2025 EDITION

ACR

THE NADCA STANDARD

For
Assessment • Cleaning • Restoration
of HVAC Systems

NADCA

The International Standard for HVAC Cleaning Professionals

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for
Assessment, Cleaning, and Restoration of HVAC Systems

2025 Edition

The International Standard Developed by the National Air Duct Cleaners Association (NADCA)

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The National Air Duct Cleaners Association (NADCA) has developed and published the Assessment, Cleaning, and Restoration of HVAC Systems ("ACR, The NADCA Standard – 2025 Edition" or the "Standard"). The Standard is intended to provide information for assessing new and existing HVAC systems, evaluating the cleanliness of HVAC system components, and guiding the cleaning and restoration of HVAC systems to a specific level of cleanliness. The Standard is also intended to assist individuals and entities in establishing and maintaining their professional competence while working in the duct cleaning industry. All persons using the Standard must be, and remain, updated and informed about developments in the duct cleaning industry so that he/she may implement changes in technology and procedures as appropriate, as well as adhere to any applicable local, regional, provincial or national codes, laws, or regulations. Since every cleaning and restoration project is unique, in certain circumstances, common sense, experience, and professional judgment may justify a deviation from the information provided in the Standard. Furthermore, this Standard is not intended to be either exhaustive or inclusive of all pertinent requirements, methods, systems, or procedures that might be appropriate on a particular job. The information upon which this Standard is based is subject to change, which may modify, supplement or invalidate any or all of the information contained herein.

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FOREWORD

Assessment, Cleaning, and Restoration of HVAC Systems (ACR, The NADCA Standard) is unique in that it is a performance standard that also provides minimum procedural requirements. This Standard has evolved from procedural-based guidelines, standards of care, and research originating from the National Air Duct Cleaners Association (NADCA), along with associated organizations. It is based on reliable principles, review of applicable industry literature and information, and practical experience.

This Standard establishes minimum performance requirements for assessing new and existing HVAC systems, evaluating the cleanliness of HVAC system components, determining the need to clean and cleaning and restoring systems to a verifiable cleanliness level. The Standard also focuses on preventing job-related hazards, such as exposure to workers and occupants, and cross-contamination to the indoor environment.

This document is written for use by those involved in the HVAC cleaning and restoration industry including specifiers, consultants, contractors, and end users. Users of this document should stay updated and informed about changes in the industry and implement changes in technology and procedures, as appropriate, while following any applicable local, regional, provincial or national codes, laws, or regulations.

All HVAC cleaning and restoration projects are unique and, in certain circumstances, common sense, experience, and professional judgment may justify deviation from this Standard. It is the responsibility of the contractor, or others relying on this Standard, to verify on a case-by-case basis, that application of this Standard is appropriate. When in doubt, use caution and seek additional professional guidance. Users of this document assume all risks and liabilities resulting from use of, and reliance upon, this Standard.

ACR is a living document that is subject to change as more information regarding the HVAC cleaning and restoration industry becomes available and advancements are made in technology and practice. ACR, The NADCA Standard – 2025 Edition will be reviewed, evaluated, and validated through application in the field and thereafter revised and improved as deemed necessary.

GENERAL

PURPOSE

This Standard defines the minimum performance and procedural requirements for the assessment, cleaning and restoration of heating, ventilation and air conditioning (HVAC) system components. ACR, The NADCA Standard – 2025 Edition supersedes all previous editions of ACR, The NADCA Standard and is considered the standard of care for the HVAC cleaning and restoration industry.

SCOPE

This Standard applies to the assessment, cleaning and restoration of HVAC component airside surfaces as defined herein. It does not include the cleaning of non-ducted open air plenums and items such as the mechanical repair of electrical or pneumatic components of any kind, repair of high-pressure vessels, gas/oil controls or preventative maintenance tasks as prescribed by, or recommended by, the original equipment manufacturer (OEM).

APPLICATION

ACR, The NADCA Standard – 2025 Edition provides minimum standards and guidance for industry professionals, HVAC assessment, cleaning, and restoration service providers, building owners, and others who manage HVAC systems and projects.

QUALIFICATIONS

Those responsible for performing work to this Standard *shall* be properly trained and qualified and possess relevant knowledge and experience before performing work of any type on HVAC Systems. It is recommended that an individual with an Air Systems Cleaning Specialist (ASCS) or equivalent certification, be responsible for oversight of the project.

LIMITATIONS

This Standard does not specifically address any and all hazards or risks that could be encountered when performing work in accordance with this document. Instead, the user is directed to perform work in strict accordance with any applicable local, regional, provincial or national codes, laws, or regulations.

DETERMINING THE NEED FOR HVAC CLEANING & RESTORATION

It is *recommended* that any HVAC system component or components be cleaned when a proper HVAC cleanliness inspection or building history indicates one or more of the following conditions exist:

- The HVAC system components show the presence of particulate;
- The HVAC system components' performance is compromised due to accumulation of particulate;
- The HVAC system components have been determined to be a source of unacceptable odors;
- The HVAC system components are discharging visible dirt or debris into the conditioned space;
- The HVAC system components have been contaminated as a result of fire, smoke, and/or water damage;
- The HVAC system components have been infested with birds, rodents, insects, or their byproducts;
- The HVAC system components have been determined to be at risk for fire hazard;
- The HVAC system components have become contaminated with construction particulate or debris;
- Microbial contamination conditions have reached either Condition 2 or Condition 3;
- Deterioration of fibrous glass duct liner, duct board, or other porous components;
- As part of an HVAC maintenance program as defined in ANSI/ASHRAE/ACCA Standard 180;
- As part of the HVAC equipment manufacturers *recommended* maintenance practices;
- As part of a proactive energy management program;
- As part of a proactive indoor air quality management program;
- As a component to achieve LEED Certification;
- When a newly-installed component or duct has been contaminated with construction and/or other dust and debris.

NOTE: If there is any question on the need to clean, the Method 2 - NADCA Surface Comparison Test or Method 3 - NADCA Vacuum Test *may* be performed to determine the need for cleaning. These tests are described in detail in Section 5 of this Standard.

