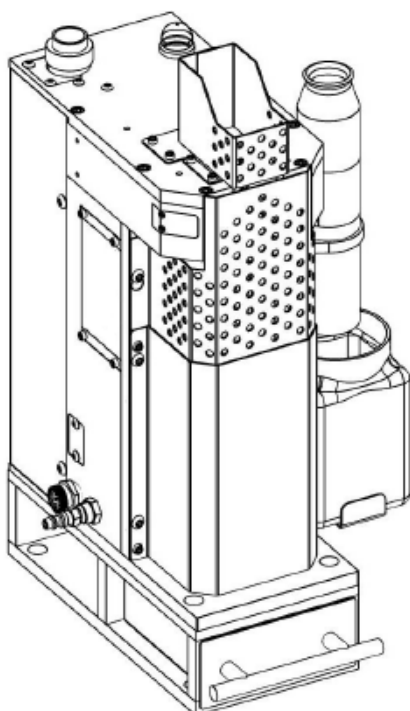


## Operator's Manual

# POWER REAM PLUS



For use with Product Numbers:

**AD2500-1**



**Register your machine:**

[www.lincolnelectric.com/register](http://www.lincolnelectric.com/register)

**Authorized Service and Distributor Locator:**

[www.lincolnelectric.com/locator](http://www.lincolnelectric.com/locator)

**Save for future reference**

Date Purchased

Code: (ex: 10859)

Serial: (ex: U1060512345)

**Need Help? Call 1.888.935.3877**

to talk to a Service Representative

**Hours of Operation:**

8:00 AM to 6:00 PM (ET) Mon. thru Fri.

**After hours?**

Use "Ask the Experts" at [lincolnelectric.com](http://lincolnelectric.com)  
A Lincoln Service Representative will contact you  
no later than the following business day.

**For Service outside the USA:**

Email: [globalservice@lincolnelectric.com](mailto:globalservice@lincolnelectric.com)

## THANK YOU FOR SELECTING A QUALITY PRODUCT BY LINCOLN ELECTRIC.

### PLEASE EXAMINE CARTON AND EQUIPMENT FOR DAMAGE IMMEDIATELY

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 and cutting 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 MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.



### WARNING

This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life.



### CAUTION

This statement appears where the information must be followed to avoid minor personal injury or damage to this equipment.



### KEEP YOUR HEAD OUT OF THE FUMES.

**DON'T** get too close to the arc. Use corrective lenses if necessary to stay a reasonable distance away from the arc.

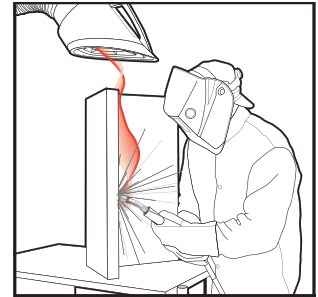
**READ** and obey the Safety Data Sheet (SDS) and the warning label that appears on all containers of welding materials.

**USE ENOUGH VENTILATION** or exhaust at the arc, or both, to keep the fumes and gases from your breathing zone and the general area.

**IN A LARGE ROOM OR OUTDOORS**, natural ventilation may be adequate if you keep your head out of the fumes (See below).

**USE NATURAL DRAFTS** or fans to keep the fumes away from your face.

If you develop unusual symptoms, see your supervisor. Perhaps the welding atmosphere and ventilation system should be checked.



### WEAR CORRECT EYE, EAR & BODY PROTECTION

**PROTECT** your eyes and face with welding helmet properly fitted and with proper grade of filter plate (See ANSI Z49.1).

**PROTECT** your body from welding spatter and arc flash with protective clothing including woolen clothing, flame-proof apron and gloves, leather leggings, and high boots.

**PROTECT** others from splatter, flash, and glare with protective screens or barriers.

**IN SOME AREAS**, protection from noise may be appropriate.

**BE SURE** protective equipment is in good condition.

Also, wear safety glasses in work area **AT ALL TIMES.**



### SPECIAL SITUATIONS

**DO NOT WELD OR CUT** containers or materials which previously had been in contact with hazardous substances unless they are properly cleaned. This is extremely dangerous.

**DO NOT WELD OR CUT** painted or plated parts unless special precautions with ventilation have been taken. They can release highly toxic fumes or gases.

### Additional precautionary measures

**PROTECT** compressed gas cylinders from excessive heat, mechanical shocks, and arcs; fasten cylinders so they cannot fall.

**BE SURE** cylinders are never grounded or part of an electrical circuit.

**REMOVE** all potential fire hazards from welding area.

**ALWAYS HAVE FIRE FIGHTING EQUIPMENT READY FOR IMMEDIATE USE AND KNOW HOW TO USE IT.**



## SECTION A: WARNINGS



### CALIFORNIA PROPOSITION 65 WARNINGS



**WARNING:** Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects, or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an exposed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to  
[www.P65warnings.ca.gov/diesel](http://www.P65warnings.ca.gov/diesel)

**WARNING:** This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code § 25249.5 *et seq.*)



**WARNING:** Cancer and Reproductive Harm  
[www.P65warnings.ca.gov](http://www.P65warnings.ca.gov)

**ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.**

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

**BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.**



### FOR ENGINE POWERED EQUIPMENT.

- Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.
- Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.
- 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.

- 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.
- 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.
- 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.
- 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.
- To avoid scalding, do not remove the radiator pressure cap when the engine is hot.
- Using a generator indoors CAN KILL YOU IN MINUTES.
- Generator exhaust contains carbon monoxide. This is a poison you cannot see or smell.
- NEVER use inside a home or garage, EVEN IF doors and windows are open.
- Only use OUTSIDE and far away from windows, doors and vents.
- Avoid other generator hazards. READ MANUAL BEFORE USE.



### ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS



- Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines
- EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.
- Exposure to EMF fields in welding may have other health effects which are now not known.
- All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:
  - Route the electrode and work cables together - Secure them with tape when possible.
  - Never coil the electrode lead around your body.
  - Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.
  - Connect the work cable to the workpiece as close as possible to the area being welded.
  - Do not work next to welding power source.



## ELECTRIC SHOCK CAN KILL.



- 3.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.
- 3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

**In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:**

- Semiautomatic DC Constant Voltage (Wire) Welder.
  - DC Manual (Stick) Welder.
  - AC Welder with Reduced Voltage Control.
- 3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.
  - 3.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.
  - 3.e. Ground the work or metal to be welded to a good electrical (earth) ground.
  - 3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
  - 3.g. Never dip the electrode in water for cooling.
  - 3.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.
  - 3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.
  - 3.j. Also see Items 6.c. and 8.



## ARC RAYS CAN BURN.



- 4.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.
- 4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- 4.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.



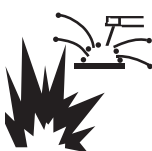
## FUMES AND GASES CAN BE DANGEROUS.



- 5.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 hardfacing (see instructions on container or SDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation unless exposure assessments indicate otherwise. In confined spaces or in some circumstances, outdoors, a respirator may also be required. Additional precautions are also required when welding on galvanized steel.**
- 5.b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.
- 5.c. 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.
- 5.d. 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.
- 5.e. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the Safety Data Sheet (SDS) and follow your employer's safety practices. SDS forms are available from your welding distributor or from the manufacturer.
- 5.f. Also see item 1.b.



## WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.



- 6.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. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.
- 6.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.
- 6.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.
- 6.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 from the American Welding Society (see address above).
- 6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.
- 6.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.
- 6.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.
- 6.h. Also see item 1.c.
- 6.i. Read and follow NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, MA 022690-9101.
- 6.j. Do not use a welding power source for pipe thawing.



## CYLINDER MAY EXPLODE IF DAMAGED.



- 7.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.
- 7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.
- 7.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.
- 7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.
- 7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- 7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.
- 7.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, 14501 George Carter Way Chantilly, VA 20151.



## FOR ELECTRICALLY POWERED EQUIPMENT.



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

**Refer to**  
**<http://www.lincolnelectric.com/safety>**  
**for additional safety information.**

## **Safety Information**

Before installation and commissioning of the POWER REAM PLUS, please read and understand all of the following safety information. Failure to follow these instructions may result in damage to the equipment or personal injury. The POWER REAM PLUS is constructed to be safe to operate provided:

- Only authorized personnel may perform installation, commissioning, and maintenance in observance of all safety precautions contained in these operating instructions.
- Accident prevention regulations, as well as the safety specifications referenced below are observed.
- ANSI/RIA R15.06-2012 Industrial Robots and Robot Systems – safety requirements followed and met.

For additional safety information see references below:

Before assembling, adjusting, or working with the POWER REAM PLUS, ensure all equipment in the area is disabled.

The POWER REAM PLUS is to be used only for torch cleaning within the technical operating specifications outlined in this document.

Do not exceed the specified operating pressure of 80 PSI.

Keep hands away from POWER REAM PLUS while in operation.

Keep hands away from the clamp and POWER REAM PLUS operating space.

Keep hands away from the wire cutter.

Keep eyes away from the sprayer.

Protective eyewear should be worn at all times while working in the vicinity of the POWER REAM PLUS.

Protective gloves should be worn at all times when maintaining the POWER REAM PLUS.

Disconnect the air and power supplies when adjusting the POWER REAM PLUS.  
Use only OEM parts and accessories.

Do not use corrosive or aggressive chemicals without first obtaining approval from the manufacturer.

Do not remove or deface warning and instruction labels on the POWER REAM PLUS.

For additional safety information, refer to the following publications:

- ANSI/RIA R15.06-2012 Industrial Robots and Robot Systems – Safety Requirements  
Robotic Industries Association, 900 Victors Way, Suite 140, Ann Arbor, Michigan, USA 48108
  - ANSI Z49.1:2012 Safety in Welding, Cutting, and Allied Processes,  
American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126
  - CAN/CSA-Z434-14 Industrial robots and robot systems,  
Canadian Standards Association, 5060 Spectrum Way, Mississauga, Ontario, L4W 5N6, CANADA
-



## Safety Information

### **WARNING**

Moving parts can crush and cut.  
Keep hands away from the operating area of the reaming bit, clamp, and wire cutter.



### **WARNING**

Rotating Reaming Bit.  
Keep hands away from the operating area of the cutter.



### **WARNING**

Entanglement Hazard.  
Do not operate with exposed long hair, jewelry, or loose clothing.



### **WARNING**

Disconnect power before servicing.



### **WARNING**

Disconnect air supply before servicing.



### **WARNING**

Do not use damaged, frayed, or deteriorated air hoses and fittings.



### **WARNING**

Maintain safe operating pressure (80 psi).

## Table of Contents

1. Specifications .....	6
2. Installation .....	7
2.1. Baseplate Dimensions .....	8
2.2. Air Connection .....	8
2.3. Electrical Connection .....	9
3. Operation .....	11
3.1. User Interface .....	11
3.2. Power-Up .....	11
3.3. Manual Operation .....	12
3.4. Automatic Operation .....	13
4. Reamer .....	13
4.1. Status Light .....	14
4.2. Position Programming .....	14
4.3. Reaming Bit Replacement .....	15
5. Sprayer .....	16
5.1. Spray Position Programming .....	16
5.2. Spray Adjustment .....	16
5.3. Spray Nozzle Replacement .....	17
6. Ream and Spray Sequence Flow Chart .....	18
7. Wire Cutter Option .....	19
7.1. Wire Cutter Position Programming .....	19
7.2. Wire Cutter Sequence Flow Chart .....	20
8. Nozzle Gas Flow Sensor (NGFS) Option .....	21
8.1. NGFS Specifications .....	21
8.2. NGFS Operation .....	21
8.3. NGFS Setup .....	22
8.4. NGFS Robot Position and Sequence Flow Chart .....	23
9. Settings .....	24
9.1. I/O Configuration .....	24
9.2. Spray .....	25
9.3. Extras .....	26
9.4. Running Mode .....	27
9.5. Motor Diagnostic .....	28
10. Preventative Maintenance .....	30
11. Troubleshooting .....	31
11.1. Error Codes .....	32
11.2. Advanced Troubleshooting .....	33
12. Pneumatic Components .....	34
13. Electrical Diagram .....	35
Appendix A: Discrete I/O Explanation .....	36
Appendix B: FANUC Robot Programming Example .....	37



## 1. Specifications

PNEUMATIC SPECIFICATIONS	
Pressure: 80 PSI	Flow: 18 SCFM
Caution: Use Filtered (5um), Non-Lubricated, Regulated Air	

ELECTRICAL SPECIFICATIONS	
Voltage: 24 VDC +/- 10%	Current: 0.75 Amp DC

REAMING SPECIFICATIONS	
Speed: 320 RPM	Power: 0.50 HP

WIRE CUTTING SPECIFICATIONS	
Minimum wire diameter: 0.030" (0.8mm)	
Maximum wire diameter: 0.063" (1.6mm)	

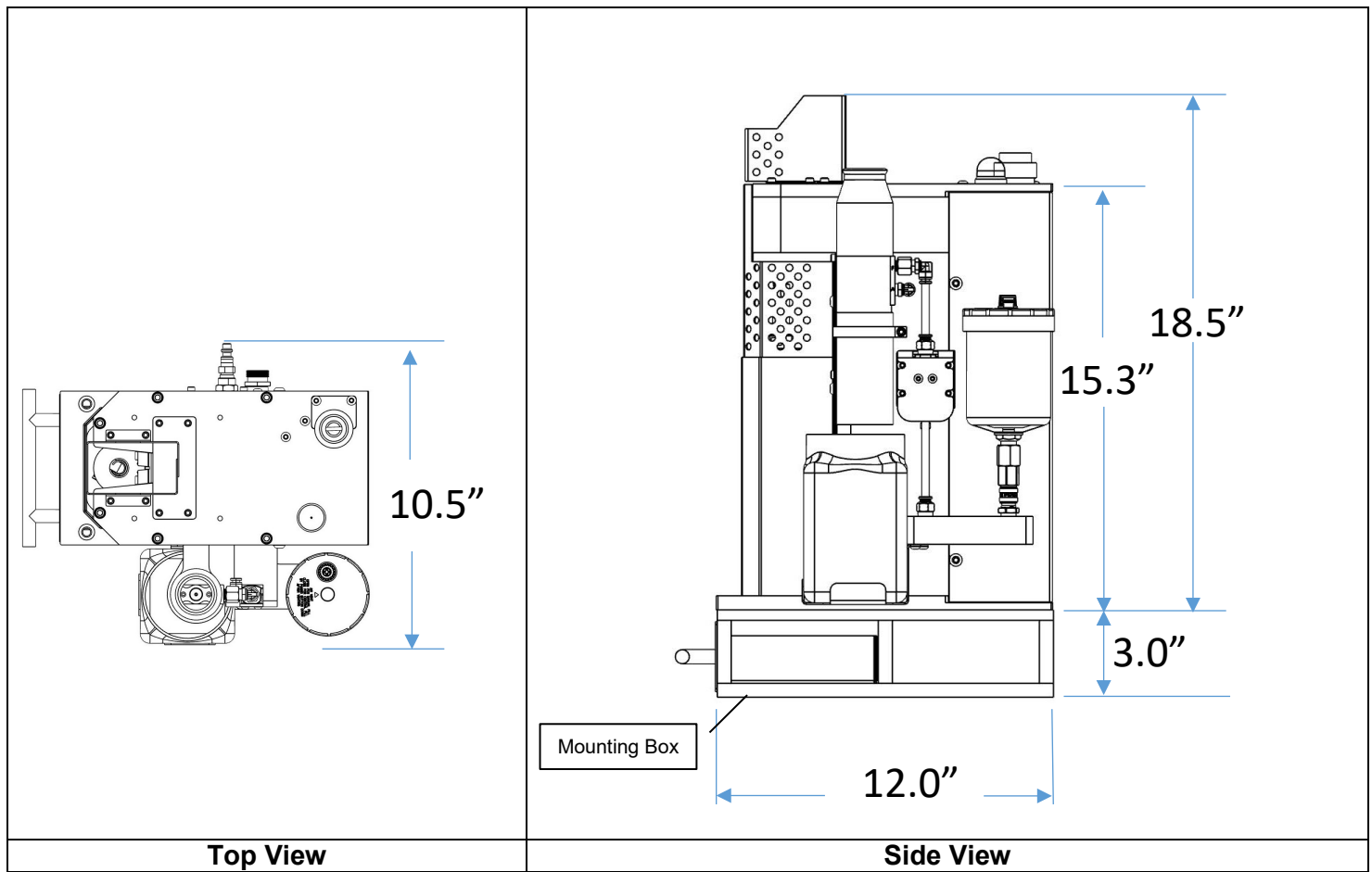
ANTI SPATTER FLUID SPECIFICATIONS	
Use recommended water based anti-spatter fluid in this product.	
Do not use oil based anti-spatter fluid.	

