Abstract training course

Part 1
- European Standard EN 1886
- European Standard EN 13053

Break

Part 2
- Eurovent certification procedure for AHUs
- Eurovent Energy Labelling System for AHUs
- Advantages of Eurovent Certification
Part 1
European Standards
One European Standard = 30 National Standards

• National Standard Bodies adopt European Standard
• All national Standards identical

Heating, cooling, ventilation

• CEN Technical Committee 156
• CEN Working Group 5
Ventilation for buildings – Air handling units – Mechanical performance
December 2007

Standard is a part of a series of standards for air handling units used for ventilation and air conditioning of buildings.
EN 1886

**Mechanical Building Services**

- Control systems
- Ventilation & air conditioning systems
- Heating systems
- Ductwork
- Air handling units
- Installation

EN 1886 Mechanical performance

EN 13053 Rating & performance for units, components and sections
EN 1886

Mechanical performance

- Fire protection
- Mechanical safety

- Mechanical strength of casing
- Casing air leakage
- Filter bypass leakage
- Thermal performance of casing
- Acoustic insulation of casing
Scope
Test methods, test requirements and classifications for AHUs, Supplying and/or extracting air via ductwork and ventilating/conditioning a part or the whole of a building.

Not applicable for:
• units serving a limited area in the building (fan coil units)
• units for residential buildings
• units producing ventilation air for manufacturing process
## EN 1886

<table>
<thead>
<tr>
<th>TEST CRITERIA CASING</th>
<th>MODEL BOX*</th>
<th>REAL UNIT**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical strength</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Air leakage</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Filter bypass leakage</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Thermal transmittance</td>
<td>X</td>
<td>–</td>
</tr>
<tr>
<td>Thermal bridging</td>
<td>X</td>
<td>–</td>
</tr>
<tr>
<td>Acoustic insulation</td>
<td>X</td>
<td>–</td>
</tr>
</tbody>
</table>

* General classification; marked (M)
** Particular classification; marked (R)
EN 1886

Model box
- empty enclosure with standard casing construction features
- internal height and width between 0.9 and 1.4 m
- total external surface between 10 and 30 m²
- assembly of at least 2 sections
- each section shall have (at least) one access door
- filter frame installed without filter medium
- assembly in accordance with normal production procedures

Real unit
- factory made assembly comprising air handling functions
EN 1886

1. Mechanical strength of casing

A = Panel deflection
B = Frame deflection
### EN 1886

1. **Mechanical strength of casing**

<table>
<thead>
<tr>
<th>Casing class</th>
<th>Maximum relative deflection [mm×m⁻¹]</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>4</td>
</tr>
<tr>
<td>D2</td>
<td>10</td>
</tr>
<tr>
<td>D3</td>
<td>&gt;10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test criterion</th>
<th>Model box</th>
<th>Real unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection</td>
<td>± 1.000 Pa</td>
<td>Operating pressure at design</td>
</tr>
<tr>
<td>Withstand maximum pressure</td>
<td>± 2.500 Pa</td>
<td>Maximum fan pressure at design fan speed</td>
</tr>
</tbody>
</table>
2. Casing air leakage

Leakage classes based on leakage classification for ductwork

<table>
<thead>
<tr>
<th>Leakage classification for ductwork</th>
<th>Maximum leakage rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$0.027 \times p^{0.65}$</td>
</tr>
<tr>
<td>B</td>
<td>$0.009 \times p^{0.65}$</td>
</tr>
<tr>
<td>C</td>
<td>$0.003 \times p^{0.65}$</td>
</tr>
</tbody>
</table>
EN 1886

2. Casing air leakage

Maximum leakage rate at 400 Pa negative pressure

<table>
<thead>
<tr>
<th>Leakage class of casing</th>
<th>Maximum leakage rate [l×s⁻¹×m⁻²]</th>
<th>Filter class (EN 779)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 (C)</td>
<td>0.15</td>
<td>Superior to F9</td>
</tr>
<tr>
<td>L2 (B)</td>
<td>0.44</td>
<td>F8 and F9</td>
</tr>
<tr>
<td>L3 (A)</td>
<td>1.32</td>
<td>G1 to F7</td>
</tr>
</tbody>
</table>
2. Casing air leakage

