NELSON STUD WELDING

Nelweld 4000 and 6000

Operations and Service Manual

Manual Version 1.19

June 2008

CE

For Control Board Software Versions 2.09 and higher

NELWELD POWER CONTROL UNIT

LIMITED WARRANTY

Nelson's only warranty is that goods being sold will be free from defects in workmanship and material. This warranty is expressly in lieu of other warranties, expressed or implied and whether statutory or otherwise, including any implied warranty of merchantability or fitness for a particular purpose.

Nelson's liability for breach of warranty shall arise only upon return of the defective goods at Buyer's expense after notice to Nelson of the claimed breach, and shall be limited to furnishing a like quantity of such goods free from such defects or, at Nelson's option, to refunding the purchase price (less reasonable depreciation based on actual use); provided, however, that Nelson will not accept receipt of equipment returned unless buyer has previously afforded Nelson's personnel a reasonable opportunity to inspect and repair said equipment at buyer's facility or such other location as is mutually agreeable. Notice to Nelson must be given within 30 days of such defect or failure and within two (2) years from the date the equipment was delivered or before the welding of one million Nelson studs, whichever occurs first. No compensation or reimbursement for transportation costs of any kind will be allowed.

Please note that this warranty does not extend beyond the original registered purchaser, and does not warrant equipment that has been modified by any party other than Nelson, or equipment that has been improperly installed, improperly operated, or misused based upon industry standards, or equipment which has not had reasonable and necessary maintenance, or equipment which has been used for operation outside of specifications for the equipment. Nelson shall never be liable for consequential damages.

Nelson reserves the right to make engineering and/or part changes, at any time without notice, as a result of our commitment to continuous improvement.

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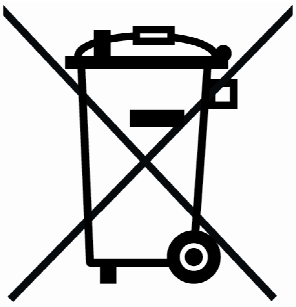

Only for EU countries

Do not dispose of Nelson stud welding units and system components with household waste!

Nelson stud welding units and system components are B2B devices[1] and therefore exclusively designed for commercial use.

We expressly point out that Nelson stud welding units and system components must neither be disposed of with household waste nor at municipal collection points!

In accordance with the European 2002/96/EC directive on waste electrical and electronic equipment and within the scope of this directive's translation into national law, Nelson offers the collection and environmentally-compatible disposal of its units and system components against payment of a fee.

Please contact us!

1.0 SAFETY

Safety depends on you. Nelson stud welding power supplies, studs, and equipment are designed and built with safety in mind. However, your overall safety can be increased with proper installation, use, and thoughtful operation on your part. ***Do not install, operate, or repair this equipment without reading this manual and the safety precautions contained throughout.*** Most importantly, think before you act, and be careful.

1.1 Safety Symbols

This machine is designed with operator safety as the number one priority. Every effort has been made to protect the trained operator from injury. Take responsibility for your own safety - *please read this entire manual before operating the equipment to minimize the risk of injury.*

The safety symbols used in this manual have the following meaning:

This attention symbol indicates potentially dangerous situations. It is always used in connection with one of the additional terms defined below.

WARNING — When "warning" is indicated, death or serious bodily harm or considerable damage to property can occur if the corresponding preventative measures are not taken.

DANGER — When "danger" is indicated, death or serious bodily harm or considerable damage to property will occur if the corresponding preventative measures are not taken.

CAUTION — When "caution" is indicated, important information about the correct method of handling the product or special advice directed to the user, is being indicated to the reader.

i — This attention symbol indicates that important information about the correct method of handling the product or special advice directed to the user is being indicated to the reader.

⚠ WARNING

STUD WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY.

PACEMAKER WEARERS SHOULD CONSULT WITH THEIR PHYSICIANS BEFORE OPERATING STUD WELDING MACHINERY.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974.

BE SURE THAT ONLY QUALIFIED INDIVIDUALS PERFORM ALL INSTALLATION, OPERATION, MAINTENANCE, AND REPAIR PROCEDURES.

1.2 Safety Concerns

Safety should be one of the utmost concerns for each user of a Nelweld unit. Knowledge of and careful attention to all safety advice granted in this manual is highly advised by Nelson Stud Welding, Inc.

Observing all safety warnings and advice is a prerequisite for safe and correct handling and trouble-free operation of the Nelweld series of stud welding power supplies.

1.2.1 Safety Advice

Operating instructions must always be kept at the place the Nelweld unit is used. The ability to quickly consult the manual is highly recommended to all Nelweld users.

Safety signs, stickers, etc. must remain attached to the Nelweld unit at all times. They should remain free from dirt and be kept in legible condition.

1.2.2 Personnel Training

All operating personnel of the Nelweld power supply series must:

- Be instructed in handling welding appliances,
- Have had training and possess authorization to perform stud welding,
- Know and follow the contents of this operations manual.

All electrical repair personnel must:

- Have had training that qualifies them to carry out repairs on the Nelweld unit,
- Be entitled to operate electrical circuits and appliances in accordance with safety engineering standards.

Apprentices, or personnel receiving on-the-job training, must:

- Work with the welding system *only* under the supervision of an experienced specialist,
- Know and follow the contents of this operations manual.

1.2.3 Personal Protection Equipment

Wearing proper protective equipment is a mandatory stipulation for all operating personnel, apprentices, and trainees. This includes the use of:

- Oil-free, protective garments covering the entire body, such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap over your hair (for downhand and vertical welding),
- Welder's protective glasses with a protective filter,
- Helmet, when welding overhead,
- Ear protection is recommended, but not required.
- During welding, exposed metallic parts of the weld gun, such as the stud, chuck, and all parts electrically connected to these parts, are current-carrying. To reduce the risk of accidental electrocution, do not wear conductive jewelry, like rings, watches, or chains.

1.2.4 Protective Measures at the Worksite

The workplace must be of such a nature that people in the vicinity are adequately protected from the harmful effects of optical radiation and generated heat. Space limiters and protective screens must be placed in such a way that the reflection and permeability of any radiation are avoided as much as possible.

Combustible and flammable materials must be removed from the welding zone. A guarantee must be given that a fire extinguisher is on hand on the premise, and within easy reach of the operator. Only weld in areas or rooms where adequate ventilation of weld gases is possible, and where there are no fire, smoke, or explosion hazards. In the event that such a location cannot be used or such conditions cannot be avoided, consult an authorized welding supervisor or fire safety officer *prior to* welding.

Ensure that the workspace is adequately lit.

As a result of the weld process, strong electromagnetic fields are present during the weld cycle. These electromagnetic fields can be dangerous without proper considerations, and can:

- Interfere with any cardiac pacemakers, resulting in a life-threatening situation for pacemaker wearers,
- Damage or hamper the use of both electrical lines and electronic appliances,
- Irrevocably erase magnetic data carriers (computer memory),
- Magnetize and damage watches or similar digital devices.

While the strongest electromagnetic fields are present around the Nelweld power supply, fields also emanate from the welding cables. Proper precautions should be taken near the cables as well.

Both the work and ground welding cables should be laid out in as straight a manner as possible, and with sufficient clearance from other electrical equipment. This is particularly applicable when welding on building sites and on special installations. If in doubt, consult the respective equipment manufacturers.

It is the operator's obligation to ensure that the worksite is in accordance with the standards set forth in this manual.

1.2.5 Safety on the Job

Before every work shift, check:

- The correct application of all protective equipment,
- All system components for damage,
- All connecting cables for loose contacts and/or scorching.

During normal operation:

- Only use the welding system when it is in a technically perfect condition,
- Refrain from any manner of working that is not safe.

⚠ WARNING

During the welding process, certain exposed parts of the weld gun, such as the stud, chuck, and all parts electrically connected to them are current carrying.

Do not touch these parts during the welding cycle!

Wear no electrically conductive jewelry while welding, such as rings, watches, or chains.

Welding units of this output class can cause radio interference in residential and commercial areas.

After every work shift:

- Switch the welding unit off and remove the main power plug,
- Secure and label the welding unit to prevent unauthorized use,
- Ensure that the stipulated maintenance intervals are observed, as seen in Section 5.3.

In case of *malfunction*:

- Switch the welding unit off and remove the main plug.
- Secure and label the welding unit to prevent unauthorized restart,
- After repair, the operability of the welding power supply must be guaranteed.

⚠ WARNING

Only a *qualified* electrician should perform any work inside the unit's casing. Any work done should be made in accordance with all local and national electrical codes.

Failure to do so may result in bodily injury or death.

1.2.6 Electrical Danger

When working with any electrical device, it is a good idea to ensure that a safe working environment is present at all times. Such a safe environment is not present when:

- In confined spaces with electrically conductive walls,
- The work area/room is wet, damp, extremely dry, or hot,
- Freedom of movement on electrically conductive parts is restricted (i.e. metallic ladders, scaffolding, mounting rails, floor plates),
- Working conditions entail being in a confined space between or on electrically conductive parts.

Under these working conditions, the following protective measures must be taken:

- The welder must be adequately protected against electrical dangers by using insulating underlay or intermediary layers,
- Any insulating materials used must be applied in such a way that touching conductive parts, damp walls, and damp flooring is eliminated,
- If the use of insulating materials is not possible due to an increase in danger, such as risk of falling or special room conditions, work must at least be done in dry, undamaged working clothes.

1.3 Intended Use

The relevant standards and accident prevention regulations were taken into account when developing the Nelweld series of stud welding power supplies. The welding unit was built according to the latest technological developments and is operationally reliable.

Despite this, dangers can originate from a Nelweld power supply if it is operated by untrained people or not used as intended.

- The Nelweld stud welding power supply line is designed to accommodate welding in both the Electric Arc and Short Cycle welding processes.
- The specifications in this operations manual, with regard to safe welding, testing, and qualification practices, must be observed.
- Care should be used when operating a Nelweld power supply in residential or commercial areas, as damage to external electrical and electronic devices may be caused by electromagnetic interference generated by the welding arc.
- Nelweld units may only be configured with those unit components that are specified throughout this operations manual, or by a Nelson customer service or technical representative. Configuration with components manufactured or distributed by other manufacturers, or other arbitrary structural alterations to the system, are not allowed.
- The welding unit may only be operated with spare parts and accessories specified in this operations manual or by a Nelson technical representative.
- The specified maintenance and inspection routines, as well as replacing worn components, have to be implicitly observed.
- Nelweld units must never be used to attempt pipe thawing.

Furthermore, the observance of general and particular safety advice throughout this operations manual, as well as relevant accident prevention regulations, falls under intended use.

Usage exceeding the limits set forth in this manual are inadmissible and possibly dangerous. The manufacturer is not liable for damage resulting hereof; the operator alone bears the risk.

1.4 Guarantee and Liability

Guarantee and liability claims in cases of physical injury and property damage are excluded if they are due to one or more of the specified reasons below:

- Non-intended use of the Nelweld welding unit,
- Non-compliance with the operating instructions of the Nelweld unit.

- Non-compliance with the operating instructions for the system components.
- Improper startup, operation, and maintenance of the system.
- Use of the welding system in residential and commercial areas.
- Improper handling of the shielding gas or related accessories.
- Use in damp, flammable, and potentially dangerous surroundings.
- Startup in cases of improperly mounted or implemented protective devices or repair work.
- Startup by improperly trained personnel, unsupervised trainee(s), or unqualified personnel.
- Arbitrary structural alterations to the system.
- Non-compliance with the stipulated maintenance intervals.

1.5 Copyright

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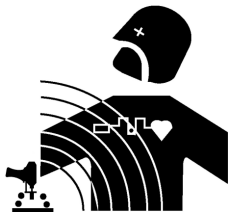
⚠ DANGER

ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS

- Electric current flowing through any current conducting material causes localized Electric and Magnetic Fields (EMF). Welding causes EMF around welding cables and welding machines.
- EMF may interfere with some pacemakers. Welders having a pacemaker should consult his or her physician before welding.
- Exposure to EMF generated while welding may have other additional health risks. These effects are currently unknown, but are under investigation.
- All welders should use the following procedures in order to minimize exposure to EMF from the welding circuit:
  - Route the gun and ground cables together and secure them together with tape, when possible.
  - Never coil the gun cable around your body.
  - Do not place your body between the gun and ground cables. If the gun is on your right side, the ground cable should also be on your right side.
  - Connect the ground cable to the workpiece as close as possible to the area being welded.
  - Do not work next to the welding power source. Maintain at least 3 feet between you and the welding power source.

ARC RAYS CAN BURN

- Use a face/eye shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Faceshield and filter lenses should conform to ANSI Z87. I standards.
- Use suitable clothing made from durable flame-resistant material to protect you. Any assistants should dress to the same standard as the primary welder.
- Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc or expose themselves to the arc rays, hot spatter or newly welded metal.



WELDING SPARKS CAN CAUSE FIRE OR EXPLOSION

- Have a fire extinguisher readily available.
- Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines.
- Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap over your hair. Always wear safety glasses with side shields when in a welding area.

ELECTRIC SHOCK CAN KILL

- The gun and ground circuits are electrically live, or "hot," when the welder is powered and the gun trigger is pressed. Do not touch these "hot" parts with your bare skin or wet clothing.
- Wear dry, hole-free gloves to insulate hands. Insulate yourself from work and ground circuits using dry insulation. Make certain the insulation is large enough to cover the full area of physical contact between you and the work and ground circuits.
- Ground the workpiece to be welded to a good electrical (earth) ground using the ground cable.
- Always be sure the ground cable maintains a solid electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.
- Maintain the welding gun(s), work clamps, welding cables, and welding machine so that they are in good, safe operating condition. Replace any damaged insulation.

2.0 INTRODUCTION TO STUD WELDING

2.1 Processes

There are two main stud welding processes that can be accomplished by the Nelweld series of power supplies:

- Drawn Arc (Electric Arc)
- Short Cycle/Gas Arc

Each process is a bit different, and is intended for different applications. Thus, it is important to choose the correct process for your needs.

2.2 Principles of the Drawn Arc (Electric Arc) Welding Process

Electric Arc stud welding involves the same electrical, mechanical, and metallurgical principles as any other arc welding process. In stud welding, the power source and stud welding control system are set to control the amperage flow (current) and the duration (time) of arcing. The weld gun has a trigger circuit to initiate the weld and a lifting mechanism to draw the stud *away* from the base material and initiate the welding arc. The gun accessories include a chuck to hold the stud and a ferrule grip to hold the ceramic ferrule, which is also called an arc shield.

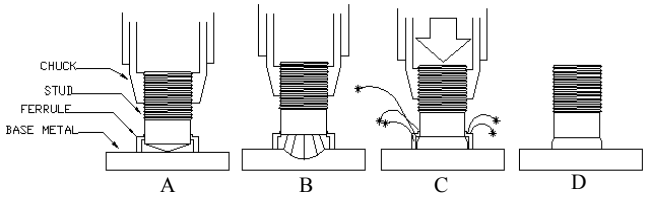


Figure 2-1: Stud welding sequence of operations

The sequence of operations to make a stud weld are as follows:

- A stud and ferrule are loaded into the chuck and grip.
- The gun is positioned against the base material taking up the *plunge*, or stud length available for burn off against the gun spring pressure. (Step A)
- The trigger is then depressed to start the fully controlled automatic sequence. This sequence consists of initiating the weld current, lifting the stud to create an arc by energizing the gun solenoid (Step B), timing out the weld time, plunging the stud by de-energizing the gun solenoid (Step C), and turning off the weld current at the end of the weld cycle. (Step D)

The fasteners for electric arc stud welding have a special shape and flux on the end of the stud that is to be welded. This flux initiates, improves starting, and stabilizes the welding arc, and deoxidizes the molten weld metal for a sound, void free weld zone producing a full penetration weld which is strong enough to develop the full stud strength.

The ceramic ferrule confines the weld arc and heat to a specific area of the base material and holds the molten metal in place to provide the uniform weld flash. The term flash is used instead of fillet since the weld zone is made up of a mixture of material melted from the end of the stud and from the base plate material rather than from a filler material as is used in other welding processes.

2.3 Principles of the Short Cycle/Gas Arc Welding Process

In the Short Cycle stud welding process, a welding power source provides a continuous welding current. Both welding current and time are important factors when welding using the Short Cycle process, as in the Electric Arc process. Typically, the welding time varies from 10-100 milliseconds (0.01 – 0.1 seconds), and the current varies from 300 to 1800A, depending on the size of the stud. Shielding gas may be used as a welding aid in place of ceramic ferrules.

The welding cycle proceeds in a manner that is very similar to the Electric Arc process. However, unlike the Electric Arc process, the studs used do not have a flux load in the tip of the stud. The speed of the process renders a flux load obsolete.

Rather, the studs have a machined, slightly tapered point through which the welding current passes.

The weld pocket that is formed during Short Cycle welding is not very deep, making it ideal for welding to thin base materials.

Additionally, since the process can utilize shielding gases, it is suitable for welding a wider variety of metals, and attaching studs of greater diameter. The use of a shielding gas during the Short Cycle welding process defines the Gas Arc welding process. The gas provides an inert atmosphere in which highly reactive metals can be welded safely.

Examples of the applications covered by both Short Cycle and Gas Arc welding include welding aluminum; copper, nickel, or chrome-plated material; stainless steel; magnesium; and even titanium.

2.4 Stud Welding Equipment

Stud welding was developed and has been in continuous use for over 60 years. During that time there have been many improvements in the equipment used in the process, but the principles remain the same. D.C. power is passed from a stud welding control system that is set to provide the time and current necessary to weld the stud, and the lifting of the gun.

In past years, the power was supplied by power sources separated from the control system such as motor generators, transformer rectifiers or battery banks.

The evolution in the stud welding industry in recent years has been from mechanical to solid state welding equipment with closed loop controls. Incorporation of solid-state electronics into stud welding units has facilitated:

- Verification to measure both the weld time and current
- Compensation for weld cable or other resistance changes in the weld circuit.
- Compensation for incoming power fluctuations
- System shutdown in case of variation from the established weld parameters.

These features have contributed greatly to simplified weld set up and increased weld quality of current stud welding power supplies.

In another example, the change in the welding gun plunge dampener from a potentially erratic pneumatic weld plunge dampener to a very reliable, self contained, sealed hydraulic plunge dampener control has been another significant contribution to weld quality.

2.5 Stud Materials

Stud materials and base materials must be compatible with the stud welding process. Suppliers of both materials can provide physical and chemical certification on the products they supply and these should be requested when orders are placed, if needed.

Studs of all styles are available in low carbon steel and various stainless steel grades. Most commonly, Mild Steel Grades 1010 through 1020 and 18-8 Stainless Steel are used as stud materials.

2.6 Stud Welding Setup Parameters

Full strength stud welding results can be obtained by understanding the following settings or adjustments, and how they relate to weld quality.

- *Plunge* is the amount of stud that protrudes beyond the ferrule. This portion of the stud length is available to be “burned off”, or melted, to develop the weld flash. Long or excessive plunge may cause excessive splatter and high or uneven fillet formation. Plunge is a physical measurement set and measured with the stud and ceramic ferrule in place on the stud gun.
- *Lift* is the distance the gun pulls the stud away from the base material. Lift is essential to the stud weld process since is creates an air gap which the current must bridge. The current flow across the resistance of this gap creates the heat to melt the stud and base material.

If no gap exists, the current will not create sufficient heat to melt the metal. Short lift may allow molten metal to bridge the arc-gap, resulting in cold welds. Excessively long lift increases the chance of having arc blow and welds that are bonded on only one side of the fillet. Lift is set on the stud gun and is measured physically when the weld cycle is initiated. Note that this should be set and measured by placing the stud and ferrule on a non-conductive surface and initiating the weld cycle so that an actual molten weld is not made while lift is being measured.

- *Time* is the normal duration of the weld. On thin base material, shorter than normal time and higher amperage can be used to achieve sufficient heat, and still prevent melting through the base material.

  On some base materials, longer times and reduced amperage improves the ductility of the weld zone.

- *Amperage* is the current from the power source that flows through the weld arc. Increasing the amperage increases the weld heat. As with the time setting, a higher amperage setting is needed for larger stud sizes. Amperage is set on the stud welding control system current setting indicator.

- *Alignment* is centering the stud in the ceramic ferrule so that the stud does not contact the ceramic ferrule during the lift and plunge, which may cause friction or binding between the stud and ferrule. Binding can slow the stud plunge so that there is less than full penetration of the stud into the molten weld pool resulting in less than full weld strength.

