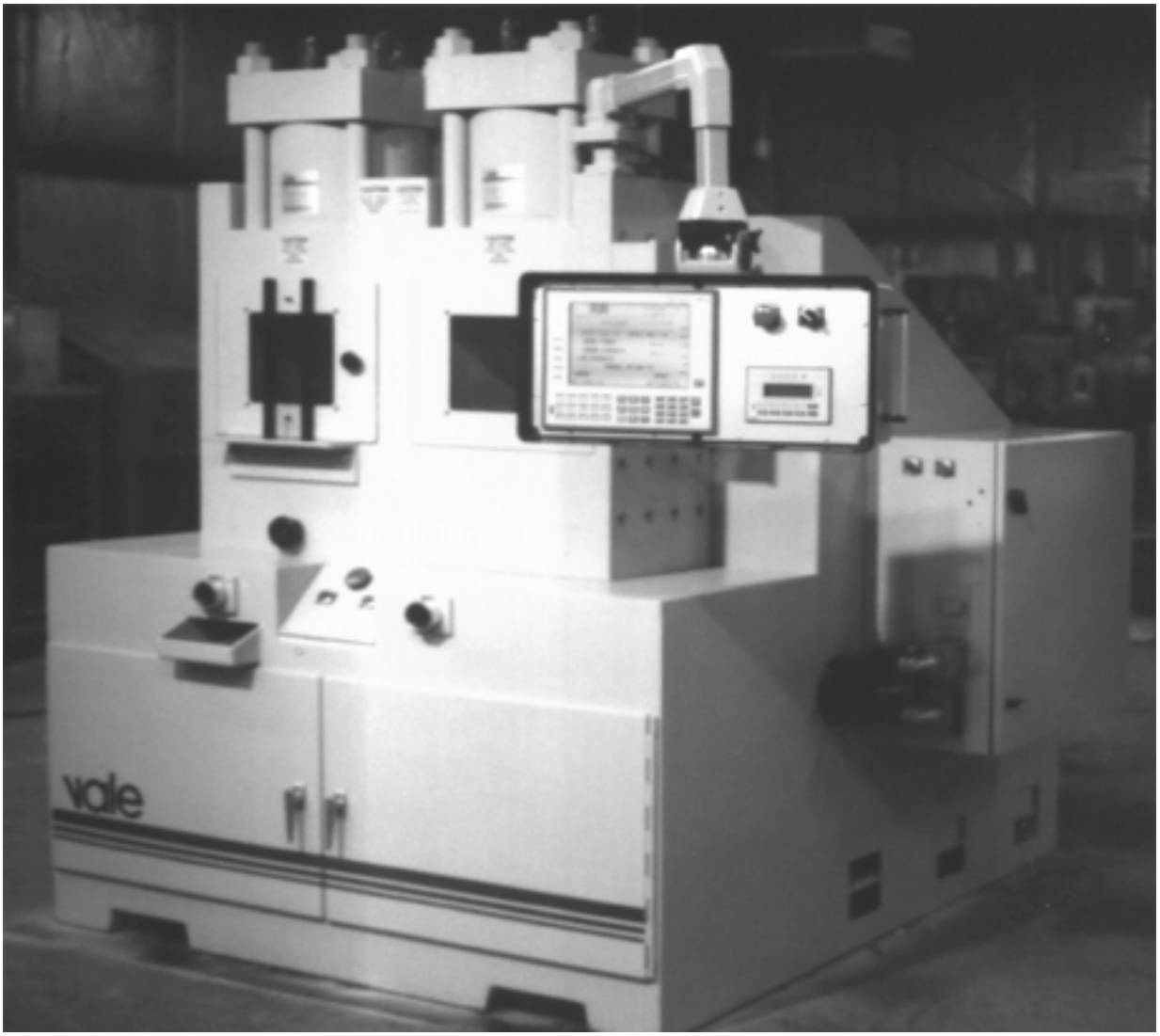
vale

# VU-3 CUT
# Maintenance Manual

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# SAFETY INSTRUCTIONS

**READ THESE INSTRUCTIONS CAREFULLY!**
**FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SEVERE PERSONAL INJURY**

**OPERATING MACHINE**

**- READ OPERATING INSTRUCTIONS**
**- WEAR EYE, FACE, AND FOOT PROTECTION**
**- INSPECT TOOL DAILY FOR UNSAFE CONDITIONS**
**- CHECK THAT ALL GUARDS ARE IN PLACE AND ALL SAFETY DEVICES ARE WORKING PROPERLY. DO NOT OPERATE TOOL WITH ANY SAFETY GUARDS REMOVED.**
**- DO NOT WEAR LOOSE CLOSING OR JEWELRY**
**- NEVER PUT ANY PART OF YOUR BODY INTO, UNDER, OR NEAR MOVING PARTS**
**- NEVER OPERATE TOOL ABOVE SPECIFIED PRESSURE**
**- DO NOT EXCEED RECOMMENDED PERFORMANCE LIMITATIONS**

**SERVICING MACHINE**

**- SHUT OFF & LOCK OUT POWER SOURCE TO TOOL**
**- NEVER LIFT HEAVY TOOLS BY HAND. USE MACHINERY MOVING EQUIPMENT.**
**- FOLLOW THE MAINTENANCE INSTRUCTIONS IN YOUR MANUAL**
**- USE THE CORRECT TOOLS TO REPAIR MACHINE**

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SUPPORTING COMPONENT SPECIFICATIONS
- Proportional Directional Control Valve
- DNC Card
- Directional Control Valve
- Relief Valve
- Piston Pump
- Returnline Filter
- Pressure Transducer
- Hydraulic Schematic

## Forward

The main purpose of this manual is to provide information regarding the servicing and maintenance of the Vale Upset tester and power unit. This manual, therefore, should be directed into the hands of your service or maintenance department. The manual also deals in general maintenance procedures for hydraulic equipment, which would apply to most Vale Industries designed hydraulic equipment, when accompanied with supplementary information, i.e. drawings, individual component service literature, etc. regarding the specific application. You will find that your Vale equipment is of simple and rugged construction requiring very little maintenance; however, when the need for service becomes necessary, merely apply good mechanical principles, handle parts carefully, and be sure they are clean and not marred or nicked when assembled. When ordering spare parts, order by part number and description, this will minimize errors in filling orders. If you should require more information or service assistance call your local representative or Vale Industries directly, where your calls or letters will receive prompt attention.

## Upset Tester Specifications

Maximum Shear Capacity: In 1020 M.S. - 2" Diameter (50 mm)

Maximum Operating Pressure: 5000 PSI (345 bar)

Normal Operating Pressure: 5000 PSI (345 bar) Upset Press
4500 PSI (310 bar) Shear Press

Displacement: 2 @ 26 gpm (98 L/min)

Motors: 2 @ 40 HP, 575/3/60, 1800 RPM, TEFC

Pump: Variable Displacement Axial Piston

Control Valve: D05 size, Proportional Directional Control Valve - Upset Press
D08 size, Directional Control Valve - Shear Press

Relief Valve: Unloading Relief Valve / Direct Acting Relief Valve - Upset Press
Relief Valve - Shear Press

Return Filter: 10 Micron, Betamicron Media

Reservoir: 100-Gallon Capacity, Welded Steel (380 L)

Starter: Dual Magnetic: 120-Volt Control

Approximate Dimensions: Height - 90 inches (2290 mm)
Width - 79 inches (2000 mm)
Depth - 80 inches (2030 mm)
Weight - 10,500 pounds (4760 kg)

## Overview

The VU3-CUT Upset Tester is designed to test the mechanical properties of rod stock, verifying the suitability of the steel for varied manufacturing processes. The Upset Tester can be used in the Test Laboratory, or the finishing end of a rolling mill for analysis. With a ten-second-cycle rate, either batch testing or 100 % testing is possible. The VU3-CUT Upset Tester is PLC controlled, with a linear encoder, Pressure transducers and proportional directional control valve. The Pressure transducer on the Shear Press monitors the force required to Shear the sample. The Pressure transducer on the Upset Press monitors the force required to upset the sample. The linear encoder and proportional directional control valve on the Upset Press give a final height accuracy of +/- .0015 of an inch. The test data can be viewed on the Graphic Operator Interface and it can be sent to a data acquisition system.

## System Functional Description
## Shear Press

The Shear Press is powered by a 12" bore, 2-3/4” stroke double acting hydraulic cylinder that will develop 250 tons of force at 4,500 P.S.I. operating pressure. The Shear Press is PLC controlled. The hydraulic pressure is monitored with a pressure transducer and a high speed peak capture meter. The high speed peak capture meter captures the peak pressure from the Shear Press pressure transducer and outputs the shear peak pressure to the PLC. Then the PLC calculates the sample shear force. The stroke of the Shear Press is controlled by an upper limit switch and lower limit switch. Both switches are non-adjustable and factory set. The switches are located in the enclosure at the back of the Shear Press.