Section 1 – Inspections

1.0 Overview: Inspections are an important component of any HVAC cleaning and restoration project. HVAC inspections *shall* be performed to determine the need for cleaning. HVAC inspections *shall* also be performed to determine the scope of work, engineering controls, safety measures and tools and equipment necessary to perform a cleaning and restoration project.

1.1 When to Perform an Inspection: Inspections *shall* be performed before and after HVAC cleaning and restoration projects. It is also *recommended* that routine inspections be performed as part of a proactive maintenance, energy, and indoor air quality management plan.

1.2 HVAC Inspector Qualification: It is *recommended* that a qualified HVAC inspector, such as an Air Systems Cleaning Specialist (ASCS), Certified Ventilation Inspector (CVI), or equivalent, be used to determine the preliminary state of HVAC system component cleanliness. At minimum, such personnel *shall* have a verifiable working knowledge of basic HVAC system design, fundamental HVAC engineering practices, current industry HVAC cleaning and restoration techniques, and applicable industry standards. Individuals who are inspecting for microbial contamination *shall* be qualified (through training and experience) and licensed (where applicable by law) to determine Conditions 1, 2 and 3.

1.2.1 Risk Assessment: Prior to conducting an inspection of the HVAC system components the inspector *shall* have a clear understanding of what impact the inspection process *may* have on the building environment and its occupants.

1.3 HVAC Pre-Inspection: HVAC mechanical plans, building plans, and understanding the layout of the home or building will provide important information needed to establish the scope of work. Both building floor plans and mechanical plans, if available, *shall* be used during the inspection, cleaning, and restoration work.

1.4 Appropriate Environmental Engineering Controls: HVAC inspection activities *may* adversely influence a building's indoor environment. Of primary concern is the disturbance of settled particulate and the potential for disturbed particles to be released into occupied areas. During an inspection, appropriate engineering controls *shall* be used to manage the general workspace environment.

1.5 Routine HVAC Inspection: It is *recommended* that HVAC system component inspections be part of a building's overall maintenance, energy, and indoor air quality management plan, and that the inspections be addressed in accordance with documents such as ANSI/ASHRAE/ACCA Standard 180 *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems* and NFPA 90-A *Standard for the Installation of Air- Conditioning and Ventilating Systems*.

1.5.1 Inspection Schedule Table
HVAC system components *shall* be routinely inspected for cleanliness by visual means. Table 1 provides a *recommended* inspection schedule for major HVAC system components within different building use classifications. The inspection intervals specified in Table 1 are minimum recommendations.

1.5.1.1 It is *recommended* that more frequent cleanliness inspections be performed when geographical, human, or mechanical conditions make it necessary.

Table 1
HVAC Cleanliness Inspection Schedule
(Recommended Intervals)

Building Use Classification	Air-handling Unit	Supply Duct	Return Duct / Exhaust Duct
Residential	1 year	2 years	2 years
Commercial	1 year	1 year	1 year
Industrial	1 year	1 year	1 year
Healthcare	1 year	1 year	1 year
Marine	1 year	2 years	2 years

1.6 HVAC System Component Inspection – Construction, Retrofit, and Remodel: HVAC system components often collect significant amounts of debris and particulate during construction activities within a building. It is *recommended* that new and existing HVAC system components that are part of a construction, retrofit, or remodel project be inspected for cleanliness before the system is permitted to operate.

1.7 Performing HVAC System Component Inspections: The cleanliness inspection *shall* include, at minimum, 10% of the HVAC system components being inspected. Components include, but are not limited to, supply air ducts, return air ducts, VAV boxes, fan powered terminal boxes, and mixing boxes. If the inspection is being conducted as part of a microbial remediation project in accordance with ANSI/IICRC Standard S520, then all components of the HVAC system *shall* be inspected.

1.7.1 Air-Handling Unit Inspections: The air-handling unit (AHU) cleanliness inspection *shall* include, but is not limited to, the following components within the unit: filters and air bypass; heating and cooling coils; condensate pans; condensate drain lines; humidification systems; acoustic insulation; fans and fan compartments; dampers; door gaskets; and general unit integrity. This would also include components such as fan coil units, evaporative coolers, etc.

1.7.2 Supply Air Duct Inspections: The supply duct cleanliness inspection includes, but is not limited to, the following components: air ducts; mixing boxes; VAV boxes; fan powered terminal boxes; reheat coils; and all other associated components.

1.7.3 Return Air Duct Inspections: The return air duct cleanliness inspection includes return components including, but not limited to: return air ducts; dampers; return plenums; and all other associated components.

1.7.4 Non-Ducted/Open Air Plenum Inspections: Open air plenum inspections may or may not be considered as part of the contractual scope of work. Open air plenums present unique cleaning and environmental control challenges. Therefore, it is recommended to refer to the NADCA White Paper, Inspection & Cleaning of Open Air Plenums in HVAC Systems.

1.7.5 Exhaust Air Duct Inspections: General exhaust, bathroom exhaust, and heat recovery exhaust are considered part of the ventilation system and a part of the overall inspection.

1.7.6 Damaged Components: Damaged or unsafe components observed during the inspection *shall* be documented.

1.8 Exposure to Hazardous Materials: If the possibility exists that the inspector or others *may* be exposed to hazardous materials, consultation with a qualified indoor environmental professional (IEP) or other health and safety professional is *recommended*.

1.9 Suspect Microbial Contamination: During the cleanliness inspection, if suspect microbial contamination (i.e. mold) is observed, **i**t is *recommended* that a preliminary determination of the level of contamination (Condition 1, 2, or 3) be noted. It is *recommended* that the cause and extent be further assessed, if necessary, by an indoor environmental professional (IEP) or other appropriate professional, in strict accordance with any applicable local, regional, provincial or national codes, laws, or regulations.

1.9.1 If the inspection of an HVAC unit's air-handling components reveals suspect microbial contamination, then the supply and return ducts *shall* be inspected during that same inspection time rather than in accordance with the intervals specified in Table 1.

1.9.2 If water damage or suspect microbial growth is observed on building products or furnishings, this condition is not within the scope of this document. Refer to ANSI/IICRC S520 and/or in strict accordance with any applicable local, regional, provincial or national codes, laws, or regulations.

