Designation: F2437/F2437M – 17

Standard Specification for Carbon and Alloy Steel Compressible-Washer-Type Direct Tension Indicators for Use with Cap Screws, Bolts, Anchors, and Studs[1]

This standard is issued under the fixed designation F2437/F2437M; 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 the requirements for carbon and alloy steel compressible-washer-type direct tension indicators (DTIs) capable of indicating a specified bolt tension in cap screws, bolts, anchors, and studs.

1.2 Direct tension indicators in inch sizes ¼ through 2½ in. and metric sizes M6 and M72 are covered.

1.3 Direct tension indicators have two styles and four grades for inch fasteners, Grades 5, 8, 55, and 105, and two property classes for metric fasteners, property classes 8.8 and 10.9 each of which differ in their compressive load requirements at a given gap (see Table 1 and Table 2).

1.3.1 Style 1 DTIs are suitable for comparatively smaller bearing surfaces. Style 1 DTIs are available in Grades 5 and 8, which differ in the amount of tension they indicate at a prescribed gap (see Table 1 and Table 3).

1.3.2 Style 2 DTIs are suitable for comparatively large bearing surfaces. Style 2 DTIs are available in Grades 55 and 105, which differ in the amount of tension they indicate at a prescribed gap (see Table 1 and Table 3).

1.4 Direct tension indicators are intended for installation under a bolt or cap screw head, a hex nut, or against a hardened washer or other flat hardened surface.

1.5 *Recommended Fasteners*—Fasteners meeting the requirements of the standards referenced in Table 3 are considered compatible with the DTI grade or class listed.

1.6 The values stated for Inch DTIs are expressed in inch-pound units and for Metric DTIs values are expressed in SI units.The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.7 *The following precautionary statement pertains only to the test method portions, Section 12of 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.*

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]

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

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

A307 Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

A354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

A449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

A563 Specification for Carbon and Alloy Steel Nuts

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

F436/F436M Specification for Hardened Steel Washers Inch

[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] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

TABLE 1 Acceptable Range of Compression Load[A] for Inch DTIs

DTI Nominal Diameter (in.)	Mean Compression Load[B] Range in Pounds (lbs) Style 1		Mean Compression Load[C] Range in Pounds (lbs) Style 2	
	Grade 5	Grade 8	Grade 55	Grade 105
¼	2200 to 2450	3100 to 3450	. . .	. . .
5⁄16	3500 to 3850	4950 to 5500	. . .	. . .
⅜	5300 to 5850	7500 to 8300	. . .	. . .
7⁄16	7200 to 7900	10 100 to 11 200	. . .	. . .
½	9700 to 10 700	13 700 to 15 340	4450 to 4900	8500 to 9400
9⁄16	12 350 to 13 600	17 400 to 19 200	5700 to 6300	10 900 to 12 050
⅝	15 550 to 17 200	21 850 to 24 200	7050 to 7800	13 500 to 15 000
¾	22 600 to 25 000	31 900 to 35 300	10 500 to 11 600	20 000 to 22 150
⅞	30 850 to 34 100	43 550 to 48 100	14 500 to 16 000	27 650 to 30 550
1	40 200 to 44 400	56 700 to 62 700	19 000 to 21 000	36 250 to 40 100
1⅛	40 250 to 44 450	73 150 to 80 900	23 950 to 26 450	47 300 to 52 300
1¼	51 100 to 56 450	91 750 to 101 450	30 400 to 33 600	59 850 to 66 150
1⅜	61 150 to 67 600	112 450 to 124 250	38 550 to 42 600	73 800 to 81 600
1½	74 350 to 82 150	135 150 to 149 400	44 050 to 48 700	89 300 to 98 700
1⅝	. . .	. . .	55 800 to 61 700	106 200 to 117 400
1¾	74 450 to 82 300	177 850 to 196 500	59 550 to 65 850	124 600 to 137 750
1⅞	...	206 050 to 227 750	75 550 to 83 500	144 500 to 159 700
2	98 000 to 108 300	236 850 to 261 750	78 650 to 86 950	165 800 to 183 300
2¼	127 400 to 140 800	277 900 to 307 100	102 050 to 112 750	212 900 to 235 350
2½	156 750 to 173 250	379 600 to 419 600	125 400 to 138 600	240 550 to 265 850

