

# Low Temperature Cooling



Low temperature cooling is cooling of a process or area that is initially below 10°C to a lower temperature. This form of cooling provides cooling used for many industrial processes and also for cold storage applications.

The low temperatures involved in these cooling applications means that more energy is required for the operation of the systems than what would be required for higher temperature systems. Typically ammonia is used as a refrigerant in these systems due to its very good thermodynamic properties at low temperatures.

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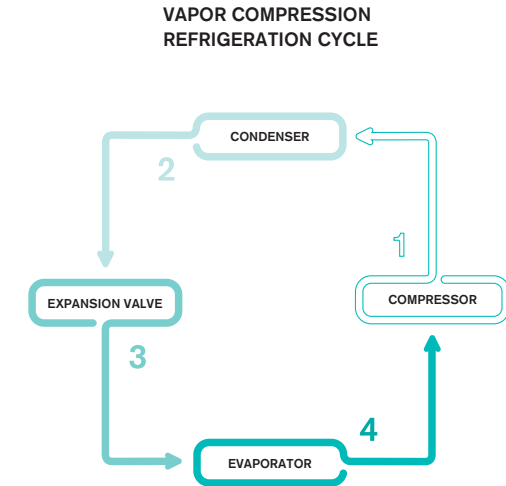


## Types of Low Temperature Refrigeration Systems

The main types of low temperature refrigeration systems used in Ireland are:

- The single stage vapour compression refrigeration cycle powered by an electric compressor, (for cooling to temperatures above  $-20^{\circ}\text{C}$ ).
- Two stage vapour compression refrigeration cycle powered by an electric compressors (for cooling to temperatures between  $-20^{\circ}\text{C}$  to  $-40^{\circ}\text{C}$ ).
- Direct cooling with a low temperature gas – such as nitrogen (typically used when small quantities of product needs to be cooled).

## Single Stage Refrigerant Cycle Process Flow Diagram



### The steps of the single stage low temperature cooling cycle are:

- **1-2:** Compressor of low pressure refrigerant gas using mechanical electrically driven compressor to a higher pressure and a temperature above ambient.
- **2-3:** The heat that the gasses absorbed in the evaporator is released in the condenser by either blowing air over the refrigerant gasses or by letting water flow around the tubes containing the gasses. The high pressure refrigerant gasses are allowed to expand to a lower pressure.
- **4-1:** The lower pressure refrigerant gasses are allowed to flow in a metered fashion into the evaporator which is in contact with the medium that needs to be cooled. Here the gasses absorb heat and in doing so cool the product or place.

In the two-stage refrigeration cycle, another intermediate compression stage is added, along with an intercooler. The effect is to increase the efficiency of the low temperature cooling. Some process found in the meat industry use the two-stage process to provide two separate stages of cooling, one at a high temperature for chilling at -10°C and one at a lower temperature for blast cooling at -40°C.

### Low Temperature Cooling Energy Saving Opportunities

- Replace compressors with different more efficient units. Significant energy savings may be available for the replacement of the existing compressors with a more appropriate or updated unit with a better Co-efficient of Performance (COP) and hence lower energy consumption.
- Reduce condensing pressures by improving condensing surface areas, addition of electronic expansion valves, and improving maintenance like removing air from condenser.
- Increase evaporating temperatures by increasing evaporator surface area removing oil from evaporator.
- Save energy by better control of compressor sequencing, control of electric defrosts and installation of hot gas defrosts systems.
- Improve insulation of cold stores and blast freezers. Control cold room lights better. Use better control on cooler fans.
- Ensure that cooling towers are well maintained. Check water treatment and scaling. Replace cooling tower spray nozzles with more efficient units.
- Pre-cool products before artificial cooling. Use free cooling if possible.
- Replacement of CFC unit. CFCs are being replaced by more environmental friendly products which may additionally improve the overall energy efficiency of the installation. Ammonia offers a good alternative to CFC's by offering better efficiencies.
- Variable speed compressors. These are now available as a means for modulating refrigeration output efficiently as the load on the systems reduces and increases.
- Thermographic Imaging. Using thermographic imaging techniques on low temperature refrigeration can quickly identify problems with cold room insulations or air ingress and can therefore save much energy.
- Cool at night. Cold stores can be brought down in temperature during the night using cheaper night time power. There may also be special tariff incentives to encourage demand control in this area.

ESB Independent Energy has considerable expertise in the efficient utilisation of Low Temperature Cooling Systems. If you require further information please contact your Customer Relationship Manager or ESBIE Head Office at 00 353 1 8628300.