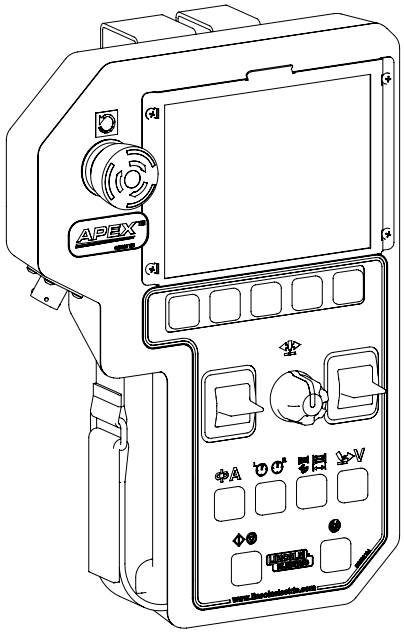
INSTRUCTION MANUAL

APEX® 3 SERIES MIG PENDANT



For use with Product/Code Numbers:

12879, 13230

Save for future reference

Date Purchased

Code: (ex: 10859)

Serial: (ex: U1060512345)

IM6122-A | Issue DateNov - 2025
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THE LINCOLN ELECTRIC COMPANY
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Contents

OPERATION..... SECTION A
SYMBOLS & ICONS..... A-1
SAFETY PRECAUTIONS..... A-2
PROPER HANDLING..... A-2
EXPLANATION OF WELDING TERMS..... A-3
SYSTEM START UP..... A-3
SYSTEM LOG IN..... A-7
IDLE SCREEN..... A-9
IDLE SCREEN TEST / WELD MODES..... A-11
JOG SCREEN..... A-14
OSCILLATION SCREEN..... A-16
SETUP MENU..... A-19
PROCESS SETUP SCREEN..... A-23
MODE SELECT..... A-24
ADVANCED PROCESS SETUP..... A-26
START SETTINGS..... A-27
END SETTINGS..... A-28
GMAW / FCAW TIMING DIAGRAM..... A-29
SERVICE MENU..... A-30
USERS..... A-34
INCREMENTS SETTINGS..... A-37
PROGRAMS..... A-40
STANDARD PIPING SCHEDULE CHART..... A-47

APPENDIX
WIRING DIAGRAM
CUSTOMER ASSISTANCE POLICY

SAFETY INFORMATION

SAFETY DEPENDS ON YOU

Lincoln 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.

⚠ DANGER

This statement indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

This statement indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

This statement indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

Notice: This statement indicates the possibility of damage to equipment if the potential risk is not avoided.

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.

KEEP YOUR HEAD OUT OF THE FUMES



- **DON'T** get too close to the weld. Use corrective lenses if necessary to stay a reasonable distance away from the weld.
- **USE ENOUGH VENTILATION** or exhaust at the weld, 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.
- **USE NATURAL DRAFTS** or fans to keep the fumes away from your face.
- **READ** and obey the Safety Data Sheet (SDS) and the warning label that appears on all containers of welding materials.

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

WEAR CORRECT EYE, EAR AND BODY PROTECTION



- **PROTECT** your eyes and face with 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 spatter, flash, and glare with protective screens or barriers.
- **PROTECT** your eyes and face with welding helmet
- **IN SOME AREAS**, protection from noise may be appropriate.
- **BE SURE** protective equipment is in good condition.



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

- **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.
- **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.**

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.

⚠ 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.)

For more information go to https://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.



- 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.



- Generator exhaust contains carbon monoxide. This is a poison you cannot see or smell.
- Using a generator indoors **CAN KILL YOU IN MINUTES**.
- **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



- 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.
- 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.
- In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.
- 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.
- Ground the work or metal to be welded to a good electrical (earth) ground.
- Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
- Never dip the electrode in water for cooling.

- 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.
- When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.
- **Also see** WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION **and** FOR ELECTRICALLY POWERED EQUIPMENT

ARC RAYS CAN BURN



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



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.**
- 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.
- 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.
- Shielding gases used for welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.
- 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.
- Also see FOR ENGINE POWERED EQUIPMENT

WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION



- 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.
- 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.

- 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.
- Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to ensure 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.
- Vent hollow castings or containers before heating, cutting or welding. They may explode.
- Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuff-less 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.
- 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.
- **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.
- **DO NOT** use a welding power source for pipe thawing.

CYLINDER MAY EXPLODE IF DAMAGED



- 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.
- Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

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.
- Never allow the electrode, electrode holder or any other electrically “hot” parts to touch a cylinder.
- Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.
- Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.
- Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, “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



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

BATTERY HANDLING, STORAGE, AND DISPOSAL



Batteries can be flammable substances such as lithium or other organic solvents, which may result in overheating, rupture, or combustion. Failure to follow the battery manufactures instructions may result in fire, personal injury, and damage to property if used improperly.

- DO NOT short circuit, disassemble, deform, or heat batteries.
- DO NOT attempt to recharge batteries unless they are specifically marked as "rechargeable".
- DO NOT use or charge the battery if it appears to be leaking, deformed or damaged in any way.
- Store in a cool location. Keep batteries away from direct sunlight, high temperature, and high humidity.
- Immediately discontinue use of the battery if, while using, charging, or storing the battery, the battery emits an unusual smell, feels hot, changes color, changes shape, or appears abnormal in any other way.
- Keep batteries out of reach of children, should a child swallow a battery, consult a physician immediately.
- Recycle or dispose of batteries in accordance with local and federal laws.

FOR LASER EMITTING EQUIPMENT



- Hazardous Class 4 (IV) laser products emit invisible, infrared laser radiation which can permanently damage the eye's retina and/or cornea, burn skin, and pose a fire risk. End users shall assign a qualified Laser Safety Officer (LSO) who has the certifications required by applicable law/standards, have a documented Laser Safety Program and have a Laser Controlled Area (LCA) that confirms to ANSI Z136.1 & Z136.9.
- Do not operate laser before end user's LSO has completed a risk assessment and all the prescribed Risk Mitigations measures have been fully implemented. Ensure the laser is operated/ demonstrated safely by trained personnel and that the environment surrounding the laser welding cell or laser-controlled area is safe for people nearby when the laser is in operation.
- Never point the laser at yourself or others. Never look directly into a laser aperture, even if wearing full eye protection.
- All persons inside LCA must wear proper PPE to avoid eye or skin exposure to laser radiation. The end user's LSO shall select proper PPE including, but not limited to, heat-resistant gloves, flame-resistant clothing, laser safety eye wear and laser-safe helmets that conform to ANSI Z136.1 Optical Density requirements for the wavelength and output power of the laser in use. Standard safety glasses and welding helmets DO NOT provide adequate protection from laser beam hazards. Always inspect PPE for damage or improper fit before use.
- Only qualified persons shall install, operate or service this unit per ANSI Z136.1 standards and your LSO's instruction. Read and follow all labels and manuals before installing, operating, or servicing hand held any laser welding equipment.
- Do not operate outside of a LCA, or if the laser protective housing is modified or damaged, or if safety interlocks have been bypassed or otherwise defeated. Inspect all equipment and LCA for damage or tampering prior to use.
- Reflected beams from the laser can damage eyes and skin and can pose a fire risk. Prior to use, the LCA should be assessed by the LSO to understand the surfaces where hazardous reflected beams can exist. Never position yourself or flammable material in the anticipated laser beam path and take extra precautions when working on reflective materials like aluminum and stainless steel.
- Follow all standards, individual facility or building regulations, and national, state, and local codes.

DEALER LOCATOR & PRODUCT REGISTRATION

Register your machine:

https://www.lincolnelectric.com/register

Authorized Service and Distributor Locator:

https://www.lincolnelectric.com/locator

ADDITIONAL SAFETY INFORMATION

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

Electromagnetic Compatibility (EMC)

Conformance

Products displaying the CE mark are in conformity with European Community Council Directive of 15 Dec 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility, 2004/108/EC. It was manufactured in conformity with a national standard that implements a harmonized standard: EN 60974-10 Electromagnetic Compatibility (EMC) Product Standard for Arc Welding Equipment. It is for use with other Lincoln Electric equipment. It is designed for industrial and professional use.

Introduction

All electrical equipment generates small amounts of electromagnetic emission. Electrical emission may be transmitted through power lines or radiated through space, similar to a radio transmitter. When emissions are received by other equipment, electrical interference may result. Electrical emissions may affect many kinds of electrical equipment; other nearby welding equipment, radio and TV reception, numerical controlled machines, telephone systems, computers, etc. Be aware that interference may result and extra precautions may be required when a welding power source is used in a domestic establishment.

Installation and Use

The user is responsible for installing and using the welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing (grounding) the welding circuit, see Note. In other cases it could involve construction of an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Note: The welding circuit may or may not be earthed for safety reasons according to national codes. Changing the earthing arrangements should only be authorized by a person who is competent to access whether the changes will increase the risk of injury, e.g., by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

Assessment of Area

Before installing welding equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

- Other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment.
- Radio and television transmitters and receivers.
- Computer and other control equipment.
- Safety critical equipment, e.g., guarding of industrial equipment.
- The health of the people around, e.g., the use of pacemakers and hearing aids.
- Equipment used for calibration or measurement.
- The immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.
- The time of day that welding or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of Reducing Emissions:

Mains Supply

Welding equipment should be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently

installed welding equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

Maintenance of the Welding Equipment

The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustments covered in the manufacturers instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Welding Cables

The welding cables should be kept as short as possible and should be positioned close together, running at or close to floor level.

Equipotential Bonding

Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of the Workpiece

Where the workpiece is not bonded to earth for electrical safety, not connected to earth because of its size and position, e.g., ships hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding installation may be considered for special applications[1].

Note: [1]Portions of the preceding text are contained in EN 60974-10: "Electromagnetic Compatibility (EMC) product standard for arc welding equipment."

WEEE



Do not dispose of electrical equipment together with normal waste! In observance of European Directive 2012/19/EC on Waste Electrical and Electronic Equipment (WEEE) and its implementation in accordance with national law, electrical equipment that has reached the end of its life must be collected separately and returned to an environmentally compatible recycling facility. As the owner of the equipment, you should get information on approved collection systems from our local representative.

By applying this European Directive you will protect the environment and human health!

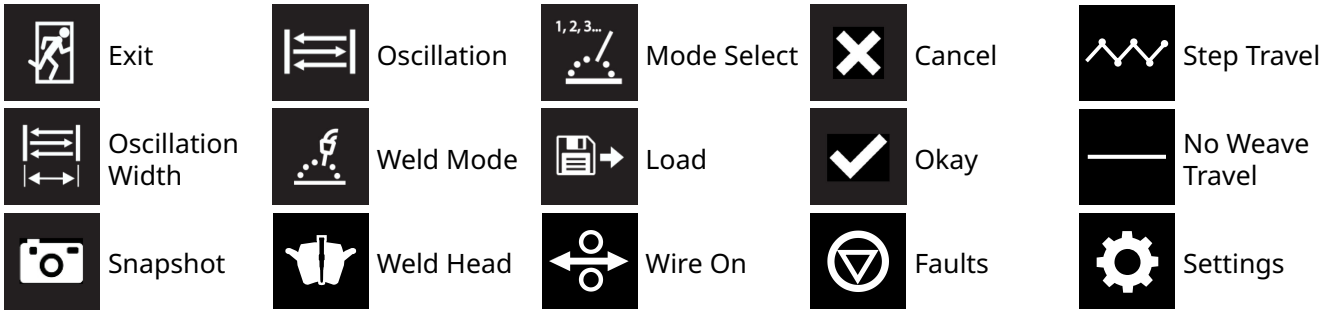
WEEE

OPERATION

SYMBOLS & ICONS

This list is a quick reference for all icons from the pendant and on the control unit.

 Users	 Set Up / Modes	 Wire	 Reboot	 Insert
 Weld	 Weld Time	 Upslope / Start Settings	 Process	 Track Ring
 Test Mode	 Reset Settings	 Downslope / End Settings	 Version	 Track Ring Diameter
 Segment	 Enter	 Time	 Motion	 Pipe
 Trash	 Voltage	 Program	 Return Home	 Pipe Diameter
 Gas Purge Pre / Post Flow	 Amperage	 Trim Volts	 Trim	 Log Out
 Save	 Travel / Travel Setup	 Osc Speed	 Left Dwell	 Settings / Service Page
 Swap	 Shift Case	 Osc Width	 Right Dwell	 Increment Unit Settings
Gas	Advanced Settings	Next / Index	Travel Direction	Positioner
ID Track	Kilowatts Water	Wire Feed	Travel Direction	Wire / Wire Feed Speed
OD Track	Steering / Oscillator	Wire Retract	Travel Direction	Previous / Index
Flat Track	Wire Diameter	Pass	Travel Direction	Add User
Direction	Delay	Amps	Details	Weave Type
Manual Height	Torch / Auto Height	Oscillation Speed	Copy To	Constant Travel



SAFETY PRECAUTIONS

Read entire manual before installation or operation.

⚠ WARNING



ELECTRIC SHOCK CAN KILL

Only qualified personnel should perform this installation.

Turn the input power OFF at the disconnect switch or fuse box before working on this equipment turn off the input power to any other equipment connected to the welding system at the disconnect switch or fuse box before working on the equipment.

Do not touch electrically hot parts.

Always connect the power supply grounding lug to a proper safety (Earth) ground.

PROPER HANDLING

The APEX 3 SERIES MIG PENDANT is designed to be turned on and off through the welding power supply. The pendant should be kept dry and sheltered from rain and snow. Do not place or drop the pendant on wet ground or in puddles. Always place the pendant on a sturdy, flat level surface when not in use and be sure to unplug it.

Keep hands away from weld head, wire feeder and other moving parts while in operation. Read this entire process and operations manual before using the equipment.

Only operate the system while on a firm level surface. Always verify that the system cart is secured in place before operating the system.

Keep hands away from weld head, wire feeder and other moving parts while in operation.

⚠ CAUTION



Never unplug or plug in control cables to the weld head while the system is powered on.

Verify that the system is properly grounded before beginning to weld.

Refer to the individual components manuals for additional instructions.

EXPLANATION OF WELDING TERMS

GMAW: Gas Metal Arc Welding

FCAW: Flux Cored Arc Welding

STT: Surface Tension Transfer

WFS: Wire Feed Speed

OSC: Oscillation

ACC: Automatic Current Control

AHC: Automatic Height Control

ID: Inside Diameter

OD: Outside Diameter

WFS: Wire Feed Speed

IPM: Inches per minute

CM / MIN: Centimeters per minute

Volts: Voltage

Amps: Amperage

SYSTEM START UP

Ensure all components are connected. Refer to the individual component manuals for full connection instructions.

Prior to beginning the weld, turn on the welding power supply. The system is designed to be turned on and off through the welding power supply. Ensure all components are connected. Refer to the individual component manuals for full connection instructions.

Note: With power applied to the system, check the reset button. **If the reset button is engaged the system will not initialize**. To disengage the reset button, rotate the knob clockwise. See Figure to the Right - APEX Pendant Reset Button.

This reset button can be used to restart the system for troubleshooting purposes and to halt welding and system movement.

