



Designation: **A579/A579M – 17a** **A579/A579M – 20**

Standard Specification for Superstrength Alloy Steel Forgings¹

This standard is issued under the fixed designation A579/A579M; 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 (ϵ) 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-eight 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 SI units or inch-pound units are to be regarded separately as standard. The values stated in each system ~~may~~ are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other. ~~Combining other, and~~ values from the two systems ~~may result in non-conformance with the standard; shall not be combined.~~

1.6 Unless the order specifies the applicable “M” specification designation, the material shall be furnished to the inch-pound units.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[A255 Test Methods for Determining Hardenability of Steel](#)

[A275/A275M Practice for Magnetic Particle Examination of Steel Forgings](#)

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A388/A388M Practice for Ultrasonic Examination of Steel Forgings](#)

[A788/A788M Specification for Steel Forgings, General Requirements](#)

[E3 Guide for Preparation of Metallographic Specimens](#)

[E21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials](#)

[E45 Test Methods for Determining the Inclusion Content of Steel](#)

[E112 Test Methods for Determining Average Grain Size](#)

[E165/E165M Practice for Liquid Penetrant Testing for General Industry](#)

3. Ordering Information and General Requirements

3.1 In addition to the ordering information required by Specification [A788/A788M](#), the purchaser shall include with the inquiry and order a detailed drawing, sketch, or written description of the forging. Additionally the purchaser shall specify one of the types, grades, and classes shown in [Tables 1-3](#).

3.2 Material supplied to this specification shall conform to the requirements of Specification [A788/A788M](#).

¹ 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.

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² 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.

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



TABLE 1 Minimum Tension Test Requirements

Type	Grade	Yield Strength (0.2 % offset), ksi [MPa]	Tensile Strength, ksi [MPa]	Elongation, ^A %	Reduction of Area, ^A %
Quench and Tempered					
Type 1	13, 21, 22, 23, 12, 12a	140 [965]	150 [1035]	13	40
Type 1	13, 21, 22, 23, 11	160 [1100]	175 [1210]	12	36
Type 1	13, 21, 22, 23, 31	180 [1240] ^B	190 [1310]	10	32
Type 1	13, 21, 22, 23	200 [1380] ^B	210 [1450]	9	28
Type 1	22 ^C , 23, 32, 33	225 [1550] ^B	250 [1720]	6	25
Air Hardening					
Type 2	41	200 [1380] ^B	260 [1790]	9	30
Type 2	41	225 [1550] ^B	280 [1930]	8	25
Martensitic Stainless					
Type 3	51, 52, 53	140 [965]	175 [1210]	12	45
Type 3	52	160 [1100]	220 [1520]	10	40
No. 1 Precipitation Hardening Stainless					
Type 4	61	140 [965]	165 [1140]	12	50
Type 4	61	160 [1100]	180 [1240]	10	45
Type 4	61	180 [1240] ^B	200 [1380]	8	40
No. 2 Precipitation Hardening Stainless					
Type 5	64	140 [965]	165 [1140]	12	25
Type 5	64	160 [1100]	185 [1275]	10	25
Type 5	64	180 [1240] ^B	210 [1450]	10	25
No. 3 Precipitation Hardening Stainless					
Type 6	62	140 [965]	165 [1140]	6	25
Type 6	62, 63	160 [1100]	180 [1240]	6	25
Type 6	63	180 [1240] ^B	200 [1380]	6	25
Type 6	63	200 [1380] ^B	225 [1550]	5	25
Maraging Steels					
Type 7	74	160 [1100]	170 [1170]	15	65
Type 7	75	180 [1240] ^B	190 [1310]	14	60
Type 7	71	200 [1380] ^B	210 [1450]	12	55
Type 7	72	250 [1720] ^B	255 [1760]	10	45
Type 7	73	275 [1895] ^B	280 [1930]	9	40
Miscellaneous					
Type 8	81	180 [1240] ^D	190 [1310]	13	45
Type 8	82	200 [1380] ^D	210 [1450]	10	30
Type 8	83 ^D	225 [1550] ^D	260 [1790]	7	20
Type 8	83 ^E	250 [1720] ^D	280 [1930]	4	15
Type 8	84	180 [1240] ^D	185 [1275]	14	45
Type 8	85	180 [1240]	240 [1450]	40	35
Type 8	85	170 [1172]	212 [1462]	10	33

^A See Note in Table 3.

^B Vacuum melting normally required to achieve list properties.

^C By agreement.

^D Bainitic.

^E Martensitic.

