ENERPAC
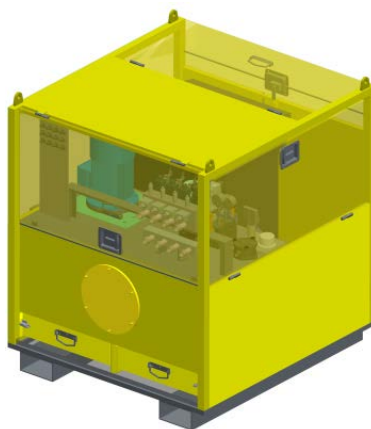
POWERFUL SOLUTIONS

Global force

USER MANUAL
EVO SYSTEM

ENERPAC EVO SYSTEM
User Instruction Manual

Model	EVO421460 EVO421460W	EVO440460 EVO440460W	EVO821460 EVO821460W	EVO840460 EVO840460W	EVO1221460 EVO1221460W	EVO1240460 EVO1240460W
Nr points	4	4	8	8	12	12
Flow high pressure	2,1l/min	4 l/min	2,1l/min	4 l/min	2,1l/min	4 l/min
Flow low pressure	11,1l/min	13 l/min	11,1l/min	13 l/min	11,1l/min	13 l/min
Motor power	3 kw	7,5 Kw	3 kw	7,5 Kw	3 kw	7,5 Kw
Speed motor	inverter	inverter	inverter	inverter	inverter	inverter
Frequency	15-50Hz	15-50Hz	15-50Hz	15-50Hz	15-50Hz	15-50Hz
Motor voltage	460VAC	460VAC	460VAC	460VAC	460VAC	460VAC
Control voltage	24VDC	24VDC	24VDC	24VDC	24VDC	24VDC
Max pressure	700bar	700bar	700bar	700bar	700bar	700bar
Reservoir	250ltr	250ltr	250ltr	250ltr	250ltr	250ltr
Weight	900 kg	1005 kg	910 kg	910 kg	920 kg	1025 kg
Oil	ISO32	ISO32	ISO32	ISO32	ISO32	ISO32

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GENERAL DESCRIPTION

1.1 ENERPAC EXPERIENCE

With more than 50 years of experience, Enerpac has gained unique expertise which is acknowledged by industrial and construction professionals around the world. In addition to standard products and components, Enerpac specializes in the design, manufacture and supply (sale & rental) of high-force hydraulic systems required for the precise controlled movement of heavy structures.

Engineers and construction experts consult with Enerpac to develop integrated hydraulic solutions, which have included:

- The incremental launching equipment for the tallest bridge in the world Le Viaduct de Millau in France.
- Construction solutions for the China Olympics: Beijing's National Stadium (the world's largest steel structure), and the retractable roof system for the Nantong Olympic Stadium.
- Automatic foundation levelling systems for offshore wind turbines.
- Strand jacking equipment for construction, oil & gas and industrial heavy lifting applications.

Across every continent Enerpac has presence through local offices, including application engineers, authorized distributors and service centres to deliver innovative solutions and technical assistance.

The deciding factor to choose for Enerpac resides on a history of supply of quality products & systems, as well as a strong relationship with customers, Enerpac local representation and an excellent back-up in technical support.

REASONS TO WORK WITH ENERPAC

1. Expert Design
2. Reliability
3. Service Excellence
4. Worldwide Experience
5. Application Support
6. Availability
7. Quality
8. Value
9. Innovative Products
10. Global Vision
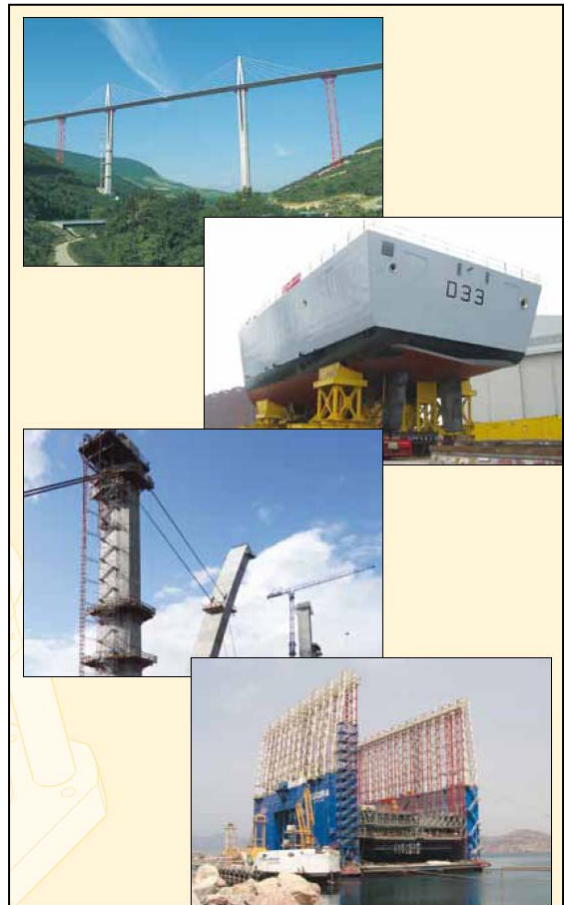
1.2 ENERPAC EVO-SYSTEM

1.2.1 THE MULTI-FUNCTIONAL SYNCHRONOUS LIFTING SYSTEM

Enerpac has set the control standard with the new generation of their multifunctional synchronous lifting system: the EVO-System – the evolutionary result of more than 25 years experience in specialised hydraulic engineering and lifting technology using digitally controlled hydraulics.

This experience is available to all our customers who need assistance with critical lifting applications. By combining the incredible strength of high-pressure hydraulics with the high-speed of today's PLC-controlled systems, Enerpac has the expertise to accurately and safely lift the largest and unique structures on Earth.

The new Enerpac EVO-System is a versatile synchronous lifting system with specialized multi-functional lifting control software. One PLC-controlled hydraulic power unit can be used for 9 hydraulic movement functions. The integrated 9 inch touch screen (HMI) offers a user friendly interface with logical visual system management and navigation. The hydraulic movements and cylinder positions can be monitored and controlled during the lifting procedure with visual real-time on screen representation. The EVO-System includes active and passive system securities with five warning and thirteen stop alarms.

EVO 8 - Synchronous Lifting System

1.2.2 FUNCIONALITY

Enerpac synchronous lifting technology monitors & manages lifting, lowering, weighing, alignment and load transfer procedures of non-uniform distributed heavy loads. By monitoring the position and load of each lifting position, comparing it with a global datum and adjusting to the desired target position - movements are safely and efficiently managed, within permissible load and synchronous stroke tolerance parameters, preset to suit the project.

Control box with 9" touch screen on the HPU

A single operator controls all movements from a central control position, which comprehensively displays the live operation and records stroke and load data for each lifting position at user defined intervals, for client scrutiny or procedure certification. The EVO hydraulic power unit (HPU) is designed as a single unit for 4, 8 or 12 lifting points and can be extended into a network with up to four units. When using 2 or more HPUs the networked system is controlled by a separate and portable master control box.

The standard EVO-System allows customers to use their existing standard Enerpac cylinders. For more complex and demanding applications the special EVO-System (EVO-W) offers additional control features for weighing systems with or without load cells.

1.2.3 EVO-SYSTEM FEATURES AND BENEFITS

Some of the system features are:

- Multi-functional system with 9 standard hydraulic control modes: Manual, pre-load, automatic (by position or load), retract fast, depressurize, tilting, stage lifting (step-by-step), weighing and centre of gravity (CoG).
- Available to control 4, 8 or 12 points with one HPU.
- Network capability to link up to 4 hydraulic power units (HPU) to a master control.
- Interface with easy navigation and access to set-up, movement and software menus.
- Data storage and recording capabilities at user defined intervals.
- Wireless remote control.
- Variable frequency drive motor (VDFM) and Siemens PLC for very precise synchronization and control of oil flow and cylinder stroke and speed.
- For use with standard single- or double acting 700 bar cylinders.
- 3,0 kW hydraulic power unit with 250 litres reservoir.

Some of the advantages of digitally controlled lifting over manual control are:

Safety – PLC-controlled system eliminates manual intervention with multi-operator manual control approach. The EVO-System includes warnings, alarms and stop functions.

Full monitoring and control – Programmable failsafe monitoring and safety alarms. Reduces risk of structural damage by bending, twisting or tilting due to uneven weight distribution or load-shifts between lifting points. Easy-to-use and very user friendly touch screen interface displays the movement process, cylinder positions and load read-outs by lifting points and total load.

Increased productivity – less staffing required than for manually controlled lifting. One operator controls the entire lifting process while the status of every lifting point is constantly monitored and displayed. Time saving is another advantage of synchronous lifting. The process does not have to be stopped after any incremental value, checked, manually re-measured and corrected. The EVO-System carries out these actions during the entire lifting process, even with low lifting or lowering speeds. Depending on the application, time savings up to 60 percent can be achieved.

Monitoring and data storage– the EVO-System constantly monitors pressure and position of every lifting point for safe and accurate control of hydraulic movements. All values can be stored on a USB-stick for later use and full documentation of the process. With satisfactory progression of the procedure the EVO-System provides both contractor and client with a clear indication that excessively high stresses have not occurred.

Networking - One HPU for single use controls 4, 8 or 12 lifting points. Networked up to 4 HPUs must be controlled by the separate portable master control box.

1.3 ENERPAC WARRANTY

1.3.1 ENERPAC GLOBAL WARRANTY POLICY

ENERPAC products are warranted to be free of defects in materials and workmanship under normal use for as long as they are owned by the original purchaser, subject to the exclusions and limitations described below. This warranty does not cover ordinary wear and tear, overloading, alterations, (including repairs or attempted repairs by parties other than ENERPAC or its Authorized service representatives), improper fluid, use in a manner for which they are not intended or use which is contrary to instructions for the products.

This warranty is limited to new products sold through enerpac authorized distributors, original equipment manufacturers or other designated channels of distribution. No agent, employee, or other representative of enerpac has the authority to in any way change or amend this warranty.

Electronic products and components are warranted against defects in material and workmanship for a period of two years from the date of purchase.

The following items supplied with ENERPAC products are excluded from this warranty:
Components not manufactured by ENERPAC, including air motors, electric motors, gasoline engines, and diesel engines. Such items are warranted to the extent of the warranty provided by the manufacturers of such items.
Consumable items, including cutter blades, nut splitter chisels, punches and dies.
Chains

If the customer believes a product is defective, the product must be delivered, or shipped freight prepaid, to the nearest ENERPAC Authorized Service Center. The customer should contact ENERPAC to locate an Authorized Service Center in the customer's area. Products that do not conform to this warranty will be repaired or replaced at ENERPAC's expense and returned by ground transportation, freight prepaid.

The foregoing warranty is exclusive and is in lieu of all other express and implied warranties, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

The remedy of repair, replacement or refund is customer's exclusive remedy in the event of breach of this warranty.

Seller shall not be subject to and disclaims:

1- Any other obligations or liabilities arising out of breach of contract or of warranty,
2- Any obligations whatsoever arising from tort claims (including negligence and strict liability) or arising under theories of law with respect to products sold or services rendered by seller or any undertakings, acts or omissions relating thereto, and
3- All consequential, incidental and contingent damages whatsoever.

ENERPAC's liability in all cases is limited to, and shall not exceed, the purchase price paid.
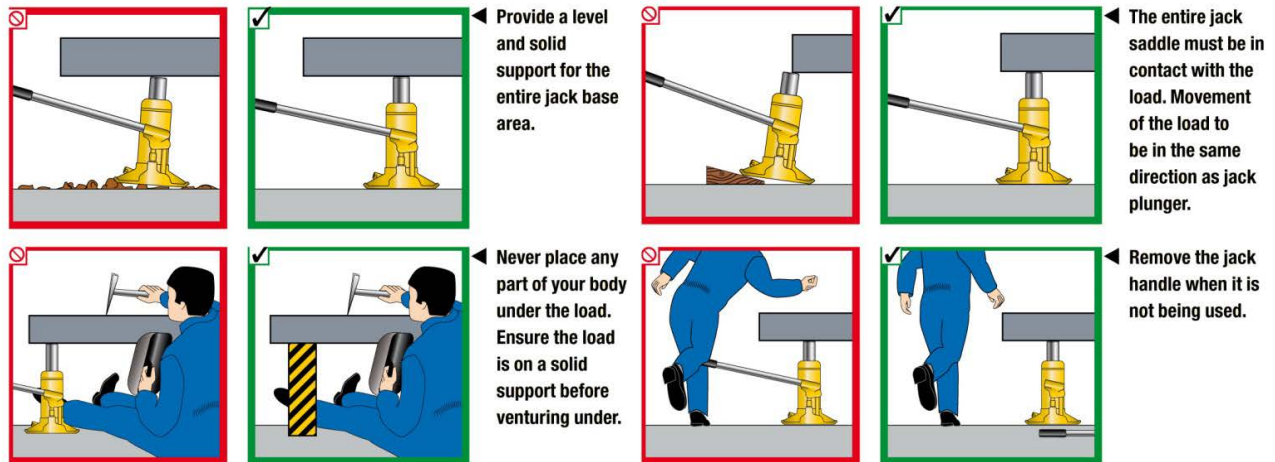
Effective June 1, 1997

1.4 GENERAL SAFETY INSTRUCTIONS

When used correctly, hydraulic power is one of the safest methods of applying force to your work. And to that end we offer some DO's and DON'Ts, simple common sense points which apply to practically all Enerpac hydraulic products.
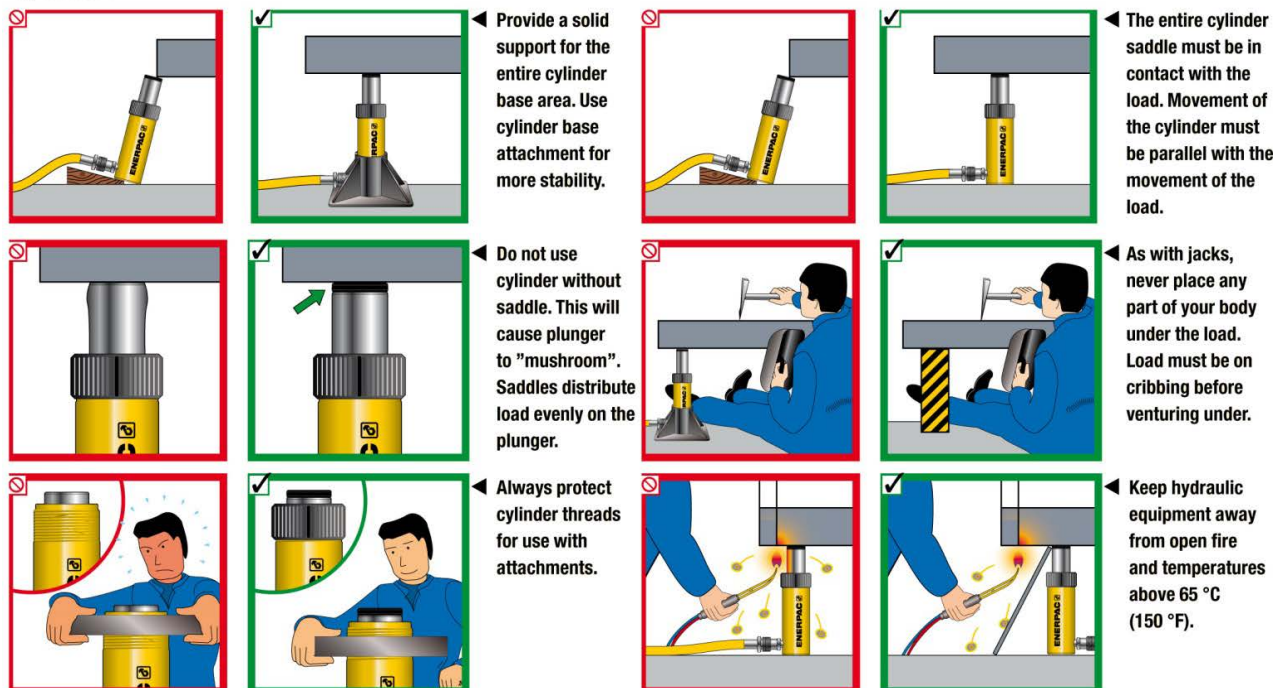• Lift slowly and check often
• Avoid standing in the line of force
• Anticipate possible problems and take steps to avoid them.

See in the documents attached an extension of the safety recommendations.

Jacks

Provide a level and solid support for the entire jack base area.

The entire jack saddle must be in contact with the load. Movement of the load to be in the same direction as jack plunger.

Never place any part of your body under the load. Ensure the load is on a solid support before venturing under.

Remove the jack handle when it is not being used.

Cylinders

Provide a solid support for the entire cylinder base area. Use cylinder base attachment for more stability.

The entire cylinder saddle must be in contact with the load. Movement of the cylinder must be parallel with the movement of the load.

Do not use cylinder without saddle. This will cause plunger to "mushroom". Saddles distribute load evenly on the plunger.

As with jacks, never place any part of your body under the load. Load must be on cribbing before venturing under.

Always protect cylinder threads for use with attachments.

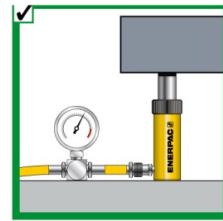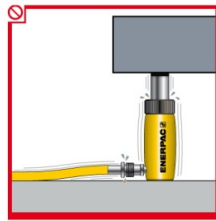Keep hydraulic equipment away from open fire and temperatures above 65 °C (150 °F).

General

80% Manufacturer's rating of load and stroke are maximum safe limits. Good practice encourages using only 80% of these ratings! **80%**
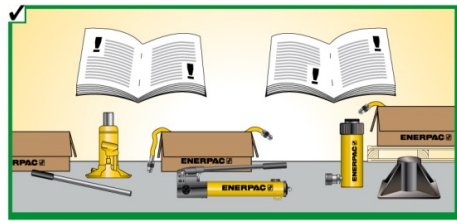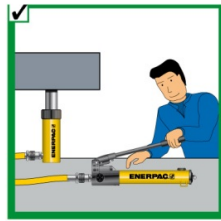
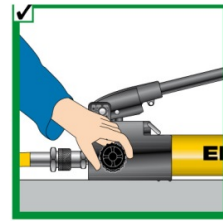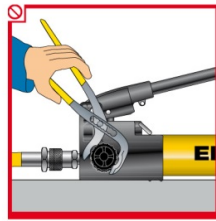Always read instructions and safety warnings that come with your Enerpac hydraulic equipment.

Don't override the factory setting of relief valves. Always use a gauge to check system pressure.
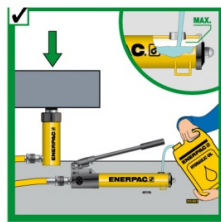
Pumps

Don't use handle extenders. Hand pumps should be easy to operate when used correctly.

Close release valve finger tight. Using force will ruin the valve.

Fill pump only to recommended level. Fill only when connected cylinder is fully retracted.
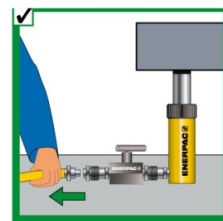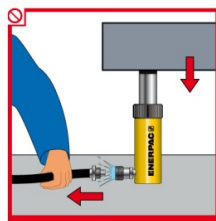
Use only genuine Enerpac hydraulic oil. Wrong fluid can destroy seals and pump and will render your warranty null and void your guarantee.
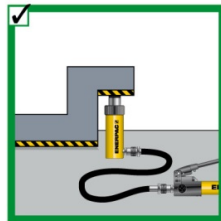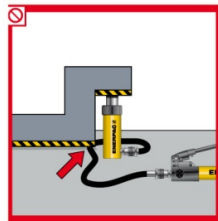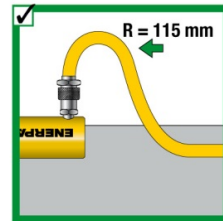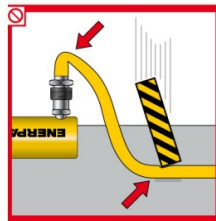
Hoses and couplers
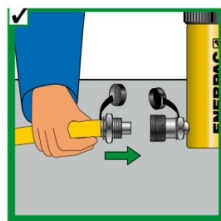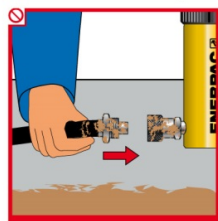
Clean both coupler parts before connecting. Use dust caps when coupler parts are not connected.
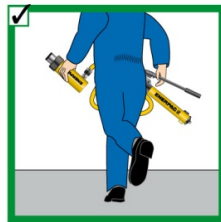
Detach cylinder only when fully retracted or use shut-off valves or safety valves to lock-in cylinder pressure.
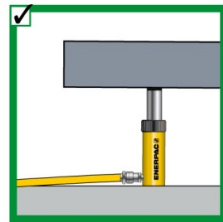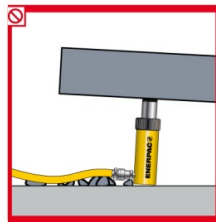
Keep hoses away from the area beneath loads.

R = 115 mm

Don't kink hoses. Bending radius should be at least 115 millimetres. Don't drive over or drop heavy objects on hoses.

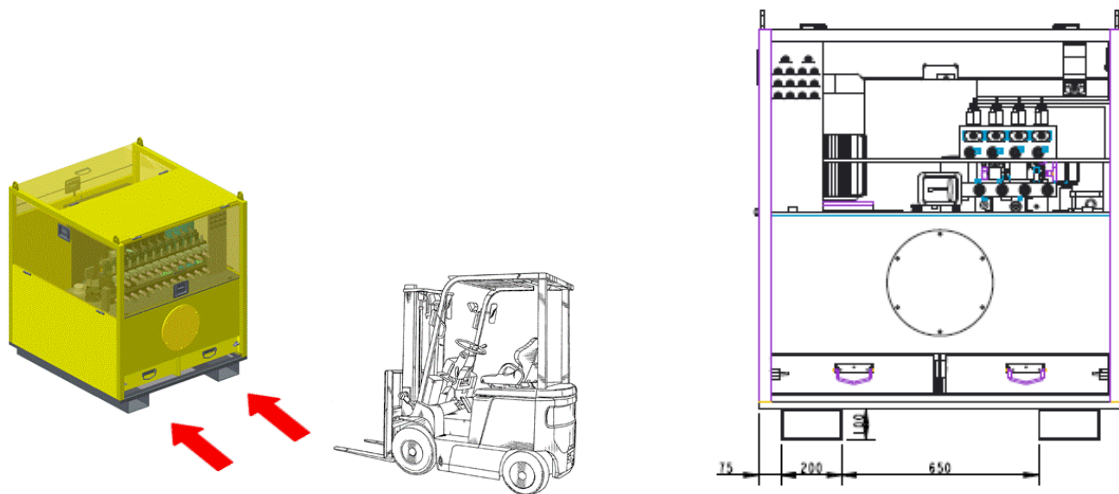Don't lift hydraulic equipment by the hoses.

Never allow the cylinder to be lifted off of the ground through the couplers.

13

1.5 TRANSPORTATION

The machine is designed to be lifted by a fork lift or by a crane. To be lifted with a forklift, use the square tubes under the base of the frame. See in the picture how to do it:

In order to know the weight of the machine, see in the second page the weight depending on the model of EVO

The machine also can be moved by the lifting lugs. It has been welded 4 lifting lugs to the frame in order to lift or lowering the machine using them. These devices have been manufactured under the UE standards and according to Australian standard AS4991 and AS1554.
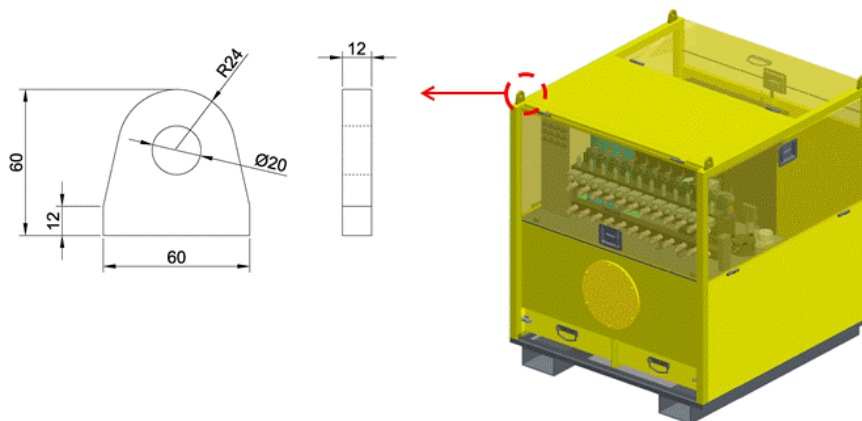
The frame only can be lifted using the 4 lifting lugs at the same time. Otherwise they will not withstand the total weight of the machine and can break causing personal injury and equipment damage.