Electric Arc Stud Welding Setups for Mild and Stainless Steel Studs Welded and Base Materials

Diameter		Area	Downhand Welding				Overhead Welding				Vertical Welding			
(in)	(mm)	(in^2)	Amp	Sec	Lift	Plunge	Amp	Sec	Lift	Plunge	Amp	Sec	Lift	Plunge
3/16	4.8	0.0276	300	0.15	0.062	0.093	300	0.15	0.062	0.125	300	0.15	0.062	0.125
1/4	6.4	0.0491	450	0.20	0.062	0.093	450	0.17	0.062	0.125	450	0.17	0.062	0.125
5/16	7.9	0.0767	550	0.25	0.062	0.125	500	0.25	0.062	0.125	500	0.25	0.062	0.125
3/8	9.5	0.1105	650	0.35	0.062	0.125	550	0.33	0.062	0.125	600	0.33	0.062	0.125
7/16	11.1	0.1503	700	0.45	0.062	0.125	675	0.42	0.062	0.125	750	0.33	0.062	0.125
1/2	12.7	0.1964	850	0.55	0.062	0.125	800	0.55	0.062	0.125	875	0.47	0.062	0.125
5/8	15.9	0.3068	1200	0.70	0.062	0.187	1200	0.67	0.093	0.187	1275	0.60	0.062	0.187
3/4	19.1	0.4418	1500	0.90	0.093	0.187	1500	0.84	0.093	0.187	1700	0.73	0.093	0.187
7/8	22.2	0.6013	1750	1.10	0.125	0.250	1700	1.00	0.125	0.250	Not Recommended			
1	25.4	0.7854	2000	1.40	0.125	0.250	2050	1.40	0.125	0.250	Not Recommended			

Short Cycle Welding Setups for Mild and Stainless Steel Studs and Base Materials

Diameter		Area	All welding positions			
in	mm	(in^2)	Amp	Sec	Lift	Plunge
0.156	4	0.019	400	0.060	0.040	0.062
0.198	5	0.031	500	0.070	0.050	0.062
0.237	6	0.044	600	0.080	0.050	0.062
0.276	7	0.060	650	0.090	0.062	0.062
0.315	8	0.078	700	0.100	0.062	0.080
0.354	9	0.098	800	0.120	0.062	0.100
0.394	10	0.122	900	0.150	0.070	0.100
0.471	12	0.174	1100	0.180	0.080	0.120

The *Weld Settings* table specifies the recommended weld settings. It should be noted that these settings are only *suggested* starting points for obtaining a final set up which is then *verified* by visual inspection, after weld measurement and physical testing. Other factors such as grounding of the welding system, base plate composition, ambient temperature, cable connections, etc. can influence the weld settings.

Stud manufacturers are required to qualify their studs' weld base diameters by tests with currents at plus or minus 10% from optimum (except in the case of 7/8"and 1" diameters which are plus or minus 5%), an indication of the variability that can occur under actual welding conditions. This quantification helps ensure that the settings listed above are a good starting point for most welding applications.

2.7 Stud Welding Practice

2.7.1 General Guidelines

In stud welding as in other welding and fabricating methods, there are some general guidelines to consider when determining the basics of good practice. Among these are:

Weld Plate Thickness: A plate thickness that is at least 1/3 of the stud shank diameter will develop the full steel tensile and shear capacity of the stud. The weld base plate will, however, undergo distortion and bending in many cases, leading to a change in the stud diameter/plate thickness ratio, when high loads are applied which are not satisfactory in many cases.

Weld Plate Cleanliness: The most applicable rule is that the area where the stud is to be welded (weld spot) should be as clean as possible to eliminate welding problems. The spot where the ground clamp(s) are to be fastened should also be cleaned on both sides of the plate so a good current path is established. Normally, a light rust or light mill scale is not detrimental. Heavy mill scale or heavy, flaky rust should be removed as should any deleterious coating such as heavy oil, paint, galvanizing, grease, moisture etc. While zinc galvanizing is electrically conductive, studs should not be welded to a galvanized plate. Zinc is a weld contaminant and will cause brittle welds. Weld and ground spots can be cleaned very quickly by spot grinding with an abrasive wheel, wire brush or wheel, drill bur, end mill, or other similar device. It should be noted that solid grinding wheels or abrasive discs do not remove zinc plating very well, but usually just result in the grinding disc or wheel filling with zinc and then merely spreading the zinc plating around making the weld spot look shiny and clean but allowing enough zinc to remain in the weld area to still cause welding problems. Use of open pore abrasive disc or a grinding wheel is preferable when removing galvanizing.

Galvanizing: Galvanizing should be done after the base plate has been stud welded. If galvanizing is done prior to welding, the effects of hydrogen embrittlement should be considered when hot dip galvanizing is used. Hydrogen embrittlement can have several points of origin that can cause serious brittleness in the weld or in the stud shank when studs are bent with a very tight bend diameter.

Other causes are improper pickling of the finished weld plate either by pickling too long or not rinsing thoroughly after pickling, plating too long or at too high a temperature. It can also occur when the stud is very high strength in comparison with the base plate material strength.

Edge Distance: Studs welded near an edge should be placed no closer to a free edge of a base plate than the diameter of the stud plus 1/8" to the edge of the stud base. This distance should preferably be not less than 1" to 1-1/2 " from a free edge or edges. Special ferrules should be used in situations where studs are welded closer than this requirement or on the edge of a plate or bar.

Grounding/Arc Blow: Edge distance (above) and ground placement can influence weld quality due to arc blow. That is, the welding arc is electromagnetically deflected away from the grounding point or toward the larger mass of the base plate configuration being welded.

Figure 2-2 shows typical ground and edge effect patterns due to arc blow. These effects are less noticeable where large masses of steel are present such as in large beams, but relatively small embedment plates can present difficulties. Typically, there is a lack of weld fillet on the periphery of the stud opposite the arc blow direction that can adversely affect weld strength and quality.

For example, a welding platen table may be grounded at all 4 corners by 4 separate ground cables bolted to the table and joined to the welding system single ground wire by a bolted connection. This in essence turns the entire platen into a grounded mass and arc blow on a small plate set onto the table is minimized. On longer, rectangular plates a double ground (one at each end on opposite edges of the plate provides a good current flow pattern.

i The ground connection does not have to be a screw type "C" clamp, but can be fast action spring clamps or lever action hold down clamps mounted to the welding table and connected to the stud welding system ground cable(s).

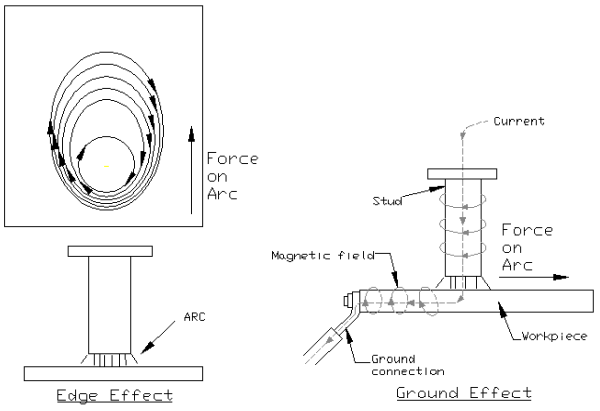
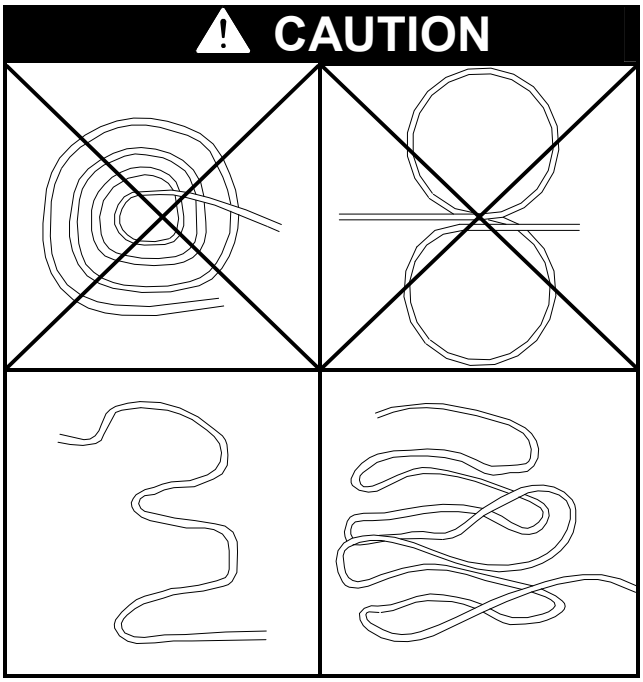


Figure 2-2: Effect of (A) welding near an edge, and (B) ground connection on the distortion of magnetic field.

Frequently, a copper or steel plate larger than the base plate to be welded with a center ground bolted to the bottom will eliminate or minimize arc blow effects. If a welding platen, table, or surface is used for this purpose, it should be kept clean by removing weld splatter, weld berries and ferrule pieces so that the surface contacts the weld plate cleanly and evenly to assure good electrical contact and current flow. It may take some time and trials to establish a good a current flow path for your typical base plate configuration, but the end result is a significant increase in weld quality and consistency and lower rejections and repair costs.

Weld Cables: It is *not* recommended to leave combination or ground cables in a circular or coiled fashion during unit operation. Failure to place cables as recommended below may result in poor weld quality and the development of dangerous electromagnetic fields.



Ceramic Ferrules: These are also termed ceramic arc shields. Ferrules serve several functions.

- Contain the pool of molten metal and form it into the fillet (flash) formed around the stud periphery.
- Control to a great extent the amount of arc brightness seen and the quantity of sparks expelled during the weld.
- They are designed with specific vent patterns so that when the arc is initiated, the flux in the end of the stud is consumed and deoxidizes the weld zone. Weld gasses are expelled through the vents, thus preventing oxygen from entering the weld area.
- Style variations allow welds in many positions and to plate edges, corners, etc.

It is important to keep the ferrules dry. If they absorb a great deal of moisture, heat from the weld instantly turns the moisture into steam, which may cause the ferrule to shatter. If the ferrule shatters, molten metal will be forcefully ejected from the weld zone, leading to dangerous situation for the operator. A very porous and weak weld would then result.

Ferrule cartons are marked with a warning that they contain silica, a possible health hazard. Since the ferrules are made from "green" fireclay ceramic with binders, and fired at high temperature, there is no free silica material at inhalable sizes released during the weld. If simply broken free of the weld, they are basically an inert, inorganic material, such as fired aggregate or rock, and may be disposed of easily and safely. It would take an extensive amount of ferrule breakage or grinding to produce sufficient loose powder to reach any inhalable level dangerous to the stud welding operator or those nearby.

Position Welding: Studs of all weld base configurations and diameters from minimum to maximum available can be easily welded in the downhand position. As a general rule, studs up to and including 3/4" diameter can be welded to the weld plate vertical position with consistent, full strength results. Special ceramic ferrules are used with studs 5/8" and above when welding to the plate vertical position. There is a special ceramic ferrule for welding 7/8" diameter studs in the vertical position, but welding this diameter stud requires very carefully controlled conditions. Studs larger than 7/8" cannot be welded in the vertical position.

Welding overhead can also be done with all stud diameters. Naturally, the overhead position causes an increased amount of welding sparks to fall during welding and suitable operator protection is needed. There are spark retention accessories available from Nelson Stud Welding, Inc.

Ceramic ferrules are also available in a wide variety of configurations, including but not limited to, welding studs to round or rectangular tubing and bars, plate or bar edges, channels, and struts.

Welding Stainless Steel Studs to Carbon Steel Base Plates: Full strength welds are made when standard carbon steel studs are welded to either approved stainless steel base or carbon steel plate materials. Similarly, welds made with stainless steel studs to stainless steel or carbon steel base plate materials develop full stud steel capacity in tension or shear. However, in cases where stainless steel studs are welded to carbon steel plates, and are to be subject to repetitive or cyclic loads, stress corrosion failure in the weld can occur.

It is good practice to specify that the stainless studs to be used in such conditions are either annealed after manufacture or made from annealed-in-process stainless steel with a hardness less than 90 on the Rockwell B scale, in the finished condition. This minimizes the chance of weld failures.

Stud Welding In Adverse Weather Conditions: Studs should not be welded when the base plate temperature is below 0º F (-18º C), or when the surface of the base plate is wet, frost covered, or exposed to falling rain or snow. Additionally, it is not recommended to use stud welding equipment in environments where falling rain or snow, or standing water are present.

A brittle failure by impact testing at low temperatures in the weld or in the base metal is quite common. Tension and shear tests done at temperatures below -40º F (-40º C) on studs welded at that temperature showed no loss in strength of the stud weld. It is the impact testing that causes weld failure. Whenever possible welding and testing studs at low temperature welding should be avoided.

2.7.2 Material Selection and Verification

Studs are made from steel supplied to the Nelson Stud Welding, Inc. by quality, approved steel suppliers. Quality assurance procedures established at the manufacturing facility require that the steel supplier provide certified mill test

reports (CMTR) for each heat and diameter of steel supplied. These mill test reports certify compliance to welding code specified material grades and chemistry, and are available from the stud manufacturer as part of their certification package on every shipment of studs made when requested at the time of purchase.

At the time of manufacture, studs are also tested to determine that their mechanical properties are in compliance with welding code requirements. A certificate of compliance (COC) for each stud shipment can be made at the time of shipment, certifying chemical and physical property compliance to customer or engineering specifications sent with the stud purchase order.

COC's can certify compliance with steel specifications, such as:

- ASTM – A108
- ASTM – A276
- AWS D1.1, Structural Welding Code – Steel
- AWS D1.6, Structural Welding Code – Stainless Steel
- Canadian Welding Bureau W59 – Welded Steel Construction
- International Standards Organization ISO –13918 Welding Studs and Ceramic Ferrules for Arc Stud Welding, etc.

Similarly, the weld plate fabricator should require certified mill test reports from its vendors on steel purchased for use as base materials in its welding operations to verify compliance to welding code approved materials. *Stud manufacturers are required by welding codes to weld test and qualify their weld base diameters and materials.*

Along with the stud certificates of compliance and material certified test reports for both studs and weld plates, the stud weld base qualifications should be kept on file at the weld plate fabricators location to verify compliance with quality programs and welding codes.

2.7.3 Operator Training and Qualification

Operator Training: Introductory training of operators in the stud welding process is the first step in successful production stud welding. This familiarizes the operators with the general principles of the process, proper set up of the equipment, weld set up for the studs being used, general guidelines and inspection techniques. Highly skilled representatives of Nelson Stud Welding, Inc. can provide both written and visual materials as part of a complete program concluding in formal qualification of both the operators and the stud welding process.

Process Qualification: Stud welding is a prequalified process, unique among the many welding processes due to the many millions of studs that have been successfully welded with the process.

i When studs are welded in the downhand position to approved base plate materials, only two (2) studs are required to be welded and tested. The test consists of both a visual inspection and a physical inspection by bending the studs 30º from the vertical position by hammering on the unwelded end or bending with a pipe or other bending device.

If the bend test and visual inspection are both satisfactory, both the process and the operator are considered qualified for those stud diameters welded downhand as long as there are no process changes. Such changes include those made in the studs, settings, equipment, welding cables, ceramic ferrules, or from an approved to a non-approved base material qualified by the test. The two-stud test is required at the start of *every production period* such a shift change or operator change, and if any process changes are made.

Stud Qualification Testing

Welding Procedure	No. of Studs to be Tested
• Downhand, standard welding configuration • To approved base plate	2
• Special welding position • Welding through metal deck • To non-approved base plate material	10

Studs welded to a non-approved base plate material, in the vertical or overhead position, to the fillet or heel of an angle, etc., must be application qualification approved by welding ten (10) of each of the stud styles and diameters to be used in production in the position(s) and base materials to be used in production with the same

equipment, settings, welding cables and ceramic ferrules to be used in production welding.

All ten studs of each diameter and position to be qualified must be tensile and/or bend and/or torque tested to failure. They must also meet visual inspection requirements. Failure must be in the stud shank or in the base plate material, not in the weld for all studs tested.

Note that *failure is allowed in the base plate material,* given certain conditions. This provision is acceptable when it is known that the base plate material may be of a composition, strength or thickness that will not fully develop the strength of the stud weld, but the strength and weld results are acceptable for the end use intended. *Such a failure is not acceptable in the case of embedment plates used for structural connections or for attachments requiring full strength and ductility.* The successful completion of the application qualification tests qualifies both the operator and the process.

Documentation of the qualification of the operator and the stud welding process should be part of the overall records of the plate fabrication facility. This can be done by first establishing a Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) for the stud diameters, equipment, settings, cable lengths, welding positions, weld plate materials and ceramic ferrules that are to be used in the welding operation.

Once the welding procedure specifications are completed and documented, the operators trained in stud welding should be tested. They should set up and do the stud welding using the WPS guidelines, seen in the *Stud Qualification Testing* chart. The welds are then visually inspected, tested, and certified by the welding supervisor or welding trainer, and the operator is certified by name using the same form as a Welder Qualification Record (WQR).

These records should be retained, along with material certifications and production inspection records, as part of the documentation files for review by customers, the engineer of record, quality certification agencies, or other interested parties.

2.7.4 Visual Weld Inspection

A proper relationship between the Lift, Plunge, Time, and Amperage is needed to obtain good weld results. The length reduction or burn-off and the weld fillet appearance are determined by the weld settings. Visual weld inspection consists of interpreting the appearance of the weld flash, and is normally very accurate if certain guidelines are followed.

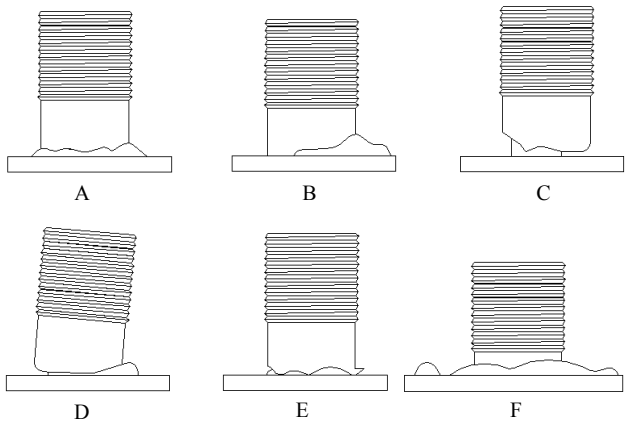


Figure 2-3: Visual Weld Quality

A Satisfactory weld with good flash formation
B Stud in which plunge is too short
C Hang-up during plunge – possible ferrule/stud binding
D Poor vertical alignment
E Stud weld made with insufficient heat
F Stud weld made with excessive heat

A *good weld* is characterized by:

- Even flash formation.
- A shiny, bluish hue to the flash surface.
- A slight flow or bend of flash metal into the base material.
- Good flash height.
- Consistent after-weld length.
- Full “wetting” – flash around the stud periphery

A *cold weld,* which requires more time and/or amperage, is indicated by:

- Low flash height.
- Incomplete flash formation.
- A dull gray cast to the flash surface.
- Stringers of flash metal forming "spider legs."

A *hot weld* made with too much time and/or amperage is distinguished by:

- Excessive splatter.
- A washed-out flash.
- Undercutting of the stud.

- Burn through the base material.

In most arc welding processes the weld fillet metal comes from the addition of filler metal from a stick electrode or a spool of welding wire. In stud welding a portion of the stud itself is the source of the weld metal. The length of the stud that is melted to develop the flash is called *burn-off*, and is defined as the difference in length between a welded stud and its original length.

The length reduction or burn-off is a very good gauge of weld quality, since the burn-off is determined by the weld settings of time, current, lift, and plunge. Proper burn-off also indicates that there was no bind or hang-up during the plunge motion of the gun.

i The most convenient method of checking burn-off is to stand an unwelded stud upside down (load end up) next to a welded stud to compare the length difference. After weld height can also be checked with a sliding carpenter's level/square tool. The *Stud Burnoff Length* table shows typical burn-off length reductions when welding to bare plate of sufficient thickness.

Stud Burn-Off Lengths
(not including flux load)

Stud Diameter	Length Reduction
3/16" through 1/2" (5mm through 12mm)	1/8" (3mm)
5/8" through 7/8" (16mm through 22mm)	3/16" (5mm)
1" and over (25mm and over)	1/4" (6mm)

2.7.5 Physical Weld Inspection

Two studs should be welded according to qualified settings during pre-production testing. Following satisfactory visual inspection, they are bent 30º or torque tested in the case of threaded studs. This procedure should also be followed if there is any change of operator or any change in equipment, position, settings, etc. Studs that are bent may be straightened to the original axis. *Studs should not be heated during bending or straightening without approval by the Engineer of Record*. Torque testing is done to a proof load level slightly lower than the nominal yield of the stud so there is no permanent distortion of the threads. Torque test proof load requirements are found in AWS D1.1, D1.5, or D1.6. The test studs may be used in production.

The stud welding operator is responsible for pre-production set up and testing. The operator shall weld two studs to a production weld plate or to a piece of material similar to the weld plate in material composition and within 25% of the production weld plate thickness.

Inspections during production are also the responsibility of the operator. Pre-production and production inspection test results should be recorded and approved by the welding supervisor. Any unsatisfactory pre-production and/or production inspections and tests should be brought to the welding supervisor's attention and corrections made, accompanied by additional tests with fully satisfactory inspection and test results before proceeding with further welding.

At regular intervals during production welding, the studs welded after the last testing interval should have the ceramic ferrules removed and should be visually inspected. If the visual inspection shows a full periphery weld flash, without undercut, and satisfactory after weld length, welding may continue. If the visual inspection shows a lack of flash or insufficient weld burn off, the questionable studs should be marked and appropriate supervisory personnel notified.

Minimum Weld Flash Size

Stud Diameter	Weld Flash Size
3/16" through 7/16" (5mm through 11mm)	3/16" (5mm)
1/2" (12mm)	1/4" (6mm)
5/8" through 7/8" (16mm through 22mm)	5/16" (8mm)
1" and over (25mm and over)	3/8" (10mm)

In accordance with codes, contract documents or quality assurance inspection criteria, studs without a full peripheral flash, but with a satisfactory after weld length may be bent 15º in the direction opposite the lack of flash, or

repaired with a hand weld by adding a minimum fillet weld as required in the *Weld Flash Size* table. The repair weld shall extend at least 3/8" beyond each end of the discontinuities being repaired.

If any of the studs bend tested fail the test or if there is continued and frequent evidence of insufficient stud burn off, production must be halted and appropriate supervisory personnel notified. The welding variables should be checked, the necessary adjustments made and the process and operator qualification procedures repeated with satisfactory results before welding continues.

2.8 Closing Comments

Over one hundred million studs of all types are welded throughout the world each year. Stud welding is a long recognized and practiced welding method.

