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RATING STANDARD
for the
CERTIFICATION
of
Non-Ducted FAN COIL UNITS

RS 6/C/002-2017

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Modifications as against last version:

Nb	Modifications	Section	Page
1	Scope: Air flow also expressed in m ³ /h	II	4
2	Correction: the unit of sound power level is dB not dB(A)	III	4
3	Temporary definitions of FCEER and FCCOP in 2017 in order to keep the same Energy Classes in spite of new heating conditions	III	5
4	Editorial: Updated title of table 1	III	6
5	Reversal of conditions (standard and application ratings) in heating	V.1	7
6	Update of the part about high failure in the OM-1A	VII	9
7	Adaptation of the testing tolerances	VII	9
8	Case of unit with a controller	A	11
9	Titles of Figures 1 and 2 completed	A	11 and 12
10	Editorial: Manufacturer instead of manufacturer	All the document	

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TABLE OF CONTENTS

I.	PURPOSE _____	4
II.	SCOPE _____	4
III.	DEFINITIONS _____	4
IV.	TESTING REQUIREMENTS _____	6
V.	RATING REQUIREMENTS _____	6
	V.1 Thermal test	6
	V.2 Sound power test	7
	V.3 Air flow rate test	7
VI.	CERTIFIED PERFORMANCES _____	8
	VI.1 Thermal performances	8
	a. In Standard Rating conditions	8
	b. In Application Rating conditions	8
	VI.2 Acoustic and aeraulic performances.....	8
VII.	TOLERANCES _____	9
APPENDIX A.	TESTING PROCEDURE FOR VARIABLE SPEED UNITS _____	10
	A.I. PURPOSE	10
	A.II. SCOPE	10
	A.III. DEFINITIONS	10
	A.IV. TESTING REQUIREMENTS	10
	A.V. RATING REQUIREMENTS	12
	A.VI. CERTIFIED PERFORMANCES	12
	A.VII. TOLERANCES.....	12

I. PURPOSE

The purpose of this Rating Standard is to establish definitions and specifications for testing and rating **Non-Ducted** Fan Coil Units (FC) in the related Certification Programme for Fan Coil Units (FCU) of Eurovent Certified Certification, in accordance with the Operational Manual OM-1A.

II. SCOPE

This Sub-Programme applies to Fan Coil Units using hot and chilled water or chilled water only.

The units are designed for an air flow lower than $0.7 \text{ m}^3/\text{s}$ ($2520 \text{ m}^3/\text{h}$) and an external static duct pressure published at 40 Pa maximum.

III. DEFINITIONS

A Fan Coil unit is a factory made assembly which provides the functions of cooling and/or heating air using chilled or hot water with air flow to the room ensured by one or more electrically driven fans. Fan Coil Units may be of the cabinet style, within a room, for free air delivery, or of the chassis style, concealed within the building structure with minimal ducting appropriately connected to the inlet and/or outlet of the unit.

The principal components are:

- one or more heat exchangers,
- one or more fans with electric motors,
- an appropriate enclosure,
- condensed water collecting facilities when cooling,
- air filter

Total cooling capacity [kW]: Total heat energy removed from the air by the unit which is the sum of the sensible and latent cooling capacities. The total cooling capacity is determined as the cooling capacity measured on the water side minus the fan power input (net value).

Sensible cooling capacity [kW]: Heat which is removed from the air by means of a dry-bulb temperature drop.

Latent cooling capacity: Heat which is removed from the air by condensation of water vapour on the cooling coil.

Heating capacity [kW]: Total heat added to the air by the unit. The heating capacity is determined as the heating capacity measured on the water side plus the fan power input.

Fan power input [W]: Electric power absorbed by the fan(s) of the unit.

Water pressure drop [kPa]: Negative pressure difference measured between the outlet and inlet connections of the water circuit of the unit.

Sound power level [dB]: Total sound power radiated by the Fan Coil Unit.

A-weighted sound power level [dB(A)]: A single figure on a specific scale which can be related to the subjective assessment of the loudness of a noise.

