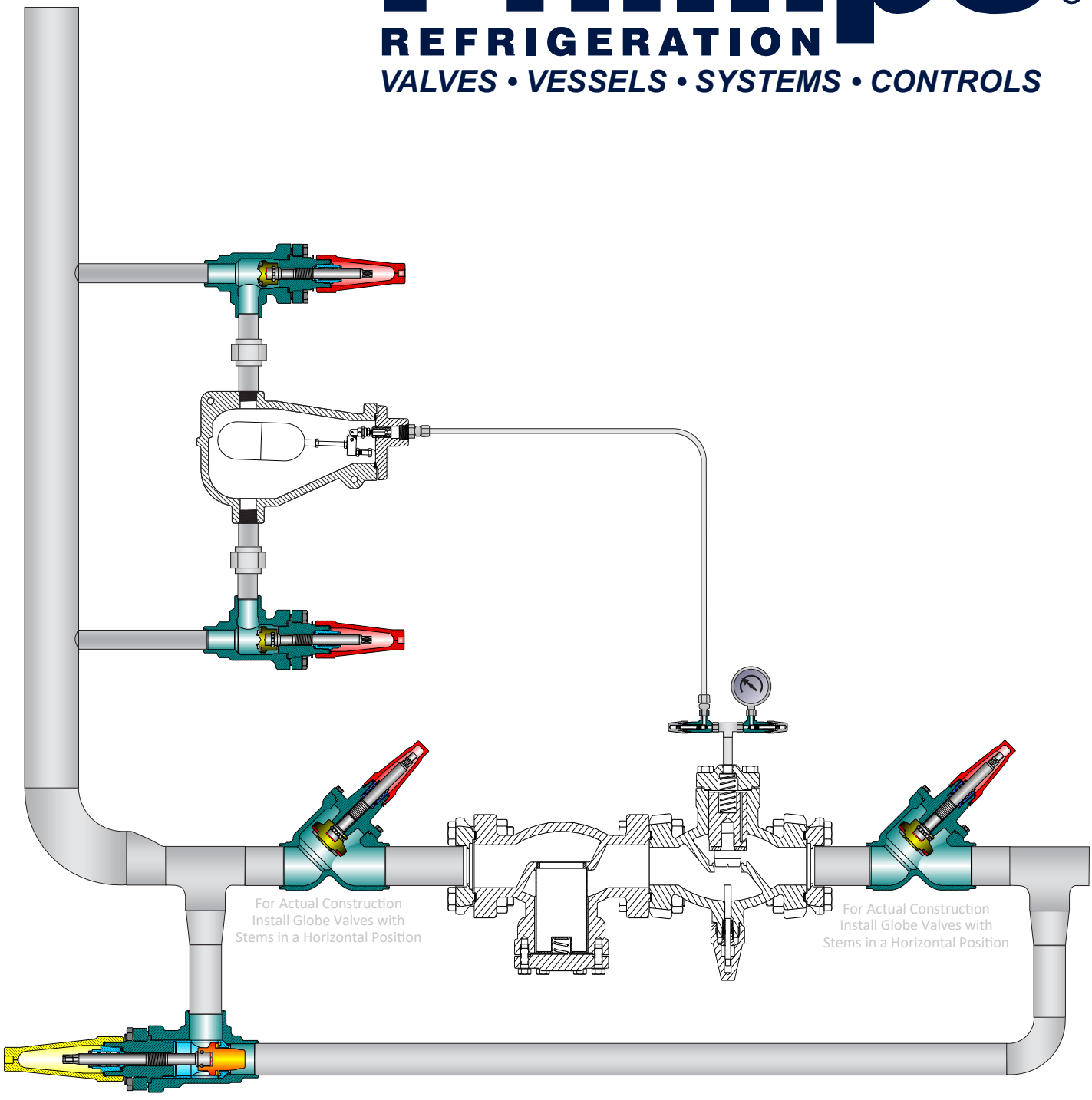
PHILLIPS REFRIGERATION ● VALVES & ACCESSORIES

Phillips®
REFRIGERATION
VALVES • VESSELS • SYSTEMS • CONTROLS



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Introduction to H. A. Phillips & Co. (AKA Phillips Refrigeration)

Capabilities:

H. A. Phillips & Co. is a single source manufacturer and supplier of modulating control solutions for industrial refrigeration systems. Our product lines include float valves, electronic and pressure regulating valves, ASME code pressure vessels, recirculation systems, Anhydrator system cleaners, PUR air purgers and accessory components. No other industrial refrigeration manufacturer offers a comparable range of products! H. A. Phillips & Co. is also the North America Distributor for Danfoss industrial refrigeration valves and controls.

Pioneers in Ammonia Refrigeration

Since 1928, H. A. Phillips & Co. has designed and manufactured ammonia refrigeration controls for industrial refrigeration applications worldwide. The company was founded by one of the pioneers of the ammonia refrigeration industry, Harry Alexander Phillips. Harry developed numerous patents related to modulating liquid level controls, refrigerant injectors, and automatic systems to protect refrigeration compressors from liquid ammonia slop-over.

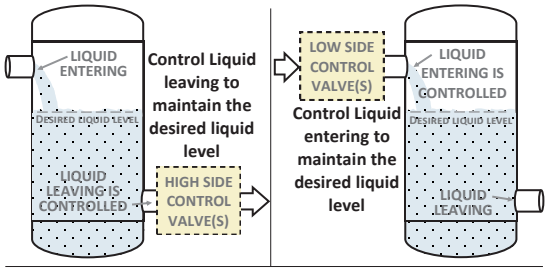
Harry Alexander Phillips

Engineering

H. A. Phillips & Co. employs engineers with relevant refrigeration education and experience. We take pride in the ability of our applications engineers to service our customer base at a high level, and we feel this technical acumen helps separate us from our competitors. Allow our applications and sales engineers to answer your questions about the application or design of our products.

High Side & Low Side Expansion/Level Controls

Amongst other things, Phillips specializes in mechanical style modulating expansion valves to meter/flash refrigerant and maintain liquid levels in industrial refrigeration systems. High side controls (direct feed or pilot operated valves) maintain a liquid level on the high side (upstream side) of a valve by metering flow to a lower pressure location. Low side controls (direct feed or pilot operated valves) control the liquid level on the low side (downstream side) of a valve by metering flow from a higher pressure location into the lower pressure location.



Simplified High Side and Low Side Controls

About This Document

This document is intended to familiarize users with a quick overview of our most commonly used valves and accessories and some common applications for these products. This document also lists code number nomenclature (to be used for ordering and identifying existing valves) for each product family. Other products not mentioned in this document do exist. Only brief descriptions and most relevant product data will be listed; for more info on our products please see the beneath section.

Other Literature and Info

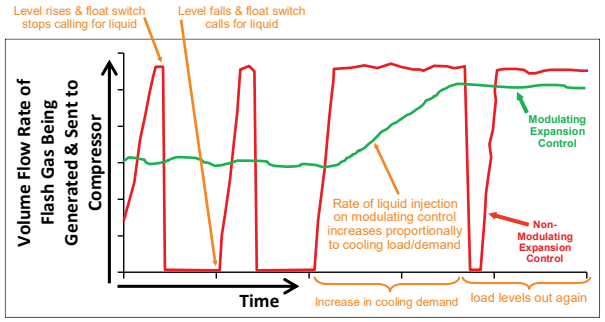
More engineering data, product details, application examples, service instructions, and other literature can be found on our website or provided upon request. Our current list pricing and valve identifier (used to both ID valves and specify code number for ordering) can also be found on our website. Please do not hesitate to contact us with your valves, vessels, systems and control needs. As an industrial refrigeration manufacturer with a wide range of products, and as the U.S. distributor for Danfoss industrial refrigeration valves and controls, H. A. Phillips & Co. is confident that we can provide the products that you require for your applications.

Table of Contents

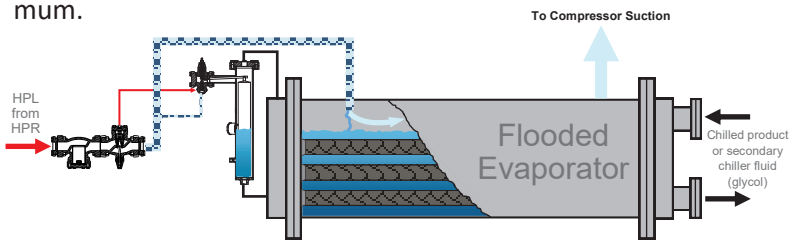
Mechanically Operated Expansion/Level Controls Overview

Modulating Expansion Control Versus Non-Modulating Control:

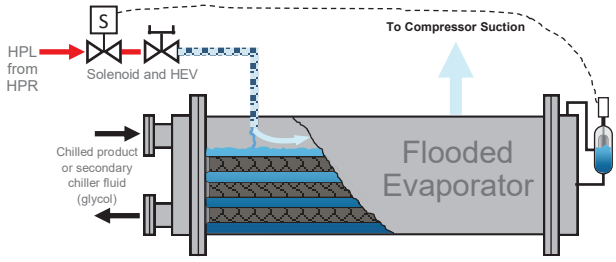
A standard liquid makeup design with a HEV (hand expansion valve) and a solenoid, energized/de-energized by a float switch making/unmaking, will result in very unsteady amounts of flash gas being produced. Ideally, the HEV is set to the smallest opening degree possible while still being able to provide enough refrigerant flow to meet demands at full expected loads (typically set to be feeding 85-90% of the time at the highest expected load). On the other hand, **modulating liquid level regulation provides liquid injection that is proportional to the actual capacity. This gives a steady amount of flash gas, thus ensuring stable regulation and economic operation** because variations in pressure and temperature are held to a minimum.



Volume of Flash Gas Generated as a Function of Time and Load

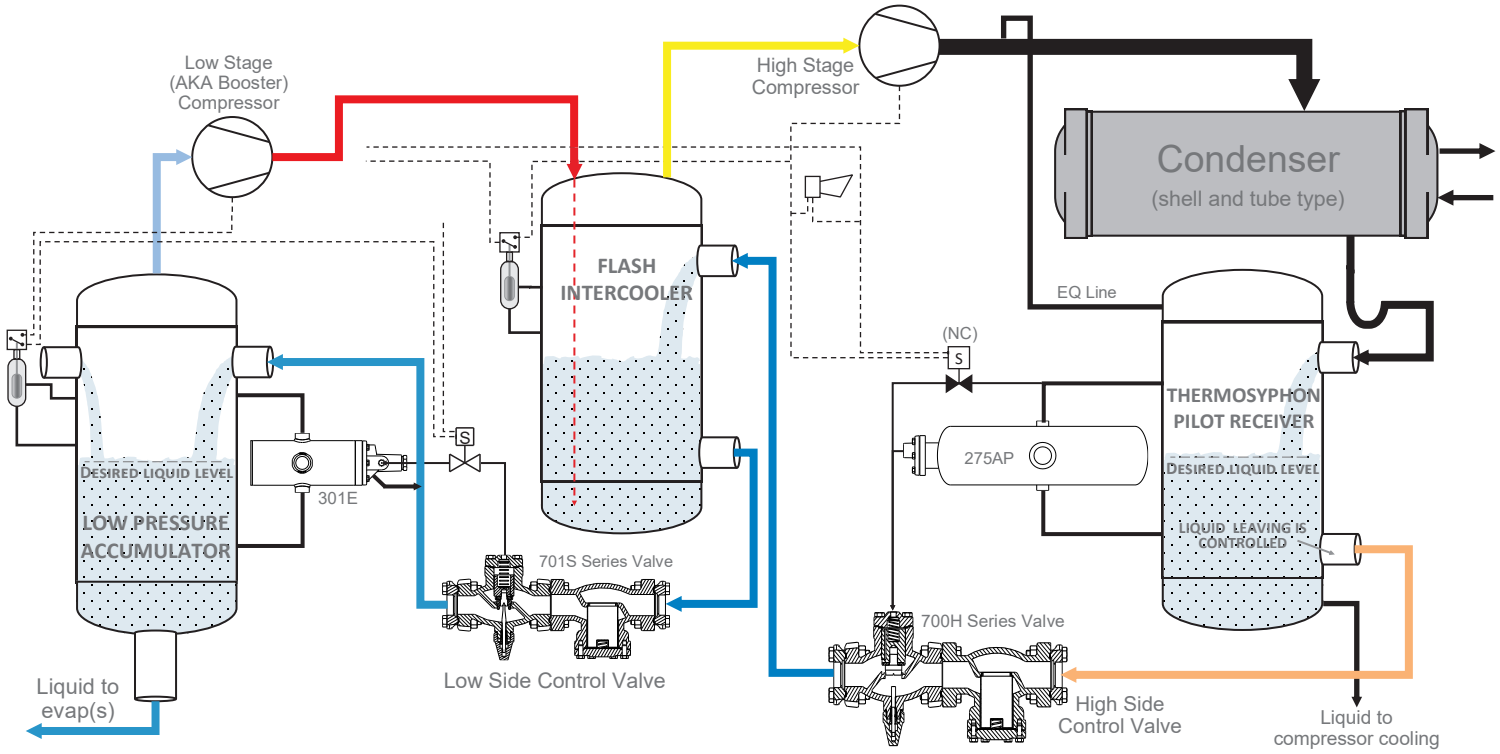


Typical Phillips' Modulating Liquid Makeup Low Side Control



Typical Non-Modulating (HEV) Liquid Makeup

Simplified System Diagram with Modulating Expansion/Level Controls



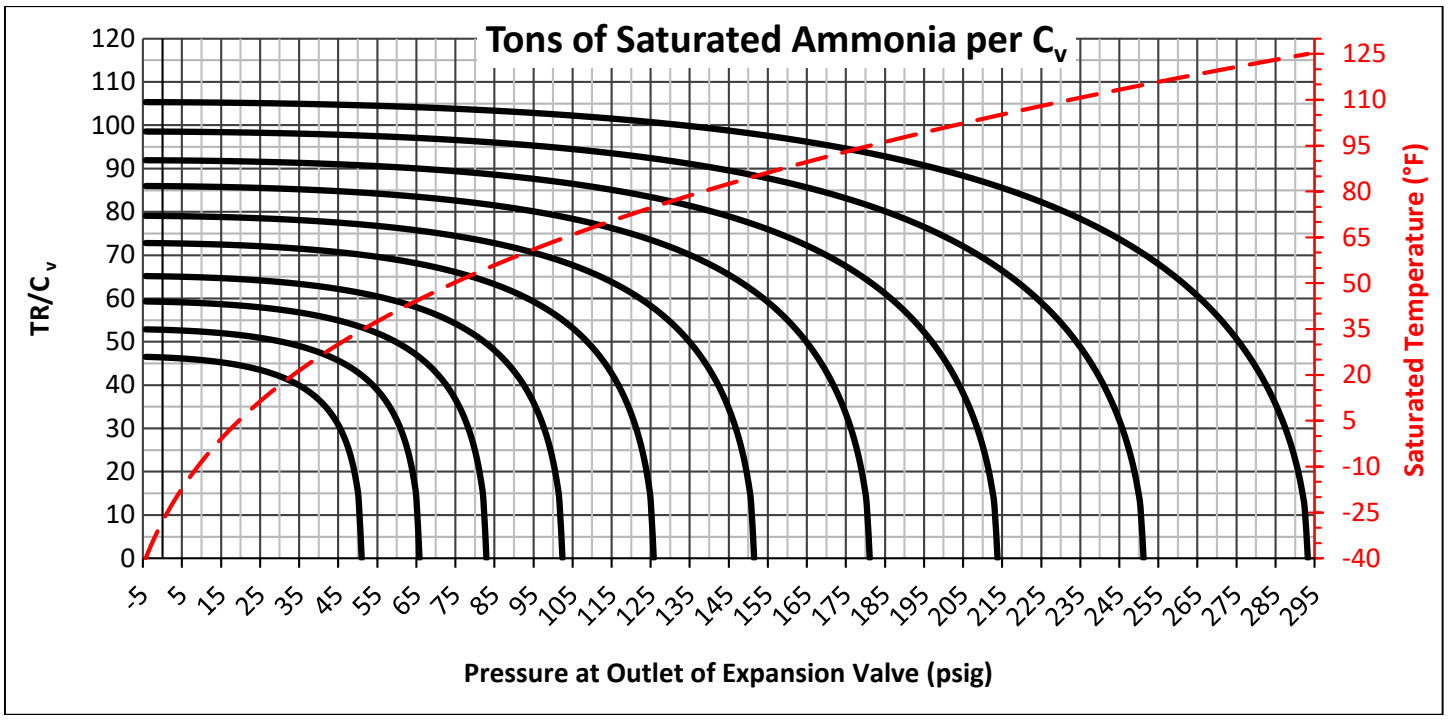
Simplified Single Temperature, two Stage Compression, and two Stage Modulated Liquid Expansion System

Sizing Expansion Valves by Cooling Capacity per Valve Flow Coefficient (Cv)

The beneath graph shows the expected tons of refrigeration (TR) that can be obtained per Cv at ten different constant inlet pressures to the valve over a range of outlet pressures. The point/values at which the bold lines meet the horizontal axis are that line's constant inlet pressure. The dashed red line can be used to determine the corresponding saturated pressure for given temperatures (or vice versa).

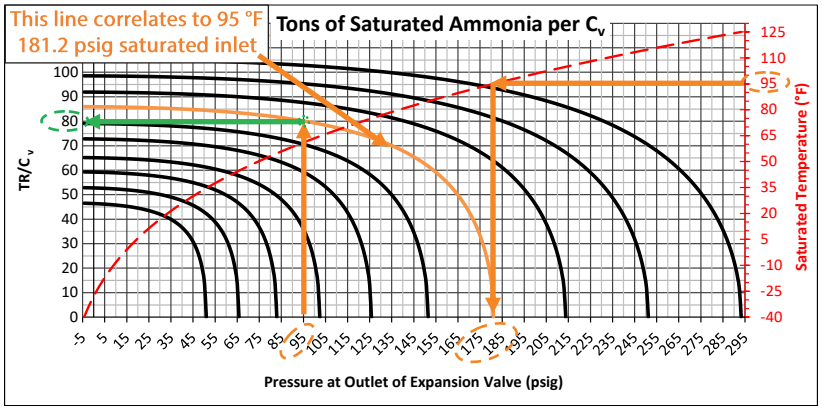
For Cv Values of Different Valve Options See Pages 10 & 16

- The beneath graph is to be used for sizing valves experiencing a phase change (valves used for expansion service) across their metering device. The liquid entering valve is assumed to be saturated. Adjustments for subcooled inlet conditions can be made via the table listed beneath. If needed, please contact engineering support for sizing valves with two phase flow conditions at inlet of valve.
- The beneath curves already have a small factor of safety applied to them. Avoid oversizing valves by too much if possible. Grossly oversized valves are subject to poorer modulation characteristics, and potential wire drawing of components. That being said, Phillips valves generally operate well with minimal loss in performance down to 30% of the values obtained from the TR/Cv curves.



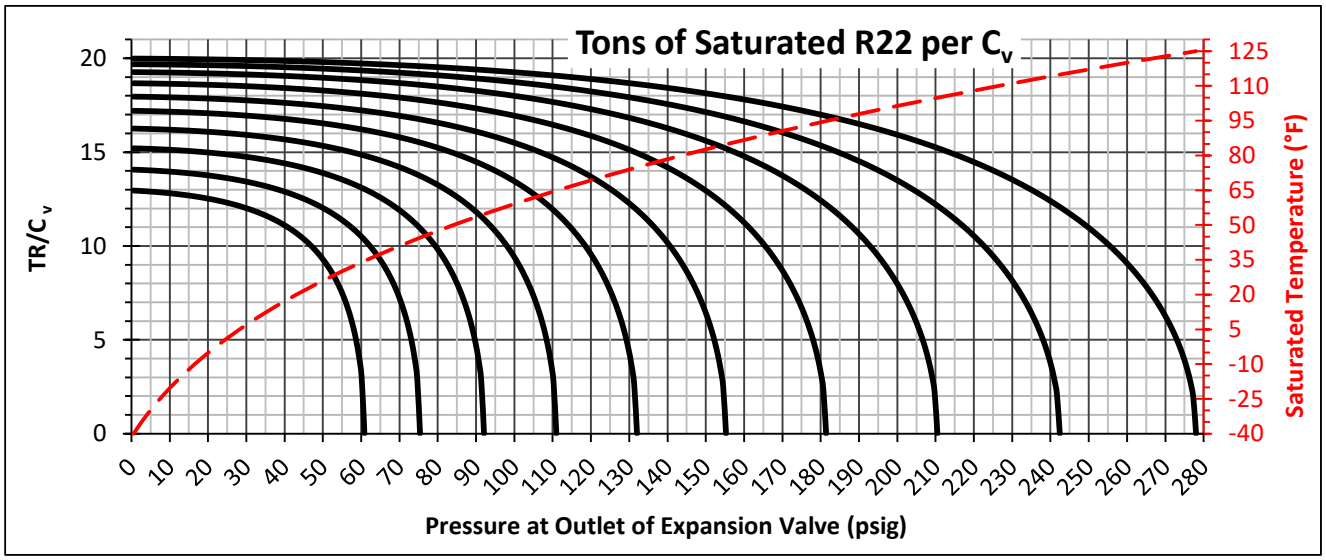
°F Subcooling	Multiplier *
5 °F	1.02
10 °F	1.04
20 °F	1.08
30 °F	1.15
50 °F	1.20

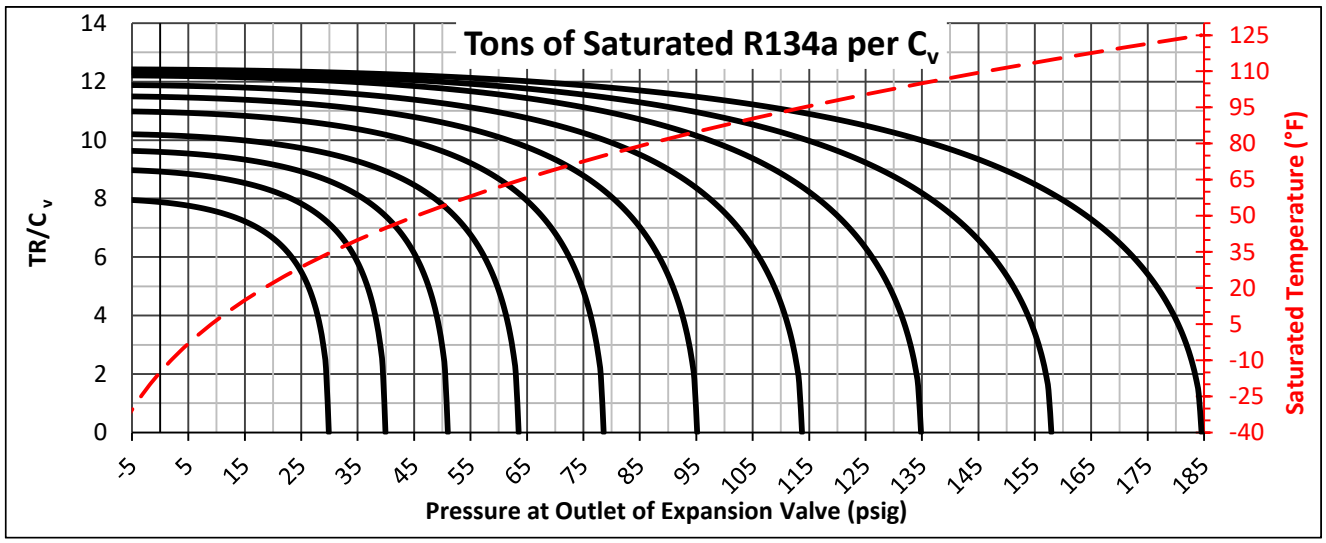
*Multipliers listed in this table are for when flashing still occurs across valve. Capacities for conditions where the amount of subcooling present is enough to result in no flashing across valve will be approximately 1.4 to 1.6 times the values shown on graph.

