



Designation: A 579 – 04

## Standard Specification for Superstrength Alloy Steel Forgings<sup>1</sup>

This standard is issued under the fixed designation A 579; 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 requirements for forged steel shapes for highly stressed structural members requiring yield strengths in excess of 140 ksi [965 MPa].

1.2 This specification is not intended for applications limited by creep deformation.

1.3 Twenty-seven grades are covered by this specification. Selection will depend upon design, service conditions, and mechanical properties required.

1.4 Supplementary requirements are provided for use when additional testing or inspection is desired. These shall apply only when specified individually by the purchaser in the order.

1.5 The values stated in either inch-pound or SI (metric) units are to be regarded separately as standards. Within the text and tables, the SI units are shown in brackets. The values in each system are not exact equivalents; therefore, each system must be used independently of each other. Combining values from the two systems may result in non-conformance with the specification.

### 2. Referenced Documents

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

**A 255** Test Methods for Determining Hardenability of Steel  
**A 275/A 275M** Test Method for Magnetic Particle Examination of Steel Forgings

**A 370** Test Methods and Definitions for Mechanical Testing of Steel Products

**A 388/A 388M** Practice for Ultrasonic Examination of Heavy Steel Forgings

**A 788** Specification for Steel Forgings, General Requirements

**E 3** Methods of Preparation of Metallographic Specimens

**E 21** Test Methods for Elevated Temperature Tension Tests of Metallic Materials

**E 45** Test Methods for Determining the Inclusion Content of Steel

**E 112** Test Methods for Determining Average Grain Size

**E 165** Test Method for Liquid Penetrant Examination

### 3. Ordering Information and General Requirements

3.1 In addition to the ordering information required by Specification **A 788**, the purchaser shall include with the inquiry and order a detailed drawing, sketch, or written description of the forging.

3.2 Material supplied to this specification shall conform to the requirements of Specification **A 788**, which outlines additional ordering information, manufacturing requirements, testing and retesting methods and procedures, marking, certification, product analysis variations, and additional supplementary requirements.

3.3 If the requirements of this specification are in conflict with the requirements of Specification **A 788**, the requirements of this specification shall prevail.

### 4. Materials and Manufacture

4.1 The steel shall be made in accordance with the Melting Process Section of Specification **A 788**. A sufficient discard shall be made to secure freedom from injurious pipe and undue segregation.

4.2 The material shall be forged as close as practical to the specified shape and size.

4.3 The finished product shall be a hot-worked forging as defined by Specification **A 788**.

4.4 *Heat Treatment Performed by Forging Supplier*—Forgings may be furnished in one of the following conditions as specified in the inquiry and purchase order (some conditions are not applicable to all grades):

- 4.4.1 Stress relieved,
- 4.4.2 Annealed,
- 4.4.3 Solution treated,
- 4.4.4 Solution treated and aged,
- 4.4.5 Normalized,
- 4.4.6 Normalized and tempered, or
- 4.4.7 Quenched and tempered.

4.5 *Heat Treatment Performed by Purchaser*—When final heat treatment is to be performed by the purchaser after machining or fabrication, or both, a capability heat treatment

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.06 on Steel Forgings and Billets.

Current edition approved January 1, 2004. Published January 2004. Originally approved in 1967. Last previous edition approved in 2001 as A 579 – 01.

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



duplicating the purchaser's final heat treatment must be performed by the supplier on representative samples (see 6.3) to qualify the forgings. The results of these capability tests shall conform to the requirements of Table 1 and Table 2. See also Table 3.

## 5. Chemical Requirements Chemical Requirements

5.1 *Heat Analysis*—The heat analysis obtained from sampling in accordance with Specification A 788 shall comply with Table 4.

## 6. Mechanical Properties

6.1 The material shall conform to the mechanical properties specified in Table 1, when ordered to 4.4.4 or 4.4.7. For the other heat treatments specified in 4.4, the provisions of 4.5 apply.

