SAE International	SURFACE VEHICLE STANDARD	J492 APR2013
		Issued 1928-02 Reaffirmed 2013-04 Superseding J492 JUN2005

Guide for Rivet Selection and Design Consideration

RATIONALE

J492 has been reaffirmed to comply with the SAE five-year review policy.

1. Scope

This is a guide intended to aid the user in the proper selection and application of rivets as a fastening means. It consists of general information on the advantages of riveting, various methods of riveting, selection of rivets and design considerations.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein.

2.1.1 ASME Publications

Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900.

ASME B 18.1.1—Small Solid Rivets 7/16 in. Nominal Diameter and Smaller—Inch Series
ASME B 18.1.2—Large Rivets 1/2 in. Nominal Diameter and Larger—Inch Series
ASME B 18.7—General Purpose Semi-Tubular Rivets, Full Tubular Rivets, Split Rivets and Rivet Caps—Inch Series

3. General

This guide includes in Section 2 – titled “References”, ASME B 18 Rivet Specifications which covers the complete general and dimensional data for the various types of rivets mentioned in this guide.

4. Advantages of Riveting

Riveting as a means of fastening is popular because of its simplicity, dependability, and low cost. Where the parts to be assembled do not normally need to be disassembled and, in the case of tubular, semi-tubular and split rivets, the tensile and fatigue strength of the joinings made are not critical, riveting has many advantages. Some of the more outstanding of these are:

1. Metallic rivets are almost universally made by cold heading in high speed headers, and this makes a rivet a very economical fastener.
2. Investment in assembly equipment is low.
3. Maintenance costs of assembly equipment are low.
4. Rate of assembly is high and due to its simplicity, riveting lends itself to automation.
5. A minimum of skill is required to perform the operation.
6. Metallic or nonmetallic materials, or combinations thereof, may be joined.
7. Rivets can be produced in a great variety of metals, ranging from low carbon steel to precious metals such as silver or gold.
8. Rivets may be used, not only as fasteners, but as functional components, such as pivots, electrical contacts, spacers, or supports.
9. Riveting normally requires no supplementary parts such as plain washers, lock washers, nuts, or safety wiring, nor are additional operations required such as assembly of nuts or locking devices as in the case of threaded fasteners.
10. Except for tubular, semitubular and split rivets, the rivet, when driven, usually fills the hole and prevents shifting of the parts joined.

5. Methods of Riveting

Riveting operations are performed by a number of methods, some of which are applicable only to particular types of rivets. The most commonly used methods are as follows:

5.1 Impact

This method employs a header die which strikes repetitive blows thus forming a head while the preformed end of the rivet is backed up with a tool called a buck or bucking bar. The header die may also be rotated while striking the repetitive blows. In machine riveting the buck is usually a part of the holding fixture.

The method is applicable to solid rivets driven either hot or cold. Hot riveting is usually confined to large rivets used for structural purposes, while cold riveting is the method generally used for industrial applications on manufactured products. During the riveting operation the rivet material is displaced outward and downward into contact with the sides of the hole in which it is being assembled. The remainder of the material at rivet end forms the head. Upsetting of the shank can be controlled by using the proper impact force. See Figure 1.

5.2 Squeeze

As its name implies, this method consists of applying steady pressure with a formed header die while the preformed end of rivet is backed up with a block which may be made a part of the holding fixture.

This method is applicable to solid rivets driven hot or cold. As in the case of impact riveting, the rivet material is displaced outward and downward into contact with the sides of the hole in which it is being assembled. The remainder of the material forms the head. See Figure 2.

