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2015-03-03
M104146/04 MRE/KRR

Fabric „STEP“ Manufacturer Gabriel A/S

**Determination of the
airflow resistance according to EN 29053**

Test Report No. M104146/04

Client:	Gabriel A/S Hjulmagervej 55 9000 Aalborg Denmark
Consultant:	Dipl.-Ing. (FH) Eva Müller
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Certified quality management system according to ISO 9001
Accredited testing laboratory according to ISO/IEC 17025

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Table of contents

1	Task	3
2	Basics	3
3	Test objects	3
4	Execution of measurements	3
5	Measurement results	4
6	Remarks	4

Appendix A: Measurement results and evaluation

Appendix B: List of test equipment

1 Task

On behalf of Gabriel A/S, DK – 9000 Aalborg, the airflow resistance of three samples of the fabric type “STEP” was to be determined according to EN 29053 [1].

2 Basics

This test report is based on the following document:

- [1] EN 29053: Acoustics – Materials for acoustical applications – Determination of airflow resistance. 1993

3 Test objects

The tested fabric is described in table 1. The indicated characteristic values were determined by the testing laboratory on the basis of the sample.

Table 1. Test object.

Test object (manufacturer's information)	Area specific mass m' [g/m ²]	Thickness d [mm]	Appendix A, page
Sample 1: fabric type “STEP”, manufacturer Gabriel A/S material: 100 % Trevira CS	335	1.0	1
Sample 2: fabric type “STEP”, manufacturer Gabriel A/S material: 100 % Trevira CS	343	1.0	2
Sample 3: fabric type “STEP”, manufacturer Gabriel A/S material: 100 % Trevira CS	342	0.95	3

4 Execution of measurements

The airflow resistance was determined according to EN 29053 [1].

The test method, the test facility and the test equipment used are described in Appendix B.

5 Measurement results

For the tested fabric type "STEP" a specific airflow resistance of

$$R_s = 325 \text{ Pa} \cdot \text{s/m}$$

was determined.

The determined air flow resistances of each of the three samples are shown in table 2.

The measurement results are shown in diagrams and tables in the test certificate in Appendix A of this report.

Table 2. Determined airflow resistances of the fabric "STEP".

Test object	Airflow resistance R_s [Pa · s/m]	Appendix A, page
Sample 1: fabric type "STEP"	329	1
Sample 2: fabric type "STEP"	327	2
Sample 3: fabric type "STEP"	318	3

6 Remarks

The test results exclusively relate to the investigated subjects and conditions described.



Dipl.-Ing (FH) Eva Müller



Dipl.-Ing. (FH) Dominik Reif

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EN 29053

Determination of airflow resistance

Client: Gabriel A/S
Hjulmagervej 55
9000 Aalborg, Denmark

Project No.: M104146

Mueller-BBM Probe No.: 10053

Test object: fabric Step, sample no. 01
colour: 60004
composition: 100 % Trevira CS

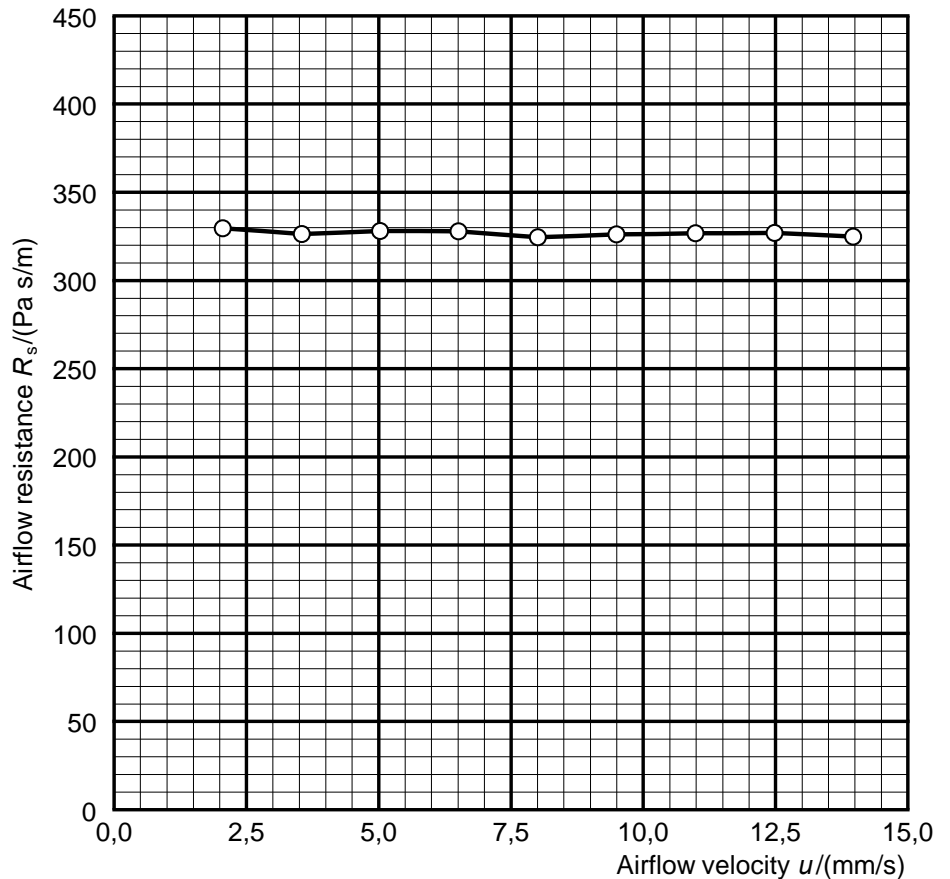
Diameter: 100 mm
Thickness: 1 mm
Area-specific mass: 335 g/m²

