



Designation: **A354 – 11 A354 – 17**

Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners¹

This standard is issued under the fixed designation A354; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification² covers the chemical and mechanical requirements of quenched and tempered alloy steel bolts, studs, and other externally threaded fasteners 4 in. and under in diameter for application at normal atmospheric temperatures, where high strength is required and for limited application at elevated temperature (**Note 1**). Any alloy steel capable of meeting the **minimum** mechanical and chemical properties set forth in this specification may be used.

NOTE 1—For bolts, studs, or other externally threaded fasteners, to be used at elevated temperatures, refer to Specification **A193/A193M**.

1.2 ~~Two levels of bolting strength~~ strength levels are covered, designated Grades BC and BD. Selection will depend upon design and the stresses and service for which the product is to be used.

NOTE 2—Quenched and tempered alloy steel bolts for structural steel joints up through 1½ in. in diameter are covered in Specification **A490F3125/F3125M**. ~~Alloy steel bolts, studs, and other externally threaded fasteners (that is, heavy hex structural bolts over 1½ in. in diameter) exhibiting similar mechanical properties to bolts conforming to Grade BC may be considered for structural steel bolting where tensile strength above 120 ksi is necessary and Grade BD may be considered for structural steel bolting where tensile strength above 150 ksi is necessary. In this event, additional requirements of Specification **A490F3125/F3125M** shall be covered by Grade BD of this specification.~~ For fastener diameter sizes above 1½ in., hex bolts, anchor bolts, and countersunk bolts) exhibiting similar mechanical properties to bolts conforming to Grade BC may be considered for structural steel bolting where tensile strength above 120 ksi is necessary and Grade BD may be considered for structural steel bolting where tensile strength above 150 ksi is necessary. In this event, additional requirements of Specification **A490F3125/F3125M** shall be covered by Grade BD of this specification. ~~such as head size, lubricant, and magnetic particle inspection, should be carefully considered.~~

~~When bolts of Grade BD of this specification are considered for pretensioned applications in excess of 50% of the bolt tensile strength, the additional requirements of head size, maximum tensile strength, nut size and strength, washer hardness, tests, and inspections contained in Specification **A490** should be carefully considered.~~

1.3 Nuts are covered in Specification **A563**. Unless otherwise specified, the grade and style of nut for each grade of fastener shall be as follows:

Document Preview

ASTMA354-17

<https://standards.iteh.ai/catalog/standards/sist/048e8987-ab74-4c87-ae17-b77627852c38/astm-a354-17>

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. 15, 2011; May 1, 2017. Published December 2011; June 2017. Originally approved in 1952. Last previous edition approved in 2007 as **A354 – 07a**; **A354 – 11**. DOI: 10.1520/A0354-11; 10.1520/A0354-17.

² For *ASME Boiler and Pressure Vessel Code* applications see related Specification SA-354 in Section II of that Code.

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

Grade of Fastener and Surface Finish
 BC, plain (or with a coating of insufficient thickness to require over-tapped nuts)
 BC, zinc-coated (or with a coating thickness requiring over-tapped nuts)
 BD, all finishes

Nut Grade and Style^A
 C, heavy hex
 DH, heavy hex
 DH, heavy hex

^A Nuts of other grades and styles having specified proof load stresses (Specification [A563](#), Table 3) greater than the specified grade and style of nut are suitable.

~~1.4 The values stated in inch-pound units are to be regarded as the standard. Optional supplementary requirements are provided at the end of this standard.~~

1.5 Terms used in this specification are defined in Terminology [F1789](#) unless otherwise defined herein.

~~1.6 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.~~

~~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:³

[A193/A193M](#) Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

~~[A490](#) Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength (Withdrawn 2016)⁴~~

[A563](#) Specification for Carbon and Alloy Steel Nuts

[A751](#) Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

[B695](#) Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

[E23](#) Test Methods for Notched Bar Impact Testing of Metallic Materials

[E709](#) Guide for Magnetic Particle Testing

~~[D3954/E1268](#) Practice for Commercial Packaging Assessing the Degree of Banding or Orientation of Microstructures~~

[E1417/E1417M](#) Practice for Liquid Penetrant Testing

[E1444/E1444M](#) Practice for Magnetic Particle Testing

[E2884](#) Guide for Eddy Current Testing of Electrically Conducting Materials Using Conformable Sensor Arrays

~~[F436/F436M](#) Specification for Hardened Steel Washers (Metric) F0436_F0436M Inch and Metric Dimensions~~

~~[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~~

[F788/F788M](#) Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

[F1470](#) Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

[F1789](#) Terminology for F16 Mechanical Fasteners

[F2328](#) Test Method for Determining Decarburization and Carburization in Hardened and Tempered, Threaded, Steel Bolts, Screws, Studs, and Nuts

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

[F3125/F3125M](#) Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

2.2 ASME Standards:⁴

[B1.1](#) Unified Screw Threads

[B18.2.1](#) Square and Hex Bolts and Screws, Inch Series

[B18.24](#) Part Identifying Number (PIN) Code System Standard for B18 Fastener Products

2.3 ISO Publication⁵

[ISO TR 20491](#) Fundamentals of Hydrogen Embrittlement in Steel Fasteners⁶

³ 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.

