After a Clean - What Next?

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Having paid out a great deal of money to have his ventilation system cleaned the client is entitled to ask 'what do I do next '?

This short presentation will attempt to answer this question by way of a series of recommendations based on over 40 years experience in Building Services Engineering.

The recommendations that I shall make will cover the following points:

- Post-cleaning inspection.
- Checking of fire dampers.
- Checking of system airflow's.
- Reducing the financial impact of future duct cleaning contracts by:
    i) Identifying risk locations
    ii) Reducing the ingress of dust and contaminants into the systems.

Post-cleaning inspection.

Just because a reputable and experienced duct-cleaning contractor has carried out the work, complacency should not set in - the value of a post-cleaning inspection cannot be overestimated.

The following slides illustrate this point conclusively.

These photographs were taken by CGA inspection teams using a simple camera, and show the inside of a hospital ventilation system after it had supposedly been cleaned.

The areas most likely to be missed are the small ducts, which are considered difficult to get to.

Looking into access doors or behind grilles can easily inspect most systems and, where difficult, a camera can be held into a small opening and triggered.

If a more thorough inspection is considered necessary then mobile cameras and boroscopes are available to buy or hire.

An inspection should also be made to ensure that all access doors are closed and secure. This is particularly important where the ductwork is used to handle contaminants, for example in the chemical and pharmaceutical industries.

Flexible connections on fans and ductwork are often disconnected during a cleaning exercise and they must be securely replaced - at the same time these connections should be inspected for signs of wear and be renewed if necessary.

A client called in a CGA commissioning team on one occasion, because of a reported reduction in airflow after a ductwork clean. The problem was found to be a missing flexible connection from the fan outlet in an air handling unit – the air was simply re-circulating within the fan chamber!

Checking of fire dampers.

Having accepted that the systems are clean, the next step is to ensure that the systems are safe.

In many ventilation systems fire and smoke dampers are installed to meet statutory requirements.

Although they were installed for reasons of safety, in many instances they are then forgotten and can go for many years without inspection. Indeed the CGA fire damper inspection teams have reported many surprising discoveries covering such things as dampers held open with

bricks or blocks of wood and the lack of inspection doors, which indicated that the dampers could not have been checked at the time of installation – how these were passed by the fire inspector is beyond explanation.

One of the most dangerous situations, which could occur during fire fighting, is a 'blow back'.

It is well understood that during a fire incomplete combustion often takes place and the smoke and particles involved rise to high level where they accumulate, or they may be drawn into a ductwork system., as illustrated on this slide. The rising heat from the fire can cause the gases at high level to reach such a high temperature that the incompletely combusted particles can again reach ignition temperature.

If this should happen, and the fire damper does not close, as shown on this slide, the resulting firebomb could ignite the gases at high level and inside the ductwork system. The rapid expansion of the air could not be contained inside the ductwork and could conceivably 'blow back' through a grille in an area behind the fire fighters with the possibility of disastrous consequences.

This horrific scenario could conceivably happen in a ventilated building.

In my opinion, unless the lives of the occupants are at risk, no self respecting Fire Officer should risk the safety of his fire fighters by allowing them to go inside a ventilated building without assurance that the fire dampers are regularly tested, and particularly after a duct clean. The surest way for a building owner to do this would be to issue the Local Fire Brigade with a Certificate of Inspection.

During a duct clean the mechanism of the fire damper can become full of dust and grime - simply be reason of the cleaning action employed. This is a golden opportunity to carry out a test and inspection of these dampers and then ensure that they are included in the regular maintenance programme or are regularly validated by a specialist.

Checking of system airflows

During duct cleaning it will be necessary for the contractor to move airflow regulating dampers from their pre-set position. The cleaning contractor would normally record the position of the damper handle by marking it with a pen and would then re-set the damper handle to the same position after cleaning.

You will have noted that I said damper 'handle' and not damper 'blade'.

Simple dampers, like this sliding gate damper, can be marked and re-set with some degree of confidence, as can this type of damper which is operated by rotating cogs.

However the most common type of damper incorporates a spindle with linkages connecting the blades as shown here. These dampers do not usually allow you to return the 'blades' to the original setting simply by returning the handle to its original position. The reason for this is that the square shank of the spindle fits into a square hole in the handle and there is always a certain degree of 'play'. In many instances the handle can move 5 cms either way before the blade is moved.

The easiest way to mark the blade setting with this type of damper is to cut a line in the end of the square spindle with a hacksaw, so that the damper blade direction is known, and to mark the position of this 'cut'.

Dependant on the location of the damper and air turbulence, a few millimetres play can make a big difference to airflow serving a branch grille – a discrepancy of 20-25% is not an exaggeration in some instances.

If the system was set up properly at the handover of the building, the airflow would have been checked by a commissioning specialist.

During the period from initial occupation to the time of ductwork cleaning, the air flows through the system would have changed as the system got dirty.

It is quite possible that the fall-off in airflow was noticed by the engineer or occupants and that damper settings were changed to compensate for this.

At the duct clean stage the airflow will be increased, unless automatic volume control dampers have been installed.

For reasons of economy and comfort, the clean system airflows should be checked. Ideally, a commissioning specialist should be consulted prior to the duct clean to advise on this.

Having assured himself that the system has been restored to it's original operating condition, what can the owner do to try and extend the time between duct cleans?

He can do three things:

1. Wait until the system gets dirty;
2. Inspect the system regularly with sufficient inspection points at risk locations, and carry out minor cleaning on coils and dampers on a regular basis;
3. Try to reduce the amount of dust, dirt and grime entering the system.

