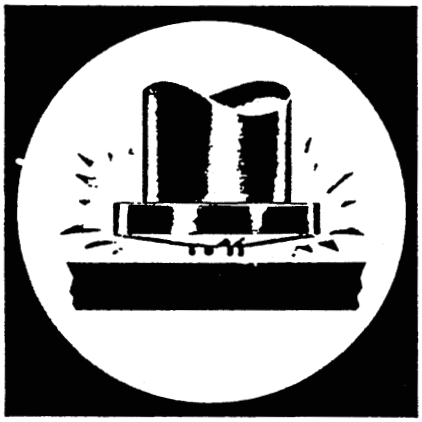
STUDS (General Information)

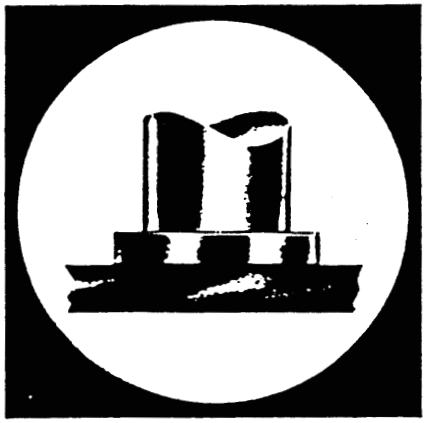
THE CAPACITOR DISCHARGE (CD) STUD WELDING PROCESS

1. STUD AGAINST WORK.

2. STORED ENERGY DISCHARGED THROUGH SPECIAL WELD "TIMING" TIP AND STUD STARTS DOWNWARD.



3. STUD FORCED INTO MOLTEN METAL.



4. METAL SOLIDIFIES AND WELD IS COMPLETED IN MILLISECONDS.

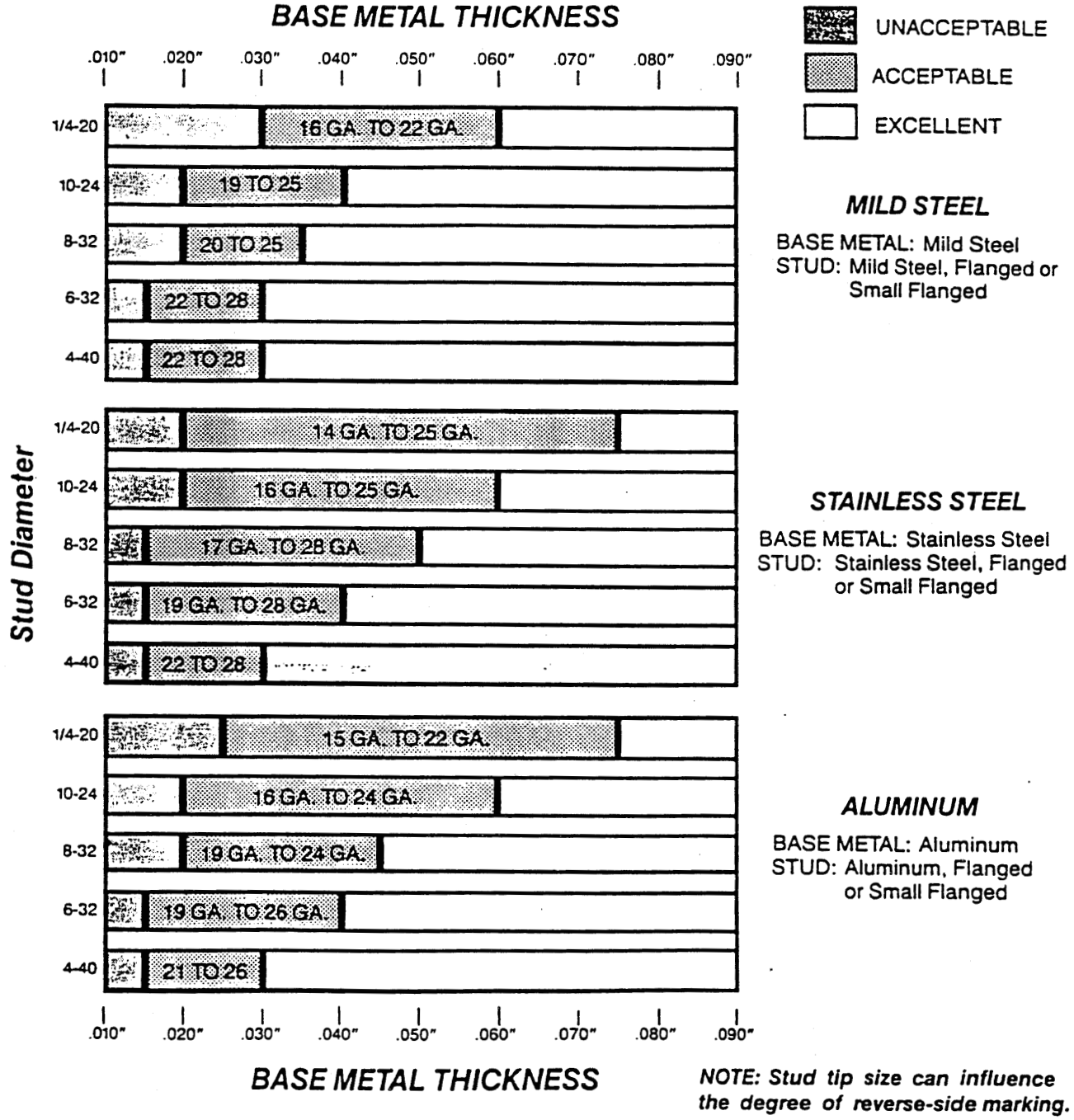
Capacitor Discharge (CD) Stud Welding involves the same basic principles and metallurgical aspects as any other arc welding procedure. When the weld gun is activated, a special precision weld tip initiates a controlled electric arc from the welder capacitor bank which melts the end of the stud and a portion of the base metal. The stud is held in place as the molten metal solidifies instantly accomplishing a high quality fusion weld.

