

Chapter 3. Symbols

Communication

Frequently, this one aspect of a job becomes the factor deciding whether the job will be a success or a failure. In today's industry practice, drawings are used to convey the designer's concepts to those performing the work. Intricate details can be much more accurately and efficiently described through graphic presentation than through the use of the written word.

In the case of welded connections, a great deal of information may be required in order for the welder to successfully provide a weld adequate for the designer's intended purpose. One method for conveying the design concepts is through the use of written notes. However, this can become quite complex and time consuming for intricate details. A simpler and more efficient method uses welding symbols.

The American Welding Society has developed a system of standard welding symbols now used and accepted worldwide. Figure 3.1 depicts the various types of welding symbols and explains the purposes and locations of the basic elements. A detailed description of the system can be found in AWS A2.4-79, Symbols for Welding and Nondestructive Testing.

Figure 3.2 effectively shows the advantages offered when welding symbols replace the written explanation.

Figures 3.3 and 3.4 show various other welding symbols and how they are used to define the welding requirements. The adjacent details graphically illustrate the significance of each symbol.

Just as the welding symbol is important to the welder, equally important is the welding inspector's knowledge of its meaning. Otherwise, the inspector would be unable to assure that the welder has actually complied with the requirements set forth by the designer. Typical informa-

tion depicted by welding symbols that would be of interest to a welding inspector includes type of weld, size of weld, weld location, joint configuration, finished condition of face and root of weld, as well as other special instructions.

When welding is to be visually inspected, knowledge of the information provided by the welding symbol is essential to the inspector. Once the inspector understands what the engineer requires, a thorough and highly effective visual inspection can result. It has been stated that a conscientiously applied program of visual inspection can eliminate eighty to ninety percent of the commonly encountered welding defects. Many situations, however, warrant a more extensive check than can be provided by visual inspection alone. In such cases, other forms of nondestructive testing (NDT) are often employed.

When nondestructive testing is involved, the inspector can gain from the weld symbol a great deal of insight into the applicability of a particular test. In ultrasonic testing, for example, useful information provided by the welding symbol might include the joint configuration and location. From this information, the NDT operator can determine whether the test can be physically conducted as well as what transducer angle would most readily reveal any discontinuities that might be encountered.

When radiographic inspection is to be used, the welding symbol can provide valuable information concerning how the test can best be applied. Such information as joint configuration, weld location, type of weld, and size of weld can provide the radiographer with clues as to the best method for revealing any discontinuities that might be present, as well as information that might be helpful in the accurate interpretation of the results. Such details allow the inspector to plan his test so that the best technique and procedure will be used.

6/WELDING INSPECTION

Basic Welding Symbols and Their Location Significance								
Location Significance	Filet	Plug or Slot	Spot or Projection	Seam	Back or Backing	Surfacing	Scarft for Brazed Joint	Flange Edge
Arrow Side								
Other Side						Not used		
Both Sides		Not used	Not used	Not used	Not used	Not used		Not used
No Arrow Side or Other Side Significance	Not used	Not used			Not used	Not used	Not used	Not used

Supplementary Symbols Used with Welding Symbols	
Convex Contour Symbol Convex contour symbol indicates face of weld to be finished to convex contour	Weld-All-Around Symbol Weld-all-around symbol indicates that weld extends completely around the joint
Joint with Backing With groove weld symbol Note: Material and dimensions of backing as specified	Joint with Spacer With modified groove weld symbol Note: Material and dimensions of spacer as specified
Flush Contour Symbol Flush contour symbol indicates face of weld to be made flush. When used without a finish symbol, indicates weld without subsequent finishing	Melt-Thru Symbol Any applicable weld symbol Melt thru symbol is not dimensioned (except height)
Field Weld Symbol Field weld symbol indicates that weld is to be made at a place other than that of initial construction	Multiple Reference Lines First operation shown on reference line nearest arrow Second operation, or supplementary data Third operation, or last information

