



IM-378

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SP-85
January 1991
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OPERATING MANUAL



SP-85 WELDERS GUIDE

This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.

DAMAGE CLAIMS

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

SAFETY DEPENDS ON YOU

Lincoln arc welding equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation...and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS OPERATING MANUAL AND THE ARC WELDING SAFETY PRECAUTIONS ON PAGES 2 AND 3.** And, most importantly, think before you act and be careful.



THE LINCOLN ELECTRIC COMPANY

World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors
Sales and Service Worldwide Cleveland, Ohio 44117-1199 U.S.A.

ARC WELDING SAFETY PRECAUTIONS



WARNING: PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH.



ELECTRIC SHOCK can kill.

1. a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
- b. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".
- c. Insulate yourself from work and ground using dry insulation. When welding in damp locations, on metal framework such as floors, gratings or scaffolds, and when in positions such as sitting or lying, make certain the insulation is large enough to cover your full area of physical contact with work and ground.
- d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.
- e. Ground the work or metal to be welded to a good electrical (earth) ground.
- f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
- g. Never dip the electrode in water for cooling.
- h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
- i. When working above floor level, protect yourself from a fall should you get a shock.
- j. Also see Items 4c and 6.



ARC RAYS can burn.

2. a. Use a 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. Headshield and filter lens should conform to ANSI Z87.1 standards.
- b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- c. Protect other nearby personnel with suitable non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



FUMES AND GASES can be dangerous.

3. a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding on galvanized, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.
- b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
- c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.
- d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices.
- e. Also see item 7b.



WELDING SPARKS can cause fire or explosion.

4. a. 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. Have a fire extinguisher readily available.
- b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.
- c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
- d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned." For information purchase "Recommended Safe Practices for the Preparation for

Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1-80 from the American Welding Society (see address below).

- e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- f. 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. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.
- g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.
- h. Also see item 7c.



CYLINDER may explode if damaged.

5. a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.
- b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.
- c. Cylinders should be located:
 - Away from areas where they may be struck or subjected to physical damage.
 - A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.
- d. Never allow the electrode, electrode holder, or any other electrically "hot" parts to touch a cylinder.
- e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- f. Valve protection caps should always be in place and handtight except when the cylinder is in use or connected for use.
- g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.



FOR ELECTRICALLY powered equipment.

6. a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.
- b. Install equipment in accordance with the National Electrical Code, all local codes and the manufacturer's recommendations.
- c. Ground the equipment in accordance with the National Electrical Code and the manufacturer's recommendations.



FOR ENGINE powered equipment.

7. a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



- b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.



- c. Do not add the fuel near an open flame, welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.



- d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.
- e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.
- f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.



- g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.
- h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR WORK performed by qualified people.

For more detailed 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.

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THANK YOU for selecting a Lincoln Electric Company product. We want you to have pride in owning a Lincoln product... proud as we are in bringing this product to you.

PRODUCT DESCRIPTION

The SP-85 is a compact, lightweight, and portable wire feeder/power source. It has been designed for workshop, hobby, and light maintenance applications, and is capable of general purpose welding with self-shielded flux-cored (Innershield®) wire or solid wire electrode. The use of solid wire requires a supply of weld shielding gas, a gas regulator, and hose.

The SP-85 operates on 115 volt 60 Hz AC input power, making it easy to install. A convenient chart is located on the inside of the wire feed section door to aid in setting welding procedures. It has been designed for dependable service and long life.

RECOMMENDED PROCESSES AND EQUIPMENT

The SP-85 can be used for welding mild steel using the GMAW (MIG), single pass process which requires a supply of shielding gas or it can be used for the self-shielded FCAW process. It will feed .023" through .030" (0.6 through 0.8mm) solid wire electrode and .035" (0.9mm) Innershield flux-cored wire electrode.

The recommended gases for the GMAW process are welding grade CO₂ gas, or an argon-CO₂ blended gas (75 to 80% argon and 20 to 25% CO₂). The blended gas is recommended for welding on heavier gauge steel, 14 gauge (2.0mm), for example. The recommended electrode for the GMAW process is .025" (0.6mm) diameter Lincoln L-56

mild steel welding wire, supplied on 12½ lb. (5.67kg) spools. This solid wire electrode can be used with the SP-85 to weld 24 through 14 gauge (0.6 through 2.0mm) steel.

The recommended wire electrode for the self-shielded FCAW process is .035" (0.9mm) diameter Innershield NR®-211-MP supplied on 10 lb. (4.5kg) spools. This electrode can be used with the SP-85 for welding 20 gauge through 9 gauge (1.0 through 3.9mm) thick steel using a single pass weld technique. The .035" (0.9mm) NR-211-MP can also be used for the welding of galvanized coated sheet metal.

A comparison of the two processes is at the bottom of this page.

SPECIFICATIONS

Model	(K475-1) SP-85
Input Power (AC Only) at Rated DC Output	115 Volts 60 Hertz 20 Amps
Rated DC Output	85 amps @ 18 volts 20% Duty Cycle
Maximum Open Circuit Voltage (DC)	32 Volts
Wire Speed Range	50 to 300 in/min (1.3 to 7.6m/min)
Wire Sizes	.023" through .030" (0.6-0.8mm) Solid Steel .035" (0.9mm) Flux-Cored
Spool Sizes	8" OD x 2" ID x 2.2" wide (203mm OD x 51mm ID x 56mm wide) 4" OD x 5/8" ID x 1.7" wide (102mm OD x 16mm ID x 43mm wide)
Weight	50 lbs. (22.6kg)
Dimensions H x W x D Less Handle	12" x 9¾" x 16½" (305mm x 248mm x 419mm)

Electrode Wire	.025" (0.6mm) Dia. L-56 (GMAW)	.035" (0.9mm) Dia. NR-211-MP Innershield (FCAW) ¹
Shielding Gas	CO ₂ or Blended	None (self-shielded)
Minimum Gauge	24 ga. (0.6mm)	20 ga. (1.0mm) — requires more skill to use on light gauge material than is required with .025" (0.6mm) L-56.
Maximum Gauge²	14 ga. (2.0mm)	9 ga. (3.9mm)
Penetration into Base Metal	Good	Good
Smoke Level	Low	Higher than (GMAW)
Amount of Slag	Low, little or no cleaning required	Slag must be removed

¹At the time of this printing, Lincoln NR-211-MP Innershield® Electrode is recommended for the FCAW process, other electrodes may become available at a later date.

⚠ WARNING
USE OF THE SP-85 ON THICKER MATERIALS THAN RECOMMENDED MAY RESULT IN POOR WELDS. THE WELDS MAY "LOOK" GOOD, BUT MAY JUST BE "SITTING" ON TOP OF THE PLATE. THIS IS CALLED "COLD CASTING" AND WILL RESULT IN WELD FAILURE.

OPTIONAL ACCESSORIES

- K463 CO₂ Gas Regulator and Hose Kit** — Includes a preset, nonadjustable pressure and flow regulator for use on CO₂ cylinders. Also included is a 10 foot (3.0m) gas hose which connects to the rear of the SP-85.
- K499 Ar-Mixed Gas Regulator and Hose Kit** — Includes a preset, nonadjustable pressure and flow regulator for use on argon-mixed gas cylinders. Also included is a 10 foot (3.0m) gas hose which connects to the rear of the SP-85.

INSTALLATION

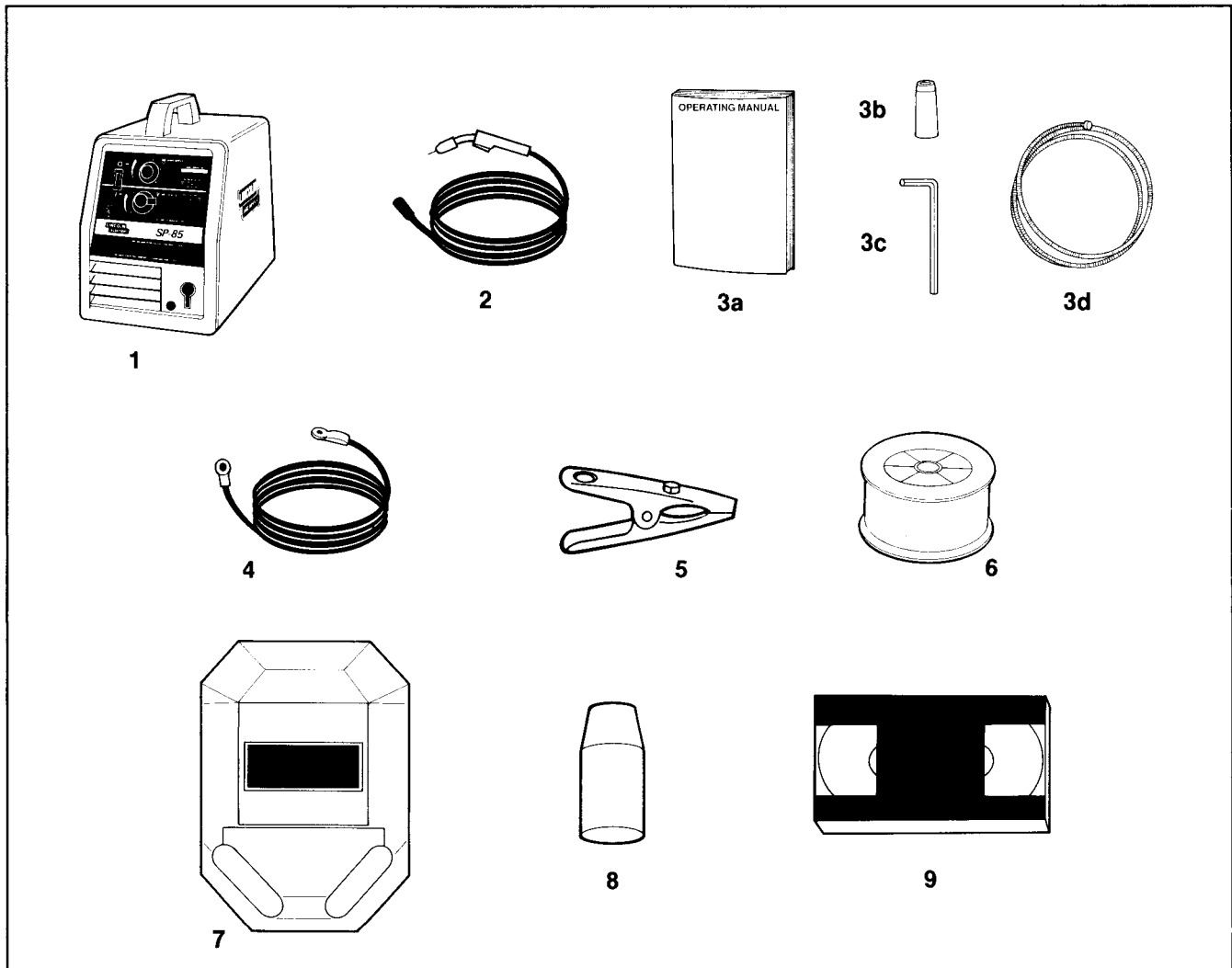
SAFETY PRECAUTIONS

- Read "ARC WELDING SAFETY PRECAUTIONS" on pages 2 and 3 of Operating Manual before proceeding.
- Only personnel that have read and understood the Operating Manual should install and operate this equipment.
- Machine must be plugged into receptacle and connected to system ground per the National Electrical Code and any applicable local codes.
- Turn power switch to the off position (marked "O") when installing work cable and gun and when connecting power cord to input power.

