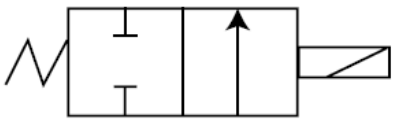
EH50 Product Manual – Version 2015.3

Last Updated: 3/2/15 – J.Koba

Product Description:

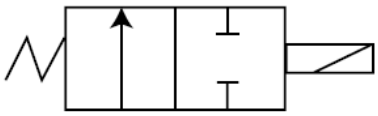
The EH50 Series encompasses 2-way, pilot operated solenoid valves with a maximum allowable inlet pressure of 10,000 psi [68.9 MPa] for normally closed valves and 7,500 psi [51.7 MPa] for normally open valves. Maximum allowable differential pressure ($P_{inlet} – P_{outlet}$) depends upon the coil selected to operate the valve, and the minimum pressure differential must be above 100 psi [0.7 MPa] to operate the valve. The valve is designed for water, non-corrosive and non-viscous liquids, gases, and hydrogen. Do not use this valve with dirty fluids or solutions that will leave a large amount of deposits.

When the normally closed valve is energized, flow occurs from the inlet to outlet. When de-energized, flow stops. The EH50 is unique from other high pressure products offered by Clark Cooper in that it is available with a built in check valve option. Without this option, the valve will only stop flow in the direction of inlet to outlet. It does not stop flow in the reverse direction, i.e. P_{inlet} must be greater than or equal to P_{outlet} at all times to prevent back flow.



Normally Closed

When the normally open valve is energized, flow stops moving from the inlet to the outlet. Once closed, there is very limited ability of the valve to stop flow from moving in the reverse direction from outlet to inlet unless the valve is configured with the built in check valve option.



Normally Open

Installation:

The normally closed EH50 must be mounted in the vertical orientation with the coil on top. This is because gravity is used to reset an internal component upon closing. Normally open valves can be mounted with the coil in any orientation but should be specified when purchasing the valve.

The ½-14 NPT valve body threads per ANSI/ASME B1.20.1 require a sealant, such as PTFE tape, by design. Follow the sealant manufacturer installation instructions. Some general guidelines are:

- Use only 2 to 3 wraps (max) of PTFE tape around the external thread.
- Looking at the external thread, wrap the PTFE tape clockwise. When the threads are turned together, this will eliminate friction trying to unravel the tape.
- Start the tape at least one thread away from the end to eliminate any chance of a thread getting in the flow path.
- Do not combine thread sealant and PTFE tape.
- Do not back off a connection simply to adjust orientation. This may destroy the seal.

There is surprisingly no set specification that dictates exact torque values for taper threads. A reputable fitting manufacturer goes as far as to make the statement below.

"As a general rule, pipe fittings with tapered threads should not be assembled to a specific torque because the torque required for a reliable joint varies with thread quality, port and fitting materials, sealant used, and other factors. Where many of these factors are well-controlled, such as particular jobs on an assembly floor, a torque range that produces the desired results may be determined by test and used in lieu of turns count for proper joint assembly."

Due to our agreement with this statement, we err on the side of caution and do not publish installation torque values for NPT threads.

Make sure that connecting pipes or tubes are clean and free of particulates.

***Install a filter upstream and close to the solenoid valve (see details in Filter section).**

No lubrication is required.

Filters:

Foreign matter such as particulates, rust flakes, PTFE tape, pipe dope, etc., can jam moving parts within a solenoid valve, clog the small orifices, or damage softer sealing surfaces. The result can be a failure to open, close, and seal. A strainer/filter with 200 mesh (0.0029" gaps) or finer is recommended for the EH50 Series.

The strainer should be placed upstream (inlet side) and as close to the valve as possible. Be sure to select a model that is safe for the inlet pressure. Size the filter so that the pressure drop across it is acceptable for the flow rate.

Configurations:

Part number breakdown: EH50-XX-XXXX-XX

Port Size

Options (multiple)

Coil Voltage

Port Sizes:

08 – 0.500”

Coil Voltage:

A024 – 24V AC, 60 Hz
A120 – 120/60 Hz, 110/50 Hz V AC
A240 – 240/60 Hz, 220/50 Hz V AC
D012 – 12V DC
D024 – 24V DC
D120 - 120V DC

All standard configurations use a 10 watt coil. The “–XP” option designates a 22 watt coil for a higher allowable differential pressure.

