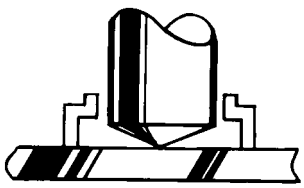
The Process

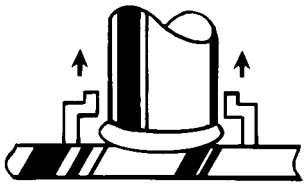
Arc Stud Welding

1



Stud and ceramic ferrule against the work plate

2

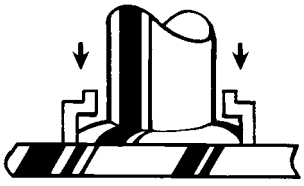


Stud lifts and arc is drawn

Arc Stud Welding involves the same basic principles and metallurgical aspects as any other arc welding procedure, in that a controlled electric arc is used to melt the stud or electrode and a portion of the base metal. The stud is thrust automatically into the molten metal and a high quality fusion weld is accomplished where the weld is stronger than the stud itself. Stud Welding is applicable to mild steel, stainless and aluminum.

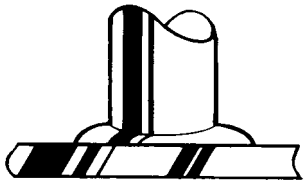
Welded fasteners or studs may be almost any size, or type and there are literally hundreds, however, they must be made of weldable materials and one end of the fastener must be designed for welding. Conventional DC welding machines of all types may be used, but special power units designed specifically for stud welding are also available.

3



Control times out and stud plunges into molten steel

4



Metal solidifies and weld is completed in a split second

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General Information

Basic engineering specifications which cover all of the studs listed in this publication regardless of size or shape are detailed below.

STUD DIMENSIONS (After Weld Length)

The length dimension (L) carried throughout the specifications is the overall length of the stud Before Weld. The After Weld length will be shorter dependent upon the size of the stud as shown in the following table.

Stud Diameter	Length Reduction
1¼4" Dia. Through 1¼2" Dia.	1⅛8"
5⅛8" Dia. Through 7⅛8" Dia.	3¼16"
1 Dia. and Over	3¼16" - 1¼4"

MATERIALS

All of the studs shown are available in mild or stainless steel. When a stud is stocked, the steel grade it is stocked in is indicated.

The low carbon steel or mild steel studs conform with reasonable limits to the analysis shown:

C - 0.23% Max. P - 0.040% Max.
Mn - 0.090% Max. S - 0.050% Max.

STAINLESS STEELS: Stainless steels most commonly used is 18-8 stainless steel.

ALUMINUM: In aluminum, alloy 5356 is most commonly used for stud welding.

THREADS

The standard threads on studs are UNC-2A. Other threads are available on request. Standard maximum thread length is 3".

FLUX

All Studs 1¼4" diameter and over are solid fluxed. Below 1¼4" diameter solid flux or non fluxed studs are available upon request. The rectangular studs shown in this publication are not fluxed.

ANNEALING

S.W.A. Studs can be annealed to a maximum of 75 Rockwell B for low carbon steel and 85 Rockwell B for Stainless Steel. An extra charge is applicable for annealing and will be quoted if desired.

MECHANICAL PROPERTIES
(as cold drawn)

STUD TYPE	MATERIAL	TENSILE (ultimate)	REDUCTION IN AREA
PD, FT, FB, RB TP, CL, SH, NT R6, R7, R2	C-1010/C-1020 ASTM-A108	55,000 psi Min	50% Min.
HA, SC	C-1010/C-1020 AWSD1.1 & ASTM-A108	60,000 psi Min	50% Min.
DA	Low Carbon/ASTM 496	80,000 psi Min	___
CD	C-1010/C01020 ASTM-A108	50,000 psi Min.	___

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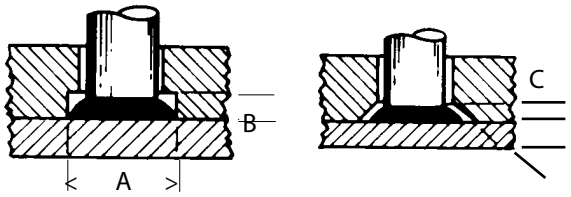
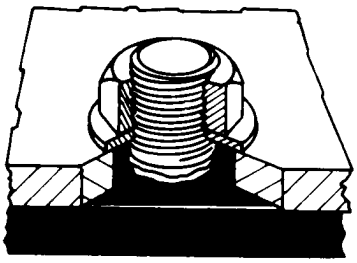
Accommodating The Fillet

When a stud is end-welded, a fillet forms around its base with the fillet dimensions being closely controlled by the design of the ferrule used. Since the diameter of the fillet is generally larger than the diameter of the stud, some consideration is required in the design of mating parts. Counter bore and counter sink methods are commonly used. Dimensions will vary with studs and ferrules. Additional methods of accommodating fillet include oversized clearance holes, use of a gasket material around the fillet or use of a dog-type construction.

