

Alnor Systemy Wentylacji Sp. zo.o.  
Aleja Krakowska 10  
PL 05-552 WOLA MROKOWSKA  
Polen

## Testing of air tightness of a circular duct system

(2 appendices)

### Assignment

An air leakage test was carried out on a circular ventilation duct system in connection with the yearly surveillance audit.

### Test object

Circular duct system consisting of:

- 1 pc. 1.0 meter duct, Ø 100 mm (sheet thickness 0,5 mm\*).
- 1 pc. 3.0 meters duct, Ø 160 mm (sheet thickness 0,5 mm\*).
- 1 pc. 3.0 meters duct, Ø 355 mm (sheet thickness 0,6 mm\*).
- 1 pc. 3.0 meters duct, Ø 710 mm (sheet thickness 0,7 mm\*).
- 1 pc. 3.0 meters duct, Ø 1600 mm (sheet thickness 1.2 mm\*).
- 1 pc. Reduction Ø 200 mm → 100 mm.
- 1 pc. Reduction Ø 355 mm → 160 mm.
- 1 pc. Reduction Ø 355 mm → 200 mm.
- 2 pcs. Reduction Ø 710 mm → 355 mm.
- 1 pc. Reduction Ø 1600 mm → 710 mm.
- 2 pcs. Bend 90° Ø 100 mm.
- 1 pc. Bend 90° Ø 160 mm.
- 1 pc. Bend 90° Ø 200 mm.
- 2 pcs. Bend 90° Ø 355 mm.
- 1 pc. Z-Connection Ø 160 mm.
- 1 pc. Z-Connection Ø 355 mm.
- 1 pc. T-Connection Ø 355 mm.
- 1 pc. T-Connection Ø 710 mm.
- 1 pc. Endplate Ø 160 mm.
- 1 pc. Endplate Ø 355 mm.
- 1 pc. Endplate Ø 1600 mm.

The system consisted of ducts made of galvanized steel. The duct system was built in accordance with Swedish technical approval 0103/07. For photos of the duct system, see appendix 1.

\* Sheet thickness was checked on randomly selected ducts.

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### SP Technical Research Institute of Sweden

Postal address  
SP  
Box 857  
SE-501 15 BORÅS  
Sweden

Office location  
Brinellgatan 4  
SE-501 15 BORÅS

Phone / Fax / E-mail  
+46 10 516 50 00  
+46 33 13 55 02  
info@sp.se

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## Place and date of test

The test was carried out by SP Energy and Bioeconomy in September 28, 2016 on a duct system assembled by Alnor Systemy Wentylacji sp.z.o.o, at the factory in Warsaw. During the test Zbigniew Jablonski, Alnor Systemy Wentylacji sp.z.o.o was present.

## Test procedure

The test was carried out according to standard EN 12237:2003 "Ventilation for buildings – Ductwork – Strength and leakage of circular sheet metal ducts".

The duct system was connected to a variable speed fan to provide the correct static pressure and an air flow meter to measure the air leakage.

## Results

The measured and calculated values for pressure and air leakage factors are presented in tables 1-2 and in the diagram in appendix 2.

The reported values have been corrected to an air density of 1.2 kg/m<sup>3</sup>. The measurements were made at an atmospheric pressure of 1008 hPa and the ambient temperature was about 16°C.

The tested circular system had a total surface area (A) of 45.78 m<sup>2</sup> and a total joint length (L) of 47.06 m. This resulted in a ratio L/A = 1.03 1/m.

**Table 1. Results for circular duct system at static positive pressure.**

Static positive pressure Pa	Measured leakage factor l/s/m <sup>2</sup>	Demand acc. to class B l/s/m <sup>2</sup>	Demand acc. to class C l/s/m <sup>2</sup>	Demand acc. to class D l/s/m <sup>2</sup>
101	0,009	0,180	0,060	0,020
202	0,015	0,284	0,095	0,032
406	0,024	0,446	0,149	0,050
766	0,036	0,675	0,225	0,075
1517	0,060	1,052	0,351	0,117
2006	0,072	1,261	0,420	0,140

**Table 2. Results for circular duct system at static negative pressure.**

Static negative pressure Pa	Measured leakage factor l/s/m <sup>2</sup>	Demand acc. to class B l/s/m <sup>2</sup>	Demand acc. to class C l/s/m <sup>2</sup>	Demand acc. to class D l/s/m <sup>2</sup>
101	0,010	0,181	0,060	0,020
202	0,016	0,284	0,095	0,032
295	0,020	0,363	0,121	0,040
405	0,024	0,446	0,149	0,050
597	0,031	0,573	0,191	0,064
756	0,034	0,669	0,223	0,074

No deformation of the duct system was observed during the test.

