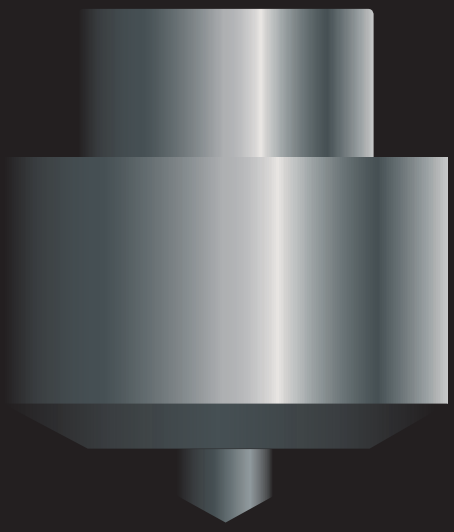
TUFFSTUDDS®
WELDING MANUAL



Now that you are using TUFFSTUDDS® for your equipment, this manual will show you how to get the best out of your product and help to achieve the highest quality application.

Please read carefully before installing TUFFSTUDDS®.

TUFFSTUDDS®
Welder Training Manual

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1 WHY TUFFSTUDDS®

Many high wear areas of mining equipment have been effectively protected against wear with hard-facing. TUFFSTUDDS® hard-facing is intended to make this protection more substantial and efficient. The system has the following advantages:

1. Deposits more protection faster.
2. Deposits higher profile wear protection.
3. Welds with less heat input into the base metal.
4. Traps mineral for "dead bed" effect.
5. Generates minimal fumes and smoke.

All of this makes installations more efficient, effective and competitive. It is for this reason that we will take a more in-depth look at the proper techniques of TUFFSTUDDS® installation.

2 SAFETY ASPECTS OF STUD WELDING

Rules governing safe arc welding practices apply to stud welding. Safe arc welding practices as regulated by your company's internal regulations as well as local, state and federal regulations also apply to stud welding. Special attention should be directed to the following points:








- Comply with all electrical, fire and other applicable codes or ordinances in the installation and use of stud welding systems.
- Remove all combustible or volatile materials from the weld area. Although weld spatter or berries resulting from stud welding are normally minimal, proper precautions should be taken when welding near or through combustible materials to insure that sparks or berries do not come in contact with combustible material and start a fire.
- Recommend wearing of eye protection at all times when welding. Spectacle type frames with Shade No. 3 absorptive and filter lens and side shields are suggested. For sustained welding face shields are recommended.
- Use of protective clothing is suggested. Type of clothing will vary as to application, weld position and stud welding being used, however, in all cases, it should be fire resistant and sufficient to protect welding operator from weld spatter and berries.
- Clean the surfaces of all debris, scale and moisture before you weld. TUFFSTUDDS® should be applied on smooth dry surfaces. Light grinding or wire brushing may be sufficient. Preheat when temperatures are below 50 deg F (10 deg C) or base material has work hardened
- KEEP HANDS, CLOTHING, ETC. AWAY FROM THE WELD STUD, CHUCK AND ALL OTHER PARTS IN CONTACT WITH THEM DURING THE WELD CYCLE.
- KEEP WELD CABLE AND CONNECTORS IN GOOD CONDITION. INSPECT PERIODICALLY FOR BROKEN INSULATION AND/OR OTHER ELECTRICAL HAZARDS.
- WARNING: USE EXTREME CAUTION WHEN SERVICING OR TROUBLE-SHOOTING ANY COMPONENT OF THE STUD WELD SYSTEM. If possible turn all power controls "OFF" and disconnect all l electrical cables.

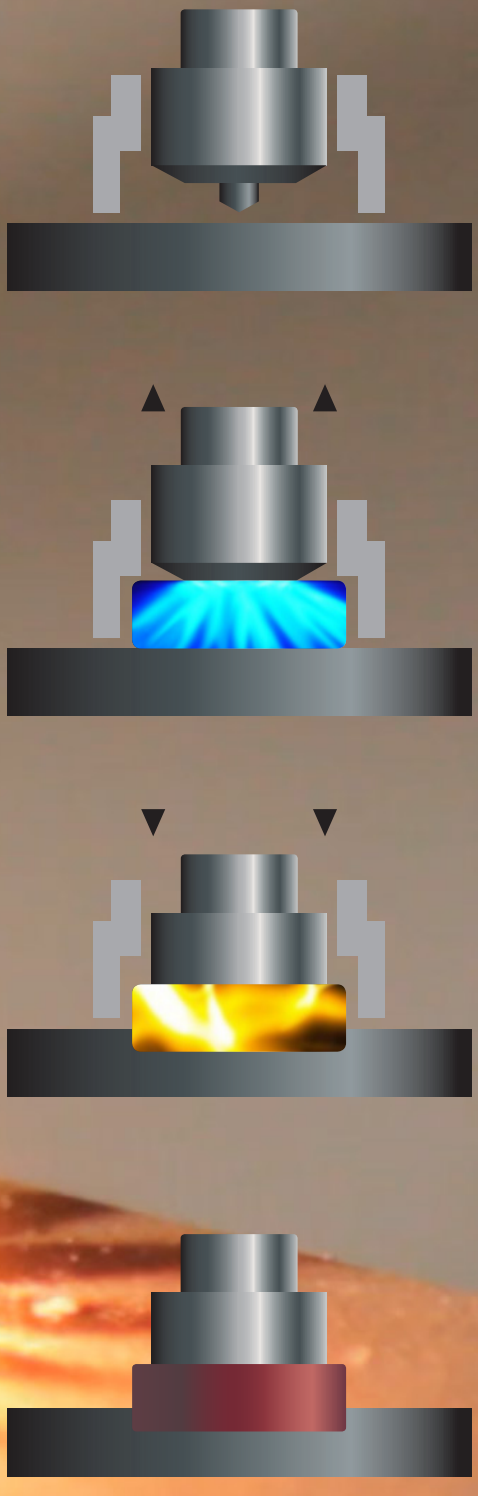
  Otherwise, stud welding is a simple, safe and efficient process for a wide variety of applications.

3 STUD WELDING PROCESS AND EQUIPMENT

PROCESS

Stud welding involves developing an arc melted pool on the base metal and the tip of the stud - plunging the two partly melted components together in a controlled reproducible cycle to form a full fusion, cross sectional weld.

The drawn stud arc welding process is much like conventional arc welding – what you do every day. The weld consumable is brought in contact with the base and lifted slightly. This develops an arc; an energy source that melts the tip of the consumable and the base metal. An automatic cycle control and gun mechanism plunges the two parts together and we have a full metallurgical joint.



EQUIPMENT SETUP

STUD WELDING EQUIPMENT AND CABLES

Arc stud welding equipment is manufactured by several North American manufacturers. Typically, your arc welding system will consist of a D.C. rectifier power source and control unit, appropriate cables and a stud welding gun (Figure 1). We recommend True Weld Equipment, specially designed for TUFFSTUDDS®.

Power to these transformer rectifier units can be supplied by line power or a diesel driven A.C. Generator.

Portable truck mounted stud welding units represent the "Cadillac" level of capabilities. These units are self contained and fully portable.

A.C. Power from the generator is delivered at about 440 volts and about 100 amperes to the stud welding machine. The stud welding machine uses a transformer to reduce voltage to about 70 volts and to increase amperes to higher levels. The transformed three phase A.C. Power is then rectified using three separate SCR rectifiers to a smooth D.C. power suitable for drawn arc stud welding.

Today's systems use sophisticated electronic controls for optimum arc stability. Timer controls permit accurate controls over the time that the arc is on – usually between 0.5-1.0 second. Continuously adjustable current controls provide for selection of accurate reproducible power levels. The combined effect of how these settings are adjusted determines the amount of melting produced in the melt zone.

