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.

Designation: F1554 – 17

Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength[1]

This standard is issued under the fixed designation F1554; 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 straight, bent, headed, and headless anchor bolts (also known as anchor rods) made of carbon, medium carbon boron, alloy, or high-strength low-alloy steel. It provides for anchor bolts in three strength grades, two thread classes, and in the diameters specified in Section 4. The specification also covers all-thread rod for use in anchoring to concrete. References to anchor bolts in this standard do not necessarily exclude all-thread rod.

1.2 Anchor bolts are intended for anchoring structural supports to concrete foundations. Such structural supports include building columns, column supports for highway signs, street lighting and traffic signals, steel bearing plates, and similar applications.

1.3 Supplementary requirements are included to provide for Grade 55 weldable steel, permanent manufacturers and grade identification, and impact properties for Grades 55 and 105.

1.4 Zinc coating requirements are in Section 7.

1.5 Suitable nuts and washers are listed in 6.7. Washers are detailed in 6.8.

1.6 This specification does not cover mechanical expansion anchors, powder-activated nails or studs, or anchor bolts fabricated from deformed bar.

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

1.8 *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]

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A194/A194M Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A563 Specification for Carbon and Alloy Steel Nuts

A673/A673M Specification for Sampling Procedure for Impact Testing of Structural Steel

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

B695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

F436/F436M Specification for Hardened Steel Washers Inch and Metric Dimensions

F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F1789 Terminology for F16 Mechanical Fasteners

F2329/F2329M Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

2.2 *American Institute of Steel Construction:*[3]

Design Guide 1: Base Plate and Anchor Rod Design

2.3 *ASME Standards:*[4]

B 1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

B 1.3 Screw Thread Gaging Systems for Acceptability: Inch and Metric Screw Threads (UN, UNR, UNJ, M MJ)

B18.2.1 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag

[1] This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers.

Current edition approved Dec. 1, 2017. Published February 2018. Originally approved in 1994. Last previous edition approved in 2015 as F1554 – 15$^{\varepsilon 2}$. DOI: 10.1520/F1554-17.

[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.

[3] American Institute of Steel Construction, One East Wacker Drive, Suite 700, Chicago, IL 60601

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

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

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

Screws (Inch Series)
B 18.2.2 Square and Hex Nuts
B 18.18 Quality Assurance for Fasteners

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *anchor bolt*—steel fastener, typically made from bar stock or wire, and partially or fully threaded, one end of which is intended to be cast in concrete, while the opposite end projects from the concrete, for anchoring other material. The end cast in concrete may be either straight or provided with an uplift-resisting feature such as a bent hook, forged head, or a tapped or welded attachment.

3.1.2 *producer*—manufacturer of the steel bar stock or wire used for anchor bolts.

3.2 All other terms in this standard are used as defined in Terminology F1789.

4. Classification

4.1 Anchor bolts may be furnished in three grades (denoting minimum yield strength) and two classes (denoting thread class) as follows:

Grade	Description		
	Tensile Strength, ksi (MPa)	Yield Strength, min, ksi (MPa)	Diameter Range, in.
36	58–80 (400–558)	36 (248)	½ –4
55	75–95 (517–655)	55 (380)	½ –4
105	125–150 (862–1034)	105 (724)	½ –3
Class			
1A	anchor bolts with Class 1A threads		
2A	anchor bolts with Class 2A threads		

5. Ordering Information

5.1 Orders should include:

5.1.1 Quantity.

5.1.2 Product name.

5.1.3 ASTM designation and year of issue.

5.1.4 Grade and class.

5.1.5 Copper content, if copper bearing steel is required.

5.1.6 *Size and Dimensions*—Nominal diameter and thread pitch, bolt length, thread length, head type (if required) and hook angle and hook length (if required).

5.1.7 *Coatings*—If required, the coating process and the length to be coated as measured from the exposed end. See Section 7.

5.1.8 Number of nuts. See 6.7.

5.1.9 Number of washers, and washer dimensions and material, if applicable. See 6.8.

5.1.10 Source inspection requirements, if any. See Section 15.

5.1.11 Color coding, if different than Section 18.

5.1.12 Test reports, if required. See Section 17.

5.1.13 Supplementary requirements, if required.

5.1.14 Special packaging requirements, if required.

NOTE 1—An example of a typical order follows: 5000 pieces; anchor bolts; ASTM F1554-15 Grade 55; Class 2A; 1.0-8 tpi. diameter by 15-in. long, 3.0-in. thread length, 4.0-in. hook; zinc-coated by hot dipping 5.0 in. from exposed end; each with one zinc-coated nut and washer; test report required; Supplementary Requirement S1 required.

