Dual Position Solenoid Valve

Type S4AD

Port Size: 20 mm to 100 mm (3/4" – 4")
For Ammonia, R-22 and
other common Refrigerants

Bulletin 30-95C

May 2007
Service and Installation

Features

- Prevents the damaging effects of vapor propelled liquid
- Combined use as a hot gas and soft gas valve
- Integrated S6A Pilot Solenoids
- Standard Coil Housing Meets NEMA 3R and NEMA 4 - Rain Tight
- Reduces installed costs
- Pilot Light Available
- Manual Opening Stem
- Maximum Rated Pressure (MRP): 27.6 bar (400 psig)

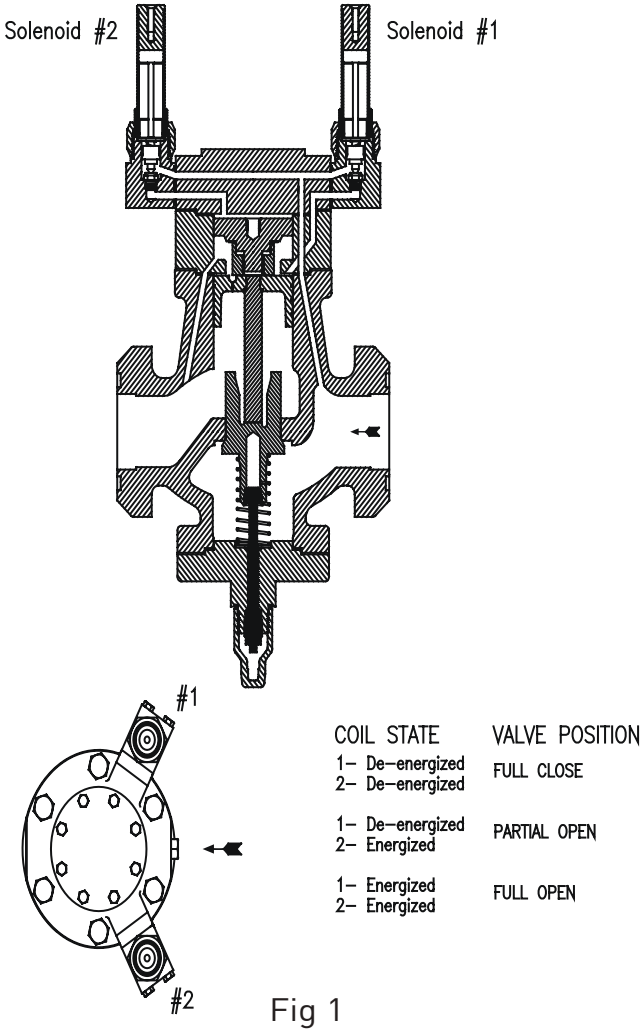


Fig 1

Description

The S4AD is based on the same valve body, principles, and length dimension as the standard S4A valves making for easy field replacements. This heavy duty solenoid valve is suitable for ammonia, R-22, other refrigerants, and certain oils and other fluids approved for use in refrigeration. The S4AD is a pilot operated, dual-position, normally closed valve. alt will close on power failure. The S4AD may be opened by means of the manual opening stem for servicing or in case of electrical power failure.

The Type S4AD Solenoid Valve is furnished with FPT Internal NPT (U.S. Standard Taper Pipe Thread), Socket Weld, Weld Neck or ODS (solders over copper tubing of given diameter) connections. The valve may be easily removed from between the flanges for servicing.

It is advisable to install as strainer upstream of each valve to prevent entrance of foreign material into the valve and the rest of the system. Refrigerating Specialties strainers are available to close-couple to valve inlets.

Purpose

The S4AD is a spring closing valve, suitable for use in refrigerant liquid, hot gas or suction lines in a temperature range of -45° to 105° C (-50° to 220° F).

The dual-position feature of the S4AD is specifically designed to help aid against the damaging effects of liquid hammer and sudden liquid deceleration. This valve is typically appliedas a combination hot gas valve and soft gas valve or as a liquid solenoid.

Principles of Operation

The Type S4AD is a pilot operated dual-position solenoid. The valve includes two solenoid assemblies. When both solenoids coils are energized the main valve is 100% open. With solenoid coil #2 is energized, the valve is open approximately 10% of its' full stroke. When solenoid coil #1 is energized, the valve will then be fully open. If both solenoid coils are de-energized, the main valve is closed.