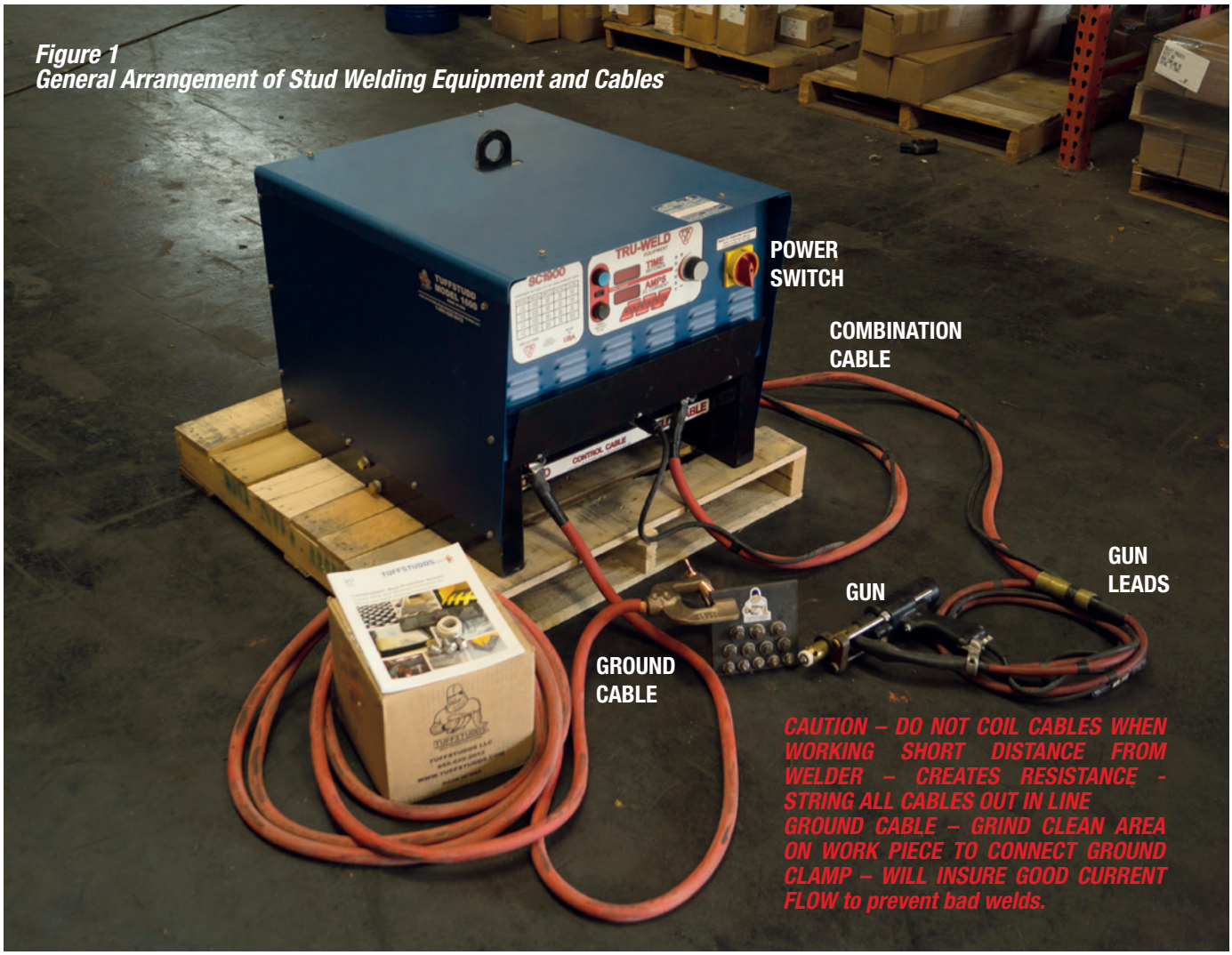


Figure 1
General Arrangement of Stud Welding Equipment and Cables

THREE CABLES ARE NEEDED TO CARRY OUT ARC STUD WELDING:

1) Control Cable
2) Power Cable
3) Ground Cable

1. The control cable connects the timer control circuits in the machine to a solenoid and switch in the gun body. The weld cycle functions that depend on information conveyed through the cable include:

1) Energizing of gun solenoid and lift of stud.
2) Initiation and shutdown of weld arc.
3) De-energizing of solenoid and plunge of stud into the melted liquid weld pool.

2. The power cable from the negative terminal of the stud welding machine connects to the gun with the stud. The power cable carries the welding current to the arc and needs to be of adequate size to do the job. For welding of TUFFSTUDDS® we need cable size 4/0. We may carry up to 1600 amperes of welding current through the cable. The insulation of the cables must be kept in top shape to avoid accidental shorting and trouble. Remember that once the trigger is depressed and the weld cycle is on, the cable and exposed gun parts are electrically energized. If you touch the live parts and complete the circuit with the ground the consequences can be moderate shock – 70 OCV-minimum amperage.

3. The ground cable fastened to the positive terminal of the welder and the work piece provides return path for the welding current. It is essential that this cable is also kept in good repair for it does carry the same 70v – 1600 amp D.C. power levels as the welding cable. We recommend 4/0 cable size and a substantial 8-10 inch (20-25 cm) "C" clamp for the system.

STUD WELDING GUN

Parts of the gun include gun body, handle, trigger, legs, foot piece, arc grips, tapered chuck adapter and cable connectors (Figure 3).

The legs hold in place a foot piece. The foot piece holds an arc shield grip with a ceramic arc shield. The legs provide for adjustment of a plunge depth – the distance the stud is plunged in the molten pool. Adjustment between the leg and the foot piece provides for accurate centering between the ceramic arc shield and the stud. Welding problems can originate from inaccurate centering between the arc shield ceramic and the stud.

The chuck holds the stud during welding and also functions as part of the welding current circuit. Welding of TUFFSTUDDS® requires that chucks are tight and maintain tension in service. For this reason we use special alloy heat treated chucks.

Outside Components of Stud Welding Gun

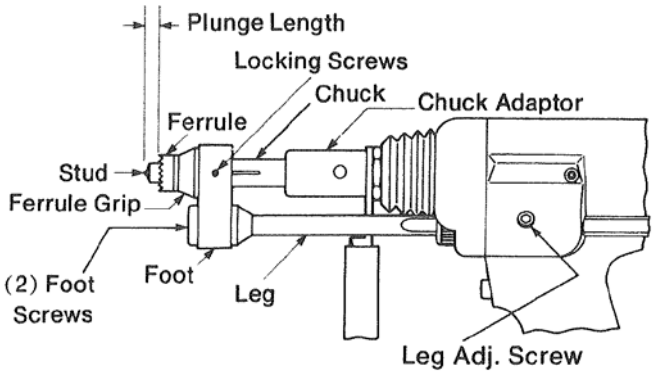


Figure 3

ACCESSORIES FOR INSTALLING TUFFSTUDDS®

TUFFSTUDD® SIZE	PART #	DESCRIPTION
HCA/I-58	CN-062	5/8" STANDARD CHUCK
	GDF-062	5/8" LONG FERRULE GRIP
	B-2N	MEDIUM FULL FOOT
TSA/I-68	CN-050	1/2" STANDARD CHUCK
	GN-075	¾" STANDARD FULL GRIP
	B-2N	MEDIUM FULL FOOT
TSA/I-78	CN-062	5/8" STANDARD CHUCK
	GN-087	7/8" STANDARD FULL GRIP
	B-3N	LARGE FULL FOOT

CHUCKS

FERRULE GRIPS FOOT

ADJUSTMENT OF CHUCKS FOR WELDING TUFFSTUDDS®

CHUCKS WITH ADJUSTABLE DEPTH SCREW:

HCA/I-58 (5/8" diameter-16mm) TUFFSTUDDS®

Turn out internal adjusting screw until the depth is set to engage one half of the top of the stud.

TSA/I-68 (3/4" diameter – 19mm) and TSA/I-78 (7/8" diameter-22mm)

Turn out internal adjusting screw until it is to the depth to insert 1/2"(13mm) or 5/8" (16mm) and stop tightly against the screw but leaving 2-3 mm from end of chuck to major diameter.

This will help keep the chuck away from the molten metal.

If excessive molten metal is going above the major diameter, reduce the amount of stud sticking out through ferrule a few mm at a time by sliding legs out of the gun body until proper stick out is reached and good welds are obtained.

Excessive molten metal may also be due to welding parameters being set to hot. Reduce time or amperage slightly until quality welds are achieved.

If chuck becomes stretched out, due to flexing when removing from stud or heat, retighten tines by squeezing with pliers or Channel Locks to create tighter grip.

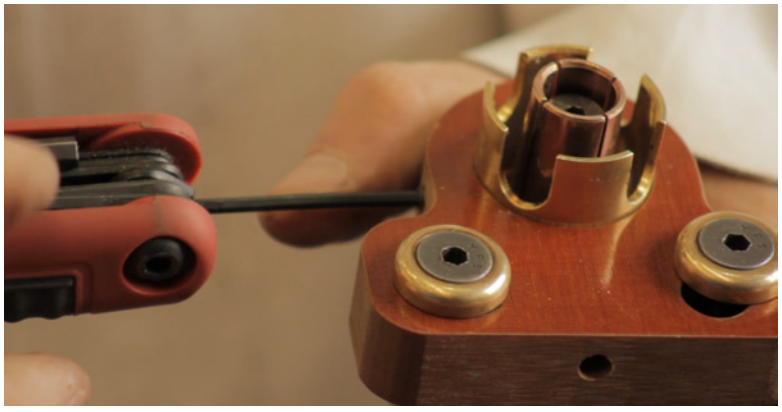
Chucks having a fixed depth cannot be adjusted.