6. Materials and Manufacture

6.1 *Process*—Steel for anchor bolts shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

6.2 *Threading*—Threads shall be rolled, cut, or ground at the option of the manufacturer, unless otherwise specified.

6.3 *Heat Treatment:*

6.3.1 Grade 105 bolts (or their raw material) shall be heat treated. Heat treatment may be performed prior to or after bending or threading.

6.3.2 When heat treatment is performed, anchor bolts (or their raw material) shall be quenched in a liquid medium from above the transformation temperature and then tempered by reheating to a temperature not less than 800°F for Grade 55 and 1100°F for Grade 105.

6.4 *Weldability*—Grade 36 anchor bolts are considered weldable. See Note 2. At the manufacturer's option, a weldable Grade 55 may be supplied when Grade 36 is specified. (Weldable steel for Grade 55 is provided for in Supplementary Requirement S1.) See 17.1.1.

6.5 *Bending:*

6.5.1 When required, bending may be performed by hot- or cold-bending, at the manufacturer's option. The bent portion shall be free from cracks when examined at 10× magnification after bending. Any bending shall not reduce the cross-sectional area below that required in 10.3.

6.5.2 Hot bending temperatures for non-heat-treated anchor bolts shall not exceed 1300°F. Anchor bolts shall be allowed to air cool after bending.

6.5.3 The maximum hot bending temperature for heat-treated anchor bolts shall be less than 700°F for Grade 55 and less than 1000°F for Grade 105. Anchor bolts shall be allowed to air cool after bending.

6.6 *Secondary Processing*—If a party other than the manufacturer or producer performs heat treatment, coating, welding, machining, or another process which affects the anchor bolt properties, that party shall inspect or test the anchor bolts for the affected properties.

6.7 *Nuts:*

6.7.1 Recommended nuts from Specification A563 for each grade and diameter of the anchor bolt are as follows:

Anchor Bolt Grade and Diameter, in.		Specification A563 Nut			
		Plain		Hot-Dip or Mechanical Zinc-coated in accordance with Section 7[A]	
Grade	Diameter, in.	Grade	Style	Grade	Style
36	½ –1½	A	Hex	A	Hex
	over 1½	A	Heavy Hex	A	Heavy Hex
55	½ –1½	A	Hex	A	Heavy Hex
	over 1½ –4	A	Heavy Hex	A	Heavy Hex
105	All	DH	Heavy Hex	DH	Heavy Hex

[A] See Note 3 and Section 7.

6.7.2 A listed nut may be substituted by a nut listed in Specifications A194/A194M or A563 having a proof load stress equal to or higher than the anchor bolt's specified minimum tensile strength.

6.7.3 Nuts for use with zinc-coated anchor bolts shall be zinc-coated by the same process as the bolts. See Section 7 and Note 3.

6.8 *Washers:*

6.8.1 Unless the washer material and dimensions are otherwise specified in the inquiry and the order, washers conforming to the requirements of Specification F436/F436M, Type 1 shall be furnished. (See Note 4.)

6.8.2 Unless otherwise specified, when zinc-coated anchor bolts are specified, the washers shall be zinc coated in accordance with 7.1.4.

NOTE 2—Many factors potentially affect steel weldability; this specification utilizes limits on carbon content for Grades 36 and 55 to help assure it. See Specification A6/A6M, Appendix X3 for more information. When anchor bolts are to be welded, welding procedures and techniques are of fundamental importance. Welding procedures suitable for the bolt's grade, chemistry, condition (that is, hot-rolled, cold-drawn, or heat-treated), and intended use or service should be utilized.

NOTE 3—Zinc-coated nuts of the grade and style recommended in 6.7, when overtapped with the diametral allowance for the thread series listed in Specification A563, will develop the bolt tensile strength required in Table 2 of this specification. However, coated nuts with 8 UN threads in sizes 1-¾ in. and larger, when overtapped, will not develop the tensile strength in Table 2 when the nut and associated bolt dimensions approach the minimum material limits of ASME B 1.1 and B 18.2.2, respectively.

NOTE 4—Washers used on anchor bolts or installed over base plate holes may require design consideration. (For guidance, refer to AISC Design Guide 1.)

