



Designation: **F1554 – 07a<sup>ε1</sup> F1554 – 15**

## Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength<sup>1</sup>

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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—Table S1.2 was editorially corrected in October 2011.

### 1. Scope\*

1.1 This specification covers ~~straight and bent, headed and headless, carbon, 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 anchor bolts (also known as anchor rods). The anchor bolts are furnished steel.~~ It provides for anchor bolts in three strength grades, two thread classes, and in the sizes/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 ~~The anchor~~ 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 included in Section 7 for applications requiring corrosion protection.

1.5 ~~The recommended grade and style of nut and washer are included.~~ Suitable nuts and washers are listed in 6.66.7 and Washers 6.7 for each are detailed in 6.8 grade.

1.6 This specification does not cover the requirements for 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.

### 2. Referenced Documents

- 2.1 ~~ASTM Standards:~~<sup>2</sup>
- [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](#)
  - ~~D3951 Practice for Commercial Packaging~~
  - [F436 Specification for Hardened Steel Washers](#)
  - ~~F606~~[F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets \(Metric\)](#) ~~F0606~~ ~~F0606M~~ [Direct Tension Indicators, and Rivets](#)
  - [F1789 Terminology for F16 Mechanical Fasteners](#)

<sup>1</sup> 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, 2007/Sept. 1, 2015. Published January 2008/November 2015. Originally approved in 1994. Last previous edition approved in 2007 as F1554 – 07/F1554 – 07a<sup>ε1</sup>. DOI: 10.1520/F1554-07A.10.1520/F1554-15.

<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.

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

~~F2329F2329/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 Research Council on Structural Connections Standard:~~ American Institute of Steel Construction.<sup>3</sup>

~~Specification for Structural Joints Using ASTM Design Guide 1: Base Plate and A325 or Anchor Rod A490 Bolts Design~~

~~2.3 ASME Standards:<sup>4</sup>~~

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

~~B 1.3 Screw Thread Gaging Systems for Dimensional Acceptability 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 Screws (Inch Series)~~

~~B 18.2.2 Square and Hex Nuts~~

~~B-18.18.2MB 18.18 Inspection and Quality Assurance for High Volume Machine Assembly Fasteners~~

### 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *anchor bolt*—~~steel rod or bar, 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 is threaded and projects from the concrete, for anchoring other material to the concrete material. The end cast in concrete may be either straight or provided with an anchor uplift-resisting feature such as a bent hook, forged head, or a tapped or welded attachment to resist forces imposed on the anchor bolt, as required attachment.~~

3.1.2 *manufacturer*—~~manufacturer of the anchor bolt; the party that performs the cutting, bending, and threading operations.~~

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

3.1.4 *purchaser*—~~purchaser of the finished anchor bolt, or his designated agent.~~

3.1.5 *responsible party*—~~see Section 18; this may be the manufacturer or supplier.~~

3.1.6 *supplier*—~~agent who furnishes the finished anchor bolt and nuts to the purchaser; this may be the manufacturer.~~

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

### 4. Classification

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

Grade	Tensile Strength, ksi (MPa)	Description Yield Strength, min, ksi (MPa)	Size Range, in. (mm)
36 <sup>A</sup>	58–80 (400–558)	36 (248)	1/2–4 (6.4–102)
55	75–95 (517–655)	55 (380)	1/2–4 (6.4–102)
105	125–150 (862–1034)	105 (724)	1/2–3 (6.4–76)
Class			
1A		anchor bolts with Class 1A threads	
2A		anchor bolts with Class 2A threads	

<sup>A</sup> When Grade 36 is specified, a weldable Grade 55 may be furnished at the supplier's option.