6.2 Tension tests are required for all material ordered to this specification. However, room-temperature Charpy V-notch impact tests are required only for those grades which have minimum impact strength requirements listed in Table 2.

**TABLE 1 Minimum Tension Test Requirements**

Grade	Yield Strength (0.2 % offset), ksi [MPa]	Tensile Strength, ksi [MPa]	Elongation <sup>A</sup> , %	Reduction of Area <sup>A</sup> , %
Quench and Tempered				
13, 21, 22, 23, 12, 12a	140 [965]	150 [1035]	13	40
13, 21, 22, 23, 11	160 [1100]	175 [1210]	12	36
13, 21, 22, 23, 31	180 [1240] <sup>B</sup>	190 [1310]	10	32
13, 21, 22, 23	200 [1380] <sup>B</sup>	210 [1450]	9	28
22 <sup>C</sup> , 23, 32, 33	225 [1550] <sup>B</sup>	250 [1720]	6	25
Air Hardening				
41	200 [1380] <sup>B</sup>	260 [1790]	9	30
41	225 [1550] <sup>B</sup>	280 [1930]	8	25
Martensitic Stainless				
51, 52, 53	140 [965]	175 [1210]	12	45
52	160 [1100]	220 [1520]	10	40
No. 1 Precipitation Hardening Stainless				
61	140 [965]	165 [1140]	12	50
61	160 [1100]	180 [1240]	10	45
61	180 [1240] <sup>B</sup>	200 [1380]	8	40
No. 2 Precipitation Hardening Stainless				
64	140 [965]	165 [1140]	12	25
64	160 [1100]	185 [1280]	10	25
64	180 [1240] <sup>B</sup>	210 [1450]	10	25
No. 3 Precipitation Hardening Stainless				
62	140 [965]	165 [1140]	6	25
62, 63	160 [1100]	180 [1240]	6	25
63	180 [1240] <sup>B</sup>	200 [1380]	6	25
63	200 [1380] <sup>B</sup>	225 [1550]	5	25
Maraging Steels				
74	160 [1100]	170 [1170]	15	65
75	180 [1240] <sup>B</sup>	190 [1310]	14	60
71	200 [1380] <sup>B</sup>	210 [1450]	12	55
72	250 [1720] <sup>B</sup>	255 [1760]	10	45
73	275 [1890] <sup>B</sup>	280 [1930]	9	40
Miscellaneous				
81	180 [1240] <sup>D</sup>	190 [1310]	13	45
82	200 [1380] <sup>D</sup>	210 [1450]	10	30
83 <sup>D</sup>	225 [1550] <sup>D</sup>	260 [1790]	7	20
83 <sup>E</sup>	250 [1720] <sup>D</sup>	280 [1930]	4	15
84	180 [1240] <sup>D</sup>	185 [1270]	14	45

<sup>A</sup> See Note in Table 3.

<sup>B</sup> Vacuum melting normally required to achieve list properties.

<sup>C</sup> By agreement.

<sup>D</sup> Bainitic.

<sup>E</sup> Martensitic.



**TABLE 2 Minimum Room-Temperature Charpy V-Notch Energy Absorption<sup>A</sup> for Respective Yield Strength Classes, ft-lbf [J]**

