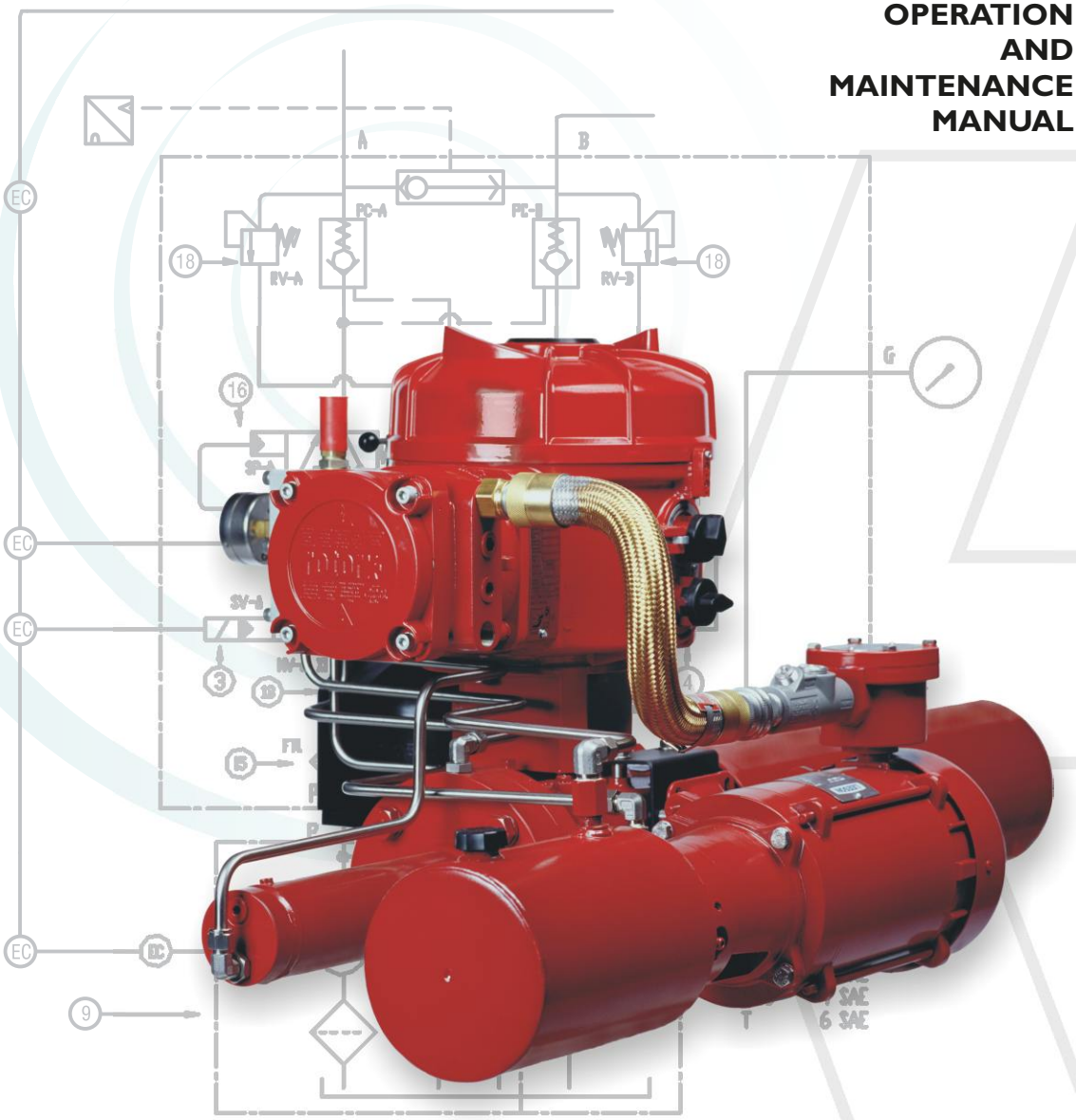
rotork®
Fluid Systems

Established Leaders in Valve Actuation

SKILMATIC RANGE **EH**

SELF-CONTAINED ELECTRO-HYDRAULIC ACTUATORS

INSTALLATION, OPERATION AND MAINTENANCE MANUAL



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1.0 Introduction

1.1 General Overview

The Rotork EH Range of self-contained, electro-hydraulic actuators include an integrated control module; a hydraulic manifold; and a power unit consisting of a motor, hydraulic pump and reservoir. EH actuators are available in double-acting or spring-return configurations for both quarter-turn and linear applications.

They can be configured to mount in any position, including remote mounting of the control module and/or hydraulic power unit (HPU). Torque requirements up to 600,000 Nm (5.3 million lbf-in) and thrusts up to 5,500,000 N (1.2 million lbs) can be accommodated.

All electronics are protected in a watertight or explosion-proof enclosure. Other features include local manual control, indication feedback via dry contacts and 4-20 mA signal; or optional digital control via Modbus, Foundation Fieldbus, Profibus, DeviceNet or Rotork Pakscan communication systems. The EH Range can be supplied for operation with virtually any single phase, three phase, or 24VDC power supply.

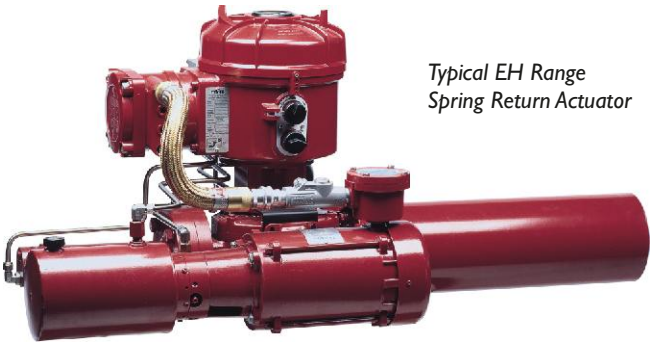
1.2 Operational Overview:

Spring-Return Units

Hydraulic power is provided by a pump/motor combination to stroke the actuator in one direction. Spring force provides power to stroke the actuator in the other direction.

The controller uses an internal potentiometer or external position transmitter and pressure transducer to constantly monitor valve position and hydraulic pressure. The system allows for torque seating of the valve and also detects valve obstructions. The motor will turn on to re-charge the system if pressure drops below a configurable preset value. EH units may be configured to stop based on pressure or position limits.

Travel speed adjustment of the spring stroke is provided as a standard feature. Speed control of the hydraulic stroke is possible through the fitting of an optional accumulator or by using the interrupter timer. A pressure switch is used to maintain the correct pressure in the accumulator.



Typical EH Range Spring Return Actuator

For positioning units, an additional solenoid is added to route the hydraulic supply through a smaller orifice. This allows the actuator to slow down as it approaches its demand position resulting in better positioning accuracy.

There is also a solenoid fitted to direct the pump output directly to the reservoir. This allows the motor to remain on, rather than rapidly cycling on/off, while the actuator direction is frequently reversed in the small gradations inherent in positioning systems.

An optional, manual hydraulic pump is available. This may be used to manually stroke the actuator/valve during loss of electrical power or during start-up.

Local and Remote operation is provided as standard. The actuator can be opened and closed locally or will accept a number of remote commands.

1.3 Operational Overview:

Double-Acting Units

Hydraulic power to stroke the actuator open or close is provided by a pump/motor combination. A 4-way, 2-position, directional control valve is used to control direction. Dual pilot operated check valves lock the actuator in place at end of travel.

The controller uses an internal potentiometer or external position transmitter and pressure transducer to constantly monitor valve position and hydraulic pressure. The system allows for torque seating of the valve and also detects valve obstructions. The motor will turn on to re-charge the system if pressure drops below a configurable preset value. EH units may be configured to stop based on pressure or position limits.

For positioning units, an additional solenoid is added to route the hydraulic supply through a smaller orifice. This allows the actuator to slow down as it approaches its demand position resulting in better positioning accuracy.

Unless the EH unit is fitted with an accumulator, the actuator will fail "as-is" on loss of electrical power. Units with a failsafe accumulator fitted use a continuously energized solenoid to retain stored accumulator pressure. On loss of power, the accumulator pressure will fail the actuator to a pre-configured position — either full open or full close.

An optional, manual hydraulic pump is available. This may be used to manually stroke the valve during loss of electrical power or start-up.

Local and Remote operation is provided as standard. The actuator can be opened and closed locally or accept a number of remote commands.

2.0 Health and Safety

2.1 Installation

The installation should be carried out as outlined in this manual and also in accordance with any relevant standards or codes of practice. Since many EH actuators include features not covered in this generic manual, always refer to order specific documentation including operating instructions, hydraulic schematic (HS) and wiring diagram (WD). If the unit has a nameplate indicating that it is suitable for installation in potentially explosive atmosphere (hazardous area), it must not be installed in a hazardous area that is not suitable for the gas groups and temperature class defined on the nameplate.

For the UK: *Electricity at Work Regulations 1989* and the guidance given in the applicable edition of the *IEE Wiring Regulations* should be applied. Also, the user should be fully aware of their duties under the *Health and Safety Act of 1974*.

For the USA: *NFPA70, National Electrical Code* ® is applicable.

No inspection or repair should be undertaken unless it conforms to the specific hazardous area certification requirements. Under no circumstances should any modification or alteration be carried out on the unit as this could invalidate the conditions under which its certification was granted.

Access to live electrical conductors is forbidden in the hazardous area, unless this is done under a special permit to work. Otherwise all power should be isolated and the unit moved to a non-hazardous area for repair or attention.

Only persons competent by virtue of their training or experience should be allowed to install, maintain and repair these units. The user and those persons working on this equipment should be familiar with their responsibilities under any provisions relating to the health safety of their workplace.

Trained service technicians are available to assist with or perform commissioning and maintenance. If you have any questions or concerns regarding installation, commissioning, maintenance or operation, contact your local Rotork office for assistance.

2.2 Enclosure Materials

The EH actuator control module is manufactured from aluminium alloy with carbon steel fasteners.

The user must ensure that the operating environment and any materials surrounding the unit cannot lead to a reduction in the safe use of, or the protection afforded by, the unit. Where appropriate the user must ensure the unit is suitably protected against its operating environment.

Should further information and guidance relating to the safe use of the EH Range Actuator be required, it will be provided on request.

