HVAC HYGIENE

SYSTEM INSPECTION AND ASSESSMENT

Maintaining clean systems is an important part of sustainable HVAC system management. Clean HVAC systems can deliver considerable benefits, including improved indoor air quality and operational efficiency, reduced occupant complaints and energy use, as well as reduced system maintenance and failures.

PULL OUT

Overall, maintaining clean HVAC systems reduces the building owners' and system operators' costs and exposure to risk.

Contaminants in HVAC systems can take many forms. Common contaminants include dust and particles, bacteria or fungus, debris from rusted HVAC components, man-made fibres, mould spores, pollens and moisture. Other contaminants can include asbestos, building debris, litter from animals, birds or insects, and smoke residues.

Few, if any, HVAC systems are free of all contaminants. In fact, particles are deposited in HVAC systems before they are even installed. Poor design, improper installation and commissioning practices, low-efficiency air filtration, excessive filter bypass, inadequate or infrequent preventative maintenance practices, humid conditions, and many other factors can result in contaminated HVAC systems. Considering HVAC hygiene during all stages (installation, commissioning and operation) of the system is essential to achieving optimum HVAC system outcomes.

HYGIENE LEVELS DEFINED

The descriptions listed in the table below (Table 1.1) provide the HVAC system hygiene inspector with four hygiene levels. These help determine if cleaning is required when assessed against the minimum acceptable hygiene standards, which are listed in Table 1.3.

Hygiene level	Description
1. Clean	No visible dust, debris or other contamination.
2. Light	Only slightly visible layer of fine general dust consistent over the component surface with little to no variations in density. Component surface remains visible beneath the fine layer of dust.
3. Moderate	Visible levels of general dust with varying density and limited areas of accumulated fine debris. Component surface is still visible in some areas beneath the fine dust but in isolated sections may not be.
4. Heavy	High levels of visible dust, debris, fibres or any other contamination that cover the component. Component surface is barely if not at all visible beneath the contamination.

Table 1.1: Definition of hygiene levels.

ACCESS FOR INSPECTION

Access allows the inspection of internal surfaces of all components, and a representative portion of the internal surfaces of the HVAC systems. AS/NZS 3666 parts 1 and 2 both require adequate provision of access for maintenance. Visual inspections and assessments are generally carried out directly, but can also be carried out remotely using robotic or manually operated camera systems.

Where possible, access to HVAC system interiors should be made through existing openings such as supply diffusers, return grilles and existing duct access openings.

Access openings in air ducts are usually located adjacent to:

- Dampers (balancing, fire and smoke, air control, back draft, splitter, etc.)
- Duct-mounted electric heaters
- Heating, reheat and cooling coils
- Mixing and VAV boxes
- Other in-duct mechanical components and sensors
- Turning vanes
- Duct transitions, offsets, and changes of direction.

New access openings should be located near the aforementioned system components. Each of these locations may require one or more access openings to properly access the ducts for inspection or cleaning. General recommendations for the installation of new access openings in ductwork systems are covered in detail in AIRAH's HVAC Hygiene Best Practice Guidelines (see endbox).

New access opening locations should be indicated on the updated "as installed" system drawings, if available. System operating and maintenance information should also be updated.

INSPECTION FREQUENCY

Table 1.2 specifies the routine hygiene inspection frequency for HVAC systems and components. Inspection frequencies are the same for both general use and special use HVAC systems.

The inspection intervals specified in Table 1.2 are minimum recommendations. More frequent inspections may be necessary due to numerous environmental, regulatory, mechanical and operational factors.

High-humidity areas, for example, could require more frequent inspections during particular times of the year, due to the increased potential for microbial amplification. Similarly, HVAC systems that serve enclosures subject to a high rate of contaminant generation typically require more frequent inspection. Where system contamination rates are consistently high, the system filtration may need to be installed or upgraded.

HVAC system inspections can be instigated as a result of complaints received from the building occupants, or as a result of the findings of an occupant survey, indoor air quality assessment or indoor environment quality assessment.

If a contaminated HVAC system component is discovered, then an inspection of the complete HVAC system – including all related components – should be conducted during that same inspection, rather than in accordance with the intervals specified in Table 1.2.

The HVAC systems in all newly constructed or renovated buildings should be inspected and verified as clean prior to system commissioning.

