DESIGN HANDBOOK
for
CALCULATING
FILLET WELD SIZES

Located, reviewed and reformatted under the AWS Product Development Committee as a service for quality-minded welding fabricators.

This publication is designed to provide information in regard to the subject matter covered. It is made available with the understanding that the publisher is not engaged in the rendering of professional advice. Reliance upon the information contained in this document should not be undertaken without an independent verification of its application for a particular use. The publisher is not responsible for loss or damage resulting from use of this publication. This document is not a consensus standard. Users should refer to the applicable standards for their particular application.
TABLE OF CONTENTS

Foreword .......................................................................................................................................................................... ii
1.0 Introduction ........................................................................................................................................................................1
2.0 Development of Criteria ................................................................................................................................................ 1
3.0 Development of Fillet Weld Sizes ................................................................................................................................ 3
4.0 Fillet Weld Size Tables .................................................................................................................................................. 3
5.0 Assumptions ..................................................................................................................................................................... 4
6.0 References ....................................................................................................................................................................... 4
Appendix A ........................................................................................................................................................................... 9
Part I — Steel
    Intercostal Member
        Ordinary Strength Steel .................................................................................................................................................. 10
        High Strength Steel ...................................................................................................................................................... 11
        Quenched and Tempered Steel (HY 80) ...................................................................................................................... 12
Part II — Austenitic Stainless Steel
    Intercostal Member
        Austenitic Stainless Steel ............................................................................................................................................. 15
        Ordinary Strength Steel ............................................................................................................................................. 15
        High Strength Steel .................................................................................................................................................... 16
        Quenched and Tempered Steel (HY 80) .................................................................................................................... 16
Part III — Aluminum Alloy
    Intercostal Member
        Aluminum Alloy 5052 .................................................................................................................................................. 16
        Aluminum Alloy 5083 .................................................................................................................................................. 18
        Aluminum Alloy 5086 .................................................................................................................................................. 20
        Aluminum Alloy 5454 .................................................................................................................................................. 21
        Aluminum Alloy 5456 .................................................................................................................................................. 23

LIST OF TABLES

Table
1.  Base Material Strength Values ........................................................................................................................................ 5
2.  Filler Material Strength Values ........................................................................................................................................ 6

LIST OF FIGURES

Figure
1.  Double Fillet Welded Joint Loaded in Longitudinal Shear .......................................................................................... 7
2.  Double Fillet Welded joint Loaded in Transverse Shear ............................................................................................. 7
1.0 INTRODUCTION

Selection of the correct fillet weld size is essential for the satisfactory performance of many weldments in service today. Fillet welds are used in virtually every industry, and when properly designed, provide effective and efficient connections.

Traditional designs base the size of the welds on the allowable unit loads that the welds are expected to experience in the intended applications. For sections of different thicknesses, the minimum fillet size is governed by the thicker member (references 1 and 2).

While this approach is conservative, the weld sizes may not be the optimum. Fillet welds can be too large or too small and it is important to have the correct size for each connection. As the volume of weld metal is severely impacted by the size of the weld, each increase in the specified fillet weld leg length has a dramatic effect on the amount of welding required.

The larger than necessary welds will increase the amount of welding material, reduce the speed of welding, and increase the resultant distortion effects. All of these will have a negative impact on the economy of the work and the overall productivity of the operation.

Similarly, too small fillet welds will not provide the necessary performance for the weldment and will most likely result in repair work being required.

An alternative system for calculating fillet weld sizes was presented by two researchers through reference 3. This approach is the basis for this handbook, and seeks to provide a method for determining the optimum fillet weld size. This document is not a standard.

2.0 DEVELOPMENT OF CRITERIA

As the strength and ductility of fillet welded joints varies as a function of the loading direction, design equations must be developed for both longitudinal and transverse shear loads. It is also fundamentally important that the equations be applicable for a wide range of base materials and filler materials.

It is common for all fillet welds to have a combination of longitudinal shear, Figure 1, and transverse shear, Figure 2. For design purposes, bending moments should be similar to transverse loading on the fillet welds. It is common in structural design for the intercostal member to be the “weaker” member in the joint. For these cases, the longitudinal shear connection need only develop the ultimate shear strength of the intercostal member, and the transverse shear connection must develop the ultimate tensile strength of the intercostal member. When welds are designed for these loading conditions, they are normally adequate for the variety of combinations of shear and tension loads that a member can sustain.

Traditionally, fillet weld size is based upon the thickness of the “weaker” member and two mechanical properties, the ultimate tensile strength of the base material, and the longitudinal shear strength of the weld material. The alternate method, presented in this handbook, requires six equations and four mechanical properties, the same two as before, plus the ultimate shear strength of the base material and the transverse shear strength of the weld material for the intercostal member. A similar set of equations is required for the continuous member.