2.3 Cable Entry

Only appropriate certified explosion-proof entry reducers, glands or conduit may be used if the unit is installed in a hazardous area.

Remove any transit plugs. Make cable entries appropriate to the cable type and size. Ensure that threaded adaptors, cable glands or conduit are tight and fully waterproof. In non-hazardous areas, seal unused cable entries with a steel or brass plug. In hazardous areas an appropriately certified threaded blanking plug must be used.

On EEXde enclosures units, connections to the power and control terminals must be made using AMP type 160292 ring tabs for power and earth terminals and AMP type 34148 ring tabs for the control terminals.

Refer to the applicable wiring diagram to identify functions of terminals. Check that the supply voltage and hydraulic working pressure is the same as that marked on the nameplate.

2.4 Maintenance

A thorough maintenance programme is important to maintaining proper operation. Period maintenance should be performed as outlined in Section 6.

2.5 Hazardous Area Approvals

Note: Refer to the unit nameplate for its specific approval details.

2.6 Hydraulic System Precautions

EH actuators utilise hydraulic fluid. Refer to applicable specification for type required.

Always wear safety glasses and appropriate protective clothing including gloves when working with hydraulic fluid. Also remove any jewelry or other objects that might conduct electricity.

Prior to performing any maintenance, make sure that electric power to the actuator is removed and that hydraulic system pressure is released.

Hydraulic fluid is a hazardous material. Consult the material safety data sheet (MSDS) for detailed health and safety information. Fluids should be contained and disposed of properly in accordance with applicable regulations.

Hydraulic fluid is a skin irritant and, when pressurised, can pierce the skin, enter the bloodstream and cause serious injury or death. Never use any part of the body to check for hydraulic leaks.

3.0 Installation

3.1 Fitting to Valve

It is recommended that before lifting an actuator onto a valve, great care be taken to ascertain the position of the valve and orient the actuator accordingly.

Rotork actuators must be mounted on valves in the correct orientation. See job specific installation drawing.

WARNING: Do not lift the actuator & valve assembly via the actuator. Always lift the combined assembly via the valve.

3.2 Adjusting Travel Stops

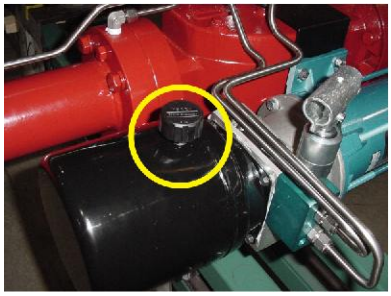
When the actuator has been bolted to the valve flange or adaptor and keys inserted; the position of the stop bolts should be checked to ensure full opening and closing of the valve.

If the preset end positions are not suitable, the stop bolts may be adjusted by first loosening the jam nut and screwing the bolts in or out until the desired position is obtained. Stroke the yoke away from the stop bolt when adjusting then return to check position. When the correct position is obtained, re-tighten the jam nut.

Certain valves incorporate their own stops. In these cases, it is recommended that the actuator stop bolt positions coincide with the valve stop positions.

3.3 Hydraulic Fluid

EH actuators are supplied without hydraulic fluid and must be filled prior to operation. See Section 7.2.



If the actuator is fitted with an accumulator it must be drained to the reservoir before adding oil. With the spring, or for double-acting actuators the piston, fully extended, fill the reservoir to approximately 50 mm (2 inches) below the top. Stroke the actuator two times and re-check the reservoir level. Add additional oil as required. Refer to Section 7.2 for the oil specification.

3.4 Electrical Connections

Always refer to the job specific wiring diagram for connection instructions.

Remove the four screws holding the terminal box cover to expose the terminal bung. Care should be taken to avoid damage to the O-ring.

A minimum of three ½" NPT conduit entries are provided for customer power and communication connections.

Remove the terminal cover, inside of the terminal housing, to expose terminals 1, 2, 3 and ground.

Single-phase incoming power, connections should be across terminals 1 and 3.

Three-phase connections should be across terminals 1, 2 and 3. Proper lead placement can be verified by viewing the pump/motor fan while in operation. It should rotate clockwise. If rotation is anti-clockwise, reverse leads to terminals 1 and 2. The pump will not charge the system and may be damaged if the leads are incorrectly terminated.

24VDC should be connected with positive on terminal 3 and negative on terminal 1.

A wiring diagram is supplied with each actuator and is available from Rotork Fluid Systems upon request.

3.5 Power Accumulators

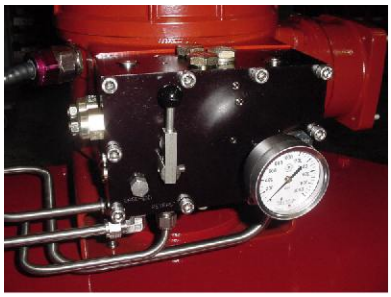
Some EH Range actuator configurations are equipped with hydraulic accumulators to store energy for stroking the actuator.

Accumulators must be pre-charged with dry nitrogen prior to operation. See Appendix A.

4.0 Operation

4.1 System Pressure

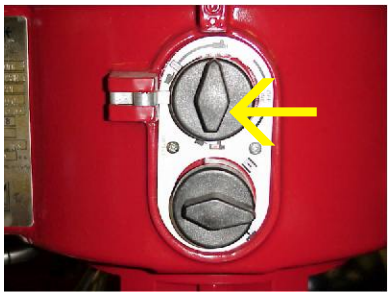
Hydraulic supply pressure is indicated by a gauge on the manifold. The pump will run automatically as required to maintain adequate system pressure. For actuators with accumulators, the motor is controlled by an internal or external pressure switch.



4.2 Local/Remote Selection

Local/Remote control selection is via the upper of two rotary switches located on the side of the control module.

Rotated fully anti-clockwise is the *Remote* control position. Rotated fully clockwise is the *Local* control position. The mid-rotation position is *Offline*, prohibiting local or remote control of the actuator. The latch must be depressed while rotating the selector.
When control signal input source is changed in the course of travel, the actuator will stop in its current position until a new command is received.



4.3 Local Operation

The Local/Remote selector switch must be in the *Local* position to manually operate the actuator. The Open/Close selector switch is disabled when the Local/Remote selector switch is set for *Remote* operation.

4.3.1 Open / Close Selection

Open/Close selection is via the lower of two rotary switches on the side of the control module.

Rotate the knob from the center detent position, anti-clockwise to open or clockwise to close. This contact can be set either as momentary or hold-to-run via the configuration set-up Refer to Section 5.2.5 "cL". Direction of travel may be reversed during the stroke.

4.3.2 Local Position Indicator

Local position indication is available via an illuminated LCD display visible through a window in the top of the control module cover.

The display is also used for controller configuration and fault indication. Refer to Section 4.8.

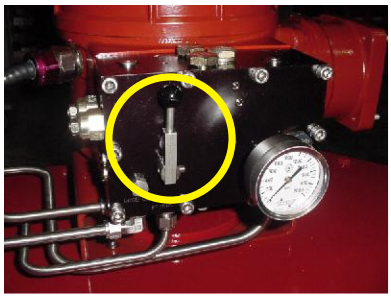
4.3.3 Hydraulic Manual Override

An optional, manually operated override is available to operate the actuator in the event of a loss of electrical supply to the pump/motor. When supplied, a pump with a removable handle is located on or near the power unit.

continued next page

4.3.3 Hydraulic Manual Override (continued)

In most cases, a two-position lever on the side of the manifold selects the direction of travel. Some special actuators have a ball valve(s) to control hand pump operation. Consult your job specific hydraulic schematic for operation details.



4.4 Remote Operation

The Local/Remote selector switch must be in the *Remote* position for remote control operation of the actuator. The Open/Close selector switch is disabled when the Local/Remote selector is set for *Remote* operation.

4.4.1 Remote Control Signals

The actuator may be operated with an external voltage.

Refer to job specific wiring diagram for detailed connection information.

4.4.2 ESD Signal

A dedicated ESD digital input is provided with all standard actuators.The actuator may be configured to Fail-in-Position, Fail Close or Fail Open. The ESD signal can also be configured to override the Local Stop command.

Double -acting units without an optional accumulator require power to the motor in order to stroke the actuator to the ESD position.

The actuator will return to its previous form of control when the ESD signal is removed. Operational code "Ed" is displayed when an ESD signal is present.

Refer to the wiring diagram for input terminals. Refer to Section 5.2.4 for settings.

4.4.3 Partial Stroke

A dedicated Partial Stroke input is provided as a standard feature for Open/Close applications. Its purpose is to verify valve and actuator operation without significant effect on valve flow.

Partial Stroke is initiated when the Partial Stroke digital input is activated (minimum 300 ms duration required). The actuator will be commanded to travel to a user-defined position (default 90%) and then return to its fully open or closed position as specified in setting "PP". Checks are made to ensure that the actuator moves from its limit within a pre-defined time, and also that it reaches a defined position within a pre-defined period of time.

A fault is generated if the partial stroke is not successful. During a partial stroke, any other signals will take precedence so that the partial stroking function does not interfere with normal operation. Operational code "PS" indicates that a partial stroke signal is present.

Refer to wiring diagram for input terminals. Refer to Section 5.2.5 for settings.

4.4.4 Analogue Control

Most actuators can be configured to position to match an analogue demand signal. This can be either a 0-20mA current range or 0-10V voltage range, configurable as a software setting. Refer to wiring diagram for input terminals. Selectable slowband, deadband and hysteresis values will be used to determine how closely the actuator position should match the demand. Refer to Section 5.2.4 for configuration.

4.4.5 Bus System Options

As an optional feature, EH units can be equipped with a bus communication card for remote operation by any of the following bus systems: Rotork Pakscan, Modbus, DeviceNet, Profibus or Foundation Fieldbus. The unit can be ordered with one of the previous option cards or they can be added later.

By configuring the actuator to Option Control the network card will position the actuator via digital signals passed to the controller and report position values back over the network.

Refer to wiring diagram for input terminals. Refer to Section 5.2.4 for configuration. Additional configuration is required via the applicable bus system.