PHYSICAL DIMENSIONS			
HEIGHT	WIDTH	DEPTH	NET WEIGHT
19 in.	10.5 in.	12 in.	44 lbs
483 mm	267 mm	305 mm	20 kg

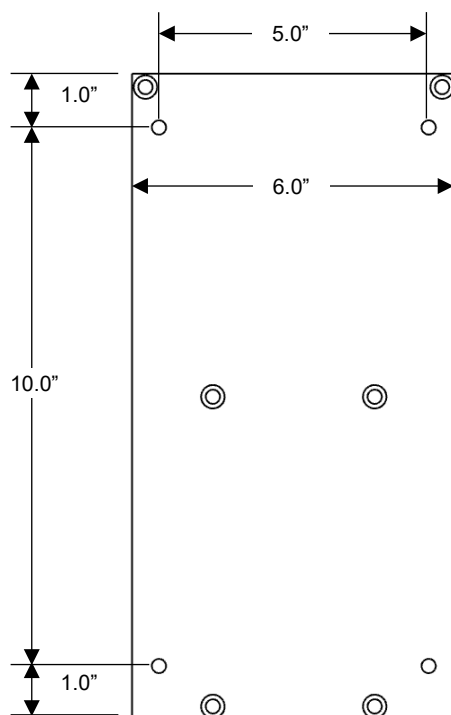
## 2. Installation

### **Danger of accident when connecting the pneumatic or electrical supply!**

- Prior to installation ensure that all protective measures have been taken and will remain in place while performing the installation.
- Ensure that the air supply and electrical power to the POWER REAM PLUS are disconnected until the installation is complete.
- The POWER REAM PLUS should be installed within the weld cell at a convenient location. Be sure to consider movable fixtures, robot envelope, and maintenance personnel accessibility.
- Affix the mounting box to a sturdy platform using the four bolt holes provided for 1/4"-20 Socket Head Cap Screw (SHCS) mounting hardware.
- Affix POWER REAM PLUS to the mounting box platform using mounting hardware provided.
- Before operating the POWER REAM PLUS, ensure that the correct reaming bit for the torch nozzle is installed.



## 2.1. Baseplate Dimensions



Mounting Box Bottom View

## 2.2. Air Connection

Use only regulated, filtered, non-lubricated air. Mount a 5-micron airline filter (not supplied) in the airline to the POWER REAM PLUS.

AIR SUPPLY REQUIREMENTS: 80 PSI at 22 SCFM. Connect the inlet supply line to the quick connect pneumatic fitting located at the side of the POWER REAM PLUS.

## 2.3. Electrical Connection

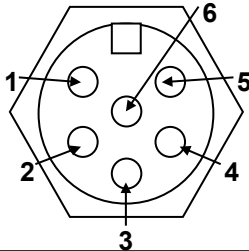
Damage to equipment may occur if connected improperly. Only a qualified technician should perform the following connections. Secure the 6-pin connector by threading the connector to the receptacle near the base of the POWER REAM PLUS. The POWER REAM PLUS is powered through this connection and requires a 24 VDC, 0.75 Amp DC power supply. It is recommended that power to the POWER REAM PLUS (both +24VDC and 0VDC) is wired to safe power (i.e., concurrent with robot servo power), interruptible by an emergency stop condition.

### Signal Description

Connect cable wires according to the following description

<u>Wire Color</u>	<u>Name</u>	<u>Description</u>
Red	+24 VDC	Power supply (+24 VDC, 0.75 Amp DC)
White	0 VDC	Power supply return.
Orange	Start <sup>1</sup>	Robot output. Pulse this output for a minimum of 0.5 sec to start the ream cycle.
Black	Spray <sup>1</sup>	Robot output. Pulse this output for a minimum of 0.5 sec while positioned over the sprayer.
Green	Complete	Robot input. The robot should check this input before and after a reaming cycle.
Blue	Error <sup>2</sup>	Robot input. The robot can check this input after a reaming cycle to ensure error free operation. Refer to the “Troubleshooting” section for error codes.

### Interface Receptacle



#### Wiring

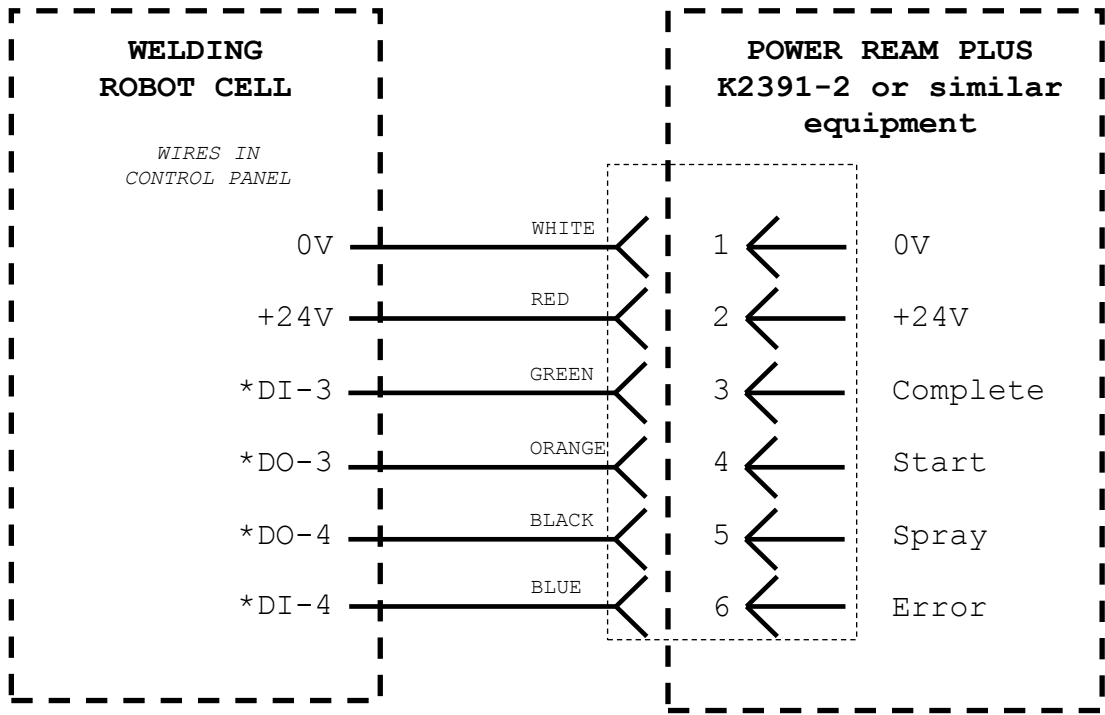
1.	0 VDC	(WHT)
2.	+24 VDC	(RED)
3.	Complete	(GRN)
4.	Start	(ORG)
5.	Spray	(BLK)
6.	Error	(BLU)

The POWER REAM PLUS inputs and outputs may be sinking or sourcing. The factory default is for automatic detection of the input and output type, alternatively the input and output type may be configured manually. To verify automatic detection is enabled or to adjust the input and output types see section 9.1. Refer to Appendix A "Discrete I/O Explanation" for more details.

<sup>1</sup>NOTE: To activate the **wire cutter**, turn on both the "Start" and "Spray" outputs simultaneously. For further information regarding the wire cutter operation, refer to section 7.

<sup>2</sup>NOTE: The "Error" signal has additional functionality for the **Nozzle Gas Flow Sensor**. When no error is present (i.e., the POWER REAM PLUS is in its waiting state), the Error signal will turn on when gas flows through the Nozzle Gas Flow Sensor at the preset flow rate. For further information regarding the nozzle gas flow sensor option, refer to section 8.

POWER REAM PLUS to Lincoln Electric Welding Robot Cell



\*These labels are for reference only.

### 3. Operation

#### 3.1. User Interface

The user interface is part of the Reamer Control Module (RCM) and can be found on the electrical supply side of the POWER REAM PLUS (opposite the reservoir). The user interface provides the following features:

- Manual operation of the clamp, lift and spray system
- The status of each solenoid is shown on its respective button
- Monitor sensor operation of the clamp and lift reed switches
- Input / Output configuration and other feature settings
- Control logic reset

Item	Name	Description
1	Settings	Settings mode and status
2	Reset	Device and control logic reset
3	CLAMP	Solenoid activation and status
4	CLAMP Sensor	Status (Red / Green)
5	LIFT	Solenoid activation and status
6	LIFT Sensor	Status (Red / Amber / Green)
7	SPRAY	Solenoid activation and status

#### 3.2. Power-Up

Once the POWER REAM PLUS is wired into the controller and power is applied, the device status LEDs will display the power up sequence (green – yellow – red) and then show positions of the cylinders according to the legend next to the LEDs.

Power Up LED check →					
<b>CLAMP</b> OPEN CLOSED					
<b>LIFT</b> TOP BOTTOM					

If the sensor LEDs are not reporting the clamp open and the lift at the bottom, then check the air pressure or sensor positions. If the sensor LEDs are flashing yellow and green, check for **start lock** (see below). If the LEDs are flashing yellow, ensure the settings pushbutton is not pressed or defective.

**Start Lock:** The start lock feature is a safety measure that blocks a command signal during power-up when it is unsafe to begin an operation. If a command is present while the POWER REAM PLUS powers up, the POWER REAM PLUS will enter a start lock mode instead of cycling immediately and the “Error” input will turn on. During power up, the device status LEDs will display the power up sequence (green-yellow-red) and then flash yellow/green if an output from the controller is present. To resume operation, turn off all controller outputs to the POWER REAM PLUS.



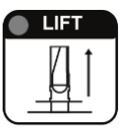



**Robot Input:** If the device has completed the power up sequence, and is not in cycle, then with the clamp open, and lift at the bottom, the “Complete” input to the robot controller will be on. Similarly, if an error has occurred during a machine operation, the “Error” input will be on.

**Robot Output:** If no action occurs by turning on the “Start” or “Spray” output from the robot controller, check the wiring of the sourcing outputs at the controller.

### 3.3. Manual Operation

Operation of the clamp, lift and spray valves is possible with the buttons on the user interface. The green LED indicator at the top left shows button feedback and solenoid operation. The sensor LED indicators to the right indicate the sensor feedback of the corresponding device.

Note: a “Local Lockout” mode is enabled for 5 seconds following the press of any of these buttons. Robot I/O is disabled and the LEDs blink slowly during this time. The lockout will cancel itself after 5 seconds or if the “Settings” button is pressed. One second before the lockout is cancelled, the user interface LEDs will be turned on to indicate the lockout expiry.

	 <p><b>WARNING: the clamp will operate under this condition. KEEP HANDS CLEAR</b> of the operating space of the clamp and wire cutter. This device is intended for one-man operation during setup.</p>
	 <p><b>WARNING: the lift cylinder will operate under this condition. KEEP HANDS CLEAR</b> of the operating space of the reaming bit. This device is intended for one-man operation during setup.</p>
	 <p><b>WARNING: the spray will operate under this condition. KEEP FACE and HANDS CLEAR</b> of the operating space of the sprayer. This device is intended for one-man operation during setup.</p>



### 3.4. Automatic Operation

The following diagram shows the 7-step reaming sequence and color of the device status LEDs at each stage. The LEDs show the position of the clamp and lift cylinders on the control module.

CLAMP ● OPEN ● CLOSED		1	2	3	4	5	6	7
LIFT ● TOP ● BOTTOM		G	R	R	R	R	R	G
		G	G	Y	R	Y	G	G
		Ready	Clamp Closed	Raising Ream Bit	Ream Bit at Top	Lowering Ream Bit	Ream Bit at Bottom	Clamp Open
"Start" Output		↗	Pulse 0.5s	Off				
"Complete" Input		On	On	Off				
								On

The above chart shows the robot inputs and outputs as the sequence progresses.

#### Automatic Retry

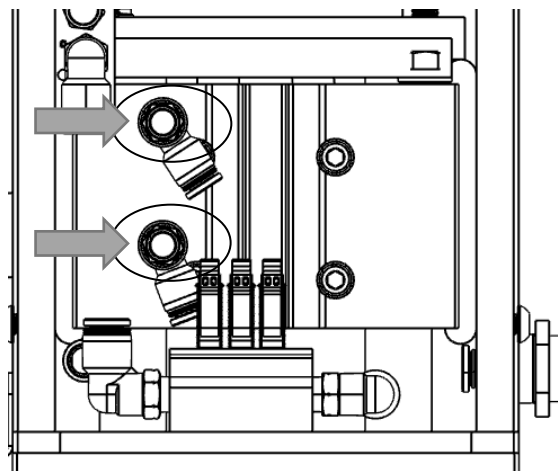
If excessive spatter is built up in the nozzle, or the programmed position of the nozzle is off center not allowing the reaming bit to extend to the full depth inside the nozzle within a specific amount of time, the POWER REAM PLUS will automatically perform a single retry.

#### Cycle Optimization

The lift rate of the reaming bit will determine how many reaming revolutions will occur within the nozzle. This setting should be adjusted based on the amount of spatter buildup in the nozzle between reaming cycles. More spatter buildup will require a slower lift rate. Less spatter buildup will allow a faster lift rate.

To set the lift rate, remove the rear cover and adjust the top needle valve. Turning clockwise will decrease the lift rate (for more spatter removal) and turning counterclockwise will increase the lift rate (for a shorter cycle time).

To set the retracting rate, adjust the bottom needle valve. Turning clockwise will decrease the retracting rate and turning counterclockwise will increase the retracting rate.

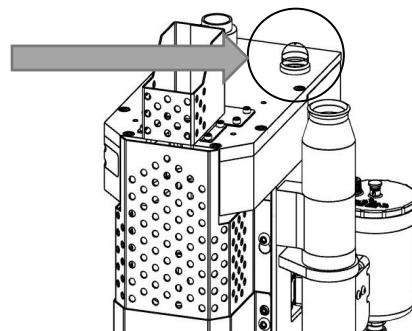


## 4. Reamer

### 4.1. Status Light

The status light on the top lid of the POWER REAM PLUS indicates the current state of operation.

Color	Meaning
Off	Ready to cycle
Red	In cycle
Flashing Red	In alarm, flashing error code



### 4.2. Position Programming

The POWER REAM PLUS features a “no trial, no error” position programming technique as described below:

1. Hold the “LIFT” button to raise the reaming bit without spinning.



**WARNING: the lift cylinder will operate under this condition. KEEP HANDS CLEAR** of the operating space of the reaming bit. This device is intended for one-man operation during setup.

Once the reaming bit is at the top position (“LIFT” LED is red), release the “Settings” button.

2. Using the robot, move the torch nozzle into the clamp so the reaming bit is inset to the full depth required inside the nozzle.
3. Press and release the “CLAMP” button to verify the clamp engages the cylindrical body of the nozzle equally, and the nozzle does not change orientation or position when clamped.



**WARNING: the clamp will operate under this condition. KEEP HANDS CLEAR** of the operating space of the clamp and wire cutter. This device is intended for one-man operation during setup.

