Operating Instruction Manual: OM-SLV-01	Serial Numbers: All

This 'Original instructions' document assumes that the operator carrying out any operation with this product is trained and competent to do so. This manual does not attempt to cover all details or variations in the equipment. Nor does this manual claim to provide for every possible contingency met in connection with the installation, operation, or maintenance thereof. Should further information be desired, or should a particular problem arise which is not covered in sufficient detail, the matter should be referred to Hi-Force.

OPERATING INSTRUCTION MANUAL

SLV SERIES | SYNCHRONOUS LIFTING SYSTEM - VARIABLE SPEED DRIVE

The Hi-Force SLV Synchronous Lifting System with Variable Speed Drive is designed for precise lifting and lowering of heavy loads, using multiple synchronised hydraulic cylinders. The system can maintain a tolerance across all cylinders of as low as 1mm. Available as standard with up to 32 outlet ports for single-acting or double-acting cylinders and a variable speed motor for better operational speed control. In high-pressure mode, the pump delivers 4.8 lpm of hydraulic oil at a maximum operating pressure of 700 bar (10,000 psi). This manual applies to the Hi-Force SLV Synchronous Lifting System with Variable Speed Drive. It contains the latest product information available at the time of publication and approval. For information relating to the servicing of a synchronous lifting system pump, see the servicing instructions, which are available on the Hi-Force website. Hi-Force reserves the right to make changes to this document at any time without notice.

Table of Contents

NOTE: Images contained within this document are for illustrative purposes **ONLY**.

1.0 Inspection upon Receipt

Upon receipt of the product, visually inspect the item for any evidence of shipping damage. Please note: the warranty does not cover shipping damage. Notify the courier immediately if shipping damage is found and refrain from putting the product into service. The carrier is responsible for repair and replacement costs resulting from damage that occurred in transit.

2.0 Safety Precautions

2.1 Introduction

Read and follow all the instructions and safety warnings carefully before handling, installation or use of any hydraulic equipment. Failure to do so could lead to equipment damage, equipment failure, personal injury or even death. Hi-Force will not be held responsible for any damage to the equipment, injury or death resulting from the unsafe use of, lack of maintenance to, or incorrect operation of the product. If in doubt on the correct use of any Hi-Force equipment, contact your nearest Hi-Force office or distributor. Only qualified personnel should be allowed to operate hydraulic equipment. If an operator has not been trained on high-pressure hydraulic equipment and its safe usage, consult your local Hi-Force sales office or distributor who can offer training courses for operators.

⚠ CAUTION! Failure to observe and obey the following safety precautions could result in property damage, equipment damage or minor / moderate personal injury;

2.2 Work Area Safety

- Keep work areas clean and well lit. Cluttered spaces and inadequate lighting can result in unnecessary accidents.
- Keep bystanders clear of any hydraulic tool activity. Personnel working in close-range should be made aware of all high-pressure work before commencing.
- Ensure that the lifting device/s are placed entirely under the load and that lifting is parallel.

2.3 Electrical Safety Precautions

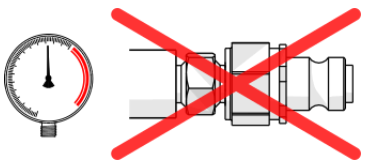
- Electrical power plugs / sockets **MUST** match the power source outlet socket. Never modify electrical power plugs or tool / equipment electrics.
- **DO NOT** abuse cabling. **DO NOT** use electric cables to carry, move or disconnect tools. Make sure electrical cabling is clear of heat sources, sharp edges or moving parts.
- When using the unit outdoors, use a suitably rated extension lead (if required) to reduce the risk of electric shock.

2.4 General Hydraulic System Safety Precautions

⚠ WARNING! Failure to observe and obey the following safety precautions could result in property damage, significant personal injury or death;

- When operating any hydraulic equipment, all operators should ensure that all necessary personal protective equipment (PPE) is worn, as specified by their employer. Steel toe-cap safety shoes, safety glasses / visor, ear protection and protective gloves should be worn at all times. All relevant risk assessments should be completed before the use of the equipment.
- Keep hydraulic equipment away from open flames and direct heat.
- **NEVER** use a coupler as a tool handle, especially if the system is pressurised.
- Inspect hoses regularly for damage and wear.
- **NEVER** use hoses that are frayed, kinked, abraded or leaking.
- **NEVER** handle a pressurised hydraulic hose. Hydraulic fluid escaping under pressure from a ruptured hose can penetrate the skin and lead to a significant medical emergency, and in some cases, death. Should this incident occur, seek out medical attention immediately.
- Seek medical attention immediately if a hydraulic injection injury (no matter how minor) occurs.
- The system operating pressure **MUST NOT** exceed the pressure rating of the lowest-rated component in the system.

  Good Practice: Use a pressure gauge to monitor the entire system.
- Only use hydraulic tools / cylinders in a complete and tested, coupled system. **NEVER** attempt to use a tool / cylinder that is not correctly coupled to its operational pump.

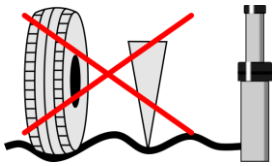


- **NEVER** pressurise an unconnected male coupler/s.
- **NEVER** attempt to disconnect a hose from a hydraulic system until the system's pressure has been completely released. Doing so can result in that pressure becoming trapped within the system and relieving trapped pressure can be dangerous.
- **NEVER** try to relieve trapped hydraulic pressure in the system by loosening or attempting to remove the coupler. Trapped hydraulic pressure can cause a loosened coupler to dislodge unexpectedly with great force. This action could result in serious personal injury or death.
- Loosening a coupler under pressure can result in the escape of hydraulic oil at high pressure, which can penetrate the skin and cause significant injury or death.

- **NEVER** use a hammer and punch to unseat a coupler check valve that is under pressure. Doing so could result in the sudden, uncontrolled release of hydraulic oil at high pressure, which could cause significant injury or death.
- **NEVER** attempt to solve, or clean-up leaks in the system while the system is pressurised.
- Immediately replace any worn or damaged parts using genuine Hi-Force parts only.
- **DO NOT** use any hydraulic equipment if you are under the influence of alcohol, drugs or medication. Lack of attention whilst operating high-pressure hydraulic tools can result in personal injury or death.
- **NEVER** over-stroke failsafe (HFL & HFG) or HSG cylinders. These cylinders are not fitted with a piston stop ring. Equipment failure and injury can occur.

⚠ CAUTION! **Failure to observe and obey the following safety precautions could result in property damage, equipment damage or minor / moderate personal injury;**

- **NEVER** lift, carry or move any hydraulic components by the hose or hoses connected to them.
- Avoid damaging hydraulic hoses. **ALWAYS** route hoses to ensure that they are free from sharp bends and kinks. Using a sharply bent or kinked hose will result in severe back-pressure, which can lead to hose failure.
- **NEVER** use a coupler/s to lift, carry or position a tool.
- Servicing of hydraulic equipment must only be undertaken by a qualified technician.



- **DO NOT** drop or place heavy objects on a hydraulic hose, as this may cause internal damage, which could result in rupture of the pressurised hose. A ruptured hose could cause significant damage to components and possible severe injury to personal operating nearby.
- The manufacturer rated load capacity and stroke length for cylinders represent the maximum safe limits.

  Good Practice: Use 80% of the rated figures, as the maximum values for load capacity and stroke length.

- Select cylinders with sufficient over-capacity. See guidance above.

  For multi-cylinder lifting operations, 50% of the total number of cylinders used should be able to withstand the full weight of the load being lifted / lowered. I.e. The system capacity should be at least twice that of the load being lifted / lowered.

- **DO NOT** let familiarity gained with any hydraulic tools allow you to become complacent. Complacency with any tooling can result in a lack of discipline toward working guidelines and safety principles.

- **DO NOT** remove any labels from the product. Replace any damaged or unreadable labels immediately.
- Avoid loose clothing and jewellery that could get caught in moving parts, tie back long hair.

2.5 Synchronous Lifting System Specific Safety Precautions

⚠ WARNING! Failure to observe and obey the following safety precautions could result in property damage, serious personal injury or death;

- **DO NOT** mix high-pressure and low-pressure components. All equipment must be rated for the same operating pressure. I.e. 700 bar (10,000 psi)
- **NEVER** exceed the maximum rated capacity of any SLV system. Hi-Force manufactures its SLV unit to operate at a maximum working pressure of 700 BAR (10,000 PSI). Overloading hydraulic pumps can result in component failure and possible serious personal injury.
- **DO NOT** connect hydraulic equipment with a lower pressure capacity rating to any Hi-Force Pump of this model series.
- **DO NOT** weld any items to the unit or modify it in any way from its delivered condition. Your warranty may be invalidated, and it could lead to serious personal injury.
- Only use hydraulic cylinders in a complete and tested, coupled system. **NEVER** attempt to use cylinders that are not correctly coupled to their operational pump.
- **NEVER** attempt to connect or disconnect, hydraulic equipment while the system is under pressure.
- **NEVER** leave a pressurised system unattended. If you must leave the area, release the pressure and ensure the hydraulic release valve on the pump unit if fully open.
- This pump is **NOT ATEX RATED**. I.e. **NOT** suitable for work which takes place in explosive environments.

⚠ CAUTION! Failure to observe and obey the following safety precautions could result in property damage, equipment damage or minor / moderate personal injury;

- **ALWAYS** stand the equipment on a stable, level surface during operation.
- **BEWARE** of hot surfaces on the motor. **DO NOT** obstruct the flow of cooling air around the motor.
- To protect your warranty, only use the hydraulic oil grade specified in Section 5.2.

3.0 Declaration of Incorporation / Conformity

Hi-Force declares that this product has been tested and complies with the standards set out in the relevant EU directives. The EU Declaration of Incorporation / Conformity is included as Annex A to this instruction document and is supplied with all shipments of this product.

4.0 Component Identification

4.1 SLV Pump Unit

1	Hydraulic Oil Drain Plug	**6**	Hydraulic Oil Level Gauge
2	Hydraulic Control Manifold *	**7**	Electrical Control Box
3	Motor	**8**	Hydraulic Outlet Couplings
4	Oil Filler Breather Cap	**9**	Pressure Relief Valve
5	Oil Reservoir	**10**	'Return Line Filter' Pressure Gauge

* Can be configured for single-acting or double-acting cylinders.
For single-acting systems, excess outlets are sealed with blanking plugs.

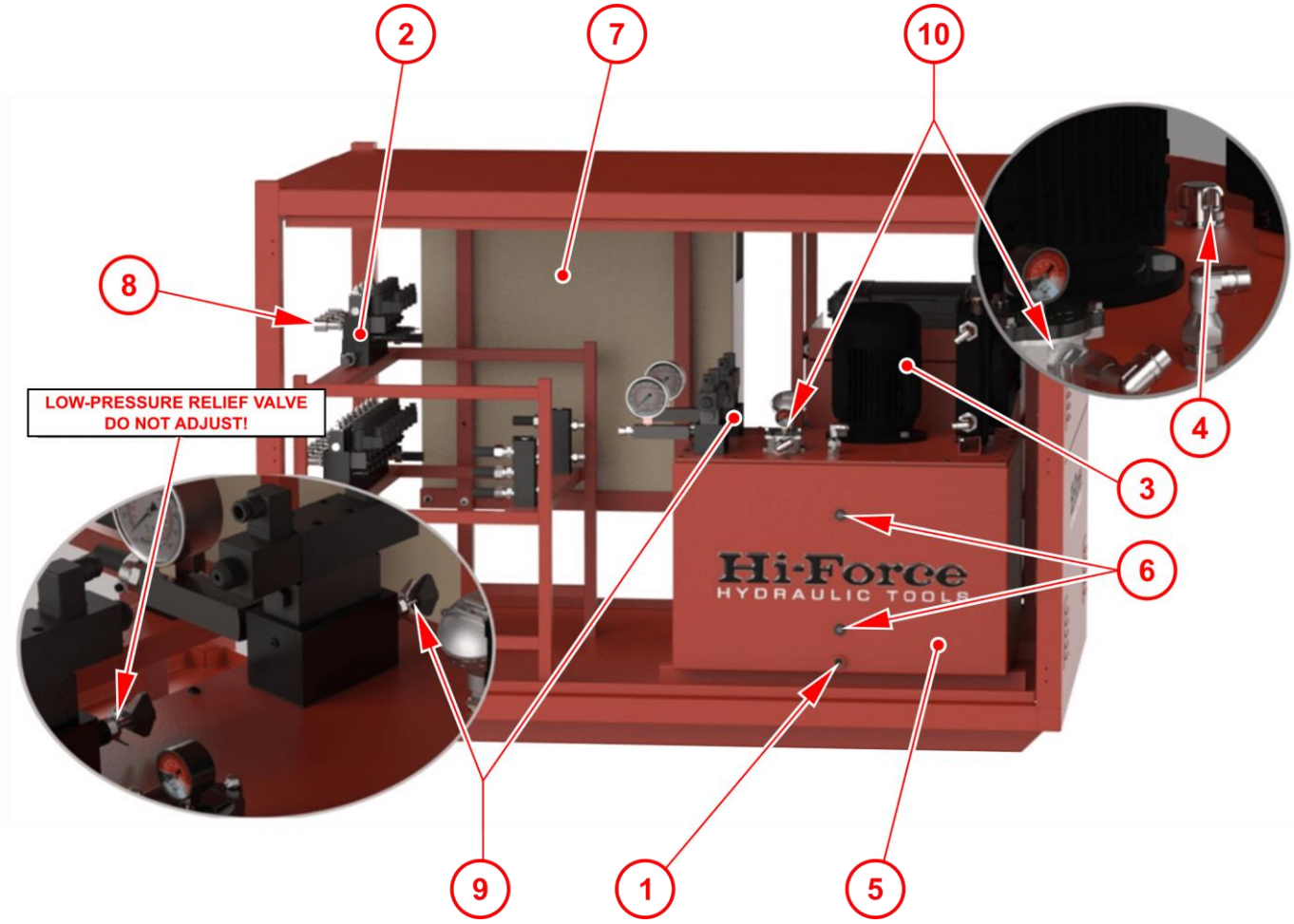


Figure 4.1: Component Identification - Pump Unit
(Illustration Purposes Only)

4.2 Control Unit

1	Control Unit	**6**	Control / Settings Screen
2	Jack / Cylinder Screens *	**7**	Emergency Stop
3	Data Logging “Upload” Port	**8**	Motor ‘Start’
4	Operate ‘Start’	**9**	Motor ‘Stop’
5	Operate ‘Stop’	**10**	Motor Variable Speed Control

* Quantity and Layout dependant on no. of outlet ports.

