SAP PCDB: Test method for central mechanical supply and exhaust ventilation system packages with heat recovery used in a single dwelling

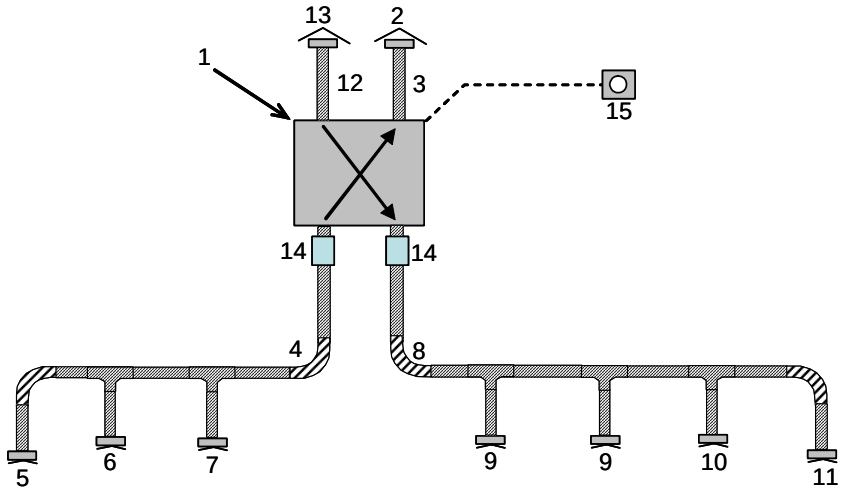
1 Introduction

This test method is based on the European Standard BS EN 13141-6:2004, to define the duct configurations, and 13141-7:2004, covering the testing of heat recovery ventilation devices, and must be read alongside these standards. Central mechanical supply and exhaust ventilation system packages tested by a UKAS accredited third-party to this standard can be recognised within the SAP Product Characteristics Database (PCDB) for use in single dwellings.

2 Scope

This test method specifies laboratory methods for measuring the aerodynamic and thermal performance of assembled supply and exhaust ventilation packages with heat recovery used for a single dwelling.

The object of this test method is to assess the ability of a ventilation package to provide the continuous supply and extract (trickle) air flow rates required by the Building Regulations Approved Document F (Ventilation). The method also allows the effective power input to the fan to be determined at this flow rate at each operating point when the system is installed in accordance with the manufacturer's instructions.



1	Heat recovery and fan unit	9	Bedroom supply terminal device
2	Roof / wall outlet terminal	10	Living room supply terminal device
3	Duct from fan to outlet terminal	11	Kitchen diner supply terminal device
4	Exhaust duct	12	Duct from fan to supply terminal
5	Kitchen exhaust terminal device	13	Roof / wall supply terminal
6	Bathroom exhaust terminal device	14	Sound attenuators
7	Toilet exhaust terminal device	15	System controller
8	Supply duct		

Figure 1 - Typical components that may form part of a mechanical supply and exhaust ventilation system package with heat recovery

3 Terms and definitions

The terms and definitions used in this test method are the same as those in European Standard BS EN 13141-6 and 13141-7.

3.1 Leakage classification

The leakage classes used in this test methodology shall be those defined in BS EN 13141-7 Clause 3.2.

4 Test methods

4.1 General

Tests shall be conducted with a unit containing all components as supplied for intended use, and installed according to the manufacturer's instructions.

When a single value is assigned by the manufacturer as rated voltage, this shall be the test voltage. Where a voltage range is assigned to the product by the manufacturer that includes 230 V, the test voltage shall be 230 V.

This test voltage shall be maintained to ± 1% throughout the testing.

4.2 Performance testing of aerodynamic characteristics

4.2.1 Leakages

The internal and external leakages shall be determined as defined in BS EN 13141-7 Clause 6.2.1.

4.2.2 Total air flow rate

4.2.2.1 Test installation

The test shall be carried out with all components supplied by the manufacturer directly linked in accordance with the manufacturer's instructions. The test configurations shall include all combinations of room supply and exhaust air terminal devices specified as being suitable by the manufacturer.

- The minimum number of room exhaust terminal devices shall be two; representing one kitchen and one additional wet room.
- The maximum number of room exhaust terminal devices shall be specified by the manufacturer, but include one kitchen and additional wet rooms.
- The number of room supply terminal devices shall exceed the number of exhaust terminal devices by one.

4.2.2.2 Installation of duct connecting roof/wall outlet terminal to the fan unit

The exhaust and supply fan spigots shall be connected to the wall/roof outlet terminal by the following ducting:

- Straight duct 0.5 m long
- 90^{o} elbow
- Straight duct 2.0 m long

The supply and exhaust duct sizes shall be based on the duct spigots of the fan as detailed in Table 1.