If the method is employed properly using suitable equipment and qualified settings with trained operating personnel, approved studs and base plate materials and appropriate quality assurance and inspection procedures, it is reasonable to expect that 100% of all welds made will develop full strength and full quality.

3.0 INSTALLATION

3.1 Technical Specifications

3.1.1 Nelweld Characteristics

Machine	Standard Input Voltage/Frequency	Unit Weight	Weld Current (amps)		Weld Time (seconds)		Number of Guns	Part Number
			Min	Max	Min	Max		
Nelweld 4000	208/230/460/575 VAC 3 ϕ 60Hz	725 lb 330 kg	300	2100	0.020	1.400	1	750-601-001
							2	750-601-501
	230/460/575VAC 3 ϕ 60Hz	725 lb 330 kg	300	2100	0.020	1.400	1	750-601-000
							2	750-601-500
	220/380/415/440 3 ϕ 50/60 Hz	725 lb 330 kg	300	2100	0.020	1.400	1	750-601-051
							2	750-601-551
	400 VAC (CE) 3 ϕ 50/60 Hz	725 lb 330 kg	300	2100	0.020	1.400	1	750-601-055
							2	750-601-555
Nelweld 6000	208/230/460/575 VAC 3 ϕ 60Hz	1050 lb 480 kg	300	2500	0.020	1.500	1	750-600-001
							2	750-600-501
	230/460/575VAC 3 ϕ 60Hz	1050 lb 480 kg	300	2500	0.020	1.500	1	750-600-000
							2	750-600-500
	220/380/415/440 3 ϕ 50/60 Hz	1050 lb 480 kg	300	2500	0.020	1.500	1	750-600-051
							2	750-600-551
	400 VAC (CE) 3 ϕ 50/60 Hz	1050 lb 480 kg	300	2500	0.020	1.500	1	750-600-055
							2	750-600-555

3.1.2 Recommended Input Wire and Fuse Sizes

Machine	Input Voltage / Frequency	Input Current/ Duty Cycle	Portable Power Cable[1]	Fuse or Breaker Size Specifications[2]		Fuse Rating (Amps)	Recommended Fuse (Super Lag)
				Current	Time		
Nelweld 4000	208/60	488/6.7%	3/0	601	1.0	150	LPN-RK(250V)RK1
	230/60	442/6.7%	3/0	544	1.0	150	LPN-RK(250V)RK1
	460/60	224/6.7%	AWG 6	275	1.0	100	LPS-RK(600V)RK1
	575/60	181/6.7%	AWG 6	222	1.0	100	LPS-RK(600V)RK1
	220/50	461/6.7%	95mm^2	568	1.0	150	LPN-RK(250V)RK1
	380/50	270/6.7%	70mm^2	332	1.0	100	LPS-RK(600V)RK1
	400/50	257/6.7%	70mm^2	316	1.0	125	LPS-RK(600V)RK1
	415/50	248/6.7%	70mm^2	305	1.0	100	LPS-RK(600V)RK1
	440/50	234/6.7%	70mm^2	288	1.0	100	LPS-RK(600V)RK1
Nelweld 6000	208/60	547/23.3%	250 MCM	717	1.4	150	LPN-RK(250V)RK1 or FRN-R(250V)RK5
	230/60	496/23.3%	3/0	649	1.4	150	LPN-RK(250V)RK1 or FRN-R(250V)RK5
	460/60	253/23.3%	1/0	330	1.4	100	LPS-RK(600V)RK1
	575/60	204/23.3%	AWG 6	266	1.4	100	LPS-RK(600V)RK1
	220/50	518/23.3%	95mm^2	678	1.4	150	LPN-RK(250V)RK1 or FRN-R(250V)RK5
	380/50	304/23.3%	70mm^2	397	1.4	100	LPS-RK(600V)RK1
	400/50	289/12% #	70mm^2	378	1.4	125	LPS-RK(600V)RK1
	415/50	279/23.3%	70mm^2	364	1.4	100	LPS-RK(600V)RK1
	440/50	264/23.3%	70mm^2	344	1.4	100	LPS-RK(600V)RK1

1 Four (4) conductor, 600V - 90°C

2 Fuse should break for currents greater than those listed and/or times longer than those listed. Additionally, ensure that the fuse or breaker is compatible with the listed voltage and maximum instantaneous current.

For CE-marked, 400V, 50/60Hz units, duty cycle is reduced by 50% due to temperature/rating limits imposed by EN60974-12.

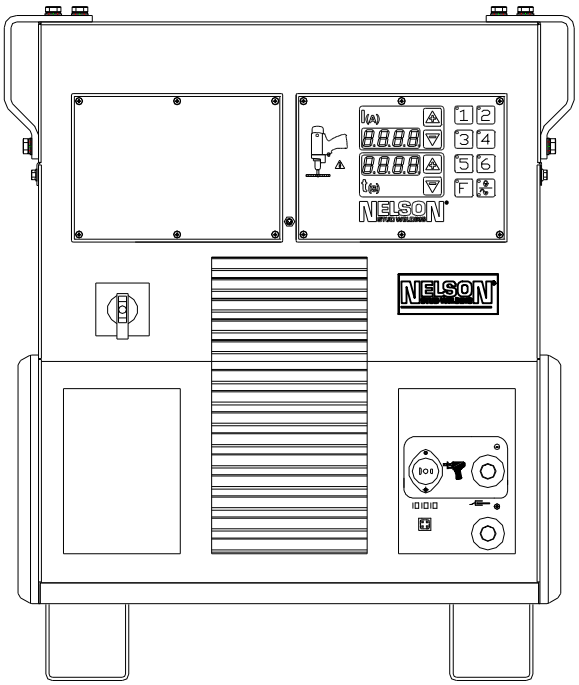
* Please consult local standards.

⚠ CAUTION

Verify that all fuses or circuit breakers are suitable for the electrical load applied. Failure to comply with the recommended input fuse sizes and warnings can result in damage to the Nelweld unit.

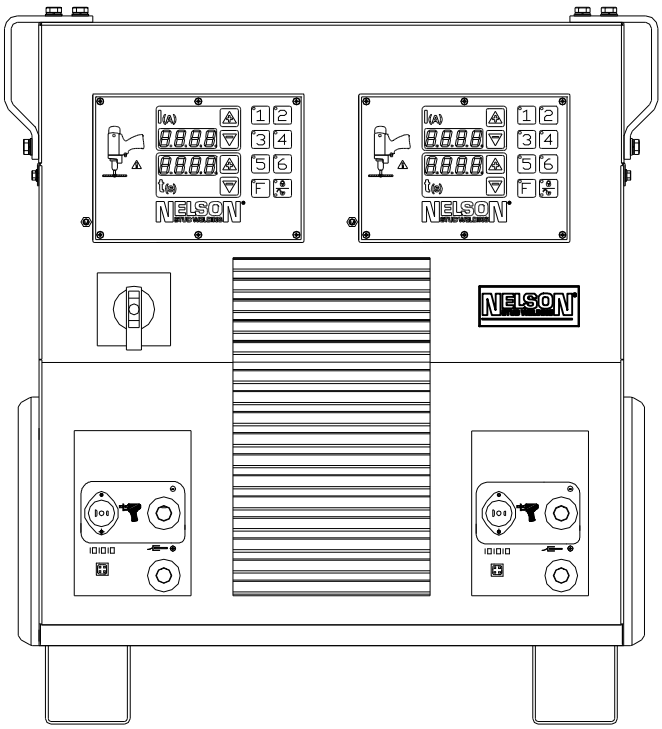
Fuses are always preferred over circuit breakers due to the high inrush current (on the order of 1300A for 1-2 cycles)

3.1.3 Physical Dimensions



Nelweld 4000

Shown with Single Gun Configuration



Nelweld 6000

Shown with Double Gun Configuration

Physical Dimensions (excluding handles and side bumpers)				
Machine	**Height**	**Width**	**Depth**	**Weight**
Nelweld 4000	32 in (813 mm) with legs 35.3 in (897 mm) with casters	24 in (610 mm) 27 in (686 mm) over handles	33.5 in (850 mm)	725 lbs (330 kg)
Nelweld 6000	34 in (865 mm) with legs 39.6 in (1005 mm) with casters	28 in (710 mm) 31 in (786 mm) over handles	35.5 in (900 mm)	1050 lbs (480 kg)

3.1.4 Temperature Ranges

Operating Temperature Range	32°F to 104°F	0°C to 40°C
Storage Temperature Range	-58°F to 185°F	-50°C to 85°C

3.1.5 Enclosure Safety Rating IP23

Suitable for Outdoor Use	Yes
Protection from Precipitation	Safe in wind-blown rain up to 60 degrees from vertical
Protection from Ingress of Objects	Objects with 12.5 mm minimum diameter can not enter
Protection from Access by User	Human finger can not touch hazardous parts

⚠ CAUTION

ELECTRIC SHOCK CAN KILL

- Only qualified personnel should perform this installation.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Turn the power switch on the Nelweld power source to "OFF" before connecting or disconnecting output cables or other equipment.
- Do not touch electrically "hot" parts.
- Always connect the Nelweld power source's grounding terminal (located on the welder base near the reconnect panel) to a good electrical earth ground.

3.2 Extent of Delivery

Included in the extent of delivery of a Nelweld power supply are the following unit components:

- One (1) Nelweld welding unit, as specified at the time of order,
- One (1) set of operating instructions, "Nelweld 4000 and 6000 Operations and Service Manual"

3.3 Extent of Dispatch

Unless otherwise agreed, the type of packing complies with HPE Regulations, which were laid down by the Federal Association of Wooden Materials, Pallets, and Export Packing.

3.4 Inspection of Incoming Materials

The operability of welding units are tested prior to dispatch. On arrival, the welding unit has to be checked for damage, as well as for the completeness of the parts within the extent of delivery. Any possible transport damage and/or missing parts must immediately be made known to Nelson Stud Welding, Inc. or the authorized forwarding company.

3.5 Intermediate Storage

If a Nelweld welding unit is not operated immediately after delivery, it must be put into storage in a secure location. The location must sufficiently protect the unit from dust and moisture, and maintain the appropriate storage temperature, seen in Section 3.1.4, -58°F to 185°F.

3.6 Locating the Power Source

The primary concerns when finding an appropriate location for a Nelweld unit are safety and cooling ability.

The unit must be located on a horizontal, vibration-free, non-slip floor space. The unit may topple over if it is tilted more than 10 degrees. Nelweld units cannot be stacked.

The load-carrying capacity of the floor space should be equivalent to at least double the weight of the welding unit. Additionally, the location should provide proper protection against the intrusion of liquid, and should not be located on pipelines.

Place the welder where clean cooling air can freely circulate into the machine through the front louvers and out through the case rear vent. Make sure the unit is not placed up against a wall such that the rear vent is blocked. A clearance of 3 feet (1 m) should be allowed between the Nelweld unit and any other obstruction.

Entry of dirt, dust, or any foreign material that can be drawn into the power source should be kept at a minimum. To help minimize contamination, the power source is designed with an on-demand cooling fan. This internal fan remains off until cooling is required. Use of filters on the air intake to prevent dirt from building up restricts airflow. Do not use such filters. Failure to observe these precautions can result in excessive operating temperatures and frequent, unanticipated shutdowns.

3.7 Moving the Power Source

This equipment has been designed for portability. Nelweld models are supplied from the factory with legs in the four corners of the base. This allows a forklift to lift these machines from their front or the side for easy relocation. There are also Caster Kits available, which take the place of the stationary legs, for those requiring continuous mobility. Once positioned, the swivel casters should be locked to prevent accidental movement.

The main cable is not a structural member, and must not be used as a handle during transport.

i All Nelweld power sources have side handles that can be used to help move a power unit with a Caster Kit installed. These are also designed to allow hoisting by using a fabric slings, each at least 39" long and having a load-carrying capacity of 1100 lbs (500 kg), strung diagonally through opposite corner handles, as shown in *Figure 3-1*. The sling may be strung through either two or four handles. If the handles need to be removed, the screws holding the handles in place must be retorqued to 25 ft-lbs, otherwise handle failure may result when lifting the unit.

3.8 Input Connections

⚠ WARNING

Only a *qualified* electrician should connect the input leads to the power source. Connections should be made in accordance with all local and national electrical codes, following the connection diagram located on the inside of the reconnect/input access panel of the machine.

Failure to do so may result in bodily injury or death.

3.8.1 Input Voltage Connection

The power switch on the front panel should be turned to the off position before making any power connections. Connections should be made in accordance with all local and national electrical codes, following the connection diagram in *Figure 3-2*.

Use a three-phase supply line. Remove the left side case side panel, with respect to the front of the machine. A 2½ inch (63.5 mm) diameter hole for the input supply is located on the lower left of the rear cabinet panel.

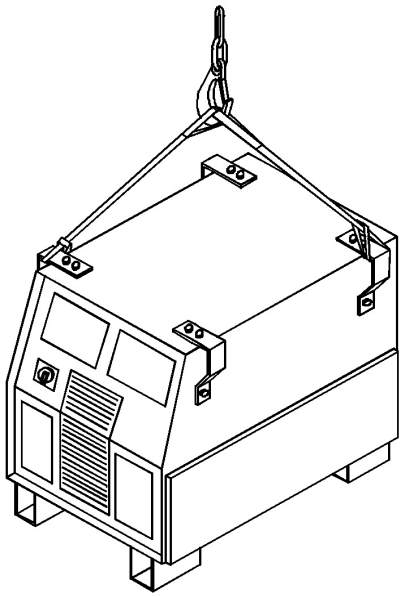


Figure 3-1: Proper hoisting technique of a Nelweld power supply using two handles.

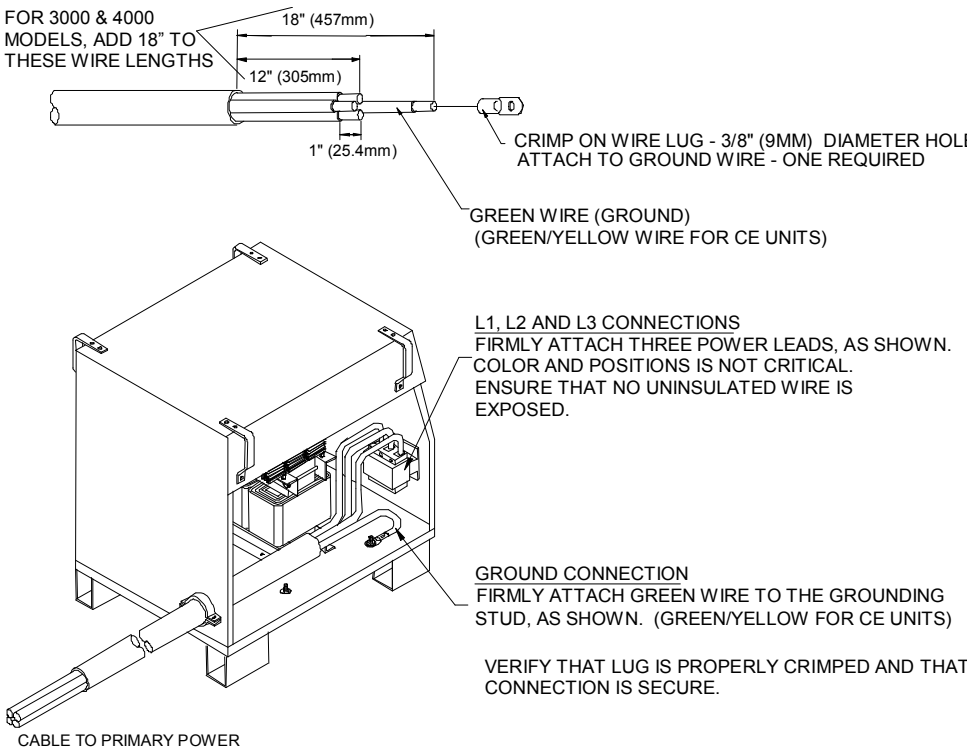


Figure 3-2: Connecting the input power cables

Connect L1, L2 and L3 to the top of the front mounted disconnect switch. Connect the ground lead to the stud provided on the cabinet floor.

Ensure that the transformer jumper links are appropriately connected for the input line voltage being supplied, as shown in *Figures 3-3, 3-4,* and *3-5*. Removing the upper case panel and handles are not required in order to change jumper settings, and is not recommended.

⚠ WARNING

When changing jumper links, *DO NOT OVERTIGHTEN NUTS,* otherwise, damage may occur to the Nelweld unit.

Additionally, do not lubricate the posts, nuts, or jumpers.

Figure 3-3: Link connections for 208/230/460 V model (Systems shipped prior to April 2006.)

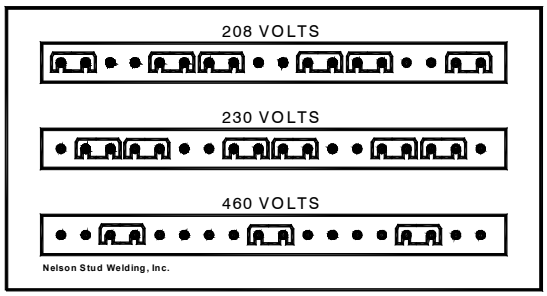


Figure 3-4: Link connections for 230/460/575 V model. (Systems shipped prior to April 2006)

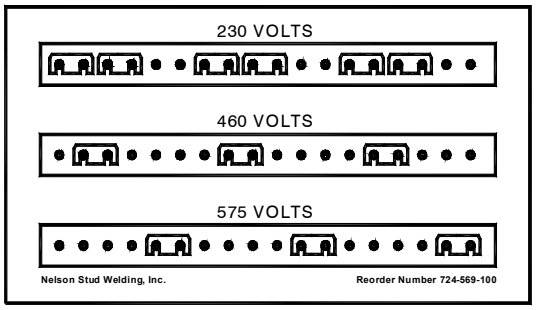


Figure 3-5: Link connections for 208/230/460/575 V model. (Systems shipped after April 2006).

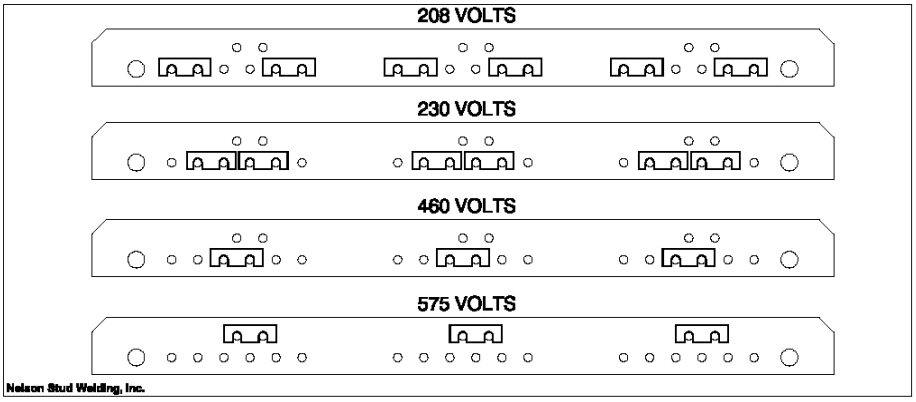
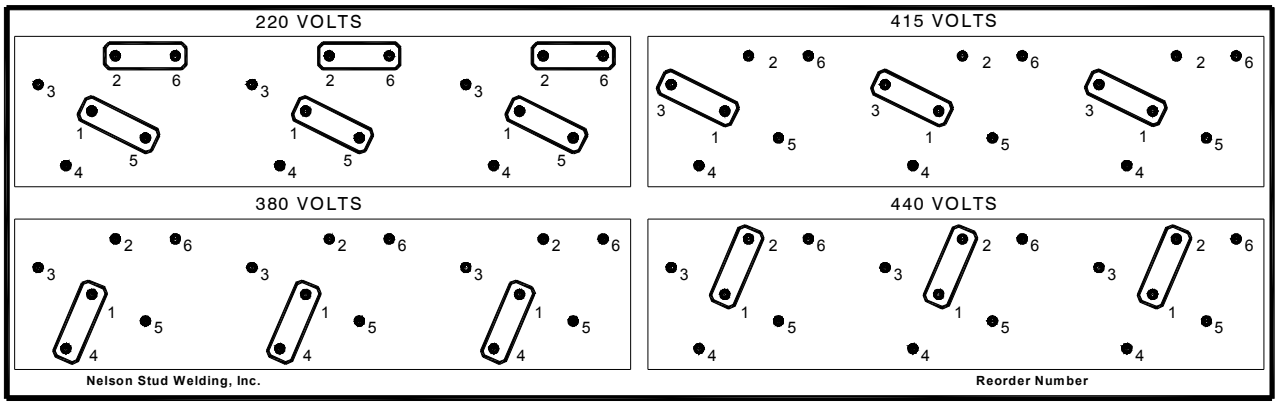


Figure 3-6: Link connections for 220/380/415/440 V model



3.8.2 Machine Grounding

The frame of the welder must be grounded. A ground stud marked with the ⏚ symbol is located on the cabinet floor for this purpose. Do not connect this external ground lead to a stud that already has an internal ground lead connected to it. Consult your local and national electrical codes for proper grounding methods.

3.8.3 Input Fuse and Supply Wire Considerations

Refer to the Technical Specifications at the beginning of this Installation section for recommended fuse and wire sizes. Fuse the input circuit with the recommended super lag fuse or delay type breakers (also called "inverse time" or "thermal/magnetic" circuit breakers). Choose input and grounding wire size according to local or national electrical codes. Using fuses or circuit breakers smaller than recommended may result in inappropriate shut-offs from welder inrush currents, even if the machine is not being used at high currents.

