Applications Corner

Chiller Solution Marketing

This Chiller Solutions Update Newsletter's edition of Applications Corner can be found in the Chiller Solutions Update Newsletter – July 2012.

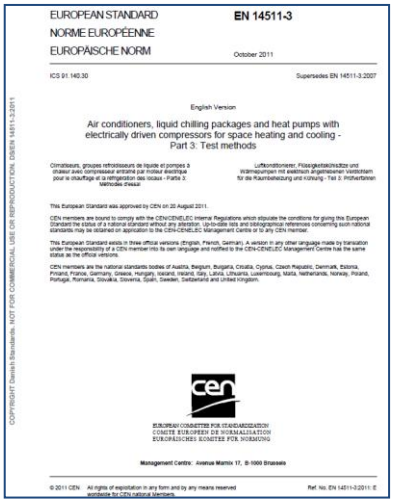
A Review of Changes to Global Standards

EUROPE

EN14511 has changed, so what?

Eurovent enforces chiller and heat pump manufacturers' published performance to comply with requirements of EN14511:2011

Summary:


EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 14511-3

October 2011

ICS 91.140.30

Supersedes EN 14511-3:2007

English Version

Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling - Part 3: Test methods

Climatiseurs, groupes refroidisseurs de liquide et pompes à chaleur avec compresseur entraîné par moteur électrique pour le chauffage et la réfrigération des locaux - Partie 3 : Méthodes d'essai

Luftkonditionierer, Flüssigkeitskühlsätze und Wärmepumpen mit elektrisch angetriebenen Verdichtern für die Raumbeheizung und Kühlung - Teil 3: Prüfverfahren

This European Standard was approved by CEN on 20 August 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 14511-3:2011: E

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EN14511 standard specifies the test methods for the ***rating performance*** or air conditioners, ***liquid chilling packages*** and heat pumps using either air, water or brine as heat transfer media, with electrically driven compressors when used for space heating and cooling.

The EN14511:2011 revision supersedes the EN14511:2007 revision and introduces corrections in the way to measure, calculate and declare cooling/heating capacities, power input and efficiencies at full and part load.

Those corrections have an **adverse effect on efficiency** and efficiencies published according to EN14511:2011 will be lower than those published according to EN14511:2007.

Starting 1st January 2013, Eurovent is enforcing all participants to the "Liquid Chilling Packages and Heat Pumps" program to fully comply with the requirements set by EN14511:2011.

This directive from Eurovent will force all participant manufacturers to change the way they communicate Eurovent-certified chiller and heat pump performance to their customers.

At Johnson Controls, we will be making changes throughout the remainder of 2012 to our published documentation and selection software to prepare for compliance with the new standard. You will find in the bulletin further information on how these changes will impact you and your customers.

Details:

What is EN14511?

EN14511 is the European Standard used as reference for Air Conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.
It is divided in 3 parts:

Part 1: Terms and definitions
Part 2: Test Conditions
Part 3: Test Methods

This standard has recently been updated. The current EN14511:2011 revision now replaces the EN14511:2007 revision.

Johnson Controls

What is changing in the declared values when adopting the new revision EN14511:2011? And how will this affect all chillers/heat pumps?

In this new version, EN14511:2011, the way to calculate cooling/heating capacities and the total input power is changing. Published values and efficiency indicators calculated from these values (EER, COP, ESEER) are also changing.

Those values now have to take into account 1) the pumping power to overcome the pressure drops induced by the evaporator (and condenser if water cooled unit) and 2) the heat dissipated by the pump(s) in the water loop(s).

The overall impact will be a reduction of the published efficiency. The reduction can be as high as **10%** !

When this change is applicable?

EN14511:2011 has been released on 4th January 2012. While Eurovent has decided to exclusively adopt this new standard for their 2012 performance verification campaign, they are also considering 2012 as a transition year.

As a consequence, Eurovent has introduced dual performance certification on their website, where performance is shown according to both the new standard and the old standard (so called "gross" performance).

