



# Solenoid Valves for Secondary Coolant CO<sub>2</sub>

XSP Series

SPORLAN



ENGINEERING YOUR SUCCESS.

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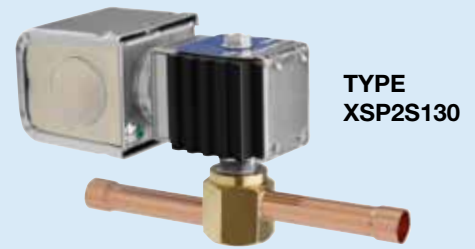
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**FOR USE ON AIR CONDITIONING and REFRIGERATION SYSTEMS ONLY**

# XSP SERIES SOLENOID VALVES FOR SECONDARY COOLANT CO<sub>2</sub>

- **Direct Acting, Hermetic Valves**
  - no gaskets eliminate source for external leaks
  - tighter seating at lower pressure differentials
- **Mount Horizontally**  
For best performance, it is recommended to mount valve with coil in vertical position or at 45° angle.
- **Extended Solder Type Connections**



- **MKC-1 Coil, Class F**
- **Sporlan Catch-All® Filter-Drier is Recommend Upstream**

## APPLICATION

Types XSP2, XSP3, and XSP5 are hermetic, direct-acting solenoid valves primarily for refrigeration and air conditioning applications.

**These valves may be mounted with coil pointing up or at 45° angle.**

Types XSP2, XSP3, and XSP5 series solenoid valves feature extended solder type connections as standard. One important benefit to the user is that all valves in the “XSP” series can be installed using either low or no silver content brazing alloy.

The MKC-1 coil is Class “F” temperature rated and is provided as standard, therefore a high temperature coil is not required for discharge service.

## ORDERING INSTRUCTIONS

When ordering complete valves, specify Valve Type, Connections, Voltage and Cycles. When ordering Body Assembly, specify Valve Type and Connections. When ordering Coil Assembly ONLY, specify Coil Type, Voltage and Cycles.  
**Example: MKC-1 120/50-60.**

Type XSP Series is identified by an expanded nomenclature. The system of valve identity is based on port size. In addition, the XSP Series identifies the connection size and type. The advantage of the XSP Series nomenclature system is that it allows ease in valve identification of the standard line and can provide considerable information about special valves supplied to manufacturers.

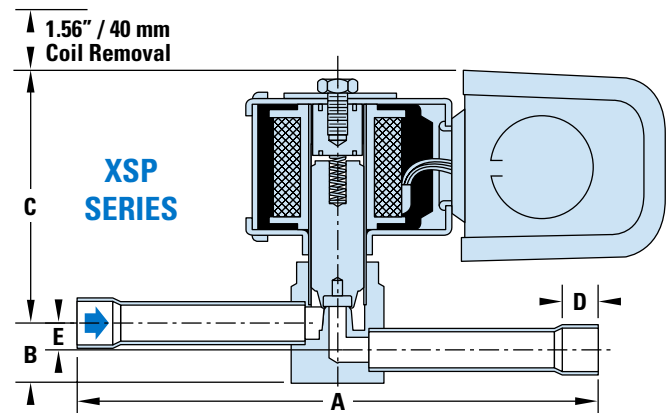
For connections and other special features consult Sporlan Division of Parker, Washington, MO.

## NOMENCLATURE

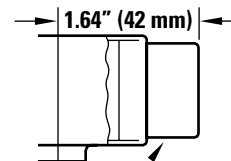
<b>XSP</b>	<b>2</b>	<b>S</b>	<b>1</b>	<b>3</b>	<b>0</b>
Valve Series	Port Size in 1/32"	Fitting S = Sweat	Coil Type 1 = MKC-1 ①, ②	Fitting Size in 1/8"	*Fitting Inlet x Outlet 0 = ODF x ODF

① The MKC-1 is fungus proof and meets MIL-I-631C.  
 ② The standard MKC-1 is class “F” rated.  
 \* Standard connections are ODF inlet x ODF outlet on XSP Series valves. Minimum quantities will be required for other connections.