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

4.2 Weldable steel for Grade 55 is provided for in Supplementary Requirement SI.

### 5. Ordering Information

5.1 ~~Orders for anchor bolts should include the following information:~~ should include:

<sup>3</sup> Available from Research Council on Structural Connections, c/o Industrial Fasteners Institute, 1717 East 9th Street, Cleveland, OH 44114. American Institute of Steel Construction, One East Wacker Drive, Suite 700, Chicago, IL 60601

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

5.1.1 *Quantity (Number of Pieces)*—If the purchaser intends to perform destructive tests on finished anchor bolts, the manufacturer should be advised so that an adequate number are produced, especially for the sizes and types not readily available from stock. Quantity.

5.1.2 *Name of product (steel anchor bolt).* Product name.

5.1.3 *ASTM designation and year of issue.*

5.1.4 *Grade and class, that is, Grade 36, 55, or 105 and Class 1A or 2A. Weldable Grade 55 may be furnished when Grade 36 is ordered (see class 4.1):*

5.1.5 *Copper, Copper content, if copper bearing steel is required.*

5.1.6 *Size and Dimensions*—Include the Nominal diameter and threads (based on nominal thread diameter), thread pitch, bolt length, thread length, and length of hook if a hook is required, or provide a drawing showing the required information, head type (if required) and hook angle and hook length (if required).

5.1.7 *Coatings*—Zinc coatings in accordance with If 7.1. When zinc coatings in accordance with 7.1 are required, specify the zinc coating process to be used, that is, hot dip, mechanically deposited, or no preference (see coating process and 7.1). Also, specify the length to be coated as measured from the exposed end. See Section 7.

5.1.8 *Other Coatings*—Specify other protective coatings, if required (see 7.2).

5.1.8 *Number of nuts, either nuts. See 6.7 the total number or number per bolt.*

5.1.9 *Number of washers, either the total number or number per bolt, and dimensions if other than and washer dimensions and material, if applicable. See 6.8 standard.*

5.1.10 *Inspection at place of manufacture, if required (see Source inspection requirements, if any. See Section 15.115).*

5.1.11 *Color coding, if different from the standard in than Section 19.118.*

5.1.12 *Test reports, if required (see required. See Section 17.117).*

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; steel anchor bolts; ASTM F1554 designations including issue date; 15 Grade 55; Class 2A; Supplementary Requirement S 1; 1.0-8-in. thread size-1.0-8 tpi. diameter by 15-in. long, 3.0-in. thread length, 4.0-in. hook; zinc-coated 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 When required, the anchor bolts may be heat treated to develop the specified properties. Heat treatment shall be at the option of the manufacturer.

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 required, the performed, anchor bolts shall be heat treated by quenching (or their raw material) shall be quenched in a liquid medium from above the transformation temperature and then tempering tempered by reheating to a temperature not less than 800°F (425°C) for Grade 55 and 1100°F (593°C) 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, hooks, shall bending may be made performed by cold bending or hot bending. 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.

6.4.2 Hot bending performed on bar stock without heat treatment shall not have the temperature exceed 1300°F (705°C) at any location during hot bending and shall be allowed to air cool after bending.

6.5.2 Hot bending performed on heat-treated bar stock shall not have the temperature come within 100°F (56°C) of the tempering (stress relieve) temperature of the heat-treat process at any location during hot bending and 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 bending shall not reduce the cross-sectional area below that required in maximum hot bending temperature for heat-treated anchor bolts shall be less than 700°F for Grade 55 and less 10.3 than 1000°F for Grade 105. Anchor bolts shall be allowed to air cool after bending.

6.6 *Secondary Processing*—If a subcontractor, or party other than the manufacturer or producer, producer performs heat treatment, coating, welding, machining, or other another process affecting the properties or performance of the anchor bolts, the anchor bolts shall be inspected and tested after such processing by the party responsible for supplying the anchor bolts to the purchaser, which affects the anchor bolt properties, that party shall inspect or test the anchor bolts for the affected properties.