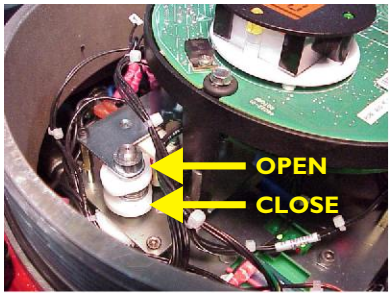
4.5 Limit Switches

When fitted, open and close limit switches are pre-set at the factory to correspond to the actuator mechanical travel stops. Pre-set positions should be checked to ensure full opening and closing of the valve.

Should adjustment be required, they must be manually set and are accessed by removal of the control module cover. The upper-most switch is the open switch; the lower is the close switch.

Switch cam adjustment is by fingertip rotation in either direction. Cams are compression spring loaded and are held in position by tapered centers.

Open and Close position limits must also be set via controller configuration. Refer to Section 5.2.3.



4.5.1 Open Switch Adjustment

Move the valve/actuator to the fully open position. Locate the proper switch cam. Push the cam down and rotate anti-clockwise until the switch operates and release the cam. The switch is now set.

4.5.2 Close Switch Adjustment

Move the valve/actuator to the fully closed position. Locate the proper switch cam. Lift and turn the cam clockwise until the switch operates and release the cam. The switch is now set.

4.5.3 Four SPDT Option

Refer to DOC1613.

4.6 Speed Control

Speed control is a standard feature only on the spring stroke of spring return actuators. For the hydraulic stroke of spring-return actuators and for double-acting actuators, it is an available option requiring the addition of a hydraulic power storage accumulator.

Typically, speed control valves are located on the hydraulic manifold. Refer to the hydraulic schematic for adjustment details.

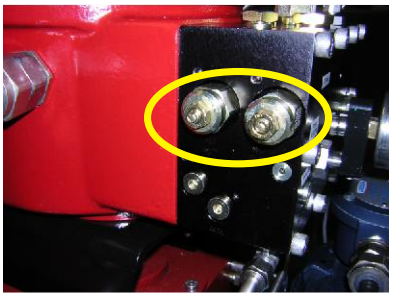
4.6.1 Spring-Return Adjustment (No Accumulator)

Only the stroke time for the spring stroke is adjustable. This is done with the needle valve labeled *Retract* on the hydraulic manifold. Loosen the jam nut and turn the needle valve clockwise to decrease the stroke time or anti-clockwise to increase stroke time.

The speed of the hydraulic stroke is not adjustable by the *Extend* speed control. This is due to the nature of fixed displacement pumps. The *Extend* speed control should be fully anti-clockwise.

4.6.2 Spring Return Adjustment (Accumulator Fitted)

Speed Control of the spring stroke is adjusted as outlined in Section 4.7.1. The hydraulic stroke is adjusted by the *Extend* needle valve. Loosen the jam nut and turn the valve clockwise to decrease stroke time and anti-clockwise to increase stroke time.



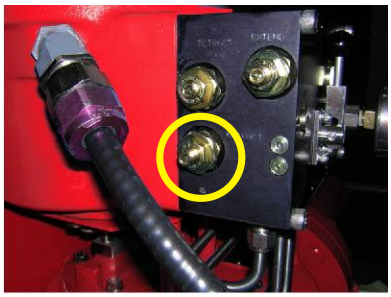
4.6.3 Spring Return Units For Positioning Applications

Positioning units will have an additional speed control labeled *Retract Slow*. This is used to slow the spring stroke as the actuator approaches its demand position. This will be factory set to maximize positioning accuracy and should not need adjusting.

4.6.4 Double-Acting Adjustment (Accumulator Fitted)

Speed control of double acting units is not possible unless a hydraulic accumulator is supplied.

The speed control labeled *NV-EXT* and *NV-RET* are used to adjust the stroke time. Loosen the jam nut and turn the appropriate valve clockwise to decrease and anti-clockwise to increase.



4.6.5 Double-Acting Adjustment (No Accumulator)

Speed control is not available on double-acting units without an accumulator. This is due to the nature of fixed displacement pumps.

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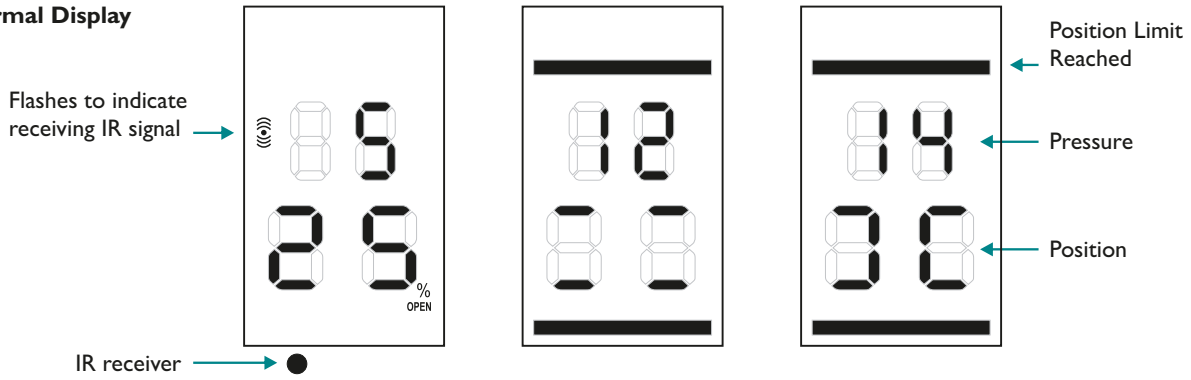
4.8 Digital Display

The LCD displays three categories of information: Normal Display – Pressure and Position are indicated, Operational Codes, and Configuration Mode.

4.8.1 Normal Display



500 PSI or 50 Bar*
25% Open

1200 PSI or 120 Bar*
Fully Open - 100%

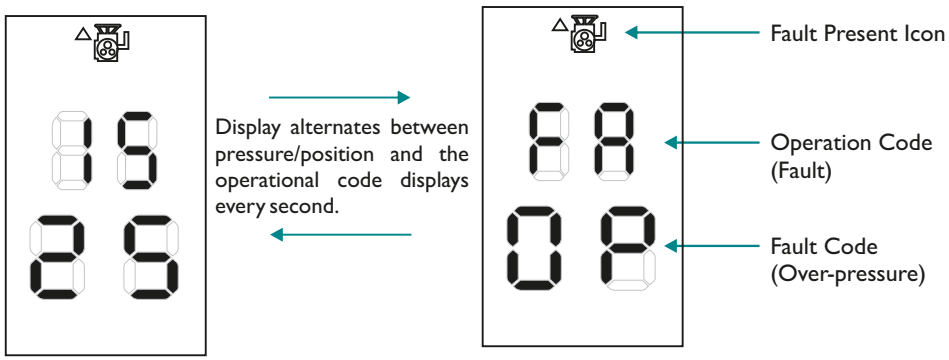
1400 PSI or 140 Bar*
Fully Closed - 0%

* Units as determined in Section 5.2.9 "nP".

4.8.1 Operational Codes

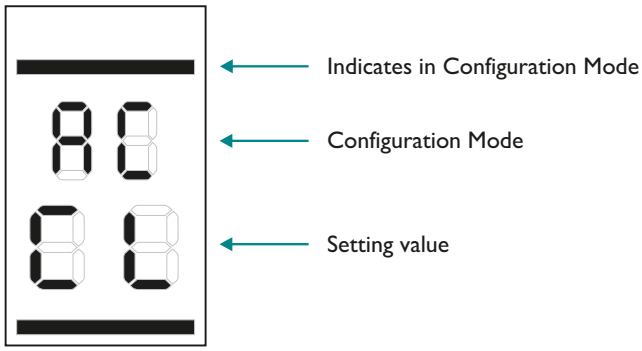
Refer to:
Section 5.3 for Operational codes.

Section 5.3.1 for Fault codes.



4.8.2 Configuration Mode

Refer to Section 5.2 for Configuration codes.



5.0 Configuration

The Rotork EH Range actuator allows configuration without removing any covers. Setting pressure limits and other settings is achieved using the Infra-red Setting Tool. The Setting Tool in certified intrinsically safe to allow configuration in hazardous areas.

All configuration settings are stored in non-volatile memory in the actuator. The Setting Tool enables viewing of all actuator functions via the display window on top of the control module cover. As each function is viewed, its setting can be checked and, if required, changed within the parameters of that function.

5.1 Setting Tool

A hand held Remote Setting Tool is supplied for accessing the controller for configuration or diagnostics. The Setting Tool transmits to the actuator via infra-red pulses. It must therefore be oriented so that the IR transmitter at the end of the remote is pointing directly into the display viewing window from a distance not greater than 0.5 meters.

5.1.1 Battery

The Remote Setting Tool is powered by a 9-volt battery. Battery status can be checked by looking at the infra-red transmitter at the end of the remote. The red transmitter light should be briefly visible when any button is pressed. Should battery replacement be necessary, it must be carried out in a safe area. The battery is accessed by removal of the back cover.

In order to maintain hazardous area certification fit only Duracell MN1604 or Rayovac Alkaline Maximum NoAL-9V battery types.

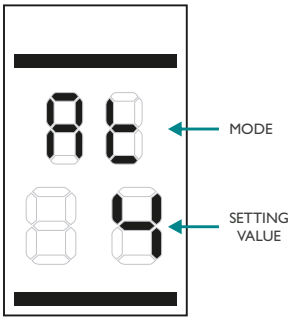
Refit the cover ensuring the red LED faces the transmitter window in the cover.

5.1.2 Remote Setting Tool Specification

Enclosure:	IP67
Certification:	EEx ia IICT4 FM, INT SAFE, Class I & II Div I Groups A, B, C, D, E, F, G, T4A CSA, EXia, Class I, II Div I Groups A, B, C, D
Power Supply:	9V Battery (supplied and fitted)
Operating range:	0.5 meter from display window

5.2 Changing Configuration Settings

Place the Local/Remote selector to *Local/Offline* prior to performing configuration. Settings are edited using the Remote Setting Tool. See table below on how to use the remote to navigate through the various menus and change settings. Altered values must be entered by pressing the *Accept* key. The setting indication flashes to confirm the new setting.



