ANNUAL SYSTEM INSPECTIONS REDUCE ELECTRIC ENERGY CONSUMPTION.

Norman Mitchell FIMgt FInstR MRAC President AREA

Considerable capital investment is made daily in refrigeration and air conditioning equipment throughout Europe. This investment is in plant that is required to use energy to operate and for this plant to operate in the most efficient manner it does require regular attention. Annual maintenance is often thought of as just a means of preventing breakdowns in the coming year. This may be true but there are also worthwhile benefits to be gained in saving energy.

The refrigerating plant, whatever type of equipment it is, should have been designed and selected to operate at its optimum performance both in terms of output and energy use. Regular maintenance inspections, carried out correctly, will ensure the plant is running as close to its design intentions as possible. When the plant was installed, a record of the commissioning data should have been kept and passed to the owner or operators of the equipment. These records should include the settings for the various limiting devices and other control settings, temperature settings, type and charge of refrigerant gas.

The records will enable the maintenance staff to check and compare them during maintenance inspections. The records required should be able to be found in the Operation and Maintenance Manuals. Any settings or detail, which do not compare can be investigated.

Some of the more important checks will be directed at the system condenser, the system evaporator and the system pipe work.

Where air has been chosen as the condenser cooling medium the air flows to and across that condenser will be of prime importance. Firstly can the air reach the condenser freely? Condensers are often sited in out of the way places, in the back yard, on a roof or in an isolated corner. The airflow can easily be restricted by blocking the air path to or from the condenser. This can occur when goods, waste paper or cardboard are stored too close to the condenser, sometimes blocking the whole face. Obstruction of the airflow will cause the condensing temperature to increase.
A 1º C increase in condensing temperature increases the running costs through higher energy use by between 2% and 4%.

The cooling capacity also drops and the required temperature in the cooled space may not be achieved.
The warmer the air onto the condenser, the higher the condensing temperature. Shading the condenser if necessary, ensuring warm air is not recirculated and removing any thing obstructing the airflow will help to lower the condensing temperature.

The cleanliness of the condenser surfaces is very important, if the air is free to move around the condenser but cannot readily contact the heat transfer surfaces due to dust, dirt or other contamination then the condensing temperature will continue to run unnecessarily high. A 10ºC uplift due to dirt is not unusual, resulting in an increase in energy use of between 20 and 40%.

Cleaning the condenser fins thoroughly including, where required, a chemical cleaning process to remove grease, oil, fat or baked on dirt, will help to return the plant to its design energy consumption.

Condenser fans should not be overlooked as a build up of dust or dirt on the blades also detracts from energy efficient running.

With water cooled plant the condenser heat exchanger should be kept free of fouling, corrosion or scale, cooling water will usually need to be treated to avoid this.

Air or other non-condensables in the system may accumulate in the condenser and will increase the condensing temperature again resulting in lower efficiency. These should be removed to restore efficiency.

At the cooling end of the system the evaporator needs to be kept clean and unobstructed. In a direct expansion air cooler the fin block should be kept clear of dirt or slime and adequately defrosted to prevent ice build up.

Ice will build up on the evaporator and so decrease the efficiency when the evaporating temperature is below 0º Celsius (which will be for most refrigeration applications).

Where defrosting can only be achieved by introducing heat, energy efficiency can be helped by initiating a defrost operation only when it becomes necessary through detectable lack of performance and by stopping the defrost cycle as soon as the fin block is totally clear of ice. Condensate drains must also be kept clear to prevent water build up in the drain tray freezing on the coil stopping successful defrosting.

Blocking or partial blocking of the fin coil due to any obstruction will drop the evaporating temperature; a 1ºC drop in evaporating temperature increases the energy use by 2 to 4%. The capacity also drops and the cooled space may not get down to the required temperature.

Defrost heaters, where fitted, should be checked for correct function and also any drain heaters. Heaters remaining on unnecessarily will not only consume energy but will cause the plant additional work to remove the heat, again wasting energy. Any failed heaters will cause uneven defrosting preventing the coil block clearing fully of ice.

Refrigeration compressors pump a small amount of oil with the refrigerant. The installation should have been designed to ensure that this oil circulates around the system and returns to the compressor.

Oil logging in components such as evaporators can significantly reduce their efficiency and a shortage of oil in a compressor will decrease its reliability and eventually result in a mechanical failure.

The system pipe work joins the system components and contains the refrigerant fluid within the system. The pipes and joints are a possible source of leakage of refrigerant from the system. Refrigerant leakage causes the system reliability to decline – even before the leak is detected. Its impact on efficiency can be dramatic: independent tests have shown that even average leakage rates can cause a 45% drop in chilling capacity. This creates additional energy use for the plant due to longer running.

Thorough leak testing the whole of the accessible pipe work and components will enable any leakage to be detected and most importantly for energy use and the environment will enable the leak to be repaired.

The most common causes of leakage are flare joints, shaft seals, other mechanical joints, signal lines and small bore lines, valves and glands and vibration or chafing. Damage to pipe work will also be potential a leak site.

The frequency of leak testing is dependent on a number of factors, the size of the plant and its charge and the critical nature of the use are probably the most important. The larger the charge the more frequent the leak checking should occur. Fixed permanent leak detection equipment will enable early rectification on larger plant.

On no account should refrigerant be added until the cause of the leak is found and repaired. Over charging can, in certain circumstances, consume more power than necessary and have more refrigerant to loose in the case of a leak.

Other items that may contribute to energy saving can be checked during maintenance. Superheat settings, thermostat settings and other controls as they may have drifted away from the commissioning settings. Door opening times on cold rooms can be observed as well as checking that product is loaded so that it does not impede the airflow to or from the evaporator. Refrigerated cabinets should not be loaded above the load line.

Checking door seals and door strip curtains are still in good condition will keep heat ingress to a minimum. Insulation on the suction lines should be in good condition reducing the heat gains in the suction vapour between the evaporator and the compressor.

These points and others depending on the type of plant if not adjusted to the designed optimum will increase the energy consumption of the plant.

In conclusion, the good records generated at installation commissioning and the design parameters will go a long way to assist the maintenance technician. These will ensure that the plant can be set up to its optimum efficiency and energy consumption at each maintenance visit with little deviation between each visit.

It has been estimated that 20% plus saving in energy consumption can be achieved by good maintenance. It is possible to make a reliable plant that is not very efficient. Plant designed and operated to be efficient, however is inevitably more reliable, for two main reasons:

A) The compressor does not have to work so hard in an efficient plant, which makes it less prone to breakdown and, therefore more reliable.

B) Planned maintenance maintains efficiency and improves reliability, minimising environmental impact indirectly through the energy consumed and directly through the effect of refrigerants if they leak to atmosphere. Planned maintenance saves energy and contributes to better profits.

Mitchell's
(GLOUCESTER) LTD

PO BOX 25, 88 Bristol Road
Gloucester, GL1 5XA
Telephone: (01452) 302206
Fax: (01452) 302106
e-mail: mitchells@mcmail.com