

For Ammonia (R717) and Other Refrigerants

FEATURES

- **Protect compressors for liquid carry-over (sloper)**
- **Avoid continuous liquid buildup in the suction accumulator**
- **Available in gas pressure transfer, gas-assisted gravity transfer, or gas-assisted pump transfer versions**
- **Available as an assembled skid-mounted unit, or sold as a group of components for field assembly**

DESCRIPTION

H. A. Phillips & Co.'s compressor protection systems transfer liquid refrigerant carry-over (sloper) from the low side of the system back to a vessel of higher pressure in order to protect the mechanical integrity of the compressors. Four basic compressor protection system types are available, all of which economically reclaim the required refrigerating effect and avoid continuous liquid refrigerant buildup in the suction accumulator.

In all systems, the excess liquid is first gravity drained from the suction accumulator into a dump trap. The systems differ in where and how they transfer liquid back to the high side of the system.

TYPE T:

If a controlled pressure receiver (or some other intermediate pressure vessel such as intercooler or desuperheater) is available, this is the simplest compressor protection system. Excess entrapped liquid refrigerant is transferred from the dump trap to a controlled pressure receiver using compressor discharge gas. The Type T system only operates with an intermediate pressure vessel because it does not develop enough pressure to transfer liquid to the high pressure receiver.

TYPE A:

The Type A system transfers excess entrapped liquid refrigerant to the high pressure receiver using a combination of compressor discharge gas and gravity. It is only applicable when the dump trap is located above the high pressure receiver with enough vertical height (head) to allow gravity drainage of liquid refrigerant.

TYPE DK:

The Type DK system transfers excess entrapped liquid refrigerant to the high pressure receiver by pressurizing the dump trap to a pressure higher than the receiver pressure. This is accomplished through operation of an interrupting valve (regulator with electric wide open and differential pressure capabilities) located in the compressor discharge line. By energizing the interrupting valve during the transfer cycle, a pressure differential is set up that allows the discharge gas to move the liquid into the receiver. The interrupting valve is normally wide open, and only energizes the differential function for about 30 seconds to accomplish the liquid transfer. Should pressure rise above the setting of the interrupting valve, its internal relief will open and allow excess vapor to flow to the condenser.

TYPE G:

If the system cannot accommodate an interrupting valve in the discharge line, the Type G system provides an alternative. The Type G system transfers excess entrapped liquid refrigerant to the high pressure receiver using a combination of compressor discharge gas and a mechanical pump. Once the transfer cycle starts and the dump trap pressure rises to discharge pressure, a liquid pump provides the necessary remaining head to transfer liquid to the high pressure receiver.



EACH SYSTEM MAY BE FACTORY ASSEMBLED & WIRED AND COMES COMPLETE WITH THE FOLLOWING ITEMS:

Dump Trap:

Suitably sized for given design criteria to allow adequate liquid refrigerant transfer and to prevent liquid slopover. Vessels meet ASME code for 300PSI MAWP and -50°F MDMT, stamped and National Board Registered.

Three-Way Valve:

Phillips Series 3000 solenoid-operated 3-way valve, with angle filter.

Check Valves:

Phillips Series 600 and 700 flanged in-line disc and piston type check valves as indicated in system piping schematics.

Service Valves:

Hand stop valves (with hand wheels or seal caps) as indicated in system piping schematics.

Level Control:

Stainless steel external float switch

Accessories:

Each system is supplied with a gauge and gauge valve, relief valve and unions as indicated in piping schematics.

Control Panel:

UL/NEMA 4 enclosure with adjustable timer(s), manual transfer switch, mounted cycle counter, alarm selector switch, and pilot light indicators.

Additional Items for Type G Systems:

Pump: Nikkiso and Teikoku pumps are standard. Corken centrifugal and Magnetic drive pumps optional.

Pump Relief: A check valve is placed in the bypass line connected to the pump suction to prevent deadheading.