4. Register this position in the robot controller using a fine position level as the “Ream” position described in the programming chart above.

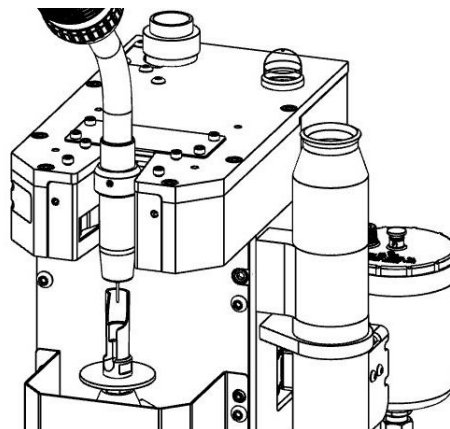
#### Ream Position

5. Press the “LIFT” button to exit programming mode. The reaming bit will lower without spinning.



**WARNING: the lift and clamp will operate under this condition. KEEP HANDS CLEAR** of the operating space of the reaming bit.

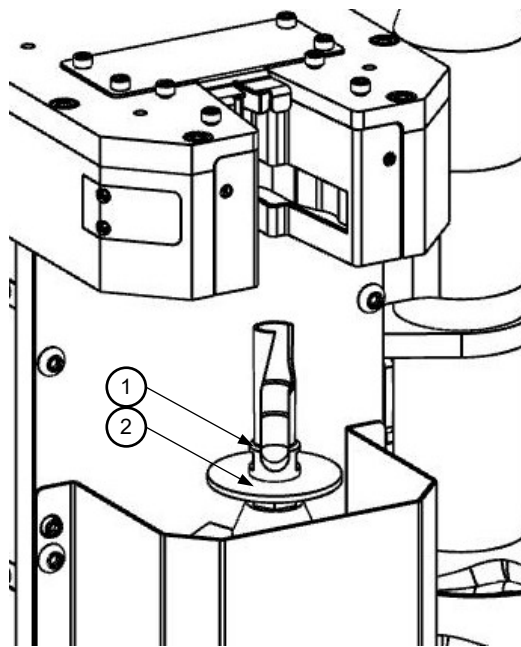
This device is intended for one-man operation during setup.



### 4.3. Reaming Bit Replacement

#### **⚠WARNING**

- Disconnect air and electrical supply.
- Remove the front ream guard cover (not shown).
- Hold the ream rod, item 2, from rotating with a 5/8" wrench.
- Unfasten the reaming bit, item 1, with a second 5/8" wrench.
- Remove the reaming bit.
- Insert the reaming bit into the ream rod.
- Hold the reaming rod from rotating with a 5/8" wrench.
- Tighten the reaming bit with a second 5/8" wrench.
- Replace the front ream guard cover.
- Reconnect air and electrical supply.



## 5. Sprayer

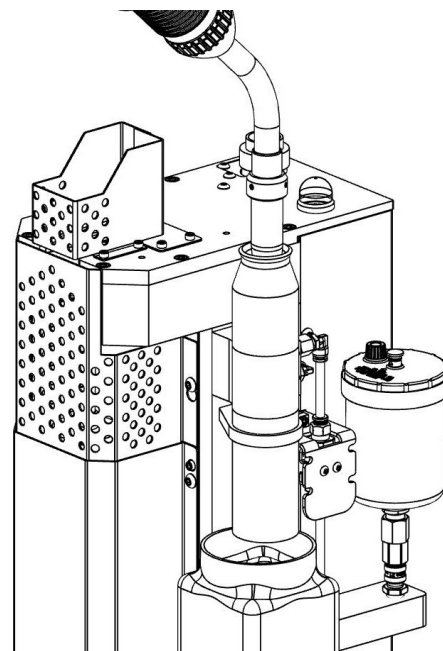
The Sprayer combines pressurized air and anti spatter fluid to deliver a radial spray pattern to uniformly coat the interior surface of the nozzle and help prevent spatter buildup.

The spray containment tube helps to manage overspray from the spray nozzle and maintain a clean robot welding cell.

The sprayer may use a built-in post flow timer of 0,  $\frac{1}{4}$ ,  $\frac{1}{2}$ , or 1 second. Airflow from the spray nozzle will be present for the post flow time after the spray output and corresponding fluid valve have been turned off.

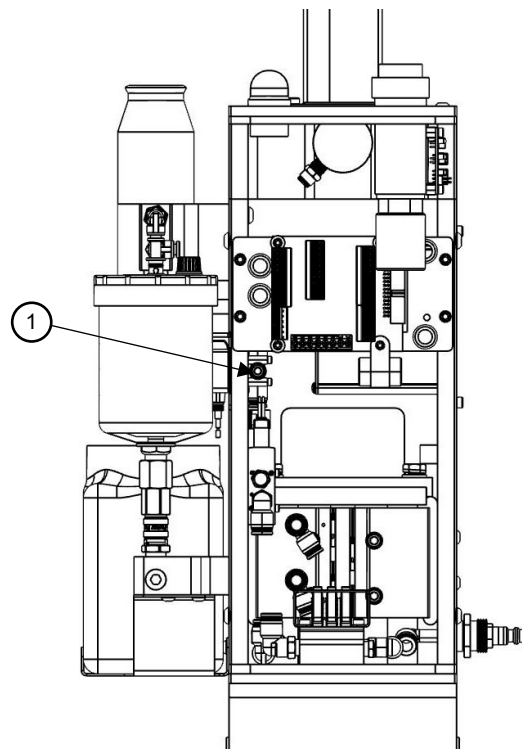
### 5.1. Spray Position Programming

Center the nozzle  $1\frac{1}{2}$  inches above the spray head. Record this position as the “Spray Approach” position. Move the nozzle into the hole at the top of the spray cone and record this position as the “Spray Target” position. The sprayer has a built-in post flow timer. Airflow from the spray nozzle will be present for set time (0,  $\frac{1}{4}$ ,  $\frac{1}{2}$  or 1 second) after the spray output and corresponding fluid valve have been turned off.



### 5.2. Spray Adjustment

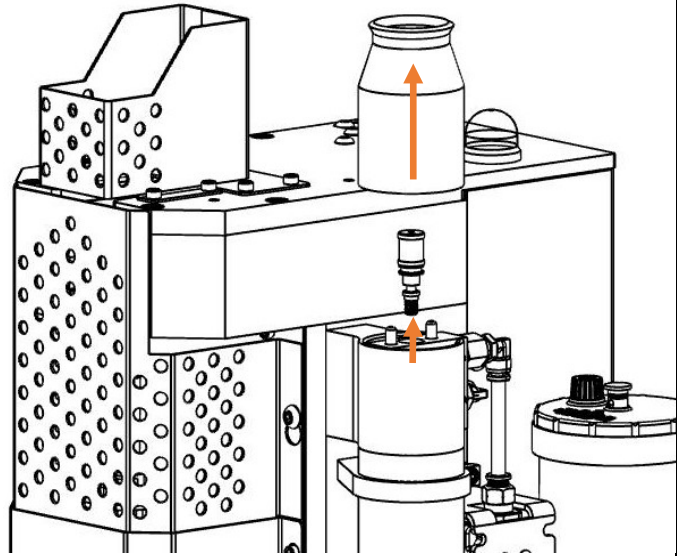
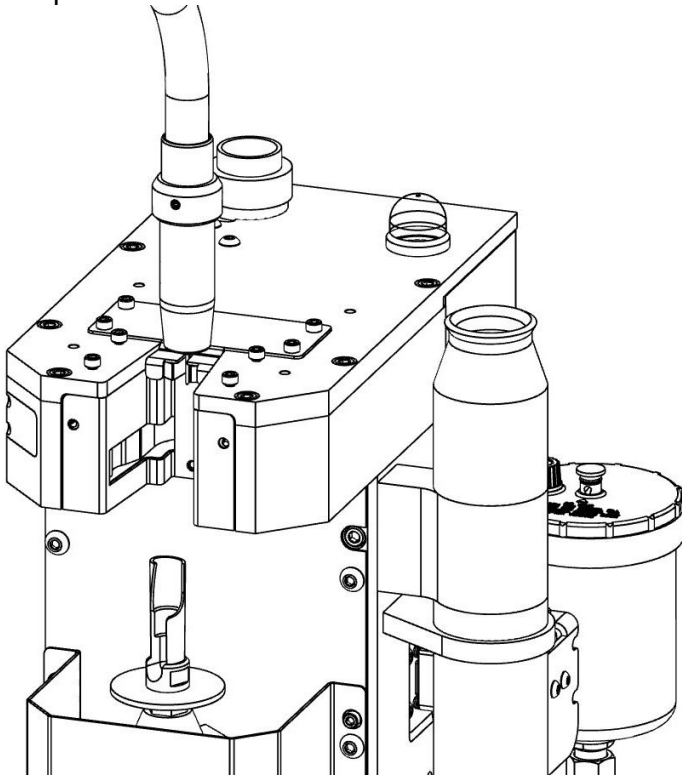
The amount of spray may be adjusted with the needle valve, item 1, located behind the rear cover. Turn clockwise for less spray.



### 5.3. Spray Nozzle Replacement

#### **⚠ WARNING**

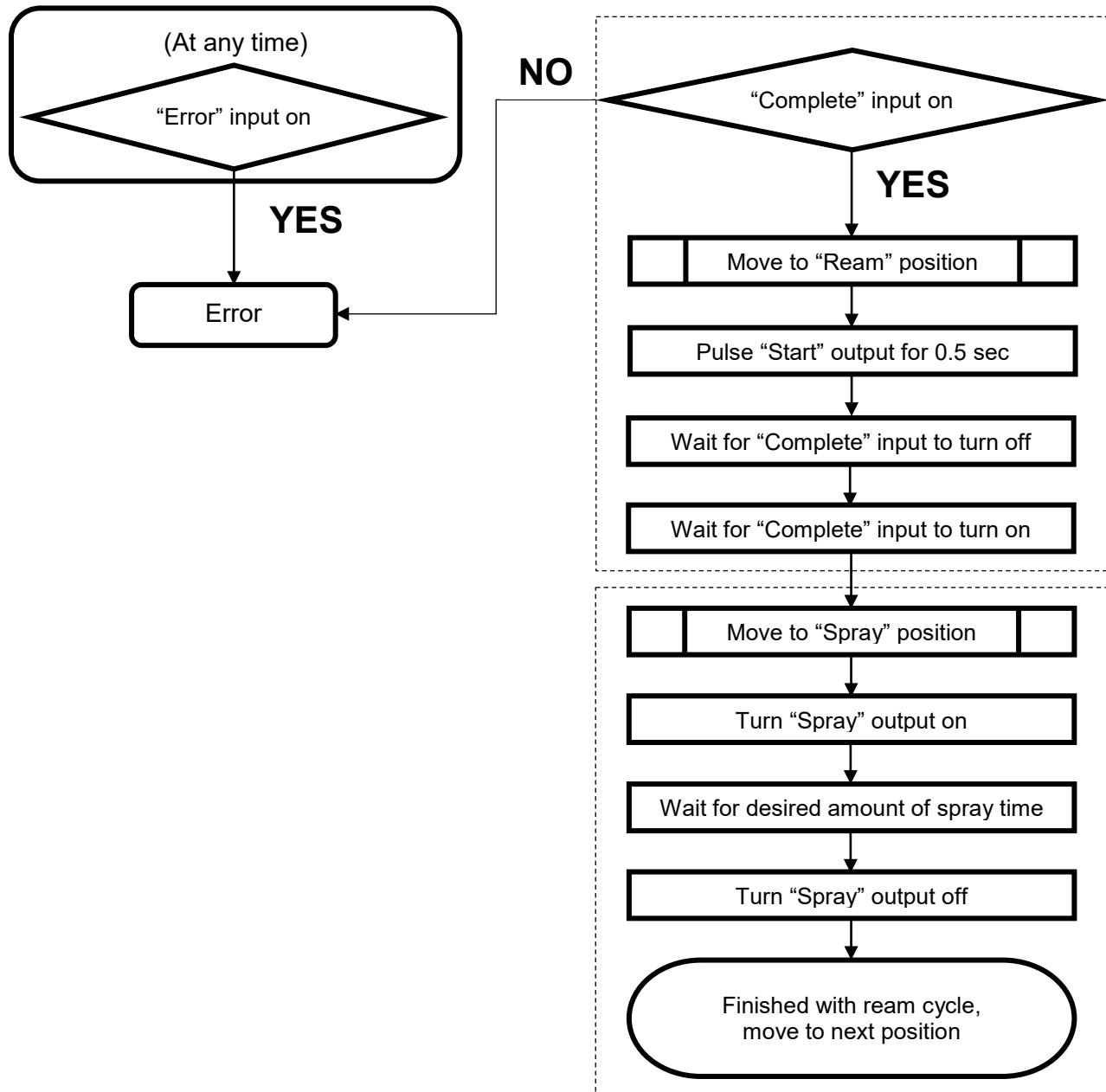
- Disconnect air and electrical supply.
- Lift spray cone straight up to remove.
- Unthread spray nozzle and lift straight up to remove.
- Replace in reverse



order.

## 6. Ream and Spray Sequence Flow Chart

The following flow diagram shows the recommended procedure for the reaming and spraying sequences.



For the wire cutter and nozzle gas flow sensor see the following sections.

## 7. Wire Cutter Option

The POWER REAM PLUS offers a wire cutter as a factory installed option (G4827-6). The wire cutter is used to remove the ball at the end of the wire created by the welding process. It will leave the welding wire with a tapered point at the end of the wire stick-out for improved arc starting.

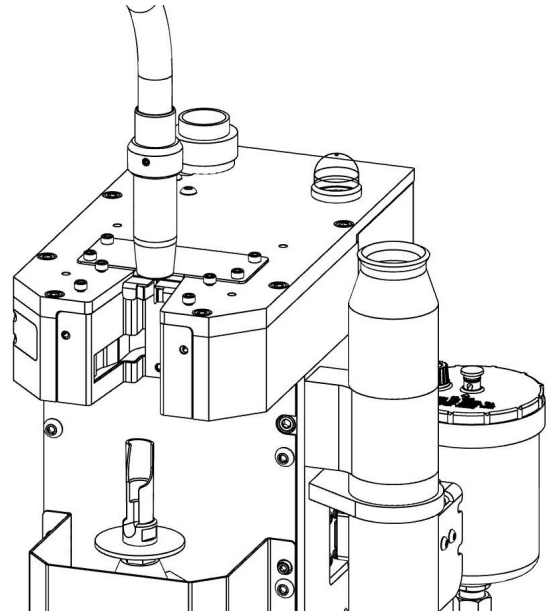
### 7.1. Wire Cutter Position Programming

To obtain the "Wire Cut" position mentioned in the procedure outlined, center the nozzle at the desired stick-out height above the wire cutter and record this position.

Once a week, the wire cutter should be inspected visually. Look for dullness and possible breakage of the cutting blades, replace if necessary.



