

LCPRS LIMITED

LOW CHARGE PRESSURE RECEIVER SYSTEMS

Ammonia Low Pressure Receivers

This has been updated to include revised curves for R717

1.0 Introduction

The LCPRS low pressure receiver has been designed to allow refrigerating systems to operate with smaller refrigerant charges than direct expansion systems.

The escalating costs of refrigerants associated with the production limitations stipulated in the Montreal Protocol mean that considerable savings can be made by designing our plant to hold minimal charge.

Designing for minimal charge is also seen as environmentally sound. Ammonia is now being routinely specified for medium sized installations.

2.0 Details

2.1.0 Ammonia Systems

Page 4 shows a schematic of the low-pressure receiver for use with ammonia.

The system uses an RS solenoid valve and orifice plate for expansion. The solenoid valve is energised if liquid backs up into the float liquid level sensor at the outlet from the condenser. The RS solenoid valve is chosen to withstand a high number of pulsed operations. A non-return valve is fitted in parallel to allow reverse flow during defrost.

2.1.1 Liquid Sub-Cooling

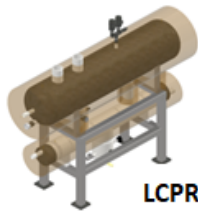
The liquid heat exchanger is specially designed with steel tubes for use with ammonia. Again, the vessel must be sized to act as a receiver for all the liquid refrigerant which could return to it.

2.1.2 Oil Return on Ammonia Plant

During recovery oil is drained from the bottom of the low-pressure receiver heat exchanger under the action of gravity. The oil drains through a Parker CN1 5 oil filter (without restrictor) and EVRAT20 solenoid valve and is returned to the compressor suction.

The oil collecting vessel welded to the bottom of the low-pressure receiver is fitted with an electric heater. The heater is constantly energised to boil off any liquid ammonia collecting in the vessel. When there is only a little oil, the evaporating effect of the ammonia keeps the temperature low. As oil builds up, the evaporating effect reduces and the temperature increases. When the temperature reaches a pre-set level and provided the compressor is running, the oil return solenoid valve is energised to return oil into the compressor suction.

The oil return is dependent on gravity. It is important to minimise pressure drop in the oil return line and to design the package unit with the suction pipe as low as possible. On occasion, it may be necessary to protect the compressor from high suction pressures during and after a defrost by fitting a PM valve in the suction to limit the suction pressure. If a PM valve is fitted, the oil should be returned to the suction line before the PM valve.



LCPRS LIMITED

LOW CHARGE PRESSURE RECEIVER SYSTEMS

2.1.2 Oil Return on Ammonia Plant (Cont)

For commissioning purposes, the solenoid valve is replaced with a Herl 38E spring loaded drain valve to allow a manual check on the condition of the oil using a special fitting which replaces the solenoid valve.

Note: An alternative oil recovery arrangement is currently under evaluation. Design Engineers should consult the Technical Department.

2.1.3 Reduced Compressor Discharge Temperatures

There is no upper heat exchanger. The full flow area is available for droplet separation. Operating with minimal suction superheat means lower compressor discharge temperatures.

3.0 Charging — Low Charge LPRs

The plants require careful charging. A sight glass is fitted low on the vessel end cap.

We should charge the plant until we obtain good sub-cooling and aim to stop charging before a liquid level shows in the sight glass.

On fluorocarbon jobs, charging is complete when the oil rectification is functioning correctly (note: this could take up to two to three days), the evaporator suction temperature is wet (i.e. flooded operation) and, on a reversed cycle defrost system, the charge is correct for an efficient defrost. There must be sufficient wet return to give sub-cooling to the high-pressure liquid before entry to the expansion valve. The charge can be assessed by measuring the sub-cooling effect through the heat exchanger.

The most critical requirement is probably to ensure good defrosting but beware that poor defrosting is not the result of some other fault.

4.1 Selection Procedure

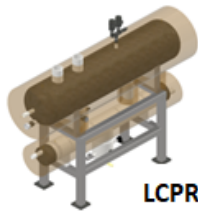
4.1.1 Check the refrigerant charge for the selected duty.

4.1.2 Select the low-pressure receiver from the curves attached to this specification, considering the required storage volume.

In most cases the required storage volume may be taken as 60% of the cooler coil volume. Where necessary, this should be increased to consider special features, for example long pipe runs, a particularly large evaporative condenser, the volume of a defrost liquid receiver, etc. The storage volume of the low-pressure receiver may be taken as % of the total vessel volume.

The following vessel dimensions have been used:

o.d.	mm	219	273	355	457	610	762	915	1067	1219
shell length	mm	800	1000	1350	1560	1840	2500	3000	3800	3800
storage volume	l	19	38	87	175	381	797	1393	2394	3214



LCPRS LIMITED

LOW CHARGE PRESSURE RECEIVER SYSTEMS

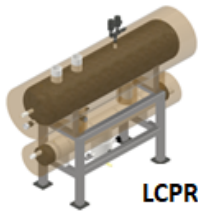
5.0 Summary of advantages with the low pressure receiver over other systems