Proper sequencing (energizing and de-energizing) of the solenoid coils is essential for proper operation of the valve.

From the closed position

To open the valve to the first stage energize solenoid coil #2 and leave solenoid coil #1 de-energized. This forces the secondary piston down fully and the primary piston down partially, opening the valve to the first stage position. This is approximately 10% of valve's total capacity. The valve will stay in this position as long as coil #2 stays energized.

From the first stage position

To open the valve completely, keep solenoid coil #2 energized and energize solenoid coil #1. This forces the primary piston down which in turn forces the main valve plug to the full open position. Note, in order for the valve to open completely coil #2 must be energized prior to or simultaneously to coil #1, and both solenoids must remain energized to hold the valve fully open.

From the wide open position

To partially close the valve, de-energize solenoid coil #1 while keeping solenoid coil #2 energized. This allows the spring to push the main plug and primary piston back against the bottom of the secondary piston at the first stage position. Again, the valve will stay in this position as long as coil #2remains energized.

To completely close the valve

De-energize both coils. This allows the trapped pilot gas to bleed off around the secondary piston and through an orifice in the primary piston to the downstream side of the valve. Once the trapped gas is allowed to bleed off, the return spring forces the valve closed.

For existing 120 & 240 volt installations Refrigerating Specialties offers an adjustable time delay relay (108723) which can be used to control the solenoid sequencing.

Manual Opening Stem

The manual opening stem on the Type S4AD is for the purpose of opening the valve without energizing the solenoid coil. For access to the stem the seal cap on the bottom of the valve must be removed. This must be done with caution as refrigerant may have been trapped inside the seal cap. To open the valve manually, turn the stem counterclockwise as far as it goes. To reset for automatic operation turn the stem clockwise until only the flats on the end of the stem protrude from the packing nut.

Installation

Protect inside of valve from dirt, chips and moisture during installation. Mount only in the horizontal pipe line with solenoid coil at the top; this valve will work properly only in this position. In a liquid line the Solenoid Valve should be near the expansion valve inlet. It is advisable to install the S4AD close coupled companion strainer ahead of the valve for protection against dirt and chips.

The S4AD solenoid valve must be installed with the arrow on the valve body in the direction of flow through the valve. If the valve is backwards, the flow will not be stopped when the valve is electrically de-energized. Like all Solenoid Valves, the S4AD can stop flow only in the direction from the normal inlet to normal outlet (as shown by the arrow on the body). If reversal of pressure occurs in the system so the outlet pressure exceeds the inlet pressure the piston will be blown away from its seat and reverse flow will occur. If a system has this type of pressure reversal (as encountered during hot gas defrost with liquid recirculation systems), a check valve such as Refrigerating Specialties Division Type CK4A in series with the solenoid valve will prevent flow reversal. (CK4A must be installed downstream to avoid trapping liquid.)

Electrical

The Refrigerating Specialties Division molded water resistant solenoid coil is designed for long life and powerful opening force. The standard coil housing meets NEMA 3R and 4 requirements. This sealed construction can with stand direct contact with moisture and ice. The coil housing far exceeds the requirements of NEMA standard ICS, 1-110.57 salt spray test for rust resistance.

By definition, Class "F" coil construction will permit coil temperatures, as measured by resistance method, as high as 130° C (226° F). Final coil temperatures are a function of both fluid and ambient temperatures. The higher fluid temperatures require lower ambient temperatures so the maximum coil temperature is not exceeded. Conversely, low fluid temperatures permit higher ambient temperatures.

The molded Class "F" coil is available from stock with most standard voltages. However, coils are available for other voltages and frequencies, as well as for direct current. Coils are also available as transformer type with a 6 volt secondary winding for use with the Refrigerating Specialties Division Pilot Light Assembly (see current copy of Bulletin 60-10, "Pilot Light Assembly and Solenoid Transformer Coil").

The solenoid coil must be connected to electrical lines with volts and Hertz same as stamped on coil. The supply circuits must be properly sized to give adequate voltage at the coil leads even when other electrical equipment is operating. The coil is designed to operate with line voltage from 85% to 110% of rated coil voltage. Operating with a line voltage above or below these limits may result in coil burnout. Also, operating with line voltage below the limit will definitely result in lowering the valve opening pressure differential.