Air flow rate [m³/h]: Volume air flow through the unit at standard conditions

RPM: Motor rotational speed for dry coils

FCEER and FCCOP: For each unit the Manufacturer shall select three speeds called High, Medium and Low speed. The Fan Coil Energy Efficiency Ratio (FCEER) and the Fan Coil Coefficient of Performance are defined as follow:

Temporary definitions for 2017 campaign (adaptation to net values of total cooling capacities + heating conditions are reversed):

$$FCEER = \frac{5\% \cdot (Pc_{high} + Pe(c)_{high}) + 30\% \cdot (Pc_{med} + Pe(c)_{med}) + 65\% \cdot (Pc_{low} + Pe(c)_{low})}{5\% \cdot Pe(c)_{high} + 30\% \cdot Pe(c)_{med} + 65\% \cdot Pe(c)_{low}} \quad \text{Eq. 1}$$

$$FCCOP = \frac{5\% \cdot PhNS1_{high} + 25\% \cdot PhNS1_{med} + 70\% \cdot PhNS1_{low}}{5\% \cdot Pe(h)NS1_{high} + 25\% \cdot Pe(h)NS1_{med} + 70\% \cdot Pe(h)NS1_{low}} \quad \text{Eq. 2}$$

Definition of FCEER from 2018 campaign:

$$FCEER = \frac{5\% \cdot Pc_{high} + 30\% \cdot Pc_{med} + 65\% \cdot Pc_{low}}{5\% \cdot Pe(c)_{high} + 30\% \cdot Pe(c)_{med} + 65\% \cdot Pe(c)_{low}} \quad \text{Eq. 1bis}$$

$$FCCOP = \frac{5\% \cdot Ph_{high} + 25\% \cdot Ph_{med} + 70\% \cdot Ph_{low}}{5\% \cdot Pe(h)_{high} + 25\% \cdot Pe(h)_{med} + 70\% \cdot Pe(h)_{low}} \quad \text{Eq. 2bis}$$

With:

$Pc_{high,med,low}$: Total cooling capacity at standard condition at High, Medium and Low speed respectively [kW]

$Pe(c)_{high,med,low}$: Power input in cooling mode at standard condition at High, Medium and Low speed respectively [kW]

$Ph_{high,med,low}$: Heating capacity at standard condition at High, Medium and Low speed respectively [kW]

$Pe(h)_{high,med,low}$: Power input in heating mode at standard condition at High, Medium and Low speed respectively [kW]

$PhNS1_{high,med,low}$: Heating capacity at application rating condition 1 at High, Medium and Low speed respectively [kW]

$Pe(h)NS1_{high,med,low}$: Power input in heating mode at application rating condition 1 at High, Medium and Low speed respectively [kW]

Energy Efficiency Classes in cooling and heating: A to E energy efficiency scale for Fan Coil units based on FCEER and FCCOP and defined in Table 1 below.

Table 1 - Energy Efficiency Classes in cooling and heating for non-ducted Fan Coil units

Class	Cooling mode	Heating mode
A	FCEER \geq 185	FCCOP \geq 265
B	185>FCEER \geq 120	265>FCCOP \geq 160
C	120>FCEER \geq 80	160>FCCOP \geq 100
D	80>FCEER \geq 55	100>FCCOP \geq 70
E	55>FCEER	70>FCCOP

IV. TESTING REQUIREMENTS

Standard and Application Ratings shall be established respectively at the Standard Rating conditions and the Application Rating conditions (also called non-standard conditions) specified in Section V.

Standard and Application Ratings shall be verified by tests conducted by the Eurovent Certita Certification -selected laboratory in accordance with the following standards:

The thermal test has to be performed according to **EN 1397:2015** “Heat exchangers - Hydronic room fan coil units – Test procedures for establishing the performance” at the speed chosen by Eurovent Certita Certification (Low, Medium or High speed)

The air flow rate test (optional) has to be performed according to **EN 1397:2015** “Heat exchangers - Hydronic room fan coil units – Test procedures for establishing the performance” for the 3 declared speeds (Low, Medium and High speed)

The sound power test has to be performed according to **EN 16583:2015** “Heat exchangers - Hydronic room fan coils units – Determination of the sound power level” for the 3 declared speeds (Low, Medium and High speed)

V. RATING REQUIREMENTS

All tests shall be carried out with the air filter fitted as supplied by the Manufacturer. Fan Coil Units with variable speed fan(s) have to be tested according to the procedure described in APPENDIX A.