[A] Compression load requirements establish the capability of the direct tension indicators to satisfy typical tension requirements for these grades. The user is not obliged to install fasteners and DTIs to these tensions, and is free to specify installation to lower tension values. When so specified, the DTI supplier shall provide a load-gap curve in accordance with 15.2 to enable the user to select the appropriate gap criteria for the intended target tension of the application.
[B] The Mean compression load values for Grades 5 and 8 in nominal sizes up through 1-½ in are based upon 75% of the proof load for SAE J429 cap screws. For Grade 5 in nominal sizes over 1-½ in and up to 2-½ in inclusive, the mean compression load values are based on 75% of the proof load for ASTM A449. For grade 8 in nominal sizes over 1-½ in and up to 2-½ in inclusive, mean compression load values are based upon 75 % of the proof load for ASTM A354BD.
[C] Mean compression load values for Grades 55 and 105 are based upon 60 % of the yield strength for the matching fasteners on which they are used.

TABLE 2 Acceptable Range of Compression Load[A] for Metric DTIs

Nominal Diameter (M)	Mean Compression Load Range in kN	
	Property Class 8.8	Property Class 10.9
M6	8 to 9	12 to 13
M8	15 to 17	22 to 24
M10	24 to 27	35 to 38
M12	35 to 39	50 to 55
M14	48 to 53	68 to 75
M16	65 to 72	93 to 103
M18	82 to 91	114 to 125
M20	105 to 116	145 to 160
M22	130 to 143	179 to 198
M24	151 to 167	209 to 231
M27	196 to 217	271 to 300
M30	240 to 265	332 to 367
M33	297 to 328	410 to 454
M36	349 to 386	483 to 534
M39	417 to 461	577 to 638
M42	479 to 529	662 to 732
M45	560 to 619	775 to 856
M48	628 to 695	869 to 961
M52	752 to 832	1041 to 1150
M56	868 to 959	1200 to 1327
M60	1009 to 1115	1396 to 1543
M64	1146 to 1266	1585 to 1752
M68	1308 to 1446	1810 to 2000
M72	1479 to 1635	2046 to 2262

[A] The Mean compression load values for property classes 8.8 and 10.9 are based upon 75% of the proof load for ISO 898-1 Bolts/Stud/Screws.

and Metric Dimensions
F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
F1554 Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

TABLE 3 Recommended Fasteners

Series/Grade or Property Class		Recommended Cap Screws, Bolts, Anchors, or Studs[A]	Recommended Nuts[B]	Recommended Flat Washers
Inch Fasteners	Style 2 Grade 55	Specification F1554 Grade 55 Specification A307	Specification A194/A194M 2H Specification A563 A, C, DH	Specification F436/F436M
	Style 2 Grade 105	Specification A193/A193M B7 Specification F1554 Grade 105	Specification A194/A194M 2H Specification A563 DH	Specification F436/F436M
	Style 1 Grade 5	Specification A449, Specification A354 BC SAE J429 Grade 5	SAE J995 Grade 5 Specification A563 B, C, D, DH	Specification F436/F436M
	Style 1 Grade 8	Specification A354 BD SAE J429 Grade 8	SAE J995 Grade 8 Specification A563 D, DH	Specification F436/F436M
Metric Fasteners	Property Class 8.8	Specification ISO 898-1 Class 8.8	Specification ISO 898-2 Class 10	Specification ISO 887 (300 HV) DIN 125 Part 2
	Property Class 10.9	Specification ISO 898-1 Class 10.9	Specification ISO 898-2 Class 10	Specification ISO 887 (300 HV) ISO 7089

[A] A Inch bolt and cap screw dimensions are designated in ASME B18.2.1 and metric bolt dimensions are designated in ISO 4014.
[B] Inch nuts dimensions are designated in ASME B18.2.2 and metric nut dimensions are designated in ISO 4032.

F1789 Terminology for F16 Mechanical Fasteners
F1941/F1941M Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric

2.2 *ASME Standards:*[3]

ASME B18.2.1 Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.2.8 Clearance Holes for Bolts Screws, and Studs

2.3 *SAE Standards:*[4]

SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners
SAE J995 Mechanical and Material Requirements for Steel Nuts

2.4 *ISO Standards*[5]

ISO 887 : Plain washers for metric bolts, screws and nuts for general purposes -- General plan
ISO 898-1 : Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs with specified property classes - Coarse thread and fine pitch
ISO 898-2 : Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread
ISO 4014 : Hexagon head bolts - Product grades A and B
ISO 4032 : Hexagon regular nuts (style 1) - Product grades A and B
ISO 7089 : Plain washers — Normal series — Product grade A

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.
[4] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.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.

