Welding Symbols

Like other aspects of drafting, there’s a set of symbols for welding operations to simplify the communication between designer and builder (i.e. the welder). This language may seem a little strange at first, so it’s best to learn it one symbol at a time. For example, check out the horizontal stick figures below:

These figures represent the core structure of every drafting specification for a weld to be performed. The welding symbol has an arrow, which points to the location on the drawing where a weld is required. The arrow is attached to a leader line that intersects with a long horizontal reference line. Finally, there’s a tail at the opposite end of the reference line that forks off in two directions. The tail is optional and only needed for special instructions.

Dangling from the middle of the reference line, you’ll see a geometric shape or two parallel lines identifying what type of weld should be performed on the metal. This is called the weld symbol (not to be confused with the overall welding symbol). The three weld symbols you see in the drawings above represent a square, fillet and V-groove weld, respectively.

The weld symbol may also be placed above the reference line, rather than below it. This placement is important. When the weld symbol hangs below the reference line, it indicates that the weld must be performed on the “arrow side” of the joint. For example, in the next drawing a fillet weld is specified on the arrow side. You can see the actual weld in the second depiction:

Now, if the weld symbol were to appear on top of the reference line, then the weld should be made on the opposite side of the joint where the arrow points. Here’s how that will look:

Optional Tail = Special Instructions

The forked tail of the welding symbol is used to convey details that aren’t part of the normal parameters declared on the reference line. For instance, the engineer or designer might want the welder to use stick welding (i.e. SMAW), or another welding process. Or there may be other information to convey:

More Complicated Welding Specifications

Once you master the basics, you’ll be ready to absorb the many other particulars conveyed on shop drawings and blueprints. Among the most common:

- Finish and contour instructions
- Countersink and chamfer specs
- Grinding or other machining
- Spot or plug weld instructions

See the charts at the end of this guide for more info on how to read welding symbols.

Copyright © 2015
TheCityEdition.com
For more info and guides, please visit
WeldersUniverse.com
If the weld symbol appears on both sides of the reference line, as shown below, it specifies that a weld must be performed on both sides of the joint.

Numerous weld symbols have been devised to represent all the different weld types used in the trade, as well as any joints that must be cut or beveled during fit-up. Here are the most common ones to learn:

<table>
<thead>
<tr>
<th>Bead</th>
<th>Fillet</th>
<th>Plug or Slot</th>
<th>Groove or Butt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Square, V, Bevel, U, J, Flare V, Flare Bevel</td>
</tr>
</tbody>
</table>

If you’re not familiar with either welds or joints, be sure to review those topics in the Welders Universe *Welding to Code* section on the website. Even if you are familiar, it still takes time to memorize all these symbols and what type of welds they represent. Therefore, it’s a good idea to print out or photocopy a chart that contains both the symbols and drawings of the completed welds. Sample charts are provided after this tutorial.

**Dimensions and Angles**

Needless to say, numbers are also a big part of a welding specification. The width, depth, root opening and length of a weld, as well as the angle of any beveling required on the base metal before welding can all be communicated succinctly above or below the reference line. As you see in the image below, these numbers explain why the reference line is long:

In most cases, the weld width (or diameter) is located to the left of the weld symbol (expressed here in inches), while its length is written to the right. The weld’s width is the distance from one leg of the weld to the other.

Often, no length is indicated, which means the weld should be laid down from the beginning to the end of the joint, or where there’s an abrupt change in the joint on the base metal. Naturally, any dimensions provided below the reference line apply to the joint on the arrow side, while dimensions written above the reference line apply to the joint on the other side. In the image above, welds are indicated for both sides of the joint.

Sometimes, a series of separate welds are specified, rather than a single long weld. This is common when thin or heat-sensitive metals are welded on, or where the joint is a really long one. In the following symbol and drawing, 3-inch intermittent fillet welds are specified.

Notice that the weld symbols on either side of the reference line above are offset, rather than mirroring each other. This means the welds should be located at staggered spots on either side of the joint, as depicted in the drawing below it. A weld symbol may also specify an angle, root opening or root face dimension. This is common when the base metal to be welded on is thicker than 1/4 inch. The following example is a symbol and drawing calling for a V-groove joint:

Here, the groove weld has dimensions written inside the symbol. The first is 1/8, which pertains to a root opening of 1/8 inch. The larger number below it signifies 45 degrees, which represents the **included angle** between the plates.
“Included” means the sum of the angles beveled on each side. So in this example the bevel made on each plate is 22 1/2, which equals 45 degrees.

Other Symbols and Multiple Reference Lines

Moving to another part of the overall welding symbol, at the intersection of the reference line and the leader line, two other symbols may be inserted, as shown below:

A flagpole indicates a field weld, which simply tells the welder to perform the work on site, rather than in the shop. The weld-all-around circle, located at the same juncture, means just that. While this symbol is often used in pipe and tubing, a non-circular structural component may likewise need welding on all sides.

A curve located above the weld symbol’s face specifies that the finished weld should be either flat, convex or concave. (If you see a straight line, then it’s a flat weld - i.e. flush face.) As shown on the top right, a V-groove weld symbol with a box above it indicates a backing strip or bar is required for this joint. The strip or bar must be welded onto the back side of the joint before the groove weld is performed.

A backing strip or bar is sometimes confused with a “back weld “ or a “backing weld”. They are not the same thing as using a backing strip. A back weld is where a second weld is created on the back side of the joint after the primary weld is completed. Conversely, a backing weld is a weld that the welder performs first (so it serves the same function as a backing strip). A backing strip is a piece of metal welded on to the bottom of the plates to facilitate a smooth, even weld. Each of these three options is illustrated below using both the tail and the weld symbol to communicate what needs to happen.

As you can see, the only difference between the back and backing welds is when they’re performed. The symbols look the same, so both must be specified by name. In the third symbol, the dimensions and type of steel (A-38) for the backing strip are specified. When a welding operation involves a lot of steps, you will sometimes see multiple reference lines on the welding symbol, as shown below:

To keep the instructions clear, several reference lines may extend from the leader line at a parallel trajectory. Each line represents a separate operation and is performed in order, beginning with the line closest to the arrow.
Common Weld Symbols

<table>
<thead>
<tr>
<th>Designation</th>
<th>Illustration</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-V butt/groove weld</td>
<td><img src="image1.png" alt="Illustration" /></td>
<td><img src="image2.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Square butt/groove weld</td>
<td><img src="image3.png" alt="Illustration" /></td>
<td><img src="image4.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Single bevel butt/groove weld</td>
<td><img src="image5.png" alt="Illustration" /></td>
<td><img src="image6.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Single-U butt/groove weld</td>
<td><img src="image7.png" alt="Illustration" /></td>
<td><img src="image8.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Single-J butt/groove weld</td>
<td><img src="image9.png" alt="Illustration" /></td>
<td><img src="image10.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Butt weld between plates with raised edges (ISO)</td>
<td><img src="image11.png" alt="Illustration" /> Edge weld on a flanged groove joint (AWS)</td>
<td><img src="image12.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Single-V butt weld with broad root face</td>
<td><img src="image13.png" alt="Illustration" /></td>
<td><img src="image14.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Single bevel butt weld with broad root face</td>
<td><img src="image15.png" alt="Illustration" /></td>
<td><img src="image16.png" alt="Symbol" /></td>
</tr>
</tbody>
</table>
Interpreting The Weld
Operation Specified