Designation: F3111 – 16

Standard Specification for Heavy Hex Structural Bolt/Nut/Washer Assemblies, Alloy Steel, Heat Treated, 200 ksi Minimum Tensile Strength[1,2]

This standard is issued under the fixed designation F3111; 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 heat treated, alloy steel, heavy hex structural bolt/nut/washer assemblies, also referred to as "sets," having a tensile strength of 200 to 215 ksi. These assemblies are capable of developing a minimum predetermined tension when installed by applying an initial torque followed by rotation to the nut or bolt head, while at the same time preventing the rotation of the opposite side of the assembly.

NOTE 1—The installations in Appendix X1 are important to the proper application of this product.

1.2 An assembly consists of a heavy hex structural head bolt, nut and two washers covered by this specification.

1.3 The assemblies are available in sizes 1 in. to 1 ¼ in. inclusive.

1.4 The fastener assemblies are intended for use in structural connections in the following environmental conditions:

1.4.1 Interiors, normally dry, including interiors where structural steel is embedded in concrete, encased in masonry or protected by membrane or noncorrosive contact type fireproofing.

1.4.2 Interiors and exteriors, normally dry, under roof, where the installed assemblies are soundly protected by a shop-applied or field-applied coating to the structural steel system.

1.5 The fastener assemblies are not intended for use in structural connections in the following environments, with or without protection by a shop-applied or field-applied coating to the structural steel system:

1.5.1 Exteriors not under roof.

1.5.2 Chemical environments in which strong concentrations of highly corrosive gases, fumes, or chemicals, either in solution or as concentrated liquids or solids, contact the fasteners or their protective coating.

1.5.3 Heavy industrial environments severe enough to be classified as a chemical environment as described in 1.5.2.

1.5.4 Condensation and high humidity environments maintaining almost continuous condensation, including submerged in water and soil.

1.5.5 Cathodically protected environments, in which current is applied to the structural steel system by the sacrificial anode method or the DC power method.

1.6 *Units*—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 The following precautionary statement pertains only to the test method portions, Section 13, Section 14 and Annex A2 of this Specification*: This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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

E709 Guide for Magnetic Particle Testing

E1444/E1444M Practice for Magnetic Particle Testing

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

[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.

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[2] The "Heavy-Hex Structural Bolt/Nut/Washer Assemblies, Alloy Steel, Heat Treated, 200 ksi Minimum Tensile Strength" of Grade 2 is covered by US patent number 7 070 664, July 4, 2006. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

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.

[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.

F788 Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series
F812 Specification for Surface Discontinuities of Nuts, 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

2.2 *ASME Standards:*[4]
B1.3 Screw Thread Gaging Systems for Acceptability: Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)
B1.15 Unified Inch Screw Threads (UNJ Thread Form)
B18.2.6 Fasteners for Use in Structural Applications

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 The definition of terms used in this specification shall be as specified in Terminology F1789, unless otherwise defined herein.

3.1.2 *component lot, n*—component lot, for the purpose of assigning an identification number and from which test samples shall be selected, shall consist of all bolts, all nuts or all washers processed essentially together through all operations to the shipping container, of which each component has the following common characteristics: heat number (mill heat); nominal dimensions (size), grade, and heat treatment lot.

3.1.3 *manufacturer, n*—entity that assembles, lubricates, tests, and certifies compliance with this specification.

4. Ordering Information

4.1 Orders for assemblies shall include the items of information below. Optional items not on the purchase order shall be considered as not being required (see Note 2):

4.1.1 Quantity of assemblies,

4.1.2 Size, including nominal bolt diameter, bolt length, and thread pitch,

4.1.3 Grade, that is, Grade 1 or Grade 2,

4.1.4 Name of product, that is, heavy hex structural bolt/nut/washer assemblies,

4.1.5 ASTM designation and year of publication, and

4.1.6 Special requirements, if required.

NOTE 2—A typical order description follows: 1000 assemblies, 1 ¼ diameter by 4 in. long with 7 threads per inch, Grade 2, Heavy Hex Structural Bolt/Nut/Washer Assemblies, ASTM F3111-14.

5. Materials and Manufacture

5.1 *Heavy Hex Structural Bolt/Nut/Washer Assemblies:*

5.1.1 The bolts shall be heavy hex structural bolts.

5.1.2 The assemblies shall consist of one heavy hex structural bolt, with one nut and two washers assembled on the bolt and the nut threaded on the bolt a minimum of one turn.

