RS/2/C/003MR - 2016

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RATING STANDARD
for the certification of
Rigid Metallic Ductwork Systems with Rectangular Cross-section

RS/2/C/003MR - 2016

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I. PURPOSE

The purpose of this rating standard is to establish definitions and specifications for testing and rating of Rigid Metallic Ductwork Systems with Rectangular Cross-section (DUCT-MR) 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 Rigid Metallic Ductwork Systems with Rectangular Cross-section for applications in the HVAC field.

The DUCT-MR sub-programme applies to ductwork systems with integrated sealing solution as described in paragraph III.7.

II.2 Certify-all requirement

Whenever a company participates in the present DUCT-MR 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-MR 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 per the ductwork classification that appear in the relevant standard: EN 1507:2006 for Metallic rectangular ducts.

Table 1 : Air tightness classification (according to EN 1507:2006)

Air tightness class	***Air leakage limit (f_{max}) [$m^3 \cdot s^{-1} \cdot m^{-2}$]***	***Static gauge pressure limits (p_s) [Pa]***			
		Negative at all pressure classes	Positive at pressure class		
			1	2	3
A	$0.027 \times p_t^{0.65} \times 10^{-3}$	200	400		
B	$0.009 \times p_t^{0.65} \times 10^{-3}$	500	400	1000	2000
C	$0.003 \times p_t^{0.65} \times 10^{-3}$	750	400	1000	2000
D	$0.001 \times p_t^{0.65} \times 10^{-3}$	750	400	1000	2000

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

Surface area (m^2) of the ductwork determined according to EN 14239:2004 for regular ducts and fittings and EN 15727:2010 for technical ductwork components.

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 (see Table 2 and Table 3).

On the contrary, a sealing solution is said “additional” when applied on the construction/application/installation site (see Table 4).

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

Table 2 : Integrated sealing solutions for rectangular ducts cross-sectional (transverse) joints

Description	***Reference in SMACNA Standard***
Companion angles flange connection : flange + continuous gasket (or caulk or tack weld if factory applied) + rivet or screw	T-22 [1]
Slide-on or slip-on flange connection (flange + continuous gasket + corner pieces + clamps or cleats)	Slip-on flange [1]
Other flange connection (flange + continuous gasket)	T-24; T-24A; T-25a; T-25b [1]
Welded flange	T-21 [1]

[1] ANSI/SMACNA 006-2006: HVAC Duct Construction Standards - Metal and Flexible, 3rd edition (2005), fig. 2-1

Table 3 : Integrated sealing solutions for rectangular ducts longitudinal seam joints

Description	***Reference in SMACNA Standard***
Pittsburgh lock seam	L-1 [2]
Button punch snap lock seam	L-2 [2]
Grooved / Pipe lock / Flat lock seam / Double corner seam	L-3 [2]
Standing seam	L-4 [2]
Single corner seam	L-5 [2]

Table 4 : Additional / Not integrated sealing solutions for rectangular ducts

Additional / Not integrated sealing solutions
Tape (peal and seal; pressure sensitive…etc)
Caulk / Mastic sealant
Liquid sealant
Following transverse joints(1): Drive slip, S slip, Hemmed S slip, Double S slip, Standing S slip, Standing seam

(1) Considered as not integrated whenever the final assembly (weld for instance) is to be performed on the construction site. See Figure 2-1 of ANSI/SMACNA 006-2006 Standard for illustrations.

In consequence, ductwork fittings that involve the use of an additional sealing solution on installation site (e.g take-offs) are not part of the present DUCT-MR 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 Longitudinal seam

Joint oriented in the direction of the air flow.

III.10 Range

A range of Metallic rectangular ductwork present the following identical features:

- range designation
- geometry (rectangular cross section)
- material list (main material + available options)
- rigidity (rigid as per definition stated in standard EN 12792:2003)
- sealing solution designation
- mechanical connection designation

[2] ANSI/SMACNA 006-2006: HVAC Duct Construction Standards - Metal and Flexible, 3rd edition (2005), fig. 2-2

III.11 Rigid/semi-rigid/flexible ductwork

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

III.12 Side lengths

A ductwork of rectangular cross-section is characterized by its side lengths a and b as defined in EN 1505:1998.

III.13 Size categories

The present document refers to size categories which are defined as follows:

- Size S ("small") for cross-sections between 0,02 m^2 and 0.36 m^2 included;
- Size L ("large") for cross-sections between 0.36 m^2 excluded and 4 m^2 included;

Ductwork elements of dimensions out of these categories are not part of the certification programme scope.

