Type: T, A, DK, & G
For Ammonia (R-717) and Halocarbon Refrigerants

Features

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

Description

H. A. Phillips & Co's compressor protection systems transfer liquid refrigerant carry-over (slopover) 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.

Type T:
If a controlled pressure receiver (or other intermediate pressure vessel such as an 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 a 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 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 located in the compressor discharge line. During normal system operation, the interrupting valve is wide open. During a transfer cycle the valve operates as a differential pressure regulator to ensure the pressure in the dump trap is higher than the pressure in the high pressure receiver. At the end of the transfer cycle, the interrupting valve returns to its fully-open position.

Type G:
If the refrigeration 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 head to transfer liquid refrigerant to the high pressure receiver.

Compressor Protection System Components

Each system may be factory assembled (including wiring) and comes complete with the following:

Dump Trap:

Suitably sized for given design criteria to allow adequate liquid refrigerant transfer and to prevent liquid slopover. Vessels meet ASME code for 300 PSI MAWP and –50°F MDMT, dual 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:

Phillips model number SSLL external float switch.

Accessories:

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

Control Panel:

Factory pre-wired UL Rated NEMA Type 4 enclosure (for T, A, and DK systems), complete with an adjustable off—delay system timer, manual transfer switch, alarm selector switch, terminal block and pilot light indicators.

For G systems only:

A 230/460 volt (pump power), 120 volt control panel is factory pre-wired enclosure complete with:

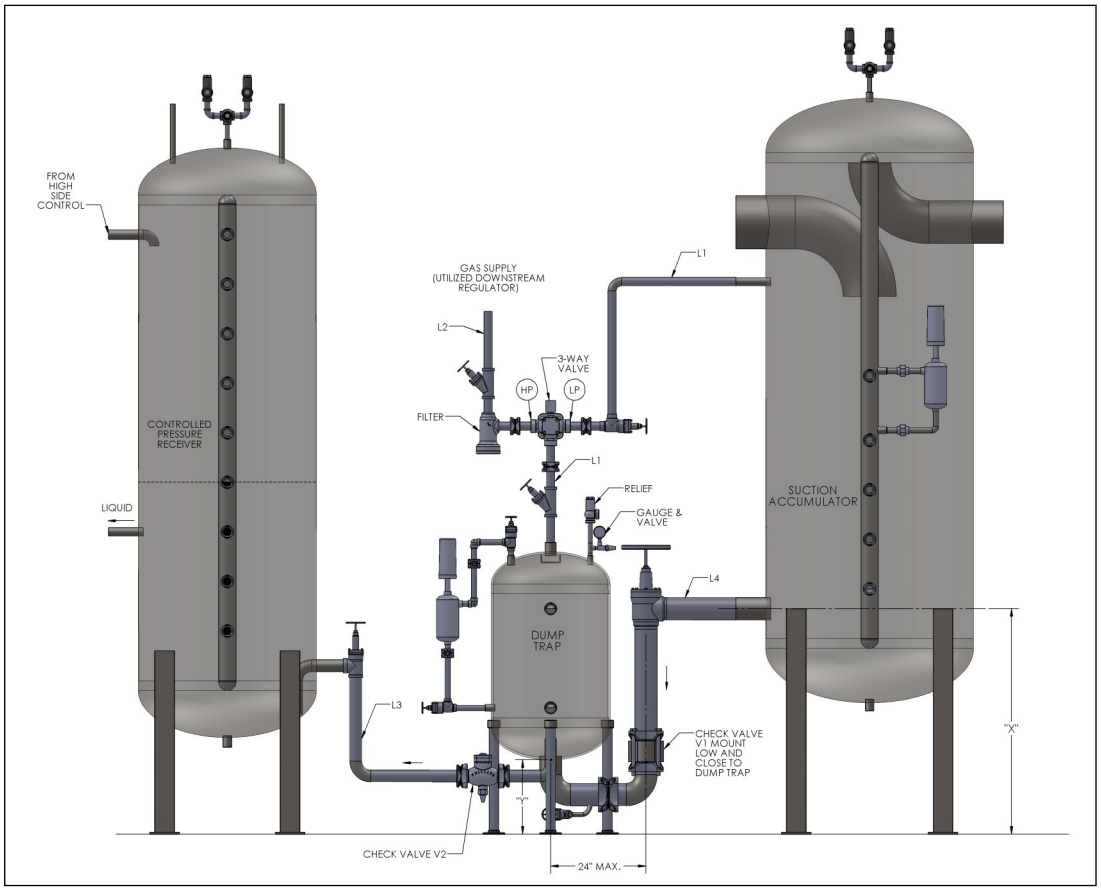
- NEMA rated starter with adjustable solid state OL relay (manual reset)
- Fused disconnect switch with a lockable handle
- Off time delay relays
- (2) On time delay relay (pump delay and cycle protection)
- Manual Transfer push button switch
- Control circuit transformer
- Pilot lights
- Terminal strip
- Alarm horn
- Counter with manual reset