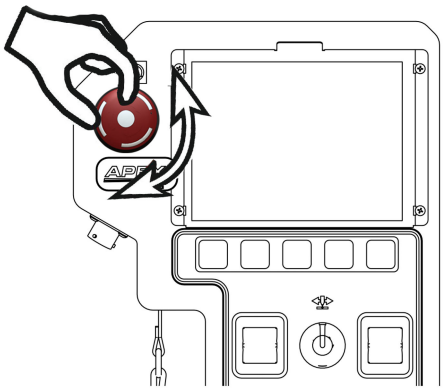


Figure 1 : Pendant Reset Button

STARTUP SCREEN

When the system is reset at the Power Wave, the screen will display “Checking Network Connection... Calibrating System - See Figure to the Right - Startup Screen. This is a normal part of the initialization process.

Note: During the start up interval, the weld head goes through a self-calibration cycle. The system will not allow the user to log in until the calibration cycle has been completed.



Figure 2 : Startup Screen

When the system is fully calibrated, the user is presented with a log in screen - See Figure to the Right - Log In Screen. Log in to begin use. See the next sections for pendant operation.



Figure 3 : Log In Screen

PENDANT OPERATION

The APEX 3 SERIES MIG PENDANT is designed around full functionality and easy operator experience. The pendant’s buttons serve multiple purposes, depending on the screen display. See Figure 4 : PENDANT ITEMS on page A-6 - to review each button, knob and switch on the pendant.

BUTTON ACTIONS

Each of the buttons and toggles may perform differently depending on how the buttons are pressed.

Listed below are the four types of button presses.

1. **SHORT PRESS**

   A short press is a standard press that engages the button and is not held in place. Most operations are performed as a short press.

   Example: Quickly pressing down button 7 will center the oscillator.
2. **LONG PRESS**

   For some screens, holding a button down for a length of time exceeding two seconds signals the system to perform an alternate function.

   Example: A long press of more than two seconds on button 7 will start the oscillation test mode on some screens.
3. **HOLD**

By pressing and holding down a button or toggle, the effects exhibited will continue or speed up.

Example: When pressing button 1 in the jog screen, gas will purge for three seconds. Holding down button 1 will cause the gas to continuously purge.

4. **HOLD AND ROTATE**

   The steering knob also acts as a button. It can be pressed or rotated for different actions for some screens. It can also be held down and rotated for faster navigation.

SELECTION BUTTONS

Buttons 1 through 5 are selection buttons. Their functions change depending on the screen. In each screen there will be an icon just above the button to indicate its function. A short press enables, disables or selects the shown variable.

NAVIGATION CONTROLS

Items 6 through 8 control navigation. They function primarily for navigating through the menus and changing values while setting up the system.

Note: When welding, steering knob 7 functions only for steering or oscillation steering if oscillation is enabled.

6. **LEFT TOGGLE (WHITE BORDER)**
   - **Short Press** - Navigates or changes the selected value (in this example, it will change the value in the left dwell box).
   - **Hold** - Increases or decreases value / change speed on some screens.
7. **STEERING KNOB**
   - **Rotate** - Steers oscillation in and out or changes the selected variable.
   - **Short Press** - Centers the oscillation or moves to the next variable.
   - **Long Press** - Starts / Stops oscillation test (in idle mode only).
   - **Hold & Rotate** - Fast navigation between selected variables.
8. **RIGHT TOGGLE (GRAY BORDER)**
   - **Short Press** - Navigates or changes the selected value (in this example, it will change the value in the right dwell box).
   - **Hold** - Increases or decreases value / changes speed on some screens.

MENU BUTTONS

Buttons 9 through 12 are the menu buttons. Pressing one of these buttons will bring up a menu while in the idle, test or welding screens.

9. **WIRE FEED / AMPS**
   - **Short Press** - Wire Feed / Amps options.
   - **Long Press** - Navigates to the Jog Screen from the Idle Weld screen.
10. **DWELL**
   - **Short Press** - Dwell options.
   - **Long Press** - Navigates to the Oscillation Screen from the Idle Weld screen.
11. **OSCILLATION**
   - **Short Press** - Oscillation options.
   - **Long Press** - Navigates to the Oscillation Screen from the Idle Weld screen.
12. **TRAVEL / VOLTS**

- **Short Press** - Travel / voltage options.
- **Long Press** - Navigates to the jog screen from the idle weld screen.

CONTROL BUTTONS

Buttons 13 through 15 are the pendant control buttons. These buttons have specific purposes that typically do not change.

Note: The control buttons may be disabled in menu screens.

13.START / STOP

- **Short Press** - Start if idle, stop if welding, stop / start test weld when in test mode.

14.SECTOR

- **Short Press** - Switches between sectors and changes passes (if available) on the Increments screen.

15.RESET

- **Short Press** - stops the welding sequence and all motion.
- **Twist Release**

Important: The reset button is not an emergency stop button. Power is still being applied to the system.



Figure 4 : PENDANT ITEMS

COLOR CODING

The menu buttons and toggles are color-coded. For example, the icons above button 9 are Wire Feed (white icon) and Amps (gray icon). When the operator presses the 9 button in the weld (idle) screen, the value for the Wire Feed (white icon) will be presented and can be changed by the left toggle (white border) and the value for Amps (gray icon) will be presented and can be changed by the right toggle (gray border).

FAST MOVEMENT

Certain screens allow for fast movement using the steering knob. Movement and selection can still be accomplished with the left and right toggle. In addition the steering knob will allow the user to change the selection by turning the knob and moving to the next section by pressing the knob.

For fast movement between selections hold the steering knob down while turning to rapidly move from one selection to the other.

SYSTEM LOG IN

When powered on, the system will go through a self-calibration routine. Make sure the torch is free to move before starting the system.

When the calibration routine is complete, the user will be presented with a Log In Screen - See Figure 3 : Log In Screen on page A-4 and Figure 5 : Change User on page A-7 . The system requires a four-digit user code to log in.

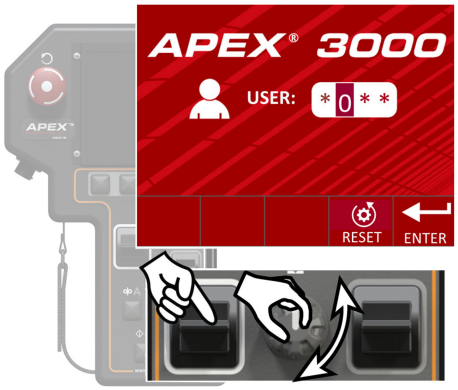
Figure 5 : Change User



FAST MOVEMENT

Fast movement using the steering knob is enabled on this screen - see Figure 6 : Fast Movement on page A-7 . Use the steering knob or left and right toggles for navigation and selection.

Figure 6 : Fast Movement



Use the left toggle or press the steering knob to change from one variable to the next. Use the right toggle or turn the steering knob to change the selected variable.

Press the Enter Selection button when the complete four digit user code has been entered. Once a four digit code is accepted, the system automatically moves into the default Idle screen - see Figure 7 : Idle Screen Default on page A-7 . This screen is shown when a supervisor logs into the system. Logging in as an operator will default to the Program Load Screen.

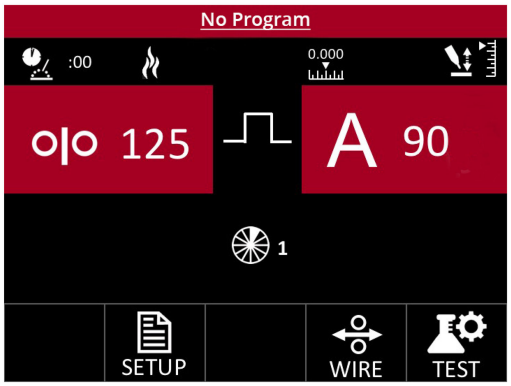


Figure 7 : Idle Screen Default

LOG IN SCREEN

The following buttons and options are available from the log in screen - see Figure below.



Figure 8 : Log in Buttons

1. **N/A**
   - No Effect
2. **N/A**
   - No Effect
3. **N/A**
   - No Effect
4. **RESET**
   - **Short Press** - Will change password entry back to “0000”.
5. **ENTER**
   - **Short Press** - Attempts to log in to the system with the currently entered user code.
6. **LEFT TOGGLE (White Border)**
   - **Short Press** - Pressing up or down moves cursor between spaces.
7. **STEERING KNOB**
   - **Short Press** - Moves cursor to the next space.
   - **Rotation** - Quickly cycles through available character options.
   - **Hold & Rotate** - Quickly moves the cursor from one selection to the next.
8. **RIGHT TOGGLE (Gray Border)**
   - **Short Press** - Pressing up or down changes value of the selection.
9. **WIRE FEED / AMPS**
   - No Effect
10. **DWELL**
    - No Effect
11. **OSCILLATION**
    - No Effect
12. **TRAVEL / VOLTS**
    - No Effect
13. **START / STOP**
    - No Effect
14. **SECTOR**
    - No Effect
15. **Short Press** - stops the welding sequence and all motion.
    - Twist Release

IDLE SCREEN

The Idle Screen is the first screen presented to a supervisor when logging in - see Figure 7 : Idle Screen Default on page A-7 . This screen allows the supervisor to set up all parameters for welding, test the parameters if necessary and to start welding.

MENU OPTION VARIABLES

The Idle Screen will show the user eight variables (two variables on four separate screens), depending on which Menu button has been pressed. Pressing the different Menu buttons will change the values shown. The different variables shown correspond to the icons on the Menu buttons.

Press the Menu button to open the Wire Feed / Amps Menu options.



Press the Menu button to open the Dwell Menu options.



Similar variables are paired together. The variables shown on the screen can be changed using the left and right toggles. It is possible to change between these menu options while idle or welding.

Press the Menu button to open the Oscillation Menu options.



Press the Menu button to open the Travel / Voltage Menu options.



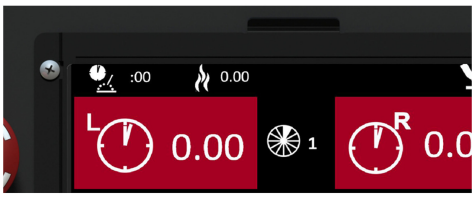
IDLE SCREEN BUTTONS

The Idle Screen - see Figure 9 : Idle Screen on page A-10 - will change depending on which menu button has been selected. Some items in the Selection button windows will change depending on system configurations.



Figure 9 : Idle Screen

1. **AUTO HEIGHT**
   - **Short Press** - Turns Auto Height on and off in weld mode.
2. **SETUP**
   - **Short Press** - Navigates to the Setup Screen.
3. **PASS**
   - **Short Press** - Switches to the next pass in the weld program (if available).
4. **N/A**
   - No Effect
5. **TEST / WELD**
   - **Short Press** - Switches between weld and test modes (Image shows system in Weld Mode).
6. **LEFT TOGGLE (White Border)**
   - Changes the value displayed in the top left box (in this example it will change the value in the left dwell box).
7. **STEERING KNOB**
   - **Rotate** - Moves the oscillation in and out.
   - **Short Press** - Centers the oscillation.
   - **Long Press** - Starts / stops oscillation test.
8. **RIGHT TOGGLE (Gray Border)**
   - Changes the value displayed in the top right box (in this example it will change the value in the right dwell box).
9. **WIRE FEED / AMPS**
   - **Short Press** - Wire Feed / Amps options.
   - **Long Press** - Navigates to the Jog Screen.
10. **DWELL**
    - **Short Press** - Dwell options.
    - **Long Press** - Navigates to the Jog Screen Dwell.
11. **OSCILLATION**
    - **Short Press** - Oscillation options.
    - **Long Press** - Navigates to the Jog Screen Oscillation.
12. **TRAVEL / VOLTS**
    - **Short Press** - Travel / Voltage options.
    - **Long Press** - Navigates to the Jog Screen.
13. **START / STOP**
    - **Short Press** - Starts or stops welding or testing.
14. **SECTOR**
    - **Short Press** - Switches to the next sector if multiple sectors are enabled.



Current sector is displayed here at the center of the screen near the sector icon.

15. **Short Press** - stops the welding sequence and all motion.
    - Twist Release

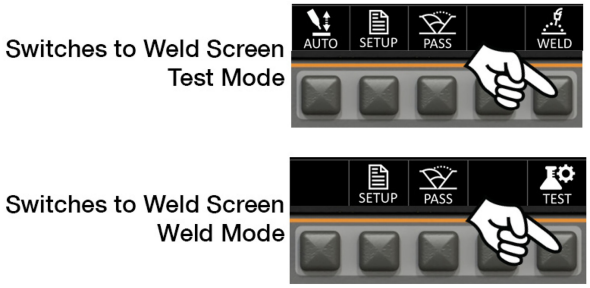
    Important: This is not an emergency stop button. Power is still being applied to the system. The system will ask you to wait as it resets.

IDLE SCREEN TEST / WELD MODES

After preparing a program, it is recommended that the user test the parameters before striking an arc. The system allows for a test mode of all non-weld functions such as travel, gas purge / flow, oscillation and others.

Press the Weld / Test Selection button.





This example shows how to change the system from the Test Mode to the Weld mode. The icon in the Selection Button window indicates what mode the system is in.

Note: Auto Height is not an option while in Test Mode.

Pressing the Start / Stop Control Button will switch the pendant from the Idle Screen to the Test Screen or Weld Screen depending on which mode the user is in.

STATIC SCREEN ITEMS

There are many icons common through the Idle, Weld and Test screens. These items give helpful information to the user throughout the setup and welding process.

1. **Arc Time** - Indicates the amount of time spent welding.
2. **Heat Input** - Displays the amount of heat input for the current weld in kilojoules / in or kilojoules / cm.
3. **Sector** - Displays the current sector in the weld program, if applicable.
4. **Program Name** - Displays the currently loaded weld program and program pass.

   Note: Program Name changes to Italics when program parameters have changed.
5. **Oscillation Location** - Displays the relative location of the oscillation axis.
6. **Torch Height** - Displays the relative location of the height axis.

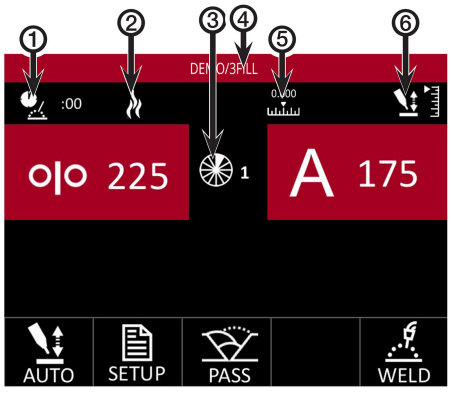


Figure 10 : Static Items

The screen shot above illustrates the icons that appear on the weld screen. These icons are for information only and are not selectable variables.

WELD SCREEN

During the weld, the screen will show voltage and amperage feedback on the Weld Screen - see Figure 11 : Weld Screen Options on page A-12 . Pressing the menu buttons will move the user through the Menu Option Variables similar to Figure 13 : All Test Screens on page A-13 .

The Setup Selection is replaced with the Adv. Selection. Auto-height can also be engaged or disengaged. See Figure 11 : Weld Screen Options on page A-12 .

WELD SCREEN BUTTONS

The Weld Screen buttons work similar to the Idle screen buttons - see Figure 9 : Idle Screen on page A-10 .