REMOTE SETTING TOOL OPERATION	
KEY	INSTRUCTION
↓	Display next function.
→	Display previous function.
–	Decrease/change displayed function's value or option setting.
+	Increase/change displayed function's value or option setting.
↵	Accept displayed value or option setting.
≡	Open actuator. Non-functional.
I	Close actuator. Non-functional.

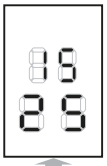
Note: Pressing *Next* and *Previous* keys together returns the display to the position indication mode.

5.2.1 Configuration Menu Structure

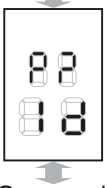
Due to its sophistication and versatility, the EH controller necessarily has many configurable settings. Most settings are pre-configured when shipped from the factory. Although Section 5 covers all available configuration settings, when commissioning or upon assembly to the valve, generally, only the following tasks remain:

1. Verify proper position of the mechanical stops per Section 3.2.
2. Configure Open and Close settings per Section 5.2.3.
3. Verify proper setting of limit switches per Section 4.5.

Note: Since many EH actuators include features not covered in this generic manual, always refer to order specific documentation including operating instructions, hydraulic schematic (HS) and wiring diagram (WD).



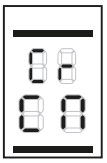
Operational Display
(Actuator in *Offline* mode)



Password Screen

Note: To access the configuration settings, the password must be entered and accepted by pressing the *ACCEPT* key.

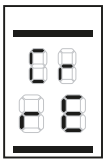
Cross-roads
See 5.2.2



Configuration
(See 5.2.3)

- **AC** Close Action
- **AO** Open Action
- **PC** Close Pressure
- **PO** Open Pressure
- **LC** Closed Limit
- **LO** Open Limit

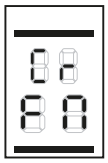
Exit Configuration



Remote Control
(See 5.2.4)

- **rS** Remote Select
- **rP** Remote Priority
- **EA** ESD Action
- **EO** ESD L. Override
- **Et** ESD Type
- **FA** Fault Action
- **db** Deadband
- **HS** Hysteresis
- **SL** Slow Band
- **Pr** Pump Run-on

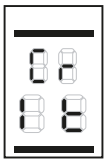
Exit Configuration



Functions
(See 5.2.5)

- **cL** Configure Local
- **PP** P. Stroke Pos
- **PS** P. Stroke Limit
- **HL** Limit Maint
- **PH** Press Hysteresis
- **LH** Limit Hysteresis
- **Pc** Mid-Close Pres
- **Po** Mid-Open Pres

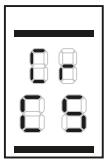
Exit Configuration



Interrupter Timer
(See 5.2.6)

- **OJ** I. Timer Enable
- **Jd** I. Timer Dir
- **JC** I. Timer Close
- **JO** I. Timer Open
- **JS** I. Timer Interval
- **Jn** I. Timer On Time
- **JF** I. Timer Off Time
- **JE** I. Timer on ESD

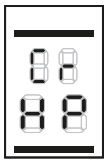
Exit Configuration



Controller Set-up
(See 5.2.7)

- **dL** Demand Low
- **dH** Demand High
- **oP (CL)** CPT Closed
- **oP (OP)** CPT Open
- **LP** Low Power
- **PE** Password Edit
- **rd** Reset to Defaults
- **CF** Confirm Faults

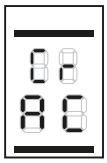
Exit Configuration



Help Screens
(See 5.2.8)

- **H1** Limit Flags
- **H2** Local Control
- **H3** Remote Signals
- **H4** Digital Feedback
- **H5** Control Flags 1
- **H6** Driver Outputs
- **H7** Error Flags 1
- **H8** Error Flags 2
- **H9** Error Flags 3
- **HA** Driver Logic
- **HB** Systems Status

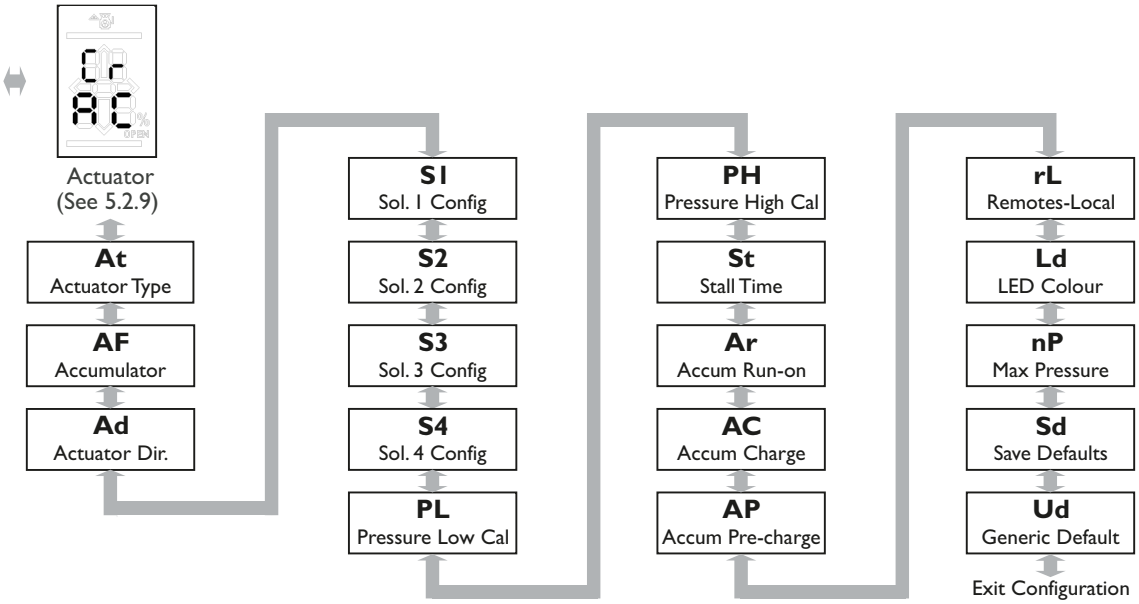
Exit Configuration



Actuator
(See 5.2.9)

The settings under the Actuator menu are related to the configuration of the actuator itself not operational variables. Because user configuration of these settings is not required, this menu is "hidden" to help prevent accidental changes. To access these screens the Actuator menu must first be activated by pressing the Open and Close keys together for approximately two seconds while on the Password screen. The Actuator menu will then be available from the Crossroads. See listing of available screens on the next page.

5.2.1 Menu Structure (continued)



5.2.2 Cross-roads Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
PP	1d = **Password**	**Enter Password to Allow Editing** Step to configured password.(Initial screen shown at left is factory set default). Editing Mode indication bars will appear to indicate correct password. Once the correct password is accepted, pressing Open and Close buttons together makes the Actuator Configuration Menu available.
Cr	Cn = Configuration rE = Remote Control Fn = Functions It = Interrupt Timer CS = Controller Set-up HP = Help Screens AC = Actuator	**Select Menu to be Accessed**

5.2.3 Configuration Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
AC	CL = Limit **CP = Pressure**	**Set the Action For Close** CL - Actuator will stop at Closed Position Limits (setting "LC"). CP - Actuator will travel to Closed Position Limits and continue to run until Pressure Limit as defined in "PC" (Section 5.2.3) is reached.
AO	**OL = Open on Limit** OP = Open on Pressure	**Set the Action For Open** OL - Actuator will stop at Open Position Limit (setting "LO"). OP - Actuator will travel to Open Position Limit and continue to run until Pressure Limit as defined in "PC" is reached.
PC	**10 = 1000 PSI or 100 BAR**	**Set High-Pressure Shut off Point – Close Direction** Sets the system pressure that will shut off the pump/motor. In proper operation, pressure will build to this maximum at end of stroke. If this pressure is reached in mid-stroke it would indicate a valve obstruction or other problem and signal an "OP", over pressure alarm. Adjustment range is 0-99. Units read in PSI or BAR as defined in "nP" (Section 5.2.9).
PO	**10 = 1000 PSI or 100 BAR**	**Set High-Pressure Shut off Point – Open Direction** Sets the system pressure that will shut off the pump/motor. In proper operation, pressure will build to this maximum at end of stroke. If this pressure is reached in mid-stroke it would indicate a valve obstruction or other problem and signal an "OP", over pressure alarm. Adjustment range is 0-99. Units read in PSI or BAR as defined in "nP" (Section 5.2.9).
LC	88 = 88% of potentiometer travel (120°)	**Set the Closed Position Limit** Ensure the actuator's mechanical stops are correctly set. Use local controls to move the actuator to the fully closed position against the mechanical stop and back off the stop approximately 2% Value shown in the display is the actual position, not the set point.
LO	22 = 22% of potentiometer travel (120°)	**Set the Open Position Limit** Ensure the actuator's mechanical stops are correctly set. Use local controls to move the actuator to the fully open position against the mechanical stop and back off the stop approximately 2%. Value shown in the display is the actual position, not the set point.

5.2.4 Remote Control Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
rS	OF = No Remote Control **rE = Remote Control** OP = Option Control OE = Option Control w/ESD Override AI = Analogue Control	**Set Remote Control Type** Remote control not available. The actuator will respond to signals from the Remote Digital Inputs. The actuator will respond to signals from any network card connected to the 48 way connector. The actuator will respond to signals from any network card connected to the 48 way connector and to hardwired ESD override. The actuator will move a position corresponding to the analogue demand signal as set in the Controller Set-up menu (Section 5.2.7).
rP	CL = Close Priority OP = Open Priority **SP = Stay in Position**	**Set Remote Control Signal Priority** Sets the overriding priority in the event both Open and Close inputs are asserted simultaneously.
EA	**E = Open All Solenoid Valves** C = Close O = Open IP = Stay in Position	**Set Action to be Taken for an ESD Signal** E - Action the same as set for Fail Action in"FA". C - Electrically move to Close position. O - Electrically move to the Open position. IP - Stay in position.
EO	**OF = Do Not Override** OO = Override	**Set Local Stop Override** Determine if an ESD signal will override a local stop command.
Et	**OO = Normally Open** OC = Normally Closed	**Set ESD Solenoid Type** Normally open is not Fail Safe. Normally closed is Fail Safe.

