

# AIR CONDITIONING AND REFRIGERATION Journal

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## Eurovent Certification Of Air-Cooled Heat Exchangers



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This article gives both a historical and technical background on the subject of performance rating of Unit Coolers and Air Cooler Condensers used in the European market. Readers familiar with the HVACR industry in India will find historical similarities with many products first introduced in India in the early years and now being commonly manufactured by several companies such as unit coolers, refrigeration compressors, cooling towers, test facilities exist within the country which performance test such products for greater customer confidence - Editor.

The expression "commercial factor" was, from memory, first heard in the U.K. in the early 1960s. Refrigeration, industrial & particularly commercial, was expanding rapidly and there was a proliferation of new heat exchange products of which almost all were made under overseas licence. For whatever reason and the cause was not clear, experience

suggested that for certain products there existed a capacity shortfall. Thus was born the above expression which could be summed up as:

Commercial Factor =

$$\frac{\text{Capacity claimed for product}}{\text{Capacity genuinely available}}$$

It was used of certain ranges with tolerance and even humour and it rarely exceeded 15%. Despite their shortcomings the offending ranges were not shunned, deficiencies were known and generally the solution was to use published selection data and select the next model up.

How could this have occurred? What is the U.K. and European situation now and what, if anything, is the relevance to the future Indian market?

It should be emphasized that 'The Problem' was concentrated almost entirely in the area of most rapid growth, the commercial sector. Unsurprising because users and installers of industrial products had a much clearer idea of the relationship between capacity, fans and air volume and cooler surface. They knew what they wanted!

On the commercial side it was a new world and more difficult, The fact is that product performance in the field is almost impossible to measure with any accuracy - precise design conditions rarely occur for any length of time, measurements are difficult and external factors often present a moving target. Second, a performance shortfall may often be camouflaged by other factors. A plant may run 20 hours per day instead of the design 16, a cooler may operate on an 8° C T.D. (temperature difference) instead of the promised 6° C and probably nobody will comment. Finally, contractors or others may well add safety margin at the design stage. The deficiency is there but pinpointing the cause is another matter.

Had it stopped there it might have been acceptable but in a highly competitive market the temptation to stretch optimism into downright cheating is always present. In Europe it was a slippery slope and eventually it got out of hand. It may sound unbelievable but ultimately capacities exceeding 60% above reality were being claimed.

Five years ago a group of manufacturers representing some 60/70% of the European market met in the U.K. to discuss the problem. They acknowledged its seriousness and that the situation benefited nobody. They were cheating customers and, ironically, cheating themselves out of sales worth at least 30%! Most important though, it was agreed that unless the industry put its own house in order then, others, perhaps in the shape of Government or Local Authority, would impose order on

them and that this might well be supervised by persons with neither knowledge of nor sympathy for the workings of industry.

Thus was born the Eurovent Certification Company. Based in Paris it is a union of manufacturers associations, Eurovent (Heating & Ventilating) and Ceconaf (Refrigeration), and the former already had in place a modest scheme for testing its own products. The new company was to be dedicated to the rating and testing of product ranges using a chain of 'Independent' test laboratories.

Nothing new here, you may feel, and it is worth noting that some laboratories already operated their own test schemes and "Approved" logo, But true independence was a fragile flower or, 'he who pays the piper calls the tune'. The manufacturer paid and, sadly, if his expectations were not realized the, in disappointment, he might well shift to a more sympathetic source. At the same time some unscrupulous manufacturers would offer a single model for test and it would pass. The 'Tested' logo would adorn the brochure with the obvious implication that 'the range' had been tested. Sadly human nature had interfered and close inspection would show that the model tested, by comparison with others, and for reasons not clear was more generously endowed - usually with surface. Yet the 'Tested' logo was there and it took a bold or foolish laboratory to protest. The laboratory schemes were a step forward but little more than that.

Last year it had become clear that old habits die hard and the signatories to the initial scheme met once again. It transpired that some manufacturers have been selective in their choice of ranges for test. They might offer a couple of uncritical ranges for test, their catalogues might bear the Eurovent logo, yet a dubious but commercially important range would deliberately remain untested. It is not hard to understand, after all the Technical Director of a large company might agree with the testing principle but when he returned home, he had to sell to an unhappy Sales Director proposals for re-rating which would put plans and budgets in jeopardy.

The scheme came close to unraveling yet grudgingly the 'Certify All' scheme emerged and all, plus some new-comers, have signed up. The agreement covers Unit Coolers, Air Cooled Condensers and Dry Air Fluid Coolers. Others will follow. It agrees that from the testing of the first product, 80% of all ranges must be tested a within 18 months or removed from brochures or other Point of Sale. Testing is carried out at eight laboratories around Europe and they, in turn, are 'tested' A product of known capacity is disguised as a fresh test and quietly passed around. Accuracy of known capacity is disguised as a fresh test and quietly passed around. Accuracy of 2 to 3% is expected.

