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COMMUNICATION FROM THE COMMISSION

in the framework of the implementation of Commission Regulation (EU) No 1253/2014 of 7 July 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units, and of the implementation of Commission Delegated Regulation (EU) No 1254/2014 of 11 July 2014 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of residential ventilation units
(*Publication of transitional methods*)

VERSION OF 21/12/2015
(2016/C …/…)

(Text with EEA relevance)

1. Publication of titles and references of transitional methods of measurement and calculation[1] for the implementation of Commission Regulation (EU) No 1253/2014 of 7 July 2014 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for ventilation units, and of the implementation of Commission Delegated Regulation (EU) No 1254/2014 of 11 July 2014 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of residential ventilation units

2. Parameters *in italics* are determined in Regulation (EU) No 1253/2014 and in Regulation (EU) No 1254/2014

3. References

3.1. Types of units

Under the regulation, there are different types of units to be tested according to harmonised standards or transitional methods - both regarding RVU and NRVU:

Type		**Recirculation**	**HRS**
Unidirectional	Ducted	Not relevant	No exchanger
	Non ducted	Not relevant	No exchanger
Bidirectional	Ducted	With recirculation* (option)	Plate heat exchanger
			Rotary heat exchanger
			Run around coils
			Heat pipes
			Alternating (regenerator) Regenerative heat exchanger with shifting direction of airflow
		Without recirculation*	Same as above
	Non ducted	With recirculation* (option)	Same as above
		Without recirculation*	Same as above

*: recirculation means that the circulating airflow on the inside (casing side) is greater than the fresh air supply.

[1] It is intended that these transitional methods will ultimately be replaced by harmonised standard(s). When available, reference(s) to the harmonised standard(s) will be published in the Official Journal of the European Union in accordance with Articles 9 and 10 of Directive 2009/125/EC.

For most parameters, measurements can be conducted according to existing standards. However, in some cases, there is a need for a revision of the standards as they could be improved regarding the measured values, nomenclature, test setups and methods. To ensure that new terms, such as $SFP_{int,}$ are correctly applied, CEN/TC 156 is working on revision of a number of standards as well as a number of sub-standards. All measurements for RVU and NRVU (including references to other standards) will be addressed in standards:

RVU: EN 13141-series (sub-number depending on type of unit)
EN 13142 (scoping standard)
NRVU: EN 13053 (primarily for BVUs (bidirectional ventilation units) but UVUs (unidirectional ventilation units) can be measured similarly)

The key topics will be described in the relevant sections on the relevant standards and will be accompanied by illustrative drawings.

Non-ducted BVUs
If non-ducted BVUs are intended to be installed with wall penetrations (i.e. ducts), all performance tests must be performed with these wall penetrations and corresponding exhaust and supply air terminal devices. Alternatively with ducts of equal diameter to the unit on the external-side (EHA and ODA) of 0.5 m length and corresponding exhaust and supply air terminal devices (optional standard façade grill declared by the manufacturer). The test is performed as usual in category A, where the wall penetrations and terminal devices are considered as an in integrated part of the unit.

Declaration of Non-residential BVUs
The declared nominal conditions refers to the airflow passing through the heat recovery system (normally winter design conditions).

As the calculation of SFP_{int} for unbalanced airflows (different pressure drops etc.) requires values for both sides of the BVU, it is suggested, that manufacturers declare values for both sides (SUP-side) and (EHA-side), if unequal flows is the case.

3.2. Residential ventilation units (RVUs)

Measured/calculated parameter	Organisation	Reference/Title	Notes
SEC - Specific Energy Consumption for ventilation per m^2 heated floor area of a dwelling or building [kWh/(m^2.a)]	European Commission	Commission Regulation (EU) No 1253/2014 Annex VIII	No standards describe SEC, but the equation is given in Regulation 1253/2014, Annex VIII, and in Regulation 1254/2014, Annex VIII.
The specific power input (SPI)	CEN	EN 13142 and the EN 13141-series acc. to product type	Calculation of SPI is described in EN 13142: 2013 for BVUs and the test method for measured values is described in the 13141-series regarding type of unit. For UVUs the same definition and method can be used

Measured/calculated parameter	Organisation	Reference/Title	Notes
			However, it must be measured and calculated according to the reference flow and pressure described in the regulation. For BVUs measured at at least 70% of max flow and 50 Pa on the inlet side (maximum flow at 100 Pa). For non-ducted units at minimum pressure at reference flow. On page 13 in Annex 1, section (13), SPI is expressed in $W/m^3/h$, and on page 24 in Annex 8, SPI is expressed in $kW/m^3/h$. At information level, SPI must be set out in $W/m^3/h$. For the calculation of SEC, SPI must be in $kW/m^3/h$.
Effective (total) power input	CEN	EN 13141-series acc. to product type supplemented by ISO 5801	EN 13141-7 and 13141-6 refer to 13141-4 (6.1) which refers to ISO 5801 (Chapter 10, Power input). The definition in the standards is 'power input' or 'total power input' and not 'effective power input' as in the regulation. EN 13141-8 has no description of method or reference and lacks requirements for measurement uncertainty. BVU: To be measured summarized for both fans and control equipment. The electric power consumption for auxiliaries is to be included e.g. BVUs with rotating HRS also include rotor motor.
External total pressure difference	CEN	EN 13141-series acc. to product type supplemented by ISO 5801	For ducted units to be measured in connected ducts in order that the consumers receive consistent pressure and flow values. External total pressure difference is, according to Regulation 1253/2014, the **static pressure** difference **for ducted RVUs** and **the total pressure** difference **for non-ducted** RVUs between inlet and outlet, for BVU both airflows (if not equal ref. to supply). To which connection the pressure is delivered is not described in the regulation. The distribution is optional but it is suggested that for ducted RVU to be distributed with 1/3 of the external total pressure difference on the outside (EHA and ODA) and 2/3 of the external total pressure difference (ETA and SUP) at the building side according to the EN 13141-series. For further description, see Chapters 4 and 5 in this document **BVU** The test is described in EN 13141-7 (6.2.2), which describes that the test must be conducted in all 4 ducts. EN 13141-7 refers to EN 13141-4 (5.2.2) in which the installation of the ducts is defined. **UVU (exhaust)**