4 SETTING UP THE STUD WELDING GUN

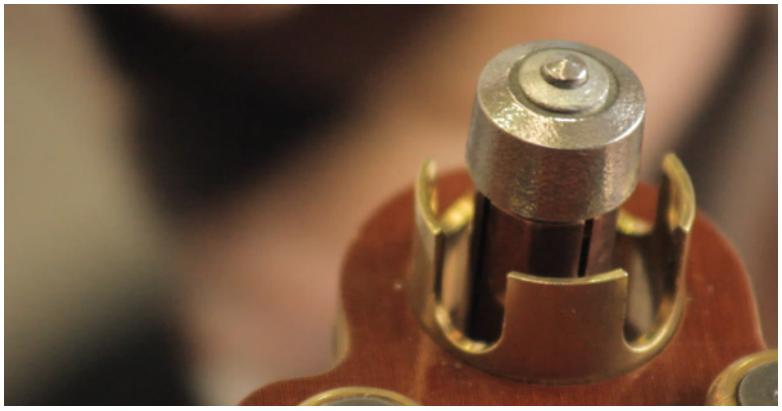
1) FIRMLY tap the chuck into place. (Without the stud in the chuck).

2) screw the foot piece into the legs of the gun.

3) Fit the Ferrule Grip into the foot piece, aligning the holes and set the screws.



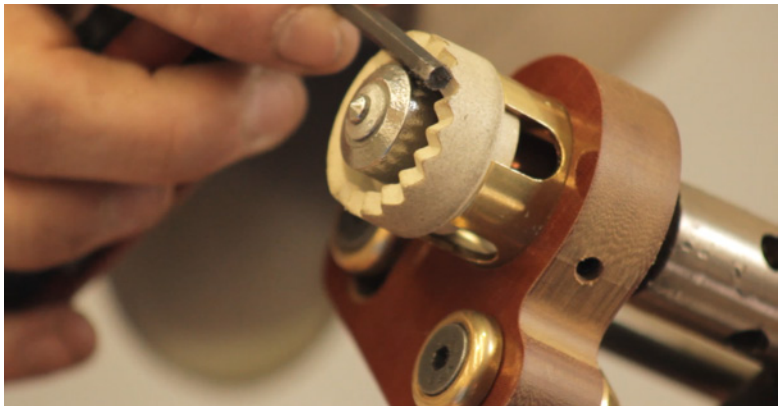
4) Align the holes and set the screws.



5) Insert a TUFFSTUDD® into the chuck.

6) Fit the ferrule into the ferrule grip.

7) Check the shield for centered position.



8) Check the plunge length. For the best results extend the shoulder of the stud 1/8 of an inch beyond the tips of the ceramic arc shield. That's the thickness of the Allen wrench used to set the leg screws. If it needs adjustment raise or lower the ceramic arc shield by loosening the leg screws and slide the legs in or out to adjust the length of plunge. Note: Do not include the tip of the stud in your measurement of the plunge length.

ARC LENGTH

Drawn arc welding depends on arc geometry that can be characterized by–diameter-as in electrode welding. Proper amperage for the diameter will melt the stud. The arc length is determined by the distance that the solenoid in the gun body is allowed to lift the stud.

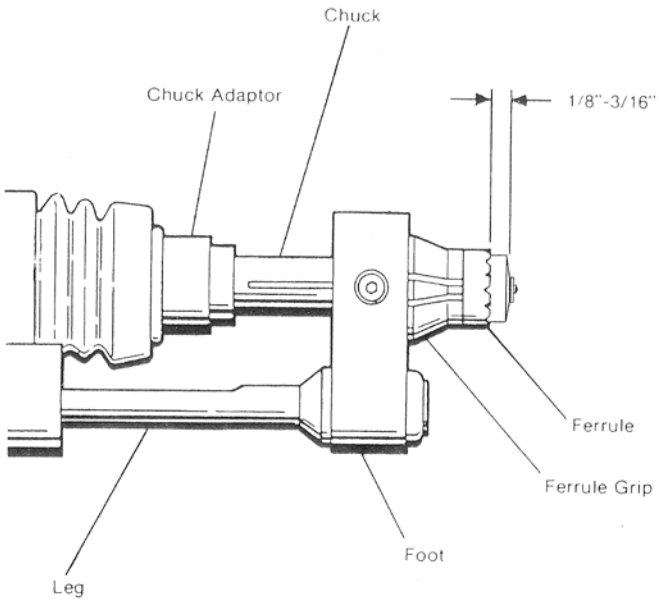
At the back of the gun body is an adjustable stop with a lock screw. The adjustable stop on the rear of the gun limits the length the solenoid shaft can travel. This limits the height the stud is lifted during welding and hence sets the arc length.

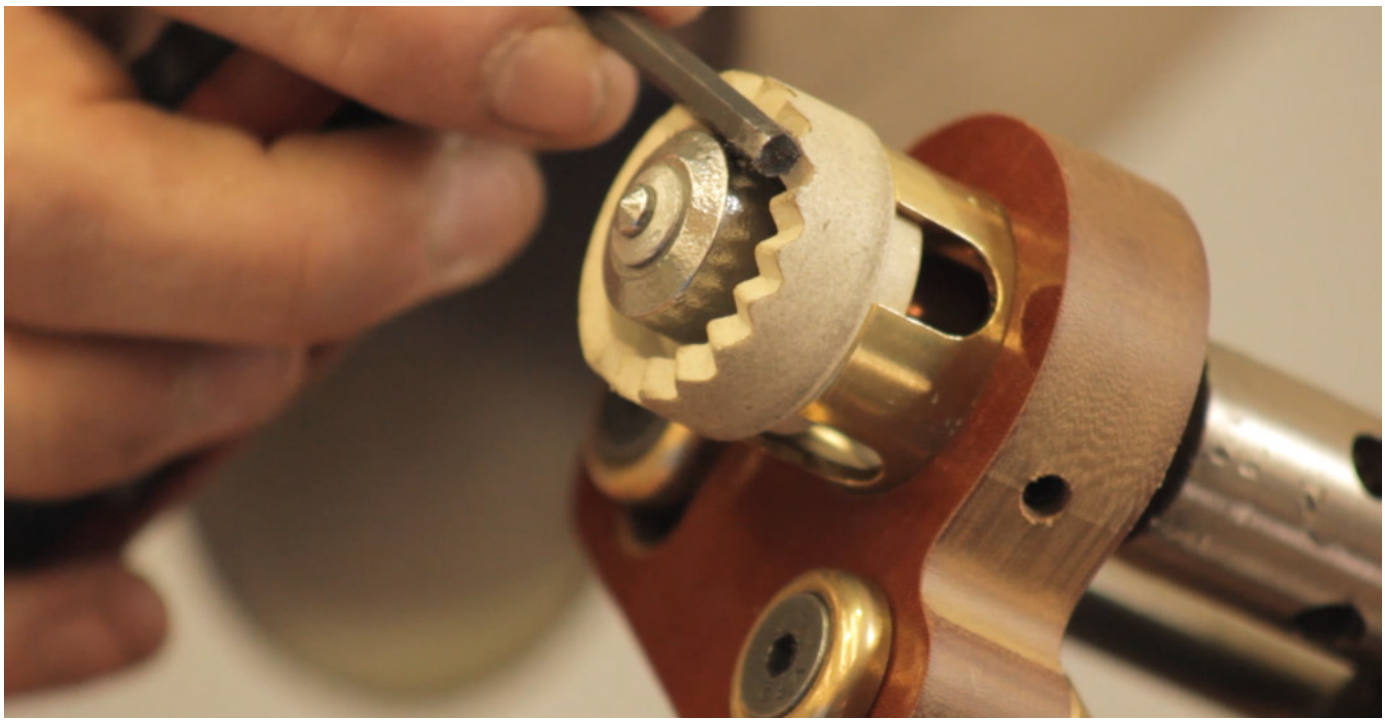
GOOD OPERATING CONDITIONS FOR TUFFSTUDD® INSTALLATION require an arc length of about 1/8". The arc length – stud lift height – can be measured by observing the travel distance of the chuck when the gun trigger is activated. Use caution – do not touch the gun's exposed parts when you check the lift distance. Simply mark a desired distance on the chuck and observe the lift distance.

PLUNGE LENGTH

Given that there has been adequate melting of the base and the stud, the two parts can now be plunged together. The distance that the stud is plunged into the melt pool is set by adjustment of the legs holding the arc shield. Experience shows that good welds can be produced when the shoulder of the stud is set to extend about 3/32 inches to 1/8 inches beyond the tips of the ceramic arc shield. Conveniently the thickness of two 25 cent pieces is just under 1/8 inch (Figure 5).

Figure 5
Plunge Length Setting – VERY IMPORTANT





PLUNGE DAMPENER

Once the arc has melted a sufficient quantity of liquid metal the timer shuts off the current and releases the solenoid. Spring tension in the gun body can now plunge the stud into the liquid pool.

