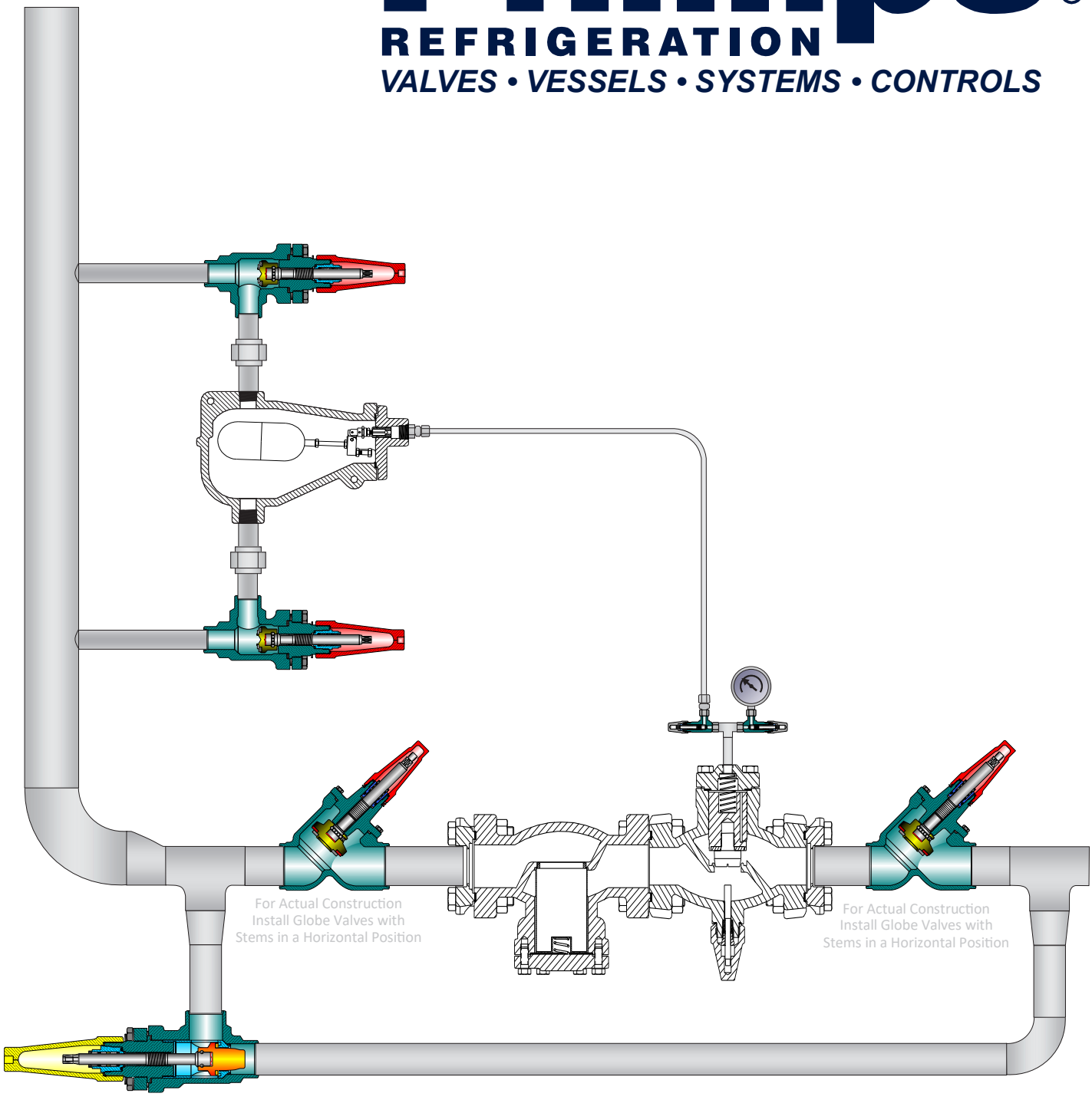
PHILLIPS REFRIGERATION ● VALVES & ACCESSORIES

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! The valves featured in this catalog are built to meet our highest quality standards and are designed for a service life of over a decade. When properly maintained, systems using these components can provide dependable performance for over 20 years.

Pioneers in Ammonia Refrigeration


Harry Alexander Phillips

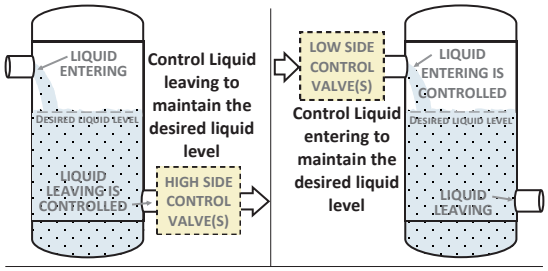
Since 1928, H. A. Phillips & Co. has been designing and manufacturing ammonia refrigeration controls for industrial refrigeration applications worldwide. The company was founded by one of the pioneers of the ammonia refrigeration industry, Harry Alexander Phillips. Harry developed numerous patents related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

Engineering

H. A. Phillips & Co. employs engineers with relevant refrigeration education and experience. We take pride in the ability of our applications engineers to serve our customer base at a high level, and we believe this technical acumen helps set us apart 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

Among other things, Phillips specializes in mechanical-style modulating expansion valves to meter and flash refrigerant to maintain liquid levels in industrial refrigeration systems. High-side controls (direct-feed or pilot-operated valves) maintain the liquid level on the high side (upstream) of a valve by metering flow to a lower-pressure location. Low-side controls (direct-feed or pilot-operated valves) maintain the liquid level on the low side (downstream) 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 provide users with a quick overview of our most commonly used valves, accessories, and typical applications for these products. It also includes code number nomenclature (used for ordering and identifying existing valves) for each product family. While other products not mentioned in this document do exist, only brief descriptions and the most relevant product data are provided in this catalog. For more detailed information on our products, please see the section below.

Other Literature and Info

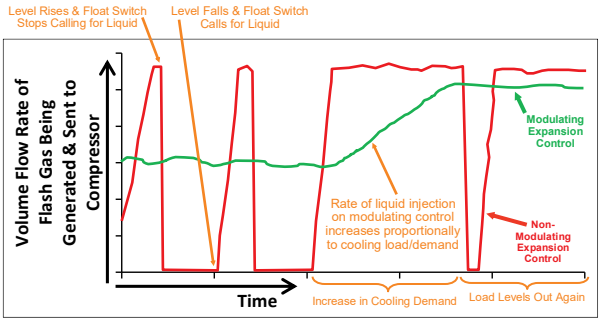
More engineering data, product details, application examples, service instructions, and other literature can be found on our website or provided upon request. Our current list pricing and valve identifier (used to both identify valves and specify code numbers for ordering) are also available on our website.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

Table of Contents

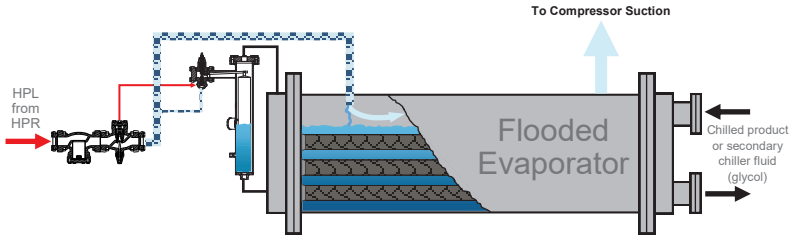
Mechanically Operated Expansion/Level Controls Overview

Modulating Expansion Control Versus Non-Modulating Control

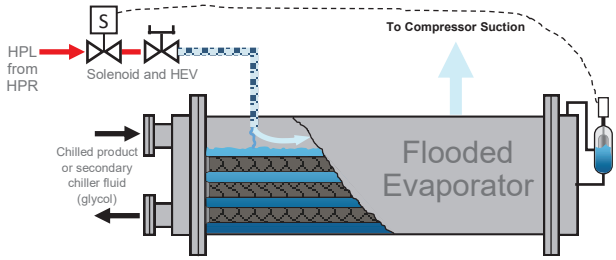
A standard liquid makeup design with a hand expansion valve (HEV) and a solenoid, that is energized/de-energized by a float switch making/unmaking, will result in very unsteady amounts of flash gas being produced. Ideally, the HEV is set to the smallest opening degree possible while still providing enough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



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

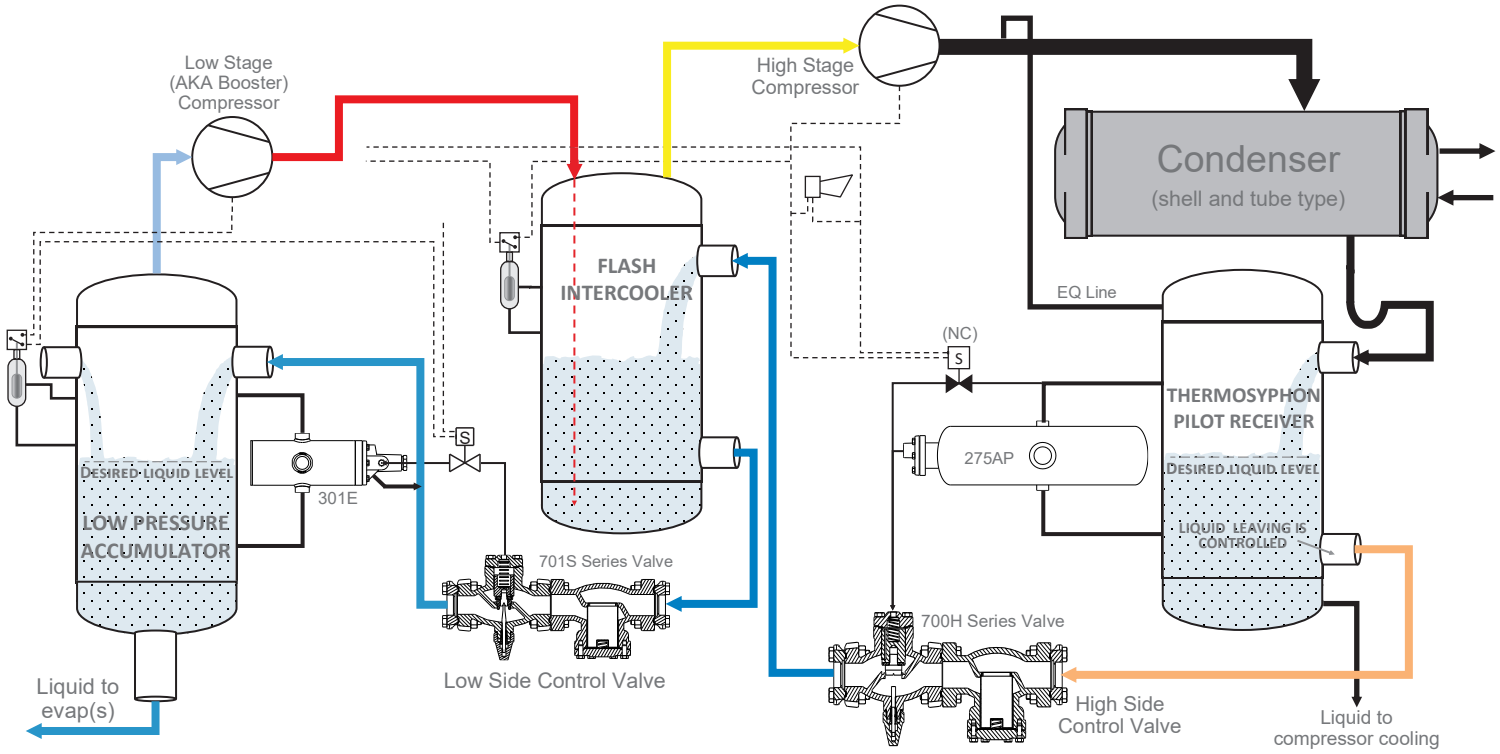


Typical Phillips' Modulating Liquid Makeup Low-Side Control



Typical Non-Modulating (HEV) Liquid Makeup

Simplified System Diagram with Modulating Expansion/Level Controls



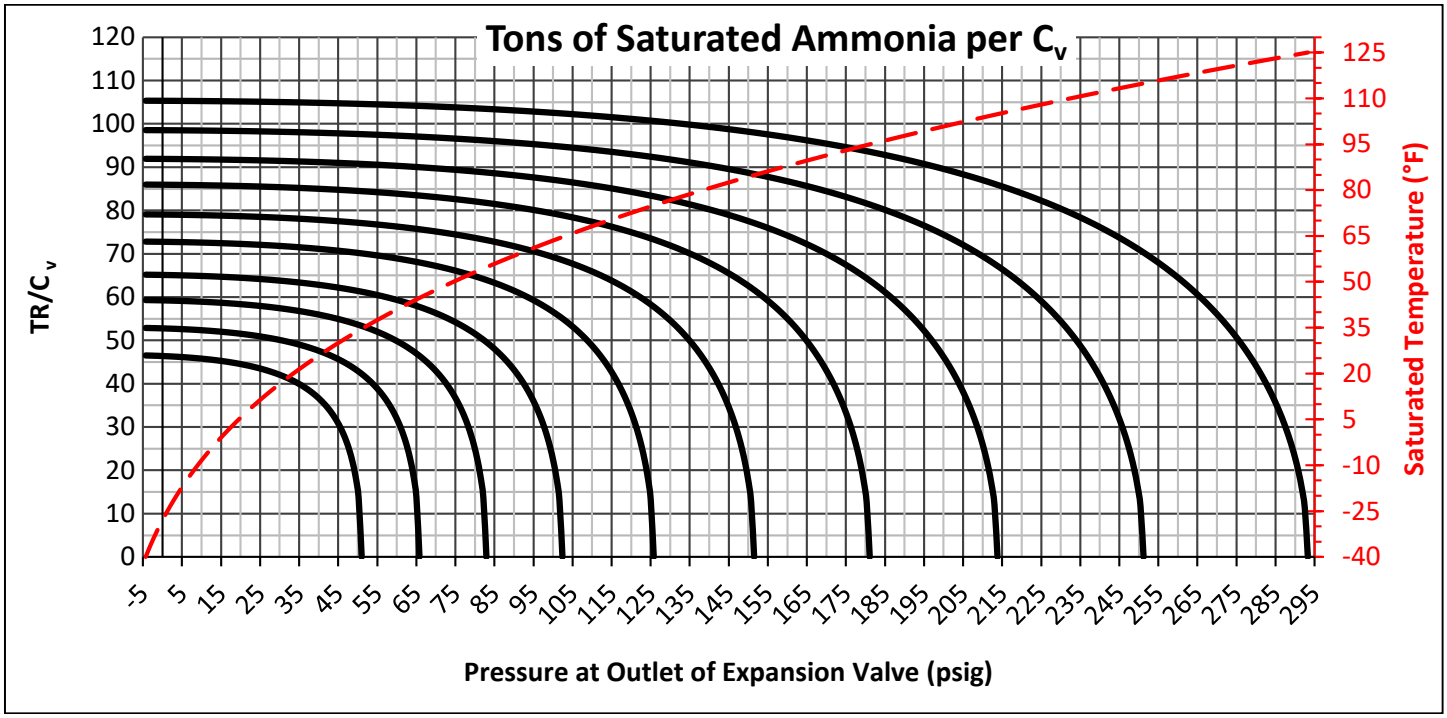
Simplified Single-Temperature, Two-Stage Compression, and Two-Stage Modulated Liquid Expansion System

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

The graph below shows the expected tons of refrigeration (TR) obtainable per C_v at ten different constant inlet pressures to the valve, over a range of outlet pressures. The points where the bold lines intersect the horizontal axis represent each line's constant inlet pressure. The dashed red line can be used to determine the corresponding saturated pressure for given temperatures (or vice versa).

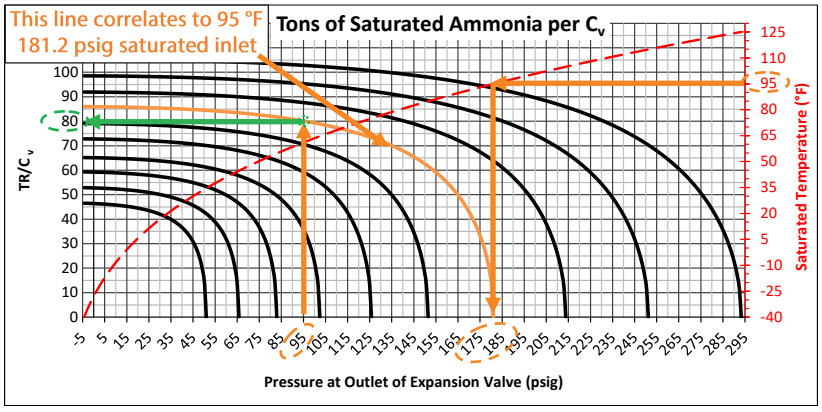
For C_v Values of Different Valve Options See Pages 10 & 16

- The graph is intended for sizing valves that experience a phase change (valves used for expansion service) across their metering device. The liquid entering the valve is assumed to be saturated. Adjustments for subcooled inlet conditions can be made using the table provided below. If needed, please contact engineering support for assistance with sizing valves that have two-phase flow conditions at the inlet.
- The curves below include a small built-in safety factor. Avoid oversizing valves excessively, as this can lead to poor modulation performance and potential wire drawing of internal components. That said, Phillips valves generally operate well with minimal performance loss down to 30% of the values obtained from the TR/C_v curves.



