Passivhaus MVHR Commissioning Requirements V121 SGPW

I. Introduction

Mechanical Ventilation and Heat Recovery (MVHR) with airtight construction is still a relatively new technology in the UK and experience has shown defects are not often identified before handover. The process outlined in this document makes recommendations for commissioning methods and equipment, complete with a modified "final protocol" excel worksheet to allow more robust commissioning to be recorded.

With this in mind, the aim of this document is to:

1. Clarify the commissioning engineer's role and acceptable methods
2. Make it easier for the client, certifier & designer to know when the MVHR has been commissioned correctly
3. Make it easy for a commissioning engineer to declare a system 'not fit for purpose'

II. Preparation

a) Commissioning Reports:
Use the Blank "Final protocol sheet" with design information filled in by the designer. We would strongly suggest that an electronic version on a laptop is used to allow calculation during the process.

b) Support:
For further advice and support contact WARM (01752 542 546)

III. Commissioning Targets in order of priority:

1. **Total air supply to dwelling to be within 5% of stated flow at speed 2**
2. **Balance between intake and supply, and extract and exhaust to be within 10% at speed 2 (i.e. low duct leakage)**
3. **Balance between supply and extract to be within 10% at speed 2**
4. **Noise levels in bedrooms and living rooms to be below 25dBA (i.e. generally inaudible at bed head)**
5. **Individual rooms supply or extract terminals to be roughly in line with design figures.**

Other requirements:

6. Speed 1 and speed 3 total air supply to reach target within 5%
7. Pressure drop of system within 30% of design figure at speed 2
8. Transfer grilles or door undercuts to have less than 1m/s indicate with door shut – use hot wire probe.

Note: a minimum of 3 speeds should be provided to the occupants, where speed 2 is normal operation, speed 3 is boost or peak operation and speed 1 is the minimum or base ventilation rate.

III. Commissioning method:

Once initial checks have been undertaken there are 3 options for commissioning:

OPTION ONE: Measure the direct external grille flowrates (intake & exhaust). This is the best method but requires access to external grilles which may not always be available. A similar approach can be taken if the ventilation system has inbuilt measurement of flowrates that is regarded to be sufficiently accurate.

1. Set the index terminals to fully open and arrange the remaining terminals as best estimate whilst running at speed 2.
2. Take measurements of external grilles. Unfortunately it is not recommended to use a 100mm vane type anemometer and hood as resistance is likely to alter result. Only large area volume flow meter types are acceptable for external terminal flow. When undertaking measurements on the external grilles ensure wind pressure is not significant, and that a good seal around the hood is maintained.
3. On the commissioning sheet select 'Direct' under Balance & duct leakage. Use Box B to fill in data, and fan speed settings. The intention is that the total flowrate should match design, and the flowrates for extract and intake should be within <10% (Target 3). If required to achieve this make adjustments to fan speed and test again, iterate until achieved (note overwrite the values in the sheet to only show the last reading)
4. Then measure supply and extract terminals for speed 2, filling in the 'Terminal flowrate' section of the sheet. Sum of supply to be within 10% of intake value, sum of extract to be within 10% of exhaust (Target 2). In addition, flowrate to each terminal to be within 5% of design (Target 1) If required to achieve this make adjustments to terminal dampers and test again, iterate until achieved (note overwrite the values in the sheet to only show the last reading)
5. If any of the targets cannot be achieved go straight to fault finding.

OPTION TWO: Carry out a duct leakage test on internal ducts ensuring that they meet the standard in DW142: class A. If ductwork leakage is minimal, then the supply and extract terminal flows can be summed to give total overall balance and satisfy Target 3.

1. Seal up all terminals bar 1, seal up vent unit (“cling” film on filter is often easiest)
2. On the commissioning sheet select ‘Duct leakage test’ under Balance & duct leakage. Use Box A to fill in data. The intention is that the duct leakage for at least the supply and extract branches meet DW142 Class A (equiv to Target 3) although there is space on the sheet for all 4 branches, ie including the intake and exhaust. Calculate internal surface area of each branch and enter into box A.
3. Pressurise supply and extract using open terminal to 100-500Pa, typically a single reading is acceptable. Fill in section of the commissioning sheet to confirm compliance with DW142 class A. Once achieved then:
4. Unseal system. Set the index terminals to fully open and arrange the remaining terminals as best estimate whilst running at speed 2.
5. Then measure supply and extract terminals for speed 2, filling in the ‘Terminal flowrate’ section of the sheet. Sum of supply to be within 10% of intake value, sum of extract to be within 10% of exhaust (Target 2). In addition, flowrate to each terminal to be within 5% of design (Target 1) If required to achieve this make adjustments to fan speed & terminal dampers and test again, iterate until achieved (note overwrite the values in the sheet to only show the last reading)
6. If any of the targets cannot be achieved go straight to fault finding.

OPTION THREE - NOT RECCOMENDED: Either a pitot tube or a hot wire probe on the main airstreams (supply & extract or intake & exhaust) It is very difficult to get accurate readings due to turbulence from bends.

