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SURFACE VEHICLE RECOMMENDED PRACTICE

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Mechanical and Chemical Requirements for Nonthreaded Fasteners Carbon Steel Solid Rivets—Inch Series

Foreword

This document has been revised to update standard and to include grade and manufacturer head markings, and a section on surface discontinuities.

1. Scope

These specifications cover the mechanical and chemical requirements, and surface discontinuities limits for carbon steel solid rivets used in automotive and other related industries.

1.1 Product Classification

This specification covers the following Grades as described below:

Grade	Diameter, inches	Hardness	Tensile Strength, psi
0	7/16 and smaller	65 HRB max	40 000 – 55 000
1	7/16 and smaller	85 HRB max	52 000 – 62 000
2	1/2 and larger	No Requirement	55 000 – 70 000
3	1/2 and larger	76 - 85 HRB	68 000 – 82 000

1.2 Rationale

General revision to update standard and to include grade and manufacturer head markings and a section on surface discontinuities.

2. References

2.1 Applicable Publication

The following publication forms a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J417—Hardness Test and Hardness Number Conversions

2.1.2 ASTM PUBLICATION

Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

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

2.1.3 ISO PUBLICATION

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 3269—Fasteners—Acceptance Inspection

3. Grouping

Rivets in Grades 0 and 1 fall in two groups; namely, those of small diameter—7/16 in nominal diameter and less, usually driven cold, and those over 7/16 in nominal diameter usually driven hot. It is recommended that the rivets in Grades 0 and 1 for cold driving in sizes over 7/16 in nominal diameter be ordered annealed.

4. General Data

Rivets for cold driving are specified so as to provide the necessary ductility for the application.

The properties of rivets intended for hot driving are not necessarily those found in the driven rivet. Therefore, the specifications for hot driven product are designed to furnish satisfactory properties after cooling from the driving heat.

5. Chemical Requirements

Steel shall be produced by any suitable process to conform to the chemistry specified in Table 1.

TABLE 1—MECHANICAL AND CHEMICAL REQUIREMENTS OF RAW MATERIAL

Grade	Tensile Properties of Hot Rolled Rod or Bar from Which Rivets are Produced	Chemical Composition Ladle Analysis % Max
0	Tensile strength, psi: 40 000 – 55 000 Yield point, min, psi: 23 000 Elongation in 8 in, Min, %: 27	P—0.040 S—0.050
1	Tensile strength, psi: 52 000 – 62 000 Yield point, Min, psi: 28 000 Elongation in 8 in, Min, %: 24	P—0.040 S—0.050
2	Tensile strength, psi: 55 000 – 70 000 Yield point, Min, psi: 29 000 Elongation in 8 in, Min, %: 22	C—0.28 Mn—0.30—0.90 P—0.040 S—0.050 Si—0.25
3	Tensile strength, psi: 68 000 – 82 000 Yield point, Min, psi: 38 000 Elongation in 8 in, Min, %: 20	C—0.30 Mn—1.65 P—0.040 S—0.050 Si—0.25

6. Mechanical Requirements

6.1 Heat Treatment

Rivets of Grade 0 and 1 are supplied in the annealed condition for 7/16 in nominal diameter and under.

Rivets of Grades 2 and 3 are intended for hot driving only. The tensile requirements of Grade 3 are met by heating to 1450 °F, holding at this temperature for not less than 30 min and cooling slowly in a furnace.

6.2 Hardness

When hardness is specified, the test shall be conducted on the top of the rivet head after suitable surface preparation.

Hardness requirement for Grade 0 is HRB 65 max and for Grade 1 is HRB 85 max.

There are no specified hardness requirements for Grade 2.

Hardness requirement for Grade 3 is HRB 76-85.

7. Surface discontinuities

The following specifies allowable limits for the various types of surface discontinuities that may occur during the manufacture and processing of solid rivets. Through out the following requirements D designates the nominal diameter.

Surface discontinuities for rivets are divided into five “types”, as defined as follows:

7.1 Crack

A clean (crystalline) fracture passing through or across the grain boundaries and may possibly follow inclusions of foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment. Where parts are subjected to significant reheating, cracks usually are discolored by scale.

7.2 Forging Cracks

May occur during the cut-off or forging operations and are restricted to the center of the top surface of the heads of rivets. Typical forging cracks are shown in Figure 1.

Forging cracks *o*n the top of heads shall not exceed a length of 1 D or a width or depth of 0.040 D or 0.010 in whichever is greater.

