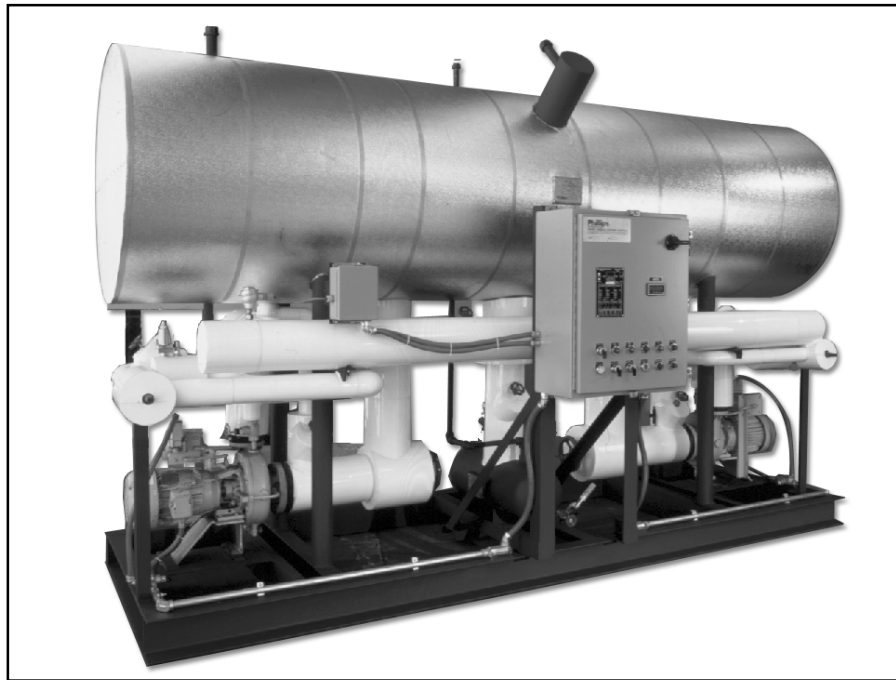


## HORIZONTAL AND VERTICAL ASSEMBLIES For Ammonia (R-717) and Halocarbon Refrigerants



### Features

- **One central vessel (accumulator) for all evaporators on a common suction system.**
- **Provides liquid slop-over protection for system compressor(s).**
- **Provides increased, efficient utilization of evaporator's internal coil surface for heat transfer.**
- **Liquid refrigerant feed to the evaporator(s) is insensitive to floating head pressure.**
- **Refrigerant oil that may find its way into the system's low side is transferred back to the low-pressure receiver via the defrost condensate and drained from the pressure-protected non-insulated oil drain pot.**

### Description

H. A. Phillips & Co. offers Horizontal and Vertical Liquid Recirculator Packaged Units for both ammonia and halocarbon refrigerants. These packages are factory assembled, pre-wired and pre-piped on a common structural steel base complete with:

- **Accumulator:** Suitably sized for given design criteria to maintain adequate separation velocity and dry gas velocity for compressor suction return. Vessels are ASME code designed, stamped and National Board registered.
- **Pumps:** Suitably sized to meet given system flow requirements as a function of required BTU removal, required bypass flow to meet minimum pump flow requirements and system head at liquid specific gravity. Centrifugal pumps are dual mounted with one serving as a standby. Pumps are supplied with TEFC motors, suction service valves, discharge stop/check service valves, bypass hand regulator valves and relief regulators, and volute vent valves.