CHAPTER

2

DESCRIPTION OF HYDRUALIC COMPONENTS

2.1 DESCRIPTION OF HYDRAULIC COMPONENTS

In this paragraph has been described the most important hydraulic components of the machine. Note that all of them have a number between parentheses. This number is the component number given in the drawings and list of materials. To see the hydraulic scheme and bill of materials see the references at the end of this manual.

2.1.1 RESERVOIR (1)
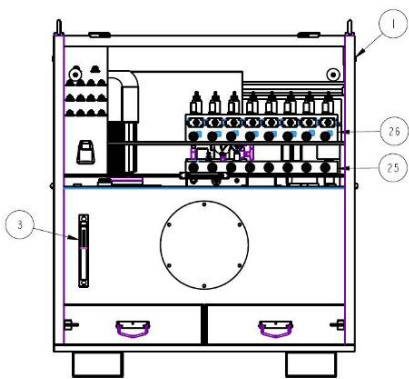
The tank is where the amount of oil required to ensure that the circuit is adequately lubricated is stored. One of its characteristic design features is that the top part also contains the circuit's systems. The ergonomic design of the surface is sloped, which prevents the accumulation of impurities on the top part. The control opening is located in one of the front sections, and is large enough to allow interior cleaning and maintenance tasks. We can also highlight that there is a plug in the base to drain it, which is accessed from below. The reservoir capacity is 250 L. Ensure that cylinders are empty before refill the reservoir.
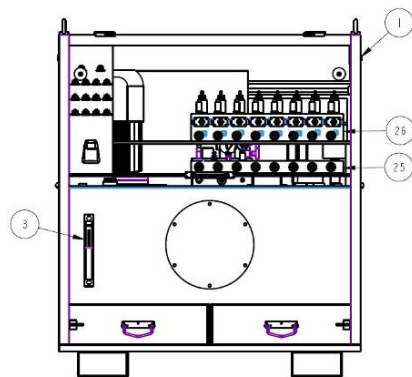
2.1.2 HYDRAULIC OIL (2)

Enerpac Hydraulic oil

| Viscosity Index	100 min
Viscosity at 210°F	42/45 S.U.S.
Viscosity at 100°F	150/165 S.U.S.
Viscosity at 0°F	<12,000 S.U.S.
API Gravity	31.0/33.0
Flash, C.O.C.°F	400
Pour Point, °F	-25
Aniline Point, °F	210/220
Paraffinic Base Color	Blue

2.1.3 VISUAL OIL LEVEL WITH THERMOMETER (3)

This device has two measurement systems. The level can be used to observe the quantity of liquid in the tank at all times. The thermometer indicates the temperature of the oil in the tank.
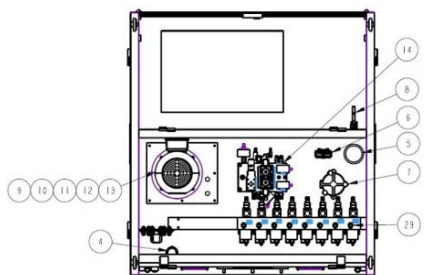
When the reservoir is going to be filled, ensure that cylinders are empty of oil. Otherwise exists danger of overfilled

2.1.4 PLUG (4)
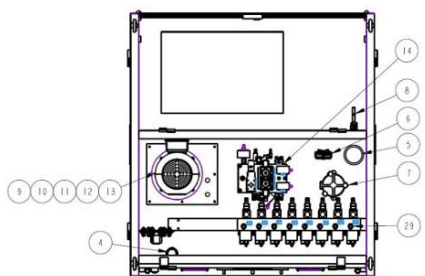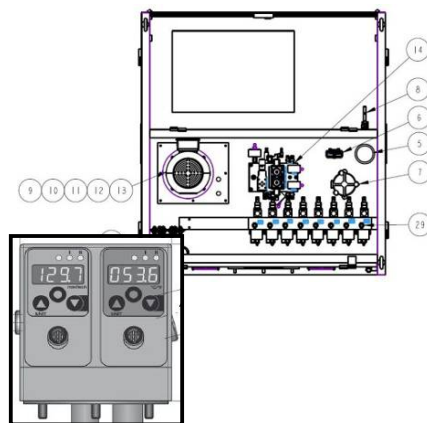
The plug prevents impurities from entering the tank through the filling opening.

2.1.5 AIR FILTER (5)

This instrument allows the tank to be ventilated correctly as it prevents impurities from entering. It permits a flow of 0.15 to 0.75 m3 and a filtering ratio between 10 and 40 µ.

2.1.6 OIL LEVEL AND THERMO SWITCH (6)

A device with a system to control the level of oil and the temperature of the fluid, which provides an updated reading that is sent to the control centre. The device includes a small display, which can be used to adjust the measurement ranges, and view the different measurements by pressing the "set" button.

2.1.7 RETURN FILTER (7)
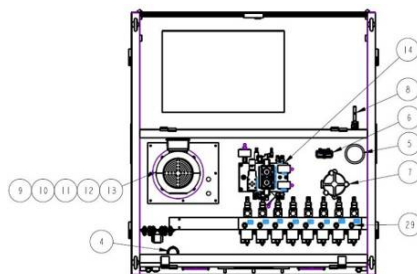

This element includes a filtering screen, protection bypass valve and a pressure indicator to detect when the filter is dirty and must be replaced

2.1.8 BALL VALVE (8)
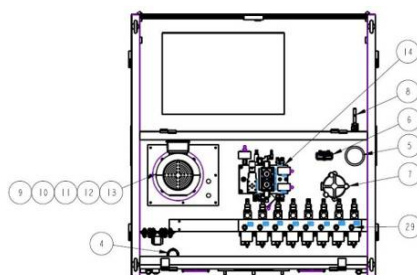
Quick opening and closing valve, which needs only a quarter turn to change its position. It is fully sealed. In this case, when the valve is in the "always closed" position, the tank can be opened to drain the oil.

2.1.9 ELECTRIC MOTOR (9)
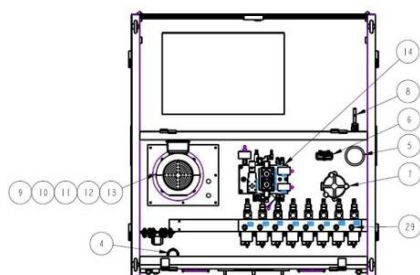
The motor drives the machine. It transforms the electrical current into mechanical movement and then transmits the movement to the pump. The motor's working characteristics are listed on its identification plate. It is important to know the correct direction of the electrical phase to ensure that the motor rotation is performed in the right direction (for one rotation direction pumps, since some pumps work in both directions), and that the pump can work correctly. If it is necessary to know the motor rotation direction, it will be indicated with an arrow.

2.1.10 BELL-HOUSING & COUPLING (10 - 11)
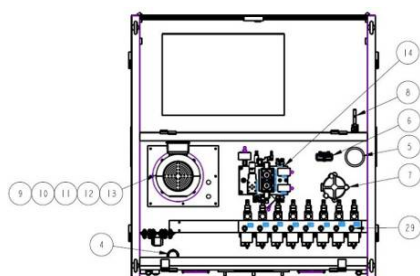
The transmission's protection element protects and guarantees the correct connection between the motor and pump, and the elastic coupling mechanically transmits the rotation and turning torque to the pump. Its elastic properties allow it to absorb radial forces, enabling a silent and safe torque transmission in case the transmission's axes are not aligned correctly

2.1.11 PUMP (12)
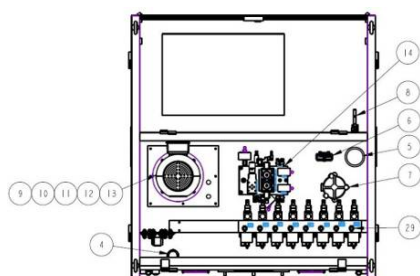
This device receives the mechanical energy from the motor and converts it into pressure energy that can be transmitted from one place to another in the hydraulic system through oil, i.e., the oil's molecules are subjected to this pressure. The hydraulic pumps are the elements which drive the oil or hydraulic liquid, converting the mechanical rotary energy into hydraulic energy.

2.1.12 SUCTION FILTER (13)
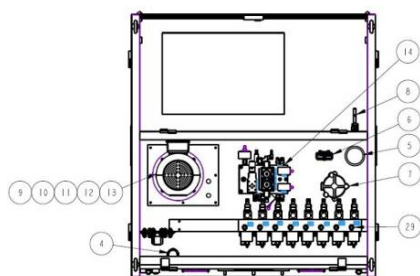
Suction filter elements are designed to be fitted into the suction lines of pumps. It is important to ensure that the suction filter elements are always fitted well below the minimum oil level. The standard filtration rating is 125 micron

2.1.13 MANIFOLD (14)
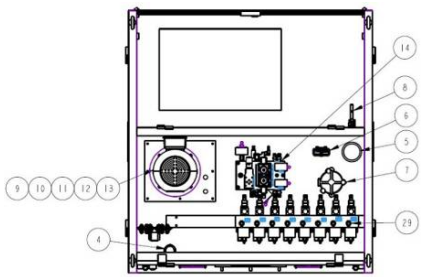
Support block that contains valves and pipes. In this case, this manifold contains the general valves to manage .

2.1.14 PRESSURE SWITCH (15)
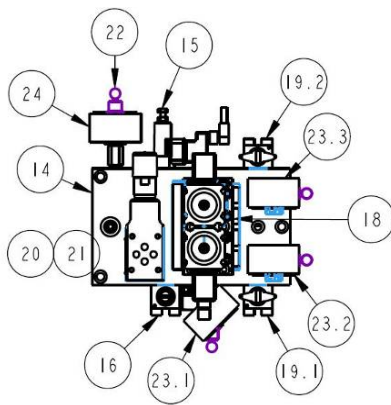
Electro-hydraulic pressure switches are devices which close or open electrical contacts when pressurized. This is used to say to the control that the pressure line is got to 125 bar. Then valve 21 will change the position allowing the flow from the gear pump goes to tank. In this step, the flow will change from the low pressure line to the high pressure line and can get up to 700 bar of pressure.

## 2.1.15 RELIEF VALVE (16)
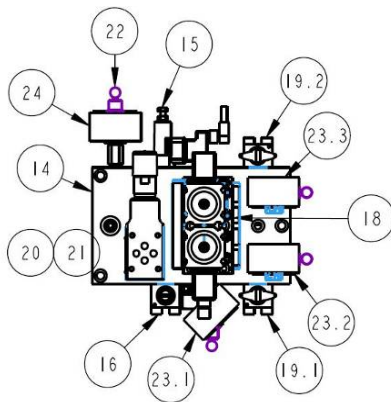
The safety valve is used to protect the circuit against overpressures. When the valve reaches to the set safety pressure level, it distributes the flow of the circuit towards the tank to balance the working pressure. The valve can be adjusted by turning the screw installed for this purpose.

This valve is set at 700 bar, protecting the line P1 of the circuit of overpressures.
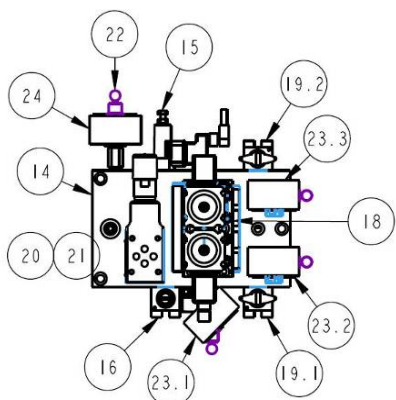
2.1.16 CHECK VALVE (17)
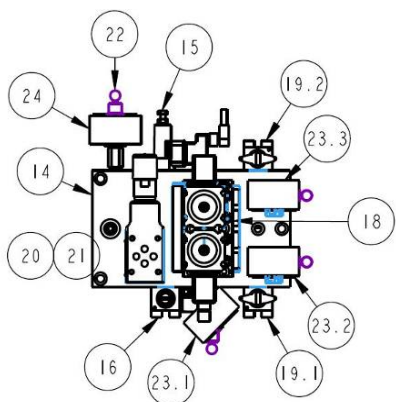
In a hydraulic system these valves are used to block the flow in one direction, enabling the free flow in the opposite direction. In this case the valves protect the pump from the pressure sent to the line.

This valve avoid that the high pressure line goes to low pressure pump, but in the other way allows sum flows.

2.1.17 SOLENOID VALVE (18)

This valve is designed to distribute the fluid through the different areas of the circuit. It is composed of two solenoid valves and two springs. Depending on which solenoid is active, a different distribution model will be activated. In the event that neither of the solenoid valves are in operation, the springs will position the valve in the central position.

If solenoid EA1 is connected flow position is distributed from P1 & P2 to A and B to R (extend cylinder position).

If solenoid EA2 is connected flow position is distributed from P1 & P2 to B and A to R (retract cylinder position).

If solenoid EA1 neither EA2 are connected, valve stays in the central position, which means that maintains the pressure into the cylinders and flow from the pumps goes to tank.

2.1.18 RELIEF VALVE (19.1)
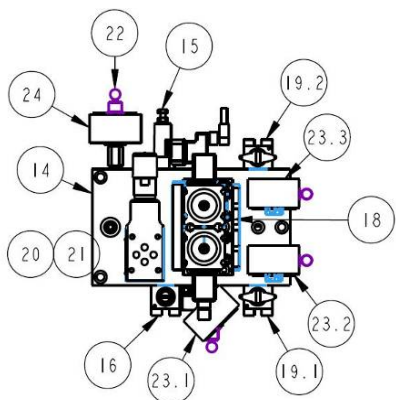
The safety valve is used to protect the circuit against overpressures. When the valve reaches the set safety pressure level, it distributes the flow of the circuit towards the tank to balance the working pressure. The valve can be adjusted by turning the screw installed for this purpose.

This valve is set at 700 bar, protecting the line A of the circuit of overpressures.
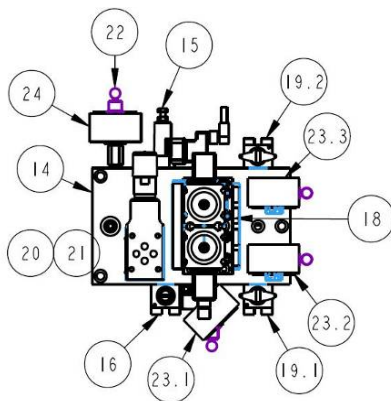
2.1.19 RELIEF VALVE (19.2)
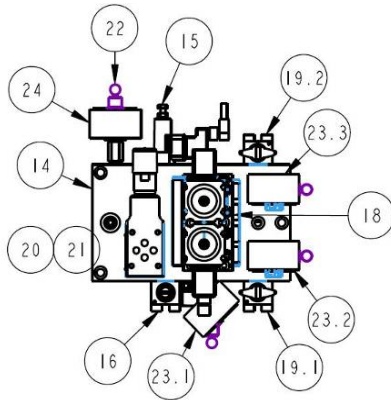
The safety valve is used to protect the circuit against overpressures. When the valve reaches the set safety pressure level, it distributes the flow of the circuit towards the tank to balance the working pressure. The valve can be adjusted by turning the screw installed for this purpose.

This valve is set at 250 bar, protecting the line B of the circuit of overpressures.

2.1.20 RELIEF VALVE (20)

The safety valve is used to protect the circuit against overpressures. When the valve reaches the set safety pressure level, it distributes the flow of the circuit towards the tank to balance the working pressure. The valve can be adjusted by turning the screw installed for this purpose.

This valve is set at 135 bar, protecting the line P2 (high flow low pressure line) of the circuit of overpressures.

2.1.21 SOLENOID VALVE (21)
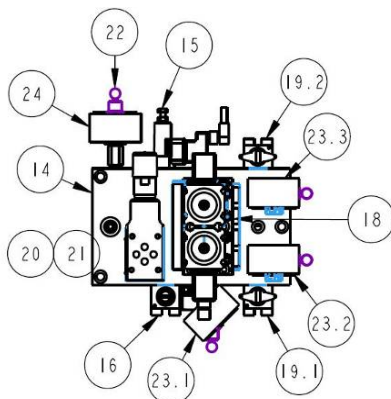
This valve is operated electronically, and in the standby state the fluid can flow through its cavities. When the valve is activated the flow of the fluid between the installed hoses is interrupted.

When the pressure switch (15) get to 125 bar, sends a signal to the control and valve 21 changes the position allowing the flow from low pressure line go to the tank.
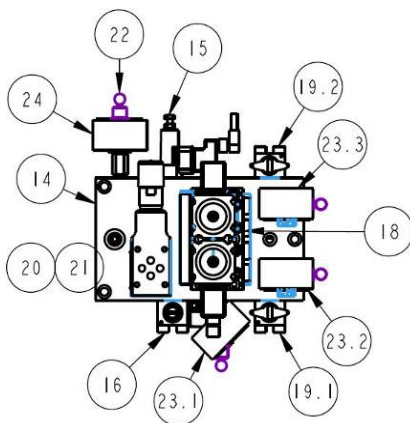
The solenoid that actives the valve is called EB.

2.1.22 NEEDLE VALVE (22)
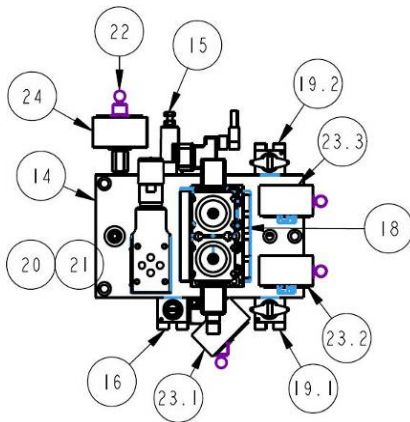
An easy-to-operate manual valve that seals the opening. When the valve is closed fluids cannot pass through, thereby insulating the circuit in both directions.

In this case, it opens or seals off the circuit so that the pressure from manometers can be read

2.1.23 GAUGE (23.1)

This measurement instrument is used to measure the pressure of fluids in closed recipients. In the case of Enerpac's manometer, all pressure-sensitive parts have been sealed and dampened with glycerine to obtain a long working life.

This manometer reads the output pressure line (line P1 and P2). So it will never read more than 700 bar

2.1.24 GAUGE (23.2)
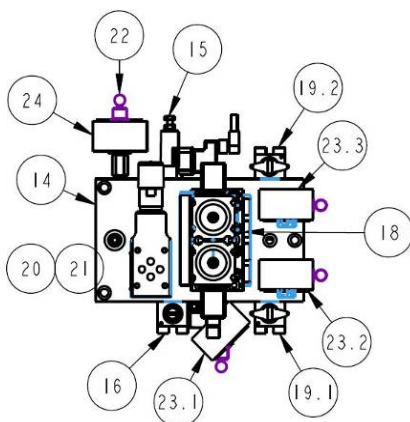
This measurement instrument is used to measure the pressure of fluids in closed recipients. In the case of Enerpac's manometer, all pressure-sensitive parts have been sealed and dampened with glycerine to obtain a long working life.

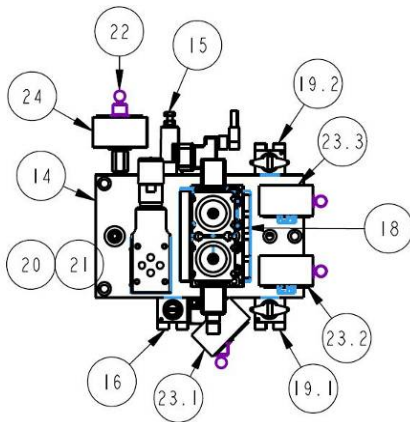This manometer reads the output pressure line (line A). So it will never read more than 700 bar

2.1.25 GAUGE (23.3)

This measurement instrument is used to measure the pressure of fluids in closed recipients. In the case of Enerpac's manometer, all pressure-sensitive parts have been sealed and dampened with glycerine to obtain a long working life.

This manometer reads the output pressure line (line B). So it will never read more than 250 bar
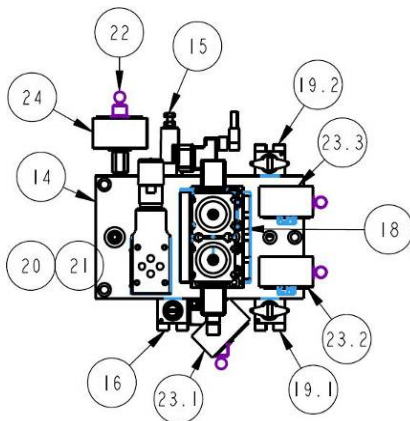
2.1.26 GAUGE (24)

This measurement instrument is used to measure the pressure of fluids in closed recipients. In the case of Enerpac's manometer, all pressure-sensitive parts have been sealed and dampened with glycerine to obtain a long working life.

This manometer reads the output pressure line (line P2 low pressure high flow). So it will never read more than 135 bar

2.1.27 MANIFOLD (25)
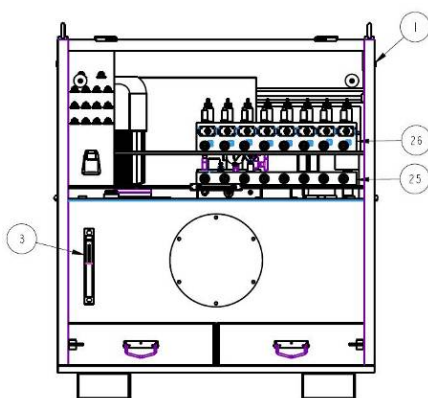
Flow distribution block, which has an input opening and various output openings. Several other elements are screwed onto said block.

This manifold contains the line B couplers. Hoses from big chamber of the cylinders, must be plugged into this couplers
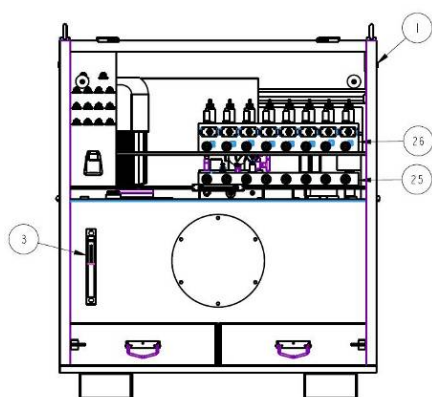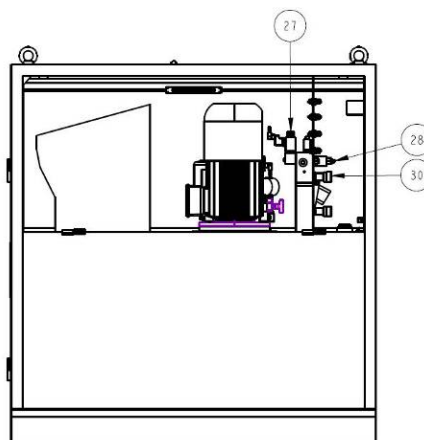
2.1.28 MANIFOLD (26)

Flow distribution block, which has an input opening and various output openings. Several other elements are screwed onto said block.