SEQUENCE OF OPERATIONS

For all types of transfer systems, the transfer cycle is initiated when the liquid draining from the suction accumulator reaches the middle of the upper Level Eye on the dump trap. This signal energizes the 3-way valve changing its operation from vent to hot gas supply. Liquid is then transferred according to system type:

Type T: As liquid starts to transfer, the level in the trap drops causing the float switch to open. This starts the adjustable off-delay cycle timer. When the cycle times out, the 3-way valve de-energizes and allows the trap to vent back to the accumulator. The timer should be set so that all liquid is drained past the outlet check valve.

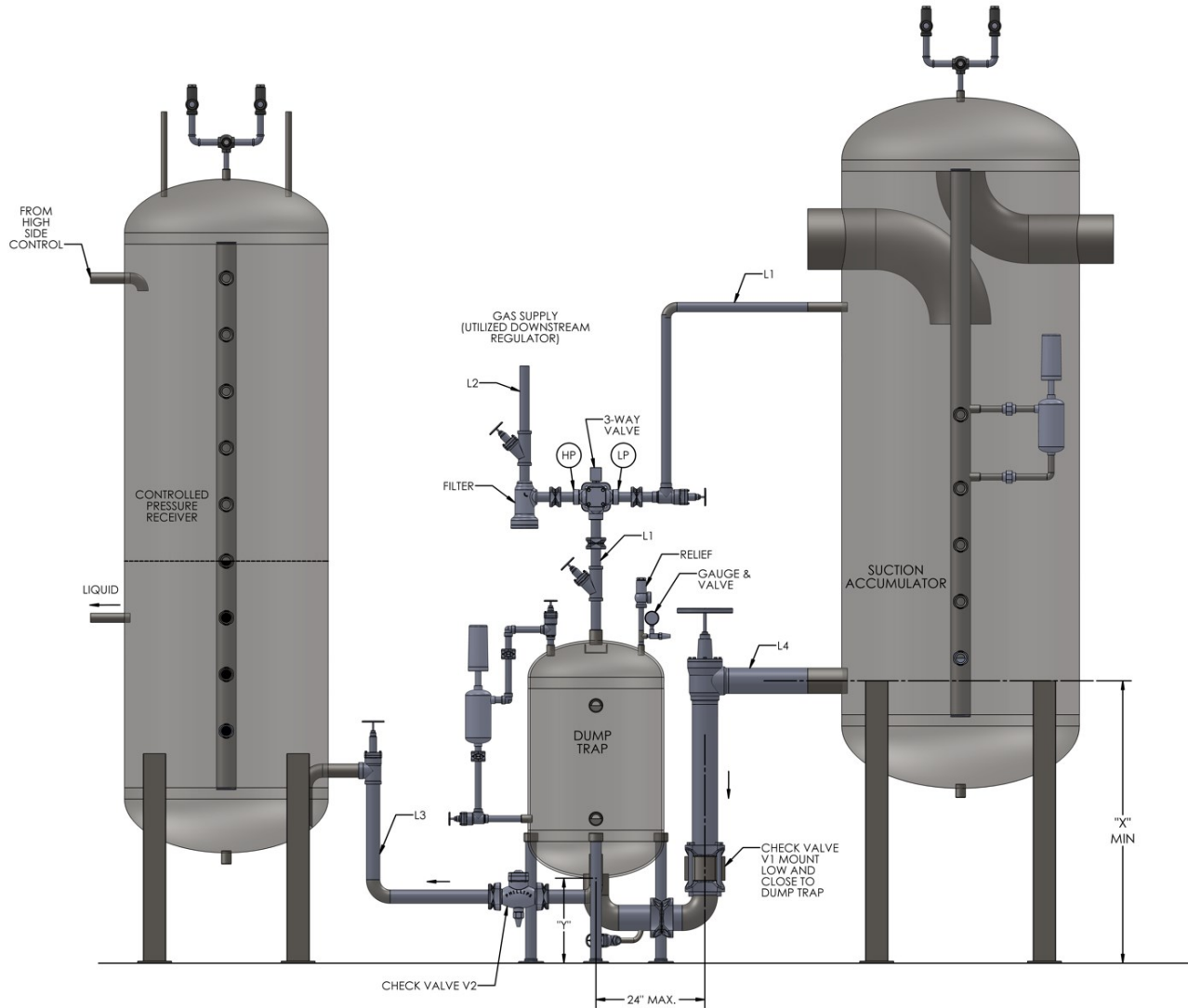
Type A: As liquid starts to transfer, the level in the trap drops causing the float switch to open. This starts the adjustable off-delay cycle timer. When the cycle times out, the 3-way valve de-energizes and allows the trap to vent back to the accumulator. The timer should be set so that all liquid is drained past the outlet check valve.