1.10 System Component Assessment: Information collected from the HVAC inspection *shall* be documented and evaluated to assess the condition of the HVAC system components at the time of the inspection. The assessment *shall* include a recommendation on the need for cleaning, a clearly defined scope of work for the cleaning and restoration project, recommended cleaning techniques, a determination of the environmental engineering controls required for the workspace, and any unique requirements.

Section 2 – Work Plans

2.0 Overview: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor *shall* provide a written work plan. A written work plan is a document that communicates responsibilities and specific tasks associated with the cleaning and restoration project. The work plan is based upon information gathered from the HVAC inspection and system assessment.

2.1 Purpose: The primary purpose for providing a written work plan is to allow the client, the cleaning contractor, field personnel, and others involved in the project to have a clear understanding of what work tasks and procedures will be performed.

2.2 Scope of Work: A scope of work *shall* be included that clearly identifies which HVAC components are to be cleaned or restored. The scope of work *shall* also include the environmental engineering controls required for the workspace, and any unique requirements.

2.3 Means and Methods: It is *recommended* that the written work plan identify the specific means and methods of cleaning and restoration that will be used for the particular project.

2.4 Other Trades and Their Tasks: When applicable, it is *recommended* that the work plan include the name of all firms, contractors, and representatives involved in the project, along with contact information. It is *recommended* that the tasks others will perform be clearly identified.

2.5 Project Schedule: When appropriate, it is *recommended* that the work plan include the dates and times the work will take place and an overall timeframe for completion.

2.6 Work Site Communication Plan: When more than one company is associated with the project, it is *recommended* that the written work plan list the name, company name and contact information of pertinent individuals, along with their responsibilities for the project.

2.7 Product Submittals: All general use and/or specific "chemical type" products and coatings specific to the project *shall* be clearly listed on the work plan. Additionally, the manufacturer's instructions for use and application *shall* be available at all times for workers and others.

2.7.1 Safety Data Sheets: The work plan *shall* include Safety Data Sheets (SDS) for all chemical products to be used on the project. In addition, the SDS *shall* be maintained on-site and be available for review for the duration of the project. Documentation showing that the products have been submitted to the client for review *can* also be included in the work plan.

2.7.2 Controlling Vapors and Odors: Where applicable, the plan *shall* include a description of Engineering Controls (see Section 3) to be employed to control occupant and worker exposure to chemical vapors and odors.

2.8 Safety Plan & Safety Concerns: When life safety detection equipment (e.g., air duct sensors and smoke detectors) needs to be off-line or disabled, the work plan *shall* address life safety concerns, which will likely require the input of others. It is *recommended* that the written work plan define the responsibilities of each organization's designated representative involved with executing the plan for the duration of the HVAC system cleaning and restoration project.

Section 3 - Engineering Controls for HVAC Cleaning and Restoration Projects

3.0 Overview: Engineering controls *shall* be used to prevent cross-contamination. Engineering controls *may* include but are not limited to: source control; isolation barriers; pressure differentials; dust suppression methods; HEPA vacuuming and filtration; detailed cleaning; temperature and humidity control; and a sanitary approach.

3.1 Equipment Maintenance: All contractor equipment *shall* be maintained in good working order, consistent with applicable jurisdictional requirements, including but not limited to: vacuum collection equipment; power tools; pressurized air sources; electrical power cords and plugs; ground fault protection devices; vacuum collection hoses; fluid and pneumatic lines; manual and mechanical rotary brush systems; robotic equipment; pneumatic cleaning systems; air duct zoning devices; ladders; staging equipment; and hand tools.

3.1.1 Equipment Maintenance Before Project: Before any equipment is brought onto the work site it *shall* be cleaned and inspected to ensure that it will not introduce contaminants into the indoor environment or HVAC system components.

3.1.2 Equipment Maintenance During a Project: During a project, all equipment *shall* be serviced as needed to limit possible cross-contamination from poor hygiene, and/ or unsafe operating conditions for service personnel and building occupants.

3.1.2.1 Collector Filter Maintenance During a Project: Any activity requiring the opening of contaminated vacuum collection equipment on-site, such as servicing, or filter maintenance *shall* be performed in an appropriate containment area or outside of the building.

3.1.3 Transportation and Relocation of Equipment: All collection devices, vacuums and other tools and devices *shall* be cleaned or sealed before relocating to different areas of the building and before removing the equipment from the building.

3.1.4 On-Site Equipment Verification: It is *recommended* that an on-site maintenance verification be performed on vacuum collection equipment prior to commencement of work.

3.2 Fuel-powered Equipment: Generators, vacuum trucks, air compressors or other fuel-powered equipment *shall* be positioned in a location to prevent combustion emissions and air exhaust emissions from entering an occupied space.

3.2.1 Location *shall* be monitored and managed during a project to prevent the introduction of combustion emissions into the occupied space.

3.3 Vacuum Equipment Exhausting Indoors: When using vacuum collection equipment exhausting within the building envelope, it *shall* utilize HEPA filtration with 99.97% collection efficiency at 0.3 micron particle size.

3.4 Negative Pressure Requirements: A continuous negative pressure *shall* be maintained in the portion of the HVAC system components being cleaned in relation to the surrounding indoor spaces. The negative pressure *shall* be verifiable at representative locations during the cleaning process.

3.5 Handling of Contaminated Materials: To prevent cross-contamination, all contaminated materials removed from the HVAC system components *shall* be properly contained prior to removal from the building.

3.5.1 Materials deemed to be hazardous by governmental agencies *shall* be handled in strict accordance with any applicable local, regional, provincial or national codes, laws, or regulations.

3.6 Ambient Air Cleaning: It is *recommended* that ambient air cleaning using HEPA-filtered air scrubbers be employed as a supplemental engineering control for particle reduction, during and immediately after HVAC cleaning and restoration work.

3.7 Control of Product Emissions: Any application of cleaning agents or other chemicals *shall* be used in strict accordance with manufacturer's recommended procedures and product application instructions, including exhaust ventilation as required.

3.8 Negative Pressure Failure: It is *recommended* that redundant equipment be available on-site in the event of negative pressure failure.

3.9 Level 1 Containment: Level 1 is the minimum level of containment that *shall* be used on all HVAC system component cleaning projects.

3.9.1 Negative Pressure: The HVAC system component, or area being cleaned/restored, *shall* be placed under negative pressure during all cleaning activities. Negative pressure *shall* be sufficient to prevent migration of any particulate material out of the HVAC system component.