5.1.3 All nuts shall be heavy hex structural.

5.1.4 All washers used in the assembly shall be circular and through hardened.

5.1.5 *Protective Coatings*—The bolts, nuts and washers shall not be coated by hot dip zinc coating, mechanical deposition, electroplating, dip-spin, dip-drain, or spray methods with zinc or other metallic coatings.

NOTE 3—Protective coatings may be shop-applied or field-applied to installed assemblies.

5.1.6 *Lubrication:*

5.1.6.1 The assemblies shall be lubricated by the manufacturer to meet the Assembly Lot Tension Test requirements in Section 8.

5.1.6.2 Lubrication in addition to that applied by the manufacturer is permitted, provided the Assembly Lot Tension Test requirements in Section 8 are met.

5.1.7 *Secondary Processing*—Secondary processing shall not be permitted to an assembly lot, except that lubrication may be added as provided in 5.1.6.2.

5.2 *Heavy Hex Structural Bolts:*

5.2.1 *Heat Treatment:*

5.2.1.1 If phosphate coating has been applied to the raw material, the residual phosphate shall be removed prior to heat treatment, and a record of the application of this processing step shall be maintained by the processor.

5.2.1.2 Heavy hex structural bolts shall be heat treated by quenching in oil from the austenitizing temperature and then tempering by reheating to a temperature not less than 1000°F.

5.2.2 *Thread*—The threads of heavy hex structural bolts shall be rolled.

5.3 *Nuts:*

5.3.1 Nuts shall be made by hot forming.

5.3.2 Nuts shall be heat treated by quenching in a liquid medium from a temperature above the transformation temperature and tempering at a temperature of at least 850°F.

5.3.3 Threads shall be formed by tapping.

5.4 *Washers:*

5.4.1 Washers shall be through hardened.

6. Chemical Composition

6.1 *Heavy Hex Structural Bolts:*

6.1.1 Steel for bolts shall be made by the basic oxygen process.

6.1.2 Bolts shall be alloy steel conforming to the chemical composition in Table 1.

6.1.3 Product analysis may be made by the purchaser on finished bolts representing each lot. The chemical composition shall conform to the requirements in Table 1, Product Analysis.

6.1.4 Heats of steel to which bismuth, selenium, tellurium, lead or boron has been intentionally added shall not be permitted.

6.1.5 Compliance with 6.1.4 shall be based on certification that heats of steel having any of the listed elements intentionally added were not used to produce the bolts.

6.1.6 Chemical analysis shall be performed in accordance with Test Methods, Practices, and Terminology A751.

6.2 *Nuts:*

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

TABLE 1 Chemical Requirements for Bolts

NOTE 1—Aluminum, cobalt, niobium/columbium, nickel, titanium, tungsten, zirconium, or any other alloying elements may be added to obtain the desired alloying effect.

Element	Composition, %			
	Heat Analysis, %		Product Analysis, %	
	min	max	min	max
Carbon	0.38	0.42	0.36	0.44
Manganese	0.40	0.60	0.37	0.63
Phosphorus	. . .	0.01	. . .	0.015
Sulfur	. . .	0.01	. . .	0.015
Silicon	. . .	0.10	. . .	0.12
Chromium	1.20	1.40	1.15	1.45
Molybdenum	0.60	0.80	0.57	0.83
Vanadium	0.30	0.40	0.27	0.43

6.2.1 Steel for nuts shall be made by the basic oxygen or electric-furnace process.

6.2.2 Nuts shall conform to the chemical composition in Table 2.

6.2.3 Product analysis may be made by the purchaser on finished nuts representing each lot. The chemical composition shall conform to the requirements in Table 2, Product Analysis.

6.2.4 Chemical analysis shall be performed in accordance with Test Methods, Practices, and Terminology A751.

6.3 *Washers:*

6.3.1 Steel used in the manufacture of washers shall be produced by the basic-oxygen or electric-furnace process.

6.3.2 Washers shall conform to the chemical composition specified in Table 3.

6.3.3 Product analysis may be made by the purchaser on finished washers representing each lot. The chemical composition shall conform to the requirements in Table 3, Product Analysis.