## DIMENSIONS



**Extended Connection**



Optional 1/2" (13 mm) Conduit Boss

### Inches (mm)

VALVE SERIES	TYPE	A	B	C	D Fitting Depth ODF	E Offset
<b>XSP</b>	XSP2S120	4.63" (118 mm)	0.55" (14 mm)	2.10" (53 mm)	0.31" (8 mm)	0.30" (8 mm)
	XSP2S130	4.56" (116 mm)	0.49" (12 mm)	2.16" (55 mm)	0.31" (8 mm)	0.24" (6 mm)
	XSP3S130	4.56" (116 mm)	0.49" (12 mm)	2.16" (55 mm)	0.31" (8 mm)	0.24" (6 mm)
	XSP3S140	5.00" (127 mm)	0.47" (12 mm)	2.19" (56 mm)	0.39" (10 mm)	0.13" (3 mm)
	XSP5S130	4.56" (116 mm)	0.53" (13 mm)	2.19" (56 mm)	0.31" (8 mm)	0.24" (6 mm)
	XSP5S140	5.00" (127 mm)	0.53" (13 mm)	2.19" (56 mm)	0.39" (10 mm)	0.24" (6 mm)

## CAPACITIES - TONS, CIRCULATION RATE 2

- EVAPORATOR TEMPERATURE -20°F
- LIQUID TEMPERATURE -20°F
- SUCTION VAPOR TEMPERATURE -19°F

REFRIGERANT	VALVE TYPE	CONNECTION Inches	PORT SIZE Inches	C <sub>v</sub>	MOPD psi	TONS of REFRIGERATION								COIL RATINGS		
						PRESSURE DROP - psi								STANDARD VOLTS/CYCLES	WATTS AC	
						1	2	3	4	5	7.5	10	15			20
744	XSP2S120	1/4 ODF x 1/4 ODF	0.062"	0.15	300	0.4	0.6	0.7	0.9	1.0	1.2	1.4	1.7	24/50-60 120/50-60 208-240/50-60 120-208-240/50-60	10	
	XSP2S130	3/8 ODF x 3/8 ODF				0.8	1.2	1.5	1.7	2.0	2.4	2.8	3.5			4.0
	XSP3S130	3/8 ODF x 3/8 ODF	0.101"	0.30	100	1.3	1.9	2.4	2.7	3.1	3.8	4.4	5.4			6.3
	XSP3S140	1/2 ODF x 1/2 ODF				1.3	1.9	2.4	2.7	3.1	3.8	4.4	5.4			6.3
	XSP5S130	3/8 ODF x 3/8 ODF	0.150"	0.48	50	1.3	1.9	2.4	2.7	3.1	3.8	4.4	5.4			6.3
	XSP5S140	1/2 ODF x 1/2 ODF				1.3	1.9	2.4	2.7	3.1	3.8	4.4	5.4			6.3

- EVAPORATOR TEMPERATURE 20°F
- LIQUID TEMPERATURE 20°F
- SUCTION VAPOR TEMPERATURE 21°F

REFRIGERANT	VALVE TYPE	CONNECTION Inches	PORT SIZE Inches	C <sub>v</sub>	MOPD psi	TONS of REFRIGERATION								COIL RATINGS		
						PRESSURE DROP - psi								STANDARD VOLTS/CYCLES	WATTS AC	
						1	2	3	4	5	7.5	10	15			20
744	XSP2S120	1/4 ODF x 1/4 ODF	0.062"	0.15	300	0.3	0.5	0.6	0.7	0.8	0.9	1.1	1.4	24/50-60 120/50-60 208-240/50-60 120-208-240/50-60	10	
	XSP2S130	3/8 ODF x 3/8 ODF				0.7	1.0	1.2	1.4	1.5	1.9	2.2	2.7			3.2
	XSP3S130	3/8 ODF x 3/8 ODF	0.101"	0.30	100	1.1	1.5	1.9	2.2	2.4	3.0	3.5	4.3			5.0
	XSP3S140	1/2 ODF x 1/2 ODF				1.1	1.5	1.9	2.2	2.4	3.0	3.5	4.3			5.0
	XSP5S130	3/8 ODF x 3/8 ODF	0.150"	0.48	50	1.1	1.5	1.9	2.2	2.4	3.0	3.5	4.3			5.0
	XSP5S140	1/2 ODF x 1/2 ODF				1.1	1.5	1.9	2.2	2.4	3.0	3.5	4.3			5.0

