Description of course:

1) Appreciation of Welding Processes & Quality

This 2 day course is designed to give people who are not directly involved in welding technology to have basic knowledge and understanding of welding processes and quality so as to assist them in their decision making responsibilities or when making judgments. This course basically covers the following:

Objectives

- Knowledge and understanding of the common welding processes
- Understand the common welding terminologies and definitions
- Knowledge of the various types of welding consumables and equipment used in the above processes
- Knowledge and understanding of the common welding quality standards and requirements
- Knowledge of the common types of welding inspection and weld defects
- Understand the steps taken in preparation of welding procedures

Contents

1. Common welding processes e.g SMAW, GTAW, GMAW, FCAW, SAW
2. Welding terminologies and definitions
3. Types of welding consumables e.g electrode, wire, flux, rod, shielding gas
4. Welding equipment and power source
5. Quality standards and requirements for welding
6. Welding inspection including mechanical and non-destructive testing (NDT) techniques
7. Welding procedures and welder approval

Target audiences:

Managers, executives, engineers, technicians and supervisors who want to have basic knowledge and understanding of the common welding processes and quality.

Important topics should be covered as below

Section I. Print Reading

GENERAL

1. Drawings. Drawing or sketching is a universal language used to convey all necessary information to the individual who will fabricate or assemble an object.

2. Reproduction Methods. Various methods of reproduction have been developed which will produce prints of different colors from the master copy.

    2.1. One of the first processes devised to reproduce a tracing produced white lines on a blue background, hence the term "blueprints".

    2.2. A patented paper identified as "BW" paper produces prints with black lines on a white background.

    2.3. The ammonia process, or "Ozalids", produces prints with either black, blue, or maroon lines on a white background.

    2.4. Vandyke paper produces a white line on a dark brown background.

    2.5. Other reproduction methods are the mimeograph machine, ditto machine, and photostatic process.

PARTS OF A DRAWING

1. Title Block. The title block contains the drawing number and all the information required to identify the part or assembly represented.

2. Revision Block. Each drawing has a revision block which is usually located in the upper right corner. All changes to the drawing are noted in this block.

3. Drawing Number. All drawings are identified by a drawing number. If a print has more than one sheet and each sheet has the same number, this information is included in the number block, indicating the sheet number and the number of sheets in the series.

4. Reference Numbers and Dash Numbers. Reference numbers that appear in the title block refer to other print numbers. When more than one detail is shown on a drawing, dashes and numbers are frequently used

5. Scale. The scale of the print is indicated in one of the spaces within the title block. It indicates the size of the drawing as compared with the actual size of the part. Never measure a drawing--use dimensions. The print may have been reduced in size from the original drawing.

6. Bill of Material. A special block or box on the drawing may contain a list of necessary stock to make an assembly. It also indicates the type of stock, size, and specific amount required.

CONSTRUCTION LINES

1. Full Lines. Full lines represent the visible edges or outlines of an object.

2. Hidden Lines. Hidden lines are made of short dashes which represent hidden edges of an object.

3. Center Lines. Center lines are made with alternating short and long dashes. A line through the center of an object is called a center line.

4. Cutting Plane Lines. Cutting plane lines are dashed lines, generally of the same width as the full lines, extending through the area being cut.

5. Dimension Lines. Dimension lines are fine full lines ending in arrowheads. They are used to indicate the measured distance between two points.

6. Extension Lines. Extension lines are fine lines from the outside edges or intermediate points of a drawn object. They indicate the limits of dimension lines.

7. Break Lines. Break lines are used to show a break in a drawing and are used when it is desired to increase the scale of a drawing of uniform cross section while showing the true size by dimension lines.

WELD AND WELDING SYMBOLS

GENERAL

Welding cannot take its proper place as an engineering tool unless means are provided for conveying the information from the designer to the workmen. Welding symbols provide the means of placing complete welding information on drawings. The scheme for symbolic representation of welds on engineering drawings used in this manual is consistent with the "third angle" method of projection. This is the method predominantly used in the United States.

ELMENTS OF A WELDING SYMBOL

A distinction is made between the terms "weld symbol" and "welding symbol". The weld symbol indicates the desired type of weld. The welding symbol is a method of representing the weld symbol on drawings.

BASIC WELD SYMBOLS

General.