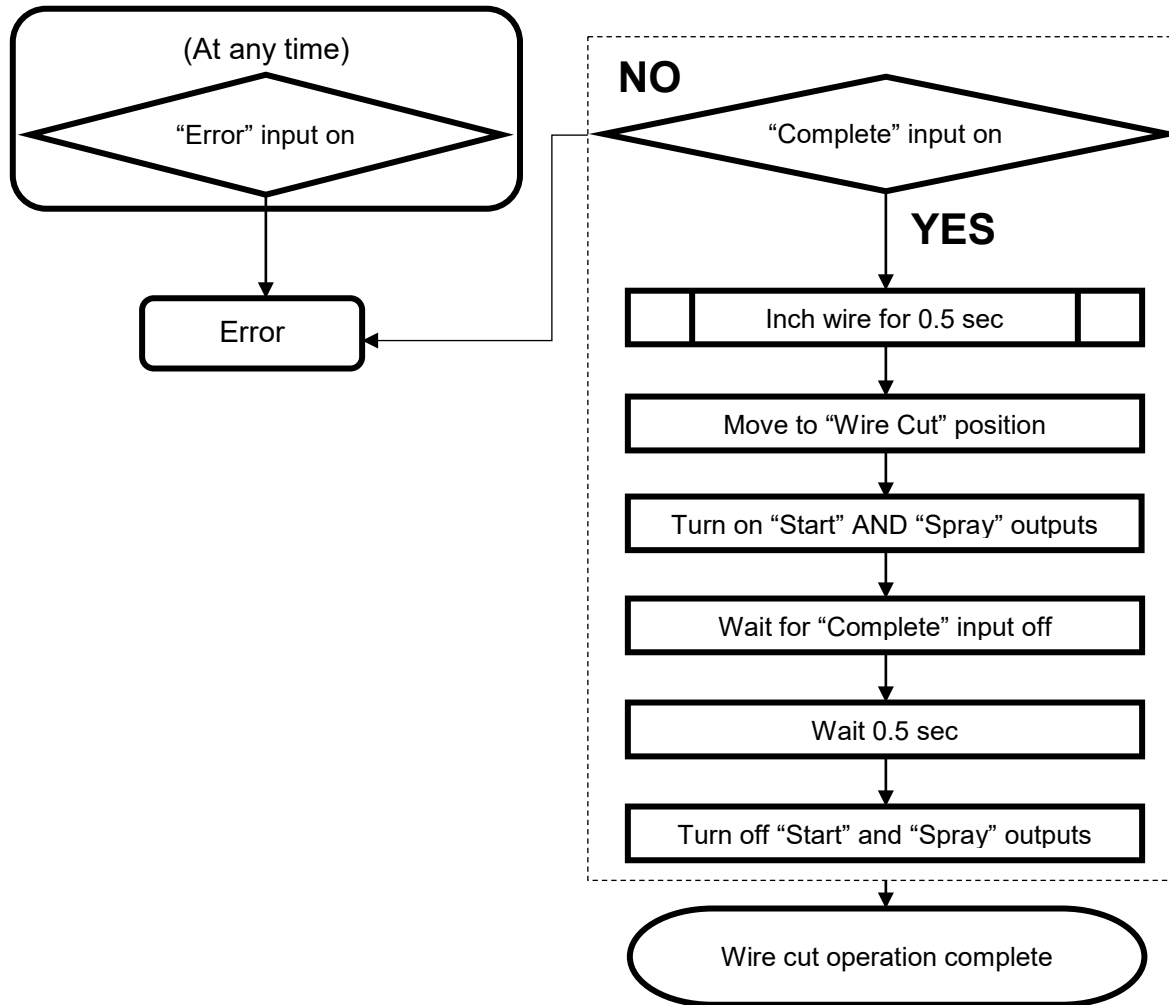
**WARNING:** Anytime the clamp is closed, the wire cutters will be closed as well. Keep hands clear of the wire cutter area and clamp area.





## 7.2. Wire Cutter Sequence Flow Chart

The wire cutter utilizes the clamping cylinder and sensor already present on every POWER REAM PLUS. The POWER REAM PLUS will perform a wire cut operation if both the "Start" and the "Spray" outputs are turned on simultaneously. Following is the suggested wire cutting program logic.



**8. Nozzle Gas Flow Sensor (NGFS) Option**

The POWER REAM PLUS offers a nozzle gas flow sensor as a factory installed option (G4827-66). The integrated nozzle gas flow sensor measures gas flowing out the end of the torch nozzle. This method is advantageous to an inline flow sensor installed in the gas hose as there may be undetected leaks downstream. By measuring gas flow at the nozzle, the point of use, the system verifies adequate gas coverage for the weld puddle where it is required.

**8.1. NGFS Specifications**

GAS FLOW SPECIFICATIONS	
Max Pressure: 60 PSI	Flow: 10 - 60 SCFH
For use with CO2, AR, or Mixed gas (AR, CO2, He)	

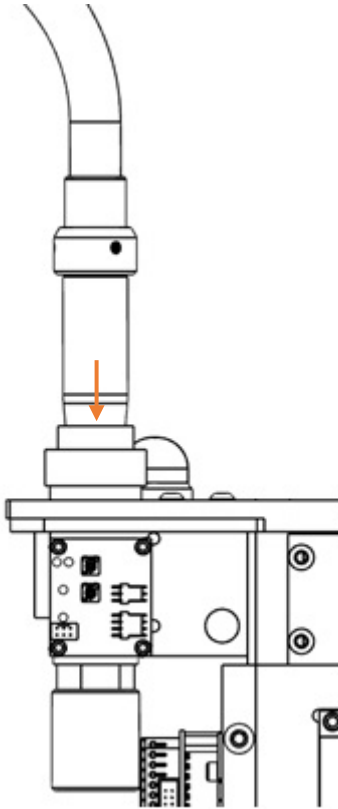
**8.2. NGFS Operation**

When the welding gas solenoid turns on there is normally a surge of gas before the flow stabilizes to the steady state flow preset by the regulator. The Nozzle Gas Flow Sensor Signal will turn on after 0.5 sec of stable gas flow within a defined window of operation.

### 8.3. NGFS Setup

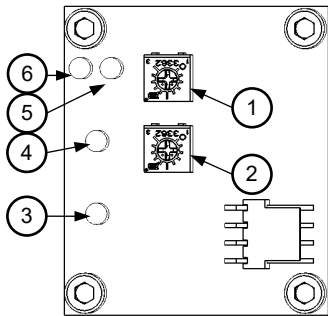
There are two settings available to change the window of operation; (1) Flow Set point and (2) Flow Tolerance Band. The set point adjustment (1) will move the entire band (minimum and maximum) up or down. The tolerance band adjustment (2) will adjust the span between the maximum and minimum levels.

#### Setup Procedure



1. Using an independent measurement device, set the desired welding nozzle gas flow to the desired flow rate.
2. Move the robot to bring the nozzle to the target position with the nozzle fully engaged in the flow cone. The module has a small amount of movement built into the spring mounts which will allow the nozzle to fully contact the cone for optimal flow transfer.
3. Remove the side plate to expose the circuit board.
4. Check for sensor power supply on (LED4 is ON).
5. Turn on gas flow through the nozzle at desired flow rate.
6. Adjust the Flow Set Point potentiometer (P1) until LED1 and LED2 are flashing equally. If LED1 is flashing alone turn P1 Clockwise, if LED2 is flashing alone turn P1 counterclockwise.
7. Check for output signal active (LED3 is ON).
8. Turn off gas flow.
9. Check that the output signal deactivates (LED3 is OFF) and the High Side (6) / Low Side (5) LEDs are also off.
10. Move the robot to bring the nozzle out of the flow cone to the approach position.

#### Circuit Board Detail

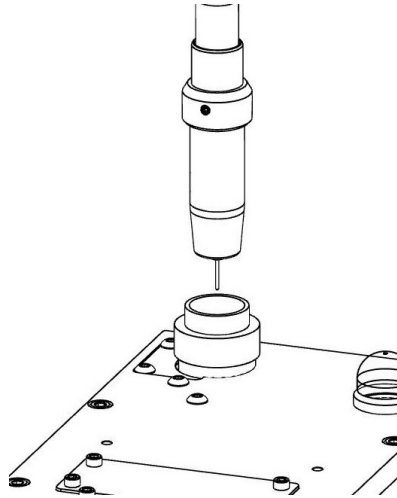


	Designator	Description
1	P1	Flow Set point
2	P2	Tolerance Band
3	LED3	Output Signal Active
4	LED4	Sensor Power Supply
5	LED1	Low Side indicator
6	LED2	High Side indicator

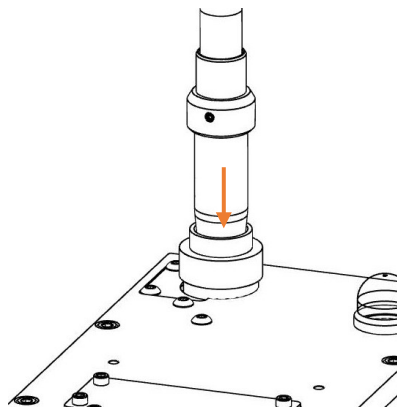
#### 8.4. NGFS Robot Position and Sequence Flow Chart

To properly detect gas flow, the correct robot position must be programmed with the nozzle inserted into the cone of the sensor. An approach position is recommended as the first step followed by the target position inside the cone.

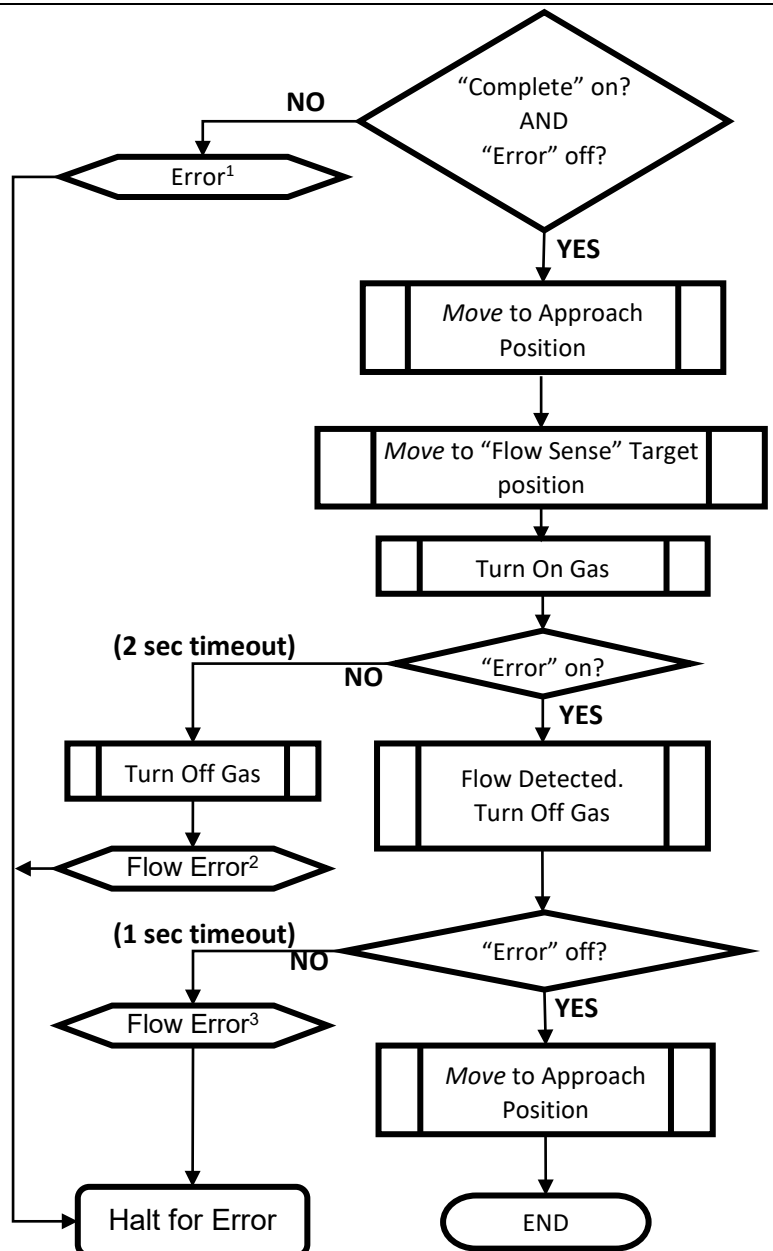
The following figures and flowchart show the recommended programming sequence with nozzle location for the approach and target positions.



**Approach Position:** the nozzle is in-line with and directly above the cone.



**Target Position:** The nozzle lightly touches the inside of the cone. The nozzle is vertical.

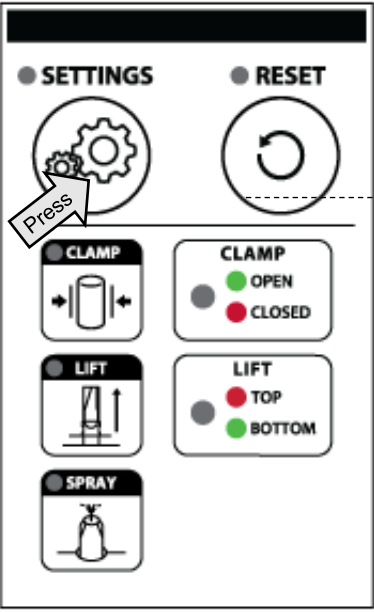






















**Errors:**

1. POWER REAM PLUS Error from previous Cycle
2. Gas flow turn-on undetected
3. Gas flow turn-off undetected

## 9. Settings

Several features may be setup to optimize performance of the POWER REAM PLUS. To access the configuration menus, press and hold the settings button for the required time as shown below. The device status LEDs will change their color pattern to indicate the menu that is accessible at a specific time. Release the settings button when the color pattern for the desired configuration menu is shown.

	>3 sec (I/O config)	>5 sec (Spray)	>7 sec (Extras)	>9 sec (Mode)	>11 sec (Diagnostic)	>13 sec
						
						
						

*Note: The default setting for each configuration is first and last in each sequence.*

### 9.1. I/O Configuration

The POWER REAM PLUS automatically detects sinking or sourcing inputs and outputs from the controller. For more information on discrete I/O See Appendix A: Discrete I/O Explanation.

To disable the automatic-detect feature and manually configure the I/O types, use the following procedure:

Press and hold the settings button for at least 3 seconds (until the LIFT bottom LED is solid red).

Upon releasing the settings button, the sensor LEDs will show the present I/O configuration. This is the first in the sequence of teachable configurations. Subsequent pressing and releasing of the settings button will sequence the following configurations in order of appearance. To register the desired configuration, press the reset button when that configuration is displayed.

The top LED shows the controller input type (green = Active low, red = Active high).  
The bottom LED shows the controller output type (green = Sinking, red = Sourcing).

<b>CLAMP</b> OPEN CLOSED		Present Input	Active High	Active Low	Active High	Active Low	Auto	Clamp status
<b>LIFT</b> TOP BOTTOM		Present Output	Sinking	Sinking	Sourcing	Sourcing	Auto	Lift status
								Done

**AUTO:** Enable the automatic I/O configuration feature. The sinking and sourcing outputs in the POWER REAM PLUS are short circuit protected with integrated over-current circuitry between 0.65-1.4 Amp DC. If a short circuit occurs, error code #8 will flash (Refer to troubleshooting section).

## 9.2. Spray

The sprayer has a built-in post flow timer. Airflow from the spray nozzle will be present for set time (0, 1/4, 1/2 or 1 second) after the spray output and corresponding fluid valve have been turned off, the default is 0 (disabled).

Follow the steps outlined in section 9.2 to access the spray settings menu. Upon releasing the settings button, the LEDs will show the current spray setting. This is the first in the sequence of teachable configurations. Subsequent pressing and releasing of the setting button will sequence the following configurations in order of appearance. To register the desired configuration, press the reset button when that configuration is displayed.

<b>CLAMP</b> OPEN CLOSED	Default	0 sec	1/4 sec	1/2 sec	1 sec	Clamp status
<b>LIFT</b> TOP BOTTOM						Lift status
						Done

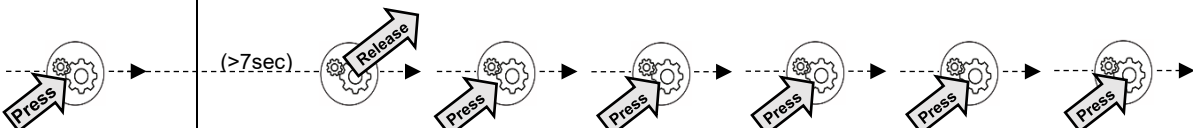

















### 9.3. Extras

1. Blow-off: The motor spins and exhausts (blowing off over spray) for two seconds after spraying.
2. De-Ringer: A pilot reaming stroke removes the spatter ring that forms on the end of a welding nozzle, followed by a full extension reaming stroke. Using this technique, the spatter ring is not pushed into the nozzle where it may become lodged.