HVAC system components	Minimum inspection intervals
Air handling units	Monthly
Supply system – moisture producing equipment	Monthly
Air intakes and exhaust outlets	Monthly
Supply air systems	Annually
Return air systems	Annually
Outside air systems	Annually
Exhaust air systems	Annually
Evaporative coolers	Quarterly
Non-ducted air conditioning	Monthly

Table 1.2: HVAC systems hygiene inspection frequency

Note: Inspection frequencies are the same for general and special use HVAC systems as per the requirements of AS/NZS 3666.2.

Other HVAC components – including electric duct-mounted heaters, and fire and smoke control dampers – are required to be regularly inspected and maintained. Refer to AIRAH DA19 for a comprehensive specification of HVAC maintenance.

INSPECTION PROTOCOLS

Systems and components

The HVAC hygiene inspection should include all air handling units and representative areas of the related HVAC system components and ductwork as defined under the subhead "HVAC hygiene audit report".

Contaminant disruption

The hygiene inspection should not negatively impact the indoor environment by disrupting settled dust and debris, or through microbial amplification. In cases where biological or fungal contamination is suspected, or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented.

Filters

System filters should be assessed for:

- Classification – Confirm that the type and classification of the installed filter is consistent with the operating and maintenance documentation.
- Air bypass – Assess the filter frame, seals and housing for evidence of system air bypassing the filter.
- Loading – Assess the contaminant loading of the filter, either visually or by pressure drop assessment, and any sign of filter microbiological contamination.
- Maintenance – Assess for evidence of a scheduled filter maintenance program.

HVAC system damage

Document HVAC components that require repair due to pre-existing damage or degradation, and bring them to the attention of the building owner or representative. These should be included in the HVAC hygiene inspection report.

Damage may include worn bearings, broken belts, lubricant leakage, rust and corrosion, damaged dampers, leaking coils or valves, leaking ductwork or access panels, damaged insulation, excessive noise or vibration, etc.

HVAC system performance

If contamination build-up is compromising the performance of an HVAC system, it should be cleaned, as well as its components. An HVAC system may also require cleaning if contamination is causing it to use more energy, reduce airflow, or cause occupant ill health or discomfort.

SYSTEM ASSESSMENT

During inspections, systems should be assessed against the following minimum HVAC hygiene criteria.

General dust and particulates

Any system or components that have accumulated general dust and particulate debris greater than the minimum acceptable hygiene standards (as specified in Table 2.3, below) should be cleaned.

When the HVAC system or component is itself the source of contaminants, the system should be cleaned to stop the contamination. The source of the contamination should be identified and rectified.

HVAC system classification	HVAC system or component	Minimum hygiene level (See Table 1.1)
General use systems	Air handling unit (AH)	Clean
	Supply system – moisture producing equipment	Clean
	Air intakes and exhausts	Clean
	Supply air system	Pre-filtration – Moderate
	Return air system	Post-filtration – Light
	Outside air system	No filtration – Light
	Exhaust air system	Moderate
	Non-ducted refrigerated A/C	Light
	Evaporative coolers	Light
Special use systems	AHU	Clean
	Supply system – moisture producing equipment	Clean
	Air intakes and exhausts	Clean
	Supply air system	Pre-filtration – Light
	Return air system	Post-filtration – Clean
	Outside air system	No filtration – Clean
	Exhaust air system	Moderate
	Non-ducted refrigerated A/C	Clean
	Evaporative coolers	Clean

Table 1.3: Minimum acceptable system hygiene standards

Note: Certain HVAC special use applications such as clean rooms, operating theatres and the like may have specific requirements for higher levels of HVAC hygiene determined by other governing bodies, manufacturing/processing activities, regulations and the like.

Biological contamination

Visually assess the HVAC system and components for biological contamination, and clean any biologically contaminated surfaces.

Particular attention should be given to outside air intakes, exhaust discharges and where the contaminants might be coming from. Air intake and discharge points should be screened to prevent the entry of pests, contaminants and moisture. Sources of biological contamination should be investigated and mitigated.

Coils, pans, sumps, drains and any wet surface in the HVAC system should be visually assessed for biological contamination. Components should be cleaned if there is any bacterial contamination or surface biofilm.

Fungal contamination

The HVAC system and components should be visually assessed for fungal colonisation or fungal contamination on surfaces.

If fungal contamination in or on a system component is suspected, but not readily identifiable through visual assessment, then surface samples should be taken for laboratory analysis.

A mould-affected system should only be decontaminated or remediated once the system has been thoroughly assessed – the assessment should not be based on limited samples.