7. Protective Coatings

7.1 *Zinc, Hot Dip or Mechanically Deposited:*

7.1.1 When zinc-coated anchor bolts are required, the purchaser shall specify the coating process, for example, hot dip, mechanically deposited, or no preference. When no preference is specified, the supplier may furnish bolts coated with either process. The supplier's option is limited to one process per item, with no mixed processes in a lot.

7.1.2 When hot-dip zinc coated anchor bolts are specified, the anchor bolts and nuts shall be zinc-coated in accordance with the requirements of Specification F2329/F2329M.

7.1.3 When mechanically deposited zinc coated anchor bolts are provided, the anchor bolts and nuts shall be zinc-coated in accordance with the requirements of Specification B695, Class 55.

7.1.4 Unless otherwise specified, when zinc-coated washers are required, the washers shall be hot-dip zinc-coated in accordance with Specification F2329/F2329M, or mechanically deposited zinc coated in accordance with Specification B695, Class 55. The coating process for the washers need not be the same as that for the anchor bolts and nuts.

7.2 *Other Coatings:*

7.2.1 When indicated on the inquiry and purchase order, coatings other than those in 7.1 shall be as agreed upon by the purchaser and supplier.

8. Chemical Composition

8.1 Anchor bolts shall conform to the chemical compositions listed in Table 1.

8.2 Grade 55 ordered as weldable shall conform to the requirements specified in Supplementary Requirement S1.

TABLE 1 Chemical Composition Requirements

Element	Grade 36		Grades 55 and 105
	Diameters up to ¾, incl	Over ⅞ to 4, incl	All Diameters
Carbon, max, %			
Heat	0.25	0.25	...
Product	0.28	0.28	...
Manganese, %			
Heat	...	0.60–0.90	...
Product	...	0.54–0.98	...
Phosphorus, max, %			
Heat	0.04	0.04	0.04
Product	0.05	0.05	0.048†
Sulfur, max, %			
Heat	0.05	0.05	0.05
Product	0.06	0.06	0.058†
Copper, min, % (when specified)			
Heat	0.20	0.20	0.20
Product	0.18	0.18	0.18

†Editorially corrected in April 2016.

8.3 Anchor bolts made from low-carbon martensitic steel shall not be permitted.

8.4 The application of heats of steel to which bismuth, selenium, tellurium, or lead has been added intentionally shall not be permitted.

9. Mechanical Properties

9.1 Finished anchor bolts (or the bar stock from which they are made, when tested as permitted in 14.2.6) shall conform to the tensile properties listed in Table 2 for axial tests performed on full-size specimens and drawn coupons or in Table 3 for tests performed on machined specimens. See 14.2.

10. Anchor Bolt Dimensions

10.1 *Nominal Size*—The nominal anchor bolt diameter shall be the same as the nominal thread diameter.

10.2 *Body Diameter*—Finished anchor bolts' body diameters shall measure no less than the dimensions in Table 4.

10.3 *Bend Section*—The bend section of bent anchor bolts shall have a cross-sectional area not less than 90 % of the area of straight portions. The area in the bend shall be calculated by the following formula:

$$A_b = 0.25\pi D \cdot d$$

where:

A_b = cross-sectional area in the bend,
D = major diameter, at the same cross section as, and at 90 degrees to, the minor diameter, and
d = minor (or minimum) diameter at any point, generally in the plane of the bend.

10.4 *Length:*

10.4.1 The overall length of straight anchor bolts, or length to the inside of the hook if present, shall be the specified length ±½ in. for lengths 24 in. or less, and ±1 in. for longer bolts (see Fig. 1).

10.4.2 The length of hooks shall be the specified inside length, ±10 % of the specified hook length, or ±½ in., whichever is greater. (See Fig. 1, Dimension "h".)