Barometric pressure:
 $B = 94,6 \text{ kPa}$

Temperature:
 $\theta = 22,8 \text{ °C}$

Relative humidity:
 $r. h. = 13,9 \%$

$u/$ (mm/s)	$R_s/$ (Pa s/m)
2.06	329
3.55	326
5.03	328
6.51	328
8.01	324
9.49	326
10.98	327
12.48	327
13.97	325



Airflow resistance $R_s = 329 \text{ Pa s/m}$

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Responsible: Dipl.-Ing. (FH) Eva Müller
Date: 2015/03/03

EN 29053

Determination of airflow resistance

Client: Gabriel A/S
Hjulmagervej 55
9000 Aalborg, Denmark

Project No.: M104146

Mueller-BBM Probe No.: 10054

Test object: fabric Step, sample no. 02
colour: 60004
composition: 100 % Trevira CS

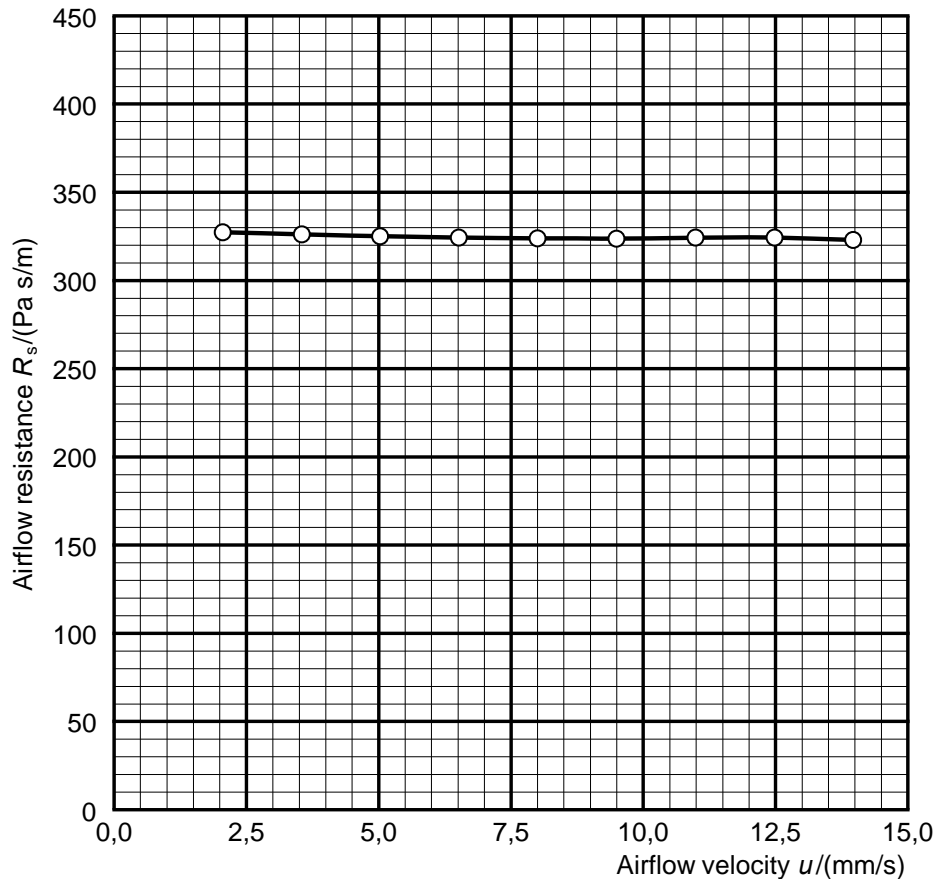
Diameter: 100 mm
Thickness: 1 mm
Area-specific mass: 343 g/m²

Barometric pressure:
 $B = 94,6 \text{ kPa}$

Temperature:
 $\theta = 22,8 \text{ °C}$

Relative humidity:
 $r. h. = 11,8 \%$

$u/$ (mm/s)	$R_s/$ (Pa s/m)
2.06	327
3.55	326
5.03	325
6.51	324
8.00	324
9.49	324
10.98	324
12.48	324
13.96	323



Airflow resistance $R_s = 327 \text{ Pa s/m}$

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Date: 2015/03/03

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EN 29053

Determination of airflow resistance

Client: Gabriel A/S
Hjulmagervej 55
9000 Aalborg, Denmark

Project No.: M104146

Mueller-BBM Probe No.: 10055

Test object: fabric Step, sample no. 03
colour: 60004
composition: 100 % Trevira CS

