CLARK COOPER
A DIVISION OF MAGNATROL VALVE CORP.
941 HAMILTON AVENUE
ROEBLING, NJ 08554
WWW.CLARKCOOPER.COM

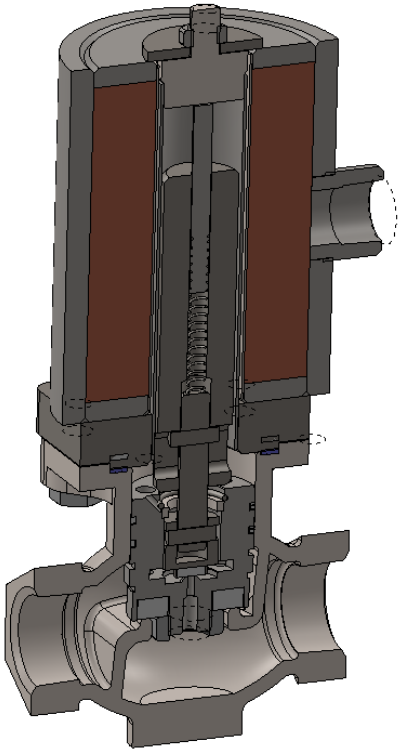
Product Manual

EH70

2/2 Pilot Assisted, Direct Operating Solenoid Valve
Version 2015.1

Product Description:

The **EH70** Series encompasses 2-way, direct operated pilot assisted, solenoid valves with a maximum allowable inlet pressure varying from 1,200 to 1,500 psig, depending on model. Both normally closed (fail closed) and normally open configurations are available. There is no minimum differential pressure ($P_{inlet} - P_{outlet}$) required to make the valve open. The valve is designed for liquids and gases compatible with 300 Series stainless steel pressure boundary components. It may be used for cryogenic to 400°F fluids. The valve opens in less than 0.5 seconds. Closing time varies from 0.5 to 2.0 seconds, depending on fluid viscosity. The EH70 is less sensitive to particulates than the Clark Cooper "EH40" Series products due to larger pilot and bleed orifices.



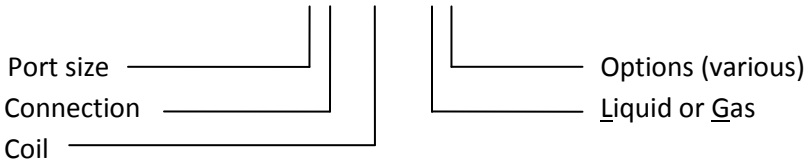
When the normally closed valve is energized, flow occurs from the inlet to outlet. When de-energized, flow stops. The valve will only stop a fluid in the direction of inlet to outlet. It does not stop fluid from moving in the reverse direction, i.e. P_{inlet} must be greater than or equal to P_{oulet}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

Do not use this valve with dirty fluids. If the working fluid is a solution that may leave deposits, the user should test the valve in the application to be sure that the deposit does not create an unacceptable amount of leakage or operational issues. See section on installation for filtration recommendations.

The valve is designed to achieve Class 2 sealing. See sealing section for details. However, as mentioned above, particulates or solution deposits may interfere with disk to seat contact and reduce the quality of the seal. Select softer disk materials that are compatible with the working fluid for excellent sealing at lower pressures.

Part Number Configuration:

Part number breakdown: EH70-XXX-XXXX-X-XX



Connection and Orifice Sizes:

08 – 0.50”
12 – 0.75”
16 – 1.00”
24 – 1.50”
32 – 2.00”

Connection Types:

A – NPT per ANSI/ASME B1.20.1 (General Purpose)
B – Socket (customer may weld pipes in)
G – Class 150 flange per ANSI B16.5, raised face
H – Class 300 flange per ANSI B16.5, raised face
J – Class 600 flange per ANSI B16.5, raised face

Coil:

The items codes in the chart below are used to select various voltages for the valve. The "200 Series" coil is currently used on EH70 sizes ½", ¾", and 1". The "300 Series" coil is used on EH70 sized 1.5" and 2".

