Air Conditioning Product of the Year

ClimaCheck – system performance analyser

"If you can't measure it, you can't manage it."

IBM corporate policy

A true statement, and applicable to most fields of human activity.

The problem in relation to the rac industry is that for two hundred years – since the invention of mechanical cooling in fact – we have not been able to accurately measure the performance of working cooling systems.

At least, not without a fully equipped climate-controlled laboratory, thousands of pounds-worth of sophisticated monitoring equipment, and a team of technicians supported by banks of data loggers and a super-computer.

This kind of resource has been the province of a few big manufacturers, with deep pockets. In any case, this approach does not lend itself to testing in the field by practitioners, in real world conditions - where the performance of plant really matters.

"...we need plant that wrings every ounce of cooling from every electron of power consumed. But without being able to measure performance accurately, we are in the dark."

In the low carbon age, this is now critical, in response to the imperative to deliver high performance, high efficiency cooling that wrings every ounce of cooling for each electron of power consumed.

But without being able accurately to measure the performance of plant, engineers and end users are in the dark.

As a result…

The critical issue of how well cooling systems actually perform in practice has remained one of the great mysteries, on a par with the building of the Great Pyramids and the purpose of Stone Henge.

Until now…

An innovation that changes everything…

> ***"Importantly, ClimaCheck is a non-invasive technology, and does not require breaking into the refrigeration circuit"***

The ClimaCheck performance analyser is a ground-breaking piece of technology that has the potential to revolutionise the industry's approach to evaluating system performance.

Its development and commercialisation marks a watershed in our ability to assess the actual, objective performance of working cooling plant.

For the first time, it enables engineers in the field to determine how well operating plant is performing, its actual COP, and other vital performance parameters.

It quickly and accurately determines a working system's:

- Coefficient of Performance
- Cooling and heating capacity
- Power input, and
- Compressor isentropic efficiency

This vital data is presented in clear charts, enabling the engineer or end user to gain an immediate picture of the actual performance of the system.

Ground-breaking approach – how it works

Importantly, ClimaCheck is a non-invasive technology, and does not require significant disruption of the refrigeration circuit. This eliminates the possibility of leaks of harmful refrigerant to atmosphere. Instead, it uses five simple sensors that are quickly attached at strategic points around the system.

An engineer can hook up ClimaCheck in a few minutes. Then the data starts flooding in. From the information gathered, ClimaCheck accurately determines the key operating parameters that pinpoint the system's actual performance.

The genius at the heart of the system

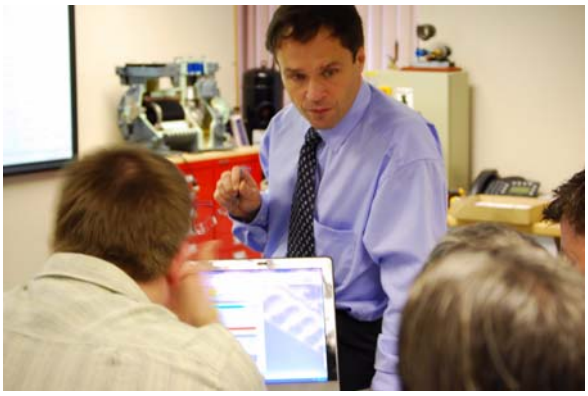
At the heart of ClimaCheck are a series of sophisticated algorithms, based on the thermodynamic properties and operating characteristics of the specific system refrigerant in use. ClimaCheck already manages 52 refrigerants and 38 refrigerant blends, including CO2, Propane, Ammonia, Hydrogen and so on.

The collected data are fed are recorded and are subject to extensive and complex calculations from which the true performance of the plant is then determined.

Pioneering inventor

The technology was developed by Swedish inventor and refrigeration pioneer, Klas Berglof.

He has worked for 20 years on the sophisticated mathematical algorithms on which the system is based.



Templates for different system types, such as those with external oil cooling and economisers and two-stage cascade systems, have been created, enabling ClimaCheck to be used with all mainstream systems in use today – and any speciality system of the future.

Tesco uses ClimaCheck to test new C02 systems for superstores

Tesco has invested in the technology to check on the performance and efficiency of its new store-based refrigeration systems.

The retailer is using ClimaCheck to monitor the performance of a new generation of environmentally friendlier cooling technologies under development, to help evaluate which operates most efficiently before adopting new systems.