V.1 Thermal test

For cooling test, the following Standard and Application (non-standard) Rating conditions shall be used:

Table 2 - Standard and Application Rating conditions for cooling tests

	Cooling		District cooling	
	Water temperature [inlet temperature / outlet temperature]	Air temperature [inlet dry bulb (inlet wet bulb)]	Water temperature [inlet temperature / outlet temperature]	Air temperature [inlet dry bulb (inlet wet bulb)]
Standard rating condition	<u>7°C / 12°C</u>	<u>27°C (19°C)</u>	5.5°C / 14.5°C	24°C (18°C)
Application rating condition 1	<u>10°C / 15°C</u>	<u>27°C (19°C)</u>	9°C / 18°C	26°C (18.6°C)
Application rating condition 2	7°C / 12°C	25°C (17.9°C)		
Application rating condition 3	14°C / 18°C	26°C (18°C)		

Note: underlined conditions are in accordance with EN 1397:2015

For heating test, the following Standard and Application (non-standard) Rating conditions shall be used:

Table 3 - Standard and Application Rating conditions for heating tests

	Heating (4 pipes)		Heating (2 pipes)	
	Water temperature [inlet temperature / outlet temperature]	Air temperature [inlet dry bulb (inlet wet bulb)]	Water temperature [inlet temperature / outlet temperature]	Air temperature [inlet dry bulb (inlet wet bulb)]
Standard rating condition	<u>65°C / 55°C</u>	<u>20°C (15°C max)</u>	<u>45°C / 40°C</u>	<u>20°C (15°C max)</u>
Application rating condition 1	<u>70°C / 60°C</u>	<u>20°C (15°C max)</u>	50°C / *	20°C (15°C max)

* = Same water flow as in cooling for standard rating (consequently the outlet water temperature can vary among units)

Note: underlined conditions are in accordance with EN 1397:2015

V.2 Sound power test

Sound power test shall be carried out at ambient conditions without water flow. When supply of cabinet is optional, the test shall be carried out without cabinet. Uncertainty of 1 dB(A) will be taken into account.

V.3 Air flow rate test

Air flow rate test shall be carried out at ambient conditions without water flow. Measured values shall be transposed to the standard conditions.

VI. CERTIFIED PERFORMANCES

VI.1 Thermal performances

a. In Standard Rating conditions

The following performance characteristics at Low, Medium or High speed declared by the Manufacturer, and chosen by Eurovent Certita Certification (one tested speed), shall be verified by tests:

- Total cooling capacity
- Sensible cooling capacity
- Heating capacity
- Water pressure drops in cooling and heating
- Fan power input in cooling and heating

b. In Application Rating conditions

Eurovent Certita Certification shall choose one application rating condition to test among the following: cooling application rating 1, 2 or 3 or heating application rating 1.

The following performance characteristics at Low, Medium or High speed declared by the Manufacturer, and chosen by Eurovent Certita Certification (the same tested speed as for standard rating conditions (VI.1.a)), shall be verified by tests:

If cooling application rating 1, 2 or 3 is chosen:

- Total cooling capacity
- Sensible cooling capacity
- Water pressure drops in cooling
- Fan power input in cooling

If heating application rating 1 is chosen:

- Heating capacity
- Water pressure drops in heating
- Fan power input in heating

VI.2 Acoustic and aeraulic performances

The following performance characteristics at Low, Medium and High speeds (three tested speeds) shall be verified by tests:

- A-weighted sound power level
- Air flow rate (option only)

The declaration of air flow rate is optional but, if applied, the air flow rate shall be verified at the fan speeds used for the testing of A-weighted sound power level.

VII. TOLERANCES

When tested by the Eurovent Certita Certification -selected Laboratory, the characteristics obtained shall not differ from the claimed values by more than the tolerance (see Table 4).

Mean Failure: When tested, if the performances obtained differ from the values claimed by the Manufacturer by more than the mean deviation threshold, the failure shall be included in the MVF calculation. See APPENDIX D in the Operational Manual OM-1A.

High Failure: When tested, if the performances obtained differ from the values claimed by the Manufacturer by more than the high deviation threshold, the high failure treatment shall be applied (see part IV.4.d in the Operational Manual OM-1A).