Figure 4.2: Component Identification - Control Unit

4.3 Cylinder and Displacement Sensor

1	Cylinder Body	**7**	Mounting Kit - Base Plate
2	Female Coupler	**8**	Displacement Sensor
3	Lifting Eye	**9**	Over-Stroke Port *
4	Mounting Kit - Cylinder Saddle	**10**	Advance Coupler
5	Mounting Kit - Cylinder Saddle Bar	**11**	Retract Coupler
6	Mounting Kit - Band	**12**	Pressure Relief Valve

NOTE: For cylinder specific component identification, see cylinder's instructions manual.

* HFL, HFG & HSG cylinder series only.

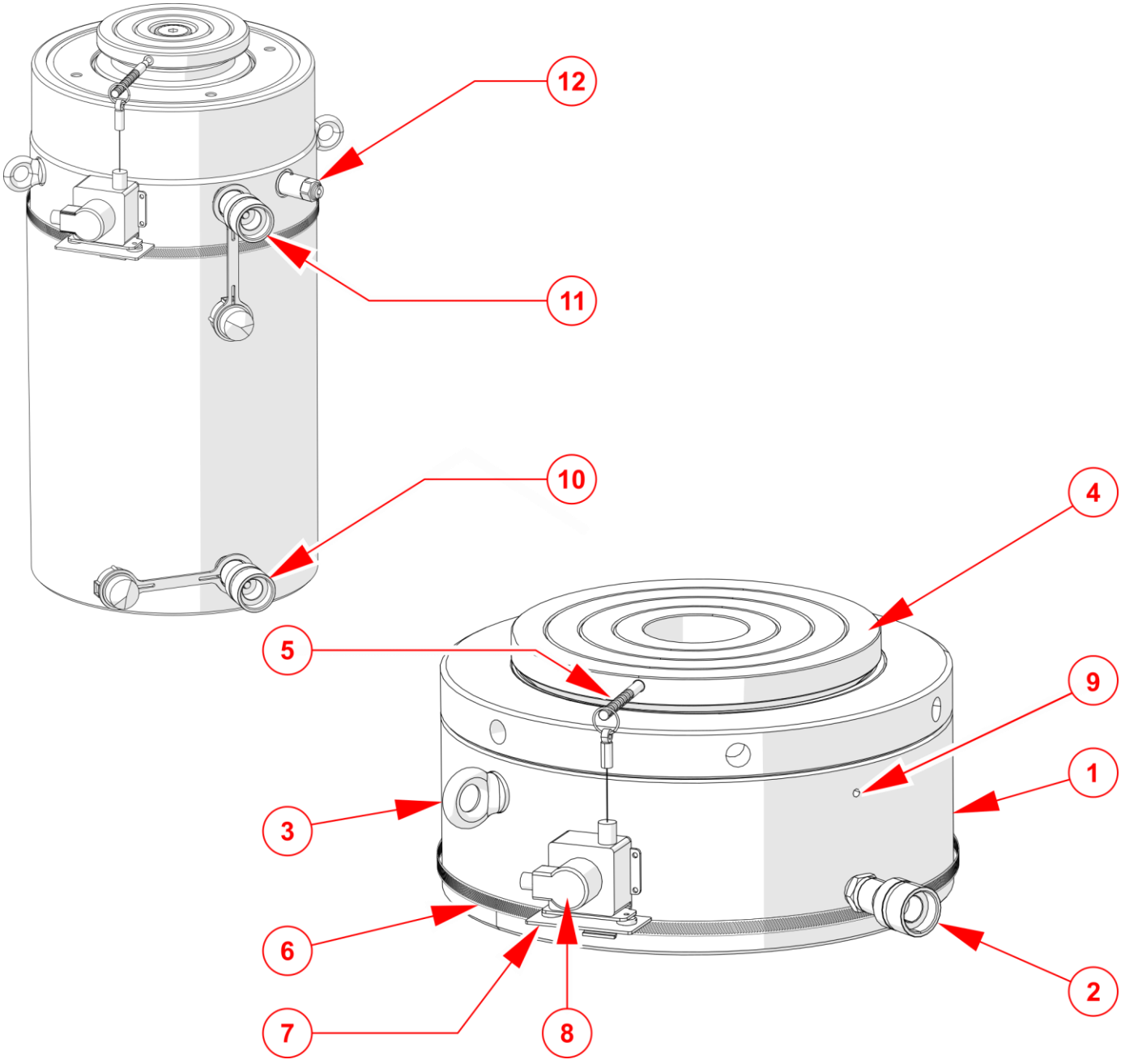


Figure 4.3: Component Identification - Cylinder & Displacement Sensor

5.0 Installation / Setup

IMPORTANT: Images used through-out this manual are for illustrative purposes **ONLY.** Images may display a different system configuration and different tools or accessories to those being used. Additionally, some details may have been removed for clarity purposes.

5.1 Before First Use

1. Immediately after unpacking, examine the unit for signs of transit damage and if found contact the shipping company.

2. Remove the temporary transit fitting / plate which is fitted in the position of the oil filler breather cap (4) and fit the oil filler breather cap which is packed separately.

3. Establish the oil level in the oil reservoir (1) using the level gauge (6). Depending on the shipping method used, the reservoir may either be supplied full or empty. If the reservoir is empty, it must be correctly filled before use (*See section 5.2*). If the reservoir was supplied full of oil, no further action is required.

   IMPORTANT: Running the pump without oil will result in damage.

4. Make sure that the voltage indicated on the motor rating plate corresponds with the available supply.

5.2 Filling the Pump with Oil

IMPORTANT: The SLV Range of Pumps uses **ISO46 Grade Hydraulic Oil.**

- Stand the pump on a firm, level surface.
- Remove the filler cap (4) from the filler breather.
- Fill the reservoir with clean, high-quality ISO46 hydraulic oil via the filler breather until the oil level reaches the upper-level indicator (6).
- Replace the filler cap (4) on the filler breather.

⚠ **CAUTION!** Ensure the oil level does not fall below the minimum level, as shown by the lower-level indicator (6). Running the pump without oil will result in damage.

IMPORTANT: Only add oil to the reservoir when all connected cylinders are fully retracted. Failure to do so will result in the system containing more oil than the reservoir can hold.

5.3 Hydraulic Connections

Connect the hydraulic hose/s between the cylinder/s and the pump outlet/s (8), ensuring that the coupler/s are **fully hand-tightened ONLY**. To do so: [1] Press the male coupler into the female coupler, [2] then turn the threaded-collar clockwise (by hand) until the threads are fully engaged.

⚠ **CAUTION!** **NEVER** use wrenches in an attempt to connect the coupling/s. Incorrectly connected couplers are one of the most common causes of faulty operation.

IMPORTANT: Make sure that all coupler threads are fully engaged. (*See figure 5.1, panel 3*)

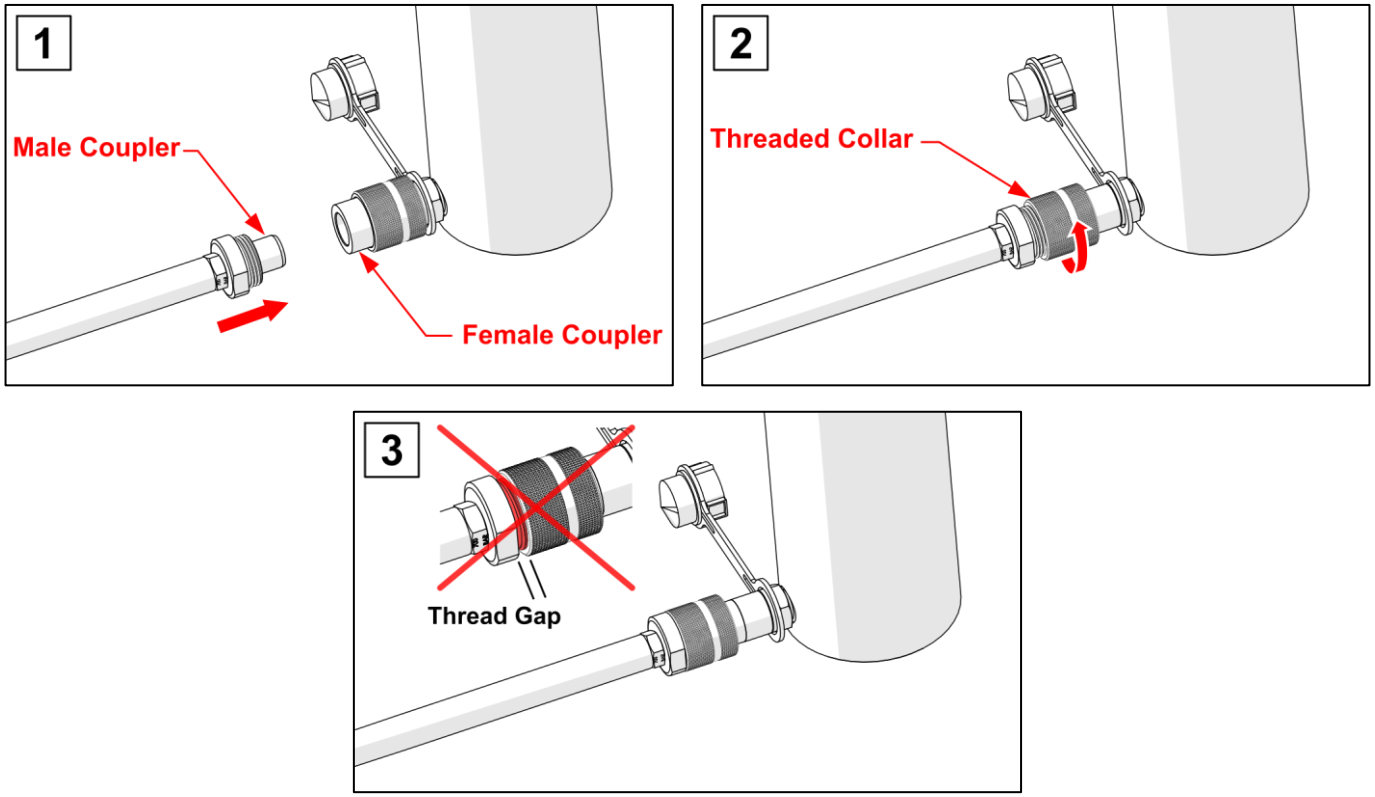


Figure 5.1: Hydraulic Connection

5.4 Connecting Hydraulic Cylinder/s and their Accessories to the Pump Unit

1. Fit the correct, complete (SLMK-*) sensor mounting kit to each cylinder in the system. A detailed table of cylinders and their applicable sensor mounting kits can be found on the Hi-Force website or in the latest Hi-Force Catalogue.

