
(2014/C …/…) 

1. Publication of titles and references of transitional methods of measurement and calculation\(^1\) for the implementation of Regulation (EU) No [insert after publication], and in particular Annexes III and IV thereof.

(Text with EEA relevance)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ESO</th>
<th>Reference/Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_{\text{nom}} ) rated heating capacity</td>
<td>CEN</td>
<td>[See note]</td>
<td>prEn1020:2007, EN 1319:2009, EN 1196:2011, EN 621:2009 and EN 778:2009 do not describe methods to establish the heat output. The efficiency is calculated on the basis of the flue gas loss and the heat input. The heat output ( P_{\text{nom}} ) can be calculated with the equation ( P_{\text{nom}} = Q_{\text{nom}} \cdot \eta_{\text{th,nom}} ), where ( Q_{\text{nom}} ) is the nominal heat input and ( \eta_{\text{th,nom}} ) is the nominal efficiency. ( P_{\text{nom}} ) shall be based on the gross calorific value of the fuel. Similarly ( P_{\text{min}} ) can be calculated with the equation ( P_{\text{min}} = Q_{\text{min}} \cdot \eta_{\text{th,min}} ).</td>
</tr>
<tr>
<td>( P_{\text{min}} ) minimum heating capacity</td>
<td>prEn1020:2007 - see clause 7.4.5 EN1319:2009 clause 7.4.4 EN 1196:2011, clause 6.8.2 EN621:2009 clause 7.4.5 EN 778:2009 clause 7.4.5</td>
<td>Efficiency can be determined as described in applicable standards, but shall be expressed on basis of gross calorific value of fuel</td>
<td></td>
</tr>
<tr>
<td>( \eta_{\text{th,nom}} ) useful efficiency at rated heating capacity</td>
<td>prEn1020:2007 - see clause 7.4.6 EN1319:2009 clause 7.4.5 EN 1196:2011, clause 7.4.5</td>
<td>Efficiency can be determined as described in applicable standards, but shall be expressed on basis of gross calorific value of fuel</td>
<td></td>
</tr>
<tr>
<td>( \eta_{\text{th,min}} ) useful efficiency at minimal load</td>
<td>prEn1020:2007 - see clause 7.4.6 EN1319:2009 clause 7.4.5 EN 1196:2011, clause 7.4.5</td>
<td>Efficiency can be determined as described in applicable standards, but shall be expressed on basis of gross calorific value of fuel</td>
<td></td>
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</tbody>
</table>

\(^1\) It is intended that these transitional methods will ultimately be replaced by harmonised standard(s). When available, reference(s) to the harmonised standard(s) will be published in the Official Journal of the European Union in accordance with Articles 9 and 10 of Directive 2009/125/EC.
<table>
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</thead>
<tbody>
<tr>
<td>AF&lt;sub&gt;n&lt;/sub&gt;nom air flow at rated heating capacity</td>
<td>[See note]</td>
<td>None of the standards describes methods to establish the warm air flow rate (or air delivery rate).</td>
<td></td>
</tr>
<tr>
<td>AF&lt;sub&gt;m&lt;/sub&gt;min air flow at minimal load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>elnom electric power consumption at rated heating capacity</td>
<td>[See note]</td>
<td>According prEN1020:2007 the electric power input shall be expressed on the data plate (clause 8.1.2. f) in volts, amperes, etc. The manufacturer may convert the applicable values to Watts using known conventions. Care should be taken not to include the fan for transport/distribution of warm air in the electric power consumption.</td>
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</tr>
<tr>
<td>elmin electric power consumption at minimum load</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>elsb electric power consumption at standby mode</td>
<td>IEC 62301:2011-01</td>
<td>IEC 62301:2011 applies to household appliances / issues to be discussed with relevant TC's.</td>
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<tr>
<td>P&lt;sub&gt;pilot&lt;/sub&gt; permanent pilot flame power consumption</td>
<td>[See note]</td>
<td>According prEN1020:2007 clause 8.4.2 the technical instructions for installation and adjustment shall contain &quot; a technical table (that includes) heat input, heat output, rating of any ignition burner, (etc.), air delivery volumes, etc. The heat input by the permanent pilot flame can be determined in a way similar to the main energy input.</td>
<td></td>
</tr>
<tr>
<td>Emissions of nitrogen oxide (NOx)</td>
<td>CEN</td>
<td>CEN Report CR 1404:1994 (currently revised by CEN/TC 238/WG2)</td>
<td>NOx emission values are to be expressed in mg/kWh, based on gross calorific value GCV of the fuel.</td>
</tr>
<tr>
<td>Fenv envelope losses</td>
<td>Cen</td>
<td>EN 1886:2007</td>
<td>Insulation class according five classes, designated as T1-T5</td>
</tr>
<tr>
<td>IP rating (ingress protection rating)</td>
<td>EN 60529:2011</td>
<td></td>
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</table>