This manifold contains the line A couplers. Hoses from small chamber of the cylinders, must be plugged into this couplers
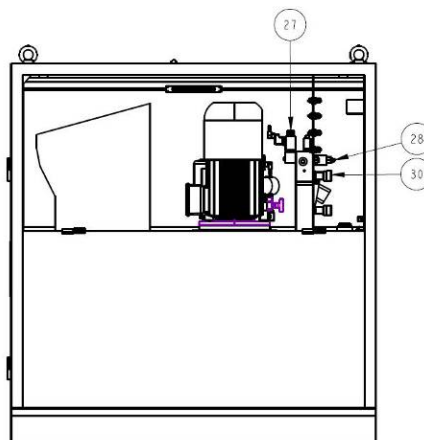
2.1.29 SOLENOID VALVE (27)

This is a two-way valve with two positions (2/2) operated by computerised control to open and close the circuit, depending on the fluid needs of the associated cylinder at a given moment.

This valve is also called synchronization valve.

2.1.30 FLOW CONTROL VALVE (28)

Flow regulation valves are used to change the speed of the fluid in the circuit by changing the transverse section of the flow (decreased or increased) at the pinch-off point. It includes an anti-return system to regulate the flow in only one direction.

This valve is usually used to control the lowering loads.

2.1.31 PRESSURE TRANSDUCTER (29)
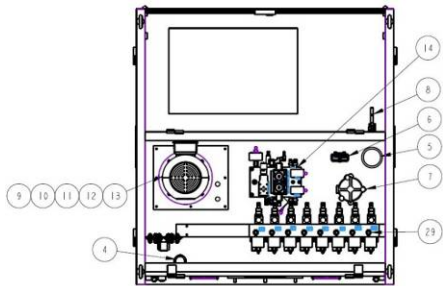
Device that transforms a physical cause (pressure) into an electrical signal. In this case, it detects a determined pressure level (synchronisation input or output, depending on the direction of the flow in the circuit), sending the data to the synchronisation processor so that it can send the order to the synchronisation valve.

Each output (so each cylinder) has its own pressure transducer, to know in each moment the pressure of that point.

2.1.32 FEMALE COUPLER (30)
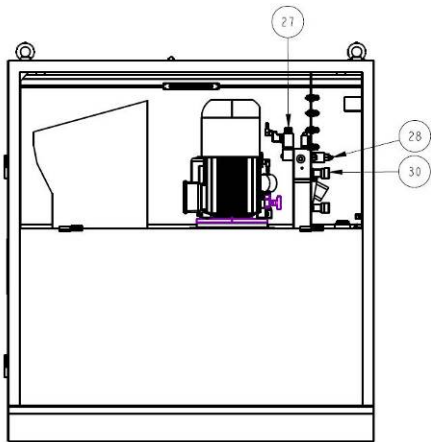
Enerpac CR400 coupler.

⚠️ **Couplers should be pressurized only when completely connected and should not be coupled or uncoupled when pressurized**

2.2 DIAGRAMS OF FLOW

In this electronic document has been attached some diagrams of flow in order to enhance the understanding the hydraulic system operation.
In these diagrams it is showed the way of the oil in the different states of valves depending of working mode. In red is showed pressure line, and in blue return line.
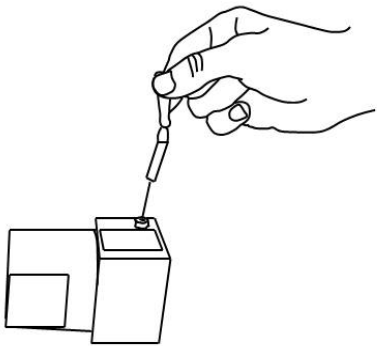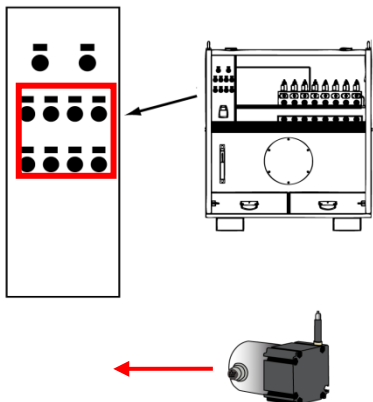See in the last chapter the reference of the diagram flow in order to see the drawings.
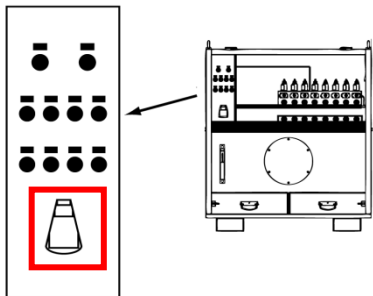
CHAPTER

3

GENERAL
CONECTIONS

3.1 ELECTRICAL CONECTIONS

1		Install the stroke sensors in the cylinder.
2		Connect the stroke sensor cable from stroke sensor to the machine plugs. Remember that all of them must be installed following the order taken for the cylinders. Cylinder 1 $\longrightarrow$ Stroke sensor 1 $\longrightarrow$ plug 1
3		Connect the electrical plug to the general electrical supply plug. The features of the installation must be: **3 + N + PE 400 V and 16 A**.

3.2 MASTER AND SLAVE CONNECTIONS

When there is more than one powerpack working, they have to be connected in line and managed by a main control (called master control).

See in the next diagram how they should be connected:
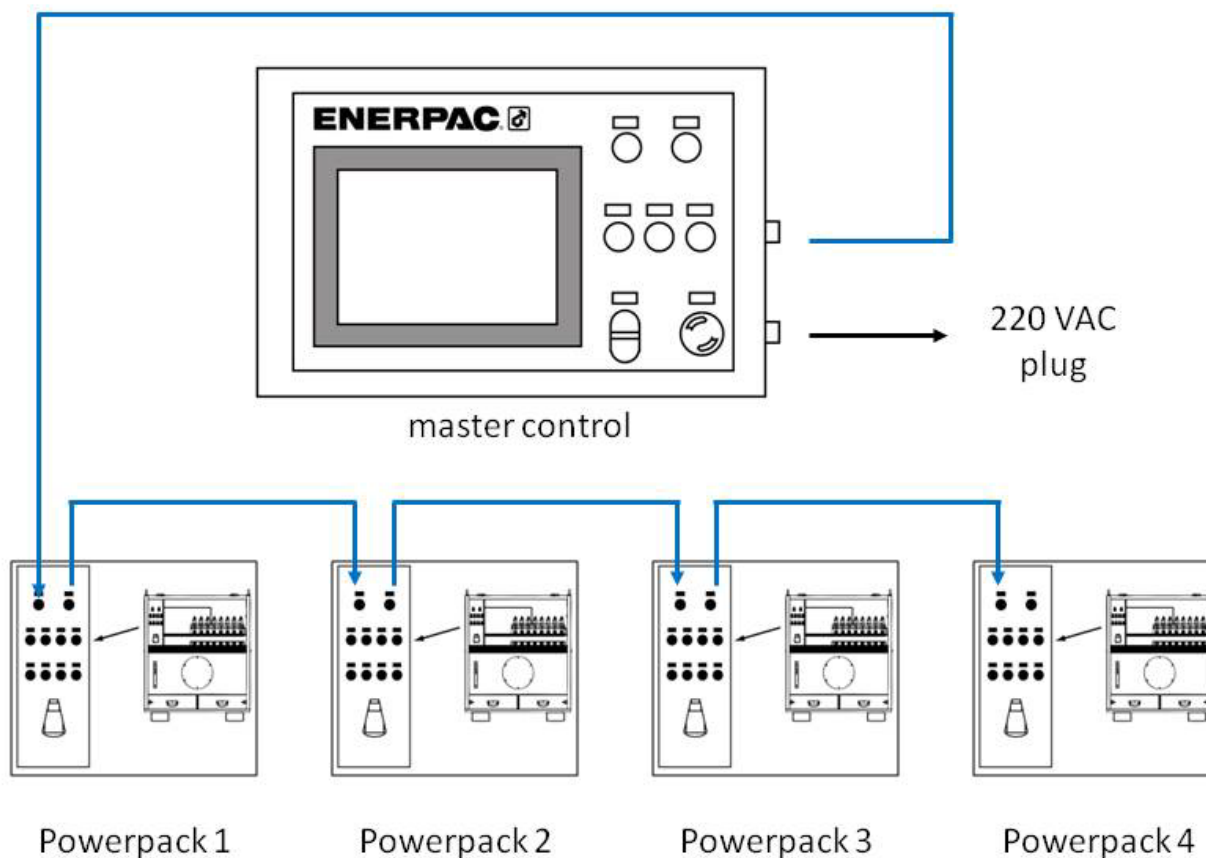
3.3 HYDRAULIC CONECTIONS

Connect hoses between powerpack and cylinders as is showed in the picture.
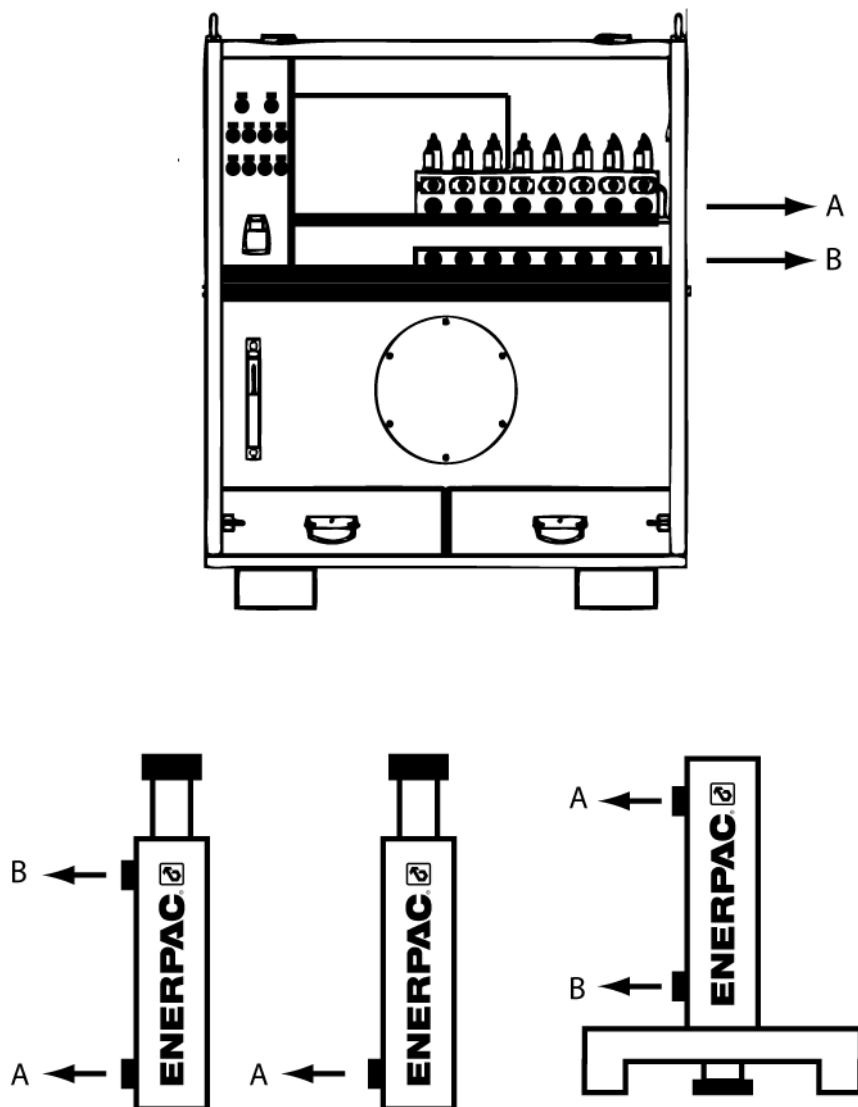
Bear in mind that depend on what kind of cylinder (double acting, single acting or BLS) the connections are different.

CHAPTER

4

DESCRIPTIONS OF GENERAL SCREENS. SLAVE

4.1 DESCRIPTION OF SCREENS

These screens have been designed for all the machine slaves. From these screens the operator can access to the operational screens described in the next chapters.

The software has been designed with a colour code in order to have a best visual identification of the screen and advises.

The screens in blue colour are for those screens related to set up screens.
The screens in grey colour are for those screens related to movements' screens
The screens is yellow colour are for the screens that do not have any relation to the movement but with software set up.

When any button is selected becomes green.

Some buttons are selection buttons. The picture showed is the selection active in that moment.

Some buttons which change critical parameters are protected with a holding system. This means that the operator has to hold the button during 3 seconds to make the change
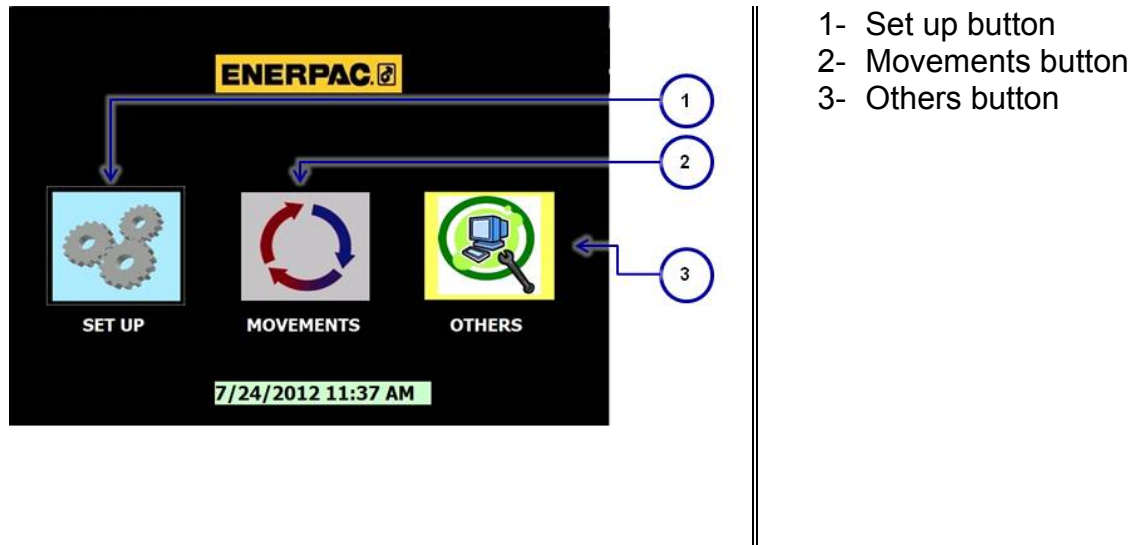
4.1.1 INITIAL SCREEN
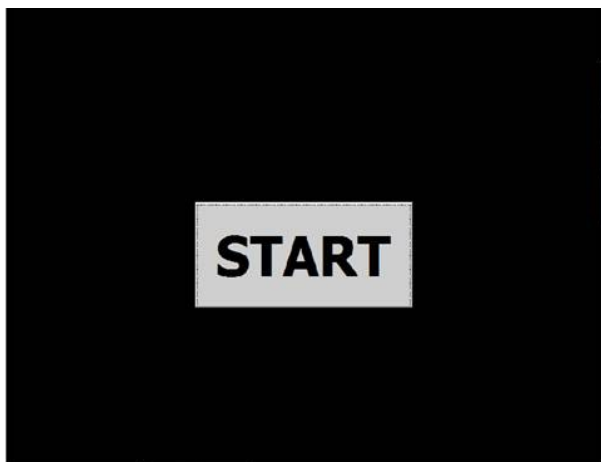
This is the first screen of the software. When the start button is pushed the software will request for the id and password. The operator will type the next:

Id: Enerpac
Password: 100

4.1.2 GENERAL SCREEN

1- Set up button
2- Movements button
3- Others button

This is the general screen of the software. From this screen the operator can access to the set up screens in order to set up parameters of the machine, to the movements screen in order to make the movements of the cylinders and to the others screen where the operator can adjust other parameters of the software not related with the movements

1-**Set up button**

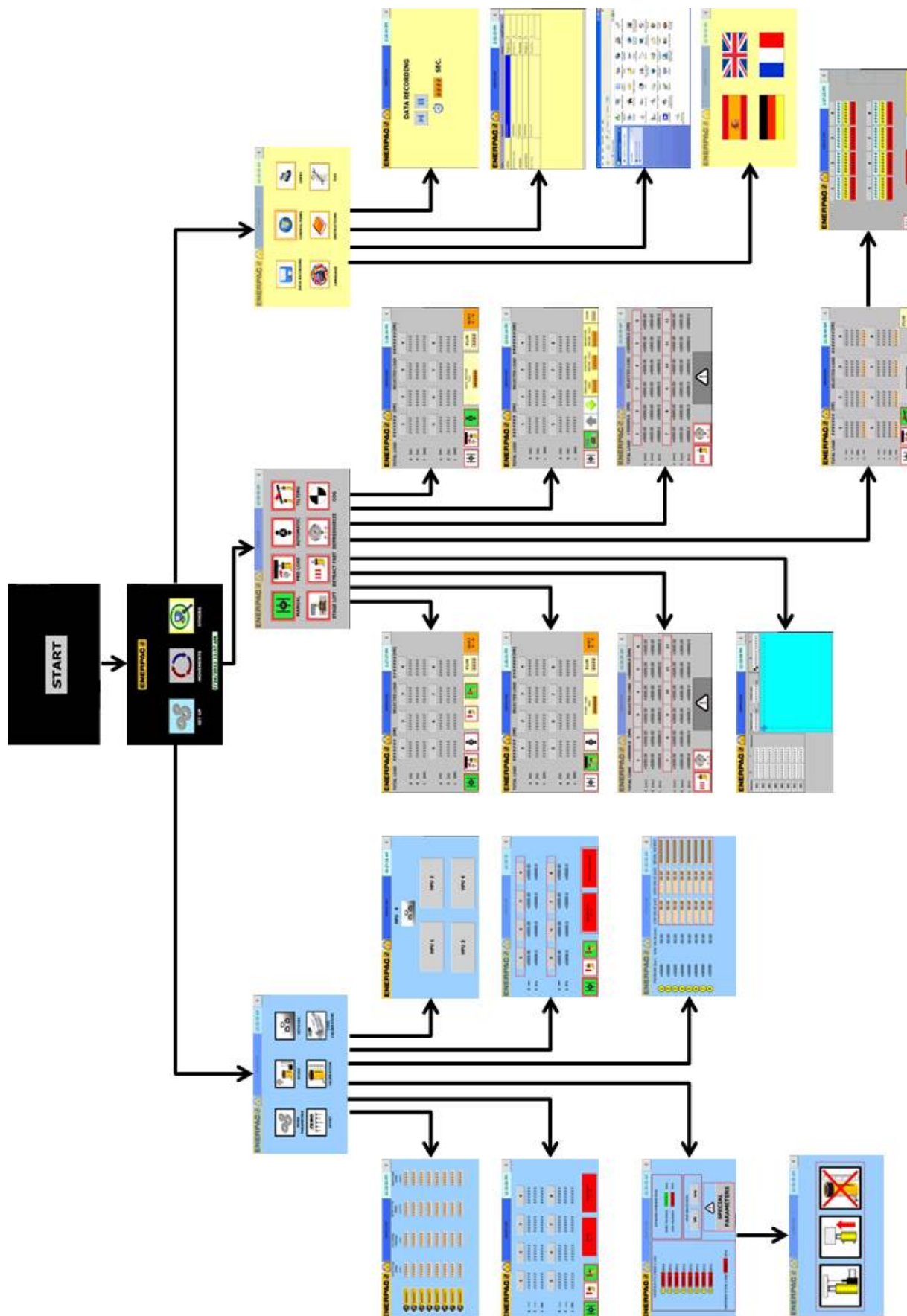It shows set up screen where the operator can define the parameters related to the movement of the cylinder.

2-**Movements button**

It shows the movement screen where the operator can manage all the movements of the cylinders

3-**Others button**

It shows the others screen where the operator can adjust other parameters of the software not related with the movements
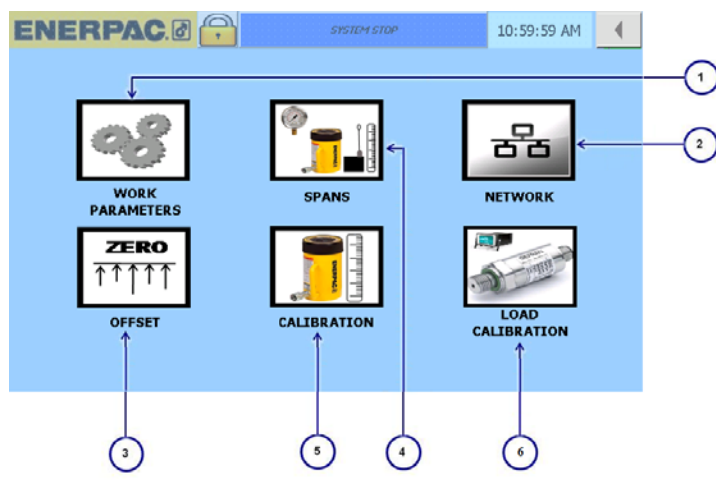
4.2 MAP OF SCREENS

CHAPTER

5

DESCRIPTION OF SET UP SCREENS

5.1 DESCRIPTION OF SCREENS

5.1.1 SET UP SCREEN

1. Work parameters screen Button
2. Network screen Button
3. Offset screen button
4. Spans screen button
5. Calibration screen button
6. Load calibration screen button

In this screen the operator can access to the screens to define the parameters related to the movement of the cylinder

1-**Parameters screen button**

It shows work parameters screen

2-**Network screen button**

It shows the network screen

3-**Offset screen button**

It shows the screen of the offset
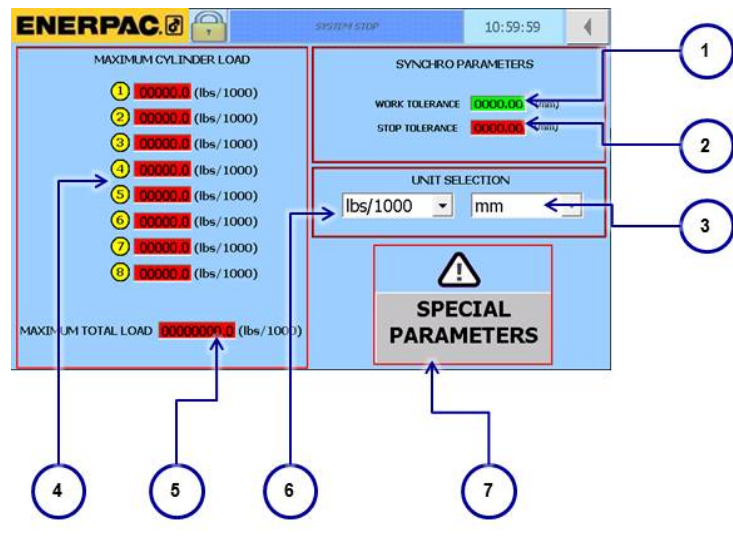
4-**Spans screen button**

It shows spans screen

5-**Calibration screen button**

Shows calibration screen

6-**Load calibration screen button**

Shows load calibration screen

5.1.2 WORK PARAMETERS SCREEN

1- Work tolerance box
2- Stop tolerance box
3- Length unit selector button
4- Maximum cylinder load boxes
5- Maximum total load box
6- Weight unit selector
7- Special parameters button

1-Work tolerance box

It is the distance between the most delayed cylinder in the movement and the average of the distance of all cylinders.

This parameter avoids desynchronize the movement.