## CAPACITIES - kW, CIRCULATION RATE 2

- EVAPORATOR TEMPERATURE -28°C
- LIQUID TEMPERATURE -28°C
- SUCTION VAPOR TEMPERATURE -27°C

REFRIGERANT	VALVE TYPE	CONNECTION Inches	PORT SIZE mm	K <sub>v</sub>	MOPD bar	kW of REFRIGERATION								COIL RATINGS		
						PRESSURE DROP - bar								STANDARD VOLTS/CYCLES	WATTS AC	
						0.07	0.14	0.21	0.27	0.34	0.52	0.69	1.03			1.37
744	XSP2S120	1/4 ODF x 1/4 ODF	2 mm	0.13	20.6	1.4	1.9	2.5	3.0	3.3	4.2	4.9	6.0	24/50-60 120/50-60 208-240/50-60 120-208-240/50-60	10	
	XSP2S130	3/8 ODF x 3/8 ODF				2.8	4.2	5.1	6.0	6.9	8.4	9.8	12.1			14.1
	XSP3S130	3/8 ODF x 3/8 ODF	3 mm	0.25	6.9	4.6	6.7	8.3	9.5	10.7	13.2	15.3	19.0			22.0
	XSP3S140	1/2 ODF x 1/2 ODF				4.6	6.7	8.3	9.5	10.7	13.2	15.3	19.0			22.0
	XSP5S130	3/8 ODF x 3/8 ODF	4 mm	0.41	3.4	4.6	6.7	8.3	9.5	10.7	13.2	15.3	19.0			22.0
	XSP5S140	1/2 ODF x 1/2 ODF				4.6	6.7	8.3	9.5	10.7	13.2	15.3	19.0			22.0

- EVAPORATOR TEMPERATURE -7°C
- LIQUID TEMPERATURE -7°C
- SUCTION VAPOR TEMPERATURE -6°C

REFRIGERANT	VALVE TYPE	CONNECTION Inches	PORT SIZE mm	K <sub>v</sub>	MOPD bar	kW of REFRIGERATION								COIL RATINGS		
						PRESSURE DROP - bar								STANDARD VOLTS/CYCLES	WATTS AC	
						0.07	0.14	0.21	0.27	0.34	0.52	0.69	1.03			1.37
744	XSP2S120	1/4 ODF x 1/4 ODF	2 mm	0.13	20.6	1.1	1.6	1.9	2.3	2.6	3.2	3.9	4.7	24/50-60 120/50-60 208-240/50-60 120-208-240/50-60	10	
	XSP2S130	3/8 ODF x 3/8 ODF				2.3	3.3	4.0	4.7	5.3	6.7	7.7	9.5			11.1
	XSP3S130	3/8 ODF x 3/8 ODF	3 mm	0.25	6.9	3.7	5.3	6.5	7.6	8.4	10.4	12.1	14.9			17.4
	XSP3S140	1/2 ODF x 1/2 ODF				3.7	5.3	6.5	7.6	8.4	10.4	12.1	14.9			17.4
	XSP5S130	3/8 ODF x 3/8 ODF	4 mm	0.41	3.4	3.7	5.3	6.5	7.6	8.4	10.4	12.1	14.9			17.4
	XSP5S140	1/2 ODF x 1/2 ODF				3.7	5.3	6.5	7.6	8.4	10.4	12.1	14.9			17.4

- Maximum rated pressure 700 psi (48 bar).
- Dual voltage 4-wire coils, 120-208-240/50-60 are available at slight additional cost. For other voltages and cycles, consult Sporlan, Washington, MO 63090.
- Capacity at +20°F (-7°C) evaporator temperature is based on +20°F (-7°C) liquid temperature.
- Capacity at -20°F (-29°C) evaporator temperature is based on -20°F (-29°C) liquid temperature.
- Available with conduit boss or junction box at no extra charge.
- For mounting holes and/or bracket information see Bulletin 30-11.
- XSP Series with mounting holes are NOT standard.

## APPLICATION

### Filter-Driers are Essential

Dirt and other system contaminants present a problem for refrigeration and air conditioning controls. Since solenoid valves operate with rather close tolerances, system cleanliness is imperative. The Sporlan **Catch-All® Filter-Drier** filters out minute particles of dirt and other foreign matter, thus protecting the valve.

Sporlan recommends using a **Catch-All® Filter-Drier** ahead of every solenoid valve on all refrigeration and air conditioning applications. Contact Sporlan before adding a **Catch-All® Filter-Drier** in the discharge line.

### Transformer Selection for Low-Voltage Control Systems

Many systems utilize low voltage controls, requiring the use of a transformer for voltage reduction, normally to 24 volts. The selection of a transformer is not accomplished by merely selecting one that has the proper voltage requirements. The volt-ampere (VA) rating is equally important. To determine the VA requirement for a specific solenoid valve, refer to the chart below. It should be noted, that insufficient transformer capacity will result in reduced operating power or lowering of the MOPD value.

