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HVCA

Guide to Good Practice

Heating and Ventilating Contractors' Association

Internal Cleanliness of Ventilation Systems

Incorporating DW/TM2 (1991) and TR17 (1998 and 2002)

TR/19

Guide to Good Practice

Cleanliness of Ventilation Systems

TR/19

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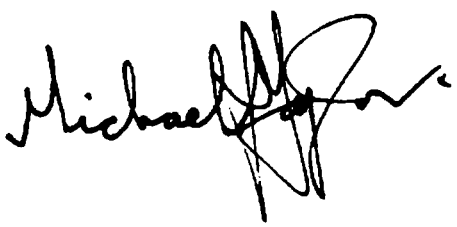
FOREWORD

As air is invisible there is a tendency to take the quality of the air we breathe for granted. Moreover, given that the average person has an air intake of about 3.4 litres of air every minute, the dangers of an inadequate or polluted air supply are obvious. This, coupled with the risk of fire from build up of grease deposits in kitchen extract systems and the expectations of building occupiers and legislators, have resulted in an ever more stringent level of ventilation system cleanliness being required.

HVCA published TR/17 in 1998 in order to give guidance to good practice and to establish standards for testing, cleaning and verification of the internal cleanliness of ventilation systems. A second edition, published in 2002, included an enlarged section on kitchen extract systems. This latest edition incorporates some further improvements to best practice and also includes the former HVCA publication DW/TM2 – Internal cleanliness of new ductwork installations. To differentiate this expanded edition from its predecessor publications, it has been renumbered TR/19.

The Guide can be used for new build, upgrade and maintenance of ventilation systems and will directly benefit users of the indoor environment as well as specifiers and consultants. Since its inception in 1998, this Guide has been widely accepted within the building services sector and by the UK insurance industry as the standard to which ventilation systems should be cleaned.

HVCA would like to thank members of the HVCA Ventilation Hygiene Group Branch and the many persons and organisations who have contributed to this Guide.



Michael J Taylor
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CONTENTS

SECTION 1

Introduction

1.1 The first edition of TR/17 established a level of particulate cleanliness verification for both new and existing ventilation systems and an indication of when it is considered appropriate to clean systems in use. The second edition was expanded to include an enlarged section on kitchen extract systems. It established levels of grease surface deposit at which it is appropriate to clean a kitchen extract ventilation system and at which post-clean verification is achieved. This new publication TR/19 incorporates both TR/17 and the former DW/TM2 – Guide to Good Practice Cleanliness of New Ductwork Installation. TR/19 now includes guidelines to ensure that new ductwork systems remain protected during the installation period and prior to commissioning. It also places a responsibility on the designer to clearly state if verifiable cleanliness is required for newly installed ductwork.

1.2 Until now legislation and guidance on standards in buildings has been directed towards the design and construction of buildings and associated systems. Increasingly, the proper maintenance of building systems is recognised as crucial to the healthy, economic and safe operation of occupied spaces.

1.3 The Workplace (Health, Safety and Welfare) Regulations 1992 require that effective provision should be made to ensure that every enclosed workplace is ventilated by a sufficient quantity of fresh or purified air. Where this ventilation is provided by mechanical means the regulations require those mechanical ventilation systems to be maintained (including cleaned as appropriate) in efficient working order. Failure to carry out these duties is a breach of the Regulations. (Please see **Appendix B** for further reference.)

1.4 Appendix M (Revised) of DW/144 (1998) Specification for Sheet Metal Ductwork, makes reference as follows: *"It will be in the interests of the designer, both financially and practically, to consider employing a specialist cleaning contractor at the outset of a contract to internally clean newly installed ductwork prior to handover."*

1.5 General ventilation systems (not affected by kitchen grease) as defined, and referred to in this guide include but are not limited to the following:

- Ductwork.
- Air handling units.
- Fan coil and induction units.
- Constant Air Volume Units
- Variable Air Volume Units
- Control dampers.
- Attenuators
- Air Terminals
- All plant and ancillaries associated with the air distribution system.

1.6 Kitchen extract systems as defined and referred to in this guide include but are not limited to the following:

- Canopy/Extract plenum
- Canopy
- Ductwork
- Fans
- All plant and ancillaries associated with the extract system
- Other systems that may be affected by grease/oil deposits eg dish wash, pot wash, general kitchen extract ventilation
- Fire dampers (where fitted) and attenuators

Section 7 (Specific Considerations for Kitchen Extract Systems) can be read separately for the convenience of readers solely interested in this aspect of the cleanliness of ventilation systems.

1.7 **Table 5** is applicable to all systems except kitchen extract systems (which are dealt with in Section 7) and defines the levels of dust deposit at which it is appropriate to clean a general system. The levels of deposit referred to in **Table 5** relate to normal nuisance dust and are based on good practice. **Table 9** defines the level of grease deposit at which it is appropriate to clean a kitchen extract system and is again based on good practice.

1.8 Levels of cleanliness are detailed which would verify acceptable cleaning performance for general and kitchen extract systems.

1.9 Measurement methods within this guide do not apply to microbiological contamination or hazardous materials, such as lead, asbestos, toxic process dusts, etc. Where such materials or contamination are present, specialist advice should be sought.

Appendix A gives general information on microbiological contamination. More detailed advice is given in TM26:2000 published by CIBSE (see Appendix E)

1.10 The onus is on the specifier/client to select and state clearly the level(s) of cleanliness required. The scope of work must be clearly defined i.e. verification responsibility and which ventilation systems and plant are to be included (refer to Section 4). The following items should be specifically quantified:

- Any component to be replaced (eg filter media, flexible ductwork etc)
- Items requiring repair or remedial attention (eg damaged or corroded ductwork or fittings)
- Re-commissioning or testing requirements.

Alternatively, contingency sums should be considered.

Appendix C gives advice on the selection of specialist contractors.

SECTION 2

Protection, delivery and installation standards for maintaining the internal cleanliness of new ductwork prior to commissioning and/or handover

IMPORTANT NOTES!
All interested parties should be made aware of this Section — especially with regard to the working environment in which the ductwork is to be installed.

All specifiers who made use of the HVCA's withdrawn publication DW/TM2, GUIDE TO GOOD PRACTICE - INTERNAL CLEANLINESS OF NEW DUCTWORK INSTALLATIONS are particularly requested to familiarise themselves with the introduction to this section.

Introduction

2.1 Section 2 is a replacement for the HVCA publication *DW/TM2 Guide to Good Practice Internal Cleanliness of New Ductwork Installations*. In order to reduce the risk of contamination, DW/TM2 dealt with the level of protection afforded to new ductwork during manufacture, transit to site, on-site storage and installation. It did not provide or make reference to any measurable level of cleanliness. It was the frequent failure of specifiers to recognise this point that gave rise to 'contractual' disputes as to whose responsibility it was not only to provide a suitable working environment but also if the ductwork became contaminated.

2.2 Since DW/TM2 was first published in 1991, clients have increasingly demanded greater levels of internal cleanliness not only in existing systems, but also in newly installed ductwork. The publication by HVCA of TR17 in 1998 provided, for the first time, a measurable level of cleanliness of ventilation systems. However, practice has shown that some specifiers are

applying DW/TM2 when they should be using TR/17. It has therefore been decided to withdraw DW/TM2 from circulation in favour of incorporating its contents into this all-inclusive Guide to Good Practice Cleanliness of Ventilation Systems — TR/19. At the same time opportunity has been taken to update the advice given in the former DW/TM2.

2.3 Section 2 offers Protection, Delivery and Installation (PDI) levels 1 and 2 to replace the original DW/TM2 categories of BASIC and INTERMEDIATE as it is considered, that with the advent of specialist cleaning, the factory sealing of ductwork associated with the former ADVANCED Level of Protection in DW/TM2 is no longer necessary. This is not only due to the adverse site conditions that can exist during installation but also the advent of a more definite approach to on-site specialist cleaning and the greater demand for on-going building services maintenance programmes. It is recognised that some sites may be able to guarantee a dry and clean working environment/area and Clause 2.17.1 highlights the additional considerations that may be required to offer protection of the ductwork during transportation and site storage.

2.4 **Air movement devices and in line plant and equipment**
The scope of this Guide does not cater for the protection and cleanliness of in-line equipment including air handling units, filters, attenuators, fans and terminal units or for the transfer of dust and dirt into the duct system from such plant.

2.5 The specification for plant and equipment must ensure that the internal cleanliness, protection and storage of the equipment is compatible with the levels of cleanliness specified for the ductwork.

Notes for Designers and Specifiers

2.6 This Section defines standards for the delivery, installation, protection and cleanliness of new ductwork with the emphasis on there being a reasonable and practical approach to the exclusion of dust and foreign matter. In addition to Sections 2.7 to 2.11 that follow, the designer/specifiers attention is particularly drawn to Sections 2.4, 2.12, 2.15, 2.17.1 and 2.17.2.