As a manufacturer, we also have until 1st January 2013 to update our customer facing documentation, date by which all our literature and selection software would have to fully comply with the new 2011 revision. On that date, Eurovent will also remove from their website references to the performance according to the old standard.

Example:

To illustrate the effect of the change, let us have a look at the YLAA0515HE example:

For this unit, the declared values (acc to EN 14511:2007) were:

Cooling Capacity	521	kW
Total Input Power	170.3	kW
EER	3.06	kW/kW
ESEER	4.33	kW/kW
Water Flow	24.9	L/s
Pressure Drop	42	kPa

For ***exactly*** the same unit, but applying the EN14511:2011, the declared values are and will be:

New Cooling Capacity	519.3	kW	(-0.35%)
New Total Input Power	172	kW	(+0.88%)
New EER	3.02	kW/kW	(-1.2%)
New ESEER	4.15	kW/kW	(-4.16%)
Water flow	24.9	L/s	
Pressure Drop	42	kPa	

In this example, the unit is the same and only the way to calculate the values has changed.

In the past, total input power was directly measured and the cooling capacity was calculated using the following formula. When the unit was fitted with an integrated pump kit, the measurement was always performed with the pumps switched off (the water flow rate was controlled by the test lab pumps). Water-side pressure drop through the heat exchangers was also disregarded

$$Pc_m = q \times \rho \times c_p \times \Delta t$$

Where:

P_{Cm} is the cooling capacity, expressed in Watts

q	is the volume flow rate, expressed in cubic meters per second
ρ	is the density, expressed in kilograms per cubic meter
c_p	is the specific heat at constant pressure, expressed in joules per kilogram and Kelvin
Δt	is the difference between inlet and outlet temperatures, expressed in Kelvin (always positive)

Now, the cooling capacity and the total input power are calculated applying the following corrections:

1) The total input power is corrected to include the fraction of the pumping power that is required to overcome the pressure drop through the heat exchanger(s). When the unit is not fitted with an integral pump, a virtual pump, as defined in the EN14511:2011 Annex H, is considered.

2) The cooling capacity is corrected to deduct the heat dissipated by the pump (either real or virtual) into the water loop.

In our example, the correction factor is calculated using the formula that appears in the EN14511:2011, section 4.1.6.4, that is:

$$\frac{q_{wi}\left(-\Delta p_{i,wi}\right)}{\eta_{pi}}$$

Where:

q_{wi}	is the water flow through the evaporator, in cubic meter per second
$\Delta p_{i,wi}$	is the water pressure drop through the evaporator at q_{wi} water flow in Pascal
η_{pi}	is the efficiency of the pump calculated according to Annex H of the EN14511:2011 standard

Numerically, we obtain:

q_{wi}	0.0249 m^3/s	Correction Factor = 1,7 kW
$\Delta p_{i,wi}$	42000 Pa	
η_{pi}	0.6	

This correction factor is then applied as follows:

Cooling Capacity = 521 kW – 1.7 kW = 519.3 kW
Power Input = 170.3 kW + 1.7 kW = 172 kW
EER = 519.3 / 172 = 3.02 kW/kW

It must be noted that the new rating standard will in most cases cause published efficiency to lower, although there has not been any changes to the unit.

Another consideration to make is that the correction factor is constant and independent of the load of the unit (the unit is considered to be installed on a constant primary flow system). Therefore, the lower the load of the unit, the higher the effect of the correction factor will be. That is why, in our example, the full load EER reduces only 1.2% and the ESEER 4.2%.

The example above applies to an air cooled unit when not fitted with an integral pump kit. Appendix 1 gives details for other type of chillers and heat pumps.

Frequently Asked Questions

Q1. Will this new standard application affect to our documentation? How? When? What?