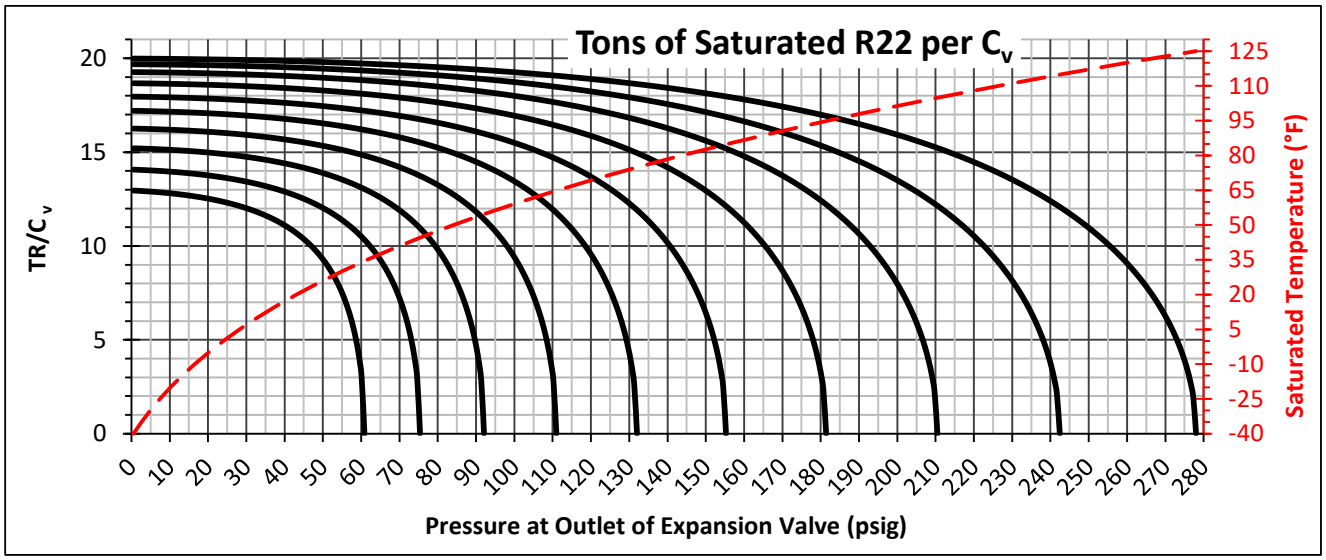
°F Subcooling	Multiplier *
5 °F	1.02
10 °F	1.04
20 °F	1.08
30 °F	1.15
50 °F	1.20

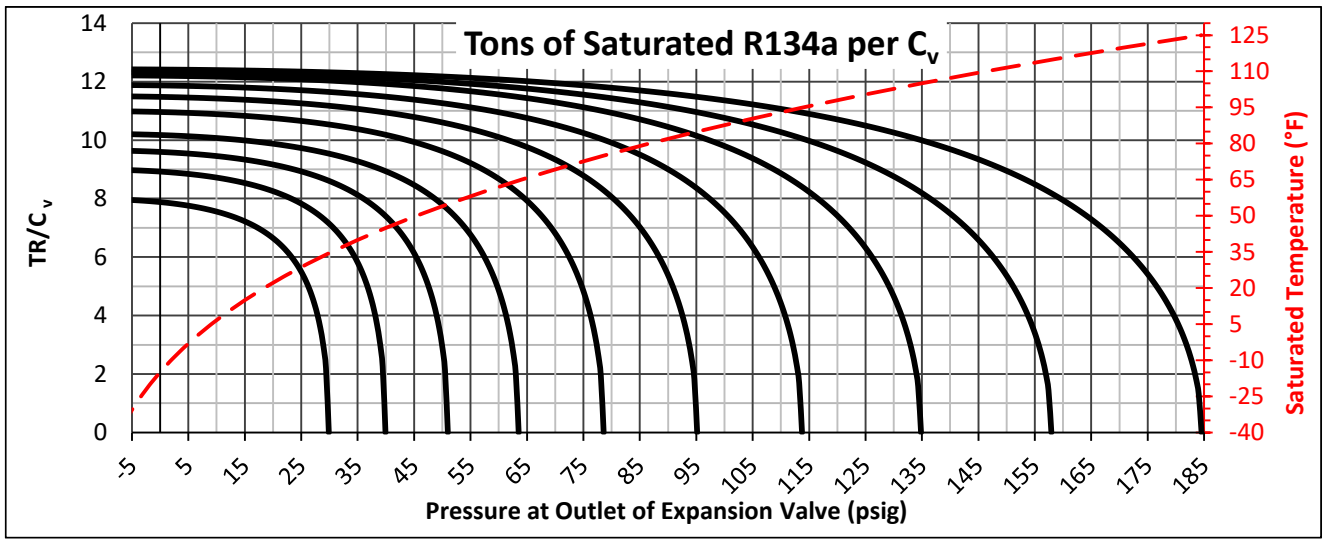
*Multipliers listed in this table apply when flashing still occurs across the valve. For conditions where the amount of subcooling is sufficient to prevent flashing across the valve, capacities will be approximately 1.4 to 1.6 times the values shown on the graph.

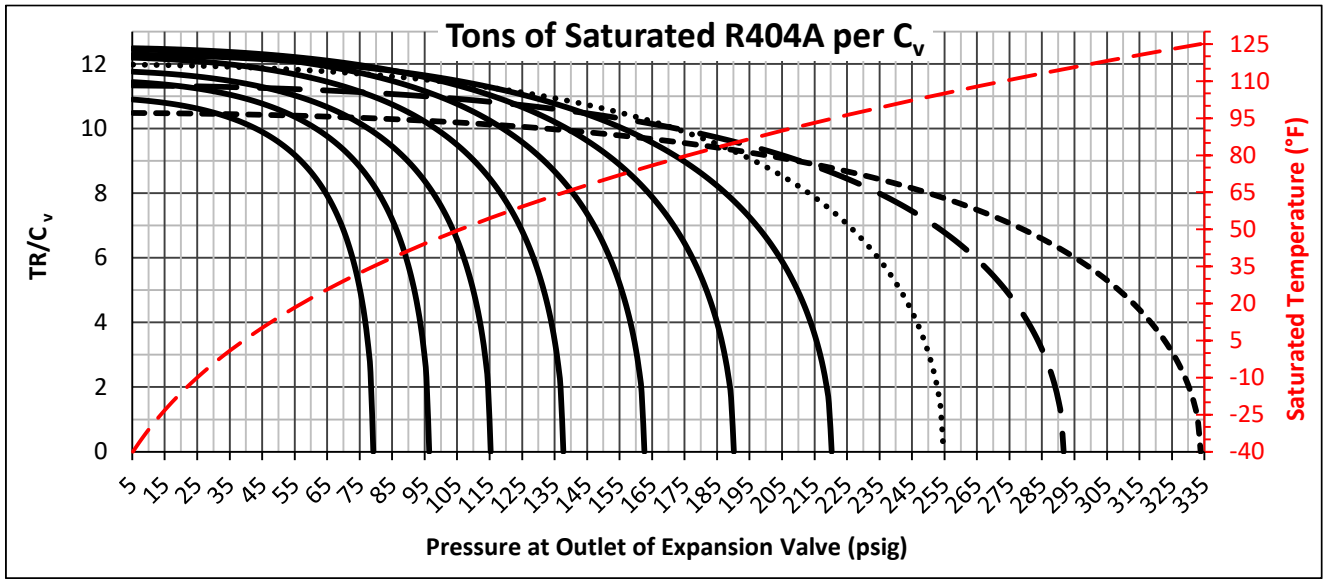


The sample to the left demonstrates how to read the TR/C_v charts:

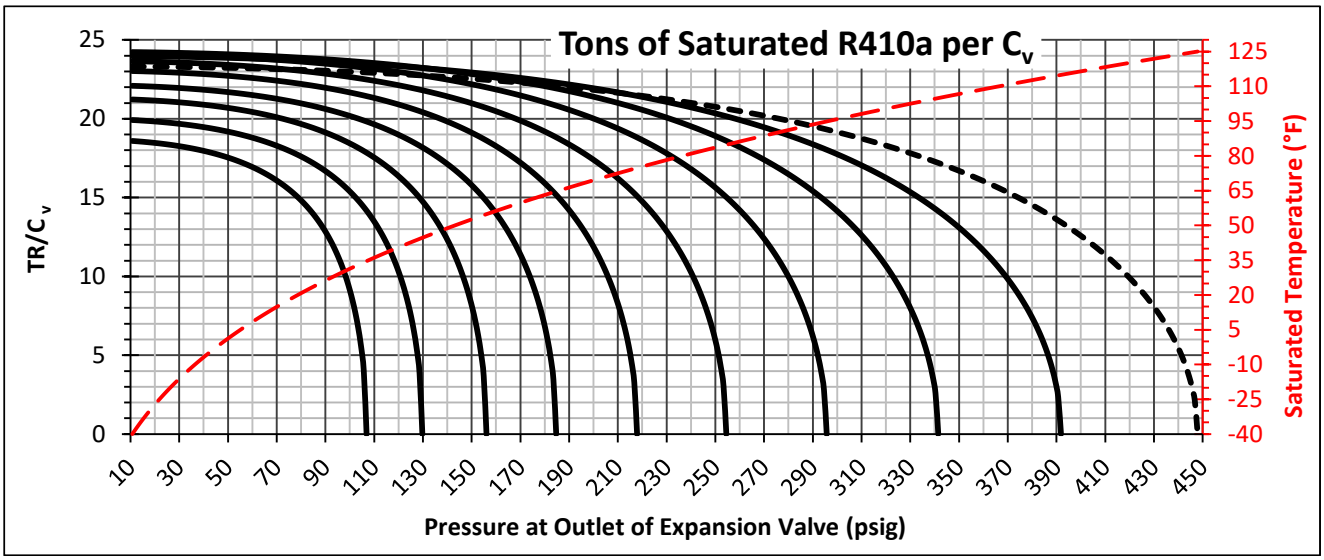
For 95°F inlet temperature (corresponding saturated pressure is 181.2 psig) and 95 psig downstream pressure, the expected capacity is 80 TR per C_v. This means that a valve with a C_v value of 0.5 is good for about 40 TR R717 at the stated conditions.

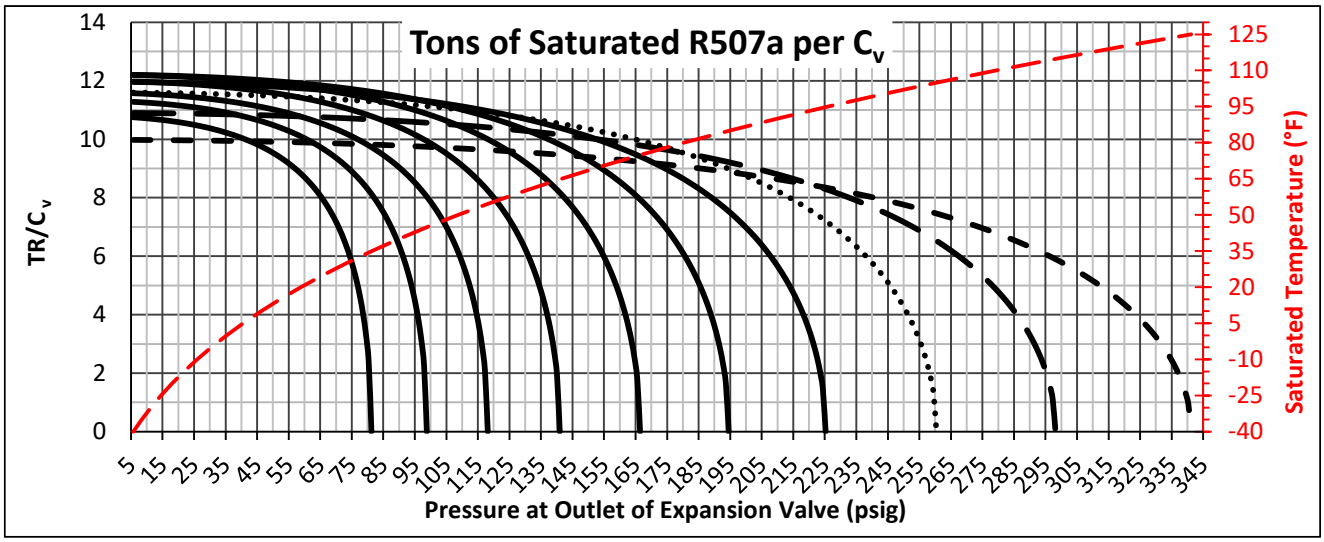

Tons of Saturated R22 per C_v
TR/C_v
Saturated Temperature (°F)
Pressure at Outlet of Expansion Valve (psig)

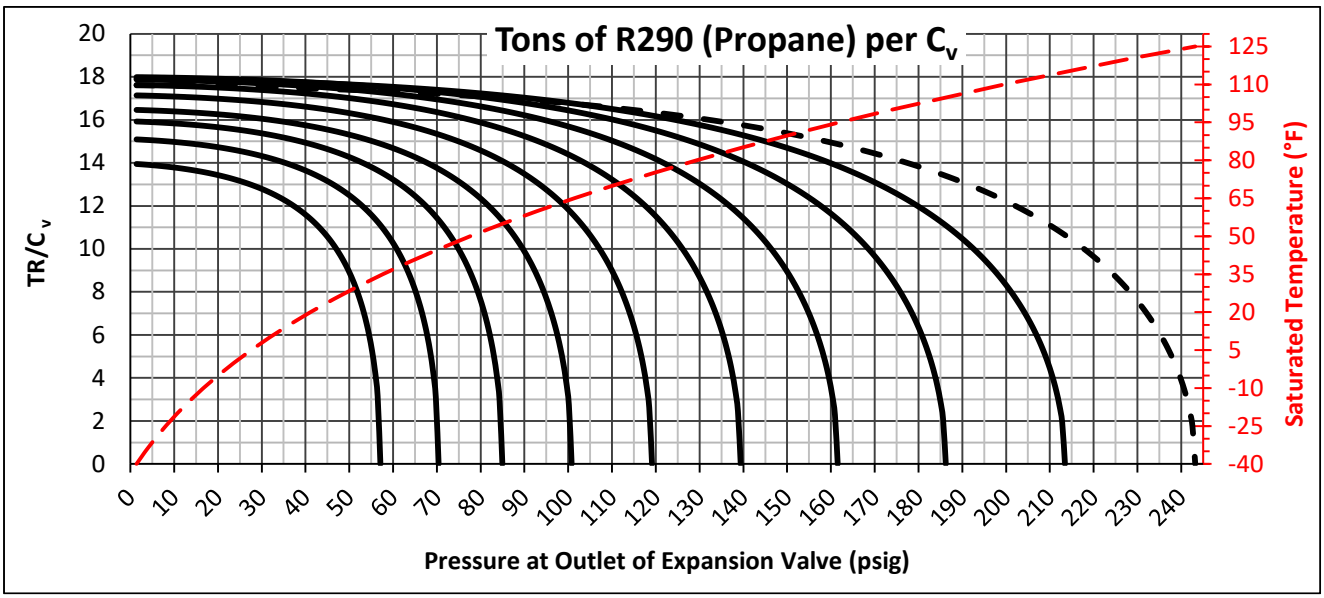

Tons of Saturated R134a per C_v
TR/C_v
Saturated Temperature (°F)
Pressure at Outlet of Expansion Valve (psig)


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 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 the plant and good piping practices. **The following operating conditions apply:**

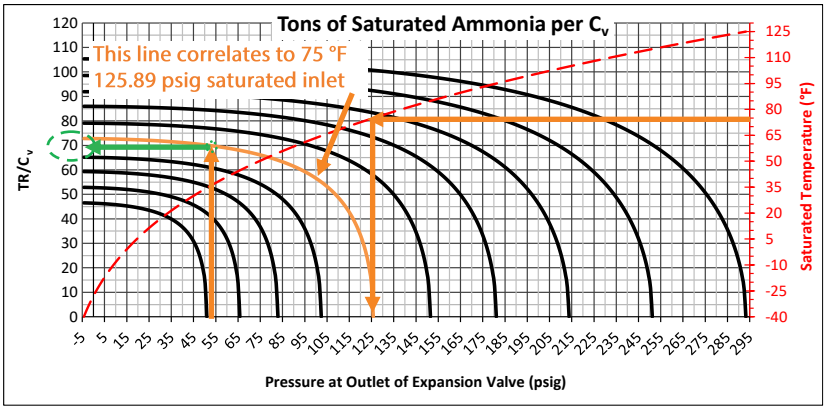
- **470 TR R717** *(The load will remain at this level nearly all year-round, as it is a steady, process driven load).*
- **95°F SCT** *(saturated condensing temperature)* during warm months, and **75°F SCT** in cooler months *(floating head pressure).*
- The Surge drum will be maintained at **36°F SST**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

Assumptions:

- Pressure losses due to friction and restrictions in piping and components are neglected for this application.
- The liquid enters the expansion valve in a saturated state.

Step 1: Determine the Required C_v Value (Valve Flow Coefficient)

We will size for the worst-case scenario—typically the highest cooling demand at the lowest available differential pressure. In this case, we will size for **470 TR** with **75°F SCT** and **36°F SST**. From the **TR/C_v graph**, we determine that we should get about **70 TR/C_v** at these conditions. Therefore, we need valve(s) with a sum total **C_v value of 6.71** (*C_v required = TR ÷ value from chart*).



Step 2: Check Required Line Sizes

We can use Danfoss' **Coolselector®2** program for this step. We will size a liquid line to maintain a velocity between **3-8 ft/s** upstream of the expansion valve, and a two-phase flow velocity (downstream of the expansion valve) below **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 Meet Required C_v and Line Size

From the High Side Valve Overview (see page 10), we see that a **700AXH** valve with a metering plug angled between **5° and 10°** will provide both the required **C_v value** and the appropriate **line size**. Based on this, we will use an **8° plug**.