2.7 These guidance notes apply to ductwork constructed in accordance with the latest HVCA standards.

2.8 Practical experience shows that due to the various activities that typically occur on construction sites, there is a risk that the installed ductwork will not avoid dust contamination regardless of any measures of protection employed.

2.9 Whilst capping off will help to minimise the ingress of dust and foreign matter, the only certain way to ensure cleanliness on final handover is to employ a specialist cleaning contractor. A measurable level of cleanliness is defined in Section 5 of this guide.

2.10 It should be noted that the specified level of protection can only be achieved if the working environment is compatible. For certain levels of protection, the installation of the ductwork may not be possible until the construction work has reached an advanced stage. Factory and site sealing of ductwork and/or its open ends may be wasteful if ductwork is installed, subjected to or left in a dust laden atmosphere. Under such circumstances, natural air movement through the ductwork and its temporarily exposed openings will inevitably result in the ingress of dust into a ductwork system. Where the working environment is not compatible with the selected levels of cleanliness, the specifier shall decide an alternative method of achieving the selected level, for example, by changing the level of protection, revising the ductwork installation programme or employing a specialist cleaning contractor at commissioning stage. In the case of choosing the latter option, see Section 2.15 and, in particular, the benefits outlined in Section 2.15 (iv).

2.11 It is the responsibility of the specifier to assess the acceptable risk of contamination and to select and state clearly, in the invitation to tender:

i) the level of protection required for the ductwork as defined in Sections 2.12 to 2.14

ii) the requirement for specialist cleaning (PDI Level 3) (where the specialist cleaning contractor will be responsible for ensuring that the ductwork is cleaned to meet the post-clean verification test set out in Section 9 of this guide).

Protection, Delivery and Installation (PDI)

2.12 Three levels of care and protection, PDI Level 1, PDI Level 2 and PDI Level 3, have been identified but, regardless of the specified choice, it is the responsibility of the main building contractor to provide the following:

a) a dry and clean storage area adjacent to the working area for ductwork and equipment and this may require a boarded floor and a water resistant covering;
b) a dry and clean working area.

2.13 PDI Level 1 Protection

2.13.1 Condition of ducts ex-works

Ductwork leaving the premises of the manufacturer will include some or all of the following:-

a) internal and/or external self-adhesive labels or marking for part(s) identification;
b) exposed mastic sealant;
c) light zinc oxide coating on the metal surface;
d) a light coating of oil on machine formed ductwork;
e) minor protrusions into the airway from rivets, screws, bolts and other jointing devices;
f) internal insulation and associated fixings;
g) discoloration marks from plasma cutting process

It should be noted that ductwork will not be wiped down or specially cleaned at this level unless specified.

2.13.2 Delivery to site

Unless otherwise specified, ductwork delivered from the premises of the manufacturer will have no protection. However, care must be taken to prevent damage during transportation and off loading.

2.13.3 Installation

Before the installation of individual duct sections, they are to be inspected and should be free from debris. The ductwork will not be wiped down or specially cleaned.

2.13.4 Protection of ductwork risers

All risers must be covered to prevent the entry of debris into the duct. In respect of the safety of personnel full regard should be given to the requirements of the Health and Safety at Work, etc., Act 1974.

2.13.5 Downward facing and horizontal duct openings

Downward facing and horizontal openings will not be covered.

2.13.6 Access provisions for on-going maintenance

The specifier shall define the size, location and type of access opening required for maintenance of the system (see Tables 1 and 2).

2.13.7 Access openings to in-duct plant

Access covers shall be firmly fitted in position on completion of each section of the work.

2.14 PDI Level 2 Protection

In addition to the provisions of PDI Level 1, the following requirements should also be undertaken:

2.14.1 Site storage away from the working area

The area provided for storage shall be permanently clean, dry and dust free and this may require a boarded floor and water resistant covering.

2.14.2 Installation

a) the working area must be clean and dry and protected from the elements;
b) the internal surfaces of the ductwork shall be wiped prior to installation. However, this would not be to a verifiable standard. For specialist cleaning see PDI level 3;
c) open ends on completed ductwork and overnight work-in-progress shall be sealed except where solvent based sealants and

cleaning materials have been used where capping off should only take place after an appropriate curing period has elapsed (see important consideration with regard to hazardous conditions, Section 2.17.2).

2.14.3 Second fix installation

Prior to the installation of air terminal devices, any remaining protective end covers are to be removed. Dampers are to be left in the closed position by the ductwork contractor, to be opened by others at commissioning stage.

2.15 PDI Level 3 (Pre-commission Specialist Cleaning)

In addition to PDI Level 1, all internal identification labels must be removed by the ductwork contractor either in the factory or on site. External labels are permissable.

Protection of ductwork on a construction site will not guarantee internal cleanliness of the ductwork. Where specific verifiable levels of internal cleanliness are required it will be the responsibility of the designer to specify the inclusion of a specialist cleaning contractor at the outset of a contract to internally clean newly installed ductwork just prior to commissioning work commencing (see Section 2.10). This approach would realise the following benefits:-

i) The actual number of cleaning access panels may be determined to suit the method of cleaning to be adopted.

ii) As a result of the involvement of a specialist cleaning contractor, clear direction may be provided to the ductwork contractor as to the size and location of cleaning access panels required to be installed during the manufacturing process.

iii) A specialist cleaning operation prior to commissioning would enable the cleaning contractor to verify the practical access requirements for the future cleaning operations associated with a regular maintenance programme.

iv) A specialist cleaning operation prior to commissioning would allow the specifier to reduce the need for wipe downs and capping-off — as referred to in Clause 2.17.

v) The cleanliness of the installation can be confirmed and documented by means of the post clean verification test procedure as set out in section 9.4 of this guide and the issue of a report.

2.16 Summary

Table 'A' is a summary of the Protection, Delivery and Installation requirements for the three protection levels.

Table A: PDI Levels

Level	Factory seal	Protection during transit	Protection during site storage	Wipe down	Cap off on site	Pre-commission specialist cleaning
PDI Level 1	No	No	No	No	Risers Only see 2.13.4	No
PDI Level 2	No	No	See 2.14.1	Yes	Yes	No
PDI Level 3	No*	No*	No*	No	Risers Only see 2.13.4	Yes

* Specifier may wish to request additional requirements referred to such as additional sealing of open ends for delivery (see 2.17.1)

2.17 Other important considerations

2.17.1 Factory/Site sealing of ductwork

In certain circumstances such as clean rooms, the specifier may require that the internal surfaces of new ductwork are protected during transportation and site storage. This can be achieved by factory sealing all ductwork either by blanking or capping duct ends, bagging small fittings, surface wrapping or shrink wrapping (see important consideration with regard to hazardous conditions, Clause 2.17.2). The specifier must clearly specify this requirement to the ductwork contractor and also to the Main Contractor in terms of ensuring dry/clean storage and working areas.

2.17.2 Hazardous conditions

In certain concentrations some cleaning materials and sealants can pose a risk to operatives. The Control of Substances Hazardous to Health Regulations (COSHH) require employers to assess the risk to employees' health from using hazardous materials and take precautions to minimise that risk. For example, when using internally applied solvent based sealants and adhesives on site, ducts should only be capped-off after an appropriate curing period has elapsed (normally a minimum of 24 hours). Ducts should be left to naturally ventilate prior to sealing-off the installed ductwork.

2.17.3 Site drilling of ductwork

Swarf will be generated during the installation and possibly during commissioning/air balancing e.g. test probe covers. Some swarf will therefore remain inside the ductwork unless a form of on-going specialist cleaning is specified.

SECTION 3

Design and Access to the internal surfaces of the Ventilation System

3.1 HVCA specification DW/144 covers the provision of access panels for the inspection/servicing of adjacent items of in-line equipment. In a new ductwork system these are the only access panels that a ductwork contractor will provide unless there is a clear indication by the designer/specifier as to their requirements for access to facilitate cleaning survey/inspection (see Table 1 of this Guide) or cleaning activity (see Table 2 of this Guide).

3.2 This section gives general guidance regarding provisions for the system hygiene inspection/testing and system cleaning of both new and existing ductwork systems. The location of access panels for these purposes is set out in Tables 1 and 2. A specifier may consider variances to this advice having taken due regard of specific cleaning methods. In the case of new ductwork systems, alternative guidance to that given in Table 2 is also provided for the designer/specifier in DW/144, Appendix M (Revised).

3.3 The precise location, size and type of access would be dependant upon the system design and the type of ductwork cleaning, inspection and testing methods to be adopted. The advice of the specialist cleaning contractor should be sought at an early stage.

3.4 At design stage, the access panels desired should be clearly shown on the design drawings to avoid ambiguity. Alternatively, instructions should be written into a project for pre-commissioning cleaning to be carried out and the necessary access doors to be installed by the cleaning specialist at that stage.

3.5 It is essential to note that the tabulated access schemes cannot necessarily be used prescriptively since consideration must be given by the designer to the particular building, services and architectural interfaces and system require-

ments. The designer's responsibility under the CDM regulations is to ensure that the system can be safety maintained, inspected and cleaned.

