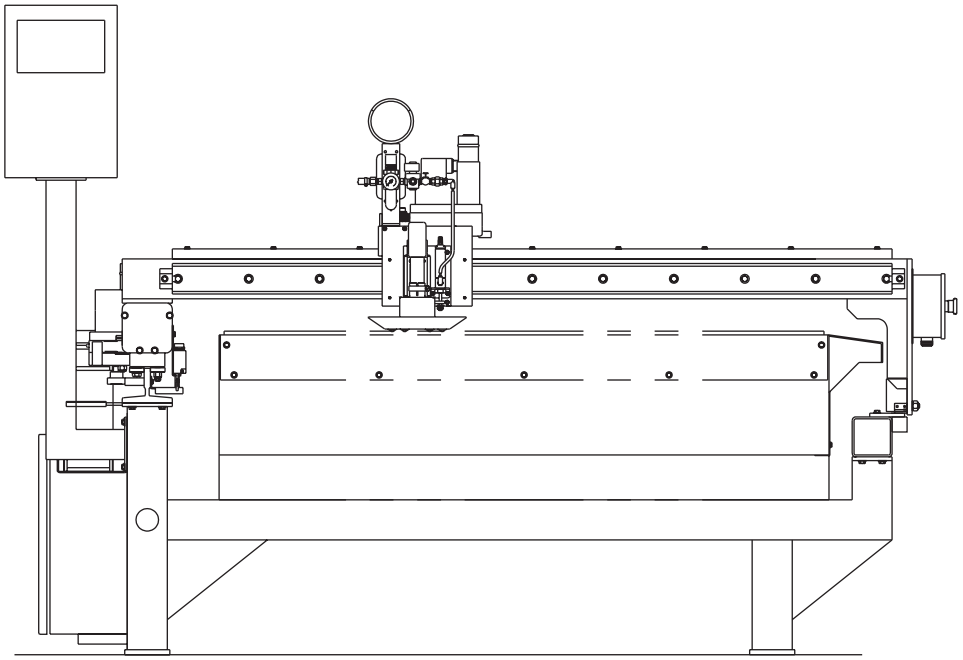
F14-503
June, 2003

Installation, Operation, and Maintenance Manual for the

Piecemaker 2

GANTRY SHAPE CUTTING MACHINE



ESAB® **CUTTING SYSTEMS**

411 S. Ebenezer Road
Florence, SC 29501-0545

The equipment described in this manual is potentially hazardous. Use caution when 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.

ESAB Cutting Systems is not responsible for any errors that may appear in this document. Information in this document is subject to change without notice.

This manual is ESAB Part No. F14-503.

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 U.S.A.

This manual is not a safety guide for 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 safe and proper operation of the equipment.

The following definitions apply to DANGER, WARNING, and CAUTION found throughout this manual:

⚠ DANGER	**Used to call attention to immediate hazards which, if not avoided, will result in immediate, serious personal injury or loss of life.**
⚠ WARNING	**Used to call attention to potential hazards that could result in personal injury or loss of life.**
⚠ CAUTION	**Used to call attention to hazards that could result in minor personal injury.**
CAUTION	**Used to call attention to potential hazards which, if not avoided, could result in property damage.**

The following definition applies to NOTICE found throughout this manual:

NOTICE	**Used to call attention to important installation, operation, or maintenance information not directly related to safety hazards.**

Contents

Piecemaker 2

Preface

The Piecemaker 2 is an advanced heavy duty numerically controlled gantry cutting machine manufactured by ESAB Cutting Systems of Florence, South Carolina. The PieceMaker II may be equipped with various types of plasma cutting equipment. 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 optional features and configurations available for the Piecemaker 2. For completeness, all of these are described in this manual. However, not all options 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 machine, one should become familiar with this manual in its entirety, with special attention to the SAFETY section.

Contents

Piecemaker 2

1.1 Introduction

The process of cutting metals with oxy-fuel or plasma equipment provides industry with a valuable and versatile tool. ESAB cutting machines are designed to provide both operation safety and efficiency. However, as with any machine tool, sensible attention to operating procedures, precautions, and safe practices is necessary to achieve a full measure of usefulness. 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 personnel injury or severe equipment damage. The following precautions are general guidelines applicable when working with cutting machines. More explicit precautions pertaining to the basic machine and accessories are found in the instruction literature. For a wide scope of safety information on the field of cutting and welding apparatus, obtain and read the publications listed in the Recommended References.

1.2 General Safety Information

⚠ WARNING

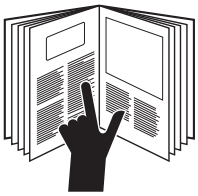
Machine starts automatically.

This equipment moves in various directions and speeds.

Moving machinery can crush.

1. **Only qualified personnel should operate or service equipment.**
2. **Keep all personnel, materials, and equipment not involved in production process clear of entire system area.**
3. **Keep gear racks and rails clear of debris or obstructions, such as tools or clothing.**
4. **Fence off entire work cell to prevent personnel from passing through area or standing in the working envelope of the equipment.**
5. **Post appropriate WARNING signs at every work cell entrance.**
6. **Follow lockout procedure before servicing.**

⚠ WARNING



Read and understand this operator's manual before using machine.

Failure to follow operating instructions could result in death or serious injury.

1. **Read entire procedure before operating or performing any system maintenance.**
2. **Special attention must be given to all hazard warnings that provide essential information regarding personnel safety and/or possible equipment damage.**
3. **All safety precautions relevant to electrical equipment and process operations must be strictly observed by all having system responsibility or access.**
4. **Read all safety publications made available by your company.**

⚠ WARNING

Read and understand all safety warning labels on machine.

Failure to follow safety warning label instructions could result in death or serious injury.

Refer to operator's manual for additional safety information.

1.3 Installation Precautions

⚠ WARNING

Improperly installed equipment can cause injury or death.

Follow these guidelines while installing machine:

Flashback arrestors must be installed between service supply lines and machine as outlined in NFPA51B. Burn back to source can cause serious explosion or fire.

Properly identify all oxygen and fuel gas service lines and equip with correct fittings to prevent possibility of crossover connection.

Do not connect a cylinder directly to machine inlet. An appropriate cylinder regulator must be installed on a fuel gas cylinder to reduce pressure to a reasonable inlet supply pressure (20 PSIG maximum). Machine regulator is then used to obtain pressure required by torches.

Contact your ESAB representative before installation. He can suggest certain precautions regarding piping installation and machine lifting, etc. to ensure maximum security.

Never attempt any machine modifications or apparatus additions without first consulting a qualified ESAB representative.

Observe machine clearance requirements for proper operation and personnel safety.

1.4 Electrical Grounding

Electrical grounding is imperative for proper machine operation and SAFETY. Refer to this manual's Installation section for detailed grounding instructions.

⚠ WARNING

Electric shock hazard.

Improper grounding can cause severe injury or death.

Machine must be properly grounded before put into service.

⚠ WARNING

Improper grounding can damage machine and electrical components.

1. **Machine must be properly grounded before put into service.**
2. **Cutting table must be properly grounded to a good Earth ground rod.**

1.5 Operating A Cutting Machine

⚠ DANGER

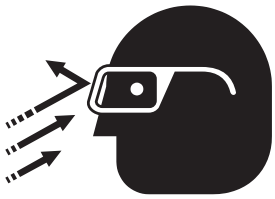
Crush hazard.

Moving machine can crush.

Machine moves automatically.

1. **Stay clear of rails and cutting table during operation.**
2. **Follow lockout procedure before servicing.**

⚠ WARNING



Flying debris and loud noise hazards.

Hot spatter can burn and injure eyes.

Loud noise can injure ears.

1. **Wear goggles to protect eyes from burns and flying debris generated during operation.**
2. **Wear ear protection as required for cutting various materials.**

⚠ WARNING

Burn hazard.

Hot metal can burn.

1. **Do not touch metal plate or parts immediately after cutting. Allow metal time to cool, or douse with water.**
2. **Do not touch plasma torch immediately after cutting. Allow torch time to cool.**

DANGER

Crush hazard.

Moving parts can cut and crush.

1. **Keep hands clear of drive gears.**
2. **Do not operate with any protective covers removed.**
3. **Follow lockout procedure before servicing.**

WARNING

Hazardous voltages.

Electric shock can kill.

1. **Do not operate with any protective covers removed or electrical component boxes open.**
2. **Follow lockout procedures before servicing.**

⚠ CAUTION

Pinch hazard.

Moving vertical slides can crush or pinch.

Keep hands clear of torch and slide during operation.

⚠ CAUTION

Pinch hazard.

Moving carriages can crush or pinch.

Keep hands clear of carriages during operation.

1.6 Working with Plasma Cutting Equipment

⚠ DANGER

Hazardous voltages.

Electric shock can kill.

1. **Do NOT touch plasma torch, cutting table or cable connections during plasma cutting process.**
2. **Always turn power off to plasma power supplies before touching or servicing plasma torch.**
3. **Always turn power off to plasma power supplies before opening or servicing plasma plumbing or flow control box.**
4. **Do not touch live electrical parts.**
5. **Keep all panels and covers in place when machine is connected to power source.**
6. **Insulate yourself from workpiece and electrical ground: wear insulating gloves, shoes and clothing.**
7. **Keep gloves, shoes, clothing, work area, and equipment dry.**

⚠ DANGER

Toxic fume hazard.

The cutting process can produce poisonous fumes and toxic gases.

Certain chlorinated solvents decompose and form phosgene gas when exposed to ultraviolet radiation.

Do not cut metal or painted metals containing zinc, lead, cadmium or beryllium unless fume removal equipment is installed and operating properly.

1. **Keep cutting area well ventilated.**
2. **Wear proper breathing mask when cutting galvanized metal and use proper ventilation and fume removal methods.**
3. **Insure chlorinated solvents are not in cutting area.**

⚠ WARNING

Radiation hazard.

Arc rays can injure eyes and burn skin.

1. **Wear correct eye and body protection.**
2. **Wear dark safety glasses or goggles with side shields. Refer to following chart for recommended lens shades for plasma cutting:**

Arc Current	Lens Shade
Up to 100 Amps	Shade No. 8
100-200 Amps	Shade No. 10
200-400 Amps	Shade No. 12
Over 400 Amps	Shade No. 14

3. **Replace glasses/goggles when lenses are pitted or broken**
4. **Warn others in area not to look directly at the arc unless wearing appropriate safety glasses.**
5. **Prepare cutting area to reduce reflection and transmission of ultraviolet light.**
6. **Paint walls and other surfaces with dark colors to reduce reflections.**
7. **Install protective screens or curtains to reduce ultraviolet transmission.**

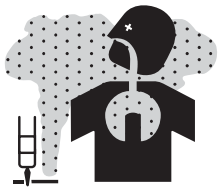
⚠ WARNING

Noise hazard.

Noise from plasma arc can damage hearing.

Wear correct ear protection when cutting above water.

⚠ WARNING



Fume hazard.

Fumes and gases generated by the plasma cutting process can be hazardous to your health.

1. **Do NOT breathe fumes.**
2. **Do not operate plasma torch without fume removal system operating properly.**
3. **Use additional ventilation to remove fumes if necessary.**
4. **Use approved respirator if ventilation is not adequate.**

⚠ WARNING

Spark hazard.

Heat, spatter, and sparks cause fire and burns.

1. **Do not cut near combustible material.**
2. **Do not cut containers that have held combustibles.**
3. **Do not have on your person any combustibles (e.g. butane lighter).**
4. **Pilot arc can cause burns. Keep torch nozzle away from yourself and others when activating plasma process.**
5. **Wear correct eye and body protection.**
6. **Wear gauntlet gloves, safety shoes and hat.**
7. **Wear flame-retardant clothing that covers all exposed areas.**
8. **Wear cuffless trousers to prevent entry of sparks and slag.**

⚠ DANGER

Hydrogen explosion hazard.

Hydrogen explosions can cause personal injury or death.

Hydrogen can create explosive gas pockets in the water table. These pockets will explode when ignited by sparks or the plasma arc.

1. **Before cutting, be aware of possible hydrogen sources in the water table – molten metal reaction, slow chemical reaction and some plasma gases.**
2. **Explosive gas pockets accumulate underneath the cutting plate and inside the water table.**
3. **Clean slag (especially fine particles) from bottom of table frequently. Refill table with clean water.**
4. **Do not leave plate on table overnight.**
5. **If water table has not been used for several hours, vibrate or jolt it to break up hydrogen pockets before laying plate on the table.**
6. **If possible, change water level between cuts to break up hydrogen pockets.**
7. **Maintain water pH level near 7 (neutral).**
8. **Programmed part spacing should be a minimum of twice the kerf width to ensure material is always under the kerf.**
9. **If cutting underwater, aerate water under plate with compressed air to prevent hydrogen pockets.**
10. **If cutting above water, use fans to circulate air between plate and water surface.**

⚠ DANGER

Explosion hazard.

Certain molten aluminum-lithium (Al-Li) alloys can cause explosions when plasma cut with water.

Do not plasma cut the following Al-Li alloys with water:

Alithlite (Alcoa)	**X8192 (Alcoa)**
Alithally (Alcoa)	**Navalite (US Navy)**
2090 Alloy (Alcoa)	**Lockalite (Lockheed)**
X8090A (Alcoa)	**Kalite (Kaiser)**
X8092 (Alcoa)	**8091 (Alcan)**

These alloys should only be dry cut on a dry table.

DO NOT dry cut over water.

DO NOT water injection cut.

Contact your aluminum supplier for additional safety information regarding hazards associated with these alloys.

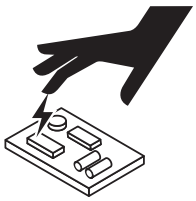
1.7 Service Precautions

CAUTION

Establish and adhere to preventive maintenance. A composite program can be established from recommended schedules in the instruction literature.

Avoid leaving test equipment or hand tools on machine. Severe electrical or mechanical damage could occur to equipment or machine.

CAUTION



Extreme caution should be used when probing circuitry with an oscilloscope or voltmeter. Although many steps have been taken to protect integrated circuits, they are susceptible to over voltage damage. Test probes should be connected while machine power is off to prevent accidental shorting of components.

Be thorough when handling electronic components. When finished servicing, confirm that all circuit boards are securely seated in sockets, all cables are properly connected, all cabinets are closed and locked, all guards and covers are replaced.

Never plug or unplug a printed circuit board while machine power is on. Instantaneous surges of voltage and current can damage electronic components.

Never trace wiring with buzzer or light. Use an ohm meter or logic probe. When tracing circuits make certain that tracing currents do not damage solid-state devices.

1.8 Welding

CAUTION

Special precautions must be observed if any arc welding is performed on this machine.

Failure to observe the following precautions can result in large induced currents causing severe damage to electronic components in machine control system.

Machine damage caused by improper welding practices is considered abuse and voids certain warranty provisions.

1. **Disconnect all cables to Relay Box, Numerical Controller, Tracer System, and Control Console.**
2. **Always connect welder ground cable directly to the part to be welded and as close to the weld point as possible.**
3. **Keep the current path between the ground point and the weld as short as possible.**
4. **Never connect the ground to points where the welding current path could include moving parts or bolted joints. This can result in a high resistance circuit that could divert high current into the control system and damage mechanical components (e.g. bearings).**

1.9 Working with Waterjet Cutting Equipment

⚠ DANGER

Cutting hazard.

High velocity water pressure will severely damage hands and/or fingers during the cutting process.

The waterjet area must be clear of personnel, materials and equipment not involved in the process. Keep hands clear of waterjet cutting head during application.

⚠ WARNING

Pressurized fluid hazard.

Pressurized fluid streams can penetrate skin, causing severe personal injury. If any fluid is ejected against the skin, get medical attention immediately.

Turn Intensifier power OFF and relieve all pressure in lines before attempting any repairs. Do not repair any water leaks with Intensifier ON. Use a piece of cardboard when checking for leaks – NEVER YOUR HAND.

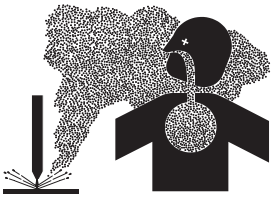
⚠ WARNING

Burn hazard.

Friction generated by abrasive cutting heats the cutting plate and the cut parts.

Cut parts are hot immediately after the cutting process. Handle carefully.

⚠ CAUTION



Dust hazard.

Abrasive dust can irritate.

Wear dust mask.

1.10 Recommended References

The following nationally recognized publications on safety in welding and cutting operations are recommended. These publications have been prepared to protect persons from injury or illness and to protect property from damage, which could result from unsafe practices. Although some of these publications are not related specifically to this type of industrial cutting apparatus, the principles of safety apply equally.

"Precautions and Safe Practices in welding and Cutting with Oxygen-Fuel Gas Equipment," Form 2035. ESAB Cutting Systems.

"Precautions and Safe Practices for Electric Welding and Cutting," Form 52-529. ESAB Cutting Systems.

"Safety in Welding and Cutting" - ANSI Z 49.1, American Welding Society, 2501 NW 7th Street, Miami, Florida, 33125.

"Recommended Practices for Shielded Gases for Welding and Plasma Arc Cutting" – AWS C5.10-94, American Welding Society.

"Standard for Fire Protection in Use of Cutting and Welding Procedures" - NFPA 51B, National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts, 02110.

"Standard for Installation and Operation of Oxygen - Fuel Gas Systems for Welding and Cutting" - NFPA 51, National Fire Protection Association.

"Safety Precautions for Oxygen, Nitrogen, Argon, Helium, Carbon Dioxide, Hydrogen, and Acetylene," Form 3499. ESAB Cutting Systems. Obtainable through your ESAB representative or local distributor.

"*Design and Installation of Oxygen Piping Systems,*" *Form 5110*. ESAB Cutting Systems.

"The Oxy-Acetylene Handbook," Form 4430. ESAB Cutting Systems.

"The Safe Handling of Acetylene" Form 4373. ESAB Cutting Systems.

Literature applicable to safe practices in welding and cutting with gaseous materials is also available from the Compressed Gas Association, Inc., 500 Fifth Ave., New York, NY 10036.

Piecemaker 2

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Piecemaker 2

2.1 Specifications

2.1.1 Gantry System

Cutting Width	60" (1524mm)	72" (1828mm)
Cutting Length	144" (3658mm) 252" (6400mm)	144" (3658mm) 252" (6400mm) 331" (8407mm)
Machine Width	95" (2413mm)	107" (2718mm)
Rail Length	16' (4.8m) 25' (7.6m)	16' (4.8m) 25' (7.6m) 32" (9.7m)

NOTICE

Cutting length is total rail length minus truck length and travel limits.

Rails are available in 16ft. (4.8m), 25ft. (7.6m) or 32ft. (9.7m) lengths.

Truck Length (parking area)	43" (1092mm)
Machine Height	66" (1676mm)
Cutting Table Height	32" (813mm)
Speed Range (inches per minute)	2-750 ipm (50 – 19,050mm/min)
Maximum Number of plasma stations	1

The ESAB Group reserves the right to change specifications without notice.

2.1.2 Performance

When properly installed and maintained, the Piecemaker 2 can achieve the following performance limits.

Accuracy Measured over a 60" x 60" area.	±0.015" (0.38mm)
Repeatability Measured over a 60" x 60" area.	±0.005" (0.13mm)
Contouring Speed	2 - 300ipm (50 - 10,160mm/min)
Traverse Speed	2 – 750 ipm (50 - 19,050mm/min)
Kerf Compensation	Up to 0.250 " (6.4mm)

2.1.3 Requirements

The following are requirements for cutting machine gantry only. Refer to vendor supplied manuals for process equipment and accessories.

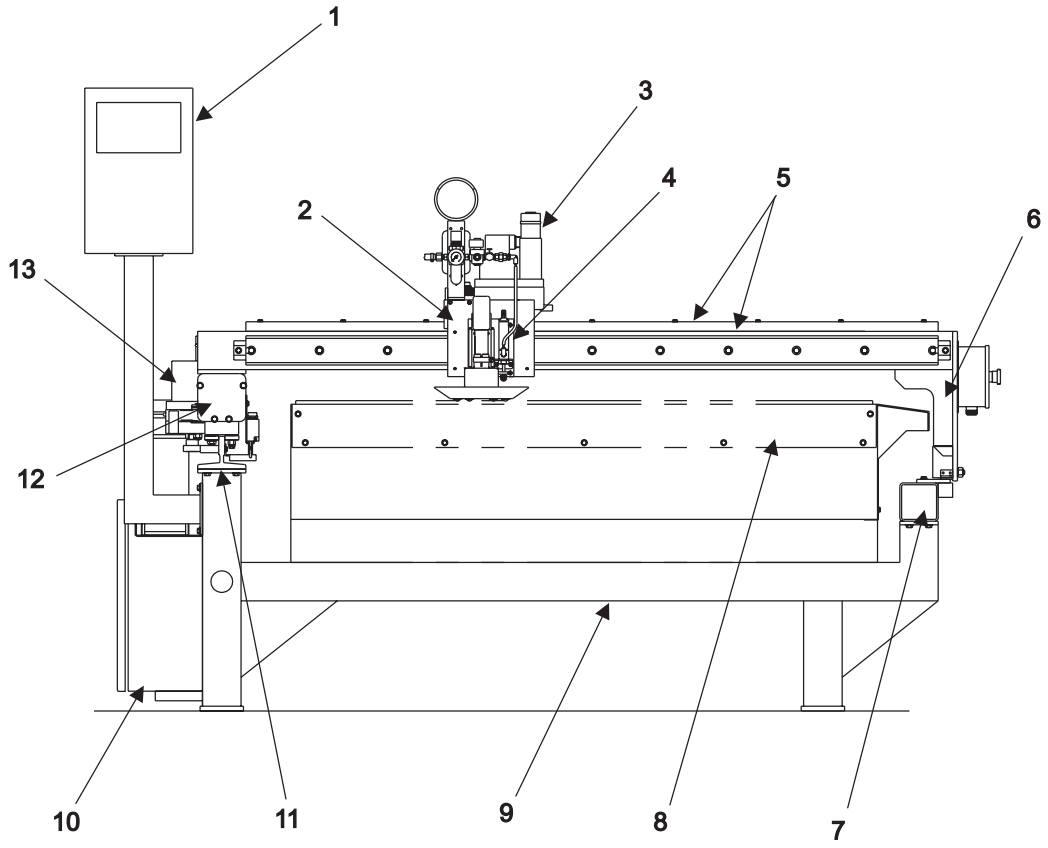
Electrical Power	120 VAC, 20 Amp, 50/60 HZ, single-phase
Operating Temperature (Ambient)	32° - 122°F (0° C to 50° C)
Relative Humidity (non-condensing)	5% - 95%
Compressed Air (clean, dry) Required for plasma torch and torch lifter.	450 CFH @ 100 psi.

NOTICE

When air temperature surrounding the cutting machine is more than 104° Fahrenheit (40° C) or the duty cycle is more than 50%, special cooling equipment may be required. Contact ESAB for more detailed information.

2.2 General Description

2.2.1 Machine Overview



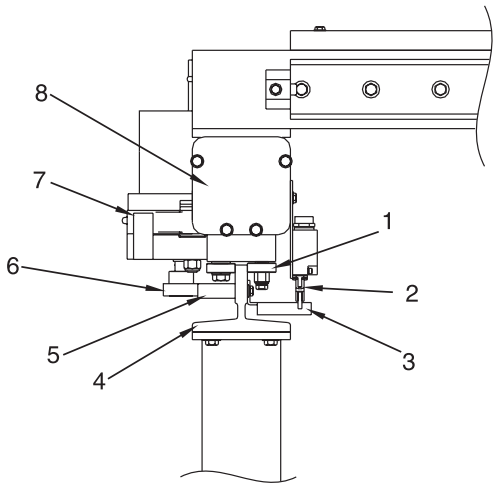
1 Control console
2 Y-axis carriage
3 Y-axis drive
4 Torch lift
5 Y-axis beam & rail
6 X-axis floater truck
7 X-axis floater rail
8 Cutting table
9 Rail pedestal assembly
10 Electronics cabinet
11 X-axis rail guide
12 X-axis guide truck
13 X-axis drive

These general descriptions are to familiarize the user with terminology, machine parts and functions. Detailed descriptions follow in the manual.

Structurally, the Piecemaker 2 is a gantry machine with a beam and deck spanning the cutting area. The cutting of part programs is accomplished with a coordinate drive system that moves the cutting torches in two axes. The entire gantry moves along a pedestal mounted rail system in the longitudinal direction. The carriage moves across the beam of the machine providing motion in the transverse direction. The machine is designed to accommodate gauge thickness sheet metal in cut sheets.

The torch station is equipped with a plasma cutting torch to cut any metal at high speed. The torch station has a vertical lift to raise the torch out of the way when not in use and lower the torch to the plate for cutting.

2.2.2 Lower Carriage



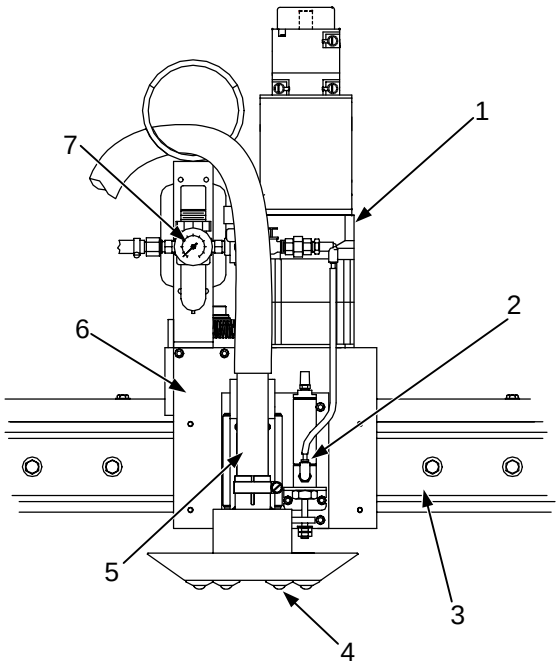
1	Guide rails
2	Limit switch
3	Limit switch cam
4	Rail
5	Drive rack
6	Drive pinion
7	X-axis motor & gearbox
8	Guide truck

The Piecemaker 2 uses a single side drive angled reinforcing deck to provide motion to the longitudinal (X-axis) direction. Support for the machine is accomplished on machined T-rails on the drive side and a flat track bar on the floating side. Rails are mounted on steel pedestals anchored to the floor with leveling adjustments located at each pedestal. The drive rack is mounted on the outside of the T-rail. The rail system must be properly installed before the machine installation.

Two wheels guide the truck assembly ride on the machined top surface of the rail. Side rollers at each end of the guide truck follow the machined sides to provide accurate guidance.

A servo drive system is mounted in the guide truck, providing accurate positioning and consistent speed control via a closed loop feedback system. The drive assembly is mounted in the truck frame; positioned to allow the drive pinion to engage the drive rack mounted on the outside surface of the T-rail. A spring applies pressure to the drive pinion, keeping it engaged with the drive rack. Manually disengage the rack and pinion to perform maintenance on the drive system.

2.2.3 Upper Carriage



1 Y-axis AC drive motor & gearbox
2 Torch lift
3 Y-axis beam & rail
4 Plate rider
5 Plasma torch
6 Y-axis carriage
7 Air controls

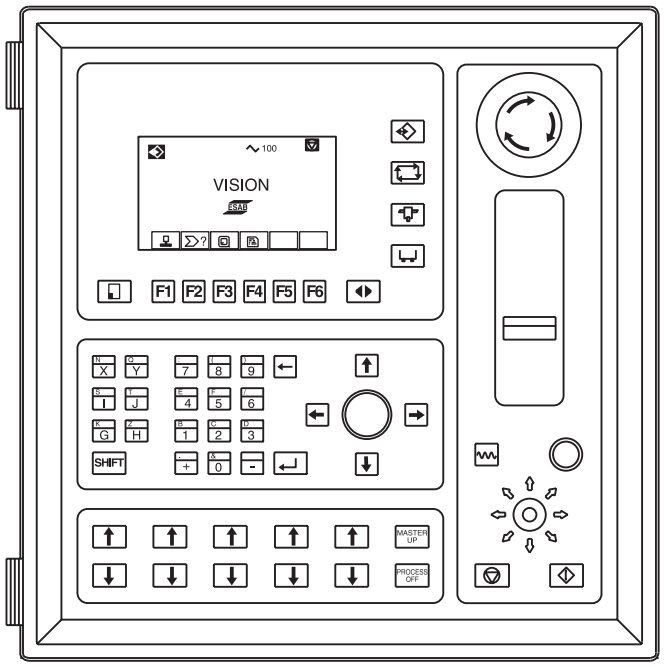
The truck houses the longitudinal drive and provides support for the main beam and deck. The main beam spans across the top front edge of the trucks providing a rigid gantry where the transverse (Y-axis) carriage is mounted. A machine guide rail is mounted on the front side of the beam to provide upper carriage support and tracking. The transverse drive is mounted on a carriage and functions like the lower carriage drive system. A drive pinion is engaged with the drive rack mounted on top of the main beam.

An angled rear deck spans the trucks, providing bracing for the main beam and a facility where auxiliary machine components such as electronic boxes and hose and cable carriers are mounted.

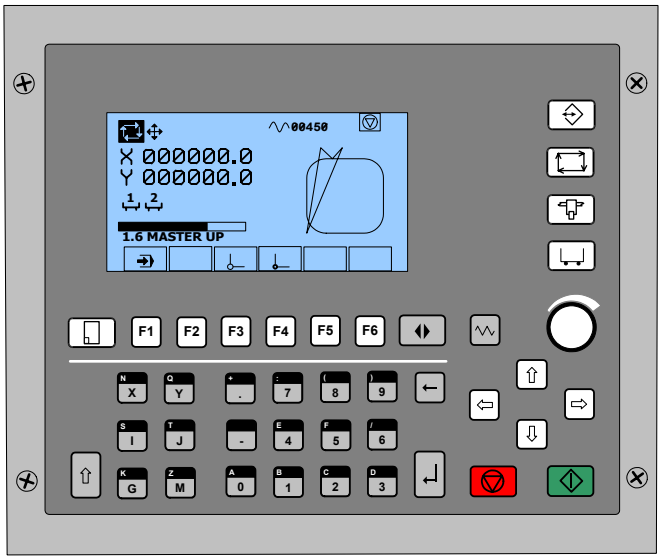
2.2.4 Operator Controls

Computer Numerical Control

The primary operator controls used in the cutting process are on the Vision 1000 control console and Vision LE. Detailed descriptions of the operator controls are in the Operation Section and in the Vision 1000 CNC Operating Instructions, F-14-054, Vision LE Operating Instructions, F-14-177.

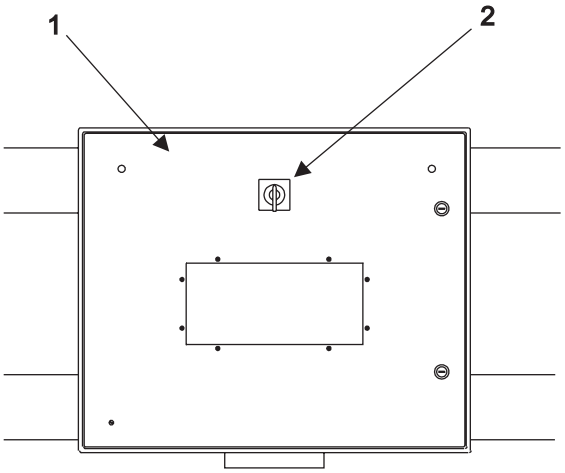


Vision 1000



Vision LE

2.2.5 Control Circuits



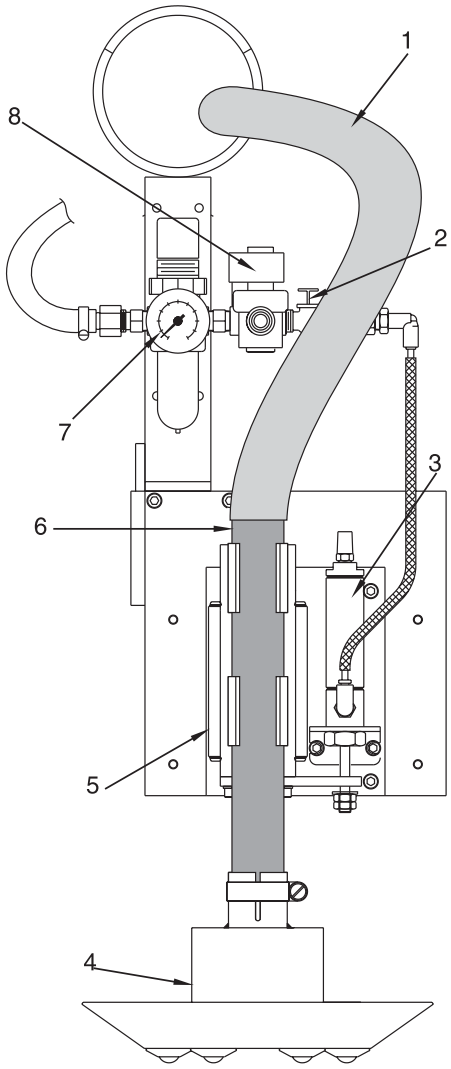
The electronics controlling the cutting machine are grouped into two main areas. The Vision CNC is a self-contained unit and all CNC circuitry is contained in the operators control console.

The rest of the electronic control circuitry is grouped inside the electronics cabinet. Components are laid out inside the cabinet according to their function and include the drive amplifier unit, input/output circuits, power distribution circuits and process control circuits.
The main power switch is located on the electronics cabinet and switches off all power to the CNC, the drives and process controls.

1 Electronics cabinet

2 Main power switch

2.2.6 Plasma Station



1 Torch leads
2 Needle valve
3 Air cylinder
4 Torch shield
5 Linear slide
6 Plasma torch handle
7 Air regulator
8 Solenoid valve

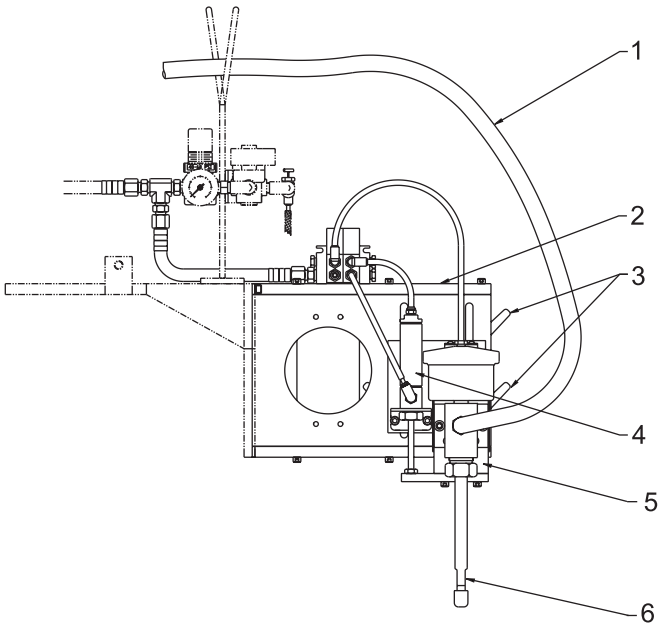
The plasma cutting torch provides high-speed cutting through carbon steel, stainless steel and aluminum. The plasma system consists of a plasma torch mounted on the machine carriage, plasma torch leads and a plasma power supply.

A plasma torch uses an electrical arc constricted through an orifice by a compressed gas to form a “plasma jet” that cuts through metal plate. The plate being cut is part of the electric circuit that provides a complete current path to the power source.

Separate instruction material covering the plasma system is provided with machines equipped with plasma stations. Operators should become familiar with all instruction literature and follow all safety precautions.

2.2.7

2.2.8 Insulation Cutting



Waterjet systems utilize the cutting action of water to further automate the duct cutting process. The Insulation Piecemaker 2 can cut ductwork from galvanized steel with the plasma torch, then cut the insulation layers on the outside of the duct fittings with the waterjet. Both part programs are downloaded into the CNC and one machine and one set of rails is capable of two different processes (thermal and nonthermal) on two different materials. The waterjet station includes the cutting head and a pneumatic slide that lowers the head for cutting and raises it out of the way when not in use.

1	3/8" hose (5000 psi)
2	Waterjet station mounting bracket
3	Adjustable handles
4	Pneumatic cylinder
5	Pneumatic slide
6	Waterjet cutting head

To accommodate different insulation thickness', the station can be moved up or down and locked with adjustable handles. This can be done at the beginning of a cut or anytime a different material thickness is changed.

Pump

The 5hp pump provides continuous pressure output up to 5000 psi for waterjet cutting.
Stand-alone pumps are built on four wheels for easy access and movement flexibility.
The pump is connected to the machine using a 3/8" id. hydraulic hose (5000 psi or above rating) supplied by ESAB. The customer is responsible for providing the power cable and 3/8" hose (low pressure with a quick disconnect fitting) to the pump.

Pump Specifications

Footprint	19-½" wide x 44" long x 37" height on cart wheels
Capacity	2 gpm
Electrical Power	230/460 VAC, 20/10 Amps, 60 Hz, 3-phase

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Contents

3.1 Introduction

The machine installation process is divided into three general phases: preparation, rail and gantry installation and preliminary setup.

It is important to understand which areas are the customer's responsibility and which areas the ESAB Service Representative will supervise.

Preparation

The preparation phase includes those items that must be prepared before machine arrival. All of these items are the customer's responsibility.

Rail and Gantry Installation

The rail and gantry installation phase includes rail system installation, placing the machine gantry on rails and connecting supplies to the machine. It is the customer's responsibility to receive the machine, install the rail system and set the gantry on the rails. However, the ESAB representative will supervise the remaining critical areas of machine installation. The remaining information in this chapter is provided for those customers capable of completing these steps without supervision.

Preliminary Setup

The preliminary setup phase includes setups and adjustments that must be made before operating the machine, but are usually done after the ESAB Service Representative arrives. Some procedures require machine power to be on. In some instances, the customer can complete these items before the ESAB Service Representative arrives.

3.2 Installation Checklist

This checklist is a guide to machine installation. For more information on each topic refer to the appropriate subsection.

Complete all items listed before the ESAB Service Representative arrives. He will supervise the remaining critical areas of machine installation.

Review completed items with the service representative before he arrives to avoid any unnecessary delays or service charges.

Completing all items in advance allows the service representative more time to train your operations and maintenance personnel.

When scheduling permits, an onsite pre-installation visit can be arranged. If this is not possible, a pre-installation phone discussion will be arranged. If questions arise during site preparation, call the Technical Service Department.

Item	Description
Prepare Area	• Check for minimum clearance between equipment and any wall and/or overhead obstruction per OSHA.
	• Check easy access for maintenance.
	• Check space required for efficient material flow.
	• Plan location of fume removal system (optional for downdraft table) including ductwork and blower.
Equipment Location	• Determine machine service inlet location.

	• Service inlets for supply gas, air and water can be located on either side of the machine depending on the installation requirements. Each inlet is labeled by the service intended and uses different hardware to prevent cross connections. • Supply gas for plasma is supplied through a red hose and notched connectors having left-hand threads. • Determine location for water purification system (for waterjet process). • Refer to the Safety Section and additional safety literature supplied or recommended to establish the safest conditions possible for personnel and equipment.
Prepare Foundation	• Make foundation plan drawings. Include location of machine, rails, air, water and power supplies, ground rod, utility trench (if desired), fume removal system and water drain pipe for cutting table.
	• Install new foundation (if required), utility trench and ground rod.
Electrical Power Needs	• Electrical service is distributed through steel tube conduits built into the deck structure for protection against an environment that could damage conductors and create hazardous conditions.
	• Determine electrical power requirements for cutting machine, plasma power supply and water pump. Refer to the installation drawings to determine power required by each piece of equipment.
	• All wiring to the cutting machine, grounding protection and optional items must meet or exceed National Electrical Code (NEC) standards and any applicable local ordinances.
	• Design and install electrical supplies, including power drops, conduit and breakers or fused disconnects, within five meters of machine service inlet (center of powertrack).

Compressed Air Supply	• Specify new air system or modifications to existing system to meet requirements for machine and plasma system.
	• Install new air system, regulators, filters, shutoff valves and piping within five meters of the machine service inlet.
	• Entire air system must be free of water, oil and particulate matter before operating.
Gas Supplies	• Determine maximum cutting requirements and specify the gas system accordingly.
	• Consult with local gas supplier for assistance with gas supplies and regulators.
	• Consult specific plasma manuals for gas requirements.
	• Check requirements for torch types used on your machine.
	• Gas supply specifications must meet or exceed all OSHA requirements and local regulations.
	• Install the gas supply system, evaporators and regulators, shutoff valves and piping to within five meters of machine service inlet.
Install Rail System	• Install rail system to tolerances listed in this manual.
Cutting Table	• Install cutting table per installation drawings. • Install all piping to the cutting table including the water supply and drainpipe.
	• Install fume removal system including ductwork and blower.
DNC Cable	• Install fiber optic cables for DNC connection.

Grounding	• Read “Cutting Machine Grounding” (ESAB Part No. F14074), included with the pre-installation package, in its entirety before starting the installation process. • Install a good earth ground rod for the cutting machine, rail system and cutting table, within 10 ft (3m) of star ground.
	• Determine location of the star ground point on the cutting table and on the machine chassis.
	• Earth ground rod must be connected to the star point on the cutting table(s).
	• All electrical enclosures must be bolted to machine chassis. • Machine chassis must be grounded to the star point on the cutting table.
	• Rails must be grounded to the cutting table at all four corners.
	• Plasma ground must be connected to the start point on the cutting table.

3.3 Preparation

3.3.1 Introduction

This section discusses the installation preparation phase. These items require preparation well in advance of actual machine installation. Perform topics in the order they are arranged.

Some items may require major facility rework to accommodate the machine. Complete all applicable items before the ESAB Service Representative arrives. Start preparations as soon as machine is purchased.

3.3.2 Prepare Area

Before the cutting machine delivery, prepare a safe, efficient cutting area with an adequate foundation and adequate gas, electrical and water systems.

The area must provide:

- A safe work environment, including proper air circulation, ventilation, noise protection and other conditions, depending on cutting machine options.
- Recommended electrical power, gas, oxygen, air, water and water drainage systems as determined by machine and options purchased.
- A separate earth ground rod to ensure safe operation and reduce RFI problems. Refer to ESAB manual "*General Guidelines for Cutting Machine Grounding*" (Part # F14-074).
- Material handling equipment to carry work pieces and parts to and from the cutting machine in an efficient and convenient manner.
- Sufficient clearance around and above the gantry for safe and efficient operation.
- A good foundation with protection against vibration and mechanical shock.

You should be familiar with the following sources on cutting operations and plasma arc cutting before preparing your cutting machine area:

U.S.A. Standard ANSI Z 49.1-1983 *"Safety in Welding and Cutting."*

National Fire Protection Association Bulletin No. 51B *"Standard for Fire Prevention In the Use of Cutting and Welding Processes."*

American Welding Society, Inc., Bulletin No. AWS C5.2-83 *"Recommended Practices for Plasma Arc Cutting."*

3.3.3 Equipment Location

Determine location of the rail system and the plasma power supply before installation.

All hoses and cables are conducted from a fixed point on the floor to the moving machine gantry via a powertrack cable carrier system.

Since all hoses and cables enter the powertrack at the center of its travel, all gas and electrical supplies and auxiliary equipment should be located near the center of the rail system. Sufficient cables and hoses are supplied to reach five meters from the termination of the powertrack. Take into account vertical runs and obstructions when measuring the five meters. See drawing below for a typical layout of a machine and its auxiliary equipment.