Supplementary Symbols		Location of Elements of a Welding Symbol	
Weld-All-Around 	Field Weld 	Melt-Thru 	Backing, Spacer
Complete Penetration Indicates complete penetration regardless of type of weld or joint preparation		Contour Flush Convex Concave 	
Field Weld Symbol Field weld symbol indicates that weld is to be made at a place other than that of initial construction		Location of Elements of a Welding Symbol Finish symbol Contour symbol Root opening, depth of filling for plug and slot welds Effective throat Depth of preparation, size or strength for certain welds Specification, process, or other reference Tail (Tail omitted when reference is not used) Basic weld symbol or detail reference Groove angle; included angle of countersink for plug welds Length of weld Pitch (center-to-center spacing) of welds Field weld symbol Arrow connecting reference line to arrow side member of joint Weld-all-around symbol Reference line Elements in this area remain as shown when tail and arrow are reversed (BOTH SIDES) (ARROW/OTHER SIDE) (N) Number of spot or projection welds	

Basic Joints—Identification of Arrow Side and Other Side of Joint		
Butt Joint Arrow of welding symbol Arrow side of joint Other side of joint	Corner Joint Arrow of welding symbol Arrow side of joint Other side of joint	T-Joint Arrow of welding symbol Arrow side of joint Other side of joint

Fig. 3.1—AWS Standard welding symbols

Basic Welding Symbols and Their Location Significance

Flange	Square	V	Bevel	Groove	J	Flare-V	Flare-Bevel	Location Significance
Corner				U				Arrow Side
								Other Side
Not used								Both Sides
Not used		Not used	Not used	Not used	Not used	Not used	Not used	No Arrow Side or Other Side Significance

Typical Welding Symbols

Spot Welding Symbol Depth of filling in inches (omission indicates filling is complete) Orientation, location and all dimensions other than depth of filling are shown on the drawing	Square-Groove Welding Symbol Omission of size indicates complete joint penetration Root opening	Flare-V and Flare-Bevel-Groove Welding Symbols Root opening Size is considered as extending only to flange points Root opening
Plug Welding Symbol Included angle of countersink Pitch (distance between centers) of welds Depth of filling in inches (omission indicates filling is complete) Size (diameter of hole at root)	Chain Intermittent Fillet Welding Symbol Size (length of leg) Pitch (distance between centers) of increments Length of increments	Edge- and Corner- Flange Welding Symbols Radius Size of weld Height above point of tangency
Backgouging Welding Symbol Back gouging Second reference line used for back gouging and welding as a second operation Size (diameter of hole at root) Size (length of leg)	Back or Backing Welding Symbol Any applicable angle groove weld symbol Size (length of leg)	Surfacing Welding Symbol Indicating Built-up Surface Size (height of deposit) Omission indicates no specific height desired Orientation, location and all dimensions other than size are shown on the drawing
Flash or Upset Welding Symbol No arrow side or other side significance Process reference must be used to indicate process desired	Staggered Intermittent Fillet Welding Symbol Pitch (distance between centers) of increments Length of increments Size (length of leg)	Single-V Groove Welding Symbol Indicating Root Penetration Size Depth of preparation Effective throat Root opening Groove angle
Spot Welding Symbol Size (diameter of weld) Strength (in lb per weld) Process reference must be used to indicate process desired	Double-Bevel-Groove Welding Symbol Arrow points toward member to be prepared Omission of size dimension indicates a total depth of preparation equal to thickness of members Root opening Groove angle	Projection Welding Symbol Projection welding reference must be used Pitch (distance between centers) of welds Number of welds
Seam Welding Symbol Length of welds or increments Size (width of weld) Strength (in lb per linear inch) may be used instead Pitch (distance between centers) of increments Process reference must be used to indicate process desired	Double-Fillet Welding Symbol Size (length of leg) Specification, process, or other reference Length Omission indicates that weld extends between abrupt changes in direction or as dimensioned	
Welding Symbols for Combined Welds 		

Basic Joints—Identification of Arrow Side and Other Side of Joint

Lap Joint 	Edge Joint
----------------------	-----------------------

Process Abbreviations

Where process abbreviations are to be included in the tail of the welding symbol, reference is made to Table A, Designation of Welding and Allied Processes by Letters, of AWS 2.4-79, 71.