CD Stud Welding is generally used to weld smaller diameter studs to thin base metals, especially where reverse side marking is not permissible. Since the entire weld cycle is completed in milliseconds, welds can be made to thin material without pronounced distortion, burn-through or reverse side discoloration. As long as one end of stud is designed for CD welding, CD studs can be manufactured in almost any shape.

CD Stud Welding is compatible with just about any weldable material, and permits the welding of dissimilar metals.

STUDS (General Information)

HOW TO FIND THE OPTIMUM COMBINATION OF STUD SIZE AND BASE METAL THICKNESS IN ORDER TO PREVENT REVERSE-SIDE MARKING.



MILD STEEL

BASE METAL: Mild Steel
STUD: Mild Steel, Flanged or Small Flanged

STAINLESS STEEL

BASE METAL: Stainless Steel
STUD: Stainless Steel, Flanged or Small Flanged

ALUMINUM

BASE METAL: Aluminum
STUD: Aluminum, Flanged or Small Flanged

NOTE: Stud tip size can influence the degree of reverse-side marking.

STUDS (General Information)

CD STUD WELD INSPECTION (VISUAL)

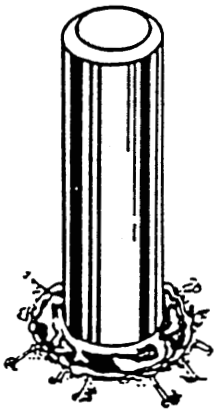
The CD stud weld can be visually inspected by observing the fillet at the base of the stud. The illustrations and comments below will assist you in visually judging the quality of the weld.

GOOD

Full, even fillet all around stud.

COLD

No or uneven fillet.



HOT

Large crater-excessive metal expulsion, very shiny appearance.

STUDS (General Information)

GENERAL SPECIFICATIONS

	CAPACITOR DISCHARGE	ARC
MATERIAL	Standard in low carbon steel, 302/304/305 stainless, and 1100, 6061, & 5000 series aluminum. Brass and other grades of stainless steel are also available.	Standard in low carbon steel and 302/304/305 stainless. Aluminum, monel, inconel, and other grades of stainless steel are available.
PLATING	Copper plating is standard. Nickel, Zinc, and other platings are available.	Nickle Plating, Copper Plating, zinc to ASTM-B 633 (formerly A 164) and other platings are available. Non-weldable plating is removed from the weld end to avoid contamination of the weld.
ANNEALING	All low carbon steel and stainless steel studs are annealed upon request.	Low carbon steel can be annealed to a maximum of 75 Rockwell B and stainless steel to a maximum of 90 Rockwell B.
THREADS	UNC-2A is standard for external threads prior to plating and UNC-2B for internal threads. Metric and other thread sizes are available.	
WELD BASE	Flanged, small-flanged, and non-flanged are available.	1/4" dia. and over have solid flux. Diameters under 1/4" are standard pointed, and flux is optional.
STUD LENGTH	CD studs have no appreciable length reduction after welding.	The arc stud length designations are BEFORE WELD; AFTER WELD lengths are shown in the table below.
FERRULES	Does not apply to CD	All orders include ferrules when they are required.

