



Designation: B 691 – 95

## Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire<sup>1</sup>

This standard is issued under the fixed designation B 691; 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 reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers iron-nickel-chromium-molybdenum alloys (UNS N08366 and UNS N08367)\* in the form of hot-finished and cold-finished rounds, squares, hexagons, octagons, and rectangles.

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

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 12, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards:*

E 8 Test Methods for Tension Testing of Metallic Materials<sup>2</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>3</sup>

E 140 Hardness Conversion Tables for Metals (Relationship Between Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness, and Knoop Hardness)<sup>2</sup>

E 1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys<sup>4</sup>

### 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 The terms rod, bar, and wire, as used in this specification, are described as follows:

3.1.1.1 *bar*—hot-finished or cold-finished material of

round, square, hexagon, octagon, or rectangular solid section in straight lengths.

3.1.1.2 *rod*—hot-finished material of round, square, hexagon, octagon, or rectangular solid section furnished in coils for subsequent cold drawing into finished products.

3.1.1.3 *wire*—cold-finished material of round, square, hexagon, octagon, or rectangle solid section furnished in coils.

### 4. Ordering Information

4.1 Orders for material under this specification shall include the following information, as required:

4.1.1 Quantity (feet, metres, or number of pieces),

4.1.2 Form (rod, bar, wire),

4.1.3 Name of material or UNS number,

4.1.4 Finish (see 8.2),

4.1.5 Dimensions, including length,

4.1.6 Certification, if required (Section 15),

4.1.7 Purchaser's inspection, if required (Section 13),

4.1.8 ASTM designation and year of issue, and

4.1.9 Samples for product analysis, if required.

### 5. Chemical Composition

5.1 The material shall conform to the composition limits specified in Table 1.

5.2 If a product (check) analysis is made by the purchaser, the material shall conform to the permissible variations for product (check) analysis in Table 1.

### 6. Mechanical Properties and Other Requirements

6.1 The material shall conform to the mechanical property requirements specified in Table 2.

### 7. Dimensions and Permissible Variations

7.1 *Size:*

7.1.1 *Rounds*—The permissible variations in size of cold-finished round shall be as given in Table 3. For hot-finished round bars and rod, they shall be as given in Table 4.

7.1.2 *Squares*—The permissible variations in size of cold-finished square bars shall be as given in Table 5. For hot-finished square bars and rods, they shall be as given in Table 4.

7.1.3 *Hexagons and Octagons*—The permissible variations in size of cold-finished hexagons and octagons shall be as given in Table 5. For hot-finished bar and rod hexagons and

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B-2 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt, and Alloys Containing Nickel or Cobalt, or Both, as Principal Constituents.

Current edition approved Aug. 15, 1995. Published October 1995. Originally published as B 691 – 81. Last previous edition B 691 – 94.

\* New designation established in accordance with ASTM E 527 and SAE J1086, Practice for Numbering Metals and Alloys.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 03.06.

octagons they shall be as given in Table 6.

7.1.4 *Flats (Rectangles)*—The permissible variations in width and thickness of cold-finished flats shall be as given in Table 7 for bars and for wire in Table 8. For hot-finished flat bars and rods, the tolerances for width and thickness shall be as given in Table 9.

7.2 *Out-of-Round*—Hot-finished rounds and cold-finished rounds (except forging quality), all sizes, in straight lengths, shall not be out-of-round by more than shown in Table 4 and Table 3.

7.3 *Corners*—Cold-finished squares, rectangles, hexagons and octagons will have equal angles and sharp corners.

7.4 *Machining Allowances*—When the surfaces of hot-finished material are to be machined, the allowances given in Table 10 are recommended for normal machining operations.

7.5 *Length:*

7.5.1 Unless multiple, nominal, or cut lengths are specified, random mill lengths shall be furnished.

7.5.2 When bars are ordered in multiple lengths, ¼ in. (6.4 mm) will be allowed for each multiple cut, unless otherwise specified.

7.5.3 The permissible variations in length of hot or cold-finished bars shall be as specified in Table 11 or Table 12 depending upon whether or not the material is specified to be machine-cut after straightening.

7.6 *Ends:*

7.6.1 Bars ordered to random or nominal lengths will be furnished with either cropped or saw-cut ends.

7.6.2 Bars ordered to cut lengths will be furnished with square saw-cut or machine cut ends.

7.7 *Straightness:*

7.7.1 The permissible variations in straightness of cold-finished bars shall be as specified in Table 13.

7.7.2 The permissible variations in straightness of hot-finished bars shall be as specified in Table 13.

## 8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and condition, smooth, commercially straight or flat, and free of injurious imperfections.

8.2 Finishes available include hot-rolled, hot rolled-annealed-descaled, cold-drawn, ground, turned, and machined.

## 9. Sampling

9.1 *Lot Definition:*

9.1.1 A lot for chemical analysis shall consist of one heat.

9.1.2 Lots for mechanical testing shall consist of the material from one heat, in the same condition (temper), and of the same specified size (excepting length) and cross-section.

9.2 *Test Material Selection:*

9.2.1 *Sampling for Chemical Analysis:*

9.2.1.1 An analysis of each lot shall be made by the manufacturer from a representative sample obtained during the pouring of the heat or subsequent processing.

9.2.1.2 If samples for product (check) analysis are specified, a representative sample shall be taken from each lot of finished material.

9.2.2 *Sampling for Mechanical Testing*—Samples of the material to provide test specimens for mechanical testing shall

be taken from such locations in each lot (see 9.1.2) as to be representative of that lot.

