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RATING STANDARD
for the certification of
Semi-Rigid Non-Metallic Ductwork Systems predominantly made of Plastics

RS/2/C/004P - 2016

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I. PURPOSE

The purpose of this Rating Standard is to establish definitions and specifications for testing and rating of Semi-Rigid Non-Metallic Ductwork Systems predominantly made of Plastics (DUCT-P) for the related Eurovent Certified Performance (ECP) certification sub-programme, in accordance with Operational Manual OM-19.

II. SCOPE

II.1 General

The present sub-programme scope covers Semi-Rigid Non-Metallic Ductwork Systems predominantly made of Plastics for applications in the HVAC field.

The DUCT-P sub-programme applies to ductwork systems with circular or semi-circular cross-section fitted with integrated sealing solution as described in paragraph III.7.

The DUCT-P sub-programme applies to ductwork systems which cross-section is limited to 0.032 m^2.

II.2 Certify-all requirement

Whenever a company participates in the present DUCT-P sub-programme, all ranges that are promoted by the applicant/participant to end-users, specifiers, trading companies, contractors by means of paper or electronic catalogue, price list or software within the scope of the programme, shall be certified, in accordance with the relevant Rating Standard. This includes all models in modular ranges. For the present DUCT-P sub-programme, the certify-all requirement as defined in the Certification Manual is applicable not only to the European market but worldwide.

III. DEFINITIONS

For definitions regarding the certification scheme refer to Certification Manual.

III.1 Air leakage limit

The air leakage limit (f_{max}) is the maximum permitted leakage factor for the ductwork according to its air tightness class defined as per the ductwork classification.

III.2 Air tightness class

The air tightness classes A to D are defined as follows:

Table 1 : Air tightness classification for Semi-Rigid Non-Metallic Ductwork

Air tightness class	*Air leakage limit (f_{max}) [$m^3 \cdot s^{-1} \cdot m^{-2}$]*
A	$0.027 \times p_t^{0.65} \times 10^{-3}$
B	$0.009 \times p_t^{0.65} \times 10^{-3}$
C	$0.003 \times p_t^{0.65} \times 10^{-3}$
D	$0.001 \times p_t^{0.65} \times 10^{-3}$

III.3 Design operating pressure

Maximum static pressure difference p_{design} (Pa) for which the installed ductwork is designed to operate under normal conditions.

III.4 Duct

A duct is in a general way the envelope of the space in which the air is carried.

III.5 Ductwork surface area

The ductwork surface area, or total internal surface area (m^2), is the sum of each internal perimeter multiplied by the length of that section of the ductwork. For semi-rigid ductwork the length to be considered is the centerline.

III.6 Ductwork system

The ductwork system refers to the assembly of the ducts and fittings of an HVAC (Heating, Ventilation and Air-Conditioning) installation that are used to supply the air to or extract the air from the conditioned spaces.
It does not include components such as air handlers, heat recovery units, air terminal devices, coils.

III.7 Integrated/additional sealing solution

In the present document a sealing solution is referred to as “integrated” when it is supplied in each delivery as an integral part of the sealing solution or factory installed (cf. Table 2).

On the contrary, a sealing solution is said “additional” when applied on the construction/application/installation site (cf. Table 3).

For the present DUCT-P sub-programme the sealing solutions are classified as follows:

Table 2 : Integrated sealing solutions

Integrated sealing solutions for cross-sectional (transverse) joints
Seal ring
Clamp

Table 3 : Additional / Not integrated sealing solutions

Additional / Not integrated sealing solutions
Tape (peal and seal; pressure sensitive…etc)

In consequence, ductwork fittings that involve the use of an additional sealing solution on installation site are not part of the present DUCT-P sub-programme.

III.8 Leakage factor

The leakage factor (f) is the leakage flow rate per unit of ductwork surface area expressed in [$m^3 \cdot s^{-1} \cdot m^{-2}$] with q_v the leakage flow rate at a given test pressure in [$m^3 \cdot s^{-1}$] and A the ductwork surface area in [m^2]:

$$f = \frac{q_v}{A}$$

III.9 Minimum / maximum Service Temperature

Lowest / highest temperature at which the ducts and fittings, when installed, continue to function within specified limits of performance.

