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Climgas Position Paper on ErP Directive - LOT 6

Gas Engine driven Heat Pump (GEHP) technology

- CLIMGAS Association

Climgas is the Gas-Fired Air Conditioning Appliance Manufacturers' and Distributors' Association. Climgas is part of ANIMA, Federation of Italian Associations of Mechanical and Engineering Industries that is the trade industry organization within Confindustria (Italian Confederation of Industry) which represents the major mechanical and engineering manufacturers in Italy.

- GEHP Technology

First of all we would like to do a brief reminder on the GEHP technology and its main advantages.
The operation of a Gas Engine driven Heat Pump (GEHP) is similar to electric Heat Pump (EHP). GEHP uses a natural gas-powered or LPG-powered engine to drive the compressor in a vapour-compression refrigeration cycle and it can be either an air/water or air/air system.
The main characteristic is the energy recovery from the engine coolant, in particular the GEHP allows to recover the thermal energy from the engine cooling system, which is normally lost.
This energy recovery has two main advantages compared to the EHP:

- in heating mode, the heating capacity remains constant whatever the outdoor temperature conditions may be;
- in cooling mode, the heat recovery enables to produce domestic hot water.

- GEHP European market

The GEHP technology has been introduced in the European market since 2002 and now there are around 6.000 units installed in Europe.
Every year 600-700 units are imported in Europe, so these products have not a substantial market in Europe yet.
Therefore it is a market in expansion notably in countries using primarily natural gas. There is also strong interest from gas utilities.

- GEHP European Standards CEN/TC299 WG3

We are working as expert member, in the CEN TC 299 / WG 3 "Gas fired sorption appliances, indirect fired sorption appliances, gas-fired endothermic engine gas pump and domestic gas-fired washing and drying appliances". The aim of the working group is to define standards and testing protocols for the gas-fired endothermic engine heat pumps (GEHP) in order to find the appropriate integration and harmonization of this technology with the directives Renewable Energy Directive 2009/28/CE and Energy Using Products (2009/125/EU) as GEHP are include in their scopes.
At the present other technologies such as Sorption Heat pumps (SHP) and Electrical Heat Pumps (EHP) are provided with standards: the prEN 12309-2 defines the testing conditions for SHP, the EN 14511 and EN14825 define testing protocols for EHP, but GEHP technology is not provided with such document and requires specific standard.
Thus the need for a specific standard for this technology, in order to compare it properly with SHP and EHP.

- CLIMGAS's requests for LOT6

Since this kind of product has no specific standards yet, we ask to consider the possibility to exclude GEHP from the scope of the Energy Requirement legislation (in particular NOx emission limits and the energy requirements) until the standard will be defined. This request is supported by two main reasons:

I. **It is pending the completion of CEN TC 299 – WG3 work in order to define specific standard for the GEHP, especially until the SEER calculation method will not be definitively approved, since there are some evident function differences compared to Electrical Heat Pumps (EHP) and Sorption Heat pumps (SHP)**

II. **Considering actual small dimension of the market – although it is in expansion – the impact on the environment will be very limited until CEN TC 299 – WG3 finish its work. Theoretically, products in the scope must have a substantial market in Europe (that is not the case) and the spirit of the ERP Directive process is to ban gradually a small percentage of products.**

Otherwise, by applying the proposed NOx emission values (240mg/kWh calculated at thermal input) and energy requirements (minimum SEER starting from the EHP ones without taking into account the inherent operating characteristics of the technology), there is a higher possibility that in the future all GEHP products will be banned in the European market: this is not logical and against the spirit of the Directive, as shown in Art. 15.5 of Directive 2009/125/EC.

In any case, if the GEHP technology has to be included in the ErP Directive, **Climgas asks to pay attention to the following points**:

A) NO_x EMISSION LIMIT

1) To raise the minimum NO_X value respect the proposed value of 240 mg/kWh, decreasing it gradually afterwards.

For the GEHP, Climgas proposes a starting value of 500 mg/ kWh and to lower it step by step in the coming years to 350 mg/ kWh.
In this way the manufacturers would have time to plan technology improvements during these years by reducing the NOX emissions gradually, mainly reducing the emission at partial load, which is the most frequent working condition (around 90% of the working time).
The GEHP's technology uses "lean burn" engine and even if lower power can be achieved, the efficiency of the engine is much higher. This means that the engines are designed to achieve the best efficiency and consequentially to reduce the fuel consumption and the primary energy necessary. For example, an engine of 2000 cc has a power of 12-15kW.
The main drawback of lean burning is NOx emissions a little bit higher against a very high efficiency and lower fuel consumption, so we would like to ask you to rise your NOx initial value proposed to give to the manufacturers the possibility to improve the technology and reduce the emissions gradually in the next years.