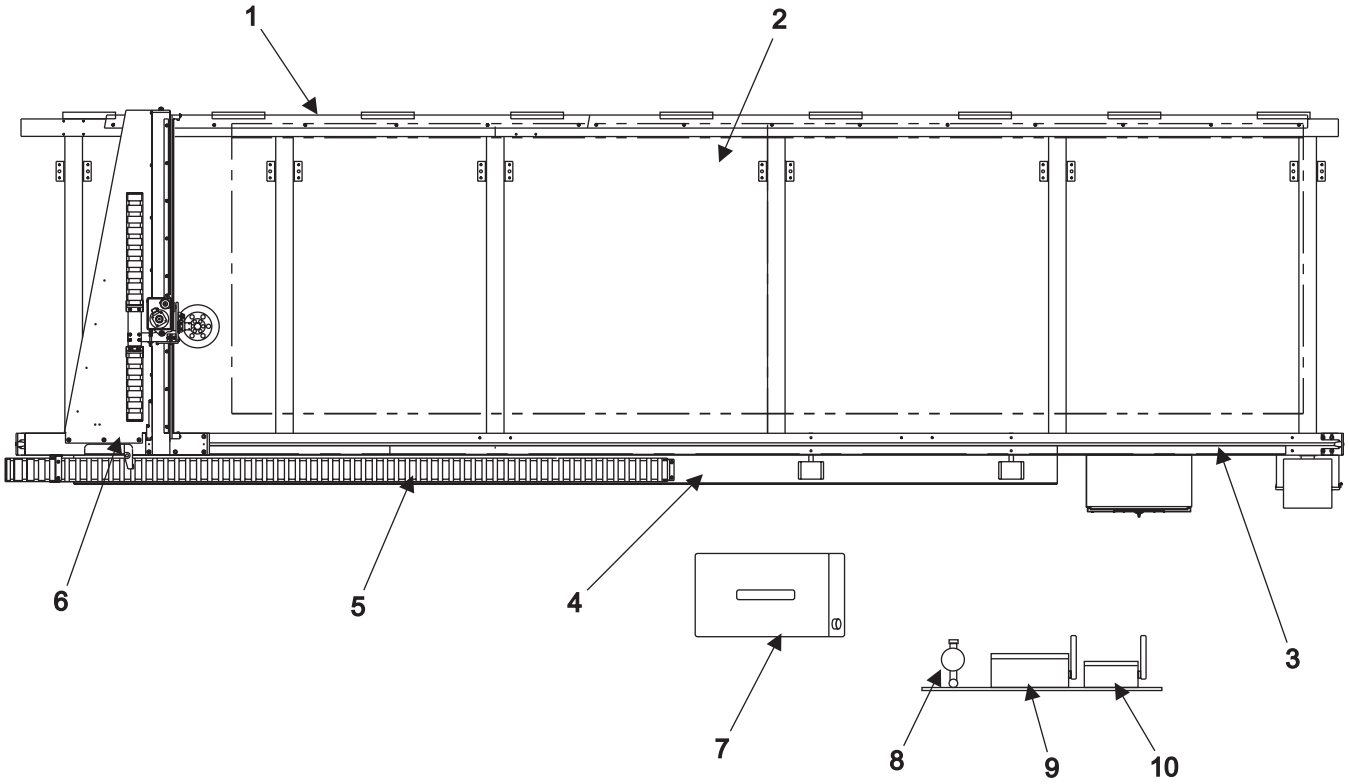
Locate the power disconnects and the air supply readily accessible by the operator.

Fume Removal System

The fume removal system is an optional system that removes fumes generated by the plasma cutting process. The fume collection boxes, included as part of the downdraft table, terminate in a 16" (406mm) duct. The customer is responsible for installing the appropriate ducting to connect these boxes to a fume removal blower. Consider the amount of clearance needed for the ductwork required by the exhaust system. The standard exhaust system includes all ductwork from the cutting table to the air connection at the damper. The connecting duct is 16" (406mm) diameter. We recommend installing the blower on the back or left side of the machine. The fume removal blower must be rated for at least 2100 CFM.

3.3.4 Suggested Equipment Layout

Standard Layout



1 Floater rail
2 Cutting table
3 Guide rail
4 Powertrack tray
5 Powertrack
6 Gantry
7 Plasma power supply
8 Gas/air supply
9 Disconnect for plasma power
10 Disconnect for machine power
11 Control console

The following illustrates a suggested equipment layout. Each installation varies depending on the customer's site and equipment options.

The standard layout is for machines with the control console in the standard position - front, left corner of machine.

3.3.5 Foundation Requirements

The following guidelines apply to all cutting machine installations:

- Situate entire rail system on a single slab of reinforced concrete, free from severe vibration and major cracks.
- Floor should be at least 6" (152mm) thick.
- Floor must not have any severe height changes, and must not have an overall height change greater than 2" (50mm).
- If new concrete is needed to meet these specifications, allow sufficient time for concrete to cure before installing rails.
- Special floor pads or foundations may be needed to isolate the gantry from vibration created by nearby equipment.
- Soil under the concrete floor must settle completely so the machine load and the floor do not cause further settling.

3.3.6 Grounding

Machine grounding is an important part of installation. The most difficult part of the grounding process is designing and installing a low impedance earth ground rod. However, the better the Earth ground rod, the less chance of having EMI (Electromagnetic Interference) problems after installation is complete.

While the National Electric Code addresses grounding for fire prevention and short circuit protection, it does not address equipment protection and EMI noise reduction. Therefore, this manual presents more stringent requirements addressing these special problems.

⚠ WARNING

Electric shock hazard.

Can shock, burn or cause death.

Machine must be properly grounded before put into service.

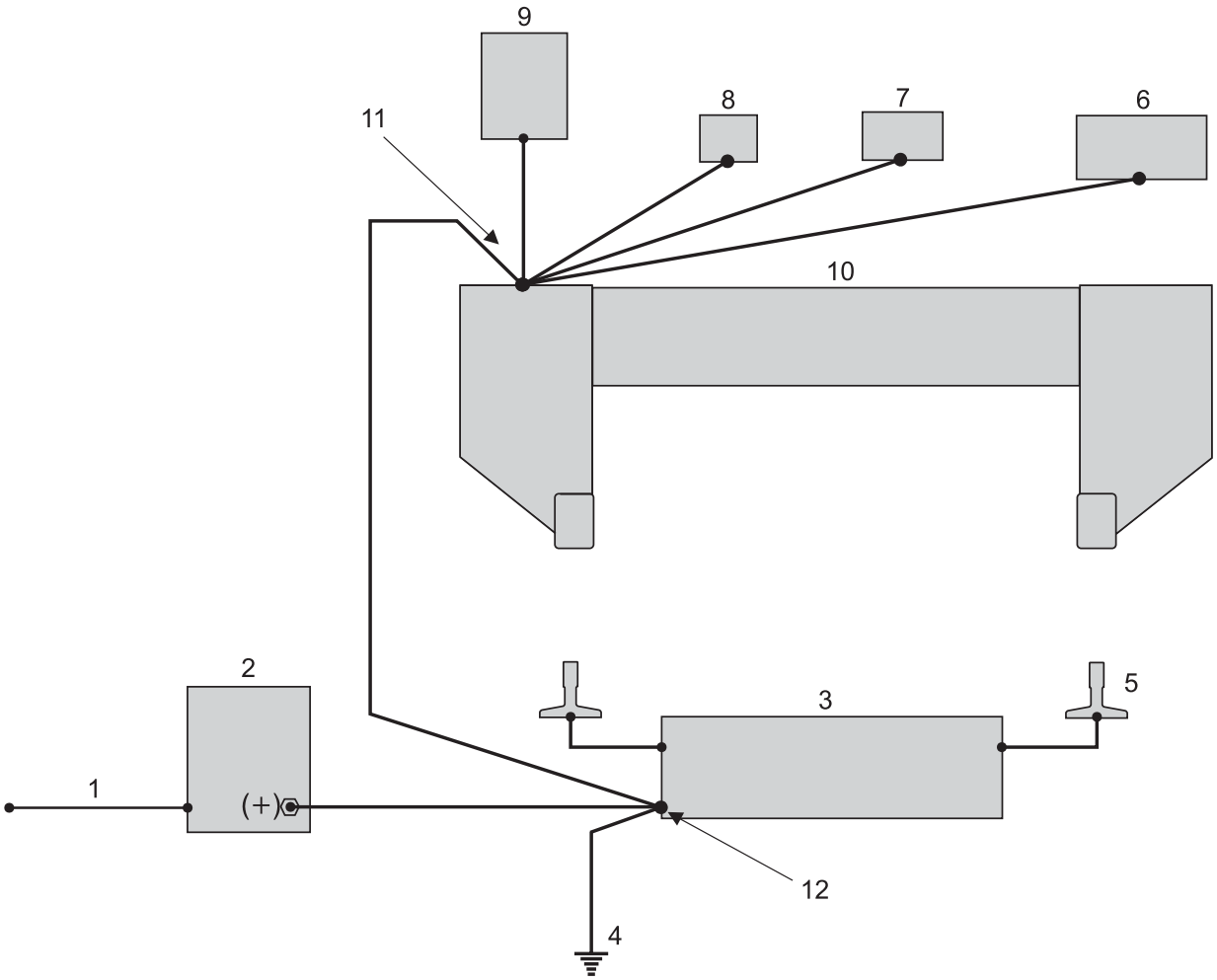
⚠ WARNING

Improper grounding can damage machine and electrical components and voids certain warranty provisions.

Machine must be properly grounded before put into service.

The cutting table must be properly grounded to a good Earth ground rod.

3.3.6.1 Grounding Overview



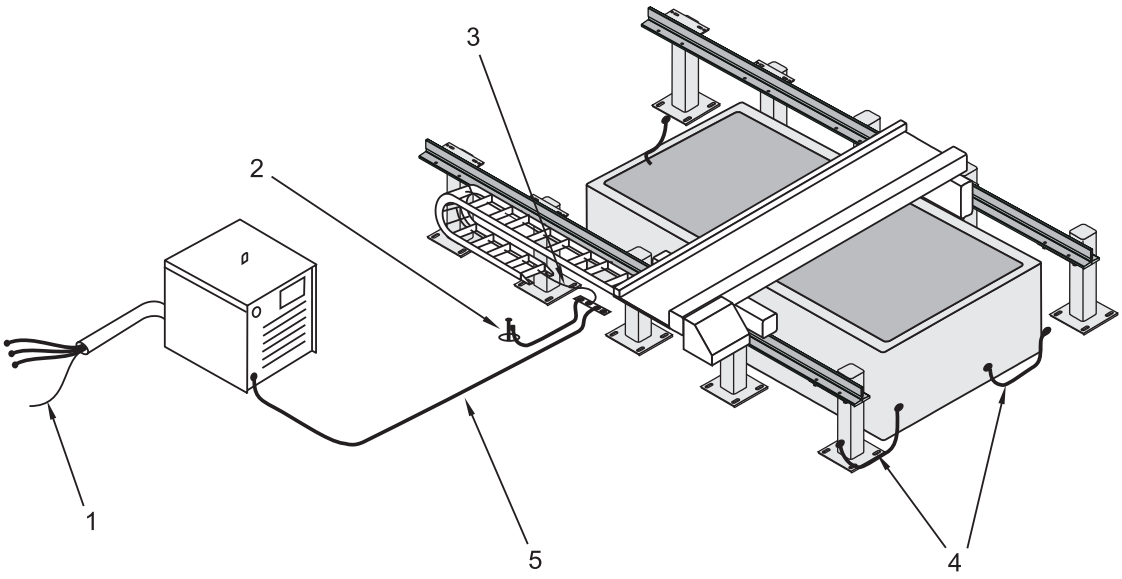
1 Electrical ground
2 Plasma power supply
3 Cutting table
4 Earth ground rod
5 Rails
6 Flow control
7 Plumbing box
8 AHC box
9 CNC enclosure
10 Machine chassis
11 Machine star ground
12 Cutting table star ground

Grounding is accomplished by connecting all the system components to a single star point on the cutting table, which is then connected to the Earth ground rod. The rail system is also electrically connected to the cutting table through mounting bolts. The following connections need to be made:

- All electrical enclosures bolted to machine chassis.
- Machine chassis grounded to star point on cutting table.
- Rails grounded to cutting table at all four corners.
- Plasma ground connected to star point on cutting table.
- Earth ground rod connected to star point on cutting table.

3.3.6.2 Grounding System

The ground system consists of five main components: plasma ground, ground rod, utility power electrical ground, cutting machine chassis ground and rail system safety ground. Each element is important for creating a complete ground system. Make provisions for each element during installation, as shown below.



1 3-phase electrical supply must include electrical ground

2 Single ground rod connected to table (1/0)

3 Machine chassis ground (6 Ga.) connected to table

4 Rails grounded to table at all four corners (1/0)

5 Plasma positive (+) connected to table (1/0)

Notes

1. Use 1/0 AWG 600 volt welding cable for all plasma grounds.
2. Use 6 AWG stranded wire to ground machine chassis.
3. Use cutting table as the star ground point.
4. Use a single ground rod located within 10 ft (3m) of star ground. Resistance to the earth ground should be less than three ohms. Measure as shown for earth ground test.
5. The plasma power supply housing must be grounded to main power distribution ground. Wire size must comply with local electrical code.

Make sure all interconnections make good electrical contact. Good electrical contact requires connections that are made with bare metal to metal contact and are very tight and protected from rust and corrosion. When connecting cable lugs to any metal surface, use a grinder or wire wheel to clean all paint, rust and dirt from surface. Use an electrical joint compound (such as ESAB Part No. 73585980) between cable lugs and metal surfaces to prevent future rust and corrosion. Use the largest size bolts, nuts and washers possible and tighten fully. Use lock washers to ensure connections stay tight.

Plasma Ground

The return path ground cable is the first and most important element of the ground system because it completes the plasma current path. Solid, low impedance and well-maintained electrical connections are necessary. The plasma cutting current is generated by the plasma power supply. Welding cables carry this current from the negative (-) connection on the plasma power supply to the torch, where it arcs to the work piece on the cutting table. The current path must be closed so the current can easily return to its source. This is done by connecting the cutting table to the positive (+) connection on the plasma power supply.

If the return path ground cable is not connected, the plasma system will not work because the arc cannot establish between the torch and the work piece. If cable is connected but connections have a very high resistance, the arc current is limited causing dangerous voltage levels between system components.

Ground Rod (Plasma System Safety Ground)

The ground rod serves several important purposes. It provides frame voltage for personnel safety by ensuring there are no potential differences between the system components and the building components. It provides a stable signal reference for all digital and analog electrical signals on the cutting machine. It helps control RF (Radio Frequency) emissions and other EMI (Electro-Magnetic Interference). It also provides a discharge path for short circuits and high voltage spikes, such as those caused by lightening.

The ground rod can be optimized in two ways: length and diameter. The longer the ground rod, the better the connection. The larger the diameter, the better the connection. The standard ground rod specification is 1" (25mm) diameter rod, 20 ft (7m) long.

Electrolytic Ground Rods

A grounding expert may suggest using an electrolytic ground rod with conditioned backfill. Although expensive, this option gives the best possible ground connection. To install one of these rods, excavate or drill the ground, install rod, then backfill around rod with conditioned soil. The result is a very low impedance earth ground that maintains itself for the cutting machine lifetime.

Multiple Ground Rods

Do not use multiple ground rods. While installing multiple rods may improve a safety or lightening ground, they offer no advantage for EMI reduction and can cause more problems than they are worth. For more information, refer to form F-14-074, General Guidelines for Cutting Machine Grounding.

Utility Power Electrical Ground

The utility power electrical ground must accompany all 3-phase and single-phase power feeds. This electrical ground provides the proper reference for all incoming power. Failure to provide this ground is a violation of some electrical codes and a serious safety hazard.

Connect the electrical ground to the appropriate terminal inside the plasma power supply. Size wire according to local electrical codes.

Cutting Machine Chassis Ground

Because all cutting machine electrical enclosures and shields are connected to the chassis, proper functioning of the electronic systems depends on the chassis being grounded. The cutting machine chassis ground connects the chassis of the cutting machine gantry to the plasma system star ground point. This is usually a 6-gauge stranded copper wire, connected to the cutting table. This wire connects all electrical and chassis grounds on the machine to the ground rod. This wire is supplied with the cutting machine and is connected during machine installation.

Rail System Safety Ground

The rail system safety ground ensures the entire rail is at ground potential, eliminating any possible shock hazard and providing backup for the machine chassis ground in case of a plasma current short circuit.

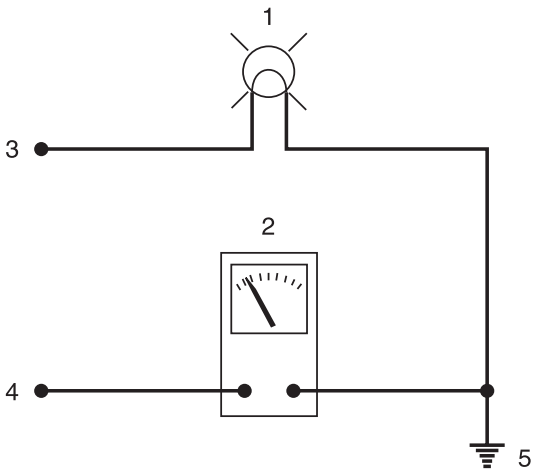
Earth Ground Test

WARNING

Electric shock hazard.

Can shock, burn or cause death.

Do not touch the ground rod while power is being applied to the light bulb.



1 100 watt lamp
2 AC setting (three volts or less for plasma)
3 115 VAC (Hot)
4 AC Neutral
5 Ground rod

To test the earth ground, connect a 100-Watt light bulb between 115 VAC HOT and the cutting machine's ground rod. Connect a digital voltmeter between AC NEUTRAL from the same source and ground rod.

The meter displays the voltage between AC NEUTRAL and the ground rod, which is equal to the resistance in ohms between these two points. **The meter must read three volts or less for plasma machines.**

The ideal condition between the ground rod and the electrical ground is three ohms or less. However, this value may be difficult to achieve.

To reduce ground resistance, take one of the following steps:

1. Increase rod length and/or diameter.
2. Condition soil surrounding ground rod by adding moisture or salt.
3. Use an electrolytic ground rod with conditioned backfill.

3.3.7 Electrical Requirements

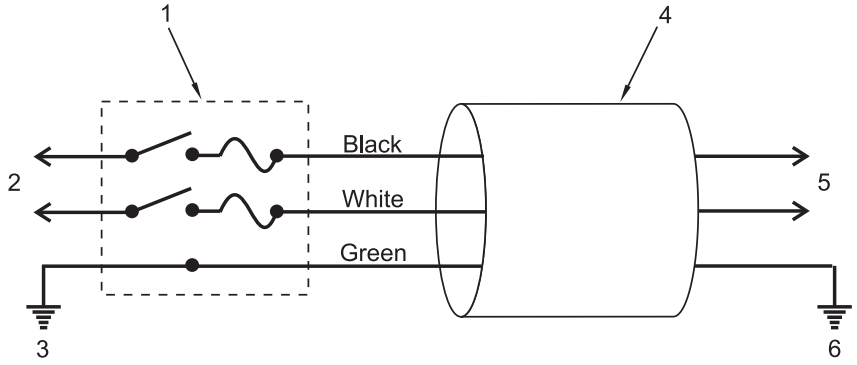
Electrical requirements for a cutting machine installation fall into two categories - power for cutting machine gantry and power for auxiliary equipment. In general there is only one power cable supplying power to the gantry and any auxiliary equipment mounted on the gantry will draw power from that cable. However, any auxiliary equipment not mounted on the gantry requires separate input power disconnects supplied by the customer.

This section covers only the input power requirement for the cutting machine gantry, not auxiliary equipment. For auxiliary equipment power requirements, see the manual for that piece of equipment.

NOTICE

Contact your local power company to provide proper electrical service and fusing.

	Voltage	Amperage	Recommended Fuses
Gantry Power	120 VAC, single-phase, 60 Hz	20 Amps	20 Amp, Time-Delay



1 Fused disconnect box (customer supplied)

2 Customer's AC power

3 Power ground

4 Input power cable (supplied w/machine)

5 120 VAC machine power

6 Machine chassis

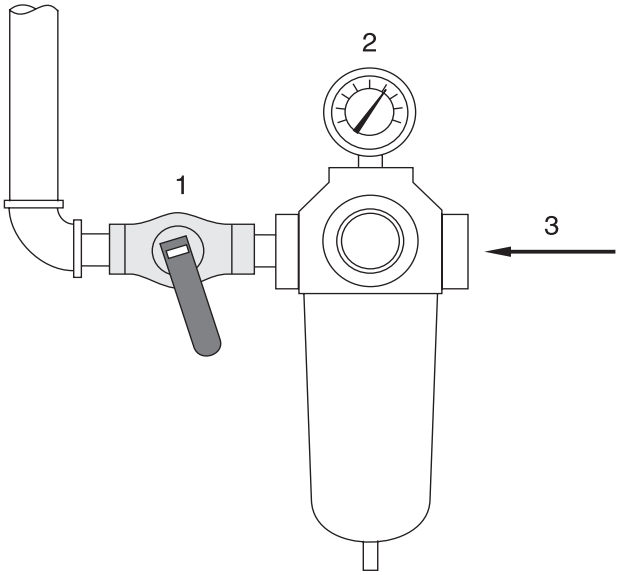
3.3.8 Compressed Air Supply

This cutting machine requires a source of clean, dry regulated air with the following specifications:

Line Pressure	Supply Connection
90 psi (6.2 bar)	½" NPT Female

CAUTION

Keep air system free of water, oil, and particulate matter. Failure to keep air system clean may cause damage to mechanical components.



Typical Air Supply Connection

Air supplies must be filtered, regulated, have a shutoff valve and be terminated using ½" NPTF connection.

1 Shutoff valve
2 Filter/regulator
3 ½" NPT Female

Plasma systems that require compressed air should be supplied from a separate source, through an air line dryer.

CAUTION

Compressed air for plasma systems must be clean and dry. Poor consumable life and starting problems will result if oil and moisture are present in air line.

3.3.9 Water Requirements

The water requirements for this machine are listed below. The water input line must be PVC, rubber or stainless steel with manual shutoff valve. Other auxiliary equipment such as water recovery and conditioning systems, use water in closed circulating systems and do not require an external water source.

Water Requirements for Cutting Machine

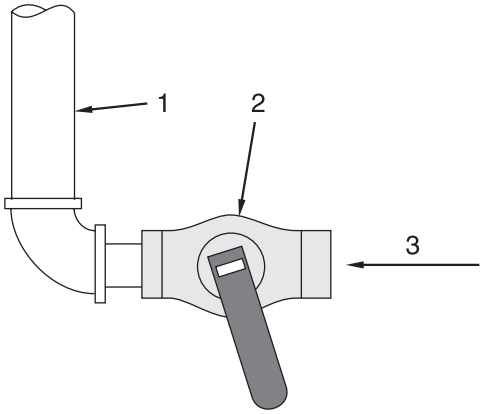
	Flow Rate	Line Pressure	Supply Connection
Cutting Head		5,000 psi	3/8" S/S, ¾"–16 Female (ESAB supplies plumbing from pump to cutting head) [1]
Pump Cutting Water Inlet	Up to 2 GPM	5 – 30psi	½" PVC Pipe, ½" NPT Female
Cutting Table Water	[2]	50 psi (3.4 bar)	1" water hose, 1" NPT Female

[1] Install the water filtration system with ¾" NPT connections.

[2] Most cutting tables are designed to automatically refill when water level is low. This water input connection is usually piped. Refer to the installation information provided with your table.

NOTICE

Contact your local water department or authority to obtain possible restrictions regarding the disposal of cutting table water.



Typical Service Water Supply Connections

Water supplies must have a shutoff valve and be terminated using ½" NPTF connection.

1 Regulated supply

2 Shutoff valve

3 ½" NPT female

3.4 Rail and Gantry Installation

3.4.1 Introduction

The rail and gantry installation phase includes all necessary steps from receiving machine to connecting supplies and cables. Customer must complete all items in this section before the ESAB representative arrives.

3.4.2 Receiving the Machine

Upon receiving machine, carefully open and inspect all crates and cartons for shipping damage. Contact your shipper immediately if any damage is evident.

As you unpack machine, carefully inventory all parts against the packing list. Immediately report any discrepancies.

3.4.3 Rail Installation

3.4.3.1 Introduction

This section provides a basic guide to completing rail and machine installation. **When possible, the machine is shipped pre-assembled, requiring minimal installation work.** However, longer rail systems or special shipping requirements may require machine to be shipped disassembled. In this case, assemble and install rails as shown in this section.

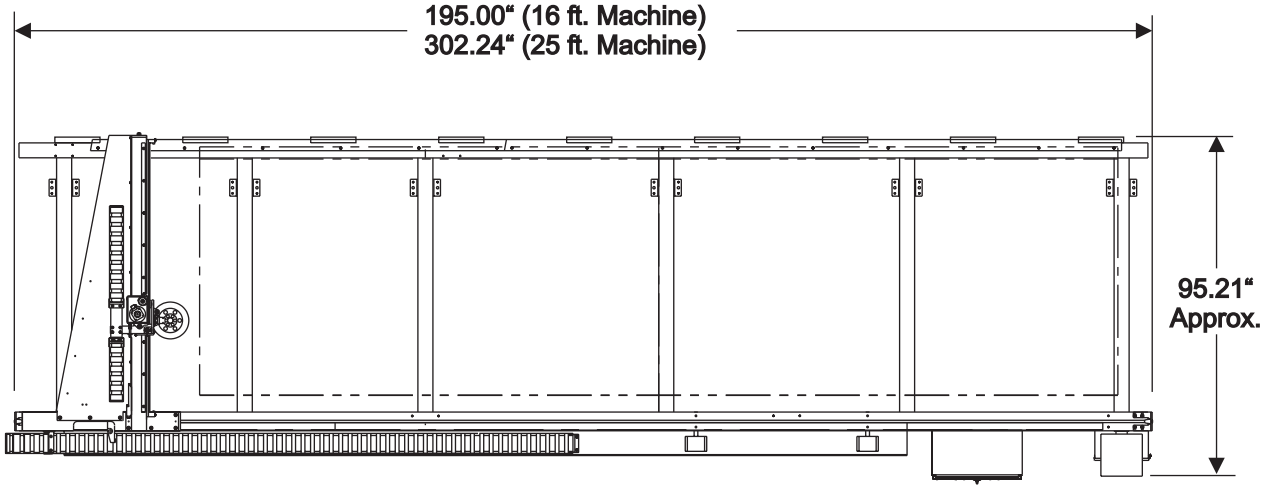
3.4.3.2 Rail Installation Tolerances

Install rail system to the following tolerances. Although very strict, these tolerances are attainable using the tools and techniques described below. Achieving these tolerances ensures accurate and repeatable performance from your ESAB cutting machine.

- Guide rail straight to within ± 0.005" (0.13mm) over entire length of rail.
- Track gauge must be within ± 0.031" (0.78mm) over entire length of rail system.
- Top surface of guide rail level within ± 0.002 " (0.05mm) per every 10 ft (3.3m) of longitudinal travel.
- Top of floater rail track bar level within ± 0.031" (0.78mm) over entire rail system.
- Top surface of rails level in the transverse direction within ± 0.002" (0.05mm).
- Top and side edges of rail joints should be flush with no gaps between rail ends.

3.4.3.3 Area Preparation

Clear out machine installation area. Determine area size from machine outline drawing below. Situate entire rail system on a single slab of reinforced concrete, free from severe vibration and major cracks. Floor should be at least 6" (152mm) thick. Floor must not have any severe height changes and must not have an overall height change greater than 2" (50mm). If new concrete must be poured to meet these conditions, allow enough time for concrete to cure before rail installation.



3.4.3.4 Rail Installation Tools

The following tools and materials are needed to complete rail installation:

1. Precision spirit level, 14" (357mm) long, graduated at 0.0005" (0.013mm) per ft.

2. Small precision machinists' level with ground vial, about 4" (102mm) to 6" (152mm) long, graduated at 0.005" (0.13mm) per ft.

3. Fifty-foot spool of steel music wire, about 0.010" (0.25mm) to 0.012" (0.30mm) in diameter.

4. Three precision spacers. Square key stock, or machine tool bits may be used. Spacers may be about ½" (13mm) thick by 2" (50mm) long but all three must have the same thickness within 0.0005" (0.013mm).

5. A 3/8" (9.5mm) drive socket wrench, including long ratchet handle (breaker bar), 8" (203mm) extension and metric sockets. Air or electric impact tools help speed installation.

6. Metric and inch combination wrenches.

7. At least two "C" clamps suitable for clamping music wire to rail sides. Requires 3" (75mm) opening capacity. Kant Twist toggle-type parallel clamps are recommended.

8. At least two "C" clamps suitable for clamping the gauge rack to drive rack to set proper rack joints. Require 3" (75mm) opening capacity.

9. Steel measuring tape 100 ft (33m) long.

10. Chalk line with chalk.

11. Supply of cleaning rags.

12. Nonflammable, non-toxic cleaning solvent to remove rust preventative on rails and rack.

13. Large hammer drill capable of drilling ¾" (19mm) diameter holes in concrete.

14. Forklift or other means of lifting and moving rail sections into position. Always lift rail sections from bottom. If rail sections are lifted by overhead crane, use nylon straps to prevent damage to machined surfaces.

3.4.3.5 Clean Rails

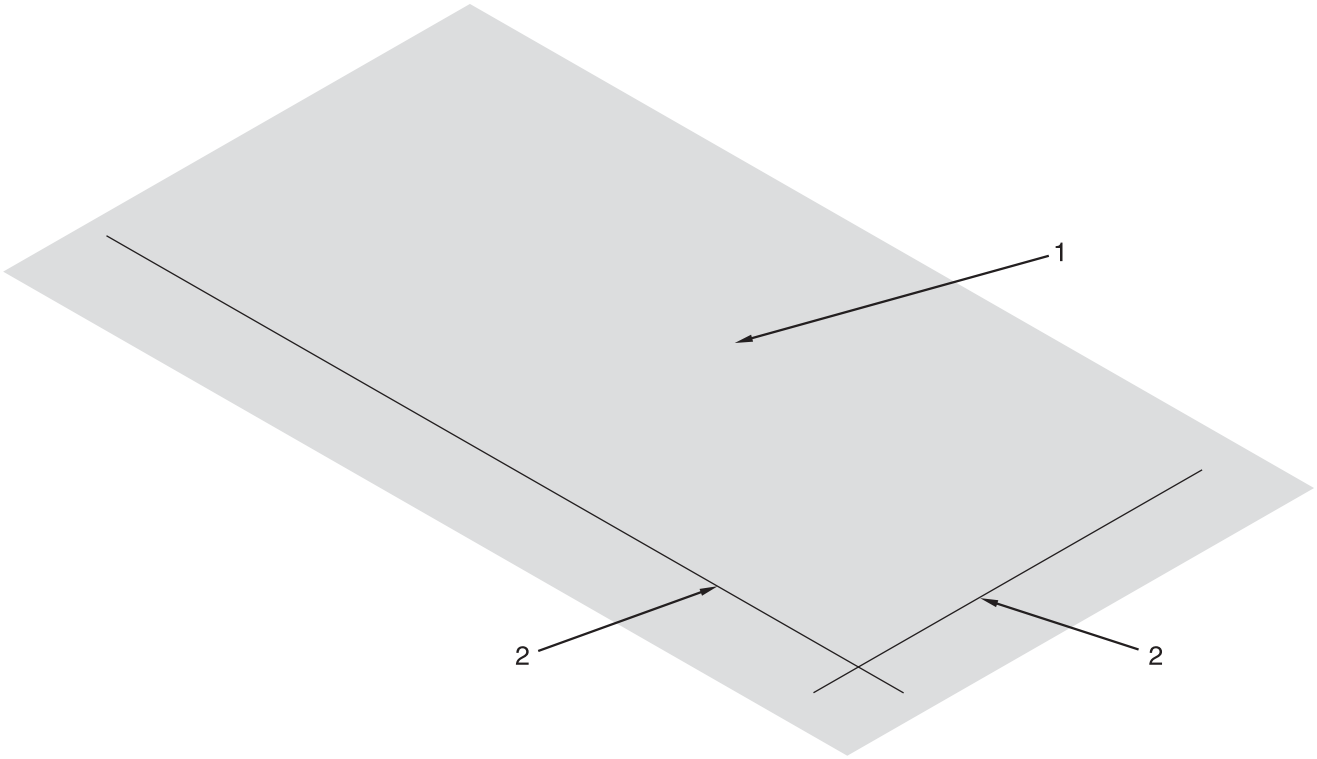
- Remove rails from shipping crates and clean off rust preventative coating put on at factory. Use a nonflammable, non-toxic solvent. Be very careful when handling rails to prevent damage to machined surfaces. Take safety precautions when moving rails to prevent injury to personnel.

- Clean tongue and groove at rail joint. Clean out any burrs or debris from all machined surfaces.

- Clean out any burrs or debris from all rail-mounting holes.

- Clean flat bar strip on the floater rail.

3.4.3.6 Layout Rail Location Chalk Lines



1 Machine area

2 Chalk lines

1. Determine guide rail installation based on customer's site, side of machine where control console is located and machine service inlet side.

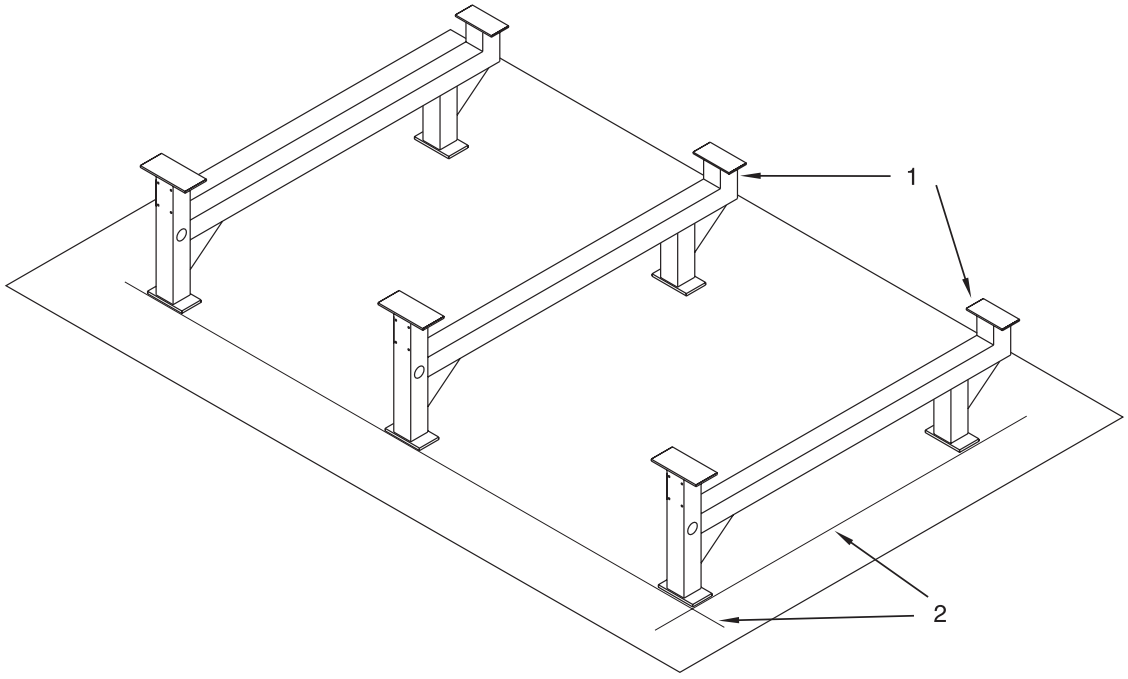
2. Use the chalk line to layout a line representing the centerline of the guide rail.

3. On that line determine where the front end of the rail system will be. Layout a second chalk line perpendicular to the original chalk line.

3.4.3.7 Assemble Rail System

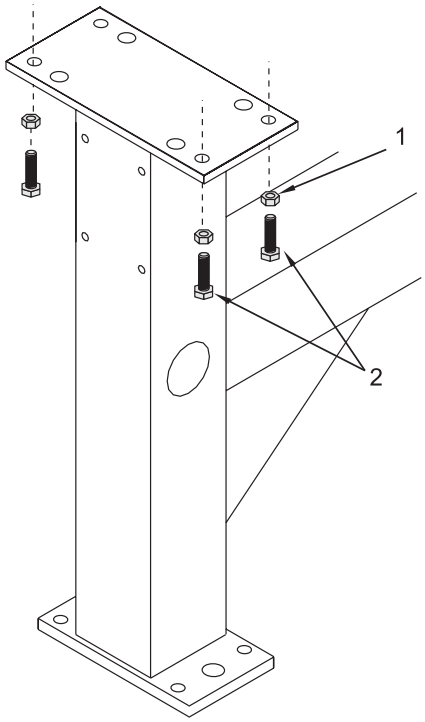
Assemble rails in three steps:

1. Set cradles in place.
2. Set rails on cradles.
3. Align and level rails.



1 Rail cradles

2 Chalk lines



1 M12 jam nuts

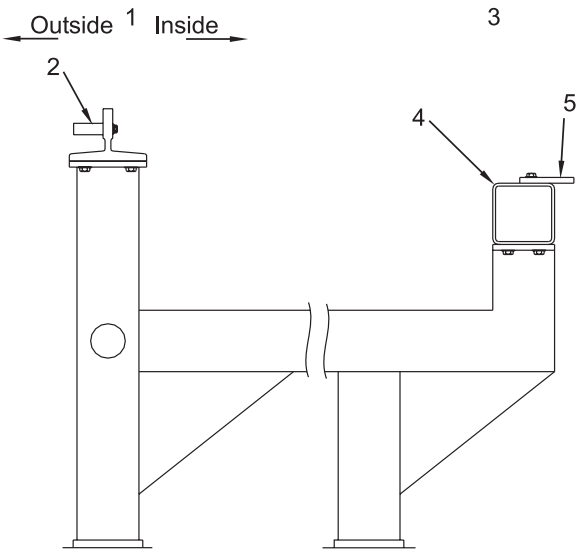
2 M12 x 30mm bolts

Setting the Cradles In Place

Set each cradle in its location along the chalk line for each rail. Line up anchor boltholes directly over chalk line.

Place each cradle as shown so guide rail is mounted on the straight, or left-hand pedestal.

Install an M12 x 30mm hex head cap screw and M12 hex jam nut in each cradle jacking bolthole. Make sure these bolts do not protrude through top pad of cradle.



1 Guide rail

2 Rack

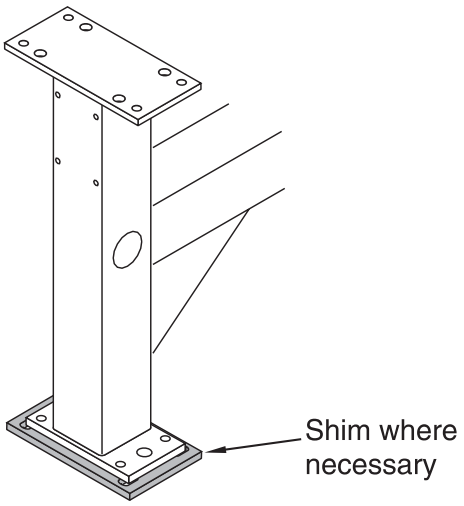
3 Floater rail

4 Floater tube rail

5 Flat bar track

Setting the Rails On The Rail Cradles

After cleaning rails, place T-rails on top of the taller cradles, on the left-hand side of the machine. This is the guide rail. Place floater rail tube on the shorter cradles, on the right hand side of machine. On the guide rail, mount the rack on the outside of the rail. On the floater rail, mount the flat bar track toward the outside of the tube.

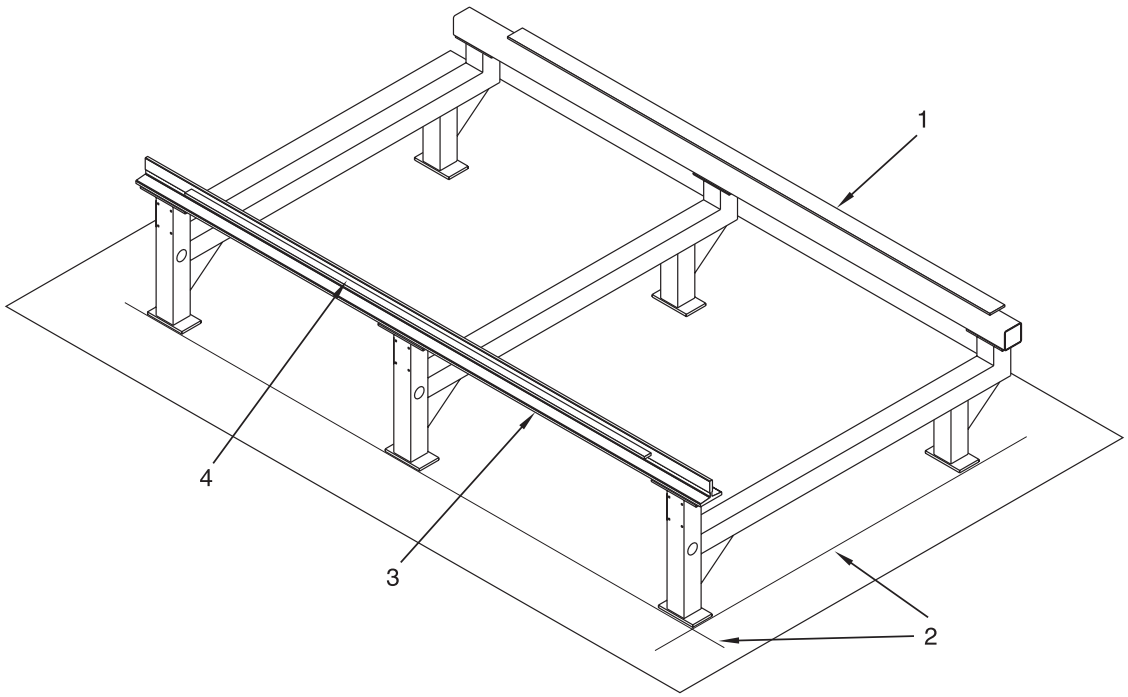


Level Rail Cradles

After assembling the rail to the cradles, roughly check for straightness and level. Do this before anchoring the rails to simplify leveling and straightening.

Use the precision spirit level to check the slope of the rail between each cradle. Add shim plates where necessary to bring tops of all rail cradles within 1/8" (3mm), or to compensate for gaps between cradle and floor.

The assembled rail appears as shown below. Shown is a 16 ft (5.2m) rail system. The 25 ft (8.2m) rail system consists of a 16 ft (5.2m) rail and a 9 ft (3m) extension.



1 Floater rail

2 Chalk lines

3 Guide rail

4 Drive rack mounted to outside of rail

Aligning and Leveling the Rails

If rail cradles were aligned and leveled properly, this step should be a quick check of rails. However, you must verify the rails are within the adjustment range of the rail cradles before drilling anchor holes.

With rail system completely assembled, but not yet anchored to the floor, complete a rough alignment of the entire rail system. Tighten all rail mounting hardware as you go.

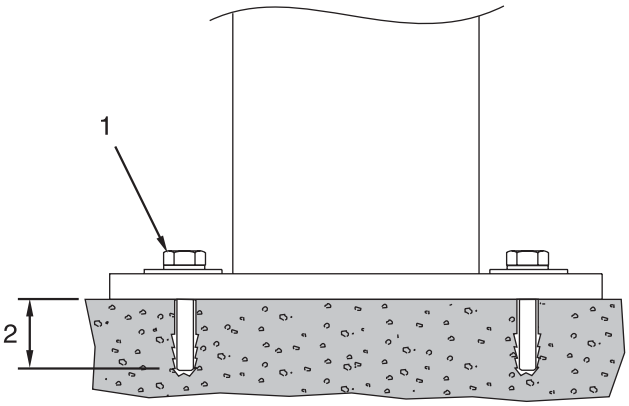
1. Verify rail system position.

2. Using a nylon string stretched over the length of guide rail, roughly straighten rail by moving cradles until rail is roughly straight, within ±1/16" (1.5mm).

3. Use the precision spirit level to check the slope of the top surface of the rail between each rail pad location. Add shim plates, if necessary, to raise all rail pad locations within ±1/8" (3mm).

4. Use the same techniques to adjust the floater rail, so it is straight and level within 1/8" (3mm).

3.4.3.8 Drill Floor & Anchor Rails



1 Anchor bolt

2 4" minimum

With entire rail system straight, level and parallel within 1/8" (3mm) drill the floor and install anchors.

Different types of anchors and methods of anchoring base plates to the floor may be used, but it is the customer's responsibility to provide a solid machine foundation that will not allow the rail system to move or become misaligned during operation. Anchor bolts must reach at least 4" (102mm) into the floor.

1. Starting at the front of the guide rail, drill both anchor holes for the first cradle. Use the anchor holes in the base plate as a template and drill through the holes without moving the rail assembly. Install all four anchors, washers and nuts. Finger tighten nuts on anchor bolts.

2. Move to the next cradle and repeat procedure. Do not move rail system while drilling floor.

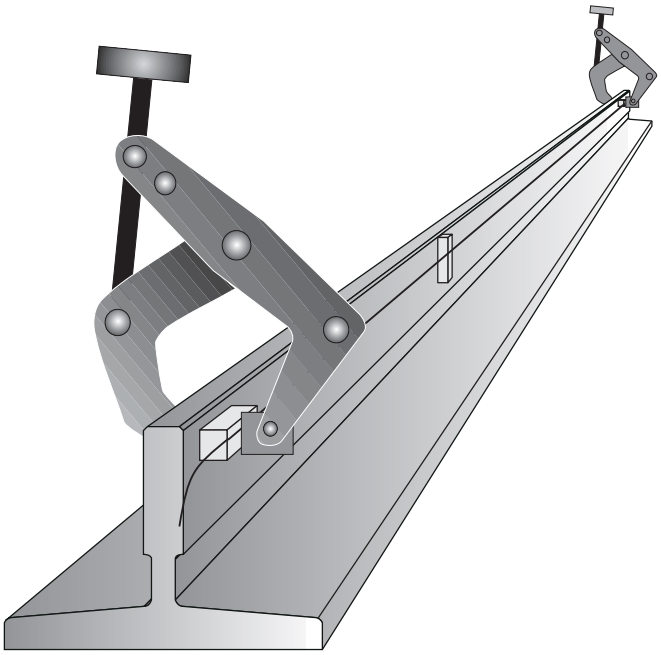
3. Complete entire guide rail. Double check the rough level, straightness and rail gauge dimension before moving to the non-guide rail.