Note: Decontamination of a HVAC system due to mould or microbial contamination is a specialised activity that is outside the scope of this Skills Workshop.

Fungal analysis samples need to be sent to a mycological laboratory for testing and assessment, and identification of a fungal growth site. Details of sample removal, transport, assessment and analysis should be coordinated with the testing laboratory.

Once the system has been decontaminated and cleaned, the system hygiene level should be verified. In particular, the presence and source of moisture supporting any mould growth should be identified and prevented.

More generally, mould in buildings is covered in the World Health Organisation Guidelines for indoor air quality, dampness and mould.

Asbestos

If an HVAC system appears to be contaminated with asbestos dust or fibres, samples should be taken and analysed. If asbestos contamination is confirmed, the entire system should be decontaminated by competent persons.

If potentially friable asbestos-containing materials are found within a HVAC system, the system should be shut down, the asbestos containing material should be removed by licensed asbestos removalists, and alternative insulation installed in its place. This includes the insulation board surrounding duct-mounted electric heaters, if it is verified to contain asbestos.

Note: All asbestos removal work should be carried out in accordance with NOHSC: 2002 – National Code of Practice for the Safe Removal of Asbestos and all other applicable state and local government regulations and requirements.

Once all asbestos materials and contamination have been removed, the entire HVAC system should be cleaned and the system's hygiene level verified. The components should be labelled as asbestos-free, and the hazardous materials/asbestos register updated.

Deterioration or non-porous surfaces

If non-porous components have deteriorated surfaces that are contributing particulates or odours to the air stream – or otherwise adversely affecting air quality – they should be restored, and all downstream components inspected and cleaned as required.

Deterioration of porous surfaces and linings

Occasionally, internal HVAC insulation or lining materials deteriorate, and traces of the insulation or lining are found within the system components. In this case, the deteriorated surfaces should be restored, the affected components cleaned, and the entire system inspected for contaminants and cleaned.

Water damage

HVAC system surfaces and components subjected to water damage should be evaluated to determine salvageability and likely success of restoration. In particular, internal insulation should be investigated for waterlogging or fungal growth.

Salvageable components or ducts should be thoroughly cleaned and free from microbial growth. Any water-affected or waterlogged insulation products should be replaced.

Water damage due to condensation must be assessed, and the cause of the condensation identified and mitigated. Any water leaks (pipes, building structure) need to be identified and repaired prior to undertaking any HVAC cleaning or restoration work.

Fire and smoke damage

All HVAC system components subjected to heat or smoke should be evaluated to determine their integrity and likely success of any restoration activity. In particular, all fire and smoke dampers and all electric duct-mounted heaters should be assessed for fitness for purpose in accordance with the survey and maintenance protocols of AS 1851.

Components or surfaces that cannot withstand proper mechanical cleaning and restoration are beyond salvage and should be replaced. All porous surfaces subjected to fire or smoke damage should be evaluated for friability and odour retention following the cleaning process. Friable areas should be replaced or resurfaced. Any materials likely to impart odours to the supply air stream should be replaced.

Note: Friable means a solid substance that can be reduced (crushed or crumbled) into small pieces with little effort.

Any surface with heat exposure damage should be restored to an acceptable condition or replaced. Smoke residue that may remain on the internal surfaces of the system should be considered, as certain types of smoke residue can be highly corrosive. Some smoke residues can also be toxic. Any metal surfaces affected by smoke, heat or smoke residue should be evaluated by competent persons to determine if restoration will be achievable or effective.

Any components affected by water from fire suppression activities should be assessed in accordance with the water damage procedures above.

Building or renovation contamination

Any system or components found to have accumulated general dust and particulate debris greater than the levels specified in Table 2.3 should be cleaned. Depending on the type of contamination encountered, certain irritant particulates may require cleaning at levels less than specified in Table 1.3.

Odours

Odours are difficult to assess objectively, and any odour contamination should be brought to the attention of the building owner.

If objectionable odours cannot be removed by system cleaning, the HVAC component(s) in question should be replaced.

HVAC system damage

Damaged or degraded HVAC components should be assessed for their potential to contaminate the system, or to allow contaminants to enter the system. Any HVAC system or component damage noted during the assessment should be documented and brought to the attention of the building owner or representative. ▲

MORE INFORMATION

The information in this month's Skills Workshop was taken from AIRAH's HVAC Hygiene Best Practice Guidelines, which is available in AIRAH's online store. Visit www.airah.org.au

PULL OUT

Next month: **Maintenance strategies**