"Up to now, the only way to find this information was through complex and invasive monitoring. It was extremely expensive and time-consuming", says Andy Campbell, head of Tesco's Environmental Refrigeration Research and Development Programme.

Gold mine for engineers

"With ClimaCheck, you just hook up the machine and it automatically calculates a full set of data on actual plant performance. This information is a gold mine for engineers, as you can use it to diagnose problems, check on performance, and as a tool for optimising the operation of plant."

Practical benefits

Armed with the information provided by ClimaCheck, engineers can quickly identify plant performance problems, including:

- refrigerant shortage or over-charge
- incorrect superheat setting
- oil logging in the condenser
- fan underperformance
- compressor damage or wear

ClimaCheck even identifies irregularities in compressor performance that could result in future impairment of performance – or even plant breakdown, enabling pre-emptive maintenance.

Armed with this vital information, engineers can address the issues identified, optimising system performance. The result is huge potential savings in power consumption and carbon emissions over a plant's lifetime.

Without ClimaCheck, these would have gone unrealised, with the plant continuing to perform inefficiently – or eventually breaking down with potentially catastrophic consequences for refrigerant loss and stock damage.

Advantages for the user in the field

ClimaCheck can be connected in minutes, with immediate results.

It can be disconnected quickly and connected to one refrigeration system after another, without the need for time-consuming or costly cleaning.

ClimaCheck requires no time-consuming cleaning between performance tests

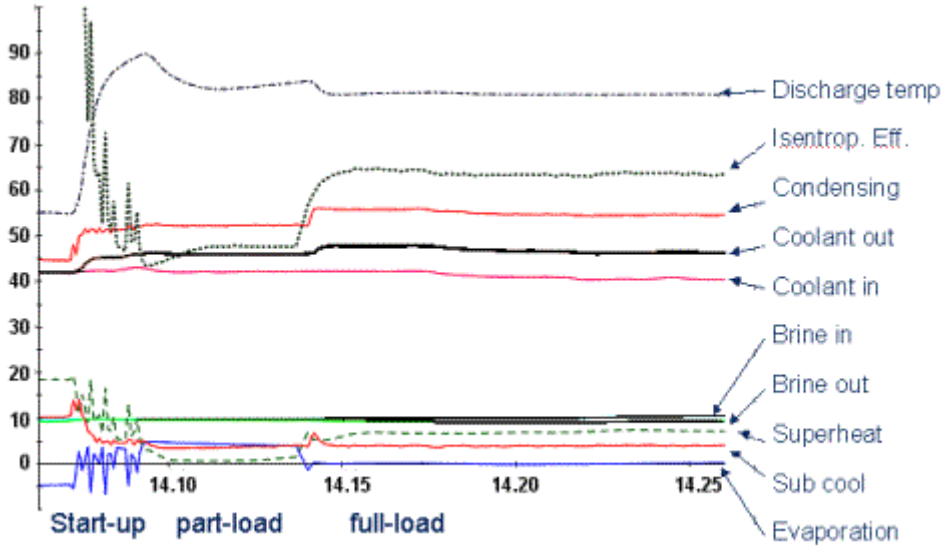
It is easily portable, being contained in a small hand-held flight case. Alternatively, it can be permanently installed as a compact version featuring GPRS Wireless Communication and even sends specific warning Text Messages.

It is straightforward to use and requires just a brief training session to connect up and begin applying the results.

It is relatively low cost, and pays for itself quickly through practical, verifiable results. Payback is typically between six to 12 months.

High quality, clear analysis

The following shows a print-out from a plant performance analysis carried out by ClimaCheck. It gives a clear visual read-out of key system parameters and operating characteristics, at start-up, part- and full-load.



R134a Chiller log showing improved efficiency at full load

The data is sent to a notebook PC or via MODEM to a Web Server.

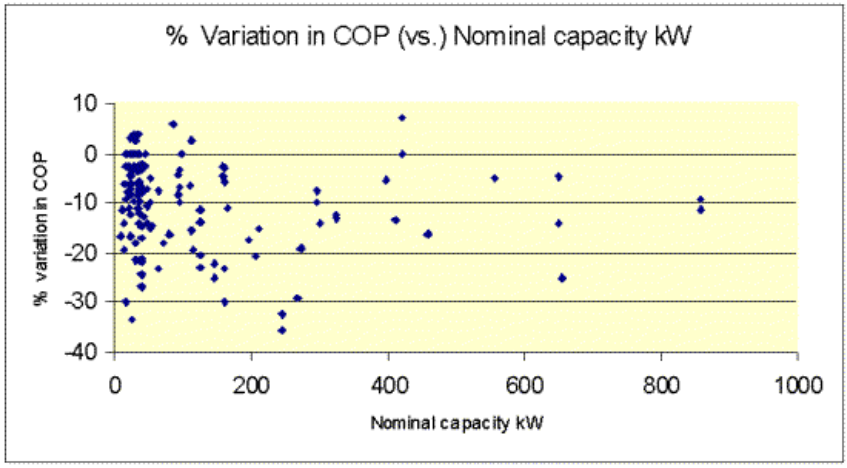
Dedicated software is then used to provide tabulated real-time logs and charts, which are easy to interpret.