3.6 It is for the designer and the other project parties responsible for the implementation of the design, under CDM "cascade" principles, to ensure that access panels are not obstructed by pipework, cable trays or any other obstacle during the building process. Consideration should be given to the future use of the building including occupation.

3.7 Access panels in accordance with DW/144 should be suitable for the purpose for which they are intended. They should incorporate quick release catches, sealing gasket and thermal, acoustic and fire-rated insulation properties equal to that of the duct to which the panel is fitted. The panel and aperture should be free of any sharp edges.

3.8 For system hygiene inspection and testing and for system cleaning, Tables 3 and 4 indicate the minimum sizes of access panel required.

3.9 Generally it is acceptable to access a branch duct for cleaning by removal of the flexible duct that connects to the grille plenums.

Table 1: Guidance as to location of access panels for inspection purposes

Control Dampers	**One 300mm x 200mm**
Fire Dampers	**One 300mm x 200mm**
Heating/Cooling Coils	**One 300mm x 200mm (Upstream)**
Attenuators (Rectangular)	**One 300mm x 200mm (Downstream)**
Attenuators (Circular)	**One 300mm x 200mm (Downstream)**
Filter Sections	**One side (for removal purposes**
Air Turning Vanes	**None**
Changes of Direction	**None**
In Duct Fans/Devices	**One side**

3.10 For the purpose of cleaning the ventilation system and its component parts, the recommended location of the access panels, size and type is taken from European draft standard ENV 12097 "Requirements for ductwork components to facilitate maintenance of ductwork systems".

3.11 This document reproduces this information in part, so as to establish the location, size and type of access panels, for new build and upgrade of existing ductwork systems. These details are given in Tables 2, 3 and 4.

Table 2: Guidance as to location of access panels for cleaning

Control Dampers	**Both sides**
Fire Dampers	**One side**
Heating/Cooling Coils	**Both sides**
Attenuators (Rectangular)	**Both sides**
Attenuators (Circular)	**One side**
Filter Sections	**Both sides**
Air Turning Vanes	**Both sides**
Changes of Direction	**One side**
In Duct Fans/Devices	**Both sides**

Notes to Table 2

1. Other than in the locations shown in Table 2, access panels should be located as a minimum every 10m in horizontal ductwork systems for the purpose of normal usage but not greater than 1m from the throat of a square 90° bend.
2. In kitchen extract systems, or other areas deemed by the specifier to require greater access, panels should be installed at a maximum of 3m centres. See also Section 7.
3. In the case of vertical ductwork, an access opening at the bottom and top of each riser should be provided as a minimum.
4. Access panels can be positioned to allow access to more than one component depending on ductwork dimensions, distance between components and the cleaning technique used.
5. Access panels should normally be positioned within 1m of the item to be cleaned.

6. A change of direction is deemed to be a 90° bend and branches. With regard to circular ductwork it is not necessary for there to be an access panel on every change of direction.

Table 3: Recommended size of Openings (Rectangular & Flat Oval)

Duct size up to longest side major axis mm	Minimum dimension of openings mm	
200	300	100
500	400	200
1000	450	450
Duct Entry*	600	500

Table 4: Recommended size of Openings (Circular)

Duct size up to mm	Minimum dimensions of openings mm	
315	300	100
500	400	200
1000	450	450
Duct Entry*	600	500

Note.

* Duct entry to be determined by local conditions/requirements and may be required in ductwork sizes above 1000mm longest side major axis/diameter subject to risk assessment. Also see Section 10.

SECTION 4

Specific Considerations for System Components

Air Handling Units & Other System Components

4.1 To obtain satisfactory conditions of cleanliness all the components associated with the ventilation system should be included in specific cleaning and maintenance procedures.

Fresh Air Inlet

4.2 Inlets should be protected by weather louvers backed by maximum 12mm mesh and situated away from potential sources of contamination. Heavy contamination within inlets prior to filters is common and may include insects, feathers, bird droppings, nesting materials, wind blown leaves, grass, soil and paper. Inlets near roads may suffer carbon based deposits.

4.3 Water entry as droplets or condensation can support mould growth in inlets and make dirt deposits difficult to remove, as well as causing rust and permanent water marking.

4.4 The provision of extra access panels may be required to give operator entry to remove deposits by scraping, vacuuming, brushing or wet methods and to repair louvers, mesh and corrosion damage.

4.5 Where significant bird contamination or mould problems are encountered a preliminary disinfection before starting work may be required and appropriate protection provided for cleaning operatives.

Access to Air Handling Units

4.6 Access to all sections of the air handling unit is required for adequate cleaning. Occasionally there is no usable access door to the space between sections, for example heating and cooling coils. In this event extra access panels may have to be installed subject to the design of the unit. Defective door seals are a common and significant source of inward dirt leakage.

Filters

4.7 All filters should be correctly installed and maintained. Incorrectly fitted and collapsed filters are a common cause of ductwork system contamination.

Linings

4.8 Air handling units, ductwork and other system components may be lined with Machine-Made Mineral Fibre (MMMF) which may or may not be protected by a coating, foil or fabric. Damaged linings releasing particles into the air system are common. Foam may be also be used as a lining. This can break down with age to release fine particles.

4.9 Many linings are porous and have the capacity to absorb dirt. They require thorough but careful vacuum cleaning with a soft brush head to remove dirt without causing damage. Complete dirt removal is unlikely to be achieved.

4.10 Where moisture is present significant microbiological growth within the lining is possible. Biocidal treatment is an option, but may not be fully effective due to the porous surface. It would be difficult to assess the full extent of the damage/reaction caused by moisture or cleaning/biocidal chemicals.

4.11 The existing condition of the lining, or potential damage caused by cleaning activities, may necessitate the removal, repair or coating of the ductwork lining interior.

Moisture

4.12 Humidification and condensation on chilled surfaces and leakage can cause dampness or in extreme cases standing water resulting in corrosion or excessive microbial growth. Similar problems can occur at droplet eliminators. Poor drainage of condensate from chilled coil drip trays may require cleaning of drain lines and traps. Treatments to prevent microbiological growth contaminating and blocking trays and drain lines are a possible option.

4.13 Design and maintenance considerations to protect against proliferation of legionella species are dealt with in ACOP L8 and NHS Guidance (see Appendix E).

Heating and Cooling Coils

4.14 Those with very closely spaced fins and/or which are very deep, can suffer blockage due to accumulated dirt, corrosion and hardness deposits. They are prone to severe deterioration of the fins. Coils located before filters are particularly vulnerable.

4.15 Vacuum brushing, compressed air blast, washing, water jetting, and the application of chemical cleaning methods, singly or in combination may be required. Care must be taken to avoid damage to fins.

Fans

4.16 Fans, motors and drives may be heavily contaminated especially if oil or grease has leaked. Impellers may have heavy deposits on the blades. For full insitu cleaning, partial dismantling and, possibly, the creation of extra access panels in fan casings, subject to manufacturer approval, may be required.

Sound Attenuators

4.17 Sound attenuators (also called silencers) may be located within air handling plant or situated remotely in ducts. These usually have linings covered with woven fabric or perforated sheet metal. Dirt readily accumulates in silencers and their porous nature makes complete cleaning impossible. Careful vacuum brushing with a soft brush head or gentle application of compressed air are possible methods.

4.18 Where damage has occurred which may allow the release of MMMFs, consideration should be given to repair or replacement.

Turning Vanes, Volume Control Dampers, Fire Dampers

4.19 These tend to accumulate dirt which can affect their operation and may require access panels added to one or both sides to allow full cleaning and surface restoration.

4.20 Manually set volume control dampers should have the 'as found' setting marked indelibly to aid resetting.

4.21 Fire dampers should be physically cleaned, but inspection and functional testing of smoke/fire dampers should be separately specified.

In-duct Heat Exchanger Coils

4.22 Lack of access for inspection and routine cleaning can result in these being blocked with dirt, restricting air flow through them (methods as used for air handling units apply). Additional access panels to give access to both sides of the coil will usually be required.

Flexible Ducts

4.23 Flexible ducts trap dirt in the corrugations. This dirt can be difficult to completely remove if the corrugations are deep and/or compressed together. Light weight foil, plastic flexible or aged flexible are liable to damage. Cleaning methods must be adjusted to account for the type of flexible duct. Brush methods require soft bristle brushes and gentle application. Compressed air methods may require a pressure reduction to avoid tearing the duct material.

4.24 It may be necessary to remove and extend flexible ducts to release dirt from folds.

4.25 Decay of the material of construction, or difficulties in releasing flexible ducts from their connection spigots without causing damage may make replacement a better option than cleaning.

Diffusers and Grilles

4.26 Where possible these should be removed for cleaning. Washing to remove grease and tobacco staining may be required.

4.27 Diffuser/grille locations and orientation should be marked or recorded if they are to be taken away for washing, so that they can be returned to the correct location. Opposed blade dampers should have the 'as found' setting marked to aid resetting.

