

Stud Welding in Insulation Fastening

Apprentice Workbook/Reference

Prepared for
The Insulation Industry's National
Apprenticeship and Training Fund
by



Table of Contents

I. Basics

II. CD Stud Welding

III. Arc Stud Welding

IV. Safety

V. Summary Guidelines

I. Basics

Stud welding involves several simple electrical principles and incorporates them through a limited number of practical, or "field-applied" methods. In its simplest form this process of applying fasteners involves "controlling" an electrical short. It is extremely similar to the other types of welding in popular use (Mig, Tig. etc.) except that due to the nature of equipment in use, it becomes a brief, semi automated process requiring only limited technical skills of the system operator/user.

More directly, stud welding systems (be they pin, stud or otherwise) involve giving the user a unit which controls most, or all, welding procedures so that he may use the system, in multiple environments under varied conditions, and receive consistent and reliable results, almost without fail. These systems involve several components, regardless of the brand, model, method, or type. First, power is required. Next, you must have a unit (usually called a "box" or "controller") to make the power weld-usable

(i.e.: type of power, amount of power, time applied, etc). From this control box, a transmission means is needed, therefore cables are involved. And finally, all stud/pin-welding systems employ a "gun" which is the heart of the manually operated stud welder. Assembled these components give the user an entire system to control electricity and create a bond or "weld" quickly and reliably.

As in use today, the two popularized methods are capacitor discharge ("CD") and "Arc" stud welding. These types differ to the user most observably in the type of bond they yield. This means everyday use shows some readily understood differences as they exist in the field.

II. CD Stud Welding

The CD weld is the most popular mechanical fastening method in insulation work. It is extremely useful in small diameters (1/8"-3/8") and has become the accepted means of pin welding. Actually this type welding is used even up through 3/8" diameter "studs" and can be hand-held (as normally field-used), or automated where studs, parts, and the welding process are totally automated or "robotized".

The CD weld itself is a surface weld which contributes to its popular use. This surface bond allows the CD method to be applied on even light gauges of sheet metal, without fear of burn-through and usually without so-much as a backside mark or discoloration.

The process takes its name from the equipment. The controller or "box" contains a set of capacitors which act more or less as batteries. From simple 115 volt outlet or extension-cord power the capacitor bank is loaded and during weld discharges on signal (triggering) from the gun. The pin or stud itself has a nib or weld tip which controls the actual weld-area cycle. When the large amount of current passes through the tip, it explodes due to electrical overload, this explosion creates a "gap" or "arc" (as needed in all types of welding). The arc heats both the fastener surface and the work's weld area. The gun then "drives" the stud into the hot area, where it immediately cools and develops the bond. The gun then has served as electrode holder, fastener fixture, and mechanical "driver." The "box" controlled the Charge which was carried to, from, and through cables.

Due to the years of experience in equipment design and today's availability of solid state components, actual welder hardware is extremely reliable. For that reason, training in set-up and equipment use is extremely important. FULLY 75%, OR MORE, OF FIELD PROBLEMS ARE DUE TO FIELD-TRACEABLE SET-UP or MECHANICAL PROBLEMS, most of which you can solve yourself. Further, due to the equipment's reliability, another simple statement needs to be remembered. THE UNITS EITHER WORK OR DON'T WORK, if you see a situation where partial welds occur or the system works sometimes and then not, you most likely have a set-up or cable mechanical problem. Through simple "gun-or-cable swapping" and standard set-up rules the majority of these problems can be solved without much wasted time.

REMEMBER: Once you are sure you have good incoming power (usually the "box" light or welder "hum") a complete connection (box to cable, cable to gun, gun to fastener, box to solid ground connection) and proper gun set-up. *STOP*. You have done your job and a serviceman should be called. DO NOT OPEN and TRY TO WORK INSIDE THE POWER UNIT UNLESS YOU HAVE HAD SPECIAL TRAINING.

The weld itself can be "read" or used to tell you what results you are getting. A good weld will show melted material or "berries" all around the pin base or flange. A bad weld, in a pin that breaks off, will usually tell you why the weld failed. If the pin shows silvery, "soldery", remains of the weld tip not being fully burned away it was "COLD" in that not enough heat, or time, was present during the weld cycle. A failed pin that has no flange left and sits in a "crater" was much too HOT to allow proper bonding. Just remember, look at your results before pull testing a pin. They will tell you a lot.

You *can* go steps farther to make sure the welders on your jobs work well however. Set-up all guns properly. Expose only the normal 1/8" of pin/stud to allow proper gun spring pressure. Use the gun foot to assure consistent pressure on straight pins or use proper "hand-gauged" technique on cupheads. Use all proper accessories and replace worn or loose accessories---after the first "arc" a collet or chuck will always deteriorate more rapidly. It is a good rule of thumb to clean or replace these visibly worn parts. Protect your cables. Breaks, strains, pulls, etc. will be one of your biggest enemies. Always assure a good, clean, solid ground connection. In general keep the components as clean as possible, treat the tool as one of your own. Finally, ask for training, it is best to be part of an in-shop or on-site class at least every other year to sharpen your old skills and "stay-up" on technical changes in the stud welding field.