   Fit the Sensor Mounting Kit as follows:

   - Fit the mounting kit saddle (4).
   - If necessary, loosen the Mounting Kit Band (6) until it is loose enough to fit over the cylinder body.
   - Hook the Mounting Kit Base Plate into the Mounting Kit Band and slide the band over the cylinder body. (*See figure 5.2*)

- Fasten the Mounting Kit Band to the cylinder body so that the top of the base plate sits approx. 120mm below the top face of the cylinder body (*See figure 5.3*). This should position the displacement sensor the correct distance below the saddle bar, to achieve the minimum sensor cable extension required for the control unit to register the sensor. (*See step 5*)

- Fasten the saddle bar into the threaded hole on the mounting saddle. (*See Figure 5.3*)

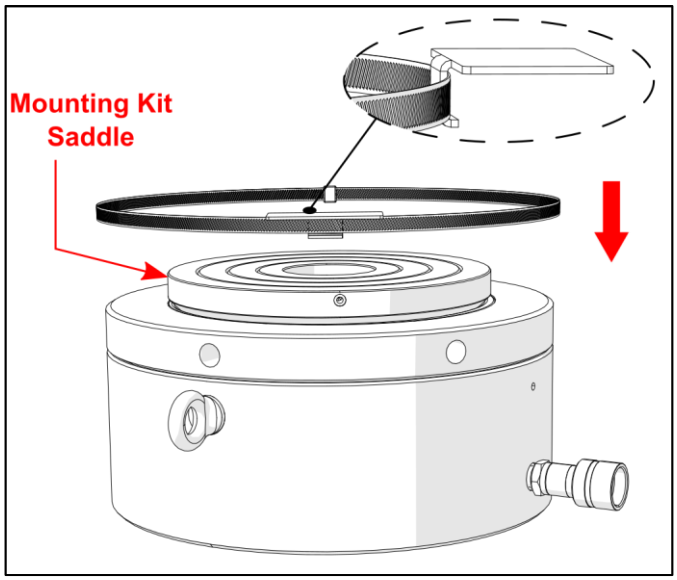


Figure 5.2: Mounting Kit Base Plate Installation.

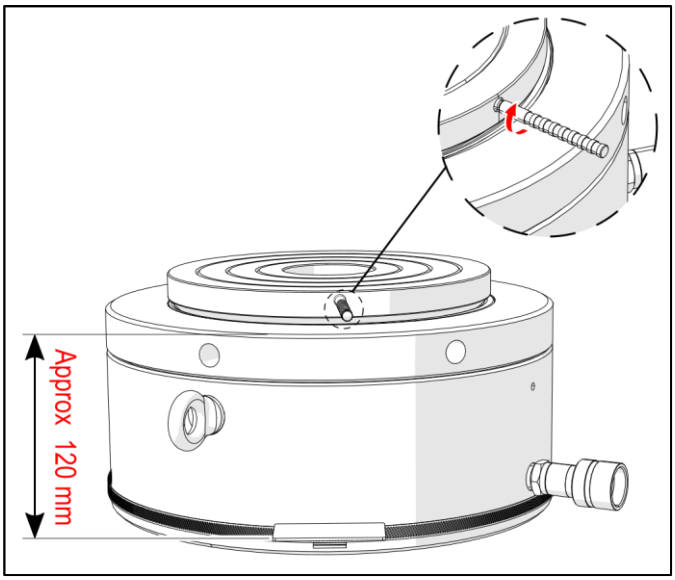


Figure 5.3: Mounting Kit Saddle Bar Installation & approx. Base Plate Position

2. With cylinders setup in their correct operating positions, use Hi-Force HC*C type hoses to make hydraulic connections between the cylinders and the pump (*See section 5.3*).

   The SLV outlet ports are labelled V1 → V#. The outlet port number is important, as it is how each cylinder will be identified by the control unit (E.g. Outlet port V1 will be Jack 1) and it will dictate which electrical socket the displacement sensor of each cylinder **must** be connected to. E.g. The cable from the displacement sensor on the cylinder connected to outlet port V1, **must** be plugged into socket D1 on the electrical control box. (*See Figure 5.4*)

Figure 5.4: Hydraulic outlet port & Sensor Socket Matching

3. Attach displacement sensors to all cylinders fitted with a sensor mounting kit. Magnets on the bottom of the displacement plate connect the sensor to the base plate and hold it in place during operation.

4. Use sensor signal cables to connect each displacement sensor to the corresponding port on the electrical control box. (*See figure 5.4*)

   To connect each cable, line up the keyways on the male and female connector/s for correct orientation and press together. Turn the collar/s on the cable connector/s clockwise to fully engage the connector/s and secure the cable connection/s.

   NOTE: Should the connector/s on the electrical box rotate while fitting a cable, stop and have the connector tightened. Allowing the connector to be rotated excessively will damage the electrical connection to the connector.

5. With all sensors and sensor cables correctly fitted, make the sensor connections between the cylinder bodies and the piston saddle bars. (*See figure 5.5*)

   - Rotate the saddle so that the saddle bar sits directly above the sensor.
   - While holding the displacement sensor body steady, gently pull the sensor wire cable out from the sensor and slip the connector ring over the mounting kit saddle bar. Position the ring on the bar so that the wire cable exits the sensor body as straight as possible. Skewed cable wire can affect the accuracy of the sensor.

     IMPORTANT: DO NOT jerk the wire cable when extending it, or release it and allow the wire cable to retract uncontrollably, as doing so will damage the unit.

     NOTE: When connected to the saddle bar, the wire cable must be pulled a minimum of 20mm from the sensor body. Less than this will result in an 'under range' fault being displayed on the control unit and the pump will not operate with this jack enabled. (*See figure 5.6*)

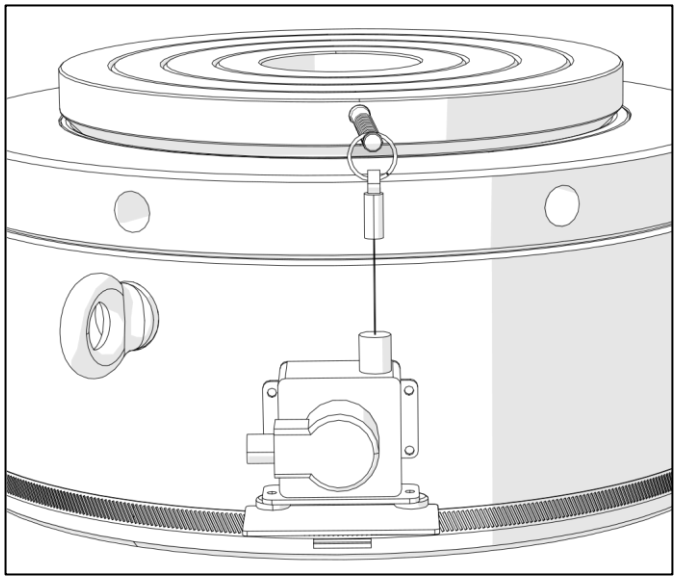


Figure 5.5: Displacement Sensor Mounting (Signal Cable not shown)

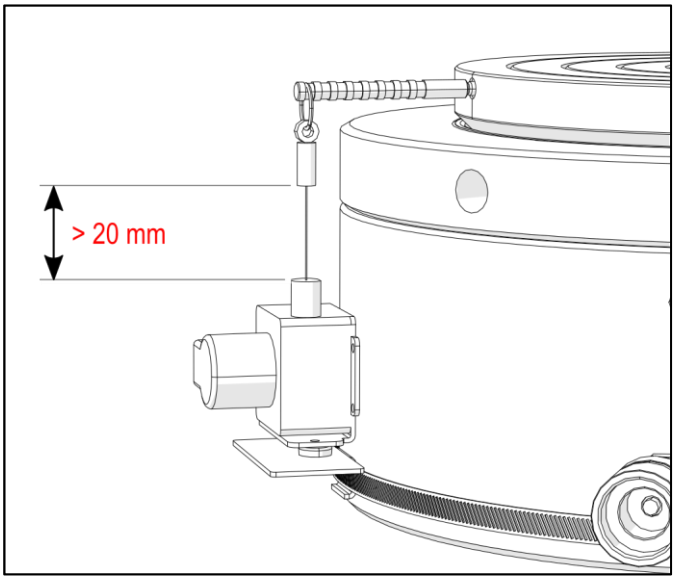


Figure 5.6: Minimum Sensor Cable Extension

⚠ CAUTION! When using failsafe lock ring cylinders, **DO NOT** cover the over-stroke port (*9*) with the SLMK-* mounting kit. Covering the over-stroke port could cause unseen piston over-stroke, overflow of hydraulic oil and pressure build-up between the cylinder and the mounting kit, resulting in cylinder / equipment damage and/or possible serious injury.

5.5 Electrical Connection

Before making an electrical connection, refer to the data plate located on the motor (3) for voltage and current requirements. Once satisfied that the supply is suitable, an electrical connection can be made using the 415V 32A cable 'end socket' provided. (*See figure 5.7*)

NOTE: Supply voltages vary from country to country. Hi-Force pumps will operate within the normal voltage tolerance ranges. But in extreme cases where they are operated for long periods at high pressures and in low voltage conditions, the motor may overheat and shut down.

NOTE: A common cause of pump failure is the use of long extension cables to connect the pump to the mains supply. The pump should be situated as close as possible to the primary power source.

- Pull out the top shelf that the control unit sits on and connect the control unit to the electrical control box with one of the 2 (different lengths) control unit cables provided. (*See figure 5.8*)

Figure 5.7: Mains Connection

Figure 5.8: Control Unit Connection

Figure 5.9: Mains Power Switch

5.6 Bleeding Trapped Air from the System

Hydraulic cylinders and hoses are not always completely filled with oil when new. For safe and efficient operation, the air must be removed (bled) from the system.

Single-Acting Cylinders

It is not usually necessary to bleed air from single-acting cylinders. However, you **MUST** ensure that all hydraulic hoses are pre-filled with oil before connection, to ensure no additional air is introduced into the system.

⚠ CAUTION! **NEVER** over-stroke failsafe (HFL & HFG) or HSG cylinders. These cylinders are not fitted with a piston stop ring. Equipment failure and injury can occur.

Double-Acting Cylinders

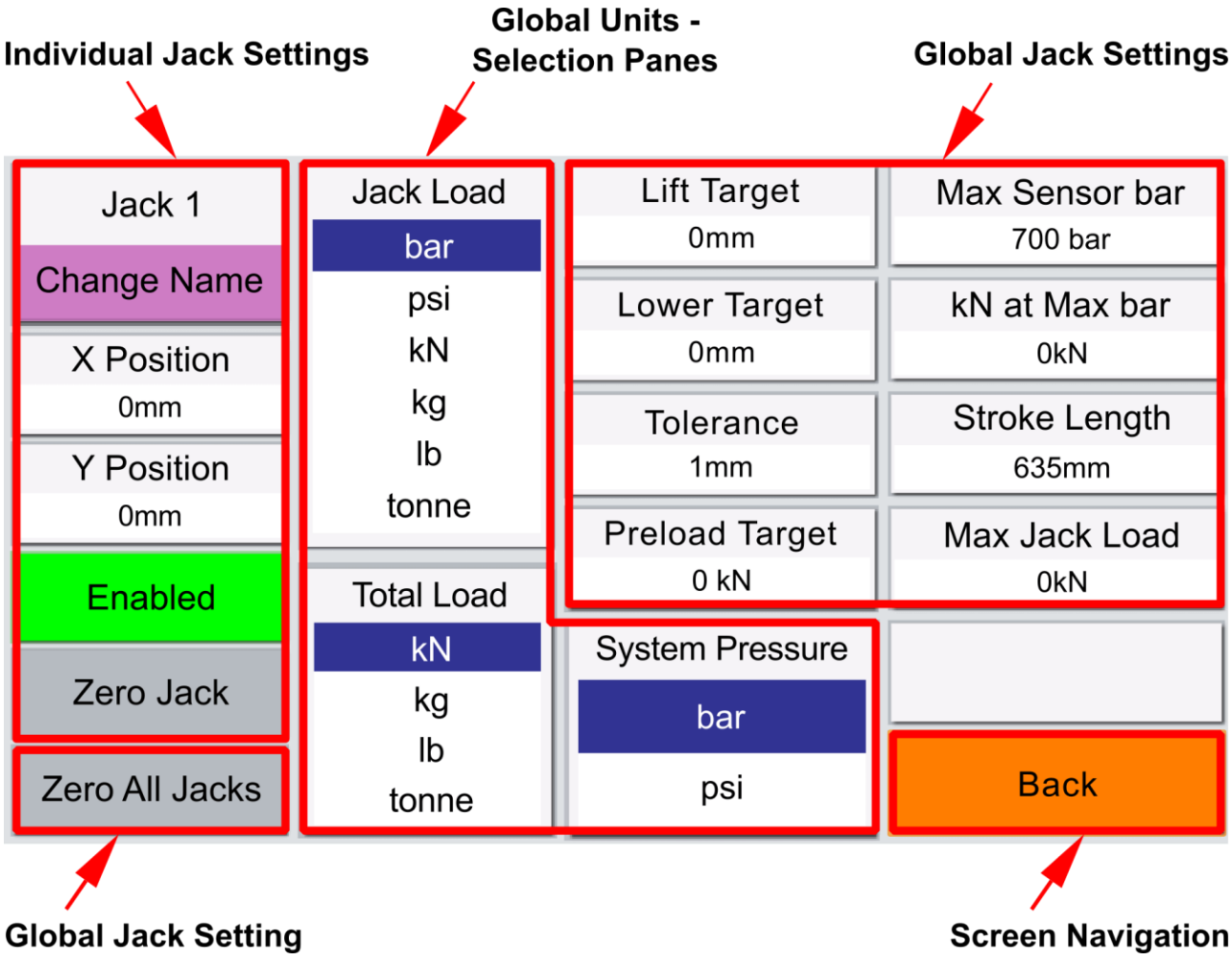
To bleed the air from the system, select manual mode and fully advance & retract the connected jacks / cylinders, **under no-load conditions**. Repeat this process several times until all jacks / cylinders operate smoothly. Visually check the system for leaks. (See section 6.7 for manual operation)