UNPACKING THE SP-85

Carefully open the carton and make sure you have the following loose items:

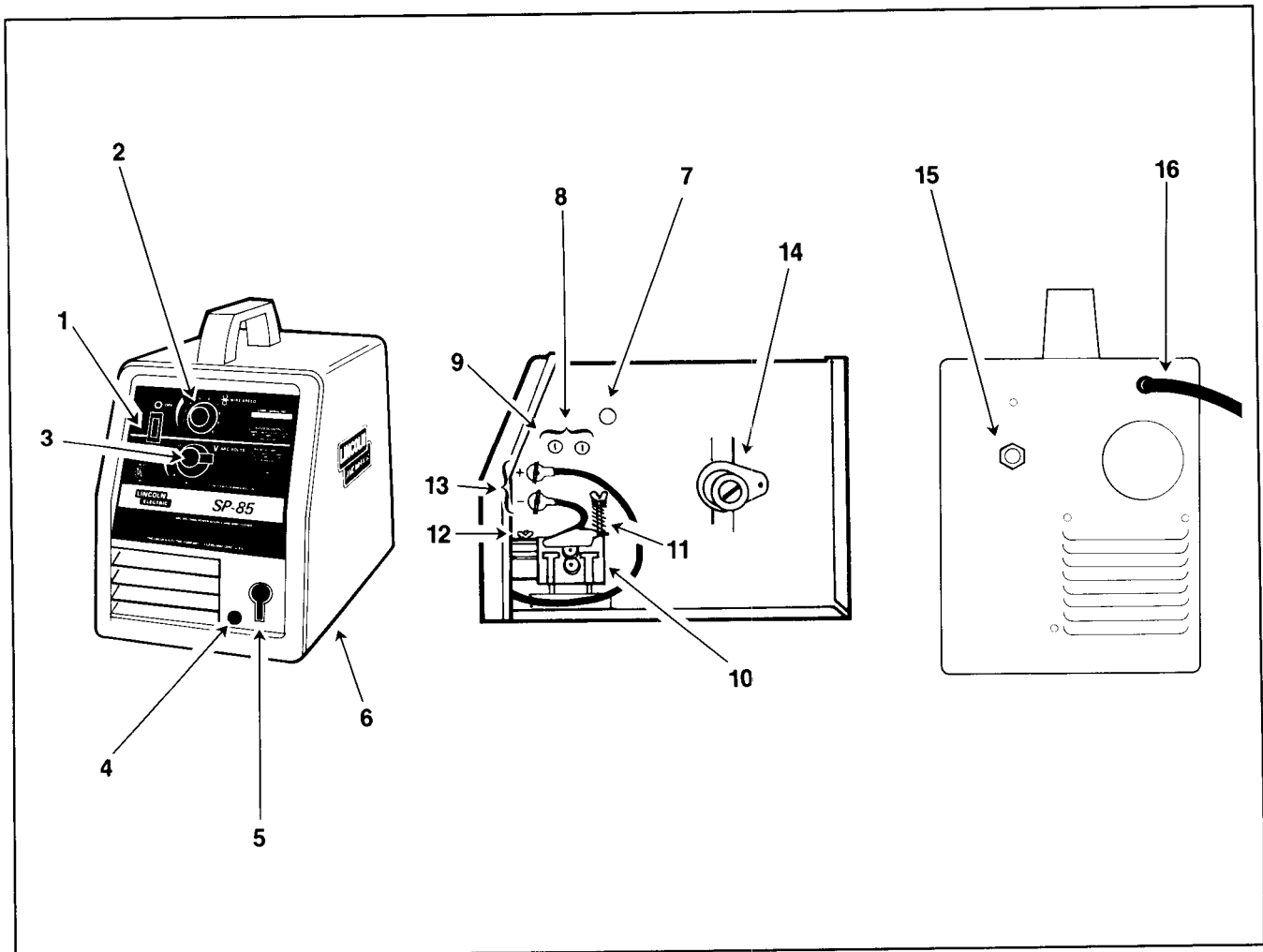
1. SP-85.
2. Gun and cable assembly — ready to feed .035" (0.9mm) diameter cored wire.
3. Literature package envelope which contains: a) operating manual; b) separate contact tips for .025" (0.6mm), .030" (0.8mm) and .035" (0.9mm) diameter wire; c) a hex key wrench for removal of the drive roll; d) cable liner for .023" through .030" (0.6 through 0.8mm) diameter wire.
4. 10 ft. (3.0m) work cable.
5. Work clamp.
6. Sample spool of Innershield .035" (0.9mm) NR-211-MP electrode.
7. Handshield with filter plate and lens.
8. Gas nozzle (used for MIG welding).
9. Instructional video.



FAMILIARIZATION OF THE SP-85

Become familiar with the SP-85 controls and components before attempting to weld. Refer to illustrations and numbered items below for brief descriptions and view the video included with the unit.

1. Power on/off switch — when the power is on, the fan motor will run and air will be exhausted out the louvers in the front of the machine.
2. Wire speed control — controls wire speed from 50-300 inches per minute (1.3 - 7.6m/min). This control is marked $\phi\phi$.
3. Voltage control — a four-position tap switch control provides full range adjustment of power source output voltage. **DO NOT ADJUST WHILE WELDING.** This control is marked "V."
4. Work cable access hole.
5. Gun cable and control lead access hole.
6. Wire feed section door — with gauge chart and machine setting procedures.
7. Circuit breaker — protects machine from damage if maximum output is exceeded. (Manual reset.)
8. Gun trigger lead connectors.
9. Shielding gas hose (factory installed, not shown) — routed from gas solenoid inside rear of machine to gun connector block.
10. Wire feed gearbox and gun connector block.
11. Spring loaded pressure arm — adjusts pressure of idle roll on wire.
12. Thumbscrew — secures gun and cable assembly.
13. (+) Positive and (-) negative output terminals.
14. Wire spool spindle.
15. Gas solenoid inlet fitting.
16. Input cable.

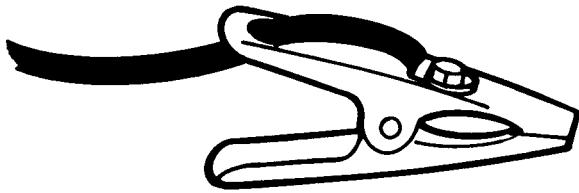


WORK CABLE AND CLAMP INSTALLATION

Work Clamp Installation

Attach the work clamp to the work cable per the following:

1. Unplug the SP-85 or turn power switch to the off "O" position.
2. Insert the work cable terminal lug with the larger hole through the strain relief hole in the work clamp as shown below.
3. Fasten securely with the bolt and nut provided.



Work Cable Installation

1. Open the wire feed section door on the right side of the machine.
2. Pass the end of the work cable that has the terminal lug with the smaller hole through the work cable access hole next to the louvers in the case front.
3. Route the cable under and around the back of the wire feed unit through the plastic retainer.
4. Using provided wing nut, connect the terminal lug to the positive (+) output terminal located above the wire feed unit (make certain that **both** wing nuts are **tight**).

NOTE: This connection gives the correct negative (-) electrode polarity for the self-shielded FCAW process. If using the GMAW (MIG) process, see Output Polarity Connection Section below for positive electrode polarity connection.

OUTPUT POLARITY CONNECTION

The welder, as shipped, is connected for (DC-) negative electrode polarity.

To connect for positive electrode polarity (required for the GMAW process), connect the short cable attached to the gun connector block to the positive (+) output terminal and the work cable to the negative (-) terminal using the provided wing nuts (make certain that **both** wing nuts are **tight**).

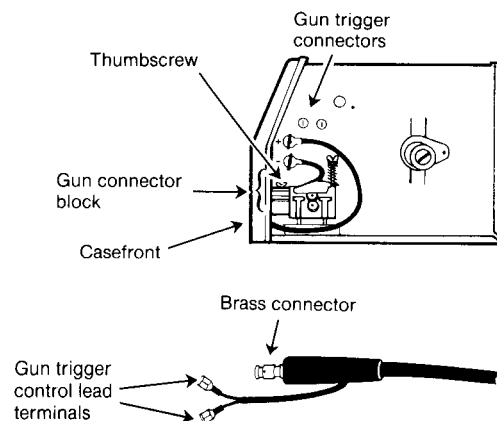
GUN INSTALLATION

As shipped from the factory, the gun is ready to feed .035" (0.9mm) Innershield® wire. If .023" through .025" (0.6mm) or .030" (0.8mm) solid wire is to be used, change the contact tip, cable liner and gasless nozzle. The .023"-.025" contact tip is stenciled .6mm and .030" contact tip is stenciled .8mm. See Maintenance Section on page 20 for instructions to change contact tip and cable liner. The **gasless nozzle** which is factory installed on the end of the gun must be replaced with the **gas nozzle** provided when GMAW (MIG) welding.

Connect the gun cable to the machine per the following:

1. Unplug the SP-85 or turn the power switch to the off "O" position.
2. Pass the insulated terminals of the gun trigger control leads, one at a time, through the rectangular "keyhole" opening in the case front. The leads are to be routed up the inside of the case front and behind the gas line.
3. Insert the brass connector on the gun conductor cable through the large hole in the case front. Brass connector must be all the way in the gun connector block to obtain proper gas flow. Rotate the brass connector so control leads are on the underside and tighten the thumb screw in the gun connector block.
4. Connect the insulated gun trigger control lead terminals to the two insulated 1/4 inch (6.4mm) gun trigger connectors located above the "Gun Trigger Connection" decal in the wire feed section. Either lead can go to either connector.

CAUTION: The gun trigger switch must be a normally open, momentary switch. The switch terminals and leads must be insulated from the welding circuit. Malfunction of the welder will result if the gun trigger circuit shorts to the welding output circuit or is common to any electrical circuit other than the trigger circuit.