3.8.4 Input Voltage Reconnect Procedure

Welders with transformers that have primary voltage taps rated for 460VAC/60Hz or 440VAC/50 Hz will be shipped wired for these voltages respectively. To move this connection to a different voltage, remove the left side case side panel, with respect to the front of the machine, and refer to the reconnect instructions located on the decal attached to the machine floor in front of the transformer, or as shown in *Figures 3-3, 3-4, 3-5, and 3.6*. Welders with transformers rated at 400 VAC, 50 Hz are not reconnectable, and thus are shipped wired at 400 VAC.

3.9 Output Connections

Use the largest welding and ground cables suitable for the job. For large studs and/or long cable runs, 4/0 copper wire cables are preferred. Voltage drops can become excessive, leading to poor welding characteristics if undersized welding cables are used.

To avoid interference problems with other equipment and achieve the best possible results,

- Route all cables directly to the work and gun.
- Avoid excessive lengths
- Bundle the gun and ground cables together where practical
- Do not coil excess cable.

3.9.1 Gun Control Cable Connections

Connect the control cable between the gun and the power source output panel connector marked with a gun symbol.

3.9.2 Stud and Work Leads – Stud Negative Applications (straight polarity)

Most welding applications run with the stud being negative (-). For these applications, connect the stud gun weld cable to the gun connector on the power source output panel marked with a gun symbol. A grounding cable must be run from the positive (+) power source output panel connector to the work piece. The work piece connection must be firm and secure. Excessive voltage drops at the work piece connection may result in unsatisfactory welding performance.

3.9.3 Stud and Work Leads – Stud Positive Applications (reverse polarity)

When positive stud polarity is required, such as in some galvanized applications, install as above, except reverse the output connections at the power source, namely, with the stud gun weld cable to the positive (+) connector and grounding cable to the negative (-) connector marked with a gun symbol.

⚠ CAUTION

"Stud positive" applications should only be attempted with single gun machines. The power source is not designed to operate two outputs with one or both guns operating in the "stud positive" mode.

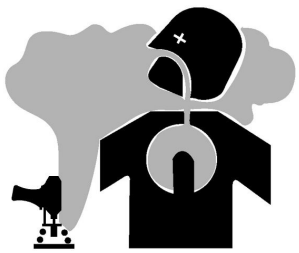
Failure to observe this precaution may result in a dangerous welding situation.

4.0 OPERATION

4.1 Safety Precautions

⚠ WARNING

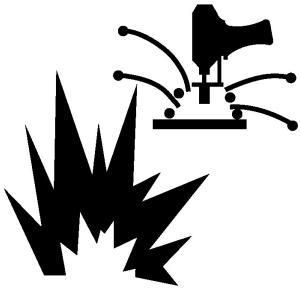
FUMES AND GASES can be dangerous.



- Keep your head away from fumes.
- Use ventilation or exhaust fans to remove fumes from the breathing zone.

⚠ WARNING

WELDING SPARKS can cause fire or explosion.



- Keep flammable material away.
- Do not weld on containers that have held combustibles.
- Always wear safety glasses when welding.

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts with skin or wet clothing.
- Insulate yourself from work and ground.
- Always wear dry, insulating gloves
- Maintain solid electrical connections.

⚠ WARNING

ARC RAYS can burn.

- Wear eye, ear, and body protection.
- Protect those near the welding area by posting caution signs and/or non-flammable screening.

⚠ WARNING

Observe additional Safety Guidelines detailed throughout this manual.

4.2 Basic Operation Procedure

The process to begin welding using a Nelweld unit is very easy. Once the proper electrical connections and gun connections are established:

- Turn the main power switch on the front of the unit to the "on" position. Wait for the unit to complete its startup sequence.
- Set the desired current and time settings.
- Save any setpoints, if desired.
- Adjust other settings by accessing the proper function.
- Perform a lift check to verify proper gun lift.
- Lock the unit, if desired.
- Perform test welds to verify the correct welding settings.

After establishing proper setup, production welding may begin.

4.3 General Description

The Nelweld welding systems are high performance, digitally controlled transformer-rectifier power sources, capable of welding a vast array of weld studs over a myriad of applications. When equipped with a compatible Nelson stud welding gun and appropriate accessories, they can support manual, gas arc, and automated stud welding processes to meet the most stringent requirements.

4.4 Recommended Processes and Equipment

Nelson recommends using original Nelson guns, feeders, and genuine Nelson studs to insure the highest quality welded stud solution. Nelson, as the inventor and industry leader in stud welding, recognizes the importance of taking a systems approach to avoiding and resolving stud welding problems. Only by using original Nelson products and equipment for all aspects of the system can we guarantee the best possible weld results.

4.5 Design Features

4.5.1 Modular Design

This product line is designed in a modular fashion, which leads to many customer benefits:

- Allows for easy upgrades as customer requirements change. For example, a single gun unit can be field-upgraded to a dual gun system using a Second Output Kit.
- Modular design approach leads to the highest value offering: *the customer pays only for the options that are desired.*
- Most field-installed options are interchangeable between each power source size.
- The common design of the product line minimizes the required equipment training and aids in troubleshooting.

4.5.2 System Cooling and Thermal Protection

This power source is designed to effectively manage heat generated by the power source and inherent to its working environment. Built-in fans are used to pull cool air into the case front, through the machine, and out the case rear. A thermostat controls these fans so that they only operate when necessary to keep the machine within the allowed temperature range.

The power source also has thermostats built-in to monitor the temperature of critical internal components. If any of these temperatures exceeds its maximum allowed value, machine output is disabled, and the operator is notified by a fault indicator and warning code displayed on the front panel. The system remains in the disabled state until the temperature is reduced to an acceptable level.

⚠ WARNING

Keep all body parts away from the cooling fan. The fan may start without warning, causing bodily injury to hands, arms, or any other body parts that are in contact with the fan blades.

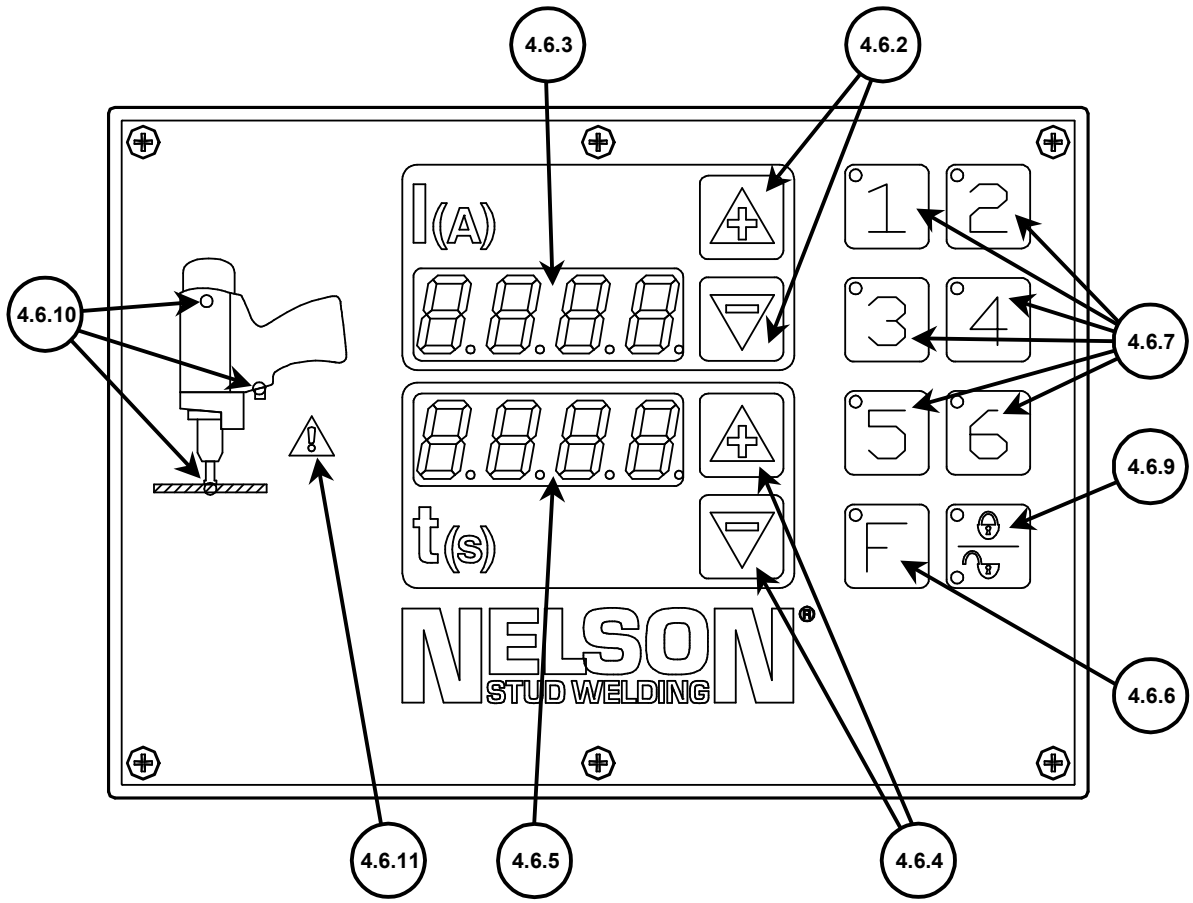
Do not service or repair the cooling fan while the power is connected.

Failure to do so may result in bodily injury or death.

4.6 Operational Features and Controls

4.6.1 Power-up

The main switch controls the input power to the machine. Upon powering up, the internal control software performs a series of diagnostic tests to ensure correct connection and operation of the power source. The unit also displays the current software version and model designation during the power up routine. Once the startup routine is complete, the time and current settings are reported on the corresponding front panel displays. The unit is now ready to weld.



Nelweld Maximum Settings				
Power source	Current (amps)		Time (seconds)	
	Min	Max	Min	Max
Nelweld 4000	300	2100	0.020	1.400
Nelweld 6000	300	2500	0.020	1.500

4.6.2 Setting the Current

The current setting is displayed on the front panel upper display. It can be changed using the + and – keys to the right of the current display in one (1) amp increments. As each of these keys remains pressed, the current setting will increase or decrease at a faster rate.

4.6.3 Current Display

The current setting is the current setting during a weld, and can be viewed in the front panel's upper display. It can be changed using the + and – keys to the right of the current display in one (1) amp increments. In normal operating modes, the desired setting and the actual current will be the same. In this situation the display does not change during or after a weld. However, in conditions where it is not possible for the power source to deliver the desired current, a warning light will light on the front panel display. This typically occurs when using high currents with small or excessively long weld cables.

4.6.4 Setting the Time

The time setting is displayed on the front panel lower display. It can be changed using the + and – keys to the right of the time display in one (1) millisecond (0.001 second) increments. As each of these keys remains pressed, the time setting will increase or decrease at a faster rate. This time is represented by t_4 on the "Timing Diagrams" in the Section 7.1 of this guide.

4.6.5 Time Display

The time display is used to display both the desired time setting and the actual weld time. In normal operating modes, the desired setting and the actual weld time will be the same. When this is the case, the display does not change during or after a weld. However, if an error condition occurs, the proper error code will be displayed on the front panel display. This will typically happen if a weld is aborted early.

i Please note that when the current and time are specified, the actual current and time delivered during the weld cycle are accurate to 3% of the specified value. Only when the specified value is beyond this tolerance will the current and/or time displays show a different value.

4.6.6 Special Functions

The power source has several special functions as described throughout this manual. These are accessed by pressing the function, or "F", key followed by a numeric function code. When accessing the special functions, the LED on the function button will light and the upper display will show "F" followed by the function code. All of the preset button LED's are OFF when in the Special Function mode since they now act as a keypad for entering the function codes. Scrolling through the function codes can also be accomplished by using the + and – keys to the right of the function code display. The lower display shows the current status or current value of the selected function. When in the special function mode, the selected machine output is disabled. Note: as tabulated in Section 7.3, the special function codes are sequentially numbered using only digits 1 through 6.

4.6.7 Setpoints

The power source has six available setpoint configurations. Each of these is assigned a time and current setting for commonly welded stud sizes. To select a setpoint, simply press key 1, 2, 3, 4, 5, or 6. When a setpoint is selected, its time and current are displayed on the front panel, and the LED on the selected preset key lights.

4.6.8 Setpoint Programming

Nelweld users are not restricted to pre-programmed setpoints, but may save more usable weld settings. To do so, first select the desired time and current settings using the corresponding + and – keys. Then press and hold the desired preset key for 4 seconds. When the green LED of the preset button being pressed turns ON, the selected preset has been successfully programmed.

Factory Set Preset Weld Settings

Preset	Stud Size	Time (seconds)	Current (amps)
1	3/16" (5mm)	0.150	300
2	1/4" (6mm)	0.200	450
3	5/16" (8mm)	0.250	550
4	3/8" (10mm)	0.350	650
5	1/2" (12mm)	0.550	850
6	5/8" (16mm)	0.700	1200

4.6.9 Front Panel Lock

The front panel has a lockout feature that prevents any changes from being made to the front panel settings. The power source is shipped with the lock disabled. Before using the lock function, it must be enabled using special function F45. The default combination for the lock is 1-2-3-4.

To lock the control panel, press the LOCK key followed by a 4-digit combination, as determined by the operator. *Combinations of numbers that are less than four (4) digits cannot be used to lock the front panel.* Enter the combination into memory by pressing the LOCK key again. This will cause the LOCK key's closed-lock-icon LED to turn ON.

To unlock the control panel, press the LOCK key followed by the previously entered combination, and the LOCK key again. The LOCK key's open-lock-icon LED turns ON indicating that the panel is now unlocked. In case a combination is forgotten, a supervisory combination will work to unlock the panel. The supervisory combination

can be changed using special function code F46, a function only accessible after entering the supervisory locking password. The default value for the supervisory password is also 1-2-3-4.

When locked, the LED on the LOCK key's closed-lock icon is illuminated, the displays read time and current but adjustments cannot be made. Most of the special functions can still be viewed in the locked mode, however, they cannot be modified. When unlocked, the open lock icon LED is lit indicating that setpoints and special function parameters may be modified.

The preset-enabled lock function provides a different type of lock function where, while the control panel is locked, any of the 6 presets may be selected, but not modified, by the operator. This feature is enabled by using special function F111

4.6.10 Status LED Operation

The control panel has three green LED's on the gun diagram and function as follows:

- Gun Coil LED – this LED is on whenever the gun coil is energized. This LED will blink if there is no gun connection detected. It will blink and the Fault Icon will illuminate if the gun coil is shorted.
- Trigger LED – this LED is on whenever the gun trigger is pulled or whenever the unit is welding.
- Contact LED – this LED is on whenever the stud chucked in the gun is in contact with the work.

4.6.11 Fault Icon Indicator

This indicator turns ON when a fault condition occurs. Please refer to the troubleshooting section of this guide for fault condition descriptions and resolution.

4.6.12 Weld Counter

The power source has two weld counters – one resettable and one non-resettable:

- User Weld Counter – The User Weld Counter keeps track of all the welds performed since the last time the counter was reset. This weld counter is displayed using special functions F31, F32, and F33.

  To reset the user weld counter, press and hold the time display's down arrow for three seconds while viewing F31, F32, or F33.

- System Weld Counter – The system weld counter keeps track of all the welds performed during the life of the power source. It cannot be reset without the aid of special software, available only in the factory.

  This weld counter is displayed using special functions F34, F35, and F36. It does not roll over this number but simply displays this maximum value for the remainder of the life of the power source.

In the weld counters, F31 and F34 display millions, F32 and F35 display thousands, and F33 and F36 display hundreds of welds. This is done because the displays cannot show more than four digits at one time. So, if the user's weld counter shows F31 as 128, F32 as 932, and F33 as 067, then 128,932,067 welds have been performed since this counter was last reset. Each counter, user and system, is shipped set to zero and can record up to one billion welds.

4.6.13 Chuck Stripper

The power source model features a chuck stripper option, which makes it easier for the operator to pull the gun off of a welded stud. This feature is particularly useful for studs with short chuck engagement, such as Nelson's capped grounding lug studs.

When in this operating mode, after a weld is completed, the gun coil is energized a second time. This pulls (strips) the chuck from the welded stud. By default, the chuck stripper function is disabled, but can be enabled using special function F41.

The chuck stripper has two adjustable time parameters associated with it:

- Chuck stripper delay time – After a weld is completed, this is the delay time before the gun coil is energized the second time. The delay time allows the weld to solidify and

cool, and is represented by t_9 on the "Timing Diagrams" in Section 7.1 of this guide. It is set using special function F42 and has a default value of 200 milliseconds (0.200 seconds).

- Chuck stripper hold time – This is the length of time that the gun coil is energized during the chuck stripping process. It is represented by t_{10} on the "Timing Diagrams" in Section 7.1 of this guide. The hold time is set using special function F43 and has a default value of 50 milliseconds (0.050 seconds).

4.6.14 Lift Check

The power source features a lift check function that allows the gun lift distance to be quickly verified and to simplify lift adjustment.

To perform a lift check, first load a stud and ferrule into the gun with the proper plunge setting for welding. Then, press the stud against an insulating workpiece, namely wood or similar non-conductive surface. Pull and hold the gun trigger. The gun will energize for the weld time set on the front panel. *Continue to hold the gun trigger.* After the lift check delay time, the gun coil will energize a second time and remain energized for the time specified by the user. This second energizing time is the lift check hold time. When the gun lifts during the second time, a scale may be placed next to the stud to measure the lift.

If a non-conductive workpiece is not available, the gun may be air triggered, and pressed against any surface *only after the first gun lift*.

The lift check function times outlined above are adjusted as follows:

- Lift Check Delay Time – this time is represented by t_6 on the "Timing Diagrams" in Section 7.1 of this guide. It can be adjusted using special function F12. It has a default value of 2000 milliseconds (2.000 seconds) when lift check is enabled.

Lift Check Hold Time – this time is represented by t_8 on the "Timing Diagrams" in the Section 7.1 of this guide. It can be adjusted using special function F13. It has a default value of 2000 milliseconds (2.000 seconds) when lift check is enabled.

For safety reasons, once in the lift check mode, machine output is disabled and no voltage is present in the gun. *Ensure that there is no contact between current-carrying gun components and a grounded workpiece when initiating a lift check.*

To disable the lift check option, change the value of special function F11 to 0.

4.6.15 Weld Through Deck Mode

The Nelweld power sources can be optimized to perform the weld-through-deck process by using special function F2. When enabled, the plunge time is extended to 180 milliseconds (0.180 seconds) and the maximum weld time is increased to 2.5 seconds. The Nelweld 6000 is shipped with the weld through deck mode disabled.

4.6.16 Chuck Saver

The chuck saver circuit prevents damage to the chuck after a weld is performed. This feature can be disabled by adjusting special function F56.

When special function F56 is enabled: After a weld is completed, the power source requires that electrical contact with the workpiece is broken before it allows the next weld to be initiated. Therefore, if the gun trigger is pulled a second time after a weld is complete, but contact has not been broken to the welded stud, then the second trigger pull is ignored.

When special function F56 is disabled: After a weld is completed, the power source does not require that electrical contact with the workpiece is broken before it allows the next weld to be initiated. Therefore, if the first weld attempt did not complete, a second attempt can be made without breaking contact between the stud and workpiece. This function should be used carefully as it is possible to weld the chuck to the stud if a second weld is attempted after the first weld was successful.

4.6.17 Resetting Default Parameters

To reset all controllable functions, to default conditions, select special function F44 and press and hold the time minus key until system resets. This function resets the preset setpoints, as well as the user weld counter.

4.6.18 Diagnostic Mode Enable

To help determine the cause of a problem welding, enable diagnostic mode using special function F66. When this function is enabled, a flashing indicator on the control panel allows the user to see that an error occurred. This error can then be examined by interrogating special function F1. (See diagnostic codes in the troubleshooting guide).

4.6.19 Quick Retry Enable

To truncate the gun lift time on a misfire, enable special function F26. When this function is disabled, the gun will lift for the entire weld time even on a misfire.

i Special function F26 is particularly useful in Weld Though Deck applications in which high weld time settings are typically used. For this reason, special function F26 is automatically enabled or disabled when Weld Through Deck is enabled or disabled. *The 'Quick Retry Enable' state may still be overridden after being automatically changed.*

4.6.20 Loadbank Mode Enable

The Loadbank Mode Enable function provides a means of supplying weld power through a loadbank by bypassing some logical checks (such as pilot arc voltage and contact latch states). This is primarily used for the purpose of calibration because the loadbank is a stable load. When this function is enabled, the gun coil will not lift. Enable this function by setting F112 to one. Disable this function for normal welding by setting its value to zero.

4.6.21 Stud Feed Weld Success Function

The 'Stud Feed Weld Success Function' allows the stud feed control to give the stud feed signal only after completing the weld cycle with the full main current. When this function is disabled, the signal will be given after every weld attempt. When this function is enabled, the signal will be given after every successful weld. Weld errors such as pilot arc errors (E009 or E010) and shunt errors (E012) can be flagged using this function.

Note: F25 (Feed Signal Air Trigger Enable) is overridden by this function.

4.6.22 Calibration Factor

The Calibration Factor allows for offset adjustment of the output current. For example, the Nelweld may be set to deliver 500A, but it is proven to deliver only 490A. The calibration factor may be adjusted in the positive direction until the Nelweld is proven to deliver exactly 500A.

