ENERPAC
Hydraulic Technology Worldwide

Instruction Sheet

8-Point Synchronous Lift Controller

L2583 Rev. E 04/08

Index:

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Repair Parts Sheets for this product are available from the Enerpac web site at www.enerpac.com, or from your nearest Authorized Enerpac Service Center or Enerpac Sales office.

1.0 IMPORTANT RECEIVING INSTRUCTIONS

Visually inspect all components for shipping damage. Shipping damage is **not** covered by warranty. If shipping damage is found, notify carrier at once. The carrier is responsible for all repair and replacement costs resulting from damage in shipment.

SAFETY FIRST

2.0 SAFETY ISSUES

Read all instructions, warnings and cautions carefully. Follow all safety precautions to avoid personal injury or property damage during system operation. Enerpac cannot be responsible for damage or injury resulting from unsafe product use, lack of maintenance or incorrect product and/or system operation. Contact Enerpac when in doubt as to the safety precautions and operations. If you have never been trained on high-pressure hydraulic safety, consult your distribution or service center for a free Enerpac Hydraulic safety course.

Failure to comply with the following cautions and warnings could cause equipment damage and personal injury.

A **CAUTION** is used to indicate correct operating or maintenance procedures and practices to prevent damage to, or destruction of equipment or other property.

A **WARNING** indicates a potential danger that requires correct procedures or practices to avoid personal injury.

A **DANGER** is only used when your action or lack of action may cause serious injury or even death.

WARNING: Wear proper personal protective gear when operating hydraulic equipment.

WARNING: Stay clear of loads supported by hydraulics. A cylinder, when used as a load lifting device, should never be used as a load holding device. After the load has been raised or lowered, it must always be blocked mechanically.

WARNING: USE ONLY RIGID PIECES TO HOLD LOADS. Carefully select steel or wood blocks that are capable of supporting the load. Never use a hydraulic cylinder as a shim or spacer in any lifting or pressing application.

DANGER: To avoid personal injury keep hands and feet away from cylinder and workpiece during operation.

WARNING: Do not exceed equipment ratings. Never attempt to lift a load weighing more than the capacity of the cylinder. Overloading causes equipment failure and possible personal injury. The cylinders are designed for a max. pressure of 700 bar [10,000 psi]. Do not connect a jack or cylinder to a pump with a higher pressure rating.

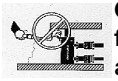
Never set the relief valve to a higher pressure than the maximum rated pressure of the pump. Higher settings may result in equipment damage and/or personal injury.

WARNING: The system operating pressure must not exceed the pressure rating of the lowest rated component in the system. Install pressure gauges in the system to monitor operating pressure. It is your window to what is happening in the system.

CAUTION: Avoid damaging hydraulic hose. Avoid sharp bends and kinks when routing hydraulic hoses. Using a bent or kinked hose will cause severe back-pressure. Sharp bends and kinks will internally damage the hose leading to premature hose failure.

Do not drop heavy objects on hose. A sharp impact may cause internal damage to hose wire strands. Applying pressure to a damaged hose may cause it to rupture.

IMPORTANT: Do not lift hydraulic equipment by the hoses or swivel couplers. Use the carrying handle or other means of safe transport.



CAUTION: Keep hydraulic equipment away from flames and heat. Excessive heat will soften packings and seals, resulting in fluid leaks. Heat also weakens hose materials and packings. For optimum performance do not expose equipment to temperatures of 65°C [150°F] or higher. Protect hoses and cylinders from weld spatter.

DANGER: Do not handle pressurized hoses. Escaping oil under pressure can penetrate the skin, causing serious injury. If oil is injected under the skin, see a doctor immediately.

WARNING: Only use hydraulic cylinders in a coupled system. Never use a cylinder with unconnected couplers. If the cylinder becomes extremely overloaded, components can fail catastrophically causing severe personal injury.

WARNING: BE SURE SETUP IS STABLE BEFORE LIFTING LOAD. Cylinders should be placed on a flat surface that can support the load. Where applicable, use a cylinder base for added stability. Do not weld or otherwise modify the cylinder to attach a base or other support.

Avoid situations where loads are not directly centered on the cylinder plunger. Off-center loads produce considerable strain on cylinders and plungers. In addition, the load may slip or fall, causing potentially dangerous results.

Distribute the load evenly across the entire saddle surface. Always use a saddle to protect the plunger.

IMPORTANT: Hydraulic equipment must only be serviced by a qualified hydraulic technician. For repair service, contact the Authorized ENERPAC Service Center in your area. To protect your warranty, use only ENERPAC oil.

WARNING: Immediately replace worn or damaged parts by genuine ENERPAC parts. Standard grade parts will break causing personal injury and property damage. ENERPAC parts are designed to fit properly and withstand high loads.

3.0 GENERAL DESCRIPTION/GLOSSARY OF TERMS

The Enerpac Synchronous Lift System is a package that provides precise positional control of the lifting and lowering of high tonnage objects. The microprocessor-based controller receives electronic signals from load position sensors attached to the load in the vicinity of each cylinder. The controller processes this information and sends signals to the valves controlling each cylinder, opening and/or closing the valves as required to raise or lower a load evenly and within the accuracy parameters defined by the operator.

The Enerpac Synchronous Lift System consists of the basic components shown below. Refer to Figure 3 for the layout of a typical four point lift system.

IMPORTANT: The ENERPAC PLC BASED SYNCHRONOUS LIFT SYSTEM is a precision position control system, which can be used in a wide variety of applications. Make certain that user supplied components are compatible. All operators should read and thoroughly understand this operating manual before using the equipment.

3.1 Standard Components
(refer to Fig. 1)

A CONTROLLER, SLCG-8
The CONTROLLER is where the operator selects the lift parameters and controls up to eight lift points. The CONTROLLER distributes signals to the appropriate CYLINDER CONTROL VALVES, causing them to open or close, as necessary, to control the lifting or lowering functions.

B CYLINDER CONTROL VALVES, SLCV-24 (24 volt coils)
The CYLINDER CONTROL VALVES receive on/off commands from the controller. These valves open and close, controlling flow into the cylinders as they advance, or controlling flow out of the cylinders as they retract, keeping the load moving in a controlled synchronous motion while maintaining the accuracy desired by the operator.

C PUMP DIRECTIONAL CONTROL VALVE CABLE, SLPVC-1
Connects PUMP DIRECTIONAL CONTROL VALVE to the SLGG-8 controller.

D STROKE SENSOR, SLSS-500, 1000, 2000
Contains the electronics to detect load movement.

E SENSOR CABLE (SLSC-15)
The SLSC15 (15 meters) SENSOR CABLE transmits sensor feedback to the CONTROLLER. Optional cable extensions (SLEC 15 & SLEC 50-meter lengths) are available to permit sensor placement farther than 50 feet.

F CHECK VALVE PACKAGE (SCK-1) (not shown)
The PILOT-OPERATED CHECK VALVE provides additional safety margin for load holding in the event of a leaking or ruptured hose. Useable on both double- and single-acting cylinders. VELOCITY FUSE locks and holds the cylinder position in the event of a catastrophic hose failure. Useable on single- and double-acting cylinders. The VELOCITY FUSE can be used in lieu of the CHECK VALVE PACKAGE in some cases. Consult Enerpac on specific recommendations.