TABLE 2 Axial Tensile Properties for Full-Size Tests of Anchor Bolts and Drawn Coupons[A]

Nominal Diameter, in.	Threads/ in.	Stress Area,[B] in.^{2}	Anchor Bolt Grade					
			36		55		105	
			Tensile Strength, lbf	Yield, min, lbf	Tensile Load, lbf	Yield min, lbf	Tensile Load, lbf	Yield min, lbf
Unified Coarse Thread Series (UNC)								
½	13 UNC	0.1419	8 200–11 400	5 100	10 600–13 500	7 800	17 700–21 300	14 900
⅝	11 UNC	0.226	13 100–18 100	8 100	17 000–21 500	12 400	28 200–33 900	23 700
¾	10 UNC	0.334	19 400–26 700	12 000	25 000–31 700	18 400	41 800–50 100	35 100
⅞	9 UNC	0.462	26 800–37 000	16 600	34 600–43 900	25 400	57 800–69 300	48 500
1	8 UNC	0.606	35 200–48 500	21 800	45 400–57 600	33 300	75 800–90 900	63 600
1⅛	7 UNC	0.763	44 300–61 000	27 500	57 200–72 500	42 000	95 400–114 400	80 100
1¼	7 UNC	0.969	56 200–77 500	34 900	72 700–92 100	53 300	121 000–145 000	102 000
1½	6 UNC	1.405	81 500–112 400	50 600	105 000–133 000	77 300	176 000–216 000	148 000
1¾	5 UNC	1.90	110 000–152 000	68 400	142 000–180 000	104 500	238 000–285 000	200 000
2	4½ UNC	2.50	145 000–200 000	90 000	188 000–238 000	138 000	312 000–375 000	262 000
2¼	4½ UNC	3.25	188 000–260 000	117 000	244 000–309 000	179 000	406 000–488 000	341 000
2½	4 UNC	4.00	232 000–320 000	144 000	300 000–380 000	220 000	500 000–600 000	420 000
2¾	4 UNC	4.93	286 000–394 000	177 000	370 000–468 000	271 000	616 000–740 000	518 000
3	4 UNC	5.97	346 000–478 000	215 000	448 000–567 000	328 000	746 000–896 000	627 000
3¼	4 UNC	7.10	412 000–568 000	256 000	532 000–674 000	390 000	. . .	. . .
3½	4 UNC	8.33	483 000–666 000	300 000	625 000–791 000	458 000	. . .	. . .
3¾	4 UNC	9.66	560 000–773 000	348 000	724 000–918 000	531 000	. . .	. . .
4	4 UNC	11.08	643 000–886 000	399 000	831 000–1 053 000	609 000	. . .	. . .
8 Thread Series (8 UN)								
1⅛	8 UN	0.790	45 800–63 200	28 400	59 200–75 000	43 400	98 800–118 500	83 000
1¼	8 UN	1.000	58 000–80 000	36 000	75 000–95 000	55 000	125 000–150 000	105 000
1½	8 UN	1.492	86 500–119 400	53 700	112 000–142 000	82 100	186 000–224 000	157 000
1¾	8 UN	2.08	121 000–166 000	74 900	156 000–198 000	114 000	260 000–312 000	218 000
2	8 UN	2.77	161 000–222 000	99 700	208 000–263 000	152 000	346 000–416 000	291 000
2¼	8 UN	3.56	206 000–285 000	128 000	267 000–338 000	196 000	445 000–534 000	374 000
2½	8 UN	4.44	258 000–355 000	160 000	333 000–422 000	244 000	555 000–666 000	466 000
2¾	8 UN	5.43	315 000–434 000	195 000	407 000–516 000	299 000	679 000–815 000	570 000
3	8 UN	6.51	378 000–521 000	234 000	488 000–618 000	358 000	814 000–976 000	684 000
3¼	8 UN	7.69	446 000–615 000	277 000	577 000–731 000	423 000	. . .	. . .
3½	8 UN	8.96	520 000–717 000	323 000	672 000–851 000	493 000	. . .	. . .
3¾	8 UN	10.34	600 000–827 000	372 000	776 000–982 000	569 000	. . .	. . .
4	8 UN	11.81	685 000–945 000	425 000	886 000–1 122 000	650 000	. . .	. . .

[A] Tensile properties calculated from the tensile requirements given in Table 3. Yield strength measured at 0.2% offset.
[B] Stress areas extracted from ASME B 1.1.

WINDOWTAL 亿多金属

TABLE 3 Tensile Properties for Bars and Machined Specimens

	Grade		
	36	55	105
Tensile strength, ksi	58–80	75–95	125–150
Yield strength, min, ksi (0.2 % offset)	36	55	105
Elongation in 8 in. , min, %[A]	20	18	12
Elongation in 2 in. min, %[A]	23	21	15
Reduction of Area, min, %	40	30	45

[A] Elongation in 8 in. applies to bars. Elongation in 2 in. applies to machined specimens.