Step 4: Select Pilot Valve Orifice Size and 700AXH Valve Spring

The standard **275AP** pilot orifice size for piloting a **700AXH** valve is **5/64"**, as shown in one of the tables on **page 15**. We also see on page 15, that the recommended spring selection for the minimum expected differential pressure (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 - Sizing and Selection Example

Low Side Controls - Sizing and Selection Example

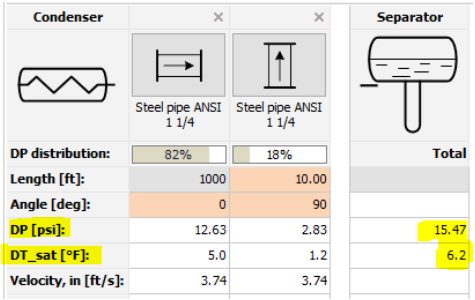
Low side ammonia controls are required to maintain liquid levels in four identical surge drums, which are gravity-feed plate and frame heat exchangers. Liquid makeup to these units will be subcooled HPL (high pressure liquid) as listed below. Each unit will have its own piping run, with a total equivalent pipe length—accounting for friction losses in elbows and other components—of approximately 1,000 ft, with a vertical elevation change of 10 ft.

The following operating conditions apply:

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

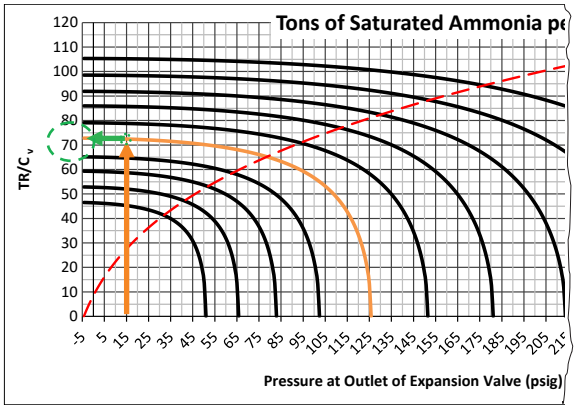
Step 1: Determine Line Sizes and Pressure Losses up to Low Side Control Valves

We can use Danfoss' **Coolselector®2** program for this. We will size the liquid line to maintain a velocity upstream of the expansion valve between **3-8 ft/s**, while keeping the pressure losses and saturation temperature drop within reasonable limits. 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. This results in a total pressure loss of **15.5 psid** and a corresponding saturation temperature drop of **6.2°F**.



Step 2: Determine Required C_v Value (Valve Flow Coefficient)

From Step 1, we see 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/C_v graph**, we see that the system delivers approximately 70 TR/C_v at saturated conditions and this pressure. The subcooling correction table on page 5 shows an increase in capacity of about **8%** due to the subcooling remaining by the time liquid reaches the valve. Thus, we can expect about **75.6 TR/C_v** (1.08 x 70 TR = 75.6 TR), and need a valve with a **Cv value of approximately 2.65** (*C_v required = TR ÷ value from chart*).



Step 3: Select Valve(s) That Provide the Required C_v 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** exceeds the required C_v value and provides the desired line size. Alternatively, if we choose to use direct acting valves, two **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 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 series** valve to pilot, as it allows for liquid level adjustments in the surge drum. From the table just above that one, we must select the spring based on the available pressure differential across the valve—106 psid. Therefore, 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 C_v Values and Overview

Valve Type	Valve Model Number*	C_v	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	Socket Weld or NPT 1/2, 3/4, or 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	Socket Weld or NPT 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	Socket Weld or NPT 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	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 is calculated based on 95°F saturated liquid at the valve inlet and feed into a 20°F vessel. Pressure losses upstream and downstream are not considered.

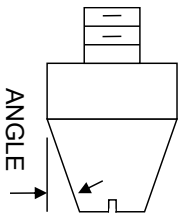
See Page 5 for Sizing Info

Avoid using a 0° metering plug, as the valve's capacity does not change significantly until the plug is fully withdrawn from the port.

Valves with these metering plugs tend to have poor modulation characteristics. Please consult the factory for assistance. Consider using a smaller body size with a larger metering plug angle. Expanders or reducers can be added to match the line size.

ZINC

All Valve Bodies & Cast Chambers Come Standard with Clear Zinc Plating!



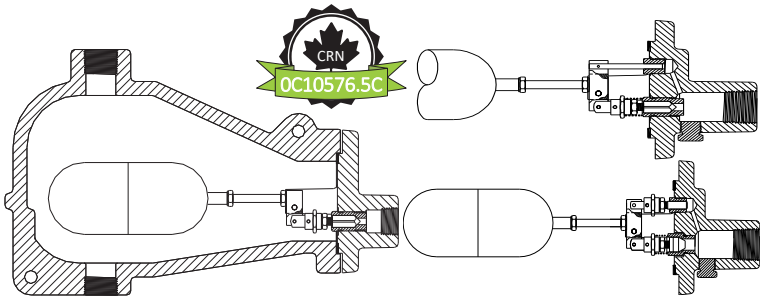
Metering Plug From 700H Series

We can machine a custom angle on the metering plug as needed. The options listed in the table represent 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 opens the orifice, allowing liquid to flow downstream.** These valves are typically used in refrigeration systems with a fixed (critically charged) refrigerant charge. They feature a simple needle-and-seat construction. The 270A valve has a single port, while the 270AX and 270AY valves are balanced-port designs, making them suitable for larger-capacity applications.

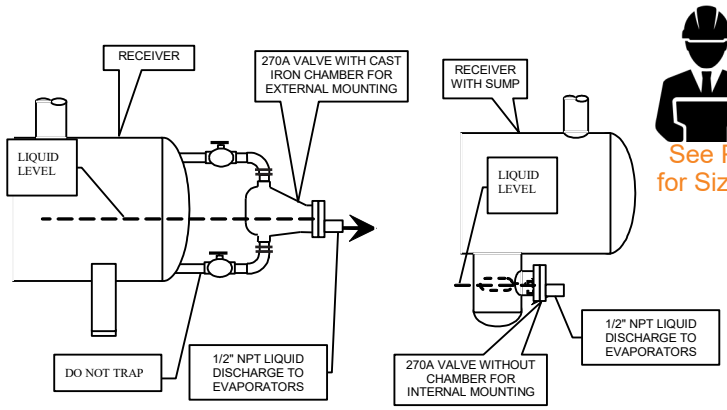


270A shown with cast chamber (left); 270AX (top right); and 270AY (bottom right)

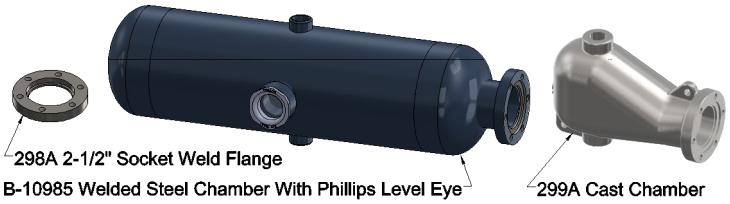
Users can order 270A Series valves with one of the following chamber configurations:

- **A cast chamber**, zinc-plated as standard.
- **A painted welded steel chamber with a Phillips Level Eye**, which allows users to visually confirm the presence and level of liquid in the chamber (see *Level Eye* product documentation for more details).
- **A socket weld flange,** for direct mounting to a vessel, with the float ball designed to protrude into the vessel cavity.

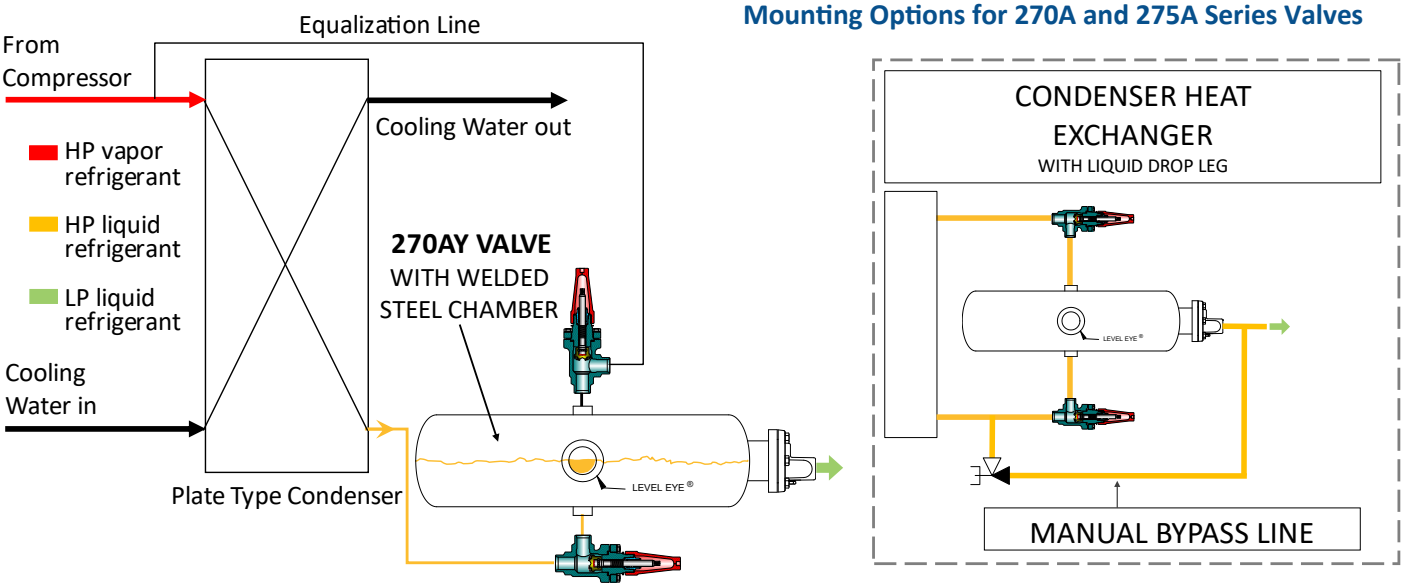
When using welding flanges to mount a 270A valve directly to a vessel, special considerations must be given to ensure adequate clearance for the float ball to move freely with changes in liquid level. Refer to the engineering bulletin for more information.



See Page 5 for Sizing Info



Mounting Options for 270A and 275A Series Valves



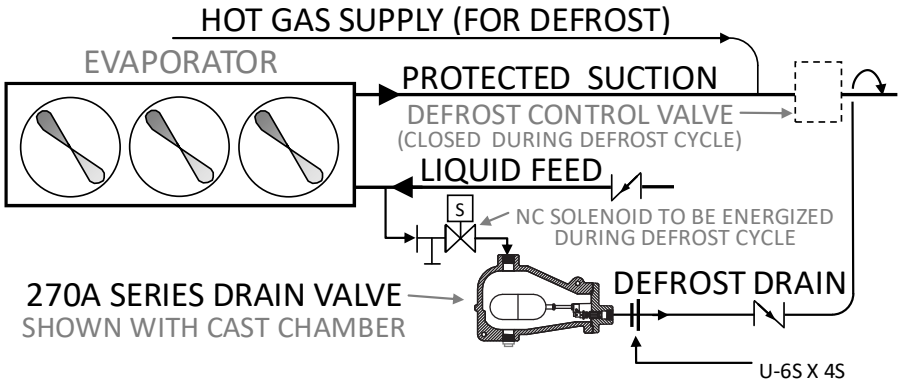
270A Series Valve, Low Capacity High Side Control, Condenser Application

Direct Acting High Side Expansion/Level Controls

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

Phillips' 270A Series valves, which open as liquid level rises, are excellent for condensate draining. The valve opens only after enough liquid has condensed to fill up the chamber approximately halfway and cover the outlet. It then drains the liquid to a lower pressure location, such as a protected suction line, while minimizing the flow of higher pressure vapor downstream—helping prevent artificial loading on the compressor.

When using a float valve as a defrost and/or reheat coil drain, it is imperative that the hot gas supply is regulated via an outlet (aka downstream) pressure regulator. When sizing a high side valve for a defrost condensate drain application, it is typical to size the valve with a tonnage rating 2 to 4 times the nominal tonnage of the evaporator.



270A Series Condensate Drain Application

Size the valve to **double** the nominal rating for evaporators that operate at warmer temperatures and accumulate little ice. Size to **3 to 4 times** the nominal rating for low-temperature evaporators that experience greater ice buildup.

An optimized defrost control system—including a float drainer—is **estimated to reduce total system energy consumption by more than 5% compared to traditional hot gas arrangements.**

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

Phillips' 270A Series valves also make for exceptional condensate drainers in hot gas main lines. Pressure and heat losses—such as those that occur in rooftop hot gas lines during winter—can cause vapor in the mains to condense and accumulate in horizontal piping runs. If this condensate is not properly drained, there is a risk of a liquid slug being propelled down the line during a sudden surge in flow, such as when an evaporator goes into defrost mode.

Drain valves for hot gas mains should be installed at the low points of the piping, allowing liquid to collect and drain into the valve chamber mounted beneath the line. The drain line should connect to the bottom of the chamber, while the upper connection should be piped to the top of the main line. This setup ensures proper pressure equalization and prevents vapor lock within the chamber.

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

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

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

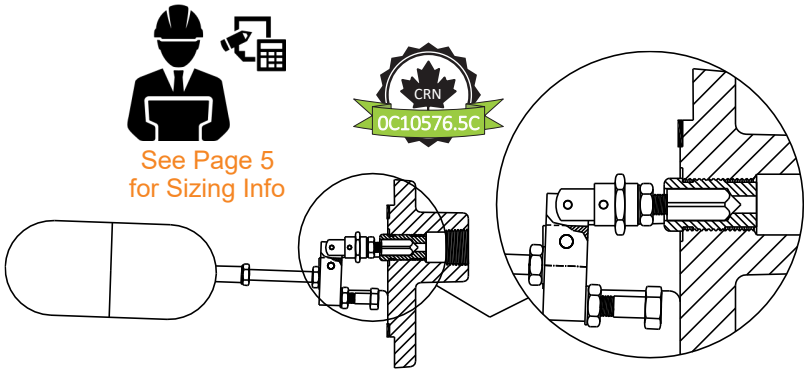
270A Valve Series Includes: 270A, 270AX*, 270AY**

Direct Acting High Side Control

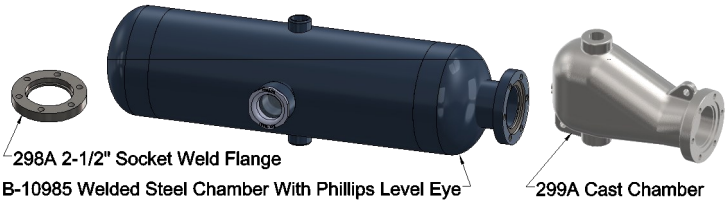
275A Series Float Control

The 275A Series valves are direct-feed valves that operate in the opposite manner of the 270A Series. Unlike the 270A, which opens as the liquid level rises, **the 275A remains open unless a liquid level builds up** and raises the float ball, thereby closing the valve. The 275AP valve is typically used to pilot the Phillips 700H series high side control valve. While the Phillips 270A and 275A valves differ in design, they share the same mounting options. **Note:** The valves are mounted in opposite orientations—refer to the diagrams for proper installation details.

See Page 5 for Sizing Info



275AP Valve Less Chamber



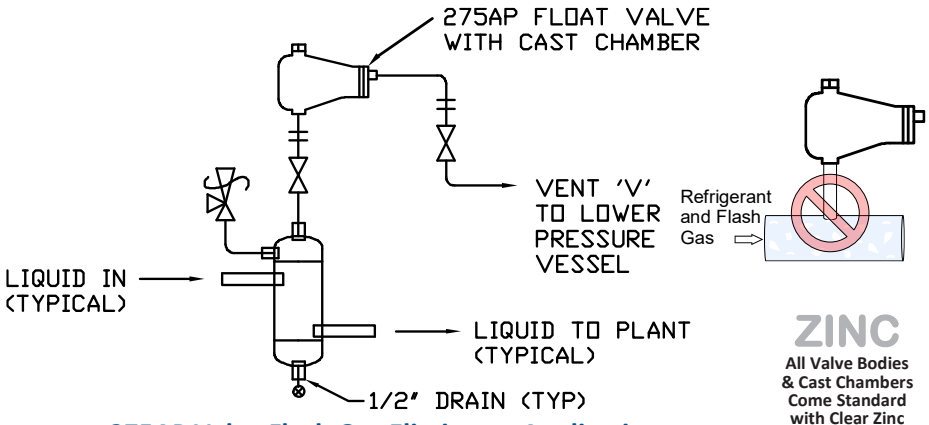
Mounting Options for 270A and 275A Series Valves

Users can order 275A Series valves with one of the following chamber configurations:

- **A cast chamber**, zinc-plated as standard.
- **A painted welded steel chamber with a Phillips Level Eye**, which allows users to visually confirm the presence and level of liquid in the chamber (see *Level Eye* product documentation for more details).
- **A socket weld flange,** for direct mounting to a vessel, with the float ball designed to protrude into the vessel cavity. When utilizing welding flanges to directly mount a 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 valve on top of a liquid line carrying excess flash gas will not work, as the flash gas will not effectively have the chance to migrate into the pipe stub before being carried downstream. If flash gas must be eliminated from a location where it will not naturally separate from the liquid (such as a liquid line), then a small vessel is recommended to facilitate the separation of liquid and vapor. Please contact Phillips for assistance with vessel sizing and pricing.