WIRE DRIVE ROLL

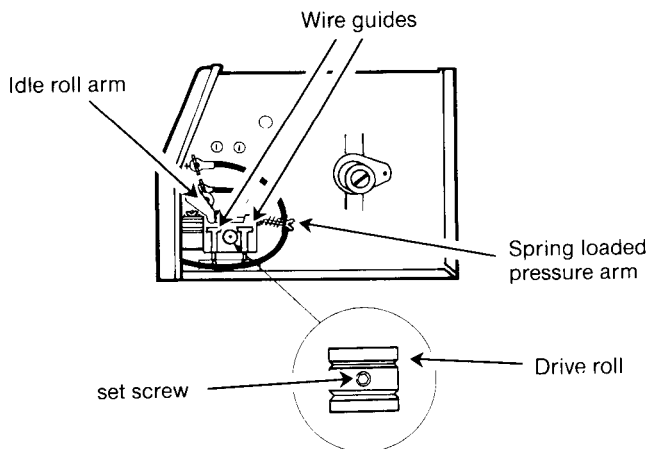
The drive roll has two grooves: one for .023"-.025" (0.6mm) solid wire electrode and a larger knurled groove for .030" (0.8mm) solid and .035" (0.9mm) flux-cored wire electrode. As shipped, the drive roll is installed in the .030/.035" (0.8/0.9mm) position.

If .023"-.025" (0.6mm) wire is to be used, the drive roll must be reversed as follows:

1. Push the spring loaded pressure arm down and lift up the idle roll arm.
2. Set wire speed to min. and jog drive unit with gun trigger switch until drive roll set screw is facing up.

NOTE: The SP-85 must be connected to input power and power switch turned on (marked "I") to jog wire drive. See following Electrical Input Connection section.

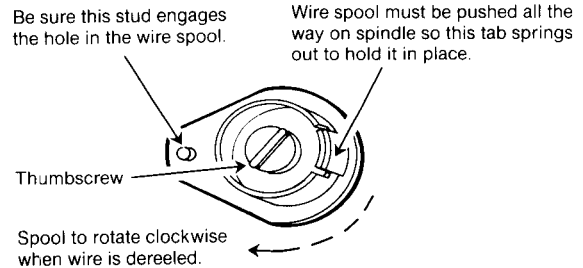
3. Unplug the SP-85 or turn the power switch to its off position (marked "O").
4. Loosen the drive roll set screw with the hex wrench supplied.
5. Remove the drive roll, turn over and install with the .023"/.025" (0.6mm) groove (the smaller groove) closest to the gearbox.
6. Push a length of straightened welding wire through the wire feeder guide tubes and adjust the position of the drive roll so that the groove is centered on the wire.
7. Make certain the set screw is located on the flat portion of the shaft and tighten.



WELDING WIRE LOADING

CAUTION: The SP-85 power switch should be turned to the off ("O") position before working inside the wirefeed enclosure.

The welder is shipped from the factory ready to feed 8 inch (200mm) diameter spools — 2.2 inch (56mm) maximum width. These spools fit on a 2 inch (51mm) diameter spindle that has a built-in, nonadjustable friction brake to prevent overrun of the spool and excess slack in the wire. The thumb screw at the end of the shaft is not intended to be loosened; it should be tightened full clockwise.




To use 4 inch (100mm) diameter spools such as the sample spool included, the 2 inch (51mm) diameter spindle must be removed. Remove the thumb screw at the end of the shaft and remove the spindle. It can be stored in the wire feed compartment. A 4 inch (100mm) diameter spool is mounted directly on the 5/8" (16mm) diameter shaft and held in place with the previously removed thumb screw. Make certain that the thumbscrew is tightened full clockwise and the end of the wire which may protrude through the side of the spool does not contact any metallic case parts.

Thread the welding wire through the wire guides per the following instructions:

1. Push the spring loaded pressure arm down and lift the idle roll arm away from the drive roll. (Check that groove on drive roll matches wire size being used — See Wire Drive Roll Section.)
2. Carefully detach the end of the wire from the spool. **To prevent the spool from unwinding, do not release the wire until instruction "6."**
3. Cut the bent portion of wire off and straighten the first 4 inches (102mm).
4. Thread the wire through the incoming guide, over the drive roll, and into the outgoing guide.
5. Close the idle roll arm and latch the pressure arm in place.
6. Now you may release the welding wire.
7. The idle roll pressure adjustment wing nut is normally set for full pressure (full clockwise). If feeding problems occur because the wire is flattened excessively, turn the pressure adjustment counterclockwise to reduce distortion of the wire.

NOTE: See operating instructions for feeding welding wire on page 11.

ELECTRICAL INPUT CONNECTION FOR RATED OUTPUT

⚠ WARNING	<ul style="list-style-type: none"> • Have an electrician install and service this equipment. • Do not remove SP-85 welder case. • Use only grounded receptacle.
	
ELECTRIC SHOCK can kill	

Line Cord Connection

A line cord (NEMA Type 5-15P) with a 15 amp, 125 volt, three-prong plug is factory installed. Connect this plug to a mating grounded receptacle which is connected to a 20 amp branch circuit with a nominal voltage rating of 115 to 125 volts, 60 hertz. AC only.

<p>CAUTION: Do not connect the SP-85 to an input power supply with a rated voltage that is greater than 125 volts.</p>

Code Requirements

The United States National Electrical Code (Article 630-B, 1987 Edition) provides standards for amperage handling capability of supply conductors based on duty cycle of the welding power source.

If there is any question about the installation meeting the National Electrical Code and local code requirements, consult a qualified electrician.

Recommended Extension Cord

If an extension cord is required, use one that is rated for the application and is #14 AWG* (2.1mm²) 3-conductor or larger. The recommended **maximum** lengths are 25 feet (7.5m) if #14 AWG* is used and 50 feet (15m) if #12 AWG* (3.3m²) is used.


*American Wire Gauge

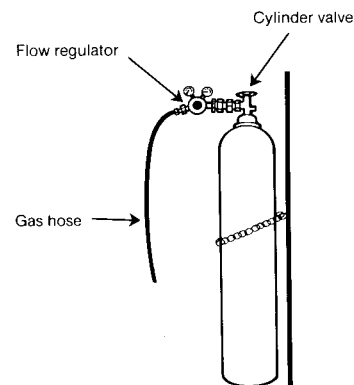
SHIELDING GAS

When using the GMAW process, a cylinder of carbon dioxide (CO₂) or argon-carbon dioxide mixed shielding gas, flow regulator, and an inlet gas hose must be obtained.

The Lincoln K463 CO₂ or K499 Ar-mixed gas regulator and hose kit is recommended for use with the SP-85.

Weld shielding gas may be obtained from a welding supply distributor.

WARNING	<ul style="list-style-type: none"> • Keep cylinder upright and chained to support. • Keep cylinder away from areas where it may be damaged. • Never lift welder with cylinder attached. • Never allow welding electrode to touch cylinder. • Keep cylinder away from welding or other live electrical circuits.
	
CYLINDER may explode if damaged	
<p>SEE AMERICAN NATIONAL STANDARD Z-49.1, "SAFETY IN WELDING AND CUTTING" PUBLISHED BY THE AMERICAN WELDING SOCIETY.</p>	



1. Chain the cylinder to a wall or other stationary support to prevent the cylinder from falling over.
2. With the cylinder securely installed, remove the cylinder cap. Stand to one side away from the outlet and open the cylinder valve **very slightly for an instant**. This blows away any dust or dirt which may have accumulated in the valve outlet.

⚠ WARNING
<p style="text-align: center;">BE SURE TO KEEP YOUR FACE AWAY FROM THE VALVE OUTLET WHEN "CRACKING" THE VALVE.</p>

3. Attach the flow regulator to the cylinder valve and tighten the union nut securely with a wrench. Flow regulator for carbon dioxide **must** have plastic washer seated in the fitting that attaches to the cylinder.
4. Attach one end of inlet gas hose to the outlet fitting of the flow regulator and tighten the union nut securely with a wrench. Connect the other end to the inlet gas fitting on rear of the SP-85 (5/8-18 female threads — for CGA-032 fitting). Make certain the gas hose is not kinked or twisted.

- Open the cylinder valve slowly.

⚠ WARNING



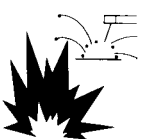
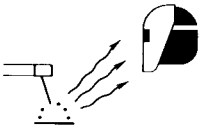
NEVER STAND DIRECTLY IN FRONT OF OR BEHIND THE FLOW REGULATOR WHEN OPENING THE CYLINDER VALVE. ALWAYS STAND TO ONE SIDE.

- Keep the cylinder valve closed, except when using the welder. When finished welding: a) first close the cylinder valve to stop gas flow, b) then depress the gun trigger briefly to open the gas solenoid in the SP-85 (this releases pressure in the hose), and c) turn off the welder.

NOTE: If using a regulator with an adjustable flowmeter, close the gun trigger and adjust the flow to give 15-20 cubic feet per hour (7-9 liters per minute). Use 20-25 cubic feet per hour (9-12 liters per minute) when welding out of position or in a drafty location.

OPERATING INSTRUCTIONS

SAFETY PRECAUTIONS

⚠ WARNING	
	<ul style="list-style-type: none"> Do not touch electrically live parts or electrode with skin or wet clothing. Insulate yourself from work and ground. Always wear dry insulating gloves.
ELECTRIC SHOCK can kill.	
	<ul style="list-style-type: none"> Keep your head out of fumes. Use ventilation or exhaust to remove fumes from breathing zone.
FUMES AND GASES can be dangerous.	
	<ul style="list-style-type: none"> Keep flammable material away. Do not weld upon containers which have held combustibles.
WELDING SPARKS can cause fire or explosion.	
	<ul style="list-style-type: none"> Wear eye, ear and body protection.
ARC RAYS can burn.	

⚠ WARNING

SEE ADDITIONAL WARNING INFORMATION UNDER "ARC WELDING SAFETY PRECAUTIONS" ON INSIDE OF FRONT COVER OF OPERATING MANUAL.

DUTY CYCLE AND RATED OUTPUT

The duty cycle of the SP-85 is based upon the industry standard 10 minute time period. A 20% duty cycle rating means the SP-85 can be operated for 2 minutes out of every 10 minute cycle, at 85 amps maximum output. The remaining 8 minutes are required for cooling.

Type K475-1, SP-85		
Duty Cycle	Amps	Volts
20%	85	18

SELECTING WIRE SPOOL SIZE

Select a spool size so that the wire is used up within a six month period. This eliminates needless waste of wire due to oxidation and rusting. Dirty, oxidized, or rusty wire results in poor wire feeding and poor welding performance. This wire should be discarded.

FEEDING WELDING WIRE

⚠ WARNING

WHEN INCHING THE WELDING WIRE, THE DRIVE ROLLS, THE GUN CONNECTOR BLOCK, AND THE GUN CONTACT TIP ARE ALWAYS ELECTRICALLY ENERGIZED RELATIVE TO WORK AND GROUND AND REMAIN ENERGIZED SEVERAL SECONDS AFTER THE GUN TRIGGER IS RELEASED.

