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An American National Standard

Recommended Practices for Friction Welding

American Welding Society

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Recommended Practices for Friction Welding

1st Edition

Prepared by the
American Welding Society (AWS) C6 Committee on Friction Welding

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This recommended practice describes friction welding fundamentals and basic equipment requirements. Suggested procedure qualification, inspection methods, and joint designs are detailed. Typical mechanical property data are referenced.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

Foreword

This foreword is not part of ANSI/AWS C6.1-89 (R2009), *Recommended Practices for Friction Welding*, but is included for informational purposes only.

The Committee on Friction Welding was formed in 1977 with representatives from governmental agencies, industry, and research organizations. The initial objective of the committee was the exchange of friction welding technical information. As the process gained wider acceptance, it became increasingly apparent that there was a growing need for a set of guidelines to the variations and application of the process.

This recommended practice represents the culmination of committee activity to assemble a summary of friction welding technology into a single source.

This document is intended to serve as a guide for use of the process. Specific applications may require the consideration of other factors outside the scope of this document.

This document has been reaffirmed in 2009 and includes errata. A vertical line in the margin indicates a revision from the 1989 edition.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, Committee on Friction Welding, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

Erratum

The following Erratum has been identified and incorporated into the current reprint of this document.

Page 14, equation in 6.2 was changed from

$$\text{Weld Area} = \frac{\pi\,(\text{WOD})^2 - (\text{WID})^2}{4} \qquad \text{to} \qquad \text{Weld Area} = \frac{\pi\,(\text{WOD}^2 - \text{WID}^2)}{4}\ .$$

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Recommended Practices for Friction Welding

1. Scope

These recommended practices for friction welding are intended to serve as a basic guide for those interested in using any of the variations of this process as a method of joining two or more pieces.

Contained in this document are process fundamentals and requirements, equipment descriptions, joint design basics and material compatibilities. Suggested qualification procedures and inspection methods along with a review of present applications and typical mechanical property data are included. Consideration of these suggested measures will aid in the efficient utilization of friction welding in a wide range of applications.

2. Definitions

All welding terms used herein are in accordance with the latest edition of ANSI/AWS A3.0, *Welding Terms and Definitions*.[1]

3. Measurement

The U.S. customary units are primary in this publication and are to be regarded as the standard. The approximate metric (SI) equivalents are in accordance with the latest edition of ANSI/AWS A1.1, *Metric Practice Guide for the Welding Industry*, and appear throughout the text.

When mechanical testing is desired, such testing shall be in accordance with the latest edition of ANSI/AWS B4.0, *Standard Methods for Mechanical Testing of Welds*.

Appendix A contains an explanation of friction welding nomenclature and associated metric conversion factors.

4. Process Fundamentals

4.1 Process Description. Friction welding is a solid state joint process that produces coalescence of materials under compressive force contact of workpieces rotating or moving relative to one another to produce heat and plastically displace material from the faying surfaces. Under normal conditions, the faying surfaces do not melt. Filler metal, flux, and shielding gas are not required with this process.

Friction welding in production is an automatic weld process essentially for circular components. The basic steps in friction welding are illustrated in Figure 1. First, one workpiece is rotated and the other is held stationary, as shown in Figure 1(A). The two workpieces are brought together as an axial compressive force (friction welding force) is applied and shown in Figure 1(B).

Rubbing of the faying surfaces heats the workpiece locally and upsetting (change in length) begins, Figure 1(C). The process is complete when rotation of the one workpiece stops and upsetting ceases, Figure

1. AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.