Maximum leakage rate at 700 Pa positive pressure

<table>
<thead>
<tr>
<th>Leakage class of casing</th>
<th>Maximum leakage rate [l×s⁻¹×m⁻²]</th>
<th>Filter class (EN 779)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L₁ (C)</td>
<td>0.22</td>
<td>Superior to F9</td>
</tr>
<tr>
<td>L₂ (B)</td>
<td>0.63</td>
<td>F8 and F9</td>
</tr>
<tr>
<td>L₃ (A)</td>
<td>1.90</td>
<td>G1 to F7</td>
</tr>
</tbody>
</table>
EN 1886

2. Casing air leakage

Basic test setup and test requirements

- highest filter class decisive
- positive pressure test required if operating pressure > 250 Pa
- positive test pressure 700 Pa, or actual operating pressure if >700 Pa
3. Filter bypass leakage

- Filter bypass leakage is related to filter class
- Test pressure differential 400 Pa
- Leakage rate is a percentage of nominal air flow rate
- For model box nominal flow is 0.93 m$^3$/s for full filter (=2.5 m/s face velocity on 610 x 610 mm square)
- Bypass leakage is the total amount of unfiltered air supplied to the building; hence:
  - for upstream filters, bypass around filter cells + casing leakage between filter and fan
  - for downstream filters, only bypass around filter cells
3. Filter bypass leakage

Acceptable filter bypass leakage rates

<table>
<thead>
<tr>
<th>Filter class</th>
<th>G1-F5</th>
<th>F6</th>
<th>F7</th>
<th>F8</th>
<th>F9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum filter bypass leakage rate as % of nominal flow rate*</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

* leakage is the total amount of unfiltered air
3. Filter bypass leakage

Test setup for upstream bypass leakage test

\[ q_{L_{tot}} = q_L + q_{Lf} \]

Bypass lekkage:  \( q_{L_{to}} \)
4. Thermal transmittance

Mean heat loss coefficient (thermal transmittance “U”) is only measured on model box and is calculated as:

\[ U = \frac{P_{el}}{A \times \Delta t_{air}} \]

- \( U \) = thermal transmittance \([W \times m^{-2} \times K^{-1}]\)
- \( P_{el} \) = electrical power input for heater(s) and circulating fans \([W]\)
- \( A \) = external surface area \([m^2]\)
- \( \Delta t_{air} \) = air to air differential temperature (ti-ta) \([K]\)
- \( ti \) = mean internal air temperature \([^{\circ}C]\)
- \( ta \) = mean external air temperature \([^{\circ}C]\)
4. Thermal transmittance

Classification of thermal transmittance $U$

<table>
<thead>
<tr>
<th>Thermal class</th>
<th>Thermal transmittance $U$ $[W\times m^{-2}\times K^{-1}]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>$U \leq 0.5$</td>
</tr>
<tr>
<td>T2</td>
<td>$0.5 &lt; U \leq 1.0$</td>
</tr>
<tr>
<td>T3</td>
<td>$1.0 &lt; U \leq 1.4$</td>
</tr>
<tr>
<td>T4</td>
<td>$1.4 &lt; U \leq 2.0$</td>
</tr>
<tr>
<td>T5</td>
<td>No requirements</td>
</tr>
</tbody>
</table>
5. Thermal bridging

Thermal bridging (bridging factor “$k_b$”) is only measured on model box and is calculated as:

$$k_b = \frac{\Delta t_{\text{min}}}{\Delta t_{\text{air}}} = \frac{t_i - t_{s-\text{max}}}{t_i - t_a}$$

- $k_b$ = bridging factor [-]
- $\Delta t_{\text{min}}$ = least differential temperature (internal air – casing) [K]
- $\Delta t_{\text{air}}$ = air to air differential temperature [K]
- $t_i$ = mean internal air temperature [°C]
- $t_{s-\text{max}}$ = measured maximum external surface temperature [°C]
- $t_a$ = mean external air temperature [°C]
5. Thermal bridging