Pressing the Start / Stop button during the weld halts the weld and moves into the Jog Menu. See Figure 15 : Jog Menu Screen on page A-15 .

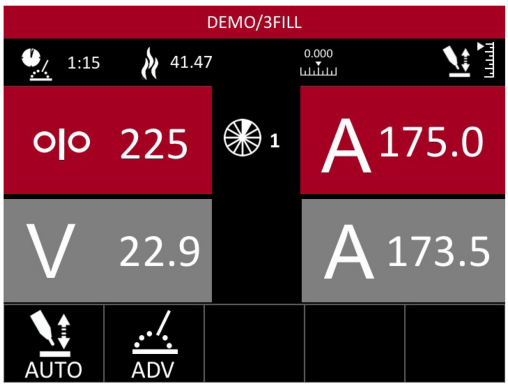


Figure 11 : Weld Screen Options

TEST SCREEN

Similar to the Weld Screen, the Test Screen will show voltage and amperage feedback but the feedback values will be zero - see Figure 12 : Test Screen Options on page A-12 . Pressing the menu buttons will move the user through the Menu Option Variables as shown in the Idle Screen section.

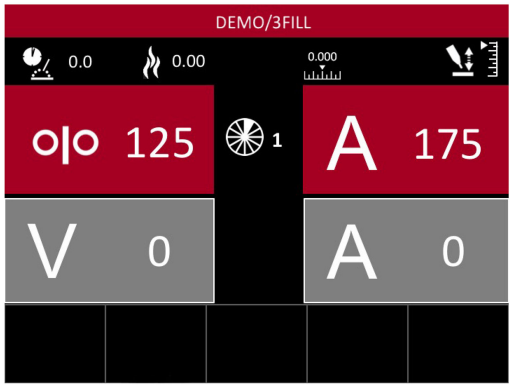


Figure 12 : Test Screen Options

TEST SCREEN BUTTONS

The Test Screen buttons work similar to the Weld screen buttons - see Figure 13 : All Test Screens on page A-13 .

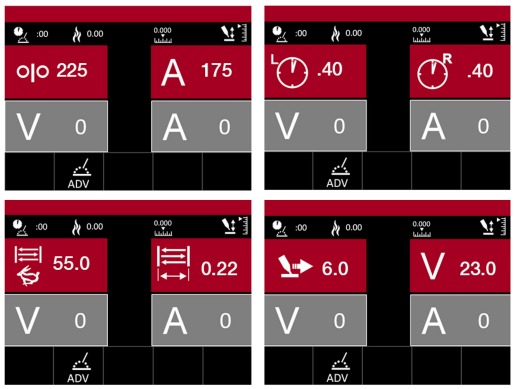
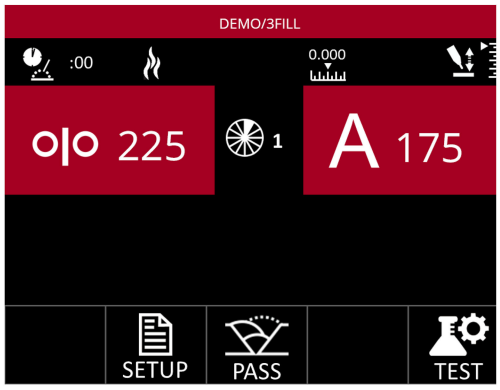


Figure 13 : All Test Screens

JOG SCREEN

The Jog Screen - see Figure 15 : Jog Menu Screen on page A-15 - is used to test movement of the system before welding. The Jog Screen can be entered from the Idle or Oscillation screens.



From the Idle Screen, press and hold the Wire Feed / Amps or the Travel / Voltage menu buttons to enter the Jog Menu.

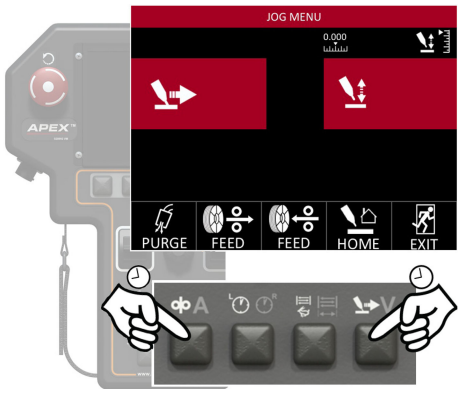


Figure 14 : Engaging Jog Mode

The screen above - see Figure 14 : Engaging Jog Mode on page A-14 - provides for moving the weld head along the track, adjusting torch height, purging gas and shows the icons for both cold feed forward and cold feed reverse.

Press the Exit selection button to return Idle screen as shown below.



JOG BUTTONS

The following buttons and options are available from the Jog Menu.



Figure 15 : Jog Menu Screen

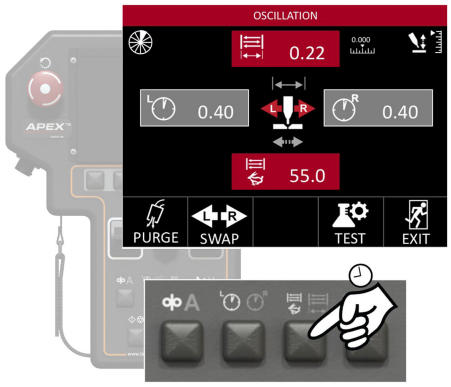
1. **GAS PURGE**
   - **Short Press** - Purge welding gas for 3 seconds.
   - **Hold** - Continually purges welding gas while held.
2. **COLD FEED FORWARD**
   - **Short Press** - Feeds wire slightly.
   - **Hold** - Feeds wire continuously and accelerates the WFS.
3. **COLD FEED REVERSE**
   - **Short Press** - Retracts wire slightly.
   - **Hold** - Retracts wire continuously and accelerates the WFS. Be sure to keep the spool tight as wire is retracted.
4. **HOME**
   - **Short Press** - Returns the weld head to starting position on the track. Starting position is determined by previous weld or test start.
5. **EXIT**
   - **Short Press** - Returns to Idle Screen.
6. **LEFT TOGGLE (White Border)**
   - **Short Press** - Travels forward or backward slightly.
   - **Hold** - Travels forward or reverse and ramps travel speed.
7. **STEERING KNOB**
   - **Rotate** - Moves the oscillation in and out.
   - **Short Press** - Centers the oscillation.
   - **Long Press** - Starts / stops oscillation test.
8. **RIGHT TOGGLE (Gray Border)**
   - **Short Press** - Adjusts the torch up and down.
   - **Hold** - Adjusts the torch up and down and ramps adjustment speed.
9. **WIRE FEED / AMPS**
   - No Effect
10. **DWELL**
    - **Short Press** - Navigates to Jog Menu for oscillation and dwell (short press does the same).
11. **OSCILLATION**
    - **Short Press** - Navigates to Oscillation screen.
12. **TRAVEL / VOLTS**
    - No Effect
13. **START / STOP**
    - **If in TEST, it will run the TEST MODE; if in WELD, the machine will start the weld.**
14. **SECTOR**
    - No Effect
15. **Short Press** - stops the welding sequence and all motion.
    - Twist Release

Important: This is not an emergency stop button. Power is still being applied to the system. The system will ask you to wait as it resets.

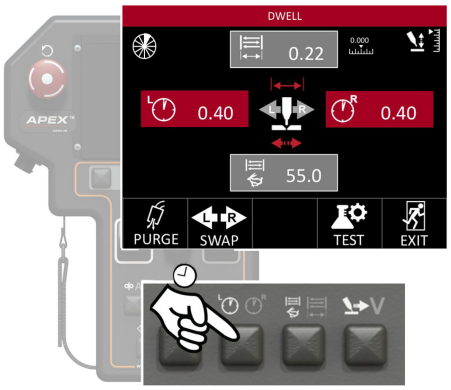
OSCILLATION SCREEN

The Oscillation Screen is used to test and adjust system oscillation before welding. To enter, press and hold the Dwell or Oscillation menu buttons while in the Jog, Idle or Weld screens.

From the Idle screen, pressing and holding the Oscillator Menu Button will present the user with the option to change the oscillation width and the oscillation speed.



From the Idle screen, holding down the Dwell Menu Button will present the user with the option to change the left and right dwells.

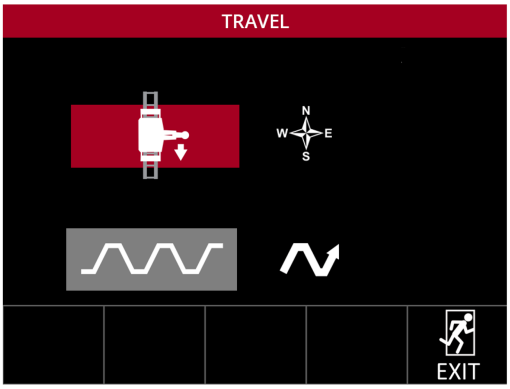


In either screen, use a short press to switch between Oscillation and Dwell. The items highlighted in red are the variables that can be changed.

Press the Swap Selection Button to be taken to the Travel Setup Screen.



Travel Setup is discussed in the Travel Setup Screen section. This screen allows the user to quickly change weld head orientation or change the weave pattern.



Press the “Exit” selection button to return to the Jog Screens. Once all parameters have been input and checked, exit out of the Jog Screen to return to the Weld (also called the “Idle”) Screen.

OSCILLATION BUTTONS

The following buttons and options are available from the from the Oscillation menu:



Figure 16 : Oscillation Screen

1. **PURGE**
   - **Short Press** - Purge welding gas for 3 seconds.
   - **Hold** - Continually purges welding gas while held.
2. **L / R SWAP**
   - **Short Press** - Navigates to the Travel Direction Setup Screen.
3. **N/A**
   - No Effect
4. **TEST / WELD**
   - **Short Press** - Starts / Stops oscillation test.
5. **Exit**
   - **Short Press** - Returns to Idle Screen.
6. **LEFT TOGGLE (White Border)**
   - **Short Press** - Increases or decreases Left Dwell time or Oscillation Width.
   - **Hold** - Increases increment speed.
7. **STEERING KNOB**
   - **Rotate** - Moves the oscillation in and out.
   - **Short Press** - Centers the oscillation.
   - **Long Press** - Starts / stops oscillation test.
8. **RIGHT TOGGLE (Gray Border)**
   - **Short Press** - Increases or decreases Right Dwell time or Oscillation Speed.
   - **Hold** - Increases or decreases value continuously.
9. **WIRE FEED / AMPS**
   - **Short Press** - Navigates to Jog Menu.
10. **DWELL**
    - **Short Press** - Switches to Dwell option (when in Oscillation option, otherwise no effect).
11. **OSCILLATION**
    - **Short Press** - Switches to Oscillation option (when in Dwell option, otherwise no effect).
12. **TRAVEL / VOLTS**
    - **Short Press** - Navigates to Jog Menu.
13. **START / STOP**
    - **Starts and stops TEST or WELD MODE.**
14. **SECTOR**
    - **Short Press** - If multiple sectors are available, a short press will move to the next available sector and display the values associated with that sector.
15. **Short Press** - stops the welding sequence and all motion.
    - Twist Release.

Important: This is not an emergency stop button. Power is still being applied to the system. The system will ask you to wait as it resets.

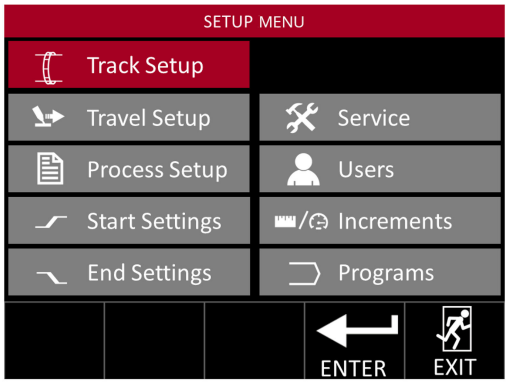
SETUP MENU

The setup screen allows the user to access all parameters for welding. Please note that this screen can only be accessed by authorized supervisors set up in the User's Menu. This is explained further in the User's Setup Screen section.

The Setup Menu - see Figure 17 : Setup Menu on page A-19 - can be accessed from the Weld Menu. This menu is accessible in either test or weld mode, but it is not accessible while welding. Press the Setup Selection button to enter into the setup screen. Once in the SetUp Menu, the user has access to multiple system screens.



Figure 17 : Setup Menu



To select the individual screens, the user moves the red cursor to the desired field using the Left Toggle (White Border), and presses the Enter Selection button. Pressing Exit will return the user back to the Idle screen.

SETUP SCREEN OPTIONS

Track Setup - employs internal or external track, flat track and the size of the pipe (where applicable).

Travel Setup - change the steering controls based on where the operator is standing in relation to the track, and set up the weave pattern.

Process Setup - sets up the weld process.

Start Settings - adjustment specific to the programs affecting how the system will react when the weld starts.

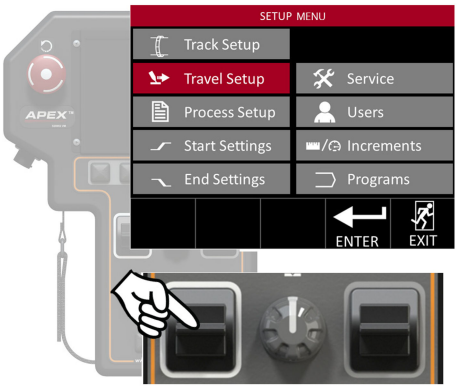
End Settings - adjustment specific to programs, affecting how the system will react when the weld ends.

Service - access to current software information and can change certain motion settings, as well as monitor production, faults and tests.

Users - assigns operator and supervisor codes for the system.

Increments - allows limits and the increment value of each welding variable to be set. This screen also enables the user to choose between imperial and metric units.

Programs - The Programs screen is where all programs are saved, loaded, deleted or copied.



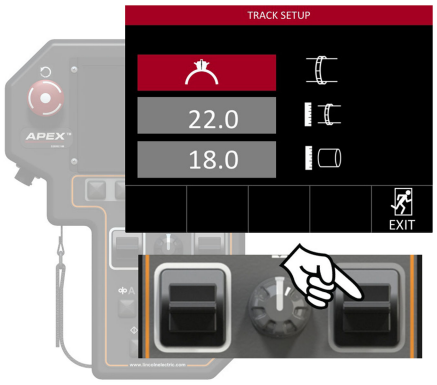
TRACK SETUP

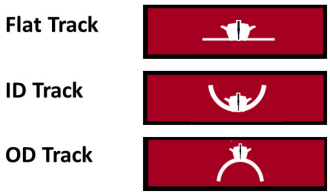
The Track Setup Screen presents the user with several options. From this screen the operator can change the type of track, the size of the track and the size of the pipe.

Track Type

The first selectable option is track type. With the track type field highlighted in red the user is able to switch between the different types of tracks. These tracks consist of:

- Outside Diameter (OD) Track
- Inside Diameter (ID) Track
- Flat Track





Track Ring Size

Track sizes range from 4 to 100 inches in increments of 2 inches. Pressing and holding the right toggle will increase the speed at which the values change. Use the nominal sizes for the track rings. **THESE NOMINAL SIZES ARE STAMPED INTO THE TRACK**.

Pipe Size

The third field that can be changed is the pipe size. Currently this can range from 4 inches to 100 inches.