AMERICAN WELDING SOCIETY, INC.
2501 N. W. 7th Street, Miami, Florida 33125

8 / WELDING INSPECTION

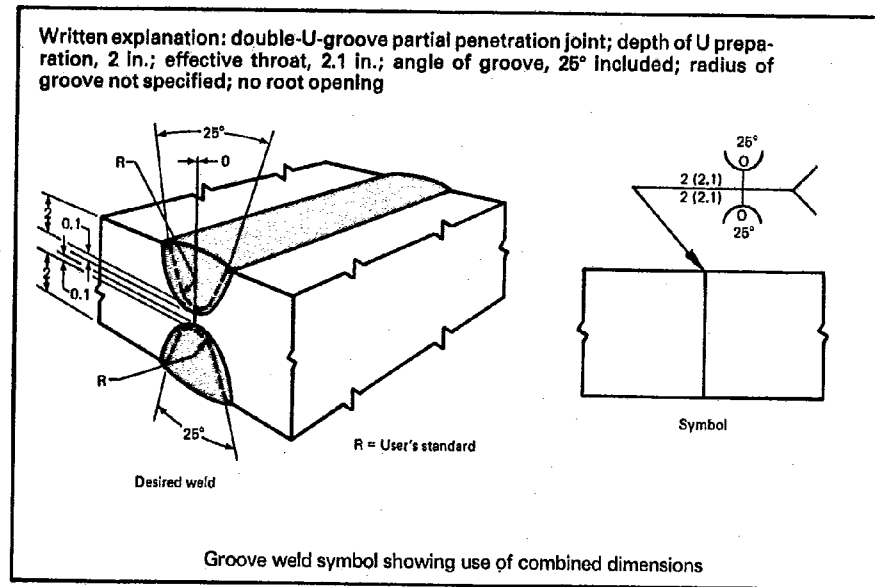


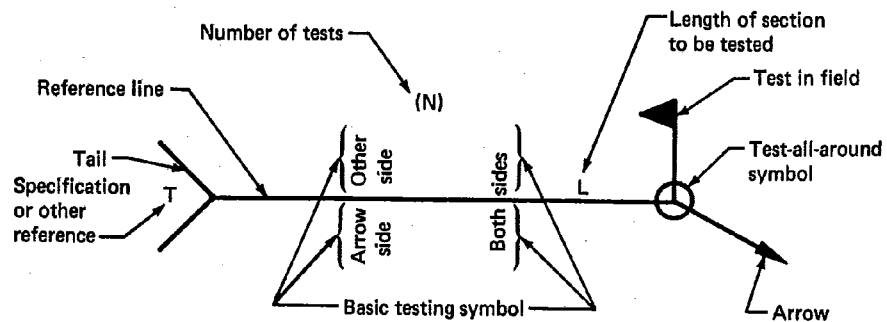
Fig. 3.2—Comparison of welding symbol and written explanation

Nondestructive Testing Symbols

With the increased interest in and use of nondestructive testing by today's construction industries, it becomes convenient for the engineer to include any testing requirements on the fabrication drawings as well, perhaps avoiding many after-the-fact inconsistencies associated with the extent or type of testing. As with welding instructions, a system has been established to communicate nondestructive testing information,

using a symbol virtually identical to that used for welding. A complete description of this system is included in AWS A2.4, Symbols for Welding and Nondestructive Testing.

The construction of nondestructive testing symbols uses the same basic elements found in welding symbols along with similar governing rules. Therefore, the arrow side and other side designations retain their same location significance. The illustration below shows the basic elements of the testing symbol and their standard locations with respect to each other.



