

IFI NOTES:

1. *During the early 1970's, ASME Standards Committee B18 undertook development of a dimensional standard for threaded projection weld studs. A proposed standard incorporating basic requirements was then drafted. When circulated for public review, it became apparent that the preponderance of weld studs in use were uniquely designed for individual applications and to include all would be impractical. Despite the Committee's sincere efforts, reaching consensus on the contents of a single document for national recognition was unachievable and the project was discontinued.*
2. *IFI also recognized the impracticality of developing a national standard for threaded projection weld studs. However, it considered the earlier efforts of Committee B18 to have merit and be worth preserving. Consequently, with the sole intent of providing useful guidance to designers and engineers when considering the use of weld studs, the contents of the 1970 draft standard, editorially modified to be informational only, were presented in IFI's 5th (1970) and 6th (1988) editions of its Fastener Standards book.*
3. *Even though lower carbon content projection weld studs enhance weldability, there has been a trend in recent years by certain end users to purchase medium/high carbon, carburized or carbonitrided products. These run the risk of brittle welds.*
4. *To warn against the practice of welding other than low carbon steels, IFI's original guidance document has been elevated to "industry standard" status with designation herein as IFI-148 and published as a separate document for immediate and broader recognition.*

1.0 Introductory Notes

1.1 Scope

1.1.1 This document covers general and dimensional data for various types of weld studs having one or more integrally formed projections under or on top of the head suitable for resistance welding.

1.1.2 The inclusion of dimensional data in this standard is not intended to imply that only the products described are commercially available. Consumers are requested to consult with manufacturers concerning other designs and sizes.

1.1.3 When a weld stud is welded to another material, the heat-affected zones are momentarily heated to a red heat. This momentary heating is above the transformation temperature of the steel, similar to when the material was hardened. The large mass of surrounding cold material is sufficient to cool the heated area quickly, as in quenching a part in oil or water. In steel of 1020 carbon content or higher, this can produce a very brittle area on the weld stud of untempered martensite, if the process is not properly controlled.

1.1.4 If the welded parts are placed in a container after welding, varying degrees of brittleness can be encountered. The first parts into the container cool quickly, and can become brittle. Subsequent parts are exposed to some heat from other parts already in the container. By the time the container is filled near capacity, the last parts in may experience sufficient heat enabling them to cool slower from the welding temperature. This could approach a normalized or even an annealed condition and would cause the last parts in the container to be more ductile than the first ones.

1.1.5 The higher the carbon content (1020 and above) in the steel, the greater the potential for brittle welds. High temperature stress relief up to 1500°F is recommended. If the weld stud must be heat treated, a hardness range of Rc 24 to 34 is recommended with a minimum tempering temperature of 650°F. Most automotive specifications limit the material used for weld studs to SAE 1005, 1008, 1010 to 1018, 1020 or 1022 as found in SAE J403 or IFI-140 as 1022A or 1022B.

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1.2 Referenced Documents

All standards are latest issue unless otherwise specified.

1.2.1 ASME standards are available from The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME B1.1 *Unified Inch Screw Threads (UN, and UNR Thread Form)*

ASME B18.6.3 *Machine Screws and Machine Screw Nuts*

ASME B18.12 *Glossary of Terms for Mechanical Fasteners*

ASME B18.18.1 *Inspection and Quality Assurance for General Purpose Fasteners*

1.2.2 ASTM standards are available from The American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A307 *Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength*

1.2.3 IFI standards are available from the Industrial Fasteners Institute, 6363 Oak Tree Boulevard, Independence, OH 44131-2500.

IFI-140 *Carbon and Alloy Steel Wire, Rods and Bars for Mechanical Fasteners*

IFI-548 *Threaded Projection Weld Studs - Metric*

1.2.4 SAE Standards are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J403 *Chemical Compositions of SAE Carbon Steels*

1.3 Head Types

The types of heads covered in this document are classified by the location, quantity and/or configuration of the weld projection or projections and consist of the following:

1.3.1 Type U3. The Type U3 head defined in Table 1 is cylindrical and has flat, parallel surfaces. The underside welding surface has three integrally formed hemispheroidal shaped weld projections equally spaced on a locating circle concentric with the shank.

1.3.2 Type T3. The Type T3 head defined in Table 2 is cylindrical and has flat, parallel surfaces. The top welding surface has three integrally formed hemispheroidal shaped weld projections equally spaced on a locating circle concentric with the shank.

1.3.3 Type TD. The Type TD head defined in Table 3 is cylindrical and has flat, parallel surfaces. The top welding surface has a single integrally formed spherical segment shaped weld projection centered on the welding surface.

1.3.4 Type UR. The Type UR head defined in Table 4 is cylindrical and has flat, parallel surfaces. The underside welding surface has an integrally formed annular ring weld projection on a locating circle concentric with the shank.

1.3.5 Type US3. The Type US3 head defined in Table 5 is cylindrical and has flat, parallel surfaces. The underside welding surface has three integrally formed sausage shaped weld projections equally spaced on a locating circle concentric with the shank.