III.10 Nominal size

A ductwork of circular cross-section is characterized by its nominal diameter d_n as defined in EN 1506:2007.

A ductwork of semi-circular cross-section is characterized by its hydraulic diameter D_H expressed in [m] with A_c the internal cross-sectional area of the duct in [m^2] and P the internal perimeter of the cross section of the duct in [m]:

$$D_H = \frac{4 \times A_c}{P}$$

III.11 Range

A range of Semi-rigid Non-Metallic ductwork present the following identical features:

- range designation
- geometry (circular or semi-circular cross section)
- material list
- rigidity (semi-rigid as per definition stated in standard EN 12792:2003)
- sealing solution designation
- mechanical connection designation

III.12 Resistance to external pressure

The resistance to external pressure value is given as the force F that is the maximum allowed force received to reach a duct height deformation of 3 mm. The value shall be rounded down to the nearest ten.

III.13 Rigid/semi-rigid/flexible ductwork

The definitions for rigid/semi-rigid and flexible ductwork that are stated in standard EN 12792:2003 apply.

III.14 Technical ductwork product

Component, including its connection pieces, installed in the ductwork that has one or more functions more than conveying air.

III.15 Test pressure

Static air pressure difference p_{test} (Pa) between the ductwork to be tested and the surrounding air.

III.16 Total joint length

Length (m) of joints resulting from the installation of the ductwork, that is the sum of each joint perimeter.

III.17 Transverse joint

Connection of two duct or fitting elements, oriented perpendicular to the air flow.

III.18 Typical ductwork system

When a ductwork system is set up in compliance with the requirements specified in §IV.2 it is then considered representative of the range to be certified and referred to as “typical ductwork system”.

IV. TESTING REQUIREMENTS

IV.1 General

The tests shall be conducted in the independent testing laboratory facility.

The test samples shall be conditioned in air at the test temperature for at least 24 hours prior to testing. All tests shall be carried out at an ambient temperature of 20±3 °C.

IV.2 Composition of the typical ductwork system

The test is to be performed on a typical ductwork system considered representative of the product portfolio content for the range to be certified.

The typical ductwork system boundaries are the distribution box/plenum chamber/manifold on the one hand and the terminal adaptator (valve or floor grille adaptator) on the other hand, both included.

a. General requirements

The general requirements are the following:

- the test sample shall contain a representative variety of duct dimensions and fittings;
- the test section shall include straight ducts of a minimum length of 2.5 m;
- the ductwork surface area to be tested shall be at least 3 m^2;
- the ratio (L/A) between the total joint length (L) and ductwork surface area (A) shall be comprised between 0.4 and 0.6 m^{-1} included.

To ensure the test feasibility the ductwork system overall dimensions shall occupy an area of 10 m x 7 m as a maximum.

b. Set-up for ductwork of circular cross-section

To comply with the criteria specified in §IV.2a, the set-up shall comprise the following elements:

- Semi-Rigid straight duct elements of circular cross-section:
  - with at least one element which length is higher or equal to 2.5 m;
- Fittings:
  - Bends : at least two (2) 90° bends with one (1) horizontal and one (1) vertical whenever possible;
  - Converging / diverging junctions: at least one (1) piece among the following : 90° angle T-piece or Y-piece;
  - Straight connectors or adaptators ;
  - Distribution box/plenum chamber/manifold or collecting pipe;
  - Terminal adaptator (valve or floor grille adaptator);
  - Closing covers.
- Technical ductwork products :
  - at least one (1) air flow restrictor or regulator if included in the product portfolio;

c. Set-up for ductwork of semi-circular cross-section

To comply with the criteria specified in §IV.2a, the set-up shall comprise the following elements:

- Semi-Rigid straight duct elements of semi-circular cross-section:
  - with at least one element which length is higher or equal to 2.5 m;
- Fittings:
  - Bends : at least two (2) 90° bends with one (1) horizontal and one (1) vertical whenever possible;
  - Converging / diverging junctions: at least one (1) piece among the following : 90° angle T-piece or Y-piece;
  - Straight connectors or adaptators ;
  - Distribution box/plenum chamber/manifold or collecting pipe;
  - Terminal adaptator (valve or floor grille adaptator);
  - Closing covers.
- Technical ductwork products :
  - at least one (1) air flow restrictor or regulator if included in the product portfolio;

d. Set-up for ductwork of mixed circular and semi-circular cross-sections

To comply with the criteria specified in §IV.2a, the set-up shall comprise the following elements:

- Semi-Rigid straight duct elements:
  - of both circular and semi-circular cross-section whenever compatible;
  - with at least one element which length is higher or equal to 2.5 m;
- Fittings:
  - Bends : at least two (2) 90° bends with one (1) horizontal and one (1) vertical whenever possible;
  - Converging / diverging junctions: at least one (1) piece among the following : 90° angle T-piece or Y-piece;
  - Transformation elements : at least one (1) circular/semi-circular transition piece ;
  - Straight connectors or adaptators ;
  - Distribution box/plenum chamber/manifold or collecting pipe;
  - Terminal adaptator (valve or floor grille adaptator);
  - Closing covers.
- Technical ductwork products :at least one (1) air flow restrictor or regulator if included in the product portfolio;

IV.3 Test pre-requisites

Before testing, the laboratory shall check dimensions to ensure that the elements delivered correspond to the ductwork system selected.

If one of the ductwork elements is not compliant, the laboratory shall not perform the test and contact Eurovent Certita Certification who shall ask the applicant/participant to send a new ductwork element for testing (see also OM-19).

IV.4 Selection for testing : particular rules for DUCT-P sub-programme

In the frame of the qualification procedure two (2) typical ductwork systems shall be tested. The selection will be done as follows:

- One (1) system selected per ductwork cross-section type (circular or semi-circular)
- Each of the two (2) systems corresponding to a different nominal size if available in the portfolio

In the frame of the repetition procedure, one (1) typical ductwork system shall be tested.

A rotation will be foreseen so that each type of set-up (circular cross section, semi-circular cross section, mixed cross sections) is tested in turn. If there is only one type of cross section in the product portfolio the minimum frequency of tests is once every two years.

In any case the nominal size of the ductwork will change from one test to another.

V. RATING REQUIREMENTS

V.1 Particular specifications for testing and rating

The ductwork system shall be installed by the laboratory personnel with as many mounting clips as specified in the manufacturer's documentation.

a. Air tightness class

Leakage testing shall be conducted in accordance with standard EN 12237:2003 "Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts" for 5 positive and 5 negative test pressures (p_t), defined according to declared positive and negative design operating pressures (p_{design}), as shown in Table 4 and Table 5.

Table 4 : Positive test pressures

p_{design_pos}	*Positive test pressures (p_t) in Pa*										
200	20	50	100	150	200						
250		50	100	150	200	250					
300		50	100		200	250	300				
400		50	100		200		300	400			
500		50			200		300	400	500		
1000		50			200		300		500	1000	
2000		50			200				500	1000	2000

Table 5 : Negative test pressures

p_{design_neg}	*Negative test pressures (p_t) in Pa*								
-200					-200	-150	-100	-50	-20
-250				-250	-200	-150	-100	-50	
-300			-300	-250	-200		-100	-50	
-400		-400	-300		-200		-100	-50	
-500	-500	-400	-300		-200			-50	

b. Minimum and maximum service temperatures

The ductwork elements shall be exposed to the minimum and maximum service temperatures as declared by the manufacturer for a minimum of 24 hours. After the test, the ductwork elements shall not have any visible cracks or more than 2% deformation of all relevant dimensions of the duct for the intended function when the ductwork component has reached the ambient temperature (20 +/-3°C).

c. Resistance to external pressure

The test specimen shall be laid on a horizontal metal plate, which has a length of ≥ 300mm and a width ≥ 1.5 times the test specimen's.

A force shall be applied vertically on five (5) ductwork sections using a metal plate of more than 250 mm long and which width is 10 mm ± 0.5mm.

The force shall be applied at the appropriate deformation speed as indicated in Table 6 below:

Table 6 : Deformation speed

Nominal height of duct (mm)	*Deformation speed (mm/min)*
h ≤ 100	2 ± 0,1
100 < h ≤ 200	5 ± 0,25

The force shall be applied increasingly until the ductwork section height has decreased by 3%. The applied force values (F_1, F_2, F_3, F_4, F_5) shall be recorded. The average force shall be calculated and rounded down to the nearest ten, giving the resistance to pressure value F.