4.28 Certain grille and diffuser arrangements may be installed such that they cannot be practicably removed for cleaning, e.g. linear diffusers or those trapped by partition walls. Insitu cleaning by air line and extraction to capture dislodged deposits may be used.

4.29 Diffusers may have plenum boxes, possibly containing dampers behind them, which also require cleaning. Access will be required to permit cleaning or air jetting and extraction methods.

Terminal Equipment

4.30 Equipment such as fan coils, mixing boxes, CAV, VAV, induction units and unit air conditioners may be included in a cleaning programme.

4.31 Wall and sill mounted equipment is frequently obstructed by difficult to move furniture and fittings, preventing or hindering access for cleaning. Responsibility for moving obstructions should be defined by the Specifier.

4.32 Ceiling mounted equipment may be obstructed by services and structures preventing the opening of access panels and withdrawal of internal components. Some terminal units have filters which may require cleaning or which are disposable. Contractual responsibility for supplying replacement filters will require definition by the Specifier.

4.33 Terminal units may be lined or include attenuator sections. Maintenance activity, ageing and erosion by air flow may have resulted in damage to the lining allowing fibre escape. If damage to the lining occurs remedial action should be taken immediately. The lining may have accumulated dirt within its matrix. The limited access to all air passages, especially labyrinth passages in attenuators within terminal units and the presence of delicate porous linings can prevent total dirt removal.

4.34 Gentle vacuum brushing or air jetting, plus high volume extraction may be required. Some units have air jet nozzles or small air passages which become blocked with dirt. This dirt can form a hard deposit which requires mechanical removal with suitable tools to chip or ream it away. Jet nozzles may also require washing.

4.35 It is important for the Specifier to define the extent of cleaning for Induction Units e.g. whether secondary and mixed air surfaces only are included or whether typically less accessible primary air surfaces (plenum box) are also included.

Plenum Void

4.36 Ceiling and floor void plenums may be used as an integral part of the air distribution system and should therefore, be subject to the same hygiene consideration as other system components. Regard should be given to the selection of cleaning technique(s) in view of the different construction materials used.

SECTION 5

System Testing (Inspection/Monitoring)

5.1 The Workplace (Health, Safety and Welfare) Regulation 5 imposes a duty to clean mechanical ventilation systems "as appropriate." The Workplace Regulations are accompanied by an Approved Code of Practice (ACOP) which gives guidance on how compliance with the regulations can be achieved. Regulation 3 of the Management of Health & Safety at Work Regulations 1999 imposes a duty on every employer to conduct a risk assessment and the testing procedure within this guide would assist in assessing some of the risks in relation to ventilation systems.

5.1.1 **ACOP 22(A)** States that regular maintenance (including, as necessary, inspection, testing, adjustment, lubrication and cleaning) should be carried out at suitable intervals.

5.1.2 **ACOP 33** States that "Mechanical ventilation systems (including air conditioning systems) should be regularly and properly cleaned, tested and maintained to ensure that they are kept clean and free from anything which may contaminate the air."

5.2 A testing procedure is defined in this guide which may be used to establish whether or not it would be appropriate to clean a mechanical ventilation system. This provides one reasonable practicable way of satisfying the Regulation and ACOPs relevant to the cleanliness of ventilation systems. Specific guidance is given in Appendix D

5.3 Testing is a specialist activity which is not normally covered within the scope of a standard maintenance schedule.

5.4 Many different methods of testing are offered by service providers. It should be noted that there is a clear difference between tests to monitor ventilation system surface condition and tests to monitor 'ventilation air quality'. Surface condition tests will indicate the potential for the

system to release contaminants into the air at any point in the future, whilst air quality tests will indicate contaminants that are actually in the air, but only at the time of collecting the sample. Additionally, the source of these contaminants can only be defined where sampling arrangements are controlled carefully.

Table 5: Surface Deposit Limits

System Type	Surface Contaminant Limits	Test Method
Extract	**6g/m²**	**V.T.**
	180 μm	**D.T.T.**
Recirculation	**1g/m²**	**V.T.**
	60 μm	**D.T.T.**
Supply	**1g/m²**	**V.T.**
	60 μm	**D.T.T.**

5.5 The owner or operator should select the type(s) of test(s) and frequency to be included within their testing regime to suit the particular requirements of the building served by the ventilation system. The regime should be reviewed regularly (e.g. annually), to take into account any changes in the building use, legislation and/or health and safety guidance.

5.6 The HVCA's Ventilation Hygiene Group Branch have investigated many different methods for 'ventilation system surface condition' testing to establish an objective method for determining when a ventilation system is considered dirty in terms of particulate and hence when it would be appropriate to clean. Two alternative testing methods are recommended as follows:-

1. Deposit Thickness Test (D.T.T.)
2. Vacuum Test (V.T.)

Separate testing and contaminant levels specifically for kitchen extract systems are detailed in Section 7.

5.7 The D.T.T. method determines the mean surface deposit in terms of micron thickness, whereas the V.T. method determines the mean deposit weight in grams per m². Both test methods provide an objective method of measuring internal duct floor surface deposits.

5.8 The tests, which are detailed in Appendix D, are recommended to be repeated at intervals not exceeding 12 months. Depending on the quality of input air, the level of filtration and sensitivity of the served area, the frequency of inspection and testing may be increased or decreased. For example, a rolling programme of inspections may be devised such that individual systems are inspected within a 3 year period; with more frequent inspections of sensitive areas eg air handling units, filters, etc. The frequency of the tests should be reviewed annually.

5.9 To aid the owner or operator of a ventilation system to establish when it would be considered appropriate to clean a ventilation system, this Guide sets guideline maximum levels of surface deposits. These are set out in Table 5. Above these levels it would be considered appropriate to clean the system. It should be noted that these are guideline levels to ensure that excessive deposits do not accumulate.

5.10 Monitoring of system condition through regular testing will allow the rate of accumulation to be ascertained and the appropriate action to be determined. In certain instances it may be considered necessary to set more stringent levels of hygiene where specific risks have been identified in the event of particle release into the air stream (e.g. operating theatre supply).

5.11 The levels given in Table 5 are based on current good practice. They take away the subjectivity of a visual inspection. At these levels the system would appear visibly dirty.

5.12 The levels should not be confused with levels set for verification of cleanliness following a system clean, which are far more stringent, these are detailed in Section 9.

5.13 The scope of a regular testing regime or initial condition assessment should include, but not be restricted to:

1. Provision of suitable access points.

2. Visual inspection.This may be assisted by the use of equipment such as cameras, endoscopes and robotic CCTV with appropriate records such as photographs and video footage.

3. Quantitative surface dust measurement by the D.T.T. or V.T. method. Where grease or adhered deposits are clearly the issue then only the D.T.T. method, or the wet film thickness test method (W.F.T.T.) detailed in Section 6, should be used. In view of the difficulty in measuring deposits on curved surfaces, visual comparison can be made between the appearance of the curved surface and an appropriate flat surface. A minimum of three test points per system should be included with no less than one test point per 50 linear metres of ducting up to 300 linear metres and no less than one test point per 100 linear metres thereafter. An average should be calculated across all tests conducted on each system and used to determine whether it is appropriate to clean the system. However, individual results that are excessively high may indicate a need for local attention.

4. The following components should be subject to cleanliness inspection as a minimum:

- Fresh air intakes, air handling unit including filters and coils) and selected in-duct plant and ancillaries such as attenuators, fire dampers, volume control dampers, heat exchangers, VAV boxes etc.
- A selection of ductwork, including (but not limited to) changes of direction, terminations, straight horizontal and vertical ducts.
- A selection of terminal equipment such as flexible ducts, grilles, diffusers and equipment e.g. induction and fan coil units.

The number of inspection locations and tests should be clearly defined by the specifier.

5. The client should be given the opportunity to witness the sample testing of ductwork surfaces.

SECTION 6

Cleaning Methods

6.1 This guide is not intended to be prescriptive in relation to the method of cleaning, as there are many existing and emerging technologies available depending upon the type of deposit to be removed. To conform with this guide, the actual application of the methods listed in Tables 6 and 7 must be capable of achieving the required result.

6.2 Considerations when using dry cleaning methods

In all cases where Note A appears, the particulate should be collected using an air movement and containment machine. This will generally require appropriate filtration and should assist in the containment of contaminants.

6.3 Considerations when using wet cleaning methods

- Moisture can assist in the growth of micro-organisms and the system should be thoroughly dried prior to commissioning/re-commissioning.
- The introduction of cleaning chemicals or biocides should only be considered where a risk assessment has been carried out, the details recorded and any adverse effects of the applied chemicals have been assessed and determined with appropriate safe procedures set out in a formal method statement.
- Steam cleaning and high pressure washwater are not recommended for ductwork that is situated above ceilings or in sensitive areas unless carried out in a controlled manner to contain leakage. Again, procedures must take account of operative safety and should be set out in written form.
- Careful consideration should be given to the use of chemicals and/or water for

surfaces that are porous e.g. internally-lined ductwork, attenuators, fibre board ductwork etc., as permanent damage may result.