It also called synchro tolerance.
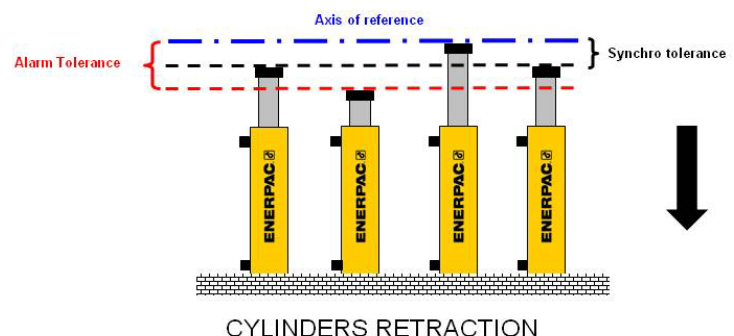

CYLINDERS EXTENSION
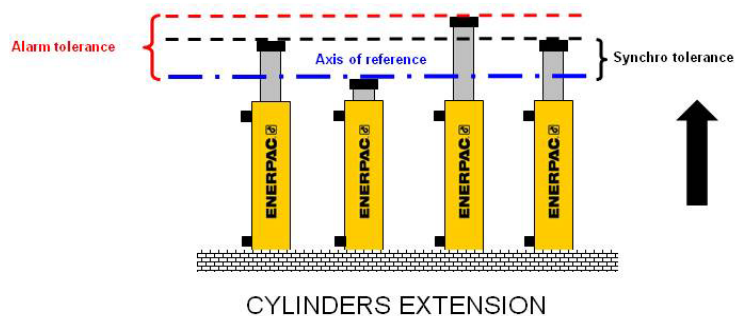
2-Stop tolerance box

It is the distance between the most delayed cylinder in the movement and the most advanced cylinder.

When work tolerance distance is exceeded, the system shows a stop alarm and stops the movement.

It also called Alarm tolerance.

CYLINDERS RETRACTION

3-Length unit selector button

This button allows to the operator choose the visualization of the movement between millimetres or inches

4-**Maximum cylinder load boxes**

Type in this boxes the maximum load that is expected each cylinder withstand. If this value is exceeded, the control will show a warming alarm.

⚠️ **Bear in mind that this box never must have a quantity higher than cylinders capacity.**

5-**Maximum total load box**

Type in this box the total weight that cylinders are going to move. When the machine detects that this weight has been exceeded, shows a stop alarm and stops the movements.

6-**Weight unit selector**

This button allows to the operator choose the visualization of the movement between Kilonewtons, metric tonnes, short tonnes, and lbs/1000.

⚠️ **Bear in mind that when the unit is changed all the values are updated to the new unit. It is not need to type new values in that case.**
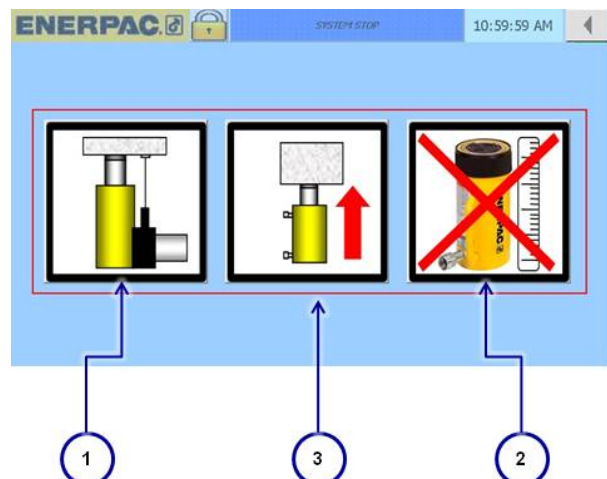
7-**Special parameters button**

Push this button to access to the special parameters screen. The system will request for an id and password. The operator will type the next:

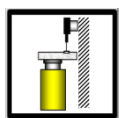Id: Enerpac
Password: 200

5.1.3 SPECIAL PARAMETERS SCREEN

1- Direct/indirect selection button
2- Calibration button
3- Push/pull selection button
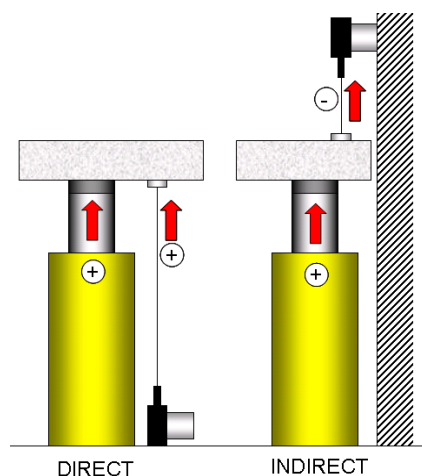
1-Direct/indirect selection button

Depending of the layout of the stroke sensor, select one of the next choice;

Direct: When the stroke sensor has a positive readings (stroke sensor going out) when the plunger goes out.
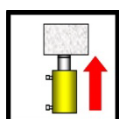
Indirect: When the stroke sensor has a negative readings (stroke sensor going in) when the plunger goes out.

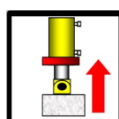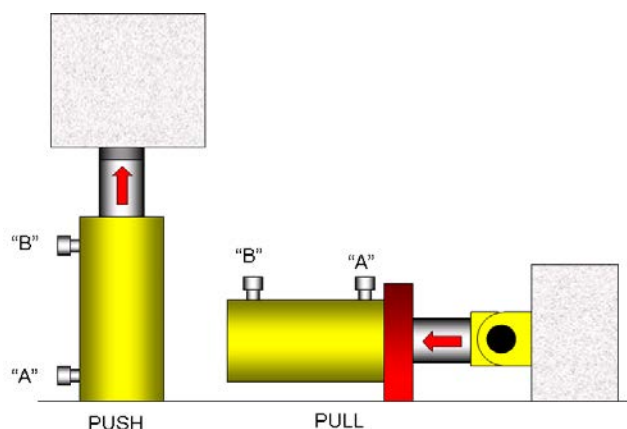
2-Push/pull selection button

Depending of the kind of work, there is in the market two kinds of cylinders;

Push cylinders: cylinders that the effort is done extracting the plunger.

Pull cylinders: cylinders that the effort is done recovering the plunger.

Select the kind of the cylinder that is going to work in the application.

According to the picture, Line A is the pressure line and Line B is the return line.

3-**Calibration/No calibration button**

Depend on the applications sometimes it is not necessary to calibrate cylinders. In that case, select, "no calibration" button. When cylinders are calibrated the control knows cylinder's stroke and sensor stroke. In that case the control can make calculations to avoid damage these tools due to mistakes typing values.

⚠️ **Enerpac, does not recommend work without calibrating cylinders, except for the cases indicated.**

5.1.4 LOAD SPANS SCREEN

1- Number of cylinder indicator
2- Stroke sensor span
3- Stroke cylinder span
4- Effective surface span
5- Pressure span
6- Units button

1-**Number of cylinder indicator**

This number indicates the row of the cylinder parameters

2-**Stroke sensor span**

Type the maximum measurement that can be read by the stroke sensors. That information can be found on the label on each stroke sensor.

3-**Stroke cylinder span**

Type the maximum stroke of each cylinder.

4-**Effective surface span**

In this box, we should enter the cylinder's effective pressure area. It is the cylinder's plunger where the fluid is going to exert pressure. This information can be obtained from the cylinder's own characteristics in the Enerpac catalogue.

5-**Pressure span**

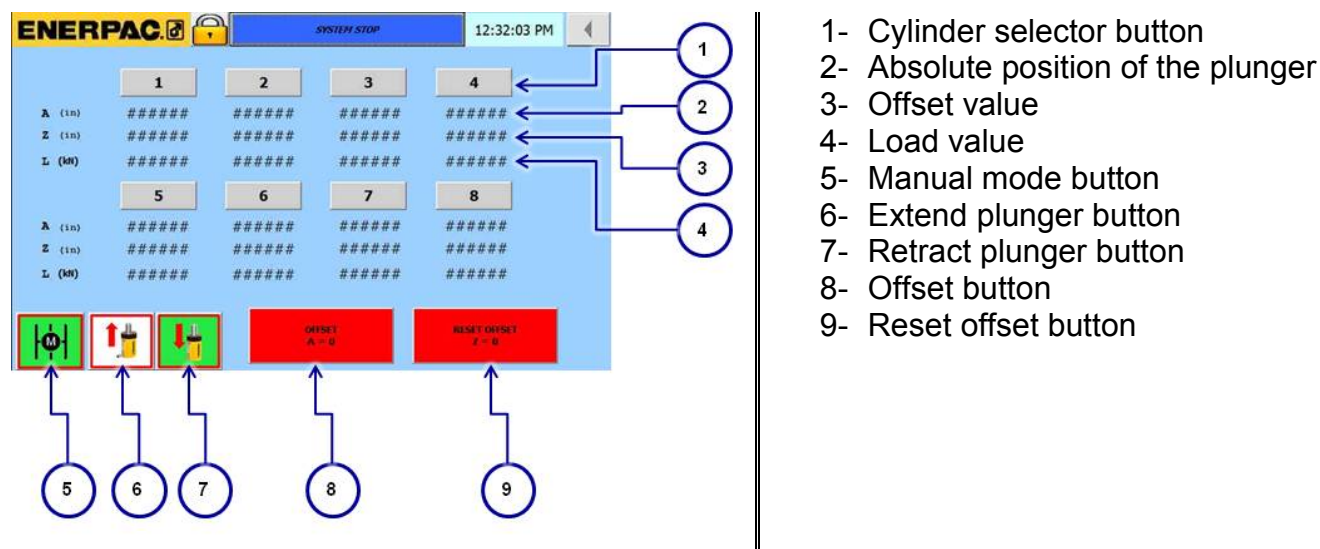Type transducer's maximum allowed pressure. There is one transducer for each out point. Usually transducers have the same features. This information is written on the sticker of each pressure transducer.

6-**Units button**

With this button the operator can change the units between metric and imperial units. The values also will change when the units change, so the computer makes the conversion.

5.1.5 OFFSET SCREEN

1- Cylinder selector button
2- Absolute position of the plunger
3- Offset value
4- Load value
5- Manual mode button
6- Extend plunger button
7- Retract plunger button
8- Offset button
9- Reset offset button

1-**Cylinder selector button**

Select this button to select the cylinder which is going to be moved. Every movement will be done only in selected cylinders.

2-**Absolute position of the plunger**

This box shows the readings of the stroke sensor of each cylinder. It reads the real extension of the wire of the stroke sensor.

3-**Offset value**

This value keeps the absolute position value when the offset is realized (when A=0 is set)

4-**Load value**

This box shows the load withstood by the cylinder in that moment

5-**Manual mode button**

Push this button to operate manually with the system. When any extending or retracting movement want be done by the operator this button must be pushed

6-**Extend plunger button**

Push this button when the operator wants to extend the plunger of the button. After this, push start cycle button in the console

7-**Retract plunger button**

Push this button when the operator wants to retract the plunger of the button. After this, push start cycle button in the console

8-<u>**Offset button**</u>

When the stroke sensor is set on the cylinder the system reads the extended length of the wire (A).

In that moment Z=0 and A has a real reading of the sensor. Each cylinder will have a different value of A.
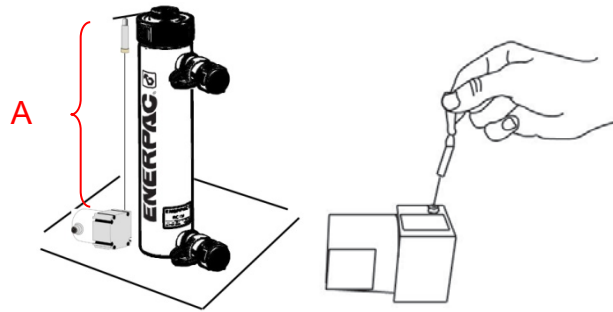
In order to have an initial common reference for all the cylinders, it is highly recommendable to set all the cylinders with the same reference. To do that follow the next;

When all the wire sensors are extended and set on the cylinders, press OFFSET button and every cylinder will become Z= A and A = 0.
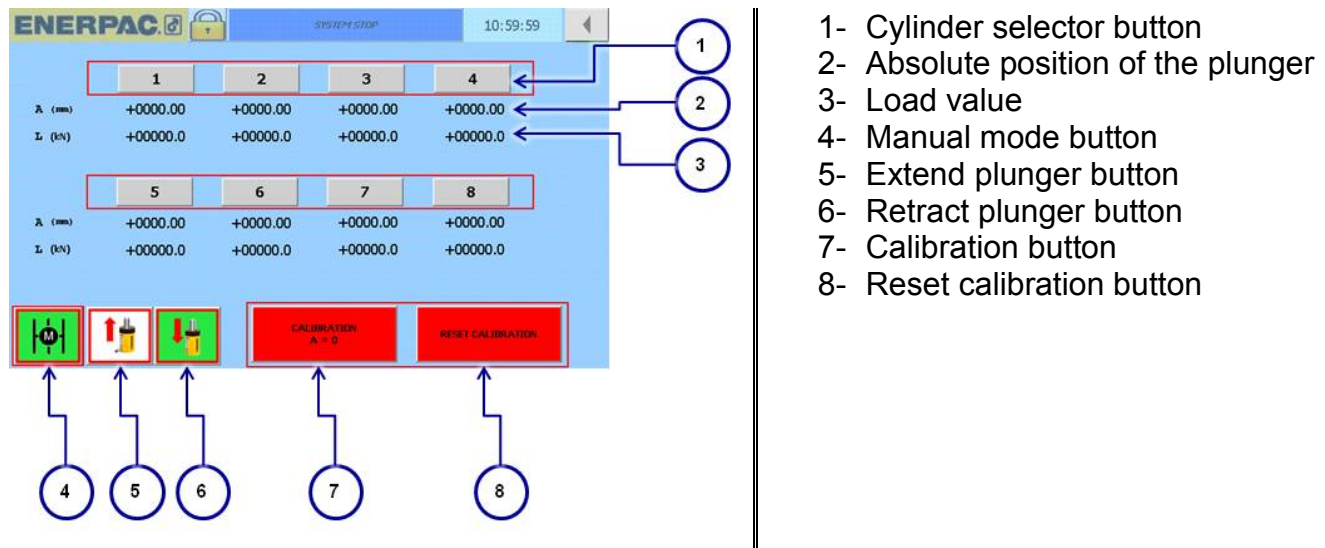
By this way, all the cylinders will have the same start point and however the system will not lose the real value of the stroke.

9-<u>**Reset offset button**</u>

If in the future the operator wants to recover the real reading of the stroke sensor, just hold this button during 3 seconds and A=Z an Z=0.

5.1.6 CALIBRATION SCREEN

1- Cylinder selector button
2- Absolute position of the plunger
3- Load value
4- Manual mode button
5- Extend plunger button
6- Retract plunger button
7- Calibration button
8- Reset calibration button

Through calibration and spans parameters, the system can make the security calculates to prevent mistakes in the typing of the parameters.

If some illogic figure (i.e. bigger than allowed range) is typed in delta position box, the machine will autocorrect and will change to the maximum allowed range.

⚠ **All cylinders must be calibrated before to start a new application with the exception of the cylinders with internal stroke sensors (Balluff).**

1-**Cylinder selector button**

Select this button to select the cylinder which is going to be moved. Every movement will be done only in selected cylinders.

2-**Absolute position of the plunger**

This box shows the readings of the stroke sensor of each cylinder. It reads the real extension of the wire of the stroke sensor.

3-**Load value**

This box shows the load withstood by the cylinder in that moment

4-**Manual mode button**

Push this button to operate manually with the system. When any extending or retracting movement want be done by the operator this button must be pushed

5-**Extend plunger button**

Push this button when the operator wants to extend the plunger of the button. After this, push start cycle button in the console

6-**Retract plunger button**

Push this button when the operator wants to retract the plunger of the button. After this, push start cycle button in the console

## 7-<u>**Calibration button**</u>

This button set all cylinders real position box to zero. Hold pressed 3 seconds to be effective the change

8-<u>**Reset calibration button**</u>

If any mistake is happened in calibration works, pushing this button can be reset and start again from the beginning. Hold pressed 3 seconds to be effective the change

In order to know how to calibrate cylinders, please see in this chapter in the protocols chapter

5.1.7 NETWORK SCREEN

1- Slave number
2- Slave selector
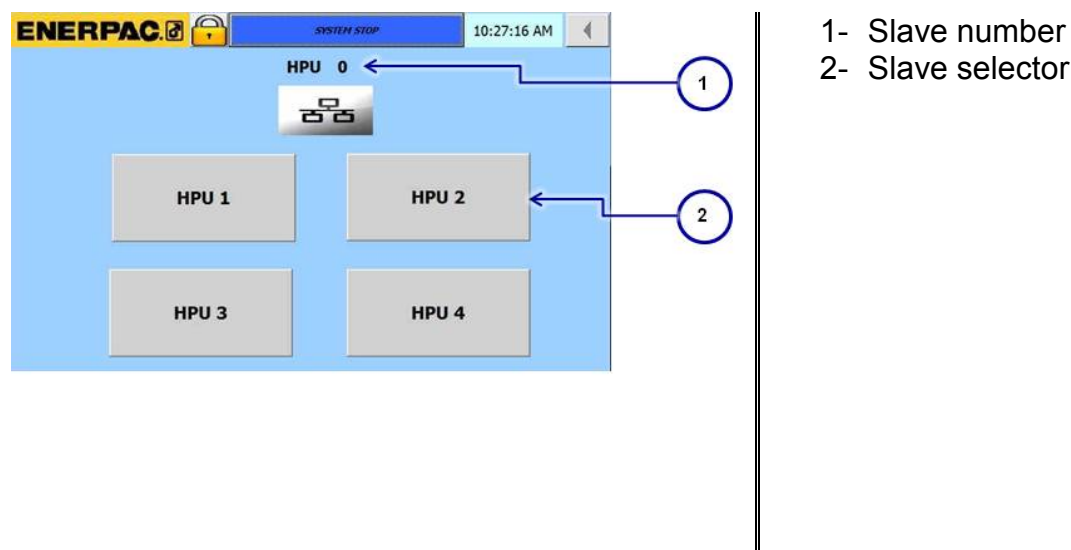
This screen is designed to indicate to the system what number of the powerpack (slave) is. This is used when the system is composed by more than 2 powerpacks (slaves) and 1 master.

1-**Slave number**

In this part of the screen, the system shows the number of slaves designed for the powerpack. If the operator wants to change it must to select the number of the slave in the slave selector buttons and hold it

2-**Slave selector**

There are 4 possibilities to select the number of the powerpack. Just hold the number that the operator wants to choose for the powerpack.

In the master screens the operator will see the number of the powerpack selected.

5.1.8 LOAD CALIBRATION

This screen is used when the operator needs more accuracy when reading the load in some cylinder.

Therefore he can type manually the minimum and maximum analogical values given by the calibration certifies of pressure transducers.

The screen shows the pressure (bar) that the machine has in each point and the real value of analogical signal (mA).

The parameters that can be typed are Low Value (mA) and High Value (mA). These values must be given by the manufacturer.

Furthermore the operator can type the serial number of the transducer in order to have a trace reference.

By default all the values are in 4.00 mA (as the minimum value) and 20.00 mA (as the maximum value). It is hardly recommended do not change these values if it is not clear which are the calibration values.

CHAPTER

6

DESCRIPTION OF MOVEMENTS SCREEN

6.1 DESCRIPTION OF SCREENS

6.1.1 MOVEMENTS SCREEN

1- Manual screen button
2- Automatic screen button
3- Tilting screen button
4- Stage lift button
5- Preload screen button
6- Retract fast screen button
7- Depressurize screen button
8- Cog screen button.
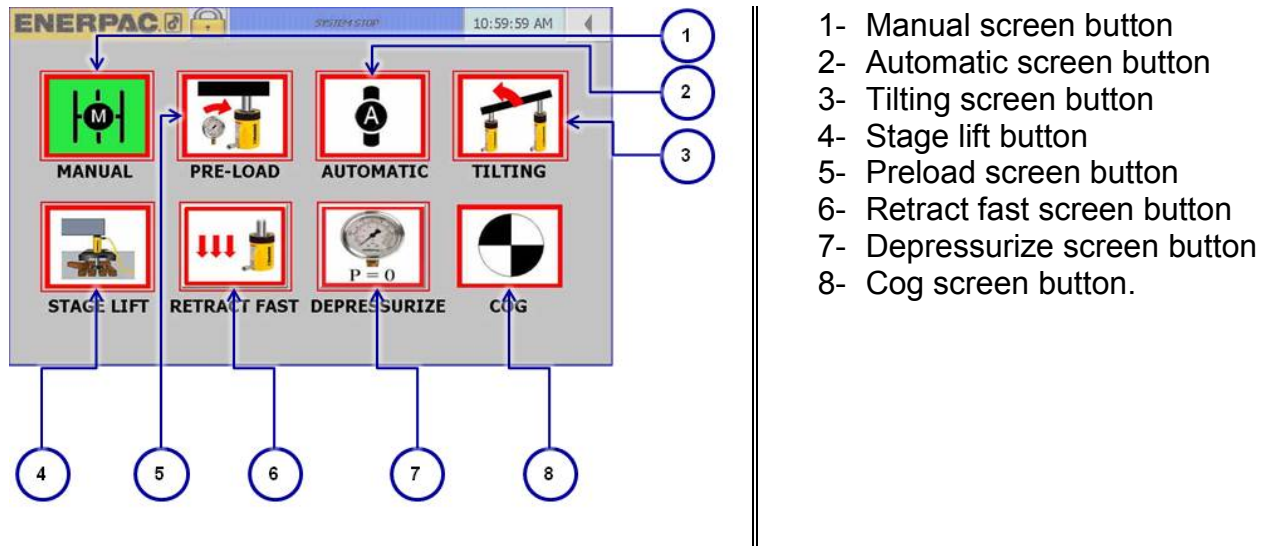
From this screen the operator can access to any screen related to the cylinders movements. In order to improve the movement between screens, some buttons of others screens have been included in to the screens. This case happens with manual, preload and automatic movements which have the access from each other and with depressurize and retract fast screen.

1-**Manual screen button**

It shows the manual movements screen

2-**Automatic screen button**

It shows the automatic movements screen

3-**Tilting screen button**

It shows the tilting movements screen

4-**Stage lift button**

It shows the stage lift movements screen

5-**Preload screen button**

It shows the preload screen

6-**Retract fast screen button**

It shows the retract fast screen

7-**Depressurize screen button**

It shows the depressurize screen

8-**COG screen button**

It shows COG (centre of gravity) screen

6.1.2 MANUAL MODE SCREEN

1- Selected Load parameter
2- Cylinders data section
3- Manual work mode button
4- Total Load parameter
5- Extend cylinder button
6- Retract cylinder button
7- Flow value
8- Reset relative position
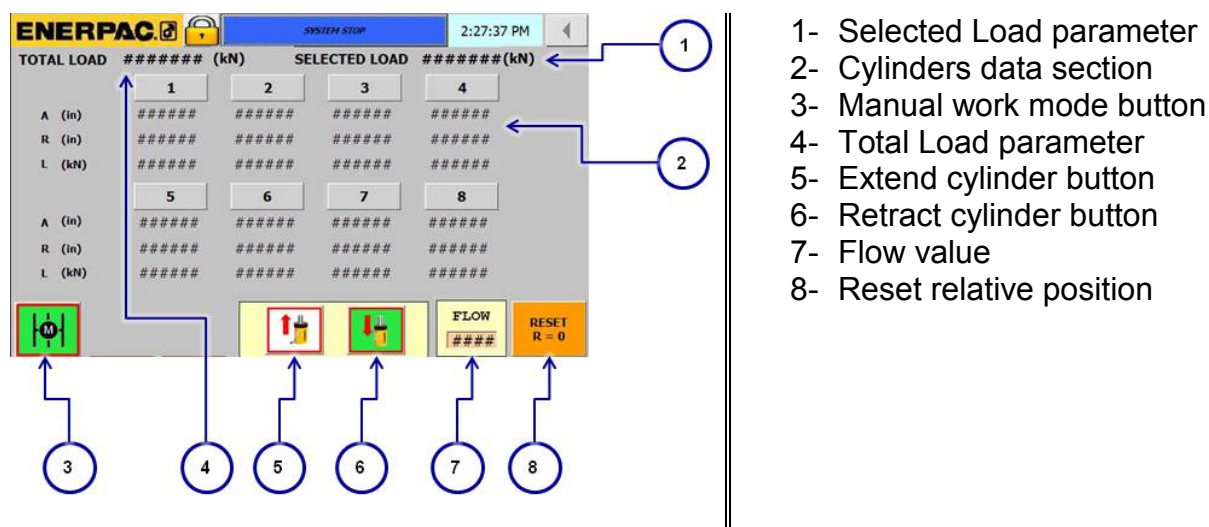
1-Selected load parameter

This box shows the sum of the weights withstood by only the selected cylinders

2-Cylinders data section
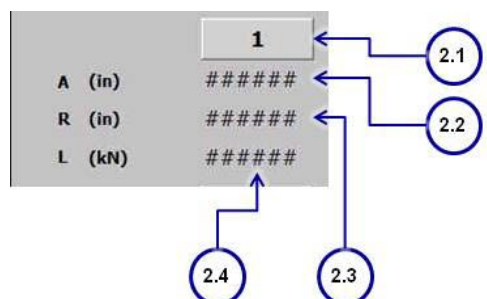
2.1-Cylinder selection button

Select this button to select the cylinder which is going to be moved. Every movement will be done only in selected cylinders.