Table 4 - Table of tolerances, mean and high deviation thresholds

		Characteristic	Tolerance (Acceptance criterium)	Mean Deviation threshold	High Deviation threshold		
Thermal performances	Standard Rating condition	Sensible capacity	Fixed speed	-8%	-13%		
			Variable speed	-10%	-15%		
		Total cooling capacity	Fixed speed	-7%	-12%	-17%	
			Variable speed	-9%	-14%	-19%	
		Heating capacity	Fixed speed	-7%	-12%	-17%	
			Variable speed	-9%	-14%	-19%	
		Fan power input in cooling		max (+10% ; 1W)			
		Fan power input in heating		max (+10% ; 1W)			
		Water pressure drop in cooling		+ 15%			
	Water pressure drop in heating		+ 15%				
	Application Rating condition	Sensible capacity	Fixed speed	-8%	-18%		
			Variable speed	-10%	-20%		
		Total cooling capacity	Fixed speed	-7%	-17%		
			Variable speed	-9%	-19%		
		Heating capacity	Fixed speed	-7%	-17%		
			Variable speed	-9%	-19%		
		Fan power input in cooling		max (+10% ; 1W)			
		Fan power input in heating		max (+10% ; 1W)			
Water pressure drop in cooling		+ 15%					
Water pressure drop in heating		+ 15%					
Acoustic performance	A-weighted sound power level		+ 2 dB(A)	+ 3 dB(A)	+ 4 dB(A)		
Aeraulic performance	Air flow rate		-10%				

APPENDIX A. TESTING PROCEDURE FOR VARIABLE SPEED UNITS

A.I. PURPOSE

The purpose of this appendix is to establish definitions and specifications to be used in connection with the Certification Programme for non-ducted Fan Coil Units in order to test these units equipped with variable speed fans.

A.II. SCOPE

The scope is the same as for the standard current testing procedure. It adds a new section within these procedures to specifically test variable speed fans units.

A.III. DEFINITIONS

A variable speed fan is different from a multi-speed fan by the fact that it is capable to continuously change its speed whereas the multi-speed fan has discrete (and limited) outputs to change its own speeds.

The direct measurable outputs are:

- **Fan Power Input:** Electric power absorbed by the fan(s) of the unit.
- **Available Static Pressure:** The available air static pressure at the discharge of the air way cross section of the unit.
- **Sound Power Level:** Total sound power radiated by the Fan Coil Unit
- **A-weighted Sound Power Level:** A single figure on a specific scale which can be related to the subjective assessment of the loudness of a noise.
- **Air Flow Rate:** Volume air flow through the discharge air way cross section of the unit at the air flow testing conditions.
- **RPM:** motor rotational speed for dry coils
- **Low, Medium and High speed:** Speeds published as available on the unit with the corresponding motor control device.

A.IV. TESTING REQUIREMENTS

Standard and Application Ratings shall be established at the conditions specified in Section V. Standard and Application Ratings shall be verified by tests conducted by the Eurovent Certita Certification -selected laboratory in accordance with the following specifications:

- The Manufacturer shall select three speeds among the variable fan speed functioning range so called Low speed, Medium speed and High speed.
- The Manufacturer will declare the unit performances for these three speeds as it does with multi-speed fans.
- The Manufacturer shall provide to the incumbent laboratory the instructions manual to enable the people in charge of the tests to implement the right settings corresponding to the declared speeds. The laboratory shall preferably use its own

controls. The control voltage used during the measurements shall be reported in the test report for thermal, airflow and acoustic tests. The allowed tolerance on the control voltage is 0.5%. When a unit has a controller, the laboratory shall include the controller consumption in the measurements of fan power inputs.

- The fan power measurement shall be done at the electrical terminals of the fan(s) motor, not at the control device ones.
- The thermal, air flow rate and sound power tests shall be performed with the usual test procedures.
- The laboratory shall always begin a complete test with a test in dry battery (sound power test or air flow rate test).
- To take into account the different types of technologies, for each complete test, the Manufacturer will have the choice between 2 preparatory procedures during the first test in dry battery (sound power test or air flow rate test):
 - Option 1: The laboratory sets the declared control voltages for each speed with its own control or sets the speeds using the unit controller (see below Figure 1).
 - Option 2: (only for units without controller) Control voltages for each speed are adjusted to match with the declared fan rotation speed (see below Figure 2).
- For partial second test on the same unit the laboratory shall set the same control voltages as for the first complete test.
- Only one Component Failure due to deviation on fan rotation speed and/or control voltage is allowed per model.