3.3 If the requirements of this specification are in conflict with the requirements of Specification A788/A788M, 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 A788/A788M. 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 A788/A788M.

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.

TABLE 2 Minimum Room-Temperature Charpy V-Notch Energy Absorption^A for Respective Yield Strength Classes, ft-lbf [J]

Type	Grade	Yield Strength Class, ksi [MPa]						
		140 [965]	160 [1100]	180 ^B [1240]	200 ^B [1380]	225 ^B [1550]	250 ^B [1720]	275 ^B [1900]
Type 1	11	...	45 [60]	...	...	...	...	...
Type 1	12, 12a	50 [70]	...	...	...	...	...	...
Type 1	13	20 [25]	10 [15]	^C	...	...	...	...
Type 1	21	35 [45]	30 [40]	20 [25]	15 [20]	...	...	...
Type 1	22	30 [40]	25 [35]	20 [25]	15 [20]	...	...	...
Type 1	23	35 [45]	25 [35]	20 [25]	15 [20]	10 [15]	...	...
Type 1	31	...	...	25 [35]	...	...	...	...
Type 1	32	...	...	...	...	12 [17]	...	...
Type 1	33	...	...	...	...	15 [20]	...	...
Type 2	41	...	...	...	15 [20]	^C	...	...
Type 3	51	15 [20]	...	...	...	...	...	...
Type 3	52	^C	^C	...	...	...	...	...
Type 3	53	^C	...	...	...	...	...	...
Type 4	61	25 [35]	...	^C	...	...	...	...
Type 6	62	^C	^C	...	...	...	...	...
Type 6	63	^C	^C	^C	...	...	...	...
Type 5	64	25 [35]	15 [20]	15 [20]	...	...	...	...
Type 7	71	...	...	...	35 [45]	...	...	...
Type 7	72	...	...	...	...	...	20 [25]	...
Type 7	73	...	...	...	...	...	...	15 [20]
Type 7	74	...	60 [80]	50 [70]	...	...	...	...
Type 8	81	...	...	25 [35]	...	...	...	...
Type 8	82	...	...	...	20 [25]	...	...	...
Type 8	83	...	...	...	...	15 [20]	10 [15]	...
Type 8	84	...	...	25 [35]	...	...	...	...
Type 8	85	...	...	40 [55]	...	...	...	...

^A See Note in Table 3.

^B Vacuum melting may be required to achieve listed properties.

^C By agreement.

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

NOTE 1—Tables 1-3 show grades and maximum section sizes in which the indicated yield strength levels can usually be achieved at a ¼ 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.

Type	Grade	Maximum Annealed Hardness (HB)	Yield Strength Class, ksi [MPa]						
			140 [965]	160 [1100]	180 [1240]	200 [1380]	225 [1550]	250 [1720]	275 [1900]
Type 1	11	321	...	6.5 [165]	...	...	...	...	...
Type 1	12, 12a	...	4.0 [100]	...	...	...	...	...	...
Type 1	13	229	1.0 [25]	1.0 [25]	1.0 [25]	...	...	...	...
Type 1	21	285	4.5 [115]	4.5 [115]	4.0 [100]	4.0 [100]	...	...	...
Type 1	22	302	4.5 [115]	4.5 [115]	4.0 [100]	4.0 [100]	3.5 [90]	...	...
Type 1	23	302	8.0 [200]	8.0 [200]	8.0 [200]	8.0 [200]	8.0 [200]	...	...
Type 1	31	262	...	...	3.0 [75]	...	...	...	...
Type 1	32	302	...	...	...	...	5.5 [140]	...	...
Type 1	33	302	...	...	...	...	2.0 [50]	...	...
Type 2	41	235	...	...	...	6.0 [150]	6.0 [150]	...	...
Type 3	51	197	2.0 [50]	...	...	...	...	...	...
Type 3	52	255	2.0 [50]	2.0 [50]	...	...	...	...	...
Type 3	53	285	4.0 [100]	...	...	...	...	...	...
Type 4	61	375	8.0 [200]	8.0 [200]	1.0 [25]	...	...	...	...
Type 6	62	207	6.0 [150]	6.0 [150]	6.0 [150]	...	...	...	...
Type 6	63	241	...	6.0 [150]	6.0 [150]	6.0 [150]	...	...	...
Type 5	64	321	6.0 [150]	6.0 [150]	6.0 [150]	...	...	...	...
Type 7	71	321	...	...	...	12.0 [300]	...	...	...
Type 7	72	321	...	...	...	...	...	12.0 [300]	...
Type 7	73	321	...	...	...	...	...	...	12.0 [300]
Type 7	74	321	...	12.0 [300]	...	...	...	...	...
Type 8	75	321	...	...	12.0 [300]	...	...	...	...
Type 8	81	341	...	...	6.0 [150]	...	...	...	...
Type 8	82	341	...	...	...	5.0 [125]	...	...	...
Type 8	83	341	...	...	...	...	3.0 [75]	3.0 [75]	...
Type 8	84	341	...	...	6.0 [150]	...	...	...	...
Type 8	85	321	...	...	10.0 [250]	...	...	...	...