2) To refer the NO_X value to the thermal output instead of thermal input. Measuring the NO_X emissions considering the thermal input could be logical if the efficiency of the equipments is lower than one as for boilers or cogenerators.

Whereas the thermal output of the equipment is higher than the energy input, as in the case of the heat pumps, it is crucial – as well as logical – to measure the NO_X emission per unit of thermal output rather than for thermal input.
In fact, if we had two devices with the same thermal input but with different COP (and different thermal output) the more efficient device could be penalized compared to the other one (in term of emissions) if we don't take into account of the COP.

3) To calculate the NO_X emission weighing the calculation at nominal and partial loads, as per UNI EN 297/2007 or UNI EN 12309.

The NO_X emission should be calculated not only at a full load, but weighing the working conditions at both nominal and partial loads according to the existing European Standards. As mentioned at the previous point, it is not logical to assess the performance only at full load, since this condition is required only for a small period of time over the whole year.

B) ENERGY REQUIREMENTS

1) To consider the heat recovered from the engine in the calculation of the GEHP's performances.

To measure properly the GEHP performances the energy produced by the heat recovery from the coolant of the engine must be considered. Heat recovery from the engine is a feature that only GEHP boasts, allowing it to reach high values of the SEER and SCOP in terms of energy output vs. primary energy input.
Especially, in cooling mode the heat recovered from the engine can be used for domestic hot water production or into the water air handling units for the post heating of the Air.
One of the purposes of the WG3 CENTC 299 is to find a test method to consider also the heat recovery from the engine in the global efficiency of the GEHP.
So we ask to exclude GEHP from the scope of the Energy Requirement legislation pending completion of the work of the CEN TC 299 – WG3 to define specific standard for the GEHP.

2) To reduce drastically the SEER limit values proposed since for this technology it isn't defined the SEER calculation method yet (activity under progress by the CENTC 299 - WG3).

Also without a specific SEER calculation method for this technology, there is a higher possibility and an higher risk that all GEHP products will be banned, because the limit values proposed might not be reachable. As mentioned above, it is not logical to fix a minimum value of SEER, without:

- taking into account the characteristics of the product and by using only a comparison with other technologies (SHP-EHP)
- a defined SEER calculation method, (CEN TC 299 – WG3 competence)

In case of the GEHP, the following aspects must be considered:

I. energy recovered from the coolant of the engine (as mentioned above)

II. engine efficiency

It is not appropriate calculating minimum SEER required for GEHP only by multiplying the minimum required SEER for EHP to the average power plant efficiency (40% or 37%). With this kind of calculation method, GEHP technology will be unreasonably penalized because the engine efficiency of GEHP is 10% lower than the efficiency of the power plant, if we do not consider the GEHP's whole energy output.
In case of GEHP, in fact, the mechanical efficiency of the engine is around 30-31% and even if it is less than the power plant efficiency (around 40%), the total efficiency of GEHP is higher than the EHP one. In fact - as explained in point 1) - GEHP recover and reuse the thermal energy of the engine's coolant (until 50%) which is normally lost.
If all the GEHP energy output is taken into account to calculate performance data, the efficiency of GEHP is much higher than EHP.
In other words, the energy requirements suggested could be reachable by considering also the thermal energy.

III. minimum partial load reachable by each GEHP

The minimum partial load reachable by each GEHP is variable and depends on the minimum engine rpm of each model.

In fact, the same engine is used for several GEHP's models with different nominal engine rpm values (different capacities) but with the same minimum engine rpm, so the behaviour at partial load is strictly related to the minimum engine rpm and it is different compared to the EHP one.
The CEN TC 299 – WG3 is analyzing and evaluating several possibilities how to consider and calculate the SEER by taking into account the minimum partial load. Therefore, for this reason, we ask to suspend GEHP from the scope of the Energy Requirement legislation pending completion of the work of the WG3 to define specific standard for the GEHP.
For example by adapting the EN 14825 to GEHP (using full load values and Cd factors) the SEER of Air/Air system, calculated according to the manufacturer data, is around 1.03 and it very far from 1.67 proposed in the draft of the Regulation (-38%).

For all the above reasons we ask to revise the SEER proposed for GEHP otherwise all GEHP products will be banned in the European market: this would be not logical and against the spirit of the Directive, as shown in Art. 15.5 of Directive 2009/125/EC.