Fan spigot diameter	Test duct size
150 mm or greater diameter	150 mm diameter rigid duct
125 mm diameter rigid	125 mm diameter rigid duct
204 x 60 mm rectangular	204 x 60 mm rectangular duct
100 mm or smaller diameter rigid	Same diameter as fan spigot
100 x 50 mm rectangular	100 x 50 mm rectangular duct

Table 1 - Supply and exhaust duct sizes to be used for testing

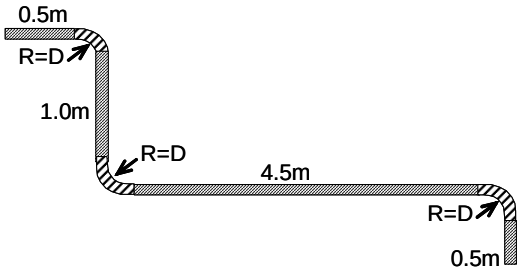
Installation of the fan unit

Where a fan unit has many spigots, the spigots not in use must be capped off using the device supplied by the manufacturer for this purpose.

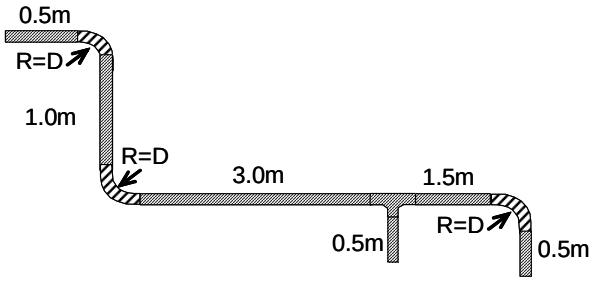
4.2.2.3 Installation of ducts connecting room supply and exhaust air terminal devices and the fan unit

All room supply and exhaust air terminal devices shall be connected to the fan unit using long or long branched ducts in accordance with Figure 2.