Yes, this new standard will significantly impact the published information (capacities, input power, EER and ESEER values) shown in the literature and selection software. All manufacturers participating to the Eurovent program have to review their published information before the end of 2012. Johnson Controls' objective is to review all sales and technical documents during the last quarter of 2012, in order to be ready for full compliance with EN14511:2011 by 1st January 2013.

Q2. The published efficiency according to EN14511:2011 is lower than published to date. Why is my chiller/heat pump less efficient?

It is important to note that your chiller/heat pump is not less efficient. The chiller is the same and its performance has not changed. The only change is the way to calculate the performance indicators as we have demonstrated above. At first, this will most likely appear confusing to your customer. As a leading manufacturer in this industry, it is our responsibility to ensure that our customers do not mistake the new published data for a reduction of efficiency.

Q3. How is the competition expected to react?

This change is an industry-wide change that Eurovent is enforcing onto all of its participants. Competitors participating to the Eurovent program are expected to comply with the change of standard. While exact timing is left to the manufacturer appreciation, the deadline is for all manufacturers to update their documentation is 31st December 2012.

It is to be expected that some manufacturer not participating to the Eurovent program may continue for some time to publish information according to the previous standard. You must remain vigilant to this situation and ensure that whenever a comparison is made, it is made using data according to the same standard.

Q4. I have noticed that a competitor is still declaring values according to previous standard. What should I do?

Manufacturers are allowed to provide rating information according to the new and/or old standard until 31st December 2012. After that date, EN14511:2011 performance information should be listed on customer facing documentation.

After 2012, all manufacturers participating to the Eurovent program must publish EN14511:2011 compliant performance information. If you notice a breach to this rule, you should make contact with the Chiller Product team that will evaluate the situation and make the necessary contact with Eurovent to ensure that this is officially reported and corrected.

Whether or not the competitor participates in the Eurovent program, you should always take the time to explain the differences in rating standard to your customer so that he is not misled in comparing and eventually selecting the appropriate chiller for its application.

Appendix 1: Difference between gross (EN 14511:2007) and net (EN 14511:2011) performances.

Air to water unit (non ducted outdoor):

	Indoor pump is an integral part		Indoor pump is not an integral part	
	ECC 2011 (gross)	EN14511:2011	ECC 2011 (gross)	EN14511:2011
Ph	Ph_m [(1)]	$Ph_m - \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	Ph_m	$Ph_m + \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$
Pc	Pc_m [(1)]	$Pc_m + \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	Pc_m	$Pc_m - \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$
Pe	Pe_m [(1)]	$Pe_m - \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	Pe_m	$Pe_m + \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$

(1) Measured with the indoor pump not running

Water to water unit:

		Indoor pump is an integral part		Indoor pump is not an integral part	
		ECC 2011 (gross)	EN14511:2011	ECC 2011 (gross)	EN14511:2011
Ph	Outdoor pump is an integral part	$Ph_m{}^{(1)(2)}$	$Ph_m - \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	$Ph_m{}^{(2)}$	$Ph_m + \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$
	Outdoor pump is not an integral part	$Ph_m{}^{(1)}$	$Ph_m - \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	Ph_m	$Ph_m + \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$
Pc	Outdoor pump is an integral part	$Pc_m{}^{(1)(2)}$	$Pc_m + \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	$Pc_m{}^{(2)}$	$Pc_m - \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$
	Outdoor pump is not an integral part	$Pc_m{}^{(1)}$	$Pc_m + \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}}$	Pc_m	$Pc_m - \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}}$
Pe	Outdoor pump is an integral part	$Pe_m{}^{(1)(2)} - \frac{q_{wo}\Delta p_{e,wo}}{\eta_{po}}$	$Pe_m - \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}} - \frac{q_{wo}\Delta p_{e,wo}}{\eta_{po}}$	$Pe_m{}^{(2)} - \frac{q_{wo}\Delta p_{e,wo}}{\eta_{po}}$	$Pe_m + \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}} - \frac{q_{wo}\Delta p_{e,wo}}{\eta_{po}}$
	Outdoor pump is not an integral part	$Pe_m{}^{(1)} + \frac{q_{wo}(-\Delta p_{i,wo})}{\eta_{po}}$	$Pe_m - \frac{q_{wi}\Delta p_{e,wi}}{\eta_{pi}} + \frac{q_{wo}(-\Delta p_{i,wo})}{\eta_{po}}$	$Pe_m + \frac{q_{wo}(-\Delta p_{i,wo})}{\eta_{po}}$	$Pe_m + \frac{q_{wi}(-\Delta p_{i,wi})}{\eta_{pi}} + \frac{q_{wo}(-\Delta p_{i,wo})}{\eta_{po}}$