III.14 Static gauge pressure limit

Maximum design operating pressure p_s (Pa) for the ductwork according to its air tightness class.

III.15 Technical ductwork product

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

III.16 Test pressure

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

III.17 Total joint length

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

III.18 Transverse joint

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

III.19 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 Test standard

The tests shall be conducted in accordance with EN 1507:2006 "Ventilation for buildings. Sheet metal air ducts with rectangular section. Requirements for strength and leakage" as full tests (i.e performing both leakage and strength tests steps).

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 on the one hand and the junction between sleeve and ductwork on the other hand.

a. General requirements

The typical ductwork system criteria, consistent with paragraph 5.2.1 of standard EN 1507:2006, are the following:

- the test sample shall, whenever possible, contain a representative variety of duct dimensions, materials and fittings.
- the ductwork surface area to be tested shall be at least 10 m^2.
- the ratio (L/A) between the total joint length (L) and ductwork surface area (A) shall be comprised between 1 and 1.5 m^{-1}.

To ensure the test feasibility the overall dimensions are limited as follows:

- the ductwork surface area to be tested shall be limited to 50 m^2;
- the ductwork system overall dimensions shall occupy an area of 10 m x 7 m as a maximum;

b. Basic set-up for a ductwork system made of size S elements

To comply with the criteria specified in IV.2a the basic set-up for a ductwork system composed only of size S elements shall comprise the following elements:

- Rigid straight single-wall duct elements of rectangular cross-section:
  - of at least 3 different nominal sizes (a x b) ;
  - with a mix of beaded ducts and cross broken ducts whenever applicable;
- Fittings:
  - Bends :
    - at least two (2) pieces among the following : 45° or 90° bend, different whenever possible;
    - at least one (1) S-bend or “offset” if included in the product portfolio;
    - at least one of the aforementioned bends with sharp corner (“square throat bend”) whenever possible;
  - Bifurcations :
    - at least one (1) piece among the following : T-piece or R-piece or Split-piece;
  - Transformation elements : at least one (1) taper or rect-to-round transition;
  - End covers.
- Technical ductwork products : at least one (1) damper or valve or sound attenuator if included in the product portfolio;

c. Basic set-up for a ductwork system that mixes elements of sizes L and S

In the case of a typical ductwork system where size L elements are mixed with size S elements, the minimum composition is the following:

- Rigid straight single-wall duct elements of rectangular cross-section:
  - of at least 4 different nominal sizes (a x b) with as minimum 2 from size S category and 2 from size L category;
  - with a mix of beaded ducts and cross broken ducts whenever applicable;

- Fittings:
  - Bends :
    - ➢ at least two (2) pieces among the following : 45° or 90° bend, different whenever possible;
    - ➢ at least one (1) S-bend or “offset” if included in the product portfolio;
    - ➢ at least one of the aforementioned bends with sharp corner (“square throat bend”) whenever possible;
  - Bifurcations :
    - ➢ at least one (1) piece among the following : T-piece or R-piece, different whenever possible;
  - Transformation elements :
    - ➢ at least one (1) taper or rect-to-round transition;
  - End covers.
- Technical ductwork products :
  - at least one (1) damper or valve or sound attenuator if included in the product portfolio;

d. <u>Extended set-up</u>

The extended set-up is composed of the basic set-up to which are added the following elements:

- Components fitted with maintenance accessories such as doors and inspection panels;
- Maximum 1 meter long flexible duct with integrated sealed connection meant to connect the basic set-up to air diffusion components such as
  - air terminal devices (grids, diffusers, registers)
  - complementary accessories (equalizing grids)

The air diffusion components are excluded from the extended set-up and are replaced by end caps.

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).

V. RATING REQUIREMENTS

V.1 Particular specifications for testing and rating

When testing under positive test pressures that exceed +750 Pa, the assembly shall be done using as many clamps as specified by manufacturers in their assembly procedure.