10.5 *Coated Length*—When only a portion of the anchor bolt is required to be coated, the coated length shall not be less than that specified on the order.

10.6 *Thread Length*—The thread length shall be the specified length, +1.0 in., −0.00 in.

10.7 *Bolt Heads*—At the manufacturer's option, headed bolts ordered under this specification shall be hex or heavy hex bolts conforming to ASME B18.2.1, unless otherwise specified.

10.8 *Bend Angle*—The bend angle of hooks shall be the specified angle, ±5°.

10.9 *Other Dimensions*—Unless otherwise specified, tolerances for dimensions other than those given in this section shall be in accordance with the manufacturer's practice.

11. Thread Dimensions

11.1 *Uncoated Anchor Bolts:*

11.1.1 Unless otherwise specified, threads on Class 1A and 2A anchor bolts shall conform to Class 1A and 2A, Unified Coarse Thread Series of ASME B 1.1, respectively. When an anchor bolt class is not specified, Class 2A shall be furnished.

11.1.2 For diameters above 1.0 in, a purchaser may specify threads conforming to Class 2A, 8 UN Thread Series of ASME B1.1.

11.2 *Zinc Coated Anchor Bolts:*

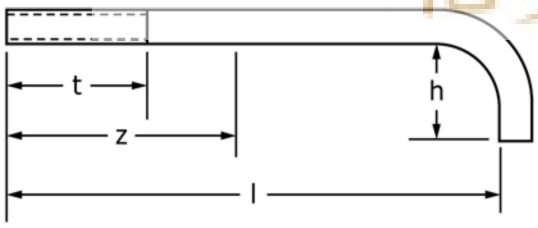
11.2.1 Unless otherwise specified, zinc-coated anchor bolts threads shall conform to Class 1A or 2A, Unified Coarse Thread Series of ASME B 1.1 before coating. For diameters 1.125 through 1.50 in, a purchaser may specify threads conforming to Class 2A, 8 UN Thread Series of ASME B1.1 before coating (see Note 3). After zinc coating, the pitch diameter and major diameters shall not exceed the dimensions listed in Table 5.

TABLE 4 Minimum Body Diameters[A]

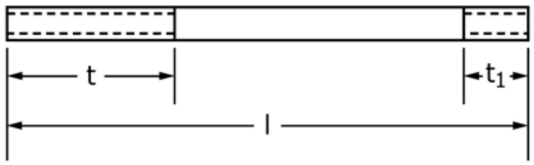
Nominal Diameter, in.	Threads/ in.	Body Diameter, min, in.		
		Rolled Threads[B]		Cut Threads[C] Classes 1A and 2A
		Class 1A	Class 2A	
Unified Coarse Thread Series (UNC)				
½	13 UNC	0.4411	0.4435	0.4822
⅝	11 UNC	0.5561	0.5589	0.6052
¾	10 UNC	0.6744	0.6773	0.7288
⅞	9 UNC	0.7914	0.7946	0.8523
1	8 UNC	0.9067	0.9100	0.9755
1⅛	7 UNC	1.0191	1.0228	1.0982
1¼	7 UNC	1.1439	1.1476	1.2232
1½	6 UNC	1.3772	1.3812	1.4703
1¾	5 UNC	1.6040	1.6085	1.7165
2	4½ UNC	1.8385	1.8433	1.9641
2¼	4½ UNC	2.0882	2.0931	2.2141
2½	4 UNC	2.3190	2.3241	2.4612
2¾	4 UNC	2.5686	2.5739	2.7111
3	4 UNC	2.8183	2.8237	2.9611
3¼	4 UNC	3.0680	3.0734	3.2110
3½	4 UNC	3.3177	3.3233	3.4610
3¾	4 UNC	3.5674	3.5730	3.7109
4	4 UNC	3.8172	3.8229	3.9609
8 Thread Series (8UN)				
1⅛	8 UN	. . .	1.0348	1.1004
1¼	8 UN	. . .	1.1597	1.2254
1½	8 UN	. . .	1.4093	1.4753
1¾	8 UN	. . .	1.6590	1.7252
2	8 UN	. . .	1.9087	1.9752
2¼	8 UN	. . .	2.1584	2.2251
2½	8 UN	. . .	2.4082	2.4751
2¾	8 UN	. . .	2.6580	2.7250
3	8 UN	. . .	2.9077	2.9749
3¼	8 UN	. . .	3.1575	3.2249
3½	8 UN	. . .	3.4074	3.4749
3¾	8 UN	. . .	3.6571	3.7248
4	8 UN	. . .	3.9070	3.9748

[A] Extracted from ANSI/ASME B 1.1.
[B] Minimum body diameter is the same as minimum pitch diameter.
[C] Minimum body diameter is the same as minimum major diameter.