### 6.7 Recommended Nuts:

6.7.1 Unless otherwise specified, all nuts used on these anchor bolts shall conform to the requirements of Specifications Recommended nuts from Specification A194/A194M or A563 and shall be of the grade, surface finish, and style for each grade and sizediameter of the anchor bolt are as follows:

Anchor Bolt Grade and Size, in.-(mm)		Specification <u>A563</u> Recommended Nut Plain		Hot-Dip or Mechanical Zinc-Coated in accordance with 7.1	
Grade	—Size, in.-(mm)	Grade	—Style	Grade	—Style
36	1/2–1 1/2 (6.4–38)	A	Hex	A	Hex
-	over 1 1/2–4.0 (38–102)	A	Heavy Hex	A	Hvy-Hex
55	1/2–1 1/2 (6.4–38)	A	Hex	A	Hvy-Hex
-	over 1 1/2–4.0 (38–102)	A	Heavy-Hex	A	Hvy-Hex
105	1/4–1 1/2 (6.4–38)	D	Hex	DH	Hvy-Hex
-	over 1 1/2–3.0 (38–76)	DH	Heavy-Hex	DH	Hvy-Hex

Anchor Bolt Grade and Diameter, in.		Specification <u>A563</u> Nut Plain		Hot-Dip or Mechanical Zinc-coated in accordance with Section 7 <sup>A</sup>	
Grade	Diameter, in.	Grade	Style	Grade	Style
36	1/2–1 1/2	A	Hex	A	Hex
-	over 1 1/2	A	Heavy Hex	A	Heavy Hex
55	1/2–1 1/2	A	Hex	A	Heavy Hex
-	over 1 1/2–4.0	A	Heavy Hex	A	Heavy Hex
105	All	DH	Heavy Hex	DH	Heavy Hex

<sup>A</sup>See Note 3 and Section 7.

6.7.2 The requirements for the recommended grade and style of A listed nut may be fulfilledsubstituted by furnishing a nut of one of the grades or styles a nut listed in Specifications A194/A194M or A563 having a proof load stress equal to or higher than the minimum tensile strength specified for the anchor bolt.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 Recommended Washers:

6.7.1 The washer material and dimensions shall be specified in the inquiry and the order (see Note 2).

6.8.1 Unless the requirement of washer material 6.7.1 is met, and dimensions are otherwise specified in the inquiry and the order, washers conforming to the requirements of Specification F436, Type 1 shall be furnished. (See Note 4.)

6.8.2 When Unless otherwise specified, when zinc-coated anchor bolts are specified to be zinc-coated,specified, the washers shall be zinc coated as specified in 7.1, exceptaccordance with 7.1.4that the coating process for the washers need not be the same as that for the anchor bolts and nuts.

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 1-3/4 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, installed in holes with dimensions greater than oversize or short slot as defined by the Research Council on Structural Connections, bolts or installed over base plate holes may require design consideration. (For guidance, refer to Specification for Structural Joints Using ASTM-AISC Design Guide 1.) A325 or A490 Bolts.)

## 7. Protective Coatings

7.1 Zinc, Hot Dip or Mechanically Deposited—Deposited: Specification F2329, and mechanically deposited, Specification B695, Class 55.

7.1.1 When zinc-coated anchor bolts with the coating specified in 7.1 are required, the purchaser shall specify the zinc 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 is specified, the fasteners shall be zinc coated by the hot-dip process zinc coated anchor bolts are specified, the anchor bolts and nuts shall be zinc-coated in accordance with the requirements of Specification F2329F2329/F2329M.

7.1.3 When mechanically deposited is specified, the fasteners shall be zinc coated by the mechanical deposition process in accordance with the requirements of Class 55 of Specification B695.

7.1.3 When no preference is specified, the supplier may furnish either a hot-dip zinc coating mechanically deposited zinc coated anchor bolts are provided, the anchor bolts and nuts shall be zinc-coated in accordance with Specification **F2329**, or a mechanically deposited zinc coating in accordance with Specification requirements of Specification **B695**, Class 55. Threaded components (bolts and nuts) shall be coated by the same zinc-coating process, and the supplier's option is limited to one process per item, with no mixed processes in a lot.