The standard coils offered are UL listed and CSA certified. Hazardous location approvals are Class I, Division 1 & 2, Groups A, B, C, and D, and Class II, Division 1 & 2, Group E. The NEMA rating is 7 & 9, which allows continuous immersion. Coil wire length is 18”, but longer lengths are available at an additional charge and lead time. The general service option “-GS” coil option has a NEMA rating 1, 2, 3, 4, 4x. It is not explosion proof.

Options:

CK – Integrated Check Valve

Additional components are built into the valve to prevent flow from the outlet to the inlet.

DN – DIN connection on coil

DIN connector per DIN 43650A/ISO 4400 is added to the NPT threads of a coil. This is not explosion proof.

GS – General Service

Coil used has NEMA Type 1, 2, 3, 4, and 4x protection only. Not explosion proof.

HY – Class 5 Seat Leakage Test

Seat leakage is tested at the factory using helium. The valve must pass Class 5 sealing per FCI 91-2-2001. Helium leaks more easily than air, and is therefore a more stringent test.

NO- Normally Open

The valve closes upon energizing the coil.

OX – Cleaned for Oxygen Service

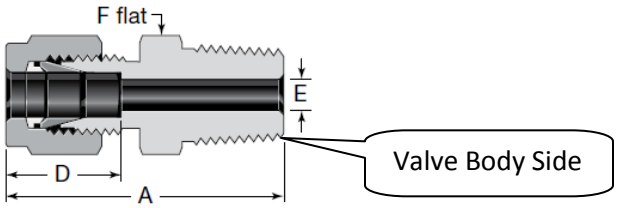
The valve undergoes extensive cleaning per internal procedure OP-0475 to remove all oil, microscopic sediment, and particulates from all valve components. Components are black light inspected for trace residue.

SS – 316 Stainless Steel Body

Standard valve bodies are 7075-T6 anodized aluminum.

TC – Tube connection

Valve is supplied with straight fittings attached to the valve body that allow clamping to 1/2” nominal tube using a ferrule connection.



VT – Fluorocarbon (Viton) O-Rings

The standard o-ring is Buna-N and has a suggested temperature range of -50 to 225° F. Select the fluorocarbon o-ring option to allow fluid temperature range from 20° F to 400°F.

XP – Extra Pressure

22 watt coil for higher allowable differential pressure. The standard offering is explosion proof as described above, but a general service variant is available as well. See pressure table for expanded pressure ratings.

T5 – Class 5 Seat Leakage Test with Air

The valve must pass Class 5 sealing per FCI 91-2-2001 with air.

Available Valve Body Connections:

- ½-14 NPT per ANSI/ASME B1.20.1

Pressures:

Maximum Pressure Differential (psi)	
Normally Closed, AC Voltage (10 Watt):	7,500
Normally Closed AC Voltage (-XP, 22 Watt):	10,000
Normally Closed DC Voltage (10 Watt)	3,500
Normally Closed DC Voltage (-XP, 22 Watt):	5,000
Normally Open AC Voltage (10 Watt):	7,500
Normally Open DC Voltage (10 Watt):	2,500
Normally Open DC Voltage (22 Watt):	5,700

The EH50 Series requires a minimum pressure differential of 100 psi [0.7 MPa] to move the valve piston and operate the valve.

The EH50 Series is designed to withstand pressures approaching four times maximum allowable inlet pressure at room temperature without bursting. However, the inlet pressure should NEVER be allowed to exceed 10,000 psi.

Open/Close times will depend upon the differential pressure and fluid. The response time is typically less than 0.5 seconds, and is significantly faster towards the high end of the allowable differential pressure.

Standard Materials:

Valve Body – 7075-T6 anodized aluminum
Bonnet Tube – 316 and 430 Stainless Steel
Piston - Polyether ether ketone (PEEK) for temperatures <280°F
Other wetted components – 302, 303, and 430 stainless, PTFE, copper (AC powered only)
Springs – 302 SS (various available)
Seals – Buna-N, Viton, and others available
Alternate piston material may be selected to perform at elevated temperatures

Flow Rate:

The flow rate of a fluid through a valve is a function of the inlet and outlet conditions, liquid or gas properties, and properties of the specific valve. Pressure, temperature, and piping geometry are inlet and outlet conditions. Pertinent liquid properties are composition, density, vapor pressure, viscosity, surface tension, and thermodynamic critical pressure. Pertinent gas properties are composition, density, and ratio of specific heats. Valve characteristics such as flow path, valve travel, and of course size influence flow rate. ANSI/ISA-75.01-1985 (R1995) provides equations to approximate flow.