How does it help protect the environment?

Refrigeration and air conditioning plant is estimated to use between 15 to 20 per cent of the electrical energy in Europe. This share is increasing as the requirement for comfort increases.

There is enormous potential to save energy by optimising existing refrigeration and air conditioning systems.

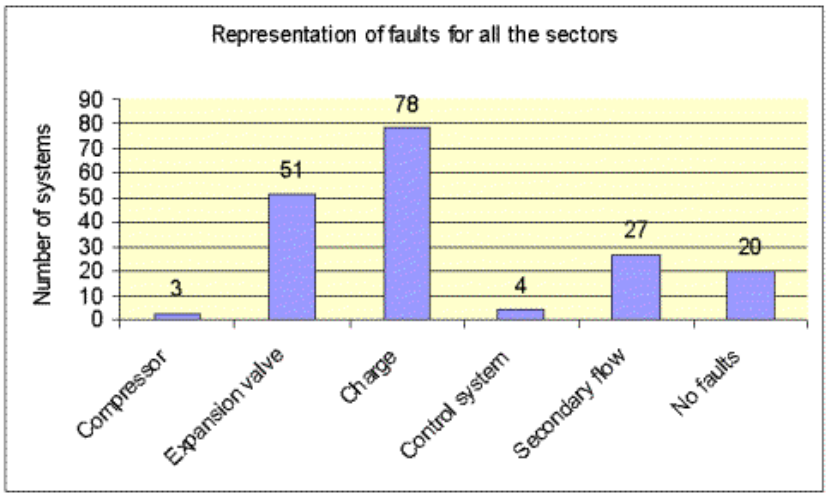
A striking survey based on 164 performance inspections on air conditioning, refrigeration and heat-pump systems showed that only 13 per cent of the systems operated within the specified performance criteria. That means that some 87 per cent did not perform to specification.



The problems identified (in the order of their frequency), with examples of possible causes, were:

- **Incorrect refrigerant charge** caused by leaks or over-/ undercharging.
- **Incorrect operation of expansion device**. This can be caused by improper adjustment, malfunction or an incorrectly selected device.
- **Incorrect air or liquid flow over condenser / evaporator** due to incorrect design, wrong selection of fans / pumps and/or blocked filters resulting in higher system energy consumption.
- **Poorly adjusted controls.** For example, low pressure cut-out or condenser pressure controls causing significant waste of energy.
- **Poor efficiency of compressor.**

The results are summarised in the graph below:



The survey covered mostly relatively new systems in connection with commissioning or end of warranty. In most cases, the contractor will have "pre-checked" a significant number of these installations and corrected some problems.

Consequently, it is more likely that the average improvement potential of all systems will be higher rather than lower.

Can the benefit be quantified?

The Master's Thesis Study at the Royal Institute of Technology in Stockholm shows that power savings averaging 10 per cent could be achieved in the 164 systems surveyed by ClimaCheck.

If this was extrapolated on a European-wide level, the potential savings would be dramatic.

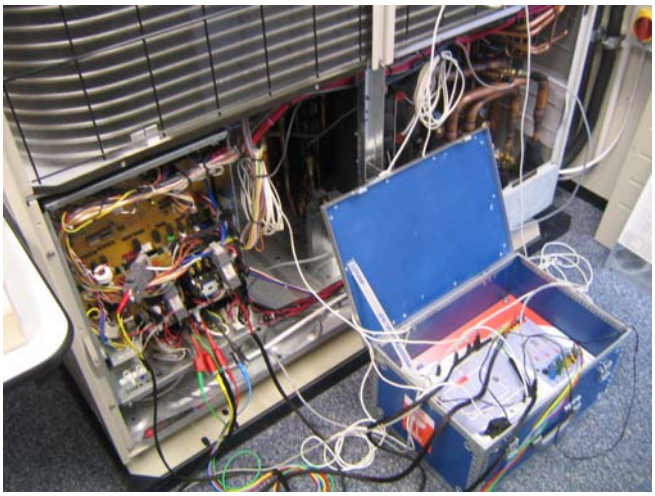
The power saved would correspond to the equivalent of all the wind power produced in Europe or the total electrical consumption of Denmark or Portugal.

