M-368

Revision B

IFB 2 Dynamic Waterjet with 50i-S Pump

Operation and Service Manual

November 2004

Flow

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Do the tables of contents help you easily find topics? Yes [ ] No [ ] .....

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Is the information contained in each chapter well organized? Yes [ ] No [ ] .....

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Is the page layout well-suited to the material being presented? Yes [ ] No [ ] .....

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How do you rate the photos and illustrations? Excellent [ ] Adequate [ ] Poor [ ] .....

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Text

Does the information in the manual adequately explain how to operate and service the equipment? . . . . . .

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If there are any paragraphs or procedures you feel need clarification, please identify them and comment.

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Is there anything you'd add to or delete from the manual to make it more useful to you? . . . . . .

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Is there any information that should be covered more thoroughly? . . . . . .

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General comments

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Integrated Flying Bridge with Dynamic Waterjet and 50i-S Pump

Introduction

The information in this manual will help you become familiar with your new Flow International (FLOW) equipment. It was compiled from the most current information available at the time of publication and is intended to cover the most common configurations.

Related documents

This manual is designed to be used with the following manuals:

- M-127, Small High-Pressure Components
- M-310, ESL Intensifier
- M-320, FlowPATH User's Guide
- M-322, FlowCUT User's Guide
- M-359, PASER® ECL *Plus*

Safety

All operating personnel and service technicians must read and follow the procedures in this manual to avoid creating unsafe conditions, or risking damage to the equipment.

The comprehensive list of safety precautions in Chapter 2 must be followed to ensure safe operation of the equipment. These precautions must be reviewed and understood by operating and maintenance personnel before installing, operating, or servicing the equipment. The high-pressure waterjet system is a powerful cutting tool and must always be treated with respect.

Warnings, cautions, & notes

Before operating the equipment, please read, thoroughly understand, and follow all warnings, cautions, and notes that appear in this manual. They are defined as follows:

WARNING
Highlights an operating or service procedure or condition that can result in death or serious injury to personnel.

CAUTION
Highlights an operating or service procedure or condition that can lead to impaired system operation or equipment damage.

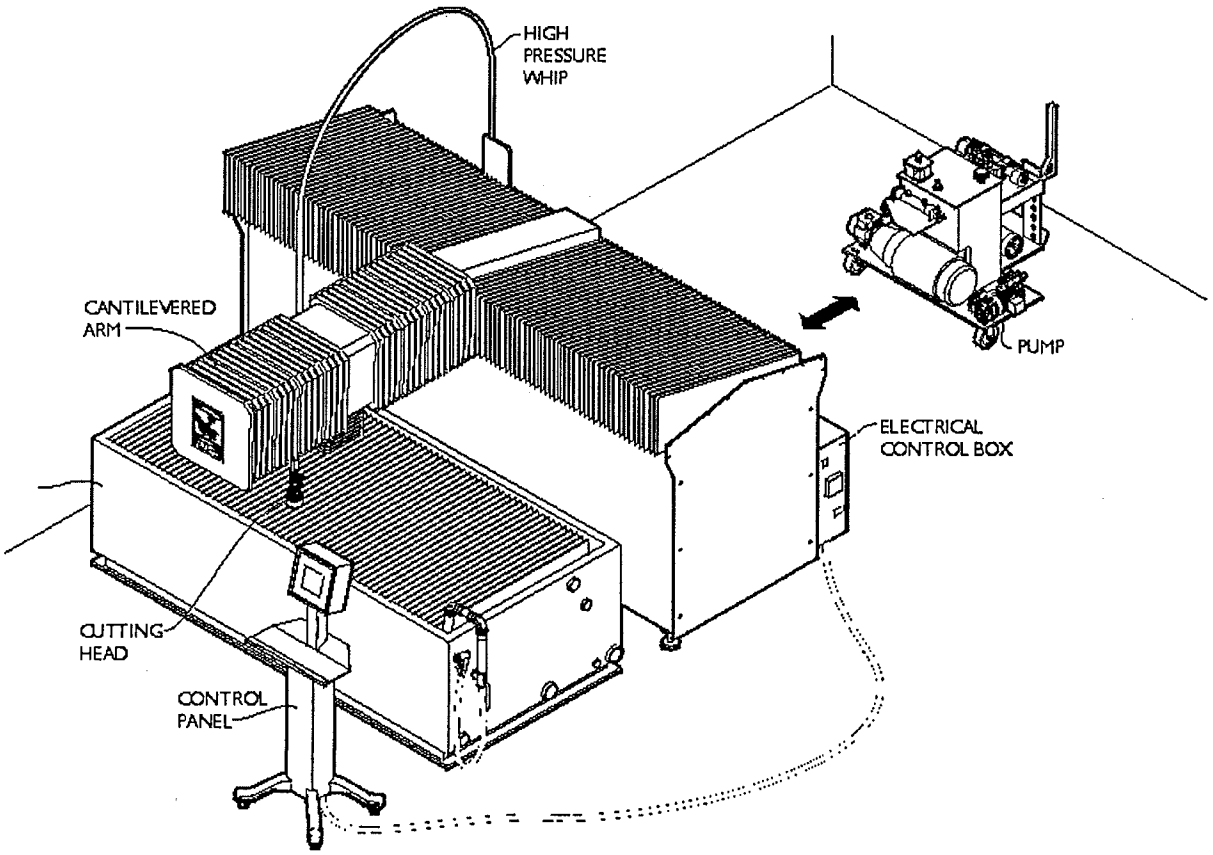
Note: Highlights an operating or service procedure or condition that is essential for efficient operation and service.

Notes

CHAPTER 1

Equipment Description & Installation

The Integrated Flying Bridge with Dynamic Waterjet (IFB DWJ) is a free-standing gantry shapecutting system. This machine is electric AC servomotor-driven and microprocessor-controlled from the FlowMaster PC-based controller.



System components

The IFB DWJ includes the following components.

Dynamic Waterjet end effector

The Dynamic Waterjet (DWJ) is an end effector designed for flat stock machines. Its revolutionary design provides a better way to correct two common drawbacks to abrasivejet cutting—taper and inside corner kickback.

See Chapter 4

Intensifier pump

The intensifier pump is a powerful, ultrahigh-pressure waterjet cutting tool designed for minimum maintenance and reliable performance. The pump has an output water pressure rating of 60,000 psi (4138 bar), and is assembled on a pull-out plate, which provides easy maintenance and service access.

see Chapter 4

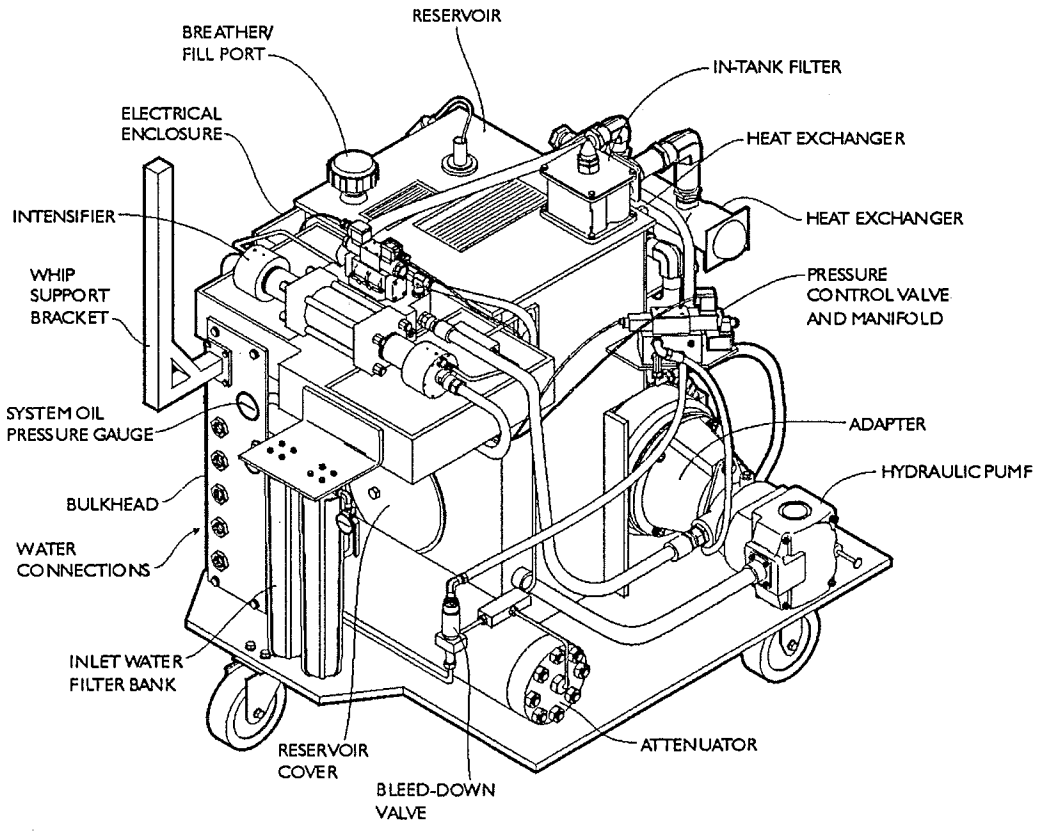
FlowMaster PC-based controller

refer to the FlowMaster CD.

WaterVeyor abrasive removal system

The Waterveyor abrasive removal system is designed to remove spent abrasive and kerf material from the catcher tank.

Refer to manual M-357, Waterveyor Abrasive Removal System



System specifications

Machine features

PC-based control

FlowMaster PC controller includes CAD, path ordering, machine controls and diagnostics, optional nesting

Digital servo system

X and Y axes (digital AC servos) provide high accuracy and low maintenance

Ball screw drives

High-precision ball screws and ways

Options

Vacuum assist

Helps when piercing brittle materials such as glass, composite, or stone

Abrasive flow monitor

Alarm activates when abrasive flow rate exceeds high or low limits.

X,Y-Z jog pendant

Allows the operator to adjust cutting head position remotely from the main control console.

Installation requirements

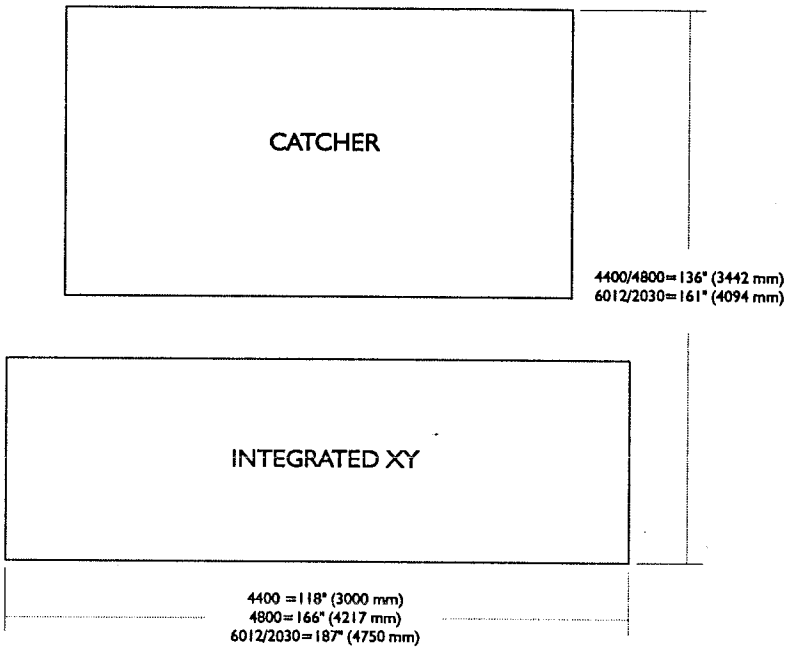
Conditions described in this chapter must be met before installing the equipment.

Foundation

The base frame comes with leveling pads—six on a 4 x 8 IFB, and eight on a 6 x 12 IFB. Leveling pads are used when installing the X,Y table on an uneven surface. This is explained in more detail in *Initial assembly.*

Note: Do not set the machine across an expansion joint in the concrete. The machine must be set on a single slab foundation.

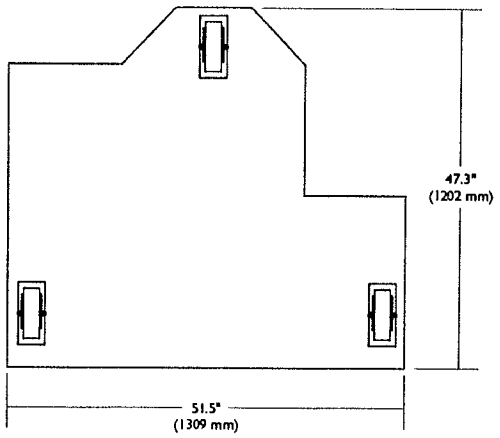
The intensifier pump comes with three wheels to allow you to easily roll the pump into position under the X,Y table.



Environment

The 50i-S pump is designed only for factory or shop use.

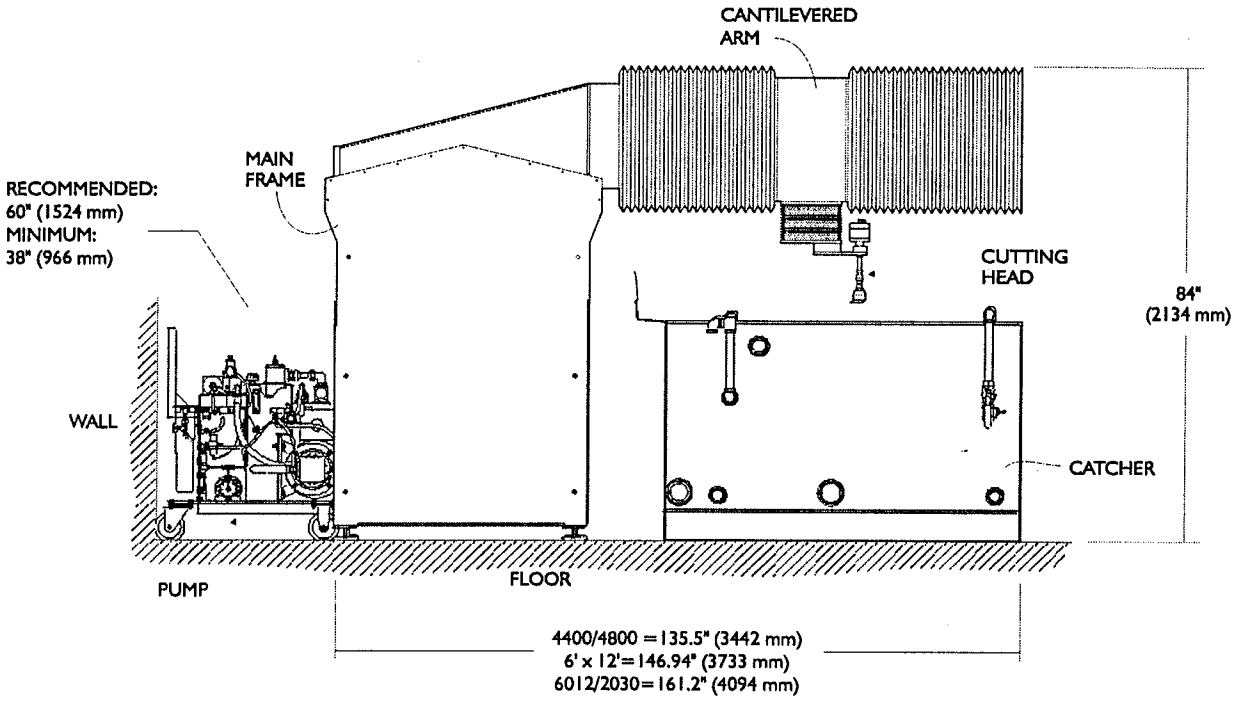
Ambient temperature	60° to 100°F (15.5° to 38°C)
Relative humidity	Up to 90% @ 100°F (38°C) non-condensing
Airborne dust/ contaminants	Minimal
Radio frequency interference	Minimal
Lighting	Adequate to operate and service the equipment



Electrical

- See layout drawings, located in Chapter 6.

System dimensions



Hydraulic oil for the 50i-S intensifier pump

Use an oil that does not contain anti-wear additives; the following oils are recommended, but other manufacturer's equivalents can be used:

- Mobil DTE Medium
- Shell Turbo T 46
- Chevron Turbine Oil GST 46
- Exxon Teresstic 46
- Texaco Regal R&O 46

Kinematic viscosity	310 SSU @ 100°F (38°C)
Reservoir capacity	27 gallons (102 L)
System capacity	28 gallons (106 L)
Filtration	2 microns, continuous flow
Cooling	Oil-to-water heat exchanger
Optimum oil temperature	105°F (40.5°C)

High-pressure tubing

High-pressure tubing certified for continuous operation at 60,000 (4138 bar) is used to route high-pressure water from the intensifier pump to the cutting equipment.

- If you need assistance, contact FLOW Technical Service.
- Refer to manual M-127, Small High-Pressure Components, for more information on high-pressure tubing, components, and related service.

Water requirements

The 50i-S intensifier pump requires two sources of water: cutting and cooling. Also required are three water drain lines: coolant drain, leakage drain, and bleed-down water. Leakage and bleed-down water drain lines may be plumbed together when necessary. Leakage drain must be separate where local regulations do not permit oil in drains. Specific requirements are defined in the following descriptions.

Cutting water

CAUTION

A high concentration of dissolved solids (especially silicates and calcium) in the inlet water can reduce waterjet nozzle life. If water quality is poor and filtration will not correct it, the customer must add additional water treatment equipment. Contact FLOW Technical Service for more information.

FLOW recommends the use of a water softener to pretreat the cutting water. Systems should be sized for 150% of your pump capacity, and should match your intended maximum duty cycle.

Water pressure

Water pressure to the intensifier pump must stay between 20 and 100 psi (1.4 and 6.9 bar) at all times.

Water flow rate

The minimum inlet water flow rate must be equal to 1.5 times the maximum output flow rate.

Cooling water (to heat exchanger)

Dual heat exchangers regulate heat build-up in the hydraulic oil. Optimum hydraulic oil temperature is 105°F (40.5°C). Tap water is routed first to a heat exchanger in the pump case drain line, then to a heat exchanger in the intensifier return line.

A thermostatically controlled cooling water flow control valve designed for partially open operation is installed in the line to regulate the water flow for maximum water conservation.

Water flow must be sufficient to ensure that the hydraulic oil reservoir temperature is always maintained below 110°F (43°C). Cooling water flow rate is typically 3 gpm (11 lpm) per 50 hp at an inlet water temperature of 60°F (15°C).

Water with low levels of minerals and acid will maximize heat transfer efficiency and heat exchanger life.

- Waterjet systems perform better with soft water.

Drain requirements

Cooling water drain

Cooling water leaving the intensifier pump is considered waste water. This water can be routed to a waste water recovery system, a recirculation system, or a drain—whichever is most applicable for the installation. If the water is reused for cooling, a commercial water cooling system can be used.

If the cooling water is routed directly to a waste water drain, you must have a minimum drain capacity of 5 gpm (19 lpm).

Leakage drain (oil or water)

The pump has a drip pan to collect oil or water leakage from the intensifier seals. Leakage is usually negligible; however, the drain line is sized to accommodate the worst case (if the bleed-down valve opens) of 10 gpm (38 lpm).

Do not connect the leakage water drain to the coolant water drain line or any other pressurized drain system.

Bleed-down water

The bleed-down valve exhausts water through the BLEED DOWN WATER port on the bulkhead. This can be connected to the same drain as the catcher overflow, if required.

Water interface connections

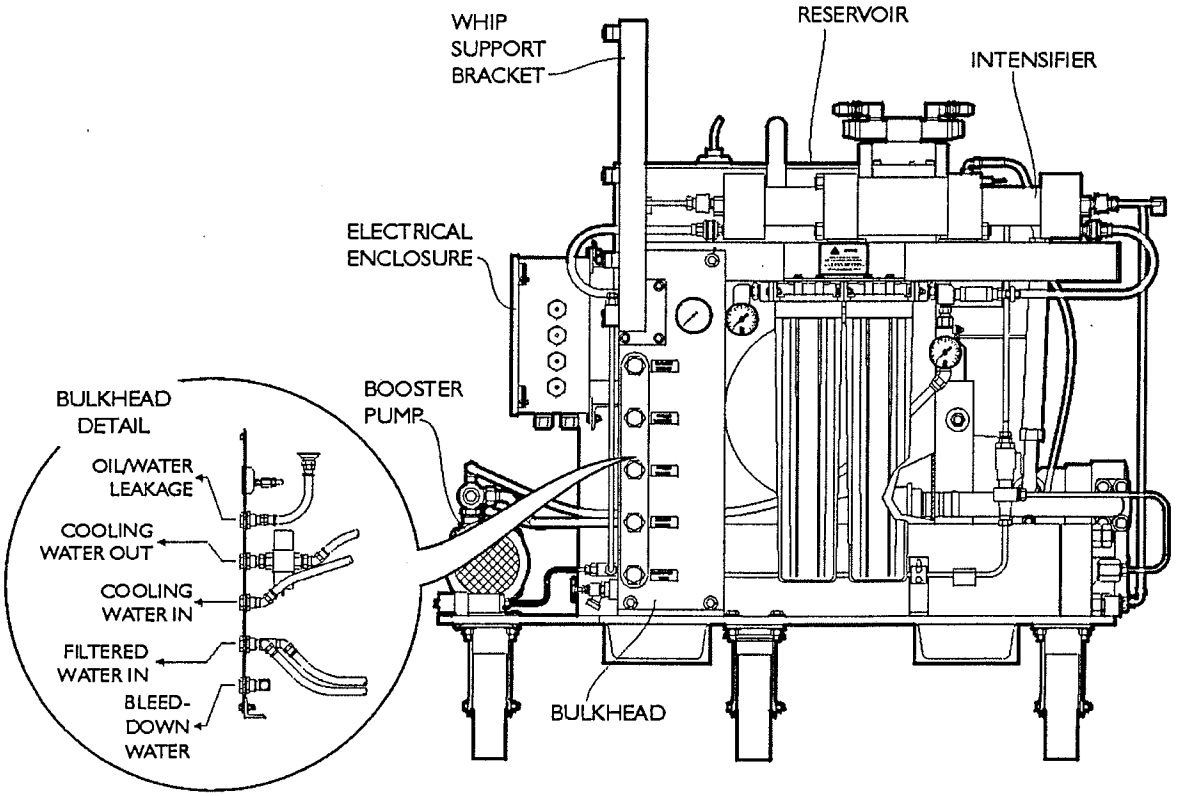
Please note the following:

- FLOW recommends that you install manual on/off valves in the inlet water and cooling water lines. Locate valves as close as possible to the pump interface connection to make them easier to service.
- Coolant water lines must be made from noncorrosive pipe or rubber hose. Rubber hose per SAE Standard 20R1, 30R1, or equivalent is recommended.
- Cutting water lines (from the filtering system to the intensifier pump) must be as short as possible and must be constructed of PVC, copper, or equivalent. Do not use galvanized iron piping—it will introduce minerals to the water, which will shorten orifice life.

Making the interface connections

- Connect inlet water line to FILTERED WATER IN.
- Connect LEAKAGE WATER to the appropriate drain or bucket (can contain oil).
- Connect BLEED-DOWN WATER to the appropriate drain.
- Connect cooling water supply line to COOLING WATER IN.
- Connect COOLING WATER OUT to the factory drain system.

Note: Purge the inlet water lines of debris before completing the connection to the pump.



Customer preinstallation information

The customer is responsible for performing the following installation procedures at customer expense.

- Prepare all electrical, water, cooling, drain, and air connections, including interconnects between system components, in accordance with all local codes.
- Provide any site-specific brackets required to support the high-pressure tubing.
- Make sure the floor load rating is adequate for all the equipment (refer to preinstallation drawings).
- Make sure the installation location allows for adequate maintenance and service access on all sides of the equipment.
- After installation, be prepared to fill the pump reservoir with the correct hydraulic fluid.

Schedule FLOW's start-up services

- At least three weeks before you complete the customer installation responsibilities detailed in this chapter, call FLOW's Technical Service Coordinator and arrange for a field service engineer to arrive when installation preparation is complete. You should allow at least one week between final delivery of the equipment and the arrival of the FLOW field service personnel.
- Provide qualified technicians to assist with system start-up. This is especially beneficial to your own technicians, as it will further acquaint them with the system before they have formal training.

When the equipment arrives

Carefully check the crates and their contents against the packing slip. Immediately notify the freight carrier of any damage or loss. Each piece of a 4800 system can weigh as much as 6000 lb (2721 kg) and each piece of a 6012 system can weigh as much as 10,000 lb (4536 kg). The pump can weigh as much as 2500 lb (1134 kg). Take care when transporting any pieces of the equipment, whether crated or uncrated.

- Remove the plastic covering from the outside of the equipment.
- Place the system on the installation site.
- Leave 5 ft between the back of the system and the wall.
- Leave 3 ft of space on the left and right sides of a 4800/4400 system; 18 in. on the right side of a 6012/2030 system.

Uncrating the equipment

Uncrate the Y-bridge and base axis

1. Position the forklift so that the forks are on both sides of the Z-axis plate and under the bridge.
2. Leaving the Y-bridge on the shipping fixture, lift and move to a safe location away from the system assembly area.
3. Remove plastic wrap from the base axis.

Uncrate the pump

1. Remove the metal straps from the shipping crate.
2. Remove the top, sides, and ends of the crate. Do not remove the bottom.
3. Move the pump to the installation site with a forklift. Place the forks through the crate bottom, and make sure the pump is firmly on the forks before lifting.
4. Unbolt and remove the crate bottom.
5. Lift the pump off the crate bottom with the fork lift. Again, make sure the pump is firmly on the forks before lifting.
6. Lower the pump and set it out of the way.

Initial assembly

1. Remove protective plastic wrap from rails. Clean grease from rails and ballscrew.
2. Lift the X-axis frame with a forklift and install the leveling pads.
3. Move X-axis frame into place. Adjust leveling pads to lowest level. This is necessary to prevent the rail from touching the pump, but it limits the Z-axis travel.
4. Check the level on the X-axis rails and the Y-bridge support plate using a machinist level. Adjust length of support pads to level the X-axis pads as well as to the Y-bridge support plate.

FLOW TECHNICAL SERVICE

Installation Procedures

CAUTION

The installation steps that follow are to be performed only by FLOW. If the customer attempts any of this installation without assistance from FLOW, the customer is responsible for any failure or damage to the machine resulting from improper installation. Installation by other than FLOW personnel shall void all equipment warranties.

Complete base axis installation

1. Re-check level (done by customer).
2. Lag base using ¾ x 10 in. wedge anchors. A 6 x 12 requires 5 anchors, a 4 x 8 requires 4 anchors.

   Note: Make sure holes are free of dust before installing the anchors. Anchors will not hold if holes are not properly cleaned.

3. Tighten lag anchors and recheck level; adjust as required.
4. Tighten jam nuts on leveling pads.

Install the Y-bridge

1. Move the Y-bridge near the assembly area and remove the shipping frame.
2. Move bearing plate to center of machine.
3. Raise Y-bridge into place and mount on bearing plate. Anchor the Y-bridge to the bearing plate using the 12 bolts from the installation kit.

   Snug all bolts, but do not torque at this time.

4. Connect the large connector to the mating plug from the cat-track.
5. Run the motor cables through the Y-bridge center hole and connect to encoder and motor connectors.
6. Connect abrasive and air hoses and install/tighten clamps.

Install the PC

1. Unpack the computer and place in the electrical enclosure.
2. Connect AC power.
3. Connect the monitor, mouse, and keyboard.
4. Connect the 60-pin ribbon cable to the PMac card.
5. Connect the 26-conductor ribbon cable from the PC to J4A port of ACC34 board.

Install the pump

The pump was completely assembled and tested at the factory. After a quality inspection, the hydraulic oil was drained and all interface connections were capped. The pump requires no assembly, and is ready to install.

Water, drain, and air requirements for the pump are described at the beginning of Chapter 1.

1. Determine the location for the pump under the machine. Remove the bolt-on beam from the rear of the base module. Move the pump into position and reinstall the beam.
2. Lower the stabilizing feet on the pump casters to raise the pump off its wheels. Make sure the pump is not touching any part of the machine frame.

3. Install wiring:
   - Motor SO cord to motor starter
   - J4 cable to main electrical panel
   - Booster motor cable to contactor (intensifier pump only)
4. Connect air line to proportional valve (Note: for HyPlex pumps only).
5. Attach water and drain lines:
   - HyPlex pumps: attach inlet water and hot water drain. If chiller option is purchased, inlet water will route through chiller before attaching to pump
   - 50i-S and 100i-D intensifier pumps: connect filtered water in, cooling water in and out, bleed-down, and leakage water.
6. Fill unit with oil:
   - HyPlex pump: 2.5 qt SAE 30 non-detergent oil is required.
   - 50i-S and 100i-D intensifier pumps: approx. 27 gal of hydraulic oil is required.

   Note: Specific types and brands of recommended oils are listed in Chapter 1, or on the specification plate attached to the pump.

Install the console

1. Open back panel of roll-around console.
2. Remove the packing that supports the video display.
3. Run cables for mouse and keyboard through the smaller hole in the base of the monitor enclosure, and connect to mating plugs.
4. Run cabling at end of console umbilical through the rubber boot at the bottom left side of the main electrical panel.
5. Connect AC cord to the outlet strip.
6. Connect the 25-pin cable to the adapter or separate keyboard.
7. Connect J1 cable.
8. Connect green ground wire to ground buss.
9. Connect J3 cable (for dual head systems only).

Connect high-pressure plumbing

1. Install stanchion on rear of base module.
2. Install coil kit (for 50hp HyPlex).
3. Install main whip from stanchion to top of Y bridge.
4. Install on/off valve on Z-axis.
5. Install Z whip from top of Y bridge to on/off valve.

Connect main air supply

1. Install air regulator on end of base module.
2. Connect air supply (80–120 psi) from customer source.

Install abrasive hopper

1. Locate hopper at customer-preferred location.
2. Connect air source to hopper (80 psi max). Connect J2 to hopper from electrical enclosure.
3. Connect abrasive supply hose.
4. Install mini-hopper.
5. Connect abrasive supply hose to mini hopper.
6. Install performance monitor gauge.
7. Install abrasive delivery hose from mini-hopper to cutting head.

Paser ECL Plus

Refer to manual M-359, PASER ECL *Plus* Abrasivejet System.

Machine startup and final assembly

1. Turn the power disconnect ON. Make sure the E-stop is NOT on. Turn the computer ON. (The display should be in FlowCUT; press Control On.)
2. Click on *Run Machine*.
3. Move the cursor to *Home Machine Recommended;* click *OK*.
4. Jog X,Y, and Z by moving the keyboard arrows to verify axes are moving properly.
5. Check for proper Z-axis movement by using the Z-axis switch on the front of the Y-bridge.
6. Install the front covers and the covers over the lifting ports. Attach bellows to each side of the Z-axis assembly.
7. Home the A,B, and Z axes, then home X and Y.
8. Jog the X-axis to the center of the range of movement.

CAUTION
Make sure the tank clears the nozzle tip when moving the tank into position. You made have to temporarily remove the tank splash guard.

9. Move cutting tank so the Y-axis is in the center of the tank. Verify that the tank is resting flat on the floor.
   a. Jog X and Y axes around the outside of the tank to verify that the tank is centered. Adjust the tank as necessary.
   b. Connect water, air, and drain lines.
   c. Fill catcher tank ¾ full of water.
   d. Level tank support using adjusting screws located at each corner of the tank. Check level using a machinist's level and a flat plate [24 x 24 in. (610 x 610 mm)] located approximately at the center of the tank.
10. There are two methods for verifying that the X and Y axes are aligned perpendicular to each other:

    Method 1:
    a. Put the 24 in. x 24 in. plate in a convenient place to observe the dial indicator readings.
    b. Attach the dial indicator to the Z-axis so the dial indicator is perpendicular to the plate surface and zero indicator.
    c. Jog the X and Y axes to move the indicator over the plate surface. Shim the plate so it is level with X and Y axis.
    d. Place a machinist's square on the plate with the short side of the square parallel to the X-axis.
    d. Jog the axes so the dial indicator pointer touches the side of the square that is parallel to the X-axis.
    e. Jog the X-axis the full length of the square. Adjust the position of the square until the dial indicator reads zero run-out.
    f. Jog the axes so the dial indicator touches the side of the square parallel to the Y-axis; zero the indicator. Jog the Y-axis the full length of the square and note the change of reading. Run- out should not exceed ±0.0005 in. (0.013 mm).

    Note: Do NOT move the square.

    g. To adjust the reading, move the Y-axis to the point of maximum run-out. Loosen the 12 bolts in the X-bearing plate and adjust the Y-axis (using adjustment blocks) to one-half of run-out.

    Re-zero the dial indicator and repeat Steps 9f and 9g until the reading is equal to ±0.0005 in.

    h. Torque all 12 bolts to 29 ft-lb (39 N-m). Repeat Step F to verify Y-axis did not shift when bolts were torqued.

    Method 2:
    a. Set up a ballbar in the approximate center of the machine work envelope.
    b. Run a ballbar plot.
    c. Obtain the XY square error from the ballbar analysis of the plot.
    d. Slightly loosen the 12 bolts that hold the Y bridge to the X bearing plate. Using the 4 squaring adjustment screws, move the Y axis to correct the square error.
    e. Repeat Steps B, C, and D until X and Y are square to the machine spec.
    f. Torque the 12 bolts to 29 ft-lb (39.3 N-m).

10. Attach the bellows on the Y-axis and Z-axis.
11. Install side panels and Y-axis covers.
12. Move all bellows to center and attach to the X,Y bearing plate.
13. Attach bellows at each end of the machine.

This concludes the FLOW-only portion of the installation procedures.

Starting the pump after installation and after major service

After initial installation, and whenever you perform major service on the intensifier pump, you must follow this startup procedure when putting the equipment back into service. This procedure provides checks to make sure the pump is correctly reassembled.

Before starting the equipment:

- Be sure you know how to stop it.
- Read the manuals, get training from an experienced operator, and review the safety precautions.
- Follow a written checklist that includes an inspection for needed or ongoing service, damaged or missing parts, leaks, and anything that could make equipment unsafe to operate.
- Make sure doors are closed and covers are in place.
- Call out "START-UP" to let anyone in the area know the equipment will be starting up.

WARNING
NEVER operate the IFB or intensifier with uncertified parts—this can cause explosive separation of parts and serious bodily injury. Contact FLOW or seek professional installation assistance.

- All operators and service personnel must review the safety precautions in manual MS-2274 and in all manuals provided with this equipment before operating the equipment.
- Cutting equipment and nozzle must be installed and working before operating the pump. Operating the pump without proper line restriction will damage high-pressure components.

Starting the pump

CAUTION
Debris in the water supply line can cause extensive damage to high-pressure components. Such damage IS NOT covered by warranty.

1. Flush debris from all water supply hoses before connecting them to the pump.

CAUTION
Never operate the pump without oil—this can cause extensive damage and IS NOT covered by warranty.

2. Fill the pump case with a recommended oil (see the list on Page 13).
3. Make sure water lines, air lines, and drain lines are correctly connected and routed.
4. Clear all tools, parts, and rags from around the pump. Check areas in and around the pump for foreign objects and debris.

CAUTION
The inlet water valve must be open before operating the pump. Operating the pump with the inlet water valve closed will cause damage.

5. Open the inlet water valve; check all connections for leaks.

CAUTION
Cutting equipment and nozzles must be installed when operating the pump. Operating the pump without proper line restriction can cause damage.

6. Place the main electrical disconnect in the ON position.
7. Release the E-stop button.
8. Activate FlowCUT and open a part program. Select Run Machine. The screen will display the pump on/off control. Verify that the low-pressure icon is checked.

CAUTION
Do not try to tighten any loose or leaking connections while the pump is operating or while the line is pressurized.

9. Click on the high-pressure icon.
10. Turn the pump on by clicking on the pump ON button.
11. When the pump reaches 60,000 psi (4138 bar), operate the pump at this pressure for additional 5-10 minutes while checking for leaks. Correct as required.
12. Turn the pump off, exit FlowCUT, and press the E-stop button.

Operation

The intensifier pump is operated from FlowMaster. See manual M-322, FlowCUT User's Guide for more detailed information on running the machine. A pump operation button on the FlowMaster Run Machine screen is used for starting and stopping the pump. Select HIGH PRESSURE or LOW PRESSURE for the dual- pressure feature.

Running the pump

When the machine is in position to start a cut, click on the ON pump button. The intensifier pump will not start immediately; first the water booster pump turns on to charge the system. After approximately 5 seconds, the intensifier pump starts and begins ramping up pressure. The pump uses an electronic proportional control valve to automatically ramp up high-pressure water. The digital high-pressure gauge on the FlowCUT screen indicates the amount of water pressure in the system.

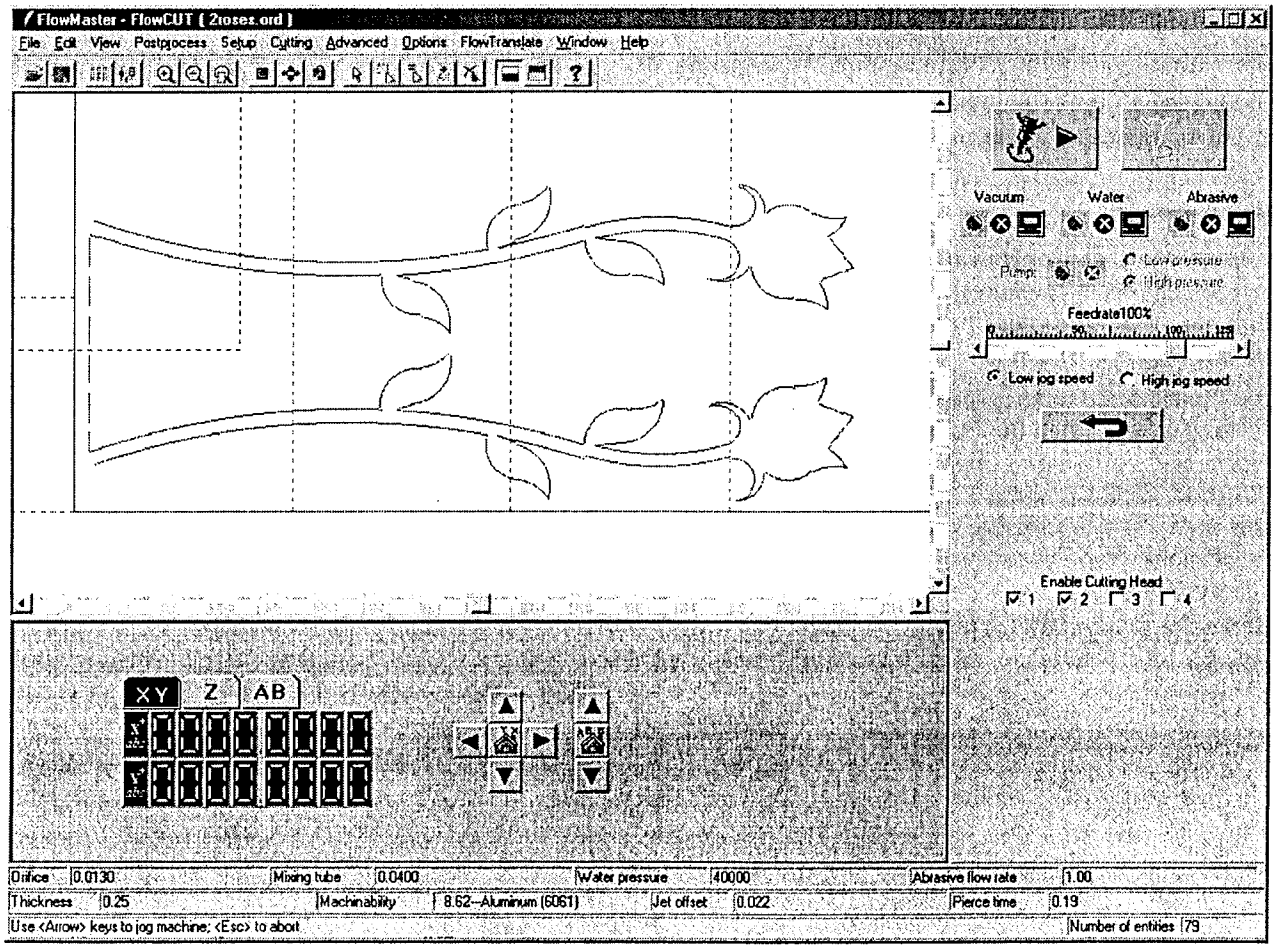
When the system reaches the desired operating pressure, you can begin cutting. Click the OFF pump button to turn off the pump. All system pressure is bled to 0 psi within one second of shutting down the pump.

Using dual pressure

Brittle materials, such as glass, stone, or composites, should be pierced at a lower operating pressure (such as 20,000 psi/1379 bar). To select high or low pressure, highlight either the HIGH PRESSURE or LOW PRESSURE box to the right of the PUMP on/off button. The default setting is HIGH PRESSURE, which is normally set for an operating pressure of 60,000 psi (4138 bar). Selecting LOW PRESSURE will lower the pressure, usually to 12,000–20,000 psi (828–1379 bar).

Use the LOW PRESSURE setting together with the FlowMaster PIERCE ALL HOLES FIRST function to pierce holes in a given program before cutting.

Sample FlowMaster screen



Shipping or storing the intensifier pump

Whenever moving, storing, or shipping a FLOW pump, following these guidelines will help prevent damage caused by movement or environmental conditions. These instructions comply with transportation regulations.

Note: U.S. Department of Transportation regulations require that hydraulic fluid be transported only in sealed containers. Before shipping, remove all hydraulic fluid from the oil reservoir.

Service steps

1. Disconnect power and turn off inlet water.
2. Disconnect main motor lead terminations from the motor starter in the machine power enclosure. DO NOT CUT LEADS.

   Note: Motor leads are terminated with eye lugs and bolted to terminations from the motor starter primary conductors.
3. Remove water filters from housings. Empty and clean the housings, then reinstall without filters.
4. Disconnect the plumbing from the water leakage line.
5. Disconnect customer plumbing from the FILTERED WATER IN bulkhead connection.

Install antifreeze

Note: Use Dow Chemical Dowfrost Propylene Glycol food-grade antifreeze (or equivalent). Antifreeze, container, pump, and hoses must be clean to prevent contamination.

6. Use a small pump to force clean antifreeze through the inlet water circuit. Bypass the solenoid valve, if applicable. A drill-motor operated transfer pump is often adequate. Continue to pump antifreeze until it exits both the high-pressure water and leakage water connections, then disconnect the hose from the inlet water connection.

   Remove all water from each water circuit in the same way.
7. Remove the filter housings, empty out the antifreeze, and install two new filters.

Plug fittings

8. Plug all bulkhead connections. Tie wrap the inlet water line, drain line, and air line.

Crating

9. The pump must be shipped on a framed and reinforced wooden pallet designed to isolate and support its weight and load characteristics.
10. Secure the filter bracket so it cannot vibrate.
11. Wrap a plastic band around the horizontal circumference of the pump, protecting all corners with cardboard between the strap and the cover corner. Wrap an additional plastic band around the top and under the frame, also protecting corners with cardboard.
12. The pump cover package must also be fully enclosed in a rigid wooden crate for shipment.

CHAPTER 2

Safety

This chapter contains a comprehensive list of safety precautions that must be followed to ensure safe operation of the equipment. These precautions must be read and understood by everyone operating and maintaining the equipment—before they start working with the equipment. Note that OSHA and state safety agency rules must be complied with in addition to those given in this chapter and elsewhere in this manual. Applicable plant general safety precautions must also be followed.

Safety precautions

FLOW designed your high-pressure waterjet cutting system and related equipment with safety in mind. Throughout the manual, safety precautions and warnings for specific operations are highlighted. Safety precautions are also posted on the equipment. The operator and service personnel shall pay particular attention to these precautions at all times.

Operators of a high-pressure waterjet cutting system must treat the system as they would treat any high-speed cutting tool. Although the waterjet may appear harmless, it is a high-energy cutting tool capable of cutting many non-metallic materials such as composites, plastics, and wood products. Misuse of this equipment or carelessness in its application can be extremely hazardous to operating personnel. Always treat the waterjet cutting system with respect.

Warnings, cautions, and notes

Service procedures in the waterjet manuals include safety warnings, cautions, and notes that must be read, understood, and adhered to. These are specific categories of safety notices, and are defined as follows:

WARNING
Highlights an operating condition or service procedure that can result in death or serious injury to personnel.

CAUTION
Highlights an operating condition or service procedure that can lead to impaired system operation or equipment damage.

Note: Highlights an operating condition or service procedure that is considered essential for efficient operation and service.

Replacement labels

- Part # 006317-1
  3.75 x 6 in.
- Part # 009837-1
  1.8 x 3 in.

Safety tips

- Do not allow the waterjet stream to touch any part of your body—it will cause serious injury.
- Do not point the waterjet at anyone.
- During equipment maintenance, take the system out of service. The controls must be properly locked and marked with a warning sign.
- All personnel required to perform any system operating or service function must pay particular attention to all warning signs and notices posted in the plant and on the equipment.
- All protective guards, shields, and covers must be in place on the equipment at all times.
- First aid facilities must be provided in convenient locations throughout the plant. These locations must be known by all personnel.
- Always keep the work area around the equipment clean and free of debris. Oil spillage results in slippery floors and must be cleaned up immediately.
- Any unfavorable conditions that may result in injuries must be reported to the plant supervisor without delay.
- As a general practice, it is recommended that safety shoes, glasses, and hearing protection be worn by all personnel working around the equipment. Do not wear rings, watches, or necklaces when working around any equipment that has moving parts.

Mechanical system

- Don't start the system unless you know how to stop it.
- Never maintain, service, or clean around the equipment while it is operating.
- Use only the correct tools—wrong tools can cause injury or costly damage to equipment.
- Never climb on or around the equipment on makeshift devices. Use only approved catwalks, ladders, or platforms.
- Do not exceed specified pressure setting limits for pneumatic or hydraulic components. Exceeding these limits may result in serious injury to personnel or damage to the equipment.
- Shield and bundle equipment hoses and cables so they do not obstruct the operator's freedom of movement.
- Be alert at all times when working around the equipment.
- Clear all tools, parts, and rags from moving parts after servicing the equipment.

Electrical system

- Only properly trained personnel shall perform electrical and/or electronic troubleshooting and servicing of electrical devices.
- Always assume that power is ON in all electrical systems. Always check and lock out the main power switches before servicing the equipment. Post a sign, "Maintenance in Progress — Do Not Energize."
- Be aware that live electrical circuits are present in the control console whenever the master disconnect is on, regardless of whether the E-Stop is engaged.
- Disconnect circuit breakers and lock them in the OFF position before servicing the electrical system. If this isn't possible, have someone stand by to prevent someone from powering up the system.
- Take extra precautions when servicing the power system in a damp environment.
- Never alter or bypass protective interlocks or devices unless specifically instructed to do so, and only if all precautions are followed.
- You must give capacitors sufficient time for discharge. If this is not possible, discharging should be done manually and with care.
- Do not use jumper wires across fuses, fuse holders, or breakers.
- Make sure all tools are properly insulated for the job.
- Use only proper test apparatus; check regularly to make sure it is working correctly.
- Use caution when connecting a test probe to test points.
- All replacement wires must conform to the manufacturer's specifications, including color coding, wire numbers, and size.
- Close the control panel doors or junction box covers after servicing.

Waterjet system

- High-pressure water can remain in the system for an extended time after shutting down the water source. Always bleed-down system pressure before servicing any part of the system.
- Do not touch weep holes with your bare hands or try to stop water by plugging the holes.
- Remember that the waterjet stream is a knife. Do not introduce anything into its path that you do not intend to cut.
- Wear a face shield when required by operating instructions.

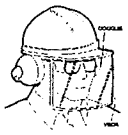
- Do not remove protective shields from high-pressure tubing. If shields are removed for servicing, they must be replaced before starting the system.
- Torque all fittings to the manufacturer's torque specifications.
- Stepping or leaning on high-pressure tubing can break connections, causing leakage.
- Use only high-pressure fittings, valves, and tubing certified for 60,000 psi (4138 bar) when making alterations or additions to the high-pressure water system.
- Do not alter or eliminate stress relief tubing coils.
- Follow the tubing manufacturer's recommendations for high-pressure tube bending radii.
- Do not exceed specified operating pressures for high-pressure water system components.
- Do not over-torque fittings or bend swivels excessively.
- Follow the manufacturer's recommendations for servicing the equipment, and use only original manufacturer replacement parts.
- Follow the manufacturer's system startup procedure to ensure safe operation.
- Use care when lifting equipment covers during operation.

Protective clothing

Personnel operating hand-held, high-pressure water cutting or cleaning equipment and those working nearby should wear the protective clothing and safety devices described in this chapter.

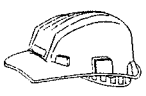
FLOW recommends that work-site safety personnel approve all safety equipment and clothing for everyone working around waterjet equipment.

Eye protection



- Operators must wear visors and goggles to guard against spray and flying debris. A goggles and visor combination is a typical requirement for waterjet cleaning.

Head protection



- Helmets must be worn at all times by all personnel within the work area.
- Helmet material must withstand mechanical shock to 10 G in 8 ms without fracturing.

Hand protection

- The operator must wear gloves at all times. Leather gloves are preferred.

Foot protection

- Safety footwear with steel toe-caps 0.02-in. (5 mm) thick (minimum) must be worn. The toe cap must cover at least 30% of the footwear length.
- For some applications, footwear must be equipped with metatarsal guards to provide instep protection.

Hearing protection

- Operators and other personnel exposed to noise levels of more than 90 dBa for more than 1 hour must wear suitable ear protection. Ear plugs and muffs are usually adequate.

Body protection

- Waterproof garments only protect the operator from spray and flying debris. They DO NOT provide any protection from direct jet impact.

WARNING
NEVER point a waterjet cutting or cleaning tool at yourself or at any person. Do not aim any waterjet tool at anything you do not want to cut.

Emergency medical information

Anyone who receives equipment-related injuries while operating high-pressure water equipment should be given immediate hospital attention. It is vital that medical personnel have information about this type of injury. Therefore, all waterjet operating personnel should carry a waterproof emergency medical tag or card that describes their work and the nature of injuries inherent in using waterjet cutting devices. The card illustrated below can be purchased from FLOW (P/N A-8466).

The tag or card should contain the following standard information:

MEDICAL ALERT

This card is to be carried by personnel working with high-pressure waterjet equipment. Obtain medical treatment immediately for ANY high-pressure waterjet injuries.

FLOW INTERNATIONAL CORPORATION
23500 64th Avenue South
Kent, Washington 98032 USA
(253) 850-3500

This person has been working with water jetting at pressures to 60,000 psi (413 MPa, 4138 bar) with a jet velocity of 3000 fps (914 mps). This should be taken into account during diagnosis. Unusual infections with microaerophilic organisms occurring at lower temperatures have been reported. These may be gram-negative pathogens, such as those found in sewage. Bacterial swabs and blood cultures may therefore be helpful. A local poison control center should be contacted for additional treatment information.

CHAPTER 3

Intensifier Pump Maintenance & Service

Periodic maintenance

Periodic maintenance is service to be performed on the equipment at regular intervals, designed to help minimize unscheduled production down time and premature parts failure. FLOW recommends that you keep detailed service records to help you prepare a maintenance schedule that is compatible with your application and production requirements.

General precautions

Observe the following general precautions at all times. Review the safety information in Chapter 2 before performing any maintenance or service. Do not make any unauthorized changes to equipment or components.

Electrical

- Maintain all electrical components, protective guards, and shutdown devices according to approved practices.
- Make sure power cannot be applied to equipment during maintenance. On diesel units, turn off the battery disconnect switch before beginning work.
- Before servicing, use a volt meter to make sure the system is not energized. Take extra precautions when servicing the electrical system in a damp environment.
- Never use jumper wires across fuses, fuse holders, or breakers.
- Do not use metal rulers, flashlights, pencils, or tools that have exposed conducting material.
- De-energize all equipment before connecting or disconnecting meters or test leads.
- When connecting the volt meter to terminals, use a range higher than the expected voltage.
- Replacement wires must conform to the manufacturer's specifications, including proper color coding and wire numbers.

Mechanical

- Use only high-pressure fittings, valves, and tubing certified for 60,000 psi (4138 bar) when making changes to the high-pressure water system.
- Immediately repair any leaks in fittings or connections. Torque all fittings to the manufacturer's specifications.
- When pressurizing any new, rebuilt, or recently serviced high-pressure component, clear all personnel from the immediate area until system pressure has been applied for three minutes and cycled on and off at least three times. Increase pressure slowly, a maximum of 20,000 psi/min. (1380 bar/min).
- Do not touch high-pressure leaks.
- Bleed down system pressure before servicing any part of the system. Never tighten pressurized fittings.
- Follow the manufacturer's recommendations for servicing the equipment, and use only original manufacturer replacement parts.
- Use cleaning solvents only in well-ventilated areas. Avoid prolonged breathing fumes and contact with skin or eyes.
- Inspect the entire system before operating it. Correct any fault or malfunction.

Tools

- Use only approved test equipment, and check it regularly for correct operation and calibration.
- Use the correct tools—the incorrect tool can cause injury to personnel or costly damage to equipment.
- Clear all tools and rags from around the machine after service and before starting the equipment.
- Use only approved work platforms. Never climb on or around the equipment using makeshift devices.

Protective clothing

- Do not wear loose clothing while working near rotating parts of machinery.
- Pressurized air can drive particles into eyes and skin if handled improperly. To prevent injury, use appropriate protective equipment and clothing and exercise extreme caution.

Torque specifications

Refer to the following table when specific torque requirements are not listed in a service procedure.

CAUTION
Never torque mounting bolts and machine screws beyond the manufacturer's recommended limits.

The torque values for high-pressure water assemblies and fittings are listed in U.S. Customary System foot-pounds (ft-lb) and Systéme International (SI) Newton-meters (N-m).

High-pressure gland nuts	U.S. ft-lb	SI N-m
1/4 in.	15–25	20–34
3/8-in.	35–45	47–60
9/16-in.	60–75	80–100

Inspection & maintenance schedule

FLOW equipment has been designed for long service life. However, maximizing the life, safety, and efficiency of the equipment depends on daily inspections and regular maintenance. Periodic maintenance can take the form of regularly scheduled preventive maintenance, such as the items listed below. It also includes replacing worn parts that have reached the end of their service life.

Every day

Before startup

- Inspect pump, high-pressure tubing, connections, and valves for leakage. Correct any problems before starting the pump.
- Check the oil level in the pump.
- Check the main electrical disconnect for "Out of Service" tags and check all around the equipment for indications of maintenance work in process.

After startup

- Listen for unusual sounds as the pump starts and water pressure increases. Look for leaks.

End of shift

- Clean machine work area.

Troubleshooting

The troubleshooting guide will help you identify the probable cause of a system malfunction and establish the most effective corrective action.

Troubleshooting tips

The following tips have been helpful in isolating system malfunctions and in correcting problems quickly.

- Listen to the machine and watch it operate. Learn to recognize the normal noises, temperature, and operating conditions. This will increase your ability to notice any unusual machine behavior.
- Keep a record of all service performed on the equipment. This will provide valuable information to help you stock spare parts and schedule maintenance.

A maintenance and service log is located at the end of this chapter.

Weep holes

Weep holes provide an outlet for high-pressure water in case of seal problems, and thus can help you identify problems with the pump. Leakage is usually caused by a failed high-pressure seal, but could also be caused by:

- a loose or leaking end cap
- failed check valve body o-rings
- cracked or scored high-pressure check valve body

Troubleshooting the high-pressure components

If you have questions about anything on the troubleshooting tables, contact FLOW Technical Service.

Using the troubleshooting table

The probable causes of each malfunction are listed in order, starting with the most likely to occur. Each corrective action is a condensed, step-by-step summary of the service required to fix the problem.

When you encounter a system malfunction, refer to the troubleshooting table and:

1. Define the problem.
2. Locate the symptom that most closely resembles the problem.
3. Identify the most likely probable cause.
4. Follow the corrective action procedure.

If the symptoms in the guide do not correspond to your malfunction, or if the problem is not eliminated by the recommended corrective action, contact FLOW Technical Service.

Troubleshooting the intensifier pump

Follow this troubleshooting table if you experience any of the following conditions. Required maintenance (minor and major) procedures and service procedures referenced in the troubleshooting table are located in this chapter.

1. Intensifier	
Note: Verify that the intensifier is operating correctly by looking for seal leakage and checking for high temperatures. Refer to manual M-310, ESL Intensifier.	
2. Intensifier overspeeding	
Intensifier problem.	Check intensifier for leaks and high temperatures.
Orifice problem.	Check orifice(s) for correct size and condition.
High-pressure water leak.	Check entire installation for evidence of leaks.
Low inlet water pressure.	Clogged inlet water filters or other inlet water line restriction. Check filters and lines; replace as needed. Check filter differential pressure indicator and inlet water pressure switch; replace as needed.
Leaking auto bleed-down valve.	The valve is hot to the touch; rework or replace the valve.
3. Oil and high-pressure water pressure are satisfactory, but water flow though the nozzle is low	
Flow restriction in the downstream high-pressure plumbing or components.	1. Inspect the high-pressure inline filter, if installed. 2. Check for blockage of tubing and components; remove any blockage. 3. Check for correct operation of on/off valve. Replace components as required.
4. Supply oil pressure is OK; high-pressure water pressure is low at the pump and nozzle	
Oil return pressure is too high.	There may be a restriction in the return line from the intensifier to the hydraulic pump.
	The filter is clogged and bypassing (this will be worse if bypass is restricted). Remove restrictions and replace components as required.
	Cold oil at startup. Not a significant problem.
5. Supply oil pressure and high-pressure water pressure are low at the pump	
Intensifier problem.	Check intensifier for leaks and high temperatures. Refer to manual M-310.
Orifice problem.	Check orifice(s) for correct size and condition.
High-pressure water leak.	Check entire installation for evidence of leaks.
Leaking auto bleed-down valve.	The valve is hot to the touch; rework or replace the valve.
Pressure control problem.	The pressure control valve has malfunctioned. Replace pressure control valve.
6. No supply oil pressure or high-pressure water pressure	
No hydraulic oil in the system.	Turn the intensifier pump off. Examine all suction and delivery lines for leaks; check the oil level in the reservoir. Remove oil spillage.
Broken motor shaft, pump shaft, or coupling.	Examine the motor and pump shafts and coupling. Replace as required.
Defective pressure control valve.	Replace pressure control valve.
Defective hydraulic pump.	Replace the hydraulic pump. See *Replacing the hydraulic pump*.

7. Hydraulic oil is milky or foamy	
Leaking heat exchanger.	1. Test the heat exchangers either removed or in place, for a static air leak at 150 psi (10.3 bar). Replace as necessary. Drain oil from the reservoir, hydraulic pump case, hoses, and intensifier assembly. Refill reservoir (and pump case for CE pump only) with clean hydraulic oil. 2. If the heat exchangers are not defective, look for a source of water vapor condensation.
8. Oil is leaking around pump shaft	
Defective hydraulic pump seal.	Replace the seal; check for leaking after replacement. See *Replacing the shaft seal.*
9. Hydraulic oil contains metallic particles	
Excessive wear of the intensifier low-pressure cylinder. Immediately stop the 50i-S pump if one or more of the listed signs is present.	
Signs of excessive wear: hydraulic system is running hot, uneven stroking, unusually high hydraulic pump noise during shifting, sudden drop in the intensifier's ability to meet demand for high-pressure water, and severe pressure fluctuation in the output water.	1. Disassemble the intensifier, inspect the components, and rebuild, replacing all worn parts. Inspect hoses. 2. Drain, thoroughly clean, and refill the hydraulic oil system (see *Cleaning a contaminated hydraulic system*). 3. Replace the screen filter in the reservoir. 4. Replace the oil filter. 5. Reinstall the intensifier and recommission the equipment.
Excessive wear of the hydraulic pump. Immediately stop the pump if you see one or more of the listed signs.	
Signs of a faulty hydraulic oil pump: higher-than-normal pump noise, inability to maintain the rated hydraulic oil pressure, or loss of water pressure.	1. Drain and thoroughly clean the hydraulic oil system. Replace the hydraulic pump. Refill the hydraulic oil reservoir and pump case; see *Cleaning a contaminated hydraulic system.* 2. Return the pump to service.
Using the wrong oil.	Replace with approved oil.
10. Excessive pump noise and loss of oil pressure	
Insufficient inlet hydraulic oil flow to the pump.	1. Make sure the in-tank strainer is clear of debris. 2. Make sure the reservoir is full of oil.
Air in oil.	Inspect suction line for leaks.
Water in oil.	Inspect oil in reservoir. See Item 7 of this troubleshooting guide.
Loose motor or hydraulic pump coupling halves.	1. Check alignment of motor and hydraulic pump coupling halves. Make sure there is no obstruction. 2. Replace the coupling insert (see *Replacing the coupling insert*). 3. Adjust the position of the coupling halves if required. 4. Torque the set screws on the coupling halves.
Loose hydraulic pump mounting screws or misaligned hydraulic pump shaft.	1. Torque the hydraulic pump mounting screws as specified. Make sure all mounting surfaces are free of debris and are not deformed. 2. Replace the coupling insert. 3. Adjust the position of the coupling halves and torque the set screws.
Malfunctioning hydraulic pump.	Replace the hydraulic pump (see *Replacing the hydraulic pump*).
11. Orifice assembly life is too short	
Poor water quality.	1. Check the inlet water filter elements. Inlet water must be filtered to 0.5 micron and have a pH value of 6-8. Replace filter elements if clogged. 2. If applicable, check the deionization and water treatment systems.
Clogged or ruptured delivery system component filter.	Remove and inspect filters; replace if clogged or ruptured.

12. Attenuator is leaking water from end cap weep hole	
There is a loose connection at outlet or inlet fitting to attenuator.	Loosen the 9/16-in. tubing gland nut and torque the fitting adapter into the attenuator housing to 60-75 ft-lb (81-102 N-m). Retorque the gland nut to 60-75 ft-lb and check for leaks. If leaking continues, replace the fitting insert.
13. Attenuator is leaking water between the main housing and end cap	
A leak in this location is not field repairable. Do not attempt to repair. Contact FLOW Technical Service.	
14. High-pressure tubing is leaking	
Excessive torsional movement or alternating load (relative movement of fitting components).	Re-torque the fitting to recommended torque values; repair or replace as required.
High-pressure collar incorrectly installed.	Allow 2–3 threads between collar and tip.
Coning and/or threading of tubing is incorrect.	Recone and rethread the leaky fitting if retorquing does not eliminate leakage. Refer to the coning and threading procedure in manual M-127, Small High-Pressure Components.
Eroded fitting.	Replace fitting.
15. Electric motor will not start	
E-stop is engaged.	Release the E-stop.
Abrasive proximity switch is open.	Refer to manual M-359, Paser ECL *Plus*.
Main electrical disconnect is open.	Close the main electrical disconnect.
Line fuses are blown are missing.	Check for the cause of blown or missing fuses. Replace affected fuses.
Motor relay is open.	Check wiring diagram for a control relay. Replace relay if defective.
Defective motor starter coil.	Check for defects by testing with power applied to the coil. Replace motor starter coil if defective.
Start circuit is wired incorrectly.	Check wiring against wiring diagram and correct all errors.
16. Electric motor will not stop	
Defective motor starter.	Check relays and replace if defective.
Stop circuit is wired incorrectly.	Check wiring against wiring diagram and correct all errors.
17. Electric motor is excessively noisy.	
No bearing lubrication.	Lubricate electric motor bearings.
Loose mounting bolts.	Adjust and tighten mounting bolts.
18. Electric motor runs briefly, then stops	
Loss of one phase of electric power.	Make sure all lines are energized. Correct power loss problems as necessary.
Magnetic overload adjustment is set too low.	Readjust the overload to a higher setting, but do not exceed 130% of the motor's full load current.

Using the FlowMaster warning display and diagnostic tool

Each IFB with FlowCUT Version 3.1 or newer has a Warning display feature and Diagnostic Tool feature, used for troubleshooting the pump. The flashing Warning Display is actually the background of the machine position display and it flashes from black to yellow when a warning condition occurs. A warning condition will not shut the machine down or turn off the pump.

Warning conditions

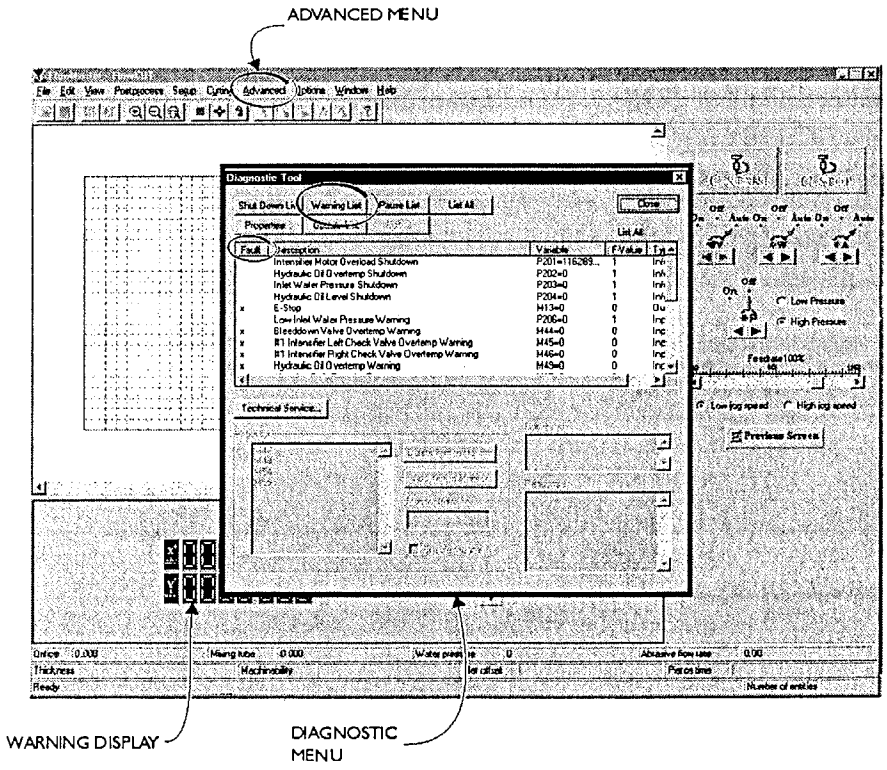
There are four warning conditions for the pump:

- Low inlet water pressure
- High hydraulic oil temperature
- High check valve temperature
- High bleed-down valve temperature

To find the specific warning condition go to the Advanced menu in FlowCUT and then the Diagnostic Tool menu. This brings up the *Diagnostic Tool* screen with several options. Click on Warning List and a list of the possible problems will appear. Look in the Fault column for the X indication, which should specify the warning condition.

Shutdown conditions

- Low inlet water pressure
- High hydraulic oil temperature
- Low hydraulic oil level
- Intensifier motor overload
- Emergency stop



Warning and shutdown conditions

1. Low inlet water pressure (warning and shutdown)	
Dirty filters	Replace 0.5 and/or 1 micron inlet water filters.
Inlet water turned off or incoming water supply interrupted.	Inspect supply valves and hoses.
2. High hydraulic oil temperature (warning and shutdown)	
Incorrectly adjusted cooling circuit	Adjust cooling water flow control valve on pump bulkhead.
Faulty heat exchanger	Inspect and replace heat exchanger.
3. High check valve temperature (warning)	
Worn check valve	Service check valve (See *Servicing the check valve* in manual M-310, ESL Intensifier).
4. High bleed-down valve temperature (warning)	
Worn bleed-down valve	Service bleed-down valve (See *Servicing the bleed-down valve).*
5. Low hydraulic oil level (shutdown)	
Low oil level in reservoir	Check for leaks; add hydraulic oil.
6. Intensifier motor overload (shutdown)	
Incoming voltage is low on one or more 3-phase legs.	Check plant power supply.
Motor starter failure.	Check operation of contactor; replace if necessary.
Hydraulic pump is seized or bound.	Inspect hydraulic pump.
Faulty motor	Replace if necessary.

Service procedures

The service procedures contain step-by-step instructions, and most include illustrations to help explain how to service the equipment. Service instructions cover how to replace parts during scheduled or unscheduled maintenance, and also include preventive maintenance procedures to help ensure trouble-free operation. Refer to the illustrations in the chapter, plus the engineering drawings in Chapter 5, to identify parts.

- Intensifier components—refer to manual M-310, ESL Intensifier.
- High-pressure parts not covered in this manual—refer to M-127, Small High- Pressure Components.

Service tips

Review the safety precautions in Chapter 2 and the general maintenance tips at the beginning of this chapter before starting any maintenance or service work. If you have questions about any service, contact FLOW Technical Service.

- Inspect the equipment every day before operating it. If you see any problem, refer to the troubleshooting guide and related service procedure(s).
- Read and understand each service procedure before starting any work. Pay particular attention to the precautions in the service procedures.
- Maintain records of service performed on the equipment. This will provide valuable information to help you restock spare parts.
- If applicable, turn off the electrical power and relieve system pressure before starting any service. If you must perform a service procedure while power to the equipment is on, or while the system is pressurized, take extra precautions to avoid injury.
- Handle critical parts with care and avoid scratching or denting the high-pressure water system components. Routinely check for loose bolts or wire connections.
- Protect all machined and lapped mating surfaces against nicks, scratches, and burrs. Carefully work out any damage to seal wiping surfaces, or seal damage and leaks will be a recurring problem.
- Do not use a substitute for the fluids, sealants, and lubricants recommended by FLOW. Clean off grease fittings before connecting grease gun to avoid injecting dirt-filled grease into the bearings.
- New bearings are frequently packed with only a light shipping grease. Be sure they are properly lubricated before operation.
- Make every effort to find a clean service area. Do not tear down parts in the same area where you are cleaning parts. Airborne dirt and abrasive will seriously shorten component life.
- Only clean parts with fresh, clean solvent that does not leave a residue (such as Citra-safe or isopropyl alcohol). FLOW recommends that you set up a dedicated solvent tank for these critical parts. Contamination from other industrial parts will seriously shorten component life.
- Carefully clean and blow out all parts being reassembled. Do not use paper towels. Do not create airborne dust.
- Check around the equipment for parts, tools and rags; remove them before starting the equipment.

Service notes

The following recommendations were provided by FLOW customers and technicians. Following this advice can lead to lower repair costs, shorter repair times, and increased service life.

- Monitor water seepage from end cap weep holes. If seepage is cold (same temperature as inlet water), it is usually not necessary to change seals, but you should schedule maintenance as soon as possible. If seepage is hot, shut down the system and repair the pump. Cracked parts and leakage from the check valve MUST be repaired immediately.
- All threaded high-pressure connections require an even coating of Blue Lubricant (A-2185). Substitute no other product.
- All parts that contain high-pressure water (cylinder, check valve housing, tubing) are susceptible to stress fatigue accelerated by stress risers. Stress risers result when scratches, nicks, or other surface disruptions are present. Rework all such damage or replace the component.
- Life expectancy of high-pressure water seals and other high-pressure parts is related to the stress on the parts, and is a function of stroke rate, water pressure, and inlet water temperature. Exceeding pump ratings can lead to increased costs and downtime.

Servicing the hydraulic system
Hydraulic oil pump

A hydraulic pump generates hydraulic flow to operate the intensifier. The pump is connected directly to an electric motor by a flexible coupling and a soft coupling insert. The pump does not need routine maintenance.

Problems associated with the pump are leaks, noise, metallic debris in the hydraulic oil, and erratic or low oil pressure. These problems are addressed in the following procedures:

- Adjusting the hydraulic pump compensator
- Repairing the compensator
- Replacing the hydraulic pump shaft seal
- Replacing the coupling insert
- Replacing the hydraulic pump
- Cleaning a contaminated hydraulic system
- Checking the hydraulic oil
- Changing the hydraulic oil
- Replacing the hydraulic oil filter

CAUTION
The hydraulic pump is specially modified and tested for this application. Do not use a substitute pump.

If the hydraulic pump reacts very slowly or overreacts to changes in demand, the compensator may need adjustment. See *Adjusting the hydraulic pump compensator.*

If the pump is running normally and you hear no unusual sounds, but the hydraulic oil pressure will not reach the rated value, there could be a problem with the hydraulic pump compensator. See *Repairing the compensator.*

Adjusting the hydraulic pump compensator

The compensation override control on the hydraulic pump is a pressure relief valve that limits the system oil pressure to a pre-set maximum. It is a safety feature that prevents the operator from exceeding the maximum normal operating pressure. If the front panel pressure control valve and the compensation override control valve fail, the main relief valve will operate and limit the system pressure to a safe value. See *Main system relief valve* in this chapter.

Test equipment required

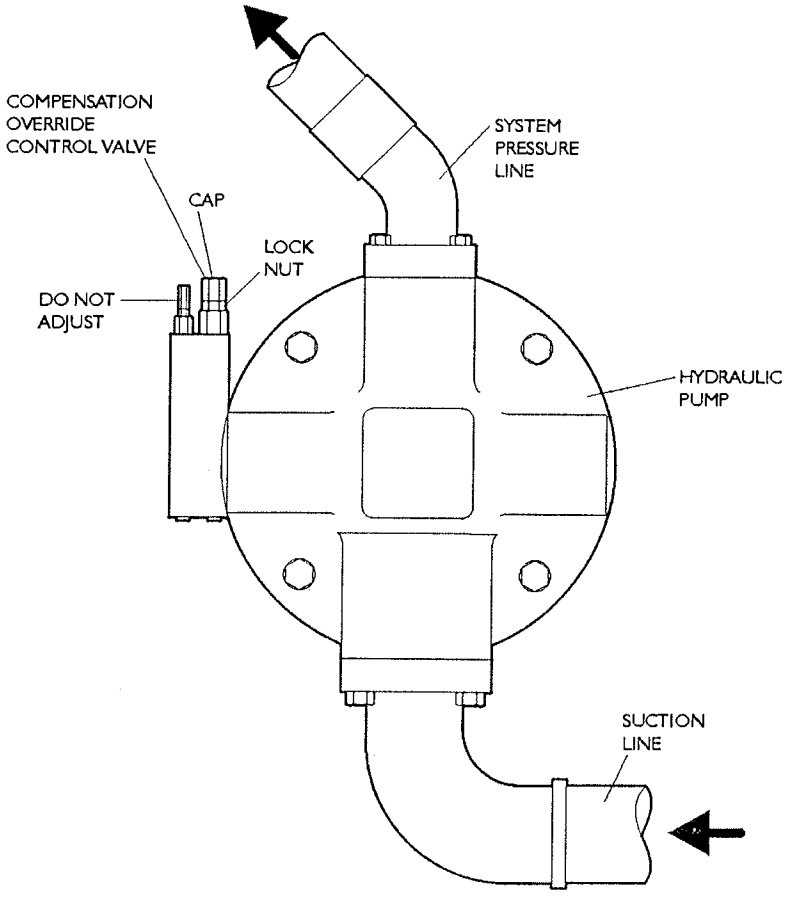
- Calibrated 0–5000 psi (0–345 bar) hydraulic pressure test gauge with fitting for -4 SAE o-ring style straight thread port (7/16-20 TPI thread).
- Straight thread run tee fitting with one -4 SAE o-ring style straight thread (7/16-20 TPI thread) end and two -4 SAE (JIC) 37° Flare Tube (7/16-20 TPI thread) ends (Parker 4R5OX or Parker 053T-4-4 or equivalent).