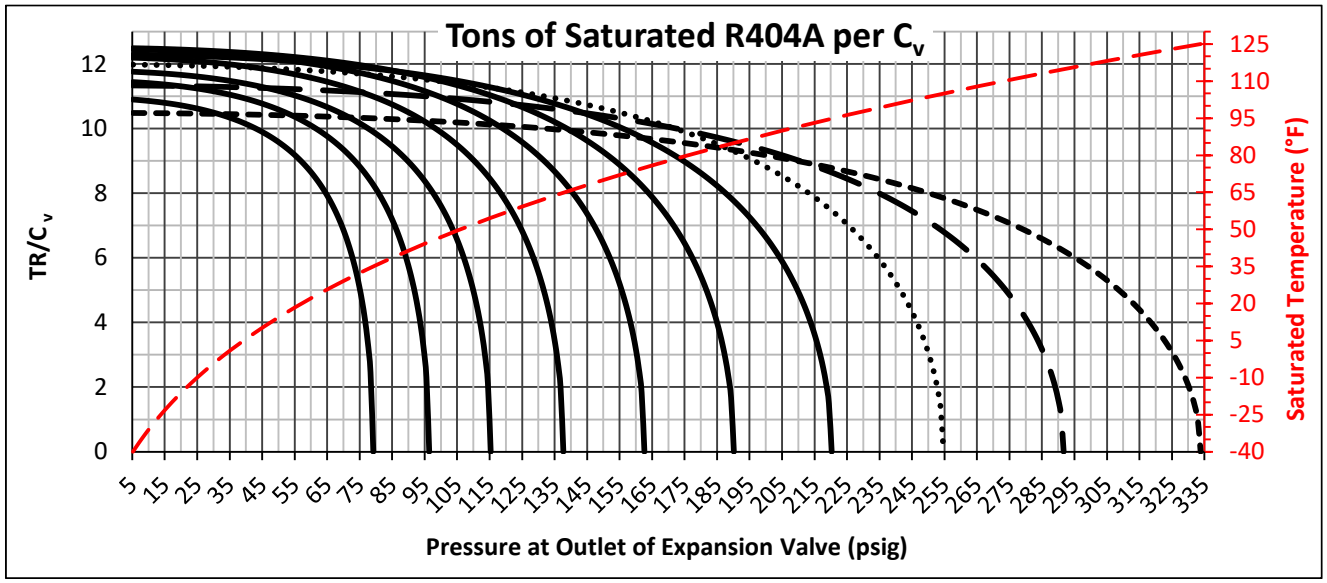


The sample to the left shows how to read the TR/Cv charts…

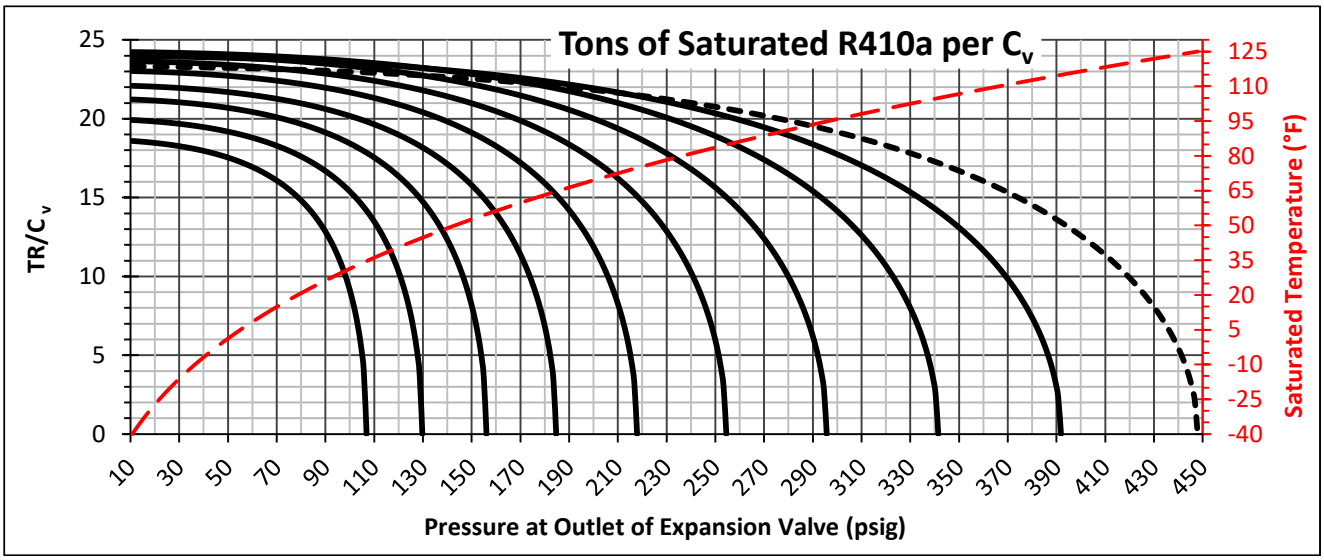
For 95°F (corresponding saturated pressure is 181.2 psig) inlet to valve, and 95 psig downstream pressure, the expected capacity per Cv is 80 TR per Cv. This means that a valve with a Cv value of 0.5 is good for about 40 TR R717 at the stated conditions.

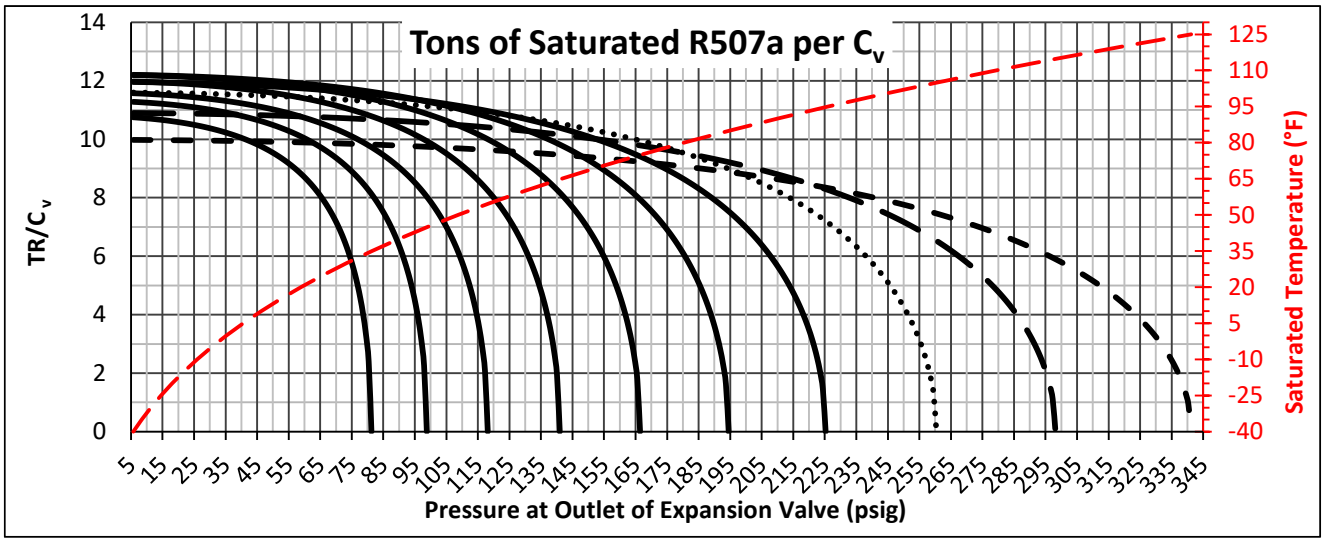

Tons of Saturated R22 per C_v
TR/C_v
Saturated Temperature (°F)
Pressure at Outlet of Expansion Valve (psig)

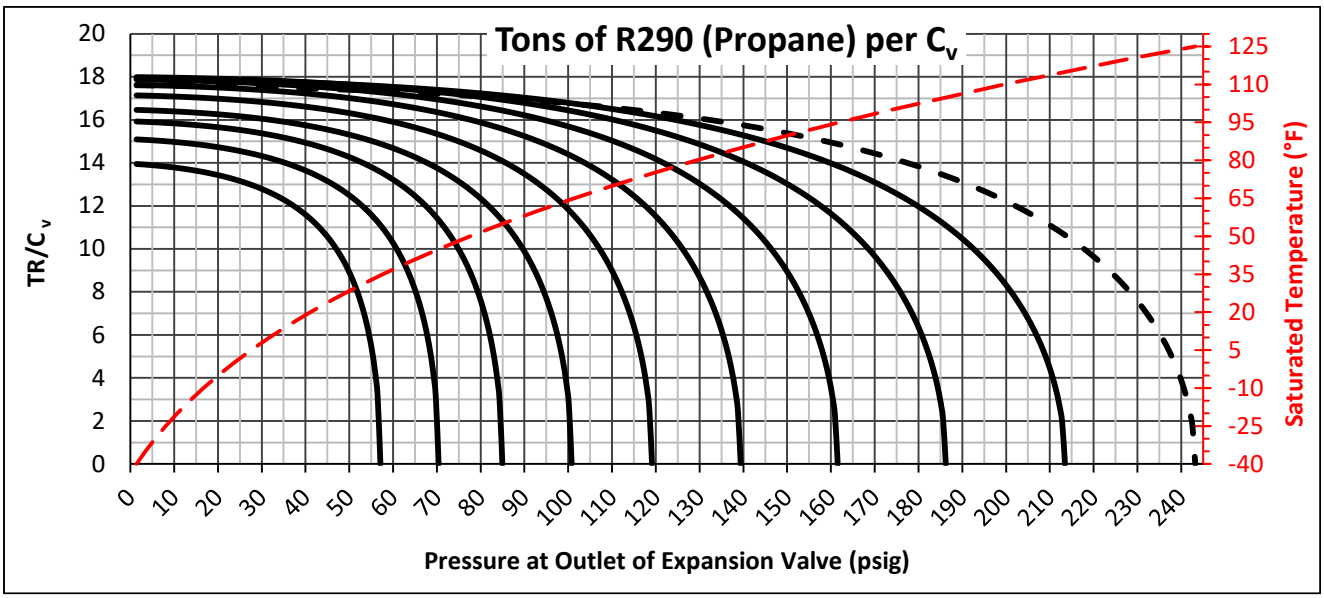

Tons of Saturated R134a per C_v
TR/C_v
Saturated Temperature (°F)
Pressure at Outlet of Expansion Valve (psig)


Tons of Saturated R404A per C_v
TR/C_v
Saturated Temperature (°F)
Pressure at Outlet of Expansion Valve (psig)

Capacity Charts & Sizing Info







High Side - Sizing and Selection Example

High Side Controls - Sizing and Selection Example

A high side control is required for a single condenser/single evaporator, critically charged system servicing a food processing plant. This high side control will maintain a liquid seal in the condenser drop leg, and will expand refrigerant directly into the surge drum. Pressure losses in piping and components will be negligible due to the size of plant and good piping practices. **The beneath operating conditions apply:**

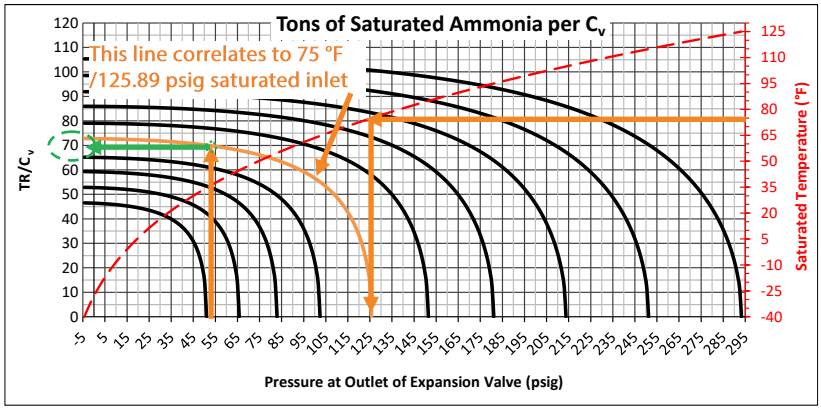
- **470 TR R717** *(load will remain at this level nearly all year round since this is a steady process driven load)*
- **95°F SCT** *(saturated condensing temperature)* during warm months, and **75°F SCT** in cooler months *(floating head pressure).*
- Surge drum will be maintained at **36°F SST** *(saturated suction temperature)* year round.

Assumptions:

- The pressure losses due to friction and restrictions in piping and components can be neglected for this application.
- The liquid is assumed to be entering the expansion valve at a saturated state.

Step 1: Determine required Cv value (valve flow coefficient):

We will size for the worst case scenario (usually the highest cooling demand at the lowest differential pressure available). In this case, we will size for 470TR with 75°F SCT and 36°F SST. From the TR/Cv graph we read that we should get about 70TR/Cv at these conditions. Thus we need valve(s) with a sum total Cv value of 6.71 (Cv required = TR/value from cart).



Step 2: Check Required Line Sizes

We can use Danfoss' Coolselector®2 program for this. We will size a liquid line that will keep the velocity upstream of the expansion valve between 3-8 ft./s, and a two phase flow velocity (downstream of the expansion valve) beneath 78 ft./s . Using Coolselector®2, http://refrigerationandairconditioning.danfoss.us/knowledge-center/software/coolselector/#/, we come up with a selection of 2" line size.

Condenser				Separator
	Steel pipe ANSI 2	Steel pipe ANSI 2	REG 25-A straight	Steel pipe ANSI 2	
DP distribution:	100%	0%	96%	4%	Total
Length [ft]:	1.50	30.00	-	30.00	
Angle [deg]:	-90	0	-	0	
Max. capacity [TR]:	-	-	741.1	-	
Min. capacity [TR]:	-	-	31.87	-	
Load [%]:	-	-	63	-	
DP [psi]:	-0.38	0.19	70.28	2.87	72.96
DT_sat [°F]:	-0.2	0.1	37.0	2.0	39.0
Velocity, in [ft/s]:	3.60	3.60	12.22	45.88	

Step 3: Select Valve(s) that give required Cv and line size

From the High side valve overview, see page 10, we see that a 700AXH valve with a metering plug with an angle between 5° and 10° will give us the required Cv value as well as required line size, thus we will go with a 8° plug.

Step 4: Select pilot valve orifice size and 700AXH valve spring

The standard 275AP pilot orifice size when piloting a 700AXH valve is 5/64" as read from one of the tables on page 15. We can also see on page 15 that the recommended spring selection for the minimum differential pressure expected (125 psig - 53 psig = 72 psid) is a 705A-30L spring.

Step 5: Determine desired assembly part number(s)

275AP pilot valve: From the assembly part number nomenclature on page 13: *275AP-BZB*
700H series valve: From the assembly part number nomenclature on page 15: *700AXH-ZRFRA*

Part Number	Description
275AP-BZB	Float Valve, 5/64" Orifice, with Steel Chamber
700AXH-ZRFRA	Pilot Operated Valve, 705A -30L Spring, 8 Deg Metering Plug, 2" Socket Weld Flanges, with Strainer

Low Side Controls - Sizing and Selection Example

Low side ammonia controls are required to maintain liquid levels in four identical surge drums which are gravity feeding plate and frame heat exchangers. Liquid makeup to these units will be subcooled HPL (high pressure liquid) as listed beneath. Each unit will have it's own piping run, with a total equivalent pipe length (accounts for friction losses in elbows and other components) running to each unit of around 1000 ft., with a vertical change in height of 10 ft.

The beneath operating conditions apply:

- **200 TR Max Load/150 TR Min load** (Ton of R717 per unit)
- Makeup liquid will be supplied from the HPR after running through a subcooler. The minimum expected SCT is **80° F**, and the subcooler is expected to maintain a minimum of **30°F of subcooling**.
- Surge drum will be maintained at **0°F SST**.

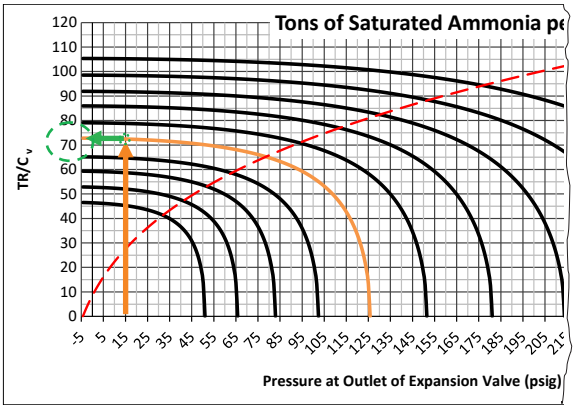
Step 1: Determine Line Sizes and pressure losses up to low side control valves.

We can use Danfoss' Coolselector®2 program for this. We will size a liquid line that will keep the velocity upstream of the expansion valve between 3-8 ft./s, and keep the pressure losses/saturation temperature beneath a reasonable level. Using Coolselector®2, (see example on previous page for download link) , we come up with a selection of 1-1/4" line size as being reasonable; which yields a total pressure loss of 15.5 psid and a corresponding decrease in saturation temperature of 6.2°F.

Condenser			Separator
	Steel pipe ANSI 1 1/4	Steel pipe ANSI 1 1/4	
DP distribution:	82%	18%	Total
Length [ft]:	1000	10.00	
Angle [deg]:	0	90	
DP [psi]:	12.63	2.83	15.47
DT_sat [°F]:	5.0	1.2	6.2
Velocity, in [ft/s]:	3.74	3.74	

Step 2: Determine required Cv value (valve flow coefficient):

From step 1, we know that the liquid should reach the low side valves at an inlet state of 122 psig with 23.8°F of subcooling remaining. From the TR/Cv graph we can read that the TR/Cv for saturated conditions at these pressure should be about 70 TR/Cv. The subcooling correction table on page 5 shows an increase in capacity of about 8% due to the subcooling remaining by the time we reach the valve, thus we can expect about 75.6 TR/Cv (1.08 x 70TR = 75.6TR). Therefore we need a valve with a Cv value of about 2.65.



Step 3: Select Valve(s) that give required Cv and line size

From the low side valve overview, see page 16, we see that a 701S valve with a 9/16" port and 445.25 metering plug will exceed the required Cv value as well as provide the desired line size. Alternatively, if we wanted to use direct acting valves, (2) 101A valves with 3/8" orifices operating in parallel would also suffice.

Step 4: Select pilot valve orifice size and 701S series valve spring

From the table at the bottom of page 22 we can see that either a 101VP18 or a 301E with a 3/32" orifice is used to pilot a 701S valve with a 9/16" port. For this example we will use a 101 valve to pilot since the liquid level in the surge drum can be adjusted with a 101 series valve. From the table just above that one, we must select the spring for the available pressure differential across the valve of 106 psid: thus we will select the 705-60R spring.

Step 5: Determine desired assembly part number(s)

101VP18 pilot valve: From the assembly part number nomenclature on page 17: *101VP18-CRB*

701S series valve: From the assembly part number nomenclature on page 21: *701S-TJSJA*

Part Number	Description
101VP18-CRB	Float Valve, 3/32" Orifice, Right Hand Flow, with Chamber
701S-TJSJA	Pilot Operated Valve, 9/16" Port, 705-60R Spring, 445.25 Metering Plug, 1-1/4" Socket Weld Flanges, with Strainer

High Side Expansion/Level Controls Model Overview

High Side Valves Cv Values and Overview

Valve Type	Valve Model Number*	Cv	Metering Plug angle or Orifice Size	Nominal Tons** Ammonia	Connections *(inches)*
Direct Acting	270A	0.10	1/16"	8.5	3/4 FPT on float chambers 1/2 FPT outlet
		0.14	5/64"	11.9	
		0.17	3/32"	14.5	
		0.38	1/8"	32.4	
		0.70	3/16"	60	
	270AX	0.80	13/64"	68	3/4 FPT on float chambers 3/4 FPT outlet
	270AY	1.20	3/8"	102	
Pilot Operated	700JRH	0.71	0°	61	I.P.S., Thd. or Socket Weld 1/2, 3/4, 1 Weld Neck (AKA Butt Weld) 1/2 or 3/4 O.D. Copper 1-1/8 or 1-3/8
		1.04	1°	89	
		1.57	3°	134	
		2.18	5°	186	
		2.85	8°	243	
		3.34	10°	285	
	700XH	0.78	0°	66	I.P.S., Thd. or Socket Weld 1 or 1-1/4 Weld Neck (AKA Butt Weld) 1 or 1-1/4 O.D. Copper 1-5/8
		1.68	2°	143	
		2.8	5°	239	
		4.0	8°	341	
		4.7	10°	401	
		6.4	15°	546	
		8.0	20°	682	
	700AXH	2.87	0°	245	I.P.S., Thd. or Socket Weld 1-1/2 or 2 Weld Neck (AKA Butt Weld) 1-1/2 or 2 O.D. Copper 2-1/8
		5.91	5°	504	
		11.2	10°	955	
		14.5	15°	1236	
		18.9	20°	1611	
		21.9	25°	1867	
	700BXH	4.04	0°	344	I.P.S., Thd. or Socket Weld 3 Weld Neck (AKA Butt Weld) 3 O.D. Copper 3-3/8
		15.1	5°	1287	
		21.9	10°	1867	
		28.2	15°	2404	
		35.0	20°	2984	
		39.6	25°	3376	
		44.0	30°	3751	
		51.0	45°	4348	
		54.0	60°	4604	

* 'F' suffix on valve model number indicates use with halocarbon refrigerants.

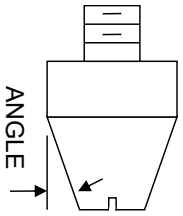
** Nominal TR of R717 calculated for 95°F saturated liquid at inlet to valve, and feed into a 20°F vessel. Pressure losses upstream and downstream are not considered.

See Page 5 for Sizing Info

Avoid 0° metering plug because capacity of valve does not change much until plug is fully pulled out of port.

Valves with these metering plugs tend to not modulate as well. Please consult factory for assistance. Consider using smaller body size with a larger metering plug angle. You can add expanders or reducers to match line size.

ZINC
All Valve Bodies & Cast Chambers Come Clear Zinc Plated Standard!



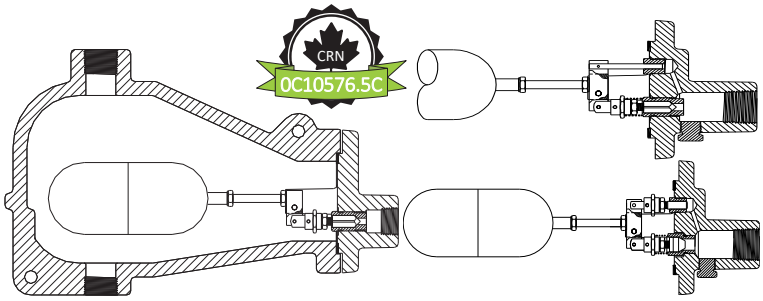
Metering Plug From 700H Series

We can machine a custom angle on the metering plug as needed. Options listed in the table are only the most common sizes.

Direct Acting High Side Expansion/Level Controls

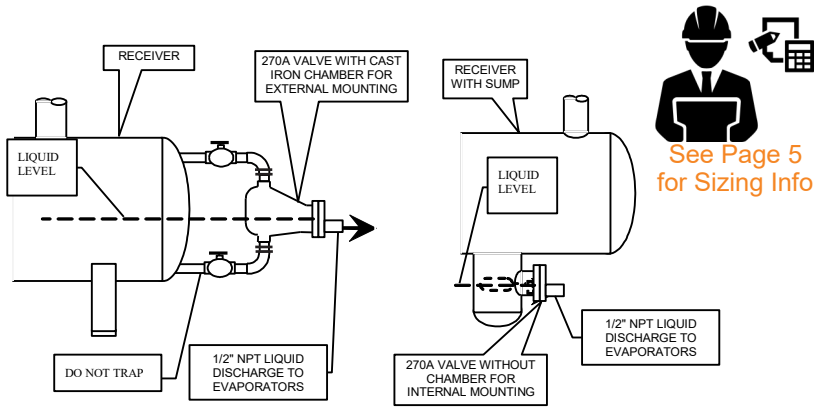
270A Series Float Control Valves

The 270A Series valves are direct feed High Side level controls. Mounted in a chamber balanced to a vessel, or directly in a sump, **a rise in liquid level will open the orifice and allow the liquid to flow downstream.** These valves are generally applied to refrigeration systems with a fixed charge (critically charged system). These valves have a simple needle and seat construction. The 270A valve has a single port, but the 270AX and 270AY valves are balanced port valves, allowing their use with larger capacity applications.