5.1 Compared to DX Systems

- 1 Enhanced efficiency
- 2 Lower compressor discharge temperature
- 3 Better uses of evaporator surface (flooded operation)
- 4 Good distribution in evaporator due to sub-cooling
- 5 Receiver can store excess refrigerant
- 6 Higher reliability and reduced risk of compressor damage
- 7 All control valves on the packaged unit
- 8 Can combine easily with reversed cycle defrost
- 9 Improved efficiencies in low ambient conditions
- 10 Longer life and lower maintenance costs
- 11 Minimum sitework required
- 12 Closer approach temperature in evaporator (no superheat)
- 13 Automatic oil return from evaporator
- 14 Performance not adversely affected by pressure drop in liquid line
- 15 Better controls under part load conditions

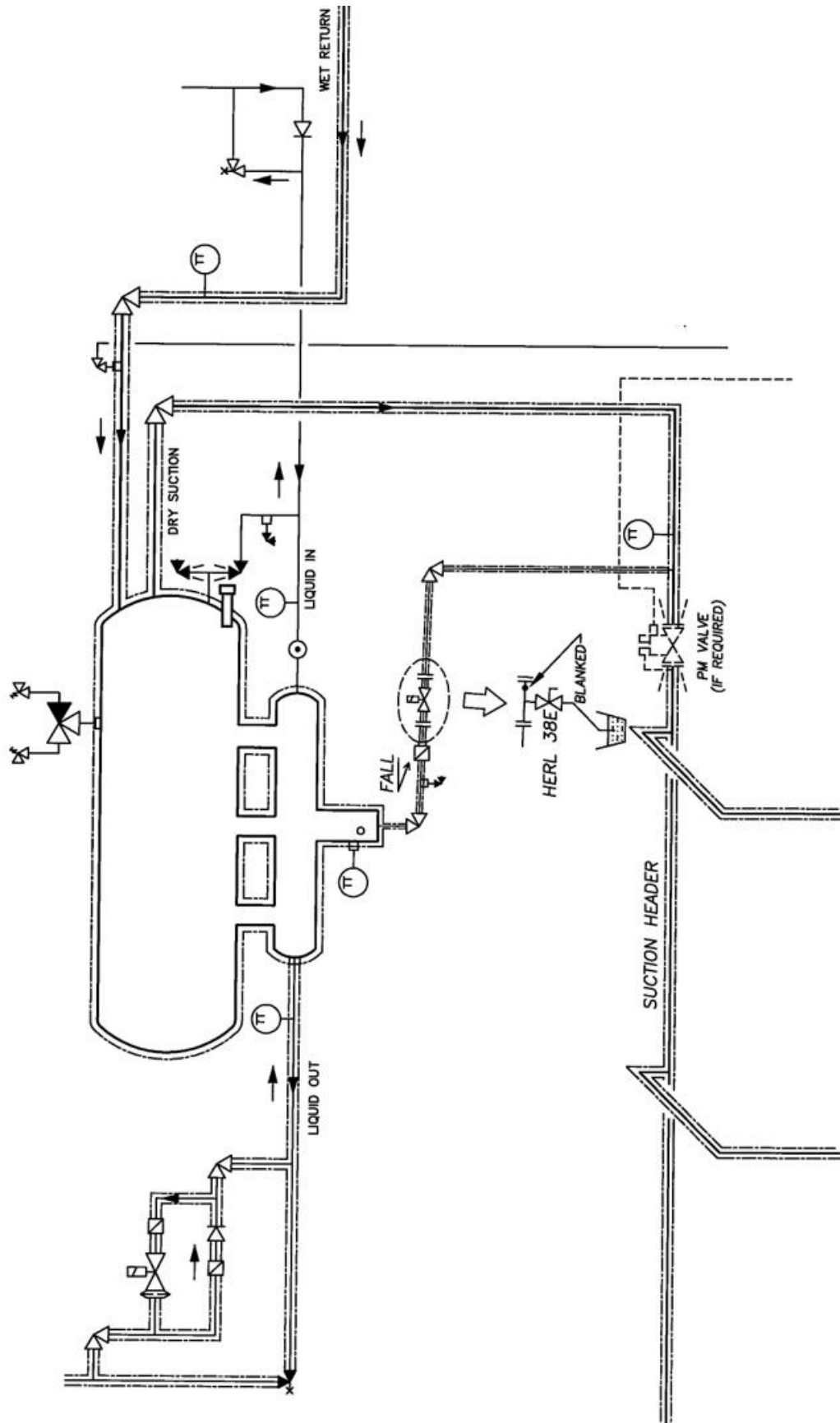
5.2 Compared to Pumped Circulation System

- 1 Reduced charge with the low-pressure receiver (typically 70% less)
- 2 Reduced capital cost
- 3 Simplicity of operation
- 4 No power required for refrigerant pumps
- 5 Easier to maintain
- 6 Less pressure drop in wet suction line
- 7 Smaller suction and liquid lines
- 8 Simpler and more efficient defrost system
- 9 Simpler control system
- 10 Compressor/receiver packages built in factory so less site work



LCPRS LIMITED

LOW CHARGE PRESSURE RECEIVER SYSTEMS

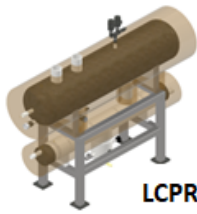


AMMONIA

PRESSURE RECEIVER

RETURN

TYPICAL ARRANGEMENT



LCPRS LIMITED

LOW CHARGE PRESSURE RECEIVER SYSTEMS

R717 Low Charge Low Pressure Receiver Selection

Valid for Condensing Temperatures 15°C to 45°C