Continued next page

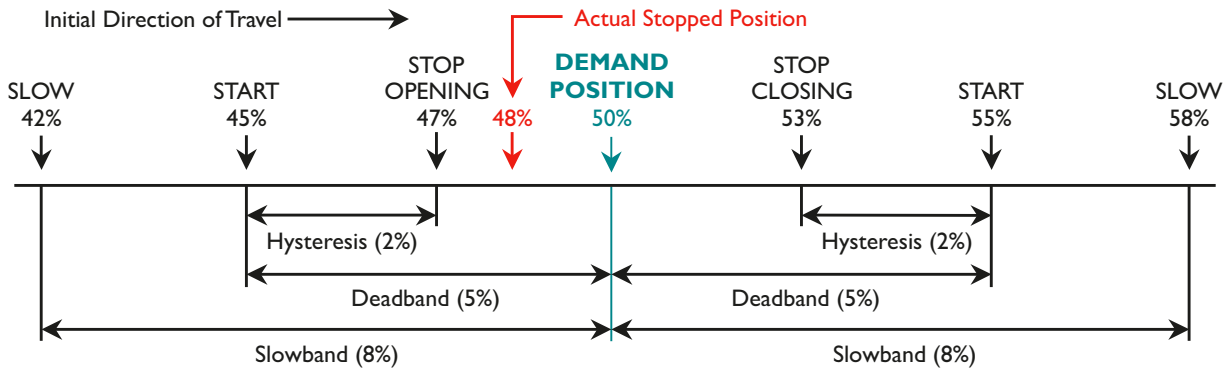
5.2.4 **Remote Control Menu** (continued)

DISPLAY	SETTING (default in bold)	DESCRIPTION
EA	OF **= No Alarm** A = Alarm AE = Alarm with ESD	**Set Failure Action for Loss of Analogue Signal** Determine action taken on detected loss of signal < ½ calibrated minimum value. "OF" Any signal < minimum value is treated as minimum value. No fault indication. (e.g. If the signal range is 4-20mA with 4mA set to Close; the actuator will go Close if the signal drops below 2mA.) "A" Stop moving. Fault "dN" indicated. "AE" Fault "dN" indicated. Perform ESD action as determined in "EA".

5.2.4 Remote Control Menu (continued)

Selectable slowband, deadband and hysteresis values are used to determine how closely the actuator position will match the demand signal. Proper calibration settings provide accurate positioning, prevent the system from hunting and reduce the number of pump/motor starts. Some understanding of the operational design parameters is required to optimally set Deadband "db". Hysteresis "HS" and Slowband "SL". The chart below shows how the slowband, deadband and hysteresis settings effect control of the actuator.

A Slowband of 8%, deadband of 5% and hysteresis of 2% is shown with a demand position of 50%. If the actuator is started at 40%, the controller will command it to move in the open direction until it reaches 42% (Demand-Slowband). It will then move open at a slower rate until it reaches 47% (Demand-(Deadband-Hysteresis)). Momentum/solenoid response times within the system may cause the actuator to continue moving after the stop command has been issued as shown by the "Actual Stopped Position" at 48%. Movement is not commanded again until the measured position falls outside of the deadband on either side of the demand position. If the deadband was smaller, it would be possible for the actual stopped position to have fallen the other side of the deadband in which case, the actuator would be commanded to move in the opposite direction to meet the demand. This would result in hunting as the actuator oscillated around the Demand point. By increasing the deadband and also increasing the amount of hysteresis, the actual demand position can be met without hunting occurring. Outside of the Slowband (<42% and >58%) normal fast operation should occur.



Example of Positioning Control using Slowband (8%), Deadband (5%) and Hysteresis (2%)

DISPLAY	SETTING (default in bold)	DESCRIPTION
db	10 = 1%	**Set Position Deadband Adjustment** Analogue signal deadband is adjustable over a range of 0.1% to 9.9% of travel. Adjustments are made in 0.1% increments/decrements.
HS	05 = 0.5%	**Set Position Hysteresis Adjustment** Analogue signal hysteresis is adjustable over a range of 0.1% to 9.9% of travel. Adjustments are made in 0.1% increments/decrements.
SL	05 = 5%	**Set Slow Mode Band Adjustment** Set the distance from the demand position at which the actuator travel speed will enter Slow Mode. This adjustment allows for accurate positioning. Setting is adjustable from 1% to 99%.
Pr	05 = 5 Seconds	**Set Pump/Motor Run On Time** This function is only applicable to actuators not fitted with accumulators. Its purpose is to reduce the number of pump/motor starts. Set the time for the pump/motor to run after reaching the demand position. This setting is useful to decrease motor starts during modulating operation. Setting is adjustable from 1 to 60 seconds.

5.2.5 Functions Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
cL	Pr = Push to Run **00 = Maintained**	**Configure Local Control Switch** In Push to Run mode, actuator travel will stop when the switch is released. In Maintained mode, once travel is initiated the actuator will run until in reaches the Stop Limits as set in "LO" and "LC" (Section 5.2.3) — even if the switch is released.
PP	**90 = 90% Open**	**Set Partial Stroke Position** Set the amount of stroke to be performed when commanded to Partial Stroke. Adjustment range is 0% to 90%.
PS	**OP = Open Limit** CL = Close Limit	**Set Partial Stroke Limit** Indicate the Limit from which the Partial Stroke will be initiated.
HL	OF = Do not Hold Limit **On = Hold Limit**	**Configure Limit Maintenance** When the Hold Limit is On: 1. In order to maintain the Pressure Limits as set in "PO" and "PC" (Section 5.2.3) the pump/motor will run if pressure drop is greater than that set in "PH" (Section 5.2.5). 2. In order to maintain the Position Limits as set in "LO" and "LC", the pump/motor will run if the actuator moves off the limit by an amount greater than that set "LH".
PH	**01 = 100 PSI or 10 BAR**	**Set Hysteresis for Maintain Pressure** Defines the amount of pressure hysteresis to be used when Hold Limit is On. Adjustment range is 1-99. Units read in PSI or BAR as defined in "nP" (Section 5.2.9).
LH	**05 = 0.5%**	**Set Hysteresis for Position Limit** Defines the amount of limit hysteresis to be used when Hold Limit is On. Adjustment range is 1-99.
Pc	**00 = Off** 01 = 100 PSI or 10 BAR	**Set Mid-Close Stroke Pressure** Set the maximum pressure expected in mid-stoke in the close direction. If pressure exceeds this amount during the close stroke, an "OP" fault is indicated. If the value is set to "00" the Pressure Off setting configured in "PC" is used by default. Units read in PSI or BAR as defined in "nP" (Section 5.2.9).
Pb	**00 = Off** 01 = 100 PSI or 10 BAR	**Set Mid-Open Stroke Pressure** Set the maximum pressure expected in mid-stoke in the open direction. If pressure exceeds this amount during the open stroke, an "OP" fault is indicated. If the value is set to "00" the Pressure Off setting configured in "PO" is used by default. Units read in PSI or BAR as defined in "nP" (Section 5.2.9).

5.2.6 Interrupter Timer Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
Ed	OF **= Timer Off** On = Timer On	**Set Interrupt Timer Enable** Enables the Interrupt Timer. When enabled, the start/stop action is affected by the settings below. The purpose of the Interrupt Timer is to prevent "water hammer".
Jd	OP = Start Opening CL **= Start Closing**	**Set Interrupt Timer Start Direction** Sets the direction in which the Interrupt Function will begin.
JC	25 **= 25%**	**Set Interrupt Timer Close Position** If the setting for "Jd" above is "CL", set the position at which the Interrupt function will begin in the Close direction. If the setting for "Jd" above is "OP", set the position at which the Interrupt function will end in the Close direction. Set position to anywhere between the Open and Close limits as set in Section 5.2.3.
JO	25 **= 25%**	**Set Interrupt Timer Open Position** If the setting for "Jd" above is "CL", set the position at which the Interrupt function will end in the Open direction. If the setting for "Jd" above is "OP", set the position at which the Interrupt function will begin in the Open direction. Set position to anywhere between the Open and Close limits as set in Section 5.2.3.
JS	OF **= 100 mS** On = 1.0 S	**Set Interrupt Timer Interval** Set the Interrupt Timer interval between pump/motor stops/starts to either 1.0 second or 100 mS.
JN	05 **= 500 mS or 5 seconds**	**Set Interrupt Timer On Time** Set the Interrupt Timer On time. Adjustment range is 1-99. Units as set in "JS" above.
JF	25 **= 25 Seconds or 2.5 Seconds**	**Set Interrupt Timer Off Time** Set the Interrupt Timer Off time. Adjustment range is 1-99. Units as set in "JS" above.
JE	OF **= No Override** On = ESD Override	**Configure Interrupt Timer ESD Override** Determine if an ESD signal should override the Interrupt Timer. An ESD signal will override the Interrupt Timer regardless of the setting here if the ESD action as defined in "EA" is "E" Section 5.2.4).