3.9.2 Protective Coverings: Clean, protective coverings *shall* be used within the work area. Protective coverings *shall* extend beyond the work area to provide protection of flooring, equipment, and furniture whenever necessary.

3.9.3 Cross-Contamination Control: Engineering controls *shall* be in place to control contaminant discharge from the HVAC system components and/ or cross-contamination into occupied space during the cleaning process.

3.10 Level 2 Containment:

3.10.1 Include Level 1 requirements: All Level 1 containment requirements apply to Level 2 containments.

3.10.2 Temporary Containment Barriers: Temporary barriers *shall* be constructed to isolate the work area.

3.10.2.1 It is *recommended* that containment barriers be erected from floor to ceiling when applicable.

3.10.2.2 It is *recommended* that above-ceiling work areas are isolated from occupied spaces and/or non-work areas when applicable.

3.10.2.3 It is *recommended* that containment barriers are built utilizing 6-mil fire retardant polyethylene sheeting or equivalent.

3.10.2.4 These barriers are *recommended* to be sealed airtight where they meet the ceiling, floor, and walls or other areas.

3.10.3 Containment Area Floor: The containment *shall* have a two-layer floor utilizing 6-mil fire retardant polyethylene or equivalent. The floor material *shall* extend at least 6 inches (15.2 centimeters) up the containment side walls. The floor material *shall* be sealed to side walls in a manner that will remain secure and airtight during the depressurization.

3.10.4 Containment Area Access: A zipper-type access, with a single flap covering the zipper is the most common work practice.

3.10.4.1 In the event a zipper is not available or practical, then a vertical cut in the containment side wall *can* provide access into the containment area. The vertical cut *shall* be entirely covered by two flaps, one on each side of the polyethylene.

3.10.5 Negative Pressure: The containment area *shall* be kept under negative pressure at all times. The negative pressure *shall* be sufficient to prevent airborne migration of particulate material out of the containment area.

3.10.6 Validate Negative Pressurization: A manometer or airflow measuring/monitoring device *shall* be used to validate negative pressurization.

3.10.7 Ambient Air Cleaning *A*mbient air cleaning with HEPA-filtered air scrubbers *shall* be performed. Ambient air cleaning *shall* maintain, at minimum, four (4) air changes per hour.

3.10.8 Dismantling: Interior surfaces of the containment enclosure *shall* be wet-wiped and/or HEPA vacuumed before moving or dismantling the containment enclosure. In the healthcare environment, an appropriate post-remediation verification *shall* be performed prior to dismantling the containment.

3.11 Level 3 Containment: Level 3 is a containment with a single chamber decontamination unit.

3.11.1 Include Level 1 and Level 2 Requirements: All of the Level 1 and 2 containment requirements apply to Level 3 containments. In addition, the following protective actions *shall* be used under Level 3 Containment strategies.

3.11.2 Decontamination Facility: A single chamber decontamination facility *shall* be utilized in conjunction with the containment area. The decontamination chamber *shall* be attached and sealed directly to the containment area. The decontamination chamber *shall* be separated from the containment area by a zipper access with single flap or the use of two flaps as described in Level 2 Containment.

3.11.3 Monitoring Requirements: Level 3 containment areas *shall* be monitored for negative pressure on a continuous basis by using an instrument sensitive enough to detect a loss of negative pressure. Background monitoring for total particulate *shall* be performed prior to set-up of containment to establish baseline airborne total particulate concentrations. It is *recommended* that monitoring also be conducted during set-up of containment. Real time monitoring for total particulate *shall* be conducted on a regular basis during the work to ensure that particulate is not escaping the containment. If airborne particulate levels exceed background levels, work *shall* cease until airborne particulate levels are reduced to background levels and the cause of the problem is found and corrected.

3.12 Level 4 Containment: A Level 4 containment is a containment with a two-chamber decontamination unit.

3.12.1 Include Level 1, Level 2 and Level 3 Requirements: All of the Level 1, Level 2, and Level 3 containment requirements apply to Level 4 containment areas. In addition, the following protective actions *shall* be used under Level 4 containment strategies.

3.12.2 Decontamination Facility: A decontamination facility as described for a Level 3 containment area *shall* be utilized, except that the decontamination facility *shall* consist of two chambers. Each chamber *shall* be constructed according to the requirements described for a Level 3 containment area.

3.12.3 Monitoring Requirements: Monitoring requirements described for a Level 3 containment area apply. In addition, the containment *shall* have a constant recording pressurization monitor with an appropriate alarm.

3.13 Summary of Engineering Controls: Appropriate engineering controls are mandatory on every HVAC cleaning and restoration project. Protecting workers and building occupants and preventing cross-contamination *shall* be considered a priority on every project. It is *recommended* that the above listed engineering controls are considered minimum requirements. When a contractor has any questions about project-specific engineering controls, it is *recommended* that an Indoor Environmental Professional (IEP) be consulted.

Section 4 - Cleaning and Restoration Procedures

4.0 Overview: All cleaning and restoration procedures *shall* achieve the minimum level of visibly clean or the specified level of cleanliness verification as defined in the contractual documents for components within the project scope of work.

4.1 Negative Duct Pressurization: Prior to and throughout the duration of the cleaning process, the HVAC system components and associated air ducts *shall* be kept at an appropriate negative pressure differential relative to the indoor non-work area. This negative pressure differential *shall* be maintained between the portion of the HVAC duct system components being cleaned and surrounding indoor occupant spaces.

4.1.1 Verifying Negative Pressure Differential: Under all circumstances, you *shall* verify pressurization differential during the project.

4.1.2 Equipment Exhausting Indoors: Vacuum collection equipment exhausting indoors *shall* be HEPA-filtered and be capable of retaining dislodged debris.

4.1.3 Equipment Exhausting Outdoors: All equipment used to create negative duct pressurization that does not have HEPA filtration *shall* be exhausted outdoors.

4.2 Service Openings: Service openings *may* be needed to perform assessment, cleaning and restoration (ACR) procedures. Below are the minimum requirements for service openings.

4.2.1 Service openings installed into the system *shall* not degrade the structural, thermal, or functional integrity of the system components.