- Before applying wet cleaning methods care should be taken to ensure that condensed vapours and cleaning fluids can be removed from the ductwork system.

Table 7: Wet Cleaning Methods

Generic Name	Method of Removing Deposit
Wet Vacuum	**Suction**
Chemical Clean	**Softens or dissolves deposits**
Hand Wash	**Washing of internal surface using appropriate medium**
Steam/High pressure water wash	**High pressure system used to dislodge/ dissolve deposits**

Table 6: Dry Cleaning Methods

Generic Name	Energy Source	Method of Removing Deposit
Air Whip/Skipper Ball (A)	**Compressed Air (Low Volume)**	**A rubber hose or plastic ball that under pressure agitates the wall of the ductwork**
Air Lance (A)	**Compressed Air (Low Volume)**	**Usually an air gun with a trigger that is able to direct compressed air locally**
Air Nozzle (A)	**Compressed Air (High Volume)**	**Usually a plastic or metal ball placed on the end of a flexible hose. Compressed air leaving small openings in the ball propels the hose forward inducing the nozzle to closely traverse the internal surface of the duct.**
Hand Wipe	**Manual**	**Wiping of the surface using a medium appropriate to the purpose**
Hand Scrape	**Manual**	**Removing heavy deposits by hand scraping**
Hand Brushing	**Manual**	**Brushing the surface using a brush appropriate to the purpose**
Hand Vacuum	**Electricity/Manual**	**Suction**
Mechanical Brushing (A)	**Compressed Air and/or Electricity**	**Brushing the surface of the ductwork using mechanical action**
Mechanical Brush and Air Technology Combined (A)	**Compressed Air/ Electricity**	**Brushing the surface of the ductwork using mechanical action and compressed air**

SECTION 7

Specific Considerations for Kitchen Extract Systems

7.1 The kitchen extract system presents particular hazards due to the potential for the accumulation of grease. Accumulated grease within an extract system forms a hidden combustion load. Under certain circumstances flame or very high temperature within the duct can ignite the grease causing fire to spread rapidly through the duct. Flame and heat within the duct can ignite surrounding materials at various points along the ductwork path and transfer fire in ways that are difficult to predict and control by designers, installers and ultimately fire fighters.

7.2 Kitchen extract ventilation systems are defined here as the extract systems intended to collect and remove contaminants, heat and moisture from cooking appliances (See also DW/172). A kitchen extract system would typically comprise of the following components:-

Canopy – Also referred to as hood, canopy hood, extraction hood, cooking hood, cooker hood, cooking canopy or extraction canopy. This would most likely include a vertical canopy skirt running around the perimeter of the canopy. A "U' channel on the bottom edge of the skirt; a canopy roof sitting horizontally on the top of and joining the skirts; a grease filter housing assembly (with grease filters and traps) hanging within the boundary of the skirts.

Canopy/Extract plenum – This is typically the area immediately behind the grease filter housing and below where the ducting commences.

Ducting – Beyond the canopy/extract plenum, extraction ductwork would be connected. This may involve short transition ducts connected directly to the suction side of an extract fan or could include many linear metres of horizontal and/or vertical ductwork. Vertical ductwork, also referred to as riser may pass through many levels of a building. Contained within the ducting there may be attenuators, flow control dampers, fire dampers, air turning vanes and sensors.

Extract Fan – To create extraction from the canopy an extract fan would be connected to the ductwork, some extract fans (roof mounted) discharge directly to atmosphere via a cowl.

Discharge Duct – On the exhaust side of the fan a discharge duct would direct extract air out of the building via an outlet. This outlet point may include weather louvres and mesh to prevent the ingress of weather and vermin.

Other systems such as ventilated ceilings and directly ducted extraction are also used. It is important that the person responsible for implementing cleaning regimes clearly understands the breakdown of the system so that any cleaning regime is compliant with the terms of buildings insurance relevant to the kitchen extract maintenance.

7.3 Other extraction systems serving the cooking area, such as potwash/dishwash systems, general extraction etc. may also be affected by grease deposits and similar considerations will apply.

7.4 Kitchen extract systems are liable to internal fouling by grease and oils. It is usual for the systems to be protected by grease filters, but these differ widely in terms of efficiency of grease removal and of barrier to flame. Total grease removal is not normally feasible and therefore fouling of systems downstream will occur to a greater or lesser degree.

7.5 Grease deposits within systems also pose hygiene, odour, vermin and mechanical efficiency hazards. Poorly designed and installed or damaged ductwork can leak grease, thus extending the fire risk, hygiene, odour and vermin hazards. Also, where ductwork distorts under fire conditions, burning grease can leak out and spread the fire to duct surroundings.

7.6 Supply or make-up ventilation systems should be maintained in hygienic condition as detailed in this Guide. Due to the accumulated grease within extract systems, the majority of the duct-

work cleaning will be by manual rather than mechanical methods. At the time of system survey, a detailed schematic should be provided, highlighting any areas which are inaccessible and therefore, will remain uncleaned. The client must be advised of any inaccessible areas, the reason for their inaccessibility and, if possible, the likely cost to provide full and free access. It is the clients responsibility to highlight this to their insurer or other relevant third party, if required, who must confirm whether an exception to the total cleaning in accordance with TR/19 is acceptable.

7.7 This section of the Guide provides specific advice on how to clean and maintain kitchen extract systems, but similar consideration will apply to non-kitchen areas that might be affected by grease and/or oil deposits.

Design and Access to the Internal Surfaces of the Kitchen Extract System

7.8 Advice is provided in HVCA DW/172: Specification for Kitchen Ventilation Systems (2005).

7.9 Internal surfaces of kitchen extract systems should be free of irregularities, all of which make grease accumulation more likely and cleaning more difficult.

7.10 It is essential that a kitchen extract ductwork system, and canopy/extract plenum, is provided with access panels of sufficient number, quality and size to enable unrestricted access for regular cleaning and inspection of the internal surfaces and in-line components.

7.11 Location of access to the internal surfaces of a kitchen extract system is dependent on a number of design and operational considerations

- Design and location of ductwork
- Building design and construction materials
- Location of kitchen within the building
- Location of extract fan and accessibility for maintenance
- Accessibility to physically reach the ductwork
- Any building modifications and current uses that may restrict access
- Location and number of system components requiring access.

7.12 Access panels should be suitable for the purpose for which they are intended. The panels and frames should be constructed of the same material as the ductwork. As a minimum they should incorporate quick release catches, sealing gasket and thermal, acoustic and fire rated insulation properties equal to that of the duct to which they are fitted. Particular consideration must be given to maintaining the fire integrity of fire-rated ductwork. The recommendations of the manufacturer or specialist fire protection adviser should be followed where appropriate.

7.13 Access panels should be as large as the duct size permits to a maximum of 460mm x 610mm without weakening the structure of the system. Openings should not be obstructed by other building services, stored equipment or by the fabric of the building. The panel and aperture should be free of any sharp edges.

7.14 Access panels should be fitted at the side of the duct, a minimum of 10mm above the base to minimise the risk of grease leakage. Exceptionally, they may be fitted on the top of the duct, but due consideration should be given to the accessibility of the panel. Where access panels must be fitted to the underside of a duct, particular care must be taken to ensure a leak-free fit and notice should be affixed warning of the risk of oil being released on opening the panels. In designing systems due consideration should be given to providing physical unobstructed access to all access panels.

7.15 Access panels should be fitted on either side of in-line components, as detailed in Table 8, to allow physical entry to clean these intricate surfaces. This Table includes components, such as fire dampers and attenuators, which are not normally recommended to be installed, but are often found in practice.

Table 8: Location of Access Panels for Cleaning and Inspection Purposes

Volume Control Dampers	Both sides
Fire Dampers (see Note 7)	Both sides
Attenuators	Both sides
Changes in Direction	Both sides
Filter Sections	Both sides
Horizontal Ducts	Generally every 3 metres (see Note 2)
Risers	Top and bottom as a minimum (see Note 3)
Extract Fans	Both sides (see Note 4)
Discharge grille/mesh	One side (see Note 6)

Notes to Table 8

1 Additional builders work hatches may need to be fitted in ceilings/walls in existing installations, or provided for in new constructions. Consideration should also be given to safe high level access to external ductwork.

2 Access openings for cleaning purposes are generally required at a maximum of 3 metre centres and/or at each change of direction. This distance should be reduced where the size of the duct prevents adequate cleaning by hand, where there are several changes in direction or where other external features restrict the positioning of panels.

3 Internal kitchen extract risers often require access doors fitted on at least each floor level so that all internal surfaces can be reached and fire dampers, where fitted, cleaned and checked. In older buildings this may require additional builders works (e.g. hatches through brickwork) to reach the riser ducts (see 7.6).