Adjusting the compensation override setting

The compensation override control valve(s) is set at the factory and should not need adjustment. However, if a new pump is installed, the valve(s) may need to be adjusted as described in the following two procedures.

Adjusting the compensation override on dual pumps

1. Open the front and right-hand access doors on the pump.
2. Locate the hydraulic pump and the two compensation override control valves.
3. Remove the hex cap from the left pump valve, loosen the lock nut and turn the set screw until you feel no resistance.



4. Tighten the set screw until you feel resistance, then turn in a half turn more.
   - Repeat Steps 3 and 4 on the right pump valve.
5. Close the high-pressure water system hand valve to deadhead the pump, OR remove the system high-pressure tubing and install a high-pressure plug in the pump bulkhead high-pressure fitting.
6. Remove the port plug from the front intensifier manifold 'PS' port and install the hydraulic pressure test gauge in the port.

   Note: Each pump must be adjusted separately. The pump being adjusted must be connected to the intensifier with the test gauge in the manifold 'PS' port. Verify that the left pump supplies oil to the front intensifier—if not, reverse the following instructions for left pump and right pump.
7. Start the pump and turn the front panel pressure control hand valve to maximum pressure (fully clockwise).
8. Slowly turn the left pump control valve set screw until the test gauge in the intensifier manifold reaches the correct maximum hydraulic system pressure of 3000 psi (207 bar).
9. Tighten the lock nut; replace and tighten the cap. Make sure the lock nut and cap o-rings are correctly located and undamaged.
10. Stop the pump.
11. Remove the test gauge from the front intensifier manifold and reinstall the original port plug.
12. Disconnect the hose from the rear intensifier manifold 'PS' port elbow and remove the elbow. Install the test tee fitting in the port and reconnect the hose to the tee. Connect the test gauge to the remaining leg of the tee.
13. Start the pump.
14. Repeat steps 8–10 on the right control valve set screw.
15. Remove the test gauge and tee and reinstall the original elbow and hose in the rear intensifier manifold 'PS' port.
16. Return the high-pressure system to operating condition by opening the high-pressure hand valve or removing the high-pressure plug at the bulkhead and reinstalling the high-pressure tubing.
17. Close the access doors. The pump is ready for operation.

Adjusting the compensation override on single and redundant pumps

1. Open the front and right access doors on the pump.
2. Locate the hydraulic pump and the compensation override control valve.
3. Remove the hex cap from the valve, loosen the lock nut and turn the set screw until no resistance is felt.
4. Turn the set screw until resistance is felt, then screw in a further half turn.
5. Close the high-pressure water system hand valve to deadhead the pump, OR remove the system high-pressure tubing and install a high-pressure plug in the pump bulkhead high-pressure fitting.
6. Disconnect the hose from the intensifier manifold 'PS' port elbow and remove the elbow. Install the test tee fitting in the port and reconnect the hose to the tee. Connect the test gauge to the remaining leg of the tee.
7. Start the pump.
8. Slowly turn the compensation override control valve set screw until the test gauge in the intensifier manifold reaches the correct maximum hydraulic system pressure of 3000 psi (207 bar).
9. Tighten the lock nut; replace and tighten the cap. Make sure the lock nut and cap o-rings are correctly located and undamaged.
10. Stop the pump.
11. Remove the test gauge and tee and reinstall the original elbow and hose in the rear intensifier manifold 'PS' port.
12. Return the high-pressure system to operating condition by opening the high-pressure hand valve or removing the high-pressure plug at the bulkhead and reinstalling the high-pressure tubing.
13. Close the access doors. The pump is ready for operation.

Replacing the hydraulic pump shaft seal

Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

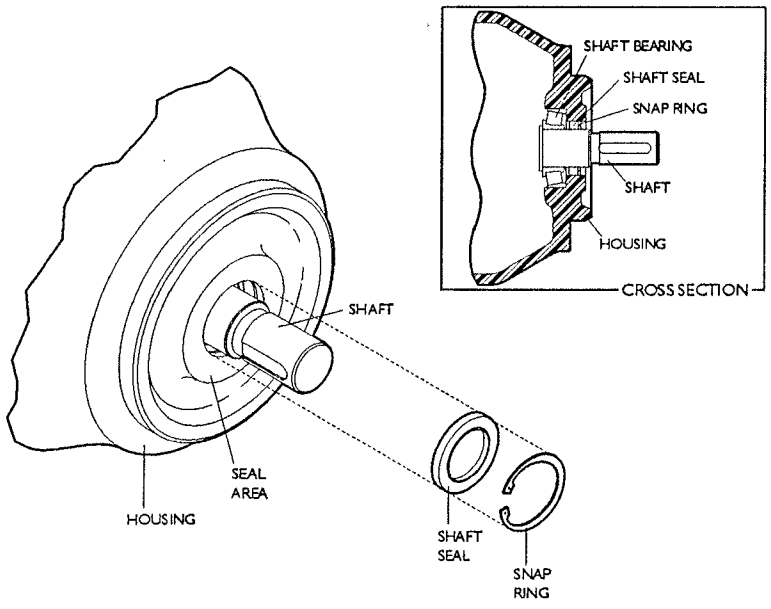
1. Shut down the system.
2. Remove the hydraulic pump from the frame. See *Replacing the hydraulic pump*, and follow Steps 1–17.
3. Support the pump in a vertical position with the shaft end up.
4. Clean the shaft, the seal area, and the case around the seal area.
5. Remove the snap ring that holds the seal in place. Measure and note the depth of the seal within the housing.
6. Use a sharp, flat cold chisel to punch through the steel backing face of the shaft seal and remove it. Do not scratch or damage the shaft surface—this will cause future oil leaks.
7. Clean the seal housing area and the exposed length of the shaft.
8. Inspect the shaft sealing area for wear. A deep groove will necessitate pump replacement or repair to prevent further leaks.
9. Lubricate the inner sealing lip on a new seal with clean hydraulic oil. Place it over the shaft and push down to the seal housing area.
10. Use a pipe of the correct diameter length with a burr-free square end to push the seal into the housing (you measured the correct depth in Step 5).

CAUTION
The seal must clear the snap ring groove so the snap ring can be reinstalled, but should not be any deeper. If the seal is pushed too far into the housing it will rub against the shaft bearing and become damaged.

11. Reinstall the snap ring.
12. Reinstall the hydraulic pump. See *Replacing the hydraulic pump*, and follow the procedure from Step 18.

    Note: When running the pump as described at the end of this procedure, pay particular attention to the shaft seal area when checking for leaks.

If all work is satisfactory, shut down the pump. Remove tools, parts, and rags from the equipment. Remove the *Out of Service* tag from the main electrical disconnect. The pump can be returned to operation.



Replacing the coupling insert

Replace the coupling if it:

- begins to deteriorate
- becomes too loose or noisy

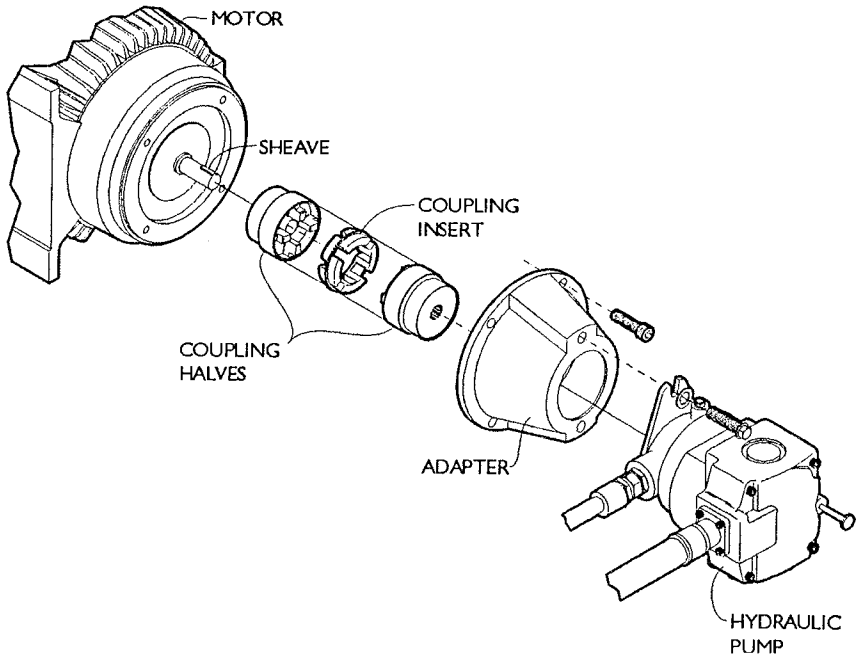
Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Remove the hydraulic pump from the frame.
3. Loosen the set screw in the pump side coupling half and slide the half towards the pump.
4. Support the hydraulic pump so it can be pulled away from the motor at least 3 in. (76 mm). Move the pump carefully—it can weigh more than 150 lb (68 kg). Use blocking or jacks to support the pump, or use a forklift.
5. Remove the four allen screws that mount the adapter to the electric motor. Slide the pump and adapter assembly away from the electric motor.
6. Remove the old coupling insert and inspect for damage. Remove both coupling halves and inspect the drive dogs for cracks.
7. Clean both coupling halves and reinstall on the shafts, using an anti-seize compound on the coupling bores, shafts, and keys.

   Push the coupling halves well back on the shafts so there is no end loading of the pump shaft while installing the pump on the adapter.
8. Install the new insert into one of the coupling halves.
9. Slide the pump and adapter up to the electric motor and install the four Allen screws. Torque to 125 ft-lb (169 N-m) using a figure-8 pattern.
10. Push the coupling halves together and position the coupling so it clears the motor and the pump.
11. Torque the coupling half set screws to 35 ft-lb (47 N-m).
12. Replace adapter cover.
13. Remove tools, parts, and rags from the pump. Replace the pump in the frame. Start the pump and operate for 5 minutes.

Remove the *Out of Service* tag from the main electrical disconnect. The pump is ready for operation.



Replacing the hydraulic pump

Replace the hydraulic pump if:

- system oil pressure is abnormally low
- pump operation is unstable
- pump is excessively noisy

Expect oil spillage with this service. When factory floor drains must be oil-free, install a barrier to block oil. Limit oil spillage by using drip pans, plugging each line and port, and allowing a generous drip time.

CAUTION

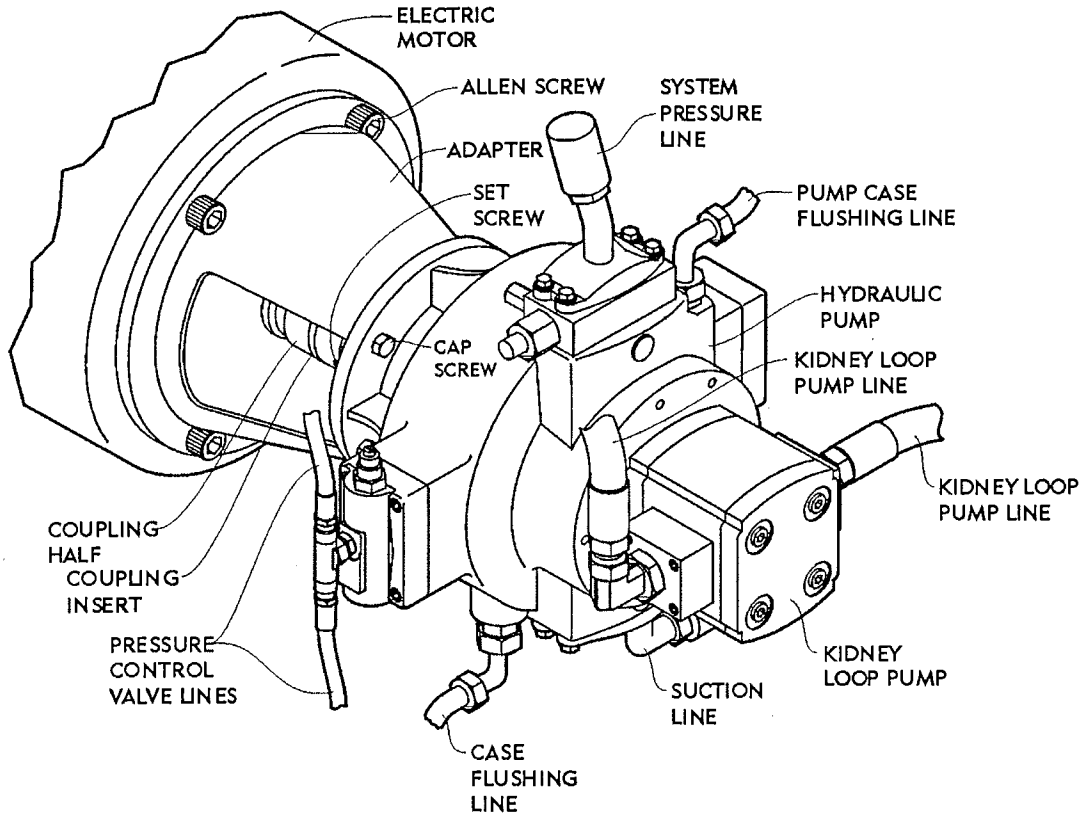
If replacing the hydraulic pump because a catastrophic hydraulic pump failure contaminated the hydraulic oil system, see *Cleaning a contaminated oil system.*

Service steps

WARNING

Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Remove the pump from the frame.
3. Place drip pans under the hydraulic pump.
4. Drain the reservoir.



5. Loosen the suction line at the lowest point to drain oil from the line and pump.
6. Remove the compensator line. Plug the line and secure it out of the way.
7. Remove the system pressure line. Plug and secure the line.
8. Remove the pump control drain or case drain line. Plug and secure the line.
9. Support the pump so it can be pulled away from the motor. Be careful when handling the pump—it can weigh more than 150 lb (68 kg). Use blocks or jacks to support the pump, or use a forklift.
10. Remove the four Allen screws that mount the adapter to the electric motor.
11. Carefully move the pump and adapter away from the frame and set it on end, pump side down.
12. Loosen the set screw and remove the coupling half. If you can't easily remove the coupling, use a gear puller. Retain the shaft key.
13. Remove the two flange screws that hold the adapter to the pump. Remove the adapter. Clean up any oil or grease that may have leaked into the adapter.
14. Attach the adapter to the new pump with the flange screws. Torque the flange screws to 125 ft-lb (169 N-m) using a crow's foot wrench.
15. Use an anti-seize compound on the coupling bores, shafts, and key, then reinstall both cleaned and inspected coupling halves on their shaft.

    Note: If installing a new pump, transfer all fittings, including the bypass manifold, to the new pump.

16. Install the coupling insert into one of the coupling halves.
17. Move the pump up to the motor. Make sure the coupling insert is in place.
18. Attach the adapter to the electric motor with the four allen screws. Torque to 125 ft-lb (169 N-m) using a figure-8 pattern.
19. Push the coupling halves together and position the coupling assembly on the shafts so that it clears the motor and the pump.
20. Torque the coupling half set screws to 35 ft-lb (47 N-m).
21. Connect the compensator, case drain, system pressure, bypass drain, and suction lines. Make sure the lines are not twisted and all fittings are correctly oriented to minimize stress on the lines. Lubricate the o-rings with Parker Super O Ring Lube or clean hydraulic oil.
22. Clear away all tools, parts, and rags.
23. Fill the hydraulic oil reservoir until oil is visible in the sight gauge. See Chapter 1 for a list of recommended oils.

CAUTION
You must add oil to the reservoir AND the hydraulic pump case before operating the pump or you will SEVERELY damage the system.

25. To purge air from the pump, jog the pump by successively clicking the START/STOP button, waiting for the 5 second booster pump delay in between clicks, and waiting a few moments after each jog. The pump should pick up pressure after 4–5 jogs. If it does not, make sure the reservoir contains oil.
26. Run the pump at Low Pressure for 3–5 minutes while checking for leaks. Increase the pressure to High Pressure; continue checking for leaks.
27. Operate the pump an additional 7–10 minutes.
28. Check the oil level in the sight gauge and add oil as needed.

If all work is satisfactory, shut down the pump. Remove tools, parts, and rags from the equipment. Remove the *Out of Service* tag from the main electrical disconnect. The pump can be returned to operation.

Cleaning a contaminated hydraulic system

When the hydraulic pump is being replaced because of a catastrophic failure (indicated by the presence of metal flakes throughout the hydraulic oil system), you must completely clean the hydraulic system. If you do not, the new pump, intensifier, shift valve, pilot valve, pressure control valve, and other components can fail.

Service steps

> **WARNING**
> **Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.**

1. Shut down the system.
2. Follow the procedures below for each pump component, then continue with Step 3.

Reservoir

- Drain the contaminated oil from the reservoir.
- Remove the cover from the reservoir and completely clean the interior.
- Remove and thoroughly clean the suction line strainers.

Hoses

- Remove ALL hydraulic oil hoses: case drain, suction, bypass drain, system pressure, compensator, pressure control valve manifold, and bleed-down valve system. Pour fresh oil through all loose lines (hoses) to clean and flush out the old oil.

Hydraulic pump

- Flush the hydraulic oil pump by pouring fresh oil in the top of the pump and hand rotating the coupling to move the fresh oil through the pump.

Heat exchangers

- Remove the heat exchangers and test them for leaks (see *Servicing the heat exchangers*). If the heat exchangers do not leak, flush them with fresh oil. If the heat exchangers are faulty, replace them.

  Note: Before installing a new heat exchanger, test it for leaks as described in *Servicing the heat exchangers*.

Oil filters

- Remove the oil filter and discard. Thoroughly clean the housing and install a new filter.

Intensifier

- Remove the intensifier from the frame.
- Remove the shift valve, pilot valve, and manifold. Completely clean and flush with fresh oil.
- Remove the pressure control valve, relief valve, and lines. Flush with fresh oil.
- Completely disassemble the intensifier. Inspect for seal failure and replace parts as needed. Completely clean the intensifier. Refer to your intensifier manual for instructions.

Service continues

3. Reassemble the hydraulic system.
4. Fill the hydraulic oil reservoir until oil is visible in the sight gauge. See Chapter 1 for a list of recommended oils.

> **CAUTION**
> **You must add oil to the reservoir AND the hydraulic pump case before operating the pump or you will SEVERELY damage the system.**

5. To purge air from the pump, jog the pump by successively clicking the START/STOP button. Wait for the 5 second booster pump delay to elapse in between clicks. Wait a few moments after each jog. The pump should pick up pressure after 4 or 5 jogs. If it does not, make sure there is oil in the reservoir.
6. Operate the pump at low pressure 3–5 minutes while checking for leaks. Increase the pressure to high pressure; continue checking for leaks.

   Note: After servicing the hydraulic system, the oil level may be low. Check the reservoir oil level and add oil as needed.

7. After operating the pump for 7 to 10 minutes and all work is satisfactory, shut down the pump.

Remove tools, parts, and rags from the equipment. Remove the *Out of Service* tag from the main electrical disconnect. The pump can be returned to operation.

After operating the pump with fresh oil for 10–20 hours, drain the reservoir and refill with fresh hydraulic oil. Replace the oil filter.

Checking the hydraulic oil

Check the hydraulic oil:

- after a specific number of operating hours
- at the end of a specific time period
- if the oil becomes contaminated
- when you replace the hydraulic pump.

Refer to MS-2258 for recommended service intervals.

Service steps

1. Open the drain valve on the bottom of the tank. Drain the oil into a clear beaker until you see pure oil, then close the drain valve. Place the beaker on a level surface and let the oil settle for at least 10 minutes.
2. Check the beaker. If the beaker only contains oil, you do not have a condensation problem. If you see hydraulic oil floating on a layer of water, the reservoir contains condensation from air drawn into it as the oil cools.
   - If there is more than 200 ml of water in the beaker, drain the water from the reservoir at least every 2 to 3 weeks to keep the monthly condensation level less than 200 ml. See *Changing the hydraulic oil.*
   - If the oil looks milky, there could be an excessive amount of water in the oil. Make sure the oil filler cap is in place. Check the heat exchanger for leaks. Fix any problems and change the oil before operating the pump.
   - If the oil has a burned color or smell, or if there is debris in the oil sample, additional service work is required. See *Servicing the hydraulic pump* for more information.

Changing the hydraulic oil

This is the accepted procedure for changing hydraulic oil. Your oil supplier can tell you how to properly dispose of used hydraulic oil.

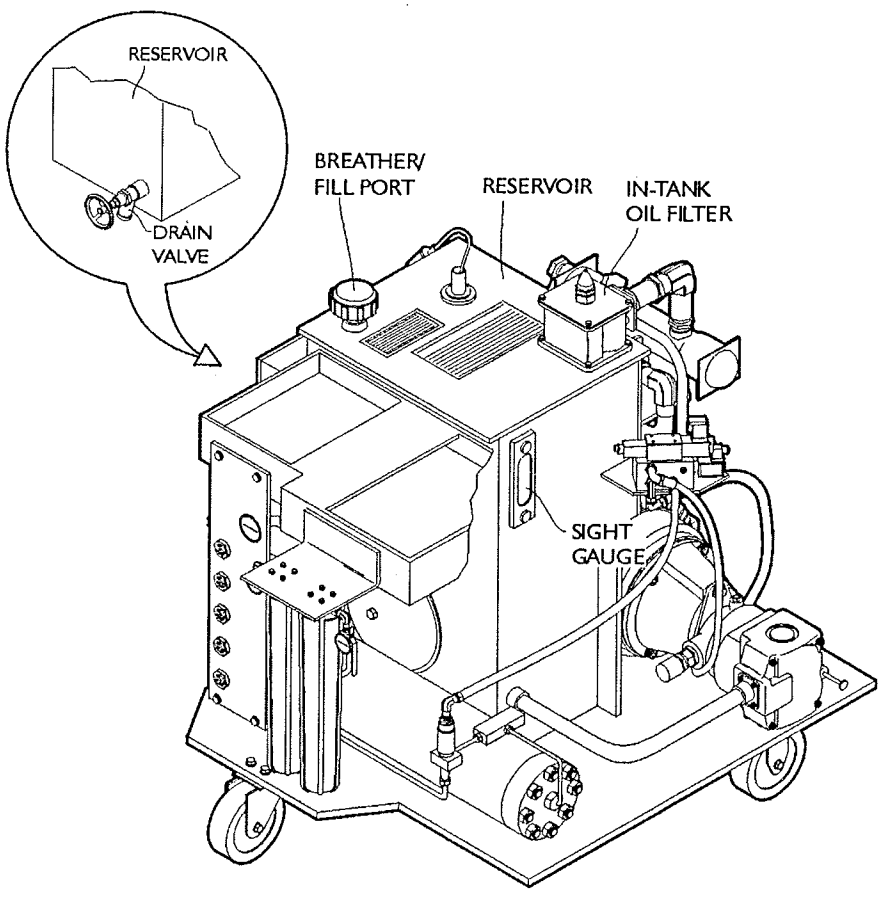
Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Use a hose to drain the oil from the reservoir drain valve into a container large enough to hold 30 gal (114 L).
3. Flush out the reservoir by pouring 1–2 gal (3.8–7.6 L) of fresh oil through the oil filter into the reservoir. Watch the oil as it drains from the reservoir and keep flushing until the oil drains clean.
   - If the oil was contaminated with metal particles because of a pump or hydraulic piston failure, see *Cleaning a contaminated oil system.*

CAUTION
You must thoroughly clean the reservoir after metal flakes have been pumped through it or the pump, intensifier, shift valve, pilot valve, shift cables, pressure control valves, and other components can fail. Your warranty does not cover this damage.

4. Change the hydraulic oil filter. See *Replacing the hydraulic oil filter.*



5. Close the drain valve and refill the reservoir with fresh hydraulic oil until the level is visible on the sight gauge. The reservoir can hold up to 27 gal (102 L). Use an oil that does not contain anti-wear additives; recommended oils are listed in Chapter 1.
6. Restart the system by jogging the pump 5–6 times. Do not operate the pump under full pressure until air is purged from the system.

   Jog the pump by successively clicking the START/STOP button. Wait for the 5 second booster pump delay in between clicks, and wait a few moments after each jog.

   Jog the pump until all air has been purged from the system. The pump should pick up pressure after 4–5 jogs. If it does not, make sure the reservoir shutoff is open and there is oil in the reservoir.

   CAUTION
   Operating the pump under full pressure before all air is purged from the system can damage the pump.

7. Start the pump, operate it for 3–5 minutes at High Pressure, and check for leaks. Check the reservoir oil level; add oil as needed.

When all work is satisfactory, remove tools, parts, and rags from the pump and close the doors. Remove the *Out of Service* tag from the main electrical disconnect.

Replacing the hydraulic oil filter

Replace the hydraulic oil filter:

- if the restriction indicator has actuated
- after a specific number of operating hours
- after a specific length of time
- when you change the hydraulic oil

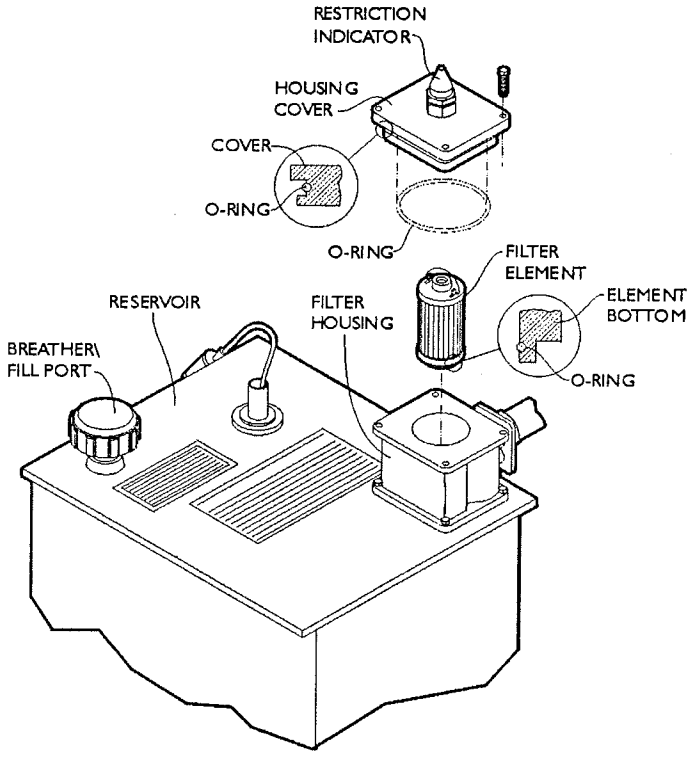
Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Locate the oil filter housing on top of the reservoir.
3. Remove the cover; you might need to carefully work the cover loose using a slotted screwdriver.

   Note: Do not pry up and down on the cover. Do not let the screwdriver touch anything but the outer edges—it can damage both housing and cover.
4. Remove the filter element and place in a drip pan. Inspect the element for visible dirt or particles—this can give early warning of component failure.
5. Clean out the filter housing and insert a new element.
6. Lubricate the cover o-ring with Parker Super O Ring Lube or fresh hydraulic oil.
7. Reinstall the cover on the housing. Torque the screws to 15–20 ft-lb (20–27 N-m).
8. Operate the pump for 3–5 minutes at the maximum rated pressure. Check for leaks.

When all work is satisfactory, remove tools, parts, and rags from the pump and close the cover. Remove the *Out of Service* tag from the main electrical disconnect.



Servicing the heat exchangers

This service procedure is a test to see if the heat exchangers are leaking water into the oil system.

Dual oil-to-water heat exchangers control heat build-up in the hydraulic oil. The heat exchangers require no routine maintenance.

If the hydraulic oil looks milky but doesn't contain air bubbles, the oil is contaminated with water. This can be caused by contaminated oil in the reservoir, excessive condensation in the reservoir, a missing reservoir filler cap, or a leaky heat exchanger.

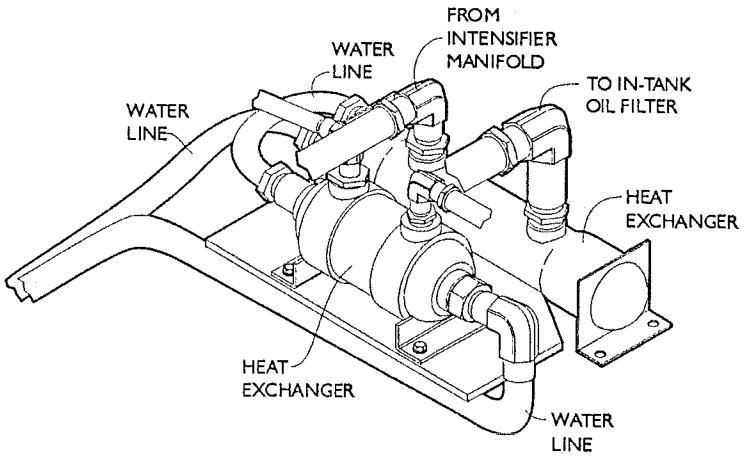
Note: A continual rise in oil level is a sign of catastrophic heat exchanger failure.

Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Drain the contaminated oil from the reservoir. If you see a large amount of water in the oil, the hydraulic oil system must be completely drained to remove all water, including intensifier, hydraulic pump, filter, and hoses.

   See *Checking the hydraulic oil* and *Cleaning a contaminated hydraulic system*.



3. Disconnect the water hoses from the heat exchanger.
4. Disconnect and plug the hydraulic oil lines. Hold the heat exchanger level, and use a drip pan and rags to catch dripping oil.
5. Remove the bolts that hold the heat exchanger to the support; move the heat exchanger to a workbench.
6. Plug one of the water ports and insert an air line fitting into the other.
7. Top off the oil level in the heat exchanger.
8. Connect an air line to the fitting. The air line must be regulated to a maximum of 150 psig (10.3 bar) air pressure, and have an on/off valve within easy reach.
9. Watch the oil ports for air bubbles while slowly opening the air valve and pressurizing the heat exchanger. If the heat exchanger is leaking, you'll see bubbles within a few seconds.
   - If the heat exchanger is defective, repair or replace it.
   - If the heat exchanger is OK, remove the fittings and reinstall the heat exchanger.
   - Repeat Steps 3–9 for the second heat exchanger.
   - If both heat exchangers are OK, water in the oil was probably caused by putting contaminated oil into the reservoir, excessive condensation in the reservoir, or a missing reservoir filler cap.

   See *Checking the hydraulic oil*.
10. Fill the hydraulic oil reservoir until oil is visible in the sight gauge (see list of oils in Chapter 1).

CAUTION
You must add oil to the reservoir AND hydraulic pump case before operating the pump or you will SEVERELY damage the system.

Servicing the bleed-down valve

This service procedure is for bleed-down valve C-5841-1. You will need these kits:

004694-1 Bleed-down valve repair kit
B-5716-1 High-pressure valve assembly tool kit

Troubleshooting

Problem	Cause
Unable to build water pressure* High stroke rate Hard shifting Water leaking from weep holes	High-pressure valve failure
Oil leaking from weep holes	Actuator failure
Unable to build water pressure*	Solenoid valve failure

* Lack of water pressure is more likely caused by high-pressure valve failure than by solenoid valve failure.

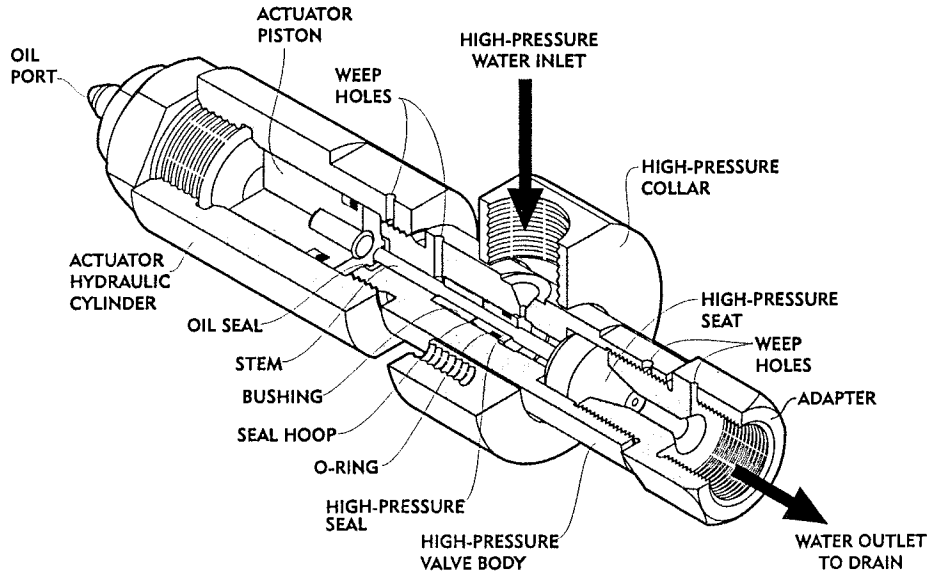
WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

Service steps

1. Shut down the system.
2. Remove the hydraulic hose from the oil port of the bleed-down valve.
3. Remove the gland nut that connects the water drain tubing to the bleed-down valve.
4. Remove the gland nut from the collar at the high-pressure water inlet port.
5. Place the valve on a clean workbench.
6. Separate the actuator body from the bleed-down valve. Refer to manual M-127, Small High-Pressure Components (on/off valve C-2740-X).
7. Remove the high-pressure collar from the high-pressure valve assembly.
8. Remove the adapter from the high-pressure body.
9. Remove and discard the high-pressure seat from the high-pressure body.
10. Remove and discard the high pressure seal assembly (stem, seal, seal hoop, o-ring, and bushing) by inserting the extraction end of the tool through the oil seal and pushing on the high-pressure stem.

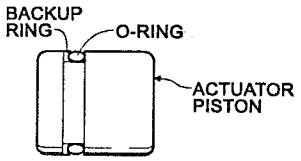
    Note: Do NOT remove the oil seal from the high-pressure valve body unless it is damaged or worn. If removed, note the orientation of the seal.

11. Use a ¼-in. dowel (or similar) to push the piston insert and piston out of the actuator body through the oil port.

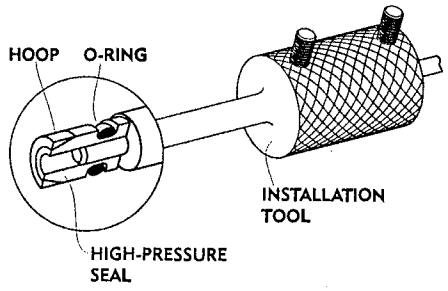


12. Remove and discard the o-ring and backup ring from the piston.
13. Clean the remaining parts with an ultrasonic cleaner. Check the parts for nicks and burrs. Replace as necessary.
14. Lubricate a new o-ring, backup ring, and the inner surface of the actuator body with Parker Super O Ring Lube (200006) or equivalent.
15. Install the new o-ring and backup ring on the piston. Install the piston insert and the piston assembly into the actuator body until seated.

    Note: Avoid damaging the o-ring on the threads and inside corners of the actuator body.

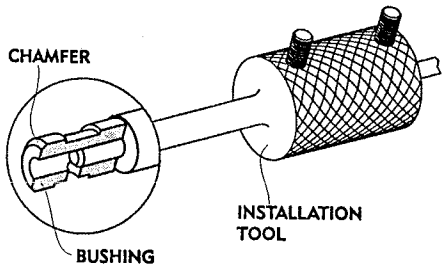


16. If necessary, insert a new oil seal into the actuator end of the high-pressure valve body, cup side out.
17. Lubricate the stem, seal, hoop, o-ring, and bushing with White Food Grade O-ring Lube.
18. Install the o-ring and seal hoop onto the high-pressure seal, as shown.



19. Install the new bushing onto the installation tool as shown (chamfered side out). Then insert the bushing into the high-pressure body using the installation tool.
20. Place the high-pressure seal assembly onto the installation tool, then insert the high-pressure seal assembly into the high-pressure body.

    Note: Make sure the seal assembly is installed past the high-pressure port hole.
21. Lubricate the high-pressure stem with White Food Grade O-Ring Lube.



22. Install the high-pressure stem tip into the seal assembly, then use a plastic or wood dowel to push the stem through the seal assembly until its tip just passes through the oil seal at the actuator end of the high-pressure valve body.
23. Install the high-pressure seat into the high-pressure body, applying Blue Lubricant to mating surfaces.
24. Install the adapter, applying Blue Lubricant to the threads. Torque to 35 ft-lb (48 N-m).
25. Install the high-pressure collar.
25. Connect the high-pressure valve assembly to the actuator body.
26. Reinstall the bleed-down valve by attaching the gland nut to the high-pressure collar at the high- pressure port of the valve. Torque the gland to 35 ft-lb (47 N-m).
27. Install the gland nut connecting the water drain tubing to the bleed-down valve.
28. Reattach the hydraulic hose to the oil port of the bleed-down valve.

Return the intensifier pump to operation. Correct any water or oil leaks.

Servicing the booster pump

Replacing the booster pump

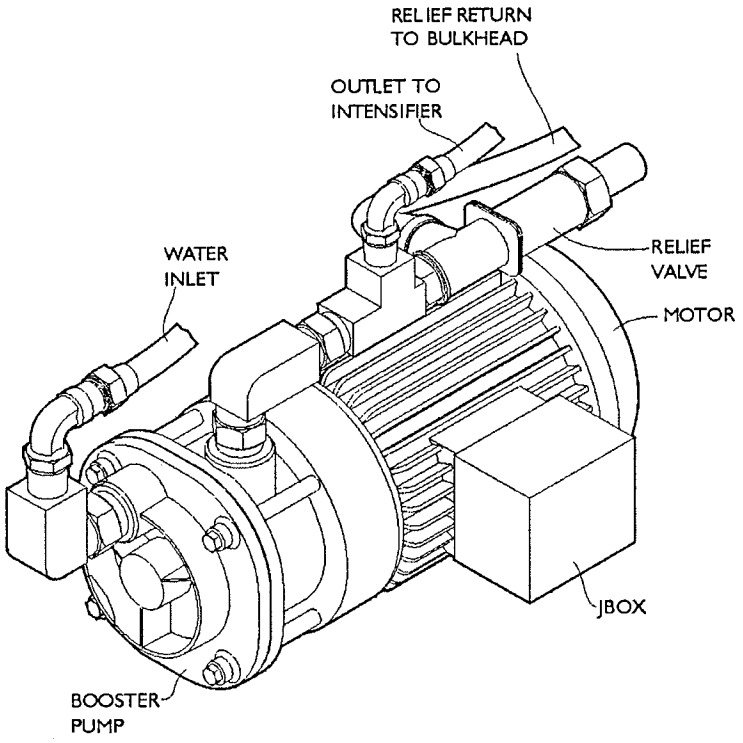
Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Disconnect the water hoses from the booster pump.
3. Remove the hard plumbing fittings from the booster pump and transfer to the new pump.
4. Mark and remove the wiring from the booster pump motor junction box.
5. Unfasten the booster pump/motor assembly from the baseplate and install the new assembly.
6. Reconnect the wiring and water hoses.

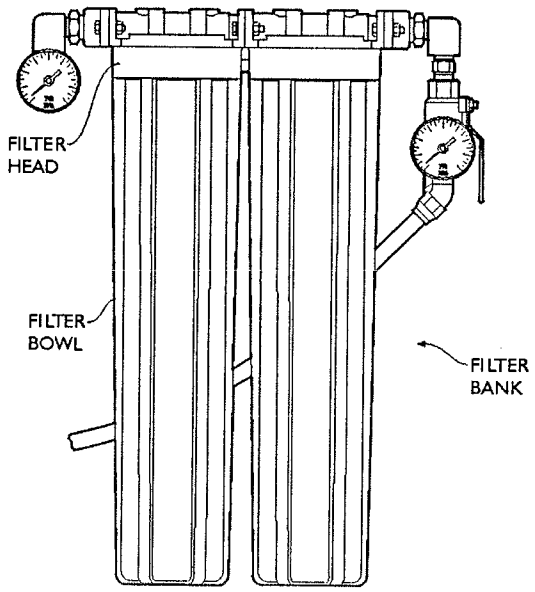
Remove tools, parts, and rags from around the pump. Remove the *Out of Service* tag from the main electrical disconnect. Run the pump for 5 minutes and check for correct operation.

The pump is ready for operation.



Replacing the filter elements

Replace the filter elements if the pressure difference between the inlet and outlet exceeds 20 psig (1.4 bar) or after six months of operation, whichever occurs first.



Service steps

1. Close the inlet valve for the filter bank.
2. Unscrew the filter bowls slightly to relieve pressure.

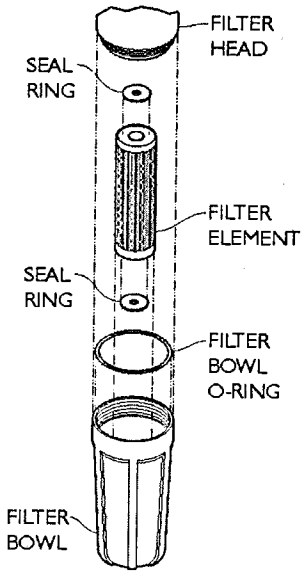
Notes

- If you can't remove bowls by hand, use a strap or band wrench at the top of the bowl *only*. Avoid excessive pressure to the side of the bowl.
- A small amount of water will spill when the filter bowls are removed. A shallow drip pan under the filter will minimize clean-up.

3. Remove the filter bowl and elements together. Remove and discard the filter elements. Inspect the contents of the bowls. A change in water quality, pump housing, or impeller deterioration, or a missing or damaged upstream filter, can sometimes be detected early by inspecting the filter bowls and elements.
4. Clean the bowls and fill with fresh water.

   Install the new elements in the bowls, and then install on the filter heads. Seal rings, provided with the elements, seal the elements to the heads. Lubricate the rings with food-grade grease. Make sure the filter elements are installed on the correct filter heads; look for the markings to make sure.
5. Make sure the seal ring is in place, then tighten each bowl hand tight on the filter bank head.
6. Open the inlet valve. Check for leaks.
7. Run the intensifier pump for 5 minutes at low pressure with the cutting nozzle open to purge any air from the system. Failure to do so could damage the high-pressure seals.

The filters are ready for use.



Servicing the intensifier low-pressure system

As the piston in the intensifier hydraulic oil cylinder nears the end of the stroke, it pushes an actuating pin, which electrically shifts the pilot valve spool. This reverses the oil flow, then the cycle repeats itself. The electric shift parts require no routine maintenance.

Problems associated with faulty electric shift parts are usually limited to a non-cycling intensifier. Uneven stroking can be caused by problems with the shift valve, pilot valve, shift sensors, or check valves.

These problems are addressed in these procedures:

- Shift valve and manifold
- Shift sensor assembly
- Pilot valve
- Main system relief valve

Intensifier overspeed is usually associated with the filtered water supply or the high-pressure water system. For more information on the intensifier system, refer to your intensifier manual.

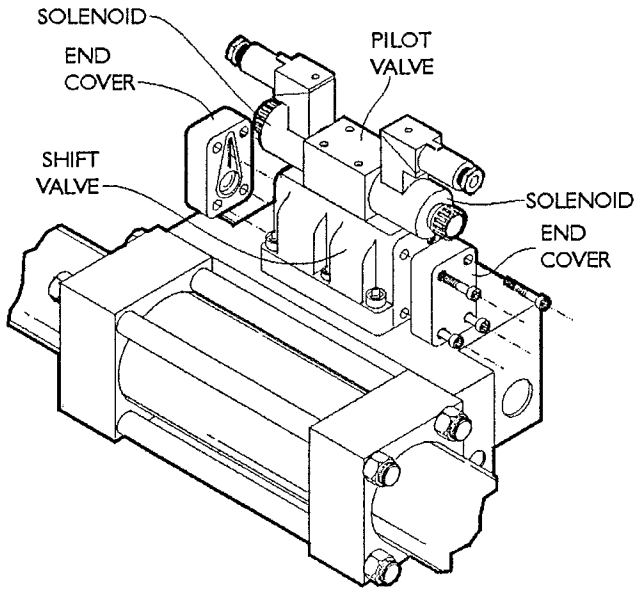
Shift valve and manifold

Oil flowing in and out of the intensifier hydraulic cylinder flows through the shift valve. The valve spool directs pressurized oil into one end of the cylinder, and drains oil from the opposite end. This causes the intensifier to stroke. The spool movement is controlled hydraulically by a pilot valve mounted directly on the shift valve. The shift valve and manifold require no routine maintenance.

> **WARNING**
> **The shift valve is specially modified for this application. Using a substitute shift valve can create a potential safety hazard, can lower the performance of your pump, and will void your warranty.**

Some troubleshooting tips:

- Uneven, slow, or noncycling intensifier—usually related to a faulty shift valve, electric shift components, or intensifier check valves.
- Overspeeding—usually associated with leaks in the filtered water supply or high-pressure water system, or a damaged or oversized nozzle.
- Leaking o-rings—usually caused by misaligned end bells (i.e., one end bell is rotated in relation to the other).



Service steps

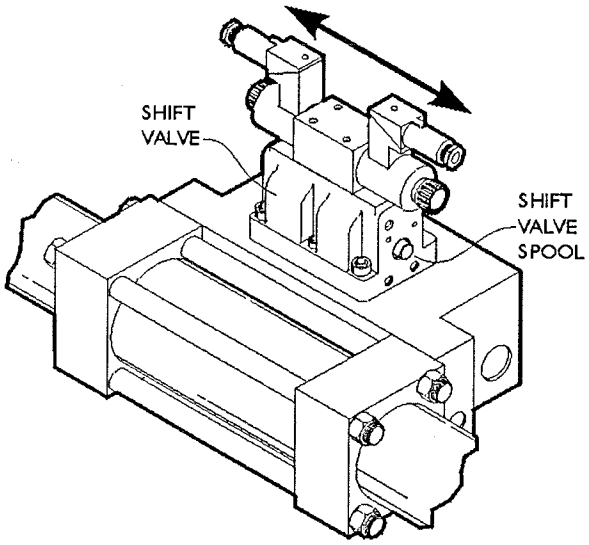
WARNING

Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

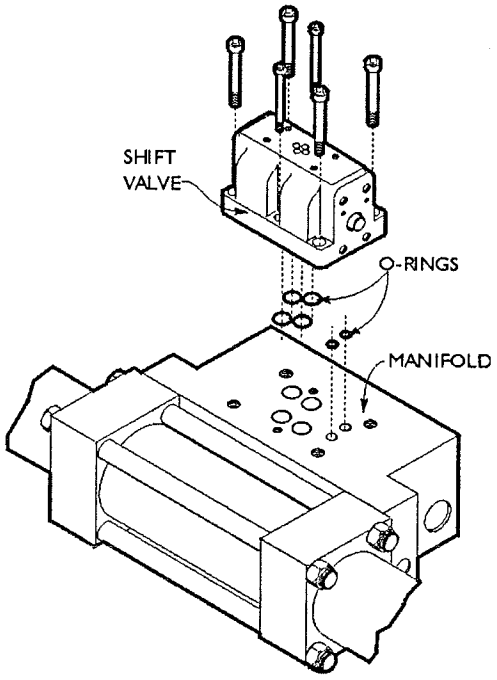
When the pump is operating, the shift valve can contain 3000 psi (207 bar) oil pressure. NEVER start or operate the pump when any of the shift valve parts are loose or removed.

1. Shut down the system.
2. Remove the four cap screws that hold each end cover to the shift valve; remove the end covers.
3. Use your fingers to make sure the shift valve spool moves freely. The spool must move with light pressure through the full stroke.

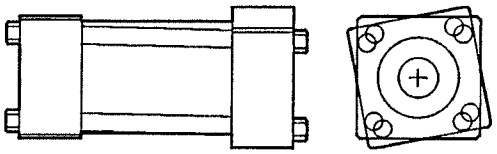
   If the spool is jammed, replace the valve. Skip to Step 5.



4. Remove the spool and make sure the spool grooves are clean and polished surfaces are undamaged. Check the inside of the shift valve body for any damage or foreign objects.
   - If the shift valve and manifold are OK, insert the spool into the shift valve and replace the end caps, torquing the cap screws to 10 ft-lb (14 N-m). You need not follow this procedure any further.
   - If the shift valve or port o-rings must be replaced, continue with Step 5.
5. Remove the pilot valve and set it aside.
6. Loosen the fasteners on the shift valve in ⅛-turn increments until all torque is removed. Remove the shift valve and discard if faulty.
7. Check the manifold and o-rings.
   - If they need service, continue with Step 8.
   - If they don't need service, skip to Step 20.
8. Disconnect the water supply lines at the quick-disconnect fittings.
9. Disconnect and remove the high-pressure water lines.
10. Disconnect and remove the shift sensors, actuators, and actuating pins.



11. In ⅛-turn increments, loosen the cap screws that mount the intensifier to the manifold
12. If the manifold o-rings are damaged, use a precision straight edge to make sure the end bells are aligned with each other. If they are not, mount the intensifier on the intensifier fixture and loosen the tie rod nuts.

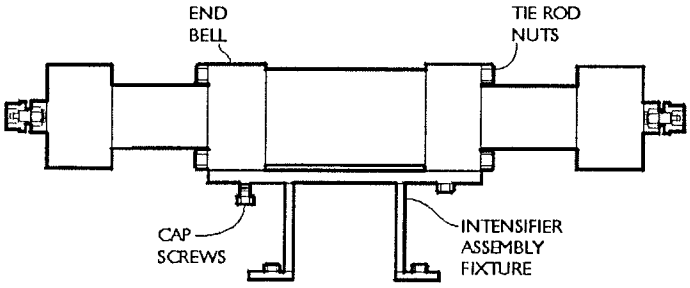


Torque the four cap screws that hold the end bells to the assembly fixture to 35 ft-lb (48 N-m), then back off ⅛–¼ turn until more than finger tight.

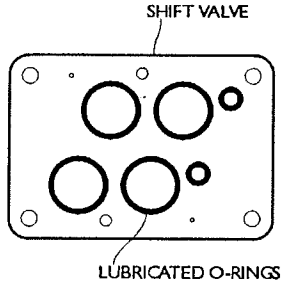
The bolts must hold the end bells tight against the fixture to prevent any misalignment but not so tight that they interfere with tightening the tie rod nuts.

13. Torque tie rod nuts to 120 ft-lb (163 N-m), in 20 ft-lb (27 N-m) increments, using a figure-8 pattern. Remove the intensifier from the assembly fixture and return it to the pump.

Note: These torque specifications are for wet (lubricated) tie rod nuts.



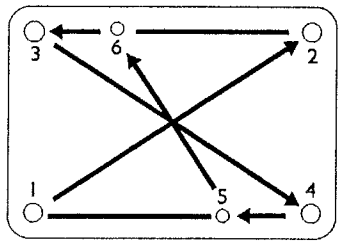
14. Clean and inspect all parts to be reused.
15. Lubricate the new o-rings with Parker Super O Ring Lube (200006) and place in the end bell ports.
16. Install the intensifier.
17. Align the manifold ports with the intensifier ports and thread in the fasteners.
18. Torque all cap screws to 30 ft-lb (41 N-m) in ⅛–¼ turn increments using a figure-8 pattern.
19. Lubricate the o-rings with Parker Super O Ring Lube and place them in the ports of the shift valve being installed.



20. Place the shift valve on the manifold and thread in the fasteners. Torque the fasteners in ⅛-turn increments in this two-step process:
    a. Torque all cap screws (1 to 6) to 10 ft-lb (14 N-m).
    b. Torque the outer cap screws (1 to 4) to 25 ft-lb (34 N-m).

CAUTION

You must follow the torquing sequence when installing the shift valve. If you don't, the body can warp badly enough to keep the spool from moving. This damage is usually not reversible.



TORQUING SEQUENCE

21. Use your fingers to make sure the spool moves freely.
22. Lubricate the end cover o-rings with Parker Super O Ring Lube and mount the end covers to the shift valve housing. Torque the cap screws to 10 ft-lb (14 N-m).
23. Install the pilot valve (see *Pilot valve).*
24. Attach the water supply lines at the quick disconnect fittings. Attach the high-pressure tubing at both ends, then torque the gland nuts.
25. Reinstall actuating pins, actuators, and shift sensors. Reconnect the sensors, making sure to align plug and receptacle before engaging to avoid shorting or incorrect contact between pins and sockets.
26. Check the intensifier for incomplete work, tools, parts and rags.
27. Jog the hydraulic pump by successively clicking the START/STOP button. Wait for the 5 second booster pump delay to elapse. Wait a few moments after each jog. Jog until all air has been purged from the hydraulic system.
28. Use the low pressure setting, then go to the rated output while checking for leaks.
29. Stop the pump and inspect for any leakage; correct as required.

Shift sensor assembly

The shift sensor assembly consists of an actuating pin, actuating plunger, spring, and sensor housing.

As the low-pressure piston ends its stroke, it pushes on the actuating pin. The pin pushes on the actuating plunger and spring, which brings the magnet end into the cupped end of the sensor housing. The magnetic field causes the sensor to send a signal to the PC. The PC then energizes the appropriate pilot valve solenoid, initiating the stroking of the intensifier in the opposite direction.

CAUTION

Take care when connecting or disconnecting the shift sensor cable at the plug and receptacle if the electrical enclosure is still connected to its supply. Pushing the E-stop does not de-energize the shift sensors.

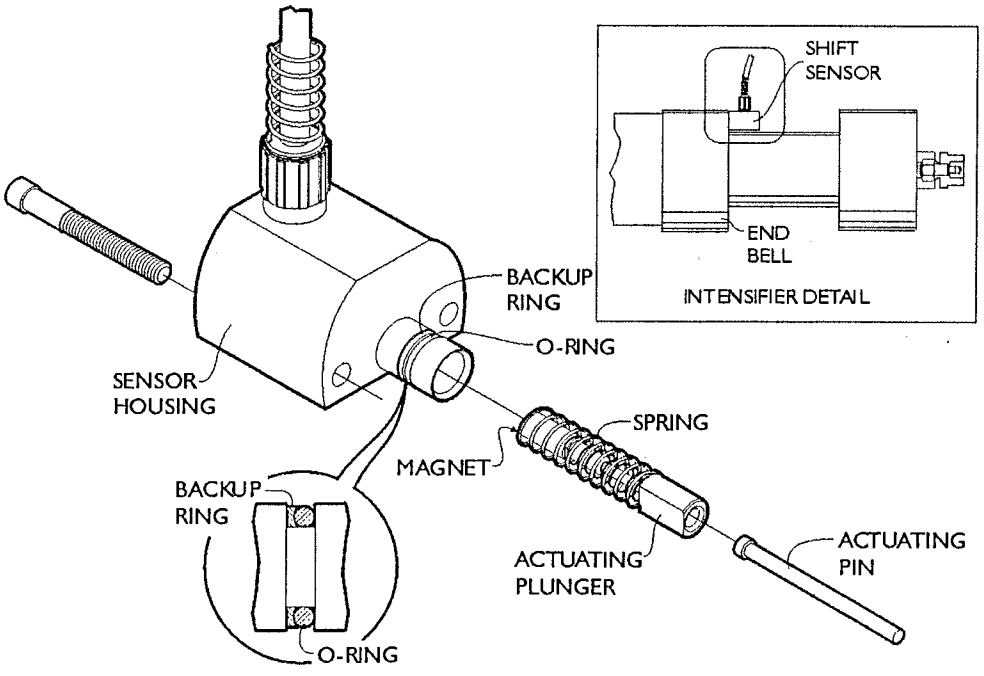
Do not short circuit or misconnect the pins and sockets of the plug and receptacle. The shift sensors will be permanently damaged.

Make sure the plug and receptacle are correctly aligned with each other before connecting. The plug and receptacle are keyed to make this easier.

Note: Troubleshooting will be easier if you learn which LED indicators correspond to which shift sensor inputs and solenoid outputs on the input and output modules of the PC. These modules are located in the electrical enclosure.

WARNING

High voltages are present in the electrical enclosure at all times when the main electrical disconnect is in the ON position.



LED inputs/outputs

The electrical schematic drawing in Chapter 5 contains sensor inputs and solenoid outputs. Typically the LEDs are allocated as follows:

	Intensifier	
	Left hand	**Right hand**
Shift sensors Opto-22 board #1	Opto, wire 3260	Opto, wire 3270
Shift solenoids Opto-22 board #2	Opto, wire 4260	Opto, wire 4270

Note: Check drawing and actual installation, as wiring codes may be updated.

When the sensor is in standby (not triggered by the presence of the actuating plunger), the associated input module LED will be lit. As the low- pressure piston ends its stroke, pushes on the actuating pin, and causes the actuating plunger magnet to enter the shift sensor, this LED will go out.

When the PLC is energizing a solenoid, the associated output module LED and the connector plug on the pilot valve solenoid will both be lit.

Single shift example

This is the correct sequence:

- When the left pilot valve solenoid is energized, the low-pressure piston is moving to the right. The left solenoid LED and connector are lit. Both shift sensor LEDs are lit.
- The piston approaches the right side of the intensifier and actuates the right shift sensor. The right shift sensor LED goes out.
- In response, the PLC de-energizes the left pilot valve solenoid and energizes the right pilot valve solenoid. The left solenoid LED and connector go out and the right solenoid LED and connector light up.
- The low-pressure piston moves to the left, away from the right shift sensor. The right shift sensor LED lights up.
- The left shift sensor LED has remained lit throughout the shift.

Service steps

If the shift sensor LED does not light up, the fault is usually in the sensor assembly components or in the wiring to the PC.

WARNING

Do not start the 50i-S intensifier pump unless all shift sensors are correctly installed. Starting the intensifier pump in this condition can result in injury to personnel or equipment damage.

When the pump is operating, oil pressure in the shift sensor end bell bore can be as high as 3000 psi (207 bar). If the shift sensor assembly is not correctly installed, it can be projected violently from the end bell and could cause injury.

1. Shut down the system and push the E-stop in. Do not disconnect the electrical supply. Place an *Out of Service* tag on the pump electrical console.
2. Remove the two shift sensor housing fasteners; remove the housing from the end bell.
3. Remove the spring and actuating plunger. Inspect these parts for a chipped magnet, loose retaining screw, or broken spring.
   - The plunger should be 2.23 in. (56.6 mm) long. Replace if necessary.
   - The spring should have a free length of approximately 1.5 in. (38 mm). Replace if necessary.
4. Remove the actuating pin. You will need the shift pin tool (002228-1) and a 6-in. (150 mm) piece of 16 AWG insulated electrical wire with one end stripped for 0.24 in. (6 mm) and frayed out. Lubricate the o-ring of the shift pin tool and insert the tool into the intensifier shift sensor housing bore, o-ring end first. Pulling out the tool creates suction, which extracts the pin into the bore. Remove it using the frayed end of the wire.
5. Inspect the actuating pin. It should be approximately 1.15 in. (29 mm) long, have a shaft diameter of approximately 0.09 in. (2.3 mm), and have no measurable bend. Replace if necessary.

6. Inspect the actuating pin bore in the end bell. It must be polished and have no gouges, burrs, or other surface disruptions. It must not be elongated in section.
7. Check the shift sensor housing and wiring:
   a. Make sure the sensor is plugged into the wiring receptacle.
   b. Identify the associated LED light on the input module.
   c. Insert the magnet end of the actuating plunger into the cupped end of the sensor.
   d. If the LED does not operate as described previously, the wiring can be checked separately by using a sensor that is new or known to be functioning.
8. Inspect the sensor housing o-ring and backup ring for wear and damage. Replace as necessary. Install the o-ring on the outer, end bell end of the housing and the backup ring behind it with the cupped face toward the o-ring.
9. Reinsert the actuating pin into the end bell.
   - Place the pin in the groove of the shift pin tool with the pin head toward the o-ring.
   - Insert the tool into the shift sensor bore with the o-ring end facing out. When the tool is fully engaged, use the wire to apply pressure against the pin. Rotate the tool in the bore until the pin lines up with the actuating pin bore. The pressure will force the actuating pin into the bore. When the pin is correctly installed, hold it in position with the wire and remove the tool.
10. Reinsert the actuating plunger into the bore with the magnet end facing out.
11. Reinstall the spring.
12. Lubricate the o-ring and backup ring with Parker Super O-ring Lube (200006) and insert the shift sensor housing into the end bell. Reinstall the two housing fasteners.

CAUTION

Be careful when connecting or disconnecting the shift sensor cable at the plug and receptacle if the electrical enclosure is still connected to its supply. Pushing the E-stop does not de-energize the shift sensors.

Do not short circuit or misconnect the pins and sockets of the plug and receptacle. The shift sensor will be permanently damaged.

13. If necessary, reconnect the shift sensor cable. Make sure the plug and receptacle are correctly aligned with each other before connecting. The plug and receptacle are keyed to make this easier.

Make sure all shift sensors are in place. Remove the *Out of Service* tag. The intensifier pump is ready for operation.

Pilot valve

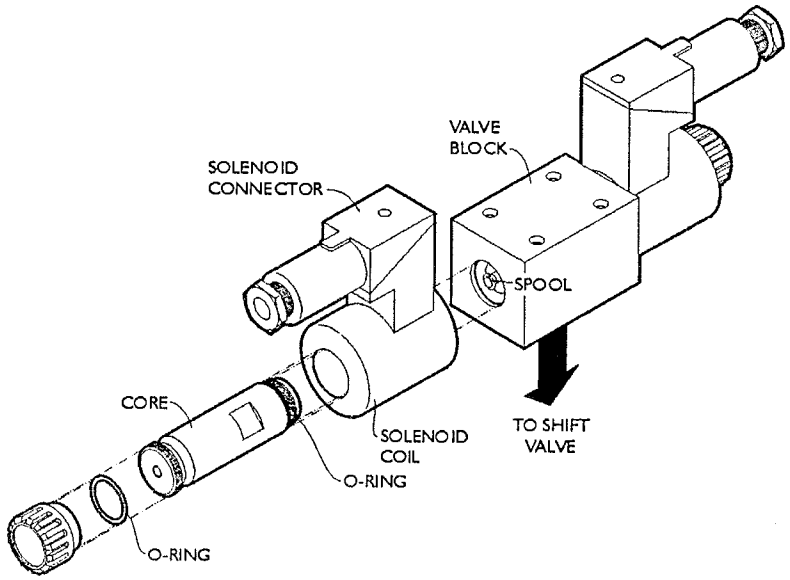
The pilot valve spool is electrically operated by two solenoids, which are energized by the PC. Oil from the pilot valve is then used to cycle the shift valve spool, which in turn causes the intensifier to cycle. Each solenoid connector lights up when that solenoid is energized.

Service steps

WARNING
Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

1. Shut down the system.
2. Remove the solenoid connectors by unscrewing their top screws and unplugging the connector bodies from the solenoids. The solenoid coil continuity can be checked using an ohmmeter across the two channel-shaped pins. Electrical resistance should be approximately 19 ohms. The third, flat pin is the ground connection.
3. Remove each solenoid by unscrewing the large black knob, removing the o-ring, and sliding the solenoid coil off its core.
4. Unscrew each core with a wrench on the two flats close to the valve body. Inspect the o-ring for damage.
5. With a finger on each end of the pilot valve spool, slide the spool in its bore from side to side. The spool must move smoothly through its full stroke. If the spool is jammed, the pilot valve must be replaced.
6. To remove the pilot valve body, unscrew the four fasteners in a figure-8 pattern in ⅛ to ¼–turn increments until all torque has been removed. Lift the pilot valve from the main shift valve. Inspect the interface sealing rings and replace as necessary.
7. Lubricate new sealing rings with Parker Super O-ring Lube (200006) and place in the ports of the pilot valve.
8. Place the pilot valve onto the shift valve and screw in the fasteners. Torque in a figure-8 pattern in ⅛–¼ turn increments to 10 ft-lb (14 N-m). Make sure the spool moves smoothly.
9. Screw the solenoid cores into the pilot valve body, being careful not to nick the o-rings. Tighten with a wrench.
10. Install the solenoids onto their cores, making sure the locating pin on the solenoid end face engages the hole in the valve body, and the solenoid connector location is correctly oriented. Place the o-rings on the cores and screw on the retaining knobs hand tight.
11. Reconnect the solenoid connectors and tighten the screws.

Remove the *Out of Service* tag. The intensifier pump is ready for operation.



Main system relief valve

The main system relief valve is mounted in the intensifier manifold. The valve is a mechanical way to safely limit the maximum hydraulic oil pressure in the unlikely event of multiple component failure. Since it opens at a value higher than the maximum rated value, it remains closed during routine operation.

The valve needs no routine maintenance and is replaced only if it bypasses oil at or below the pressure control valve setting. See the table below.

Service steps

WARNING

Place the main electrical disconnect in the OFF position and bleed down all high-pressure lines. Place an *Out of Service* tag on the main electrical disconnect and lock it out. Failure to do so can result in equipment damage or injury to personnel.

The main system relief valve is a safety device that mechanically limits the maximum oil pressure in the hydraulic oil system in the unlikely event of multiple relief valve failures.

DO NOT operate the intensifier pump with the valve removed and plugged—this could result in serious injury to the operator as well as equipment damage if concurrent relief valve failure occurs.

1. Shut down the system.
2. Locate the main system relief valve on the intensifier manifold.
3. Remove the relief valve.
4. Check the manifold port; clean as required. Any degradation in the port can cause bypassing, which can decrease the maximum oil pressure and overheat the oil.

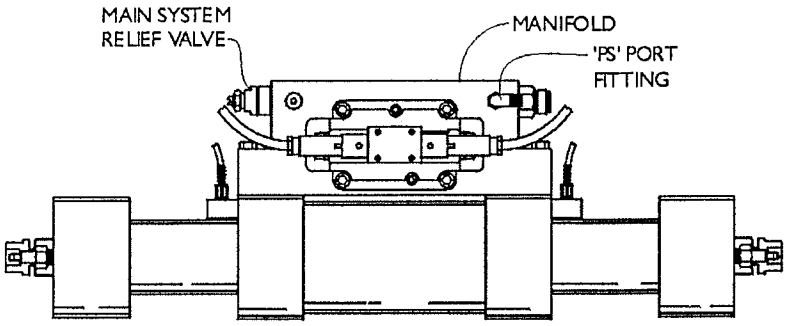
   Note: Bypassing can be identified by listening for a squealing or hissing sound from the valve using either a mechanic's stethoscope, or by holding the end of a screwdriver against the valve body to transmit the sound to the ear. Bypassing will also heat the valve body to a higher temperature than the manifold.

5. Install the new relief valve.

Remove tools, parts and rags from the pump. Remove the *Out of Service* tag from the main electrical disconnect. The pump can be returned to service.

Relief valve setting

Pump	Pressure control valve setting	Main system relief valve setting
60,000 psi	3000 psi (207 bar)	3200 psi (221 bar)



INTENSIFIER ASSEMBLY

Notes

CHAPTER 4

Dynamic Waterjet End Effector

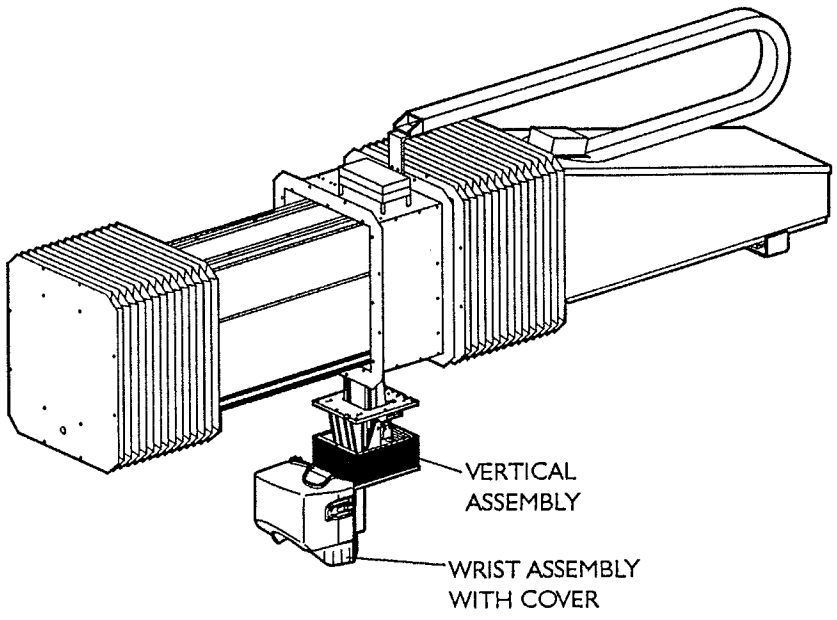
The Dynamic Waterjet (DWJ) is a wrist end effector designed for flat stock machines. Its revolutionary design provides a better way to correct two common drawbacks to abrasivejet cutting—taper and inside corner kickback.

Slowing down the cutting speed used to be the best way to reduce these effects. The DWJ cutting head provides a better way. Tilting the head removes the taper from one side of the cut, leaving a vertical cut on the side of the part.

The DWJ end effector has five main components, which are illustrated and described in this chapter:

- Z-axis
- Mini-wrist
- High-precision cutting head
- Mini on/off valve
- Height sensor

Tips and guidance on using the DWJ effectively can be found in manual MS-2276, How To Be Successful With Dynamic Waterjet.



Z-axis

Work envelope

Tilting a cutting head influences the overall travel of an X,Y system. In comparison to a perpendicular head, a tilting head with the DWJ kinematics needs X,Y,Z travel to compensate for variation in the tool center point.

Depending on maximum tool length, the maximum travel of the X and Y axes is decreased by about 4 in. (50 mm).

The available travel of the Z axis is influenced by tilting the cutting head and by mixing tube length. Only a 4-in. mixing tube can be used with the DWJ.

The FlowMaster screen automatically shows the available cutting envelope.

Maintenance

- The components used in the Z-axis are protected from everyday machine operation, and should provide years of reliable operation without servicing. There are no serviceable parts inside the Z-axis and the unit must never be opened except by FLOW technicians.
- Z-axis lubrication is explained in Chapter 5.
- In case of a collision with any foreign object, please consult FLOW technical service for information on realignment.
- Never operate the equipment without covers and pierce shield in place.

CAUTION
Cutting without covers and pierce shield in place will result in damage that is not covered by machine warranty.

DWJ wrist assembly

The wrist assembly is powered by two servo-driven actuators, which allow two more axes of movement (A and B). The wrist assembly has a unique cutting head clamp that allows the operator to easily service the cutting head.

Specifications

Width ..... 321 mm
B-motor rotation..... +/- 10°
A-motor rotation..... +/- 10°

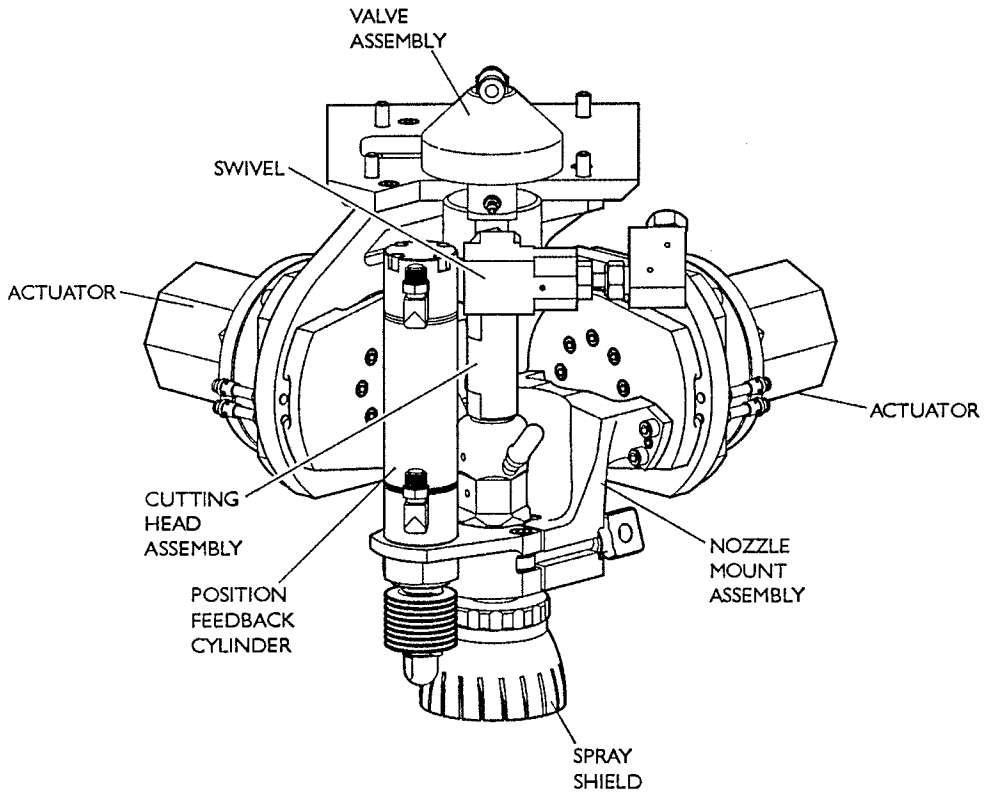
Maintenance

- In case of a collision with any foreign object, please consult FLOW technical service for information on realigning the wrist.