1. Weld symbols are used to indicate the welding processes used in metal joining operations, whether the weld is localized or "all around", whether it is a shop or field weld, and the contour of welds.
2. Arc and Gas Weld Symbols.
3. Resistance Weld Symbols.
4. Brazing, Forge, Thermit, Induction, and Flow Weld Symbols.
    - 4.1. These welds are indicated by using a process or specification reference in the tail of the welding symbol
    - 4.2. When the use of a definite process is the process may be indicated by one or more of the letter designations
    - 4.3. When no specification, process, or other symbol, the tail may be omitted
    - 4.4. Other Common Weld Symbols. The weld-all-around and field weld symbol, and resistance spot and resistance seam welds.
    - 4.5. Supplementary Symbols. These symbols are used in many welding processes in congestion with welding symbols and are used.

LOCATION SIGNIFICANCE OF ARROW

1. Fillet, Groove, Flange, Flash, and Upset welding symbols.
2. Plug, Slot, Arc Spot, Arc Seam, Resistance Spot, Resistance Seam, and Projection Welding Symbols.
3. Near Side.
4. Near Member.

LOCATION OF THE WELD WITH RESPECT TO JOINT

1. Arrow Side.
2. Other Side.
3. Both Sides.
4. No Side Significance.

REFERENCES AND GENERAL NOTES

1. Symbols With References.
2. Symbols Without References.
    2.1. A note similar to the following appears on the drawing
    2.2. The welding procedure to be used is described elsewhere, such as in shop instructions and process sheets.
3. General Notes. General notes similar to the following may be placed on a drawing to provide detailed information pertaining to the predominant welds.
4. Process Indication.
5. Symbol without a Tail.

WELD-ALL-AROUND AND FIELD WELD SYMBOLS

1. Welds extending completely around a joint are indicated by mans of the weld-all-around
2. Field welds are welds not made in a shop or at the place of initial construction and are indicated by means of the field weld symbol.

EXTENT OF WELDING DENOTED BY SYMBOLS

1. Abrupt Changes.
2. Hidden Joints.

LOCATION OF WELD SYMBOLS

1. Weld symbols, except resistance spot and resistance seam, must be shown only on the welding symbol reference line and not on the lines of the drawing.
2. Resistance spot and resistance seam weld symbols may be placed directly at the locations of the desired welds.

USE OF INCH, DEGREE, AND POUND MARKS

NOTE

Inch marks are used for indicating the diameter of arc spot, resistance spot, and circular projection welds, and the width of arc seam and resistance seam welds when such welds are specified by decimal dimensions.

In general, inch, degree, and pound marks may or may not be used on welding symbols, as desired.

CONSTRUCTION OF SYMBOLS

1. Fillet, bevel and J-groove, flare bevel groove, and corner flange symbols shall be shown with the perpendicular leg always to the left.
2. In a bevel or J-groove weld symbol, the arrow shall point with a definite break toward the member which is to be chamfered.
3. Information on welding symbols shall be placed to read from left to right along the reference line in accordance with the usual conventions of drafting.
4. For joints having more than one weld, a symbol shall be shown for each weld.

5. The letters CP in the tail of the arrow indicate a complete penetration weld regardless of the type of weld or joint preparation.
6. When the basic weld symbols are inadequate to indicate the desired weld, the weld shall be shown by a cross section, detail, or other data with a reference on the welding symbol according to location specifications.
7. Two or more reference lines may be used to indicate a sequence of operations. The first operation must be shown on the reference line nearest the arrow.

FILLET WELDS

1. Dimensions of fillet welds must be shown on the same side of the reference line as the weld symbol.
2. When fillet welds are indicated on both sides of a joint and no general note governing the dimensions of the welds appears on the drawing, the dimensions are indicated as follows:

    2.1. When both welds have the same dimensions, one or both may be dimensioned

    2.2. When the welds differ in dimensions, both must be dimensioned.

3. When fillet welds are indicated on both sides of a joint and a general note governing the dimensions of the welds appears on the drawing, neither weld need be dimensioned.

SIZE OF FILLET WELDS

1. The size of a fillet weld must of a fillet weld be shown to the left of the weld symbol.
2. The size the fillet weld with unequal legs must be shown in parentheses to left of the weld symbol.
3. Unless otherwise indicated, the deposited fillet weld size must not be less than the size shown on the drawing.
4. When penetration for a given root opening is specified, the inspection method for determining penetration depth must be included in the applicable specification.