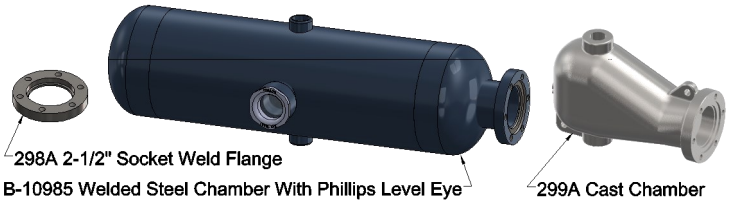


270A shown with cast chamber (left); 270AX (top right); and 270AY (bottom right).

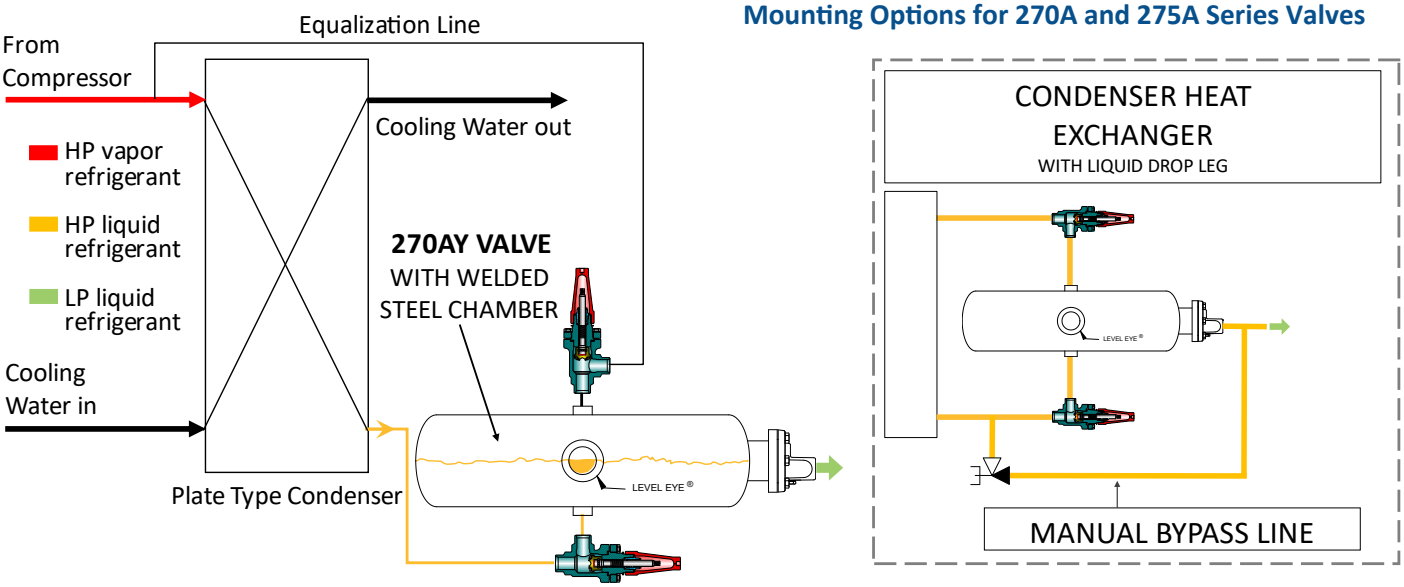
Users can choose to order 270A or 275A series valves with a cast chamber (Zinc Plated as standard), a painted welded steel chamber with Phillips Level Eye (allows user to check for liquid presence/level in chamber; see Level Eye product for more details), or a socket weld flange for mounting directly to a vessel (float ball to protrude into vessel cavity). When utilizing welding flanges, to directly mount a 270A/275A valve to a vessel, special consideration must be given to ensure that enough clearance is allowed for the valve's float ball to move up and down with a rise/fall in liquid level (see engineering bulletin for more info).



See Page 5 for Sizing Info



Mounting Options for 270A and 275A Series Valves



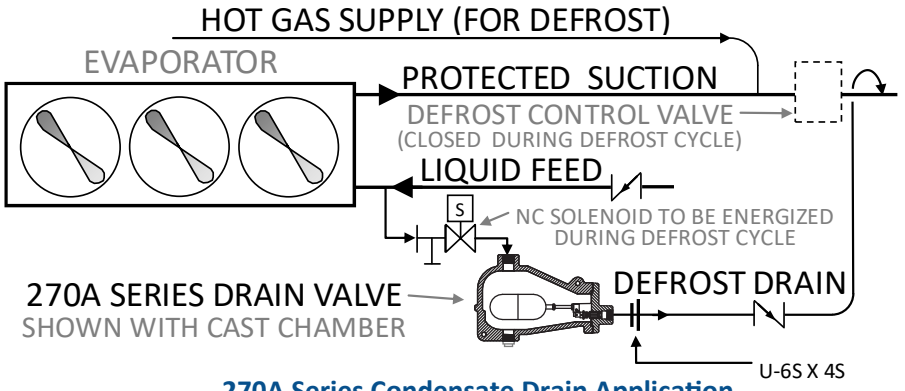
270A Series Valve, Low Capacity High Side Control, Condenser Application

Direct Acting High Side Expansion/Level Controls

270A Series Float Control Valves for Defrost and Reheat Condensate Relief

Phillips' 270A series valves (open on a rise in liquid level) make for excellent condensate drainers. The valves will open only once enough liquid has condensed to fill up the chamber about halfway and cover the outlet of the valve. The valve will then open and drain the liquid to a lower pressure location, such as a protected suction line, while preventing most of the higher pressure vapor from flowing downstream which could otherwise create an artificial load on the compressor.

When using a float valve as a defrost and/or reheat coil drain, it is imperative that the hot gas supply feed is regulated via an outlet (aka downstream) regulator. When sizing a high side valve for a defrost condensate drain application, it is typical to size the valve for a tonnage rating 2 to 4 times the nominal tonnage of the evaporator. Size for double the nominal rating for evaporators that run warmer, and will not have much ice accumulation. Size for 3 to 4 times for evaporators that run at low temperatures and are subject to larger amounts of ice accumulation. It is estimated that **an optimized defrost control, which includes a float drainer, can result in savings in excess of 5% of the total system energy consumption when compared to traditional hot gas arrangements.** Click here to read the white paper (or request a copy from Phillips).



270A Series Condensate Drain Application

270A Series Float Control Valves for Drainage of Hot Gas Mains

Phillips' 270A series valves (open on a rise in liquid level) also make for excellent condensate drainers in hot gas main lines. Pressure losses and heat losses (hot gas lines on a roof in the winter is an example of where heat losses can occur) can result in some of the vapor in the hot gas mains condensing and accumulate in the horizontal piping runs. If this condensate is not drained, then there is a risk of sending a liquid propelled slug down the line when there is a sudden rush of volume in the hot gas main (such as when an evaporator goes into defrost mode).

Drain valves for hot gas mains should be installed in the low portions of the piping so that liquid drains into the valve chamber which is mounted beneath the piping. The drain line should mount to the bottom of the chamber, and the upper connection on the chamber should be connected to the top of the main piping so that the chamber can easily equalize and not get vapor locked.

The condensed liquid can then be relieved to a lower pressure location such as a protected suction line.

ZINC
All Valve Bodies & Cast Chambers Come Clear Zinc Plated Standard!

Assembly Part Number Nomenclature

270AX	F	-J	Z	B

Base Valve Model

REFRIGERANT TYPE
(BLANK) = Ammonia
F = Halocarbon
P = Propane

ORIFICE
A = 1/16" I = 3/16"
B = 5/64" J = 13/64" *
C = 3/32" P = 3/8" **
F = 1/8"

Z (PLACE HOLDER)

CHAMBER
A = Cast Iron Chamber
B = Welded Steel Chamber
Z = No Chamber

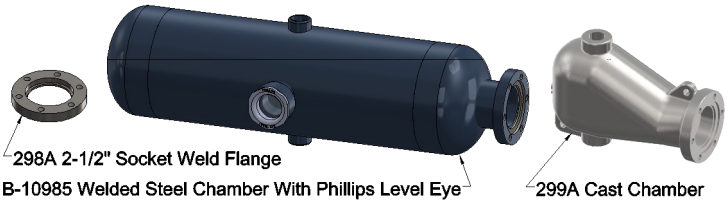
270A Valve Series Includes: 270A, 270AX*, 270AY**

Direct Acting High Side Control

275A Series Float Control

See Page 5 for Sizing Info

275AP Valve Less Chamber

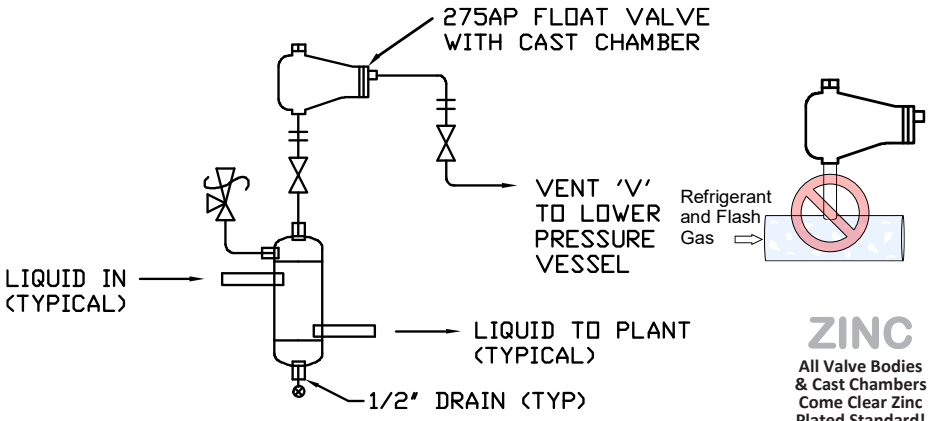


Mounting Options for 270A and 275A Series Valves

The 275A series valves are direct feed valves that operate in the opposite fashion of the 270A series valves. **The 275A valves will remain open unless a liquid level builds up** and raises the valve's float ball, effectively closing off the valve. The 275AP valve is typically used to pilot the Phillips 700H series high side control valve. Phillips 270A and 275A valves differ in design but utilize the same mounting options (please note that the valves are mounted in opposite orientation; please see diagrams for details). Users can choose to order a 270A or 275A valve with a cast chamber, a welded steel chamber with Phillips Level Eye (allows user to check for liquid presence/level in chamber; see Level Eye product for more details), or a socket weld flange for mounting directly to a vessel (float ball to protrude into vessel cavity). When utilizing welding flanges, to directly mount a 270A/275A valve to a vessel, special consideration must be given to ensure that enough clearance is allowed for the valve's float ball to move up and down with a rise/fall in liquid level (see engineering bulletin for more info).

275AP Flash Gas Eliminator Application

A common non-high side application for the 275A series valve is as a flash gas eliminator. When using a 275A valve to vent flash gas, to a lower pressure location in the system, the liquid and flash gas must be allowed to separate. Simply installing a 275A on top of a liquid line carrying excess amounts of flash gas will not work since the flash gas will not effectively have a chance to migrate into the pipe stub before it is carried downstream. If eliminating flash gas from a location where the flash gas will not naturally have an opportunity to separate from the liquid (such as a liquid line) then a small vessel is recommended to facilitate the separation of the liquid and vapor. Please contact Phillips for help with sizing and pricing of vessel.



275AP Valve Flash Gas Eliminator Application

ZINC
All Valve Bodies & Cast Chambers Come Clear Zinc Plated Standard!

Assembly Part Number Nomenclature

275AP	F	-C	Z	B

Base Valve Model

REFRIGERANT TYPE
(BLANK) = Ammonia
F = Halocarbon
P = Propane

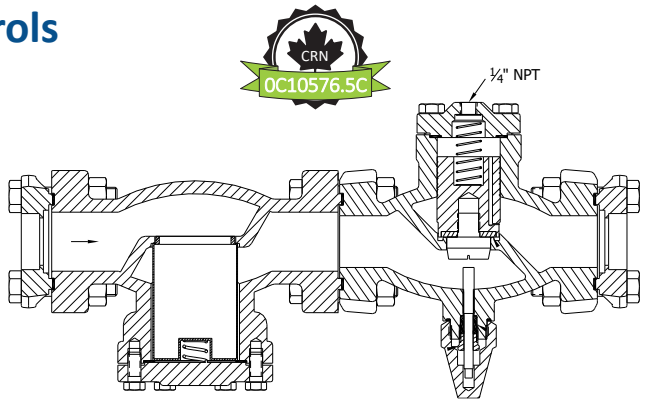
ORIFICE
A = 1/16" F = 1/8"
B = 5/64" I = 3/16"
C = 3/32"

Z (PLACE HOLDER)

CHAMBER
A = Cast Iron Chamber
B = Welded Steel Chamber
Z = No Chamber

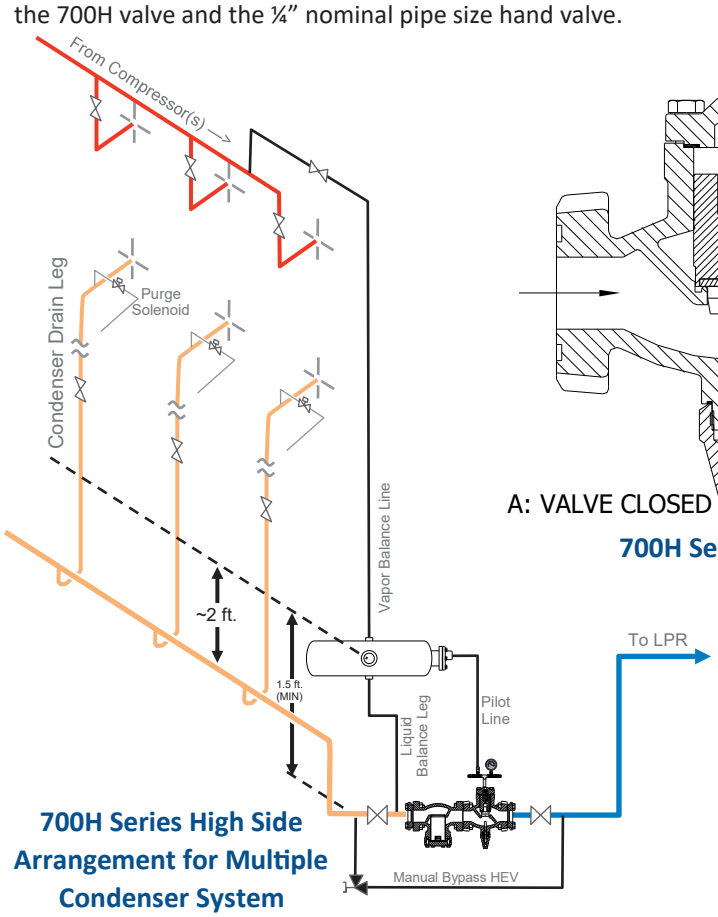
Pilot Operated High Side Expansion/Level Control

700H Series High Side Pilot Operated Controls

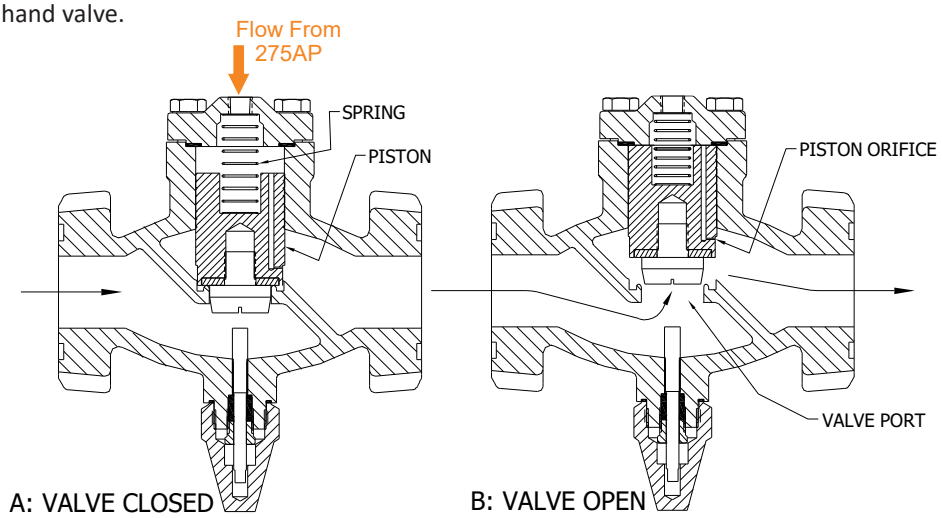


700H Series Valve With Direct Mount Strainer

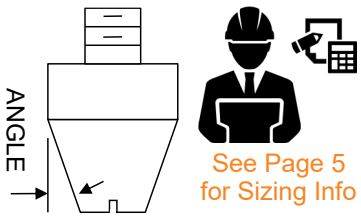
The 700H Series valves are pilot operated valves that modulate the flow of liquid refrigerant to a lower pressure location by utilizing a 275AP pilot float valve. These valves may also be applied to controlled pressure receivers, thermosyphon vessels, economizers, and drainage of condensed vapor in heat reclaim vessels. These flanged piston-type valves have a manual lifting stem and replaceable PTFE seat disc. **It is necessary to size the internal metering plug and spring for the design criteria to which the 700H valve is to be applied**, including mass flow or tonnage and the inlet and outlet pressures of the valve. The valve is pilot operated by a remote pilot float valve with an orifice suitably sized for each 700H body size. The typical application of the 700H Series Pilot Operated Valve is to maintain a liquid seal in the condenser drain line, or in a thermosyphon vessel, utilizing a 275AP Pilot Float Valve in a chamber. The pilot float valve follows the upstream liquid level. As the condensing load increases, the 275AP float ball rises, slowly closing the pilot orifice. This reduces the pressure in the pilot line to the 700H valve, and pressure on top of the piston bleeds to the downstream side of the 700H valve. The balance of forces causes the piston with metering plug to rise, allowing more liquid to move downstream. Alternately, as the condensing load decreases, the float ball drops and opens the pilot orifice, thereby putting higher pressure on the 700H piston. The 700H valve then modulates toward reducing the flow. The pilot line must be a minimum of ¼" nominal pipe for proper operation (3/8" OD copper tubing is acceptable for halocarbon applications). It is imperative to install a pressure gauge in the pilot line between the bonnet of the 700H valve and the ¼" nominal pipe size hand valve.



700H Series High Side Arrangement for Multiple Condenser System



700H Series Operation (valve closed left) (valve open right)



See Page 5 for Sizing Info

Metering Plug From 700H Series

Pilot Operated High Side Expansion/Level Control

700H Series High Side Pilot Operated Control Continued...

700H SERIES VALVE SPRING SELECTION

Valve Number	Spring Number (Number in parentheses is the minimum required pressure differential across the piloted valve.*)				
700JRH	705-1L (5)	705-5L (20)	705-10L (44)	705-20L (70)	-
700XH	705-1L (5)	705-5L (16)	705-10L (30)	705-20L (60)	-
700AXH	705A-2L (5)	705A-10L (30)	705A-30L (40)	705A-60L (80)	-
700BXH	705B-3L (5)	705B-10L (16)	705B-30L (30)	705B-60L (44)	705B-100L (80)

*When the MINIMUM pressure differential available across the 700H series valve falls between two successive numbers shown in brackets, choose the spring for the lower pressure differential.

700H SERIES VALVES DATA & 275AP VALVE CORRELATION

Pilot Operated Valve*	Strainer	275AP Pilot Float Valve* Orifice (in.)	Available Connections (in.)			Weight (lbs.)			
			I.P.S., Thd. or Socket Weld	Weld Neck	O.D. Copper	Pilot Operated Valve	P.O. Valve w/ Strainer	P.O. Valve, Str., Float w/ Cast Iron Chamber	P.O. Valve, Str., Float w/ Steel Chamber
700JRH	S701JRP	1/16	1/2, 3/4, 1	1/2, 3/4	1-1/8, 1-3/8	16	25	47	75
700XH	S701	1/16	1, 1-1/4	1, 1-1/4	1-5/8	20	30	52	80
700AXH	S701A	5/64	1-1/2, 2	1-1/2, 2	2-1/8	40	70	92	120
700BXH	S701B	3/32	3	3	3-1/8	78	154	172	200

* 'F' suffix on valve number indicates use with halocarbon refrigerants.

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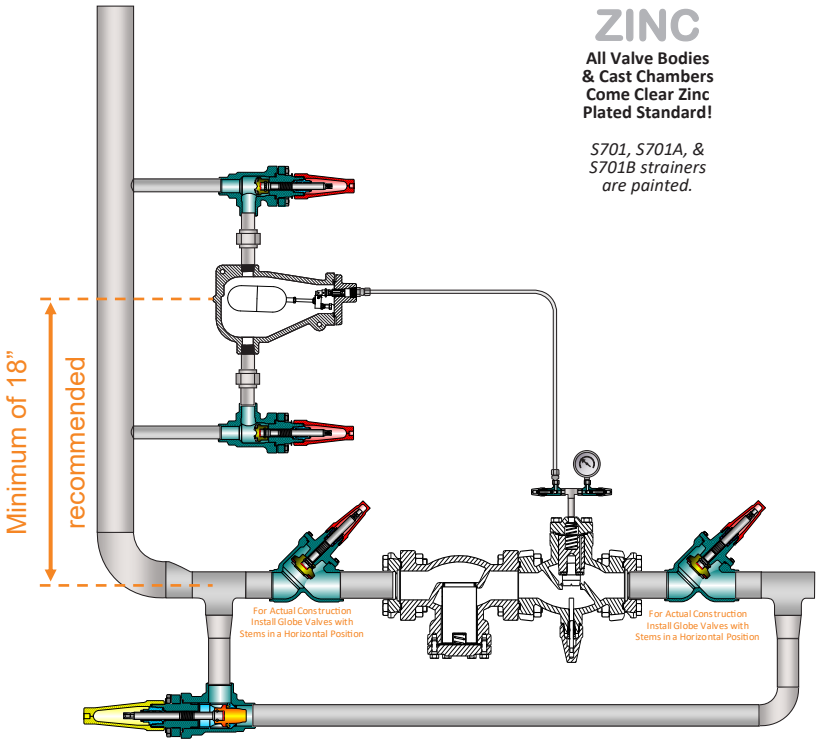
S701, S701A, & S701B strainers are painted.



700H Series High Side Arrangement for Single Condenser System

Assembly Part Number Nomenclature

700AXH	F	-Z	B	D	M	A

Base Valve Model

REFRIGERANT TYPE
(BLANK) = Ammonia
F = Halocarbon

(PLACE HOLDER)

SPRING

B = 705-1L	Q = 705A-20L
C = 705-5L	R = 705A-30L
D = 705-10L	S = 705A-60L
E = 705-20L	T = 705A-110L
F = 705-35L	A3 = 705B-3L
G = 705-35R	A4 = 705B-10L
I = 705-60L	A6 = 705B-30L
J = 705-60R	A7 = 705B-60L
O = 705A-2L	A8 = 705B-100L
P = 705A-10L	A9 = 705B-160L

METERING PLUG

A = "Zero"	F = #8	K = #30
B = #1	G = #10	L = #45
C = #2	H = #15	M = #60
D = #3	I = #20	Z9 =Special
E = #5	J = #25	

FLANGES

A=1/2" FPT	J=1-1/4" SW	R=2" SW
B=1/2" SW	K=1-1/4" WN	S=2" WN
C=3/4" FPT	L=1-1/2" FPT	T=2-1/8" ODC
D=3/4" SW	M=1-1/2" SW	U=3" FPT
E=1" FPT	N=1-1/2" WN	V=3" SW
F=1" SW	O=1-3/8" ODC	W=3" WN
G=1" WN	P=1-5/8" ODC	X=3-1/8" ODC
H=1-1/8" ODC	Q=2" FPT	Z=None
I=1-1/4" FPT		

STRAINER
A = Strainer Included
Z = No Strainer

Low Side Expansion/Level Controls Model Overview

Low Side Valves Cv Values and Overview

ZINC
All Valve Bodies & Cast Chambers Come Clear Zinc Plated Standard!