2.2-Absolute position box

This box shows the readings of the stroke sensor of each cylinder.

2.3-Relative position box

This box shows the partial movement done by the cylinder. This box can be set to zero when desired by operator pushing reset button (8). (f.i. when one cycle has been done, set this box to zero to know the distance covered by the plunger.)

2.4-load box

This box shows the load withstood by each cylinder
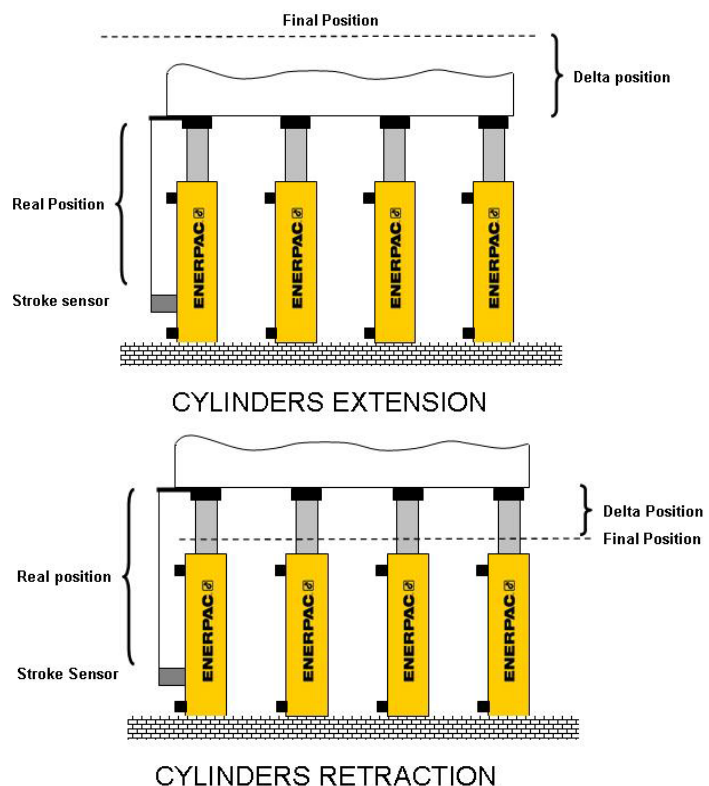
3-Manual work mode button

Select this button to work in manual mode. See in protocols chapter how to work in this mode.

4-Total load parameter

This box shows the sum of the weights withstood by all the cylinders of the system.

5-<u>Extend cylinder button</u>

In manual mode, extend the plunger of the selected cylinders.

6-<u>Retract cylinder button</u>

In manual mode, retract the plunger of the selected cylinders

7-<u>Flow value</u>

The system allows select the movement speed of the cylinders. This value is a percentage and can be typed between 25 and 100% of the total flow. See in the chapter 2 the characteristics of the pump and the flow capacity of the hydraulic system.

8-<u>Reset relative position</u>

This button set to zero the relative position of all cylinders selected (R=0). Hold the button during 3 seconds to be effective the change

6.1.3 PRE LOAD MODE SCREEN
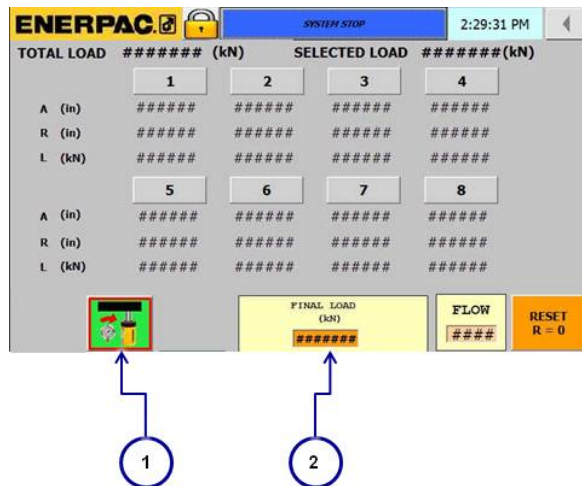
1- Load work mode button
2- Final Load box

Many elements of this screen are identical to the manual screen, so they are not explained in this section. Please go to the manual screen section in order to know the description.

This mode is used to have the first contact with the object which is going to be lifted.
This work mode allows the operator set a load limit for each cylinder. When each cylinder reaches this limit the system stops moving it.

1-Load work mode button

Select this button to work in load work mode. See in in the protocols chapter how to work in this mode.

2-Final Load box

In the Load work mode this box is the load target that cylinders are going to search. When the system works in Load mode, cylinders will be moved until they get to final load weight (typed in this box)

Final load is used normally to have a real reference of the position of the load. When every cylinder has got its final load, the operator can be sure that every cylinder is touching the load.

CYLINDERS EXTENSION

CYLINDERS RETRACTION

6.1.4 AUTOMATIC MODE SCREEN
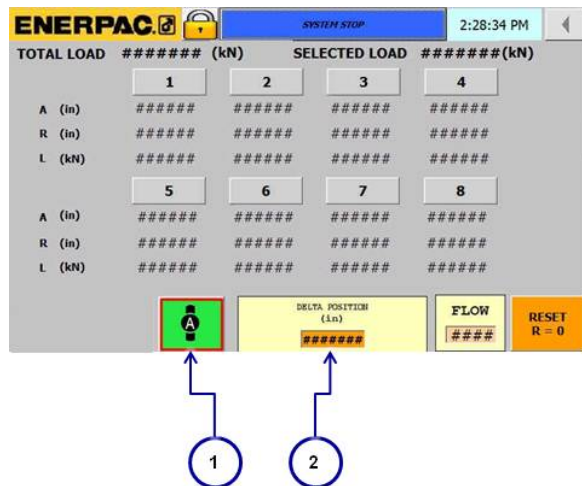
1- Automatic work mode button
2- Delta position box

Many elements of this screen are identical to the manual screen, so they are not explained in this section. Please go to the manual screen section in order to know the description.

This is the most common working mode, synchronisation by the each cylinder's relative position. With this method depending on the position calculated for each cylinder, the system injects oil to try to introduce all the cylinders within the previously established range.

The operator must type the final length that wants the cylinders to reach in the "delta position" box.

1-**Automatic work mode button**

Select this button to work in synchronized work mode. See in this in the protocols chapter how to work in this mode.

2-**Delta position box**

In the synchronized work mode, delta position is the next position where cylinders are moving.

This value could be positive or negative, depend on the relative position of the cylinders.

This box can be used for retracting or for extending cylinders.

The pictures show the different options

CYLINDERS EXTENSION

CYLINDERS RETRACTION
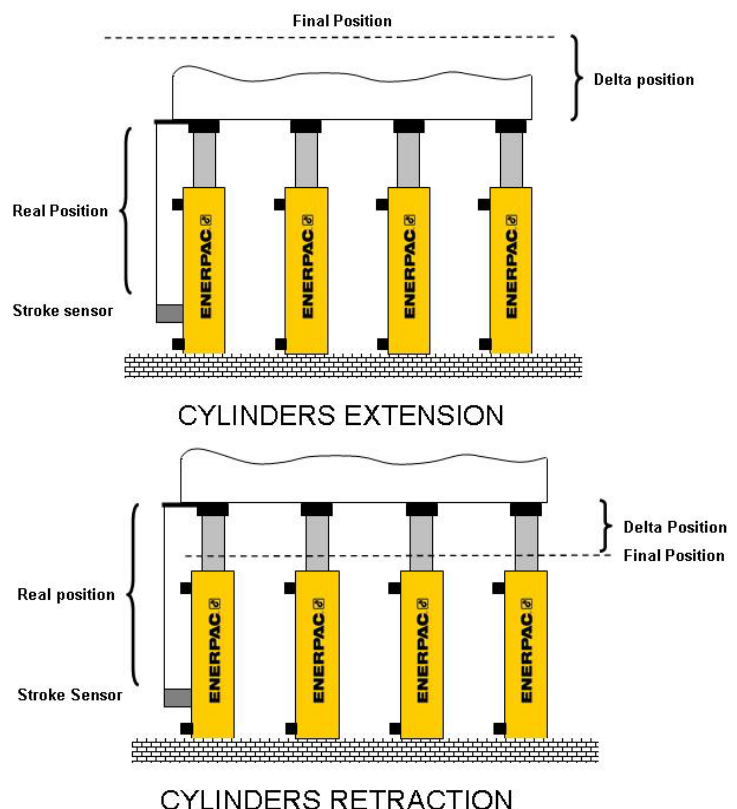
6.1.5 RETRACT FAST MODE SCREEN
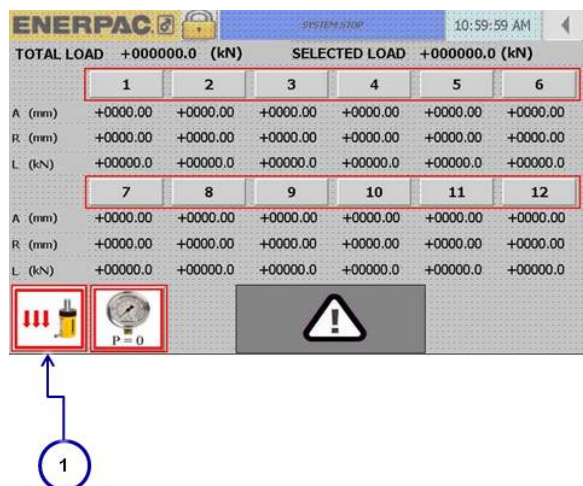
1- Retract fast button

Many elements of this screen are identical to the manual screen, so they are not explained in this section. Please go to the manual screen section in order to know the description.

This screen has been designed for those applications that only are used single acting cylinders. When the retraction is due to gravity weight, the cylinders need more time to retract the plunger. To avoid having a person continuously pushing the start cycle button (dead man's button) through this button the operator can leave the hand free for doing something else.

> **When this work mode is operating, always must be a person supervising the movement. It is completely forbidden leave the machine working alone.**

> **It is important to bear in mind that with this work mode, the valves will be completely opened and will leave to oil flows to the tank free of opposition. Depending on the type of configuration of the application (cylinders, load, hoses, etc.) the load may have an incorrect speed and may cause an incident.**

1-**Retract fast button**

Push this button in order to operate with this work mode.

6.1.6 DEPRESSURIZE SCREEN
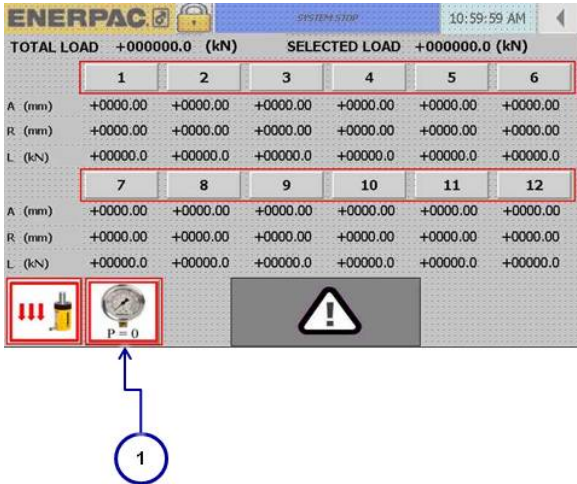
1- Depressurize button

Many elements of this screen are identical to the manual screen, so they are not explained in this section. Please go to the manual screen section in order to know the description.

Many times after working with cylinders can remains pressure in hoses and cylinders. When this happens, it is very difficult to disconnect hoses and cylinders. To take the pressure out, push this button and then start cycle in the console

⚠ **Do not use this button when cylinders are withstanding a load. This button is only allowed use when over the cylinders there is any load.**

1-**Depressurize button**

Push this button in order to depressurize hoses and cylinders to dismantle the system.

6.1.7 STAGE LIFT SCREEN
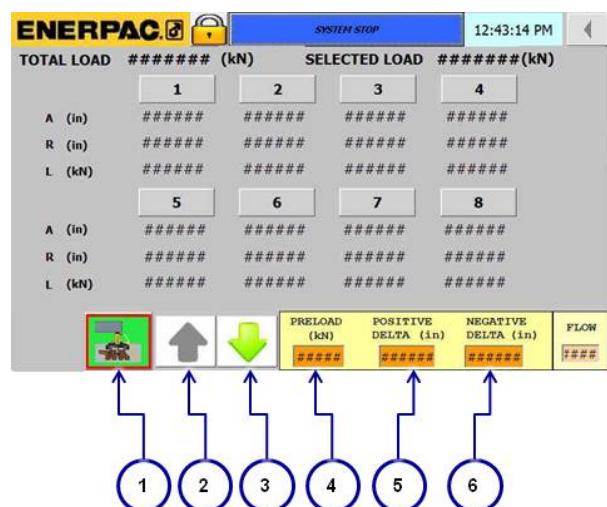
1. Stage lift button
2. Extend button
3. Retract button
4. Preload box
5. Positive delta box
6. Negative delta box

Many elements of this screen are identical to the manual screen, so they are not explained in this section. Please go to the manual screen section in order to know the description.

Stage lift mode is a semiautomatic mode. It allows rise or get down the load synchronously by cycles that ask for operator confirmation. See protocol stage lift in the protocol chapter.

1-**Stage lift button**

Push this button in order to indicate to the system that this mode is going to be set.

2-**Extend button**

Push this button to set system into extend mode. System will extend plungers through cycle stage lift.

3-**Retract button**

Push this button to set system into retract mode. System will retract plungers through cycle stage lift.

4-**Preload**

Type the weight that every cylinder must reach before starting to do a new cycle.

5-**Positive Delta box**

Type the value that the load must be raised or got down per cycle.

6-**Negative delta box**

Type the value that cylinder must be got down to place the load on

6.1.8 TILTING SCREEN
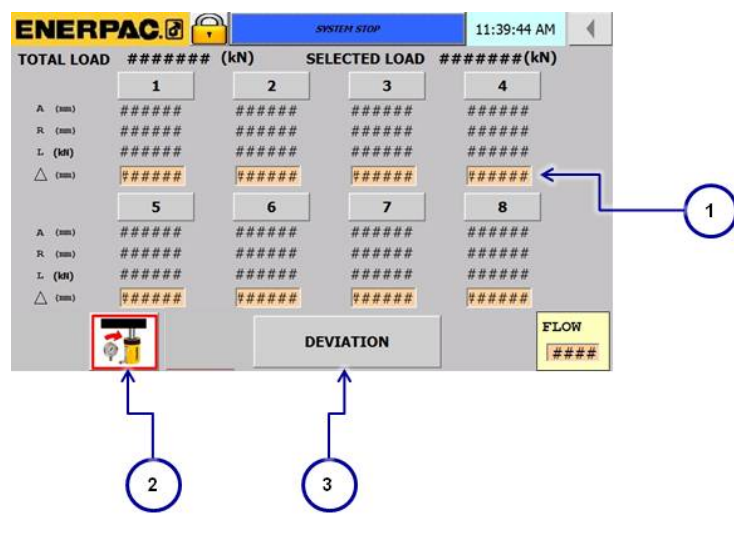
1. Individual delta position box.
2. Tilting work mode button
3. Deviation screen button

Many elements of this screen are identical to the manual screen, so they are not explained in this section. Please go to the manual screen section in order to know the description.

1-**Individual delta position box.**

In this box, the operator must type the stroke that each cylinder is going to move. This parameter can be different for each cylinder.

2-**Tilting work mode button**

Push this button and push in the console start cycle button. Every cylinder selected will move to delta position typed in each box. The movement will be done synchronously. See protocol of the movement for a extended explanation

3-**Deviation screen button**

This button shows relative position of tilting screen.

6.1.9 DEVIATION TILTING SCREEN
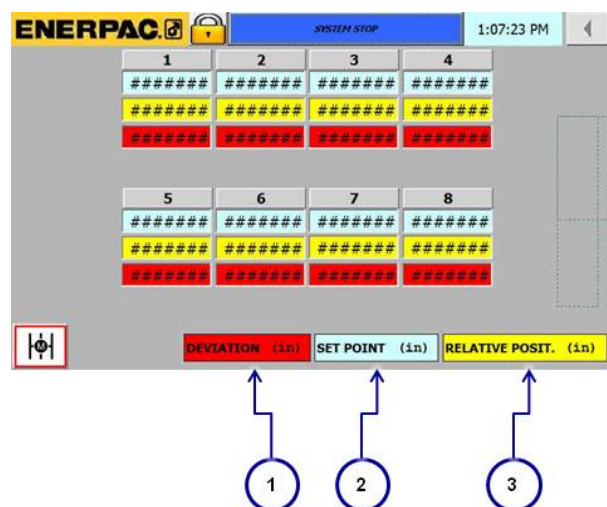
1. Deviation box
2. Set point box
3. Relative position box

For tilting movements, the system makes a calculating of where should stay the stroke in the movement. This theoretical point is called set point. See an extended explanation in protocols operation chapter

1-**Deviation box**

Difference between the relative position and the set point

2-**Set point box**

Theoretical situation point of the plunger calculated by the system

3-**Relative position box.**

This box shows the partial movement done by the cylinder. See the description in manual mode screen.

6.1.10 GRAVITY CENTER SCREEN
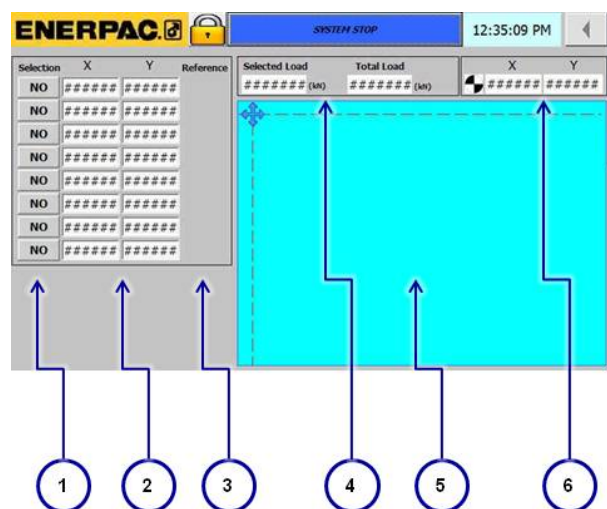
1. Cylinder selection buttons
2. Position of X and Y axis
3. Cylinder reference
4. Load of cylinder
5. Canvas for graphic
6. Gravity center coordinates

1-Cylinder selection buttons

Select what cylinders are included in the calculation of the gravity center.

2-Position of X and Y axis

Every cylinder has a real position from the cylinder reference. Type the real distance in the X axis and in the Y axis from the reference cylinder.

3-Cylinder reference

All the distances must be taken from a reference point. That reference point is a selected cylinder. Please select which is the cylinder reference.

4-Load of cylinder

This box shows the load withstood by each cylinder

5-Canvas for graphic

In this area the system shows the position of each cylinder and the position of the COG

6-Gravity Center coordinates

When every data are in, the system calculate where is placed the gravity center of the load.

CHAPTER

7

DESCRIPTION OF OTHERS SCREENS

7.1.1 OTHERS SCREEN
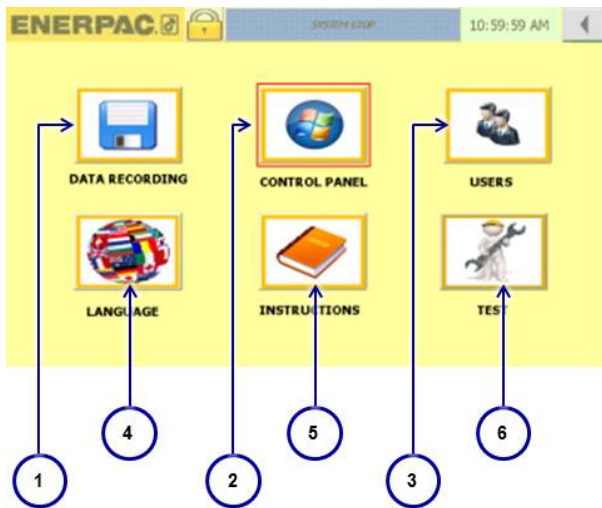
1. Record data button
2. Control panel button
3. Users button
4. Language button
5. Instruction manual button
6. Test screen button

From this screen the operator can access to the screen that do not have a direct relation with the movement. Through this screen the operator can set up some features of the software

1-**Record data button**

This button shows record data screen.

2-**Control panel button**

This button shows windows control panel screen.

3-**Users button**

This button shows password managing screen.

4-**Language button**

This button shows the language screen

5-**Instruction manual button**

This button is inactive in this version of the machine

6-**Test screen button**

This button shows the test screen

7.1.2 RECORD DATA SCREEN
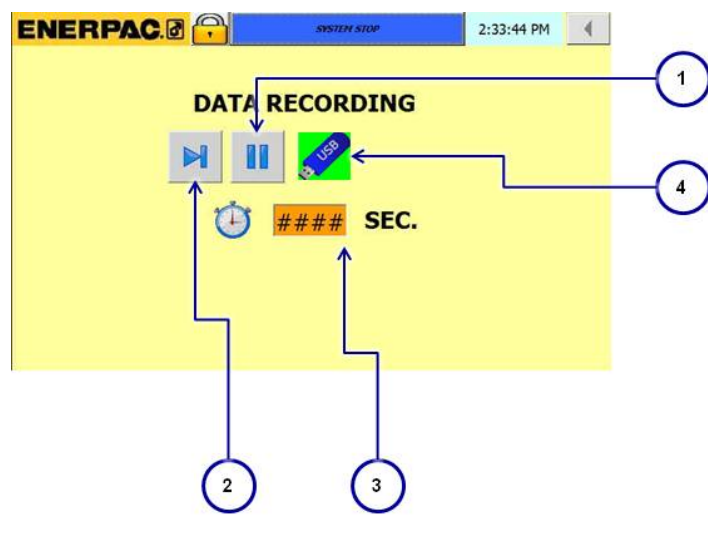
1. Pause record button
2. Start record button
3. Time interval box
4. Pen drive icon

With this screen the operator can record and download the movement data into a pen drive.

1-Pause record button

Push this button to stop of recording data of the movements in the pen drive of the machine.

2-Start record button

Push this button to start to storage data of the movements in the pen drive of the machine.

3-Time interval box

Type the time in seconds of how often the machine takes data of the movement

4-Pen drive icon

These icon appear when the system is recording data.

7.1.3 PASSWORD MANAGING SCREEN

In this screen the operator can change some characteristics such as the user name, the password and the level of the permits that the user can have.

7.1.4 CONTROL PANEL SCREEN
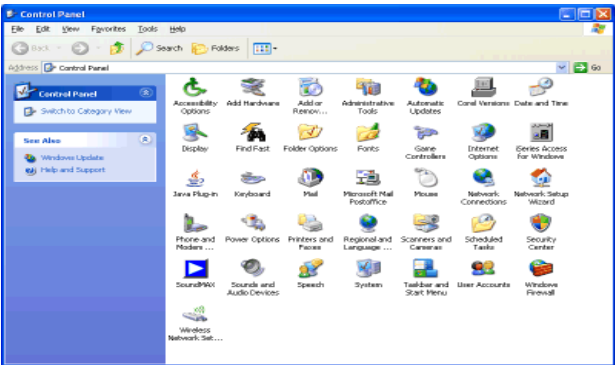
In this screen the operator have the access to the control panel of the operative system. Here can be adjusted time and date.