WINDO METAL
亿多金属



Anchor Bolt with Hook



Straight Anchor Bolt

h = inside length of hook
l = inside length of hook
t = length of threads (exposed end)
t_1 = length of threads (encased end), when required
z = length of zinc coating, min, when partial zinc coating is required

FIG. 1 Anchor Bolt Dimensions

TABLE 5 Allowable Zinc Buildup on Coated Threads and Corresponding Thread Dimensions

Nominal Diameter, in.	Threads/in.	Diametral Zinc Buildup, in.[A]	Anchor Bolt Diameter, max, in.	
			Major	Pitch
½	13	0.018	0.5165	0.4685
⅝	11	0.020	0.6434	0.5844
¾	10	0.020	0.7682	0.7032
⅞	9	0.022	0.8951	0.8229
1	8	0.024	1.0220	0.9408
1⅛	8	0.024	1.1469	1.0657
1⅛	7	0.024	1.1468	1.0540
1¼	8	0.024	1.2719	1.1667
1¼	7	0.024	1.2718	1.5740
1½	8	0.027	1.5248	1.4436
1½	6	0.027	1.5246	1.4163
1¾	5	0.050	1.7973	1.6674
2	4.5	0.050	2.0471	1.9028
2¼	4.5	0.050	2.2971	2.1528
2½	4	0.050	2.5469	2.3845
2¾	4	0.050	2.7968	2.6344
3	4	0.050	3.0468	2.8844
3¼	4	0.050	3.2967	3.1343
3½	4	0.050	3.5467	3.3843
3¾	4	0.050	3.7966	3.6342
4	4	0.050	4.0466	3.8842

[A] These values are the same as the overtap requirements for zinc-coated nuts given in Specification A563.

11.3 *Thread Gaging System*—Thread acceptability shall be in accordance with ASME B 1.3 System 21, unless otherwise specified.

12. Workmanship

12.1 Anchor bolts shall be commercially smooth and free of manufacturing defects that would make them unsuitable for the intended application.

13. Number of Tests and Retests

13.1 *Testing Responsibility*—The anchor bolt manufacturer or supplier shall conduct the tests required to determine compliance with this specification, or shall provide evidence when requested that such tests have been conducted. See 14.2.

13.2 *Test Frequency:* Except as permitted in 14.2.6, the number of tests shall be in accordance with Table 6, with an acceptance number of zero discrepancies.

13.3 *Retests*—If a nonconforming characteristic is found in final inspection, the lot may be retested for that characteristic with a sample size twice the size of the original final acceptance sample. The acceptance criterion shall then be zero discrepancies.

13.4 *Purchaser's Inspection:*

13.4.1 Except as noted in 13.4.2, if the purchaser discovers a nonconforming part, he/she may sample the lot for the nonconforming characteristic(s) in accordance with 13.2.

13.4.2 If the nonconforming characteristic in 13.4.1 is a thread dimension (other than thread length), and the anchor bolt grade and nominal diameter are within the ranges of 14.2.4, and the anchor bolt manufacturer or supplier contests the findings, the final determination of thread acceptability shall be as follows: a full-size axial tension test shall be made on the threaded anchor bolt and nut assembly, at the manufacturer's or supplier's expense, and the bolt shall develop the tensile load specified in Table 2. See Note 3.

14. Test Methods

14.1 *Chemical Composition*—Chemical analysis shall be conducted in accordance with Test Methods, Practices, and Terminology A751.

14.2 *Tensile Tests:*

14.2.1 Tensile tests on bar stock shall be conducted in accordance with Test Methods and Definitions A370.

14.2.2 Tensile tests on finished anchor bolts shall be conducted in accordance with the Axial Tension Test Method in F606/F606M.

14.2.3 Yield strength shall be determined by the 0.2 % offset method.

14.2.4 Except as permitted in 14.2.6 and 14.2.7, finished anchor bolts in Grades 36 and 55 with nominal diameters of 1½ in. and less, and in Grades 105 with nominal diameters of 1¼ in. and less, shall be tested using full-size specimens.

