NCD+ Auto-Gap Gun

Instruction & Maintenance Manual

(729-110-042)

CAUTION

These instructions are intended for experienced operators.

If you are not fully familiar with the principles of operation and safe practices for arc welding equipment, we urge you to read AWS SP – "Safe Practices" available from the American Welding Society.

Do not permit untrained persons to install, operate or maintain the equipment. Do not attempt to install or operate the equipment until you have read and fully understand these instructions.

If you do not fully understand these instructions, contact your supplier for further information. Be sure to read the Safety section before utilizing this equipment.

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 90 days from the date the equipment was delivered, whichever comes 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.

WARNING

The following Safety section is for your protection. It summarizes precautionary information from the references listed in the Additional Safety Information section. Before performing any installation or operating procedures, be sure to read and follow the safety precautions listed below as well as all other manuals, material safety data sheets, labels, etc. Failure to observe these precautions can result in injury or death.

PROTECT YOURSELF AND OTHERS

Some welding, cutting, and gouging processes are noisy and require ear protection. The arc, like the sun, emits ultraviolet (UV) rays and other radiation which can harm the skin and eyes. Hot metal can cause burns. Training in the proper use of the processes and equipment is essential to prevent accidents. Therefore:

1. Always wear safety glasses with side shields in any work area, even if welding helmets, face shields and goggles are also required.
2. Use a face shield fitted with filter shade #3 per ANSI Z87.1. Cover sparks and rays of the arc when operating or observing operations. Warn bystanders not to watch the arc and not to expose themselves to the rays of the electric-arc or hot metal.
3. Wear flameproof gauntlet type gloves, heavy long-sleeve shirt, cuffless trousers, high topped shoes, and a welding helmet or cap for hair protection, to protect against arc rays and hot sparks or hot metal. A flameproof apron may also be desirable as protection against radiated heat and sparks.
4. Hot sparks or metal can lodge in rolled up sleeves, trousers cuffs or pockets. Sleeves and collars should be kept buttoned and open pockets eliminated from the front of clothing.
5. Protect other personnel from arc rays and hot sparks with suitable nonflammable partitions or curtains.
6. Use goggles over safety glasses when chipping slag or grinding. Chipped slag may be hot and can fly far. Bystanders should also wear goggles over safety glasses.

FIRES AND EXPLOSIONS

Heat from flames and arcs can start fires. Hot slag or sparks can also cause fires and explosions. Therefore:

1. Remove all combustible materials well away from the work area or cover the materials with a protective nonflammable covering. Combustible materials include wood, cloth, sawdust, liquid and gas fuels, solvents, paints and coatings, paper, etc.
2. Hot sparks or hot metal can fall through cracks or crevices in floors or wall openings and cause a hidden smoldering fire or fires on the floor below. Make certain that such openings are protected from hot sparks and metal.
3. Do not weld, cut, or perform other hot work until the work piece has been completely cleaned so that there are no substances on the work piece which might produce flammable or toxic vapors. Do not do hot work on closed containers. They may explode.
4. Have appropriate fire extinguishing equipment handy for instant use, such as a garden hose, water pail, sand bucket or portable fire extinguisher. Be sure you are trained for proper use.
5. Do not use equipment beyond its ratings. For example, overloaded welding cable can overheat and create a fire hazard.
6. After completing operations, inspect the work area to make certain there are no hot sparks or hot metal which could cause a later fire. Use fire watchers when necessary.
7. For additional information, refer to NFPA Standard 51B, “Fire Prevention in Use of Cutting and Welding Processes,” available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

ELECTRICAL SHOCK

Contact with live electrical parts and ground can cause severe injury or death. DO NOT use welding current in damp areas, if movement is confined, or if there is danger of falling. Therefore:

1. Be sure the power source frame (chassis) is connected to the ground system of the input power.
2. Connect the work piece to a good electrical ground.
3. Connect the work cable to the work piece. A poor or missing connection can expose you or others to a fatal shock.
4. Use well-maintained equipment. Replace worn or damaged cables.
5. Keep everything dry, including clothing, work area, cables, torch/electrode holder and power source.
6. Make sure that all parts of your body are insulated from work and from the ground.
7. Do not stand directly on metal or the earth while working in tight quarters or a damp area; stand on dry boards or an insulating platform and wear rubber soled shoes.
8. Put on dry, hole-free gloves before turning on the power.
9. Refer to ANSI/ASC Standard Z49.1 for specific grounding recommendations. Do not mistake the work lead for a ground cable.

ELECTRICAL AND MAGNETIC FIELDS

Electric and magnetic fields may be dangerous. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding and cutting current creates EMF around welding cables and welding machines. Therefore:

1. Operators having pacemakers should consult their physician before welding. EMF may interfere with some pacemakers.
2. Exposure to EMF may have other health effects which are unknown.
3. Operators should use the following procedures to minimize exposure to EMF:
4. Route the electrode and work cables together. Secure them with tape when possible.
5. Never coil the torch or work cable around your body.
6. Do not place your body between the torch and work cables. Route cables on the same side of your body.
7. Connect the work cable to the work piece as close as possible to the area being welded.
8. Keep welding power source and cables as far away from your body as possible.

FUMES AND GASES

Fumes and gases can cause discomfort or harm, particularly in confined spaces. Do not breathe fumes and gases. Shielding gases can cause asphyxiation. Therefore:

1. Always provide adequate ventilation in the work area by natural or mechanical means. Do not weld, cut, or gouge on materials such as galvanized steel, stainless steel, copper, zinc, lead, beryllium, or cadmium unless positive mechanical ventilation is provided. Do not breathe fumes from these materials.
2. Do not operate near degreasing and spraying operations. The heat or arc rays can react with chlorinated hydrocarbon vapors to form phosgene, a highly toxic gas, and other irritant gasses.
3. If you develop momentary eye, nose, or throat irritation while operating, this is an indication that ventilation is not adequate. Stop work and take necessary steps to improve ventilation in the work areas. Do not continue to operate if physical discomfort persists.
4. Refer to ANSI/ASC Standard Z49.1 (see listing on next page) for specific ventilation recommendations.

ELECTRICALLY POWERED EQUIPMENT

Faulty or improperly electrified equipment can cause injury or death. Therefore:

1. Always have qualified personnel perform the installation, troubleshooting, and maintenance work. Do not perform any electrical work unless you are qualified to perform such work.
2. Before performing any work inside a power source, disconnect the power source from the incoming electrical power using the disconnect switch at the fuse box before working on the equipment.
3. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacture's recommendations.
4. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

CYLINDER HANDLING

Cylinders, if mishandled, can rupture and violently release gas. Sudden rupture of cylinder, valve, or relief device can injure or kill. Therefore:

1. Use the proper gas for the process and use the proper pressure reducing regulator designed to operate from the compressed gas cylinder. Do not use adaptors. Maintain hoses and fittings in good condition.
2. Always secure cylinders in an upright position by chain or strap to suitable hand trucks, undercarriages, benches, walls, post, or racks. Never secure cylinders to work tables or fixtures where they may become part of an electrical circuit.
3. When not in use, keep cylinder valves closed. Have valve protection cap in place if regulator is not connected. Secure and move cylinders by using suitable hand trucks. Avoid rough handling of cylinders.
4. Locate cylinders away from heat, sparks, and flames. Never strike an arc on a cylinder.
5. For additional information, refer to CGA Standard P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders", which is available from Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

HEARING PROTECTION

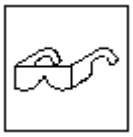
Prolonged Noise from Capacitor Discharge welding applications can damage hearing if levels exceed limits specified by OSHA. Therefore:

1. Use Approved ear plugs or ear muffs if noise level is high.
2. Warn others nearby about noise hazard.
3. For additional information, refer to OSHA Safety Standards 3074.

MOVING PARTS CAN CAUSE INJURY

Electric fan can start at any time without warning and cause severe injury, therefore:

1. Always disconnect electrical power prior to service to prevent the fan from starting unexpectedly.
2. Keep all doors, panels, covers, and guards closed and securely in place.
3. Have only qualified people remove guards or covers for maintenance and troubleshooting as necessary.
4. Keep hands, hair, loose clothing, and tools away from moving parts.
5. Reinstall panels or guards and close doors when servicing is finished and before reenergizing welder.