LENGTH OF FILLET WELDS

1. The length of a fillet weld, when indicated on the welding symbol, must be shown to the right of the weld symbol.
2. When fillet welding extends for the full distance between abrupt changes in the direction of the welding, no length dimension need be shown on the welding symbol.
3. Specific lengths of fillet welding may be indicated by symbols in conjunction with dimension lines.

EXTENT OF FILLET WELDING

1. Use one type of hatching (with or without definite lines) to show the extent of fillet welding graphically.
2. Fillet welding extending beyond abrupt changes in the direction of the welding must be indicated by additional arrows pointing to each section of the joint to be welded except when the weld-all-around symbol is used.

DIMENSIONING OF INTERMITTENT FILLET WELDING

1. The pitch (center-to-center spacing) of intermittent fillet welding shall be shown as the distance between centers of increments on one side of the joint.
2. The pitch of intermittent fillet welding shall be shown to the right of the length dimension.
3. Dimensions of chain intermittent fillet welding must be shown on both sides of the reference line. Chain intermittent fillet welds shall be opposite each other.
4. Dimensions of staggered intermittent fillet welding must be shown on both sides of the reference line.

TERMINATION OF INTERMITTENT FILLET WELDING

1. When intermittent fillet welding is used by itself, the symbol indicates that increments are located at the ends of the dimensioned length.
2. When intermittent fillet welding is used between continuous fillet welding, the symbol indicates that spaces equal to the pitch minus the length of one increment shall be left at the ends of the dimensioned length.
3. Separate symbols must be used for intermittent and continuous fillet welding when the two are combined along one side of the joint.

SURFACE CONTOUR OF FILLET WELDS

1. Fillet welds that are to be welded approximately flat, convex, or concave faced without recourse to any method of finishing must be shown by adding the flush, convex, or concave contour symbol to the weld symbol.

2. Fillet welds that are to be made flat faced by mechanical means must be shown by adding both the flush contour symbol and the user's standard finish symbol to the weld symbol.

3. Fillet welds that are to be mechanically finished to a convex contour shall be shown by adding both the convex contour symbol and the user's standard finish symbol to the weld symbol.

4. Fillet welds that are to be mechanically finished to a concave contour must be shown by adding both the concave contour symbol and the user's standard finish symbol to the weld symbol in accordance with location specification.

5. In cases where the angle between fusion faces is such that the identification of the type of weld and the proper weld symbol is in question, the detail of the desired joint and weld configuration must be shown on the drawing.

6. NOTE Finish symbols used here indicate the method of finishing (" c" = chiping, "G" = grinding, "H" = hammering, "M" = machining), not the degree of finish.

PLUG AND SLOT WELDING SYMBOLS

1. General. Neither the plug weld symbol nor the slot weld symbol may be used to designate fillet welds in holes.

2. Arrow Side and Other Side Indication of Plug and Slot Welds. Holes or slots in the arrow side member of a joint for plug or slot welding must be indicated by placing the weld symbol on the side of the reference line toward the reader.

3. Plug Weld Dimensions. Dimensions of plug welds must be shown on the same side of the reference line as the weld symbol. The size of a weld must be shown to the left of the weld symbol. Included angle of countersink of plug welds must be the user's standard unless otherwise indicated.

4. Depth of Filling of Plug and Slot Welds. Depth of filling of plug and slot welds shall be completed unless otherwise indicated.

5. Surface Contour of Plug Welds and Slot Welds. Plug welds that are to be welded approximately flush without recourse to any method of finishing must be shown by adding the finish contour symbol to the weld.

6. Slot Weld Dimensions. Dimensions of slot welds must be shown on the same side of the reference line as the weld symbol.

7. Details of Slot Welds. Length, width, spacing, included angle of countersink, orientation, and location of slot welds cannot be shown on the welding symbols. This data must be shown on the drawing or by a detail with a reference to it on the welding symbol, in accordance with location.

ARC SPOT AND ARC SEAM WELDS

1. General. The spot weld symbol, in accordance with its location in relation to the reference line, may or may not have arrow side or other side significance. Dimensions must be shown on the same side of the reference line as the symbol or on either side when the symbol is located astride the reference line and has no arrow side or other side significance. The process reference is indicated in the tail of the welding symbol. Then projection welding is to be used, the spot weld symbol shall be used with the projection welding process reference in the tail of the welding symbol. The spot weld symbol must be centered above or below the, reference line.