275AP Valve Flash Gas Eliminator Application

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

Assembly Part Number Nomenclature

275AP	F	-C	Z	B

Base Valve Model

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

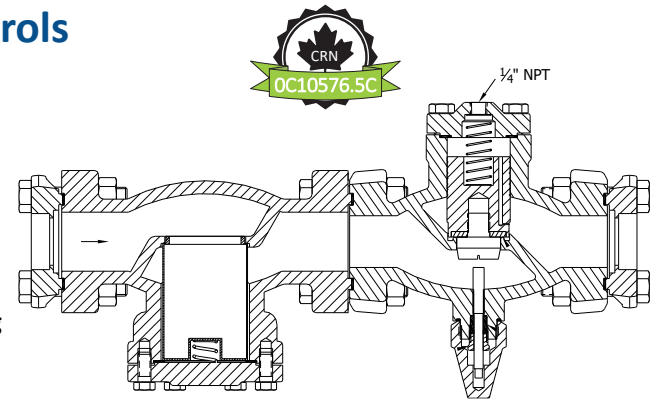
ORIFICE
A = 1/16" F = 1/8"
B = 5/64" I = 3/16"
C = 3/32"

Z (PLACE HOLDER)

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

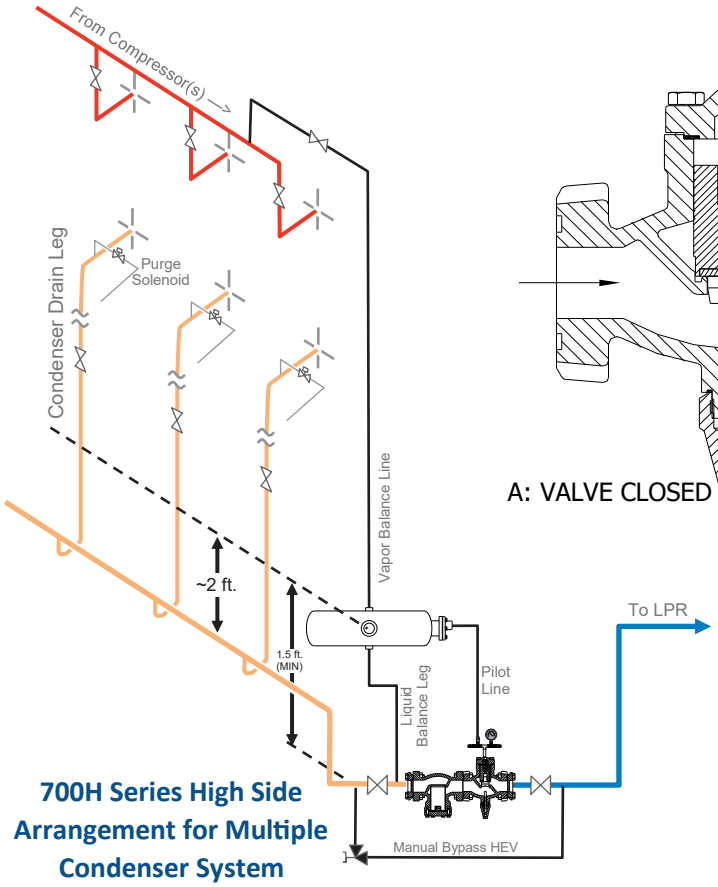
Pilot Operated High Side Expansion/Level Control

700H Series High Side Pilot Operated Controls

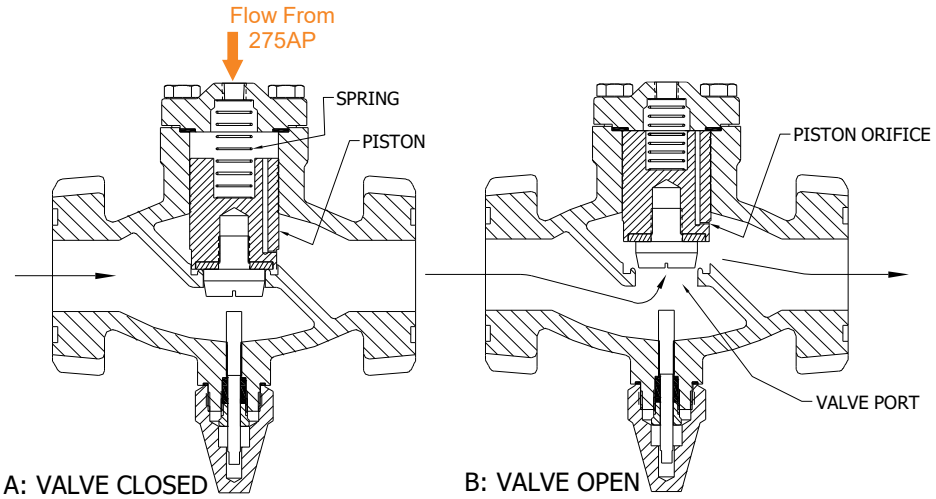


700H Series Valve With Direct Mount Strainer

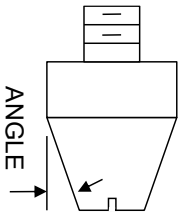
The 700H Series valves are pilot operated valves that modulate the flow of liquid refrigerant to a lower pressure location by utilizing a 275AP pilot float valve. These valves may also be applied to controlled pressure receivers, thermosyphon vessels, economizers, and the drainage of condensed vapor 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 according to the design criteria for which the 700H valve is intended**, 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. A 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, allowing pressure on top of the piston to bleed to the downstream side. The balance of forces causes the piston with metering plug to rise, allowing more liquid to move downstream. Conversely, as the condensing load decreases, the float ball drops and opens the pilot orifice, thereby increasing the pressure on the 700H piston. The 700H valve then modulates to reduce the flow. The pilot line must be a minimum of ¼" nominal pipe size 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



Metering Plug For 700H Series

See Page 5 for Sizing Info

Pilot Operated High Side Expansion/Level Control

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

700H SERIES VALVE SPRING SELECTION

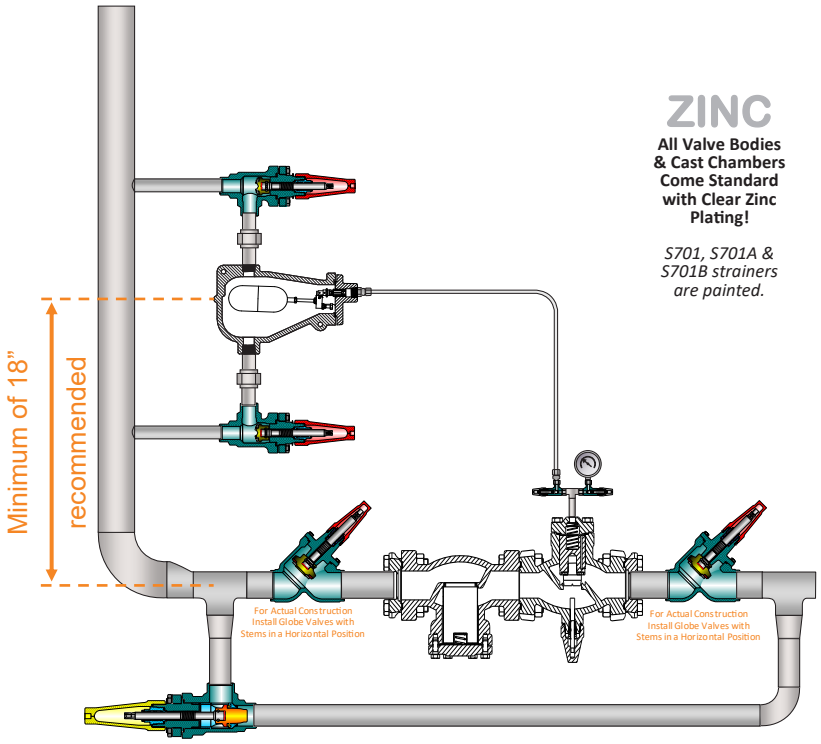
Valve Number	Spring Number (Number in parentheses is the minimum required pressure differential across the piloted valve.)*				
700JRH	705-1L (5)	705-5L (20)	705-10L (44)	705-20L (70)	-
700XH	705-1L (5)	705-5L (16)	705-10L (30)	705-20L (60)	-
700AXH	705A-2L (5)	705A-10L (30)	705A-30L (40)	705A-60L (80)	-
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)			
			NPT or Socket Weld	Weld Neck	ODC Copper	Pilot Operated Valve	P.O. Valve w/ Strainer	P.O. Valve, Strainer, Float w/ Cast Iron	P.O. Valve, Strainer, Float w/ Steel
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 (SW only)	3	3-1/8	78	154	172	200

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



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

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	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		

STRAINER
A = Strainer Included Z = No Strainer

Low Side Expansion/Level Controls Model Overview

Low Side Valves C_v Values and Overview

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

See Page 5 for Sizing Info

Direct Acting Valves

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

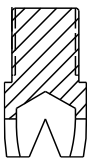
701S Series Metering Plug Nomenclature

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°

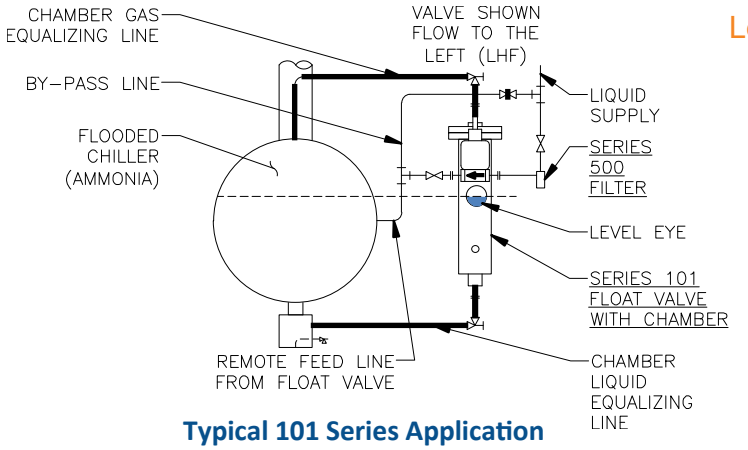
* 'F' suffix on valve model number indicates use with halocarbon refrigerants.

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

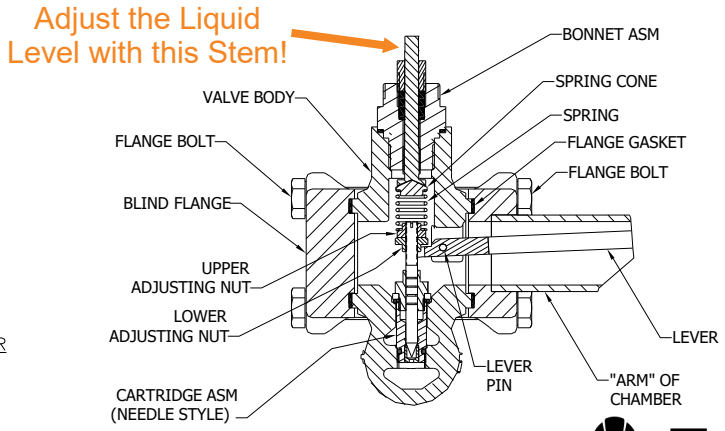
Direct Acting Low Side Control

101 Series Float/Expansion Control

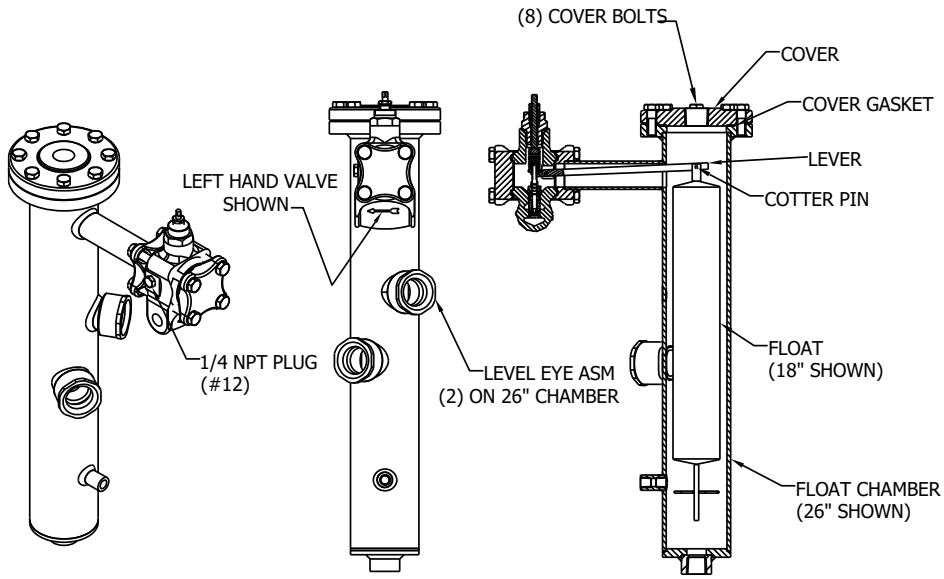
The 101 Series valve float ball is linked through a forked lever to act upon a needle or plunger directly over the orifice controlling the refrigerant flow. A spring is installed over the needle, working in opposition to the lever, which supports the weight of the float ball. The spring pressure can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



Typical 101 Series Application



101 Series Design



101 Series Valve Assembly with 26" Long Chamber

ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!

See Page 5 for Sizing Info

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

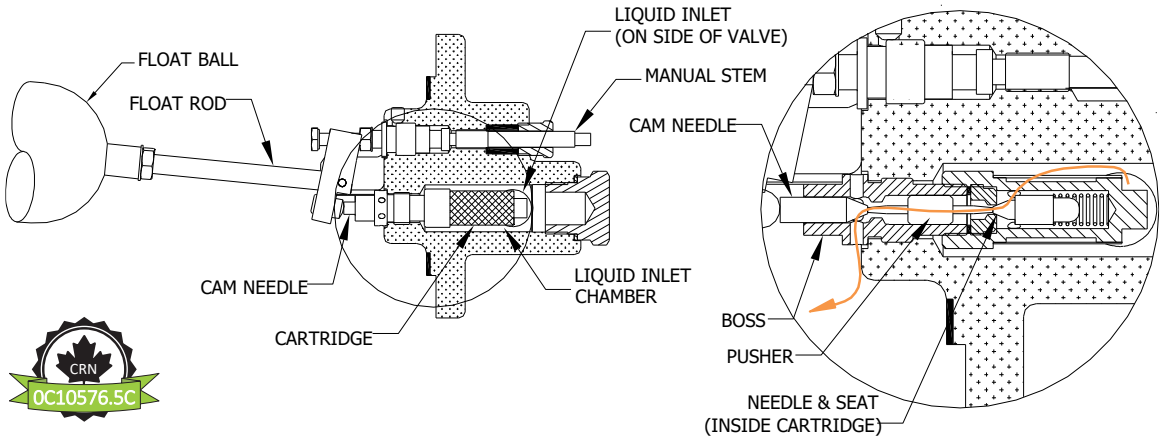
101 Valve Series Includes: 101, 101A

300H Series Float/Expansion Control

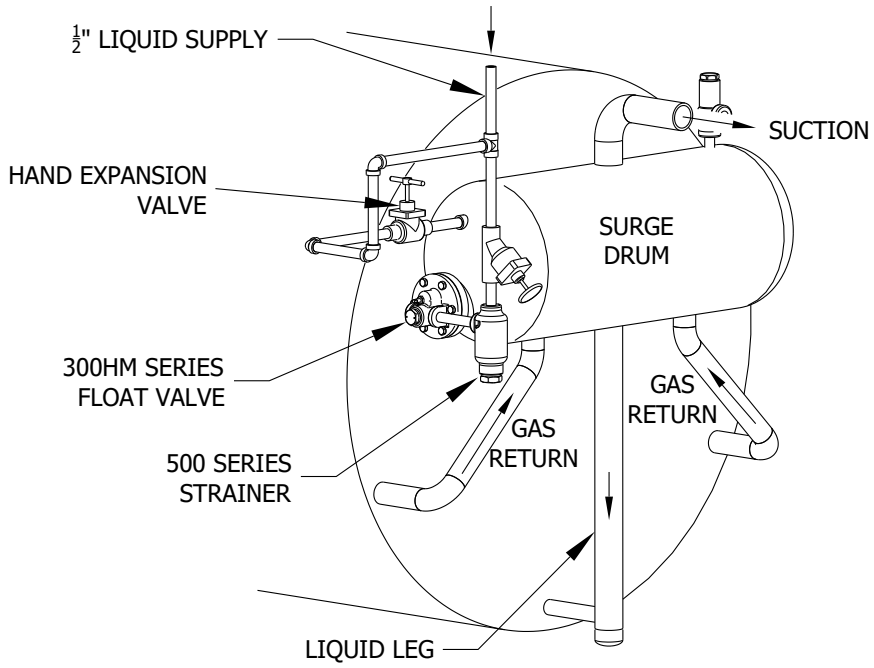
The 300H Series internal mounting, fixed level, low side float valves are modulation type liquid level controls designed primarily for use with ammonia. The valves incorporate a replaceable cartridge that contains the working needle and seat. **This cartridge can be removed without pumping down the surge 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 a heavier float ball. When utilizing welding flanges to mount these valves directly to a vessel, special consideration must be given to ensure that sufficient clearance is provided for the valve's float ball to move freely with changes in liquid level (see engineering bulletin for more information).

See Page 5 for Sizing Info

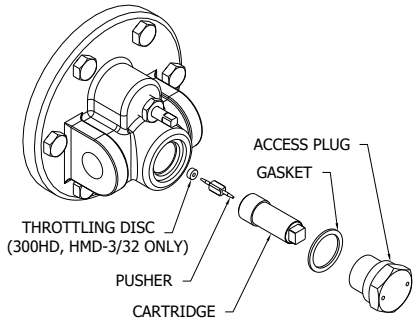
CRN 0C10576.5C



300H Series Design (Expands Directly Through the Valve Into the Vessel)



300H Series Typical Application



Easily Serviceable Cartridge Design

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

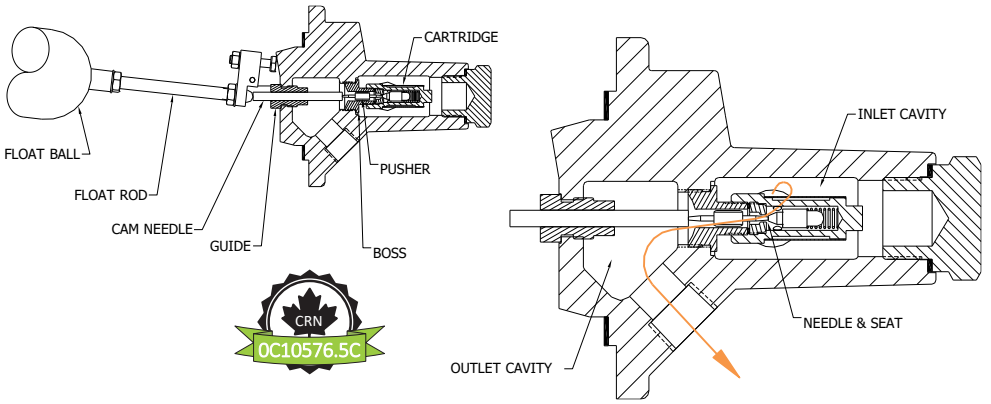
ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!