Through a standard test procedure, a Valve Flow Coefficient "C_v" can be assigned to a particular valve. This coefficient can then be used to approximate flow rates with reasonable accuracy for different fluids and gases at any inlet and outlet conditions. C_v is essentially the number of gallons of water that will flow through a particular valve in 1 minute at exactly 1.0 psi of differential pressure between the inlet and outlet. The C_v for the EH50 series is approximately 4.5.

The flow rate through an EH50 valve can be **approximated** as follows:

- P1 = Inlet Pressure (psi)
- P2 = Outlet Pressure (psi)
- C_v = Valve flow coefficient (no units)
- SG = Specific Gravity (no units) at standard conditions
- Q = Flow Rate (gal/min)

For a gas:

Calculate $P_{Critical} = 0.53*P1$

For a constant P1, flow will increase as P2 decreases until reaching $P_{Critical}$. As P2 falls below $P_{Critical}$, no further increase of flow rate occurs.

If $P2 > P_{Critical}$:

$$Q_m = C_v * \sqrt{\frac{P*(P1-P2)}{SG}} * \sqrt{\frac{520}{T}}$$

SCFM (Standard Cubic Feet per minute at 14.7 psi and 60°F)

If $P2 < P_{Critical}$:

$$Q_m = C_v * \frac{P1}{\sqrt{2*SG}} * \sqrt{\frac{520}{T}}$$

SCFM

For liquid:

$$Q = C_v * \sqrt{\frac{P1-P2}{SG}}$$

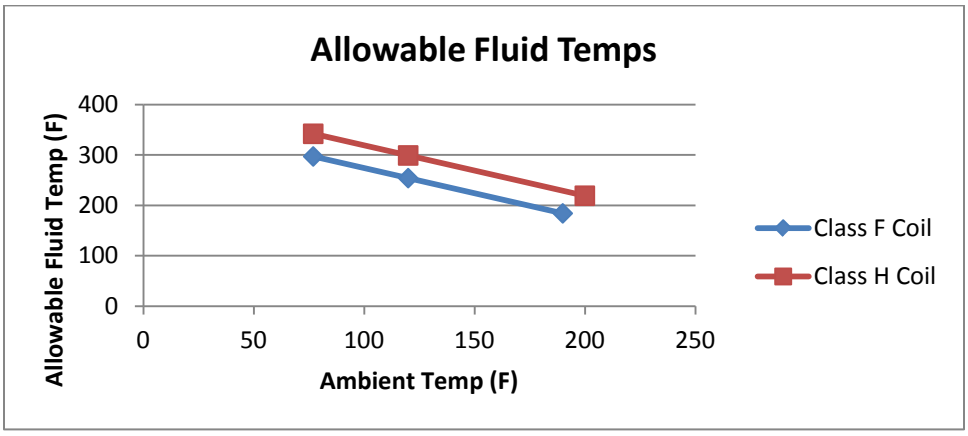
gal/min

Operating Temperatures:

Solenoids will get very hot from normal usage (>250°F). The high temperature limit of the coil is based upon the coil wire insulation. If the temperature limit is exceeded, permanent and self-perpetuating damage will result.

As solenoid coil wire temperature rises, electrical resistance increases and less current flows. Since pull force of a solenoid is directly proportional to amperage, a solenoid operating at the upper temperature limit may produce less pull force.

The 22 watt coils are temperature Class H. The 10 watt coils are temperature Class F. The charts below give guidelines for allowable fluid temperature for a given ambient temperature assuming that the coil is being **held in the energized state**.



If the coil is only being powered for short periods of time and does not reach steady state high temperatures, the allowable fluid temperature is 400°F when in an ambient temperature of 77°F. Fluorocarbon (Viton) o-rings and special piston materials may be selected for such elevated temperatures.

AC powered coils experience a current “inrush” upon each energize cycle. The number of allowable energize cycles per minute is dependent upon fluid and ambient temperature. It is strongly advised to use DC coils if frequent cycling (>5 time per minute), particularly if fluid temperatures are above ambient.

There are other factors not taken into account for maximum allowable fluid temperature. It is suggested that if a fluid temperature is going to be near the high limit, the application should be thoroughly tested to ensure a robust design.

Sealing:

Six different valve seat leakage classifications are defined by ANSI/FCI 91-2-2001. All valves must pass a leakage test prior to the leaving the factory based on the requirements of this specification. The standard leakage for this product is Class 2. Class 5 is applied to part number suffixes –HY and –T5.