2. Size of Arc Spot and Arc Seam Welds.

    2.1. These welds may be dimensioned by either size or strength.

    2.2. The size of arc spot welds must be designated as the diameter of the weld. Arc seam weld size shall be designated as the width of the weld.

    2.3. The strength of arc spot welds must be designated as the minimum accept-able shear strength in pounds or newtons per spot.

3. Spacing of Arc Spot and Arc Seam Welds.

    3.1. The pitch (center-to-center spacing) of arc spot welds and, when indicated, the length of arc seam welds must be shown to the right of the weld symbol.

    3.2. When spot welding or arc seam welding extends for the full distance between abrupt changes in the direction of welding, no length dimension need be shown on the welding symbol.

4. Extent and Number of Arc Spot Welds and Arc Seam Welds.

    4.1. When arc spot welding extends less than the distance between abrupt changes in the direction of welding or less than the full length of the joint.

    4.2. When a definite number of arc spot welds is desired in a certain joint, the number must be shown in parentheses either above or below the weld symbol.

    4.3. A group of spot welds may be located on a drawing by intersecting center lines. The arrows point to at least one of the centerlines passing through each weld location.

5. Flush Arc Spot and Arc Seam Welded Joints. When the exposed surface of one member of an arc spot or arc seam welded joint is to be flush, that surface must be indicated by adding the flush contour symbol in the same manner as that for fillet welds.

6. Details of Arc Seam Welds. Spacing, extent, orientation, and location of arc seam welds cannot be shown on the welding symbols. This data must be shown on the drawing.

GROOVE WELDS

1. General.

    1.1. Dimensions of groove welds must be shown on the same side of the reference line as the weld symbol.

    1.2. When no general note governing the dimensions of double groove welds appears, dimensions shall be shown as follows:

        1.2.1. When both welds have the same dimensions, one or both may be dimensioned.

        1.2.2. When the welds differ in dimensions, both shall be dimensioned.

    1.3. When a general note governing the dimensions of groove welds appears, the dimensions of double groove welds shall be indicated as follows:

        1.3.1. If the dimensions of both welds are as indicated in the note, neither symbol need be dimensioned.

        1.3.2. When the dimensions of one or both welds differ from the dimensions given in the general note, both welds shall be dimensioned.

2. Size of Groove Welds.

    2.1. The size of groove welds shall be shown to the left of the weld symbol.

2.2. Specifications for groove welds with no specified root penetration are shown as follows:

2.2.1. The size of single groove and symmetrical double groove welds which extend completely through the member or members being joined need not be shown on the welding symbol.

2.2.2. The size of groove welds which extend only partly through the member members being joined must be shown on the welding symbol.

2.3. The groove welds, size of groove welds with specified root penetration, except square must be indicated by showing the depth of chamfering and the root penetration separated by a plus mark and placed to the left of the weld symbol.

2.4. The size of flare groove welds is considered to extend only to the tangent points as indicated by dimension lines.

3. Groove Dimensions

3.1. Root opening, groove angle, groove radii, and root faces of the U and J groove welds are the user's standard unless otherwise indicated.

3.2. When the user's standard is not used, the weld symbols are as follows:

3.2.1. Root opening is shown inside the weld symbol.

3.2.2. Groove angle of groove welds is shown outside the weld symbol.

3.2.3. Groove radii and root faces of U and J groove welds are shown by a cross section, detail, or other data, with a reference to it on the welding.

4. Back and Backing Welds. Bead-type back and backing welds of single-groove welds shall be shown by means of the back or backing weld symbol.

5. Surface Contour of Groove Welds. The contour symbols for groove welds are indicated in the same manner as that for fillet welds.

5.1. Groove welds that are to be welded approximately flush without recourse to any method of finishing shall be shown by adding the flush contour symbol to the weld symbol, in accordance with the location.

5.2. Groove welds that are to be made flush by mechanical means shall be shown by adding the flush contour symbol and the user's standard finish symbol to the weld symbol, in accordance with the location.

5.3. Groove welds that are to be mechanically finished to a convex contour shall be shown by adding both the convex contour symbol and the user's standard finish symbol to the weld symbol.