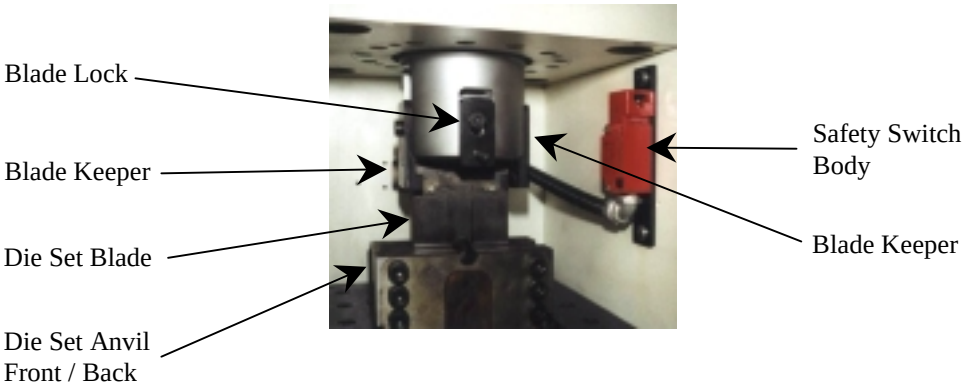
The Shear Press safety interlock switch is mounted inside the shear compartment. The safety switch body is mounted on the shear compartment sidewall. The safety switch key is mounted on the shear compartment door. When the shear compartment door is closed the safety switch key inserts into the safety switch body actuating the safety switch. **The Shear Press compartment door must be closed for safe operation.**

The proper die size should be selected and inserted into the slots in the bottom of the shear compartment. The die should slide back into the slots until the die blade can be engaged in the die keepers. The blade lock must be raised in order to allow the die blade to engage into the die keepers. The die set should be slid back all the way to the stop against the scrap chute. When the blade lock is released it should return to the down position, this will prevent the die from accidentally working forward out of the die keepers during operation. The die keepers are attached to the ram with shoulder bolts, allowing some play in the keepers. In the event that the die blade has not been properly engaged in the keepers and the Shear Press is cycled the keepers will be driven up into the clearance slots, preventing damage to both the die set and the Shear Press ram.

With the die in place, the Shear Press is ready for calibration. The calibration routine is activated from the start up screen on the Operator Interface (see the operation manual for Operator Interface Start Up Screen operation details). During the calibration routine the Shear Press completes five cycles. The system pressure for each cycle is tabulated. The PLC averages the total pressure of the five cycles, determining the force required to cycle the Shear Press with the die set. The average force is used to calculate the sample shear force.

After calibration the Shear Press is ready for normal operation. The sample should be inserted through the slot in the safety door far enough to insure that the end of the sample piece protrudes at least one (1) inch beyond the back of the die set. This will prevent damage to the die set and will assist the scrap slug exiting the shear compartment on the scrap chute. Hold the sample piece so that it lies flat or in plane with the lower die anvil to prevent "whipping" of the end held by the operator. The Shear Press is activated with the button on the front of the Shear Press or the function key on the Operator Interface (see the operation manual for Operator Interface function key operation). The Shear Press will complete one cycle automatically, shearing a sample and returning to the start position. The sheared sample can be retrieved from the sample tray in the front of the machine. The scrap slug will be discharged out the rear of the shear compartment on the scrap chute. Occasionally, the sample should be checked for deformation. If the sample is not square and burr free, the dies should be re-sharpened or replaced (see shear die maintenance for details). Operating the Shear Press with dull or damaged die sets will affect the shear strength calculation accuracy, and the sample height, which will affect the sample final height accuracy.

### Shear Compartment



## Upset Press

The Upset Press has a 12" bore, 3” stroke double acting hydraulic cylinder that will develop 250 tons of force at 5,000 PSI operating pressure. The Upset Press is PLC controlled. The PLC monitors the hydraulic pressure on the cap end and the rod end of the Upset Press hydraulic cylinder with two pressure transducers. The difference of these two pressures is required to accurately calculate the sample upset force. The PLC monitors the ram position with a linear encoder and controls the ram velocity and position with a proportional directional control valve.

The Upset Press safety interlock switch is mounted inside the upset compartment. The safety switch body is mounted on the upset compartment sidewall. The safety switch key is mounted on the upset compartment door. When the upset compartment door is closed the safety switch key inserts into the switch body actuating the safety switch. **The Upset Press compartment door must be closed for safe operation.**

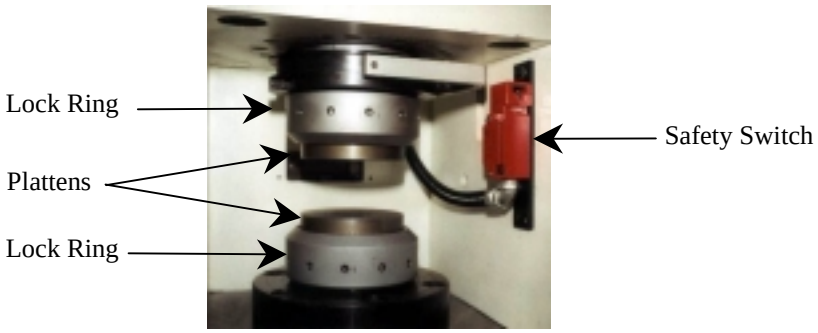
The Upset plattens are held in place with a lock ring and can be easily removed for maintenance or replacement with the aid of the spanner wrench provided for this purpose. The surface of the plattens should be routinely inspected. If the platten surface is indented or marked the plattens should be changed, or repaired (see section on maintaining upset plattens). **Operating the Upset Press with damaged plattens will affect the final height accuracy**.

**To insure calibration accuracy the operator must heat up the reservoir, and clean up the upset chamber. The reservoir temperature should be 120 F / 50 C degrees, just running the pumps combined with the reservoir heaters should heat up the reservoir. Remove any samples from the Upset Chamber and clean both platten faces.**

The Upset Press is ready for calibration, the calibration routine is activated from the Start Up Screen on the main Operator Interface (see the operation manual for Operator Interface Start Up Screen details). During the calibration routine the ram does a first kiss to get a rough estimate of platten to platten location. The ram is retracted separating the plattens approximately .100”. Next the ram extends in creep speed for the second kiss finding a platten to platten reference. Then the ram retracts to the home limit switch. The Upset Press calibration is complete. The Upset Press must be calibrated every time the PLC control cabinet is powered up. The PLC uses the platten to platten reference to calculate the ram stroke required to upset the sample to the desired upset height.

Next the operator must define three upset parameters, sample upset height (final or percentage), rod diameter, and die selection in the Heat Setup screen on the Operator Interface. Now the Upset Press is ready for normal operation. The sample should be placed in an upright position, as close to the center as visually possible, on the lower platten. Close the safety door; activate the button on the front of the Upset Press or the function key on the Operator Interface (see Operation Manual for Operator Interface Function Key details). The ram will extend toward the sample. When the ram nears the target height the PLC commands the proportional directional control valve to slow speed, decreasing the ram velocity. As the ram approaches the desired height the PLC commands the proportional directional control valve to creep speed, again decreasing the ram velocity. When the ram reaches the desired sample height the PLC commands the proportional directional control valve to reverse the ram’s direction, completing the sample’s upset. When the ram is fully retracted the upper limit switch is activated resetting the Upset Press for the next upset. Now the sample can be removed from the upset compartment, and inspected. **Care should be used when initially touching the sample after the upset because of heat build-up during cold working of the material.**

### Upset Compartment



## Back up Mode

The back up mode is a complete control system to operate the Upset tester if the main PLC fails. The Upset tester can be switched into the backup mode on the control pendant panel. Turn the selector switch from normal to backup operation. In the backup mode the small operator interface on the pendant panel is the start / stop control for the Shear Press hydraulic pump and the Upset Press hydraulic pump. The buttons on the front of the Upset tester will activate the Shear Press cycle and the Upset Press cycle. The Upset tester will operate like a manual Upset tester.

## Back up Mode - Shear Press

The Shear Press safety interlock switch is mounted inside the Shear Compartment. The safety switch body is mounted on the Shear Compartment sidewall. The safety switch key is mounted on the shear compartment door. When the Shear Compartment door is closed the safety switch key inserts into the safety switch body actuating the safety switch. **The Shear Press compartment door must be closed for safe operation.**

The proper die size should be selected and inserted into the slots in the bottom of the Shear Compartment. The die should slide back into the slots until the die blade can be engaged in the die keepers. The blade lock must be raised in order to allow the die blade to engage in the die keepers. The die set should be slid back all the way to the stop against the scrap chute. When the blade lock is released it should return to the down position, this will prevent the die from accidentally working forward out of the die keepers during operation. The die keepers are attached to the ram with shoulder bolts, allowing some play in the keepers. In the event that the die blade has not been properly engaged in the keepers and the Shear Press is cycled the keepers will be driven up into the clearance slots. Preventing damage to both the die set and the Shear Press ram.

With the die set installed the Shear Press is ready for back up mode operation. The sample should be inserted through the slot in the safety door far enough to insure that the end of the sample piece protrudes at least one (1) inch beyond the back of the die set. This will prevent damage to the die set and will assist the scrap slug exiting the shear compartment on the scrap chute. Hold the sample piece so that it lies flat or in plane with the lower die anvil to prevent "whipping" of the end held by the operator. The Shear Press is activated with the button on the front of the Shear Press. The Shear Press will complete one cycle automatically, shearing a sample and returning to the start position. The sheared sample can be retrieved from the sample tray in the front of the machine. The scrap slug will be discharged out the rear of the shear compartment on the scrap chute. Occasionally, the sample should be checked for deformation. If the sample is not square and burr free, the die should be re-sharpened or replaced. (See sections on shear die maintenance) Operating the Shear Press with dull or damaged die sets will affect the sample height, which will affect sample final height accuracy.