IMPORTANT: Outlet ports (jacks) that are not connected, **MUST** be disabled. (*See section 6.1.3, pg 23*)

6.0 Operation

6.1 Control Unit - Screen Layouts and Button / Panel Functions

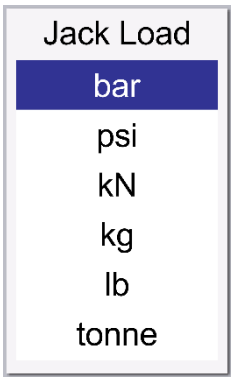
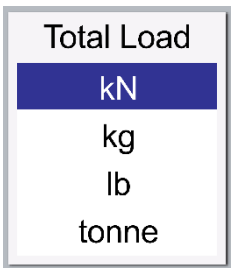
6.1.1 Settings Screen



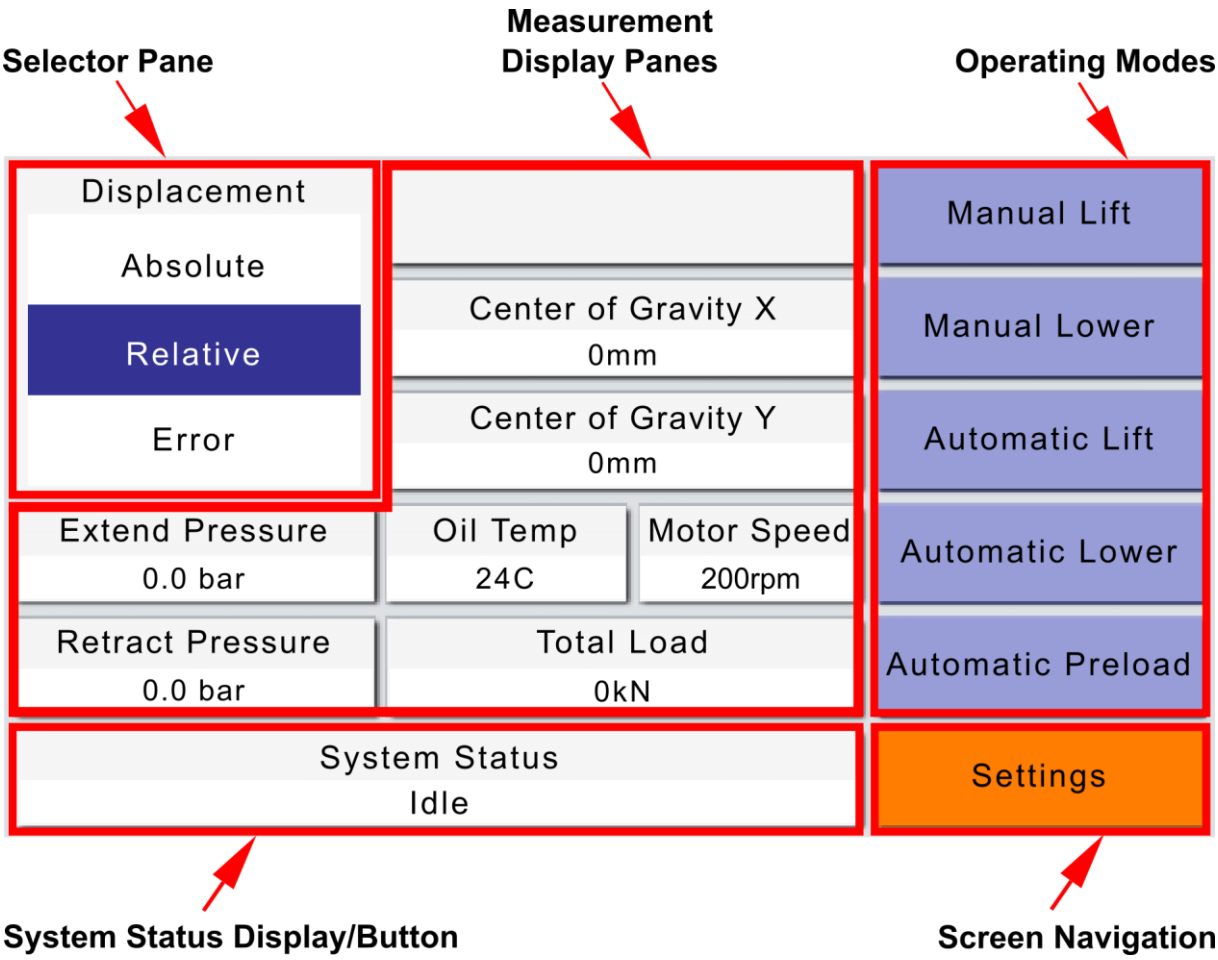
Settings Screen - Button / Pane Functions				
Image	**Description**	**Applicable to:**	**Type**	**Range**
Jack 1 Change Name	Jack Name (Press to change)	Individual Jack Setting	Button	9 Character input
X Position 0mm	Press to set the X-coordinate of the jack. (for Centre of Gravity)	Individual Jack Setting	Button	0 - 99999mm
Y Position 0mm	Press to set the Y-coordinate of the jack. (for Centre of Gravity)	Individual Jack Setting	Button	0 - 99999mm
Max Sensor bar 700 bar	Factory set to the maximum working pressure of the pump. (700 bar)	Global System Setting (Fixed)	Display	-
kN at Max bar 0kN	Press to set the Maximum Capacity (kN) at Max bar. **	Global Jack Setting	Button	0 - 20000kN
Sensor Length 635mm	Factory set to the length of the supplied sensor.	Global Jack Setting (Fixed)	Display	-
Max Jack Load 0kN	Press to set the Maximum Jack Load. **	Global Jack Setting	Button	0 - 20000kN
Enabled Disabled	Press to enable / disable individual jacks.	Individual Jack Setting	Toggle Button	-
Zero Jack	Press to zero the displacement value on selected jack Only.	Individual Jack Setting	Button	-
Zero All Jacks	Press to zero the displacement value on all jacks.	Global Jack Setting	Button	-
System Pressure bar psi	Allows operator to select which units system pressure is displayed in.	Global System Setting	Selector Pane	-

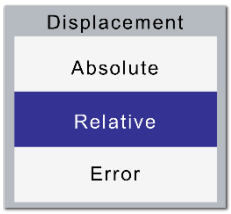
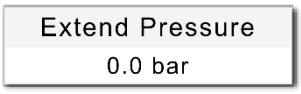
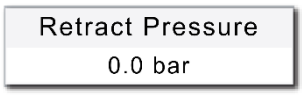
⚠ WARNING!

** These values are for calculation purposes **ONLY**. They cannot be used to restrict operation / capacity in any way. Incorrectly entered values will result in the control unit returning incorrect readings and the system / components operating at a pressure / load different to that expected / displayed.

Settings Screen - Button / Pane Functions (continued…)				
Image	**Description**	**Applicable to:**	**Type**	**Range**
	Allows operator to select which units individual jack loads are displayed in.	Global System Setting	Selector Pane	-
	Allows operator to select which units total system load is displayed in.	Global System Setting	Selector Pane	-
	Press to set the lifting target.	Automatic Lifting Only	Button	-635mm - 635mm
	Press to set the lowering target.	Automatic Lowering Only	Button	-635mm - 635mm
	Press to set the tolerance the system will maintain across all enabled jacks during automatic operation.	Automatic Lifting & Lowering Only	Button	1 - 50mm
	Press to set the force that will be applied during the preload operation.	Automatic Lifting & Lowering Only	Button	0 - 9813kN
	Returns the operator to the Control Screen.	-	Button	-

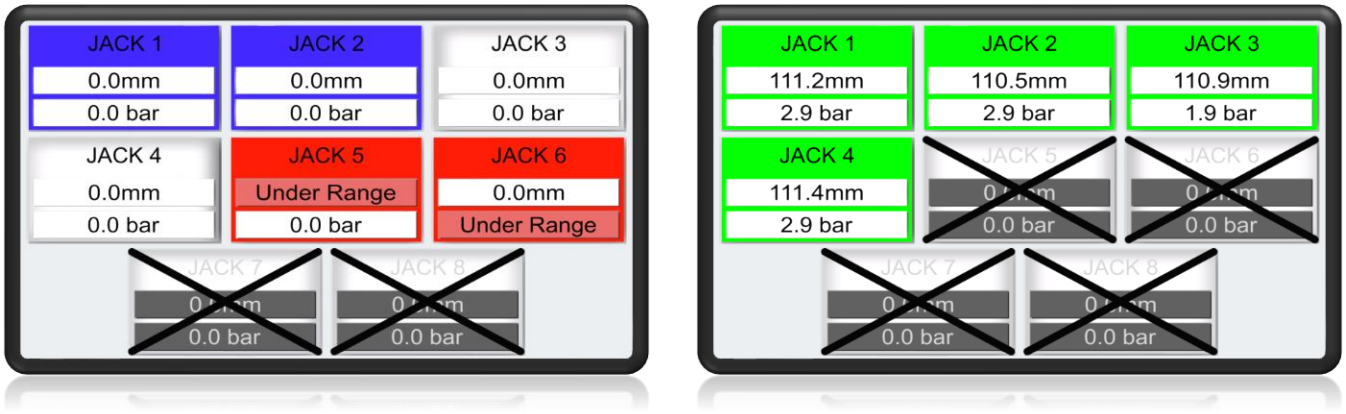
6.1.2 Control Screen



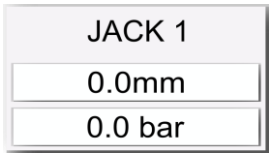
Control Screen - Button / Pane Functions		
Image	**Description**	**Type**
	Allows the operator to select how the displacement figures are displayed on the jack screens.	Selector Pane
	Displays the extension pressure in the system.	Display
	Displays the retraction pressure in the system.	Display
	Displays the set lifting / lowering target. (Displayed above 'Centre of Gravity X', only when 'Automatic Lift' or 'Automatic Lower' mode selected)	Display

Control Screen - Button/Pane Functions (continued…)		
Image	**Description**	**Type**
Left 120mm	Displays the remaining lifting / lowering distance. (Displayed above 'Centre of Gravity X', only when 'Automatic Lift' or 'Automatic Lower' mode selected)	Display
Preload Target 20kN	Displays the set preload target. (Displayed above 'Centre of Gravity X', only when 'Automatic Preload' mode selected)	Display
Center of Gravity X 0mm	Displays Centre of Gravity X-Value	Display
Center of Gravity Y 0mm	Displays Centre of Gravity Y-Value	Display
Oil Temp 24C	Displays System Oil Temperature	Display
Motor Speed 200rpm	Displays the Speed of the Variable Speed Motor. Motor speed can be adjusted using the control knob (item 10, pg 10) on the control unit. Range 200rpm - 1800rpm.	Display
Total Load 0kN	Displays the total load being lifted / lowered by the system.	Display
System Status Idle System Status Fault	Displays System Status Press to access System Status Screen (see pg 35)	Button / Display
Manual Lift	Selects Manual Lift mode	Button
Manual Lower	Selects Manual Lower mode	Button
Automatic Lift	Selects Automatic Lift mode	Button
Automatic Lower	Selects Automatic Lower mode	Button
Automatic Preload	Selects Automatic Preload mode	Button
Settings	Navigates operator to the settings screen.	Button

6.1.3 Jack Screens



NOTE: The information displayed for each jack/cylinder above, corresponds to the outlet port 'V#' and sensor port 'D#' numbers. The jack/cylinder information displayed in the 'Jack 1' position above, corresponds to the outlet port 'V1' and sensor port 'D1'. (*See figure 5.6*) You are advised to keep this number if jack names are changed, for easy identification of jacks/cylinders.

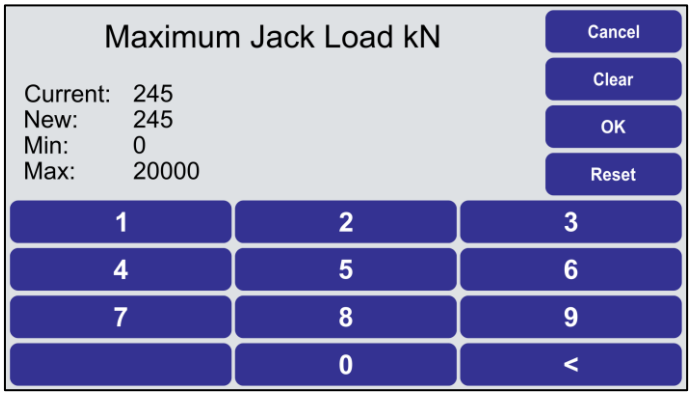
Jack Screens – Jack Status Details		
Image	**Status**	**Description**
	Jack Disabled (Crossed Out)	Jack is disabled and will not operate in any mode. **Note:** Jacks can be selected, and their settings can be adjusted/entered while disabled.
	Jack Enabled (Grey)	Jack is enabled and available for operation. **Note:** All enabled jacks will operate automatically when an automatic operation is started.
	Jack Selected (Blue)	Select jacks 1 at a time to enter their settings. Only selected jacks will operate when a manual operation is performed.
	Jack in Operation (Green)	**Manual:** Will display until the operate start button is released. **Automatic:** May flick on and off as the solenoids work to maintain tolerance.
	Jack Error (Red)	Indicates a displacement sensor error. (See sections 5.5 & 11.0 for trouble shooting)
	Jack Error (Red)	Indicates a pressure sensor error. (Contact your local Hi-Force sales office or distributor for advice)

6.2 Jack Settings

There are 3 individual and 2 global jack settings / values that can be input / changed via the Settings Screen. The process for entering / changing each value is the same, and is as follows:

1. Select the figure to change by pressing the relevant button on the settings screen.

   The screen will change to a display similar to that shown below.