Classification of thermal bridging factor $k_b$

<table>
<thead>
<tr>
<th>Thermal class</th>
<th>Thermal bridging factor $k_b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB1</td>
<td>$0.75 \leq k_b &lt; 1.00$</td>
</tr>
<tr>
<td>TB2</td>
<td>$0.60 \leq k_b &lt; 0.75$</td>
</tr>
<tr>
<td>TB3</td>
<td>$0.45 \leq k_b &lt; 0.60$</td>
</tr>
<tr>
<td>TB4</td>
<td>$0.30 \leq k_b &lt; 0.45$</td>
</tr>
<tr>
<td>TB5</td>
<td>No requirements</td>
</tr>
</tbody>
</table>

In class TB3 and TB4, 1% of the external surface may have lower bridging class
5. Thermal bridging

Practical application of bridging factor $k_b$

Risk of external condensation if internal temperature is lower than external temperature!
After conversion of formula the minimum external surface temperature is calculated with equation below:

$$k_b = \frac{t_{\text{min}} - t_i}{t_a - t_i} \Rightarrow k_b \times (t_a - t_i) = t_{\text{min}} - t_i \Rightarrow t_{\text{min}} = t_i + k_b \times (t_a - t_i)$$

Example:
Bridging factor = 0.6
Internal air temperature 10°C
External air temperature 30°C

Result:
$t_{\text{min}} = 10° + 0.6 \times (30° - 10°) = 22°C$
no condensation if dewpoint $t_a < 22°$
maximum relative humidity 62%
6. Acoustic insulation of casing

Measurement of sound insertion loss value $D_p$

$D_p$ is the difference of the measured sound pressure level in a sound source-enveloping surface without and with model box around the source.
Values measured in octave bands 125 – 8000 Hz.
6. Acoustic insulation of casing

*Sound source on reflecting floor*
6. Acoustic insulation of casing

*Enveloping surface around sound source*

Measurement of $L_{P\text{-SOURCE}}$ in enveloping surface, averaged per octave band
6. Acoustic insulation of casing

*Enveloping surface around model box; sound source in model box*

Measurement of $L_{P-ENCLOSURE}$ in enveloping surface, averaged per octave band

$$D_p = L_{P-SOURCE} - L_{P-ENCLOSURE}$$
EN 1886

7. Fire protection
   Design and construction requirements; not relevant for Eurovent Certification

8. Mechanical safety
   Design and construction requirements; not relevant for Eurovent Certification
EN 13053

Ventilation for buildings – Air handling units – Rating and performance for units, components and sections

August 2006

Revision prEN 13053rev – 2009®

Standard is a part of a series of standards for air handling units used for ventilation and air conditioning of buildings.
EN 13053

Rating & performance for units, components and sections

- Air handling unit as a whole
- Fan section
- Coils
  - Damper section
  - Mixing section
  - Filter section
- Heat recovery systems
  - Humidifiers
EN 13053

Scope
Test methods and requirements for ratings and performance of AHUs as a whole. Requirements, recommendations, classification and testing of specific components and sections of AHUs.
Applicable to standardised designs in a range of sizes and to custom-designed units.

Not applicable for:
• units serving a limited area in the building (fan coil units)
• units for residential buildings
• units producing ventilation air for manufacturing process
Ratings and performance of the entire AHU

1. Testing of aerodynamic performance
Air volume flow rate versus external total pressure

- $P_{\text{total}} = P_{\text{total-outlet}} - P_{\text{total-inlet}}$
- average filter pressure drop is simulated by increasing the external total pressure with a value (design – initial)
- if final filter pressure drop is design pressure drop the correction value on external pressure shall be (final – initial)
- testing is performed with dry cooling coils
- air volume flow rate measured in accordance with ISO 5801
- testing of a unit with heat recovery shall be performed taking the leakage into consideration
- characteristics shall be converted to standard air density 1.2 kg/m$^3$
Ratings and performance of the entire AHU