- Remove the gas nozzle (if GMAW welding) and contact tip from end of the gun cable assembly according to the instructions in the maintenance section of this manual.
- Turn the machine on (marked "I").
- Hold the gun and cable assembly out straight (**point gun away from yourself and others while feeding wire**).
- Depress the gun trigger switch and hold it down, feeding welding wire through the gun and cable. Release gun trigger after wire appears at end of gun.
- Replace contact tip and gas nozzle.
- Cut the wire off 3/8 to 1/2 inch (9.5 to 12.5mm) from the end of the tip. The SP-85 is now ready to weld.

OVERLOAD PROTECTION SHUTDOWN

CAUTION: Exceeding the rating can reduce the life of the machine.

SP-85 Protection

The SP-85 has both a thermostat and a circuit breaker to protect the machine from damage if the maximum output is exceeded. If either device is tripped, there will be no wire feed or output voltage when the gun trigger is depressed. (The fan will continue to run.)

If the machine shuts down due to an output overload, first check the circuit breaker which is located on the inside panel of the wire feed section. If the button is extended, reset, after several minutes of cooling, by depressing the button.

If there is no output and the circuit breaker is not tripped, the internal thermostat has probably tripped. This device will automatically reset after several minutes of cooling. (Leaving the machine on with the fan motor running will cool the machine at a faster rate, allowing the thermostat to reset sooner.)

If the machine does not operate and the fan does not run with the machine "ON," the power supply branch circuit protection (circuit breaker or fuse) has tripped.

LEARNING TO WELD

The serviceability of a product or structure utilizing this type of information is and must be the sole responsibility of the builder/user. Many variables beyond the control of The Lincoln Electric Company affect the results obtained in applying this type of information. These variables include, but are not limited to, welding procedure, plate chemistry and temperature, weldment design, fabrication methods and service requirements.

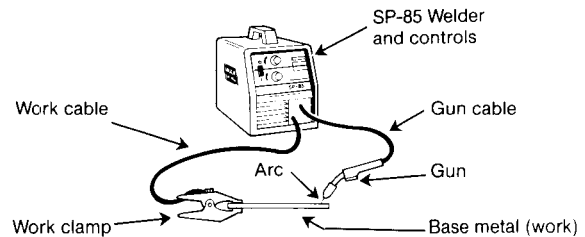
No one can learn to weld simply by reading about it. Skill comes only with practice. The following pages will help the inexperienced operator to understand welding and develop this skill. For more detailed information, order a copy of "New Lessons in Arc Welding" listed inside the back cover of this manual.

THE ARC-WELDING CIRCUIT

The operator's knowledge of arc welding must go beyond the arc itself. The operator must know how to control the arc, and this requires a knowledge of the welding circuit and the equipment that provides the electric current used in the arc. Following is a drawing of the

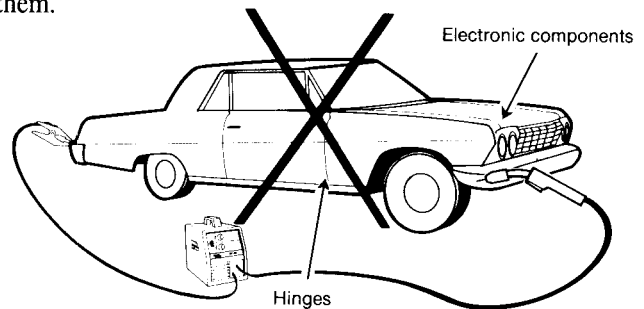
welding circuit for the SP-85. The circuit begins where the gun cable is attached to the welding machine. Current flows through the gun cable, gun, and contact tip, to the wire and across the arc. On the work side of the arc, current flows through the base metal to the work cable and back to the welding machine. This circuit must be complete for the current to flow.


The SP-85 welding circuit has a voltage output of 32 volts maximum. This voltage is quite low and is only present when the gun trigger is depressed.



The SP-85 welding circuit.

To weld, the work clamp must be **tightly** connected to **clean** base metal. Remove paint, rust, dirt or oil as necessary and connect the work clamp as **close** as possible to the area you wish to weld. This helps prevent current from going through an unwanted path. Avoid allowing the welding circuit to pass through hinges, bearings, electronic components, or similar devices that can be damaged. Always disconnect electrical devices before welding upon them.



 <p>WARNING</p> <p>ELECTRIC SHOCK can kill.</p>	<ul style="list-style-type: none">• Do not touch wire electrode or work with bare skin or wet clothing.• Insulate yourself from work and ground using dry insulation.• Always wear dry insulating gloves.• Read section on Electric Shock on page 2 of this manual.
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The gun and cable assembly is held by the operator who guides the automatically fed wire along the joint, maintaining a contact tip to work distance of about 3/8 to 1/2 inch (10-12mm) (this is called electrical stickout). This electrical stickout (ESO) must be properly maintained by the operator. The electric arc is made in the gap between

the work and the tip end of a small diameter wire. When the power source is properly set, the arc gap is maintained automatically.

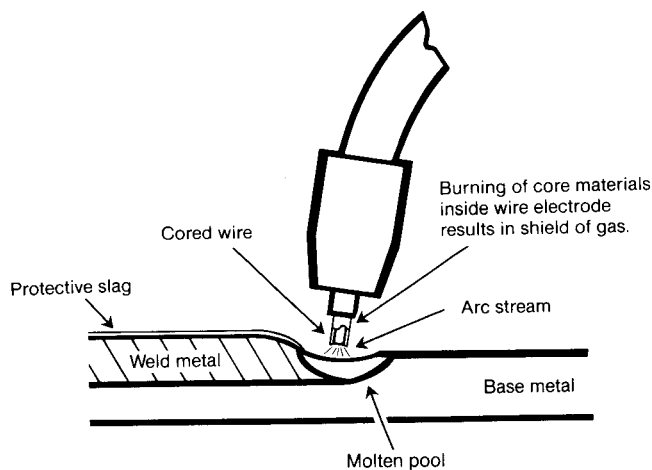
Arc welding is a manual skill requiring a steady hand, good physical condition, and good eyesight. The operator controls the welding arc and, therefore, the quality of the weld made.

THE SELF-SHIELDED FCAW WELDING ARC

The following drawing illustrates the action taking place in the self-shielded FCAW (Innershield) welding arc. It closely resembles what is actually seen while welding.

The “arc stream” is seen in the middle of the picture. This is the electric arc created by the electric current flowing through the space between the end of the wire electrode and the base metal. The temperature of this arc is about 6000°F, which is more than enough to melt metal. The arc is very bright, as well as hot, and cannot be looked at with the naked eye without risking painful injury. **The very dark lens, specifically designed for arc welding, must be used with the hand or face shield whenever viewing the arc.**

The arc melts the base metal and actually digs into it, much as water through a nozzle on a garden hose digs into the earth. The molten metal forms a molten pool or crater and tends to flow away from the arc. As it moves away from the arc, it cools and solidifies.



The self-shielded FCAW welding arc.

The function of the Innershield cored wire electrode is much more than simply to carry current to the arc. The wire core is composed of fluxes and/or alloying ingredients

around which a steel sheath has been formed. It is simply a stick electrode turned inside out in a continuous wire form.

The cored wire melts in the arc and tiny droplets of molten metal shoot across the arc into the molten pool. The wire sheath provides additional filler metal for the joint to fill the groove or gap between the two pieces of the base metal.

The core materials also melt or burn in the arc and perform several functions. They make the arc steadier, provide a shield of smoke-like gas around the arc to keep oxygen and nitrogen in the air away from the molten metal, and provide a flux for the molten pool. The flux picks up impurities and forms the protective slag on top of the weld during cooling.

After running a weld bead, the slag may be removed with a chipping hammer and wire brush. This improves appearance and allows for inspection of the finished weld.

Since machine size and output characteristics limit the size and type of wire electrode which can be used, Lincoln .035" (0.9mm) NR-211-MP Innershield electrode is recommended for Self-Shielded Flux Cored Arc Welding on the SP-85.

MACHINE SET UP FOR THE SELF-SHIELDED FCAW PROCESS

1. See page 5, “Recommended Processes and Equipment” for selection of welding wire and shielding gas, and for range of metal thicknesses that can be welded.
2. See the “Welding” chart on the inside of wire feed section door for information on setting the controls. (Also on page 22 of this manual.)
3. Set the “Voltage” and “Wire Speed” controls to the settings suggested on the chart for the welding wire and base metal thickness being used. The voltage control is marked “V” and the wire feed speed is marked “ $\circ\circ$ ”.
4. Check that the polarity is correct for the welding wire being used. Set the polarity for DC- when welding with NR-211-MP Innershield electrode. (See installation instructions on page 8 on how to make output polarity connection.)
5. When using Innershield electrode, the gasless nozzle (thread protector) may be used instead of a gas nozzle to give improved visibility.
6. Connect work clamp to metal to be welded. Work clamp must make good electrical contact to the workpiece. The workpiece must also be grounded as stated in “Arc Welding Safety Precautions” section of this manual.

WELDING TECHNIQUES FOR THE SELF-SHIELDED FCAW PROCESS

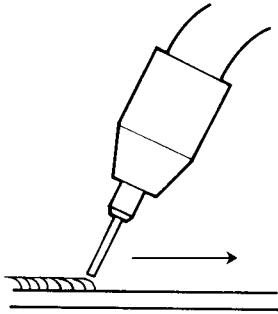
Four simple manipulations are of prime importance. With complete mastery of the four, welding will be easy.

The Correct Welding Position.



Illustrated below is the correct welding position for right-handed people. (For left-handed, it is opposite.)

Hold the gun (of the gun and cable assembly) in your right hand, and hold the hand shield with your left hand. (Left handers simply do the opposite.)

When using the self-shielded FCAW process, weld from left to right (if you are right handed). This enables you to clearly see what you are doing. (Left handers do the opposite.) Tilt the gun toward the direction of travel holding the electrode at an angle as shown below.

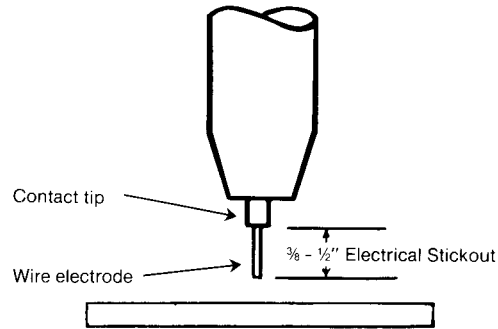


The Correct Way to Strike an Arc.

 WARNING	<ul style="list-style-type: none">• When using an open arc process, it is necessary to use correct eye, head and body protection.• Protect yourself and others; read section on Arc Burn on page 2 of this manual.
 ARC RAYS can burn.	

1. Be sure the work clamp makes good electrical contact to the work.
2. Position gun over joint. End of wire may be lightly touching the work.
3. Place faceshield to protect face and eyes, close gun trigger, and begin welding. Hold the gun so the contact tip to work distance is about 3/8 to 1/2 inch (10-12mm).
4. To stop welding, release the gun trigger and then pull the gun away from the work after the arc goes out.
5. A ball may form at the tip end of the wire after welding. For easier restrikes (with Innershield wire), the ball may be removed by feeding out a few inches of wire and simply bending the wire back and forth until it breaks off.
6. When no more welding is to be done, turn off the machine.