The spring return of the stud into the molten pool is softened by a hydraulic plunge dampener. It reduces weld spatter from the stud entering the molten pool and controls the fillet.

Maintenance of this gun area should be the responsibility of a trained technician.

WELD APPEARANCE

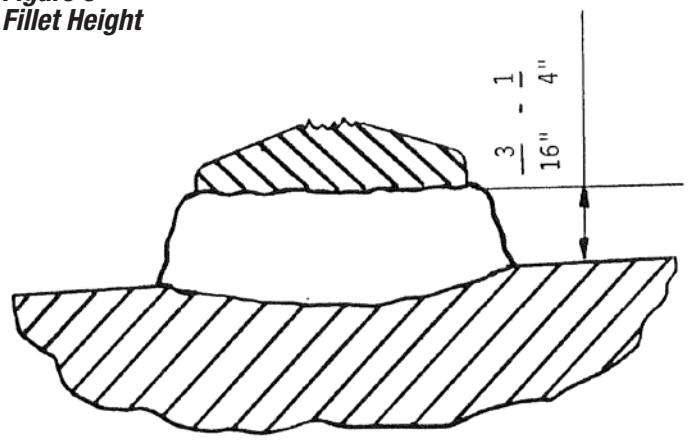
There are two aspects of TUFFSTUDD® weld appearance that have a bearing on how TUFFSTUDDS® perform:

1) The fillet formed around the periphery of the stud serves as a good indicator of weld quality.

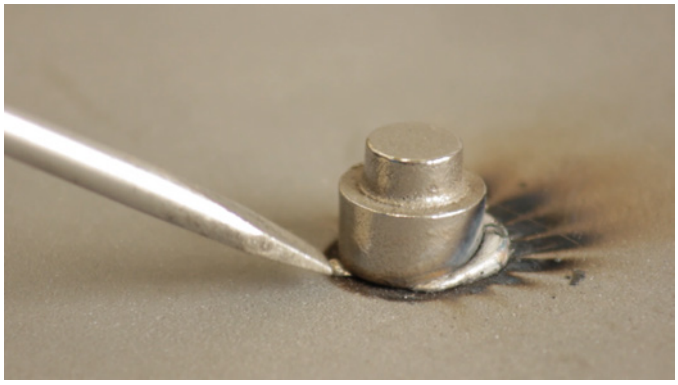
2) Stud spacing on a work piece is another important aspect that will determine the kind of wear protection you will get from TUFFSTUDDS® hardfacing.

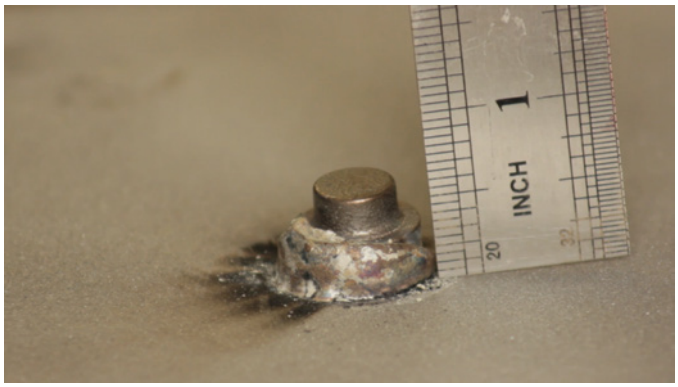
Fillets
For optimum weld performance we need to melt a pool in the base metal slightly larger than the diameter of the stud. Concurrent with the melting of the base the stud tip will melt. When both of these parts are plunged together the excess metal will form fillet around the weld base. We have found that the fillet height is a good indicator of weld integrity. When the fillet is low, say 1/16" – 1/8" (2-3 mm), we cannot be certain that there is good complete fusion across the full width of the stud.

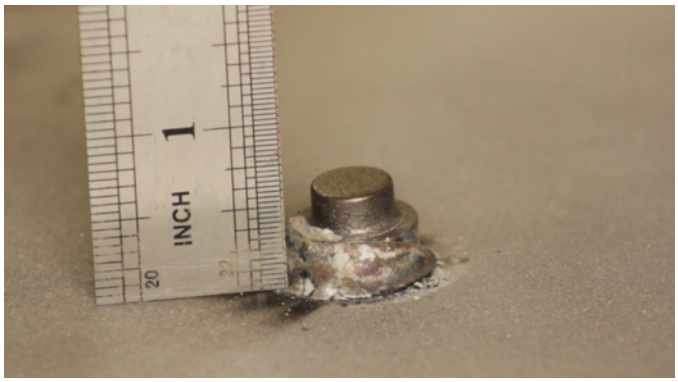
Figure 6
Fillet Height



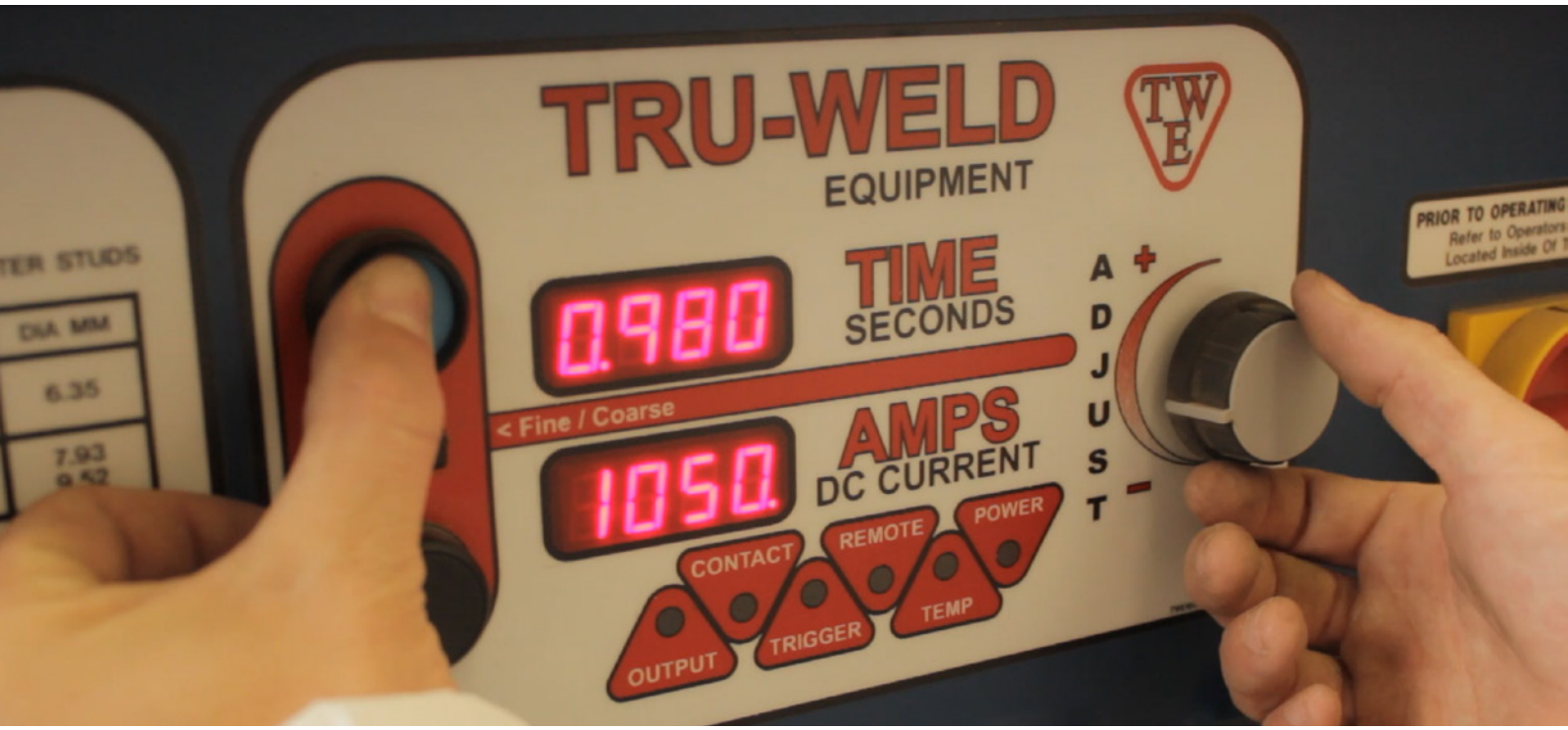
A fillet height between 3/16" and 1/4" (5-6 mm) will usually indicate complete fusion across the whole cross-section of the stud. As a consequence, TUFFSTUDDS® with fillet height between 3/16" and 1/4" will seldom fail in the weld zone when applied on weldable base materials.







5 STUD WELDING TECHNIQUES



WELDING AMPERAGE

The welding energy to melt the base metal and the tip of the stud comes from the welding arc. The strength of the arc is the product of AMPERAGE and VOLTAGE.