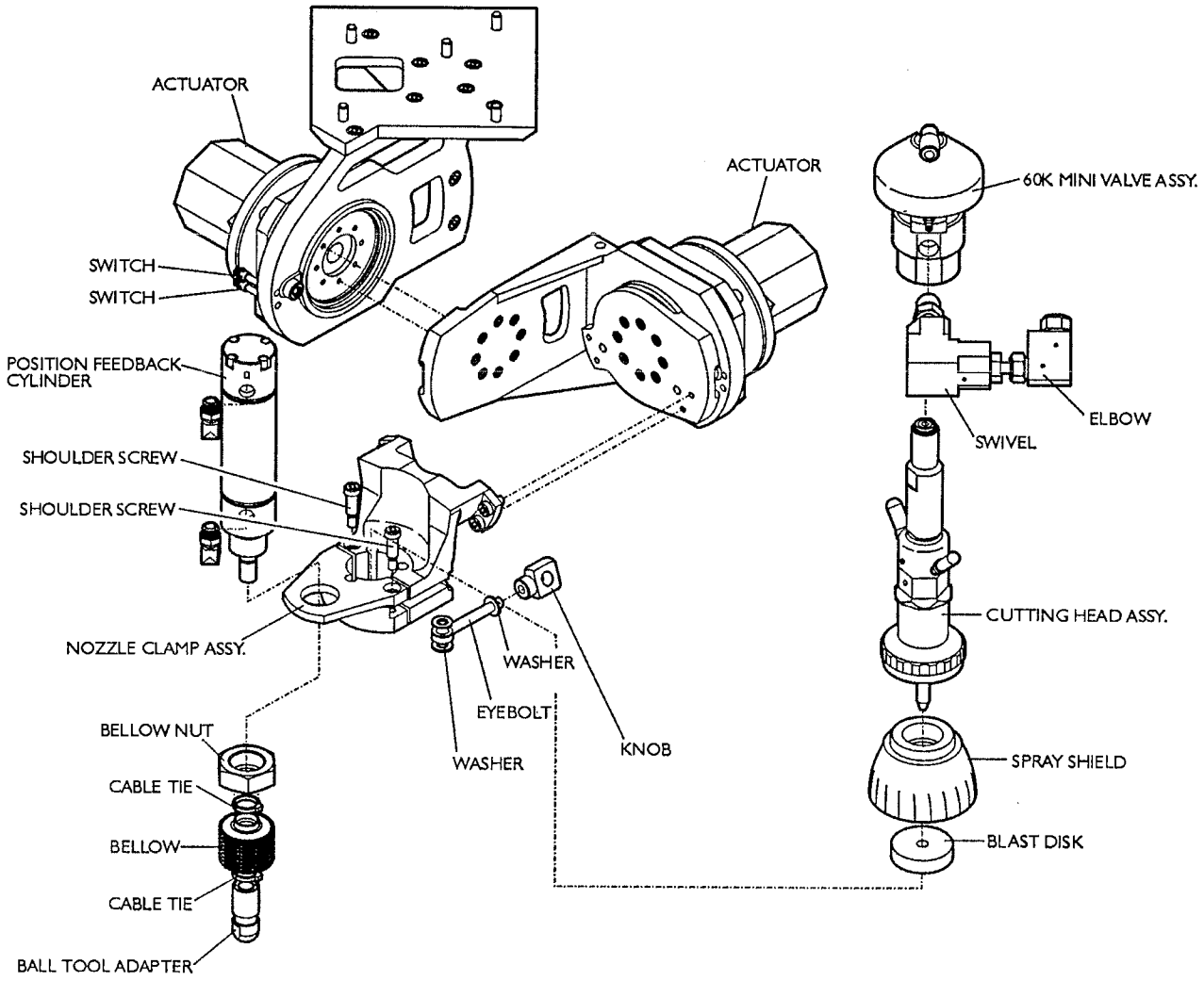
Service

The components used in the wrist are protected from everyday machine operation, and should provide years of reliable operation without service.

Note: There are no serviceable parts inside the wrist assembly and the unit MUST NOT be opened except by FLOW technicians.



Wrist assembly exploded view



Mini on/off valve (710870-1)

The mini on/off valve, designed specifically for the DWJ, is a pneumatically actuated valve that opens and closes the high-pressure water line, thus controlling water flow to the cutting head and nozzle.

The mini-valve has three distinct features:

- Its small size allows it to mount directly above the cutting head and tilt with the cutting head.
- The low-mass actuator (0.5 lb) allows full acceleration and tilting of the cutting head.
- The design of the valve-to-nozzle body connection allows the valve to be oriented by the operator in any radial direction to mate easily to high-pressure tubing and other rigid components.

Specifications

Operating water pressure . . . . . 0–60,000 psi (0–4138 bar)
Water connection . . . . . std. UHP ¼-in. tubing port
Valve weight. . . . . 1.5 lb (0.68 kg)
Recommended water flow rate. . . . . 0–2 gpm (7.5 liter/min)
Shop air (dry or lubed) . . . 60–100 psig (4.1–6.9 bar)
Air connection . . . . . 6 mm air line
Configuration . . . . . normally closed, air to open
Response time*
Opening . . . . . 0.045 secretary
Closing . . . . . 0.100 sec

* Note that the response time will vary depending on (1) length of the air line from the solenoid to the actuator and (2) air pressure.

Maintenance

Recommended spares

To minimize downtime and reduce the need for rush orders, you should have at least one repair kit for each on/off valve.

711484-1 . . . . . On/off Valve Repair Kit
A-2185 . . . . . Blue Lubricant
A-4689. . . . . Food Grade O-Ring Lube (white)

Estimated life of mini on/off valve parts

Repair kit (seal)
711484-1 . . . . . 60,000–120,000 on/off cycles
Actuator assembly
710875-1 . . . . . 300,000–1 million on/off cycles
Valve body
710866-1 . . . . . 1 million+ on/off cycles
Nozzle body
710951-1 . . . . . 250,000+ on/off cycles

Tips for increasing life of on/off valve parts

- The on/off valve is sensitive to debris in the high- pressure water line that can damage the high-pressure seal assembly. To increase life of the seal assembly (s well as high-pressure orifice life), FLOW recommends adding a 5-micron high-pressure in-line water filter assembly (012832-2) to your system.
- After replacing high-pressure plumbing or other equipment on your high-pressure pump, flush the system directly into the catcher tank before running the high-pressure water through the on/off valve and orifice. This will help minimize debris in the high-pressure lines that could damage the valve or orifice.
- Always follow the service procedures in this manual when repairing the on/off valve to ensure proper assembly and installation of the valve.

Troubleshooting the valve

There are two main categories of failure of the mini on/off valve: leaking water (most common) and improper opening and closing. Depending on which problem you are experiencing, use the corresponding chart to help you troubleshoot and solve the problem.

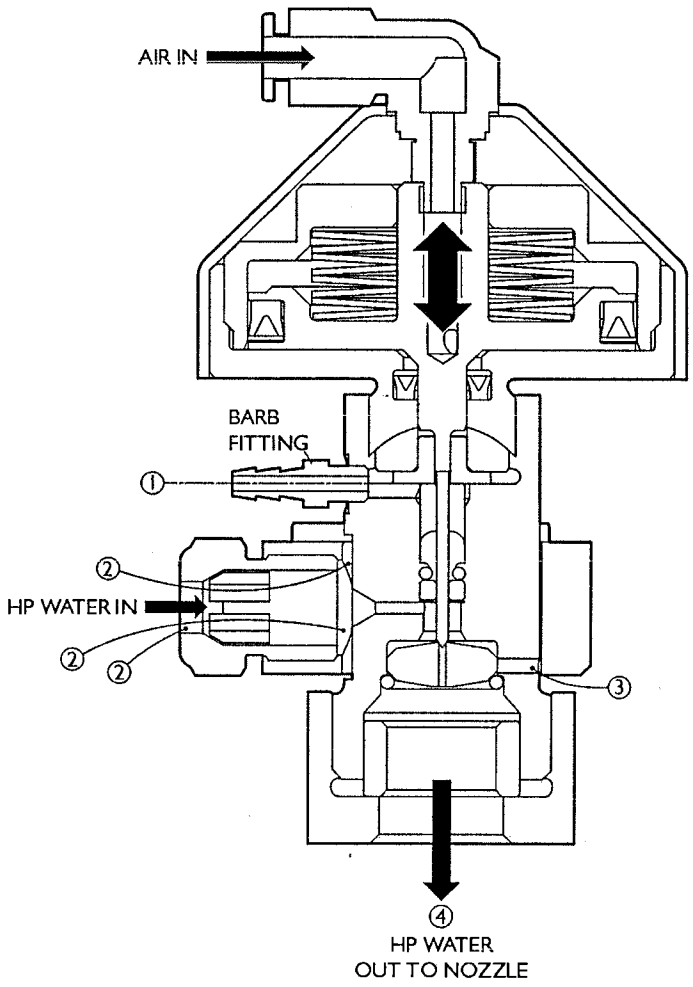
In case of irregular failure or problems with the operation of the mini on/off valve, the troubleshooting guide is still useful. Pay special attention to the utility connections and air lines—the high-pressure water supply could be partially blocked, or there could be bends, holes, or loose connections in the air lines.

Importance of replacing all the seal kit components

Sometimes after troubleshooting, it may appear that only one or two parts included in the seal kit need to be replaced. However, you must replace all components of the seal kit at the same time for several reasons:

- All the components of the seal kit have similar expected life times, so if one component fails, the others are likely to fail very soon.
- Failure of one component can cause undue stress on the other components and increases the likelihood that they will fail.
- Replacing the entire seal kit at the same time will save you from more maintenance time and machine downtime.

If causes other than those listed in the chart are found, please forward the information to the service department in FLOW USA or FLOW Europe. They will forward the information to the Technical Publications Department for inclusion in future revisions of the manual.



Troubleshooting

Refer to illustration on previous page for leakage locations.

Valve is leaking

1	***Continuous leakage from the barb fitting***	
	Failed high-pressure seal	Remove and replace the high-pressure seal assembly (Kit 711484-1, *Servicing the mini on/off valve*. Note: If this is a new valve, return the failed high-pressure seal assembly to FLOW technical service for evaluation.
	A few drops leak from barb fitting at start up or when valve is cycled rapidly	
	Worn high-pressure seal	The high-pressure seal will start by leaking one drop every few cycles, gradually increasing in frequency and volume of drops. The valve will continue to function in this state for many thousands of cycles, until the drops form a steady stream. The high-pressure seal assembly can be replaced at the operator's discretion until the leak becomes a steady stream (see above). At that point it MUST be replaced.
2	***Continuous leakage from the high-pressure water inlet***	
	Misaligned connection between high-pressure tubing and valve	Open the high-pressure tubing connection. Make sure the tubing is aligned properly with the port in the valve. Inspect the collet gland—a minimum of 3 threads must be showing. Reassemble.
	Loose connection between high-pressure tubing and valve	Tighten high-pressure fitting between valve and tubing.
	High-pressure valve body failure	Valve body failure is not common, so check the high-pressure seal assembly first. If the valve still leaks continuously after replacing the high-pressure seal assembly, there may be a problem with the valve body. Remove the valve (see *Servicing the mini on/off valve)*. Inspect the area of the valve body near the high-pressure water inlet for a crack or damage to the inlet cone. If cracked, order a replacement valve body (710866-1) and seal kit (711484-1). If this is a new valve, return the failed valve to FLOW Technical Service for evaluation.
3	***Leakage from weep hole below high-pressure water inlet while valve is open***	
	Poor connection between nozzle body & valve body	1. Open the connection of the nozzle body to the valve body. 2. Inspect the mating of collar (710869-1) to nozzle body. There should be at least 3-4 threads exposed to ensure a proper seal from nozzle body to valve seat. 3. If the large o-ring has extruded through the weep hole, replace it (A-0275-014). 4. Re-assemble the nozzle body to the valve body. This high-pressure connection requires about 70–80 ft-lb (95–110 N-m) of torque.
4	***Leakage from nozzle tip while valve is closed and high-pressure pump is on***	
	Debris in the seat/poppet or high-pressure seal area	Remove and inspect the seat and poppet interface for debris such as metal shavings (see *Servicing the mini on/off valve)*. Remove any debris and reassemble the valve. If leakage persists, inspect the high-pressure seal for damage from debris. If there is damage or continued leaking, replace the high-pressure seal kit (see *Servicing the mini on/off valve)*.
	Poppet/seat has failed	Remove and inspect the seat (see *Servicing the mini on/off valve)*. If there is erosion on the edge of the seat bore or if there are radial cracks, replace the seal assembly. Note that it is common to see a ring on the seat where the seat seals against the valve body (picture). Unless there is evidence of severe galling, which can result from not using blue lubricant (A-2185), this ring is normal and not a cause of valve failure.
		Inspect the poppet tip for wear. If the poppet is worn, follow the service instructions to repair the valve and replace the high-pressure seal assembly.

Valve does not open

Low or no air pressure	1. Make sure the shop air supply is on, properly connected, and the pressure is 70-120 psig (4.8-8.3 bar) at the actuator. 2. Turn on the air and listen for leaks in the system. Check for kinks, breaks, and holes in the air line. 3. Check the lights on the solenoid box (on the bridge) to make sure it is switching on and off when commanded.
Lack of high-pressure water	Make sure the pump is running. Check to see that all the hand valves leading to the on/off valve are open.
Partially blocked high-pressure water	1. Turn off the pump and close the hand valve. 2. Disconnect the high-pressure water line from the valve, aim it into the tank, and secure it. 3. Open the hand valve and turn the high-pressure pump back on. Watch to make sure there is a steady stream of high-pressure water shooting into the tank. If the stream is erratic, there may be a blockage in the lines. 4. Check all high-pressure in-line water filters in the system. If necessary, replace with the appropriate new filter element. (See manual M-127, Small High-Pressure Components.
Actuator failure	Watch the top of the actuator while manually switching the air on and off with the high-pressure water on. If the air port on top of the actuator does not move up and down, there is a problem with the actuator. Remove the mini-actuator from the air line, valve, and machine. Order a new actuator assembly (710875-1) and return the assembly to FLOW Technical Service for evaluation.
	FLOW TECHNICAL SERVICE ONLY: Disassemble the actuator. Make sure the u-cup seals are installed in the correct orientation and are free from kinks or folds. Remove and replace the actuator seals as required. Clean all parts. If the internal springs are rusted, replace them. Lube internal parts and reassemble the actuator. If it is still not working, replace it. Check the customer's air line to make sure it is providing dry, lubed air.
Damaged high-pressure valve seal	If the air port on top of the actuator moves up and down, but the valve still does not open (and you have already checked for little or no air pressure) there may be a problem with the valve seal. If the on/off valve has been operated while the barb fitting has been continuously leaking, the high-pressure seals may be melted and stuck in the valve body. Replace the seal assembly (see *Servicing the mini on/off valve).*
Controller command	Make sure the controller is signaling the valve to open.

Valve does not close	
Valve is leaking water	Determine where the valve is leaking. Follow the troubleshooting tips for *Valve is leaking* to diagnose the problem.
Air is not turning off	Try manually switching the air on and off or disconnecting the air line to see if the valve will close. There may be a problem with your software program or controller command to turn the air off.
Damaged high-pressure valve seal	If the air port on top of the actuator moves up and down, but the valve still does not open (and you have already checked for little or no air pressure) there may be a problem with the valve seal. If the on/off valve has been operated while the barb fitting has been continuously leaking, the high-pressure seals may be melted and stuck in the valve body. Replace the seal assembly (see *Servicing the mini on/off valve).*
Actuator will not close	Remove the valve assembly from the machine and remove the actuator from the valve (see *Servicing the mini on/off valve).* Check the operation of the actuator without the valve or high-pressure water. • The piston should move up and down, but slower than when used with high-pressure water • If the piston does not move, there is a problem with the actuator Return the actuator assembly to FLOW for evaluation and order a new actuator assembly (710875-1).
	FLOW TECHNICAL SERVICE ONLY: Disassemble the actuator. Make sure the u-cup seals are installed in the correct orientation and are free from kinks or folds. Remove and replace the actuator seals as required. Clean all parts. If the internal springs are rusted, replace them. Lube internal parts and reassemble the actuator. If it is still not working, replace it. Check the customer's air line to make sure it is providing dry, lubed air.

Servicing the valve

You will need these tools and parts before starting any service on the mini on/off valve:

- Set of crescent wrenches (standard size)
- Soft-jaw vise
- Work bench
- 711484-1 Mini on/off valve repair kit
- A-2185 Blue Lubricant
- A-4689 Food grade o-ring lube (white)

Removing the valve

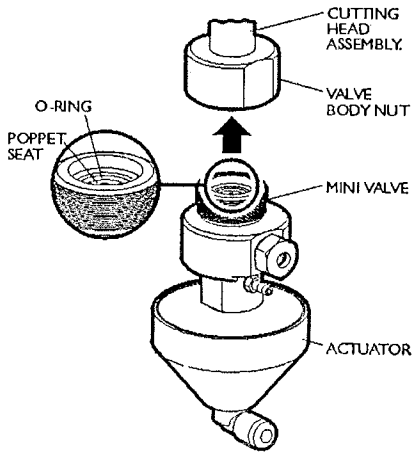
1. Turn off air to the valve and disconnect the pneumatic line.

> **WARNING**
> **Shut down the system and bleed all high-pressure from the system. Turn off the high-pressure water and high-pressure water pump. Close the hand valve between the pump and the cutting head.**

2. Disconnect the high-pressure plumbing from the valve body.
3. Open the DWJ clamp and remove the entire cutting head assembly, including the valve and actuator. Take the assembly to a clean workbench for any repair procedures.

Repairing the valve

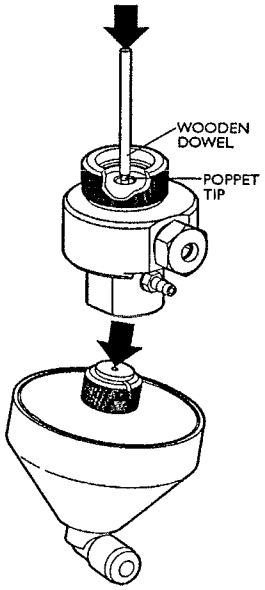
4. Place the assembly in the soft-jaw vise; unscrew the valve body nut from the valve body. This will separate the mini valve and actuator from the cutting head and expose the poppet seat.



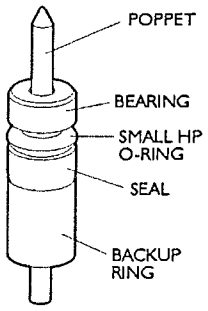
5. An o-ring helps hold the poppet seat in place. Remove the o-ring and the poppet seat. Discard the seat and o-ring.

   Note: If the seat does not fall out when you tap the nozzle body, use your finger or the wooden dowel to help loosen the seat.
6. Unscrew the valve body from the actuator assembly. Set the actuator assembly aside.
7. Place the $\frac{3}{16}$-in. wooden dowel (from the valve repair kit) against the poppet tip and push it out from the valve body.

   The bearing, high-pressure seal, and backup ring should come out with the poppet. If not, push the bearing, seal, and backup ring out of the valve body in the same direction as you pushed the poppet. Discard the poppet, seal, o-ring, and backup ring.

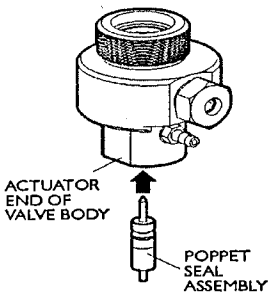


8. Clean any foreign material from the inside and outside of the valve body.
9. Apply a thin film of white food grade o-ring lube (A-4689) to the new poppet, o-rings, seal, bearing, and backup ring (from kit 711484-1)
10. Put together the new seal assembly.
    a. Slide the bearing onto the poppet.
    b. Place the small high-pressure o-ring on the high-pressure seal.
    c. Push the seal onto the poppet with the o-ring toward the point of the poppet.
    d. Slide the backup ring into place against the high-pressure seal.

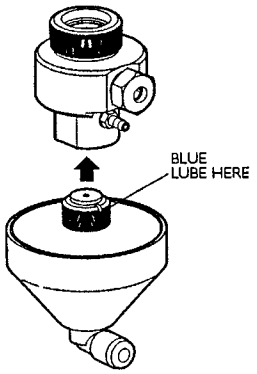


The seal assembly should be approximately centered on the poppet.

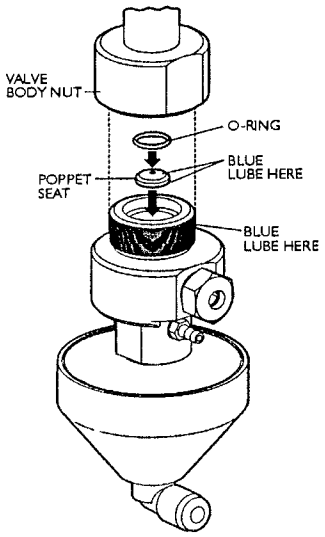
11. Slide the poppet seal assembly into the actuator end of the high-pressure valve body, pointed end first.



12. Apply a small amount of Blue Lubricant (A-2185) to the threads of the actuator. Reinstall the actuator assembly to the valve body.



13. Apply a small amount of Blue Lubricant to both sides of the new poppet seat. Install the poppet seat into the valve body. Push the o-ring into the groove to hold the poppet seat in place.
14. Apply a small amount of Blue Lubricant to the external threads of the valve body and thread it onto the nozzle body by tightening the valve body nut. Leave this connection hand-tight for now.



15. Reinstall the cutting head and on/off valve assembly to its original location on the machine by clamping the cutting head in place.

Reinstalling the valve

> **WARNING**
> **Make sure the high-pressure pump is OFF and the hand valve between the high-pressure pump and the cutting head is closed.**

16. Attach the pneumatic control line to the valve actuator assembly and turn "ON" the air to open the valve.
17. With the valve in the open position, align the valve with the high-pressure tubing so that the weep tube and high-pressure tubing point toward the front of the machine.
18. Tighten the connection between the nozzle body and the valve body nut to 35–40 ft-lb (47–54 N-m). Once the connection is tight, turn off the air to close the valve.

    Note: Opening the valve before tightening this connection reduces the possibility of galling between the poppet and seat interface and reduces the force required as you are not working against the high spring force of the actuator.

19. Attach the high-pressure tubing to the valve. Be careful not to over-torque this connection.
20. Open the hand valve between the high-pressure water source and the cutting head.

Turn on the high-pressure water source and slowly raise the pressure while checking for leaks. Manually actuate the valve a few times to make sure it is operating correctly.

Initial height sensor

The DWJ has an automatic height sensor that touches down on the material to be cut, senses the height of the material, and sets the programmed standoff for the cutting head.

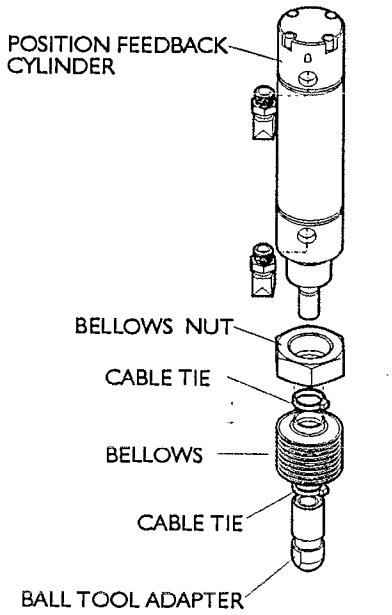
NOTE
This sensor only sets the INITIAL height for each cut. It DOES NOT follow the surface of the material throughout the cut.

Specifications

Stroke ..... 38.1 mm
Drive ..... pneumatic
Weight ..... 0.34 kg

Air requirements

Max. air pressure ..... 150 psi
Desired air pressure ..... 10–30 psi



How it works

This is the basic sequence followed by the sensor as it sets the initial standoff distance of the cutting head from the target material. Note that the cutting head should already be raised a suitable distance above the target material before starting this sequence.

- The X, Y axes move the cutting head to the location of the next pierce point, stopping when the height sensor is over the pierce point.
- The height sensor plunger extends downward, then the Z-axis drops quickly until the plunger is compressed against the material.
- The Z-axis raises slowly until the proper sensor location is detected, then the plunger retracts.
- The Z-axis raises and the X, Y axes move the cutting head back to the pierce point.
- The Z-axis lowers the cutting head to the correct standoff and the jet is turned on.

After cutting, the Z-axis is raised and the process starts over.

Troubleshooting the height sensor

Before troubleshooting the height sensor operation, be sure you are familiar with the correct operating sequence as described on the previous page.

Symptom	Possible cause(s)
Height sensor plunger does not extend or retract.	• Incorrect air pressure to regulator or incorrect regulator setting. • No power to I/O or malfunctioning Profibus network. • Damaged I/O module or incorrect I/O mapping in FlowCUT or Profibus network.
Sensor extends over the pierce point but is immediately retracted, causing a shutdown in FlowCUT.	• Sensor contacts the target material before it is fully extended. • Incorrect sensor air pressure or damage to plunger.
Sensor is lowered and plunger is compressed, but the Z-axis continues to lift when lifting off the material. Note: Lifting height could be sporadic; in extreme cases the Z-axis will lift to the upper overtravel limits.	Plunger is not immediately re-extending from compressed state. • Air pressure regulator setting is too low • Feedback values from the sensor are drifting.
Mixing tube consistently lowers into the target material.	• Sensor is not calibrated correctly. • Mixing tube was not inserted completely. • The standoff value entered in the FlowCUT setup screen is too small.
Inconsistent standoff distance.	• Sensor is not calibrated correctly. • Feedback values from sensor are drifting. Plunger is not immediately re-extending from compressed state.
Standoff distance is consistently too high.	• Standoff value entered in the FlowCUT setup screen is too large. • Sensor is not calibrated correctly. • The mixing tube is too short, or the tube was inserted too far (broken mixing chamber).

High-precision cutting head

The DWJ cutting head has the same purpose and functionality as the standard FLOW PASER 3 system, however, it has been modified to provide the superior cutting precision necessary for DWJ applications.

The cutting head assembly includes the nozzle body, orifice, mixing chamber, collet and nozzle nut, mixing tube, and Integrated spray shield and blast disk.

How it works

When the mini on/off valve is opened, high-pressure water flows through the orifice assembly into the mixing chamber, where it creates an area of partial vacuum. The vacuum draws a metered flow of abrasive through the abrasive delivery line, where it combines with the water to create a high-energy abrasivejet cutting stream.

This stream exits the cutting head through the mixing tube at a velocity of up to 3000 ft/sec (914 m/s). After cutting, the residual energy of the abrasive stream (up to 70% of nozzle tip energy) is contained and dissipated by a catcher.

Orifice assembly

A tapered mount in the top of the high-precision mixing chamber secures and aligns the high-pressure orifice assembly. Standard FLOW PASER 3 orifice assemblies are used with the DWJ.

High precision mixing chamber

The mixing chamber holds the orifice assembly and the mixing tube in alignment. It also provides a place for the abrasive and water to mix. A pin in the body limits how far you can insert the mixing tube, making it easier to get the correct tool length. The pin does not wear under normal conditions.

Note: If the Z-axis of the DWJ accidentally hits the workpiece during operation, it is possible to damage the pin inside the mixing chamber and create misalignment of the mixing tube. If this happens, a new mixing chamber must be installed to ensure proper alignment and tool length for DWJ cutting.

The mixing chamber has two abrasive inlets. In most cutting configurations, only one inlet is used. Be sure to cover the unused inlet with the provided plastic cap.

Collet and nozzle nut

The high-precision collet aligns the mixing tube radially. The collet snaps into the nut, so that when the nut is removed the collet and mixing tube are removed as well. Tighten the nut by hand only; using a tool will make the mixing tube hard to remove. An o-ring built into the nut seals the collet to the mixing tube. This creates the proper suction for the abrasive and, in particular, for use with vacuum assist.

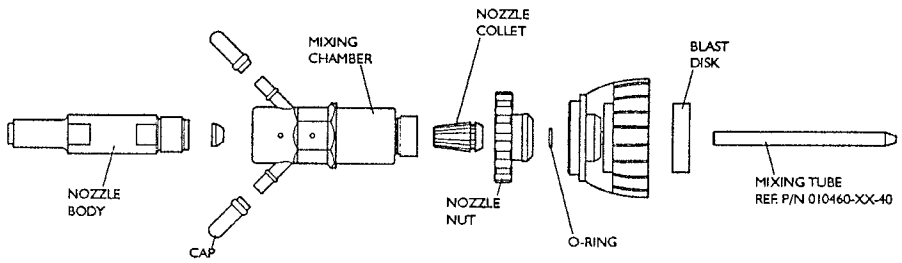
Mixing tube

The mixing tube focuses the mix of abrasive and high-pressure water that is generated in the mixing chamber. Unlike the standard PASER 3 system, the DWJ uses 4-in. long mixing tubes in order to improve cutting precision while tilting the head.

Integrated spray shield and blast disk

The blast disk protects the collet, nut and other precision components from jet reverse spray while piercing material. The spray shield protects the operator and the rest of the components of the DWJ wrist while cutting.

The shield snaps into the nut and the blast disk fits into the shield. They can be replaced individually or together when worn through. FLOW recommends that you keep two of each on hand and replace them as soon as necessary. This will help prevent excessive wear of the more expensive precision components in the DWJ system.



Servicing the cutting head components

Orifice

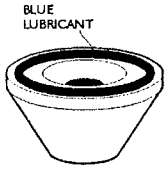
If you are experiencing loss of cutting power or jet quality, check the high-pressure orifice assembly for evidence of blocking debris or damage.

Changing the orifice

1. Turn the high-pressure pump off and bleed all pressure from the system.
2. Pull firmly on the abrasive feed line to remove it from the cutting head.
3. Open the cutting head clamp.
4. Use one wrench on the nozzle body and one on the mixing chamber to loosen the connection between the two parts.

CAUTION
When changing orifices or otherwise working on high-pressure components, it is CRITICAL that you use backup wrenches. Excessive torque on the cutting head can damage the wrist motors. Such damage will void your warranty.

5. Once separated, the nozzle body can be stashed in the feature on top of the cutting head clamp and the mixing chamber can be taken to a workbench.
6. Tap the body upside down on a table to remove the orifice assembly. If necessary, lightly pry on the mount with a screwdriver.
7. Apply a small amount of Blue Lubricant at the top of the orifice assembly.



8. Make sure the seating surface in the mixing chamber is free of abrasive and debris. Then drop the orifice assembly into the body and tap it until it drops into the taper.
9. Attach the mixing chamber to the nozzle body and tighten with 30-35 ft-lb (40-47 N-m) of torque.
10. Use a shop rag or cloth to clean the top surface of the cutting head clamp of abrasive and other debris.
11. Place the cutting head assembly back in the clamp. Make sure the flat on the cutting head is sitting flush with the top surface of the clamp before closing the clamp securely.
12. Reattach the abrasive feed line.

Mixing tube

Inspecting the mixing tube

For the best cutting accuracy, inspect the mixing tube once per shift or before starting a new job in order to monitor and limit ID growth. This is very important for effective and efficient use of the DWJ.

Tools required

- Pin gauges, or a dial caliper

Procedure

1. Unscrew the nut from the mixing chamber and remove the mixing tube from the collet.

CAUTION
The mixing tube is very brittle—do not drop, bend, or twist.

2. Inspect the mixing tube for obvious cracks, chips, erosion, and other damage. Replace the mixing tube if any of these conditions exist:
   - Prominent, off-centered wear at the nozzle exit tip ID.
   - Chips in the downstream end, outside edge of the nozzle that originate at the outside diameter, leaving less than 0.020 in. nozzle wall thickness.
   - Cracks that extend radially from nozzle ID to OD or extend down the length of the nozzle.
   - Chips in either end of the nozzle that originate at the inside diameter. Note: Do not confuse normal wear (concentric or off-center) of the upper end of the mixing tube with chipping. Some obvious erosion of the upper end of the tube is acceptable, as long as the wear does not allow water and abrasive to migrate between the tube OD and the body ID or cause degraded abrasivejet stream appearance or performance.

- The nozzle tip exit ID is worn enough to degrade cutting accuracy and performance below acceptable levels:

  For DWJ cutting: 0.010 inch (0.25 mm) greater than original size

  For non-tilt cutting: 0.02 inch (0.5 mm) greater than original size

Tip: Nozzles that are too worn for DWJ cutting can be used for parting material and other non-precision cutting jobs, rather than using new, expensive nozzles for these jobs.

Changing the mixing tube

No tools are necessary for this procedure.

Procedure

1. Make sure the high-pressure pump is off and all pressure is bled from the system.
2. Unscrew the nut from the mixing chamber and remove the collet and mixing tube with it.
3. Use a compliant surface such as wood or plastic to press the mixing tube out of the collet and nut assembly.
4. Snap the collet into the nut (if removed) and insert a new mixing tube into the collet and nut assembly. Slide the new mixing tube up into the mixing chamber until it stops against the pin, then tighten the nut.

CHAPTER 5

X,Y Table

Maintenance schedules

The following inspection schedules are based on a 16-hour production day, 5 days a week, with the equipment located in a suitable environment. Schedule changes may be necessary, depending on actual production hours and equipment environment.

The following covers only the X,Y machine. Be sure to refer to pump inspection and maintenance schedules located in Chapter 3, and in other component manuals shipped with the IFB system. These are listed at the beginning of this manual.

Inspection

Daily inspection

- Clean all exposed rails, ways, and cylinder rods. Lubricate with a light coating of aluminum complex base grease.
- Clean all debris from machine and part holding/cutting fixtures.
- Check part clamp linkages, part clamps, locating pins, proximity switches, limit switches, and air/electrical lines on the part holding/cutting fixture. Repair or replace as needed.
- Make sure electrical enclosures and junction boxes are closed and secure.
- Individually activate all emergency stop devices, including E-stop buttons, floor mats, and light curtains. Check for proper operation and lock out any machine that has malfunctioning emergency stop devices.

Weekly inspection

- Lubricate all rail and way bearings.
- Clean all linear drive lead screws.

Quarterly inspection

- Remove all debris from equipment and clean thoroughly. Check all hoses, tubing, fittings, and electrical lines. Replace any worn or chafed lines.
- Check condition of wire ways, traveling cables, and cable track. Clean and lubricate joints as necessary with light machine oil.
- Clean all rails and ways thoroughly. Examine closely for any defect, damage, or excessive wear. Repair or replace as required, then lubricate with a light coating of aluminum complex base grease.
- Check the general condition of the equipment. Repair or replace lamps, indicating gauges, and switches as required.

Recommended lubricants

Use the following lubricants for X,Y components. Refer to the pump manual and PASER ECL Plus manuals for recommended lubricants for these components. Use only a hand operated, low volume grease gun when applying lubricants.

For X,Y,Z ball nut and ball screw

- Mobilith AW-2

For X,Y,Z linear bearings

- Mobilith AW-2

CAUTION
FLOW does not recommend using any other type of bearing grease. Mixing can cause the grease to solidify, reducing bearing life up to 75%.

Recommended cleaners

For lead screws and rails

- CRC Industries, Technical Grade 3-36. Spray on a light coat and allow to penetrate residue. Wipe clean using a lint-free cloth. Repeat as necessary.

For bellows cover, painted surfaces

- Johnson Envy instant cleaner (or equivalent). Spray foam evenly over surface, wipe clean with cloth, sponge, or paper towel. Repeat as necessary.

X,Y table troubleshooting guide

1. Y-axis not true

Contact FLOW Technical Service.

2. X-axis is not true

Set up a precision square, run the X in and out. Contact FLOW Technical Service, if necessary.

3. X,Y axis locked in corner or will not jog

1. Exit all programs.
2. Turn machine power off and wait for 10 seconds.
3. Turn power back on and wait for PC boot-up to complete.
4. Push or pull X or Y or both axes out of corner or current position about 6 in.
5. Return to FlowCUT, select *Run Machine*, and then home the machine. Jog the axis.

If this does not fix the problem, call FLOW Technical Service.

4. Rough cuts are observed

Incorrect clearance.	1. Check the clearance between the pump/motor plate and the frame. 2. Make sure the machine frame is level and steady. 3. Make sure the catcher tank and grate are secure 4. Make sure your workpiece is secure.

5. X-axis makes a rough binding noise

X axes rails are not aligned.	Move the carriage and feel or listen to where the binding occurs. Realign the rails. When correctly aligned, tighten bolts.

6. No pressure display

Power off, improperly connected, or brown-out.	1. Check wiring. 2. Verify power is ON.

7. "....." pressure in display

Input display out of range.	1. Check unit scaling. 2. Check for electrical disturbance.
Loss of data set-ups.	1. Check data set-ups. 2. Check for electrical disturbance. 3. Disconnect and reconnect power.

8. Pressure display wanders

Loss of data set-ups	1. Check data set-ups. 2. Check for electrical disturbance. 3. Disconnect and reconnect power.

9. Jittery pressure display

Electrical noise in process or line.	1. Increase digital filtering. 2. Increase display rounding increment. 3. Re-route signal wires.
Process inherently unstable.	Dampen process to eliminate oscillations.

10. "ULULUL" in pressure display	
Input underload (negative overload).	Check input levels.
11. "OLOLOL" in pressure display.	
Input overload.	Check input levels.
12. Servomotor does not start	
Power not connected.	1. Correct the power circuit. 2. Check fuses.
Loose connection.	Tighten any loose parts.
Connector external wiring incorrect.	Refer to connection diagram and correct wiring.
Servomotor disconnected.	Reconnect wiring or replace cable. Cable may be broken in cat-track.
Alarm tripped.	Reset servo amplifiers.
13. Servomotor moves instantly and then stops	
Encoder wiring incorrect or broken.	Replace cable or connectors.
14. Servomotor speed unstable	
Wiring connection to motor defective.	Tighten any loose terminals or connectors.
15. Servomotor overheated	
Ambient temperature too high.	Reduce ambient temperature to 40°C (104°F) max.
Servomotor surface dirty.	Clean dust and oil from motor surface.
Overloaded.	Run under no load. If looks fine, look for mechanical binding.
16. Abnormal noise	
Mechanical mounting incorrect.	1. Tighten mounting screws. 2. Center coupling. 3. Balance coupling.
Bearing defective.	Check noise and vibration near bearing. Call FLOW Technical Service.
Machine causing vibrations.	Call FLOW Technical Service.

CHAPTER 6

Engineering Drawings

The following drawings are provided with this manual. Please note that drawings are provided for reference only. Drawings and part numbers can become obsolete as a part of FLOW's ongoing product improvement. If part numbers are replaced by new numbers, FLOW Customer Service will inform you when you order new parts.

50i-S pump

013670	50i-S intensifier pump assembly
012692	Attenuator assembly
010559	Check valve assembly
010583	Intensifier/manifold assembly
011377	Filter assembly
011379	Booster pump assembly
C-5841	Bleed-down assembly

Sub-assemblies

009930	Metering valve assembly
009967	Interconnect assembly with gauge
015292	Central lube system schematic
015382	Plumbing assembly
015444	Air regulator/filter assembly
711727	Pneumatic schematic
711938	Air regulator

Dynamic Waterjet

710870	Mini on/off valve
712262	DWJ cutting head assembly
712453	DWJ retrofit kit for IFB
712457	Z axis assembly
712486	Cable carrier assembly
712497	Wrist assembly

Electrical

Elementary electrical drawings for the IFB system are located in the electrical cabinet.

710649	Light curtain (optional)
711595	X,Y table electrical drawing
712108	Control panel assembly
712341	DWJ add-on panel assembly
712540	DWJ electrical drawing

Layout

712875	IFB DWJ 4400/4800 layout
712876	IFB DWJ 2030/6012 layout

X,Y drawings

713589 2400 system

712356 Base assembly
713591 Bridge assembly
713015 Mobile console
714152 Motorized HD Z-axis assembly

713633 6012/2030 system

711834 Base assembly
713617 Bridge assembly
713015 Mobile console

712207 4800 system

711886 Base assembly
711893 Bridge assembly
713015 Mobile console

712655 4400 system

712356 Base assembly
711893 Bridge assembly
713015 Mobile console

Vertical assemblies

712231 Heavy duty vertical assembly
714152 Motorized HD Z-axis assembly
712125 Basic vertical assembly, 8″

Repair kits

001198-1 Rev. G
60K high-pressure seal kit

#	Qty	Part #	Description
1	1	A-4689	Food grade o-ring lube
4	2	B-1465-1	Intensifier seal ring
5	4	B-8075-119	Ultrahigh-pressure o-ring
6	4	004406-1	High-pressure seal
7	4	004407-1	Hoop seal

004694-1 Rev. C
Bleed-down valve repair kit

Used with valve C-5841.

#	Qty	Part #	Description
1	1	A-0275-008	O-ring
2	1	A-0275-114	O-ring
3	1	A-0276-114	Nitrile back-up ring
4	1	B-5700-1	Bushing
5	1	B-5701-2	Seal
6	1	B-5702-1	Stem
7	1	B-5703-1	Seat
8	1	B-5723-1	Cone seal
9	1	A-0274-6	O-ring
10	1	A-0274-8	O-ring

Intensifier kits

Refer to manual M-310, ESL Intensifier

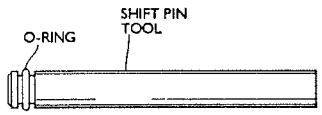
010641-1 Low-pressure seal kit
010642-1 ESL repair kit

Tools

007140-1 Rev. H 60K intensifier pump tool kit

#	Qty	Part #	Description
1	A-1275	1	1-in. strap wrench
2	A-1628	1	2-in. spanner wrench
3	A-6333	1	3-in girth wrench
6	B-5716-1	1	Tool assembly kit
7	C-2217-1	1	Intensifier assembly fixture
8	A-8466	10	Medical Alert card
9	002228-1	1	Shift pin tool assembly
11	A-2185	1	Blue Lubricant
13	A-1904	1	Glass plate
14	A-1903	3	Grinding paper, 320 grit
15	A-1902	3	Grinding paper, 600 grit
17	B-2484-1	1	Seal install tool disc
18	B-1868-1	1	Seal install tool sleeve
19	B-1867-1	1	Seal install tool guide
20	B-1866-1	1	Seal install tool plunger

002228-1 Shift pin tool



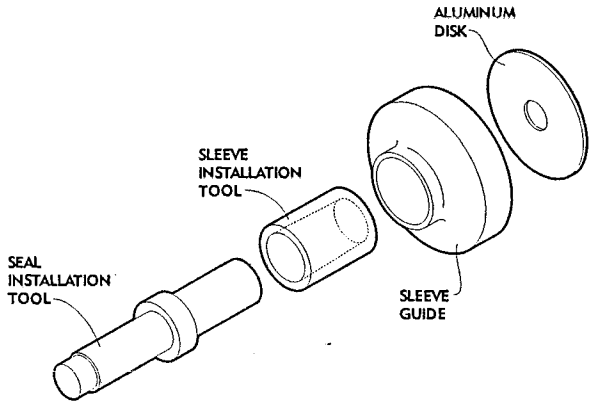
Item	Part #	Qty	Description
1	002227-1	1	Shift pin tool, 4 in.
2	A-0275-012	1	O-ring

B-1813-1 Check valve lapping kit

Item	Part #	Qty	Description
1	A-1904	1	Glass plate
2	A-1903	3	320 grit grinding paper
3	A-1902	3	600 grit grinding paper

B-2291-1 Seal tool kit

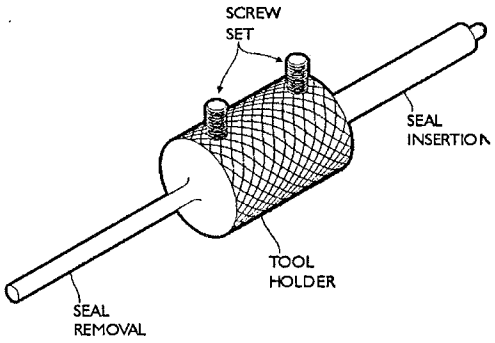
Part of 007140 intensifier pump tool kit



Item	Part #	Qty	Description
1	B-2484-1	1	Aluminum disc
2	B-1868-1	1	Sleeve
3	B-1867-1	1	Sleeve guide
4	B-1866-11	1	Seal installation tool

B-5716-1 High-pressure valve tool

Part of 007140 intensifier pump tool kit



Item	Part #	Qty	Description
1	B-5915-1	1	Seal removal tool
2	B-5913-1	1	Tool holder
3	-5914-1	1	Seal insertion tool
4	A-0509-4	2	Set screw

Dynamic Waterjet kits

711484-1 Rev. A
Mini on/off valve repair kit

FLOW Technical Service recommends that you keep two repair kits on hand.

#	Qty	Part #	Description
1	1	710819-1	Backup ring
2	1	710820-1	Seal
3	1	710821-1	Stem bushing
4	1	710822-1	Poppet
5	1	710823-1	Poppet seat
6	1	A-0275-014	O-ring
7	1	B-8075-005	O-ring
8	1	014203-1	Seal removal tool

712090-14 Rev. 02
DWJ startup kit, .014"

#	Qty	Part #	Description
1	2	711621-1	Spray shield
2	4	711933-1	Blast disc
3	1	C-2691-1	Installation tool
4	1	B-5910-1	Swivel repair kit
5	1	B-6263-1	Swivel seal puller
6	1	710806-1	Precision nozzle collet
7	1	014194-40-40	Mixing tube assembly
8	2	014201-14	Orifice assembly
9	1	711484-1	Mini on/off valve repair kit
10	1	A-15034-1	O-ring
11	4	100313-080	80 mesh garnet sample

Consumables kits

011767-1 Rev. 02
Consumables for the 50i-S pump

#	Qty	Part #	Description
3	1	010641-1	Low-pressure seal kit
5	1	A-2185	Blue Lubricant
8	1	A-1449	0.45 micron filter cartridge
9	1	A-1555	1 micron filter cartridge
11	2	A-4689	Food-grade grease
12	4	B-1465	Seal ring
13	8	B-8075-119	O-ring
14	8	004406-1	High-pressure seal
15	8	004407-1	Hoop seal
19	4	A-1606	Compression spring
20	8	A-0275-125	O-ring
21	4	005917-1	Outlet poppet
22	4	004382-1	Intensifier insert
23	4	004380-1	Inlet check valve screw
24	4	010001-1	Inlet poppet
25	4	010564-1	Inlet check valve support
28	1	A-0275-008	O-ring
29	1	A-0275-114	O-ring
30	1	A-0276-114	Backup ring
31	1	B-5700-1	Bushing
32	1	B-5701-2	High-pressure seal
33	1	B-5702-1	Valve stem
34	1	B-5703-1	Valve seat
35	1	B-5723-2	Cone seal
36	1	A-0274-6	O-ring
37	1	A-0274-8	O-ring

Consumables for the cutting head

014201-X	Orifice assembly
014194-X-40	Mixing tube
711933-1	Blast disc
711621-1	Spray shield

Spares

011768-1 Rev. A
50i-S pump spares

Item	Part #	Qty	Description
1	A-11367	1	6 micron filter element
2	A-2185	2	Blue Lubricant
3	C-1000-1	1	Low-pressure cylinder
4	B-1002-2	1	Seal backup sleeve
5	007038-3	2	HP cylinder end
6	010559-3	2	Check valve assembly
7	010561-1	1	ESL piston assembly
8	A-12571	1	Solenoid valve
9	B-1702-1	2	Firing pin
10	B-8346-1	2	Actuator assembly
11	A-2409	2	Compression spring
12	A-0276-012	2	Backup ring
13	A-0275-012	2	O-ring

Recommended spares

FLOW recommends that you keep these parts on hand.

Dynamic Waterjet

~~A-18780-2~~ Boot cover DWJ IFB
A-19322-1

Water filters

A-1449	0.45 micron cartridge
A-1555	1 micron cartridge

Other

A-2185	Blue Lubricant
A-4689	Food grade o-ring lube

DWJ electrical

Part #	Qty	Description
A-13495	1	Limit switch with cable
A-13944-4	2	A,B axes servo motor
A-13944-5	1	Z servo motor with brake
A-14132-1	2	Proximity switch N.O.
A-15056-1	2	Proximity switch N.C.
A-14822-3	1	Position feedback cable
712585-1	2	A,B,Z bridge encoder cable
712585-2	2	A,B,Z base encoder cable
712586-1	2	A,B,Z bridge motor cable
712586-2	2	A,B,Z base motor cable
712486-X	1	DWJ cable carrier assembly
A-13945-2	1	Z axis amplifier
A-13945-4	1	A,B axes amplifier
A-13430-3	1	Turbo PMAC card
A-18150-1	1	DC/DC voltage regulator

Recommended spares

X,Y table electrical spares

FLOW recommends that you keep these parts on hand.

P/N	X,Y Table Size				Description
	2030	4080	4040	2040	
A-13454	1	1	1	1	24VDC power supply
A-13457	1	1	1	1	5 +/-15vd power supply
A-13473	2	2	2	2	CE relay socket
A-13499	2	2	2	2	CE relay;24VDC;4P
A-13533	1	1	1	1	ACC-28 A/D board
A-13809	2	2	2	2	Control relay
A-13944-2	0 0	0 1	1 1	1 1	Base axis servo motor, 400W Bridge axis servo motor, 400W
A-13944-3	1 1	1 0	0 0	0 0	Base axis servo motor, 750W Bridge axis servo motor, 750W
A-13945-3	1	1	0	0	Servo motor amplifier, 750W
A-13945-2	0	1	1	1	Servo motor amplifier, 400W
A-13953	1	1	1	1	Digital DC input module
A-13954	1	1	1	1	Digital DC output module
A-14007	1 1	1 1	1 1	1 0	Base limit switch Bridge limit switch
A-14060	1	1	1	1	PMAC interface board
A-14829-11	1	1	1	1	Circuit breaker, 4A (D trip)
A-14829-14	1	1	1	1	Circuit breaker, 8A (D trip)
A-14829-19	1	1	1	1	Circuit breaker, 15A (D trip)
A-14829-2	1	1	1	1	Circuit breaker, 0.5A (D trip)
A-14829-7	1	1	1	1	Circuit breaker, 2A (D trip)
A-14830-4	1	1	1	1	Circuit breaker, 0.8A (G trip)
A-14835-1	1	1	1	1	6 plug power strip, 4' , 15A
A-14838-1	2	2	2	1	Barrier block;540;2 terminal
A-19244-1	0	0	0	1	Bridge limit switch, NO
A-19245-1	0	0	0	1	Bridge limit switch, NO

X,Y mechanical spares

P/N	X,Y Table Size				Description
	2030	4080	4040	2040	
A-01023-04	1	1	0	0	Timing belt
A-14003-1	2	0	0	0	Extension spring
A-19856-30	2 0	2 2	2 2	2 2	Bridge linear bearing Base linear bearing
A-19889-30-1	2	0	0	0	Base linear bearing
R33761-1	0	1	1	1	Bearing mount
712233-1	1	0	0	0	Stabilizer swing arm assembly

Z-axis spares

Standard

P/N	X,Y Table Size				Description
	2030	4080	4040	2040	
A-14006	1	1	1	0	Gear motor
A-14904	0	0	0	1	Gear motor, 12VDC, 15 in-lb
A-19856-20	2	2	2	1	Linear rail block (44x22x20)

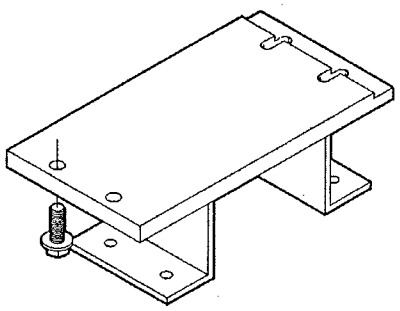
HD

P/N	X,Y Table Size				Description
	2030	4080	4040	2040	
A-14904	1	1	1	1	Gear motor, 12VDC, 15 in-lb
A-19856-20	2	2	2	2	Linear rail block (44x22x20)

DWJ

P/N	X,Y Table Size				Description
	2030	4080	4040	2040	
A-10165-5	2	2	2	N/A	Linear rail block, 34x17x15
A-13944-5	1	1	1	N/A	Servo motor, 400W with brake
712331-1	1	1	1	N/A	Coupling, 14mm-10

Miscellaneous service parts



Part #	Description
C-2217-1	Intensifier assembly fixture

Bolts to a workbench; use for assembling the intensifier on a workbench.

A-2185 Blue Lubricant

Anti-galling compound for all threaded high-pressure connections.

A-4689 White Food Grade O Ring Lube

Use as a lubricant for all o-rings that come in contact with water.

200006 Parker Super O Ring Lube

Use as a lubricant for all o-rings that come in contact with hydraulic oil.

MS-2258 Intensifier Pump Maintenance and Service Log

Notes

NOTES:

101 SET ITEM 38 [illegible]PSI MAX PRIOR TO OPERATION.

103 APPLY LOCTITE 242 TO INDICATED PIPE THREADS.

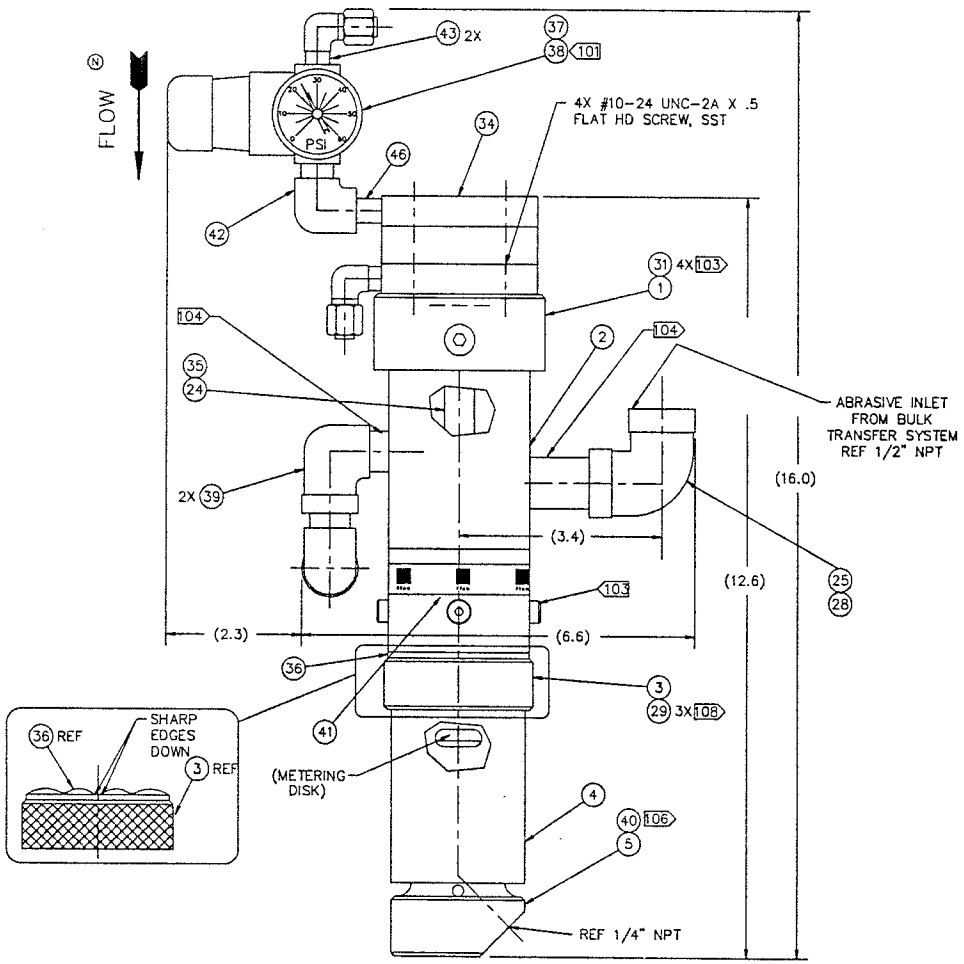
104 APPLY TEFLON TAPE.

106 APPLY SILICONE ITEM 40.

107 ITEM NOT SHOWN.

108 APPLY SILICONE TO TOP O-RING.

109 PACKAGE WITH COMPLETED ASSEMBLY. USED ON FLYING BRIDGE.



-1 & -2 CONFIGURATION

ITEM	-4 QUANTITY	-3 QUANTITY	-2 QUANTITY	-1 QUANTITY	U/M	BILL OF MATERIAL PART NUMBER	DESCRIPTION
1	1	–	1	–	EA	009922-1	ASSY;MINI HOPPER;PASER 3
2	1	–	1	–	EA	009925-1	MINI HOPPER;MTRG VLV;PASER 3
3	1	–	1	–	EA	009927-1	BODY;METERING VALVE;PASER 3
4	1	–	1	–	EA	009928-1	SHROUD;PASER 3
5	1	–	1	–	EA	009929-1	DIVERTER;LOCKING;PASER 3
24	1	–	1	–	EA	009932-1	ROD;PLUNGER;PASER 3
M 25	–	–	1	–	EA	A-12093-4	NIPPLE;1/2NPT X 2";SCH80PVC
28	–	–	1	–	EA	A-0192-4	ELBOW;90 DEG;1/2"
29	3	–	3	–	EA	A-0275-133	O-RING;BUNA-N;70 DUR;NO.2-133
31	4	–	4	–	EA	A-0448-8	SCREW;FLH SKT;1/4-20;SST;1/2LG
34	1	–	1	–	EA	A-11072	CYLINDER;AIR;1-1/2 BORE X .75
35	1	–	1	–	EA	A-11073	BUMPER;RUBBER
36	1	–	1	–	EA	A-11077	SPRING;WAVE;SST
37	1	–	1	–	EA	A-11093	CE GAUGE;AIR;0-60 PSI;1/8 BACK
38	1	–	1	–	EA	A-11142	REGULATOR;AIR;1/8
39	2	–	2	–	EA	A-4516	ELBOW;STREET;SST;3/8 NPT
40	1	–	1	–	EA	A-0275-126	O-RING;BUNA-N;70 DUR;NO.2-126
41	1	–	1	–	EA	010014-1	LABEL;FLOW;MINI HOPPER;PASER 3
42	2	–	1	–	EA	A-0652-1	ELBOW;STREET;BRASS;1/8
43	2	–	2	–	EA	A-00513-04-02	ELBOW;MALE SWIVEL;TUBE
46	–	–	1	–	EA	A-0591-11	NIPPLE;PIPE;BRS;1/8 NPT;1-1/2"
107 47	–	1	–	1	EA	010295-1	METERING DISK KIT
49	1	–	–	–	EA	A-0652-10	ELBOW;STREET;BRASS;1/2"
50	1	–	–	–	EA	A-0665-2	NIPPLE;PIPE;HEX;BRASS;1/8 NPTF
51	–	1	–	–	EA	009930-4	WMC METERING VALVE;W/O DISK KIT
109 52	–	–	–	1	EA	009930-2	METERING VALVE;W/O DISK KIT

ENG. REFERENCE	
ASSY NO.	DESCRIPTION
009930-1	W/METERING DISK KIT
009930-2	W/O METERING DISK KIT
009930-3	WMC W/METERING DISK KIT
009930-4	WMC W/O METERING DISK KIT

THIRD ANGLE PROJECTION	flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
REVISION N	MODELED IN NONE	MATERIAL: SEE P/L
DRAWN BY R. SMITH	STARTED 8-14-95	TITLE METERING VALVE ASSEMBLY
ENG MASSENBURG	SCALE 0 1:1	BASE PART NUMBER 009930 — 1 OF 2

NOTES:

201 SET ITEM 38 [illegible] PSI MAX PRIOR TO OPERATION.

203 APPLY LOCTITE 242 TO INDICATED PIPE THREADS.

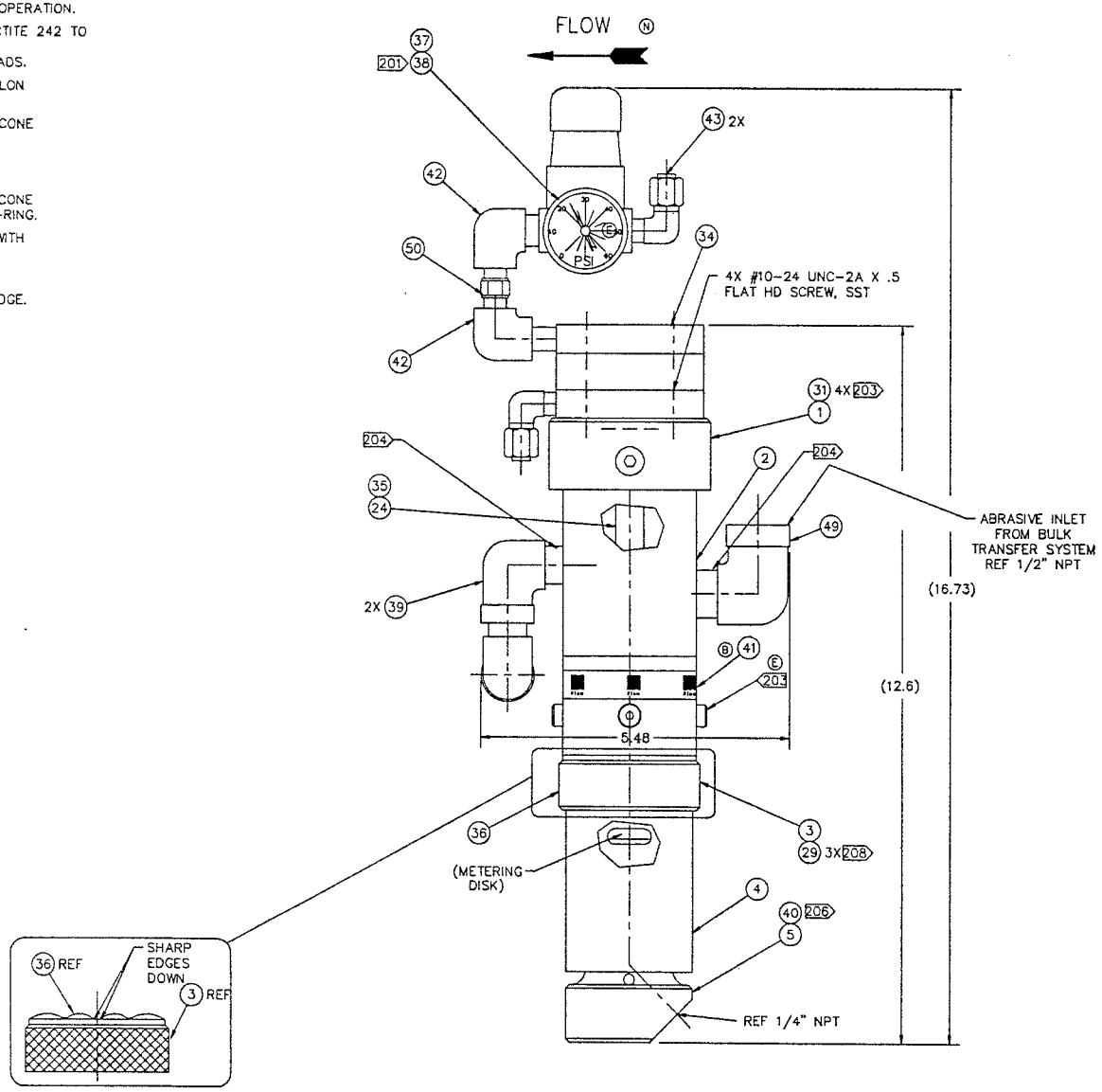
204 APPLY TEFLON TAPE.

206 APPLY SILICONE ITEM 40.

207 ITEM NOT SHOWN.

208 APPLY SILICONE TO TOP O-RING.

209 PACKAGE WITH COMPLETED ASSEMBLY. USED ON FLYING BRIDGE.



-3 & -4 CONFIGURATION

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION N	MODELED IN NONE	TITLE METERING VALVE ASSEMBLY
DRAWN BY R. SMITH	STARTED 8-14-95	
ENG MASSENBURG	SCALE D 1:1	BASE PART NUMBER 009930 — 2 OF 2

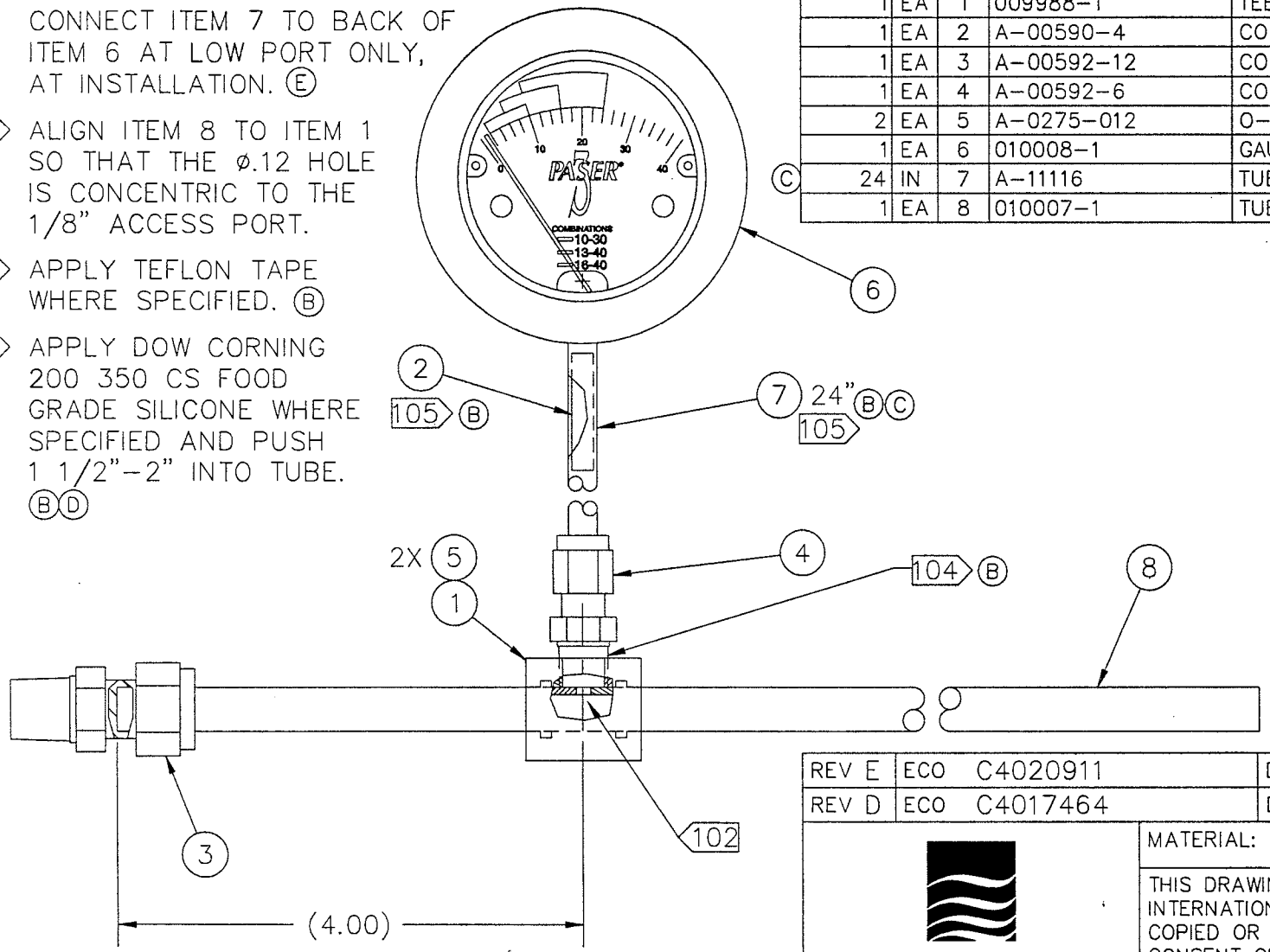
NOTES:

101. CONNECT ITEM 7 TO BACK OF ITEM 6 AT LOW PORT ONLY, AT INSTALLATION. (E)

102 ALIGN ITEM 8 TO ITEM 1 SO THAT THE ø.12 HOLE IS CONCENTRIC TO THE 1/8" ACCESS PORT.

104 APPLY TEFLON TAPE WHERE SPECIFIED. (B)

105 APPLY DOW CORNING 200 350 CS FOOD GRADE SILICONE WHERE SPECIFIED AND PUSH 1 1/2"–2" INTO TUBE. (B)(D)



-1

PARTS LIST

QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
1	EA	1	009988-1	TEE;PASER 3
1	EA	2	A-00590-4	CONNECTOR;IN-LINE;.008 DIA
1	EA	3	A-00592-12	CONN;MALE;3/8 TUBE X 1/4 NPT
1	EA	4	A-00592-6	CONN;MALE;1/4 TUBE X 1/8 NPT
2	EA	5	A-0275-012	O-RING;BUNA-N;70 DUR;NO.2-012
1	EA	6	010008-1	GAUGE;PERFORMANCE MONITOR
(C) 24	IN	7	A-11116	TUBING;POLYURETHANE;1/4 IN
1	EA	8	010007-1	TUBING;ABR. DELIVERY;PASER 3

REV E	ECO C4020911	DATE 3/7/01	BY KW
REV D	ECO C4017464	DATE 9/20/99	BY KW

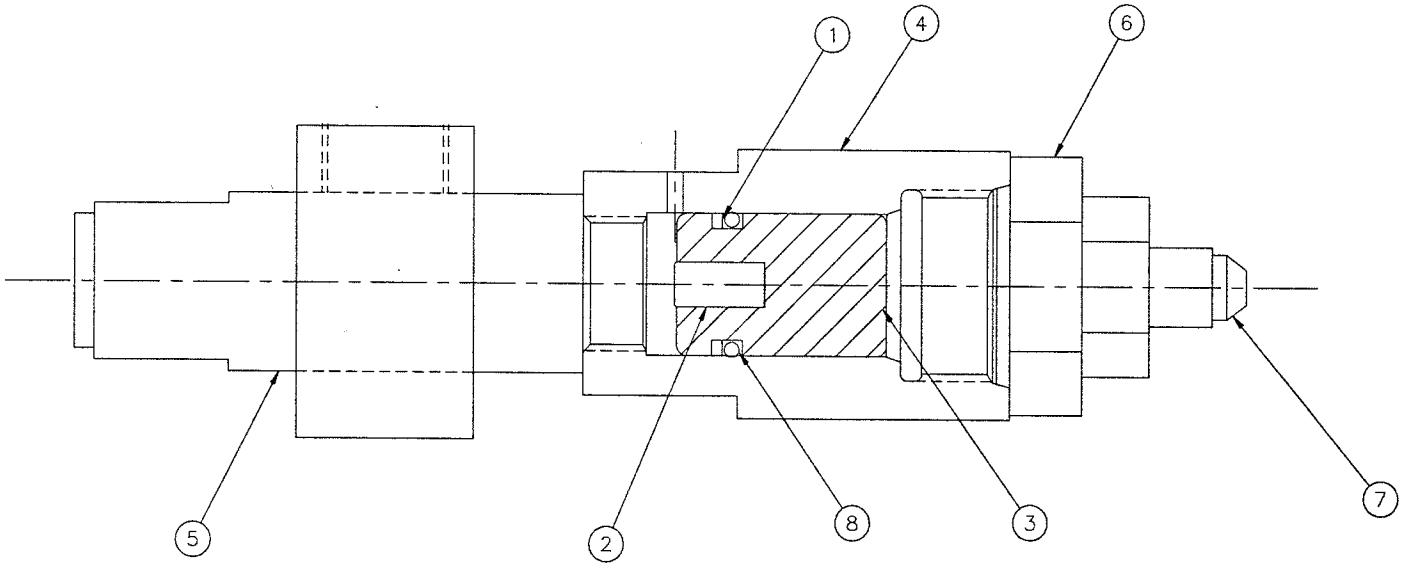
FLOW INTERNATIONAL CORPORATION
23500 64TH AVE SOUTH
KENT, WASHINGTON 98032

MATERIAL: SEE P/L

TITLE: INTERCONNECT ASSEMBLY W/ GAUGE

DRAWN BY R. SMITH	DATE 9-22-95		
ENG MASSENBURG	SCALE B 1:1	DRAWING NUMBER 009967	1 OF 1

-1			PARTS LIST	
QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
1	EA	1	A-0276-114	RING;BACK UP;NITRILE;.640 DIA
1	EA	2	B-8426-1	INSERT;PISTON
1	EA	3	B-8428-1	PISTON
1	EA	4	B-8427-1	BODY;ACTUATOR
1	EA	5	C-2740-1	VALVE ASSY;HIGH-PRESSURE;UNTESTED
1	EA	6	A-0635-9	REDUCER;EXPANDER;STL;3/4 OD
1	EA	7	A-0636-6	CONNECTOR;STR THD;STL;1/4" OD
1	EA	8	A-0275-114	O-RING;BUNA-N;70 DUR;NO.2 -114



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS IN INCHES AND DEGREES.
DIAMETERS ON A COMMON CENTERLINE TO BE TRUE POSITION WITHIN .010.
REMOVE BURRS AND BREAK SHARP CORNERS AND FILLET RADII .030 MAX.