Service Pointers

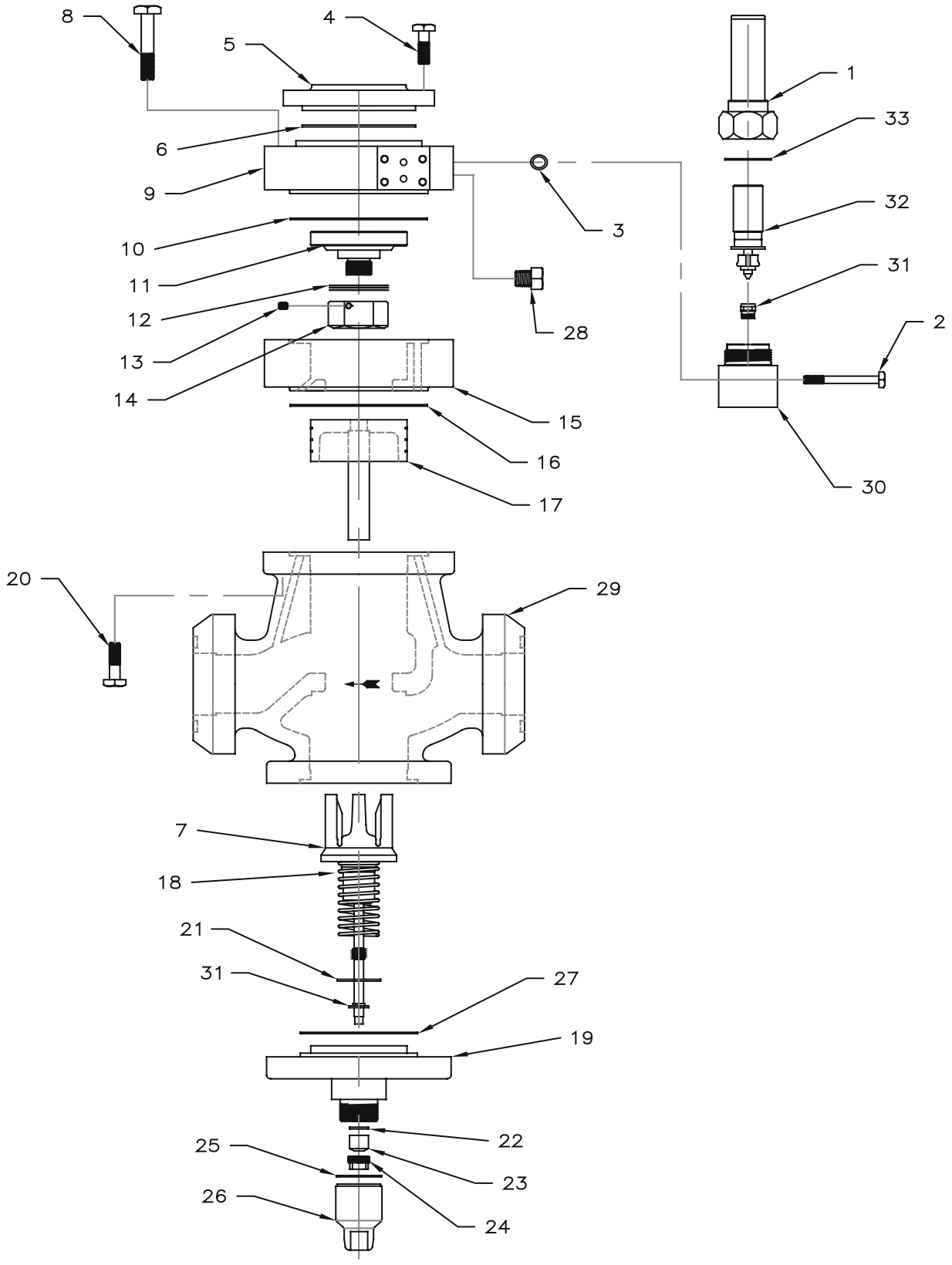
The S4AD Solenoid Valve and Strainer are easily removable for cleaning or repairing. To remove valve and strainer, first manually open the valve and pump out the refrigerant in the section of the line sealed off. Then unscrew the flange bolts and spread the flanges slightly apart.