## 10. Number of Tests and Retests

10.1 *Chemical Analysis*—One test per lot.

10.2 *Mechanical Tests and Tension Tests*—One test per lot.

10.3 *Retests*—If the specimen used in the mechanical test of any lot fails to meet the specified requirements, an additional specimen shall be taken from a different sample piece and tested. The results of this test specimen shall meet the specified requirements.

## 11. Specimen Preparation

11.1 Tension test specimens shall be taken from material in the final condition (temper) and tested in the direction of fabrication.

11.2 All rod and bar shall be tested in full cross-section size when possible. When a full cross-section size test cannot be performed, the largest possible round specimen shown in Test Methods E 8 shall be used. Longitudinal strip specimens shall be prepared in accordance with Test Methods E 8 for flats up to ½ in. (12.7 mm), incl, in thickness that are too wide to be pulled full size.

## 12. Test Methods

12.1 Determine the chemical composition and mechanical properties of the material, as enumerated in this specification, in the case of disagreement, in accordance with the following ASTM methods:

12.1.1 *Chemical Analysis*—Test Methods E 1473.

12.2 *Tension test*— Test Methods E 8.

12.3 *Determination of significant places*—For purposes of determining compliance with the specified limits for the requirements of the properties listed in the following table, round an observed or a calculated value as indicated, in accordance with the rounding methods of Practice E 29.

Requirement	Rounded unit for observed or calculated value
Chemical composition	nearest unit in the last right-hand place of figures of the specified limit
Tensile strength and yield strength	nearest 1000 psi (7 MPa)
Elongation	nearest 1 %

## 13. Inspection

13.1 Inspection of the material shall be agreed upon between the purchaser and the producer or supplier as part of the purchase contract.

## 14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection shall be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

## 15. Certification

15.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has

been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

### 16. Product Marking

16.1 Each bundle or shipping container shall be marked with the name of the material, UNS number, heat number, condition (temper), the specification number, the size, gross, tare, and net weights, consignor and consignee address, contract or order number, or such other information as may be defined in the contract or purchase order.

16.2 When so specified on the contract or purchase order, larger size bars shall be marked individually with the name of the material, heat number, condition (temper), the specification number, size, and producer's name or mark.

### 17. Keywords

17.1 bar; N08366; N08367; rod; wire

**TABLE 1 Chemical Requirements**

Element	Composition Limits, %		Product (Check) Analysis Variations, under min or over max, of the Specified Limit of Element, %
	N08366	N08367	
Carbon	0.035 max	0.030 max	0.005
Manganese	2.00 max	2.00 max	0.04
Silicon	1.00 max	1.00 max	0.05
Phosphorus	0.040 max	0.040 max	0.005
Sulfur	0.030 max	0.030 max	0.005
Chromium	20.00 to 22.00	20.00 to 22.00	0.25
Nickel	23.50 to 25.50	23.50 to 25.50	0.20
Molybdenum	6.00 to 7.00	6.00 to 7.00	0.15
Nitrogen	...	0.18 to 0.25	0.01
Iron <sup>A</sup>	remainder	remainder	...
Copper	...	0.75 max	0.04

<sup>A</sup> Iron shall be determined arithmetically by difference.

**TABLE 2 Mechanical Properties**

	Cold-Finished-Annealed and Hot-Finished-Annealed (All Sizes)		Forging Quality (All Sizes)	
	N08366	N08367	N08366	N08367
Tensile strength, min, ksi (MPa)	75 (517)	95 (655)	A	A
Yield strength, 0.2 % offset, min, ksi (MPa)	30 (206)	45 (310)	A	A
Elongation in 2 in. or 50 mm, or 4D, min, %	30	30	A	A

<sup>A</sup> No tensile properties are required on forging quality.

**TABLE 3 Permissible Variations in Diameter Cold-Finished Round Bars and Wire**

Specified Diameter, in. (mm)	Diameter tolerance, in. (mm) <sup>A,B,C</sup>
	Plus and Minus
0.0030 (0.076) to 0.0048 (0.122), excl	0.0001 (0.003)
0.0048 (0.122) to 0.0080 (0.203), excl	0.0002 (0.005)
0.0080 (0.203) to 0.0120 (0.305), excl	0.0003 (0.008)
0.0120 (0.305) to 0.0240 (0.610), excl	0.0004 (0.010)
0.0240 (0.610) to 0.0330 (0.838), excl	0.0005 (0.013)
0.0330 (0.838) to 0.0440 (1.118), excl	0.0008 (0.020)
0.0440 (1.118) to 0.3125 (7.938), excl	0.001 (0.03)
0.3125 (7.938) to 0.5000 (12.700), excl	0.0015 (0.038)
0.5000 (12.700) to 1.000 (25.4), excl	0.002 (0.05)
1.000 (25.4) to 1.500 (38.1), excl	0.0025 (0.06)
1.500 (38.1) to 4.000 (101.6), incl	0.003 (0.08)

<sup>A</sup> Diameter tolerances are over and under as shown in the above table. Also, rounds can be produced to tolerances all over and nothing under, or all under and nothing over, or any combination of over and under, if the total spread in diameter tolerance for a specified diameter is not less than the total spread shown in the table.

<sup>B</sup> The maximum out-of-round tolerance for round wire is one-half of the total size tolerance shown in the above table.

<sup>C</sup> When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown in the table for sizes 0.0240 in. (0.610 mm) and over.