STUD DIAMETER	*APPROX. REDUCTION*
3/16" thru 1/2"	1/8"
5/8" thru 7/8"	3/16"
7/8" and over	1/4"
1/8" wide rectangulars	1/8"

STUDS (General Information)

CD STUD LOAD STRENGTHS

STUD MATERIAL	STUD SIZE	MAXIMUM FASTENING TORQUE (Inch Lbs.)*	ULTIMATE TENSILE LOAD (Lbs.)	MAXIMUM SHEAR LOAD (Lbs.)
LOW-CARBON, COPPER-FLASHED STEEL	6-32	6	500	375
	8-32	12	765	575
	10-24	14	960	720
	1/4-20	43	1750	1300
	5/16-18	72	2900	2200
	3/8-16	106	4300	3250
STAINLESS STEEL: 18-8	6-32	10	790	590
	8-32	20	1260	940
	10-24	23	1530	1150
	1/4-20	75	2880	2160
	5/16-18	126	3750	5350
	3/8-16	186	4850	7150
ALUMINUM ALLOY: 1100	6-32	2.5	200	125
	8-32	5	295	185
	10-24	6.5	380	235
	1/4-20	21.5	670	415
	5/16-18	36	1125	695
	3/8-16	53	1660	1000
ALUMINUM ALLOY: *5000 Series*	6-32	3.5	375	235
	8-32	7.5	585	365
	10-24	10	735	460
	1/4-20	40	1360	850
	5/16-18	70	2300	1400
	3/8-16	81	3400	2100
	1/2-13	140	5500	3000
ALUMINUM ALLOY: 6061	6-32	6.5	350	160
	8-32	13	560	229
	10-24	19	670	310
	1/4-20	40	1240	679
	5/16-18	70.5	2025	1210
	3/8-16	100	2985	1750
BRASS: 70-30 (260) 65-35 (268)	6-32	8	600	390
	8-32	16	860	560
	10-24	18.5	1040	680
	1/4-20	61	1950	1275
	5/16-18	102	3280	2140
	3/8-16	150	4800	3160

*These values should develop fastener tension to slightly less than yield point and should be used only as a guide.

STUDS (General Information)

CD STUD/BASE METAL COMBINATION WELDING CAPABILITIES

BASE WELD SURFACE MATERIAL	STUD MATERIAL			
	MILD STEEL	STAINLESS	ALUMINUM	BRASS
	1008, 1010, 1018	302, 304, 305	1100, 5000, 6061	70-30, 65-35
MILD STEEL 1006 through 1030	Excellent	Excellent	—	Excellent
MEDIUM CARBON STEEL 1030 through 1050	Good*	Good*	—	Good*
GALVANIZED SHEET DUCT OR DECKING	Excellent	Excellent	—	—
STRUCTURAL STEEL	Excellent	Excellent	—	Excellent
STAINLESS STEEL: 405, 410, 430, and 300 Series, except 303	Excellent	Excellent	—	Excellent
LEAD FREE BRASS; ELECTROLYTIC COPPER; LEAD-FREE ROLLED COPPER	Excellent	Excellent	—	Excellent
MOST ALUMINUM ALLOYS OF THE 1100, 3000, 5000, AND 6000 SERIES **	—	—	Excellent	—
DIE-CAST ZINC ALLOYS	Good*	Good*	Excellent	Good*

*Good: Generally full strength results, depending upon the combination of stud size and base metal.
**Other materials, such as 7000 Series aluminum, titanium alloys, Inconel, etc. can be welded under specified conditions.

CD STUD REVERSE-SIDE MARKING LIMITATIONS

The charts on the following page will be of help in determining the best combination of stud weld base size and base metal thickness. The terms on the chart are defined as follows:
EXCELLENT — No marking, excellent weld.
ACCEPTABLE — Visible markings, excellent weld.
UNACCEPTABLE — Unacceptable marking, base metal failure.

It should be noted that these charts are based on optimum laboratory conditions. Even under optimum conditions, it is difficult to determine the precise point at which reverse-side marking will appear. Therefore, these charts should be used only as a guide.

STUDS (General Information)

CD STUDS WEIGHT CHARTS (FLANGED — STEEL)