EYE PROTECTION

Flying metal can injure eyes. Welding, chipping, wire brushing and grinding can cause sparks and flying metal. As welds cool, they can throw off slag. Therefore:

1. Wear approved safety glasses with side shields even under your welding helmet.
2. Warn others nearby about flying metal hazard.

EQUIPMENT MAINTENANCE

Faulty or improperly maintained equipment can cause injury or death. Therefore:

1. Always have qualified personnel perform the installation, troubleshooting, and maintenance work. Do not perform any electrical work unless you are qualified to perform such work.
2. Before performing any maintenance work inside a power source, disconnect the power source from the incoming electrical power.
3. Maintain cables, grounding wire, connections, power cord, and power supply in safe working order. Do not operate any equipment in faulty condition.
4. Do not abuse any equipment or accessories. Keep equipment away from:
   - heat sources such as furnaces
   - wet conditions such as water puddles and inclement weather
   - oil or grease
   - corrosive atmospheres
5. Keep all safety devices and cabinet covers in position and in good repair.
6. Use equipment only for its intended purpose. Do not modify it in any manner.

ADDITIONAL SAFETY INFORMATION

For more information on safe practices for electric arc welding, refer to the following publications.

1. ANSI/ASC Z49.1 Safety in Welding and Cutting
2. AWS C5.1 Recommended Practices for Plasma Arc Welding
3. AWS C5.6 Recommended Practices for Gas Metal Arc Welding
4. AWS SP Safe Practices (Reprint) Welding Handbook
5. ANSI/AWS F4.1 Recommended Safe Practices for Welding and Cutting of Containers That Have Held
   Hazardous Substances.

Contents

1 Overview

The Nelson NCD+ stud welding guns are made to be used with Nelson NCD+ stud welding power units, which utilize the capacitor discharge principal of stud welding. This system is designed to use fasteners, which are manufactured with a small projection on the weld end and are welded by either the Contact or Gap method. Heat for fusion is obtained from an electric arc, which is established by flashing away the small projection. The discharge of the welding current or energy stored in the capacitors produces an arc that melts the end of the stud and a portion of the base material. The stud is forced into the molten metal before the conclusion of the arc cycle. Upon cooling, a uniform cross section bond is achieved. A special advantage of the capacitor discharge process is the limited heat generated, and low penetration which allows the fasteners to be welded to thin and/or coated parts opposite the weld side.

Selection of the “gap” or “contact” welding mode is application dependent. Gap welding usually provides superior weld reliability with aluminum and other non-ferrous metals. Contact welding is generally used with carbon steel and stainless steel especially when weld appearance is not a prime consideration. The contact welding setup is easier to make and the contact mode is somewhat more tolerant to work piece flexing.

The welding guns in this series are a “contact gun” which is suitable only for contact welding and an “auto-gap gun” which is suitable for both gap and contact welding.

NOTE: Depending upon the weld setup established for any particular stud size or material, the noise generated by the flashing away of the stud tip may exceed the allowable level established by the Occupational Safety and Health Administration (Section 50-204.10 of the Federal Register, Part II). For this reason, it is recommended that the stud welding operator and anyone working within the immediate area of the stud welding operation use proper ear protection.

SAFETY SYMBOLS **ATTENTION! BE ALERT! Your safety is involved.** 		**Used to call attention to immediate hazards which, if not avoided, will result in immediate, serious personal injury or loss of life.**
		**Used to call attention to potential hazards which could result in personal injury or loss of life.**
		**Used to call attention to hazards which could result in minor personal injury.**

1.1 Nelson NCD+ Welding Modes

There are 2 modes of the CD welding process offered with the NCD+ line of equipment: Contact and Auto-Gap. Each method has its own uses and set-up requirements. The method you select will be determined by the metals to be joined, esthetics, strength and fixturing. Nelson Stud Welding can assist you in determining which method and settings best suit your needs.

1.1.1 Contact Mode Capacitor Discharge Welding

1. Gun is loaded and properly positioned with the stud in contact with the work. Operator takes up the spring pressure.
2. The trigger is closed the projection tip is flashed off leaving an arc space.
3. The remaining stored energy is discharged across the arc space (Stud and base material are heated).
4. The spring pressure plunges the stud into the work piece.
5. The weld solidifies and connection is complete.

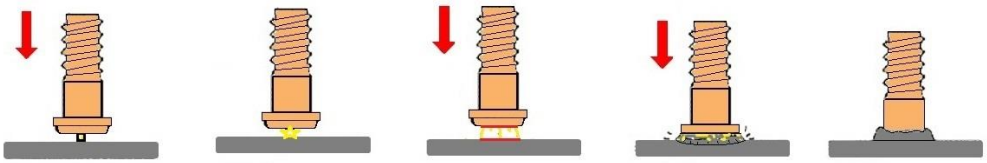


Figure 1.1 Contact Mode

1.1.2 Gap Mode Capacitor Discharge Welding

1. Gun is loaded and properly positioned with the stud in contact with the work. Operator takes up the spring pressure.
2. The trigger is closed and the coil lifts the stud momentarily.
3. The coil is de-energized. Spring pressure forces the stud to contact the work piece.
4. Upon contact the projection tip is flashed off leaving an arc space.
5. The remaining stored energy is discharged across the arc space (Stud and base material are heated).
6. The spring pressure plunges the stud into the work piece.
7. The weld solidifies and connection is complete.

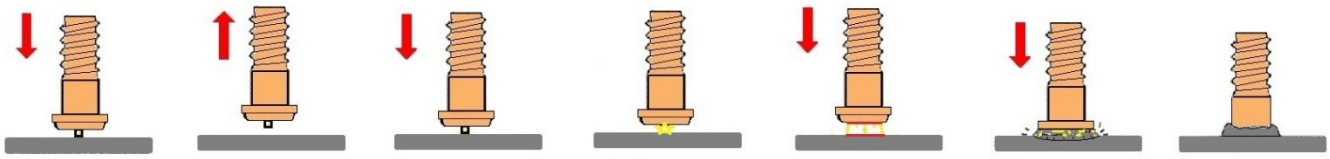


Figure 1.2 Gap Mode

1.2 NCD+ Guns

This manual covers the Auto-Gap weld gun. This gun can be used for Auto-Gap and Contact style welding applications.

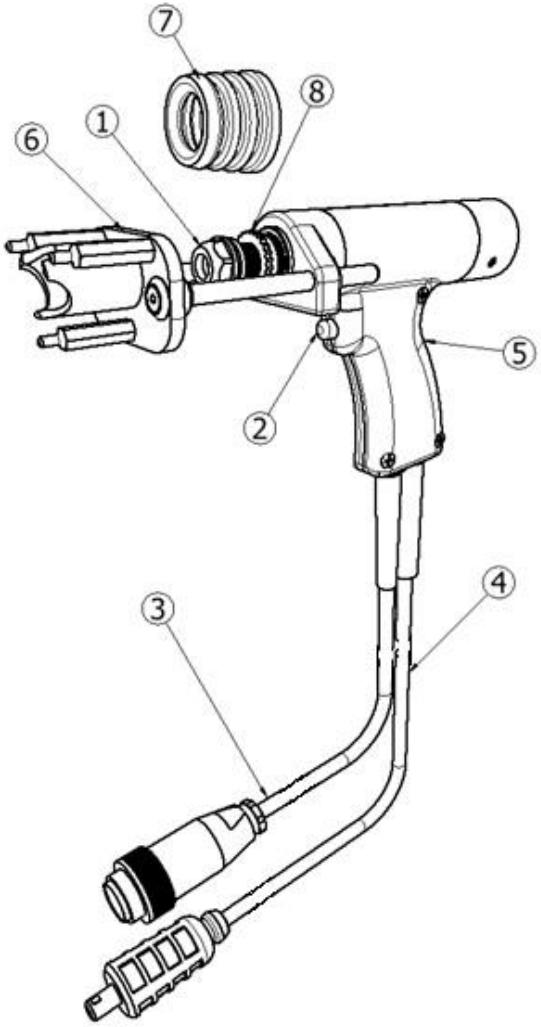
1.2.1 Operation of the Auto-Gap Gun (Gap Mode)

The NCD+ Auto-Gap gun is a capacitor discharge lift gun. There are two wires in the control cable that go to the gun coil and two wires that go to the trigger. When the trigger is pulled, the stud rises off the workpiece. The gun de-energizes and the main spring then pushes the stud back towards the workpiece. The arc begins once the stud contacts the work.