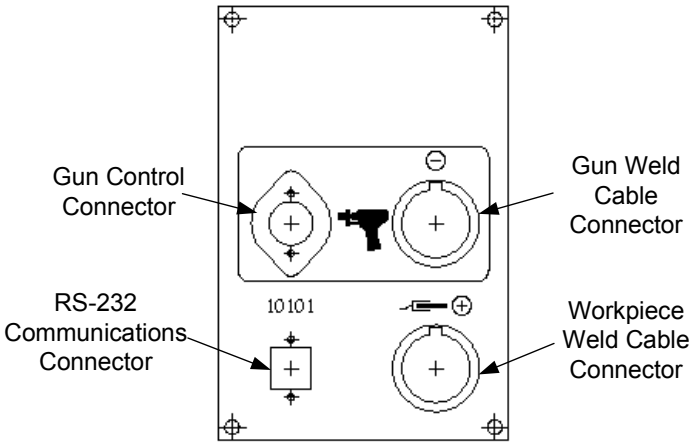
4.6.23 KFL Mode Enable

In the default state (disabled, or zero), the gun drive circuit is set to drive a handgun. When enabled, the KFL mode boosts the gun drive supply as needed by the KFL gun. Enable this function only when using the KFL gun.

4.6.24 Quick Pilot Arc Mode

In the default state (disabled, or zero), the pilot arc time duration is as set with special function F4. When enabled (or one), main current begins as soon as the pilot arc is established, thus truncating the pilot arc time duration.

4.6.25 Output Panel Layout



4.6.26 RS-232 Port /Cable

This port is accessed through the connector shown on the output panel. It allows for connection between the welder and a personal computer or laptop, and is necessary for the use of any additional Nelson software kits (Nelware kits).

The isolated RS-232 interface cable that connects the welder to the computer is sold separately. The user can extend this cable up to 25 feet. With the use of additional hardware, this distance is virtually unlimited.

4.7 Custom Adjustments

4.7.1 Pilot Arc Time Adjustment

Pilot Arc Time is defined as the time the pilot arc is turned on before main current flows and is represented by t_3 on the "Timing Diagrams" in the Section 7.1 of this guide. The factory default setting for this parameter is 50 milliseconds (0.050 seconds). For some applications, it may be desirable to change this time setting. The Pilot Arc Time can be adjusted using special function F4.

4.7.2 Hot Plunge Time Adjustment

Hot plunge time is defined as the time main current is on after the gun coil is shut off. It is represented by t_5 on the "Timing Diagrams" in the Section 7.1 of this guide. The factory default setting for this parameter is 50 milliseconds (0.050 seconds). For some applications with very slow or very fast gun operation, it may be desirable to change this time setting. The Plunge Time can be adjusted using special function F3.

4.8 Accessories

This section specifies options that are available for use with Nelweld units. Nelson Factory Trained Personnel should install the kits where specified. Where a connection to a computer is required, an RS-232 port must be either factory or field-installed. If Nelson software must be installed on the computer as part of the kit, the computer must meet the minimum specifications set forth in the *PC Requirements* table. When ordering kits, consult the part numbers listed in the *Nelweld Accessory and Kit Numbers* table.

4.8.1 Caster Kits: User Install

The Nelweld power supplies are shipped from the factory with legs installed on the base. If unit mobility is a requirement, customer-installed Caster Kits are available. The front casters swivel to allow lateral motion while rear casters are stationary. Each swivel caster is equipped with a brake to prevent movement once the unit is located in the desired position.

To install, unbolt the legs, place the casters over the holes, and reattach the bolts. Opening the cabinet is unnecessary.

4.8.2 Gas Valve Control Kit: Tech Install

The Nelweld units are designed to control a gas valve using the Gas Valve Control Kit. One kit is required per unit output. This kit may be either installed by Nelson Factory Trained Personnel or by the customer.

By default, the power source is shipped with the gas valve control disabled. Special function F14 must be used to enable the gas valve option.

There are two adjustable parameters associated with the gas valve control:

- Gas Valve Preflow Time – after the trigger is pulled, the gas valve is energized for a short period of time before the weld is initiated. This allows the gas line to be purged of air and to ensure adequate shielding. This time is represented by t_1 on the "Timing Diagrams" in Section 7.1 of this guide. It can be adjusted using special function F15, and has a default value of 500 milliseconds (0.500 seconds).
- Gas Valve Postflow Time – after a weld is completed, the gas valve continues to be energized for a short period of time to maintain the gas shield while the weld metal solidifies and cools. This time is represented by t_2 on the "Timing Diagrams" in Section 7.1 of this guide. It can be adjusted by using special function F16, and has a default value of 500 milliseconds (0.500 seconds).

4.8.3 Stud Feeder Interface Kit: Tech Install

All Nelweld models are capable of interfacing with an external stud feeding device using the Stud Feed Interface Kit. With this kit installed, an isolated contact is provided to trigger the stud feeding device.

To install this kit, a connector assembly is added as part of a replacement output panel, and a wiring harness is simply plugged into the existing SCR Power PC board. Special function F21 must be used to enable the control of a stud feeder.

There are three adjustable parameters associated with the stud feed option:

- Feed Signal Level – using special function code F22, the feed signal level can be selected, allowing "normally open" or "normally closed" operation. The default setting for this function is "normally open."
- Feed Signal Style – the feed signal can be set to occur after the weld is completed ("after weld") or after contact to the welded stud is lost ("contact loss"). "After weld" is used for very high speed applications, while "contact loss" is typical for most other applications. Special function F23 adjusts this parameter, which has a default setting of "contact loss."
- Feed Signal Pulse Width – this time is represented by t_7 on the "Timing Diagrams" in Section 7.1 of this guide. It can be adjusted as required by using special function F24, and has a default value of 10 milliseconds (0.010 seconds). A value from 100 to 500 milliseconds (0.100 to 0.500 seconds) is recommended.

4.8.4 Second Output Kit: Tech Install

Nelweld power supplies can accommodate welding by up to two users. Units that are manufactured as single gun units may be converted to dual gun units through the installation of a Second Output Kit. This kit consists of a control panel, an output panel, a bridge assembly, and associated wiring and hardware.

Part numbers for Second Output Kits are listed in the *Nelweld Accessory and Kit Numbers* table.

4.8.5 RS-232 Port Kit: Tech Install

This kit allows for interface between a personal computer or laptop. An RS-232 port is necessary for any additional Nelson software kits (Nelware kits) that require communication between the Nelweld unit and a computer. The kit is only needed for units that do not have a factory-installed RS-232 port.

The kit consists of a front panel socket assembly, a drilling template, and a 10-foot (3.0 meter) long isolated RS-232 interface cable. The user can extend this cable up to 25 feet. With the use of additional hardware, this distance is virtually unlimited.

4.8.6 Remote Control Kit: Tech Install

The Remote Control Kit allows the use of a computer to emulate the front panel interface to provide remote operation of the power source. This kit includes Nelware Remote Control

Software to be installed on the user's personal computer.

4.8.7 Process Monitoring Kit: Tech Install

The Process Monitoring Kit allows the use of a personal computer or laptop to keep track of preset and actual weld parameters to meet QS-9000 and ISO 9000 requirements. The kit includes Nelware Process Monitoring Software to be installed on the user's computer.

4.8.8 Diagnostic Kit: Tech Install

This kit allows the use of a personal computer to setup and troubleshoot the Nelweld unit for more demanding applications. The kit includes Nelware Diagnostic Software to be installed on the user's computer.

4.8.9 Calibration Kit: Tech Install

This kit allows the use of a personal computer for calibration of the power source. The kit includes Nelware Calibration Software to be installed on the user's computer, and other hardware.

PC Requirements	
Component	**Minimum**
Processor	200 MHz
RAM	32 MB
Video	800 x 600 VGA
Operating System	Windows 95/98/NT 4.0

Nelweld Accessory and Kit Numbers		
Kit Name	Model Number	Part Number
Caster Kit, 6”	4000	512-387-000
Caster Kit, 8”	6000	512-387-001
Gas Valve Control Kit	All	512-387-015
Stud Feeder Interface Kit	All	512-387-040
Second Output Kit	4000	512-387-010
Second Output Kit	6000	512-387-011
RS-232 Port Kit	All	512-387-020
Nelware Remote Control Kit	All	Contact Nelson
Nelware Process Monitoring Kit	All	Contact Nelson
Nelware Diagnostic Kit	All	Contact Nelson
Nelware Calibration Kit	All	Contact Nelson
Isolated RS-232 Cable	All	721-310-009

4.9 Compatible Equipment

4.9.1 Two-Wire Controlled Guns

The Nelweld power supply line is compatible with two-wire welding guns employing Nelweld Lift Technology™.

Nelweld Gun Description	Part Number
Standard Duty, Drawn Arc – NS40, two-wire	751-692-000
Short Cycle – NS40SC, two-wire	751-695-000
Heavy Duty – NS20AHD, two wire	751-693-000

Note that a three pin connector is used even though welding guns only use two wires.

4.9.2 Three- and Four-Wire Controlled Guns

Nelweld power sources are compatible with all existing Nelson stud welding guns with three- and four-wire control with the use of a converter.

4.9.3 Stud Feeding System Interface

With the Stud Feeder Interface Kit installed, the power source can trigger any feeding device whose trigger requirements meet the following specifications:

Output Type	Isolated Contact
Open Circuit Voltage Max	250VAC, 220VDC
Rated Resistive Loads	.40A @ 125VAC 2.0A @ 30VDC
Rated Inductive Loads	.20A @ 125VAC 1.0A @ 30VDC
Max Operating Current - Resistive	3A (AC) 3A (DC)
Max Operating Current - Inductive	1.50A (AC) 1.50A (DC)
Max Switching Capacity - Resistive	50VA, 60W
Max Switching Capacity - Inductive	25VA, 30W

4.10Limitations

4.10.1 Duty Cycle

The duty cycle limits for the Nelweld 3000, 4000, 5000, and 6000 can be seen in the *Stud Weld Rate* table.

4.10.2 Weld Cable Length

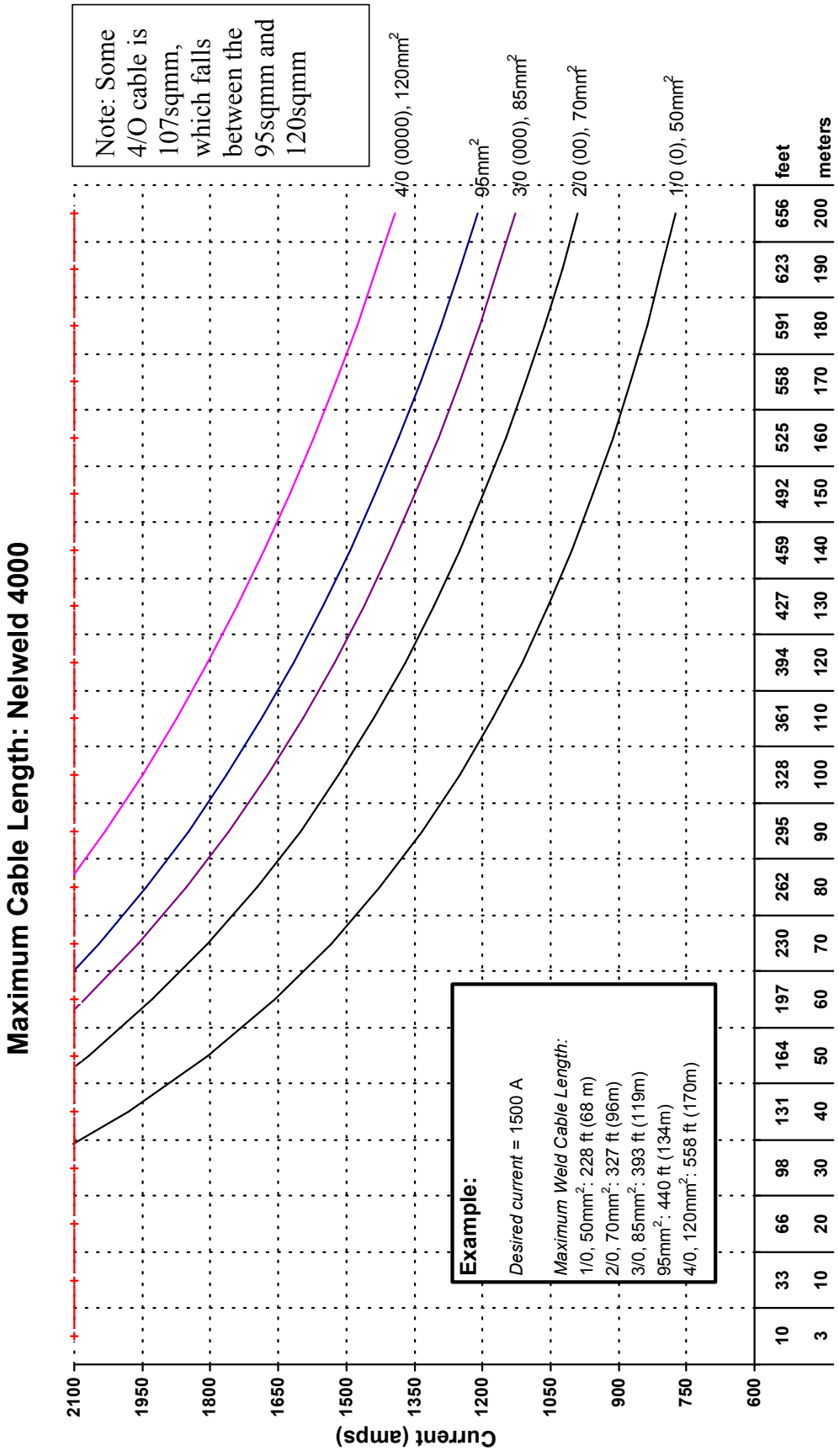
The diameter and length of the weld cable limit the amount of current that can be supplied to the stud welding arc. For best performance, use the largest diameter cable, only use as much cable length as needed, bundle the gun and ground cables together where practical, and do not coil excess cable.

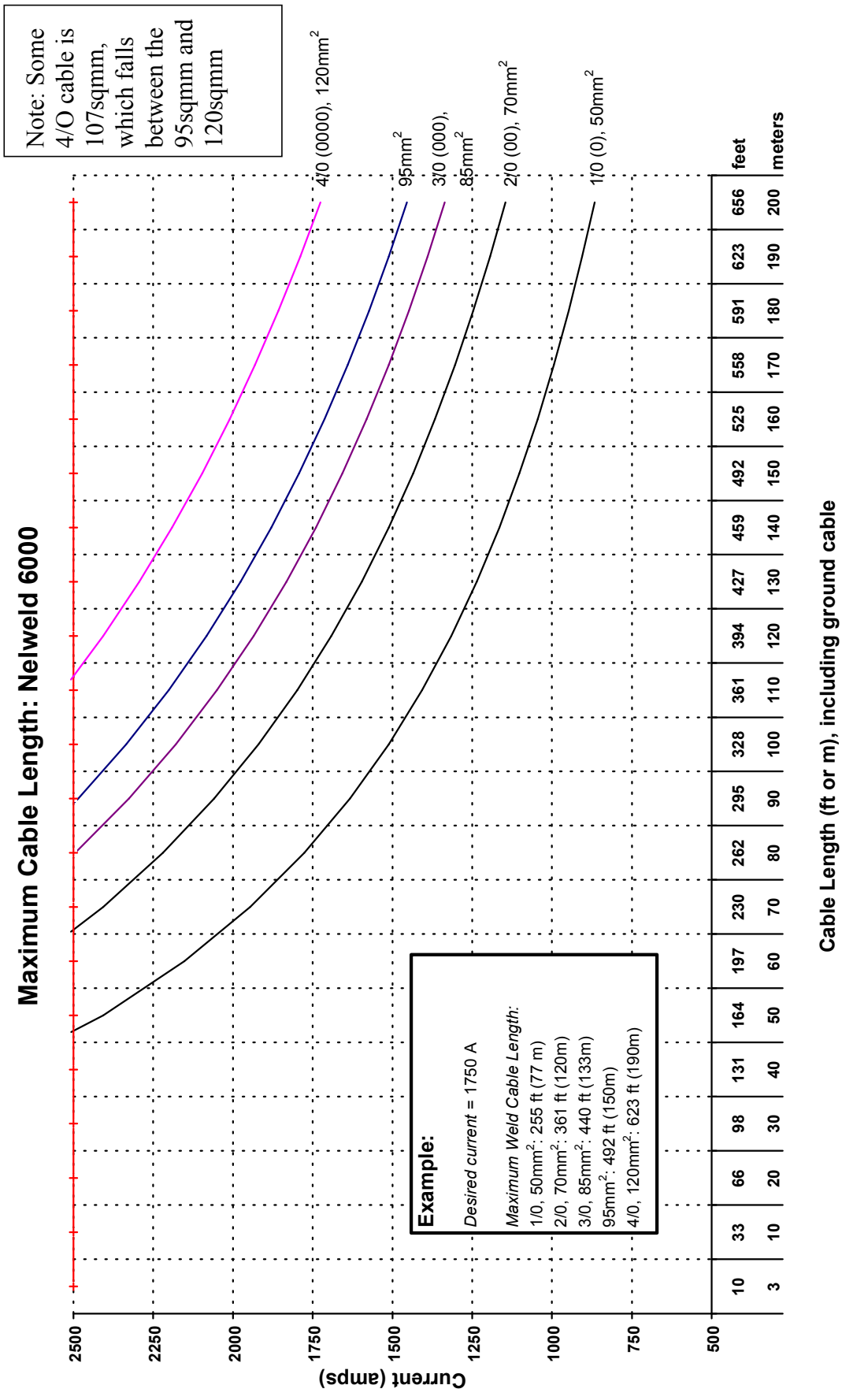
The following graphs define cable length limits for each machine in the product line.

The total weld length includes the work lead. Thus if welding with 200 feet of gun cable and 200 feet of ground cable, then the total cable length is 400 feet.

Stud Weld Rate Parameters listed are those used during testing, and should be used only when considering weld duty cycle							
Stud Size		Time (sec)	Current (A)	Weld Rate (studs per minute)			
(in)	(mm)			Nelweld 4000	Nelweld 6000		
3/16”	5mm	0.15	300	Unlimited	Unlimited		
1/4”	6mm	0.17	450	50	Unlimited		
5/16”	8mm	0.25	500	40	Unlimited		
3/8”	10mm	0.33	550	22	Unlimited		
1/2”	13mm	0.55	800	19	30*		
5/8”	16mm	0.67	1200	15	25*		
3/4”	19mm	0.84	1500	12	20*		
7/8”	22mm	1.00	1700	4	13*		
1”	25mm	1.40	2000		10*		

* For CE-marked, 400V, 50/60Hz units, stud weld rates are reduced by 50% due to temperature rating limits imposed by EN60974-12.


Maximum Cable Length: Nelweld 4000
Note: Some 4/O cable is 107sqmm, which falls between the 95sqmm and 120sqmm
4/0 (0000), 120mm²
95mm²
3/0 (000), 85mm²
2/0 (00), 70mm²
1/0 (0), 50mm²
Example:
Desired current = 1500 A
Maximum Weld Cable Length:
1/0, 50mm²: 228 ft (68 m)
2/0, 70mm²: 327 ft (96m)
3/0, 85mm²: 393 ft (119m)
95mm²: 440 ft (134m)
4/0, 120mm²: 558 ft (170m)
Current (amps)
2100
1950
1800
1650
1500
1350
1200
1050
900
750
600
10 33 66 98 131 164 197 230 262 295 328 361 394 427 459 492 525 558 591 623 656 feet
3 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 meters
Cable Length (ft or m), including ground cable


Maximum Cable Length: Nelweld 6000
Note: Some 4/O cable is 107sqmm, which falls between the 95sqmm and 120sqmm
4/0 (0000), 120mm²
95mm²
3/0 (000), 85mm²
2/0 (00), 70mm²
1/0 (0), 50mm²
Example:
Desired current = 1750 A
Maximum Weld Cable Length:
1/0, 50mm²: 255 ft (77 m)
2/0, 70mm²: 361 ft (120m)
3/0, 85mm²: 440 ft (133m)
95mm²: 492 ft (150m)
4/0, 120mm²: 623 ft (190m)
Current (amps)
2500
2250
2000
1750
1500
1250
1000
750
500
10 33 66 98 131 164 197 230 262 295 328 361 394 427 459 492 525 558 591 623 656 feet
3 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 meters
Cable Length (ft or m), including ground cable

5.0 MAINTENANCE

5.1 Safety Precautions

⚠ WARNING

ELECTRIC SHOCK CAN KILL

- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment.
- Turn the Power switch on the Nelweld power source "OFF" before connecting or disconnecting output cable or other equipment.
- Do not touch electrically hot parts.

⚠ WARNING

5.2 Care and Cleaning

The stud welding unit requires no special care. See operating instructions for the necessary cleaning work for welding guns or any attached peripherals.

The cleaning or maintenance specified in this chapter is necessary for the proper functioning of any Nelweld unit. Please observe the following specifications when performing any maintenance duties:

- Aggressive, combustible, or alcohol-based solvents should not be used for cleaning work.
- Exterior cleaning should be done using a dry cloth and leave any safety or warning stickers legible.
- *Cleaning the unit is required in accordance with the operating conditions and degree of soiling.* Cleaning any electrical connections should be done only by proper electrical repair personnel.
- Impurities inside the welding unit, such as metallic dust, must be wiped off or blown out.
- In case of contact with liquids, the Nelweld unit must be shut down immediately and repaired by a Local Authorized Nelson Field Service Facility.

5.3 Maintenance Schedule

Maintenance Interval	Suggested Tasks	Notes
Daily	Visual inspection of the outside of the unit casing, including: • Welding cables, control cables, and hoses • Inspect lifting handles, ensuring they are secure and tight • Main plug and cable* • Display and control elements* • Connecting sockets and plugs*	Any task marked with an asterisk (*) should only be carried out by proper electrical repair personnel.
Weekly	Blow out the machine using a low-pressure air stream, including the intake louvers, rear vent, and cooling channels.	
Every 6 months	Visual inspection inside the unit casing, including: • Wiring* • Circuit boards* • Electrical connections and components*	Any task marked with an asterisk (*) should only be carried out by proper electrical repair personnel.
Every 5 years	General overhaul of the Nelweld unit by Nelson Factory Trained personnel.	General maintenance to verify that the machine is functioning properly.