(1) Measured with the indoor pump not running
(2) Measured with the outdoor pump not running

Where:

q_{wi} is the nominal liquid flow rate at the indoor coil, expressed in cubic meters per second;

q_{wo} is the nominal liquid flow rate at the outdoor coil, expressed in cubic meters per second;

q_a is the nominal air flow rate at the outdoor coil, expressed in cubic meters per second;

$\Delta p_{e,wi}$ is the measured available external static pressure difference in the water (brine) circuit at the indoor coil (normally positive for integral liquid pump);

$\Delta p_{e,wo}$ is the measured available external static pressure difference in the water (brine) circuit at the outdoor coil (normally positive for integral liquid pump);

$\Delta p_{e,a}$ is the measured available external static pressure difference in the air circuit at the outdoor coil (always positive for integral ducted fan);

$\Delta p_{i,wi}$ is the measured internal static pressure difference in the water (brine) circuit at the indoor coil (always negative) [1];

$\Delta p_{i,wo}$ is the measured internal static pressure difference in the water (brine) circuit at the outdoor coil (always negative) [2];

$\Delta p_{i,a}$ is the measured internal static pressure difference in the air circuit at the outdoor coil (always negative);

η_{pi} is the efficiency of the pump at the indoor coil calculated according to Annex H of EN14511-3 (2011);

η_{po} is the efficiency of the pump at the outdoor coil calculated according to Annex H of EN14511-3 (2011);

η_f is the efficiency of the fan at the outdoor coil; it is equal to 0.3 by convention;

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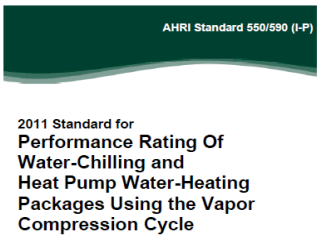
NORTH AMERICA

AHRI Standard 550/590 (I-P) 2011 Standard for Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle

All the changes were effective January 2012:



Water cooled chillers up to 3,000 tons and Air cooled chillers up to 400 tons are included in the scope, and after July 2013 the air cooled range will be expanded to 600 tons.
What does this mean for your Customers?
More products now in scope, giving them confidence in the ratings we provide.

Air-to-water heat pumps and water-to-water heat pumps are new to the standard.
What does this mean for your Customers?
Confidence in the performance ratings of the new technology.

AHRI certified rating temperature ranges have been expanded for water cooled chillers. Evaporator range is now 36.0-60.0 F and the condenser range is 55.0-105.0 F.
What does this mean for your Customers?
Low ECWT is a key design element of our YK product, now ratings are certified with 55 degree condenser water. The evaporator range has been expand to be applicable to more vertical markets

During a AHRI performance test the number of data points taken has been increased from 3 to 4.
What does this mean for your Customers?
An average of 4 points helps to minimize the effects of transient conditions and is more representative of the overall performance at given conditions

A new Appendix F has been added. This appendix details the method to adjust measured test data to the local barometric pressure for air cooled chillers.
What does this mean for your Customers?
Air cooled chiller test facilities are located throughout North America at different elevations, this new text normalizes the data for a true comparison.

If you have a question that you would like the application engineering team to answer in a future Applications Corner, please send questions / topics to jill.h.woltkamp@jci.com.