Pump:

(For Type G systems only) a hermetic sealless liquid refrigerant pump is provided.

Centrifugal liquid refrigerant pumps with a mechanical seal are available as an option.

Type “T” Liquid Return System



ENGINEERING DATA

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	¾	¾	¾	1¼	270
T287V/H	240	6.1	12 x 26	30	25	10	¾	¾	¾	1½	285
T387V/H	440	10.9	16 x 38	40	30	11	¾	¾	1¼	2	430
T487V/H	760	19.1	20 x 40	46	35	13	1¼	1¼	1¼	3	670
T587V/H	1480	31.2	24 x 42	47	42	16	1¼	1¼	2	4	810
T687H	2000	56.5	24 x 72	SP.	42	16	1¼	1¼	3	4	1180
T787H	3000	73.4	24 x 84	SP.	42	16	2	1¼	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.

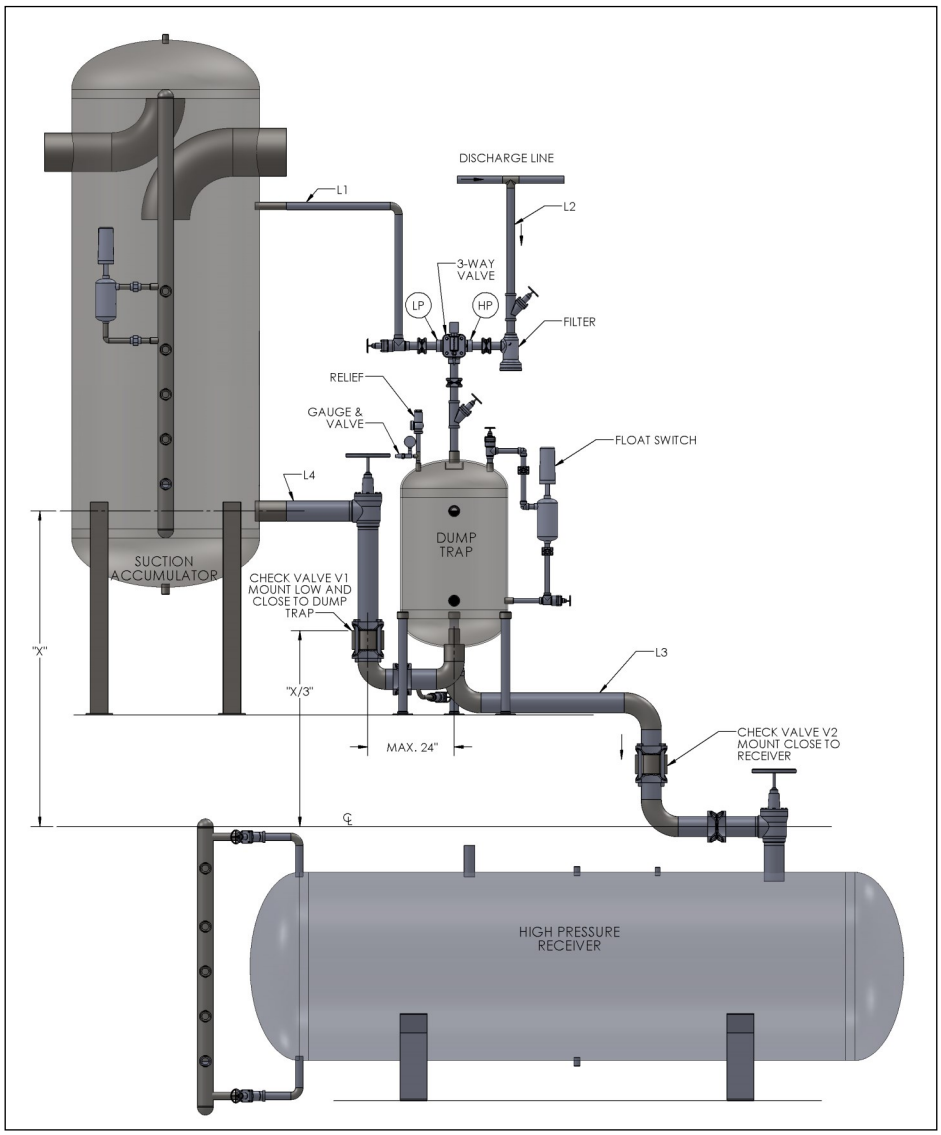
“T” Systems under a different nomenclature can be used for various other applications:

a) For transferring excess refrigerant from a pumped liquid recirculation suction accumulator to another vessel, or to a liquid transfer unit that will return it to the high pressure receiver. The dump trap is modified to accept the liquid from the pump discharge header.

b) For lifting slopover refrigerant from the vertical outlet header of a plate freezer back to the suction accumulator, greatly reducing pressure drop.

c) For lifting liquid in trapped suction lines and transferring to a higher level of suction line, or directly back to the suction accumulator, or to a liquid transfer unit that will return it to the high pressure receiver.

Type “A” Liquid Return System



ENGINEERING DATA

CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA x LNG (IN.)	"X" (MIN REQ'D) (IN.)		IPS LINE SIZES				SHIPPING WEIGHT (LBS.)
				VERT.	HOR.	L1 VENT	L2 GAS SUPPLY	L3 TRANSFER	L4 DRAIN	
A187V/H**	100	2.7	12 x 26	38	28	¾	¾	1¼	1¼	270
A287V/H	200	6.7	12 x 26	40	30	¾	¾	1½	1½	285
A387V/H	300	7.5	16 x 38	55	36	¾	¾	2	2	450
A487V/H	800	20.2	20 x 40	62	45	1¼	1¼	3	3	700
A587V/H	1320	33.3	24 x 42	70	55	1¼	1¼	4	4	850

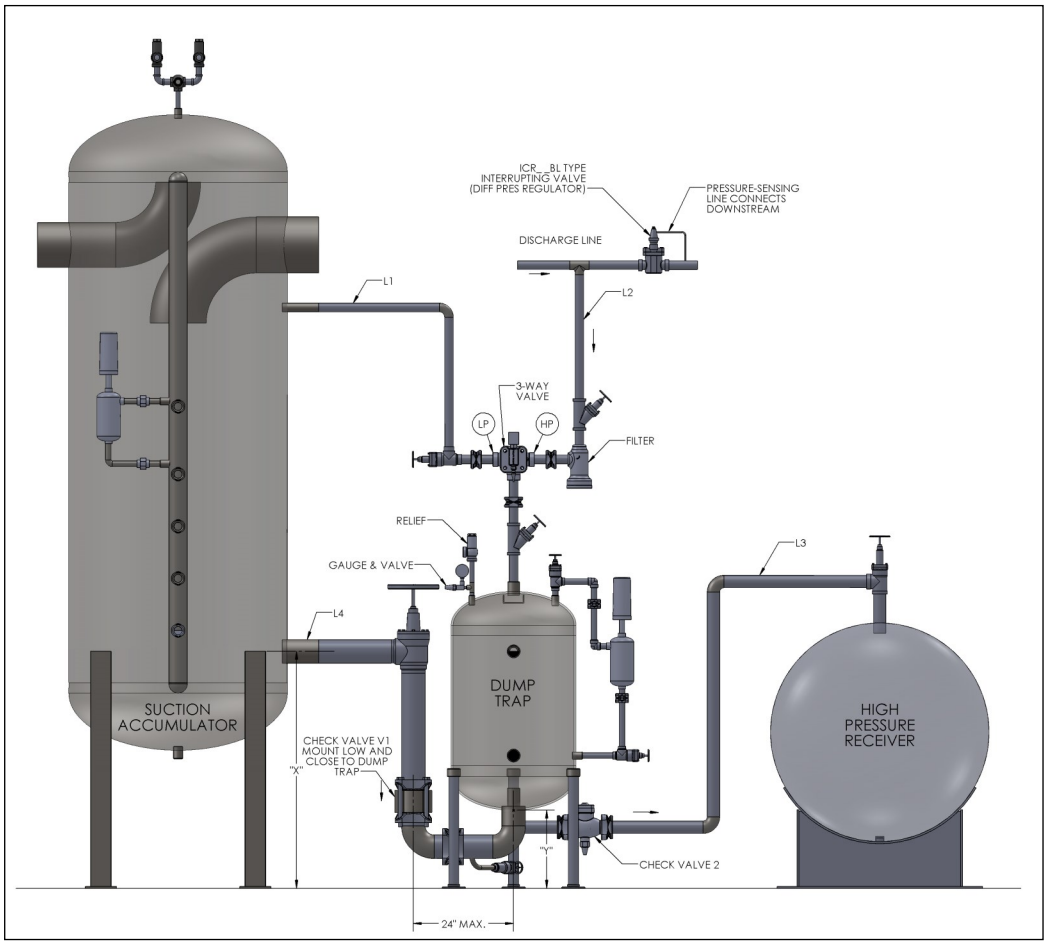
Ordering Instructions:

* 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. 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.

Type “DK” Liquid Return System



ENGINEERING DATA

CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA x LNG (IN.)	"X"		"Y" (REF.) (IN.)	IPS LINE SIZES				SHIPPING WEIGHT (LBS.)
				VERT.	HOR.		L1 VENT	L2 GAS	L3 TRANSFER	L4 DRAIN	
DK187V/H**	120	3	12 x 26	30	25	10	¾	¾	¾	1¼	270
DK287V/H	200	5.1	12 x 26	30	25	10	¾	¾	¾	1½	285
DK387V/H	360	9.1	16 x 38	40	30	11	¾	¾	1¼	2	430
DK487V/H	560	14.2	20 x 40	46	35	13	1¼	1¼	1¼	3	670
DK587V/H	1160	29.2	24 x 42	47	42	16	1¼	1¼	2	4	810

Ordering Instructions:

Order “DK” system based on accumulator tonnage.

* 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.

INTERRUPTING VALVES FOR DK SYSTEMS			
VALVE CATALOG NUMBER	PLANT TONS (R717)	PIPE SIZE (IPS)	SHIPPING WEIGHT (LBS.)
ICR40BL	80	1½ ; 2	40
ICR50BL	140	2	55
ICR65BL	320	3	175
ICR80BL	640	4	265
ICR100BL	1160	5	380
ICR125BL	1800	6	400