The value can be adjusted in increments of 0.01 inches. Holding the right toggle for longer than 2 seconds will amplify the speed at which the values increase.

Entering the correct value for track and pipe size ensures accurate travel speed.

HEAVY WALL PIPES

Heavy wall pipes may require the user to change the pipe size in later passes.

Example: A 20 inch Schedule 120 pipe has an OD of 20 inches and an ID of 17 inches. The pipe diameter for the root pass should be entered as 17.00 inches, then increased as the weld progresses outward. This will help to maintain an accurate welding travel speed throughout the weld.

Note: For additional OD and ID pipe and tube size information, please refer to the "Standard Schedule Pipe and Tube Chart".

POSITIONER SETUP

This system can be used as a part of a 1G system with certain positioners. When the system detects positioners as part of the setup, the Travel Setup screen will change. See Figure 18 : Track Setup Screen on page A-21 .

When the system is set to control multiple positioners the right toggle will switch between positioner A and B.

Use the Index Selection buttons to index the weld head on its mount.

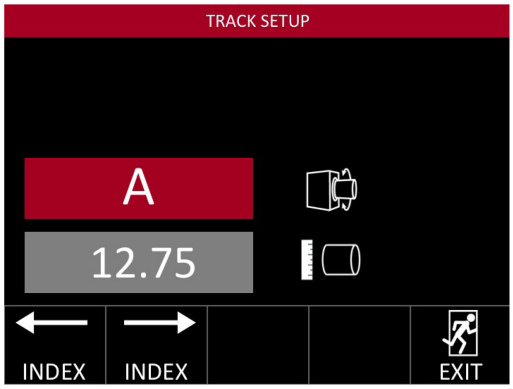


Figure 18 : Track Setup Screen

When the system is used to control positioners, the weld screens will show the current positioner as a selection. Pressing the Positioner Selection button will switch from positioner A to positioner B.

TRAVEL SETUP SCREEN

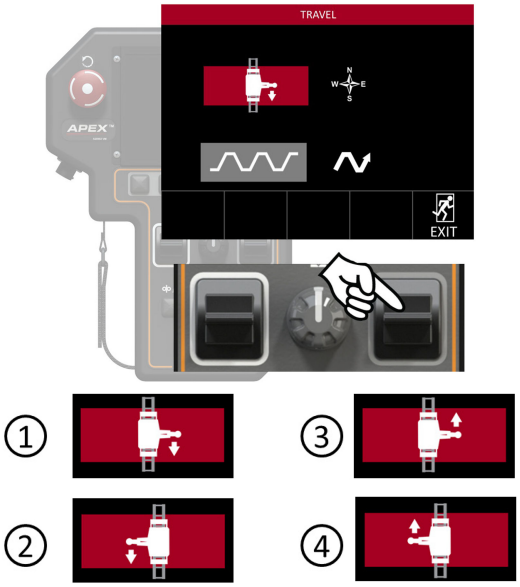
The travel setup allows the supervisor to set how the travel controls will work while welding and change the weave pattern.

Travel

The operator has the option of choosing how the weld head is oriented on the track. Setting the orientation and travel direction allows for intuitive operation.

With the travel field highlighted, the weld head orientation and the travel direction can be selected. There are four different options available. All directions refer to the weld head and are in relation to the user's view facing the weld head.

1. Facing Right, Traveling Down
2. Facing Left, Traveling Down
3. Facing Right, Traveling Up
4. Facing Left, Traveling Up



TRAVEL PATTERN

The second field the operator can choose is the weave pattern. There are three options to choose from:

No Weave

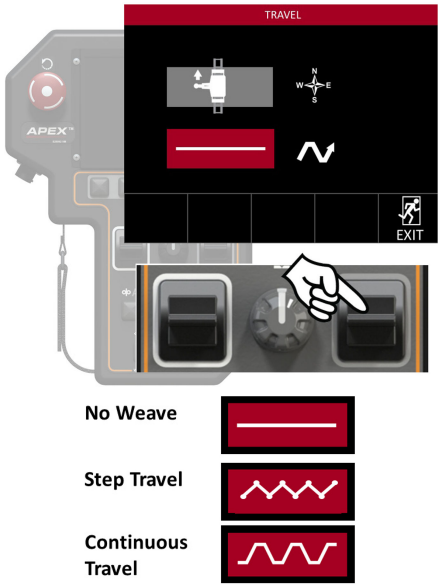
When no weave is selected, the oscillator does not move during the welding process. The user can still manually steer the oscillator.

Step Travel

During step travel, the travel speed stops during the dwells. This allows the energy to be directed to the side walls.

Continuous Travel

Continuous travel will continue traveling throughout the weld process, during oscillation, excursion and dwells.



PROCESS SETUP SCREEN

The Process Setup Screen - see Figure 19 : Process Setup on page A-23 - allows the user to select from several options to determine the variables in the weld.

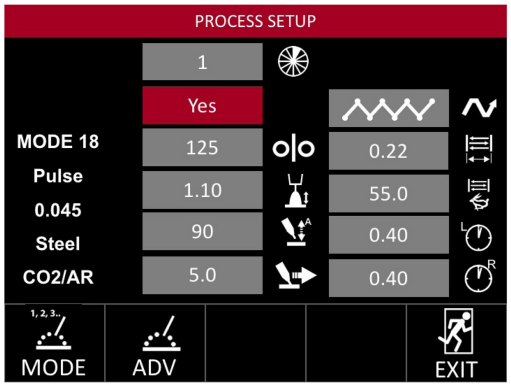
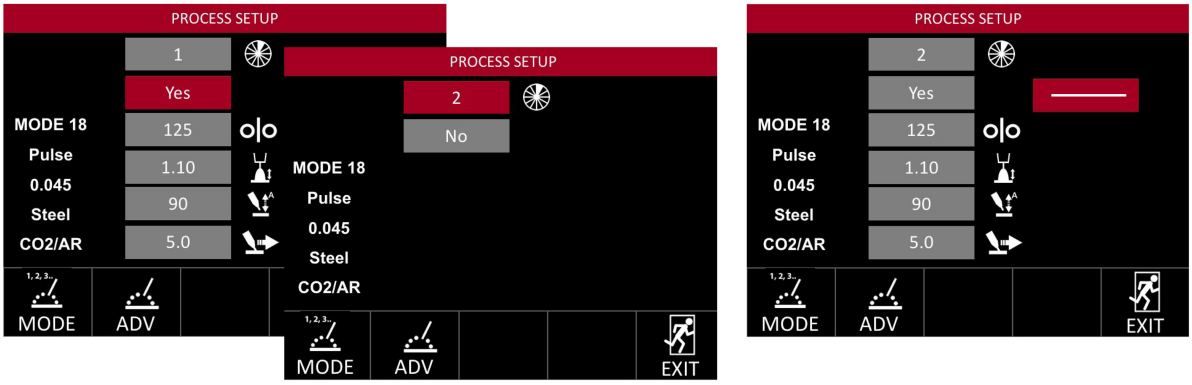


Figure 19 : Process Setup

STANDARD PROCESS OPTIONS

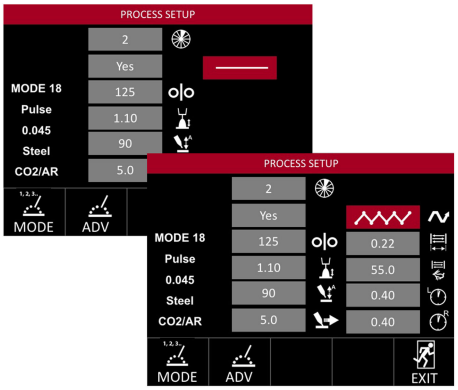
Certain process options should be set up for every weld and every sector. These options are:

- **Sector** - Determines which sector the options are being set for out of eight possible sectors.
- **Wire Speed** - Sets wire feed speed.
- **Trim / Voltage** - Controls the welding arc length.
- **Torch Height (Amperage)** - Controls the welding amperage by raising or lowering the torch when the Auto Height is turned on.
- **Travel Speed** - Sets the electrode travel speed Enabling a sector presents the process variables for that sector. With only one sector selected, the Idle, Weld and Test screens will not show the sector icon.



WEAVE PROCESS OPTIONS

- **Weave** - Refer to the Travel Pattern section for the different weave options.
- **Oscillation Width** - Determines the width of the oscillation weave (limited by the weld head).
- **Oscillation Speed** - The speed at which the torch moves during oscillation.
- **Left Dwell** - How long the torch remains on the left side of oscillation.
- **Right Dwell** - How long the torch remains on the right side of oscillation.



The purpose of this screen is to set up base settings before the weld begins. Without a weave selected, oscillation settings will not appear on the screen.

MODE SELECT

The weld mode is determined by the wire size, type, process and type of gas being used. Refer to the Power Wave operator's manual for additional information about weld modes. The system can be a guide when the user is not sure which mode is appropriate for their application.

Pressing the Mode selection button will take the user to the Manual Mode Select Screen.



The user is prompted to select the wire size, type, process and then gas type. Mode Select guides the user through the settings. Selecting a wire diameter moves to wire type. See Figure 20 : Manual Mode Select on page A-25 .

Selecting wire type leads to a specific process and then to gas selection.

Each selection filters the list of available weld modes to match your application. A cored wire would not allow the user to select an STT process.

The selected mode is displayed on the left side of the screen - see Figure 21 : List Mode Screen on page A-25 . These processes are accessed from the Power Wave, and are updated with the standard Power Wave updates.

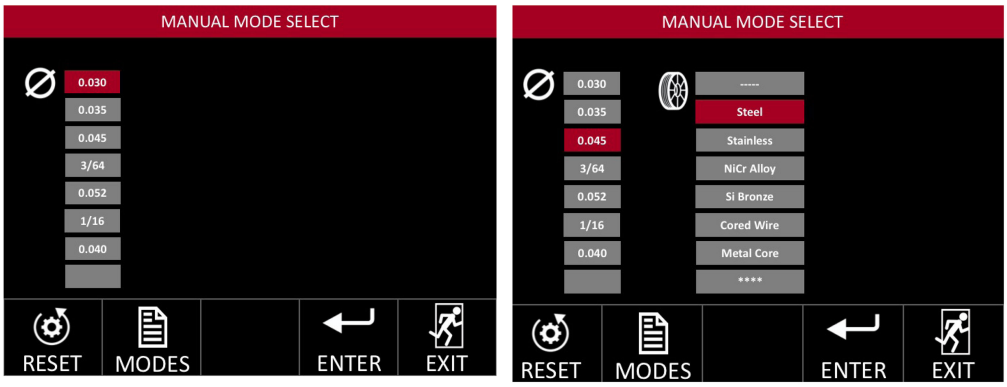


Figure 20 : Manual Mode Select

LIST MODE SELECT

Lincoln Electric power supplies come with pre-set welding modes for particular welding applications and wire types. Press the Modes selection button on the Manual Mode Selection Screen to see a list of weld modes loaded into the power supply.

Press the Modes selection button - see Figure 21 : List Mode Screen on page A-25 .

The available weld modes are displayed in sequential order. The available modes depend on the present equipment.

Use the left toggle or turn the steering knob to choose an available weld mode then press the Enter Selection button.

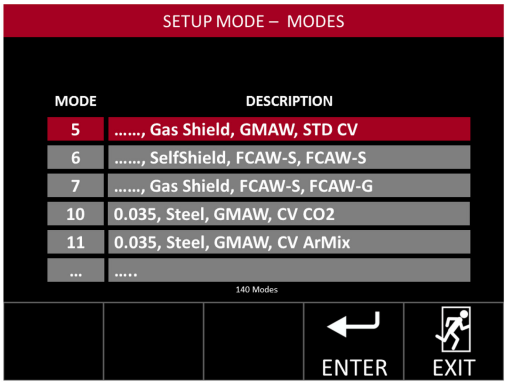


Figure 21 : List Mode Screen

ADVANCED PROCESS SETUP

Certain weld modes have advanced settings specific to that mode or process. Pressing the ADV Selection button on the Process Setup screen will present the user with the advanced options associated with the selected weld mode - see Figure 22 : Advanced Settings on page A-26 .

ADVANCED OPTIONS

Available options are based on the selected weld mode. See the Power Wave settings for a full breakdown and explanation of advanced options.

WAVE CONTROLS

Some typical wave controls are:

- Pinch
- Hot Start
- UltimArc

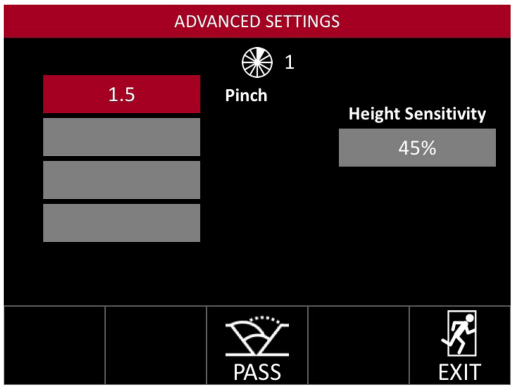


Figure 22 : Advanced Settings

HEIGHT SENSITIVITY

Height sensitivity is a global setting available regardless of the weld mode selected. The operator can program the system to react to changes following the profile of the joint.

Higher sensitivity will result in faster adjustment which could cause hesitation in torch height and abrupt changes in the weld as shown in Figures A and B to the Right.

Maintaining a low height sensitivity allows for higher quality and more consistent welds. This includes adjusting for out-of-round pipes, maintaining heat input and helping with puddle control on the joint profile. It is recommended that the operator start the weld at a lower sensitivity setting for the best performance. This will also assist in avoiding an over reaction to changes in the structure of the materials being welded.

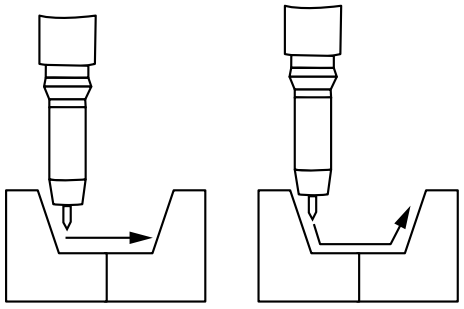


FIGURE A - JOINT
Low Sensitivity < 50

FIGURE B - JOINT
High Sensitivity > 50

START SETTINGS

The Start Settings should be set up after the process setup has been completed. The start settings screen - see Figure 24 : Start Settings Screen on page A-27 - allows the user to adjust the start settings specific to the program which affect how the system acts when the weld starts. The start settings take effect as soon as the Start / Stop button is pressed to initiate the weld. Refer to Figure 26 : GMAW / FCAW TIMING DIAGRAM on page A-29 to see a full timing diagram.