Measured/calculated parameter	Organisation	Reference/Title	Notes
			Not described in EN 13141-6. Use ISO 5801 or EN 13141-4. **BVU (single room non-ducted)** Overall description in EN 13141-8, Section 5.2.3 (and Annex A), which refers to EN 13141-4 and ISO 5801. **UVU (supply systems)** The test is described in EN 13141-11 (6), which refers to EN 13141-4 and ISO 5801 How the pressure is measured in the duct (measurement ducts)/chamber and the permissible deviation is not described in all standards. This must be designed and tested according to ISO 5801.
Reference flow rate	CEN	EN 13141-series acc. to product type supplemented by ISO 5801	The standards do not describe the reference or maximum flow and pressure. Nor do they describe how to achieve these according to the regulation. They only describe how to measure the flow according to the design of the individual units (except 13141-8 regarding flow and 13141-11 regarding pressure). Se description in Chapter 4 of this document on how to declare reference flow rate for ducted units A method is also specified for the case, where a unit is not capable of achieving a pressure at 100 Pa but is capable of achieving 50 Pa. The reference flow rate cannot be higher than the maximum flow rate. **BVU** The test setup is described in EN 13141-7 (6.2.2). EN 13141-7 refers to EN 13141-4 (5.2.2) in which the installation of the ducts is defined. For BVUs; if the test is conducted with a numerical unbalanced airflow SUP-SIDE in relation to the EHA-SIDE it should be noticed in the test report. For BVUs units, the flow rate applies to the air supply outlet. **UVU (exhaust)** Overall, the test setup is described in EN 13141-4 / 6. EN 13141-6 refers to airflow measurements according to ISO 5221 (from 1984 WITHDRAWN)! Use ISO 5801 instead. **UVU and BVU (single room non-ducted)** Overall description in EN 13141-8 (3.1.9). Method in accordance with EN 13141-4 Section 5.2.3 and ISO 5801. **UVU (supply systems)** The test is described in EN 13141-11 (3.6). Method description (6) refers to EN 13141-4 and ISO 5801.

Measured/calculated parameter	Organisation	Reference/Title	Notes
Flow rate/pressure diagram	CEN	EN 13141-4 EN 13141-7 supplemented by ISO 5801	EN 13141-7 refers to BVUs but the method can also be applied to other products. ISO 5801 refers to fans, but the method can also be applied to other products.
Maximum flow rate	CEN	EN 13141-series acc. to product type supplemented by ISO 5801	For all products, see reference flow
Thermal Efficiency, η_t	CEN	EN 13141-7 and ISO 5801 EN 13141-8 and ISO 5801	Thermal efficiency can normally be measured according to EN 308 or EN 13141-7, EN 13141-8 and ISO 16494 for equal mass flows in-out and without condensation. **But the regulation states that the temperature difference between in and out shall be 13 K, which is why only the EN 13414-7 and EN 13141-8 can be used.** Must be measured with contribution from fan. For BVU use EN 13414-7. For BVUs for single room installation use EN 13141-8. Flow measured according to ISO 5801. All other values are according to EN 13141-7 or EN 13141-8 depending on unit design. Temperature measuring points must be performed outside the unit, as contribution from fan must be included (in the ducts for ducted units). The ducts/connection box between the unit and measuring plane must be insulated with an insulation material with a thermal resistance of at least $1 m^2 K W^{-1}$ (approx. 50 mm insulation material). **EN 13141-7** sets only requirements on the leakage (no requirements for the heat balance), and can be used to this extent. However, it is suggested to follow the requirements in EN 308 (leakage 3% and heat balance 5%). In case, the unit is with unequal mass flow, it is suggested, that data is delivered as part of the product information. **EN 13141-8** For units with alternating HRS there is an overall test model description in EN 13141-8 in section 5.4.7. Please note that it normally requires fast measuring equipment. It is recommended that necessary measures must be taken to ensure that outdoor and indoor mixing is reduced under test. **Notes regarding not applicable standards:** **EN 308** is normally used to asses the performance of the HRS alone where contribution for fans is

Measured/calculated parameter	Organisation	Reference/Title	Notes
			deducted and the test is performed with a temperature difference of 20K, why it cannot be used for RVUs. **ISO 16494** describes a test procedure for an AHU with HRS. Specific demands regarding the static pressure in the inlets and outlets and fan settings. Test setup equal to EN 14141-7 and EN 308. Refers to ISO 5801, ISO 3966 and ISO 5167-1 regarding airflow measurement method. ISO 16494 allows a large ambient temperature tolerance which influence the test results and it is not consistent with EN 13141 or EN 308.
Electric power input and effective power input	CEN	EN 13141-4 and EN 13141-7 supplemented by ISO 5801	EN 13141-7 (section 6.5) refers to 13141-4 (6.1) which refers to ISO 5801 (section 10). Definition in the standards is mostly 'power input' or 'total power input' and not 'electric power input' or effective power input as in the regulation. BVU: To be measured summarised for both fans and control equipment
Sound Power Level (L_{WA})	CEN	EN-ISO 9614-2 or EN ISO 3744 or EN ISO 3746 or ISO 3743-1 or ISO 3741 or ISO 13347 or ISO 9614-1 or ISO 3745 or ISO 3743-2 or	Can be measured according to ISO 9614-2 (sound intensity scanning) or EN ISO 3744 or EN ISO 3746 (sound pressure in free field). To reduce test costs, it is often preferred to use the sound intensity scanning method. Alternatively ISO 3743-1 or ISO 3741 sound power in reverberation room. Because of different methodologies used in the different standards, the reproducibility of results between one methodology and another one cannot be always guaranteed. Therefore, it is recommended to compare results obtained with the same methodology.
Reference pressure difference in Pa;	CEN	13141-series acc. to product type supplemented by ISO 5801	For measuring method and notes, see 'External total pressure difference'.
Maximum internal and external leakage rates and carry over	CEN	EN 308 EN 13141-7 EN 1886 ISO 16494	**Leakage** Both internal and external leakage can be tested according to EN 308 and EN 13141-7 (EN 13141-series only valid for RVUs)). EN 308 focuses originally only the HRS component, but can and is usually also applied to the test of the complete unit. In EN 308, it is only measured in one point (same as the regulation). In EN 13141-7 it is measured in three