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

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁶ Pending approval.

3. Ordering Information

- 3.1 Orders for bolts and studs (including nuts and accessories) under this specification shall include the following:
- 3.1.1 ASTM designation and year of issue,
 - 3.1.2 Name of product (that is, bolt or stud),
 - 3.1.3 Grade (that is, BC or BD),
 - 3.1.4 Quantities (number of pieces by size, including ~~nuts~~), ~~nuts, and washers~~,
 - 3.1.5 ~~Size and length~~, Size, including nominal bolt diameter and bolt length, and thread pitch if other than standard,
 - 3.1.6 ~~Washers—Specify quantity and size (separate from bolts) (4.3),~~
 - 3.1.6 Zinc Coating—When zinc-coated Grade BC fasteners are required, specify the zinc-coating process required, for example hot-dip, mechanically deposited, or no preference (see 4.44.3).
 - 3.1.7 Other Finishes—Specify other protective finish, if required.
 - 3.1.8 Specify if inspection at point of manufacture is required,
 - 3.1.9 Specify if ~~Certification Test Reports~~ (Section 1417) ~~is~~ are required, ~~and~~
 - 3.1.10 Specify additional testing (Section 912) or special ~~requirements~~. requirements, and
 - 3.1.11 Any supplementary requirements.
 - 3.1.12 For establishment of a part identifying system, see ASME B18.24.

4. Materials and Manufacture

~~4.1 The steel shall be made by the open-hearth, electric-furnace, or basic-oxygen process.~~

4.1 All fasteners shall be heat-treated. At the option of the manufacturer, heat treatment may be performed on the raw material, during the manufacturing operations, or after final forming or machining. Heat treatment shall consist of quenching in a liquid medium (~~except Grade BD sizes 1½ in. and smaller shall be quenched in oil~~) from above the austenite transformation temperature and then tempering by reheating to a temperature of not less than 800°F (427°C) for Grade BC and for Grade BD. 800°F. When heat treatment is performed after threading for headed fasteners or double end studs, the fasteners shall be quenched in oil.

NOTE 3—The manufacturer should ensure that the austenite transformation temperature has been exceeded and sufficient time allowed to achieve adequate transformation to martensite throughout the fastener during quenching. This requirement is especially critical for sizes above 1½ in. as they require more time for heat transfer from the center. This microstructure helps to ensure uniform mechanical properties, specifically hardness, strength and toughness, are achieved throughout the fastener.

4.2 ~~When used, suitable hardened washers shall be quenched and tempered (non-carburized)~~ Washers for bolts supplied to this standard shall be in accordance with Specification ~~F436~~F436/F436M. Nuts for bolts supplied to this standard shall be in accordance with Specification A563.

4.3 ~~Zinc Coatings, Hot-Dip and Mechanically Deposited~~ Deposited Requiring Over-tapped Nuts: c38/astm-a354-17

4.3.1 When zinc-coated fasteners are required, the purchaser shall specify the zinc coating process, for example, hot-dip, mechanically deposited, or no preference.

4.3.2 When “hot-dip” is specified, the ~~fasteners threaded components~~ (bolts and nuts) shall be zinc coated by the hot-dip process in accordance with the requirements of Specification ~~F2329~~F2329/F2329M.

4.3.3 When ~~mechanically deposited~~ “mechanically deposited” is specified, the ~~fasteners threaded components~~ (bolts and nuts) shall be zinc-coated by the mechanical-deposition process in accordance with the requirements of Class 55 of Specification B695.

4.3.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification ~~F2329~~F2329/F2329M, or a mechanically deposited zinc coating in accordance with 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.

NOTE 3—When the intended application requires that assembled tension exceeds 50% of minimum bolt proof load, an anti-galling lubricant may be needed. Application of such a lubricant to nuts and a test of the lubricant efficiency are provided in Supplementary Requirement S1 of Specification ~~A563~~ and should be specified when required.

4.3.5 Unless otherwise specified, when zinc-coated washers are required, the washers shall be hot-dip zinc coated in accordance with Specification ~~F2329~~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 threaded components (bolts and nuts).