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

7.2.2 The complete specification shall be included as part of the purchase order when other coatings are specified.

8. Chemical Composition

8.1 Anchor bolts shall have a chemical composition conforming conform to the requirements chemical compositions listed in Table 1 for Grade 36 and Table 2 for Grades 55 and 105.

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

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.

8.5 Product analyses may be made by the purchaser from finished anchor bolts representing each heat. The chemical composition thus determined shall conform to the requirements specified in 8.1 through 8.4.

9. Mechanical Properties

9.1 Bars The bars or rods from which the anchor bolts are made 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, except when heat treated after bending or for tests performed on machined specimens. See 14.2 threading.

TABLE 1 Chemical Requirements for Grade 36 Composition Requirements

Element	Diameter, in. (mm) Grades 55 and 105		
	Element Grade 36 To Diameters 3/4 (20) up to 3/4, incl	Over 7/8 to 1 1/4 (20 to 40), incl	Over 1 1/2 All Diameters 1/2 to 4 (40 to 100), incl
Carbon, max, %			
—Heat	0.26	0.27	0.28
—Heat	0.25	0.25	...
—Product	0.29	0.30	0.31
—Product	0.28	0.28	...
Manganese, %			
—Heat	<sup>A</sup>	0.60–0.90	0.60–0.90
—Heat	...	0.60–0.90	...
—Product	<sup>A</sup>	0.54–0.98	0.54–0.98
—Product	...	0.54–0.98	...
Phosphorus, max, %			
—Heat	0.04	0.04	0.04
—Product	0.05	0.05	0.05
—Product	0.05	0.05	0.48
Sulfur, max, %			
—Heat	0.05	0.05	0.05
—Product	0.06	0.06	0.06
—Product	0.06	0.06	0.58
Copper, min, % (when specified)			
—Heat	0.20	0.20	0.20
—Product	0.18	0.18	0.18

<sup>A</sup> Optional with the manufacturer but shall be compatible with weldable steel.

TABLE 2 Chemical Requirements for Grades 55 and 105

Element	Composition, %	
	Heat Analysis	Product Analysis
Phosphorous, max	0.040	0.048
Sulfur, max	0.050	0.058
Copper, min (when Cu is specified)	0.20	0.18

TABLE 3 Tensile Properties for Bars and Machined Specimens

	Grade		
	36	55	105
Tensile strength, ksi	58-80	75-95	125-150
Tensile strength, MPa	(400-552)	(517-655)	(862-1034)
Yield strength, min, ksi (0.2% offset)	36	55	105
Yield strength, min, MPa (0.2% offset)	248	380	724
Elongation in 8 in. (200 mm), min, % <sup>A</sup>	20	18	12
Elongation in 2 in. (50 mm), min, % <sup>A</sup>	23	21	15
Reduction of Area, min, %			
— ¼ to 2 in. (6.4 to 50 mm), incl	40	30	45
— over 2 to 2½ in. (50 to 63 mm), incl	40	22	45
— over 2½ to 3 in. (63 to 76), incl	40	20	45
— over 3 to 4 in. (76 to 102 mm), incl	40	18	...

<sup>A</sup> Elongation in 8 in. (200 mm) applies to bars. Elongation in 2 in. (50 mm) applies to tests on machined specimens.