Measured/calculated parameter	Organisation	Reference/Title	Notes
			points. EN 1886 can only be used for external leakage. The flow used to calculate the leakage and carryover (in the standard described as the nominal air mass flow rate indicated by the manufacturer) is the reference flow for RVUs and the nominal flow for NRVUs as defined in the regulation. **Carryover** Carryover can be tested according to EN 308. It should be indicated in which direction the leakage is. Leaks from dirty to clean air should be avoided (from EHA-side to SUP-side). At low flows, the purge zone needs more time for cleaning and the rotor rpm must be reduced. This has a significant impact on the leakage and must be taken into consideration. **Further description regarding leakage:** A further enlightening of the leakage test is set out in Annex V (NRVU) of Regulation 1253/2014, where it is described that the test and calculation can be carried out according to either **a pressurisation test** (**acc. to the pressure set out in the definitions**) **or** with **tracer gas test method** at **declared system pressure** although this is not clarified under (in line with) the definitions. Since the regulation does not distinguish between different types of exchangers it is suggested that the leakage rate is measured with an appropriate and quick method chosen by the test manager. The declared value is the specified leakage rate and the standard used. The test can either be carried out as a "static pressure test" according to the pressure defined in the definitions, where the pressure is considered as a positive/negative applied pressure to the one side of the BVU (or inside/outside regarding external leakage) or as a "dynamic test" (e.g. Extract Air Transfer Ratio - EATR) where the test pressure is the actual pressure difference inside the unit as a result of the reference/nominal configuration (external pressure). The tracer gas method is mentioned in EN308 regarding leakage test but how to carry out the test is not described. The tracer gas method is described in ISO 16494 and EN 13141-7 and prEN 16798-3.

Measured/calculated parameter	Organisation	Reference/Title	Notes
Mixing rate	CEN	EN 13141-8	EN 13141-8, (5.2.2.1) describes the test and calculation of the internal leakage and indoor and outdoor mixing. It is recommended that the measurement is carried out isothermally to reduce testing time, and the effect is not significant. Values for both indoor and outdoor mixing is to be declared. Mixing rate for alternating unit with combined discharge and intake ports are not possible to determine without contamination of the test room and consequently the mixing rate for these types of units is not to be declared before a revision of standards has developed a valid method.
The airflow sensitivity to pressure variations	CEN	EN 13141-8 Annex A and section 5.2.3	EN 13141-8 can be used.
The indoor/outdoor air tightness	CEN	EN 13141-08	EN 13141-08 describes the measurement and can be used.

3.3 Non-residential ventilation units (NRVUs)

Measured/calculated parameter	Organisation	Reference/Title	Notes
Thermal efficiency of heat recovery η_{t_nrvu}	CEN	EN 13053 EN 308	**EN 13053** (section 6.5 and Annex A) refers to EN308 regarding test setup and procedure. The only exception is the placing of the temperature sensors in the unit. Annex A3 of EN 13053 describes how the temperature sensors must be placed inside the unit and between the fan and HRS. EN 308 focuses originally only the HRS, but can and is normally also applied to test of the complete unit. **EN 13779** (section 6.6) refers to EN 13053 regarding description and classification of HRS. Refers to EN308 regarding test setup and procedure. **ISO 16494** describes a test procedure for an AHU with HRS. Specific demands regarding the static pressure in the inlets and outlets and fan settings. Test setup equal to EN 13141-7 and EN308. Refers to ISO 5801, ISO 3966 and ISO 5167-1 regarding airflow measurement method.

Measured/calculated parameter	Organisation	Reference/Title	Notes
			The regulation states that the temperature difference between in and out should be 20 K. This is why only EN 308 / EN 13053 can be used. Measured with no contribution from fan preferably inside the unit. If possible, the placing of the temperature sensors must be in accordance with EN 13053. If it is not possible to place the sensors inside the unit and between the fan and HRS, two test procedures are possible. 1. The fans are in operation and the heat contribution from the fan/motor must be taken into account in the calculation of ratios. 2. The fans are not in operation. The flow used for measurement and testing is the nominal NRVU flow rate which passes the heat exchangers (winter conditions without recycling or bypass) Temperature measurement points must be radiation-protected. The requirement in EN 308 under section 6.4 '.... The maximum allowed deviation in a measuring plane is equal to 0.05 (t22-t21)'. This cannot be fulfilled when measured inside a unit and should not be followed.
Nominal NRVU flow rate in m^3/s q_{nom} (New symbol)	CEN	Preferred std.: EN 13053 ISO 5801 Alternative std.: EN 13141-4,5,6,7,8,11 regarding type of unit and	Can be measured according to EN 13053 and ISO 5801**.** EN 13053 refers to ISO 5801, ISO 5167-1 or ISO 3966 (regarding fluids). Can also be measured according to EN 13141-4,5,6,7,8,11 regarding type of unit and ISO 5801. EN 13141 refers primarily to residential ventilation but is more detailed and can be used for areas where EN 13053 procedures are not specified yet. Nominal NRVU flow rate does not have a symbol in the regulation. Use $q_{nom.}$ The value for q_{nom} used to calculate the η_{fan} for BVUs is with regard to the airflow side (SUP-side and EHA-side) and not the sum of both supply and extract airflow divided by two. The declared information value for q_{nom} is the sum of both supply and extract airflow divided by two. **Notes:** The 'nominal flow rate' for NRVUs is the 'declared design flow rate', at the conditions laid down in definition 6 of Annex I, Part 2. Therefore, freedom is left to the manufacturer on how to determine more in detail such conditions, depending on the specific design choices (e.g, including or not a pressure reserve for clogging).

Measured/calculated parameter	Organisation	Reference/Title	Notes
			As an indirect conclusion stemming from definition 8 of Annex I, Part 2, it is deemed necessary that the 'nominal flow rate' is the one at which the maximum rated fan speed occurs.
Nominal external pressure $\Delta p_{s,\,ext}$ in Pa	CEN	Preferred std.: EN 13053 ISO 5801 Alternative std.: EN 13141-4,5,6,7,8,11 regarding type of unit and	Can be measured according to EN 13053 and ISO 5801. EN 13053 refers to ISO 5801 (5.2.3.1.1). Can also be measured according to EN 13141-4,5,6,7,8,11 regarding type of unit and ISO 5801. EN 13141 refers primarily to residential ventilation but is more detailed and can be used for areas where EN 13053 procedures are not specific yet. Overall, for BVU the test is described in EN 13141-7 (6.2.2) (and the other standards in the 13141-series regarding type of unit). The test must be conducted in all four ducts. EN 13141-7 refers to EN 13141-4 (5.2.2), which defines the installation of the ducts. The external pressure must be set to design pressure condition. It is recommended that the internal pressure is taken in to consideration and there in the supply air section just after the HRS is a higher pressure than the pressure in the extract air section just before the HRS to avoid leakages. For ducted units the pressure must be measured in connected ducts so that the consumers receive consistent values of pressure and flow. The nominal external pressure is the static pressure difference between inlet and outlet. In case of BVUs for both airflows. The pressure measured in the duct (measurement ducts) and the permissible deviation must be designed and tested according ISO 5801, as long as applicable. It is recommended that the pressure distribution applied to the each side of the unit is described by the manufacturer, as the performance of the unit can change according to the pressure distribution. For further descriptions, see Chapters 4 and 5 in this document
Nominal electric power input (P) (W) and the effective electric power input	CEN	EN 13053 ISO 5801	The electric power consumption can be measured according to several harmonised standards (motors) and ISO 5801 and EN 13053 depending on the measurement uncertainty. EN 13053 describes that the electric power, voltage and current must be measured, but it does not refer to any standards or describes any methods (Table 2). There is a general test method reference to ISO 5801 (5.2.2). Can also be measured according to EN 13141-4,5,6,7,8,11 regarding type of unit and ISO 5801.The EN 13141-series refers primarily to residential