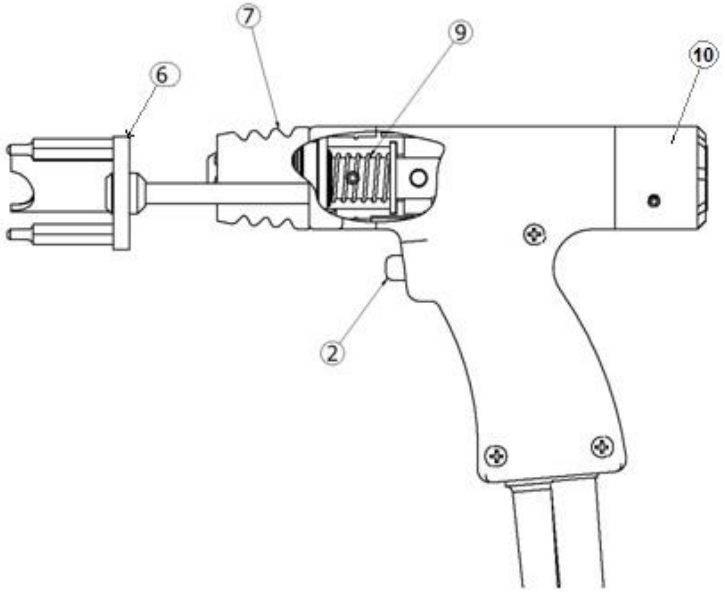
1.2.2 Operation of the Auto-Gap Gun (Contact Mode)

The NCD+ Auto-Gap Gun can also be used as a capacitor discharge contact gun. The coil does not lift the stud in this application. When the trigger is pulled, the capacitors discharge as the stud is held firmly against the workpiece. The tip is flashed off, that establishes an arc and allows the stud to plunge.

2 Features



1	CHUCK NUT
2	TRIGGER
3	CONTROL CABLE
4	WELD CABLE
5	GUN BODY (2 HALVES)
6	FOOT ASSEMBLY
7	BELLOWS
8	SPRING ADJUSTMENT COLLAR
9	MAIN SPRING
10	REAR CAP AND TRAVEL ADJ SCREW



3 Gun Set-Up

3.1 Chuck Assembly Instructions

CAUTION **The unit should be switched off before inserting or changing a chuck.**

3.1.1 Chuck Assembly

At the beginning of a welding series or in case of a necessary change to different stud dimensions, the chuck must be set to the correct stud type.

The chucks (**Figure 3.1 Chuck and Stop Assembly**) are not included and should be ordered separately.

*See

Accessories" for correct sizes and part numbers.

Job Preparation

Tools Required: Screwdriver, open-end wrench (7mm, 8mm), and caliper gauge

1 Select chuck with the correct diameter for the stud to be welded.
2 Stop pin assembly for the proper stud length.

3.1.2 Adjusting Chuck and Stop Assembly

CAUTION **The unit should be switched off before inserting or changing a chuck.**

To adjust the Chuck and Stop Assembly (Figure 3.1 Chuck and Stop Assembly):

The proper size chuck for the type of stud being welded must be used to ensure good electrical contact between the stud and the stud chuck. If the stud fit seems too loose with the proper chuck, the chuck tines may be pressed slightly together at the front end of the chuck.

3.1.3 Adjusting Stud Stop Assembly

1 Loosen the set screw.
2 Adjust the stud stop so that the stud being welded extends 4 mm beyond the chuck.
3 Tighten set screw.

NOTE: For long studs, use maximum chuck depth. The chuck is assembled as shown and inserted into the chuck adaptor. The chuck must be in firm contact with the stud stop while tightening the chuck nut.

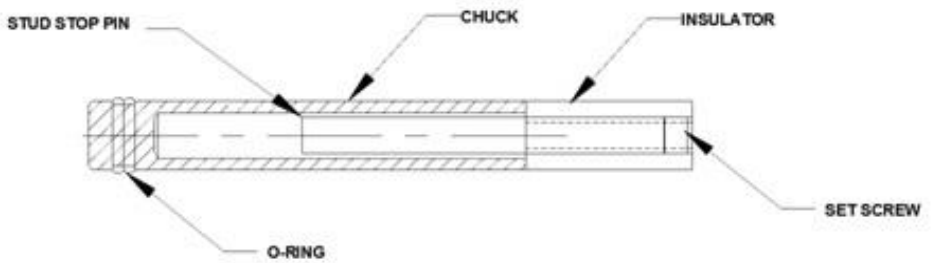


Figure 3.1 Chuck and Stop Assembly

3.2 Setting Up Foot and Leg Assembly

The NCD+ guns come supplied with a foot and spark shield (**Figure 3.2a** Spark shield Foot & Leg Assembly). The foot is installed on the end of the legs. Alignment of the foot is important. The chuck should be located in the center of the spark shield. To install the foot, unscrew the leg screws and place them through the holes in the foot. Reattach the leg screws to the legs. Maintain concentricity between the chuck and spark shield.

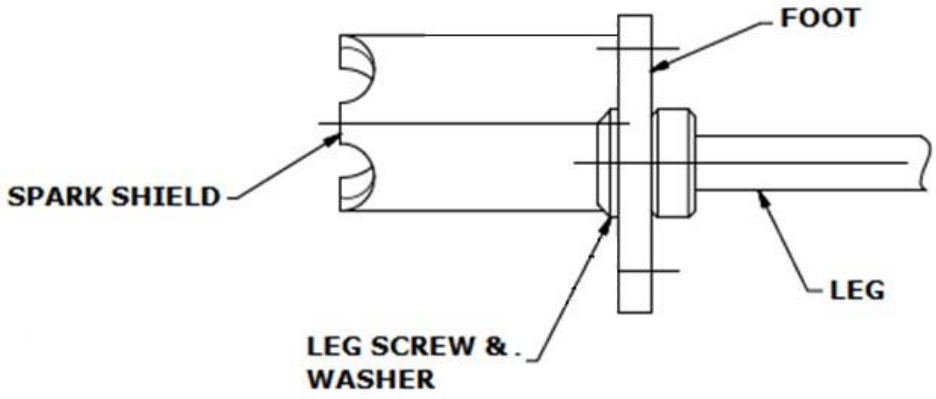


Figure 3.2a Spark shield Foot & Leg Assembly

Also included with the foot & leg assembly are three locating pins used to make the tripod setup. The spark shield and the locating pins may be used together or independently during welding operations.

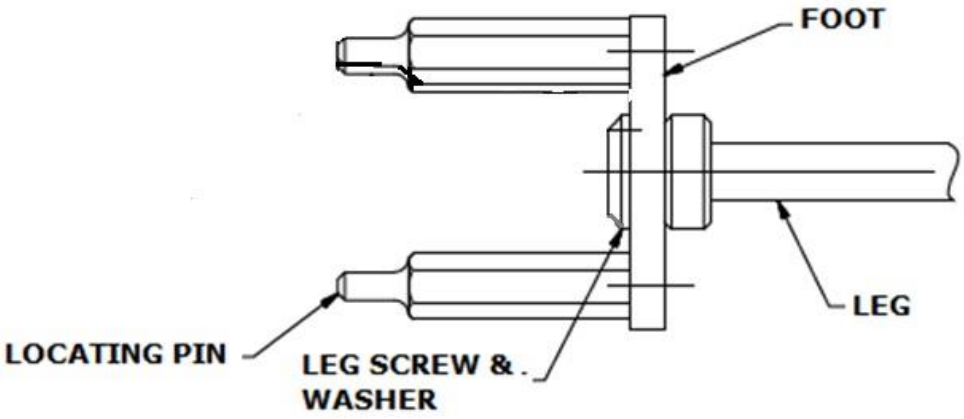


Figure 3.3b Tripod Foot & Leg Assembly

*See section 7 for part numbers

3.3 Setting Spring Pressure (Auto-Gap Mode)

3.3.1 Setting Travel/Lift and Spring Pressure in Gap Mode

In the Auto-Gap Capacitor Discharge welding process, the distance the stud is lifted from the work-piece is called the gap. The plunge rate is affected by the amount of travel and the spring pressure selected. To properly adjust the lift and spring pressure, it is important to make the adjustments as follows.