Is independent verification of claimed performance available?

The method and accuracy of ClimaCheck results have been validated by SP Swedish National Testing and Research Institute (report available).

The method has also been evaluated by Professor Per Fahlén at Chalmers University in Gothenburg, Sweden. The findings were presented at major conferences organised by the International Institute of Refrigeration and the Institute of Refrigeration in the UK.

ClimaCheck is also used alongside traditional, laboratory-based flow measurements by several world leading manufacturers, as well as by research teams at Swedish Universities and in Training Centres for technicians.



ClimaCheck is now being used by leading manufacturers and research institutes, alongside flow-based approaches. The results measure up

Are there any additional risks associated with the product?

Introduction of pressure transducers could conceivably result in a miniscule amount of refrigerant leakage. However, as the product is primarily used by Refrigerant Safe Handling Certified engineers, this is not an issue.

Moreover, the sensors are specially made for refrigeration applications and feature a specially extended threaded housing and nylon seal that allows the Schrader connection to be fully sealed before the depressor is activated. The seal is so effective, sensors only have to finger-tightened lightly to effect a complete seal.

What are the costs and benefits of using the innovation?

The major cost is the capital cost of the equipment. The complete packaged kit - inclusive of all sensors, logger, power transformer, software and ancillaries packaged in a rugged box - is around £3000.

The payback for competent service personnel in terms of time saved in diagnosing faults can be very short - less than 6 months to 1 year. Substantial discounts are available for training applications.

Where mandatory performance inspections are required, the additional cost of recording system behaviour with this equipment is negligible. Most of the cost is associated with sending an inspector to site.

Data can be recorded for subsequent analysis, or made visible in real time to competent analysts by using the modem and web server.

"The payback time for a competent engineer is estimated to be between six months and a year"

Resolves disputes quickly
There are many examples of energy optimisation being achieved and cases where years of conflicts between owner and contractor have been solved in just a few hours by documenting the actual equipment operation with ClimaCheck.

One example is a large water chiller installation with a dual condenser system for heat recovery, where a system overcharge caused unacceptable operating conditions, resulting in damage to two compressors requiring repairs costing more than 40,000 Euro. The system was under three years old. Based on an analysis with ClimaCheck, the refrigerant charge in the system was corrected, resulting in a decreased annual electricity cost of 10,000 Euro per year.

ClimaCheck can resolve disputes on plant performance that might otherwise rumble on for years

This transformed the capacity of the system. Eight compressors were previously required to run with a capacity shortfall. After adjustment using ClimaCheck, only six compressors were required throughout the summer.

In addition, the heat recovery facility finally began to function during the winter season.

A skilled refrigeration engineer might have solved the problem after much diligent effort and considerable time, although several consultants and service companies had previously failed to identify the cause.

Several costly measures, such as installing sprinklers on the dry coolers, were taken without correcting the problem. The clear documentation of the system's behaviour in different operation modes using ClimaCheck made the cause of the problem obvious. It was then solved quickly.

How widespread is the use of the innovation?

ClimaCheck is being used by increasing numbers of contractors, field engineers, end users, researchers and educators as an indispensable tool for evaluating plant performance.

Does it have potential for more widespread use in future?

It has enormous potential that has only just begun to be tapped.

Why does this entry deserve to win this award?

Quite simply because it a "breakthrough technology", that for the first time enables engineers in the field to gain a quick and accurate assessment of the *true and actual* performance of operating refrigeration and air conditioning systems.

Armed with this essential and hitherto unavailable information, engineers can accurately diagnose and rectify performance problems - and dramatically improve the operating efficiency and reliability of plant. Moreover, Cooling or Heat Pump capacity is derived *without the need to measure air / water flow rates or temperatures!* This was never achievable until now!

As one leading Field Service Manager said after being introduced to ClimaCheck for the first time:

> *"It is what the industry has always wanted. ClimaCheck gives us a window to see what is happening inside systems. We are no longer in the realm of trial and error and guesswork. It transforms our ability to improve the performance and energy efficiency of plant."*

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