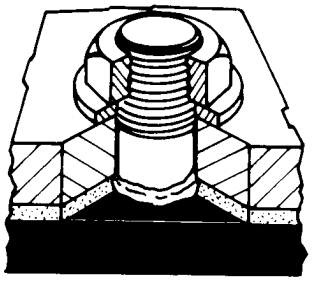
Fillet Clearance For Electric-Arc Welded Full Base Studs



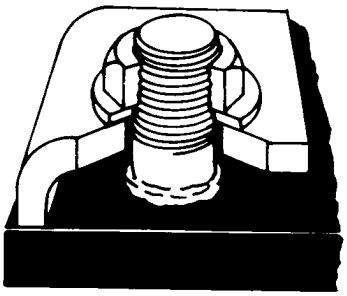
STUD SIZE (in.)	COUNTERBORE (in.)		90° COUNTERSINK (in.)
	A	B	C
1/4	0.437	0.125	0.125
5/16	0.500	0.125	0.125
3/8	0.593	0.125	0.125
7/16	0.656	0.187	0.125
1/2	0.750	0.187	0.187
5/8	0.875	0.218	0.187
3/4	1.125	0.312	0.187



(a) Oversize clearance hole



(b) Gasket material



(c) Dog clamp

Welded studs designed with reduced weld bases so that weld fillet does not exceed maximum diameter of fastener.
This design is not recommended if fastener strength is important.

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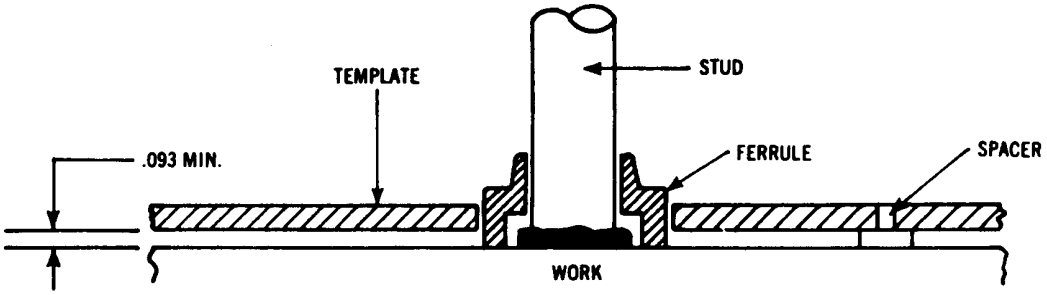
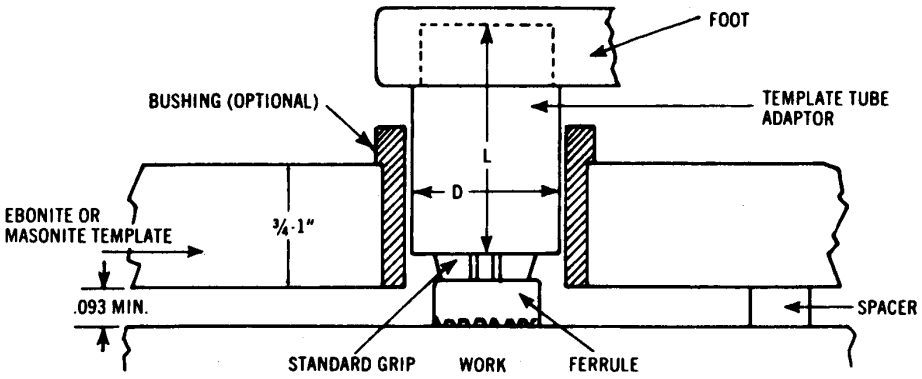
Template Design For Stud Locating



This method of templating is recommended for use with all ferrules. The template is usually a steel plate $^{3}/_{32}$" to $^{3}/_{16}$" thick. Spacers are required to allow the gases to escape during the welding cycle. The ferrule can be held by a standard ferrule grip or where clearance is prohibitive a tube type set-up can be used. The recommended hole sizes on the template to locate the ferrules should equal the maximum outside diameter of the ferrule plus $^{1}/_{32}$". Holes may be drilled or bored at required locations. See stud specification sheets for ferrule detail.



Stud Size	D	L
$^{1}/_{2}$" and under	1.250	2.000
$^{5}/_{8}$" and $^{3}/_{4}$"	1.562	2.500
$^{7}/_{8}$" and larger	2.125	2.500

This method of templating is recommended for use with all stud styles. The design makes it possible to accurately hold angular alignment of the studs as well as stud location. The template should be made of ebonite or masonite of a thickness sufficient to afford good alignment. Bushings may be used to insure greater accuracy and extend the life of the template. Standard copper ferrule grips are used with the tube adapter. This permits standardization of templates since it is only necessary to change the copper ferrule grip to weld studs of different diameters. The hole diameter of the bushing or template should be approximately .010 larger than the maximum outside diameter of the template tub adapter.