4.2.2 Service openings *shall* be created in a manner that allows for proper closure.

4.2.3 Service openings *shall* not hinder, restrict, or alter the airflow within the air duct.

4.2.4 Service openings *shall* be in compliance with industry standards and local codes, using materials acceptable under those standards and codes.

4.2.5 Service Panels

4.2.5.1 Service panels used for closing service openings in the HVAC system components *shall* be of an equivalent gauge or heavier so as to not compromise the structural integrity of the duct.

4.2.5.2 Service panels used for closing service openings *shall* be mechanically fastened (screwed or riveted) at minimum every 4" on center. The panel *shall* overlap the ductwork surfaces by a minimum of 1" on all sides.

4.2.5.3 Service panels used for closing service openings *shall* be sealed with gaskets, duct sealants, mastic or tape.

4.2.5.4 All tapes and mastics used in the closure of service openings *shall* meet the requirements of UL 181A/B.

4.2.6 Prefabricated Duct Access Doors: The gauge of the duct access door *shall* be based on the pressure class of the duct system and *shall* be installed according to manufacturers' specifications.

4.2.7 Flammability and Smoke Spread Rating: Materials used in the fabrication of duct access doors and service panels *shall* be those classified for flammability and smoke spread if the material is exposed to the ducted airside surface. These materials are classified as having a flame-spread rating of not over 25 without evidence of continued progressive combustion and a smoke-developed rating of not over 50, as determined by UL 723. These materials *shall* comply with SMACNA and other applicable standards.

4.2.8 Fibrous Glass System Service Openings

4.2.8.1 Access and closure of service openings installed in fibrous glass *shall* be created and closed in such a manner that there are no exposed fibrous glass edges within the system common to the airstream.

4.2.8.2 Any fibrous glass removed during the installation of a service opening *shall* be repaired or replaced with like material of the same thickness so that there are no breaks or openings that would degrade the R value, service rating or vapor/air barrier characteristics. This includes any disruption to the external duct wrap.

4.2.9 Flexible Duct Systems: Service openings *shall* not be made in flexible ductwork.

4.2.9.1 It is recommended that the manufaturers' instructions be followed when disconnecting and reattaching flexible ductwork.

4.2.10 All service openings *shall* comply with applicable UL, IMC, SMACNA and NFPA standards and in strict accordance with any applicable local, regional, provincial or national codes, laws, or regulations.

4.3 Cleaning and Restoration of HVAC Systems: HVAC systems *shall* be cleaned by using a suitable agitation device to dislodge non-adhered substances from the HVAC component airside surface and then capturing the dislodged debris with a vacuum collection device.

4.4 Wet Cleaning, Power Washing, and Steam Cleaning: Wet cleaning, power washing, steam cleaning and any other form of wet process cleaning of HVAC system components *shall* not damage or result in subsequent damage to the components and/or facility equipment. Cleaning agents or water *shall* never be applied to electrical, fibrous glass or other porous HVAC system components.

4.5 Vacuum Collection Equipment: Vacuum collection equipment *shall* be operated continuously during cleaning. The collection equipment *shall* be used in conjunction with agitation tools and other equipment to convey and collect debris and prevent cross-contamination of dislodged particulate during the mechanical cleaning process.

4.5.1 Capture Velocity: When the vacuum collection device is used to convey air with debris, it *shall* maintain a sufficient velocity and negative pressure differential in the portion of the HVAC system component being cleaned. Table 2 defines *recommended* velocities for various types of contaminants.

4.6 Air-Handling Unit (AHU) Cleaning: It is *recommended* that air-handling coils, fans, condensate pans, drains and similar non-porous surfaces be wet cleaned in conjunction with mechanical methods.

4.6.1 Efforts to control water extraction *shall* be sufficient to collect debris and prevent water damage to the HVAC components and surrounding equipment and structure.

4.6.2 The capture, containment, testing and disposal of waste water generated while performing wet cleaning *shall* be in accordance with applicable local, regional, state and federal regulations.

4.7 Air Duct Cleaning: Air ducts *shall* be cleaned to remove all non-adhered substances and *shall* be capable of passing NADCA cleanliness verification tests.

4.7.1 Air ducts *shall* be accessed through service openings in the system that are large enough to accommodate mechanical cleaning procedures and allow for cleanliness verification.

4.7.2 Air ducts *shall* be cleaned using mechanical agitation methods to remove particulate, debris, and surface contamination.

4.7.3 Dislodged substances *shall* be captured with a vacuum collection device.

4.7.4 Cleaning activities *shall* not damage any HVAC components.

4.8 Dampers: Dampers and any air-directional mechanical devices *shall* have their position marked prior to cleaning and *shall* be restored to their marked position after cleaning.

4.9 Registers, Grilles, Diffusers: It is *recommended* that all registers, grilles, diffusers, and other air distribution devices be removed if possible, properly cleaned, and *shall* be restored to their previous position.

4.10 Smoke and/or Fire Detection Equipment: Cleaning activities *shall* not impair, alter or damage any smoke and fire detection equipment located within the facility, or attached to and serving the HVAC system components.

4.11 Coil Surface Cleaning: When coil cleaning is performed, both upstream and downstream sides of each coil section *shall* be accessed for cleaning. When both sides of a coil are not accessible for cleaning then removal and/or replacement *may* be required.

4.11.1 Preliminary Coil Inspection: A visual inspection of the coil and drain pan *shall* be conducted prior to cleaning a coil to determine whether Type 1 (Dry Cleaning) or Type 2 (Wet Cleaning) is required.

4.11.1.1 If it is determined the coil cannot be properly cleaned through Type 1 (Dry Cleaning), Type 2 (Wet Cleaning) *shall* be performed.

4.11.1.2 If the preliminary visual inspection reveals suspect microbial contamination on any portion of the coil or drain pan, Type 2 (Wet Cleaning) *shall* be performed.

4.11.1.3 When the metal fins of the coil are damaged, deteriorating, or showing signs of corrosion, replacement *may* be necessary. If cleaning will result in further damage to the coil, replacement is *recommended*.