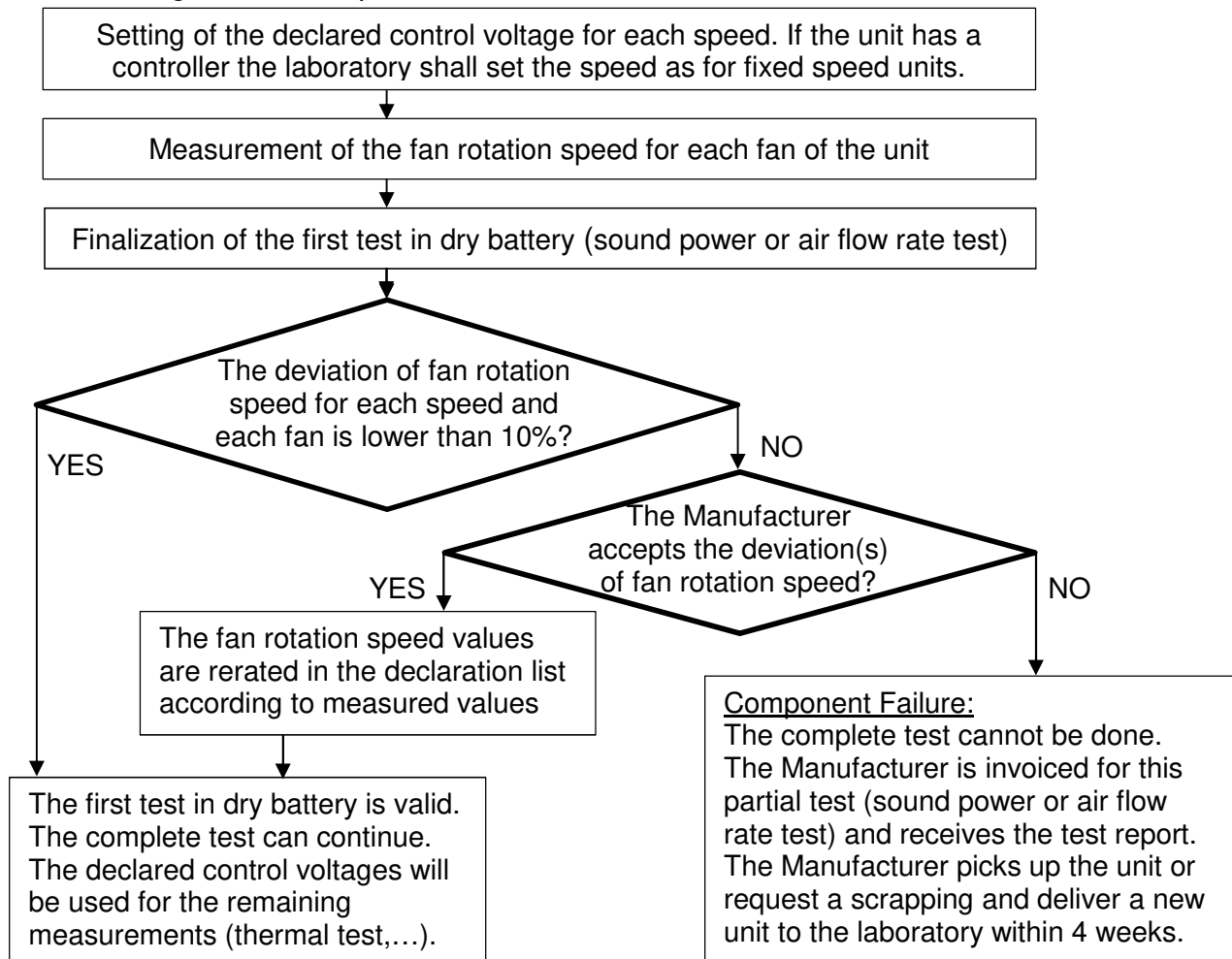


Figure 1: Preparatory procedure – Option 1 (Voltage setting)