## Back Up Mode - Upset Press

The Upset Press safety interlock switch is mounted inside the upset compartment. The safety switch body is mounted on the upset compartment sidewall. The safety switch key is mounted on the upset compartment door. When the upset compartment door is closed the safety switch key inserts into the switch body actuating the safety switch. **The Upset Press compartment door must be closed for safe operation.**

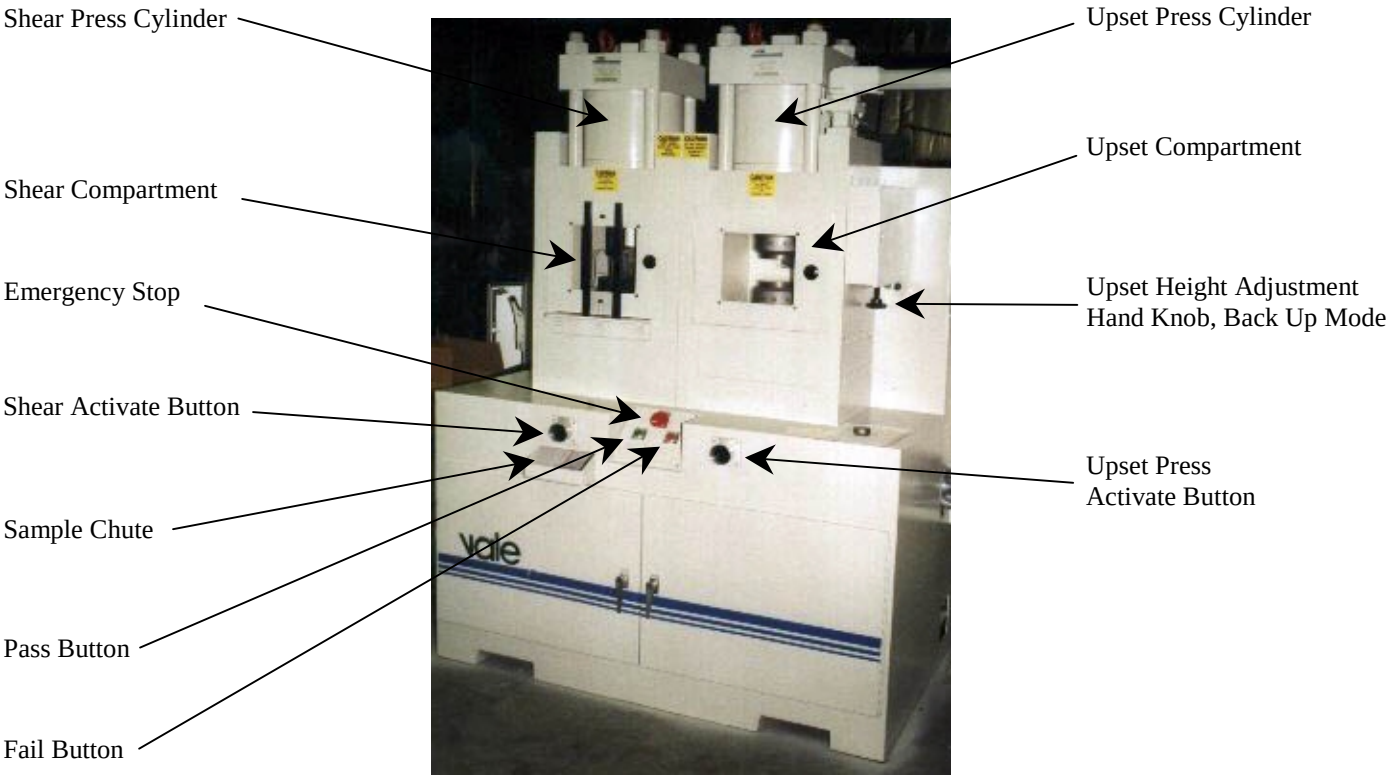
The upset plattens are held in place with a lock ring and can be easily removed for maintenance or replacement with the aid of the spanner wrench provided for this purpose. The surface of the plattens should be routinely inspected. If the platten surface has indents or marked the plattens should be changed, or repaired (see section on maintaining upset plattens). Operating the Upset Press with damaged plattens will affect the final height accuracy.

The final height adjustment must be set. The upper limit switch is factory set and non-adjustable. The lower limit switch controls the distance that the upset ram travels and is adjustable by means of the upset adjustment hand knob located under the enclosure on the right hand side of the press. Viewed looking at the hand knob, rotating the hand knob clockwise will decrease the sample final height, rotating the hand knob counterclockwise will increase the sample final height. A sample will have to be upset and measured to verify the Upset Press final height setting. If the sample upset height is not correct, adjust the hand knob

and upset another sample, again measure the sample to verify the final height setting. These steps will have to be repeated until the final height setting is correct.

The Upset Press is ready for back up mode operation. The sample should be placed in an upright position, as close to the center as visually possible, on the lower platten. Close the safety door, press the Upset Press CYCLE START push-button. The Press will cycle automatically upsetting the sample to the final height setting and then returning to the start position. Now the sample can be removed from the upset compartment, and inspected. **Care should be used when initially touching the sample after upset because of heat build-up during cold working of the material.**

### Upset Tester Front View




## PLC Control Cabinet

The PLC control cabinet is located on the right side of the Upset Tester. The Upset Tester logic controls are mounted in the enclosure. To keep the logic components clean and in good working condition the enclosure door must be kept closed except for service or maintenance.

## Main PLC

The Main PLC (PLC is an acronym for **P**rogrammable **L**ogic **C**ontroller) is an Allen Bradley SLC 503. It is located in the PLC control cabinet. If the PLC is unpowered for more than five days the Lithium Battery will maintain the PLC memory. Therefore the Lithium Battery must maintain the PLC memory when the Upset Tester is operated in the Backup Mode. Typical life of the lithium battery is two years, so changing the Lithium Battery on a two-year interval is recommended. When changing the Lithium Battery power up the PLC for 5 minutes, than disconnect the power and change the Lithium Battery. Powering up

the PLC prior to changing the Lithium Battery will hold the PLC memory while the battery is changed. The Upset Tester program was loaded into the Main PLC when it left the factory, a hard copy of the program is provided in the Operation Manual and on the EEPROM Memory Module (EEPROM is an acronym for **E**lectronically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory) installed in the PLC. It is recommended that the EEPROM remained installed in the PLC. If required the program can be downloaded into the PLC memory. To down load the program from the EEPROM to the PLC Allen Bradley communication and programming software is required. The communication software is RSLINX LITE or RSLINX version 2.1 or better. The programming software is RSLOGIX 500. In the event of the EEPROM being erased accidentally a programmed EEPROM can be obtained from Vale Industries, Inc. The EEPROM should be installed, used, and removed only by qualified personnel who are familiar with the EEPROM section of Allen-Bradley's SLC 503 Programmable Controller.

## Backup PLC

The Backup PLC (PLC is an acronym for **P**rogrammable **L**ogic **C**ontroller) is an Allen Bradley Micro Logic 1500. It is located in the PLC control Cabinet. If the PLC is unpowered for more than five days the Lithium Battery will maintain the PLC memory. Therefore the Lithium Battery must maintain the PLC memory when the Upset Tester is operated in the Normal Mode. Typical life of the lithium battery is two years, so changing the Lithium Battery on a two-year interval is recommended. When changing the Lithium Battery power up the PLC for 5 minutes, than disconnect the power and change the Lithium Battery. Powering up the PLC prior to changing the Lithium Battery will hold the PLC memory while the battery is changed. The Upset Tester Backup Mode program was loaded into the Backup PLC when it left the factory, a hard copy of the program is provided in the Operation Manual and on the EEPROM Memory Module (EEPROM is an acronym for **E**lectronically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory) installed in the PLC. It is recommended that the EEPROM remained installed in the PLC. If required the program can be downloaded into the PLC memory. To down load the program from the EEPROM to the PLC Allen Bradley communication and programming software is required. The communication software is RSLINX LITE or RSLINX version 2.1 or better. The programming software is RSLOGIX 500. In the event of the EEPROM being erased accidentally a programmed EEPROM can be obtained from Vale Industries, Inc. The EEPROM should be installed, used, and removed only by qualified personnel who are familiar with the EEPROM section of Allen-Bradley's SLC 503 Programmable Controller.

## High Speed Capture Meter

During the Shear Press shearing cycle the PLC commands the High Speed Capture Meter to capture the peak pressure from the Shear Press pressure transducer, and outputs the shear peak pressure to the PLC. The meter is set up for the correct input and output range no field set up is required.

## Temperature Controller

The temperature controller monitors the reservoir temperature. In the Backup Mode the controller will trigger an output to the Backup PLC to turn on the reservoir cooling system at 125 F / 52 C degrees.