NOTE: To enter a negative value for the 'lower target' setting for automatic lower operations, enter the desired value first, then press the negative (-) sign.

2. Press the "Clear" button to remove the current setting.
3. Enter the new value and press "OK".

   You will be returned to the settings screen, and the new value displayed below the button's title.

6.3 Operation Settings

There are 4 configurable operation settings. These settings only apply to automatic operations and are automatically applied to all enabled jacks.

'Lift Target', 'Lower Target' and 'Preload Target' are only applicable to their related operation.

'Tolerance' applies to 'Automatic Lift' and 'Automatic Lower' operations only.

Enter these values as described in section 6.2.

6.4 Calculation of the Jack Force at Max Pressure (kN) & Max Jack Load Values

Equations:

Metric: Load / Force (kN) = Maximum Tonne of Cylinder x 9.81

Imperial: Load / Force (kN) = Maximum Ton of Cylinder x 8.90

To calculate a Hi-Force Cylinders load / force (kN) at Maximum Pressure (bar). Multiply the chosen cylinders maximum capacity in tonnes (I.e. at 700bar) by 9.81 (Round the result to the nearest whole number).

Example:

A Hi-Force HSS256 cylinder has a maximum capacity of **25 tonnes** at 700bar.

Therefore: Load / Force (kN) = 25 x 9.81

= 245.25 kN (Round to the nearest whole number)

= 245 kN

This value that **MUST** be input for both; Jack Force at Max Pressure & Max Jack Load (kN).

6.5 Tolerance Setting

The tolerance setting is a global setting which keeps all active jacks / cylinders synchronised during automatic operations. It applies to all enabled jacks / cylinders during the 'Automatic Lift' and 'Automatic Lower' operations. The system maintains the set tolerance by continually switching individual jacks / cylinders on and off, ensuring they stay within the set range (tolerance).

The tolerance restricts the distance between the least extended jack / cylinder and most extended jack / cylinder. The extension of all other jacks / cylinders in the system will fall between these values.

E.g. If the tolerance is set to 2mm, the maximum distance between the least extended jack / cylinder and most extended jack / cylinder during operation will be 2mm.

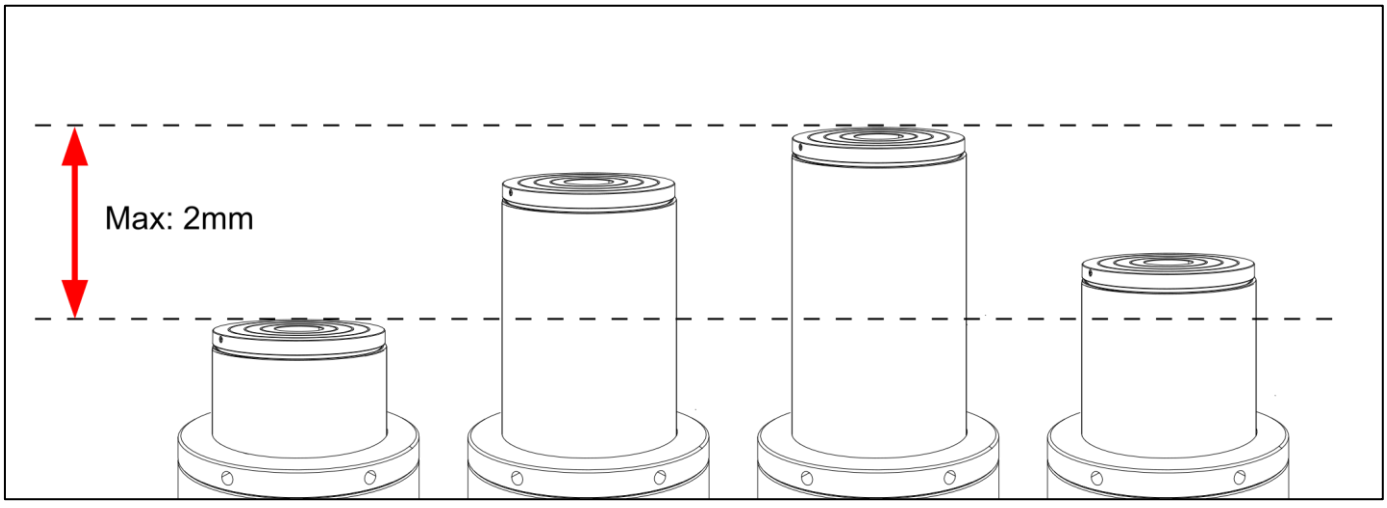


Figure 6.1: 2mm Tolerance Illustration (exaggerated for clarity)

To set the tolerance press the "Tolerance" button on the settings screen and set as per section 6.2

6.6 Displacement Sensors

The system is able to work with a wide variety of displacement sensors, allowing the customer to specify sensors according to the application requirements and local availability.

The SLDS650 sensors supplied by Hi-Force have a full stroke length of 635mm. If a sensor with a different stroke length is used, the software will need to be updated to reflect this. Contact your local Hi-Force office / distributor for further details.

6.7 Manual Operation

In 'Manual Lift' and 'Manual Lower' modes, you will need to select the jacks / cylinders to be operated. It is an operator-controlled process, and the "Operate Start" button must be pressed and held down to keep the jacks / cylinders in operation. The cylinder pistons will stop as soon as the "Operate Start" button is released.

Motor speed can be adjusted in operation via the speed control knob (item 10, pg 10), to increase or decrease the cylinder piston movement speed, for better control of the operation.

NOTE: In manual modes, there is no synchronisation.

To perform a manual operation:

1. Make sure all jacks have been configured with the correct input values as per section 6.2.
2. Select 'Manual Lift' or 'Manual Lower' from the control screen. (The selected mode will be highlighted).
3. On the jack screen/s select all jacks / cylinders required for the operation.

   NOTE: Jacks / cylinders can only be selected after a manual operation mode has been selected. Pressing a button on the control screen after jacks / cylinders have been selected, will deselect all jacks / cylinders. They will need reselecting before the operation.

   NOTE: If a jack / cylinder has been selected in error, pressing the jack button again will deselect it.
4. Press and hold the "Operate Start" button to operate the selected cylinders. Releasing the "Operate Start" button will stop the operation immediately.

⚠ **WARNING!** In manual modes, there is no synchronisation. Loads will need to be monitored more closely to ensure they are lifted / lowered in a safe manner.

6.8 Automatic Preloading

This mode is selected in order to extend the jacks until they 'just' make contact with the object to be lifted / lowered. The preload value must be set in settings screen on the control panel unit before this operation is started. It is recommended that the preload value be set at the lowest load possible, allowing the cylinders to touch the object to be lifted / lowered, but not move it.

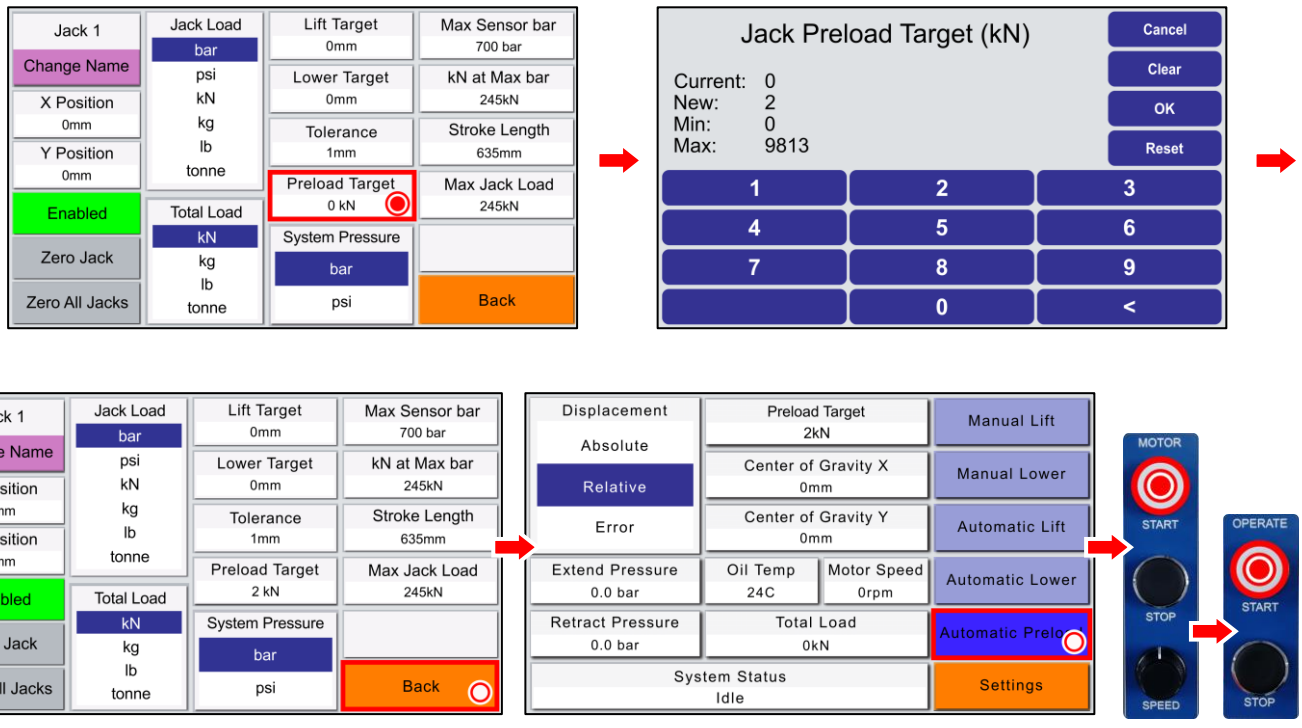
When the 'Operate Start' button is pressed, the system will extend all enabled jacks / cylinders, stopping each of them as they achieve the set preload force. The operation can be stopped before it has completed, by pressing the "Operate Stop" button on the control unit.

Motor speed can be adjusted in operation via the speed control knob (item 10, pg 10), to increase or decrease the cylinder piston movement speed, for better control of the operation.

⚠ CAUTION! In this mode, there is no synchronisation and the jacks / cylinders maximum load capacity (or high target loads) should not be entered into the control unit.

Operation:

1. Set the desired preload value by selecting "Preload Target" on the Settings screen and following the process described in section 6.2.
2. Press the "Back" button on the settings screen to access the control screen.
3. Select "Automatic Preload" on the control screen. It will be highlighted when selected.
4. Press the "Start Motor" button on the control unit to start the pump motor.
5. Press the "Operate Start" button on the control unit to start the 'preload' operation.