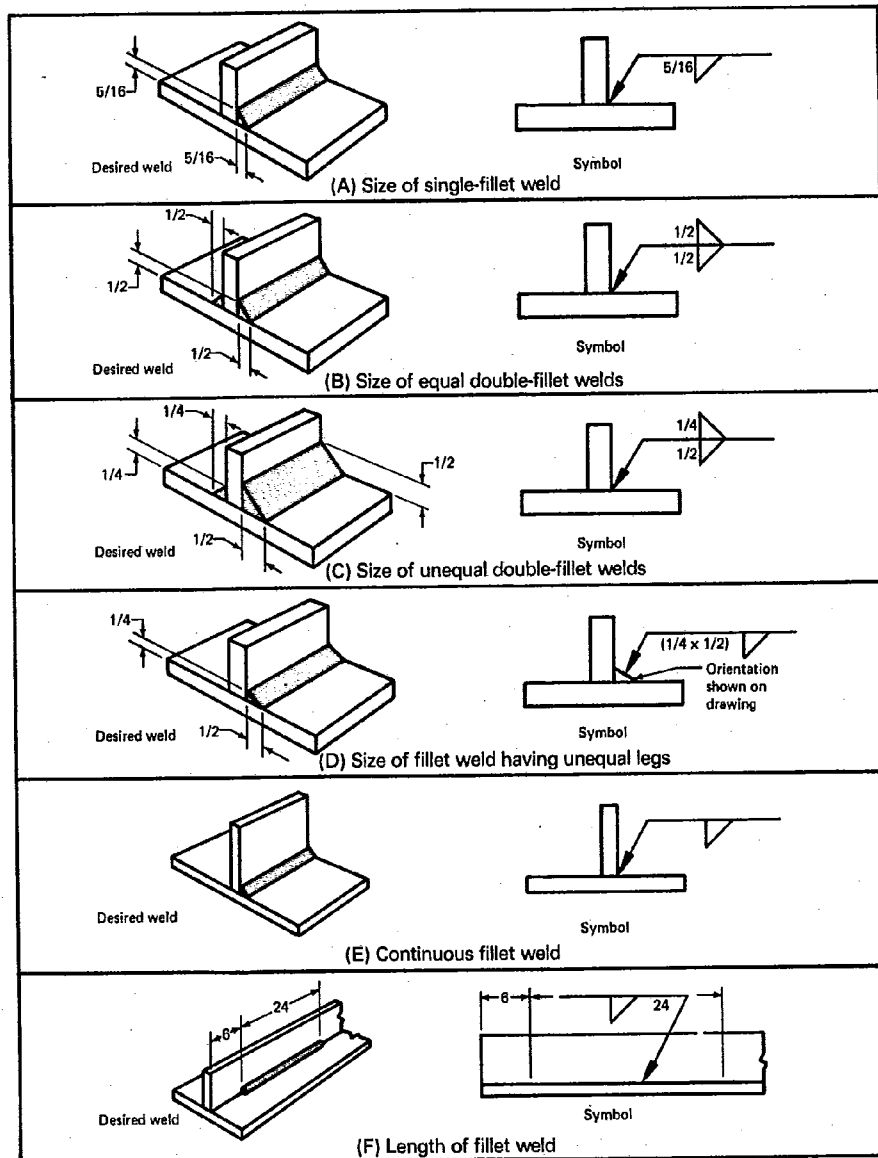


Fig. 3.3—Examples of typical fillet welds showing the corresponding symbols and dimensions