III. Arc Stud Welding

The arc stud welding basics are extremely similar to those of CD. You still have incoming power, a controller (or timer), cables, and a gun. In general, however, the units employ different-type and higher-voltage power. Arc stud welding is usually used on larger diameter fasteners (1/8" up to 7/8" normal diameters) and develops a more penetration type weld with burn-off of the stud and a heated zone into the weld surface of a full 1/8" in many cases. Due to this penetration, these systems are attractive on many jobs of small diameter stud where surface contamination (paint, rust, scale, etc.) and 14 gauge or heavier surface metal is present or where shear/load fastener strength is of high importance. (For the insulation market these applications are much more limited than CD, but are still regularly found). Arc studs themselves have no tip; instead an aluminized flux ball starts the welding process. Also each stud uses a ceramic insulator, shield or "ferrule." This part contains the melted stud (usually about 1/8" of the stud itself), vents gas from the weld area, and concentrates the weld arc during cycle time.

The gun, similar to CD, holds the stud and fixtures the work area. In arc stud welding the gun also holds the ceramic in place around the stud and mechanically "lifts" the stud from the work surface to create the weld arc. After timing-out of the weld cycle (overseen by the control box unit), the gun "plunges" the stud down into the "hot pool" of molten metal and allows formation of the metal bond in the weld zone. As stated the control box converts weld-usable power and performs "brain" functions to control all parts of the welding cycle (time, voltage, etc.)

Arc system trouble-shooting uses all items discussed in the CD section and then some. Protrusion, cables, accessories, ground, etc. are as important as ever. Incoming power is more complicated and must be of sufficient type and level to weld the desired diameter. NOTE: If there are suspected and confirmed problems in the incoming power and/or hook-up, an electrician should be used for all necessary readings and adjustments.

As a user, the gun and cables of the arc system require more time. Specifically the gun has more moving parts and must perform its lift and plunge functions freely and cleanly to assure good, consistent welds. The stud must move through the ceramic shield without "hang-up" or "rub" to permit proper melt-off and welding. Any job requiring the extended use of an arc-system should have periodic maintenance to any-and-all arc stud guns by a trained user or a factory representative. Units seldom used should receive similar preventative maintenance before going to a new job---ideally under full welding condition. If problems do occur in use, the above noted maintenance items should be reviewed to trouble-shoot it is much more likely, if you have carefully checked the basics (and due to insulators' less frequent use of arc systems), that you will need the assistance of a factory trained service representative who is job-site available.

IV. Safety

Regardless of the system in use there are certain precautions to always observe as protection for yourself and others. Remember you are using a welding system and act accordingly, complying with all electrical and fire codes. Keep the following in mind:

A. Eye protection should be worn at all times. Avoid looking directly at the arc during welding.

Side shields are recommended.

A. Wear proper clothing to protect hands, arms, face and head.

B. Avoid contact directly with the weld circuit during any stage of use,

C. Never stand in water, sit welder or cables in water, or weld with wet or damp clothing.

D. Remove Flammable or explosive hazards from welding area and adjacent areas.

E. Allow only trained service personnel to go beyond the external basics of the system.

V. Summary Guidelines

Pin Welder Guide

Do

- Connect Welder to standard 115V AC power.
- Use extension cables at all times.
- Twist all connectors to lock (or snap) in-place.
- Make sure gun is set up properly for your particular application.
- Tighten all set screws (collet-protectors, legs, etc.).
- Use legs and foot if at all possible, fastener should extend 1/8" past foot.
- Connect ground clamp tightly to clean surface.
- Connect gun to Negative (or Gun) port unless welding to paint, galvanization. or rust.
- Apply only LIGHT (1/8"), CONSISTENT pressure during the weld.
- USE proper gun spring for material welded.
SILVER-mild steels,
stainless BLACK-aluminum
COPPER - heavy duty tip pins
- When welding CupHead pins always use a pin at least 1/8" longer than material depth. Use paper washers on cupheads welded thru foil-faced material.
- Expect unit to "hum" after each weld.
- Observe ALL electrical fire codes and rules of common sense.

Don't

- Coil up cables in one area.
- Automatically turn unit all the way up to highest voltage setting to solve welding problems.
- Remove cover from unit for any reason with power connected.
- Lubricate Gun, Gun shaft, or any part of unit.
- Push Gun down until spring "Bottoms Out" on *any* type pins.
- Use a collet or chuck that will not grip the fastener snugly or shows burn signs.
- Look directly at weld area during welding.
- Move gun during weld.
- Stand in water to weld, sit unit or cables in water, or weld with wet or damp clothing.
- Weld near flammables or explosive hazards.
- Weld overhead without proper eye and body protection.

Remember: The basics are simple. Be logical, step back and use a common sense view of the whole situation. Review what you know on these levels. Be careful, DO NOT jeopardize yourself, your job, your trade, or your employer simply to see what's inside the box. Many times you can only make matters worse, not to mention taking needless risk. Every contractor should know skilled, job-available service people. Assure that you have done your part and ask that they be used when you see fit. Tradesmen, Contractors, and Suppliers will all benefit in the long run.