 to 1 860	40
$6,00 < d \leq 6,50$	1 420 to 1 570	1 420 to 1 570	1 420 to 1 570	1 710 to 1 860	40
$6,50 < d \leq 7,00$	1 420 to 1 570	1 420 to 1 570	1 420 to 1 570	1 660 to 1 810	40
$7,00 < d \leq 8,00$	1 370 to 1 520	1 370 to 1 520	1 370 to 1 520	1 660 to 1 810	40
$8,00 < d \leq 9,00$	1 340 to 1 490	1 370 to 1 520	1 340 to 1 490	1 620 to 1 770	35
$9,00 < d \leq 10,00$	1 340 to 1 490	1 370 to 1 520	1 340 to 1 490	1 620 to 1 770	35

1 N/mm<sup>2</sup> = 1 MPa.

<sup>a</sup> A restricted tensile strength range may be specified as follows:

Grade	150 N/mm <sup>2</sup>	100 N/mm <sup>2</sup>
VDC, TDC	$d \leq 1,00$ mm	$d > 1,00$ mm
VDCrV-A, TDCrV-A	$d \leq 3,00$ mm	$d > 3,00$ mm
VDCrV-B, TDCrV-B	$d \leq 3,00$ mm	$d > 3,00$ mm
VDSiCr, TDSiCr	$d \leq 2,00$ mm	$d > 2,00$ mm

<sup>b</sup> A lower value of 1 620 N/mm<sup>2</sup> may be specified for diameter  $\leq 1,60$  mm.

<sup>c</sup> A lower value of 1 660 N/mm<sup>2</sup> may be specified for diameter  $\leq 2,50$  mm.

**5.5.2 Torsion test**

**5.5.2.1** The torsion test shall be applied to wires of nominal diameters from 0,70 mm to 6,00 mm, using a gauge length equivalent to 100 wire diameters. Other gauge lengths are permitted only by agreement.

**5.5.2.2** There are two methods for the torsion test. In the first method the torsion test piece shall be twisted in one direction until fracture. No harmful defects shall be visible on surface after fracture. The fracture plane shall be perpendicular to the wire axis and show no visible cracks. The minimum number of torsions required may be specified at the time of ordering.

The second method, in which the torsion test piece shall be twisted in two directions, is optional for grade TD and VD. The requirements specified in Table 8 shall be applied.

**Table 8 — Torsion test requirements**

Nominal diameter <i>d</i> , mm	TDC, VDC		TDCrV, VDCrV		TDSiCr, VDSiCr	
	turns right	turns left	turns right	turns left	turns right	turns left
$0,70 \leq d \leq 1,00$	6	24	6	12	6	0
$1,00 < d \leq 1,60$	6	16	6	8	5	0
$1,60 < d \leq 2,50$	6	14	6	4	4	0
$2,50 < d \leq 3,00$	6	12				
$3,00 < d \leq 3,50$	6	10				
$3,50 < d \leq 4,50$	6	8				
$4,50 < d \leq 5,60$	6	6			3	0
$5,60 < d \leq 6,00$	6	4				

**5.5.3 Bend test**

**5.5.3.1** The bend test may be applied to wires with nominal diameter greater than 6,00 mm.

**5.5.3.2** The wire shall not show any sign of fracture when bent through an angle of 90° around a mandrel of diameter equal to twice the wire diameter.

**5.5.4 Coiling test**

The coiling test may be applied to wires with nominal diameter not more than 0,70 mm.

## 6 Test methods and other requirements

Test methods and general requirements shall be in accordance with ISO 8458-1. For details, see Table 9.

The extent of testing shall be in accordance with Table 10.

**Table 9 — Summary of the information on test methods and requirements**

Test method	Wire grades/diameter ranges	Requirement <sup>a</sup>
Chemical analysis	All	O
Tensile test Reduction in area	All/> 1 mm	M M
Coiling test	All/≤ 0,70 mm	O
Wrapping test	All/< 3,00 mm	O
Bend test	All/> 6,00 mm	O
Torsion test	VD, TD	M
	FD	O
	} 0,70 to 6,00 mm	
Non metallic inclusion	VD	M
Surface discontinuity	All	M
Decarburization	FD	O
	TD, VD	M
Dimensions	All	M
<sup>a</sup> M (mandatory): the test is carried out in each case. O (optional): the test is carried out only if agreed upon at the time of ordering.		

**Table 10 — Acceptance unit and number of samples and test pieces**

Type of requirement	Number of samples or test pieces
Production analysis	1
Tensile test	10 % <sup>a</sup>
Wrapping test Bend test Torsion test Surface discontinuity Decarburization Coating adherence	To be agreed upon (as far as applicable)
Coating mass Coiling test	To be agreed upon
Dimensions	100 %
<sup>a</sup> 10 % of the wire units in the production batch (= test unit), up to a maximum of 10 samples. However, for 20 or fewer coils, a minimum of 2 samples shall be tested.	