1. Failure to Open: (a) Coils are of incorrectly high voltage. See "Electrical." Check voltage printed on the coil. (b) Line voltage is abnormally low. See "Electrical." Check line voltage at coil leads with a voltmeter. (c) Failure to electrically energize. Check control circuit. (d) Pressure difference across valve is too high. The S4AD will open against a maximum pressure difference across the valve of 21 bar (300 psig). (e) Solenoid Coil is burned out. See "Electrical," and replace with proper coil. (f) Plunger / Needle Assembly is sticking. To disassemble the S4AD for inspection of internal parts (after pumping out the system as required): disconnect power source to the Solenoid Coils, remove the Tube Assemblies, lift out the Plunger Assembly, then remove the Adapter Assembly. Remove every trace of dirt from the piston and cylinder using fine emery cloth to remove burrs if necessary. Thoroughly clean all parts and reassemble using a light film of refrigerant oil on the piston.

2. Failure to Close: (a) Electrical control circuit is not opening properly. Check wiring and controls. (b) There are chips or dirt on the Pilot Seat or the Top and Main Valve Seats, preventing proper seating. Disassemble and clean Valve as outlined in (1]) above. (c) Main Valve Seat, Pilot Seat, or valve Needle may be worn or damaged and therefore leaking. Disassemble and clean Valve as outlined in (1f) above. If any of these parts need replacing, it is advisable to replace using the proper replacement kit. (d) One or both of the pistons are sticking. See (1f) above. (e) Manual Opening Stem is turned all or partly out holding Modulating Plug Assembly open and permitting flow through the valve. (f) Coil housing Screw (made of non-magnetic stainless steel) has been replaced with a screw made of magnetic material and residual magnetism is holding the Plunger Needle Assembly in the open position. Consequently, the Main Valve is not closing. Replace with screw of correct material.

3. Leakage Through Valve: See (2) above.

4. Overheating: The Solenoid Coils are designed to operate hot and are constructed of high temperature materials accordingly. Unless troubled with actual coil burnouts, high coil temperature should be ignored. Persistent burnouts indicate improper line or coil voltage. See (1e) above.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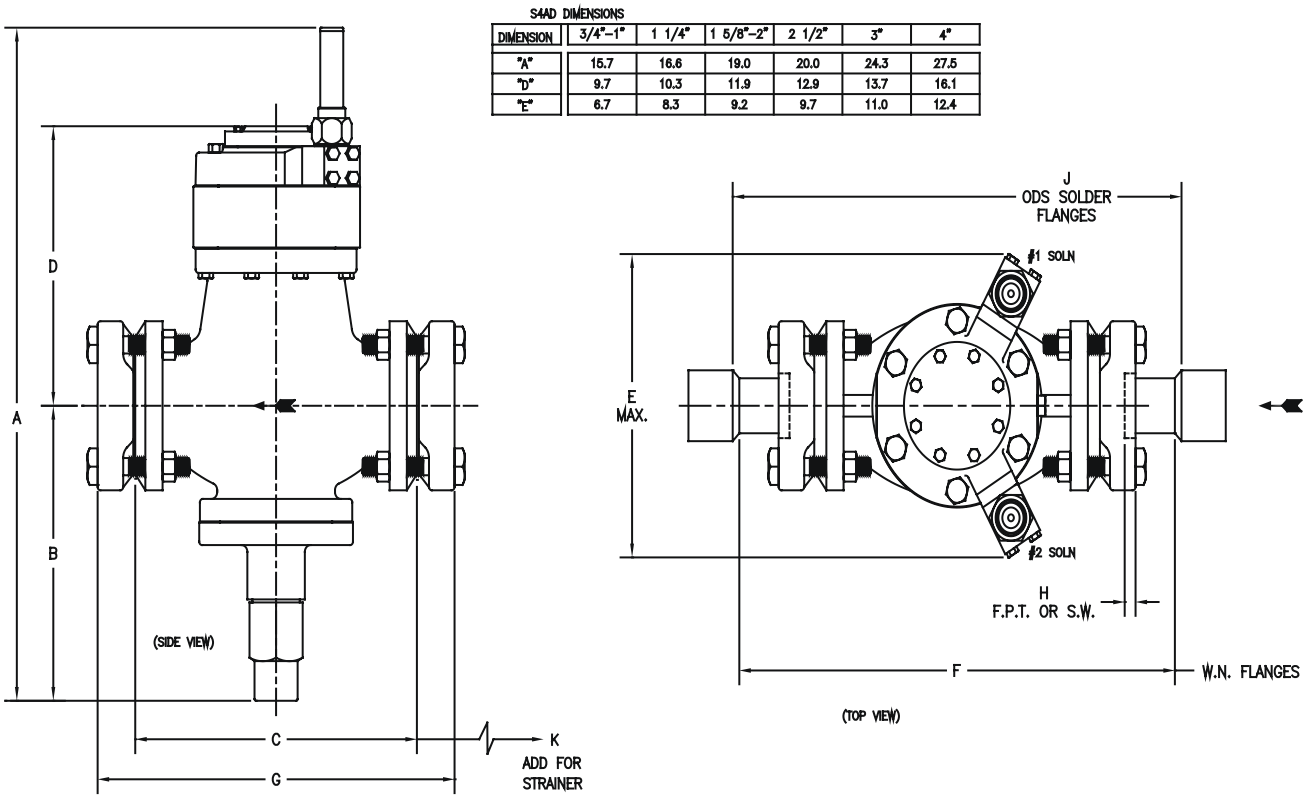
S4AD
Fig 2