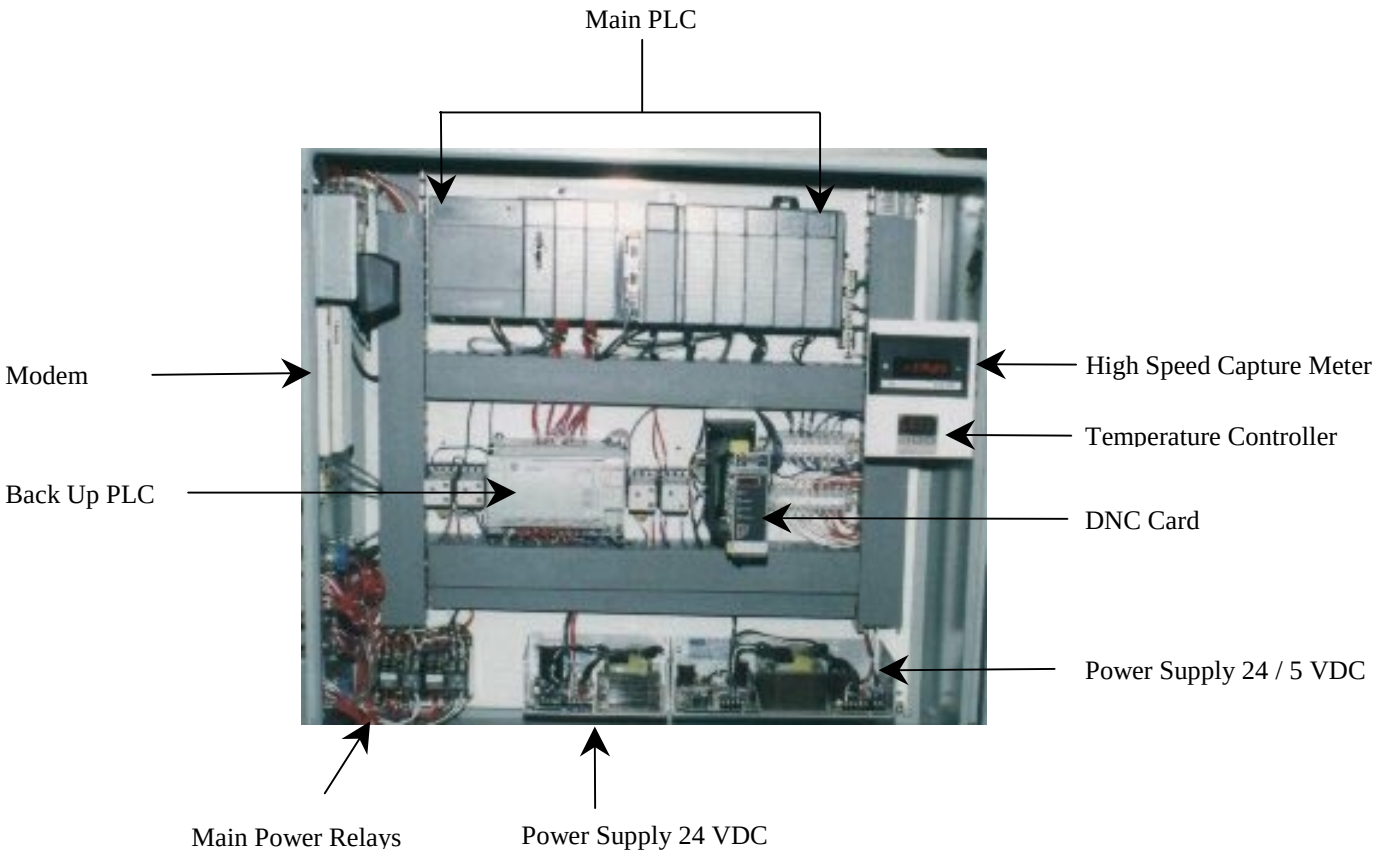
## Modem

The Modem is used to communicate with the main PLC from a remote location. This will allow remote monitoring of the Upset Tester operation and set up. Program modification or updates can also be downloaded.

## Power Supplies

There are two power supplies mounted in the PLC enclosure. The first is a 24 VDC power supply that supplies the Proportional Directional Control Valve. The second is a 24 / 5 VDC power supply that supplies the Linear Encoder, Pressures Transducers, DNC Card, and control signal for the DNC in Backup Mode.

### PLC Control Cabinet




## Emergency Stop

There are two large red mushroom head Emergency Stop push buttons. One is on the Control Pendant Panel, and the other is on the front panel in the center of the Upset Tester. If it is necessary to press either button, the electrical power to the control cabinets and to the pump motors will be terminated and all Upset Tester functions will stop. **The Emergency Stop button will stop all mechanical functions in whatever position the machine is at the time of activation.**

## Stopping Operation

When the Shear Press and Upset Press operations are complete, the pump motors are shut off using the Shear Pump Off and the Upset Pump Off push buttons on the Operator Interface (see Operation Manual for functional key details). Then the PLC may be shut down using the PC OFF push-button, on PLC control cabinet on the right side of the Upset Tester. Then the main panel disconnect can turned off, this will disconnect all electrical power to the controls on the Upset Tester.

## Upset Press Will Not Upset Sample

If the force of the Upset Press is insufficient to upset the sample, the upset ram stroke control device will not be activated. This will cause the ram to remain in the down position under load (pressure). The PLC monitors for this condition with a ten-second timer, if the timer times out, the ram will be retracted. If this condition occurs, the amount of upset should be re-adjusted or the material strength should be evaluated because the Upset Tester is attempting to function beyond its capacity. No damage will occur under these conditions unless the Upset Tester is operated in this manner on a continuous basis or over a long period of time. Operating the Upset Press beyond it capacity will affect the final height accuracy

## Power Unit

The power unit was assembled using standard industrial practice with ease of access in mind for service and maintenance; it is located in the rear of the Upset Tester cabinet. The reservoir has a 100-gallon capacity and is fabricated out of carbon steel. Two 40 horsepower electric motors are the prime movers for the two piston pumps. The Upset Press Pump Control is set up as a variable volume pressure compensated with a maximum volume stop. The Shear Press Pump Control is set up as a fixed volume with a maximum volume stop. The filling filter, filters all incoming fluid during reservoir filling and filters the incoming air when the reservoir fluid level changes during the Upset Tester operation. The return line filter has an 87 PSI / 6 Bar bypass relief valve, 10-micron Betamicron disposable element; it filters the fluid as it returns to the reservoir, retaining debris created by the system. The reservoir fluid level can be visually monitored at the fluid level sight gauge on the rear of the reservoir. The PLC monitors the reservoir fluid level with a Float Switch that has two floats. Each float will trigger a separate alarm, float one will trigger a LOW OIL / ADD SOON alarm, float two will trigger an OIL OUT SHUTDOWN alarm. The hydraulic fluid temperature is monitored with a thermocouple mounted on the right side of the reservoir.

Two 2-kilowatt heaters are installed in the reservoir to maintain a minimum oil temperature during cold weather operation. During extreme cold weather operation a heat blanket or a heat retention structure may have to be installed to maintain a 120 F / 38 C degree running temperature. The two station steel manifold has two isolated pressure ports with two pressure port to tank port relief cavities, a single tank outlet, and two D08 mounting pads. One mounting pad for the Shear Press directional control valve. The other mounting pad for the Upset Press proportional directional control valve. The Shear Press and Upset Press hydraulic circuits are discussed in the following sections.

**Water Cooled Power Unit**

The brazed plate heat exchanger is a water / oil heat exchanger that will limit the maximum fluid temperature. The Y-strainer mounted in the heat exchanger water inlet port protects the heat exchanger from large debris in the cooling water. The Y-strainer should be cleaned periodically. The two way normally closed water valve controls the cooling water flow to the heat exchanger. The water valve will be turned on and off by the PLC as required to maintain the fluid temperature.

**Optional Air Cooled Power Unit**

The air / oil heat exchanger is an air over oil heat exchanger that will limit the maximum fluid temperature. The heat exchanger is equipped with air filters to keep dirt from building up on heat exchanger cooling fins. The filter elements should be checked and replaced as required. The heat exchanger fan motors will be turned on and off by the PLC as required to maintain the fluid temperature. Because the heat exchanger mounting elevation is higher than the power unit a 65-PSI crack check valve was installed at the returnline filter to create a backpressure. This backpressure will keep the hydraulic oil in the heat exchanger, when the returnline filter-housing lid is removed when changing the filter element.