## How does the system work?

A signatory to the agreement applies for range approval to the certification company. He provides technical detail from which Eurovent selects a few, perhaps two or three models for testing with the intention of covering the widest heat flux, (high to low fan speed)

Tested are:

- Capacity
- Air volume
- Fan motor power
- Sound Power Level
- Coil Detail (tubes and fins)

The Certification Company places an order with a Test House to which the units are sent. Results are sent to the Company which relays them to the manufacturer. If within permitted tolerances, approval is given, if outside, the manufacturer may re-rate at the test figures, or may modify and retest. The scheme provides for a 'challenge' mechanism whereby one company may demand a test of another's product - the loser pays the costs.

Apart from verification of the above items there are other benefits. Brochures carry correction factors for variations on refrigerants (particularly the new generation), for descending evaporating temperature, for fin and tube materials etc. etc. Variations were often substantial and could be used unfairly. These have now been agreed and for customer and manufacturer another source of dispute has been eliminated.

Testing is to the following European Standards:

Unit Coolers - pr.EN328

Air Cooled Condensers-pr.EN327

Dry Air Fluid Coolers - EN.1048

Noise Assessment - ISO.3741, 3744,3745,ISO,9614-1, pr.EN.13487.

Rating Standards are as follows:

Unit Coolers for Refrigeration 7/C/001-1999

Air Cooler Condensers 7/C/002-1999

Dry Air Fluid Coolers 7/C/003-1999

Certified Operations Manual OM-2-1999

As of 6th December 1999 the following companies had contracted to join the scheme. They represent a substantial majority of European manufacturers. It is expected that

participants will market this aggressively in the hope that others will follow. Users and specifiers will add their support.

- Asarum
- Centaurd
- Coolers & Condensers
- Delta Technics
- Fincoil
- Goedhart
- Hans Guntner
- Helpman
- Kobol
- Kuba
- LGL France
- LU-VE Contardo
- Profroid
- Searle
- Thermal
- Walter Roller

A crucially important part has been agreement on some basic definitions of which 'T.D.' (temperature difference) is the most important. It is worth considering this in some detail.

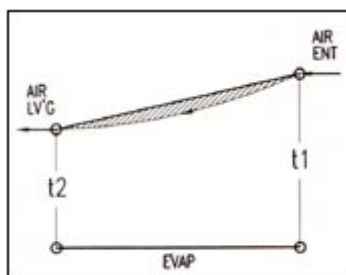


Figure 1

### 'LMTD' (log Mean Temperature Difference)

The performance of a finned tube heat exchanger is related directly to its 'LMTD'. In the case of an evaporator it is defined as:

$$\text{LMTD} = \frac{(t_1 - t_2)}{\ln\left(\frac{t_1}{t_2}\right)}$$

Where:

$$t_1 = (\text{Entering Air} - \text{Evap. Temp.})$$

$$t_2 = (\text{Leaving Air} - \text{Evap. Temp.})$$

Eg. If  $t_1 = 6^\circ \text{C}$ ,  $t_2 = 4^\circ \text{C}$  then:

Arithmetic mean =  $5^\circ$

Log mean =  $4.93^\circ$

The difference between the two figures is represented by the shaded area in **Figure 1**

Note:

1. Log mean is less than arithmetic because air temperatures drops rapidly at the beginning.
2. Coils perform according to LMTD but rating them against LMTD is far too complex.
3. The solution is to rate them against either  $t_1$ ,  $t_2$  or a combination which is measurable.

## Definition of Evaporating Temperature

This is defined as the equivalent of "the saturated suction pressure measured at the evaporator outlet" A gauge tells all.

It is a clear and satisfactory definition in that it allows the coil designer to select his circuiting at will.

Increasing the circuit loading by selecting fewer passes will improve performance by improved internal film coefficient. But it will also eat into the available LMTD and reduce performance. Consider the previous example:-

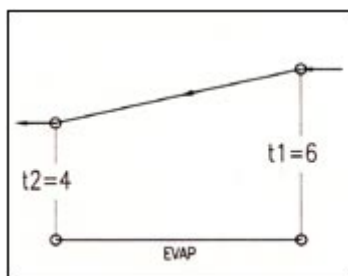


Figure 2

**A.** Low circuit load, negligible change in evaporating temperature,

$t_1 = 6^\circ \text{C}$ ,  $t_2 = 4^\circ \text{C}$ . See **Figure 2**

LMTD =  $4.93^\circ \text{C}$

**B.** High circuit load gives  $1.2^\circ \text{C}$  change in evaporating temperature. See **Figure 3**

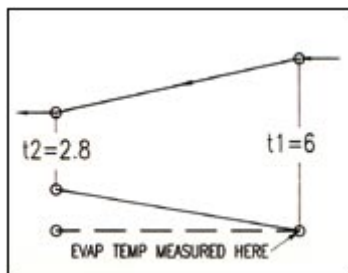


Figure 3

Since the evaporating temperature is measured at the cooler outlet, the pressure drop must eat into the coil.

$$\text{i.e. } t_2 = (4 - 1.2) = 2.8^\circ \text{C}$$

The LMTD is reduced to  $4.2^\circ \text{C}$  (reduction 15%) Any improvement in internal film coefficient must produce at least a comparable overall improvement to match it, or it is pointless.