The leakage testing shall be conducted on the typical ductwork system for 5 positive and 5 negative test pressures (p_t) as shown in Table 5 including:

- the negative static gauge pressure limit corresponding to the declared air tightness class (p_{s_neg}) as per Table 1;

- the positive static gauge pressure limit corresponding to the declared air tightness class (p_{s_pos}) as per Table 1;

Table 5 : Test pressures according to the declared ratings

C_P	*Cl1*			*Cl2*		*Cl3*	
C_{AT}	***A***	***B***	***C or D***	***B***	***C or D***	***B***	***C or D***
Test pressures (p_t) in Pa			-750		-750		-750
		-500	-500	-500	-500	-500	-500
		-400	-400	-400	-400	-400	-400
		-300	-300	-300	-300	-300	-300
	-200	-200		-200		-200	
	-150						
	-125						
	-100	-100	-100	-100	-100	-100	-100
	-50						
	50						
	100	100	100	100	100	100	100
		150	150				
	200	200	200	200	200		
	300	300	300				
	400	400	400	400	400	400	400
				750	750	750	750
				1000	1000	1000	1000
						2000	2000

If the design operating pressures (p_{design}) declared by the applicant/participant go beyond the static gauge pressure limits (p_s) the leakage test shall also be conducted for the negative (p_{design_neg}) and/or positive design operating pressures (p_{design_pos}).

The strength testing shall be performed as per §5.3 of of standard EN 1507:2006 applying the negative static gauge pressure limit (p_{s_neg}), and the negative design operating pressure (p_{design_neg}) if beyond p_{s_neg}, on the test object.

V.2 Optional test

In addition to the basic ductwork system test the applicant/participant can request to test an extended ductwork system as defined in IV.2d.

The applicant/participant shall declare specific ratings for this extended ductwork system.

V.3 Rerating rules

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 static pressure limits (p_s) specified in Table 1 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 air tightness class and the static gauge pressure limits have to be rerated.

The new rating proposal 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 test status is PASSED. The leakage factor (f) values are then compared to the air leakage limit (f_{max}) values corresponding to one pressure class down until the requirement is fulfilled for the same air tightness class as a first step and then for one air tightness class down if necessary.
- Case 2: $f < f_{max}$ for all test pressures but the strength test status is FAILED:
  - If the failure occurred for the negative static gauge pressure limit (p_{s_neg}) the air tightness class is directly rated down of one class.
  - If the failure occurred for the negative design operating pressure (p_{design_neg}) the technical documentation will have to be modified with the static gauge pressure limits as new design operating pressures.
- Case 3: Both leakage and strength tests are FAILED:
  - The leakage factor (f) values are compared to the air leakage limit (f_{max}) values as for Case 1.
  - The new maximum design operating pressures are the ones corresponding to the new air tightness class rating.

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 manufacturer claims air tightness class C and pressure class 2 for a typical ductwork system of 10 m^2 surface area and made of size S elements only. The tests are performed in the laboratory facility.

Table 6 : Example of test conclusion

Test Pressure	***-750***	***-500***	***-400***	***-300***	***-100***	***100***	***200***	***400***	***750***	***1000***
Measured leakage factor (f)	23	12.1	9.1	6.2	2.1	2.8	5.9	12.4	25	36
Air leakage limit (f_{max}) for $C_{AT}C/C_P2$	22.5	15	12	9	3	3	6	12	22.5	30
$f < f_{max}$	NO	YES	YES	YES	YES	YES	YES	NO	NO	NO
Strength test	NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 7 : Possible rerating

Test Pressure	***-500***	***-400***	***-300***	***-200***	***-100***	***100***	***200***	***400***	***750***	***1000***
Measured leakage factor (f)	12.1	9.1	6.2	N.C	2.1	2.8	5.9	12.4	25	36
Air leakage limit (f_{max}) for $C_{AT}B/C_P2$	67.5	45	36	27	9	9	18	36	67.5	90
$f < f_{max}$	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Both strength and leakage requirements failed at -750 Pa so class C rating is not accurate:

- The new air tightness class rating proposal is class B since the leakage factor exceeds class C leakage limit at +400 Pa; +750 Pa and +1000 Pa but class B leakage limit is fulfilled at these pressures.
- The pressure class is then maintained at Class 2.

- The new static gauge pressure limits are -500 Pa (p_{s_neg}) and 1000 Pa (p_{s_pos})
- The new maximum design operating pressures are -500 Pa (p_{design_neg}) and 1000 Pa (p_{design_pos})

The manufacturer is therefore asked to either rerate the values as stated above or perform a test on a new copy of the same ductwork system (see OM-19).

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
- Static gauge pressure limits (p_s) [Pa]
- Dimensions

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
- Static gauge pressure limits: as claimed (no tolerance)
- Dimensions: as per EN 1505:1998