Type DK: When the 3-way valve is energized, so is the interrupting valve, causing it to change from wide open to differential pressure control. Since the pressure in the hot gas line to the trap is higher than the HPR pressure, the liquid will start to flow out of the trap, causing the float switch to open. This starts the adjustable off-delay cycle timer. When the cycle times out, the 3-way valve de-energizes allowing the trap to vent back to the accumulator and the interrupting valve is de-energized causing it to return to Wide Open state. The timer should be set to drain the liquid completely past the outlet check valve.

Type G: The float switch actuation starts 2 adjustable on-delay timers, one for the pump and one for pump protection. When the pump on-delay timer times out, the pump starts and the transfer begins. As liquid starts to transfer, the level in the trap drops causing the float switch to open. This starts the adjustable off-delay cycle timer. When the cycle timer times out, the pump stops and the 3-way valve is de-energized, allowing the trap to vent back to the accumulator. The pump on-delay timer must be set to allow time for the trap to become fully pressurized before the pump starts. The off-delay timer should be set to time out when the liquid level reaches the lower Level Eye. The pump protection on-delay timer should be set 10-15 seconds longer than the complete cycle and is meant to stop the pump if the float switch ever sticks open.



TYPE T COMPRESSOR PROTECTION SYSTEM



CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA. X LNG (IN.)	"X" (MIN REQ'D, IN)		"Y" (REF.) (IN.)	IPS LINE SIZES				SHIPPING WEIGHT (LBS.)
				VERT.	HOR.		L1 VENT	L2 GAS	L3 TRANSFER	L4 DRAIN	
T187V/H**	140	3.7	12 x 26	30	25	10	3/4	3/4	3/4	1 1/4	270
T287V/H	240	6.1	12 x 26	30	25	10	3/4	3/4	3/4	1 1/2	285
T387V/H	440	10.9	16 x 38	42	27	11	3/4	3/4	1 1/4	2	430
T487V/H	760	19.1	20 x 40	46	33	13	1 1/4	1 1/4	1 1/4	3	670
T587V/H	1480	31.2	24 x 42	50	39	15	1 1/4	1 1/4	2	4	810
T687H	2000	56.5	24 x 72	SP.	42	15	1 1/4	1 1/4	3	4	1180
T787H	3000	73.4	24 x 84	SP.	42	15	2	1 1/4	3	4 (2)	1630

Ordering Instructions:

* When ordering, specify suffix "V" (for vertical dump trap) or suffix "H" (for horizontal dump trap).

** Do not use 187 size systems when accumulator suction temperature is below 0°F. Upsize to 287 system.

If system is to be used for Halocarbon refrigerant, use 1/4 of the tonnage ratings shown for R-717.

Add an "F" in front of the Catalog Number. Seal cap valves and accessories will be furnished.

ALWAYS mount the inlet check valve as low and close to the dump trap as possible.