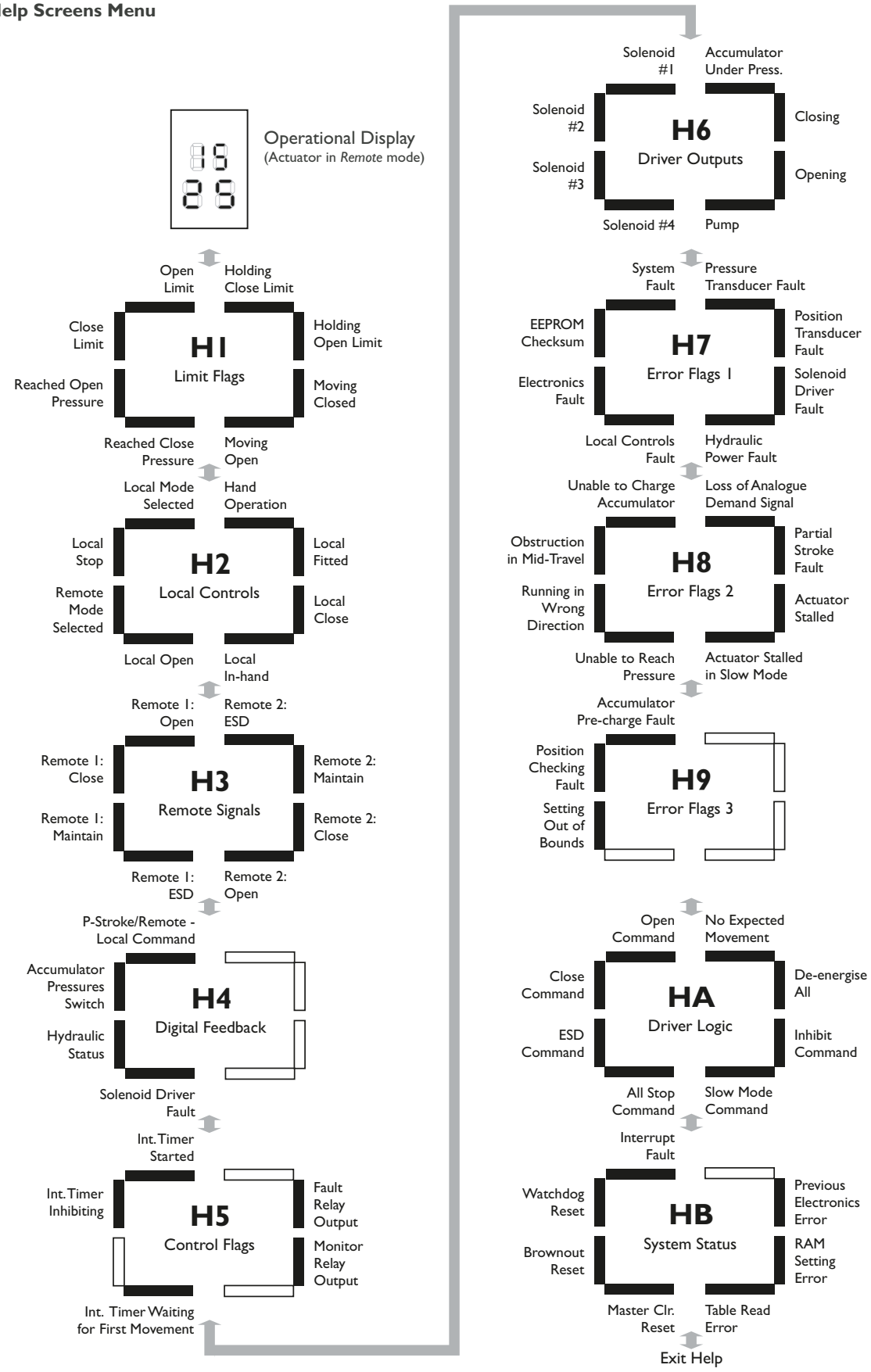
5.2.7 Controller Set-up Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
dL	14 = 14% of full range	**Calibrate the Demand Signal for Close** To calibrate, apply the Close demand signal to the actuator and Accept.
dH	91 = 91% of full range	**Calibrate the Demand Signal for Open** To calibrate, apply the Open demand signal to the actuator and Accept.
oP	04 = Set Close current (Default is 4mA)	**Set CPT Output Current Limit for Close** Position the actuator at the Close limit. Connect a meter to the CPT output terminals(consult applicable wiring diagram) to measure output. Use +/- keys to adjust to the output current desired and Accept. A linear scale is performed for positions between the open and close limits.
oP	20 = Set Open current (Default is 20mA)	**Set CPT Output Current Limit for Open** Position the actuator at the Open limit. Connect a meter to the CPT output terminals(consult applicable wiring diagram) to measure output. Use +/- keys to adjust to the output current desired and Accept. A linear scale is performed for positions between the open and close limits.
LP	OF = Off - Full Power **On = Low Power** EL = Extra Low Power	**Set Low Power Mode** Two options are available to reduce power consumption. In Low Power mode the backlight is switched off unless there is movement or calibration is being performed. In Extra Low Power mode the backlight is switched off unless there is movement or calibration is being performed; the monitor relay is inverted; and the CPT is disabled.
PE	1d **= Password**	**Set New Password** Enter a new Password that will be required to edit settings. Hexadecimal digits from 00 to FF are used. An encrypted value is displayed if the correct password has not already been entered and accepted.
rd	1d **= Password**	**Reset to Factory Defaults** Scroll down to password immediately following the configured password and Accept. Factory defaults can be redefined. See "Sd" (Section 5.2.9).

5.2.7 **Controller Set-up Menu** (continued)

DISPLAY	SETTING (default in bold)	DESCRIPTION
CF	EE = EEPROM Checksum Fault PS = Partial Stroke Fault OP = Over-Pressure dI = Direction Fault UP = Under-Pressure SL = Stall in Slow Mode SE = Stall AC = Accumulator Charge Fault AP = Accumulator Pre-Charge Fault HE = Previous Hardware Error Logged	**Multiple Fault View / Confirm** View current fault codes. Multiple faults display, based on priority, from highest to lowest. Accepting a fault will clear it from the display and the next fault, if any, will be shown.

5.2.8 Help Screens Menu



5.2.9 Actuator Menu

DISPLAY	SETTING (default in bold)	DESCRIPTION
At	**Si = Spring-Return Isolating** Sr = Spring-Return Modulating dI = Double-Acting Isolating dM = Double-Acting Modulating SF = Safety Actuator	**Set Actuator Type** Define the type of service for which the actuator is configured. This setting must conform to way the actuator is assembled. Simply changing the setting will not enable the actuator to perform for a service other than which it was assembled.
AF	**AF = No Accumulator** AO = Accumulator	**Accumulator Fitted** Indicate whether or not an accumulator is fitted. If an accumulator is fitted, the pump/motor will run as required to maintain pressure independent of control signals.
Ad	**AC = Normally Closed** AO = Normally Open	**Set Actuator Fail Direction** Indicate the actuators fail direction for spring-return units or double acting units with a fail-safe accumulator fitted.
S1	**nO = Normal** IO = Inverted	**Configure Solenoid #1** Solenoid output can be inverted from the default configuration. The default setting is dependent upon actuator type. See reference table Appendix B.
S2	**nO = Normal** IO = Inverted	**Configure Solenoid #2** Solenoid output can be inverted from the default configuration. The default setting is dependent upon actuator type. See reference table Appendix B.
S3	**nO = Normal** IO = Inverted	**Configure Solenoid #3** Solenoid output can be inverted from the default configuration. The default setting is dependent upon actuator type. See reference table Appendix B.

Continued next page

5.2.9 **Actuator Menu** (continued)

DISPLAY	SETTING (default in bold)	DESCRIPTION
S4	00 **= Normal** 01 = Inverted	**Configure Solenoid #4** Solenoid output can be inverted from the default configuration. The default setting is dependent upon actuator type. See reference table Appendix B.
PL	10	**Calibrate the Low Pressure Signal** To calibrate, apply the lowest pressure setting (4mA or 0.5V) to the actuator and press Accept on the remote, regardless of the reading in the display.
PH	90	**Calibrate the High Pressure Signal** To calibrate, apply the highest pressure setting (20mA or 4.5V) to the actuator and press Accept on the remote, regardless of the reading in the display.
St	05 **= 5 Seconds**	**Set Stall Timer** Indicate the maximum time for actuator movement to >0.15% of full position sensor travel. If this travel time is exceeded a fault is indicated. Adjustment range is 1-99 seconds.
Ar	05 **= 5 Seconds**	**Set Accumulator Run-On Time** Set time for the pump/motor to run after the pressure switch has tripped. The function is to provide hysteresis to reduce pump/motor starts. Adjustment range is 1-60 seconds. Units are seconds.
AC	01 **= 1 Minute**	**Set Accumulator Maximum Charge Time** Set the maximum time for the pump/motor to run before a fault is indicated. This function is disabled when the actuator is moving. Adjustment range is 1-99. Units are minutes. 99 = unlimited.
AP	00 **= Off**	**Set Accumulator Minimum Charge Time** Enter the minimum amount of time the accumulator should take to charge. This allows the loss of pre-charge to be detected — a fault is indicated. Adjustment range is 0-60. The function is disabled with a setting of "00".
rL	08 **= No Remote Local Control** 00 = Remote Local Control Fitted	**Set Remote Local Control Enable** Indicate whether Remote Local Control is fitted. When enabled, hardwired remote signals will override all other controls.
Cd	gr **= Green** rd = Red	**Set Closed LED Indicator Colour** Set the colour used to indicate the closed limit has been reached. The other colour will indicate that the open limit has been reached. A yellow lamp indicates mid-stroke and cannot be re-configured.

5.2.9 Actuator Menu (continued)

DISPLAY	SETTING (default in bold)	DESCRIPTION
bP	**30 = 3,000 PSI**	**Determine Pressure Units** Set the display for a value to indicate 3,000 psi. This setting allows pressure to be displayed in BAR or other units. (e.g. 21=210 bar)
Sd	1d = Password	**Save Current Settings as Configured Factory Default** To set, scroll to the Password immediately following the pre-defined Password and Accept. Function "rd" (Section 5.2.7) can later be used to return all settings to this default.
Ud	1d = Password	**Return all Settings to Generic Default** To set, scroll to the Password immediately following the pre-defined Password and Accept. Any changes that have been made to settings will be permanently lost.

5.3 Operational Codes

Several operational events are indicated in the upper set of characters in the display.

DISPLAY	DESCRIPTION
H	Pressure signal is > maximum value (e.g. > 3,000 psi or sensor failure). Replaces pressure value indication — is not alternately displayed.
Hn	Actuator is in manual hand pump mode. Display alternates between the code and pressure value.
Ed	An ESD command has been received and is being acted upon. Display alternates between the code and pressure value.
FA	Actuator has detected an operational fault. Display alternates between the fault indication/fault code and pressure/position values.
PS	Actuator is performing a partial stroke sequence. Display alternates between the code and pressure value.

5.3.1 Fault Indication

In the event of a fault, a fault type code will be displayed in the lower set of characters in the display. The following table contains code descriptions and relay status. The Monitor relay is energised if the unit is available for remote operation. It is de-energised when the unit has been placed in Local control mode or by certain fault conditions. The Fault relay is normally de-energised and is energised to indicate that a fault is present. If multiple errors are present, the highest priority will be displayed. Fault definitions are listed in order of priority. "CF" in the menu indicates the fault is clearable through the Confirm Faults menu option. Refer to Section 5.2.7.