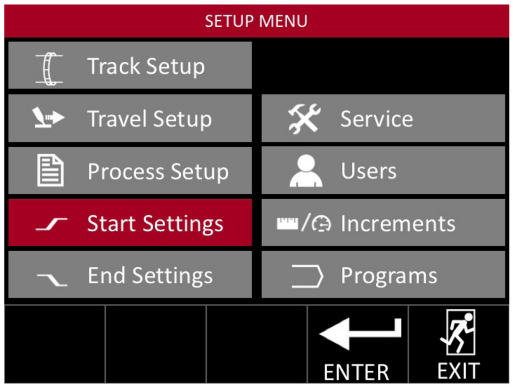


Figure 23 : Setup Menu

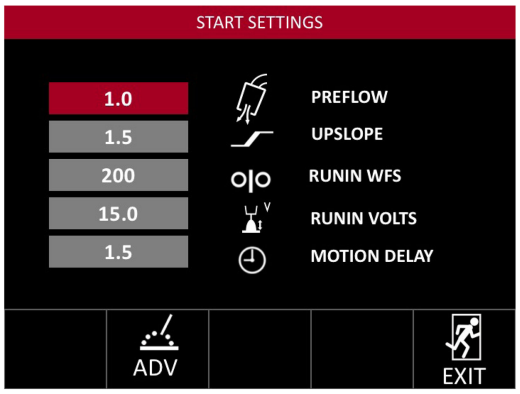


Figure 24 : Start Settings Screen

The settings that can be changed in this screen are:

Preflow

The amount of time (sec) that gas flows before welding begins to ensure adequate gas coverage for the weld preventing starting porosity.

Upslope

This is the amount of time (sec) it takes for the system to ramp up from start settings to welding parameters.

Run-In WFS

Determines the WFS prior to establishing an arc will ramp up to welding WFS during upslope.

Run-In Volts

The voltage or trim setting at which the system begins to weld. Once established, it will ramp to welding voltage during upslope.

Motion Delay

This determines how long the system will wait before beginning to travel and oscillate.

END SETTINGS

The end settings screen - see Figure 25 : End Settings Screen on page A-28 - allows the user to adjust the end settings specific to the program, which affect how the system will behave at the end of the weld. End settings take effect as soon as the Start / Stop button is pressed to stop the weld. (Refer to Figure 26 : GMAW / FCAW TIMING DIAGRAM on page A-29 to see a full GMAW / FCAW timing diagram.) The settings that can be changed in this screen are:

Crater WFS - The wire feed speed during crater.

Crater Volts / Trim - The amount of voltage / trim during crater.

Crater Time - The duration of crater.

Burn back - The time the arc is maintained after the wire stops at the end of a crater.

Downslope - The time to ramp from welding parameters to crater parameters.

Postflow - How long the gas continues to flow after the weld to provide shielding.

Both the Start and End Settings screens provide access to the Advanced screen to allow advanced values to be set for start and end of weld.

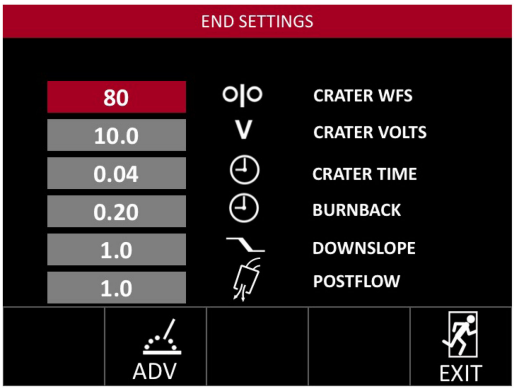


Figure 25 : End Settings Screen

GMAW / FCAW TIMING DIAGRAM

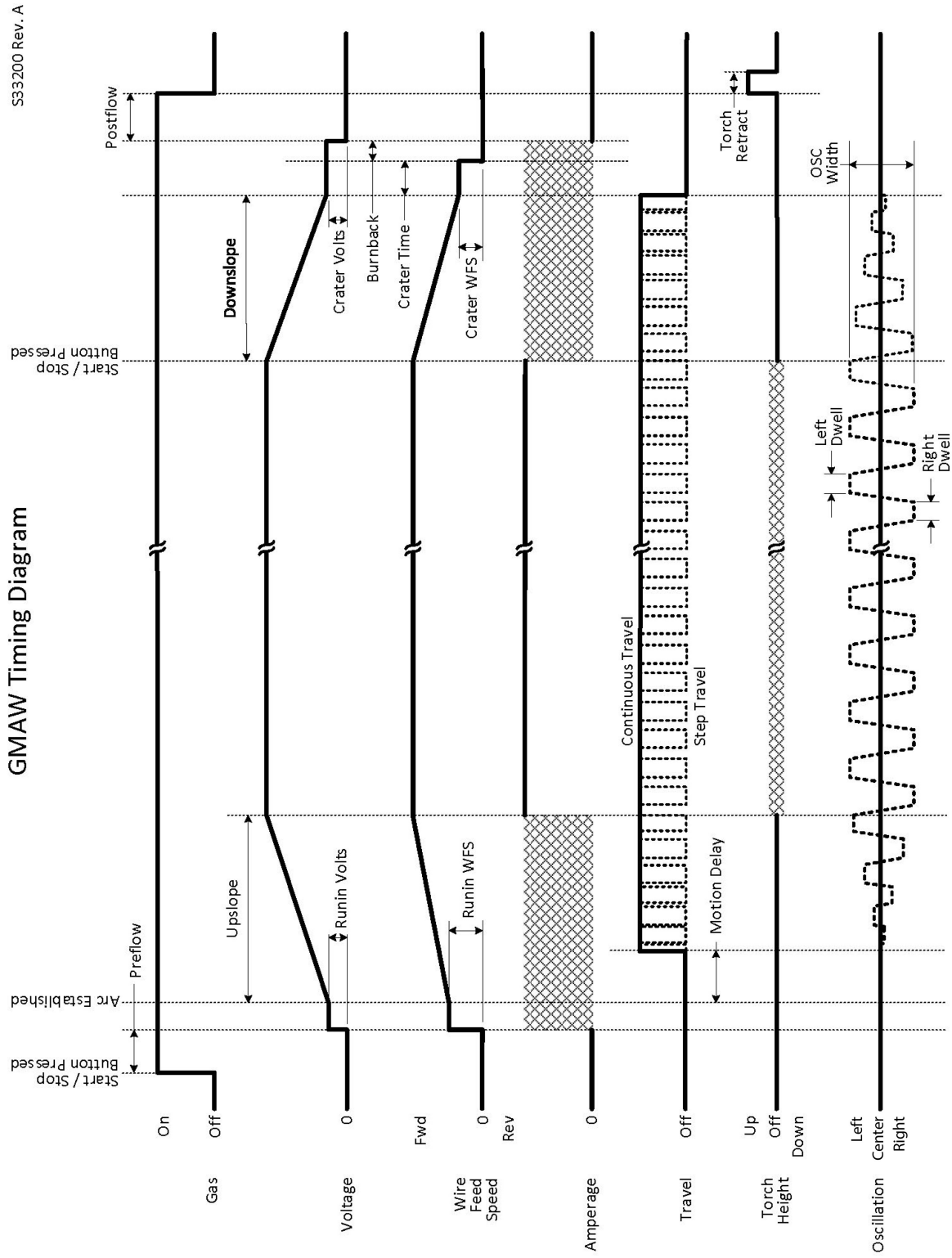


Figure 26 : GMAW / FCAW TIMING DIAGRAM

SERVICE MENU

The Service Screen allows for advanced welding options. There are five menus available in the Service Screen: Version, Motion, Faults, Settings and Input Tests.

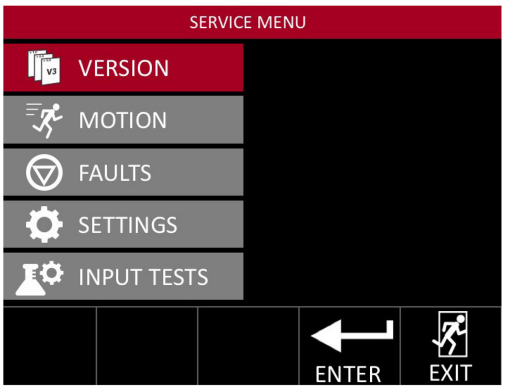


Figure 27 : Service Options Page

VERSION

The version option of the service menu shows the user information about the installed software and hardware. Paging through the screens can be done using the Next Selection button and the Previous Selection button - see Figure 28 : Service Screen Versions on page A-30 .

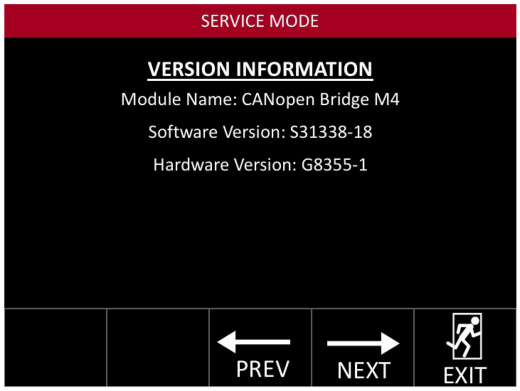


Figure 28 : Service Screen Versions

MOTION

Motion controls allows the user to select certain motions and behaviors of the weld system - see Figure 29 : Motion Controls Screen on page A-31 - for available options.

Service Motion items are:

Steering Increment - Changes the distance the oscillation axis will move for each click of the steering knob.

Head Orientation - Rotating the orientation of the torch relative to the weld head requires changing the system settings and physically inverting the weld head. The setting must match the physical orientation.

Torch Retract Distance - Changes how far the torch retracts at the end of the weld. This allows for greater clearance, enabling a return home to trim the wire before restarting.

WFS Test - The APEX system performs all calibrations internally. However, in order to comply with welding standards, the system allows for verification. The WFS Test will produce a desired amount of wire for a preset length of time for verification.

Travel Test - The APEX system does all calibrations internally. However, in order to comply with welding standards, the system allows for verification. Travel Test will travel for the specified distance for verification. **The distance must be measured on the track ring gear or on a flat track**.

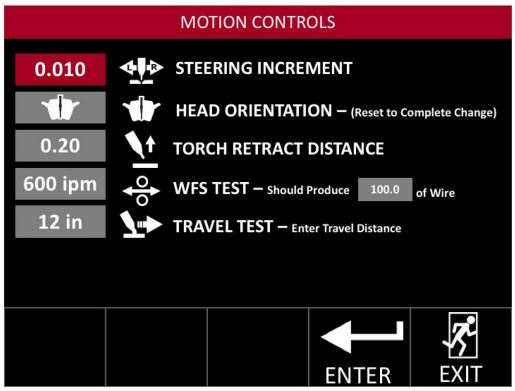


Figure 29 : Motion Controls Screen

FAULTS

While welding, the flow of shielding gas and / or cooling water can be monitored if the appropriate hardware is present. For gas flow, the required level can be specified. The Faults Screen On Settings shown in Figure 30 : Faults Screen On Settings on page A-32 provides access to these features. Water flow is detected by an ArcLink connected CoolArc 55S.

Use the Left Toggle to select GAS or WATER and then the Right Toggle to turn monitoring ON / OFF. With gas monitoring turned ON, two additional controls are made available; a LEVEL selection to input the required level of gas flow using the Right Toggle and a REF value which will display the current gas flow value when the PURGE button is pushed.

If the Gas Fault is turned ON, gas flow level will be monitored during welding and compared to the required flow level. If the monitored flow level is less than the required level, the weld will be terminated and a message will be displayed indicating a Gas Fault.

With the Water Fault turned ON, water flow will be monitored during welding. If it's determined that water is not flowing, the weld will be terminated and a message will be displayed indicating a Water Fault.

If the Gas and Water faults are turned OFF, welding will continue regardless of the level of Gas or Water flow. If the appropriate flow sensor hardware is not present in the system then the corresponding fault(s) should be disabled.

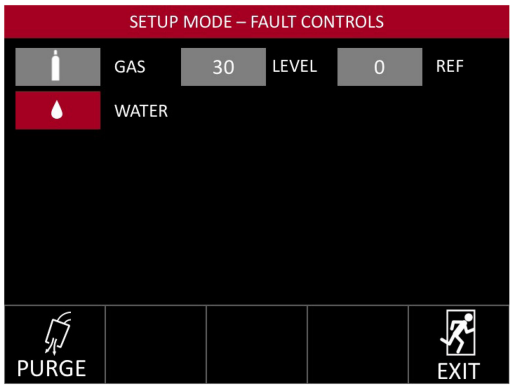


Figure 30 : Faults Screen On Settings

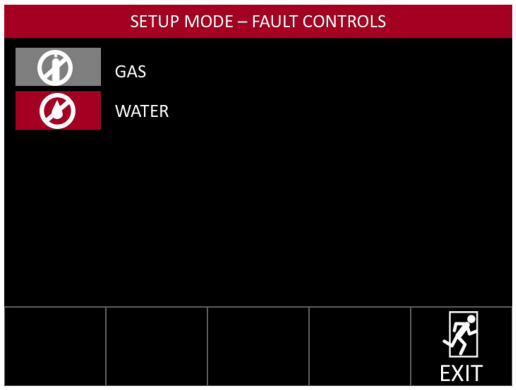


Figure 31 : Faults Screen Off Settings

SETTINGS

The Settings Menu shown in Figure 32 : Settings Screen on page A-32 - provides access to the Production Monitoring feature. When enabled, it will automatically archive a summary of each weld to an inserted USB drive. Use the Right Toggle to turn this feature ON / OFF.

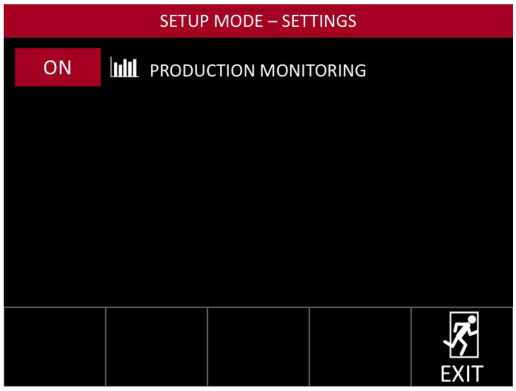


Figure 32 : Settings Screen

INPUT TEST

The Input Test menu shown in Figure 33 : Input Test Screen on page A-33 - provides a Supervisor with the ability to quickly determine if the pendant input devices (buttons, switches, and steering knob) are working correctly.

Note: Pushing the Reset Button resets the system. Once the Input Test screen is displayed, a system test may be performed. Each button and toggle switch on the Pendant will turn green when pushed up, down or released.

Turning the steering knob clockwise should turn the right portion of the knob green indicating the direction of the rotation. Turning the steering knob counter-clockwise should turn the left portion of the knob green indicating the direction of the rotation.

Pushing and releasing the steering knob button should turn the center of the knob green and produce a corresponding message. After operating all Pendant input devices, the representations of the devices on the screen should be highlighted in green. Any that are not highlighted are not working correctly.

Return to the Service Options page by pushing the steering knob and sector button at the same time.

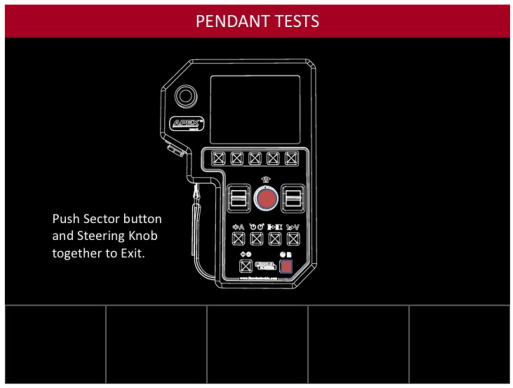


Figure 33 : Input Test Screen

HOW TO TAKE A SNAPSHOT

If a USB drive is inserted into the APEX 30M controller, APEX 30S controller or APEX 3000 controller, the Pendant will allow a snapshot to be taken from the screen shown in Figure 34 : Snapshot Service Mode on page A-33 .