Measured/calculated parameter	Organisation	Reference/Title	Notes
			ventilation but is more detailed regarding some product types and can be used for areas where EN 13053 procedures are not specified yet. In this case use method from EN 13141-series and the measuring principle from EN 13053/ ISO 5801. In general, use measuring principle from ISO 5801. The nominal electric power input (P) must be expressed in kW and SFP_{int} in $W/m^3/s$.
SFP_{int} in $W/(m^3/s)$	European Commission	Commission Regulation (EU) No 1253/2014 Annex VIII	See description in Chapter 5 of this document. The declared value for the SFP_{int} of unidirectional NRVUs not intended to be used with a filter must be 'not applicable'.
'static pressure (p_{sf})' 'total pressure (p_f)' 'stagnation pressure'	CEN	ISO 5801/No relevant standard is adequate	ISO 5801 can be used for external measurements. For internal measurements, no relevant standard is adequate. Se description in Chapter 5 of this document for measuring and calculation.
Face velocity in m/s at design flow rate	CEN	EN 13053 and ISO 5801	Face velocity is described in EN 13053. However, the measuring method and metrics according to area measurement are not described. The flow can be measured according to ISO 5801. Use EN 13053 and ISO 5801 for measuring of flow and velocity. Meter the area for calculating of the velocity with an uncertainty within +/-3%. The area is the the free unit area at the filter section or fan section. The declared value is the highest of SUP/EHA.
Internal pressure drop of ventilation components; ($\Delta p_{s,int}$) in Pa and Internal pressure drop of additional non-ventilation components ($\Delta p_{s,add}$)	European Commission	Commission Regulation (EU) No 1253/2014 Annex VIII	No relevant harmonised standard exists. • EN 13053 (6.1) refers to EN 13779 • EN 13779 (A.10.5) refers to EN 13053 • EN 1216 (7.2.3) Air pressure drop coils is measured with pitot tube traverse See description in Chapters 5 of this document for measuring and calculation. The NRVU inlet and outlet losses must be included in the 'the internal pressure drop of ventilation components ($\Delta p_{s,int}$). If a ducted air-handling unit has full size openings (the internal cross section of the duct systems is equal to the cross section of the NRVU), it has no additional pressure losses at the inlet and outlet openings.

Measured/calculated parameter	Organisation	Reference/Title	Notes
Fan efficiency (η_{fan})	CEN	External - ISO 5801 (for UVU without filter/additional components) Internal - No relevant standard is adequate	For UVU without filter use ISO 5801 and the external fan efficiency, measured at nominal flow rate and nominal external pressure. Please note that the operational point is not by definition the best efficiency point of the fan but the nominal conditions of the ventilation unit as stated in Annex 1, 2 (2). The fan efficiency is the external static fan efficiency. For all other products no relevant harmonised standard exists, because the efficiency must be measured within the ventilation unit for the use of SFP_{int} calculating, even though the following standards describe measuring of fan efficiency: • EN ISO 13348:2007 • ISO 12759:2010 • EN ISO 5801 • Com.reg. 327/2011 The primary issue is how to measure the pressure rise over the fan. The electric power consumption can be measured according to the relevant harmonised standards. *The fan efficiency* η_{fan} is the 'overall static efficiency drive' at nominal airflow and nominal external pressure drop to be measured at the fan section, in %, according to ISO 12759, but when the fan is placed in the intended casing, i.e. considering system effects. It is the **static efficiency** including motor and drive efficiency of the individual fan(s) in the ventilation unit (reference configuration) determined at nominal airflow and nominal **external pressure drop** (and internal and additional pressure drop). It is the ratio between the nominal airflow multiplied by the static pressure rise of the fan (equal to the sum of pressure drops of all ventilations components, clean and dry, and the nominal external pressure) divided by the electrical power of the fan drive. The placement of a fan in a casing will affect the fan pressure rise and the power consumption compared to an idealised performance outside of the unit. The fan efficiency must be measured/calculated in the BVU and with the external (and internal and additional) pressure loss at nominal airflow (defined by the manufacturer) according to the definition of SFP even though the calculation of SFP_{int} only uses the internal pressure drop. For BVU calculated and summarised for both airstreams respectively, the supply air stream (SUP) and the extract air stream (ETA) for determination of SFP_{int}. For UVU calculated for one airstream. For further description see Chapters 5 of this document.

Measured/calculated parameter	Organisation	Reference/Title	Notes
Declared maximum external leakage rate (%) of the casing of ventilation units; and declared maximum internal leakage rate (%) of bidirectional ventilation units or carry over	CEN	EN 308 (BVU): EN 1886 and EN 308 (UVU) ISO 16494	See description under RVU regarding Maximum internal and external leakage rates and carry over. The flow used to calculate the leakage and carryover (in the standard described as the nominal air mass flow rate indicated by the manufacturer) is the reference flow for RVUs and the nominal for NRVUs as defined in the regulation.
The casing sound power level (L_{WA}) *(in the case of NRVUs specified for use indoors,)*	CEN	EN-ISO 9614-2 or EN ISO 3744 or EN ISO 3746 or ISO 3743-1 or ISO 3741 or ISO 13347 or ISO 9614-1 or ISO 3745 or ISO 3743-2 or	Can be measured according to ISO 9614-2 (sound intensity-scanning) or EN ISO 3744 or EN ISO 3746 (sound pressure in free field). To reduce test costs it is often preferred to use the sound intensity-scanning method. Alternatively ISO 3743-1 or ISO 3741 sound power in reverberation room. The casing sound power level is in the definitions defined acc. to the reference airflow. For NRVUs this is to be considered as the nominal airflow Because of different methodologies used in the different standards, the reproducibility of results between one methodology and another one cannot be always guaranteed. Therefore, it is recommended to compare results obtained with the same methodology.
Filter performance	CEN	EN 779:2012 EN 1822:2009	Use description in the Regulation Annex IX according to the relevant standards.