Arc stud welding uses a variable voltage 70v open circuit power source. Once the circuit is completed and the arc is initiated the voltage – arc voltage drops to about 40v.

The part of the arc energy that you have control is the amperage. Stud welding systems have a variable control that provides current (amperage) control from 0 to as high as 2400 amperes. Welding of TUFFSTUDDS® requires between 850 – 1500 amperes. This level of current melts a sufficient amount of base material and stud tip in a workable time frame.

Considering the need for this high level of welding current – almost 10 x higher than your normal arc welding amperage, we have to pay attention to the special needs of conductors and connections for the circuit. Clamps and cables need to be of adequate size and well maintained.

WELDING TIME CONTROL

Welding amperage and voltage determines the welding energy intensity. The time that the arc acts on the weld area is the third aspect of the total heat input. Therefore:

TOTAL ENERGY INPUT TO THE WELD ZONE = AMPERAGE x VOLTAGE x TIME

Shorter welding times provide shallower heat zones – longer weld times deeper heat penetration. Given the sensitivity for Martensite formation in the types of materials we weld it is advisable to use longer weld times when possible. There are limits however. The longer the arc acts upon the molten metal the more opportunity there is for some instability and spatter.

Your specific welding conditions may dictate settings slightly different than the ones shown in the table. Experience shows that most welding conditions can be accommodated with less than 10% adjustment in time or amperage.

THE BEST SETTINGS FOR TUFFSTUDDS® WELDING ARE:

AMPS	TIME	SIZE	
800 - 1000	0.5 - 0.7	5/8”	16mm
950 - 1200	0.7 - 0.9	3/4”	19mm
1150 - 1350	0.8 - 1.1	7/8”	22mm

WITH THE HEXAGONAL STAGGERED PATTERN, COVERAGE IS AS FOLLOWS:

STUD SIZE	PIECES / square foot	PIECES / square meter
5/8 (16mm)	144 - 160	1500 - 1700
3/4 (19mm)	110 - 120	1200 - 1300
7/8 (22mm)	77 - 80	800 - 900

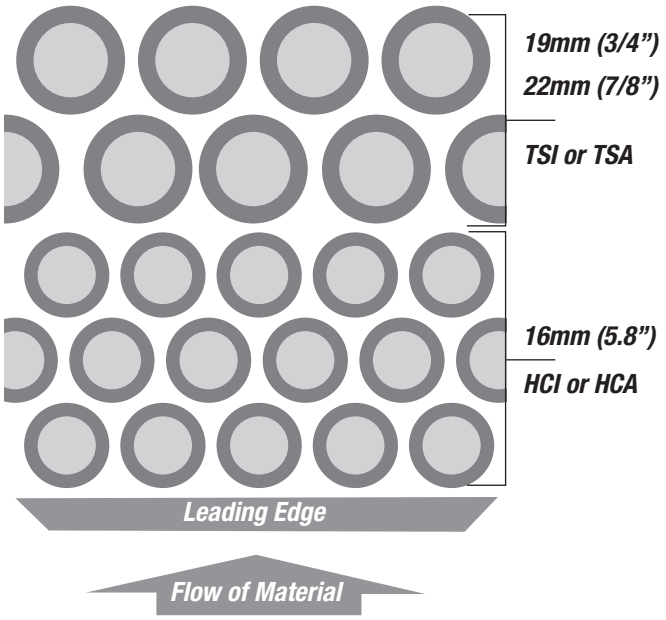
WELD SPACING FOR LAYOUT OF TUFFSTUDDS®

Besides the actual weld quality, as observed by the height of weld fillets, we also need to consider weld arrangement and spacing. Experience has shown that the best wear protection from TUFFSTUDDS® is obtained with the studs arranged in an offset hexagonal pattern (Figure 7). The offset pattern should be arranged so that any free flow between the TUFFSTUDDS® is blocked out by the next row of TUFFSTUDDS®.

The second aspect of spacing is the actual distance between TUFFSTUDDS®. Experience shows that normal hardfacing provides protection that is proportional to the volume or weight that has been applied to a part. TUFFSTUDDS® are no different. The tighter the application pattern the better the wear resistance.

Practical considerations make it simple and natural to apply TUFFSTUDDS® using the ceramic arc shields as typical spacing.

Figure 7
Arrangement of TUFFSTUDDS®



6 APPENDIX A CABLE SIZE

Welding Cable: 4/0 size

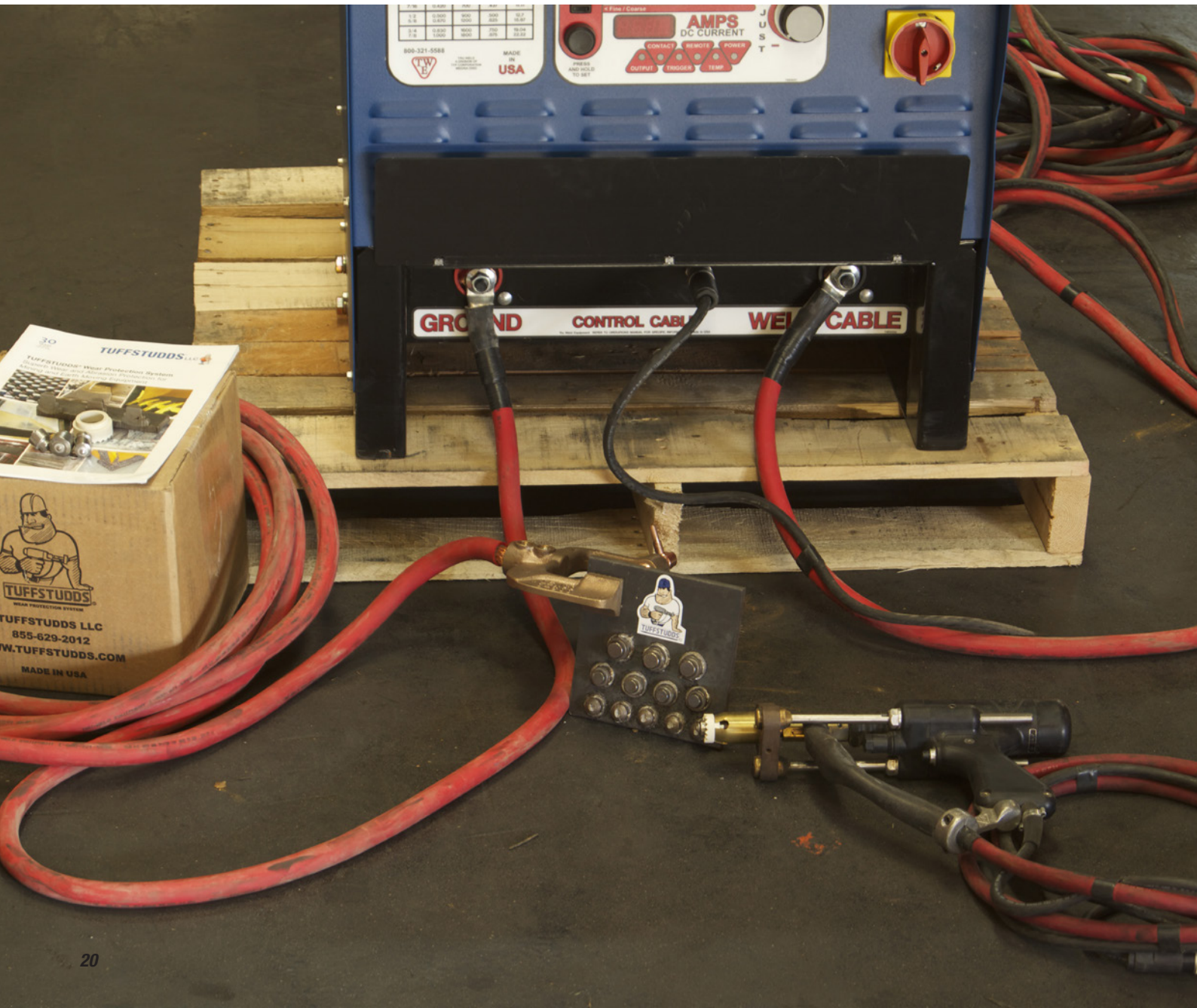
Ground Cable: 4/0 size

Short Gun Lead Cable: 1/0 size

Gun power leads must be kept outside gun body to prevent local overheating.

Primary AC – input power cables also need to be of adequate size to let the system function smoothly. The minimum cable size depends on the voltage of primary currents:

Primary Voltage	Cable Size
230 V	1/0
460 V	4
575 V	6



7 APPENDIX B BASE MATERIALS

WELDING PARAMETERS

WELDING PROBLEMS RELATED TO BASE MATERIALS

Successful installation of TUFFSTUDDS® requires attention to many details. Awareness of the weldability of the base materials is an especially important area. Fortunately most steels used for mineral handling are made from compositions that are suitable for TUFFSTUDD® welding. There are, however, some problem areas:

1) Some steels and cast high alloy irons may not be suitable for quality TUFFSTUDD® installation.