4.11.2 Type 1 Coil Cleaning (Dry Cleaning): Type 1 (Dry Cleaning) methods of coil cleaning *shall* be used for removing loose dust, dirt or debris collected upon coil surfaces. Negative air machines *shall* be operated continuously during Type 1 (Dry Cleaning) coil cleaning process. The coil *shall* be isolated from the duct system during the cleaning process to ensure disrupted particulate does not migrate to, or redeposit on, unintended areas. Physical removal of debris *may* be accomplished through a variety of methods which *may* include:

- HEPA-filtered contact vacuuming
- Brushes for penetrating between coil fins
- Compressed air
- Fin straightening tools

4.11.3 Type 1 (Dry Cleaning) Post-Cleaning Inspection: This inspection *shall* be performed after Type 1 (Dry Cleaning) coil cleaning has been completed. If debris still remains on the coil or the coil is impacted, Type 2 (Wet Cleaning) *shall* be performed.

Table 2
Range of Minimum Duct Design Velocities

Nature of Contaminant	Examples	Design Velocity
Vapors, gases, smoke		Any desired velocity (economic optimum velocity usually 1,000-2,000 fpm) [5.08-10.16 m/s]
Fumes, metal smokes	Welding	2,000-2,500 fpm [10.16-12.70 m/s]
Fine light dust	Cotton lint, wood flour, litho powder	2,500-3,000 fpm [12.7-15.24 m/s]
Dry dusts and powders	Fine rubber dust, Bakelite molding powder dust, jute lint, cotton dust, shavings (light), soap dust, leather shavings	3,000-3,500 fpm [15.24-17.78 m/s]
Average industrial dust	Grinding dust, buffing lint (dry), wool jute dust (shaker waste), coffee beans, shoe dust, granite dust, silica flour, general material handling, brick cutting, clay dust, foundry (general), limestone dust, packaging and weighing asbestos dust in textile industries	3,500-4,000 fpm [17.78-20.32 m/s]
Heavy dusts	Sawdust (heavy and wet), metal turnings, foundry tumbling barrels and shake-out, sand blast dust, wood blocks, hog waste, brass turnings, cast iron boring dust, lead dust	4,000-4,500 fpm [20.32-22.86 m/s]
Heavy or moist dusts	Lead dusts with small chips, moist cement dust, buffing lint (sticky), quick-lime dust	4,500 fpm [22.86 m/s] and up

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4.11.4 Type 2 Coil Cleaning (Wet Cleaning): Type 2 (Wet Cleaning) methods are appropriate for removing debris on all coil, drain pan, and drain line surfaces. Type 2 (Wet Cleaning) *shall* be performed if assessment has determined that Type 1 cleaning will not be sufficient or if debris remains after utilizing Type 1 methods. Type 2 (Wet Cleaning) *may* include the following methods:

- Application of coil cleaning products (which shall be used in accordance with the manufacturer's product labeling)
- Water washing at normal water line pressure
- Pressure washing equipment
- Hot water or steam cleaning equipment

4.11.4.1 The condensate drain pan and drain line *shall* be cleaned and flushed. The condensate drain pan *shall* be inspected and tested to verify drainage before and after cleaning.

4.11.4.2 Cleaning methods and products *shall* not cause damage to, or erosion of, the coil surface or fins and *shall* conform to coil manufacturer recommendations when available. It is *recommended* that only coil cleaning solutions that are as close to pH neutral as possible are used.

4.11.5 Type 2 Post-Cleaning Inspection: Type 2 (Wet Cleaning) inspections *shall* be conducted after completion of Type 2 (Wet Cleaning) methods. If debris still remains on the coil after Type 2 (Wet Cleaning), the process *shall* be repeated. When debris cannot be removed using Type 2 (Wet Cleaning) methods, replacement *may* be necessary.

4.11.6 Measuring the Effectiveness of Coil Cleaning: Visual observation of coil surfaces can be misleading; therefore, it is *recommended* that a static pressure drop measurement be obtained before and after the cleaning process to demonstrate the effectiveness of such efforts.

4.11.7 Inline Coils: Wet cleaning processes using pressurized water and chemical agents are normally required for coil cleaning. Precautions *shall* be taken to capture rinse water when wet cleaning duct mounted coils without drain pans. Type 1 (Dry Cleaning) and/or Type 2 (Wet Cleaning) methods *shall* be used for cleaning inline coils.

4.11.8 Electric Resistance Coils: When cleaning electric resistance coils, the power source to the coils *shall* be de- energized and locked out/tagged out. When wet process cleaning is used, only non-corrosive detergents *shall* be used, and the coil *shall* be rinsed free of chemicals and thoroughly dried prior to being re-energized.

4.12 Control of Odors and Product Emissions: All products used *shall* comply with any local, regional, state and federal regulations and/or other laws regulating the use of such agents.

4.13 Remediation of Microbial Contamination: Remediating microbial contamination *shall* be performed in accordance with the ANSI/ IICRC S520 *Standard for Professional Mold Remediation* and the cleaning/restoration of the HVAC system component provisions as outlined within this Standard.

4.14 Restoration and Repair of Mechanical Systems: Restoration procedures *shall* only be performed after mechanical cleaning.

4.14.1 HVAC system components subjected to catastrophic events such as fire, smoke, flood, or water damage *shall* be subject to appropriate restoration procedures as described in Sections 4.23 and 4.24.

4.14.2 Components that are compromised *shall* be addressed as part of the restoration procedure to the extent possible.

4.14.3 It is *recommended* that HVAC system components be replaced if cleanliness levels specified in this Standard cannot be achieved through mechanical cleaning and restoration methods.

4.14.4 Any components and/or surfaces unable to withstand proper mechanical cleaning and restoration *shall* be documented, brought to the attention of the customer, and recommended for repair or replacement.

4.15 Surface Treatments: Surface treatments *may* be used to restore the integrity of material surfaces as an alternative to replacement. Surface treatments *shall* only be applied after confirming the system has been cleaned and has passed the specified level of cleanliness verification.

4.15.1 Surface treatments *shall* meet the requirements of UL 181.

4.16 Removal of Microbial Contaminated Porous Materials: It is *recommended* that porous materials with microbial growth (Condition 3) be properly removed and replaced. This task *shall* be followed by surface cleaning using mechanical cleaning methods.

4.17 Cleaning Fibrous Glass Duct System Components: The cleaning of fibrous glass duct liner or duct board present in equipment or air ducts *shall* be performed in accordance with Section 4.7 of this Standard.