4. Additional elements for measurements and calculations

4.1. Determination of the reference and maximum flow for ducted RVUs

Standard example that describes the flow/pressure diagram and the method to determine the reference and maximum point/curve.

A ducted RVU must always be able to deliver 50 Pa, as this defines the reference flow rate and the reference point for calculation of the SEC. (situation 1 below).

In case, the ducted RVU cannot deliver 100 Pa (situation 2 below) according to Article 2, Definitions (4), the maximum flow rate can be determined at the maximum external static pressure difference that the ducted RVU can deliver (between 50 and 100 Pa).

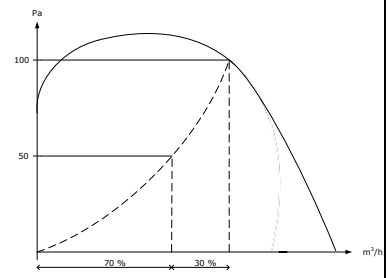
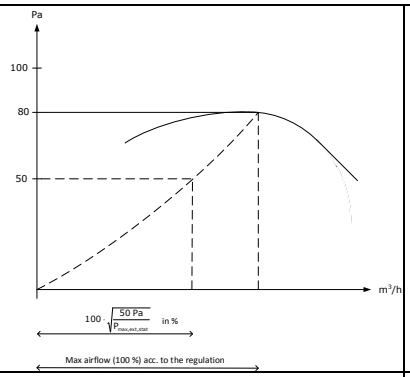
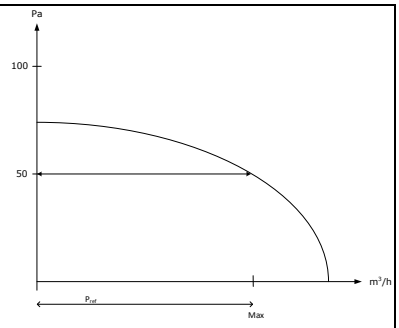
For such ducted RVU the maximum flow can be chosen above or equal to an external static pressure difference of 50 Pa.

The reference flow rate can optionally be determined as the abscissa value to a point on a curve in the flow rate/pressure diagram which is the at or closest to a reference point at $100 \cdot \sqrt{\frac{50\ Pa}{P_{max,ext,stat}}}$ % of the

maximum flow rate, where $P_{max,ext,stat}$ is the maximum external static pressure difference (between 50 and 100 Pa) (situation 2 below).

In case, the ducted RVU cannot deliver a higher pressure at a higher flow rate than the reference flow (situation 3 below), maximum and reference flow rates can be selected by the manufacturer, bearing in mind the reference external static pressure difference is kept.

The reference external static pressure difference is always 50 Pa.

		
1: Normal determination	2: 100 Pa is not possible to achieve	3: Higher pressure at a higher flow rate than the reference flow (and reference pressure) is not possible to achieve

4.2. Determination of reference and maximum flow for other ducted RVUs

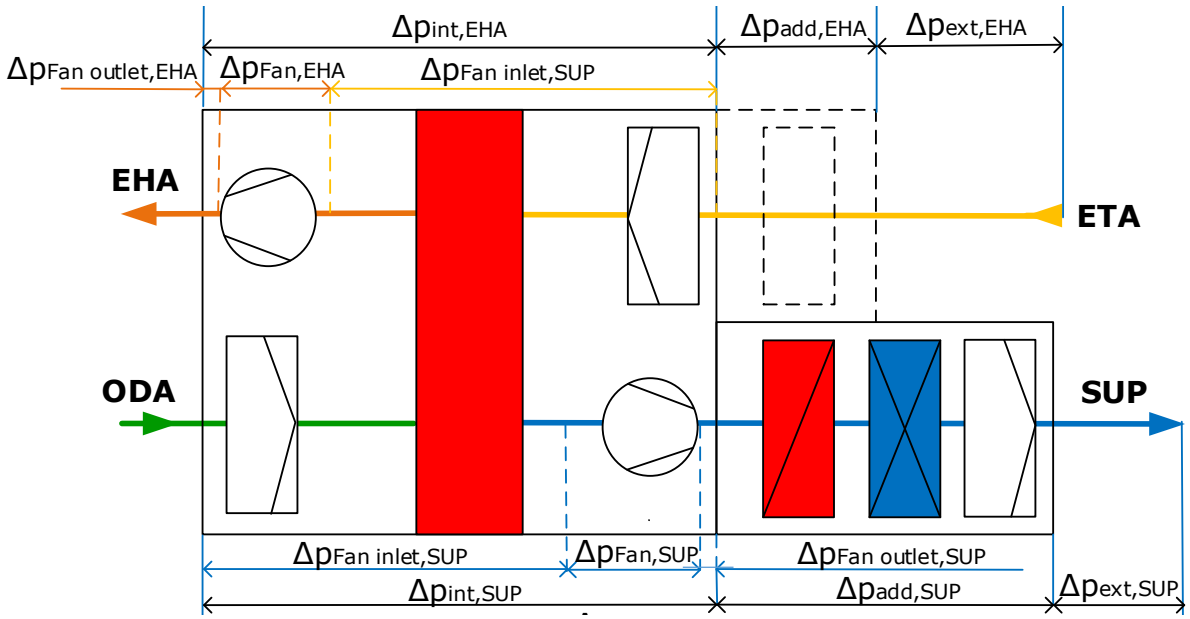
See prEN 13142 Annex A5

5. Calculation and measurement of SFP_{int}, internal pressure and internal fan efficiency.

5.1. Terminology related SFP_{int} values

To achieve consensus between standards and regulations, symbols and subscripts from prEN 16798-3 have been adopted for the cases where no such symbols are described in Regulations 1253/2014 and 1254/2014. Where there is inconsistency between symbols used in the standards and the regulations, the regulations symbols are used.

The figure below is a sketch of a BVU. The components are placed randomly and can be placed in different orders. The figure applies to both BVU and UVU. For UVU, only one of the sides is considered, i.e. either the exhaust airside (EHA) or the supply airside (SUP).



Symbols and subscripts are described in in the following. All values can refer to both total and static pressure rise (only static is used for SFP_{int} calculation).