6.9 Automatic Lifting

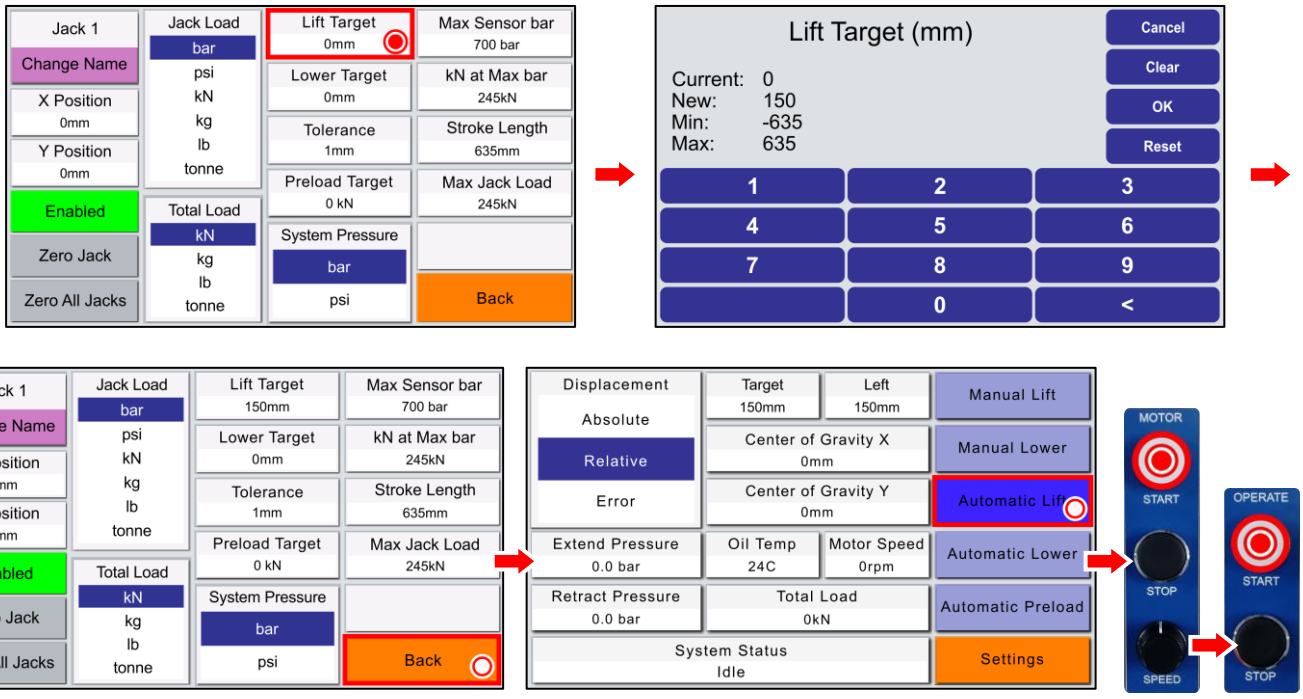
This mode is selected to lift a load, a specified distance in a synchronised fashion. The 'Lift Target' and synchronised 'Tolerance' must be set in the settings screen, and the displacement sensor/s should be zeroed before this operation is started. When the 'operate start' button is pressed, the system will extend/advance all **enabled** jacks/cylinders. This mode will automatically stop and start the individual jacks/cylinders to keep them within the set synchronisation tolerance. Once all jacks/cylinders have reached the 'Lift Target', the operation will automatically stop.

The operation can be stopped and restarted before it completes the lift by pressing the "Operate Stop" or "Operate Start" button on the control unit.

Motor speed can be adjusted in operation via the speed control knob (item 10, pg 10), to increase or decrease the cylinder piston movement speed, for better control of the operation.

Operation:

1. Preload the jacks if necessary. See section 6.8.
2. Set the desired lifting distance value by selecting "Lift Target" on the Settings screen and following the process described in section 6.2.
3. Set the desired tolerance value by selecting "Tolerance" on the Settings screen and following the process described in section 6.2.
4. Press the "Back" button on the settings screen to access the control screen.
5. Select "Automatic Lift" on the control screen. It will be highlighted when selected.
6. Press the "Start Motor" button on the control unit to start the pump motor.
7. Press the "Operate Start" button on the control unit to start the 'automatic lift' operation.



6.10 Automatic Lowering

This mode is selected to lower a load, a specified distance in a synchronised fashion. The 'Lower Target' and synchronised 'Tolerance' must be set in the settings screen, and displacement sensor/s should be zeroed before the operation is started. When the 'operate start' button is pressed, the system will lower/retract all **enabled** jacks/cylinders. This mode will automatically stop and start the individual jacks/cylinders to keep them within the set synchronisation tolerance. Once all jacks/cylinders have reached the 'Lower Target', the operation will automatically stop.

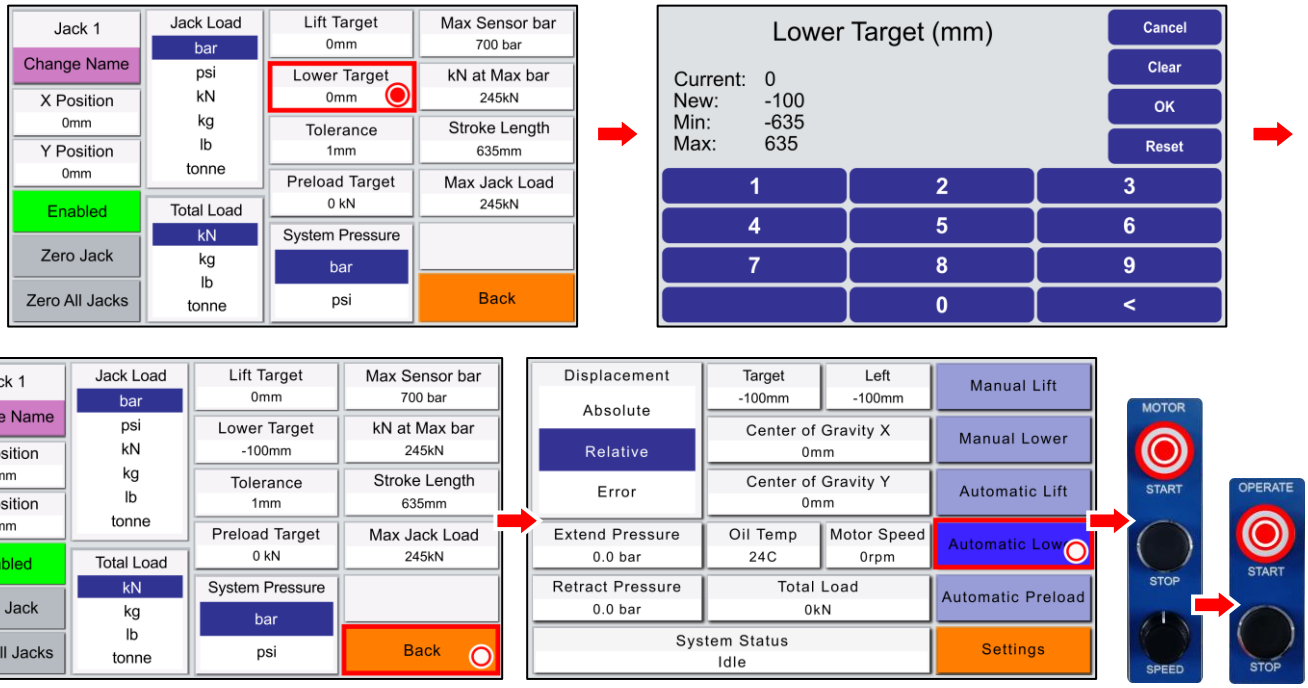
The operation can be stopped and restarted before it completes by pressing the "Operate Stop" or "Operate Start" button on the control unit.

Motor speed can be adjusted in operation via the speed control knob (item 10, pg 10), to increase or decrease the cylinder piston movement speed, for better control of the operation.

Operation:

1. Preload the jacks if necessary. See section 6.8.
2. Set the desired lowering distance value by selecting "Lower Target" on the Settings screen and following the process described in section 6.2.

   If jacks are zeroed, a negative (-) target will need to be set. (See note in section 6.2)
3. Set the desired tolerance value by selecting "Tolerance" on the Settings screen and following the process described in section 6.2.
4. Press the "Back" button on the settings screen to access the control screen.
5. Select "Automatic Lower" on the control screen. It will be highlighted when selected.
6. Press the "Start Motor" button on the control unit to start the pump motor.
7. Press the "Operate Start" button on the control unit to start the 'automatic lower' operation.



6.11 Releasing Hydraulic Pressure from the System

After retracting the cylinders, there may be pressure trapped in the retract line of the system. This pressure is trapped behind the manifold/s and will be displayed under 'Retract Pressure' on the control screen.

NOTE: This pressure does not extend past the manifold and will not inhibit hydraulic disconnections as long as the 'Extend Pressure' shows 0 bar on the control screen.

To release trapped **'retract pressure'** proceed as follows:

1. With the motor running, set the motor speed to approximately 500rpm.
2. Select 'Manual Lift' on the control screen and select 1 or 2 jacks on the jack screen.
3. Press the "Motor Stop" Button to turn off the motor.
4. Approximately 1 second later, quickly press and release the "Operate Start" button.

   It will open all the electric solenoids, dumping the trapped pressure back into the oil reservoir.
5. Repeat if necessary

To release trapped **'extend pressure'** proceed as follows:

Important: Pressure trapped in the extend / advance line **MUST** be fully released before trying to disconnect the hydraulic cylinders or hoses. **NEVER** try and undo / release couplings, fittings or hoses while hydraulic pressure is within the system. You will risk, hydraulic injection and personal injury.

1. With the motor running, set the motor speed to approximately 500rpm.
2. Select 'Manual Lower' on the control screen and select the jacks showing pressure on the jack screen.
3. Press the "Motor Stop" Button to turn off the motor.
4. Approximately 1 second later, quickly press and release the "Operate Start" button.

   It will open all the electric solenoids, releasing the hydraulic pressure and allowing disconnection of cylinders and hoses.
5. Repeat if necessary.

6.12 Throttle Flow Control Valves

The throttle flow control valve fitted above the advance outlet port (see figure 6.2) controls the return flow of hydraulic fluid to every enabled jack/cylinder. These throttle control valves come factory set at 3.5 revolutions - max flow rate: 4.1 litres per minute (lpm).

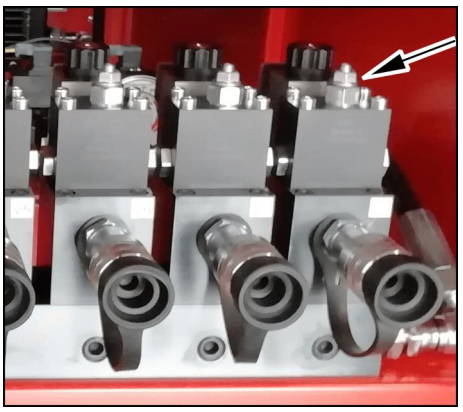


Figure 6.2: Flow Control Valve

Tools required for setting/adjusting throttle valve.

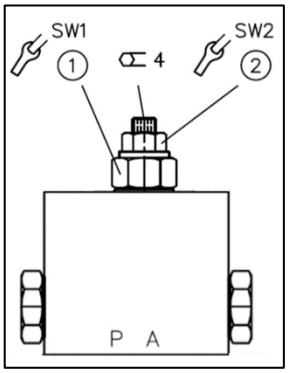
19 mm for Sealing Nut (SW1) 13 mm for Lock Nut (SW2)

4 mm Hex Key for adjustment screw.

Adjustment

While holding the Sealing Nut (SW1) in a stationary position with a 19mm Spanner, use a 13mm spanner to slightly loosen the Lock Nut (SW2). Using the 4mm Hex key, turn the throttle valve clockwise to decrease/restrict the flow or anti-clockwise to increase the flow. The double spindle sealing nut ensures leak-free adjustment.

Valve Adjustment	
Revolutions	Flow Rate (lpm)
0.5	0.15
1	0.45
1.5	0.75
2	1.05
2.5	1.4
3	2.1
3.5	4.1
4	29.5
4.5	29.5
open	29.5



Nut	Tightening Torque
Sealing Nut (SW1)	70 Nm
Lock Nut (SW2)	23 Nm

⚠ CAUTION! Hi-Force highly recommends that the flow control valves be left at their factory pre-set value. The factory setting has been optimised for use with the Hi-Force lifting cylinder ranges.

Risk of injury due to unexpected operation movement speed in the system, due to incorrect flow settings!

Be prepared for unexpected, fast movement, if flow settings are changed. Small changes can have significant effects on the flow rate.

ALWAYS monitor the system closely when setting or adjusting the flow rate.