200 Series		Amperage	
Item Code	Voltage	Inrush	Holding
A024	24V AC	n/a	3.29
A120	120V AC	n/a	0.74
A240	240V AC	n/a	0.44
D024	24V DC	n/a	3.29
D120	125V DC	n/a	0.74
D240	250V DC	n/a	0.44

300 Series		Amperage	
Item Code	Voltage	Inrush	Holding
A024	24V AC	n/a	4.80
A120	120V AC	n/a	1.00
A240	240V AC	n/a	0.44
D024	24V DC	n/a	4.80
D120	125V DC	n/a	1.00
D240	250V DC	n/a	0.44

Chart 1 – Voltages

Pipe & Orifice Size	**Maximum Inlet Pressure (psig)**	**C_v**	**Coil**	**Voltages Available**	**Current (amps)**
1/2"	1500	3.5	200 Series	24V AC/DC	3.29
3/4"	1200	7.5		120V AC/DC	0.74
1"	1200	13		220V AC/DC	0.44
1 1/2"	1200	25	300 Series	24V AC/DC	4.80
				120V AC/DC	1.00
2"	1200	48		220V AC/DC	0.44

Chart 2 - Data

The 200 and 300 Series coils are seal welded canisters that slide over the bonnet tube of the valve. The working fluid running through the valve never comes in contact with interior or exterior of the coil. The coils are coated in a high temperature, peel resistant paint. Customers may request a NEMA 4X coating (currently not certified by 3rd party).

Two lead wires of standard length 36" extend from a ½" NPT conduit entry. There is no polarity, i.e. either lead wire may be positive. Four diode bridge rectifiers built into the coils accepts

either AC or DC voltage for a given unit. Only DC current reaches the copper wire in either case. Frequent cycling is permissible since there is no in-rush current. The standard wire insulation is

rated for up to 200°C [392°F]. The diodes are rated for -65 to +150°C [-85 to 302°F]. Consult Clark Cooper engineers for temperature rise data.

The valve may be configured with explosion-proof coils for use in Class I, Division 1, Groups A-D hazardous locations for operating temperature code "T2" in ambient temperature range -20 to +85°C per UL-1203 and CSA C22.2 No. 30. When configured as such, the valve units are intended to be permanently mounted and require a conduit seal within 1" of solenoid.

The 200 and 300 Series coils have an optional ETL listing for recognition to UL STD 429 and CSA C22.2 #139, with subject UL STD 906. Consult Clark Cooper engineering for information on individual valves listed to UL 429 and CSA C22.2 #139.

Fluid Type:

Select "L" for liquid or "G" for gas as the working fluid. For steam applications, use "L".

Options:

CY: Cryogenic service.
Maximum allowable differential pressure is reduced. Consult engineering.

DN: DIN connector
The DIN connection is per DIN 43650A/ISO 4400. This cannot be used with "explosion proof" coils.

ETL: ETL Listed Coil
Explosion Proof, Class I, Division 1, Groups A-D Hazardous Locations. Operating temperature code "T2" for ambient temperature range -20 to +85 Celsius. Ordinary Location recognized to UL STD 429, CAN/CSA C22.2 No. 139, with subject UL STD 906.

HY: Seal approved for hydrogen service. The valve is tested at the factory for Class 5 sealing per FCI 91-2-2004 using helium. See section on sealing.

NO: Normally Open

OX: Cleaned for oxygen service
Extra cleaning is done on all internal surfaces to remove oil, microscopic sediment, and particulates. Distilled water is used for the final rinse, and components are black light inspected.

S1: Single Switch

SS: Stainless steel tag

X1 – Single Switch, explosion proof

T5 - The valve is tested at the factory for Class 5 sealing per FCI 91-2-2004 using air. See section on sealing.

Pressures:

There is no minimum required pressure differential between the inlet and outlet to open the EH70 series valves. When mounted vertically upright with the coil on top, there is no minimum required pressure differential to close all sizes of EH70 valves. If mounted horizontally or upside down, the smaller EH70 valve sizes ½" and ¾" will operate normally. The 1" EH70 will require some fluid flow to guarantee closing. EH70 size 1 ½" and 2" will not operated properly if mounted horizontally or upside down.

The EH70 pressure boundary components were designed according to ANSI B16.34, the Boiler and Pressure Vessel Code, and other applicable standards. The valves can withstand pressures approaching four times maximum allowable inlet pressure at room temperature without bursting. However, the inlet pressure should NEVER be allowed to exceed the catalog maximum inlet pressure.

