



Designation: F 90 – 07

# Standard Specification for Wrought Cobalt-20Chromium-15Tungsten-10Nickel Alloy for Surgical Implant Applications (UNS R30605)<sup>1</sup>

This standard is issued under the fixed designation F 90; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

## 1. Scope\*

1.1 This specification covers the requirements for wrought cobalt-20chromium-15tungsten-10nickel alloy used for surgical implants. The properties specified apply specifically to wrought bar, rod, wire, sheet, and strip, but do not apply to surgical fixation wire (see Specification F 1091).

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents in parentheses are for information only.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

E 8 Test Methods for Tension Testing of Metallic Materials

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 45 Test Methods for Determining the Inclusion Content of Steel

E 354 Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

F 981 Practice for Assessment of Compatibility of Biomaterials for Surgical Implants with Respect to Effect of Materials on Muscle and Bone

F 1091 Specification for Wrought Cobalt-20Chromium-15Tungsten-10Nickel Alloy Surgical Fixation Wire [UNS R30605]

F 2527 Specification for Wrought Seamless and Welded and Drawn Cobalt Alloy Small Diameter Tubing for Surgical Implants (UNS R30003, UNS R30008, UNS R30035, UNS R30605, and UNS R31537)

### 2.2 Aerospace Material Specification:<sup>3</sup>

AMS 2269 Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys

AMS 5759 Cobalt Alloy, Corrosion and Heat Resistant Bars, Forgings, and Rings, 52Co – 20 Cr – 10Ni – 15W, Solution Heat Treated

### 2.3 ISO Standards:<sup>4</sup>

ISO 5832-5 Wrought Cobalt-Chromium-Tungsten-Nickel Alloy

ISO 6892 Metallic Materials Tensile Testing at Ambient Temperature

ISO 9001 Quality System—Requirements

### 2.4 American Society for Quality (ASQ) Standard:

C1 Specification of General Requirements for a Quality Program<sup>5</sup>

## 3. Classification

3.1 *Bar*—Round, rectangular, or other complex shaped product delivered straightened and cut to defined lengths, with a maximum cross-sectional area of 16 in.<sup>2</sup> (103 cm<sup>2</sup>).

3.2 *Wire*—Round, rectangular, or other complex shaped product produced and delivered in coils.

3.3 *Fine Wire*—Wire with diameter or major dimension less than 0.063 in. (1.6 mm).

## 4. Ordering Information

4.1 Inquiries and orders for material under this specification shall include the following information:

4.1.1 Quantity,

4.1.2 ASTM designation and date of issue,

4.1.3 Mechanical properties (see Section 7),

4.1.4 Form (bar, rod, wire, sheet, strip),

4.1.5 Applicable dimensions including size, thickness, width, and length (exact, random, or multiples) or drawing number,

4.1.6 Condition (see 5.1),

4.1.7 Finish (see 5.2),

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>5</sup> Available from American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203, <http://www.asq.org>.

\*A Summary of Changes section appears at the end of this standard.

4.1.8 Other requirements.

## 5. Materials and Manufacture

5.1 *Condition*—Bar, wire, sheet, and strip shall be furnished to the purchaser, as specified, in the annealed or cold-worked condition.

5.2 *Finish*:

5.2.1 Bar and wire shall be furnished bright annealed, cold drawn, pickled, ground, or ground and polished, as specified by the purchaser.

5.2.2 Sheet shall be furnished bright annealed, pickled, cold-rolled, or polished, as specified by the purchaser.

## 6. Chemical Requirements

6.1 The heat analysis shall conform to the chemical composition of **Table 1**. The supplier shall not ship material that is outside the limits specified in **Table 1**.

6.1.1 Requirements for the major and minor elemental constituents are listed in **Table 1**. Also listed are important residual elements. Analysis for elements not listed in **Table 1** is not required to verify compliance with this specification.

6.2 *Product Analysis*—The product analysis is either for the purpose of verifying the composition of a heat or lot or to determine variations in the composition within the heat.

6.2.1 Acceptance or rejection of a heat or lot of material may be made by the purchaser on the basis of this product analysis.

6.2.2 Product analysis tolerances do not broaden the specified heat analysis requirements but instead cover variations between laboratories in the measurement of chemical content. Product analysis limits shall be as specified in **Table 2**.

6.3 For referee purposes, Test Methods **E 354** shall be used.

6.4 Methods and practices relating to chemical analysis required by this specification shall be in accordance with Test Methods **A 751**.

## 7. Mechanical Requirements

7.1 The material in the annealed condition shall conform to the mechanical properties specified in **Tables 3 and 4**.

7.2 Material in the cold worked condition shall conform to the mechanical properties specified in **Table 3**.

**TABLE 1 Chemical Requirements**

Element	Composition, % (mass/mass)	
	min	max
Carbon	0.05	0.15
Manganese	1.00	2.00
Silicon	...	0.40
Phosphorus	...	0.040
Sulfur	...	0.030
Chromium	19.00	21.00
Nickel	9.00	11.00
Tungsten	14.00	16.00
Iron	...	3.00
Cobalt <sup>A</sup>	balance	balance

<sup>A</sup> Approximately equal to the difference between 100 % and the sum percentage of the other specified elements. The percentage of the cobalt difference is not required to be reported.

**TABLE 2 Product Analysis Tolerances<sup>A</sup>**

Element	Tolerance Under the Minimum Limit or Over the Maximum Limit <sup>B</sup>
Carbon	0.01
Manganese	0.04
Silicon	0.03
Phosphorous	0.005
Sulfur	0.005
Chromium	0.25
Nickel	0.15 under min; 0.20 over max
Tungsten	0.25
Iron	0.07

<sup>A</sup> Refer to **AMS 2269**.

<sup>B</sup> Under minimum limit not applicable for elements where only a maximum percentage is indicated.

7.3 Tensile properties shall be determined in accordance with Test Methods **E 8**. Perform at least one tension test from each lot. Should any test piece not meet the specified requirements, test two additional test pieces representative of the same lot, in the same manner, for each failed test piece. The lot shall be considered in compliance only if all additional test pieces meet the specified requirements.

7.3.1 Tensile tests result for which any specimen fractures outside the gauge length shall be considered acceptable, if both the elongation and reduction of area meet the minimum requirements specified. Refer to subsections 7.11.4 and 7.11.5 of Test Methods **E 8**. If either the elongation or reduction of area is less than the minimum requirement, discard the test and retest. Retest one specimen for each specimen that did not meet the minimum requirements.

## 8. Metallurgical Requirements

8.1 The microcleanliness of the alloy as determined by Method A of Test Methods **E 45**, except using Plate I-r, on representative billet or bar samples from the heat shall not exceed the limits of **Table 5**.

## 9. Significance of Numerical Limits

9.1 The following applies to all specified numerical limits in this specification. To determine conformance to these limits, an observed or calculated value shall be rounded to the nearest unit in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of Practice **E 29**.

## 10. Certification

10.1 Certification shall be provided by the supplier that the material meets the requirements of this specification. A report of the test results shall be furnished at the time of shipment.

## 11. Quality Program Requirements

11.1 The alloy producer and any processors shall maintain a quality program, such as defined in **ASQ C1** or **ISO 9001**.

## 12. Keywords

12.1 cobalt alloys (for surgical implants); cobalt chromium; L-605 alloy; metals (for surgical implants)—cobalt alloys