Item No.	Description	Qty.	20mm 3/4”	25mm 1”	32mm 1-1/4”	40mm 1-5/8”	50mm 2”	65mm 2-1/2”	75mm 3”	100mm 4”
31	Plunger/Needle Asm.	1								
32	Seat Asm.	1								
33	Gasket	1								
	Plunger/Seat Kit		201630	201630	201630	201630	201630	201630	201630	201630
32	Plunger/Needle Asm.	1								
33	Gasket	1								
	Plunger Kit, Needle		201019	201019	201019	201019	201019	201019	201019	201019
17	Piston	1								
16	Gasket	1								
	Piston Kit		200760	200760	200767	200389	200389	200391	200393	200227
	Plug/Stem Asm.	1								
24	Nut, Packing	1								
22	Washer, Flat	1								
23	Packing, Stem	1								
	Plug Kit, Main Valve		202037	202038	202039	202024	202025	202026	202027	202028
27	O-Ring	1								
18	Spring, Comp	1								
21	Wiper, Dirt	1								
31	Washer, Flat	1								
	Spring Kit, Closing		202298	202298	202299	202302	202302	202303	202304	202305
22	Washer, Flat	1								
24	Nut, Packing	1								
23	Packing, Stem	1								
	Packing Kit, Stem		202100	202100	202100	202100	202100	202100	202101	202101
26	Seal Cap	1								
25	Gasket	1								
	Cap Kit, Seal		202110	202110	202110	202110	202110	202110	202111	202111
7,18										
21-24,31	Plug Kit, Main Valve	1								
19	Cover, Bottom	1								
27	Gasket	1								
25,26	Cap Kit, Seal	1								
	Bottom Asm. Kit		202018	202019	202020	202013	202014	202015	202016	202017

Item No.	Description	Qty.	20mm 3/4”	25mm 1”	32mm 1-1/4”	40mm 1-5/8”	50mm 2”	65mm 2-1/2”	75mm 3”	100mm 4”
10	Gasket, Adapter	1								
11	Piston, Top	1								
12	Spacer, Piston	3								
13	Set Screw, Piston	1								
14	Nut, Piston	1								
	Piston Kit	1	208355	208355	208356	208357	208357	208358	208359	208360
6	Gasket, Cover	1								
8	Bolt, Adapter	6								
10	Gasket, Adapter	1								
11	Piston, Top	1								
12	Spacer, Piston	3								
13	Set Screw, Piston	1								
14	Nut, Piston	1								
15	Bore Plate	1								
16	Gasket, Body	1								
20	Bolt, Body	8								
	Piston/Bore Plate Kit	1	208415	208415	208416	208417	208417	208418	208419	208420
3	O-ring	4								
4	Bolt, Cover	8								
5	Cover	1								
6	Gasket, Cover	1								
8	Bolt, Adapter	8								
9	Adapter	1								
10	Gasket, Adapter	1								
21	Orifice	2								
	Adapter/Cover Kit	1	208397	208397	208398	208399	208399	208400	208401	208402
2	Bolt	4								
3	O-ring	2								
	Bolt/O-ring Kit	1	201574	201574	201574	201574	201574	201574	201574	201574
	Gasket/O-ring Kit	1	208379	208379	208380	208381	208381	208382	208383	208384