4. Check the rail gauge dimension between guide and non-guide rails. Make necessary adjustments to position of cradles to maintain correct gauge dimension ± 1/16" (1.5mm).

5. Starting at front of floater rail, drill all four anchor holes for the first cradle. Install all four anchors, washers and nuts. Finger tighten nuts on anchor bolts.

6. Move to next cradle and repeat procedure. Do not move rail system while drilling floor.

3.4.3.9 Final Align & Level

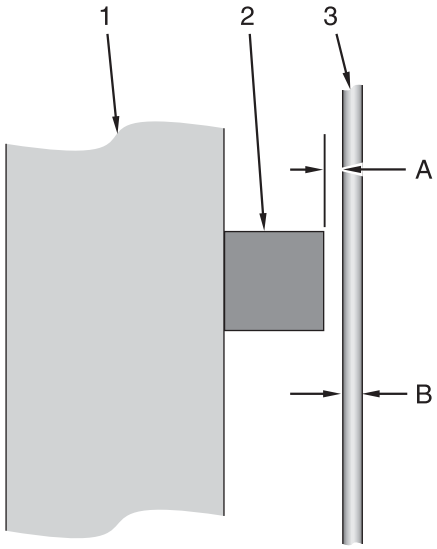


Final Straight

Using music wire stretched over the length of the rail, straighten rail to tolerance listed earlier in this chapter. Start with the guide rail.

1. Use a C-clamp to clamp music wire to the side of the rail at each end. Clamp a precision spacer between the music wire and the side of rail to establish a precise distance between rail and wire. Stretch wire very tight. Verify that wire is flat against spacer by inserting a third spacer right next to the clamp.

2. Using the third precision spacer, check distance between the music wire and the side of rail at each cradle location over entire length of rail.



3. Tap side of the rail base with hammer to move rail from side to side. To reach the straightness tolerance, adjust rail until the gap between spacer and wire is within one-half the wire width when using 0.010" (0.25mm) wire. Use a magnifying glass to verify.

4. Once guide rail is straight, fully tighten all anchor bolts and recheck straightness. Make final level adjustments and recheck straightness before moving to floater rail. Adjusting rail elevation slightly disturbs the rail straightness.

1 Rail

2 Spacer

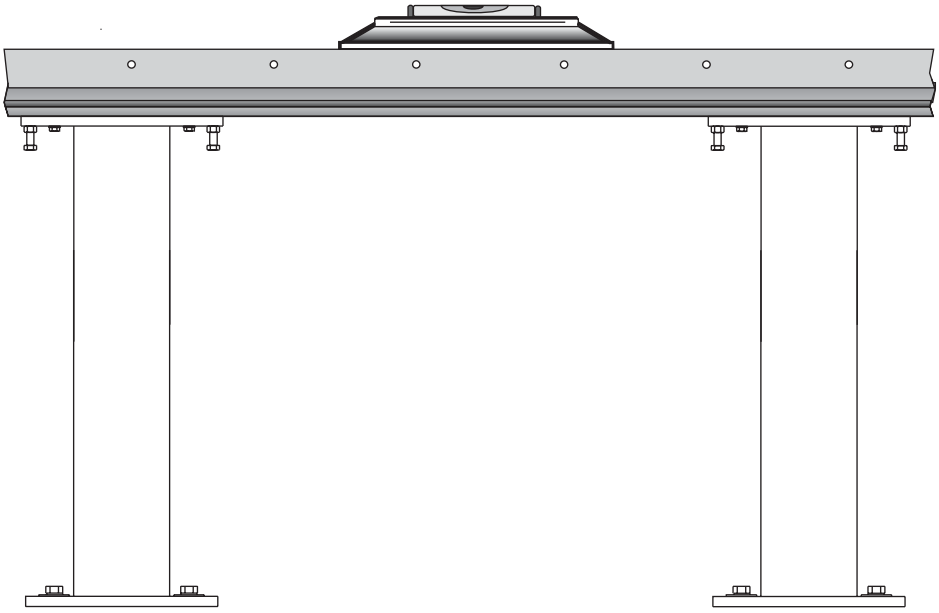
3 Wire

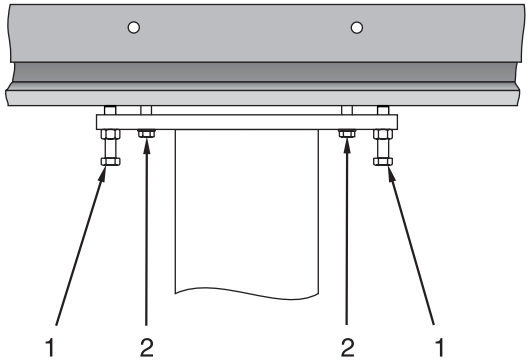
A Not to exceed ½ width of wire

B 0.010" wire

Final Level

To bring rail within tolerance, use a precision spirit level to check the incline of the rail between each cradle. Starting near the highest cradle, place precision level on the top of the rail between the two cradles and adjust the lower jacking bolts at the lower cradle until span is level. Move down length of rail, checking between each cradle. Tighten all hardware at each pad.

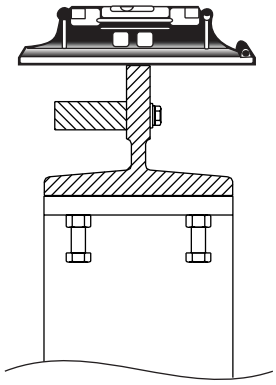




While raising the rail at each cradle using the jacking bolts, it is necessary to loosen mounting bolts. After adjusting rail at each cradle, tighten mounting bolts and recheck level.

1 Jacking bolts

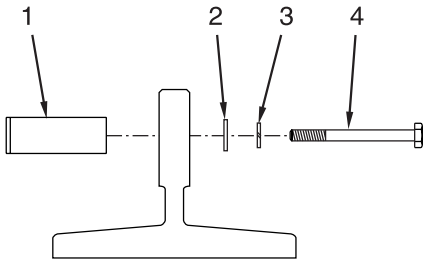
2 Mounting bolts



While adjusting rail elevation, the top surface of the rail must be kept level in the transverse direction. Use the small precision level placed on the top surface of the rail to adjust jacking bolts as necessary.

3.4.3.10 Install Accessory Hardware

3.4.3.11 Install Rack



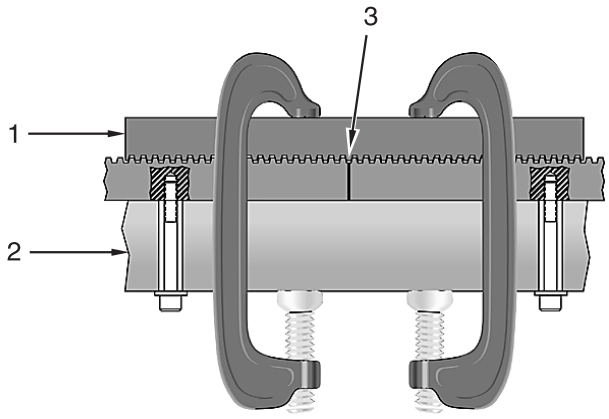
1 Rack
2 M6 flat washer
3 M6 lock washer
4 M6-1.0 x 3mm hex head bolt

After completing Steps 1 - 3 of rail installation, install the drive rack sections to the side of the rails. Mount racks using hardware supplied with rail system, as shown here.

Mount racks on the side of rails facing the outside of the rail system, away from the cutting table.

Mount all rack sections and finger tighten hardware.

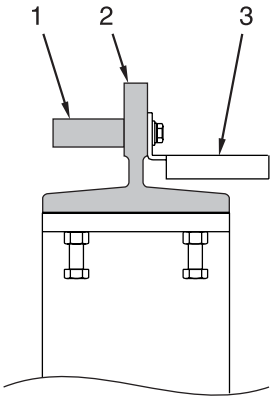
Start adjusting racks at center of rail system. Tighten first rack section then align first rack joint. Move outward from center of rail, aligning each rack joint before tightening the mounting bolts.



1 Gauge rack
2 Rail
3 Rack joint

Align rack joints using the short piece of the dummy rack as a template. Use two C-clamps to clamp dummy rack into main rack, forcing correct spacing between the teeth at the rack joint. Do not overtighten C-clamps. When properly aligned, there is a small gap between the ends of the rack sections, but tooth spacing is consistent. This step must be done properly, since machine accuracy in the longitudinal axis depends on proper spacing of rack joints.

With the gauge rack clamped in place, tighten bolts on second piece of rack. Align each rack joint, making sure the distance from the top surface of the rack to the top surface of the rail remains constant.



1 Rack

2 Rail

3 Limit switch cam

Install Limit Switch Cam

A limit switch cam is included with the rail hardware. The machine uses the cam to detect the home position. It is mounted inside the rail at the back of the machine.

Install Powertrack Tray

Install the powertrack support tray to the side of the cradles. The powertrack tray mounting location depends on the machine configuration. The powertrack tray is mounted to the left rear of the rail system if the control console is mounted at the left front position. The tray is mounted to the left front of the rail system if the control console is mounted at the right rear position. This positioning maintains maximum separation between plasma torch leads and CNC interface cables.

3.5 Gantry Installation

Introduction

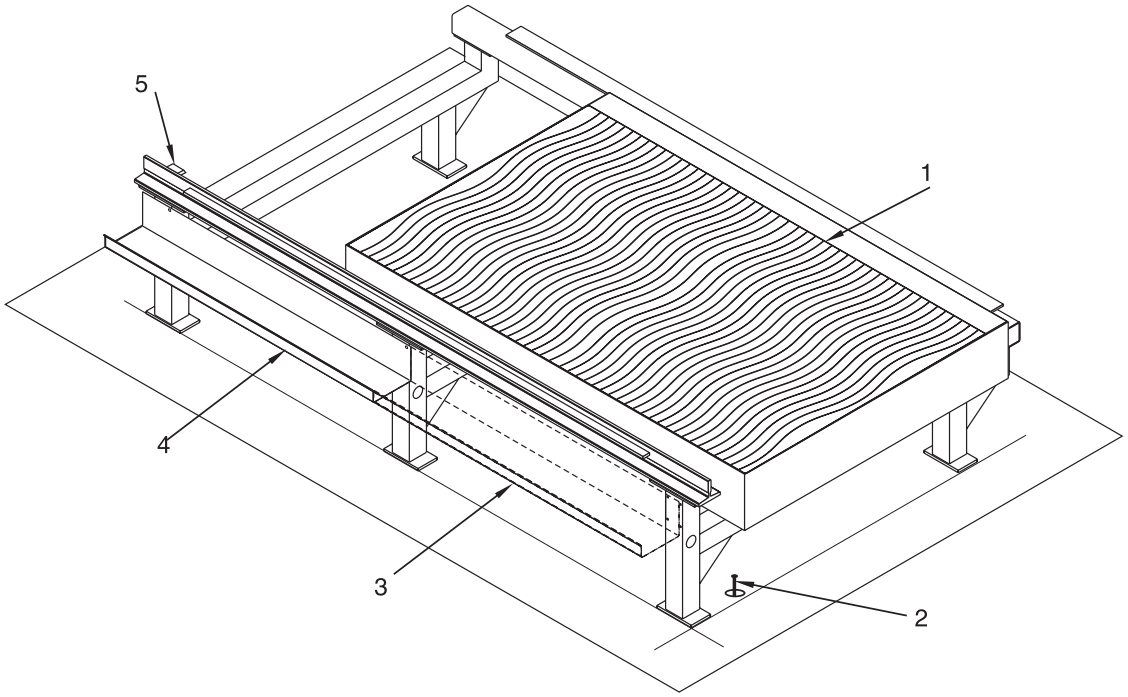
This section discusses the steps to complete machine gantry installation.

Install Ground Rod

Install ground rod if not already in place. The ground rod can be located underneath the cutting table. (Must be installed before table is set in place.)

Install Cutting Table

Install cutting table between rails mounted to the rail cradles.



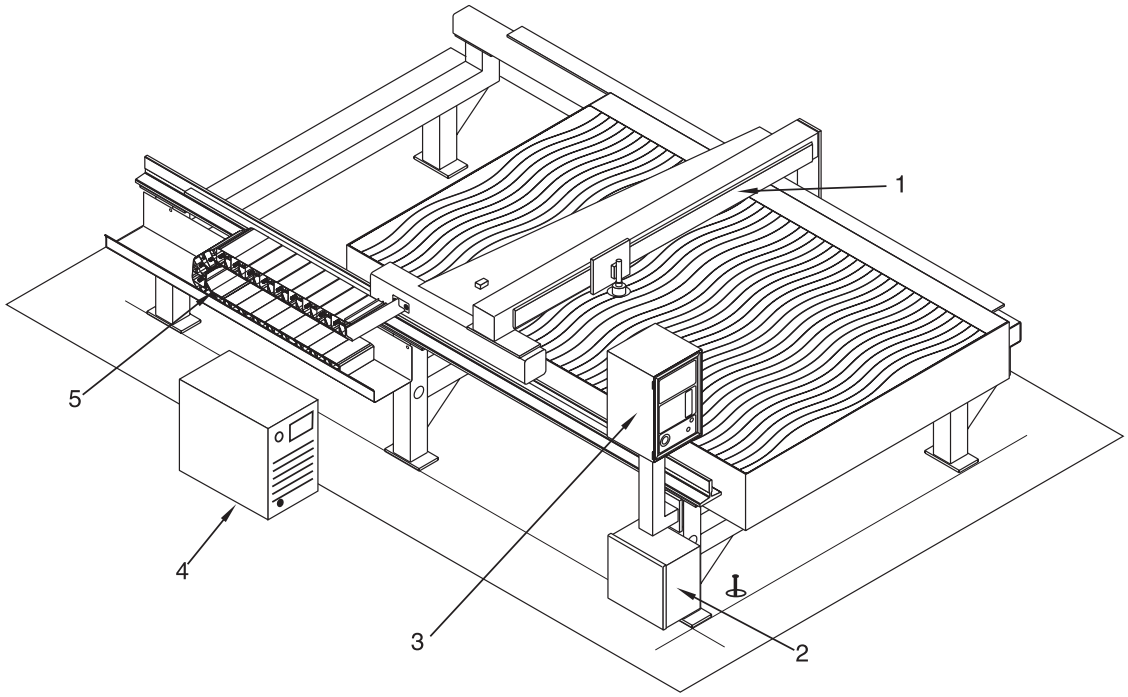
1 Cutting table
2 Ground rod
3 Powertrack support tray (alternate position)
4 Powertrack support tray (standard position)
5 Reference switch cam

3.5.1.1 Install Machine Gantry

When finished, the gantry will appear as shown below depending on console location. Follow procedures below to ensure proper installation.

Standard Console Location

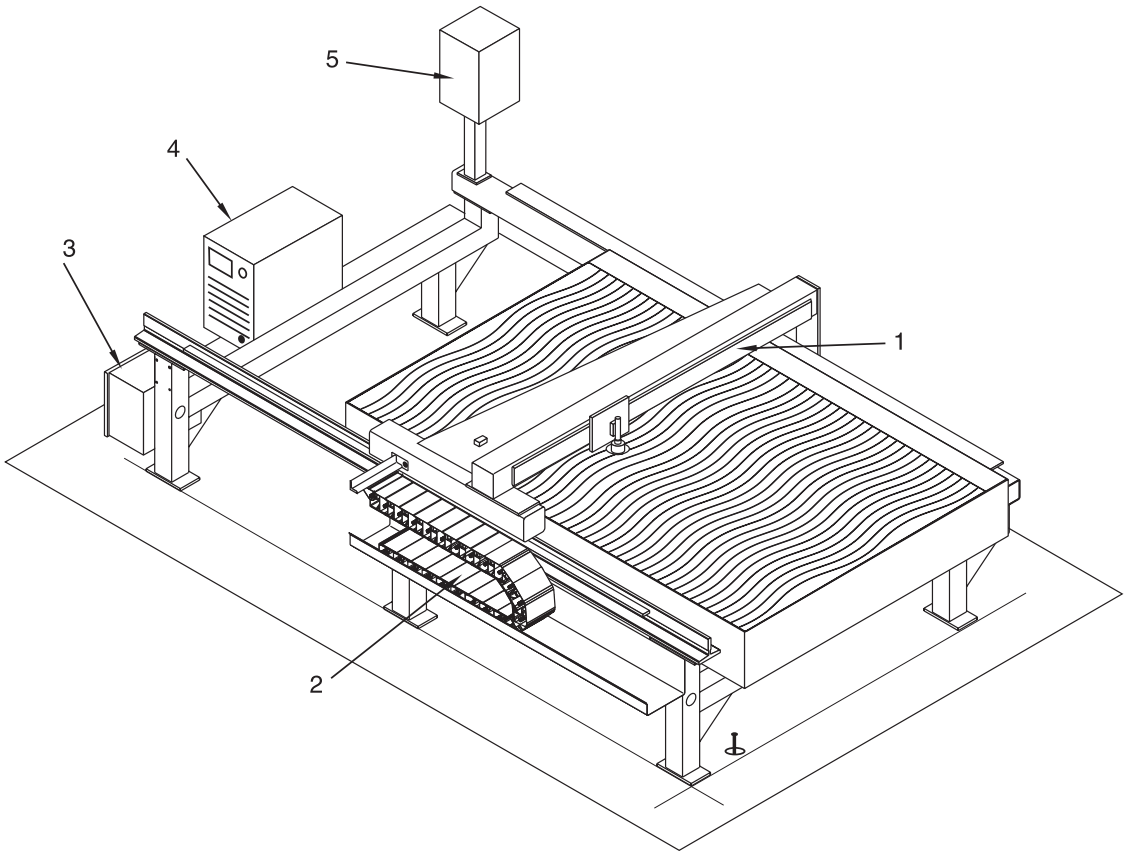
A machine configured with a standard console location is shown here.



1 Machine gantry
2 Electronics cabinet
3 Control console
4 Plasma power supply
5 Powertrack

Alternate Console Location

A machine configured with an alternate console location is shown here.



1 Machine gantry
2 Powertrack
3 Electronics cabinet
4 Plasma power supply
5 Control console

3.5.1.2 Setting Machine On the Rails

For the most part, the machine is shipped pre-assembled and ready to be placed on the completed rail installation. The following procedures are a guide for completing that step of machine installation.

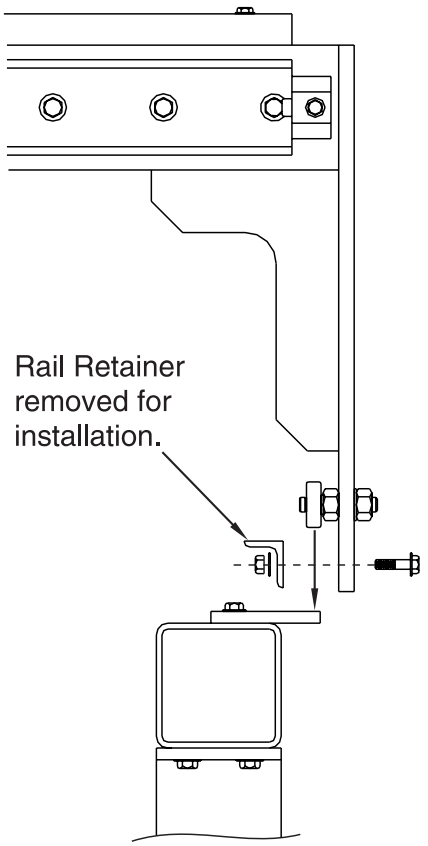
1. Follow your plant safety guidelines. DO NOT allow unauthorized personnel near machine during lifting and transporting.

2. Remove all obstacles from transporting path of machine to installation site.

3. If lifting from overhead make sure slings or chains DO NOT hit or apply pressure to machine components, i.e. cross rails, carriage, etc. If lifting with forklift, spread forks to widest spacing available to provide maximum lifting support. Forks should be blocked so support is distributed along beam and deck. DO NOT allow forks to contact machined rails on front of beam.

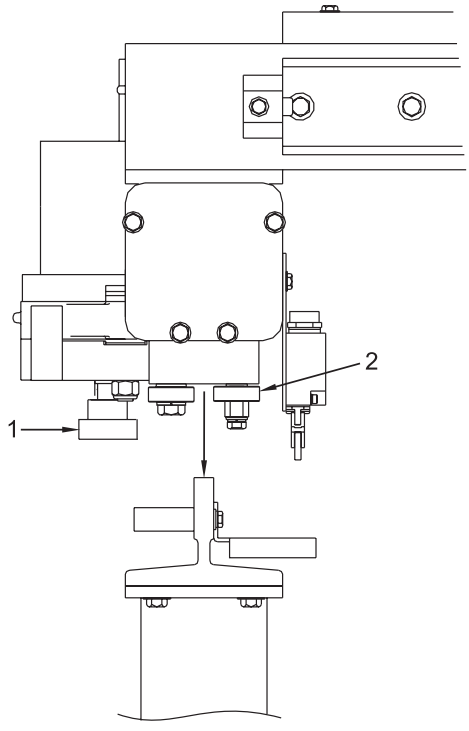
4. After attaching lift devices at determined points for balance, and before transporting machine, make a limited height (few inches) test lift to determine proper balance. Make adjustments to lift points as required to achieve balance.

5. Before lifting and transporting machine, secure cross carriage to prevent motion during lifting.



6. Before setting the machine on rails, disengage the drive pinions and adjust eccentric side guide bearings out to maximum clearance. This assures drive pinions, gearboxes, bearings and rails are not damaged when machine is lowered onto rails.

7. Remove floater rail retainer to allow floater side bearing to be set on track bar.



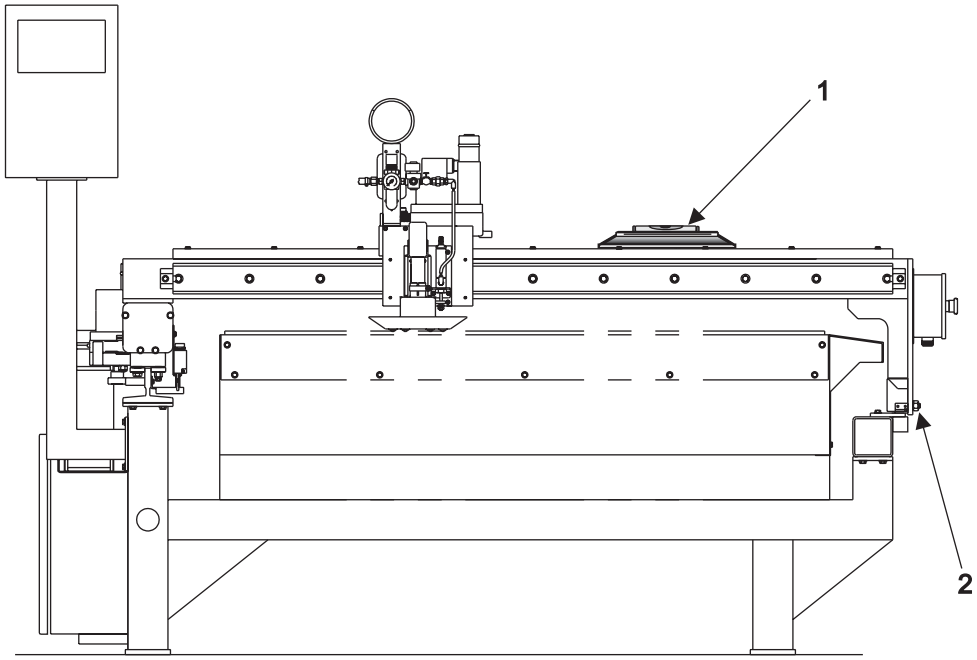
8. As machine is lowered onto rails, check the following:

   - Wheels must set down on rail surface.
   - Side guide rollers must clear side edges of rails.
   - Make sure drive pinions are not jammed against racks.

1 Drive pinion pulled out

2 Eccentric bearing adjusted out

9. Once machine is resting on the rails, place a precision spirit level on top of the beam to verify machine is level. Adjust the wheel on the floater side of the machine to level beam if necessary.

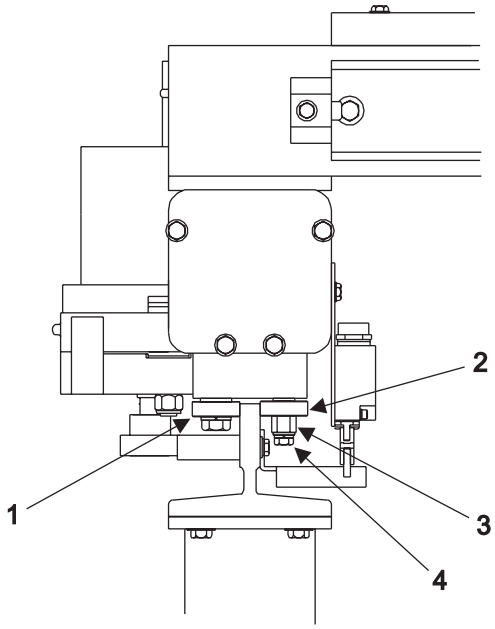


1 Precision spirit level

2 Adjustable wheel

Side Guide Bearings

The left side truck is designated as the “guide” truck equipped with side guide bearings on each side of the rail. These bearings keep the truck straight on the rail. The bearing is mounted on a fixed shaft outside the rail. On the inside of the rail, bearings are mounted on eccentric spacers that allow space between the bearings to be adjusted. During installation, set these adjustable bearings to the proper clearance.



1. Carefully push machine up and down rail system until both straight bearings are contacting the rail. Check for rail contact by trying to turn bearing by hand.
2. Once both straight bearings are in contact with the rail, loosen bolt in the eccentric spacer.
3. Turn eccentric spacer in toward rail.
4. Using a 0.005" (0.13mm) shim, or feeler gauge, adjust eccentric until bearing applies pressure to shim.

1 Fixed bearing
2 Bearing
3 Eccentric bushing
4 Shoulder bolt

5. Tighten bolt while holding eccentric spacer. Roll machine off shim material.
6. When set properly, only one bearing will contact rail at any time, the other bearing has a maximum 0.003" (0.07mm) to 0.005" (0.13mm) clearance.

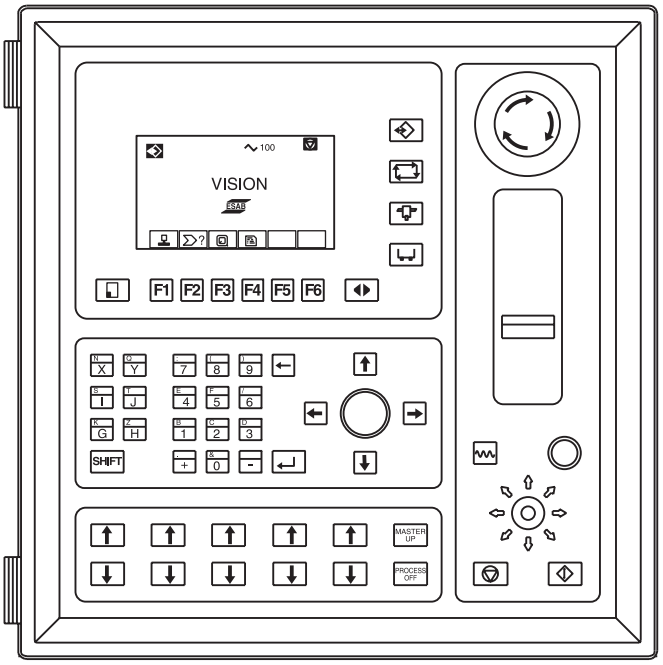
Contents

4.1 Introduction

This chapter provides operating instructions for the PieceMaker 2 Shape Cutting Machine and setup and operating procedures for cutting processes normally used on this machine. For detailed information on the Vision Computer Numerical Control (CNC) operation, refer to the Vision CNC operation manual. For information on writing part programs for the Vision CNC, refer to the Programming Instructions for the Vision CNC, Form F-14-082. For detailed instructions on the operation of plasma equipment, refer to the appropriate instruction manuals.

A shape cutting machine requires a certain amount of preliminary setup before the actual operating process. The information in this chapter, combined with information contained in the literature for specific equipment (regulators, torches, nozzles, marker, etc.) provides instructions for safe, efficient machine use.

4.2 Control Console

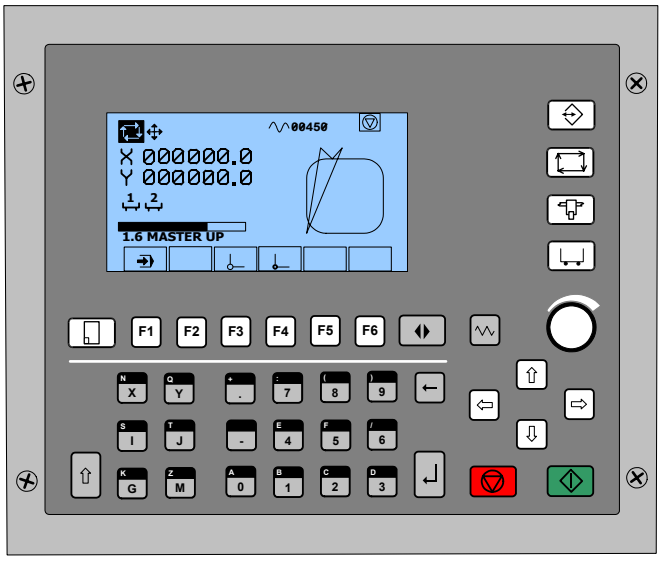


The Operators Control Console is the primary operator control that directs the cutting machine. It gives the operator control of all machine functions through one compact panel.

With the Vision CNC, all machine controls are centralized and integrated into the CNC. Therefore, all operator controls and adjustments for program input, machine motion, the cutting and marking process and carriage control are controlled through the CNC.

The Vision family of CNC controls uses the same principles of operation. The Vision 1000 is shown here. For detailed CNC operation information, refer to the appropriate Vision Control manual.

Vision 1000



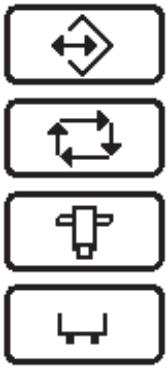
Vision LE

4.2.1 Principles of Operation

Control of part programs, machine motion, cutting processes and cutting stations are all accomplished through the Vision CNC console.

Vision control operation is based on the use of four window buttons, six function keys, Menu Extension key, Shift key and Page key. These main keys, located on the control panel, are used to navigate through screens and selections appearing on the display.

Each of the four main window buttons accesses a different group of menu options. Use Shift Key to access additional windows.



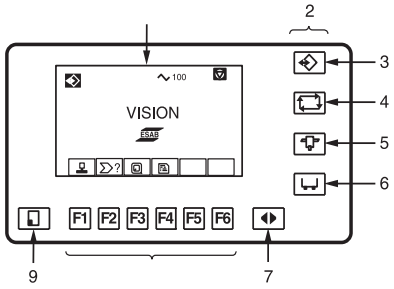
Data Input Window

Motion Window

Process Window

Station Select Window

Menu selections are made by pressing the soft key directly below the symbol of the desired action. The Menu Extension key accesses additional menu items when there are more than six items on a single menu level. The Page key steps backward through menu selections, or “backtracks” out of a selection.



1 LCD display
2 Window buttons
3 Data input (service)
3 Motion
5 Process (timers)
6 Station (up/down)
7 Menu extension key
8 Function keys
9 Page key

4.2.2 Basic Windows

Data Input Window

The basic menu of the **Data Input Window** has menu icons for:

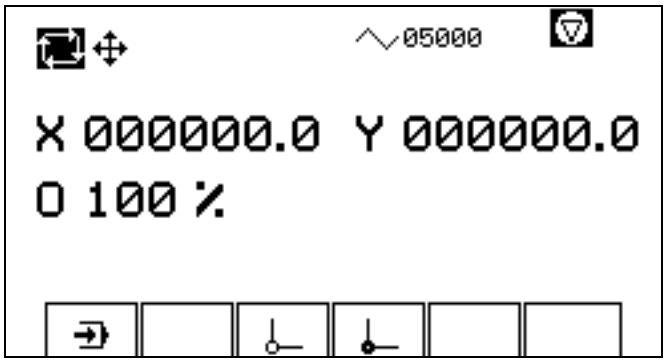
Downloading Programs via UDL

Managing Programs in Memory

Shape Library

Program Editor

Movement Window



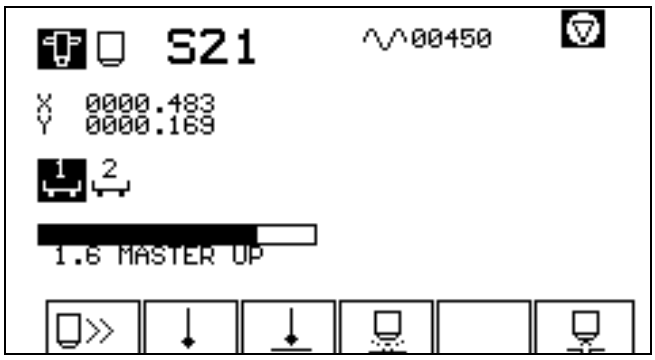
The basic menu of the **Motion Window** has menu icons for:

Automatic Mode for Program Execution

Movement to a Fixed Point

Referencing Machine

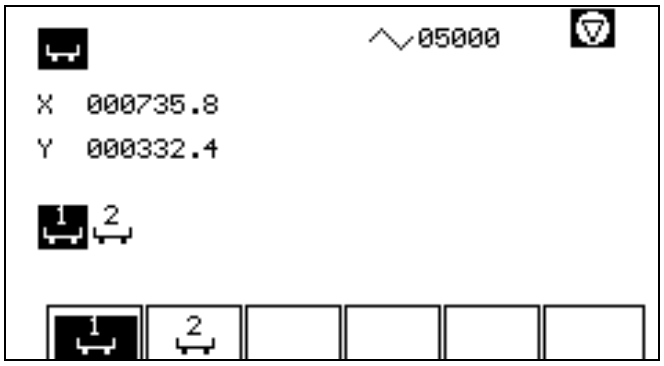
Process Window



The **Process Window** sets up and controls the cutting process. Appropriate process controls are displayed for stations currently selected. Processes are automatically selected when station is turned on.

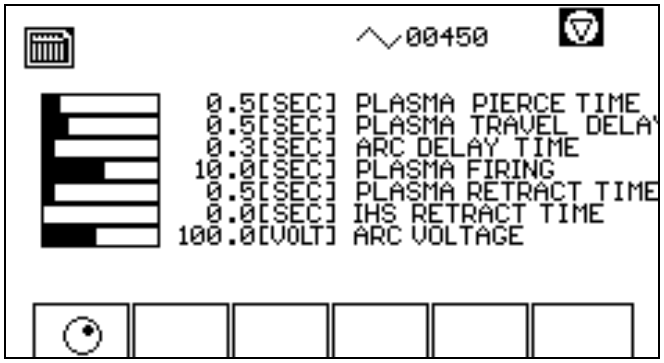
Items controlled in the Process Window include automatic height control, Process On/Off, cutting table water controls, station band clamping and manual marking or scribing.

Station Select Window



The **Station Select Window** turns desired cutting station(s) on and off. A menu icon appears for each cutting station installed on the machine. Function keys turn the stations on and off.

Process Parameter Window

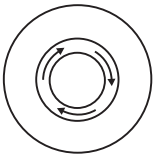


Press **Shift-Process Window** to access the Process Parameter Window.

This window adjusts process timers and parameters. To change a timer or process setting, use the handwheel (Speed Knob on Vision LE) or cursor keys to scroll the list. When the cursor is in front of desired timer, press and hold **F1 Adjust Timer**, while turning the handwheel.

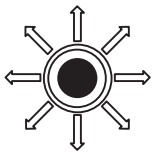
4.2.3 Manual Controls

Manual controls provide operator control over program execution and machine motion.

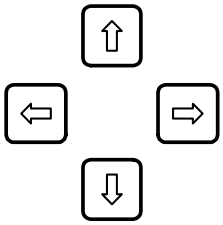


Emergency Stop button is provided for emergency shut down of both process and machine motion.

Speed Potentiometer adjusts machine speed, or feed rate, during automatic cutting and manual motion.



Joystick manually moves machine in jog modes.



Directional Keypad manually moves machine in jog moves. Takes the place of a joystick on the LE model.

Rapid allows the operator to toggle in and out of rapid feedrate during manual jogging of machine.

The green **Program Start** button starts part program execution in automatic mode.

The red **Program Stop** button halts execution of a part program in automatic mode. Programmed motion is stopped, but cutting processes are not turned off.

Process Off stops the cutting or marking process. For processes equipped with automatic height control, a Master Up cycle is performed, raising motorized tool lifts. Use this button with **Program Stop** to manually stop a programmed cutting sequence.

Master Up raises all selected motorized station lifts for as long as button is pressed.

4.3 Basic Operating Procedure

This basic operating procedure outlines the basic steps to cut production parts. Refer to subsequent sections for more detailed step descriptions.

Procedure

1. Power on machine.

See Page 4-9

2. Homing the machine.

See page 4-11

3. Download a program.

See Page 4-12

4. Jog to start point.

See Page 4-13

5. Select station

See Page 4-14

6. Start program execution.

See Page 4-15

7. Plasma operation.

See Page 4-18

8. Insulation cutting operation (if required).

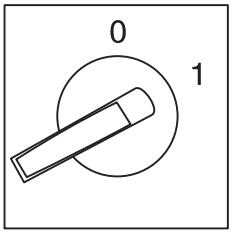
See Page 4-24

4.4 Machine Power

4.4.1 Power On

Machine power on is a three-step process.

Step 1: Main Power Switch

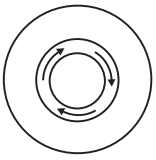


The Main Power Switch is located on the electronics cabinet.

1 = Power ON

0 = Power OFF

Step 2: E-Stop Button



Once the main power switch is ON, the **Emergency Stop** button enables or disables power to the machine drive and cutting processes.

- Turn CLOCKWISE for power ON.
- PUSH for power OFF.

When powered up, the CNC performs a Power On Self-Test and displays the **Data Input Window.**

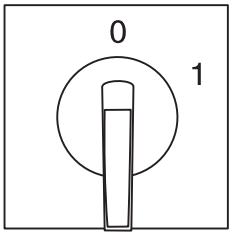
Step 3: Shift-Program Start

Push **Shift-Program Start** to turn on +24 volt power supply and enable the Vision Control outputs. Do this any time the **E-Stop** button is pressed or machine power is removed.

4.4.2 Power Off

To turn cutting machine power off :

1. Push **Shift-Program Stop** to switch off +24 volt power supply, disable drives and the CNC outputs. The CNC remains powered up, but machine gantry is powered down.



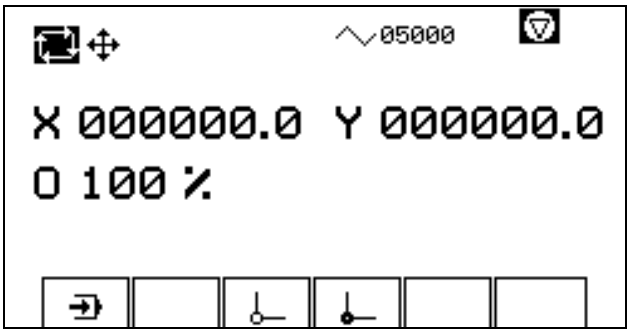
2. Leave CNC powered up, unless machine will be inactive for a long time. If so, turn main power switch to “0” to turn off all power to the Vision control.

3. Leave wall disconnect switch (or breaker) on unless performing machine maintenance.

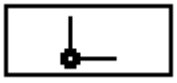
4.5 Homing the Machine

Each time the machine is powered up and before running any programs or moving the machine, the gantry must be “homed”. This requires sending the machine to the home position cams in each axis. This is where the CNC detects the home point, which sets the reference point for all machine movement. This allows the CNC to resume part cutting in case of power failure and enables the fixed points and software limit switches.

Press **Motion Window**.



The Motion Window appears. If the Motion Window is not at the main level, as shown, press **Page** until this screen appears.



Press **F4 Reference Point Movement**.

Adjust **Speed Potentiometer** to low speed. If machine speed is too fast during the homing procedure, machine will automatically E-Stop.

⚠ WARNING

Crush hazard.

Machine starts automatically.

Before pressing Start, verify no personnel or equipment are in the machine’s way.

Machine will move by itself in both axes.

Press **Start**. Machine moves to the home position in each axis.

4.6 Downloading Programs

Production ductwork layouts are usually downloaded to the CNC using the UDL feature (Up/Down Load). UDL uses a serial data connection to transmit part program data from a host computer to the CNC.

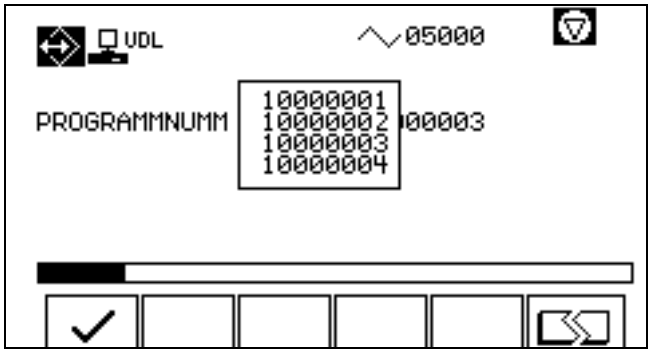
Procedure

Select **Data Input Window**.

Press **F1** to select **Program Input-Output.**

Press **F1** again to select **UDL**.

Press **F1** again to select **Download**.



A list box appears and shows program names available at the host computer. Use the **Speed Knob** or **Joystick** to scroll through list. Place cursor in front of desired program name.

Press **F1 Confirm** to select highlighted program.

Selected program is transmitted to the CNC. During transmission, block numbers are displayed to indicate transmission progress.

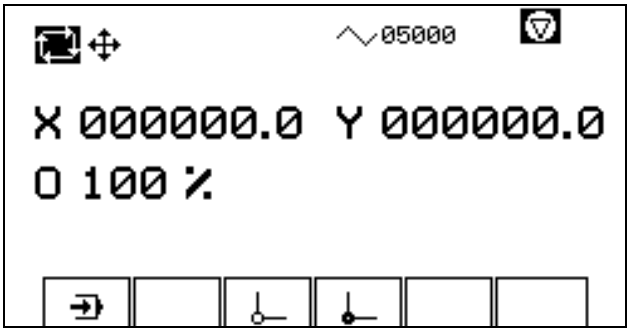
Press **Page** to cancel transmission.

4.7 Moving the Machine

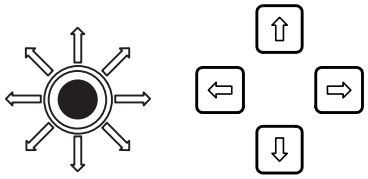
To position the cutting and marking tools and move the gantry bridge, use the **Joystick** on the CNC to manually jog machine in the longitudinal (rail) direction and transverse (beam) direction. Since the four main windows are active simultaneously, the **Joystick** can be used anytime the **Motion Window** is at the main level.

Procedure

Press **Motion Window**.



The **Motion Window** appears. If the screen is not at the main level, as shown, press **Page** until this screen appears.



Use the **Joystick (or Keypad on LE)** to move machine to desired cutting position.

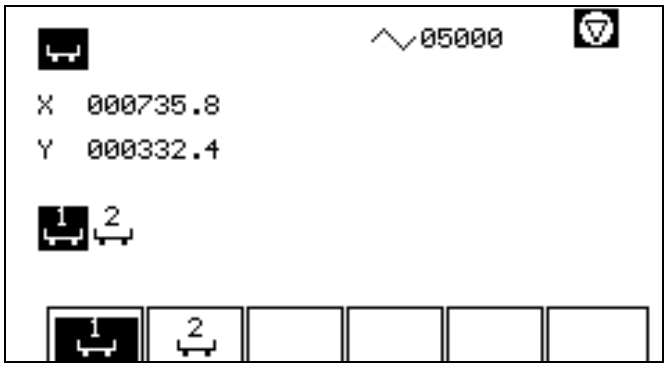
Use the **Speed Potentiometer** and **Rapid** buttons to control machine speed.

4.8 Station Selection

Before cutting with any process, the appropriate cutting station must be turned on or “selected” via the Station Select Window on the Vision CNC. In the Station Select Window menu, an icon appears for the cutting station.

Procedure

Press **Station Select**.



Station Select window appears.

Press **F1** to select cutting station. Selected station is indicated by inverse video.

NOTICE

If no station is selected, machine will execute the program’s movements without turning on the cutting process. (A dry run.)

4.9 Running Programs

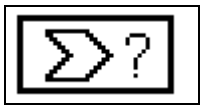
All production part cutting is done by executing a part program. The part program contains cut path information as well as codes to turn the cutting process on and off at appropriate times. Programs may also contain feedrate information, kerf offset value and process setup data.