The Correct Electrical Stickout.



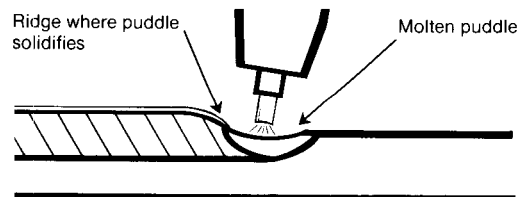
The electrical stickout (ESO) is the distance from the end of the contact tip to the end of the wire.

Once the arc has been established, maintaining the correct ESO becomes extremely important. The ESO should be approximately 3/8 to 1/2 inch (10-12mm) long.

The easiest way to tell whether the ESO is the correct length is by listening to its sound. The correct ESO has a distinctive "crackling" sound, very much like eggs frying in a pan. A long ESO has a hollow, blowing or hissing sound. If the ESO is too short, you may stick the contact tip or nozzle to the weld puddle and/or fuse the wire to the contact tip.

The Correct Welding Speed.

The important thing to watch while welding is the puddle of molten metal right behind the arc. Do not watch the arc itself. It is the appearance of the puddle and the ridge where the molten puddle solidifies that indicate correct welding speed. The ridge should be approximately 3/8" (10mm) behind the wire electrode.

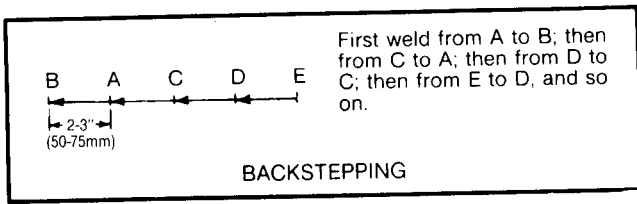


Most beginners tend to weld too fast, resulting in a thin, uneven, "wormy" looking bead. They are not watching the molten metal.

Helpful Hints.

1. For general welding, it is not necessary to weave the arc; neither forward or backward nor sideways. Weld along at a steady pace. You will find it easier.
2. When welding on thin plate, you will find that you will have to increase the welding speed, whereas when welding on heavy plate, it is necessary to go more slowly in order to get good penetration.

3. When welding sheet metal 16 gauge (1.5mm) and lighter, heat buildup may cause part warpage and burnthrough. One way to eliminate these problems is to use the backstepping method.



Practice.

The best way of getting practice in the four skills that enable you to maintain:

1. Correct welding position
2. Correct way to strike an arc
3. Correct electrical stickout
4. Correct welding speed

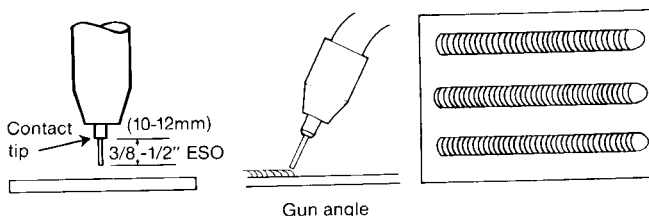
is to spend a little more time on the following exercise.

Use the following:

Mild Steel 12 gauge or 1/8 inch (2.5 or 3.0mm)
 Electrode .035" (0.9mm) NR-211-MP
 Innershield wire

Voltage setting "V" D
 Wire feed speed 3

1. Learn to strike an arc by positioning the gun over the joint and touching the wire to the work.
2. Position handsheld to protect face and eyes.
3. Depress gun trigger, hold gun so contact tip to work distance is about 3/8 to 1/2 inch (10-12mm) and the gun is at proper angle.
4. After you strike the arc, practice the correct electrical stickout. Learn to distinguish it by its sound.
5. When you are sure that you can hold the correct electrical stickout, with a smooth "crackling" arc, start moving. Look at the molten puddle constantly, and look for the ridge where the metal solidifies.
6. Run beads on a flat plate. Run them parallel to the top edge (the edge farthest away from you). This gives you practice in running straight welds, and also gives you an easy way to check your progress. The 10th weld will look considerably better than the first weld. By constantly checking on your mistakes and your progress, welding will soon be a matter of routine.



COMMON METALS

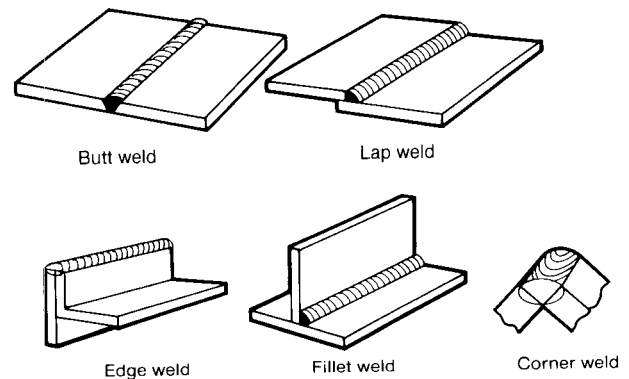
Most metals found around the farm, small shop or home are low carbon steel, sometimes referred to as mild steel. Typical items made with this type of steel include most sheet metal, plate, pipe and rolled shapes such as channels and angle irons. This type of steel can usually be easily welded without special precautions. Some steels, however, contain higher carbon levels or other alloys and are more difficult to weld. The SP-85 is not recommended for such materials. Basically, if a magnet sticks to the metal and if you can easily cut the metal with a file, chances are good that you will be able to weld the material with the SP-85. For further information on identifying various types of steels and other metals, and for proper procedures for welding them, we again suggest you purchase a copy of "New Lessons in Arc Welding" (see page 23).

Regardless of the type of metal being welded, it is important in order to get a quality weld that it be free of oil, paint, rust or other contaminants.

TYPES OF WELDS

Five types of welding joints are: Butt Welds, Fillet Welds, Lap Welds, Edge Welds and Corner Welds.

Of these, the Butt Weld and Fillet Weld are the two most common welds.

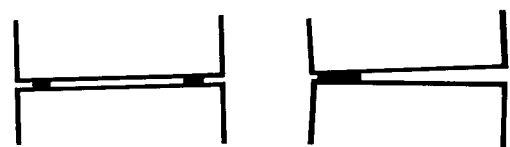


WELDING PROCEDURES

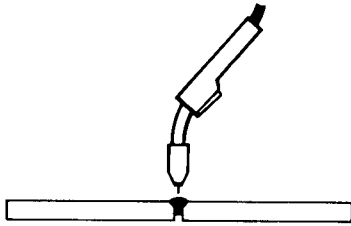
Butt Welds

Place two plates side by side, leaving a space approximately one half the thickness of the metal between them in order to get deeper penetration.

Securely clamp or tack weld the plates at both ends, otherwise the heat will cause the plates to move apart (see drawing):



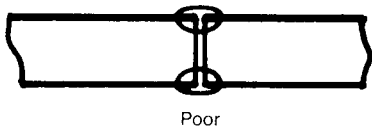
Now weld the two plates together. Weld from left to right (if right handed). Point the wire electrode down in the crack between the two plates, keeping the gun slightly tilted in the direction of travel.



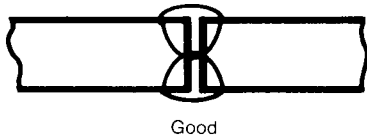
Watch the molten metal to be sure it distributes itself evenly on both edges and in between the plates.

Penetration

Unless a weld penetrates close to 100% of the metal thickness, a butt weld will be weaker than the material welded together. In this example, the total weld is only half the thickness of the material; thus the weld is only approximately half as strong as the metal.

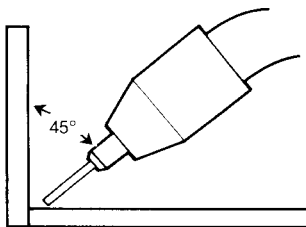


In this example, the joint has been welded so that 100% penetration could be achieved. The weld, if properly made, is as strong as or stronger than the original metal.



Fillet Welds

When welding fillet welds, it is very important to hold the wire electrode at a 45° angle between the two sides, or the metal will not distribute itself evenly. The gun nozzle is generally formed at an angle to facilitate this.



WELDING IN THE VERTICAL POSITION

Welding in the vertical position can be done either vertical-up or vertical-down. Vertical-up is used whenever a larger, stronger weld is desired. Vertical-down is used

primarily on sheet metal 5/32" (3.9mm) and under for fast, low penetrating welds.

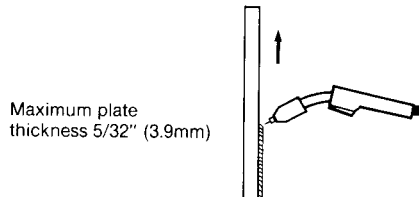
⚠ WARNING

USE OF THE SP-85 ON THICKER MATERIALS THAN RECOMMENDED MAY RESULT IN POOR WELDS. THE WELDS MAY "LOOK" GOOD, BUT MAY JUST BE "SITTING" ON TOP OF THE PLATE. THIS IS CALLED "COLD CASTING" AND WILL RESULT IN WELD FAILURE. SEE RECOMMENDED PROCESSES AND EQUIPMENT ON PAGE 5.

Vertical-Up and Overhead Welding

The problem, when welding vertical-up, is to put the molten metal where it is wanted and make it stay there. If too much molten metal is deposited, gravity will pull it downwards and make it "drip." Therefore, a certain technique has to be followed.

When welding out-of-position, run stringer beads. Don't whip, break the arc, move out of the puddle, or move too fast in any direction. Use WFS in the low portion of the range. General techniques are illustrated below.

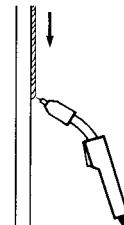


Generally, keep the electrode nearly perpendicular to the joint as illustrated. The maximum angle above perpendicular may be required if porosity becomes a problem.

Vertical-Down Welding

Vertical-down welds are applied at a fast pace. These welds are therefore shallow and narrow, and as such are excellent for sheet metal. Vertical-down welds may be applied to 5/32" (3.9mm) and lighter material. This material is within the range of the SP-85 when used with .035" (0.9mm) NR-211-MP Innershield electrode.

Use stringer beads and tip the gun in the direction of travel so the arc force helps hold the molten metal in the joint. Move as fast as possible consistent with desired bead shape.



The important thing is to continue lowering the entire arm as the weld is made so the angle of the gun does not

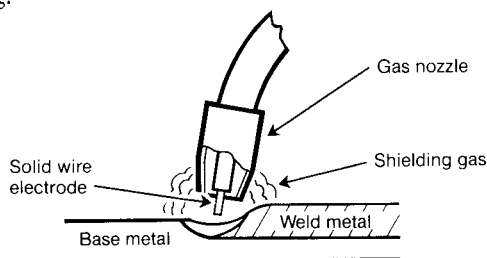
change. Move the electrode wire fast enough that the slag does not catch up with the arc. Vertical-down welding gives thin, shallow welds. It **should not** be used on heavy material where large welds are required.

