

These application notes are for general guidance and information only. Users will need to undertake independent analysis for specific sites.

Summary

Chiller systems are a major energy load and careful analysis of the entire system is required in conjunction with choosing the best chiller to achieve optimum energy efficiency. Measures should be taken to reduce chiller load as far as possible whilst at the same time a projection of future capacity is required. Future capacity will depend on many factors, but it is only a consideration if the entire chiller system is capable of expansion, that is, there is enough capacity in the reticulation system.

Mechanical systems such as cooling towers, condenser and chilled water pumps, and air and water distribution systems should all be evaluated for potential efficiency improvements. Controls play a key role in chiller system performance so it is important to consider the total control system as part of the chiller system design. Frequently, major performance improvements can be achieved simply by improving the controls.

Why install a high efficiency chiller in an inefficient system without optimising the entire chiller system? Only partial benefits will be gained at a high capital cost.

Choosing a Chiller

Economic analysis of a chiller purchase is required at a variety of efficiency levels to ensure that the additional cost of a high efficiency chiller has an acceptable payback period. Based on a new chiller installation, lifetime cost of ownership for an average chiller is in the order of 25% chiller and installation and 75% energy and maintenance.

Chillers should be evaluated and selected according to the actual running conditions, not the standard conditions as laid out in technical literature, to ensure low overall running costs. When more than one chiller is required, unequal sized chillers can increase system efficiency by better matching low load requirements. In some instances multiple chillers will provide better performance levels but in all cases the load profile must dictate chiller size and numbers.

Evaluate Part Load Performance

It is essential to evaluate the entire load profile of a chiller with an emphasis on part load performance. Most chillers will run at full load for only about 5-10% of their life. In fact most chillers run at between 40 to 70 percent load for most of their life.

Factors that Affect Efficiency

In all chiller types a large factor affecting energy efficiency is the size and type of condenser. Whether air cooled or water cooled, the larger the condenser, the greater the heat rejection capacity therefore the greater the overall efficiency. Some heat exchangers have extended surface area tubes that increase performance. Caution should be exercised in condenser selection as some high efficiency exchangers have large pressure drops which can result in increased pumping costs.

Variable speed drives are available for centrifugal chillers. These vary output to precisely meet cooling load conditions at part load during low ambient conditions whilst reducing power

consumption. For centrifugal chillers further efficiencies can be gained by lowering the temperature of the condenser water. Consideration should be given to over sizing the cooling tower for these applications.

Select soft start and energy efficient motors as even 1-2% increase in efficiency can have a large impact on annual running costs. Motor peak load limiting controls can reduce maximum demand charges during peak times by controlling chiller capacity and cycling.

Chilled Water System Impact on Chiller Efficiency.

Chilled water system components interact in complex ways and the chiller is just one discrete part. Chiller performance should always be considered as one part of the overall energy efficiency of the chilled water system. Minimising the energy consumption of each individual component does not necessarily lead to the most efficient system. Optimisation of controls, lower condenser water temperatures and a well designed piping and pumping system can be more cost effective than installing the highest efficiency chiller on its own.

Lowering the chilled water temperature will normally increase pumping efficiency but decrease chiller efficiency. Connecting two or more chiller evaporators in series instead of in parallel will recover lost chiller performance whilst still providing modest pumping improvements. This is ideal for new plant but existing plant will require evaluation of system performance at low flow.

References

HVAC: Rotary Screw Chillers. http://www.fpl.com/savings/energy_advisor/EA/PA_15.html

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Department of Human Services, Capital Management Branch - Guide to selection of cooling systems (Draft) -

[http://www.dhs.vic.gov.au/pdfs/capdev/guide_to_selection_of_cooling_systems\(Draft\).pdf](http://www.dhs.vic.gov.au/pdfs/capdev/guide_to_selection_of_cooling_systems(Draft).pdf)