F14-129

August, 1997

INSTRUCTION MANUAL for the

ESAB SmartFlow

PLASMA CUTTING SYSTEM

ESAB CUTTING SYSTEMS

411 South Ebenezer Road
Florence, SC 29501-0545

The equipment described in this manual is potentially hazardous. Use caution in installing, operating, and maintaining this equipment.

The purchaser is solely responsible for the safe operation and use of all products purchased, including compliance with OSHA and other government standards. ESAB Cutting Systems has no liability for personal injury or other damage arising out of the use of any product manufactured or sold by ESAB. See standard ESAB terms and conditions of sale for a specific statement of ESAB's responsibilities and limitations on its liability.

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This manual is ESAB Part Number F14129.

This manual is for the convenience and use of the cutting machine purchaser. It is not a contract or other obligation on the part of ESAB Cutting Systems.

Printed In USA

This manual is not a safety guide for the use of the equipment. The purchaser, through its own judgment and safety procedures, is solely responsible for safe operation. However, in presenting the information in this manual, a system of advisory notes has been provided to point out specific information that will be helpful in the safe and proper operation of the equipment.

The method used to identify these notes and the purpose for each are as follows:

⚠ NOTE	*An operational procedure or background information that aids the operator in efficient use of the system and in performing maintenance, or information that requires additional emphasis.*
⚠ CAUTION	***An operational procedure which, if not properly followed, may cause damage to the system.***
⚠ WARNING	**An operational procedure that, if not properly followed, may cause injury to the operator or others in the operating area.**

Preface

This manual applies only to the ESAB SmartFlow Plasma Cutting System using the Vision CNC and ASIOB I/O Structure. For plasma systems with alternate hardware, refer to the appropriate manual.

The ESAB SmartFlow Plasma Cutting System is an advanced, numerically controlled plasma cutting package manufactured by ESAB Cutting Systems of Florence, South Carolina. This system is designed to be installed on an ESAB Gantry Shape Cutting Machine. It is designed to provide years of dependable, accurate, repeatable part cutting, with a high degree of reliability, ease of service and ease of operation.

There are various optional configurations possible with the SmartFlow system. For completeness, all of these options are described in this manual. However, not all options or capabilities described in this manual are present on all machines. In addition, more capabilities and features may be added in the future, which are not covered in this manual. ESAB Cutting Systems reserves the right to change or add features and capabilities without notice.

Before operating the system, one should become familiar with this manual in its entirety, with special attention to the SAFETY section.

Contents

1 Safety

1.1 Introduction

ESAB plasma cutting products are designed to provide both safety and efficiency in operation. However, sensible attention to operating procedures, precautions, and safe practices is necessary to achieve a full measure of safety. Whether an individual is involved with operation, servicing, or as an observer, compliance with established precautions and safe practices must be accomplished. Failure to observe certain precautions could result in serious injury to personnel or severe damage to the equipment. The following precautions are specific guidelines applicable to the plasma cutting process. More general precautions are presented in the instruction literature pertaining to the cutting machine.

1.2 General Safety Information

All personnel, materials, and equipment not involved in the production process must be kept clear of the entire system area. Only qualified personnel should be allowed to operate or service the equipment.

Read entirely through a procedure to become familiar with the task before operating or performing maintenance on any part of the system. Special attention must be given to all WARNINGS, CAUTIONS, and NOTES which provide essential information regarding personnel safety and/or possible damage to equipment.

All safety precautions relevant to electrical equipment and the process operations must be strictly observed by all who have responsibility or access to the system. DO NOT touch the plasma marking torch during operation. Do not operate any part of the system with any of the protective covers removed or electrical component boxes open. Refer to all safety publications made available by your company.

Fence off the entire work cell to prevent personnel from passing through the area or standing within the working envelope of the equipment. Post appropriate CAUTION signs at every entrance to the work cell area.

1.3 Plasma Cutting Precautions

1.3.1 Electrical Shock Prevention

The plasma arc cutting process employs high voltages. High voltage can kill. Do NOT touch the marking torch, cutting table or cable connections during the plasma cutting process.

⚠ WARNING

Electrical Shock Can Kill You!

- Always turn off power to the plasma power supplies before touching or servicing a plasma marking torch.
- Always turn off power to the plasma power supplies before opening or servicing the plasma power supply or interface box.
- Do not touch live electrical parts.
- Keep all panels and covers in place when the machine is connected to a power source.
- Insulate yourself from the workpiece and electrical ground: wear insulating gloves, shoes and clothing.
- Keep gloves, shoes, clothing, work area, and this equipment dry.

1.3.2 Eye Safety

⚠ WARNING

Arc rays can injure eyes and burn skin.

To protect your eyes from burns caused by high intensity ultraviolet light, sparks and hot metal :

- Do not look at the arc.
- Wear correct eye protection. Wear dark safety glasses or goggles with side shields.
- Replace glasses/goggles when the lenses become pitted or broken
- Warn other people in the area not to look directly at the arc unless they wear appropriate

safety glasses.

- Prepare the cutting area in a manner that reduces the reflection and transmission of ultraviolet light:
- Paint walls and other surfaces with dark colors to reduce reflections.
- Install protective screens or curtains to reduce ultraviolet transmission.

1.4 Skin Safety

To protect skin against burns caused by high intensity ultraviolet light, sparks and hot metal:

- Wear protective clothing:
- Wear gauntlet gloves.
- Wear flame-retardant clothing which covers all exposed areas.
- Wear cuffless trousers to prevent entry of sparks and slag.
- Do not touch the torch when it is about to start or while marking. After marking, allow time for the front of the torch to cool.

1.5 Electrical Grounding

Electrical grounding is imperative for proper machine operation as well as for SAFETY.

⚠ NOTE

All ESAB Shape Cutting Machines must have a good electrical connection to earth ground.

2 Introduction

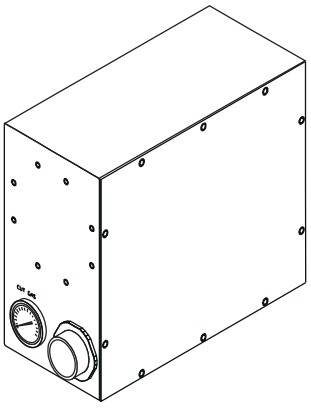
2.1 Overview

The SmartFlow Plasma Cutting System is a streamlined, high performance plasma cutting package designed for use exclusively with the ESAB Vision CNC. ESAB's exclusive SmartFlow technology integrates gas and water control into the cutting machine CNC.

Using a system of proportional valves driven by CNC outputs, this system dramatically reduces the amount of plumbing hardware necessary to control the plasma torch. Operation is simplified by putting control of gas and water flow rates on screen at the Vision CNC.

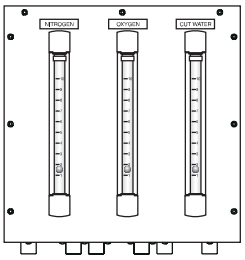
2.2 System Description

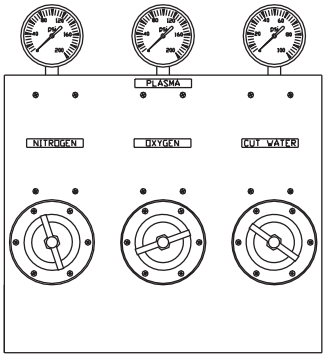
2.2.1 Component Description



Plumbing Box

Flow Tube Box





Regulator Panel

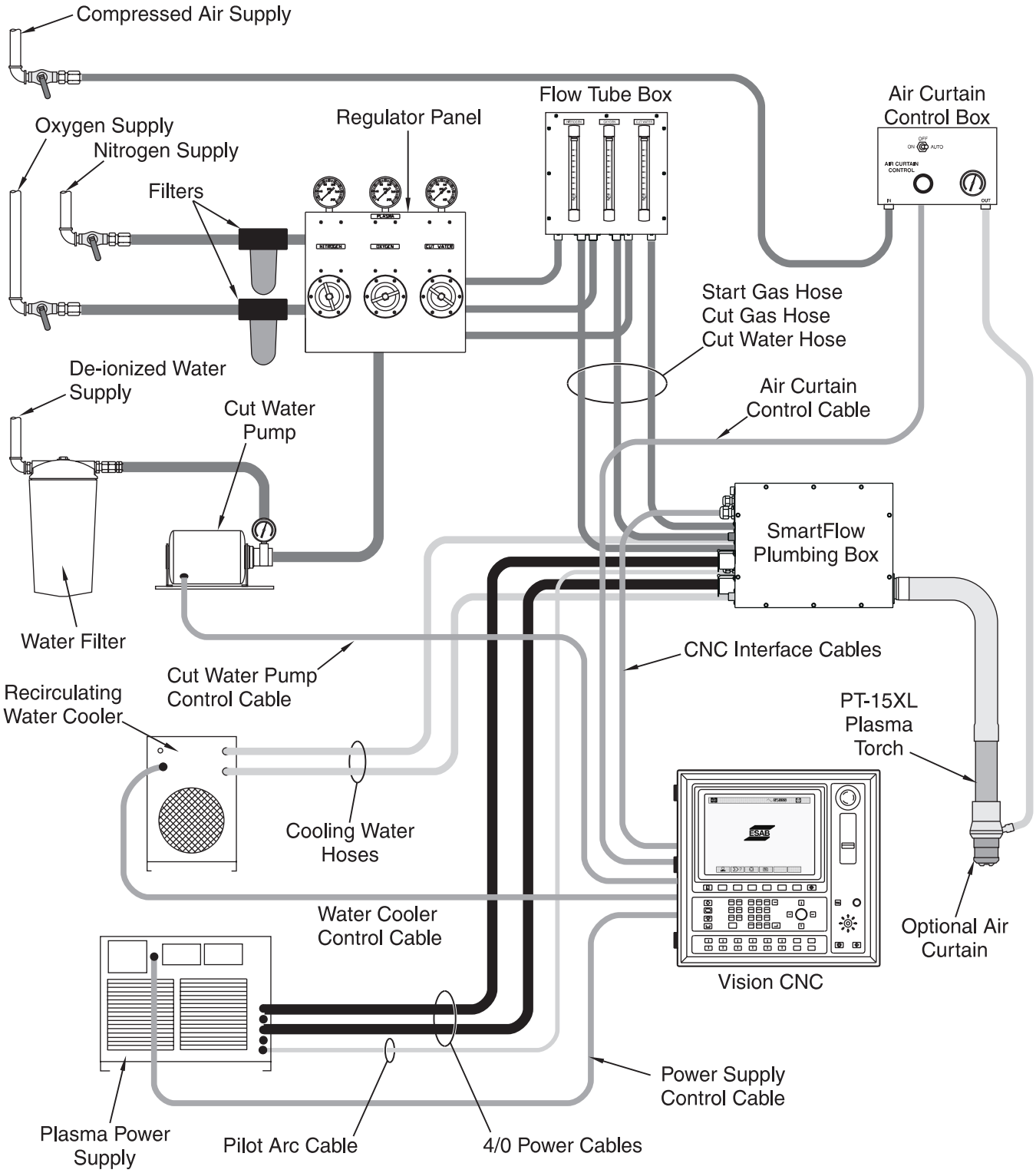
The SmartFlow system components include a plumbing box, a flow tube box, and a regulator panel. The plumbing box contains the proportional valves and plumbing necessary to control gas and water flows. The flow tube box contains three flow indicator tubes, which provide visual feedback to the machine operator of the actual gas and water flow rates. The regulator panel provides pressure regulation for the incoming gas and water supplies.

When the PT-15XL water injection torch is used, the complete SmartFlow cutting system also includes a plasma power supply, a recirculating water cooler, a cut water pump, an air curtain control, and the Vision CNC. If the PT-19XL dry torch is used, then the cut water supply system and air curtain control are omitted.

The following pages show the complete system overviews.

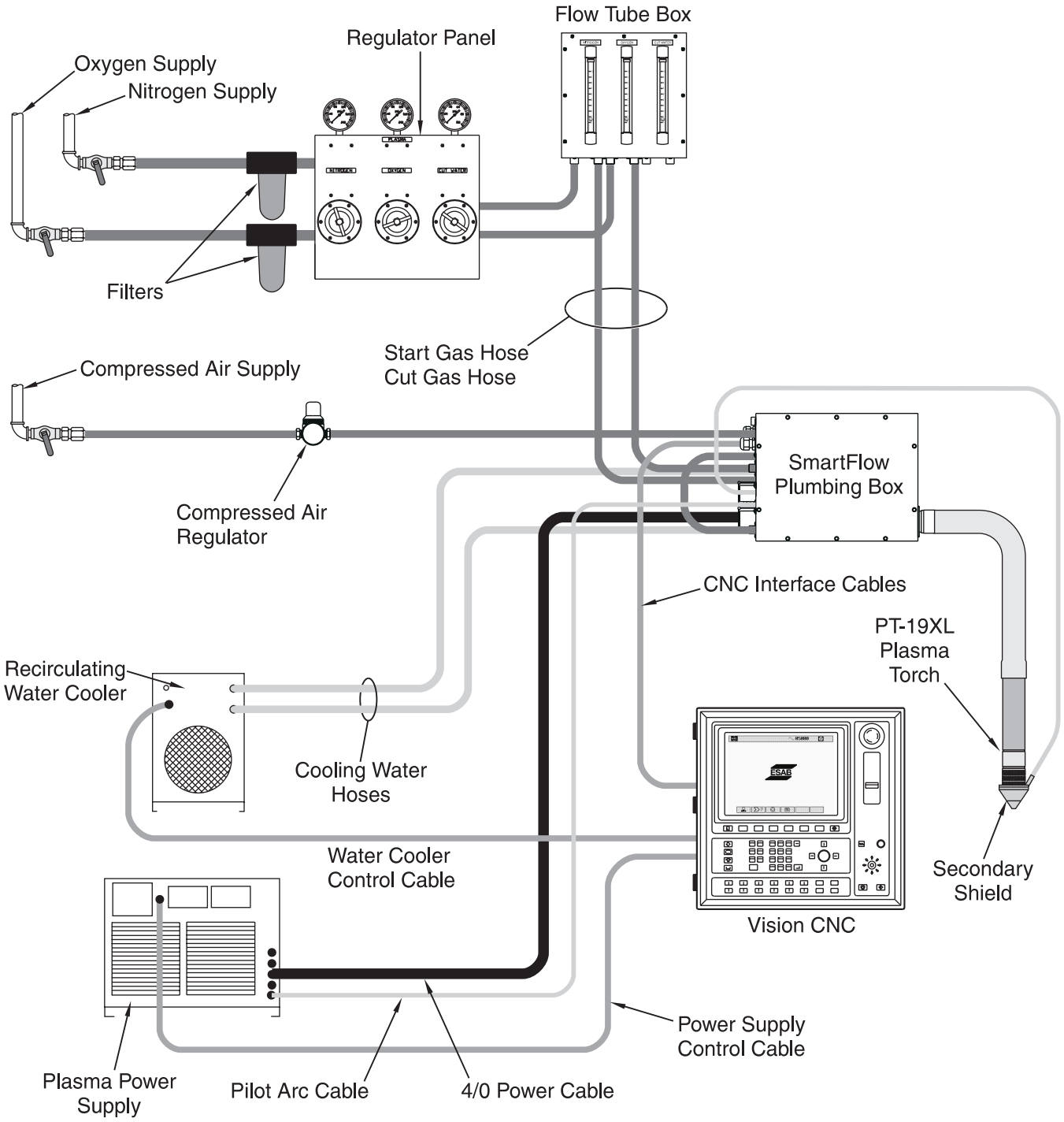
2.2.2 SmartFlow System with PT-15XL Torch

The illustration below shows the SmartFlow system when a PT-15XL water injection torch is used.



2.2.3 SmartFlow System with PT-19XL Torch

The illustration below shows the SmartFlow system when the PT-19XL dry torch is used. In this system the cut water supply equipment is omitted, a secondary shield is used instead of an air curtain, and shield gas is controlled through the SmartFlow plumbing Box.



Section 2

3 Installation

3.1 Requirements

3.1.1 Gas Supply Requirements

Nitrogen	125 PSI (1/2 NPT)
	99.999% Pure
Oxygen	125 PSI (1/2 NPT)
	99.999% Pure
Compressed Air (PT-19XL with Secondary Shield only)	100 PSI (1/2 NPT)
	Clean, Dry, Filtered to 5 micron.