2) Most operating/maintenance personnel are uncertain about precise composition and analysis of the alloys used at their operations.

This means that all of the base materials on which you weld need to be treated with certain caution and that the information you receive about material compositions should be taken "with a certain amount of salt"...

We can divide the commonly encountered materials into three groups as shown in the attached tabulation. On site there is no easy way to determine what material you are actually working on. A handy file test can give you some feel for hardness. RC20 files easy – it is soft. RC65 cannot be filed. Most steels that you will encounter will fall somewhere in between.

Nihard type steels will not be encountered on most mining equipment. You may see Nihard in some extra severe erosive environment.

Wear plates and castings with hardness in excess of BHN-400 can be identified by "feel" with a file. Welding these harder materials often leaves a telltale dark soot deposit at the arc shield vent hole areas.

Manganese type castings can produce variable quality weld response. Good sound Manganese castings can be tuffstudded without problems. The weld current for Manganese steel castings will be about 30% less than for welds on other steel bases. For better quality welds always pre-heat manganeses steel castings to 300°F and never over 400°F (148°C - 204°C).

On other Manganese castings you may achieve a number of normal welds, then in other areas there may be heavy outgassing and resulting poor welds that give the appearance of too much heat. Some Manganese type castings are non-magnetic and can be identified with a small pocket magnet.

Poor quality carbon steel castings with heavy molding sand entrapment may also occasionally experience heavy local outgassing.

Hardfacing overlays are easily seen and identified.

When in doubt as to whether the base is suitable for welding try a few welds and then use a hammer to test weld integrity. Care is needed here as a broken off stud can fly like a bullet. Keep people away from the danger area and minimize the effect by keeping a suitable waste rug on the opposite side of the hammer blow on the test stud. This is not a guarantee of weld quality, but if the weld zone holds, you most likely have a satisfactory weld and therefore acceptable base material.

TYPICAL BASE MATERIALS

Easy to Weld	Use Caution	Avoid
Mild Steel T-1 type wear plates with hardness up to RHN-360 (R_c39) Astrology* type air hardening steels with hardness up to BHN-360 (R_c39). Most good quality wear castings with hardness up to R_c40.	T-1 Type Steels with BHN-400 hardness. (R_c43) Astrology* Type – air hardening steels with hardness of about BHN-400 (R_c43). Wear castings with hardness in range R_c40 to 45. Spherodized cast irons. Most welded overlays. Manganese type steels. Steels containing high nickel content.	Hardfaced areas. Nihard type steels. T-1 type steels with hardness in excess of BHN-400 (R_c43). Astrology* air hardening steels with hardness exceeding BHN-400 (R_c43). Common wear castings with hardness levels exceeding R_c45. Poorly made castings with heavy embedment of mold sand and/or poor heat treating.

*Special attention must be given to removal of the "mill scale" from new Astrology materials prior to welding. This scale is particularly adherent and, if not removed, can cause severe difficulty during welding.

COMPATIBLE BASE METALS FOR INSTALLATION OF TUFFSTUDDS®

ASTM #	AISI #	Basic Description	Mn	Carbon Content
A 36	1010-1020	Mild Steel		0.10 - 0.20
A 514 grB	1030-1034	T-1 Structure Q&T	0.60 - 0.90	0.32 - 0.38
AR		Abrasion Resistant (min)		0.35 - 0.50
T-1 AR		T-1 Abrasion Resistant	0.70 - 1.0	0.12 - 0.21
AR 400		Hi Abrasion Resistant	1.15 - 1.60	0.30 max
Super 500AR		Work Hardening – AR	0.35 - 0.60	0.27 - 0.34
Manganese Plate & Castings				
	1330	Low Manganese	1.6 – 1.9	0.28 – 0.33
	1335	Low Manganese	1.6 – 1.9	0.33 – 0.38
		Hi Manganese	12.0 – 15.0	0.90 – 1.20
		*as produced may work harden up to 550 Bn		

The above referenced steel plate and casting are representative of typical base materials which are appropriate for TUFFSTUDDS® applications.

With new material there should be little concern for welding TUFFSTUDDS® WITH THE EXCEPTION OF MANGANESE WHICH REQUIRES KEEPING THE WELD SURFACE BELOW **400F° (204°C)**.

CAUTION SHOULD BE USED WHEN INSTALLING TUFFSTUDDS® on manganese that has been worn as the material may have work hardened above 400 Br causing imbrittlement in the weld. CHECK HARDNESS

TUFFSTUDD® WELDING PARAMETERS FOR WELDING

TO LOW ALLOY BASE MATERIALS – 500 BRINNEL MAXIMUM

Type	Diameter	Time	Amperage
HC-58	5/8”	**0.55 – 0.70**	**800 – 1000**
TS-68	3/4”	**0.65 – 0.80**	**950 – 1200**
TS-78	7/8”	**0.80 - 1.1**	**1150 - 1350**

FOR WELDING TO MANGANESE STEEL BASE MATERIAL – 12% MAXIMUM

Type	Diameter	Time	30% less Amperage
HC-58	5/8”	**0.55 – 0.70**	**500 – 700**
TS-68	3/4”	**0.65 – 0.80**	**650 – 825**
TS-78	7/8”	**0.80 - 1.1**	**800 - 950**

All are approximate settings. Adjust as needed for local work conditions and one parameter at a time for proper weld quality results.

Plunge: stud should stick out through ferrule 3/16” (minimum) – ¼” (maximum) before welding to insure proper penetration into base material.

TUFFSTUDD® INSTALLATION ON 8 – 13% MANGANESE BASE MATERIAL

High amperage and high heat input into MANGANESE base materials can cause weld quality problems such as severe undercutting and embrittlement of the heat affected zone.

Normal welding amperages for given diameter electrodes / stud welded fasteners, especially hardfacing type alloys (TUFFSTUDDS®) are generally reduced by 25 – 40%.

Base material temperature should be held at 300F° and never over 400°F (148°C - 204°C).
400F degrees maximum over the course of the welding surface area.

The following TIME and AMPERAGE RANGE should be followed when welding TUFFSTUDDS® to base materials containing 8 – 13% maximum MANGANESE.

TUFFSTUDD®	Time	Amperage
HCA/I – 58	0.55 – 0.70	550 – 675
TSA/I – 68	0.65 – 0.80	700 – 825
TSA/I – 78	0.85 – 1.10	850 - 1100

FOR OPTIMUM QUALITY RESULTS follow the recommendations of the steel manufacturer for PRE-HEAT OR POST-HEAT.

8 TROUBLE SHOOTING PROBLEMS

BASIC CHECKS FOR PROBLEMS

ITEMS TO CHECK

All things being equal – TUFFSTUDD® alloy and composition has not changed – problems can be attributed to:

Power source
Stud Gun Function
Base Material

Check as follows:

WELDER – USING A VOLT-OHM METER

1) Check AC input to make sure power is on all three phases

2) Check Open Circuit Voltage (OCV)- between Positive –Negative weld cable connectors (output terminals).
SET AMPERAGE TO 100 – SET TIME TO 1.0 SECONDS
Stick Mode (Optional) – 70 Volts DC – Minimum -on contact
Stud Mode - 70 Volts DC – Minimum (when gun triggered in air) – will go from 0 to 70

3) Rheostat (amperage) –turn from stop (minimum) to stop (maximum)
If pointer goes below 0 or above 1800-1850 settings, indicates bad potentiometer
Digital – if settings do not read - indicates PC board failure

GUN

1) Check the plunge action – set up with stud and ferrule – plunge (stud stickout)
should be 1/8" – 1/4". For vertical welding 5/16" 1/4" is best

2) Place gun in welding position against wood block and trigger to prevent arc start.
Is lift and or plunge dragging on return? Adjust accordingly to prevent dragging

3) Lift (checking in welding position) should be 0.09375 (3/32") minimum) to 0.125 (1/8") maximum. Shorter lift (arc length) produces a hotter arc and provides better penetration.

Indicates work hardened base material. Should have used pre-heat and longer arc time when welding. Pre-heat or grinding will help to eliminate cold welds.

WELDING PARAMETERS

TUFFSTUDD® FAILURE ON INSTALLATION

CABLES – do not coil cables when working in short distance – creates resistance – string all cables out in line.
Ground Cable – grind clean spot on work piece to connect ground cable clamp to insure good current flow.