4.17.1 The mechanical cleaning methods selected for duct liner or fibrous glass duct board *shall* not create abrasions, breaks, or tears to fibrous glass liner or duct board surfaces.

4.18 Resurfacing/Coating Fibrous Glass Surfaces: Resurfacing/coating *may* be considered when thermal acoustic fibrous glass components, including air duct liner or duct board in the HVAC system, are considered friable, or exhibit visual signs of abrasion, degradation, or other undesirable conditions. Resurfacing/coating *may* also be considered when the project work plan requests smoothing fibrous glass surfaces to reduce future particulate collections within the HVAC system components.

4.18.1 If resurfacing/coating is to be performed, an assessment *shall* be made to determine whether the surface of the component will provide a strong, bondable surface for the coating material after undergoing proper mechanical cleaning.

4.18.2 If fibrous glass materials are beyond restoration and deemed unsuitable to support the proper application of a surfacing product or unable to provide a long- term bondable surface, resurfacing/coating *shall* not be performed.

4.19 Damaged Fibrous Glass Material: When there is evidence of damage, deterioration, delaminating, or friable material, such that cleaning, or resurfacing/coating cannot restore fibrous glass materials, replacement is *recommended.*

4.20 Thermal-Acoustic HVAC Insulation Replacement: All metal surfaces of the duct system that have undergone removal of degraded thermal-acoustic material *shall* have the base surface scraped clean and be free of loose, visible debris prior to installation of new insulation.

4.20.1 In the event the fibrous glass removal was due to microbial contamination, the base surface *shall* be cleaned to a Condition 1 status prior to reapplying any fibrous glass insulating products.

4.20.2 All materials used for insulation replacement within the HVAC system components *shall* meet or exceed the specifications of the original materials or current applicable codes. Installation of the replacement materials *shall* be in accordance with the manufacturer's written instructions.

4.20.3 Installation of thermal-acoustic HVAC system components insulation common to the air stream *shall* comply with current SMACNA, NAIMA and other applicable codes and standards.

4.20.4 Following completion of the installation of replacement materials, all new fibrous glass surfaces *shall* be capable of meeting NADCA cleanliness verification requirements.

4.20.5 No cleaning process *shall* be performed that will damage a properly designed, installed, and structurally sound HVAC system and its components, or negatively affect the performance, operation, or normal life expectancy of the system.

4.21 Non-Porous Material Restoration: If the surface conditions of non-porous components, following cleaning, reveal a surface that will continue to contribute particulate, odors, or adversely affect the quality of the air moving through the system, restoration is *recommended.*

4.22 Flooding/Water Damage: All HVAC system surfaces and components subjected to water damage due to flooding *shall* be evaluated and categorized according to industry recognized methods to determine the ability to salvage and restore**,** as defined in documents such as the current ANSI/ IICRC Standard S500, *Standard and Reference Guide for Professional Water Damage Restoration.* To a large extent, the category of water entering the HVAC system components will dictate methods of cleaning and environmental engineering controls. Any system components and/or air ducts deemed worthy of salvage *shall* be thoroughly cleaned.

4.23 Fire/Smoke Damage: All HVAC system components subjected to heat and smoke *shall* be evaluated for restoration. Any components and/or surfaces unable to withstand proper mechanical cleaning and restoration *shall* be replaced.

4.23.1 All porous surfaces subjected to fire/smoke damage *shall* be evaluated following proper mechanical cleaning for friability and odor retention.

4.23.2 Any areas assessed as being friable and/or retaining odors *shall* be resurfaced or replaced.

4.23.3 Following cleaning, any component surface exhibiting damage due to heat exposure *shall* be restored to an acceptable condition or replaced.

4.23.4 If there is a question as to whether a system component is contaminated with soot or smoke from a fire, it is *recommended* that sampling be performed in accordance with documents such as ANSI/IESO/RIA 6001- 2011 *Evaluation of Heating, Ventilation and Air Conditioning (HVAC) Interior Surfaces to Determine the Presence of Fire- Related Particulate as a Result of a Fire in a Structure.*

4.24 HVAC System Components Repair: HVAC system components found to have pre-existing damage during the cleaning process *shall* be documented and brought to the attention of the client.

4.24.1 Repair or replacement of malfunctioning mechanical devices is not included in the scope of this Standard. Restoration does not include the sealing of air leaks within duct systems or HVAC systems.

Section 5 - Cleanliness Verification and Documentation

5.0 Overview: The purpose of cleanliness verification is to determine the presence of particulate. It does not determine microbial contamination and/or the presence of hazardous materials. Cleanliness verification *shall* be performed on all specified components to verify compliance with this Standard. All components within the project scope of work *shall* be cleaned, at minimum, to the level of visibly clean or the specified method of cleanliness verification.

5.1 When to Perform Cleanliness Verification: Perform cleanliness verification immediately after HVAC system component cleaning and prior to system operation.

5.2 Description of Method 1 - Visual Inspection: A visual inspection of porous and non-porous HVAC system components *shall* be conducted to assess if the HVAC system components are visibly clean. An interior surface is considered visibly clean when it is free from non-adhered substances and debris. If a component is visibly clean, then no further cleanliness verification methods are necessary.

5.2.1 Method 1 Inconclusive: If Method 1 - Visual Inspection is inconclusive or disputed, then it is *recommended* that Method 2 - Surface Comparison Test or Method 3 - NADCA Vacuum Test, be used to verify cleanliness.

5.3 Description of Method 2 - Surface Comparison Test: The Surface Comparison Test *may* be used to determine cleanliness of both porous and non-porous HVAC component surfaces. The component's surface conditions are evaluated by comparing visible characteristics of the test surface before and after implementing a specific procedure of contact vacuuming.

5.3.1 Test Method 2 - Surface Comparison Test Protocol: A vacuum brush *shall* be attached to a contact vacuum and the device *shall* be running. The brush *shall* be passed over the surface test area four (4) times, with the brush depressed against the surface being tested using light to moderate pressure (as used in routine cleaning). The testing contact vacuum *shall* be HEPA-filtered and capable of achieving a minimum of 80 inches of static lift (WC). The contact vacuum *shall* be fitted with a 2.5 inch round nylon brush attached to a 1.5 inch diameter vacuum hose.