If more than one solenoid valve and/or other accessories are operated from the same transformer, then the transformer VA rating must be determined by adding the individual accessories' VA requirements.

### Fusing

Sporlan Solenoid Valves are not supplied with fuses. Fusing should be according to local codes. We recommend fusing the hot leg of the valve wiring with fast acting fuses and the valve should be grounded either through the fluid piping or the electrical conduit.

### Liquid Overfeed Ratio Definition

If you look at the evaporation process on a Pressure Enthalpy diagram, liquid is fed to an expansion valve, expanded to a lower pressure and enters the evaporator coil somewhere in the dome at a certain quality for a normal DX system, the refrigerant then collects heat from the air and boils the refrigerant until is superheated.

With a liquid overfeed CO<sub>2</sub> system, no expansion valves are used on the evaporators. The liquid CO<sub>2</sub> pressure that is required for the cases is maintained via a heat exchanger connected to a high side DX system. The liquid CO<sub>2</sub> in the tank is fed to the pump at a certain head pressure to ensure no cavitation, then is supplied to the display cases or evaporators. The liquid out of the pump is subcooled because the pump was fed liquid CO<sub>2</sub> and then raised the pressure. This liquid enters the case somewhat subcooled, or all liquid.

This liquid is at the saturated evaporator temperature required for the case, and so the liquid starts to boil off in the evaporator, however since the CO<sub>2</sub> is returned to the tank without any compression, the optimum efficiency to reduce pressure drop and optimize heat transfer in the coil is to design the coils to maintain a quality of  $x = 0.5$  at the outlet of the coil, otherwise half vapor and half liquid. A liquid overfeed ratio of 2 to 1, really means you are pumping twice as much liquid as you need to the display cases to enable raising the evaporator temperature due to higher heat transfer coefficient and overcome any piping errors. So instead of superheat in liquid overfeed systems you actually have liquid and vapor returning to the tank that is maintained at saturated suction pressures desired by the cases.

### OR

Quality is a ratio of mass. So, if only half of the refrigerant mass flow is vaporized, it takes 2 times the mass flow of refrigerant to have an exiting quality of 0.5.

Calculating the liquid overfeed ratio or rate is simple. As long as you don't confuse overfeed rate with circulation rate. A circulation rate of 2 to 1 is simply two times the mass flow rate. However, the overfeed rate is 1 for a 2 to 1 circulation rate. See Chapter 4 of the ASHRAE 2010 Refrigeration Handbook, page 4.3 to 4.4. For a circulation rate of 4 to 1, the overfeed rate is 3 at full load and 4 at no load.

## GENERAL

### Purpose

The primary purpose of an electrically operated solenoid valve is to automatically control the flow of fluids, liquid, or gas. Sporlan Solenoid Valves may be applied on a wide variety of applications.

### Basic Type

The most common type of solenoid valve is the normally-closed type, in which the valve opens when the coil is energized, and closes when the coil is de-energized.

### Principles of Operation

Solenoid valve operation is based on the theory of the electromagnet. The solenoid valve coil sets up a magnetic field when electrical current is flowing through it. If a magnetic metal, such as iron or steel, is introduced into the magnetic field, the pull of the field will raise the metal and center it in the hollow core of the coil. By attaching a stem to the magnetic metal or plunger, this principle is used to open the port of the valve. When the electrical circuit to the coil is broken, the magnetic field will collapse and the stem and plunger either will fall by gravity or be pushed down by the kick off spring.

COIL KIT	24 VOLTS / 50-60 CYCLES		120 VOLTS / 50-60 CYCLES		240 VOLTS / 50-60 CYCLES		TRANSFORMER RATING VOLTS-AMPERES
	CURRENT-AMPERES		CURRENT-AMPERES		CURRENT-AMPERES		FOR 100% OF RATED MOPD OF VALVE
	INRUSH	HOLDING	INRUSH	HOLDING	INRUSH	HOLDING	
<b>MKC-1</b>	1.9	0.63	0.39	0.14	0.19	0.09	60

• All current values are based on 60 cycles.

• Volt-ampere ratings are based on inrush currents.

• Above values are based on the most severe conditions. — Consult Sporlan Division of Parker, Washington, MO for coil characteristics on specific valve types.