Symbols

According to prEN 16798-3		***According to regulation***	
$\Delta p_{int\ tot}$	Total internal pressure rise from the ventilation components (fan casing, heat recovery, and filters) in Pa	*None*	*None*
$\Delta p_{add\ tot}$	Total additional pressure rise from the additional components (cooler, heat exchanger, humidifier, silencer, etc.) in Pa		*None*
$\Delta p_{ext\ tot}$	Total external pressure rise from the ductwork and external components in Pa	*None*	*None*
$\Delta p_{int\ stat}$	Static internal pressure rise from the ventilation components (fan casing, heat recovery and filters) in Pa	$\Delta p_{s,int}$	*'internal pressure drop of ventilation components ($\Delta p_{s,int}$)' (expressed in Pa) means the sum of the static pressure drops of a reference configuration of a BVU or an UVU at nominal flow rate.*
$\Delta p_{add\ stat}$	Static additional pressure rise from the additional components (cooler, heat exchanger, humidifier, silencer, etc.) in Pa	$\Delta p_{s,add}$	*'internal pressure drop of additional non-ventilation components ($\Delta p_{s,add}$)' (expressed in Pa) means the remainder of the sum of all internal static pressure drops at nominal flow rate and nominal external pressure after subtraction of the internal pressure drop of ventilation components (Δps,int);*
$\Delta p_{ext\ stat}$	Static external pressure rise from the ductwork and external components in Pa	$\Delta p_{s,\ ext}$	*'nominal external pressure ($\Delta p_{s,\ ext}$)' (expressed in Pa) means the declared design external static pressure difference at nominal flow rate.*
Δpf_{an}	Static pressure difference between the fan outlet and inlet section.	*None*	*None. The following is used* $\Delta p_{s,Fan}$
η_{tot}	$\eta_{fan\ tot}$ x η_{tr} x ηm x ηc based on total pressure	*None*	*None*
η_{stat}	ηfan stat x ηtr x ηm x ηc based on static pressure	*None*	*None*

According to prEN 16798-3		***According to regulation***	
$P_{sfp,int}$	Internal SFP value of the bidirectional air-handling unit.	*SFP_{int} [W/(m^3/s)]*	*'internal specific fan power of ventilation components (SFP_{int})' (expressed in W/(m^3/s)) is the ratio between the internal pressure drop of ventilation components and the fan efficiency, determined for the reference configuration;*
η_{fan}	The overall efficiency ηfan is based on the efficiencies of the single components (impeller, motor, belt drive, speed control, etc.)	*η_{fan} ($\eta_{s,Fan}$)*	*'fan efficiency (η_{fan})' means the static efficiency including motor and drive efficiency of the individual fan(s) in the ventilation unit (reference configuration) determined at nominal airflow and nominal external pressure drop;* *In the following written as $\eta_{s,Fan}$*
P	Fan power	*P [kW]*	*'nominal electric power input (P)' (expressed in kW) means the effective electric power input of the fan drives, including any motor control equipment, at the nominal external pressure and the nominal airflow;*
$q_{V;SUP;ahu;nom.}$	Nominal airflow rate	*q_{nom} [m^3/s]*	*'nominal flow rate (q_{nom})' (expressed in m^3/s) means the declared design flow rate of an NRVU at standard air conditions 20°C and 101 325 Pa, whereby the unit is installed complete (for example, including filters) and according to the manufacturer instructions;*

Subscripts

According to prEN 16798-3		***According to regulation***	
ODA	Outdoor air	*Outdoor**	*Annex I-6* *Annex I NRVU-6,11*
SUP	Supply air	*Air supply outlet* *Supply*	*Annex I-15* *Annex I-5,6,7,8,11* *Annex I NRVU-11,15* *Article 2-5,6*
ETA	Extract air	*Extract* *Indoor***	*Annex I-7,11* *Annex I NRVU-15* *Annex II & IV* *Annex I-6* *Annex I NRVU-6,11*
EHA	Exhaust air	*Exhaust*	*Annex 1-5,6,8* *Annex I NRVU-11,14* *Annex IV-4 (RVU)* *Annex IX* *Article 1-2a,5,6*
s	static	*s*	*static*

Other specifications		***According to regulation***	
Indoor-side	Indoor side of AHU (SUP and ETA)	*Indoor***	*Annex I-10,33* *Annex I NRVU-11* *Article 2-5,6* *Annex IV & V VIII*
Outdoor-side	Outdoor side of AHU (ODA and EHA)	*Outdoor**	*Annex I-10,33* *Article 2-5,6* *Annex IV & V VIII*

SUP-SIDE*** (ODA-to-SUP)	Supply airside. The airflow going from Outdoor(ODA) through the unit to Supply (SUP).	*Inlet-side Supply-side*	*Annex I NRVU -3,4 Annex I NRVU -14*
EHA-SIDE*** (ETA-to EHA)	Exhaust airside. The airflow going from Extract (ETA) through the unit to Exhaust (EHA).	*Exhaust-side Extract-side*	*Annex I-3,14 ANNEX II & IV (RVU) Annex 1 NRVU-15*
INS	Test conducted inside the unit	*None*	*None*
OUT	Test conducted outside the unit	*None*	*None*

According to ISO 5801		***According to regulation***	
Fan outlet	The positive pressure side of the fan	*Fan outlet*	*Annex I-27&29*
Fan inlet	The negative pressure side of the fan	*Fan inlet*	*Annex I-27 Annex I NRVU-3,4*

**In the regulation 'outdoor' is used as both outdoor-side and outdoor air.*

***In the regulation 'indoor' is used as both indoor-side and indoor air.*

******* *The specification 'SUP-SIDE' is used instead of 'SUP' and 'EHA-SIDE' instead of 'EHA' when using the specification for the whole side of the unit (from outdoor to supply and from extract to exhaust).*

5.2. Measurements and calculations related to SFP_{int}

Additional elements for measurements and calculations related to the internal specific fan power of ventilation components (SFP_{int}) of NRVUs.

5.2.1. Definition of SFP_{int}

Unidirectional ventilation unit (UVU):

$$SFP_{int} = \frac{\Delta p_{s,int}}{\eta_{s,Fan}}$$

For bidirectional ventilation units (BVUs), the SFP_{int} is calculated as the sum of the internal specific fan power of the air supply side and the air extract side of the unit:

$$SFP_{int} = \frac{\Delta p_{s,int\ SUP}}{\eta_{s,Fan\ SUP}} + \frac{\Delta p_{s,int\ EHA}}{\eta_{s,Fan\ EHA}}$$

5.2.2. Applicable test methods

Two test methods are applicable for determining the SFP_{int} according to the Regulation 1253/2014:

1. VU where internal pressure measurements <u>can</u> be performed (recommended with local face velocity's in the measuring section for internal pressure drop below 3 m/s);
2. VU where internal pressure measurements <u>cannot</u> be performed (can be used with both low and high local face velocity's).