Procedure

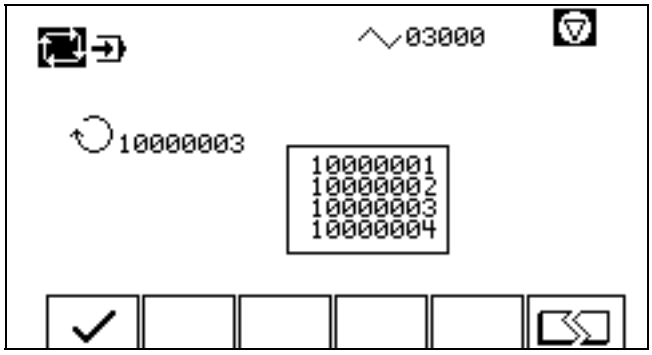
Select **Station Window** to select cutting station.

Select **Motion** Window.

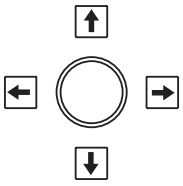
Press **F1** to select Automatic Mode.



Press **F2** to select a program from Memory.



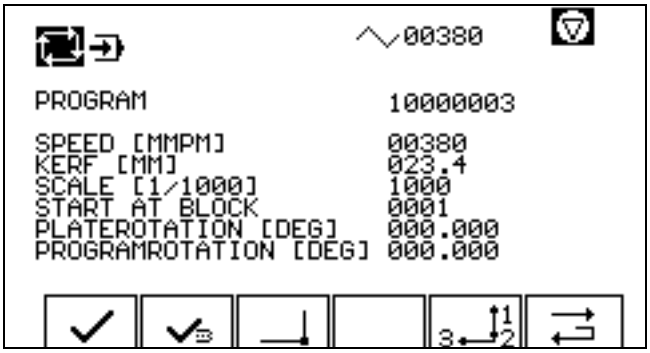
The Motion Window, Automatic Mode, Program Selection screen appears. A selection box appears containing a list of all programs currently in memory.



Use **Handwheel** and cursor keys to scroll through program list.

Position cursor next to desired program.

Press F1 Confirm to select highlighted program.



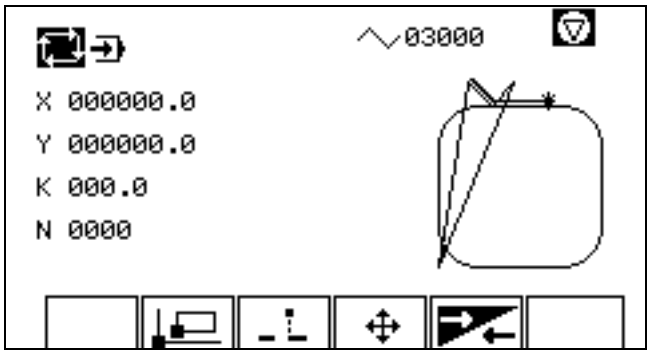
The selected program is loaded and the Program **Setup Screen** is displayed.

Enter desired speed, kerf value and rotation values.

"Start at:" is normally set to 0001 and "Scale:" should be set to 1000.

When all parameters are set, press F1 Confirm. The Program Execution screen appears.

Press Program Start. Machine executes program.

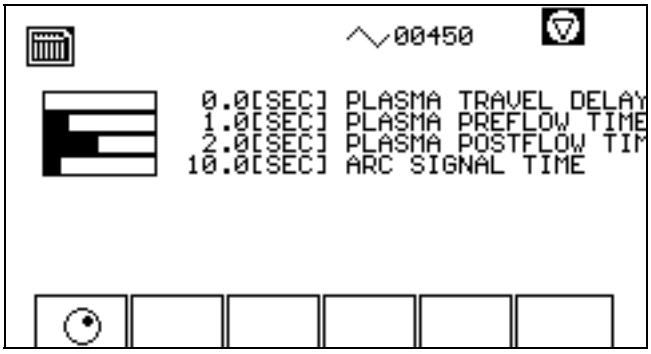


During program execution, the graphics cursor displays the actual position of the cutting tool along the programmed path. The path is highlighted as it is cut, and the X- and Y-program coordinates are updated to show actual tool position. Kerf offset value (K) and current program block number (N) are also displayed. Actual feedrate is displayed at the top of screen.

Program Stop halts program motion but does not stop the cutting process.

4.10 Timers and Process Parameters

Press **Shift-Process Window** to access timers and process parameters.



Parameter Window displays timers and process settings.

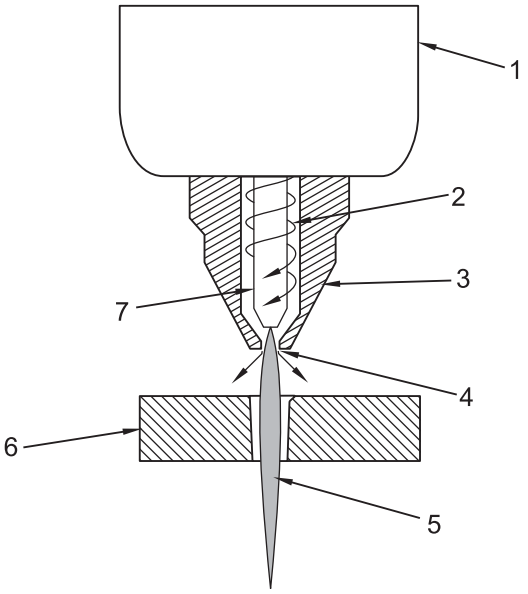
To change a timer or process setting, use the **Speed Knob** or cursor keys to scroll through list.

When cursor is in front of desired timer, press and hold **F1 Adjust Timer**.

To adjust parameter setting, turn **Speed Knob** while pressing **F1**.

4.11 Plasma Operation

4.11.1 Introduction



1 Plasma torch
2 Plasma gas
3 Nozzle
4 Orifice
5 Plasma jet
6 Plate
7 Electrode

Plasma arc cutting uses a high velocity plasma gas jet to cut through carbon steel, stainless steel and aluminum. This thermal cutting process severs metal by melting it then blowing the molten metal out of the way.

The plasma jet is formed by constricting a DC electric arc through an orifice using pressurized gas. Constricting the arc increases heat density, which speeds the melting process. Constricting the gas through the orifice, combined with the arc's heating action creates a high velocity jet of ionized gas that blows away the molten material.

Modern plasma systems also utilize the oxidizing action of oxygen or air as the plasma gas to increase speed and improve edge quality on carbon steel.

There are three steps to start a plasma arc cutting cycle: high frequency, pilot arc and main arc. Plasma gas is preflowed through the nozzle orifice. A relay that connects the copper nozzle to the ground (plate) is closed. A high frequency, high voltage signal is generated between the electrode and nozzle, which results in a low amperage, high frequency spark. This spark ionizes the plasma gas, creating a path for the pilot arc. The pilot arc is a low amperage DC arc that jumps from electrode to nozzle. The plasma gas then blows the pilot arc out of the orifice, where it contacts the workpiece, creating a path for the main arc. Once the main arc is established between the electrode and workpiece, the high frequency and pilot arc are switched off. This entire process takes place within a fraction of a second.

4.11.2 Setup

Plasma system setup varies depending on plasma torch model, flow control and machine power supply. Refer to plasma system literature for proper setup of plasma cutting parameters.

Plasma system setup may require adjustment of:

Cut Gas

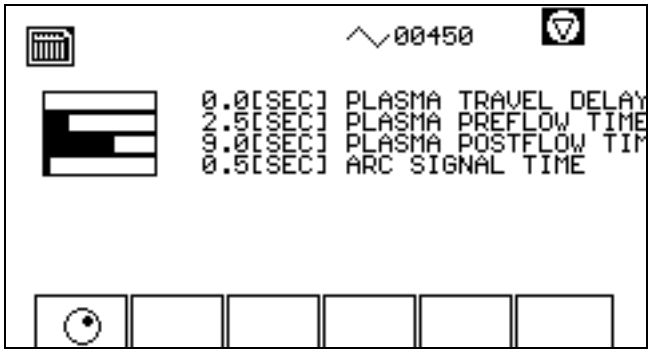
Select cut gas type, usually air or oxygen. Set pressure and/or flow rate.

Cutting Amperage

Set cutting amperage (AMPS) depending on material thickness and nozzle size.

4.11.3 Process Parameters

Press **Shift-Process Window** to access process parameters.



The Parameter Window appears. Below are applicable timer descriptions and how they effect the plasma cutting process.

Plasma Travel Delay — Sets the length of time the torch will stand still after the arc strikes. Set longer for thicker materials to allow time to pierce through material. For gauge materials, set timer to zero.

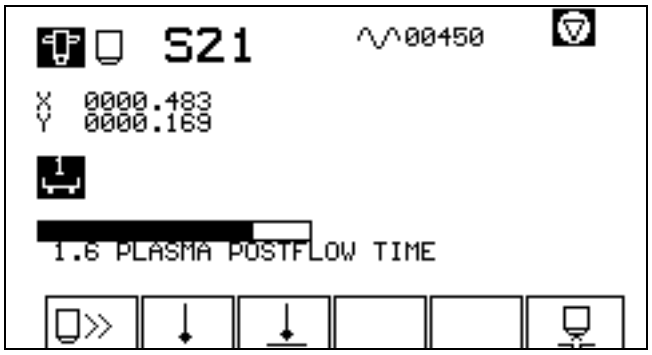
Plasma Preflow Time — Timer is factory set and should not be changed.

Plasma Postflow Time — Timer is factory set and should not be changed.

Arc Signal Time — Timer is factory set and should not be changed.

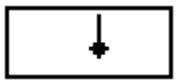
4.11.4 Operator Controls

To access the Plasma Process Menu, select **Process Window** while the plasma station is selected.



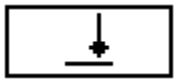
Because the plasma process is complex and steps to initiate a plasma arc require very precise timing, plasma sequencing is always handled by the CNC.

A plasma start command can be given to the CNC via part program codes or console buttons.



F2 AHC Allow

This toggle enables or disables automatic height control (AHC) for plasma torches. Default condition is on. When on, the CNC will automatically raise and lower the torch at appropriate times.



F3 AHC On/Off

This toggle manually raises and lowers plasma torch, if AHC Enable is on. Icon switches to inverse video.

F6 Plasma On/Off

This function toggles plasma on and off. Starts an automatic plasma start sequence controlled by CNC. Icon switches to inverse video when plasma is on. Press button again to turn off plasma system. The plasma torches can also be turned off with the Process Off button on the control panel or the E-Stop button (in case of emergency).

Process Off button stops the cutting process. It performs the same function as a programmed M66, or pressing Plasma On/Off key while process is on.

4.11.5 Automatic Operation

Automatic Plasma Cutting is done by starting a part program in Automatic Mode. Before starting program, check the following:

Station Selection. Select plasma station in Station Selection Window.

Process Settings. In the Process Parameter Window, set process timers and AHC parameters appropriately for material thickness and type.

When ready, press **Program Start** in Movement Window, Automatic Mode.

4.11.6 Manual Operation

CNC must control the plasma cutting sequence. Manual operation of the plasma system simply requires pressing the Plasma On button. The CNC takes over control of plasma system sequencing. When the plasma arc is initiated, motion will be enabled.

Making a Manual Strip Cut

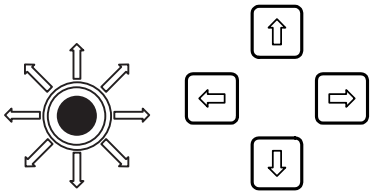
1. In **Station Select Window** select appropriate plasma station.
2. Use the **Joystick (or Keypad on LE)** to position torch at appropriate point over material.
3. Use **Speed Potentiometer** to set desired cutting speed.

4. Press **Process Window**.

5. Press **AHC On/Off** to turn on AHC. Torch will lower to the plate.

6. Press **Plasma On/Off**.

7. Press **Movement Window**.



8. Press and hold the **Joystick (or Keypad on LE)** in desired direction of travel. As soon as the arc strikes, the CNC will delay the appropriate length of time then will begin traveling in the selected direction.
9. Continue holding the **Joystick (or Keypad on LE)** in desired cut direction. If cutting scrap, jog torch off plate edge and arc will go out by itself.

10. When the end of the cut is reached, press **Process Off** to turn arc off.

Manually Starting Plasma In a Program

If a program has been halted or interrupted, you may need to manually restart the plasma. Take the following steps:

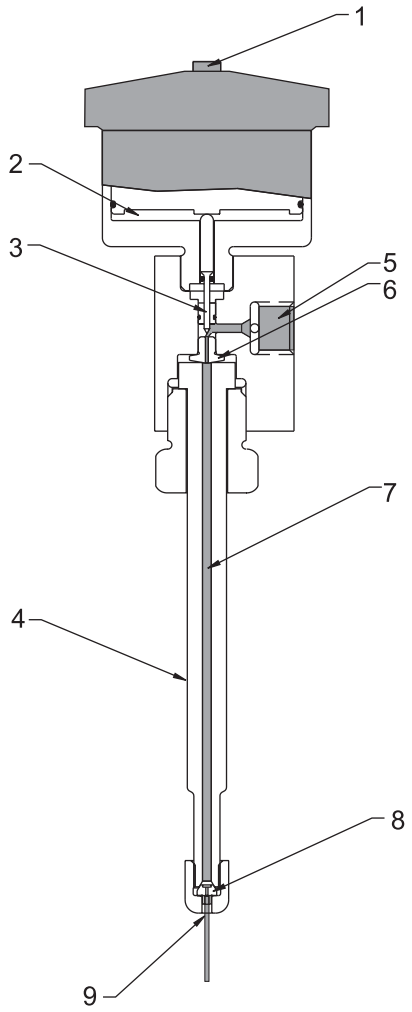
1. Use the **Speed Potentiometer** to set desired cutting speed.

2. Press **Plasma On/Off**. Torch will descend towards plate.

3. Before the arc starts, press **Program Start**. As soon as the arc strikes, the CNC will delay the appropriate length of time then begin traveling according to programmed movements

4.12 Insulation Cutting Operation

4.12.1 Introduction



1 Water inlet
2 Air chamber
3 Needle valve
4 Nozzle
5 Water inlet
6 Seat
7 Water chamber
8 Orifice
9 Water stream

Waterjet cutting uses the power of water to cut through any material.

The 5hp pump provides pressurized water to the cutting head. The unique features of the cutting head stabilize the water before it enters the orifice, which shapes the water into a fine stream capable of extremely accurate cutting.

Water flow to the orifice is controlled by a needle valve, which is normally kept closed by a spring-loaded plunger. A solenoid valve controls the air pressure required to open the needle valve. When the solenoid valve opens, air pressure is introduced into the air chamber. The air pressure shifts the needle valve open, allowing water to flow through the orifice.

When the air pressure exhausts, the spring in the air cylinder extends the plunger, closing the needle valve and stopping water flow.

The waterjet cutting head is lightweight and versatile. It is rated for up to 5000 psi with a wide range of orifice and nozzle sizes. The orifices are premounted in a setscrew style retainer, which makes them easy to change with an Allen wrench.

4.12.2 Setup

Waterjet setup procedures may require adjustment to some or all of the following:

Pump

Check connecting hoses for water leaks – fix any leaks before proceeding with operation.

Air Pressure

Check air pressure supplied to machine. It should be 90 psi.

4.12.3 Timers

The following timers are used in insulation waterjet cutting:

Pressure Delay Allows time for pump to reach full pressure. After the pump is turned on, sets the length of time the control will wait before supplying water to the cutting head.

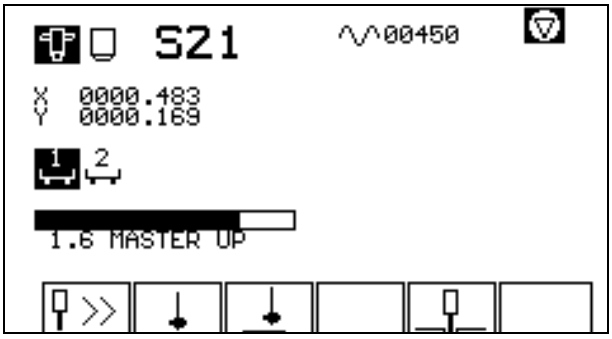
Travel Delay After water is on, sets the length of time the control will delay travel to allow the water to pierce insulation completely before starting to move. The water drills a small hole deeper and deeper until the insulation is completely pierced. On thicker insulation this delay is longer. **This timer must be set correctly. If not, the insulation will not get completely pierced and the part will not be completely cut out.**

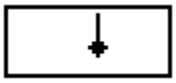
4.12.4 Operator Controls

Vision CNC allows fully automatic control of the cutting process and also provides manual controls for every part of the cutting cycle.

A waterjet start command can be given to the CNC via part program codes or console buttons.

To access the Waterjet Process Menu, select Process Window while a waterjet station is selected.



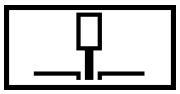


AHC Allow

This toggle enables or disables the automatic height control for the waterjet cutting head.

AHC On/Off

This toggle manually raises and lowers the waterjet cutting head if AHC Allow is on. Icon switches to inverse video.



Water On/Off

This icon toggles water on and off. Pressing this key will start an automatic waterjet start sequence controlled by the CNC. Icon switches to inverse video when waterjet cutting head is on. Press button again to turn waterjet process off. The waterjet cutting head can also be turned off with the Process Off button on the control panel or the E-Stop button (in case of emergency).

4.12.5 Automatic Operation

Automatic waterjet cutting is done by starting a part program in Automatic Mode. However, before starting the program, check the following:

⚠ DANGER

Cutting hazard.

Water pressure can severely damage hands and/or fingers during the cutting process.

The waterjet area must be clear of personnel, materials and equipment not involved in the process. Keep hands clear of waterjet cutting head during application.

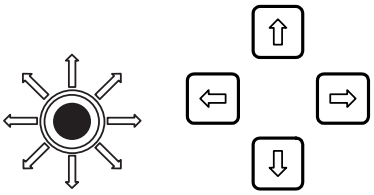
Station Selection. Select appropriate cutting station in **Station Select Window.**

Process Settings. In the Process Parameter Window, set process timers appropriately for insulation thickness and type.

AHC On. Turn AHC on to drop waterjet cutting head. AHC Allow must be on.

Set Station Height. Manually raise or lower cutting station lift to desired height -usually 2-½" above the cutting surface – and lock in position with adjustable handles on back of station.

AHC Off. Press AHC again to raise waterjet cutting head.



Adjust Position. Use joystick (or Keypad on LE) to position torch at appropriate point over material.

Load Cutting Program. Selected program is loaded.

When ready, press **Program Start** in Movement Window, Automatic Mode.

4.12.6 Manual Operation

Manual operation of waterjet cutting process is possible for cutting scrap or testing purposes.

Procedure

This method uses functions in the Process Window to manually control water operation sequence.

DANGER

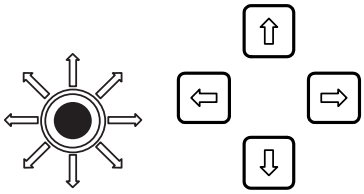
Cutting hazard.

Water pressure can severely damage hands and/or fingers during the cutting process.

The waterjet area must be clear of personnel, materials and equipment not involved in the process. Keep hands clear of waterjet cutting head during application.

1. In **Station Select Window** select the waterjet station.

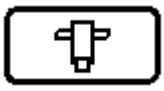
2. Manually raise or lower cutting station lift to desired height -usually 2-½" above the cutting surface – and lock in position with adjustable handles on back of station.



3. Use the **Joystick (or Keypad on LE**) to position torch at appropriate point over material.

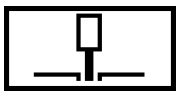
4. Use **Speed Potentiometer** to set desired cutting speed.

5. Turn water pump on. Check for water leaks – fix any leaks before proceeding with operation.



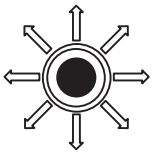
6. Press Process Window.

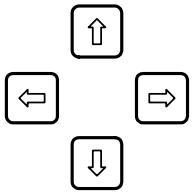
7. Press **AHC On/Off.** Waterjet cutting head will lower to cutting position. Icon will turn dark for process on.



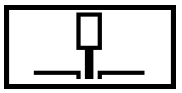
8. Press **Water On/Off.** Icon will turn dark for process on.

9. Press **Movement Window.**





10. Press and hold the **Joystick (or Keypad on LE)** in the desired direction of travel. As soon as the water has pierced the material, continue using the joystick to control cut direction. Adjust speed if necessary.



11. When the end of the cut is reached, press **Water On/Off** to turn process off.

12. Press **AHC On/Off** to raise cutting head.

Contents

5.1 Introduction

The information in this chapter is provided to allow trained maintenance personnel to effectively maintain and repair the cutting machine. This manual covers subjects relating to the gantry including drives, vertical lifts and electronic subsystems. It is recommended that maintenance personnel read the control descriptions and operating instructions in this manual for a better understanding of machine operation. Before any maintenance is attempted, read and understand the Safety Section in the front of this manual.

Before an effort is made to repair the machine or numerical control, ensure the problem is not an operator error or a programming problem. Once these sources are eliminated, consider the machine itself. Mechanical components, such as gearboxes, motors, connections, switches and disk drives are subject to damage and wear. Only after these potential problem sources are proved trouble free, should attention turn to the solid-state electronics.

The Vision CNC is described in a separate manual supplied with the machine. Refer to ESAB manual "*Operating Instructions for the Vision PC/NT Computer Numerical Controls*" (Part # F14-133). Consult that manual for troubleshooting procedures regarding control and errors that appear on the CNC. This manual also contains information on using special diagnostic control capabilities that can isolate many machine problems.

5.2 Routine Maintenance

Introduction

Routine maintenance is generalized into three categories: cleaning, adjustment and lubrication. Routine maintenance procedures are an integral part of normal machine operation and will lengthen the life of various machine components.

The information in this chapter, combined with information contained in literature for specific equipment (torches, nozzles, etc.) provides instructions that ensure safe, efficient machine maintenance.

⚠ DANGER

Pressurized fluid hazard.

Before starting any service or maintenance, turn equipment off and relieve all water pressure in lines.

Pressurized fluid streams can penetrate skin, causing severe personal injury. If any fluid is ejected against the skin, get medical attention immediately.

5.2.1 Frequency of Routine Maintenance

Perform these procedures on a regular basis, depending on machine location and usage. Consider the following factors which may increase maintenance frequency:

- Machine is outdoors
- Machine is located near the ocean.
- Machine is exposed to high humidity.
- Machine is used continuously.
- Machine does not use a cutting table with downdraft fume exhaust.
- Machine is used above a dry cutting table, instead of a water table.
- Machine is used in a shop where other equipment produces dust and dirt.

If any of these factors applies to your installation, increase frequency of routine maintenance.

5.2.2 Cleaning

Because the cutting machine operates in a harsh environment, routine cleaning is one of the most important maintenance procedures. Dust and grit generated and distributed by plasma torch cutting accumulates on moving parts causing jamming and wear out. In addition, metallic dust that accumulates on electronic components can cause failures or serious damage. Listed below are the most important items to be cleaned:

Bearings

Any moving part on the cutting machine uses some type of bearing to provide smooth motion. Keep these bearings and the surface they roll on, clean and in some cases, lubricated. Clean bearings and bearing surfaces in the following locations:

- V-block wheels on the Y-axis carriage. Wipe with a clean cloth; use non-toxic, nonflammable solvent to remove hardened dirt deposits. Do not allow solvent to get inside bearings.

- Side guide bearings on the bottom of the main truck. Wipe with a clean cloth. Use non-toxic, nonflammable solvent to remove hardened dirt deposits. Do not allow solvent to get inside bearings.

Control Console

The control console exterior accumulates dust and dirt and should be kept clean so nothing gets inside the box or the button panels. Wipe CRT glass with a soft, damp cloth. Wipe dirt from the top and sides of the console weekly. Brush front panel off with a soft bristle brush or soft cloth. Do not use paper, which can scratch, or harsh chemicals, which can damage material.

Clean the floppy disk drive. The disk drive, while fairly well protected, may accumulate magnetic particles on the read/write head. Purchase a standard 3½" (89mm) floppy disk drive cleaning kit at most computer supply stores and use monthly.

The inside of the control console is well sealed and should not require cleaning.

Electronics Cabinet

⚠ WARNING

Electric shock hazard.

Electric shock can cause severe injury or death.

Make sure power supply is OFF before starting any maintenance inside the electronics cabinet.

The electronics cabinet is well sealed but may accumulate grit inside. When cleaning inside the cabinet, vacuum dust and dirt from the bottom. Do not disturb any electrical connections.

5.2.3 Adjustment

The following items may require occasional adjustments to keep machine in top running order. Consult adjustment procedures in this chapter if there is a problem in any of these areas.

- Carriage V-blocks
- Side guide bearings

5.2.4 Lubrication

Very few cutting machine parts require regular lubrication. Most moving mechanical devices and bearings are sealed and do not require lubrication.

Waterjet Lift

The pneumatic slide on the waterjet cutting assembly requires a squirt of oil weekly. Use SAE 30 or equivalent.

Drive Gearbox

Gearboxes used on this machine are packed with grease and require no additional lubrication.

Bearings

All cutting machine bearings are sealed and should not be lubricated.

5.3 Preventive Maintenance Schedule

Time periods suggested below are based on average usage. If a machine is employed in a heavy usage cycle or is used outdoors, suggested time periods may be shortened. If usage is light, maintenance periods may be lengthened.

⚠ DANGER

Pressurized fluid hazard.

Before starting any service or maintenance, turn equipment off and relieve all water pressure in lines. Close all hand valves before disassembling HP components.

Pressurized fluid streams can penetrate skin, causing severe personal injury. If any fluid is ejected against the skin, get medical attention immediately.

Daily

- Clean any slag accumulation from inside plasma torch shield/plate rider. Use a screwdriver or wire brush but avoid damaging plasma torch.
- Check plasma torch for wear and replace if necessary.
- Vacuum excess dirt and dust off machine; close all electronic cabinets to prevent dust entry.
- Wipe off main rails. There should not be any foreign objects that could interfere with wheels or pinion/drive rack.

CAUTION

Do not lubricate drive racks. Lubricants applied here accumulate dirt and promote problems.

- Wipe off beam guiding surfaces and ensure rack is clean and free from interference.
- Check powertrack for free movement. Cables must not be pinched or chaffed.

⚠ DANGER

Pressurized fluid hazard.

Turn pump power OFF and relieve all pressure in lines before attempting any repairs. Do not repair any water leaks with pump ON. Use a piece of cardboard when checking for leaks – NEVER YOUR HAND.

Pressurized fluid streams can penetrate skin, causing severe personal injury. If any fluid is ejected against the skin, get medical attention immediately.

- Inspect all water hoses for leaks and damage. Replace if necessary.
- Inspect waterjet cutting head for leaks and wear. Replace if necessary.

Weekly

- Carefully inspect all hoses and hose connections for damage or looseness. Immediately replace those showing damage.
- Check plasma torch slide and waterjet pneumatic slide for smooth travel. Clean if necessary. Both slides require a squirt of SAE 30 motor oil, or equivalent.
- Inspect water seals and o-rings for leakage. Replace as necessary.
- Check rail scrapers for proper operation.
- Disengage Y-axis carriage and move by hand to make certain it travels freely.
- Use joystick and make certain machine and cross travel is smooth and steady.
- Check all filters in compressed air system. Remove any accumulated water in filter bowls.
- Check all control panel functions and lights.

Monthly

- Check drive engage pivot for each drive assembly. Make sure it pivots freely in and out of rack. Check for play in the thrust bearings.
- Clean floppy disk reader using a standard 3½" (89mm) floppy disk cleaning kit.
- Inspect all electrical cable connectors and plugs. Make sure plugs are tight, cables are in good condition and do not bind or pull when moved. Replace any cables showing signs of wear.
- Inspect guide rollers on machine and carriage; readjust where necessary.
- Open electronics cabinet and carefully vacuum any dirt and dust accumulation. Do not blow out with compressed air.
- Check drive racks and replace or repair any badly worn sections.
- Inspect drive pinions on each axis drive. Replace any showing visible wear or teeth deformation.

Semiannually

- Drain cutting table. Refer to manual included with table for maintenance procedures.

Annually

- Repeat monthly procedures.
- Replace 3/8" hydraulic hose (5000psi) connecting pump to cutting head.
- Check straightness of main guide rail by stretching a piano wire along track with spacer blocks. Overall deviation from straightness should not exceed 0.005" (0.13mm) and should occur gradually (i.e., deviation in any 20 ft (7m) rail length should be substantially less).

5.4 Gantry Alignment Procedures

5.4.1 Introduction

This section covers mechanical and electrical alignment of this gantry shape cutting machine. These procedures may never be needed, or they may be used often, depending on machine installation, usage and maintenance. Only trained personnel with mechanical and electrical knowledge should use the following procedures. If trained personnel are not available, an ESAB Service Engineer should perform these procedures.

5.4.2 Sequence of Alignment

This gantry cutting machine is designed to provide accurate, smooth, repeatable, high-speed motion for the plasma cutting process. When problems occur with the machine's performance, the first step is to eliminate the cutting process and analyze the gantry's performance. If the problem is in the gantry's performance, follow alignment procedures below. The alignment sequence is critical because each alignment procedure assumes that all previous alignments are correct.

1. Rail Alignment
2. Side Guide Bearings
3. Servo System Electrical Adjustments

5.4.3 Rail Alignment

Machine rails are the reference point for all machine movement and must be properly aligned before addressing other machine portions. Rails must be straight, level, parallel and the correct gauge (distance between rails). Improperly installed rails can move or "walk" during operation and lose alignment. If there is any reason to believe the rails are distorted in any plane mentioned above, perform the following rail alignment procedure.

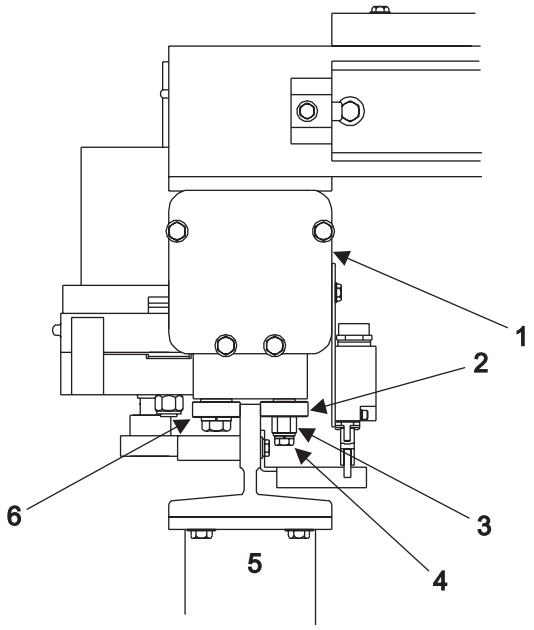
NOTICE

Severe rail misalignment can cause a number of easily misinterpreted symptoms. The X-rail (on left-hand side) is the most critical rail member and its straightness is the most critical factor. If this rail is not straight, the machine can be forced out of square to follow it. The drives fight this misalignment while running and will, in the most serious cases, cause one or more of the following symptoms:

- Excessive "DEVIATION ERRORS" in X-axis.
- "EXCESS CURRENT" faults on PWM Drive boards.
- X-axis performance problems.
- Rough drives in X-direction.

If the machine exhibits these symptoms, if rails have been bumped or jarred in any way or machine is relocated, you must realign rails per the instructions in the Installation Section.

5.4.4 Side Guide Bearings



1 Truck
2 Bearing
3 Eccentric bushing
4 Shoulder bolt
5 Guide rail
6 Fixed bearing

Side guide bearings keep the machine trucks positioned correctly on the rails. Confirm their correct adjustment before proceeding with alignment. Check front and rear of side guide bearings for minimum clearance. Adjust so they are touching rails on both sides but can still be hand-turned on one side. If the above is not true, follow alignment procedure below.

To adjust side guide bearings:

1. Disengage drives.
2. Push machine down rails (repeatedly if necessary) until both outboard bearings are in contact with the side of the rail.
3. Loosen shoulder bolt with box-end wrench.
4. Turn eccentric bushing with open-end wrench. Adjust bearing until it begins to contact side of rail.
5. While holding bushing with one wrench, tighten shoulder bolt with the other.

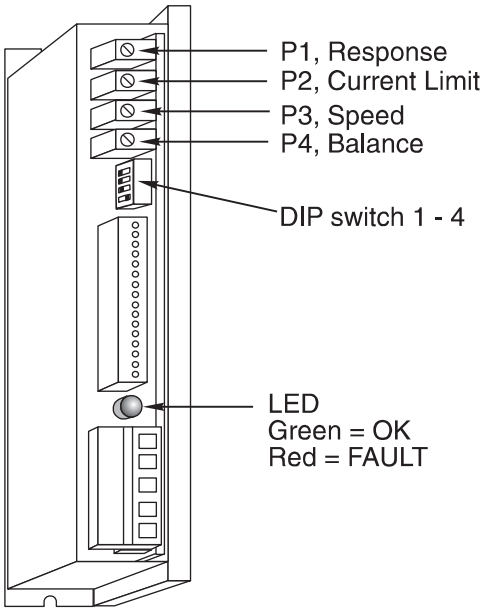
You should be able to turn bearing by hand but feel it rub against side of rail.

5.5 Servo System Electrical Adjustments

5.5.1 Introduction

CAUTION

This procedure only applies to machines with PWM Drive Amplifiers shown below.



There are four potentiometer adjustments on the motor drive unit. These adjustments are preset at the factory and should not require field adjustment. However, if a motor drive unit is replaced or the performance needs to be modified, these pots function as follows:

P1	Loop gain	CW increases gain
P2	Current limit	CW increases current limit
P3	Reference gain	CW increases gain
P4	Offset adjust	N/A

Presets

Four DIP switches on the motor drive unit set the amplifier's operating mode. Set all four switches to OFF position.

Set Current Limit potentiometer, P2, fully clockwise.

Check gain and balance adjustments for each axis. The gain adjustment affects the motor speed for a given drive signal. The balance adjustment affects the motor drift when there is no drive signal. Both adjustments can be made without any measuring devices and both use the CNC to provide speed feedback from the motors.

5.5.2 Gain Adjustment

Use the Speed Measurement display of Vision CNC to adjust gain of PWM amplifiers. This feature momentarily drives the motors and displays the resulting maximum drive speed. Adjust each axis to have the same maximum drive speed.

⚠ WARNING

Crush hazard.

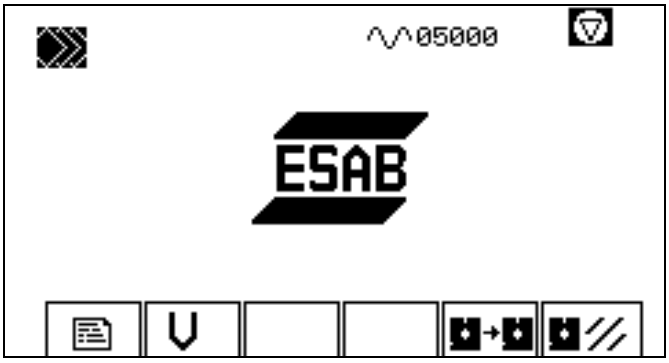
Machine starts automatically.

1. **Before doing Speed Measurement Test, verify no personnel or equipment are in machine's way.**
2. **Machine will move by itself in both axes.**

Procedure

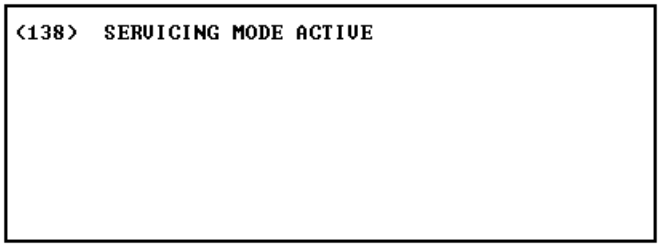
Leave drives engaged.

Press **Shift-Data Window** to select Startup Window.



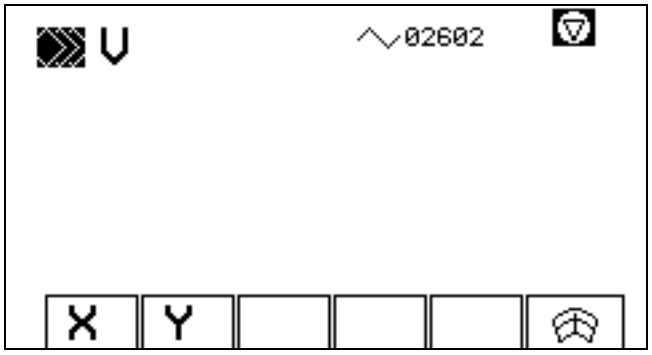
Startup Window appears.

If **Startup Window** menu does not display all options shown here, press **Shift-Rapid** to access Service Mode.



A message indicates **Service Mode** is activated. Press **F1** to clear message.

In Startup Window, press **F2** to select **Speed Measurement Test**.

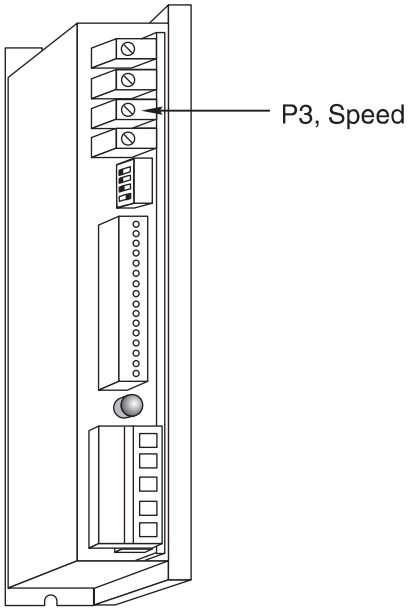


Speed Measurement screen appears.

To start **Speed Measurement**, press **F1** to select X-axis or **F2** to select Y-axis.

During speed measurement, the function key for the selected axis is displayed in inverse video. When machine stops, it returns to normal.

The selected axis moves about 1" (25mm) in the positive direction, and then moves back about 1" (25mm) in the negative direction. Display shows calculated drive speed.



At this time, make adjustments to Speed Potentiometer, P3, on PWM drive board. Repeat test and check speed display. Continue making adjustments and repeat test until a speed of 400ipm (10160 mm/min) is displayed.

When each drive is adjusted satisfactorily, press **Backpage** to exit Speed Measurement display. New speed values are recorded in Machine Constants.

5.5.3 Balance Adjustment

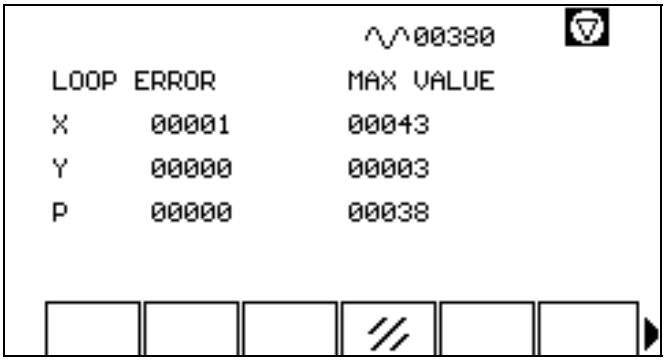
To adjust balance of PWM amplifiers, disconnect the drive signal outputs and use the Loop Error Display feature of the CNC. This display shows the position following the error of each axis. When an amplifier's balance is out of adjustment, the loop error value climbs.

Procedure

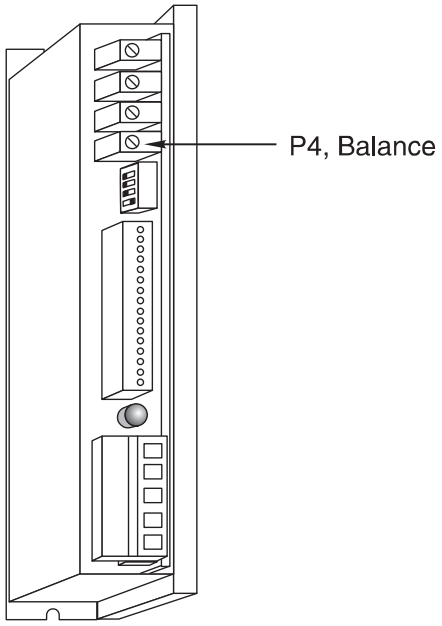
Manually release the tension spring to disengage the drive pinions from drive rack. Use a block of wood to block out drives. Disengage drives, but watch carefully in case they drift.

Open the CNC console. Disconnect the X8 connector from the Process I/O Board (PIO). This disconnects the CNC's drive signal output. The PWM drive amplifiers should hold the motors still. Since actual motor output shaft cannot be seen, use the Loop Error Display to see if motors are drifting.

Press **Shift-F1** to access Loop Error Display.

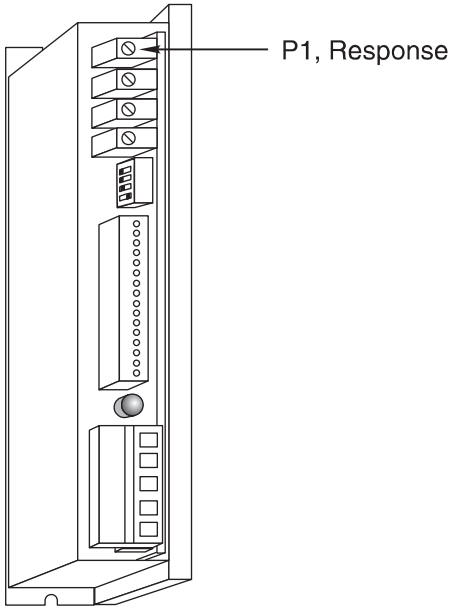


The loop error (position following distance) is displayed for each axis.



If the loop error is climbing for any of the axes, adjust Balance Potentiometer, P4, on the PWM drive board for that axis until loop error stops changing.

5.5.4 Response Adjustment



While still in Loop Error Display, adjust Response potentiometer, P1, on PWM drive unit. Turn potentiometer clockwise until drive makes a high-pitch squeal, then back off counterclockwise three full turns.

Repeat above steps until each axis is adjusted satisfactorily.

Turn OFF machine power

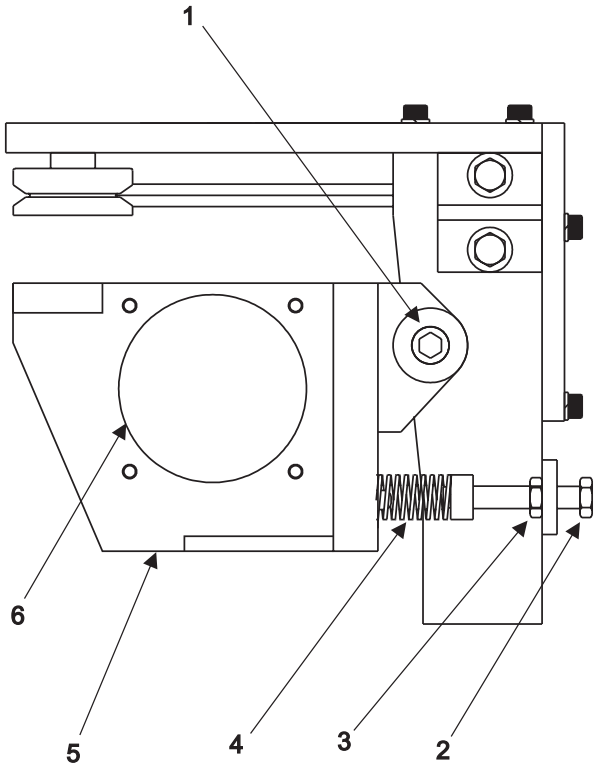
Reconnect X8 connector to Process I/O Board.

Attach tension spring to re-engage drive pinions.

5.6 Maintenance Procedures

The following section contains maintenance procedures for many of the systems and devices used on ESAB cutting machines. Only qualified maintenance personnel should use these procedures.