ALL MACHINED SURFACES TO 125
TOLERANCES PER ANSI Y14.5.
DIMENSIONAL X.XXX ±.001
X.XX ±.010
X.X ±.030
ANGULAR X.X ±1
X ±3

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION E	MODELED IN NONE	TITLE BLEED DOWN VALVE ASSEMBLY
DRAWN BY GES	STARTED 1-22-86	
ENG T.HAGMAN	SCALE C 2:1	BASE PART NUMBER C-5841 — 1 OF 1

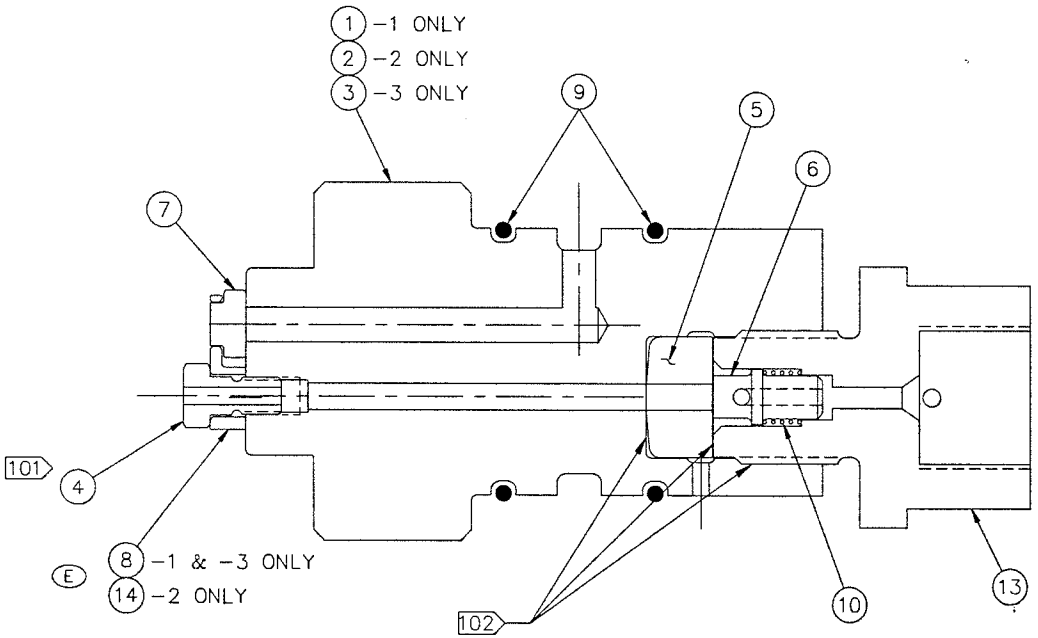
NOTES:

101 APPLY ITEM (12) (ADHESIVE) TO THREADS AND TORQUE TO 40 IN-LBS.

102 APPLY LIGHT COAT OF ITEM (11) (BLUE GOOP) TO THE THREADS AND FACE OF ITEM #13 (C-1313-1), AND TO THE RADIUS SIDE OF ITEM #5 (004382-1)

		-3	-2	-1	BILL OF MATERIAL		
	ITEM	QUANTITY	QUANTITY	QUANTITY	U/M	PART NUMBER	DESCRIPTION
	1	–	–	1	EA	004383-1	BODY; MAIN CHECK VALVE
	2	–	1	–	EA	004383-2	BODY; MAIN CHECK VALVE
	3	1	–	–	EA	004383-3	BODY; MAIN CHECK VALVE
	4	1	1	1	EA	004380-1	SCREW; RETAINING INLET CHCK VLV
	5	1	1	1	EA	004382-1	INSERT; INTENSIFIER HO
	6	1	1	1	EA	005917-1	OUTLET POPPET
	7	1	1	1	EA	010011-1	POPPET; INLET
E	8	1	–	1	EA	010564-1	SUPPORT; INLET CHK VLV; 60-87K
	9	2	2	2	EA	A-0275-125	O-RING; BUNA-N; 70 DUR; NO.2-125
	10	1	1	1	EA	A-1606	SPRING; COMPRESSION; SS
	11	0	0	0	EA	A-2185	LUBRICANT; BLUE
	12	0	0	0	EA	A-3202	LOCTITE; 242
	13	1	1	1	EA	C-1313-1	OUTLET BODY
E	14	–	1	–	EA	010564-2	SUPPORT; INLET CHK VLV; 40-45K

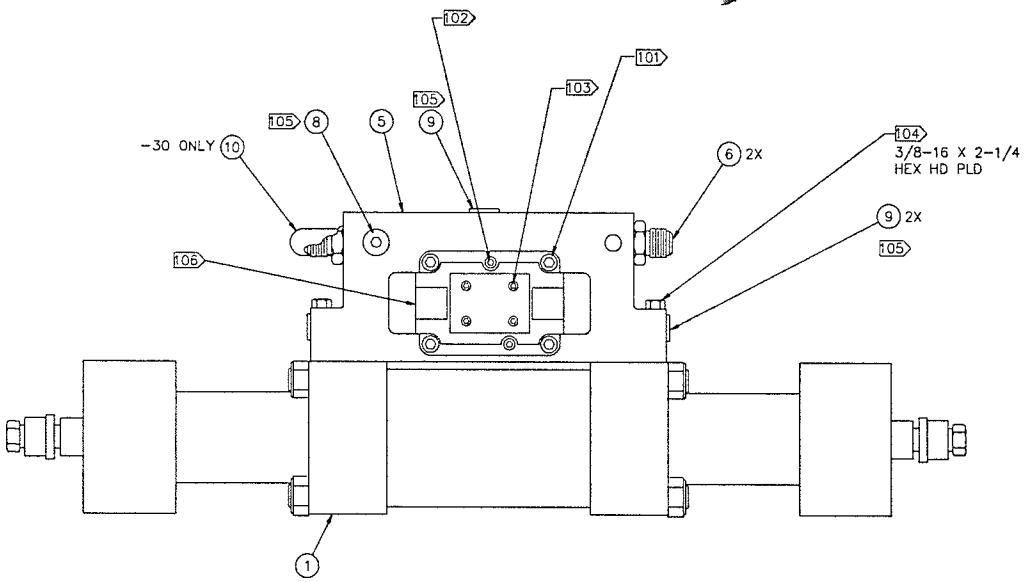
ASSY NUMBER	ENGR. REF.
010559-1	30K
010559-2	40K
010559-3	60K

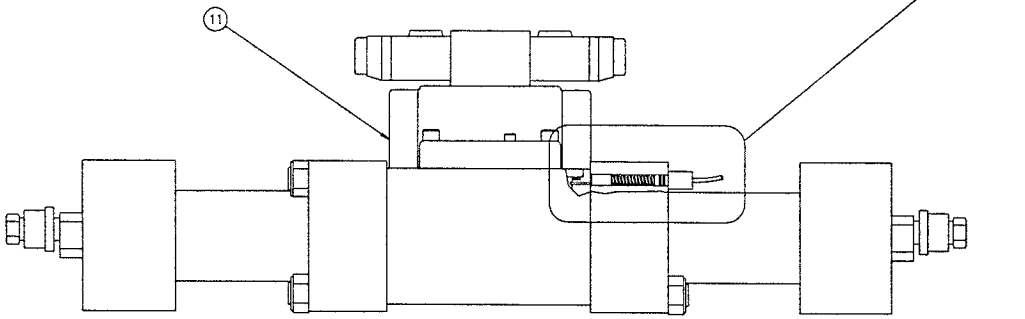


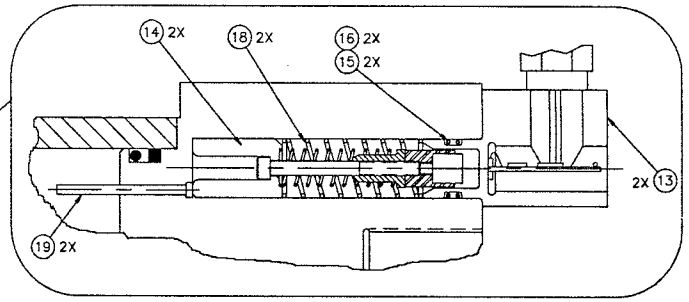
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL: SEE PARTS LIST	
REVISION E	MODELED IN NONE	TITLE CHECK VALVE ASSEMBLY	
DRAWN BY B SCHUMAN	STARTED 8-12-96		
ENG S MORDRE	SCALE 2 : 1	BASE PART NUMBER 010559	1 OF 1

NOTES:

101 TORQUE RANGE: 17-22 FT/LB.
102 TORQUE RANGE: 8-10 FT/LB.
103 TORQUE RANGE: 45-50 IN/LB.
104 TORQUE RANGE: 25-30 FT/LB.
105 USE LOCTITE 545 ON THREADS.
106 TORQUE RANGE: 2.4-4.8 IN/LB.
107 ITEM NOT SHOWN.







SCALE: 4:1 C G

ITEM	-52 QUANTITY	-30 QUANTITY	-3 QUANTITY	U/M	PART NUMBER	DESCRIPTION
1	1	1	–	EA	010558-30	INT ASSY;BASIC ESL;60K;UNTESTD
5	1	1	–	EA	013403-1	MANIFOLD;SINGLE INTENSIFIER
6	2	2	–	EA	A-0636-23	CONNECTOR;STR THD;STL;1" OD
105 8	1	1	–	EA	A-0641-6	PLUG;HOLLOW HEX;STR HD;1/2" OD
105 9	3	3	–	EA	A-0641-7	PLUG;HOLLOW HEX;STR HD;5/8" OD
10	–	1	–	EA	A-14322	VALVE;PRESSURE RELIEF
11	1	1	–	EA	A-18862	SHIFT VALVE;PILOT OPERATED
13	2	2	–	EA	011275-1	SENSOR ASSY;ELECTRIC SHIFT;24V
14	2	2	–	EA	B-8346-1	ACTUATOR ASSY;ELECTRONIC SHIFT
15	2	2	–	EA	A-0276-012	RING;BACK UP;NITRILE;.390 DIA
16	2	2	–	EA	A-0275-012	O-RING;BUNA-N;70 DUR;NO.2-012
107 17	4	4	–	EA	A-0102-16	SCREW;SKT HD;10-24UNC 3A;1" LG
18	2	2	–	EA	A-2409	SPRING COMPRESSION;P/N C0480-0
19	2	2	–	EA	B-1702-1	PIN;FIRING
20	–	–	1	EA	010583-30	INT/MANF ASSY;ESL;ELEC;UNTESTD

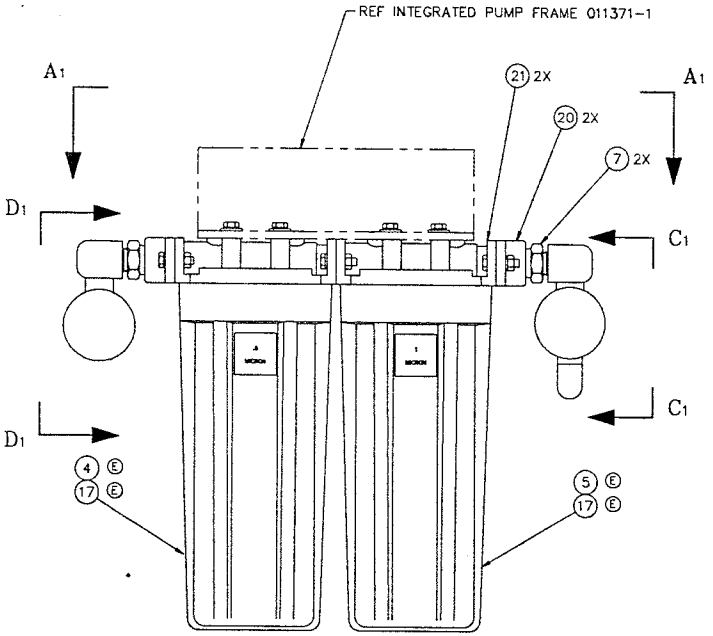
M

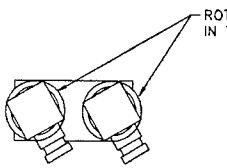
MANIFOLD/SINGLE INTENS. ASSY	BASIC INTENSIFIER ASSY	ENGINEERING REF.	
		PRESSURE RATING	
010583-3	010558-30	60 KSI	TESTED WITH PRESSURE RELIEF VALVE
010583-30	010558-30	60 KSI	UNTESTED WITH PRESSURE RELIEF VALVE
010583-52	010558-30	60 KSI	UNTESTED WITHOUT PRESSURE RELIEF VALVE

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION M	MODELED IN NONE	TITLE INT/MANF ASSY; ESL; ELEC
DRAWN BY CW	STARTED 9-4-96	
ENG JL	SCALE 1:2	BASE PART NUMBER 010583 — 1 OF 1

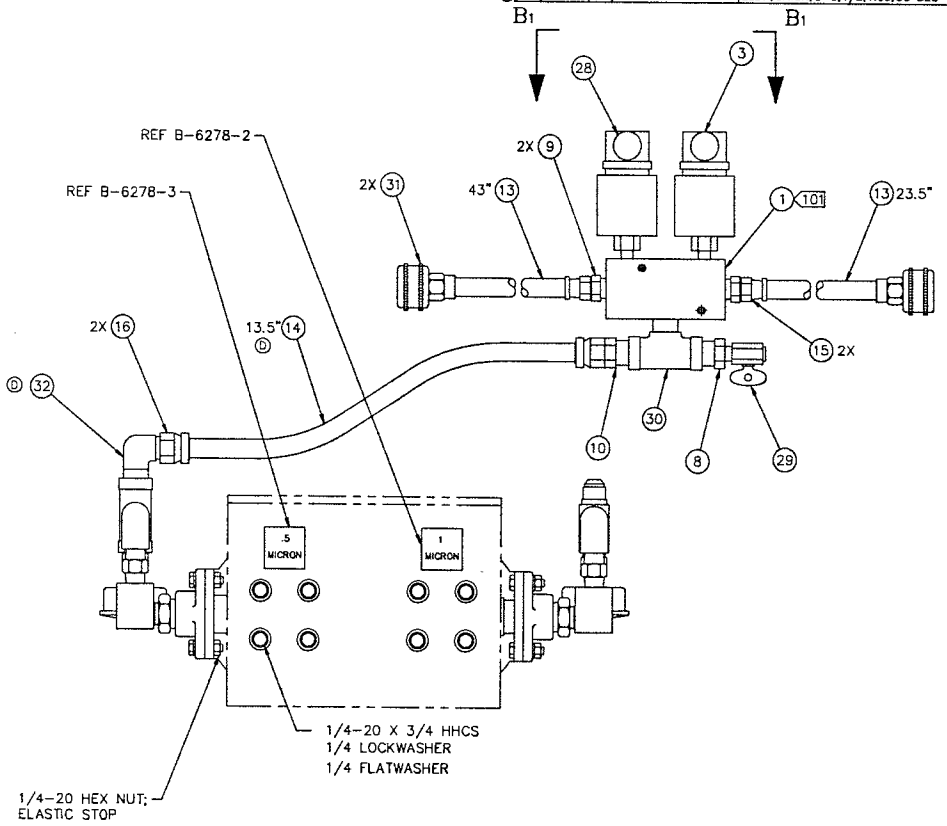
NOTES:
(101) LOCATE AT ASSEMBLY.

ITEM	QUANTITY	U/M	PART NUMBER	DESCRIPTION
1	1	EA	009176-1	MANIFOLD; WATER
3	1	EA	A-00257-8	CE SWITCH; PRESSURE; 40 PSI
(E) 4	1	EA	A-1449	FILTER; CARTRIDGE; .45 MICRON
(E) 5	1	EA	A-1555	FILTER CARTRIDGE; 1 MICRON
7	2	EA	A-0656-13	BUSHING; RDCR; THD; BRS; 3/4 X 1/2
8	3	EA	A-0656-8	BUSHING; RDCR; THD; BRS; 1/2 X 1/4
9	2	EA	A-0713-10	CONN; MALE; BRS; 3/8" OD; 3/8 NPTF
10	1	EA	A-0713-14	CONN; MALE; BRS; 1/2" OD; 1/2 NPTF
13	66.5	IN	A-0796-2	HOSE; LOW PRESS; PUSH-LOK; 3/8"ID
(D) 14	13.5	IN	A-0796-3	HOSE; LOW PRESS; PUSH-LOK; 1/2"ID
15	2	EA	A-0817-3	CONNECTOR; 37 DEG; SWVL; PUSH-LOK
16	2	EA	A-0817-5	CONNECTOR; 37 DEG; SWVL; PUSH-LOK
(E) 17	2	EA	A-6060	BOWL; FILTER
18	2	EA	A-2171	CE GAUGE; GLYCERINE
20	2	EA	A-6058	ADAPTER; 3/4 NPT; FILTER BOWL
21	2	EA	A-6059	HEAD; FILTER
23	2	EA	A-7291	ELBOW; STREET
24	1	EA	A-7293	TEE; STREET
28	1	EA	A-00257-10	CE SWITCH; PRESSURE; 50 PSI
29	1	EA	A-4309	COCK; DRAIN; 1/4" NPT; BRASS
30	2	EA	A-0654-10	TEE; MALE BRANCH; BRS; 1/2 NPTF
31	2	EA	A-0820-2	COUPLER; QUICK DISC; BRS; 3/8 ID
(D) 32	2	EA	A-0714-14	ELBOW; MALE; BRS; 1/2"OD; 1/2 NPTF
(C) 33	2	EA	A-7294	NIPPLE; HEX
(C) 34	2	EA	A-00449-6	ELBW; UNION; B-B; 1/2; 1.09; 90 DEG

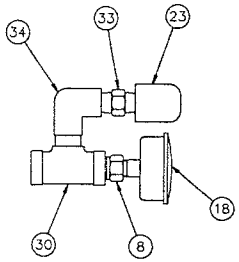




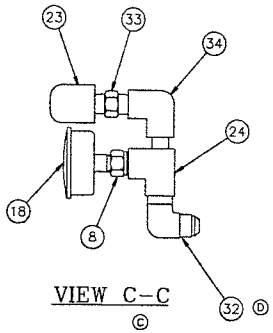
VIEW B_1-B_1
ROTATED 180°



VIEW A_1-A_1



VIEW D-D (C)



VIEW C-C
(C)

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION E	MODELED IN NONE	TITLE FILTER ASSY; INTEGRATED PUMP
DRAWN BY R. SMITH	STARTED 2/4/98	
ENG MOORE	SCALE D 1:2	BASE PART NUMBER 011377 — 1 OF 1

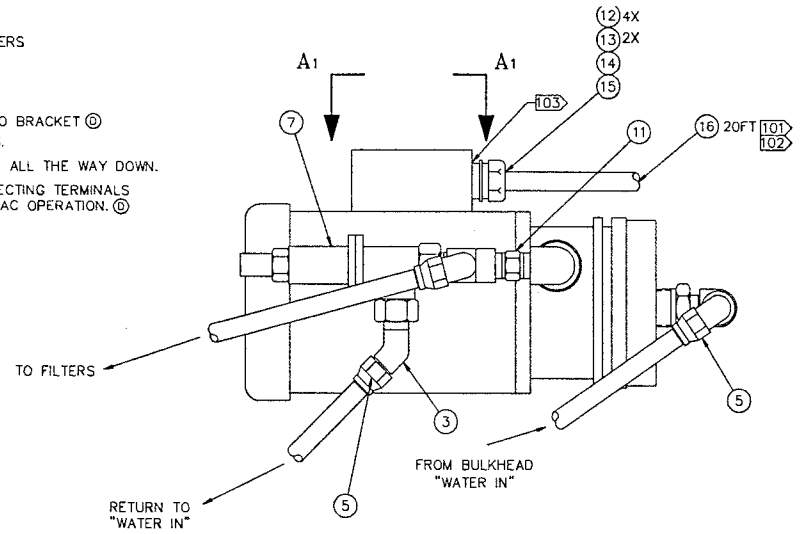
NOTES: (B)

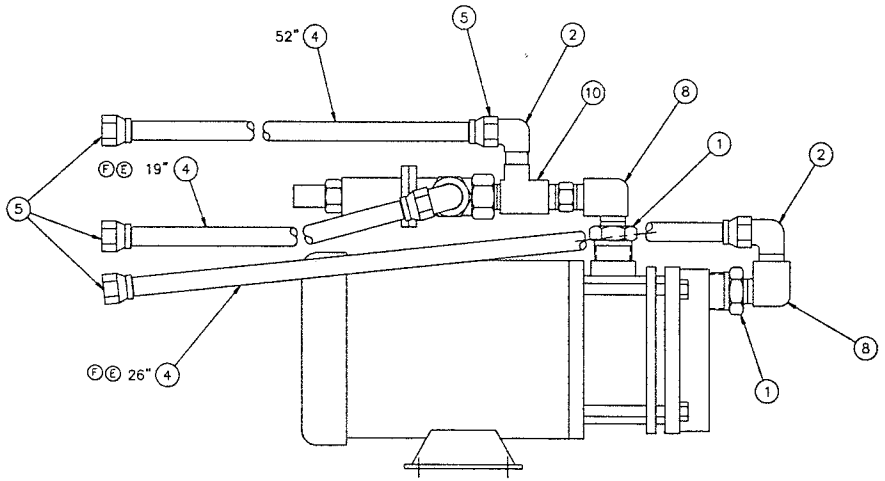
(101) WIRE BOOSTER AS FOLLOWS: 4-7, 5-8, 6-9 > JUMPERS
L-1-RED
L-2-WHITE
L-3-BLACK
GREEN BOLTS TO BRACKET (D)

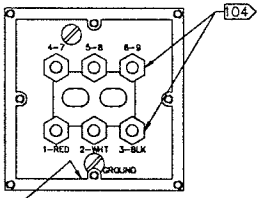
(102) STRIP WIRE AS REQUIRED FOR BEST RESULTS.

(103) TAP HOLE TO 1/2-14 NPT DO NOT RUN TAP ALL THE WAY DOWN.

(104) REMOVE AND DISCARD ALL "JUMPERS" CONNECTING TERMINALS IN JUNCTION BOX BEFORE WIRING FOR 480 VAC OPERATION. (D)







GROUND LABEL MUST BE NEXT TO GROUND LUG

VIEW A-A (D)
SCALE 2:1

	QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
	2	EA	1	A-0656-13	BUSHING;RDCR;THD;BRS;3/4 X 1/2
	2	EA	2	A-0714-14	ELBOW;MALE;BRS;1/2" OD;1/2 NPTF
	1	EA	3	A-0716-14	ELBOW;MALE;45 DEG;BRS;1/2" OD
(F)(E)	97	IN	4	A-0796-3	HOSE;LOW PRESS;PUSH-LOK;1/2"ID
	6	EA	5	A-0817-5	CONNECTOR;37 DEG;SWVL;PUSH-LOK
	1	EA	6	A-12629	PUMP;REGENERATIVE TURBINE
	1	EA	7	A-7230	VALVE;1/2"NPT ANGLE BP
	2	EA	8	A-7291	ELBOW;STREET
	1	EA	10	A-7293	TEE;STREET
	1	EA	11	A-7294	NIPPLE;HEX
(B)	4	EA	12	579708	TERMINAL RING;B14-10
(B)	2	EA	13	A-0567-3	CONNECTOR;LIQ TIGHT STRAIN RLF
(B)	1	EA	14	A-0570-1	GASKET;SEALING;CONDUIT;1/2"
(B)	1	EA	15	A-0886-2	LOCKNUT;1/2"
(B)	20	FT	16	A-0878-6	CORD;SO TYPE;600 VOLTS;16/4

REV F	ECO C4017110	DATE 7-29-99	BY DH
REV E	ECO C4016559	DATE 5-26-99	BY DH
REV D	ECO C4016004	DATE 3-10-99	BY DH
REV C	ECO C4015774	DATE 2-9-99	BY DH
REV B	ECO 14978	DATE 11/30/98	BY PAL CK .

FLOW INTERNATIONAL CORPORATION
23500 64TH AVE SOUTH
KENT, WASHINGTON 98032

DRAWN BY R. SMITH	DATE 2/4/98
ENG MOORE	SCALE 0.1:2

MATERIAL: SEE P/L

TITLE: PUMP ASSEMBLY; BOOSTER; ELECTRIC

DRAWING NUMBER: 011379 1 OF 1

NOTES:

101. ASSEMBLE PER ASSEMBLY REFERENCE LIST. TIGHTEN ALL NUTS 6 FLATS PRIOR TO PRESSURE TEST. (F)

102. HYDROSTATIC TEST PER "WORKING DATA" TABLE AND MD-0100. (C)

103. FINAL APPLICATION OF TORQUE TO NUTS AFTER HYDROSTATIC PRESSURE TEST: TIGHTEN NUTS 1 ADDITIONAL FLAT (TOTAL OF 6 + 1 = 7 FLATS). CENTER PUNCH ON NUT SHOULD THEN ALIGN WITH CENTER PUNCH ON CAP. (F)

104 H.P. FITTING ASSY IS ADDED AT HIGHER ASSY.

105 DIMENSIONS IN [ ] METRIC REFERENCE.

106 PRESSURIZED MEDIUM: NON FLAMMABLE LIQUID (WATER ETC)
OPERATIONAL LIFE: UNTIL UNIT LEAKS (-1, -2)
ALL FAILURE MODES: LEAK BEFORE BREAK

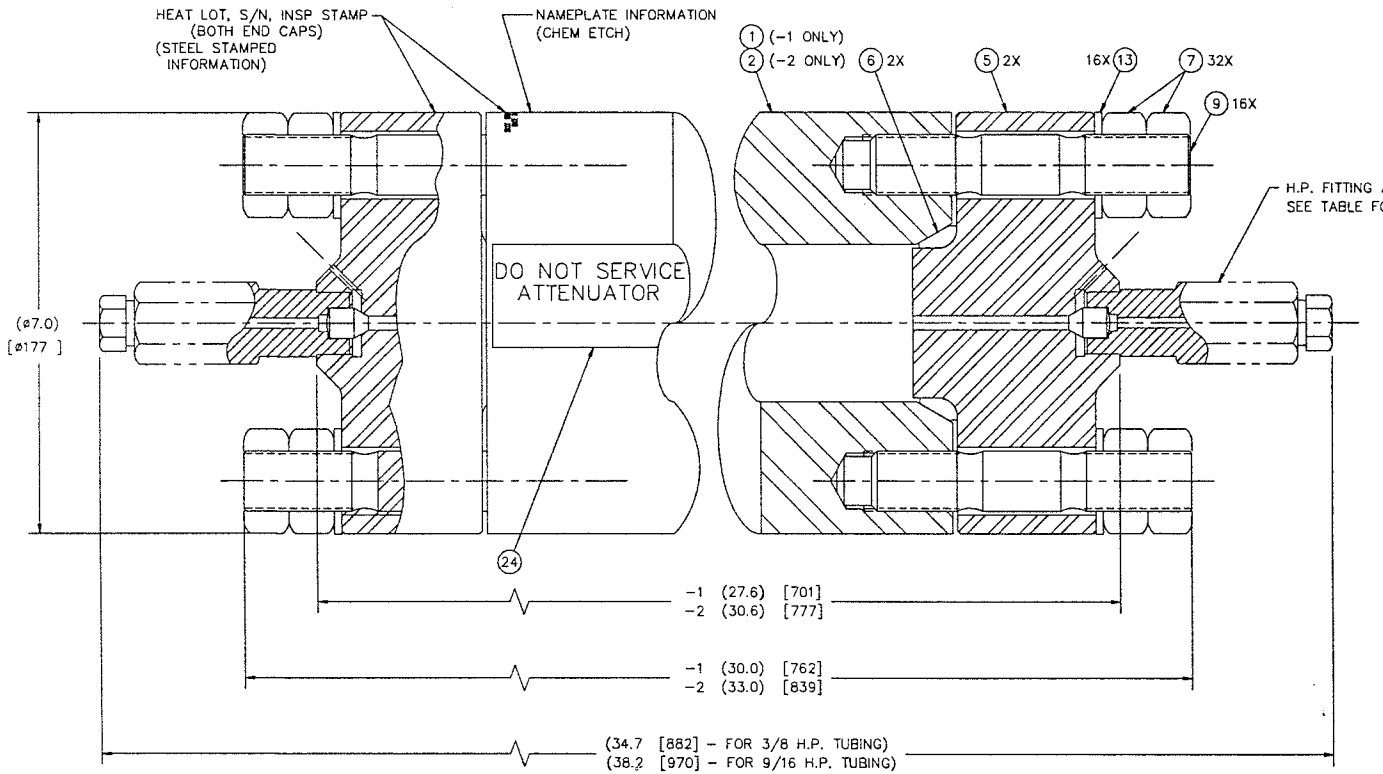
107 INSURE LABEL IS NOT APPLIED OVER ATTENUATOR STAMPINGS. ITEM NOT SHOWN.

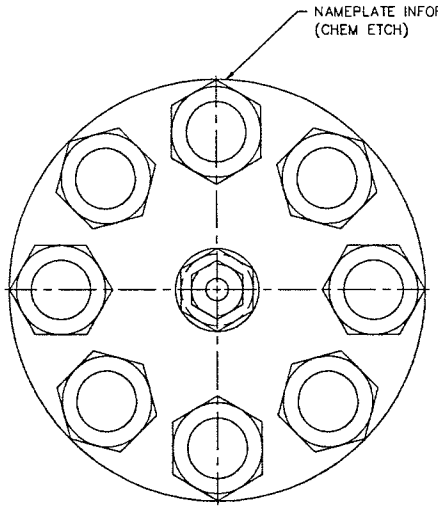
ENGINEERING REFERENCE				
DASH NO.	VOLUME		H.P. PORT	
	(CU. IN.)	(LITER)	H.P FITTING ASSY 104	PORT SIZE
012692-1	110	2.0	007656-1	3/8
			007657-1	9/16
012692-2	125	2.2	007656-2	3/8
			007657-2	9/16

BILL OF MATERIAL

ITEM	-2 QUANTITY	-1 QUANTITY	U/M	PART NUMBER	DESCRIPTION
1	–	1	EA	007097-1	BODY;60K ATTENUATOR;2 LITER
2	1	–	EA	007097-2	BODY;60K ATTENUATOR;2.2 LITER
5	2	2	EA	007096-1	CAP;60K ATTENUATOR
6	2	2	EA	007098-2	SEAL;STATIC ATTENUATOR
7	32	32	EA	007650-1	NUT;60K ATTENUATOR
9	16	16	EA	007101-3	STUD;60K ATTENUATOR
12	0	0	EA	A-2185	LUBRICANT;BLUE
13	16	16	EA	007100-1	WASHER;60K ATTENUATOR
24	1	1	EA	009195-1	LABEL;DO NOT SERVICE
(E)107	25	1	1	EA	012874-1	LABEL;60KSI-4137 BAR

ASSEMBLY REFERENCE LIST		
ATTENUATOR NUMBER		MD NUMBER
012692-1,-2	MUST USE	MD0047 -1,-2
012692-97,-98	MUST USE	MD0047 -97,-98,-99





WORKING DATA		
ENGLISH	U.S. UNITS	METRIC
RATED PRESSURE	60000 PSI	4137 BAR
HYDROSTATIC PRESSURE	78000 PSI	5380 BAR
RATED TEMP.	122° F	50° C
VOLUME -1	110 CU. IN.	2.0 LITER
-2	125 CU. IN.	2.2 LITER

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE PARTS LIST.
REVISION G	MODELED IN NONE	TITLE ATTENUATOR ASSEMBLY 60K
DRAWN BY JHO	STARTED 9-23-99	
ENG S MORDRE	SCALE D 1:1	BASE PART NUMBER 012692 1 OF 1

NOTES:

101 ITEM NOT SHOWN.

102. SEAL ALL PIPE THREAD CONNECTIONS WITH PIPE SEALANT, ITEM 49.

103 LOCATE ITEM 98 ON INSIDE LID OF ITEM 10.

104 TO PRESSURE GUAGE ON BULKHEAD.

105 FILL FILTER BOWLS WITH WATER AND BLEED OFF AIR IN LINES PRIOR TO START-UP AND AFTER EACH FILTER SERVICE INTERVAL.

106. TEST PER TD-1023/MD-0063.

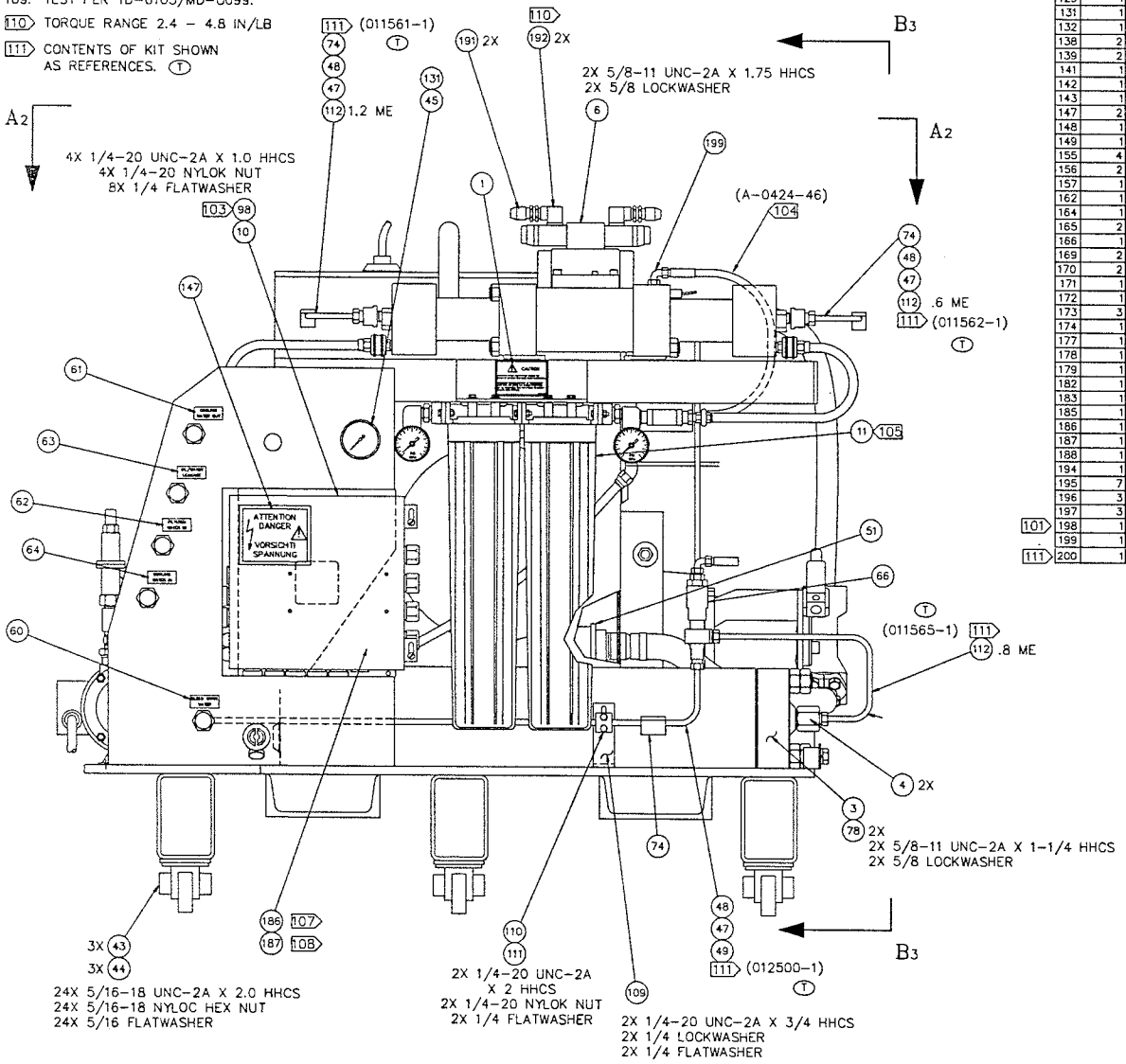
107 LOCATE NEXT TO GROUND CONNECTOR ON INSIDE OF ITEM 10.

108 LOCATE NEXT TO GROUND CONNECTOR ON INSIDE LID OF ITEM 10.

109. TEST PER TD-0105/MD-0099.

110 TORQUE RANGE 2.4 - 4.8 IN/LB

111 CONTENTS OF KIT SHOWN AS REFERENCES. (T)



BILL OF MATERIAL

ITEM	-1 QUANTITY	U/M	PART NUMBER	DESCRIPTION
107	1	EA	A-2236	HALF;COUPLING;1 1/4 X 5/16 KE
108	1	EA	A-2237	COUPLING INSERT;MAGNALOY #570
109	1	EA	010752-1	MOUNT;H.P. TUBE CLAMP
110	1	EA	A-2582	CLAMP;TOP PLATE
111	1	PR	A-2585	CLAMP;3/8" TUBE
112	4.7	ME	A-2884	TUBING;FLEX;13/32
114	1	EA	202699-16	SPLIT FLANGE KIT;CODE 61;1"
115	2	EA	A-0716-14	ELBOW;MALE;45 DEG;BRS;1/2" OD
116	1	EA	A-0665-13	NIPPLE;PIPE;HEX;BRS;3/4 X 1/2
117	1	EA	A-7291	ELBOW;STREET
118	1	EA	A-7293	TEE;STREET
122	1	EA	A-0714-15	ELBOW;MALE;BRS;1/2"OD;3/4 NPTF
125	1	EA	A-0639-5	PLUG;STRAIGHT THD;STL;9/16-18
129	1	EA	A-0726-10	ELBOW;SWIVEL;NUT;45 DEG;STEEL
131	1	EA	A-0734-4	CONN;FEM;STL;1/4" OD;1/4 NPTF
132	1	EA	201706-24	CLAMP;SUPPORT;1.5 ID
138	2	EA	A-0792-1	ADAPTER;MALE/FEM;HP;SST;1/4
139	2	EA	A-0775-1	ELBOW;HP;60 KPSI;1/4"
141	1	EA	A-2866	GLAND;HIGH PRESSURE;1/4
142	1	EA	A-2867	COLLAR;HIGH PRESSURE;1/4
143	1	FT	A-2883	TUBING;FLEX 9/32
147	2	EA	C-5683-4	LABEL;ATTENTION DANGER
148	1	EA	B-6278-2	LABEL;FILTER HOUSING;1 MICRON
149	1	EA	B-6278-3	LABEL;FILTER HOUSING;.5 MICRON
155	4	EA	A-0288-5	SEAL;FASTENER & FTG;SIZE -1/4
156	2	EA	A-0567-30	CONN;STRAIN RLF;LIQ TIGHT;2
157	1	EA	A-0405-17	WASHER;FLAT;NYLON;.656 ID
162	1	EA	201706-12	CLAMP;SUPPORT
164	1	EA	A-14612	MANIFOLD ASSEMBLY;PROPORTIONAL
165	2	EA	A-0638-5	ELBOW;STR THD;STL;1/4" OD
166	1	EA	A-0275-222	O-RING;BUNA-N;70 DUR;NO.2-222
169	2	EA	A-12812	CE VALVE;24VDC;SOLENOID;1/2IN
170	2	EA	A-0666-4	NIPPLE;CL;BRS;1/2 NPT;1-1/8 LG
171	1	EA	A-0519-9	COUPLING;BRONZE;3/4 NOM
172	1	EA	A-0589-15	NIPPLE;PIPE;BRASS;3/4 NPT;15LG
173	3	EA	A-0714-14	ELBOW;MALE;BRS;1/2"OD;1/2 NPTF
174	1	EA	A-0652-14	ELBOW;STREET;BRASS;3/4
177	1	EA	202699-32	SPLIT FLANGE KIT;CODE 61;2"
178	1	EA	A-14580	HOSE FTG;45;2 FLG X 1-1/2 HOSE
179	1	EA	A-0644-10	ELBOW;45 DEG;STR THD;STL;3/4"
182	1	EA	010768-1	CE LABEL;HIGH LEAKAGE CURRENT
183	1	EA	C-5683-1	LABEL;ATTENTION DANGER
185	1	EA	011980-22	LABEL;ISO;2 IN.;HOT SPOT
186	1	EA	010813-1	CE LABEL;PROTECTIVE EARTH
187	1	EA	010814-1	CE LABEL;GROUND
188	1	EA	014184-1	HOSE KIT;50 IS
194	1	EA	A-00741-5	CE MOTOR;50HP;460V
195	7	EA	201706-15	CLAMP;SUPPORT;STEEL
196	3	EA	A-19741-1	CONNECTOR; INSUL MECH;2P;1/0
197	3	EA	A-19741-2	CONNECTOR; INSUL MECH;3P;1/0
101 198	1	EA	014489-2	CABLE W/LUGS ON ONE END
199	1	EA	A-0638-3	ELBOW;STR THD;STL;1/4" OD
111 200	1	EA	015581-1	KIT; TUBE;50I PUMP ASSEMBLY

BILL OF MATERIAL

ITEM	-1 QUANTITY	U/M	PART NUMBER	DESCRIPTION
1	1	EA	001843-1	CE LABEL;CAUTION
3	1	EA	012692-2	ATTENUATOR ASSY;60K;2.2 LITER
4	2	EA	007656-2	FITTING ASSY;3/8 HP;ATTEN;60K
6	1	EA	010583-30	INT/MANF ASSY;ESL;60K;UNTESTED
7	1	EA	012498-1	FRAME;50I-S;WMC
10	1	EA	013678-1	CE CONTROL CONSOLE ASSY;50I-S
11	1	EA	011377-1	FILTER ASSY;INTEGRATED PUMP
12	1	EA	012572-1	PUMP ASSY;BOOSTER ELEC;WMC
13	1	EA	200680-02	GAUGE;LIQUID LEVEL
14	1	EA	200681-14	COVER;TANK RESERVOIR 14" DIA
16	4	EA	A-0288-7	SEAL;FASTENER & FTG;SIZE-5/16
18	1	EA	A-0636-3	CONNECTOR;STR THD;STL;1/4" OD
19	1	EA	A-0656-13	BUSHING;RDCR;THD;BRS;3/4 X 1/2
21	5	EA	A-0668-4	CONN;ANCHOR;BRASS;1/2-14 NPTF
22	1	EA	A-0713-14	CONN;MALE;BRS;1/2" OD;1/2 NPTF
27	1	EA	A-0739-19	ELBOW;MALE;STL;3/4"OD;3/4 NPTF
34	3	EA	A-0776-2	TEE;HP;3/8"
35	38.5	IN	A-0796-3	HOSE;LOW PRESS;PUSH-LOK;1/2"ID
37	5	EA	A-0817-5	CONNECTOR;37 DEG;SWVL;PUSH-LOK
41	1	EA	A-0993-19	CONNECTOR;STR THD;FLARELESS
43	3	EA	A-18377	CASTER;LEVELING
44	3	EA	014708-1	SPACER;CASTER;50IS
45	1	EA	A-1623	CE GAUGE;OIL PRESSURE
47	4	EA	A-2838	GLAND;HIGH PRESSURE;3/8
48	4	EA	A-2839	COLLAR;HIGH PRESSURE;3/8
49	0	EA	A-3253	SEALANT;PIPE;W/TEFLON LOCTITE
51	1	EA	A-3582	FILTER;TANK
52	1	EA	A-3609	BREATHER;THREADED
53	1	EA	A-4421	DRAIN COCK;BRASS BOILER;3/4"
55	1	EA	014705-1	HEAT EXCHANGER ASSY;50IS
56	1	EA	A-5479	FILTER ASSY;IN-TANK;HYDRAULIC
57	1	EA	A-5605	ADAPTER;SHORT
58	1	EA	A-13489	PUMP;VARIABLE AXIAL PISTON
59	1	EA	B-7870-1	ADAPTER;HP/STD PRESSURE
60	1	EA	C-1060-11	LABEL;BLEED DOWN WATER
61	1	EA	C-1060-2	LABEL;WATER;LEAKAGE
62	1	EA	C-1060-3	LABEL;WATER IN
63	1	EA	C-1060-4	LABEL;WATER DRAIN
64	1	EA	C-1060-9	LABEL;FILTERED WATER IN
66	1	EA	C-5841-1	BLEED DOWN VALVE ASSY
70	1	EA	A-6851	VALVE;WATER;TEMP ACTUATED
73	2	EA	A-00825-4	CLAMP;T-BOLT;SST;2 IN
74	3	EA	002192-1	SENSOR ASSEMBLY;58 DEG.C
78	2	EA	007823-1	RETAINER;ATTENUATOR
85	1	EA	A-12764	PRESSURE TRANSDUCER; 0-10V OUT
98	1	EA	010769-1	CE LABEL;MODEL/SERIAL NUMBER
99	1	EA	C-1060-7	LABEL;WARNING;60000 PSI
100	1	EA	012172-1	LABEL;SERVICE;5X/7X/9XV/50IS
102	0	EA	200377	ADHESIVE;THREAD LOCKING LOC 2
103	2	EA	201706-20	CLAMP;SUPPORT;STEEL
105	1	EA	A-0636-5	CONNECTOR;STR THD;STL;1/4" OD
106	1	EA	A-4261	HALF;FLEXIBLE COUPLING

THIRD ANGLE PROJECTION

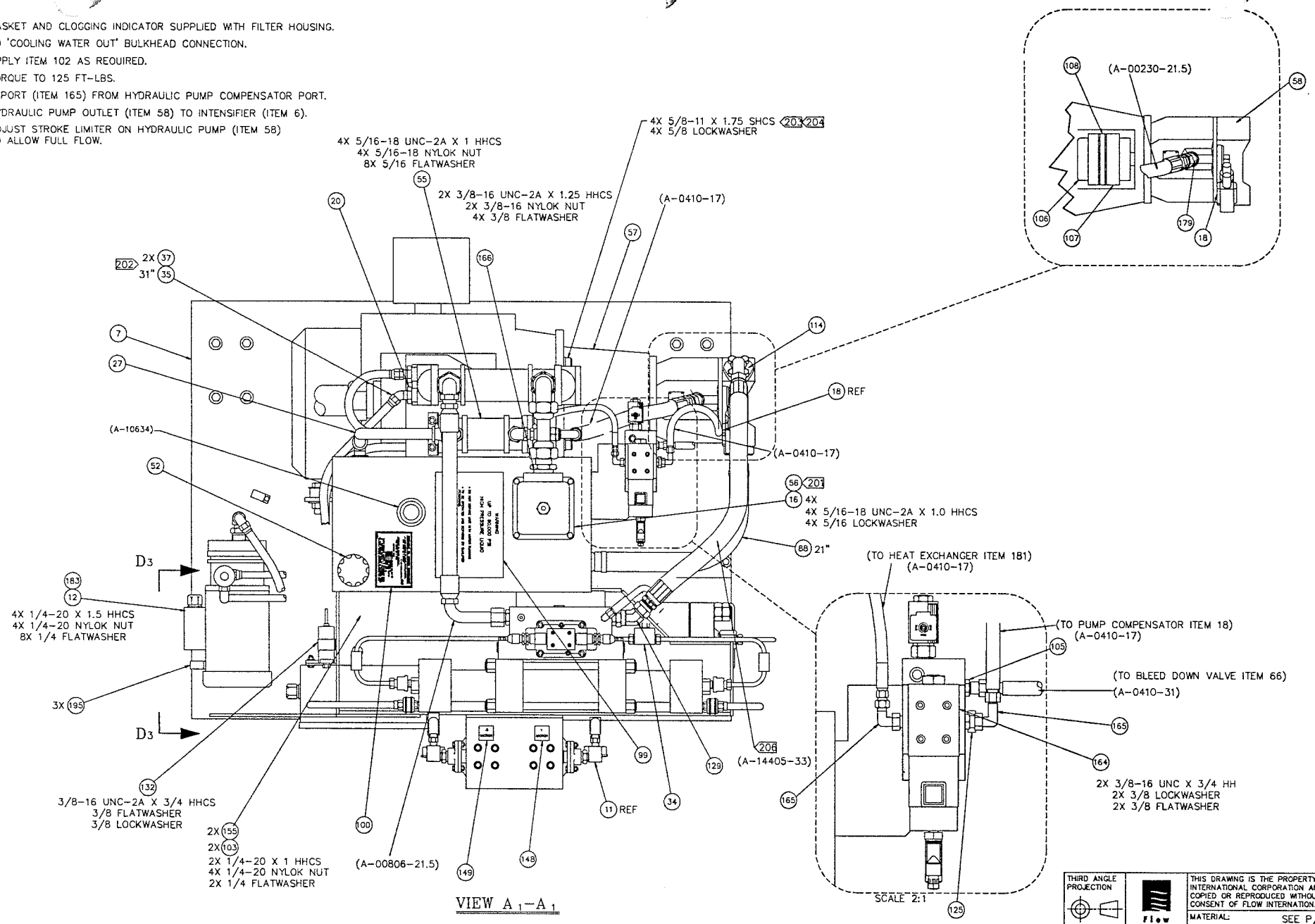
Flow

REVISION T	MODELED IN NONE	MATERIAL: SEE P/L
DRAWN BY LINSE	STARTED 2/19/01	TITLE: CE PUMP ASSEMBLY;50I-S
ENG LINSE	SCALE D 1:4	BASE PART NUMBER 013670 — 1 OF 4

CE

NOTES:

201 GASKET AND CLOGGING INDICATOR SUPPLIED WITH FILTER HOUSING.
202 TO 'COOLING WATER OUT' BULKHEAD CONNECTION.
203 APPLY ITEM 102 AS REQUIRED.
204 TORQUE TO 125 FT-LBS.
205 P PORT (ITEM 165) FROM HYDRAULIC PUMP COMPENSATOR PORT.
206 HYDRAULIC PUMP OUTLET (ITEM 58) TO INTENSIFIER (ITEM 6).
207 ADJUST STROKE LIMITER ON HYDRAULIC PUMP (ITEM 58) TO ALLOW FULL FLOW.



THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION T	MODELED IN NONE	TITLE: CE PUMP ASSEMBLY; 50I-S
DRAWN BY LINSE	STARTED 2/19/01	
ENG LINSE	SCALE D 1:4	BASE PART NUMBER 013670 — 2 OF 4

CE

NOTES:

301 FILTER ELEMENT, A-5480, IS SUPPLIED WITH FILTER HOUSING, A-5479 (ITEM 56), AND MAY BE PURCHASED SEPARATELY.

304 TO 'W' PORT ON ITEM 164, PROPORTIONAL MANIFOLD ASSY.

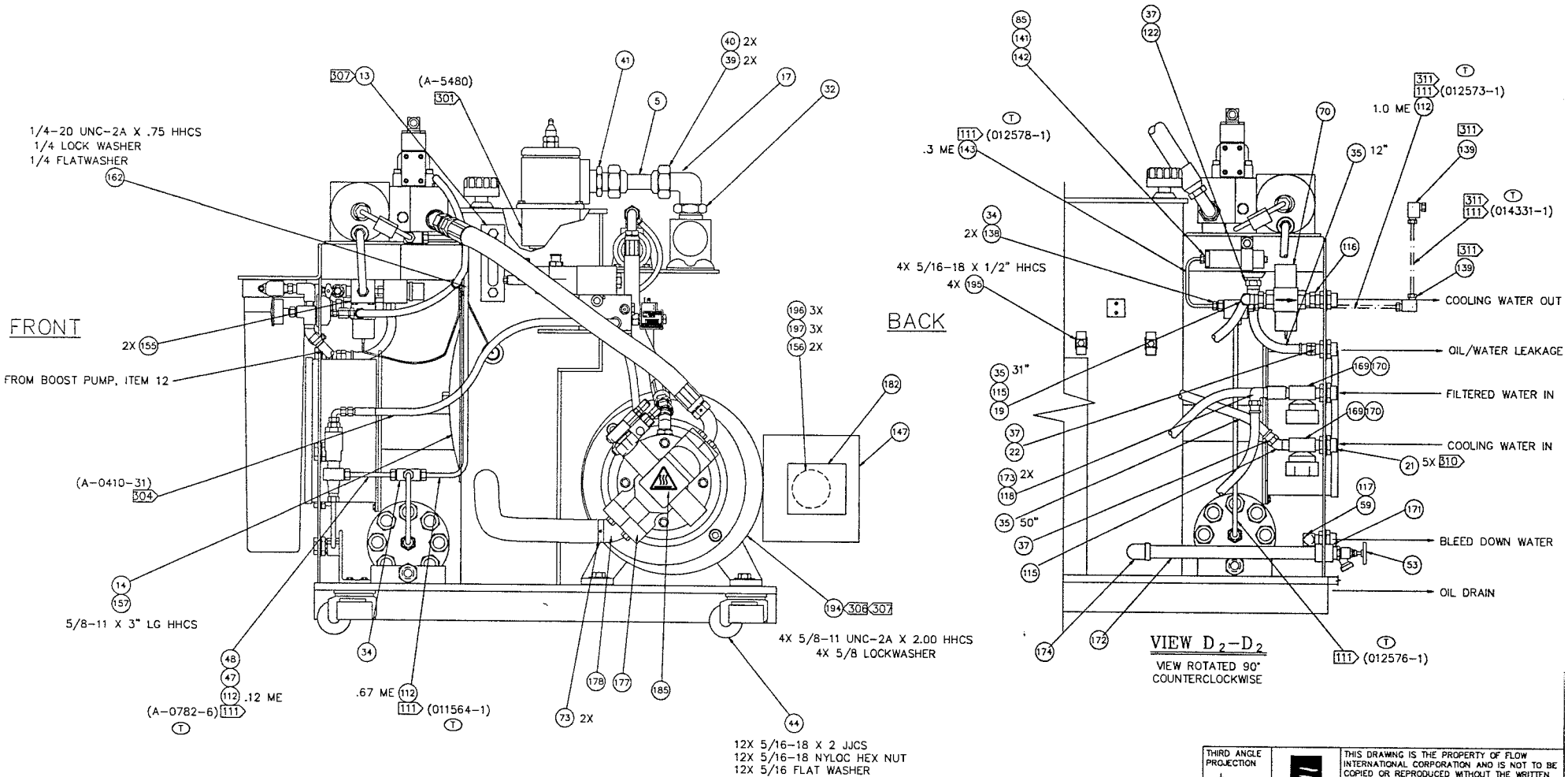
306 TORQUE TO 125 FT-LBS.

307 APPLY ITEM 102 AS REQUIRED.

309 HIGH PRESSURE PLUMBING LINES AND ELECTRICAL J-BOX NOT SHOWN FOR CLARITY PURPOSES.

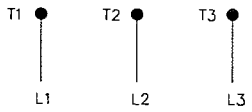
310 JAM NUT LOCATED ON OUTSIDE OF BULKHEAD PLATE.

311 SHIP FITTINGS AND TUBING UNASSEMBLED.

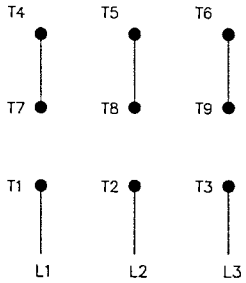


THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION T	MODELED IN NONE	TITLE CE PUMP ASSEMBLY; 50I-S
DRAWN BY LINSE	STARTED 2/21/01	
ENG MODRE	SCALE D 1:4	BASE PART NUMBER 013670 — 3 OF 4

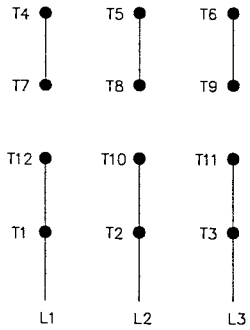
CE



3 LEAD HIGH VOLTAGE RUN (460V)



9 LEAD HIGH VOLTAGE RUN (460V)



12 LEAD HIGH VOLTAGE RUN (460V)

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION T	MODELED IN NONE	TITLE CE PUMP ASSEMBLY; 501-S
DRAWN BY LINSE	STARTED 2/21/01	
ENG S.MORDRE	SCALE D 1:4	BASE PART NUMBER 013670 — 4 OF 4

CE

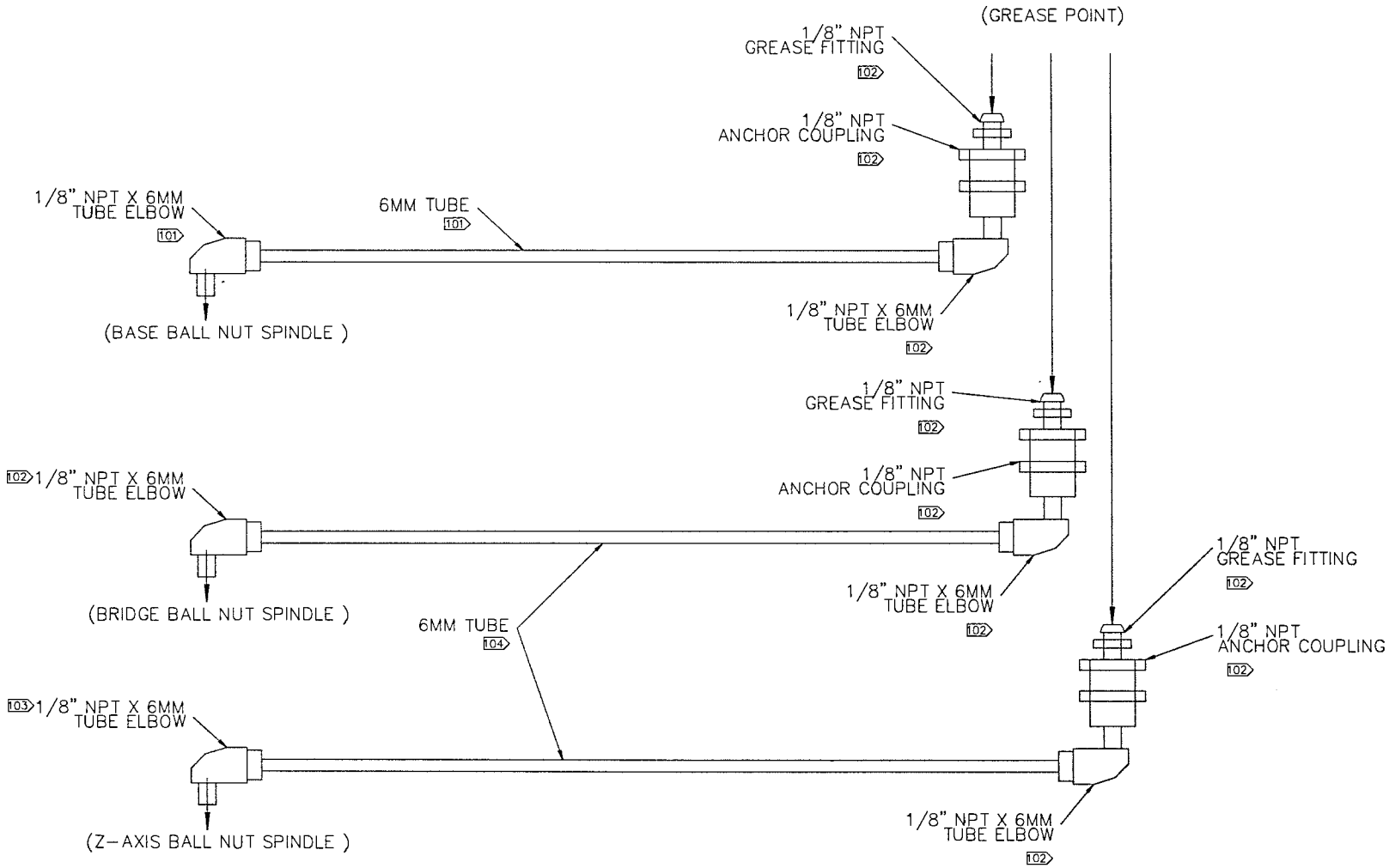
NOTES:

101 PARTS ON BASE BOM

102 PARTS ON BRIDGE BOM

103 PARTS ON Z-AXIS BOM

104 PARTS ON BRIDGE CABLE CARRIER BOM



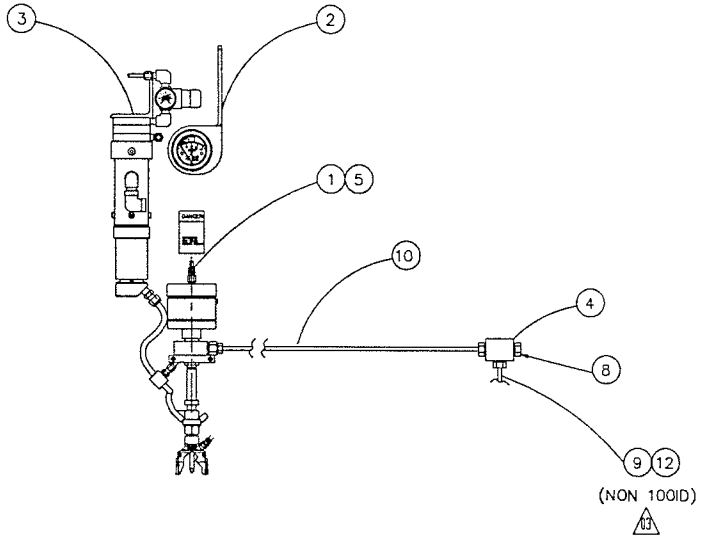
CENTRAL LUBRICATION SYSTEM

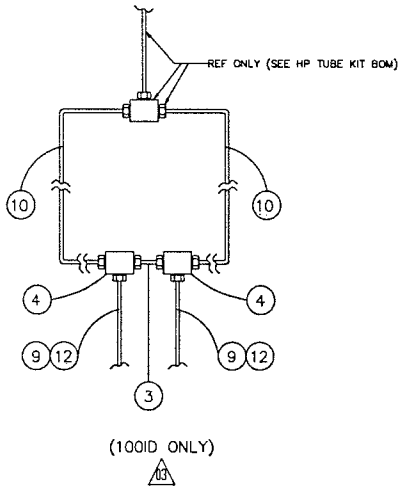
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL:
REVISION A	MODELED IN NONE	TITLE CENTRAL LUBE SYSTEM SCHEM; IFB
DRAWN BY JMF	STARTED 8/18/04	
ENG G.PAGEAU	SCALE N/A	BASE PART NUMBER 015292 1 OF 1

NOTES:

101 ITEM NOT SHOWN

	ITEM	-5 QUANTITY	-4 QUANTITY	-3 QUANTITY	-2 QUANTITY	-1 QUANTITY	U/M	PART NUMBER	DESCRIPTION
	1	1	1	1	1	1	EA	A-00449-1	ELBOW; UNION; 2-2; 1/8; .56; 90 DEG
	2	1	1	1	1	1	EA	R33860-4	BRACKET; VACUUM GAUGE
	3	1	1	1	1	1	EA	R33879-4	BRACKET; METERING VALVE
	4	2	2	2	1	1	EA	A-0776-4	TEE; HP; 1/4"; ANTI-VIBRATION
	5	1	1	1	1	1	EA	A-13926-3	CONNECTOR; 6MM OD TO 1/8 NPT
101	6	12	12	9	6	6	EA	A-2581	CLAMP; 1/4" TUBE
101	7	12	12	9	6	6	EA	A-2582	CLAMP; TOP PLATE
02	8	–	–	1	1	1	EA	A-0784-1	PLUG; H.P.; 1/4"
101	9	–	2	2	–	1	EA	712617-1	WHIP ASSY; HP; 1/4"; 18FT
02	10	2	2	1	1	1	EA	712555-1	TUBING WHIP; FORMED; IFB
101	11	1	1	1	1	1	EA	712182-1	BRACKET; WHIP SUPPORT; IFB
101	12	2	–	–	1	–	EA	R03550402	WHIP; HP
101	13	1	1	1	–	–	EA	A-0781-19	NIPPLE; TUBING; 1/4 HP; 19 LG
101	14	–	–	1	–	–	EA	014510-1	H.P. COIL ASSEMBLY; HYPLEX
101	15	1	1	–	–	–	EA	015227-1	SUPPORT PLATE; DUAL WHIP
101	16	24	24	18	12	12	EA	A-14292-7	SCREW; SKT HD; M6; 40MMLG; SST
101	17	24	24	18	12	12	EA	A-0398-4	WASHER; LOCK; METRIC; SST; 6MM
101	18	1	1	–	–	–	EA	015310-1	TUBE KIT; 100 ID; INSTALL





PART #	DESCRIPTION	MACHINE SIZE
015382-1	PLUMBING ASSY; HP; IFB; 30HP&50IS	2400, 4400, & 4800
015382-2	PLUMBING ASSY; HP; IFB; 30HP&50IS	2030
015382-3	PLUMBING ASSY; HP; IFB; 50HP	ALL
015382-4	PLUMBING ASSY; HP; IFB; 100ID	2400, 4400, & 4800
015382-5	PLUMBING ASSY; HP; IFB; 100ID	2030

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION A	MODELED IN ACAD	TITLE PLUMBING ASSY; HP; IFB
DRAWN BY JMF	STARTED 9/1/04	
ENG G.PAGEAU	SCALE NONE	BASE PART NUMBER 015382 — 1 OF 1

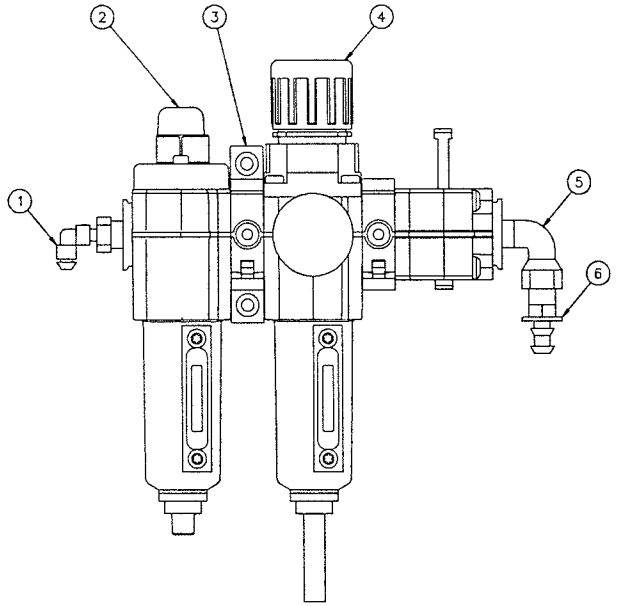
NOTES:

101 ITEM NOT SHOWN

102) PACKAGE AND LABEL ALL PARTS OR ASSEMBLIES

BILL OF MATERIAL

ITEM	-1 QUANTITY	U/M	PART NUMBER	DESCRIPTION
1	1	EA	A-19649-4	ELBOW;PRESTOLOK;METRIC;6 1/4
2	1	EA	A-14429	FILTER;OIL REMOVAL
3	1	EA	A-14431	CLAMP;QUICK
4	1	EA	A-14430	FILTER/REGULATOR/GAUGE
5	1	EA	A-20229-1	ELBOW;MALE PIPE;SWVL;1/4 NPTF
6	1	EA	A-0815-3	CONNECTOR;MALE PIPE;PUSH-LOK
101 7	1	EA	711836-1	ASSEMBLY, ABRASIVE PLUMBING
101 8	1850	MM	A-20193-1	TUBING;POLYURETHANE;BLUE;6MM



DETAIL OF AIR REGULATOR/FILTER ASSEMBLY

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION A	MODELED IN NONE	TITLE AIR REGULATOR/FILTER ASSY;iFB
DRAWN BY JMF	STARTED 9/20/04	
ENG G.PAGEAU	SCALE NONE	BASE PART NUMBER 015444 — 1 OF 1

NOTES:
101 ITEM NOT SHOWN
102. REAR WALL MAY BE USED FOR 4TH SIDE WHEN MACHINE SIDES ARE OPEN AS SHOWN IN FIGURE 1
103. LAYOUTS SHOWN ARE AS REFERENCE ONLY FOR TYPICAL LAYOUTS. BE SURE LIGHT CURTAIN BEAM IS MINIMUM OF 1320MM (4.3FT) FROM CUTTING AREA.
104. USE THE APPRORIATE MACHINE ELECTRICAL SCHEMATICS FOR CONNECTION PURPOSES. 713208-DWG FOR WMC AND 711595-DWG FOR IFB MACHINES

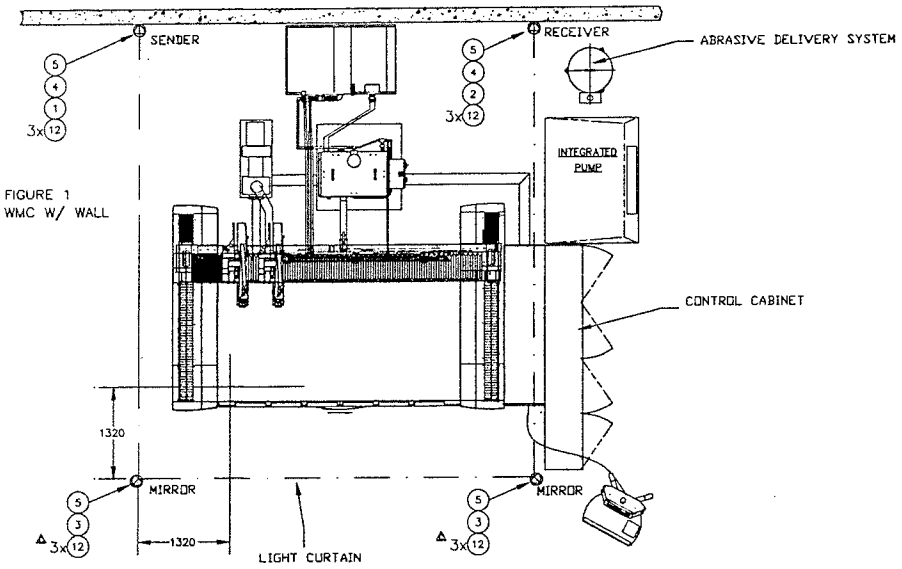


FIGURE 1
WMC W/ WALL

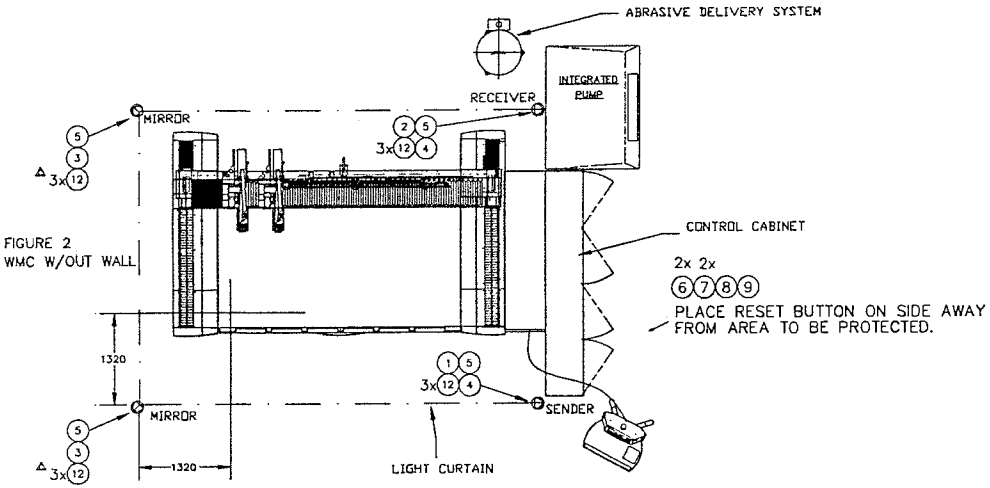


FIGURE 2
WMC W/OUT WALL

	-4 QTY	-3 QTY	-2 QTY	-1 QTY	U/M	ITEM	PART NUMBER	LIST DESCRIPTION
	1	1	–	1	EA	1	A-13903	CE LIGHT CURTAIN; SENDER UNIT
	1	1	–	1	EA	2	A-13904	CE LIGHT CURTAIN; RECEIVER UNIT
	2	2	–	2	EA	3	A-13905	CE LIGHT CURTAIN; MIRROR TOWER
	2	2	–	2	EA	4	A-13906	CE LIGHT CURTAIN; MOUNT. TOWER
	4	4	–	4	EA	5	A-14209	CE LIGHT CURTAIN; LEVELING PLT
	–	–	2	2	EA	6	A-13499	CE RELAY; 24VDC; 4P
	–	–	2	2	EA	7	A-13473	CE RELAY SOCKET
	–	–	1	1	EA	8	A-6613	SWITCH; PUSH BUTTON
	–	–	1	1	EA	9	A-6614	BASE; CONTACT BLOCK
101	–	–	15	15	ME	10	A-18927-75-3	SIGNAL CABLE 3 x 0.75
101	–	–	15	15	ME	11	A-18927-75-7	SIGNAL CABLE 7 x 0.75
	12	12	–	12	EA	12	A-18925-1	ANCHOR SET M10X140
101	2	–	–	–	EA	13	A-18920-1	GUARD; 750 X 1200
△	–	–	1	1	EA	14	A-20317-1	LABEL; LIGHT CURTAIN RESET

△MINIMUM DISTANCE OF 1320mm (1600mm/sec*0,29sec+850mm) IS BASED ON:
* MAX. 0,015 SEC RESPONSE TIME OF LIGHT CURTAIN RECEIVER
* APPROX. 0,275 SEC WATERJET STOP TIME CONSISTS OF:
  - APPROX. 0,2 SEC STOP TIME FOR ON/OFF-VALVE
  - APPROX. 0,075 SEC SUMMARY OF ELECTRICAL, PNEUMATICAL REACTION TIMES

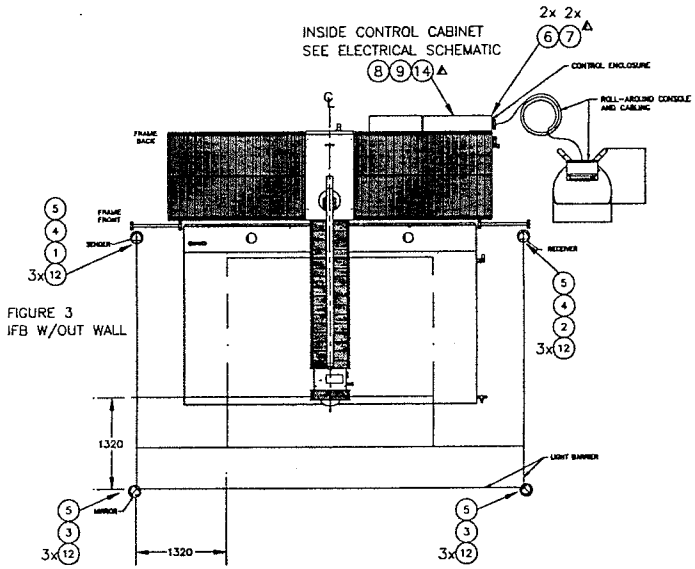


FIGURE 3
IFB W/OUT WALL

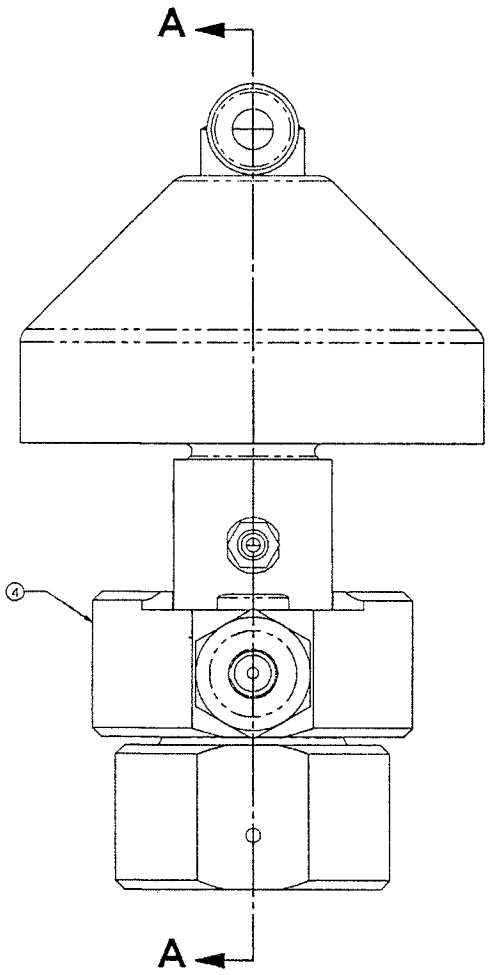
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION F	MODELED IN NONE	TITLE LIGHT CURTAIN ASSY; 4 POINT
DRAWN BY TAP	STARTED 10/8/03	
ENG TAP	SCALE NA	BASE PART NUMBER 710649 — 1 OF 1

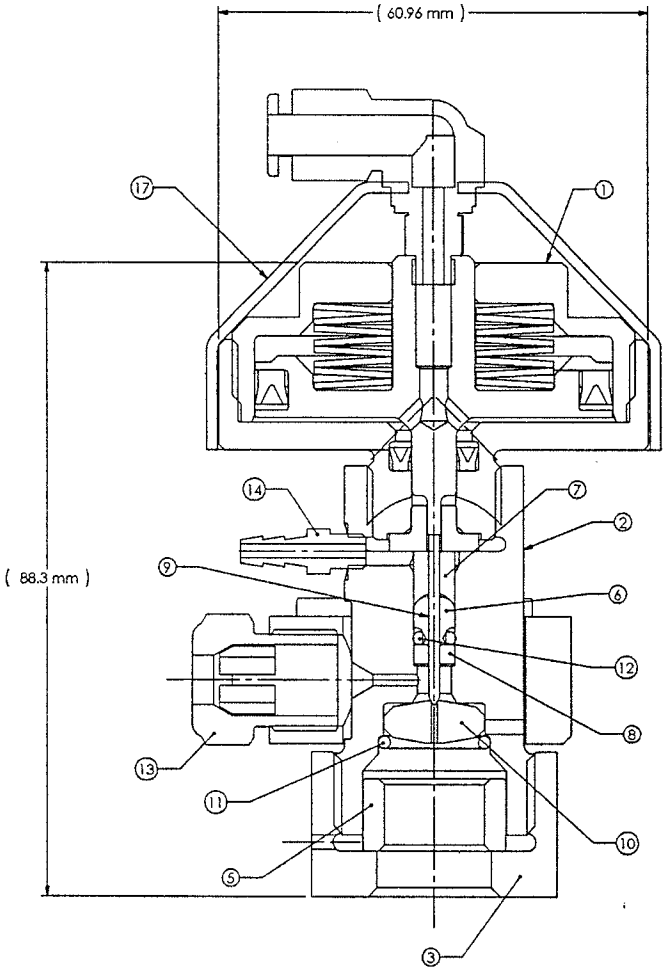
CE

NOTES:

101. APPLY AIR PRESSURE OF 60 PSI MIN. BEFORE TIGHTENING THE BODY (ITEM 2) TO THE ACTUATOR (ITEM 1).

102. DO NOT OVERTIGHTEN BODY (ITEM 2) TO ACTUATOR (ITEM 1), HAND TIGHT IS SUFFICIENT.





SECTION A-A

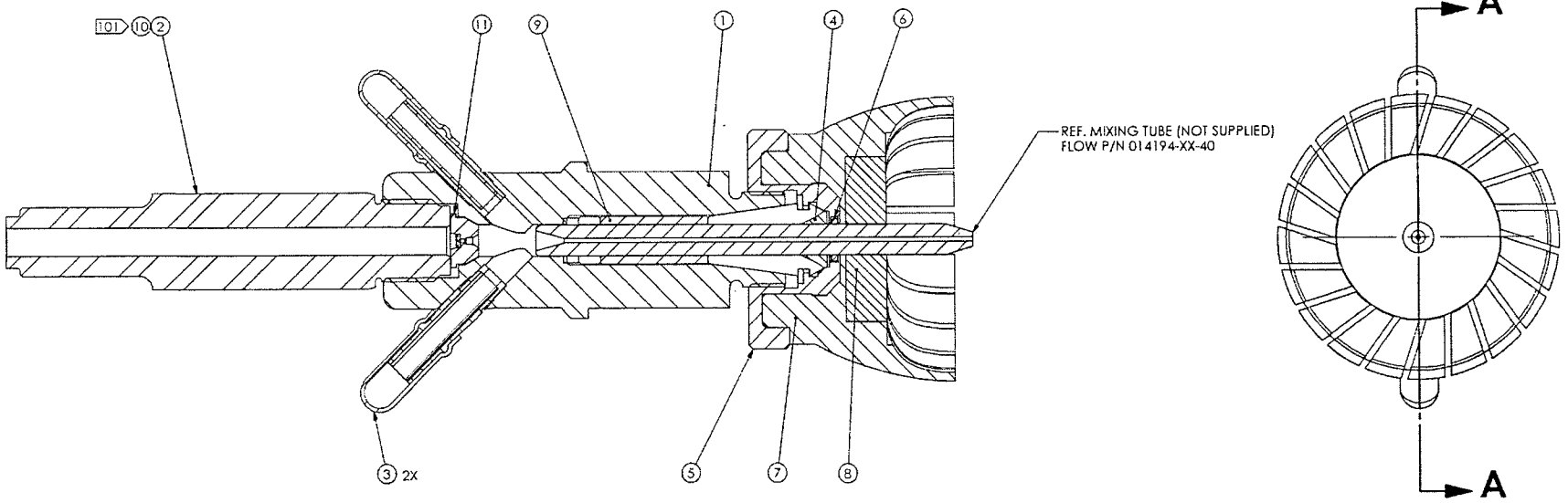
ITEM	QTY	U/M	PART NUMBER	DESCRIPTION
1	1	EA	710875-1	ACTUATOR; 60K MINI VALVE
2	1	EA	710866-1	BODY; 60K MINI VALVE
3	1	EA	710867-1	GLAND; 60K MINI VALVE
4	1	EA	710868-1	COLLAR; 60K MINI VALVE
5	1	EA	710869-1	COLLAR; WATER BODY
6	1	EA	710820-1	SEAL;INSTAJET II;87 KSI
7	1	EA	710819-1	BACKUP RING;INSTAJET II;87 KSI
8	1	EA	710821-1	BUSHING;STEM;87 KSI
9	1	EA	710822-1	POPPET;ON/OFF VALVE;87 KSI
10	1	EA	710823-1	SEAT;POPPET;87K
11	1	EA	A-0275-014	O-RING;BUNA-N;70 DUR;NO.2-014
12	1	EA	B-8075-005	O-RING;ULTRA HP;SILICONE DIP
13	1	EA	A-0689-1	COLLET;GLAND;ANTI-VIB;1/4"
14	1	EA	A-5850	FITTING;BARB
15	0	EA	A-2185	LUBRICANT;BLUE
(8) 16	0	EA	A-18736	LOCTIE 603;RET COMP;OIL RESIS
17	1	EA	712177-1	COVER BELLOW;MINI ON/OFF VALVE

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL SEE P/L	
REVISION B	MODELED IN SOLIDWORKS	TITLE VALVE ASSY;60K MINI	
DRAWN BY M.SAHNEY	STARTED 7/25/00		
ENG M.SAHNEY	SCALE 1.5:1	BASE PART NUMBER 710870	1 OF 2

UNCONTROLLED COPY. USER IS RESONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.