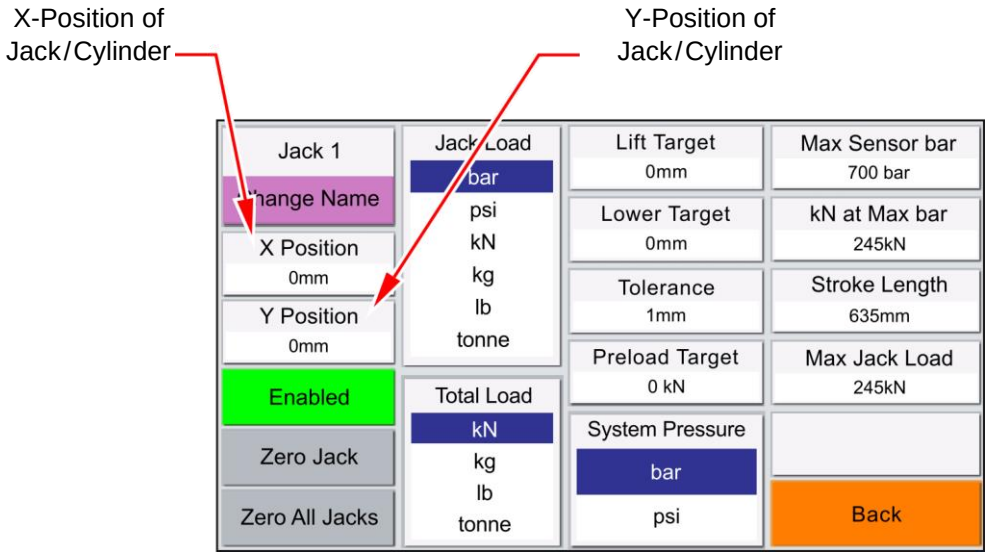
6.13 Centre of Gravity

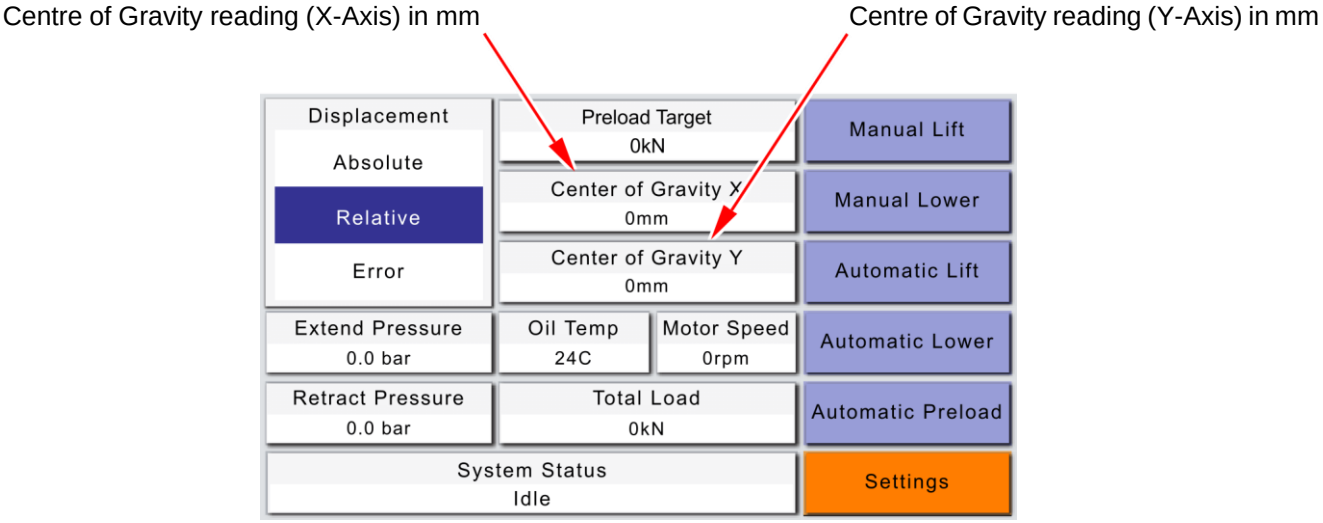
The centre of gravity function allows constant monitoring of the full load, performing calculations, measurements (in millimetres) and displaying the centre of gravity (COG) point in relation to the position of the jacks/cylinders. These values are based on the jack/cylinder information manually entered into the Control Unit.

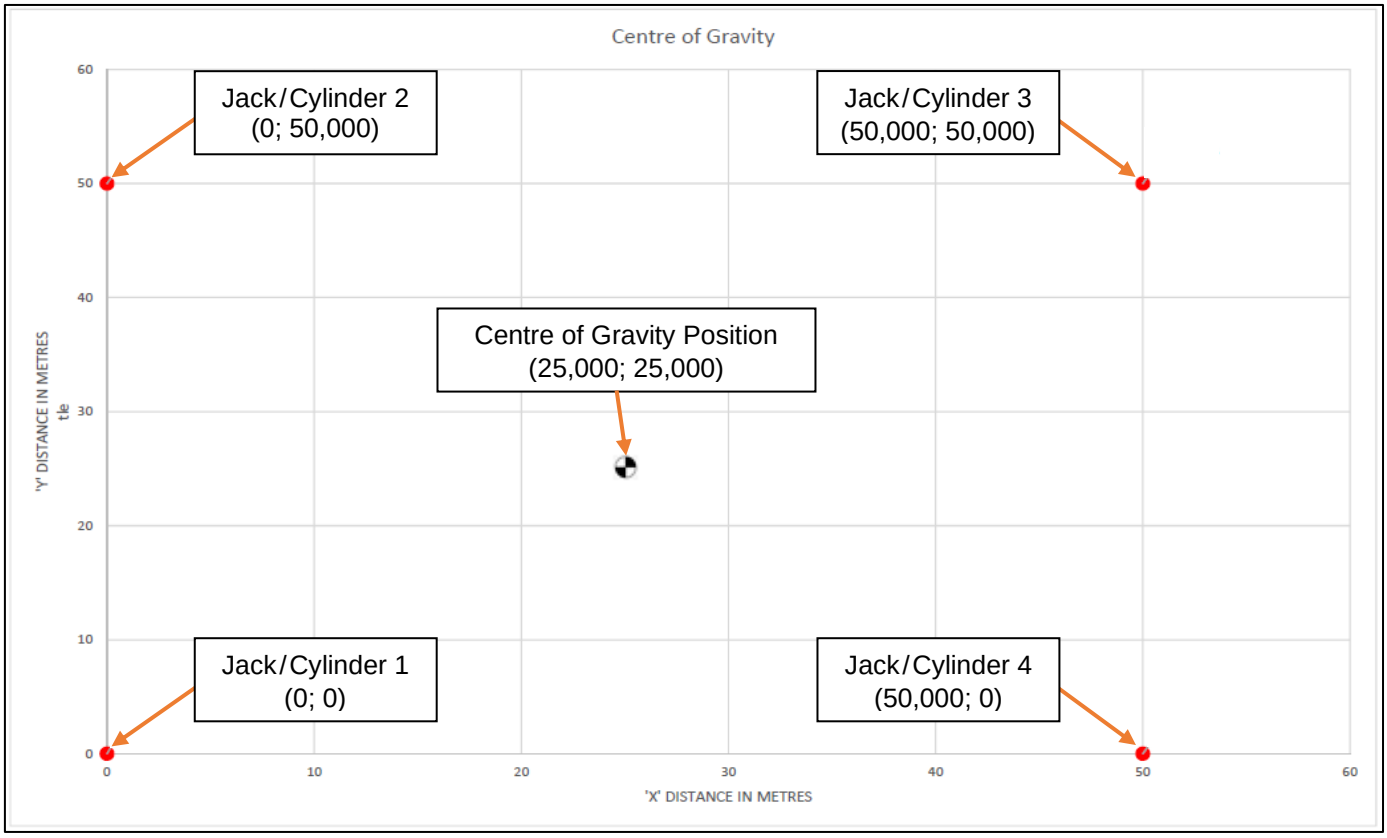
The centre of gravity function will monitor the movement of a loads' centre of gravity, during any lifting or lowering operation. Displaying any weight shift (live loads) or the spread of the load, if unknown prior to lifting an uneven load.

Setting Centre of Gravity

Enter the X and Y positions, in millimetres (mm), for every jack/cylinder enabled. (See section 6.2).







1m = 1000mm

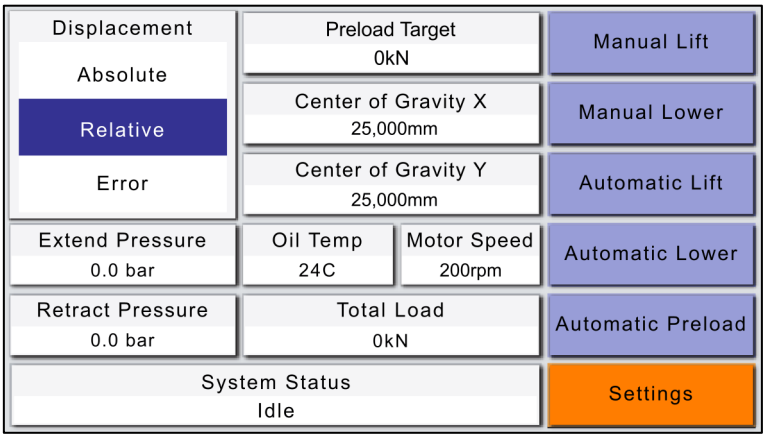
Example of cylinder positioning with X and Y input measurements:

X and Y Input values for each jack/cylinder:

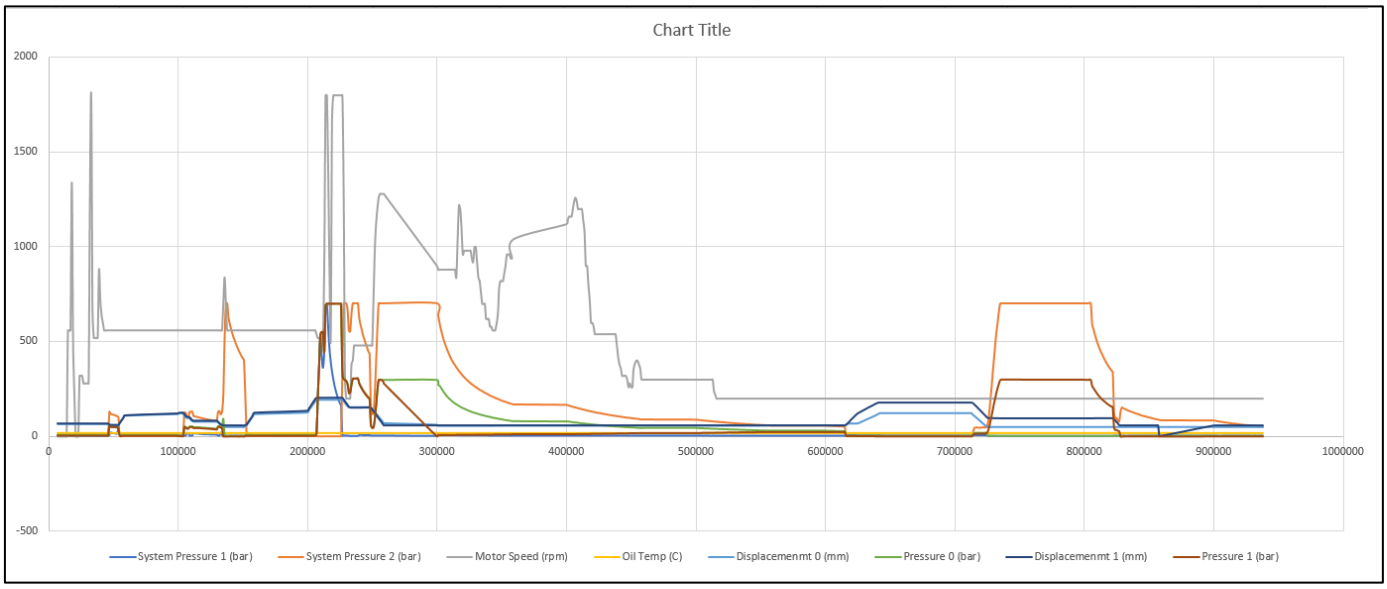
Jack/Cylinder 1	Input reading	X = 0	; Y = 0.
Jack/Cylinder 2	Input reading	X = 0	; Y = 50,000
Jack/Cylinder 3	Input reading	X = 50,000	; Y = 50,000
Jack/Cylinder 4	Input reading	X = 50,000	; Y = 0

Centre of gravity for this even-load example, would read as follows on the main control screen:

X = 25,000 mm
Y = 25,000 mm



6.14 Data Logging



The SLV data logging software provides traceable data. Monitoring, system hydraulic pressure, system displacement / stroke travel, oil temperature, motor R.P.M and complete 'cycle running times' of each enabled jack / cylinder. The control unit has 8GB of built-in memory and automatically overwrites the oldest data with that from the most recent operations.

The control unit can be connected (after every operation) to any windows based PC / Laptop via the USB Type-B output connection in the top left corner. The control unit does not need to be connected to a power source to retrieve the collected data. Hi-Force 'data translation' software is included, on the provided Hi-Force memory stick. Data is converted from a text file into an Excel compatible CSV file, using the Hi-Force conversion software.

Converting Collected Data

1. Open the converted Excel format file.
2. Above the column title "Timestamp", right-click on the cell "A" and click insert. A new column should appear on the left side of "A". Title this new column Seconds.
3. In cell "A2" type the following: =(B2/1000)/60 (This should convert the value into seconds)
4. Then drag the formatted cell A2 as far down as you need to. When complete, all your selected values should be converted.
5. Next, hide column B. You no longer need it, and we don't want to display it on the graph. Don't delete it either, or all the data in column "A" will disappear.
6. Select the cells containing data you want to graph, including the titles in row 1.
7. Once you have selected all your data, click "insert" on the menu bar and click "recommended charts". Then select "all charts" and select "X Y Scatter with smooth lines".
8. That should generate the complete graph. (You may need to resize the graph to see all the data).

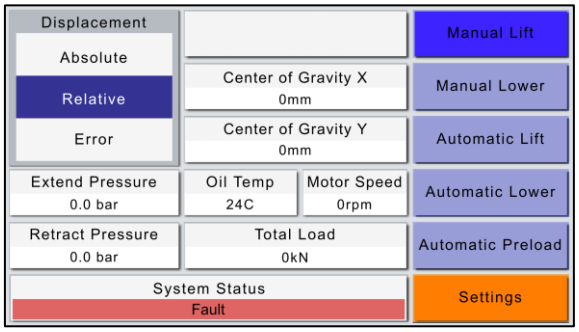
7.0 Error Reporting

Comms Lost

Communication between the control unit and the electrical control box has been lost.

- Check that the cable is connected properly at both ends, and check the cable for damage.

