



Designation: A489 – 12

Standard Specification for Carbon Steel Lifting Eyes¹

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

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 standard. No other units of measurement are included in this standard.

1.4 Terms used in this specification are defined in Terminology F1789 unless otherwise defined herein.

2. Referenced Documents

2.1 *ASTM Standards*:²

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

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

E112 Test Methods for Determining Average Grain Size

F606 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

F1789 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 B18 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 B18.24.

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.

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, http://www.asme.org.

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

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

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 A751.

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 F606.

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.

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 |
| ⅜–18 | 0.0524 | 3 400 | 1 360 |
| ½–16 | 0.0775 | 5 000 | 2 000 |
| ⅞–14 | 0.1063 | 6 900 | 2 760 |
| 1–13 | 0.1419 | 9 200 | 3 680 |
| 1¼–12 | 0.182 | 11 830 | 4 740 |
| 1½–11 | 0.226 | 14 700 | 5 880 |
| 1¾–10 | 0.334 | 21 700 | 8 680 |
| 2–9 | 0.462 | 30 000 | 12 000 |
| 2½–8 | 0.606 | 39 400 | 15 760 |
| 3–7 | 0.763 | 49 600 | 19 840 |
| 3½–7 | 0.969 | 63 000 | 25 200 |
| 4–6 | 1.41 | 91 600 | 36 520 |
| 4½–5 | 1.90 | 123 500 | 49 400 |
| 5–4 | 2.50 | 162 500 | 65 000 |
| 5½–4 | 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 *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).

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 A370. 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 A370.

7. Grain Size

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