Designation: A 489 – 04$^{\epsilon 1}$

Standard Specification for Carbon Steel Lifting Eyes[1]

This standard is issued under the fixed designation A 489; 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 Department of Defense.

ε[1] NOTE—Sections 2.2 and 3.1.10 were editorially revised in October 2006.

1. Scope*

1.1 This specification covers weldless forged, quenched, and tempered carbon steel threaded lifting eyes (formerly eyebolts) for overhead lifting.

NOTE 1—Lifting eyes carrying this specification number even though they are liquid quenched and tempered may be processed from carbon steel which, in the composition range permitted by this specification, could have a fracture appearance transition temperature (50 % shear) higher than operating temperatures. Therefore, in order to minimize the possibility of a brittle cleavage failure, these lifting eyes should never be loaded above the proof load, and should not be used when surface discontinuities exist on the lifting eyes.

1.2 The specification includes two types denoting shank pattern and one style denoting shank length (both defined in ASME B 18.15) as follows:

1.2.1 *Type 1*—Plain pattern (straight shank).

1.2.2 *Type 2*—Shoulder pattern.

1.2.3 *Style B*—Short length.

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

1.4 Terms used in this specification are defined in Terminology F 1789 unless otherwise defined herein.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

D 3951 Practice for Commercial Packaging

E 112 Test Methods for Determining Average Grain Size

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F 1789 Terminology for F16 Mechanical Fasteners

2.2 *ASME Standards:*[3]

B 1.1 Unified Inch Screw Threads

B 18.15 Forged Lifting Eyes

B 18.24 Part Identifying Number (PIN) Code System Standard for B 18 Fastener Products

3. Ordering Information

3.1 Orders for lifting eyes under this specification should include the following information:

3.1.1 ASTM specification number and date of issue.

3.1.2 Name of product, that is lifting eyes.

3.1.3 Type and style (see 1.2, Type 1 Style B) will be furnished when a Type and Style is not specified.

3.1.4 Drawing, if nonstandard lifting eyes are required (see 8.3).

3.1.5 Number of pieces.

3.1.6 Size, nominal thread diameter and threads.

3.1.7 Certification, if required (see Section 14).

3.1.8 Supplementary requirements, if required.

3.1.9 Other special requirements.

3.1.10 For establishment of a part identifying system, see ASME B 18.24.

4. Materials and Manufacture

4.1 *Melting Process*—The steel shall be made by the open-hearth, basic-oxygen, or electric-furnace process and shall be made to a fine-grain practice.

4.2 *Forging*—Lifting eyes shall be forged without welds.

4.3 *Heat Treatment*—The lifting eyes shall be liquid quenched and tempered prior to machining the threaded end.

4.4 *Machining*—The lifting eyes shall be machined after the quench and temper operation.

4.5 *Threads*—The lifting eyes shall be threaded. Threads may be rolled, cut, or ground.

[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.

[3] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

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

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5. Chemical Composition

5.1 *Limits*—The lifting eyes shall be manufactured from steels having a heat analysis conforming to the requirements in Table 1.

5.2 *Product Analysis*:

5.2.1 Analyses of finished lifting eyes may be made by the purchaser or may be requested to be made by the manufacturer. The composition thus determined shall conform to the product analysis requirements specified in Table 1.

5.3 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology A 751.

6. Mechanical Properties

6.1 *Proof Load*—The lifting eyes shall withstand the proof load specified in Table 2.

6.1.1 The proof load shall be defined as the load that can be applied without causing permanent deformation exceeding 0.01 in. (0.255 mm) between prick punch marks at opposite ends of the diameter across the eye. The proof load shall be applied through a mandrel having a diameter of one half the nominal inside diameter of the eye.

6.2 *Breaking Strength*—The lifting eyes shall conform to the breaking strength specified in Table 2.

6.2.1 The breaking strength shall be determined by screwing the lifting eye to the full thread engagement into a block secured in one jaw of the testing machine and held to the other jaw by means of a mandrel passing through the eye. Failure of the lifting eye below the specified breaking strength constitutes a failure.

6.3 *Tensile Test Requirements*—A specimen machined from a finished lifting eye shall conform to the tensile requirements specified in Table 3.

6.3.1 When the lifting eye is too small to have a tensile bar machined from it, a test specimen from the same heat of steel and same heat treatment lot or charge as the lifting eyes to be tested shall be used to establish the tensile properties of the material in accordance with 6.3.