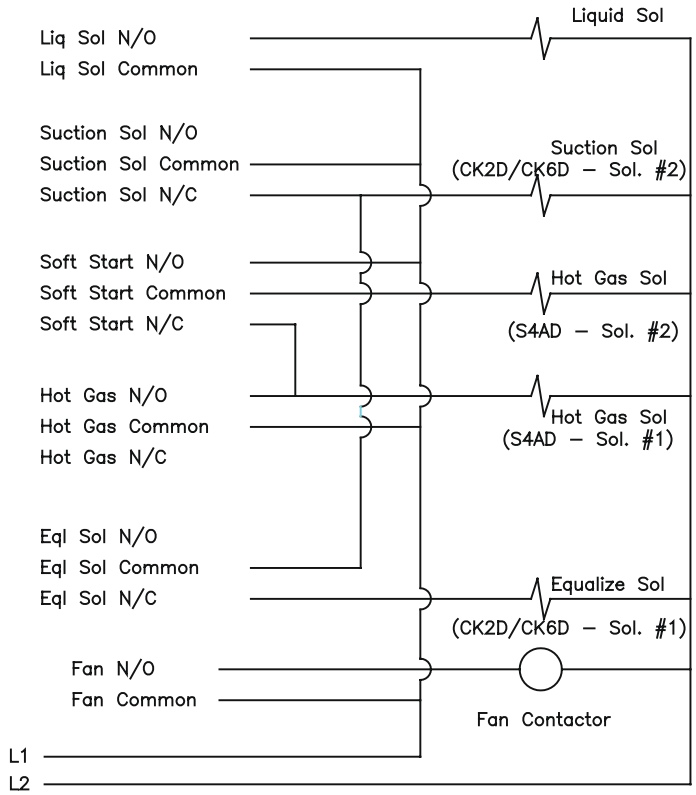


S4AD
Fig 3

PORT SIZE		A		B		C		D		E		F			G		H		J			K	
mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	Conn.	mm	in.	mm	in.	mm	in.	Conn.	mm	in.	mm	in.
20-25	3/4"&1"	39.9	15.7	14.7	5.8	15.7	6.2	24.6	9.7	17.0	6.7	3/4"	25.4	10.0	21.6	8.5	1.3	0.5	1-1/8"	28.7	11.3	15.0	5.9
												1"	26.2	10.3					1-3/8"	28.4	11.2		
												1-1/4"	26.2	10.3					1-5/8"	30.0	11.8		
32	1-1/4"	42.2	16.6	16.0	6.3	20.3	8.0	26.2	10.3	21.1	8.3	1-1/4"	30.0	11.8	25.7	10.1	1.5	0.6	1-3/8"	32.5	12.8	17.8	7.0
												1-1/2"	30.5	12.0					1-5/8"	33.8	13.3		
																			2-1/8"	37.1	14.6		
40-50	1-5/8"&2"	48.3	19.0	17.5	6.9	25.1	9.9	30.2	11.9	23.4	9.2	1-1/2"	36.3	14.3	30.7	12.1	1.5	0.6	1-5/8"	41.4	16.3	25.1	9.9
												2"	37.1	14.6					2-1/8"	40.4	15.9		
																			2-5/8"	42.9	16.9		
65	2-1/2"	50.8	20.0	18.0	7.1	25.1	9.9	32.8	12.9	24.6	9.7	2-1/2"	40.1	15.8	33.0	13.0	2.5	1.0	2-5/8"	43.2	17.0	31.5	12.4
																			3-1/8"	46.7	18.4		
75	3"	61.7	24.3	27.2	10.7	31.0	12.2	34.8	13.7	27.9	11.0	3"	47.8	18.8	38.9	15.3	2.8	1.1	3-1/8"	49.5	19.5	31.5	12.4
																			3-5/8"	54.1	21.3		
100	4"	69.9	27.5	29.2	11.5	35.8	14.1	40.9	16.1	31.5	12.4	4"	57.2	22.5	45.0	17.7	3.3	1.3	4-1/8"	61.2	24.1	36.3	14.3