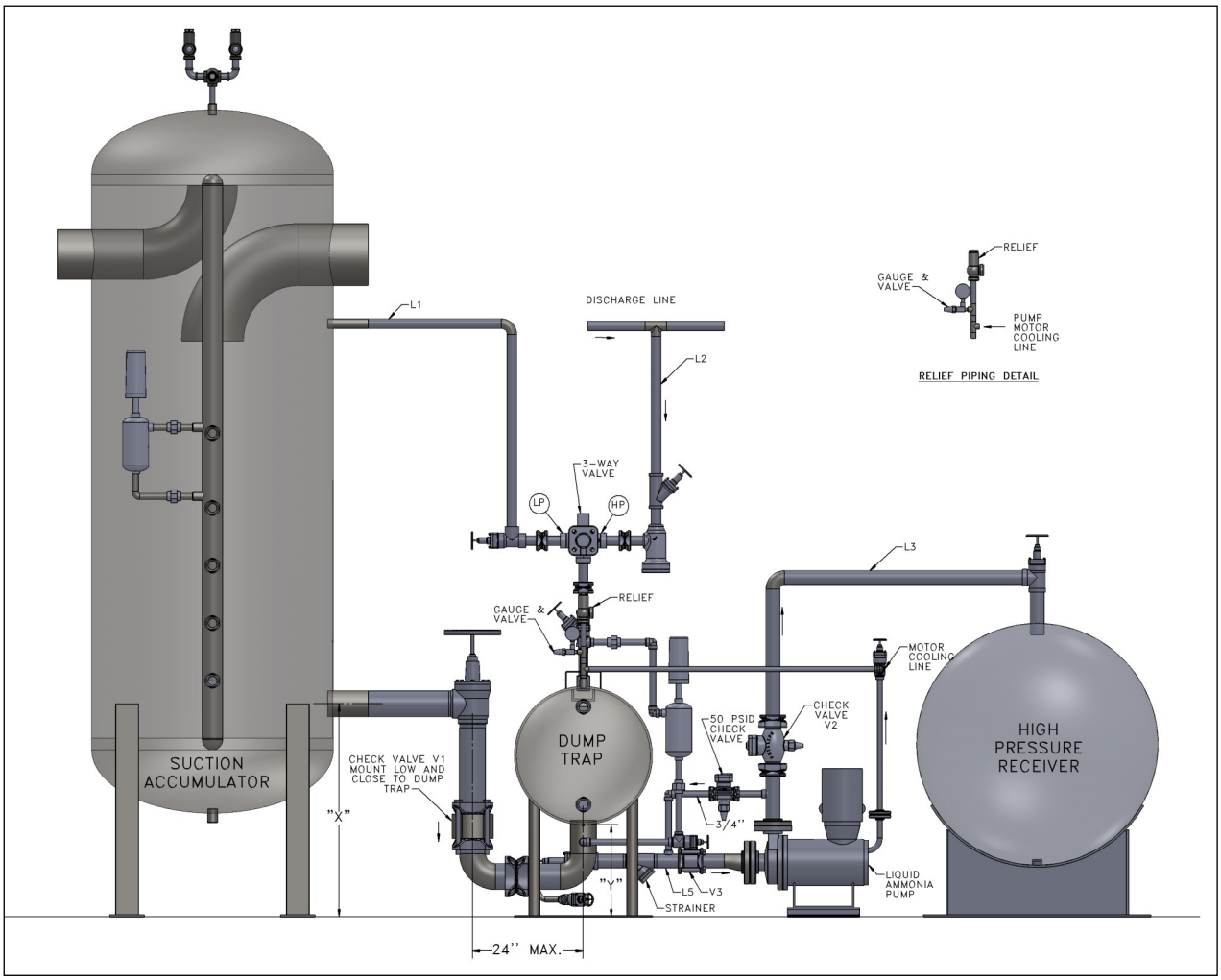
*Interrupting valve sold separately

Ordering Instructions:

Order interrupting valve based on tonnage of discharge line to be used for installation.

Never use an interrupting valve that is more than one pipe size smaller than the usable discharge line.

Type “G” Liquid Return System



ENGINEERING DATA

CATALOG NUMBER*	ACCUM. CAP (TONS)	SYSTEM CAPACITY (GPM)	DUMP TRAP DIA x LNG (IN.)	NIKKISO "X" (MIN REQ'D) (IN.) VERT.	NIKKISO "X" (MIN REQ'D) (IN.) HOR.	NIKKISO "Y" (REF.) (IN.)	NIKKISO PUMP MOTOR (HP)	TEIKOKU "X" (MIN REQ'D) (IN.) VERT.	TEIKOKU "X" (MIN REQ'D) (IN.) HOR.	TEIKOKU "Y" (REF.) (IN.)	TEIKOKU PUMP MOTOR (HP)	CORKEN "X" (MIN REQ'D) (IN.) VERT.	CORKEN "X" (MIN REQ'D) (IN.) HOR.	CORKEN "Y" (REF.) (IN.)	CORKEN PUMP MOTOR (HP)	IPS LINE SIZES L1 VENT	IPS LINE SIZES L2 GAS SUPPLY	IPS LINE SIZES L3 TRANSFER	IPS LINE SIZES L4 DRAIN	IPS LINE SIZES L5 PUMP SUCTION	SHIPPING WEIGHT (LBS.)
G187V/H**	120	3	12 x 26	33	28	13*	2.17	32	27	12*	1.7	30	25	10	¾	¾	¾	1	1¼	1¼	515
G287V/H	170	4.3	12 x 26	33	28	13*	2.17	32	27	12*	1.7	30	25	10	¾	¾	¾	1	1½	1¼	535
G387V/H	360	9	16 x 38	42	32	13*	2.17	42	32	13*	1.7	40	30	11	2	¾	¾	1¼	2	1½	750
G487V/H	560	14	20 x 40	46	35	13	2.17	46	35	13	1.7	46	35	13	2	1¼	1¼	1¼	3	1½	1060
G587V/H	1040	26	24 x 42	47	42	16	3.21	47	42	16	1.7	47	42	16	3	1¼	1¼	2	4	2	1695
G687H	1200	30	24 x 72	SP.	42	16	3.21	SP.	42	16	1.7	SP.	42	16	3	1¼	1¼	3	4	3	2000
G787H	2000	50	24 x 84	SP.	42	16	3.21	SP.	42	16	5.2	SP.	42	16	5	2	1¼	3	4 (2)	3	2600

*Stock horizontal trap requires shim to meet "Y" dimensions

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 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 460/3/60 voltage.