10 / WELDING INSPECTION

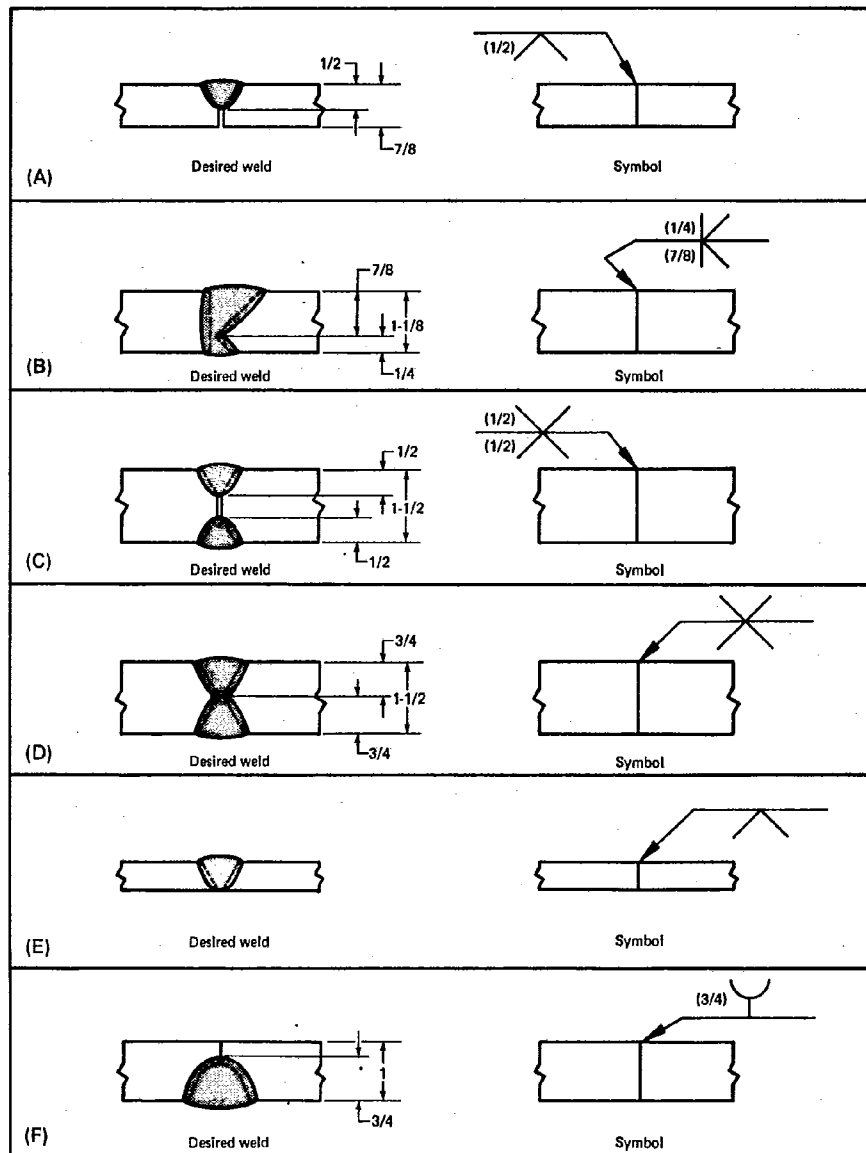


Fig. 3.4—Examples of typical groove welds showing the corresponding symbols and dimensions