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

Direct Acting Low Side Control

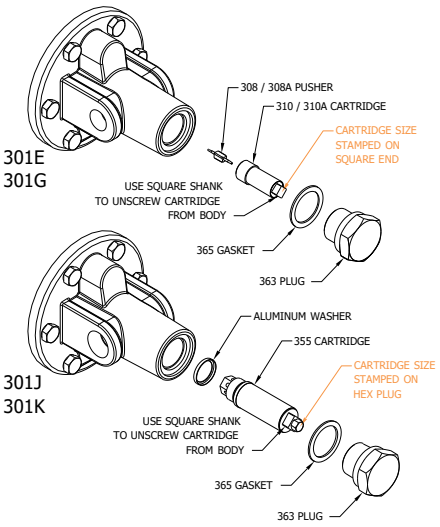
301E Series Float/Expansion Control

The 301E Series external mounting, fixed level, float valves are modulating liquid level controls. The welded steel chamber features a Phillips Level Eye for visual inspection of the liquid level. These valves incorporate a replaceable cartridge containing the working needle and seat. Pump down of the chamber is required to service the valve. The 301E Series valves are designed for use with unitary surge drums and evaporators, as well as for intercooler or desuperheater level control, small ammonia or halocarbon chillers, and other applications requiring external level control. A remote feed line is required from the valve outlet to the vessel or evaporator. For halocarbon systems, the valves are fitted with heavier float balls to accommodate the different operating characteristics.

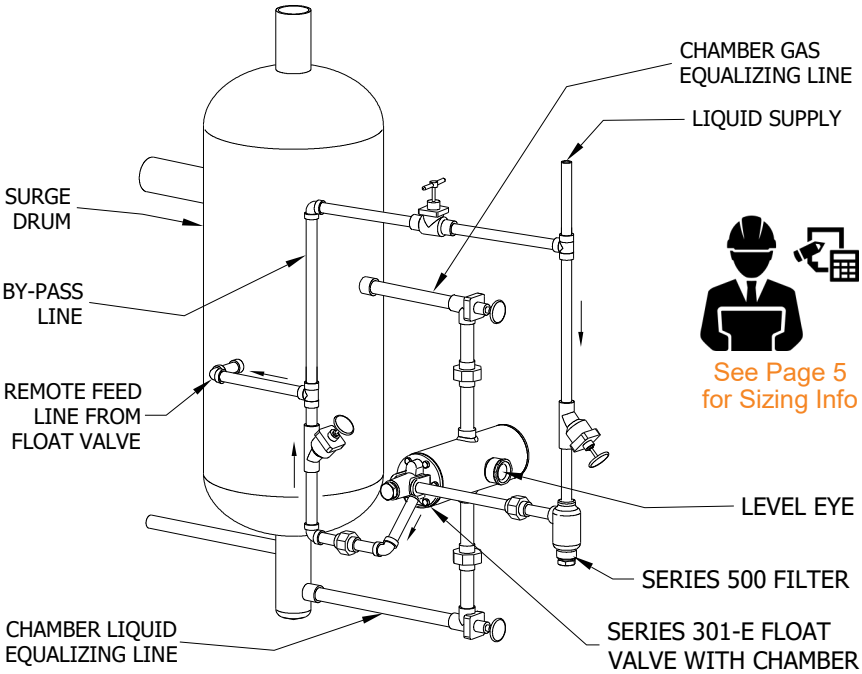


301E Series Design (Expands Through Valve and Is Fed Into Vessel via Remote Line)

ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!



Easily Serviceable Cartridge Design



See Page 5 for Sizing Info

301E Series Typical Application

Assembly Part Number Nomenclature

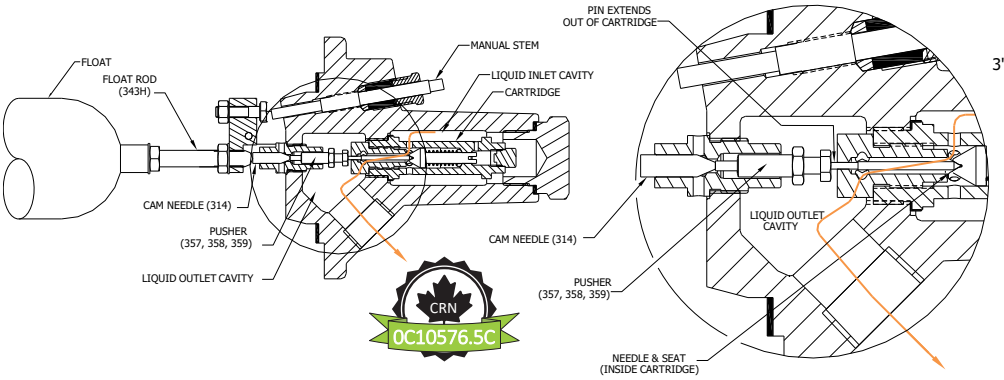
301E		-G	Z	B
Base Valve Model				
REFRIGERANT TYPE (BLANK) = Ammonia F = Halocarbon P = Propane				
ORIFICE				
B = 5/64”	G = 9/64”			
C = 3/32”	H = 5/32”			
D = 3/32D	I = 3/16”			
E = 7/64”	K = 7/32”			
F = 1/8 “	N = 9/32”			
(PLACE HOLDER)				
CHAMBER B = Welded Steel Chamber Z = No Chamber				

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

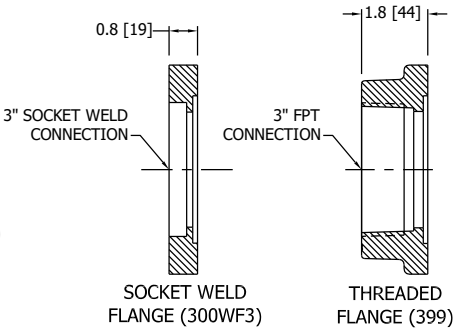
Direct Acting Low Side Control

301H Series Float/Expansion Control

The 301H Series internal mounting, fixed level, low side float valves are modulating liquid level controls. These fixed level controls require a remote feed line 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 pumping down the surge drum or evaporator, thanks to a secondary shut-off arrangement built into the valve.** The stem on the front of the valve operates the backseating arrangement and should not be used as a hand expansion bypass. When used in halocarbon systems, these valves can be supplied with heavier float balls. When welding flanges are used to directly mount these valves to a vessel, special consideration must be given to ensure sufficient clearance for the valve's float ball to move up and down with changes in liquid level (see engineering bulletin for more information).



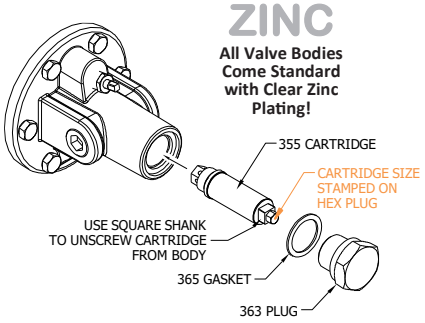
301H Series Design (Expands Through Valve and Is Fed Into Vessel via Remote Line)



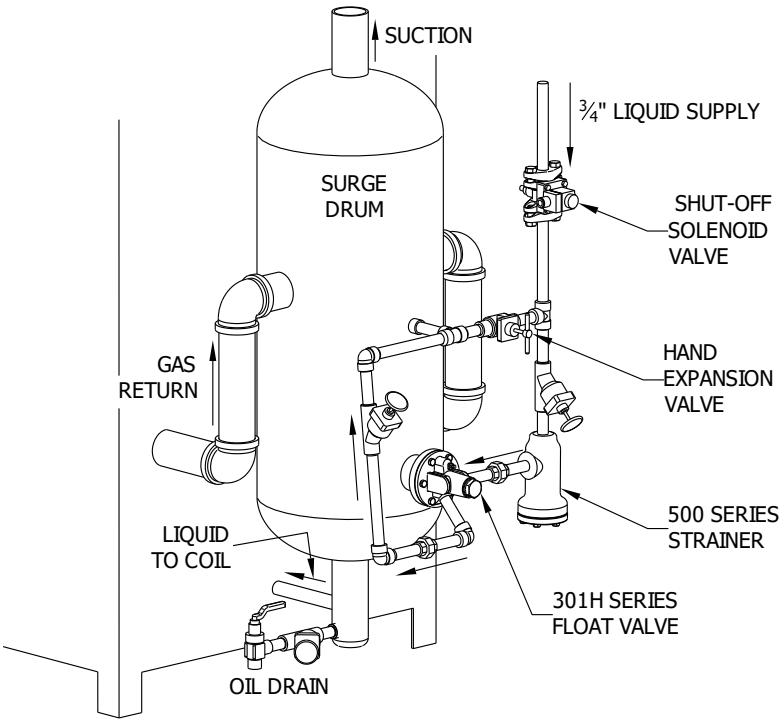
Flange Options for Mounting

See Page 5 for Sizing Info

ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!



Easily Serviceable Cartridge Design



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				

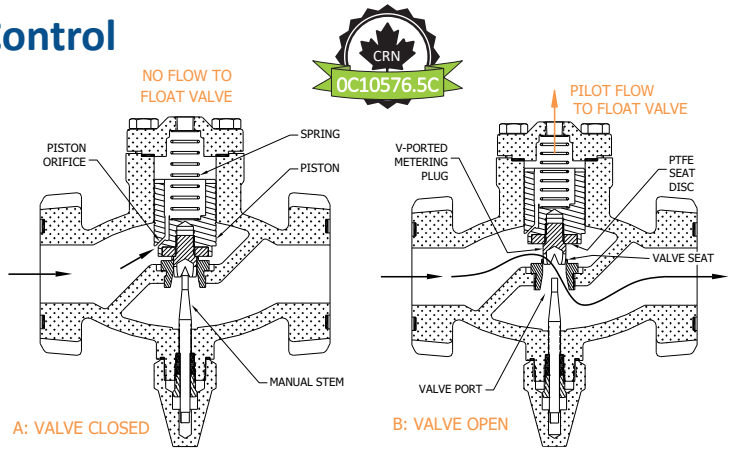
301H Valve Series Includes: 301H, 301A

*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 that 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 that responds to changing requirements, providing a modulating control. The 701S valves are flanged and may be supplied with a mating strainer. **A metering plug and spring are selected based on specific operating conditions.** A manual opening stem, used to raise the metering plug off the internal port, and a replaceable Teflon (PTFE) seat disc are standard features.



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 is mounted inside the controlled vessel, can 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 features an adjusting stem that allows the operator to change the liquid 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 for visual indication.

The 701S valve is actuated by controlling the pressure above its internal piston. A drop in liquid level, detected by the pilot valve, reduces the pressure in the pilot line as the pilot orifice opens. This pressure drop causes the 701S piston to rise, opening slots in the metering plug. Conversely, a rise in liquid level closes the pilot float orifice and increases the pressure in the pilot line, 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 located toward the "tail" of the arrow cast into the 101 valve body. On a 301E valve, the pilot line may be connected to either of the inlet connections on the sides of the valve body. The pilot line must be 1/4" Nominal Pipe for proper operation (3/8" OD copper tubing is also acceptable for halocarbon applications). Refer to 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	

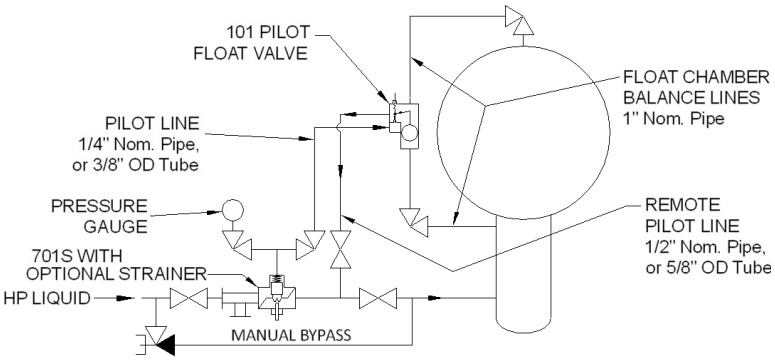
FLANGES

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	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	Y=4" WN
H=1-1/8" ODC	Q=2" FPT	Z=None
I=1-1/4" FPT		

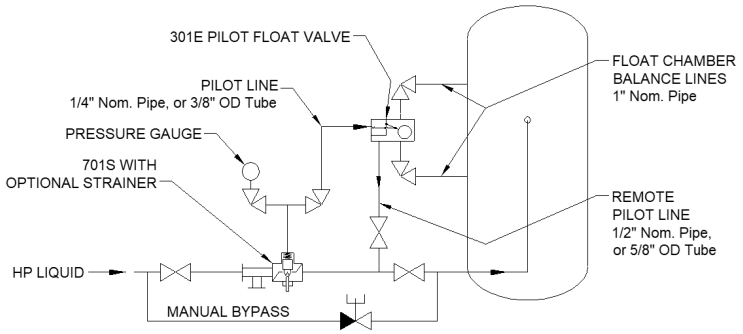
STRAINER
A = Strainer Included
Z = No Strainer

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

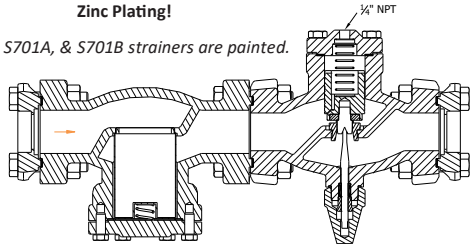


General Application for 701S Series Pilot Operated Valve with 301E Series Fixed Level Pilot Float Valve

ZINC

All Valve Bodies Come Standard with Clear Zinc Plating!

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

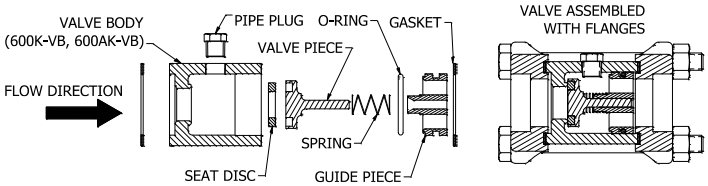
Pilot Operated Valve Model Number*	Port Size (in.)	Strainer Number	Pilot Float Valve with Chamber		Available Connections (in.)			Weight (lbs)		
			Float Valve Number	Orifice Size (in.)	NPT or Socket Weld	Weld Neck	O.D. Copper	Pilot Operated Valve	P.O. Valve w/ Strainer	P.O. Valve w/ Strainer & Float
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 (SW only)	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)

600 Series Cast Ductile Iron Check Valves



600 Series Check Assembly Example (Ease of Serviceability)

The 600 Series flanged, in-line, disc-type check valves are spring closing. **They may be installed in either vertical or horizontal runs. A removable back plate allows for easy disassembly and maintenance.** The 600J and 600K Series valves are Teflon (PTFE) seated. When ordered with the 'S' suffix, the valve is equipped with a spring that requires approximately a 2 psi pressure differential to open. **When ordered without the 'S' suffix, these valves are supplied with a light spring with a ¼ psi cracking pressure, making them suitable for gravity drain lines.** The 600 Series check valves are designed to prevent reverse flow of refrigerant in suction, hot gas, and liquid lines. These valves are suitable for liquid refrigerant gravity drain applications, pump discharge, and suction lines. **When used for gravity drain, they should be mounted vertically.** The Series 600J check valves are rated for a maximum working pressure of 300 psi. Series 600K check valves are rated for a maximum working pressure of 600 psi. In hot gas defrost applications, they are installed between the drain pan and the hot gas inlet to the evaporator. In this configuration, the valve prevents liquid from collecting in the drain pan coil during normal evaporator operation. The 600 Series check valves are **not well-suited** for reciprocating compressor discharge applications or for installations where flow pulsation creates resonant frequency with the valve.