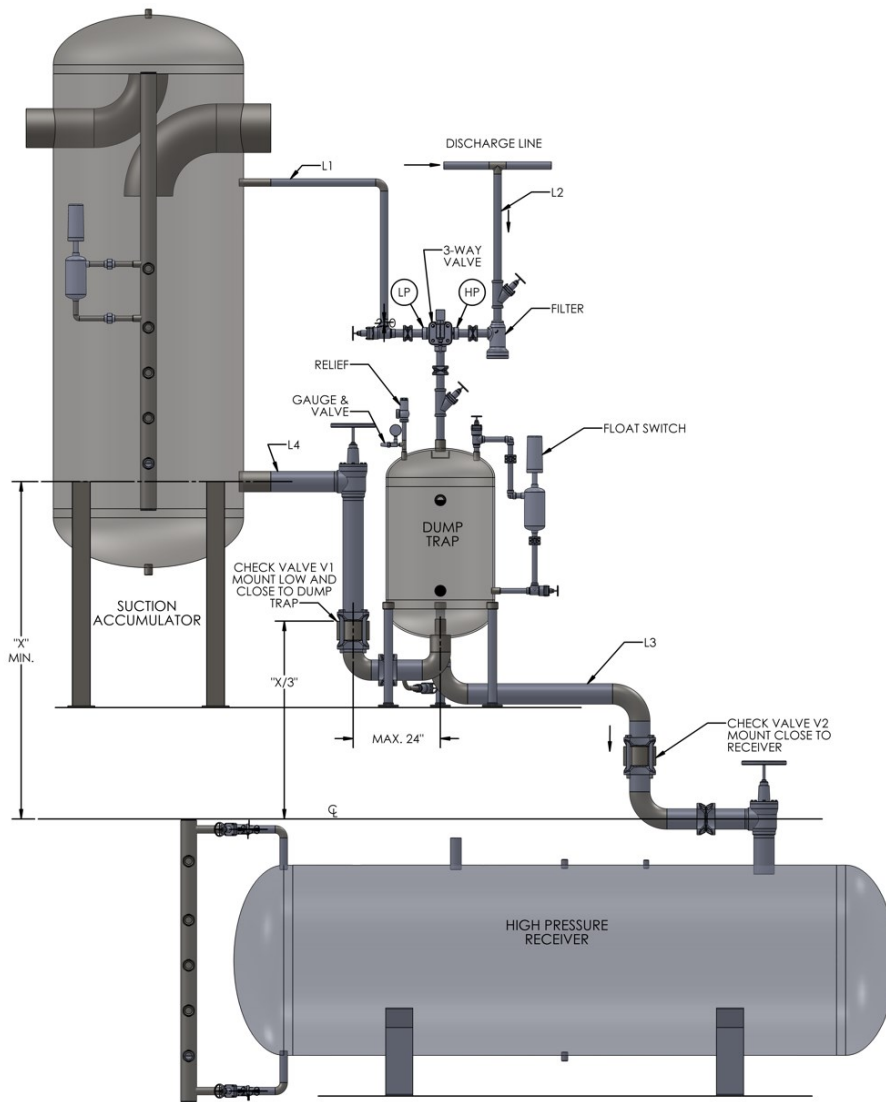
Disc type checks should be mounted in the vertical orientation unless it is absolutely necessary to mount horizontally.

Piston type checks should be mounted in either orientation but horizontal is preferred. Mount below lower Level Eye on trap if possible.

Insulate the dump trap; do not insulate the check valves.



TYPE A COMPRESSOR PROTECTION SYSTEM



CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA X LNG (IN.)	"X" (MIN REQ'D)		IPS LINE SIZES				SHIPPING WEIGHT (LBS.)
				VERT.	HOR.	L1	L2	L3	L4	
						VENT	GAS	TRANSFER	DRAIN	
A187V/H**	100	2.7	12 x 26	38	28	3/4	3/4	1/4	1/4	270
A287V/H	200	6.7	12 x 26	40	30	3/4	3/4	1/2	1/2	285
A387V/H	300	7.5	16 x 38	55	36	3/4	3/4	2	2	450
A487V/H	800	20.2	20 x 40	62	45	1/4	1/4	3	3	700
A587V/H	1320	33.3	24 x 42	70	55	1/4	1/4	4	4	850

Ordering Instructions:

* When ordering, specify suffix "V" (for vertical dump trap) or suffix "H" (for horizontal dump trap)

** Do not use 187 size systems when accumulator suction temperature is below 0°F.

If system is to be used for a Halocarbon refrigerant, use 1/4 of the tonnage ratings shown for R-717.