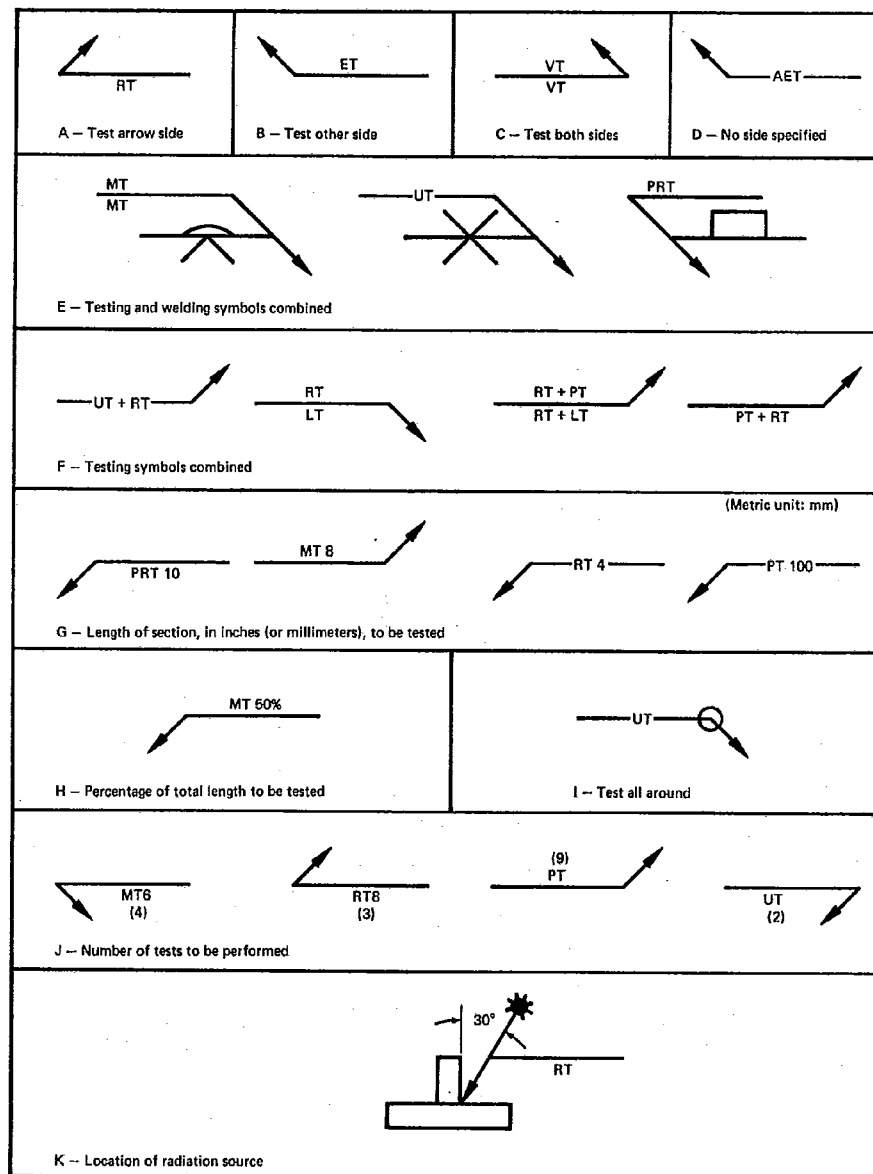


Fig. 3.5—Examples of typical nondestructive testing symbols

12 / WELDING INSPECTION

The basic testing symbols are given in tabular form below. When the engineer requires non-destructive testing, a symbol can be constructed using these basic elements to describe clearly and concisely the type and extent of inspection.

Basic Testing Symbols

Type of test	Symbol
Visual	VT
Radiographic	RT
Ultrasonic	UT
Magnetic particle	MT
Penetrant	PT
Eddy current	ET
Acoustic emission	AET
Leak	LT
Proof	PRT

Nondestructive testing symbols may appear separately on drawings or in combination with the welding symbol. In either case, they should convey such information as the type of test to be performed, the location and extent of testing, and any special instructions or techniques to be used.

As the examples in Fig. 3.5 illustrate, non-destructive testing symbols are an effective shorthand method for conveying detailed inspection instructions. Figures 3.5(A), (B), (C), and (D) show that the same location references used in welding symbols also apply to non-destructive testing symbols: that is, operations noted below the reference line, as shown in Fig. 3.5(A), are performed on the arrow side, while notations occurring above the reference line, as shown in Fig. 3.5(B), prescribe tests performed on the other side. When both sides are to receive treatment, the proper symbol appears both above and below the reference line, as shown in Fig. 3.5(C). In the case where the side or sides to be tested have no special significance, as in Fig. 3.5(D), the symbol is placed in a broken portion of the reference line.

When more than one operation is to be performed on a particular joint, it sometimes becomes convenient to combine various testing symbols, or welding and testing symbols, for

neater and less confusing drawings. Figure 3.5(E) shows various ways in which welding and testing symbols can be combined. In Fig. 3.5(F), the examples illustrate how two or more testing symbols can be combined.

Many times, inspection of the entire length of a weld is not necessary. Figure 3.5(G) shows how the length of the section to be tested can be noted on the nondestructive testing symbol. The dimensions are expressed in units corresponding to the system used on the drawing. Figure 3.5(G) gives examples with dimensions expressed in both inches and millimeters. Another common method for stipulating partial testing of a joint is to note what percentage of its total length will be inspected, as shown in Fig. 3.5(H). When a test is to be applied to the entire length of continuous nonlinear joint, the symbol for testing all around can be used, as shown in Fig. 3.5(I). Figure 3.5(J) shows how the number of tests to be performed at random can be designated by a number placed in parentheses.