## Description (continued)

- **Interconnecting Pipe, Valves and Fittings:** H. A. Phillips & Co. packages are furnished with the required interconnecting refrigerant pipe, valves and fittings, including pump vent lines, volute vent lines, pump bypass lines, gauges, and gauge valves. Valves are low temperature steel construction. Pipe 2" and smaller is schedule 80. Pipe 2-1/2" through 10" is schedule 40. Pipe for applications -20°F and above is ASTM A106 GRADE B. For applications below -20°F, ASTM 333 GRADE 6 carbon steel pipe is used. Pipe joints 1-1/2" and smaller are socket welded with 3000# class, socket weld fittings. Pipe joints 2" and larger are butt welded with fittings compatible with the wall thickness of the pipe.
- **Control Column:** Column incorporates Phillips® Level Eye®, isolation valves with flanged unions, electronic probe, high liquid level float switch, and drain valve. Column and accessories are shipped loose.
- **Oil Pot:** A 300 psi ASME CODE oil pot is provided with a relief valve, return service valve, vent service valve, oil drain service valve, and a spring return oil drain valve.
- **Control Panel:** A NEMA 12 (460v power/120v control, 60 Hertz) pre-wired control panel is provided complete with the following:
  - (1) Liquid pump starters with individual H-O-A switches
  - (2) Main power disconnect
  - (3) Individual pump "PROOF RUN" indicators
  - (4) High and low level indicators with alarm
  - (5) Operating liquid level indicator
  - (6) Low level reset
  - (7) Horn silence

### Optional Control Panel Features:

- (1) Variable frequency drive with PID and keypad
- (2) Individual pump motor amperage monitor/display
- (3) Probe controller (interfaced)
- (4) Individual pump suction pressure readout
- (5) Discharge liquid temperature readout
- (6) Individual pump heater control
- (7) Individual pump safety limit control



## Design Function

Mechanically pumped liquid refrigerant overfeed systems are very prevalent in industrial ammonia refrigeration applications. These systems function through the use of a mechanical pump that circulates liquid refrigerant through the evaporator(s). The two-phase (liquid/vapor mixture) is then returned to and separated in a central low-pressure receiver (accumulator) with the dry vapor directed back to the compressor(s). An operating liquid refrigerant level is maintained (by liquid makeup) in the low-pressure receiver to replace liquid refrigerant that evaporated in the evaporator(s) by means of either electro-mechanical or electronic control devices.

In some cases, the system may witness a greater liquid refrigerant flow rate than the load requires, consequently producing disproportionate two-phase flow (added pressure drop) in the liquid/vapor return line to the low-pressure receiver.

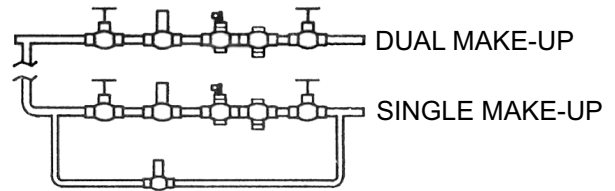
## Options

### Liquid Make-up Control (Sub-assembled or Shipped Loose)

- Conventional solenoid valve with strainer and hand expansion valve
- Phillips Modulating Liquid Level Control
- Danfoss AKVA electronic pulse-width valve

### Accumulator Pressure Surge Control

- Phillips Modulating Liquid Level Control
- Danfoss AKVA electronic pulse-width liquid level control valve
- Danfoss Variable Frequency Control



LIQUID MAKE-UP CONTROL

### Variable Frequency Drive:

- Saves Energy by varying the speed of the pump to provide only the flow required to meet the system refrigeration demands (no energy wasting proportional valves or bypass loops).
- Optimizes System Efficiency by maintaining constant discharge (head) pressure via built-in PID controller.
- Protects against pump cavitation and recirculation by continuously monitoring the pump motor current.

### Optional Features of Variable Frequency Drive:

- Power Loss Ride
- Stall Prevention
- Low and High Current Projection
- Overload Detection
- Overtorque Detection
- Thermal Overload Protection
- Low Input Line Harmonics
- Voltage Spike Protection
- UL/cUL Listed
- CE Marked
- Phase Loss Protection
- Short Circuit/Ground Fault Protection

4-Line LCD Display with the following data available:

Output Frequency	Run Hours	Feedback Valve
Motor Thermal Status	Motor Current	Drive Thermal Status
Motor Torque	Power (kw or HP)	
Output Energy (kwhr)	Setpoint/Speed Reference (in %)	