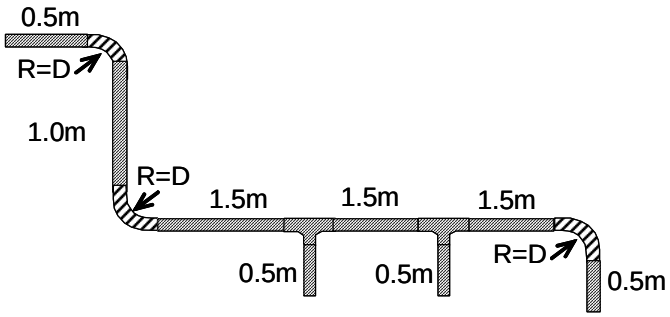
Long duct



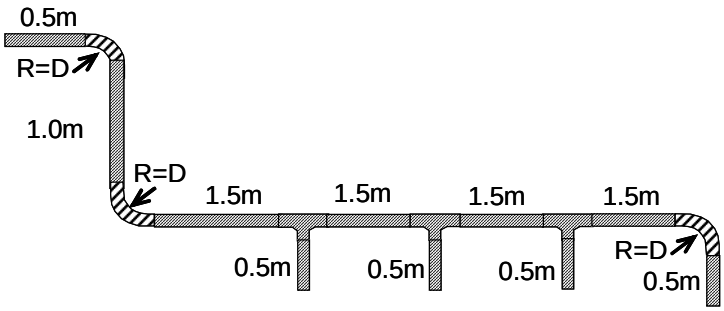
Long branched duct, 2 terminals



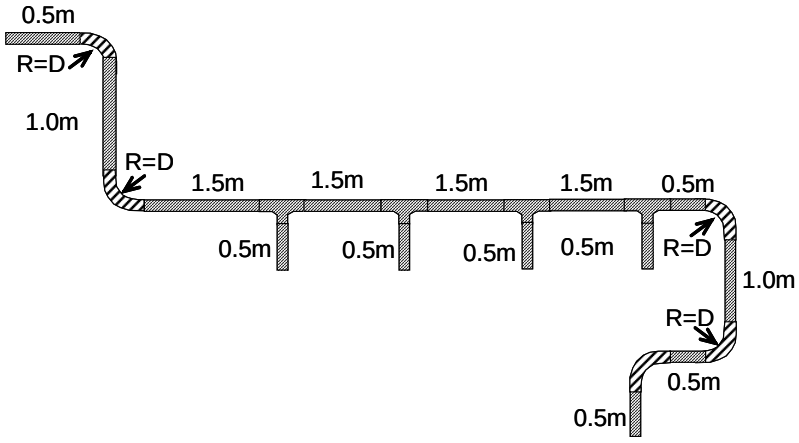
Long branched duct, 3 terminals



Long branched duct, 4 terminals



Long branched duct, 5 terminals



Long branched duct, 6 terminals

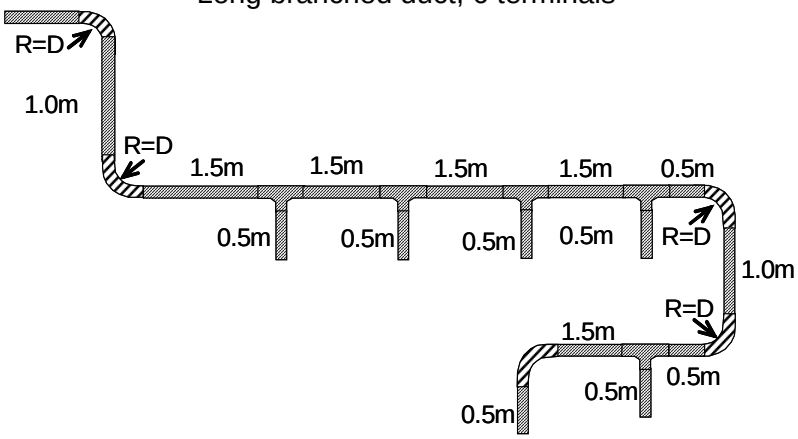


Figure 2 - Examples of duct connections

For the purpose of testing the following duct configurations shall be used:

- In a long branched duct configuration, the main living room will always be assumed to be the furthest supply terminal from the fan.

- In a long branched duct configuration, the kitchen will always be assumed to be the furthest exhaust terminal from the fan.

When rigid ducts are specified by the manufacturer, the size of the test duct connected to the exhaust and supply duct spigot of the fan and for the first 3 m of duct shall be as detailed in Table 2.

Fan spigot diameter	Test duct size
150 mm or greater diameter	150 mm diameter rigid duct
125 mm diameter	125 mm diameter rigid duct
204 x 60 mm rectangular	204 x 60 mm rectangular duct
100 mm or smaller diameter	Same diameter as fan spigot
100 x 50 mm rectangular	100 x 50 mm rectangular duct

Table 2 - Duct sizes for first 3 m of rigid duct connecting room supply and exhaust air terminal devices and the fan unit - sizes to be used for testing

When flexible ducts are provided or specified, the size of the test duct connected to the exhaust and supply duct spigot of the fan and for the first 3 m of duct shall be as detailed in Table 3

Fan spigot diameter	Test duct size
150 mm or greater diameter	150 mm diameter flexible duct
125 mm diameter	125 mm diameter flexible duct
100 mm or smaller diameter	Same diameter as fan spigot

Table 3 - Duct sizes for first 3 m of flexible duct connecting room supply and exhaust air terminal devices and the fan unit - sizes to be used for testing

The remaining test duct size shall be based on the duct sizes specified by the manufacturer for installation of the fan as detailed in Table 4.

Manufacturer's specified duct size for installation	Test duct size
125mm or greater diameter rigid duct or, 204 x 60mm rectangular duct.	204 x 60mm rectangular duct
100mm or smaller diameter rigid duct or, 100 x 50mm rectangular duct.	100 x 50mm rectangular duct
All sizes of flexible duct	100mm diameter flexible duct

Table 4 - Duct sizes for ducts connecting room supply and exhaust air terminal devices and the fan unit, excluding first 3 m - sizes to be used for testing

When flexible ducts are provided or specified, they shall be extended to 90% of their maximum length and shall be supported to prevent sagging and to maintain the specified elbow radius.

4.2.2.4 Test conditions

4.2.2.4.1 Exhaust air flow rates

If the air flow rate through each terminal device is set after installation, the continuous extract air flow rate shall be with the air flow rate through each terminal device configured to meet the following:

Kitchen	9 l/s
Additional wet rooms	6 l/s

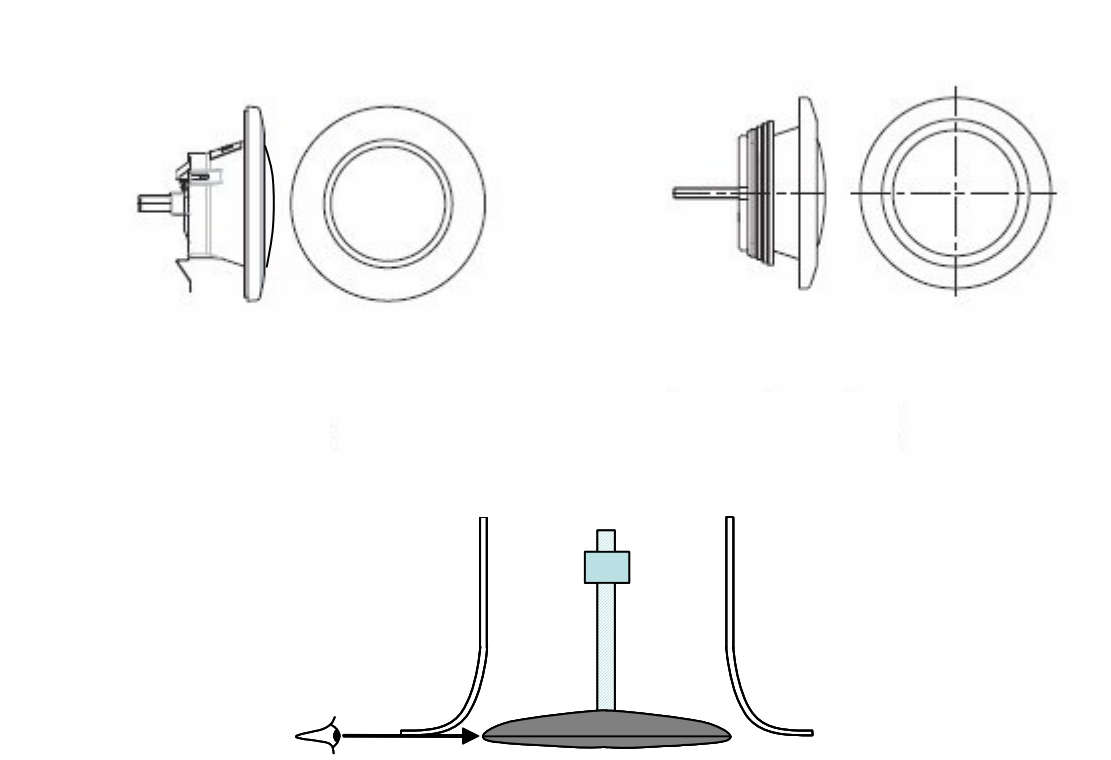
Air flow rates are at 20^{o}C and 101.325KPa

If the system is configured to self regulate air flow rates by the manufacturer, the air flow rates through each terminal device shall be balanced proportionally to the air flow rates defined above for the kitchen and additional wet rooms.

Balancing of the air flow rate through terminal devices shall be undertaken using standard commissioning instrumentation, i.e. rotating vane anemometer.

Total exhaust air flow rate shall be determined in accordance with the requirements of BS EN 13141-7 Clause 6.2.2.

An exhaust air terminal device shall be deemed to be fully open in the following configuration:



Valve in the fully open position

Figure 3 - Examples of exhaust air terminal devices fully open

4.2.2.4.2 Supply air flow rates

If the air flow rate through each terminal device is set after installation, the continuous supply air flow rate shall be with the air flow rate through each terminal device configured to be equal.

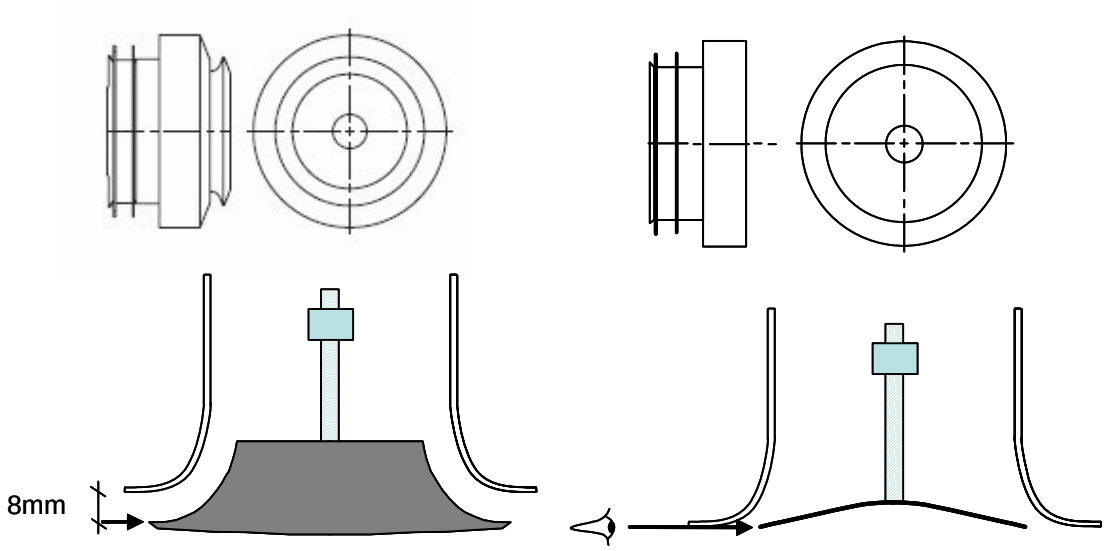
If the system is not configured to self regulate air flow rates by the manufacturer, the balance between continuous supply and extract air flow rates shall be as follows:

- The total supply and exhaust air volume flow rates shall be balanced to within 3%.

Balancing of the air flow rate through terminal devices shall be undertaken using standard commissioning instrumentation, i.e. rotating vane anemometer.

Total supply air flow rate shall be determined in accordance with the requirements of BS EN 13141-7 Clause 6.2.2.

A supply air terminal device shall be deemed to be fully open in the following configuration:



Valve in the fully open position

Figure 4 - Examples of supply air terminal devices fully open

4.2.2.4.3 Normal supply and exhaust conditions

The system shall be tested under the following supply and exhaust condition:

The pressure difference between the pressure upstream of the supply or exhaust and the pressure downstream of the inlet or outlet shall be 0 ± 0.5 Pa.

4.2.2.4.4 Temperature

The temperature of the test room shall be in accordance with BS EN 13141-6 Clause 4.2.5.2.

4.2.2.5 Test procedure

4.2.2.5.1 Air flow measurements

Air flow measurements shall be in accordance with BS EN 13141-6 Clause 4.3.1.

4.3 Electrical power

4.3.1 Method

The electrical power of the ventilation systems package shall be determined according to ISO 5801 for all fan speed / supply and exhaust terminal configurations assessed in 4.2.2.1.

4.3.2 Analysis of results

The electrical power input shall be used to calculate the 'specific fan power', the energy consumption per unit of total air flow rate at the air flow rates specified in 4.2.2.4.

4.4 Performance testing of temperature ratios

Temperature ratios shall be determined at each air flow rate defined in 4.2.2.4, according to EN 308. The tests shall be conducted with the duct static pressure immediately up or down stream of the fan spigot at that measured for each terminal configuration air flow rate tested in 4.2.2.4.

The inlet air conditions shall be those presented in Table 5. The temperature of the test room shall be maintained at 21±2^{o}C.

Air stream	Temperature
Exhaust air	
Dry bulb temperature	25^{o}C
Wet bulb temperature	< 14^{o}C
Supply air	
Dry bulb temperature	5^{o}C

Table 5 - Air temperatures to be used for temperature ratio determination

No correction for the fan power input or that of other components to the temperature ratio shall be made.

Heaters shall not be operated during these tests.

5 Presentation of results

The test configurations and flow rate conditions shall be clearly described.

Aerodynamic, specific fan power and temperature ratio data shall as appropriate be presented in accordance with Table 6, for each supply and exhaust terminal configuration and fan speed setting specified by the manufacturer.

Exhaust terminal configuration	Fan speed setting	Total exhaust flow rate (l/s)	Total supply flow rate (l/s)	Specific fan power (W/l/s)	Temperature ratio (%)
Kitchen + 1 additional wet room					
Kitchen + 2 additional wet rooms					
Kitchen + .. additional wet rooms					

Table 6 - Presentation of test results at minimum flow rate condition – example

6 Application of results

6.1 Building Regulations ADF

Assessment of the performance of a MVHR system for compliance with the requirements of Building Regulations ADF requires determination of the leakage classification and aerodynamic characteristics at each fan speed / exhaust terminal configuration specified as being suitable by the manufacturer.

The leakage classification shall be Class 2 or better i.e. 5% internal and external leakage or less. If the unit fails to meet class 2 or better, the aerodynamic air flow rate and thermal tests shall not be undertaken.

6.2 Building Regulations ADL – Standard Assessment Procedure

Results that are to be used for assessing compliance with the requirements of Building Regulations ADL through SAP requires that the aerodynamic, electrical power characteristics and temperature ratio are determined at each fan speed/ exhaust terminal configuration specified as being suitable by the manufacturer.

If the air flow rate is not pre-set by the manufacturer, one of the following must be provided to ensure effective commissioning can be undertaken on site:

- a fan speed readout or indicator that will allow the fan speed to be set in increments not exceeding 5%, or;
- a means of determining the air flow rate to within ±10%.

If neither of these is provided, the fan is considered as unsuitable for SAP Product Characteristics Database listing.