Add an "F" in front of the Catalog Number. Seal cap valves and accessories will be furnished.

ALWAYS mount the inlet check valve as low and close to the dump trap as possible.

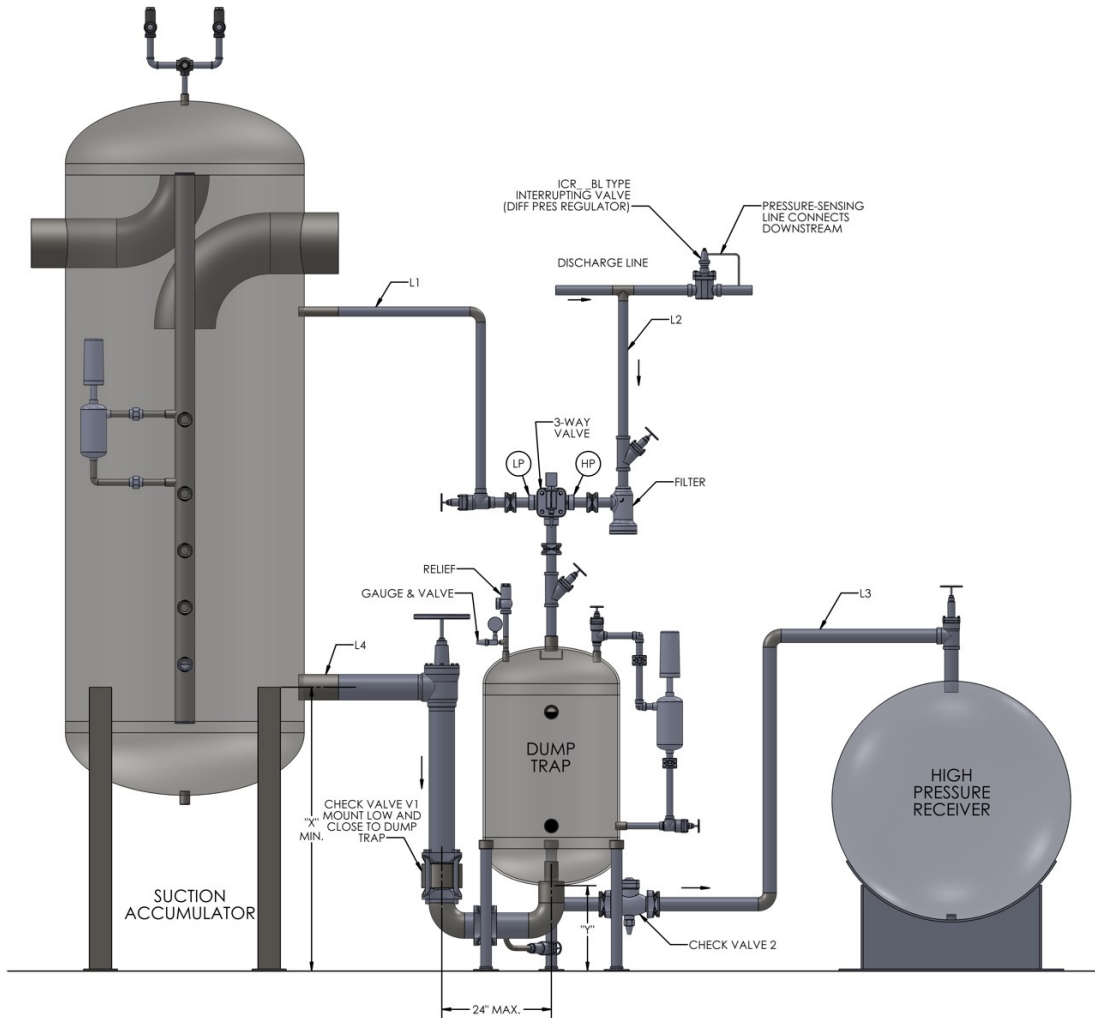
Disc type checks should be mounted in the vertical orientation unless it is absolutely necessary to mount horizontally.