NOTE:
101 ATTACH LABEL TO ITEM 2 AT ASSEMBLY

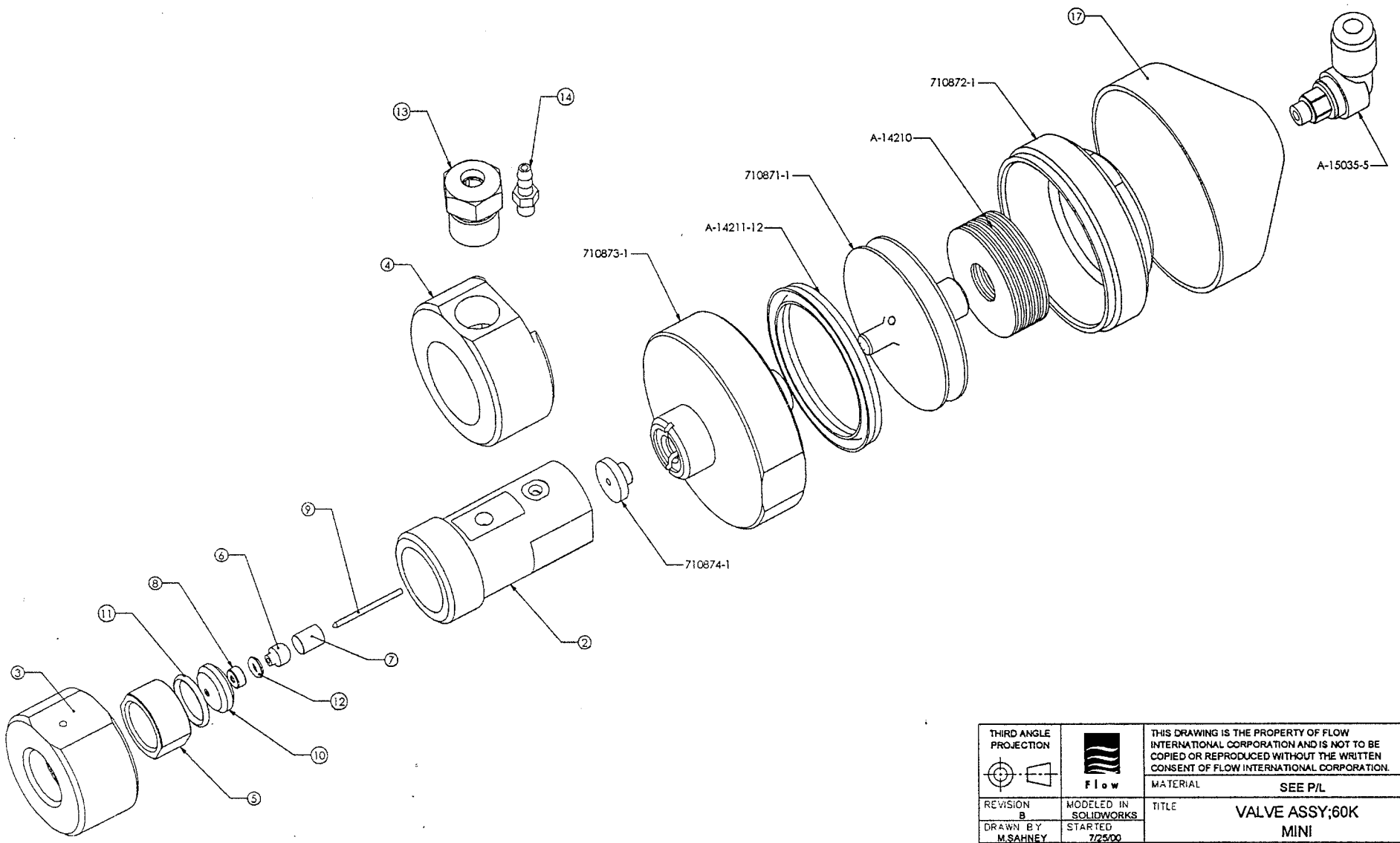
ITEM	QTY	U/M	PART NUMBER	DESCRIPTION
1	1	EA	712263-1	MIXING CHBR ASSY;PASER DWJ ECL
2	1	EA	710951-1	BODY;MINI PRECISION NOZZLE;AWJ
3	2	EA	A-11080	CAP;PLUG
4	1	EA	710806-1	COLLET;NOZZLE;PRECISION
5	1	EA	711589-1	NOZZLE NUT;DYNAMIC WATERJET
6	1	EA	A-15034-1	O-RING;METRIC;7MM ID;1.5MM CS
7	1	EA	711621-1	SHIELD;SPRAY;URETHANE;EVEREST
8	1	EA	711933-1	BLAST DISK; DYNAMIC WATERJET
9	1	EA	712265-1	MIXING TUBE SPCR;PASER DWJ ECL
101 10	1	EA	014223-1	LABEL; WARNING; PASER ECL PLUS
11	1	EA	014201-14	ORIFICE ASSY;PASER ECL;.014



SECTION A-A

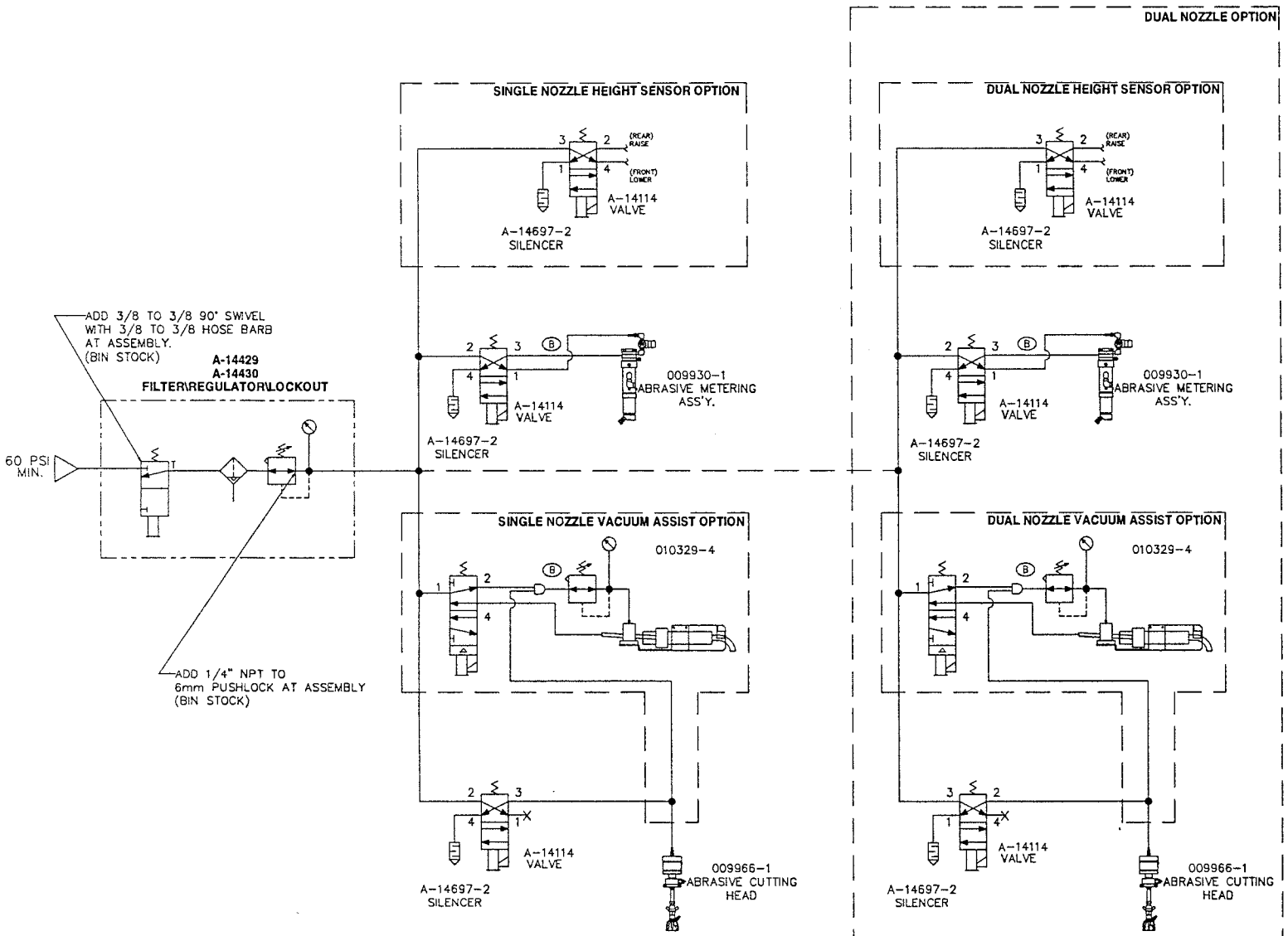
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION: A	MODELED IN: SOLIDWORKS	TITLE: CUTTING HD ASSY; PASER;DWJ ECL
DRAWN BY: A.PETTIT	STARTED: 05/07/02	
ENG: A.PETTIT	SCALE: 1:1	BASE PART NUMBER: 712262 — 1 OF 1

UNCONTROLLED COPY. USER IS RESONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.



THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL: SEE P/L	
REVISION: B	MODELED IN: SOLIDWORKS	TITLE: VALVE ASSY;60K MINI	
DRAWN BY: M.SAHNEY	STARTED: 7/25/00		
ENG: M.SAHNEY	SCALE: 1:1	BASE PART NUMBER: 710870	2 OF 2

UNCONTROLLED COPY. USER IS RESONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.



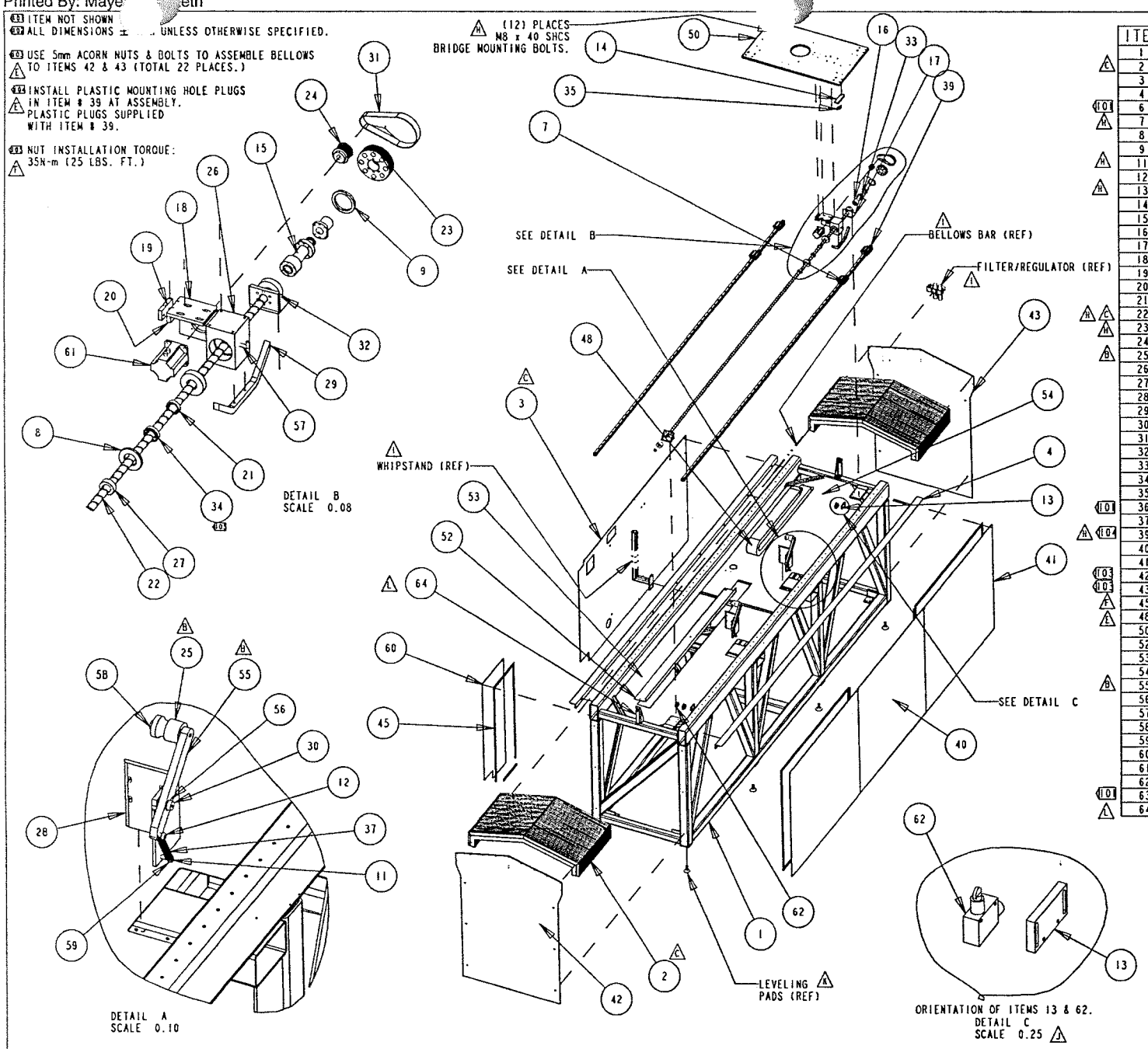
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION B	MODELED IN NONE	TITLE SCHEMATIC; IFB PNEUMATIC
DRAWN BY TK	STARTED 7/26/01	
ENG TK	SCALE 1:1	BASE PART NUMBER 711727 — 1 OF 1

(03) ITEM NOT SHOWN
(02) ALL DIMENSIONS ± UNLESS OTHERWISE SPECIFIED.

(03) USE 5mm ACORN NUTS & BOLTS TO ASSEMBLE BELLOWS TO ITEMS 42 & 43 (TOTAL 22 PLACES.)

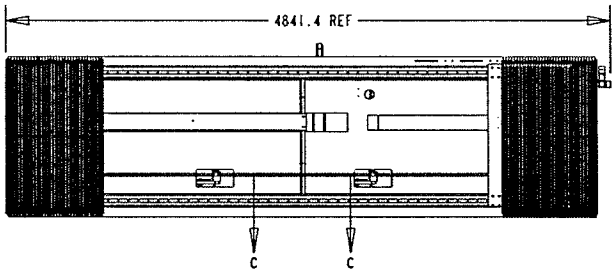
(04) INSTALL PLASTIC MOUNTING HOLE PLUGS IN ITEM # 39 AT ASSEMBLY. PLASTIC PLUGS SUPPLIED WITH ITEM # 39.

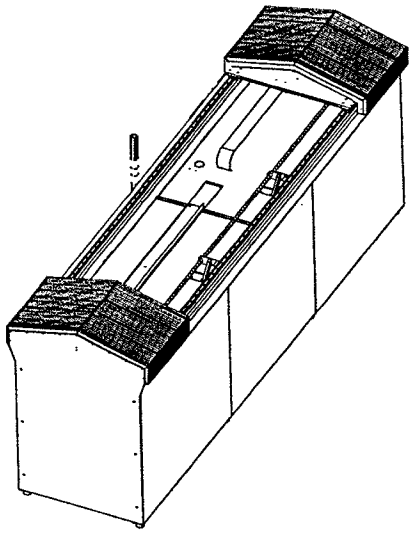
(03) NUT INSTALLATION TORQUE: 35N-m (25 LBS. FT.)

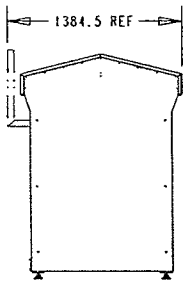


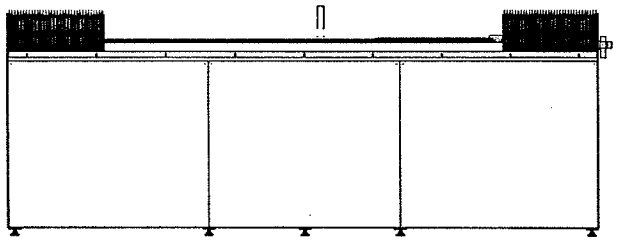
ITEM	QTY	UOM	PART NO.	DESCRIPTION
1	1	EACH	711838-1	BASE;MACHINE 12'
2	2	EACH	R03522901	BASE AXIS WAYCOVERS 12' STROKE
3	1	EACH	711839-1	PANEL, BACK 1/8" ABS
4	2	EACH	R03538501	GUIDE, BELLOWS 3" CONN.
6	5	EACH	A-13405-1	BOLT; ANCHOR; 3/4"x10"
7	4	EACH	A-19889-30	BLOCK;LINEAR RAIL;INA;EX;KWVE30L
8	1	EACH	A-14047	SEAL, CR; 45 x 80 x 8
9	1	EACH	A-14048	SEAL, CR; 63 x 80 x 8
11	2	EACH	A-14503-2	BOLT;SHOULDER;SCKT HD;M10x25
12	2	EACH	A-14503-1	BOLT;SHOULDER;SCKT HD;M10x12
13	2	EACH	015205-1	HOLDER, LIMIT SWITCH
14	1	EACH	R34003-2	MOUNT, CAM
15	1	EACH	015320-1	SHAFT; DRIVE; INA
16	2	EACH	711840-1	SUPPORT; COLLAR
17	2	EACH	711841-1	MOUNT, BALLSCREW END
18	1	EACH	711842-1	MOUNT,MOTOR
19	1	EACH	711843-1	BLOCK,BELT TENSION
20	1	EACH	711844-1	BLOCK,BELT TENSION(FIXED)
21	1	EACH	R34291-1	RING, SUPPORT SPACER
22	1	EACH	714333-2	BALLSCREW;IFB;COLLAR MT
23	1	EACH	015321-1	PULLEY; MODIFICATION; INA
24	1	EACH	R34359-2	DRIVE PULLEY MODIFICATION
25	2	EACH	712232-1	CASTER;STABILIZER;GLOBAL
26	1	EACH	711845-1	MOUNT; ROTATING NUT
27	1	EACH	R34961-2	HOUSING,GREASE SEAL
28	2	EACH	711846-1	MOUNT,STABILIZER ASSY
29	1	EACH	711847-1	RAMP, STABILIZER
30	2	EACH	A-14503-3	BOLT;SHOULDER;SCKT HD;M16x25
31	1	EACH	A-01023-04	TIMING BELT;500-5MM-25
32	2	EACH	A-14027-5	BEARING;40 DEGREE CONTACT
33	2	EACH	A-14025-5	NUT;BEARING RETAINING
34	1	EACH	A-14025-11	NUT;BEARING RETAINING
35	2	EACH	A-13979-1	CAM, BALLUFF
36	1	EACH	006419-1	LABEL;LOGO;DUAL STRIPE
37	2	EACH	A-14003-1	SPRING;EXTENSION;.063 WIRE DIA
39	2	EACH	A-19857-30-4424-12	LINEAR RAIL;INA;TKVD30/4424/12
40	1	EACH	711848-1	COVER, FRONT
41	2	EACH	711849-1	COVER, FRONT R-L
42	1	EACH	711850-1	PANEL, LEFT SIDE
43	1	EACH	711851-1	PANEL, RIGHT SIDE
45	60	FEET	A-10108	MAGNET;FLEXIBLE STRIP
48	1	EACH	713640-1	CABLE CARRIER ASS'Y; X;6X12
50	1	EACH	711854-1	BASE AXIS SUB-PLATE (WIDE)
52	1	EACH	R03672102	GUIDE;CABLE TRACK
53	1	EACH	R03671701	COVER; INSIDE LEFT
54	1	EACH	R03671801	COVER; INSIDE RIGHT
55	2	EACH	712233-1	ARM;STABILIZER SWING;ASS'Y
56	8	EACH	A-14428-4	WASHER;THRUST
57	1	EACH	A-14501-14	FITTING;ELBOW;1/4 THR X 1/8 TB
58	2	EACH	A-14503-4	BOLT;SHOULDER;SCKT HD;M16x80
59	4	EACH	A-0399-13	WASHER;FLAT;STEEL;10MM NOM
60	1	EACH	711852-1	COVER;RIGHT REAR
61	1	EACH	A-13944-3	SERVOMOTOR;750W
62	3	EACH	A-14007	LIMIT SWITCH
63	1	EACH	711727-DWG	SCHEMATIC; IFB PNEUMATIC
64	2	EACH	015809-1	BRACKET;SIDE PANEL;IFB

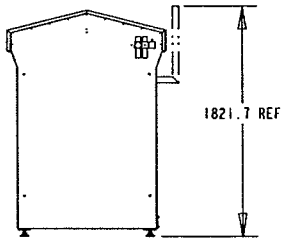
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION L	MODELED IN PRO-E	TITLE ASSEMBLY, BASE AXIS 12' / 3 M
DRAWN BY TK	STARTED 26-Jun-01	
ENG RL	SCALE 0.025	BASE PART NUMBER 711834 — 1 of 3

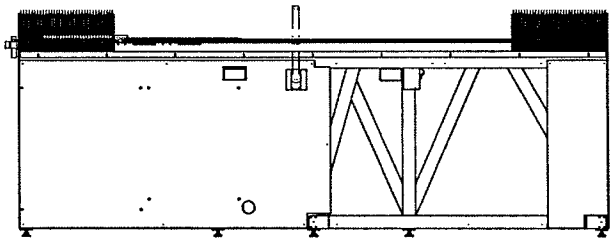




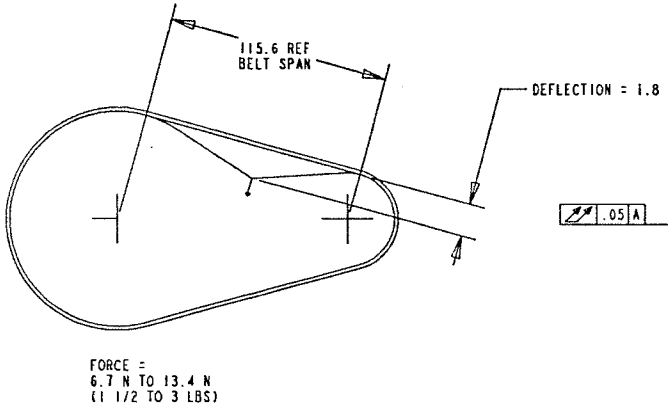




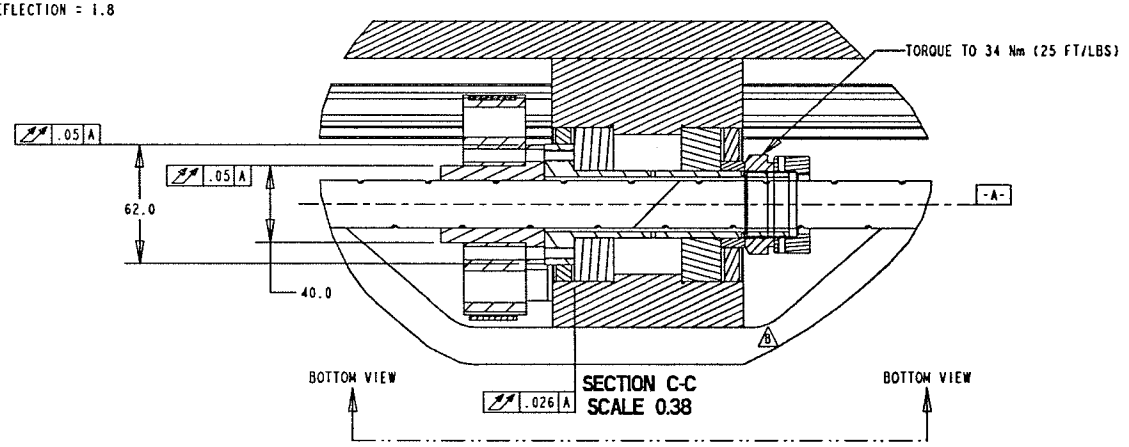




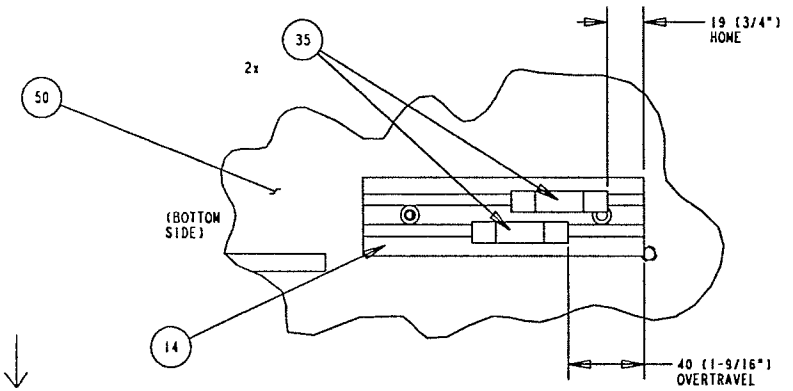
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION L	MODELED IN PRO-E	TITLE ASSEMBLY, BASE AXIS 12' / 3 M
DRAWN BY TK	STARTED 26-Jun-01	
ENG RL	SCALE 0.025	BASE PART NUMBER 711834 — 2 OF 3



HTD BELT DEFLECTION FORCE
SCALE 0.38



SECTION C-C
SCALE 0.38

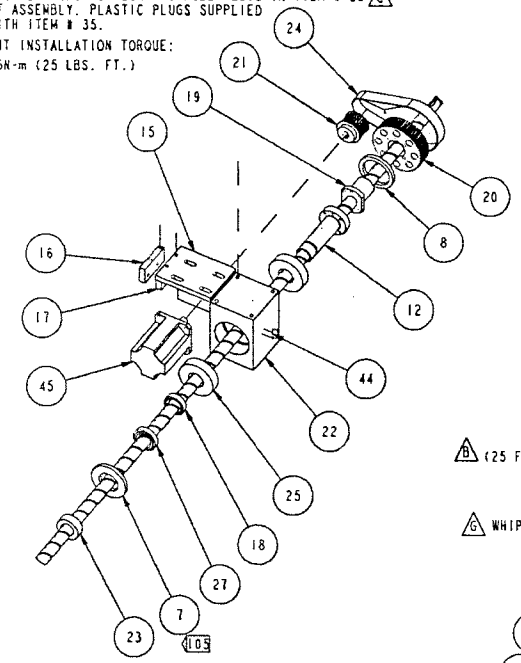


⚠ BOTTOM VIEW
(UNDERNEATH SUB-PLATE)
SCALE: 0.38

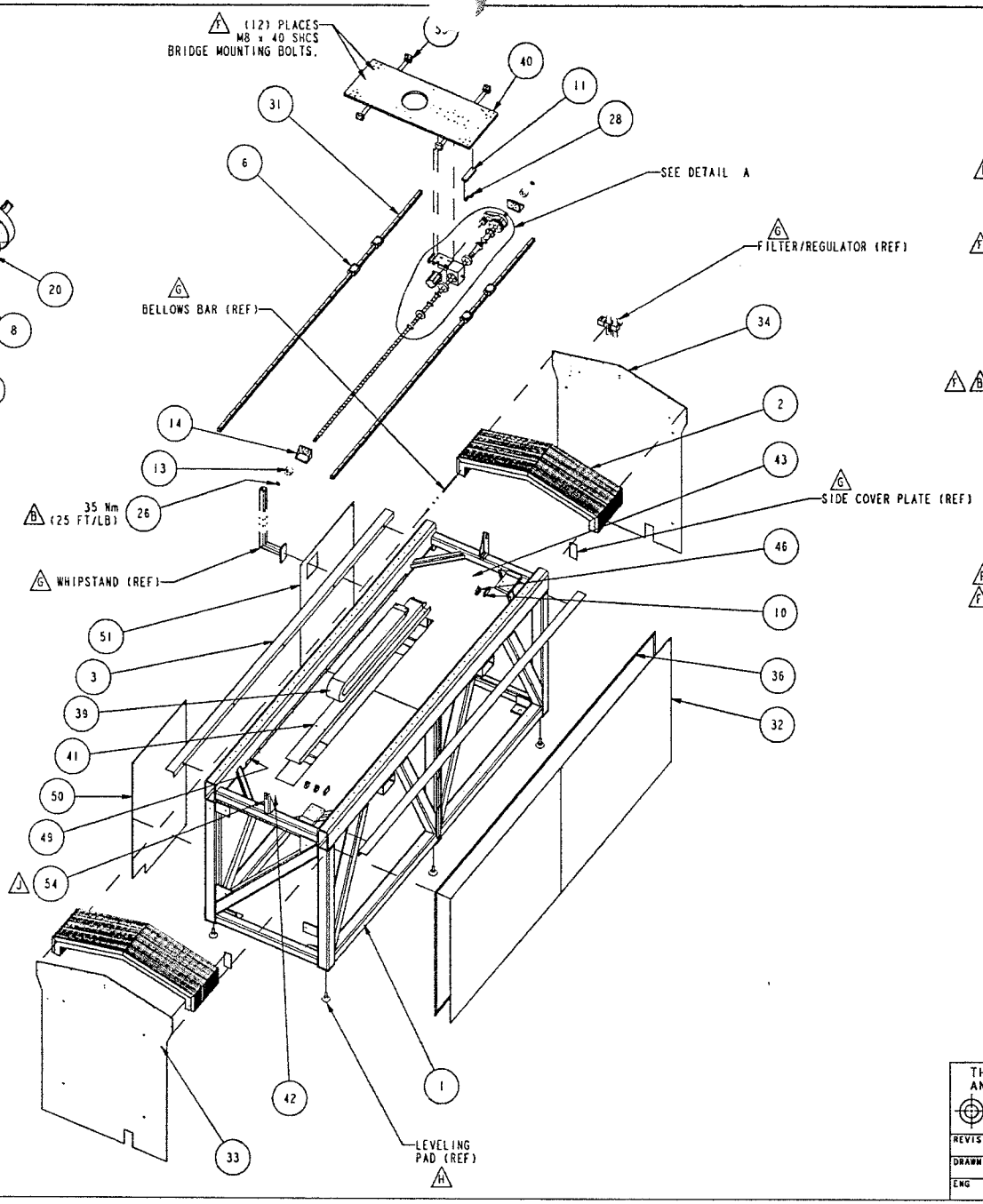
⚠ ADDED SHEET #3

THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION L	MODELED IN PRO-E	TITLE ASSEMBLY, BASE AXIS 12' / 3 M
DRAWN BY TK	STARTED 26-Jun-01	
ENG RL	SCALE 0.025	BASE PART NUMBER 711834 — 3 of 3

101 ITEM NOT SHOWN
102 ALL DIMENSIONS ± 1mm UNLESS OTHERWISE SPECIFIED.
103 USE 5mm ACORN NUTS & BOLTS TO ASSEMBLE BELLOWS TO ITEMS 33 & 34 (TOTAL 22 PLACES.) C
104 INSTALL PLASTIC MOUNTING HOLE PLUGS IN ITEM # 35 AT ASSEMBLY. PLASTIC PLUGS SUPPLIED WITH ITEM # 35. C
105 NUT INSTALLATION TORQUE: 35N-m (25 LBS. FT.) E

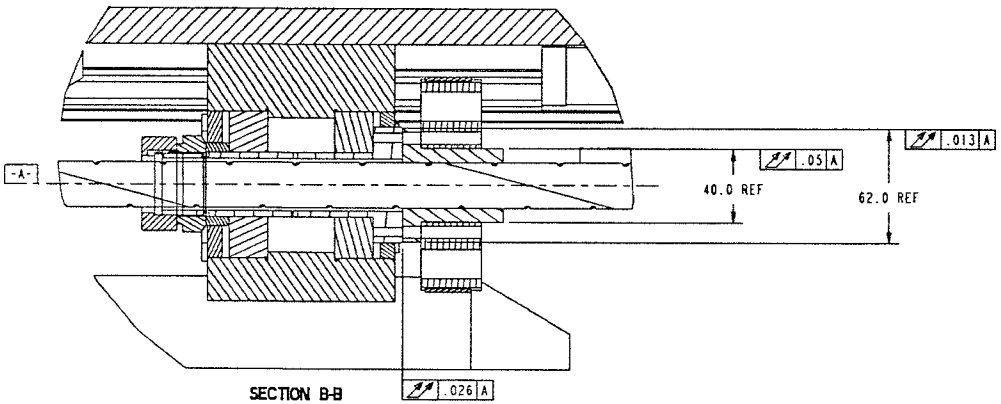


DETAIL A
SCALE 0.20

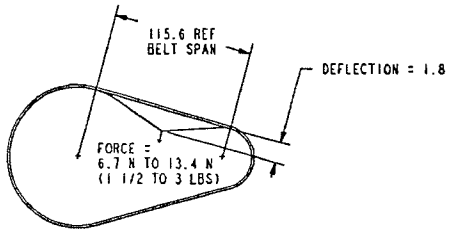


711186-1 - ASSEMBLY; BASE AXIS; 8'				
ITEM	QTY	UOM	PART NO	DESCRIPTION
1	1	EACH	711877-1	BASE; MACHINE; 8'
2	2	EACH	R03522904	BASE AXIS WAYCOVERS 8' STROKE
3	2	EACH	R34354-4	GUIDE; BELLOWS; 8'
5 F	1	EACH	006418-1	LABEL;LOGO;DUAL STRIPE
6 F	4	EACH	A-15856-30	BLOCK;LINEAR RAIL;INA;KWVE30S
7	1	EACH	A-14047	SEAL, CR; 45 x 80 x 8
8	1	EACH	A-14048	SEAL, CR; 63 x 80 x 8
10 F	2	EACH	015205-1	HOLDER, LIMIT SWITCH
11 F	1	EACH	R34003-2	MOUNT, CAM
12 F	1	EACH	015320-1	SHAFT; DRIVE; INA
13	2	EACH	711840-1	SUPPORT; COLLAR
14	2	EACH	711841-1	MOUNT, BALLSCREW END
15	1	EACH	711842-1	MOUNT,MOTOR
16	1	EACH	711843-1	BLOCK,BELT TENSION
17	1	EACH	711844-1	BLOCK,BELT TENSION(FIXED)
18 F	1	EACH	R34291-1	RING, SUPPORT SPACER
19 F B	1	EACH	714333-1	BALLSCREW;1FB;COLLAR MT
20 F	1	EACH	015321-1	PULLEY; MODIFICATION; INA
21	1	EACH	R34359-2	DRIVE PULLEY MODIFICATION
22	1	EACH	711845-1	MOUNT; ROTATING NUT
23	1	EACH	R34961-2	HOUSING,GREASE SEAL
24	1	EACH	A-01023-04	TIMING BELT;500-5MM-25
25	2	EACH	A-14027-5	BEARING;40 DEGREE CONTACT
26	2	EACH	A-14025-5	NUT;BEARING RETAINING
27	1	EACH	A-14025-11	NUT;BEARING RETAINING
28 F	2	EACH	A-13979-1	CAM, BALLOFF
29 101	1	EACH	711727-DWG	SCHEMATIC; 1FB PNEUMATIC
31 F	2	EACH	A-19857-30-3064-12	LINEAR RAIL;INA;TKVD30/3064/12
32 F 104	2	EACH	711878-1	COVER; FRONT; LEFT/RIGHT
33 103	1	EACH	711880-1	PANEL; SIDE; LEFT
34 103	1	EACH	711879-1	PANEL; SIDE; RIGHT
35 101	4	EACH	A-13405-1	BOLT; ANCHOR; 3/4";10"
36	64	FEET	A-10108	MAGNET;FLEXIBLE STRIP
39 C	1	EACH	713640-3	CABLE CARRIER ASS'Y; X;488;00
40	1	EACH	R34351-4	SUB-PLATE; BASE AXIS; THIN
41 E	1	EACH	R03672101	GUIDE;CABLE TRACK;1FB 4X8
42	1	EACH	R03671602	COVER; LEFT; INSIDE
43	1	EACH	R03671601	COVER; RIGHT; INSIDE
44 101	1	EACH	A-14501-14	FITTING;ELBOW;1/4 THR X 1/8 TB
45	1	EACH	A-13944-3	SERVOMOTOR;750W
46	3	EACH	A-14007	LIMIT SWITCH
49	2	EACH	R34615-4	REST; COVER; INSIDE
50	1	EACH	712221-1	COVER; BACK; RIGHT; 4X8
51	1	EACH	712222-1	COVER; BACK; LEFT; 4X8
53 B	4	EACH	711871-1	BLOCK, ADJUSTMENT
54 J	2	EACH	015809-1	BRACKET;SIDE PANEL;1FB

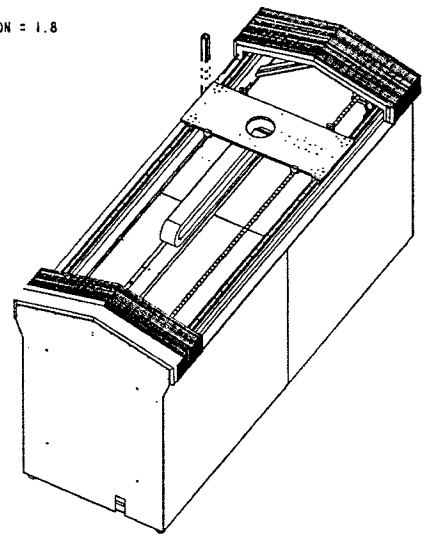
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION J	MODELED IN PRO-E	TITLE ASSEMBLY; BASE AXIS; 8'
DRAWN BY TK	STARTED 14-Mar-02	
ENG RL	SCALE 0.06	BASE PART NUMBER 711886 — 1 OF 2



SECTION B-B
SCALE 0.75



HTD BELT DEFLECTION FORCE
SCALE 0.50



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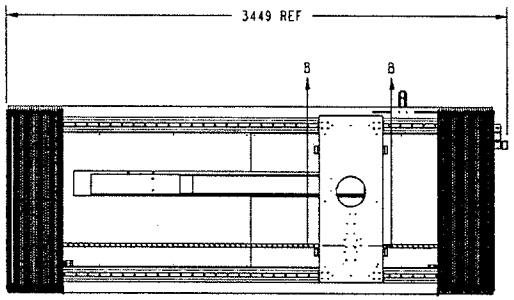
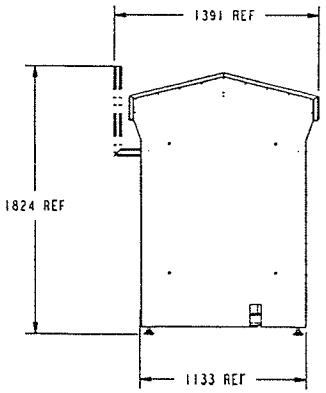
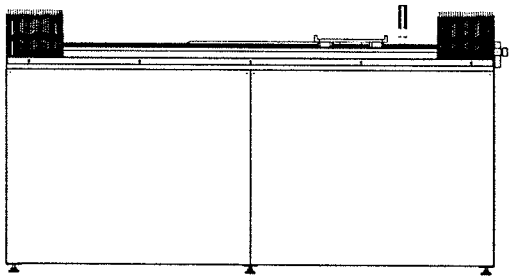
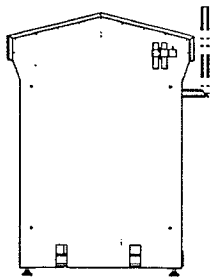
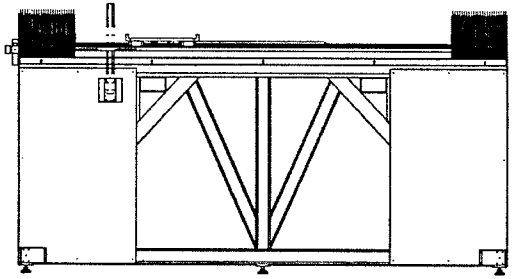










THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION J	MODELED IN PRO-E	TITLE ASSEMBLY; BASE AXIS; 8'
DRAWN BY TK	STARTED 14-Mar-02	
ENG RL	SCALE 0.06	BASE PART NUMBER 711886 — 2 OF 2

NOTES

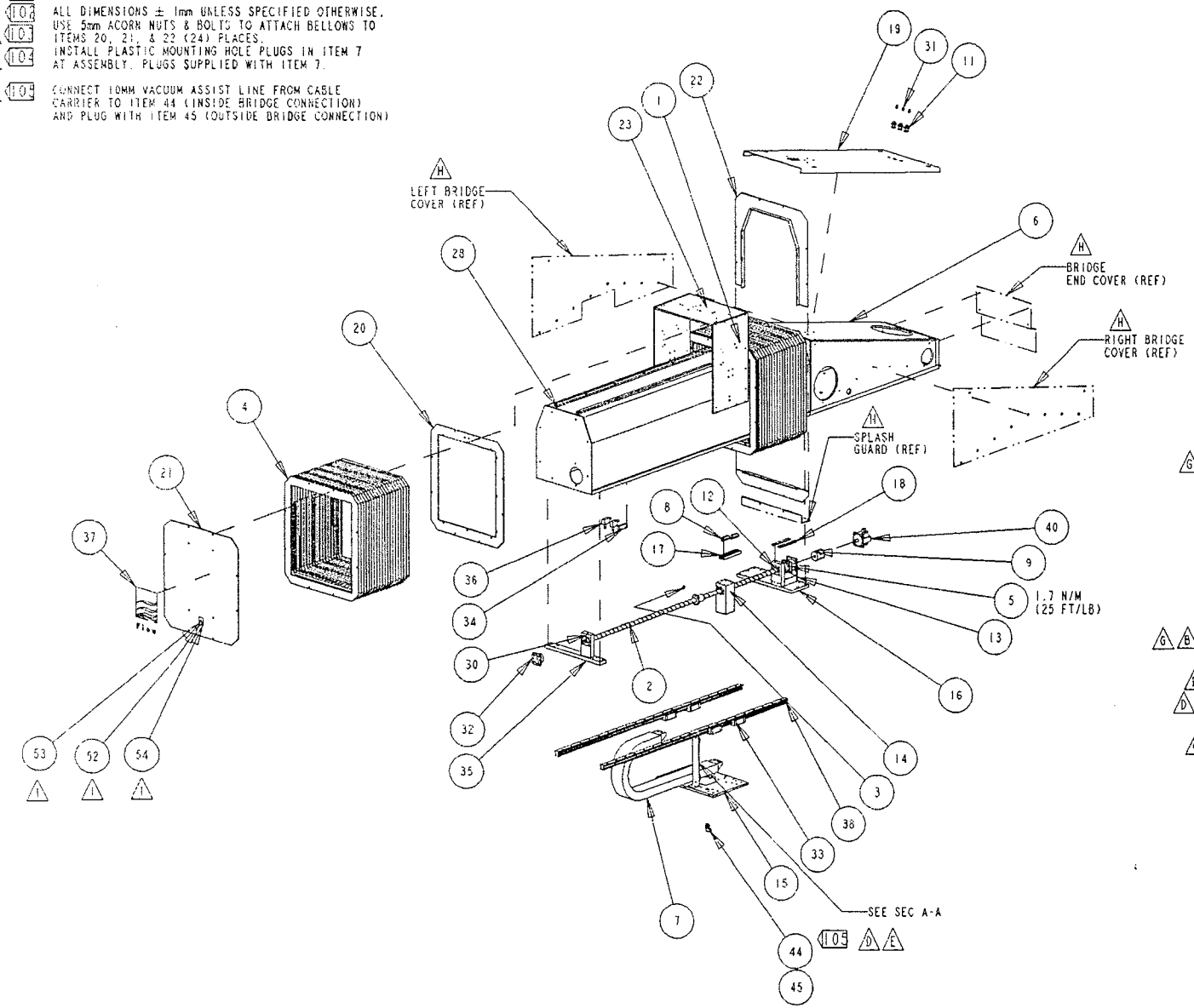
101 ITEM NOT SHOWN.

102 ALL DIMENSIONS ± 1mm UNLESS SPECIFIED OTHERWISE.

C 103 USE 5mm ACORN NUTS & BOLTS TO ATTACH BELLOWS TO ITEMS 20, 21, & 22 (24) PLACES.

C 104 INSTALL PLASTIC MOUNTING HOLE PLUGS IN ITEM 7 AT ASSEMBLY. PLUGS SUPPLIED WITH ITEM 7.

B 105 CONNECT 10MM VACUUM ASSIST LINE FROM CABLE CARRIER TO ITEM 44 (INSIDE BRIDGE CONNECTION) AND PLUG WITH ITEM 45 (OUTSIDE BRIDGE CONNECTION)



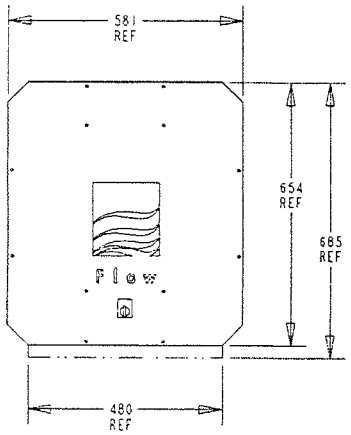
ITEM	QTY	UOM	PART NO.	DESCRIPTION
1	2	EACH	R34897-4	SIDE CARRIAGE ATTACH PLATE
G 2	1	EACH	714331-2	BALLSCREW;IFB;ROT.SCREW
3	1	EACH	A-14426	ADAPTOR;THK
103 4	2	EACH	R035338-2	BELLOWS;Y-AXIS FOLDED
5	1	EACH	A-13983	SUPPORT UNIT;FLANGE TYPE
6	1	EACH	711888-1	CROSSBRIDGE;WELD/MACH;4'
C 7	1	EACH	713641-3	CABLE CARRIER ASSY;Y,4
8	2	EACH	A-13979-2	CAM, BALLUFF
9	1	EACH	A-14052-6-3	COUPLING;SERVO ZERO MAX
11	3	EACH	A-14050-1	ANCHOR COUPLING
12	1	EACH	R33691-1	RING;SPACER
13	1	EACH	711857-1	DRIVE MOUNT; BRIDGE AXIS
G 14	1	EACH	015317-1	MOUNT, CROSSBRIDGE BALL NUT
15	1	EACH	R33858-4	CARRIAGE PLATE;CROSSBRIDGE
16	1	EACH	711858-1	CROSS SUPPORT FIX. END
17	1	EACH	R34002-2	MOUNT;CAM
18	2	EACH	711859-1	GUSSET STRIP BRIDGE AXIS
19	1	EACH	711892-1	COVER; TOP, BRIDGE; THIN
20	2	EACH	711861-1	Y-AXIS BELLOWS PLATE
21	1	EACH	711862-1	PLATE;END BRIDGE
22	1	EACH	711863-1	Y-AXIS BELLOWS REAR MOUNT
23	1	EACH	R34896-4	TOP CARRIAGE ATTACH PLATE
28	2	EACH	R33541-2C	GUIDE; BELLOWS; UHMW
G F 30	1	EACH	711860-1	MOUNT;BEARING(FIXED)
31	3	EACH	A-13682	FITTING;GREASE;1/8 NPT
32	1	EACH	R33761-1	MOUNT;BEARING;SIMPLE SUPPORT
G 33	4	EACH	A-19856-30	BLOCK;LINEAR RAIL;INA;KWVE30S
34	2	EACH	R32597-4	HOLDER, LIMIT SWITCH
35	1	EACH	711870-1	CROSS SUPPORT;FLT END
36	3	EACH	A-14007	LIMIT SWITCH
37	1	EACH	R0354400I	LABEL; FLOW LOGO
G B 104 38	2	EACH	A-19857-30-1608-44	LINEAR RAIL;INA;TKVD30/1608/15
40	1	EACH	A-13944-2	SERVO MOTOR; 400W
E D 44	1	EACH	A-19600-1	FTG; BLKHD UNION L 10 MM TUBE
D 101 45	1	EACH	A-13930-5	PLUG;TUBING;10MM
G 46	1	EACH	015225-1	TARGET;LIMIT SWITCH;IFB;Z-AXIS
G 47	1	EACH	A-19437-2	TRACK;ADJUSTABLE CAM;300MM
G 48	2	EACH	A-13979-1	CAM, BALLUFF
H 49	1	EACH	A-0825-11	FTG; HOSE;BARBED;3/4"; 1/2-14
H 50	1	EACH	A-00449-6	ELBOW; UNION; 8-8; 1.09; 90 DEG
H 51	1	EACH	A-14687-1	ADAPTER;MALE PIPE;SWIVEL
I 52	1	EACH	A-13985	SWITCH;SELECT;3POSTION
I 53	1	EACH	A-6587	CONTACT BLOCK;BASE
I 54	1	EACH	A-14088	IFB TAG;Z-AXIS;RAISE,LOWER

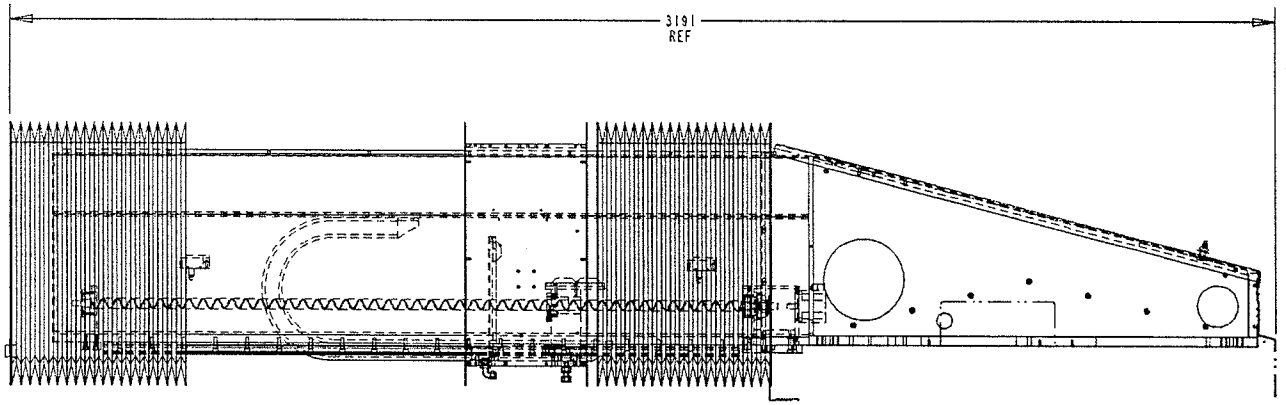
THIRD ANGLE

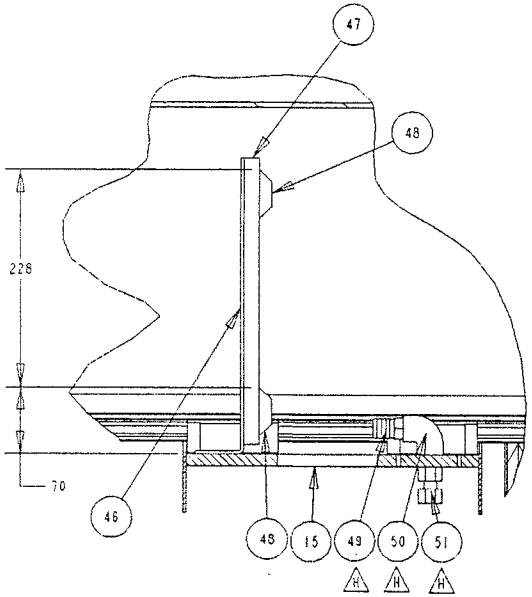
Flow

MATERIAL: N/A

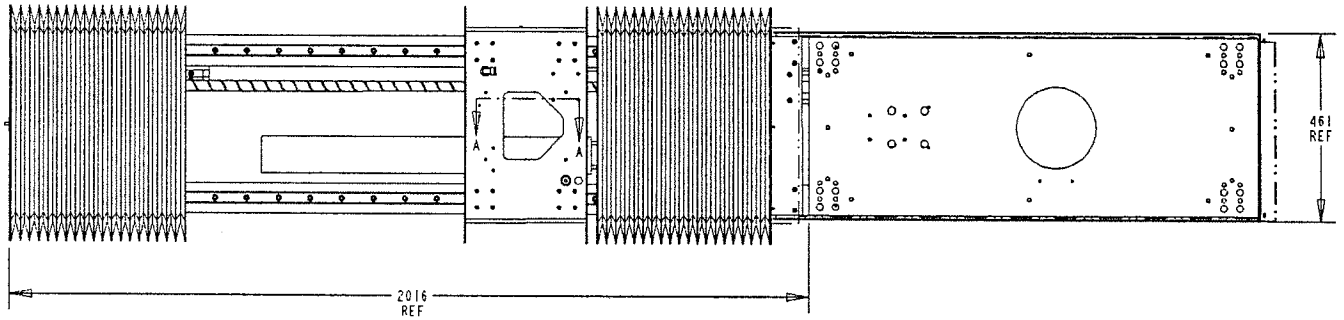
REVISION	MODELED IN	TITLE
I	PRO-E	ASSEMBLY;BRIDGE; 4'
DRAWN BY TR	STARTED 26-Jun-01	
ENG RL	SCALE D 0.04	BASE PART NUMBER 711893







SECTION A-A
SCALE 0.19 G



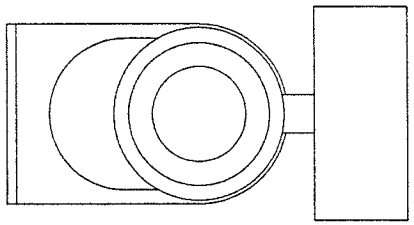
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE; 4'
DRAWN BY TK	STARTED 26-Jun-01	
ENG RL	SCALE D 0.08	BASE PART NUMBER 711893 — 2 OF 2

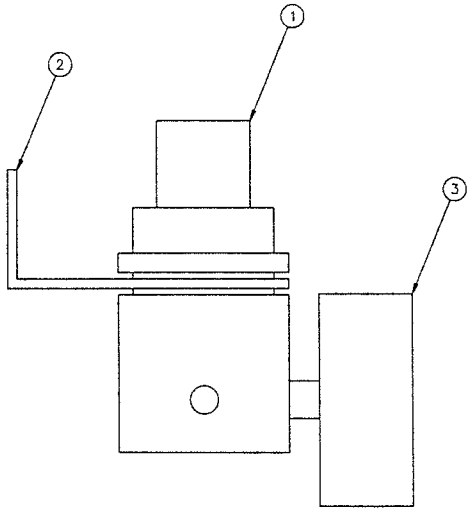
101 ITEM NOT SHOWN

-1

PAR[illegible]

QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
1	EA	1	A-11142	[illegible]OR; AIR; 1/8
1	EA	2	A-15038-1	BRACKET;REGULATOR;PLASTIC NUT
1	EA	3	A-11093	GE GAUGE; AIR; 0-60 PSI;1/8 BACK
101 2	EA	4	A-13926-3	CONNECTOR;6MM OD TO 1/8 NPT

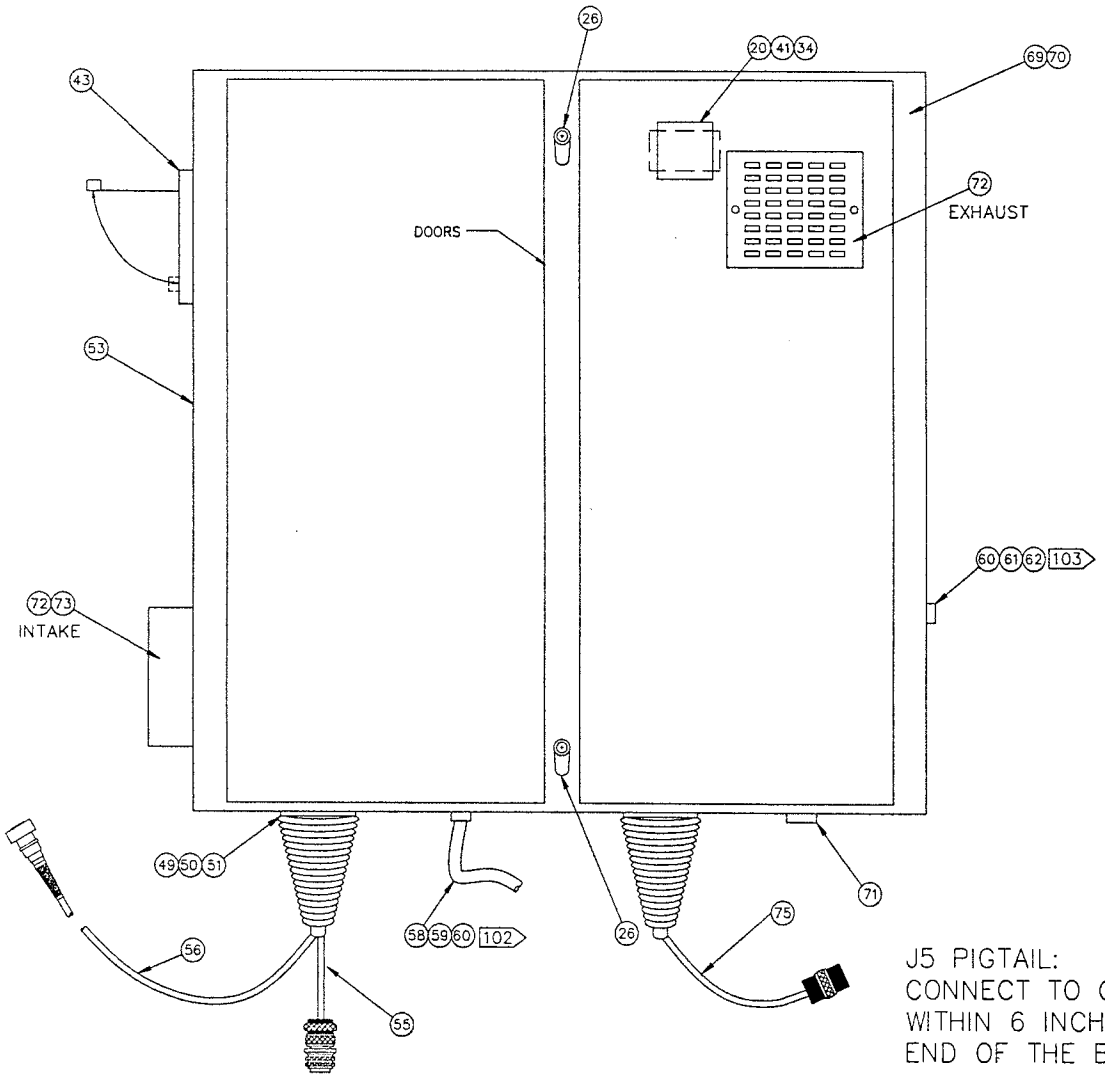




THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION A	MODELED IN NONE	TITLE ASSEMBLY; REGULATOR; AIR; 1/8
DRAWN BY TK	STARTED 11/12/01	
ENG DB	SCALE D 2:1	BASE PART NUMBER 711938 — 1 OF 1

101 > NOT SH[illegible]
102 > 4X8 AND 4400 MACHINES ONLY
103 > 6X12 AND 2X3 MACHINES ONLY

PART NO.	DESCRIPTION
712108-1	CNTRL PNL ASSY;IFB;BASIC;2030
712108-2	CNTRL PNL ASSY;IFB;BASIC;4X8
712108-3	CNTRL PNL ASSY;IFB;BASIC;4400

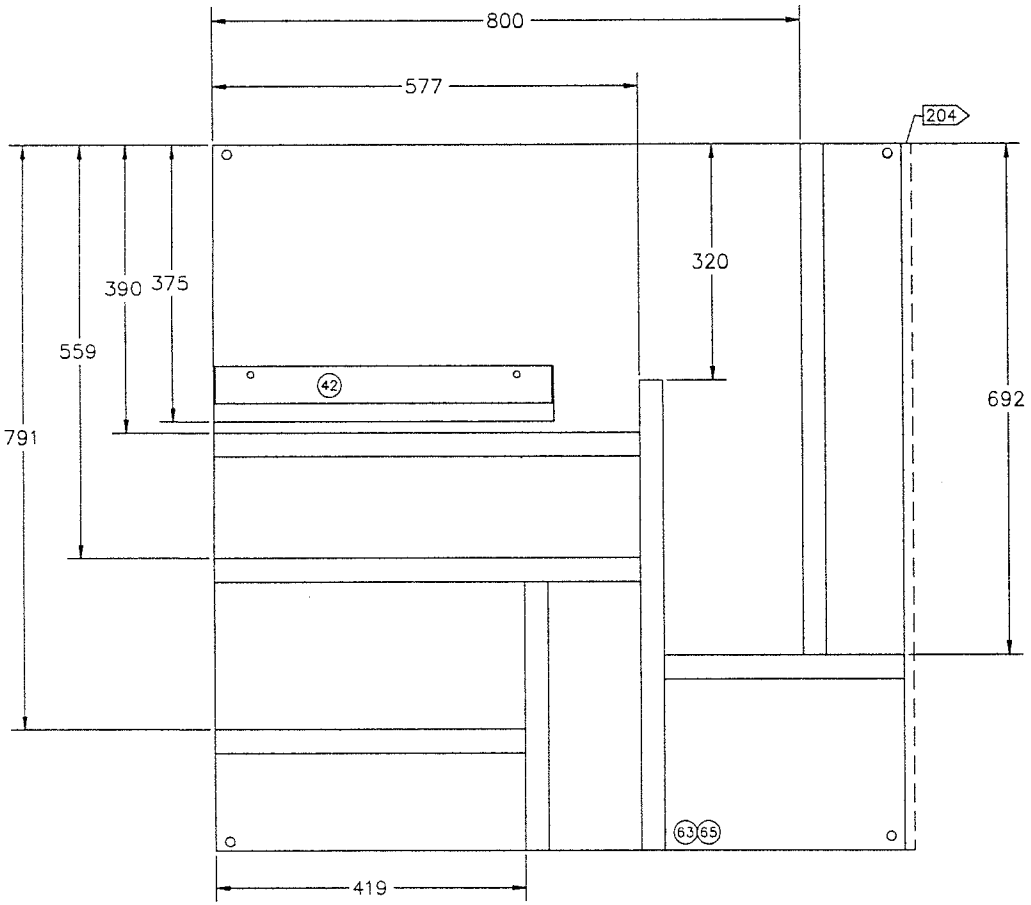


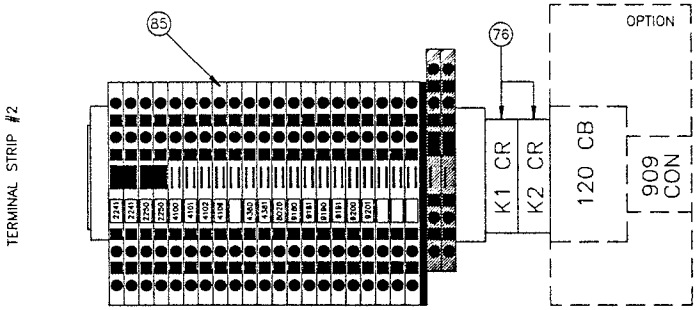
J5 PIGTAIL:
CONNECT TO CABLE CARRIER WITHIN 6 INCHES OF THE END OF THE BOOT.