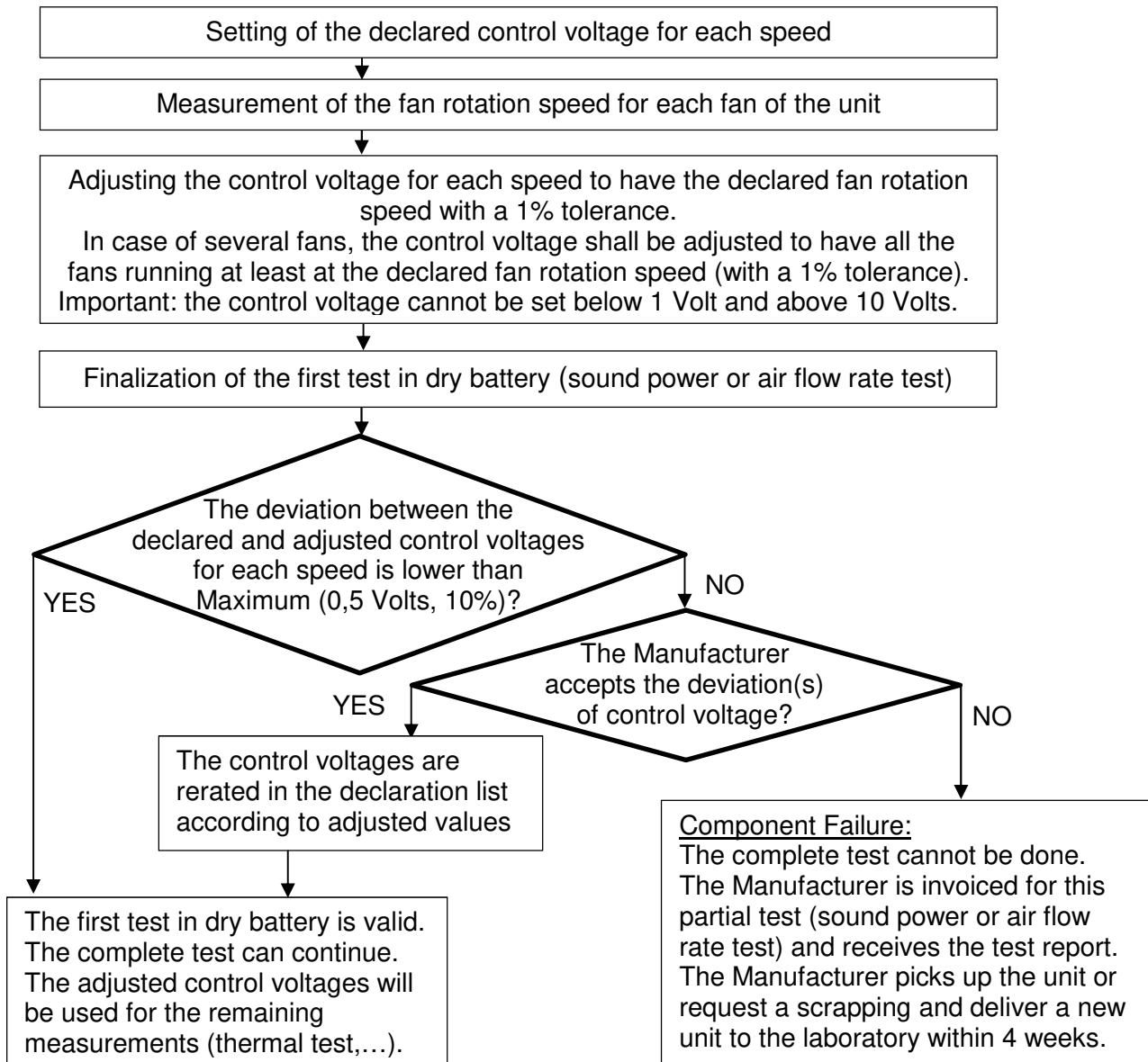


Figure 2: Preparatory procedure – Option 2 (Voltage adjustment)

A.V. RATING REQUIREMENTS

See usual rating requirements defined in the proper procedures.

In addition, the airflow information will have to be published for ducted Fan Coils programme. For non-ducted Fan Coils the airflow information is kept optional.

A.VI. CERTIFIED PERFORMANCES

The same performances as for multi-speed units shall be verified by test.

A.VII.TOLERANCES

The same tolerances as for the multi-speed units shall be applied (see section VII).