3.1.2 Water Supply Requirements

Cooling Water	120 PSI
	1.5 GPM

3.1.3 Deionized Water Requirements (PT-15XL)

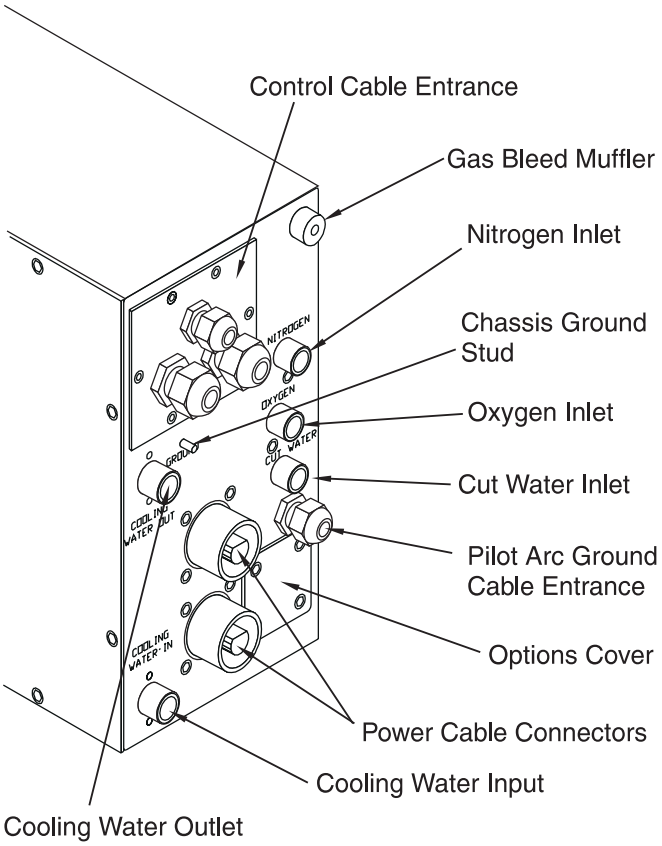
Deionized Water	35 PSI (1/2 NPT)
	> 200,000 Ω
	.5 GPM for up to 600 Amp cutting 1.5 GPM for 1000 Amp cutting

3.1.4 Electrical Input Requirements

Voltage Supply	+24 VDC for proportional valves, flow and pressure switches.
	+15 VDC for pressure switch.
Voltage Signals	120 VAC input to start gas solenoid valve.
	120 VAC input to cut gas solenoid valve.
	120 VAC input to Arc Starter.
	0 - 10 Volt DC inputs to proportional valves.

3.2 Connections

3.2.1 Hose and Cable Connections



The SmartFlow Plasma Cutting package is designed to be interfaced with the ESAB Vision CNC and any ESP Plasma Power Supply. Connections to the plumbing box are illustrated here. A color code is used on the hose connections between the flow tube box and the plumbing box:

Green = Oxygen

Yellow = Nitrogen

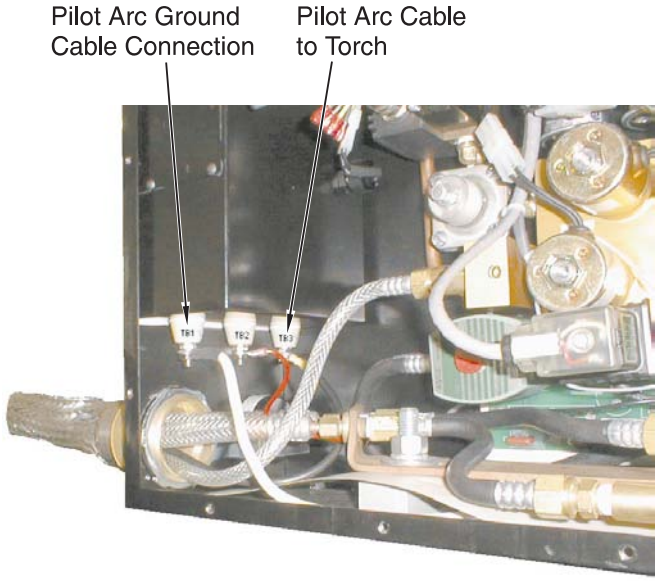
White = Cooling Water

Blue = Cut Water

The Control Cable Entrance plate can be removed, allowing the control cables to be installed or removed without any re-wiring at the plug terminals.

The Options Cover is replaced by an additional hose adaptor when the PT-19XL is used with a Secondary Shield kit, allowing the plumbing box to control shield gas flow. The Options Cover also allows space for a third power cable connector for PT-15XL installations cutting at 1000 Amps.

3.2.2 Pilot Arc Cable Connections



The Pilot Arc Cables must be connected properly to the insulated high voltage terminals at the Arc Starter Box, as shown here.

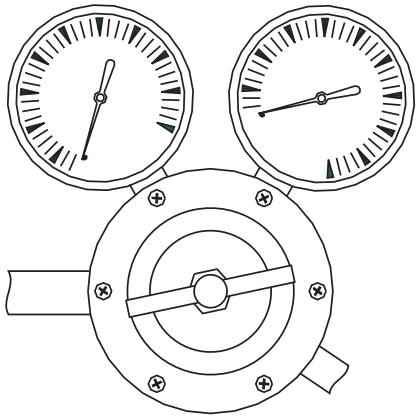
The Pilot Arc Ground Cable (from the plasma power supply) is connected to TB1, toward the open side of the plumbing box.

The Pilot Arc Torch Cable (from the torch leads) is connected to TB3, toward the back of the plumbing box.

TB2 is connected to the Busbar, internal to the plumbing box.

3.3 Supply Setup

3.3.1 Gas Supply Pressures



The Oxygen and Nitrogen gases may be supplied from bottles or bulk tanks. The supplies to the cutting machine must be controlled with the proper type of regulator. Adjust these pressures as follows:

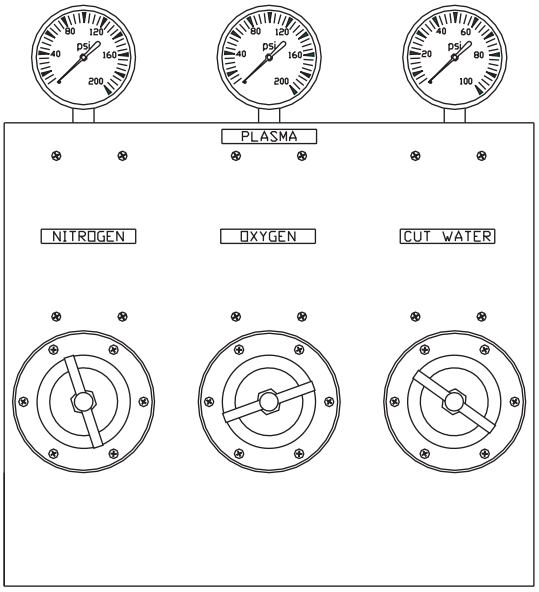
Oxygen

Set the Oxygen pressure to 140 PSI while the gas is flowing.

Nitrogen

Set the Nitrogen pressure to 140 PSI while the gas is flowing.

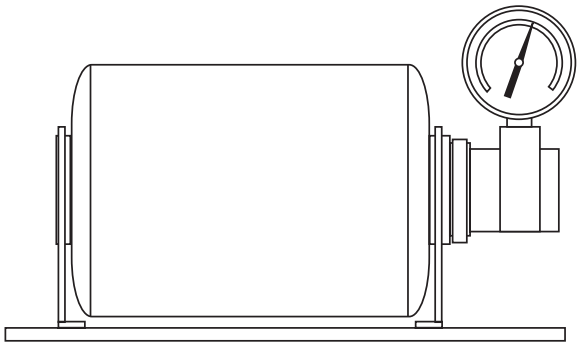
3.3.2 Cut Water Supply Pressure



Installations using the PT-15XL water injection torch require a supply of deionized water. This water must be regulated to a minimum of 30 PSI to prevent the cut water pump from cavitating.

The cut water regulator is located on the Plasma Regulator Panel. Set the Cut Water pressure to 30 PSI while the water is flowing.

3.3.3 Cut Water Pump Setup



Installations using the PT-15XL water injection torch require a cut water pump. The cut water pump supplies high pressure water to the plumbing box, where the flow is regulated. The cut water pump must be adjusted to 120 PSI. Refer to Section 6.3.6 for the adjustment procedure.

4 Setup

4.1 Introduction

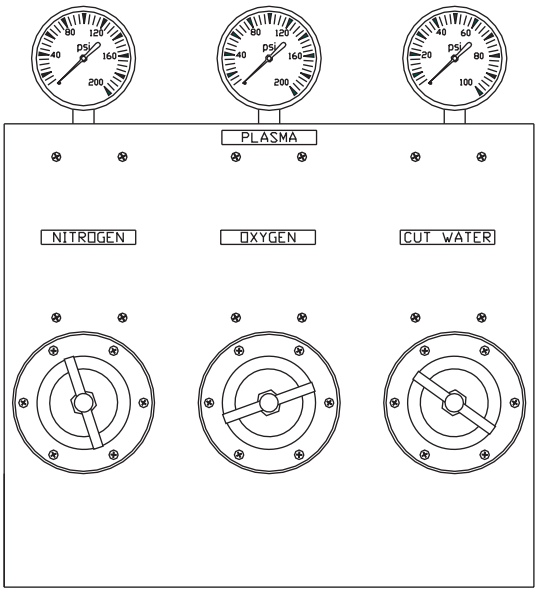
The information in this section is intended for use by the operator during daily setup prior to starting the cutting process.

4.2 Prerequisites

The following setup procedures can only be completed after all of the requirements, connections, and suppliy setups have been properly completed, as detailed in Section 3.

4.3 Gas Regulator Setup

4.3.1 Gas Regulator Panel Setup



The plasma system requires regulated gas and water supplies for proper operation. The plasma regulator panel, shown here, is mounted on the cutting machine gantry near the operator's control console.

When the PT-15XL torch is used, all three regulators must be set properly. When the PT-19XL torch is used, only the oxygen and nitrogen regulators are used.

Adjust the pressure settings while the gas is flowing, since there will be a slight drop in indicated pressure when the gas is flowing.

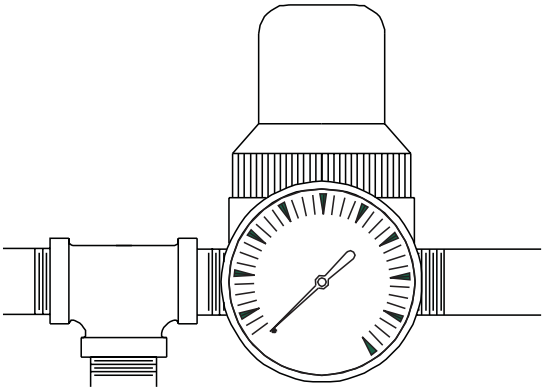
Oxygen

Set the Oxygen pressure to 120 PSI while the gas is flowing.

Nitrogen

Set the Nitrogen pressure to 120 PSI while the gas is flowing.

4.3.2 Shield Air Regulator



When the secondary shield is used with the PT-19XL torch, an air regulator is located at the Plumbing Box. This regulator sets the air supply pressure for the secondary shield air.

Set the regulator pressure to 60 PSI. Air flow is then controlled throught he Vision CNC's parameter screen.

4.4 CNC Setup

The SmartFlow Plasma System may is interfaced to the ESAB Vision CNC. The following parameters are adjusted through the CNC. Prior to plasma cutting, check these parameters at the Vision CNC:

Standoff This parameter adjusts the actual cutting height that the torch will maintain, after the arc has started.

Initial Height Set the distance to raise the torch after sensing the plate. When VHC is turned on, the torch will lower to the plate, then retract this distance before starting the arc.

Start Gas Flow This parameter adjusts the flow of gas prior to and during arc starting. Start Gas, which is Nitrogen, is flowed at this rate during preflow and postflow.

Cut Gas Flow This parameter adjusts the flow of plasma gas during plasma cutting. When the arc starts, the gas supplied to the torch switches from the Start Gas Flow rate to the Cut Gas Flow rate. Cut Gas may be Oxygen or Nitrogen.

Start Water Flow Systems equipped with a water injection torch use Cut Water. It can be flowed at a reduced rate prior to and during arc starting. This parameter sets the water flow during preflow, arc starting, and postflow.

Cut Water Flow This parameter sets the water flow rate after arc starting, during the cutting process.

Start Shield Gas Systems equipped with a secondary shield instead of a cut water system use the SmartFlow plumbing box to control Shield Gas flow. This parameter sets the Shield Gas flow rate during preflow, arc starting, and postflow.

Shield Gas This parameter sets the Shield Gas flow rate after the arc starts, during the cutting process.

Remote Current Set the cutting Amperage for the plasma power supply.

Pre Switch Cut Gas This timer sets the length of time prior to starting the arc that the system will switch from start gas to cut gas. This allows the system to be used equally well with any length of torch leads. When set

properly, the cut gas will reach the torch momentarily after the arc starts.

Plasma Rise On Pierce — Set this timer according to the length of time you want the plasma torch to raise, starting at the moment the arc strikes. This can be used to raise the torch while piercing to avoid blow-back and spatter. See the chart following this list.

Plasma Pierce Time — This timer starts when the Plasma Rise On Pierce time ends. The lift motor is de-energized, AHC is turned OFF, and machine motion is held. This timer can be set longer for thicker material, to allow more time to pierce through the material, while the torch is held at a set height. See the chart below.

Plasma Travel Delay — This timer starts when the Plasma Pierce Time ends. AHC is turned ON, but Travel is delayed. This can be set longer for thicker materials to allow time to pierce through the material. It also allows the torch to reach the cutting height before travel starts. See the chart following this list.

Master Up — This timer sets the length of time the torch will be raised at the end of each cut.

Refer to Section 5 of this manual for the appropriate values for each of these parameters.

Refer to the machine manual for detailed instructions on how to change process parameter settings.

Section 5

5 Process Data

The SmartFlow Plasma System can produce high quality cuts on a wide range of plate thicknesses and cutting amperages. It is designed to support both the PT-15XL and the PT-19XL plasma cutting torches. The following pages provide process data for various material thicknesses. Each page shows the setup parameters for one material thickness.

These cutting parameters were developed under laboratory conditions. Actual cutting conditions will vary, and cutting parameters must be adjusted as necessary.