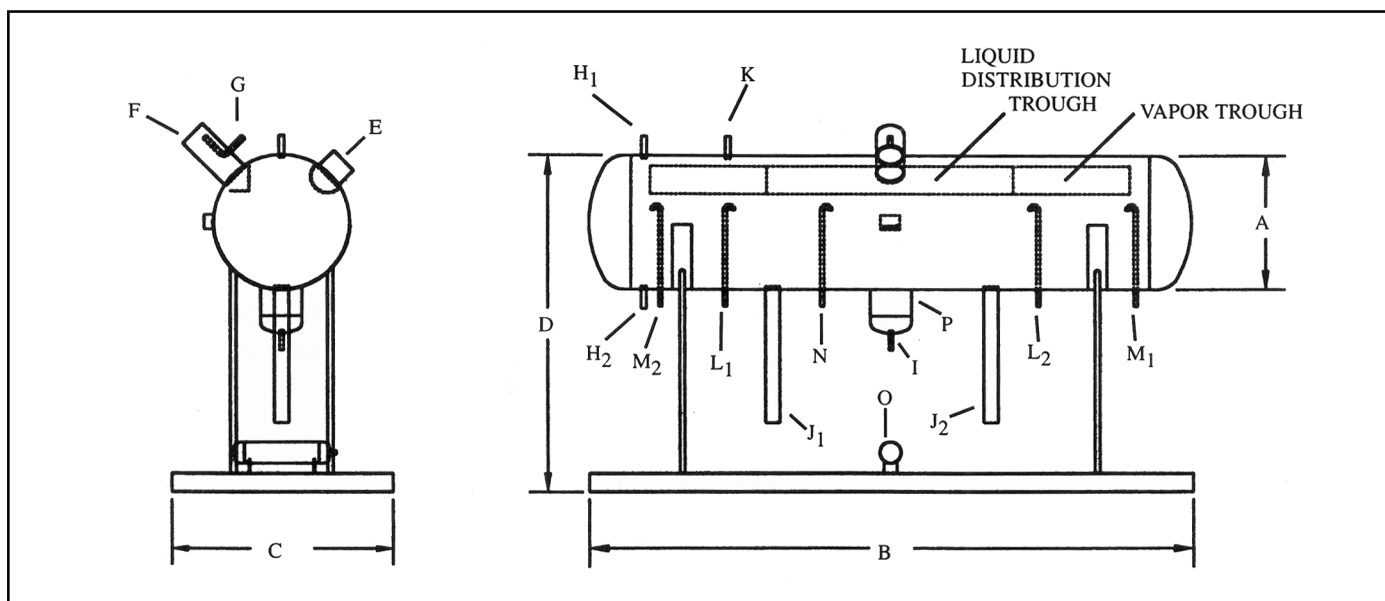


## ORDERING INSTRUCTIONS

Specify:

- (1) Model Number
- (2) Refrigerant
- (3) Capacity Requirement (TR)
- (4) Saturated Suction Temperature
- (5) Pressure Differential Required (PSID)
- (6) Recirculation Rate
- (7) Required Vessel Design Pressure
- (8) Required Surge Volume
- (9) Pump Selection
- (10) Required Electrical Characteristics
- (11) Optional Liquid Make-up Control
- (12) Optional Accumulator Pressure Surge Control
- (13) Optional Isolation Valves
- (14) Optional Variable Frequency Drive

## HORIZONTAL RECIRCULATOR ASSEMBLY



### LEGEND

- |                             |                                  |  |                                     |
|-----------------------------|----------------------------------|--|-------------------------------------|
| A Outside Diameter          | F Liquid/Vapor Return Connection | J <sub>1</sub> Pump Suction Connection | M <sub>1</sub> Pump Vent Connection |
| B Overall Length            | G Liquid Make-up Connection      | J <sub>2</sub> Pump Suction Connection | M <sub>2</sub> Pump Vent Connection |
| C Base Width                | H <sub>1</sub> Column Connection | K Relief Connection                    | N Oil Pot Vent Connection           |
| D Overall Height            | H <sub>2</sub> Column Connection | L <sub>1</sub> Pump Bypass Connection  | O Oil Pot                           |
| E Suction Return Connection | I Oil Pot Drain Connection       | L <sub>2</sub> Pump Bypass Connection  | P Oil Dome Reservoir                |