3. Terminology

3.1 For terminology definitions refer to Terminology F1789.

4. Ordering Information

4.1 Orders for direct tension indicators under this specification shall include the following:

4.1.1 Quantity (number of pieces);
4.1.2 Name of product (direct tension indicator);
4.1.3 Size, that is, nominal diameter;
4.1.4 ASTM designation and year of issue (if not specified, current issue shall be used);
4.1.5 Grade: Grade 5, 8, 55 or 105 for inch products or property class 8.8 or 10.9 for metric products.
4.1.5.1 *Style 2*—Either Grade 55 or Grade 105,
4.1.5.2 *Style 1*—Either Grade 5 or Grade 8;
4.1.6 Finish or coating type, if required (5.4);
4.1.7 Source inspection, if required (Section 13);
4.1.8 Test Reports, if required (Section 15); and
4.1.9 Any special requirements, including those for load-gap curves or other special test data, as well as intended bolt, anchor, or stud tension, if known.

4.2 *Recommended Fasteners*—Fasteners meeting the requirements of the Standards referenced in Table 1 are considered compatible with the DTI type(s) listed.

4.2.1 Coating or plating of previously tested DTIs requires retesting. See 10.3.

5. Materials and Manufacture

5.1 Direct tension indicators shall have a configuration produced by extrusion, punching, pressing, or similar forming to permit a measurable decrease in thickness when placed in compression.

5.2 The design shall be such that the degree of plastic deformation of the protrusions shall indicate the tension in a tightened cap screw, bolt, anchor, or stud.

5.3 *Heat Treatment:*

5.3.1 The heat treatment of DTIs is optional at the manufacturer's discretion, provided the DTIs meet all of the mechanical and performance requirements.

5.3.2 When heat treatment is performed, the process shall be through-hardening by heating to a temperature above the upper transformation temperature, quenching in a liquid medium, and tempering by heating to a suitable temperature.

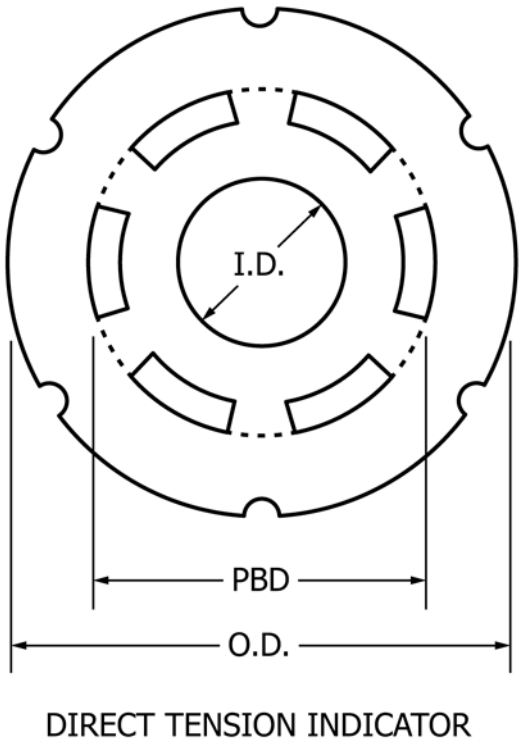
5.4 *Protective Coatings or Platings:*

5.4.1 Unless otherwise specified, the direct tension indicators shall be furnished "plain" with the "as-fabricated" surface finish without protective coatings.

5.4.2 When "coated" is specified, the direct tension indicators shall be processed in accordance with the requirements of Specification B695 for mechanical zinc, or Specification F1941/F1941M for electroplated zinc. The class and type of finish is at the discretion of the supplier unless specifically indicated by the purchaser.

5.4.3 Direct tension indicator manufacturers are free to offer other coatings, platings, or finishes when specified. However, application of any such coating, plating, or finish shall not be undertaken without the approval of the direct tension indicator manufacturer.

5.5 All direct tension indicators shall have circumferential indentations spaced equally around the outside circumference, corresponding to and in alignment with each space between the protrusions. Indentations shall be clearly visible but not so large as to interfere with the function of the direct tension indicator (see Fig. 1).



NOTE 1—Contour of protrusions will vary from manufacturer to manufacturer. The example shown is illustrative.