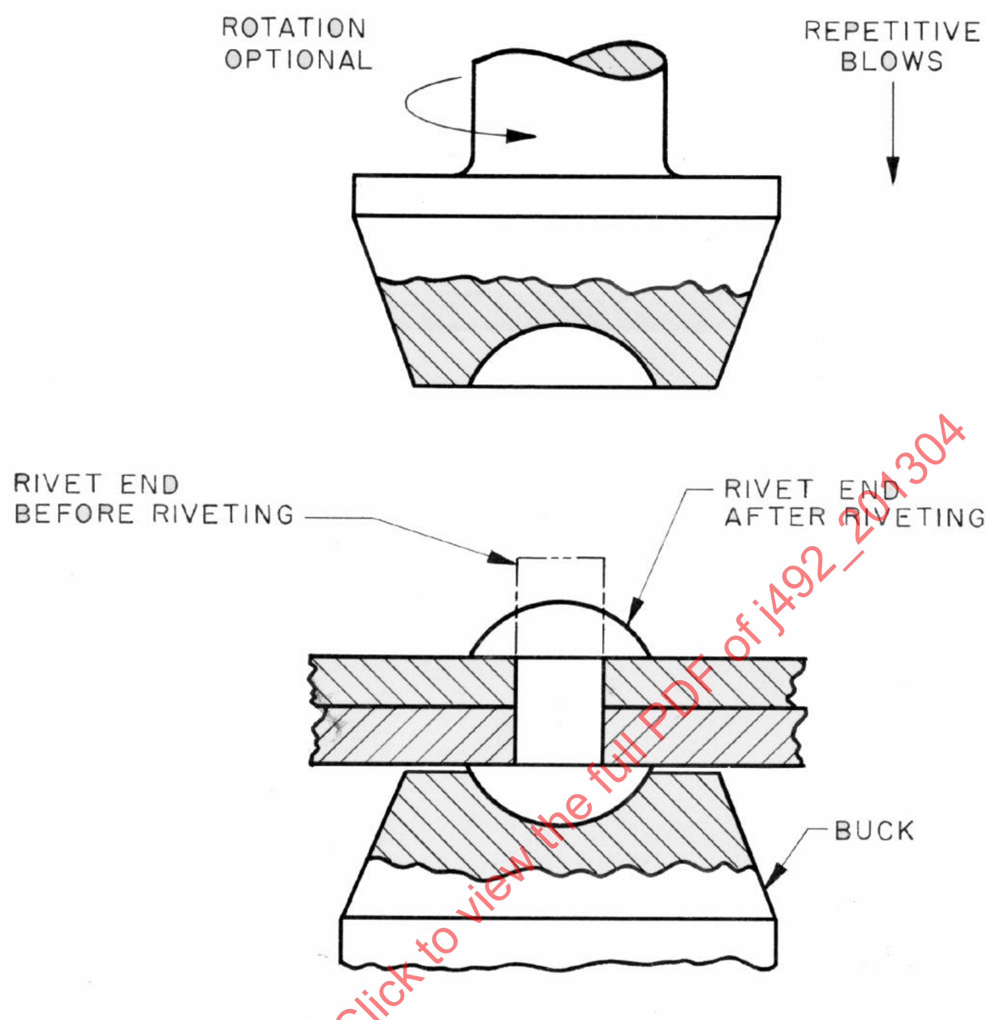

FIGURE 1—IMPACT RIVETING

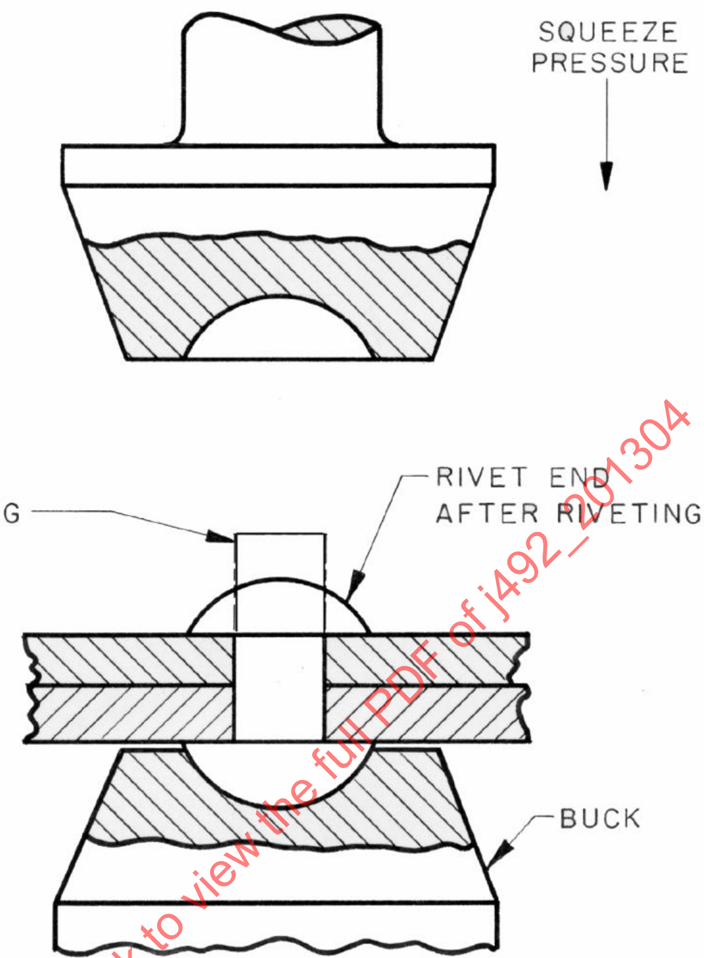

FIGURE 2—SQUEEZE RIVETING

5.3 Clinch

This method of riveting involves forming the hollow end of tubular rivets and eyelets or prongs of split rivets back against the material being fastened and, depending on the shape and extent of the forming, is referred to as roll clinching, star or corrugated clinching, or scored clinching. See Figure 3. Roll clinching is accomplished by applying pressure with a formed header die, commonly called anvil, which turns or rolls the tubular shank or prongs of the rivet outward and over to bring it into contact with the part being assembled and is the method generally used to rivet semitubular and full tubular rivets and eyelets when used in metals or other hard materials. Star or corrugated clinching is accomplished by applying pressure with a formed header die which first splits or splays the tubular shank of the rivet and then turns or rolls the splayed portions outward and over to bring it into contact with the parts being assembled and is the method generally used to rivet full tubular rivets or eyelets when used in soft or resilient materials. When the splayed portions are actually turned back into the material being fastened, the method is often referred to as scored clinching. Where a finished appearance on both sides of the assembly is desirable, tubular and split rivets may be clinched into rivet caps designed for the purpose.