6.3.4 Chemical analysis shall be performed in accordance with Test Methods, Practices, and Terminology A751.

7. Mechanical Property Requirements for Heavy Hex Bolts, Nuts and Washers

7.1 *Heavy Hex Bolts:*

7.1.1 *Hardness*—Bolts shall conform to the hardness specified in Table 4.

7.1.2 *Tensile Properties:*

7.1.2.1 Bolts shall be wedge tested full size and shall conform to the minimum and maximum wedge tensile load, and proof load or alternative proof load specified in Table 5. The load achieved during proof load testing shall be equal to or greater than the specified proof load.

TABLE 2 Chemical Requirements for Nuts

Element	Composition, %			
	Heat Analysis, %		Product Analysis, %	
	min	max	min	max
Carbon	0.30	0.48	0.28	0.50
Manganese	0.60	0.90	0.57	0.93
Silicon	0.15	0.35	0.13	0.37
Phosphorus	. . .	0.050	. . .	0.055
Sulfur	. . .	0.050	. . .	0.055

TABLE 3 Chemical Requirements for Washers

Element	Composition, %			
	Heat Analysis, %		Product Analysis, %	
	min	max	min	max
Carbon	0.42	0.48	0.40	0.50
Manganese	0.60	0.90	0.57	0.93
Silicon	0.15	0.35	0.13	0.37
Phosphorus	. . .	0.030	. . .	0.035
Sulfur	. . .	0.030	. . .	0.035

TABLE 4 Hardness Requirements for Bolts

Bolt Size, in.	Bolt Length, in.	Rockwell C	
		Min	Max
1 to 1 ¼, incl	all	38	45

7.1.2.2 When the length of the bolt makes full size testing impractical, machined specimens shall be tested and shall conform to the requirements specified in Table 6. When bolts are tested by both full size and machined specimen methods, the full size test shall take precedence.

7.1.2.3 For bolts on which both hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event of low hardness readings.

7.1.2.4 Sample bolts shall be used to verify that the alloy steel material and heat treatment provides resistance to Environmental Hydrogen Embrittlement (EHE), in accordance with the requirements of Annex A2.

7.2 *Nuts:*

7.2.1 Nuts shall conform to the surface hardness specified in Table 7.

7.2.2 Nuts shall withstand the proof load stress specified in Table 8.

7.3 *Washers:*

7.3.1 Washers shall conform to the core hardness specified in Table 9.

8. Assembly Lot Tension Test

8.1 *Purpose*—The assembly lot test hall be performed on fastener assemblies to determine the ability of the assembly to provide the required initial tension range when the initial torque is applied, and to provide the minimum required pretension when the final rotation is applied.

8.2 *Requirement*—Full size completed assemblies shall be tested in accordance with 14.4. When the specified torque in Table 10 Column 1 is applied, an initial bolt tension shall conforming to the requirements of Table 10 Columns 2 and 3. When the Final Rotation specified in Table 10 Column 4 is subsequently applied, the minimum bolt tension shall conform to the requirements of Table 10 Column 5.

9. Carburization/Decarburization of Heavy Hex Structural Bolts

9.1 This test is intended to evaluate the presence or absence of carburization and decarburization as determined by the difference in microhardness near the surface and core.

9.2 *Requirements:*

TABLE 5 Tensile Requirements for Full Size Bolts

Bolt Size, Threads per in.	Stress Area,[A,B] in.^{2}	Tensile Load,[C] lbf		Proof Load, lbf	Alternative Proof Load, lbf
		Min	Max	Length Measurement Method	Yield Strength Method
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
		Grade 1			
1 in. - 8	0.615	123 100	132 300	98 500	119 100
1 ⅛ in. - 7	0.776	155 200	166 800	124 200	139 700
1 ¼ in. - 7	0.983	196 700	211 400	157 400	177 000
		Grade 2			
1 in. - 8	0.640	128 000	137 700	102 400	115 200
1 ⅛ in. - 7	0.808	161 600	173 600	129 300	145 400
1 ¼ in. - 7	1.019	203 800	219 100	163 000	183 400

[A] The stress area for Grade 1 is calculated as: $A_s = 0.7854[0.5\ (d_{3\ max} + d_{2\ max})]^2$

[B] The stress area for Grade 2 is calculated in accordance with Annex A1.