4 Extract fan design should allow thorough cleaning of impellor blades and internal surfaces without the need for dismantling, i.e. ductwork with access panels should be provided immediately upstream and downstream. Larger fans should be designed with panels in the casing. Similarly, attenuators or other in-line fittings likely to obscure cleaning activity should be provided with access on both sides.

5 Guideline access frequency given above may be reduced where remote cleaning methods and personnel entry can be adequately applied. However, in all instances every section of ductwork should be capable of verification inspection.

6 Design consideration should be given to the provision of safe access to the downstream side of discharge grilles, bird guard mesh and louvres.

7 Fire dampers are not fitted in new installations, but may still be found in older systems.

7.16 During cleaning maintenance it is essential to ensure that the mechanical and any fire integrity of access provision is maintained. Access panels should be identified and marked on a schematic sketch (see Verification of Cleanliness below). Control procedures should ensure that all access panels are properly replaced after cleaning, and that any fire protection removed for cleaning (e.g. cladding board) is properly re-fitted both at the duct and at any builders work. The number of access panels removed at any one time should be kept to a minimum. All panels should be replaced at the end of the working shift.

7.17 Designers, installers or specialist cleaners should define and justify the number of access panels to be fitted to an installation in line with this Guide.

System Testing (Inspection/Monitoring)

7.18 The Health & Safety Executive and industry and insurance guidance and regulations (see Appendices B & E) stipulate that kitchen extract systems should be kept clean to minimise fire and other risks. This Guide now provides a method of measuring and defining cleanliness and dirtiness as a benchmark for good practice.

7.19 The HVCA Ventilation Hygiene Group Branch has investigated a variety of methods for testing ductwork system internal surfaces to measure grease deposits and recommends the Wet Film Thickness Test (W.F.T.T.) measurement method. This method is described in Appendix D.3.

7.20 The Deposit Thickness Test (D.T.T), as described in Section 5, may also be used and may be necessary in the case of extremely hard-baked, carbonised, deposits. It is however less reliable for soft or liquid deposits and the finding of hard-baked deposits would normally indicate a requirement to clean or in the case of cleanliness verification a requirement to re-clean.

7.21 The testing methods provide an objective, repeatable and verifiable measurement of grease deposits, and overcome the subjectivity of visual inspection alone.

7.22 It is recommended that testing be carried out at intervals not exceeding 12 months. Monitoring of grease deposits may need to be carried out more frequently if it is necessary to establish a precise definition of required cleaning frequencies. The cleaning frequency required should be estimated by a specialist service provider and/or client on initial inspection or assessment and subsequent pre-clean testing will confirm whether the initial predicted frequency is correct or requires adjustment.

7.23 Measurements should be taken at the following locations where practicable:

- Canopy/Extract plenum behind filters
- Duct 1 metre from canopy
- Duct 3 metres from canopy
- Duct midway between canopy and fan
- Duct upstream of fan
- Discharge duct downstream of fan

7.24 Table 9 sets out guideline maximum levels of grease deposit and actions recommended. The actual recommended action timing will depend on the rate of accumulation, the risk vulnerability of the system and site and any particular warranties imposed by the building insurers.

Table 9: Surface Grease Deposit Limits

Wet Film Thickness Test Measurement	Recommended Action
200μm as a mean across the system	**Complete cleaning required**
Any single measurement above 500μm	**Urgent local cleaning required**

Notes to Table 9

1 In the absence of, and the likely theoretical difficulties of, an absolute measure of the flammability of various quantities of grease deposit, the surface grease deposit limits are given in Table 9 and paragraph 7.42. These levels were determined by extensive field testing to measure at what levels good practice employers, or operators of systems, carry out system cleaning and what levels of cleanliness are normally achieved by specialist duct cleaners using available cleaning and measurement technology within reasonable economic bounds.

2 The deposit limits refer to the degree of grease deposition within the ductwork consistent with good practice. Other factors such as cooking methods, potential ignition sources, and other combustible debris will affect the risk of fire.

3 The mean measurement is calculated by dividing the total of the test results by the number of testing locations.

4 The second category of any single measurement above 500μm is provided to cater for local "hot spots" which should be cleaned even where the whole system does not require complete cleaning. Examples might be immediately local to a canopy or at a fan

5 The extent of urgent local cleaning precipitated by the presence of grease deposits above 500μm should be subject to reasonable appreciation of the extent of fouling and risk posed.

7.25 The surface grease deposits limits should not be confused with the level set for Post - Clean verification which is far more stringent and detailed in paragraph 7.42.

7.26 Stand-alone, regular or post-clean testing can usefully be combined with inspection of other kitchen extract system safety issues. If specified by a client, a service provider should provide evidence of competence to carry out such inspection. Such inspection should include, but not be restricted to:

1. Adequacy of filters and their regular maintenance
2. Adequacy of regular cleaning of canopy, and associated drains and traps
3. Existence and visual condition of any fire suppression or detection system
4. Damage to fire protection
5. Ductwork grease leakage
6. Ductwork damage
7. Damage to or inappropriate ductwork fixtures
8. Visual/audible check of fan operation
9. Rubbish/debris adjacent to system
10. Visual assessment of any special filtration
11. Discharge condition, including grease splatter/staining

7.27 Such inspection should not be regarded as a substitute for proper maintenance of plant such as fans and fire suppression or detection systems.

Cleaning Methods

7.28 This guide is not intended to be definitive in relation to the method of cleaning, as there are many existing methods that can be applied in tandem, and emergent new technologies. Examples of cleaning methods are listed in Table 10.

7.29 To conform with the Guide, the actual method or methods must be capable of achieving the required results, i.e. Post-Clean Verification, not only on the internal surfaces of the extract duct but also on system components.

7.30 When choosing the cleaning method, consideration should be given to operative safety and

Table 10: Examples of Cleaning Methodology

Generic Name	Energy Source	Removal Method
Hand wipe	**Manual**	**Wiping the surface of the ductwork**
Hand scrape	**Manual**	**Removing heavy deposits by hand scraping**
Chemical	**Manual**	**Softens or dissolves deposits making them suitable for hand scraping**
High pressure water wash (steam)	**Electrical or compressed air**	**Vapour or liquid expelled at high pressure from lance to dislodge/dissolve deposits**
Blasting (remote or direct) using suitable medium as appropriate	**Compressed air**	**Blasting medium dislodges contaminant from duct and component surfaces to be removed via vacuum techniques or high volume filtered extraction.**

also to effects on the surrounding environment, particularly where using wet cleaning methods, since grease/moisture can leak from the ductwork components and damage the surrounding fabric.

7.31 Steam cleaning and high pressure water washing are not recommended for ductwork that is situated above false ceilings or in sensitive areas, due to possible leakage of contaminants from the duct, unless specifically designed for wet cleaning.

7.32 After applying wet cleaning methods care should be taken to ensure that any condensed vapours and cleaning fluids are removed from all parts of the system.

7.33 The use of chemical cleaning agents should only be considered where a risk/COSHH assessment has been carried out (See Section 10), the details recorded and the effects of the applied chemicals have been assessed on the material construction, environment and for hazards to cleaning personnel.

7.34 It should be noted that it is not normally economically practicable to clean kitchen extract systems to a "like new" bright metal condition due to substrate staining.

Frequency of Cleaning

7.35 The need for specialist cleaning of extract systems will depend on the level of usage of the cooking equipment, types and quantity of cooking and other risk factors such as vulnerability of the system to ignition and of the building and its occupant/users to system fire, hygiene, vermin and mechanical hazards. Typical cleaning intervals are shown in Table 11:

Table 11: Frequency of Cleaning

Heavy Use	**12-16 hours per day**	**- 3 monthly**
Moderate Use	**6-12 hours per day**	**- 6 monthly**
Light Use	**2-6 hours per day**	**- 12 monthly**

Note to Table 11

The canopy and canopy/extract plenum is an area of higher fire risk and consideration should be given to more frequent cleaning in accordance with insurers' requirements (see 7.39)

7.36 The frequency of cleaning should be adjusted by means of system testing (inspection/monitoring) - see paragraph 7.23, so that surface grease deposit limits in Table 9 are not exceeded. The buildings insurance company should be consulted to ensure that the cleaning regime is compliant with the terms of their specific warranty.

7.37 Any cleaning regime should be justified by a considered risk assessment. (The latest Fire Precautions Workplace, and Management of Health & Safety at Work Regulations apply).

7.38 Regular cleaning will result in an improved mean standard and reduce the costs of cleaning as deposits are not allowed to bake and harden.

7.39 Periodic specialist cleaning should be accompanied by daily or weekly cleaning of canopies, filters and associated drains and traps in accordance with manufacturers' recommendations, typically carried out by the kitchen operator.

Post-Clean Verification of Cleanliness

7.40 The primary method of assessment is visual. For cleaned system verification, the surface should be visibly clean and capable of meeting the level of cleanliness specified.