WELDING PARAMETERS – REFER TO "WELDER TRAINING MANUAL"

For VERTICAL (side hand) welding REFER TO "WELDER TRAINING MANUAL"
Based on welder producing amperage/time at settings

WELDING PARAMETERS (cont'd)
Test weld studs in down hand position with the above settings. Check with 3 lb. hammer strikes – NOT 8 LB GRAND SLAM SWING

BASE MATERIAL

1) Is chemistry known – max carbon content should be 0.40 or less

2) Is it magnetic – check with magnet

3) COLD-50°F-(10°C) – heat with rosebud torch to warm up (75°F-100°F / 38°C) and drive out moisture

4) Work hardened – grind clean or pre-heat to 100°F / (38°C) minimum or check steel manufacturers recommendations for welding

5) High hardness steel, High Strength Steel and Abrasion Resistant steel may require pre-heat of up to 400°F / 204°C, to achieve good quality welds. Consult manufacturer's recommendations.

Note; if the above does not produce satisfactory results–contact your TUFFSTUDD® REPRESENTATIVE for further test options to determine source of the problem

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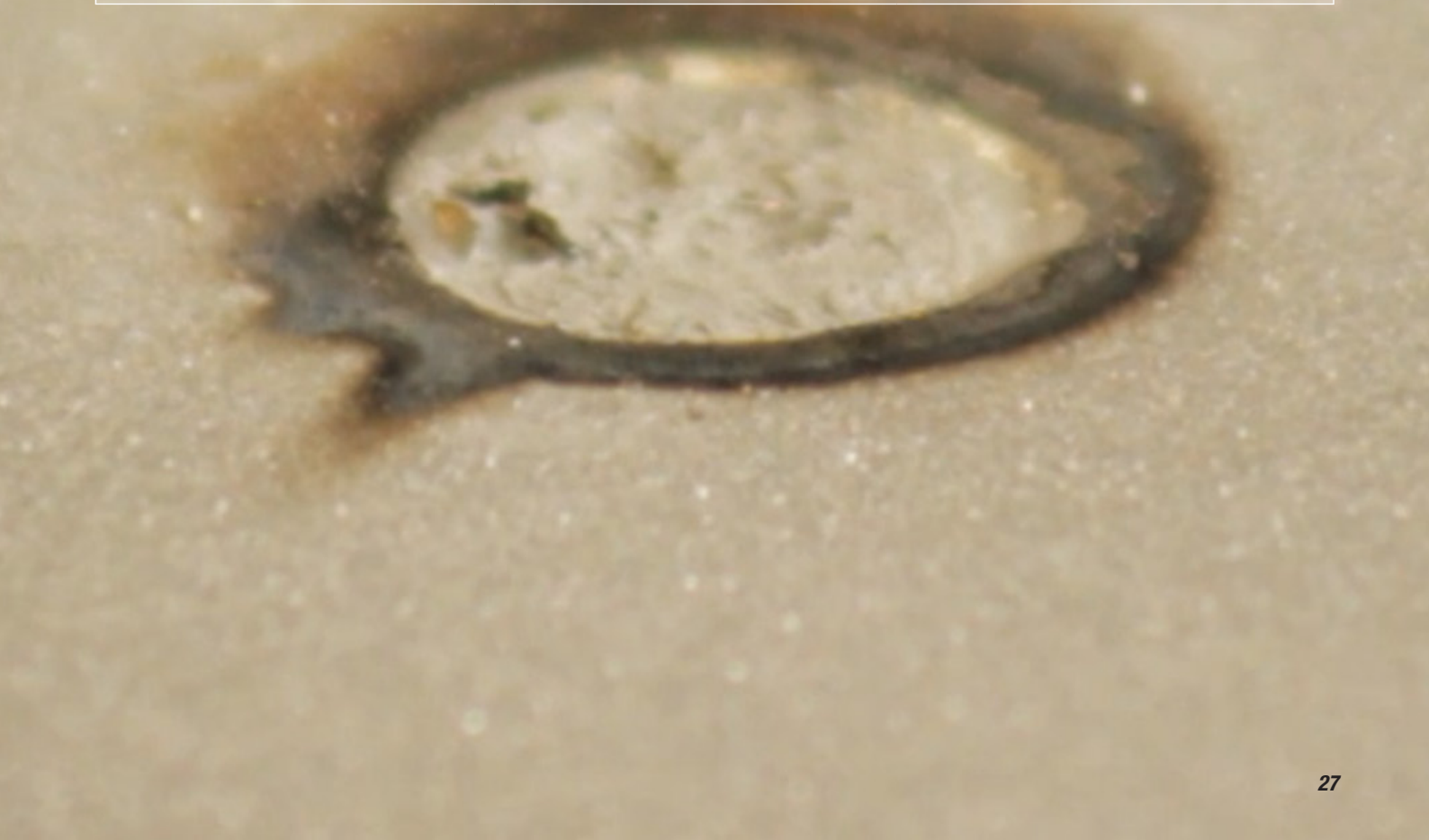
Cold welds- lack of penetration due to insufficient amperage, time or plunge. Surface is dirty – may be work hardened , cold base metal or containing moisture. Preheat to 100°F (38°C) / Grind surface clean.

WELD FAILURES

COLD WELDS

TUFFSTUDD® WELDING PARAMETERS

THE BEST SETTINGS FOR TUFFSTUDDS® WELDING ARE:		
TUFFSTUDD® SIZE	**TIME**	**AMPERAGE**
	(seconds)	DC
HCA-58/HCI-58 (5/8" - 16mm)	**0.60-0.75**	**850 - 1000**
TSA-68/TSI-68 (3/4" - 19mm)	**0.70-0.85**	**1000 - 1150**
TSA-78/TSI-78 (7/8" - 22mm)	**0.70-1.0**	**1200 - 1450**
Downhand Welding - start at mid range - adjust time and amperage separately until best quality welds are achieved		
Vertical Welding - reduce time by 10-20% and increase amperage by 10-20% until 75 - 100% fillets are achieved. **WELD FROM BOTTOM TO TOP**		
STUD GUN SET UP - PLUNGE LENGTH SETTING VERY IMPORTANT Stud stick out through ferrule should be 1/8"(0.125mm) minimum to 1/4" (0.25mm) maximum Adjust by sliding legs in or out from body - center stud in ferrule grip		
QUALITY CONTROL TEST Strike with 3 pound (1.5 Kg) hammer to determine weld quality before doing production welding Studs broken out of weld zone or base material indicate cold welds. Adjust time or amperage untill stud remains firmly in place when struck repeatedly		

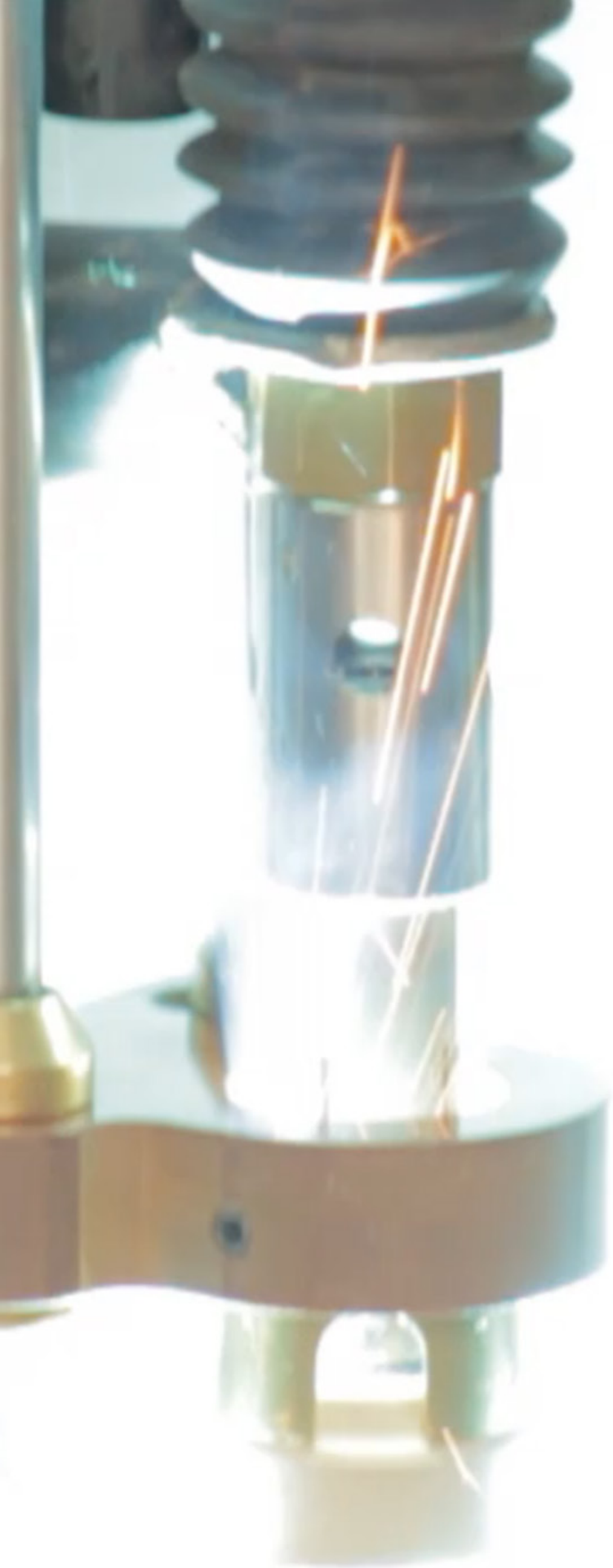


9 EQUIPMENT TROUBLE SHOOTING

ARC-1850 SYSTEM

Whenever possible, have a qualified electrician do the maintenance and troubleshooting work. Tum the input power off using the disconnect switch at the fuse box before working inside the machine.