Identifying Risk Locations

Let us now briefly wander through the plant and ductwork system of an air conditioning or ventilation installation and identify the locations where the source of risk may be found.

1. Air Intake

- Lack of bird or insect screens – allows entry into the intake duct. Bird droppings or dead birds/insects and leaves can promote bacteria growth which can be drawn into the system. Incidentally, outside lights sited adjacent to air intakes can attract insects at night!
- Intake louvres which are not rain resistant or are badly selected for too high a velocity can allow water penetration, again promoting bacteria growth.
- A certain amount of dust and dirt will always deposit here.
- A badly sited location could allow the intake of chemicals from vehicle exhausts and other sources.

2. Pre-heat Coil

- To protect filters from freezing fog, this coil is often located in this position.
- The first dust trap in the system. Pipework and fins can attract dust, dirt, grease and chemical deposits from the atmosphere.

- Dust and dirt has a tendency to retain moisture.

- Dust and dirt can insulate coil surfaces causing loss of performance.

- I would recommend that the spacing of fins on an unprotected pre-heater be kept to a minimum of 3mm between fins.

3. Filters

- These are designed to attract dirt and dust – high grade filters can hold bacteria and other finer particles. These are a source of infection and I always recommend that personal protection be worn when removing dirty filters from the plant.

- Filters should be regularly checked and changed since the added resistance can reduce airflow and system performance.

4. Cooling Coil

A coil designed to produce some latent cooling, and thus moisture removal, is a greater risk source than a heating coil. Dust will adhere to a wet coil more readily than a dry coil causing loss of performance.

5. Drain Pans and Pipework

Sufficient space should be allowed under plant to install a properly designed trap, I would suggest 300mm. A source of dust collection and stagnant water.

6. Duct After A Cooling Coil

If the cooling coil is partially blocked or badly selected, some moisture carry over can occur and may deposit in this section of ductwork, thus creating a source for bacteria growth.

7. Control Sensors

Dust adhering to temperature and humidity sensors located in the air stream can affect controllability.

8. Fan Chamber

- Dust can be drawn into the fan chamber via badly fitted panels, where the fan is down stream of filters, this dust will pass through the system into the occupied zone.
- Dust could accumulate in the fan chamber and over the fan motor causing over heating and possible fire.

9. Fans

- Dust deposits occur inside fans on impeller blades and also inside the scroll surface. These deposits can severely reduce airflow performance and the effect should not be underestimated.
- Another question to ask – where does the carbon dust from worn motor brushes go, and also the dust from worn fan belts over the years?
- Answer: into the ducts and workplace!

10. Humidifiers

A source of moisture which should be regularly checked for efficient operation.

11. Duct After Humidifier

If the humidifier is operating inefficiently, or is badly located, or if this section of ductwork is unlagged in a cold environment, then this could be damp. A possible source of bacteria, particularly if dust and dirt is present.

12. Attenuators

Sound attenuators can break down giving a location for dust collection and, if sited after a humidifier or cooling coil, can collect moisture. Breakdown can also cause a reduction in airflow.

13. Fire Dampers

Accumulated dust can cause mechanisms to stick, rendering fire dampers inoperative. We generally recommend that fire dampers in the supply ductwork should be certified at intervals of 1-2 years, whilst extract fire dampers should be checked every year (more often, in some cases).

14. Supply Grilles

Usually, the only place the occupants may notice dust deposits.

15. Extract Grilles

- The extract system is usually more susceptible to dust accumulation, since more unfiltered air enters the system here. The dust come from furnishing, clothes or other activities within the occupied space. Cleaning sprays, hairsprays and other chemicals used in this space can also enter the system here.
- These materials can coat and stick to any item in the air-stream, as well as on the duct walls, causing various risks INCLUDING FIRE!

15. Air Balancing Dampers

Ductwork air balancing dampers are a point of air turbulence and can collect deposits.

16. Discharge Grilles and Plenum

- Usually warm, moist places which are ideal for bacteria growth.

INSPECTION AND CLEANING ACCESS SHOULD BE PROVIDED FOR ALL THESE RISK LOCATIONS.

Reducing the Ingress of Dust and Contaminants Into the Systems

- The frequency between duct cleans can be extended by taking action to reduce the ingress of dust and contaminants into the systems, and I offer the following suggestions:

- Check the seals on du twork joints. This slide shows stains from air escaping through the seals of a supply system. Stains would not be visible on an extra t system, where the dust is likely to be drawn into the ductwork. To save on expense, many joints can be inadequately sealed by the use of adhesive ducting tape.

- Check seals on access panels and air handling unit doors, particularly upstream of the fan, where the pressure is negative, and can draw dust in. Badly leaking seals can be heard by listening for a hissing sound.

- Check filter seals.

- Replace auto-roll type filters with bag filters.

- Look at duct sizes. In many ventilation system upgrades, old ductwork is re-used, sometimes with a reduced air flow requirement. If the airflow is too low, even fine dust will settle out in the ductwork system.

- Where the air plant can be turned off for a few hours or over night, consider changing the premises cleaning from an early morning task to an evening task. With the air plant off the dust stirred up by the cleaners will not be drawn into the extract system or recirculated but will settle out overnight before normal occupation.

- For future duct cleaning remember, that medium and high velocity duct systems can often prove to be virtually self cleaning since the velocities involved are at dust transportation velocity i.e. above 10 metres/second.