NOTE 4—See ISO TR 20491⁶, “Fundamentals of Hydrogen Embrittlement in Steel Fasteners”, listed in 2.3, in regard to the susceptibility of high hardness, electroplated zinc coated materials to hydrogen embrittlement.

4.4 Zinc-coated bolts and nuts shall be shipped in the same container unless specifically requested otherwise by the purchaser.
Other Coatings:

NOTE 4—Research conducted on bolts of similar material and manufacture indicates that hydrogen-stress cracking or stress cracking corrosion may occur on hot-dip galvanized Grade BD bolts.

4.4.1 When other coatings are required, the purchaser shall specify the coating specification, including the classification codes or grade numbers to identify the coating material, thickness, supplemental treatments, or other requirements to define the coating. The fasteners shall be coated in accordance with and conform to the specified coating specification.

4.4.2 When a specification does not apply, the purchaser shall specify the desired coating, coating thickness, supplementary treatments, or other requirements to define the coating.

5. Chemical Composition

5.1 All fasteners shall be made from alloy steel conforming to the chemical composition requirements in accordance with **Table 1**. The steel shall contain sufficient alloying elements to qualify it as an alloy steel.

NOTE 5—Steel is considered to be alloy, by the American Iron and Steel Institute, when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: manganese, 1.65 %; silicon, 0.60 %; copper, 0.60 %; or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

5.2 Product analysis may be made by the purchaser from finished material representing each lot of fasteners. The chemical composition thus determined shall conform to the requirements given in **Table 1**. Choice of alloy steel composition necessary to ensure meeting the specified mechanical requirements shall be made by the manufacturer and shall be reported to the purchaser for information purposes only.

TABLE 1 Chemical Requirements

Alloy Steel for Sizes through 4 in. for Grade BC and through 2 ¼ in. for Grade BD		
Element	Heat Analysis, %	Product Analysis, %
Carbon:		
For sizes through 1½ in.	0.30 to 0.53	0.28 to 0.55
Carbon:	0.30 to 0.53	0.28 to 0.55
For sizes larger than 1½ in.	0.35 to 0.53	0.33 to 0.55
Manganese, min	0.60	0.57
Manganese, min	0.600	0.570
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Boron, max	0.003	0.003
Alloying Elements	A	A
Alloy Steel with Boron Addition		
Alloy Steel for Grade BD Sizes over 2 ¼ in. through 4 in.		
Element	Heat Analysis, %	Product Analysis, %
Carbon	0.35-0.53	0.33-0.55
For sizes through 1½ in.	0.30-0.48	0.28-0.50
Nickel, min	0.400	0.380
For sizes larger than 1½ in.	0.35-0.53	0.35-0.55
Chromium, min	0.400	0.380
Molybdenum, min	0.150	0.150
Manganese, min	0.60	0.57
Manganese, min	0.600	0.570
Phosphorus, max	0.040	0.045
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Boron	0.0005-0.003	0.0005-0.003
Boron, max	0.003	0.003
Other Alloying Elements	A	A

^ASteel, as defined See Terminology **F1789** by the American Iron and Steel Institute, shall be considered to be alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: manganese, 1.65 %; silicon, 0.60 %; copper, 0.60 % or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect for alloy steel definition.

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

5.4 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology **A751**.

6. Mechanical Properties

6.1 ~~Fasteners shall not exceed the maximum hardness specified in **Table 2**. Fasteners less than three diameters in length and studs less than four diameters in length shall have hardness values not less than the minimum nor more than the maximum hardness limits required in **Table 2**, as hardness is the only requirement.~~

6.2 ~~Fasteners 1½ in. in diameter or less for Grade BC and 1¼ in. in diameter or less for Grade BD, other than those excepted in **6.1**, shall be tested full size and shall conform to the tensile strength and either the proof load or the yield strength requirements in accordance with **Table 3**.~~

6.1 *Tensile Properties:* ~~Fasteners larger than 1¾ in. in diameter for Grade BC and fasteners larger than 1¼ in. in diameter for Grade BD, other than those excepted in **6.1**, shall preferably be tested full size and when so tested, shall conform to the tensile strength and either the proof load or yield strength requirements in accordance with **Table 3**. When equipment of sufficient capacity for full-size testing is not available, or when the length of the fastener makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements in accordance with **Table 4**. In the event that fasteners are tested by both full-size and by the machined test specimen methods, the full-size test shall govern if a controversy between the two methods exists.~~