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 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 V=3" SW W=3" WN X=3-1/8" ODC Y=4" SW Z=None			

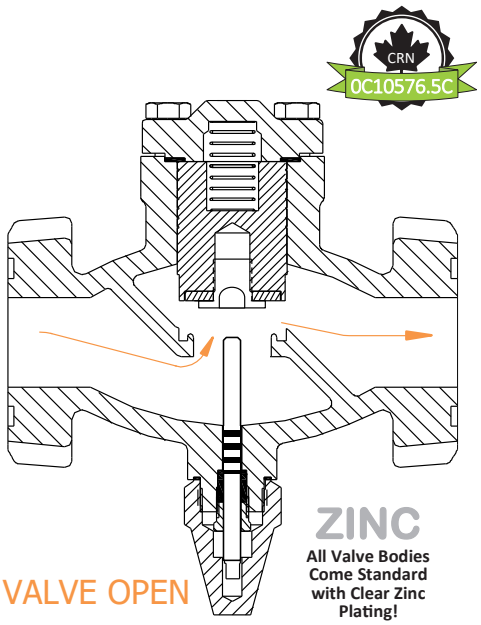
600 SERIES VALVE CONFIGURATIONS

Valve Number	Material	Port Size *(in.)*	Approx. ΔP to Open	Flange Sizes Available	# of Bolts/ Nuts	Bolt Size *(in.)*	Flange Type	Weight *(lbs)*	Wolf-Linde Ref.
600JR	Cast Ductile Iron	1	<1 psid	1/2" 3/4" 1"	2	5/8	Oval	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	15/16	<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 differential springs of 2, 5, 10, 20, 35, 50, 60, 70, and 90 pounds to suit your application. They have a manual lifting stem and replaceable Teflon (PTFE) seat disc.** The 700X Series check valves prevent reverse flow of refrigerant in suction, hot gas, and liquid lines. These valves are suitable for reciprocating compressor discharge line service, refrigerant pump discharge, suction line service, and can also be applied as hot defrost relief valves. Additionally, they can serve as outlet check valves for various liquid transfer systems. The 700X Series check valve is spring actuated and normally closed. When the differential pressure across the valve overcomes the spring force holding the check valve closed, the disc is forced away from its seat, permitting flow. As the differential pressure decreases, the disc is 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	Nominal 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

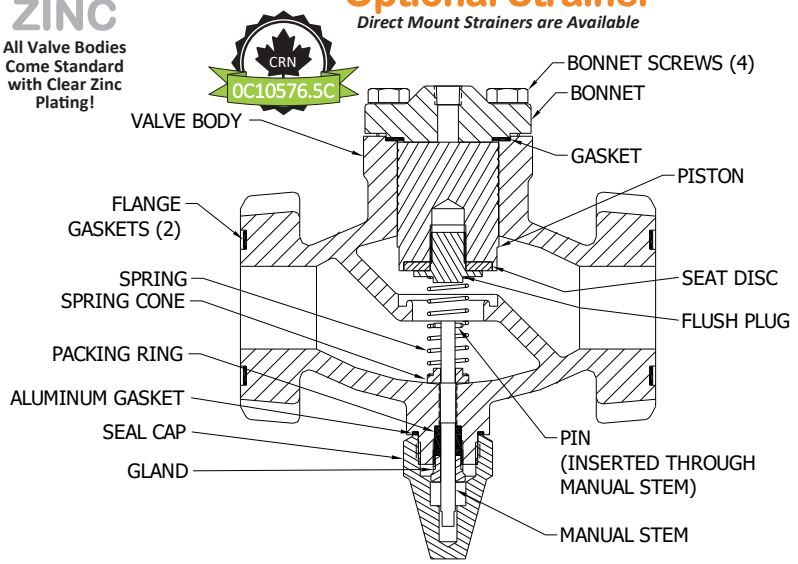
FLANGES
A=1/2" FPT
B=1/2" SW
C=3/4" FPT
D=3/4" SW
E=1" FPT
F=1" SW
G=1" WN
H=1-1/8" ODC
I=1-1/4" FPT
J=1-1/4" SW
K=1-1/4" WN
L=1-1/2" FPT
M=1-1/2" SW
N=1-1/2" WN
O=1-3/8" ODC
P=1-5/8" ODC
Q=2" FPT
R=2" SW
S=2" WN
T=2-1/8" ODC
V=3" SW
W=3" WN
X=3-1/8" ODC
Z=None

Check Valves (Gas-Powered to Close)

700S Series Gas Powered Check

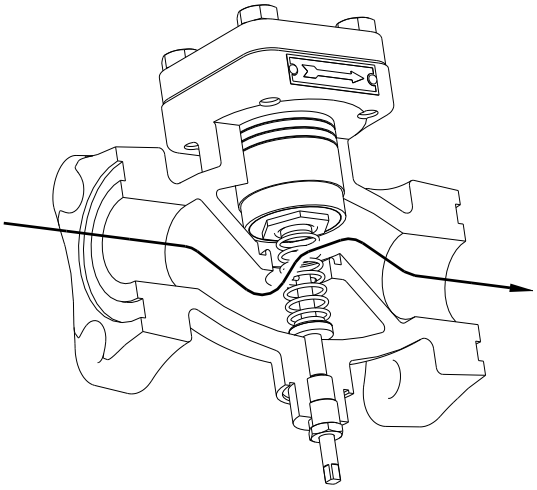
ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!

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 located beneath the valve piston. All models are equipped with a Manual Lift Stem featuring a Seal Cap closure. **The 700S Series valves are normally open and are closed by gas pressure from a remote source when a pilot solenoid valve is energized.** Gas enters the valve through the 1/4" FPT connection on top of the valve bonnet and acts upon the top of the piston, forcing the seat disc down onto the main valve seat, thereby stopping refrigerant flow. For the valve to close in the normal flow direction, the **inlet pilot pressure above the piston must be a minimum of 7 psi higher than the inlet pressure to the valve.** Flow in the opposite direction of the arrow is not permissible. To open the valve, 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. The spring beneath the piston forces it upward, fully opening the valve to allow refrigerant flow.



700S Series Permissible Flow Direction

The 700S Series valve is designed for use on liquid legs and gas return legs on flooded evaporators, as well as liquid drain lines in transfer systems. Since the valve is spring opening, no pressure is required to open the valve; thus, flow is unrestricted in gravity drain applications. **Due to the fail-open feature, this valve 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	Nominal 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	V=3" SW
D=3/4" SW	M=1-1/2" SW	W=3" WN
E=1" FPT	N=1-1/2" WN	X=3-1/8" ODC
F=1" SW	O=1-3/8" ODC	Z=None
G=1" WN	P=1-5/8" ODC	
H=1-1/8" ODC	Q=2" FPT	
I=1-1/4" FPT	R=2" SW	

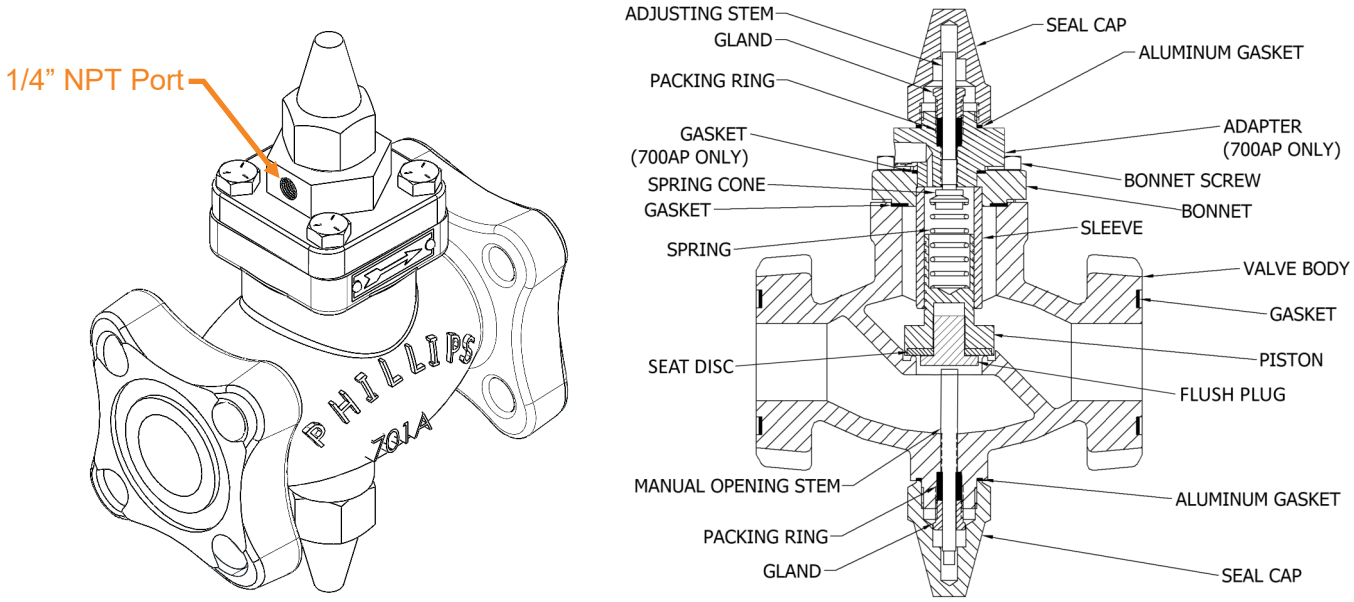
Interrupting Valve (Adjustable with External Pilot Connection)

700P Series Adjustable Interrupting Valve with External Pilot Connection

The 700P series flanged, piston type, interrupting valves are normally closed by a spring located above the valve piston. These valves are equipped with a Manual Lift Stem encased by a Seal Cap closure. The differential pressure required to open the valve can be adjusted using the top manual adjusting stem.

These valves come standard with a 1/4" NPT port on the top bonnet, allowing the cracking pressure 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 also makes it possible, with the use of additional external pilot(s), to configure the valves to regulate based on differential pressure, inlet pressure, outlet pressure, etc.** Contact Phillips for assistance with pilot configurations.

All Phillips interrupting valves may be installed upright in a horizontal line or vertically in a vertical line.



700AP Gas Powered Adjustable Interrupting Valve Assembly and Internals

Optional Strainer

Direct Mount Strainers are Available

ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!

700P SERIES CHECK VALVE DATA

Valve Model	Nominal 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

L=1-1/2" FPT
M=1-1/2" SW
N=1-1/2" WN
Q=2" FPT
R=2" SW
S=2" WN
T=2-1/8" ODC
V=3" SW
W=3" WN
X=3-1/8" ODC
Z=None

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") serves as the inlet for pressurized gas. The low pressure port (marked "LP") functions as the vent. 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 in 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. High pressure gas is supplied to the HP port.

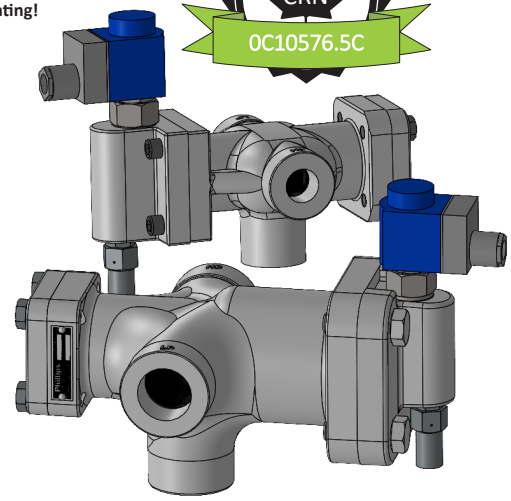
With the 3-Way valve connected as described above and the solenoid de-energized, the pathway between the common and LP (vent) ports remains open. This is achieved by high pressure gas and an internal spring, which hold the smaller HP piston closed against the HP seat, keeping the LP port open. In this "vent" position, the pumper drum vents 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, which may need to be increased for long pipe distances. However, unnecessarily high pressure can lead to premature valve wear.

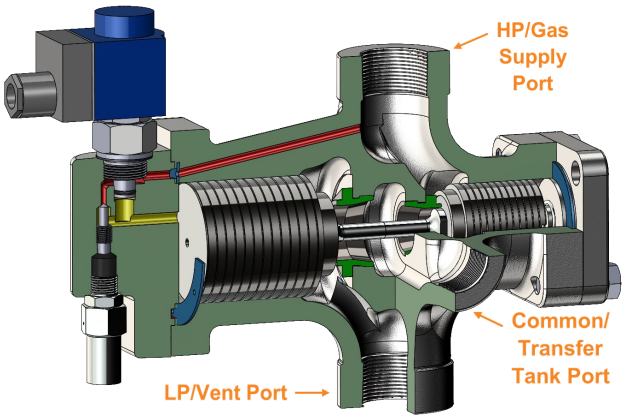
The 3000 Series valves incorporate a manual opening stem located below the solenoid. When this stem is screwed in, the valve will automatically switch from the vent to the high pressure position when the solenoid coil is energized. Opening the stem by ½ turn will manually cause the valve to switch from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

ZINC
All Valve Bodies Come Standard with Clear Zinc Plating!

CRN
0C10576.5C



3000 Series 3-Way Valves



3000AN 3-Way Valve Section View

3000 Series 3-Way Valve Data

Model	Connections	C_v Vent (flow coefficient for vent to common)	C_v 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

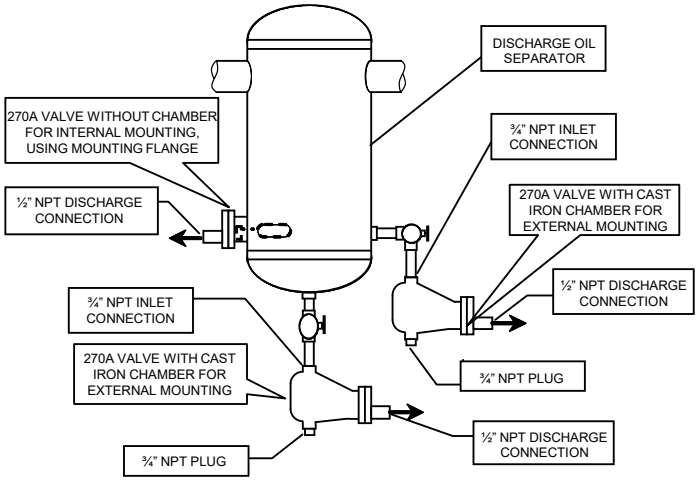
Coil Voltage
120 = 115/120 Volt AC 60 Hz Coil
240 = 208-240 Volt AC 60 Hz Coil
Z9 = Special Request

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)

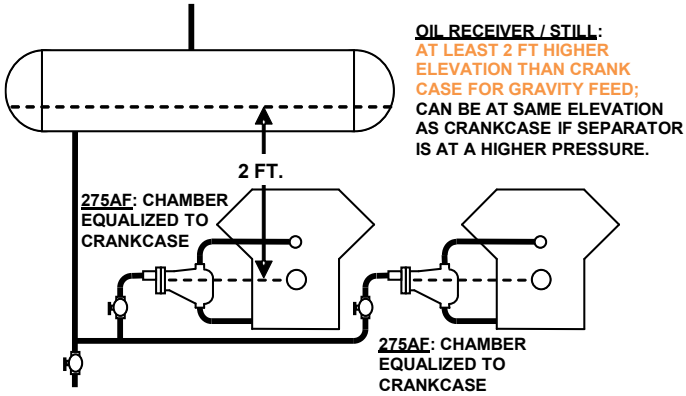
The 270A High Side Float Valve, which opens on a rise in level, transfers oil from a discharge line oil separator to the compressor's crankcase or to an oil reservoir. This valve is used for oil in ammonia and halocarbon systems. **The standard orifice supplied in the valve is 3/32", and it will operate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



270A High Side Oil Drain Valve Application
(3 Different Mounting Options Shown)

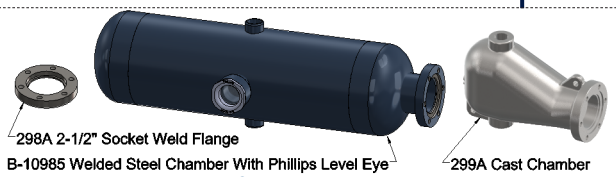
275AF Low Side (Used for Oil)

The 275AF Low Side Float valve can be used to maintain the oil level in a compressor crankcase. For multiple compressor applications, a 275AF valve should be installed on each compressor. In this configuration, the 275AF is fed from an oil reservoir at a pressure equal to or greater than that of the compressor crankcase. **If the oil reservoir pressure is equal to the crankcase pressure, it must be positioned at least two feet above the desired oil level in the crankcase to allow for gravity feed.** When the oil reservoir is at a higher pressure than the crankcase, it may be mounted at a lower elevation. **Refer to 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 Standard with Clear Zinc Plating!



Mounting Options for 270A and 275A Series Valves

270A & 275AF OIL VALVE CAPACITIES & WEIGHTS

Orifice Size *(in.)*	C_v	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	-	5.1	25
5/64	0.140	0.08	0.4	-	-		
3/32	0.170	0.10	-	-	1.5*		
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 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 ODC flanges, all other flanges are machined to Wolf-Linde dimensions. In 1998, Phillips acquired the manufacturing rights to the flanges and check valves previously sold by Wolf-Linde, Inc. For more information, please click on the Wolf-Linde logo to the right to access an archived Wolf-Linde catalog: Wolf-Linde

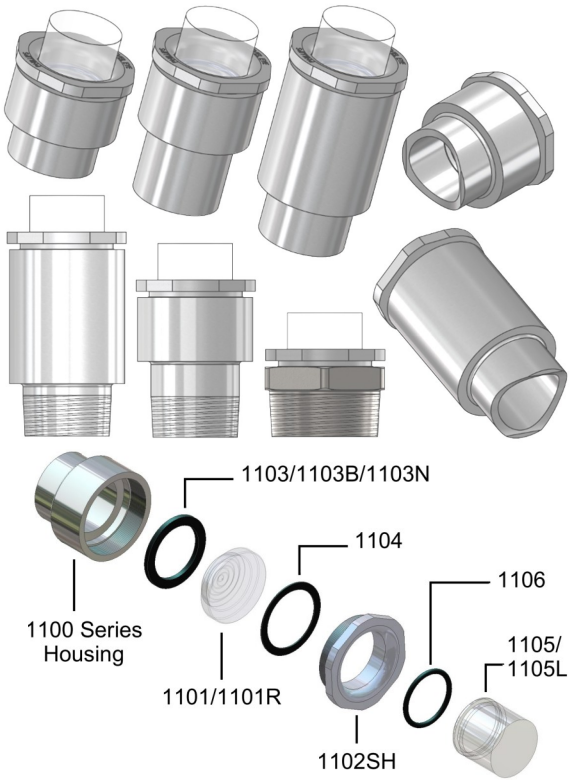
Please contact our factory for specialty flange inquiries, such as reducing flanges or flanges with copper connections.