FIG. 1 Direct Tension Indicator Inside Diameter (I.D.) Outside Diameter (O.D.) and Protrusion Bearing Diameter (PBD)

TABLE 4 Chemical Composition Requirements[A,B]

Element	Composition, %	
	Heat Analysis	Product Analysis
Carbon	0.30 to 0.55	0.27 to 0.58
Manganese	0.50 to 0.90	0.47 to 0.93
Phosphorus, max	0.04	0.048
Sulfur, max	0.045	0.053
Silicon	0.15 to 0.35	0.13 to 0.37

[A] 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 %; silicone, 0.60 %; copper, 0.60 %; or in which a definite range or definite maximum 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.

[B] Suitable materials for weathering steel DTIs include the chemistries for Type 3 products listed in Specification F436/F436M.

5.5.1 The circumferential indentations indicate where feeler gages, if used, are to be inserted during installation inspections, and further make it visually obvious that a direct tension indicator (rather than a flat washer) has been used in the assembly.

6. Chemical Composition

6.1 The direct tension indicators shall conform in chemical composition to the limits given in Table 4.

6.2 Product analysis may be made by the purchaser from finished direct tension indicators representing each lot. The chemical composition shall conform to the requirements given in Table 3.

7. Performance Requirements

7.1 *Compression Load*—When compressed to the specified gap, the compression load shall conform to the requirements specified in Table 1 and Table 2.

7.2 *Hardness:*

7.2.1 Style 2 DTIs shall have a hardness not less than HRB70 nor more than HRC22.

7.2.2 Style 1 DTIs shall have a hardness not less than HRB80 nor more than HRC35.

8. Dimensions

8.1 Style 2 (Grades 55 and 105) and Style 1 (Grades 5 and 8) Direct Tension Indicators shall conform to the dimensions specified in Table 5.

8.2 Property class 8.8 and 10.9 direct tension indicators shall conform to the dimensions specified in Table 6.

9. Workmanship, Finish, and Appearance

9.1 The direct tension indicators shall be commercially smooth and free of injurious material or manufacturing defects that would affect their performance.

10. Number of Tests and Retests

10.1 *Responsibility:*

TABLE 5 Dimensions of Style 1 and Style 2 Inch Fastener Direct Tension Indicators[A]

	Style 1: Grade 5 and Grade 8				Style 2: Grade 55 and Grade 105			
DTI Size, Nominal Diameter (in.)[B]	Inside (ID), in.	Outside Diameter (OD), in.	Thickness, in. (min.)	Protrusion Bearing Diameter[C] (PBD)	Inside Diameter (ID), in.	Outside Diameter (OD), in.	Thickness in. (min.)	Protrusion Bearing Diameter (PBD)
1/4	0.254 to 0.258	0.505 to 0.525	0.097	0.394	. . .	. . .	. . .	. . .
5/16	0.317 to 0.321	0.650 to 0.670	0.097	0.450	. . .	. . .	. . .	. . .
3/8	0.379 to 0.383	0.780 to 0.800	0.104	0.506	. . .	. . .	. . .	. . .
7/16	0.443 to 0.448	0.898 to 0.918	0.104	0.563	. . .	. . .	. . .	. . .
1/2	0.508 to 0.512	0.950 to 0.970	0.104	0.675	0.515 to 0.520	1.020 to 1.040	0.104	0.746
9/16	0.573 to 0.577	1.052 to 1.072	0.126	0.731	. . .	. . .	. . .	. . .
5/8	0.635 to 0.639	1.204 to 1.224	0.126	0.844	0.640 to 0.645	1.240 to 1.260	0.126	0.956
3/4	0.760 to 0.764	1.474 to 1.494	0.142	1.012	0.765 to 0.770	1.450 to 1.470	0.126	1.077
7/8	0.885 to 0.889	1.630 to 1.650	0.158	1.181	0.890 to 0.895	1.670 to 1.690	0.142	1.294
1	1.010 to 1.014	1.846 to 1.866	0.158	1.350	1.020 to 1.025	1.890 to 1.910	0.142	1.441
1 1/8	1.135 to 1.139	2.063 to 2.083	0.158	1.512	1.150 to 1.155	2.100 to 2.120	0.142	1.574
1 1/4	1.260 to 1.264	2.305 to 2.325	0.158	1.688	1.275 to 1.280	2.320 to 2.340	0.142	1.800
1 3/8	1.388 to 1.392	2.565 to 2.585	0.193	1.856	1.400 to 1.405	2.540 to 2.560	0.142	1.902
1 1/2	1.525 to 1.529	2.798 to 2.818	0.193	2.025	1.525 to 1.530	2.750 to 2.770	0.142	2.071
1 5/8	. . .	. . .	. . .	. . .	1.650 to 1.655	2.970 to 2.990	0.193	2.234
1 3/4	1.767 to 1.772	3.265 to 3.285	0.193	2.363	1.775 to 1.780	3.185 to 3.205	0.193	2.475
2	2.030 to 2.040	3.735 to 3.755	0.193	2.700	2.030 to 2.040	3.620 to 3.640	0.193	2.741
2 1/4	2.275 to 2.280	4.205 to 4.225	0.193	3.038	2.275 to 2.280	4.050 to 4.070	0.193	3.078
2 1/2	2.525 to 2.530	4.675 to 4.695	0.193	3.375	2.525 to 2.530	4.480 to 4.500	0.193	3.416