G HYDRAULIC PUMP
The HYDRAULIC PUMP provides flow to the HYDRAULIC CYLINDERS allowing them to advance or retract. The CONTROLLER operates the pump-mounted DIRECTIONAL CONTROL VALVE.

H HYDRAULIC CYLINDER (single- or double-acting)
The HYDRAULIC CYLINDER lifts or lowers the load.

I CYLINDER CONTROL VALVE CABLE, SLCVC
Connects CYLINDER CONTROL VALVE to SLCG 8 Controller.

J PRESSURE GAUGES (Optional, not shown)
PRESSURE GAUGES allow the operator to monitor system pressures.

K DIRECTIONAL CONTROL VALVE
The pump-mounted or remote-mounted DIRECTIONAL CONTROL VALVE controls the advance and retract flows of hydraulic fluid and is managed by the CONTROLLER.

CYLINDER CONTROL VALVE

Model No.	Power	Pressure Rating
SLCV-24	24 Volts (35 watts)	10,000 psi (700 bar)

ELECTRICAL COMPONENT SPECIFICATIONS

SLCG-8	SENSOR: SLSS-500, 1000, or 2000
Operating Temperature Range: 32 °F to 115 °F (0 °C to 46 °C)	Measuring Range:
Storage Temperature Range: 32 °F to 140 °F (0 °C to 60 °C)	SLSS-500 – 0-19.7 in (500 mm) of cord extension
Enclosure Rating – Closed NEMA 4 (IP60)	SLSS-1000 – 0-39.4 in (1000 mm) of cord extension
Enclosure Rating – Open NEMA 1 (IP20)	SLSS-1000 – 0-78.7 in (2000 mm) of cord extension
Power: 115/230 VAC, 50/60 Hz, 15-amp maximum	Operating Temperature Range: -4 °F to 176 °F (-20 °C to 80 °C)
Physical Dimensions: 24 in x 20 in x 8 in (61 cm x 50.8 cm x 20.3 cm)	Storage Temperature Range: -40 °F to 176 °F (-40 °C to 80 °C)
CAUTION: The CONTROLLER is designed to be water-resistant when closed but not waterproof. Avoid working in direct sunlight, while not causing damage, the display can be difficult to properly view. When storing unit, always make sure that the cover is closed and stored out of the weather. The CONTOLLER is a sensitive piece of electronic equipment and should not be subjected to shock, rain, snow, sand or very dusty conditions.	Stainless steel eyelet and magnets for securing to load
	CAUTION: The SENSOR is also designed to be water resistant, but not waterproof. Do not immerse in liquid. The SENSOR is also a sensitive piece of electronic equipment and should not be subjected to severe shock, rain, snow, sand or very dusty conditions.

L **MANIFOLDS** (Not shown)

The MANIFOLDS channel advance and retract flows to and from the hydraulic cylinders.

Note: These are the major system components required to operate a four-point lifting system. Additional components will be required for additional lift points. Contact Enerpac for assistance in selecting additional components.

M **VELOCITY FUSE (VF-1)** (Not shown)

The VELOCITY FUSE provides an additional safety margin for load holding in the event of a ruptured hose or a power failure. The VELOCITY FUSE is designed to be used with single-acting or double-acting HYDRAULIC CYLINDERS.

N **SUCTION VALVE (VUV-5)** (Not shown)

The SUCTION VALVE is used to help assist the return of hydraulic fluid back from the HYDRAULIC CYLINDER into the reservoir of the HYDRAULIC PUMP.

4.0 SELECTION OF HYDRAULIC COMPONENTS

4.1 Recommended Lifting/Lowering Speed

When selecting hydraulic components (pumps and cylinders), it is important to know that a trade-off exists between cylinder speed and lifting accuracy. The faster the cylinders move the harder it becomes to maintain programmed accuracy. Ideally, pump and cylinders should be selected such that the maximum lifting speed does not exceed 3-in./min. (7.5 cm./min.) with all cylinders activated. Obviously, slower speeds yield HIGHER degrees of accuracy.

4.2 Calculating Lifting Speed

A rule of thumb is to use the total effective area of all the cylinders in your lift system. Divide the flow rate of your pump under load by the total effective area of your lift cylinders. This equals the theoretical lift speed (distance/time).

Flow Rate ÷ Total Effective Area = Lift Speed

Example 1: *4 cylinders, RR-506, and a 1 1/2 HP Z-Class Pump. The area per cylinder is 11 in^2 X 4 cylinders = 44 in^2. The pump flow rate is 60 in^3/minute. 60 in^3/min ÷ 44 in^2 = 1.4 in/min.*

Example 2: *4 cylinders, RR-506, and a 1.1kw Z-Class Pump. The area per cylinder is 71.2 cm^2 X 4 cylinders = 284.8 cm^2. The pump flow rate is 0.82 liters/minute (@50 hertz) and 1.02 liters/minute (@60 hertz). 820 cm^3 and 1020 cm^3/minute respectively. 820 cm^3/min ÷ 284.8 cm^2 = 2.88 cm/min (@50 hertz) and 1020 cm^3/min ÷ 284.8 cm^2 = 3.58 cm/min lift rate (@60 hertz).*

CAUTION: Due to heavy flow restriction requirements, oil temperatures could potentially rise above acceptable levels. Coolers and/or larger pump reservoirs should be considered for lifts of long duration. Oil temperatures should not exceed 150 °F (65 °C.). By the same token, if the ambient temperature is below 32 °F (0 °C) the pump should be run and warmed to the touch before any lifting takes place. For very cold conditions, consult Enerpac on reservoir heaters and the use of synthetic oil.

The **ENERPAC SYNCHRONOUS LIFT SYSTEM** was designed to be modular in order to minimize expense to the customer who may already have some of the hydraulics required for lifting. When selecting components, it is important to keep in mind that the system is designed for 10,000 psi (700 bar) maximum operating pressure. Cylinders should be selected to lift the load at a maximum working pressure of 9000 psi (628 bar) allowing for reserve pressure to handle potential load shifts from one cylinder to another.

WARNING: All double-acting cylinders must be equipped with a load holding SCK-1 CHECK VALVE PACKAGE. All single-acting cylinders must be equipped with either the SCK-1 CHECK VALVE PACKAGE (see Fig. 4) or the VF-1 VELOCITY FUSE (see Fig. 5). The VELOCITY FUSE gives the advantage of single hose operation, whereas the SCK-1 requires two hoses even on a single-acting system. SLCV-24 CYLINDER CONTROL VALVE is <u>required</u> for safety and