Recommended Minimum Plate Thickness Of Steel And Aluminum For Electric-Arc Stud Welding

Base Dia. of Stud (in.)	STEEL		ALUMINUM	
	WITHOUT BACKUP (in.)	(gage)	WITHOUT BACKUP (in.)	WITH BACKUP (in.)
0.187	0.0359	20	0.125	0.125
0.250	0.0478	18	0.125	0.125
0.312	0.0598	16	0.187	0.125
0.375	0.0747	14	0.187	0.187
0.437	0.0897	13	0.250	0.187
0.500	0.1196	11	0.25	0.250
0.625	0.148	9	0.250	
0.750	0.187			
0.875	0.250			
1.000	0.375			

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Weight Chart

Estimated Weights Of Threaded Studs In Pounds Per 1000 Pieces								
LENGTH	1/4 dia.	5/16 dia.	3/8 dia.	7/16 dia.	1/2 dia.	5/8 dia.	3/4 dia.	7/8 dia.
3/4	8.3	12.8	18.8	25.5	34.5			
1	11.0	17.0	25.0	34.0	46.0	70.0		
1 1/4	13.8	21.3	31.3	42.5	57.5	87.5	133.8	
1 1/2	16.5	25.5	37.5	51.0	69.0	105.0	160.5	243.8
1 3/4	19.3	29.8	43.8	59.5	80.5	122.5	187.3	284.4
2	22.0	34.0	50.0	68.0	92.0	140.0	214.0	325.0
2 1/4	24.8	38.3	56.3	76.5	103.5	157.5	240.8	165.6
2 1/2	27.5	42.5	62.5	85.0	115.0	175.0	267.5	406.3
2 3/4	30.3	46.8	68.8	93.5	126.5	192.5	294.3	446.9
3	33.0	51.0	75.0	102.0	138.0	210.0	321.0	487.5
3 1/4	35.8	55.3	81.3	110.5	149.5	227.5	347.8	528.1
3 1/2	38.5	59.5	87.5	119.0	161.0	245.0	374.5	568.8
3 3/4	41.3	63.8	93.8	127.5	172.5	262.5	401.3	609.4
4	44.0	68.0	100.0	136.0	184.0	280.0	428.0	650.0
4 1/4	46.8	72.3	106.3	144.5	195.5	297.5	454.8	690.6
4 1/2	49.5	76.5	112.5	153.0	207.0	315.0	481.5	731.3
4 3/4	52.3	80.8	118.8	161.5	218.5	332.5	508.3	771.9
5	55.0	85.0	125.0	170.0	230.0	350.0	535.0	812.5
Add'l Inch	11.0	17.0	25.0	34.0	46.0	70.0	107.0	162.5
Ferrule	2.0	2.5	3.0	3.5	4.0	5.0	10.0	12.0

Estimated Weights Of No-Thread Studs In Pounds Per 1000 Pieces									
LENGTH	3/16 dia.	1/4 dia.	5/16 dia.	3/8 dia.	7/16 dia.	1/2 dia.	5/8 dia.	3/4 dia.	7/8 dia.
3/4	6.0	10.5	16.4	23.5	31.9	41.7			
1	8.0	14.0	21.8	31.3	42.5	55.6	86.6		
1 1/4	10.0	17.5	27.3	39.1	53.1	69.5	108.3	156.0	
1 1/2	12.0	21.0	32.7	47.0	63.8	83.4	129.9	187.2	225.0
1 3/4	14.0	24.5	38.2	54.8	74.4	97.3	151.6	218.4	297.5
2	16.0	28.0	43.6	62.6	85.0	111.2	173.2	249.6	340.0
2 1/4	18.0	31.5	49.1	70.4	95.6	125.1	194.9	280.8	382.5
2 1/2	20.0	35.0	54.5	78.3	106.3	139.0	216.5	312.0	425.0
2 3/4	22.0	38.5	60.0	86.1	116.9	152.9	238.2	343.2	467.5
3	24.0	42.0	65.4	93.9	127.5	166.8	259.8	374.4	510.0
3 1/4	26.0	45.5	70.9	101.7	138.1	180.7	281.5	405.6	552.5
3 1/2	28.0	49.0	76.3	117.4	148.8	194.6	303.1	436.8	595.0
3 3/4	30.0	52.5	81.8	125.2	159.4	208.5	324.8	468.0	637.5
4	32.0	56.0	87.2	125.2	170.0	222.4	346.4	499.2	680.0
4 1/4	34.0	59.5	92.7	133.0	180.6	236.3	368.1	530.4	722.5
4 1/2	36.0	63.0	98.1	140.9	191.3	250.2	389.7	561.6	765.0
4 3/4	38.0	66.5	103.6	148.7	201.9	264.1	411.4	592.8	807.5
5	40.0	70.0	109.0	156.5	212.5	278.0	433.0	624.0	850.0
Add'l. Inch	8.0	14.0	21.8	31.3	42.5	55.6	86.6	124.8	170.0
Ferrule	3.0	3.5	4.0	5.0	6.0	7.5	9.0	27.0	37.0

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