Torch	Amperage	Material	Thickness
PT-19XL	**250 Amp Cutting**	**Carbon Steel**	**1/4 inch**

Conditions:

NOZZLE:	**PN: 21822**
SHIELD:	**100-200 Amp, PN: 21945**
ELECTRODE:	**PN: 34557**
PLASMA GAS:	**Oxygen @ 125 PSI**
START GAS:	**Nitrogen @ 125 PSI**
SHIELD GAS:	**AIR @ 80 PSI**

Setup Screen:

FEED RATE:	**200 ipm**
KERF WIDTH:	**.125 inch**

Parameter Screen:

STANDOFF:	**122**
INITIAL HEIGHT:	**76**
START GAS FLOW:	**28.6** **(4.4 flow)**
CUT GAS FLOW:	**60.0** **(5.1 flow/50 PSI cutting)**
START SHIELD GAS:	**45** **(7.5 PSI while cutting)**
SHIELD GAS:	**45** **(7.5 PSI while cutting)**
REMOTE CURRENT:	**250**
PLASMA RISE ON PIERCE:	**0**
PLASMA PIERCE TIME:	**0**
PLASMA TRAVEL DELAY:	**0**

Torch	Amperage	Material	Thickness
PT-19XL	**250 Amp Cutting**	**Carbon Steel**	**3/8 inch**

Conditions:

NOZZLE:	**PN: 21822**
SHIELD:	**100-200 Amp, PN: 21945**
ELECTRODE:	**PN: 34557**
PLASMA GAS:	**Oxygen @ 125 PSI**
START GAS:	**Nitrogen @ 125 PSI**
SHIELD GAS:	**AIR @ 80 PSI**

Setup Screen:

FEED RATE:	**135 ipm**
KERF WIDTH:	**.125 inch**

Parameter Screen:

STANDOFF:	**135**
INITIAL HEIGHT:	**76**
START GAS FLOW:	**28.6** **(4.4 flow)**
CUT GAS FLOW:	**60.0** **(5.1 flow/50 PSI cutting)**
START SHIELD GAS:	**45** **(7.5 PSI while cutting)**
SHIELD GAS:	**45** **(7.5 PSI while cutting)**
REMOTE CURRENT:	**250**
PLASMA RISE ON PIERCE:	**0**
PLASMA PIERCE TIME:	**0**
PLASMA TRAVEL DELAY:	**.1**

Torch	Amperage	Material	Thickness
PT-19XL	**250 Amp Cutting**	**Carbon Steel**	**1/2 inch**

Conditions:

NOZZLE:	**PN: 21822**
SHIELD:	**100-200 Amp, PN: 21945**
ELECTRODE:	**PN: 34557**
PLASMA GAS:	**Oxygen @ 125 PSI**
START GAS:	**Nitrogen @ 125 PSI**
SHIELD GAS:	**AIR @ 80 PSI**

Setup Screen:

FEED RATE:	**115 ipm**
KERF WIDTH:	**.185 inch**

Parameter Screen:

STANDOFF:	**140**
INITIAL HEIGHT:	**76**
START GAS FLOW:	**28.6** **(4.4 flow)**
CUT GAS FLOW:	**60.0** **(5.1 flow/50 PSI cutting)**
START SHIELD GAS:	**45** **(7.5 PSI while cutting)**
SHIELD GAS:	**45** **(7.5 PSI while cutting)**
REMOTE CURRENT:	**250**
PLASMA RISE ON PIERCE:	**0**
PLASMA PIERCE TIME:	**.2**
PLASMA TRAVEL DELAY:	**0**

Torch	Amperage	Material	Thickness
PT-19XL	**250 Amp Cutting**	**Carbon Steel**	**3/4 inch**

Conditions:

NOZZLE:	**PN: 21822**
SHIELD:	**100-200 Amp, PN: 21945**
ELECTRODE:	**PN: 34557**
PLASMA GAS:	**Oxygen @ 125 PSI**
START GAS:	**Nitrogen @ 125 PSI**
SHIELD GAS:	**AIR @ 80 PSI**

Setup Screen:

FEED RATE:	**74 ipm**
KERF WIDTH:	**.185 inch**

Parameter Screen:

STANDOFF:	**145**
INITIAL HEIGHT:	**76**
START GAS FLOW:	**28.6** **(4.4 flow)**
CUT GAS FLOW:	**60.0** **(5.1 flow/50 PSI cutting)**
START SHIELD GAS:	**45** **(7.5 PSI while cutting)**
SHIELD GAS:	**45** **(7.5 PSI while cutting)**
REMOTE CURRENT:	**250**
PLASMA RISE ON PIERCE:	**.3**
PLASMA PIERCE TIME:	**.2**
PLASMA TRAVEL DELAY:	**.1**

Torch	Amperage	Material	Thickness
PT-19XL	**250 Amp Cutting**	**Carbon Steel**	**1 inch**

Conditions:

NOZZLE:	**PN: 21822**
SHIELD:	**100-200 Amp, PN: 21945**
ELECTRODE:	**PN: 34557**
PLASMA GAS:	**Oxygen @ 125 PSI**
START GAS:	**Nitrogen @ 125 PSI**
SHIELD GAS:	**AIR @ 80 PSI**

Setup Screen:

FEED RATE:	**50 ipm**
KERF WIDTH:	**.185 inch**

Parameter Screen:

STANDOFF:	**150**
INITIAL HEIGHT:	**76**
START GAS FLOW:	**28.6** **(4.4 flow)**
CUT GAS FLOW:	**60.0** **(5.1 flow/50 PSI cutting)**
START SHIELD GAS:	**45** **(7.5 PSI while cutting)**
SHIELD GAS:	**45** **(7.5 PSI while cutting)**
REMOTE CURRENT:	**250**
PLASMA RISE ON PIERCE:	**.3**
PLASMA PIERCE TIME:	**.4**
PLASMA TRAVEL DELAY:	**.1**

6 Maintenance

The SmartFlow System consists of a plasma power supply, a recirculating water cooler, a cut water pump (for the PT-15XL), a regulator panel, an optional flow tube box, the SmartFlow Plumbing Box, and the plasma torch.

For maintenance information on the plasma power supply, water cooler, cut water pump, or plasma torch, refer to the appropriate instruction manual.

6.1 Routine Maintenance

The following routine maintenance should be performed on the plasma marker system.

- Inspect the supply hoses, torch leads, ground cable, and interface cables for damage or wear at least weekly.

- Inspect and clean the PCM-500i at least monthly. The unit can be blown out using a clean, dry gas source, such as compressed air or nitrogen.

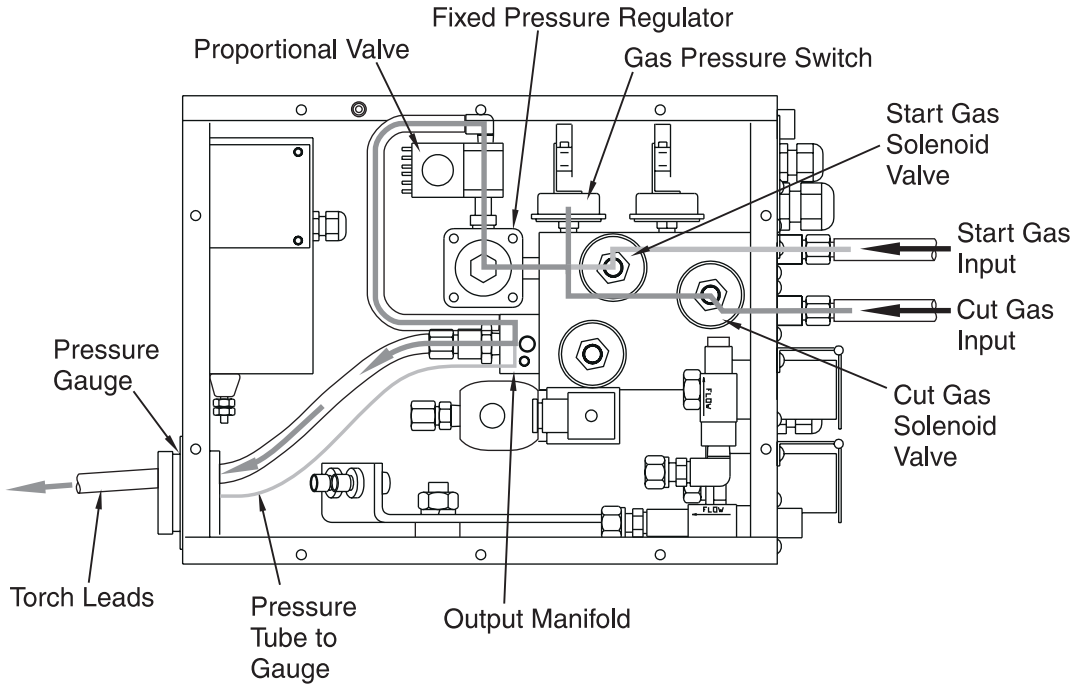
6.2 Technical Description

6.2.1 Gas Control

Control of cut gas and start gas is accomplished with two solenoid valves, a fixed pressure regulator, and a proportional valve.

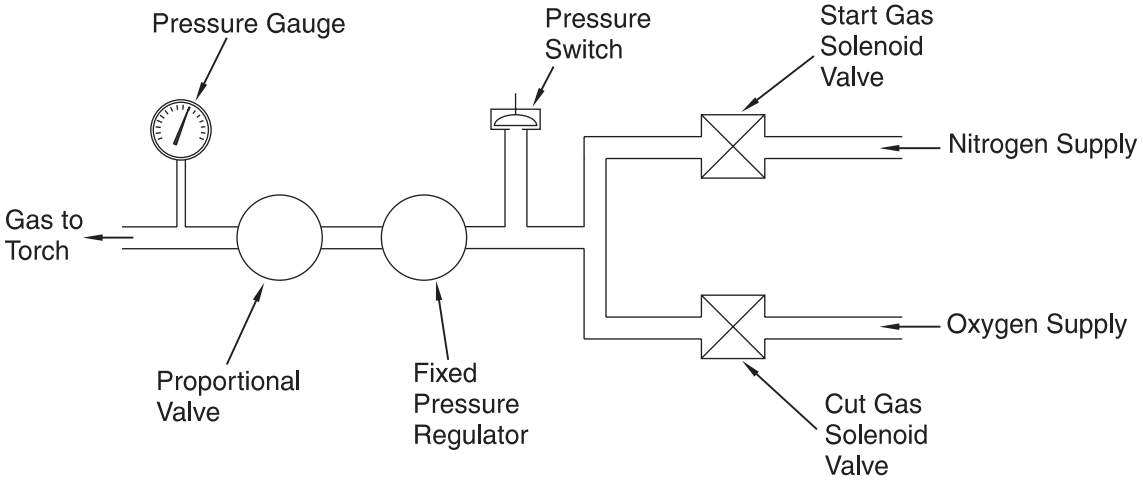
Start gas (Nitrogen) and cut gas (Oxygen) are both supplied to the plumbing box, where they are applied to the inlets of the solenoid valves. Only one of these two valves will be open at a time. The outlet of the two valves are manifolded together then fed into the fixed pressure regulator. This regulator sets the incoming line pressure to the proportional valve at a value within the range of the valve. The proportional valve is controlled by a voltage signal from the CNC, and sets the flow rate of gas based on the status of the plasma cutting cycle. A pressure switch monitors line pressure into the fixed pressure regulator, and provides an input into the CNC. The CNC can then shut down the process if gas pressure drops below a preset threshold. A pressure gauge displays actual gas pressure supplied to the torch by tapping off of the output manifold. This important indication provides visual feedback to the operator, and can be helpful in spotting torch problems.

The illustration below shows the location of gas control components in the plumbing box, and indicates the gas flow path through those components.



Gas Control Components

The diagram below shows a schematic of the gas control system.



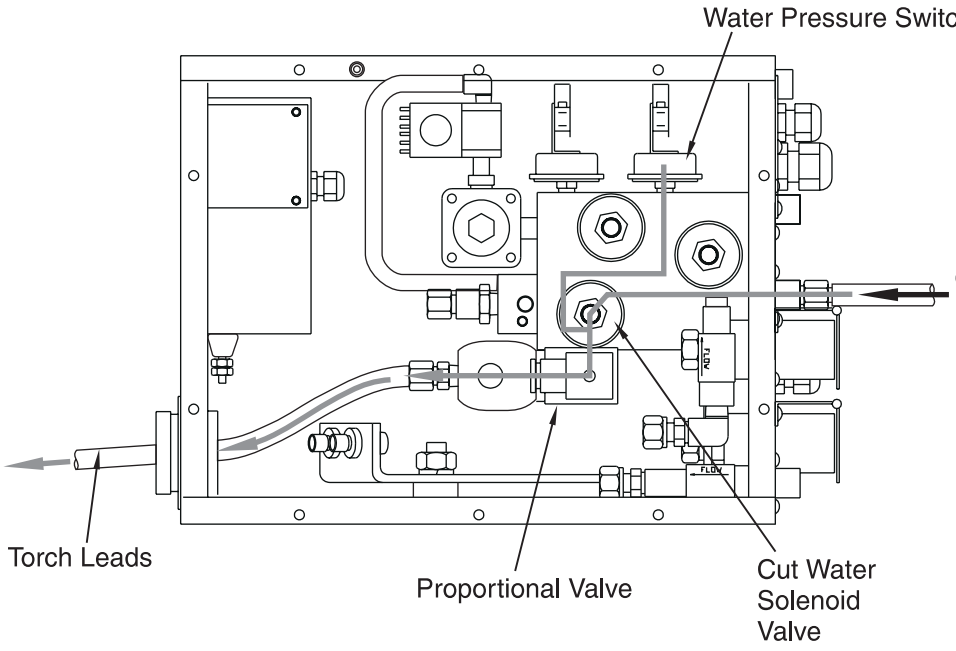
Gas Control Diagram

6.2.2 Cut Water Control

Control of cut water is accomplished with a solenoid valve and a proportional valve.

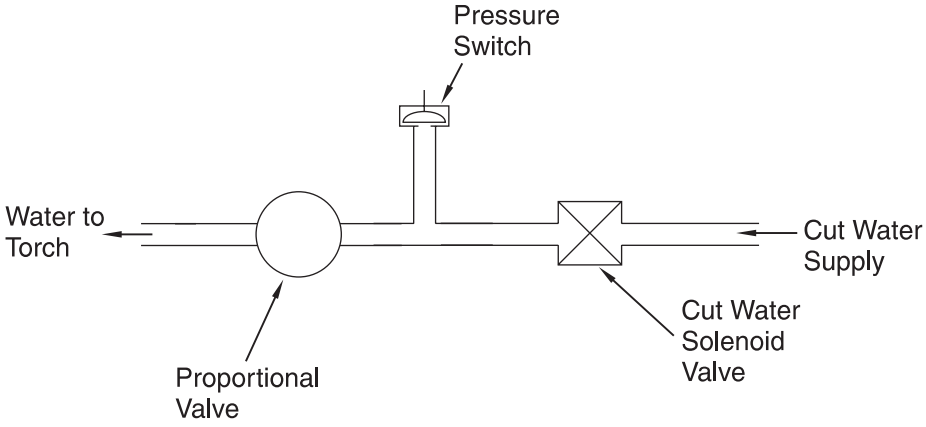
Deionized cut water is supplied to the plumbing box and applied to the inlet of the solenoid valve. The outlet of the valve is fed into the proportional valve, and is also monitored by a pressure switch. The proportional valve is controlled by a voltage signal from the CNC, and sets the flow rate of water based on the status of the plasma cutting cycle. The pressure switch monitors line pressure into the proportional valve, and provides an input into the CNC. The CNC can then shut down the process if water pressure drops below a preset threshold.

The illustration below shows the location of water control components in the plumbing box, and indicates the water flow path through those components.



Water Control Components

The diagram below shows a schematic of the water control system.



Water Control Diagram

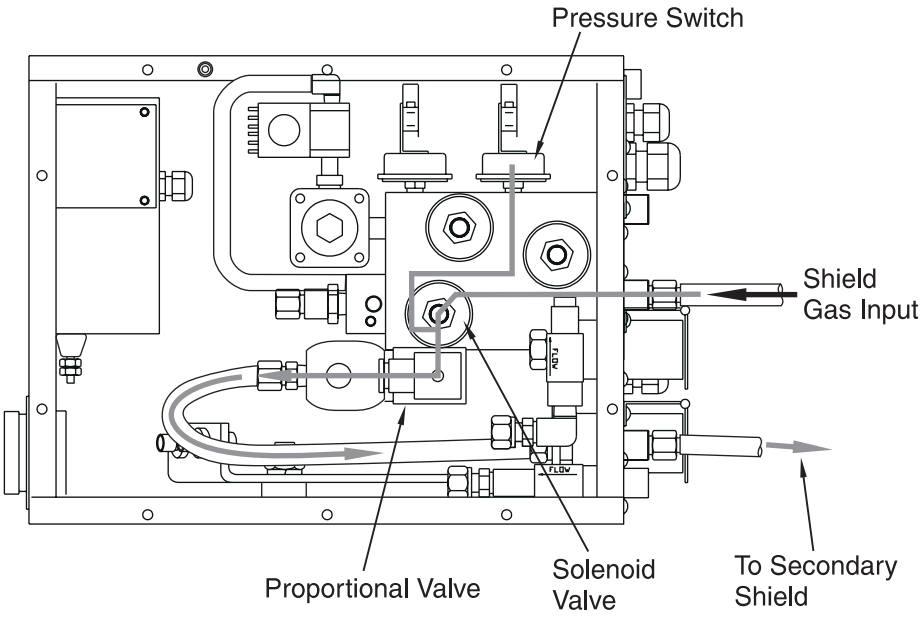
6.2.3 Secondary Shield Gas Control

The SmartFlow Plumbing Box is designed to support both the PT-15XL and PT-19XL torches. Since the PT-19XL is a dry torch, meaning it does not use cut water, the cut water control components can be used to control the secondary shield gas. An additional hose connection is installed on the rear of the plumbing box in place of the options cover, to connect the controlled shield gas to the secondary shield.

Control of secondary shield gas is accomplished with a solenoid valve and a proportional valve.

