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**REFRIGERATION** SPECIAL WORKING GROUP

04

# Condensing Pressure Reduction and Liquid Pressure Amplification

## BIG ENERGY SAVINGS ARE SIMPLE TO ACHIEVE

You can make considerable energy savings in many refrigeration systems by reducing the temperature lift. Temperature lift is the difference between the evaporating temperature and the condensing temperature of the refrigerant. These savings are often possible at little or no cost, simply by adjusting the evaporator temperature upwards and/or reducing the condenser temperature

## How to achieve savings of around 3% per °C

### EVAPORATOR

Before you invest in technical upgrades, it is crucial that the plant is operating as efficiently as possible.

To increase the evaporator temperature, normally the delivered temperature of the cooling system is increased. Key questions are:

- Do you really need the temperature setpoint you operate at?
- What is the actual temperature required by the user and how does this relate to the evaporator temperature?
- Is the evaporator functioning properly, with efficient heat transfer?

### CONDENSER

Often condenser setpoints are too high and can be reduced.

Decrease your condenser setpoint to the minimum value advised by the manufacturer. They are often set at the summer design value which can result in significant loss of efficiency and performance.

Check that the additional energy usage of cooling fans and pumps does not outweigh the savings made at the compressor.

It is normally possible to operate at lower temperatures in cooler weather, including nights.

Ensure that condensers are clean and giving efficient heat transfer.

### LIMITATIONS ON REDUCING CONDENSER PRESSURE

A number of factors limit the minimum temperature at which the condenser can operate. These vary with different refrigeration technologies, but may include:

- A minimum pressure differential is required across the expansion device. If a thermostatic expansion valve is used, it can often be replaced with an electronic expansion valve with a lower differential pressure requirement – thus allowing the condenser pressure to be reduced.
- Flooded systems will also need a minimum differential pressure across the expansion device.
- If hot refrigerant is used for defrost purposes, this may require a minimum condenser pressure.
- Compressor differential pressure is sometimes used to generate oil pressure. This can limit the minimum condenser pressure.

If any of these are your limiting factors, check with the manufacturer to establish if there is a way of eliminating or reducing their impact and then permitting the condenser temperature to be reduced.

### LIQUID PRESSURE AMPLIFICATION (LPA)

LPA involves the installation of a high-speed, hermetically sealed liquid pump in a refrigeration system, between the condenser outlet and expansion valve.

The liquid line is pressurised, with no apparent rise in temperature. This means that the temperature of the liquid refrigerant after the pump is below the saturated temperature corresponding to the pressure after the pump. A liquid in that state is designated as subcooled. Having a subcooled liquid reduces the risk of having refrigerant flashing because of pressure drops in the liquid line. As a result, vapour-free liquid delivery to the expansion valve is ensured.

The pump raises the pressure of the liquid into the expansion valve for consistency so that the valve will control well even when the head pressure falls.

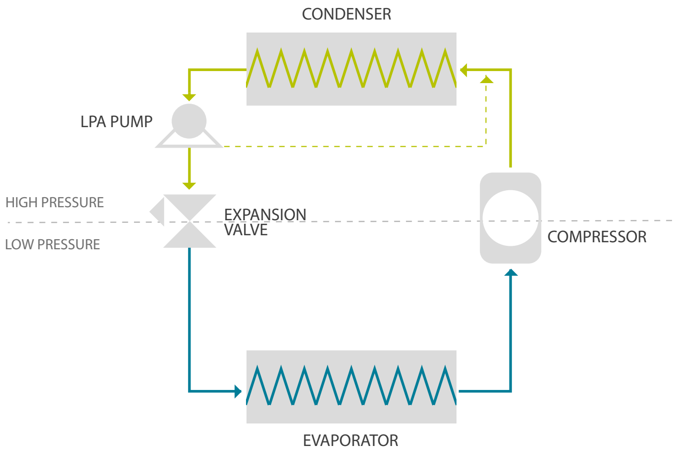
Savings are achieved by operating the system at a lower condensing pressure when ambient temperature is falling.

LPA can be used on all direct expansion systems that would normally operate with fixed head pressure control. LPA devices can also be fitted to new or existing systems.

LPA systems are most energy- and cost-effective when:

- The refrigeration system operates 24 hours a day and absorbs at least 20 kW of compressor power.
- Air-conditioning and HVAC systems operate during normal office hours, absorbing at least 40 kW of compressor power.

[1] The minimum achievable temperature will vary with the condenser type and ambient temperature.




## Checklist for suitability of LPA

- LPA systems will only be economical above a certain system size. It has been estimated that the retrofitting breakeven point in terms of economic payback of implementation costs is 15 kW refrigeration capacity for a system that runs continuously 24/7. Savings will reduce with less running hours..
- To reach its savings potential, each compressor pack needs to have a dedicated condenser.
- On saturated gas defrost systems, it is important to locate the pump in the optimum position within the system so as not to affect the defrost efficiency.
- For maximum efficiency, the refrigerant receiver should be positioned as high as possible; a bottom receiver outlet would be the preferred option.
- Due to the nature and operational parameters of the pump, LPA is not suited for flooded evaporator systems.

## How much will LPA save?

To calculate potential savings attributable to LPA, you should first ensure that:

- your condenser is clean and efficient and is operating at its minimum temperature.
- you are not operating with fixed head pressure control.

The savings will vary with ambient temperature. Thus you need to either establish the average temperature reduction or model the year-round temperature reduction, using a spreadsheet.

The refrigeration-system manufacturer will be able to indicate the savings that will accrue by reducing the condenser temperature and also whether LPA is technically suitable for the system.

In calculating savings, you will also need to take into account both operating hours and operating loads.

The LPA equipment supplier will give you a cost to install and commission the LPA system and the running cost of the LPA pump. By comparing the cost and savings, you can decide if your investment criteria are met.

Savings are site-specific and will depend on current operating conditions and the technology employed. It is necessary to design a specific solution and then calculate the energy savings.

## References for more information

Carbon Trust: *Good Practice Guide 280, 'Energy-Efficient Refrigeration Technology – the Fundamentals'.*

Carbon Trust: *Good Practice Guide 263, 'Designing Energy-Efficient Refrigeration Plant'.*

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