6.3.2 The tensile properties shall be determined in accordance with Test Methods F 606.

6.4 *Bend Test*—Type 1 straight shank lifting eyes 1½ in. (36.1 mm) or less in diameter, after being screwed into a steel block to the full thread length and bent 45° by pressure, shall not exhibit any visible surface ruptures in the unthreaded section of the lifting eye when examined at 10× magnification.

6.5 *Impact Strength*—The lifting eyes shall have an average Charpy V-notch impact strength of not less than 35 ft·lbf (47 J) at 0°C (32°F).

TABLE 1 Chemical Composition

Element	Heat Analysis	Product Analysis
Carbon, max	0.48	0.51
Manganese, max	1.00	1.06
Phosphorus, max	0.040	0.048
Sulfur, max	0.050	0.058
Silicon	0.15–0.35	0.12–0.38

TABLE 2 Breaking Strength and Proof Load Requirements, Types 1 and 2

Nominal Thread Size	Tensile Stress Area[A]	Breaking Strength, min	Proof Load, min[B]
	Inch Pound Units		
in.	in.^{2}	lbf	lbf
¼ –20	0.0318	2 100	800
5/16 –18	0.0524	3 400	1 360
⅜ –16	0.0775	5 000	2 000
7/16 –14	0.1063	6 900	2 760
½ –13	0.1419	9 200	3 680
9/16 –12	0.182	11 830	4 740
⅝ –11	0.226	14 700	5 880
¾ –10	0.334	21 700	8 680
⅞ –9	0.462	30 000	12 000
1–8	0.606	39 400	15 760
1⅛ –7	0.763	49 600	19 840
1¼ –7	0.969	63 000	25 200
1½ –6	1.41	91 600	36 520
1¾ –5	1.90	123 500	49 400
2–4	2.50	162 500	65 000
2½ –4	4.00	260 000	104 000

[A] The stress area is calculated as follows:

$$As = 0.7854\ [D - (0.9743/n)]^2$$

where:

As = stress area, in.^{2},
D = nominal bolt size, and
n = threads per inch.

[B] Proof load is calculated as 2 times the rated capacity in straight pull (0 degrees) specified in ASME B 18.15.

TABLE 3 Tensile Properties for Machined Specimens

Tensile strength, psi	65 000–90 000
Tensile strength (MPa)	(448–620)
Yield point, min, psi	30 000
Yield point, min (MPa)	(207)
Elongation in 4D, min, %	30
Reduction of area, min, %	60

6.5.1 The impact strength shall be the average of three specimens tested. Not more than one specimen shall exhibit a value below the specified minimum average, and in no case shall a value be less than 23 ft·lbf (31 J).

6.5.2 Whenever possible, test specimens shall be taken from the shank and shall conform to the standard 10 by 10-mm Charpy V-notch specimen shown in Test Methods and Definitions A 370. When lifting eyes are too small for standard-size specimens, subsize specimens may be used, or specimens that represent the same heat and have been subjected to the same forging and heat-treating practices as the lifting eyes they represent may be taken from separate test coupons.

6.5.3 The impact properties shall be determined in accordance with Test Methods and Definitions A 370.

7. Grain Size

7.1 The finished lifting eyes shall have an as-finished grain size of ASTM No. 5 or finer.

7.2 The grain size shall be rated from a broken tensile specimen end representing a heat treated lot of one size.

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7.3 Tests shall be conducted in accordance with Test Methods E 112.

8. Dimensions

8.1 The dimensions of the lifting eyes shall conform to the requirements specified in latest issue of ASME B 18.15 unless otherwise specified.

8.2 The Type and Style shall be as specified by the purchaser. When not specified, Type 1, Style B shall be furnished.

8.3 When dimensions other than specified in 8.1 are required, they shall be in accordance with the purchaser's drawing. In such cases, the proof load and breaking strength requirements are not applicable because the manufacturer cannot be assured that the purchaser's proprietary design can withstand the loads in this specification. The machined specimen tensile, impact, and bend tests shall apply in addition to all other requirements of this specification.

9. Threads

9.1 The lifting eyes shall be threaded. Threads shall conform to the Unified Coarse Thread Series as specified in ASME B 1.1 and shall have Class 2A tolerances.