THE BEST SETTINGS FOR TUFFSTUDDS® WELDING ARE:		
TROUBLE	**POSSIBLE CAUSE**	**WHAT TO DO**
Unit trips off without welding.	I. Defective main SCR. 2. Defective sustaining arc SCR. 3. Defective 600-0012 P.C. board. 4. Defective 600-0010 P.C. board. 5. Shorted control cables.	I. Check for defective SCR and replace. 2. check and replace. 3. Replace. 4. Replace. 5. Repair.
Low output.	1. Input fuse blown. Unit is single phase 2. Incorrect jumper link connection on primary board. 3. Defective 600-0012 P.C. board. 4. Defective 600-0010 P.C. board. 5. Defective current potentiometer.	1. Replace fuse, repair input line. Check for reason for fault.2. 2. Check jumper links on primary board for proper voltage. 3. Replace 4. Replace 5. Replace
Maxrmum output but no control.	1. Defective 600-0012 PC board 2. Open lead going to shunt (shielded cable). 3. Defective current potentiometer.	1. Replace 2. Repair broken leads on connection 3. Replace
Gun does not lift.	I. Blown 5 amp fuse. 2. Defective 600-0010 P.C. board. 3. Defective control cable or gun coil 4. Defective 600-0012 P.C. board. 5. Defective 600-0011 P.C. board . 6. Unit Overheated. 7. Defective thermal switch.	1. Check and replace fuse. 2. Replace. 3. Repair short in cable, replace gun coil. 4. Replace 5. Replace 6. Allow unit to cool/ then reduce weld rate to prevent reoccurrence. 7. Check and replace.
Gun lifts but does not weld.	1.Check connections for ground and weld leads 2. Defective sustaining arc SCR(s). 3. Defective 600-0010 P.C. board. 4. Defective 600-0012 P.C. board 5. Defective choke coil. 6. Open weld cable or bad weld ground connection.	1. Tighten connections – grind spot for ground cable connection 2. Replace bad part(s) 3. Replace 4. Replace 5. Check and replace 6. Check and repair
Gun lifts but does not plunge.	1. Defective 600-0010 PC Board. 2. Defective time potentiometer.	1. Replace 2. Replace
Display inoperative	1. Defective 600-0011 P.C. Board 2. Defective display	1. Replace 2. Replace



SC1900 OPERATIONS - WELDING

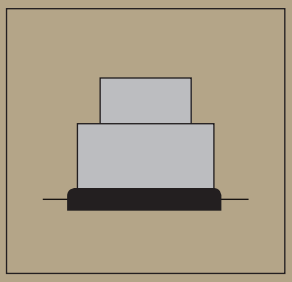
STUD WELDING – HELPFULL HINTS AND SUGGESTIONS

- Keep weld studs and ferrules clean and dry.
- Set the time for the appropriate weld base diameter (see chart on page 19).
- Set the amperage for the appropriate weld base diameter (see chart on page 19).
- Make sure the negative polarity is to the weld stud gun and ensure a good, clean ground connection.
- Align accessories so they are centered and adjust legs so that 3/16" to 1/4" of the stud protrudes beyond the ferrule.
- Make sure work surface is relatively clean so impurities do not affect weld.
- Test the welds at the beginning of each shift or change in stud. Bend two studs 30 degrees
- After cooling (Hammer test)
- Check burn off (1/8" - 3/16"), color (silver blue and shiny), and weld fillet (250 -360 degree) circumference.
- Visually inspect all welds.

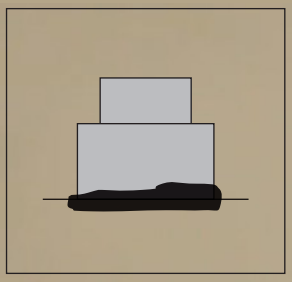
To ensure satisfactory welds, hit a number of studs (3-4 times) with 3 pound (1.4 kg) hammer.

If stud comes out of the base material, leaving a pocket, adjust welding current and/or time to get full fusion quality welds.

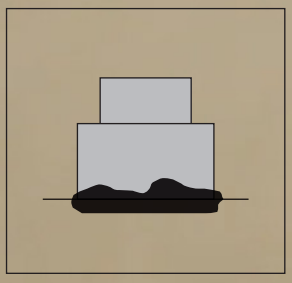
VISUAL WELD INSPECTION AND ADJUSTMENTS



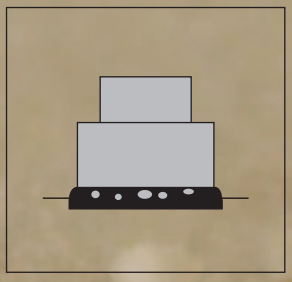
Good Weld
After shooting the stud, break away ferrule and visually inspect the weld. The collar should be smooth and even around the entire stud.



Partial Weld
This is when the collar does not extend around the entire perimeter of the base of the stud. This normally occurs when the weld power is set too low.



Irregular Weld
This is when the collar forms a bumpy or jagged collar around the base of the weld stud. This normally occurs when the weld time is set too high.



Porous Weld Collar
This usually occurs from the oxidation of the weld pool resulting from the weld time being set too long and/or the current being too low. Reduce the current and/or reduce the weld time to correct.

TUFFSTUDDS® SC 1900		
Unit will not turn on.	No power.	1. Test 3 phase power to control contactor. 2. Check taps (if applicable) on main transformer. 3. Check voltage selection plug near control transformer. 4. Check fuse located on control transformer. 5. Look for power available LED on control transformer. 6. Make these checks before contacting a TUFFSTUDD® Rep
Fan does not run when unit is turned on.	This is normal.	The fan will cycle on when the main bridge has reached nominal operating temperature. Ambient temperature of the weld site should also be taken in consideration.
Fan runs continuously (does not cycle on/off}	Thermostat circuit	A fault in the thermostatic circuit will cause the fan to run continuously. Call your TUFFSTUDD® Rep for repairs.
Unit turns on, coil boot test is good, no trigger from weld gun.	Bad connection or faulty equipment.	1. Test control cable by plugging weld tool directly into unit (4 conductor straight through wiring). 2. Check gun trigger resistance (<100 ohms when closed). 3. Check to see if trigger LED on control panel responds. 4. Check to see if weld tool is wired according to one of the three diagrams in Chart A (see page 25). 5. Locate Touch/Trigger Control Board #16002 (Chart B). Check and note the operation of the driver LED's and report the status.
Unit turns on, no coil test, no lift from gun coil, trigger is good.	Bad connection or faulty equipment	1. Test control cable by plugging weld tool directly into unit (4 conductor straight through wiring). 2. Check 10 amp fuse on control board next to breakers 3. Check hand tool coil resistance {12 - 40 ohms). 4. Locate Touch/Trigger Control Board #16001(Chart B}. Check and note the operation of the driver LED's and report the status.
	Bad connection or faulty equipment.	1. Check connections for ground and weld tool leads. 2. Check if contact LED on control panel lights when stud is touched to work surface (closing circuit). 3. Check the two circuit breakers on the control board box. 4. Check to see if you have the sustaining arc (a small blue arc for the duration of the weld time). 5. Check to see if the stud sparks at the end of the weld cycle (hot plunge). 6. Locate Touch/Trigger Control Board #16001(Chart B). Check and note the operation of the driver LED 'sand report the status.
Unit stops welding, Over Temp LED is on.	Over heating.	1. If the fan is running, allow unit to cool. 2. Slow down welding rate (fewer studs per minute). 3. Any fault in the Over Temp Thermostat Circuit will shut the system down.
Weld output erratic or weak.	Adjustments or settings.	1. Check stud gun set up ,lift, plunge, and accessory adjustments. 2. Check All weld current carry leads and connections, Including ground 3. Test the power loop by making welds on a test piece using only the starter cable set. 4. Test 3 phase power to control contactor. 5. Check taps (if applicable) on main transformer.
Weld gun lifts, but does not plunge.	Gun maintenance.	If this happens, it is most likely binding inside of the gun. Perform routine gun maintenance or replace gun if needed.

All tests should be performed by a qualified person.
Always turn off power to the welder before working on or testing components within the welder.

Contact your TUFFSTUDD® Representative for replacement parts and for servicing your welding equipment
Phone: 1-855-629-2012 / 281-894-7864