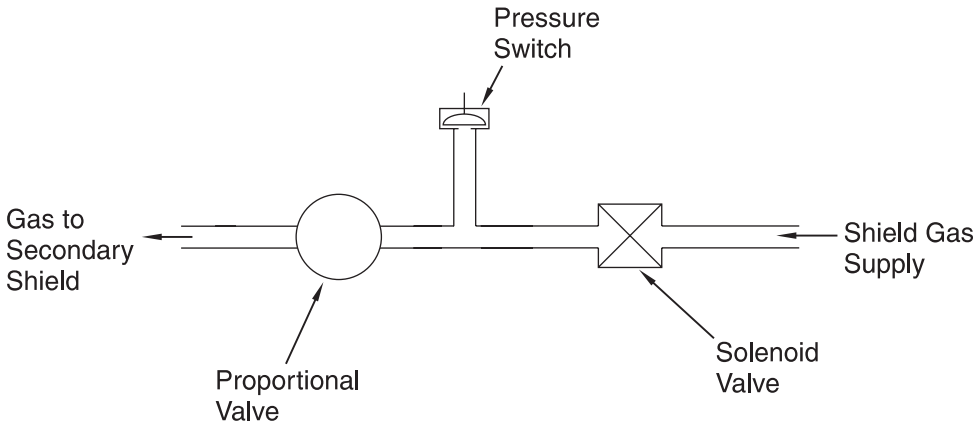
Shield gas is supplied to the plumbing box through a pressure regulator, then applied to the inlet of the solenoid valve. The outlet of the valve is fed into the proportional valve, and is also monitored by a pressure switch. The proportional valve is controlled by a voltage signal from the CNC, and sets the flow rate of shield gas based on the status of the plasma cutting cycle. The pressure switch monitors line pressure into the proportional valve, and provides an input into the CNC. The CNC can then shut down the process if gas pressure drops below a preset threshold.

The illustration below shows the location of secondary shield gas control components in the plumbing box, and indicates the gas flow path through those components.



Secondary Shield Gas Control Components

The diagram below shows a schematic of the secondary shield gas control system.



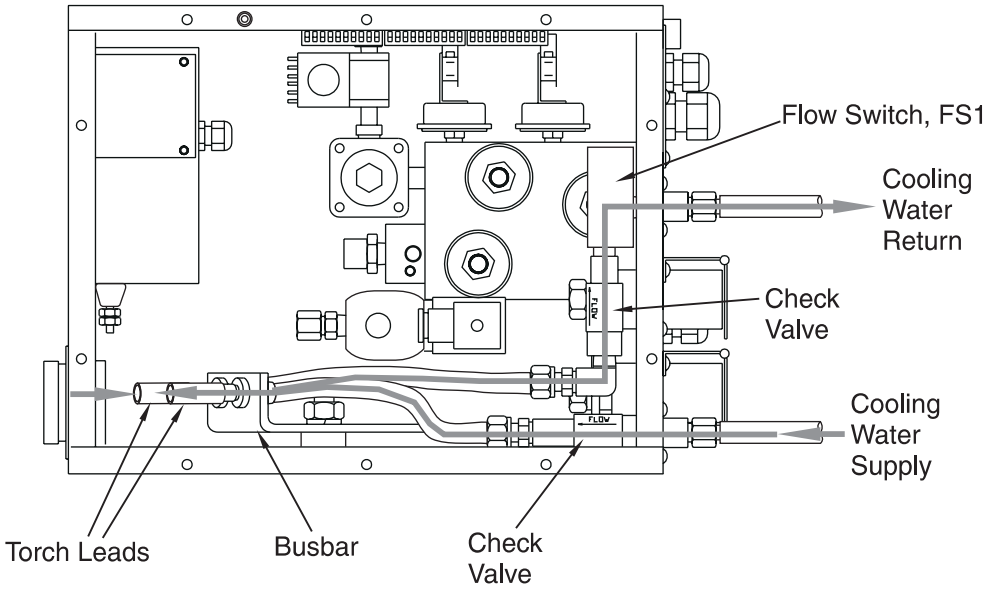
Secondary Shield Gas Control Diagram

6.2.4 Cooling Water Circuit

The cooling water circuit consists of two reverse flow check valves and a flow switch.

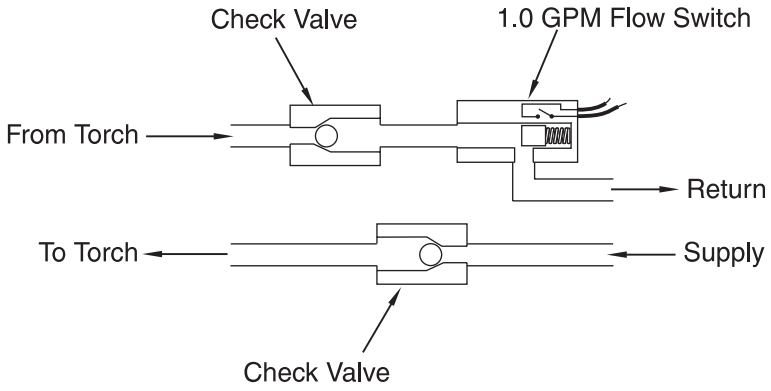
The cooling water circuit is a closed loop recirculating system which cools the electrode and torch body of the PT-15XL, or cools the electrode, nozzle, nozzle retaining cup, and torch body of the PT-19XL. The primary concern of the cooling water system is the flow rate. Insufficient cooling water flow results in insufficient cooling of the electrode and/or nozzle. The result can be catastrophic damage to the consumables and torch body. The reverse flow check valves prevent the cooling water system from draining when the consumables are removed, and prevent the system from functioning if the cooling water hoses are connected improperly The flow switch is calibrated to close at or above a flow rate of 1.0 gallons per minute, and is located in the cooling water return line so that it indicates actual flow through the torch. The switch is wired as an input to the CNC so that the system can be shut down if cooling water flow falls below this threshold.

The illustration below shows the location of the cooling water circuit components in the plumbing box, and indicates the cooling water flow path through those components.



Cooling Water Circuit Components

The diagram below shows a schematic of the cooling water circuit.



Cooling Water Circuit Diagram

6.3 Maintenance Procedures

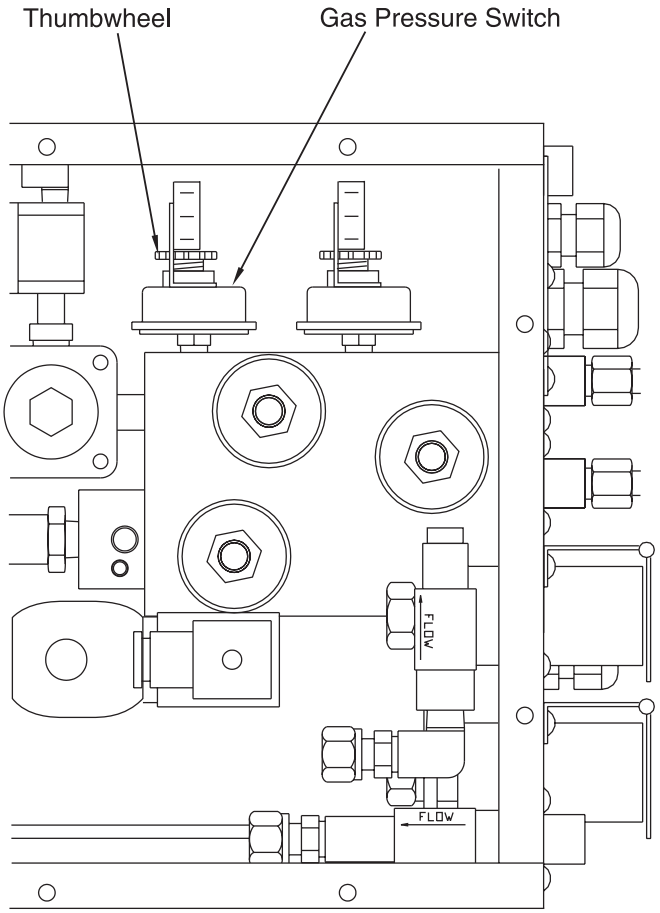
6.3.1 Introduction

The following section contains maintenance procedures for many of the systems and devices used in the SmartFlow Plumbing Box. These procedures are for use by qualified maintenance personnel. These procedures are intended to give sufficient detail to allow maintenance personnel to maintain the system.

⚠ WARNING

Electrical Shock Can Kill You! Always turn off power to the plasma power supplies before opening or servicing the plasma plumbing box.

6.3.2 Gas Pressure Switch



The gas pressure switch monitors the pressure of plasma gas supply to the plumbing box. The switch is wired as an input to the numerical control. Logic codes in the control look for a change of state of the input signal, therefore the switch can not be jumpered out of the circuit. The gas pressure switch should be set to close at 50 PSI.

To adjust the gas pressure switch:

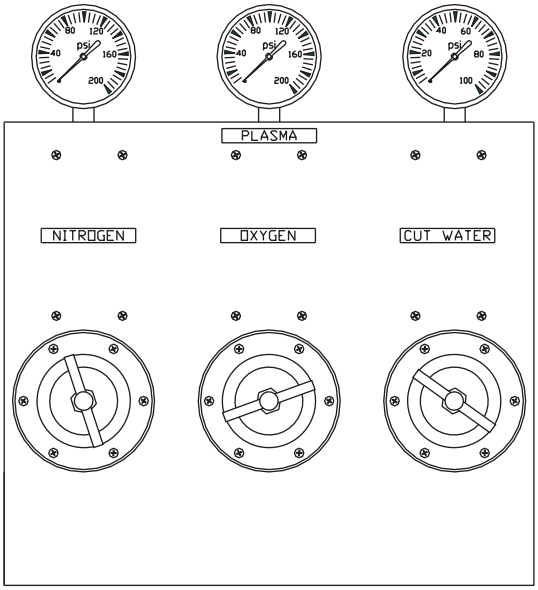
1. Switch OFF all power to the Plasma Power Supply.

⚠ WARNING

Electrical Shock Can Kill You! Always turn off power to the plasma power supplies before opening or servicing the plasma plumbing box.

2. Set a voltmeter to read 24 Volts DC. Install the volt meter across the terminals of the gas pressure switch, or across P3 plug, terminals 7 and 10. Refer to the schematics in this section. The voltmeter should read 24 Volts DC when the switch is open, 0 Volts when the switch is closed.

3. Turn ON the Plasma Test Mode. The start gas solenoid valve will open allowing start gas to preflow through the torch.



4. Observe the pressure at the nitrogen supply regulator on the plasma regulator panel.

5. Adjust the nitrogen pressure regulator until the gauge reads 40 PSI. The pressure switch should be open.

6. Slowly turn in the nitrogen pressure regulator until the gauge reads 50 PSI. The switch should close at 50 PSI.

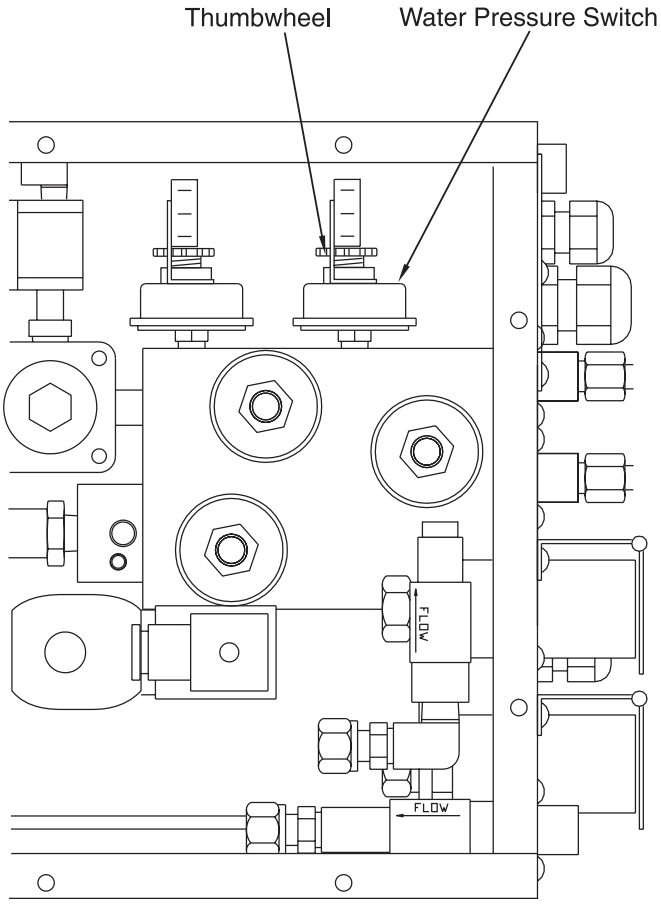
7. Adjust the thumbwheel on the pressure switch as necessary to make the switch close at 50 PSI.

8. Turn OFF the Plasma Test Mode.

9. Remove the volt meter from the plumbing box.

10. Readjust the nitrogen pressure regulator to 100 PSI.

6.3.3 Water Pressure Switch



The water pressure switch monitors the pressure of the plasma cut water supply to the plumbing box. The switch is wired as an input to the numerical control. Logic codes in the control look for a change of state of the input signal, therefore the switch can not be jumpered out of the circuit. The water pressure switch should be set to close at 50 PSI.

To adjust the gas pressure switch:

1. Switch OFF all power to the Plasma Power Supply.

WARNING

Electrical Shock Can Kill You! Always turn off power to the plasma power supplies before opening or servicing the plasma plumbing box.

2. Set a voltmeter to read 24 Volts DC. Install the volt meter across the terminals of the gas pressure switch, or across P3 plug, terminals 8 and 10. Refer to the schematics in this section. The voltmeter should read 24 Volts DC when the switch is open, 0 Volts when the switch is closed.

3. Turn ON the Plasma Test Mode. The cut water solenoid valve will open allowing cut water to preflow through the torch.

4. Adjust the cut water pump pressure down to 40 PSI. The pressure switch should be closed.

5. Slowly increase the cut water pump pressure to 50 PSI. The switch should close at 50 PSI.

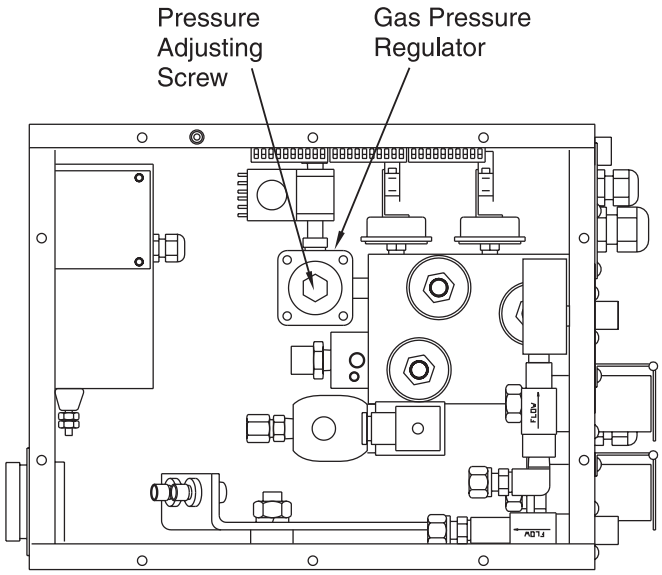
6. Adjust the thumbwheel on the pressure switch as necessary to make the switch close at 50 PSI.

7. Turn OFF the Plasma Test Mode.

8. Remove the volt meter from the plumbing box.

9. Readjust the cut water pump pressure regulator to 120 PSI.

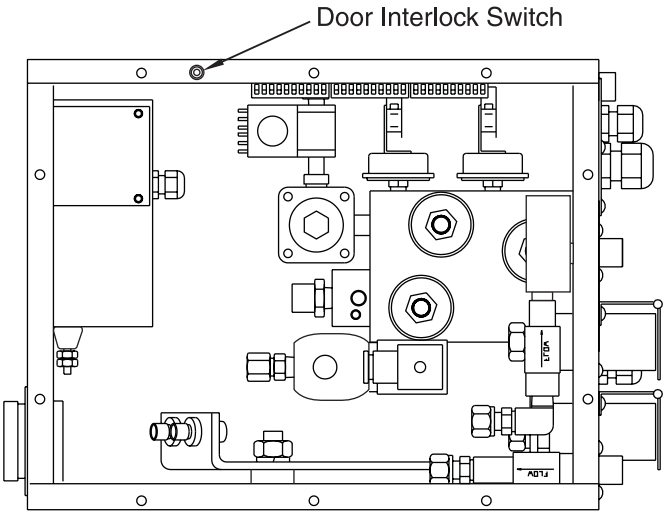
6.3.4 Gas Regulator



The gas regulator is mounted to the output of the manifold assembly. It regulates the gas pressure input to the gas proportional valve. This ensures accurate gas delivery since the proportional valve always receives the same input pressure. The proportional valve is rated for inputs up to 90 PSI. Therefore, the gas regulator is adjusted to deliver 80 PSI. This regulator is factory preset and should not be adjusted in the field, unless the regulator must be replaced.