### Room Temperature - Where is it Measured?

This is the heart of the 'T.D.' question. To answer it let us say a store owner approaches three manufacturers for a cooler. He specifies the duty, the air volume required, a room temperature of  $+6^\circ \text{C}$  and a  $6^\circ \text{C}$  T.D. from which he expects to evaporate at  $0^\circ \text{C}$  and find a  $2^\circ \text{C}$  air temperature drop over the coil.

He receives his three quotations.

#### Manufacturer 'A'

Quotes "air off" at  $6^\circ \text{C}$ . But the air comes back at  $8^\circ \text{C}$  says the customer. Only the air leaving the cooler meets the target. Unacceptable! See **Figure 4**.

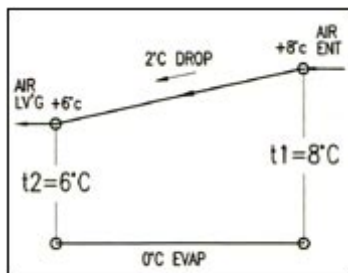


Figure 4

#### Manufacturer 'B'

Quotes "mean air temp" of  $6^\circ \text{C}$ . Air drops  $2^\circ \text{C}$  over the cooler and picking up  $2^\circ \text{C}$  through the room returns at  $7^\circ \text{C}$ . It leaves the cooler at  $5^\circ \text{C}$ . See **Figure 5**.

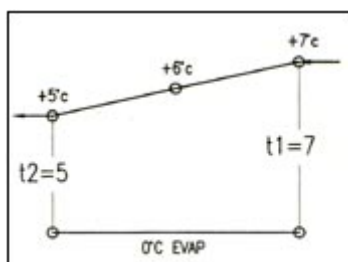


Figure 5

'Hold on' says the store owner, 'this means only half my store will be at my temperature?' To which the manufacturer replies that there will be as much below his design temperature as there is above so he has nothing to complain about.

### Manufacturer 'C'

Quotes a cooler with the air returning at + 6° C, leaving at + 4° C and picking up the 2° C as it passes through the store. See **Figure 6**.

He promises that at no place in the stores will the design temperature be exceeded. The owner is happy.

Consider now the implications for the here manufacturers. See **Table 1**

Since the coil requirements are driven by LMTD, with higher LMTDs 'A' & 'B' may reduce their coil surface below that which 'C' will provide by 29% and 17% respectively.

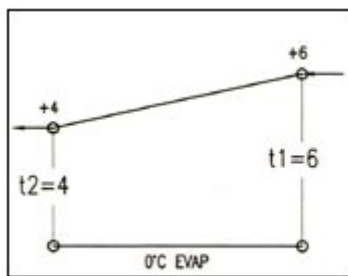


Figure 6

**Table 1 Summary of Manufacturers Offers**

Manufacturer	t <sub>1</sub> °C	t <sub>2</sub> °C	LMTD	% of Surface 'C'
A	8	6	6.952	71
B	7	5	5.944	83
C	6	4	4.933	100

### Summary

'A' is unacceptable and no manufacturer would try it. But 'B' (the measurement of room temperature as a mean either over the coil or through the room) has long held a place in catalogues. So too has measurement of the air temperature as the "air on return" to the cooler. This has been recognized by two separate T.D.'s which appeared in brochures until recently.

$$T_1 = (\text{Return Air} - \text{Evap. Temp.})$$

$$T_2 = (\text{Mean Air} - \text{Evap. Temp.})$$

For the manufacturer  $T_2$  has obvious sales advantages over a competitor using  $T_1$ , as he can get away with a smaller coil.

In order to reduce confusion and provides the customer with the best possible solution, the use of T<sub>2</sub> as a selection option is, to Eurovent signatories, no longer permitted.

## **Eurovent 'Certify All' scheme conclusions**

In terms of success in securing the support of the major players in manufacturing the omens are very good. How effective the signatories are in marketing the scheme to contractors and end users remains to be seen. If successful, the minority must follow. But for all concerned there are very real benefits in terms of brochure consistency and similar correction factors.

There is one final option signatories have against those who operate outside the scheme and make unfair claims and this is the law. A major exporter within exporter within Europe was attacked for false capacity claims by a manufacturer of that country. The exporter lost, paid all court costs, paid substantial damages and was banned from exporting into that country.

Very heavy action but the mood is serious and the prize, of fairness in competition, is worth the effort. The loser in the case has now joined the scheme.

There is no place as yet, in the Eurovent scheme for testing of Ammonia products. First, there are no test houses which can cope. Second, there is no demand. Since much of India's cold storage is flooded or pumped Ammonia it is much easier to compare the essentials of unit coolers such as surface area, air volume and fin spacing.

With the impending growth in the refrigeration field in India and the proliferation of cold storage facilities there is a need for existing and now manufacturers to get together, learn from the European experience and establish performance norms as a first step. The second and major step is to encourage the establishment of independent test houses where any manufacturer of unit coolers and other heat exchangers can have his product tested.