6.0 TROUBLESHOOTING

6.1 Safety Precautions

⚠ WARNING

Service and Repair should only be performed by *Nelson Stud Welding, Inc. Factory Trained Personnel*. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

⚠ CAUTION

This Troubleshooting Guide is provided to help you locate and remedy possible problems with machine setup or operation. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "Problem". This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting.

Step 2. PERFORM EXTERNAL / INTERNAL TESTS. The second column labeled "Possible Cause" lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. Many "Solutions" can be verified without removing the case cover. However, more thorough investigation may require examination of the inner machine contents. Use extreme caution when repairing any component within the case, and follow all safety guidelines set forth in this manual.

Step 3. SEEK PROFESSIONAL ASSISTANCE. If you have exhausted all of the recommended tests in Step 2, consult your Local Authorized Nelson Field Service Facility.

⚠ WARNING

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your LOCAL AUTHORIZED NELSON FIELD SERVICE FACILITY for assistance before you proceed.

1-800-NEL-WELD (1-800-635-9353)

6.2 Diagnostic codes – Troubleshooting Guide

The diagnostic codes can be accessed via the F1 Special Function Mode. The E codes can be scrolled with the up/down keys next to the LED Display. The error codes are erased when the unit is shut off.

Diagnostic Code	Description	Recommended Action
E001	Line Frequency Error	Invalid frequency detected. Ensure the proper line frequency is being used.
E002	Missing Phase	Phase B or C (with respect to Phase A) was not detected. Ensure that all input power phases are present.
E005	EEPROM Failure	Main Control PCB failure.
E006	Dual Output Communications Error	Check harness connections between control PCB's.
E007	Gun Coil or Gun Cable Shorted to Work	Check gun coil wiring, or gun control cable for broken insulation or water immersion of a gun control connector.
E008	Gun Coil Open	Check gun coil wiring and related circuit wiring
E009	Gun Lift Error	A short was detected after the pilot arc time expired – Check gun.
E010	Shunt Signal Open	No pilot arc current detected and/or the arc current went out. Check shunt wiring.
E012	Time Control Fault	Main weld arc went out. Clean surface or change weld parameters.
E015	High Temperature Fault	Welding is disabled until the unit's welding power supply cools to an acceptable level. This code will display automatically with or without F1 diagnostic mode enabled. This error will occur if the pilot arc board is unable to supply 15VDC. The 15VDC supply exists if two green LEDs on the pilot arc board are lit. If they are not lit, replace the pilot arc board(s).
E016	SCR Shorted	Check shunt wiring. Replace defective SCR.
E017	Weld Quality Error	Weld was outside of specified tolerance. *Only valid for Process Monitor users. See the Nelware users manual for details.*
E018	Security Error	An incorrect security code was passed to the Nelweld through the RS-232 port.

6.3 Machine – Troubleshooting Guide

Problems Occurring at Startup / Bootup		
Problem	**Possible cause**	**Solution**
Nothing happens when the machine is turned ON.	Input fuse or circuit breaker open	Check customer-provided fuse or circuit breaker
	Reconnect panel, it may be wired incorrectly.	Refer to *Section 3.5.4* of this guide and check connections.
	Internal Power Source Problem	Contact your qualified Nelson Technical Service Representative.
Machine starts up, but a strange, electrical noise is heard	Jumpers are not set properly	See *Section 3.8.1* for proper jumper settings.
Machine starts up, but there is an error code displayed immediately afterward.	Refer to *Diagnostic Code* list.	Welding cannot be done until error is corrected. Correct error, if possible. Otherwise, contact your qualified Nelson Technical Service Representative.
Gun LED on front panel flashes.	No gun connected to the power supply on startup.	Connect stud welding gun to the Master (right, with respect to the front of the machine) gun input.
Weld settings were not retained from previous setting.	EEPROM Error (E005)	Replace the main control board.

Mechanical Problems Occurring During Welding		
Problem	**Possible cause**	**Solution**
Welding gun lifts, but no weld takes place.	No contact between stud and workpiece.	Verify that the green "Contact" LED is lit. If it is not, there is no electrical contact between the stud and workpiece. Ensure that there is no rust, scale, oil, water, residue, paint, galvanization, etc. present on the stud or workpiece, per *Section 2.7.1*.
	Improper ground connection.	Ensure that the workpiece is properly grounded. No weld cycle will take place if there is not a continuous circuit from the power supply, through the workpiece, and back.
	Insufficient gun lift	Perform a Lift Check, as specified in *Section 4.5.14*. Consult *Section 2.6* to ensure proper lift settings are being used. Correct the lift to the proper setting if the lift is improperly set.
	Cable / connectors broken	Test weld cables and connectors to ensure consistent conductivity through the length of the cable during bending. If testing indicates a broken cable or connector, replace cables and/or connectors.
	No pilot arc voltage is detected (E009)	A short was detected after the pilot arc time expired. Check gun for shorts.
	Gun malfunction	The lifting mechanism may be binding, preventing the gun from lifting properly. Repair the lifting mechanism.

Mechanical Problems Occurring During Welding		
Problem	**Possible cause**	**Solution**
Welding gun lifts, but no weld takes place (continued).	No pilot arc current is detected (E010)	Check shunt wiring for faults. If no problems are found, verify that the pilot arc board is functioning. When the board is functioning properly, two green LED's, D6 and D12, should be illuminated. If either is not illuminated, check for loose cables connected to the board. Also, check and replace any fuses (3) that might have blown. Those fuses are located on the Pilot Arc PCB. If there are further problems, contact your qualified Nelson Technical Service Representative,
Welding gun does not lift when the trigger is pulled.	If in dual gun operation, another welder may be attempting to weld at the same time.	Wait for the other welder to finish the cycle, and retrigger.
	Shorted gun coil (E007)	If the coil is shorted, yellow LED D2 on the control board will be illuminated. Correct the short. Unit power must be reset for this error to be corrected.
	Open gun coil (E008)	Locate the break in the coil circuit. Check all lines between the gun coil and the power PCB board for loose connections or broken lines.
	Gun trigger not released after last weld.	Trigger may be stuck or the control cable may be shorted in the closed position. This will be indicated by a lit "Trigger" LED on the front panel. Physically release or disconnect the trigger.
Second weld gun does not fire when welding in dual-gun mode.	Another welder is welding.	Wait for the other welder to finish the cycle, and retrigger.
	Wiring harness disconnected.	Master control board (right) cannot communicate with the slave control board (left) if the wiring harness is disconnected. Ensure that the harness runs between the Master JP3 and Slave JP3.
	Board communication problem. (E006)	Error displays on the Master front panel display (right). Replace control board(s).
Unit goes into thermal shutdown repeatedly and/or often.	Duty cycle exceeded	Verify that application is within the duty cycle limits provided in the *Section 4.9.1* of this guide. If the duty cycle is exceeded, reduce weld rate.
	Output louvers blocked	Move power source to allow room for airflow out of the cabinet rear.
	Input louvers blocked	Remove obstruction from louvers on the cabinet front.
	Thermal switch may be faulty	A faulty thermal switch may generate excessively low trip-off temperatures. Replace thermal switch.
	Excessive contaminates inside machine are preventing proper cooling	Blow out machine as indicated in the *Section 5.2* of this guide. Move machine away from the source of the contamination.

Weld Quality Problems		
Problem	**Possible cause**	**Solution**
Weld appears “hot.”	Calibration value is incorrect	Adjust calibration value (F114) until correct current is achieved.
	Time setting or current setting is too high.	Check the stud burn-off. If the burn-off is much greater than what is typical for that diameter stud, the time and current settings may not be correct. Consult *Section 2.6* to ensure proper current and time settings are being used. Reduce the current setting and perform weld inspections as described in *Sections 2.7.4*, and *2.7.5*.
	Plunge is too short.	Plunge is measured by the amount of stud protruding beyond the bottom edge of the ferrule. Consult *Section 2.6* to ensure proper plunge settings are being used, and correct, if necessary.
	Incorrect ferrule.	Ensure that the ferrule being used in the welding process is the proper ferrule for the stud size and application.
	Plunge dampening is too great.	If the gun is a Heavy Duty gun, it is equipped with Tranquil Arc®. Back out the clear plastic plunge dampener housing to decrease the free travel.
Weld appears “cold.”	Time setting or current setting is too low.	Check the stud burn-off. If the burn-off is much less than what is typical for that diameter stud, the time and current settings may not be correct. Consult *Section 2.6* to ensure proper current and time settings are being used. Correct the settings and perform weld inspections as described in *Sections 2.7.4* and *2.7.5*.
	Incorrect ferrule.	Ensure that the ferrule being used in the welding process is the proper ferrule for the stud size and application.
	Insufficient gun lift.	Perform a Lift Check, as specified in *Section 4.5.14*. Consult *Section 2.6* to ensure proper lift settings are being used. Correct the lift to the proper setting if the lift is improperly set. Perform weld inspections as described in *Sections 2.7.4* and *2.7.5*.
	Inconsistent gun lift.	Perform a Lift Check, as specified in *Section 4.5.14*, several times. Consult *Section 2.6* to ensure proper lift settings are being used. If lift results are inconsistent, disassemble and clean the gun.
	Too much plunge.	Plunge is measured by the amount of stud protruding beyond the bottom edge of the ferrule. Consult *Section 2.6* to ensure proper plunge settings are being used, and correct, if necessary.
	Plunge dampening is too little.	If the gun is a Heavy Duty gun, it is equipped with Tranquil Arc®. Screw in the clear plastic plunge dampener housing to decrease the free travel.

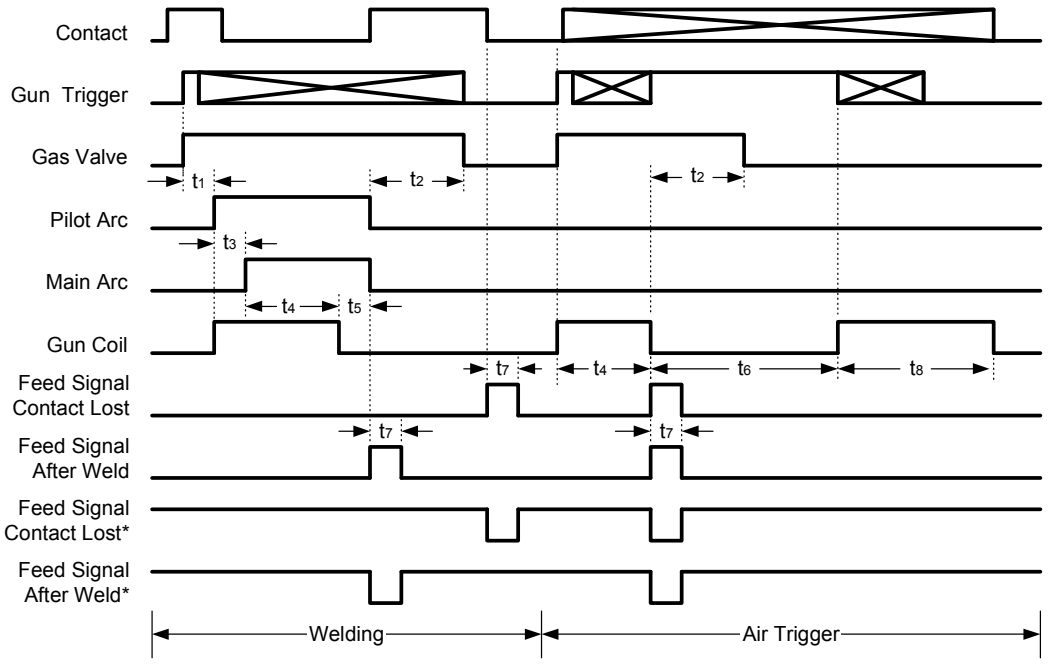
Weld Quality Problems		
Problem	**Possible cause**	**Solution**
Stud "hangs-up" during the weld.	Plunge is too short.	Plunge is measured by the amount of stud protruding beyond the bottom edge of the ferrule. Consult *Section 2.6* to ensure proper plunge settings are being used, and correct, if necessary.
	Mechanical bind in accessories or ferrule.	Position the foot or ferrule grip of the gun so that the stud is centered in the ferrule opening. If the stud is off-center, it can restrict the plunging motion of the stud during welding.
	Time setting or current setting is too high.	Check the stud burn-off. If the burn-off is much greater than what is typical for that diameter stud, the time and current settings may not be correct. Consult *Section 2.6* to ensure proper current and time settings are being used. Correct the settings and perform weld inspections as described in *Sections 2.7.4* and *2.7.5*.
	Plunge dampening is too great.	If the gun is a Heavy Duty gun, it is equipped with Tranquil Arc®. Back out the clear plastic plunge dampener housing to increase the free travel.
	Mechanical bind in gun.	Manually depress chuck adaptor and release. Chuck adaptor must return to the full out position rapidly without binding. If necessary, disassemble and clean the gun. On Heavy Duty guns, ensure that the weld cable is centered between the legs and does not rub on them.
	Base material contamination.	Contamination of the base plate or stud may cause the arc to become erratic. Ensure that there is no rust, scale, oil, water, residue, paint, galvanization, etc. present between the stud and the workpiece. Welding to a clean plate can help diagnose if there is any foreign substance on the base material or studs.
	Incorrect ferrule.	Ensure that the ferrule being used is the proper ferrule for the stud size and application.

Problems Occurring During Shutdown		
Problem	**Possible cause**	**Solution**
Machine does not shut down when the power is turned off at the main power switch.	Broken switch.	Replace main power switch.
	Switch contacts broken and/or shorted.	Replace switch contacts.

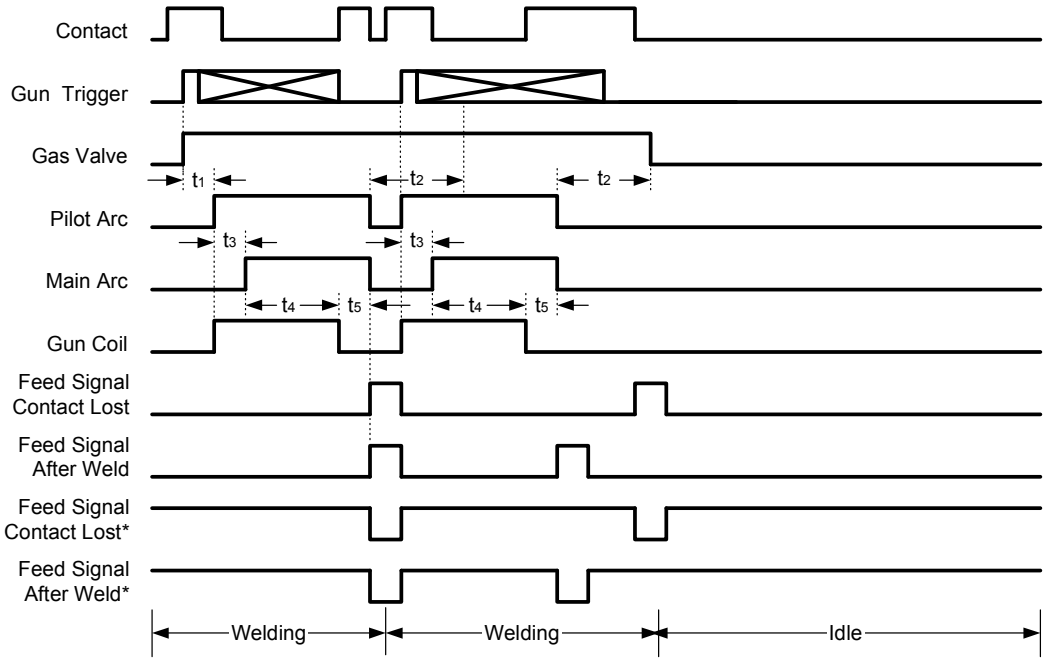
7.0 Miscellaneous Information

7.1 Timing Diagrams

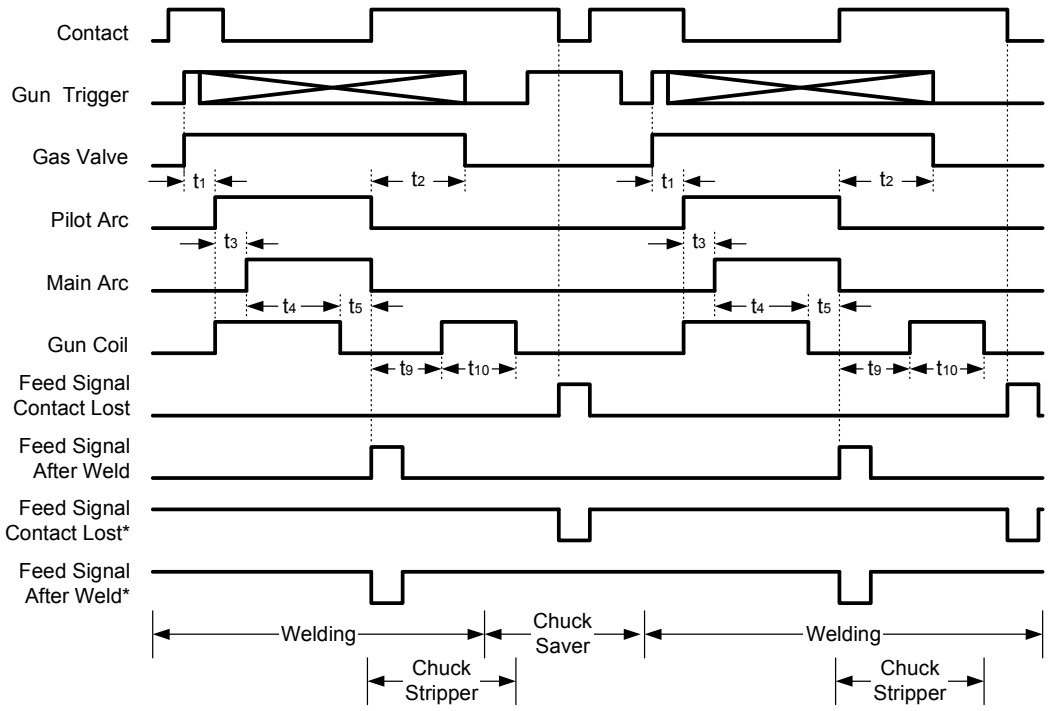
Weld sequence and air trigger for lift check



Starting a weld during gas postflow



Chuck stripper and chuck saver operation



7.2 Timing Diagram Definitions

Symbol	Description	Controlling Function	Values
t_1	Gas Preflow Time After the gun trigger is closed, the gas valve is turned on for the preflow time before the gun is lifted and before the pilot arc is turned on. This allows time for the air to purge from the gas line to insure that a gas shield is present before starting an arc. If another weld is started while gas is flowing due to the postflow timer, the preflow is aborted and the weld starts immediately.	Function F14 *Enables/Disables Gas Option*	default 0 (off) option 1 (on)
		Function F15 *When Gas Option is Enabled, Sets Preflow Time*	default 500 ms minimum 0 ms maximum 5000 ms
t_2	Gas Postflow Time After the weld is complete, the gas valve is held on for the postflow time. This provides a gas shield while the weld solidifies and begins to cools.	Function F14 *Enables/Disables Gas Option*	default 0 (off) option 1 (on)
		Function F16 *When Gas Option is Enabled, Sets Postflow Time*	default 500 ms minimum 0 ms maximum 5000 ms
t_3	Pilot Arc Time When the gun trigger is closed, the gun coil is energized and the pilot arc is turned on. After the pilot arc time expires, the main arc is turned on. This allows the gun time to lift before main current flows.	Function F4 *Sets Pilot Arc Time*	default 50 ms minimum 10 ms maximum 100 ms

Symbol	Description	Controlling Function	Values
t_4	Weld Time Weld time as set on the user interface. It starts when the main current is turned on and ends when the gun coil is shut off.	Set on front panel	default minimum 20 ms . Nelweld 4000 max. 1.4 sec . Nelweld 6000 max. 1.5 sec
		Function F2 *Enables/Disables Weld Through Deck mode*	Nelweld 6000 max., if enabled (F2 is 1) 2.5 sec
t_5	Hot Plunge Time The time that the main current is on after the gun coil is shut off.	Function F3 *Sets Plunge Time*	default 50 ms minimum 50 ms maximum 250 ms
		Function F2 *Enables/Disables Weld Through Deck mode*	Nelweld 6000 default, if enabled (F2 is 1) 180 ms
t_6	Lift Check Delay Time When the gun is air triggered, the gun coil is energized for the weld time. After it is shut off and the trigger remains pressed, the lift check delay timer starts. Once it expires, the gun coil is energized a second time to allow gun lift verification and adjustment.	Function F11 *Enables/Disables Lift Check*	default 1 (on) option 0 (off)
		Function F12 *Sets Lift Check Delay Time*	default 2000 ms minimum 100 ms maximum 9999 ms
t_7	Feed Signal Pulse Width When the Nelweld unit controls the operation of a stud feeding unit, the pulse width is the amount of time the feeder's shutter is open, allowing a stud to drop from the feeder into the gun.	Function F22 *Sets Feed Signal Level*	default 0 (active low) option 1 (active high)
		Function F23 *Sets Feed Signal Style*	default 0 (contact loss) option 1 (after weld)
		Function F24 *Sets Feed Signal Pulse Width*	default 10 ms minimum 10 ms maximum 500 ms
t_8	Lift Check Hold Time During lift check, after the gun coil is energized a second time, it remains energized for the lift check hold time. This eases lift check and adjustment.	Function F11 *Enables/Disables Lift Check*	default 1 (on) option 0 (off)
		Function F13 *Sets Lift Check Hold Time*	default 2000 ms minimum 10 ms maximum 9999 ms
t_9	Chuck Stripper Delay Time After the main current is shut off, the chuck stripper delay occurs before turning on the gun coil a second time to pull the chuck off of the welded stud.	Function F41 *Enables/Disables Chuck Stripper Function*	default 0 (off) option 1 (on)
		Function F42 *Sets Chuck Stripper Delay Time*	default 200 ms minimum 10 ms maximum 2000 ms
t_{10}	Chuck Stripper Hold Time This defines how long the gun coil is energized during the chuck stripping operation.	Function F41 *Enables/Disables Chuck Stripper Function*	default 0 (off) option 1 (on)
		Function F43 *Sets Chuck Stripper Hold Time*	default 50 ms minimum 10 ms maximum 500 ms