THE GMAW (MIG) WELDING ARC

The drawing below illustrates the GMAW (MIG) welding arc. Solid wire does not contain fluxes or ingredients to form its own shielding and no slag forms to protect the molten weld metal. For this reason, a continuous even flow of shielding gas is needed to protect the molten weld metal from atmospheric contaminants such as oxygen and nitrogen. Shielding gas is supplied through the gun and cable assembly through the gas nozzle, and into the welding zone.

The shielding gas has several other functions besides protecting the molten weld metal. It helps shape the cross section of the weld deposit, may increase or decrease arc temperature, stabilizes the arc, and regulates penetration.

When comparing the GMAW and FCAW processes, you can see that the principal difference between the two lies in the type of shielding used. GMAW uses gas for shielding, thus we have Gas Metal Arc Welding. FCAW uses the melting or burning of the core ingredients for shielding, and is thus termed Self-Shielded Flux Cored Arc Welding.



The GMAW (MIG) Welding Arc.

The recommended wire for Gas Metal Arc Welding (MIG) is Lincolnweld® .025" L-56 electrode. Lincolnweld® L-56 is capable of welding a wide range of mild steels in all positions, however, more skill is required for out-of-position welding with the GMAW process.

PROCESS SELECTION

By gaining knowledge of the differences between the two processes, you will be able to select the best process for the job you have at hand. In selecting a process, you should consider:

For GMAW (MIG) process

1. Is most of my welding performed on 16 gauge and lighter materials?
2. Can I afford the extra expense, space, safety precautions, and lack of portability required for gas cylinders and gas supply lines?

3. Do I require clean, finished-looking welds?

If you have answered yes to all the above questions, GMAW may be the process for you. If you have answered no to any of the above questions then you should consider using the FCAW process.

For FCAW (Innershield) process

1. Do I want simplicity and portability?
2. Will welding be performed outdoors or under windy conditions?
3. Do I require good all position welding capability?
4. Will most welding be performed on 16 gauge and heavier, somewhat rusty or dirty materials?
5. Weld must be cleaned prior to painting.

MACHINE SETUP FOR THE GMAW (MIG) PROCESS

1. See page 5, "Recommended Processes and Equipment" for selection of welding wire and shielding gas and for range of metal thicknesses that can be welded.
2. See the "Welding" chart on the inside of wire feed section door for information on setting the controls. (Also on page 22 of this manual.)
3. Set the "Voltage" and "Wire Speed" controls to the settings suggested for the welding wire and base metal thickness being used. The voltage control is marked "V" and the wire feed speed is marked $\odot\odot$.
4. Check that the polarity is correct for the welding wire being used. Set the polarity for DC+ when welding with the GMAW (MIG) process. (See page 8 of the Installation Instructions on how to make output polarity connections.)
5. Check that the gas nozzle and proper size liner and contact tip is being used, and that the gas supply is turned on. If adjustable, set for 15 to 20 Cubic Feet per Hour (7 to 10 liters/min.) under normal conditions; increase as high as 35 CFH (17 liters/min.) under drafty (slightly windy) conditions.
NOTE: The gas regulators included in the optional K463 and K499 kits are preset and nonadjustable.
6. Connect work clamp to metal to be welded. Work clamp must make good electrical contact to the workpiece. The workpiece must also be grounded as stated in "Arc Welding Safety Precautions."

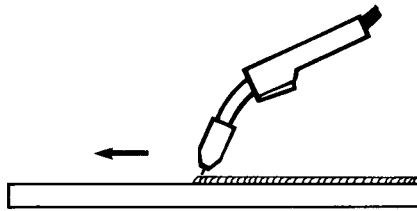
WELDING TECHNIQUES FOR THE GMAW (MIG) PROCESS

The welding techniques for the GMAW (MIG) process on light gauge material are basically the same as welding with .035 (0.9mm) NR-211-MP Innershield electrode.

(Review welding techniques in the self-shielded FCAW Innershield section on page 13.) The few exceptions are noted below.

The Correct Welding Postion

When using the GMAW process on light gauge material, weld from right to left (if right handed) pushing the electrode ahead of the arc (see figure following). This technique results in a colder weld and has less tendency for burnthrough. You may weld in the opposite direction as long as you are obtaining desirable results.



Push Technique.

The Correct Way to Strike an Arc

1. The arc is struck the same as for self-shielded FCAW welding. However, for easier restrikes, the ball at the tip end of the wire which forms after completing a weld may be removed with wire cutters.
2. When no more welding is to be done, don't forget to first close valve on gas cylinder (if used), momentarily operate gun trigger to release gas pressure, then turn off the machine.

The Correct Electrical Stickout

The electrical stickout (ESO) for GMAW (MIG) welding is 3/8 to 1/2 inch (10-12mm). The same rules apply as welding with .035" (0.9mm) NR-211-MP Innershield wire.

The Correct Welding Speed

The same rules apply as those for self-shielded FCAW welding. At first, it may be more difficult to judge speed since no slag is forming behind the molten pool. Watch the ridge where the molten puddle solidifies.

Practice

To practice your GMAW (MIG) welding skills, use the following:

Mild steel:	16 gauge (about 1/16 inch)
Electrode:	Lincolnweld® .025 L-56 electrode
Shielding gas:	CO ₂
Voltage setting "V":	C
Wire feed speed f _o :	4

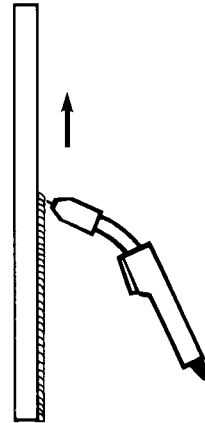
Then follow the instructions in the practice section on self-shielded FCAW welding.

WELDING PROCEDURES

When GMAW (MIG) welding on sheet metal, remember to use the "forehand" push technique, and review the welding procedures section on self-shielded FCAW Innershield welding.

Welding in the Vertical Position

One variation of welding procedure is welding in the vertical-up position. When welding in the vertical-up position, use the proper gun angle shown below.

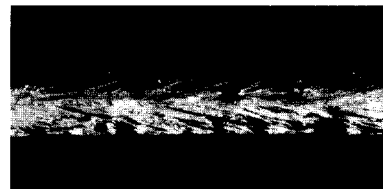


Gun angle for the GMAW process welding in the vertical-up position.

TROUBLESHOOTING WELDS



Good welds have excellent appearance.



To Eliminate Porosity (in order of importance) — Turn on gas supply, if used

1. Decrease voltage
2. Increase stickout
3. Increase WFS (wire feed speed)
4. Decrease drag angle
5. Decrease arc speed



To Eliminate a Ropey Convex Bead (in order of importance)

1. Increase voltage
2. Decrease stickout
3. Decrease WFS (wire feed speed)
4. Decrease arc speed
5. Decrease drag angle
6. Check for correct gas, if used



To Reduce Spatter (in order of importance)

1. Increase voltage
2. Increase drag angle
3. Decrease stickout
4. Increase WFS (wire feed speed)
5. Decrease arc speed
6. Check for correct gas, if used

To Correct Poor Penetration (in order of importance)

1. Decrease stickout
2. Increase WFS (wire feed speed)
3. Decrease voltage
4. Increase speed
5. Decrease drag angle
6. Check for correct gas, if used

If Arc Blow Occurs (in order of importance)

1. Decrease drag angle
2. Increase stickout
3. Decrease voltage
4. Decrease WFS (wire feed speed) and voltage
5. Decrease arc speed

To Eliminate Stubbing (in order of importance)

1. Increase voltage
2. Decrease WFS (wire feed speed)
3. Decrease stickout
4. Increase drag angle

Stubbing occurs when the electrode drives through the molten puddle and hits the bottom plate tending to push the gun up.



PROPER GUN HANDLING

Most feeding problems are caused by improper handling of the gun cable or electrodes.

1. Do not kink or pull the cable around sharp corners.
2. Keep the electrode cable straight as practical when welding.
3. Do not allow dolly wheels or trucks to run over the cables.
4. Keep the cable clean per maintenance instructions in this Operation Manual.
5. Innershield electrode has proper surface lubrication. Use only clean, rust-free electrode.
6. Replace the contact tip when it becomes worn or the end is fused or deformed.

MAINTENANCE AND TROUBLESHOOTING

SAFETY PRECAUTIONS

 WARNING	<ul style="list-style-type: none"> • Have an electrician install and service this equipment. • Unplug the SP-85 before performing any maintenance. • Do not remove SP-85 welder case.
	
ELECTRIC SHOCK can kill.	

ROUTINE MAINTENANCE

Power Source (fixed) Section

No user serviceable parts inside! Do not attempt to perform service in the power source (fixed) side of the SP-85. Take the unit to an authorized Lincoln service center if you experience problems. NO maintenance is required.

Wire Feed Section

1. When necessary, vacuum accumulated dirt from gearbox and wire feed section.
2. Occasionally inspect the incoming guide tube and clean inside diameter if necessary.
3. Motor and gearbox have lifetime lubrication and require no maintenance.

Fan Motor

Has lifetime lubrication — requires no maintenance.

Wire Reel Spindle

Requires no maintenance. Do **not** lubricate shaft.

GUN AND CABLE MAINTENANCE

Routine Gun and Cable Maintenance

Dirt can accumulate in the contact tip hole and restrict the wire feeding. After **each** spool of wire is used, remove the contact tip and push a short piece of wire through the tip repeatedly by hand. Use the wire as a reamer to remove dirt that may be adhering to the wall of the hole through the tip.

A dirty cable liner can cause rough and erratic wire feeding. Clean the liner after running 50 lbs. (23kg) of welding wire as follows:

1. Unplug the SP-85 or turn power switch to the off "O" position.
2. Remove liner from the gun and cable assembly per liner replacement section. Be careful not to kink or damage the liner or replacement will become necessary.
3. Lay the liner out straight and blow it out with compressed air. Work the cable by bending it back and forth and then blow it out again. Repeat this procedure until no more dirt comes out.

Spatter will build up inside the gas nozzle when GMAW (MIG) welding. After five minutes of welding or when spatter starts to accumulate in the nozzle, it must be cleaned. If spatter is allowed to build up and bridge the gap between the nozzle and contact tip, the nozzle will become shorted. A shorted nozzle results in poor welds and an overheated gun.

An anti-stick spray or gel may reduce buildup and aid in spatter removal. It may be obtained from a welding supply distributor.

Contact Tip Replacement

When the hole in the contact tip becomes enlarged or elongated, replacement will become necessary. An erratic or intermittent arc and poor starting are signs of a worn tip.