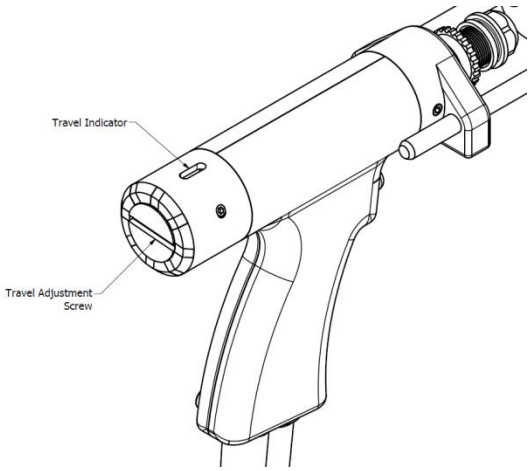


Figure 3.4a

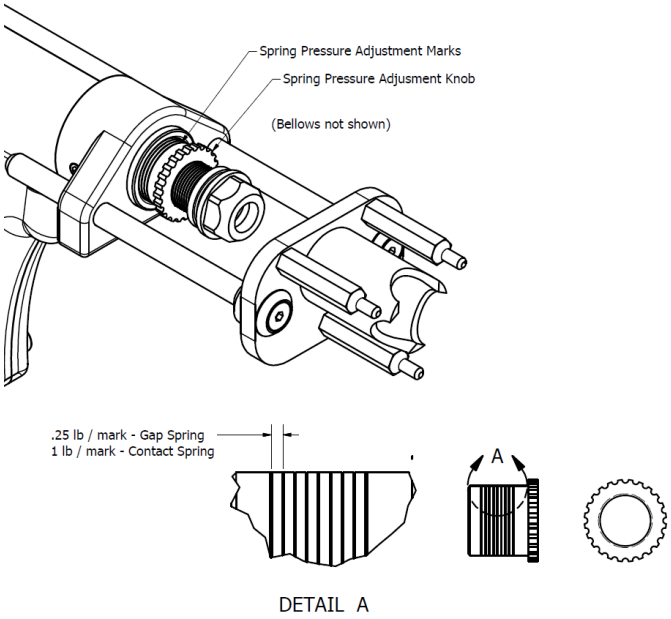


Figure 3.3b

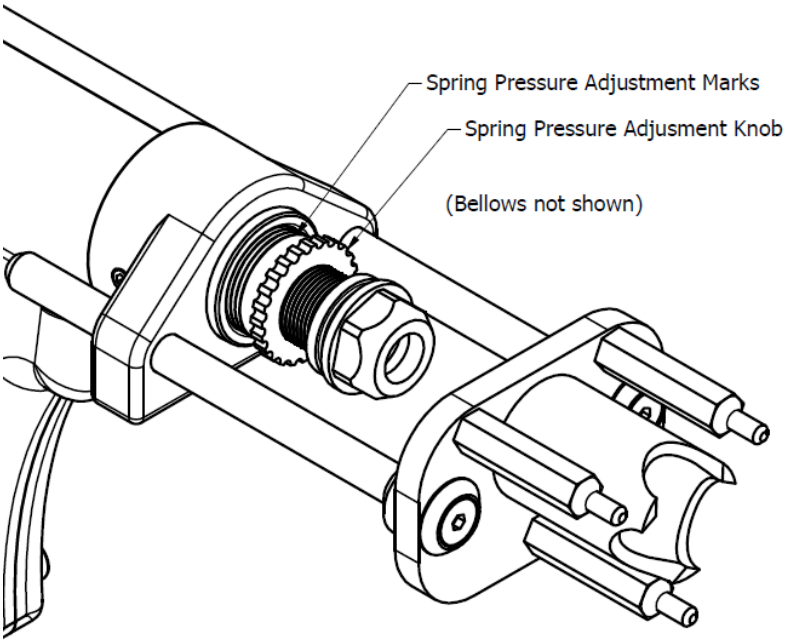
Required tools: NCD+ Weld gun, chuck and foot per application, flat bladed screwdriver

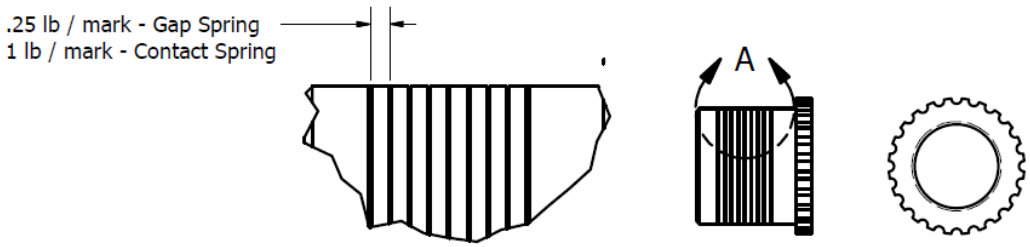
1 Ensure the included standard duty gap spring is installed.
2 Check **Section 8.4 Table of Weld Parameters** for the recommended spring pressure and lift.
3 With a flat bladed screwdriver or NCD+ Set-Up Tool #525-001-200, turn the travel adjustment screw on the back of the weld gun counter clockwise until it stops.
4 Loosen leg screws.
5 Insert stud in chuck.
6 Adjust foot so that the stud-stick out matches the desired plunge.
7 Tighten leg screws to lock tripod foot or spark shield in place.
8 With a stud in the gun, compress the gun against a **non-conductive** block. Trigger the gun to see if the chuck and stud will retract. **It should not retract.**
9 Back the travel adjustment screw out one mark at a time until the position is found where the gun just starts to lift.
10 From this start point adjust the travel adjustment screw for the desired lift. Each line is equal to approx .005" of lift. So for .100" of lift it would be necessary to turn 20 marks. See Fig. 3.3a
11 Turn the spring pressure adjustment knob to desired spring pressure. For the included standard duty **gap** spring each mark equates to .25 lbs of spring force and the minimum is 4 lbs. See Fig. 3.3b

3.3.2 Setting Spring Pressure in Contact Mode

Required tools: NCD+ Weld gun, chuck and foot per application, flat bladed screwdriver

1 Ensure Contact spring is installed per section 3.3.3
2 Check **Section 8.4 Table of Weld Parameters** for the recommended spring pressure.
3 With a flat bladed screwdriver or NCD+ Set-Up Tool #525-001-200, turn travel adjustment screw on the back of the weld gun counter clockwise until it stops.
4 Loosen leg screws.
5 Insert stud in chuck.
6 Adjust foot so that the stud stick-out matches the desired plunge.
7 Tighten leg screws to lock tripod foot or spark shield in place.
8 With a stud in the gun, compress the gun against a **non-conductive** block. Trigger the gun to see if the chuck and stud will retract. **It should not retract.**
9 Turn the spring pressure adjustment knob to desired spring pressure. For the **contact** spring each mark equates to 1 lb of spring force and the minimum is 7 lbs.