To set the gas regulator pressure, the plumbing box gas output must be restricted. Use the torch nozzle with the smallest available orifice size. Partially plug the orifice if necessary so that only a small amount of gas will leak. Turn out the pressure adjusting screw on the regulator. Turn on the cut gas and slowly turn in the pressure adjusting screw on the regulator. Adjust the regulator until a pressure of 80 PSI is achieved on the plumbing box pressure gauge. Replace the torch nozzle.

6.3.5 Interlock Switch

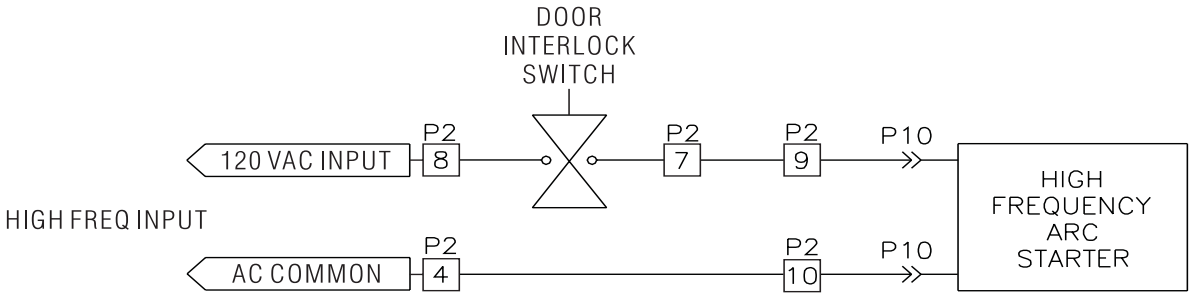


The Door Interlock Switch is mounted to the top of the plumbing box, and is positioned to actuate when the cover is installed. This switch has three positions: open, closed, and defeated. When the plumbing box cover is installed, it depresses the switch plunger, closing the switch. When the plumbing box cover is removed, the plunger is released, and the switch returns to the open position. The plunger may also be manually pulled out, where it locks in the defeated position. In this position the switch contacts are closed. The defeated position should only be used during service by qualified technicians.

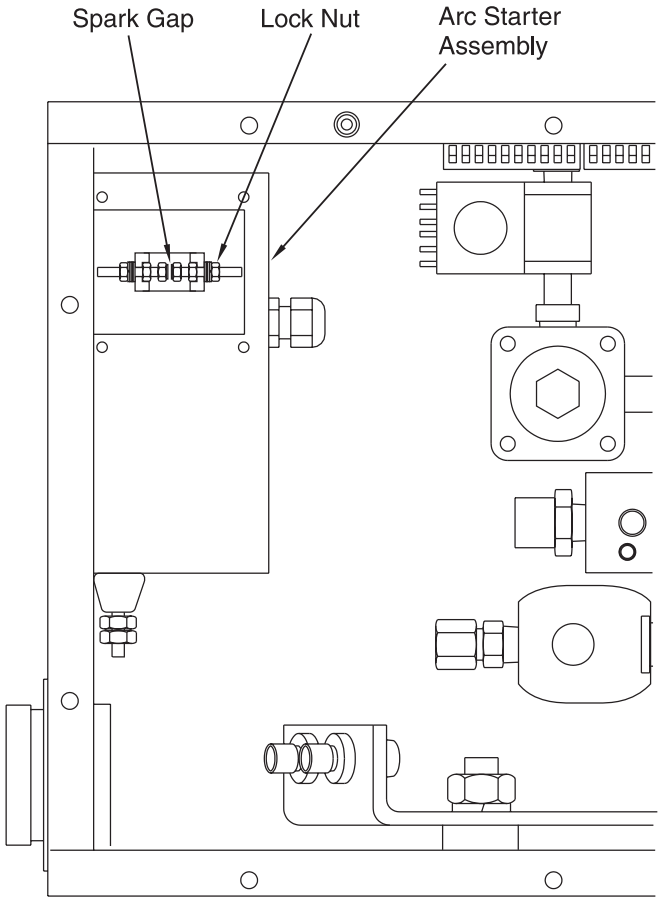
⚠ WARNING

Electrical Shock Can Kill You! The Door Interlock Switch should only be defeated by a qualified service technician. High Voltage, High Frequency .electricity can be generated when the Door Interlock Switch is defeated.

The Door Interlock Switch is wired in series with the High Frequency Arc Starter, as shown below. When the switch is open, the 120 VAC input to the arc starter is disconnected. When the switch is either closed or defeated, the arc starter will generate high frequency when the 120 VAC input is supplied.



Spark Gap



The SmartFlow plumbing box uses a high frequency arc starter to initiate the plasma arc within the cutting torch. The arc starter box is mounted in the upper left hand corner of the plumbing box, and contains an adjustable spark gap.

The spark gap forms one component of an L-C tank circuit. A capacitor discharges across the spark gap to create a high frequency signal which is then coupled to the torch nozzle through the pilot arc cable.

The spark gap setting is a compromise between reliable firing and high frequency electrical noise. As the spark gap setting is increased, more energy is coupled to the torch, which results in more reliable firing, and creates more high frequency noise. As the spark gap setting is decreased, less electrical noise is generated, but a point may be reached where the torch will not fire reliably. The spark gap in the SmartFlow plumbing box should be adjusted to .060 inches.

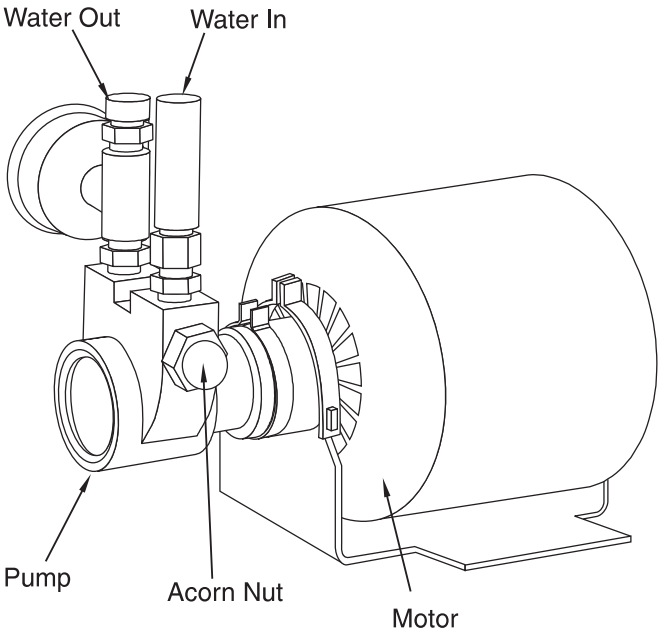
Adjustment Procedure

WARNING

Electrical Shock Can Kill You! Always turn off power to the plasma power supplies before opening or servicing the plasma plumbing box.

1. Remove the cover from the plumbing box.
2. Remove the cover from the arc starter box.
3. Use a feeler gauge to measure the spark gap setting.
4. If adjustment is required, loosen the locknut on one of the spark gap electrodes.
5. Turn the hex head on the electrode as necessary to increase or decrease the spark gap, then lock in place with the lock nut.

6.3.6 Cut Water Pressure

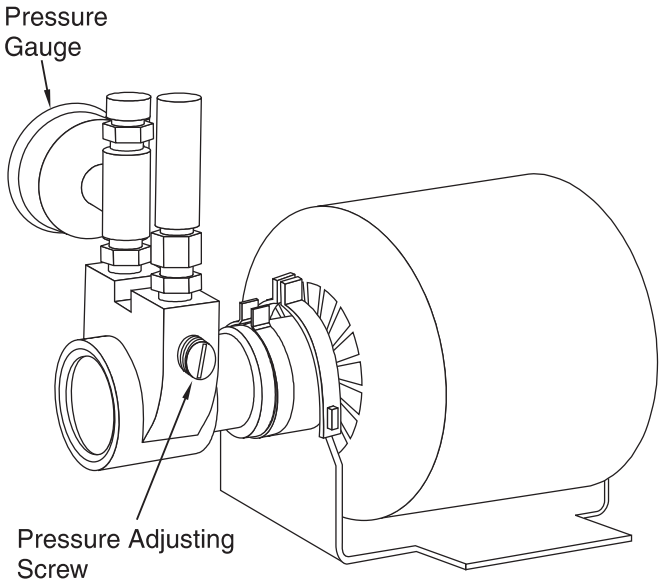


The cut water system uses a carbonator pump with bypass type pressure regulation to supply high pressure water to the plumbing box. This pump requires at least 25 PSI input to prevent cavitating, and should be adjusted to deliver 120 PSI output. Output pressure is adjusted by turning the pressure adjusting screw on the pump body, which is located beneath an acorn nut.

Adjustment Procedure

1. Remove the acorn nut with an adjustable wrench.

2. Turn ON the Plasma Test Mode. The cut water pump will energize, and the cut water solenoid will open, allowing cut water to preflow through the torch.



3. Using a screwdriver, turn the pressure adjusting screw until the pressure gauge reads 120 PSI.

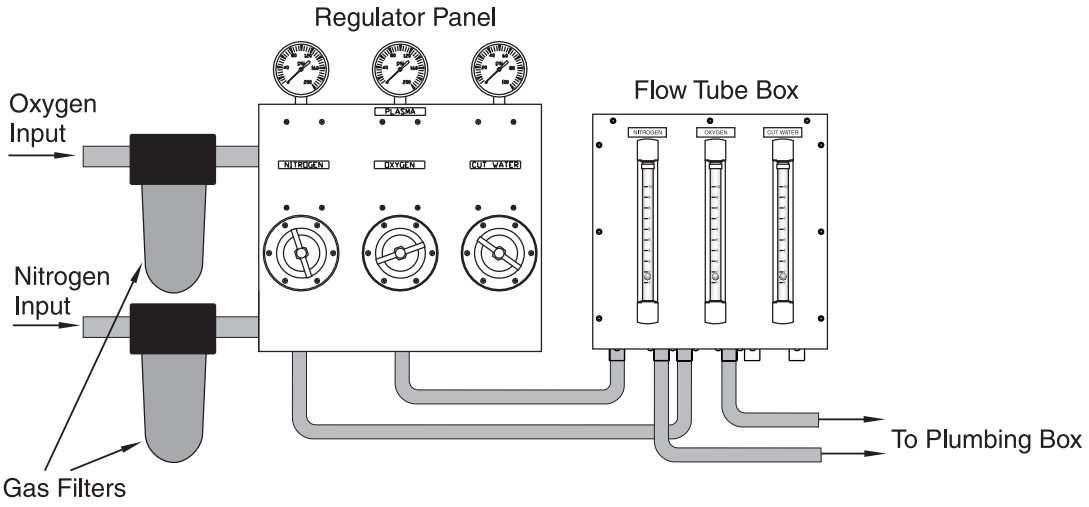
4. Reinstall the acorn nut, then recheck the pressure setting.

5. Turn OFF the Plasma Test Mode.

6.3.7 Gas Filters

The nitrogen and oxygen gas supplies must be filtered before entering the plumbing box. When using a PT-19XL with secondary shield, the air supply must also be filtered. Check these filters regularly and replace the filter element when necessary. Unfiltered gas supplied to the plumbing box will result in clogging of the proportional valves or other plumbing box components.

The gas filters should be installed in the gas supply lines prior to the Gas Regulator Panel, as shown below. Use a 5 micron filter.



6.3.8 Gas Proportional Valve

The gas proportional valve controls the flow of gas to the plasma torch. The same valve is used to regulate both start gas and cut gas. The Vision CNC outputs an analog DC voltage signal between 0 and 10 volts representing the desired gas flow rate. The proportional valve is fully open for a signal of 10 volts, fully closed at 0 volts.

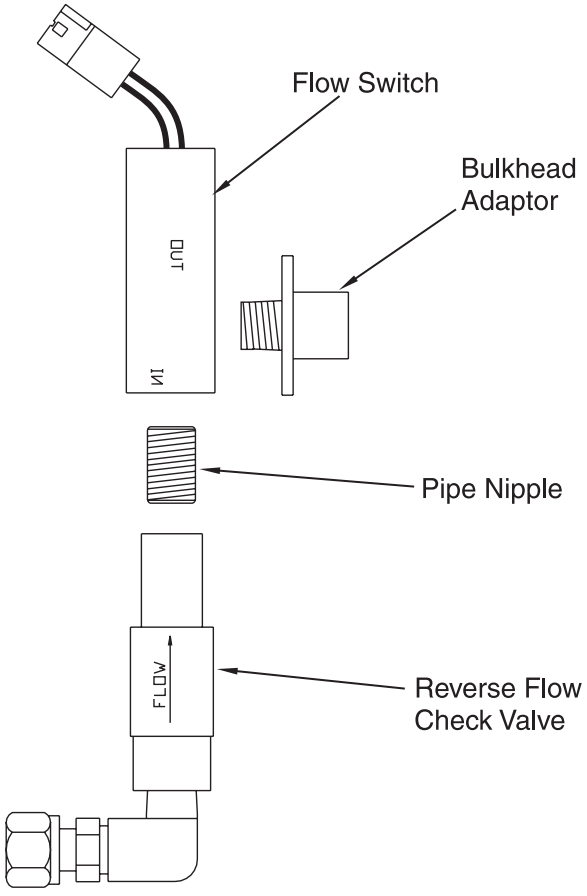
The gas proportional valve contains no user servicable parts. In case of failure, the valve should be replaced or returned to ESAB for repair.

6.3.9 Water Proportional Valve

When the SmartFlow plumbing box is used with a PT-15XL torch, the water proportional valve controls the flow of cut water. When the SmartFlow plumbing box is used in conjunction with a PT-19XL torch, the water proportional valve may be used ton control shield air. The Vision CNC outputs an analog DC voltage signal between 0 and 10 volts representing the desired water flow rate. The proportional valve is fully open for a signal of 10 volts, fully closed at 0 volts.

The water proportional valve contains no user servicable parts. In case of failure, the valve should be replaced or returned to ESAB for repair.

6.3.10 Cooling Water Flow Switch



The cooling water circuit uses a 1.0 gallon per minute flow switch to monitor cooling water flow. This flow switch is located in the cooling water return line, so that it indicates actual flow through the torch. The flow switch is wired as an input to the numerical, which looks for a change of state of the input signal when the plasma station is turned on. Therefore the switch input cannot be jumpered out of the circuit.