[A] Dimensions are as-formed, before coatings, platings, and so forth.
[B] Nominal direct tension indicator sizes are intended for use with fasteners of the same nominal diameter.
[C] PBD maximum based upon minimum bearing surface of ASME B18.2.1 hex cap screw minimum bearing surface.

TABLE 6 Dimensions of Property Class 8.8 and 10.9 Metric Fastener Direct Tension Indicators[A]

DTI Size[B]	Inside Diameter (ID), mm	Outside Diameter (OD), mm	Thickness, mm (minimum)	Protrusion Bearing Diameter[C] (PBD) mm (maximum)
M6	6.25-6.35	13.65-15.65	2.464	8.88
M8	8.25-8.35	16.98-18.98	2.464	11.63
M10	10.25-10.35	20.37-22.37	2.642	14.63
M12	12.25-12.35	24.23-26.23	2.642	16.63
M14	14.25-14.35	27.56-29.56	2.642	19.64
M16	16.25-16.35	30.95-32.95	3.200	22.49
M18	18.25-18.35	33.76-35.76	3.200	25.34
M20	20.25-20.35	37.15-39.15	3.607	28.19
M22	22.25-22.35	41.43-43.43	4.013	31.71
M24	24.35-24.45	43.69-45.69	4.013	33.61
M27	27.35-27.45	49.34-51.34	4.013	38.00
M30	30.35-30.45	54.99-56.99	4.013	42.75
M33	33.35-33.45	59.51-61.51	4.902	46.55
M36	36.35-36.45	64.83-66.83	4.902	51.11
M39	39.35-39.45	70.58-72.58	4.902	55.86
M42	42.35-42.45	75.44-77.44	4.902	59.95
M45	45.35-45.45	81.09-83.09	4.902	64.70
M48	48.35-48.45	86.74-88.74	4.902	69.45
M52	52.40-52.50	92.39-94.39	4.902	74.20
M56	56.40-56.50	97.70-99.70	4.902	78.66
M60	60.40-60.50	103.35-105.35	4.902	83.41
M64	64.40-64.50	109.00-111.00	4.902	88.16
M68	68.40-68.50	114.65-116.65	4.902	92.48
M72	75.40-75.50	120.30-122.30	4.902	97.92

[A] Dimensions are as-formed, before coatings, platings.
[B] Nominal direct tension indicator sizes are intended for use with fasteners of the same nominal diameter.
[C] PBD maximum is based upon minimum bearing surface of hex head screws in ISO 4014.

10.1.1 The direct tension indicator manufacturer shall inspect each lot of direct tension indicators prior to shipment in accordance with the quality assurance procedures described in 10.2.

10.1.2 The purpose of a lot inspection testing program is to ensure that each lot conforms to the requirements of this specification. For such a plan to be fully effective, it is essential that the purchaser continue to maintain the identification and integrity of each lot following delivery until the product is installed in its service application.

10.2 *Lot Method:*

10.2.1 All direct tension indicators shall be processed in accordance with a lot identification control-quality assurance plan. The manufacturer shall identify and maintain the integrity of each lot of direct tension indicators from raw material

selection through all processing operations and treatments to final packing and shipment. Each lot shall be assigned its own lot-identification number, each lot shall be tested, and the inspection test reports for each lot shall be retained.

10.2.2 For purposes of assigning an identification number and from which test samples shall be selected, a lot shall consist of all direct tension indicators processed essentially together through all operations to placing in the shipping container that are of the same nominal size, produced from the same mill heat of steel, heat-treated in the same heat-treatment cycle (when applicable), and of the same finish.