Accessories - Level Sight Glass

Level Eye® Sight Glass

The Phillips Level Eye is a reliable, industrial-type sight glass. **Its Reflex Lens (Bullseye Style) displays the actual liquid level without the need for a secondary lens.** The lens appears dark when liquid is present and clear when it is not. 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 1 of the ASME Boiler & Pressure Vessel Code. The housing can be welded directly into ASME Code vessels. The welding end is sized to a nominal 1-1/2" IPS Schedule 80 pipe. Both the weld neck and threaded neck are also dimensioned for a nominal 1-1/2" Schedule 80 pipe. All retainers are made from annealed 416 stainless steel forgings. Type 304 stainless steel housings are also available. **For more information, please refer to our Level Eye Service Bulletin.**



1100 Series Parts & Housing Part Numbers

	Part Type	Part No.	Description
Weld Housing	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
	304SS	1100SH	2" long housing, square end
		1100SCH	2" long housing, saddle milled
		1100LSH	4" long housing, square end
		1100LSCH	4" long housing, saddle milled
Threaded Housing	SA36	1100ATH	3" long housing, 1-1/2" MPT
		1100TH	4" long housing, 1-1/2" MPT
	SA105	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, Teflon (PTFE)*
		1103B	Gasket, Buna-N*
		1103N	Gasket, Neoprene*
		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"); for refrigerant temperatures below -20°F/-29°C
	Lens Replacement Kits	K1100	Includes 1101 clear lens, 1103 Teflon (PTFE) gasket* and 1104 fiber gasket
		K1100R	Includes 1101R reflex lens, 1103 Teflon (PTFE) gasket* and 1104 fiber gasket

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

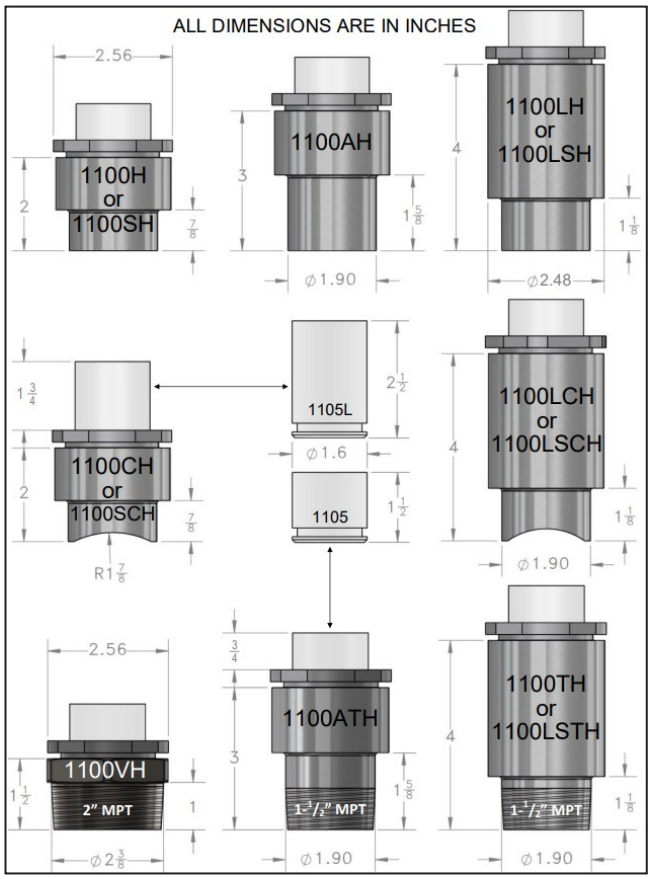
CRN 0F00829.2C

Level Eye assemblies, in both carbon and stainless steel, are registered for use in all Canadian provinces and territories, except for 1100V

ZINC

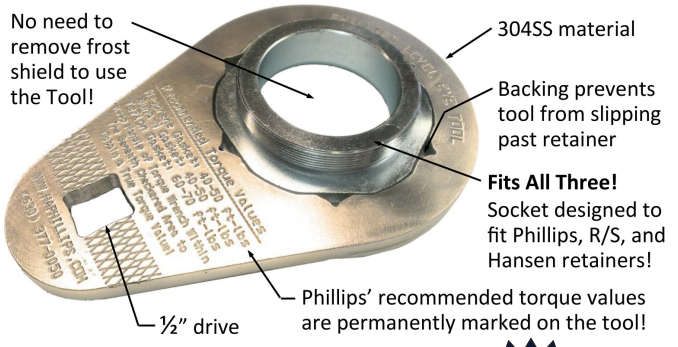
All Carbon Steel Level Eye Housings (except for 1100VH) and SS Retainers Come Standard with Clear Zinc Plating!

1100 Series Housing Options



Accessories - Level Eyes, Pressure Gauges, and Float Switches

Level Eyes Continued... (Assembly/Installation, Accessories, and 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	-P

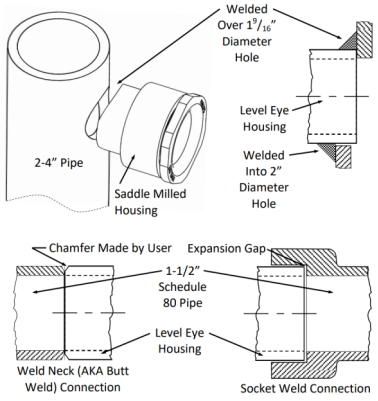
Housing Style (less 'H')
See assembly parts table
Please note that you do not list the 'H' that is part of the housing part number.

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 Teflon (PTFE)
B = Buna-N
P = Neoprene

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



Hansen and Phillips housings use the same thread type. This tap works with both!

Float Switches with a Welded Phillips Level Eye

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

Part Number	Description	Assembly Material	Electrical Connection	Fitting Connection
HAPSS-1	HAPSS with Phillips 1100SC-RN Level Eye	Stainless Steel	DIN Plug with 24" Wire Leads[1]	¾"-14 FPT or 1" Butt Weld
HAPSS	Float Switch Assembly	Stainless Steel		
HAPSW	Replacement Switch Head	N/A	DIN Plug	N/A

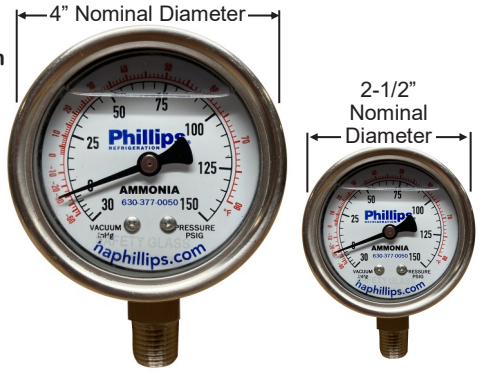
[1] A DIN quick disconnect connector with 24" wire leads is standard; 1/2" conduit connection is available.

Pressure Gauges

Part Number	Nominal 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 Available upon request**



Accessories - Injectors Overview

Phillips Recirculating Injectors - How They Work

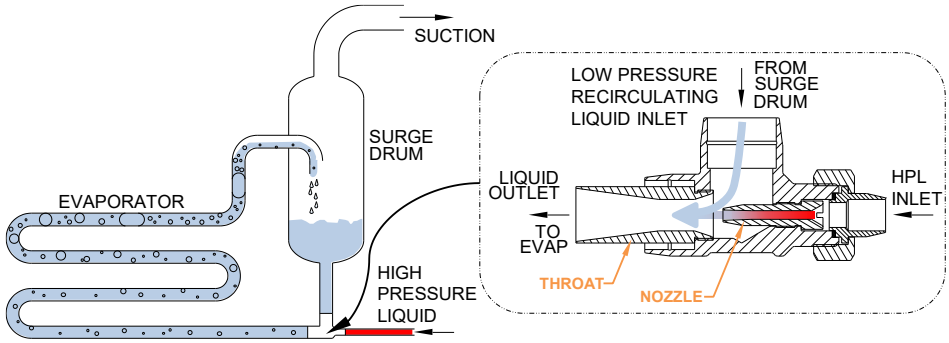
The Phillips Recirculating Injector is a simple device that utilizes the available dynamic energy of high-pressure refrigerant liquid to achieve maximum heat transfer in an evaporator. For more details on how this maximum heat transfer occurs, please refer to the "Select Major Advantages/Disadvantages of System Types" table.

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

The Phillips Recirculating Injector uses the dynamic energy of the fluid as it expands through the nozzle, acting like a liquid pump. It recirculates the excess liquid—via the nozzle's Venturi effect—from the surge drum, through the evaporator, and back to the surge drum, along with the gas that has evaporated in the tubes or plates. **In halocarbon systems, the nozzle's Venturi effect can also be used to lift and return oil.**

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

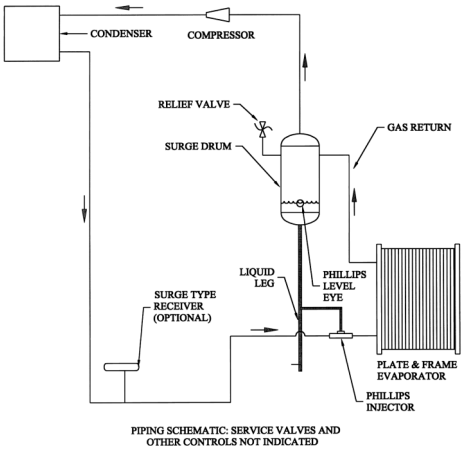
Phillips Recirculating Injector System Technology



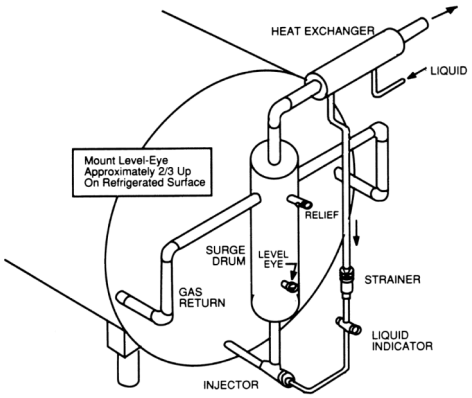
System Type	Select Major Advantages/Disadvantages of System Types	
	Major Advantages	Major Disadvantages
DX (Direct Expansion)	Liquid enters the evaporator ready to evaporate immediately, with very little to no sensible heat transfer required to boil the refrigerant (latent heat transfer). This results in optimal heat transfer characteristics!	A significant portion of the evaporator heat transfer area must be devoted to superheating the refrigerant before it leaves the evaporator. This requires a higher temperature difference (ΔT) between the suction temperature and the room temperature to achieve the necessary superheat
		Modulating feed valves with moving parts are subject to wear and tear
	Minimal refrigerant inventory required	Suction accumulator(s) are required to protect compressors from potential liquid carryover if proper superheat levels are not maintained, such as in the event of a failed feed valve and/or sensor
	No suction riser issues (as with LO systems)	
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 slow, non-turbulent liquid flow through the evaporator results in less fluid mixing compared to pumped overfeed systems (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 the evaporator(s) subcooled due to the added pressure from the pump, and must first be warmed up—often by 35 to 40°F—through sensible heat transfer before reaching the optimum heat transfer phase: boiling of the refrigerant (latent heat transfer)
	Since liquid is turbulently pumped through the evaporator, the fluid is constantly mixing. This promotes the continuous removal and replacement of the thermal insulating boundary layer adjacent to the heat transfer surface, enhancing heat transfer though forced convention	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
A Phillips recirculating injector system has all of the above mentioned major benefits, with none of the major disadvantages!		

Injectors in Critically Charged Systems

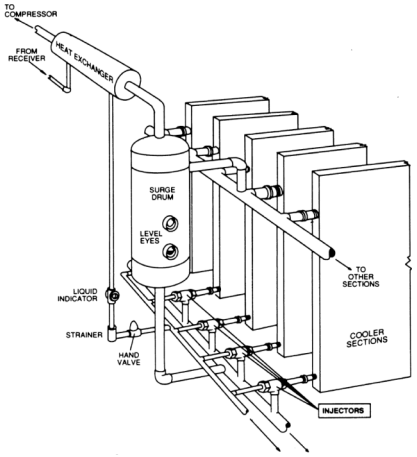
Phillips recirculating injectors have been widely used in critically charged systems with a single compressor and a single evaporator. In this type of system, the entire refrigerant charge resides in the evaporator and surge drum. The condenser (and receiver, if applicable) remains empty—except for the refrigerant currently being condensed and flowing through the liquid line to the evaporator. A liquid indicator should always be installed in the liquid feed line of critically charged systems. During normal operation, it will typically show some gas bubbles moving with the liquid. The presence of gas 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 bubbles, only liquid—may indicate a problem. Possible issues include a partially or completely plugged injector nozzle orifice, a nozzle orifice that is too small for the refrigeration load, or a significant refrigerant overcharge.



Critically Charged System Diagram



Bulk Tank Example (critically charged)



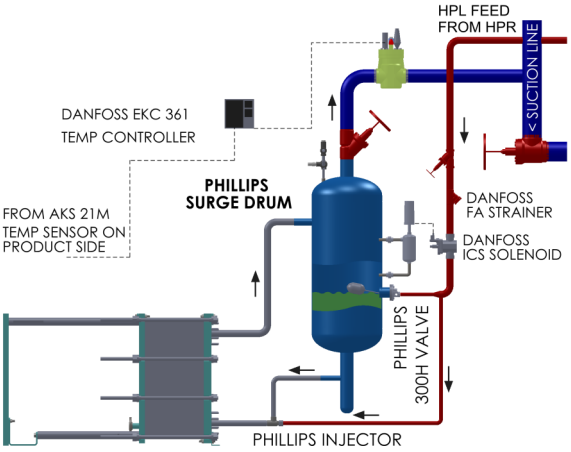
Multiple Chiller Sections (critically charge)

Injector Sizing & Considerations and Central Plant System Applications

Level Controls (Relatively Steady and Constant Cooling Loads):

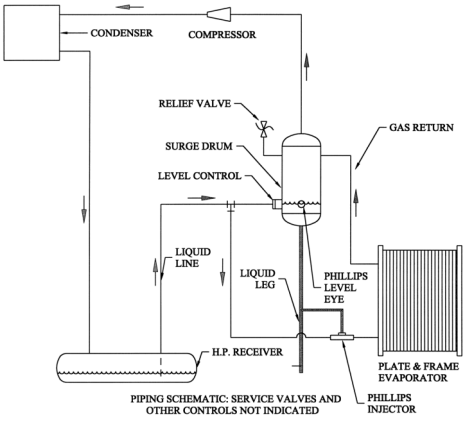
When applying injectors to central plant systems (i.e., multiple evaporators fed from a single source), or when a system only has one evaporator but is not critically charged, level control(s) must be applied to the individual surge drum(s) to prevent overfilling.

For nearly constant process applications or nearly constant cooling loads, it is recommended to size the injector(s) for 70-90% of the maximum expected load, with a Phillips low side valve providing makeup liquid to the surge drum for the remaining load plus any additional backup or safety factor capacity.



Central Plant System Evaporator Setup

Level Control Method for Constant & Steady Cooling Load



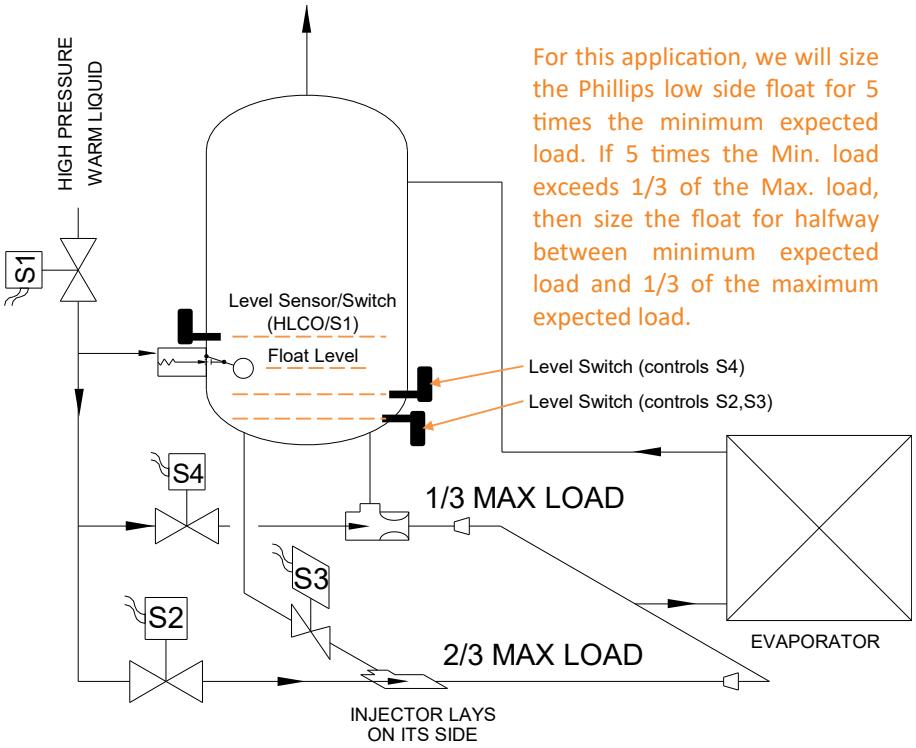
Central Plant System Diagram

Accessories - Injectors

Injector Sizing & Considerations Continued...

Level Controls (Varying Cooling Loads)

When applying injectors to evaporators with non-steady loads, it is recommended to use (2) or more injectors—possibly even in conjunction with a Phillips low side float control—to supply makeup liquid feed to the surge drum. A good example of a widely varying cooling load is using an injector to quickly cool a large tank of milk and then maintain it at a set temperature for storage. In this type of application, the cooling demand starts off high and then steadily decreases as the milk temperature approaches the evaporating temperature regulated by the EPR valve in the suction line. As the cooling load decreases, the liquid demand also decreases. For such applications, it is advisable to use two injectors in parallel to feed liquid, along with a makeup float to provide small amounts of liquid for maintaining the milk at the desired storage temperature (see example to right).



For this application, we will size the Phillips 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 the float for halfway between minimum expected load and 1/3 of the 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. **Maximum Initial Load:** Both injectors and the Phillips low side float are feeding.
2. **Refrigeration load decreases** and liquid level rises to the level switch controlling S2 & S3 —> S2 and S3 are de-energized.
3. **Refrigeration load decreases further** and liquid level rises to the level switch controlling S4 —>S4 is de-energized.