5.2.3. SFP_{int} determination for VU where internal pressure measurements <u>can</u> be performed

Unidirectional ventilation unit (UVU):

$$SFP_{int} = \frac{\Delta p_{s,int}}{\eta_{s,Fan}}$$

For bidirectional ventilation units (BVUs), the SFP_{int} is calculated as the sum of the internal specific fan power of the air supply side and of the air extract side of the unit:

$$SFP_{int} = \frac{\Delta p_{s,int\ SUP}}{\eta_{s,Fan\ SUP}} + \frac{\Delta p_{s,int\ EHA}}{\eta_{s,Fan\ EHA}}$$

The pressure drop of ventilation components is inserted with numerical values for Δp. All values are calculated for SUP-side or EHA-side for UVUs depending on whether it is a SUP or EHA fan unit and calculated values for SUP-side and EHA-side for BVUs.

$$\Delta p_{s,int} = \Delta p_{s,Fan} - \Delta p_{s,ext.TOTAL}$$

If measured with additional ventilation components as a part of $\Delta p_{s,int}$:

$$\Delta p_{s,int} = \Delta p_{s,Fan} - \Delta p_{s,ext.TOTAL} - \Delta p_{s,add}$$

Where the fan efficiency is determined as:

$$\eta_{fan} = \frac{q_{nom} \cdot \Delta p_{s,Fan}}{P} \text{ where } \Delta p_{s,Fan} = \Delta p_{s,ext} + \Delta p_{s\ in} + \Delta p_{s,add}$$

Where:

$\Delta p_{s,int}$	***Δp*****$_{s,int}$** *is the internal pressure drop of ventilation components (Δps,int) (expressed in Pa)*
$\Delta p_{s,add}$	*'internal pressure drop of additional non-ventilation components ($\Delta p_{s,add}$)'*
$\Delta p_{s,Fan}$	*The static pressure difference between the fan outlet and inlet section.*
$\eta_{s,Fan}$	*The fan efficiency η_{Fan}* is the is the internal static fan efficiency
p_{sf}	*Fan static pressure* means the fan total pressure (p f) minus the fan dynamic pressure at nominal airflow for one airstream in relation to the the face area. The stagnation pressure is only a mathematical/thermodynamic calculated value that requires expert knowledge to calculate. The use of stagnation pressure is only relevant at air velocities above 40 m/s, which is why this should not be used below 40 m/s. The measured pressure difference is the value used to calculate SFP_{int}, the external static pressure, etc.
$\Delta p_{s,ext.TOTAL}$	*Nominal external pressure* (expressed in Pa)
q_{nom}	*Nominal flow rate* (expressed in m³/s)
P	*'Nominal electric power input (P)'* (expressed in W). Is the sum of three parameters, i.e. Supply air fan + drive, Exhaust air fan + drive and Control (equally divided on SUP-side and EHA-side). The three parameters are measured separately.

5.2.3.1. Measuring on unit with/without additional components

If the unit has additional components the test has to be carried out with the additional components mounted inside the unit to ensure that the fan runs at its design operating point and not at a lower efficiency, which otherwise will lead to a higher SFP_{int} value.

SFP_{int} determination for VU where internal pressure measurements cannot be performed

Determining the SFP_{int} by measuring parameters measured outside the unit where the expression of SFP_{int} is given as:

$$SFP_{int\ UVU} = \frac{\Delta p_{s,Fan} - \Delta p_{s,ext}}{\eta_{s,Fan}} \cdot \frac{P_{Fan}}{P_{Fan,ext}}$$

All values are calculated for SUP or EHA for UVUs depending on whether it is a SUP or EHA fan unit and calculated values for SUP and EHA for BVUs.

$$SFP_{int\ BVU} = \frac{\Delta p_{s,Fan,SUP} - \Delta p_{s,ext,SUP}}{\eta_{s,Fan,SUP}} \cdot \frac{P_{Fan,SUP}}{P_{Fan,ext,SUP}} + \frac{\Delta p_{s,Fan,EHA} - \Delta p_{s,ext,EHA}}{\eta_{s,Fan,EHA}} \cdot \frac{P_{Fan,EHA}}{P_{Fan,ext,EHA}}$$

Where:

$\Delta p_{s,Fan}$	Means the static pressure difference of the fan measured outside the unit according to the ISO 5801, not necessarily at best efficiency point (BEP), but corresponding to the nominal flow and rpm regarding the regulation 1253/2014 (according to the measurements conducted on the unit).
$\Delta p_{s,ext}$	Means the static nominal external pressure drop as described under section 5.2.3 measured at the terminals of the unit.
$\eta_{s,Fan}$	Means the static efficiency including the motor and drive efficiency of the individual fan(s) in the ventilation unit (reference configuration) determined at nominal airflow and nominal external and internal pressure drop (and corresponding revolutions of the fan installed inside the unit) measured outside the unit according to the ISO 5801. The static efficiency is the ratio between the nominal airflow multiplied by the static pressure rise of the fan (equal to the sum of pressure drops for all ventilations components, clean and dry, and the nominal external pressure) divided by the electrical power to the fan drive.
P_{Fan}	Is the 'nominal electric power input (P)' (expressed in W) and means the effective electric power input of the fan drives, including any motor control equipment, at the nominal external pressure and the nominal airflow, measured on the unit.
$P_{Fan,ext}$	Is 'nominal electric power input (P)' (expressed in W) and means the effective electric power input of the fan drives, including any motor control equipment, at the nominal airflow and revolutions of the fan installed inside the unit and the corresponding Δp_{Fan} measured outside the unit according to the ISO 5801

If the unit is equipped with control equipment (inverter, etc.) η_{fan} must be reduced and $P_{el,Fan,ext}$ must be increased with the loss of the control unit. Alternatively, the data from the fan manufacturer must have been measured with the same equipment.

5.2.3.2. Measuring on unit with/without additional components

If the unit has additional components the test has to be carried out with and without the additional components to make sure that the fan runs at its design point and not at lower efficiency, which will otherwise lead to a higher SFP_{int} value.

I. Measure the external static pressure with additional components according to the design conditions (nominal)
II. Measure the external static pressure without additional components (take the additional components out) and:
    1. Hold RPM = constant according to situation 'I'
    2. Hold Airflow = constant according to situation 'I'
    3. Increase the external static pressure by damper until the flow is equal to situation 'I'.