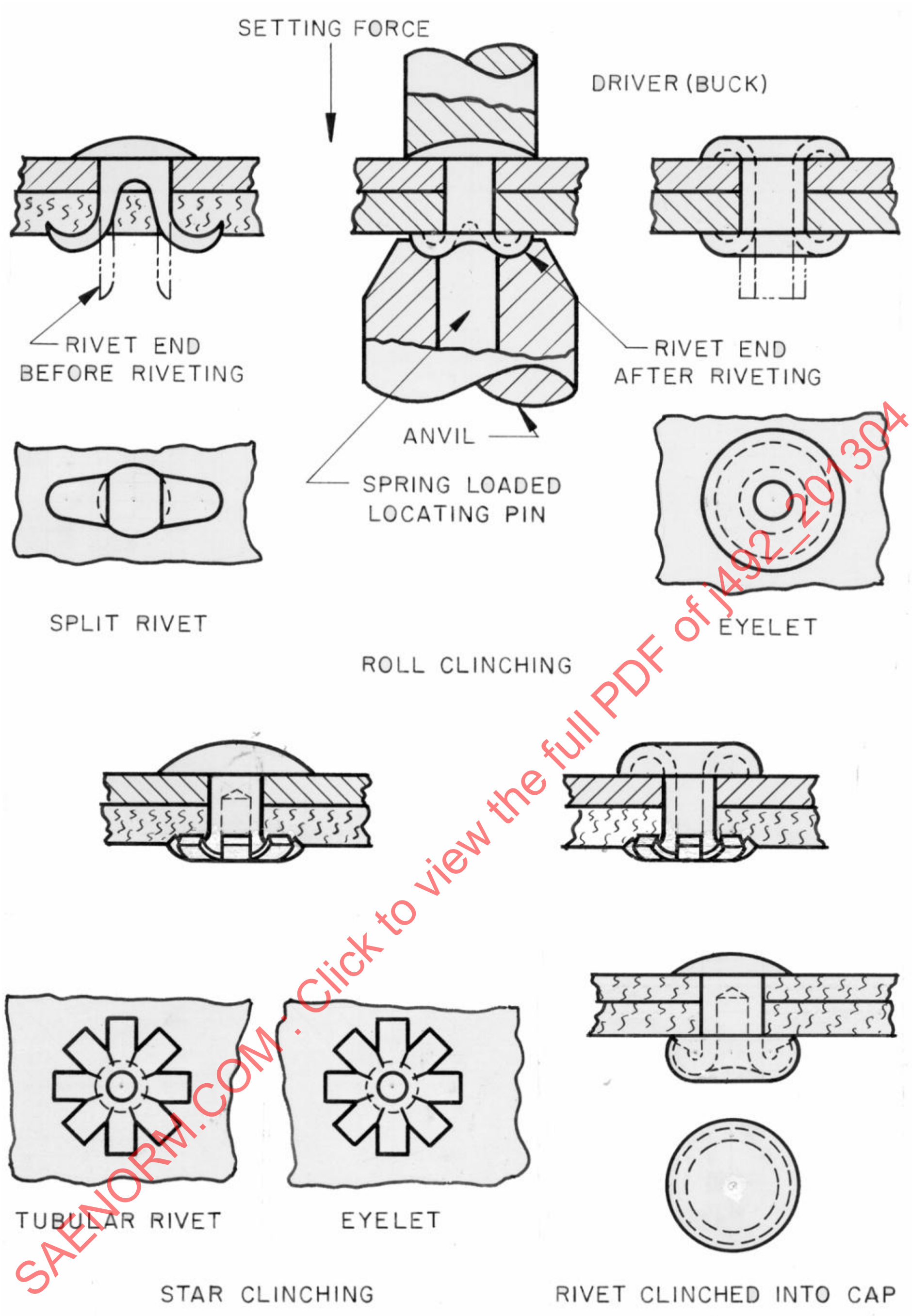

FIGURE 3—CLINCH RIVETING

5.4 Shear

This method of riveting is accomplished by the use of a circular shear tool resembling a hollow punch. The method is applicable to solid rivets and the operating is performed cold. With the rivet properly bucked the tool having a hollow portion smaller than the rivet shank shears an annulus of material from the shank and with squeeze pressure upsets or displaces it into a flat annular head formed around the stub portion of the shank left by the hollow in the tool. The annular head is in contact with the part being assembled. The shearing action terminates flush with the top of the head thus leaving the head integral with the shank. See Figure 4.