6.1.1 ~~Except as permitted in **6.1.2** and **6.1.3**, diameters of headed fasteners 1 in. and smaller having a nominal length of 2 ¼ D and longer, and diameters over 1 in. having a nominal length of 3D and longer, shall be wedge tested full size to Test Method **F606/F606M** and shall conform to the tensile load and proof load in **Table 3**.~~

6.1.2 ~~Headed fasteners with diameters 1 in. and smaller having a nominal length shorter than 2 ¼ D down to 2D, inclusive, that cannot be wedge tensile tested, shall be axially tension tested full size to Test Method **F606/F606M** and shall conform to the tensile load and proof load in **Table 3**.~~

6.1.3 ~~Headed fasteners with diameters 1 in. and smaller having a nominal length shorter than 2D and diameters larger than 1 in. with nominal lengths shorter than 3D that cannot be axially tensile tested shall be accepted on the basis of hardness in **Table 2**.~~

6.1.4 ~~Studs with nominal lengths of 5D and longer shall be axially tension tested full size and shall conform to the tensile load and proof load in **Table 3**. Studs with nominal lengths less than 5D shall be qualified on the basis of hardness in **Table 2**.~~

6.1.5 ~~Fracture on full-size tests shall be in the threads of the fastener without fracture at the junction of the head and body.~~

6.1.6 ~~When the sizes of the fastener makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements in **Table 4**. When bolts are tested by both full-size and machined specimen methods, the full-size test shall take precedence.~~

6.2 *Hardness*—~~Fasteners shall conform to the hardness in **Table 2**. Fasteners over 2¼ in. in nominal diameter shall conform to the cross sectional hardness requirements in Section 9.~~

6.3 ~~For fasteners on which both hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event that there is controversy over low readings of hardness tests, except as stated in **9.1.1**.~~

7. Carburization/Decarburization

7.1 Requirements:

7.1.1 *Carburization*—~~The bolts shall show no evidence of a carburized surface when evaluated in accordance with Test Method **F2328**.~~

7.1.2 *Decarburization*—~~Hardness value differences shall not exceed the requirements set forth for decarburization in Test Method **F2328**. Grade BC shall meet the requirements of Class 1 and Grade BD shall meet the requirements of Class 2, regardless of size.~~

TABLE 2 Hardness Requirements for Full-Size Fasteners

Size, in.	Grade	Hardness			
		Brinell		Rockwell C	
		Minimum	Maximum	Minimum	Maximum
¼ to 2½	BC	255	331	26	36
Over 2½	BC	235	311	22	33
¼ to 2½	BD	311	363	33	39
All sizes	BD	311	352	33	38
Over 2½	BD	293	363	31	39