7.41 Verification of cleanliness should be by means of the Deposit Thickness Test or Wet Film Thickness Test as detailed in System Testing (Inspection/Monitoring) at paragraph 7.23.

7.42 The level of cleanliness is that no single measurement should exceed 50μm

7.43 On completion a report should be provided containing the following:-

- The system(s) cleaned
- Pre-clean measurements (as per System Testing)

- Post-clean measurements
- Photographic records
- Additional works carried out (if any)
- COSHH data on any chemicals used
- Recommendations for future cleaning requirements
- Observations on the condition of the ductwork system
- A sketch or schematic of the system indicating access panel and testing locations and highlighting any uncleaned areas with a written explanation as to why the area could not be accessed/cleaned (see paragraph 7.6)

7.44 If specified, additional kitchen extract safety issues should also be reported (as outlined in paragraph 7.26).

7.45 The Post-Clean Verification of Cleanliness report should assist to serve as evidence of system status to insurance assessors, Environmental Health Officers, landlords' agents, etc.

SECTION 8

Hazardous Contamination

8.1 A variety of specifically hazardous contaminants may be found in the ventilation systems, especially in industrial or laboratory Local Exhaust Ventilation systems (LEV) whose performance falls under COSHH Regulations.

8.2 Hazards may include precipitated toxic, carcinogenic or otherwise hazardous particulate, condensed vapours and pathogenic micro-organisms.

8.3 Asbestos presents a variety of possible hazards including:

- Contamination of ventilation system air and surfaces by asbestos fibres.
- System construction materials which may be disturbed in gaining access to the system (e.g. cladding or panelling).
- Components such as flexible ductwork, flexible connections, gaskets, etc. containing asbestos.

8.4 Asbestos must be removed and worked on only by licensed specialist contractors.

8.5 Specifiers must define any such likely or known hazards in accordance with COSHH Regulations and contractors have a duty to satisfy themselves that hazards are known and accounted for.

8.6 Specific risk assessments should be carried out and particular method statements provided to deal with hazardous contamination.

8.7 Any swab sampling required to meet specific needs should be identified before work commences.

SECTION 9

Verification of Cleanliness

9.1 The primary method of assessment is visual. For cleaned system verification the surface should be visibly clean and capable of meeting the level of cleanliness specified.

9.2 Verification, where specified on general ventilation systems, should be by means of a vacuum test (V.T.), as described in Appendix D, based on the recommendations of the US National Air Duct Cleaners Association (NADCA) ACR 2005. A system will be considered acceptably cleaned if, following a V.T., a result of not more than .075g/m² is achieved. This is equivalent to 0.75mg/100cm² as per ACR 2005. Verification for kitchen extract systems is dealt with in Section 7.

9.3 It should be noted that verification should take place immediately after cleaning to avoid any possibility of post clean interference. The client should be given the opportunity to witness testing of ductwork surfaces.

9.4 For specialist pre-commission cleaning of new systems the vacuum test cleanliness level of 0.075g/m² set out in paragraph 9.2 is appropriate rather than the surface deposit limits (which determine dirtiness levels) set out in Table 5.

Completion Report

9.5 On completion a comprehensive report should be provided. This should clearly state the following information:

- The ventilation system(s) cleaned
- Cleaning methods used
- Verification results
- Photographic support
- Additional works carried out (if any)
- COSHH data on any chemicals used for cleaning or biocidal treatment
- Recommendations for future testing and cleaning requirements

9.6 For Kitchen Extract Systems a report should be provided as set out in paragraph 7.43.

SECTION 10

Health and Safety

10.1 A Risk Assessment and Safety Method Statement for the work should be prepared by a competent person and approved by the client before allowing the work to be started.

10.2 COSHH assessments for any substances to be used should also be made.

10.3 The Risk Assessment, Method Statement and COSHH assessments must be drawn to the attention of the operatives and their supervisors, and understood, before they commence work.

10.4 The HVCA Risk Management and COSHH Manuals give comprehensive guidance on how these legally required documents should be prepared.

10.5 Physical entry into ductwork should be avoided wherever possible, but where it is deemed necessary, the Health & Safety, Confined Spaces Regulations should be consulted and the guidance in the Approved Code of Practice to the Regulations closely followed. The ductwork itself and any supports or hangers must be assessed as to their ability to support the additional weight of the operative and any equipment he may take into the duct.

10.6 Appropriate Personal Protective Equipment (PPE), as detailed in the Method Statement, must be worn at all times. All PPE must be selected by a competent person as suitable for the purpose and must fit the individual operative properly (Health & Safety (PPE) Regulations).

10.7 A procedure for regular checking and cleaning of PPE must be set up and defects remedied by repair or replacement before any operatives are put at risk.

10.8 Particular special controls may be needed to deal with hazardous particulate, microbiological or gaseous contaminants or with hazardous cleaning processes, e.g. use of solvents, coatings, steam or pressurized water, etc.

APPENDIX A

Microbiological contamination

A1. Microbiological colonisation of air handling system surfaces, as of other surfaces, by non-pathogenic environmental micro-organisms is normal. Generally poor hygiene conditions may lead to excessive colonisation or potentially harmful or pathogenic growth. The presence of moisture will tend to encourage microbiological growth.

A2. Microbiological aspects of ventilation hygiene are covered in TM26: 2000 published by the Chartered Institute of Building Services Engineers (CIBSE). Details of this publication are given in Appendix E.

A3. Biocidal treatment should be carried out in conjunction with removal of the source of contamination e.g. dirt and/or moisture. Biocidal treatment must not be used as a substitute for physical cleaning and removal of any deposits.

Biocidal Treatment

A4. Where it has been decided that microbiological colonisation of system surfaces should be controlled, care must be taken to ensure that the biocide is safe for site users and for operatives.

A5. There is a hierarchy of treatments for the control of organisms as follows (in ascending order of severity):-

A5.1 Fumigation: The killing of large organisms including insects, mammals etc. Usually all micro-organisms would be killed by highly toxic methods, but some methods exist whereby mammals will be killed by denial of oxygen and this may not be effective against micro-organisms.

A5.2 Sterilisation: The killing of all micro-organisms leading to nil growth, usually involving highly toxic methods.

A5.3 Disinfection: The killing of pathogenic organisms and radical reduction of microbiological colonisation to very low levels.

A5.4 Sanitisation: The reduction of microbiological colonisation to lower levels.

A6. Care should be taken to specify the level of control which is actually required, with the important proviso that the level of hazard associated with the process of biocidal treatment should be the minimum to achieve the required objective. In most circumstances, sanitisation treatment will suffice. The risks and costs associated with more hazardous treatments should be avoided unless specifically required.

A7. Biocidal treatments should be subject to specific risk assessments taking account of at least the following parameters:-

a) Nature of microbiological hazard e.g. known pathogen or normal environmental micro-organisms. Where an air system is known to contain pathogenic micro-organisms, suitable pre-treatment should be carried out to make the system as safe as reasonably practicable, prior to any work being carried out on the system.

b) Nature of treatment e.g. chemicals and method of application.

c) Protection of operatives: e.g. type of Personal Protective Equipment.

d) Isolation of third parties e.g. carrying out treatment whilst the building or served area is unoccupied. If the building is not fully vacated, the area served by a system should be carefully defined to avoid any exposure of third parties to treatment.

e) Protection of site e.g. consideration should be given to inadvertent leakage of treatment chemicals.

f) In order to avoid any possibility of adding to the indoor air chemical contamination, active biocide should not normally remain within air distribution systems.

g) The biocide manufacturer's guidelines must always be followed.

A8. The specification should include a definition of the method of verifying the effectiveness of the treatment including the number and type of microbiological samples to be taken and their analysis e.g. in-house or third-party laboratory.

Notes for the Specifier

1. None of the four biocidal treatments noted above should be considered as a substitute for cleaning.

2. A COSHH Assessment and Product Data Sheet should be available for any proposed biocide and a copy retained in the system log. This information should demonstrate the suitability of the biocide for use in an HVAC system with regard to health and safety of occupants and operatives, and its compatibility with the materials of construction.

3. The space served by the system to be treated should be capable of being effectively isolated for the period of time recommended by the biocide manufacturer.

   Where this is not possible, stringent control measures e.g. reversal of supply air flows, should be employed to preclude any release of biocide into occupied areas.

APPENDIX B

Legislation and guidance

B1. Legislation and guidance on standards in buildings is largely orientated towards the design and construction of buildings and associated systems. Increasingly the proper maintenance of building systems is recognised as crucial to the healthy, economic and safe operation of occupied spaces.

Relevant Legislation and Guidance includes but is not restricted to the following.

B2. **Health and Safety at Work Act 1974** lays down that employers or persons concerned with premises owe the "common duty of care" both to employers and others who may use or visit the premises. They are required to exercise this duty "so far as is reasonably practicable."

B3. **The Control of Substances Hazardous to Health** (COSHH) Regulations. This requires an employer to make a formal assessment of health risk from hazardous substances, which includes human pathogens or any dusts present in substantial quantities in the air. Regulation 7 (1) requires the employer to prevent exposure of his employees to substances hazardous to health, or where this is not practicable, to ensure that any exposure is adequately controlled.