DISPLAY	FAULT NAME	DESCRIPTION	MONITOR RELAY	FAULT RELAY
	Loss of Mains Power	Loss of Mains power to electronics.	Off	Off
EE	EEPROM Error	Checksum error detected on EEPROM data. This is checked on power-up only. Cleared on reset or "CF".	Off	On
hA	Hardware Fault	Fault detected within the electronics hardware. Cleared on reset or "CF".	Off	On
LC	Local Controls Fault	More than one switch per knob selected (e.g. Local and Remote or Open and Close simultaneously) Cleared only when the fault is corrected.	Off (Assumes local stop)	On
PU	Hydraulic Power Unit Fault	A Switch used to detect faults in the hydraulics has opened. Cleared when all switch contacts are closed.	On	On
dr	Solenoid Driver Fault	A solenoid output is open circuit or overloaded when energised. Cleared when the fault has been fixed or the driver signal is removed.	On	On

5.3.1 **Fault Indication** (continued)

DISPLAY	FAULT NAME	DESCRIPTION	MONITOR RELAY	FAULT RELAY
PO	Position Sensor Fault	Position sensor input <5% or >95% of full travel. Indicates the sensor has become has a shorted or open circuit. Movement is inhibited. Cleared when the sensor input is >5% and <95%.	Off	On
Pr	Pressure Sensor Fault	Pressure sensor input <½ minimum calibration value or >95% of full travel. Indicates the sensor has become shorted or an open circuit. Movement is inhibited. Cleared when the sensor input is >½ minimum and <95%.	Off	On
AC	Accumulator Charge Fault	The accumulator has not reached Maximum Pressure within the Accumulator Charge Time. The pump/motor is stopped until a new command to move is received. Action determined by settings for max. pressure "PO"and "PC" (Section 5.2.3) and charge time "AC" (Section 5.2.9). Cleared when accumulator reaches pressure or "CF".	On	On
OP	Over-Pressure in Mid-Travel	The cylinder pressure in mid-stroke was measured to be > the Pressure Off value. Actuator movement is inhibited in the direction it was traveling. Action determined by settings "PO" and "PC". Cleared when movement is detected or "CF".	On	On
dI	Running in Wrong Direction	The actuator has failed to respond to a change direction command. Actuator movement is inhibited until a new command is received. Cleared when movement in the correct direction is detected or "CF".	On	On
UP	Under Pressure at End of Travel	A stall error was detected when past a limit (i.e., unable to reach Pressure Off value). Actuator movement is inhibited until a new command is received. Action determined by settings "PO"and "PC" (Section 5.2.3).	On	On
SL	Slow Mode Stall	A stall error was detected in Slow Mode. Actuator movement is inhibited until a new command is received. Action determined by settings "PO"and "PC" (Section 5.2.3). Cleared when movement is detected, "Pressure Off" value is reached, or "CF".	On	On
St	Stall	No actuator movement was detected in mid-stroke for more than the Stall Time or the Accumulator Charge Time passed the set value. Actuator movement is inhibited until a new command is received. Action determined by settings "St" and "AC" (Section 5.2.9). Cleared when movement is detected or "CF".	On	On
PS	Unsuccessful Partial Stroke	A partial stroke sequence was initiated but not completed. Cleared when a successful partial stroke is completed.	On	On
dn	Loss of Demand Signal	The analogue demand signal is less than ½ the minimum calibrated value. Action determined by setting "FA" (Section 5.2.4). Cleared when demand signal is > ½ minimum value.	On	On
AP	Accumulator Pre-Charge Fault	The accumulator has charged too quickly indicating a failure of the nitrogen pre-charge. Cleared when charge time exceeds minimum set value or "CF".	On	On

6.0 Storage and Maintenance
Rotork actuators are designed to work for long periods of time in the most severe conditions. However, a preventative approach to storage and maintenance helps prevent costly down time and will reduce the cost of ownership.

6.1 Storage
To ensure the actuator remains in proper working order, follow the recommendations listed below for inspection, protection and lubrication.

6.1.1 Make sure the actuator is clean and dry prior to placement in storage.

6.1.2 Keep out of direct sunlight to avoid premature weathering.

6.1.3 Check packaging to ensure equipment is protected against water and condensation.

6.1.4 Ensure the unit is stored in a temperature controlled area based upon the unit's temperature specification.
6.1.5 Plug any open hydraulic ports or electrical entries.

6.1.6 Fill the reservoir with the proper hydraulic oil to protect the interior from corrosion.
6.1.7 Visually inspect the equipment periodically to identify any potential corrosion. Repair as required.

6.2 General Maintenance
All maintenance and inspection must comply with the rules and regulations of the country of final installation.

6.2.1 Every 3 months

6.2.1.1 Perform partial stroke of unit, where required.

6.2.1.2 Check display for faults. Repair as needed.

6.2.1.3 Check oil level and condition (e.g., water present). Change as contaminated.

6.2.1.4 Visually inspect for oil leaks or corrosion. Repair as needed.

6.2.1.5 Check for loose hardware or fittings. Tighten as needed.

6.2.1.6 Inspect paint for damage. To ensure continued corrosion protection, touch-up as required according to applicable paint specification.

6.2.2 Every 6 months
In climates with large seasonal temperature swings it may be necessary to change the oil every six months.

6.2.3 Every year

6.2.3.1 Remove any debris that has collected on the unit.

6.2.3.2 Change the hydraulic oil. Ensure that it meets the applicable specification.

6.2.3.2 Verify proper accumulator pre-charge pressure. Recharge as required. Refer to Appendix A.

6.2.3.3 Clean the manifold filter element. Change any external filter elements installed.

6.2.3.4 Verify operation of the manual override, if provided.

6.2.3.5 Stroke the actuator to the open and closed positions. Check the display for any fault indication.

6.3 Verify Operation
Ensure that the actuator correctly operates the valve within the required cycle time. The actuator should be cycled several times with all the existing controls (e.g., remote control, local control and manual override).

6.4 Cylinder Seal Replacement
Should it become necessary to replace hydraulic cylinder seals, consult the Installation and Maintenance Manual for the prime mover supplied (e.g., GH).

6.5 Fuses
A protective fuse located within the control module. It is accessed by removing the control module cover and is located on the power PCB beneath the LCD display. See the table below for the proper replacement value.

FUSE SPECIFICATION REFERENCE

	INPUT POWER VOLTAGES	BUSSMAN ORDER CODE
3-PHASE 50 HZ	190, 200, 220, 240 VAC	TDC11-250mA
3-PHASE 50 HZ	380, 400, 415, 440, 480, 500, 525, 550, 660, 690 VAC	TDC11-150mA
3-PHASE 60 HZ	200, 208, 220, 230, 240 VAC	TDC11-250mA
3-PHASE 60 HZ	380, 400, 440, 460, 480, 575, 600, 660, 690 VAC	TDC11-150mA
1-PHASE 50 HZ	110, 115 VAC	TDC11-500mA
1-PHASE 50 HZ	220, 230, 240 VAC	TDC11-250mA
1-PHASE 60 HZ	110, 115 VAC	TDC11-500mA
1-PHASE 60 HZ	208, 220, 230, 240 VAC	TDC11-250mA
	24 VDC	TDC11-5A

7.0 Grease and Hydraulic Oil Specifications

7.1 Grease Specification

The following grease is used by Rotork Fluid Systems and is recommended for any re-lubrication:

Manufacturer:	Mobil
Trade name:	Mobiltemp 78
Colour:	Gray/black
Soap type:	Inorganic
Oil type:	Mineral
Consistency (NLGI GRADE)-ASTM D217:	1
Worked penetration at 25°C-ASTM D217:	295/325 dmm
Dropping point - ASTM D2265:	260°C
Viscosity of base oil at 40°C-ASTM D445:	485 cSt
Viscosity of base oil at 100°C-ASTM D445:	32 cSt

Note: This is the standard grease specification for Rotork EH Range actuators. If an alternative grease was specified and/or supplied, it was noted in job specific documentation and is available upon request.

7.2 Hydraulic Oil Specification

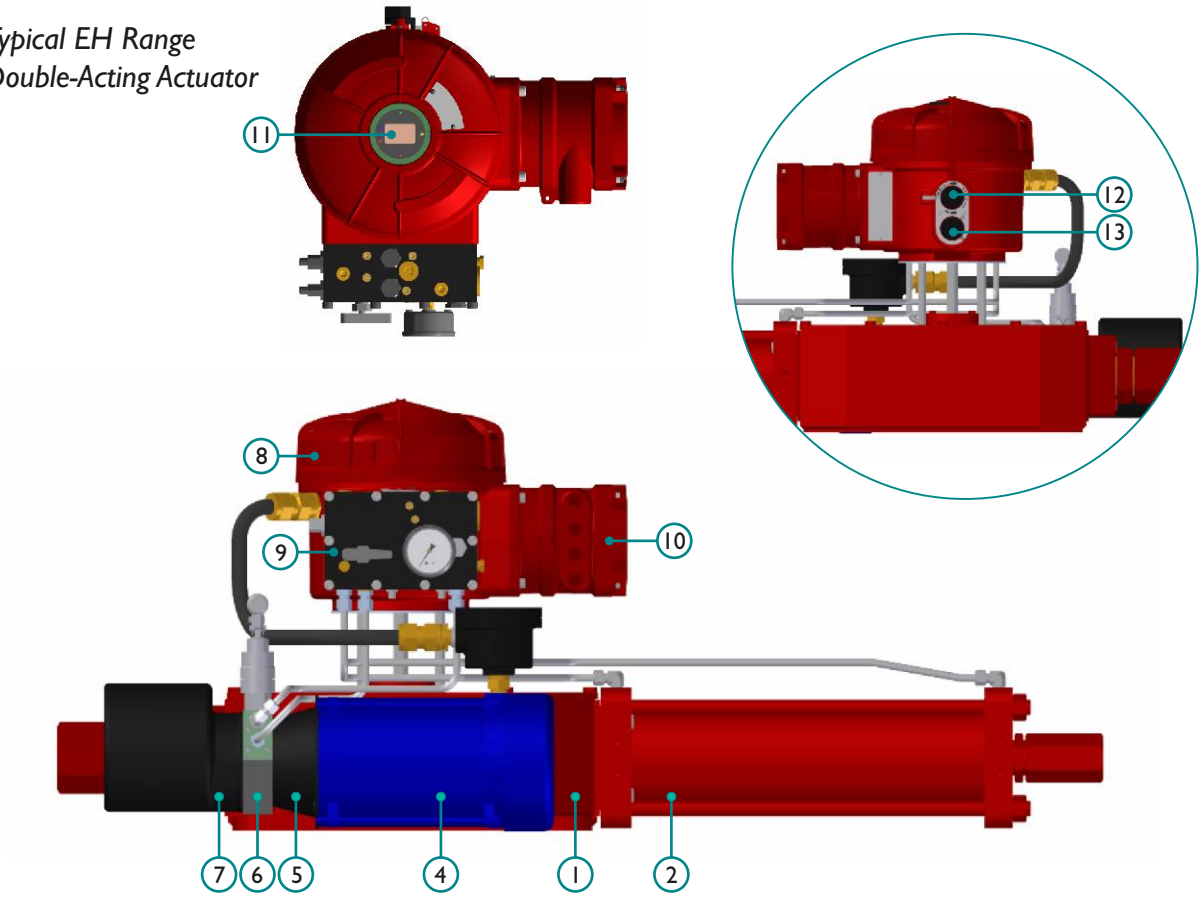
The following hydraulic oil is used by Rotork Fluid Systems and is recommended for any re-lubrication:

Manufacturer:	Mobil
Trade name:	DTE 13M
Viscosity at 40°C:	32 cSt
Viscosity at 100°C:	6.1 cSt
Viscosity index ASTM:	141
ISO Grade:	32
Pour point:	-45°C
Specific weight at 15°C:	0.874 kg/dm^3

Note: This is the standard hydraulic oil specification (-20°C to -40°C) for Rotork EH Range actuators. If an alternative oil was specified and/or supplied, it was noted in job specific documentation and is available upon request.

DRAWING / PARTS LIST

Typical EH Range Double-Acting Actuator



ITEM	DESCRIPTION
1	Actuator Centre Body
2	Hydraulic Cylinder
3	* Spring Canister (if applicable)
4	Motor
5	Pump
6	Manual Override (optional)
7	Hydraulic Reservoir
8	Control Module
9	Hydraulic Manifold
10	Terminal Compartment
11	Digital Display Window
12	Local/Remote Switch
13	Open/Close Switch

* Not Shown

The drawing above is a general representation of a typical EH Range quarter-turn actuator. Actual placement of the pump/motor/reservoir assembly and control module is dependent upon several variables including the size of the actuator, whether the actuator is configured for horizontal or vertical valve applications, and various application specific requirements such as remote mounting of the control module.

Certified drawings for configurations supplied are provided with job specific documentation including a wiring diagram and a hydraulic schematic.

APPENDIX A - Accumulator Pre-charge & Removal

1.0 Introduction

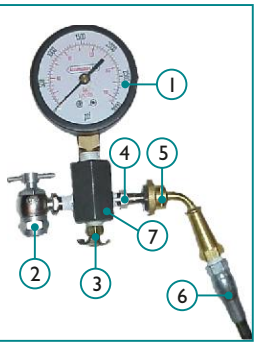
1.1 This document outlines procedures for pre-charging the accumulator, verifying pre-charge pressure and removal of the accumulator.

A charging assembly as shown below is required. The necessary components are readily available from industrial suppliers or the assembly is available for purchase from Rotork Fluid Systems. Request Rotork part number 90-183 (hose not included).

An inert gas, such as nitrogen, will also be required for pre-charging.

ITEM	DESCRIPTION
1	Pressure Gauge
2	Gas Chuck/T Handle
3	Bleed Valve
4	Gas Valve
5 *	Swivel Connector
6 *	Hose
7	Adaptor

* Required only for pre-charging, not verification or accumulator removal.



2.0 Accumulator Pre-Charging

2.1 Remove the gas valve cap.

2.2 On the charging assembly, turn the chuck (2) "T" handle fully anti-clockwise and attach the chuck to the accumulator.

2.3 Ensure the bleed valve (3) is tightly closed.

2.4 Attach the Swivel Connector (5) to the charging assembly gas valve (4) and tighten to 1-2 Nm / 10-15 in lbs.

2.5 Turn the "T" handle (2) fully clockwise. This action will open the valve.

2.6 Open the nitrogen bottle valve and SLOWLY fill the accumulator. Shut off the nitrogen supply when the gauge indicates 110% of the desired pre-charge level.

2.7 Let the pre-charge sit for 10 to 15 minutes to allow the gas temperature to stabilize. Slowly open bleed valve (3) until the desired pressure is reached. Tightly close bleed valve (3).

2.8 When finished pre-charging, turn the "T" handle (2) fully anti-clockwise, then open bleed valve (3) to release residual gas.

2.9 Use a wrench to prevent the gas valve assembly from rotating and remove the charging assembly from the accumulator.

2.10 Re-install valve cap.

3.0 Pre-charge Verification

3.1 Use the appropriate valve in the hydraulic system to discharge oil from the accumulator.

3.2 Remove the protective cover and the secondary seal from the accumulator.

3.3 Turn "T" handle (2) fully anti-clockwise. Attach the charging assembly by screwing the gas chuck to the valve stem of the accumulator. Tighten to 1-2 Nm / 10-15 in lbs.

3.4 Close bleed valve (3).

3.5 Turn "T" handle (2) clockwise to release the accumulator pre-charge to the gauge for pressure verification.

3.6 When finished checking the pre-charge, turn "T" handle (2) fully anti-clockwise, then open bleed valve (3).

3.7 Use a wrench to prevent the gas valve assembly from rotating and remove the charging assembly from the accumulator.

3.8 Replace the gas valve cap.

4.0 Accumulator Removal

4.1 Attach the charging assembly and follow steps 3.2 through 3.5.

4.2 Open bleed valve (3) until all gas pre-charge is released from the accumulator.

4.3 Remove the charging assembly. The accumulator can now be safely removed from the system.

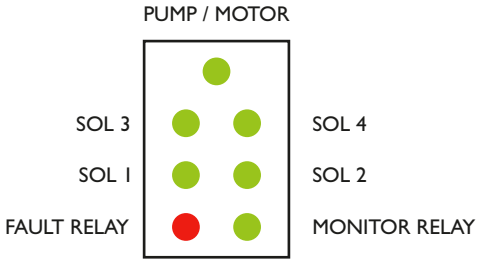
APPENDIX B - Driver Outputs (not inverted)

Actuator	Acc	Output	Name	All Stop	Stop	Fast		Slow	
						Open	Close	Open	Close
Spring Return Modulating	No	Sol #1	Open	On-U	On-U	Off-U	On-U	N/A	On-U
		Sol #2	Slow Close	D	X	X	X		✓
		Sol #3	Close	✓	✓	✓	X		✓
		Sol #4	Not Used	X	X	X	X		X
		Pump		Off	On-R	On	On-R		On-R
	Yes	Sol #1	Open	X	X	✓	X		X
		Sol #2	Slow Close	X	X	X	X		✓
		Sol #3	Close	✓	✓	✓	X		✓
		Sol #4	Not Used	X	X	X	X		X
		Pump		Off	On-A	On-A	On-A		On-A
Spring Return Isolating	No	Sol #1	Not Used	X	X	X	X	N/A	
		Sol #2	Not Used	X	X	X	X		
		Sol #3	Close	✓	✓	✓	X		
		Sol #4	Not Used	X	X	X	X		
		Pump		Off	Off	On	Off		
	Yes	Sol #1	Open	X	X	✓	X		
		Sol #2	Not Used	X	X	X	X		
		Sol #3	Close	✓	✓	✓	X		
		Sol #4	Not Used	X	X	X	X		
		Pump		Off	On-A	On-A	On-A		
Double Acting Modulating	No	Sol #1	Slow	X	X	X	X	✓	✓
		Sol #2	Direction	Off-B	Off-B	✓	X	✓	X
		Sol #3	Bypass	On-U	On-U	Off-U	Off-U	Off-U	Off-U
		Sol #4	Not Used	X	X	X	X	X	X
		Pump		Off	On-R	On	On	On	On
	Yes	Sol #1	Slow	X	X	X	X	✓	✓
		Sol #2	Direction	Off-B	Off-B	✓	X	✓	X
		Sol #3	Stop	✓	✓	X	X	X	X
		Sol #4	Not Used	X	X	X	X	X	X
		Pump		Off	On-A	On-A	On-A	On-A	On-A
Double Acting Isolating	No	Sol #1	Not Used	X	X	X	X	N/A	
		Sol #2	Direction	Off-B	Off-B	✓	X		
		Sol #3	Not Used	X	X	X	X		
		Sol #4	Not Used	X	X	X	X		
		Pump		Off	Off	On	On		
	Yes	Sol #1	Not Used	X	X	X	X		
		Sol #2	Direction	Off-B	Off-B	✓	X		
		Sol #3	Stop	✓	✓	X	X		
		Sol #4	Not Used	X	X	X	X		
		Pump		Off	On-A	On-A	On-A		

KEY

✓ = Energised
X = De-energised
Off-U = Pump must run for 0.5 seconds before de-energising.
On-U = Must be on unless pump has been off for more than 5 seconds.
On-R = Allowed to run-on.
On-A = Controlled by accumulator pressure switch.
Off-B = Switched off after short delay to prevent pressure leakage at stop.

ENERGISED INDICATION LEDS



APPENDIX C - Recommended Spare Parts

RECOMMENDED SPARE PARTS			
PART NUMBER	DESCRIPTION	QTY < 10 UNITS	QTY > 10 UNITS
WH1384	24VDC Solenoid Coil Assembly	1	1
96-197	Motor Contactor (AC motors only)	1	2
96-198	Motor Contactor (DC motors only)	1	2
WCH1469	Main Controller Circuit Board	-	1
46025	AC Power Circuit Board	-	1
46557	DC Power Circuit Board	-	1
WPH1297	Controller Seal Kit	1	2
CONTACT ROTORK*	Electric Motor	-	1
CONTACT ROTORK*	Hydraulic Cylinder Seal kit	1	2

*The electric motor and hydraulic cylinder vary with model and application. Contact Rotork Fluid Systems with the unit serial number.

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