### Warm air heaters using liquid fuel

<table>
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<tr>
<th>Parameter</th>
<th>ESO</th>
<th>Reference/Title</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>P&lt;sub&gt;n&lt;/sub&gt;nom, rated heating capacity</td>
<td>CEN</td>
<td>EN 13842: 2004 Oil-fired convection air heaters - Stationary and transportable</td>
<td>EN 13842:2004 does not describe methods to establish the heat output. The heat output P&lt;sub&gt;n&lt;/sub&gt;nom can be calculated with the equation P&lt;sub&gt;n&lt;/sub&gt;nom = Q&lt;sub&gt;N&lt;/sub&gt; * η&lt;sub&gt;th,nom&lt;/sub&gt;, where Q&lt;sub&gt;N&lt;/sub&gt; is the nominal heat input (clause 6.3.2.2) and η&lt;sub&gt;th,nom&lt;/sub&gt; is the efficiency at rated heating capacity. Q&lt;sub&gt;N&lt;/sub&gt; and η&lt;sub&gt;th,nom&lt;/sub&gt; shall be based on the gross calorific value of the fuel. Similarly P&lt;sub&gt;m&lt;/sub&gt;in can be calculated with the equation P&lt;sub&gt;m&lt;/sub&gt;in = Q&lt;sub&gt;min&lt;/sub&gt; * η&lt;sub&gt;th,min&lt;/sub&gt; where Q&lt;sub&gt;min&lt;/sub&gt; and η&lt;sub&gt;th,min&lt;/sub&gt; are the heat input and efficiency at minimum load conditions.</td>
</tr>
<tr>
<td>P&lt;sub&gt;m&lt;/sub&gt;in, minimal load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>η&lt;sub&gt;th,nom&lt;/sub&gt; useful efficiency at rated heating capacity</td>
<td>EN 13842: 2004 Clause 6.5.6, applicable to either nominal or minimum load</td>
<td>η&lt;sub&gt;th,nom&lt;/sub&gt; equals η in clause 6.5.6</td>
<td></td>
</tr>
<tr>
<td>η&lt;sub&gt;th,min&lt;/sub&gt; useful efficiency at minimal load</td>
<td></td>
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<tr>
<td>Parameter</td>
<td>ESO</td>
<td>Reference/Title</td>
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</tr>
<tr>
<td>AF&lt;sub&gt;nom&lt;/sub&gt; air flow at rated heating capacity</td>
<td>EN</td>
<td>[See note]</td>
<td>None of the standards describes methods to establish the warm air flow rate (or air delivery rate).</td>
</tr>
<tr>
<td>AF&lt;sub&gt;min&lt;/sub&gt; air flow at minimal load</td>
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<tr>
<td>el&lt;sub&gt;nom&lt;/sub&gt; electric power consumption at rated heating capacity</td>
<td>CEN</td>
<td>EN 267:2009 Automatic forced draught burners for liquid fuels; § 4.8.5. Emission limit values for NO&lt;sub&gt;x&lt;/sub&gt; and CO; § 5. Testing. ANNEX B. Emission measurements and corrections.</td>
<td>According prEN1020:2007 the electric power input shall be expressed on the data plate (clause 8.1.2. f) in volts, amperes, etc. The manufacturer may convert the applicable values to Watts using known conventions. Care should be taken not to include the fan for transport/distribution of warm air in the electric power consumption.</td>
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<tr>
<td>e&lt;sub&gt;min&lt;/sub&gt; electric power consumption at minimal load</td>
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<tr>
<td>e&lt;sub&gt;b&lt;/sub&gt; electric power consumption at standby mode</td>
<td></td>
<td>[See note]</td>
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<tr>
<td>Emissions of nitrogen oxide (NO&lt;sub&gt;x&lt;/sub&gt;)</td>
<td>CEN</td>
<td>EN 1886:2007</td>
<td>Insulation class according five classes, designated as T1-T5</td>
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<tr>
<td>F&lt;sub&gt;env&lt;/sub&gt; envelope losses</td>
<td>CEN</td>
<td>EN 60529:2011</td>
<td></td>
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<tr>
<td>IP rating (ingress protection rating)</td>
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<td>EN 14825:2013, section 6.1</td>
<td>Warm air heaters using electric Joule effect</td>
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<tr>
<td>P&lt;sub&gt;nom&lt;/sub&gt; rated heating capacity and P&lt;sub&gt;min&lt;/sub&gt; heat output at minimal load</td>
<td>CEN</td>
<td>IEC/EN 60675 ed 2.1:1998 §16</td>
<td>A standard for actual measurement of heat output of electric warm air heaters has not been identified. The electric power input at nominal or minimum load is considered representative for the nominal or minimum heat output. P&lt;sub&gt;nom&lt;/sub&gt; and P&lt;sub&gt;min&lt;/sub&gt; correspond to the usable power in IEC 60675 ed. 2.1:1998 at nominal and minimum load, minus the power requirement for fans that distribute the warm air and the power requirement of electronic controls where relevant.</td>
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<tr>
<td>η&lt;sub&gt;th,nom&lt;/sub&gt; useful efficiency at rated heating capacity</td>
<td>n.a.</td>
<td>[See note]</td>
<td>According Annex ... of Regulation No ... the value is default 100%</td>
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<tr>
<td>η&lt;sub&gt;th,min&lt;/sub&gt; useful efficiency at minimal load</td>
<td>n.a.</td>
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<tr>
<td>AF&lt;sub&gt;nom&lt;/sub&gt; air flow at rated heating capacity</td>
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<td>[See note]</td>
<td>None of the standards describes methods to establish the warm air flow rate (or air delivery rate).</td>
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<td>AF&lt;sub&gt;min&lt;/sub&gt; air flow at minimal load</td>
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<td>F&lt;sub&gt;env&lt;/sub&gt; envelope losses</td>
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<td>EN 1886:2007</td>
<td>Insulation class according five classes, designated as T1-T5</td>
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<td>IEC 60529 (ed 2.1), clause 4.1.</td>
<td>Electric driven comfort chillers, air conditioners and heat pumps</td>
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<tr>
<td>SEER</td>
<td>CEN</td>
<td>EN 14825:2013, section 6.1</td>
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<tr>
<td>$Q_c$</td>
<td>EN 14825:2013, section 6.2</td>
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<td>$Q_{CE}$</td>
<td>EN 14825:2013, section 6.3</td>
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<td>EN 14825:2013, section 6.4</td>
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<tr>
<td>EERbin(Tj), CRu, Cc, Cd</td>
<td>EN 14825:2013, section 6.5</td>
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<td>SCOP</td>
<td>EN 14825:2013, section 7.1</td>
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<td>$Q_h$</td>
<td>EN 14825:2013, section 7.2</td>
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<td>$Q_{he}$</td>
<td>EN 14825:2013, section 7.3</td>
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<td>EN 14825:2013, section 7.4</td>
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<td>$P_{off}$, $P_{sb}$, $P_{ck}$ &amp; $P_{to}$</td>
<td>EN 14825:2013, section 9</td>
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**Comfort chillers, air conditioners and heat pumps using internal combustion**