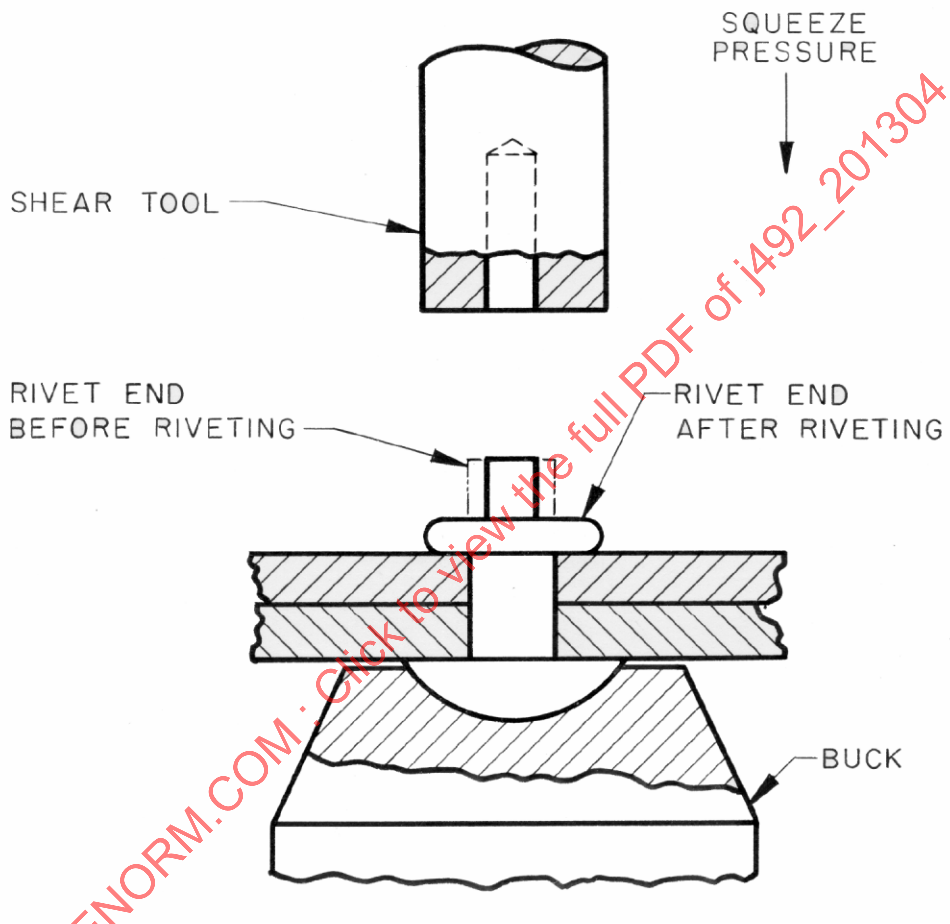

FIGURE 4—SHEAR RIVETING

5.5 Staking

Staking consists of deforming the material of assembled rivets in such a way as to prevent their loosening or becoming disassembled under operating conditions. It does not include the forming of a head.

It is done with a sharp tool at one or more points which forces the metal at these points tightly against the mating part. Where rivets are used in soft or thin materials and where light riveting is sufficient, the end of the rivet may be staked or slightly peened over the hole in a plain washer, commonly referred to as a riveting burr, to provide more bearing area on the staked side. See Figure 5.

6. Rivet Selection

6.1 Requirement Considerations

With the wide variety of rivet types available, no fixed rule can be established to cover the selection of a type best suited for a given application. Generally, however, solid rivets are indicated for maximum strength while semitubular are preferred where cost is a prime factor and tensile or fatigue strength is not as critical. Full tubular rivets can, in some cases, be used with materials such as plastic, leather, canvas fabric, and wood in which the rivet under pressure pierces its own hole. The deep hole allows the slugs of pierced material to compress inside the rivet thereby exposing the required rivet material for clinching. Split rivets are also used extensively in soft materials such as those mentioned herein. The prongs pierce their own holes and are then clinched to effect the assembly. Split rivets may be used in the self-piercing and fastening of light gage metal as well. Semitubular rivets may also be used in the self-piercing and fastening of light metal wherever the appearance of the clinch is not important. Selfpiercing riveting is economical and lends itself to high speed assembly operations.