BACK OR BACKING WELDS

1. General.

    1.1. The back or backing weld symbol must be used to indicate bead-type back or backing welds of single-groove welds.

    1.2. Back or backing welds of single-groove welds must be shown by placing a back or backing weld symbol on the side of the reference line opposite the groove weld symbol.

    1.3. Dimensions of back or backing welds should not be shown on the welding symbol. If it is desired to specify these dimensions, they must be shown on the drawing.

2. Surface Contour of Back or Backing Welds. The contour symbols for back or backing welds are indicated in the same manner as that for fillet welds.

MELT-THRU WELDS

1. General.

    1.1. The melt-thru symbol shall be used where at least 100 percent joint penetration of the weld through the material is required in welds made from one side only.

    1.2. Melt-thru welds shall be shown by placing the melt-thru weld symbol on the side of the reference line opposite the groove weld, flange, tee, or corner weld symbol.

    1.3. Dimensions of melt-thru welds should not be shown on the welding symbol. If it is desired to specify these dimensions, they must be shown on the drawing.

2. Surface Contour of Melt-thru Welds. The contour symbols for melt-thru welds are indicated in the same manner as that for fillet welds.

SURFACING WELDS

1. General.

    1.1. The surfacing weld symbol shall be used to indicate surfaces built up by welding, whether built up by single-or multiple-pass surfacing welds.

    1.2. The surfacing weld symbol does not indicate the welding of a joint and thus has no arrow or other side significance. This symbol shall be drawn on the side of the reference line toward the reader and the arrow shall point clearly to the surface on which the weld is to be deposited.

2. Size of Built-up Surfaces. The size (height) of a surface built up by welding shall be indicated by showing the minimum height of the weld deposit to the left of the weld symbol. The dimensions shall always be on the same side of the reference line as the weld symbol. When no specific height of weld deposit is desired, no size dimension need be shown on the welding symbol.

3. Extent, Location, and Orientation of Surfaces Built up by Welding. When the entire area of a plane or curved surface is to be built up by welding, no dimension, other than size, need be shown on the welding symbol. If only a portion of the area of a plane or curved surface is to be built up by welding, the extent, location, and orientation of the area to be built up shall be indicated on the drawing.

FLANGE WELDS

1. General.

    1.1. The following welding symbols are used for light gage metal joints involving the flaring or flanging of the edges to be joined (fig. 3-59). These symbols have no arrow or other side significance.

    1.2. Edge flange welds shall be shown by the edge flange weld symbol (A, fig. 3-59).

    1.3. Corner flange welds shall be shown by the corner flange weld symbol (B, fig. 3-59). In cases where the corner flange joint is not detailed, a break in the arrow is required to show which member is flanged (fig. 3-59).

2. Dimensions of Flange Welds.

    2.1. Dimensions of flange welds are shown on the same side of the reference line as the weld symbol.

    2.2. The radius and the height above the point of tangency must be indicated by showing the radius and height, separated by a plus mark, and placed to the left of the weld symbol. The radius and height must read in that order from left to right along the reference line .

    2.3. The size (thickness) of flange welds must be shown by a dimension placed outward of the flange dimensions .

    2.4. Root opening of flange welds are not shown on the welding symbol. If specification of this dimension is desired, it must be shown on the drawing.

3. Multiple-Joint Flange Welds. For flange welds in which one or more pieces are inserted between the two outer pieces, the same symbol shall be used as for the two outer pieces, regardless of the number of pieces inserted.

RESISTANCE SPOT WELDS

1. General. Resistance spot weld symbols have no arrow or other side significance in themselves, although supplementary symbols used in con-junction with them may have such significance. Resistance spot weld symbols shall be centered on the reference line. Dimensions may be shown on either side of the reference line.

2. Size of Resistance Spot Welds. Resistance spot welds are dimensioned by either size or strength as follows:

    2.1. The size of resistance spot welds is designated as the diameter of the weld expressed in fractions or in decimals in hundredths of an inch and must be shown, with or without inch marks, to the left of the weld symbol.

    2.2. The strength of resistance spot welds is designated as the minimum acceptable shear strength in pounds per spot and must be shown to the left of the weld symbol.