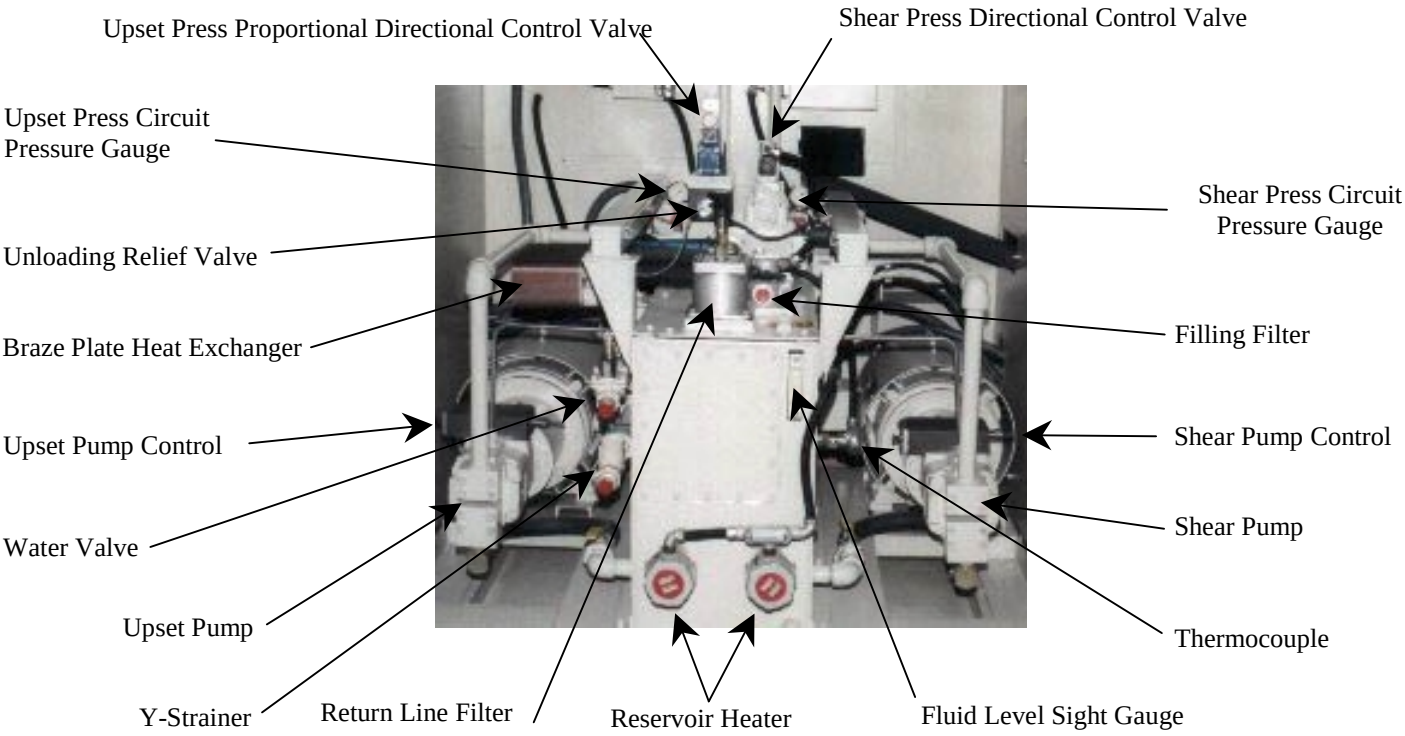
## Shear Press Hydraulic Circuit

The Shear Press hydraulic circuit major components are, the piston pump, the pressure relief valve, the directional control valve, the pressure transducer connected to the high speed peak capture meter, and the pressure gauge with shut off valve. The piston pump supplies a fixed volume of hydraulic fluid to the Shear Press hydraulic circuit. The cartridge relief valve controls the Shear Press hydraulic system pressure. The D08 manifold mounted directional control valve has a tandem center to unload the pump during cycle dwell periods and it controls the direction of travel (extend / retract) of the shear ram. The hydraulic pressure is monitored with a pressure transducer and the high speed peak capture meter. The high speed peak capture meter captures the peak pressure from the pressure transducer and outputs the shear peak pressure to the PLC. Then the PLC calculates the sample shear force. The system pressure can be checked on the liquid filled 6000 PSI pressure gauge, the gauge is mounted with a manual shut-off valve. The shut-off valve should be shut off during machine operation; this will extend the service life of the gauge.

## Upset Press Hydraulic Circuit

The Upset Press hydraulic circuit major components are the pressure compensated piston pump, the unloading relief valve, the direct acting relief valve, the proportional directional control valve, the two pressure transducers and the pressure gauge with shut off valve. The pressure compensated piston pump supplies hydraulic flow to the Upset Press hydraulic circuit. The pressure compensated piston pump will destroke supplying only enough flow to maintain the pressure compensator set pressure. The Unloading Relief Valve unloads the pump flow during cycle dwell and controls the maximum system pressure. The Directing Acting Relief Valve controls the system pressure spikes. The proportional directional control valve, controls the direction of travel (up or down) and the velocity, (fast speed, slow speed or creep speed) of the Upset Press ram. The hydraulic pressure on the cap end and the rod end of the Upset Press hydraulic cylinder is monitored with two pressure transducers. The difference of these two pressures is required to accurately calculate the sample upset force. The system pressure can be checked on the liquid filled 6000-PSI pressure gauge, the gauge is mounted with a manual shut-off valve. The shut-off valve should be shut off during machine operation; this will extend the service life of the gauge.

## Power Unit




## Reservoir Top


- Reservoir, 100 gallon, carbon steel material
- (2) 40 horsepower, 575/3/60 electric motors
- (2) Piston pumps
- (2) Pressure gauges with shut off
- Steel manifold, two D08 mounting pads, two isolated Pressure ports, two Pressure port to tank port relief cavities, single tank outlet
- Proportional directional control valve.
- Directional control valve
- Unloading relief valve, 120/60 control voltage
- Direct acting relief valve
- Relief valve
- Fluid level sight gauge
- Fluid level gauge
- Filler breather filter
- Return line filter
- Electric heater, 230/60
- Thermocouple
- Brazed plate heat exchanger
- Y-strainer
- Water valve

## Hydraulic Fluids

The hydraulic fluid in the Upset Tester has to fulfill three duties; energy transfer, lubrication, and cooling. It is therefore extremely important that the proper fluid is selected for optimum performance of the machine. In the selection of fluids the viscosity temperature characteristics must be taken into consideration. Preferably, fluids with low change in viscosity with temperature change should be used; also a fluid with good Shear strength and lubrication quality by means of HD or EP additives is recommended. To keep Pressure drop low in cold weather installations, use a fluid like the ISO viscosity group 32. Fluids for year-round use or in non-heated buildings use a moderate rated fluid like ISO viscosity group 46.

## Fluid Recommendations

Vale Industries recommends the use of a good grade general purpose, petroleum based, detergent, hydraulic fluid be used in your power unit. Like Amoco AW 32, Gulf Harmony 32 or equivalent for cold weather applications: Amoco AW 46, Gulf Harmony 46 or equivalent for year-round installations.

**Petroleum Based Fluids:**

| **Group/Grade** | **SUS @ 100 Deg.** | **ISO Viscosity Identification** |
|---|---|---|
| Cold Weather Installation | 150 | 32 |
| Most all Applications | 200 | 46 |

## Installation

The Upset Tester should be installed in your area work, considering the accessibility for operation, maintenance, and service. Protect the Upset Tester from extremes of temperature variations. Exposure to extremely low temperatures will cause difficulty with the Upset Tester ability to maintain a 120 F / 50 C degree running temperature. Prolonged exposure to high temperatures will cause Upset Tester shut downs and shorten the life of the Upset Tester's cylinder seals and power unit sealing members.

## Filling or Adding Fluid to the Reservoir

The filling filter assists maintaining the total reservoir cleanliness level by filtering the incoming fluid as it is being added to the system. Before the fluid is introduced into the system, the fluid cleanliness should be known, if the fluid doesn’t meet the required fluid cleanliness level 16/13 – 18/15 according to ISO 4406 it should not be added to the system. The reservoir should be filled with hydraulic fluid using a filter cart or transfer cart pumping the fluid through the filling filter. The filling filter inlet port is an SAE-16 o-ring threaded connection. The filling flow rate should not exceed 20 GPM. The filling filter is also a reservoir breather. The reservoir fluid level will change during the Upset Tester operation, as ambient air is drawn into the reservoir it is filtered by a breather filter element

## Start-Up Procedure

Before starting up the power unit: Fill the reservoir to about 3/4 full on the sight gauge with the appropriate type of clean and filtered hydraulic fluid as recommended in this manual (see fluid recommendations). It is recommended that for long life and optimum performance the hydraulic fluid used in this system have a fluid cleanliness level class 16/13 – 18/15 according to ISO 4406 before being put into the reservoir.