10. Workmanship, Finish, and Appearance

10.1 The lifting eyes shall be descaled.

10.2 The lifting eyes shall be free of injurious imperfections that would make them unsuitable for the intended use. The threads shall be undamaged upon receipt by the purchaser as demonstrated by the ability to accept a Go Ring Gage with normal hand force.

11. Number of Tests and Retests

11.1 *Lot Definition*:

11.1.1 A lot shall consist of forgings produced from one heat of steel per treatment charge.

11.1.2 If more than one heat of steel is used per treatment charge, all heats must be tested as defined in 11.2.1.

11.1.3 A treatment charge is defined as one furnace load of lifting eyes of the same size per quench and temper operation or in a continuous furnace as every 8 h of continuous operation in quenching and tempering of lifting eyes of the same size.

11.2 *Number of Tests*:

11.2.1 Each lot shall be tested for proof load, breaking strength, tensile, and bend properties at the frequency specified below:

Number of Pieces in Lot	Number of Tests
800 and under	1
801 to 8000	2
8001 to 22 000	3
Over 22 000	5

11.2.2 The number of tests for impact strength and grain size shall be in accordance with the manufacturer's standard quality control practices. A specific number of tests are not required but the lifting eyes shall be produced by manufacturing practices and subject to mill tests and inspection to ensure compliance with the specified requirements.

11.3 *Retests*:

11.3.1 If the results of the mechanical tests do not conform to the requirements specified, the manufacturer may retest the same lot if double the number of samples required for that lot are retested, in which case all additional tests shall meet the requirements of the specification.

11.3.2 If any test specimen shows defective machining, it may be discarded and another specimen substituted.

12. Inspection

12.1 The manufacturer shall afford the purchaser's quality assurance representative all reasonable facilities necessary to satisfy him that the lifting eyes are being produced and furnished in accordance with this specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All tests and inspections shall be made at the place of manufacture, unless otherwise agreed to.

12.2 Lots represented by lifting eyes tested by the purchaser that fail to meet the specified requirements shall be subject to rejection.

13. Rejection and Rehearing

13.1 Lifting eye lots that fail to conform to the requirements of this specification may be rejected. Rejection 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.

14. Certification

14.1 When specified by the purchaser, a test report shall be furnished for each lot showing the following:

14.1.1 Heat analysis and heat number(s),

14.1.2 Results of proof load, breaking strength, tensile, and bend tests,

14.1.3 Results of any supplementary requirements invoked,

14.1.4 Statement of compliance with grain size and impact requirements,

14.1.5 Purchase order number,

14.1.6 Lot number(s), and

14.1.7 ASTM specification number, including type, style, and date of issue.

15. Responsibility

15.1 The party responsible for the lifting eye shall be the organization that supplies the lifting eye to the purchaser.

16. Product Marking

16.1 Each lifting eye shall have the manufacturer's name or identification mark forged in raised characters on the surface of the lifting eye.

17. Packaging and Package Marking

17.1 *Packaging*:

17.1.1 Unless otherwise specified, packaging shall be in accordance with Practice D 3951.

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

17.2 *Package Marking*:

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

17.2.1.1 ASTM designation and type,

17.2.1.2 Size,

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17.2.1.3 Name and brand or trademark of the manufacturer,
17.2.1.4 Number of pieces,
17.2.1.5 Purchase order number, and
17.2.1.6 Country of origin.

18. Keywords

18.1 carbon steel; eyebolts; lifting eye; steel

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement shall apply only when specified by the purchaser as part of the purchaser's order or contract and for all agencies of the United States Government.

S1. Impact Tests

S1.1 Impact tests shall be conducted on each lot. The number of tests shall be in accordance with 11.2.1. The results shall be reported to the purchaser.

S2. *Proof Load Tests*—Proof load tests shall be conducted on each lifting eye. The results shall be reported to the purchaser.

S3. *Grain Size Tests*—Grain size shall be determined on each tensile specimen. The results shall be reported to the purchaser.

SUMMARY OF CHANGES

This section identifies the location of selected changes to this standard since the last issue, A 489–03, that may impact the use of this standard. (Approved July 1, 2004.)

(*1*) Revised Section 15, Responsibility.

This section identifies the location of selected changes to this standard since the last issue, A 489–00, that may impact the use of this standard. (Approved Oct. 1, 2003.)

(*1*) Added Section 1.4 that references Terminology F 1789 for definitions of terms.

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