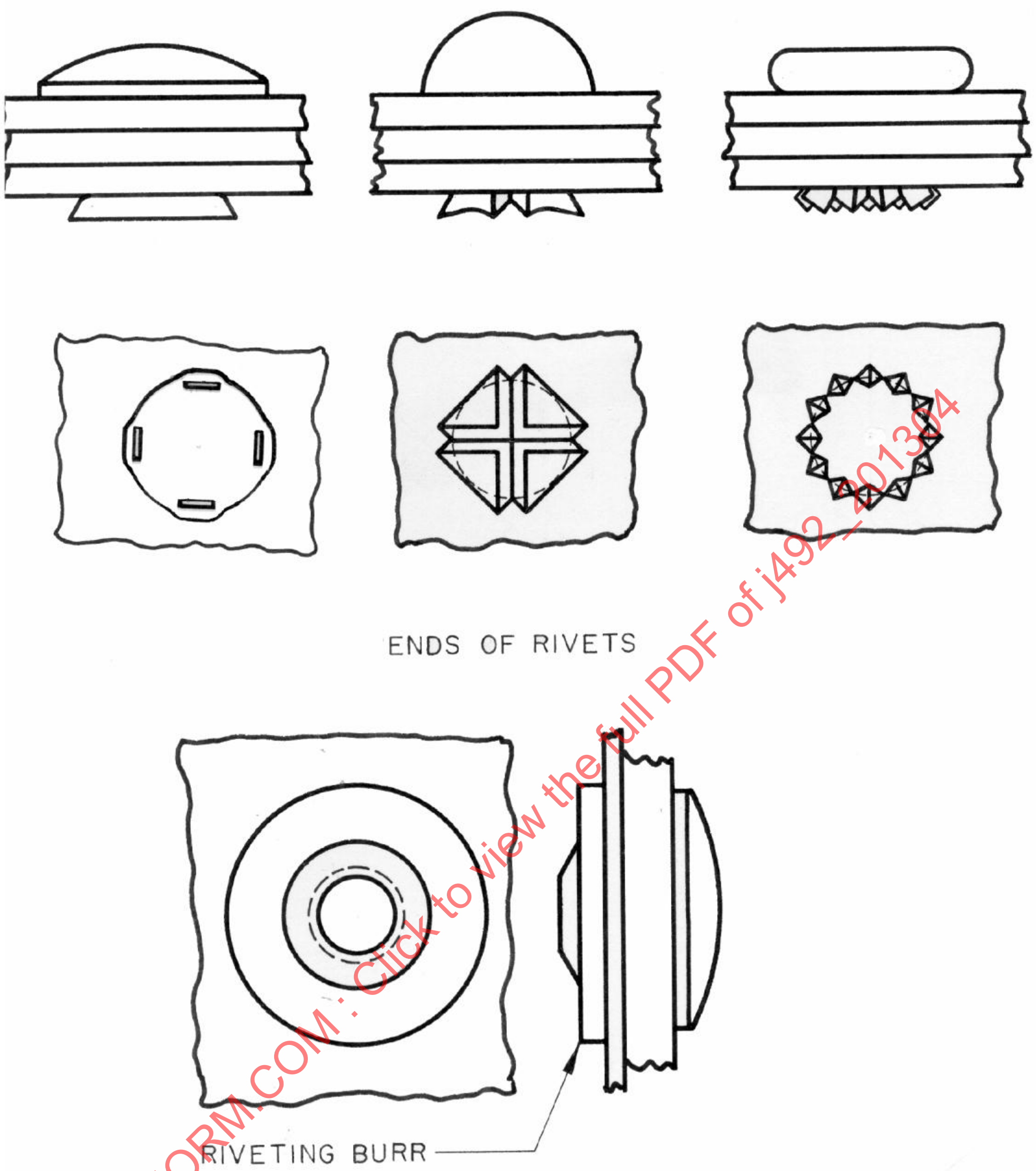

FIGURE 5—STAKING

6.2 Strength

A rivet is primarily strong only in shear. When set it is not stressed in tension. Thus, the designer must select the rivet size and material which will provide the necessary shear resistance needed in the application.

6.3 Diameter

The shear strength of a rivet is a direct function of the diameter so it is important to select a diameter which will provide the necessary shear strength.

6.4 Head Design

The type of head specified will, of necessity, be dictated by the requirements of the application such as clearance, appearance, bearing area, and so forth. Round, truss, oval, flat, pan, and similar head styles with flat bearing surfaces provide good holding power at minimum cost. The use of flat head rivets where appearance is not a consideration minimizes tooling and production problems.

Countersunk head rivets should be employed only where a flush surface is required since the countersinking or dimpling of parts to be fastened increases cost and production time on the assembly line.

6.5 Length

The length of rivet is affected by conditions such as the total compressed thickness of the members to be joined, the kind of rivet being used, the method of riveting being employed, the head style being formed, and the clearance hole into which the rivet is being assembled. The length of rivet required to provide optimum assembly conditions for a particular application can best be determined by experiment.

The following recommendations are often used to determine the length of various types of rivets for general applications and as a starting point in specific applications. The approximate length of solid rivets, when impact or squeeze riveted, required to form the head and fill the clearance space in the hole should be in excess of the thickness of the material to be riveted by an amount equal to approximately 0.75 to 1.00 times the rivet diameter for forming countersunk heads and from 1.3 to 1.7 times the rivet diameter for forming round or pan heads. See Figure 6.