When radiographic inspection is necessary, it is sometimes desirable to designate at what angle the radiation source is to be placed with respect to the joint. Figure 3.5(K) illustrates how this information is conveyed by a non-destructive testing symbol.

Figure 3.6 shows how welding and non-destructive testing symbols can accompany one another to convey fully the design requirements.

As illustrated in the examples, the use of nondestructive testing symbols can be as much a time-saver as welding symbols for accurately conveying information to those actually responsible for doing the work. When the person performing the task is well informed, his chances for successful completion of that task are greatly increased.

Summary

The preceding paragraphs explain some of the uses of and the philosophy behind symbols. Their use is becoming increasingly common, making their importance even greater. Therefore, a great deal of care should be taken when

symbols are used. The engineer must be certain that the symbol he chooses accurately describes the weld necessary to fulfill the design requirements. Conversely, the constructor must be able to interpret the symbol so the proper weld is applied. Finally, the welding inspector must apply his interpretation to assure that the original requirements have been met.

Too many times, symbols are either improperly constructed or misinterpreted, resulting in a weld different from that intended by the de-

signer. When this occurs, the possibility of failure increases. In today's world of product liability awareness, such an error could be a costly one. Therefore, when symbols are used, all concerned should be cautious as to their interpretation. With this in mind, experience should prove that proper use of both welding and nondestructive testing symbols will result not only in better communication among the involved parties, but also in increased savings in time and money.

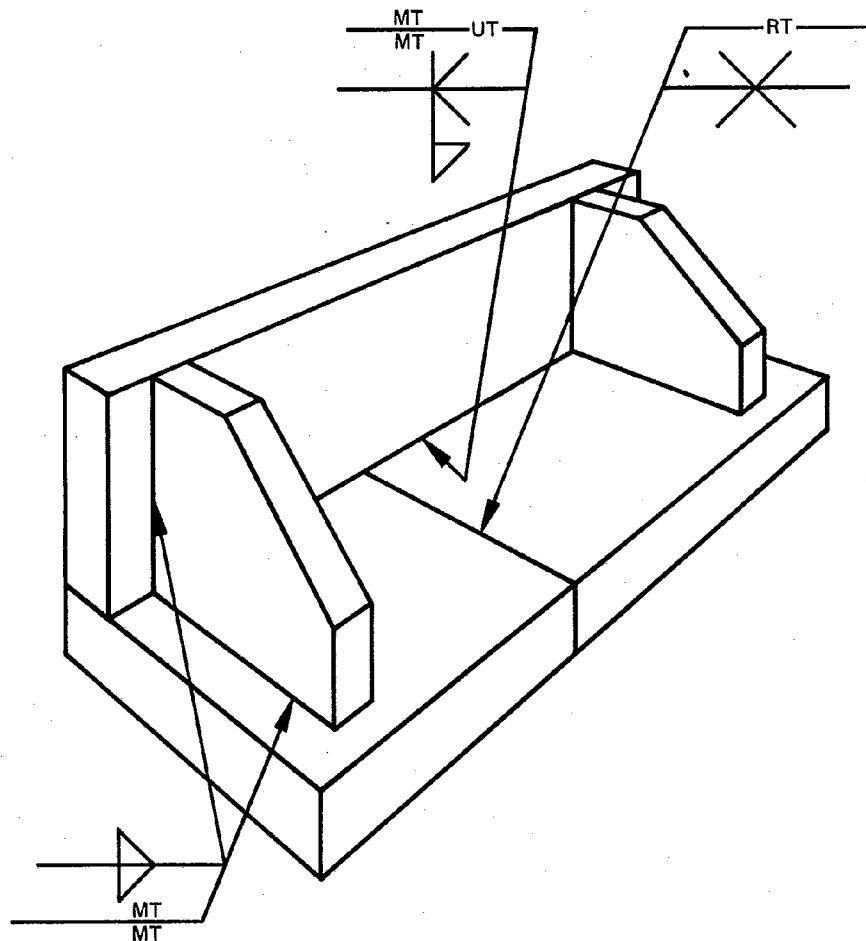


Fig. 3.6—Illustration of welding and testing symbols in use