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1.3.6 Type UC4. The Type UC4 head defined in Table 6 is cylindrical and has flat, parallel surfaces. The underside welding surface has four integrally formed hemispheroidal shaped weld projections equally spaced on a locating circle concentric with the shank. Formed integrally, and protruding on the same side as the weld projections and around the periphery of the head, is a rim.

1.3.7 Type TC4. The Type TC4 head defined in Table 7 is cylindrical and has flat, parallel surfaces. The top welding surface has four integrally formed hemispheroidal shaped weld projections equally spaced on a locating circle. Formed integrally, and protruding on the same side as the weld projections and around the periphery of the head, is a rim.

1.3.8 Type TUS3. The Type TUS3 head defined in Table 8 is cylindrical and has flat, parallel surfaces. The underside welding surface has three integrally formed sausage shaped weld projections equally spaced on a locating circle concentric with the shank.

1.4 Dimensions

All dimensions in this standard are in inches and apply before any coating, unless otherwise stated.

1.5 Terminology

For definitions of terms relating to fasteners or component features, refer to ASME B18.12.

2.0 General Data

2.1 Heads

2.1.1 Height of Head. The height of head is measured, parallel to the axis of the stud, from the welding surface to the opposite head surface and does not include the projection height.

2.1.2 Welding Surface. The welding surface of a weld stud is the spotting or locating surface excluding the projections with respect to the part to which it is welded. The welding surface should be at right angles to the axis of the threaded shank within 2 degrees.

2.1.3 Eccentricity. Eccentricity is defined as one-half of the full indicator reading.

2.1.3.1 Eccentricity of Head. The heads on weld studs should not be eccentric with the axis of the threaded shank by more than 3 percent (6 percent FIR) of the maximum head diameter determined from one diameter length of shank underhead.

2.2 Length

2.2.1 Measurement. The length of a weld stud is measured parallel to the axis of the shank from the welding surface of the head to the end of the shank, excluding the projections.

2.2.2 Tolerance on Length. The recommended tolerance on length of weld studs is tabulated below:

Nominal Stud Length	Tolerance on Length
Up to 1 in., incl.	– 0.03
Over 1 to 2 in., incl.	– 0.06
Over 2 in.	– 0.09

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2.3 Threads

Threads shall be Unified coarse or fine thread series (UNC or UNF) conforming to the dimensions in ASME B1.1, unless otherwise specified by the purchaser. Class 2A shall apply to plain finish (unplated or uncoated) studs. For studs with additive finish the 2A diameters may be exceeded by the amount of the allowance; i.e., the basic diameters shall apply to studs after plating or coating and acceptance shall be determined on the basis of a 3A GO gage and based on System 21 of ASME B1.3M. Threads shall be rolled unless otherwise agreed between manufacturer and purchaser.

2.4 Length of Thread

2.4.1 Dimension "U" is defined as the distance from the last scratch of thread to the tops of the weld projections on Types U3, UR, US3, UC4 and TUS3 weld studs. In all cases, these parts must be threaded such that the "U" dimension is sufficient to prevent damage to the projections during threading.

2.4.2 Projection weld studs of nominal lengths equal to 3 diameters or shorter shall have full formed threads extending to within 1 pitch (thread) of the bearing surface of the head, (or the top of the weld projections as applicable), or closer if practical.

2.4.3 Projection weld studs of nominal lengths greater than 3 diameters, up to and including 2 inches, shall have full formed threads extending to within 2 pitches (threads) of the bearing surface of the head, (or the top of the weld projections as applicable), or closer if practical.

2.4.4 Projection weld studs of nominal lengths greater than 2 inches shall have a minimum length of full formed threads of 1.50 inches.

2.5 Points

Weld studs are normally furnished with plain sheared ends. Header points are obtainable as defined in ASME B18.6.3.

2.6 Diameter of Body

The diameter of the unthreaded body should not be less than the minimum pitch diameter of the thread nor greater than the basic major diameter of the thread.

2.7 Material

Weld studs are normally supplied in weldable grades of low carbon steel (refer to ASTM A307, Supplementary Requirement S1 and IFI-140) or corrosion resistant steel.

If a specification from an end user calls for low carbon (boron) martensitic, higher carbon or alloy steels, or carburized lower carbon steels, it is recommended that the fastener manufacturer inform the end user of the potential for brittle welds.

2.8 Finish

Studs shall be furnished plain or plated in accordance with the respective specifications and additional requirements listed below:

NOTE: Normally, weld studs are not plated due to the detrimental effects of plating on the welding process and the toxic fumes generated during the welding sequence. For this reason, cadmium plating on weld studs is definitely undesirable and appropriate precautions must be exercised in welding operations involving zinc plated studs.

Plain finish steel studs shall be clean, free from dirt, rust and any die or drawing compounds.

2.9 Surface Discontinuities

Weld studs should be free from surface discontinuities, such as burrs or loose scale, that might affect their usability.

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