14.2.5 Except as permitted in 14.2.6 and 14.2.7, finished anchor bolts with diameters larger than those specified in 14.2.4 shall preferably be tested full size. When equipment for full-size testing of these larger diameters is not available, standard 0.500-in. diameter machined test specimens shall be tested in accordance with Test Methods F606/F606M.

14.2.6 Steel producers' tensile test reports from bar stock used for manufacturing anchor bolts may be used to qualify the finished anchor bolts' properties, provided the finished anchor bolts have undergone no further heat treatment or cold-drawing after the bar stock test. Such bar stock tests may be based on full size or machined specimens and may be based on the steel producers' sample sizes. See 9.1.

14.2.7 Tensile tests on a manufacturer's drawn sample coupons are permitted to qualify a finished anchor bolt's properties, provided *(1)* all heat-treatment or cold-drawing of the coupon is complete, and *(2)* the finished anchor bolt represented by the coupon undergoes no further heat treatment or cold-drawing. In such cases, the grade and diameter requirements in 14.2.4 and 14.2.5 shall still apply.

14.2.8 When the shape of an anchor bolt (that is, a hook or a long overall length) makes tensile testing impractical, it is permissible for manufacturers to test a specimen cut from a suitable straight portion of the anchor bolt. In such cases, the grade and diameter requirements in 14.2.4 and 14.2.5 shall still apply.

14.2.9 If bar stock or anchor bolts are tested by both full-size and machined specimen methods, and a discrepancy between the two methods exists, the full-size test shall govern.

14.3 *Zinc Coating*—Zinc coating thickness shall be determined in accordance with the applicable coating specification.

TABLE 6 Number of Tests for Final Inspection[A]

Test	Lot Size		
	999 and Fewer	1000 to 5000	5000 to 250,000
Chemical composition	One per heat, min	One per heat, min	One per heat, min
Tensile properties—bar stock	One per heat, min	One per heat, min	One per heat, min
Tensile properties—anchor bolts	2 per heat	3 per heat	4 per heat
Body Diameter	2	4	8
Head	2	4	8
Hook or bend length	8	16	32
Thread length	8	16	32
Overall length	8	16	32
Bend section	8	16	32
Bend angle	8	16	32
Coating thickness	8	16	32
Coating length	8	16	32
Workmanship	25	50	100

[A]Extracted from ASME B18.18.

15. Source Inspection

15.1 If specified in the inquiry and purchase order, an inspector representing the purchaser shall have free entry to all parts of the manufacturer's works or supplier's place of business that concern the manufacture or supply of the material ordered. The manufacturer or supplier shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspections required by the specifications that are requested by the purchaser's representative shall be made before shipment, but shall be conducted so as not to interfere unnecessarily with the operation of the works.

16. Rejection and Rehearing

16.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the manufacturer or supplier promptly and in writing. The manufacturer or supplier may then retest per 13.3 for re-approval.

17. Test Reports

17.1 When specified in the purchase order, the manufacturer or supplier shall furnish the purchaser a test report that includes the following:

17.1.1 Steel producer's heat analysis and heat number. The carbon equivalent shall be included when anchor bolts are ordered in accordance with Supplementary Requirement S1, and when weldable Grade 55 anchor bolts are substituted for Grade 36 anchor bolts per 6.4.

17.1.2 Results of tensile tests.

17.1.3 Statement of conformance with applicable coating specification.

17.1.4 Statement of conformance with product and thread dimension requirements.

17.1.5 Statement that the anchor bolts were manufactured and tested in accordance with this specification.

17.1.6 Lot number and purchase order number.

17.1.7 ASTM designation (including year), grade, and class.

17.1.8 Size, description, or purchaser's drawing number.

17.1.9 Supplier's complete mailing address.

17.1.10 Country of origin, if required.

18. Product Marking

18.1 Unless otherwise specified, the end of each anchor bolt intended to project from the concrete shall be color coded to identify the grade as follows:

Grade	Color
36	Blue
55	Yellow
55– Weldable[A]	Yellow (projecting end) & White (encased end)
105	Red

[A] See S1.

18.2 When other markings (such as Supplementary Requirements S2 or S3) are required, it shall be specified on the inquiry and purchase order.