1. Testing of aerodynamic performance

Air volume flow rate versus absorbed motor power

- if fan speed control (e.g. frequency inverter) is required, the absorbed power shall include the losses in the speed control device
- characteristics shall be converted to standard air density 1.2 kg/m³
- multiple measurements shall be presented for a stated nominal fan speed, but without corrections for inherent speed deviations caused by variable motor loads
EN 13053

Ratings and performance of the entire AHU

2. Testing of acoustic performance

**Duct borne noise tests** (sound levels in inlet and outlet duct)
- measurement in accordance with one of the EN ISO standards
- reverberation room (3741), free field (3744), in-duct (25136)
- measurements at specified duty point
- results shall not be affected by noise generation in throttling device (artificial external pressure)
- apply duct end correction where applicable (3741 & 3744)
Ratings and performance of the entire AHU

2. Testing of acoustic performance

Casing radiated noise tests (emitted sound levels through casing)
- measurement in accordance with one of the EN ISO standards
- reverberation room (3741), free field (3744 or 3746)
- measurements at specified duty point
- results shall not be affected by duct break out noise
- results shall not be affected by noise generation in throttling device (artificial external pressure)
3. Tolerances and deviations

Aerodynamic and acoustic performances

- tolerance range of duty point (t)
- uncertainty range of measured data (u)
- admissible deviation (Δ)
- measured value e.g. (Vm)
- specified (design) value (Vs)

Allowable: $\Delta V \leq t \times V_s + u \times V_m$
### EN 13053
#### Ratings and performance of the entire AHU

3. Admissible tolerances

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Tolerance [t]</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air volume flow [m3/s]</td>
<td>± 5%</td>
<td>Measuring uncertainty not included</td>
</tr>
<tr>
<td>External total pressure [Pa]</td>
<td>± 5%</td>
<td>Measuring uncertainty not included</td>
</tr>
<tr>
<td>Absorbed motor power [kW]</td>
<td>+ 8% *</td>
<td>Measuring uncertainty not included</td>
</tr>
<tr>
<td>Total sound power levels in duct and radiated casing [dB(A)]</td>
<td>4 dB</td>
<td>Measuring uncertainty not included</td>
</tr>
</tbody>
</table>

Simultaneous tolerance of 5% on air flow rate and external pressure is allowed. For absorbed motor power 8% tolerance at rated performance is permitted.*
Ratings and performance of the entire AHU

3. Admissible tolerances
EN 13053

Requirements & performance rating for components

1. Casing air handling unit
   Design, construction and maintenance requirements; not relevant for Eurovent Certification

2. Fan section
   Design, construction and maintenance requirements; not relevant for Eurovent Certification.
   Fan selection shall be based on average of initial and final filter pressure drop unless otherwise agreed (e.g. final pressure drop).
   For cooling coil pressure drop, the dry value shall be used unless specified otherwise.
## EN 13053

Requirements & performance rating for components

### 2. Fan section: classes of average velocity

Velocities based on internal filter -or fan cross section!

<table>
<thead>
<tr>
<th>Class</th>
<th>Air velocity [m/s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>( \leq 1.6 )</td>
</tr>
<tr>
<td>V2</td>
<td>( 1.6 &lt; v \leq 1.8 )</td>
</tr>
<tr>
<td>V3</td>
<td>( 1.8 &lt; v \leq 2.0 )</td>
</tr>
<tr>
<td>V4</td>
<td>( 2.0 &lt; v \leq 2.2 )</td>
</tr>
<tr>
<td>V5</td>
<td>( 2.2 &lt; v \leq 2.5 )</td>
</tr>
<tr>
<td>V6</td>
<td>( 2.5 &lt; v \leq 2.8 )</td>
</tr>
<tr>
<td>V7</td>
<td>( 2.8 &lt; v \leq 3.2 )</td>
</tr>
<tr>
<td>V8</td>
<td>( 3.2 &lt; v \leq 3.6 )</td>
</tr>
<tr>
<td>V9</td>
<td>( v &gt; 3.6 )</td>
</tr>
</tbody>
</table>