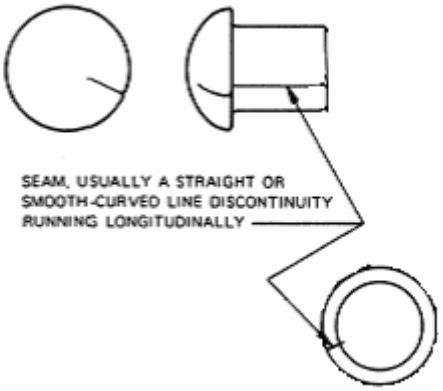
NOTE—Forging cracks are permissible discontinuities if within the limits specified in 7.2.

FIGURE 1—TYPICAL FORGING CRACKS

7.3 Seam

Seams are generally inherent in the raw material from which fasteners are manufactured. They are narrow, usually straight or smooth-curved line discontinuities running parallel to the rivet shank axis. Seams in raw material used for forged or formed rivets may lead to the formation of bursts. Seams may extend onto the tops of the heads of circular headed products as well as being present at the periphery of the head. Seams may also extend into the chamfer circle and bearing face. Typical seams are shown in Figure 2.

Seams in the shanks shall not exceed a depth of 0.030 D or 0.008 in, whichever is greater. Seams extending into the heads which do not open beyond the limits specified for bursts are acceptable.



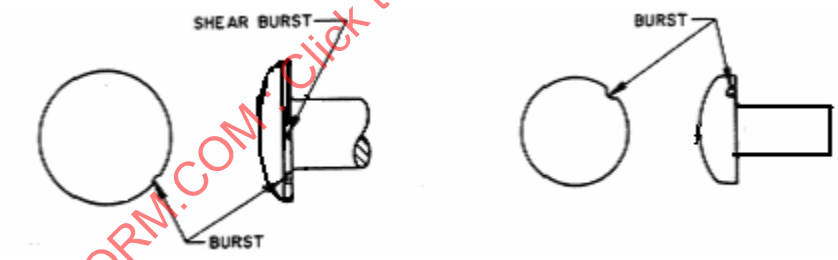
NOTE—Seams are permissible discontinuities if within the limits specified in 7.3.

FIGURE 2—TYPICAL SEAMS

7.4 Burst

An open break in the metal. Bursts occur during the forging operation and are located at the periphery of circular heads. A typical burst is shown in Figure 3.

Peripheries of circular head products may have two or more bursts or shear bursts, providing that only one has a width greater than 0.040 D; in addition this one burst shall not have a width greater than 0.080 D.



NOTE—Bursts and shear bursts are permissible discontinuities if within the limits specified in 7.4 and 7.5.

FIGURE 3—TYPICAL BURSTS AND SHEAR BURSTS

7.5 Shear Burst

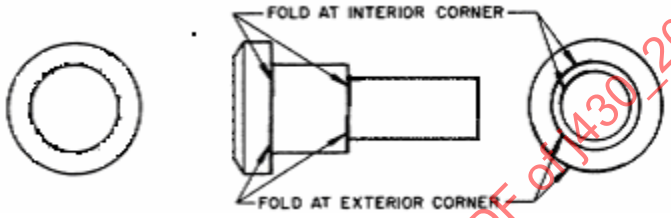
An open break in the metal, occurring most frequently at the head periphery of products having circular heads and located at approximately a 45° angle to the product axis. Typical shear burst is shown in Figure 3.

Peripheries of circular head products may have two or more shear bursts or bursts, providing that only one has a width greater than 0.040 D; in addition this one burst shall not have a width greater than 0.080 D.

7.6 Fold

A doubling over of metal that may occur during the forging operation. Folds in rivets may occur at or near the intersection of diameter changes and are especially prevalent with noncircular necks, shoulders, and heads. Typical folds are shown in Figure 4.

Folds located in internal corners at or below the bearing surface, for example, in the fillet at the junction of the head and shank, are not permitted. Folds at the intersection of the head circular periphery and bearing surface shall not project below the bearing surface. All other folds on rivets are permitted. Folds located at exterior corners are permitted.



NOTE—Folds are permissible discontinuities if within the limits specified in 7.6.

FIGURE 4—TYPICAL FOLDS

8. Finish

Unless otherwise specified, rivets and pins shall be supplied with a natural (as annealed processed) finish, unplated or coated.

Annealed rivets for cold driving should be free of loose scale.

9. Test Requirements

9.1 Number of Tests on Rivets

9.1.1 Random samples shall be selected for hardness test from each lot of rivets. Sample size for hardness shall conform to ASTM F 1470 Level B when lot control is applied or to ISO 3269 when Shipping lots are applied.

9.1.2 All samples must meet the hardness requirements of the specification for acceptance, but retests are permitted as stated in 9.1.3 Retests.

9.1.3 RETESTS

If any sample from the same lot fails to meet the specified requirement, double the number of samples shall be tested, in which case for acceptance all of the additional samples shall meet the specification.