1. Connect the electrical input wires to the electrical panel.
2. Check electrical heater nameplate, electrical data, and service voltage. Check to verify the heaters are wired correctly.
3. Check electrical motor nameplates, electrical data, and service voltage. Check to insure that the motors are wired for the correct service voltage, hertz, and the phase of the power circuit available.
4. Check to see that the overload heaters are set for the full rated current as shown on the motor nameplates.
5. Remove the pump case drain line and fill the Shear Press Pump and the Upset Press Pump case's with hydraulic oil. Replace pump case drain lines.
6. Check to see that the Shear Press pump motor and the Upset Press pump motor are running in the proper direction. Verify direction of rotation by jogging the motors with the Pump On and Pump Off buttons in rapid succession. The Pump On and Pump Off push buttons are on the Start Screen on the Operator Interface (see operation manual for detailed instructions on the Operator Interface Pump On / Pump Off control). Proper pump rotation direction can be confirmed by visual inspection of the indicating arrow on pump nametag, or arrow decal on motor cowling. If not correct, reverse circuit polarity.
7. The power unit can now be turned on.
8. Check components for damage or leaks.
9. Configure the operator interface for the material being tested. (see operation manual for detailed instructions on the Operator Interface configuration)
10. Before proceeding the reservoir temperature should be $120^{o}$ F / $50^{o}$ C. (Check the reservoir temperature on the Operator Interface Start Up or Run screen)
11. Select the correct die set for the material being tested. Install the die set into the Shear Press.
12. Activate the Shear Press calibration routine. (see operation manual for detailed instructions)
13. Install the Upset plattens.
14. Remove the samples from the Upset Chamber. Clean the platten faces. Activate the Upset Press calibration routine. (see operation manual for detailed instructions)
15. While the Shear Press and the Upset Press are cycling check to see that the Pressure control devices are set at the correct pressure. 4500 PSI or less for the Shear Press and 5000 PSI for the Upset Press, after checking the pressures shut off the gauge shut off valve. (See below for instructions.)
16. Check safety doors operation. With the pumps running, push the Shear CYCLE START button. The Shear Press ram should advance and complete one cycle, automatically returning to start position. Push the Shear button again and when the ram has advanced approximately 1/2 its stroke, open the safety door. The ram should stop in position. Now close the safety door the ram will complete its, cycle. This procedure should be repeated for the Upset Press.
17. Check emergency stop operation. Depress the large red EMERGENCY STOP push-button, the electrical power to the control cabinets and to the pump motors will be terminated, all Upset Tester functions will stop.
18. The Start-Up procedure is complete, the Upset Tester is now ready for normal operation

## Shear Press Pressure Control Adjustment Procedure

**Caution:** The following procedure to set the pressure controls overrides the built-in safety features of the Upset Tester. Remove all die sets from the Shear Press, warn all personnel to stand clear while the adjustment takes place.

The Shear Press hydraulic circuit is equipped with a cartridge-type pressure relief valve. The relief valve is located on the pump end of the manifold block. Facing the power unit, the right hand pump supplies the Shear Press and is controlled by the right hand pressure relief valve. The threaded adjustment rod is held in place with a locknut and has a hexagonal cover cap. The following steps should be followed to set the valve on the Shear Press pump.

1. Remove the shear die set from the Shear Press.
2. Open the pressure gauge shut off valve by turning counter clockwise.
3. Loosen the lock nut at the base of the relief valve adjusting bolt
4. Using a small rod or allen wrench, depress the button in the end of the solenoid case on solenoid #2, read the pressure and release the solenoid. Solenoids (#2 is on the pump end of the power unit.)
5. Turn the adjusting bolt in or clockwise for increasing the pressure and out or counterclockwise for decreasing the pressure.
6. Repeat steps 5 and 6 until the gauge reads 4500 P.S.I.
7. After the pressure has been set, the lock nut on the relief valve adjusting bolt should be tightened to prevent a change in pressure during operation of the Shear Press.
8. The pressure gauge shut off valve should then be closed so that the pressure gauge will be protected from system pressure spikes during normal Shear Press operation.

**Note:** The Pressure adjusting screw on the relief valve cannot be turned when the hydraulic circuit is under Pressure. Also note that the pressure gauge shut off valve can be opened at anytime during machine operation to check Pressure. During the Shear Press operation the gauge may indicate less than the 4500 PSI pressure set at the relief valve, this is normal.

## Upset Press Pressure Control Adjustment Procedure

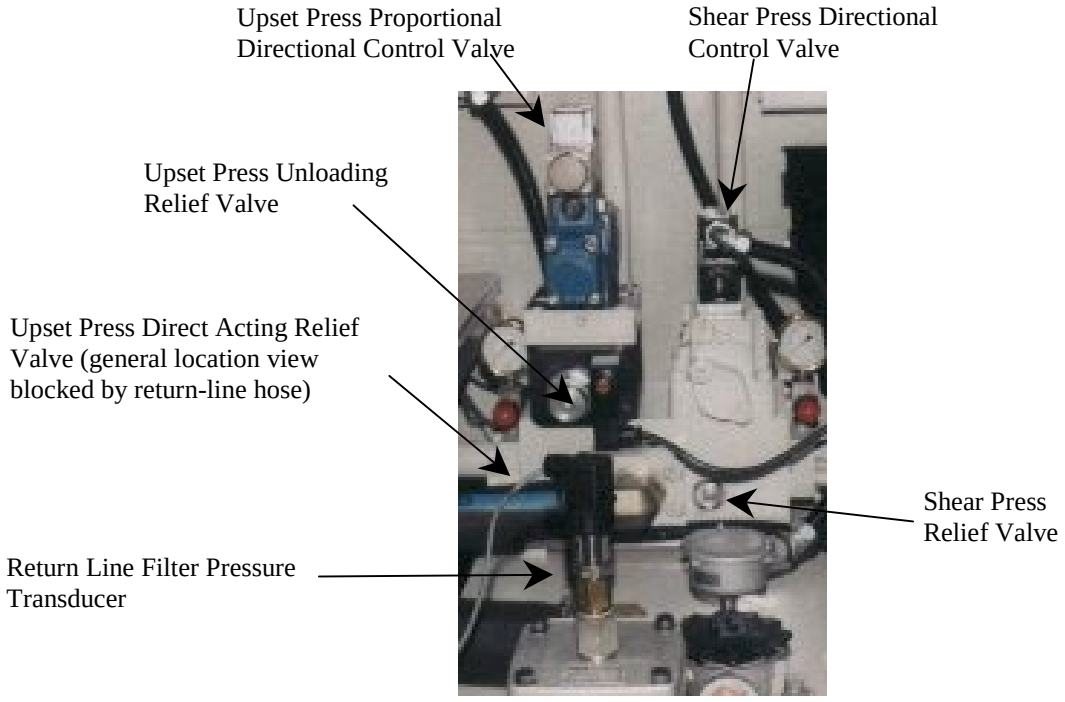
**Caution:** The following procedure to set the pressure controls overrides the built-in safety features of the Upset Tester. Remove the Upset plattens from the Upset Press, warn all personnel to stand clear while the adjustment takes place.

The Upset Press hydraulic circuit incorporates three pressure control devices, Unloading Relief Valve, Direct Acting Relief Valve, and Variable Volume Pump Pressure Compensator. The Unloading Relief Valve unloads the pump flow and controls the maximum system pressure. The Directing Acting Relief Valve controls the system pressure spikes. The Pressure Compensator will destroke the pump supplying only enough flow to maintain the Pressure Compensator set pressure. The pressure controls are factory set at the following pressures, Unloading Relief Valve 5400 PSI, Direct Acting Relief Valve 5300 PSI, and Pump Pressure Compensator 5000 PSI. If it becomes necessary to re-adjust these pressures, the following procedure is recommended. Because of the position of the Operator Interface and the pressure controls on the power unit, adjusting the pressure controls is a two-man job. One to operate the Operator Interface and the other to set and verify the pressures.

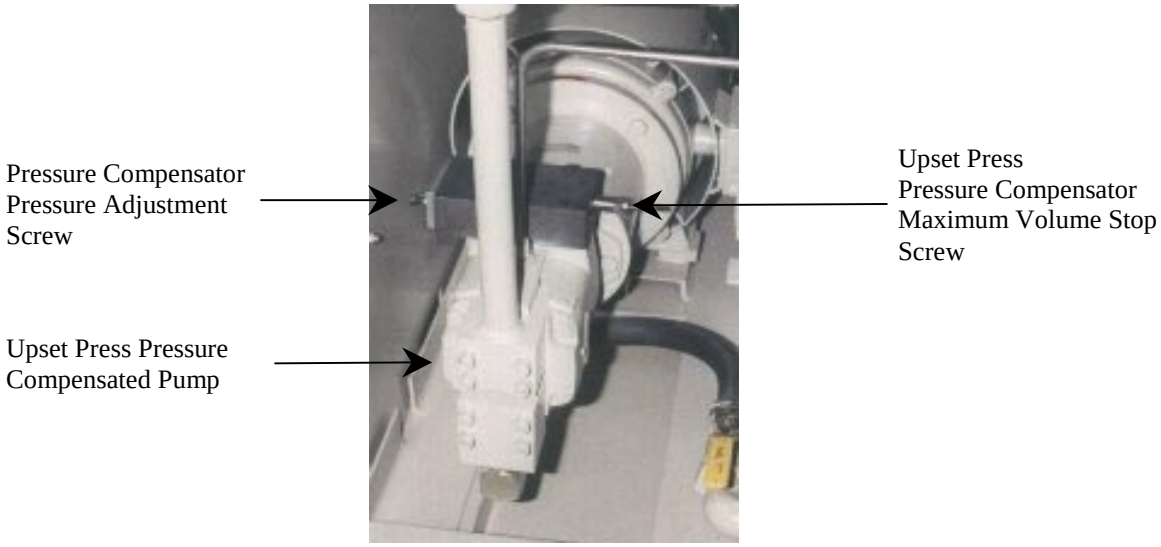
When setting multiple pressure devices for one system, the highest pressure is set first, and the lowest pressure is set last. Therefore the three pressure controls would be set, 1) Unloading Relief Valve, 2) Direct Acting Relief Valve, 3) Pressure Compensator.