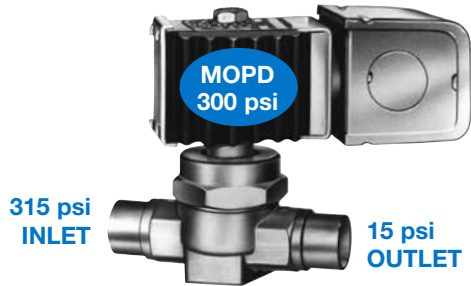
## Direct Acting Solenoid Valves

With this type of valve, the plunger assembly opens the port of the valve directly. This type of construction is limited to the smaller valves, such as the XSP Series Sporlan Solenoid Valves.

## DESIGN

### Maximum Operating Pressure Differential

The maximum pressure differential against which a solenoid valve can open is generally abbreviated MOPD. This is illustrated below.



MOPD ratings are established at 85% of rated voltage and with a hot coil after its maximum temperature is reached. For any given valve and coil design, the factors that affect MOPD are voltage deviation and coil temperature.

### Synthetic Seating

Introduced by Sporlan in 1947, synthetic seating provides permanent seat tightness. Our experience in the use of these superior seating materials provides a reliable basis for durable construction best suited for various applications.

### Solenoid Coil

The interchangeability of solenoid coils is necessarily limited by considerations of the varying requirements of power and plunger movement. Nevertheless, only one coil size is required for the XSP line of Sporlan Solenoid Valves.

### Maximum Rated Pressure

Don't confuse the MOPD rating of a valve with the maximum rated pressure. The rated pressure of a solenoid valve is a design specification indicating the maximum pressure under which the valve should be applied. Actually, the valve must be able to withstand three times its maximum rated pressure and pass fatigue cycle tests, to qualify for listing by Underwriters' Laboratories.

## CONSTRUCTION DETAILS

Sporlan Solenoid Valves are constructed to ensure long, trouble-free life. They employ proven design features for reliable performance on all applications. By using modern production equipment, Sporlan consistently provides top quality solenoid valves for air conditioning, refrigeration and other uses. Quality is maintained by strict quality control methods in all phases of production followed by detailed testing of every valve produced.

Extensive use of stainless steel, thoroughly proven synthetic materials and modern sealing methods along with top grade brass, bronze and semi-steel body materials, contribute to Sporlan's high quality product. Sporlan reserves the right to change materials that improve the quality, performance and/or integrity of the product.

## Coil Construction

Sporlan solenoid coils are constructed with some of the finest materials available for electromagnet coil manufacture.

**Standard Coils** — The number 1 coil is wound on a molded Rynite® bobbin. The wound bobbin is then inserted into a mold in a transfer press and encapsulated with a thermoset polyester compound. The coil yoke is assembled afterward and the coil is identified as MKC-1. The thermoset polyester is moisture proof, fungus proof and meets military specifications.

## ELECTRIC SPECIFICATIONS

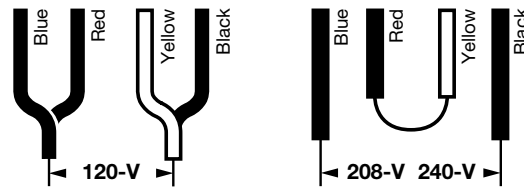
Sporlan Solenoid Valve coils are available in many voltage and cycle ratings. The standard coils required are listed in the capacity tables on page 4. Dual voltage and other alternating current (AC) coils are available for most valve types at slight additional cost. For other voltages and cycles, consult Sporlan, Washington, MO.

**Color Coded Lead Wires** — For ease of identification, coils are manufactured with the following colored lead wires:

24/50-60	Orange	<b>Dual Voltage</b>	Black, Blue, Yellow, Red
120/50-60	Blue		
208-240/50-60	Red		

All other coils are supplied with black lead wires.

### Wiring for Dual Voltage Coil



**Leads** on valves with a conduit boss are 20" long while coil leads on valves with a junction box are 6" in length.

**Junction Box** — All solenoid valves are available with either an integral junction box or a 1/2" conduit connection at no extra charge. All valves are automatically supplied with the integral junction box. If a conduit boss is required, it must be specified on the order.

All junction boxes are equipped with grounding screw provisions and marked in accordance with UL and CSA recommendations.

**Conduit Boss — Nema Rating** — The Standard (O)MKC-1 and (O)MKC-2 coil assemblies with conduit boss type yokes will satisfy Nema 4 and IP55 (Rain Tight) as well as Nema 1, 2, 3, 3R, 3S, 12 and 13.

**DIN Connector** — (O)MKC-1E and (O)MKC-2E coils with Female DIN Connectors will satisfy IP65.



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