Cooling water flow problems may fall into one of the following categories:

1. Insufficient flow due to a restriction in the cooling water circuit.

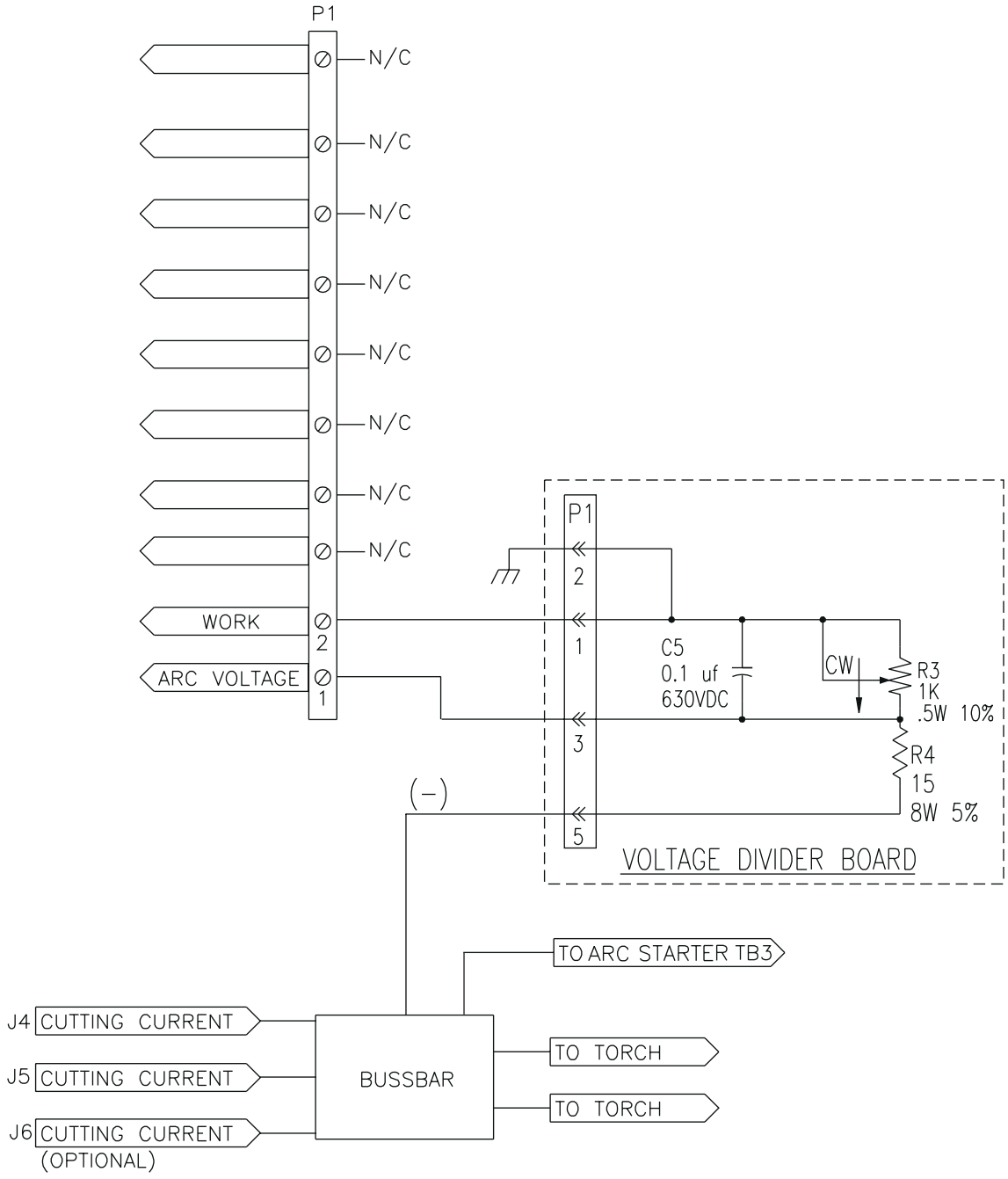
   If a cooling water flow restriction is traced to the flow switch, the switch may be disassembled and cleaned, or it may be replaced.

2. Sufficient flow but no flow switch closure.

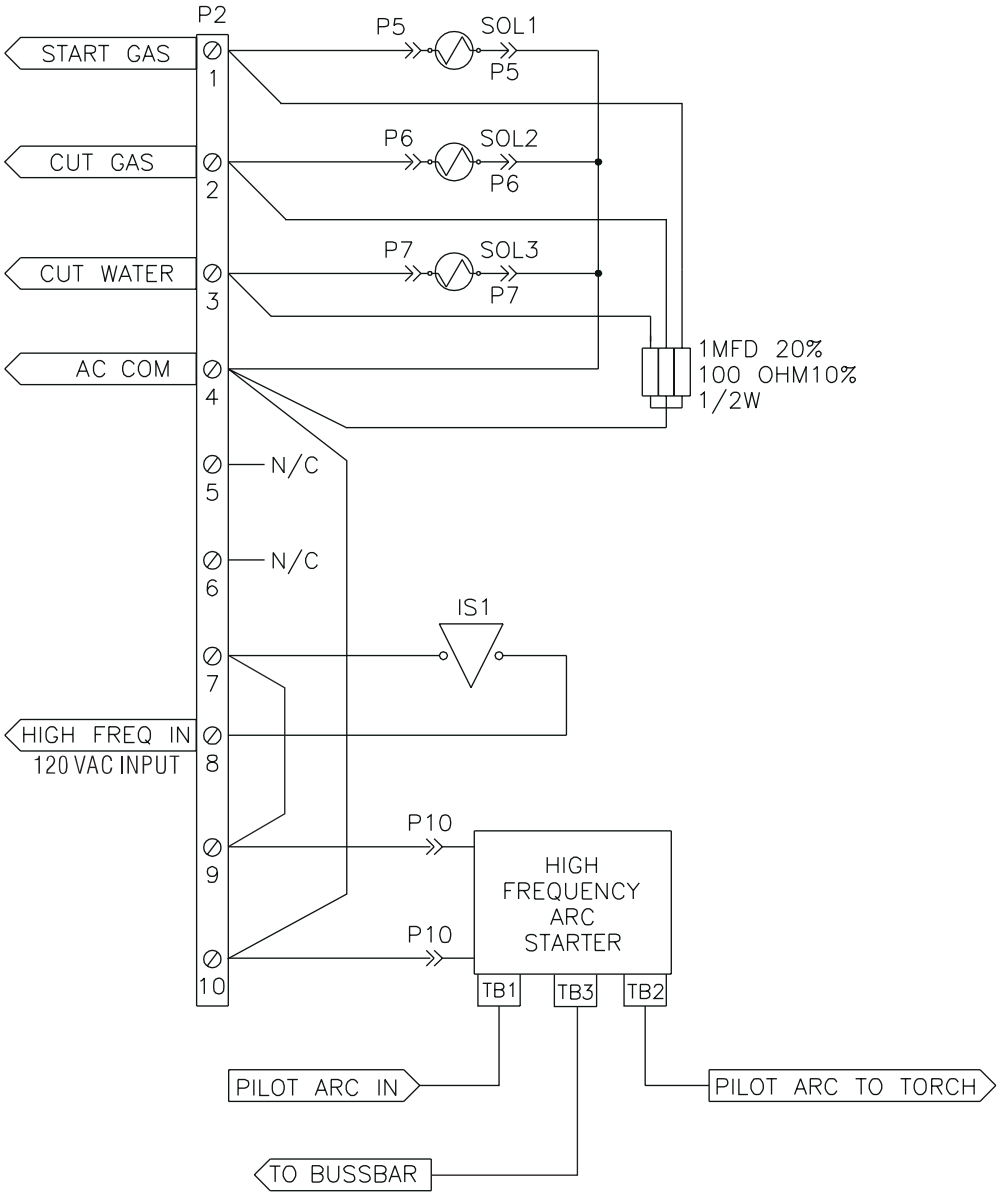
   If measurement of the actual cooling water flow rate indicates more than 1.0 gallons per minute, but the flow switch does not close, then the switch may be damaged or clogged. If disassembly and cleaning does not remedy the situation, then the switch must be replaced.

6.4 Schematics

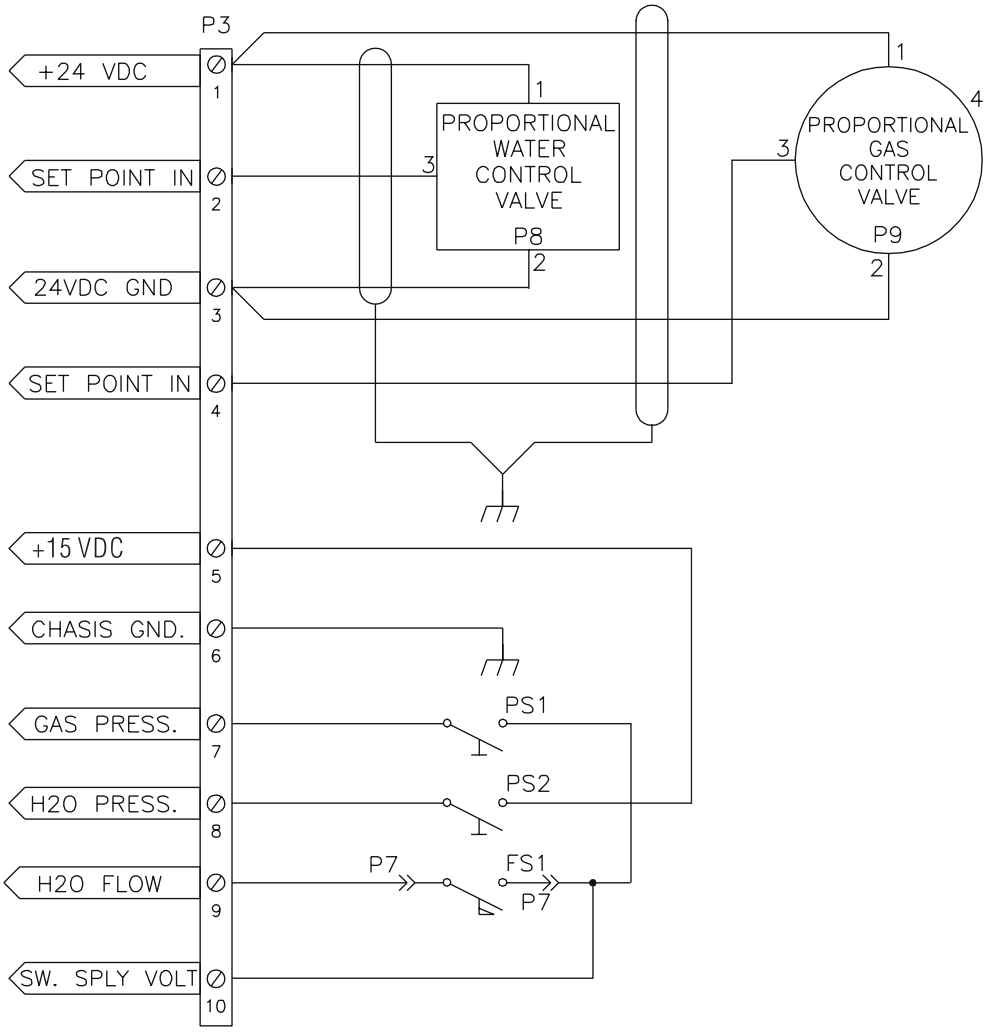
The schematic below shows the electrical connections internal to the flow control box. The schematics are based on the three plug in connectors, located in the top of the box. All of the electrical components are wired to those connectors, where they connect to interface cables from the CNC.


P1
N/C
N/C
N/C
N/C
N/C
N/C
N/C
N/C
WORK
2
ARC VOLTAGE
1
P1
2
1
3
5
C5
0.1 uf
630VDC
CW
R3
1K
.5W 10%
R4
15
8W 5%
VOLTAGE DIVIDER BOARD
(-)
TO ARC STARTER TB3
J4 CUTTING CURRENT
J5 CUTTING CURRENT
J6 CUTTING CURRENT
(OPTIONAL)
BUSSBAR
TO TORCH
TO TORCH

P1 Wiring


P2
START GAS
CUT GAS
CUT WATER
AC COM
1
2
3
4
5
6
7
8
9
10
P5
SOL1
P5
P6
SOL2
P6
P7
SOL3
P7
1MFD 20%
100 OHM10%
1/2W
N/C
N/C
IS1
HIGH FREQ IN
120 VAC INPUT
P10
P10
HIGH
FREQUENCY
ARC
STARTER
TB1
TB3
TB2
PILOT ARC IN
PILOT ARC TO TORCH
TO BUSSBAR

P2 Wiring


P3
+24 VDC
1
SET POINT IN
2
24VDC GND
3
SET POINT IN
4
+15 VDC
5
CHASIS GND.
6
GAS PRESS.
7
H2O PRESS.
8
H2O FLOW
9
SW. SPLY VOLT
10
PROPORTIONAL WATER CONTROL VALVE
P8
PROPORTIONAL GAS CONTROL VALVE
P9
PS1
PS2
P7
FS1
P7

P3 Wiring

6.5 Troubleshooting

The following error messages are associated with the SmartFlow Plasma System, and will appear on screen at the Vision CNC.

PLASMA STATION n CUT WATER PRESSURE

This error is generated if the Cut Water Pressure switch input is in the wrong state. When controlling a PT-19XL torch's secondary shield, the Cut Water Pressure switch monitors shield air pressure.

The CNC watches this input for a change of state, from the off condition to the on condition when the cut water solenoid valve is energized. An error is generated if the input is on when it should be off, or if the input is off when it should be on.

If this error message appears, check the following:

1. Check the cut water pump, it should be adjusted to deliver 120 PSI when pumping.

2. Check the appropriate BITI at the Vision CNC. It should turn on and off with the cut water.

PLASMA STATION n CUT GAS PRESSURE

This error is generated if the Cut Gas Pressure switch input is in the wrong state. This pressure switch is actuated by start gas during the start gas sequence, then by cut gas during cutting.

The CNC watches this input for a change of state, from the off condition to the on condition when one of the gas solenoid valves is energized. An error is generated if the input is on when it should be off, or if the input is off when it should be on.

If this error message appears, check the following:

1. Check the Nitrogen and Oxygen supply pressures at the regulator panel. They should be adjusted to deliver 120 PSI to the plumbing box.

2. Check the appropriate EPEP at the Vision CNC. It should turn on and off with the gas flow.

PLASMA STATION n COOLING WATER FLOW

This error is generated when the Cooling Water Flow Switch input is in the wrong state. The Cooling Water Flow Switch is in the return line of the cooling water circuit, and is calibrated to close at or above 1.0 gallons per minute of flow.

The CNC watches this input for a change of state from the off condition to the on condition when the plasma station is turned on. An error is generated if the input is on when it should be off, or if the input is off when it should be on.

If this error message appears, check the following:

1. Make sure the Water Cooler is turned on.

2. Check the cooling water recirculator pump. It should be adjusted to deliver 150 PSI.

3. Check the plasma consumables.

PLASMA STATION n DID NOT FIRE

This error is generated all inputs from the plumbing box are correct, but the torch still does not fire. The CNC monitors the Arc On input from the plasma power supply to determine if the arc has transferred. If the CNC completes a firing sequence, including energizing the high freq. arc starter, but does not receive an Arc On input, then this message is generated.

If this error message appears, check the following:

1. Check the torch consumables for wear or damage.

2. Open the spark gap cover on the High Freq. Arc Starter and observe the spark gap while firing the torch. Verify that a spark is being generated in the spark gap. Make sure that the interlock switch in the plumbing box is pulled out, in the bypass position.

7 Replacement Parts

7.1 General Information

This section provides replacement parts information and will assist the service/repair person when performing maintenance on the system.

The four column parts list for each figure is arranged to show the assembly relationship of parts and subassemblies. Information given in each of these columns is as follows:

Column 1, ITEM: Lists each index number found on the illustration. When no index number is given for a part or assembly, it is not illustrated separately in the illustration, but its name and description provide identification.

Column 2, PART #: Gives the ESAB part number of the part or assembly to which the index number has been assigned. Common hardware items or other parts readily available for commercial sources have not been included. Parts purchased by ESAB from vendors are listed by ESAB part numbers. Hardware is specified as items in our parts lists but it normally carries no ESAB part number.

Column 3, QUANTITY: Indicates the quantity of that part used in that assembly. This quantity number is not to be used as a recommended quantity of spare parts. The customer must determined how many parts are to be purchased as spare parts.

Column 4, DESCRIPTION: Gives the name of the part or assembly, as well as other information which will be helpful in identifying it.