1. Remove the Plattens from the Upset Chamber
2. Place the Operator Interface in the Manual Screen
3. Open the Gauge Shutoff Valve (counter clockwise)
4. Decrease the Maximum Volume Stop Five Turns (clockwise)
5. Decrease the Unloading Relief Valve to the minimum setting (counter clockwise)
6. Increase the Direct Acting Relief Valve to the maximum setting (clockwise)
7. Increase the Pressure Compensator to the maximum setting ( clockwise)
8. In the Manual Screen push the Upset Down button
9. The Pressure should be 100 PSI (approx.)
10. Release the Upset Down button
11. Increase the Unloading Relief Valve setting (clockwise)
12. Push the Upset Down button, read the Pressure set by the Unloading Relief Valve
13. Repeat the steps 11 / 12 until the Unloading Relief Valve is set at 5400 PSI
14. Lock adjustment screw in position with the jam nut
15. Decrease the Direct Acting Relief Valve to the minimum setting (counter clockwise)
16. In the Manual Screen push the Upset down button
17. The Pressure should be 100 psi (approx.)
18. Release the Upset Down button
19. Increase the Direct Acting Relief Valve setting (clockwise)
20. Push the Upset down button, read the Pressure set by the Direct Acting Relief Valve, Note the Pressure can not be set higher than the Unloading Relief Valve 5400 PSI set Pressure
21. Repeat the steps 19 / 20 until the Direct Acting Relief Valve is set at 5300 PSI
22. Lock the adjustment screw in position with jam nut
23. Decrease the Pressure Compensator to the minimum setting (counter clockwise)
24. In the Manual Screen push the Upset Down Button
25. The Pressure should be 100 PSI (approx.)
26. Release the Upset Down button
27. Increase the Pressure Compensator setting (clockwise)
28. Push the Upset Down button read the Pressure set by the Pressure Compensator, Note the Pressure can not be set higher than the Direct Acting Relief Valve 5300 PSI set Pressure
29. Repeat the steps 27 / 28 until the Pressure Compensator is set at 5000 PSI
30. Lock the adjustment screw in position with the jam nut
31. Increase the Maximum Volume Stop five turns (counter clockwise)
32. Shut off the Pressure Gauge Shut off Valve (clockwise)
33. Install the Plattens in the Upset Chamber

## Pressure Control Valves Reservoir Top




## Upset Press Variable Volume Pressure Compensated Piston Pump



## Maintenance

All maintenance work should be done by qualified personnel familiar with the construction, operation, and hazards involved with this type of equipment. **National Electrical Manufacturers' Association** publication number ICS 1.3; *Preventive Maintenance of Industrial Control and System Equipment* and publication numbers AB2 and ICS 2.2; *Maintenance of Motor Controllers After a Fault Condition* are recommended handbooks for personnel responsible for the maintenance of this equipment

## Monthly Inspection

- Check oil level in reservoir, if necessary add oil, The fluid level should be kept at 3/4 full in the sight gauge.
- Inspect the Upset Tester for hydraulic leaks, power unit, Shear Press, Upset Press, Shear Compartment, Upset Compartment and drip pan.
- Inspect Electrical Enclosure Doors To insure they are properly closed and sealed.
- Inspect cutting edge of the Shear Dies. Sharpen if required
- Inspect Plattens for indentations or marks. Grind if required.
- Start the Shear Press Pump and the Upset Press Pump, With the reservoir temperature @ 120 F / 50 C degrees, Check the filter backpressure on the Operator Interface Start Up Screen. If the filter pressure is greater than 60 PSI change the return line filter element.

**Water Cooled Power Unit**

- Inspect Y-Strainer be sure that it is free of debris.

**Air Cooled Power Unit**

- Inspect Air Filter be sure element is clean without airflow restriction
- Inspect Air / Oil Cooler radiator, be sure cooling fin are clear of debris and dirt / dust build up.

## Return Line Filter Element Changing Procedure

1. Shut off system by locking out and tagging out the electrical power.
2. Remove the four lid screws on the filter unit.
3. Remove the return line filter lid.
4. Inspect the lid O-ring for damage. Replace if necessary.
5. Remove contamination retainer with filter element.
6. Discard disposable filter element.
7. Clean and degrease the contamination retainer.
8. Lubricate the O-ring in the lid and O-ring in the filter element using clean system fluid.
9. Insert the new filter element into the contamination retainer.
10. Insert filter element/contamination retainer into the filter housing.
    **Note**: Use a twisting action to avoid damaging the O-ring.
11. Push lid into housing. Make certain boltholes are aligned.
12. Install lid screws.
13. Pressurize system and check for leaks.

## Maintaining Upset Plattens

The Upset plattens are made from hardened tool steel and should require very little maintenance. When it is noticed however, that the plattens are becoming indented or marked it will be necessary to regrind the working surfaces to restore them to original flatness. **Operating the Upset Press with damaged plattens will affect the final height accuracy**.

- When regrinding the plattens make sure that the original parallelism of .0005" is maintained. Finish is also important and should be held to 25 R.M.S.
- After regrinding the plattens verify the plattens touch face to face during the calibration routine. Place a piece of paper on the lower platten close the safety door and activate the calibration routine. After the ram is in the home position inspect the paper for indication that plattens touched face to face. If the paper shows no indication that the plattens touched face to face during the calibration routine one or both plattens should be replaced, because final height accuracy will be affected. **After this face to face test the Upset Press must be calibrated with the platten faces wiped clean before resuming normal operation.**

**Warning**: Never place objects in the press other than the material to be sampled or paper for the face to face test. Trying to upset objects such as ball bearings or other hardened materials will crack the plattens and could cause injury to the operator. Upsetting objects that contain moisture will create steam that could burn the operator.

## Maintaining Shear Dies

- The die set assemblies should be maintained in a sharpened condition at all times. Under operating conditions it will be noted that the inside face of both the front and back anvils will dull. By observation of the quality of the sheared sample or of the anvil faces themselves, it can be determined how frequently dies should be sharpened.
- Front and back anvil plates may flipped over for a new edge. When both edges are worn, they may be dressed on a surface grinder, removing only enough metal to restore them to their original sharpness. This procedure will permit maximum die life. After several sharpenings it maybe necessary to restore the relief on the face of each anvil. This is required in order to allow the sheared sample to drop from the die set into the sample chute. The relief should come to within 1/4 inch of the bottom of the die radius.
- To sharpen the shear blade, dress both sides, again removing only enough metal to restore original sharpness. After grinding use a micrometer to find the new thickness. Add to this dimension .002 to .004 inch and grind both spacer blocks to this thickness. (Example: Shear blade after grinding measures 1.000". Spacer blocks must be ground to 1.002" to 1.004".) In the event the sample length must be accurately maintained at the length originally provided, sharpening of the shear blade can be accomplished by grinding the shear blade radius rather than the sides of the blade as outlined above.
- Before re-assembly, de-magnetize and lightly lubricate all surfaces.

## Upset Height Input Correction Formula

After sharpening the die blades the sample overall cut height will be reduced. To determine the new upset height value that must be entered in the Setup Screen on the Operator Interface to achieve the correct sample upset using the Final Height or Percentage Height fields use the following formulas.

$L_o$ – Length Original
$L_f$ - Length Final After Upset
$L_a$ - Length Actual After Grinding
$R_o$ – Desired Percentage Reduction
$R_r$ – Enter Value Percentage Reduction

Final Height $L_f = L_a \times (1 - R_o)$

Percentage Reduction $R_r = 1 - \frac{L_a (1 - R_o)}{L_o}$

**Dimensions for VU3 Shear Dies**

| Die # | $L_o$ Dimension | Minimum $L_a$ Dimension |
|---|---|---|
| 1 | .325” / 8.25 mm | .163” / 4.13 mm |
| 2 | .488” / 12.40 mm | .325” / 8.25 mm |
| 3 | .650” / 16.51 mm | .488” / 12.40 mm |
| 4 | .813” / 20.65 mm | .650” / 16.51 mm |
| 5 | .975” / 24.77 mm | .813” / 20.65 mm |
| 6 | 1.138” / 28.91 mm | .975” / 24.77 mm |
| 7 | 1.300” / 33.02 mm | 1.138” / 28.91 mm |
| 8 | 1.463” / 37.16 mm | 1.300” / 33.02 mm |
| 9 | 1.625” / 41.28 mm | 1.463“ / 37.16 mm |
| 10 | 1.788” / 45.42 mm | 1.625” / 41.28 mm |

## Overhauling Press Hydraulic Cylinder

**Disassembly**

When it becomes necessary to disassemble the Shear Press or the Upset Press hydraulic cylinder to replace seals or other worn components, follow these procedures.

- The tie rods should be heated to approximately 600°F to 700°F taking care not to heat the cylinder barrel. The heat should be evenly distributed along the tie rods.
- The tie rod nuts should then be removed progressively, that is, each nut should be turned approximately 60° until the high torque has been relieved.