*Proportional steps ISO 3: R20 series*
EN 13053

Requirements & performance rating for components

2. Fan section: absorbed motor power

Reference value for absorbed motor power fan + drive

\[ P_{m_{\text{ref}}} = \left( \frac{\Delta p_{\text{stat}}}{450} \right)^{0.925} \times (q_v + 0.08)^{0.95} \]

- \( P_{m_{\text{ref}}} \) = reference value absorbed power \([\text{[kW]}]\)
- \( \Delta p_{\text{stat}} \) = available static pressure \((p_{\text{internal}} + p_{\text{external}})\) \([\text{[Pa]}]\)
- \( q_v \) = air flow rate of the fan \([\text{[m}^3/\text{s}]\)
EN 13053

Requirements & performance rating for components

2. Fan section: classification of power consumption fan®

<table>
<thead>
<tr>
<th>Class</th>
<th>$P_{m \text{ max}}$ [kW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>$\leq P_{m_{\text{ref}}} \times 0.85$</td>
</tr>
<tr>
<td>P2</td>
<td>$\leq P_{m_{\text{ref}}} \times 0.90$</td>
</tr>
<tr>
<td>P3</td>
<td>$\leq P_{m_{\text{ref}}} \times 0.95$</td>
</tr>
<tr>
<td>P4</td>
<td>$\leq P_{m_{\text{ref}}} \times 1.00$</td>
</tr>
<tr>
<td>P5</td>
<td>$\leq P_{m_{\text{ref}}} \times 1.06$</td>
</tr>
<tr>
<td>P6</td>
<td>$\leq P_{m_{\text{ref}}} \times 1.12$</td>
</tr>
<tr>
<td>P7</td>
<td>$&gt; P_{m_{\text{ref}}} \times 1.12$</td>
</tr>
</tbody>
</table>

Proportional steps

ISO 3: R40 series
EN 13053

Requirements & performance rating for components

3. Heating and cooling coils

Design, construction and maintenance requirements; not relevant for Eurovent Certification.

Coils shall be rated in accordance with EN 1216 (maximum 5% deviation between measured performance on air- and waterside).

Hygienic requirements adapted from VDI 6022/3803; however not relevant for Eurovent Certification.
EN 13053

Requirements & performance rating for components

4. Heat recovery sections

Categories as defined in EN 308.

Performances always based on balanced mass flows (mass flow ratio 1:1) and no condensation in exhaust air

- Category I : Recuperators
- Category II : With intermediate heat transfer medium
  - IIa – without phase change
  - IIb – with phase change
- Category III : Regenerators (accumulating mass)
  nowadays 3 sub categories (Eurovent certification)
EN 13053

Requirements & performance rating for components

4. Heat recovery sections

Fundamental table for energy efficiency of heat recovery

<table>
<thead>
<tr>
<th>Class</th>
<th>$\eta_t$</th>
<th>$\Delta p_{HRS}$ [Pa]</th>
<th>$\varepsilon$</th>
<th>$\eta_e$</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>0,75</td>
<td>2 x 280</td>
<td>19,5</td>
<td>0,71</td>
</tr>
<tr>
<td>H2</td>
<td>0,67</td>
<td>2 x 230</td>
<td>21,2</td>
<td>0,64</td>
</tr>
<tr>
<td>H3</td>
<td>0,57</td>
<td>2 x 170</td>
<td>24,2</td>
<td>0,55</td>
</tr>
<tr>
<td>H4</td>
<td>0,47</td>
<td>2 x 125</td>
<td>27,3</td>
<td>0,45</td>
</tr>
<tr>
<td>H5</td>
<td>0,37</td>
<td>2 x 100</td>
<td>26,9</td>
<td>0,36</td>
</tr>
</tbody>
</table>
EN 13053

Requirements & performance rating for components

4. Heat recovery sections

Defined characteristic values in the revised standard

• Temperature efficiency
  \[ \eta_t = \frac{t_{SUP} - t_{ODA}}{t_{ETA} - t_{ODA}} \]

• Pressure drop HRS
  \[ \Delta p_{HRS} = \Delta p_{supply} + \Delta p_{exhaust} \]