Grade	Yield Strength Class, ksi [MPa]						
	140 [965]	160 [1100]	180 <sup>B</sup> [1240]	200 <sup>B</sup> [1380]	225 <sup>B</sup> [1550]	250 <sup>B</sup> [1720]	275 <sup>B</sup> [1900]
11	...	45 [60]	...	...	...	...	...
12, 12a	50 [70]	...	...	...	...	...	...
13	20 [25]	10 [15]	<sup>C</sup>	...	...	...	...
21	35 [45]	30 [40]	20 [25]	15 [20]	...	...	...
22	30 [40]	25 [35]	20 [25]	15 [20]	...	...	...
23	35 [45]	25 [35]	20 [25]	15 [20]	10 [15]	...	...
31	...	...	25 [35]	...	...	...	...
32	...	...	...	...	12 [17]	...	...
33	...	...	...	...	15 [20]	...	...
41	...	...	...	15 [20]	<sup>C</sup>	...	...
51	15 [20]	...	...	...	...	...	...
52	<sup>C</sup>	<sup>C</sup>	...	...	...	...	...
53	<sup>C</sup>	...	...	...	...	...	...
61	25 [35]	...	<sup>C</sup>	...	...	...	...
62	<sup>C</sup>	<sup>C</sup>	...	...	...	...	...
63	<sup>C</sup>	<sup>C</sup>	<sup>C</sup>	...	...	...	...
64	25 [35]	15 [20]	15 [20]	...	...	...	...
71	...	...	...	35 [45]	...	...	...
72	...	...	...	...	...	20 [25]	...
73	...	...	...	...	...	...	15 [20]
74	...	60 [80]	50 [70]	...	...	...	...
81	...	...	25 [35]	...	...	...	...
82	...	...	...	20 [25]	...	...	...
83	...	...	...	...	15 [20]	10 [15]	...
84	...	...	25 [35]	...	...	...	...

<sup>A</sup> See Note in Table 3.  
<sup>B</sup> Vacuum melting may be required to achieve listed properties.  
<sup>C</sup> By agreement.

**TABLE 3 Material, Maximum Annealed Hardness (HB), and Section Size Capability in Inches [mm] for Respective Yield Strength Classes**

NOTE—Tables 1-3 show grades and maximum section sizes in which the indicated yield strength levels can usually be achieved at a 1/4 thickness depth in the direction of maximum working. Because of variations in forging configuration and processing it does not follow that the ductility and impact strengths listed in Table 1 and Table 2 can always be obtained at these depths. The properties listed are minimums, unless otherwise agreed by purchaser and manufacturer.

Grade	Maximum Annealed Hardness (HB)	Yield Strength Class, ksi [MPa]						
		140 [965]	160 [1100]	180 [1240]	200 [1380]	225 [1550]	250 [1720]	275 [1900]
11	321	...	6.5 [165]	...	...	...	...	...
12, 12a	...	4.0 [100]	...	...	...	...	...	...
13	229	1.0 [25]	1.0 [25]	1.0 [25]	...	...	...	...
21	285	4.5 [115]	4.5 [115]	4.0 [100]	4.0 [100]	...	...	...
22	302	4.5 [115]	4.5 [115]	4.0 [100]	4.0 [100]	3.5 [90]	...	...
23	302	8.0 [200]	8.0 [200]	8.0 [200]	8.0 [200]	8.0 [200]	...	...
31	262	...	...	3.0 [75]	...	...	...	...
32	302	...	...	...	...	5.5 [140]	...	...
33	302	...	...	...	...	2.0 [50]	...	...
41	235	...	...	...	6.0 [150]	6.0 [150]	...	...
51	197	2.0 [50]	...	...	...	...	...	...
52	255	2.0 [50]	2.0 [50]	...	...	...	...	...
53	285	4.0 [100]	...	...	...	...	...	...
61	375	8.0 [200]	8.0 [200]	1.0 [25]	...	...	...	...
62	207	6.0 [150]	6.0 [150]	6.0 [150]	...	...	...	...
63	241	...	6.0 [150]	6.0 [150]	6.0 [150]	...	...	...
64	321	6.0 [150]	6.0 [150]	6.0 [150]	...	...	...	...
71	321	...	...	...	12.0 [300]	...	...	...
72	321	...	...	...	...	...	12.0 [300]	...
73	321	...	...	...	...	...	...	12.0 [300]
74	321	...	12.0 [300]	...	...	...	...	...
75	321	...	...	12.0 [300]	...	...	...	...
81	341	...	...	6.0 [150]	...	...	...	...
82	341	...	...	...	5.0 [125]	...	...	...
83	341	...	...	...	...	3.0 [75]	3.0 [75]	...
84	341	...	...	6.0 [150]	...	...	...	...