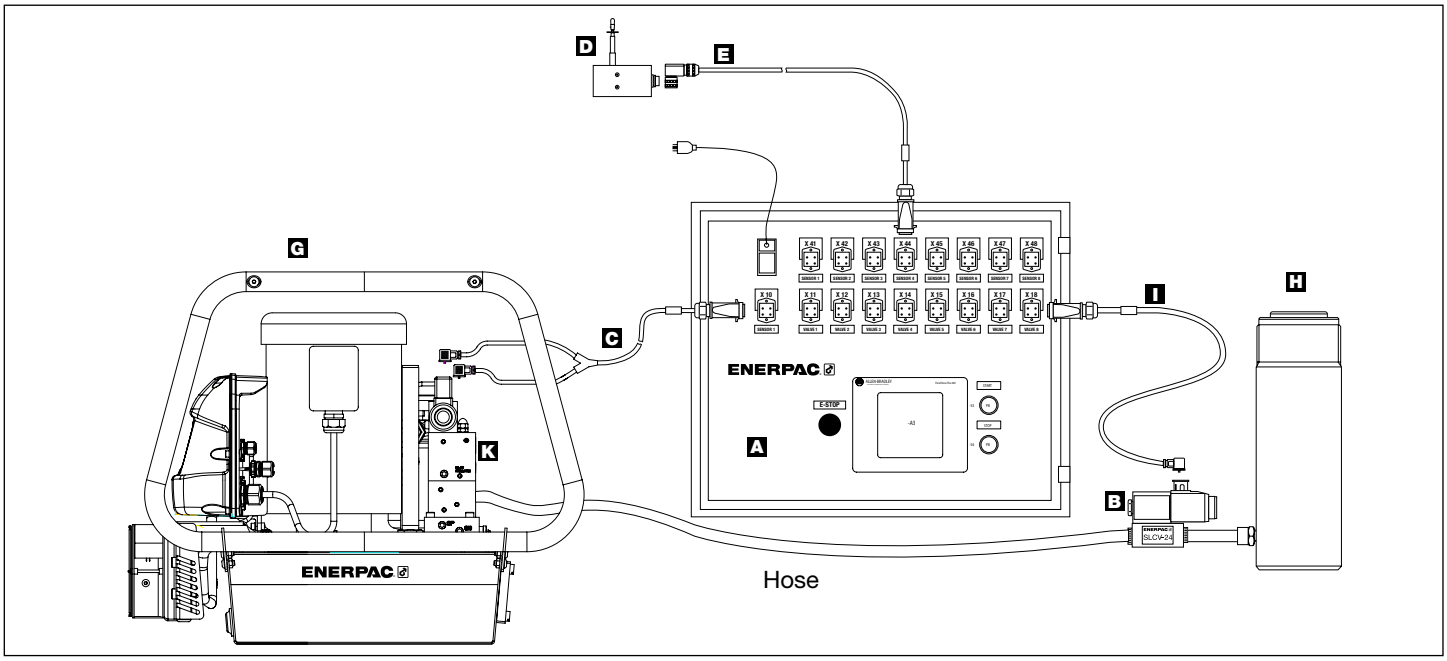


Figure 1, General Layout

lift/lower control for each cylinder. The SCK-1 check valve is designed to block the flow of hydraulic fluid out of the cylinder, holding the load in the event of a hose failure or loss of electrical power. Failure to install a CHECK VALVE or VELOCITY FUSE could result in personal injury and/or property damage.

IMPORTANT: One of the key components of the lifting system is the CYLINDER CONTROL VALVE assembly. One valve assembly is required to control each lift point. Any Enerpac pump equipped with a VE-43 solenoid activated DIRECTIONAL CONTROL VALVE can be used with this system and double-acting cylinders. A VE-33 valve can be used to control single-acting cylinders.The DIRECTIONAL CONTROL VALVE selects the cylinder extend/retract function and is under system control. The pump on/off is controlled manually.

5.0 CONTROL PANEL FUNCTIONS

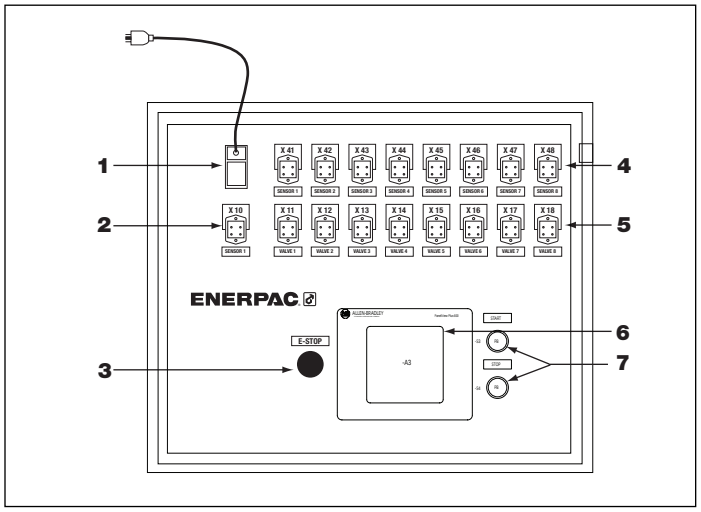


Figure 2, Control Panel (CONTROLLER)

1 Power Connection
2 Pump Control Valve Connection
3 Emergency Stop Button
4 Displacement Connection
5 Control Valve Connection
6 Operator Touch Screen
7 Start/Stop Push Buttons

5.1 Lifting Nomenclature

ABSOLUTE POSITION - When the stroke sensor is attached to the load and the sensor cable is pulled out of the sensor body to attach to the load you have the **absolute position** of that stroke sensor. See Relative Position.

ACCURACY - Allows the system operator to define the maximum allowable positional difference between the leading and lagging lift points (AUTO mode only). The actual difference in position between the leading and lagging cylinders is called the range. Once accuracy is entered, the system will not allow a lift point to vary from the mean any more than the programmed accuracy. **Example:** An accuracy input of 0.08" will result in a system accuracy of 0.04", approximately the mean. The input value of **accuracy** is the maximum allowable variation from the highest to lowest lift point. (AUTOMATIC Mode only).

Note: the controller will permit a best possible programmed accuracy as follows:
0.040" (1mm) for the 500 mm stroke sensor
0.080" (2mm) for the 1000 mm stroke sensor
0.16" (4mm) for the 2000 mm stroke sensor

C1-C8 – Shows which cylinders are active at any given time. Permits operating any and all of the cylinders in your lift system.

AUTO DOWN – Causes the cylinders to lower the load in a synchronized mode.

AUTO UP – Causes the cylinders to raise in a synchronized mode.

CANCEL - stops the current function from occurring.

ENTER (Return Key)- Completes data entry sequence and exits data entry mode

EXTEND/RETRACT - Selects extend or retract mode of cylinder.

MANUAL/AUTOMATIC - AUTOMATIC provides synchronous motion of all active cylinders. MANUAL provides non-synchronous control of active cylinders. When in MANUAL mode, the cylinders can be jogged up or down by selecting the appropriate cylinders and the EXTEND/RETRACT function and depressing the controller "START" button.

CAUTION: When operating in the MANUAL mode, the operator has only on/off control of active cylinders. The MANUAL mode does not provide synchronization of the cylinders. Note: only cylinders equipped with a stroke sensor connected can be operated in the either the manual or automatic mode.

EMERGENCY STOP (E-Stop Mushroom Button) - Cuts power to valves to stop all motion. The load will hold temporarily.

ON/OFF - Enables or disables all electrical power to controller.

RELATIVE CYLINDER POSITION - Once the stroke sensors have been attached to the load, the controller is "Reset" so that all the lift positions read as "0". This permits equal lifting even though stroke sensors cables may be extended varying amounts.

RESET - Zeros the value of the current load position of the sensors on the display.

SET-UP - Allows the operator to select Imperial or Metric mode of operation, change the type of sensors being used (500,1000 or 2000 mm stroke) and the type of lift (manual or automatic)

START - Starts the lifting or lowering cycle.

STOP - Stops the lifting or lowering cycle.