### HORIZONTAL RECIRCULATOR PACKAGE DIMENSIONS (IN.)

MODEL NUMBER	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O (DIA. x LG.)	P (DIA. x LG.)
PHR30	30	116	40	88	5	6	1	1-1/4	1	3	3/4	3/4	3/4	3/4	8 x 36	8 x 12
PHR36	36	119	40	94	5	6	1-1/4	1-1/4	1	4	3/4	3/4	3/4	3/4	8 x 36	8 x 12
PHR42	42	146	48	100	6	8	1-1/2	1-1/2	1-1/4	4	3/4	3/4	3/4	3/4	10 x 36	8 x 12
PHR48	48	149	48	108	6	8	1-1/2	1-1/2	1-1/4	4	3/4	3/4	3/4	3/4	10 x 36	10 x 12
PHR54	54	152	54	114	8	10	2	2	1-1/4	4	3/4	3/4	3/4	3/4	10 x 36	10 x 12
PHR60	60	155	60	120	8	10	2	2	1-1/4	6	1	1	1	1	10 x 36	12 x 12
PHR72	72	162	72	132	10	12	2-1/2	2	1-1/2	6	1-1/4	1	1	1	10 x 36	14 x 12
PHR84	84	168	84	144	12	14	3	2	1-1/2	8	1-1/4	1-1/4	1	1	12 x 36	16 x 12

Note: For packages with vessel diameters of 96"-144," please consult factory. These packages are custom designed for the application.

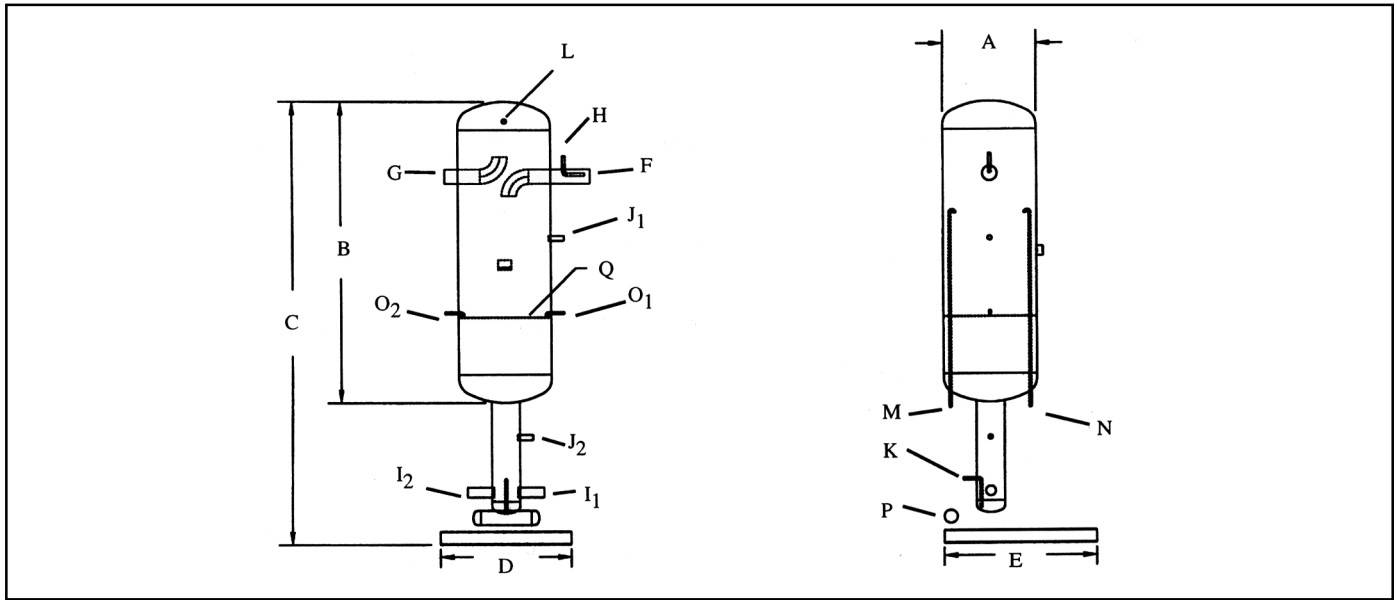
### HORIZONTAL SURGE CAPACITIES & WEIGHTS