TABLE 42 Axial Tensile Properties for Full-Size Tests of Anchor Bolts and Draw Coupons<sup>A</sup>

Nominal Size, Diameter, in.	Threads/in.	Stress Area, <sup>A</sup> in. <sup>2</sup>	Anchor Bolt Grade					
			36		55		105	
			Tensile Strength, <sup>B</sup> kibf/lf	Yield Strength, <sup>B</sup> kibf/lf Yield, <sup>BC</sup> min, kibf/lf	Tensile Strength-Load, <sup>B</sup> kibf/lf	Yield Strength, <sup>BC</sup> min, kibf/lf	Tensile Strength-Load, <sup>B</sup> kibf/lf	Yield Strength, <sup>BC</sup> min, kibf/lf
Unified Coarse Thread Series (UNC)								
¼	20 UNC	-0.0318	1.89-2.54	1.15	2.4-3.0	-1.75	3.98-4.27	-3.34
¾	16 UNC	-0.0775	4.5-6.2	-2.8	5.8-7.36	-4.26	9.7-11.6	-8.14
½	13 UNC	-0.1419	8.2-11.4	-5.1	10.6-13.5	-7.8	17.7-21.3	-14.9
¾	13 UNC	0.1419	8,200-11,400	5,100	10,600-13,500	7,800	17,700-21,300	14,900
	11 UNC	-0.226	13.1-18.1	-8.1	17.0-21.5	-12.4	28.2-33.9	-23.7
¾	11 UNC	0.226	13,100-18,100	8,100	17,000-21,500	12,400	28,200-33,900	23,700
	10 UNC	-0.334	19.4-26.7	-12.0	25.0-31.7	-18.4	41.8-50.1	-35.1
¾	10 UNC	0.334	19,400-26,700	12,000	25,000-31,700	18,400	41,800-50,100	35,100
	9 UNC	-0.462	26.8-37.0	-16.6	34.6-43.9	-25.4	57.8-69.3	-48.5
¾	9 UNC	0.462	26,800-37,000	16,600	34,600-43,900	25,400	57,800-69,300	48,500
	8 UNC	-0.606	35.2-48.5	-21.8	45.4-57.6	-33.3	75.8-90.9	-63.6
1	8 UNC	0.606	35,200-48,500	21,800	45,400-57,600	33,300	75,800-90,900	63,600
	7 UNC	-0.763	44.3-61.0	-27.5	57.2-72.5	-42.0	96.4-114.4	-80.1
1 ¼	7 UNC	0.763	44,300-61,000	27,500	57,200-72,500	42,000	96,400-114,400	80,100
	7 UNC	-0.969	56.2-77.5	-34.9	72.7-92.1	-53.3	121-145	102
1 ¼	7 UNC	0.969	56,200-77,500	34,900	72,700-92,100	53,300	121,000-145,000	102,000
	1 ½	6 UNC	-1.405	81.5-112.4	-50.6	105.0-133.0	-77.3	176-216
6 UNC		1.405	81,500-112,400	50,600	105,000-133,000	77,300	176,000-216,000	148,000
1 ¾	5 UNC	-1.90	110-152	-68.4	142-180	104.5	238-285	200
	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	145-200	-90.0	188-238	138	312-375	262
	4½ UNC	2.50	145,000-200,000	90,000	188,000-238,000	138,000	312,000-375,000	262,000
2 ¼	4½ UNC	-3.25	188-260	117	244-309	179	406-488	341
	4½ UNC	3.25	188,000-260,000	117,000	244,000-309,000	179,000	406,000-488,000	341,000
2 ½	4 UNC	-4.0	232-320	144	300-380	220	500-600	420
	4 UNC	4.0	232,000-320,000	144,000	300,000-380,000	220,000	500,000-600,000	420,000
2 ¾	4 UNC	-4.93	286-394	177	370-468	271	616-740	518
	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	346-478	215	448-567	328	746-896	627
	4 UNC	5.97	346,000-478,000	215,000	448,000-567,000	328,000	746,000-896,000	627,000
3 ¼	4 UNC	-7.10	412-568	256	532-674	390	...	...
	4 UNC	7.10	412,000-568,000	256,000	532,000-674,000	390,000	...	...
3 ½	4 UNC	-8.33	483-666	300	625-791	458	...	...
	4 UNC	8.33	483,000-666,000	300,000	625,000-791,000	458,000	...	...
3 ¾	4 UNC	-9.66	560-773	348	724-918	531	...	...