19. Packaging and Package Marking

19.1 *Packaging*—Unless otherwise specified, packaging shall be in accordance with the manufacturer's practices. When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

19.2 *Package Marking:*

19.2.1 Each shipping unit shall be marked in accordance with the manufacturer's practices. When requested in the inquiry and the purchase order, each shipping unit shall include or be marked plainly with the following information:

19.2.1.1 ASTM designation and Grade;

19.2.1.2 Size;

19.2.1.3 Name and brand or trademark of the manufacturer or supplier;

19.2.1.4 Number of pieces;

19.2.1.5 Lot number;

19.2.1.6 Purchase order number; and

19.2.1.7 Country of origin, if required.

20. Keywords

20.1 anchor bolts; anchor rods

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified in the purchase order or contract:

S1. Weldable Grade 55 Bars and Anchor Bolts

S1.1 The material described in this section is intended for welding. This supplemental section, by chemical composition restrictions and by a carbon equivalent formula, helps to provide assurance of weldability.

S1.2 Welding technique is of fundamental importance when bolts produced to this supplementary section are welded. See Note 2.

S1.3 These supplementary requirements supersede conflicting provisions of the general specification.

S1.4 *Chemical Composition:*

S1.4.1 Steel shall conform to the following limitations:

	Heat Analysis	Product Analysis
Carbon, max, %	0.30	0.33
Manganese, max, %	1.35	1.41
Phosphorus, max, %	0.040	0.048
Sulfur, max, %	0.050	0.058
Silicon, max, %	0.50	0.55

S1.4.2 *Carbon Equivalent*—In addition to the requirements specified in S1.4.1, the analysis shall provide a carbon equivalent (CE) meeting the following requirements:

S1.4.2.1 For alloy or low-alloy steel, the carbon equivalent shall not exceed 0.45 % when calculated as follows:

$$CE = \%\ C + \frac{\%\ Mn}{6} + \frac{\%\ Cu}{40} + \frac{\%\ Ni}{20} + \frac{\%\ Cr}{10} - \frac{\%\ Mo}{50} - \frac{\%\ V}{10}$$

S1.4.2.2 For carbon steel, the carbon equivalent shall not exceed 0.40 % when calculated as follows:

$$CE = \%\ C + \frac{\%\ Mn}{4}$$

S1.5 Marking—See 18.1.

S2. Permanent Manufacturer's Identification

S2.1 The end of the anchor bolt intended to project from the concrete shall be steel die stamped with the manufacturer's identification. Such a mark shall be separate and distinct from any grade marks and shall be separated by at least two spaces when on the same level.

NOTE S2.1—Marking small diameters may not be practical. Consult the anchor bolt manufacturer for the minimum diameter that can be marked.

S3. Permanent Grade Identification

S3.1 Instead of color coding as specified in 18.1, the end of the anchor bolt intended to project from the concrete shall be steel die stamped with the grade identification as follows:

Grade	Identification
36	AB36
55	AB55
105	AB105

Such a mark shall be separate and distinct from any manufacturer's marks and shall be separated by at least two spaces when on the same level. See Note S2.1.

S4. Grades 55 and 105 Charpy Absorbed-Energy Requirements

S4.1 When specified in the inquiry and the order, Grade 55 anchor bolts, when tested at +40°F, and Grade 105 anchor bolts, when tested at either +40°F or −20°F (as specified by the purchaser), shall meet the absorbed-energy requirements in Table S1.1.

S4.2 Tests shall be conducted in accordance with Test Methods and Definitions A370.

S4.3 Notch toughness tests shall be performed at the Test Frequency P (Piece Testing) of Specification A673/A673M on finished anchor bolts when the results of notch toughness tests are not available on bar stock.

S4.4 Notch toughness tests shall be performed at the Test Frequency H (Heat Lot Testing) of Specification A673/A673M on bar stock, except when heat treatment is performed after threading or bending, in which case the tests shall be those required in S4.3.

TABLE S1.1 Grades 55 and 105 Energy Requirements

Charpy V-Notch Energy Requirements	
Average for 3 Specimens, min, ft·lbf	Minimum for 1 Specimen, ft·lbf
15	12

WINDO METAL
伦多金属

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (F1554–15$^{\varepsilon 2}$) that may impact the use of this standard.

(1) Clarified hook lengths in Fig. 1 and 10.4.2.
(2) Clarified permissible sample size requirements in 13.2 and 14.2.6.
(3) Revised retest sample sizes in 13.3.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; http://www.copyright.com/

WINDO METAL

亿多金属

WINDO METAL

亿多金属