STROKE LIMIT - User defined limit which specifies the distance the load will be raised or lowered (AUTOMATIC Mode only). Stroke limit is an absolute numerical value relative to the starting position of the load.

TOLERANCE - See Accuracy

6.0 SYSTEM REQUIREMENTS

Prior to system set-up all cylinders must be equipped with an SCK-1 CHECK VALVE PACKAGE or VF-1 VELOCITY FUSE. All necessary hardware is included. A 12" long hose with two female 1/4" tube swivel ends is included to connect the “Retract Side Port” on a double-acting cylinder to the “Pilot Port” on the V-44 pilot operated check valve. For longer stroke cylinders, longer length hoses are available: HLS-524: 24" (610mm) length, HLS-536: 36" length (914mm). Other lengths also available. Contact Enerpac customer service to determine the proper hose.

Double-acting cylinder and pump systems should be equipped with a 4-way directional control valve (VE-43) must have one remotely installed. The advance port pressure should be set to a maximum of 8800-9200 psi (606-634 bar) to allow a margin of safety to handle shifting loads.

Single-acting cylinders and pump systems should be equipped with a 3-way directional control valve (VE-43) and (for load return cylinders) a VUV-5 vac-u-valve

Advance pressure should be set at a maximum of 8800-9200 psi (606-634 bar). This should be done to allow for shifting loads. Pressure in excess of 10,000 psi (700 bar) can cause system failure and/or damage to components.

8.0 HYDRAULIC COMPONENT ASSEMBLY

CAUTION: It is very important to ensure the hydraulic system remain free of contaminants. Make sure that all hydraulic couplers and fittings are free of dirt before assembly. A quality thread sealant such as Teflon paste or an anaerobic hydraulic sealer should be used to seal the threads on all hydraulic fittings. Contaminants in the hydraulic system will cause poor system performance and/or system failure. Dirt is the #1 cause of problems with this system.

1. Install ADJUSTABLE RELIEF VALVES and GAUGES in the advance and retract circuits of the hydraulic system. This can be done at the pump-mounted or remote DIRECTIONAL CONTROL VALVE.
2. Install FLOW CONTROL VALVE only on the advance side of the PUMP DIRECTIONAL CONTROL VALVE. This valve can be used to affect the rate of flow in the EXTEND AND RETRACT directions. When opened, the FLOW CONTROL VALVE allows more flow to pass through the CYLINDER CONTROL VALVE to the cylinder. This valve may be opened if the operator desires faster cylinder advance speeds and/or when response becomes a problem. For best accuracy in the lifting mode, start the flow control valve open about 1/4 turn.

IMPORTANT: Try to prefill all the hydraulic hoses by first connecting them, one at a time, to the pump electric valve and using the included pendant for the pump. Connect one end of hose to the "A" port and the other end to the "B" port. Press either the advance or retract button for a least a minute for hoses less than 30 feet (9.1meters) long and at least 2 minutes for hoses longer than 30 feet. Doing this small step will save time and improve the safety of your actual lift. Failure to prefill the hoses may result in dangerous cylinder movment, even if the individual cylinder valves are not activated.

For Double-acting Cylinders

1. Install the pilot operated SCK-1 CHECK VALVE PACKAGE on each lifting cylinder. The port marked CYL on the check valve body connects to the advance port of the cylinder using the fitting provided. The quick coupler in the cylinder advance port is removed and used in the “PUMP” port of the check valve body. **NOTE:** This coupler must be an Enerpac CR-400.
2. Install the “TEE” provided between the cylinder retract port and the coupler.
3. Install the PILOT LINE between the “TEE” of the retract port and the port marked “RET/PILOT” on the check valve body. The pilot line must be the hydraulic hose included with the SCK-1 kit or flared 1/4" tubing with a minimum wall thickness of 0.049". (Refer to Fig. 4 for typical set-up, and the instruction sheet that came with the V-44 pilot check valve in the SCK-1 kit.)

For Single-acting Cylinders

1. Remove the CR-400 coupler from the cylinder and install the VELOCITY FUSE (VF-1 Kit) as shown in Figure 5.
2. Install the CR-400 coupler into the VELOCITY FUSE with quality thread sealer, NOT TEFLON TAPE.

WARNING: Incorrect matching of hydraulic and electronic components can cause unexpected lifting behavior. Always test the control function of each cylinder prior to positioning under the load.

3. Connect the hose from the CYLINDER CONTROL VALVE (SLCV-24) to the CYLINDER CHECK VALVE. CYLINDER CONTROL VALVES must have proper V-66 flow control valve installed on the advance port of the power pump. (Refer to Fig. 3, Basic 4-point Setup.)

IMPORTANT: Quick couplers should be used on the hose assemblies, manifolds and valves, to facilitate system assembly and disassembly of system components. All fittings must be free of dirt or other contaminants when assembled. Contaminants in the hydraulic system may result in poor system performance and/or system failure.

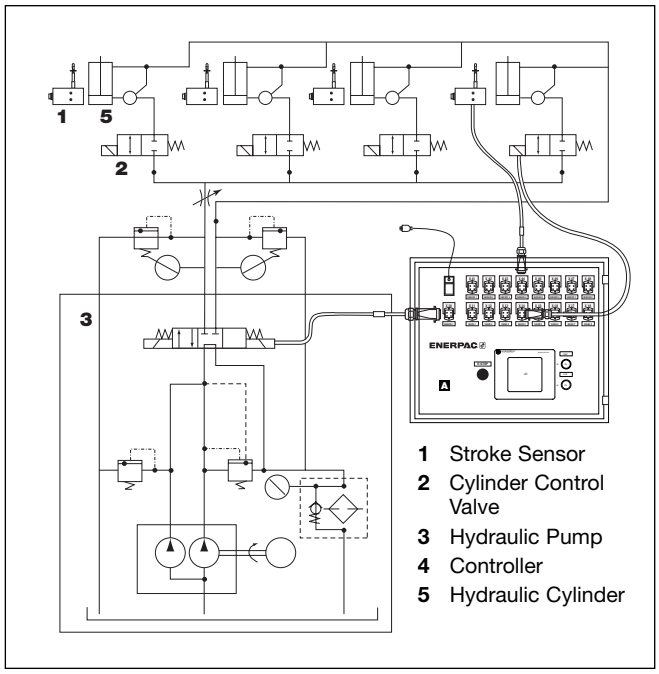


Figure 3, Basic 4-Point System Hydraulic Diagram, Shown Connected to Only One Cylinder for Illustrative Purposes

ADVANCE LINES

All cylinder advance lines are connected from a common MANIFOLD to a port on the CYLINDER CONTROL VALVE (SLCV-24) at each cylinder. The advance MANIFOLD is, in turn, connected to the V-66 flow control and then to the port of the DIRECTIONAL CONTROL VALVE (Refer to Figure 3, Basic 4-point Setup.)

RETRACT LINES

All cylinder retract lines are connected from a common MANIFOLD to the retract port of the hydraulic cylinders. The retract MANIFOLD is, in turn, connected to the retract port on the pump mounted electric valve. (Fig. 3, Basic 4 Point Setup.)

IMPORTANT: The CYLINDER CONTROL VALVE (SLCV-24) has a manual override capability. The valve is NORMALLY CLOSED and can be manually opened by depressing the pin located in the center of the valve coil. The valve will remain open when the pin is depressed and will return to the closed position when the pin is released. (Refer to Figure 4.)