Snapshots can also be taken from the screen shown in Figure 35 : Snapshot System Fault on page A-34 .

A Snapshot provides detailed information concerning the systems current configuration and status and is initiated by pushing the SNAP Selection button.

The snapshot process may take several minutes to complete during which time a status screen like the one shown in Figure 36 : Snapshot Status Screen on page A-34 is presented.



Figure 34 : Snapshot Service Mode

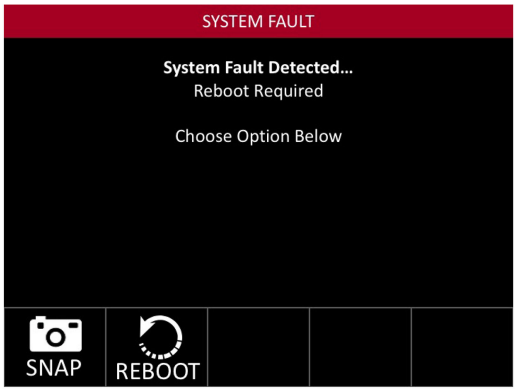


Figure 35 : Snapshot System Fault

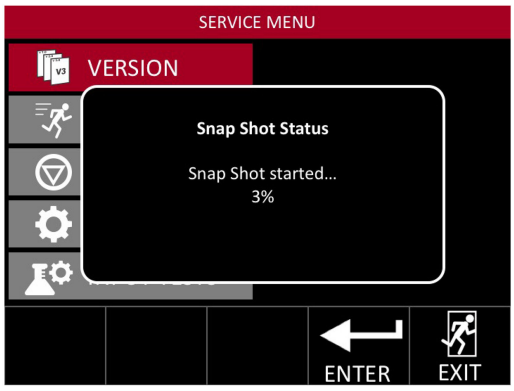


Figure 36 : Snapshot Status Screen

USERS

The Users Screen - see Figure 37 : Users Screen on page A-34 - allows the user to set up operator and supervisor log in codes. Each user can be assigned an individual code which determines the level of access.

FAST MOVEMENT

Using the steering knob, Fast Movement is enabled on this screen. In addition, use the steering knob or the left and right toggles for navigation and selection.

ADDING USERS

Only those with supervisor access are able to view the users screen.

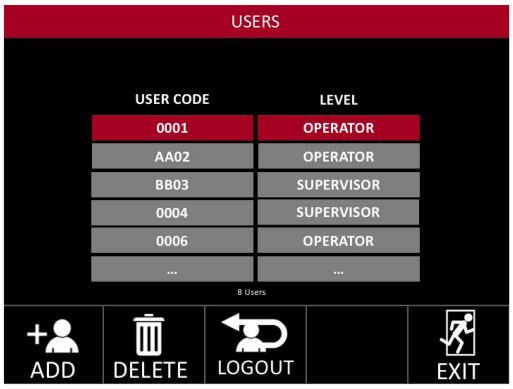


Figure 37 : Users Screen

Press the Add User Selection button.



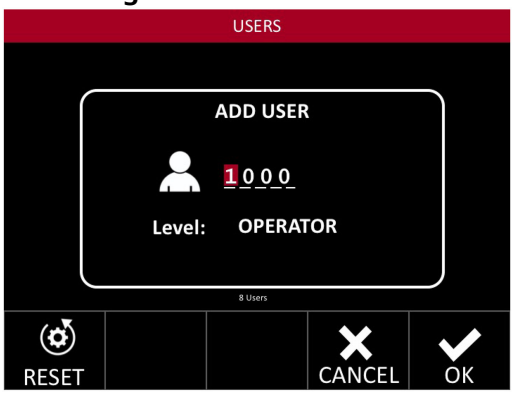


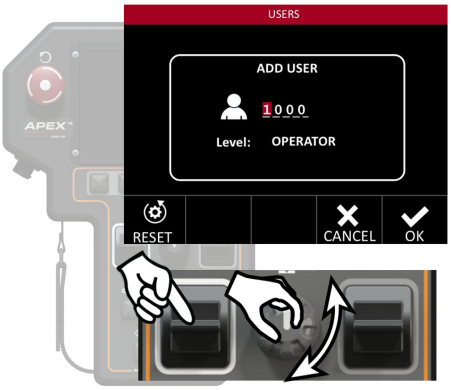
Figure 38 : Add User

As demonstrated in the example above, pressing the Add Selection button will bring up the Add User screen - see Figure 38 : Add User on page A-34 .

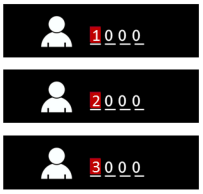
Once the code has been selected, the supervisor can determine the user's level of access.

Operator - The operator has no access to the settings and will only be able to operate within the parameters placed by the supervisor for each program.

Supervisor - The supervisor has full rights and access to all weldings parameters and setup screens.



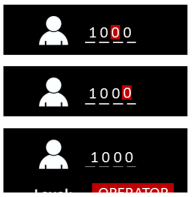
Changes the value of the selected item



Once you have chosen the appropriate User code and level of access, select OK. Reset will change characters back to "0000".



Changes the location of the cursor



DELETING USERS

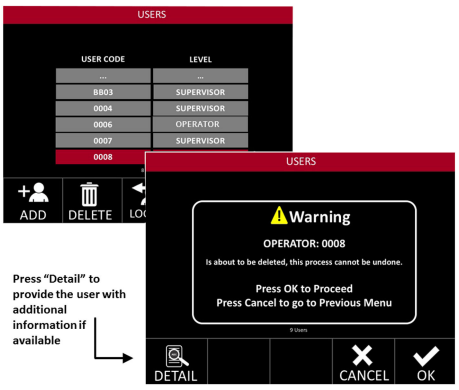
Press the Delete Selection Button after selecting a user from the list.



Deleting a user account will bring up a warning screen. Press the Detail Selection button to see more information about the shown screen.

CAUTION: DELETING ALL SUPERVISORS WILL REQUIRE A FACTORY RESET. PLEASE CONTACT THE FACTORY FOR INSTRUCTIONS.

The warning screen allows the user the chance to review what is being deleted. It also shows the level of access and the user code. The example to the Right shows OPERATOR:0008. If this User Code had supervisory access the screen would read: SUPERVISOR:0008.



If there are too many users to fit on the screen, the last box will contain ellipses - see Figure 39 : Multiple Users on page A-36 . This indicates that there are additional system users and the table will scroll to access each one. At the bottom of the fields it will tell how many user codes are currently listed in the system.

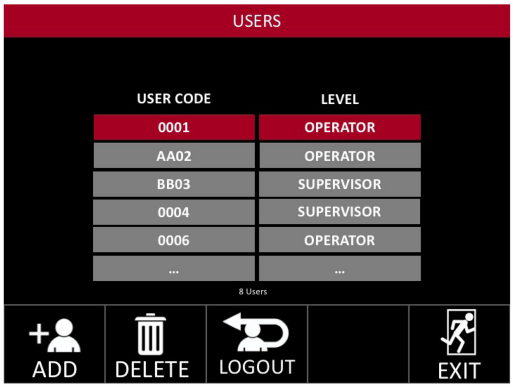


Figure 39 : Multiple Users

CHANGING USER ACCESS

To change the level of access that a user has been granted press the ADD selection button. Instead of entering a unique user code add in the existing user code that needs to be changed. With “Level” highlighted, choose the new access level.



LOG OUT

To change users, press the Logout Selection button. This logs out the current user so that a new user can log in.

Note: If the new user code is set as an operator they will not have full access to the system settings. Be sure to always have at least one supervisor code at all times for full system access.

OPERATOR LOG IN

When an operator logs into the pendant they are presented with the program screen - see Figure 40 : Operator Log In on page A-37 .

Since operators cannot save, delete, or create programs, they are presented with the program options available to them. They can select only these programs.

When entering setup mode, operators are automatically brought to the Programs Screen.

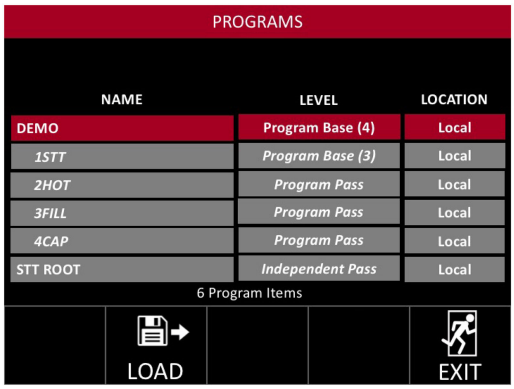


Figure 40 : Operator Log In

INCREMENTS SETTINGS

The increments screen - see Figure 41 : Increments Screen on page A-37 - is used to set how much a single button press will change each value and limit the operator's access to certain parameters.

The system minimum and maximum values provided to the user are based on the welding power source, weld mode, wire diameter and other factors.

The increment options that can be set are:

- Wire Feed Speed
- Amperage
- Voltage or Trim (depending on Weld Mode)
- Travel Speed
- Oscillation Width
- Oscillation Speed
- Dwell Time

Each of these values can have a minimum and maximum value set that the operator will not be able to exceed. These increments can be set per program and per pass.

To reset all increments back to their widest tolerance press the Reset Selection button.

Operator limitations also include the ability to set the system units between Imperial to Metric, which can only be performed by a supervisor.

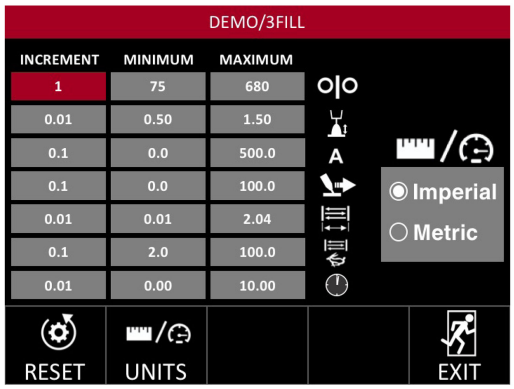


Figure 41 : Increments Screen

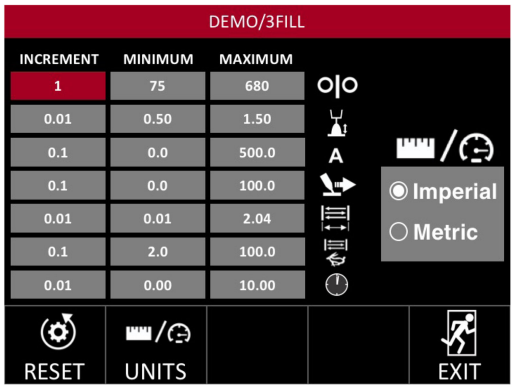
Refer to Table 1 :Increment Values on page A-38 for a complete list of increment values for both imperial and metric measurements.

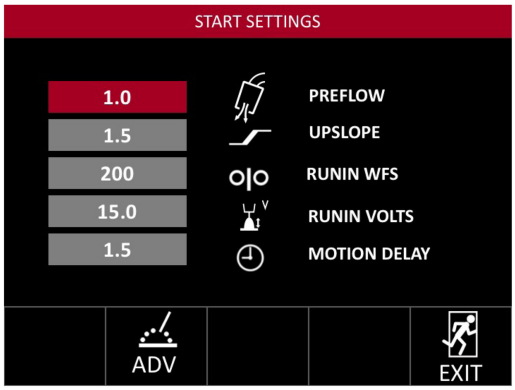
If a multi pass program is loaded, pressing the sector button (button number 14 shown to the Right) will advance to the next pass. This allows the user to quickly set the limits and increments for each pass.

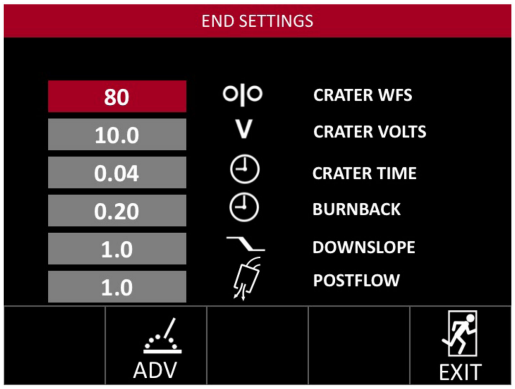
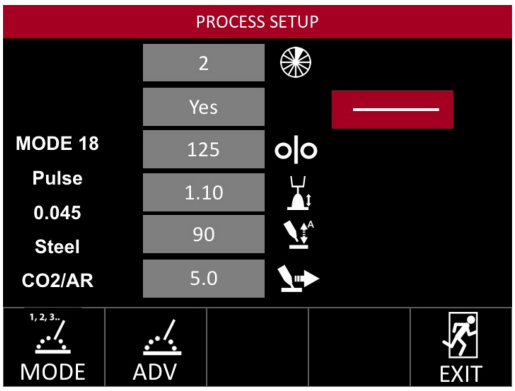
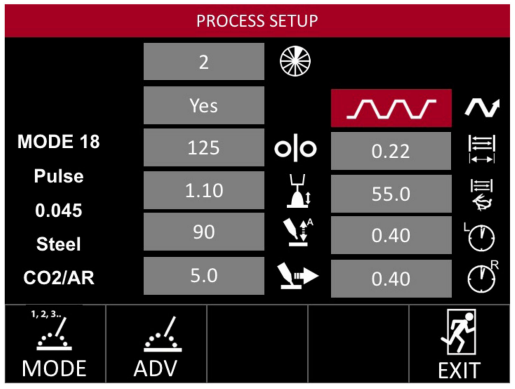


Table 1 :Increment Values

SETUP SCREEN	VALUE NAME	IMPERIAL INCREMENTS	METRIC INCREMENTS
	INCREMENTS & LIMITS MENU		
	►► Wire Speed	Ipm	cm / min
	►► Voltage	Volts	Volts
	►► Amperage	Amps	Amps
	►► Travel Speed	Ipm	cm / min
	►► Oscillation Width	Inches	Centimeters
	►► Oscillation Speed	Ipm	cm / min
	►► Oscillation Dwell	Seconds	Seconds
	START SETTINGS MENU		
	►► Preflow	Seconds	Seconds
	►► Upslope	Seconds	Seconds
	►► Runin Wire Feed Speed	Ipm	cm / min
	►► Runin Voltage	Volts	Volts
	►► Motion Delay	Seconds	Seconds





SETUP SCREEN	VALUE NAME	IMPERIAL INCREMENTS	METRIC INCREMENTS
	END SETTINGS MENU		
	►► Crater Wire Feed Speed	Ipm	cm / min
	►► Crater Voltage	Volts	Volts
	►► Crater Time	Seconds	Seconds
	►► Burnback	Seconds	Seconds
	►► Downslope	Seconds	Seconds
	►► Postflow	Seconds	Seconds
	PROCESS SETUP MENU		
	►► Wire Feed Speed	Ipm	cm / min
	►► Voltage	Volts	Volts
	►► Amperage	Amps	Amps
	►► Travel Speed	Ipm	cm / min
	►► Oscillation Width	Inches	Centimeters
	►► Oscillation Speed	Ipm	cm / min
	►► Left Dwell	Seconds	Seconds
	►► Right Dwell	Seconds	Seconds

PROGRAMS

From the program screen - see Figure 42 : Programs Screen on page A-40 - programs can be saved into the system or onto a USB memory stick.