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<td>CEN/TC299/WG3, part 6, section 6.8</td>
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<td>CEN/TC299/WG3, part 6, section 6.3</td>
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<td>GUEed,c</td>
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<tr>
<td>PEc &amp; PEh</td>
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**Comfort chillers, air conditioners and heat pumps using sorption cycle**

<table>
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<td>FprEN 12309-1:2013, Part 6, , section 4.5</td>
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<td>SAEF, $Q_{ref,h}$</td>
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<td>FprEN 12309-1:2013, Part 6, , section 4.6</td>
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<td>$Q_{ref,h}$</td>
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<td>FprEN 12309-1:2013, Part 6, , section 5.8</td>
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**High temperature process chillers**

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<td>$P_{designR}$</td>
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<td>As in EN14825:2012 - Section 3.1.3</td>
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<td>part load ratio</td>
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<td>As in EN14825:2012 - Section 3.1.5</td>
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<tr>
<td>declared capacity DC</td>
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<td>As in EN14825:2012 - Section 3.1.6</td>
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<tr>
<td>capacity ratio $C_h$</td>
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<td>As in EN14825:2012 - Section 3.1.7</td>
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<tr>
<td>bin hours</td>
<td></td>
<td>As defined in EC Regulation No ...., Annex .. [to be completed]</td>
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<tr>
<td>energy efficiency ratio at declared capacity $EER_{dc}$</td>
<td>EN 14511-1/-2/-3:2011 for the determination of EER values at given conditions</td>
<td>The EER includes degradation losses when the declared capacity of the chiller is higher than the cooling capacity</td>
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<tr>
<td>energy efficiency ratio at part load or full load conditions $EER_{pl}$</td>
<td>EN 14825:2013, section 6.6</td>
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</tbody>
</table>
### Parameter | ESO | Reference/Title | Notes
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seasonal energy performance ratio (SEPR) | | Point 6 of this Communication (European Commission) | demand
capacity control | As in EN14825:2012 - Section 3.1.32 | See comments related to capacity control of air conditioners, chillers and heat pumps
degradation coefficient $C_C$ | As in EN14825:2012 - Section 8.4.2 | |

Notes:
- There is no European standard dealing with vapour compression liquid or gaseous fuel engine driven heat pumps. A working group: CEN/TC 299 – WG3 is working on a standard.
- The European standards EN 12309 part 1 and part2, dealing with liquid or gaseous fuel sorption heat pumps are under revision in CEN/TC299 – WG2, particularly to calculate a seasonal energy efficiency.

3. Additional elements for measurements and calculations related to the seasonal space heating energy efficiency of **warm air heaters**

3.1 Test points

The useful efficiency, the useful heat output, the electric power consumption and the air flow shall be measured at nominal and minimum heat output.

3.2 Calculation of the seasonal space heating energy efficiency of warm air heaters

(a) The seasonal space heating energy efficiency $\eta_S$ for warm air heaters using fuels is defined as:

$$ \eta_s = \eta_{s, on} - \sum F(i) $$

(b) The seasonal space heating energy efficiency $\eta_S$ for warm air heaters using electricity is defined as:

$$ \eta_s = \left( \frac{1}{C_C} \right) \cdot \eta_{s, on} - \sum F(i) $$

Where:
- $\eta_{S, on}$ is the seasonal space heating energy efficiency in active mode, expressed in %;
- $C_C$ is the conversion coefficient as defined in Annex 1 of Regulation [number to be inserted after publication in the OJEU].
- $F(i)$ are corrections calculated according to point 2.7 below and expressed in %

3.3 Calculation of the **seasonal space heating energy efficiency in active mode**

The seasonal space heating energy efficiency in active mode $\eta_{s, on}$ is calculated as follows:

$$ \eta_{s, on} = \eta_{s, th} \cdot \eta_{s, flow} $$

Where:
3.4 Calculation of the seasonal thermal energy efficiency $\eta_{S,th}$

The seasonal thermal energy efficiency $\eta_{S,th}$ is calculated as follows

$$\eta_{S,th} = \left(0.15 \cdot \eta_{th,nom} + 0.85 \cdot \eta_{th,min}\right) - F_{env}$$

Where:
- $\eta_{th,nom}$ is the useful efficiency at nominal (maximal) load, expressed in % and based on GCV
- $\eta_{th,min}$ is the useful efficiency at minimum load, expressed in % and based on GCV
- $F_{env}$ is the envelope loss factor of the heat generator, expressed in %

3.5 Calculation of the Envelope loss

The envelope loss factor $F_{env}$ depends on the intended placement of the unit and is calculated as follows

(a) If the warm air heater is specified to be installed in the heated area:

$$F_{env} = 0$$

(b) If the protection against ingress of water of the part of the product that incorporates the heat generator has a IP rating of X4 or higher (IP rating according to IEC 60529 (ed 2.1), clause 4.1), the envelope loss factor depends on the thermal transmittance of the envelope of the heat generator according to Table 1.