9.0 ELECTRICAL COMPONENT ASSEMBLY

It is helpful to mark all cable connections and hose ends with some sort of identifying feature for simple assembly and trouble-shooting. Colored electrical tape is a good choice.

1. Swing open the cover from the SLCG-8 CONTROLLER and make sure the power switch is in the **OFF** position.
2. Depress the EMERGENCY STOP button and rotate clockwise to ensure that it is deactivated.
3. Connect the power cord to the CONTROLLER. The power cord plugs into the three-pin plug on the face of the CONTROLLER (Figure 2).

   Note: The SLCG-8 CONTROLLER requires 115/230VAC single-phase power to operate.
4. Connect the dual DIN plug electrical cable (SLPVC-1) from the DIRECTIONAL CONTROL VALVE to the output plug on face panel of the CONTROLLER (Refer to Figure 3, Basic 4-Point Setup drawing.)
5. Connect the CYLINDER CONTROL VALVES to the controller outputs marked VALVES. You only need to connect as many valves as you plan to use. If you use four valves, connect them to valve connection points 1-4 and so on.
6. Place an SLSS SENSOR at each lift point. Connect an SLSC-15 SENSOR CABLE between the SENSOR and the CONTROLLER. The SENSOR placed at lift point No. 1 must be connected to sensor input plug No. 1 on the front panel of the CONTROLLER; repeat this procedure for all remaining lift points.

   NOTE: SLEC-15 and SLVEC-15 EXTENSION CABLES can be used to reach jack placement greater than 50 feet. Contact Enerpac for more details.

WARNING: The matching of sensor and valve wiring is essential to synchronous lifting. Failure to do so may result in unexpected lift behavior. Always test the control function of each cylinder individually prior to positioning under the load.

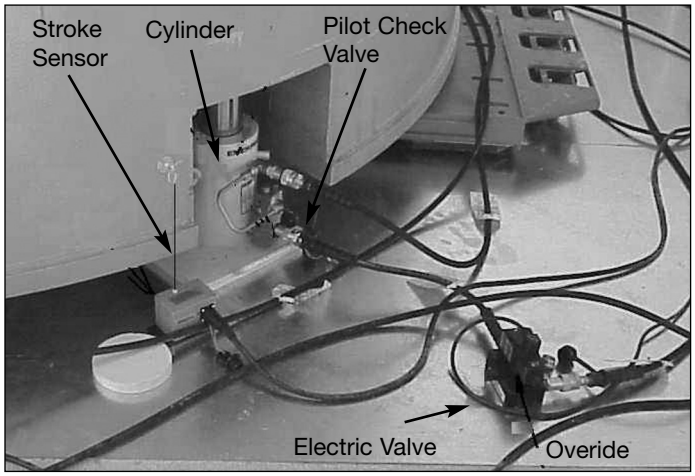


Figure 4, Lift Point Configuration Showing Electric Valve, Stroke Sensor, Cylinder and Pilot Operated Check Valve

Figure 5, Typical Velocity Fuse Installation

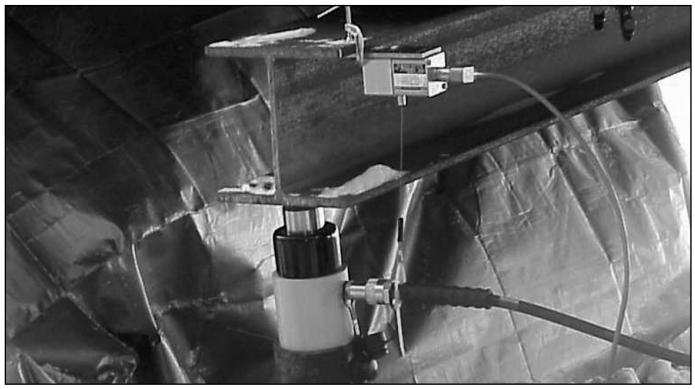


Figure 6, Alternative method of stroke sensor mounting to prevent excessive amounts of water from running down the sensor cable in raining or snowing conditions.

SYSTEM POWER UP AND CONTROL VERIFICATION

This set-up procedure should be completed in its entirety with the PUMP TURNED OFF.

POWER CABLE

1. Plug power cable from the CONTROLLER into 115/230VAC.
2. Depress the EMERGENCY STOP button and rotate clockwise to ensure that it is deactivated.
3. Turn CONTROLLER power switch on. The following screen should appear showing Preferences and System Setup.

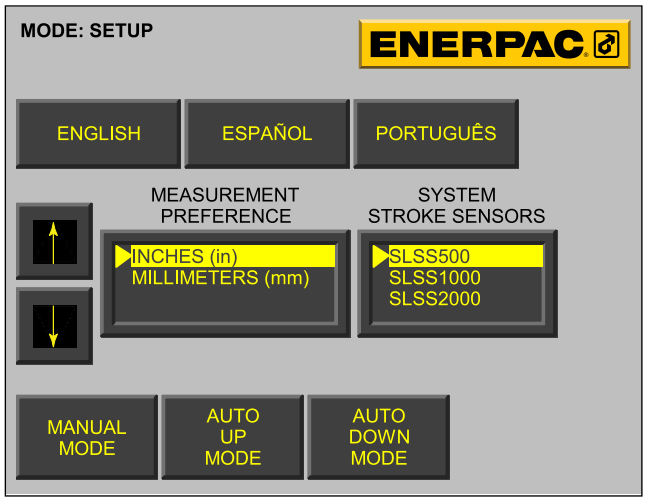


Figure 7

4. Select language by touching the appropriate bar.

5. Touch "**MEASUREMENT PREFERENCE**" bar using the up and down keys in this screen, select either inch or millimeter to complete your selection.
6. Stroke Sensors – The software is compatible with Enerpac's 500, 1000 and 2000 mm stroke sensors. Touch "System Stroke Sensors" bar. Highlight the correct stroke sensor length.

WARNING: SELECTING INCORRECT SENSOR STROKE INFORMATION COULD LEAD TO A DANGEROUS LIFTING SITUATION. NO DAMAGE WILL BE DONE TO THE SYNCHRONOUS LIFT COMPONENTS BUT THE ACCURACY AND DISTANCE LIFTED WILL BE DIFFERENT THAN THE DISPLAY SCREEN VALUE!

7. After the stroke sensor has been selected, the Lift mode can be selected. However, some basic system checkout should be done before any actual lifting or lowering takes place.

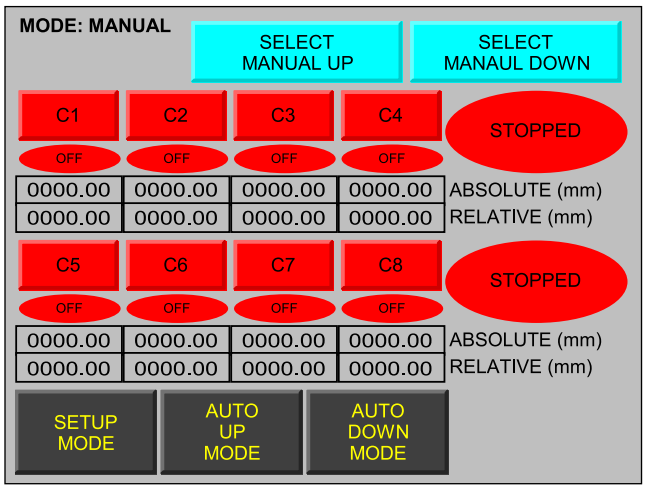


Figure 8

8. Check the system for functionality. Go to the manual mode screen by touching "**MANUAL MODE**". Press either *Manual Up* or *Manual Down* with the lift system assembled but the pump turned off. (See Fig. 8)

IMPORTANT: During this system check, your pump must be turned off. Potentially dangerous cylinder movements could take place during this test.