The features in the “extras” menu can be configured by the following procedure:

Follow the steps outlined above to access the “extras” configuration menu. Upon releasing the settings button, the LEDs will flash red on top and bottom. This is the first in the sequence of teachable configurations.

Subsequent pressing and releasing of the settings button will sequence the following configurations in order of appearance. To register the desired configuration, press the reset button when that configuration is displayed.

							
<b>CLAMP</b>  OPEN  CLOSED	Blow-off:	OFF	ON	OFF	ON	OFF	Clamp status
							
							
	De-Ringer	OFF	OFF	ON	ON	OFF	Lift status
							Done



## 9.4. Running Mode

Several running modes are available to select from.

**Automatic:** Every aspect of the cycle is commanded, monitored, and checked by the control module.

**Dry Run:** The motor and fluid solenoid are disabled.

**Timed:** Bypass the "extended" sensor on the lift cylinder. The robot must hold the start signal on for the reaming time. Auto Retry is disabled in this and the following modes:

**Open:** Bypass the "extended" and "retracted" sensor. The robot must hold the start signal on for the reaming time and hold the robot in the clamp until the reaming bit is fully retracted.

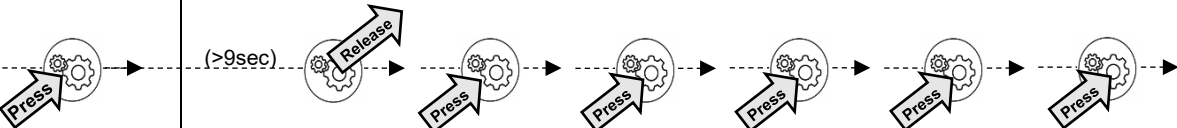
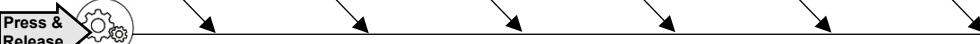
**Blind:** Bypass all sensors. The robot must hold the start signal on for the ream time and hold the torch in the jaws until the reaming bit is fully retracted and the clamp is fully opened.

**Mode configuration:** A specific running mode can be configured by the following procedure.

Follow the steps outlined above to access the mode configuration menu. Upon releasing the settings button, the LEDs will flash green on top and bottom. This is the first in the sequence of teachable configurations.

Subsequent pressing and releasing of the settings button will sequence the following configurations in order of appearance. To register the desired configuration, press the reset button when that configuration is displayed.

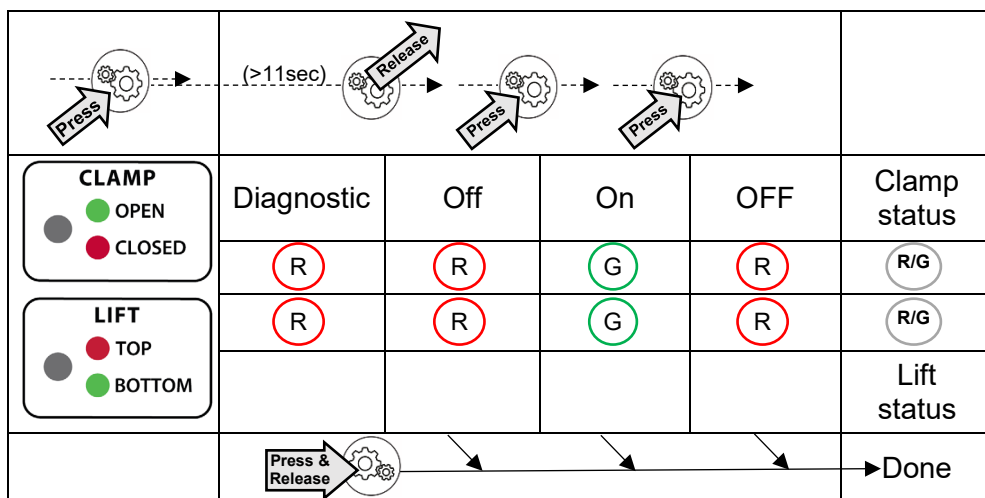
### Mode

								
<div> <b>CLAMP</b>   OPEN   CLOSED         </div> <div> <b>LIFT</b>   TOP   BOTTOM         </div>	Mode	Automatic	Dry Run	Timed	Open	Blind	Auto	Clamp status
								Lift status
								Done

## 9.5. Motor Diagnostic

This feature allows a service technician to test the air motor function manually.

Follow the steps outlined below to access the motor diagnostic configuration menu. Upon releasing the settings button, the LEDs will flash red on top and bottom. This is the first in the sequence of teachable configurations. Subsequent pressing and releasing of the settings button will sequence the following configurations in order of appearance. To register the desired configuration, press the reset button when that configuration is displayed.



### Motor Diagnostic Configurations:

**Off:** This feature is disabled.

**On:** This feature is enabled.

**Note:** Running the motor diagnostic will disable the feature so that it can only be run once each time it is enabled.

**Motor Diagnostic Operation:** Once the reset button is released, the unit will display the power-up sequence. Follow this procedure to test the air motor manually:

1. LIFT function: Press and hold the "LIFT" button to raise the reaming bit (without spinning) until it reaches the top position. Check that the "LIFT" LED on the control module is green.

**WARNING:** the lift will operate under this condition. **KEEP HANDS CLEAR** of the operating space of the reaming bit. This device is intended for one-man operation during test.



Once the POWER REAM PLUS is at the top position ("LIFT" LED is green), release the "LIFT" button and the reaming bit will maintain its position.

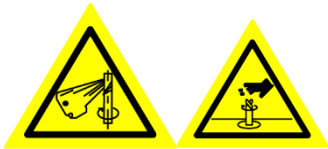
2. CLAMP function: Press the “CLAMP” button to close and open the clamp. Check that the “CLAMP” LED on the control module changes from green to red when the clamp is closed.



***WARNING: the clamp will operate under this condition. KEEP HANDS CLEAR of the operating space of the clamp and wire cutter. This device is intended for one-man operation during test.***

**Note:** The LEDs on the control module will flash red from this point on in the sequence to indicate **CAUTION** for the operating devices being tested.

3. MOTOR function: With the reaming bit raised, press both the “CLAMP” button and “LIFT” button to test the “Motor” solenoid.



***WARNING: the motor will operate under this condition. KEEP HANDS CLEAR of the operating area of the reaming bit. Do not operate with exposed long hair, jewelry, or loose clothing. This device is intended for one-man operation during test.***

## 10. **Preventative Maintenance**

The POWER REAM PLUS will require periodic maintenance to ensure a dependable service life. The following schedule is recommended.

**Shut off the air supply and disconnect the power cable before making adjustments.**

### DAILY

- Check the fluid level in spray reservoir.
- Check the reaming bit visually.

### WEEKLY

- Dump the spatter accumulated in the drawer of the mounting box or customer supplied catchment below the reamer.
- Check airlines for leaks and robot control cable for splits or cracks.
- Clean clamp gripping surfaces to ensure optimal nozzle gripping.

### SPRAY CONTAINMENT UNIT (weekly)

- Remove and clean out spray cone and drain.
- Check collection jug.

### NGFS (weekly)

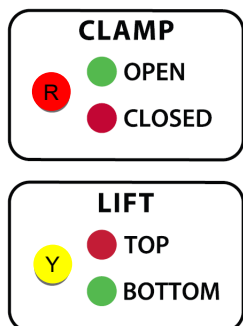
- Clean the inside face of the flow cone to remove surface buildup.
- Clean debris from the main cavity by removing the plug at the bottom.
- Check the mesh filter of debris. Clean or replace as required.

## 11. Troubleshooting

Problem	Possible Cause	Solution
<b>No device status LEDs on</b>	<ul style="list-style-type: none"> <li>-Power is off</li> <li>-Fuse is blown (controller cabinet)</li> <li>-Reset button defective</li> <li>-Circuit board defective</li> </ul>	<ul style="list-style-type: none"> <li>-Turn power on</li> <li>-Replace fuse</li> <li>-Replace reset button</li> <li>-Replace circuit board</li> </ul>
<b>Clamp/Motor/Lift/Cutter not working</b>	<ul style="list-style-type: none"> <li>-Insufficient air supply</li> <li>-Air line cut, disconnected, or twisted</li> <li>-POWER REAM PLUS in setup mode</li> <li>-Excessive spatter buildup</li> <li>-Dry run mode selected</li> <li>-Defective solenoid</li> <li>-Check error codes</li> </ul>	<ul style="list-style-type: none"> <li>-Set to 80 PSI, 15 SCFM</li> <li>-Replace or re-connect airline</li> <li>-Reset POWER REAM PLUS</li> <li>-Ream more often</li> <li>-Select automatic mode</li> <li>-Replace necessary valves</li> <li>-Check cable wiring</li> <li>-Perform a visual inspection of the equipment</li> </ul>
<b>Ream bit does not retract</b>	<ul style="list-style-type: none"> <li>-Ream bit jammed in nozzle</li> <li>-Extended sensor defective</li> <li>-"Start" output held on</li> <li>-Lift cylinder defective</li> <li>-Check error codes</li> </ul>	<ul style="list-style-type: none"> <li>-Replace damaged parts</li> <li>-Replace extended sensor</li> <li>-Pulse "Start" output for 0.5 sec</li> <li>-Replace lift cylinder</li> </ul>
<b>Controller cannot start a cycle or controller cannot complete a cycle</b>	<ul style="list-style-type: none"> <li>- "Complete" input signal not responding</li> </ul>	<ul style="list-style-type: none"> <li>-Check error codes</li> <li>-Reset POWER REAM PLUS</li> </ul>
<b>No anti-spatter liquid and/or no air flow from sprayer</b>	<ul style="list-style-type: none"> <li>-Low anti-spatter volume</li> <li>-Reservoir not vented</li> <li>-Fluid line blocked</li> <li>-Insufficient air supply</li> <li>-Solenoid valve defective</li> <li>-Spray nozzle clogged</li> </ul>	<ul style="list-style-type: none"> <li>-Refill anti-spatter reservoir</li> <li>-Open vent if closed</li> <li>-Clean or repair fluid line</li> <li>-Set to 80 PSI</li> <li>-Replace solenoid valve</li> <li>-Clean or replace spray nozzle</li> <li>*HAND TIGHTEN ONLY</li> </ul>
<b>Wire cutter won't cut wire, but the cutter closes</b>	<ul style="list-style-type: none"> <li>-Insufficient air supply</li> <li>-Cutters are worn or damaged</li> <li>-Wire diameter too large</li> </ul>	<ul style="list-style-type: none"> <li>-Set to 80 PSI</li> <li>-Replace damaged components</li> <li>-Check wire diameter</li> </ul>

## 11.1.Error Codes

The POWER REAM PLUS reports errors using the status light. When an error is reported, the status light flashes at a rate of 2 flashes per second.



When an error occurs during the reaming process, the clamp opens, the lift retracts, and the diagnostic report is shown with the top sensor LED in red. The LED will flash a certain number of times, pause, then repeat. The error count begins at 2.

Count the number of flashes between the pause and use the following chart to find the cause of the problem.

**2:** Closing Fault: The clamp took too long to close.

- Check air inlet pressure
- Check clamp sensor
- Check clamp air lines
- Check clamp solenoid
- Check clamp cylinder

**3:** Raising Fault: The lift cylinder took too long to extend from the retracted sensor.

- Check air inlet pressure
- Check extending needle valve (top needle valve on lift cylinder)
- Check retracted sensor (bottom)
- Check lift air lines
- Check lift solenoid
- Check lift cylinder

**4:** Extending Fault: The lift took too long to fully extend.

- Automatic retry; excessive spatter build up in the nozzle (ream more often), or incorrect programmed position of the nozzle not allowing the reaming bit to extend to full depth
- Check air inlet pressure
- Check extending needle valve (top needle valve on lift cylinder)
- Check extended sensor (top)
- Check lift air lines
- Check lift solenoid
- Check lift cylinder

**5:** Lowering Fault: The lift cylinder took too long to retract from the top while lowering.

- Check air inlet pressure
- Check retracting needle valve (bottom needle valve on lift cylinder)
- Check extended sensor (top)
- Check lift airlines
- Check lift solenoid
- Check lift cylinder

**6:** Retracting Fault: The lift cylinder took too long to fully retract.

- Check air inlet pressure
- Check retracting needle valve (bottom needle valve on lift cylinder)
- Check retracted sensor (bottom)
- Check lift airlines
- Check lift solenoid
- Check lift cylinder

**7:** Opening Fault: The clamp took too long to open.

- Check air inlet pressure
- Check clamp sensor
- Check clamp airlines
- Check clamp solenoid
- Check clamp cylinder

**8:** Short Circuit Fault: The output is short circuited.

- Check wiring to robot or PLC controller

**9:** Solenoid Voltage Fault: The voltage to actuate the solenoids is too low.

- Check the voltage between the solenoid voltage and 0V and adjust power supply as needed
- Check the wiring of the solenoid voltage/emergency stop circuit

**Note: Clearing Errors** – If an error has occurred with the POWER REAM PLUS, indicated by the “Error” input being turned on, it is possible to clear errors so that an operator is not required to enter the robotic welding cell. For example, if the air supply was not turned on and a ream cycle is required, the operator can simply turn on the air supply, and clear the error from outside the cell. This can be done by pulsing the “Start” output from the controller/teach pendant.

## 11.2.Advanced Troubleshooting

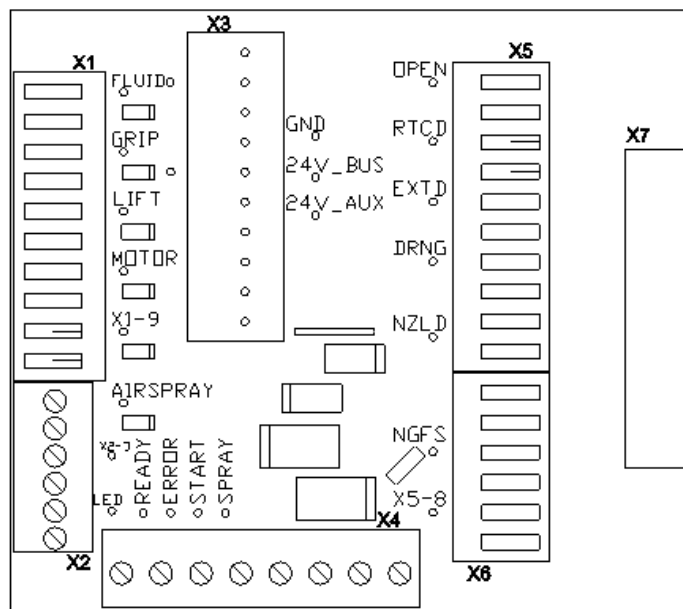
Use the test points in the following table to take readings with a voltmeter. Connect the (+) lead to the first test point and the (-) lead to the second test point.

Refer to the diagram below for test point locations.