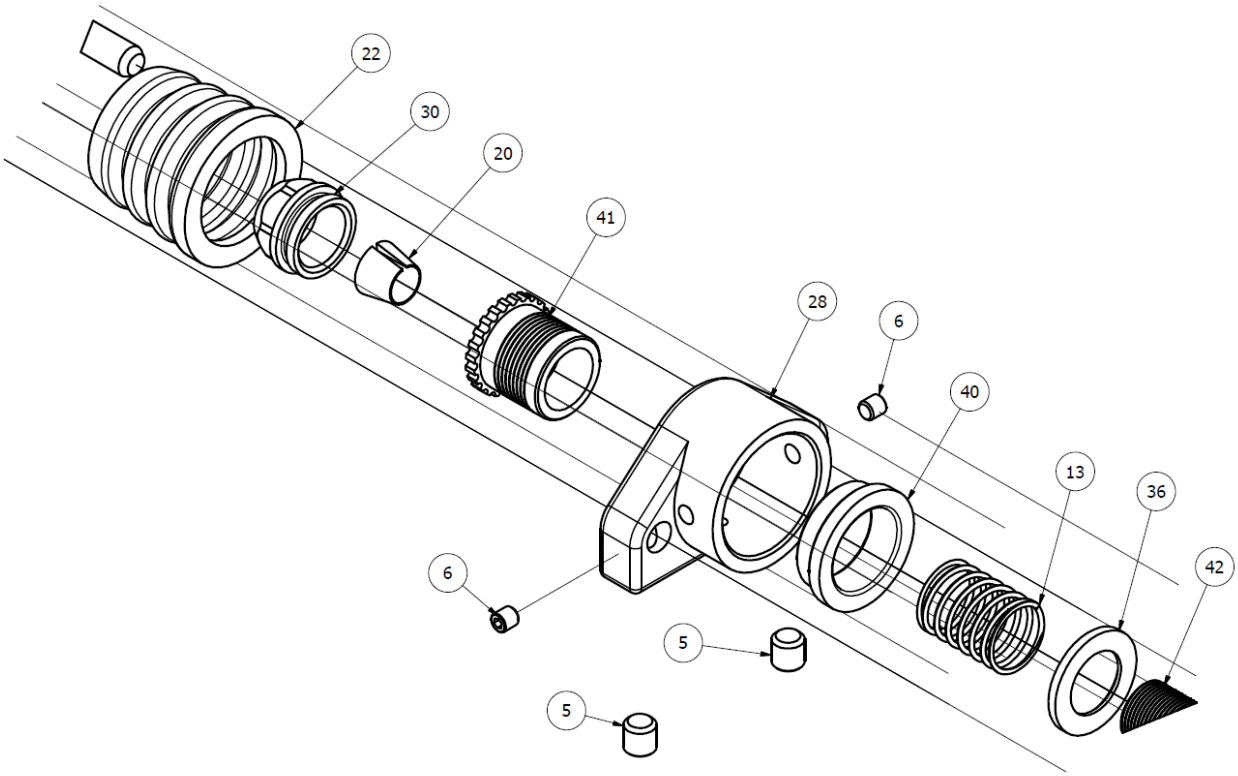


DETAIL A

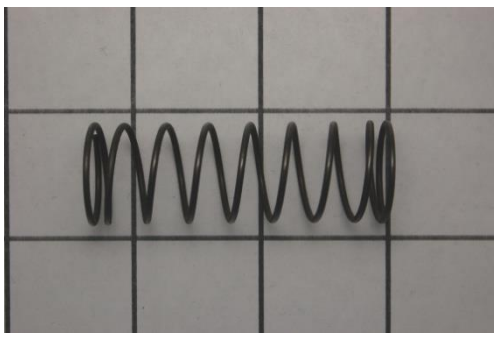
3.3.3 Changing Your Tool to Weld with Contact

Included with the Auto-Gap weld tool is a second spring. This is used for changing the weld tool to weld in contact mode. In order to make this change, follow these steps.

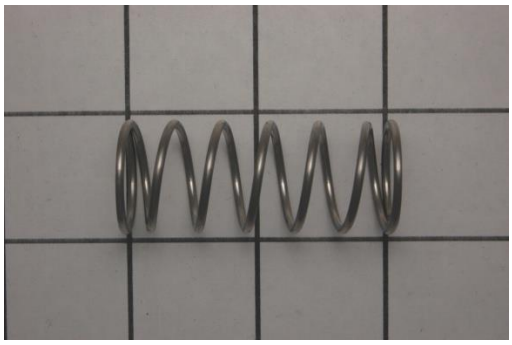
1. Loosen set screws #5. (2 places)
2. Remove the foot and leg assembly and bellows.
3. Remove the chuck nut and chuck.
4. Unscrew part #41 and remove.
5. Loosen set screws #6 (2 Places)
6. Remove front cover, part 28, and plastic bearing, part 40.
7. Change part 13 Main spring.
8. Re-assemble in reverse order.



526-001-234 Pre-installed Gap spring



526-001-268 Contact Spring included with tool.



4 Weld Setup

4.1 Auto-Gap Gun

1 Confirm the power unit is switched off.
2 Connect gun and ground cables to the appropriate terminals.
3 Set spring pressure and gap/lift using a stud per section 3.3.1.
4 Adjust voltage.
5 Replace the set up stud with a new one.
6 Begin production welding after sample welds have been validated for strength and appearance.

4.2 Post Weld

During welding, it is very important to draw the chuck (gun) straight off the stud after a weld has been made to avoid spreading the chuck tines. If this procedure is not followed, chuck life may be substantially shortened.

5 Maintenance of Stud Welding System

A majority of the maintenance of a stud welding system is in:

1 Stud Welding Gun
2 Welding Cable / Control Cable
3 Power Control Unit

5.1 Stud Welding Gun

The weld tool carries out most of the welding functions and should be periodically (at least every 3 months) disassembled and cleaned. Special attention should be given to the lifting mechanisms. This shaft must be absolutely free with no binding inside the gun and there should be no contact between the stud and the spark shield. Never lubricate the lifting mechanisms. It should be cleaned with a dry cleaner such as electrical contact cleaner. Caution should also be exercised when reassembling the gun to be certain not to pinch wires or the weld cable. This could cause erratic welding problems which are usually difficult to isolate.

5.2 Welding Cable / Control Cable

When checking cables for continuity, it is important to slightly pull on all the connectors so that if there is a break, the wires will be pulled apart. The continuity check can be performed with a standard Ohm meter. All cables: ground, control and the weld cables should be periodically inspected for damage. Repair or replace any damaged cables to protect the power control unit.

5.3 Power Control Unit

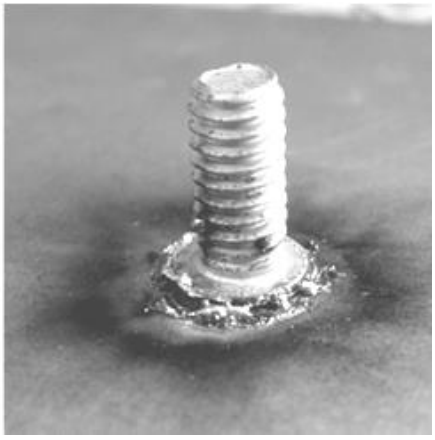
The power control unit contains electronic control boards. Normally, these items do not require maintenance. However, in harsh environments, particularly those with grinding or sanding, metallic dust can enter the welder. This conductive metallic dust can cause unexplained problems with the welding system. Periodically removing the power control unit cover and blowing out the power control unit is a good idea. Frequency will vary depending on the environment. Always disconnect power before opening any power control unit. CD units may continue to store energy after they have been unplugged. To ensure all energy is discharged, wait at least one minute before removing cover and servicing the power control unit.

6 Troubleshooting

6.1 Visual Weld Inspection and Weld Parameter Adjustments

Situation:
Cold Weld

Situation:
Acceptable Weld



Situation:
Hot Weld

Figure 6.1 Weld Quality Visual Inspection

6.2 Weld Quality Physical Inspection and Weld Parameter Adjustments

If visually inspecting the welds reveals a questionable weld, the weld should be physically tested. Initial weld set ups should also be physically tested.

Suggested physical tests for steel and stainless steel studs are as follows:

4 **Bend Test.** Stud to be tested shall be bent away from its vertical axis 90° or until failure. Failure should occur in the stud shank, or, on thin plate, a full stud diameter plug of base metal should be torn out.

5 **Torque Test.** Stud shall be torqued until a pre- specified loading is attained or until the stud fails. On thin plate, a plug of the base material should tear out.

Physical test procedures for inspecting (magnesium) aluminum alloy studs are:

1. **Bend Test.** The stud to be tested shall be bent, using a bending tool approximately 15° away from its vertical axis before the stud breaks in the shank or the base material fails.
2. **Torque Test**. The stud to be tested shall be torqued in the conventional manner by applying torque until a predetermined torque load is reached or the stud fails.

6.2.1 Recommendations

Before starting any stud welding operation, or after the equipment has remained idle for a period of time, trial or test studs should be welded to a plate for testing. Testing should continue until there is no failure of a test stud.

NOTE: Do not bend aluminum studs by striking with a hammer, always use a bending tool. The stud weld should not be damaged, only the stud shank or the base material.