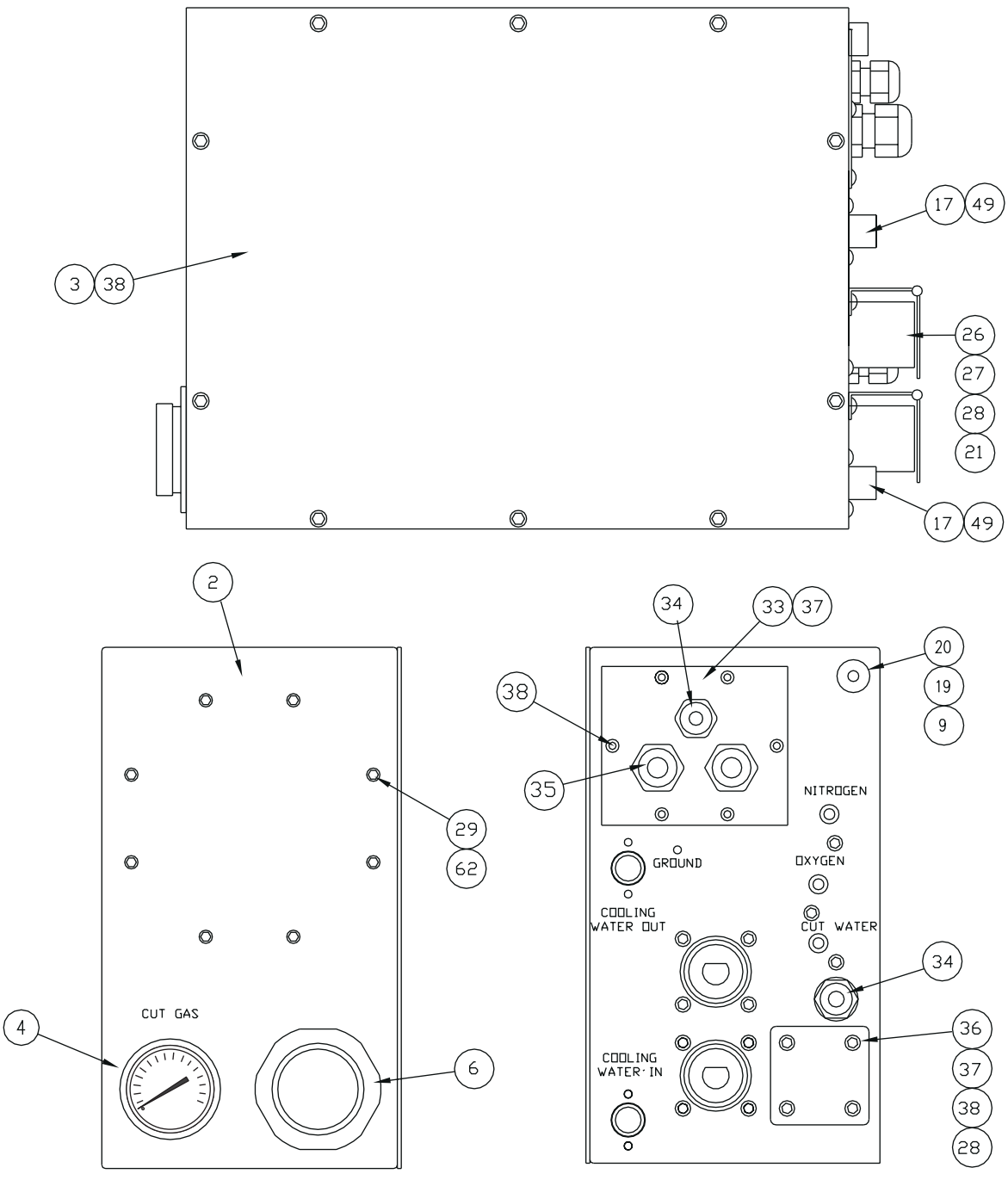
7.2 Ordering Information

When ordering replacement parts, order by part number and complete description of the part as given in the description column of the list. In addition, give the model number of the machine and the machine serial number. Address all inquiries to your local ESAB Distributor or to ESAB Cutting Systems, P.O. Box 100545, Florence, South Carolina, 29501.

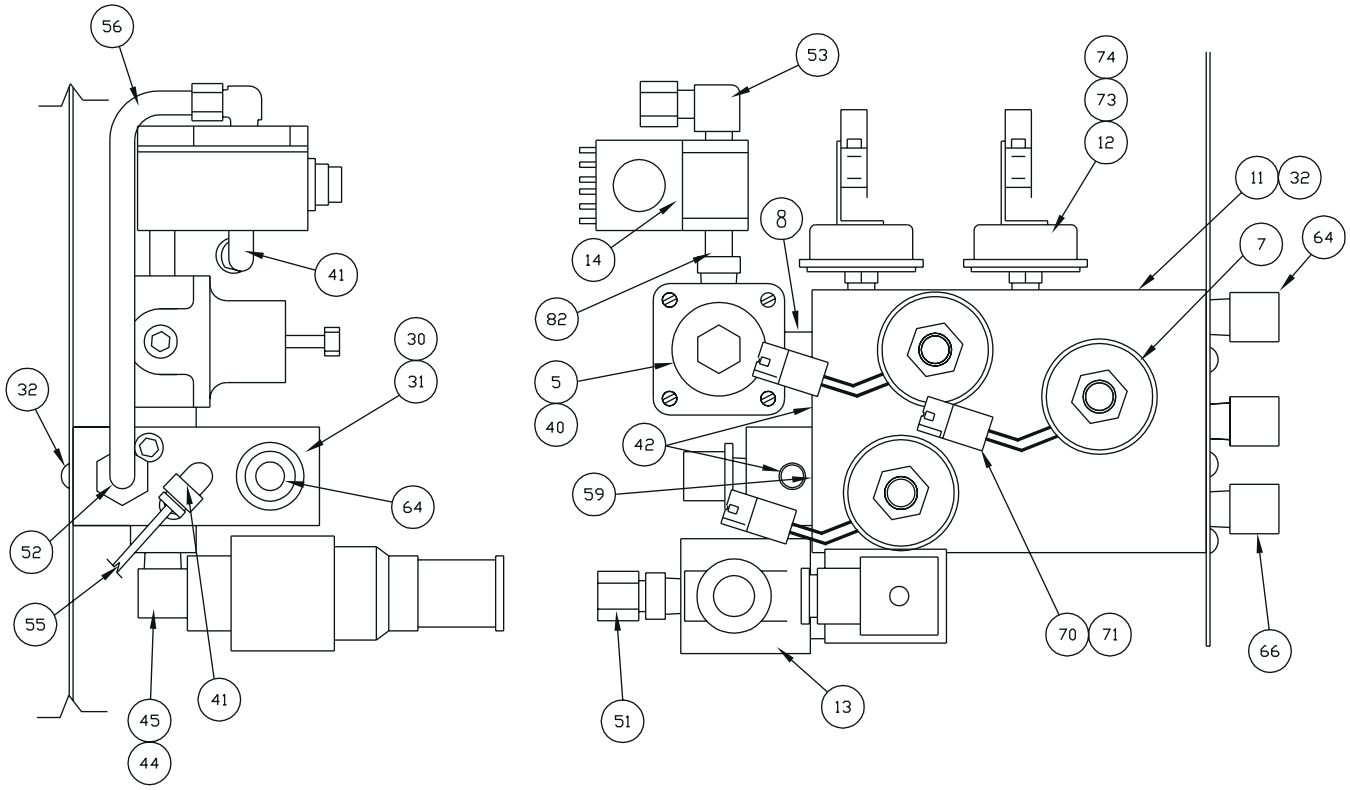
⚠ NOTE

This manual may contain illustrations of parts not applicable to your specific system. Be sure to positively identify the correct assembly before ordering replacement parts to avoid unnecessary delays.