### Table 1

<table>
<thead>
<tr>
<th>Thermal transmittance (U) [W/m²·K]</th>
<th>Factor $F_{env}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>U $\leq$ 0.5</td>
<td>0.4 %</td>
</tr>
<tr>
<td>0.5 $&lt; U \leq$ 1.0</td>
<td>0.6 %</td>
</tr>
<tr>
<td>1.0 $&lt; U \leq$ 1.4</td>
<td>1.0 %</td>
</tr>
<tr>
<td>1.4 $&lt; U \leq$ 2.0</td>
<td>1.5 %</td>
</tr>
<tr>
<td>No requirements</td>
<td>5.0 %</td>
</tr>
</tbody>
</table>

3.6 Calculation of the emission efficiency $\eta_{S,flow}$

The emission efficiency $\eta_{S,flow}$ is calculated as follows:

$$\eta_{S,flow} = 1 - 9.78 \cdot \frac{0.15 \cdot P_{nom}}{AF_{nom}} + \frac{0.85 \cdot P_{min}}{AF_{min}}$$

Where:
- $P_{nom}$ is the output power at nominal (maximal) load, expressed in kW.
- $P_{min}$ is the output power at minimum load, expressed in kW.
– $AF_{\text{nom}}$ is the air flow at nominal (maximal) load, expressed in kW/m³h, corrected to 15°C equivalent ($V_{15\text{°C}}$).
– $AF_{\text{min}}$ is the air flow at minimal load, expressed in kW/m³h, corrected to 15°C equivalent.

The emission efficiency of the air flow is based on a 15°C temperature increase. In case the unit is intended to produce a different temperature increase ($t$) the actual air flow "$V$" shall be recalculated into an equivalent air flow "$V_{15\text{°C}}$" as follows:

$$V_{15\text{°C}} = V \cdot \frac{268}{273 + t}$$

– $V_{15\text{°C}}$ is the equivalent air flow at 15°C
– $V$ is the actual delivered air flow
– $t$ is the actual delivered temperature increase

3.7 Calculation of $\sum F(i)$ for warm air heaters

$\sum F(i)$ is the summation of various correction factors, all expressed in percentage points.

$$\sum F(i) = F(1) + F(2) + F(3) + F(4)$$

(a) The correction factor $F(1)$ for the adaptation of heat output takes into account the way the product adapts to a heat load (which can be either through single stage, two stage, modulating control) and the load range $(1 - (P_{\text{min}}/P_{\text{nom}}))$ the heater can work in related to the state-of-the-art load range of this technology.

For heaters with state-of-the-art or higher load ranges the full value of parameter $B$ can be taken into account, leading to a lower value for correction factor $F(1)$. For heaters with a smaller load range a smaller than maximum value of $B$ is taken into account.

**Table 2**

*Calculation of $F(1)$ depending on heat output control and load range*

<table>
<thead>
<tr>
<th>Heat output control</th>
<th>Calculation of $F(1)$</th>
<th>Where $B$ is calculated as:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single stage (no load range)</td>
<td></td>
<td>$B = 0%$</td>
</tr>
</tbody>
</table>
| Two stage (highest load range: 50%) |                       | $B = \frac{1 - (P_{\text{min}}/P_{\text{nom}})}{(100\% - 50\%)} \cdot 2.5\%$ \(\text{with } B \text{ is maximum } 2.5\% \)
| Modulating (highest load range: 70%) | $F(1) = 5\% - B$     | $B = \frac{1 - (P_{\text{min}}/P_{\text{nom}})}{(100\% - 30\%)} \cdot 5\%$ \(\text{with } B \text{ is maximum } 5\% \)

(b) The correction $F(2)$ accounts for a negative contribution to the seasonal space heating energy efficiency by auxiliary electricity consumption for warm air heaters, expressed in %, and is given as follows:
For warm air heaters using fuels:

\[ F(2) = 2.5 \cdot \frac{0.15 \cdot e_{\text{max}} + 0.85 \cdot e_{\text{min}} + 1.3 \cdot e_{\text{sb}}}{P_{\text{nom}}} \]

For warm air heaters using electricity:

\[ F(2) = 1.3 \cdot \frac{e_{\text{sb}}}{P_{\text{nom}} \cdot CC} \]

Where:

- \( e_{\text{max}} \) is the electric power consumption when the product is providing the nominal heat output, excluding the energy needed for the transport fan, expressed in kW
- \( e_{\text{min}} \) is the electric power consumption when the product is providing the minimum heat output, excluding the energy needed for the transport fan, expressed in kW
- \( e_{\text{sb}} \) is the electric power consumption when the product is in standby mode, expressed in kW

OR a default value as set out in EN 15316-1 may be applied

(c) The correction \( F(3) \) accounts for a negative contribution to the seasonal space heating energy efficiency for gravity vented combustion systems (combustion air transported by natural draft) as additional thermal losses during time burner off have to be considered.

For warm air heaters in which transport of combustion air is by natural draught:

\[ F(3) = 3\% \]

For warm air heaters in which transport of combustion air is by forced draught:

\[ F(3) = 0\% \]

(d) The correction \( F(4) \) accounts for a negative contribution to the seasonal space heating energy efficiency by permanent pilot flame power consumption and is given as follows:

\[ F(4) = 4 \cdot \frac{P_{\text{ign}}}{P_{\text{nom}}} \]

In which the value '4' is the ratio of the average heating period (4000 hrs/yr) by the average on-mode duration (1000 hrs/yr).

4. Additional elements for calculations related to the seasonal space heating and cooling efficiency of comfort chillers, air conditioners and heat pumps.