7.1.5 LANGUAGE SCREEN

With this screen the operator can select the alarms language. This feature only will change the language of the alarms due to the rest of the words in the program will appear in the default language which is English.

7.1.6 TEST SCREEN

1. Check button
2. Pressure test button
3. Stroke test button
4. Delta position/ Final pressure parameter
5. Test result advise
6. Flow parameter
7. Percentage of flow parameter

With this screen the operator can test two features of the machine; the hydraulic and measure equipment.

Pushing pressure test button (and then check button), the machine start a hydraulic cycle where tests the main block in order to find leakages. When the main block is checked the next step is check each hydraulic output point. In order to that the machine feeds the cylinders up to maximum pressure. In this test the operator must type the final pressure that the machine must reaches.

The other test that the machine is designed to check is the stroke of the cylinders. It checks if the stroke sensors and the flow of the cylinders are according to the parameters typed. In order to do that, the machines takes the cylinders to the specified delta position typed by the operator and check either the flow is correct. The operator can type the flow percentage and the final position of the cylinder (delta position).

CHAPTER

8

OPERATION PROTOCOLS
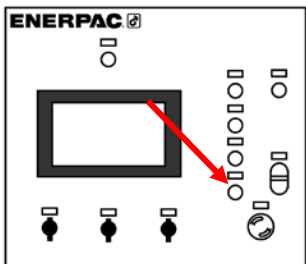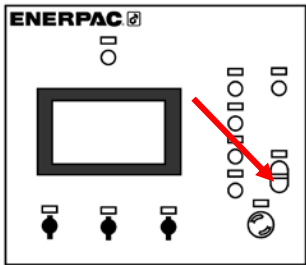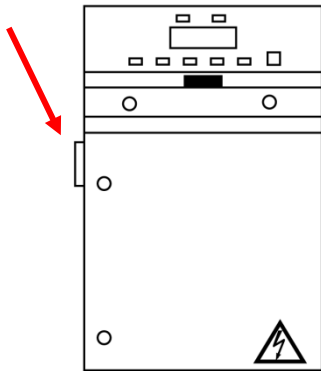
8.1 SET UP PROTOCOLS

8.1.1 TURNING THE UNIT OFF TO FINISH WORK DAY

In long periods of working the machine must be switched off and switched on the next day. To turn the machine on/off we recommend following these steps to avoid faults:

8.1.1.1 OPERATION PROTOCOL

1		Press the stop cycle button
2		Press the stop motor button
3		Turn the mains panel off
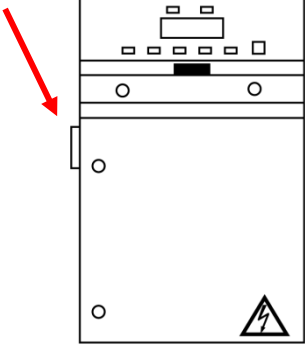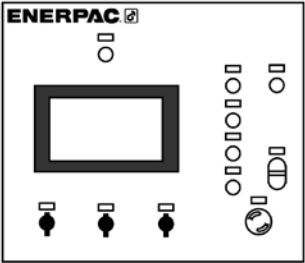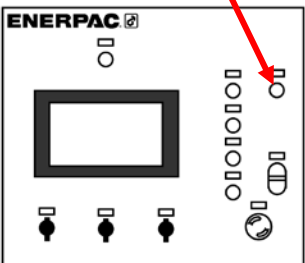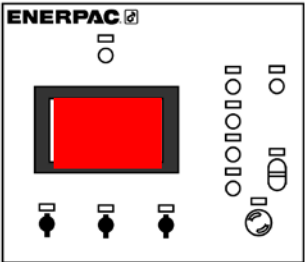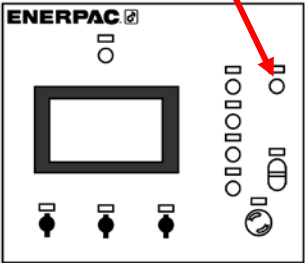
8.1.2 SWITCHING ON THE UNIT THE NEXT DAY AFTER PAUSE
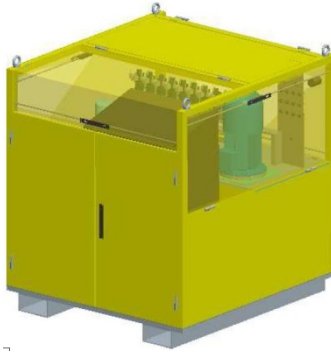
In long periods of working the machine must be switched off and switched on the next day. To turn the machine on/off we recommend following these steps to avoid faults:

8.1.2.1 OPERATION PROTOCOL

1		Perform a visual check of the hoses and cylinders, ensuring they are not bent and in the correct position.
2		Check that the hose plugs are inserted in correctly.
3		Check the level of oil. Bear in mind that if cylinders are extended, the reservoir level should be low.
4		Deactivate the emergency stop buttons on the main electrical cabinet and on the control panel. Turn the safety knob clockwise.

5		Switch on the main switch.
		Check the voltage light in the POWER electrical panel.
6		Wait until the control software loads and check the operating parameters (SPANS), adjusting them if necessary
7		At the beginning some alarms will appear
8		Check the origin of the alarm, and if they are not operating alarms confirm all of them into the screen window. If they were operating alarms check the origin and solve it. Then confirm in the control that all alarms have been solved.
9		Push red button "ALARM/RESET" in order to set up the program.
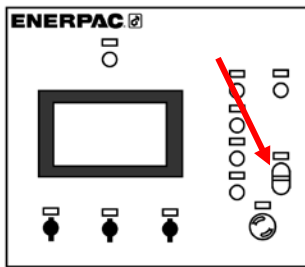
10		Press the start motor button
11		Press the start cycle button
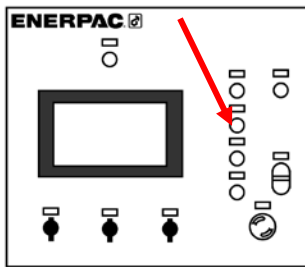
8.1.3 CALIBRATION WORKS

Calibration protocol is an exercise to set zero position in the system. Calibrating the machine takes the reference between plunger position and stroke sensor stroke.

Through calibration and spans parameters, the system can make the security calculates to prevent mistakes in the typing of the parameters.

If some illogic figure (i.e. bigger than allowed range) is typed in delta position box, the machine will autocorrect and will change to the maximum allowed range.
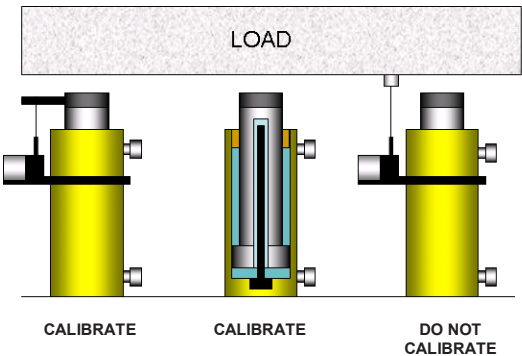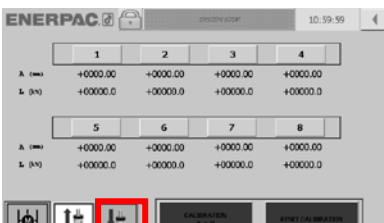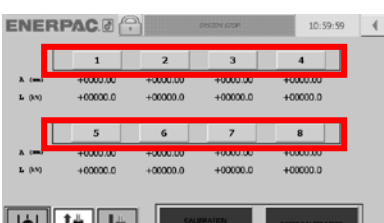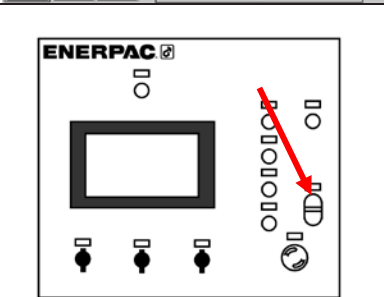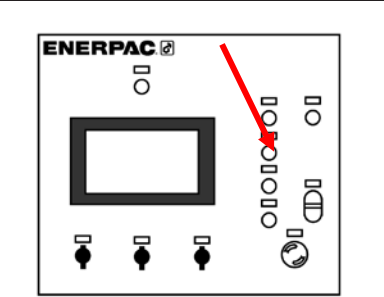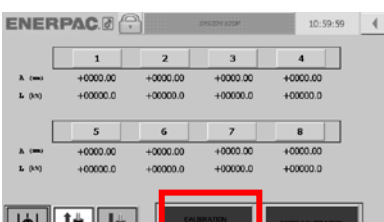
All cylinders must be calibrated before to start a new application with the exception showed in the picture (when the stroke sensor is hooked to the load).

8.1.3.1 OPERATION PROTOCOL

1		Ensure that all elements are correctly plugged and does not exist any alarm
2		Ensure that the calibration icon is enabled in the special parameters screen.
3		Go to calibration screen

4		Press Manual button.
5		Press retract button.
6		Select cylinders to move (usually all of them must be selected)
7		Press the start motor button
8		Press Start cycle button in the console and hold pressed it until all cylinders have the plunger retracted.
9		Press calibration button and hold it down during 3 seconds. Real position will change to zero.
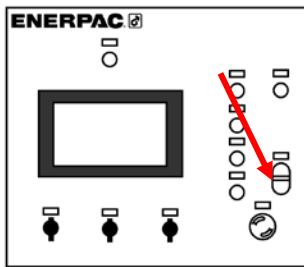
10		Stop the motor if desired.
11		Sometimes may be some error in the calibration. In that case push reset calibration and restart the calibration steps again
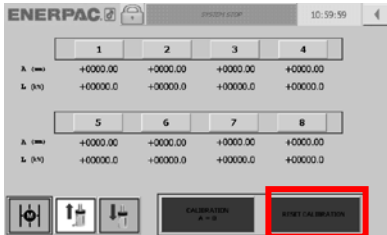
8.2 MOVEMENT PROTOCOLS
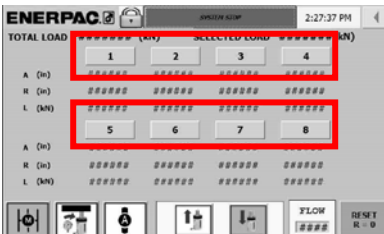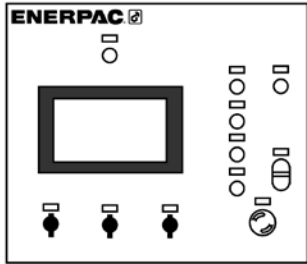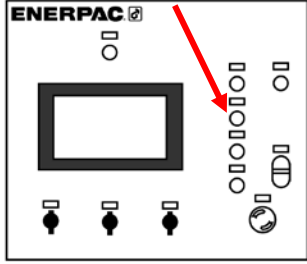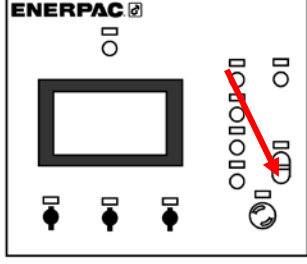
8.2.1 MANUAL MODE
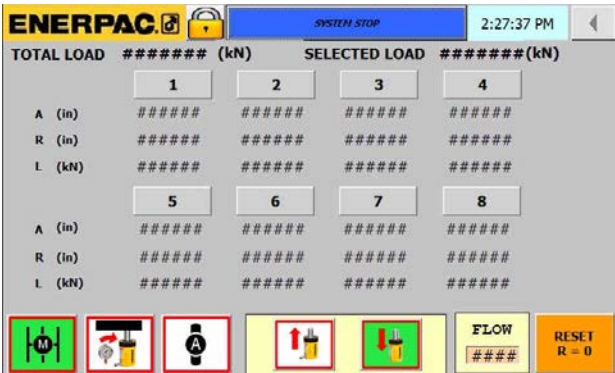
The synchronization system can be used in the manual mode. The operator can select the operation to do extend or retract of all cylinders.

8.2.1.1 OPERATION PROTOCOL

1		Ensure that all elements are correctly plugged and does not exist any alarm
2		Go to manual screen
3		Press manual button.
4		Select the cylinders movements extract or retract the plunger.

5		Select cylinders to move
6		Press Start motor button in the console.
7		Press and hold down the Start cycle button. Cylinder will start to move extending until button be released.
8		When cylinders are positioned in the desired position, release cycle button and press Stop motor button

8.2.2 PRE-LOAD MODE
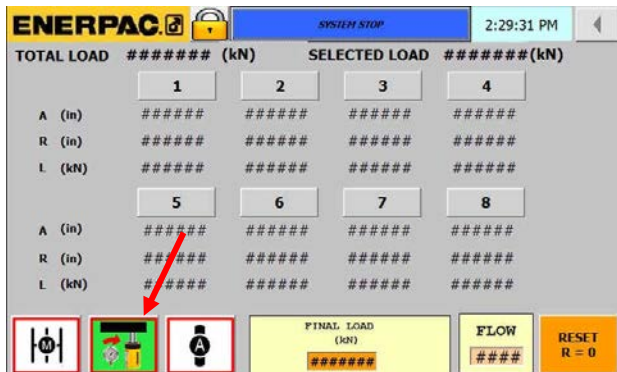
This mode is used to have the first contact with the object which is going to be lifted.
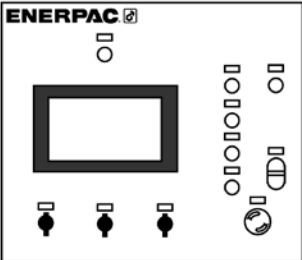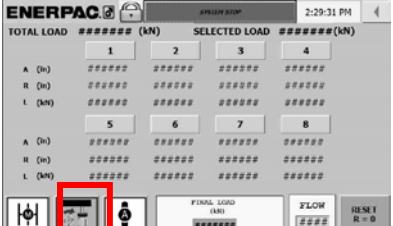
As most of the loads that are going to be moved have an irregular contact surface, it is difficult to define with the position sensor, which is going to be the motion start zero.
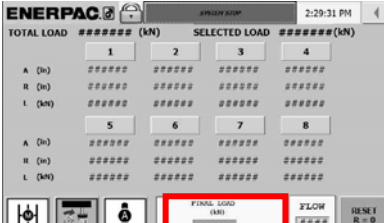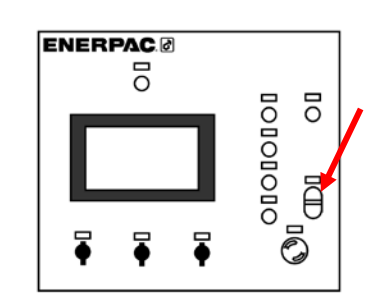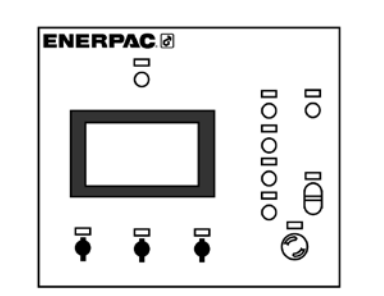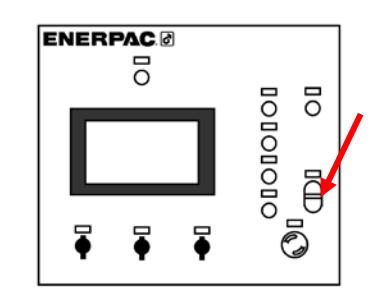
We have the load mode for this purpose. This work mode allows us set a load limit for each cylinder.

When each cylinder reaches this limit the system stops moving it.

For example, in a series of active cylinders, we want to reset when they achieve a small preset load (e.g. 200 KN). When each of the cylinders reaches this load, it will stop moving, and we can then create a common reference point for each of the position sensors (relative zero).

8.2.2.1 OPERATION PROTOCOL

1		Ensure that all elements are correctly plugged and does not exist any alarm
2		Go to pre-load screen
3		Press Load mode button.

4		Type the final load that cylinders must search. When selected cylinders get the typed load, cycle will finish.
5		Select cylinders to move
6		Press Start motor button in the console.
7		When cylinders get the typed load, cycle will finish.
8		Stop the motor if wished.

Now, the system has a real reference of where is the load in the space. When every cylinder are touching the load, the operator can press reset button to have a new zero for the relative position.
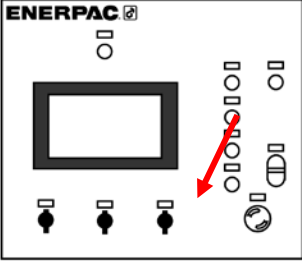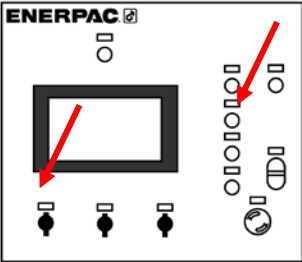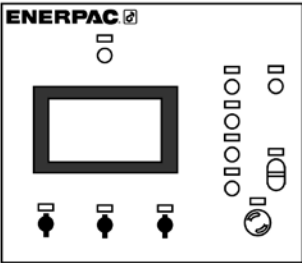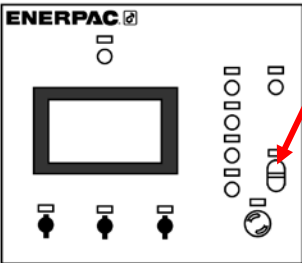
8.2.3 AUTOMATIC MODE
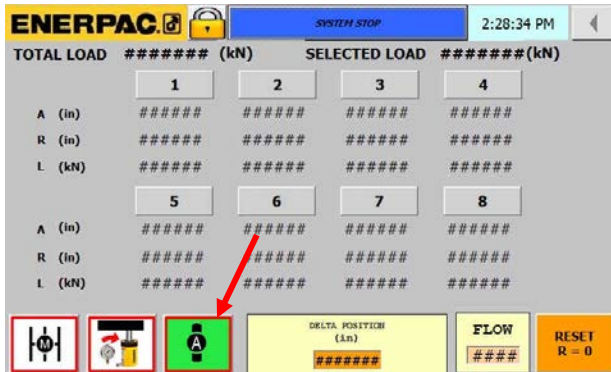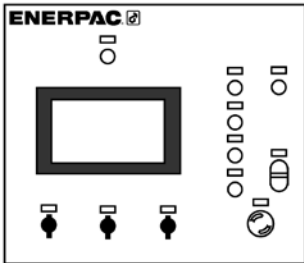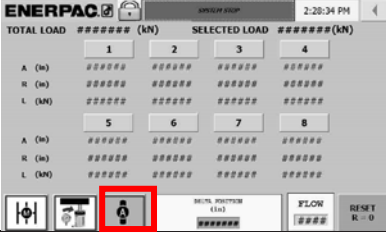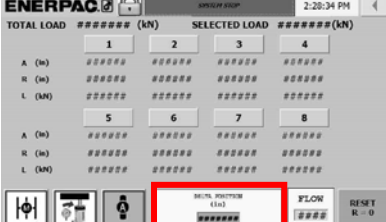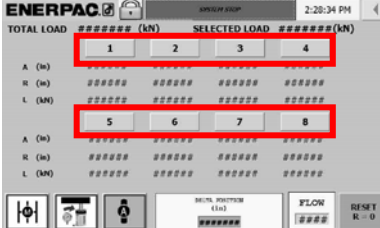
This is the most common working mode, synchronisation by the each cylinder's relative position.
With this method depending on the position each cylinder is in, the system injects oil to try to introduce all the cylinders within the previously established range.

We should type the final length we want the cylinders to reach in the "delta position" box.

8.2.3.1 OPERATION PROTOCOL

1		Ensure that all elements are correctly plugged and does not exist any alarm
2		Go to automatic screen
3		Press automatic button.
4		Type delta position parameter. Delta position is the distance in mm. that the plunger of the cylinders must be moved.

5		Select cylinders to move
6		Press Start motor button in the console.
7		Press start cycle button
8		When cylinders get the delta position, cycle will finish.
9		Stop the motor if desired.

8.2.4 LIFTING OR GETING DOWN A LOAD BY STAGES (STAGE LIFT MODE)

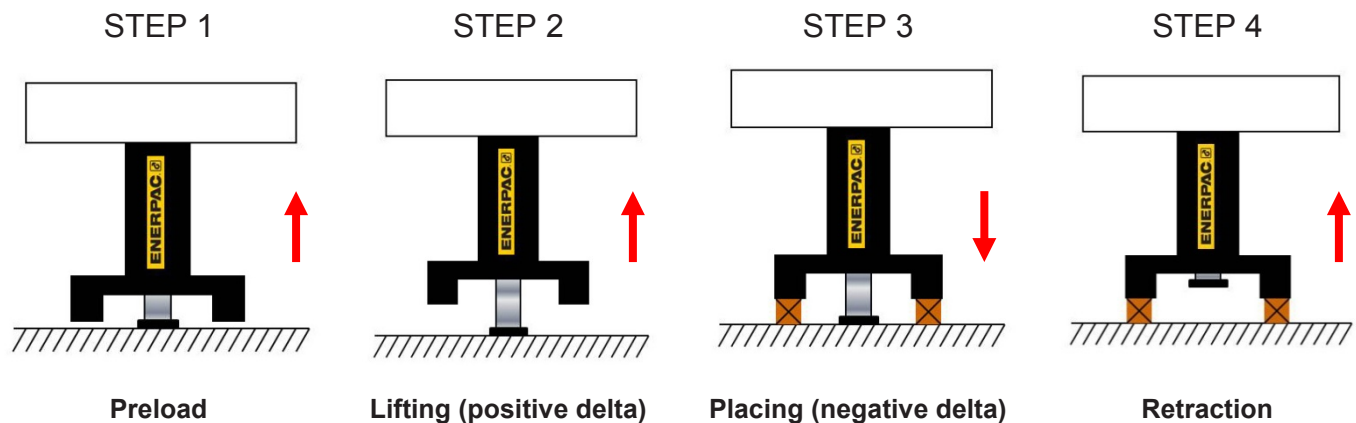Another option of the system is the movement of the load by stages lift

The system can lift or get off the load to height higher than plunger dimension, using for that solid supports whose elevate the cylinder position, as showed in the picture.

The stage lift movement is a semiautomatic cycle that is done in 4 steps. In each step the system ask for the operator confirmation in order to begin the next step.
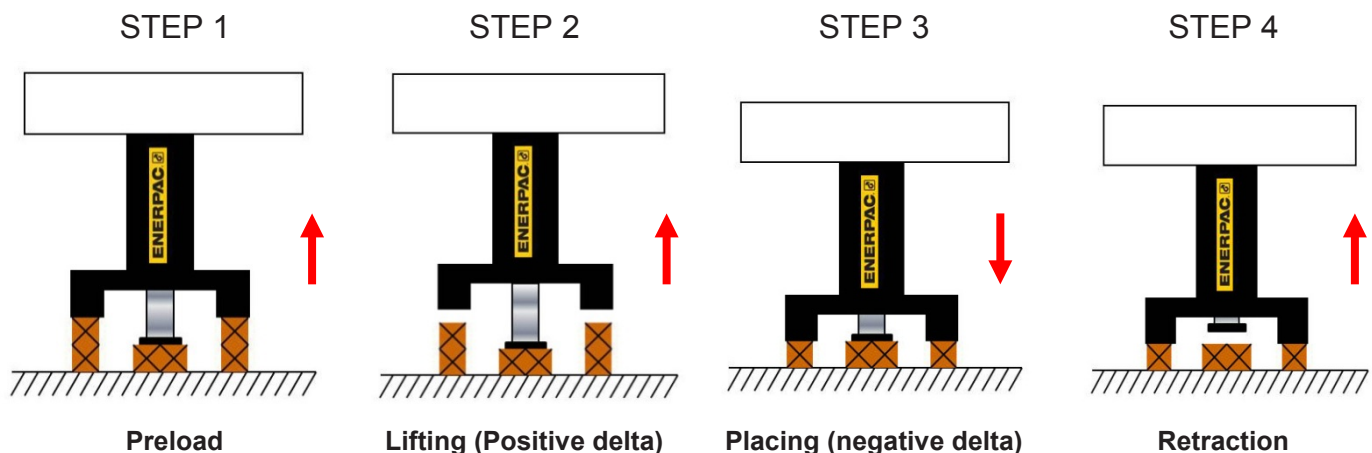
For those kinds of jobs, it is important to have cylinders perfectly calibrated. The references are always according of sensor absolute position. For this kind of jobs, it is recommended use BLS cylinder model, although is allowed use general propose double acting cylinder too.