9. Choose the Active Cylinders by selecting C1-C8, the cylinders turned on will display in **yellow** and cylinders turned off will display in **red**.

SENSOR CHECK - The following check procedure should be followed for all sensors to be used. A simple slow pull on the spring loaded stroke sensor is all that is required to check sensor functionality. Movement by the sensor cable will show as stroke movement in the absolute and relative fields.

DO NOT LET THE SENSOR WIRE SNAP BACK INTO THE HOUSING

Note: Sensors must be connected to the CONTROLLER in order to check functionality.

VALVE CHECK - The following check procedure can be used to check the function of the electric valves in the system.

Note: This should be done with your pump turned OFF for safety reasons.

When you turn on the valves (Step 9 above) an LED on the DIN plug should light up, you may also hear them click when shifted, indicating a proper connection. You can also physically put your hand on them and feel them shift. Also, the solenoid core energized (operating) will magnetically attract any small metal object such as a screwdriver.

CYLINDER CONTROL CHECK - Before the cylinders are placed under the load, each cylinder should be activated individually and control verified. Proceed through the following steps to verify control of each lifting cylinder.

1. Start the hydraulic pump.
2. From the Set-up screen, select the **MANUAL** mode. (Fig. 7)
3. Select **MANUAL UP** (Fig. 8)
4. Activate the cylinder for lift point #1 only.
5. When the cylinder is moving, the display will show a numeric value for that lift point. You saw the same thing when you manually checked the sensor by pulling on the sensor cable. Remember, this is the manual mode and no synchronization will occur between the cylinders. If possible, run each cylinder up and down a few times to help work the air out of the cylinders. This air should be minimal if you pre-filled the hoses before system setup. **If you did not prefill the hoses go back and do it now.**
6. Press the **START** button. If no movement is observed at the selected cylinder, check to see if movement has occurred at another lifting cylinder. Movement of a cylinder other than the one selected indicates incorrect electrical or hydraulic plumbing. Check all electrical and hydraulic circuits and make sure cables and hoses are plumbed correctly.

   If the cylinder operation is opposite from the direction selected, check for reversed hose plumbing from the manifold to the cylinder and from the pump to the manifolds and correct.
7. When proper cylinder control has been achieved, deactivate the lift point. **Continue the test for all lift points.**
8. If you encounter jerky cylinder movement at any of the lift points you still have some air in the system. Using the MANUAL-operating mode, bleed each cylinder by extending and retracting the cylinder full stroke several times. If possible, cylinders should be laying down with the couplers pointing upward. The preferred method of bleeding is with the hydraulic pump on a level higher than the cylinders, allowing the air to rise to the pump reservoir. Avoid building pressure in the cylinder during this procedure to prevent aeration of the oil.
9. After the system has been completely purged of air, set the system relief valves.

   Manually advance any cylinder to full stroke while adjusting the desired pressure. Do not exceed the recommended limits. (8800-9200 psi / 606-634 Bar.)

CAUTION: The system components are designed for 10,000 psi (700 Bar). Exceeding this pressure could cause system failure and damage to system components.

Route cables and hoses in a safe manner. Do not step on cables. Keep cables dry and protected from abrasion.

10. Position all cylinders under the load. Cylinders must be placed on firm foundations and plunger saddles should make full contact with the load. Using the manual mode, jog the cylinders until they make firm contact with the load.

CYLINDER/SENSOR INTERFACE CHECK -

1. Sensors for each lift point should be placed as close as possible to the cylinder for that lift point. This will ensure the most precise measurement of load displacement.

2. Manually extend the sensor cord again to verify that the sensor readout change corresponds to the lift point being tested. The cylinder and sensor operation should correspond.

CAUTION: Inaccurate load displacement data may result if SENSORS and CYLINDERS are not placed on solid foundations and in close proximity. The display may indicate that the sensors are seeing load movement, when in fact, the load may not have moved because the cylinder base has settled or compressed and the sensor position has changed as a result.

FLOW CONTROL VALVE - Located on the advance side of the PUMP DIRECTIONAL CONTROL VALVE. This valve can be used to affect the rate of flow in the EXTEND AND RETRACT directions. When opened, the FLOW CONTROL VALVE allows more flow to pass through the CYLINDER CONTROL VALVE to the cylinder. This valve may be opened if the operator desires faster cylinder advance speeds and/or when response becomes a problem. For best accuracy in the lifting mode, start the flow control valve open about 1/4 turn.

LIFTING SEQUENCE

1. Using the MANUAL mode, individually extend each cylinder until the load is contacted. This can be determined by monitoring SENSOR readout. Raise the load a very small amount with the manual mode. When readout begins changing the load is contacted. Be sure to extend the cylinders one at a time. Visually inspect each lift point to ensure that each cylinder has made load contact.
2. After extending/inspecting each lift point select the **AUTO UP** mode. Select the cylinders you want active. The STROKE LIMIT and ACCURACY values shown on the display should read zero unless the operator has entered these values earlier. (Fig. 9.)

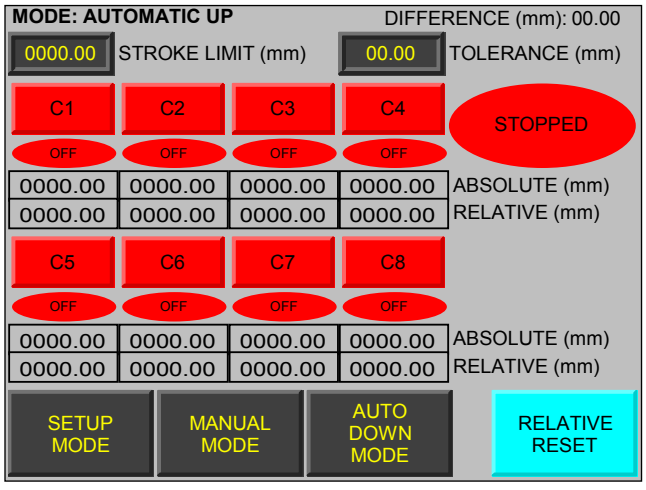


Figure 9

3. **Set STROKE LIMIT**. For the first run, set the stroke limit to a small value, just enough to move the load. To do so, touch the **STROKE LIMIT** box and enter the STROKE LIMIT. Do the same for the desired TOLERANCE.

   NOTE: The controller will hold as tight a tolerance as possible. The value you enter will be the tolerance value that will stop the lift and alert you to a possible problem.

Press RESET to zero the relative values of all lift point positions.

Resetting all the stroke values to zero establishes the plane of reference for the lift. You can view the "Absolute" values on the sensors above the releative values.

Check to make sure the mode reads AUTOMATIC UP. If so, press **START**. When the cylinders stop, check the display to verify the position of the lifting points. All lift points should have advanced. If there is problem, the controller will stop the load and indicate the problem.