[C] Loads tabulated are based on the following:

Bolt Size, in.	Column 3	Column 4	Column 5	Column 6
1 to 1 ¼	200 000 psi	215 000 psi	160 000 psi	180 000 psi

TABLE 6 Tensile Strength Requirements for Specimens Machined from Bolts

Nominal Bolt Diameter, in.	Tensile Strength, ksi		Yield Strength (0.2 % offset), min, ksi	Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, %
	min	max			
1 to 1 ¼, incl	200	215	180	14	40

TABLE 7 Hardness Requirements for Nuts

Bolt Size, in.	Surface Hardness, Rockwell C	
	Min	Max
1 to 1 ¼, incl	30	40

TABLE 8 Proof Load Requirements for Nuts

Nominal Size, Threads per inch	Stress Area, A_s,[A,B] in.^{2}	Proof Load Stress, ksi	Nut Proof Load,[C] lbf
	Grade 1		
1 in. - 8	0.615	200	123 100
1 ⅛ in. - 7	0.776	200	155 200
1 ¼ in. - 7	0.983	200	196 700
	Grade 2		
1 in. - 8	0.640	200	128 000
1 ⅛ in. - 7	0.808	200	161 600
1 ¼ in. - 7	1.019	200	203 800

[A] The stress area for Grade 1 is calculated as:
$A_s = 0.7854[0.5\ (d_{3\ max} + d_{2\ max})]^2$

[B] The stress area for Grade 2 is calculated in accordance with Annex A1.

[C] To determine nut proof load in pounds, multiply the appropriate nut proof load stress by the tensile stress area of the thread.

9.2.1 *Carburization*—The assemblies shall show no evidence of a carburized surface when evaluated in accordance with 14.1.4.

9.2.2 *Decarburization*—Hardness value differences shall not exceed the requirements set forth for decarburization in Test Method F2328 for class 3/4 H materials when evaluated in accordance with 14.1.4.

TABLE 9 Core Hardness Requirements for Washers

Rockwell C	
Min 40	Max 45

10. Dimensions of Heavy Hex Structural Bolts, Nuts, and Washers

10.1 *Heavy Hex Bolts:*

10.1.1 Bolts shall be furnished with heavy hex structural heads.

10.1.2 The head and body dimensions shall conform to the dimensional requirements in Table 11, and ASME B18.2.6 section 2.1.1 for top of head, 2.1.5 for true position of head, 2.1.6 for bearing surface, 2.1.9.3 for incomplete thread diameter, 2.1.10 for point, and 2.1.11 for straightness.

10.1.3 *Threads:*

10.1.3.1 The thread length shall be as specified in Table 11.

10.1.3.2 Threads for Grade 1 shall have the coarse series, class 2A UNJ thread as specified in ASME B1.15.

10.1.3.3 Threads for Grade 2 shall be as specified in Annex A1, and shall have Class 2A tolerances as calculated in section 4.3.3 of ASME B1.15.

10.1.3.4 The gauging limit for bolts shall be verified during manufacture. In case of purchaser/supplier controversy over thread compliance, System 21 of ASME B1.3 shall be used for referee purposes.

10.2 *Nuts:*

10.2.1 The dimensions for nuts shall conform to the dimensional requirements in Table 12, and ASME B18.2.6, sections 3.1.4, 3.1.5 and 3.1.6.

10.2.2 Threads for nuts for Grade 1 shall be coarse series, class 2B UNJ thread as specified in ASME B1.15.

10.2.3 Threads for nuts for Grade 2 shall be as specified in Annex A1, and shall have Class 2B tolerances as calculated in section 4.3.4 of ASME B1.15.

10.3 *Washers:*

10.3.1 All circular washers shall conform to the dimensions shown in Table 13.

TABLE 10 Assembly Lot Tension Test Requirements

Bolt Size, in.	Initial Torque (ft-lbs)	Initital Tension lbs, min[A]	Initial Tension lbs, max[B]	Final Rotation (degrees)[C]	Final Tension lbs, min[D]	Tension lbs, min (for information only)[E]
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
			Grade 1			
1	400	30 000	86 000	180	90 000	86 000
1 ⅛	600	38 000	109 000	180	114 000	109 000
1 ¼	900	48 300	138 000	180	145 000	138 000
			Grade 2			
1	400	31 000	90 000	180	94 000	90 000
1 ⅛	600	40 000	113 000	180	119 000	113 000
1 ¼	900	50 000	143 000	180	150 000	143 000

[A] The values in Column 2 are based upon 35% of the values in Column 6, rounded to the nearest 1000 lbs (kip).
[B] The values in Column 3 are equal to the values in Column 6.
[C] Tolerance for Final Rotation in Column 4 as applied for this test is ± 15 degrees.
[D] The values in Column 5 are based upon 105% of the values in Column 6, rounded to the nearest 1000 lbs (kip).
[E] The values in Column 6 are equal to 70% of the specified minimum tensile strength for tests of full size F3111 bolts tested in axial tension and are rounded to the nearest 1000 lbs (kip).