1. This requires straight duct for 10 diameters upstream and 2 diameters downstream to avoid inaccuracies [BSRIA 2015]. Measure flowrate in either supply or intake AND exhaust or extract.
2. Set the index terminals to fully open and arrange the remaining terminals as best estimate whilst running at speed 2.
3. Take single centreline air speed measurement in intake/supply and extract/exhaust. Great care is needed as it is very tricky to ensure the probe is in the centre of the duct, and facing the right direction by hand.
4. On the commissioning sheet select ‘Ductwork centre duct speed’ under Balance & duct leakage. Use Box B to fill in data, and fan speed settings. The intention is that the total flowrate should match design, and the flowrates for extract and intake should be within <10% (Target 3). If required to achieve this make adjustments to fan speed and test again, iterate until achieved (note overwrite the values in the sheet to only show the last reading)
5. Then measure supply and extract terminals for speed 2, filling in the ‘Terminal flowrate’ section of the sheet. Sum of supply to be within 10% of intake value, sum of extract to be within 10% of exhaust (Target 2). In addition, flowrate to each terminal to be within 5% of design (Target 1). If required to achieve this make adjustments to terminal dampers and test again, iterate until achieved (note overwrite the values in the sheet to only show the last reading)
6. If any of the targets cannot be achieved go straight to fault finding.

Once one of these options has been completed, finish the commissioning by:

1. At speed 2 check the pressure on the main branches to the supply and extract ductwork using a digital manometer, this will require drilling holes in ductwork. Alternatively carry out power check – note a simple plug in power meter can be used if MVHR has a 13A plug/socket arrangement, refer to manufacturer’s literature to give likely pressure. Fill in section of the commissioning sheet to confirm compliance
2. At speed 2 check noise levels. Undertake when low, or constant background noise and take time to ensure meter has settled down. Take measurements in bedrooms and living rooms with ventilation unit on and off at 1m below terminal. Fill in section of the commissioning sheet to confirm compliance
3. Repeat for speeds 1 & 3 (can also be undertaken earlier in the process). This is best achieved by setting the % of speed 2 required (cells C42 & G42), the required flowrates will appear in the columns below. Then make best guess at ventilation unit setting and take measurement from one terminal. Iterate until the correct flowrate is achieved within 5% (Target 6)
4. Check air transfer paths have sufficient free area, eg close doors and check undercut is less than 1 m/s with hot wire probe.

IV. Fault finding.

Basic fault finding is required if the commissioning figures cannot be obtained within the requirements above. The most common problem is low flow at some or all terminals, or flow is only possible with unacceptable noise. In general, low flow or high fan power is caused by:

- Leakage in ductwork: suggest turn fans to maximum and listen/feel to try and identify location. Smoke pellets are an option but care needs to be taken that smoke is not passed through filters or heat exchanger.
- Noisy: check
    - Pressure is in line with design, if it is then likely
    - Fault with system
    - Attenuators are insufficiently sized
- If pressure is higher than design then it is likely
    - Terminals may be too closed down
    - Blockage or constriction in ductwork

If the problem cannot be found and rectified, the system should be declared "Un-commissionable" and WARM notified.

V. Commissioning equipment

Suitable types:

- Anemometer with calibration certificate during the last year, can be divided into two types:
    - Small 100mm diameter vane type anemometer, preferably to be used with large square hood – see notes below. Obviously size restricts to low volume flow but cheap.
    - Large opening, eg 200mm by 200mm typical complete with fabric hood. Measurement can be by hot wire grid or orifice with balancing fan – significant difference is size of opening – e.g. Swema 125, (These can be bought or hired at a reasonable rate)
- Lo-tack tape and cardboard to extend hood as necessary (photograph and identify where used)
- Noise meter – down to 30dB(A) – eg Maplin N05CC
- Hot wire anemometer probe for duct/transfer grille air speed check – e.g. Testo 405 Anemometer
- Pitot tube and manometer – e.g. Testo 0635 2145 Pitot Tube & 0563 0510 Digital Pressure Meter
- 13A plug in watt meter with power factor measurement – eg Maplin L61AQ
- Duct pressure testing kit: suitable for pressure testing ductwork from 100-500Pa, and to measure airflow to the same accuracy as the main anemometer at this rate.

Most commissioning engineers will be familiar with CIBSE recommendations, but it should be noted that these do not necessarily work well with small scale domestic systems: for instance, the primary source of calibration recommended by CIBSE is the Pitot tube and traverse. However, experience has shown us that in small scale duct (<150mm) the inaccuracies in traverse position outweigh the absolute readings obtained, mainly due to the absence of suitable long straight sections of duct. For this reason, we recommend a capture hood and anemometer of some type.

Small size anemometers (100mm diameter) are fine as long as the largest square hood (eg 300 x 300mm square) is used and the flow is kept below around 60 m3/h [BSRIA 57015/2]. On supply, small hoods and high air velocities can give higher readings (+20%) due to the air swirling and producing extra momentum on to the anemometer fan blades. This effect is only found on supply valves. Thus if space is confined then rather than use a small hood on supply terminals, a large hood and a transfer piece should be made up to allow the full airflow to be captured, avoiding this error. If this is the case photograph the transfer piece used for the commissioning report. Small hoods can be used on extract with no loss of accuracy. When taking measurements ensure that calibration value is correct, and sufficient time is given for anemometer to settle down before a measurement is taken (be careful of averaging setting).