4.1 Calculation of the seasonal space heating energy efficiency for heat pumps:
(a) For heat pumps using electricity, the seasonal space heating energy efficiency \( \eta_{S,h} \) is defined as:

\[
\eta_{S,h} = \frac{1}{CC} \cdot SCOP - \sum F(i)
\]

(b) For heat pumps using fuels, the seasonal space heating energy efficiency \( \eta_{S,heat} \) is defined as:

\[
\eta_{S,heat} = SPER_h - \sum F(i)
\]

Where:
- SCOP is the seasonal coefficient of performance, expressed in %;
- SPER\(_h\) is the seasonal primary energy ratio for heating, expressed in %
- \( F(i) \) are the corrections calculated according to point 3.3, expressed in %;

(c) Calculation of SCOP of heat pumps using electricity

\[
SCOP = \frac{Q_H}{Q_{UI}}
\]

Where:

\[
Q_H = P_{design,h} \times H_{HE}
\]

and:

\[
Q_{HE} = \frac{Q_H}{SCOP_{on}} + (H_{T0} \times P_{T0}) + (H_{SB} \times P_{SB}) + (H_{CK} \times P_{CK}) + (H_{OFF} \times P_{OFF})
\]

and:

\[
SCOP_{on} = \frac{\sum_{j=1}^n h_j \times P_h(T_j)}{\sum_{j=1}^n h_j \times \left( \frac{P_h(T_j) - elbu(T_j)}{COP_{bin}(T_j)} + elbu(T_j) \right)}
\]

and:

**for fixed capacity units**, in case the lowest declared heating capacity exceeds the part load for heating (or capacity ratio \( CR_u \leq 1.0 \)):

\[
COP_{bin(T_j)} = COP_d \times \left[ 1 - C_d \times (1 - CR_u) \right]
\]

Where:
- COP\(_{bin(T_j)}\) = bin-specific coefficient of performance
- COP\(_d(T_j)\) = declared coefficient of performance
- \( C_d = 0.25 \) (default value) or established by a cycling test

and:
for staged or variable capacity units, determine the declared heating capacity and COPd(Tj) at the closest step or increment of the capacity control of the unit to reach the required heat load.

If this step does allow to reach the required heating load within ± 10 % (e.g. between 9.9 kW and 8.1 kW for a required heating load of 9 kW), then COPbin(Tj) is assumed to be equal to COPd(Tj).

If this step does not allow to reach the required heating load within ± 10 % (e.g. between 9.9 kW and 8.1 kW for a required heating load of 9 kW), determine the capacity and COPbin(Tj) at the defined part load temperatures for the steps on either side of the required heating load. The part load capacity and the COPbin(Tj) at the required heating load are then determined by linear interpolation between the results obtained from these two steps.

If the smallest control step of the unit only allows a declared heating capacity higher than the required heating load, the COPbin(Tj) at the required part load ratio is calculated using the approach laid out for fixed capacity units.

For bins representing other than above described operating conditions the COPbin shall be established by interpolation, except for part load conditions above part load condition A, for which the same values as for condition A shall be used and for part load conditions below part load condition D, for which the same values as for condition D shall be used.

(d) Calculation of SPERh of heat pumps using internal combustion

\[ \text{SPER}_h = \frac{1}{\text{SGUE}_h} + \frac{\text{CC}}{\text{SAEF}_h} \]

Where:

\[ \text{SGUE}_h = \frac{\sum_{j=1}^{n} h_j \cdot P_h(T_j)}{\sum_{j=1}^{n} h_j \cdot \left( \frac{P_h(T_j)}{\text{GUE}_{h,bin}(T_j)} \right)} \]

and:

\[ \text{GUE}_{h,bin} = \frac{Q_{Eh} + Q_{Ehr,c}}{Q_{gmh}} \]

and

Q_{Eh} = \text{effective heating capacity, in kiloWatt}
Q_{Ehr,c} = \text{effective heat recovery capacity, in kiloWatt}
Q_{gmh} = \text{is the measured heating heat input, in kiloWatt}
GUEh shall also take into account degradation effects due to cycling in a manner similar to that of electric heat pumps.
and:

\[
SAEF_{h} = \frac{Q_{ref,h}}{\left(\frac{Q_{ref,h}}{SAEF_{h,ref}} + (H_{T0} \times P_{TO}) + (H_{SB} \times P_{SB}) + (H_{CK} \times P_{CR}) + (H_{OFF} \times P_{OFF})\right)}
\]

and:

\[
Q_{ref,h} = P_{design,h} \times H_{HE}
\]

and:

\[
SAEF_{h,ref} = \frac{\sum_{j=1}^{n} hj \times P_{h}(T_{j})}{\sum_{j=1}^{n} hj \times \left(\frac{P_{h}(T_{j})}{AEF_{h,bin}(T_{j})}\right)}
\]

and:

\[
AEF_{h,bin} = \frac{Q_{Eh} + Q_{Ehr,c}}{P_{Eh}}
\]

and:

QEh = effective heating capacity, in kiloWatt
QEhr,c = effective heat recovery capacity, in kiloWatt
PEh = effective heating electrical power input, in kiloWatt

AEFh shall also take into account degradation effects due to cycling in a manner similar to that of electric heat pumps.

and:

**for fixed capacity units**, in case the lowest declared heating capacity exceeds the part load for heating (or capacity ratio \( CR_u \leq 1.0 \)):

\[
GUE_{h,bin(T_{j})} = GUE_{d} \times \left[1 - C_{d} \times (1 - CR_u)\right]
\]

and:

\[
AEF_{h,bin(T_{j})} = AEF_{d} \times \left[1 - C_{d} \times (1 - CR_u)\right]
\]

Where:

GUEd(Tj) = declared gas utilization efficiency at outdoor temperature Tj

AEFd(Tj) = declared auxiliary energy factor at outdoor temperature Tj

\( C_d = 0.25 \) (default value) or established by a cycling test

and:

\[
CR_u = \frac{F_{H}}{Q_{Eh} + Q_{Ehr}}
\]
for staged or variable capacity units, determine the declared heating capacity at the closest step or increment of the capacity control of the unit to reach the required heat load.