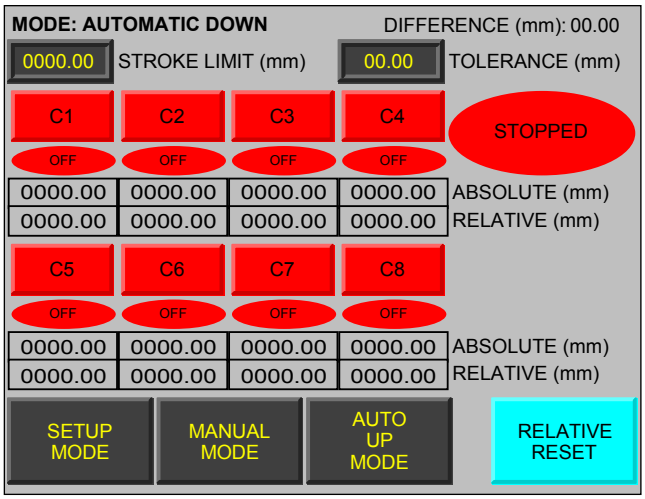


Figure 10, Automatic Down

IMPORTANT: Before proceeding further with the lift, lower the load to its original position by switching to AUTO DOWN mode (Fig. 10). This should be done to verify that the flow control setting at the pump is correct. A realistic lower speed is 1 to 3 inches per minute. (25-75 mm per minute).

Faster speeds may not hold a high enough accuracy and slower speeds may be too slow to be productive.

Choose **ACTIVE CYLINDERS**. Be sure to select the same cylinders that you used to raise the load.

WARNING: This system is not intended as a load holding device. When holding a lifted load, once the desired stroke is completed, the system does not cycle the valves on/off to make up for any leak-down which might occur. Extended periods of load holding REQUIRE blocking (cribbing) the load. Failure to do so could result in personal injury and/or property damage. This problem can be corrected by using Enerpac locknut cylinders that can mechanically lock the load in place. Contact Enerpac for details.

WARNING: The stroke values you enter are "Absolute" from the 0 (zero) position you started from. This means if you set the stroke for 4 inches (100mm) and stop the lift at 2 inches (50 mm) then restart the load, the load will stop at the 4 inch (100 mm) point. However, to go back to the 0 (zero) point you must enter a stroke value of 0 (zero) and set the controller to AUTO DOWN. If you were to set the controller to 3 inches (75mm) in the AUTO DOWN mode the load would retract down only 1 inch (25 mm) back to the 3 inch (75 mm) "Absolute" position.

10.0 ERROR CODES

"ACCURACY ERROR"

CAUSES AND CURES:

Cylinder Speed Too Fast. If needed, go back and very slightly close the flow control valve at the pump.

Mismatch Of SENSORS and Hydraulic Plumbing - Verify that the hook-up of the SENSORS, valve wiring, and hydraulic plumbing is correct (i.e. Valve wiring, sensor inputs and hydraulic circuits are matched correctly.)

Advance And Retract Hoses Reversed - Check all cylinders making sure the advance ports are connected to the advance manifold and the retract ports of the cylinder to the retract manifold.

Figure 11

RESETTING SYSTEM:

Refer to the "typical display" above. (Fig. 11)

Anytime an error occurs, the computer shuts down the system and displays the above screen with a varying message depending on the actual error that occurs. The above example is an error for the accuracy for all the lift points. This indicates that one or more than one lift point has varied by a value greater than your specified maximum. This is the most common error, especially when lifting the fist time. You may need to increase the tolerance or manually adjust the lagging cylinders at least once.

THE FOLLOWING IS A LISTING OF PROGRAM ERROR MESSAGES:

System has reached Stroke Limit

System Is Over Tolerance

Minimum Tolerance for Stroke Sensors/*X*/is Exceeded

Limit of Stroke Sensor #1 Reached

Limit of Stroke Sensor #2 Reached

Limit of Stroke Sensor #3 Reached

Limit of Stroke Sensor #4 Reached

Limit of Stroke Sensor #5 Reached

Limit of Stroke Sensor #6 Reached

Limit of Stroke Sensor #7 Reached

Limit of Stroke Sensor #8 Reached

Error Reading Active Stroke Sensor #1

Error Reading Active Stroke Sensor #2

Error Reading Active Stroke Sensor #3

Error Reading Active Stroke Sensor #4

Error Reading Active Stroke Sensor #5

Error Reading Active Stroke Sensor #6

Error Reading Active Stroke Sensor #7

Error Reading Active Stroke Sensor #8

Error: System Inactive

Error: Loss of Power at Pump Valve

Error: Loss of Power to Valves 1-4

Error: Loss of Power to Valves 5-8

Error: Loss of Power to Stroke Sensors

Emergency Stop Button is Pushed In

NOTE: Minimum tolerance will vary from sensor to sensor. See page 5 for these limits.

NOTE: Cylinder valves cannot be operated from the controller without a stroke sensor present for that cylinder. Only Enerpac can override this because of safety reasons.

NOTE: System Inactive usually points to a load that is too heavy and cannot be lifted by some or all the cylinders.

10.1 METHODS FOR CORRECTING CYLINDER TO CYLINDER ACCURACY ERRORS

METHOD #1

The error may be corrected by bringing the high or low cylinder back into the ACCURACY range.

a) Determine the cause of the fault and correct.

b) Adjust the cylinders back into position manually. Turnoff all other cylinders, change from AUTO to MANUAL operation, and select proper cylinder direction (UP or DOWN).

d) Momentarily depress the start and stop buttons to jog the cylinder into position.

e) Return to the AUTO mode and reactivate all cylinders.

f) Confirm that the tolerance value is less than the programmed tolerance. If not repeat cylinder adjustments above.

g) You may now proceed with Synchronized lifting or lowering.

METHOD #2

a) Determine the cause of the fault and correct.

b) If you feel the tolerance is too small and a larger tolerance is acceptable, it can be changed to a value larger than the value of the tolerance indicated.

c) Once the cylinders start to move the controller will try to bring all the cylinders into as close a tolerance as possible.

d) Stop the lift (or lower) and reset the tolerance to a smaller value and start the lift again.

CAUSES AND CURES FOR CYLINDER ACCURACY ERRORS:

1) Hydraulic coupling that is not fully tightened will cause blocked or restricted flow– check couplings and tighten.

2) Cylinder or sensor cord has reached its stroke limit - You may need to crib the load and take an additional step in lifting the load.

3) Flow control on advance line is permitting too much flow - adjust FLOW CONTROL VALVE to slow down flow rate.

4) Load is obstructed from movement - remove obstruction.

5) Load too heavy to allow movement at system pressure - increase system pressure, but do not exceed rated capacity of system components. If system pressure is increased to maximum and no movement occurs, larger capacity cylinders may be required.

6) In retract mode, if pressure is too low, P.O. Check may not release.

7) Sensor cable not connected to load. Connect sensor cable.