MODEL NUMBER	DIAMETER (IN.)	SHELL LENGTH ONLY (IN.)	O.A.L. (IN.)	SURGE VOLUME* (CUBIC FT.)	APPROX. SHIPPING WT. (LBS.)
PHR30	30	96	116	12.6	3400
PHR36	36	96	119	20	3800
PHR42	42	120	145	35	5300
PHR48	48	120	148	49	6500
PHR54	54	120	152	68	7300
PHR60	60	120	155	86	7800
PHR72	72	120	162	127	8900
PHR84	84	120	166	179	13,900

\*Surge volume based on 75% of remaining volume above liquid level; volumes include 2:1 ellipsoidal heads.

**Please Note:** The dimensions and weights indicated are nominal and not for construction. H. A. Phillips & Co. will supply a dimension drawing.

## VERTICAL RECIRCULATOR ASSEMBLY



### LEGEND

A Outside Diameter	F Liquid/Vapor Return Connection	J <sub>1</sub> Column Connection	N Pump Vent Connection
B Overall Height (Shell)	G Suction Return Connection	J <sub>2</sub> Column Connection	O <sub>1</sub> Pump Bypass Connection
C Overall Height (Unit)	H Liquid Make-up Connection	K Oil Pot Drain Connection	O <sub>2</sub> Pump Bypass Connection
D Base Width	I <sub>1</sub> Pump Suction Connection	L Relief Connection	P Oil Pot
E Base Length	I <sub>2</sub> Pump Suction Connection	M Oil Pot Vent Connection	Q Perforated Plate

### VERTICAL RECIRCULATOR PACKAGE DIMENSIONS (IN.)

MODEL NUMBER	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P (DIA. X LG.)
PVR30	30	116	176	42	78	6	5	1	3	1-1/4	1	3/4	3/4	3/4	3/4	8 x 36
PVR36	36	119	179	54	78	6	5	1-1/4	4	1-1/4	1	3/4	3/4	3/4	3/4	8 x 36
PVR42	42	146	209	54	78	8	6	1-1/2	4	1-1/2	1-1/4	3/4	3/4	3/4	3/4	10 x 36
PVR48	48	149	211	72	78	10	8	1-1/2	4	1-1/2	1-1/4	3/4	3/4	3/4	3/4	10 x 36
PVR54	54	152	214	74	86	10	8	2	4	2	1-1/4	3/4	3/4	3/4	3/4	10 x 36
PVR60	60	155	217	74	86	12	10	2	6	2	1-1/4	1	1	1	1	10 x 36
PVR72	72	162	224	84	90	14	12	2	6	2	1-1/2	1-1/4	1	1	1	10 x 36
PVR84	84	168	230	84	96	16	14	2	8	2	1-1/2	1-1/4	1	1	1	12 x 36

Note: For packages with vessel diameters of 96"-144," please consult factory. These packages are custom designed for the application.

### VERTICAL SURGE CAPACITIES & WEIGHTS

MODEL NUMBER	DIAMETER (IN.)	SHELL LENGTH ONLY (IN.)	O.A.L. (IN.)	SURGE VOLUME* (CUBIC FT.)	APPROX. SHIPPING WT. (LBS.)
PVR30	30	96	116	15	3200
PVR36	36	96	119	20	3400
PVR42	42	120	145	43	5000
PVR48	48	120	148	52	6300
PVR54	54	120	152	64	7000
PVR60	60	120	155	85	7600
PVR72	72	120	162	135	8700
PVR84	84	120	166	183	12,000

\*Surge volumes are based on area available in shell only. Head volumes not considered.