(+) Lead Point	(-) Lead Point	Description	“On” Voltage	“Off” Voltage
24V_AUX	FLUID	Fluid Solenoid	24 V	0 V
24V_AUX	GRIP	Grip Solenoid	24 V	0 V
24V_AUX	LIFT	Lift Solenoid	24 V	0 V
24V_AUX	MOTOR	Motor Solenoid	24 V	0 V
24V_AUX	AIRSPRAY	Air Spray Solenoid	24 V	0 V
DRNG	GND	De-ringer Sensor	24 V	0 V
EXTD	GND	Extended Sensor	24 V	0 V
RTCD	GND	Retracted Sensor	24 V	0 V
GND	GND	Clamp Sensor	24 V	0 V
24V_BUS	GND	+24 VDC	24 V	0 V
SPRAY	GND	Spray	24 V sourcing 0 V sinking	0 V sourcing* 24 V sinking*
START	GND	Start	24 V sourcing 0 V sinking	0 V sourcing* 24 V sinking*
READY	GND	Complete	24 V sourcing 0 V sinking	0 V sourcing 24 V sinking
ERROR	GND	Error	24 V sourcing 0 V sinking	0 V sourcing 24 V sinking
24V_BUS	LED	Status Light	24 V	0 V

\*A trace value of 6V is measured prior to activation

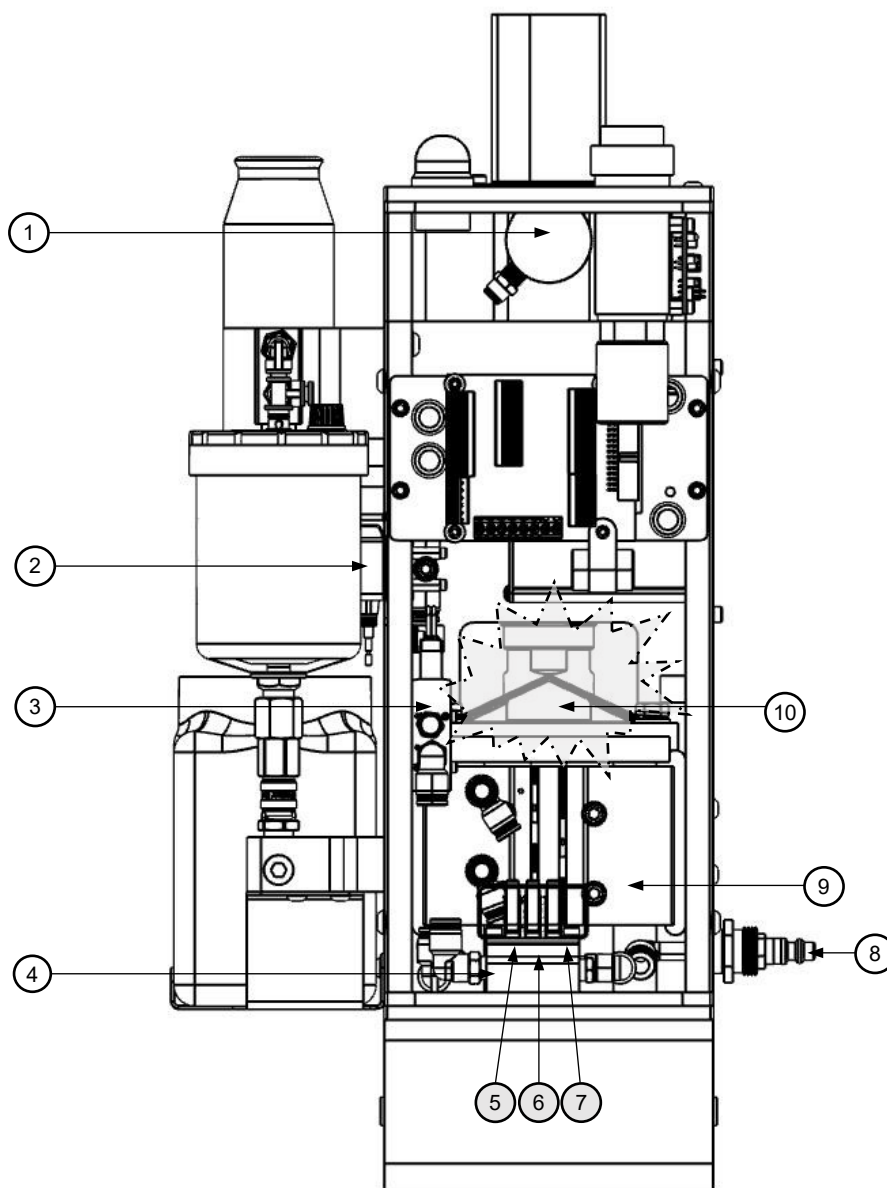
Note: all voltage readings +/- 10%





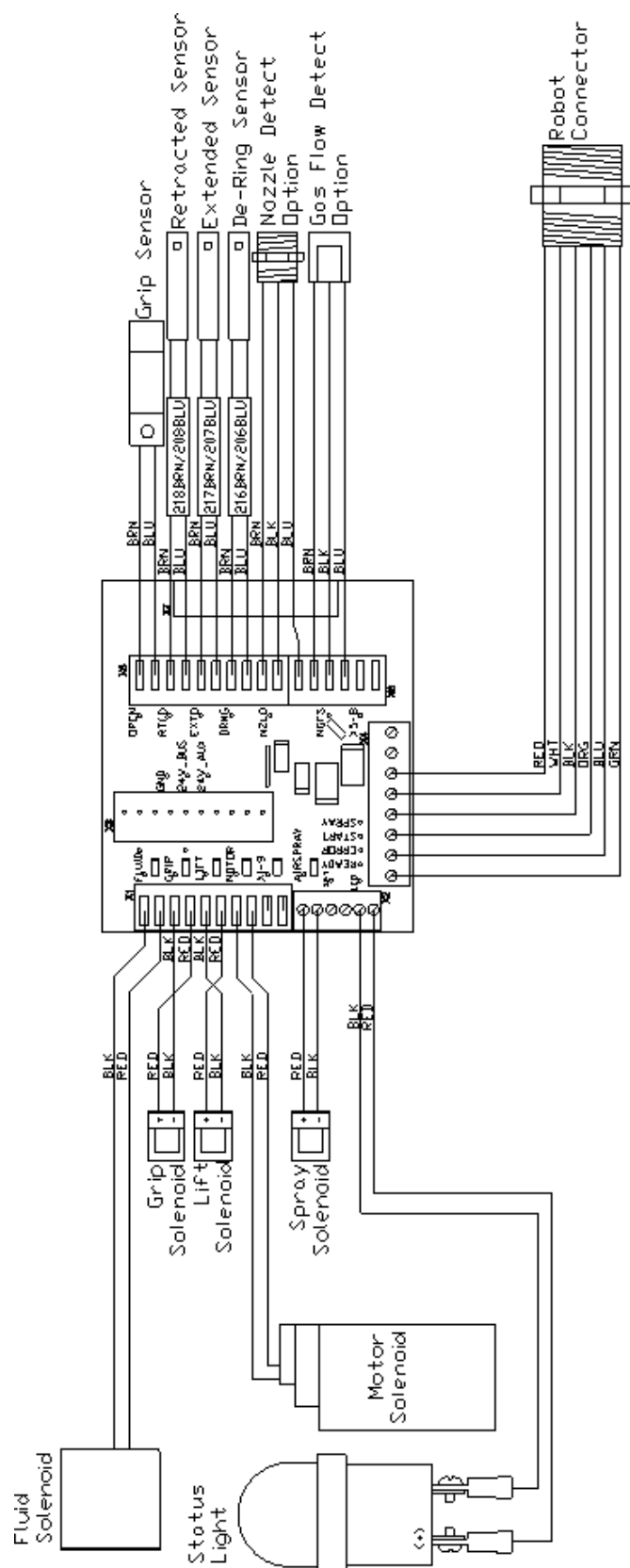
## 12. Pneumatic Components

The figure below shows the location for each pneumatic component.

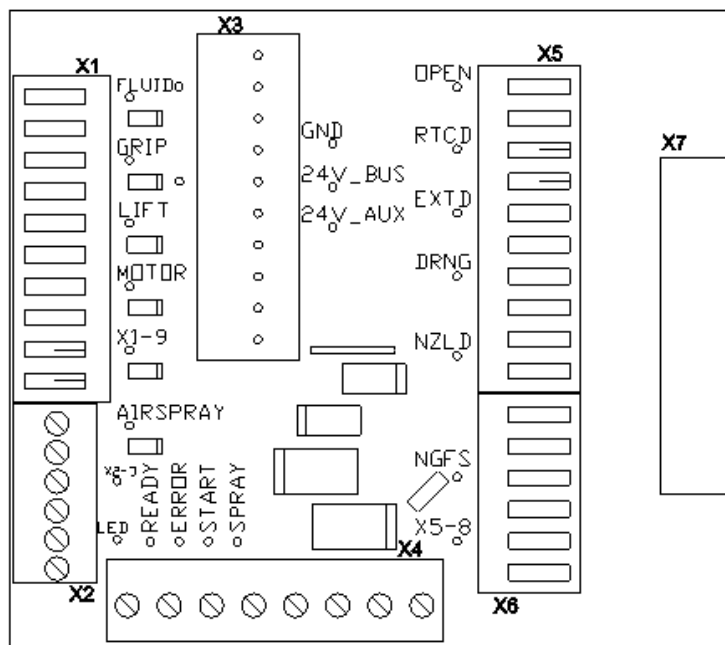


1	CLAMP CYLINDER
2	FLUID SOLENOID (behind reservoir)
3	MOTOR SOLENOID
4	MANIFOLD ASSEMBLY
5	SPRAY SOLENOID
6	CLAMP SOLENOID
7	LIFT SOLENOID
8	PNEUMATIC INLET
9	LIFT CYLINDER
10	AIR MOTOR (other side)

### 13. Electrical Diagram



Close up view of terminal block board

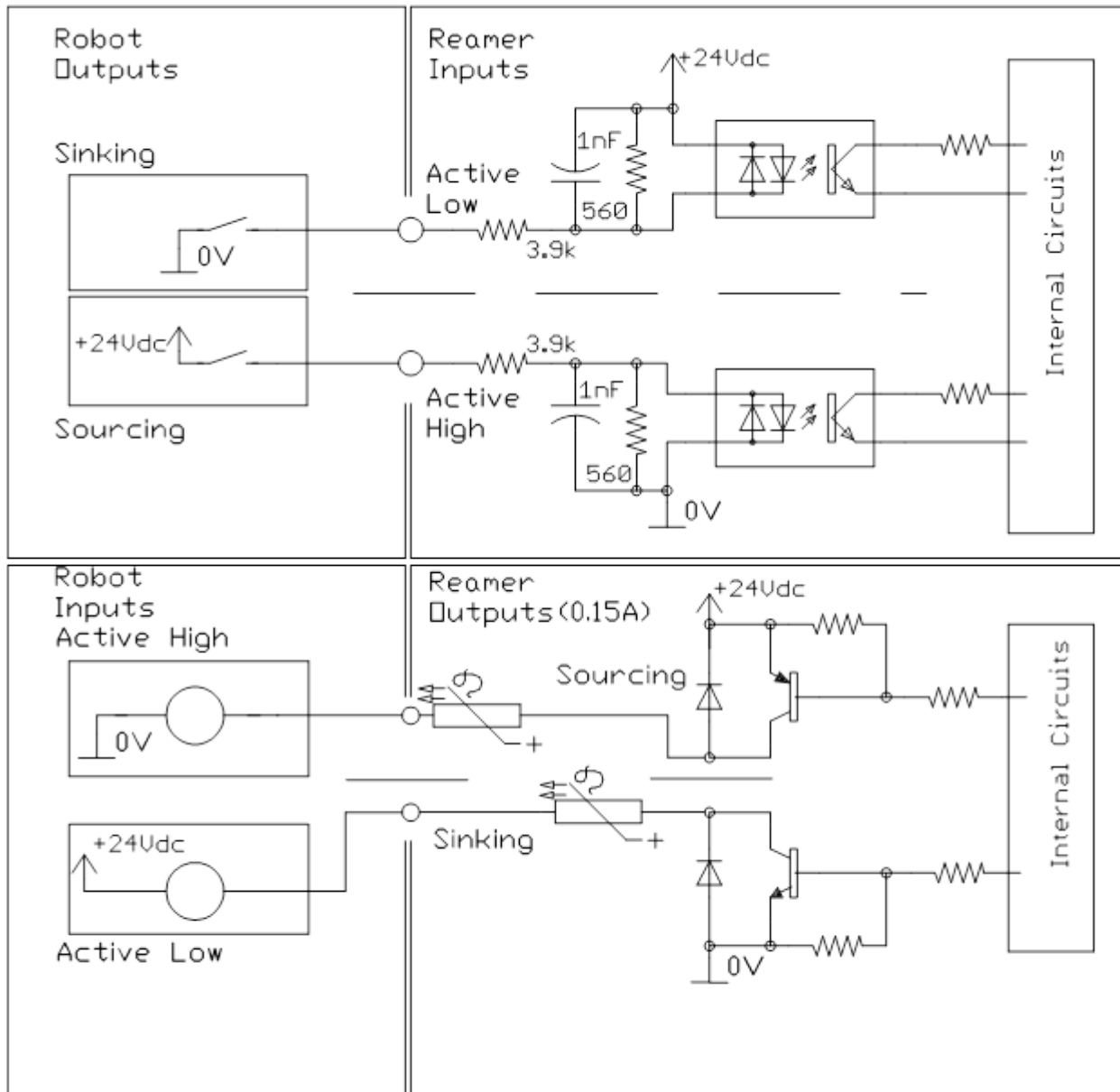


## Appendix A: Discrete I/O Explanation

The terms sinking and sourcing describe the direction of DC current flow in a load.

A sinking output provides a path to 0V for the load. Common terms used to describe sinking devices include NPN, Open Collector, Active Low, and IEC Negative Logic. An active low input is connected to the positive supply (+24V) to detect a sinking output.

A sourcing output provides the power to the load. Common terms used to describe sourcing devices include PNP, Open Emitter, Active High, and IEC Positive Logic. An active high input is connected to 0V to detect a sourcing output.



## **Appendix B: POWER REAM PLUS programming example for Fanuc robots**

1: CALL HOME;	Safe home point position
2: IF DI[3]=OFF,JMP LBL[1];	Check if the reamer is ready
3: DO[28]=PULSE,.5SEC;	Inch wire out for ½ second
4: J P[1] 100% FINE;	Safe approach point over wire cutter
5: L P[3] 500IPM FINE;	<b>Wire cut position (see illustration)</b>
6: DO[3]=PULSE,.5SEC;	Pulse reamer "start" signal, and...
7: DO[4]=PULSE,.5SEC;	Pulse reamer "spray" signal to cut
8: WAIT .5SEC;	Wait for the wire cutter
9: WAIT DI[3]=ON;	Wait for reamer "complete" signal
10: L P[2] 500IPM FINE;	<b>Ream position (see illustration)</b>
11: DO[3]=ON;	Turn on reamer
12: WAIT 2SEC;	Adjustable time for reaming operation
13: DO[3]=OFF;	Turn off reamer
14: WAIT DI[3]=ON;	Wait from reamer "complete" signal
15: L P[4] 500IPM FINE;	<b>Spray position (see illustration)</b>
16: DO[4]=PULSE,.5SEC;	Pulse anti-splatter spray
17: L P[5] 500IPM FINE;	Pull out point from spray position
18: LBL[1];	Label for JMP statement, line 2
19: CALL HOME;	Return to home point position

**NOTE: The I/O points may be different, configuration specific.**

### **How to teach reaming program instructions**

CALL HOME;	Press NEXT key, press F1 INST key, cursor to line CALL, Enter. At new submenu, cursor to line Call Program, Enter. Now cursor to program HOME, Enter.
IF DI[3]=OFF,JMP LBL[1];	Press NEXT, press F1 INST key, cursor to line IF/SELECT, Enter, cursor to line IF?.=?, Enter, cursor to line DI, Enter, Key in 3, Enter, cursor to OFF, Enter, cursor to JMP LBL, Enter Key in 1, Enter.
DO[28]=PULSE,.5SEC;	Press NEXT key, press F1 INST key, cursor to line I/O, Enter, cursor to line DO=..., Enter, Key in (28), Enter, At new submenu, cursor to desired line Pulse, Enter, key in desired time (.5), Enter.
DO[3]=ON or OFF;	Press NEXT key, press F1 INST key, cursor to line I/O, Enter, cursor to line DO[ ]=..., Enter, key in a 3, Enter, At new submenu, cursor to desired line On or Off, Enter
WAIT 2 SEC;	Press NEXT key, cursor to line WAIT, Enter, at new submenu, cursor to line WAIT... (sec), Enter, key in desired number of seconds, Enter.
WAIT DI[3]=ON;	Press NEXT key, press F1 INST key, cursor to line WAIT, Enter, cursor to line WAIT..., Enter. At new submenu, cursor to line DI[ ], Enter, key in a 3, Enter. At new submenu, cursor to line ON, Enter.
DO[3]=PULSE,.3SEC;	Press NEXT key, press F1 INST key, cursor to line I/O, Enter, cursor to line DO[ ]=..., Enter, Key in desired output (3), Enter. At new submenu, cursor to desired line Pulse, Enter, key in desired time (.5), Enter