7.3 Function Code Definitions

	Description	Default Value	Minimum Value	Maximum Value	Units	Zero state	One state	Comments
F1	Error Display	E---	E001	E018				Scrolls through error codes of active errors
F2	Weld Through Deck	0	0	1		disabled	enabled	Only Nelweld 6000 can enable this option
F3	Plunge Time	0.050	0.050	0.250	sec			Default changes to 0.180 if weld through deck enabled.
F4	Pilot Arc Time	0.050	0.010	0.100	sec			
F5	Prevent Welding if Error	0	0	1		disabled	enabled	Disables output capability when weld-related error occurs.
F6	Input Power Detection Scheme	0	0	1		autodetect	generator	Generator or power grid detection
F11	Lift Check Enable	1	0	1		disabled	enabled	
F12	Lift Check Delay Time	2000	500	9999	sec			
F13	Lift Check Hold Time	2000	500	9999	sec			
F14	Gas Valve Enable	0	0	1		disabled	enabled	
F15	Gas Valve Preflow Time	0.500	0	5.000	sec			
F16	Gas Valve Postflow Time	0.500	0	5.000	sec			
F21	Feed Signal Enable	0	0	1		disabled	enabled	
F22	Feed Signal Level	0	0	1		active low	active high	
F23	Feed Signal Style	0	0	1		contact loss	after weld	
F24	Feed Signal Pulse Width	0.010	0.010	0.500	sec			
F25	Feed Signal Air Trigger Enable	1	0	1		disabled	enabled	Stud feed on air trigger. Overridden if F21 is disabled.
F26	Quick Retry Enable	0	0	1		disabled	enabled	Truncates gun lift time on misfire.
F31	User Weld Counter (millions)	0	0	999				Resettable user weld counter - millions
F32	User Weld Counter (thousands)	0	0	999				Resettable user weld counter - thousands
F33	User Weld Counter (hundreds)	0	0	999				Resettable user weld counter - hundreds
F34	Total Weld Counter (millions)	0	0	999				Non-resettable total weld counter - millions
F35	Total Weld Counter (thousands)	0	0	999				Non-resettable total weld counter - thousands
F36	Total Weld Counter (hundreds)	0	0	999				Non-resettable total weld counter - hundreds
F41	Chuck Stripper Enable	0	0	1		disabled	enabled	
F42	Chuck Stripper Delay Time	0.200	0.010	2.000	sec			
F43	Chuck Stripper Hold Time	0.050	0.010	0.500	sec			
F44	Reset to Factory Defaults	FAC						Reset all non-preset parameters
F45	Front Panel Lock Enable	0	0	1		disabled	enabled	
F46	Supervisor's Lock Combination	1234	1111	6666				Password must be 4 digits.
F51	Model Number	4000	2000	6000				Read only - Nelweld model number (2000-6000)
F52	Line Frequency	60.0	40.0	70.0				Read only - Updates every 5 sec.
F53	Software Version	X.XX						Read only
F54	Software Installation Month/Day	mmdd						Month and day the software was installed as *mmdd*
F55	Software Installation Year	yyyy						Year software was installed as *yyyy*
F56	Chuck Saver Enable	1	0	1		disabled	enabled	Allows multiple weld attempts without breaking contact
F61	Factory Use	750	0	1000				
F62	Factory Use	ABC	ABC	ACB				
F63	Factory Use	1	1	2				
F64	Factory Use	0	0	4000				
F65	Factory Use	20	20	20	x			
F66	Diagnostic Mode Enable	0	0	1		disabled	enabled	Enable for troubleshooting weld problems

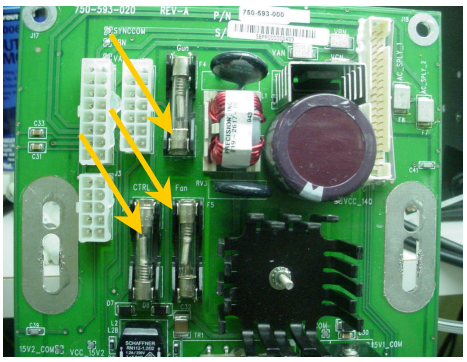
	Description	Default Value	Minimum Value	Maximum Value	Units	Zero state	One state	Comments
F111	Preset-Enabled Lock Mode	0	0	1		disabled	enabled	Enable to allow preset selections while locked.
F112	Loadbank Mode Enable	0	0	1		disabled	enabled	Enable to allow for supply of weld current through a fixed resistive load.
F113	Stud Feed Weld Success Enable	0	0	1		disabled	enabled	Enable to suppress stud feed signal under all conditions other than a successful weld.
F114	Calibration Factor	0	-200	+200				Offset adjustment factor for calibrating the Nelweld
F115	KFL Mode Enable	0	0	1		disabled	enabled	Enable only when using a KFL gun.
F116	Quick Pilot Arc Mode	1	0	1		disabled	enabled	Enable to fire main arc as soon as pilot arc is established.

7.4 Control Fuses

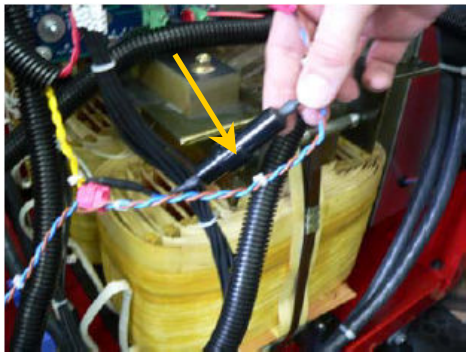
There are cartridge type fuses in the Nelweld that should only clear if the unit is abused or damaged (overvoltage, circuit board damage, wiring faults,etc).

Designator	Type	Case	Part Number	Protects	Location in Nelweld
F4	4A,250V, Slow Blow	3AG	715-060-003	F4: Gun supply.	In pilot arc board – See picture 1
F5 and F6	2A,250V, Slow Blow	3AG	715-060-004	F5: Fan Supply F6: Control supply.	In pilot arc board – See picture 1
F1*	4A,250V, Slow Blow	3AG	715-060-003	F1 Gun Supply	Wiring harness from pilot arc PCB – See picture 2
F2	2.5A, 250V, Fast	5mm x 20mm	715-060-002	F2 Control Supply	In control power supply mounted to the front panel – See picture 3

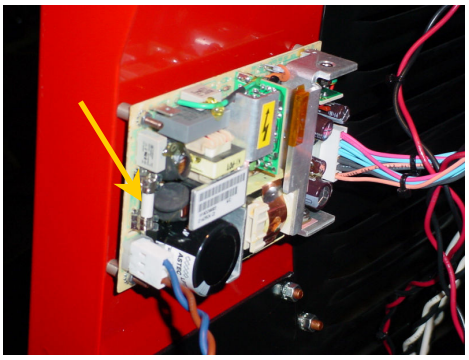
*400V units only



Picture 1. F4, F5, and F6



Picture 2. F1*



Picture 3. F2

7.5 Declaration of Conformity

Stud Welding Unit Nelweld 4000 and 6000
for the drawn-arc and short-cycle welding methods

NELSON BOLZENSCHWEISSEN

Declaration of Conformity

Manufacturer and technical documentation holder:	**Nelson Stud Welding, Inc** **7900 West Ridge Road** **Eyria, Ohio 44036-2019 USA**
European Representative:	**Nelson Bolzenschweiß-Technik GmbH & Co. KG** **58285 Gevelsberg** **Germany**

Hereby declare,
that the welding unit of type Nelweld 4000 and Nelweld 6000 for the welding of studs in keeping with the drawn-arc and short-cycle welding method was developed, constructed and manufactured in accordance with the following
EC guidelines:

- Low voltage 2006/95/EEC
- EMC 2004/108/EEC

The following harmonised European standards have been applied:

- EN 60974-1 "Safety requirements for arc welding devices" (2005)
- EN 60974-12 "Coupling devices for welding cables" (2005)
- EN 60529 "Degrees of protection provided by enclosures (IP-Code)" (2000)
- EN 60974-10 "Electromagnetic compatibility (EMC) requirements" Product standard for arc welding equipment (2003)

The following national standards and specifications have been applied:

- Accident preventation regulation BGV A3 "Electrical installations and operating materials" (1997)
- Accident preventation regulation BGV D1 "Welding, cutting and related processes" (2001)

Technical documentation is completely to hand.
The operating and service instructions pertinent to the Nelweld 4000 and 6000 are available,

- in the original version
- in the operator's language

Manufacturer:

Ken Caratelli
Managing Director
Eyria, Ohio 44036-2019
USA, 05.09.2007

Chris Hsu
Director of Engineering
Elyria, Ohio 44036-2019
USA; 05.09.2007

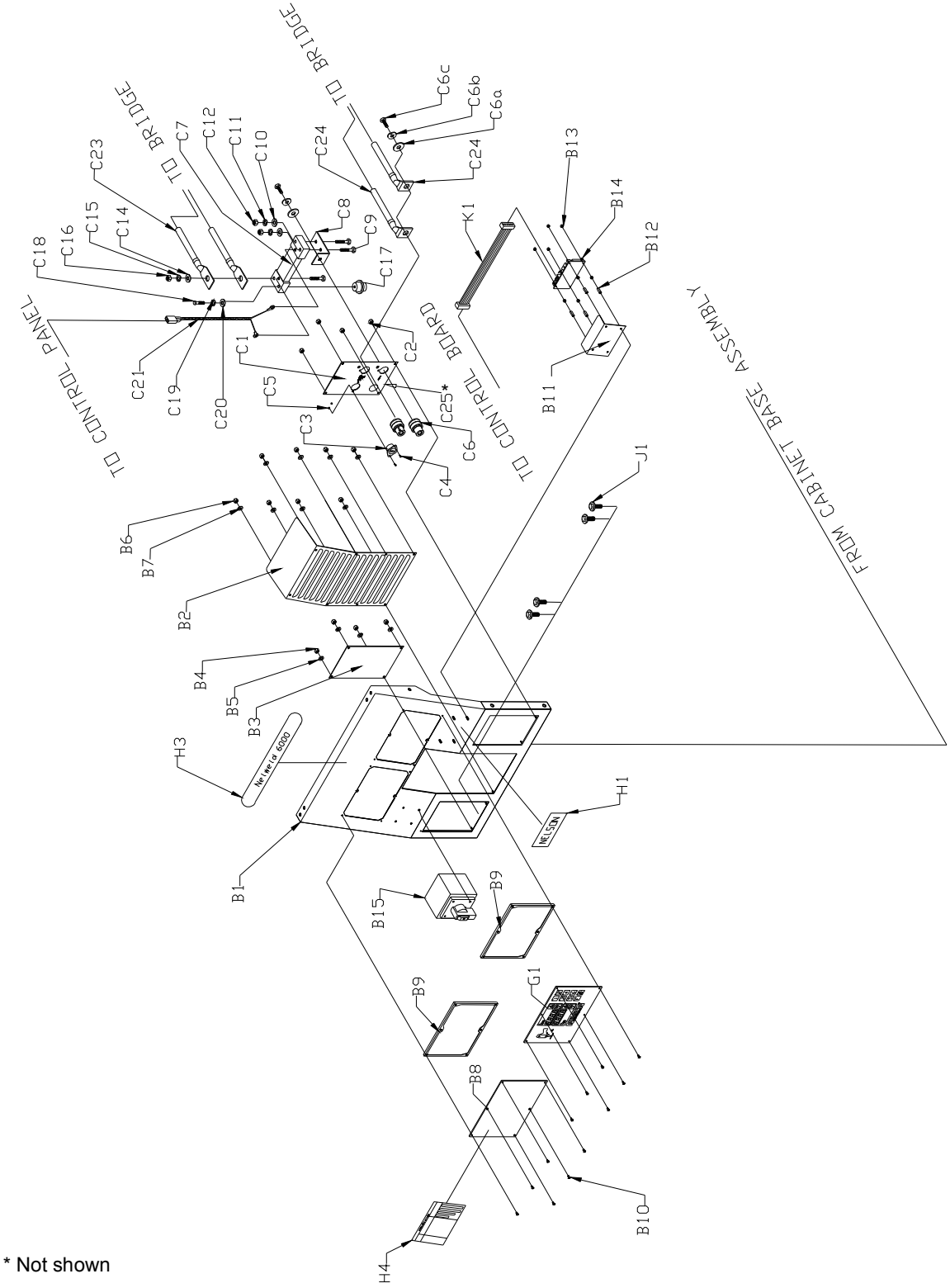
European Representative:

Detlev Vierschilling
Managing Director
58285 Gevelsberg Germany, Date _____

NELSON STUD WELDING

8.0 Diagrams and Parts Lists

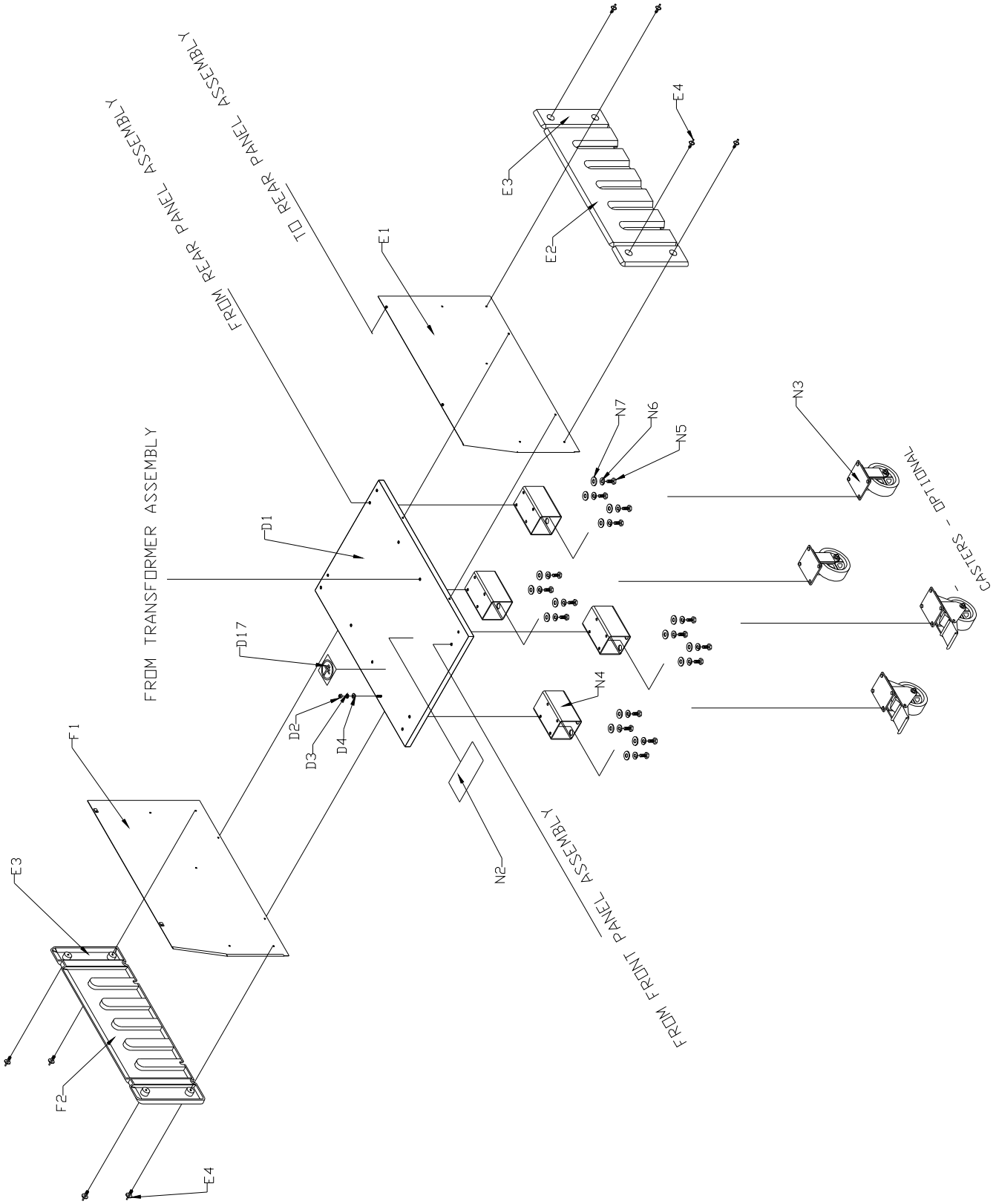
8.1 Front Section



Label	Description	Quantity 1 Gun	Quantity 2 Gun	Part Number
B1	Case front panel, 3000/4000	1	1	750-601-201
	Case front panel, 5000/6000	1	1	750-600-203
B2	Louver Panel, 3000/4000	1	1	750-601-202
	Louver Panel, 5000/6000	1	1	750-600-204
B3	Blank output panel, single output units only	1	1	750-600-216
B4	Cover plate mounting hardware, nut M5 keps	4	4	524-005-204
B5	Cover plate mounting hardware, washer 5mm flat	4	4	524-005-118
B6	Frount louver mounting hardware, nut M5 keps	4	4	524-005-204
B7	Frount louver mounting hardware, washer 5 mm flat	4	4	524-005-118
B8	Blank display panel, single output units only	1	1	750-600-218
B9	Display panel gasket	2	2	750-600-219
B10	Display panel mounting hardware, screw M4 x 12	12	12	524-005-212
B11	Power suply shield	-	-	750-600-205
B12	Power supply mounting hardware, spacer 6mm x 8mm	4	4	729-099-000
B13	Power supply mounting hardware, nut M3 keps	8	8	542-005-208
B14	Power supply, 20W +12V -12V +5V	1	1	729-011-200
B15	Switch disconnect, 3000/4000	1	1	709-261-000
	Switch disconnect, 5000/6000, 230/460/575V	1	1	709-261-010
	Switch disconnect, 5000/6000, 208/230/460V	1	1	709-261-020
C1	Output panel, 3000	1	2	750-602-201
	Output panel, 4000/5000/6000	1	2	750-600-215
C2	Frount louver mounting hardware, nut M5 keps	4	4	524-005-204
	Frount louver mounting hardware, washer 5 mm flat	4	4	524-005-118
C3	Control cable connector, 3-pin	1	2	714-174-004
C4	Control cable connector mounting hardware, M3 x 10 screw	2	4	524-005-127
C5	Control cable connector mounting hardware, nut M3 keps	2	4	524-005-208
C6	Dinse connector, female 500A, 3000	2	4	714-166-099
	Dinse connector, female 600A, 4000/5000/6000	2	4	714-166-100
C7	Shunt	1	1	729-097-000
C8	Shunt bracket, 3000	1	1	750-602-202
	Shunt bracket. 4000/5000/6000	1	1	750-600-217
C9	Shunt mounting hardware, screw M10 x 50	2	2	524-005-211

Label	Description	Quantity 1 Gun	Quantity 2 Gun	Part Number
C10	Shunt mounting hardware, washer 10mm flat	2	2	524-005-147
C11	Shunt mounting hardware, washer 10mm locking	2	2	524-005-083
C12	Shunt mounting hardware, nut M10 x 15. Hex	2	2	524-005-174
C13	Shunt mounting hardware, M10 x 50 screw	1	1	524-005-211
C14	Shunt mounting hardware, washer 10mm flat	1	1	524-005-147
C15	Shunt mounting hardware, washer 10mm lock	1	1	524-005-083
C16	Shunt mounting hardware, nut M10 x 15, hex	1	1	524-005-174
C17	Shunt standoff, insulated	1	1	729-100-000
C18	Shunt standoff mounting hardware, screw M8 x 38	1	1	542-002-220
C19	Shunt standoff mounting hardware, washer 8mm spring lock	1	1	524-005-082
C20	Shunt standoff mounting hardware, washer 8mm flat	1	1	524-005-183
C21	Shunt harness, output 1	1	1	723-241-013
	Shunt harness, output 2	0	1	723-241-018
C23	Weld cable, bridge to shunt, output 1, pos, 3000	1	1	720-544-101
	Weld cable, bridge to shunt, output 1, pos, 4000	1	1	720-544-001
	Weld cable, bridge to shunt, output 1, pos, 5000/6000	2	2	720-544-001
	Weld cable, bridge to shunt, output 2, pos, 3000	0	1	720-544-103
	Weld cable, bridge to shunt, output 2, pos, 4000	0	1	720-544-003
	Weld cable, bridge to shunt, output 2, pos, 5000/6000	0	2	720-544-003
C24	Weld cable, Dinse to bridge, output 1, neg, 3000	1	1	720-544-102
	Weld cable, Dinse to bridge, output 1, neg, 4000	1	1	720-544-002
	Weld cable, Dinse to bridge, output 1, neg,5000/6000	2	2	720-544-002
	Weld cable, Dinse to bridge, output 2, neg, 3000	0	1	720-544-104
	Weld cable, Dinse to bridge, output 2, neg, 4000	0	1	720-544-004
	Weld cable, Dinse to bridge, output 2, neg, 5000/6000	0	2	720-544-004
C25	RS-232 Assembly	1	2	721-310-003
G1	Front panel display	1	2	750-591-001
H1	Front panel display decal	1	2	724-569-600
H3	Nelson Stud Welding nameplate	1	1	724-569-003
H4	Weld data decal	1	1	724-569-007
J1	Case front panel mounting bolt	4	4	524-005-218
K1	DC power supply harness, single gun	1	0	723-241-000
	DC power supply harness, dual gun	0	1	723-241-010

