



Designation: A31 – 04(Reapproved 2009)

# Standard Specification for Steel Rivets and Bars for Rivets, Pressure Vessels<sup>1</sup>

This standard is issued under the fixed designation A31; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification<sup>2</sup> 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 standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</sup>

[A29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for](#)

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products](#)

[F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection](#)

2.2 *ASME Standards*:<sup>4</sup>

[B18.1.1 Small Solid Rivets 7/16 Inch Nominal Diameter and Smaller](#)

[B18.1.2 Large Rivets 1/2 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 A31 – 82, 10 000 pieces, steel rivets Grade A, 1/2 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 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](#).

<sup>1</sup> 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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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SA-31 in Section II of that Code.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> 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

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

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 A751.

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.

7. Dimensions, Mass, and Permissible Variations

7.1 Rivets:

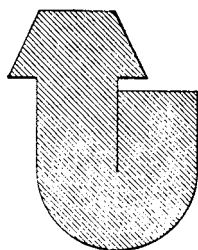


FIG. 1 Bend Test of Rivet

TABLE 2 Bend Requirements, Rivets

Diameter of Rivet Shank, in.	Ratio of Bend Diameter to Diameter of Rivet Shank	
	Grade A	Grade B
¼ and under	flat	1
Over ¼	flat	1½

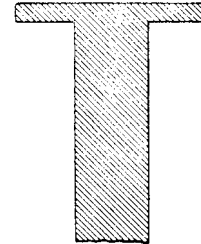


FIG. 2 Flattening Test of Rivet

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
¼ and under	flat	½
Over ¼	flat	1

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.

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.