See Page 5 for Sizing Info

Direct Acting Valves

Valve Series	Valve Model Number(s)*	Connections (in.)	Cv	Orifice Size
101	101	1" FPT on chamber 1/2" FPT in/out	0.14	5/64
			0.18	3/32
			0.29	1/8
			0.34	5/32
			0.47	3/16
	101A	1-1/4" FPT on chamber 3/4" FPT in/out	0.55	3/16
			0.96	1/4
			1.1	5/16
			1.4	3/8
300H	300H 300HM	1/2" FPT In Flow through valve	0.076	3/32D
			0.098	3/32
			0.16	7/64
	300A 300AM		0.22	1/8
			0.26	9/64
			0.35	5/32
			0.40	3/16
301E	301E	1" FPT on chamber 1/2" FPT in/out (301E)	0.056	5/64
			0.11	3/32
			0.18	7/64
			0.26	1/8
			0.31	9/64
	301G	1/2" x 3/4" FPT in/out (301G)	0.40	5/32
			0.43	3/16
	301J	1" FPT on chamber 3/4" FPT in/out	0.56	3/16
			0.80	7/32
			0.97	9/32**
	301K		0.97	9/32
301H	301H	3/4" FPT in/out	0.55	3/16
			0.78	7/32
			1.0	9/32
	301A		1.0	9/32

Pilot Operated Valves

Valve Model Number(s)*	Nom. Port Diameter (in.)	Cv	Metering Plug	Connections (in.)
701JRS	3/8	1.33	230.25	I.P.S., Thd. or SW 1/2, 3/4, 1 Weld Neck/BW 1/2 or 3/4
		2.37	430.25	
		2.98	445.25	
	9/16	5.33	845.25	O.D. Copper 1-1/8 or 1-3/8
701S	9/16	1.7	245.25	I.P.S., Thd. or SW 1 or 1-1/4 Weld Neck/BW 1 or 1-1/4
		3.1	445.25	
		5.2	445.38	
	23/32	6.7	445.43	O.D. Copper 1-5/8
701AS	23/32	5.8	245.32	I.P.S., Thd. or SW 1-1/2 or 2 Weld Neck/BW 1-1/2 or 2
		8.4	445.32	
		11.1	845.32	
	7/8	16.5	845.40	O.D. Copper 2-1/8
701BS	1-1/4	6.5	245.50	I.P.S., Thd. or SW 3 Weld Neck/BW 3
		11.0	445.50	
		14.1	645.50	
		22.5	845.50	
		23.9	1045.50	O.D. Copper 3-3/8
701BXS	1-9/16	35	60°	4" BW

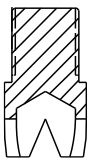
<u>701S Series Metering plug Nomenclature</u>

Example: 230.25 (Second Number = 30°; First Number = 2; Third Number = 0.25)

First number represents the number of V-Port slots machined into the face of plug. (2 slots from the above example)

Second number represents the inside angle of the V-Port (from one side of the V to the other side). (30° from the above example)

Third number is the depth of the V-port grooves. (0.25" from the above example)



V-Port inside angle options: 30°, 40°, 45°

* 'F' suffix on valve model number indicates use with halocarbon refrigerants.

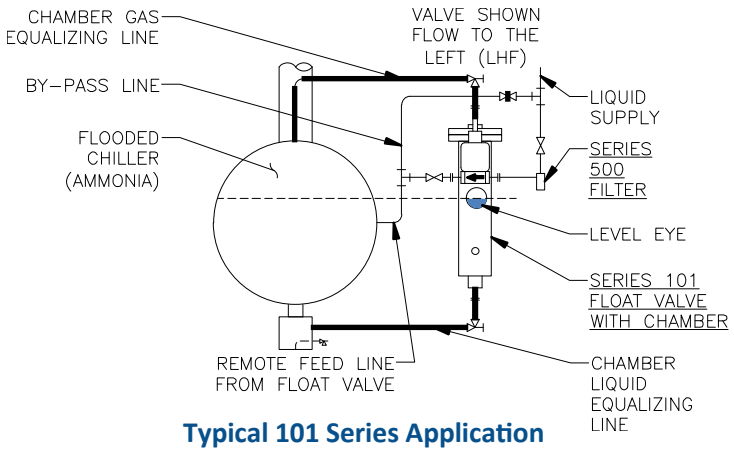
** Limited to a maximum pressure differential across the seat of 120 PSI with R-717

Direct Acting Low Side Control

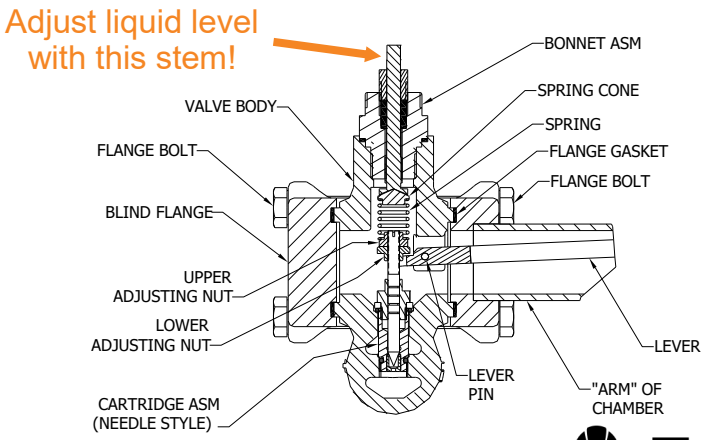
101 Series Float/Expansion Control

The 101 Series valve float ball is linked through a forked lever to act upon a needle or plunger directly over the orifice controlling the refrigerant flow. A spring is installed over the needle, working in opposition to the lever, which supports the weight of the float ball. The spring pressure can be regulated by an external adjusting stem to counteract the weight of the float, causing the liquid level to be lower or higher to any desired point within the range of the spring. Turning the adjusting stem counter-clockwise will raise the liquid level. Total level change, at a particular setting, from a fully closed to a fully open valve is about 2". Unless otherwise stated by the vessel manufacturer, liquid level set point should typically be 2/3 to 3/4 of vessel diameter for flooded ammonia chillers and 40% of vessel diameter for flooded halocarbon chillers. A separating vessel above the chiller is recommended.

ZINC
All Valve Bodies Come Clear Zinc Plated Standard!

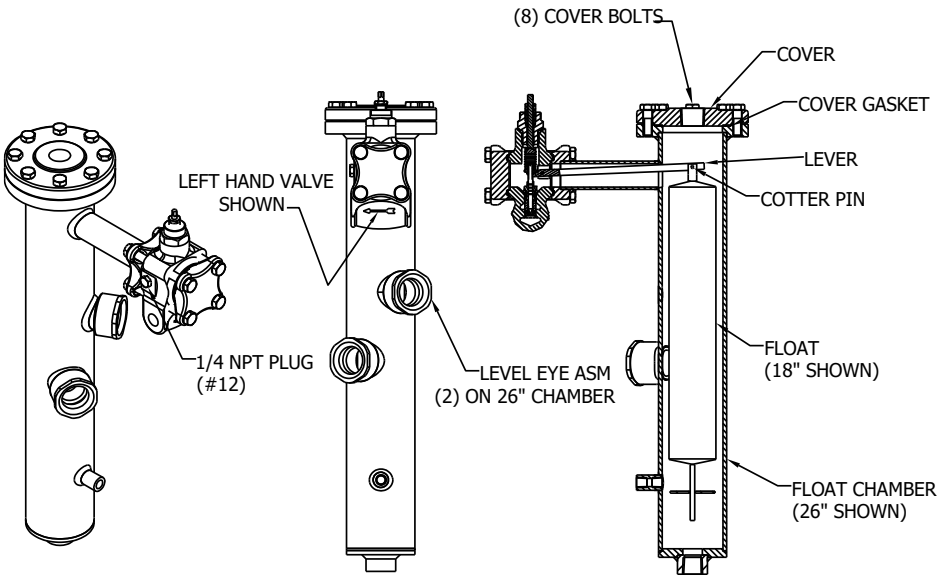


Typical 101 Series Application



101 Series Design

See Page 5 for Sizing Info



101 Valve Series Assembly with 26" Long Chamber

Assembly Part Number Nomenclature

101A	F	-M	L	Z

Base Valve Model

REFRIGERANT TYPE
(BLANK) = Ammonia
F = Halocarbon

ORIFICE

B = 5/64"	M = 1/4"
C = 3/32"	O = 5/16"
E = 7/64"	P = 3/8"
F = 1/8"	R = 7/16"
G = 9/64"	S = 1/2"
H = 5/32"	U = 5/8"
I = 3/16"	

ORIENTATION
L = Left Hand Flow
R = Right Hand Flow

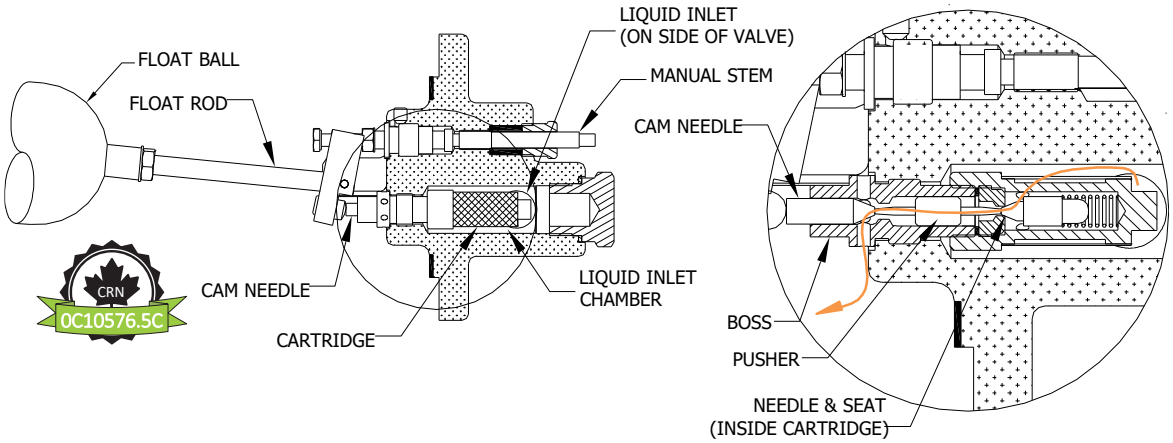
CHAMBER
B = Welded Steel Chamber
Z = No Chamber

101A Valve Series Includes: 101A, 101

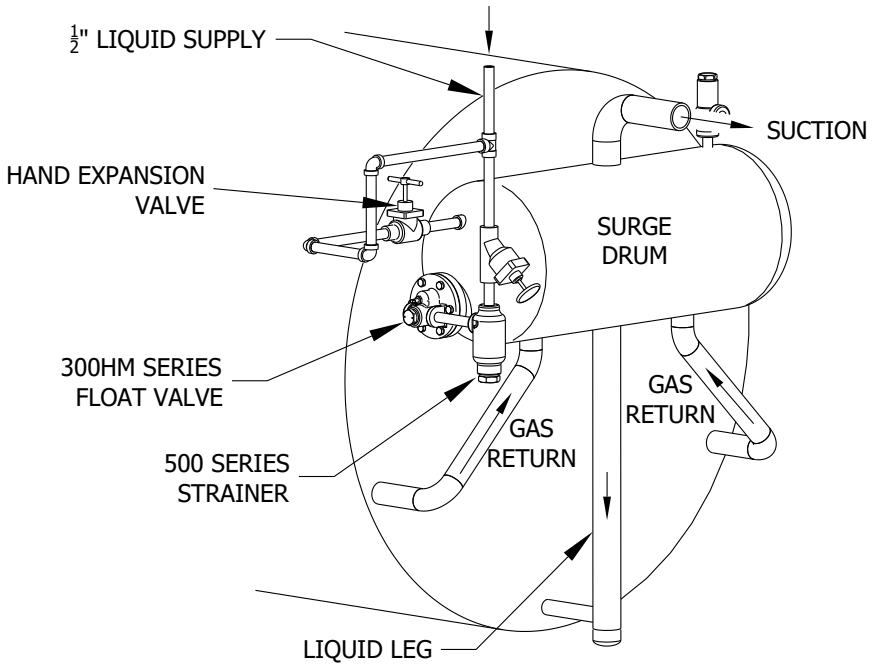
300H Series Float/Expansion Control

The 300H Series internal mounting, fixed level, low side float valves are modulation type liquid level controls, designed primarily for use with ammonia. The valves incorporate a replaceable cartridge that contains the working needle and seat. **The cartridge can be removed without pump down of the surge drum or evaporator due to a secondary shut-off arrangement built into the valve.** When used in halocarbon systems, these valves can be supplied with heavier float balls. When utilizing welding flanges, to directly mount these valves to a vessel, special consideration must be given to ensure that enough clearance is allowed for the valve's float ball to move up and down with a rise/fall in liquid level (see engineering bulletin for more info).

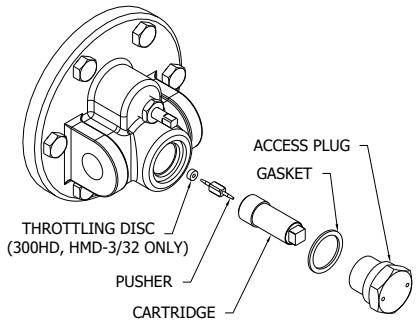
See Page 5 for Sizing Info



300H Series Design (expands directly through valve into vessel)



300H Series Typical Application



Easily Serviceable Cartridge Design

ZINC
All Valve Bodies Come Clear Zinc Plated Standard!

Assembly Part Number Nomenclature

300H	F	-C	Z	B

Base Valve Model

REFRIGERANT TYPE
(BLANK) = Ammonia
F = Halocarbon
P = Propane

ORIFICE

B = 5/64"	G = 9/64"
C = 3/32"	H = 5/32"
D = 3/32D	I = 3/16"
E = 7/64"	K = 7/32"
F = 1/8 "	N = 9/32"

(PLACE HOLDER)

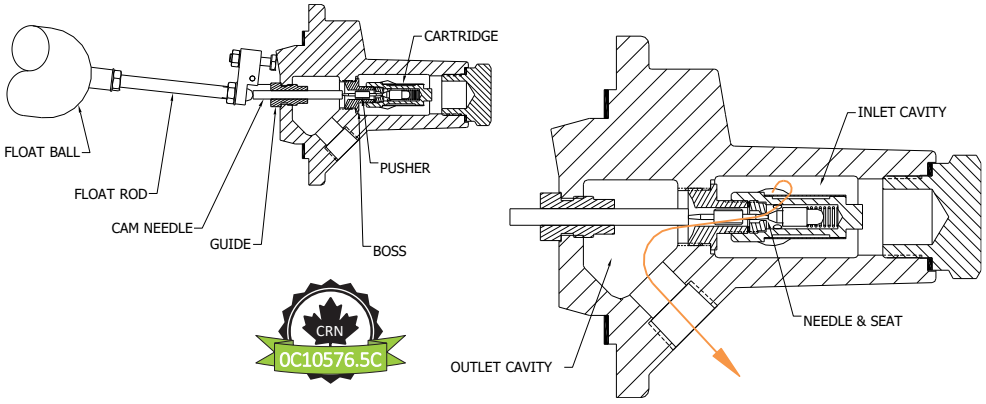
CHAMBER
B = Welded Steel Chamber
Z = No Chamber

300H Valve Series Includes: 300HM, 300A, 300AM

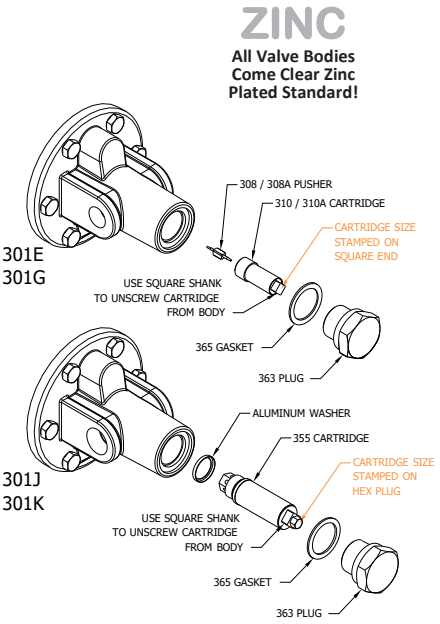
Direct Acting Low Side Control

301E Series Float/Expansion Control

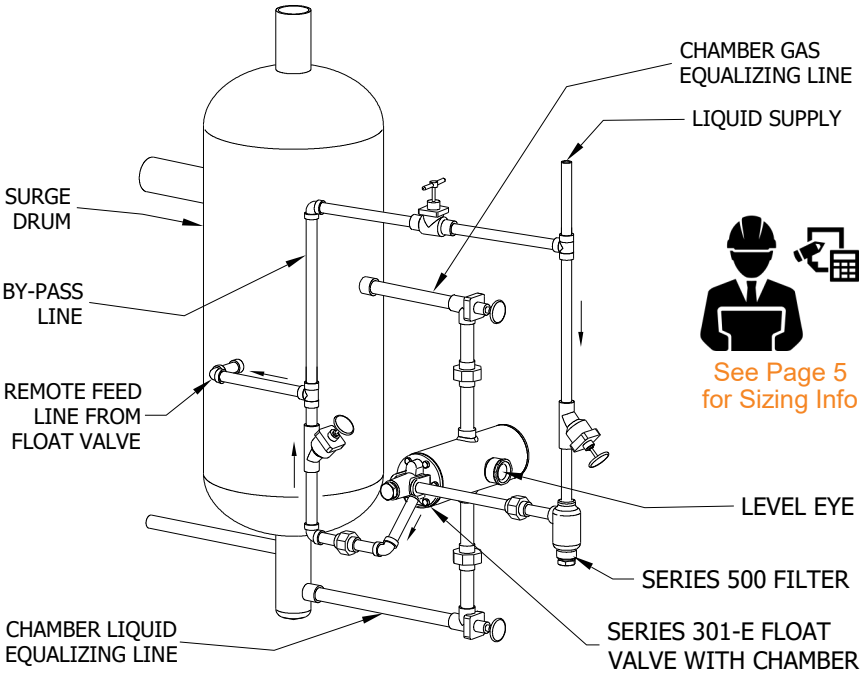
The 301E Series external mounting, fixed level, float valves are modulating liquid level controls. The welded steel chamber has a Phillips Level Eye for a visual check of the liquid level. The valves incorporate a replaceable cartridge that contains the working needle and seat. Pump down of the chamber is required to service the valve. These valves are for use with unitary surge drums and evaporators, for intercooler or desuperheater level control, small ammonia or halocarbon chillers, or other applications requiring external level control. A remote feed line is required from the valve outlet to the vessel or evaporator. When used in halocarbon systems, these valves are equipped with heavier float balls.



301E Series Design (expands through valve and fed into vessel via remote line)



Easily Serviceable Cartridge Design



See Page 5 for Sizing Info

301E Series Typical Application

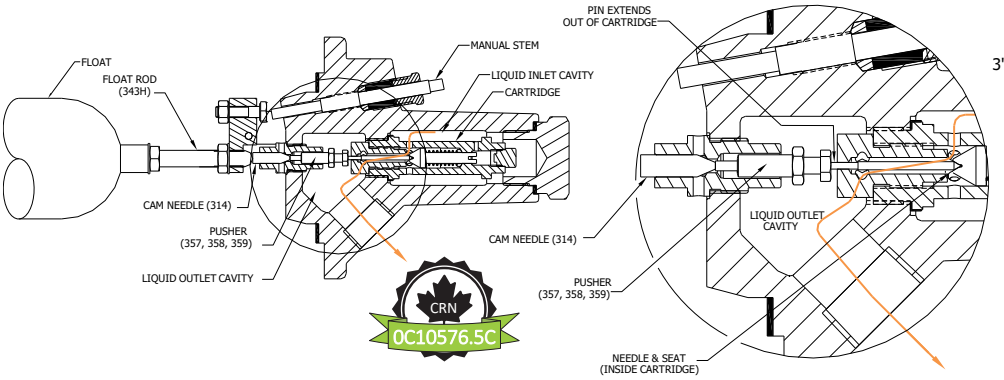
Assembly Part Number Nomenclature

301E		-G	Z	B
Base Valve Model				
REFRIGERANT TYPE (BLANK) = Ammonia F = Halocarbon P = Propane				
ORIFICE				
B = 5/64”	G = 9/64”			
C = 3/32”	H = 5/32”			
D = 3/32D	I = 3/16”			
E = 7/64”	K = 7/32”			
F = 1/8 “	N = 9/32”			
(PLACE HOLDER)				
CHAMBER B = Welded Steel Chamber Z = No Chamber				

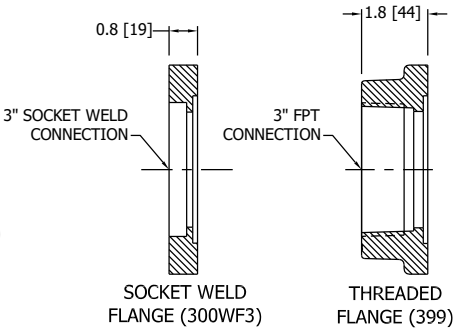
301E Valve Series Includes: 301E, 301G, 301J, 301K

301H Series Float/Expansion Control

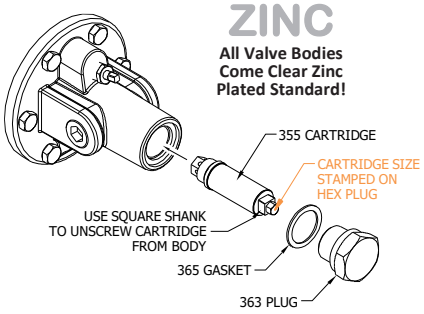
The 301H Series internal mounting, fixed level, low side float valves are modulating liquid level controls. They are fixed level controls with a remote feed line required from the valve outlet to the evaporator or surge drum. The valves incorporate a replaceable cartridge that contains the working needle and seat. **The cartridge can be removed without pump down of the surge drum or evaporator due to a secondary shut-off arrangement built into the valve.** The stem on the front of the valve is for operating the backseating arrangement and is not to be used as a hand expansion bypass. When used in halocarbon systems, these valves can be supplied with heavier float balls. When utilizing welding flanges, to directly mount these valves to a vessel, special consideration must be given to ensure that enough clearance is allowed for the valve's float ball to move up and down with a rise/fall in liquid level (see engineering bulletin for more info).



301H Series Design (expands through valve and fed into vessel via remote line)

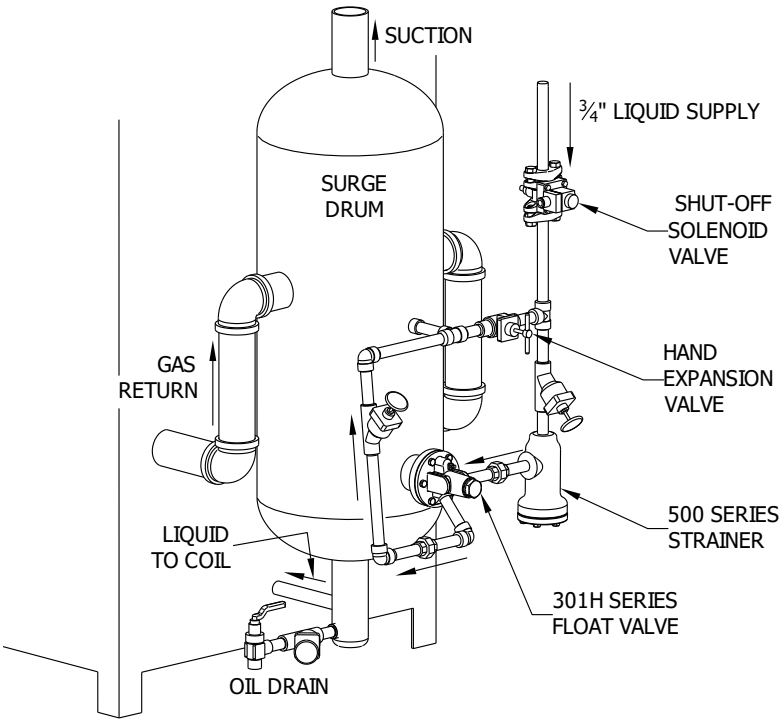


Flange Options For Mounting



Easily Serviceable Cartridge Design

See Page 5 for Sizing Info



301H Series Typical Application

Assembly Part Number Nomenclature

301H		-K	Z	B
Base Valve Model				
REFRIGERANT TYPE (BLANK) = Ammonia F = Halocarbon P = Propane				
ORIFICE				
B = 5/64"	G = 9/64"			
C = 3/32"	H = 5/32"			
D = 3/32D	I = 3/16"			
E = 7/64"	K = 7/32"			
F = 1/8 "	N = 9/32"			
(PLACE HOLDER)				
CHAMBER B = Welded Steel Chamber* Z = No Chamber				

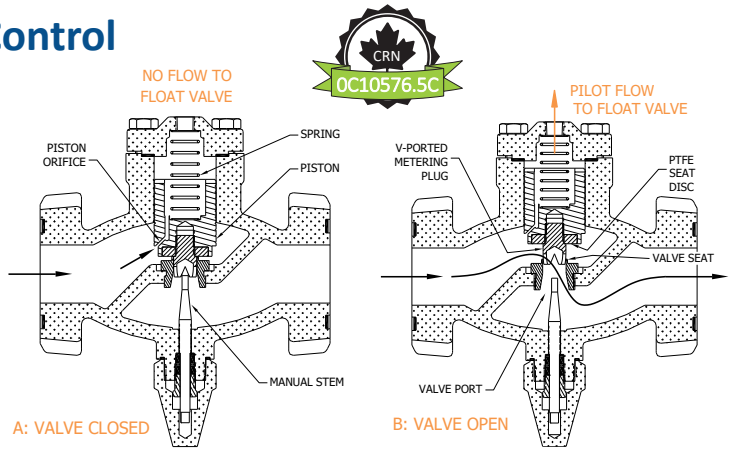
301H Valve Series Includes: 301H, 301A

*A 398B chamber can be used if desired, but may require adjustment of float

Pilot Operated Low Side Expansion/Level Control

701S Series Low Side Pilot Operated Control

The 701S Series Low side valves are pilot operated valves which meter the flow of liquid refrigerant to an evaporator or pressure vessel in response to liquid level requirements. The 701S is controlled by a float valve which responds to changing requirements, providing a modulating control arrangement. The 701S valves are flanged and may be supplied with a mating strainer. **A metering plug and spring are selected for specific operating conditions.** A manual opening stem, for raising the metering plug off the internal port, and a replaceable PTFE seat disc are standard.