At the actual test the system achieved air tightness class D according to EN 12237:2003.

The results only applies for the tested system.

### Estimated measurement uncertainty

Temperature  $\pm 1^\circ\text{C}$

Air flow  $\pm 5\%$  of actual flow

Static pressure  $\pm 1\%$  of actual pressure

Atmospheric pressure  $\pm 1\text{ hPa}$

Area  $\pm 5\%$

Leakage factor  $\pm 6\%$

The uncertainty has been calculated according to EA-4/16 with a coverage factor  $k=2$ .

### Measuring equipment

Temperature meter, Comark C9001

SP Inventory number 201 312

Manometer, Swema 2000 Man

SP Inventory number 201 562

Manometer, Swema 80 Man

SP Inventory number 202 719

Air flow meter, nozzles 5 to 25 mm

SP Inventory number 201 602

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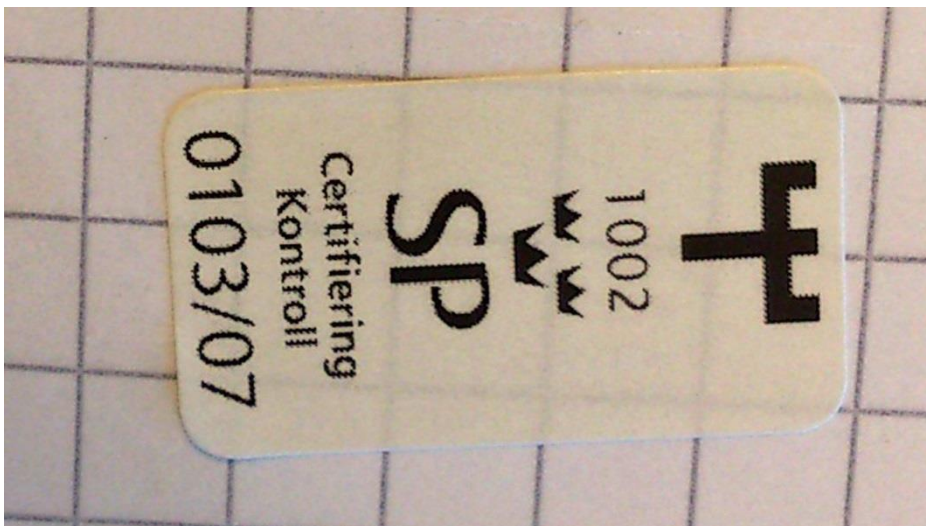
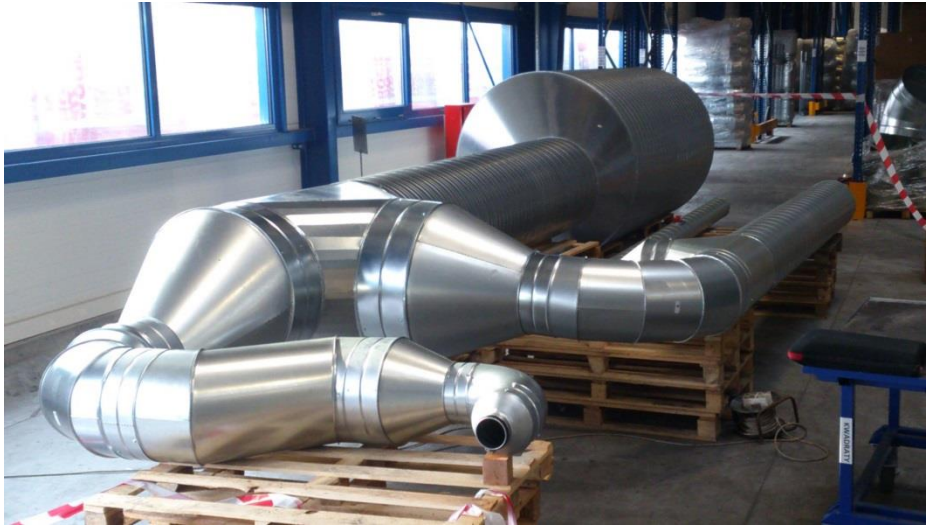
Ulf Hultman

Svein Ruud

### Appendices

1. Photos of the tested duct system.
2. Diagram: Leakage factor [ $\text{l/s/m}^2$ ] as a function of static pressure [ $\text{Pa}$ ].

Appendix 1



Appendix 2