The standard Nikkiso or Teikoku pump furnished with the systems above is a sealless hermetic pump, and operates to a minimum temperature of -50°F.
Corken centrifugal and magnetic drive pumps are optional. Optional pumps may require changes to piping schematic.

Sequence of Operation for Compressor Protection Systems

Filling Dump Trap from Suction Accumulator

All System Types

Liquid refrigerant is first separated and entrapped in a suction accumulator. It then drains by gravity through a check valve into the dump trap and accumulates until its level reaches the upper Level Eye®. A float switch operates the three-way valve through the off-delay relay, closing the vent line and allowing discharge pressures into the dump trap. This immediately causes the inlet check valve to close. Liquid is then transferred according to system type.

Transfer of Liquid to High Side

Type T

The supply gas pressurizes the dump trap beyond the pressure of the intermediate pressure vessel (controlled pressure receiver, intercooler or desuperheater), and liquid transfer begins. After the liquid level in the dump trap falls approximately two inches, the off-delay timer starts to time out and maintains the dump cycle until the dump trap is emptied. When the transfer cycle times out, the three way valve is deenergized and the dump trap is vented to the suction accumulator. The inlet check valve opens and draining resumes.
Setting the timer: The timer should be set to drain the dump trap completely past the outlet check valve.

Type A

The supply gas pressurizes the dump trap to discharge pressure, and with the assistance of gravity, the liquid starts to drain into the high pressure receiver. After the liquid level in the dump trap falls approximately two inches, the off-delay timer starts to time out and maintains the dump cycle until the dump trap is emptied. When the transfer cycle times out, the three way valve is deenergized and the dump trap is vented to the suction accumulator. The inlet check valve opens and draining resumes.
Setting the timer: The timer should be set so that all liquid in the outlet drain line is completely emptied past the hand valve at the receiver.

Type DK

The solenoid on the interrupting valve is deenergized, and the valve switches from wide open to differential pressure regulation. This ensures that the pressure in the dump trap is 20 psi higher than that in the high pressure receiver. High pressure gas flowing through the three way valve into the dump trap transfers liquid to the high pressure receiver. When the transfer cycle times out, the interrupting valve solenoid is re-energized and the three-way valve is de-energized. The interrupting valve opens fully, and the dump trap is vented to the suction accumulator. The inlet check valve opens and draining resumes.
Setting the timer: The timer should be set to drain the dump trap completely past the outlet check valve. At the end of the transfer cycle, the interrupting valve is energized wide open for normal flow of discharge gas to the condenser.

Type G

The supply gas pressurizes the dump trap to discharge pressure and, after a time delay set by the on-delay timer in the wired control panel, the liquid pump motor starts and liquid refrigerant is transferred to the high pressure receiver. When the transfer cycle times out, the pump is stopped, the three-way valve is de-energized, and the dump trap is vented to the suction accumulator. The inlet check valve opens and draining resumes.
Setting the timer: It is imperative that the off-delay timer that controls the total timing of the transfer cycle be set so that the cycle is terminated when the liquid level in the dump trap drops to the middle of the lower Level Eye® on the dump trap. Never let the pump run to a point where the liquid seal on the pump is lost. If this occurs, the life of the mechanical seal will be greatly compromised.

Type “G” Liquid Return System Panel Sequence of Operations

Type “G’’ control panels include 3 timers that must be set by the operator.

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 pressurize the trap 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 motor starter 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 eye to the lower level eye.
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 Installation Hints

- 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. The best location is to mount check valve below the trap. If necessary, slant the drain line towards the dump trap if the dump trap is somewhat remote from the drain outlet of the suction accumulator.
- On Type A systems, mount the outlet check valve in a vertical position as close to the receiver as possible. Only on an installation where the mounting parameters are extremely restrictive should the gravity type check valves be mounted in a horizontal position. On all other systems mount the piston type outlet check valve below the lower Level Eye® of the dump trap, generally in a horizontal line.
- Insulate the dump trap; do not insulate the check valves.
- It is **very important** to take special care in setting the off-delay timer that controls the cycle operation, as described in the “Sequence of Operation” section.

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