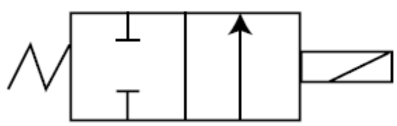
EH40 Product Manual - Version 2014.10

Last Updated: 10/9/14 - S. Bochnovich

Product Description:

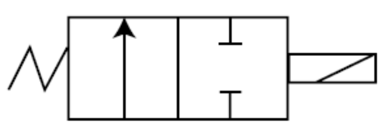
The EH40 Series encompasses 2-way, pilot operated, solenoid valves with a maximum allowable inlet pressure of 10,000 psi [68.9 MPa]. Both normally open (fail open) and normally closed (fail closed) configurations are available. Maximum allowable differential pressure (P_{inlet} – P_{outlet}) as well as minimum required differential pressure depends upon the configuration. The valve is designed for water, non-corrosive and non-viscous liquids, gases, and hydrogen.

When the normally closed valve is energized, flow occurs from the inlet to outlet. When de-energized, flow stops. The valve will only stop a fluid in the direction of inlet to outlet. It does not stop fluid from moving in the reverse direction, i.e. P_{inlet} must be greater than or equal to P_{oulet} 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.



Normally Open

Do not use this valve with dirty fluids, or solutions that will leave a large amount of deposits.

Configurations:

Part number breakdown: EH40-XX-XXXX-XX

- Port Size
- Coil
- Options (multiple)

Port Sizes:

04 – 0.250” connection
08 – 0.500” connection

Coils:

A120 - 120V AC
A240 – 240V AC
A024 – 24V 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 for hazardous locations NEMA 7/9. Coil lead lengths are 18”, but longer lengths are available at an additional charge.

The general service option “-GS” coil option complies with NEMA 1, 2, 3, 4, 4x. It is not explosion proof.

Options:

NO- Normally Open
Currently available for AC powered valves only. The valve closes upon energizing the coil.

DN – DIN connection on coil

The DIN connection is per DIN 43650A/ISO 4400. The standard coil connection is ¼-18” NPT per ANSI/ASME B1.20.3. This is a “Dryseal” NPT thread that does not require a thread sealant.

HY - Seal approved for hydrogen service

The valve is helium leak tested at the factory and qualifies for Class 2 sealing. See section on sealing.

GS – General Service

Coil used has NEMA Type 1, 2, 3, 4, 4x protection only. Otherwise, the standard explosion proof coil is NEMA 7 & 9.

OX – Oxy-clean

Extra processing to remove all oil, microscopic sediment, and particulates.

TC – Tube connection

Valve is supplied with straight fittings attached that allow clamping to ¼” OD tube using ferrule connection.

XP – 22 watt coil for higher allowable differential pressure

VT – Fluorocarbon (Viton) O-Rings

The standard o-ring is Buna-N, and has a suggested temperature range of -35 to 250° F. Select the fluorocarbon o-ring option to allow fluid temperatures up to 400°F.

ST – Connections per SAE J1926-1, REV Mar93

ATX – ATEX Coil

Coil is certified for explosive atmospheres in accordance with European Directive 94/9/EC and standards IEC/EN 60079 (gases) and IEC/EN 61241 (dust).

FL – Built in Filter

Small replaceable filter is inset in the valve body inlet. This does not handle large volumes of particulates.

Available Valve Body Connections:

- ¼-18 NPT or ½-14 NPT per ANSI/ASME B1.20.1 (standard)
- '-6' and '-8' per SAE J-1926-1, REV Mar93

Pressures:

Maximum Differential Pressure (psi)		
Orifice:	1/4"	1/2"
Normally Closed, AC Voltage (10 Watt):	7,500	7,500
Normally Closed AC Voltage (-XP, 22 Watt):	10,000	10,000
Normally Closed DC Voltage (10 Watt)	3,500	3,600
Normally Closed DC Voltage (-XP, 22 Watt):	10,000	7,200
Normally Open AC Voltage (10 Watt):	7,500	-
Normally Open DC Voltage (22 Watt):	9,700	-

A minimum pressure differential is required on the EH40 Series to move the valve piston and open the valve. The EH40-04 (1/4" orifice) requires at least 50 psi of air. The EH40-08 (1/2" orifice) requires at least 100 psi of air.