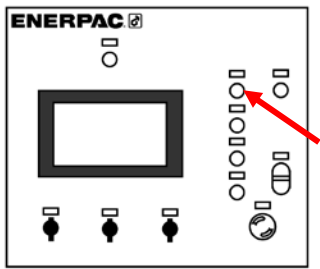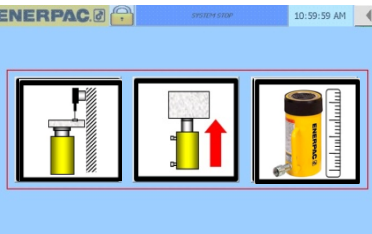In the next graphic is showed the different stages in the lifting and getting off a load.
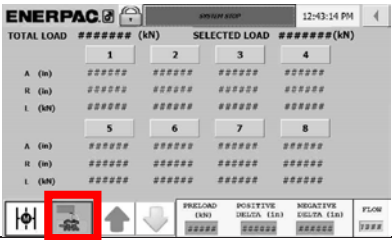
LIFTING A LOAD

STEP 1	STEP 2	STEP 3	STEP 4
Preload	**Lifting (positive delta)**	**Placing (negative delta)**	**Retraction**

LOWERING A LOAD

STEP 1	STEP 2	STEP 3	STEP 4
Preload	**Lifting (Positive delta)**	**Placing (negative delta)**	**Retraction**
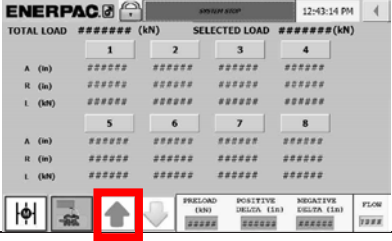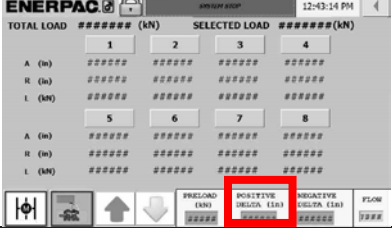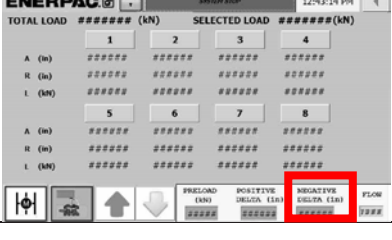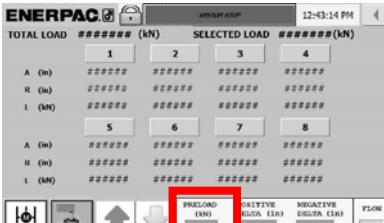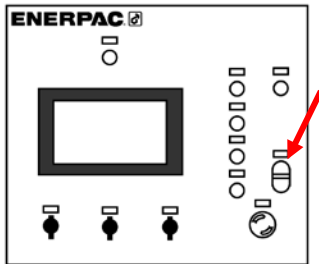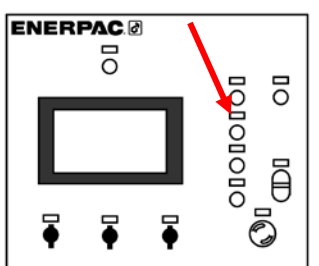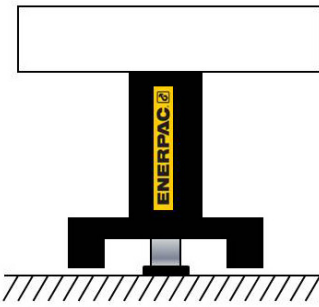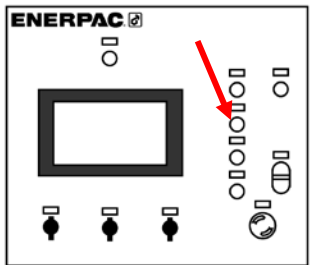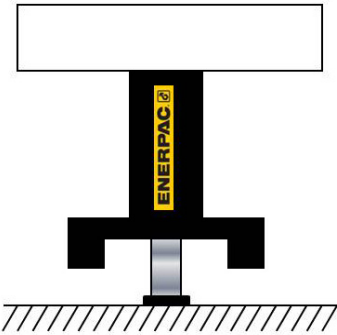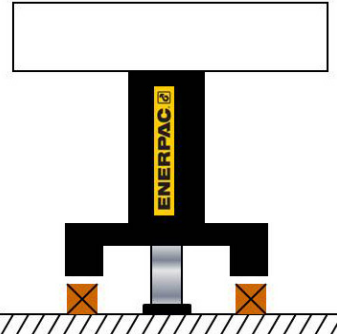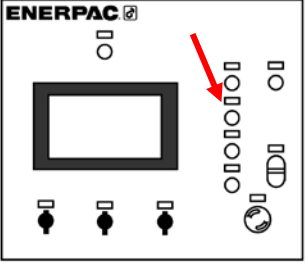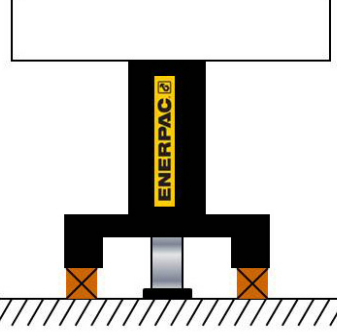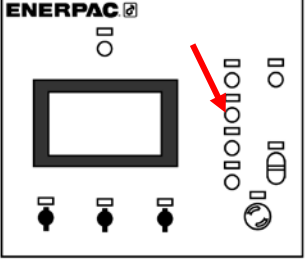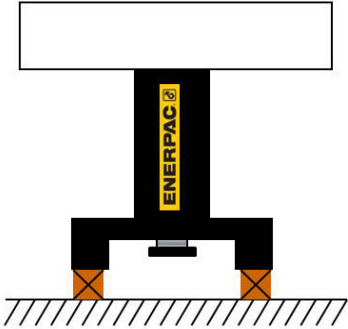
8.2.4.1 LIFTING LOAD PROTOCOL

1		Ensure that all elements are correctly plugged and does not exist any alarm.
2		In BLS special cylinders, stroke sensors make a negative Reading when the plunger is going out. Remember that indirect reading must be selected in this case.
3		Go to stage lift screen
4		Push stage lift button
5		Push up button
6		Type positive delta parameter. This parameter is the distance that load is going to be moved per cycle
7		Type negative delta parameter. This is the distance that load will be moved in step 3 in lifting work mode.

8		Type preload value. Preload must be typed In order to ensure that the plunger is completely touching the load. This means a value to ensure that every cylinder get some of pressure (F.i. a 5% of the load expected by cylinder).
9		Push start motor button
10		Push start cycle button
11		Every cylinder will start to extend the plunger until they reach that pressure value typed in preload. When all cylinders reach preload value, the system will have finish the first stage and will require the operator confirmation for the next step
12		Push start cycle button

13		Cylinders will be extended synchronically until reaching delta position value When all cylinders reach preload value, the system will have finish the second stage and will require the operator confirmation for the next step
14		Set supports in order to lift the level of the cylinders
15		Push start cycle button in order to start the third step
16		Cylinders will get the load off until reaching delta negative position. When all cylinders reach preload value, the system will have finish the third stage and will require the operator confirmation for the next step
17		Push start cycle button in order to start the fourth step
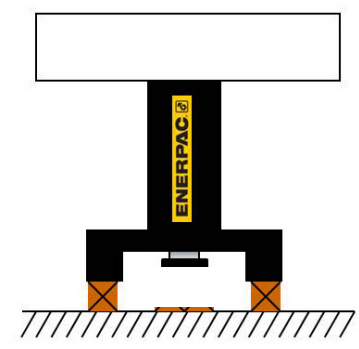
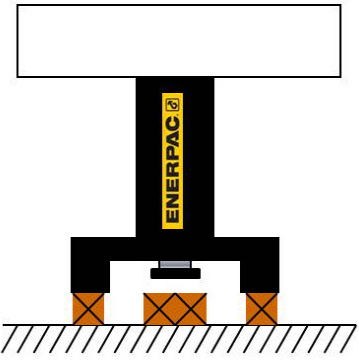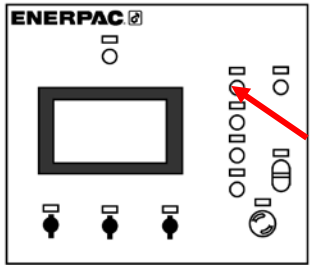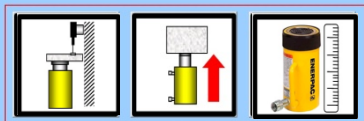| 18		Cylinders will move plunger until the initial position
19		Set the new supports for the next level and start again the cycle.

8.2.4.2 GET THE LOAD OFF PROTOCOL

1		Ensure that all elements are correctly plugged and does not exist any alarm.
2		In BLS special cylinders, stroke sensors make a negative Reading when the plunger is going out. Remember that indirect reading must be selected in this case.
3		Go to stage lift screen

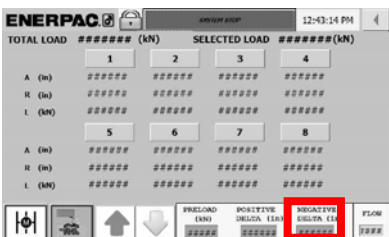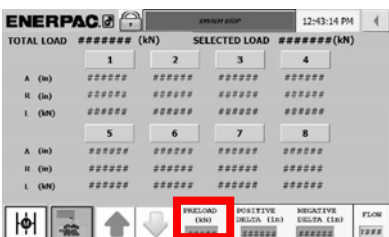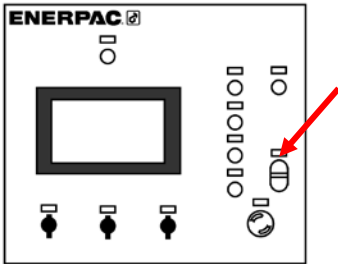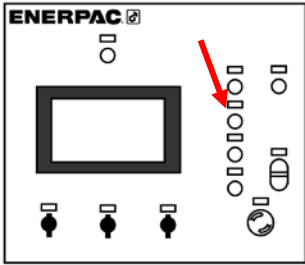|		
4		Push stage lift button
5		Push down button
6		Type positive delta parameter. This parameter is the distance that load is going to be moved per cycle
7		It is not necessary type delta negative parameter in this downloading move. Because the system takes as reference the absolute position of the sensor. The system makes the calculation automatically
8		Type preload value. Preload must be typed In order to ensure that the plunger is completely touching the load. This means a value to ensure that every cylinder get some of pressure (F.i. a 5% of the load expected by cylinder).
9		Push start motor button
10		Push start cycle button

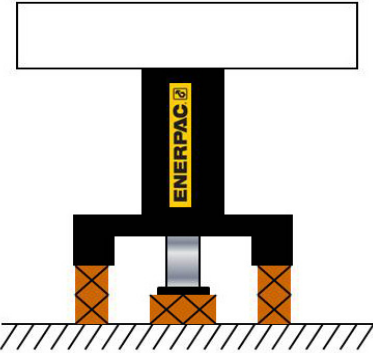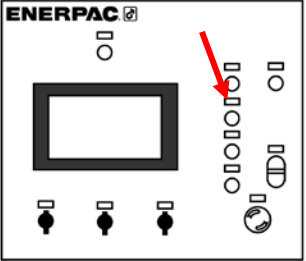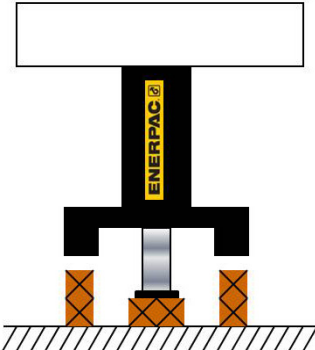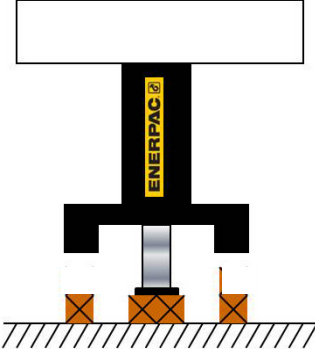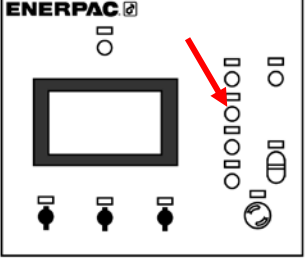| 11		Every cylinder will start to extend the plunger until they reach that pressure value typed in preload. When all cylinders reach preload value, the system will have finish the first stage and will require the operator confirmation for the next step
12		Push start cycle button
13		Cylinders will be extended synchronically until reaching delta position value When all cylinders reach preload value, the system will have finish the second stage and will require the operator confirmation for the next step
14		Take supports off in order to get low the level of the cylinders
15		Push start cycle button to start the next stage

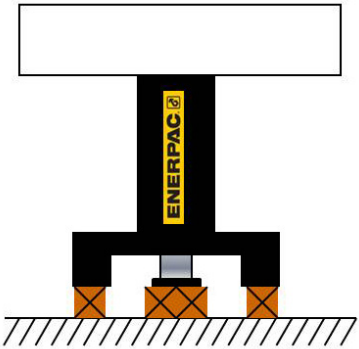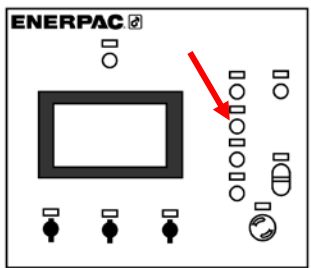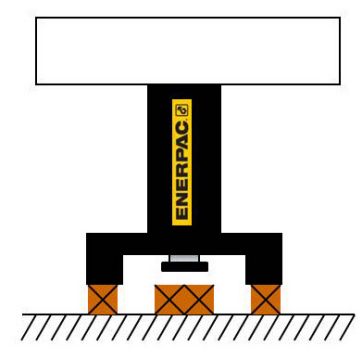| 16 | | Cylinders will get the load off until reaching delta negative position.

When all cylinders reach preload value, the system will have finish the third stage and will require the operator confirmation for the next step |
17		Push start cycle to start the third step
18		Cylinders will move plunger until the initial position.
19		Take supports off in order to start again a new downloading cycle.

8.2.5 TILTING MODE WORK OPERATION PROTOCOL
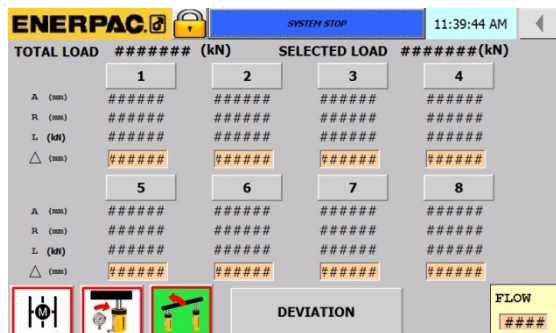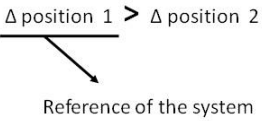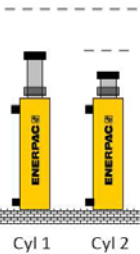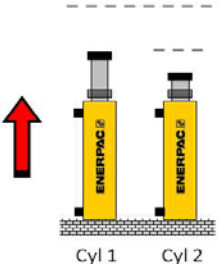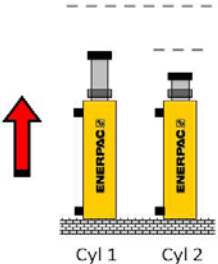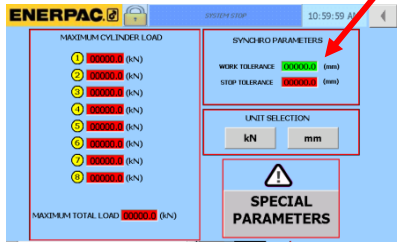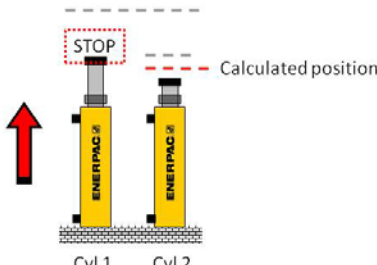
The machine is designed also to move the cylinders with different delta position, therefore different final position and different final stroke. Cylinders can move different stroke of the plungers but synchronized between them.

This explanation describes how the machine works with only two cylinders selected, but this must be useful for working with every cylinder.

8.2.5.1 OPERATION PROTOCOL

1		This is the first stage when cylinders are completely retracted. This is only a single example. Keep in mind that each cylinder could be also in the middle of the stroke for this movement.
2		Machine can get a synchronous movement with different delta position. Select in tiling screen cyl 1 and cyl 2
3		Type in delta position box, the final position that is desired the cylinders be moved. For example type for "cylinder 1" 20 mm and for "cylinder 2" 10 mm.
4		So now cylinder 1 has a delta position 1 and cylinder 2 has its own delta position, delta position 2.
5		The picture shows the final position that cylinders must reach at the end of the movement

6		The system obtains as reference of the movement the cylinder with more delta position typed. So in this example the reference for the system is delta position of cylinder 1.
7		When the movement is being executed, the system is calculating continuously which must be the position of each cylinder. This position is also called "set point" (SP) In order to calculate the set point of each cylinder in the current instant, the system needs have a "conversion factor" (CF). This conversion factor is calculated as follow: Conversion factor (CF) = Bigger delta position / Delta position of each cylinder
8		In this example cylinder 1 is the bigger delta position (20 mm) so, Cylinder 1 conversion factor (CF_1) = 20 mm / 20 mm = 1 Cylinder 2 conversion factor (CF_2) = 20 mm / 10 mm = 2
9		Now the system can calculate the theoretical position of each cylinder through this formula: cylinder 1 set point (SP_1) = Relative position of cylinder 1 / CF_1 cylinder 2 set point (SP_2) = Relative position of cylinder 1 / CF_2 As cylinder 1 CF is 1, always will be in the correct position (Is the reference of the system)
10		So the position of each cylinder should be: Theoretical position of cylinder = SP of each cylinder – work tolerance Work tolerance is set in parameters screen.
11		When cylinder 2 is out of SP_2 calculated, cylinder 1 (cylinder reference) will stop until cylinder 2 gets in to the calculated range (SP – work tolerance).
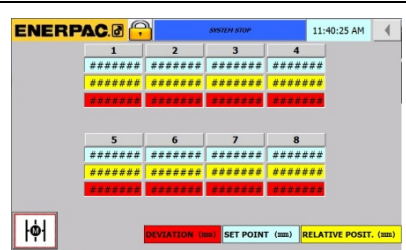
| 12 | | The system shows in this screen the tilting synchronization values.
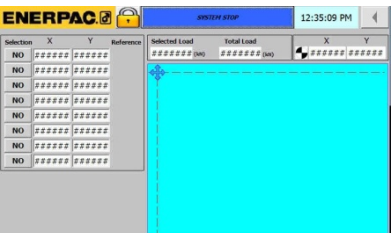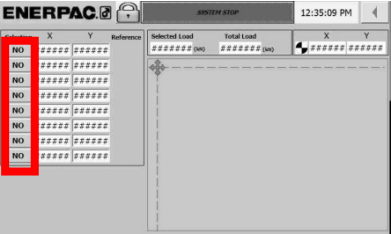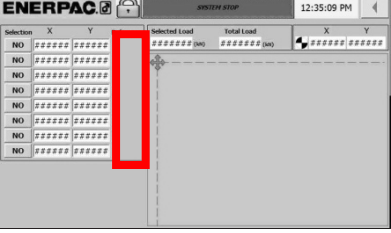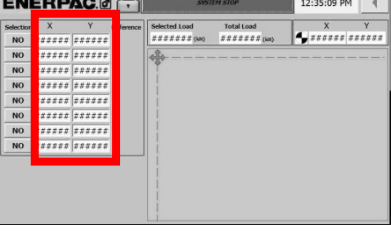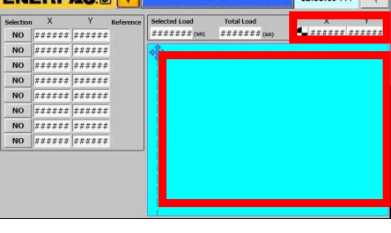
The deviation box shows the difference between the current position of the each cylinder (relative position) and its own set point. |

8.2.6 COG TOOL OPERATION PROTOCOL
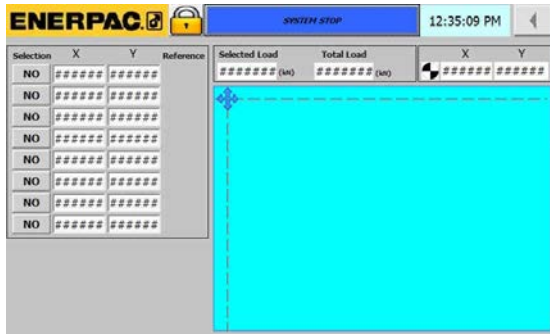
With this tool, the machine can makes the calculation of where is placed the gravity center of the load.

8.2.6.1 OPERATION PROTOCOL

1		Go to COG screen
2		Select the cylinders that are working with the load
3		Select the reference cylinder from which every cylinder will have the position.
4		Take the length of the position of the cylinder from the reference cylinder chosen and type the position in the suitable box
5		The system will make the calculation automatically and will show the position of all the cylinders and the position of the theoretical gravity center

8.2.7 RETRACT FAST OPERATION PROTOCOL

This screen has been designed for those applications that only are used single acting cylinders. When the retraction is due to gravity weight, the cylinders need more time to retract the plunger. To avoid having a person continuously pushing the start cycle button (dead man's button) through this button the operator can leave the hand free for doing something else.

⚠ **When this work mode is operating, always must be a person supervising the movement. It is completely forbidden leave the machine working alone.**.

⚠ **It is important to bear in mind that with this work mode, the valves will be completely opened and will leave to oil flows to the tank free of opposition. Depending on the type of configuration of the application (cylinders, load, hoses, etc.) the load may have an incorrect speed and may cause an incident.**

8.2.7.1 OPERATION PROTOCOL

1		Go to Retract fast screen
2		Select the cylinders that are going to be retracted
3		Push retract fast button.
4		Push start cycle button in the console.

| 5 | | Hydraulic valves will open allowing the oil flow returns to the reservoir freely. |
| 6 | | When all cylinders are retracted, push stop cycle button. |

8.2.8 DEPRESSURIZE OPERATION PROTOCOL
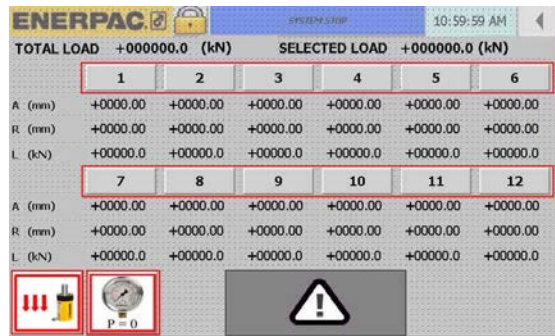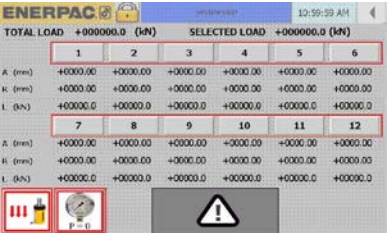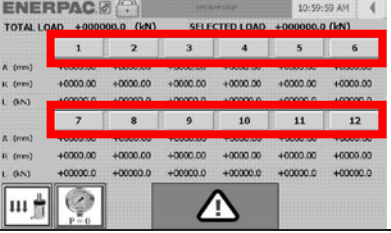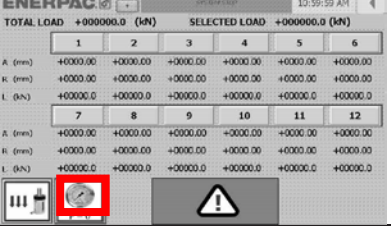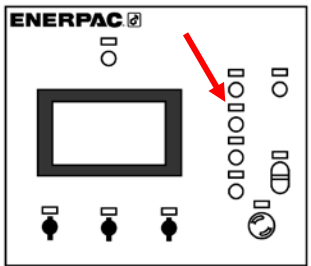
Many times after working with cylinders can remains pressure in hoses and cylinders. When this happens, it is very difficult to disconnect hoses and cylinders. To take the pressure out, push this button and then start cycle in the console

Do not use this button when cylinders are withstanding a load. This button is only allowed use when over the cylinders there is any load.