If this step allows the heating capacity to reach the required heating load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required heating load of 9 kW), then GUEbin(Tj) is assumed to be equal to GUEd(Tj) and AEFbin(Tj) is assumed to be equal to AEFd(Tj).

If this step does not allow the heating capacity to reach the required heating load within ± 10 % (e.g. between 9,9 kW and 8,1 kW for a required heating load of 9 kW), determine the capacity and GUEbin(Tj) and AEFbin(Tj) at the defined part load temperatures for the steps on either side of the required heating load. The heating capacity in part load, the GUEbin(Tj) and the AEFbin(Tj) at the required heating load are then determined by linear interpolation between the results obtained from these two steps.

If the smallest control step of the unit only allows a declared heating capacity higher than the required heating load, the GUEbin(Tj) and AEFbin(Tj) at the required part load ratio is calculated using the approach laid out for fixed capacity units.

For bins representing other than above described operating conditions the GUEbin and AEFbin shall be established by interpolation, except for part load conditions above part load condition A, for which the same values as for condition A shall be used and for part load conditions below part load condition D, for which the same values as for condition D shall be used.

4.2 Calculation of the seasonal space cooling energy efficiency for chillers and air conditioners:

(a) For chillers and air conditioners using electricity, the seasonal space cooling energy efficiency $\eta_{S,cool}$ is defined as:

$$\eta_{S,cool} = SEER - \sum F(i)$$

(b) For chillers and air conditioners using fuels, the seasonal space cooling energy efficiency $\eta_{S,cool}$ is defined as:

$$\eta_{S,cool} = SPER - \sum F(i)$$

Where:

- $SEER$ is the seasonal space cooling energy efficiency in active mode, expressed in %;
- $SPER$ is the seasonal primary energy ratio for cooling, expressed in %
- $F(i)$ are the corrections calculated according to point 3.3 expressed in %;

Calculation of SEER

$$SEER = \frac{Q_C}{Q_{CR}}$$
Where

\[ Q_c = P_{\text{design},c} \times H_{CE} \]

and

\[ Q_{CE} = \frac{Q_c}{SEER_{on}} + (H_{FO} \times P_{TO}) + (H_{SB} \times P_{SB}) + (H_{CK} \times P_{CK}) + (H_{OFF} \times P_{OFF}) \]

and

\[ SEER_{on} = \frac{\sum_{j=1}^{n} h_j \times P_c(T_j)}{\sum_{j=1}^{n} h_j \times \left( \frac{P_c(T_j)}{EER_{bin}(T_j)} \right)} \]

and, for electric air conditioners (connected to an air-based cooling system) of which the capacity control is fixed capacity, in case the lowest declared heating capacity exceeds the part load for heating (or capacity ratio \( CR_u < 1.0 \)):

\[ EER_{bin}(T_j) = EER_d \times \left( 1 - C_d \times (1 - CR_u) \right) \]

Where

- \( EER_d(T_j) \) = declared coefficient of performance
- \( C_d = 0.25 \) (default value) or established by a cycling test
- \( CR_u = \frac{P_c}{P_d} \)

and, for electric comfort chillers and high temperature process chillers (connected to a water-based cooling system) of which the capacity control is fixed capacity, in case the lowest declared heating capacity exceeds the part load for heating (or capacity ratio \( CR_u < 1.0 \)):

\[ EER_{bin}(T_j) = EER_d(T_j) \times \left( \frac{CR_u}{C_c \times CR_u + (1 - C_c)} \right) \]

Where

- \( EER_d(T_j) \) = declared coefficient of performance
- \( C_c = 0.9 \) (default value) or established by a cycling test
- \( CR_u = \frac{P_c}{P_d} \)

and, for staged or variable capacity air conditioners, comfort chillers or high temperature process chillers, determine the declared cooling capacity and \( EER_d(T_j) \) at the closest step or increment of the capacity control of the unit to reach the required cooling load.

If this step does allows to reach the required cooling load within ± 10% (e.g. between 9.9 kW and 8.1 kW for a required cooling load of 9 kW), then \( EER_{bin}(T_j) \) is assumed to be equal to \( EER_d(T_j) \).

If this step does not allow to reach the required cooling load within ± 10% (e.g. between 9.9 kW and 8.1 kW for a required heating load of 9 kW),
determine the capacity and EERbin(Tj) at the defined part load temperatures for the steps on either side of the required heating load. The part load capacity and the EERbin(Tj) at the required heating load are then determined by linear interpolation between the results obtained from these two steps.

If the smallest control step of the unit only allows a declared heating capacity higher than the required heating load, the EERbin(Tj) at the required part load ratio is calculated using the approach laid out for fixed capacity units.

For bins representing other than above described operating conditions the EERbin shall be established by interpolation, except for part load conditions above part load condition A, for which the same values as for condition A shall be used and for part load conditions below part load condition D, for which the same values as for condition D shall be used.

