Designation: A 31 – 04$^{\epsilon 1}$

Standard Specification for Steel Rivets and Bars for Rivets, Pressure Vessels[1]

This standard is issued under the fixed designation A 31; 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.

ε[1] NOTE—Sections 2.2 and 3.1.9 were editorially revised in October 2006.

1. Scope*

1.1 This specification[2] covers steel rivets for use in boilers and pressure vessels and steel bars for use in the manufacture of rivets.

1.2 Two grades are covered:

1.2.1 *Grade A*—Bars having a yield point of 23 000 psi (160 MPa) minimum with no controls on carbon content.

1.2.2 *Grade B*—Bars having a yield point of 29 000 psi (200 MPa) minimum with carbon 0.28 % maximum.

1.2.3 Rivets are manufactured from the applicable bar grade.

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

2. Referenced Documents

2.1 *ASTM Standards:* [3]

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

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

F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

2.2 *ASME Standards:*[4]

B18.1.1 Small Solid Rivets 7⁄16 Inch Nominal Diameter and Smaller

B18.1.2 Large Rivets ½ Inch Nominal Diameter and Larger

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

3. Ordering Information

3.1 Orders for rivets and bars under this specification shall include:

3.1.1 ASTM designation and date of issue,

3.1.2 *Quantity*—Number of pieces for rivets and weight for bars,

3.1.3 Name of product and grade (A or B),

3.1.4 Size (diameter and length),

3.1.5 Rivet head type,

3.1.6 If inspection at point of manufacture is required,

3.1.7 Certification, if required (Section 14), and

3.1.8 Additional testing or special requirements, if required.

3.1.9 For establishment of a part identifying system, see ASME B18.24.

NOTE 1—A typical ordering description is: ASTM A 31 – 82, 10 000 pieces, steel rivets Grade A, ½ by 2 in., button head, test reports required.

4. Materials and Manufacture

4.1 The steel shall be made by any of the following processes: open-hearth, electric-furnace, or basic-oxygen.

4.2 Rivets shall be manufactured from rivet bars conforming to the applicable grade ordered.

4.3 Rivets shall be manufactured by hot- or cold-heading.

4.4 Bars shall be furnished as rolled and not pickled, blast cleaned, or oiled. At producer's option, bars may be cleaned for inspection or cold drawn.

5. Chemical Composition

5.1 The steel shall conform to chemical composition prescribed in Table 1.

5.2 *Heat Analysis*—An analysis of each heat of steel shall be made by the bar manufacturer to determine for Grades A and B the percentages of carbon, manganese, phosphorus, and

[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 Aug. 1, 2004. Published August 2004. Originally approved in 1976. Last previous edition approved in 2000 as A 31 – 00.

[2] For *ASME Boiler and Pressure Vessel Code* applications see related Specification SA-31 in Section II of that Code.

[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 Park Ave., New York, NY 10016-5990.

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

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TABLE 1 Chemical Requirements

	Grade A		Grade B	
	Heat Analysis	Product Analysis	Heat Analysis	Product Analysis
Carbon, max, %	. . .	. . .	0.28	0.31
Manganese, %	0.30–0.60	0.27–0.63	0.30–0.80	0.27–0.83
Phosphorus, max, %	0.040	0.048	0.040	0.048
Sulfur, max, %	0.050	0.058	0.050	0.058

sulfur. This analysis shall be made from a test ingot taken during the pouring of the heat. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements for heat analysis in accordance with Table 1.

5.3 *Product Analysis*—An analysis may be made by the purchaser from finished materials representing each heat. The chemical composition thus determined shall conform to the requirements for product analysis prescribed in Table 1.

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

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

6. Mechanical Properties

6.1 *Rivet Bend Tests*:

6.1.1 The rivet shank of Grade A steel shall stand being bent cold through 180° flat on itself, as shown in Fig. 1, without cracking on the outside of the bent portion.

6.1.2 The rivet shank of Grade B steel shall stand being bent cold through 180° without cracking on the outside of the bent portion in accordance with Table 2.

6.2 *Rivet Flattening Tests*—The rivet head shall stand being flattened, while hot, to a diameter 2½ times the diameter of the shank, as shown in Fig. 2, without cracking at the edges.

6.3 *Bar Tensile Properties*—Bars shall conform to the tensile requirements in accordance with Table 3.

6.4 *Bar Bend Tests*:

6.4.1 The test specimen for Grade A steel bars shall stand being bent cold through 180° flat on itself without cracking on the outside of the bent portion.

6.4.2 The test specimen for Grade B steel bars shall stand being bent cold through 180° without cracking on the outside of the bent portion to an inside diameter which shall have a relation to the diameter of the specimen in accordance with Table 4.