Weld Issue	Weld Parameter Adjustments
Cold Weld Weld failure at low strength value, no weld flash or splatter, and weld base is incompletely melted (very weak weld). This indicates that not enough heat was available.	**Weld heat may be increased by:** • Decreasing gap setting when in gap mode - The shorter distance reduces the drop speed which allows for a longer arc or weld time. • Reducing spring pressure - Reducing the drop speed and provides a longer weld time. • Increasing voltage - Increasing the voltage increases overall energy into the weld. • Check stud timing tips (possibly too short).
Hot Weld Weld failure at low strength value, excessive weld flash and splatter, and weld base may be undercut (weak weld). This indicates that too much heat was available.	**Weld heat may be decreased by:** • Increasing gap setting when in gap mode - The longer distance speeds up the weld time (faster drop time) and the faster drop time extinguishes the arc sooner. • Increasing spring pressure - Speeding up the weld time and extinguishes the arc sooner. • Decreasing voltage - Reducing the voltage reduces overall energy into the weld. • Check stud timing tips (possibly too long).
Late or Cold Plunge Cold plunge occurs when the stud contacts the base material after solidification of the molten weld metal has started. This results in inconsistent weld strength and is recognized by a shiny, mirror-like appearance in the fracture surface.	**This issue can be rectified by:** • Increasing gap distance in gap mode - Increasing drop speed and gets the stud into the molten pool faster. • Increasing spring pressure - Increasing drop speed and gets the stud into the molten pool faster. • Decreasing voltage - Reducing the voltage reduces overall energy into the weld. • Make certain that combo cable is installed (contact mode only). Otherwise (if gap mode), remove combo cable - Reducing the amount of weld energy consumed in the cables.
Misfire No arc initiation due to timing tip failing to flash.	**This issue can be rectified by:** • Increasing voltage. • Using 10% detergent solution spray mist.

Problem: Cold Weld	
Possible Causes	**Possible Solutions**
Tip on stud is crushed due to excessive pressure. Occasionally (especially with aluminum studs), an operator can apply repeated pressure to the timing tip and crush or shorten the tip. The shortened tip reduces arc length/time and does not properly melt the stud and/or base material.	Ensure plunge is properly adjusted. Refer to Sections 3.3 and 8.4.
Coiled weld or ground cables. This reduces weld current delivered to the stud. The coiled cables act like a large inductor and inhibit the flow of energy.	Ensure weld and ground cables are not coiled during the stud welding process.
Improperly set power supply controls.	Refer to the Section 3 Normal Operation within the Operating the Capacitor Discharge NCD+ Stud Welding Unit manual.
Improperly formed tip on stud due to manufacturing process.	Replace stud with one that is correctly formed.
Changes in alloys being welded.	Changes in alloys can usually be compensated for by changing the settings on the power supply.
Equipment failure.	Refer to the **Section 3 Normal Operation** within the Operating the Capacitor Discharge NCD+ Stud Welding Unit manual.
Improperly set plunge setting.	Decrease or increase the plunge. Refer to Sections 3.3 and 8.4.
Varying gauges of sheet metal.	Changes in sheet metal can usually be compensated for by changing the settings on the power supply.
Springs inside weld tool have fatigued and don't apply the same pressure.	Return weld tool to Nelson for service.
Dirt inside weld tool prevents smooth operation and hangs up or slows gun operation.	Clean weld tool in accordance with section 5.1.

Problem: Arc Blow	
Characterized by weld spatter of fillet on only one side of the stud (looks like molten metal was "blown" out from only the one side of the stud). This problem will often cause incomplete fillet formation on one side of the stud. This incomplete cross sectional welding may lead to weld failure.	
Possible Causes	**Possible Solutions**
Molten metal runs away from the ground. Incomplete or insufficient grounding can cause this problem.	Double Ground. The addition of another ground on opposite sides of the weld area will reduce this problem. The object will be to always weld between the grounds. If you need assistance contact your Nelson Representative.
Welding near the edge (1/4 inch or less) of a piece of metal will potentially cause these phenomena. Unusual electrical current patterns are set up near the edges of metals and this can affect the flow of molten metal.	Place another piece of sheet metal of the same type and thickness next to the edge you are welding. This will "fool" the electrical currents and they will act like you are welding in the middle of the sheet metal.

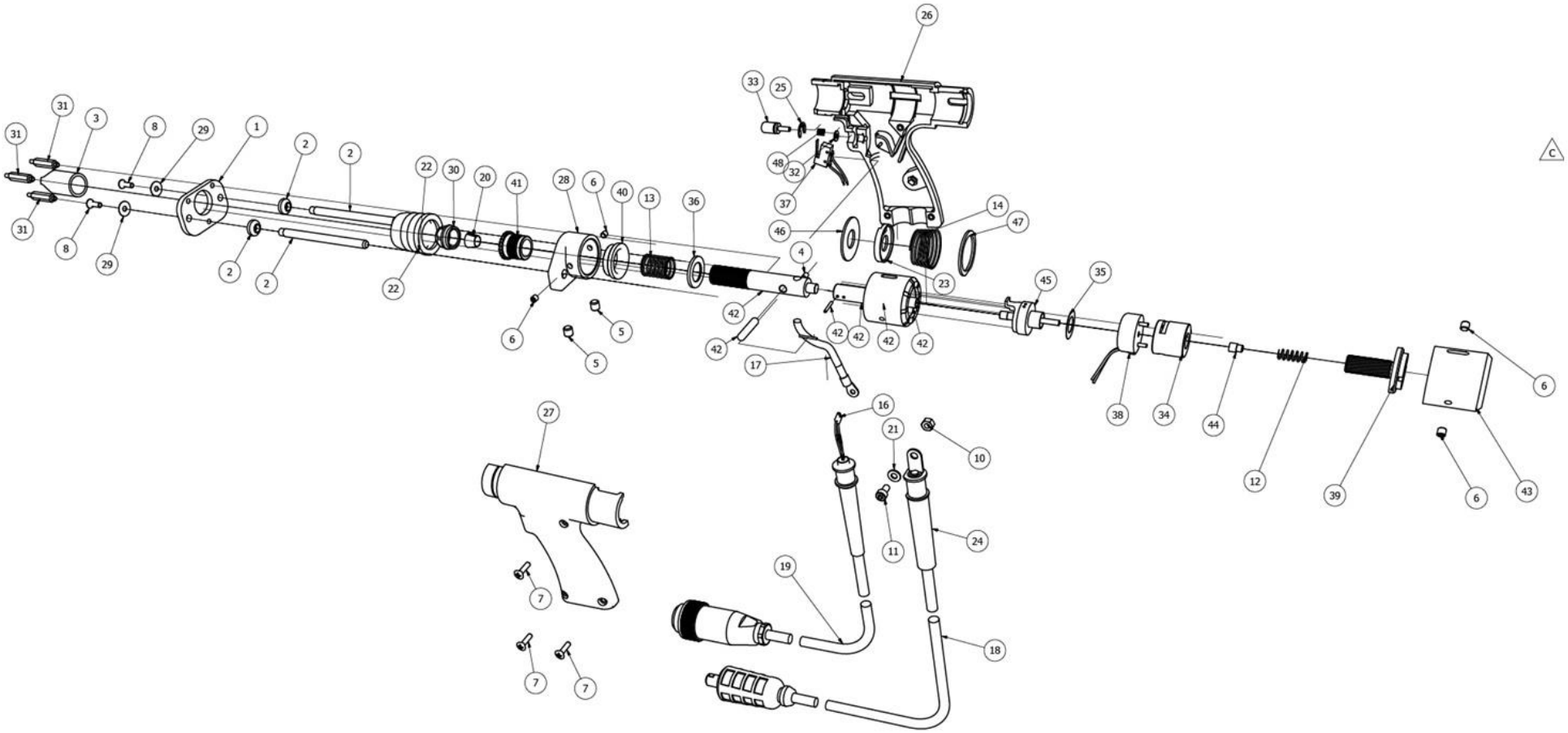
7 Exploded Drawings & Parts List

7.1 Parts List

Item Number	PART NUMBER	QTY	DESCRIPTION
1	502-001-261	1	FOOT
2	504-001-056	2	8mm x 110mm LEG ASM - NS-40
3	511-001-131	1	SPARK SHIELD
4	524-005-003	1	SCREW,M4X6 FPSS
5	524-005-007	2	SCREW,M8X8 FPSS
6	524-005-097	4	SCREW,M5X5 FPSS ZINC DIN913
7	524-005-100	3	SCREW,M4X16 OHMS ZINC
8	524-005-101	2	SCREW,M5X16 FHSC ZINC
9	524-005-103	1	SCREW,M3X5 LHS DIN7984
10	524-005-104	1	NUT M5 THICK
11	524-005-105	1	SCREW,M5X10 SHC DIN912
12	526-001-233	1	SPRING,COMPRESSION
13	526-001-234	1	SPRING,MAIN,NCD GAP GUN (Factory Installed)
14	526-001-235	1	SPRING,LIFTING RING
15	526-001-268	1	SPRING,MAIN,NCD GAP GUN HEAVY CONTACT (Not Installed)
16	713-032-000	4	SPLICE,WIRE,#16-20
17	720-517-000	1	WELD CABLE JUMPER
18	720-519-081	1	WELD CABLE ASM
19	721-268-010	1	CONTROL CABLE ASM
20	726-013-002	1	COLLET
21	729-023-017	1	WASHER 5mm CONICAL SPRING
22	751-003-029	1	DUST BELLOWS
23	751-458-016	1	LIFTING RING