For air conditioners and comfort chillers using internal combustion

Calculation of SPERc

\[
SPER_c = \frac{1}{SGUE_c + \frac{CC}{SAEF_c}}
\]

Where

and

\[
SGUE_c = \frac{\sum_{j=t}^{n} h_j \cdot P_c(T_j)}{\sum_{j=t}^{n} h_j \cdot \left( \frac{P_c(T_j)}{GUE_c,bin(T_j)} \right)}
\]

and

\[
SAEF_h = \frac{Q_{ref,c}}{\left( \frac{Q_{ref,c}}{SAEF_{c,on}} + (H_{TO} \cdot P_{TO}) + (H_{SB} \cdot P_{SB}) + (H_{CK} \cdot P_{CK}) + (H_{OFF} \cdot P_{OFF}) \right)}
\]

and

\[
Q_{ref,c} = P_{design,c} \cdot H_{CE}
\]

and

\[
SAEF_{c,on} = \frac{\sum_{j=t}^{n} h_j \cdot P_c(T_j)}{\sum_{j=t}^{n} h_j \cdot \left( \frac{P_c(T_j)}{AEF_c,bin(T_j)} \right)}
\]

and, for air conditioners with internal combustion (connected to an air-based cooling system) of which the capacity control is fixed capacity, in case the lowest
declared heating capacity exceeds the part load for heating (or capacity ratio \( CR_u \leq 1.0 \)):

\[
GUE_{c,bin(Tj)} = GUE_d \times \left\{ 1 - C_d \times (1 - CR_u) \right\}
\]

and

\[
AEF_{c,bin(Tj)} = AEF_d \times \left\{ 1 - C_d \times (1 - CR_u) \right\}
\]

Where

- \( GUE_{d}(Tj) \) = declared gas utilization efficiency at outdoor temperature \( T_j \)
- \( AEF_{d}(Tj) \) = declared auxiliary energy factor at at outdoor temperature \( T_j \)
- \( C_d = 0.25 \) (default value) or established by a cycling test

\[
CR_u = \frac{P_H}{Q_{_{\text{en}}} + Q_{\text{Enr}}}
\]

and, for **comfort chillers with internal combustion** (connected to a water-based cooling system) of which the capacity control is **fixed capacity**, in case the lowest declared heating capacity exceeds the part load for heating (or capacity ratio \( CR_u \leq 1.0 \)):

\[
EER_{bin(Tj)} = EER_{d(Tj)} \times \left( \frac{CR_u}{C_c \times CR_u + (1 - C_c)} \right)
\]

Where

- \( EER_{d(Tj)} \) = declared coefficient of performance
- \( C_c = 0.9 \) (default value) or established by a cycling test

\[
CR_u = \frac{P_c}{P_a}
\]

and, for **staged or variable capacity units**, determine the declared heating capacity at the closest step or increment of the capacity control of the unit to reach the required heat load.

If this step allows the heating capacity to reach the required heating load within ±10% (e.g., between 9.9 kW and 8.1 kW for a required heating load of 9 kW), then \( GUE_{bin}(Tj) \) is assumed to be equal to \( GUE_{d}(Tj) \) and \( AEF_{bin}(Tj) \) is assumed to be equal to \( AEF_{d}(Tj) \).

If this step does not allow the heating capacity to reach the required heating load within ±10% (e.g., between 9.9 kW and 8.1 kW for a required heating load of 9 kW), determine the capacity and \( GUE_{bin}(Tj) \) and \( AEF_{bin}(Tj) \) at the defined part load temperatures for the steps on either side of the required heating load. The heating capacity in part load, the \( GUE_{bin}(Tj) \) and the \( AEF_{bin}(Tj) \) at the required heating load are then determined by linear interpolation between the results obtained from these two steps.
If the smallest control step of the unit only allows a declared heating capacity higher than the required heating load, the GUEbin(Tj) and AEFbin(Tj) at the required part load ratio is calculated using the approach laid out for fixed capacity units.

For bins representing other than above described operating conditions the GUEbin and AEFbin shall be established by interpolation, except for part load conditions above part load condition A, for which the same values as for condition A shall be used and for part load conditions below part load condition D, for which the same values as for condition D shall be used.

and

\[ GUE_d = \frac{Q_{Ec} + Q_{Ehr,c}}{Q_{gmc}} \]

and

\[ AEF_d = \frac{Q_{Ec} + Q_{Ehr,c}}{P_{Ec}} \]

and

QEc = effective cooling capacity, in kiloWatt
QEhr,c = effective heat recovery capacity, in kiloWatt
Qgmc = is the measured cooling heat input, in kiloWatt

3.3 Calculation of F(i) for comfort chillers, air conditioners and heat pumps:

(a) The correction F(1) accounts for a negative contribution to the seasonal space heating or cooling energy efficiency of products due to adjusted contributions of temperature controls to seasonal space heating and cooling energy efficiency, expressed in %:

For comfort chillers, air conditioners and heat pumps the correction is:

\[ F(1) = 3\% \]

(b) The correction F(2) accounts for a negative contribution to the seasonal space heating or cooling efficiency by electricity consumption of ground water pump(s), expressed in %.

For water/brine-to-water comfort chillers, or water/brine-to-air air conditioners and water/brine-to-air heat pumps:

\[ F(2) = 5\% \]
5. Additional elements for calculations related to the seasonal energy performance ratio of high temperature process chillers.

5.1 Test points

5.2 Calculation of the seasonal energy performance ratio (SEPR) for high temperature process chillers.

(a) The SEPR is calculated as the reference annual refrigeration demand divided by the annual electricity consumption.

\[
\text{reference SEPR} = \frac{\sum_{j=1}^{n} [h_j \cdot P_R(T_j)]}{\sum_{j=1}^{n} \left[ h_j \cdot \frac{P_R(T_j)}{EER_{PL}(T_j)} \right]}
\]

Where :
- \( T_j \) is the bin temperature
- \( j \) is the bin number,
- \( n \) is the amount of bins
- \( P_R(T_j) \) is the refrigeration demand of the application for the corresponding temperature \( T_j \).
- \( h_j \) is the number of bin hours occurring at the corresponding temperature \( T_j \).
- \( EER_{PL}(T_j) \) is the EER value of the unit for the corresponding temperature \( T_j \). This includes part load conditions.