Under these Regulations, local exhaust ventilation systems dealing with hazardous substances are required to be checked regularly to ensure they are performing efficiently.

B4. **The Occupiers' Liability Act 1984** imposes a duty of care on an occupier of premises to prevent (so far as is reasonably practicable) risk to others of injury, which includes any disease and impairment of physical or mental condition.

B5. **The Workplace (Heath, Safety and Welfare)** Regulations 1992 require that effective provision should be made to ensure that every enclosed workplace is ventilated by a

sufficient quantity of fresh or purified air. Where this ventilation is provided by mechanical means the Regulations require those mechanical ventilation systems to be maintained (including cleaned as appropriate) in an efficient state, in efficient working order and in good repair. Failure to carry out these duties is a breach of the Regulations.

B5.1 The Approved Code of Practice (ACOP) accompanying the above Regulations gives guidance on how compliance with the Regulations can be achieved. The ACOP also includes guidance on reasonable practicable steps that can be taken. Failure to follow the ACOP is not a breach of the Regulation, but in the event of a prosecution it can be seen as a failure to comply with the relevant regulation unless it can be shown the Regulation has been complied with in another way.

B6. Health and Safety Executive: HSG202 "General Ventilation in the Workplace Guidance for Employers" describes general ventilation and fresh air requirements for ordinary workplaces. It restates the legal requirements and cites the HVCA and CIBSE as able to provide information on testing for likely contaminants in ductwork and on cleaning.

B7. The Fire Precautions (Workplace) Regulations 1997 impose requirements on the employer regarding fire precautions in the workplace.

B7.1 The Fire Precautions (Workplace) (Amendment) Regulations 1999 remove most of the exceptions to the 1997 Regulations.

B8. Sick Building Syndrome Health and Safety Executive Guidance Note HS(G) 132 gives guidance on how to deal with Sick Building Syndrome.

B9. Legionnaires Disease The HSE Approved Code of Practice L8 gives guidance on how to deal with the control of Legionellosis including Legionnaires disease.

APPENDIX C

Contractor selection

C1. The following qualification criteria should be considered when selecting specialist contractors.

a) Experience

- Number of years operation as ventilation hygiene specialist.
- Demonstration of track record with project references.
- Total number of field operatives directly employed full-time in ventilation hygiene works.

b) Affiliation

- Membership of appropriate trade bodies such as the HVCA, NADCA or similar.

c) Quality Assurance

- Work with quality systems or to accredited quality standards.
- Qualifications and technical training of staff.

d) Health and Safety

- Health and safety policy and description of safe methods of work specific to ventilation hygiene works.
- Records of training and competency.
- Availability of professional health and safety advice.
- Recognised awards.
- Safety/accident records.

e) Insurance

- Full details of any Professional Indemnity, Employers Liability, Public Liability and Contractors' All Risks Policy, clearly stating any limitations on cover.

f) Financial

- Demonstration of competence to handle contracts of proposed size in terms of finance and operational resources.

APPENDIX D -

Testing Methods

D1. DEPOSIT THICKNESS TEST (D.T.T.)

D1.1 Test equipment

1. Instrument to be used is an electro-magnetic induction type thickness gauge with statistics and a non-contact measuring tip.

2. Calibration foils required 250μm, 50μm and 25μm.

D1.2 Accuracy of Measurement

The accuracy of the machine should be within +/-3μm.

D1.3 Procedure for the Measurement of Deposit Thickness on Galvanised Ducting Systems

1. Calibrate the instrument according to the Manufacturer's recommendations using the certified foils provided.

2. Place a measuring template (250x160mm or equivalent surface area) over the surface to be tested, marking the four corners with a marker pen. Take a minimum of 20 readings randomly within the test area, recording the highest, lowest and mean values obtained.

3. Thoroughly remove the deposit coating using resin impregnated cloth and replace the grid into the same position as previously, lining up the pre-marked corners.

4. Take a further 20 readings as previously, again recording the highest, lowest and mean values obtained.

5. To determine the thickness of deposit subtract the readings obtained in stage 4 from those in stage 2.

D2. DUST VACUUM TEST (V.T)

This test is adapted by kind permission of the US National Air Duct Cleaners Association (NADCA).

D2.1 Test Equipment

1. Air Pump: A high volume air sampling pump capable of drawing 10 litres per minute through a cassette containing 37mm matched weight filters (two 0.8μm pore size mixed cellulose ester (MCE) filters in series).

2. Filter Media: 37mm mixed cellulose ester (MCE) matched weight filters (0.8 μmpore size) in three piece cassette.

3. Calibration: Air volume rate calibration device that is accurate to +/- 5% at 10 litres per minute.

4. Template: Approximately 0.4mm thick, 0.01m^2 sampling area; two 20mm x 250mm slots at least 25mm apart.

The standard slot size for the Vacuum Test Template is 20mm in width by 250mm in length. At times templates with slots of this size may not fit in a space where testing is necessary or desired. Slots of other sizes may be utilized, providing that the template adheres to the following specifications.

The slot opening size and shape can vary provided that

- The total area to be sampled is equal to 0.01m^2;
- The maximum width of the slot does not exceed 30mm, so that the sample cassette does not touch the surface being sampled;
- The minimum slot width is greater than or equal to 20mm.

D2.3 Sampling Procedure

All sampling must be preceded by Visual Inspection.

1. Secure template to surface to be sampled so that it will not shift position during sample collection. The template must lay flat against the surface to be sampled. The surface to be sampled must be dry. Fans must not be running when the sampling is being conducted.

2. Remove protective plugs from cassette.

3. Attach outlet end of cassette to pump tubing.

4. Adjust air flow using appropriate calibration device to 10.0 litres per minute.

5. Vacuum the open area of the template by sliding the cassette from one end of each template slot to the other. The cassette must be moved at a rate not greater than 50mm per second. The edges of the cassette must rest on the template. The cassette must not touch the duct surface. Each template slot must be vacuumed twice, once in each direction along the major axis of the template slot.

   Throughout the vacuum process, hold the cassette so that it touches the template surface, but so that no downward pressure is being applied.

6. After the surface has been vacuumed twice, replace the plugs in the capsule.

7. Mark the cassette with an indelible pen. A code may be used to protect client confidentiality. A log should be kept to corelate the code with other important information such as job site, location in ductwork, date, etc.

8. The cassette should be sent to an independent laboratory for weighing using a precision balance of at least 4-point accuracy.

9. In the case of cleanliness verification measurement, the filters alone are weighed, i.e. the difference between the two matched weight filters gives the result.

10. 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:

    On receipt in the laboratory the cassette is cleaned externally to remove loose dusts then:

    a) The entire cassette is weighed.

    b) The cassette housing is weighed with the filters and loose dust removed by cleaning.

    c) The bottom of the two matched weight filters is weighed and the value multiplied by 2.

    The total dust collected in the cassette is calculated as: (a-b-c)

11. The laboratory will report results in milligrams (mg). By relating to the template slot sizes, the results should be converted into g/m² and an assessment offered in general terms to comprise the report to the client.

D3 WET FILM THICKNESS TEST (W.F.T.T)

D.3.1 Test Equipment

a) A precision gauge capable of measuring wet film thickness from 50 to 800μ microns at suitable increments (including 200). Toothed combs typically used to measure wet paint film thickness are suitable.

b) Alternatively an electro-magnetic induction gauge as described in D.1.1 - D.1.3, may be used, but care must be taken to avoid compression of soft grease films.

D.3.2 Accuracy of Measurement

The accuracy of the W.F.T.T gauge will be defined by a reputable manufacturer and will typically be better than ± 5μm.

It is most important to ensure that the gauge is held strictly perpendicular to the substrate, since holding the gauge at an angle off 90° will tend to exaggerate the measured result.

Gauges subject to regular or hard use should be of sufficient durability to withstand wear, or be regularly replaced.

D.3.3 Procedure for the measurement of Grease Deposit Thickness on hard surfaces using a toothed comb

a) Using the outer side, or tooth, of the comb, slide it along a surface to reveal a clean start point of bare metal.

b) With the comb held upright and the outer posts in contact with the revealed duct surface, slide it through the deposit for 100mm. For circular ductwork, slide around the circumference of the duct.

c) Examine any tracks left by the teeth that are slightly graduated in height compared to the outer posts. The lowest ("clean") tooth, which has not touched the deposit indicates the maximum deposit thickness. The result should be given as between the lowest "clean" tooth and the adjacent tooth that has a track mark in the deposit, in microns (μm). The measurement should be uniform along the length of the 100mm long test area. If it is not, re-measure to establish a reliable representative result.

d) Clean the gauge before carrying out further measurements.

APPENDIX E

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NOTE. *The European/British Standards and other documents listed are those available at the time of publication. Users should ensure that they consult the latest version.*

Notes

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