Item Number	PART NUMBER	QTY	DESCRIPTION
25	751-585-021	1	E-RING
26	751-650-001	1	GUN BODY-RIGHT
27	751-650-002	1	GUN BODY-LEFT
28	751-650-003	1	COVER,FRONT,MACHINED
29	751-650-008	2	FINISHING WASHER
30	751-650-009	1	NUT,CHUCK
31	751-650-012	3	LOCATING PIN
32	751-650-022	1	WASHER M4 BRASS
33	751-650-027	1	TRIGGER BUTTON
34	751-650-204	1	COIL HOLDER
35	751-650-209	1	WASHER,RESIDUAL
36	751-650-210	1	WASHER,SPRING
37	751-650-211	1	SWITCH,TRIGGER ASM
38	751-650-216	1	COIL ASM
39	751-650-241	1	SCREW, CD FL SPRING ADJUSTING
40	751-650-242	1	BEARING,CD FL CHUCK ADAPTER
41	751-650-243	1	COLLAR, CD FL SPRING ADJUSTING
42	751-650-246	1	LIFTING ROD ASM FLOATING LIFT
43	751-650-247	1	REAR CAP ,CD WELD GUN (GAP GUN)
44	751-650-305	1	ARMATURE SPRING RETAINER
45	751-650-306	1	MOVABLE CORE ASSEMBLY
46	751-650-309	1	STOP WASHER
47	751-650-310	1	LIFTING RING SPRING WASHER
48	87-05-22	1	TRIGGER SPRING,4 WIRE
49	717-093-003	1	O-RING,11/16IDx7/8ODx3/32THK

7.2 Exploded Drawing



7.3 Electrical Functions of Guns

7.3.1 Coil Power Circuit

Check the coil circuit by connecting an ohmmeter parallel to pins 2 and 6 in the control plug. The resistance should be about 240 ohms cold and 275 ohms while hot. The Contact gun does not have a coil.

7.3.2 Triggering Contact

The trigger switch is checked for proper functioning by connecting a continuity tester or ohmmeter at pin 3 of the control plug and to the foot plate.

If the switch provides a proper contact, the continuity tester will emit a signal or the ohmmeter will show 0 ohms.

7.4 Gun Coding

A jumper between pins 1 and 6 tells the power unit that a set lift gun is connected. An ohmmeter will show 0 ohms.

7.4.1 Dismantling & Reassembling Gap & Contact Welding Guns

1 Loosen set screws in the front cap 2 and rear cap 1.
2 Remove the caps and lay the gun on its right side.
3 Remove 3 screws that hold the gun halves together.
4 Separate and remove the left gun body such that the internal components remain in the right half.

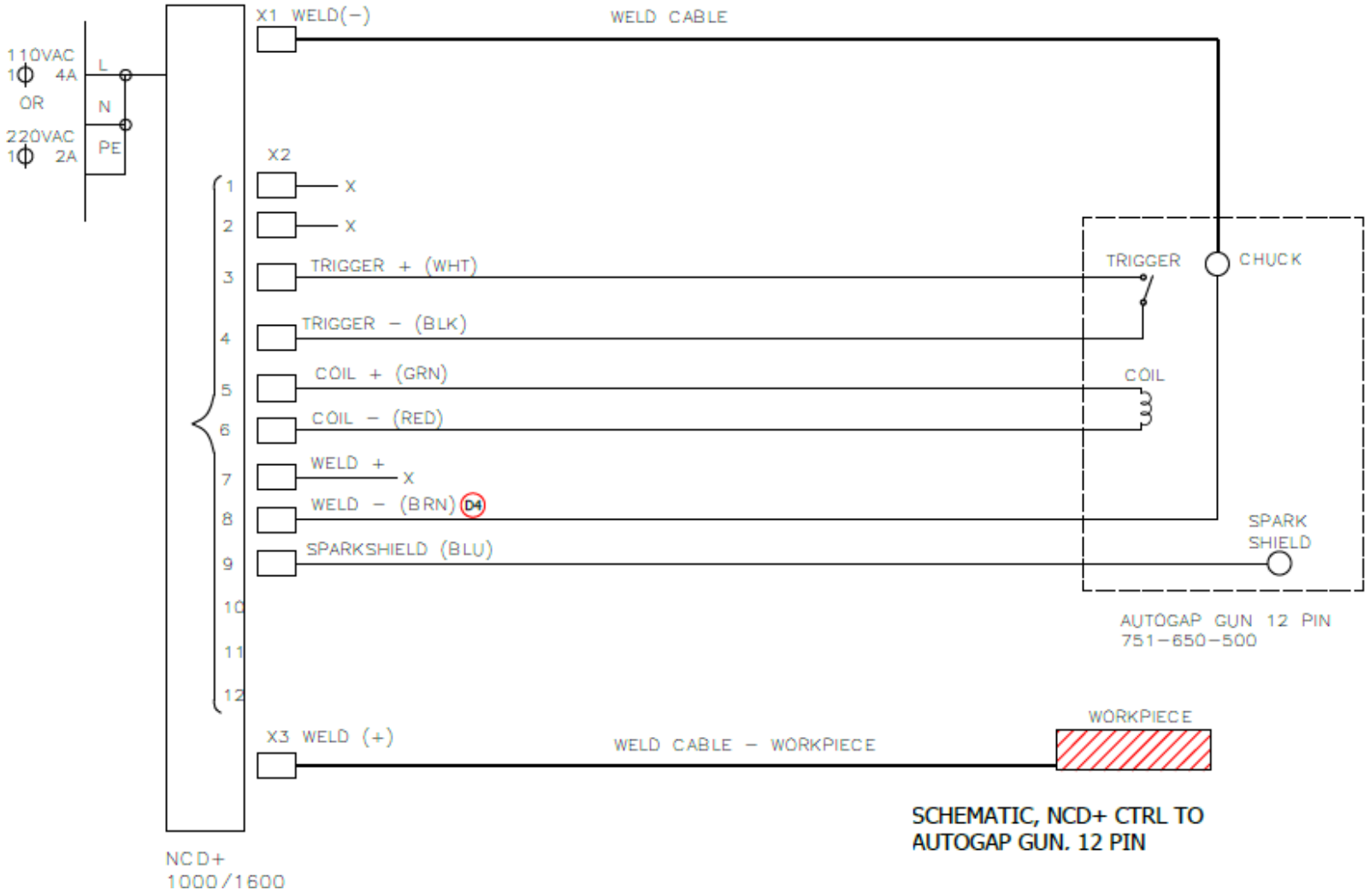
Wire Code	
Pin #3	Trigger
Pin #4	Trigger
Pin #5	Gun Coil
Pin #6	Gun Coil

5 Inspect parts for damage or excessive wear and replace if necessary.
6 Reassemble in reverse order; making sure that the radial orientation of the holding coil assembly 8 is such that where the leads emerge from the coil is adjacent to the slot in the right gun body so the leads can be neatly run into the gun handle. The spring adjusting nut 5 should be oriented such that the radial screw fits in the keyway in the gun body and the spring tension gage line is toward the top of the gun.
7 Reassemble the rear cap with the slot towards the top of the gun and the front cover with its bottom perpendicular to the gun handle.