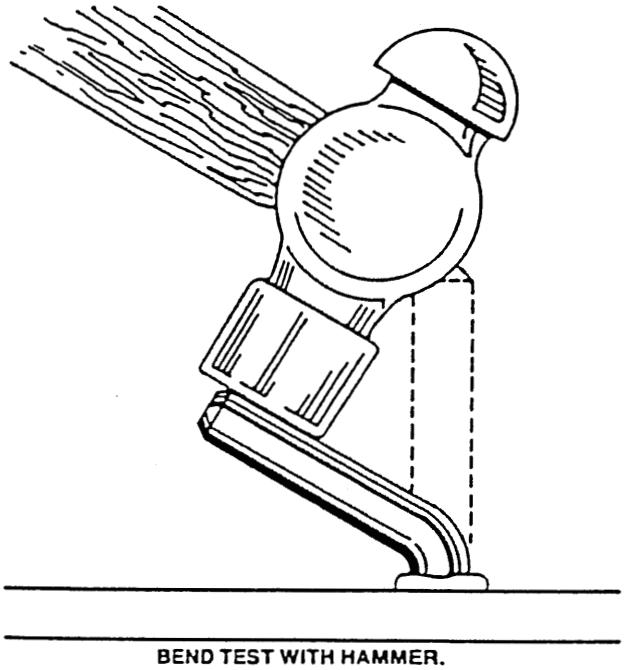
ESTIMATED WEIGHTS OF THREADED STUDS IN POUNDS PER 1000 PIECES						
LENGTH	**4-40**	**6-32**	**8-32**	**10-24**	**1/4-20**	**5/16-18**
1/4	0.69	1.00	1.39	1.79	3.08	4.90
3/8	0.94	1.38	1.93	2.50	4.37	6.98
1/2	1.18	1.76	2.49	3.21	5.66	9.06
5/8	1.43	2.13	3.04	3.93	6.95	11.13
3/4	1.67	2.51	3.60	4.64	8.24	13.21
7/8	1.92	2.89	4.15	5.35	9.52	15.29
1	2.16	3.26	4.71	6.07	10.81	17.36
1-1/4	2.65	4.02	5.82	7.50	13.39	21.52
1-1/2	3.15	4.77	6.93	8.92	15.96	25.67
1-3/4	3.64	5.52	8.04	10.35	18.54	29.83
2	4.13	6.27	9.15	11.78	21.12	33.98
2-1/4	4.62	7.03	10.26	13.21	23.69	38.14
2-1/2	5.11	7.78	11.37	14.63	26.27	42.29
EACH ADD'L. INCH	**1.96**	**3.01**	**4.44**	**5.71**	**10.31**	**16.62**

ESTIMATED WEIGHTS OF NON-THREADED STUDS IN POUNDS PER 1000 PIECES						
LENGTH	**3/32**	**1/8**	**5-32**	**3/16**	**1/4**	**5/16**
1/4	0.68	1.06	1.59	2.24	3.87	5.97
3/8	0.92	1.50	2.27	3.21	5.61	8.68
1/2	1.16	1.93	2.94	4.19	7.35	11.39
5/8	1.40	2.37	3.62	5.16	9.09	14.11
3/4	1.64	2.80	4.30	6.14	10.84	16.82
7/8	1.88	3.24	4.98	7.12	12.56	19.53
1	2.12	3.67	5.65	8.09	14.32	22.25
1-1/4	2.60	4.54	7.01	10.04	17.81	27.67
1-1/2	3.08	5.41	8.36	11.99	21.29	33.10
1-3/4	3.56	6.28	9.72	13.95	24.78	38.52
2	4.04	7.15	11.07	15.90	28.26	43.95
2-1/4	4.52	8.02	12.43	17.85	31.75	49.37
2-1/2	5.00	8.89	13.78	19.80	35.23	54.80
EACH ADD'L. INCH	**1.92**	**3.48**	**5.42**	**7.81**	**13.94**	**21.70**

STUDS (General Information)

CD AND ARC STUD WELD TESTING (PHYSICAL)

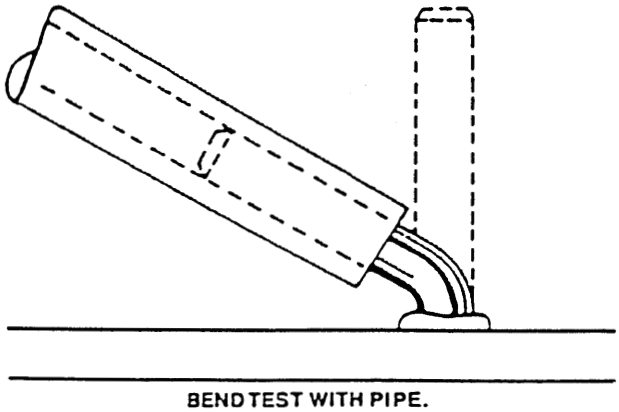
If, after visual inspection the weld quality is still questionable, or specifications require, the welded stud can be submitted to additional testing. The following are suggested physical tests.



BEND TEST WITH HAMMER.

BEND TEST: (See illustrations) By striking the stud with a hammer, or by sliding a length of pipe or tube over the stud, the stud can be bent a minimum of 30° away from its axis, or until failure occurs. Satisfactorily welded studs should exhibit a complete 90° bend without failure.

TORQUE TEST: The stud may be torqued with conventional torque testing equipment by applying torque until a predetermined torque or proof load is reached or until failure occurs.



BEND TEST WITH PIPE.

TENSILE TEST: The stud may be tested with conventional tensile testing equipment until a predetermined load is reached or until failure occurs.

OTHER: The stud and weld can be submitted to other conventional forms of destructive or non-destructive testing as specifications may require.