701S Series Operation (closed or modulating)

In fixed level applications, the 701S is typically controlled by a 301E float valve. The 301E is mounted in a welded steel chamber, external to the vessel where the level is being controlled. The chamber is equipped with a Phillips Level Eye for visual indication of the liquid level. A 300H Series float valve, which mounts internal to the vessel being controlled, will also serve as a pilot float.

See Page 5 for Sizing Info

In adjustable level applications, the 701S is controlled by a 101 float valve. The 101 valve has an adjusting stem which permits the operator to change the level being controlled in the vessel or evaporator. This valve is also mounted in a welded steel chamber external to the vessel, and is equipped with a Level Eye.

The 701S valve is actuated by controlling the pressure above the internal piston. A drop in liquid level, detected by the pilot valve, reduces pressure in the pilot line as the pilot orifice opens. This drop in pressure causes the 701S piston to rise and open slots in the metering plug. Conversely, a rise in liquid level closes the pilot float orifice and increases the pressure in the pilot line; thus moving the piston and metering plug toward the closed position.

Flow in the pilot line is from the top of the 701S to the pilot float valve. On a 101 valve, the pilot line must be connected to the port toward the "tail" of the arrow cast in the 101 valve body. On a 301E valve, the pilot line may be connected to either of the valve inlet connections on the sides of the valve body. The pilot line must be ¼" Nominal Pipe for proper operation (3/8" OD copper tubing is also acceptable for halocarbon applications). See the application diagrams for valve layouts.

Assembly Part Number Nomenclature

701AS	F	-V	P	A1	R	A

Base Valve Model

REFRIGERANT TYPE
(BLANK) = Ammonia
F = Halocarbon

PORT

P = 3/8"	W = 7/8"
T = 9/16"	X = 1-1/4"
U = 5/8"	Z = 1-9/16"
V = 23/32"	

SPRING

B = 705-1L	Q = 705A-20L
C = 705-5L	R = 705A-30L
D = 705-10L	S = 705A-60L
E = 705-20L	T = 705A-110L
F = 705-35L	V = 705A-165L
G = 705-35R	A3 = 705B-3L
I = 705-60L	A4 = 705B-10L
J = 705-60R	A6 = 705B-30L
K = 705-90L	A7 = 705B-60L
O = 705A-2L	A8 = 705B-100L
P = 705A-10L	A9 = 705B-160L

METERING PLUG

M = 60	T = 445.32	Z9 = Special
N = 230.25	U = 445.38	A2 = 845.40
O = 245.25	V = 445.43	A3 = 845.50
P = 245.32	W = 445.50	A4 = 1045.50
Q = 245.50	X = 645.50	A6 = 245.38
R = 430.25	Y = 845.25	
S = 445.25	A1 = 845.32	

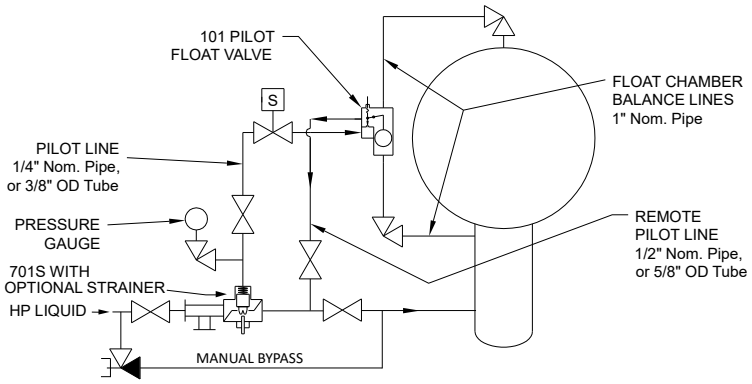
FLANGES

A=1/2" FPT	J=1-1/4" SW	R=2" SW
B=1/2" SW	K=1-1/4" WN	S=2" WN
C=3/4" FPT	L=1-1/2" FPT	T=2-1/8" ODC
D=3/4" SW	M=1-1/2" SW	U=3" FPT
E=1" FPT	N=1-1/2" WN	V=3" SW
F=1" SW	O=1-3/8" ODC	W=3" WN
G=1" WN	P=1-5/8" ODC	X=3-1/8" ODC
H=1-1/8" ODC	Q=2" FPT	Z=None
I=1-1/4" FPT		

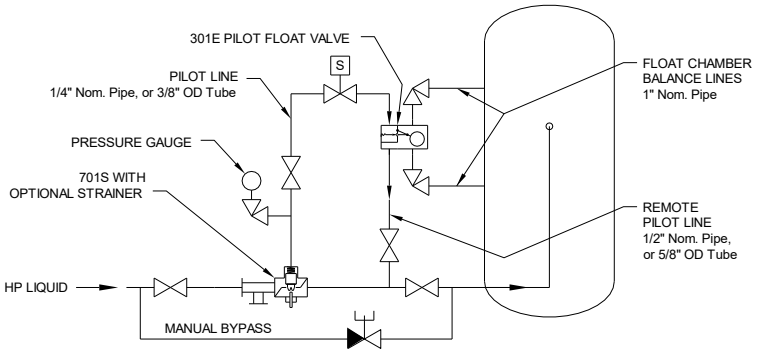
STRAINER
A = Strainer Included
Z = No Strainer

Pilot Operated Low Side Expansion/Level Control

701S Series Low Side Pilot Operated Controls Continued...



General Application for 701S Series Pilot Operated Valve with 101 Series Adjustable Level Pilot Float Valve

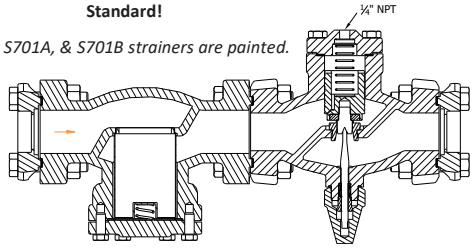


General Application for 701S Series Pilot Operated Valve with 301E Series Fixed Level Pilot Float Valve

ZINC

All Valve Bodies Come Clear Zinc Plated Standard!

S701, S701A, & S701B strainers are painted.



701S Series Valve With Strainer

701S SERIES VALVE SPRING SELECTION TABLE

Valve Number	Pressure Differential Available Across Valve (PSID)				
	10-20	20-40	40-60	60-100	100-160
701JRS & 701S	705-5L	705-10L	705-20L	705-35R	705-60R
701AS	705A-10L	705A-20L	705A-30L	705A-60L	705A-110L
701BS & 701BXS	705B-10L	705B-30L	705B-60L	705B-100L	705B-160L
Pilot Pressure Differential to Open (PSID)	5-6	10-12	16-20	30-40	50-70

701S & 101/301E SERIES VALVE CORRELATION - SIZES & WEIGHTS

Pilot Operated Valve Model Number*	Port Size (in.)	Strainer Number	Pilot Float Valve with Chamber		Available Connections (in.)			Weight (lbs.)		
			Float Valve Number	Orifice Size (in.)	I.P.S., Thd. or Socket Weld	Weld Neck	O.D. Copper	Pilot Operated Valve	P.O. Valve w/ Strainer	P.O. Valve, Str., Float
701JRS	3/8	S701JR	101VP18	3/32	1/2 3/4 1	1/2 3/4	1-1/8 1-3/8	16	25	85
			301E					16	25	65
	9/16		101VP18	3/32				16	25	85
			301E	1/8				16	25	65
701S	9/16	S701	101VP18	3/32	1 1-1/4	1 1-1/4	1-5/8	20	30	90
			301E					20	30	70
	23/32		101VP18	3/32				20	30	90
			301E	1/8				20	30	70
701AS	23/32	S701A	101VP26	1/8	1-1/2 2	1-1/2 2	2-1/8	40	70	150
			301E	9/64				40	70	110
	7/8		101VP26	1/8				40	70	150
			301E	9/64				40	70	110
701BS	1-1/4	S701B	101VP26	5/32	3	3	3-1/8	78	154	234
			301G					78	154	195
701BXS	1-9/16		101VP26	3/16	-	4	-	86	162	242
			301J	9/32				86	162	203

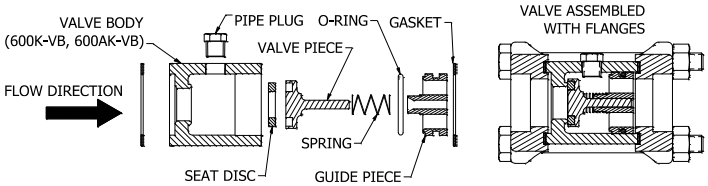
* 'F' suffix on valve model number indicates use with halocarbon refrigerants.

Check Valves (In-line Disc Type)

Check Valves (In-line Disc Type 600 Series)

The 600 Series flanged, in-line disc-type, check valves are spring closing with a light spring. **They may be installed in vertical or horizontal runs. There is a removable back plate that allows the valve to be easily disassembled for maintenance.** The 600D has a metal-to-metal seat. The 600D2 and 600D3 check valves incorporate the Durabla check valve unit. The 600D Series and 'S' suffix valves require about 2 psi pressure drop to open. The 600J and 600K Series valves are Teflon seated valves. **When ordered without the 'S' suffix, they are supplied with a light spring with a ¼ psi cracking pressure, making them suitable for gravity drain lines.** The 600 Series check valves prevent reverse flow of refrigerant in suction, hot gas, and liquid lines.

600 Series Cast Ductile Iron Check Valves



600 Series Check Assembly Example (Ease of Serviceability)

These valves are suitable for liquid refrigerant gravity drain applications, pump discharge, and suction. **When used for gravity drain, they should be mounted vertically.** These valves are designed for a 300 psi maximum working pressure. When used in hot gas defrost applications, they are installed between the drain pan and the hot gas inlet to the evaporator. In this manner, the valve prevents liquid from collecting in the drain pan coil during normal evaporator operation. The 600 Series check valves are not particularly suitable for reciprocating compressor discharge applications and where flow pulsation sets up a harmonious frequency to that of the valve.

ZINC
All Valve Bodies Come Clear Zinc Plated Standard!

Assembly Part Number Nomenclature

600AK	S	-Z	M

Base Valve Model

SPRING
(BLANK) = Standard Spring
S = Heavy Spring
(Not Suitable For Gravity Drain)

(PLACE HOLDER)

FLANGES

A=1/2" FPT	
B=1/2" SW	O=1-3/8" ODC
C=3/4" FPT	P=1-5/8" ODC
D=3/4" SW	Q=2" FPT
E=1" FPT	R=2" SW
F=1" SW	S=2" WN
G=1" WN	T=2-1/8" ODC
H=1-1/8" ODC	U=3" FPT
I=1-1/4" FPT	V=3" SW
J=1-1/4" SW	W=3" WN
K=1-1/4" WN	X=3-1/8" ODC
L=1-1/2" FPT	Y=4" SW
M=1-1/2" SW	Z=None
N=1-1/2" WN	

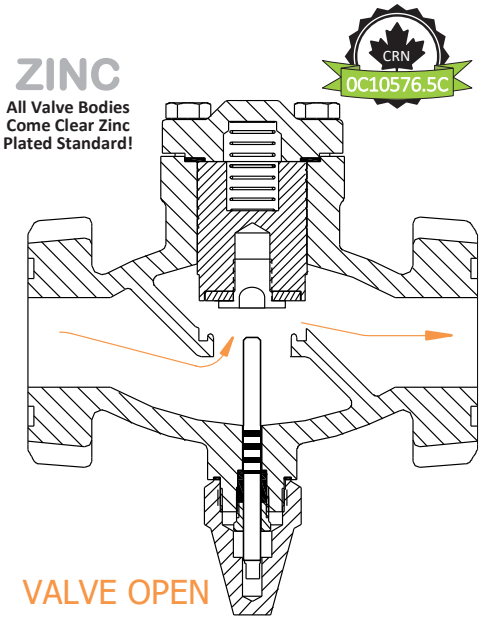
600 SERIES VALVE CONFIGURATIONS

Valve Number	Material	Port Size *(in.)*	Approx. ΔP to Open	Flange Sizes Avail.	# of Bolts/ Nuts	Bolt Size *(in.)*	Flange Type	Wt. *(lbs.)*	Wolf-Linde Ref.
600D2	Machined Steel	5/8	2 psid	1/2" 3/4"	2	5/8	Oval	4	-
600D3		7/8	2 psid	1"	2	5/8		5.5	-
600JR	Cast Ductile Iron	1	<1 psid	1/2" 3/4" 1"	2	5/8		5	5970 5972 5974
600J		1-1/2	<1 psid	1-1/4" 1-1/2"	4	1/2	Square	10	5975 5976
600AJ		2	<1 psid	1-1/2" 2"	4	5/8		12	5978
600K*	Machined Steel	1-5/16	<0.2 psid	1" 1-1/4"	4	1/2		7	-
600KS*			2 psid						-
600AK*		1-9/16	<0.2 psid	1-1/2" 2"	4	5/8		10.5	-
600AKS			2 psid						-
600BJ*	Cast Ductile Iron	3	<0.2 psid	3"	4	3/4		30	5980
600BJS			2 psid						
600DJ*		4	<0.2 psid	4"	4	7/8		45	5982
600DJS			2 psid						

*If ordered with suffix 'S', the valve will be supplied with a heavy spring (not suitable for gravity drain). Only these valves and the 'S' versions of these valves have the 1/4" FPT purge connection.

Check Valves (In-line Piston Type 700X Series)

The 700X Series flanged in-line piston type check valves are spring closing and **can generally be supplied with a 2, 5, 10, 20, 35, 50, 60, 70 and 90 pound differential spring to suit your application.** They **have a manual lifting stem and replaceable PTFE seat disc.** The 700X Series check valves prevent reverse flow of refrigerant in suction, hot gas and liquid lines. These valves are applicable for reciprocating compressor discharge line service, refrigerant pump discharge, suction line service, and can be applied as a hot defrost relief valve. These valves can also be applied as the outlet check valve for various liquid transfer systems. The 700X Series check valve is spring actuated and normally closed. When the differential pressure across the valve is enough to overcome the force of the spring, holding the check valve in the closed position, the disc is forced away from its seat and permits flow. As the differential pressure across the check valve decreases, the disc will be forced back against its seat by the closing spring. **All Phillips' check valves may be installed upright in a horizontal line, or vertically in a vertical line.**



700X Series Piston Type Check

Optional Strainer
Direct Mount Strainers are Available

700X SERIES CHECKS SPRING TABLE

Cracking ΔP (PSID)	Valve Model Numbers			
	700JRX	700X	700A & AX	700B & BX
2	705-1L	705-5L	705A-2L	705B-3L
5	705-5L	705-10L	705A-10L	705B-10L
10	705-10L	705-20L	705A-20L	705B-30L
20	705-20L	705-35L	705A-30L	705B-60L
35	705-35L	705-60L	705A-60L	-
50	705-50L	705-90L	-	-
60	705-60L	-	-	-
70	705-70L	705-130L	705A-110L	-
90	705-90L	-	705A-165L	-

700X SERIES CHECK VALVE DATA

Valve Model	Nom. Port Size *(in.)*	Flanges				Weight *(lbs.)*
		Flange Type	Flange Sizes *(in.)*	Bolts		
				No.	Size *(in.)*	
700JRX	3/4	Oval	1/2, 3/4, 1 (FPT, SW) 1-1/8, 1-3/8 (ODC)	2	1/2	14
700X	1	Oval	1, 1-1/4 (FPT, SW, WN) 1-5/8 (ODC)	2	5/8	20
700AX	1-1/2	Square	1-1/2, 2 (FPT, SW, WN) 2-1/8 (ODC)	4	5/8	40
700BX	2-1/4	Square	3 (SW, WN) 3-1/8 (ODC)	4	3/4	75

Assembly Part Number Nomenclature

700AX	10	-Q	M

Base Valve Model

CRACKING PRESSURE

(BLANK) = 2 PSID
2 = 2 PSID
5 = 5 PSID
10 = 10 PSID
20 = 20 PSID
35 = 35 PSID
50 = 50 PSID
60 = 60 PSID
70 = 70 PSID
90 = 90 PSID

SPRING

B = 705-1L
C = 705-5L
D = 705-10L
E = 705-20L
F = 705-35L
I = 705-60L
K = 705-90L
M = 705-130L
O = 705A-2L
P = 705A-10L
Q = 705A-20L
R = 705A-30L
S = 705A-60L
T = 705A-110L
V = 705A-165L
A3 = 705B-3L
A4 = 705B-10L
A6 = 705B-30L
A7 = 705B-60L
A8 = 705B-100L
A9 = 705B-160L
C8 = 705-50L
C9 = 705-70L

FLANGES

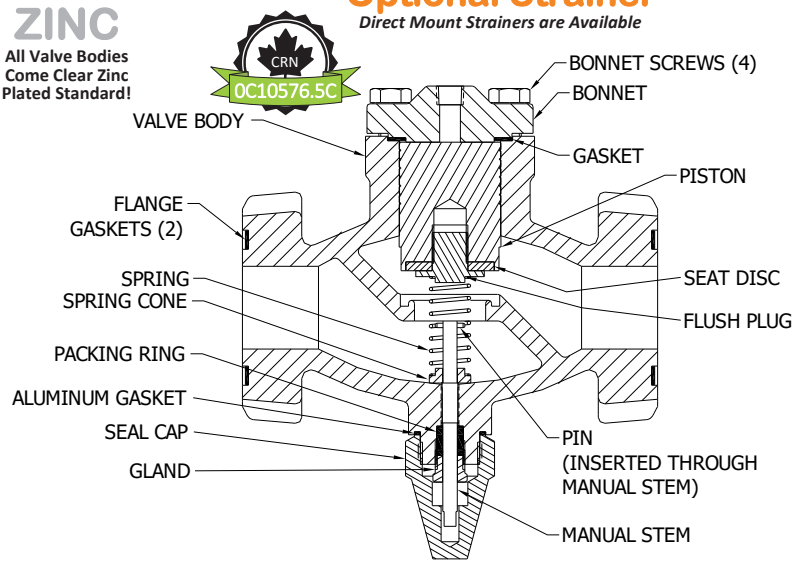
A=1/2" FPT
B=1/2" SW
C=3/4" FPT
D=3/4" SW
E=1" FPT
F=1" SW
G=1" WN
H=1-1/8" ODC
I=1-1/4" FPT
J=1-1/4" SW
K=1-1/4" WN
L=1-1/2" FPT
M=1-1/2" SW
N=1-1/2" WN
O=1-3/8" ODC
P=1-5/8" ODC
Q=2" FPT
R=2" SW
S=2" WN
T=2-1/8" ODC
U=3" FPT
V=3" SW
W=3" WN
X=3-1/8" ODC
Z=None

Check Valves (Gas Powered to Close)

700S Series Gas Powered Check

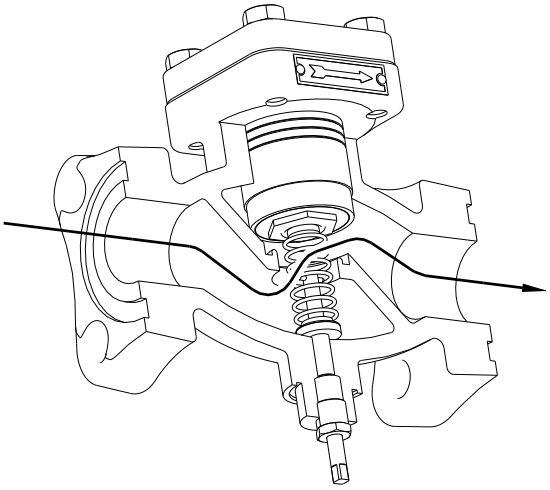
ZINC
All Valve Bodies Come Clear Zinc Plated Standard!

Optional Strainer
Direct Mount Strainers are Available



700S Series Gas Powered Normally Open Check Valve

The 700S Series flanged, piston type, gas pressure powered valve is normally open by a spring beneath the valve piston. All are equipped with a Manual Lift Stem with a Seal Cap closure. **The 700S series valves are normally open; and are closed by gas pressure from a remote source by energizing a pilot solenoid valve.** The gas entering the valve, through the 1/4" FPT connection in the top of the valve bonnet, acts upon the top of the piston; forcing the seat disc down on the main valve seat bed. This stops the refrigerant flow through the main valve. In order for the valve to close in normal flow direction, the **inlet pilot pressure on top of the piston must be a minimum of 7 psi higher than the inlet pressure** to the valve. Flow in the direction opposite of the arrow is not permissible. For the valve to open, the solenoid in the remote pilot line must be de-energized. The higher pressure above the piston then vents around the piston and approaches the lower pressure at the outlet of the valve. The spring under the piston forces the piston up, opening the valve fully to allow refrigerant flow.