FAST MOVEMENT

Fast movement using the steering knob is enabled on this screen. Use the steering knob or left and right toggles for navigation and selection.

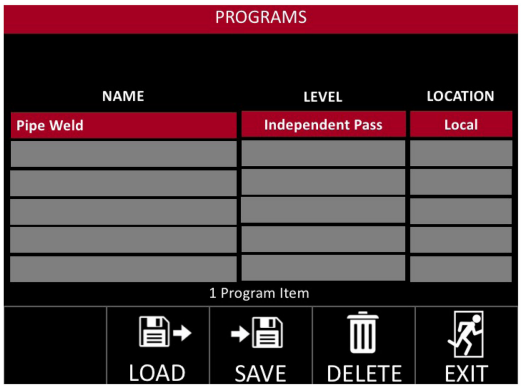


Figure 42 : Programs Screen

SAVING AN INDEPENDENT PASS

A supervisor can change the parameters of the loaded program. Once the parameters are changed, they can be saved as a new program.

Pressing the save selection button will take the user to a sub-menu. This menu will allow the user to program the following variables:

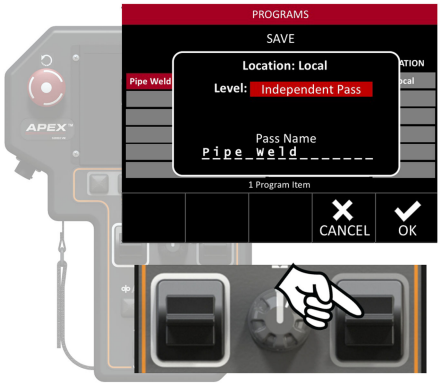
Location: Selects where the program is saved.

- Local: This saves directly to the Pendant.
- USB: This saves to the installed USB. This option only appears when a USB is plugged in.

Level: Selects what type of Program is being saved.

- Independent Pass - stand alone weld procedures, not tied to any other program.
- Program Base - The first step in creating multiple passes which tie together to form a full welding procedure; this is explained in the next section.
- Program Pass - These are tied to the Program Base and can be created as needed by the user. For example a pipe could require four passes, so each pass could be saved under a Program Base for easy retrieval.

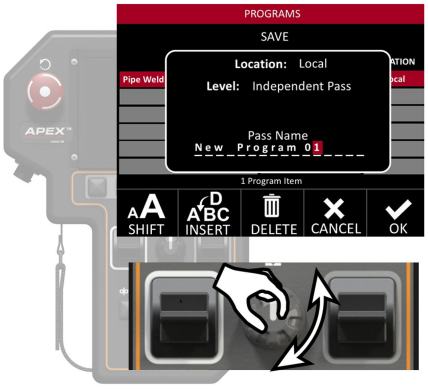
Pass Name: Allows the user to select a unique pass name to identify the pass or program.



Switches between Program Base & Independent Pass



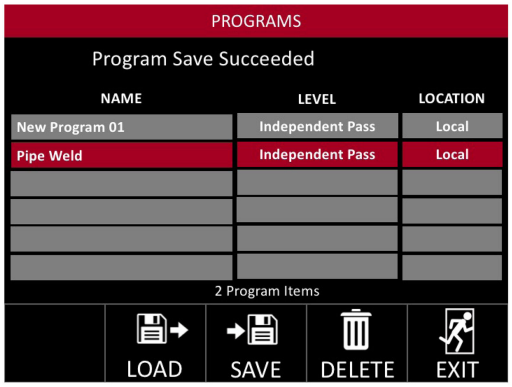




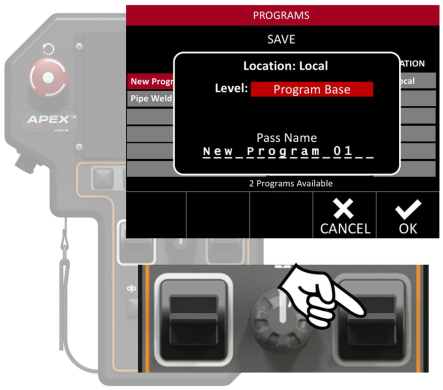
Once the location and level are set, a unique name is given to the program. This name should be distinct to prevent confusion.

Note: Saving to a USB limits the program to 8 characters.

The name field always auto populates with the name for the currently loaded program or the program name selected when the save button was pushed.



SAVING A PROGRAM BASE



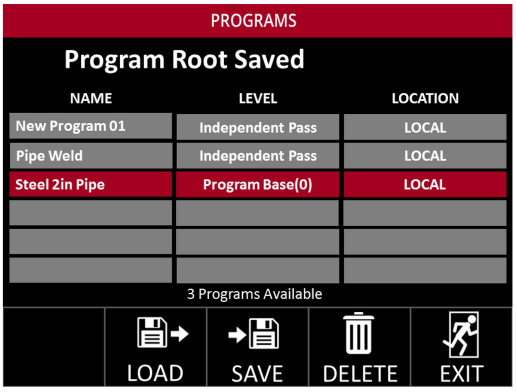
If there are multiple passes within the same procedure, setting up a Program Base is recommended.

In the save program sub-menu, change the level from Independent Pass to Program Base.

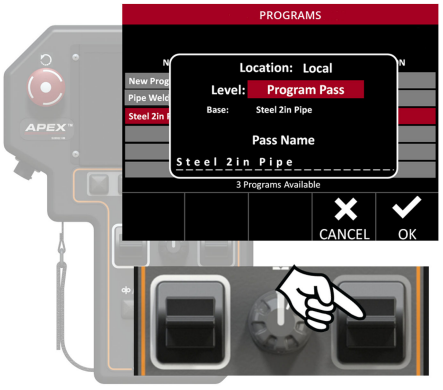
Switches between Program Base & Independent Pass





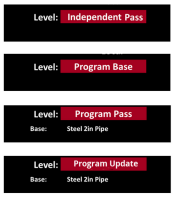


SAVING A PROGRAM PASS



Once a program base is saved, the next step is to create individual passes within the Program Base for the settings to be saved.

Switches between Independent Pass, Program Base, Program Pass and Program Update



For this example the pass has been named 1Root. Continue to save programs to this base until the required passes are all saved.

After saving the required passes they are all displayed under the base - see Figure 43 : Full Program Base on page A-43 . Pressing the steering knob will expand the program base.

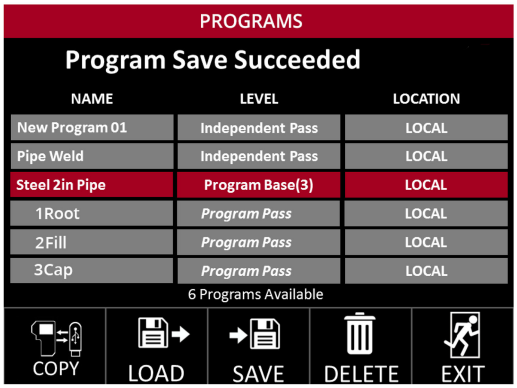


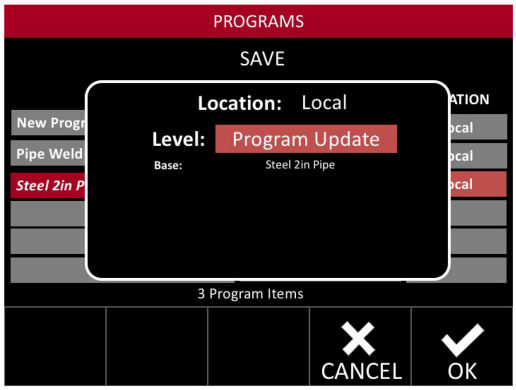
Figure 43 : Full Program Base

SAVING PROGRAM UPDATES

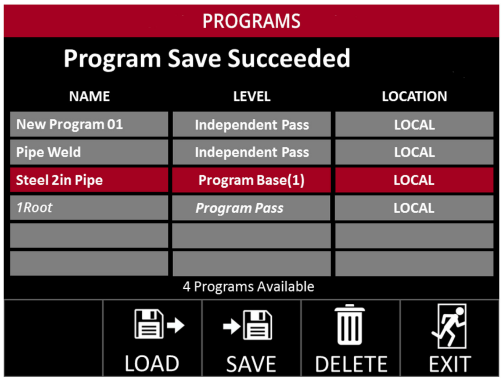
A fourth level selection, Program Update is available when changes are made to Program Passes associated with a Program Base.

When changes have been made to one or more Program Passes, the Program Base containing the changed Program Passes is selected and the SAVE button is pressed, the Program Update option becomes available on the SAVE screen.

If changes were made to one or all of the Program Passes associated with the Program Base “Steel 2 in. Pipe”, selecting the Program Base and pressing the SAVE button would produce the screen to the Right:

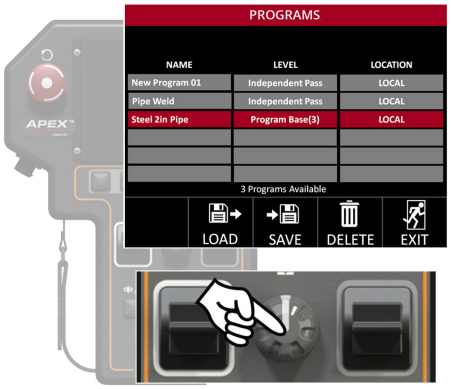


Selecting Program Update and pressing the OK button on this screen will save the changes made to all Program Passes at one time rather than requiring each Program Pass to be saved separately.



HIDE PROGRAM PASSES

The passes in a program base can be hidden by highlighting the program base and pressing the steering knob, collapsing the group. Press the steering knob again and it will expand.



SAVING TO A USB

All of the examples shown have been saved locally to the pendant. They can also be saved to a USB.

The USB has a folder set up specifically to save or read files. If this folder is missing then a prompt will appear on the screen - see Figure 44 : USB Folder Notification on page A-44 . If the flash drive is new, the system will create a folder.

To access files already saved on the USB, move them to the specified directory.

Note: A USB file name is restricted to 8 characters. Local files can be up to 16 characters. The only program name blocked is “Lincoln”.

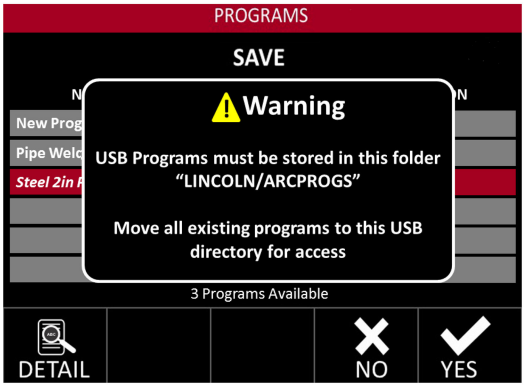
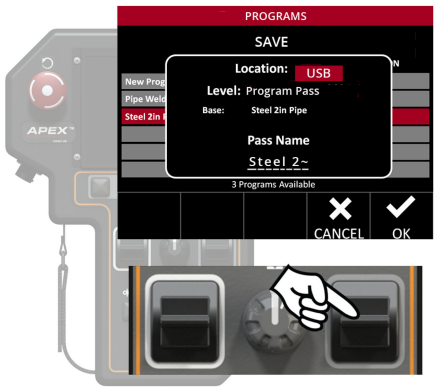


Figure 44 : USB Folder Notification



Switches between USB & Local





COPY TO/FROM USB

With the USB inserted, a Copy Icon appears in the bottom left of the screen - see Figure 45 : Copy Icon on page A-45 .

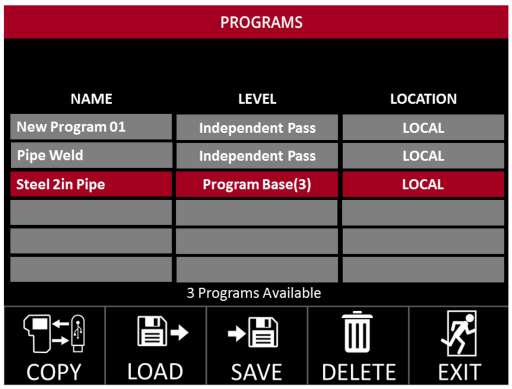


Figure 45 : Copy Icon

Press the Copy Selection Button.

A copy of the selected program is made - see Figure 46 : Copy to USB on page A-45 .

If the file is currently saved on the USB, it will save to the Pendant, if it is a Local file (saved to the pendant), it will save to USB.

Note: If a locally saved program has more than 8 characters, copying to a USB will truncate it to the first 7 characters of the original name and a tilde (~) to indicate that it's shortened. To save with a unique name, load the program and then manually save to the USB with the desired 8-character name.

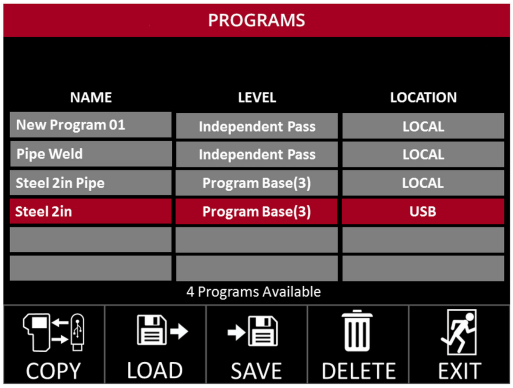


Figure 46 : Copy to USB

DELETING A PROGRAM

Saved programs can be deleted by highlighting the program and pressing the Delete Selection button. This will bring up a new window - see Figure 47 : Program Delete on page A-45 .

Press the Delete Selection Button.

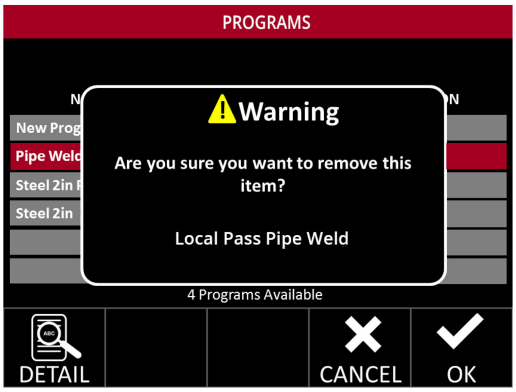


Figure 47 : Program Delete

DELETING A PROGRAM BASE

If a Program Base is deleted then all associated passes are also deleted.

LOADING A PROGRAM

Go to the Programs Menu to load the relevant program. Highlight the program or base.

Press the Load Selection button. This will load the applicable program. See Figure 48 : Loading Program on page A-46 and Figure 49 : Loaded Program on page A-46 .