10.3.2 The deviation from flatness shall not exceed 0.010 in. per inch as the maximum deviation from a straight edge placed on the cut side.

10.3.3 Circular runout of the outside diameter with respect to the hole shall not exceed 0.030 FIM.

10.3.4 Burrs shall not project above the immediately adjacent washer surface more than 0.010 in.

11. Workmanship, Finish, and Appearance

11.1 For heavy hex structural bolts, the allowable limits, inspection, and evaluation of the surface discontinuities, quench cracks, forging cracks, head bursts, shear bursts, seams, folds, thread laps, voids, tool marks, nicks, and gouges shall be in accordance with Specification F788 except that threads shall have no laps at the root or on the flanks located below the pitch line, when inspected in accordance with Specification F788, S1.2.

11.2 For the nut component, the allowable limits, inspection, and evaluation of surface discontinuities, quench cracks, forging cracks, inclusion cracks, bursts, shear bursts, seams, voids, tool marks, nicks and gouges shall be in accordance with Specification F812.

11.3 Washers shall be free of excess mill scale and foreign material on bearing surfaces.

12. Magnetic Particle Inspection for Heavy Hex Structural Bolt Longitudinal Discontinuities and Transverse Cracks

12.1 *Requirements:*

12.1.1 Each sample representative of the bolt lot shall be magnetic particle inspected for longitudinal discontinuities and transverse cracks.

12.1.2 The lot, as represented by the sample, shall be free from nonconforming bolts, as defined in Specification F788, when inspected in accordance with Section 12.2.

12.2 *Inspection Procedure:*

12.2.1 The inspection sample shall be selected at random from each bolt lot in accordance with 13.4.2.4 and examined for longitudinal discontinuities and transverse cracks in the threads, body, fillet, and underside of the head.

12.2.2 Magnetic particle inspection shall be conducted in accordance with Guide E709 or Practice E1444/E1444M. Guide E709 shall be used for referee purposes. If any nonconforming bolt is found during the manufacturers examination of the lot selected in 12.2.1, the lot shall be 100 % magnetic particle tested and all nonconforming bolts shall be removed and scrapped or destroyed.

12.2.3 Eddy current or liquid penetrant inspection may be substituted for the 100 % magnetic particle inspection when nonconforming bolts are found and 100 % inspection is required. On completion of the eddy current or liquid penetrant inspection, a random sample selected from each bolt lot in accordance with Guide F1470, shall be reexamined by the magnetic particle method. In case of controversy, the magnetic particle test shall take precedence.

12.2.4 Magnetic particle indications of themselves shall not be cause for rejection. If in the opinion of the quality assurance representative the indications may be cause for rejection, a sample taken in accordance with Guide F1470 shall be examined by microscopic examination or removal by surface grinding to determine if the indicated discontinuities are within Specification F788 limits.

13. Testing

13.1 *Testing Responsibility:*

13.1.1 Each component lot and assembly lot shall be tested by the manufacturer prior to shipment in accordance with the lot identification control quality assurance plan in 13.4.

13.1.2 When components or assemblies are furnished by a source other than the manufacturer, the responsible party as defined in Section 18 shall be responsible for assuring all tests have been performed and the components and assemblies comply with the requirements of this specification.