Refer to Chart 2 for maximum allowable inlet pressures.

Open/Close times will depend upon the differential pressure and fluid. The time to open is typically less than 0.50 seconds, and is significantly faster towards the high end of the maximum

allowable inlet pressure. Time to close varies more and is largely dependent upon fluid viscosity. As fluid viscosity increases in a valve configured for liquid service, the time to close will approach 2.0 seconds. Consult Clark Cooper engineering for more data.

Materials:

Valve Body – 316 Stainless Steel
Bonnet Tube – 316 and 430 Stainless Steel
Piston – 303 Stainless steel
Spring - 302 Stainless Steel, others available upon request
Disk – PTFE (standard), buna-n, viton, and others available
Other wetted components – 18-8, 303, 420 and 430 Stainless steels, PTFE

Flow Rate:

The flow rate of a fluid through a valve is a function of the inlet and outlet conditions, fluid 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 one minute at exactly 1.0 psi of differential pressure between the inlet and outlet.

See Chart 2 for C_v data.

The flow rate through an EH70 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:

$P_{Critical}$ = 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 (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:

EH70 valves may be used for fluid temperatures ranging from cryogenic to 400°F. There are differences in construction depending on temperature, so specify the service conditions when purchasing.

The 200 & 300 Series solenoids surface temperature will reach a maximum of approximately 312° and 323°F, respectively, when energized for several hours in a 140°F ambient environment. A thermal cutoff switch with a 378°F rating is built into the circuit. 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 with occur to the insulated copper wire.

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 its upper temperature limit may produce less pull force. It is suggested that if a fluid temperature is going to be near the high limit of 400°F, the application should be thoroughly tested to ensure acceptable performance.

Installation:

The EH70 should be mounted in a vertical orientation with the coil on top for best performance. Gravity plays a role in resetting internal components upon closing, particularly on valve sizes 1”

and larger. Sizes ½" and ¾"will operate in any orientation. The 1" EH70 may be mounted in any direction, but it is advised that some flow and pressure differential exist in order to guarantee closing. Sizes 1 ½" and 2" must be mounted vertically with the coil on top for proper operation.

When NPT valve body threads per ANSI/ASME B1.20.1 are used, they require a sealant such as PTFE tape. 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 prevent unraveling of the tape.
- Start the tape at least one thread away from the end to eliminate any chance of tape 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 break the thread seal.

There are few specifications that dictate exact torque values for taper NPT per ANSI B1.20.1 threads. UL STD 429 – 2003 does make recommendations in Table 27.1. 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.

Flange bolt torque is dependent upon bolt and gasket material. Consult with the gasket manufacturer on required compression and corresponding bolt torque. Be sure that these torque values are adjusted if anti-seize compound is used.

Make sure that connecting pipes or tubes are clean and free of particulates. Filters should be sized to catch particulates of 0.016" and larger (40 Mesh).

The moving parts within the valve do not require lubrication. Please do not add any.

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 Clark Cooper based on the requirements of this specification.

This standard leakage for the EH70 is Class 2. Note that for a ½" orifice, 10.0 cc/min of air is allowed to pass through this. Test results are typically much better. Consult Clark Cooper sales if you have a specific requirement. As mentioned earlier, Class 5 is optional.

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

Standard

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

Optional

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

Optional

Chart 3 – Sealing Classes

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 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.

The surface temperature of some coils may be >300°F (!).

Troubleshooting:

1. Depending upon size, the valve mounting may require a horizontal pipe run with the solenoid vertical and on top for best performance. Sizes 1 ½" and 2" MUST be mounted with the coil on top. See Installation details.

2. The valve must be mounted in the correct 'flow direction' with the high-pressure side at the inlet. Flow must go in the direction of the arrow embossed on the valve body.

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

4. The operating pressure must not exceed the pressure rating on the valve nameplate or in Chart 2 of this manual.

5. Verify that the power supplied to the solenoid matches the specification that is displayed on the valve nameplate.

6. This valve is configured and tested for use with either gases or liquids. Liquids with viscosity much higher than water may cause the valve to close more slowly. Consult Clark Cooper if you are having excessive close times.

7. Blockages in piston orifices may interrupt proper opening and closing. Fluids must be clean.