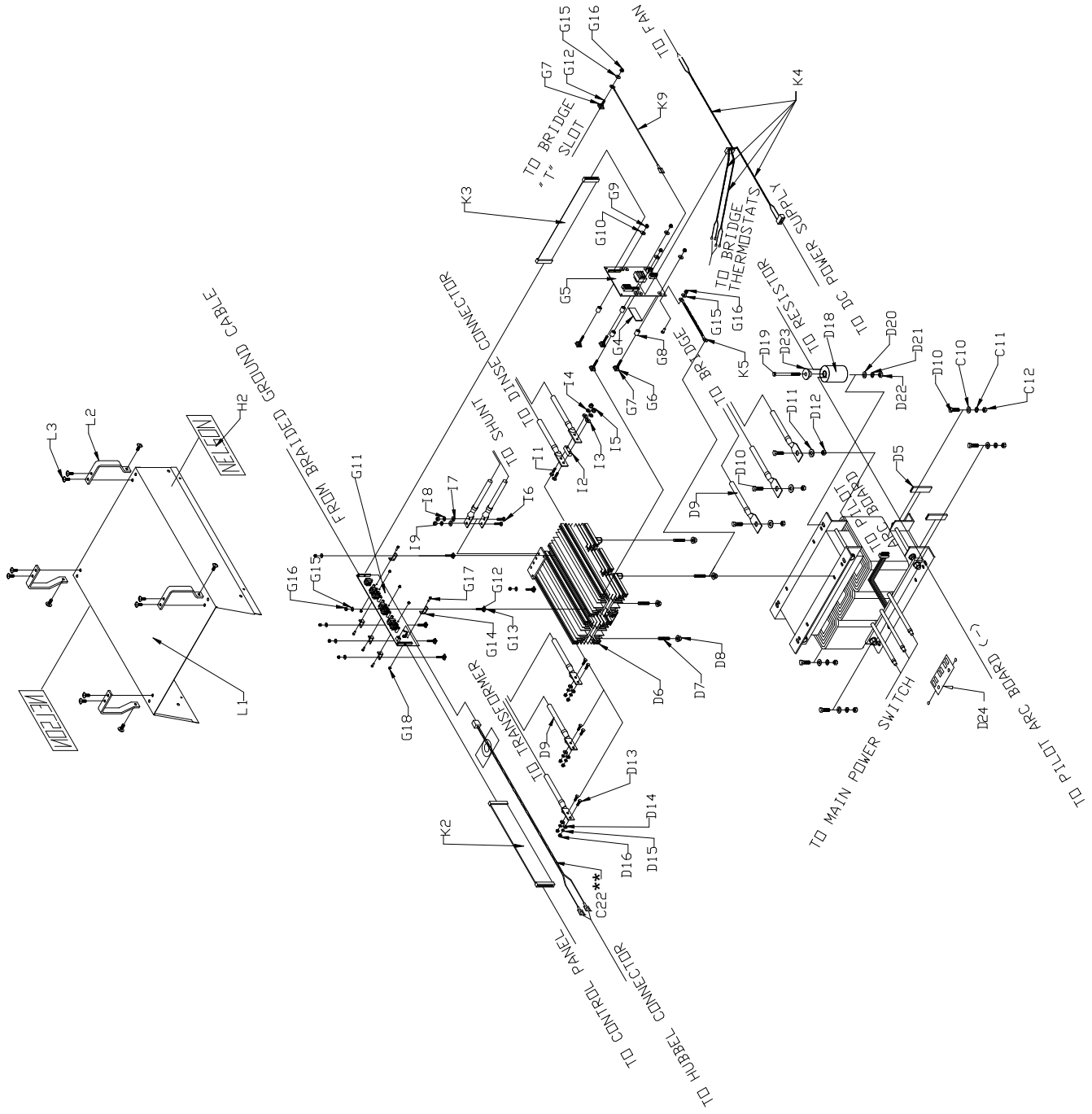
8.2 Base and Side Cabinet Section



8.3

Label	Description	Quantity 1 Gun	Quantity 2 Gun	Part Number
D1	Cabinet base panel, 3000/4000	1	1	750-601-100
	Cabinet base panel, 5000/6000	1	1	750-600-100
D2	Ground stud connection hardware, nut M8 x 1.25 hex	1	1	524-005-054
D3	Ground stud connection hardware, washer 8mm locking	1	1	524-005-082
D4	Ground stud connection hardware, washer 8mm flat	1	1	524-005-143
D17	Protected earth ground decal	1	1	724-569-005
E1	Left side cabinet panel, 3000/4000	1	1	750-601-205
	Left side cabinet panel, 5000/6000	1	1	750-600-208
E2	Left side case bumper, 3000/4000	1	1	750-601-207
	Left side case bumper, 5000/6000	1	1	750-600-210
E3	Cabinet bumper end cap, 5000/6000	2	2	750-600-212
E4	Side bumper attachment hardware, rivet push-type	8	8	729-098-000
F1	Right side cabinet panel, 3000/4000	1	1	750-601-206
	Right side cabinet panel, 5000/6000	1	1	750-600-209
F2	Right side cabinet bumper, 3000/4000	1	1	750-601-207
	Right side cabinet bumper, 5000/6000	1	1	750-600-211
N2	Voltage selection decal	1	1	724-569-100
N3	Caster kit 6", 3000/4000	opt	opt	512-387-000
	Caster kit 8" 5000/6000	opt	opt	512-387-001
N4	Cabinet base leg	4	4	750-600-201
N5	Leg attachment hardware, bolt M10 x 20	16	16	524-005-145
N6	Leg attachment hardware, washer 10mm locking	16	16	524-005-083
N7	Leg attachment hardware, washer 10mm flat	16	16	524-005-147

Transformer and Top Cabinet Section



* European units only

** Alternate is used on European units. See parts list.

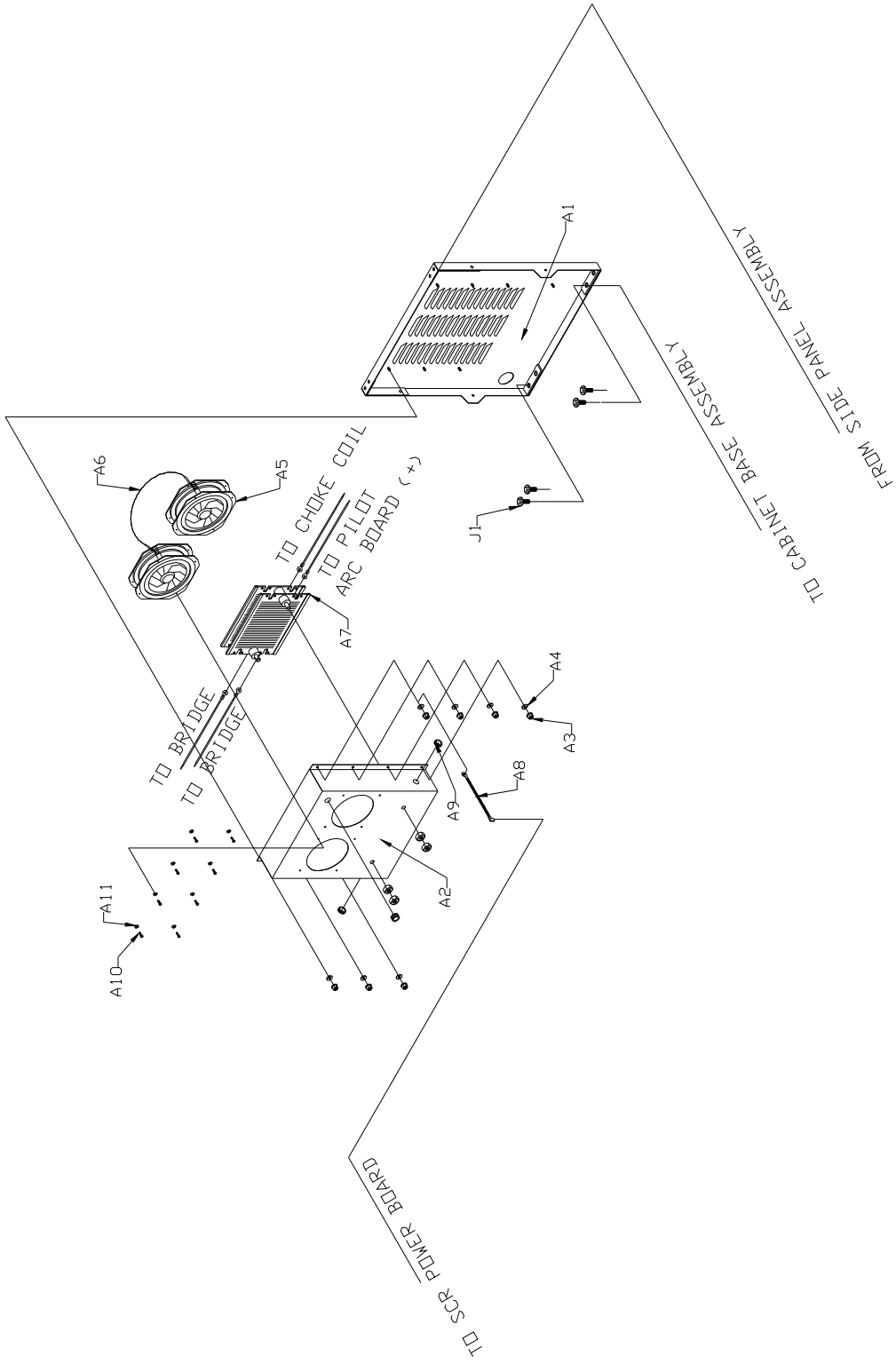
Label	Description	Quantity 1 Gun	Quantity 2 Gun	Part Number
C10	Transformer mounting hardware, washer 10mm flat	4	4	524-005-147
C11	Transformer mounting hardware, washer 10mm locking	4	4	524-005-038
C12	Transformer mounting hardware, nut M10 x 15. Hex	4	4	524-008-078
C22	Control connector to SCR Power PCB	1	2	723-241-007
C22	Alternate control connector to SCR Power PCB with filter (on European units only)	1	2	723-241-026
D5	Transformer mounting angle iron	2	2	729-105-000
D6	Bridge assembly, 1 output, 3000/4000	1	0	750-601-107
	Bridge assembly, 2 output, 3000/4000	0	1	750-601-108
	Bridge assembly, 1 output, 5000/6000	1	0	750-600-107
	Bridge assembly, 2 output 5000/6000	0	1	750-600-108
D7	Bridge mounting hardware, screw M6 x 25, 3000/4000	4	4	524-002-315
	Bridge mounting hardware, screw M8 x 38, 5000/6000	4	4	524-002-424
D8	Bridge mounting hardware, nut M6 x 1 hex	4	4	524-001-277
	Bridge mounting hardware, nut M8 x 1.25 hex	4	4	524-001-276
D9	Cable, Transformer to Bridge, 3000	3	3	720-544-100
	Cable, Transformer to Bridge, 4000/5000/6000	3	3	720-544-000
D10	Cable mounting hardware, screw M10 x 25	3	3	524-005-203
D11	Cable mounting harrdware, washer 10mm locking	3	3	524-005-083
D12	Cable mounting hardware, nut M10 x 1.5 hex	3	3	524-005-078
D13	Cable mounting hardware, screw M8 x 20	6	6	524-002-126
D14	Cable mounting hardware, nut M8 x 1.25 hex	6	6	524-002-218
D15	Cable mounting hardware, washer 8mm spring locking	6	6	524-005-082
D16	Cable mounting hardware, washer 8mm flat	6	6	524-005-143
D18	Choke coil	1	2	700-141-000
D19	Choke coil mounting hardware, bolt M10 x 90 hex head	1	2	524-001-274
D20	Choke coil mounting hardware, washer 10mm flat	1	2	524-002-021
D21	Choke coil mounting hardware, washer 10mm spring locking	1	2	524-002-020
D22	Choke coil mounting hardware, nut M10 x 1.5	1	2	524-002-019
D23	Choke coil mounting hardware, shoulder bushing	1	2	527-002-041
D24	Line Filter (on European units only)	1	2	750-600-250
G4	Gap pad, thermally conductive	1	2	729-106-030
G5	Pilot Arc PCB	1	2	750-593-000
G6	Pilot Arc PCB mounting hardware, screw M5 x 30	4	8	524-005-213
G7	Pilot Arc PCB mounting hardware, screw slot adapter	4	8	750-600-222

Label	Description	Quantity 1 Gun	Quantity 2 Gun	Part Number
G8	Pilot Arc PCB mounting hardware, spacer	4	8	750-600-224
G9	Pilot Arc PCB mounting hardware, nut M5 keps	4	8	524-005-204
G10	Pilot Arc PCB mounting hardware, washer 5mm flat	4	8	524-005-118
G11	SCR Power PCB	1	2	750-592-001
G12	SCR Power PCB mounting hardware, screw M5 x 16	5	10	524-005-136
G13	SCR Power PCB mounting hardware, screw slot adapter	5	10	750-600-222
G14	SCR Power PCB mounting hardware, mounting bracket	5	10	750-600-225
G15	SCR Power PCB mounting hardware, washer M5 fender x 20	5	10	524-005-217
G16	SCR Power PCB mounitng hardware, nut M5 keps	5	10	524-005-204
G27	SCR Power PCB mounting hardware, screw M5 x 16	5	10	524-005-214
G18	SCR Power PCB mounting hardware, nut M5 keps	5	10	524-005-204
H2	Decal, Nelson logo	2	2	724-569-004
I1	Anode lead hardware, single lead, screw M8 x 40, 3000/4000	2	4	524-002-126
	Anode lead hardware, dual lead, screw M8 x 40, 5000/6000	2	4	524-002-532
I2	Dual anode lead mounting hardware, cable lug spacer	1	2	750-600-223
I3	Single/dual lead mounting hardware, washer 8mm flat	2	4	524-005-143
I4	Single/dual lead mounting hardware, washer 8mm spring lock	2	4	524-005-082
I5	Single/dual lead mounting hardware, nut M8 hex	2	4	524-002-218
I6	Cathode lead hardware, single lead, screw M8 x 40, 3000/4000	2	4	524-002-126
	Cathode lead hardware, dual lead, screw M8 x 40, 5000/6000	2	4	524-002-220
I7	Single/dual lead mounting hardware, washer 8mm flat	2	4	524-005-143
I8	Single/dual lead mounting hardware, washer 8mm spring lock	2	4	524-005-082
I9	Single/dual lead mounting hardware, nut M8 hex	2	4	524-002-218
K2	Cable, 50-pin, SCR Power PCB to Control	1	2	723-241-003
K3	Cable, 50-pin, SCR Power PCB to Pilot Arc PCB	1	2	723-241-008
K4	Wiring harness, pilot arc	1	1	723-241-009
K5	Cable, pilot arc to ground	1	2	723-241-015
K9	Wiring harness, pilot arc to third phase	1	2	723-241-016
L1	Cabinet top panel, 3000/4000	1	1	750-601-208
	Cabinet top panel, 5000/6000	1	1	750-600-213
L2	Lifting handle	4	4	750-600-214
L3	Lifting handle mounting hardware, M10 x 20	12	12	524-005-207

709-080-001 (Thermo switch N.O. 37 deg C) for fan
709-080-002 (Thermo switch N.C. 102 deg C) for SCR overtemp.

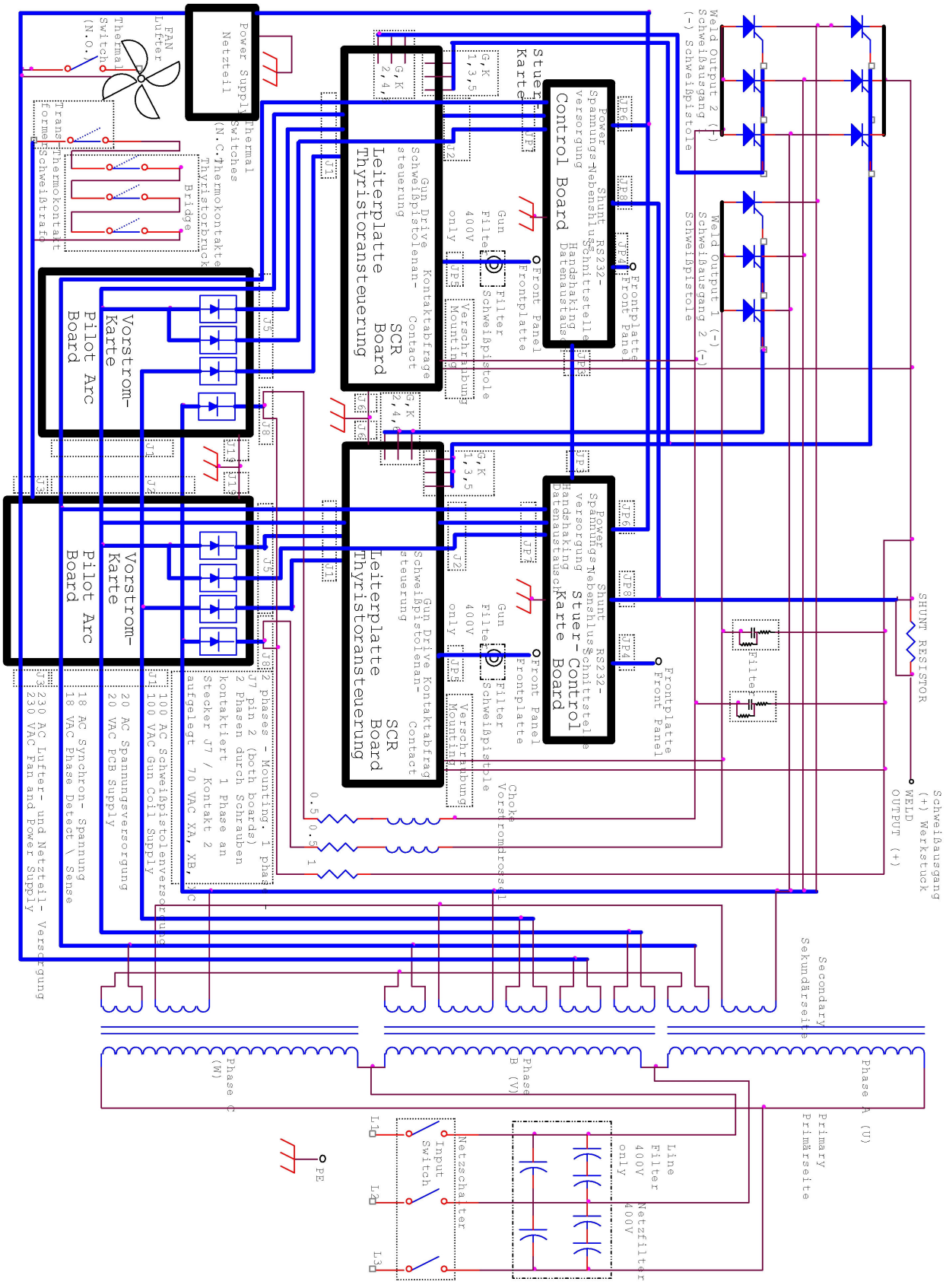
Note: Most wire harnesses are stocked in kits 723-241-300 (dual gun harness kit and 723-241-301 (single gun harness kit). For European kits: 723-241-302 (dual gun harness kit) and 723-241-303 (single gun harness kit).

8.4 Rear Cabinet Section



Label	Description	Quantity 1 Gun	Quantity 2 Gun	Part Number
A1	Cabinet rear panel, 3000/4000	1	1	750-601-203
	Cabinet rear panel, 5000/6000	1	1	750-600-206
A2	Plenum, small single fan, 3000	1	1	750-602-200
	Plenum, large single fan, 4000	1	1	750-601-204
	Plenum, dual fan, 5000/6000	1	1	750-600-207
A3	Plenum assembly hardware, nut M5 keps	7	7	524-005-204
A4	Plenum assembly hardware, washer 5mm flat	7	7	524-005-118
A5	Fan, small, 3000	1	1	729-096-010
	Fan, large, 4000	1	1	729-096-000
	Fan small, 5000/6000	2	2	729-096-010
A6	Wiring harness, 5000/6000	1	1	723-241-021
A7	Pilot arc resistor, 2 resistor assembly	1	0	705-001-007
	Pilot arc resistor, 3 resistor assembly	0	1	705-001-006
A8	Ground braid for SCR Power PCB	1	2	723-241-012
A9	Grommet, push type	3	3	717-140-002
A10	Fan mounting hardware, screw, 3000	4	4	524-001-273
	Fan mounting hardware, screw, 4000	4	4	524-001-272
	Fan mounting hardware, screw, 5000/6000	4	4	524-001-273
A11	Fan mounting hardware, washer, 3000	4	4	524-002-123
	Fan mounting hardware, washer, 4000	4	4	524-002-033
	Fan mounting hardware, washer, 5000/6000	4	4	524-002-123
J1	Case rear panel mounting bolt	4	4	524-005-218

8.5 Wiring Diagram



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