The EH40 Series was 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. In actual usage, the connections would begin to leak far below the burst pressure.

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 – 316 Stainless Steel
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)
Various spring materials available
Seals – Buna-N, Viton, and others available

Alternate piston materials 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.

	Orifice (in)	Approximate C_v
EH40-04	0.250	1.1
EH40-08	0.500	4.5

The flow rate through an EH40 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

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 $P2 > P_{Critical}$:

$$Q_m = C_v * \sqrt{\frac{P*(P1-P2)}{SG}} * \sqrt{\frac{520}{T}} \quad \text{SCFM (14.7 psi and 60°F)}$$

If $P2 < P_{Critical}$:

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

For liquid:

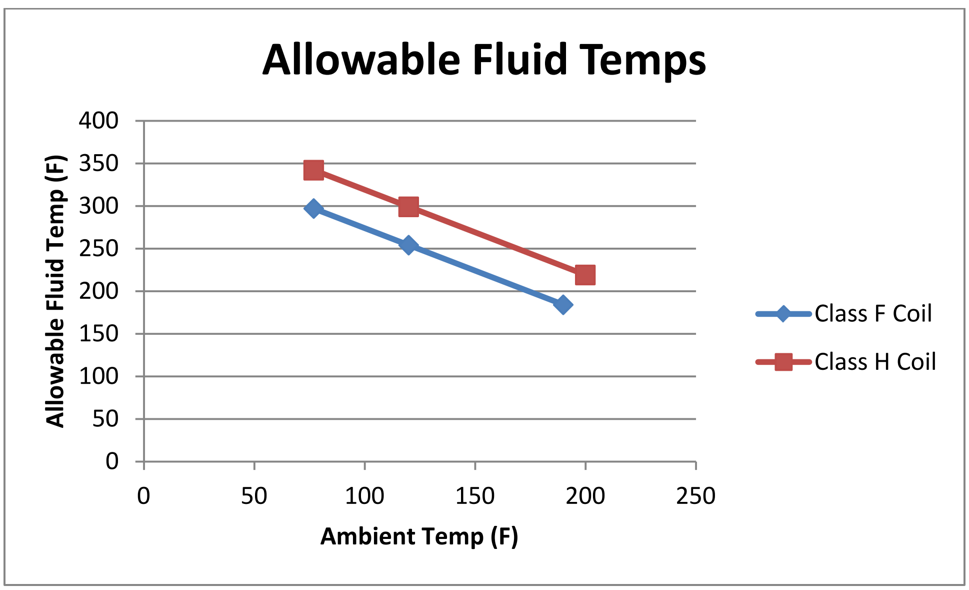
$$Q = C_v * \sqrt{\frac{P1-P2}{SG}} \quad \text{gal/min}$$

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 goes up and less current flows. Since pull force of a solenoid is directly proportional to amperage, a solenoid operating at its 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 intermittently for short periods of time, 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.

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.

Installation:

The EH40 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.

The ¼-18 NPT or 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 change 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. SAE J1926 fittings, on the other hand, are supplied by various manufacturers who publish installation torques in catalogues. Please follow those installation instructions for use in our 316 stainless steel valve bodies.

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 EH40 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.

Built in filters are now being offered.

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.

This standard leakage for this product is Class 2.

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

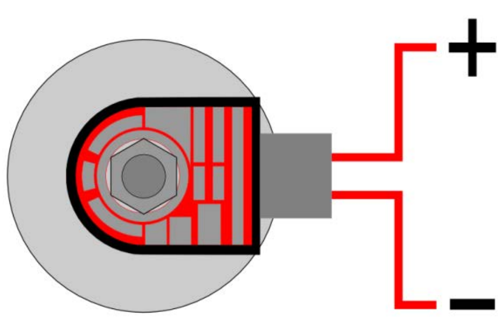


Figure 1. Typical AC and DC coil wiring.