3. Spacing of Resistance Spot Welds.

    3.1. The pitch of resistance spot welds shall be shown to the right of the weld symbol.

    3.2. When the symbols are shown directly on the drawing, the spacing is shown by using dimension lines.

3.3. When resistance spot welding extends less than the distance between abrupt changes in the direction of the welding or less than the full length of the joint, the extent must be dimensioned.

4. Number of Resistance Spot Welds. When a definite number of welds is desired in a certain joint, the number must be shown in parentheses either above or below the weld symbol.

5. Flush Resistance Spot Welding Joints. When the exposed surface of one member of a resistance spot welded joint is to be flush, that surface shall be indicated by adding the flush contour symbol to the weld symbol.

RESISTANCE SEAM WELDS

1. General.

1.1. Resistance seam weld symbols have no arrow or other side significance in themselves, although supplementary symbols used in injunction with them may have such significance. Resistance seam weld symbols must be centered on the reference line.

1.2. Dimensions of resistance seam welds may be shown on either side of the reference line.

2. Size of Resistance Seam Welds. Resistance seam welds must be dimensioned by either size or strength as follows:

2.1. The size of resistance seam welds must be designated as the width of the weld expressed in fractions or in decimals in hundredths of an inch and shall be shown, with or without inch marks, to the left of the weld symbol (fig. 3-66).

2.2. The strength of resistance seam welds must be designated as the minimum acceptable shear strength in pounds per linear inch and must be shown to the left of the weld symbol (fig. 3-67).

3. Length of Resistance Seam Welds.

3.1. The length of a resistance seam weld, when indicated on the welding symbol, must be shown to the right of the welding symbol.

3.2. When resistance seam welding extends for the full distance between abrupt changes in the direction of the welding, no length dimension need be shown on the welding symbol.

3.3. When resistance seam welding extends less than the distance between abrupt changes in the direction of the welding or less than the full length of the joint, the extent must be dimensioned.

4. Pitch of Resistance Seam Welds. The pitch of intermittent resistance seam welding shall be designated as the distance between centers of the weld increments and must be shown to the right of the length dimension.

5. Termination of Intermittent Resistance Seam Welding. When intermittent resistance seam welding is used by itself, the symbol indicates that increments are located at the ends of the dimensioned length.

6. Flush Projection Welded Joints. When the exposed surface of one member of a projection welded joint is to be made flush, that surface shall be indicated by adding the flush contour symbol to the weld symbol, observing the usual location significance .

PROJECTION WELDS

1. General.

1.1. When using projection welding, the spot weld symbol must be used with the projection welding process reference in the tail of the welding symbol. The spot weld symbol must be centered on the reference line.

1.2. Embossments on the arrow side member of a joint for projection welding shall be indicated by placing the weld symbol on the side of the reference line toward the reader.

1.3. Embossment on the other side member of a joint for projection welding shall be indicated by placing the weld symbol on the -side of the reference line away from the reader.

1.4. Proportions of projections must be shown by a detail or other suitable means.

1.5. Dimensions of projection welds must be shown on the same side of the reference line as the weld symbol.

2. Size of Projection Welds.

2.1. Projection welds must be dimensioned by strength. Circular projection welds may be dimensioned by size.

2.2. The size of circular projection welds shall be designated as the diameter of the weld expressed in fractions or in decimals in hundredths of an inch and shall be shown, with or without inch marks, to the left of the weld symbol.

2.3. The strength of projection welds shall be designated as the minimum acceptable shear strength in pounds per weld and shall be shown to the left of the weld symbol.

3. Spacing of Projection Welds. The pitch of projection welds shall be shown to the right of the weld symbol.

4. Number of Projection Welds. When a definite number of projection welds is desired in a certain joint, the number shall be shown in parentheses.

5. Extent of Projection Welding. When the projection welding extends less than the distance between abrupt changes in the direction of the welding or less than the full length of the joint, the extent shall be dimensioned.

6. Flush Resistance Seam Welded Joints. When the exposed surface of one member of a resistance seam welded joint is to be flush, that surface shall be indicated by adding the flush contour symbol to the weld symbol, observing the usual location significancel.

FLASH OR UPSET WELDS

1. General. Flash or upset weld symbols have no arrow side or other side significance in themselves, although supplementary symbols used in conjunction with then may have such significance. The weld symbols for flash or upset welding must be centered on the reference line. Dimensions need not be shown on the welding symbol.