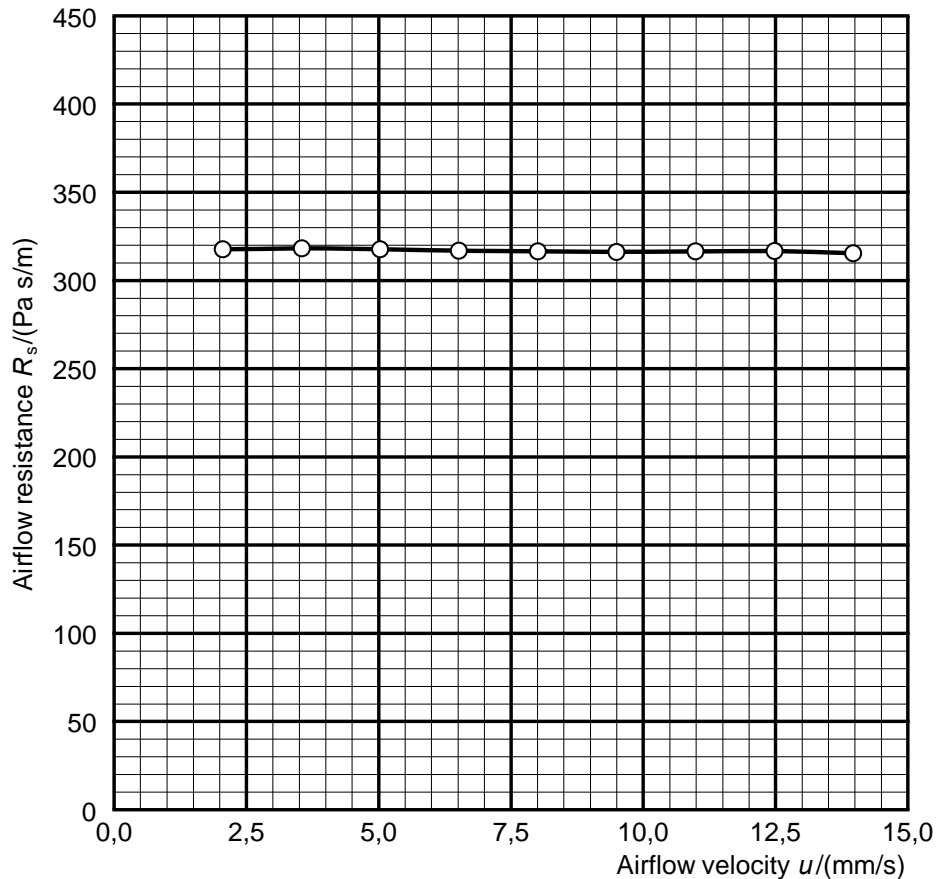
Diameter: 100 mm
Thickness: 0.95 mm
Area-specific mass: 342 g/m²

Barometric pressure:
 $B = 94,6 \text{ kPa}$

Temperature:
 $\theta = 22,8 \text{ °C}$

Relative humidity:
 $r. h. = 10,3 \%$

$u/$ (mm/s)	$R_s/$ (Pa s/m)
2.06	318
3.55	318
5.03	318
6.51	317
8.01	316
9.49	316
10.98	317
12.48	317
13.97	315



Airflow resistance $R_s = 318 \text{ Pa s/m}$

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Description of the test procedure for the determination of the airflow resistance

1 Measurand

The specific airflow resistance R_S of the test object was determined. For this purpose the air pressure difference in front of as well as behind the test object was measured at different volumetric airflow rates. The specific airflow resistance $R_{S,i}$ for each volumetric airflow rate q_i determined was calculated using the following equation:

$$R_{S,i} = \frac{\Delta p_i A}{q_i}$$

With

$R_{S,i}$ specific airflow resistance in Pa s/m;

Δp_i air pressure difference across the test object with respect to the atmosphere in Pa;

A cross-sectional area of the test object perpendicular to the direction of flow in m²;

q_i volumetric airflow rate passing through the test object in m³/s;

u_i linear airflow velocity in m/s;

In addition the linear airflow velocity u_i was determined:

$$u_i = \frac{q_i}{A}$$

The indicated measurement result is the specific airflow resistance R_S , which is calculated for an airflow velocity of $u = 0.0005$ m/s by extrapolation with help of the linear regression.

2 Test procedure

The direct airflow method (method A according to EN 29053) was applied. A steady unidirectional airflow with different air flow rates is pressed through the test object in the specimen holder. The resulting pressure drop between the two free faces of the test object is measured.

The specimen holder had a diameter of $D = 100$ mm.

3 List of test equipment

The test equipment used is listed in table B.1.

Table B.1. Test equipment.

Name	Manufacturer	Type	Serial-No.
Measurement system airflow resistance	Müller-BBM	M89319-00	315003
Software for measurement and evaluation	Müller-BBM	m ars	v1.0.0.2
Digital measuring slide	Mitutoyo	CD-15PPR	07019377
Electronic balance	Kern	440-49N	WC0633572