V.2 Rerating rules

Any of the performance items that fail during test campaign N leads to one (1) penalty test for the test campaign N+1. The penalty test is a full test (all certified performance items are measured).

a. Air tightness class

For all the test pressures the following requirements shall be fulfilled to consider that the declared air tightness class rating is accurate:

- The leakage factor (f) shall be lower than the air leakage limit (f_{max})
- The ductwork shall withstand the test pressures (p_{test}) specified in Table 4 and Table 5 without permanent deformation, or any sudden change in leakage flow rate or test pressure. This is the "strength criteria".

If one of the above requirements is not fulfilled the test status is FAILED.

The resulting action to be undertaken will depend on the criteria that failed:

- Case 1: The leakage factor (f) value exceeds the air leakage limit (f_{max}) for one or several test pressure(s) but the strength criteria is fulfilled. The leakage factor (f) values are then compared to the air leakage limit (f_{max}) values corresponding to one rating down until the requirement is fulfilled to obtain the new air tightness class rating.

- Case 2: $f < f_{max}$ for all test pressures but the ductwork shows a deformation or a sudden change of leakage flow rate or test pressure occurred. This is considered as a component failure and shall be treated as such (see OM-19 §IV.5.b).

If the ductwork system do not meet at least the class A requirements it is then out of the programme scope and certification cannot be granted/maintained.

Example : The applicant/participant claims air tightness class C for a typical ductwork system of 3 m^2 surface area and which design operating pressures are -200/+200Pa.

Table 7 : Example of test conclusion

Test Pressure	***-200***	***-150***	***-100***	***-50***	***-20***	***20***	***50***	***100***	***150***	***200***
Measured leakage factor (f)	1.81	1.34	0.82	0.37	0.14	0.15	0.38	0.83	1.36	1.83
Air leakage limit (f_{max}) for class C	1.80	1.35	0.90	0.45	0.18	0.18	0.45	0.90	1.35	1.80
$f < f_{max}$ for class C	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO
Strength criteria	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK

Table 8 : Possible rerating

Test Pressure	***-200***	***-150***	***-100***	***-50***	***-20***	***20***	***50***	***100***	***150***	***200***
Measured leakage factor (f)	1.81	1.34	0.82	0.37	0.46	0.47	0.38	0.83	1.36	1.83
Air leakage limit (f_{max}) for class B	5.40	4.05	2.70	1.35	0.54	0.54	1.35	2.70	4.05	5.40
$f < f_{max}$ for class B	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

The leakage factor exceeds class C leakage limit at -200 Pa, +150 Pa and +200 Pa but class B leakage limit is fulfilled at these pressures.

The applicant/participant is therefore asked to either rerate to air tightness class B or perform a test on a new copy of the same ductwork system (see OM-19).

b. Design operating pressures

The manufacturer is asked to rerate to design operating pressures for which the strength criteria of the leakage test was passed (see OM-19).

c. Minimum and maximum service temperatures

After the test, if the ductwork elements present any visible cracks or more than 2% deformation then the applicant/participant shall declare new temperature values. Eurovent Certita Certification invoices and schedules a second test on a new copy of the same ductwork system to confirm the new ratings.

d. Resistance to external pressure

In case of test failure regarding resistance to external pressure, the force F shall be rerated to the average of the applied force values (F_1, F_2, F_3, F_4, F_5) rounded down to the nearest ten.

VI. CERTIFIED PERFORMANCE ITEMS

The following performance characteristics, as defined in paragraph III, declared by the applicant/participant shall be verified by tests.

- Air tightness class : A, B, C or D
- Positive and negative design operating pressures (p_{design}) [Pa]
- Minimum and maximum service temperatures [°C]
- Resistance to external pressure : force F [N]

VII. TOLERANCES

When tested by the independent laboratory personnel, the obtained results shall not differ from the claimed values. The tolerances with respect to the declared ratings are the following:

- Air tightness class : as claimed or better
- Positive and negative design operating pressures: as claimed (no tolerance)
- Minimum service temperature as claimed (no tolerance)
- Maximum service temperature as claimed (no tolerance)
- Resistance to external pressure ±10%