R/S Defrost Controller Wiring Diagram

CK-2D/CK-6D Line Equilization, S4AD Soft Start



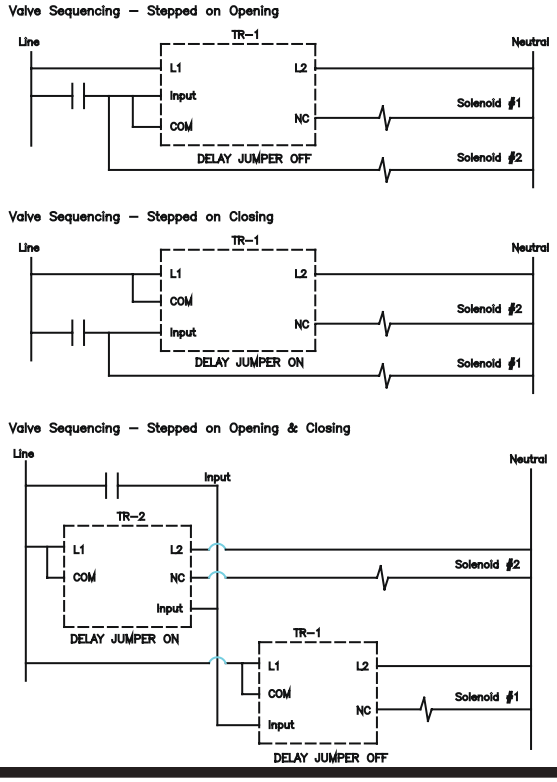
S4AD Cycle	/ Relay State	Solenoid #2 Coil State
Refrigeration	/ Energized	De–energized
Pump Out	/ Energized	De–energized
Soft Start	/ De–energized	Energized
Hot Gas	/ De–energized	Energized
Equalize	/ Energized	De–energized
Fan Delay	/ Energized	De–energized

S4AD Cycle	/ Relay State	Solenoid #1 Coil State
Refrigeration	/ Energized	De–energized
Pump Out	/ Energized	De–energized
Soft Start	/ Energized	De–energized
Hot Gas	/ De–energized	Energized
Equalize	/ Energized	De–energized
Fan Delay	/ Energized	De–energized

Note:The above wiring diagram is to be used only for a R/S defrost controller. If other manufacturer's controller is used, please consult their electrical diagram

R/S Adjustable Time Delay Wiring Diagram

Wiring Diagram using R/S Adjustable Time Delay Relay (108723)



Warranty

All Refrigerating Specialties Products are warranted against defect in workmanship and materials for a period of one year from date of shipment from factory. This warranty is in force only when products are properly installed, field assembled, maintained and operated in use and service as specifically stated in Refrigerating Specialties Catalogs or Bulletins for normal refrigeration applications, unless otherwise approved in writing by Refrigerating Specialties Division. Defective products or parts thereof, returned to the factory with transportation charges prepaid and found to be defective by factory inspection will be replaced or repaired at Refrigerating Specialties option, free of charge, F.O.B. factory. Warranty does not cover products which have been altered or repaired in the field, damaged in transit, or have suffered accidents, misuse, or abuse. Products disabled by dirt or other foreign substances will not be considered defective.

THE EXPRESS WARRANTY SET FORTH ABOVE CONSTITUTES THE ONLY WARRANTY APPLICABLE TO REFRIGERATING SPECIALTIES PRODUCTS, AND IS IN LIEU OF ALL OTHER WARRANTIES. EXPRESS OR IMPLIED, WRITTEN OR ORAL, INCLUDING ANY WARRANTY OF MERCHANTABLITLY, OR FITNESS FOR A PARTICULAR PURPOSE. No employee, agent, dealer or other person is authorized to give warranties on behalf of Refrigerating Specialties, nor to assume, for Refrigerating Specialties, any other liability in connection with any of its products.

Safe Operation (see also Bulletin RSBCV)

People doing any work on a refrigerating system must be qualified and completely familiar with the system and the Refrigerating Specialties Division valves involved, or all other precautions will be meaningless. This includes reading and understanding pertinent Refrigerating Specialties Division Product Bulletins and Safety Bulletin RSB prior to installation or servicing work.

Where cold refrigerant liquid lines are used, it is necessary that certain precautions be taken to avoid damage which could result from liquid expansion. Temperature increase in a piping section full of solid liquid will cause high pressure due to the expanding liquid which can possibly rupture a gasket, pipe or valve. All hand valves isolating such sections should be marked, warning against accidental closing, and must not be closed until the liquid is removed. Check valves must never be installed upstream of solenoid valves, or regulators with electric shut-off, nor should hand valves upstream of solenoid valves or downstream of check valves be closed until the liquid has been removed. It is advisable to properly install relief devices in any section where liquid expansion could take place.

Avoid all piping or control arrangements which might produce thermal or pressure shock.

For the protection of people and products, all refrigerant must be removed from the section to be worked on before a valve, strainer, or other device is opened or removed.

Flanges with ODS connections are not suitable for ammonia service.