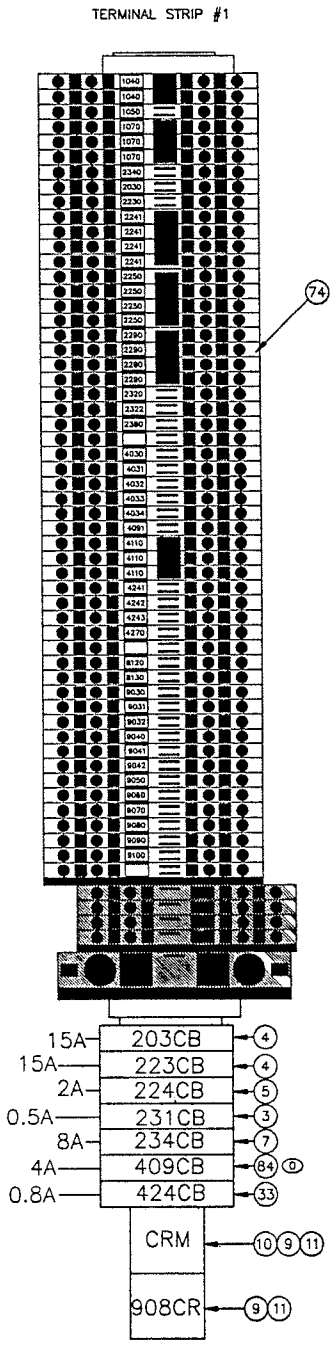
-3 QUANTITY	-2 QUANTITY	-1 QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
60	60	60	IN	2	A-5867	[illegible]N;78"
1	1	1	EA	3	A-14829-2	CIRCUIT BREAKER;0.5A;1P;D TRIP
2	2	2	EA	4	A-14829-19	CIRCUIT BREAKER;15A;1P;D TRIP
1	1	1	EA	5	A-14829-7	CIRCUIT BREAKER;2A;1P;D TRIP
1	1	1	EA	7	A-14829-14	CIRCUIT BREAKER;8A;1P;D TRIP
1	1	1	EA	8	A-13465	RECTIFIER; PLASTIC
2	2	2	EA	9	A-13809	CONTROL RELAY
1	1	1	EA	10	A-14832-1	RELAY ADDER BLOCK
2	2	2	EA	11	A-13810	SURGE SUPPRESSOR
1	1	1	EA	20	A-14103	DOOR INTERLOCK; 120VAC
1	1	1	EA	21	A-14835-1	POWER STRIP;6 PLUG;4' CORD;15A
5	5	5	EA	22	A-13993	JUMPER
22	22	22	EA	23	A-13953	DIGITAL DC INPUT MODULE
2	2	2	EA	24	A-13955	I/O MOUNTING RACK
1	1	1	EA	27	A-13534	ACC-34 BOARD
1	1	1	EA	28	A-13952	NOISE FILTER
2	2	2	EA	29	A-14059	CABLE;AMPLIFIER;SIGNAL
1	1	1	EA	30	A-13454	POWER SUPPLY; 24VDC
1	1	1	EA	31	A-13457	POWER SUPPLY;5 +/-15VDC
1	1	1	EA	32	A-13455	SUPPORT;24VDC POWER SUPPLY
1	1	1	EA	33	A-14830-4	CIRCUIT BREAKER;0.8A;1P;G TRIP
2	2	2	EA	34	A-14063	VARISTOR
6	6	6	EA	35	A-13473	CE RELAY SOCKET
6	6	6	EA	36	A-13499	CE RELAY;24VDC;4P
20	20	20	EA	39	A-13954	DIGITAL DC OUTPUT MODULE
1	1	1	EA	40	A-14060	INTERFACE BOARD;PMAC
2	2	2	EA	41	A-14838-1	BARRIER BLOCK;540;2 TERMINAL
1	1	1	EA	42	710134	COMPUTER SHELF
1	1	1	EA	43	015359-1	ASSY;PC ACCESS COVER;IFB
2	2	2	EA	44	A-14057	CABLE;50F-50F;0.1";3FEET
2	2	2	EA	48	A-14061	BELLOWS;ROUND TAPERED
2	2	2	EA	50	A-14845-8	BUSHING; CONDUIT;INSULATED;3"
2	2	2	EA	51	A-14846-9	LOCKNUT;CONDUIT;3"
--	1	2	EA	52	A-13945-3	SERVO MOTOR AMPLIFIER;750W
1	1	1	EA	53	R03544002	LABEL; FLOW LOGO
2	2	2	EA	54	010814-1	CE LABEL;GROUND
1	1	1	EA	55	711597-2	CABLE ASSEMBLY; 19 COND; FEM; 5FT
1	1	1	EA	56	713636-1	CABLE ASSY;ABT;ELEC ENCL SIDE
2	2	--	EA	58	A-0566-3	CONNECTOR;STRAIGHT;CONDUIT;3/4
170	170	--	IN	59	A-0902-3	CONDUIT;FLEXIBLE;SIZE 3/4
2	2	2	EA	60	202530-12	LOCKNUT;GASKETED 3/4"NPT
--	--	1	EA	61	A-0581-2	NIPPLE;PIPE;SCH 40;3/4"NPT;2"
--	--	2	EA	62	A-0887-2	BUSHING;INSULATING;PLSTC;3/4
30	30	30	IN	63	A-14893-1	DUCT;WIRING;TYPE G;1X3
30	30	30	IN	65	A-0922-12	COVER;DUCT;TYPE C;PVC;1";WHITE
2	1	--	EA	67	A-13945-2	SERVO MOTOR AMPLIFER,400W
1	1	1	EA	68	711595-DWG	SCHEMATIC;IFB ELECTRICAL
1	1	1	EA	70	711613-2	MOD.;CNTRL ENCLOSURE;4080 IFB
1	1	1	EA	71	711701-1	CABLE ASSY;PUMP CONTROL
2	2	2	EA	72	A-14843-1	FAN BOX;FILTERED
1	1	1	EA	73	712371-1	COVER;FAN
1	1	1	EA	74	713335-1	TERMINAL ASS'Y; TB1
--	1	1	EA	75	015206-3	CABLE ASS'Y; J5; 6FT PIGTAIL
1	1	1	EA	76	710649-2	LIGHT CURTAIN ASSY; CABINET
1	1	1	EA	80	A-13533	ACC-28 A/D BOARD
1	1	1	EA	84	A-14829-11	CIRCUIT BREAKER;4A;1P;D TRIP
1	1	1	EA	85	713335-2	TERMINAL ASS'Y; TB2
1	1	1	EA	86	015430-1	WIRE KIT;IFB

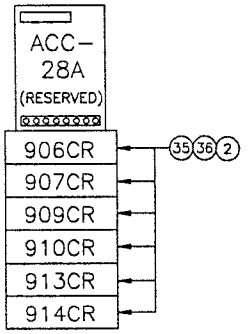
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BILL OF MATERIAL
REVISION S	MODELED IN NONE	TITLE CONTROL PANEL ASSY; IFB; BASIC
DRAWN BY ZZ	STARTED 8/08/04	
ENG ZZ	SCALE D 5/16	BASE PART NUMBER 712108 — 1 OF 3

201 TERMINAL GROUND SHOULD HAVE A GROUND LABEL.
202 ALL DIMENSIONS ± 2MM
203 ALL PANDUIT IS 1 X 3
204 FOR HOFFMAN PANEL WIDTH IS 13.5 MM GREATER THAN RITTAL









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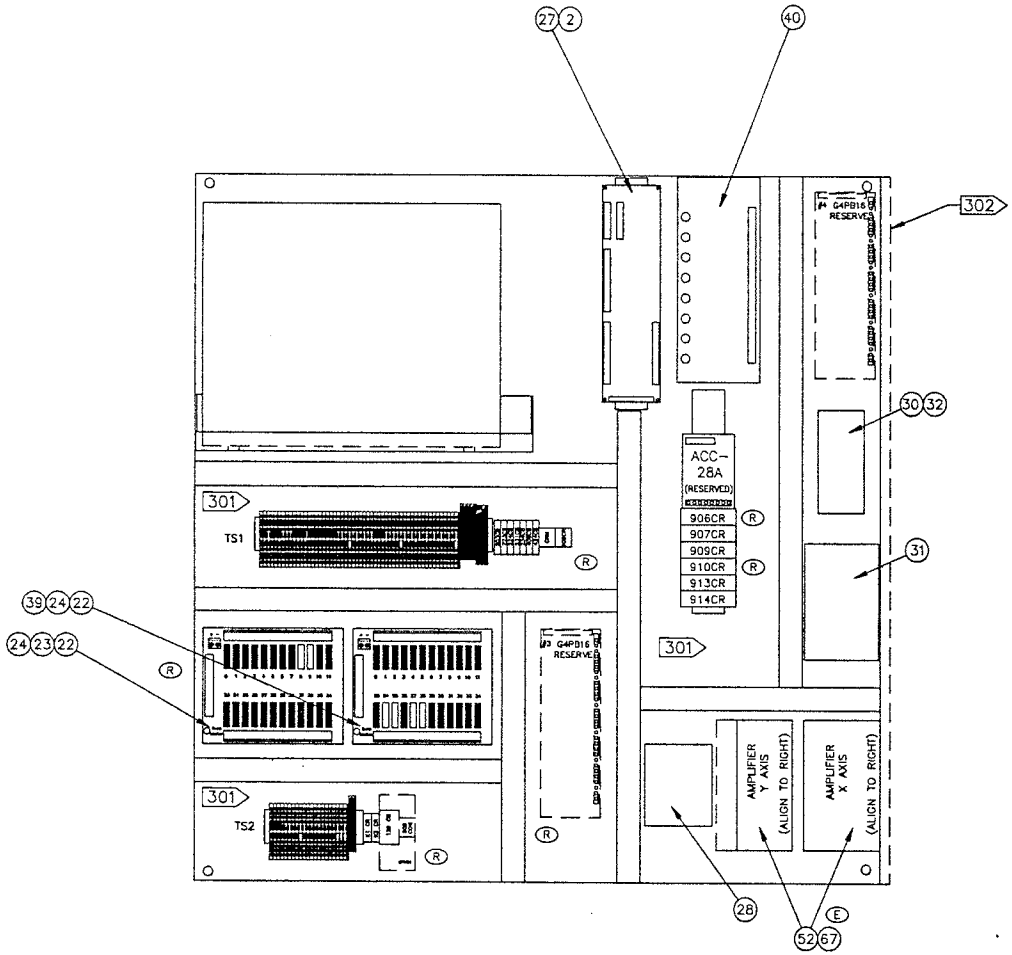
		MATERIAL: SEE BILL OF MATERIAL
REVISION S	MODELED IN NONE	TITLE CONTROL PANEL ASSY; IFB; BASIC
DRAWN BY ZZ	STARTED 8/08/04	
ENG ZZ	SCALE D 5/16	BASE PART NUMBER 712108

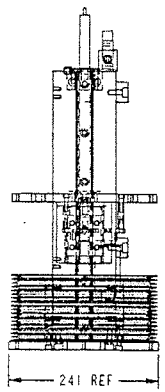
301 SEE DETAIL ON SHEET 2

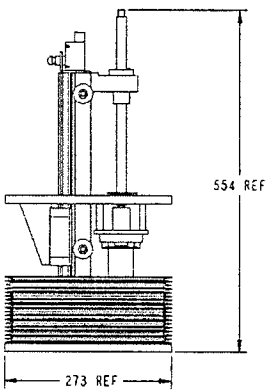
302 FOR HOFFMAN PANEL WIDTH OF SUBPANEL IS 13.5 MM GREATER THAN RITTAL

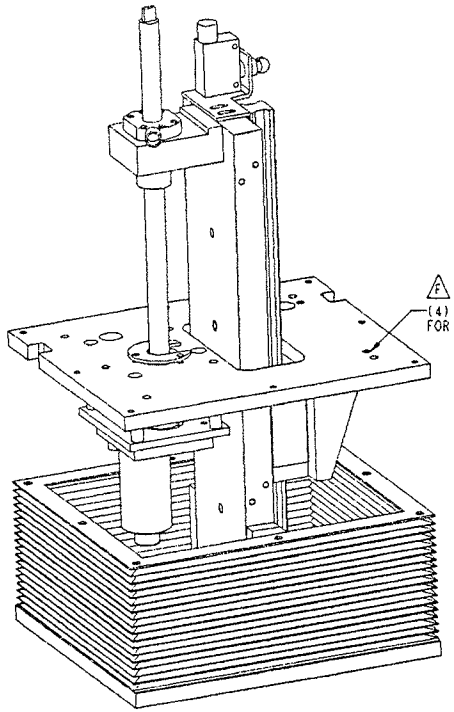


THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BILL OF MATERIAL
REVISION S	MODELED IN NONE	TITLE CONTROL PANEL ASSY; IFB; BASIC
DRAWN BY ZZ	STARTED 8/08/04	
ENG ZZ	SCALE D 5/16	BASE PART NUMBER 712108 — 3 OF 3

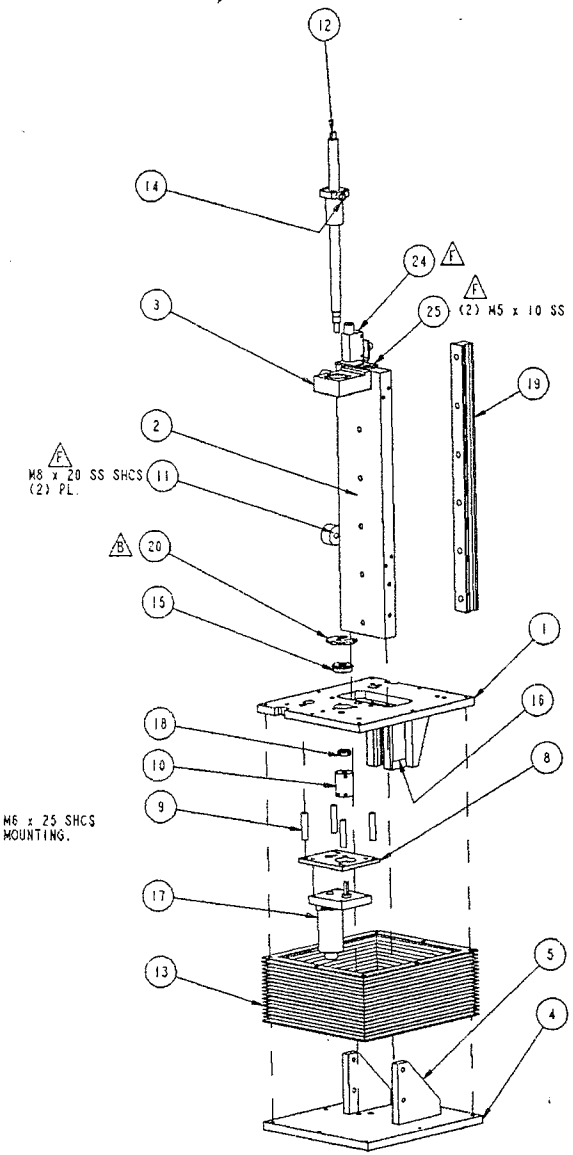
[101] ITEM NOT SHOWN [illegible]UMBING ASSEMBLY FOR LOCATION.







SCALE 0.50

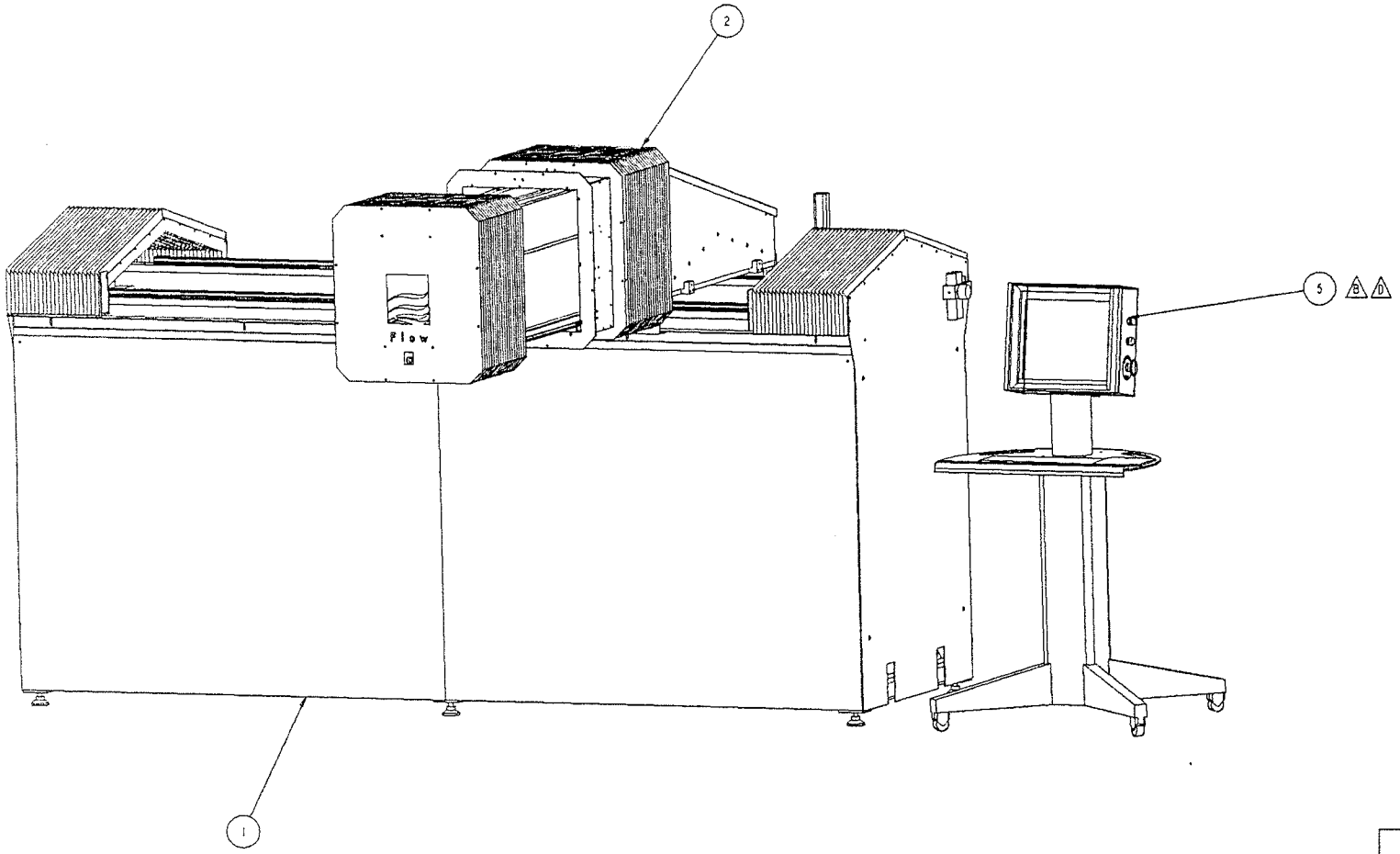


ITEM	QTY	UOM	PART NO.	DESCRIPTION
1	1	EACH	R33516-4	MOUNT;BEARING;VERTICAL
2	1	EACH	R035248-1	RAM;MOUNT;VERTICAL
G 3	1	EACH	015406-1	MOUNT;BALLNUT;VERTICAL RAM;INA
4	1	EACH	R33513-4	MOUNT;PLATE;VERTICAL RAM
5	2	EACH	R34848-2	GUSSET;Z RAM
8	1	EACH	R33587-3	MOUNT;MOTOR;VERTICAL
9	4	EACH	R33586-2	MOUNT;MOTOR;SUPPORT
10	1	EACH	R33599-2	COUPLING; MODIFICATION
F 11	2	EACH	015226-1	STOP;VERTICAL AXIS;IFB
G 12	1	EACH	714332-1	BALLSCREW;IFB;MOT.Z;334
13	1	EACH	R33525-4	WAYCOVER;VERTICAL AXIS
14	1	EACH	A-14426	ADAPTOR;THK
15	1	EACH	A-14018-2	BEARING;SINGLE ROW;12MM BORE
G 16	1	EACH	A-19856-30	BLOCK;LINEAR RAIL;INA;KWVE30S
17	1	EACH	A-14006	GEARMOTOR
18	1	EACH	A-14025-2	NUT; BEARING RETAINING
G 19	1	EACH	A-19857-30-0440-20	LINEAR RAIL;INA;TKVD30/0440/20
B 20	1	EACH	712372-1	PLATE; RETAINER; BEARING
E [101] 23	1	EACH	711964-1	COMPUTER ASSY;MINITOWER;IFB
F 24	1	EACH	A-14007	LIMIT SWITCH
F 25	1	EACH	015224-1	MOUNT;LIMIT SWITCH;IFB;Z-AXIS

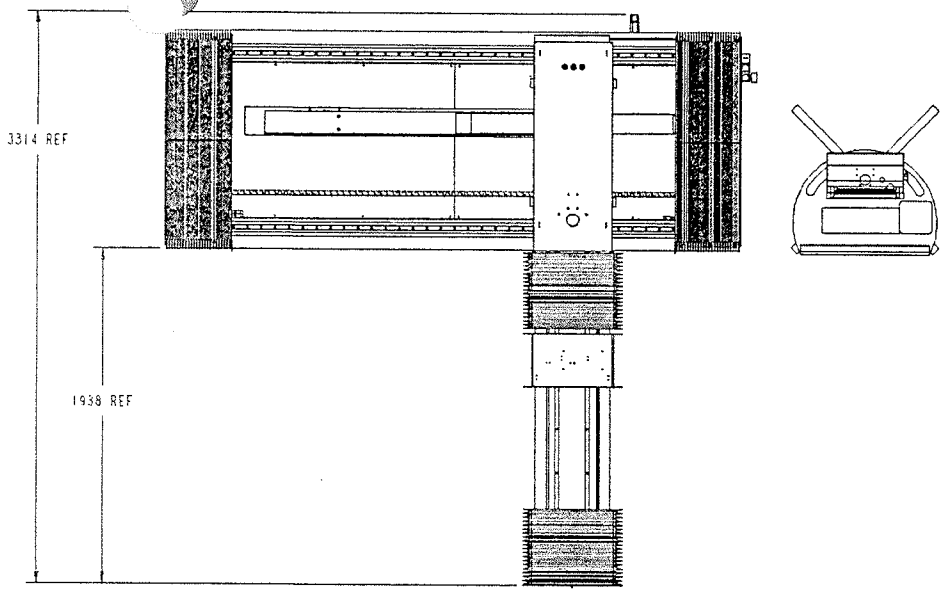
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION G	MODELED IN PRO-E	TITLE VERT. ASSY; IFB 8";BASIC
DRAWN BY TK	STARTED 11-Oct-01	
ENG TK	SCALE 0.25	BASE PART NUMBER 712125 — 1 OF 1

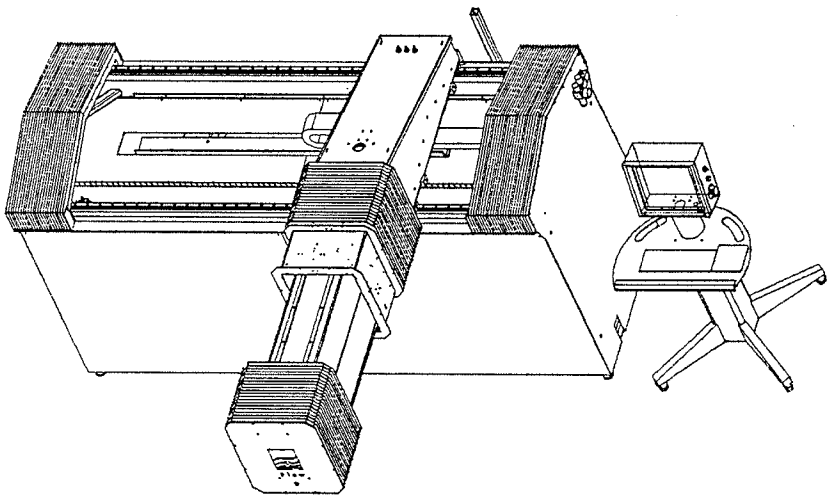
(G1) ITEM NOT SHOWN

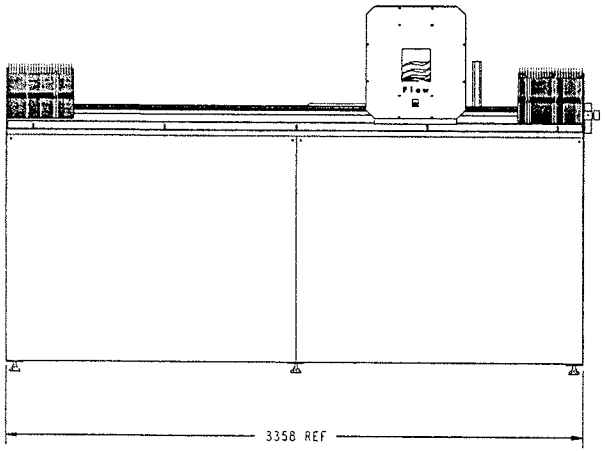
ITEM	QTY	UOM	PART	DESCRIPTION
1	1	EACH	711686-1	ASSEMBLY; BASE AXIS; 8'
2	1	EACH	711893-1	ASSEMBLY;BRIDGE; 4'
(10) 3	1	EACH	712107-1	POWER PNL. ASST;IFB;BASIC
(10) 4	1	EACH	712108-2	CNTRL PNL. ASST;IFB;BASIC;4X8
(A)(D)(B) 5	1	EACH	713015-1	CONSOLE MODULE;25FT;MOBILE;IFB
(E)(10) 9	1	EACH	015300-3	INSTALL KIT;IFB;4800

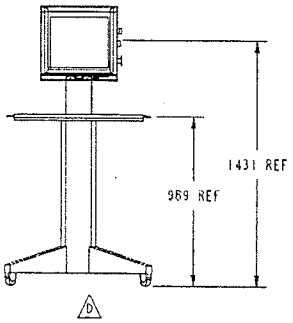


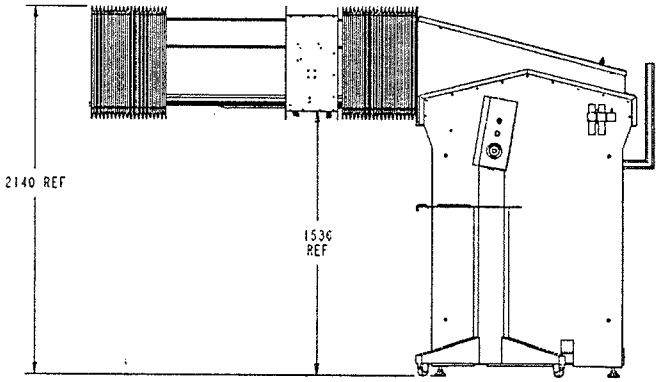
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION G	MODELED IN PRO-E	TITLE IFB;4X8;BASIC MODULE
DRAWN BY TN	STARTED 21-Mar-02	
ENG RLL	SCALE 0.12	BASE PART NUMBER 712207 — 1 OF 2





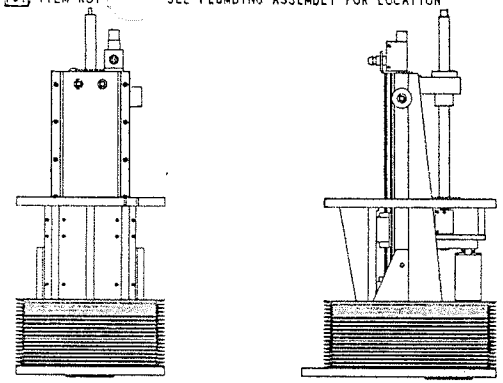


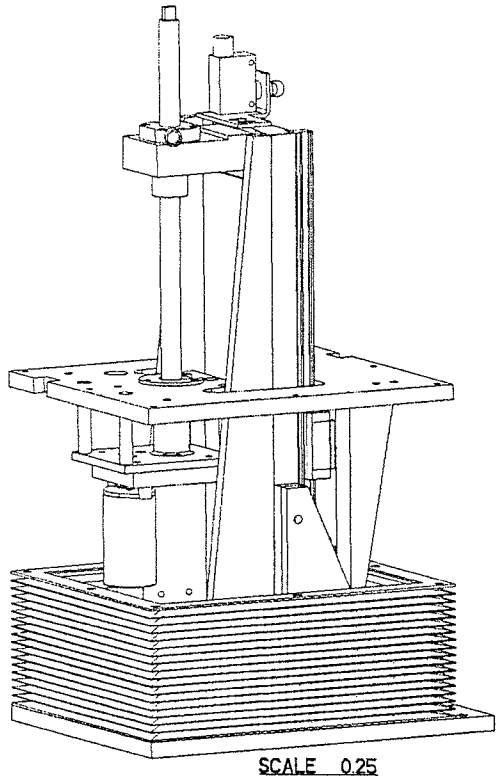




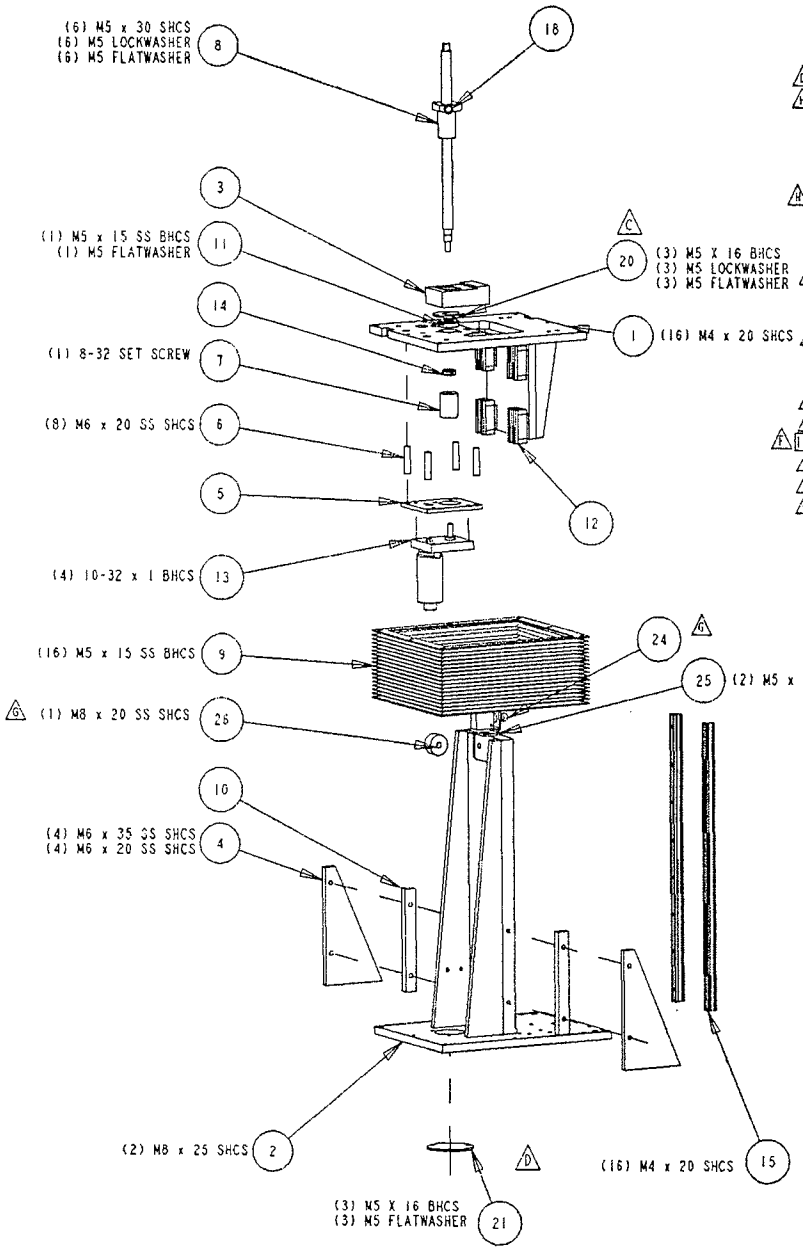
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION G	MODELED IN PRO-E	TITLE IFB;4X8;BASIC MODULE
DRAWN BY TK	STARTED 22-Mar-02	
ENG RLL	SCALE 0.07	BASE PART NUMBER 712207 — 2 OF 2

[101] ITEM NOT SHOWN - SEE PLUMBING ASSEMBLY FOR LOCATION





SCALE 0.25



-1		PARTS LIST		
ITEM	QTY	UOM	PART NO.	DESCRIPTION
1	1	EACH	R34166-4B	MOUNT, BEARING VERTICAL;STEEL
D 2	1	EACH	712500-1	RAM;VERTICAL;ALUM;DWJ
H 3	1	EACH	015405-1	MOUNT, BALLNUT VERTICAL;INA
4	2	EACH	R34200-4	GUSSET, VERTICAL RAM
5	1	EACH	R33587-3	MOUNT;MOTOR;VERTICAL
6	4	EACH	R33586-2	MOUNT;MOTOR;SUPPORT
7	1	EACH	R33599-2	COUPLING; MODIFICATION
H 8	1	EACH	714332-1	BALLSCREW;IFB;MOT.Z;334
9	1	EACH	R33525-4	WAYCOVER;VERTICAL AXIS
10	2	EACH	R34312-2	BAR, SPACER
11	1	EACH	A-14018-2	BEARING;SINGLE ROW;12MM BORE
H 12	4	EACH	A-19856-15	BLOCK;LINEAR RAIL;INA;KWVE15S
13	1	EACH	A-14904	GEARMOTOR; 12VDC; 15 IN-LB
14	1	EACH	A-14025-2	NUT; BEARING RETAINING
H 15	2	EACH	A-19857-15-0460-20	LINEAR RAIL;INA;TKVD15/460/20
17	4	EACH	A-13966-1	LUBE UNIT (STAR);SIZE 15
18	1	EACH	A-14426	ADAPTOR;THK
C 20	1	EACH	712372-1	PLATE; RETAINER; BEARING
D 21	1	EACH	712671-2	COVER;ACCESS;Z AXIS;HVYDTY
F [101] 23	1	EACH	711964-1	COMPUTER ASSY;MINITOWER;IFB
G 24	1	EACH	A-14007	LIMIT SWITCH
G 25	1	EACH	015224-1	MOUNT;LIMIT SWITCH;IFB;Z-AXIS
G 26	1	EACH	015226-1	STOP;VERTICAL AXIS;IFB

THIRD ANGLE

Flow

MATERIAL: SEE BOM

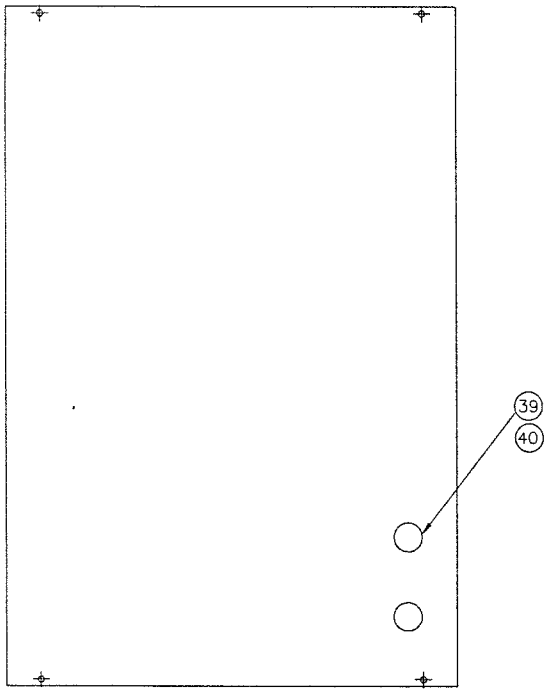
REVISION	MODELED IN	TITLE
H	PRO-E	VERTICAL ASSY;HEAVY DUTY;8"
DRAWN BY	STARTED	
TK	23-JUI-01	
ENG	SCALE	BASE PART NUMBER
RL	0.125	712231

1 OF 1

(101) ITEM NOT SHOW SEMBLY

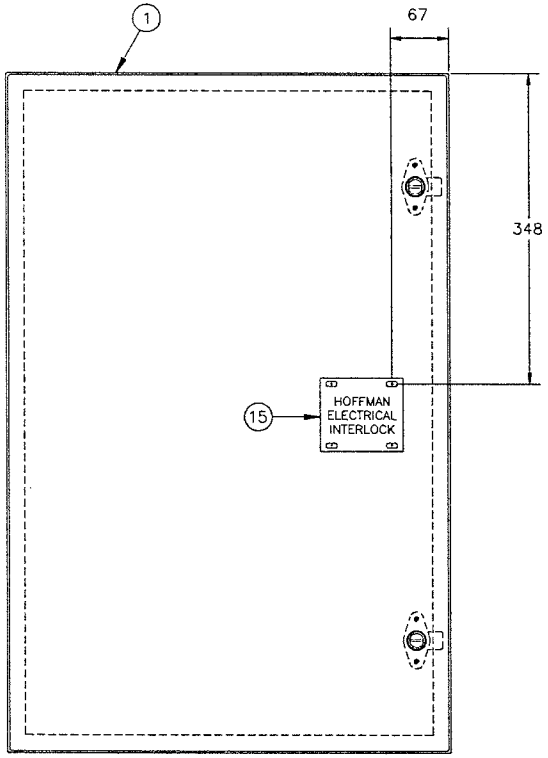
(102) ON IFB MACHINES, THESE ACCESSORIES WILL NEED TO BE MOUNTED ON EXISTING PANEL OF MAIN ENCLOSURE. REFER TO SHEET 13 & 14 OF IFB PACKAGE.

QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
1	EA	1	712685-1	ENCLOSURE MODIFICATION; DWJ; IFB
1	EA	2	712686-1	SUB-PANEL MODIFICATION; DWJ; IFB
1	EA	3	A-13945-2	SERVO AMPLIFIER, 400W
2	EA	4	A-13945-4	SERVO AMPLIFIER, 100W
(101) (06) 3	EA	7	A-14059-2	CABLE; YASKAWA AMPLIFIER; ACC8
1	EA	8	A-13427	PMAC INTERFACE BOARD
1	EA	10	A-14806-4	GROUND BAR, 4 TAP
1	EA	11	A-13809	CONTROL RELAY
1	EA	12	A-13810	SURGE SUPPRESSOR
4	EA	13	A-13499	RELAY, 24VDC, 4P
4	EA	14	A-13473	RELAY SOCKET
1	EA	15	A-14103	DOOR INTERLOCK, 120VAC
(06) 37	EA	17	A-14801-1	TERMINAL BLOCK
1	EA	18	A-14802-1	END BARRIER
2	EA	19	A-14803-1	END BLOCK
2	EA	20	A-14833-1	GROUND BLOCK
80	IN	21	A-14893-2	DUCT, WIRING, 1.5"X3"
80	IN	22	A-0922-13	DUCT, COVER, 1.5"
(101) 30	IN	23	A-5867	RAIL, DIN
(101) 1	EA	29	A-18150-1	DC/DC CONVERTER; 9 VOLT
4	EA	39	A-14845-6	BUSHING; CONDUIT; INSULATED; 2"
4	EA	40	A-14846-7	LOCKNUT; CONDUIT; 2"
(07) (101) 1	EA	41	015265-3	CABLE; ASSY; 19 COND; FEM; 5'; J9
(06) (101) 1	EA	42	010814-1	CE LABEL; GROUND



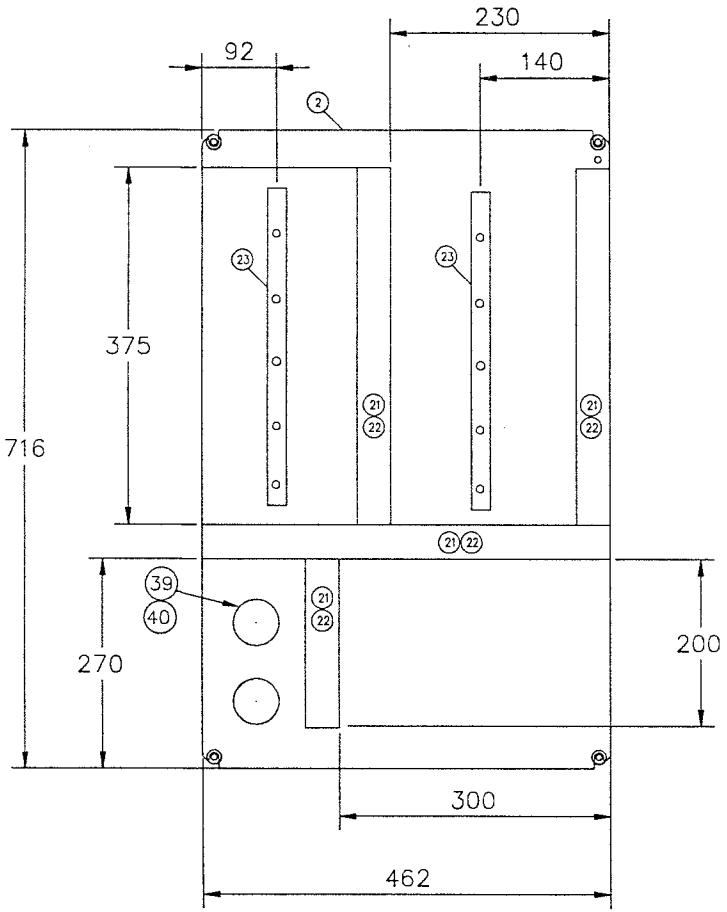
ADD-ON ENCLOSURE
BACK VIEW

OPENING FOR PASSAGE OF I/O AND MOTOR CABLES.

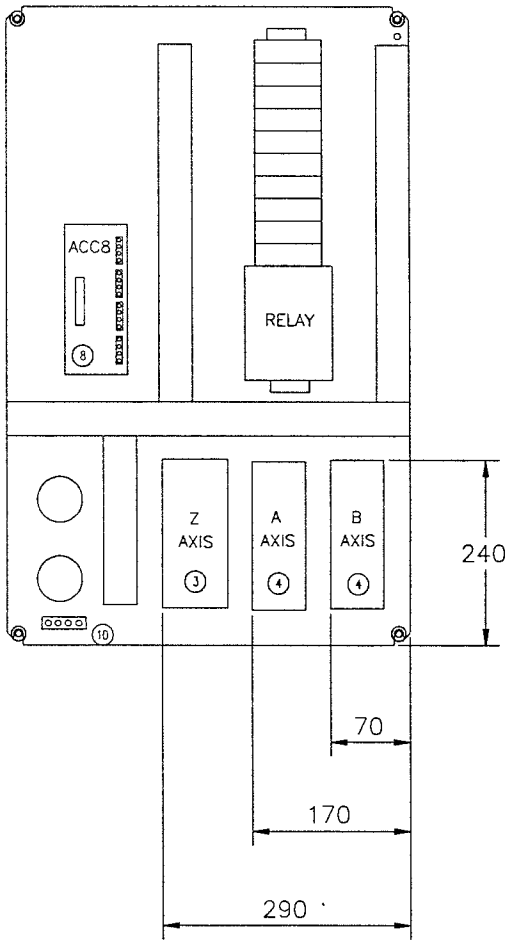


ADD-ON ENCLOSURE
FRONT VIEW

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BILL OF MATERIAL
REVISION A	MODELED IN NONE	TITLE ADD-ON DWJ OPTION BOX LAYOUT
DRAWN BY ZZ	STARTED 8/06/04	
ENG ZZ	SCALE N/A	BASE PART NUMBER 712341 1 OF 2

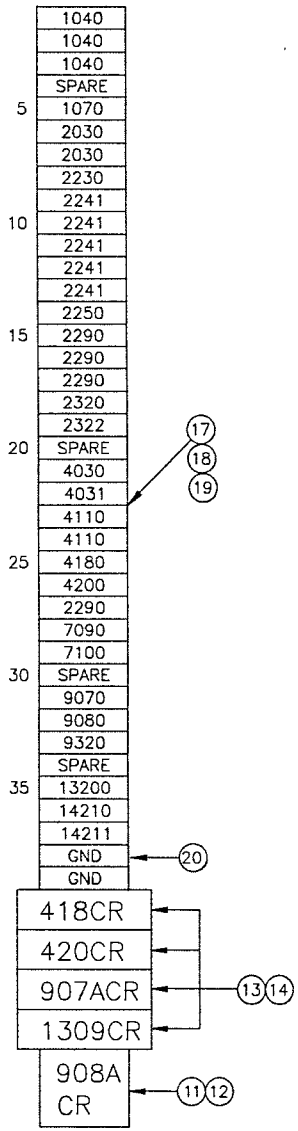


SUB–PANEL LAYOUT



SUB–PANEL ASSEMBLY

TERMINAL STRIP #3



THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BILL OF MATERIAL
REVISION A	MODELED IN NONE	TITLE ADD–ON DWJ OPTION BOX LAYOUT
DRAWN BY ZZ	STARTED 8/08/04	
ENG ZZ	SCALE N/A	BASE PART NUMBER 712341 — 2 OF 2

712356-2

102 USE 5mm ACORN NUTS TO ASSEMBLE BELLOWS TO ITEMS 14 & 15 (TOTAL 22 PLACES)

103 INSTALL PLASTIC MOUNTING HOLE PLUGS IN ITEM 17 AT ASSEMBLY. PLASTIC PLUGS SUPPLIED WITH ITEM 17

104 ALL DIMENSIONS ± 1mm UNLESS OTHERWISE SPECIFIED

1 OBSOLETED PART # 712356-1.

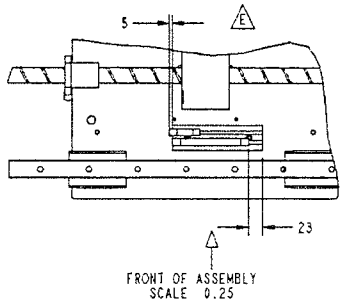
	ITEM	QTY	UOM	PART NO	DESCRIPTION
1	3	1	EACH	015335-1	MOUNT,BALL NUT;BASE
	4	1	EACH	712304-1	MOUNT;BEARING;FLOATING;BASE
	5	1	EACH	712307-1	PLATE,COVER;BACK
	6	2	EACH	712309-1	STRIP,GUSSET;BASE AXIS;4"
	7	2	EACH	712310-1	HARDSTOP; BASE; 4"
	8	1	EACH	712311-1	COVER; FRONT; 4" BASE
	9	1	EACH	712312-1	COVER; TOP; 4" BASE
1	10	1	EACH	712315-1	REST; INSIDE COVER; BACK
L	11	1	EACH	712316-1	REST; INSIDE COVER; FRONT
	12	1	EACH	712320-1	MOUNT; DRIVE; 4" BASE
	13	1	EACH	712321-1	BASE; MACHINE; 4"
102	14	1	EACH	711879-1	PANEL; SIDE; RIGHT
102	15	1	EACH	711880-1	PANEL; SIDE; LEFT
	16	2	EACH	712343-1	GUIDE, BELLOWS; 4"
J 103	17	2	EACH	A-19857-30-1864-12	LINEAR RAIL;INA;TKVD30/1864/12
J	18	4	EACH	A-19856-30	BLOCK;LINEAR RAIL;INA;KWVE30S
G	19	1	EACH	A-13944-2	SERVO MOTOR; 400W
	22	1	EACH	A-13983	SUPPORT UNIT;FLANGE TYPE
	24	3	EACH	A-14007	LIMIT SWITCH
	25	1	EACH	A-14052-6-2	COUPLING;SERVO ZERO MAX
	26	1	EACH	A-18167-1	GEARHEAD; 4" BASE
	27	2	EACH	A-14426	ADAPTOR;THK
	28	2	EACH	R03522905	BASE AXIS WAYCOVERS 4" STROKE
K	30	2	EACH	015205-1	HOLDER, LIMIT SWITCH
	31	1	EACH	R33691-1	RING,SPACER
	32	1	EACH	R33761-1	MOUNT,BEARING;SIMPLE SUPPORT
	34	2	EACH	R33873-2	MOUNT;LIMIT SWITCH;BASE
	35	1	EACH	R34003-2	MOUNT, CAM
	36	1	EACH	713640-4	CABLE CARRIER ASS'Y; 4X4;OD
	40	1	EACH	R34351-4	SBB-PLATE; BASE AXIS; THIN
	41	4	EACH	711871-1	BLOCK, ADJUSTMENT
	44	1	EACH	A-13979-1	CAM, BALLUFF
	45	1	EACH	A-13979-5	CAM, BALLUFF
K J	48	1	EACH	015334-1	BALLSCREW;1FB;ROT. SCREW,1603

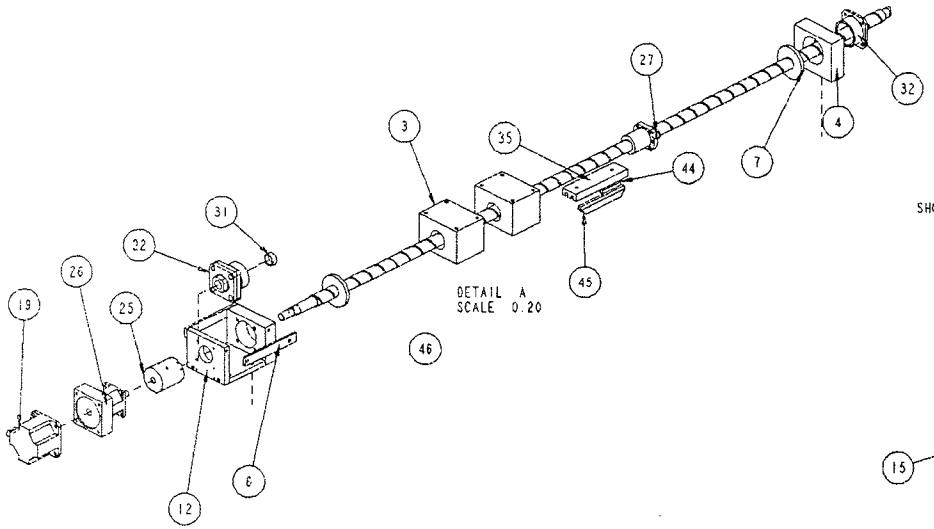
THIRD ANGLE

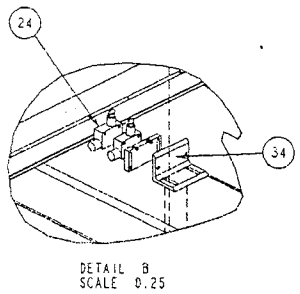
Flow

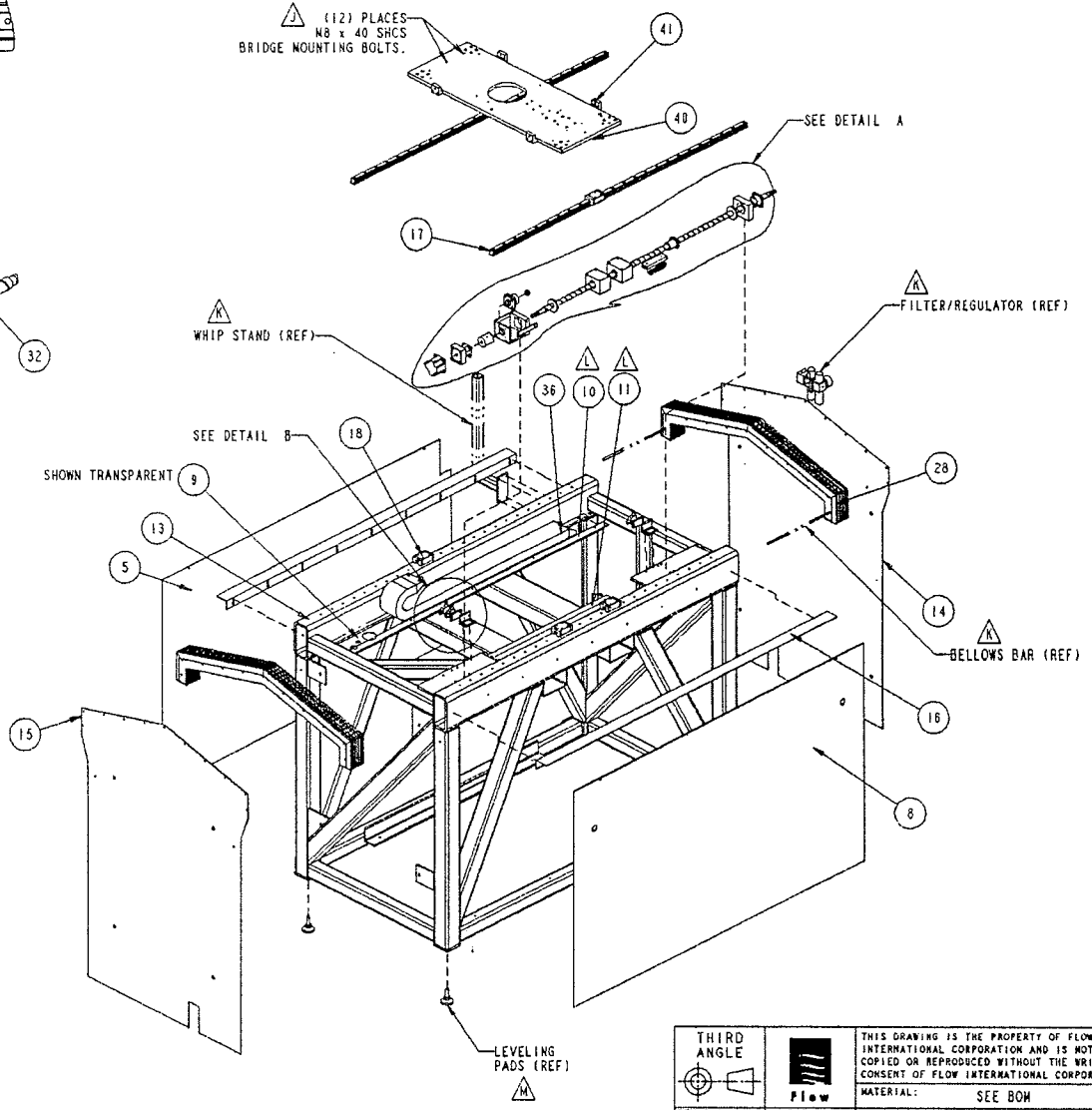
MATERIAL: SEE BOM

REVISION M	MODELED IN PRO-E	TITLE: BASE AXIS;ASSEMBLY;4";HP .001"
DRAWN BY JCC	STARTED 13-May-04	
ENG TK	SCALE 0.080	BASE PART NUMBER 712356 — 1 OF 3

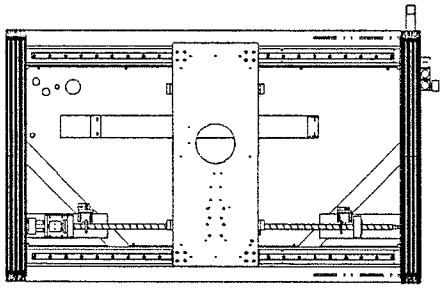


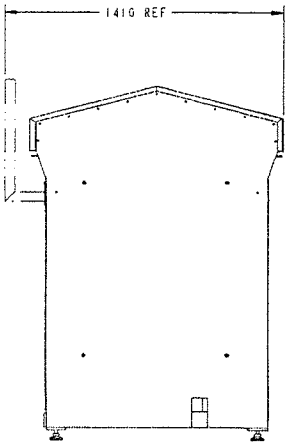


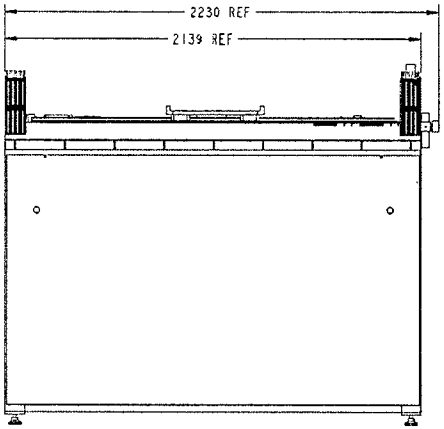


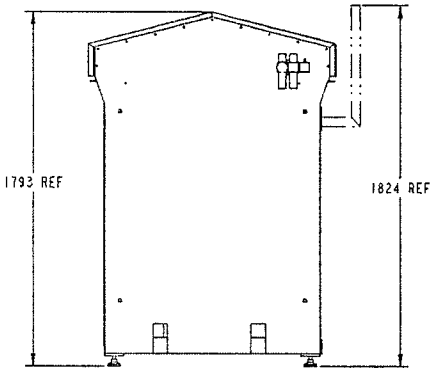


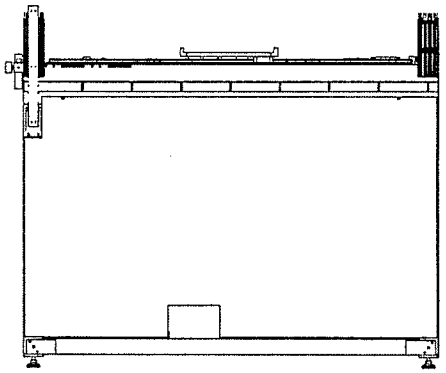
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION M	MODELED IN PRO-E	TITLE BASE AXIS;ASSEMBLY;4";HP .001"
DRAWN BY JCC	STARTED 17-Jun-02	
ENG TK	SCALE 0.08	BASE PART NUMBER 712356 — 2 OF 3







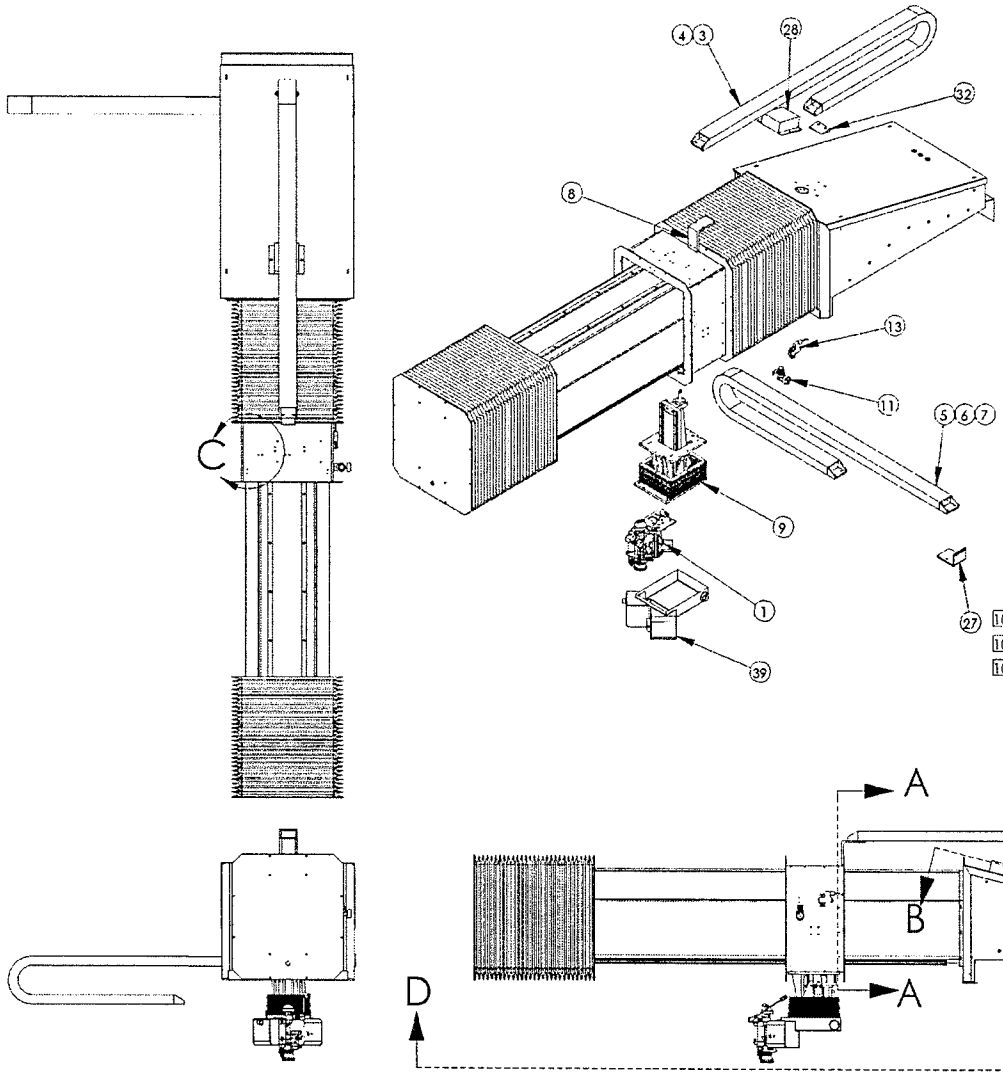




THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE BOM
REVISION N	MODELED IN PRO-E	TITLE BASE AXIS;ASSEMBLY;4';HP .001"
DRAWN BY JCC	STARTED 17-Jun-02	
ENG TK	SCALE 0.08	BASE PART NUMBER 712356 — 3 OF 3

101 ITEM NOT SHOWN.

102 FASTENERS USED TO INSTALL MINI HOPPER.



	ITEM	-3 QTY	-2 QTY	-1 QTY	U/M	PART NUMBER	BILL OF MATERIAL DESCRIPTION
	1	1	1	1	EA	712497-1	WRIST ASSEMBLY;DWJ;IFB
	3	-	1	1	EA	712486-6	CABLE CARRIER ASSY;DWJ;4' Y
	4	1	-	-	EA	712486-7	CABLE CARRIER ASSY;DWJ;2M Y
	5	-	-	1	EA	712486-3	CABLE CARRIER ASSY;DWJ;4' X
	6	-	1	-	EA	712486-4	CABLE CARRIER ASSY;DWJ;8' X
	7	1	-	-	EA	712486-5	CABLE CARRIER ASSY;DWJ;12' X
	8	1	1	1	EA	R03601501	MOUNT; CABLE TRACK
	9	1	1	1	EA	712457-1	VERTICAL ASSY;HVY DTY;8";DWJ
	11	1	1	1	EA	711938-1	ASSEMBLY; REGULATOR; AIR; 1/8
101	12	1	1	1	EA	A-14697-2	SILENCER;BRASS;1/8 NPTF
A	13	1	1	1	EA	A-20158-1	VALVE;SOL;4 PORT 2 WAY ;24VDC
101	15	1	1	1	EA	712341-1	PANEL ASSY;DWJ;IFB;ADD-ON
101	16	12200	12200	12200	MM	A-14855-2	TUBING;POLYETHYLENE;1/4
	18	5	5	5	EA	A-18149-2	CONNECTOR;MALE;PRESTOLOK;1/4
	19	1	1	1	EA	A-00051-3	TEE;UNION;1/4";BRASS
	20	1	1	1	EA	A-14501-14	FITTING;ELBOW;1/4 THR X 1/8 TB
	22	1	1	1	EA	A-18512-1	ELBOW;STREET;90;GALV;.560 OD
101	25	1	1	1	EA	A-0781-7	NIPPLE;TUBING;1/4" HP;7" LG
	27	1	1	1	EA	712643-1	MOUNT;CABLE TRACK;DWJ;X-AXIS
	28	1	1	1	EA	712371-1	COVER;FAN
101	30	1	1	1	EA	A-14845-8	BUSHING; CONDUIT;INSULATED;3"
101	31	1	1	1	EA	A-14846-9	LOCKNUT;CONDUIT;3"
	32	1	1	1	EA	712672-1	SUPPORT;WEDGE;CABLE CARRIER
101	33	1	1	1	EA	A-10299	CLAMP;1-1/2" LOOP HOSE
101	34	1	1	1	EA	R34896-DWG	DWG;TOP CARRIAGE ATTACH PLATE
101	35	1	1	1	EA	R34897-DWG	DWG; SIDE CARRAGE ATTACH PLATE
101	36	2	2	2	ME	A-2883	TUBING;FLEX 9/32
101	37	1	1	1	EA	009930-1	METERING VALVE ASSY;PASER 3
101	38	1	1	1	EA	009967-1	INTERCONNECT ASSEMBLY W/ GAUGE
	39	1	1	1	EA	A-19322-1	BOOT;DYNAMIC WATERJET WRIST
102 101	46	4	4	4	EA	A-0027-16	SCREW;HEX HD;10-24;SST;1" LG
102 101	47	4	4	4	EA	A-0406-3	WASHER;LOCK;SST;#10
102 101	48	4	4	4	EA	A-0407-3	WASHER;FLAT;SST;SIZE 10

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS IN DEGREES AND MILLIMETERS
TOLERANCES PER ASME Y14.5M-1984 ALL MACHINED SURFACES TO 3.2
DIAMETERS ON A COMMON CENTERLINE TO BE TRUE POSITION WITHIN .25
REMOVE BURRS AND BREAK SHARP CORNERS AND FILLET RADII .8 MAX.

INCH	MILLIMETER	DEGREE
X.XXX ± .005	X.XX ± .12	X.X ± .5
X.XX ± .01	X.X ± .25	X ± 1
X.X ± .03	X ± .8	

THIRD ANGLE PROJECTION

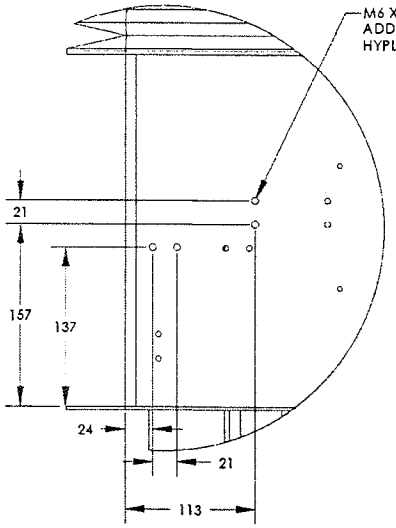
Flow

REVISION A	MODELED IN SOLIDWORKS	MATERIAL	SEE BOM
DRAWN BY JMF	STARTED 11/11/03	TITLE	RETROFIT KIT;DWJ;IFB
ENG D.BADER	SCALE 1:25	BASE PART NUMBER	712453

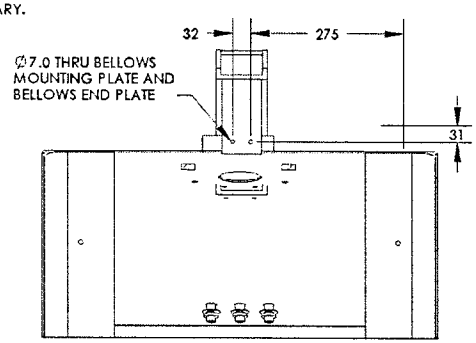
1 OF 2

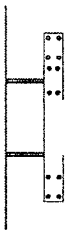
UNCONTROLLED COPY. USER IS RESPONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.

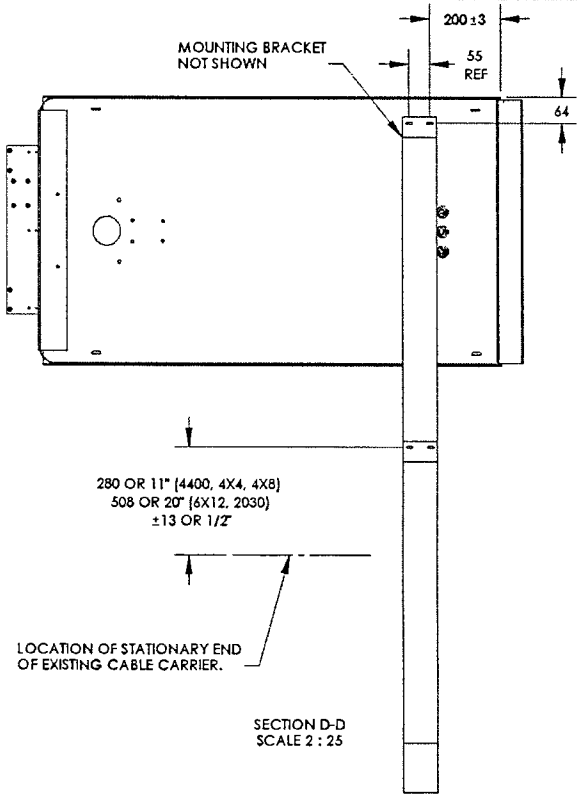
201) SEE R34896-DWG AND R34897-DWG FOR ADDITIONAL MODIFICATIONS IF NECESSARY.



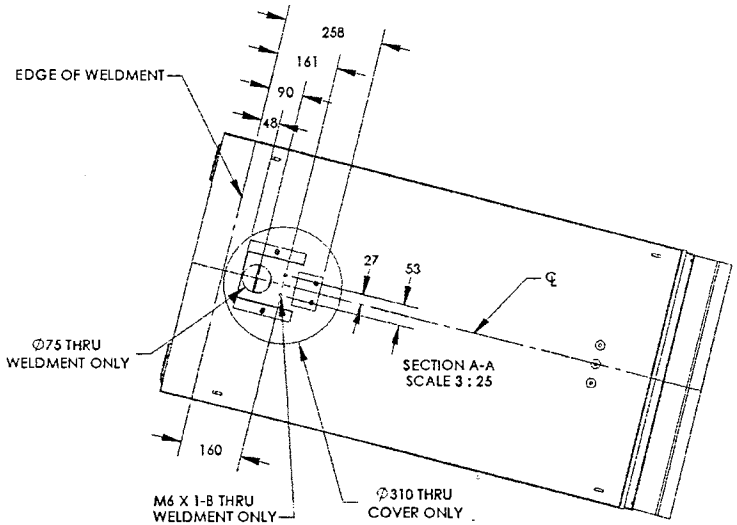
DETAIL C
SCALE 6 : 25







SECTION D-D
SCALE 2 : 25



SECTION A-A
SCALE 3 : 25

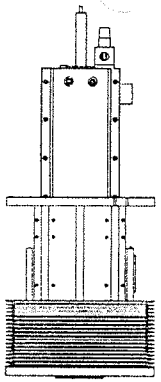
SECTION B-B
SCALE 2 : 25

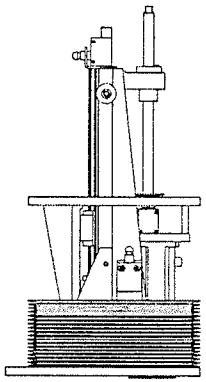
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS IN DEGREES AND MILLIMETERS
TOLERANCES PER ASME Y14.5M-1994 ALL MACHINED SURFACES TO 3.2
DIAMETERS ON A COMMON CENTERLINE TO BE TRUE POSITION WITHIN .25
REMOVE BURRS AND BREAK SHARP CORNERS AND FILLET RADII .8 MAX.

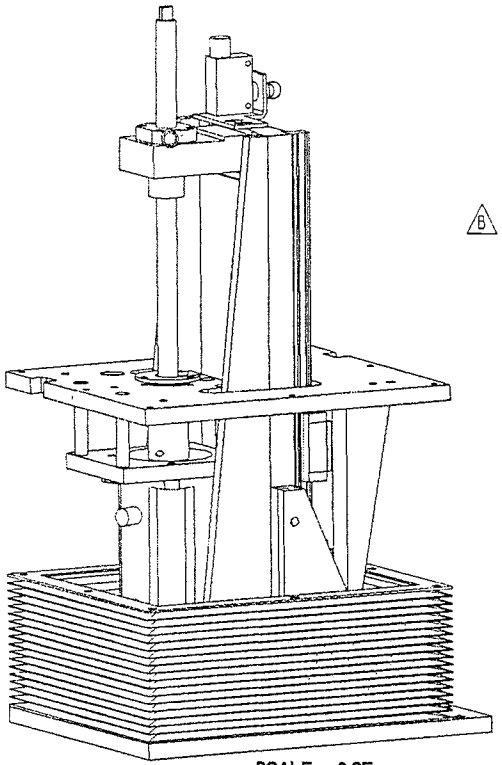
INCH		MILLIMETER		DEGREE	
X.XXX	± .005	X.XX	± .12	X.X	± .5
X.XX	± .01	X.X	± .25	X	± 1
X.X	± .03	X	± .8		

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL: SEE BOM	
REVISION: A	MODELED IN: SOLIDWORKS	TITLE: RETROFIT KIT;DWJ;IFB	
DRAWN BY: JMF	STARTED: 11/11/03		
ENG: D.BADER	SCALE: 1:25	BASE PART NUMBER: 712453	2 OF 2

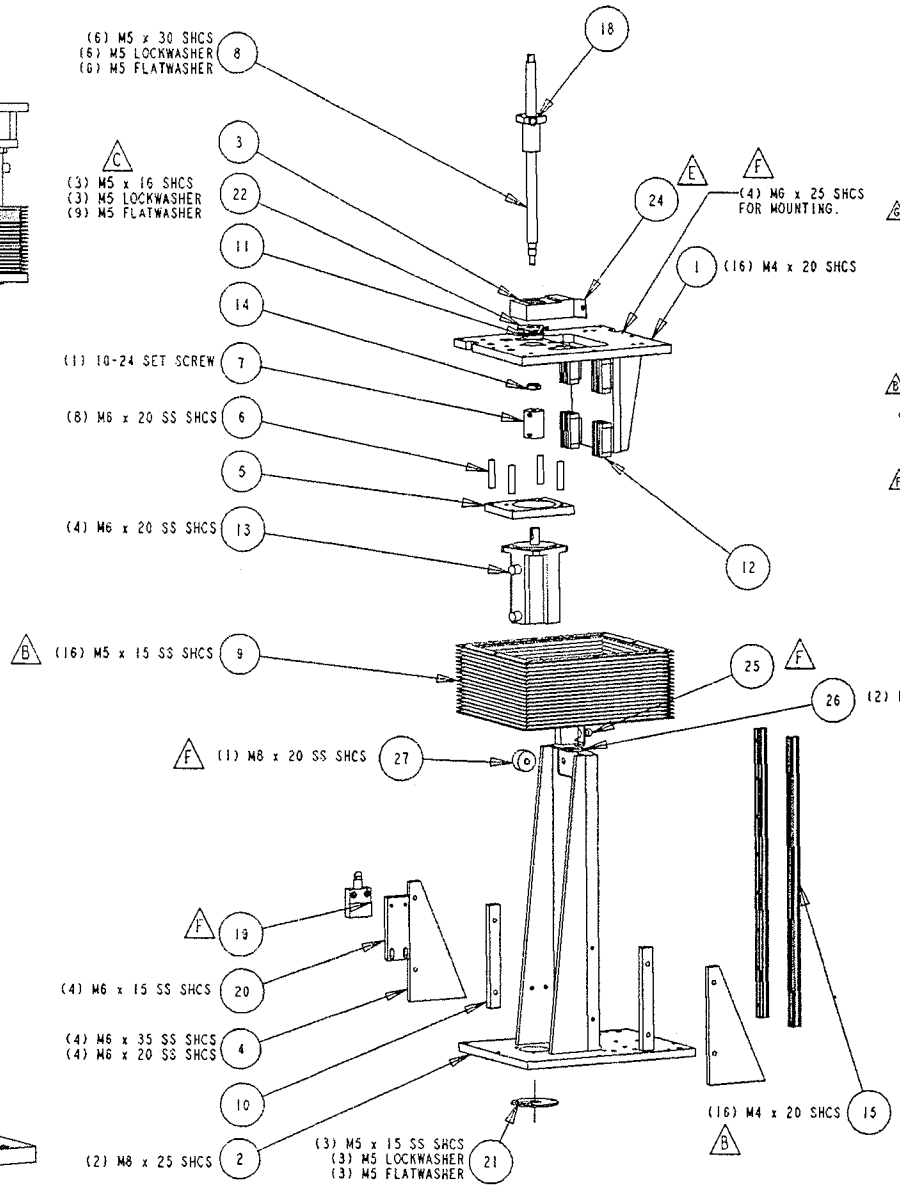
UNCONTROLLED COPY. USER IS RESPONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.







SCALE 0.25

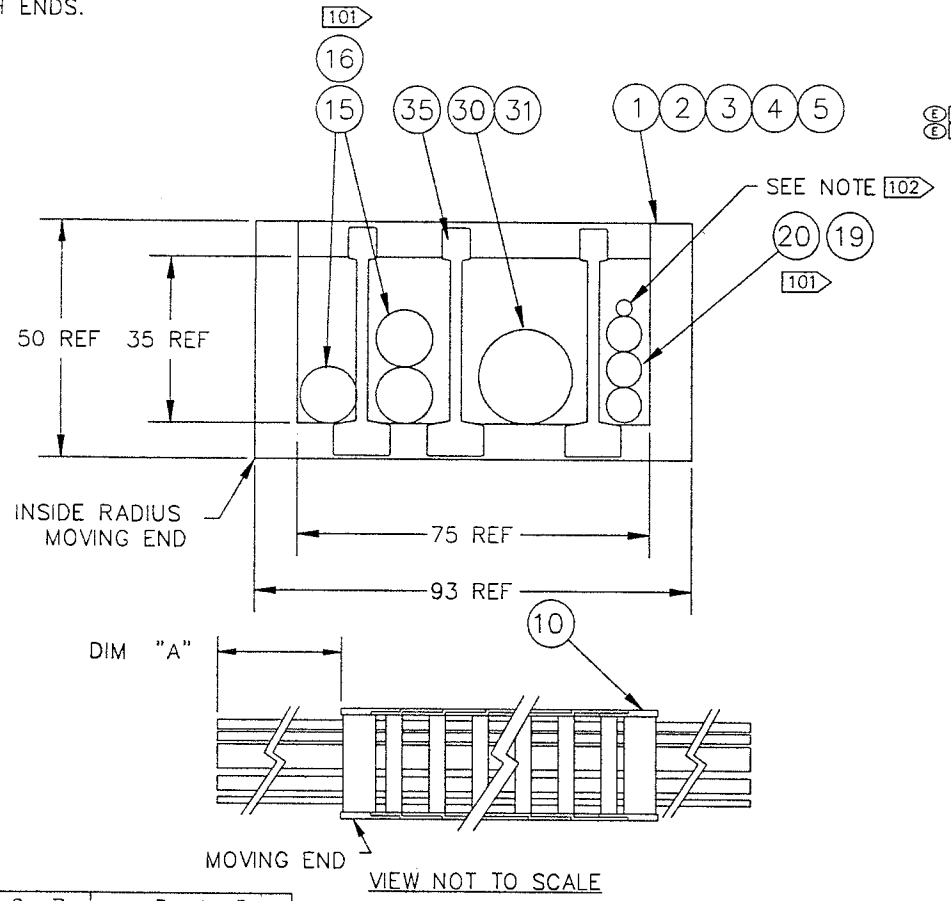


-1		PARTS LIST		
ITEM	QTY	UOM	PART NO.	DESCRIPTION
1	1	EACH	R34166-4B	MOUNT, BEARING VERTICAL;STEEL
2	1	EACH	712500-1	RAM;VERTICAL;ALUM;DWJ
G 3	1	EACH	015405-1	MOUNT, BALLNUT VERTICAL;INA
4	2	EACH	R34200-4	GUSSET, VERTICAL RAM
5	1	EACH	712284-1	MOUNT;MOTOR;VERTICAL;DWJ
6	4	EACH	R33586-2	MOUNT;MOTOR;SUPPORT
7	1	EACH	712331-1	COUPLING; MODIFICATION;14MM-8
G 8	1	EACH	714332-1	BALLSCREW;IFB;MOT.Z;334
9	1	EACH	R33525-4	WAYCOVER;VERTICAL AXIS
10	2	EACH	R34312-2	BAR, SPACER
11	1	EACH	A-14018-2	BEARING;SINGLE ROW;12MM BORE
G 12	4	EACH	A-19856-15	BLOCK;LINEAR RAIL;INA;KWVE15S
C 13	1	EACH	A-13944-5	SERVO MOTOR; 400 W w BRAKE
14	1	EACH	A-14025-2	NUT; BEARING RETAINING
G 15	2	EACH	A-19857-15-0460-20	LINEAR RAIL;INA;TKVD15/460/20
17	4	EACH	A-13966-1	LUBE UNIT (STAR);SIZE 15
18	1	EACH	A-14426	ADAPTOR;THK
19	1	EACH	A-19263-1	LIMIT SWITCH W/O CABLE
20	1	EACH	712501-1	SWITCH MOUNT;LIMIT;VERTICAL
21	1	EACH	712671-1	COVER;ACCESS;Z AXIS;DWJ
B 22	1	EACH	712372-1	PLATE; RETAINER; BEARING
[10] 23	1	EACH	711964-5	COMPUTER ASSY;IFB/DWJ
E 24	1	EACH	714334-1	SPACER; MOUNT BLOCK
F 25	1	EACH	A-14007	LIMIT SWITCH
F 26	1	EACH	015224-1	MOUNT;LIMIT SWITCH;IFB;Z-AXIS
F 27	1	EACH	015226-1	STOP;VERTICAL AXIS;IFB

THIRD ANGLE	Flow		
		MATERIAL: SEE BOM	
REVISION G	MODELED IN PRO-E	TITLE VERTICAL ASSY;HVY DTY;8";DWJ	
DRAWN BY TK	STARTED 23-Jul-01		
ENG TK	SCALE 0.125	BASE PART NUMBER 712457	1 OF 1

101 LAB[illegible] MULTIPLES OF ITEMS AS A, B, C, ETC...
(I.E.-#15 AS 15A, 15B, AND 15C)

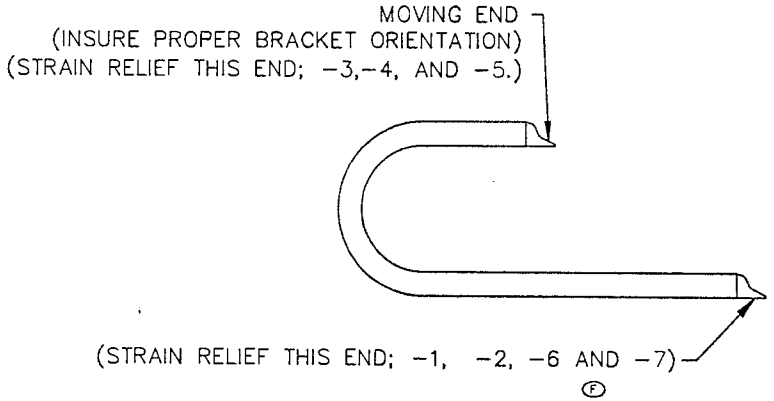
102 ALL 712486 DASH NUMBER ADD GREEN/YELLOW GROUND WIRE; MIN 10 AWG; 25' LENGTH; HAVING 1/4" RING LUG ON BOTH ENDS.