TABLE 3 Tensile Requirements for All Full-Size Fasteners—Inch-Pound Units

Bolt Size, in.	Threads per inch	Stress Area, ^A in. ²	Grade BC			Grade BD			
			Ultimate Tensile Strength, Load, min, lbf ^B	Proof Load, min, lbf ^C	Yield Strength (0.2 % offset), min, lbf ^D	Ultimate Tensile Strength, Load, min, lbf ^E	Ultimate Tensile Load, max, lbf ^F	Proof Load, min, lbf ^G	Yield Strength (0.2 % offset), min, lbf ^H
1	2	3	4	5	6	7	8	9	10
1/4	20	-0.0318	4 000	3 350	3 450	4 750	3 800	4 100	
1/4	20	0.0318	4 000	3 350	3 450	4 750	5 500	3 800	4 100
1/4	28	-0.0364	4 550	3 820	3 950	5 450	4 350	4 700	
1/4	28	0.0364	4 550	3 820	3 950	5 450	6 300	4 350	4 700
5/16	18	-0.0524	6 550	5 500	5 700	7 850	6 300	6 800	
5/16	18	0.0524	6 550	5 500	5 700	7 850	9 050	6 300	6 800
5/16	24	-0.0580	7 250	6 090	6 300	8 700	6 950	7 500	
5/16	24	0.0580	7 250	6 090	6 300	8 700	10 000	6 950	7 500
3/8	16	-0.0775	9 700	8 150	8 450	11 650	9 300	10 075	
3/8	16	0.0775	9 700	8 150	8 450	11 650	13 400	9 300	10 075
3/8	24	-0.0878	11 000	9 220	9 550	13 200	10 500	11 400	
3/8	24	0.0878	11 000	9 220	9 550	13 200	15 200	10 500	11 400
7/16	14	-0.1063	13 300	11 150	11 600	15 950	12 750	13 850	
7/16	14	0.1063	13 300	11 150	11 600	15 950	18 400	12 750	13 850
7/16	20	-0.1187	14 840	12 470	12 900	17 800	14 200	15 400	
7/16	20	0.1187	14 840	12 470	12 900	17 800	20 550	14 200	15 400
1/2	13	-0.1419	17 750	14 900	15 450	21 300	17 050	18 500	
1/2	13	0.1419	17 750	14 900	15 450	21 300	24 550	17 050	18 500
1/2	20	-0.1599	19 990	16 790	17 400	24 000	19 200	20 750	
1/2	20	0.1599	19 990	16 790	17 400	24 000	27 650	19 200	20 750
9/16	12	-0.182	22 750	19 100	19 850	27 300	21 850	23 600	
9/16	12	0.182	22 750	19 100	19 850	27 300	31 500	21 850	23 600
9/16	18	-0.203	25 400	21 400	22 100	30 400	24 400	26 350	
9/16	18	0.203	25 400	21 400	22 100	30 400	35 100	24 400	26 350
5/8	11	-0.226	28 250	23 750	24 650	33 900	27 100	29 400	
5/8	11	0.226	28 250	23 750	24 650	33 900	39 100	27 100	29 400
5/8	18	-0.256	32 000	26 800	27 900	38 400	30 700	33 250	
5/8	18	0.256	32 000	26 800	27 900	38 400	44 300	30 700	33 250
3/4	10	-0.334	41 750	35 050	36 400	50 100	40 100	43 400	
3/4	10	0.334	41 750	35 050	36 400	50 100	57 800	40 100	43 400
3/4	16	-0.373	46 600	39 100	40 650	56 000	44 800	48 450	
3/4	16	0.373	46 600	39 100	40 650	56 000	64 550	44 800	48 450
7/8	9	-0.462	57 750	48 500	50 350	69 300	55 450	60 100	
7/8	9	0.462	57 750	48 500	50 350	69 300	79 950	55 450	60 100
7/8	14	-0.509	63 600	53 400	55 450	76 400	61 100	66 150	
7/8	14	0.509	63 600	53 400	55 450	76 400	88 000	61 100	66 150
1	8	0.606	75 750	63 650	66 050	90 900	104 850	72 700	78 800
1	12	0.663	82 900	69 700	72 250	99 400	114 700	79 600	86 150
1	14 UNS	0.679	84 900	71 300	74 400	101 900	117 500	81 500	88 250
1 1/8	7	0.763	95 400	80 100	83 150	114 450	132 000	91 550	99 200
1 1/8	8	0.790	98 750	82 950	86 200	118 500	136 700	94 800	102 700
1 1/8	12	0.856	107 000	89 800	93 300	128 400	148 000	102 700	111 250
1 1/4	7	0.969	121 150	101 750	105 600	145 350	167 650	116 300	126 000
1 1/4	8	1.000	125 000	105 000	109 000	150 000	173 000	120 000	130 000
1 1/4	12	1.073	134 100	112 600	116 950	161 000	185 600	128 800	139 450
1 3/8	6	1.155	144 400	121 300	125 900	173 250	199 850	138 600	150 200
1 3/8	8	1.233	154 150	129 450	134 400	185 000	213 300	148 000	160 300
1 3/8	12	1.315	164 400	138 100	143 300	197 200	227 500	157 800	170 950
1 1/2	6	1.405	175 650	147 550	153 150	210 750	243 100	168 600	182 500
1 1/2	8	1.492	186 500	156 650	162 250	233 800	258 100	175 050	194 000
1 1/2	12	1.581	197 600	166 000	172 300	237 200	273 500	189 700	205 500
1 3/4	5	1.90	237 500	199 500	207 100	285 000	328 700	228 000	247 000
1 3/4	8	2.08	260 000	218 400	226 700	312 000	359 800	249 600	270 000
2	4 1/2	2.50	312 500	262 500	272 500	375 000	432 500	300 000	325 000
2	8	2.77	346 250	290 850	301 950	415 000	480 000	332 400	360 000
2 1/4	4 1/2	3.25	406 250	341 250	354 250	487 000	562 250	390 000	422 500
2 1/4	8	3.56	445 000	373 800	388 050	534 000	616 000	422 200	462 800
2 1/2	-4	-4.00	500 000	420 000	436 000	600 000	480 000	520 000	
2 1/2	4	4.00	500 000	420 000	436 000	600 000	692 000	480 000	520 000
2 1/2	8	4.44	550 000	466 200	483 950	666 000	768 100	532 800	577 200
2 3/4	-4	-4.93	566 950	468 350	488 050	690 200	517 650	566 950	
2 3/4	4	4.93	566 950	468 350	488 050	739 500	853 000	591 600	640 900
2 3/4	-8	-5.43	624 450	515 850	537 550	750 200	570 150	624 450	