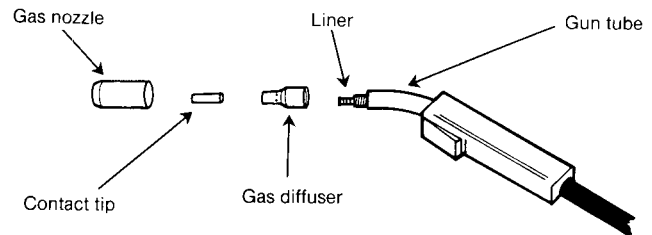
The gun and cable assembly shipped with the unit uses a quick-change, cam lock tip. Because the tip has no threads, changeover is fast and easy.

1. Unplug the SP-85 or turn power switch to the off "O" position.
2. Before removing tip, remove gas nozzle (if used) by pulling it off gas diffuser (threadless slip-fit).
3. Loosen tip by gripping with pliers and twisting counter-clockwise. Tip will now slip off.

4. To replace tip, slip tip into gas diffuser. Grip with pliers, push tip into gas diffuser until it bottoms, then twist clockwise to tighten.

NOTE: It is important that the contact tip is bottomed in gas diffuser.

5. Replace gas nozzle.



Liner Replacement

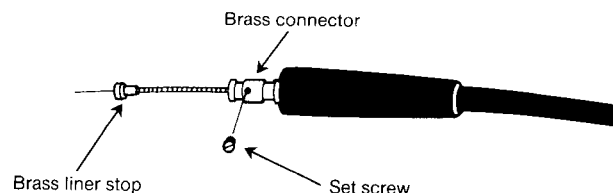
1. Unplug the SP-85 or turn power switch to the off "O" position.
2. Remove gun and cable assembly from machine.
3. Remove gas nozzle, contact tip, and gas diffuser from gun end.
4. Lay the gun and cable assembly in a straight line. Loosen the slotted set screw in brass connector at the feeder end. Grasp the brass liner stop protruding from the end of the brass connector and pull the liner from the cable.

NOTE: The end of the liner stop is color coded orange for .023"-.030" (0.6-0.8mm) wire and green for .035" (0.9mm) wire.

5. Insert the new liner into the brass connector and push all the way in until the liner stop is fully seated. A twisting motion may be necessary to seat the "O" ring in the connector. Tighten the set screw.
6. Cut and deburr the liner so that 5/8 inch (16.0mm) protrudes from the end of the gun tube at the gun end.

NOTE: Measure the 5/8 inch (16.0mm) dimension while pushing the liner into the gun and cable assembly.

7. Reinstall gas diffuser, tip and gas nozzle. Reconnect gun to welder.



PARTS LIST

<u>Part Description</u>	<u>Part No.</u>
-------------------------	-----------------

Major Internal Components

Transformer, Choke, and Control Switch	L7867-2
Voltage Control Switch	M15750
Capacitor	S13490-109
Rectifier Assembly	M15447-1
PC Board	L7836-1
On-Off Switch	T10800-32
Wire Feed Control	T10812-109
Wire Feed Control Knob	S18425-1
Voltage Control Knob	M15796
Fan Motor	M15787-1
Fan Blade	M15432
Fan-Heat Sink Bracket	G1839
Gas Solenoid	S17920
Gas Line	T10642-113

Case Parts

Case Back and Bottom	G1837-1
Center Panel	L7826-1
Case Side	L7554-3
Case Door	L7555-1
Door Hinge (2 required)	M15451
Case Front	A464

Wire Feeder

Wire Drive Assembly	M15759-3
Above item includes	
Motor Gearbox	L7801
Drive Roll with Set Screw	M16190
Set Screw	S11604-47
Idle Roll Assembly	M9300-55
Guide Tubes (2 required)	S18685-6
Optional Knurled Drive Roll	M16049
(for use with .035" (0.9mm) Innershield® only)	
Wire Drive Fastener (2 required)	T14659-3
Wire Drive Screw	S8025-70

<u>Part Description</u>	<u>Part No.</u>
-------------------------	-----------------

Miscellaneous

Input Cord	S15254-11
Spindle	M15445
Thumb Screw for Spindle	S18438
Work Cable	B-8B-120-203-204
Work Clamp	M12033
Polarity Stud (2 required)	S18432
Instruction Manual	IM-378
Instruction Video	VC85
Warning Label	S19338

Gun and Cable

Gun and Cable Assembly (Complete)	L8008
Contact Tip, .025" (0.6mm)	S18704-1
Above contact tips feed .023"-.025" (0.6mm) wire sizes	
Contact Tip, .030" (0.8mm)	S18704-2
Contact Tip .035" (0.9mm)	S18704-3
Liner .023" through .030" (0.6-0.8mm)	S18704-4
Liner .035 (0.9mm) only	S18704-5
Gas Diffuser	S18704-6
Gas Nozzle	S18704-7
Gasless Nozzle (Innershield Only)	S18704-14

K463 CO₂ Gas Regulator and Hose Kit

Pressure Regulator (CO ₂)	S18452
Gas Hose — 10 ft. (3.0m)	S18453

K499 Ar-Mixed Gas Regulator and Hose Kit

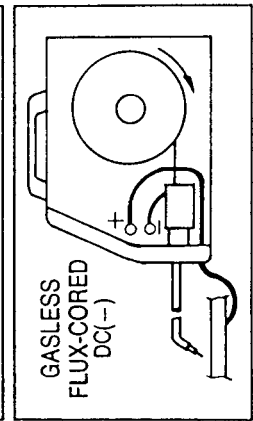
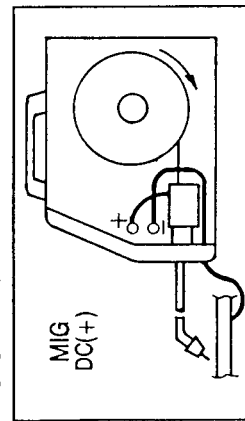
Pressure Regulator (Ar-Mix)	S17877
Gas Hose — 10 ft. (3.0m)	S18453

<p>NOTE: When ordering, give part name, part number and welder code.</p>

ADJUST FOR OPTIMUM WELDING

PROCESS	WELDING WIRE	SHIELDING GAS	STEEL THICKNESS						
			24 ga/ .024 in. 0.60 mm	22 ga/ .030 in. 0.80 mm	20 ga/ .036 in. 1.0 mm	18 ga/ .048 in. 1.2 mm	16 ga/ .060 in. 1.6 mm	14 ga/ .075 in. 2.0 mm	12 ga/ .105 in. 2.5 mm
MIG DC(+)	.025 in. (0.6 mm) DIA. SOLID STEEL WIRE (for best results use Lincoln® L-56 or Murematic® S-6)	CO ₂	A-2	A-2	B-3	B-3	C-4	D-6.5	
		C20 or C25 (75-80% Argon 25-20% CO ₂)	A-2.5	A-2.5	A-2.5	B-3.5	C-5	D-7.5	
	CO ₂			B-2.5	C-3.5	D-4.5			
GASLESS FLUX-CORED DC(-)	.030 in. (0.8 mm) DIA. SOLID STEEL WIRE (for best results use Murematic® S-6)	C20 or C25 (75-80% Argon 25-20% CO ₂)			B-3.5	B-3.5	C-4.5	D-5.5	
		NONE			A-1.5	B-2	B-2.5	C-2.5	D-3

OUTPUT POLARITY



DRIVE ROLL ORIENTATION

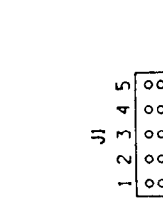
ALIGN GROOVE WITH CENTER OF GUIDE TUBES, SECURE DRIVE ROLL WITH SET SCREW CENTERED ON FLAT		GASLESS FLUX-CORED DC(-)	
MIG DC(+)	.035 (0.9 mm) DIA. INNERSHIELD® NR-211-MP	Optional knurled drive roll.	
.025 (0.6 mm) DIA. SOLID STEEL WIRE	<p>SMALL GROOVE (BEVEL SIDE)</p>	<p>LARGE GROOVE</p>	<p>- OR -</p> <p>LARGE GROOVE - OR - EITHER GROOVE</p>

Be sure to read and understand the warnings on this welding machine and the section on ARC WELDING SAFETY PRECAUTIONS in the Operating Manual. Because design, fabrication, assembly and welding variables affect the results obtained in applying this type of information, the serviceability of a product or assembly is the responsibility of the builder/user.

Sr-85 WIRING DIAGRAM

M15732 6-6-90

ELECTRICAL SYMBOLS PER E1537
LEAD COLOR CODE:
B-BLACK
W-WHITE



J1
1 2 3 4 5
6 7 8 9 10

LATCH

WIRE SPEED
5K
R2
N.C.

THERMOSTAT
(MOUNTED TO
SEC. COIL)

GUN TRIGGER

211
213

WIRE FEED MOTOR

OUTPUT CHOKE

GUN CABLE CONDUCTOR BLOCK

TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

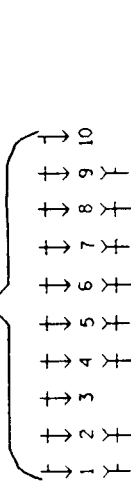
TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

CONTROL P.C. BOARD



J1

1 2 3 4 5 6 7 8 9 10

209 541 214 213 204 208 208 208 208 203

WIRE SPEED

THERMOSTAT

GUN TRIGGER

WIRE FEED MOTOR

OUTPUT CHOKE

GUN CABLE CONDUCTOR BLOCK

TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

TO GROUND PER NATIONAL ELECTRICAL CODE

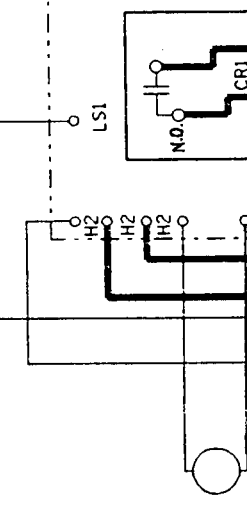
TO WORK

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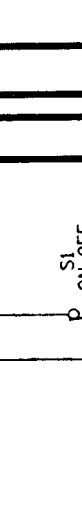
TO WORK



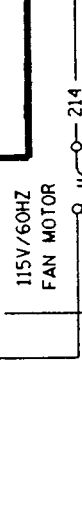
115V/60HZ GAS SOLENOID



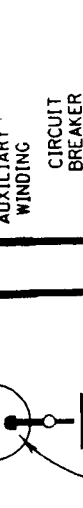
115V/60HZ FAN MOTOR



AUXILIARY WINDING



SELECTOR SWITCH



OUTPUT CHOKE



GUN CABLE CONDUCTOR BLOCK



TO GROUND PER NATIONAL ELECTRICAL CODE

TO WORK

N.A. DIODES D2 & D4 ARE MOUNTED ON THE OUTSIDE HEATSINK.
N.B. DIODES D1 & D3 ARE MOUNTED ON THE INSIDE HEATSINK, WHICH IS CLOSEST TO THE CENTER PANEL.
N.C. COMPONENT VIEWED FROM REAR.