NOTE: This annual electricity consumption includes the power consumption during active mode. Other modes, such as Off mode and standby modes are not relevant for process applications as the appliance is assumed to be running all year long.

(b) The refrigeration demand \( P_R(T_i) \) can be determined by multiplying the full load value \( (P_{\text{designR}}) \) with the part load ratio (\( \% \)) for each corresponding bin. These part load ratios are calculated using the formulas shown in Tables 1 and 2.

(c) The energy efficiency ratio \( EER_{PL}(T_j) \) at part load conditions A, B, C, D is determined as explained below:

In part load condition A (full load), the declared capacity of a unit is considered equal to the refrigeration load \( (P_{\text{designR}}) \).

In part load conditions B, C, D, there can be two possibilities:

1) If the declared capacity (DC) of a unit matches with the required refrigeration loads, the corresponding \( EER_{DC} \) value of the unit is to be used. This may occur with variable capacity units.

\[
EER_{PL}(T_{B,C,D}) = EER_{DC}
\]

2) If the declared capacity of a unit is higher than the required refrigeration load, the unit has to cycle on/off. This may occur with fixed capacity or variable capacity units. In such cases, a degradation coefficient (Cc) has to be used to calculate the corresponding \( EER_{PL} \) value. Such calculation is explained below.
I. Calculation procedure for fixed capacity units

In order to obtain a time averaged outlet temperature the inlet and outlet temperatures for the capacity test shall be determined using the equation below:

\[ t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (t_{\text{outlet, capacity test}} * t_{\text{inlet, capacity test}}) * CR \]

Where

- \( t_{\text{inlet, capacity test}} \) = evaporator water inlet temperature (for conditions B, C or D as set out in regulation [number to be inserted after publication in the OJEU], Annex III, table 23 and 24)
- \( t_{\text{outlet, capacity test}} \) = evaporator water outlet temperature (for conditions B, C or D as set out in regulation [number to be inserted after publication in the OJEU], Annex III, table 23 and 24)
- \( t_{\text{outlet, average}} \) = mean evaporator water average outlet temperature over a on/off cycle (for instance +7°C as set out in regulation [number to be inserted after publication in the OJEU], Annex III, table 23 and 24)
- \( CR \) = the capacity ratio, calculated as the refrigeration load (\( P_R \)) divided by the refrigeration capacity (\( P_d \)) at the same operating condition

\[ CR = \frac{P_R(T_f)}{P_d(T_f)} \]

For determining \( t_{\text{outlet, average}} \) an iterative procedure is required at all conditions (B, C, D) where the chiller cooling capacity (control step) is higher than the required refrigeration load.

a. Test at \( t_{\text{outlet}} \) from Table 23 or 24 with the water flow rate as determined for tests at condition “A” for chillers with a fixed water flow rate or with a fixed temperature difference for chillers with a variable flow rate;

b. Calculate CR;

c. Apply calculation for \( t_{\text{outlet, average}} \) to calculate the corrected outlet,capacity test at which the test shall be performed in order to obtain outlet,average equal to the outlet temperature as defined in Tables 23 or 24 of Annex III;

d. Retest with the corrected \( t_{\text{outlet}} \) and the same water flow rate;

e. Recalculate CR;

f. Repeat c. to e. until CR and \( t_{\text{outlet, capacity test}} \) do not change any more.

Then, for each part load conditions B,C,D the EER_{PL} is calculated as follows:
Where:

- $EER_{DC}$ is the EER corresponding to the declared capacity (DC) of the unit at the same temperature conditions as for part load conditions B,C,D.
- $Cc$ is the degradation coefficients for chillers for part load conditions B,C,D
- $CR$ is the capacity ratio for part load conditions B,C,D

For chillers, the degradation due to the pressure equalization effect when the unit restarts can be considered as negligible.

The only effect that will impact the EER at cycling is the remaining power input when the compressor is switching off.

The electrical power input during the compressor off state of the unit is measured when the compressor is switched off for at least 10 min.

The degradation coefficient $Cc$ is determined for each part load ratio as follows:

$$Cc = 1 - \frac{\text{measured power of compressor off state}}{\text{total power input (full capacity at the part load conditions)}}$$

If $Cc$ is not determined by test then the default degradation coefficient $Cc$ is 0.9.

II. Calculation procedure for variable capacity units

Determine the declared capacity and $EER_{PL}$ at the closest step or increment of the capacity control of the unit to reach the required refrigeration load. If this step does not allow reaching the required refrigeration load within +/- 10 % (e.g. between 9.9 kW and 8.1 kW for a required cooling load of 9 kW), determine the capacity and $EER_{PL}$ at the defined part load temperatures for the steps on either side of the required refrigeration load. The part load capacity and the $EER_{PL}$ at the required refrigeration load are then determined by linear interpolation between the results obtained from these two steps.

If the smallest control step of the unit is higher than the required refrigeration load, the $EER_{PL}$ at the required part load ratio is calculated using the equation for fixed capacity units.

(d) The energy efficiency ratio $EER_{PL}(Tj)$ at part load conditions, different than part load conditions A, B, C, D is determined as explained below:

The EER values at each bin are determined via interpolation of the EER values at part load conditions A,B,C,D as mentioned in the Tables 23 and 24 of regulation [number to be inserted after publication in the OJEU].
For part load conditions above part load condition A, the same EER values as for condition A are used.

For part load conditions below part load condition D, the same EER values as for condition D are used.