Figure 1 above shows the proper wiring for both AC and DC coils for the EH40 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

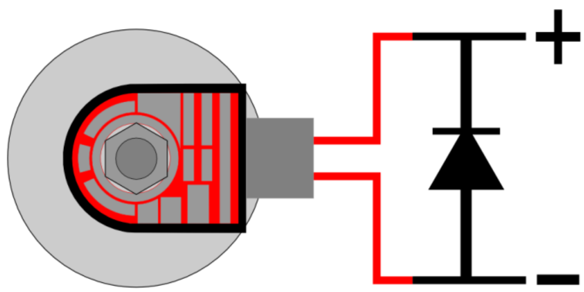


Figure 2. DC coil wiring with flyback diode.

In some systems, it may be useful to install a flyback diode to protect the circuit. 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 winding. 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.

DIN Connector Option Pin-out

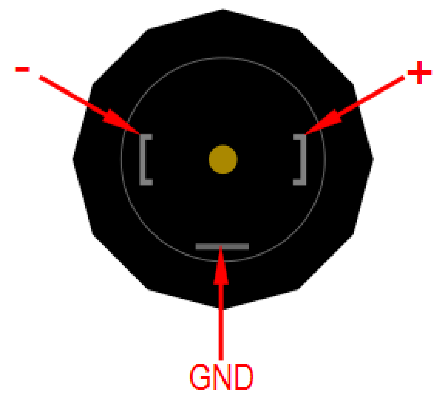
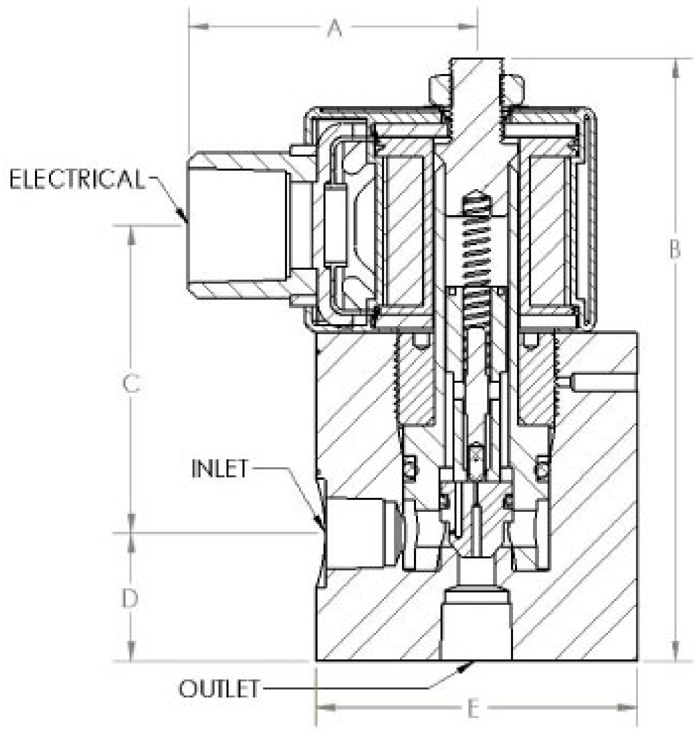


Figure 3. DIN Type A male pinout.

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 (lbs)	A	B	C	D	E
EH40-04, Normally Closed	2.9	2.0	4.1	2.1	0.9	ø2.20
EH40-08, Normally Closed	6.1	2.0	4.7	2.2	1.3	ø3.00
EH40-04, Normally Open	3.0	2.0	4.82	2.1	0.9	ø2.20

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 plyers. 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.

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. This valve will not act as a check valve. It only blocks flow in the direction of inlet to outlet.

4. 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.

5. The operating pressure must not exceed the pressure rating on the valve nameplate.

6. 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.

7. Check the coil leads for continuity. If there is no continuity or no resistance at all, 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.

8. Regulators mounted upstream from the valve can cause problems. Regulators should be mounted downstream.

9. This valve is designed and tested for use with gases, water, and fluids with viscosity similar to water.

10. 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.