10.2 STROKE VALVE IS DECREASING ON THE CONTROLLER DISPLAY

CAUSES AND CURES:

1. Valve and/or P.O. check not sealing - repair/replace valve

   Note: This condition may result when the load being lifted is very rigid. In this case it may be desirable to attach the sensor cables to the cylinder plungers. Consult Enerpac for more information.
2. Adjacent lift points are supporting load. Cylinder is not in contact with the load - manually adjust cylinder back to load contact.
3. Cylinder base sinking into support bed or plunger penetrating lifting pad - provide firm base and lifting pad bearing surface
4. Hydraulic fluid leaking past cylinder seal – repair/replace cylinder.
5. Oil leak in hydraulic system (fittings, hoses, etc.) - repair/replace-leaking component(s).

10.3 SENSOR ERROR

A SENSOR MISSING. There is a problem with either the SENSOR or the sensor cable. The CONTROLLER has detected an incomplete wiring circuit in the sensor cable or the SENSOR itself. The controller will not permit you to raise a lift point, even in MANUAL mode, without the controller detecting the needed STROKE SENSOR for that lift point.

CAUSES AND CURES:

1. Sensor cord has become disconnected from the load, (See sensor cord rapid retract caution, page 13) - fully extend then slowly retract cord to unscramble. Reattach sensor cord to load.
2. Sensor cord has been tampered with - check for source of interference and rectify.

Lowering the Load

Lowering the load is similar to raising the load, but in reverse.

1) To lower the load, you will need to select a stroke position based on the absolute cylinder position. This means if your load is raising to a height of 6 inches (152 mm) and you want to lower the load 4 inches (100 mm) you would select a stroke of 2 inches (50 mm). This indicates the load must be lowered to 2 from the home or zero position.
2) The settings for accuracy, etc. all remain the same as for raising the load except for the reversal of direction.
3) Again, the active cylinders (the ones turned on) are shown in green and the inactive cylinders will be shown in red.
4) Once the load is back down, and you need to remove the cylinders from under the load, you can switch back to the manual mode.
5) The manual mode will disregard the input from the stroke sensors and continue to retract the cylinders until you tell it to stop.

All the same error messages apply for lifting or lowering the load.

Enerpac Worldwide Locations

✦ **e-mail**: info@enerpac.com

✦ **internet**: www.enerpac.com

Africa
ENERPAC Middle East FZE
Office 423, JAFZA 15
P.O. Box 18004
Jebel Ali, Dubai
United Arab Emirates
Tel: +971 (0)4 8872686
Fax: +971 (0)4 8872687

Australia, New Zealand
Actuant Australia Ltd.
Block V Unit 3
Regents Park Estate
391 Park Road
Regents Park NSW 2143
(P.O. Box 261) Australia
Tel: +61 297 438 988
Fax: +61 297 438 648

Brazil
Power Packer do Brasil Ltda.
Rua dos Inocentes, 587
04764-050 - Sao Paulo (SP)
Tel: +55 11 5687 2211
Fax: +55 11 5686 5583
Toll Free in Brazil:
Tel: 0800 891 5770
vendasbrasil@enerpac.com

Canada
Actuant Canada Corporation
6615 Ordan Drive, Unit 14-15
Mississauga, Ontario L5T 1X2
Tel: +1 905 564 5749
Fax: +1 905 564 0305
Toll Free:
Tel: +1 800 268 4987
Fax: +1 800 461 2456
Technical Inquiries:
techservices@enerpac.com

China
Actuant China Ltd.
1F, 269 Fute N. Road
Waigaoqiao Free Trade Zone
Pudong New District
Shanghai, 200 131 China
Tel: +86 21 5866 9099
Fax: +86 21 5866 7156

Actuant China Ltd. (Beijing)
709B Diyang Building
Xin No. 2
Dong San Huan North Rd.
Beijing City
100028 China
Tel: +86 10 845 36166
Fax: +86 10 845 36220

Central and Eastern Europe, Greece
ENERPAC GmbH
P.O. Box 300113
D-40401 Düsseldorf
Willstätterstrasse13
D-40549 Düsseldorf
Germany
Tel: +49 211 471 490
Fax: +49 211 471 49 28

France, Switzerland francophone
ACTUANT - ENERPAC
France S.A., ZA de Courtaboeuf
32, avenue de la Baltique
91140 Villebon / Yvettte
France
Tel: +33 1 60 13 68 68
Fax: +33 1 69 20 37 50

Germany, Austria and Switzerland
ENERPAC GmbH
P.O. Box 300113
D-40401 Düsseldorf
Willstätterstrasse13
D-40549 Düsseldorf
Germany
Tel: +49 211 471 490
Fax: +49 211 471 49 28

India
ENERPAC Hydraulics
(India) Pvt. Ltd.
Office No. 9,10 & 11,
Plot No. 56, Monarch Plaza,
Sector 11, C.B.D. Belapur
Navi Mumbai 400614, India
Tel: +91 22 2756 6090
Tel: +91 22 2756 6091
Fax: +91 22 2756 6095

Italy
ENERPAC S.p.A.
Via Canova 4
20094 Corsico (Milano)
Tel: +39 02 4861 111
Fax: +39 02 4860 1288

Japan
Applied Power Japan Ltd.
Besshochou 85-7
Saitama-shi, Kita-ku,
Saitama 331-0821
Japan
Tel: +81 48 662 4911
Fax: +81 48 662 4955

Middle East, Turkey and Caspian Sea
ENERPAC Middle East FZE
Office 423, JAFZA 15
P.O. Box 18004
Jebel Ali, Dubai
United Arab Emirates
Tel: +971 (0)4 8872686
Fax: +971 (0)4 8872687

Russia and CIS (excl. Caspian Sea Countries)
Actuant LLC
Admiral Makarov Street 8
125212 Moscow, Russia
Tel: +7-495-9809091
Fax: +7-495-9809092

Singapore
Actuant Asia Pte. Ltd.
37C, Benoi Road Pioneer Lot,
Singapore 627796
Tel: +65 68 63 0611
Fax: +65 64 84 5669
Toll Free: +1800 363 7722
Technical Inquiries:
techsupport@enerpac.com.sg

South Korea
Actuant Korea Ltd.
3Ba 717,
Shihwa Industrial Complex
Jungwang-Dong, Shihung-Shi, Kyunggi-Do
Republic of Korea 429-450
Tel: +82 31 434 4506
Fax: +82 31 434 4507

Spain and Portugal
ENERPAC
Avda. Los Frailes, 40 – Nave C & D
Pol. Ind. Los Frailesanzo De Arriba
(Madrid) Spain
Tel: +34 91 661 11 25
Fax: +34 91 661 47 89

The Netherlands, Belgium, Luxembourg, Sweden, Denmark, Norway, Finland and Baltic States
ENERPAC B.V.
Galvanistraat 115, 6716 AE Ede
P.O. Box 8097, 6710 AB Ede
The Netherlands
Tel: +31 318 535 911
Fax: +31 318 525 613
+31 318 535 848
Technical Inquiries Europe:
techsupport.europe@enerpac.com

United Kingdom, Ireland
Enerpac Ltd
Bentley Road South
Darlaston, West Midlands
WS10 8LQ, United Kingdom
Tel: +44 (0)121 50 50 787
Fax: +44 (0)121 50 50 799

USA, Latin America and Caribbean
ENERPAC
P.O. Box 3241
6100 N. Baker Road
Milwaukee, WI 53209 USA
Tel: +1 262 781 6600
Fax: +1 262 783 9562

User inquiries:
+1 800 433 2766
Inquiries/orders:
+1 800 558 0530
Technical Inquiries:
techservices@enerpac.com

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02_08_08