TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

Energy Efficiency Checklist

Industrial Refrigeration

Cost-saving measures, productivity enhancements, and optimisation opportunities

December 2024

The Energy Efficiency Checklist for Refrigeration is a practical guide with options to reduce cost and optimise your energy use.

There are twelve categories within the checklist focusing on:

1. System considerations
2. Application heat loads
3. Evaporators
4. Compressors
5. Condensers and cooling towers
6. Expansion valves
7. Motors, drives, pumps
8. Controls
9. Secondary distribution system
10. Refrigerant selection
11. Maintenance
12. Service provider

TASK	DETAIL	COMPLETE?
System considerations	Ensure a whole-system approach is used.	
	Design for year-round efficiency.	
	Use thermal storage to meet demand peaks.	
	Use multi-stage or cascade systems where high temperature lifts are required.	
	Consider secondary coolant distribution systems to allow flammable and/or toxic refrigerants to be used safety (isolated in the plant room).	
	Explore opportunities for heat recovery, heat pumping and photovoltaic panels.	
	Consider use of the refrigeration system as a contracted interruptible load or for load shifting if it will not compromise production or product quality.	
	Select high efficiency fans, pumps, and compressors.	
	Select high efficiency motors and drives for all components of the system.	
	Design pipe layouts to minimise length and complexity to minimise pressure drops.	
	Design and operate to minimise liquid refrigerant logging in wet suction risers and condenser drop legs that lead to high static head pressure drops.	
Application heat loads	Minimise refrigeration heat loads by: • ambient pre-cooling of product and avoidance of product reheat during logistics • adequate insulation and shading to reduce solar gain for building and pipes • minimising air exchange through doorways (keeping doors closed and protecting doors) • good air flow design and high efficiency evaporator fans and motors • high efficiency light technology and occupancy controls • high efficiency motors and drives for all equipment in the refrigerated space • optimising defrost frequency and duration.	
	Adjust the layout of product within the refrigerated space to optimise exposure of product to cooled air and minimise temperature variability.	
Evaporators	Use evaporators with high surface area to achieve a higher evaporating temperature and hence lower energy consumption.	
	Use flooded evaporators or electronic expansion valves on direct expansion evaporators to maximise evaporator performance and minimise refrigerant superheat at compressor suctions.	
	Raise evaporator pressure as far as possible and allow to ‘float’ higher when the refrigeration demand is low.	
	Consider VSDs for evaporator fans and reduce speed if refrigeration demand is low.	
	Consider fan cowlings and air flow turning vanes around air cooling heat exchangers to improve air flow distribution and to reduce pressure drop and fan power.	
	Optimise defrost initiation and termination as moisture loads vary (e.g. automatically controlled on-demand defrost).	

TASK	DETAIL	COMPLETE?
Compressors	Enquire about compressor efficiency (e.g. COP) over the range of expected loads.	
	Size compressor suction and discharge piping to keep pressure drops low yet ensure oil return and no liquid logging in suction risers.	
	Use VSD control of compressors for efficient part-load performance.	
	Consider multiple compressors in parallel to meet changing refrigeration load; unload a small trim compressor with better part-load efficiency for load following and use other compressors with on/off control as baseload.	
	Consider economiser/vapour injection if using screw or scroll compressors with economiser ports.	
	Use external oil coolers for screw compressors and consider heat recovery from the oil coolers.	
	Allow head pressure to ‘float’ to make the most of low ambient conditions.	
Condensers and cooling towers	Choose between condenser types on a life cycle cost basis including consideration of capital cost, water use and water treatment as well as impact on condensing temperature.	
	Consider using water-cooled with cooling tower or evaporative condensers rather than air-cooled condensers.	
	Use a condenser with high surface area to achieve a lower condensing temperature and hence lower energy consumption.	
	Allow for removing non-condensables from the condenser.	
	Consider VSDs for condenser fans linked with head pressure controls.	
	Ensure air and/or water flow through condenser or cooling towers are well distributed and unimpeded.	
	Avoid short-circuiting of ambient air that will create a warmer microclimate near condensers.	
Expansion valves	Use electronic expansion valves where possible on small systems.	
	Link electronic expansion valve control with head pressure controls so operation at low head pressure is possible.	
Motors, drives, pumps	Use high-efficiency motors and drives.	
	Consider VSDs for loads that vary significantly.	
	Use high-efficiency fans and pumps and design pumping and air flow systems to minimise required flowrates and pressure drops.	
Controls	Aim to achieve highest possible suction pressure and lowest possible head pressure at all times (reduced temperature lift).	
	Use a control system that is responsive to compressor head pressure.	

TASK	DETAIL	COMPLETE?
	When multiple compressors are used to meet part-load periods, schedule compressors to run so that those with poor part-load performance provide the base loads while those with good part-load performance meet the varying part of the load.	
	Use any thermal storage such as secondary coolant tanks to smooth out cooling peaks to reduce the number of compressor starts or to load shift to reduce energy costs.	
Secondary distribution system	Insulate pipework and valves.	
	Select a secondary cooling fluid with appropriately high heat capacity and good flow properties.	
	Use appropriate diameter pipes to minimise pumping pressure but not so large that the heat gain becomes significant.	
	Use an energy-efficient piping system design that includes minimising bends, throttle valves and other impediments to efficient fluid flow.	
Refrigerant selection	Use a refrigerant that is most appropriate for your needs, considering efficiency, toxicity, flammability, cost and environmental impact.	
	Consider retrofit of high GWP refrigerants with lower GWP refrigerants if a suitable alternative exists.	
Maintenance	Institute an ongoing maintenance plan.	
	Train operators in maintenance for energy efficiency: • Train operators and general staff what to look out for that might indicate inefficiencies (e.g. ice build-up on pipes). • Train work staff on good practice around refrigerated areas (e.g. closing doors).	
Service provider	Use a qualified, experienced service provider that takes a system approach, examining both refrigeration supply and demand.	

NOTES