10.2.3 The minimum number of samples to be tested to determine compression loads and coating thickness (when applicable) shall be in accordance with the requirements specified in Guide F1470.

10.3 *Number of Tests After Alterations*—If direct tension indicators are heat-treated, coated, or plated, or otherwise altered by a subcontractor or manufacturer subsequent to testing, they shall be re-tested in accordance with 10.2 prior to shipment to the purchaser after all alterations have been completed.

11. Specimen Preparation

11.1 Direct tension indicators selected for tests shall be tested full size "as-received" without any special preparation.

12. Test Methods

12.1 Compression load tests shall be conducted in accordance with Test Methods F606/F606M, with the specified test gap being 0.010 in. for inch series and 0.250 mm for metric series. Additional test data, when specified, shall be taken at sufficient intervals to enable preparation of a load-gap curve for each lot.

13. Inspection

13.1 If the inspection described in 13.2 is required by the purchaser, it shall be specified in the inquiry and contract or order.

13.2 The purchaser's quality assurance representative shall have free entry to all parts of the manufacturer's works that concern the manufacture of the direct tension indicators ordered. The manufacturer shall afford the quality assurance representative all reasonable facilities to satisfy him that the direct tension indicators are being furnished in accordance with this specification. All tests and inspections required by this specification that are requested by the purchaser's representative shall be made before shipment and shall be conducted so as not to interfere unnecessarily with the operation of the plant.

14. Rejection

14.1 Disposition of nonconforming lots of direct tension indicators shall be in accordance with the section on Disposition of Nonconforming Lots of Guide F1470. Non-conforming lots should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

15. Test Reports

15.1 When specified on the order, the manufacturer shall furnish a Test Report as described in 15.2, a Certificate of Compliance, or a Certificate of Conformance as described in 15.3, whichever is required.

15.2 When test reports are required, the manufacturer shall furnish a test report for each lot from which direct tension indicators are supplied to fill a shipment. The report shall show the heat number (to ensure that the chemical composition is on record and could be furnished upon request), the compression loads, a copy of the load-gap test curve data (when specified), measured thickness of any specified protective coatings, nominal size, type, grade, production lot identification number, ASTM designation, and issue date.

15.3 When Certificates of Compliance or Certificates of Conformance, or both, are required, the manufacturer shall furnish a Certificate of Conformance certifying that the direct tension indicators have been manufactured and tested and conform to the requirements of this specification, or a Certificate of Compliance certifying that the direct tension indicators are being supplied in compliance with all applicable requirements. Such certificates shall show the lot identification number, nominal size, type, grade, ASTM designation, issue date, and purchase order number.

16. Responsibility

16.1 The party responsible for the direct tension indicators shall be the organization that supplies the direct tension indicators to the purchaser and certifies or reports that the direct tension indicator was manufactured, sampled, tested, and inspected in accordance with this specification and meets all of its requirements.

17. Product Marking

17.1 Each direct tension indicator shall be marked to identify the lot number, manufacturer or private label distributor, as appropriate.

17.2 Each direct tension indicator shall be marked with its appropriate grade or property class marking: Grades 5, 8, 55 or 105 for inch products or property class 8.8 or 10.9 for metric products.

17.3 All markings shall be depressed on the same face of the direct tension indicators as the protrusions. Raised markings are prohibited.

18. Packaging and Package Marking

18.1 *Packaging:*

18.1.1 When special packaging requirements are imposed, they shall be defined at the time of the inquiry and order.

18.2 *Package Marking:*

18.2.1 Each shipping unit shall include or be marked plainly with the following information:

18.2.1.1 ASTM designation and Style, Grade, or Property Class,

18.2.1.2 Size,

18.2.1.3 Name and brand or trademark of the manufacturer or private label distributor,

18.2.1.4 Number of pieces,
18.2.1.5 Name of product,
18.2.1.6 Lot identification number,
18.2.1.7 Finish, and
18.2.1.8 Country of origin.

19. Storage

19.1 The direct tension indicators shall be stored in an environment that preserves the surface condition supplied by the manufacturer.

20. Keywords

20.1 compressible-washer-type; direct tension indicators; DTI; load indicators; load indicating washers; tension indicators

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (F2437–14) that may impact the use of this standard. (Approved March 15, 2017)

(1) Metric information and data added to the inch standard F2437.
(2) Table 1 was revised.
(3) Table 2 was added.
(4) Table 3 was revised
(5) Table 6 was added.
(6) Section 5 was revised.