700S Series Permissible Flow Direction

The 700S Series valve is designed to be applied to liquid legs and gas return legs on flooded evaporators and liquid drain lines in transfer systems. Since the valve is spring opening, no pressure is required to open the valve; thus for gravity drain applications, flow is unrestricted. **Due to the fail open feature of this valve, it is not recommended as a suction stop valve** on larger suction lines (over 3/4"). **All Phillips' check valves may be installed upright in a horizontal line, or vertically in a vertical line.**

700S SERIES CHECK VALVE DATA

Valve Model	Nom. Port Size *(in.)*	Flanges				Weight *(lbs.)*
		Flange Type	Flange Sizes *(in.)*	Bolts		
				No.	Size *(in.)*	
700JRS	3/4	Oval	1/2, 3/4, 1 (FPT, SW) 1-1/8, 1-3/8 (ODC)	2	1/2	14
700XS	1	Oval	1, 1-1/4 (FPT, SW, WN) 1-5/8 (ODC)	2	5/8	20
700AXS	1-1/2	Square	1-1/2, 2 (FPT, SW, WN) 2-1/8 (ODC)	4	5/8	40
700BXS	2-1/4	Square	3 (SW, WN) 3-1/8 (ODC)	4	3/4	75

Assembly Part Number Nomenclature

700BXS	-Z	V
Base Valve Model		
(PLACE HOLDER)		

FLANGES

A=1/2" FPT	J=1-1/4" SW	S=2" WN
B=1/2" SW	K=1-1/4" WN	T=2-1/8" ODC
C=3/4" FPT	L=1-1/2" FPT	U=3" FPT
D=3/4" SW	M=1-1/2" SW	V=3" SW
E=1" FPT	N=1-1/2" WN	W=3" WN
F=1" SW	O=1-3/8" ODC	X=3-1/8" ODC
G=1" WN	P=1-5/8" ODC	Z=None
H=1-1/8" ODC	Q=2" FPT	
I=1-1/4" FPT	R=2" SW	

Check Valves (Adjustable with External Pilot Connection)

700P Series Adjustable Check Valve with External Pilot Connection

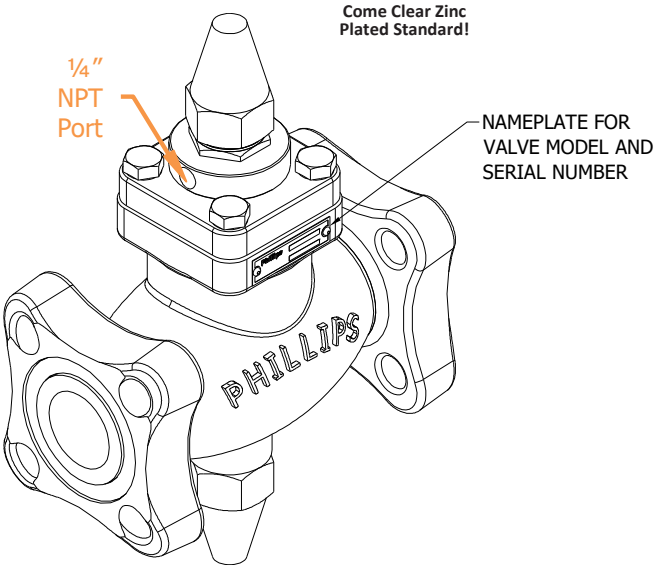
The 700P series flanged, piston type, check valves are normally closed by a spring above the valve piston. All are equipped with a Manual Lift Stem with a Seal Cap closure. The differential pressure required to open this valve can be adjusted via the top manual adjusting stem. These valves come standard with a 1/4" NPT port on the top bonnet to allow for the cracking pressure of the valve to be adjusted via a remote pressure source from another location in the refrigeration system.

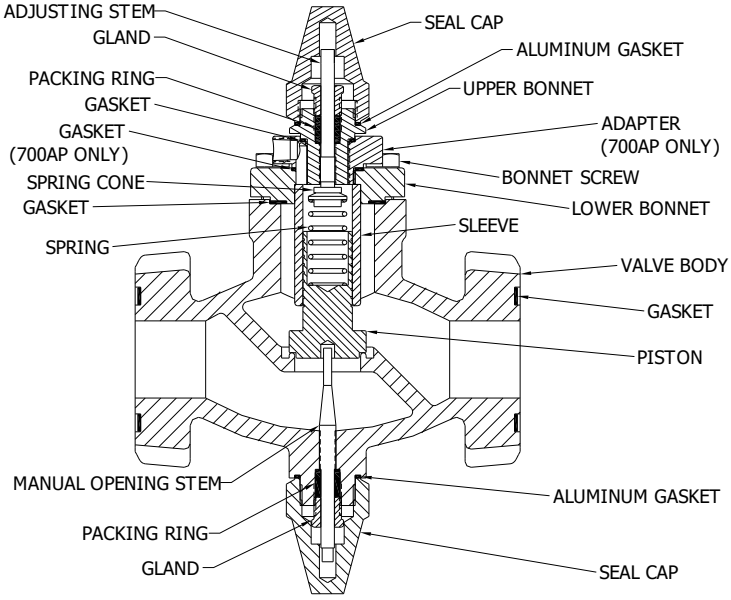
The 1/4" NPT remote pressure connection on the top bonnet makes it possible, with the use of additional external pilot(s), to configure the valves to regulate on differential pressure, inlet pressure, outlet pressure, etc. Contact Phillips for assistance with pilot configurations.

All Phillips' check valves may be installed upright in a horizontal line, or vertically in a vertical line.

Optional Strainer
Direct Mount Strainers are Available

ZINC
All Valve Bodies Come Clear Zinc Plated Standard!





700AP Gas Powered Adjustable Cracking Pressure Check Valve Assembly and Internals

700P SERIES CHECK VALVE DATA

Valve Model	Nom. Port Size (in.)	Flanges				Weight (lbs.)
		Flange Type	Flange Sizes (in.)	Bolts		
				No.	Size (in.)	
700AP	1-1/2	Square	1-1/2, 2 (FPT, SW, WN) 2-1/8 (ODC)	4	5/8	45
700BP	2-1/4	Square	3 (SW, WN) 3-1/8 (ODC)	4	3/4	80

Assembly Part Number Nomenclature

700BP	-Z	V
Base Valve Model (PLACE HOLDER)		

FLANGES

A=1/2" FPT	J=1-1/4" SW	S=2" WN
B=1/2" SW	K=1-1/4" WN	T=2-1/8" ODC
C=3/4" FPT	L=1-1/2" FPT	U=3" FPT
D=3/4" SW	M=1-1/2" SW	V=3" SW
E=1" FPT	N=1-1/2" WN	W=3" WN
F=1" SW	O=1-3/8" ODC	X=3-1/8" ODC
G=1" WN	P=1-5/8" ODC	Z=None
H=1-1/8" ODC	Q=2" FPT	
I=1-1/4" FPT	R=2" SW	

3-Way Valves

3000 Series Three Way Valves

The 3000N (3/4") and 3000AN (1-1/4") Automatic 3-Way valves are configured with three external ports. The high pressure port (marked "HP") is the inlet for pressurized gas. The low pressure port (marked "LP") is the vent port. The center "common" port is open to either the HP or LP port, depending on the position of the internal pistons, as described below.

The 3-Way valves are typically used on gas-pumped liquid transfer or recirculating systems. The valve's common port is connected to the top of the pumper drum (dump trap). The LP port is connected to the suction accumulator, above the level of the liquid but below the suction connection on the accumulator. High pressure gas is fed to the HP port.

With the 3-Way valve connected as described above and the solenoid de-energized, the pathway between the common and LP (vent) ports is held open. This is accomplished by high pressure gas and an internal spring which hold the smaller (HP) piston closed against the HP seat. The LP port is open. This "vent" position allows the pumper drum to vent to the suction accumulator while it fills with liquid.

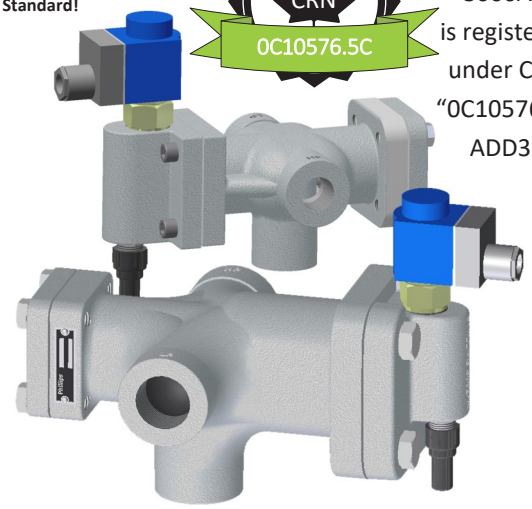
When the solenoid is energized, high pressure gas is directed internally to the space above the larger (LP) piston. This causes the pistons to move in unison, closing the LP seat and the path between the LP and common ports while simultaneously opening the HP seat and the path between the HP and common ports. This is the "high pressure" position. The high pressure gas, now flowing into the pumper drum through the common port, can push the liquid to another location in the system. Typically, the high pressure gas should be regulated to 10 to 20 psi above the liquid destination pressure. This may need to be increased for long pipe distances. However, unnecessarily high pressure can lead to premature valve wear.

The 3000N Series valves incorporate a manual opening stem below the solenoid. When this stem is screwed in completely, the valve will automatically switch from the vent to the high pressure position when the solenoid coil is energized. Opening the stem ½-turn will manually cause the valve to switch from vent to high pressure.

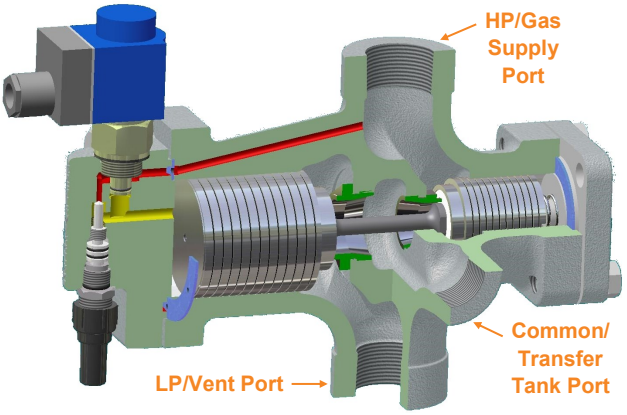
ZINC
All Valve Bodies Come Clear Zinc Plated Standard!

CRN 0C10576.5C

3000AN is registered under CRN "0C10576.5C ADD3"



3000 Series 3-Way Valves



3000AN 3-Way Valve Section View

3000 Series 3-Way Valve Data

Model	Connections	Cv Vent (flow coefficient for vent to common)	Cv HG (flow coefficient for hot gas to common)	Wt. (lbs)
3000N	3/4" FPT	6.8	5.1	20
3000AN	1-1/4" FPT	18	11	45

Assembly Part Number Nomenclature

3000AN	-120	-PL

Base Valve Model

Coil Voltage

120 = 115/120 Volt AC 60 Hz Coil
240 = 208-240 Volt AC 60 Hz Coil
Z9 = Special Request

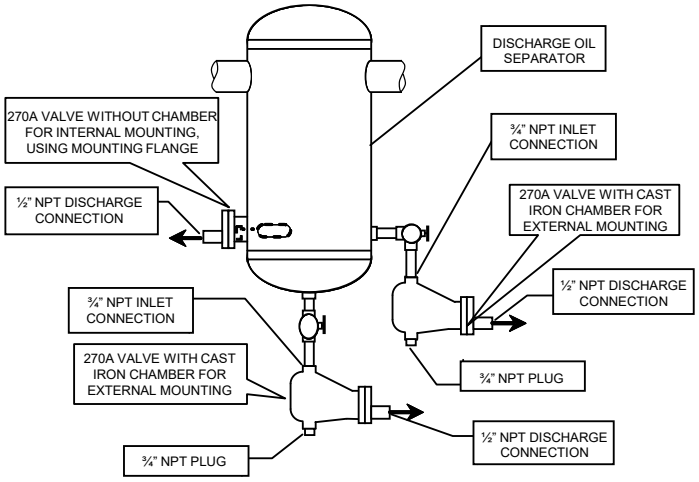
PILOT LIGHT

(Blank) = No Pilot Light
PL = With Green Pilot Light
(GREEN pilot light for blue Danfoss coils good for 24 to 250 VAC or 48 to 220 VDC)

Oil Level Control Valves

270A High Side (Used For Oil)

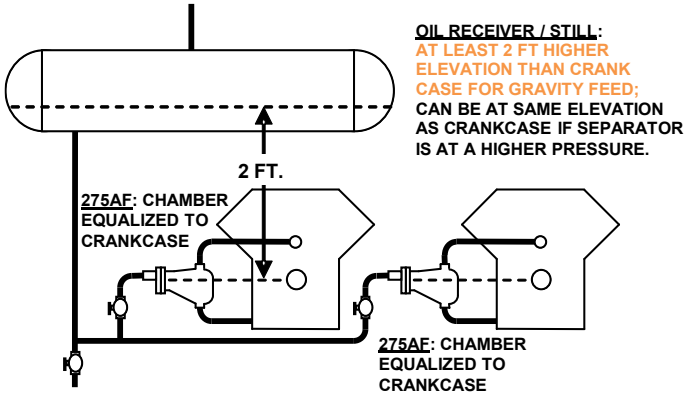
The 270A High Side Float Valve, opening on a rise in level, will transfer oil from a discharge line oil separator to the crankcase of the compressor or to an oil reservoir. This valve is used for oil in ammonia and halocarbon systems. **The standard orifice supplied in the valve is 3/32" and will operate to a pressure differential across seat of 250 psi maximum.** The capacity of the valve with oil, when fitted with the standard 3/32" orifice, is approximately 1-1/2 GPM at 100 psi pressure differential.



270A High Side Oil Drain Valve Application
(3 different mounting options shown)

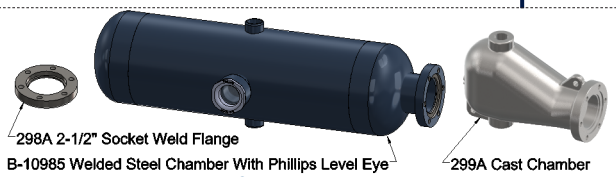
275AF Low Side (Used For Oil)

The 275AF Low Side Float valve can be used to maintain the oil level in the crankcase of a compressor. For multiple compressor applications, a 275AF valve should be installed on each compressor. In this application, the 275AF is fed from an oil reservoir at an equal or greater pressure than the compressor crankcase. **If the oil reservoir is at a pressure equal to the compressor crankcase, it must be elevated at least two feet above the desired compressor crankcase oil level so that gravity feed can take place.** When the oil reservoir is at a greater pressure than the crankcase, it may be mounted low. **Consult the table below for the maximum orifice size that can be used with various reservoir pressures.**



275AF Low Side Float Valve Application
(maintaining oil level in compressor crankcase feeding from oil reservoir)

ZINC
All Valve Bodies & Cast Chambers Come Clear Zinc Plated Standard!



Mounting Options for 270A and 275A Series Valves

270A & 275AF OIL VALVE CAPACITIES & WEIGHTS

Orifice Size *(in.)*	Cv	GPM Oil				Weight *(lbs.)*	
		1 Ft. Head	10 PSI Diff.*	20 PSI Diff*	100 PSI Diff *	Valve Only	Valve with Cast Iron Chamber
1/16	0.095	0.06	0.3	0.42	-	8	22
5/64	0.140	0.08	0.4	-	-		
3/32	0.170	0.10	-	-	100*		
1/8	0.380	0.22	-	-	-		
3/16	0.700	0.40	-	-	-		

*Do not use the 275AF valve for pressure differentials across the seat in excess of 20 PSI. When higher pressure drops are required, consult Phillips regarding the use of other low side valves.

Assembly Part Number Nomenclature

27***	-C	Z	A

Base Valve Model

N/A
(BLANK) = Standard Float Ball

ORIFICE
A = 1/16" F = 1/8"
B = 5/64" I = 3/16"
C = 3/32"

Z (PLACE HOLDER)

CHAMBER
A = Cast Iron Chamber
B = Welded Steel Chamber
Z = No Chamber

Oil level control valves: 270A, 275AF

Accessories - Flanges and Flange Unions

Flanges & Flanged Unions

- Forged A105 Steel
- 300 PSI Rating, -50°F to +400°F↗,⌘
- Tongue & Groove Flange Facings
- Available with Threaded, Socket Weld, Weld Neck (AKA Butt Weld), and ODC/ODS Connections

CRN OB11183.5CR1

All flanges and unions

FLANGE, UNION, AND SPARE PART NUMBERS

Style of Flange	Nom. Pipe Size (in.)	Flange Part Numbers (M=Male, F=Female)			Union** Part Numbers			Replacement Parts			
		Socket	Threaded	Weld Neck	Socket	Threaded	Weld Neck	Gasket Part #	Nut Part #	Bolt Part #	Kit Part # ***
Oval 2-Bolt	1/2	4-MS, 4-FS	4-MT, 4-FT	---	U-4S	U-4T	---	728	58	72	KF075
	3/4	6-MS, 6-FS	6-MT, 6-FT	---	U-6S	U-6T	---				
	1	8-MSO, 8-FSO	8-MTO, 8-FTO	---	U-8SO	U-8TO	---	626	58	72	KFO100
Square 4-Bolt	1	8-MS, 8-FS	8-MT, 8-FT	---	U-8S	U-8T	---	63	57	721B	KF125
	1-1/4	10-MS, 10-FS	10-MT, 10-FT	10-MW, 10-FW	U-10S	U-10T	U-10W				
	1-1/2	12-MS, 12-FS	12-MT, 12-FT	12-MW, 12-FW	U-12S	U-12T	U-12W	63W	57	721B	KF150
	2	16-MS, 16-FS	16-MT, 16-FT	16-MW, 16-FW	U-16S	U-16T	U-16W	73	58	72	KF200
	2-1/2	20-MS, 20-FS	---	20-MW, 20-FW	U-20S	---	U-20W	74	59	24A	KF250
	3	24-MS, 24-FS	---	24-MW, 24-FW	U-24S	---	U-24W	326Y	59	24A	KF300
	4	32-MS, 32-FS	---	32-MW, 32-FW	U-32S	---	U-32W	326YA	60	24D	KF400
Round 8-Bolt	5	40-MS, 40-FS	---	40-MW, 40-FW	U-40S	---	U-40W	5G	59	24A	KF500
	5*,↗	40-MSY, 40-FSY	---	40-MWY	U-40SY	---	---	5GY	59	24A	KF500Y
	6	48-MS, 48-FS	---	48-MW, 48-FW	U-48S	---	U-48W	6G	59	24A	KF600
	6*,↗	48-MSY, 48-FSY	---	48-MWY	U-48SY	---	---	6GY	59	24A	KF600Y
	8↗	64-MS, 64-FS	---	64-MW, 64-FW	U-64S	---	U-64W	8G	60	24E	KF800
12-Bolt	10⌘	80-MS, 80-FS	---	80-MW, 80-FW	U-80S	---	U-80W	10G	60	24E	KF1000

* These flanges machined to York flange dimensions.
** Unions consist of (1) male flange & (1) female flange; plus all nuts, bolts, and gasket required to make (1) complete flange set.
*** Kits includes one gasket and the required number of nuts and bolts for that flange size.
↗ These 5", 6", and 8" flanges are rated for 300 PSI, -45 °F to +400 °F.
⌘ This 10" flange is rated for 300 PSI, -41 °F to +400 °F.

Besides the flanges that are machined to York flange dimensions (denoted with a single star in the above table), and ODS flanges, all other flanges are machined to Wolf - Linde dimensions. In 1998, Phillips acquired the manufacturing rights to the flanges and check valves formerly sold by Wolf-Linde, Inc. For more information, please click on the Wolf-Linde logo to the right to be directed to an old Wolf-Linde catalog: Wolf-Linde

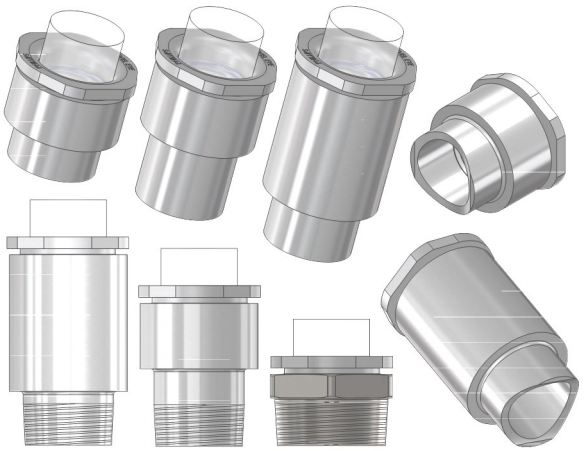
Please consult our factory for specialty flange inquiries such as reducing flanges, and flanges with copper connections.

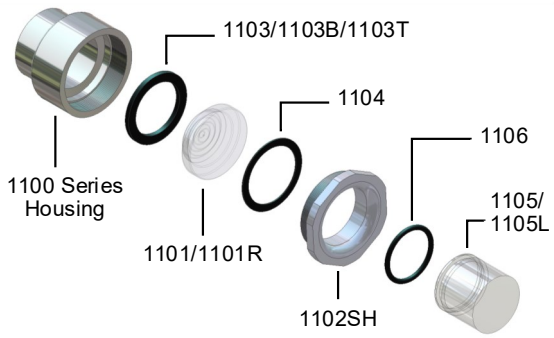
Accessories - Level Sight Glass

Level Eye® Sight Glass (Bull's Eye Style)

The Phillips Level Eye is a reliable, industrial-type sight glass. **The Reflex lens indicates the true level of liquid present without requiring a second lens.** The lens appears dark in the presence of liquid and clear when liquid is not present. Both Reflex and clear lenses are suitable for refrigerant vessels such as receivers, intercoolers, suction accumulators, oil separators, surge drums, oil pots, columns, and liquid line indicators.

The 1100 Series Level Eye is machined from SA36 material, as specified in Section VIII, Division I of the ASME Boiler & Pressure Vessel Code. The housing may be welded directly into ASME Code vessels. The welding end is dimensioned to a nominal 1-1/2" IPS schedule 80 pipe. The weld neck or threaded neck is also dimensioned to a nominal 1-1/2" schedule 80 pipe. All retainers are annealed 416 stainless steel forgings. Type 304 stainless steel housings are also available. **For more info please refer to our Level Eye Service Bulletin.**





ZINC

All Carbon Steel Level Eye Housings* and the SS Retainers Come Clear Zinc Plated Standard!

**1100VH housings are not plated*

1100 Series Parts & Housing Part Numbers

	Part Type	Part No.	Description
Weld Housing	Weld SA36	1100H	2" long housing, square end
		1100AH	3" long housing, square end
		1100CH	2" long housing, saddle milled
		1100LH	4" long housing, square end
		1100LCH	4" long housing, saddle milled
	Weld 304SS	1100SH	2" long housing, square end
		1100LSH	4" long housing, square end
Threaded Housing	SA36	1100ATH	3" long housing, 1-1/2" MPT
		1100TH	4" long housing, 1-1/2" MPT
	Steel Forging	1100VH	1-1/2" long housing, 2" MPT
	304SS	1100LSTH	4" long housing, 1-1/2" MPT
Parts	Lenses	1101	clear lens, borosilicate glass
		1101R	reflex lens, borosilicate glass
	Retainer	1102SH	retainer, forged 416SS hex
	Gaskets ** & O-Rings	1103 **	gasket standard, neoprene **
		1103B **	gasket, Buna-N **
		1103T **	gasket, Teflon (PTFE) **
		1104	gasket, vulcanized fiber
		1106	O-ring, Neoprene
	Frost Shields	1105	frost shield, Lucite, standard length (1-1/2")
		1105L	frost shield, Lucite, extended length (2-1/2"); use for refrigerant temps. below -20°F/-29°C.
	Lens Replacement Kits	K1100**	includes 1101 clear lens, 1103 Neoprene gasket** and 1104 fiber gasket
		K1100R**	includes 1101R reflex lens, 1103 Neoprene gasket** and 1104 fiber gasket

** See GASKET MATERIAL COMPATIBILITY section and custom lens replacement instructions in our Level Eye Service Bulletin.

CRN 0F00829.2C

Level Eye assemblies made with non-threaded SA36 material housings

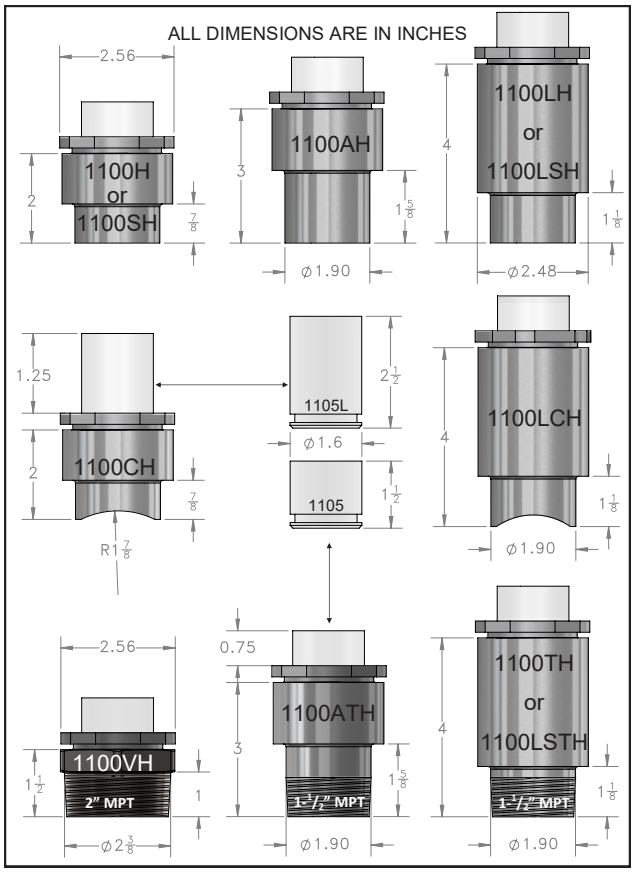
1100A, 1100/ 1100C , & 1100L/ 1100LC housings

are registered for use in all Canadian territories/ provinces.