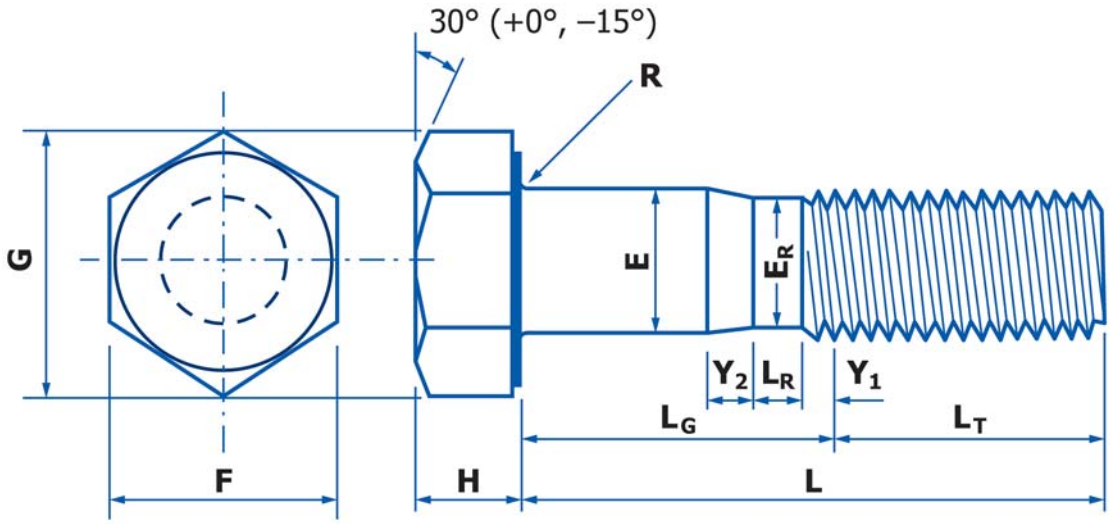
13.2 *Purpose of Lot Inspection*—The purpose of a lot inspection program is to ensure that each lot conforms to the requirements of this specification. For such a plan to be fully

TABLE 11 Heavy Hex Bolts

NOTE 1—The bolt length L shall be the distance measured parallel to the axis of the bolt from the bearing surface of the head to the center point of the groove through which shear will occur. Bolts are normally supplied in ¼ in. length increments.

NOTE 2—For bolts 1 in. diameter with length up to 6 in., inclusive, length tolerance is 3/16 in. underlength. For longer 1 in. diameter bolts and other diameters, length tolerance is ¼ in. underlength.

NOTE 3—FIM = Full Indicator Movement.



Nominal Size		1	1 ⅛	1 ¼
Basic Diameter, E, in.		1.000	1.125	1.250
Full-Size Body Diameter E, in.	max	1.022	1.149	1.277
	min	0.976	1.098	1.223
Width Across Flats, F, in.[A]	nom	1 5/8	1 13/16	2
	max	1.625	1.812	2.000
	min	1.575	1.756	1.938
Width Across Corners, G, in.	max	1.876	2.093	2.309
	min	1.796	2.002	2.209
Head Height, H, in.[B]	nom	39/64	11/16	25/32
	max	0.627	0.718	0.813
	min	0.591	0.658	0.749
Radius of Fillet, R, in.	nom	3/32	3/32	7/64
	max	0.110	0.110	0.138
	min	0.087	0.087	0.098
Transition Body Diameter, E_R, in.	nom	59/64	1 1/32	1 5/32
	max	0.933	1.046	1.171
	min	0.917	1.030	1.155
Body Transition Length, Y_2, in.	nom	0.305	0.354	0.354
	max	0.394	0.450	0.450
	min	0.207	0.244	0.244
Reduced Body Length, L_R, in.	nom	½	9/16	9/16
	max	0.625	0.715	0.715
	min	0.375	0.429	0.429
Transition Thread Length Y_1, in.[C]	Ref	0.31	0.34	0.34
Thread Length, L_T, in.[D]	Ref	2.049	2.322	2.322
Maximum Total Runout of Bearing Surface FIM, in.[E]		0.028	0.032	0.035

[A] See ASME B18.2.6, sections 2.1.2 and 2.1.3.
[B] See ASME B18.2.6, section 2.1.4.
[C] Transition thread length, Y_1, is a reference dimension, intended for calculation purposes only, that represents the length of incomplete threads and tolerance on grip gaging length.
[D] See ASME B18.2.6, section 2.1.10.2.
[E] See ASME B18.2.6, section 2.1.6.

effective, it is essential that distributors and purchasers maintain the identification and integrity of each lot until the assemblies are installed.

13.3 *Lot Control*—All components shall be manufactured, processed, and tested in accordance with a lot control plan that provides lot purity and lot identification. The manufacturer and distributors shall identify and maintain the integrity of each lot of components and finished assemblies from raw material selection through all processing operations and treatments to final packing and shipment. Each component lot shall be assigned its own component lot number and each assembly lot its own assembly lot number.