## Reassembly

- The tie rod threads should be lubricated with an anti-seize compound and screwed into the head of the cylinder to the bottom of the threads.
- Place the cylinder barrel and cylinder cap into position
- Thread the tie rod nuts onto the tie rods.
- Torque the tie rod nuts gradually and evenly to 200 foot pounds.
- Heat the tie rods to approximately 600°F to 700°F taking care not to heat the cylinder tube.
- The nuts should be turned 200° to a final torqued position. This final torquing should be done in three stages, that is; turn all nuts 70°, turn all nuts 70° again, turn all nuts the final 60°.

## Circuit Breaker Adjustment and Testing

The trip settings of the circuit breakers were set at the factory for the voltage/hertz requested at time of purchase. Further adjustment should not be necessary. If required use the following procedure to readjust the circuit breaker. Field adjustment on the trip settings of circuit breakers is dependent upon the motor full load current. Allen-Bradley recommends the selection of trip settings that are approximately 10 times the motor nameplate's full load current. This provides for a trip setting slightly above the peak motor-inrush current. The circuit breaker trip setting must never exceed 13 times the motor full load current. The trip setting is adjusted by rotating a cam lever to the appropriate position. The positions are labeled either as letters or numbers from a low of A or 1 to a high of H or 8.

## Circuit Breaker Setting Procedure

1. Place the circuit breaker in the OFF position.
2. Use a small screwdriver to depress the adjustment pointer. Turn in the direction indicated by the curved arrow to the selected setting. All pointers on each breaker must be set at the same setting.
3. Place the circuit breaker in the ON position, and start the motor. If the circuit breaker trips on starting, turn the circuit breaker to the OFF position.
4. Turn the pointers clockwise to the next higher position. Place the circuit breaker in the ON position, and start the motor.
5. Repeat these steps until the circuit breaker does not trip on starting.

## Circuit Breaker Push-To-Trip Mechanism

The circuit breaker incorporates a Push-To-Trip mechanism. When the red button located on the cover of the circuit breaker is pushed, it creates a mechanical pressure, which causes a plunger to engage the trip bar, which rotates and opens the circuit breaker contacts.

## Circuit Breakers Periodic Inspection

1. Shut off system by locking out and tagging out the electrical power before inspecting or servicing.
   **Warning:** Shut off and lock out all electrical power and tag out electrical enclosures
2. Remove dust, dirt, soot, grease or moisture from the surface of the circuit breaker using a lint free cloth brush or vacuum cleaner. DO NOT blow debris into the circuit breakers. If contamination is found, eliminate the source of the problem.
   **NOTE:** Do not spray or allow any petroleum based chemicals, solvents or paints to contact the inside or outside of breaker or electrical connections.
3. Switch the circuit breaker to the ON and OFF positions several times to be sure the mechanical linkages are free and do not bind. If mechanical linkages are not free, replace the circuit breaker.
4. Press the PUSH-TO-TRIP button to mechanically trip the circuit breaker. Trip, reset, and switch the circuit breaker on several times. If the circuit breaker cannot be turned on, replace the circuit breaker.
5. Check circuit breaker housing and handle for cracks, chipping and discoloration. Circuit breakers should be replaced if cracks or severe discoloration is found.
6. Check terminals and wire connectors for looseness or signs of overheating. Overheating will show as discoloration, melting, or blistering of conductor insulation or as pitting or melting of conductor surfaces due to arcing. If there is no evidence of overheating or looseness do not disturb or tighten the connections. If there is evidence of overheating, terminations should be replaced. Before re-energizing the circuit breaker, all wire connectors and cable should be refurbished to the original installed condition.
7. Check circuit breaker mounting hardware, tighten if necessary.

## Alarms

The PLC monitors four parameters that can trigger an alarm, Filter Pressure, Oil Level, Oil Temperature, and Machine Limitations. If any of these parameters exceed expectable levels an alarm is triggered. The alarms will appear in the Alarm Box on the Operator Interface in the Run Screen (for more details see the Operation Manual, Run Screen section Alarm Box). There are three alarm levels, Level 1 Warning - Upset Tester will operate corrective action is required at the next Upset Tester shut down, Level 2 Operation Fault – Upset Tester operation is halted until errors are cleared, and Level 3 Out Of Limits Shutdown - Upset Tester will shut down corrective action is required before the Upset Tester will operate.

### Level 1 - Warning

**Change Soon**

The return line filter is contaminated. Change the filter element at the next Upset Tester shutdown.

**Low Oil / Add Soon**

The reservoir oil level is low. Inspect the power unit, cylinders, and plumbing for leaks. If oil leaks are found evaluate and repair. Add oil to the reservoir at the next Upset tester shutdown..

**High Oil Temperature**

The oil temperature is high. At the next Upset tester shutdown inspect power unit for causes of excessive temperature alarm.

*Water Cooled Power Unit*

Inspect the brazed plate heat exchanger, verify cooling water flow. If cooling water flow is restricted check the Y-strainer, clean if required.

*Optional Air Cooled Power Unit*

Inspect air / oil exchange air filters, the filter elements should be replaced if required.

## Level 2 – Operation Fault

**Out Of Limits / Check Config And Setup**

This alarm indicates that the configuration and / or the setup parameters are out of limits creating a math overflow error in the PLC. Go to the configuration Screen on the Operator Interface and review setup.

## Level 3 - Out Of Limits Shut Down

**Change Filter**

The return line filter is contaminated to the point of element bypass. Change the return line filter element.

**No Filter**

The filter element has been removed from the return line filter housing. Install a filter element into the return line filter housing.

**Oil Out Shutdown**

The reservoir oil level is low. Inspect the power unit, cylinders, and plumbing for leaks. If oil leaks are found evaluate and repair. Add oil to the reservoir.

**Out Of Limits ShutDown**

The Out Of Limits ShutDown alarm indicates that one of the previous Level 3 alarms is active. This alarm is also activated when the reservoirs oil temperature reaches the over temperature limits. This limit is set at 135°F / 51.5°C. The HIGH OIL TEMPERATURE alarm will also be activated if the OUT OF LIMITS SHUT DOWN is due to high oil temperature. A high oil temperature could indicate that there is no or low water flow on the cooling system if a water cooled system is being used, or there is insufficient air flow over the radiator if an air cooled system is being used.

## DNC Card Failed Code

If the Upset Press Pump is running and the Upset Press Ram will not extend in the Normal Mode or the Backup Mode the DNC (digital numerical controller) Control Card or Proportional Directional Control Valve could be the reason for non-operation. The DNC card is located in the PLC control cabinet located on the right side of the Upset Tester. The status of the DNC card can be viewed on the four LED's on the front face. If the DNC card is the reason for the non-operation FAILED will scroll across the four LED's. With the DNC card failed the proportional valve will not operate. The fault can be cleared by disconnecting the electrical power and reapplying electrical power to the PLC control cabinet. Normal Mode or Backup Mode operation can be attempted, if the fault reappears the cause of the fault must be determined. The fault could be caused by the DNC Card or the Proportional Directional Control Valve. If spare components are available change out the DNC Card first. Attempt Normal Mode operation, if the fault remains change out the Proportional Directional Control Valve. Attempt Normal Mode operation, if the fault remains it would be best to call the factory for trouble shooting assistance. Be prepared to explain in depth the Upset Tester sequence of operation before the fault.

## Spare Parts List

**Group A Critical Components Required For Upset Tester Normal or Backup Operation**

| Qty | Part # | Description |
|---|---|---|
| 1 | A-5151 | Pump |
| 1 | A-3416 | Directional Control Valve |
| 1 | A-4341 | Proportional Control Valve |
| 1 | A-5024 | DNC Card |
| 1 | A-3124 | Shear Press Relief Valve |
| 1 | A-5028 | Upset Press Unloading Valve |
| 1 | A-5152 | Upset Press Direct Acting Relief Valve |
| 1 | A-4342 | Power Supply 24VDC / 5VDC |
| 1 | A-4503 | Power Supply 24 VDC |
| 1 | A-3455 | Safety Interlock Switch |

**Group B Components Required For Upset Tester Normal Operation**

| Qty | Part # | Description |
|---|---|---|
| 1 | A-4345 | 5800 PSI Pressure Transducer |
| 1 | A-5136 | 750 PSI Pressure Transducer |
| 1 | A-4442 | Hydraulic Filter Element |
| 1 | A-4448 | Reservoir Heater |
| 1 | A-4346 | Thermocouple |
| 1 | A-4460 | Operator Interface |
| 1 | A-4858 | High Speed Capture Meter |
| 1 | A-5154 | HSCE Module High Speed Counter |
| 1 | A-5155 | FI04V Module I/O Analog |
| 1 | A-5156 | P4 Module Power Supply |
| 1 | A-5157 | SLC 5/03 Processor |
| 1 | A-5158 | NT4 Module Thermocouple |
| 1 | A-4344 | Linear Displacement Transducer |
| 1 | A-5153 | Heat Exchanger (2) Air Filter Elements |

**Group C Repair Parts for the Cylinders Normally Stock at Vale Industries**

| Qty | Part # | Description |
|---|---|---|
| 1 | A-1793 | Piston Seal |
| 2 | A-1794 | Wear Ring |
| 2 | A-1795 | Cap Seal |
| 1 | A-1801 | Rod Seal |
| 1 | A-3957 | Ram Bushing |
| 2 | A-1836 | Upset Plattens |