Class 2 (Allowable Leakage/Min)		
Size	Water (cc)	Air (cc)
0.019	0.08	0.38
0.032	0.13	0.64
0.250	1.00	5.00
0.500	2.00	10.00
0.750	3.00	15.00
1.000	4.00	20.00
1.500	6.00	30.00
2.000	8.00	40.00
2.500	10.00	50.00
3.000	12.00	60.00
4.000	16.00	80.00
6.000	24.00	120.00

Class 4 (Allowable Leakage/Min)		
Size	Water (cc)	Air (cc)
0.019	0.10	0.04
0.032	0.10	0.06
0.250	0.10	0.50
0.500	0.10	1.00
0.750	0.10	1.50
1.000	0.10	2.00
1.500	0.10	3.00
2.000	0.10	4.00
2.500	0.10	5.00
3.000	0.10	6.00
4.000	0.10	8.00
6.000	0.10	12.00

Class 5 (Allowable Leakage/Min)		
Size	Water (cc)	Air (cc)
0.019	.1 / 10 Min	0.00
0.032	.1 / 10 Min	0.01
0.250	.1 / 10 Min	0.05
0.500	.1 / 10 Min	0.10
0.750	.1 / 10 Min	0.15
1.000	.1 / 10 Min	0.20
1.500	.1 / 10 Min	0.30
2.000	.1 / 10 Min	0.40
2.500	.1 / 10 Min	0.50
3.000	.1 / 10 Min	0.60
4.000	.1 / 10 Min	0.80
6.000	.1 / 10 Min	1.20

Electrical:

Electrical wiring must conform to the nameplate rating. Connect the coil leads to electrical circuit using standard electrical practice. If the coil is located in an inconvenient location, it may be re-oriented as described in the SAFETY section of this manual. Either coil lead can be hot or neutral.

Standard AC and DC coil wiring:

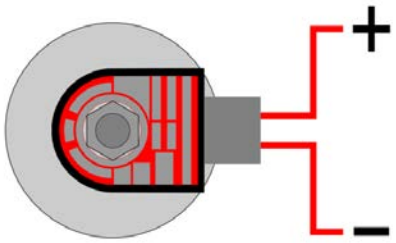


Figure 1. Typical AC and DC coil wiring.

Figure 1 above shows the proper wiring for both AC and DC coils for the EH50 series valves. For DC coils, one lead wire should be connected to the positive terminal and the other lead wire should connect to the negative terminal. For AC coils, one lead wire should connect to the hot terminal and the other lead wire should connect to the neutral terminal. These coils do not have a ground wire. The coil has no polarity so either lead wire from the coil can be the positive lead as both solenoid and valve performance will not be affected.

Optional DC Wiring With Flyback Diode:

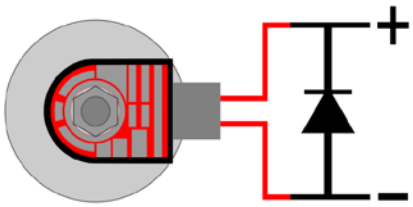


Figure 2. DC coil wiring with flyback diode.

In some systems, it may be useful to install a flyback diode between the coil and switch. The flyback diode prevents sparking between the contacts of the switch that controls power to the DC coil. When the circuit is closed, current flows through the coil and a magnetic field builds inside of the coil windings. Current does not flow through the diode as long as the breakdown voltage of the diode is higher than the voltage across the coil. When the switch is opened, the magnetic field inside of the coil starts to dissipate and in doing so, generates current in the coil and can create a very large negative voltage spike.

Because of the large potential, sparks can jump between the contacts of the switch if there is no flyback diode. With the flyback diode, there is still a closed circuit for the current to flow through even though the switch is open. The current will flow through the loop between the diode and the coil until all of the energy is lost and will not spark across the switch.

The UF4001-UF4007 series of diodes may be used as flyback diodes for circuit protection from DC coils. These diodes will handle the low current that is created by the magnetic field after the coil is turned off. Because they are fast acting, the decay time of the flyback current will be relatively shorter compared to other diodes. The table below shows what specific diode should be used for certain coil voltages.

The table of diodes is a suggestion ONLY. The entire circuit should be designed and analyzed by a licensed Professional Electrician or an Electrical Engineer. The Clark Cooper Division of Magnatrol Valve Corporation is not responsible for electrical system damage due to faulty wiring or inadequate protections.

