Preferred Vacuum Test

The preferred vacuum test is cited EN15780 (2011): *Ductwork. Cleanliness of Ventilation Systems* as the preferred method accurately and repeatably measuring the weight of dust on a duct surface.

It is based on "Finnish vacuum method" which was later described as *'Finnish brush method' (due to translation error into German)*, in an Airless project review of duct dustiness measurement methods by Dr Birgit Muller of the Berlin Technical University. Afterwards, e.g. in REHVA Guideline no 8 "Cleanliness of Ventilation Systems" (2008) it has been known as the Finnish Vacuum Method.

Some of the reasons it is preferred over e.g. the NADCA vacuum method are:

1. It works on circular ductwork
2. When dust is visually present, significantly more of the dust is collected, and is seen to be removed, from duct surface
3. Third-party scientifically verified data published for the Finnish vacuum method (see below)

It should be noted that no sample collection method is absolute and the results of different methods of sampling or measuring cannot be directly compared. The important points are to compare like-for-like and to a known standard e.g. EN15780 Preferred Vacuum Test norms.

Method

The following is taken from EN15780, with explanatory notes added. Please see also a video demonstration of the sampling.

1.1 Test equipment

1) Air pump: A high volume air sampling pump capable of drawing 15 l/min (litres per minute) through a cassette containing 37 mm matched weight or pre-weighed filters.

2) Filter media: 37 mm mixed cellulose ester (MCE) matched weight or pre-weighed filters (0.8 µm pore size) in three-piece cassette.

If pre-weighed filters are used, care has to be taken to dessicate samples at pre-weighing and post- exposure weighing to counter-act possible humidity effects

Other size sampling filters (pore size 0.8 mm) may be used, and care should be taken to ensure that smaller diameter filters (< 37 mm) are not over-loaded, i.e. they are recommended only for post-clean verification.

3) Calibration: Air volume rate calibration device that is accurate to ± 5% at 15 l/min.

4) Template: Approximately 0,4 mm thick, 0,01 m^2 sampling area, typically 10 cm x 10 cm.

Other shapes can be used to suit different sampling locations.

1.2 Sampling procedure

1) Inspect visually the surfaces.

2) Secure template to surface to be sampled so that it will not shift position during sample collection. The template to lay flat against the surface to be sampled. Check that the surface to be sampled is dry and that the fans are not running when the sampling is being conducted.

3) Remove protective plugs from cassette.

4) Attach outlet end of cassette to pump tubing. Attach a 5 cm length of suction tube to the inlet side of the cassette. [Cut at 45° at the suction end]

5) Adjust air flow using appropriate calibration device to 15.0 l/min.

6) Vacuum the open area of the template by scraping the inlet tube across the entire exposed area. Move the suction tube at a rate not greater than 5 cm/s. [Take care not to press so hard on the inlet tube that the airflow is restricted]

7) After the surface has been vacuumed, remove the tubing and replace the plugs in the capsule.

8) Mark the cassette (unless pre-marked) with an indelible pen. A code may be used to protect client confidentiality. A log should be kept to correlate the code with other important information such as job site, location in ductwork, date, etc.

9) Send the cassette to an independent laboratory for weighing using a precision balance of at least 4-point accuracy.

1.3 Analysis procedure

1) In the case of post-clean verification measurement, the filters alone are weighed, i.e. the difference between the two matched weight filters, or the gain in weight on the pre-weighed filter gives the raw result.

2) In the case of measurement of probable dirty surfaces, where loose dust is likely to have been captured in the sampling capsule but not impinged on the filter(s), a different analysis methodology is employed as follows:

a) The entire cassette is weighed.

METHOD FOR MATCHED WEIGHT FILTERS

b) The cassette housing is weighed after the filters and loose dust have been removed and put to one side.

c) The bottom (clean) of the matched weight filters is weighed and the value multiplied by 2. The total dust collected in the cassette is calculated as: (a-b-c).

METHOD FOR PRE-WEIGHED FILTER

d) The cassette housing is weighed after the filter and loose dust have been removed and put to one side.

e) The weight gain on the pre-weighed filter is measured.

The total dust collected in the cassette is calculated as: (a-d+e)

3) The laboratory will report results in grams (g) per the sampled area (100 sq.cm). The raw results should be converted into g/m^2 by multiplying by 100, and an assessment offered in general terms to comprise the report to the client.

SOURCES:

Pasanen P, Laatikainen T, Korhonen L, Nevalainen A and Ruuskanen J. (1991). Methods for evaluating dust accumulation in ventilation ducts. Proceedings of IAQ'91 Healthy Buildings, pp 379-382. ASHRAE, Atlanta, USA.

Pasanen, P., Nevalainen, A., Ruuskanen, J. ja Kalliokoski, P. (1992). The composition and location of dust settled in supply air ducts. Ventilation for energy efficiency and optimum indoor air quality 13th AIVC conference, Nice, France. s. 482-488.

Asikainen V, Holopainen R, Majanen A, Seppänen O, Seppälä A, Jalonen T, Pasanen P (2003). The verifying concept for the cleanliness of HVAC systems. Proceedings of Healthy Buildings 2003 Conference, Singapore, Vol. 2, pp. 321326.