5.6.1 Drive Preload Tension – Planetary Gearbox



An adjustable tension spring holds each drive pinion tightly against the drive racks. The spring is adjusted at the factory and normally requires little adjustment after installation. After long periods of use, the spring tension may require adjustment. Use the following guidelines to adjust the preload tension spring:

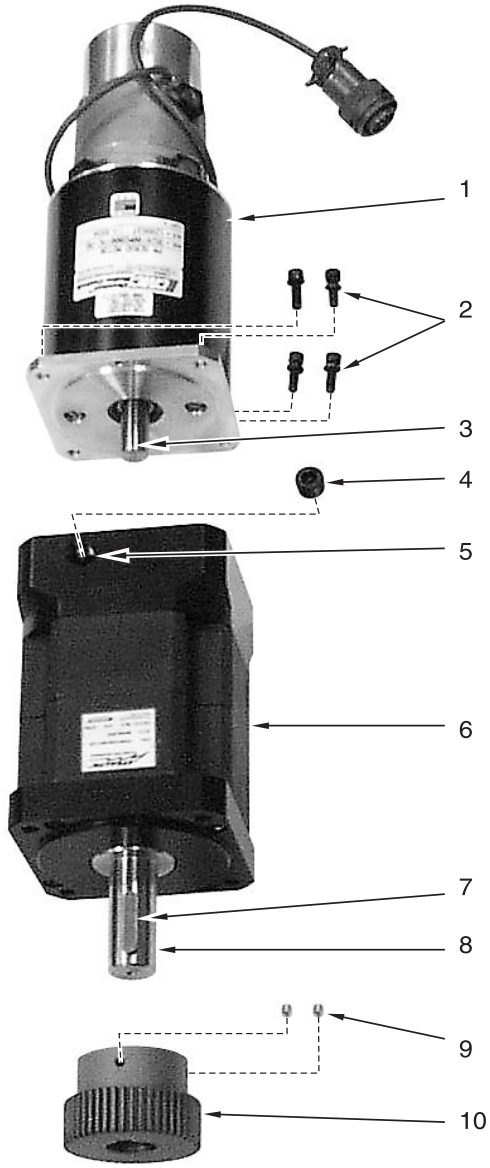
1. Completely loosen spring tension by loosening the lock nut, then turning the adjusting bolt counterclockwise.
2. Turn adjusting bolt clockwise until spring pushes slightly against the drive.
3. Turn adjusting bolt clockwise an additional 4.5 turns.
4. Tighten lock nut against bracket.
5. Check for proper engagement and disengagement by actuating the disengage air switch.

1 Pivot point
2 Adjusting bolt
3 Lock nut
4 Tension spring
5 Drive mount
6 Servo drive assembly

CAUTION

Setting preload tension too high causes excessive wear on the rack and pinion. Setting tension too low allows pinion to pop out and skip teeth while machine is running.

5.6.2 Drive System Components – Small Planetary Gearboxes



1 Motor with encoder
2 Cap screws and lock washers
3 Motor shaft
4 Threaded plug
5 Pinion bolt access hole
6 Gearbox
7 shaft key
8 Gearbox shaft
9 Setscrews
10 Drive pinion

Drive Motor

The servo drive assembly consists of the following replaceable components: motor, gearbox, encoder and output pinion in one assembly.

The drive motor may need replaced during the life of the machine. To replace:

1. Turn off and lock out all machine power.
2. Remove motor cable and encoder cable from input box at top of motor.
3. Use a 3mm (1/8") Allen wrench to remove the four cap screws mounting the motor to the gearbox.
4. Remove the threaded plug from the pinion bolt access hole on the gearbox.
5. Rotate the output pinion until the head of the input pinion bolt is aligned with the pinion access hole.
6. Insert the Allen wrench through the pinion access hole into the head of the pinion bolt and loosen the bolt.
7. Carefully remove motor by lifting it straight up from the gearbox. Do not twist or tilt motor.
8. Make sure motor shaft is clean and dry. Insert the motor shaft into the gearbox pinion. Align the motor flange mounting holes with the mounting holes on the gearbox.
9. Mount the gearbox to the motor using the four cap screws and lock washers supplied.
10. Carefully tighten the pinion bolt to the torque specified by the gearbox manufacturer.
11. Reinsert and tighten the threaded plug in the pinion bolt access hole.

Drive Pinions

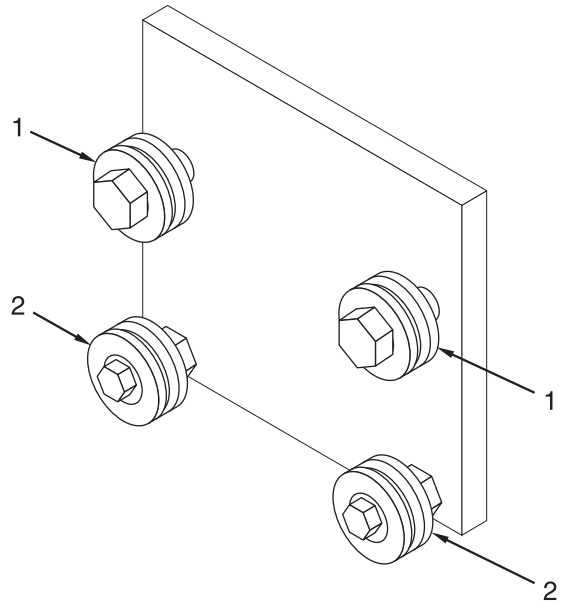
Drive pinions eventually need replacement. To change X- and Y-axis drive pinions:

1. Turn off and lock out all machine power.
2. Pull out drive assembly to disengage pinion from the rack.
3. Loosen the two setscrews that hold the pinion on the gearbox output shaft.
4. Use a gear puller to slide pinion off the shaft.
5. Clean shaft with solvent and emery cloth, if necessary.
6. Install new pinion on shaft, making sure pinion lines up with rack at proper height on shaft. Ensure key is installed properly.
7. Tighten setscrews and make sure pinion is properly engaged.
8. Adjust pinion so there is ¼" (6.4mm) gap between the pinion bottom and the shaft end.

Lubrication

Gearboxes used on this machine are packed with grease and a continuous lubricant redistribution ensures low wear over the lifetime of the gearbox. No additional lubrication is required.

5.6.3 Y-Axis Carriage Wheels



1 Stationary wheels

2 Adjustable wheels

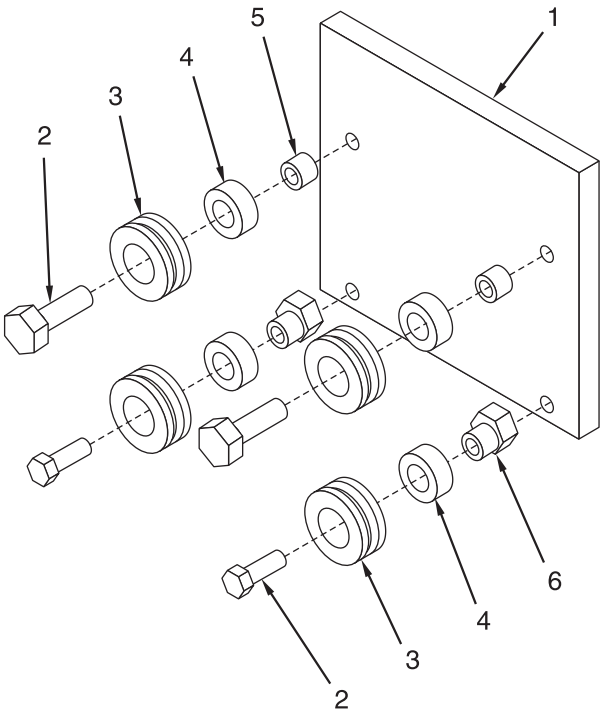
The Y-axis carriage uses four V-wheels to provide smooth linear motion along the dual-V-track of the crossbeam.

Adjustment

The top two wheels on the Y-axis carriage are fixed, the bottom two are adjustable.

To adjust V-wheels:

1. Use socket wrench or box end wrench to loosen the wheel mounting bolt.
2. Insert a narrow open-end wrench over the hexed portion of the adjustable bushing, between lower V-wheel and the carriage plate.
3. Turn bushing to adjust bearing up or down as necessary.
4. While holding the bushing in place, tighten mounting bolt.
5. The bearing should be slightly preloaded against the rail so the carriage moves freely across the rail but there is no play in carriage.



1 Y-axis carriage
2 Screw
3 V-wheel
4 Bearing
5 Spacer
6 Eccentric spacer

Replacement

A bolt holds each V-wheel in place. The upper wheels use a spacer; the lower wheels use an eccentric bushing. To replace V-wheels:

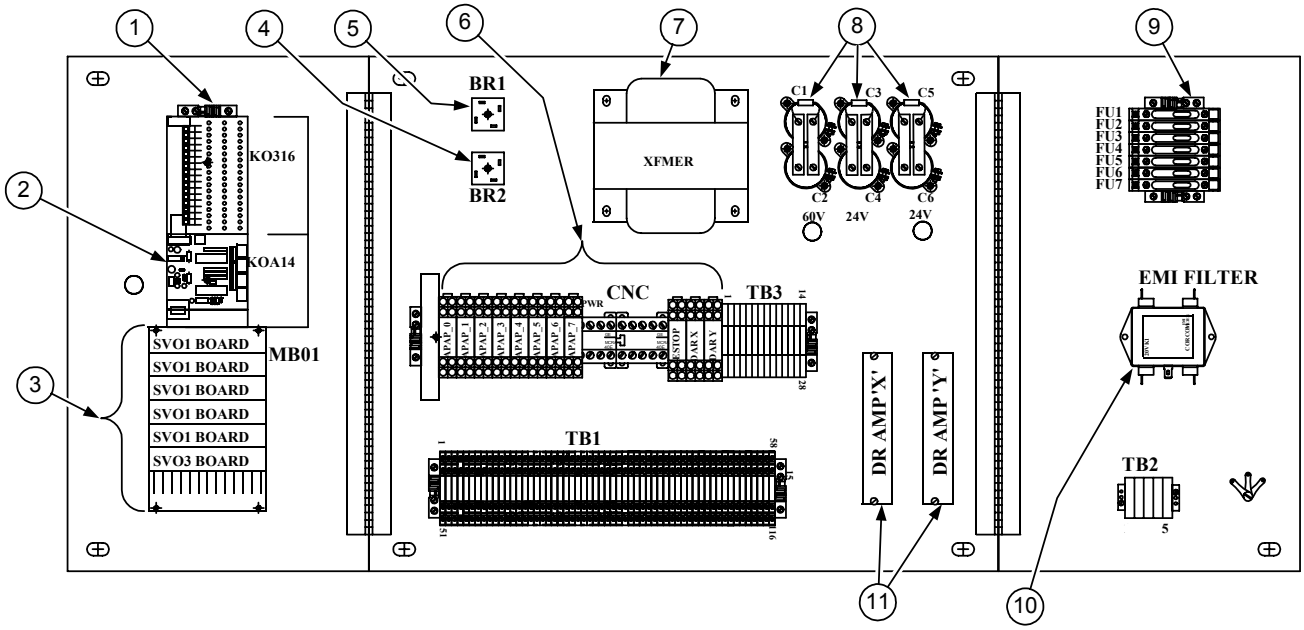
1. Remove all accessories from carriage front and top.
2. Remove the mounting bolt in order to remove the lower bearings.
3. Remove carriage from the beam and service bearings as necessary.

5.7 Technical Descriptions

The following section contains technical descriptions of many systems used on ESAB cutting machines. These technical descriptions are intended to give sufficient understanding of the systems operation for maintenance personnel to troubleshoot and maintain these systems.

5.7.1 Electronics Cabinet

The Electronics Cabinet is rail stand mounted on the side of the machine. It contains many electronic subsystems, including drives, station control electronics and power distribution circuits.



1. Triac Output Board
2. Analog Output Board
3. Mainboard/ LCASIOB
4. Rectifier, 60VAC
5. Rectifier, 24VAC
6. Miniture Relays
7. Main Transformer
8. Capacitors
9. Fuses
10. Line Filter
11. PWM Servo Amplifiers

The center panel of the electronics cabinet mounts the main terminal strip (TB1), TB3, transformer, filter capacitors, 24V and 60V rectifiers, relays, and PWM servo drive amplifiers.

The secondary voltage from the servo transformer is rectified by the 60V rectifier, then filtered by the 60V filter capacitor. The 60VDC supplies the PWM servo amplifiers for the drive motors.

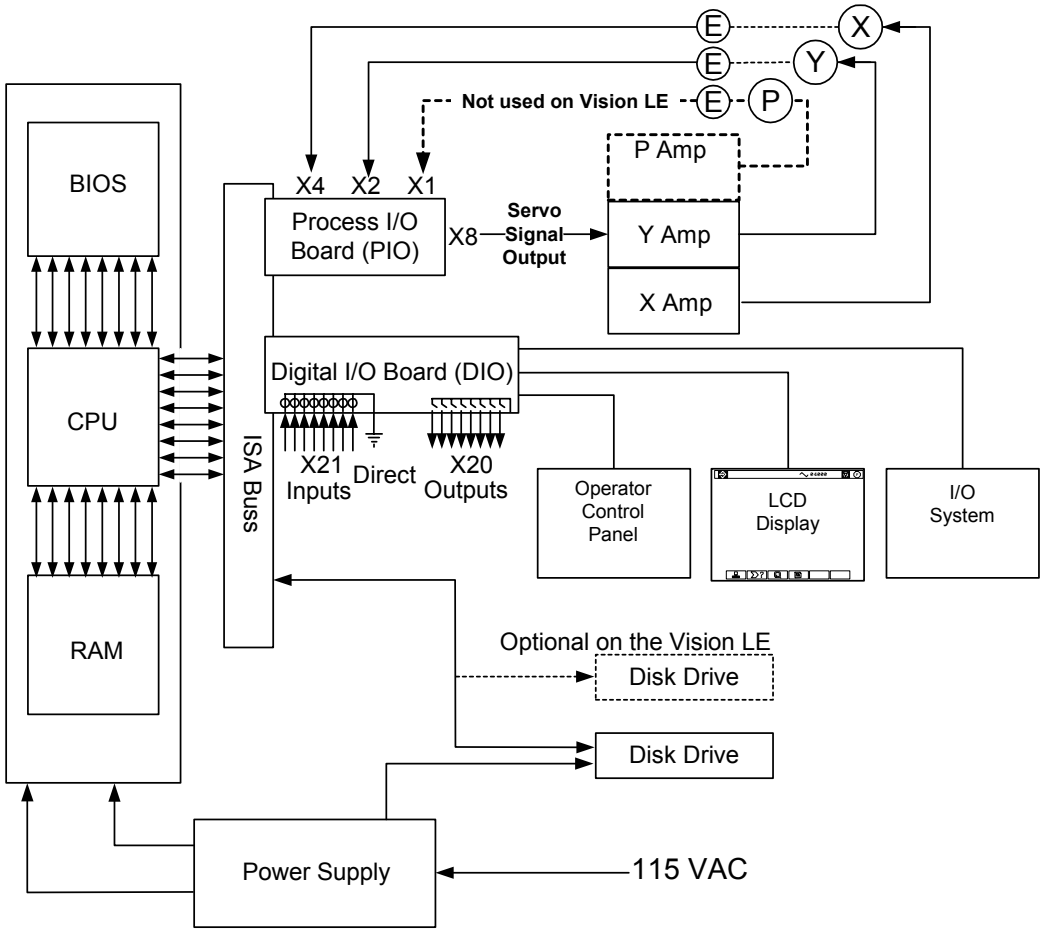
The 24-Volt DC power supply comes from a set of secondary taps from the servo transformer. AC voltage is rectified and filtered to create two separate 24VDC supplies. 24VDC is supplied to the I/O system and station lift motors.

The left-hand side panel of the electronics cabinet mounts the centralized I/O system (LCASIOB), analog board and Triac output board.

The I/O mainboard is connected to the CNC by the serial I/O bus (ASIOB). It then controls the attached I/O components, including but not limited to: analog output boards, relay output boards, and Triac output boards.

The right-hand side panel of the electronics cabinet mounts the fuses, AC line filter and TB2.

5.7.2 Vision 1000/Vision LE Technical Description



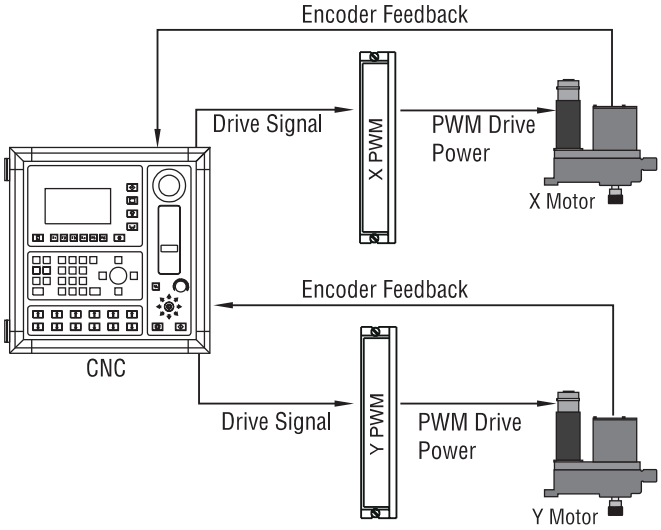
The Vision Computer Numerical Control is a PC based cutting machine controller. A PC motherboard provides processor, RAM and bus components. Drive control and I/O are handled by two additional boards - Process I/O board (PIO) and Digital I/O board (DIO).

The PIO Board controls the servo drive system providing analog outputs, drive enable outputs and encoder inputs for each axis.

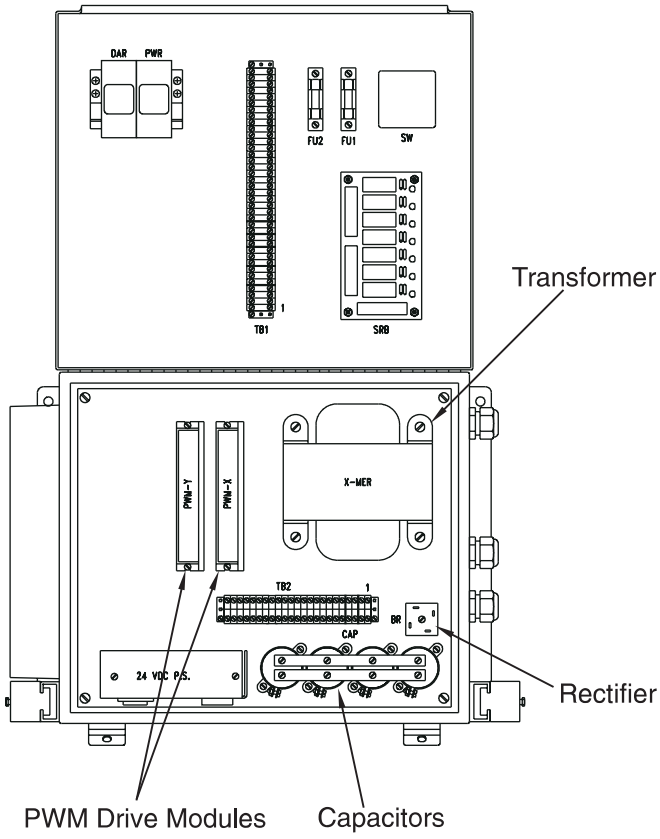
The DIO Board handles direct inputs and outputs, interface with both the operator panel and the I/O system. The I/O interface is a Serial Bus that can interface to either remote I/O boards or a serial to parallel interface boards. The Digital I/O board also supplies the digital display data signal, which is interpreted and displayed by the LCD device.

A standard floppy disk drive controller is built into the motherboard and interfaces with the two disk drives (one is standard, 2 optional on Vision LE).

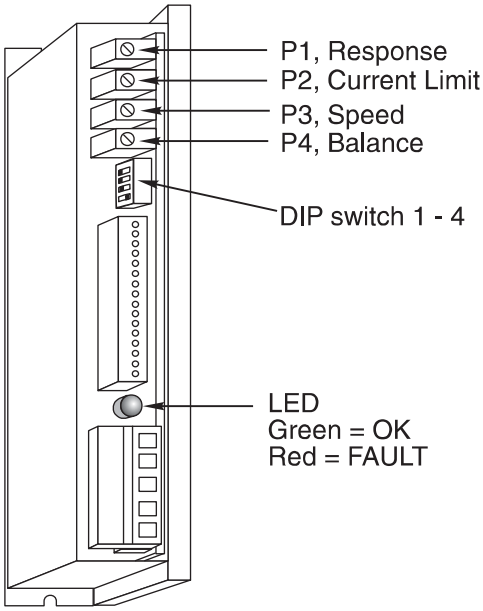
5.7.3 Drive Control System



Cutting machine motion is accomplished through a closed loop servo drive system. This drive system consists of the CNC, PWM (Pulse Width Modulation) servo amplifiers and servo drive units. Each drive functions independently, relying on the CNC to maintain machine position. The CNC outputs an analog drive signal for each axis. The drive signal is input into the PWM servo amplifier unit. The servo amplifier outputs a Pulse Width Modulated DC voltage to drive the motor, dependent on drive signal. Each motor drives the gearbox, which has an encoder mounted on the output shaft. The encoder generates a fixed number of pulses per revolution of the gearbox output shaft. The CNC counts these encoder pulses to determine exactly how far the machine has moved. The controller then compares the actual position with the command position to make corrections to the drive signal.



PWM drives are mounted in the electronics box assembly, shown here. The drives consist of PWM Drive Amplifiers and a Bus Power Supply. The Bus Power Supply is made up of a transformer, rectifier, and filter capacitors, which supply the 60-volts DC to the PWM amplifiers.



The Bus Power Supply provides 60-volts DC power to each amplifier, which uses it to power the logic circuits and motors.

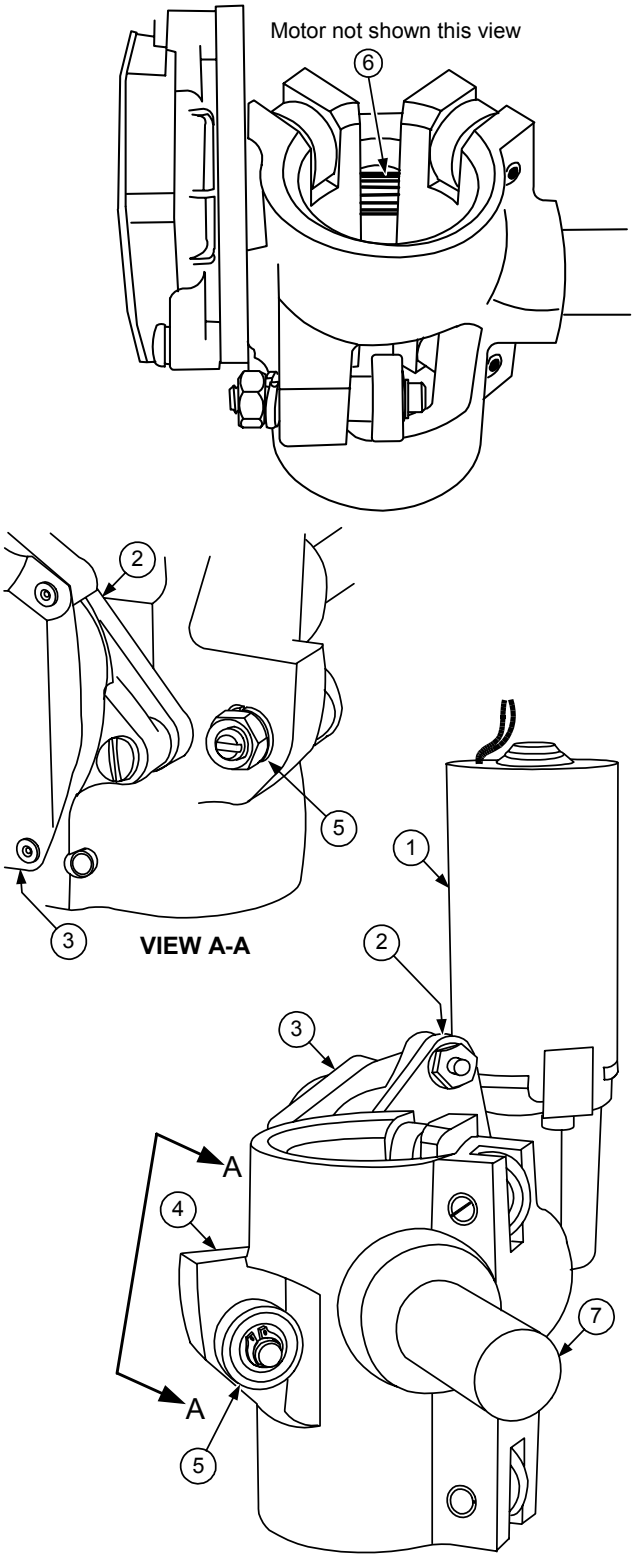
There are four potentiometer adjustments on the motor drive unit. Pots are used to adjust drive amplifier for optimum machine performance.

P1	Loop gain	CW increases gain
P2	Current limit	CW increases current limit
P3	Reference gain	CW increases gain
P4	Offset adjust	N/A

Four DIP switches on the motor drive unit set the amplifier's operating mode. All four switches should be OFF.

A two color LED provides status information. Red indicates unit is in a FAULT condition. Green indicates unit is ENABLED.

5.7.4 Budget Lift



This electric lift has three main components. Motor, gear box and torch holder.

The torch is held in the in line with 5 sealed ball bearings.

One bearing is on an eccentric shaft for torch barrel (handle) tension adjustment.

Do not over tighten eccentric bearing on torch handle. Torch damage is possible.

1. motor
2. adaptor plate
3. gearbox
4. torch holder
5. eccentric bearing assembly
6. lift pinion
7. mount shaft

Maintenance

- Clean Rack on torch to prevent buildup on pinion
- Adjust eccentric bearing just enough to prevent “rocking” of the torch. DO NOT Overtighten.
- Clean torch handle to encourage smooth operation

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Contents

Piecemaker 2

6.1 General Information

This section provides replacement part information and will assist during machine maintenance. It is arranged by functional groups or assemblies for easy identification of individual parts and replaceable assemblies.

The Replacement Parts List consists of a parts list for the main assembly and one for each major assembly and subassembly. Item numbers that identify parts in the illustration are given in the list, where applicable, along with part numbers and descriptive information.

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 part name and description provide identification. When ordering, use the correct part number for the option used on your machine.

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 from commercial sources are not included. Parts purchased by ESAB from vendors are listed by ESAB part numbers. Hardware is specified as items in the parts lists but normally doesn't have an ESAB part number.

Column 3, QUANTITY: Indicates the part quantity used in that assembly. Do not use this number as a recommended quantity of spare parts. The customer must determine how many spare parts to purchase.

Column 4, DESCRIPTION: Names the part or assembly and includes other identifying information.

6.2 Ordering Information

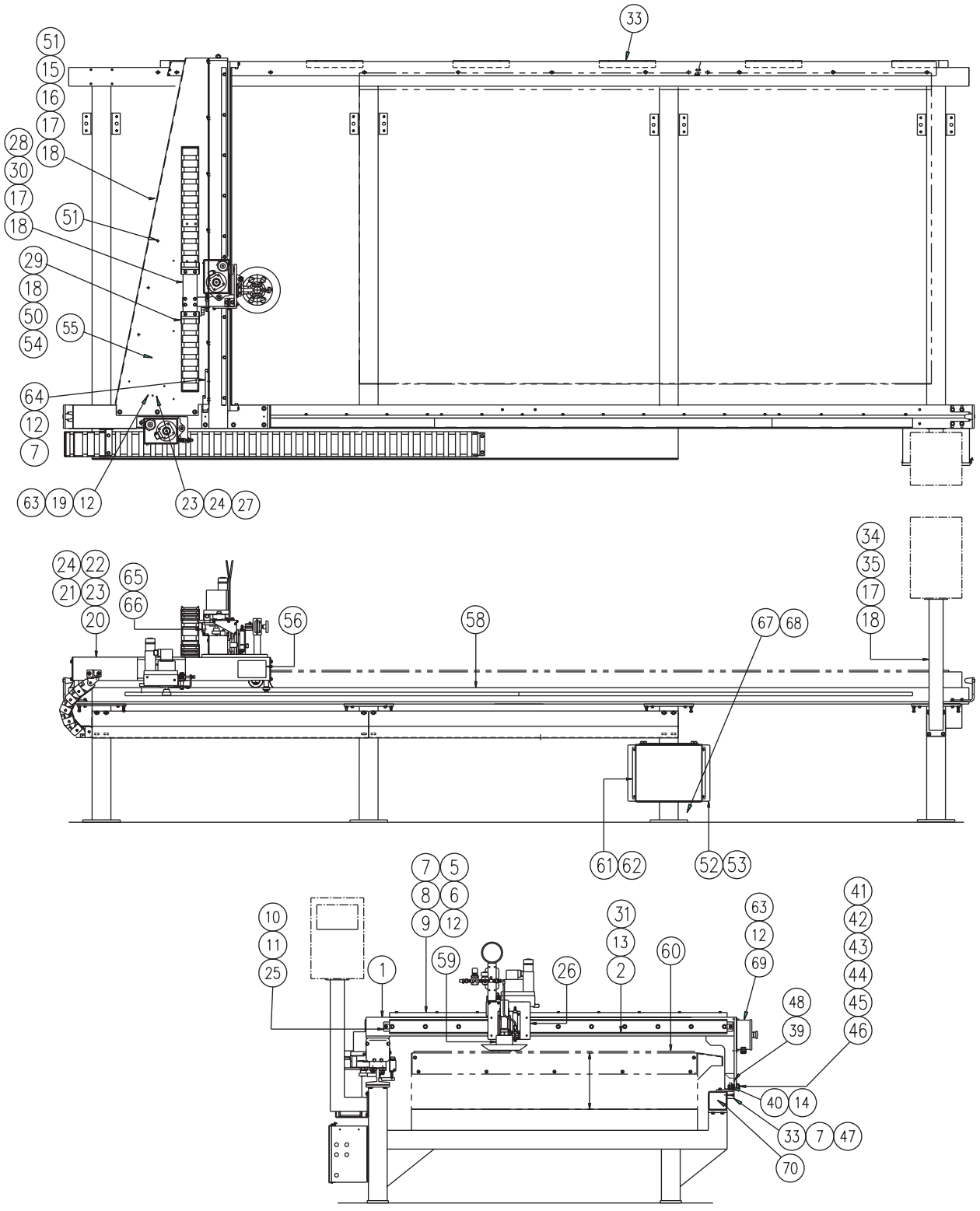
When ordering replacement parts, order by part number and complete part description as given in the description column. Also, give machine model and serial number. Address all inquiries to your local ESAB Distributor or to ESAB Cutting Systems, P.O. Box 100545, Florence, South Carolina, 29501.

NOTICE

This manual may contain part illustrations not applicable to your specific machine. To avoid unnecessary delays, positively identify your correct assembly before ordering replacement parts.

6.3 16' x 5' Wide Basic Piecemaker 2

Assembly 57000785 (A)

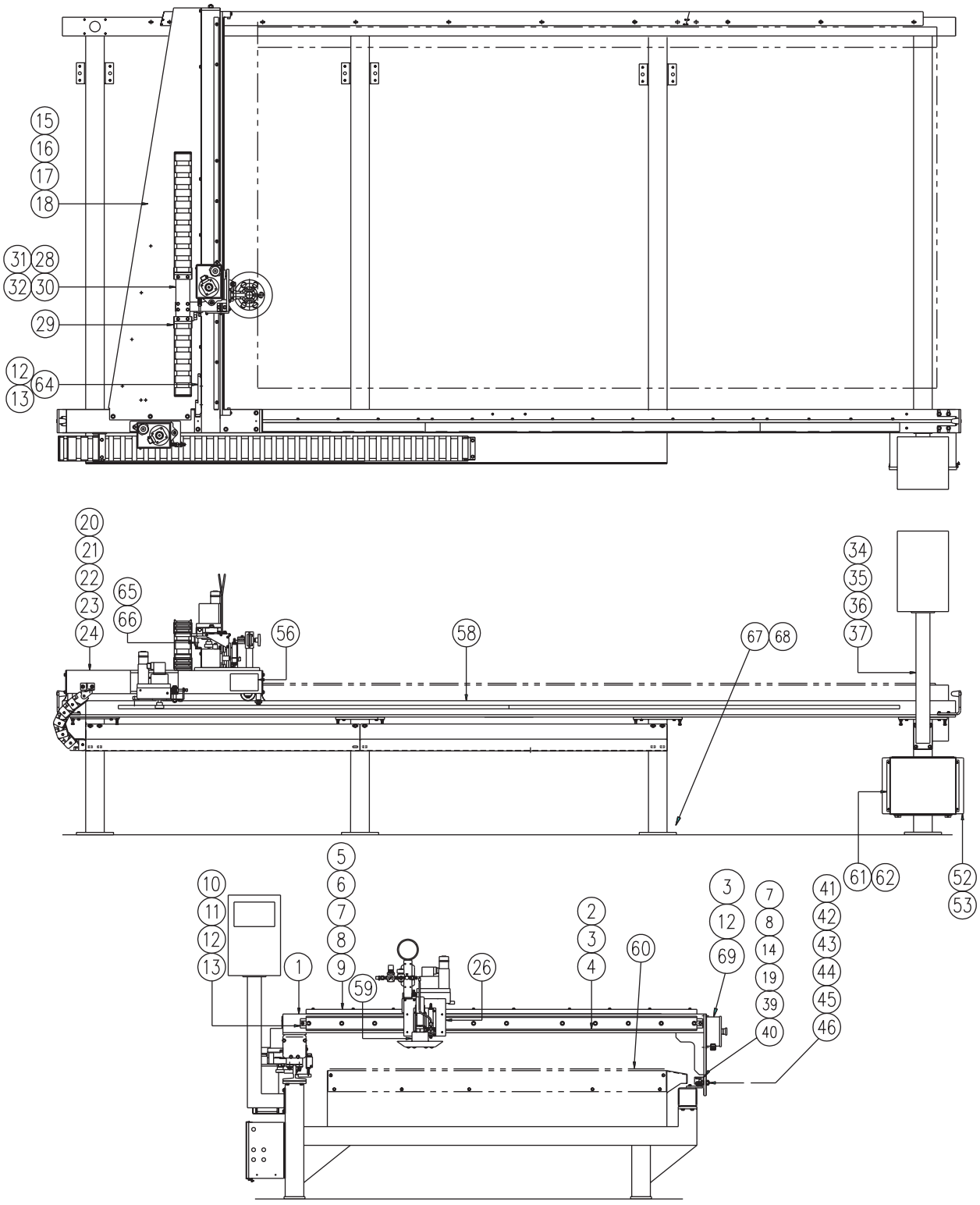


Item	Part #	Qty	Description
1	56998319	1	Beam
2	56998327	1	V-Track
3	57001068	6	Bumper Stop
4		A/R	Screw, Hex Hd. Cap M10-1.5 x 30mm Lg.
5	56998332	1	Rack, 24 DP 1" Sq. x 72" Lg.
6		A/R	Screw, Hex Hd. Cap M6-1.0 x 40mm Lg.
7		A/R	Washer, Flat M6
8		A/R	Washer, Lock M6
9	2233835	2	Clip, Rack Derailer
10	56998331	Ref.	Bracket, Stop
11	459556	2	Bumper, Rubber
12		A/R	Screw, Hex Hd. Cap M6-1.0 x 16mm Lg.
13		A/R	Washer, Flat M10
14		A/R	Scr. Trilobular Thd Forming Hex Hd. M6 x 16 Lg.
15	56998320	Ref.	Deck
16		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
17		A/R	Washer, Flat M8
18		A/R	Washer, Lock M8
19		A/R	Nut, Hex M6 X 1.0
20	56998321	1	Assembly, Truck
21	185W02	2	Pin, Roll 1/4" Dia. x 7/8" Lg.
22		A/R	Screw, Hex Hd. Cap M10-1.5 x 35mm Lg.
23		A/R	Screw, Pan Hd. M5-0.8 x 16 Lg.
24		A/R	Washer, Lock M5
25		A/R	Screw, Soc. Hd. Cap M6-1.0 x 45mm Lg.
26	56998322	1	Assembly, Carriage
27		A/R	Nut, M5-0.8
28	56998329	REF	Bracket, Powertrak Y-Axis
29	56995778	2	Powertrak, 252-I-3.4
30		A/R	Screw, Hex Hd. Cap M8-1.25 x 16mm Lg.
31		A/R	Washer, Lock M10
33	57001068	6	Bumper Stop
34	56998330	1	Stand, Console Front

35		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
39	57000996	1	Cover
40	56996084	2	Wiper Way, Fabbed
41	2235167	1	Support, Bearing
42	1006331	1	Bearing, Roller
43	2235164	1	Ring, Snap
44		A/R	Washer, Lock M12
45		A/R	Washer, Flat M12
46		A/R	Nut, Hex M12-1.75
47		A/R	Screw, Soc. Hd. Cap M6-1.0 x 40mm Lg.
48		A/R	Scr., Trilobular Thd. Forming Hex Hd. M6 x 25
50		A/R	Nut, Hex M8-1.25
51	57001481	15	Tie, Cable Mount
52	2239825	1	Plate, Transformer Support
53		A/R	Screw, Flat Hd. M6-1.00 x 16mm Lg.
54		A/R	Screw, But. Hd. Cap M8-1.25 x 25mm Lg.
55	2238956	1	Tag, Metal AMT Member
56	56996459	1	Label, Esab Logo 3"
58	57000788	Ref.	Assembly, Rail 16 Ft.
59	56998341	Ref.	Assembly, Air Slide
60	56998355	Ref.	Assembly, Downdraft Table
61	56998378	Ref.	Module, PCM875
62	56998490	1	Elec. Assy. Drive Amp
63		A/R	Washer, Star M6
64	56996954	1	Cam, Upper Travel LH
65	56998676	1	Mount, Switch
66	2239113	1	Switch, Limit Miniature
67	16901701	16	Leveler, Hex 1/2-13 x 3
68		16	Nut, Hex 1/2-13
69	56998794	1	Assy. E-Stop Enclosure
70	57000978	2	Cap, End Tube (4 x 4)

6.4 16' x 6' Wide Basic Piecemaker 2

Assembly 57000786 - LF (A) and 57000798 – RR (OR)

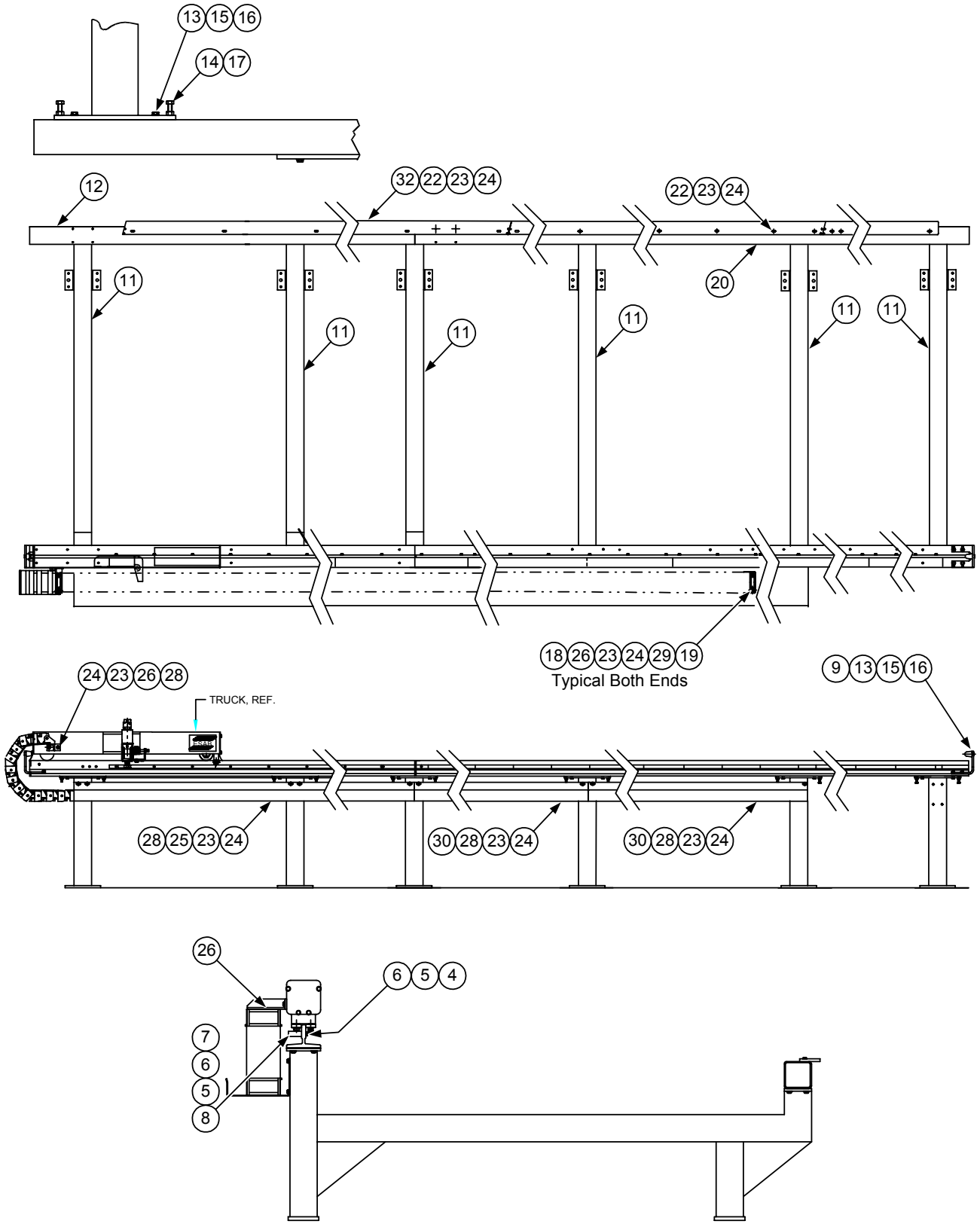


Item	Part #	Qty	Description
1	56998319	Ref.	Beam
2	57000640	1	V-Track
3	06W12064	4	Washer, Interal Star M6
4	10S10040	21	Screw, Hex Hd. Cap M10-1.5 x 40mm Lg.
5	57000637	1	Rack, 24 DP 1" Sq. x 84" Long
6	06S10040	9	Screw, Hex Hd. Cap M6-1.0 x 40mm Lg.
7	06W10066	17	Washer, Flat M6
8	06W10061	13	Washer, Lock M6
9	2233835	2	Clip, Rack Derailer
10	56998331	Ref.	Bracket, Stop
11	459556	2	Bumper, Rubber
12	06S10016	6	Screw, Hex Hd. Cap M6-1.0 x 16mm Lg.
13	06W10066	4	Washer, Flat M6 (LF)
	06W12064	4	Washer, Internal Star #6 (RR)
14		6	Screw, Soc. Hd. M6-1.0 x 20mm Lg.
15	56998320	Ref.	Deck (LF)
	57000638	Ref.	Deck (RR)
16	08S11020	7	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
17	08W01090	7	Washer, Flat M8
18	08W10082	7	Washer, Lock M8
19		4	Nut, Hex M6 x 1.0
20	56998321	1	Assembly, Truck
21	62900617	2	Pin, Dowel 3/8" Dia. x 1-1/4" Long
22	10S11035	6	Screw, Hex Hd. Cap M10-1.5 x 35mm Lg.
23	10W01110	6	Washer, Flat M10
24	10W10102	26	Washer, Lock M10
25	6C45SCSH	2	Screw, Soc. Hd. Cap M6-1.0 x 45mm Lg.
26	56998322	1	Assembly, Carriage
28	56998329	Ref.	Bracket, Powertrak Y-Axis
29	56995778	2	Powertrak, 252-I-3.4
30	08S11016	8	Screw, Hex Hd. Cap M8-1.25 x 16mm Lg.
31	08W01090	16	Washer, Flat M8
32	08W10082	8	Washer, Lock M8
34	56998330	1	Stand, Console (LF)
	56998324	1	Stand, Console (RR)

35	08S11020	8	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
36	08W01090	8	Washer, Flat M8
37	08W10082	8	Washer, Lock M8
39	56999118	2	Brack., Wiper Way
40	56996084	2	Wiper Way, Fabbed
41	2235167	1	Support, Bearing
42	1006331	1	Bearing, Roller
43	2235164	1	Ring, Snap
44	12W10122	1	Washer, Lock M12
45	12W01140	2	Washer, Flat M12
46	12N30175	1	Nut, Hex M12-1.75
52	2239825	1	Plate, Transformer Support
53	06S13016	2	Screw, Flat Hd. M6-1.00 x 16mm Lg.
55	2238956	1	Tag, Metal AMT Member
56	56996459	1	Label, ESAB Logo 3"
58	57000790	Ref.	Assembly, Rail 16 Ft.
59	56998341	Ref.	Assembly, Air Slide
60	57000646	Ref.	Assembly, Downdraft Table (LF)
	56998355	Ref.	Assembly, Downdraft Table (RR)
61	56998378	Ref.	Module, PCM875
62	56998387	Ref.	Elect. Package 16 ft. Cntrl. (LF)
	56998490	Ref.	Elect. Assy. Drive Amp. (RR)
64	56996954	1	Cam, Upper Travel LH
65	56998676	1	Mount, Switch
66	2239113	1	Switch, Limit Miniature
67	16901701	16	Leveler, Hex 1/2-13 x 3
68		16	Nut, Hex 1/2-13
69	56998794	1	Assy., E-Stop Enclosure

6.5 25' x 5' Wide Basic Piecemaker 2

Assembly 57000645 – LF (A) and 57000797 – RR (A)

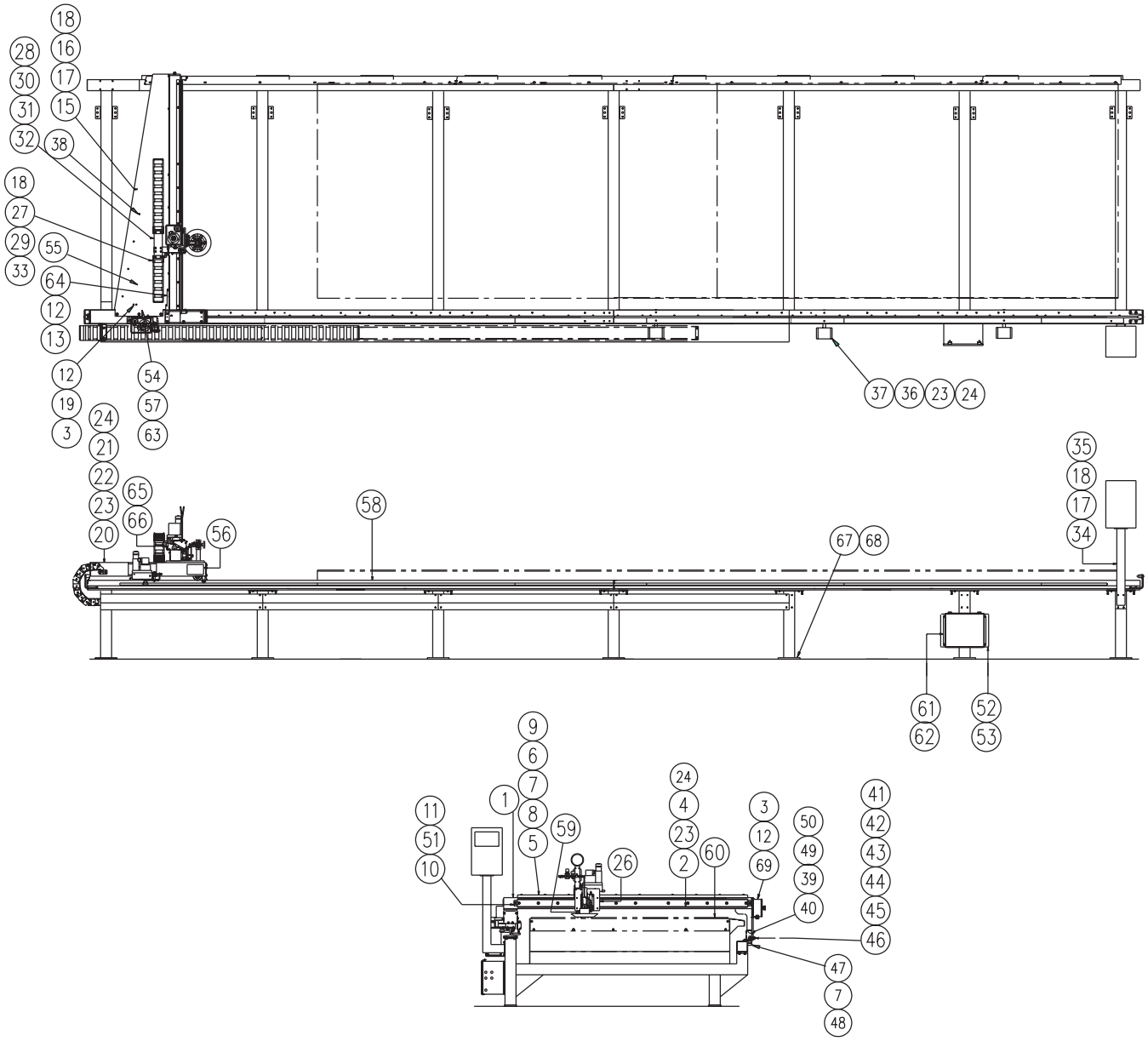


Item	Part #	Qty	Description
1	56998319	1	Beam
2	56998327	1	V-Track
3		A/R	Screw, Pan Hd. M6-1.0 x 16mm Lg.
4		A/R	Screw, Hex Hd. Cap M10-1.5 x 30mm Lg.
5	56998332	1	Rack, 24 DP,1"Sq. x 72" Long
6		A/R	Screw, Hex Hd. Cap M6-1.0 x 40mm Lg.
7		A/R	Washer, Flat M6
8		A/R	Washer, Lock M6
9	2233835	2	Clip, Rack Derailer
10	56998331	Ref.	Stop Bracket
11	459556	2	Rubber Bumper
12		A/R	Screw, Hex Hd. Cap M6-1.0 x 16mm Lg.
14		A/R	Screw, Soc. Hd. M6-1.0 x 45mm Lg.
15	56998320	Ref.	Deck
16		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
17		A/R	Washer, Flat M8
18		A/R	Washer, Lock M8
19		A/R	Nut, Hex M6-1.0
20	56998321	1	Truck Assy.
21	185W02	2	Pin, Roll 1/4" Dia. x 7/8" Long
22		A/R	Screw, Hex Hd. Cap M10-1.5 x 35mm Lg.
23		A/R	Washer, Flat M10
24		A/R	Washer, Lock M10
25	56998794	1	Assy., E-Stop Enclosure
26	56998322	1	Carriage, Master
27	57000978	2	Cap, End Tube (4 x 4)
28	56998329	Ref.	Bracket, Powertrak Y-Axis
29	56995778	2	Powertrak, 252-1-3-.4
30		A/R	Screw, Hex Hd. Cap M8-1.25 x 25mm Lg.
31	57001068	9	Bumper Stop
32		A/R	Screw, Soc. Hd. Cap M6-10 x 40mm Lg.
34	56998330	1	Stand, Console Front (LF)
	56998324	1	Stand, Console Rear (RR)
35		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
36		A/R	Screw, Trilobular Th'd. Forming Hex Hd. M6 x 16mm Lg.