On Type A systems, mount the outlet check valve vertically and as close to the HPR as possible.

Insulate the dump trap; do not insulate the check valves.



TYPE DK COMPRESSOR PROTECTION SYSTEM



CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA. X LNG (IN.)	"X" (MIN REQ'D, IN)		"Y" (REF.) (IN.)	IPS LINE SIZES				SHIPPING WEIGHT (LBS.)
				VERT.	HOR.		L1	L2	L3	L4	
						VENT	GAS	TRANSFER	DRAIN		
DK187V/H**	120	3	12 x 26	30	25	10	3/4	3/4	3/4	1 1/4	270
DK287V/H	200	5.1	12 x 26	30	25	10	3/4	3/4	3/4	1 1/2	285
DK387V/H	360	9.1	16 x 38	42	27	11	3/4	3/4	1 1/4	2	430
DK487V/H	560	14.2	20 x 40	46	33	13	1 1/4	1 1/4	1 1/4	3	670
DK587V/H	1160	29.2	24 x 42	50	39	15	1 1/4	1 1/4	2	4	810

Ordering Instructions:

Order "DK" system based on accumulator tonnage.

* When ordering, specify the suffix "V" (for vertical dump trap) or suffix "H" (for horizontal dump trap).

** Do not use 187 size systems when accumulator suction temperature is below 0°F. Upsize to 287 system.

If system is to be used for Halocarbon refrigerant, use 1/4 of the tonnage ratings shown for R-717.

Add an "F" in front of the Catalog Number. Seal cap valves and accessories will be furnished.

DK System interrupting valve sold separately (size for compressor discharge capacity)

ALWAYS mount the inlet check valve as low and close to the dump trap as possible.