ITEM	QTY	Lincoln Part Number	Description
1	1	KP2453-3	REAMING BIT, 15.5mm, W/WASHER
		KP2435-1	REAMING BIT, 1/2", W/WASHER
		KP2435-2	REAMING BIT, BOTTLENECK 1/2", W/WASHER
		AD1250-14	REAMING BIT, 5/8", W/ WASHER
		KP2435-5	REAMING BIT, 3/4", W/WASHER
		AD1250-3	REAMING BIT .565" W/WASHER
		AD1250-2	REAMING BIT .700" W/WASHER
		G4827-1	REAMING BIT WASHER, W/5/16 X 2 SS
2		K2433-1	ROBOT CABLE, 90 Degree, 20ft
		G4827-33	ROBOT CABLE, 90Degree, 30ft
3	1	G4827-3	CLAMP ASSEMBLY
4	1	G4827-57	CLAMP CYLINDER ASSEMBLY DD
5	1	G4827-6	WIRE CUTTER ASSEMBLY
6	1	G4827-58	FLUID RESERVOIR ASSEMBLY POWER REAM PLUS
7	1	G4827-8	FLUID RESERVOIR LID
8	1	G4827-59	FLUID FEMALE QUICK CONNECT ASSEMBLY
9	1	G4827-60	FLUID MALE QUICK CONNECT
10	1	G4827-61	FLUID SOLENOID ASSEMBLY DD
11	1	G4827-62	SPRAY NOZZLE REPLACEMENT ASSEMBLY
12	1	G4827-63	SPRAY CONE
13	1	G4827-64	SPRAY MANIFOLD ASSEMBLY
14	1	G4827-65	SPRAY FLOW CONTROL ASSEMBLY
15	1	G4827-66	NGFS REPLACEMENT ASSEMBLY
16	1	G4827-67	SENSOR DRAIN PLUG
17	1	G4827-68	GAS FLOW SENSOR
18	1	G4827-69	NGFS CIRCUIT BOARD + CABLE
19	3	G4827-40	LIFT SENSOR
20	1	G4827-70	FRONT COVER ASSEMBLY POWER REAM PLUS
21	1	G4827-71	BACK COVER POWER REAM PLUS
22	1	G4827-43	OPEN SENSOR ASSEMBLY
23	1	G4827-72	REAM MOTOR ASSEMBLY
24	1	G4827-73	MOTOR SOLENOID ASSEMBLY DD
25	3	G4827-74	5 WAY SOLENOID (CYLINDERS,SPRAY)
26	1	G4827-75	MANIFOLD ASSEMBLY DD
27	1	G4827-45	PR II CONITRL MODULE COMPLETE
28	1	G4827-46	PR II PC BOARD W/ MICROCONTROLLER
29	1	G4827-47	POWER REAM II ENCLOSURE ASSEMBLY
30	1	G4827-48	RIBBON CABLE ASSEMBLY
31	1	G4827-49	TERMINAL BLOCK BOARD
32	1	G4827-50	ROBOT CONNECTOR
33	1	G4827-53	STATUS LIGHT ASSEMBLY
34	1	G4827-76	REAMING BIT GUARD FULL DD
35	1	G4827-77	TOP GUARD DD
36	1	G4827-78	32 OZ PLASTIC CONTAINER
37	1	G4827-79	MOUNTING BOX ASSEMBLY DD
38	1	G4827-80	BOX TRAY ASSEMBLY DD

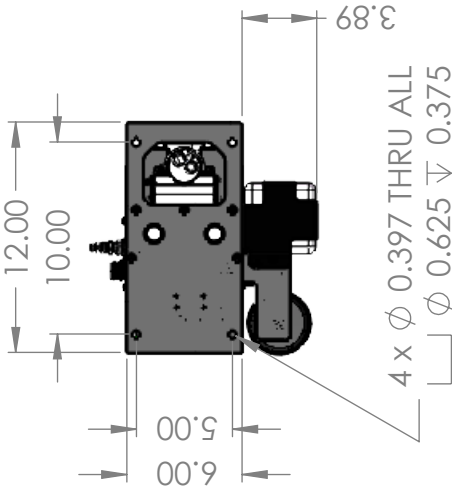
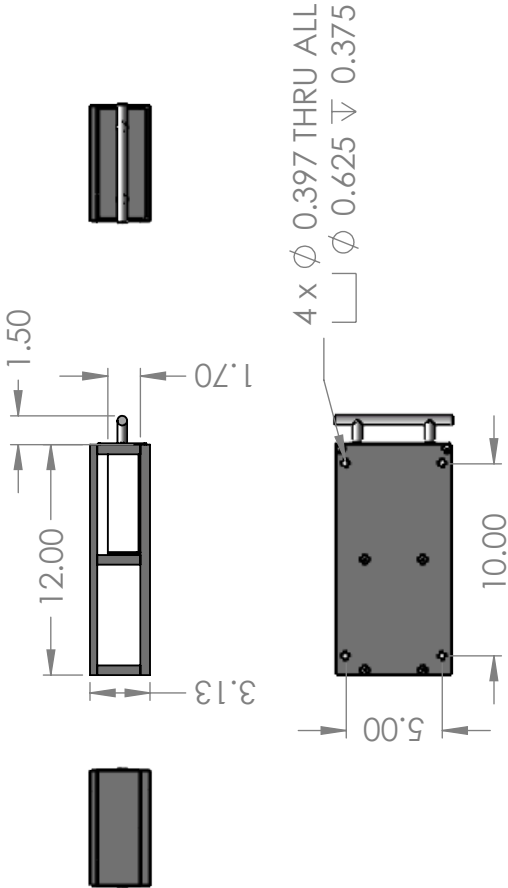
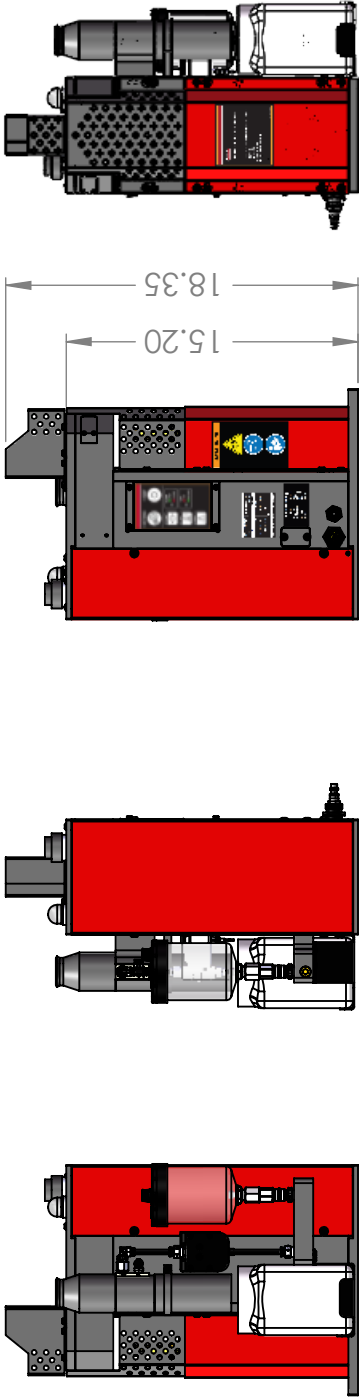
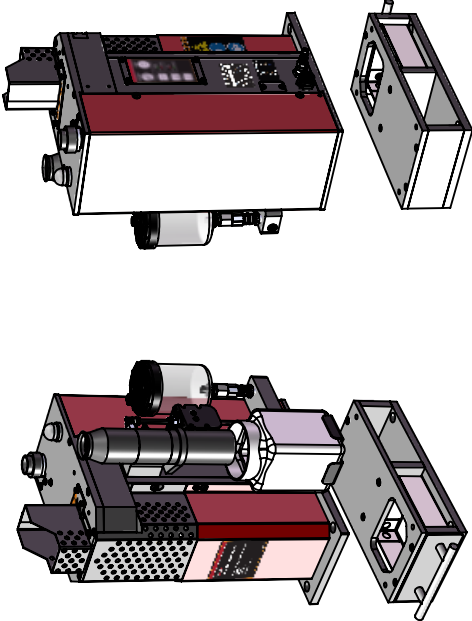
THE LINCOLN ELECTRIC COMPANY MUST BE NOTIFIED OF ANY CHANGES INVOLVING MECHANICAL, PARTS, ACCESSORIES, OR ELECTRICAL COMPONENTS THAT WOULD AFFECT THE PERFORMANCE OF THE EQUIPMENT OR ITS INTERFACE WITH OTHER LINCOLN PRODUCTS. NON-INTERCHANGEABLE DESIGN REVISIONS TO THE PRODUCT MUST INVOLVE A LINCOLN CODE NUMBER BREAK FOR SERVICE AND PARTS FROM THE LINCOLN ELECTRIC COMPANY PRIOR TO ANY SHIPMENT OF PRODUCT. BUY AS AD2500-1 FOR SALE AS FINISHED PRODUCT.

SPECIFICATIONS:

INPUT VOLTAGE : 24 VDC  
INPUT CURRENT : 0.75 ADC  
PRESSURE: 80 PSI  
FLOW RATE: 18 SCFM  
SPEED: 320 RPM  
NET WEIGHT : 44 lbs  
BOX WEIGHT: 7.5 lbs

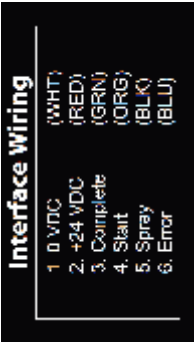
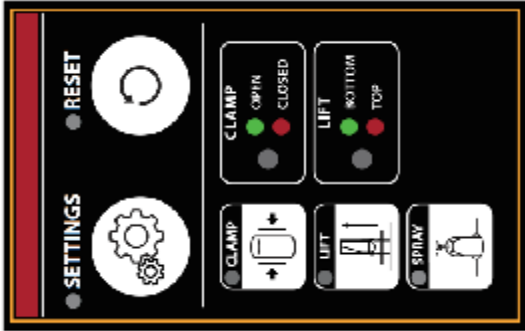
PROPRIETARY AND CONFIDENTIAL  
THE INFORMATION CONTAINED IN THIS  
DRAWING IS PROPRIETARY AND  
CONFIDENTIAL. ANY REPRODUCTION IN  
PART OR AS A WHOLE IS PROHIBITED.

REV.	ECR	DESCRIPTION	DATE	DRAWN BY
A		INITIAL RELEASE	2022-06-02	MT

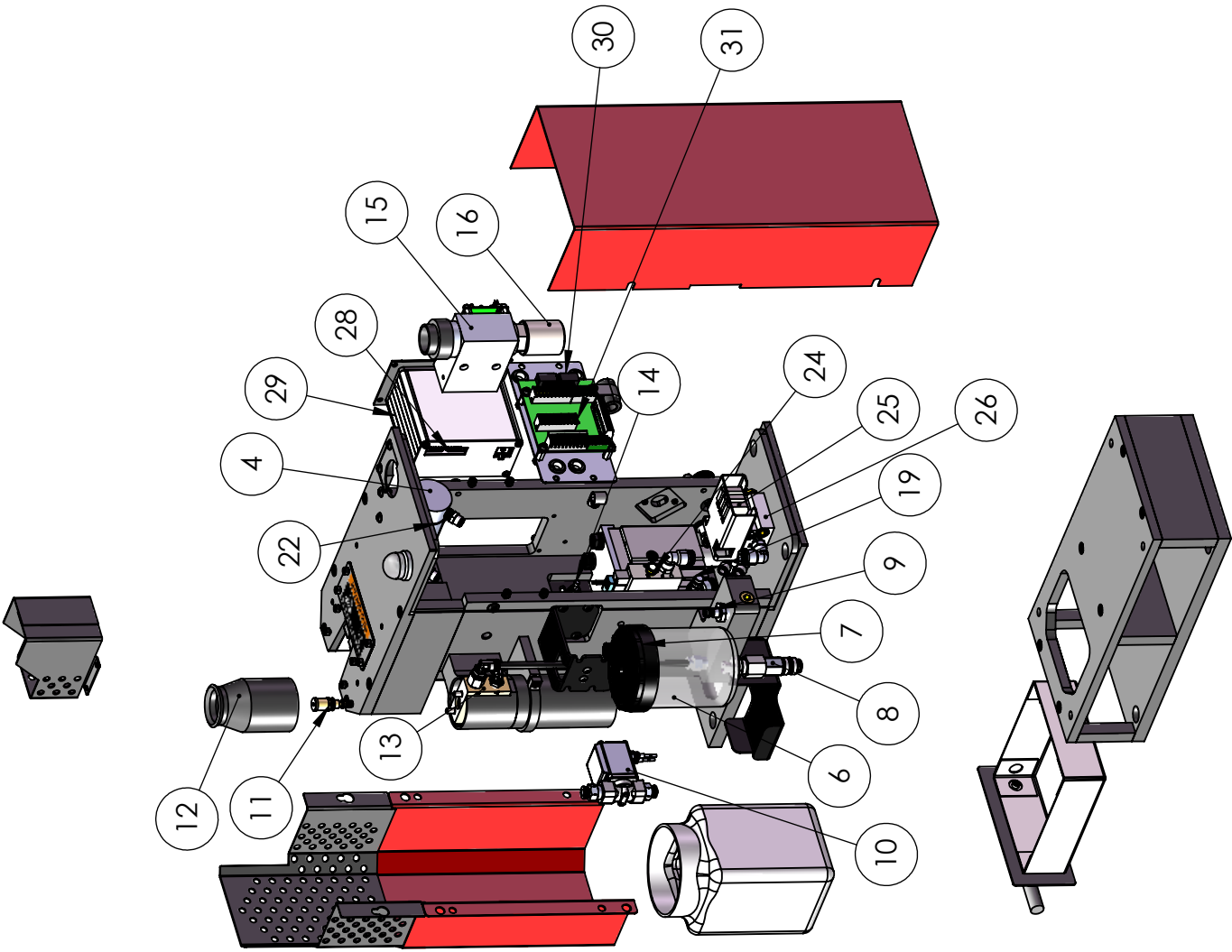
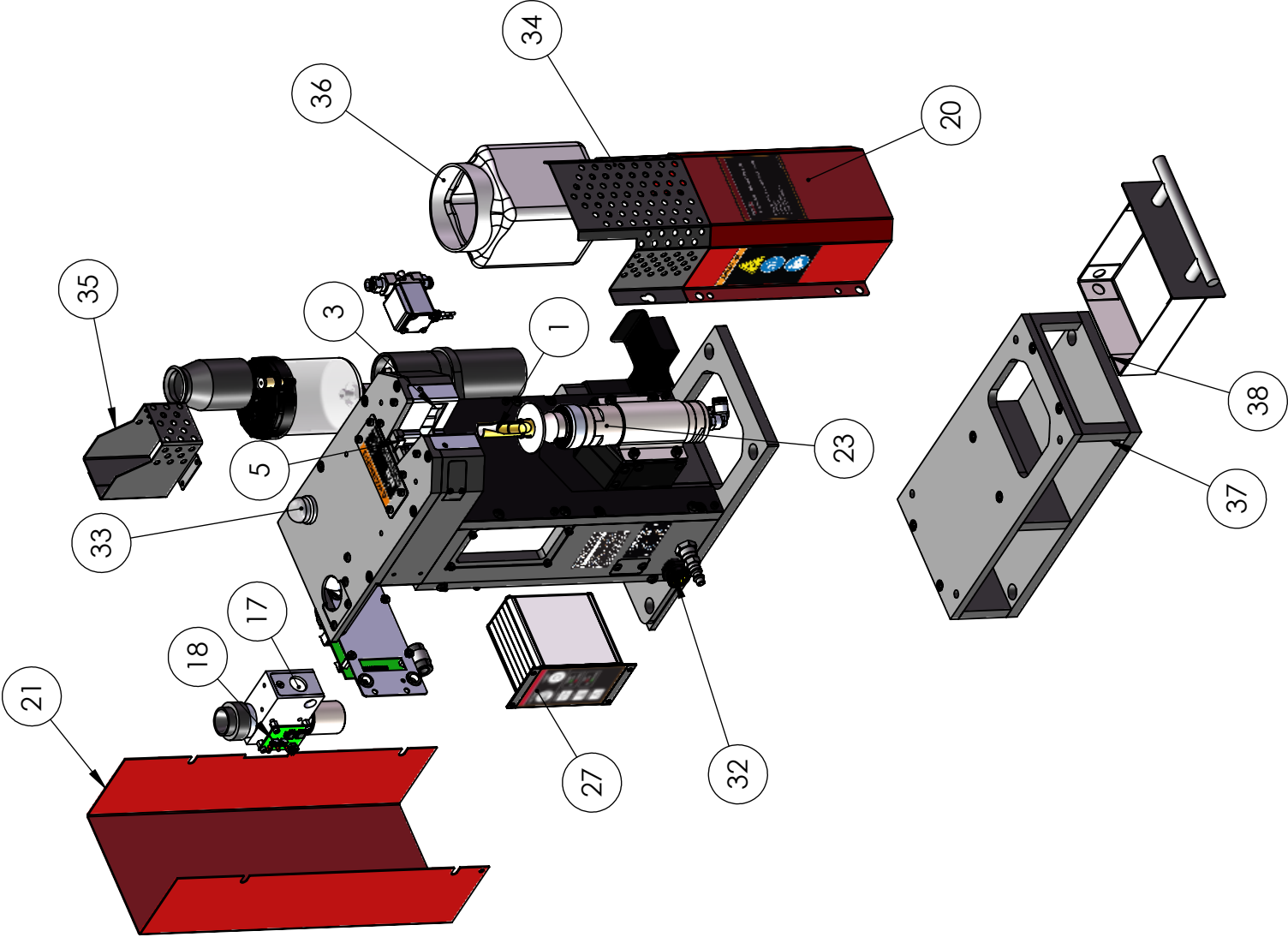