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 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

5.1 *Heat Analysis*—The heat analysis obtained from sampling in accordance with Specification A788/A788M shall comply with Table 4.

5.2 *Product Analysis*—The product analysis provisions of Specification A788/A788M may be used by the purchaser.

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.

6.3 Tests shall be conducted in accordance with the latest issue of Test Methods and Definitions A370. The largest obtainable tension test specimen as specified in Test Methods and Definitions A370 shall be used. Impact specimens shall be the standard size, Charpy V-notch, as shown in the figure for the Charpy (Simple-Beam) Impact Test of Test Methods and Definitions A370. The use of subsize impact specimens requires prior purchaser approval.

6.4 The longitudinal axis of the specimens shall be parallel to the direction of major working of the forging. For upset-disc forgings, the longitudinal axis of the test specimen shall be in the tangential direction.

6.4.1 The longitudinal axis of the specimen shall be located midway between the parallel surfaces of the test extension if added to the periphery of disks or midway between the center and surface of solid forgings. For hollow forgings, the longitudinal axis of the specimens shall be located midway between the center and outer surfaces of the wall. When separately forged test blocks are employed as defined in 6.4.3, the tension test specimens shall be taken from a location which represents the midwall of the heaviest section of the production forgings. When specimens are required from opposite ends, they shall be taken from the diagonal corners of an axial plane.

6.4.2 Except as specified herein, tests for acceptance shall be made after heat treatment has been completed.

6.4.3 When mutually agreed upon between manufacturer and purchaser, test specimens may be machined from a specially forged block suitably worked and heat treated with the production forgings. Such a special block shall be obtained from an ingot, slab, or billet from the same heat used to make the forgings it represents. This block shall receive essentially the same type of hot working and forging reduction as the production forgings; however, a longitudinally forged bar with dimensions not less than T by T by $3T$ may be used to represent a ring forging. The dimension T shall be representative of the heaviest effective cross section of the forging. For quenched and tempered forgings for which tests are required at both ends by 6.5.2.3 and 6.5.2.4, separately forged test blocks are not allowed.

NOTE 1—In using separately forged test blocks, attention is drawn to the effect of mass differences between the production forgings and the test blocks.

6.5 *Specific Requirements*—The number and location of tests are based on forging length, weight, and heat treatment, and shall be as prescribed below. The length and weight to be used for this purpose shall be the shipped length and weight of forgings produced individually or the aggregate shipped length and weight of all pieces cut from a multiple forging.

6.5.1 *Stress Relieved, Annealed Solution, Treated, Solution Treated and Aged, Normal or Normalized, and Tempered Forgings:*

6.5.1.1 For forgings weighing 5000 lb [2250 kg] or less at the time of heat treatment, one tension test shall be taken from one forging per heat in each heat-treatment charge. When heat treatment is performed in continuous-type furnaces with suitable temperature controls and equipped with recording pyrometers so that complete heat-treatment records are available, a tempering charge may be considered as any continuous run not exceeding an 8-h period.

6.5.1.2 For forgings and forged bars weighing over 5000 lb [2250 kg] at the time of heat treatment, one tension test shall be taken from each forging.

6.5.2 *Quenched and Tempered Forgings:*

6.5.2.1 For quenched and tempered forgings weighing 5000 lb [2250 kg] or less at the time of heat treatment, but not exceeding 12 ft [3.7 m] in length, one tension test shall be taken from one forging per heat in each heat-treatment charge. When heat treatment is performed in continuous-type furnaces with suitable temperature controls and equipped with recording pyrometers so that complete heat treatment records are available, a tempering charge may be considered as any continuous run not exceeding an 8-h period.

6.5.2.2 For quenched and tempered forgings and forged bars weighing over 5000 lb [2250 kg] to 10 000 lb [4500 kg] at the time of heat treatment, but not exceeding 12 ft [3.7 m] in length, one tension test shall be taken from each forging.

6.5.2.3 For quenched and tempered forgings and forged bars that exceed 12 ft [3.7 m] in length, one tension test shall be taken from each end of each forging.