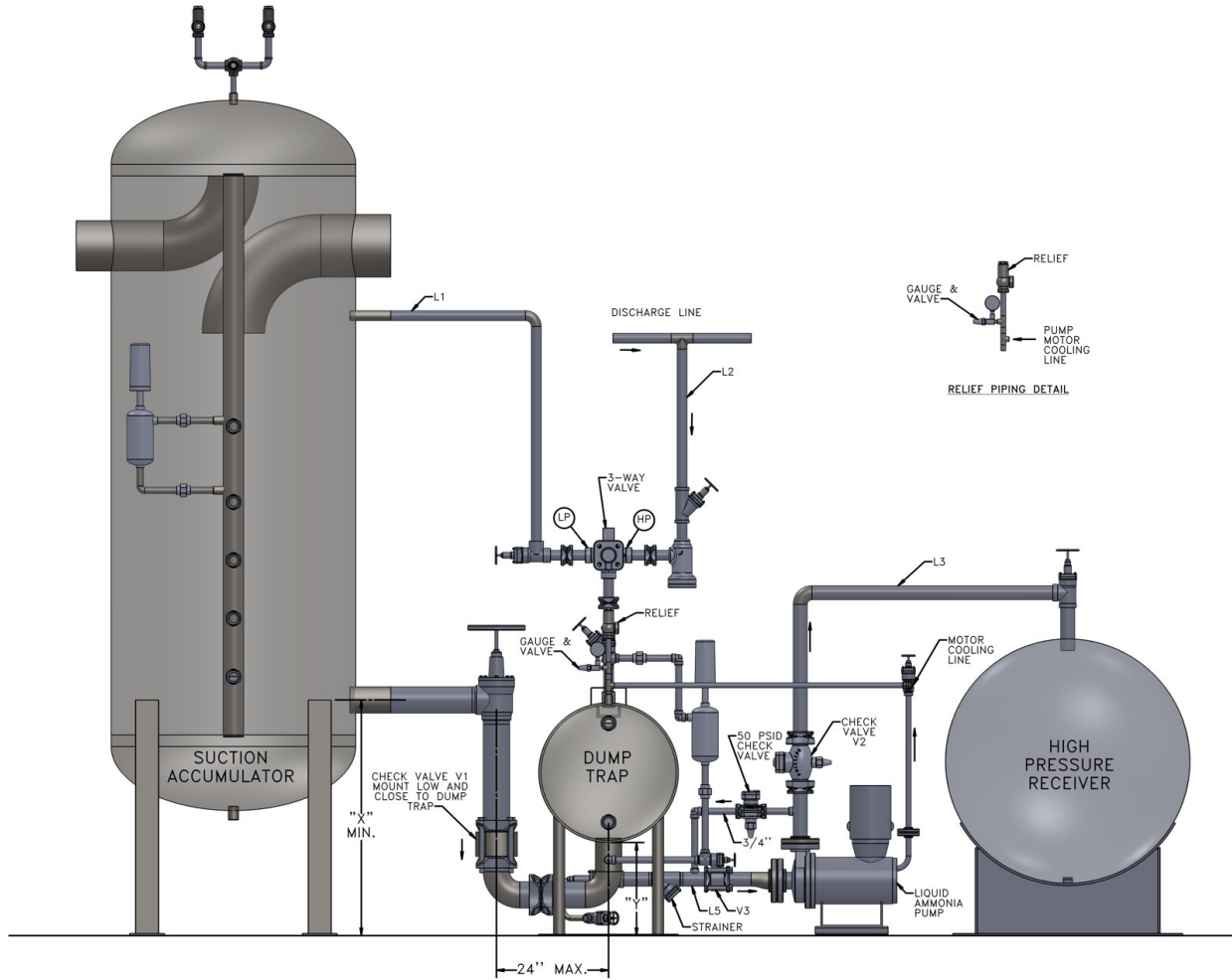
Disc type checks should be mounted in the vertical orientation unless it is absolutely necessary to mount horizontally.

Piston type checks should be mounted in either orientation but horizontal is preferred. Mount below lower Level Eye on trap if possible.

Insulate the dump trap; do not insulate the check valves.



TYPE G COMPRESSOR PROTECTION SYSTEM



CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA X LNG (IN.)	NIKKISO		PUMP HP	TEIKOKU		PUMP HP	CORKEN		IPS LINE SIZES					SHIPPING WEIGHT (LBS.)					
				"X" (MIN REQ'D)			"Y" (REF.)	"X" (MIN REQ'D)		"Y" (REF.)	"X" (MIN REQ'D)		"Y" (REF.)	L1	L2	L3		L4	L5			
				VERT	HOR		(IN.)	VERT		HOR	(IN.)	VERT	HOR	(IN.)	VENT	GAS		TRANSFER	DRAIN	SUCTION		
G187V/H**	120	3	12 x 26	33	28	13*	2.17	32	27	12*	1.7	30	25	10	3/4	3/4	3/4	1	1 1/4	1 1/4	415	
G287V/H	170	4.3	12 x 26	33	28	13*	2.17	32	27	12*	1.7	30	25	10	3/4	3/4	3/4	1	1 1/2	1 1/4	435	
G387V/H	360	9	16 x 38	42	32	13*	2.17	42	32	13*	1.7	40	30	11	2	3/4	3/4	1 1/4	2	1 1/2	650	
G487V/H	560	14	20 x 40	46	35	13	2.17	46	35	13	1.7	46	35	13	2	1 1/4	1 1/4	1 1/4	3	1 1/2	960	
G587V/H	1040	26	24 x 42	47	42	16	3.21	47	42	16	1.7	50	45	19	3	1 1/4	1 1/4	1 1/4	2	4	2	1595
G687H	1200	30	24 x 72	SP.	42	16	3.21	SP.	42	16	1.7	SP.	47	21	3	1 1/4	1 1/4	3	4	3	1900	
G787H	2000	50	24 x 84	SP.	42	16	3.21	SP.	42	16	5.2	SP.	47	21	5	2	1 1/4	3	4 (2)	3	2500	