• Electric power consumption
  \[ P_{el} = \frac{q_v \times \Delta p_{HRS}}{\eta_{el}} + P_{extra} \]

Standard value for \( \eta_{el} = 0.6 \).  \( \Delta p_{HRS} \) = according to table.
EN 13053

Requirements & performance rating for components

4. Heat recovery sections

Defined characteristic values in the revised standard

• Performance HRS: \( Q_{\text{HRS}} = q_v \times \rho \times c_p \times \eta_t (t_{\text{ETA}} - t_{\text{ODA}}) \)
  standard value for \( t_{\text{ETA}} \) and \( t_{\text{ODA}} \) according EN 308 (25°C and 5°C)

• Coefficient of performance: \( \varepsilon = \frac{Q_{\text{HRS}}}{P_{\text{el}}} \)

• Energy efficiency: \( \eta_e = \eta_t \times \left( 1 - \frac{1}{\varepsilon} \right) \)
EN 13053

Requirements & performance rating for components

4. Heat recovery sections

Classes of heat recovery obtained with defined characteristics®

<table>
<thead>
<tr>
<th>Class</th>
<th>$\eta_e$ [min %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>$\geq 71$</td>
</tr>
<tr>
<td>H2</td>
<td>$\geq 64$</td>
</tr>
<tr>
<td>H3</td>
<td>$\geq 55$</td>
</tr>
<tr>
<td>H4</td>
<td>$\geq 45$</td>
</tr>
<tr>
<td>H5</td>
<td>$\geq 36$</td>
</tr>
<tr>
<td>H6</td>
<td>No requirement</td>
</tr>
</tbody>
</table>

Proportional steps in heat exchange surface
EN 13053

Requirements & performance rating for components

5. Mixing sections
   Dampers, mixing efficiency and mixing temperature
   • dampers shall be tested according to EN 1751
   • mixing efficiency shall be measured with recirculation damper 90%, 50% and 20% open
     \[ \eta_{\text{mix}} = \left( 1 - \frac{t_{\text{max}} - t_{\text{min}}}{t_{H} - t_{L}} \right) \times 100\% \]
   • mixing temperature can be calculated with
     \[ t_{M} = \frac{t_{H} \times \rho_{H} \times q_{vH} + t_{L} \times \rho_{L} \times q_{vL}}{\rho_{\text{tot}} \times q_{v\text{tot}}} \]
## EN 13053

### Requirements & performance rating for components

5. Mixing sections

Classification mixing temperature efficiency

<table>
<thead>
<tr>
<th>Class</th>
<th>Mixing efficiency [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>≥ 95</td>
</tr>
<tr>
<td>M2</td>
<td>85 ≤ $\eta_{\text{mix}}$ &lt; 95</td>
</tr>
<tr>
<td>M3</td>
<td>70 ≤ $\eta_{\text{mix}}$ &lt; 85</td>
</tr>
<tr>
<td>M4</td>
<td>50 ≤ $\eta_{\text{mix}}$ &lt; 70</td>
</tr>
<tr>
<td>M5</td>
<td>&lt; 50</td>
</tr>
</tbody>
</table>
EN 13053

Requirements & performance rating for components

6. Humidifiers
   Design, construction and maintenance requirements; not relevant for Eurovent Certification.
   Hygienic requirements adapted from VDI 6022/3803; however not relevant for Eurovent Certification.

7. Filter sections
   Design, construction and maintenance requirements; not relevant for Eurovent Certification.
   Hygienic requirements adapted from VDI 6022/3803; however not relevant for Eurovent Certification.
Requirements & performance rating for components

7. Filter sections

Maximum final pressure drop for filters

<table>
<thead>
<tr>
<th>Filter class</th>
<th>Final pressure drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1 – G4</td>
<td>150 Pa</td>
</tr>
<tr>
<td>F5 – F7</td>
<td>200 Pa</td>
</tr>
<tr>
<td>F8 – F9</td>
<td>300 Pa</td>
</tr>
</tbody>
</table>
European Standards

End of presentation part 1

THANK YOU FOR YOUR ATTENTION

???