CRN 0F18039.21

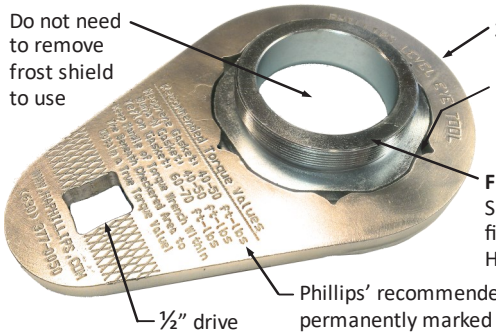
1100ATH, 1100TH (Alberta and BC)

1100 Series Housing Options



Accessories - Level Eyes, Pressure Gauges, and Float Switches

Level Eyes Continued... (Assembly/Installation, Accessories, & Part Numbers)



Part No.	Description
Level Eye Tap	Level Eye Thread Tap (**for sale only**)
Level Eye Tap - Leased	Level Eye Thread Tap (**for lease only**)
1101B	Level Eye Glass Blanking Plug, Plated Steel
LevelEyeTool	SS Level Eye sight glass retainer socket tool

Assembly Part Number Nomenclature

1100	-R	NX	-T

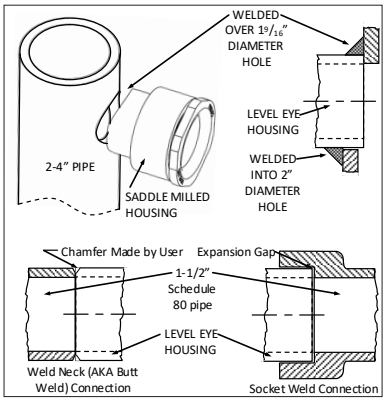
Housing Style (less 'H')
See assembly parts table
Please note that you do not list the 'H' that is part of the housing part number.

LENS
(Blank) = Clear Lens
R = Reflex Lens

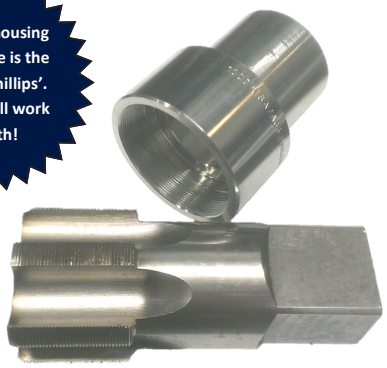
FROST SHIELD
(Blank) = No Frost Shield
N = Standard Length (1-1/2")
NX = Extended Length (2-1/2")

GASKET MATERIAL**
(Blank) = Standard Neoprene
B = Buna-N
T = PTFE (Teflon®)

**See GASKET MATERIAL COMPATIBILITY section and custom lens replacement instructions in our Level Eye Service Bulletin.



Hansen's housing thread type is the same as Phillips'. This tap will work for both!



Float Switches with welded Phillips Level Eye®

Phillips offers Hantemp float switches with a welded Phillips Level Eye®. The built in sight glass allows the user to view the liquid level inside the float switch at the refrigerant dependent switch point.

Part Number	Description	Assy. Material	Elect. Conn.	Fitting Conn.
SSLLLE	Hantemp SSLL with Phillips 1100SCH SS Level Eye®	Stainless Steel	DIN plug with 36" wire leads [1]	Combo ¾"-14 FPT/1" butt weld side and bottom connections.
SSLL	Hantemp SSLL	Stainless Steel		
SSLLSW	Replacement Switch Head (fits most manufacturers)	N/A		N/A

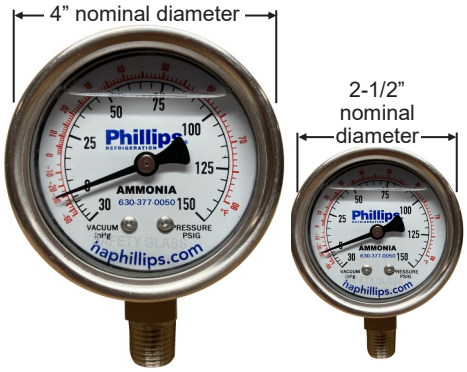
[1] A DIN quick disconnect connector with 36" wire leads is standard; 1/2" conduit connection is available

Pressure Gauges

Part Number	Nom OD	Actual OD	Pressure Scale
88-020	2-1/2"	2.625"	30 inHg[1] to 150 psig
88-021	2-1/2"	2.625"	30 inHg[1] to 300 psig
88-024	4"	4.375"	30 inHg[1] to 150 psig
88-025	4"	4.375"	30 inHg[1] to 300 psig

[1] Pressures resulting in a vacuum are measured in inches of mercury

- **1/4"-18 male NPT bottom connection**
- **Stainless steel construction**
- **2-1/2" and 4" face diameter options**
- **Dual scale face which displays both gauge pressure and corresponding ammonia saturation temperature (°F)**
- **Liquid filled to prevent flutter**
- **Helium leak tested**
- **Gauges with CRN's Available upon request**



Accessories - Injectors Overview

Phillips' Recirculating Injectors - How They Work

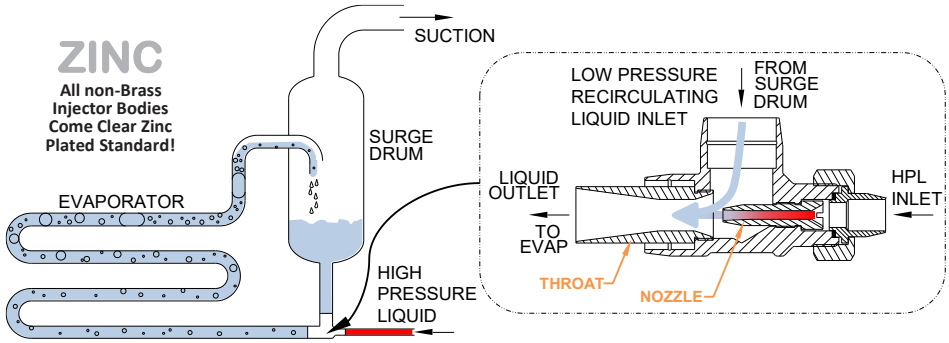
The Phillips Recirculating Injector is a simple device that uses the available dynamic energy of high-pressure refrigerant liquid to get maximum heat transfer in an evaporator. Please refer to the Select Major Advantages/ Disadvantages of System Types table for more details of how maximum heat transfer occurs.

Phillips Recirculating Injectors have found their greatest use with ice builders, milk coolers, RSW tanks (refrigerated sea water -> for fish cooling & processing) , Baudelot-type chillers, farm tanks, slush freezers, and many types of freezing plates.

The Phillips Recirculating Injector uses the dynamic energy of the fluid as it expands through the nozzle and acts like a liquid pump, recirculating the extra liquid (via the nozzle's Venturi effect) from the surge drum, through the evaporator, and back to the surge drum with the gas evaporated in the tubes or plates. **The Venturi effect of the nozzle can also be used to lift and return oil in halocarbon systems.**

In general, injectors can be applied with great success to evaporators originally designed for pumped overfeed or gravity flooded arrangements. Injectors have been applied to some DX arrangements with success, but some limiting factors apply (contact factory for assistance).

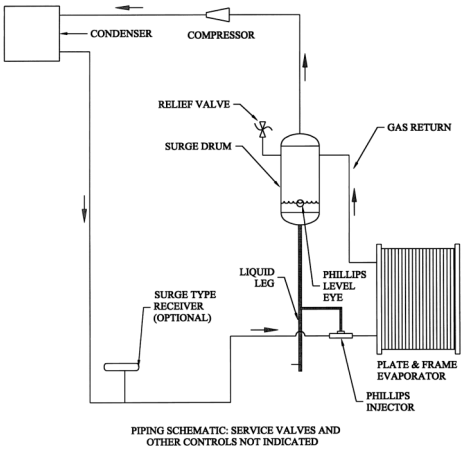
Phillips' Recirculating Injector System Technology



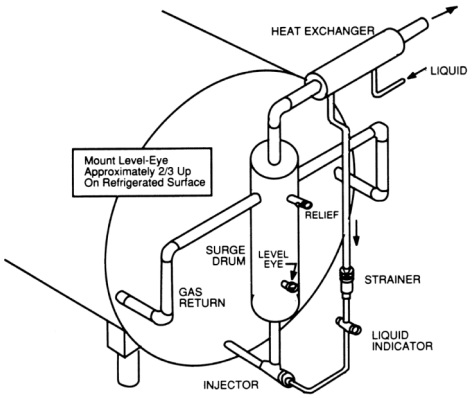
System Type	Select Major Advantages/Disadvantages of System Types	
	Major Advantage(s)	Major Disadvantage(s)
DX (Direct Expansion)	Liquid enters evaporator ready to evaporate immediately with very little to no sensible heat transfer required to boil refrigerant (latent heat transfer). This equates to optimal heat transfer characteristics!	A lot of the evaporator heat transfer area must be devoted to superheating the refrigerant before it leaves the evaporator. Higher DT required between suction temp and room temp (higher DT required to superheat refrigerant)
		Modulating feed valves with moving parts are subject to wear and tear.
	Minimal refrigerant inventory required	Requires suction accumulator(s) to protect compressors from potential liquid carryover if proper amounts of superheat are not maintained (failed feed valve and/or sensors)
	No suction risers issues (as with LO)	
GF (Gravity Flooded)	Full use of evaporator heat transfer surface area (unlike DX)	High Refrigerant inventory
	Evaporating temperature can easily be regulated/controlled by a back pressure regulator (located in the dry suction line coming off of the top of the surge drum) with no penalty to heat transfer	Only fair-to-good evaporator heat transfer characteristics: the relatively un-turbulent slow moving liquid flow through the evaporator does not cause the fluid to mix around as much when compared to pumped overfeed (see explanation beneath in LO system benefits)
	Smaller suction lines when compared to LO systems (no 2-phase flow)	
LO (Liquid Overfeed)	Full use of evaporator heat transfer surface area (unlike DX, LO systems can fully "wet" the inside of the evaporator).	Liquid enters evaps. subcooled (due to the added pressure of the pump), and thus must first be warmed up (often by 35-40 °F = sensible heat transfer) in order to reach the optimum heat transfer phase (boiling refrigerant = latent heat transfer)
	Since liquid is turbulently pumped through the evaporator, the fluid is constantly mixing; this results in the constant removal/exchange of the thermal insulating boundary layer directly adjacent to the heat transfer surface area (forced convection)	Pumps (maintenance, energy consumption, etc.)
		Susceptible to poor evaporator performance with EPR's (Evaporator Pressure Regulators), as EPR's only subcool the liquid even more in LO systems
		Difficulties setting HEV/REG valves to adjust & balance liquid flow
CPR System	Click here, or visit *www.nhtres.com/how-work.shtml* for more details	
A Phillips' recirculating injector system has all of the above mentioned major benefits, with none of the major disadvantages!		

Injectors In Critically Charged Systems

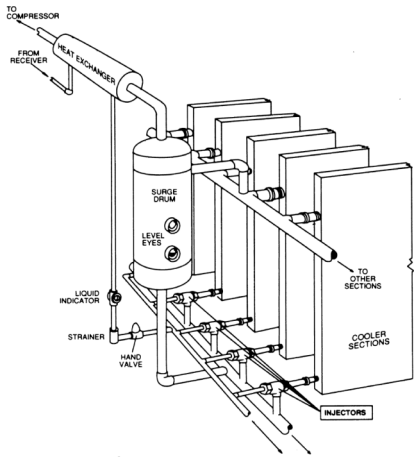
Phillips Recirculating Injectors have been widely used in critically charged systems with a single compressor and a single evaporator. This type of critically charged injector system operates with the entire charge of refrigerant in the evaporator and the surge drum. The condenser (and receiver if applicable) is always empty except for the refrigerant being condensed and passing through the liquid line to the evaporator. A liquid indicator should always be installed in the liquid feed line on critically charged systems, and will usually show some gas bubbles moving with the liquid during normal operation. The gas in the liquid line indicates that the condenser is empty, as it should be, with the entire charge in the low side. A liquid seal in the liquid line, i.e., no gas and all liquid, indicates trouble such as a partially or completely plugged injector nozzle orifice, a nozzle orifice that is too small for the refrigeration load, or an appreciable refrigerant overcharge.



Critically Charged System Diagram



Bulk Tank Ex. (critically charged)



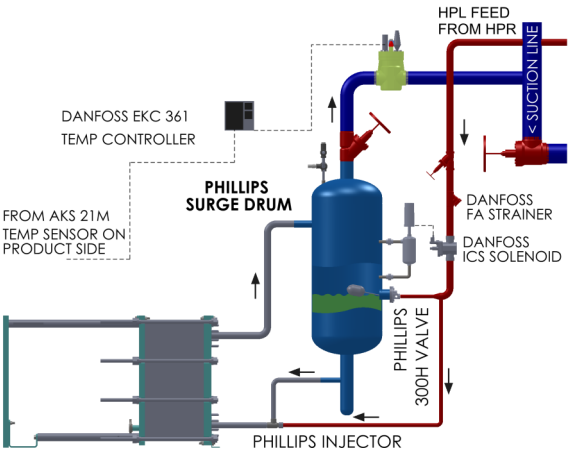
Multi. Chiller Sections (crit. charge)

Injector Sizing & Considerations and Central Plant System Applications

Level Controls (relatively steady and constant cooling loads):

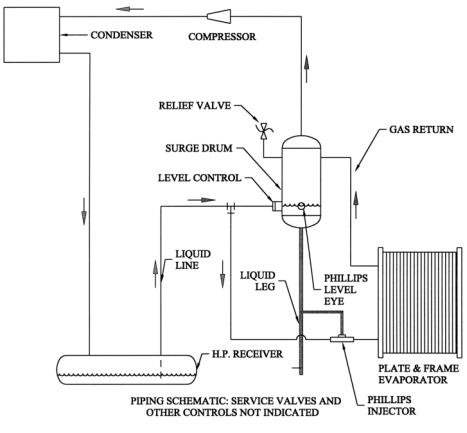
When applying injectors to central plant systems (multiple evaporators fed from one source), (or if a system only has one evaporator, but is not critically charged) level control(s) must be applied to individual surge drum(s) to prevent them from overfilling.

For nearly constant process applications/nearly constant cooling loads, it is recommended to size the injector(s) for 70-90% of the max expected load, and have a Phillips low side valve provide makeup liquid to the surge drum at the remaining load requirement plus any extra backup/ factor of safety capacity.



Central Plant System Evaporator Setup

Level control method for constant & steady cooling load



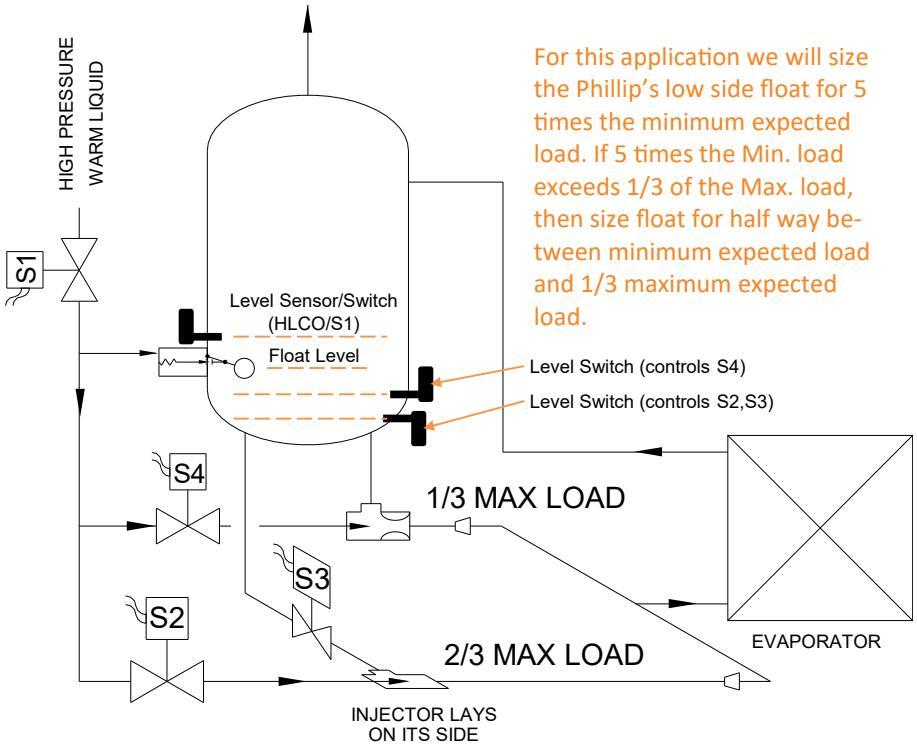
Central Plant System Diagram

Accessories - Injectors

Injector Sizing & Considerations Continued...

Level Controls (varying cooling loads)

When applying injectors to evaporator(s) with non-steady loads, it is recommended to use (2) or more injectors possibly even in conjunction with a Phillip's low side float control for makeup liquid feed to the surge drum. A good example of a cooling load that widely varies is using an injector to quickly cool a big tank of milk, and then hold it at a given temperature for storage. In this sort of application the cooling demand will start off high, and will steadily decrease as the milk temperature approaches the evaporating temperature regulated by the EPR valve in the suction line. As the cooling load decreases the demand for liquid will decrease. For this sort of application, it would be prudent to use two injectors in parallel to feed liquid, and a makeup float to provide small amounts of liquid (for holding milk at temperature for storage) (see example to right).



For this application we will size the Phillip's low side float for 5 times the minimum expected load. If 5 times the Min. load exceeds 1/3 of the Max. load, then size float for half way between minimum expected load and 1/3 maximum expected load.

Central Plant System, Varying Load, Evaporator Setup
Level control method for varying cooling load for non-critically charged system

For the above example, the control sequence would be as follows:

1. Max Initial Load: Both injectors and Phillips low side float are feeding
2. Refrigeration load decreases and liquid level rises to the level switch controlling S2 & S3 —> De-energize S2 & S3.
3. Refrigeration load decreases even more and liquid level rises to the level switch controlling S4 —> De-energize S4.
4. Float maintains level and evaporator operates in flooded mode (maintaining product temperature).

Injector Selections

Injector selection is a three-step process: (1) select the nozzle, (2) select the throat, and (3) select a body style. For Injector sections for oil syphoning (see page 38) assume a TR load equal to 1/25 of the flooded evaporator.

See Page 5 for Sizing Info

Step 1: Nozzle Sizing

The effects of an undersized nozzle are an increase in the amount of liquid recirculation, and a decrease in the injector discharge energy. Avoid under sizing the nozzle, as this reduces the system capacity and raises the head pressure. **Based off test data, systems generally find their optimal heat transfer rate with nozzles selected based off of Cv values as determined on the TR/Cv charts on page 5 (no multipliers required).**

Nozzle Cv Values and Nominal Capacities* (Tons)

Nozzle #	59	56	54	52	50	48	44	40	36	31	29	23	16	7	1	1/4"	5/16"
Orifice Dia	.041"	.047"	.055"	.064"	.070"	.076"	.086"	.098"	.107"	.120"	.136"	.154"	.177"	.201"	.228"	.250"	.313"
Approx. Cv	0.046	0.059	0.083	0.11	0.13	0.16	0.2	0.26	0.31	0.4	0.51	0.65	0.86	1.1	1.4	1.7	2.7
Ammonia	3.9	5	7	9.3	11	13	17	22	26	33	43	55	72	93	120	140	220
R-22	0.9	1.2	1.6	2.2	2.7	3.1	4	5.2	6.1	7.8	10	13	17	22	28	33	50

Injector Selections Continued...

Correction Factors for Halocarbon Refrigerants

Refrigerant	Capacity Factor
R22	1
R134a	0.82
R404a	0.74
R410a	1.10
R507A	0.82

Step 2: Throat Selection

The effects of an oversized throat are an increase in the amount of liquid recirculation and a reduction in the injector discharge head. The reverse applies to an undersized throat. Select the throat from the beneath tables for the TR that is equal to, or the next higher value, cooling load. If using a halocarbon refrigerant other than R22, a correction factor must be applied. Divide your TR by the "capacity factor" found in the table to the right, and use that value with the throat selection table.

Ammonia Throat Capacities (Tons, 2:1 Recirculation Rate)

Suction Temp.	Throat Size (in.)									
	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2
40ºF	4.8	12	20	28	50	78	110	200	310	449
30 ºF	4.2	10	17	24	42	66	94	170	270	378
20 ºF	3.4	8.8	14	20	35	54	79	140	220	315
10 ºF	2.8	7	11	16	28	43	63	110	180	260
0 ºF	2.2	5.6	9	13	23	35	51	90	140	210
-10 ºF	1.8	4.6	7.4	11	19	29	42	75	120	170
-20 ºF	1.4	3.6	5.4	8	14	22	32	57	90	130
-30 ºF	1.1	2.6	4.2	6.2	11	17	24	43	69	100
-40 ºF	0.8	2	3.4	4.6	8.2	13	19	33	53	80

Halocarbon Throat Capacities (Tons, 2:1 Recirculation Rate)

Suction Temp.	Throat Size (in.)								
	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4
40ºF	2	3.6	5.7	8.2	15	23	33	57	-
30 ºF	1.8	3.1	4.9	7.1	13	20	28	49	-
20 ºF	1.5	2.6	4.1	5.9	11	16	24	42	-
10 ºF	1.2	2.2	3.4	4.9	8.8	14	20	35	54
0 ºF	1.1	1.9	3	4.3	7.7	12	17	30	45
-10 ºF	0.9	1.6	2.5	3.6	6.4	10	14	25	37
-20 ºF	0.8	1.3	2.1	3	5.4	8.4	12	21	32
-30 ºF	0.6	1	1.6	2.3	4.2	6.5	9.4	17	26
-40 ºF	0.5	0.8	1.3	1.8	3.2	5.1	7.4	13	20

Step 3: Select Model/Body

Utilizing the beneath table, and the connection size table on the following page; select the injector Model/Body which has the required nozzle and throat sizes, and which gives you the desired connections for your piping.

Common Injector Nozzle & Throat Sizes Available For Injector Bodies*

Nozzle Size	Throat Diameter *(in.)*									
	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2
59	2020SL 2075WCB	2020SL 2075WCB	2020SL 2100SL 2075WCB	2020SL 2100SL 2075WCB 2100WCB 2100WCBA	2100SL 2100WCB 2100WCBA	2100SL 2100WCB 2100WCBA	2100SL			
56										
54										
52										
50										
48										
44					2100SL 2100WCB 2100WCBA 2125WA	2100SL 2100WCB 2100WCBA 2125WA	2100SL 2125WA			
40										
36							2100SL 2125WA 2150WA	2150WA		
31										
29	2075WCB	2075WCB	2100SL 2075WCB	2100SL 2075WCB 2100 WCB 2100WCBA						
23										
16										
7					2125WA 2150WA	2125WA 2150WA	2125WA 2150WA			
1										
1/4"					2150WA	2150WA	2150WA	2150WA 2200WA	2200WA	2200WA
5/16"								2200WA	2250WA	2250WA

*This table lists only the most common nozzle and throat sizes. Contact Phillips if the size or combination of sizes you need is not listed.

Accessories - Injectors

Injector Selection Example

An injector is required for a critically charged plate freezer application. The refrigerant load and operating conditions are expected to be fairly constant and steady. Carbon steel connections are desired.

- 16 TR R404a
- 104°F SCT
- -31°F SST

Step 1: select nozzle:

From the TR/Cv chart for R404a on page 6 we can expect a TR/Cv value of about 12 TR/Cv. Thus, we need a nozzle with a Cv value of about 16/12 = 1.33. Thus a **number 1 nozzle** (has a Cv value of 1.4) will suffice.

Step 2: select throat:

Applying the capacity correction factor, we will enter the throat capacity table with a value of 16TR/0.74 = 21.62 equivalent TR of R22. A **1-1/4" throat** is selected.