**Please Note:** The dimensions and weights indicated are nominal and not for construction. H. A. Phillips & Co. will supply a dimension drawing.

## NOMINAL VERTICAL RECIRCULATOR CAPACITIES—TONS OF REFRIGERATION

MODEL NUMBER	EVAPORATOR TEMPERATURE (°F)									
	SINGLE STAGE*					TWO STAGE**				
	+30°	+20°	+10°	0°	-10°	-10°	-20°	-30°	-40°	-50°
PVR24	140	130	110	100	90	100	90	70	60	50
PVR30	220	200	170	150	130	150	130	120	100	80
PVR36	320	290	250	230	200	230	200	170	150	110
PVR42	450	400	350	310	270	310	270	240	200	160
PVR48	570	520	450	410	360	410	350	310	270	210
PVR54	720	680	570	540	470	540	470	410	350	280
PVR60	900	850	710	660	580	670	580	510	430	340
PVR72	1340	1200	1080	940	810	940	820	720	610	190
PVR84	1780	1630	1400	1270	1140	1280	1120	980	830	660
PVR96	2320	2090	1830	1640	1500	1660	1280	1270	1080	850
PVR108	2910	2660	2320	2080	1830	2100	1830	1610	1370	1090
PVR120	3630	3320	2890	2600	2280	2620	2290	2010	1710	1360
PVR144	5230	4740	4170	3740	3290	3760	3280	2880	2450	1950

\*Assumes 96°F liquid feed temperature.

\*\*Assumes 25°F max. liquid feed temperature.

## NOMINAL HORIZONTAL RECIRCULATOR CAPACITIES—TONS OF REFRIGERATION

MODEL NUMBER	EVAPORATOR TEMPERATURE (°F)									
	SINGLE STAGE*					TWO STAGE**				
	+30°	+20°	+10°	0°	-10°	-10°	-20°	-30°	-40°	-50°
PHR24	115	110	95	85	70	80	70	60	50	40
PHR30	190	170	150	140	120	130	120	100	80	60
PHR36	295	270	240	190	170	200	170	145	120	100
PHR42	400	380	310	280	250	280	250	210	170	140
PHR48	540	490	430	360	320	365	320	270	220	180
PHR54	790	700	620	530	470	530	470	390	320	270
PHR60	980	880	790	650	580	650	580	480	400	320
PHR72	1400	1260	1110	940	830	940	830	700	570	470
PHR84	1960	1800	1600	1360	1180	1340	1190	1000	810	670
PHR96	2600	2370	2100	1760	1580	1760	1570	1310	1080	880
PHR108	3320	2980	2690	2240	1990	2240	1990	1670	1370	1120
PHR120	4110	3700	3300	2780	2450	2760	2460	2060	1690	1390
PHR144	5950	5320	4780	3990	3540	4000	3540	2980	2440	2000

\*Assumes 96°F liquid feed temperature.

\*\*Assumes 25°F max. liquid feed temperature.

## PUMP CAPACITY REQUIREMENTS NH3 FLOW GPM PER TON

OVERFEED RATE	EVAPORATOR TEMPERATURE (°F)								
	30°	20°	10°	0°	-10°	-20°	-30°	-40°	-50°
3 : 1	.206	.201	.196	.191	.186	.182	.178	.174	.171
4 : 1	.275	.268	.261	.254	.249	.243	.238	.232	.228
6 : 1	.412	.401	.391	.382	.373	.364	.356	.349	.342

## PUMP SPECIFICATIONS

PUMP DESIGNATION	MAX GPM @ 25 PSID	PUMP HP
2CBS-2-4	20	2
2CBS-3-4	55	3
2CB-3-4	90	3
3CB-7 1/2-6	250	7 1/2
3CB-10-6	350	10

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