Located in Gun Handle	
White	Trigger
Black	Trigger
Brown	Weld Cable
Blue	Safety Bypass (Spring to Front Cover)
Green	Coil
Red	Coil

8 Schematics

8.1 NCD+ CTRL TO GUN, 12 PIN, Auto-Gap



SCHEMATIC, NCD+ CTRL TO AUTOGAP GUN. 12 PIN

8.2 Specifications

	NCD+™ Auto-Gap Gun	
	Min.	**Max.**
Gap Spring Pressure Range (lbs)	4	7
Contact Spring Pressure Range (lbs)	7	15
Standard Spring Weld Mode	Auto-Gap	
Gap Mechanism	Floating Lift Solenoid Device	
Pressure Control	Stepless Nut Adjustment	
Gap Control	Stepless Screw Adjustment	
Front Ends	Adjustable, Tripod, Spark Shield	
Max Stud Length	Depends on Accessories	
Dimensions without Cable	7-1/4” x 1-1/2” x 5-1/2” (184 mm x 38 mm x 140 mm)	
Weight without Cable	2.2 lb. (1 kg) Max	
Cable Length	20 ft. (2.7 m)	
Control Cable Connector	12 Pin Binder	
Power Cable Connector	Medium Size Dinse	
Maximum Gap	0.197 in (5 mm), floating lift	
Stud Capacity (max)	1/4" flanged (NCD+ 1000), 5/16” unflanged (NCD+ 1600), 3/8” (NCD+ 3200)	
Storage Temperature (°C)	-5°C to 50°C (23°F - 122°F)	
Operating Temperature (°C)	0°C to 40°C (32°F - 104°F)	
IP Rating	20	
Stud Placement Tolerances	+/- 0.010 (0.25 mm)	

8.3 Accessories

Chucks					
Part Number	**Stud Diameter, Ø**	**Chuck Size**	**Part Number**	**Stud Diameter, Ø**	**Chuck Size**
500-001-374	0.095	13 Ga.	**500-001-366**	0.190	#10 Thd./3/16”
500-001-363	0.109	12 Ga.	**500-001-358**	0.197	5 mm
500-001-355	0.112/0.118	#4 Thd./3 mm	**500-001-362**	0.236	6 mm
500-001-390	0.125	#5 Thd./1/8”	**500-001-359**	0.250	1/4"
500-001-356	0.134/0.138	10 Ga./#6 Thd.	**500-001-360**	0.312/0.315	5/16”/8 mm
500-001-361	0.157	4 mm	**500-001-369**	0.375	3/8”
500-001-357	0.164	#8 Thd.	**500-001-506**	0.394	10 mm
500-001-372	0.172	3/16 Annular Ring (Navy Pin)			

Stud Stop Pin Assembly	
Part Number	**Stud Length**
500-017-017	1/4" - 5/8”
500-017-018	3/4” - 1-1/8”
500-017-019	1-1/4” - 1-5/8”
500-017-020	1-3/4” - 2-1/8”

Tools	
Part Number	**Description**
525-001-200	TOOL,NCD+ UNIVERSAL SET-UP
508-001-035	HEX KEY SET, METRIC

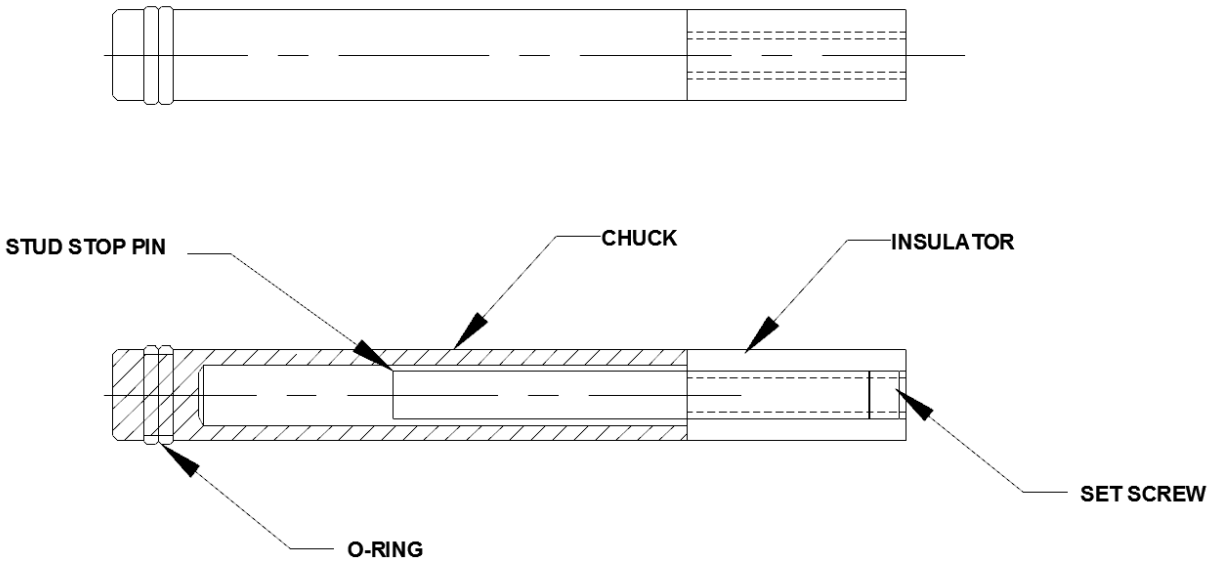


Figure 8.1 Stud Stop Pin Assembly

8.4 Table of Weld Parameters

GAP METHOD						
Stud Size	**Stud & Base Material**	**Gap In (mm)**	**Plunge In (mm)**	**Voltage**	**Spring Pressure**	**Capacitance**
M3 (#6)	Carbon Steel	.12 (3)	.06 (1.5)	120	5lbs	54K
	Stainless Steel	.12 (3)	.06 (1.5)	120	6lbs	54K
	Aluminum	.14 (3.5)	.04 (1)	160	4lbs	18K
M4 (#8)	Carbon Steel	.12 (3)	.06 (1.5)	130	4lbs	54K
	Stainless Steel	.12 (3)	.06 (1.5)	130	6lbs	54K
	Aluminum	.14 (3.5)	.04 (1)	140	6lbs	54K
M5 (#10)	Carbon Steel	.12 (3)	.06 (1.5)	140	4lbs	54K
	Stainless Steel	.12 (3)	.06 (1.5)	130	4lbs	54K
	Aluminum	.14 (3.5)	.04 (1)	160	6lbs	54K
M6 (1/4")	Carbon Steel	.12 (3)	.06 (1.5)	140	4lbs	90K
	Stainless Steel	.12 (3)	.06 (1.5)	130	4lbs	90K
	Aluminum	.12 (3)	.06 (1.5)	190	5lbs	54K
M8 (5/16")	Carbon Steel	.08 (2)	.06 (1.5)	180	4lbs	90K
	Stainless Steel	.08 (2)	.06 (1.5)	180	6lbs	90K

CONTACT METHOD Requires Use of 8m Combo Extension Cable						
Stud Size	**Stud & Base Material**		**Plunge In (mm)**	**Voltage**	**Spring Pressure**	**Capacitance**
M3 (#6)	Carbon Steel		.12 (3)	120	15lbs	54K
	Stainless Steel		.12 (3)	100	15lbs	54K
M4 (#8)	Carbon Steel		.12 (3)	120	7lbs	54K
	Stainless Steel		.12 (3)	120	15lbs	54K
M5 (#10)	Carbon Steel		.12 (3)	130	11lbs	54K
	Stainless Steel		.12 (3)	120	9lbs	54K
M6 (1/4")	Carbon Steel		.12 (3)	180	13lbs	54K
	Stainless Steel		.12 (3)	170	9lbs	54K
M8 (5/16")	Carbon Steel		.12 (3)	160	11lbs	90K
	Stainless Steel		.12 (3)	160	13lbs	90K
(3/8")	Carbon Steel		.12 (3)	180	11lbs	144K

- **Weld parameters above were established as optimum for conditions in our lab. Heavy base plate material was used for physical testing purposes. Local conditions and/or plate thickness differences may necessitate parameter adjustments.**
- **Weld parameters above were established without the use of 10% detergent solution. If detergent solution is preferred, the amount of weld heat will generally have to be increased, i.e., increase voltage and/or reduce spring pressure.**
- **Aluminum alloy 3003 was used to set the above parameters. Other alloys may require parameter adjustments.**
- **If settings are needed (or desired) other than those listed above, please consult your Nelson representative.**

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