NOTE: This diagram is for reference only. It is not accurate for all machines covered by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels. If the diagram is illegible, write to the Service Department for a replacement. Give the welder code number.

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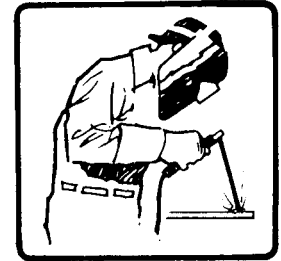
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			LESS 10% IF ORDER IS \$20.00 OR MORE	
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Name _____	School/Company _____	Total Cost _____		
Street _____		I Am Enclosing _____		
City _____	State _____	Zip _____	(Check or Money Order)	

NOTES

NOTES

LIMITED WARRANTY

STATEMENT OF WARRANTY:

The Lincoln Electric Company (Lincoln) warrants to the original purchaser (end-user) of new equipment that it will be free of defects in workmanship and material.

This warranty is void if Lincoln finds that the equipment has been subjected to improper care or abnormal operation.

WARRANTY PERIOD:

All warranty periods date from the date of shipment to the original purchaser and are as follows:

Three Years:

Transformer Welders
Motor-generator Welders
Semiautomatic Wire Feeders
Plasma-cutting Power Source
Engine Driven Welders (except engine and engine accessories) with operating speed under 2,000 RPM

Two Years:

Engine Driven Welders (except engine and engine accessories) with operating speed over 2,000 RPM

All engine and engine accessories are warranted by the engine or engine accessory manufacturer and are not covered by this warranty.

Equipment not listed above such as guns and cable assemblies, automatic wire feeders and field-installed optional equipment is warranted for one year.

TO OBTAIN WARRANTY COVERAGE:

You are required to notify Lincoln Electric, your Lincoln Distributor, Lincoln Service Center or Field Service Shop of any defect within the warranty period. Written notification is recommended.

WARRANTY REPAIR:

If Lincoln's inspection of the equipment confirms the existence of a defect covered by this warranty, the defect will be corrected by repair or replacement at Lincoln's option.

WARRANTY COSTS:

You must bear the cost of shipping the equipment to a Lincoln Service Center or Field Service Shop as well as return shipment to you from that location.

IMPORTANT WARRANTY LIMITATIONS:

- Lincoln will not accept responsibility for repairs made without its authorization.
- Lincoln shall not be liable for consequential damages (such as loss of business, etc.) caused by the defect or reasonable delay in correcting the defect.
- Lincoln's liability under this warranty shall not exceed the cost of correcting the defect.
- This written warranty is the **only** express warranty provided by Lincoln with respect to its products. Warranties implied by law such as the Warranty of Merchantability are limited to the duration of this limited warranty for the equipment involved.



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Supplement to IM-378
January 1991

This SP-85 welder includes the new Magnum™ 100L welding gun which is not included in the IM-378 Instruction Manual. The Magnum 100L features an ergonomically designed handle which provides both comfort and good looks. Although the basic operation of the gun remains the same, please note the following differences from the welding gun information given in the manual:

	New Magnum™ 100L (red trigger)	Lincoln Electric Gun (black trigger)
Part Number	K530-2	L8008
Contact Tip	Threaded	Twist-Lock
Gas Nozzle	Threaded	Slip-Fit
Liner Size Identification	Stenciled on liner bushing	Color coded on liner stop
Liner Trim Length	1 1/4" (32 mm)	5/8" (16mm)
Innershield® Welding Kit	K549-1	K464

See bulletin E891.1 (attached) for a complete parts list.

MAGNUM[™] 100L GUN AND CABLE

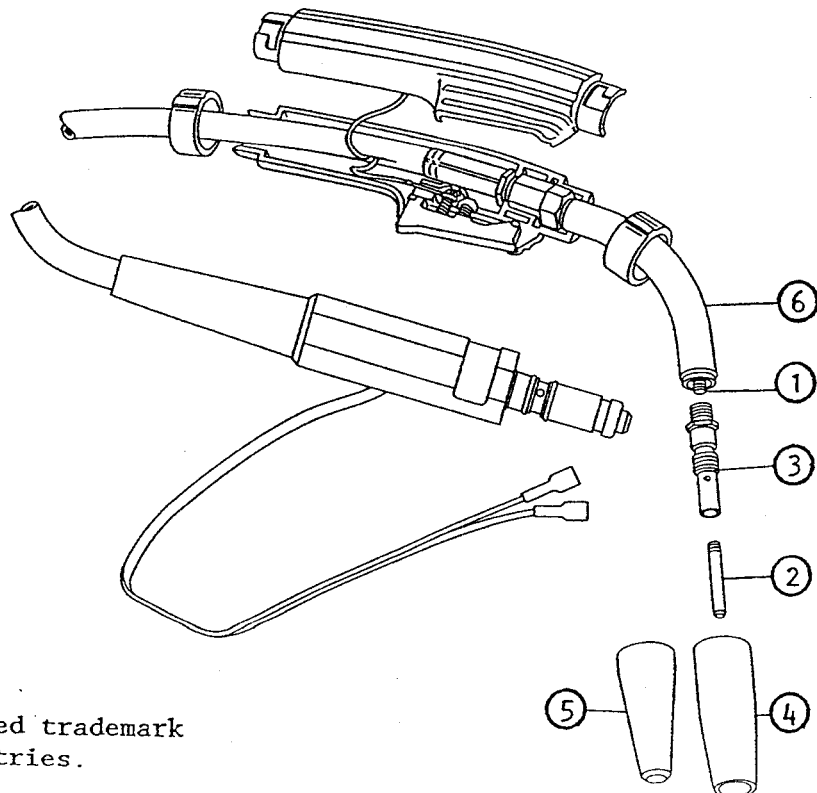
Although fully compatible for use with comparable Tweco^{®1} Mini Mig gun size tips, diffusers, gas nozzles, and cable liners, the Magnum[™] gun family offers an expanding line of quality, long life, expendable replacement parts and accessories. Table 1 lists the replacement parts and accessories currently available.

Table 1

ACCESSORIES AND EXPENDABLE REPLACEMENT PARTS FOR
MAGNUM 100L GUN AND CABLE ASSEMBLY

	DESCRIPTION	PART NUMBER	ENGLISH SIZE	METRIC SIZE
①	CABLE LINER	M16291-1*	.035-.045"	0.9-1.2 mm
		-2	.025-.030"	0.6-0.8 mm
②	CONTACT TIPS	S19726-1	.025"	0.6 mm
		-2	.030"	0.8 mm
		-3*	.035"	0.9 mm
③	GAS DIFFUSER	S19728		
④	GAS NOZZLE (for GMAW)	M16294	1/2"	12.7 mm
⑤	GASLESS NOZZLE (for Innershield)	M16418*		
⑥	GUN TUBE 60°	S19703		

* Included in K549-1 Innershield Kit.



¹Tweco is a registered trademark of Thermadyne Industries.

2,500 in Stock

Supplement to IM-366-378
January 1991

852 / 378

This SP-100 welder includes the new Magnum™ 100L welding gun which is not included in the IM-366 Instruction Manual. The Magnum 100L features an ergonomically designed handle which provides both comfort and good looks. Although the basic operation of the gun remains the same, please note the following differences from the welding gun information given in the manual:

	New Magnum™ 100L (red trigger)	Lincoln Electric Gun (black trigger)
1) Part Number	K530-2	L7538 <i>L 8008</i>
2) Contact Tip	Threaded	Twist-Lock
3) Gas Nozzle	Threaded	Slip-Fit
4) Liner Size Identification	Stenciled on liner bushing	Color coded on liner stop
5) Liner Trim Length	1 1/4" (32 mm)	5/8" (16mm)
6) Innershield® Welding Kit	K549-1	K464

See bulletin E891.1 (attached) for a complete parts list.

Supplement to IM-378
January 1991

This SP-85 welder includes the new Magnum™ 100L welding gun which is not included in the IM-378 Instruction Manual. The Magnum 100L features an ergonomically designed handle which provides both comfort and good looks. Although the basic operation of the gun remains the same, please note the following differences from the welding gun information given in the manual:

	New Magnum™ 100L (red trigger)	Lincoln Electric Gun (black trigger)
Part Number	K530-2	L8008
Contact Tip	Threaded	Twist-Lock
Gas Nozzle	Threaded	Slip-Fit
Liner Size Identification	Stenciled on liner bushing	Color coded on liner stop
Liner Trim Length	1 1/4" (32 mm)	5/8" (16mm)
Innershield® Welding Kit	K549-1	K464

See bulletin E891.1 (attached) for a complete parts list.

Supplement to IM-378
January 1991

This SP-85 welder includes the new Magnum™ 100L welding gun which is not included in the IM-378 Instruction Manual. The Magnum 100L features an ergonomically designed handle which provides both comfort and good looks. Although the basic operation of the gun remains the same, please note the following differences from the welding gun information given in the manual:

	New Magnum™ 100L (red trigger)	Lincoln Electric Gun (black trigger)
Part Number	K530-2	L8008
Contact Tip	Threaded	Twist-Lock
Gas Nozzle	Threaded	Slip-Fit
Liner Size Identification	Stenciled on liner bushing	Color coded on liner stop
Liner Trim Length	1 1/4" (32 mm)	5/8" (16mm)
Innershield® Welding Kit	K549-1	K464

See bulletin E891.1 (attached) for a complete parts list.

Supplement to IM-378
January 1991

This SP-85 welder includes the new Magnum™ 100L welding gun which is not included in the IM-378 Instruction Manual. The Magnum 100L features an ergonomically designed handle which provides both comfort and good looks. Although the basic operation of the gun remains the same, please note the following differences from the welding gun information given in the manual:

	New Magnum™ 100L (red trigger)	Lincoln Electric Gun (black trigger)
Part Number	K530-2	L8008
Contact Tip	Threaded	Twist-Lock
Gas Nozzle	Threaded	Slip-Fit
Liner Size Identification	Stenciled on liner bushing	Color coded on liner stop
Liner Trim Length	1 1/4" (32 mm)	5/8" (16mm)
Innershield® Welding Kit	K549-1	K464

See bulletin E891.1 (attached) for a complete parts list.

Supplement to IM-378
January 1991

This SP-85 welder includes the new Magnum™ 100L welding gun which is not included in the IM-378 Instruction Manual. The Magnum 100L features an ergonomically designed handle which provides both comfort and good looks. Although the basic operation of the gun remains the same, please note the following differences from the welding gun information given in the manual:

	New Magnum™ 100L (red trigger)	Lincoln Electric Gun (black trigger)
Part Number	K500-2	L8008
Contact Tip	Threaded	Twist-Lock
Gas Nozzle	Threaded	Slip-Fit
Liner Size Identification	Stenciled on liner bushing	Color coded on liner stop
Liner Trim Length	1 1/4" (32 mm)	5/8" (16mm)
Innershield® Welding Kit	K549-1	K464

See bulletin E891.1 (attached) for a complete parts list.