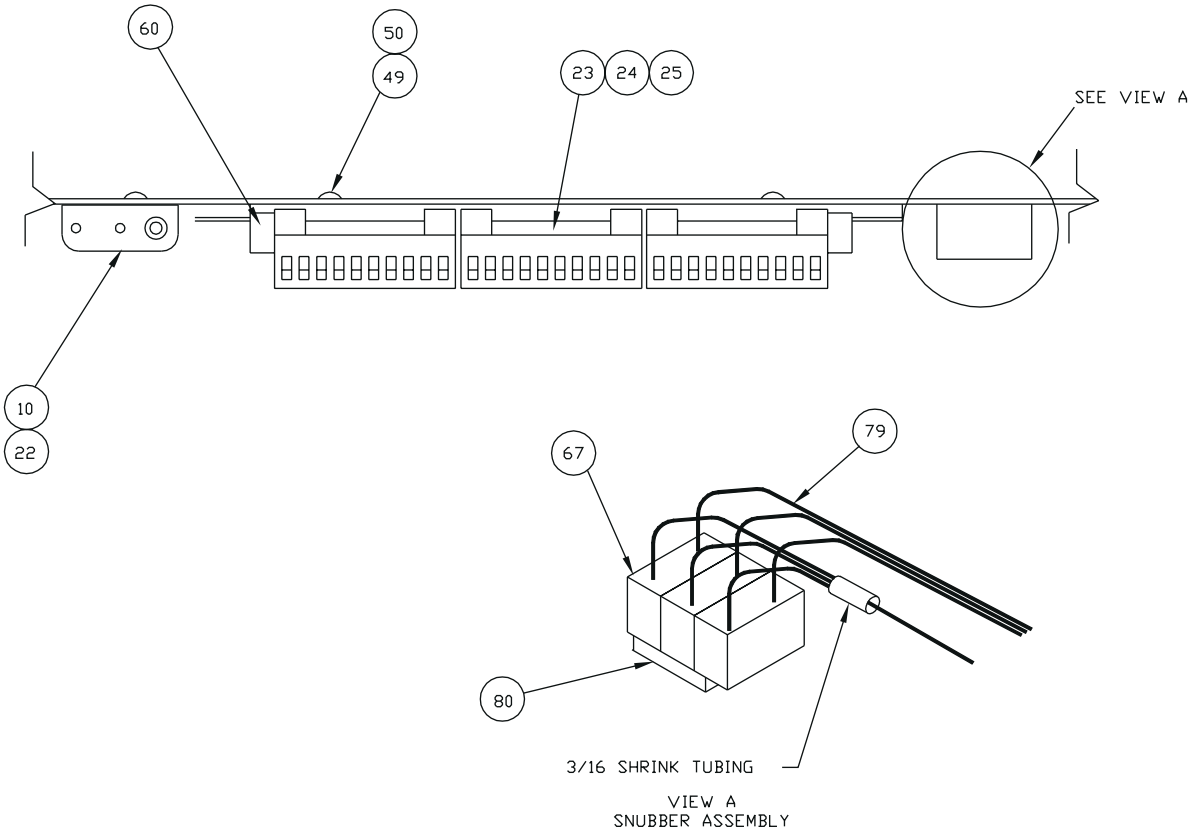
7.3 SmartFlow Plasma Flow Control



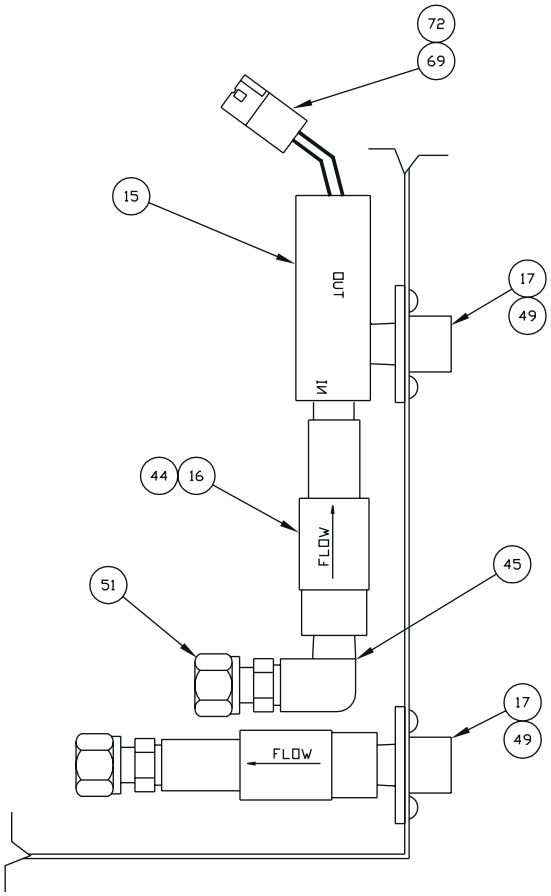
Valve and Pressure Switch Assembly



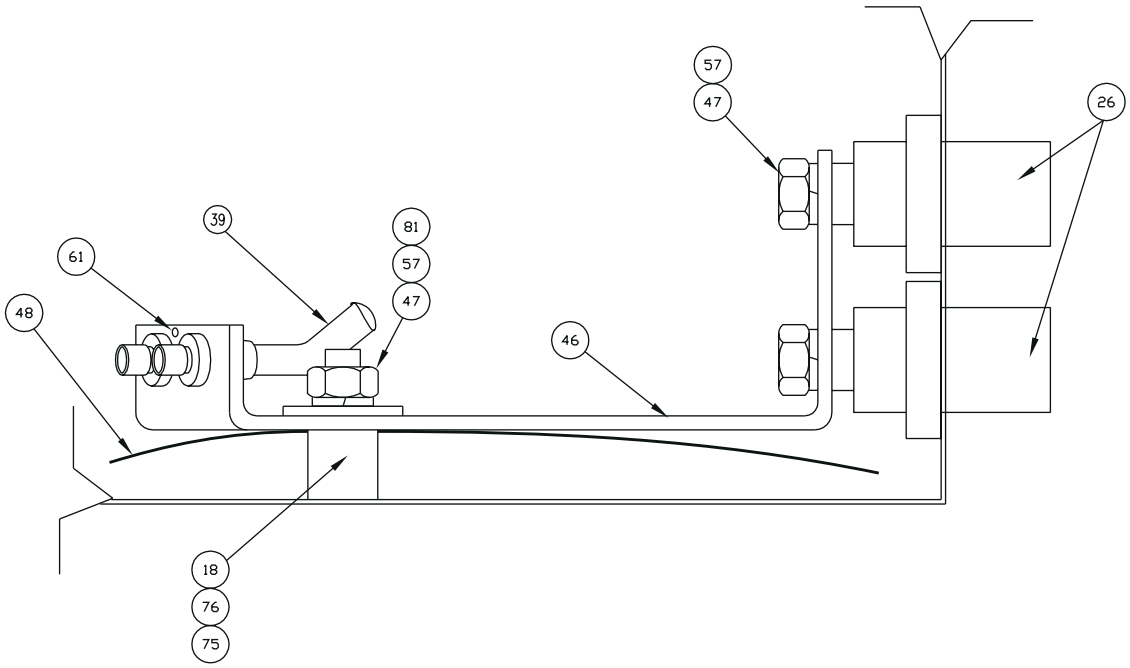
Connector Assembly



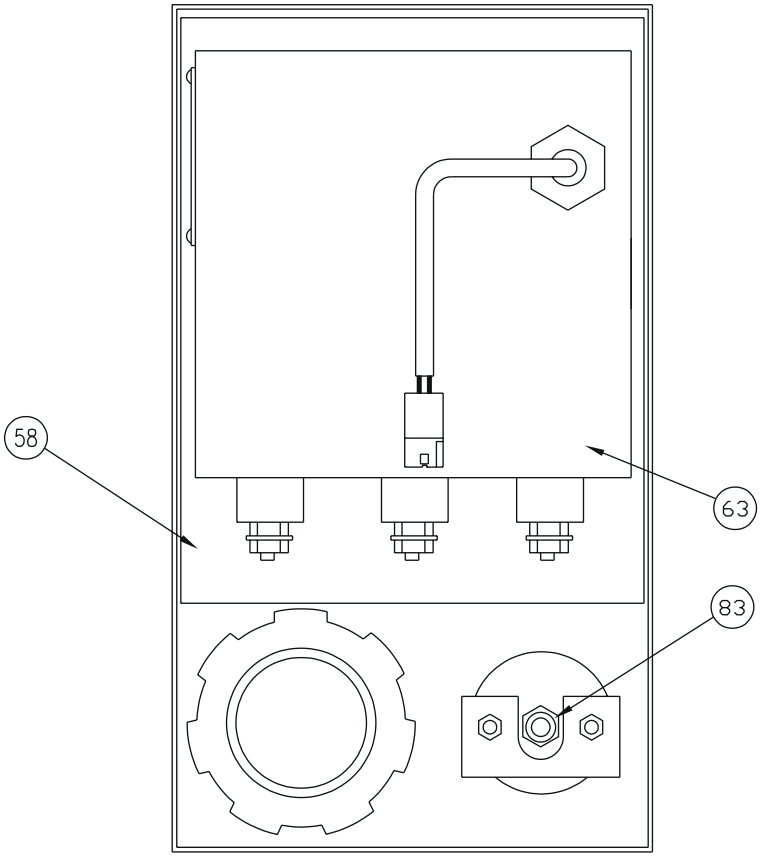
Cooling Water Connections



Buss Bar Connections



Front Panel Assembly



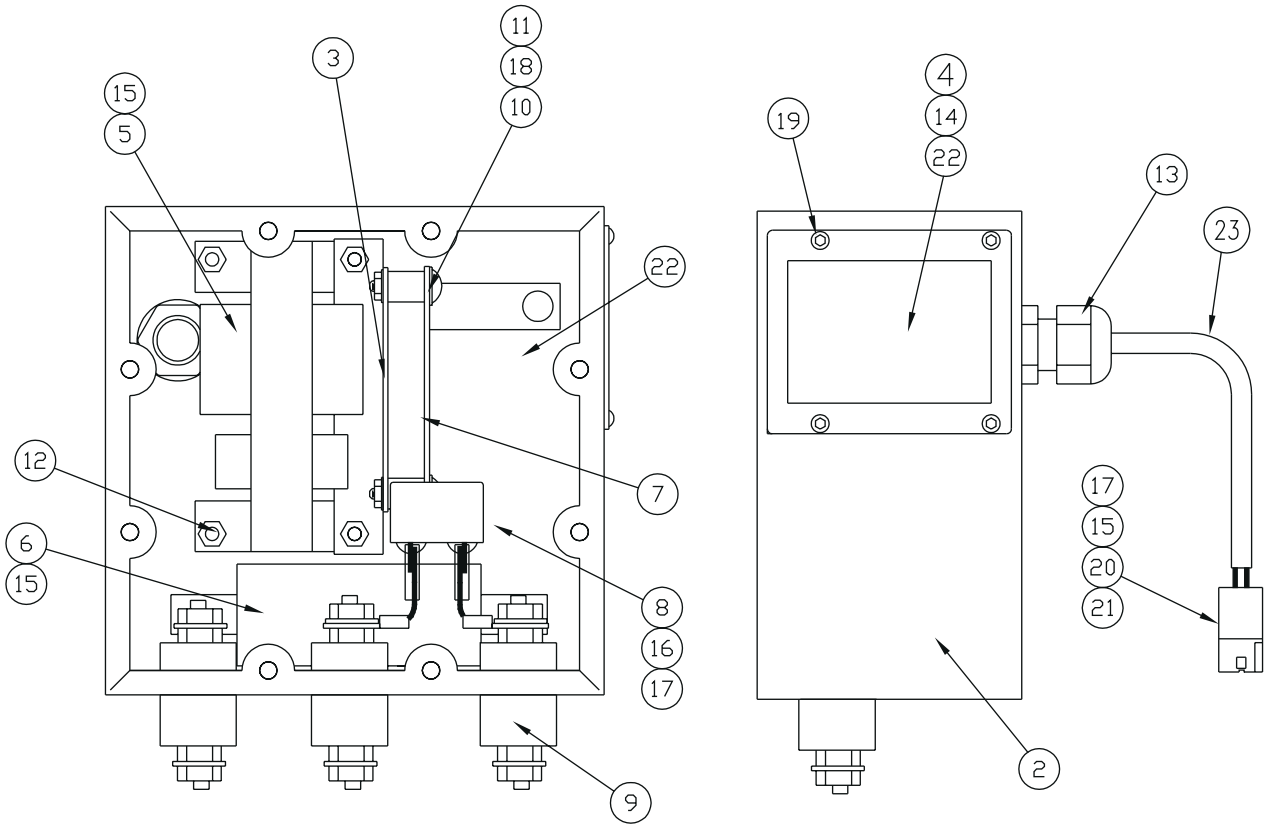
Item	Part #	Qty	Description
1			Flow Control Assembly
2	56997191	1	Enclosure
3	56997190	1	Cover
4	56998131	1	Pressure Gauge, 0-100 PSI, 2” Dia
5	56998130	1	Regulator, 0-160 PSI, 1/8 NPT
6	33053	1	Torch Connector
7	56998134	3	Solenoid Valve
8	11NZ04	1	Fitting, 1/4 x 1/4 NPTM
9	56997206	1	Exhaust Muffler, 1/8 NPT
10	2078865	1	Door Interlock Switch
11	56997189	1	Manifold Block
12	951982	2	Pressure Switch, 150 PSI
13	56997044	1	Proportional Valve, Cut Water/Shield gas
14	56995748	1	Proportional Valve, Gas

15	636383	1	Cooling Water Flow Switch
16	21124	2	Check Valve
17	58V75	2	Bulkhead Fitting
18	674156	1	Bussbar Standoff
19	98W18	1	O-ring
20	44151300	1	Coupling, 1/8 NPT
21	2062311	2	Safety Cap
22		2	Screw, 6-32x3/16, button hd
23	2234268	1	DIN Rail
24	2234266	3	Connector Socket, 10 Position
25	2234267	3	Connector Plug, 10 Position
26	2062309	2	Male CamLok Receptacle
27		8	Screw, M5-.8x20 Button hd
28		12	Hex Nut, M5-.8 self lock
29		12	Screw, M4-.7x10mm button hd
30	56997186	1	Gas Manifold
31		2	Screw, M6-1x30mm socket hd
32		4	Screw, M6-1x16mm button hd
33	56997187	1	Service Entrance Plate
34		2	Strain Relief
35		2	Strain Relief
36	56997185	1	Blanking Cover
37	2234503	A/R	Gasket, EPDM PSA, 3/4 x .90
38		20	Screw, M5-.8x10mm button hd
39	34116	2	Cooling Water Hose Assembly
40		2	Close Nipple, 1/8 NPT Brass
41		2	Elbow, 1/8 NPTM x 1/8 Tube
42		2	Hex Plug, 1/8 NPT
44		1	Nipple, 1/4 NPT x 1-1/2 Brass
45		1	Street Elbow, 1/4 NPTM x 1/4 NPTF Brass
46	56997188	1	Bussbar Assembly
47		3	Hex Nut, 1/2-13
48	33039	1	Nomex Insulator
49		2	Screw, M4-.7 x8mm button hd
50		2	Hex Nut, M4-.7, self locking
51	10Z30	3	Cooling Water Fitting
52		1	Brass Fitting, 1/4 NPTM x 3/8 Tube
53		1	Brass Fitting, 1/8 NPTM x 3/8 Tube, 90
54		1	Fitting, 1/8 NPTM x 1/8 Tube, prestolock
55		A/R	Nylon Tubing, 1/8 O.D., Natural

56	01457226	A/R	Copper Tubing, 3/8 O.D. x .308 I.D.
57		3	Split Washer, 1/2
58	84600513	A/R	Nomex Sheet, 8.75W x 6.5L x 10 mil
59		1	Set Screw, 1/4-20 hex socket hd
60		2	End Bracket
61		1	Screw, 8-32x3/8 pan hd phillips
62		12	Washer, M4, internal tooth
63	56997180	1	Arc Starter Assembly
64	74S76	2	Start Gas Inlet Fitting
65	3389	1	Oxygen Inlet Fitting
66	11N16	1	Cut Water Inlet Fitting
67	2210514	3	R-C Network (Snubber)
68		4	Ring Terminal, #8 Stud 16AWG
69		4	Connector, 2 Position Plug
70		5	Connector, 2 Position Receptacle
71		10	Terminal Crimp Female, .093
72		8	Terminal Crimp Male, .093
73		2	Terminal Full Ins. Female, .25 18AWG
74		2	Terminal Full Ins. Female, .25 16AWG
75		2	Screw, 6-32 x 5/8 Pan Hd Phillips
76		2	Flat Washer
77		2	Crimp On Terminal /187 Female
79		A/R	Wire, #18AWG, 600V, 105 Deg C
80	71200732	A/R	DOW 732 RTV Clear Silicon
81		1	Flat Washer, 1/2
82		1	Adaptor Nipple, 1/4 NPT x 1/8 NPT
83		1	Fitting, 1/8 NPTF x 1/8 Tube Prestolok
84	38039	1	Voltage Divider Circuit Board
85	951570	4	Nylon Standoff, 6-32
86	2134208	4	Nylon Hex Nut, 6-32
87	75480012	1	Pressure Plug, 1/16 NPTM Brass

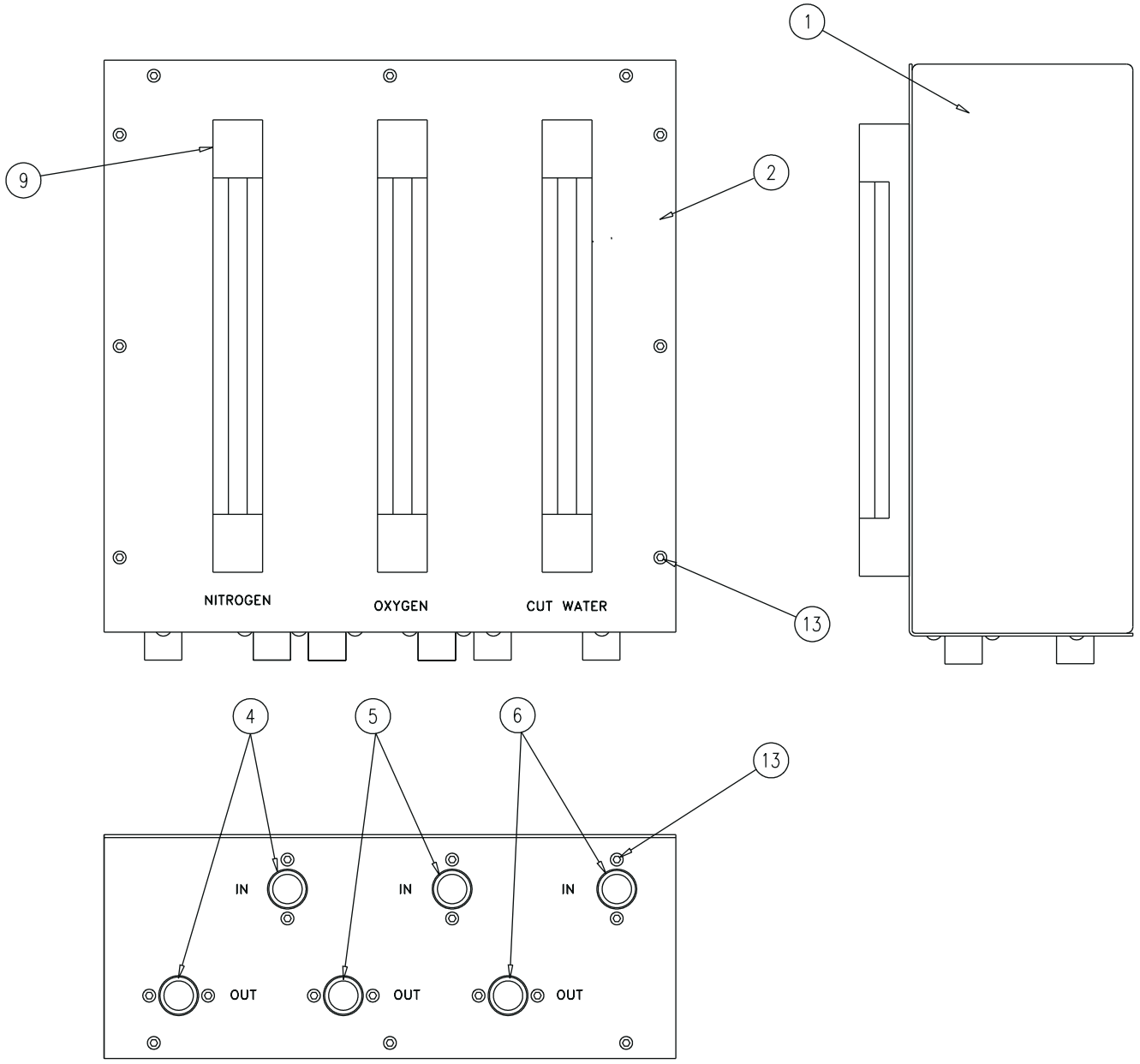
7.3.1 Arc Starter Box Assembly

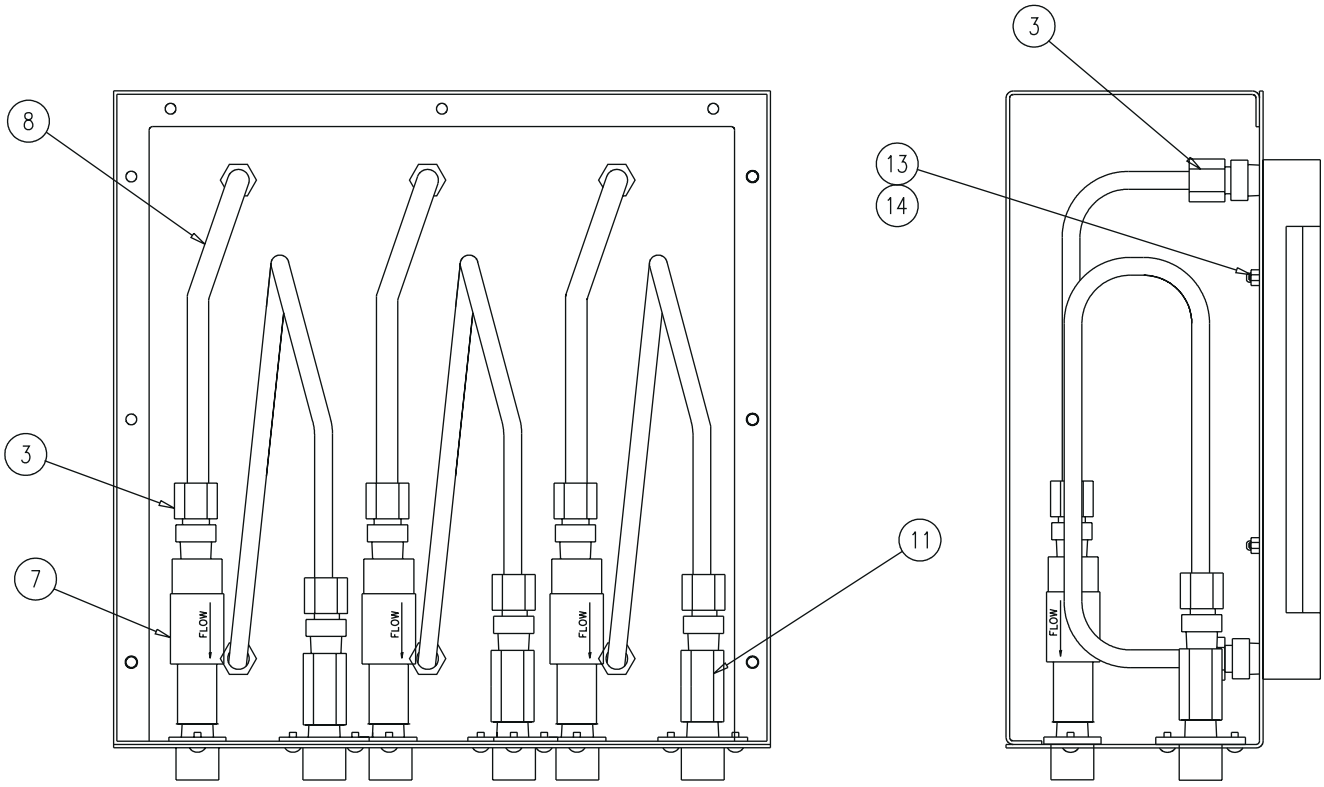
Assembly 56997180



Item	Part #	Qty	Description
1	56997180		High Frequency Arc Starter Assembly
2	56997179	1	Enclosure
3	56997178	1	PC Board Mounting Bracket
4	56997177	1	Access Cover
5	951179	1	Transformer
6	56997157	1	Choke
7	31490	1	High Frequency Circuit Board
8	2239157	1	Capacitor
9		3	High Voltage Feed Through
10		4	Unthreaded Spacer
11		4	Screw, 6-32x.75 pan hd
12		4	Hex Nut/Star Washer, 8-32
13		1	Strain Relief
14		A/R	EDPM Gasket, 3/4 x .090
15		10	Full Insulated Terminal, .25 Female
16		2	Terminal, 1/4 ring, #18-14 AWG
17		A/R	Wire, #18AWG 600V, black, 105º C.
18		5	Hex Nut/Star Washer, 6-32
19		4	Screw, M4-.7x8mm Button Hd
20		1	Connector Receptacle, 2 Position
21		2	Terminal Crimp .093 Fem #14-20AWG
22		1	Nomex Insulator, .10 Thick
23	90862534	A/R	Fiberglass Tubing, .204 ID

7.3.2 Flow Tube Box Assembly





Item	Part #	Qty	Description
1	56997181	1	Enclosure
2	56997182	1	Cover
3		12	Fitting, 1/4 NPTM x 3/8 Tube Gyrolock
4	58V58	2	Nitrogen Gas Bulkhead Fitting
5	679064	2	Oxygen Gas Bulkhead Fitting
6	58V75	2	Cut Water Bulkhead Fitting
7	821124	3	Check Valve
8	01457226	A/R	Copper Tubing, .38 OD x .308 ID
9	21898	3	Flowmeter Body
10	996854	1	Cut Water Float Ball
11		3	Brass Fitting, 1/4 NPTM
12		A/R	Teflon Tape
13		30	Screw, M4-.7x8mm Button Hd
14		6	Hex Nut, M4-.7, Nylon Self Lock
15	2132818	4	Hole Plug, .312, Nylon, Black

CUTTING SYSTEMS

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