Step 3: select model/body:

A 2200WA injector with a 1/4" nozzle and 1-1/4" throat is the closest match, so we will go with that selection. The assembly part number then is 2200WA-TIC.

Part Number	Description
2200WA-TIC	Injector Assembly, 1/4" Nozzle, 1-1/4" Throat, 3/4" FPT Inlet

ZINC
All non-Brass Injector Bodies Come Clear Zinc Plated Standard!

Injector Families, Model Numbers and Connection Sizes

Family	Model	Body Material	High Pressure Liquid Inlet	Low Pressure Liquid Inlet	Mixed Liquid Outlet
2000SL	2020SL	Forged Brass (do not use with R717)	3/8" OD Copper (1/4" Nominal)	3/4" OD Copper (5/8" Nominal)	3/4"OD Copper (5/8" Nominal)
	2100SL		5/8" OD Copper (1/2" Nominal)	1-3/8" OD Copper (1-1/4" Nominal)	1-3/8"OD Copper (1-1/4" Nominal)
2100WCB	2075WCB	Welded Carbon Steel	3/8" FPT 1/2" FPT 5/8" OD Copper	3/4" FPT	3/4" Butt Weld
	2100WCB			1" FPT	1" Butt Weld
	2100WCBA			1" MPT	
2100WA	2125WA		1/2" FPT 5/8" OD Copper	1-1/4" Butt Weld	1-1/4" Butt Weld
	2150WA		3/4" FPT 1" Butt Weld 7/8" OD Copper	1-1/2" Butt Weld	1-1/2" Butt Weld
2200WA	2200WA		1/2" FPT 3/4" FPT 1-1/8" OD Copper	2" Butt Weld	2" Butt Weld
	2250WA		1" FPT 1-3/8" OD Copper	2-1/2" Butt Weld	2-1/2" Butt Weld

Assembly Part Number Nomenclature

2100SLD	-B	T	E

Base Valve Model

NOZZLE

A=#1	M=#54	Y=#46
B=#7	N=#56	Z=None
C=#16	O=#59	Z9=Special
D=#23	P=#64	A1=#47
E=#29	Q=#67	A2=#70
F=#31	R=3/16"	A3=11/64"
G=#36	S=7/32"	A4=9/64"
H=#40	T=1/4"	A5=11/32"
I=#44	U=9/32"	A6=15/32"
J=#48	V=5/16"	A7=13/32"
K=#50	W=3/8"	
L=#52	X=7/16"	

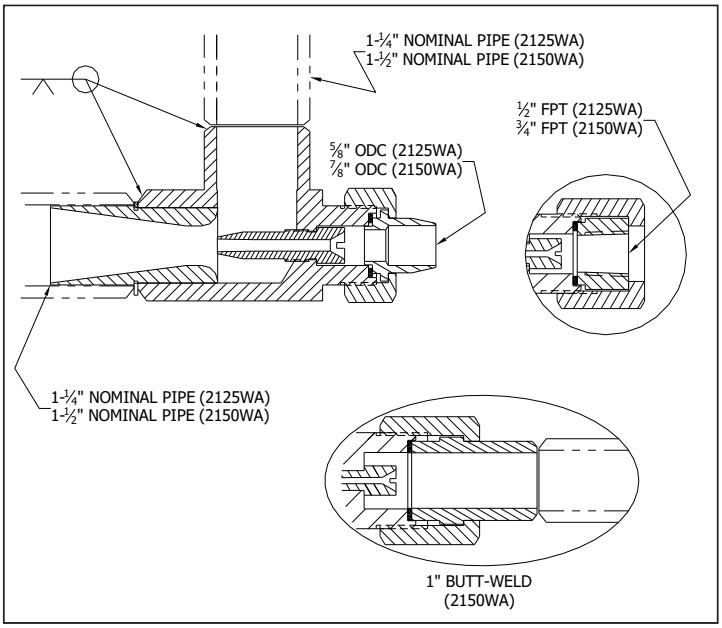
THROAT/DISTRIBUTOR

A=3/16"	M=6-3-8	X=11-8-12
B=1/4"	N=11-6-7	Y=11-8-11
C=5/16"	O=11-6-8	Z=None
D=3/8"	P=11-6-9	Z9=Special
E=1/2"	Q=11-8-5	A1=13-8-9
F=5/8"	R=11-8-6	A2=7-4-8
G=3/4"	S=11-8-7	A3=7-5-4
H=1"	T=13-8-8	A4=11-8-4
I=1-1/4"	U=11-8-9	A5=13-8-12
J=1-1/2"	V=13-8-10	
K=1-3/4"	W=13-8-11	

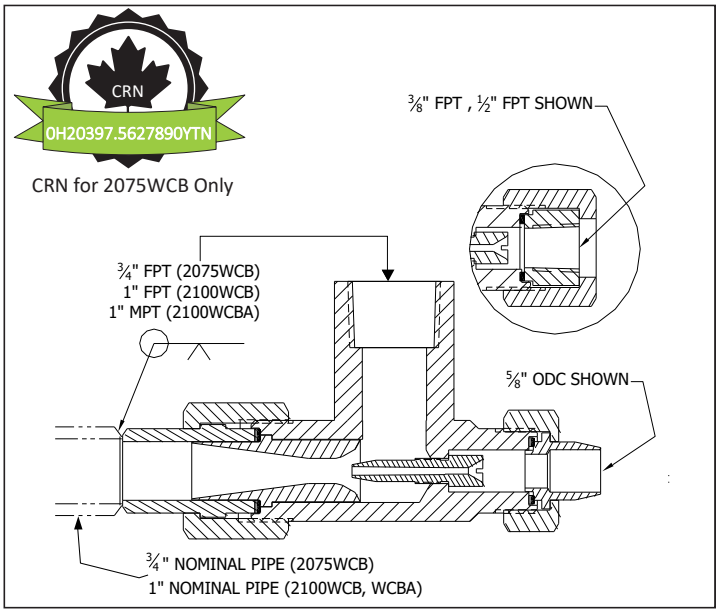
HIGH PRESSURE INLET

A=3/8" FPT	D=1" FPT	G=1-1/8" ODC
B=1/2" FPT	E=5/8" ODC	J=1" Weld
C=3/4" FPT	F=7/8" ODC	K=3/8" ODC

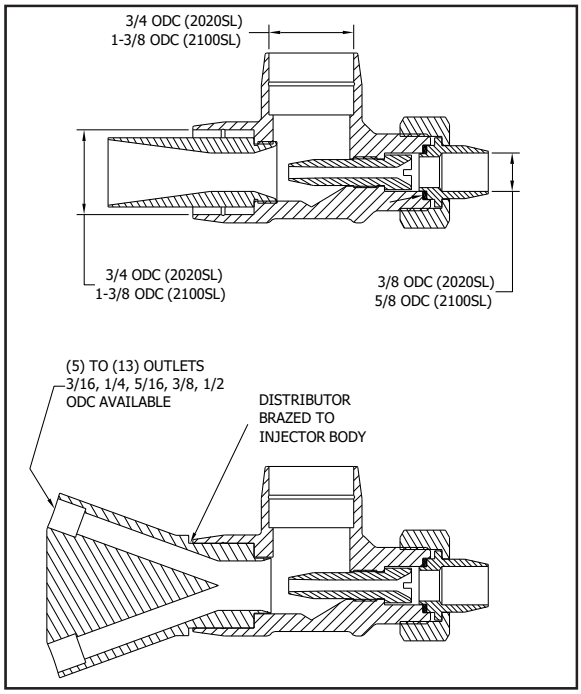
Injector Models/Body Styles



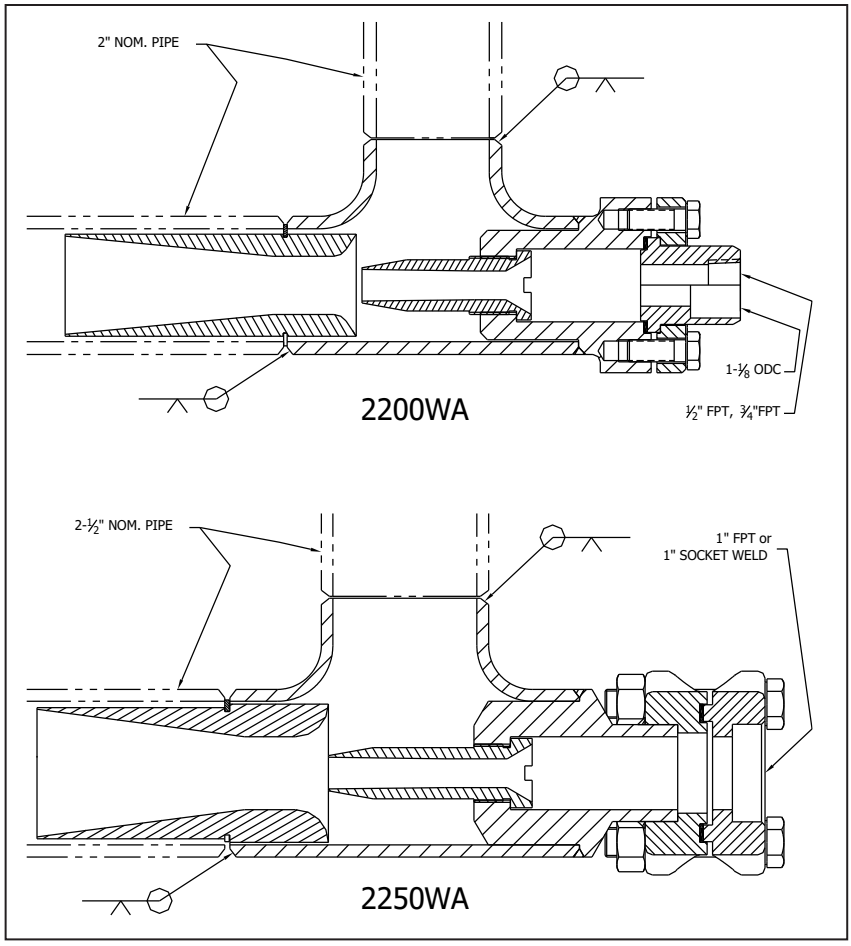
2125WA & 2150WA Injectors



2075WCB, 2100WCB, & 2100WCBA Injectors



2020SL & 2100SL Injectors



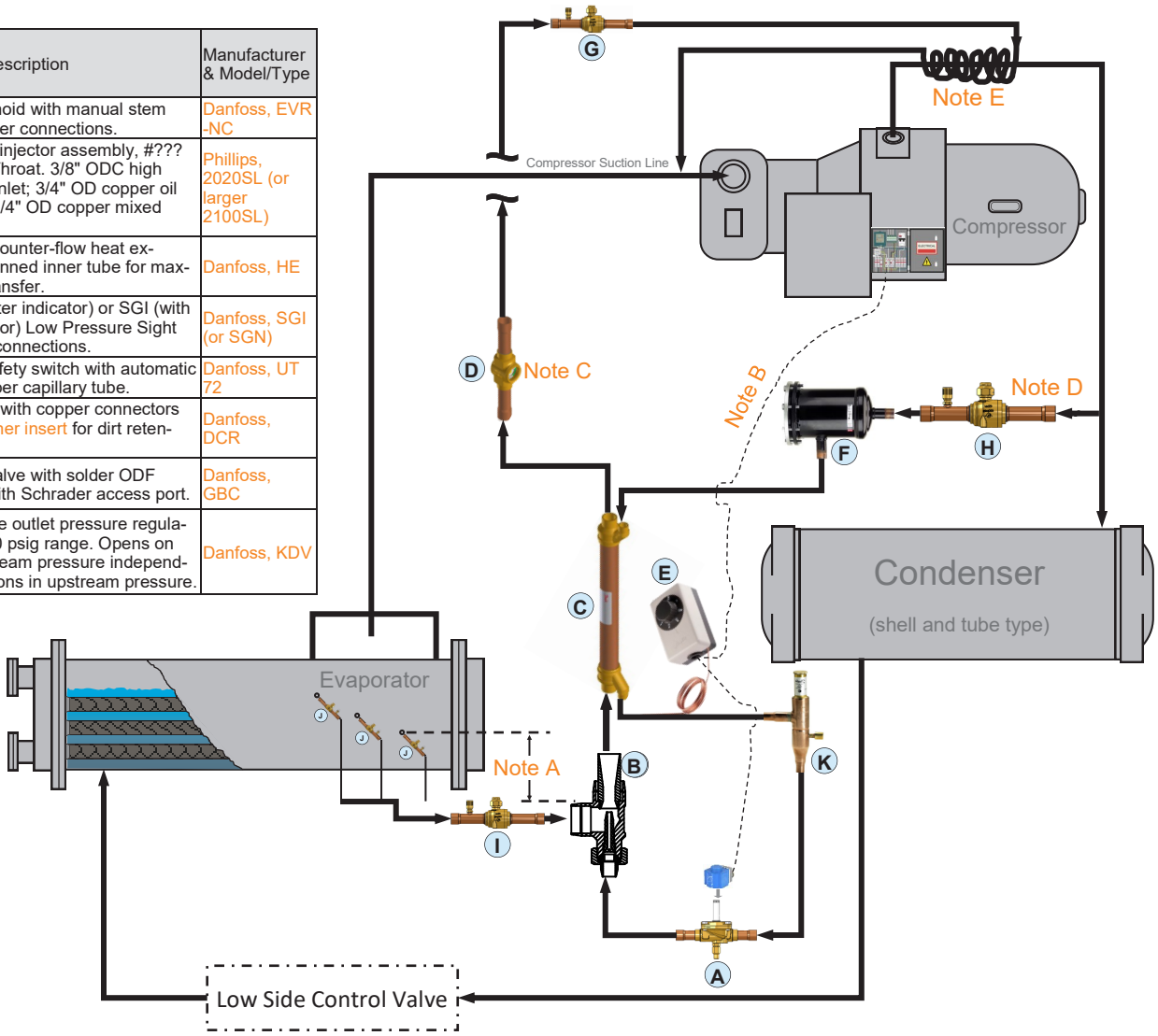
2200WA & 2250WA Injectors

Accessories - Injectors

Injector Setup For Oil Return On Halocarbon System

The Venturi effect of the injector's nozzle can also be used to lift and return oil in halocarbon systems. **As a general guideline, size injectors being used for oil return service for 1/25 of the evaporator TR load.**

Component Letter	Component Description	Manufacturer & Model/Type
A	EVR NC Solenoid with manual stem and ODF solder connections.	Danfoss, EVR -NC
B	2020SL brass injector assembly, #??? Nozzle, ???" Throat. 3/8" ODC high pressure gas Inlet; 3/4" OD copper oil mixture inlet; 3/4" OD copper mixed outlet.	Phillips, 2020SL (or larger 2100SL)
C	Tube-in-tube counter-flow heat exchanger with finned inner tube for maximized heat transfer.	Danfoss, HE
D	SGN (no moister indicator) or SGI (with moister indicator) Low Pressure Sight Glass, solder connections.	Danfoss, SGI (or SGN)
E	Thermostat safety switch with automatic reset and copper capillary tube.	Danfoss, UT 72
F	DCR, housing with copper connectors and 48-F strainer insert for dirt retention.	Danfoss, DCR
G, H, I, & J	Shut-off ball valve with solder ODF connections with Schrader access port.	Danfoss, GBC
K	KVD adjustable outlet pressure regulator with 44-290 psig range. Opens on falling downstream pressure independent of fluctuations in upstream pressure.	Danfoss, KDV

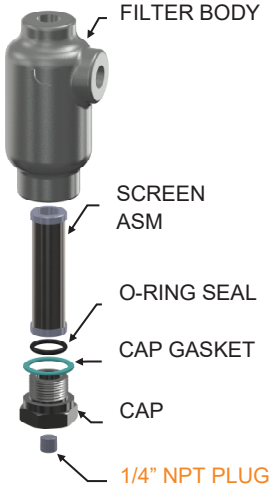


Note A: Install injector just beneath lowest syphon connection on evaporator, but no lower than 2-3" beneath for maximum efficiency (otherwise liquid and oil will flood the injector and the high pressure discharge gas will have to lift against liquid head). **Note B:** The coil feeding HG to the inlet of the injector should only be energized (thus allowing high pressure gas to flow through the valve) when the compressor is running. A thermostat switch is recommended to ensure that there is enough heat to vaporize any refrigerant in the oil mixture. **Note C:** The pressure regulating valve should be set so a small, steady stream of oil can be seen in the liquid indicator. Note that using an outlet pressure regulator ensures a steady and repeatable syphoning effect from the injector. **Note D:** Use the highest pressure/temperature gas that the components can handle to help lift the oil mixture back to the crankcase (or oil reservoir), and to vaporize any refrigerant in the oil mixture as it passes through the heat exchanger. Insulate all lines and the heat exchanger to prevent superheated refrigerant from condensing. **Note E:** In addition to the heat exchanger (or possibly in lieu of) the copper line can be coiled around the discharge line to help vaporize any possible refrigerant left in the oil mixture.

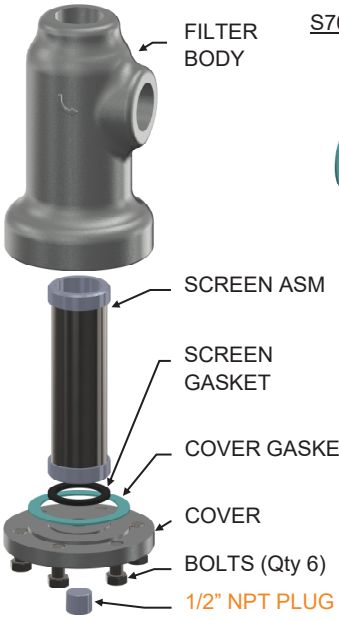
Filters/Strainers

Phillips offers three styles of compact filters to protect a variety of refrigeration equipment from particulate matter. The 510 and 575 styles are angle-type, typically used with Phillips' low-side float valves. These filters have FPT connections. The S701JRP is a flanged globe-style filter, typically used with small piston-type valves. All of these filters feature screen assemblies that are reinforced with perforated stainless steel sleeves.

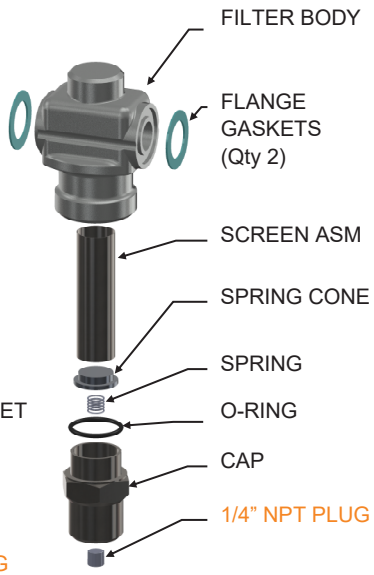
510 FILTER ASSEMBLY



575 FILTER ASSEMBLY



S701JRP FILTER ASSEMBLY



Model	Body Style	Connection Sizes/Styles Available (in.)	Body Material	Filter Area	Mesh Size*	Microns (µ)*	Weight (lbs.)
510	Angle, Threaded	1/2 & 3/4 FPT	Zinc-Plated Cast Iron	11 in^2 (71 cm^2)	200 (0.003" particle)	74µ	5
575	Angle, Threaded	3/4, 1 & 1-1/4 FPT	Zinc-Plated Cast Iron	29 in^2 (187 cm^2)	50 (0.012" particle)	297µ	20
S701JRP	Globe, Flanged	1/2, 3/4 & 1 FPT 1/2, 3/4 & 1 Socket Weld 5/8, 7/8, 1-1/8 & 1-3/8 ODC	Zinc-Plated Ductile Iron	14 in^2 (90 cm^2)	50 (0.012" particle)	297µ	6

*Mesh is the number of threads per inch. µ (microns) is the distance between two threads (1µ = 1/1000 mm)

500 & 510 Series Assemblies Part Number Nomenclature

510	-1/2
Base Valve Model	

CONNECTION SIZE (FPT)

1/2 = 1/2" NPT
3/4 = 3/4" NPT
1 = 1" NPT
1-1/4 = 1-1/4" NPT

S701JRP Assemblies Part Number Nomenclature

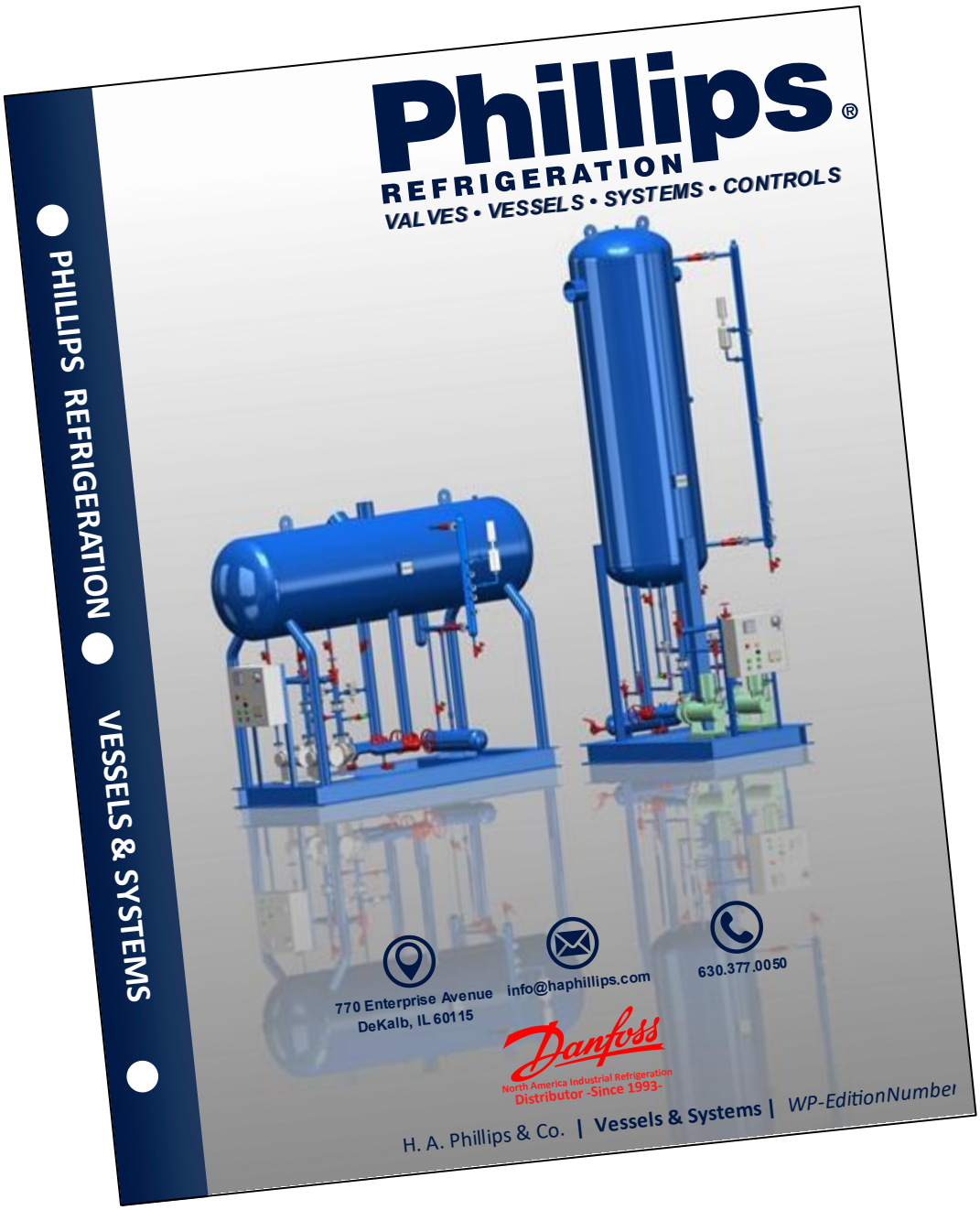
S701JRP	-Z	C
Base Valve Model		
(PLACE HOLDER)		

CONNECTION

A=1/2" FPT
B=1/2" SW
C=3/4" FPT
D=3/4" SW
E=1" FPT
F=1" SW
H=1-1/8" ODC
O=1-3/8" ODC
Z=Less Flanges and Nuts/Bolts
Z9=Special Request

ZINC
All Strainer Bodies Come Clear Zinc Plated Standard!

Be Sure to Check Out Our Welded Product Catalog!



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