8.2.8.1 OPERATION PROTOCOL

1		Go to depressurize screen
2		Select the cylinders that are going to be depressurized
3		Push depressurize button.
4		Push start cycle button in the console.
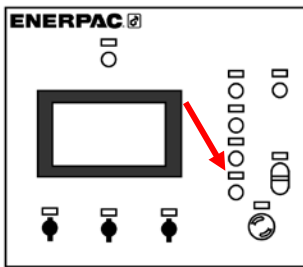
5		When all cylinders are retracted, push stop cycle button.

CHAPTER

9

SYSTEM
ALARMS

9.1 ALARMS DESCRIPTION

The system has been designed with an alarm system to avoid accidents in its manipulation.

There are some parameters that can be typed by the operator in the set up screens (active security system), and other parameters that the system have internally (passive security system).

When any alarm come up, the alarm button on the console becomes red, the "system ok" led on the console switches off and a warning window appears in the screen. If the alarm is a warning alarm, then the movement will carry on normally. But if it is a critical error, then the machine will stop automatically the movement and will wait until the problem be removed.

When any alarm is switched on the warning on the screen will inform to the operator about the characteristics and the origin of the alarm. In the next table the operator can find the alarm and brief advises of how to solve it.

In all the cases that an alarm come up, the operator must find the origin of the alarm, and when the origin of the alarm has been solved reset the alarm pushing red button on the console

Fig 10.1 Alarm button on the console

9.2 SYSTEM ALARMS

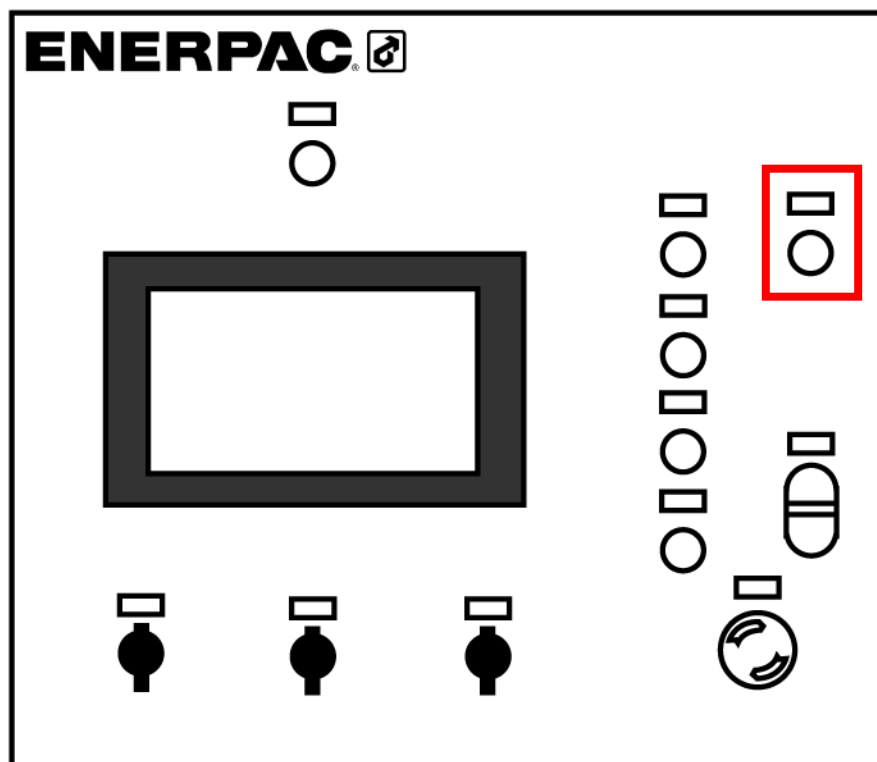| ALARM	TYPE	DESCRIPTION	SOLUTION
Safety Stop: (#)	S (stop)	Safety Stop is activated.	• Deactivate "Safety Stop" button. • Reset alarm.
24V DC Protection Failure	S	The indicated (#) DC protection has been tripped, due to an excessive consumption, overheating, short circuit...	• Open the electrical cabinet and reactivate the DC protection. • Reset alarm.
Stop Oil Level	S	The oil level is too low. Irreparable damage can be caused to the pump if the system is working at this level.	• Check if the oil level is low through the visual level. • If the visual level offers a different reading than the sensor, then the sensor is faulty and must be repaired. • If the oil level on the visual level is low, then refill the tank through the filling cup. • Reset the alarm.
Low Oil Level	W (war.)	The oil level is low.	• Check if the oil level is low through the visual level. • If the visual level offers a different reading than the sensor, then the sensor is faulty and must be repaired. • If the oil level on the visual level is low, then refill the tank through the filling cup, in order to avoid the machine from stopping before the stop alarm is activated. • Reset the alarm.
Motor Overload: (#)	S	The circuit breaker of the indicated (#) motor has been tripped, due to an excessive consumption, overheating, short circuit...	• Open the electrical cabinet and reactivate the electrical protection breaker. • Ensure that the electrical current corresponds to the characteristics of the motor. • Reset alarm.
Motor OFF	S	A start cycle operation has been attempted with the motor off.	• Reset the alarm. • Start the motor.
Maximum Cylinder (#) Load	W	The pressure of the cylinder (#) has exceeded the value entered in the "Maximum working pressure" parameter.	• Check the parameter, considering the load weight and the cylinder characteristics. If it is incorrect, change it. • Check "Effective Area" and "Pressure" spans. If one of them is incorrect, change it. • Reset alarm. The alarm only can be reset, entering a parameter bigger than the cylinder pressure.
Cylinder (#) Pressure Signal Failure	W	The pressure transducer signal of the indicated (#) cylinder is not reaching to the PLC.	• Visually check the pressure transducer and the cable. • Reset alarm.
Cylinder (#) Position Signal Failure	W	The position transducer signal of the indicated (#) cylinder is not reaching to the PLC.	• Visually check the position transducer and the cable. • Reset alarm.
Frequency Inverter Failure	S	Inverter Speed error	• Reset alarm in the inverter. To do so, push the Stop/reset button in the front face of the inverter. • Push reset button in the console.
High Oil Temperature	S	The oil has exceeded the maximum work temperature (65ºC).	• Check if the oil temperature is high through the analogue thermometer of the visual level. • If the thermometer offers a different reading than the sensor, then the sensor is faulty and must be repaired. • If the temperature on the thermometer is high, wait until the oil cools down. The machine should not be exposed to heat sources. • Reset the alarm.

Clogged Return Oil Filter	W	The filtering element of the return filter is clogged.	• Do not work in this state for very long periods. The oil is contaminated and the working life of the pump decreases. Replace the filtering element. • Sometimes an instant depressurization of several cylinders at the same time may cause an overpressure of the return filter and activate the alarm. Check if this is a temporary event, reset the alarm and continue working. • Reset alarm.
Synchronization Alarm	S	In "Synchronization" Mode, the difference between the positions of the fastest and the slowest cylinder is bigger than "Stop Tolerance" parameter.	Check the parameter, considering that "Stop Tolerance" must be at least 3 times the "Work Tolerance". If it is incorrect, change it. • If the "Tolerance" parameters are correct, reset alarm and continue the cycle. • If the alarm is activated again, visually check the • state of the stroke senor and the cylinder.
Impossible To Start Tilting. All Values Must Be Positives or Negatives	S	There are negative and positive tilting values. The movement only can be in one direction	• Adjust Deltas Positions • Reset Alarm
Wrong Selector Local/Remote	S	During the movement the selector local/remote has been changed.	• Avoid change the selector during movements • Reset Alarm
Safety Line Failure	S	In remote mode, the safety line is not correct.	• Check the safety button in all the equipments • Reset Alarm
Maximum Total Load	S	The total sum of cylinder loads (selected and non-selected) has exceeded the value entered in the "Maximum Total Load" parameter.	Check the parameter, considering the load weight and the cylinder characteristics. If it is incorrect, change it. •Check "Effective Area" and "Pressure" spans. If one of them is incorrect, change it. •Check there is no residual pressure in points that have no cylinder installed. If there is, depressurize these points or alter "Effective Area" span, putting it to "zero". • If "Maximum Total Load" parameter is correct, the load weight is bigger than the theoretical value expected in the application. Ask to the engineer about it. •Reset alarm. The alarm only can be reset, entering a parameter bigger than the cylinder load.
EXCEEDED WORK TOLERANCE. PRESS RESET	s	The difference between Relative Positions of selected cylinders is bigger than "Work Tolerance" parameter.	Review the Relative Positions of selected cylinders. •Reset the Relative Positions. •Reset alarm.

W: Warning alarm
S: Stop alarm

CHAPTER

10

MASTER CONTROL DESCRIPTION

10.1 GENERAL DESCRIPTION

Master control is the device that allows manages up to 4 powerpacks at the same time (this means up to 32 cylinders).

From this control the operator can have the total control over the pumps and their own parameters.

In order to work with this device the operator must be aware that all the connections are plugged following the suitable scheme and the remote / local selector in each powerpack with remote way selected.
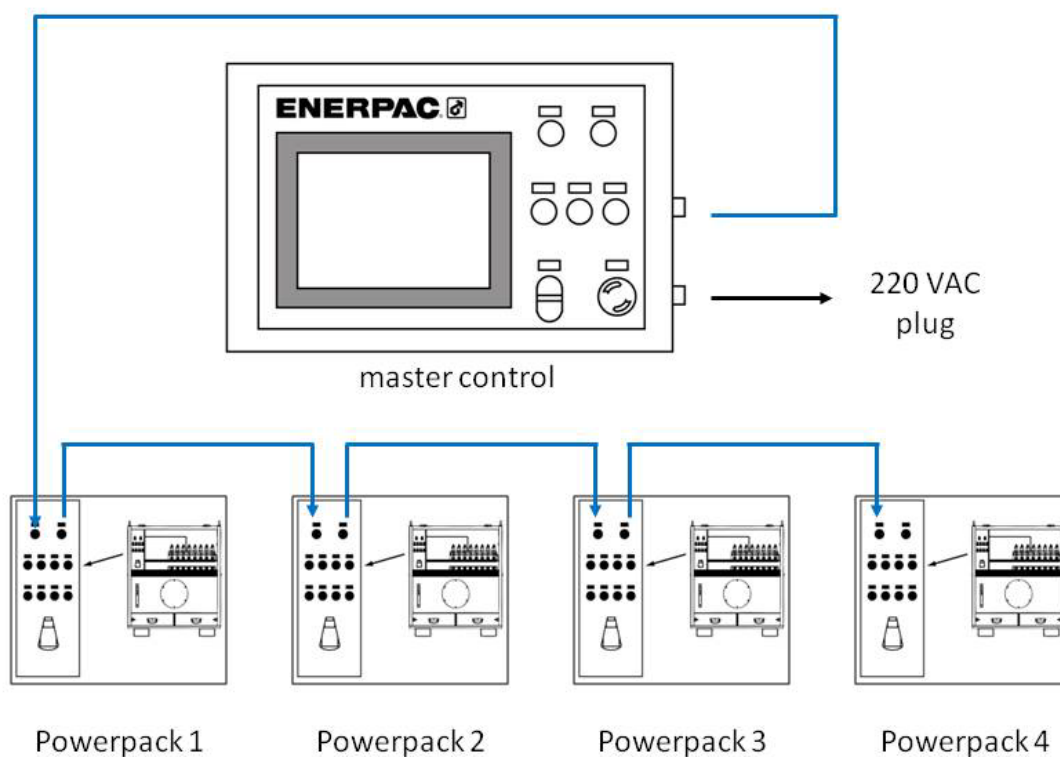
When the decision of the powerpacks order has been taken, then the operator must be type in each powerpack in the network screen the number of the pump.
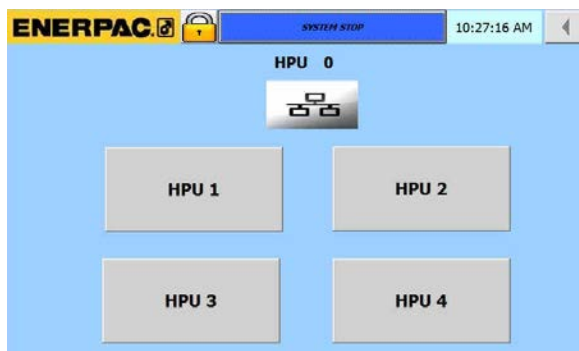
10.2 MAP OF SCREENS

Master control has a similar map of the screens have basically the same structure than the single powerpack. The only thing that changes is the visualization. In the powerpack the operator can see the elements of the powerpacks connected. For a explanation of each screen see the description of the screens in the chapters concerning to the descriptions of a single powerpack screens.
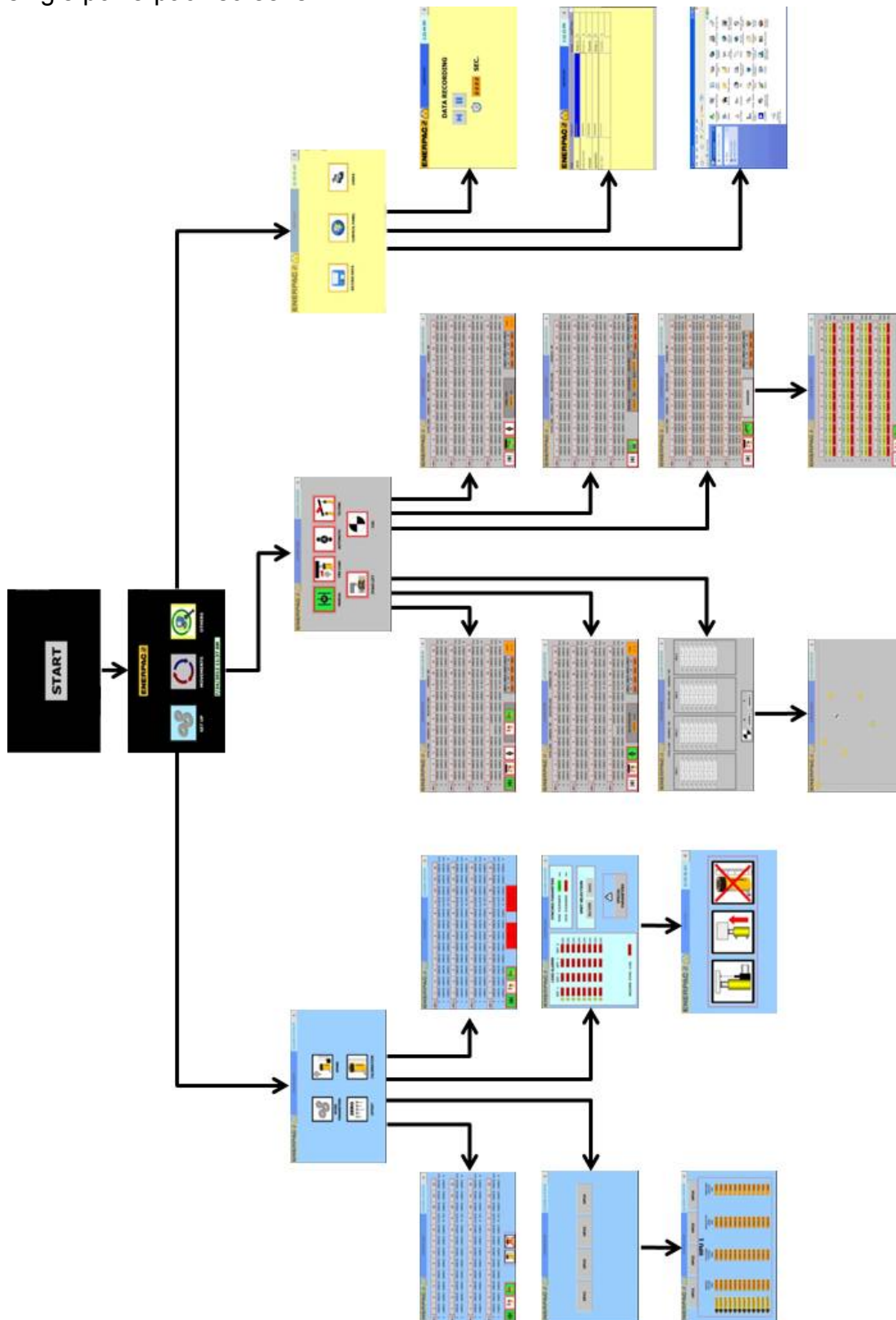
MAINTENNANCE

11.1 PREDICTIVE MAINTENANCE

In order to anticipate any kind of breakdown, it is necessary to carry out predictive maintenance, forecasting the wear and tear of the basic elements. The most important points to take into account when performing predictive maintenance are:

11.1.1 OIL CHANGE

Oil changes should be carried out every 8,000 hours of operation (in a production chain) or after one year of operation (in construction). These figures are only a guide, as the frequency will depend on the type of work carried out, the degree of pollution the machine is exposed to and its frequency of use. In general, the most evident sign of maximum oil contamination is when you find large particles in the oil filter when this is changed or the filter needs changing more often than usual.

It is recommended that the aspiration and return filters are changed together with the oil change.

11.1.2 FILTER CHANGE

The filters need to be changed every so often. Some filters have obstruction sensors that indicate on the machine's display when the filters are dirty. If the filter does not have this mechanism, a disproportionate increase in the return pressure (reading obtained with the pressure gauge) indicates that the filter is blocked.

11.1.3 SPARE PARTS

It is convenient to have certain top quality spare parts for rapid repairs in the event of a breakdown. Below are some that should be taken into consideration:

> Spare hydraulic hose
> Rapid coupler female
> Rapid coupler male
> Electrical cable
> Electrical connector
> Spare return filter
> Electro-valve exterior mounting seals
> Teflon insulating tape

11.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists in periodical checking of certain elements of the circuit to prevent their wear and eventual deterioration. Enerpac recommends carrying out preventive maintenance on the following elements:

11.2.1 COUPLERS

Before making any connection, clean each coupler (male and female) thoroughly to avoid introducing impurities in the circuit. Make sure the couplers are screwed fully tight to ensure free flow.

11.2.2 HOSES

Hoses must be kept free from folds or protected from flattening. Each hose should be visually checked for leaks before and after each use of the machine.

11.2.3 RESERVOIR

The oil in the tank should be changed at least once year. The following indications describe how to change the oil:

> With the machine switched off, remove the oil filler cap to make emptying easier.
> Remove the emptying cap in the lower part of the tank.
> Collect the oil in an appropriate recipient.
> Once the tank is completely empty, open the inspection cover and clean the tank thoroughly as there will probably be impurities stuck to the bottom of the tank.
> Change the aspiration and return filters.
> Once all the elements have been replaced, close the inspection cover and fill the tank with oil to the appropriate level.

11.2.4 FILTERS

It is advisable to change the aspiration filter with each oil change, as it is otherwise not accessible. The filter comprises one piece and, therefore, it does not have a removable mesh and the whole filter must be changed. It can be replaced from the plate that supports the motor, loosening the plate screws and lifting up the whole motor unit.

The return filter should be changed when the dirty filter indicator shows is dirty. You will need a replacement internal filter mesh, which must be appropriate for the specific model of the filter (see documentation in CD). Open the filter and change the filter mesh.

11.2.5 OIL LEVEL

Although the system has different oil level sensors, the temperature and level of oil in the tank should be visually checked on their corresponding indicators before each use.

The other elements in the circuit, given their simplicity, hardly require any preventive maintenance, except for maintaining the cleanliness that a machine of these characteristics requir

11.2.6 PURGING AIR FROM THE CIRCUIT

Purge the circuit after an oil change or whenever you think there may be air in the circuit. The following indications describe this process.

Loosen the air purge screw (do not unscrew it entirely) after filling the oil tank. Turn on the motor and allow the pump to operate without pressure during a short time. Otherwise, move the cylinder(s) a few times, without load, or do this in empty runs until all the functions operate without jerking in the pre-calculated fast operating time

Purging the pump consists of emptying air from the circuit and then filling the suction piping and the pump body with oil to make liquid suction easier.

To prevent suction problems or air entering the cylinders, the circuit must be purged before using the device for the first time or after each periodic oil change. A series of steps is provided below to purge air from the pump:

1- Undo the air purge screw (on the lid plate) completely before filling the fluid tank. This releases air from inside the pump during filling and lets the oil rise without any problems.

2- Switch the pump motor on several times for a short burst in empty mode.

3- With the pump motor running, run through all the possible movements on the hydraulic system in empty mode until these movements produce no shuddering within the pre-set time.

4- Tighten the air purge screw after filling.

⚠ **The tank must be properly full before switching on, but not overflowing. There should be sufficient space under the tank lid for the returning hot oil to be able to expand.**

5- Repeat the operation until the metal noise disappears (showing that the pump is primed).
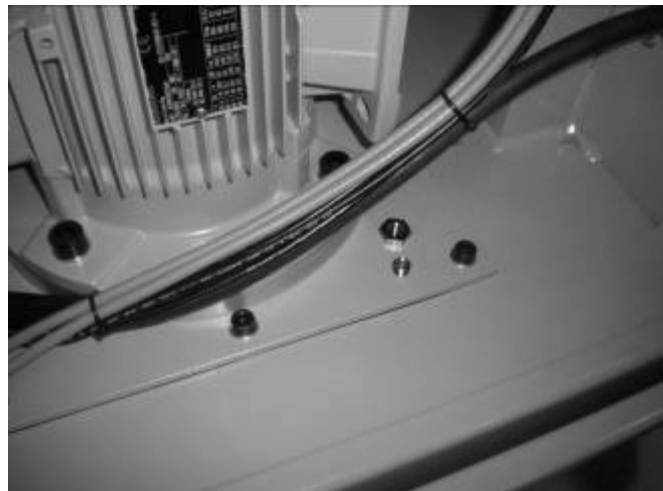
CHAPTER

12

ATTACHED DOCUMENTATION

12.1 ATTACHED DOCUMENTATION TABLE

In this electronic document have been embed the necessary documentation to handle the machine. In order to access to them push in the reference number in the next table:

DOCUMENT NUMBER	DESCRIPTION
DB9049900C.pdf	Main manifold assembly block drawing
DB9118900.pdf	Flow output manifold drawing
DB9119900.pdf	Return flow manifold drawing
DB9120900.pdf	Hydraulic drawing of the base of the HPU
DECLARATION CE.pdf	CE declaration
EC4-40-460.pdf	Electric diagrams
EVO421380ID.pdf	Powerpack assembly general drawing
EVO421380REF.pdf	Powerpack assembly with references drawing
EVO421380086.pdf	Powerpack assembly bill of materials
EVO421380826.pdf	Hydraulic scheme
PUSHING MANUAL MODE.pdf	Flow chart in manual mode, pushing state
RETRACT MANUAL MODE.pdf	Flow chart in manual mode, retract state
RETRACT SYNCHRONIZED MODE.pdf	Flow chart in synchronized mode, retracting state
START MODE.pdf	Flow chart in starting state
SYNCHRONIZED PUSHING MODE.pdf	Flow chart in synchronized mode, pushing state