Fault - System Stopped / Inoperable (*Control Screen*)

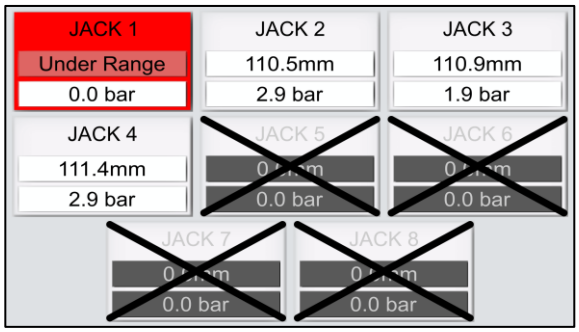


A fault has occurred which requires attention before the system can be operated.

- View the Jack / Cylinder Screens and/or access the system status screen, to diagnose and rectify the error/s. (See below).

Fault Identification

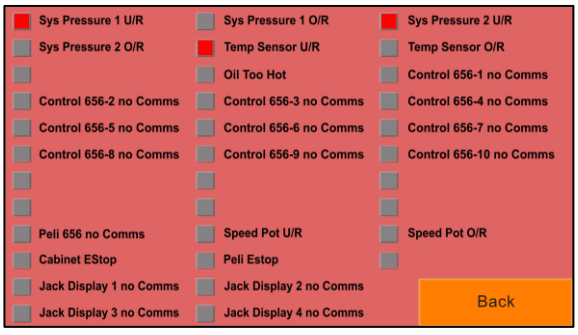
Jack / Cylinder Screen



The error indicates that the displacement sensor on Jack 1 is “Under Range”.

- Distance Under Range (*See section 5.4, figure 5.5*)
- Displacement Sensor signal cable lost.

System Status Screen



Accessed by pressing the “System Status” Button on the control Screen.

System Errors are indicated by a **Red** checkbox next to the error description.

8.0 Maintenance and Storage

IMPORTANT: Isolate the pump from the electrical supply when carrying out maintenance or adjustments.

- Monitor the oil level in the oil reservoir and do not allow the oil level to fall below the minimum level marked by the lower indicator (item 6. pg 9). Keep the oil reservoir topped up with high quality ISO46 grade hydraulic oil. Retract all hydraulic cylinder(s) before filling the oil reservoir with ISO46 grade hydraulic oil.
- Oil should be replaced after approximately 500 working hours. Drain oil via drain plug (item 1, pg 9)
- Check the return line filter 'clogging indicator' gauge (item 10, pg 9) periodically. Replace the filter element when the gauge pointer is showing in the red sector. (*See figure 8.1*)

  To replace the filter element:

  1. Remove the 3 Lid bolts and lift the lid from the filter housing. The filter element is connected to the lid via a spring and will be pulled from the housing with the lid.
  2. Detach the clogged filter element from the spring and attach a new clean filter element in its place.
  3. Replace the Filter element/lid combination and secure the lid with the lid bolts.

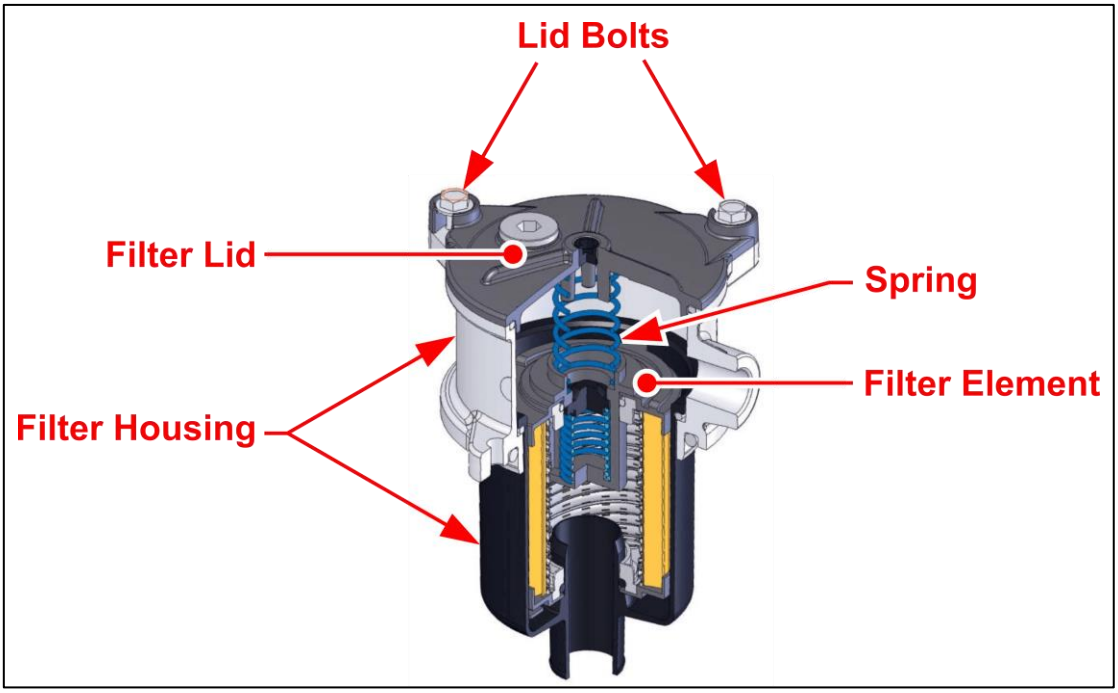


Figure 8.1: Return Line Filter

- Regularly inspect (before and after every use) the pump and all accessories for damage.
- Make sure the unit is clean before placing it into storage. Remove any dirt or debris which may have been picked up while on site.
- Store the pump in a clean and dry environment.
- Inspect the frame periodically for paint damage. Clean and touch up any exposed surfaces to prevent corrosion.
- Have the pump serviced regularly by a Hi-Force authorised repair centre.
- Inspect hoses regularly for damage and wear. **DO NOT** use hoses that are frayed, abraded or leaking.

9.0 Specifications

Refer to the nameplate on the pump for model identification.

Model Number	Number of Outlets	Motor Voltage	Displacement (litres per minute)		Changeover Pressure	Oil Capacity
			Low Pressure	High Pressure	(bar)	(litres)
SLV82	8	380/440V-3Ph	19.6	4.8	70	200
SLV122	12	380/440V-3Ph	19.6	4.8	70	200
SLV162	16	380/440V-3Ph	19.6	4.8	70	200
SLV202	20	380/440V-3Ph	19.6	4.8	70	200
SLV242	24	380/440V-3Ph	19.6	4.8	70	200
SLV282	28	380/440V-3Ph	19.6	4.8	70	200
SLV322	32	380/440V-3Ph	19.6	4.8	70	200
SLV84	8	380/440V-3Ph	19.6	4.8	70	400
SLV124	12	380/440V-3Ph	19.6	4.8	70	400
SLV164	16	380/440V-3Ph	19.6	4.8	70	400
SLV204	20	380/440V-3Ph	19.6	4.8	70	400
SLV244	24	380/440V-3Ph	19.6	4.8	70	400
SLV284	28	380/440V-3Ph	19.6	4.8	70	400
SLV324	32	380/440V-3Ph	19.6	4.8	70	400

MAXIMUM OPERATING PRESSURE: 700 bar/10,000 psi

Motor Variable Speed Range: 200 rpm – 1800 rpm

Sound Pressure Levels

A maximum “A-Weighted” sound pressure level of 85dB was measured for undefined workspaces, as per EU Directive 2006/42/EC Section 1.7.4.2 (u). Measurements taken at maximum pressure and motor speed.

10.0 Accessories

(*Refer to the Hi-force website or latest Hi-Force catalogue for further details*)

- HSS, HHS, HFL, HFG, HAS, HHA, HFA, HGG & HSG Single-Acting Cylinders.
- HHR, HDA & HRA Double-Acting Cylinders
- High-Pressure Hydraulic Hoses up to 30m. (Standard)
- Displacement Sensor Mounting Kits for single & double-acting cylinders.
- SLDS650 Displacement Sensor/s.
- Sensor Signal Cables from 10m - 100m.

11.0 Troubleshooting

Hi-Force SLV synchronous lifting system should be serviced and repaired only by authorised Hi-Force repair centres. The following table gives possible causes and solutions for common problems.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Solution
1. Pump will not start.	a. Power not connected.	Connect power.
	b. Damaged power cord.	Repair or replace power cord.
	c. Circuit breaker tripped.	i. Reset Circuit breaker. ii. Ensure breaker is adequately rated.
	d. Faulty button (Control unit).	Contact your local Hi-Force office / distributor.
	e. Blown fuse.	Replace blown fuse.
	f. Burnt out motor.	Contact your local Hi-Force office / distributor.
2. System Status - Fault	a. Displacement sensor/s under range.	Check displacement sensor/s wire cables are extended >20mm. (See figure 5.5)
	b. 'Emergency Stop' button pressed.	Check emergency stop buttons on control unit and electrical control box are released.
	c. Pressure sensor under range.	Contact your local Hi-Force office / distributor.
	d. Other error.	Check system status screen for error identification.
3. Communication Lost.	a. Relay fault.	Check relay.
4. Operation will not start.	a. Not on control screen.	Navigate to control screen on Control Unit.
	b. No operation selected.	Select operation mode.
	c. No jacks / cylinders selected (manual modes only)	Select jacks / cylinders on jack screens.
	d. All jacks / cylinders disabled.	Enable required jacks / cylinders.
	e. System Status – Fault.	See Problem 2 above.
	f. Incorrect jack / cylinder setting.	Check all settings are correct. See section 6.2
	g. Incorrect operation setting.	Check relevant operation setting. See section 6.3
	h. Jacks not zeroed.	Zero all jacks.
5. System not maintaining tolerance during automatic lift/lower operations.	a. Jacks / cylinders hydraulic outlet port and displacement sensor port do not match.	Make sure the jacks / cylinders hydraulic connection outlet port on the manifold (V#) matches the displacement sensor port on the electrical control box (D#). *See section 5.4*.

TROUBLESHOOTING GUIDE (continued…)		
Problem	**Possible Cause**	**Solution**
6. Displacement sensor not being picked up by control unit. (under range)	a. Displacement sensor signal cable fault.	i. Check sensor signal cable/s for proper connection. ii. Check signal cable for damage. Replace if required.
7. Piston travel does not match sensor reading.	a. 'Sensor Length' value does not match sensors rated cable length.	Make sure the 'Sensor Length' value matches the sensor specification. (See Section 6.6)
8. Control / Jack Screen not responding as expected.	a. Screen calibration problem.	See Calibration Process Below.

Control / Jack Screen Calibration

If a screen loses its calibration it may respond unexpectedly. Buttons may become unresponsive or may even select other features. In the unlikely event that a screen loses its calibration, the process for recalibrating a screen is as follows:

1. Power the SLV system down (turn off the isolator switch). *See figure 5.8*
2. Wait at least 10 seconds.
3. Keep your fingers off the screen.
4. Turn the isolator switch back on & place a finger on the screen within 0.5 seconds.
5. Keep the finger on the screen for 3 seconds.
6. Remove the finger from the screen. (Once removed, the screen will enter calibration mode)
7. Follow the on-screen prompts to calibrate the screen (being as accurate as possible).
8. The screen will then ask you if you want to change the ID. Set the ID according to the below list.

   The ID options are as follows:

   1 - Control Screen

   2 - Jack Screen 1

   3 - Jack Screen 2

9. Press Exit.

IMPORTANT: You **MUST NOT** have multiple screens set to the same ID when the system is in use.

NOTE: This ID setting (*step 8*) can also be used to work around a faulty screen by swapping the working screens around as necessary.

UK Head Office:

Hi-Force Limited

Prospect Way, Daventry, Northamptonshire

NN11 8PL

United Kingdom

Tel: + 44 1327 301000

Fax: + 44 1327 706555

Email: daventry@hi-force.com

Hi-Force Regional Offices:

Hi-Force Caspian **Baku** **Azerbaijan** **Tel: +994 124 474 100** **Email: baku@hi-force.com**	**Hi-Force S.R.L.** **Milano** **Italy** **Tel: +39 0257 607 174** **Email: italy@hi-force.com**
Hi-Force Hydraulics (Asia) S.B. **Selangor** **Malaysia** **Tel: +603 5525 4203** **Email: malaysia@hi-force.com**	**Hi-Force Nederland B.V.** **Numansdorp** **Netherlands** **Tel: +31 85 902 8111** **Email: holland@hi-force.com**
Hi-Force Saudi **Dammam** **Saudi Arabia** **Tel: +966 13 802 1338** **Email: saudi@hi-force.com**	**Hi-Force Hydraulics** **Abu Dhabi** **United Arab Emirates** **Tel: +9712 551 3100** **Email: abu.dhabi@hi-force.com**
Hi-Force FZE **Dubai** **United Arab Emirates** **Tel: +9714 8150 600** **Email: dubai@hi-force.com**	**Hi-Force Jebel Ali** **Dubai** **United Arab Emirates** **Tel: +9714 802 7400** **Email: jebel.ali@hi-force.com**

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