ELECTRICAL MOTOR
IMPORTANT ITEMS OF THE ELECTRICAL MOTOR

• WINDING INSULATION
• WINDING SLOTS
• QUALITY OF THE IMPREGNATING VARNISH
• BEARINGS (C4 CLEARENCE)
• GREASE
• POWER SUPPLY CABLE
• TERMINAL PLATE MATERIAL (IN SURROUNDED BY SMOKE)
• MANUFACTURING PROCESS
ELECTRICAL MOTOR
ELECTRICAL MOTOR
ELECTRICAL MOTOR
TEMPERATURE CERTIFICATION OF THE FAN
European Standard EN 12101-3

EN 12101-3

European Standard
Norme Européenne
Europäische Norm

August 2015

English Version

Smoke and heat control systems - Part 3: Specification for powered smoke and heat control ventilators (Fans)

Systemes pour la contrôle des fumées et de la chaleur - Partie 3 : Spécifications relatives aux ventilateurs pour le contrôle de fumées et de chaleur

Rauch- und Wärmefehlungen - Teil 3: Bestimmungen für maschinelle Rauch- und Wärmeeinleitungsgeräte

This European Standard was approved by CEN on 12 January 2015.

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### Classes of fire classification

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<th>Time (min)</th>
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<td>120</td>
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<td>☑️</td>
<td>$F_{842}$</td>
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Free Classification for information only

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Motor Range: FIREMOTOR ABC 123
Type of tests

Figure C.1 — Fan connected directly to furnace
Type of tests

Figure C.2 — Fan connected to furnace by recirculating duct system
Type of tests
Type of tests

Figure C.3 — Fan mounted inside furnace

Key
1. Furnace
2. Fan

TEMPERATURE CERTIFICATION OF THE FAN
Type of tests
TESTING PROCEDURE

• Warm up period (dual purpose fans)

• Heat up period

• High temperature test
Results
Results
Results
Results
Results
Results
INSTALLATION IN THE TUNNEL
Possible commissioning problems

• Aerodynamic circuit
Aerodynamic circuit
Possible commissioning problems

- Aerodynamic circuit
- Location of the equipment
Location of the equipment
Location of the equipment
Possible commissioning problems

• Aerodynamic circuit
• Location of the equipment
• Electric connection
Electric connection
Electric connection
Electric connection
SUMMARY

• Adequate Fan Selection (Aerodynamic Design)
• Mechanical Design Capable of Withstanding the Stresses to the Temperature of the Hot Fumes
• Adequate Electrical Motor
• Correct Installation in the Tunnel
Questions?

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AVOIDING FAN SYSTEM EFFECT

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Learning Objectives

- Definition of system effect
- How to calculate system effect
- System effect’s effect on power consumption
- The difference between inlet and outlet system effect
- How to avoid system effect
Fan Efficiency

Efficiency, $\eta$

Airflow, $Q$
Regulation

Efficiency, $\eta$

Airflow, $Q$

3 – 5 %

76 million ton2 of coal
What We Can Do

Efficiency, $\eta$

Airflow, $Q$
What We Can Do

Efficiency, $\eta$

Airflow, $Q$

25 - 40 %
Fan Testing for Air Performance
AMCA Standard 210
Nozzle Wall
AMCA 210 Test Results

![Graph showing the relationship between airflow (Q) and pressure (P) and power (H).]
AMCA Standards 500-D & L
Fan Operating Point

![Graph showing fan operating point](image)
Speed Change

- New Operating Point
- New speed
Damper Opening
System Effect 1\textsuperscript{st} Definition

Installed duct configuration does not match tested duct configuration
Installation Type D Ducted Inlet/Ducted Outlet
AMCA Catalog Ratings

“Performance certified is for installation type:

- A: Free inlet, free outlet”
- B: Free inlet, ducted outlet”
- C: Ducted inlet, free outlet”
- D: Ducted inlet, ducted outlet”
System Effect 2\textsuperscript{nd} Definition

Even when the tested duct configuration matches the installed duct configuration, improper duct design can introduce adverse flow conditions.
Elbow Example
AMCA Publication 201 Plenum Example
Plenum Example

<table>
<thead>
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<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>E-F</td>
<td>duct friction at 5000CMH (Q)</td>
<td>747 Pa (duct design)</td>
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<tr>
<td>E</td>
<td>contraction loss-plenum to duct</td>
<td>50 Pa (part of duct system)</td>
</tr>
<tr>
<td>E</td>
<td>$P_s$ energy required to create velocity at E</td>
<td>125 Pa (part of duct system)</td>
</tr>
<tr>
<td>D</td>
<td>$P_v$ loss (also $P_f$ loss) at D as result of air velocity decrease, $P_s$ does not change from duct to plenum at D</td>
<td>0 Pa</td>
</tr>
<tr>
<td>C-D</td>
<td>outlet duct on fan as tested</td>
<td>0 Pa</td>
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<tr>
<td>Required Fan $P_s$</td>
<td></td>
<td>922 Pa</td>
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Plenum Example
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<td>125 Pa</td>
</tr>
<tr>
<td>B-C</td>
<td>SEF</td>
<td>149 Pa</td>
</tr>
<tr>
<td>B-C</td>
<td>P&lt;sub&gt;v&lt;/sub&gt; loss (also P&lt;sub&gt;r&lt;/sub&gt; loss) at C as result of air velocity decrease, P&lt;sub&gt;s&lt;/sub&gt; does not change from duct to plenum at C</td>
<td>0 Pa</td>
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<tr>
<td></td>
<td>Required Fan P&lt;sub&gt;s&lt;/sub&gt;</td>
<td>1071 Pa</td>
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</tbody>
</table>
Plenum Example from AMCA 201

Assuming:

- Use of the same fan for both systems
- Can attain both operating points with a change in speed

\[ P_c = \left( \frac{N_c}{N} \right)^2 P \]

\[ \frac{N_c}{N} = \left( \frac{P_c}{P} \right)^{1/2} \]

- Speed change ratio; \((1071/922)^{0.5} = 1.08\)
Plenum Example from AMCA 201

\[ H_c = \left( \frac{N_c}{N} \right)^3 H \quad H, \text{ Fan Power} \]

- $1.08^3 = 1.25$ (fan law for power)
- The increased in power consumption to overcome system effect is about 25%
8% Speed Change

![Graph showing airflow, pressure, and power changes with 8% speed change. The graph indicates a 25% increase in pressure and an 8% increase in airflow.]
Inlet System Effect
Outlet System Effect
Speed Changes

Before increasing speed
• Check with the manufacturer for max safe operating speed
• Determine expected power increase
  ▪ Motor size
  ▪ Electric service
• Expect more noise