37	57001481	15	Tie Cable Mount
38	57000672	2	Brat. Spt. Ptrak.
39	57000996	1	Cover
40	56996084	2	Wiper Way, Fabbed
41	2235167	1	Support, Bearing
42	1006331	1	Bearing, Roller
43	2235164	1	Ring, Snap
44		A/R	Washer, Lock M12
45		A/R	Washer, Flat M12
46		A/R	Nut, Hex M12-1.75
47	16901701	24	Leveler, Hex 1/2-13 x 3
48		A/R	Nut, Hex 1/2-13
49	12510133	1	Nameplate
50	954698	3	Label, Warning Gear Pinch Hazard
51		A/R	Washer, Star M6
52	2239825	1	Plate, Transformer Support
53		A/R	Screw, Flat Hd. M6-1.0 x 16mm Lg.
54	954515	2	Label, Warning Rotating Parts
55	2238956	1	Tag, Metal AMT Member
56	56996459	1	Label, ESAB Logo 3"
57	2061361	2	Label, Warning
58	57000789	1	Assembly, Rail 25 Ft. (LF/RR 5'W)
59	56998341	1	Assembly, Air Slide
60	56998355	Ref.	Assembly, Down Draft Table
61		A/R	Screw, Hex Hd. Cap M10-1.5 x 25mm Lg.
62	56998490	1	Elect, Package 25 ft. Front/Left Control
63	2091514	1	Label, Warning
64	56996954	1	Cam, Upper Travel LH
65	56998676	1	Limit Switch
66	2239113	1	Switch, Limit Miniature
67		A/R	Screw Triobular Th'd. Forming Hex Hd. M6 x 25mm Lg.
68		A/R	Screw, Pan Hd. M500.8 x 16mm Lg.
69		A/R	Washer, Lock M5
70		A/R	Nut, Hex M5-0.8
72		A/R	Nut, Hex M8-1.25
73		A/R	Screw, But. Hd. Cap M8-1.25 x 25mm Lg.

6.6 32' x 6' Wide Basic Piecemaker 2

Assembly 57000787 – LH (B) and 57000799 – RR (B)

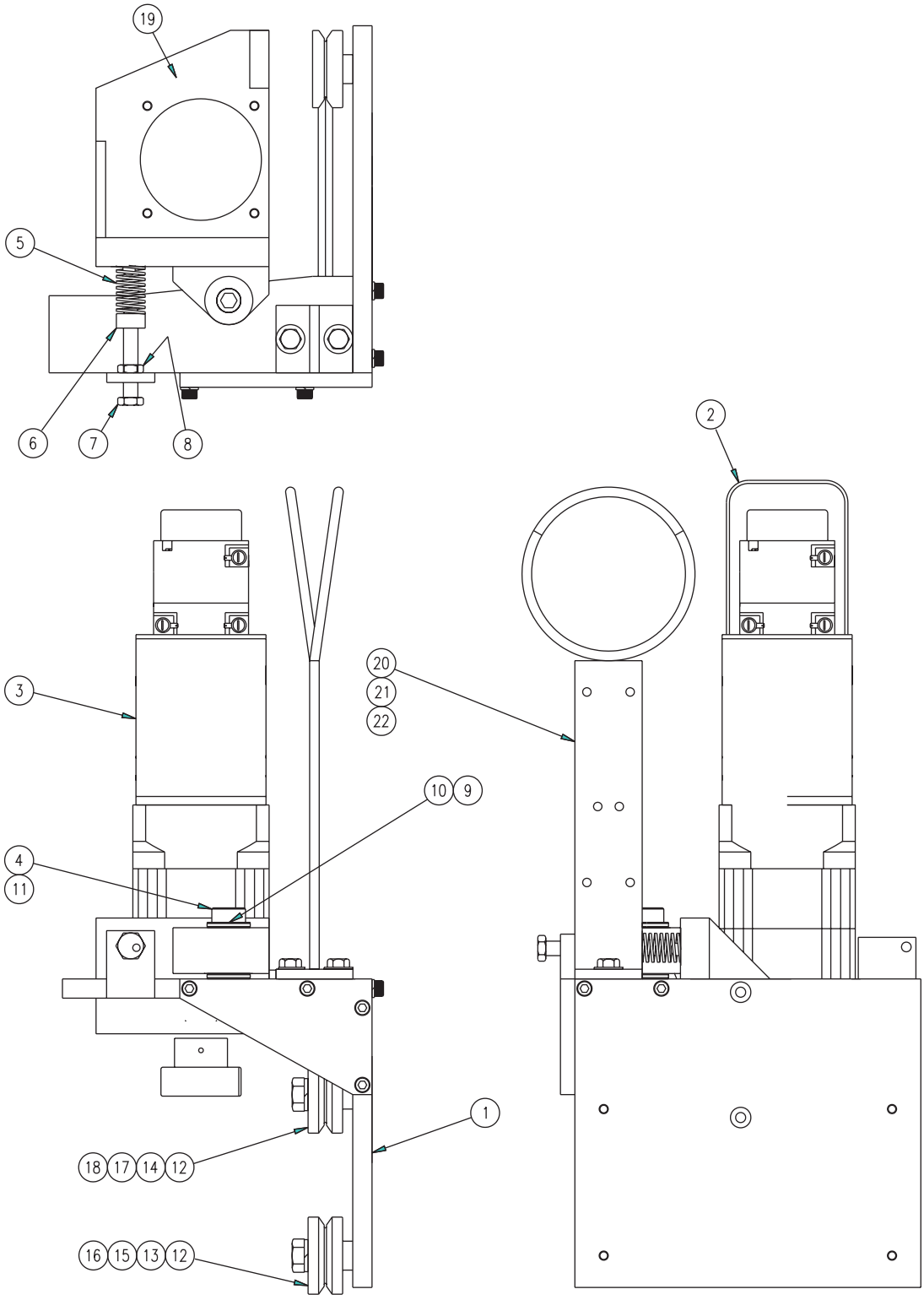


Item	Part #	Qty	Description
1	57000636	Ref.	Beam
2	57000640	1	V-Track
3		A/R	Washer, Interal Star M6
4		A/R	Screw, Hex Hd. Cap M10-1.5 x 40mm Lg.
5	57000637	1	Rack, 24 DP 1" Sq. x 84" Long
6		A/R	Screw, Hex Hd. Cap M6-1.0 x 40mm Lg.
7		A/R	Washer, Flat M6
8		A/R	Washer, Lock M6
9	2233835	2	Clip, Rack Derailer
10	56998331	Ref.	Bracket, Stop
11	459556	2	Bumper, Rubber
12		A/R	Screw, Hex Hd. Cap M6-1.0 x 16mm Lg.
13		A/R	Washer, Flat M6
14		A/R	Screw, Soc. Hd. M6-1.0 x 20mm Lg.
15	57000638	Ref.	Deck
16		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
17		A/R	Washer, Flat M8
18		A/R	Washer, Lock M8
19		A/R	Nut, Hex M6-1.0
20	56998321	1	Assembly, Truck
21	185W02	2	Pin, Roll 1/4" Dia. x 7/8" Lg.
22		A/R	Screw, Hex Hd. Cap M10-1.5 x 35mm Lg.
23		A/R	Washer, Flat M10
24		A/R	Washer, Lock M10
26	56998322	1	Assembly, Carriage
27		A/R	Nut, Hex M8-1.25
28	56998329	Ref.	Bracket, Powertrak Y-Axis
29	56995778	2	Powertrak, 252-I-3.4
30		A/R	Screw, Hex Hd. Cap M8-1.25 x 25mm Lg.
33		A/R	Screw, But. Hd. Cap M8-1.25 x 25mm Lg.
34	56998330	1	Stand, Console Front (LF)
	56998324	1	Stand, Console Rear (RR)
35		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
36		A/R	Screw, Hex Hd. Cap M10-1.5 x 25mm Lg.
37	57000672	3	Brat., Spt. Ptrak.
38	57001481	20	Tie, Cable Mount

39	57000996	1	Cover
40	56996084	2	Wiper Way, Fabbed
41	2235167	1	Support, Bearing
42	1006331	1	Bearing, Roller
43	2235164	1	Ring, Snap
44		A/R	Washer, Lock M12
45		A/R	Washer, Flat M12
46		A/R	Nut, Hex M12-1.75
47	57001068	12	Bumper Stop
48		A/R	Screw, Soc. Hd. Cap M6-1.0 x 40mm Lg.
49		A/R	Screw, Trilobular Th'd. Forming Hex Hd. M6-1.0 x 16mm Lg.
50		A/R	Screw, Trilobular Th'd. Forming Hex Hd. M6-1.0 x 25mm Lg.
51		A/R	Screw, Soc. Hd. Cap M6-1.0 x 45mm Lg.
52	2239825	1	Plate, Transformer Support
53		A/R	Screw, Flat Hd. M6-1.00 x 16mm Lg.
54		A/R	Screw, Pan Hd. M5-0.8 x 16mm Lg.
55	2238956	1	Tag, Metal AMT Member
56	56996459	1	Label, ESAB Logo 3"
57		A/R	Washer, Lock M5
58	57000791	Ref.	Assembly, Rail 32 Ft.
59	56998341	Ref.	Assembly, Air Slide
60	57000646	Ref.	Assembly, Downdraft Table
61	56998378	Ref.	Module, PCM875
62	56998490	1	Elect., Package 32ft. Cntrl. Front/Left
63		A/R	Nut, Hex M5-0.8
64	56996954	1	Cam, Upper Travel LH
65	56998676	1	Mount, Switch
66	2239113	1	Switch, Limit Miniature
67	16901701	28	Leveler, Hex 1/2-13 x 3
68		A/R	Nut, Hex 1/2-13
69	56998794	1	Assy., E-Stop Enclosure

6.7 Carriage, Servo Drive

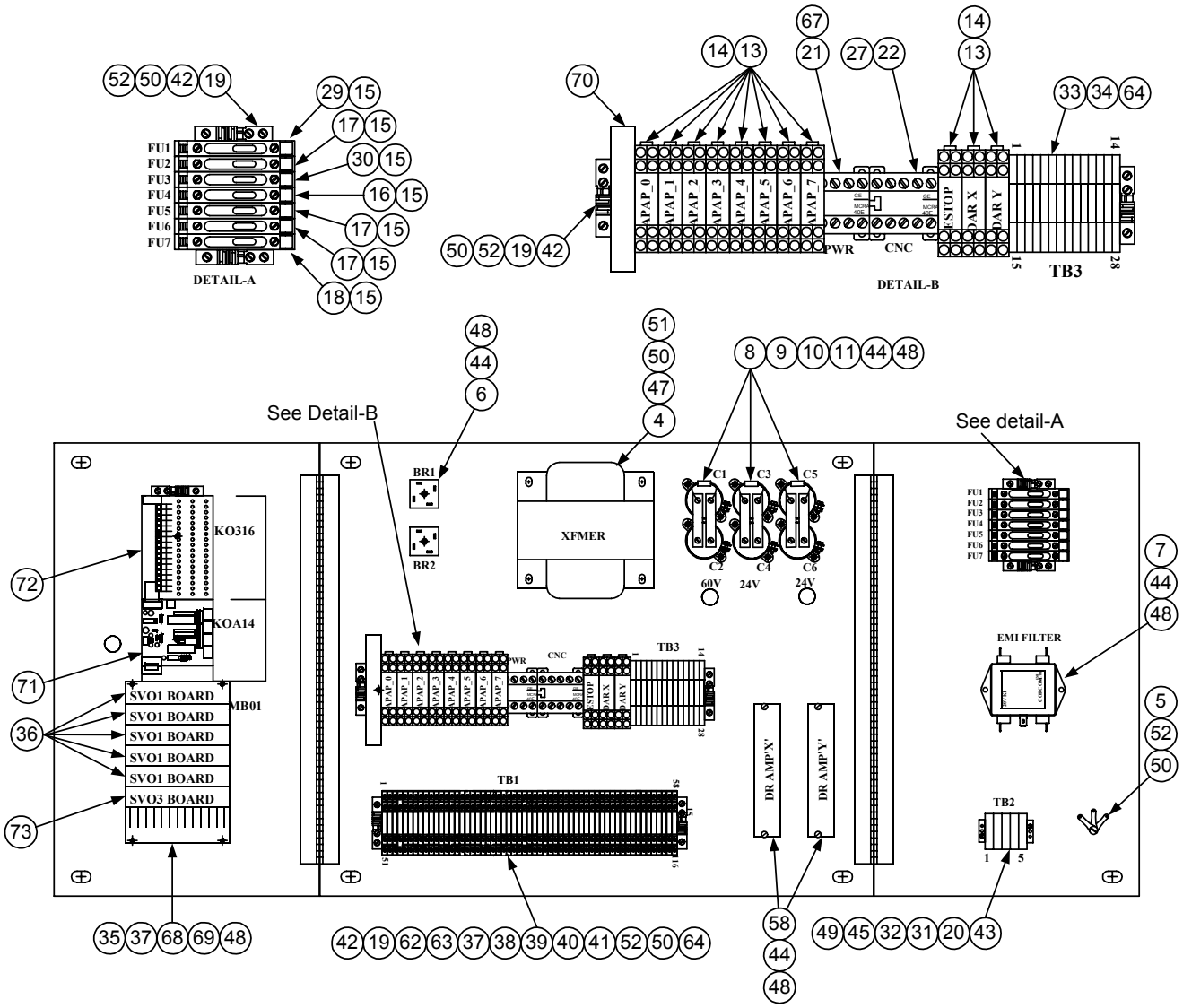
Assembly 0560985961 (A)

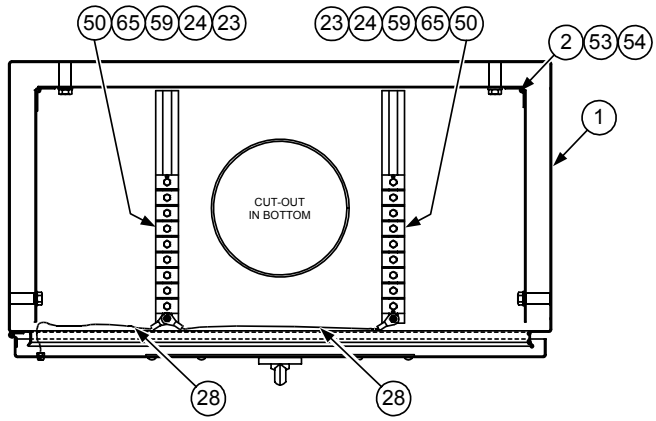


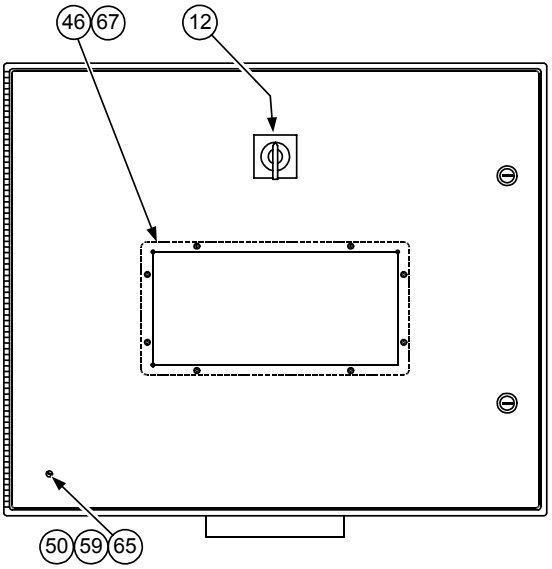
Item	Part#	Qty	Description
1	56998326	1	Carriage
2	0560985984	1	Cover Mtr Prctve
3	0560996401	1	Drive Servo Assy
4	61292652	1	Bolt, Shoulder Soc. Hd. 5/8" Dia. x 2" Lg.
5	2233820	1	Spring, Preload
6	2233819	1	Snub, Spring
7		1	Screw, Hex Hd. Cap M10-1.5 x 45mm Lg.
8		1	Nut, Hex M10-1.5
9	2233823	6	Washer, Thrust
10	2233824	2	Bearing, Thrust
11	63311183	1	Nut, Lock 1/2"-13
12	56998345	4	Wheel, Guide
13	2235115	2	Bushing, Eccentric
14	56998325	2	Stand-Off, Bearing
15		2	Screw, Hex Hd. Cap M8-1.25 x 30mm Lg.
16		2	Washer, Flat M8
17		2	Screw, Hex Hd. Cap M12-1.75 x 40mm Lg.
18		2	Washer, Lock M12
19	57000908	1	Mount Gearbox Planet Bayside
20	56998328	1	Support, Hose
21		2	Screw, Hex Hd. Cap M6-1.0 x 16mm Lg.
22		2	Washer, Lock M6
23	57001403	Ref.	Cbl Ay 8/20 10S-0 BS FX

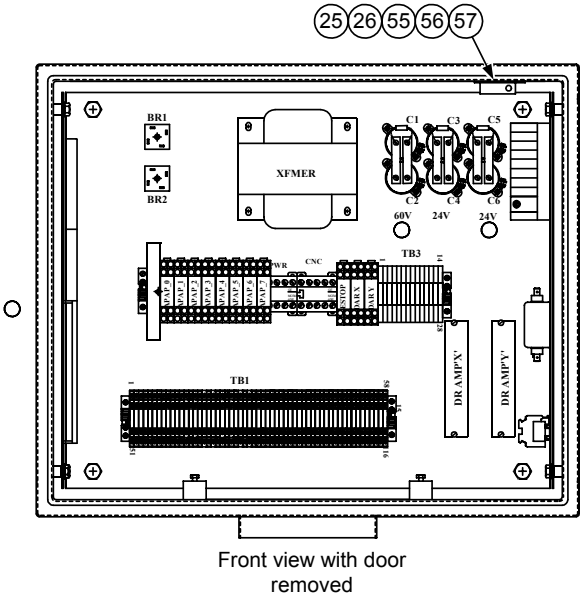
6.8 Electronics Cabinet

Assembly 0560986176 (F)









Front view with door removed

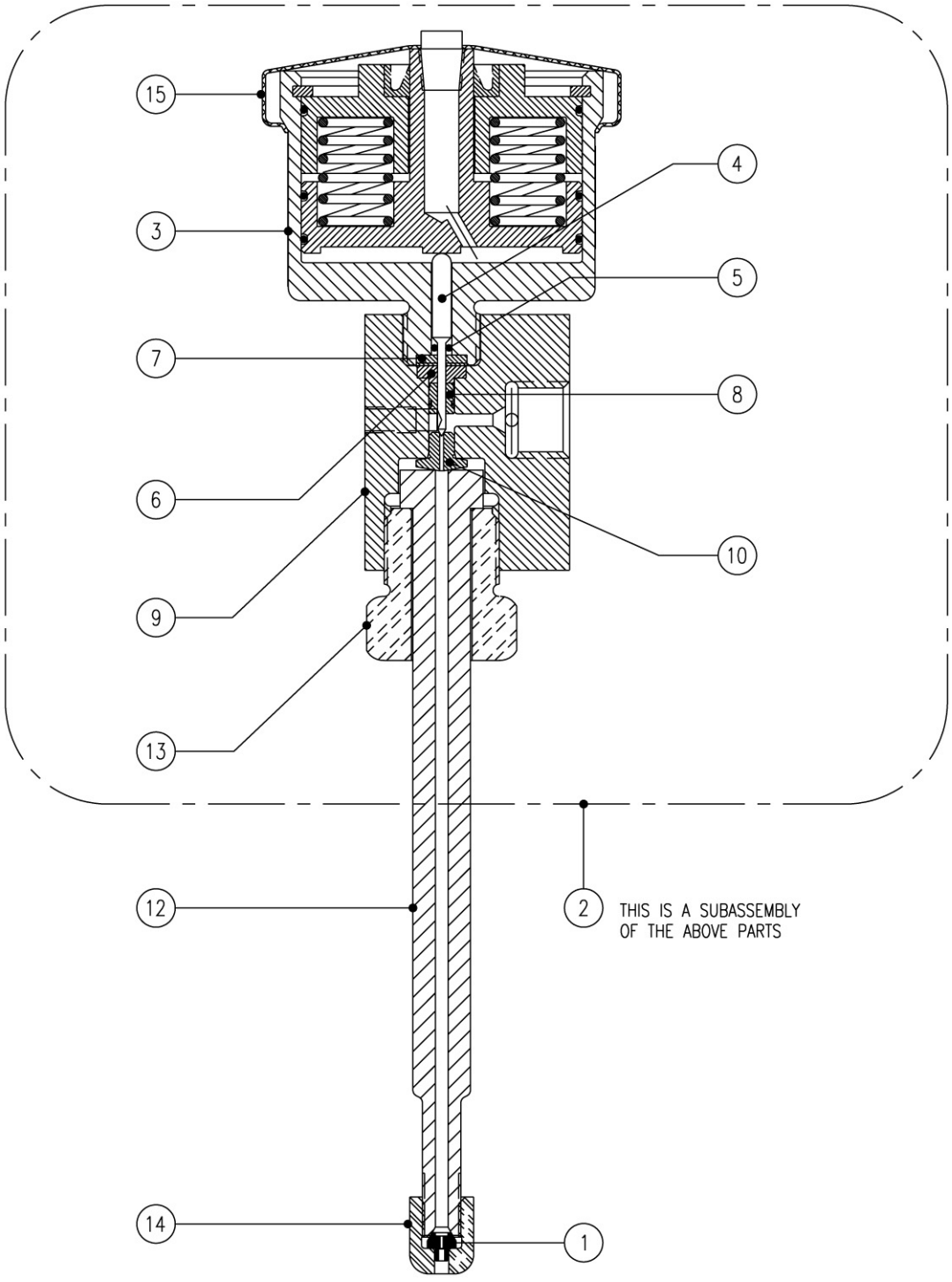
Item	Part#	Qty	Description
1	D-56997893	1	Encl Drl Sabre 1000 Control
2	D-0560986177	1	Drill Pnl Piecemaker Ii
3	A-2046741	8	Spacer
4	A-57001412	1	Transformer Control 120v Pri 50/60hz
5	A-2018994	3	Lug, Solder
6	A-13730469	2	Rectifier Bridge
7	A-0560995369	1	Corcom Filter
8	A-2238601	6	CAPACITOR 4700uf 100VDC
9	A-636612	6	Clamp Mounting Capacitor
10	A-2238605	3	Busbar
11	17615222	3	Resistor 2.2k 5w
12	A-2236401	1	Switch 2 Pole 20a
13	A-0560996138	11	Miniature Relay
14	A-0560989702	11	Mini Relay Socket
15	A-2234477	7	Fuse Block Terminal
16	A-2017107	3	Fuse 2amp Agc2
17	A-2079279	3	Fuse Abc5
18	A-2017327	1	Fuse Abc10
19	A-2234485	6	End Clamp
20	A-2234320	2	End Bracket
21	A-0560995900	1	Contactor, 110vac Four Pole
22	A-0560995899	1	Ge 24vdc Contactor
23	A-2236432	18	Clip Stirrup .23-.47 Dia
24	B-56998446	2	Rail Sectional Clamping 11" Long
25	A-2078865	1	Switch Door Interlock
26	A-56997892	1	Bracket Interlock Switch Mtg
27	A-0560996134	1	Dc Snubber
28	A-57002247	2	Strap, Ground, 12"
29	A-2044277	1	Fuse 10a 250v Mda-10
30	A-2017483	1	Fuse 1a 250v Agc1
31	A-2237990	12	Terminal Block 20-8 Awg Std
32	A-2237991	1	End Cover 20-8 Awg Std
33	A-2237993	14	Terminal Block Mini Dbl Level
34	A-2237994	8	End Cover Mini Dbl Level
35	A-56997158	REF	Card Mainboard Mb01 Lcasiob
36	A-56997159	REF	Servo-01 Lcasiob 24v 2a
37	A-0560986171	6	Plug Combicon 2 Pos
38	A-0560986172	2	Plug Combicon 4 Pos
39	A-951009	1	Receptacle P/C 6 Pos
40	A-0560986173	4	Plug Combicon 8 Pos
41	A-(8)951339	1	Plug 12 Position
42	A-2234478	AR	Mounting Rail Ns 35/7.5
43	A-2234268	AR	Mounting Rail Ns 15
44	BIN STOCK	AR	SCREW M3-0.5 X 12mm POSIDRIVE THD FORMING
45	BIN STOCK	AR	SCREW M4-0.7 X 12mm POSIDRIVE THD FORMING
46	BIN STOCK	AR	SCREW BUTTON HD M4-0.7 X 12mm

47	BIN STOCK	AR	SCREW M5-0.8 X 16mm POSIDRIVE THD FORMING
48	BIN STOCK	AR	Washer Lock M3
49	BIN STOCK	AR	Washer Lock M4
50	BIN STOCK	AR	Washer Lock M5
51	BIN STOCK	AR	Washer Flat M5
52	BIN STOCK	AR	SCREW M5-0.8 X 12mm POSIDRIVE THD FORMING
53	BIN STOCK	AR	SCREW M10-1.5 X 20mm HEX HD CAP
54	BIN STOCK	AR	Washer Lock M10
55	BIN STOCK	AR	Screw, #6-32 X .50 Lg Pan Hd
56	BIN STOCK	AR	Washer Lock #6
57	BIN STOCK	AR	Nut #6-32 Hex
58	A-0560986178	2	Pwm Drive 12abe-Es1 6a 20-80v
59	BIN STOCK	AR	M5-0.8 X 12mm PH SCREW
60	BIN STOCK	AR	#10-32 X 1/2 Posidrive Thd Forming Screw
61	BIN STOCK	AR	#10-32 Lock Washer
62	A-2237987	58	Term Block Dbl Level W/Comb
63	A-2237988	1	End Cover Dbl Level Left
64		A/R	Term. Block Markers
65	BIN STOCK	AR	M5-0.8 Hex Nut
66	D-2234274	1	Volt Panel Blank
67	A-0560996135	1	Ac Snubber
68	56995674	REF	STANDOFF BRS M3 X 10mm M/F THD
69	BIN STOCK	AR	SCREW M3-0.5 X 8mm TH'D FORMING
70	57002499	REF	Analog Isolation Module
71	56997678	REF.	Koa14 Analog Output Board
72	56997165	REF	Ko316 Triac Output Board
73	0560999106	REF	Sv03 60v 7a

* Quantity determined by machine configuration.

6.9 Waterjet Cutting Head Assembly

Assembly 0560986762 (OR)

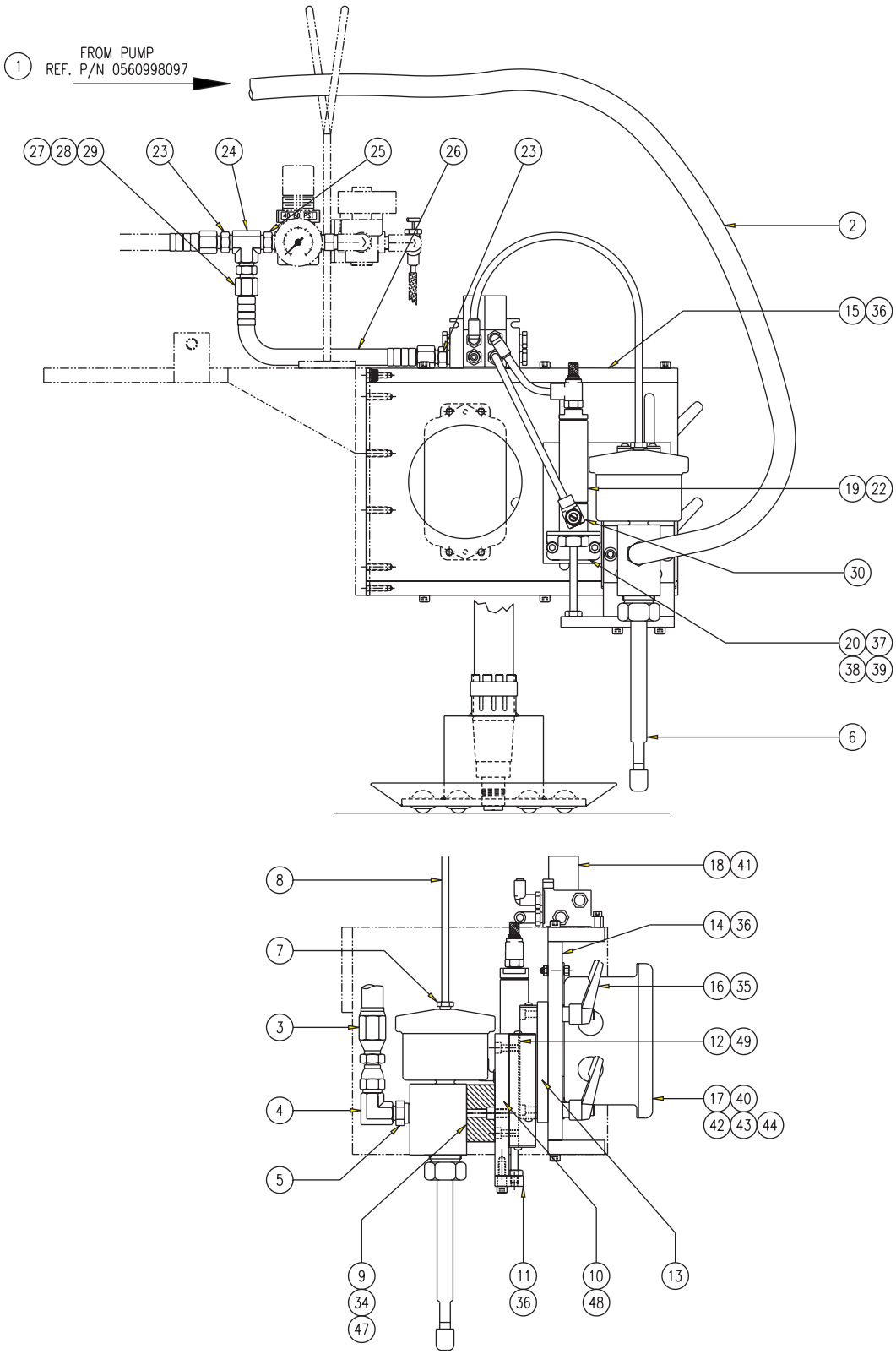


Item	Part #	Qty	Description
1	0560996079	Ref.	Orifice, 0.003" Standard
	0560996080	Ref.	Orifice, 0.004" Standard
	0560996081	Ref.	Orifice, 0.005" Standard
	0560996082	Ref.	Orifice, 0.006" Standard
	0560996083	Ref.	Orifice, 0.007" Standard
	0560996084	1	Orifice, 0.008" Standard
	0560996085	Ref.	Orifice, 0.009" Standard
	0560996086	Ref.	Orifice, 0.010" Standard
	0560996087	Ref.	Orifice, 0.012" Standard
	0560996088	Ref.	Orifice, 0.014" Standard
	0560996089	Ref.	Orifice, 0.015" Standard
	0560996090	Ref.	Orifice, 0.016" Standard
	0560996091	Ref.	Orifice, 0.018" Standard
	0560996092	Ref.	Orifice, 0.020" Standard
	0560996093	Ref.	Orifice, 0.022" Standard
	0560996094	Ref.	Orifice, 0.003" Long Life
	0560996095	Ref.	Orifice, 0.004" Long Life
	0560996096	Ref.	Orifice, 0.005" Long Life
	0560996097	Ref.	Orifice, 0.006" Long Life
	0560996098	Ref.	Orifice, 0.007" Long Life
	0560996099	Ref.	Orifice, 0.008" Long Life
	0560996100	Ref.	Orifice, 0.009" Long Life
	0560996101	Ref.	Orifice, 0.010" Long Life
	0560996102	Ref.	Orifice, 0.012" Long Life
	0560996103	Ref.	Orifice, 0.014" Long Life
	0560996104	Ref.	Orifice, 0.015" Long Life
	0560996105	Ref.	Orifice, 0.016" Long Life
	0560996106	Ref.	Orifice, 0.018" Long Life
	0560996107	Ref.	Orifice, 0.020" Long Life
	0560996108	Ref.	Orifice, 0.022" Long Life

Item	Part #	Qty	Description
2	0560996117	1	Actuator Assembly
3	0560996118	Ref.	Actuator, Normally Closed
4	0560996119	Ref.	Stem
5	0560996120	Ref.	O-ring
6	0560996121	Ref.	Back-up Ring, Brass
7	0560996122	Ref.	Back-up Ring, Stainless Steel
8	0560996123	Ref.	Seal Assembly
9	0560996508	Ref.	Valve Body
10	0560996509	Ref.	Valve Seat
12	0560996543	1	Nozzle Tube, 3/8" Dia. x 8" Long
13	0560996518	1	Valve Nut
14	0560996546	1	Nut, 3/8" Dia. Tube Nozzle
15	0560996520	1	Cover Actuator

6.10 Waterjet Addition Assembly

Assembly 0560986765 (A)

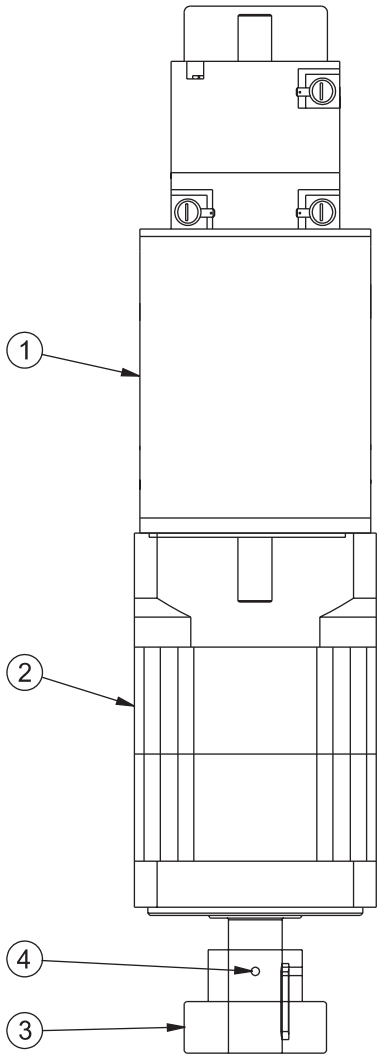


Item	Part #	Qty	Description
1	0560998097	1	Washer, 5000 psi pressure
2	0560986758	50ft.	Hose, 3/8" ID. 5000 psi
3	0560986759	2	Fitting, 3/8" NPT Swivel
4	0560987050	1	Elbow, 3/8" NPTF Street Elbow
5	0560986761	1	Adapter, 3/8" NPT – 3/8" HP
6	0560986762	1	Assy, Wjet Only Cutting Head
7	0560996732	1	Tube Fitting, 1/8" NPT – ¼" OD
8	90858001	5ft.	Tubing, ¼" OD Plastic
9	0560986763	1	Adapter Block
10	0560987044	1	Torch Mount
11	0560987045	1	Bracket, Lift
12	2081885	1	Ball Slide, CBU
13	0560986764	1	Slide Mount
14	0560986757	1	Brkt, Waterjet Station Mtg.
15	0560986766	2	Brace, Slide Mtg.
16	0560986652	4	Handle, Adjust. M8-1.25 x 25mm Lg.
17	2212144	1	Junction Box
18	0560995395	1	Valve Stack of 2
19	2213466	1	Air Cylinder
20	2213468	1	Cyl. Foot Mount
22	63340230	1	Nut 30005 STLZPC 0.625
23	810Z30	3	Adapter, Air ¼" NPT to 5/8"-18 RH
24	2059603	1	Tee, ¼" NPT Female
25	2135688	1	Nipple, ¼" NPT
26	23079995	5ft.	3/8" ID Hose
27	03Z74	2	Hose Nipple, ‘B’ to 3/8" ID Hose
28	836Z40	2	Nut, 5/8"-18 RF Female
29	39Z91	2	Ferrule

Item	Part #	Qty	Description
30	0560987432	2	Flow Control Knob Adjust
34		A/R	Screw
35		A/R	Washer, M8 Flat Zinc Plated
36		A/R	M6-1.0 x 25mm Long SHCS Zinc Plat.
37		A/R	M6-1.0 x 15mm Long HHCS Zinc Plat.
38		A/R	M6 Flat Washer Zinc Plated
39		A/R	M6 Lock Washer Zinc Plated
40		A/R	M5-0.8 x 20mm Long HHCS Zinc Plat.
41		A/R	M5-0.8 x 20mm Long SHCS Zinc Plat.
42		A/R	M5-0.8 Hex Nut Zinc Plated
43		A/R	M5 Flat Washer Zinc Plated
44		A/R	M5 Lock Washer Zinc Plated
47		A/R	¼"-28 x 1-1/4" Long SHCS Zinc Plated
48		A/R	#10-32 x ¾" Long SHCS Zinc Plated
49		A/R	#10-32 x 1" Long SHCS Zinc Plated

6.11 Servo Drive Assembly with Planetary Gearbox

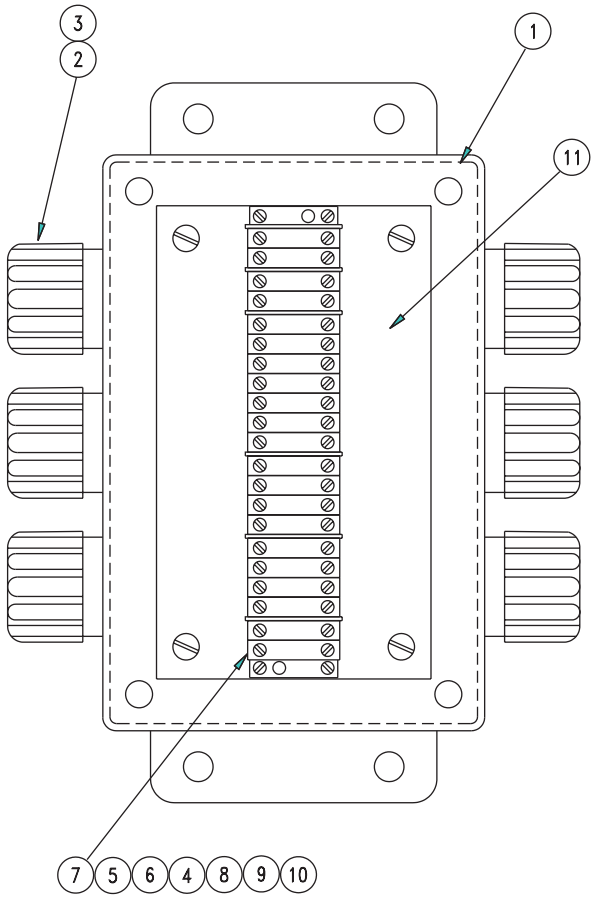
Assembly 0560996401 (F)



Item	Part #	Qty	Description
1	0560996402	1	DC Servo Motor with Encoder
2	0560996403	1	Planetary Gearbox
3	57000911	1	Pinion
4		2	Set Screw, M4-0.7 x 5mm
5	0560985984	1	Motor Cover