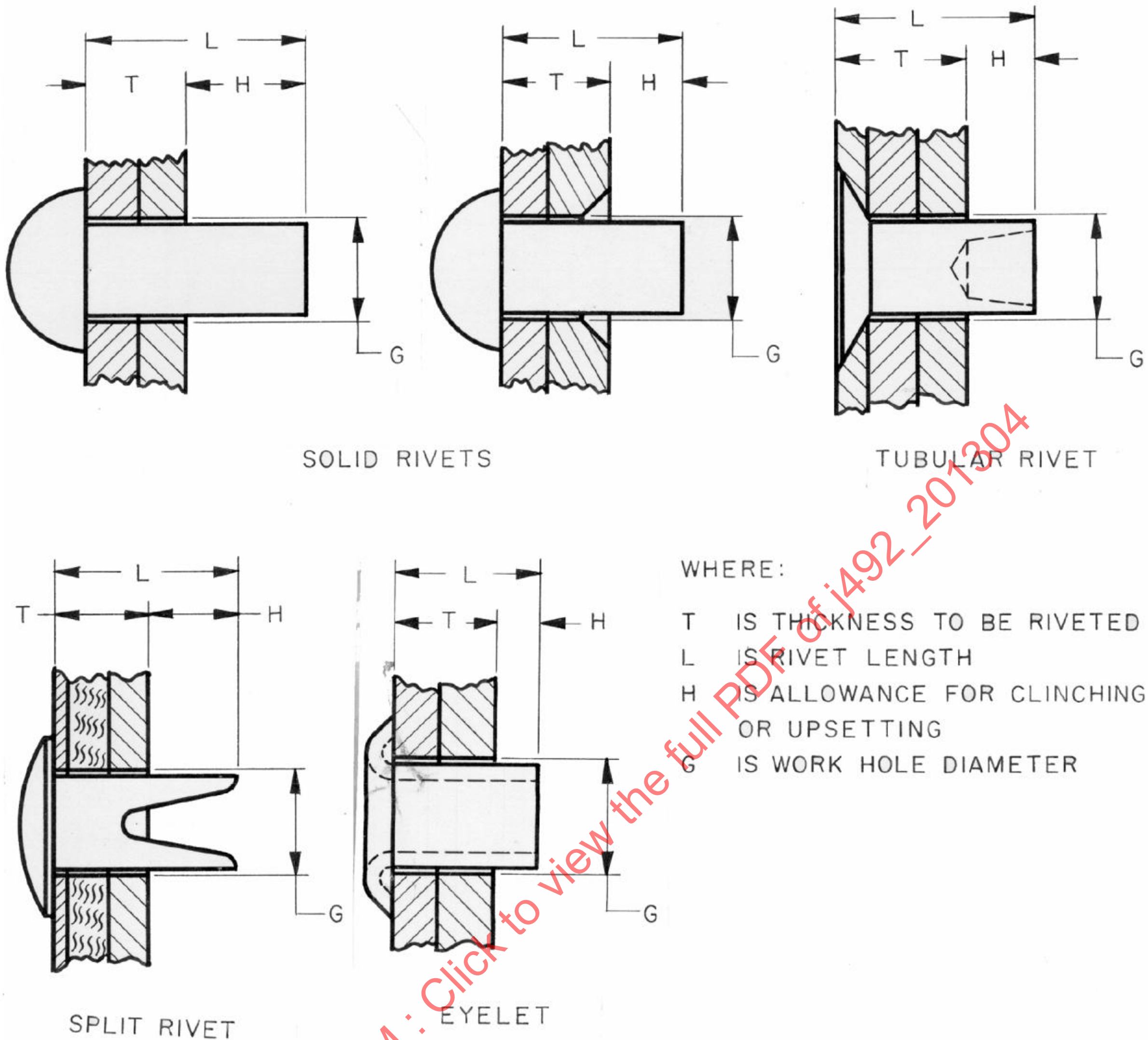

FIGURE 6—TYPES OF RIVETS

The approximate lengths for tubular rivets, split rivets, and eyelets should be determined by adding the total compressed thickness of the work to be assembled to the appropriate clinch allowance specified in Table 1. If the length so determined does not conform to the length increments shown in the specifications for the particular fastener, the next longer length should be used. See Figure 6.