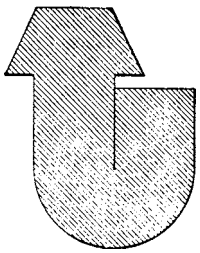


FIG. 1 Bend Test of Rivet

TABLE 2 Bend Requirements, Rivets

Diameter of Rivet Shank, in.	Ratio of Bend Diameter to Diameter of River Shank	
	Grade A	Grade B
¾ and under	flat	1
Over ¾	flat	1½

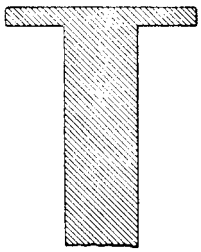


FIG. 2 Flattening Test of Rivet

TABLE 3 Tensile Requirements, Bars

	Grade A	Grade B
Tensile strength, psi (MPa)	45 000–55 000 (310–380)	58 000–68 000 (400–470)
Yield point, min, psi (MPA)	23 000 (160)	29 000 (200)
Elongation in 8 in. or 200 mm, min, %	27	22
Elongation in 2 in. or 50 mm, min, %	33	25

TABLE 4 Bend Requirements, Bars

Specimen Diameter, in.	Ratio of Bend Diameter to Diameter of Specimen	
	Grade A	Grade B
¾ and under	flat	½
Over ¾	flat	1

7. Dimensions, Mass, and Permissible Variations

7.1 *Rivets*:

7.1.1 The dimensions of rivets shall conform to B18.1.2 for nominal diameters in. and larger and B18.1.1 for nominal diameters 7⁄16 in. and less.

7.1.2 Snap gage measurement shall be made at the point of minimum diameter, but it is not required that the rivet shall turn completely in the gage. Measurements of the maximum tolerance shall be made with a ring gage, all rivets to slip full to the head in the gage of the required size for the various diameters.

7.2 *Bars*—The diameter of hot-finished rivet bars shall not vary from the size specified by more than the amounts in accordance with Table 5.

8. Workmanship, Finish, and Appearance

8.1 *Rivets*—The finished rivets shall be true to form, concentric, and free of injurious defects.

8.2 *Bars*:

8.2.1 Bars shall be free of visible pipe, undue segregation, and injurious surface imperfections.

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TABLE 5 Permissible Variations in the Size of Hot-Rolled Rounds

Specified Size, in.	Variations, from Size, in.		Out-of-Round,[A] in.
	Over	Under	
5/16 and under	0.005	0.005	0.008
Over 5/16 to 7/16, incl	0.006	0.006	0.009
Over 7/16 to 5/8, incl	0.007	0.007	0.010
Over 5/8 to 7/8, incl	0.008	0.008	0.012
Over 7/8 to 1, incl	0.009	0.009	0.013
Over 1 to 1 1/8, incl	0.010	0.010	0.015
Over 1 1/8 to 1 1/4, incl	0.011	0.011	0.016
Over 1 1/4 to 1 3/8, incl	0.012	0.012	0.018
Over 1 3/8 to 1 1/2, incl	0.014	0.014	0.021

[A] Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the same cross section.

8.2.2 *Surface Finish*—The bars shall have a commercial hot-wrought finish obtained by conventional hot rolling. See 4.4 for producer's descaling option.

9. Number of Tests and Retests

9.1 *Rivets*—Sampling for rivet bend and rivet flattening tests shall be in accordance with Guide F 1470, detection process.

9.2 *Bars*:

9.2.1 Two tension tests shall be made from each heat, unless the finished material from a heat is less than 50 tons (45 Mg), when one tension test will be sufficient. However, for material 2 in. (51 mm) and under in thickness, when the material from one heat differs 3/8 in. (9.5 mm) or more in thickness, one tension test shall be made from both the thickest and the thinnest material rolled regardless of the weight represented. Each test shall conform to the specified requirements.

9.2.2 Retests on bars may be made in accordance with Specification A 29/A 29M.

10. Specimen Preparation

10.1 *Rivets*—Rivets shall be tested in their full-size finished condition.

10.2 *Bars*:

10.2.1 Test specimen selection and preparation shall be in accordance with Specification A 29/A 29M and Test Methods and Definitions A 370.

10.2.2 Tension and bend test specimens for rivet bars which have been cold drawn shall be normalized before testing.

11. Test Methods

11.1 *Rivets*—Rivet bend and flattening tests shall be in accordance with the manufacturers standard test procedures.

11.2 *Bars*—Tension and bend tests shall be conducted in accordance with Test Methods and Definitions A 370, and especially Supplement I thereof, on steel bar products.

12. Inspection

12.1 If the testing described in Section 9 is required by the purchaser, it shall be specified in the inquiry and contract or order.

12.2 The inspector representing the purchaser shall have free entry at all times, while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification. All tests (except product analysis) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

13. Rejection and Rehearing

13.1 *Rivets*—Rivets 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.

13.2 *Bars*—Rejection and rehearing shall be in accordance with Specification A 29/A 29M.

14. Certification

14.1 When specified on the purchase order, the manufacturer shall furnish certification that the material was manufactured and tested in accordance with this specification together with a report of the heat analysis (5.2) and mechanical property test results (Section 6) as applicable to the product ordered. The report shall include the manufacturer's name, ASTM designation, grade, heat number (bars only), and authorized signature.

15. Responsibility

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

16. Packaging and Package Marking

16.1 *Rivets*—Rivets shall be properly packed and marked to prevent damage and loss during shipment.

16.2 *Bars*—Bars shall be packed and marked in accordance with Specification A 29/A 29M.

17. Keywords

17.1 bars; carbon steel; pressure vessel rivets; rivets; steel

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SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue, A 31 – 00, that may impact the use of this standard. (Approved Aug. 1, 2004.)

(*1*) Revised Section 15, Responsibility.

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