6.12 Interface Box Assembly (J-Box)

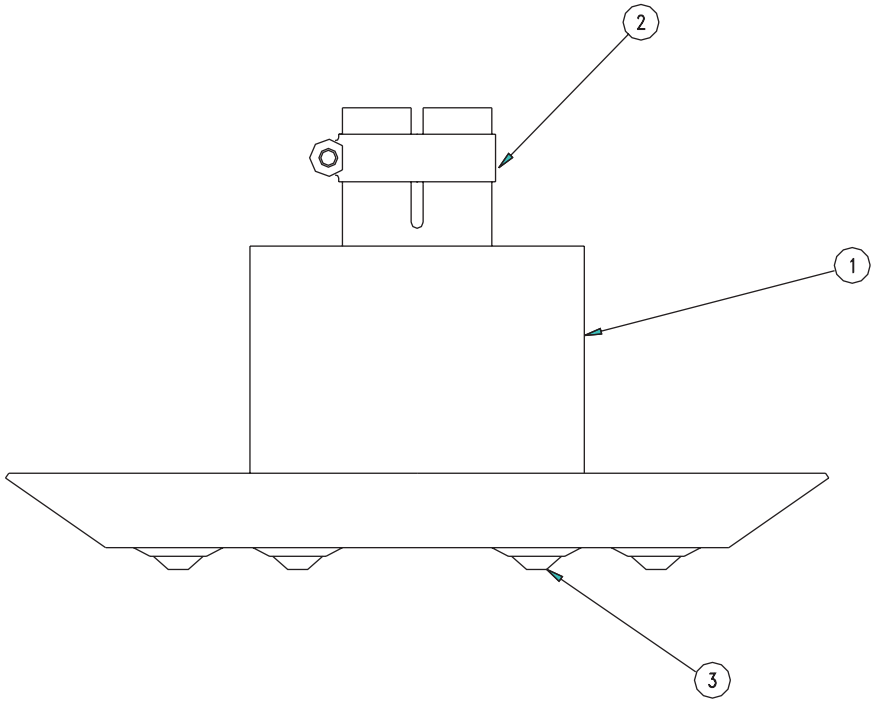
Assembly 0560986783 (B)



Item	Part #	Qty	Description
1	0560986784	1	J-Box Enclosure
2	527376	6	Strain Relief
3	2062151	6	Lock Nut
4	2234473	21	Terminal Block, Mini
5	2234320	2	End Bracket
6	2234476	6	End Cover, Mini
7	2234268	A/R	NS-15 Mounting Rail
8		A/R	Screw, M4-0.7 x 12mm, PosiDrive, Thread Forming
9		A/R	Flat Washer, M4
10		A/R	Lock Washer, M4
11	57001431	1	Drilled Panel

6.13 Plate Rider, Plasma

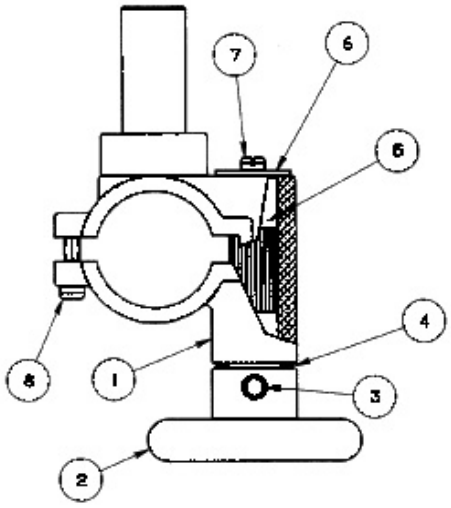
Assembly 2238229 (D)



Item	Part #	Qty	Description
1	2238228	1	Shield/Rider Plate Plas. 1.25D
2	640400	1	Clamp, Hose
3	2238227	6	Bearing Ball Transfer w/Clip

6.14 Torch Holder

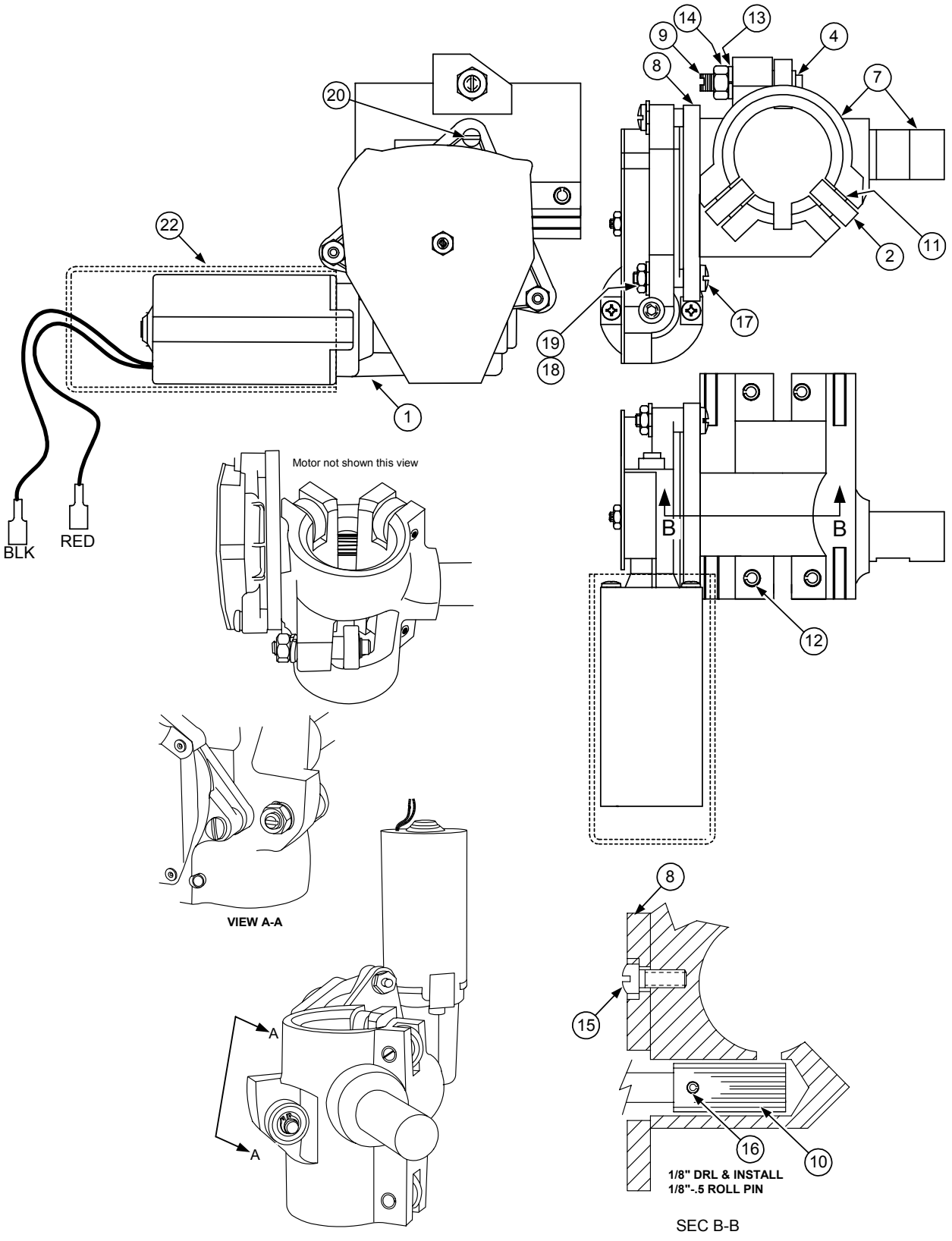
Assembly 52675 (OR)



Item	Part #	Qty	Description
1	51338	1	Body Assembly
2	1691111	1	Handwheel
3	61330084	1	Set Screw, .25-20 x .25"
4	50944	1	Spring Washer, .56" U-Bend
5	13012155	1	Pinion, 32DP, 16T, 14.5PA
6	13012183	1	Pinion Washer, .875" OD x .187" ID
7	61307006	1	Machine Screw, 10-32 x .50" Fill. Hd.
8	61300976	2	Machine Screw, 10-24 x .875" Fill. Hd.

6.15 Lift, motorized

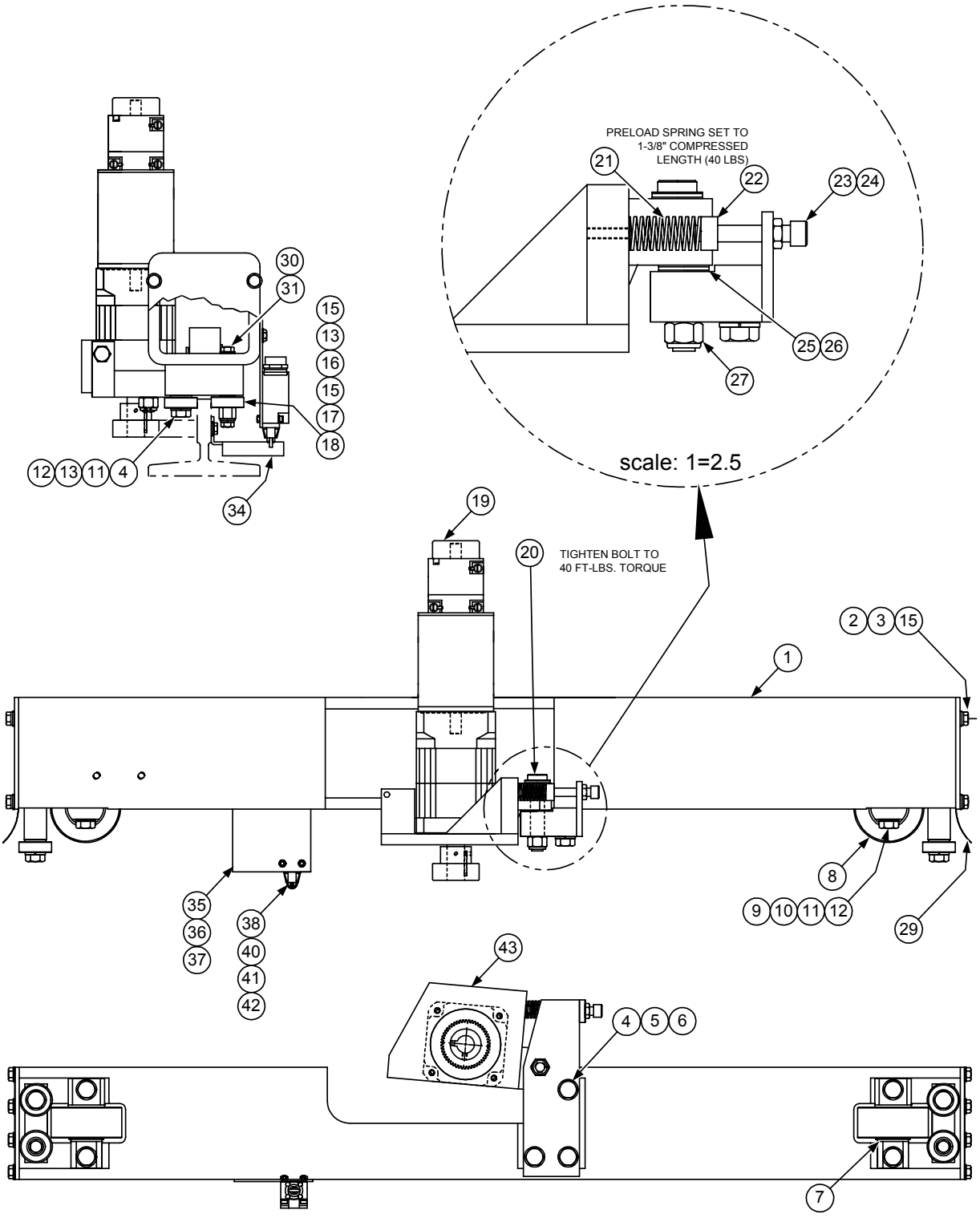
Assembly 57000381 (C)



Item	Part#	Qty	Description
1	P-66402	1	Motor - Gearbox (Esab # 4-630-480)
2	P-66403	5	Bearing - Fafner S1kcd
3			
4	P-51335	1	Snap Ring
5			
6			
7	57000674	1	Brk-A-Way Budget Torch Body
8	41016193	1	Motor Plate
9	41016195	1	Electric Bearing Plate
10	41016197	1	Pinion
11	66386	8	Washer - 1/4"I.D. X .03 Thk
12	62250519	4	Poll Pin %%C1/4 X 1"
13	64302996	1	%%C1/4" Id Lock Washer
14	63300100	1	1/4-20 Unc Nut Hex
15	61307910	3	Scr Pan Hd 10-32 Unf X 1/8
16	62240032	1	Roll Pin %%C1/8 X 1/2"
17	61301913	2	Scr Rnd Hd Mach 10-32 X 7/8"
18	64304050	2	Flat Wshr #10
19	63300917	2	Nut Hex 10-32 Unf
20	61301921	1	Scr Rnd Hd Mach 10-32 Unf X 5/8"
21	950904	2	Pan Dnf 18-250 Fim Male 18-22 Ins Coupler
22	56998729	1	Cover Lift Motor

6.16 Main Truck Assembly

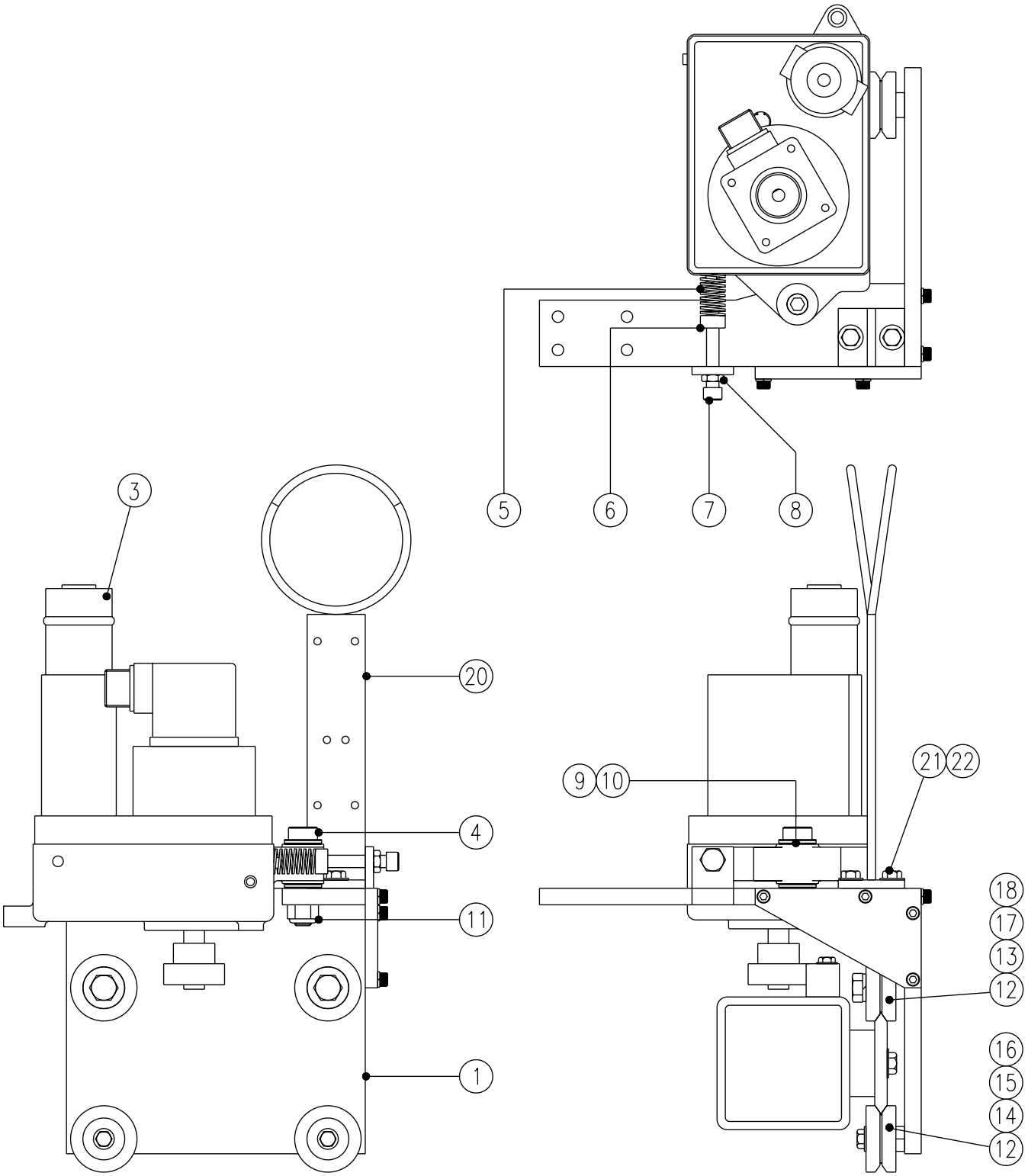
Assembly 56998321 (J)



Item	Part #	Qty	Description
1	56998323	1	Truck (+ Cap and Drive Mnt Brkt)
2	08S11016	8	Screw, M8-1.25x16mm Hex Head
3	08W10082	8	Lock Washer, M8
4	12S11070	5	Screw, M12-1.75x70mm
5	12W01140	3	Flat Washer, M12
6	12W10122	3	Lock Washer, M12
7	2235086	2	Retaining Ring
8	2235314	2	Ball Bearing
9	56997091	2	Wheel Axle
10	12S11030	4	Screw, M12-1.75x30mm hex head
11	12W10122	6	Lock Washer, M12
12	12W01140	6	Flat Washer, M12
13	2235315	4	Guide Bearing
15	08W01090	12	Flat Washer, M8
16	56997089	2	Eccentric Post
17	08W10082	2	Lock Washer, M8
18	08S11050	2	Screw, M8-1.25x500mm hex head
19	0560996401	1	Servo Drive Assembly with Planetary Gearbox
20	61292666	1	Shoulder Bolt, 5/8x2-1/2 soc head
21	2233820	1	Preload Spring
22	2233819	1	Spring Nub
23	10S10035	1	Screw, M10-1.5x35mm hex head
24	10N01150	1	Hex Nut, M10-1.5
25	2233823	4	Thrust Washer
26	2233824	2	Thrust Bearing
27	63311183	1	Locking Hex Nut, ½-13
29	56997092	2	Rail Scraper
30	08S11025	2	Screw, M8-1.25x25mm hex head
31	08S10082	2	Flat Washer, M8
32	56997720	2	Guide Bearing Spacer
34	56998677	1	Home Switch Cam
35	56997595	1	Limit Switch Bracket
36	06S10016	2	Screw, M6-1.0x16mm hex head
38	57002257	1	Limit Switch
40		2	Screw, M4-.7x30mm pan head
41		2	Lock Washer, M4
42		2	Hex Nut, M4
43	57000908	1	Gearbox Mount

6.17 Y Axis Carriage Assembly (Not current--Pre Planetary Drive)

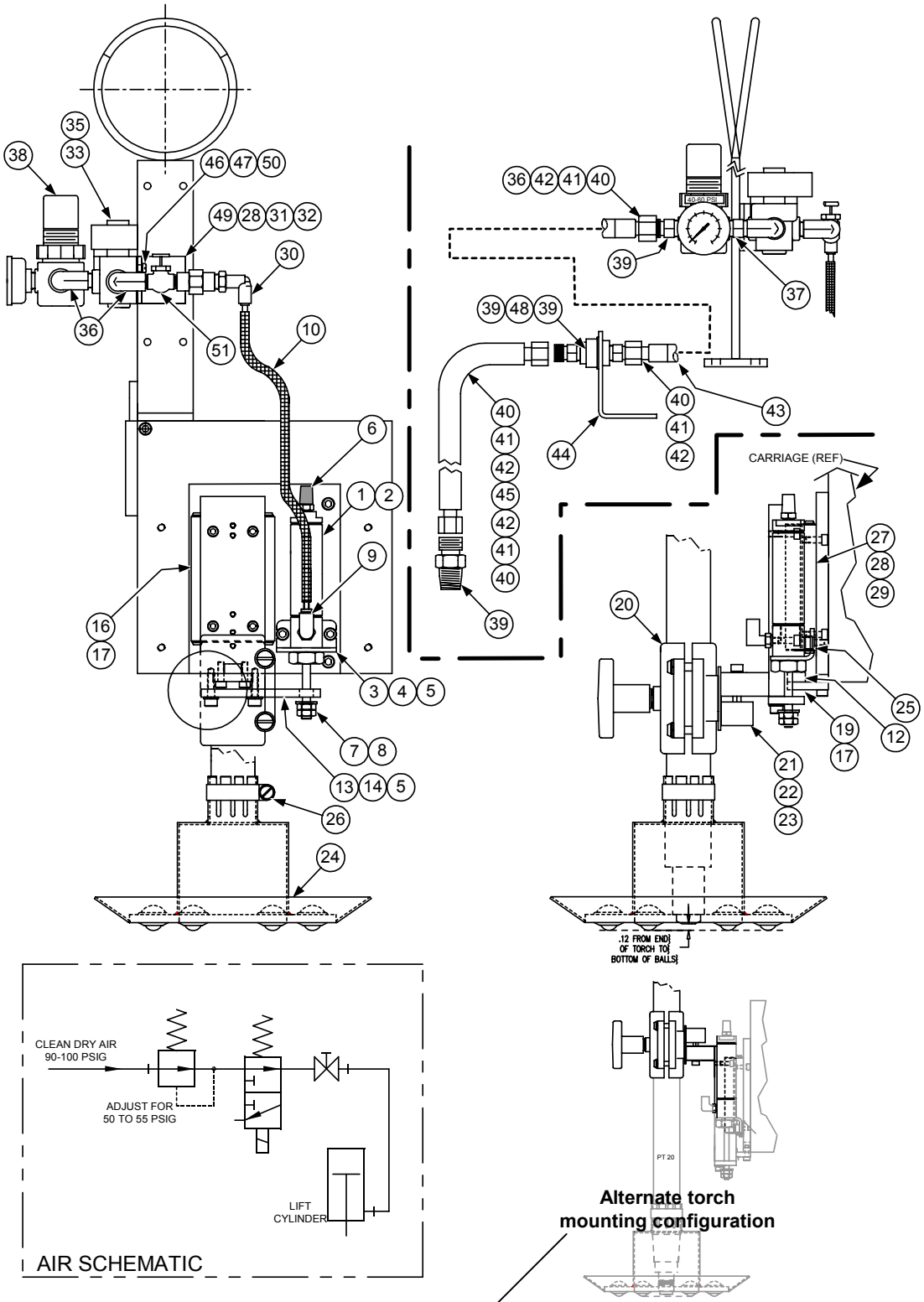
Assembly 56998322 (A)



Item	Part #	Qty	Description
1	56998326	1	Carriage
3	56998348	1	Servo Actuator
4	61292652	1	Shoulder Bolt, 5/8 x 2” Soc. Head
5	2233820	1	Preload Spring
6	2233819	1	Spring Nub
8	10N01150	1	Hex Nut, M10-1.5
9	2233823	4	Thrust Washer
10	2233824	2	Thrust Bearing
11	63311183	1	Lock Nut, ½-13
12	56998345	4	Guide Wheel
13	2235115	2	Eccentric Bushing
14	56998325	2	Stand-Off Bearing
15	08S10030	2	Screw, M8-1.25 x 30mm Hex Head
16	08W01090	2	Flat Washer, M8
17	12S10040	2	Screw, M12-1.75 x 40mm
18	12W10122	2	Lock Washer, M12
20	56998328	1	Hose Support
21	06S11016	2	Screw, M6-1.0 x 16mm Hex Head
22	06W10061	2	Lock Washer, M6

6.18 Torch Lifter Assembly

Assembly 0560985428 (D)



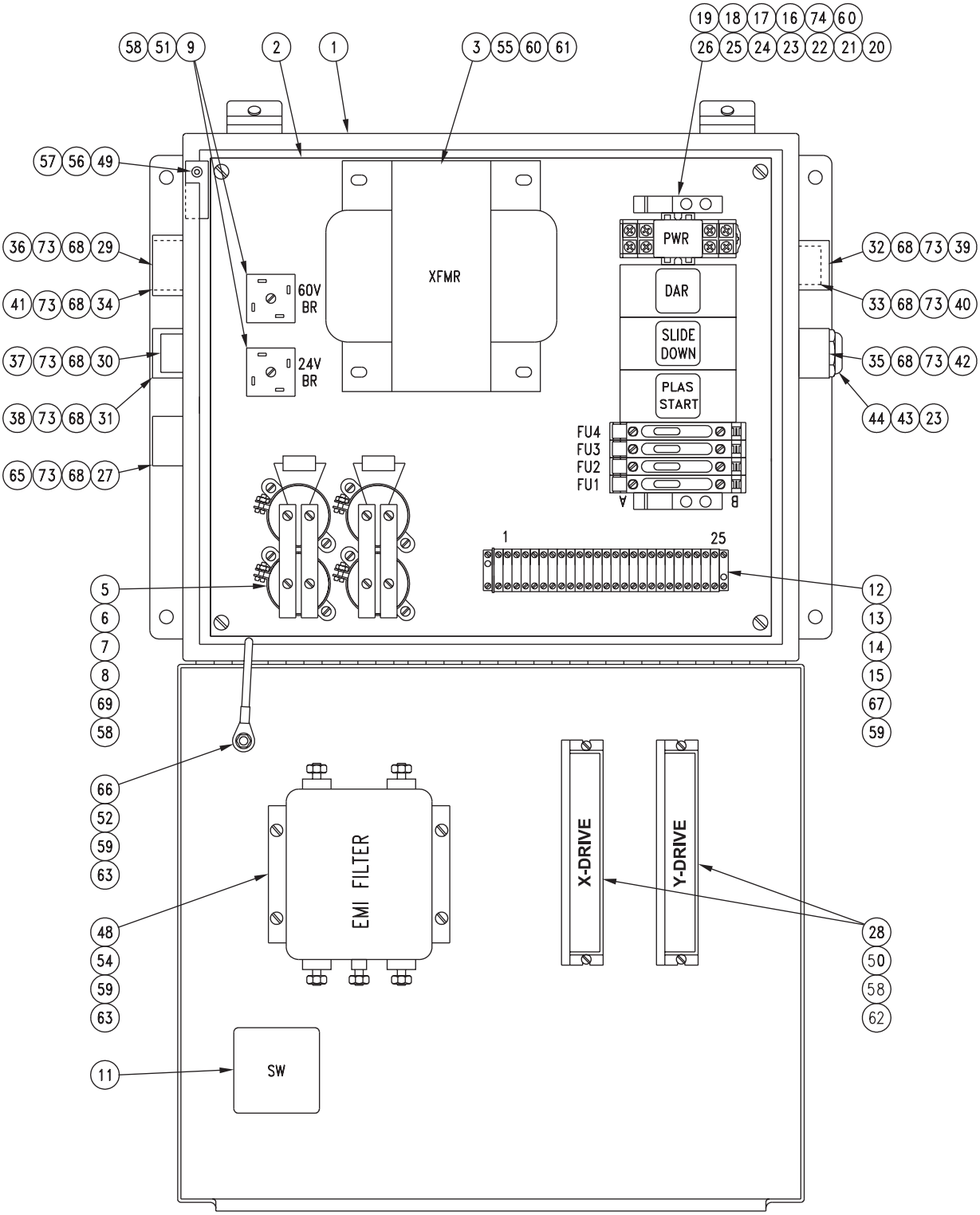
Note: Items #21,#22,#23 may need to be mounted at the top of the air cylinder, depending on type of torch used.

Item	Part #	Qty	Description
1	2213466	1	Air Cylinder, 2” stroke
2	63340230	1	Hex Jam Nut, 5/8-18
3	2213468	1	Cylinder Mount Foot
4		2	Screw, ¼-20x1/2 hex head
5		2	Flat Washer, ¼
6	567596	1	Muffler, 1/8” brass
7		2	Hex Jam Nut, 5/16-24
8		2	Flat Washer, 5/16
9	2136736	1	Adaptor Elbow, 5/32 tube x 1/8 NPT
10	57001681	4 ft	Plastic Tubing, 5/32 O.D. Spark Res.
12	1000381	1	Rubber Bumper
13	2213465	1	Air Slide Retainer
14		2	Screw, ¼-20x5/8 hex soc head
16	2081885	1	Linear Slide
17		8	Screw, #10-32x5/8 Hex soc
19	56995616	1	Air Slide Retaining Screw
20	52675	1	Adjustable Torch Holder
21		2	Screw, ¼-20x1.5” Hex soc head
22	56995572	1	Torch Clamp
23	56995571	1	Air Slide Torch Holder
24	2238229	1	Plate Rider Assembly
25		2	M6 Flat Washer
26	640400	A/R	Worm Clamp
27	2213470	1	Slide Adaptor Plate
28	61340089	6	Screw, ¼-20xx3/4 soc head
29		4	Lock Washer, ¼
30	2136727	1	Elbow, Tubing
31		2	Hex Nut, ¼”
32		2	Lock Washer, ¼”
33	2059553	1	Air Valve
35	0560987291	1	Exhaust Speed Control, .25" NPT
36	182W82	2	Pipe Elbow, St. 90 Deg ¼ M x ¼ F
37	2135688	1	Nipple, ¼ NPT
38	522368	1	Air Regulator
39	810Z30	1	Air Adaptor
40	836Z40	4	Air Nut
41	03Z73	2	Nipple, ¼ NPT
42	39Z83	2	Ferrule, ¼” Hose

43	631F02	10 ft.	Hose, ¼ I.D. Black
44	2236905	1	Inlet Bracket
45	631F02	50 ft.	Hose, ¼ I.D. Black
46		2	Screw, 8-32 x ½" Pan Head
47		2	Lockwasher, #8
48	45025000	1	Bulkhead Adaptor, ¼ NPTF
49	57000929	1	Solenoid Support Bracket
50		2	Flat Washer, #8
51	2079905	1	Needle Valve
52	44151500	1	Coupling, ¼ NPT

6.19 Electronics Cabinet Assembly (non current)

Assembly 56998490 (G)

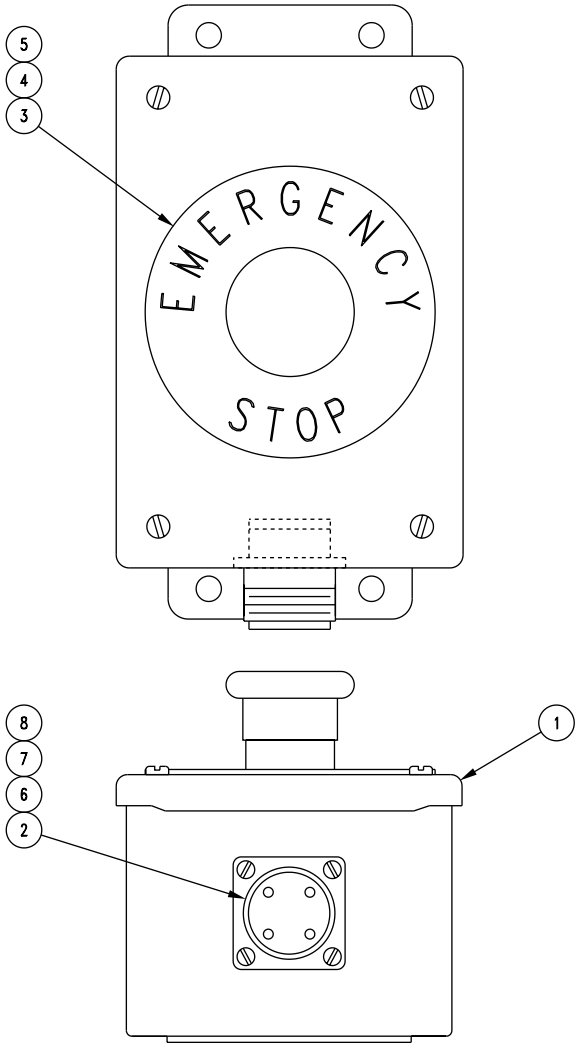


Item	Part #	Qty	Description
1	56995491	1	Enclosure
2	56998492	1	Panel
3	57001412	1	Transformer, 18/45V 12A 50/60Hz
5	2238601	4	Capacitor, 4700μF, 100VDC
6	636612	4	Capacitor Mounting Clamp
7	2238605	2	Busbar
8	17615222	2	Resistor, 2.2K 5W
9	13730469	2	Rectifier
10	52503	5	Strain Relief
11	2236401	1	Switch
12	2234473	25	Terminal Block, Mini
13	2234476	1	End Cover, Mini
14	2234320	4	End Bracket
15	2234268	A/R	Mounting Rail
16	2235711	3	Relay Socket, Rail Mounting
17	2010924	3	DC Relay
18	2234485	2	End Clamp
19	2234478	A/R	Mounting Rail
20	2234477	4	Fuse Block, Rail Mounted
21	2044278	1	Fuse, 15A
22	2079279	1	Fuse, N-T Delay, 5A 250V
23	2017327	1	Fuse, N-T Delay Ceramic, 10A 250VAC
24	2017107	1	Fuse, 2A
25	0560985303	1	DC Relay, DPDT 15A, Socket-Mounting
26	0560985302	1	Relay Socket
27	56998792	1	Connector, 4 Socket
28	0560986178	2	PWM Drive
29	950762	1	Connector, 19 Pin
30	996514	1	Connector, 5 Socket
31	993952	1	Connector, 6 Socket
32	13734545	1	Connector, 3 Pin
33	2017021	1	Connector, 6 Pin
34	182W62	1	Connector, 3 Socket
35	636692	1	Connector, 10 Socket
36	2238415		Power Supply Cable Assembly
37	56998498		Cable Assembly, 5 Conductor
38	56998502		Cable Assembly, 6 Conductor
39	2236766		Cable Assembly, 3 Conductor

40	2238779		Cable Assembly, 6 Conductor
41	56997104		Cable Assembly, 3 Conductor
42	2238311		Cable Assembly, 10 Conductor
43	8812355	25'	Cable, 3 Conductor 14 Gauge
44	2017587	1	Plug, 110V
45	672238	8	Ring Terminal
46	51876	8	Cable Label
48	2136670	1	AC Line Filter
49	2078865	1	Interlock Switch
50		A/R	Screw, M3-0.5 x 10mm, Pan Hd.
51		A/R	Screw, M3-0.5 x 16mm, Thread-Forming, Pan Hd.
52		A/R	Screw, M4-0.7 x 8mm, Pan Hd.
53		A/R	Screw, M4-0.7 x 25mm, Pan Hd.
54		A/R	Screw, M4-0.7 x 10mm, Pan Hd.
55		A/R	Screw, M5-0.8 x 16mm, Thread-Forming, Pan Hd.
56		A/R	Screw, #6-32 x 1/2", Pan Hd.
57		A/R	Lock Washer, #6
58		A/R	Lock Washer, M3
59		A/R	Lock Washer, M4
60		A/R	Lock Washer, M5
61		A/R	Flat Washer, M5
62		A/R	Hex Nut, M3
63		A/R	Hex Nut, M4
65	56998787		Cable Assembly, 4 Conductor 20 Gauge
66	56998826	1	Ground Strap, 7"
67		A/R	Screw, M4-0.7 x 8mm, Thread-Forming
68		A/R	Screw, #6-32 x 3/8", Thread-Forming
69		A/R	Screw, M3-0.5 x 10mm, Thread-Forming
70	2062196	2	Ring Terminal
71	73006899	A/R	Cable, #8
73		A/R	Washer, Star #6
74		A/R	Screw, M5-0.8 x 8mm Posi-Drive Thd. Forming

6.20 E-Stop Box Assembly

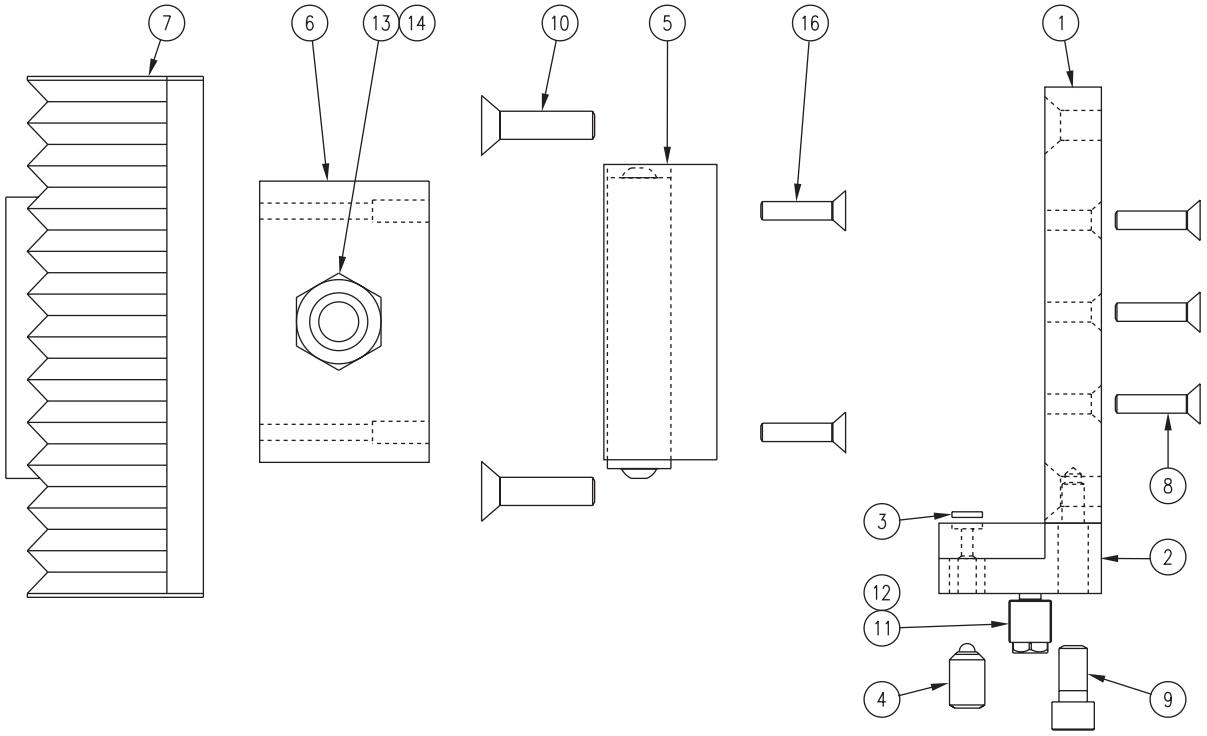
Assembly 56998794 (A)



Item	Part #	Qty	Description
1	56998793	1	Enclosure
2	51452	1	Connector Receptacle
3	93301401	1	Push Button Switch
4	2236275	1	Contact and Switch Base
5	2236276	1	E-Stop Label
6		A/R	Screw, M3-0.5 x 10mm, Pan Hd.
7		A/R	Lock Washer, M3
8		A/R	Hex Nut, M3
9	93092002	A/R	Wire, 20 AWG, 600 V, White
10	93092006	A/R	Wire, 20 AWG, 600 V, Blue

6.21 Lite Touch

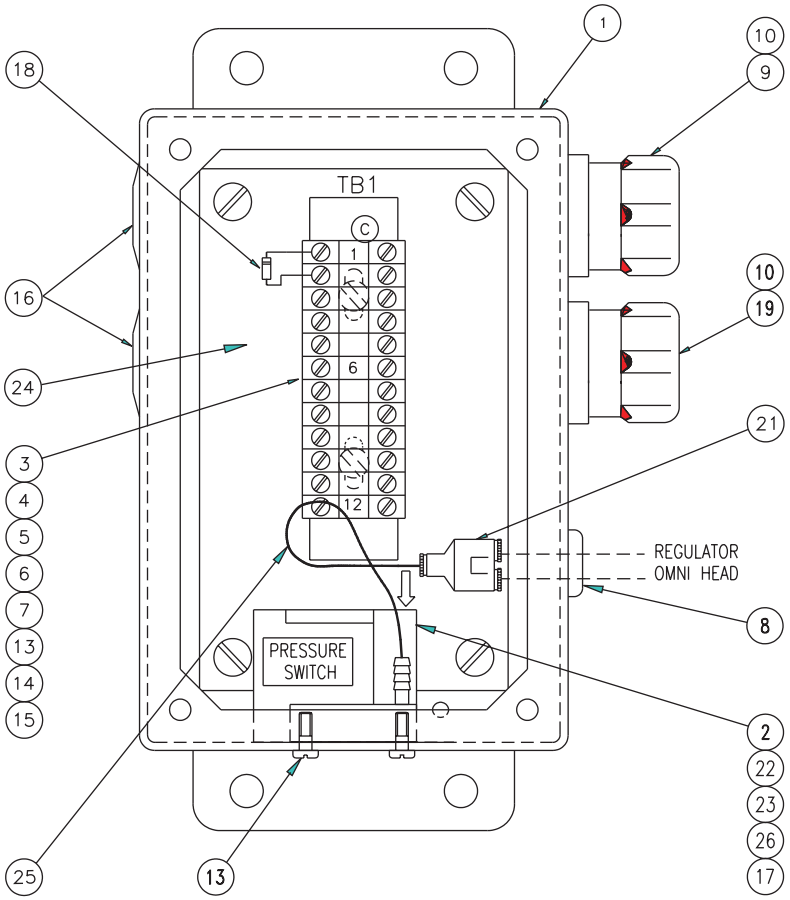
Assembly 57000412 (A)



Item	Part #	Qty	Description
1	57000375	1	Lite Touch Mounting Plate
2	57000376	1	Lite Touch End Plate
3	8996526	1	O-Ring, .145" ID x .07" Buna-70A
4	57000365	2	Ball Spring Plunger, 5/16"-18
5	56999182	1	Linear Lift
6	57000377	1	Torch Mounting Bracket
7	57000411	1	Way Bellows
8		4	Screw, M5-0.8 x 12mm, FHS
9		2	Screw, 1/4"-20, SHCS
10		2	Screw, 1/4"-20, FHS
11	2234142	1	Hex Nipple, 10-32 x 1/8" ID Hose
12	56999181	1	L-Fitting Adaptor, 10-32
13		1	Carriage Bolt, M12-1.75
14		1	Jam Nut, M12
15		A/R	Double-Sided Tape
16		2	Screw, M6-1.0 x 16mm, SHCS

6.22 Soft Touch OMNI Interface Box

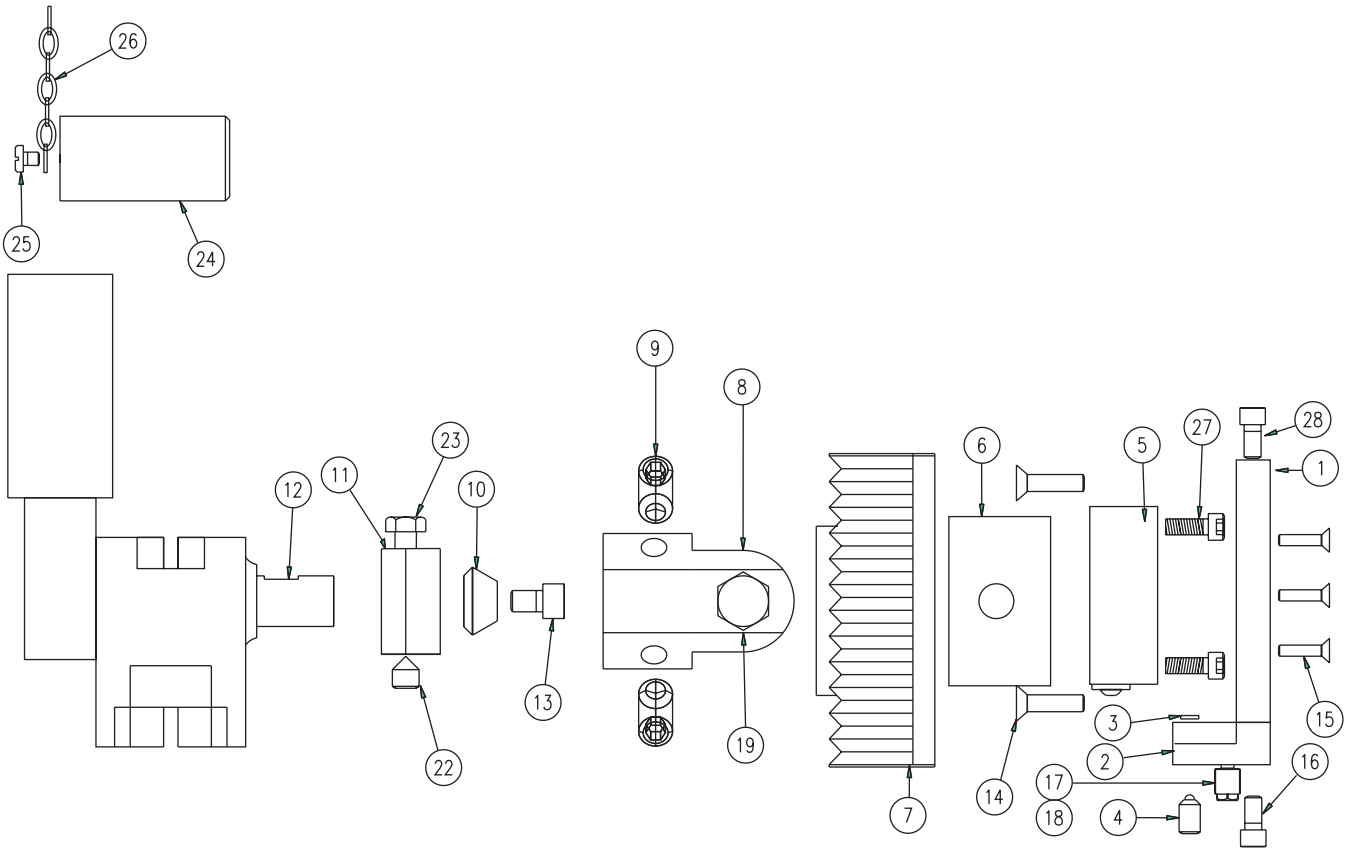
Assembly 2234691 (N)