Coil Voltage	Flyback Diode
12V DC	UF4001
24V DC	UF4001
120V DC	UF4004

DIN Connector Option Pin-out:

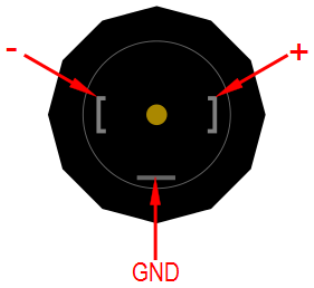
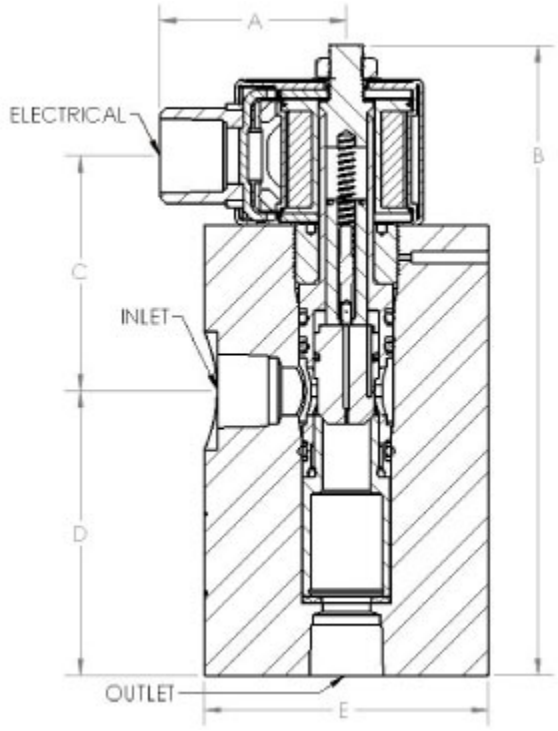


Figure 3. DIN Type A male pinout.

Coils can come with an optional Type A male DIN Connector. The pinout can be seen above. The coil has no polarity so the positive and negative terminals on the DIN connector are interchangeable. The ground pin is not used in these coils.

Schematic:



Reference Dimensions (inches)

	Weight (Aluminum Body)	Weight (316 SS Body)	A	B	C	D	E
EH50-08, Normally Closed	4.25 lbs	9.75 lbs	2.0	6.6	2.5	3.0	Ø3.00
EH50-08, Normally Open	4.50 lbs	10.0 lbs	2.0	7.3	2.5	3.0	Ø3.00

Safety:

Depressurize a system before trying to remove the valve.

Do not pressurize the valve without the coil installed. While the valve is designed to not burst at pressures approaching four times the rated maximum inlet pressure, the coil actually provides a portion of that inherent strength.

If the wires from the coil need to be directed a certain way, loosen the nut on top of the coil before trying to position. Do not grab any portion of the bonnet tube with a wrench or pliers. Doing so can damage the tube, loosen the retainer causing leakage, or damage an o-ring.

The surface temperature of some coils may be >250 degrees Fahrenheit (!) when running hot fluids and held in the energized state. Use caution when handling a coil that has just been in use.

Troubleshooting:

1. The valve must be mounted in a horizontal pipe run with the solenoid vertical and on top. Other orientations will prevent proper operation. The normally opened version does not need to be mounted with the solenoid vertical.

2. The valve must be mounted in the correct 'flow direction' as indicated by the arrow on the side of the valve body. The valve should be mounted with the high-pressure side piping at the back of the arrow (inlet) and the low-pressure side piping at the front of the arrow (outlet).

3. Foreign matter such as particulates, PTFE tape, pipe dope, etc., can jam moving parts within the valve or clog very small orifices. The result can be a failure to open and/or close completely. See the section on filters/strainers in this manual.

4. The maximum working pressure on the valve label must not be exceeded.

5. Verify that the power supplied to the solenoid matches the specification that is displayed on the valve nameplate. Valves cannot be converted from DC to AC or AC to DC by simply changing the coil.

6. Check the coil leads for continuity. If there is no continuity or resistance, you will need to replace the coil. A jammed plunger can cause coil burnout. Replacing the coil may temporarily cure the symptom but not the actual cause.

7. Pressure regulators mounted upstream from the valve can cause problems. Regulators should be mounted downstream.

8. This valve is designed and tested for use with gases, water, and fluids with viscosity similar to water. Higher viscosity fluids may slow open/close time.

9. If chatter or buzzing is ever noticed, remove power and consult customer service. This could indicate jammed components and could eventually burn out a coil or fatigue sealing surfaces.