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 selections used in oil syphoning (see page 38), assume a TR load equal to 1/25 of the flooded evaporator load.

See Page 5 for Sizing Info

Step 1: Nozzle Sizing

The effects of an undersized nozzle include increased liquid recirculation and reduced injector discharge energy. Undersizing the nozzle should be avoided, as it lowers system capacity and raises the head pressure. **Based off of test data, systems generally achieve optimal heat transfer rates when nozzles are selected using C_v values from the TR/C_v charts on page 5 (no multipliers required).**

Nozzle C_v 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 include 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 tables below for the TR that is equal to or the next higher value of the 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 table below and the connection size table on the following page, select the injector Model/Body which has the required nozzle and throat sizes, and provides 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.

- **Refrigerant:** R404a
- **Capacity:** 16 TR
- **Saturated Condensing Temperature (SCT):** 104°F
- **Saturated Suction Temperature:** -31°F

Step 1: Select Nozzle

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

Step 2: Select Throat

Applying the capacity correction factor, we divide the actual load by the factor for R404a (0.74) to convert to R22 equivalent tonnage: 16TR ÷ 0.74 = **21.62 equivalent TR of R22**. Based on the throat capacity table, a **1-1/4" throat** is selected.

Step 3: Select Model/Body

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

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

ZINC
All Non-Brass Injector Bodies Come Standard with Clear Zinc Plating!

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

2200WA	-A	I	C

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"	

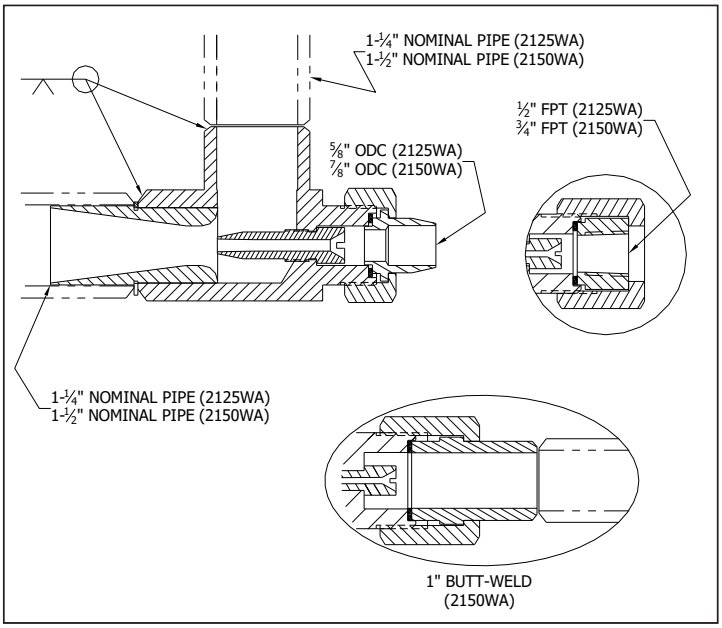
THROAT/DISTRIBUTOR

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	

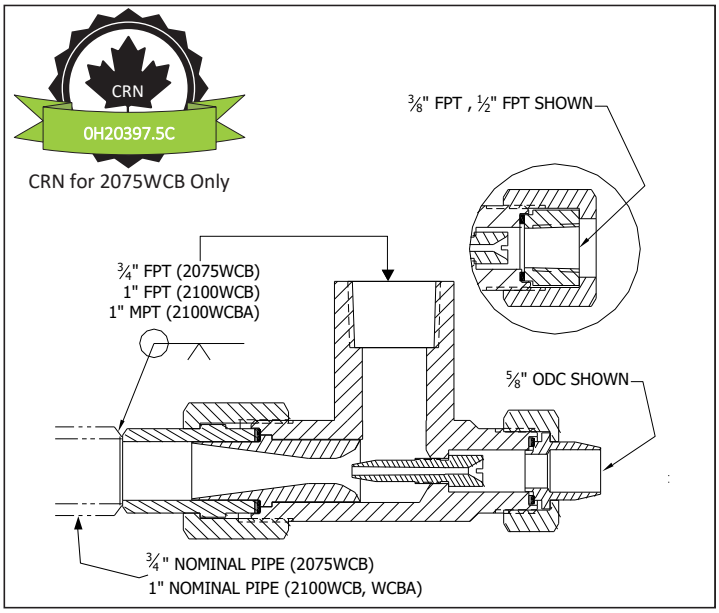
HIGH PRESSURE INLET

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

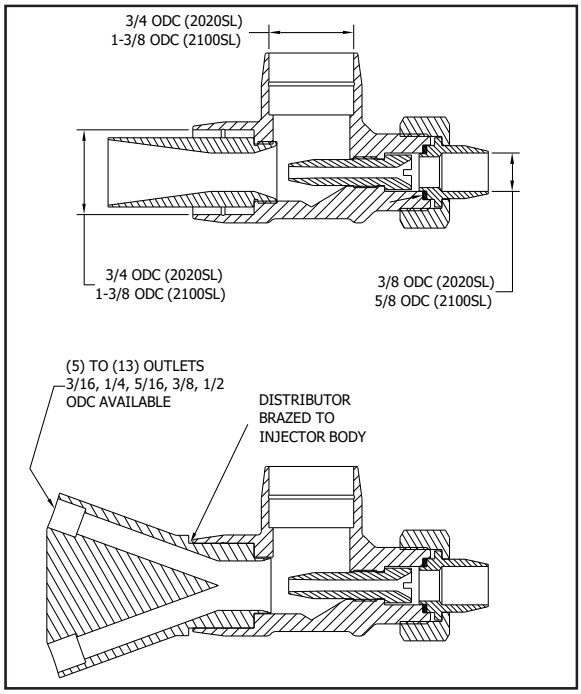
Injector Models/Body Styles



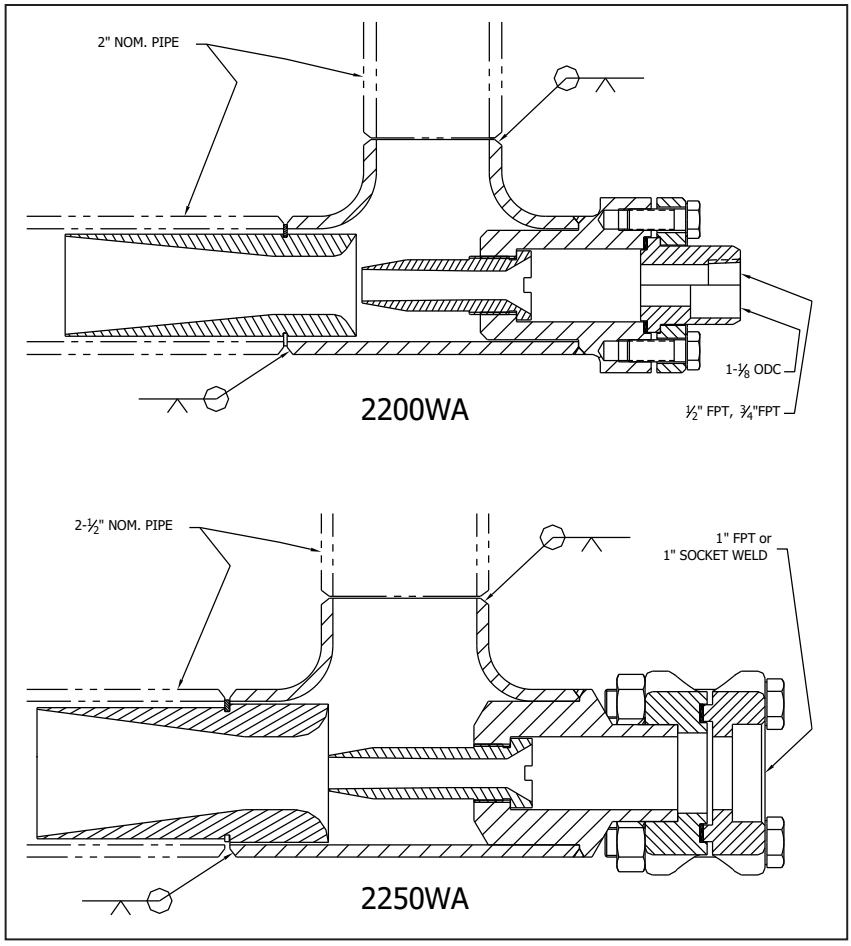
2125WA & 2150WA Injectors



2075WCB, 2100WCB, & 2100WCBA Injectors



2020SL & 2100SL Injectors



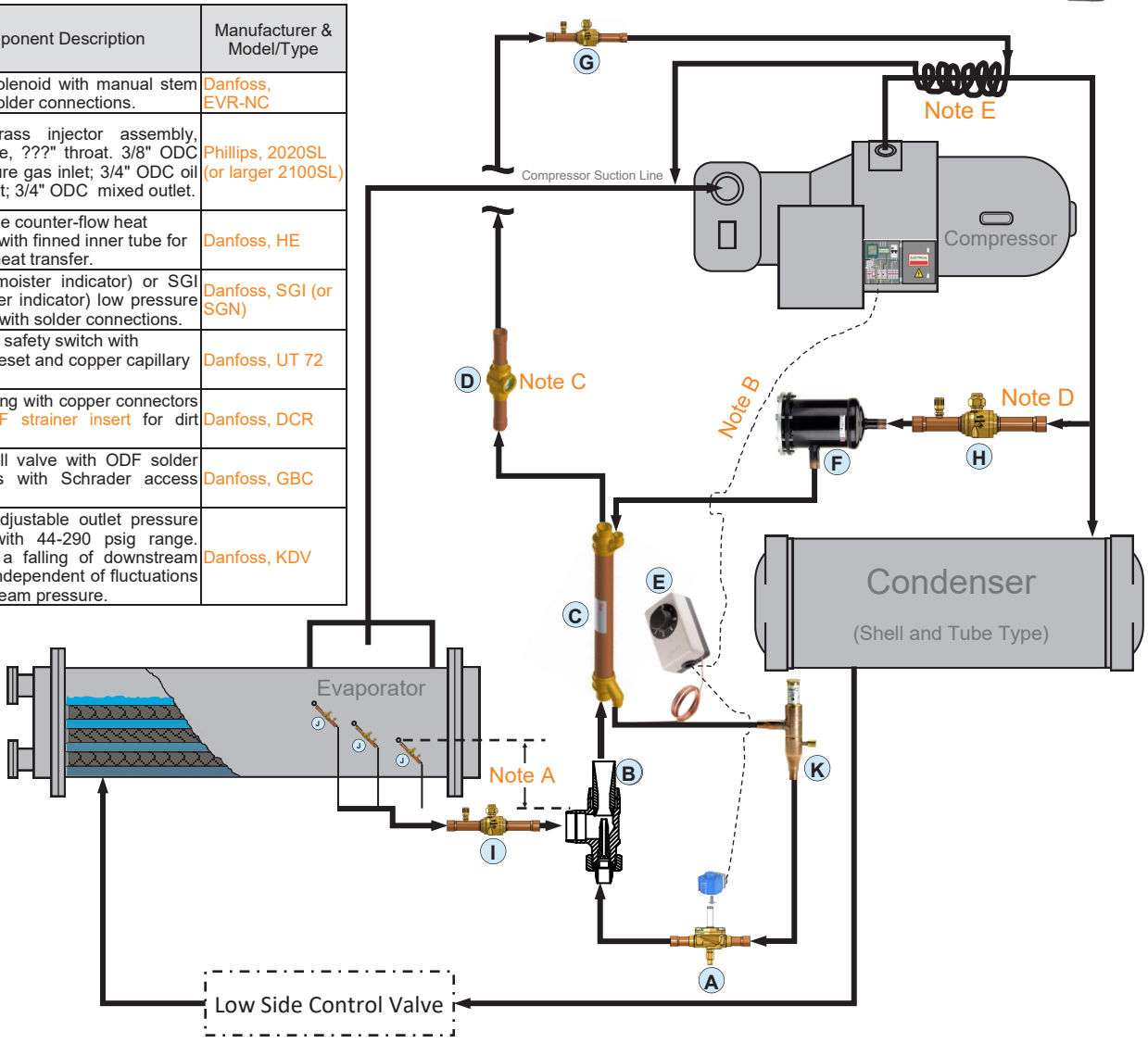
2200WA & 2250WA Injectors

Accessories - Injectors

Injector Setup for Oil Return on a 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 used for oil return service at 1/25 of the evaporator's tonnage (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" ODC oil mixture inlet; 3/4" ODC mixed outlet.	Phillips, 2020SL (or larger 2100SL)
C	Tube-in-tube counter-flow heat exchanger with finned inner tube for maximum heat transfer.	Danfoss, HE
D	SGN (no moister indicator) or SGI (with moister indicator) low pressure sight glass with 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 a 48-F strainer insert for dirt retention.	Danfoss, DCR
G, H, I, & J	Shut-off ball valve with ODF solder connections with Schrader access port.	Danfoss, GBC
K	KVD, an adjustable outlet pressure regulator with 44-290 psig range. Opens on a falling of downstream pressure, independent of fluctuations in the upstream pressure.	Danfoss, KDV

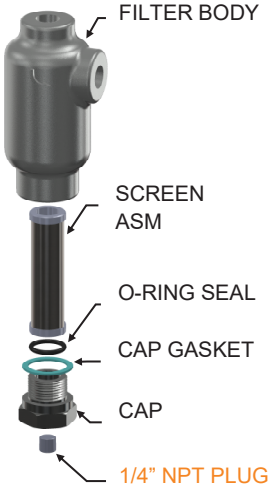


Note A: Install injector just beneath the lowest syphon connection on the evaporator, but no lower than 2-3" below it for maximum efficiency. Otherwise, liquid and oil will flood the injector, and the high pressure discharge gas will have to lift against the liquid head. **Note B:** The coil feeding high pressure gas (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 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. Using an outlet pressure regulator ensures a steady and repeatable syphoning effect from the injector. **Note D:** Use the highest pressure and 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 it—the copper line can be coiled around the discharge line to help vaporize any remaining refrigerant the oil mixture.

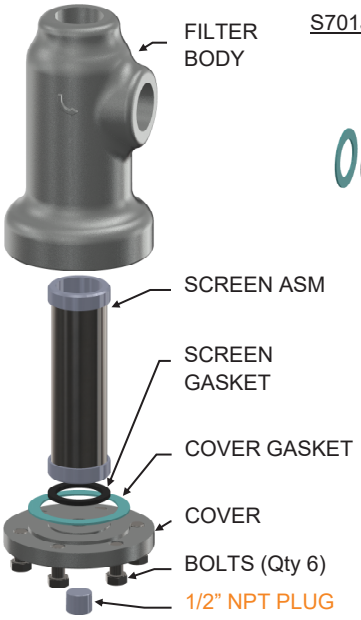
Filters/Strainers

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

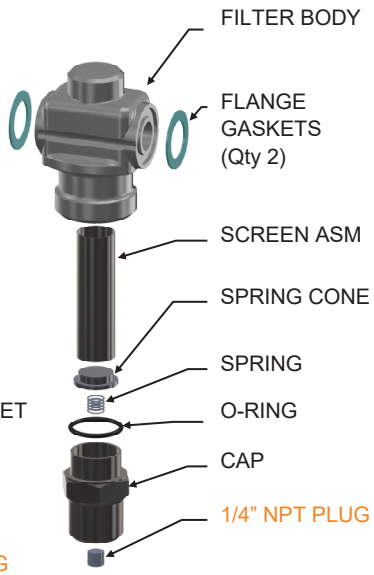
510 FILTER ASSEMBLY



575 FILTER ASSEMBLY



S701JRP FILTER ASSEMBLY



Model	Body Style	Connection Sizes/Styles Available (inches)	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 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 (NPT)

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

ZINC
All Strainer Bodies Come Standard with Clear Zinc Plating!

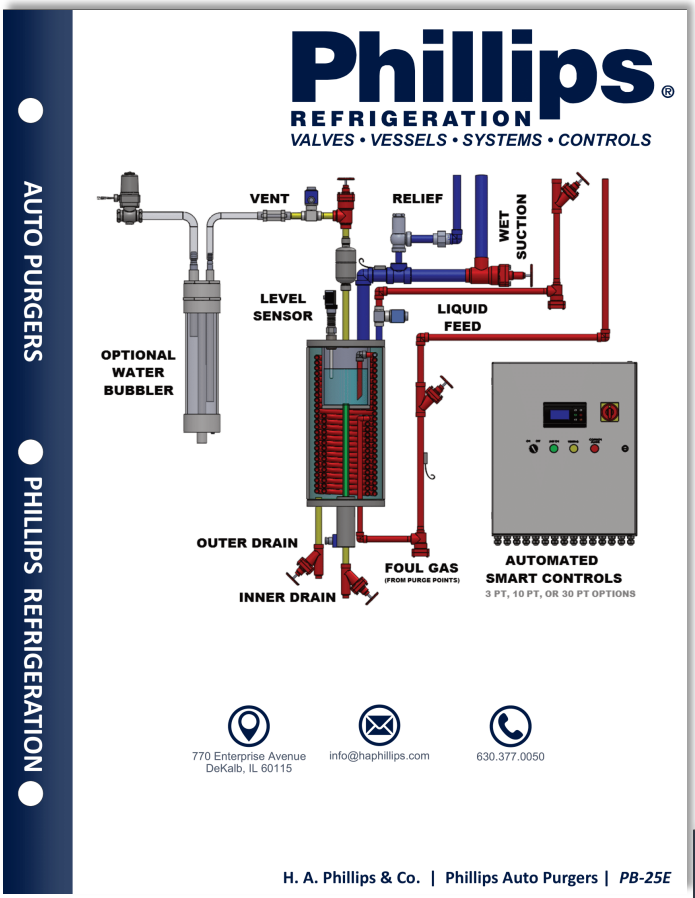
S701JRP Assemblies Part Number Nomenclature

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

Be Sure to Check Out Our Other Product Catalogs!



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