Item	Part #	Qty	Description
1	2234723	1	Junction Box
2	0560996490 0560998065	1	Pressure Switch OMNI Pressure Switch Kit (for pre-May 1999 units)
3	2234473	12	Terminal Block, Mini
4	2234320	2	End Bracket, Mini
5	2234476	1	End Cover, Mini
6	2234268	4"	Mounting Rail
7	2234480	A/R	Ferrule, 20 Ga.
8	897W34	2	Rubber Grommet
9	527376	1	Strain Relief
10	881358	2	Lock Nut, M4
11		3	Hex Nut, M3-0.5
12		3	Screw, M3-0.5 x 16mm, Slotted Hd.
13		2	Screw, M4-0.7 x 12mm, Thread-Forming
14	04W10041	2	Lock Washer, M4
15	04W01044	2	Flat Washer, M4
16	2058365	2	Hole Seal
17	93122006	48"	Wire, Blue, 20 Ga 300V
18	17615222	1	Resistor
19	526652	1	Strain Relief
20			
21	57002575	1	Tube, Y-Union, 1/4"
22	2062561	2	Connector Pin
23	90863063	A/R	Heatshrink Tubing
24	57001431	1	Panel
25	2234117	5"	Plastic Tubing, 1/8" I.D.
26	2237459	2	Wire Lug
27			

6.23 Lite Touch with Collision

Assembly 57000382 (C)

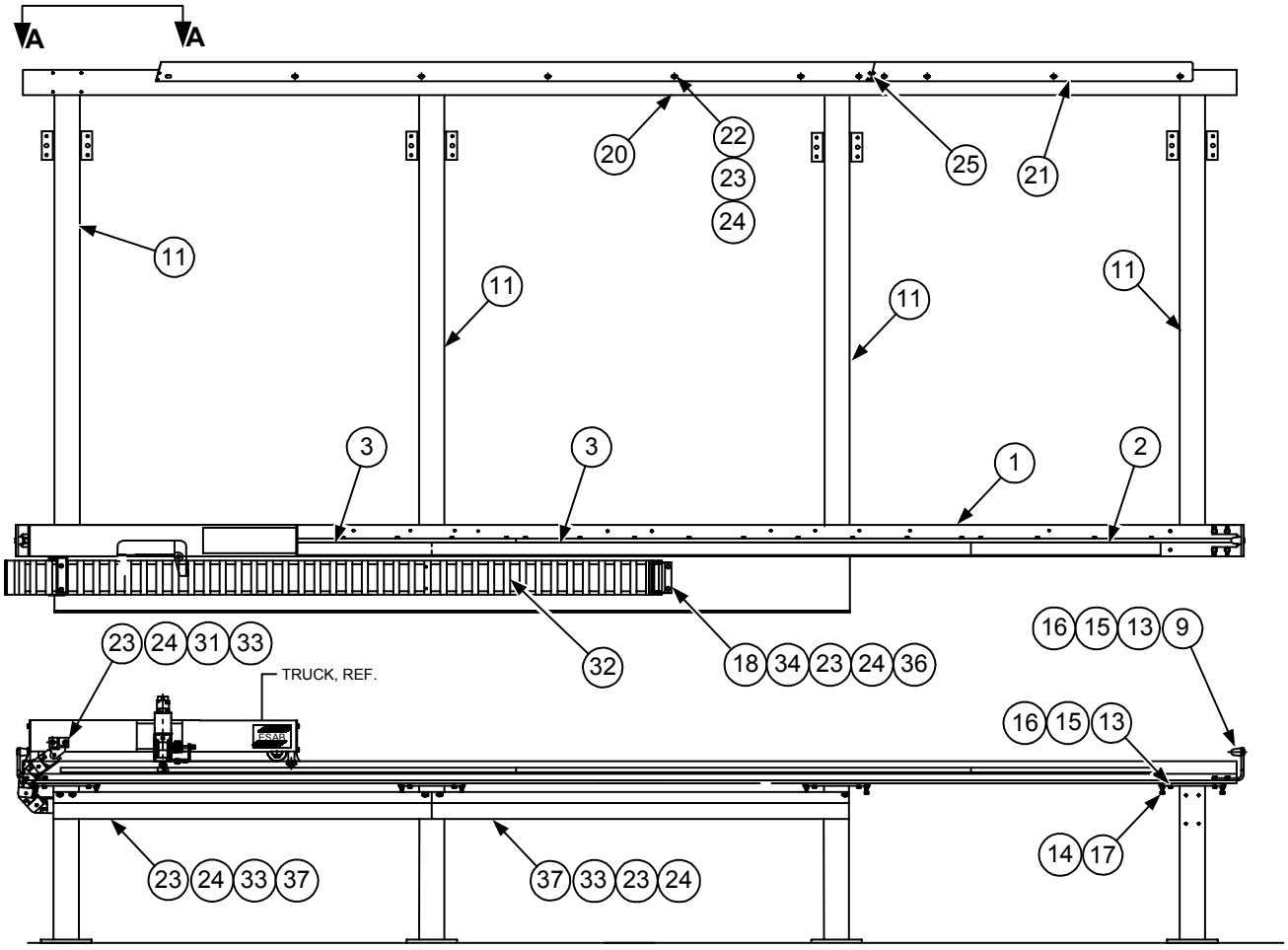


Item	Part #	Qty	Description
1	57000375	1	Lite Touch Mounting Plate
2	57000376	1	Lite Touch End Plate
3	8996526	1	O-Ring, .145" ID x .07" Buna-70A
4	57000365	2	Ball Spring Plunger, 5/16"-18
5	56999182	1	Linear Lift
6	57000377	1	Torch Mounting Bracket
7	57000411	1	Way Bellows
8	57000378	1	Crash Mounting V-Block
9	57000322	4	Ball Spring Plunger, M12
10	57000379	1	Mushroom Head

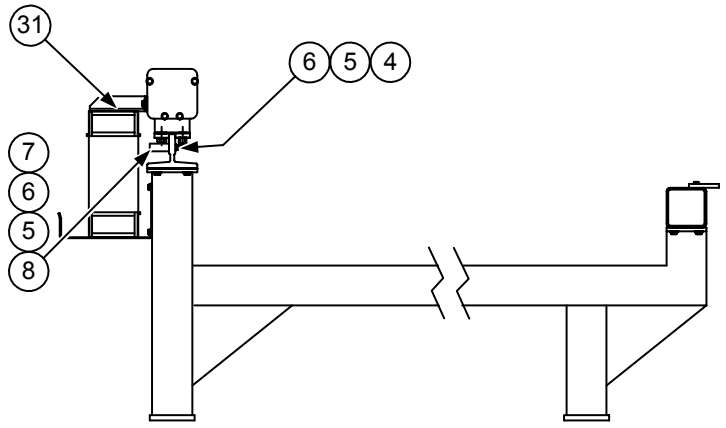
11	57000380	1	Center Mounting Block
12	57000381	1	Breakaway Torch Mount
13		1	Screw, 5/16"-18 x 3/4", SHCS
14		2	Screw, 1/4"-20 x 1/2", FHS
15		4	Screw, M5-0.8 x 12mm, Flat Hd.
16		4	Screw, M5-0.8 x 35mm, SHCS
17	2234142	1	Hex Nipple, 10-32 x 1/8" ID Hose
18	56999181	1	L-Fitting Adaptor, 10-32
19		1	Screw, M12-1.75 x 64mm, HHCS
20		1	Jam Nut, M12
21		A/R	Double-Sided Tape
22		1	Screw, M10-1.5 x 12mm, SHSS
23		1	Screw, M8-1.25 x 16mm, Hex Hd.
24	57000446	1	Tool Alignment Ball Spring
25		1	Screw, M5-0.8 x ¼"
26		12"	Chain Material, McMaster-Carr #3603T69
27		2	Screw, M6-1.0 x 16mm, SHCS
28		2	Screw, M5-0.8 x 12mm

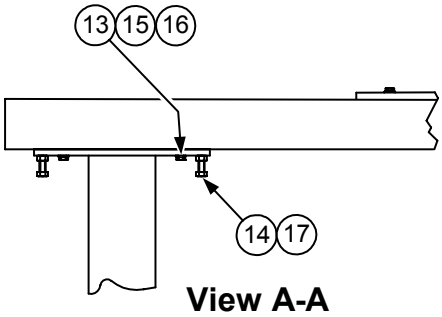
6.24 Rail, 16' x 5' Wide

Assembly 57000788 (C)



FRONT LEFT ARRANGEMENT



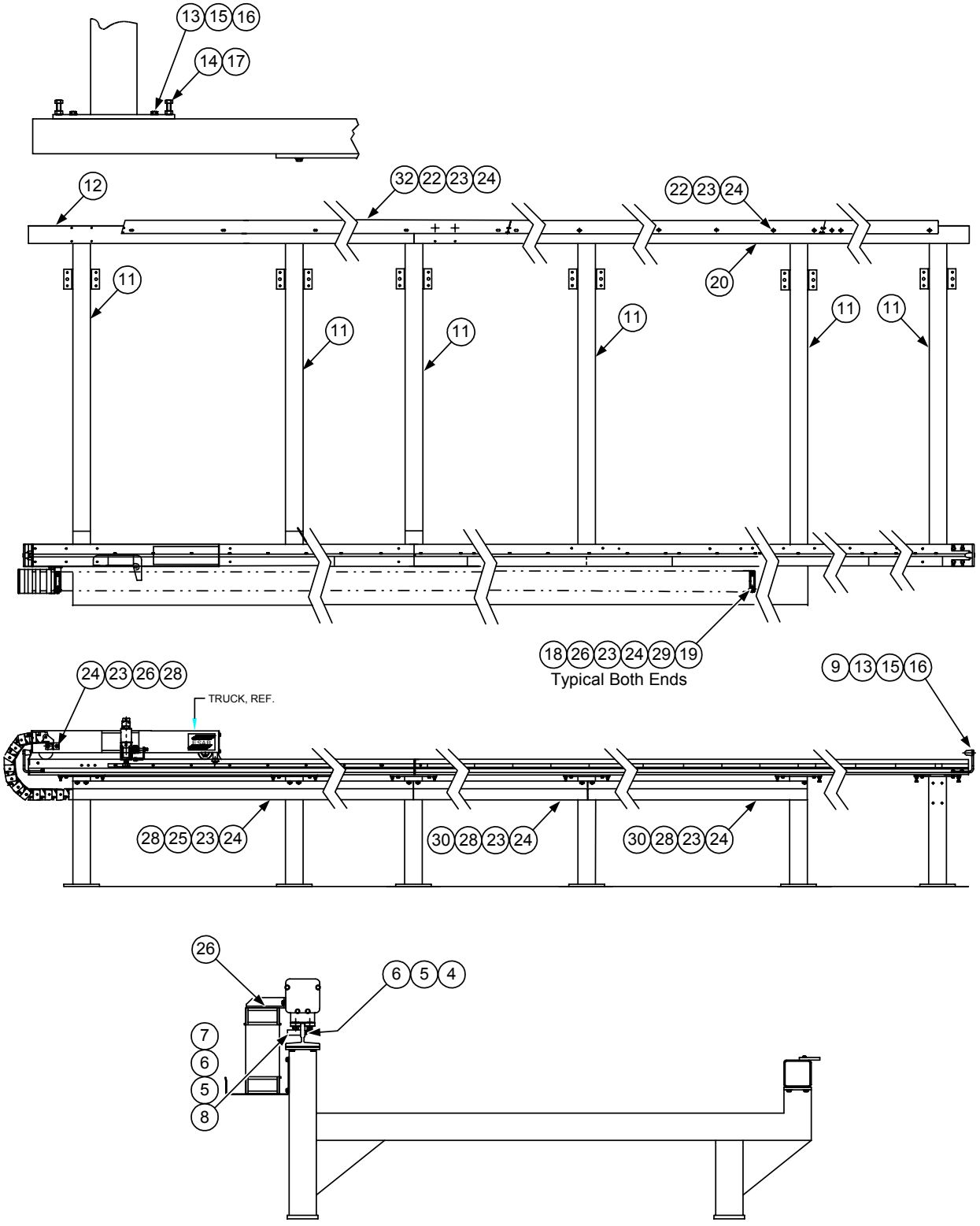


View A-A

Item	Part #	Qty	Description
1	57000641	1	Rail, 16ft. Lg.
2	57000691	1	Rack, 24 DP 3/4 x 2 X 30"
3	56998346	2	Rack, 24 DP 3/4" x 2" x 72" Lg.
4		A/R	Screw, Hex Hd. Cap M6-1.0 x 30mm Lg.
5		A/R	Washer, Flat M6
6		A/R	Washer, Lock M6
7	2233835	2	Clip, Rack Derailer
8		A/R	Screw, Hex Cap M6-1.0 x 16mm
9	56995727	2	Stop, Rail
11	56998335	4	Cradle
13		A/R	Screw, Hex Hd. Cap M10-1.5 x 30mm Lg.
14		A/R	Screw, Hex Hd. Cap M12-1.75 x 45mm Lg.
15		A/R	Washer, Flat M10
16		A/R	Washer, Lock M10
17		A/R	Nut, Hex M12-1.75
18	57000937	2	Bracket, Clamp
20	57000639	1	Tube, Support Floating Rail
21	57000655	1	Rail, Floating
22		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
23		A/R	Washer, Flat M8
24		A/R	Washer, Lock M8
25		A/R	Scr. Soc. Hd. Set F.P. M6-1.0 x 12 Lg.
26	16901701	16	Leveler, Hex 1/2 –13 X 3 inch
27	51424	1	Gauge Rack
31	56998340	Ref.	Bracket, Powertrak X-Axis
32	56996493	1	Powertrak, 252P-II-4.7R-16' Travel
33		A/R	Screw, Hex Hd. Cap M8-1.25 x 16mm Lg.
34		A/R	Screw, But. Hd. Cap M8-1.25 x 16mm Lg.
36		A/R	Nut, Hex M8-1.25
37	0560986300	1	Tray, Powertrak
38	0560986299	1	Tray, Powertrak

6.25 Rail, 25' x 5' Wide

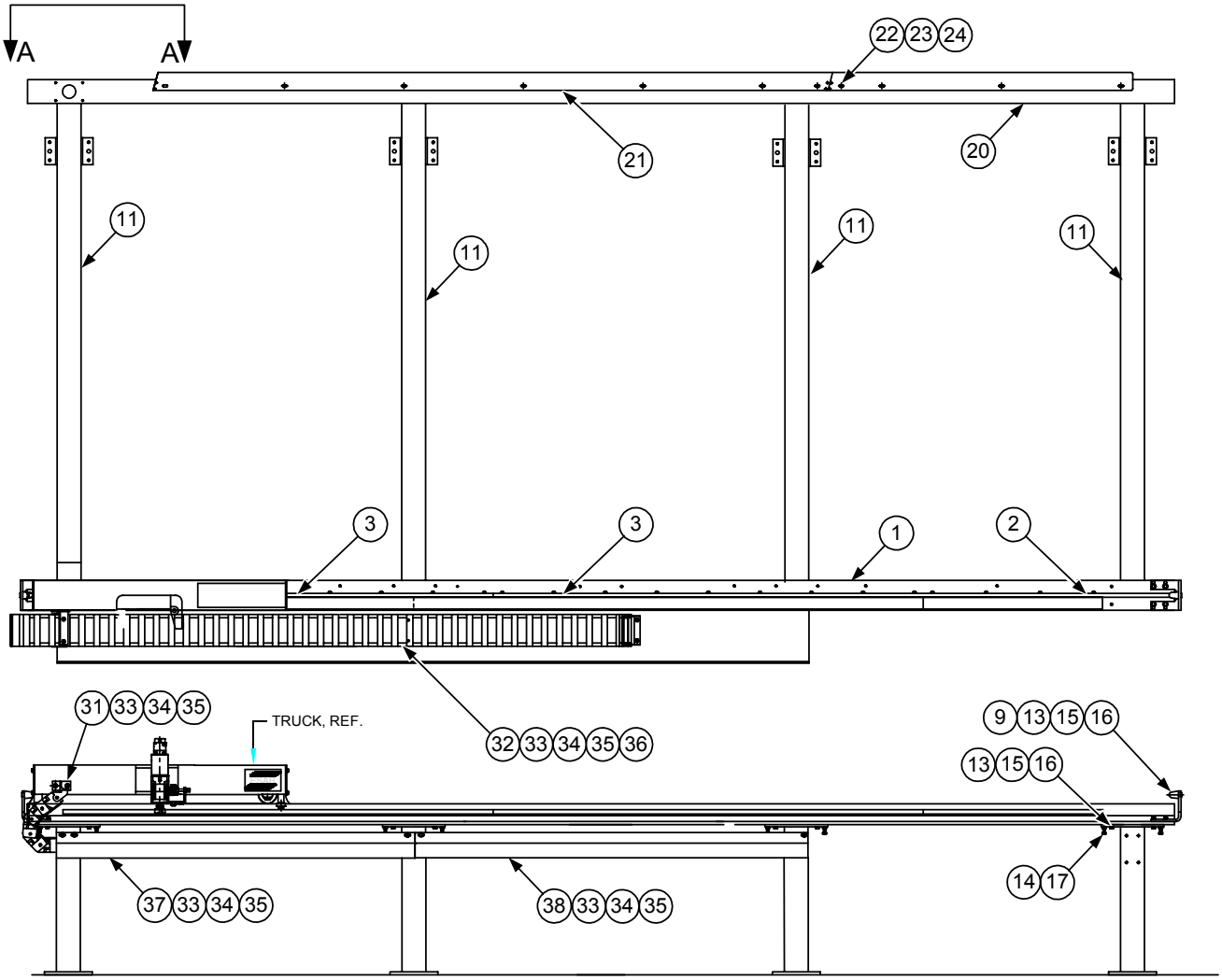
Assembly 57000789 (B)

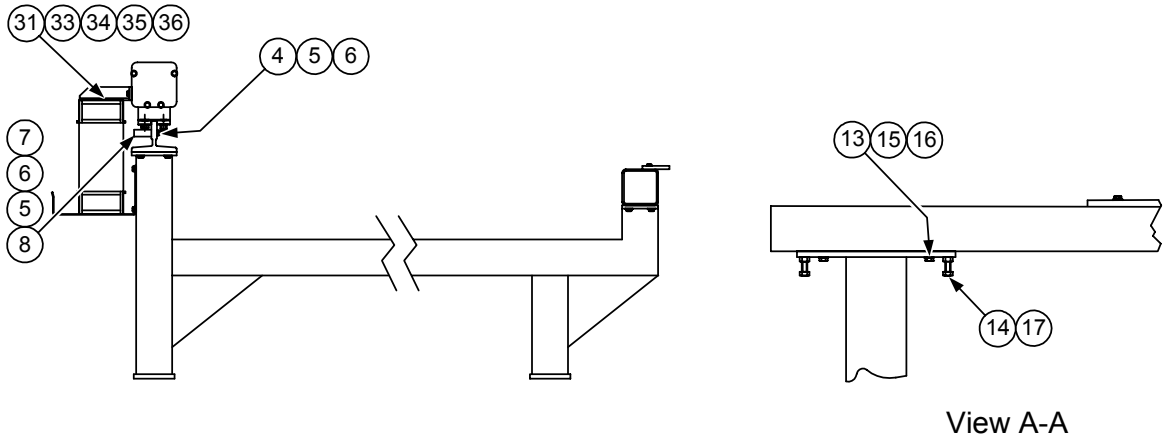


Item	Part #	Qty	Description
1	57000641	1	Rail, 16ft. Lg.
2	57000691	2	Rack, 24 DP 3/4 x 2 X 30"
3	56998346	3	Rack, 24 DP 3/4" x 2" x 72" Lg.
4		A/R	Screw, Hex Hd. Cap M6-1.0 x 30mm Lg.
5		A/R	Washer, Flat M6
6		A/R	Washer, Lock M6
7	2233835	2	Clip, Rack Derailer
8		A/R	Screw, Hex Cap M6-1.0 x 16mm
9	56995727	2	Stop, Rail
10	56998351	1	Rail, 9 Ft. Lg.
11	56998335	Ref.	Cradle
13		A/R	Screw, Hex Hd. Cap M10-1.5 x 30mm Lg.
14		A/R	Screw, Hex Hd. Cap M12-1.75 x 45mm Lg.
15		A/R	Washer, Flat M10
16		A/R	Washer, Lock M10
17		A/R	Nut, Hex M12-1.75
18	57000937	2	Bracket, Clamp
19		4	Screw, But. Hd. Cap M8-1.25 x 20mm Lg.
20	57000639	Ref.	Tube, Support Floating Rail
21	57000655	Ref.	Rail, Floating
22		A/R	Screw, Hex Hd. Cap M8-1.25 x 20mm Lg.
23		A/R	Washer, Flat M8
24		A/R	Washer, Lock M8
25	57000653	Ref.	Tray, Powertrak (98")
26	56998340	Ref.	Bracket, Powertrak X-Axis
27	57000940	1	Powertrak, 252P-II-4.7R-16' Travel
28		A/R	Screw, Hex Hd. Cap M8-1.25 x 16mm Lg.
29		A/R	Nut, Hex M8-1.25
30	0560986299	Ref.	Tray, Powertrak (64")
32	57000656	Ref.	Rail, Floating
33	0560986300	Ref.	Tray, Powertrak (59")

6.26 Rail, 16' x 6' Wide

Assembly 57000790 (B)



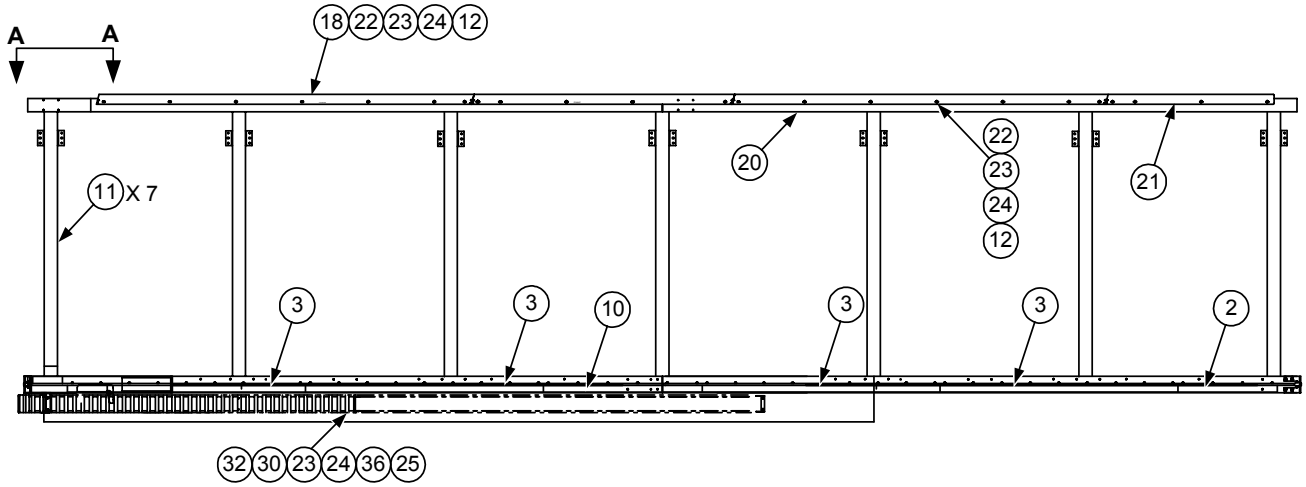


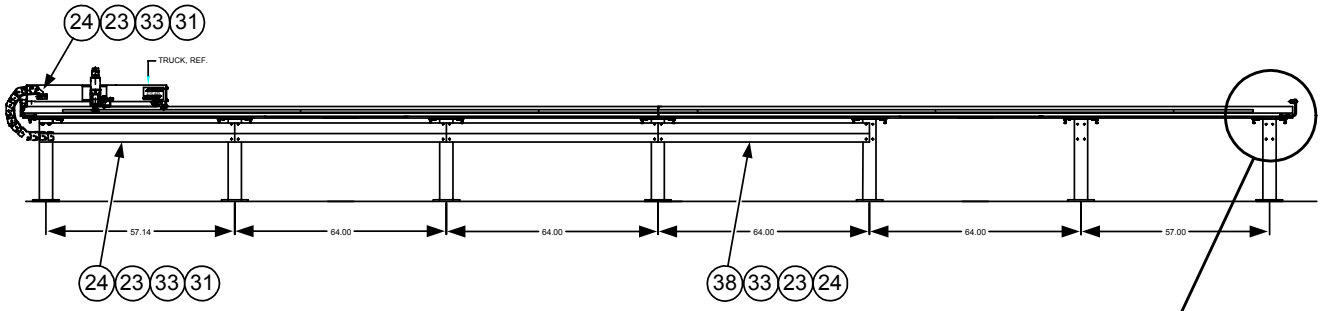
View A-A

Item	Part#	Qty	Description
1	57000641	1	Rail, 16ft Long
2	57000691	1	Rack 24 Dp 3/4 X 2 X 30"
3	56998346	2	Rack, 24dp 3/4" X 2" X 72" Long
4	06S11030	22	SCREW, HEX HEAD CAP M6-1.0 X 30mm LONG
5	06W01066	24	Washer, Flat M6
6	06W10061	24	Washer, Lock M6
7	2233835	2	Clip, Rack Derailer
8	6C16HCDZ	2	SCR HEX CAP M6-1.0 X 16mm
9	56995727	2	Stop, Rail
11	57000642	4	Cradle 6' Wide
13	10S11030	32	SCREW, HEX HEAD CAP M10-1.5 X 30mm LONG
14	12C45SCSH	32	SCREW, HEX HEAD CAP M12-1.75 X 45mm LONG
15	10W01110	32	Washer, Flat M10
16	10W10102	32	Washer, Lock M10
17	12N00175	68	Nut, Hex M12-1.75
18	38301005	3	252p-11-4.7 Gleason Grp Catrac
20	57000639	1	Tube, Support Floating Rail
21	57000655	1	Rail, Floating
22	08S10020	11	SCREW, HEX HEAD CAP M8-1.25 X 20mm LONG
23	08W10090	11	Washer, Flat M8
24	08W10082	11	Washer, Lock M8
25	16901701	16	Leveler, Hex 1/2-13x3" Ft4448+
26	51424	1	Gauge Rack 24 Pitch
31	56998340	1	Bracket, Powertrak X-Axis
32		1	Powertrak, 252p-li-4.7r-28' Travel
33	08S11016	20	SCREW, HEX HEAD CAP M8-1.25 X 16mm LONG
34	08W01090	20	Washer, Flat M8
35	08W10082	20	Washer, Lock M8
36	08N00125	2	Nut, Hex M8-1.25
37	0560986300	1	Tray Powertrak
38	0560986299	1	Tray Powertrak

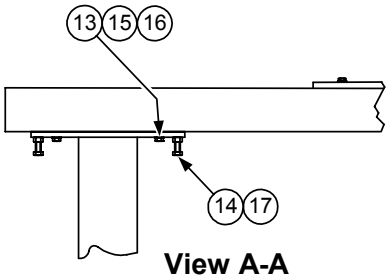
6.27 Rail, 32' x 6' Wide

Assembly 57000791 (C)

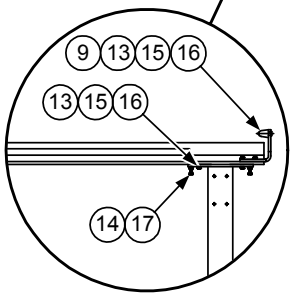


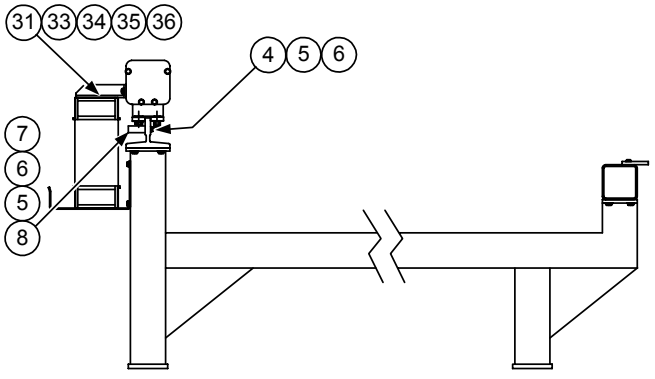


ARRANGEMENT FOR LEFT FRONT



View A-A

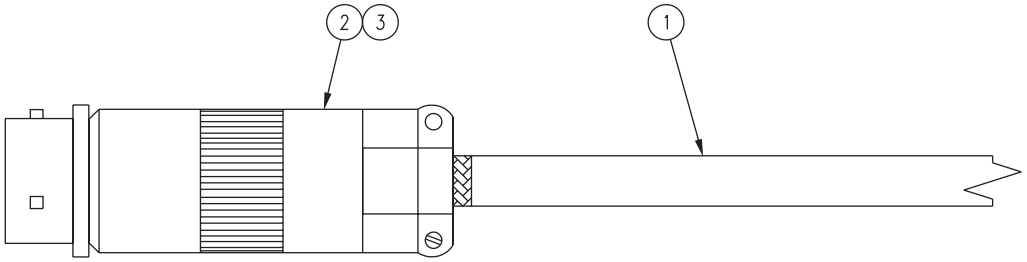




Item	Part#	Qty	Description
1	57000641	2	Rail, 16ft Long
2	57000691	1	Rack 24 Dp 3/4 X 2 X 30"
3	56998346	4	Rack, 24dp 3/4" X 2" X 72" Lg
4		A/R	SCREW, HEX HEAD CAP M6-1.0 X 30mm LG
5		A/R	Washer, Flat M6
6		A/R	Washer, Lock M6
7	2233835	2	Clip, Rack Derailer
8		A/R	SCR HEX CAP M6-1.0 X 16mm
9	56995727	2	Stop, Rail
10	57000681	1	Rack 24dp 3/4 X 2 X 48" Lg
11	57000642	7	Cradle 6' Wide
12		A/R	SCREW SOC HD SET M6-1.0 X 10mm LG
13		A/R	SCREW, HEX HEAD CAP M10-1.5 X 30mm LG
14		A/R	SCREW, HEX HEAD CAP M12-1.75 X 45mm LG
15		A/R	Washer, Flat M10
16		A/R	Washer, Lock M10
17		A/R	Nut, Hex M12-1.75
18	57000968	1	Rail Floating
19	57000657	2	Rail Floating
20	57000639	2	Tube, Support Floating Rail
21	57000655	1	Rail, Floating
22		A/R	SCREW, HEX HEAD CAP M8-1.25 X 20mm LG
23		A/R	Washer, Flat M8
24		A/R	Washer, Lock M8
25	57000937	REF	Bracket Clamp Hose (X)(Old)
26	16901701	28	Leveler, Hex 1/2-13x3" Ft4448+
27	51424	1	Gauge Rack 24 Pitch
28	2237056	1	Air Or Wtr Sup Bun 60ft
29	56998677	1	Cam , Home Switch
30		A/R	SCR BUTTON HD CAP M8-1.25 X 16mm LG
31	56998340	1	Bracket, Powertrak X-Axis
32	57000973	1	Powertrak, 252p-Ii-4.7r-32' Travel
33		A/R	SCREW, HEX HEAD CAP M8-1.25 X 16mm LONG
34	57000672	3	Brkt Sprt Ptrak Duct
35	57000978	9	Cap End Tube 4"
36		A/R	Nut, Hex M8-1.25
37	0560986300	1	Tray Powertrak (59")
38	0560986299	4	Tray Powertrak (64")
39	57001053	2	Brkt Tie Cbl/Hose H.D. 252p-11
40	57001068	12	Bumper Stop

6.28 Encoder Cable Assembly (Planetary Drives)

Reference Drawing: 57001403 (B)



Item	Part #	Qty	Description
1	2237223	A/R	Cable, 20 Ga., 4 Twisted Pairs, Shielded
2	57001404	1	Connector
3	93061804	A/R	Wire, 18 Ga., Green

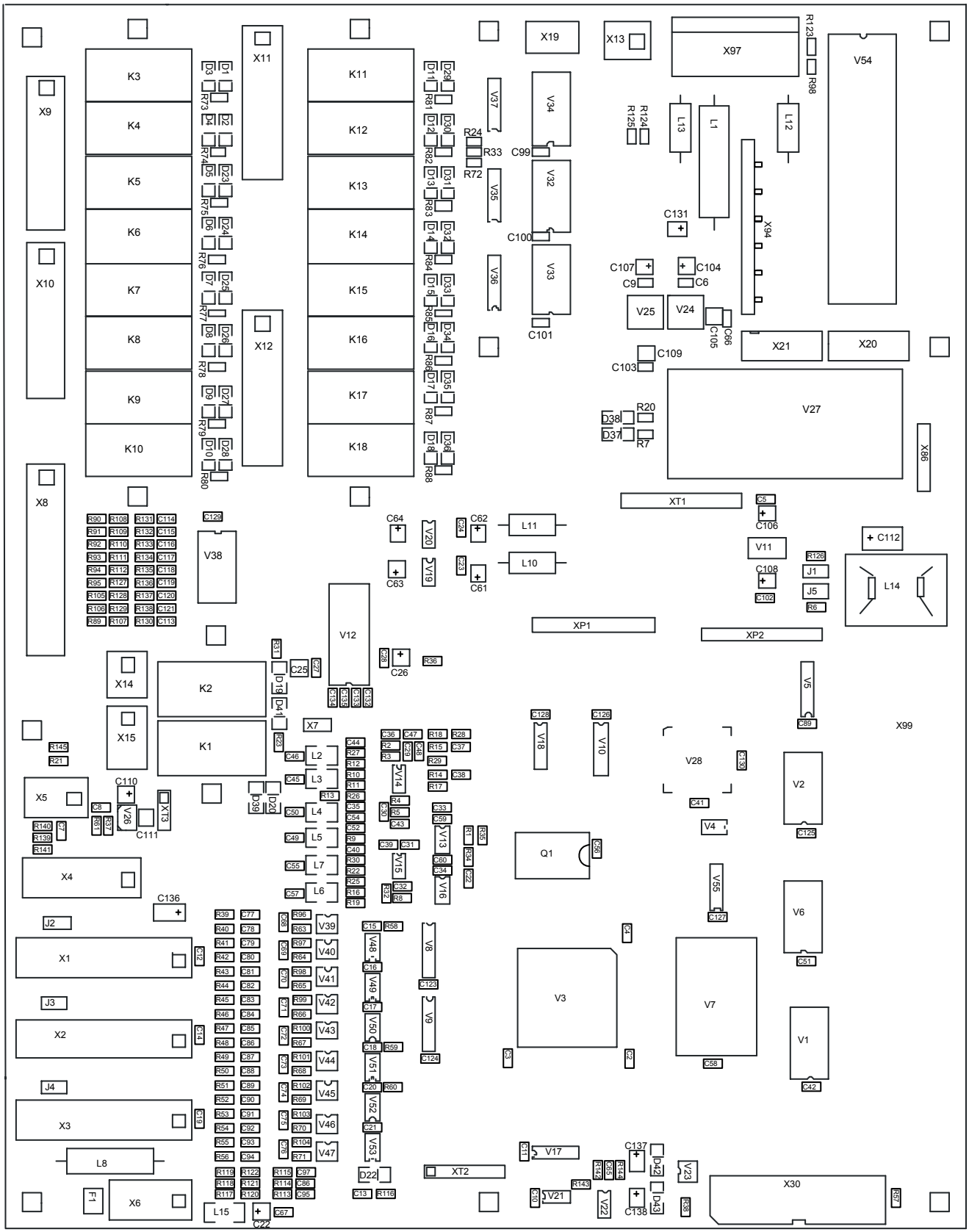
Available Assemblies:

Length	Part Number
5'	57001405
10'	57001406
15'	57001407
20'	57001408
25'	57001409
30'	57001410
35'	57001411
40'	57002260
45'	57002261
50'	57002262
55'	57002263
60"	0560987405

6.29 Vision LE CNC Control Replacement Parts

Assembly 0560935582 with connectors

Vision LE Control



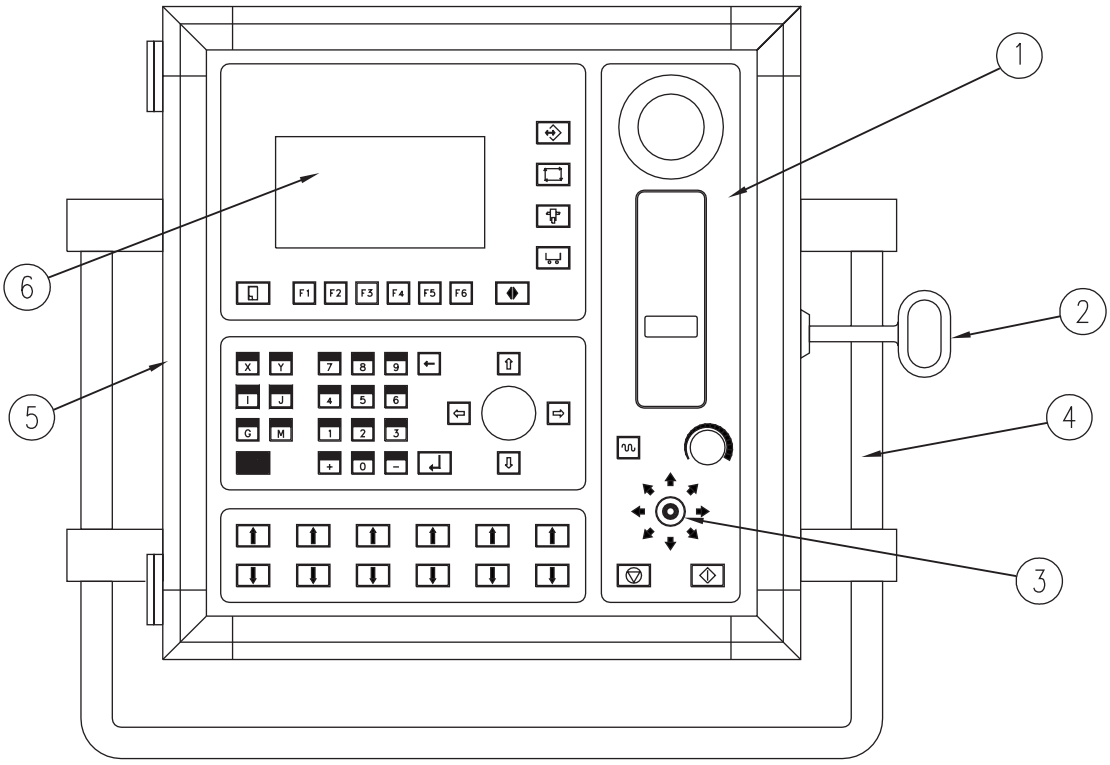
Vision LE PIO Board

Vision LE (ANC401) Replacement Parts List

Esab part #	Atas part #	Description
0560935582	65.00.03041	Vision LE package (LE and connectors) ANC401
0560935209	65.00.03000	Vision LE (LE without connectors) ANC401
0560935538	65.00.03021	ANC 401 Front Panel
0560935537	65.00.03016	ANC 401 CPU Board
0560935535	65.00.03010	PIO401 Board
0560935540	65.00.03025	ANC 401-NG Power Supply
0560935539	65.00.02198	ANC 4x LCD Display
0560935567	65.00.03015	ANC 401 Flash Drive 16MB
0560935212	65.00.03019	ANC 401 Connector Set
0560936084	65.00.03039	Vision LE Floppy drive kit (AMF4-PM External Floppy drive)
0560936083		Floppy drv cable AMF4 KAB 2M
0560936080	65.00.03032	3.5 Floppy disk drive AMF4.PM Floppy drive
0560936081	65.00.03043	Vis LE Internal floppy cable assy. ANFL-ST Floppy
0560936082	65.00.03031	External Floppy mounting plate
0560936273	65.00.03070	ANC401-LFE Bd. Vision LE Teach Trace board
0560936271	65.00.03060	ANC401-Asiob1 board
0560936272	65.00.03049	ANC401-BDM6 kit Vision LE 6 Station macro key panel kit
0560935210	65.00.03040	ANC401-TT kit includes LFE Bd, AK5 camera, connector, softw.
0560936060		Vision LE to HL90 interface cable
0560935568		Vision LE APAP relay
0560935569		Vision LE Drive Allow relay
0560935585		Vision LE Literature package

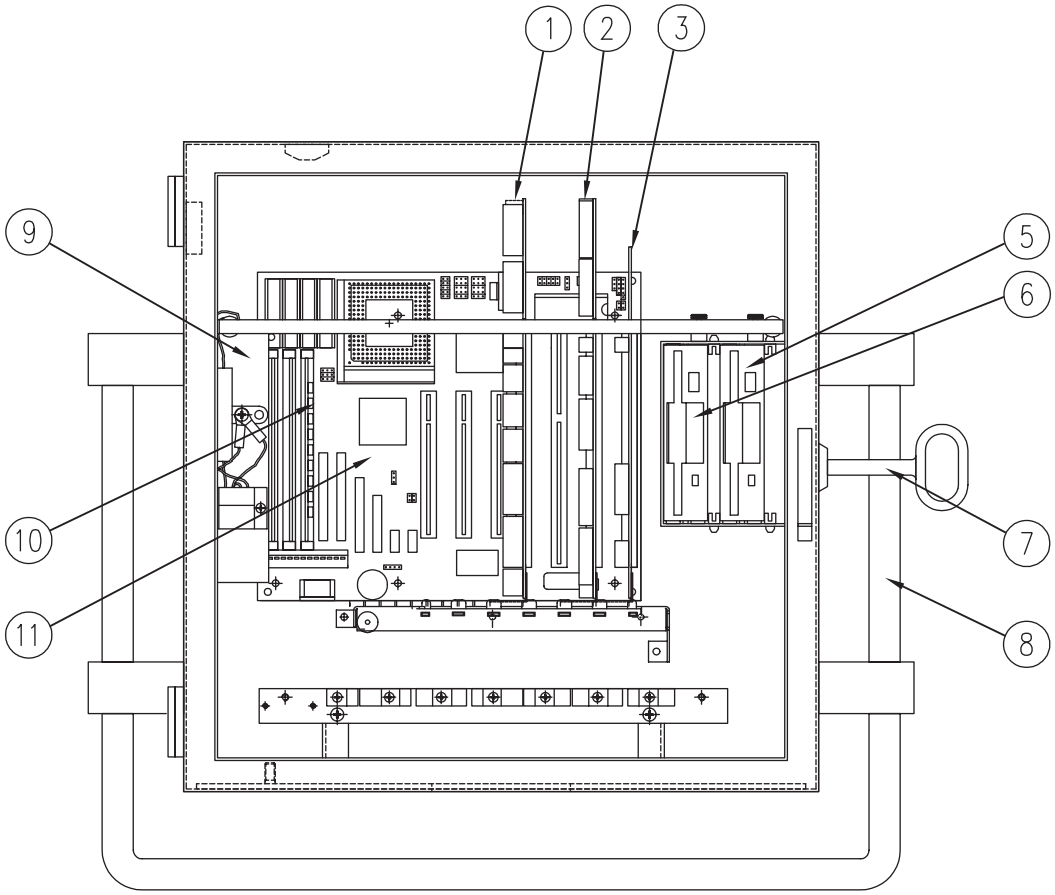
6.30 Vision 1000 Control Console

Assembly 2236338 (A)



Item	Part #	Description
1	2236893	Front Panel
2	2238787	Enclosure Key
3	56995783	Joystick
4	56995789	Handle Bars
5	56995138	Complete Front Door Assembly
6	2236894	LCD Display Module

6.31 Vision 1000 Control Electronics



Item	Part #	Description
1	2236892	Digital I/O Board (DIO)
2	2238138	Process I/O Board (PIO)
3	2237974	Tracer Interface Board
5	2236898	System Floppy Disk Drive
6	2236342	Floppy Disk Drive
7	2238787	Enclosure Key
8	56995789	Handle Bars
9	2236895	Power Supply
10		RAM Module, included with item 11
11	57000393	Mother Board (C0.121.01)
	56996850	Battery for DIO Board

Customer / Technical Support

(843)-664-4405
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ESAB Welding and Cutting Products
PO Box 100545 Ebenezer Rd
Florence, SC 29501-0545
http://www.esab.com
http://www.esabcutting.com

ESAB Cutting Systems - Canada
6010 Tomken Road
Mississauga, Ontario Canada L5T 1X9
Phone: (905) 670-0220
Fax: (905) 670-4879

ESAB-Cutting Systems GmbH
Robert-Bosch-Strasse 20
Postfach 1128
D-61184 Karben 1
Phone 011-49-6039-400
Fax 011-49-6039-403-02
http://www.esab.com

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