TITLE: PARTS REPLACEMENT,  
DIMENSIONS AND  
SPECIFICATIONS  
Sheet 1 of 2

SIZE	DWG. NO.	REV
B	Power Ream PLUS	A
SCALE: 1:10		WEIGHT: SHEET 1 OF 2



The Lincoln Electric Co. Cleveland, Ohio U.S.A		<b>POWER REAM PLUS</b>	
AUTO NO.	SERIAL NO.		
AD2500 1	RPyymum		
Pressure: 80 PSI	Flow: 18 SCFM		
Voltage: 24V DC	Current: 0.75A DC		
Speed: 320 RPM	Power: 0.5 HP		
Made in Canada			
CAUTION: Use Filtered (5µm) Regulated Air			



UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ±    BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
	CHECKED		
	ENG APPR.		
	MFG APPR.		
	Q.A.		
INTERPRET GEOMETRIC TOLERANCING PER:		COMMENTS:	
MATERIAL			
FINISH			
DO NOT SCALE DRAWING			

PROPRIETARY AND CONFIDENTIAL  
THE INFORMATION CONTAINED IN THIS  
DRAWING IS PROPRIETARY AND  
CONFIDENTIAL. ANY REPRODUCTION IN  
PART OR AS A WHOLE IS PROHIBITED.

TITLE:  
  
PARTS REPLACEMENT,  
DIMENSIONS AND  
SPECIFICATIONS  
Sheet 2 of 2

SIZE	DWG. NO.	REV
<b>B</b>	Power Ream PLUS	<b>A</b>
SCALE: 1:6.5WEIGHT:		SHEET 2 OF 2

<b>WARNING</b>	<ul style="list-style-type: none"> <li>● Do not touch electrically live parts or electrode with skin or wet clothing.</li> <li>● Insulate yourself from work and ground.</li> </ul>	<ul style="list-style-type: none"> <li>● Keep flammable materials away.</li> </ul>	<ul style="list-style-type: none"> <li>● Wear eye, ear and body protection.</li> </ul>
Spanish <b>AVISO DE PRECAUCION</b>	<ul style="list-style-type: none"> <li>● No toque las partes o los electrodos bajo carga con la piel o ropa mojada.</li> <li>● Aíslese del trabajo y de la tierra.</li> </ul>	<ul style="list-style-type: none"> <li>● Mantenga el material combustible fuera del área de trabajo.</li> </ul>	<ul style="list-style-type: none"> <li>● Protéjase los ojos, los oídos y el cuerpo.</li> </ul>
French <b>ATTENTION</b>	<ul style="list-style-type: none"> <li>● Ne laissez ni la peau ni des vêtements mouillés entrer en contact avec des pièces sous tension.</li> <li>● Isolez-vous du travail et de la terre.</li> </ul>	<ul style="list-style-type: none"> <li>● Gardez à l'écart de tout matériel inflammable.</li> </ul>	<ul style="list-style-type: none"> <li>● Protégez vos yeux, vos oreilles et votre corps.</li> </ul>
German <b>WARNUNG</b>	<ul style="list-style-type: none"> <li>● Berühren Sie keine stromführenden Teile oder Elektroden mit Ihrem Körper oder feuchter Kleidung!</li> <li>● Isolieren Sie sich von den Elektroden und dem Erdboden!</li> </ul>	<ul style="list-style-type: none"> <li>● Entfernen Sie brennbares Material!</li> </ul>	<ul style="list-style-type: none"> <li>● Tragen Sie Augen-, Ohren- und Körperschutz!</li> </ul>
Portuguese <b>ATENÇÃO</b>	<ul style="list-style-type: none"> <li>● Não toque partes elétricas e electrodos com a pele ou roupa molhada.</li> <li>● Isole-se da peça e terra.</li> </ul>	<ul style="list-style-type: none"> <li>● Mantenha inflamáveis bem guardados.</li> </ul>	<ul style="list-style-type: none"> <li>● Use proteção para a vista, ouvido e corpo.</li> </ul>
Japanese <b>注意事項</b>	<ul style="list-style-type: none"> <li>● 通電中の電気部品、又は溶材にヒフやぬれた布で触れないこと。</li> <li>● 施工物やアースから身体が絶縁されている様にして下さい。</li> </ul>	<ul style="list-style-type: none"> <li>● 燃えやすいものの側での溶接作業は絶対にしてはなりません。</li> </ul>	<ul style="list-style-type: none"> <li>● 目、耳及び身体に保護具をして下さい。</li> </ul>
Chinese <b>警告</b>	<ul style="list-style-type: none"> <li>● 皮肤或湿衣物切勿接触带电部件及焊条。</li> <li>● 使你自己与地面和工件绝缘。</li> </ul>	<ul style="list-style-type: none"> <li>● 把一切易燃物品移离工作场所。</li> </ul>	<ul style="list-style-type: none"> <li>● 佩戴眼、耳及身体劳动保护用具。</li> </ul>
Korean <b>위험</b>	<ul style="list-style-type: none"> <li>● 전도체나 용접봉을 젖은 형갑 또는 피부로 절대 접촉치 마십시오.</li> <li>● 모재와 접지를 접촉치 마십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 인화성 물질을 접근시키지 마십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 눈, 귀와 몸에 보호장구를 착용하십시오.</li> </ul>
Arabic <b>تحذير</b>	<ul style="list-style-type: none"> <li>● لا تلمس الاجزاء التي يسري فيها التيار الكهربائي أو الألكترود بجسدك أو بالملابس المبللة بالماء.</li> <li>● ضع عازلاً على جسمك خلال العمل.</li> </ul>	<ul style="list-style-type: none"> <li>● ضع المواد القابلة للاشتعال في مكان بعيد.</li> </ul>	<ul style="list-style-type: none"> <li>● ضع أدوات وملابس واقية على عينيك وأذنيك وجسمك.</li> </ul>

**READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTION FOR THIS EQUIPMENT AND THE CONSUMABLES TO BE USED AND FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES.**

**SE RECOMIENDA LEER Y ENTENDER LAS INSTRUCCIONES DEL FABRICANTE PARA EL USO DE ESTE EQUIPO Y LOS CONSUMIBLES QUE VA A UTILIZAR, SIGA LAS MEDIDAS DE SEGURIDAD DE SU SUPERVISOR.**

**LISEZ ET COMPRENEZ LES INSTRUCTIONS DU FABRICANT EN CE QUI REGARDE CET EQUIPMENT ET LES PRODUITS A ETRE EMPLOYES ET SUIVEZ LES PROCEDURES DE SECURITE DE VOTRE EMPLOYEUR.**

**LESEN SIE UND BEFOLGEN SIE DIE BETRIEBSANLEITUNG DER ANLAGE UND DEN ELEKTRODENEINSATZ DES HERSTELLERS. DIE UNFALLVERHÜTUNGSVORSCHRIFTEN DES ARBEITGEBERS SIND EBENFALLS ZU BEACHTEN.**



			
<ul style="list-style-type: none"> <li>● Keep your head out of fumes.</li> <li>● Use ventilation or exhaust to remove fumes from breathing zone.</li> </ul>	<ul style="list-style-type: none"> <li>● Turn power off before servicing.</li> </ul>	<ul style="list-style-type: none"> <li>● Do not operate with panel open or guards off.</li> </ul>	<b>WARNING</b>
<ul style="list-style-type: none"> <li>● Los humos fuera de la zona de respiración.</li> <li>● Mantenga la cabeza fuera de los humos. Utilice ventilación o aspiración para gases.</li> </ul>	<ul style="list-style-type: none"> <li>● Desconectar el cable de alimentación de poder de la máquina antes de iniciar cualquier servicio.</li> </ul>	<ul style="list-style-type: none"> <li>● No operar con panel abierto o guardas quitadas.</li> </ul>	Spanish <b>AVISO DE PRECAUCION</b>
<ul style="list-style-type: none"> <li>● Gardez la tête à l'écart des fumées.</li> <li>● Utilisez un ventilateur ou un aspirateur pour ôter les fumées des zones de travail.</li> </ul>	<ul style="list-style-type: none"> <li>● Débranchez le courant avant l'entretien.</li> </ul>	<ul style="list-style-type: none"> <li>● N'opérez pas avec les panneaux ouverts ou avec les dispositifs de protection enlevés.</li> </ul>	French <b>ATTENTION</b>
<ul style="list-style-type: none"> <li>● Vermeiden Sie das Einatmen von Schweißrauch!</li> <li>● Sorgen Sie für gute Be- und Entlüftung des Arbeitsplatzes!</li> </ul>	<ul style="list-style-type: none"> <li>● Strom vor Wartungsarbeiten abschalten! (Netzstrom völlig öffnen; Maschine anhalten!)</li> </ul>	<ul style="list-style-type: none"> <li>● Anlage nie ohne Schutzgehäuse oder Innenschutzverkleidung in Betrieb setzen!</li> </ul>	German <b>WARNUNG</b>
<ul style="list-style-type: none"> <li>● Mantenha seu rosto da fumaça.</li> <li>● Use ventilação e exaustão para remover fumo da zona respiratória.</li> </ul>	<ul style="list-style-type: none"> <li>● Não opere com as tampas removidas.</li> <li>● Desligue a corrente antes de fazer serviço.</li> <li>● Não toque as partes elétricas nuas.</li> </ul>	<ul style="list-style-type: none"> <li>● Mantenha-se afastado das partes moventes.</li> <li>● Não opere com os painéis abertos ou guardas removidas.</li> </ul>	Portuguese <b>ATENÇÃO</b>
<ul style="list-style-type: none"> <li>● ヒュームから頭を離すようにして下さい。</li> <li>● 換気や排煙に十分留意して下さい。</li> </ul>	<ul style="list-style-type: none"> <li>● メンテナンス・サービスに取りかかる際には、まず電源スイッチを必ず切して下さい。</li> </ul>	<ul style="list-style-type: none"> <li>● パネルやカバーを取り外したまま機械操作をしないで下さい。</li> </ul>	Japanese <b>注意事項</b>
<ul style="list-style-type: none"> <li>● 頭部遠離煙霧。</li> <li>● 在呼吸區使用通風或排風器除煙。</li> </ul>	<ul style="list-style-type: none"> <li>● 維修前切斷電源。</li> </ul>	<ul style="list-style-type: none"> <li>● 儀表板打開或沒有安全罩時不準作業。</li> </ul>	Chinese <b>警告</b>
<ul style="list-style-type: none"> <li>● 얼굴로부터 용접가스를 멀리하십시오.</li> <li>● 호흡지역으로부터 용접가스를 제거하기 위해 가스제거기나 통풍기를 사용하십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 보수전에 전원을 차단하십시오.</li> </ul>	<ul style="list-style-type: none"> <li>● 판넬이 열린 상태로 작동치 마십시오.</li> </ul>	Korean <b>위험</b>
<ul style="list-style-type: none"> <li>● ابعد رأسك بعيداً عن الدخان.</li> <li>● استعمل التهوية أو جهاز ضغط الدخان للخارج لكي تبعد الدخان عن المنطقة التي تتنفس فيها.</li> </ul>	<ul style="list-style-type: none"> <li>● أقطع التيار الكهربائي قبل القيام بأية صيانة.</li> </ul>	<ul style="list-style-type: none"> <li>● لا تشغيل هذا الجهاز اذا كانت الاغطية الحديدية الواقية ليست عليه.</li> </ul>	Arabic <b>تحذير</b>

**LEIA E COMPREENDA AS INSTRUÇÕES DO FABRICANTE PARA ESTE EQUIPAMENTO E AS PARTES DE USO, E SIGA AS PRÁTICAS DE SEGURANÇA DO EMPREGADOR.**

使う機械や溶材のメーカーの指示書をよく読み、まず理解して下さい。そして貴社の安全規定に従って下さい。

請詳細閱讀並理解製造廠提供的說明以及應該使用的銀焊材料，並請遵守貴方的有關勞動保護規定。

이 제품에 동봉된 작업지침서를 숙지하시고 귀사의 작업자 안전수칙을 준수하시기 바랍니다.

اقرأ بتمعن وافهم تعليمات المصنع المنتج لهذه المعدات والمواد قبل استعمالها واتبع تعليمات الوقاية لصاحب العمل.



## **CUSTOMER ASSISTANCE POLICY**

The business of Lincoln Electric is manufacturing and selling high quality welding equipment, automated welding systems, consumables, and cutting equipment. Our challenge is to meet the needs of our customers, who are experts in their fields, and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or technical information about their use of our products. Our employees respond to inquiries to the best of their ability based on information and specifications provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment, or to provide engineering advice in relation to a specific situation or application. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or communications. Moreover, the provision of such information or technical information does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or technical information, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose or any other equivalent or similar warranty is specifically disclaimed.

Lincoln Electric is a responsive manufacturer, but the definition of specifications, and the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

## **WELD FUME CONTROL EQUIPMENT**

The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.



### **THE LINCOLN ELECTRIC COMPANY**

22801 St. Clair Avenue • Cleveland, OH • 44117-1199 • U.S.A.  
Phone: +1.216.481.8100 • [www.lincolnelectric.com](http://www.lincolnelectric.com)