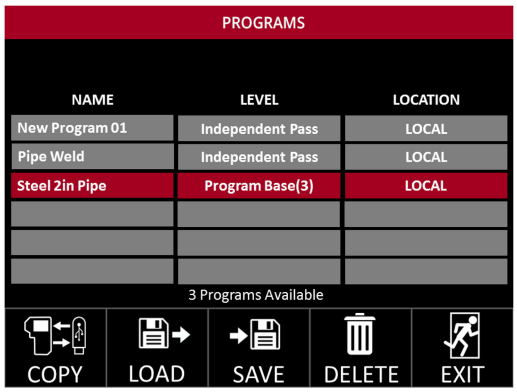


Figure 48 : Loading Program

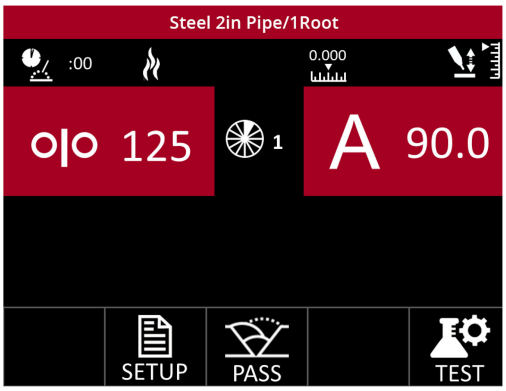
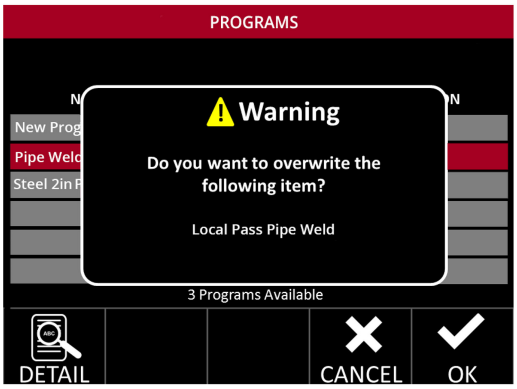


Figure 49 : Loaded Program

OVERWRITING A PROGRAM

Saving a file with the same name will overwrite the existing program. The system gives a warning that the existing program will be overwritten. Overwriting will delete the original program.



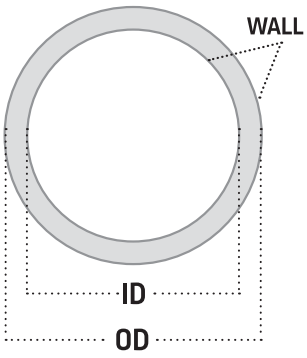
STANDARD PIPING SCHEDULE CHART

STANDARD PIPING SCHEDULE CHART

OD in	OD mm	Schedule	Wall in	Wall mm	ID in	ID mm
1/8 0.405	10.3	10S 40ST, 40S 80SX, 80S	0.049 0.068 0.095	1.24 1.73 2.41	0.307 0.269 0.215	7.8 6.83 5.46
1/4 0.54	13.7	10S 40ST, 40S 80SX, 80S	0.065 0.088 0.119	1.65 2.24 3.02	0.41 0.364 0.302	10.41 9.25 7.67
3/8 0.675	17.1	10S 40ST, 40S 80SX, 80S	0.065 0.091 0.126	1.65 2.31 3.2	0.545 0.493 0.423	13.84 12.52 10.74
1/2 0.84	21.3	5S 10S 40ST, 40S 80SX, 80S	0.065 0.083 0.109 0.147 0.188 0.294	1.65 2.11 2.77 3.73 4.78 7.47	0.71 0.674 0.622 0.546 0.464 0.252	18.03 17.12 15.8 13.87 11.79 6.4
3/4 1.05	26.7	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.065 0.083 0.113 0.154 0.219 0.308	1.65 2.11 2.87 3.91 5.56 7.82	0.92 0.884 0.824 0.742 0.612 0.434	23.37 22.45 20.93 18.85 15.54 11.02
1 1.315	33.4	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.065 0.109 0.133 0.179 0.25 0.358	1.65 2.77 3.38 43.355 6.35 9.09	1.185 1.097 1.049 0.957 0.815 0.599	30.1 27.86 26.64 24.31 20.7 15.21
1¼ 1.66	42.2	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.065 0.109 0.14 0.191 0.25 0.382	1.65 2.77 3.56 4.85 6.35 9.7	1.53 1.442 1.38 1.278 1.16 0.896	38.86 36.63 35.05 32.46 29.46 22.76
1½ 1.9	48.3	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.065 0.109 0.145 0.2 0.281 0.4	1.65 2.77 3.68 5.08 7.14 10.16	1.77 1.682 1.61 1.5 1.338 1.1	44.96 42.72 40.89 38.1 33.99 27.84
2 2.375	60.3	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.065 0.109 0.154 0.218 0.344 0.436	1.65 2.77 3.91 5.54 8.74 11.07	2.245 2.157 2.067 1.939 1.687 1.503	57.02 54.79 52.5 49.25 42.85 38.18
2½ 2.875	73	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.083 0.12 0.203 0.276 0.375 0.552	2.11 3.05 5.16 7.01 9.53 14.02	2.709 2.635 2.469 2.323 2.125 1.771	68.81 66.93 62.71 59 53.98 44.98
3 3.5	88.9	5S 10S 40ST, 40S 80SX, 80S 160 XX	0.083 0.12 0.216 0.3 0.438 0.6	2.11 3.05 5.49 7.62 11.13 15.24	3.334 3.26 3.068 2.9 2.624 2.3	84.68 82.8 77.93 73.66 66.65 58.42
3 ½ 4	101.6	5S 10S 40ST, 40S 80SX, 80S	0.083 0.12 0.226 0.318	2.11 3.05 5.74 8.08	3.934 3.76 3.548 3.364	97.38 95.5 90.12 85.45
4 4.5	114.3	5S 10S 40ST, 40S 80SX, 80S 120 160 XX	0.083 0.12 0.237 0.337 0.438 0.531 0.674	2.11 3.05 6.02 8.56 11.13 13.49 17.12	4.334 4.26 4.026 3.826 3.624 3.438 3.152	110.1 108.2 102.3 97.2 92 87.3 80.1
5 5.563	141.3	5S 10S 40ST, 40S 80SX, 80S 120 160 XX	0.109 0.134 0.258 0.375 0.5 0.625 0.75	2.77 3.4 6.55 9.53 12.7 15.88 19.05	5.345 5.295 5.047 4.813 4.563 4.313 4.063	135.8 134.5 128.2 122.3 115.9 109.6 103.2
6 6.625	168.3	5S 10S 40ST, 40S 80SX, 80S 120 160 XX	0.109 0.134 0.28 0.432 0.562 0.719 0.864	2.77 3.4 7.11 10.97 14.27 18.26 21.95	6.407 6.357 6.065 5.761 5.501 5.187 4.897	162.7 161.5 154.1 146.3 139.7 136.7 124.4
8 8.625	219.1	5S 10S 20 30 40ST, 40S 60 80SX, 80S 100 120 140 XX 160	0.109 0.148 0.25 0.277 0.322 0.406 0.5 0.594 0.719 0.812 0.875 0.906	2.77 3.76 6.35 7.04 8.18 10.31 12.7 15.09 18.26 20.62 22.23 23.01	8.407 8.329 8.125 8.071 7.981 7.813 7.625 7.437 7.187 7.001 6.875 6.813	213.5 211.6 206.4 205 202.7 198.5 193.7 188.9 182.5 177.8 174.6 173.1

LEGEND

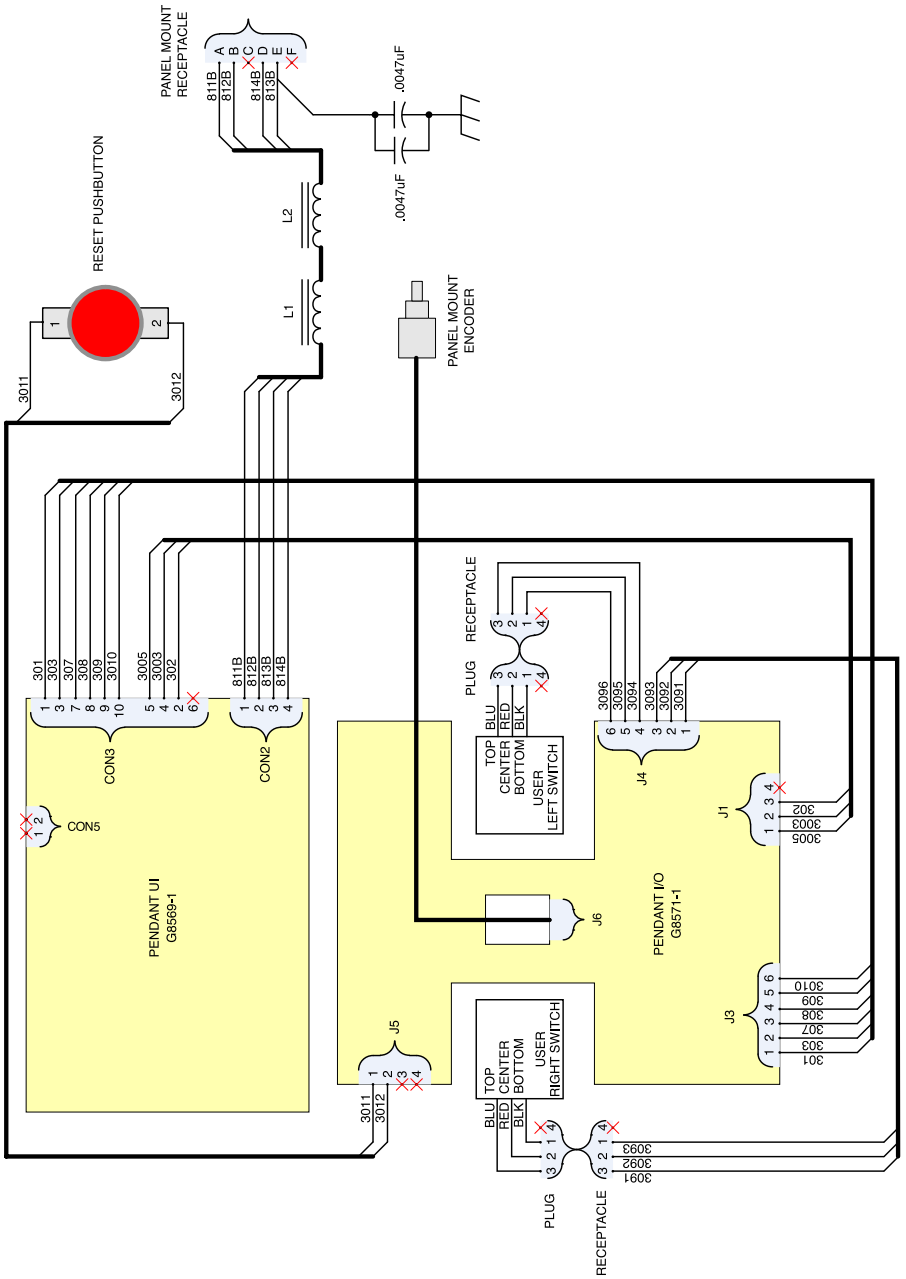
Wall: Thickness of Material
OD: Outside Diameter
ID: Inside Diameter



OD in	OD mm	Schedule	Wall in	Wall mm	ID in	ID mm
10 10.75	273	5S 10S 20 30 40ST, 40S 60XS, 80S 80 100 120 140, XX 160	0.134 0.165 0.25 0.307 0.365 0.5 0.594 0.719 0.844 1 1.12	3.4 4.19 6.35 7.8 9.27 12.7 15.09 18.26 21.44 25.4 28.58	10.482 10.42 10.25 10.136 10.02 9.75 9.562 9.312 9.062 8375 8.5	266.2 264.7 260.4 257.5 254.5 247.7 242.9 236.5 230.2 222.3 215.9
12 12.75	323.8	5S 10S 20 30 ST, 40S 40 S, 80S 60 80 100 120,XX 140 160	0.156 0.18 0.25 0.33 0.375 0.406 0.5 0.562 0.688 0.844 1 1.125 1.312	3.96 4.587 6.35 8.38 9.53 10.31 12.7 14.27 17.48 21.44 25.4 28.58 33.32	12.438 12.39 12.25 12.09 12 11.938 11.75 11.626 11.374 11.062 10.75 10.5 10.126	315.9 314.7 311.2 307.1 304.8 304.2 298.5 295.3 288.9 281 273.1 266.7 257.2
14 14	355.6	5S 10S 10 20 30,ST 40 XS 60 80 100 120 140 160	0.156 0.188 0.25 0.312 0.375 0.438 0.5 0.594 0.75 0.938 1.094 1.25 1.406	3.96 4.78 6.35 7.92 9.53 11.13 12.7 15.09 19.05 23.83 27.79 31.75 35.71	13.688 13.624 13.5 13.376 13.25 13.124 13 12.812 12.5 12.124 11.812 11.5 11.188	347.7 346 342.9 339.8 336.6 333.3 330.2 325.4 317.5 308 300 292.1 284.2
16 16	406.4	5S 10S 10 20 30,ST 40, XS 60 80 100 120 140 160	0.165 0.188 0.25 0.312 0.375 0.5 0.656 0.844 1.031 1.219 1.438 1.594	4.19 4.78 6.35 7.92 9.53 12.7 16.66 21.44 26.19 30.96 36.53 40.49	15.67 15.624 15.5 15.376 15.25 15 14.688 14.312 13.938 13.562 13.124 12.812	398 396.8 393.7 390.6 387.4 381 373.1 363.5 354 344.5 333.3 325.4
18 18	457	5S 10S10 20 ST 30 XS 40 60 80 100 120 140 160	0.165 0.188 0.25 0.312 0.375 0.438 0.5 0.562 0.75 0.938 1.156 1.375 1.562 1.781	4.19 7.78 6.35 7.92 9.53 11.13 12.7 14.27 19.05 23.83 29.36 34.93 39.67 45.24	17.67 17.624 17.5 17.376 17.25 17.124 17 16.876 16.5 16.124 15.688 15.25 14.876 14.438	449 448 445 441 438 435 432 429 419 410 398 387 378 367
20 20	508	5S 10S 10 20,ST 30, XS 40 60 80 100 120 140 160	0.188 0.218 0.25 0.375 0.5 0.594 0.812 1.031 1.281 1.5 1.75 1.969	4.78 5.54 6.35 9.53 12.7 15.09 20.62 26.19 32.54 38.1 44.45 50.01	19.624 19.564 19.5 19.25 19 18.812 18.376 17.938 17.438 17 16.5 16.062	498 497 495 489 483 478 467 456 443 432 419 408
24 24	610	5S 10, 10S 20, ST XS 30 40 60 80 100 120 140 160	0.218 0.25 0.375 0.5 0.562 0.688 0.969 1.218 1.531 1.812 2.062 2.344	5.54 6.35 9.53 12.7 14.27 17.48 24.61 30.96 38.89 46.02 52.37 59.54	23.564 23.5 23.25 23 22.876 22.624 22.062 21.562 20.938 20.376 19.876 19.312	599 597 591 584 581 575 560 548 532 518 505 491
30 30	762	5S 10, 10S ST 20, XS 30	0.25 0.312 0.375 0.5 0.625	6.35 7.92 9.53 12.7 15.88	29.5 29.376 29.25 29 28.75	749 746 743 737 730

APPENDIX

WIRING DIAGRAM



NOTE: This diagram is for reference only. It may not be 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 equipment code number.

CUSTOMER ASSISTANCE POLICY

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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.

PARTS LIST

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