Ⓕ ITEM	-1,-2,-6,-7 "A"	-3,-4,-5 "A"
15	2235 (88")	--
16	--	1270 (50")
17	2235 (88")	--
18	--	1270 (50")
19	2235 (88")	--
20	--	1270 (50")
30	--	1270 (50")
31	965 (38")	--
36	2235 (88")	1270 (50")

Ⓕ	-7 QUANTITY	-6 QUANTITY	-5 QUANTITY	-4 QUANTITY	-3 QUANTITY	-2 QUANTITY	-1 QUANTITY	U/M	ITEM	PART NUMBER	DESCRIPTION
	-	-	-	-	-	1	-	EA	1	A-14446-1	CABLE CARRIER; IGUS; 4.4'
	-	-	-	-	-	-	1	EA	2	A-14446-2	CABLE CARRIER; IGUS; 9'
	-	-	-	-	-	-	-	EA	3	A-14446-3	CABLE CARRIER; IGUS; 3.3'
	-	-	1	-	-	-	-	EA	4	A-14446-4	CABLE CARRIER; IGUS; 7.8'
	-	-	-	1	-	-	-	EA	5	A-14446-5	CABLE CARRIER; IGUS; 5.9'
	1	1	1	1	1	1	1	EA	10	A-14448-2	BRACKET SET;PIVOTING;IGUS
	3	3	-	-	-	3	3	EA	15	712586-1	CABLE;SERVO PWR;6 CNDCT;22FT
	-	-	3	3	3	-	-	EA	16	712586-2	CABLE;SERVO PWR;6 CNDCT;30FT
	3	3	-	-	-	3	3	EA	19	712585-1	CABLE;ENCODER;6 CNDCT;22 FT
	-	-	3	3	3	-	-	EA	20	712585-2	CABLE;ENCODER;6 CNDCT;30 FT
Ⓗ	-	-	1	1	1	-	-	EA	30	015265-2	CABLE;ASSY;19 COND;NEUT;26';J9
Ⓗ	1	1	-	-	-	1	1	EA	31	015265-1	CABLE;ASSY;19 COND;NEUT;20';J9
Ⓖ	66	51	66	48	36	75	66	EA	35	A-18263-2	SEPARATOR
Ⓔ 102	300	300	300	300	300	300	300	IN	36	A-0885-9-189	WIRE;UL 1015;10 GAGE;GREEN/YEL
Ⓔ 102	2	2	2	2	2	2	2	EA	37	A-00134-3	TERMINAL;1/4";12-10;RNG TONGUE
Ⓕ	-	1	-	-	-	-	-	EA	38	A-14446-6	CABLE CARRIER; IGUS; 6'
Ⓕ	1	-	-	-	-	-	-	EA	39	A-14446-7	CABLE CARRIER; IGUS; .8'

END TYPE	ITEM #	FITTING STYLE
MOVING	16,20	MALE PINS (9 PIN)
STATIONAIRY	15,19	FEMALE SOCKETS (9 PIN)
STATIONAIRY	20	2CN FEMALE FITTING
MOVING	15	FEMALE SOCKET (17 PIN)
STATIONAIRY	30,31	MALE PIN (19 PIN)
MOVING	30,31	FEMALE SOCKET (19 PIN)
MOVING	19	FEMALE SOCKET (7 PIN)
STATIONAIRY	16	TERMINALS



PART NO.	DESCRIPTION
712486-1	CABLE CARRIER ASSY;DWJ;4' Y
712486-2	CABLE CARRIER ASSY;DWJ;2M Y
712486-3	CABLE CARRIER ASSY;DWJ;4' X
712486-4	CABLE CARRIER ASSY;DWJ;8' X
712486-5	CABLE CARRIER ASSY;DWJ;12' X
Ⓕ 712486-6	CABLE CARRIER ASSY;DWJ;4' Y
Ⓕ 712486-7	CABLE CARRIER ASSY;DWJ;2M Y

THIRD ANGLE PROJECTION

Flow

MATERIAL: SEE BILL OF MATERIAL

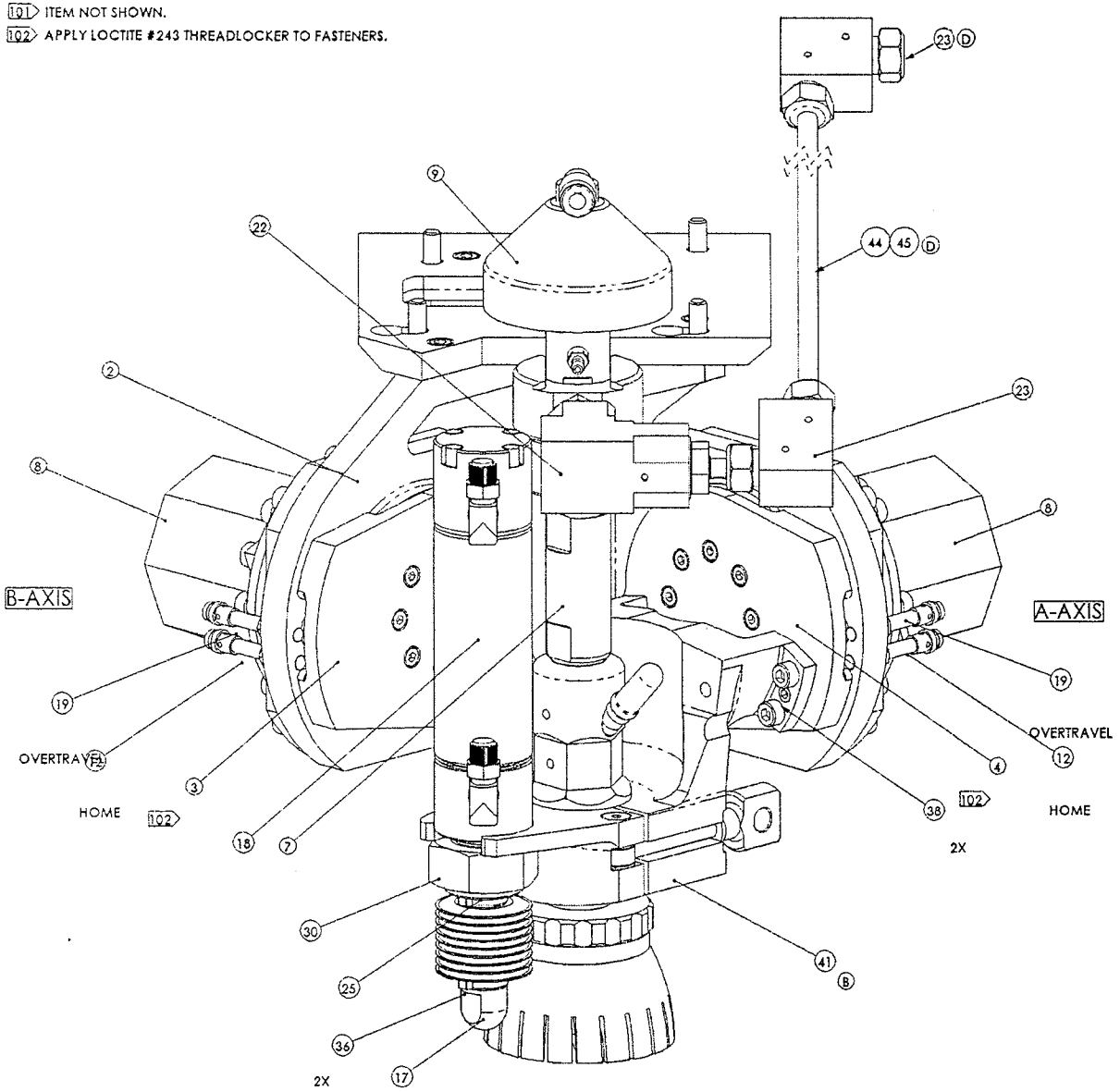
REVISION	MODELED IN	TITLE
H	NONE	CABLE CARRIER ASS'Y; DWJ
DRAWN BY ZZ	STARTED 8/08/04	
ENG ZZ	SCALE 1:2	BASE PART NUMBER 712486

1 OF 1

NOTES:

101 ITEM NOT SHOWN.

102 APPLY LOCTITE #243 THREADLOCKER TO FASTENERS.



ITEM	QTY	U/M	PART No.	DESCRIPTION
2	1	EA	711402-1	BASE MOUNT; DWJ
3	1	EA	711401-1	ELBOW; B-AXIS;DYNAMIC WATERJET
4	1	EA	711438-1	MOUNT; A-AXIS;DWJ
7	1	EA	712262-1	CUTTING HD ASSY; PASER DWJ ECL
8	2	EA	712292-2	ACTUATOR;DWJ;IFB;HDT
9	1	EA	710870-1	VALVE ASSY;60K MINI
12	2	EA	A-14132-1	SWITCH; PROX; CAP; 5MM; N.O.
15	2	EA	A-0275-226	O-RING;BUNA-N;70 DUR;NO.2-226
17	1	EA	711600-1	ADAPTER; TOOL BALL
18	1	EA	A-14822-1	POSN FEEDBACK;CYLINDER
19	2	EA	A-15056-1	SWITCH;PROXIMITY;3-WIRE;N.C.
22	1	EA	B-5725-1	SWIVEL ASSY;1/4" DOUBLE-ACTING
23	2	EA	A-0775-4	ELBOW;HP;60 KPSI;1/4" ANTI-VIB
25	1	EA	A-14865	BELLOW;BIMBA POSITION FB
28	2	EA	A-0622-4	CONNECTOR;MALE ELBOW;BRASS;4-2
30	1	EA	711598-1	BELLOW NUT;BIMBA;DWJ
36	2	EA	A-14979-1	CABLE TIE;BLACK
38	2	EA	A-14531-3	SCREW;SKT SET;CP;SST;M6X6MM
40	2	EA	A-14790	BUMPER;RUBBER;1/2" X 1/4"TALL
B	41	1	EA	712403-1	CLAMP ASSY;NOZZLE MOUNT;DWJ
B	42	2	EA	712606-1	RING;BARRIER TEFLON
C 101	43	1	EA	015266-1	CABLE;ASSY;19 COND;IFB;DWJ
D	44	1	EA	A-0781-7	NIPPLE;TUBING;1/4" HP;7" LG
D	45	0.2	ME	A-2883	TUBING;FLEX 9/32

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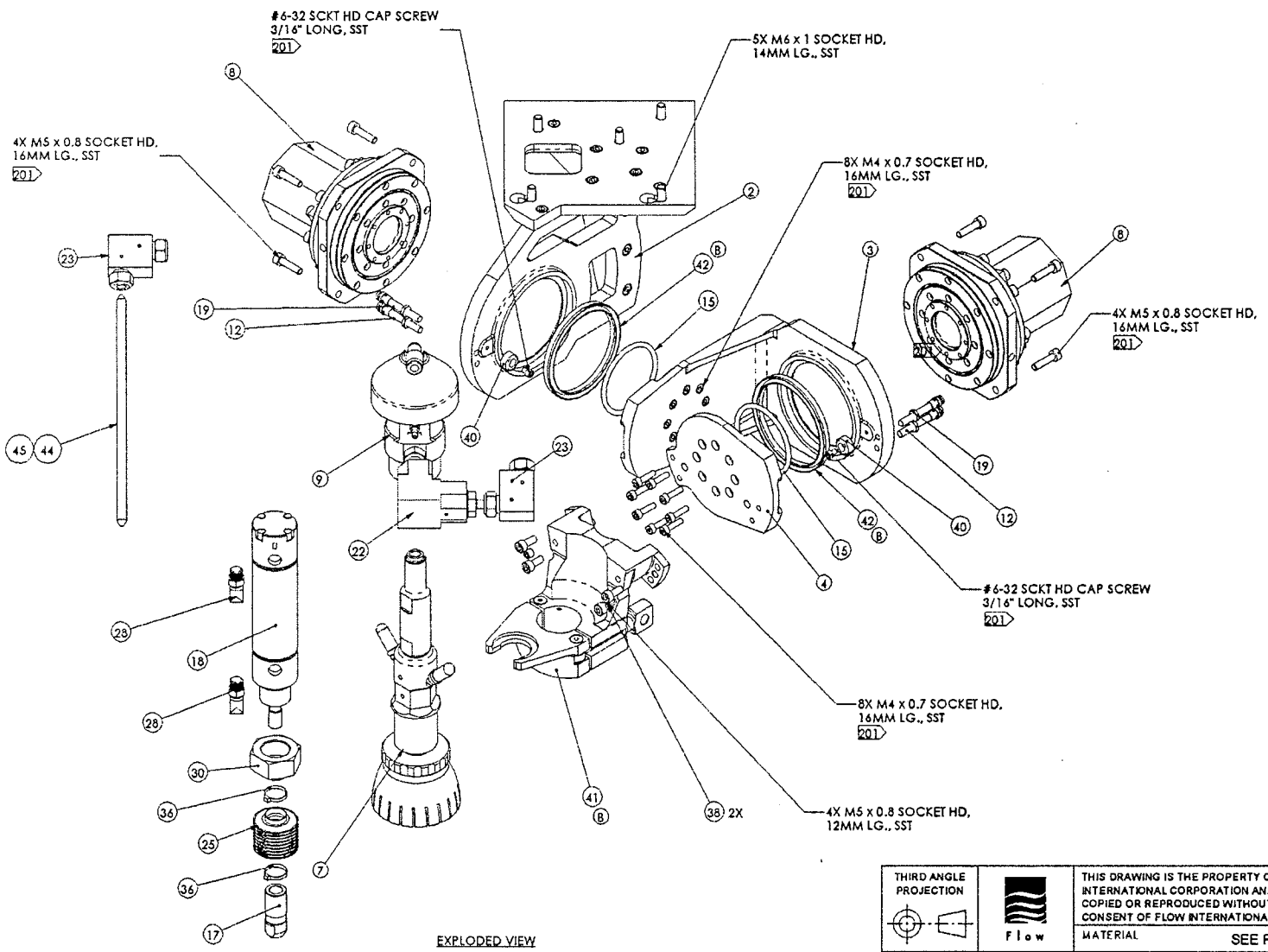
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL SEE P/L
REVISION D	MODELED IN SOLIDWORKS	TITLE WRIST ASSEMBLY DWJ; IFB
DRAWN BY T. KAELIN	STARTED 8/26/02	
ENG T. KAELIN	SCALE 1:1.5	BASE PART NUMBER 712497 — 1 OF 3

NOTES:
201 APPLY LOCTITE #243 THREADLOCKER TO FASTENERS AT ASSEMBLY.



EXPLODED VIEW

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: SEE P/L
REVISION: D	MODELED IN: SOLIDWORKS	TITLE: WRIST ASSEMBLY DWJ; IFB
DRAWN BY: T. KAELIN	STARTED: 8/26/02	
ENG: T. KAELIN	SCALE: 1:3	BASE PART NUMBER: 712497 — 2 OF 3

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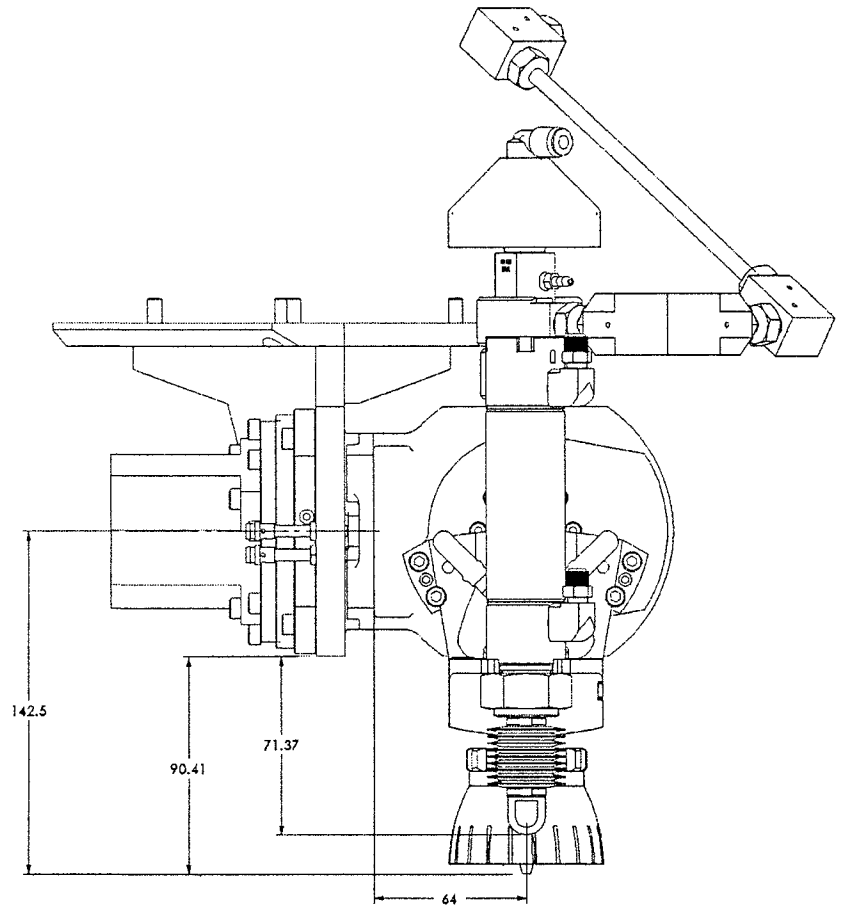
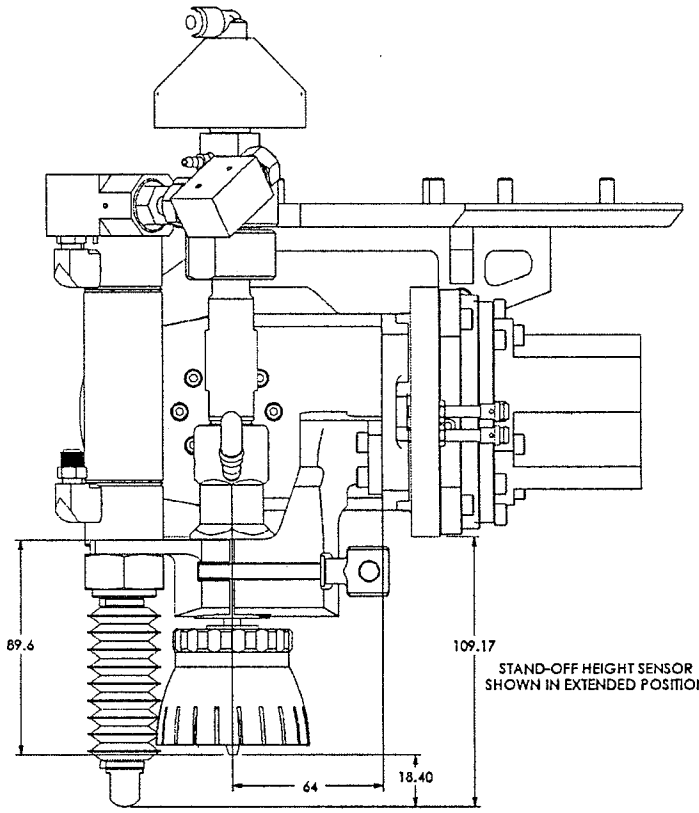




UNLESS OTHERWISE SPECIFIED:
DIMENSIONS IN DEGREES AND MILLIMETERS
TOLERANCES PER ASME Y14.5M-1994 ALL MACHINED SURFACES TO
DIAMETERS ON A COMMON CENTERLINE TO BE TRUE POSITION WITHIN .25
REMOVE BURRS AND BREAK SHARP CORNERS AND FILLET RADII .75 MAX.

INCH		MILLIMETER		DEGREE	
X.XXX	± .005	X.XX	± .12	X.X	± 1deg
X.XX	± .01	X.X	± .25	X	± 3deg
X.X	± .03	X	± .75		

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL: SEE P/L	
REVISION: D	MODELED IN: SOLIDWORKS	TITLE: WRIST ASSEMBLY DWJ; IFB	
DRAWN BY: T. KAELIN	STARTED: 8/26/02		
ENG: T. KAELIN	SCALE: 1:2	BASE PART NUMBER: 712497	3 OF 3

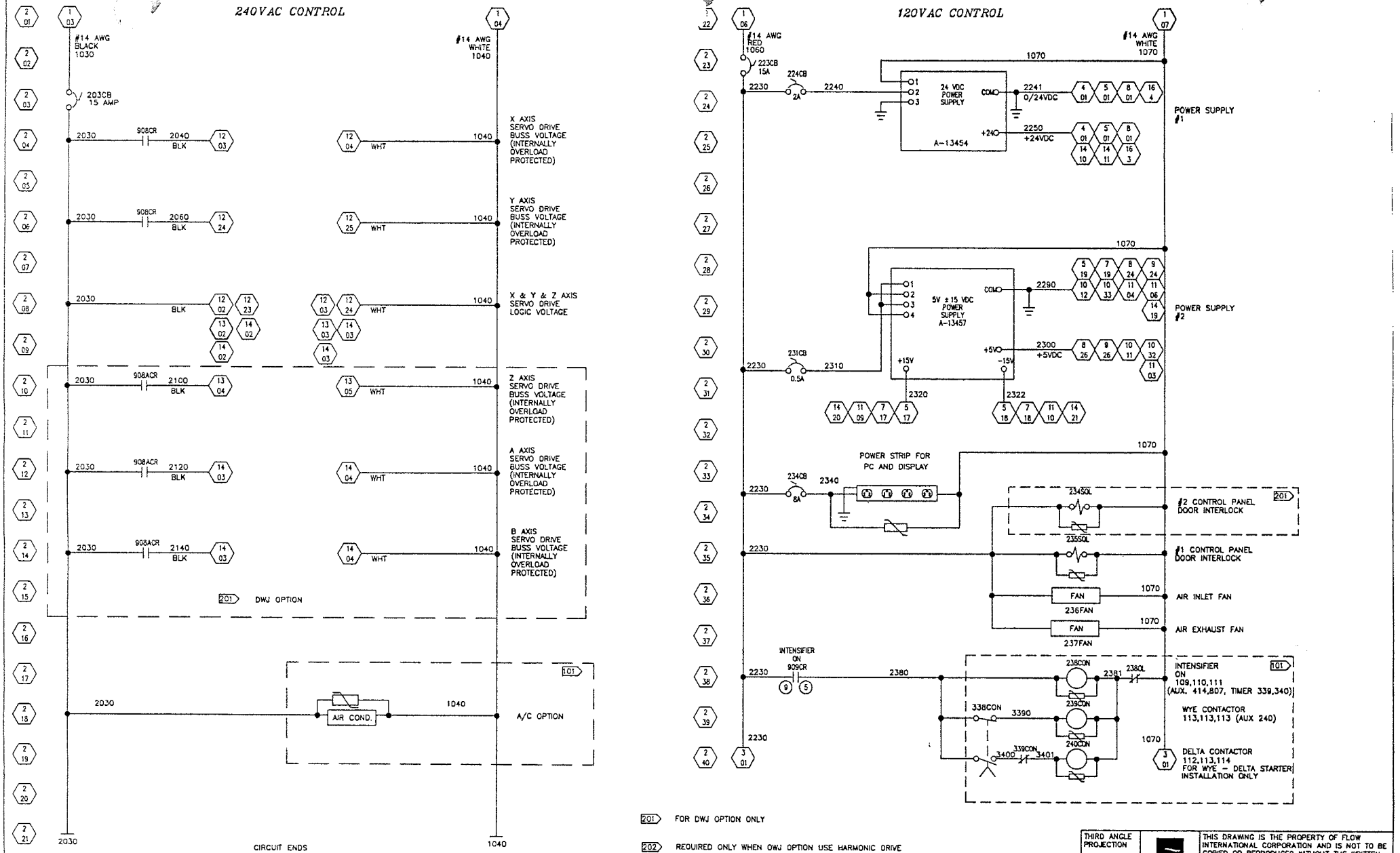
UNCONTROLLED COPY. USER IS RESONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.

FLOW INTERNATIONAL
ELECTRICAL SCHEMATIC & LAYOUT
FOR
IFB DWJ OPTION RETROFIT

DRAWING LIST

	DRAWING INDEX		
	DWG.	PAGE TITLE	REVISION DATE
	00	COVER SHEET/DRAWING LIST	9/18/02
	01	240VAC & 120VAC CONTROL	9/18/02
(02)	02	24VDC CONTROL	9/18/02
	03	HEIGHT SENSOR A/D WIRING & SETUP - OPTION	9/18/02
(02)	04	24PT OPTO 22 OUTPUT	9/18/02
	05	DWJ VERTICAL (Z) DRIVE - OPTION	9/18/02
(02)	06	DWJ ROTARY (A&B) DRIVE - OPTION	9/18/02
	07	PC & CARD INSTALLATION	9/18/02
	08	MACHINE CABLE DETAIL	9/18/02
(02)	09	MAIN ENCL. AND OPTION BOX INTERCONNECT WIRING	9/18/02

THIRD ANGLE PROJECTION	Flow	
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE COVER SHEET/ DRAWING LIST
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 0 OF 9



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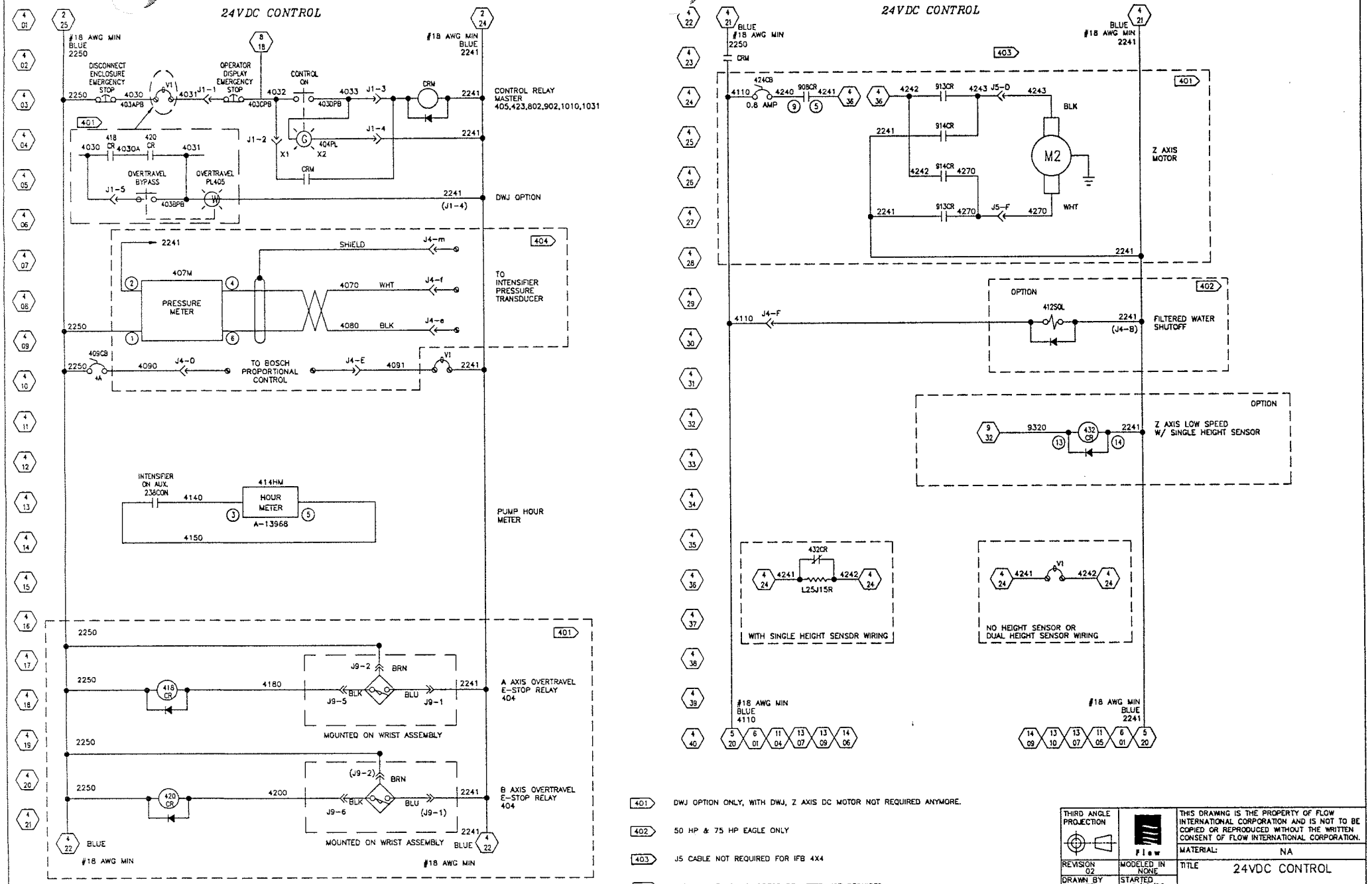
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE 240VAC & 120VAC CONTROL
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 1 OF 8



401 DWJ OPTION ONLY, WITH DWJ, Z AXIS DC MOTOR NOT REQUIRED ANYMORE.

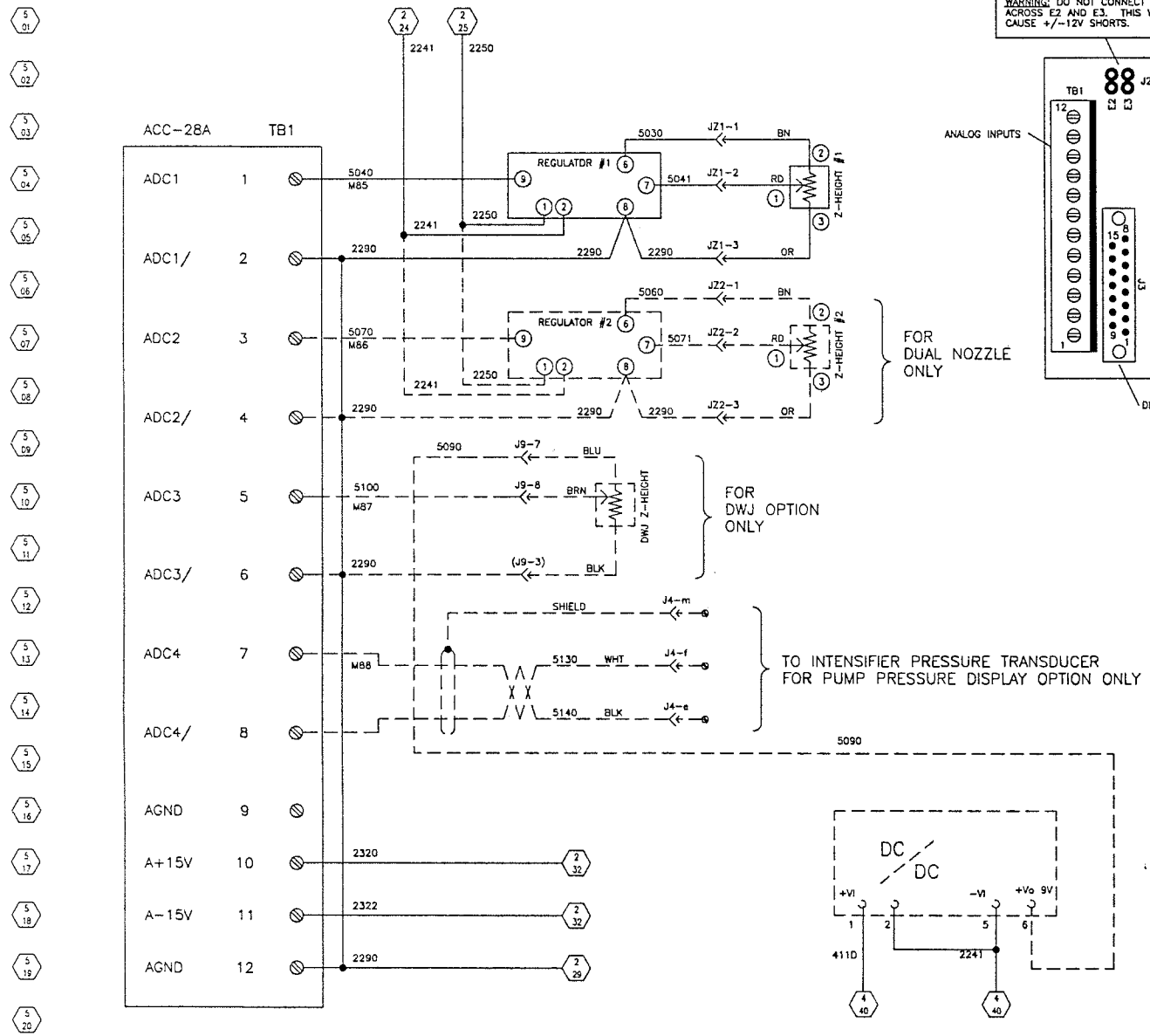
402 50 HP & 75 HP EAGLE ONLY

403 J5 CABLE NOT REQUIRED FOR IFB 4X4

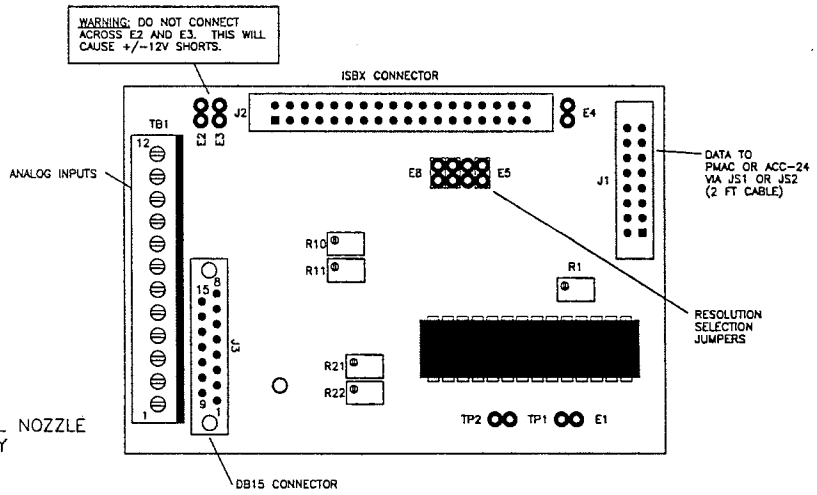
404 WITH HYPLEX PUMP, PRESSURE METER NOT REQUIRED

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE 24VDC CONTROL
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 2 OF 9

HEIGHT SENSOR OPTION



ACC-28A
4 CHAN., 16 BIT, A/D CONVERTER



SELECTION JUMPERS

DECODING	E1
DEFAULT = 2'S COMPLEMENT	OFF

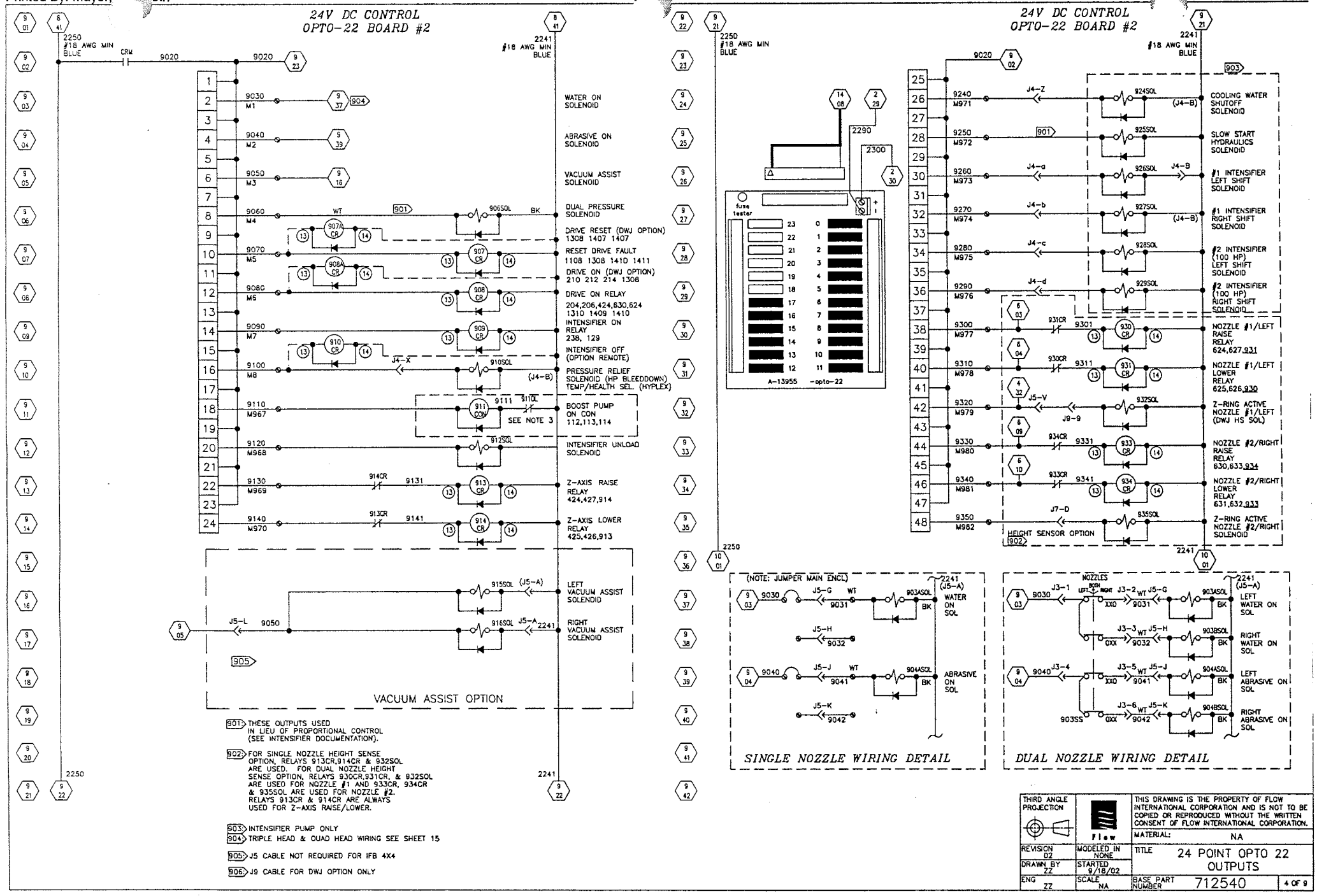
ANALOG POWER	E2	E3	E4
DEFAULT = OPTO-ISOLATED VDC	OFF	OFF	OFF

RESOLUTION	E8	E7	E6	E5
15-BITS	ON	ON	ON	ON
DEFAULT = 13-BITS				

ANALOG BIAS ADJUST

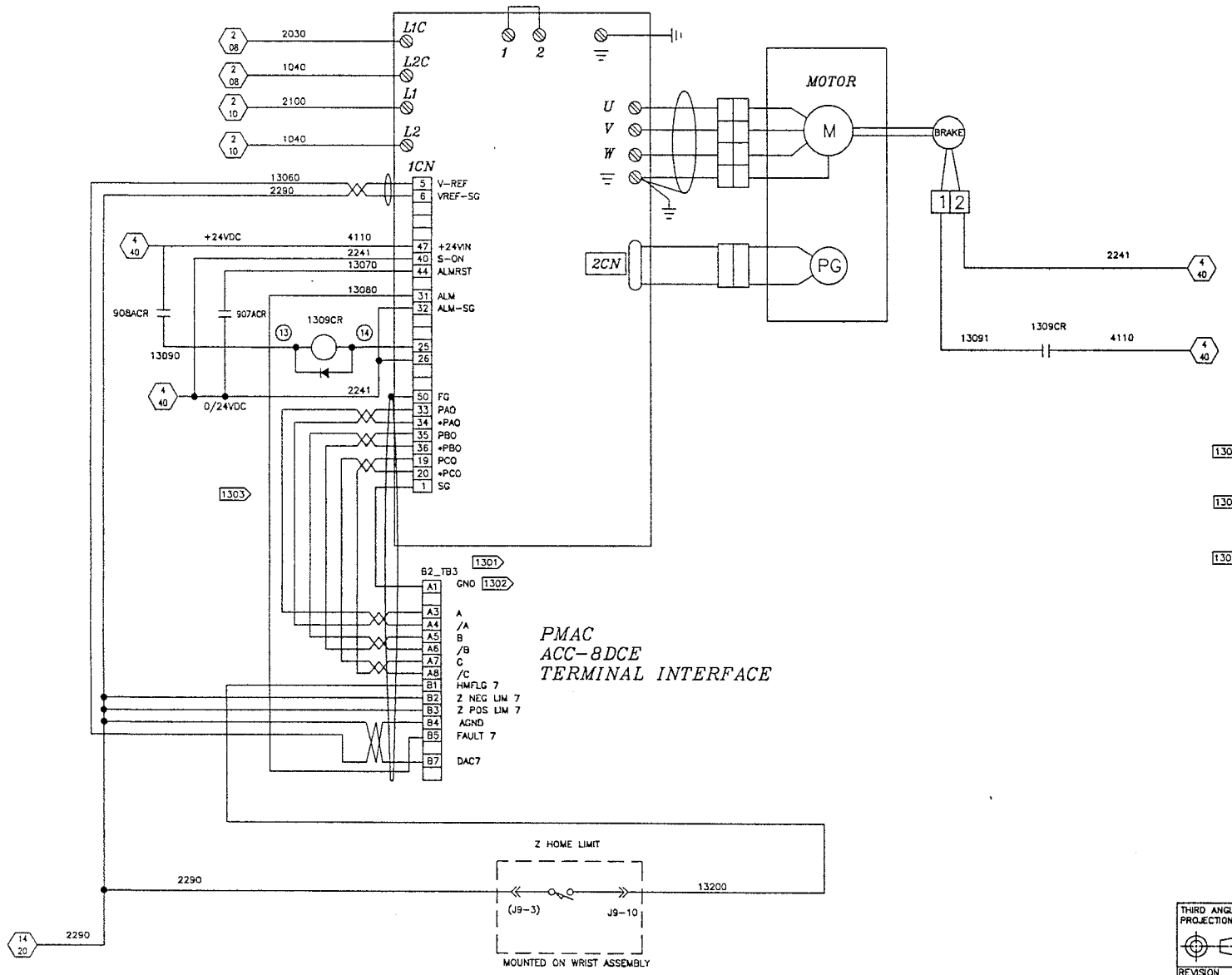
ADC1 (ADC REGISTER 1) = POT R22
ADC2 (ADC REGISTER 2) = POT R21
ADC3 (ADC REGISTER 3) = POT R11
ADC4 (ADC REGISTER 4) = POT R10

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE HEIGHT SENSOR A/D WIRING & SETUP
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 3 OF 9



THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE 24 POINT OPTO 22 OUTPUTS
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 4 OF 9

Z AXIS SERVO DRIVE



1301 DWJ USE ACC 8 BOARD #2

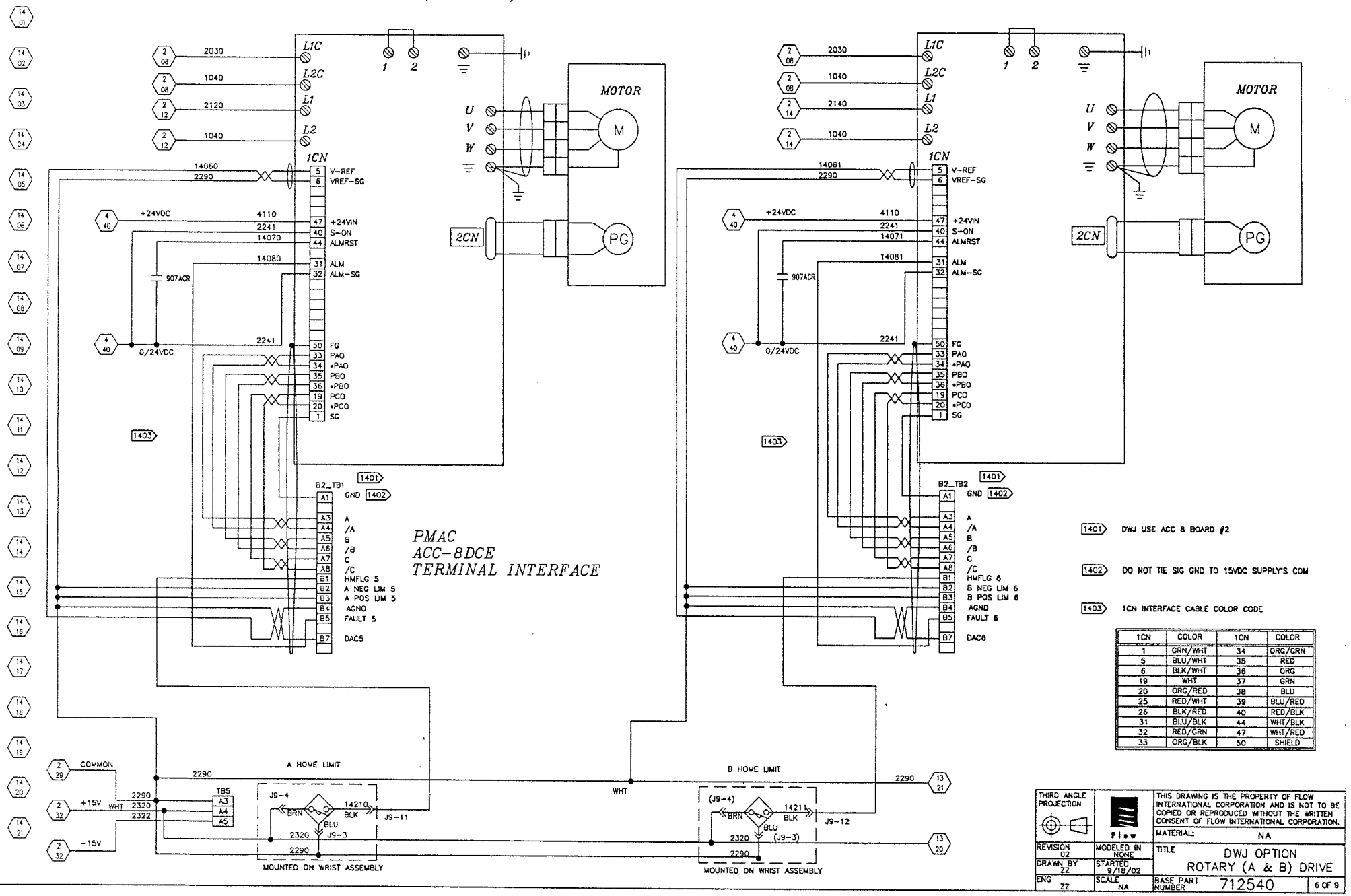
1302 DO NOT TIE SIG GND TO 15VDC SUPPLY'S COM

1303 1CN INTERFACE CABLE COLOR CODE

1CN	COLOR	1CN	COLOR
1	GRN/WHT	34	ORG/GRN
5	BLU/WHT	35	RED
6	BLK/WHT	36	ORG
19	WHT	37	GRN
20	ORG/RED	38	BLU
25	RED/WHT	39	BLU/RED
26	BLK/RED	40	RED/BLK
31	BLU/BLK	44	WHT/BLK
32	RED/GRN	47	WHT/RED
33	ORG/BLK	50	SHIELD

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE DWJ OPTION VERTICAL (Z) DRIVE
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 5 OF 9

ROTATION (A & B) AXIS POWER MODULE SERVO DRIVE



1401 DWJ USE ACC 8 BOARD #2

1402 DO NOT TIE SIG GND TO 15VDC SUPPLY'S COM

1403 1CN INTERFACE CABLE COLOR CODE

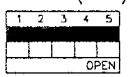
1CN	COLOR	1CN	COLOR
1	GRN/WHT	34	ORG/GRN
5	BLU/WHT	35	RED
6	BLK/WHT	36	ORG
19	WHT	37	GRN
20	ORG/RED	38	BLU
25	RED/WHT	39	BLU/RED
26	BLK/RED	40	RED/BLK
31	BLU/BLK	44	WHT/BLK
32	RED/GRN	47	WHT/RED
33	ORG/BLK	50	SHIELD

THIRD ANGLE PROJECTION		
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE DWJ OPTION ROTARY (A & B) DRIVE
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 6 OF 9

PC & CARD INSTALLATION

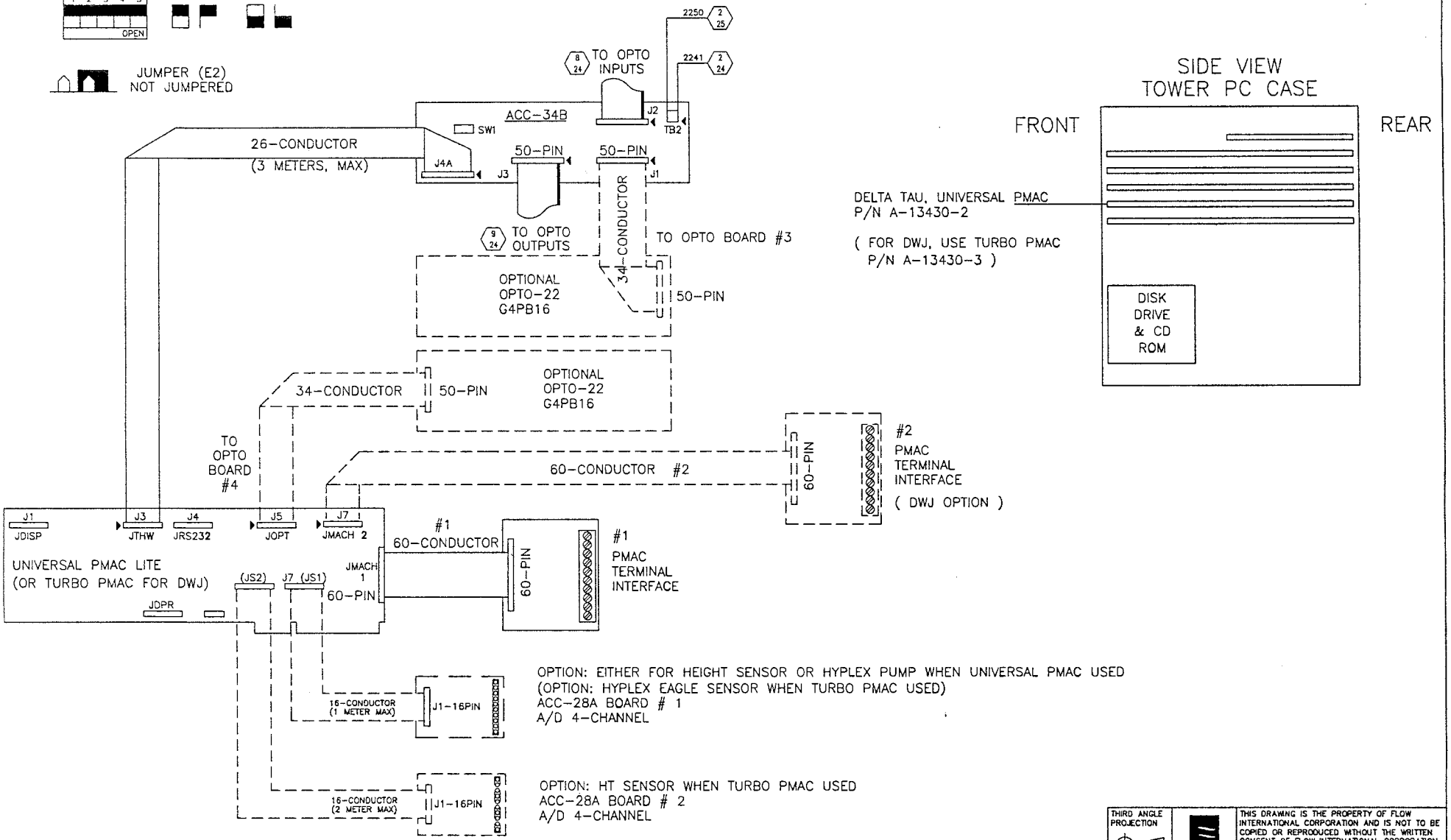
1601: ALL PMAC BOARDS NEED A JUMPER ON E-80, TO ALLOW "PMAC INTERUPT" HOST PC ON "IRQ10"
1602: "◀" DENOTES PIN ONE

SETTINGS FOR ACC-34B SWITCH (SW1)



ON OFF/OPEN

JUMPER (E2) NOT JUMPERED



SIDE VIEW
TOWER PC CASE

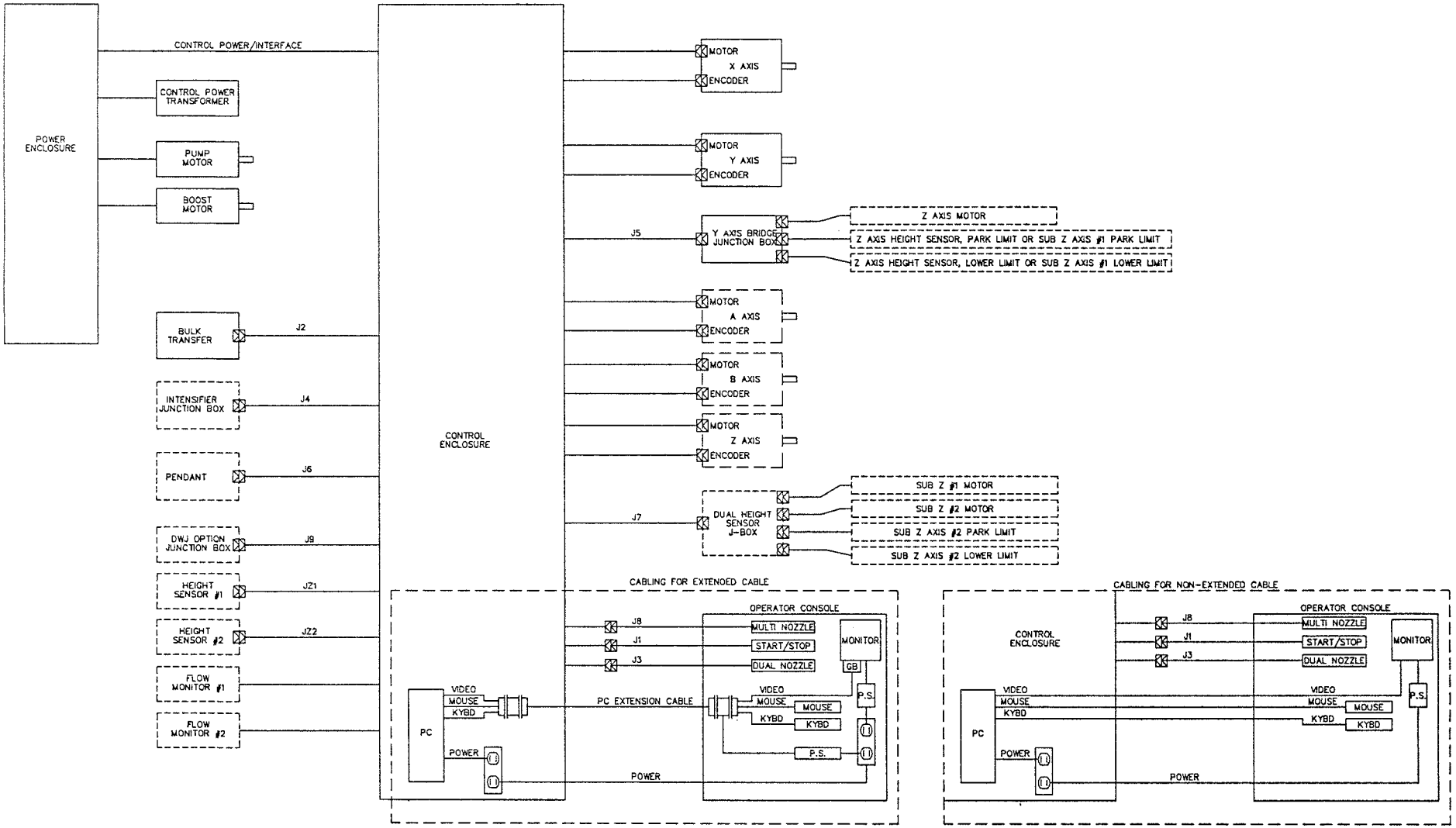
DELTA TAU, UNIVERSAL PMAC
P/N A-13430-2

(FOR DWJ, USE TURBO PMAC
P/N A-13430-3)

THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE: PC & CARD INSTALLATION
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 7 OF 9

EXTERNAL CABLE DETAIL

THIS IS NOT AN ACTUAL LAYOUT



THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE MACHINE CABLE DETAIL
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 8 OF 9

INTERCONNECT WIRING BETWEEN CONTROL ENCL. & OPTION BOX

DESCRIPTION	WIRING NUMBER	WIRING NUMBER ON VARIABLE IFB DRAWING PACKAGES								
	DWJ OPTION BOX	I6C00~01	I6C02	I6C03~04/FCE02~04/B4801	I6C05~06	I6C07/711595	FCE00	B4800~A	B4800B	B4802
NEUTRAL/240VAC	1040	1070	1070	1070	1040	1040	1070	1070	1070	1040
COM/120&240VAC	1070	1070	1070	1070	1070	1070	1070	1070	1070	1071
230VAC	2030	1240	1330	2030	2030	2030	1240	1330	1330	2030
120VAC	2230	2020	2020	2230	2230	2230	2020	2020	2020	2230
COM/24VDC	2241	2031	2031	2241	2241	2241	2031	2031	2031	2241
24VDC	2250	2032	2032	2250	2250	2250	2032	2032	2032	2250
COM/15VDC	2290	2111	2111	2321	2321	2290	2111	2111	2111	2321
+15VDC	2320	2110	2110	2320	2320	2320	2110	2110	2110	2320
-15VDC	2322	2112	2112	2322	2322	2322	2112	2112	2112	2322
A, B OVERTRAVEL	4030	2240A	2240A	4030	4030	4030	2240	4030A	4030	4030
A, B OVERTRAVEL	4031	2240B	2240B	4031	4031	4031	2241	4030B	4031	4031
24VDC /w ESTOP	4110	2290	2290	4110	4110	4110	2290	4090	4090	4110
DRIVE RESET	9070	4070	4070	9070	9070	9070	4070	6070	6070	9070
DRIVE ON	9080	4080	4080	9080	9080	9080	4080	6080	6080	9080
HEIGHT SENSOR	9320	4320	4320	9320	9320	9320	4320	6320	6320	9320
GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND
--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--

901 2240A & 2240B INSERT AFTER 2240; 4030A & 4030B INSERT AFTER 4030.

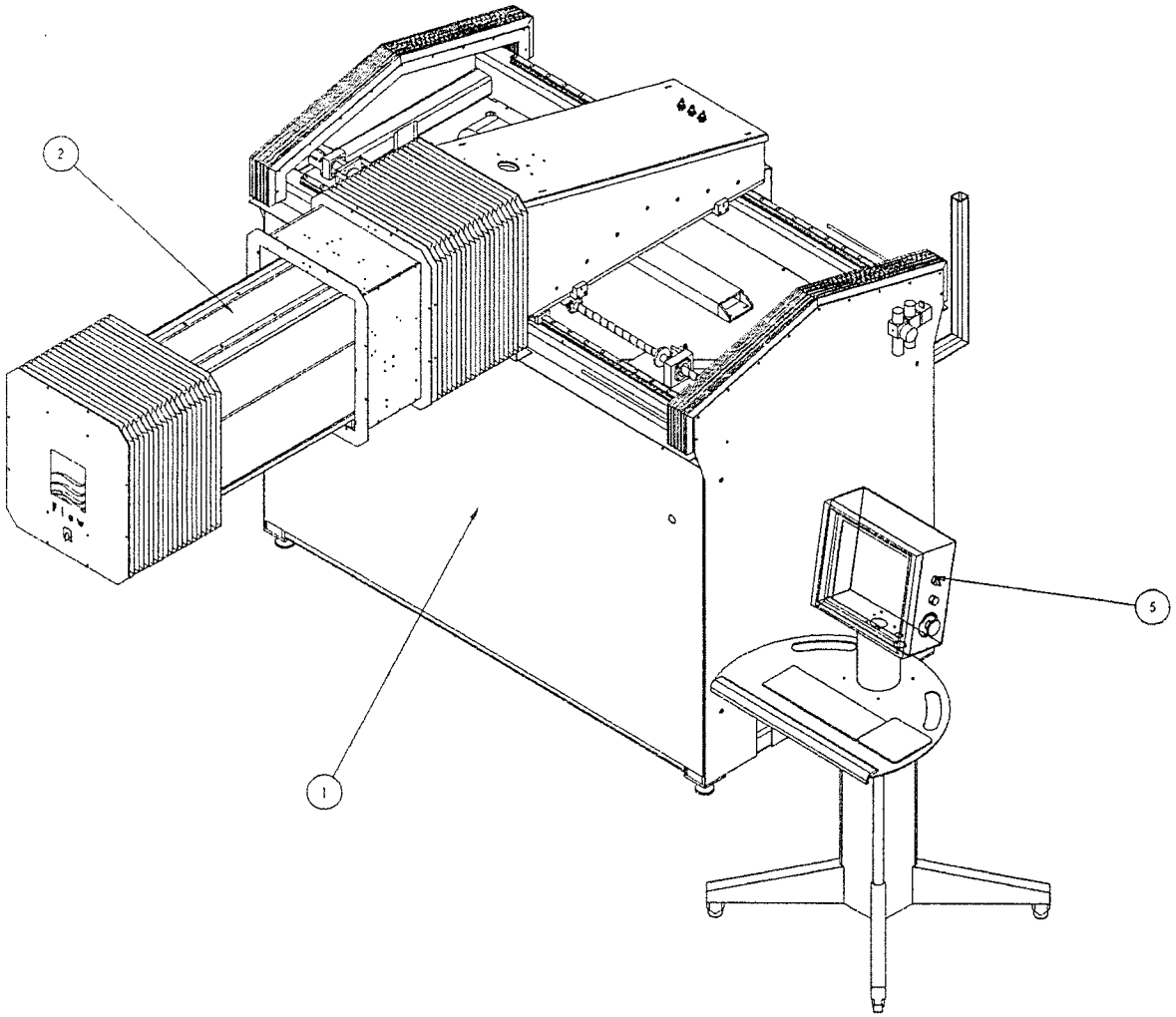
902 I6C04 ~ I6C07; FCE04; 711595 HAVE YASKAWA SIGMA II DRIVE. ALL OTHER VERSION HAS YASKAWA SIGMA I DRIVE (4 FEET BRIDGE HAS CE SIGMA I DRIVE)

903 ALL SIGMA I NON-CE DRIVE HAS TO REPLACE WITH SHIELDED POWER CABLE; ALL SIGMA II DRIVE POWER CABLE HAS TO BRING SHIELD OUT AND TIE IT AT AMPLIFIER GROUND POINT.

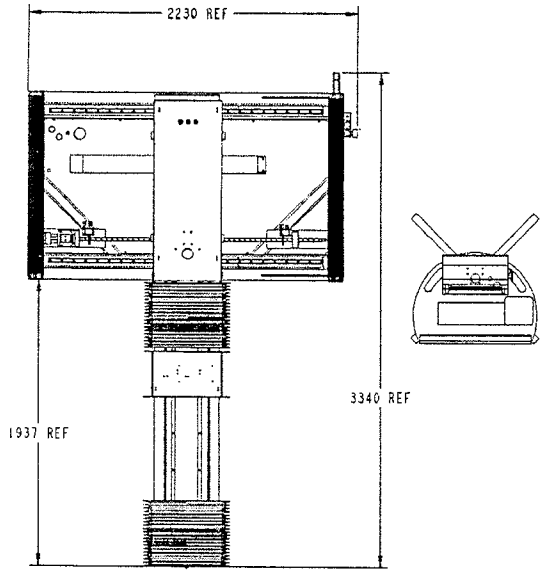
THIRD ANGLE PROJECTION	Flow	
		MATERIAL: NA
REVISION 02	MODELED IN NONE	TITLE INTERCONNET WIRING BTW. MAIN ENCL. & DWJ BOX
DRAWN BY ZZ	STARTED 9/18/02	
ENG ZZ	SCALE NA	BASE PART NUMBER 712540 — 9 OF 9

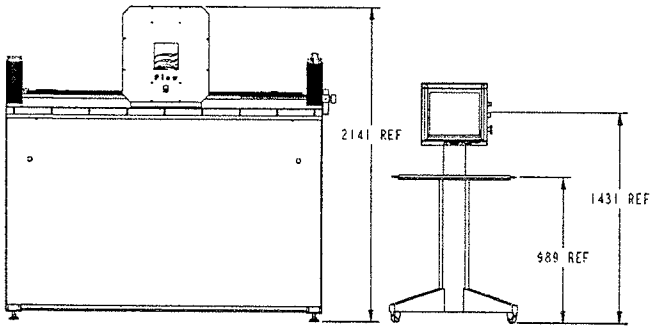
[101] ITEMS NOT SHOWN IN DRAWING

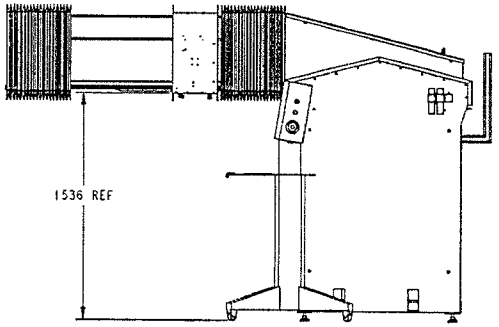
	ITEM	QTY	UOM	PART NO.	DESCRIPTION
B	1	1	EACH	712356-2	BASE AXIS;ASSEMBLY;4';HP .001"
	2	1	EACH	711993-1	ASSEMBLY;BRIDGE; 4'
[101]	3	1	EACH	712107-1	POWER PNL. ASSY;IFB;BASIC
[101]	4	1	EACH	712108-3	CNTRL PNL.ASSY;IFB;BASIC;4480
D	5	1	EACH	713015-1	CONSOLE MODULE;25FT;MOBILE;IFB
B [101]	9	1	EACH	015300-2	INSTALL KIT;IFB;4400



THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: -
REVISION D	MODELED IN PRO-E	TITLE IFB;4400;BASIC MODULE
DRAWN BY M.CORDS	STARTED 04-Mar-04	
ENG D.BADER	SCALE 0.12	BASE PART NUMBER 712655 — 1 OF 2







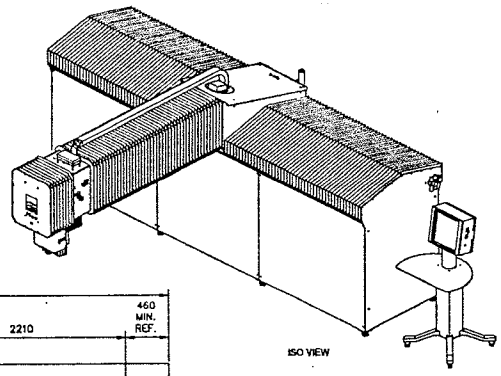
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: -
REVISION D	MODELED IN PRO-E	TITLE IFB;4400;BASIC MODULE
DRAWN BY M.CORDS	STARTED 04-Mar-04	
ENG D.BADER	SCALE 0.06	BASE PART NUMBER 712655 — 2 OF 2

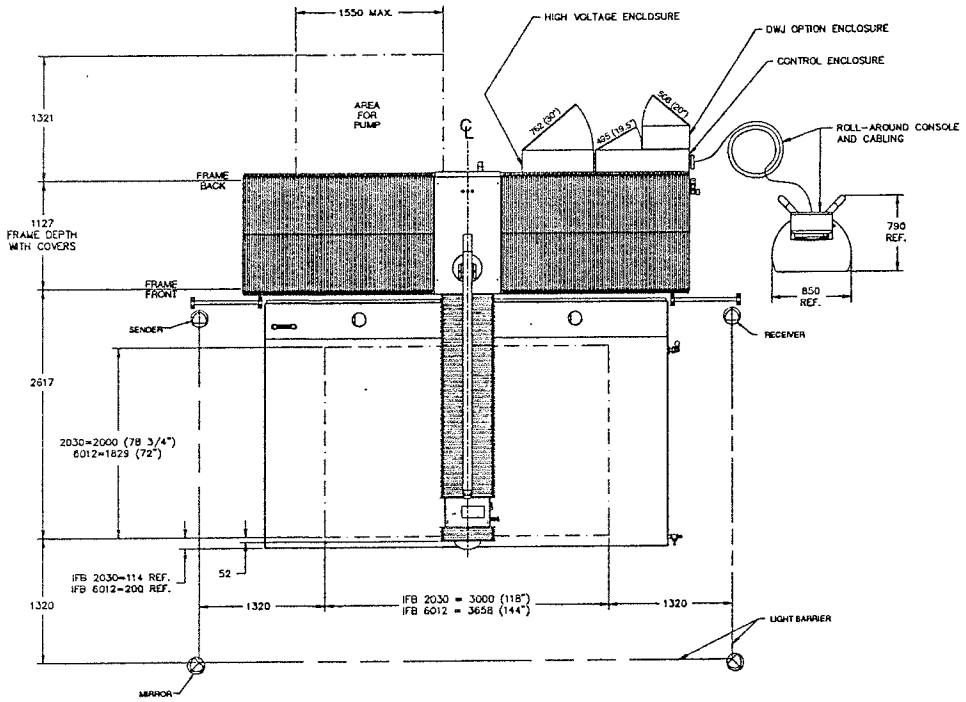
NOTES:

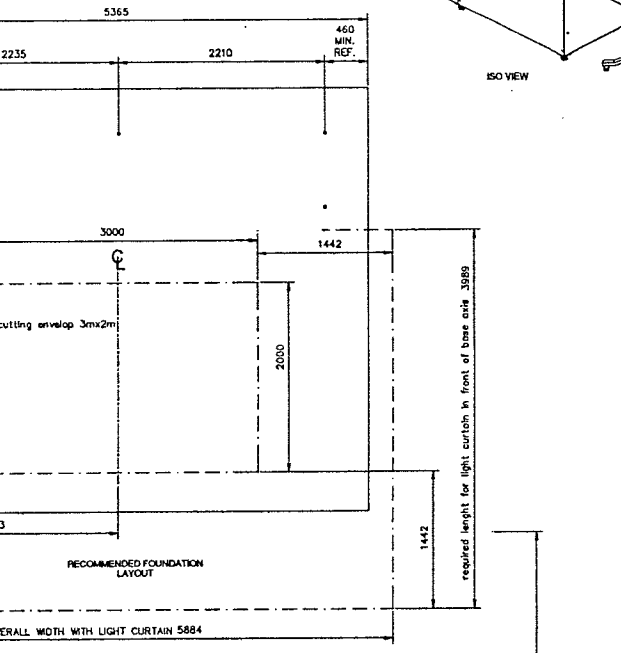
101) ALL DIMENSIONS ± 10mm (3/8")

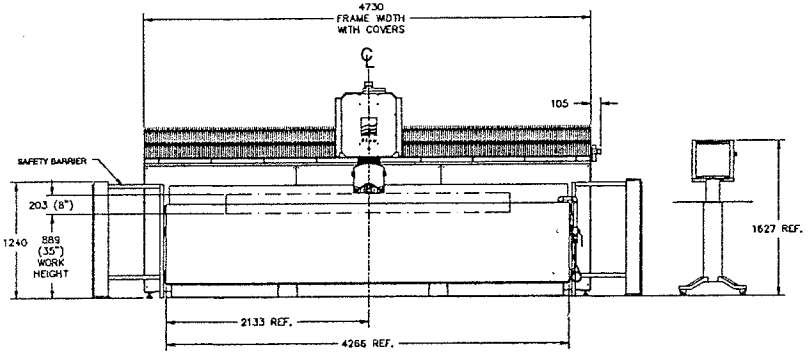
UTILITY REQUIREMENTS

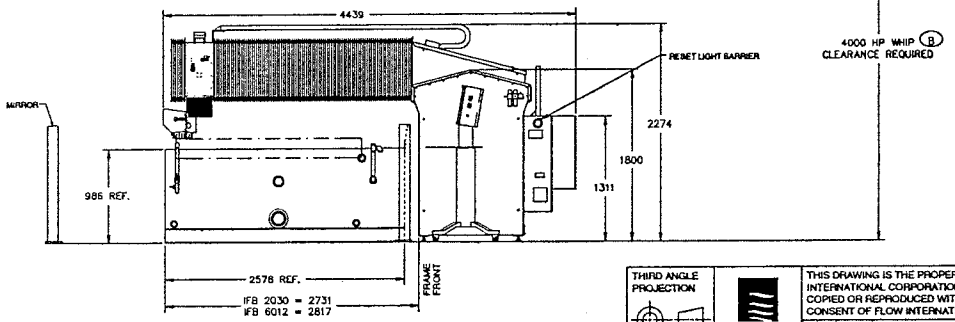
ELECTRICAL: 480V, 60Hz, 3PH, (75A @ 50HP, 140A @ 100HP)
ELECTRICAL: 400V, 50Hz, 3PH, (100A @ 50HP, 175A @ 100HP)
COMPRESSED AIR: 283 LPM (10 SCFM), 6-7 Bar (90 psi)
TANK DRAINAGE PORT: 1" FITTING, 7-8 LPM (2 GPM)











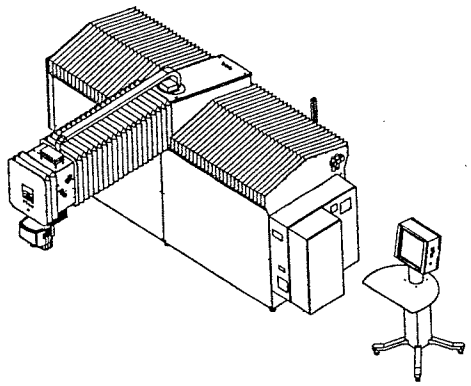
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION B	MODELED IN ACAD	TITLE LAYOUT DWG;IFB DWJ 2030/6012
DRAWN BY T. KAELIN	STARTED 12/16/02	
ENG T. KAELIN	SCALE 1:25	BASE PART NUMBER 712875 — 1 OF 1

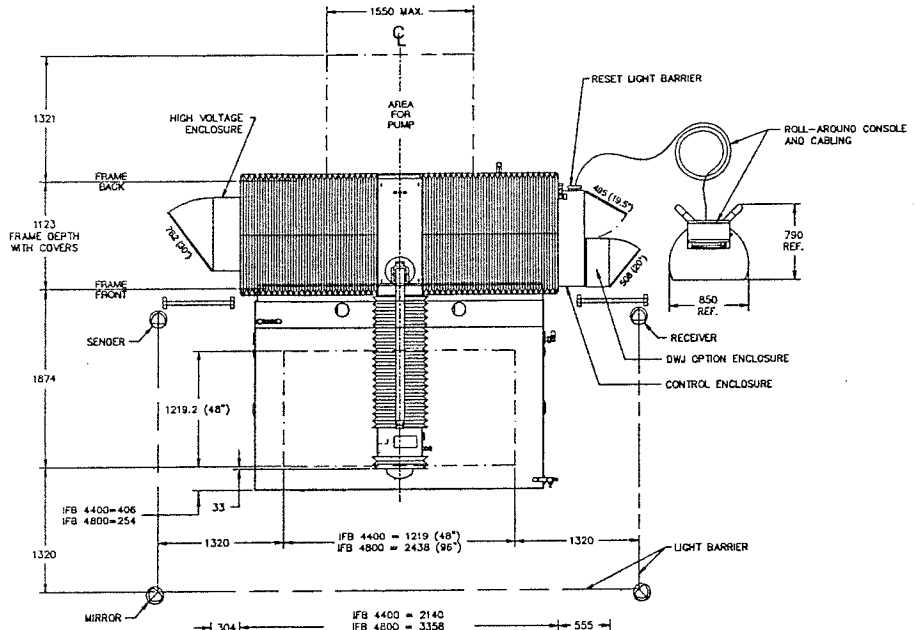
NOTES:

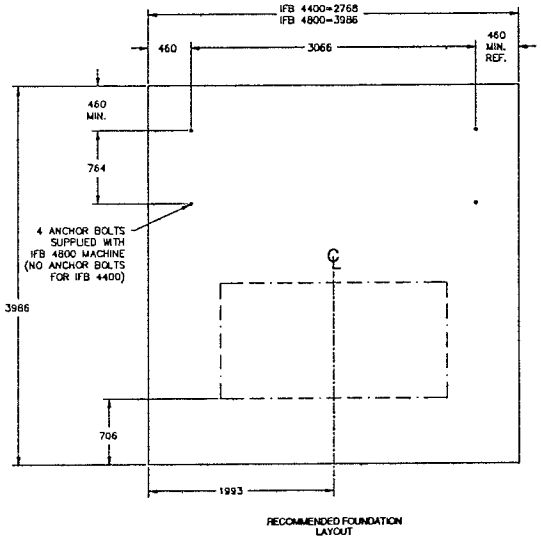
101) ALL DIMENSIONS ± 10mm (3/8")

UTILITY REQUIREMENTS

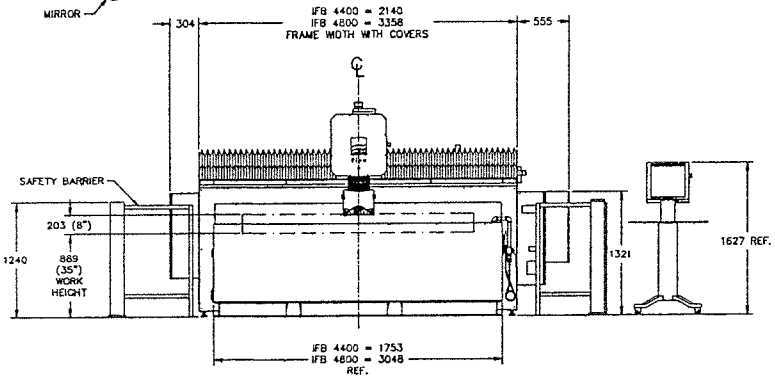
ELECTRICAL: 480V, 60Hz, 3PH, (75A @ 50HP, 140A @ 100HP)
ELECTRICAL: 400V, 50Hz, 3PH, (100A @ 50HP, 175A @ 100HP)
COMPRESSED AIR: 283 LPM (10 SCFM), 6-7 Bar (90 psi)
TANK DRAINAGE PORT: 1" FITTING, 7-8 LPM (2 GPM)

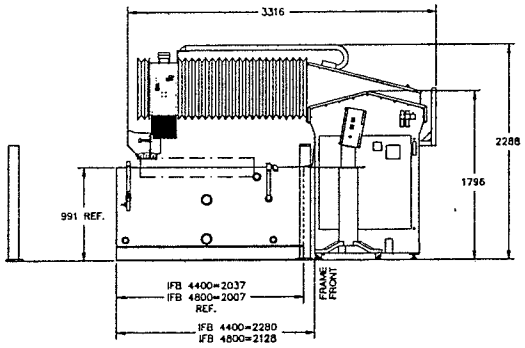






RECOMMENDED FOUNDATION LAYOUT





THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION A	MODELED IN ACAD	TITLE LAYOUT DWG;IFB DWJ 4400/4800
DRAWN BY T. KAELIN	STARTED 12/16/02	
ENG T. KAELIN	SCALE E 1:25	BASE PART NUMBER 712876 — 1 OF 1

101) ITEMS 1 THRU 8, 13, 19 THRU 21, 25, 29, 30, 31, 38, 40 THRU 45, 48 AND 50 ARE NOT SHOWN.