The SFP_{int} is calculated as:

$$SFP_{int\ UVU} = \frac{\Delta p_{s,Fan} - \Delta p_{s,ext}}{\eta_{s,Fan}} \cdot \frac{P_{FAN}}{P_{Fan,ext}}$$

$$SFP_{int\ BVU} = \frac{\Delta p_{s,Fan,SUP} - \Delta p_{s,ext,SUP}}{\eta_{s,Fan,SUP}} \cdot \frac{P_{Fan,SUP}}{P_{Fan,ext,SUP}} + \frac{\Delta p_{s,Fan,EHA} - \Delta p_{s,ext,EHA}}{\eta_{s,Fan,EHA}} \cdot \frac{P_{Fan,EHA}}{P_{Fan,ext,EHA}}$$

Where $\Delta p_{s_ext} = \Delta p_{s_ext}$II and $P_{Fan} = P_{Fan}$ I

If it is physically impossible to dismount the additional components measurements must be carried out according to section 5.2.3.

5.3. Pressure measurement inside a unit

To measure pressure inside the unit it is recommended either using a pressure relief box (electrical membrane box) or ring lines under the following conditions:

For both methods:

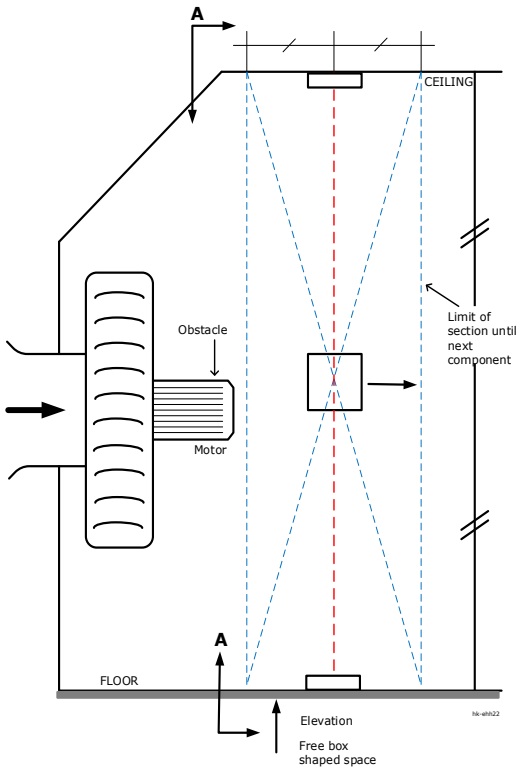
- placed at a fluidically quiet location;
- at a distance from stagnation regions; and
- the fan must not blow directly at the box/line, and if the fan blows along a surface, for example, at the bottom of the unit, the box/line cannot be placed at this surface.

For pressure relief box only:

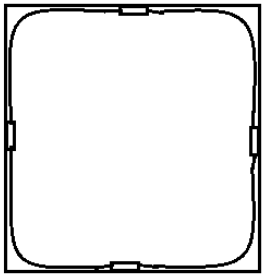
- maximum size: L=80 mm, W=80 mm, H=80 mm;
- prepare with only one hole (0,5 to 3 mm) at the bottom (backside) of the box (centre);
- the backside of the box of must be equipped with spacers (distance buds) that secure a distance between the box and the casing of approx. 1-2 mm; and
- located on a plane surface.

For ring line only:

- must be placed along all four inside surfaces of the unit at each measuring plane;
- tubes in maximum ø10 mm+/-1 mm; and
- must contain a minimum of four holes per of side (surface) of maximum 1,5mm+/-0,2 mm pr. side.



Pressure relief boxes (electric boxes)/ring-line placement in a unit



Four connected boxes or ring-line placed on internal side (wall) in unit

Pressure relief boxes (electric boxes) placed in unit

Measurement of the static pressure, before and after non-ventilation components, that cannot be dismounted and removed and it is impossible to use the four connected pressure relief boxes (electric box) or the ring-line method (see test setup) then measuring with four connected pressure taps in flush with the internal casing is acceptable.

Pressure tap, <u>not</u> in flush with the internal casing

If the non-ventilation components are placed close to each other serial or in a group, the pressure drop can be measured for the entire group as follows:

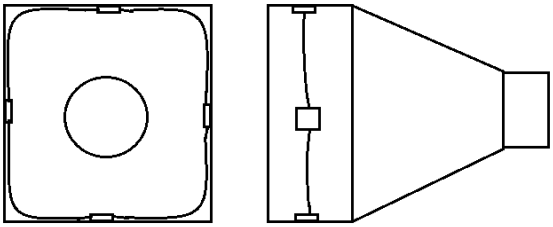
- Static pressure after group - static pressure before group.

If the non-ventilation components are placed separately, the pressure drop must be measured for each component and summarised.

5.4. Pressure measurements in duct-connections outside the unit

Pressure measured external according to ISO 5801. If the duct connections are rectangular, and the velocity is below 10 m/s in the ducts connections at the out/inlet of the VU, and the duct connections have a length and width above 500 mm, the external pressure can be measured in the transitions mounted on the unit inlets and outlets.

Four connected (with tubes) pressure relief boxes or a ring-line must be placed as showed in the figure below in the transitions mounted at the in-and outlets on the unit. The transition has to be made with a straight duct before the start angle for placing the pressure relief boxes (electric box)/ring line.



Transition with straight duct before it angle.

The angle of the transitions may not exceed 15º. The length of the straight duct must be at least half times the maximum transverse dimension before and after the pressure measuring point.

5.5. Specifications for the measuring of SFP_{int}

In addition to Chapters 1-5, the refereed standards and specifications of the regulation, the following applies to testing SFP_{int}:

- For the measurement and calculation of SFP_{int} all characteristics/values are converted from the ambient temperature and pressure measured at the time of the test, to standard air conditions 20°C and 101325 Pa approx. equal to an air density of 1,2 kg/m³.
- The fan speed must be measured when carrying out the test with all panel hatches/doors closed.
- The external temperature is measured in inlet and outlet measurement ducts dimensioned in accordance with ISO 5801.
- The temperature difference between the outdoor air and extract air has to be within ± 2°C and close to isotherm.
- Condensation of moisture is not allowed.
- $T_{extract} = 20 \pm 3°C$
- Ambient temperature $T_{amb} = T_{exhaust} \pm 2°C$.
- Measurement of relative humidity in the airflow must be measured on the coldest side of the unit and in the supply airside and exhaust airside respectively.

- Barometric pressure must be measured and recorded when the test is carried out.
- Duration of test is at least 30 minutes.