*Stock horizontal trip requires shim to meet "Y" dimension

Ordering Instructions:

- * When ordering, specify suffix "V" (for vertical dump trap) or suffix "H" (for horizontal dump trap)
- ** Do not use 187 size systems when accumulator suction temperature is below 0°F.

If system is to be used for a Halocarbon refrigerant, use 1/4 of the tonnage ratings shown for R-717. Add an "F" in front of the Catalog Number. Seal cap valves and accessories will be furnished.

The standard wired control panel is 120 Volt control; motors are dual 230/460/3/60 voltage.

The standard Nikkiso or Teikoku pump is a sealless hermetic pump and operates to -50°F. Corken centrifugal pumps operate down to -25°F.

ALWAYS mount the inlet check valve as low and close to the dump trap as possible.

Disc type checks should be mounted in the vertical orientation unless it is absolutely necessary to mount horizontally.

Piston type checks should be mounted in either orientation but horizontal is preferred. Mount lower Level Eye on trap if possible.

Insulate the dump trap; do not insulate the check valves.



Type G Compressor Protection Systems Sequence of Operations

1. When the liquid level rises to the point which causes the Liquid Transfer Vessel Float Switch to actuate (closing its electrical contact), the normally open (NO) contact on TDR1 closes.
2. This in turn starts the time delays for TDR2 and TDR3 (which are on-delay time delay relays) and simultaneously energizes the 3-way valve solenoid and the 3-way pilot light.
3. When TDR2 times out, the NO TDR2 contact closes, energizing the motor starter (MS) which in turn starts the pump motor. Therefore the time setting for TDR2 is the time needed for the 3-way valve to open and the trap to pressurize before the pump runs.
4. When the liquid level drops to the point which causes the Liquid Transfer Vessel Float Switch to return to its normal position, that returns its electrical contact to the NO position.
5. This starts the time delay for TDR1 (which is an off-delay time delay relay).
6. When TDR1 times out, its NO contact opens.
7. This de-energizes TDR2, the 3-way pilot light, the 3-way solenoid and TDR3.
8. When TDR2 is de-energized, its NO contact opens, which de-energizes MS and stops the pump.
9. Therefore the time setting for TDR1 is the time needed for the liquid level to drop to a low enough level, below the Liquid Transfer Vessel Float Switch actuation level, that will prevent the pump from cycling too frequently.
10. If TDR3 is not de-energized (in step 7) before it times out, its NC contact will open, which will stop the pump. In addition, the TDR3 NO contact will close, which will turn on the flashing red cycle malfunction alarm light.
11. Therefore the time setting for TDR3 is a little more than the time needed for a complete cycle to take place. A complete cycle is the time it takes to pump down the liquid level from the upper level to the lower level.
12. Situations which can cause a cycle malfunction include at least the following.
 - a. TDR1 or TDR2 do not function properly.
 - b. The 3-way valve does not open sufficiently to allow the liquid level to drop to the low level in a normal time period.
 - c. The Liquid Transfer Vessel Float Switch does not function properly.
 - d. The pump does not pump a normal flow of liquid.

General Tips for All System Types

- On all systems, always mount the inlet gravity check valve in a vertical position as low and as close to the dump trap as possible. This is critical for optimal operation.
- Take care to set timers properly when initially setting up any Compressor Protection System, and whenever there are changes in the refrigeration installation.
- Mount the float switch to engage at upper Level Eye®.
- Insulate the dump trap; do not insulate the check valves.
- Contact Phillips engineers for assistance setting up or trouble shooting.