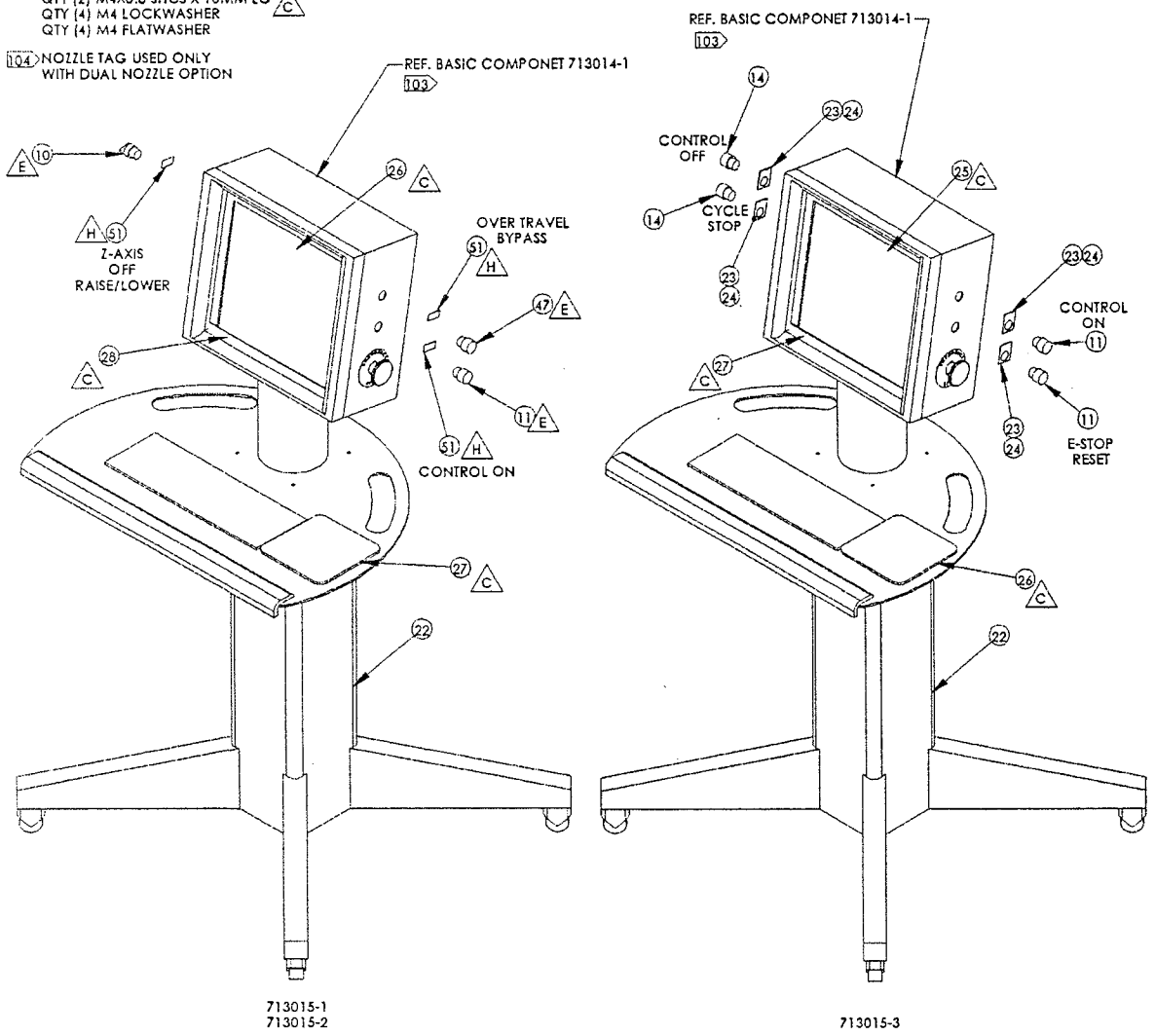
△E

102) CHANGED FROM PRE-PRODUCTION TO PRODUCTION

△A

103 ATTACH WITH:
QTY (2) M4X0.8 SHCS X 16MM LG
QTY (2) M4X0.8 SHCS X 10MM LG △C
QTY (4) M4 LOCKWASHER
QTY (4) M4 FLATWASHER

104 NOZZLE TAG USED ONLY WITH DUAL NOZZLE OPTION



713015-1
713015-2

713015-3

	ITEM	-7 QTY	-6 QTY	-5 QTY	-3 QTY	-2 QTY	-1 QTY	U/M	PART #	DESCRIPTION
	1	-	-	-	1	1	-	EA	A-14081-2	EXTENSION CORD,2+G,50'
△I △G	2	1	-	-	-	-	1	EA	A-20333-1	VGA MONITOR EXT. CABLE;25'
△I △G	3	-	-	-	1	1	-	EA	A-20333-2	VGA MONITOR EXT. CABLE;50'
△I △G	5	1	-	-	2	2	1	EA	A-20331-1	KVM EXTENDER,PS/2,KYBD/MOUSE
△I	6	2	-	-	-	-	2	EA	A-20332-1	PS/2 KYBD/MOUSE EXT. CABLE;25'
	7	-	-	-	2	2	-	EA	A-20332-2	PS/2 KYBD/MOUSE EXT. CABLE;50'
	8	1	-	-	-	1	1	EA	A-6587	CONTACT BLOCK;BASE
	10	-	-	-	-	1	1	EA	A-13965	SWITCH;SELECT3POSITION
	11	-	1	1	2	1	1	EA	A-6613	SWITCH;PUSH BUTTON
△E	13	1	1	1	2	2	2	EA	A-6614	BASE;CONTACT BLOCK
	14	-	1	1	2	-	-	EA	A-6197	OPERATOR;EXTENDED HEAD
△D	15	-	1	1	-	-	-	EA	714149-2	CONSOLE ASSY;BASIC;CNC;SIEMENS
	16	-	-	1	-	-	-	EA	A-19873-1	CORDSET;OPSTATION;SYSNODE;25 FT
△D	17	-	1	-	-	-	-	EA	A-19873-2	CORDSET;OPSTATION;SYSNODE;50 FT
△B	18	-	-	1	-	-	-	EA	A-19874-1	CABLE;ETHERNET;CROSS;25 FT
	19	-	-	-	1	-	-	EA	A-6189	MOUNTING BASE;W/CONTACT BLOCK
△E	20	-	1	-	1	1	-	EA	711597-3	CABLE;ASSY;19COND,MALE;50';WMC
△E	21	-	1	1	1	-	-	EA	711597-2	CABLE;ASSY;19 COND,FEM;9';WMC
△E	22	1	-	-	1	1	1	EA	713014-1	CONSOLE ASSY;BASIC;IFB/WMC
△E	23	-	-	-	4	-	-	EA	A-19154-1	LEGEND PLATE;SWITCH;30X60MM
	24	-	-	-	1	-	-	EA	712918-1	LABEL SET;CTRL ENCL
	25	-	3	3	1	-	-	EA	A-6198	CONTACT BLOCK;W/MTG BASE
△C	26	1	-	-	1	1	1	EA	A-14009	MONITOR;15";LCD
△C	27	1	-	-	1	1	1	EA	A-12617	MOUSEPAD,FLOWMASTER
△C	28	1	-	-	1	1	1	EA	713788-1	MONITOR BEZEL
	29	1	-	-	1	1	1	EA	R03544002	LABEL; FLOW LOGO
△D	30	-	1	-	-	-	-	EA	A-19874-2	CABLE;ETHERNET;CROSS;50 FT
△D	31	-	1	1	-	-	-	EA	A-19876-1	CORDSET;OPSTATION,MPI
△D	32	-	1	1	-	-	-	EA	A-18189-2	OPERATOR PANEL OP12
△D	33	-	1	1	-	-	-	EA	A-18194-1	19" MACHINE CONTROL PANEL
△D	34	-	1	1	-	-	-	EA	A-18198-1	SINUMERIK DISK UNIT 3.5"
△D	35	-	2	2	-	-	-	EA	A-15188	SWITCH,2-POS,W/KEYS
△D	36	-	1	1	-	-	-	EA	A-13787-1	WMC TAG,CONTROL ON,O.T. BYPASS
△D	37	-	1	1	-	-	-	EA	A-13787-3	WMC TAG,CONTROL OFF
△D	38	-	1	1	-	-	-	EA	713056-1	840D;HAA-SW;ASSY
△D	39	-	1	1	-	-	-	EA	713376-1	CE TERMINAL BLOCK ASSY;840D
△D	40	-	1	1	-	-	-	EA	A-18199-1	SINUMERIK GANTRY LICENSE LABEL
△D	41	-	1	1	-	-	-	EA	A-18909-1	MOUNTING BRACKET,SIEMENS PCU
△D	42	-	1	1	-	-	-	EA	A-18201-1	DISTRIBUTION BOX FOR HAND-HELD
	43	-	1	1	-	-	-	EA	A-19081-1	CABLE DISTRIBUTION
△E	44	-	-	1	-	-	-	EA	711597-10	CABLE;ASSY;19COND,MALE;28';WMC
	45	1	-	-	-	-	1	EA	A-14081-1	EXTENSION CORD,2+G,25'
△E	47	-	-	-	-	1	1	EA	A-18522-1	SWITCH-PUSH BUTTON,WHT
	48	-	-	-	-	-	1	EA	711597-11	CABLE;ASSY;19 COND,MALE;25 FT
△F	50	1	-	-	-	-	-	EA	711555-5	CABLE ASSEMBLY;MULTI-OPERATION
104 △H	51	-	-	-	-	1	1	EA	015579-1	TAG KIT;IFB;CONSOLE

	PART NUMBER	DESCRIPTION
	713015-1	CONSOLE MODULE;25FT;MOBILE;IFB
	713015-2	CONSOLE MODULE;50FT;MOBILE;IFB
	713015-3	CONSOLE MODULE;50FT;MOBILE;WMC
△D	713015-5	CONSOLE MODULE;MOBILE;CNC/25FT
△D	713015-6	CONSOLE MODULE;MOBILE;CNC/50FT
△F	713015-7	CONSOLE MODULE;MOBILE;BENGAL

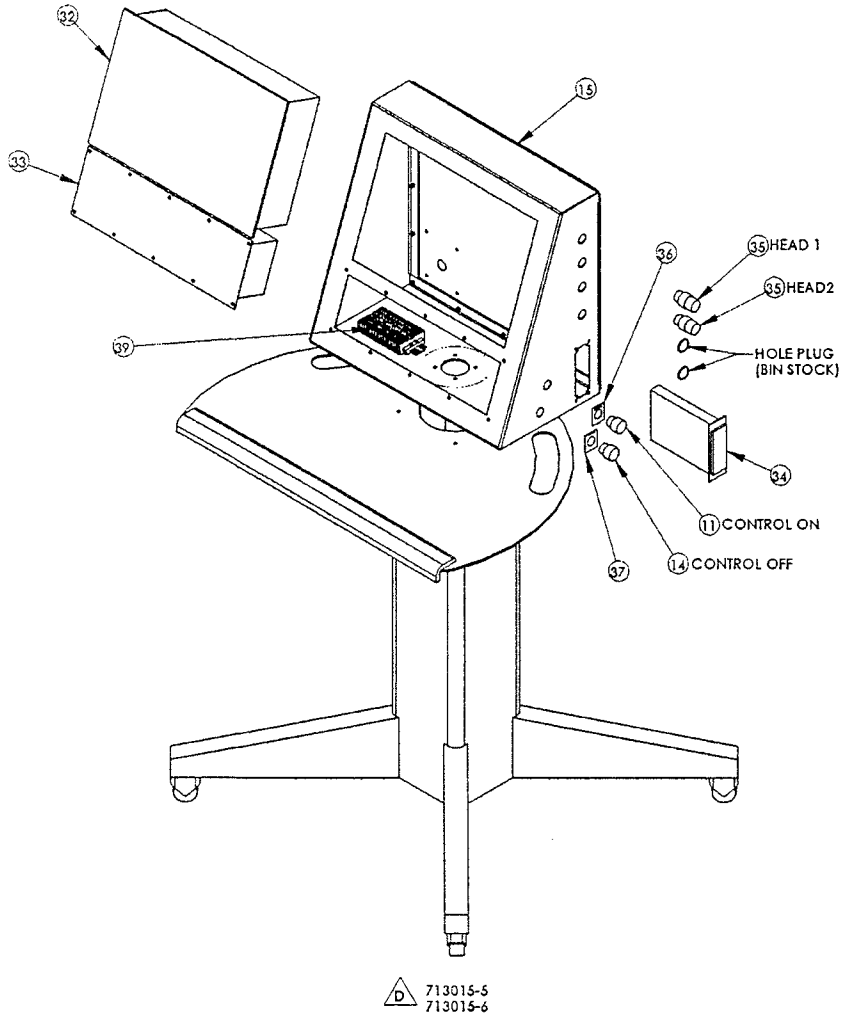
UNCONTROLLED COPY. USER IS RESONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.

THIRD ANGLE PROJECTION

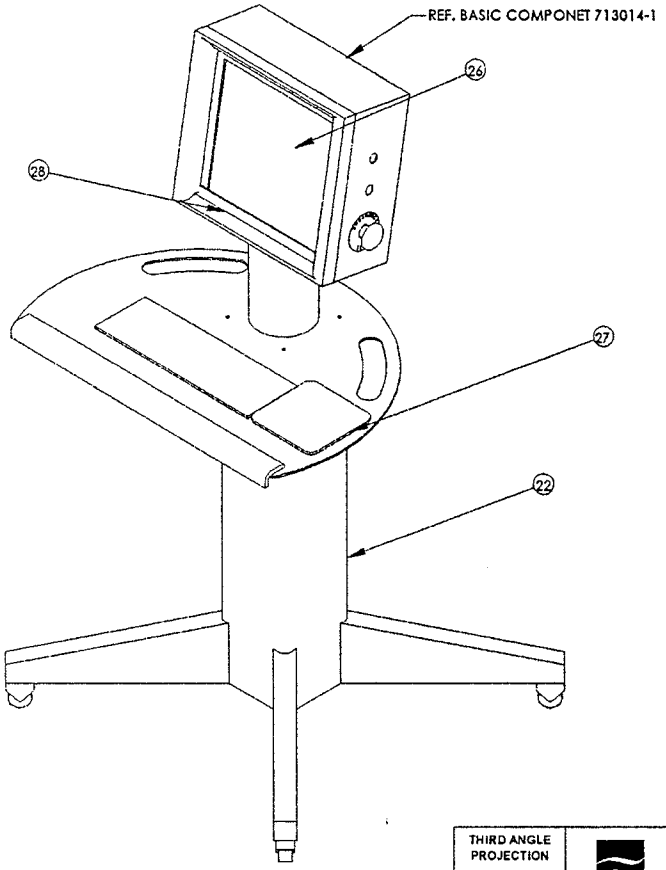
Flow

REVISION I	MODELED IN SOLIDWORKS	MATERIAL	N/A
DRAWN BY J.GIBBONS	STARTED 3/7/03	TITLE	CONSOLE MODULE;IFB/WMC
ENG D.BADER	SCALE 1:10	BASE PART NUMBER	713015

1 OF 2



D 713015-5
713015-6



F 713015-7

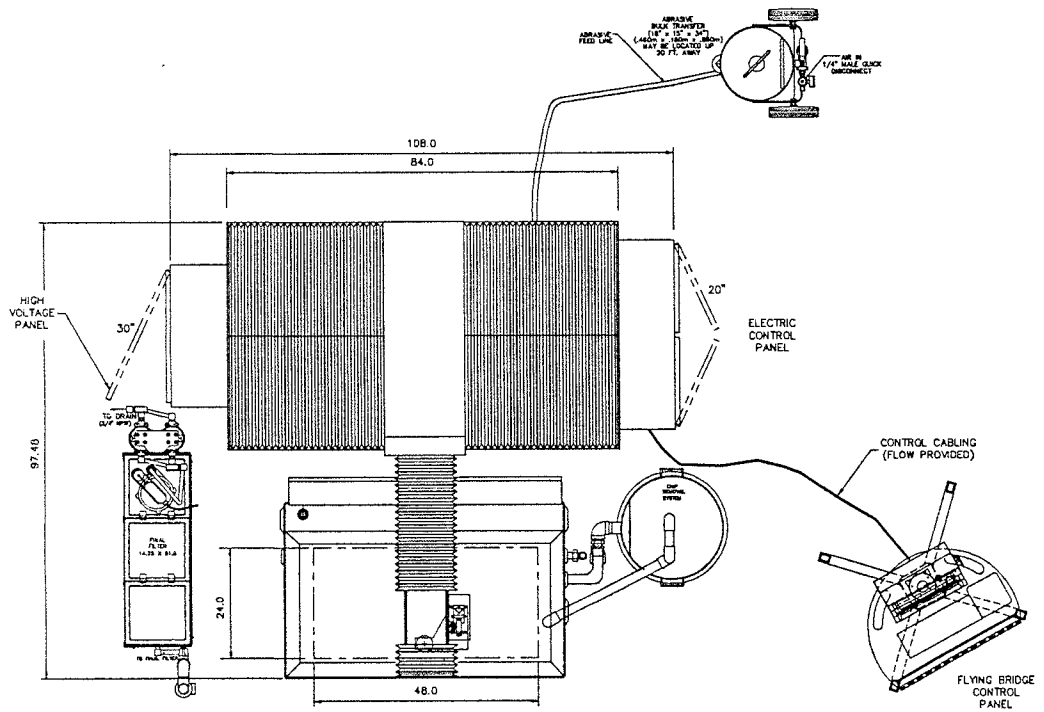
THIRD ANGLE PROJECTION	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL N/A
REVISION I	MODELED IN SOLIDWORKS	TITLE CONSOLE MODULE;IFB/WMC
DRAWN BY J.GIBBONS	STARTED 3/7/03	
ENG D.BADER	SCALE 1:10	BASE PART NUMBER 713015 — 2 OF 2

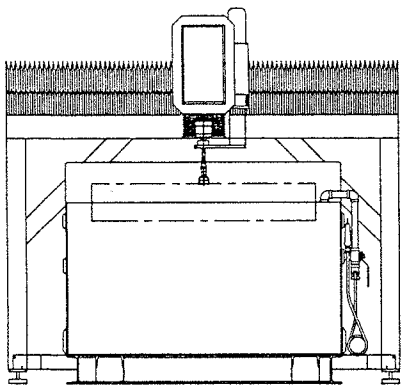
UNCONTROLLED COPY. USER IS RESPONSIBLE FOR VERIFYING THE CURRENT REVISION LEVEL.

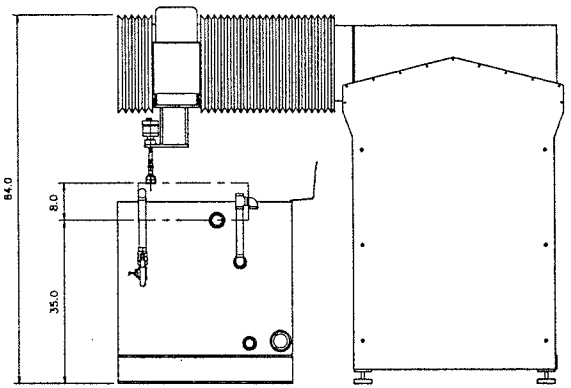
NOTE:
101) 713589-1 OBSOLETED. G
102) DELETED ITEM #7 FROM BOM H

PARTS

-2	U/M	ITEM	PART NUMBER	DESCRIPTION
1	EA	3	712107-1	POWER [illegible]NL.ASSY;IFB;BASIC
1	EA	4	712108-3	CNTRL PNL.ASSY;IFB;BASIC;4400
1	EA	8	713015-1	CONSOLE MODULE;25FT;MOBILE;IFB
1	EA	11	714152-1	ASSEMBLY;Z-AXIS;MOTORIZED;HD
1	EA	12	712356-2	BASE AXIS;ASSEMBLY;4';HD
1	EA	13	713591-2	ASSEMBLY;BRIDGE;2';HD
1	EA	16	015300-1	INSTALL KIT;IFB;2400







UTILITY REQUIREMENTS:

SHAPECUTTING SYSTEM

POWER: 480 VAC, 3 PH, 50-60 Hz
ALTERNATIVE POWER: 380-415 VAC, 3 PH, 50-60 Hz
AIR: 10 SCFM, 90 P.S.I.

CATCHER DRAIN

DRAIN PORT: 1" N.P.T: 2 G.P.M.

MACHINE WEIGHTS

XY & Z MACHINE	3700 LBS.
CATCHER (EMPTY)	3100 LBS.
CATCHER (FULL OF WATER)	13,250 LBS.

PART #	DESCRIPTION
713589-2	IFB;2400;BASIC MODULE;HIGH PRECISION

THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION: I	MODELED IN: ACAD R14	TITLE: IFB;2400;BASIC MODULE
DRAWN BY: Z. ZHANG	STARTED: 10/10/04	
ENG: Z. ZHANG	SCALE: 1/12"=1'	BASE PART NUMBER: 713589 — 1 OF 1

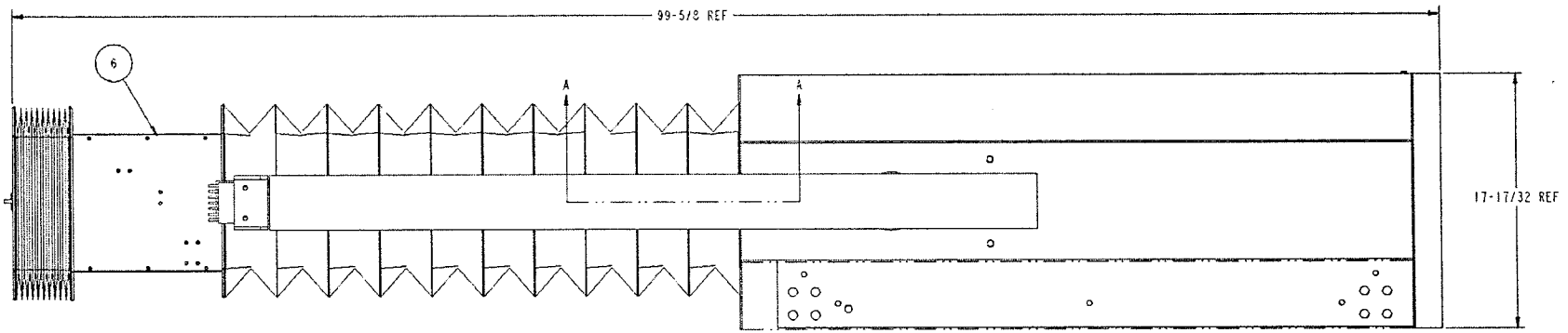
[101] ITEMS NOT SHOW.

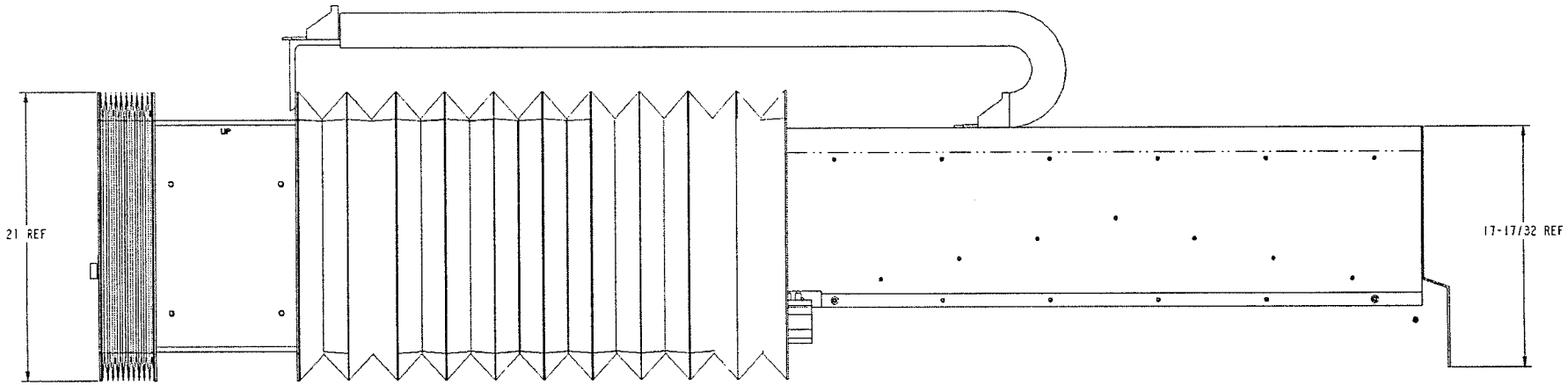
[H] OBSOLETED PART # 713591-1.

713591-2

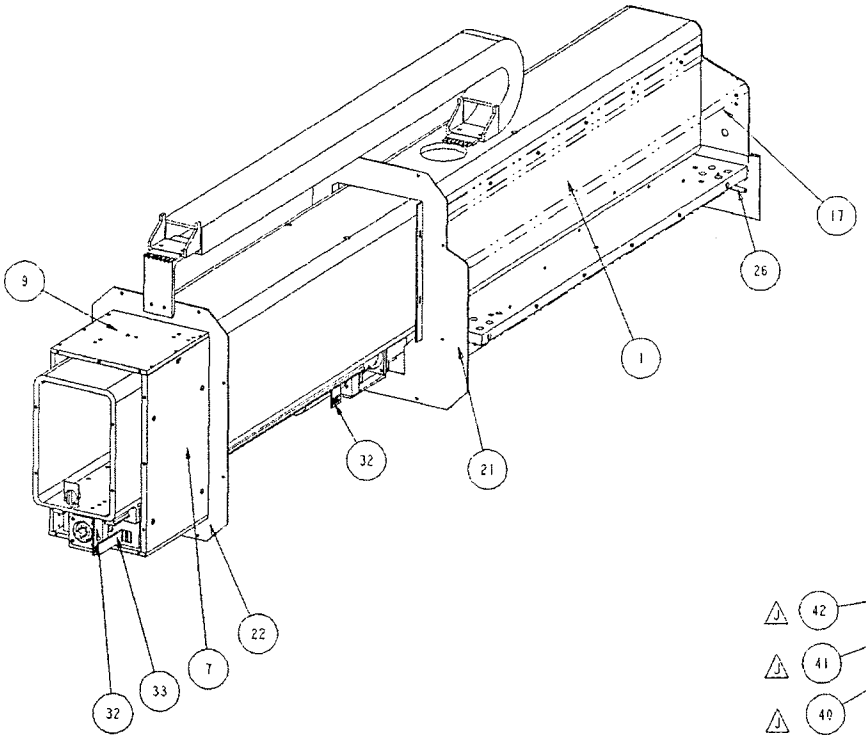
	ITEM	QTY	PART #	DESCRIPTION
	1	1	713592-1	CROSSBRIDGE;WELD/MACH;2'
[H]	2	2	A-19857-30-1050-45	LINEAR RAIL;INA;TKVD30/1050/45
[H]	3	4	A-19856-30	BLOCK;LINEAR RAIL;INA;KWVE30S
	4	2	R03470401	BEARING; SPACER
	5	1	R03545101	PLATE;CARRIAGE;BRIDGE
	6	1	R03545201	PLATE;ATTACHMENT;LEFT
	7	1	R03545001	PLATE;ATTACHMENT;RIGHT
[H]	8	1	015357-1	MOUNT; NUT; Y-AXIS
	9	1	R03544901	PLATE; ATTACHMENT TOP
	11	1	A-13983	SUPPORT UNIT;FLANGE TYPE
	12	1	R33691-1	RING;SPACER
	13	1	R03519201	MOUNT; DRIVE; BRIDGE
	14	1	R03519301	MOUNT; BEARING; SIMPLE
	15	1	R33761-1	MOUNT;BEARING;SIMPLE SUPPORT
[B]	16	2	R03545502	Y-AXIS WAYCOVERS
	17	1	R03602001	COVER;SHB;BRIDGE;REAR
	18	1	A-14025-5	NUT; BEARING RETAINING
	19	1	714197-1	CABLE CARRIER;BRIDGE
[G]	20	1	R33600-2D	STOP;HARD
	21	1	R03547801	PLATE;MOUNTING;REAR BELLOWS
	22	2	R03545401	PLATE; MOUNT; BELLOWS
	23	1	A-13944-2	SERVO MOTOR; 400W
	24	1	A-14052-6-3	COUPLING SERVO
	25	1	R03547601	PLATE;MOUNT;FRONT;BELLOWS
	26	1	R03538801	BAR, BELLOWS
	28	1	R03820401	STOP;HARD
[G]	29	1	R03601501	MOUNT; CABLE TRACK
	31	4	A-13966-4	LUBE UNIT (STAR),SIZE 30
[101]	32	2	713812-1	BRACKET;PROX SWITCH
	33	1	713813-1	BRACKET;PROX SWITCH;TARGET
	34	1	A-19244-1	SWITCH;PROX;NPN;N.O.
[101]	35	2	A-19245-1	SWITCH;PROX;NPN;N.C.
[101]	36	3	A-19243-1	CABLE;4 COND;SINGLE ENDED
[101]	37	1	713813-2	BRACKET;PROX SWITCH;TARGET
[H]	38	1	015291-1	BALLSCREW;IFB;ROT. SCREW;1176
[F]	39	2	711859-1	GUSSET STRIP BRIDGE AXIS
[J]	40	1	A-13985	SWITCH;SELECT;3POSTION
[J]	41	1	A-6587	CONTACT BLOCK;BASE
[J]	42	1	A-14088	IFB TAG;Z-AXIS;RAISE,LOWER

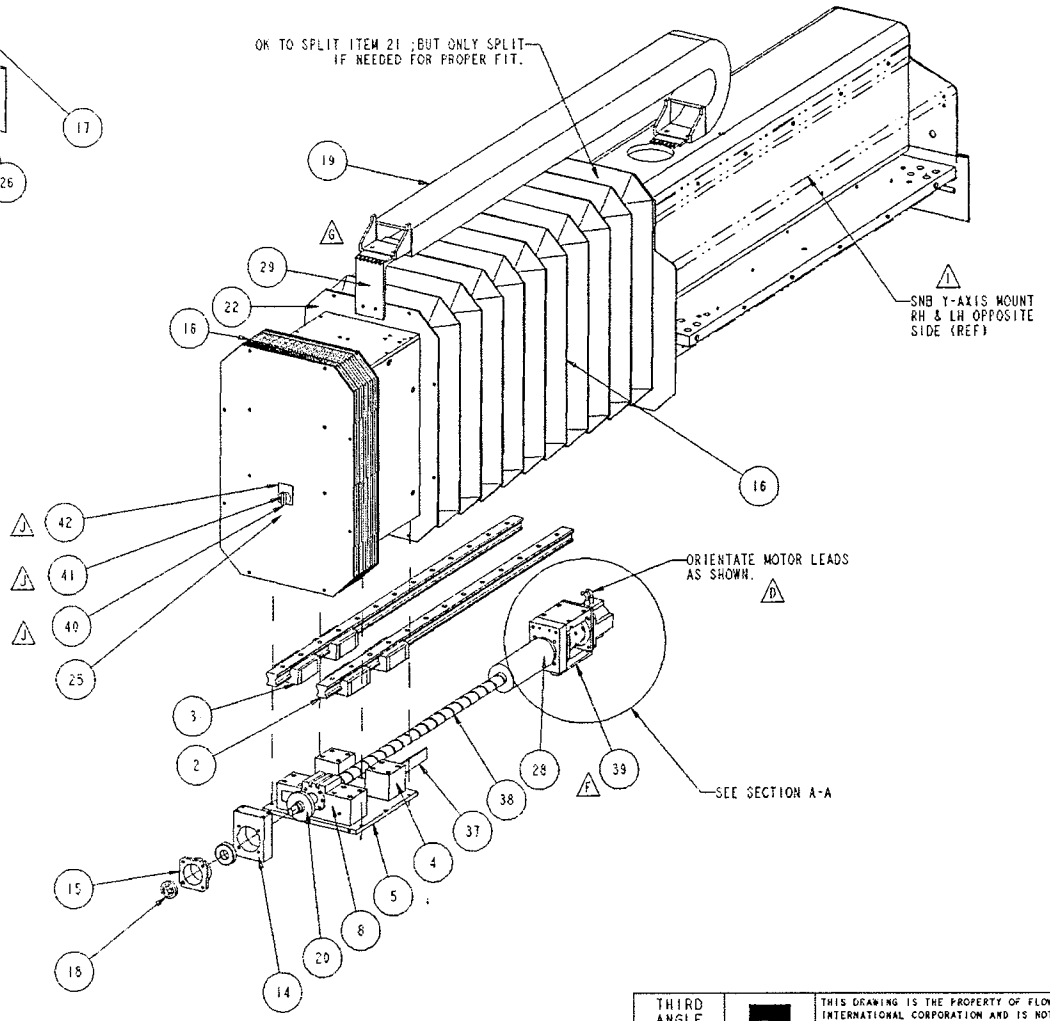
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.	
		MATERIAL: N/A	
REVISION J	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE;2'	
DRAWN BY M. PRECHTEL	STARTED 12-May-04		
ENG D.BADER	SCALE 0.25	BASE PART NUMBER 713591	1 OF 4



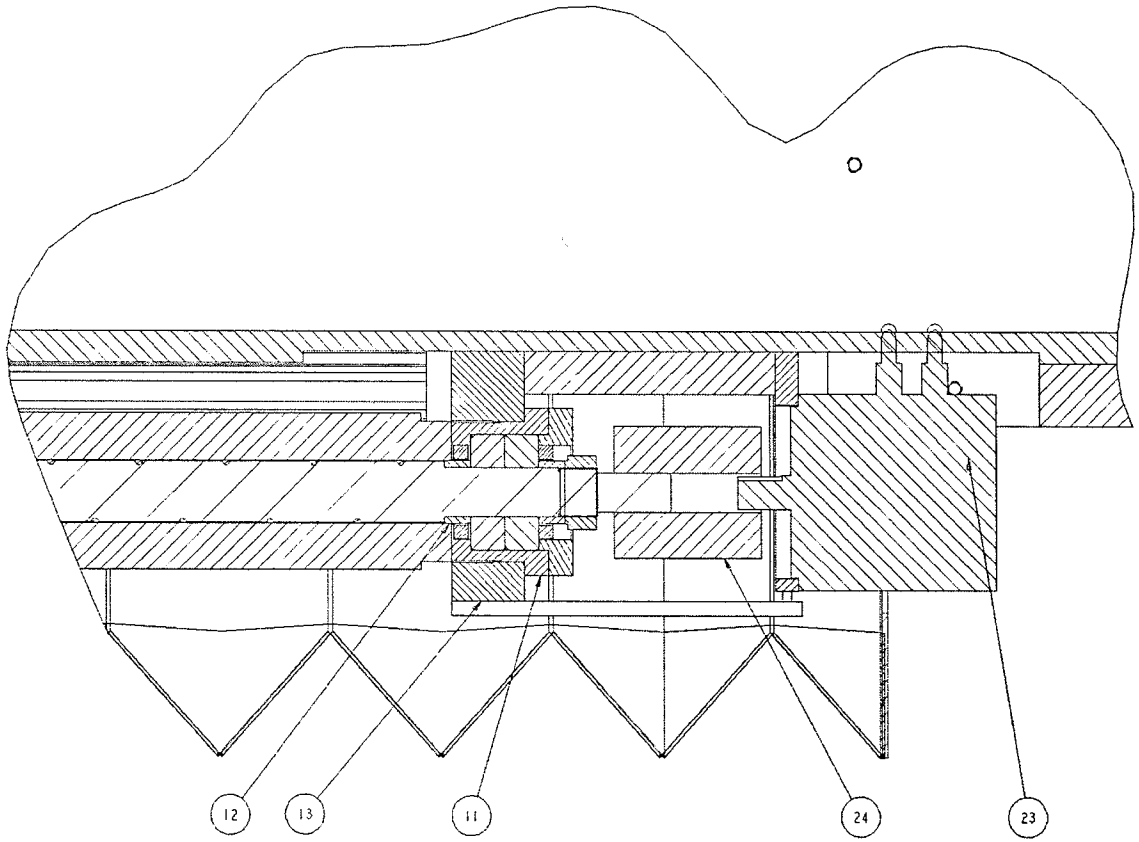


THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION J	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE;2'
DRAWN BY N PRECHTEL	STARTED 04-Jun-04	
ENG D.BADER	SCALE 0.25	BASE PART NUMBER 713591 — 2 OF 4





THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION J	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE;2'
DRAWN BY N.PRECHTEL	STARTED 04-Jun-04	
ENG D.BADER	SCALE 0.19	BASE PART NUMBER 713591 — 3 OF 4



SECTION A-A

THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION J	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE;2'
DRAWN BY M.PRECHTEL	STARTED 04-Jun-04	
ENG D.BADER	SCALE 1.0	BASE PART NUMBER 713591 — 4 OF 4

NOTES

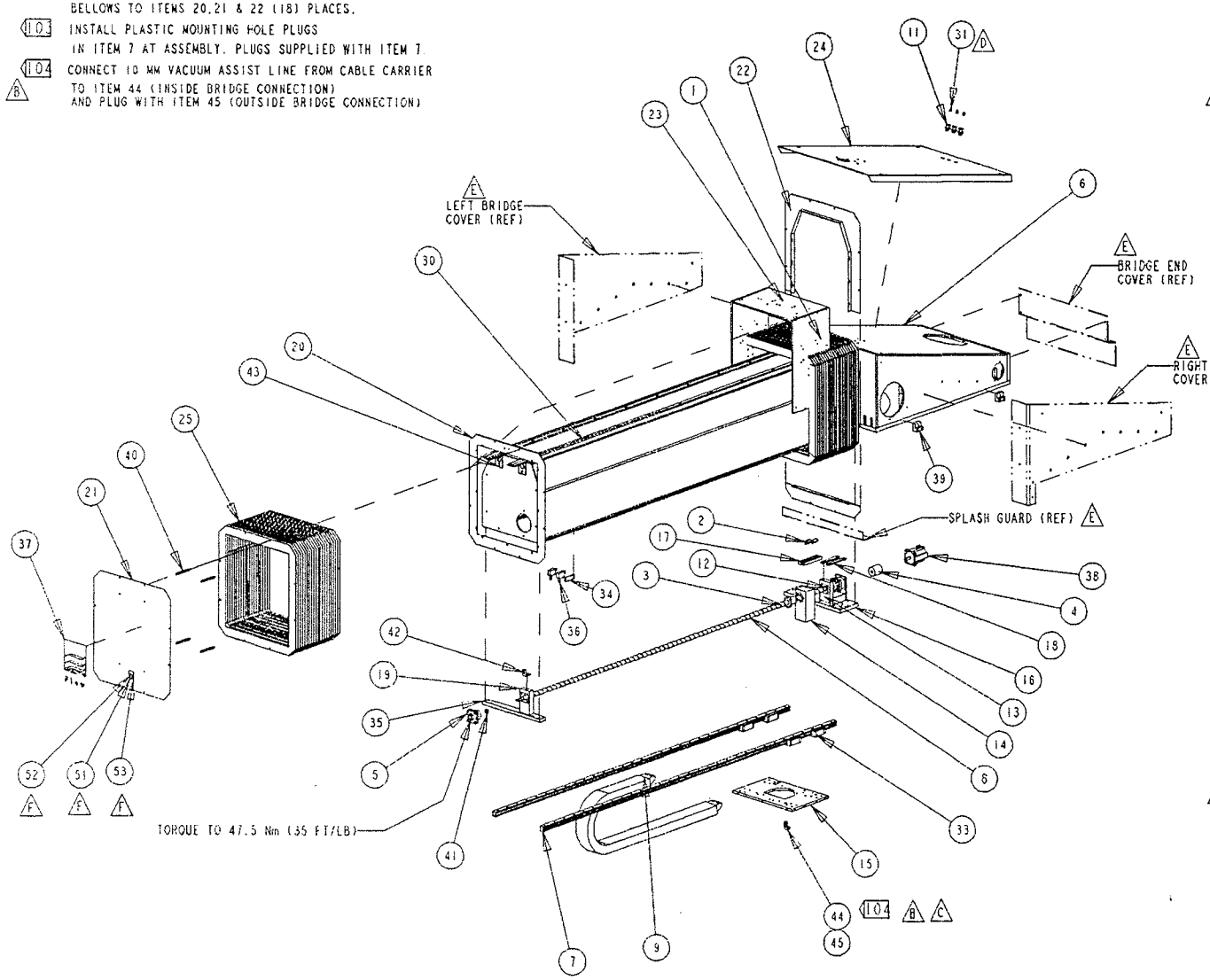
101 ITEM NOT SHOWN.

102 USE 5mm ACORN NUTS TO ATTACH BELLOWS TO ITEMS 20,21 & 22 (18) PLACES.

103 INSTALL PLASTIC MOUNTING HOLE PLUGS IN ITEM 7 AT ASSEMBLY. PLUGS SUPPLIED WITH ITEM 7.

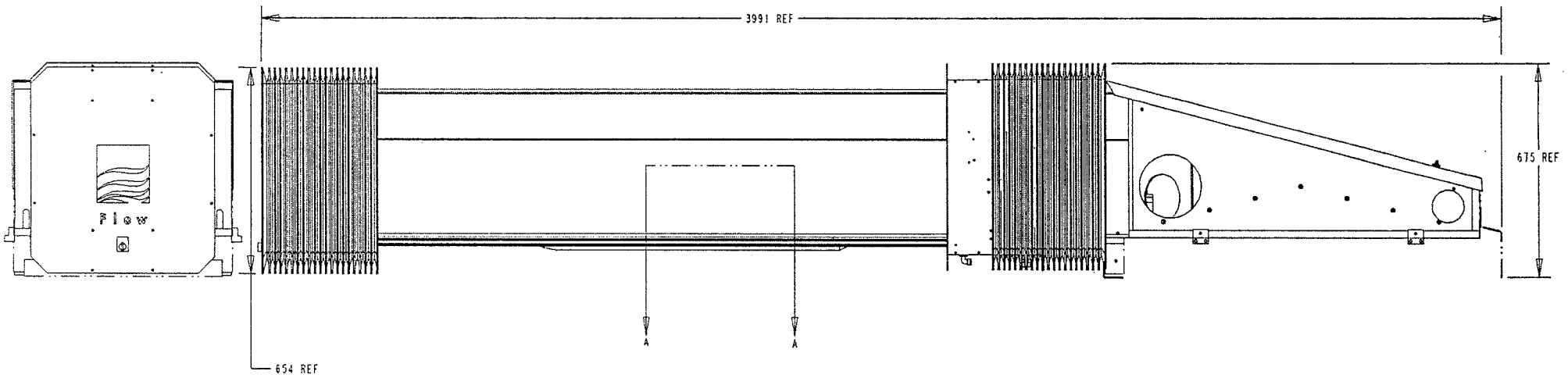
104 CONNECT 10 MM VACUUM ASSIST LINE FROM CABLE CARRIER TO ITEM 44 (INSIDE BRIDGE CONNECTION) AND PLUG WITH ITEM 45 (OUTSIDE BRIDGE CONNECTION)

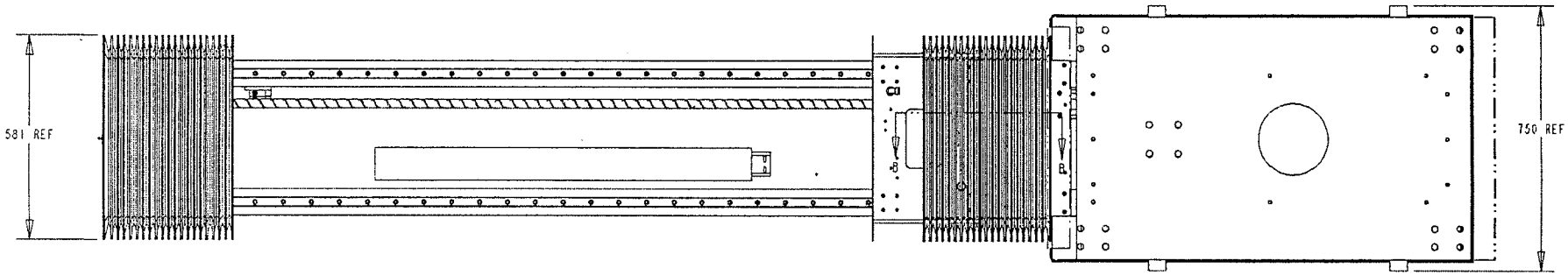
F	51	1	EACH	A-[illegible]385	SWITCH;SELECT;3POSTION
F	52	1	EACH	A-6587	CONTACT BLOCK;BASE
F	53	1	EACH	A-14088	IFB TAG;Z-AXIS;RAISE,LOWER

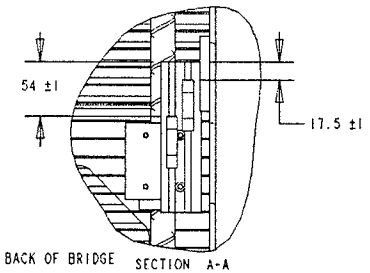


ITEM	QTY	UOM	PART NO.	DESCRIPTION
1	2	EACH	R34897-4	SIDE CARRIAGE ATTACH PLATE
2	4	EACH	A-13979-1	CAM, BALLUFF
3	1	EACH	A-14426	ADAPTOR;THK
4	1	EACH	A-14052-6-1	COUPLING;SERVO ZERO MAX
5	2	EACH	A-13983	SUPPORT UNIT;FLANGE TYPE
6	1	EACH	713618-1	CROSSBRIDGE;WELD/MACH;2M/6'
7	2	EACH	A-19857-30-2460-30	LINEAR RAIL;INA;TKVD30/2460/30
8	1	EACH	714329-2	BALLSCREW;IFB;ROT. NUT;2660
9	1	EACH	713641-1	CABLE CARRIER ASSY;Y;2M/6'
11	3	EACH	A-14050-1	ANCHOR COUPLING
12	1	EACH	R33691-1	RING;SPACER
13	1	EACH	711857-1	DRIVE MOUNT; BRIDGE AXIS
14	1	EACH	015317-1	MOUNT, CROSSBRIDGE BALL NUT
15	1	EACH	R33858-4	CARRIAGE PLATE;CROSSBRIDGE
16	1	EACH	711858-1	CROSS SUPPORT FIX. END
17	1	EACH	R34002-2	MOUNT;CAM
18	2	EACH	711859-1	GUSSET STRIP BRIDGE AXIS
19	1	EACH	711860-1	MOUNT;BEARING(FIXED)
20	2	EACH	711861-1	Y-AXIS BELLOWS PLATE
21	1	EACH	711862-1	PLATE;END BRIDGE
22	1	EACH	711863-1	Y-AXIS BELLOWS REAR MOUNT
23	1	EACH	R34896-4	TOP CARRIAGE ATTACH PLATE
24	1	EACH	711864-1	COVER, TOP
25	2	EACH	R035338-3	BELLOWS;Y-AXIS FOLDED
30	2	EACH	R03543602	BELLOWS GUIDE;UHMW
31	3	EACH	A-13682	FITTING;GREASE;1/8 NPT
33	4	EACH	A-19856-30	BLOCK;LINEAR RAIL;INA;KWVE30S
34	2	EACH	R32597-4	HOLDER, LIMIT SWITCH
35	1	EACH	711870-1	CROSS SUPPORT;FLT END
36	3	EACH	A-14007	LIMIT SWITCH
37	1	EACH	R03544001	LABEL; FLOW LOGO
38	1	EACH	A-13944-3	SERVOMOTOR;750W
39	4	EACH	711871-1	BLOCK, ADJUSTMENT
40	4	EACH	A-18252-1	STAND-OFF;MALE/FEM;M6x100
41	1	EACH	R03593401	RING;SPACER
42	1	EACH	712283-1	BRACE; END BEARING; BALLSCREW
43	2	EACH	713619-1	SUPPORT;UHMW
44	1	EACH	A-19600-1	FTG; BLKHD UNION L 10 MM TUBE
45	1	EACH	A-13930-5	PLUG;TUBING;10MM
46	1	EACH	015225-1	TARGET;LIMIT SWITCH;IFB;Z-AXIS
47	1	EACH	A-19437-2	TRACK;ADJUSTABLE CAM;330MM
48	1	EACH	A-0825-11	FTG; HOSE;BARBED;3/4"; 1/2-14
49	1	EACH	A-00449-6	ELBOW; UNION; 8-8; 1.09; 90 DEG
50	1	EACH	A-14687-1	ADAPTER;MALE PIPE;SWIVEL

THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION F	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE; 2M
DRAWN BY J.GIBBONS	STARTED 23-Sep-03	
ENG RL	SCALE 0.04	BASE PART NUMBER 713617 — 1 OF 3



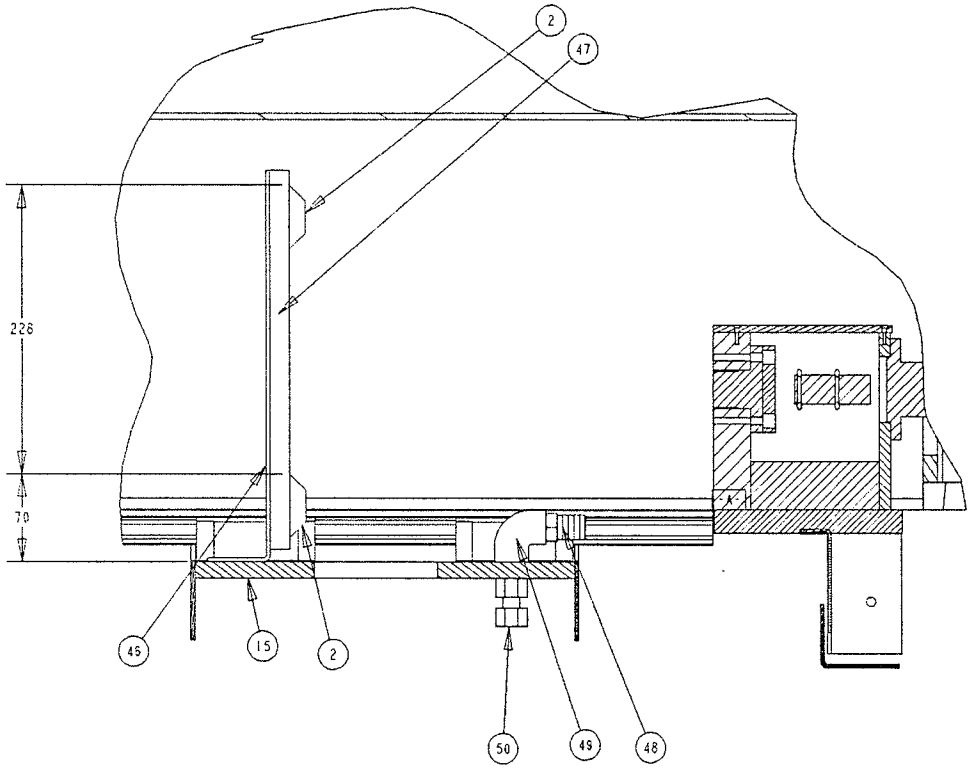




BACK OF BRIDGE SECTION A-A
SCALE 0.20

THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION F	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE; 2M
DRAWN BY J.GIBBONS	STARTED 23-Sep-03	
ENG RL	SCALE 0.08	BASE PART NUMBER 713617 — 2 OF 3

(E) ADDED SHEET #3

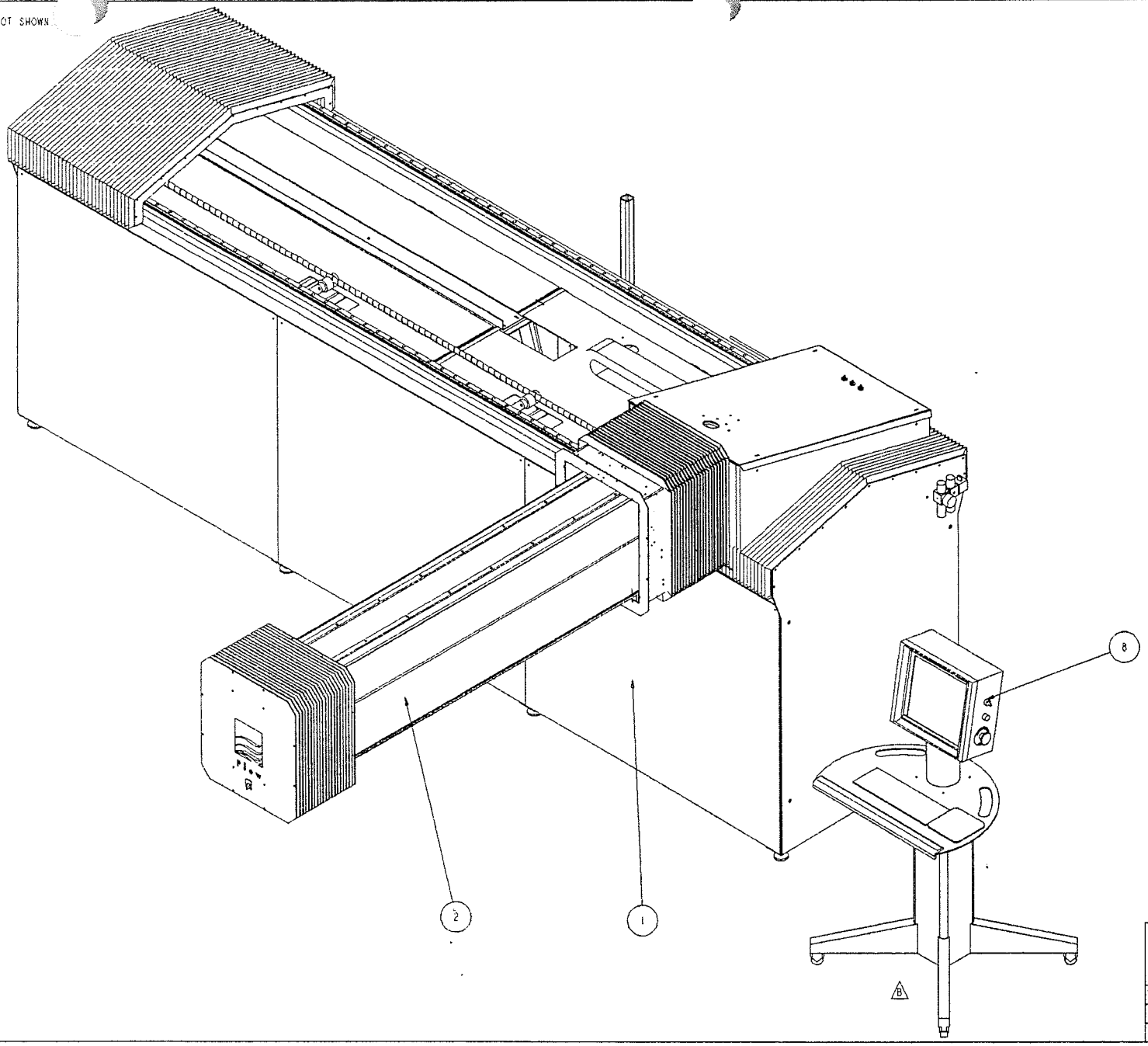


(E)
SECTION B-B
SCALE 0.25

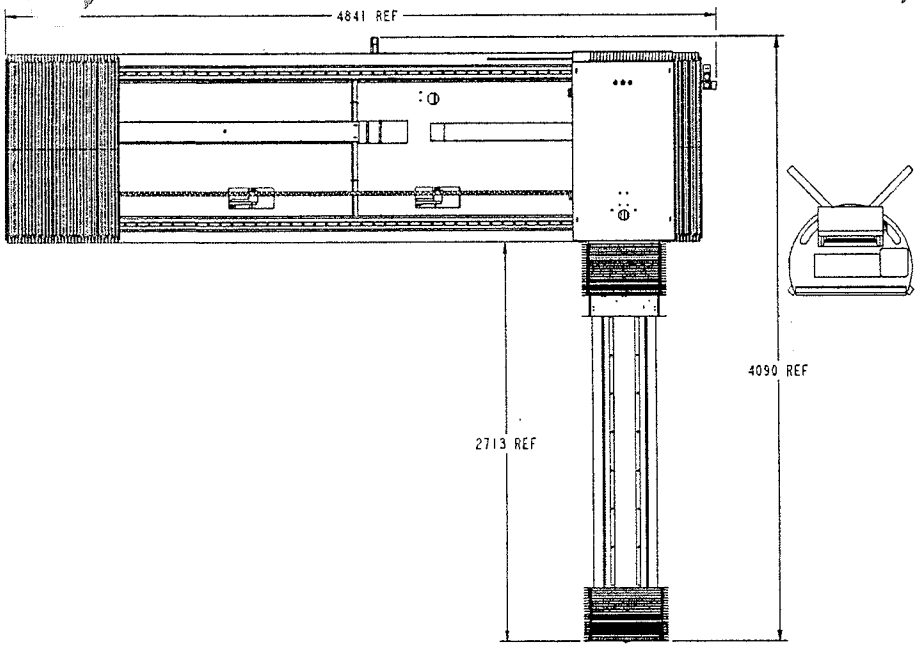
THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION F	MODELED IN PRO-E	TITLE ASSEMBLY;BRIDGE; 2N
DRAWN BY J.GIBBONS	STARTED 23-Sep-03	
ENG RL	SCALE 0.08	BASE PART NUMBER 713617 — 3 OF 3

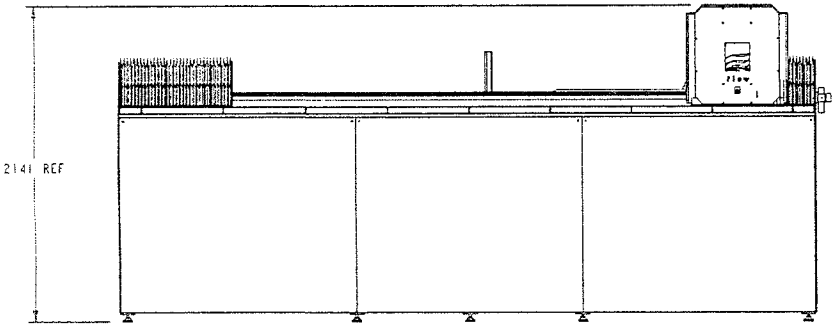
[101] ITEMS NOT SHOWN

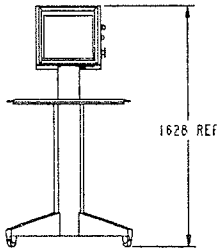
ITEM	QTY	UOM	PART NO	DESCRIPTION
1	1	EACH	711834-1	ASSEMBLY, BASE AXIS 12' / 3 M
2	1	EACH	713617-1	ASSEMBLY;BRIDGE; 2M
[101] 3	1	EACH	712187-1	POWER PNL. ASSY;IFB;BASIC
[101] 4	1	EACH	712188-1	CNTRL PNL. ASSY;IFB;BASIC;2030
B 8	1	EACH	713815-2	CONSOLE MODULE;50FT;MOBILE;IFB
C [101] 9	1	EACH	015300-4	INSTALL KIT;IFB;2030

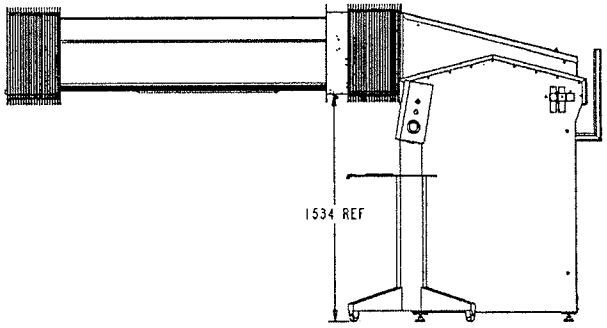


THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION D	MODELED IN PRO-E	TITLE IFB;2030/6X12;BASIC MODULE
DRAWN BY J.GIBBONS	STARTED 25-Sep-03	
ENG RL	SCALE 0.12	BASE PART NUMBER 713633 — 1 OF 2







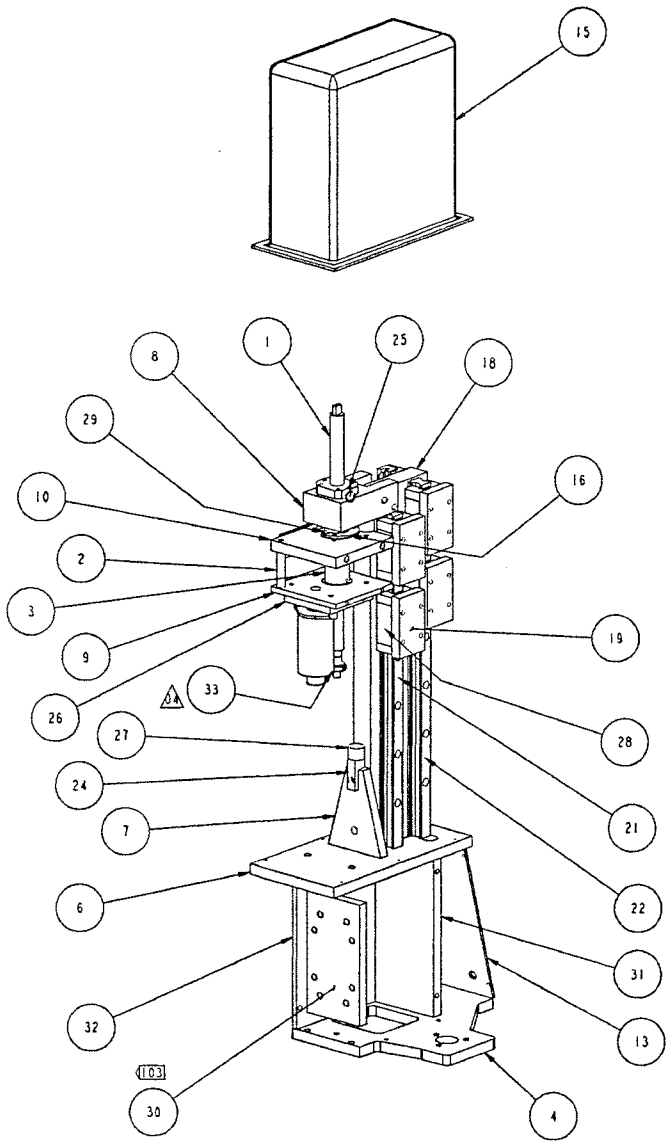


THIRD ANGLE	Flow	THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
		MATERIAL: N/A
REVISION D	MODELED IN PRO-E	TITLE IFB;2030/6X12;BASIC MODULE
DRAWN BY J.GIBBONS	STARTED 25-Sep-03	
ENG RL	SCALE 0.06	BASE PART NUMBER 713633 — 2 OF 2

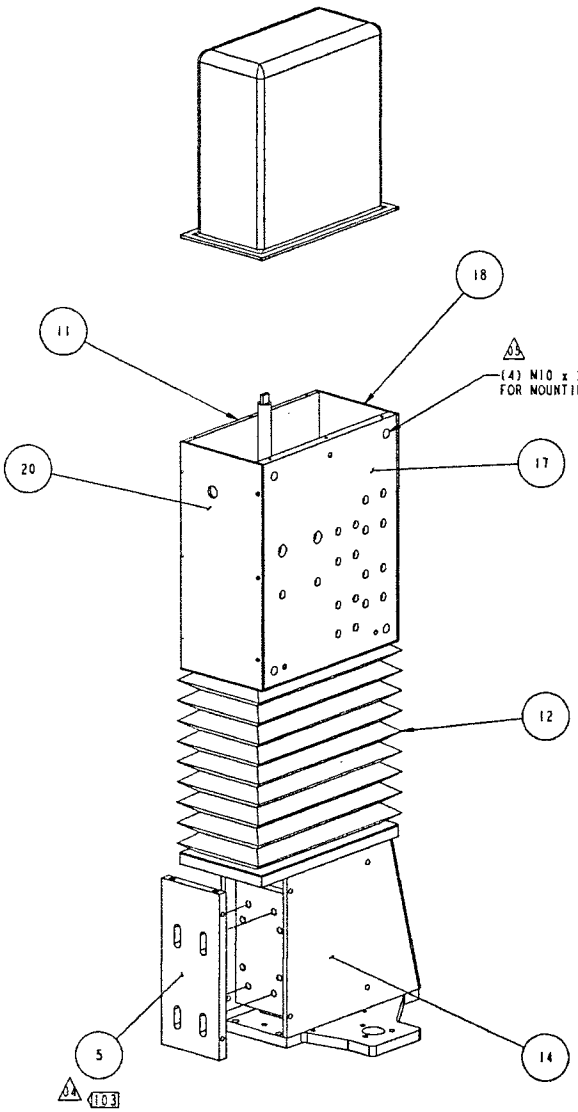
101 ITEMS NOT SHO[illegible]

102 SEAL ITEMS 4,5,6,13,14,31,32 WITH RTV SILICONE OR EQUIVALENT

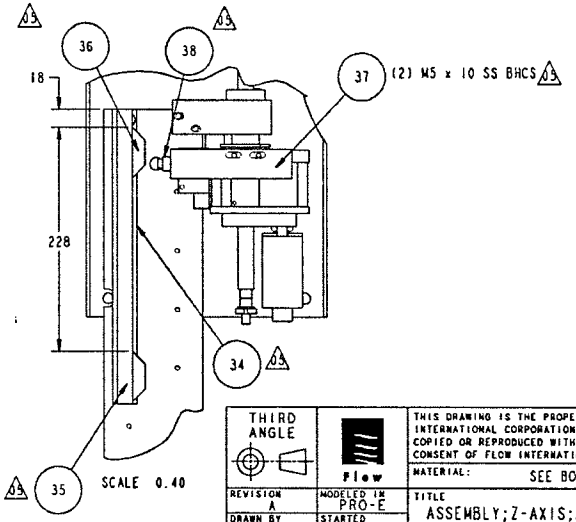
103 MOUNT ITEM 5 & 30 WITH 3/8x1" SS SHOULDER BOLTS AND SS WASHERS



EXPLODED VIEW
SOME ITEMS NOT SHOWN FOR CLARITY



SEMI-EXPLODED VIEW



ITEM	QTY	PART NO.	DESCRIPT
1	1	714332-1	BALLSCREW;[illegible];MOT.Z;334
2	2	R33586-2	MOUNT;MOTOR;SUPPORT
3	1	R33598-2	COUPLING; MODIFICATION
4	1	714168-1	MOUNT; NOZZLE; SINGLE
5	1	714173-1	EXTENSION 1; MOUNT; NOZZLE
6	1	R03470001	PLATE; LOWER; VERTICAL AXIS
7	1	R03470201	GUSSET; RAM; VERTICAL
8	1	015404-1	MOUNT; NUT; Z-AXIS;INA
9	1	R03470601	MOUNT; MOTOR; Z-AXIS
10	1	R03470801	Z-AXIS BEARING SUPPORT
11	1	R03544801	PLATE; FRONT; VERTICAL
12	1	R03560101	WAYCOVER; Z AXIS; ST
13	1	714170-1	COVER; Z-AXIS
14	1	714171-1	COVER 1; SIDE; Z AXIS
15	1	R03595501	COVER; BALL SCREW; Z-AXIS
16	1	712372-1	PLATE; RETAINER; BEARING
17	1	714150-1	VERTICAL MOUNT PLATE
18	1	714151-1	PLATE; VERTICAL; RAM
19	4	714156-1	SPACER;BLOCK;LINEAR RAIL
20	2	R03544703	COVER; SIDE; VERTICAL
21	1	A-19857-20-0410-55	LINEAR RAIL;INA;TKVD20/410/55
22	1	A-19857-20-0435-55	LINEAR RAIL;INA;TKVD20/0435/55
23	1	711964-1	COMPUTER ASSY;MINITOWER;IFB
24	1	713845-1	LOWER BUMPER MOUNT
25	1	A-14426	ADAPTOR;THK
26	1	A-14904	GEARMOTOR; 12VDC; 15 IN-LB
27	2	A-14985-4	BUMPER;RUBBER;ROUND;1/4-20
28	4	A-19856-20	BLOCK;LINEAR RAIL;INA;KWVE20S
29	1	A-14018-2	BEARING;SINGLE ROW;12MM BORE
30	1	714172-1	PLATE; MOUNT; CAMERA
31	1	714169-1	EXTENSION 2; MOUNT; NOZZLE
32	1	714174-1	COVER 2; SIDE; Z AXIS
33	1	A-14025-2	NUT; BEARING RETAINING
34	1	015255-1	TARGET;LIMIT SWITCH;IFB;2400
35	1	A-19437-2	TRACK;ADJUSTABLE CAM;300MM
36	2	A-13979-1	CAM, BALLOFF
37	1	015256-1	MOUNT;LIMIT SWITCH;IFB;2400
38	1	A-14007	LIMIT SWITCH

THIRD ANGLE	Flow		THIS DRAWING IS THE PROPERTY OF FLOW INTERNATIONAL CORPORATION AND IS NOT TO BE COPIED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF FLOW INTERNATIONAL CORPORATION.
			MATERIAL: SEE BOM
REVISION A	MODELED IN PRO-E		TITLE ASSEMBLY;Z-AXIS;MOTORIZED;HD
DRAWN BY PER	STARTED 06-May-04		
ENG PER	SCALE 0.350	BASE PART NUMBER 714152	1 OF 1

CHAPTER 7

Reference

- MS-2258, Maintenance Log
- MS-2266, Customer Support
- MS-2276, How To Be Successful With Dynamic Waterjet