5.3.2 Interpretation of Method 2 - Surface Comparison Test Results: When the procedure described in Section 5.3.1 has been completed, a comparison *shall* be made to determine if the visible characteristics of the surface have changed significantly. The HVAC component surface is considered to be clean when there is no significant visible difference in the surface characteristics.

5.3.3 Method 2 Inconclusive: If Method 2 – Surface Comparison Testing is inconclusive or disputed, then Method 3 – NADCA Vacuum Test *may* be used to make a final cleanliness determination. The NADCA Vacuum Test does not apply to porous system components.

5.4 Description of Method 3- NADCA Vacuum Test: The NADCA Vacuum Test is used for scientifically evaluating particulate levels of non-porous HVAC system component surfaces. Using this procedure, a NADCA Vacuum Test Template is applied to the component's ducted airside surface. A closed-face vacuum cassette with filter media is attached to a calibrated air sampling pump and the closed-face filter cassette is passed over two (2) 2 cm x 25 cm openings within the template.

At no time *can* any portion of the vacuum cassette directly contact the component surface being tested. The template is specifically designed to allow the cassette to ride above the surface being tested. Airflow is accelerated through a narrow opening between the template and the test surface of the component, allowing any latent remaining particulate from the component's surface to be dislodged through increased velocity and impinged onto the filter media within the vacuum cassette. After this procedure is complete, the cassette is prepared and weighed to determine the amount of total debris collected on the filter media.

5.4.1 Test Components: The following describes the materials and test components used to perform Method 3 - NADCA Vacuum Test verification:

- Air Sampling Pump: An air sampling pump capable of drawing a minimum of 15 liters per minute through a closed-face cassette containing 37 mm matched weight filters (two 0.8 or.45 micrometer pore size mixed cellulose ester (MCE) filters in series) *shall* be used.
- Filter Media: Filter media within the vacuum cassette *shall* be 37 mm mixed cellulose ester (MCE) matched weight filters (0.8 or.45 micrometer pore size preloaded in three-piece cassette.)
- Calibration Device: The vacuum pump *shall* be calibrated using a calibration device that is accurate to ±5% at 15 liters per minute.
- NADCA Vacuum Test Template: The template *shall* be 15 mil thick (0.381 mm) and *shall* provide a 100 cm2 sampling area consisting of two (2) 2 cm x 25 cm slots at least 2.5 cm apart.

5.4.1.1 The standard size openings for the NADCA Vacuum Test Template are 2 centimeters in width by 25 centimeters 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, subject to the specifications to follow:

5.4.1.2 The template opening size and shape *can* vary provided that (1) the total area to be sampled is equal to 100 square centimeters; (2) the maximum width of the opening does not exceed 3.7 centimeters, so that the sample cassette will not touch the surface being sampled; and (3) the minimum opening width is greater than or equal to 2.0 centimeters.

5.4.2 Sampling Protocol: Secure the template to the surface to be sampled so that it will not shift position during sample collection (i.e., taped at four corners).

- The template *shall* lay flat against the surface to be sampled. The surface to be sampled *shall* be dry. The air-handler *shall* not be running when the sampling is being conducted.
- Cassettes *shall* be sealed with shrink tape by the supplier. Remove protective plugs from the new cassette. Attach the outlet end of the cassette to the vacuum pump tubing.
- Adjust air flow using an appropriate calibration device to 17 liters per minute + or -2 liters per minute.
- Vacuum the open area of the template by sliding the cassette from one end of each template opening to the other. The cassette *shall* be moved at a rate not greater than 5 cm per second (5 seconds per slot each direction). The edges of the cassette *shall* always rest on the template. The cassette *shall* not touch the duct surface. Each template's openings *shall* be vacuumed twice (once in each direction).
- Throughout the vacuum process, hold the cassette so that it touches the template surface, with no downward pressure being applied.
- After the template's openings have been vacuumed twice, the vacuum pump *may* be turned off. Then replace the plugs.
- Label the cassette and record the area of the surface sampled. The cassette may now be prepared and weighed to determine the amount of debris collected on the filter media. Analysis based on the National Institute for Occupational Safety and Health (NIOSH) Method 0500 (total nuisance dust) *shall* be used.
- Scale sensitivity *shall* be equal to or greater than 0.7 milligram and *shall* be calibrated in accordance with the manufacturer's written recommendations. Results *shall* be reported in milligrams per 100 square centimeters (mg/100 cm2) of sampling area.

Generally, samples are sent to a laboratory for testing, however, sampling equipment is capable of being brought on to the work site. It is *recommended* that samples be procured by a qualified individual designated by the client or client's agent and analyzed by an accredited laboratory.

5.5 Passing Criteria for NADCA Vacuum Test: To be considered clean according to the NADCA Vacuum Test, the net weight of the debris collected on the filter media *shall* not exceed 0.75 mg/100 cm2.

5.6 Post-Project Documentation: It is *recommended* that documentation showing compliance with this Standard is provided for all work performed. Documentation *can* include organized and legible written and visual records.

5.6.1 If the NADCA Vacuum Test is used for cleanliness verification, a copy of the lab results *shall* be included with this documentation.

5.6.2 If any outside laboratories or testing agencies are used, chain of custody documentation *shall* be added.

5.6.3 It is *recommended* that photo images, HVAC plans, and other supporting documents such as submittal forms for materials used and/ or warrantees or guarantees are included as part of Post-Project Documentation.

Definitions

Abrasion: A surface loss of material due to friction.

Access: The ability to gain entry to the interior of the air duct or HVAC component.

Access Door: Fabricated metal barrier (hatch) by which a service opening is accessed or closed.

Adhered Substance: A material that is not removed by cleaning and restoration procedures as described in Section 4 of ACR, The NADCA Standard. (Examples may include paint, mastic, sealant, stains, etc.)

Agitation: A process that involves using an agitation device to dislodge or move non-adhered substances within an HVAC system.

Agitation Device: A tool or tools used to dislodge or move non-adhered substances within the HVAC system. (Examples may include, brushes, whips, compressed air, contact vacuum attachments, etc.)

Air Duct: A passageway for distribution and extraction of air, excluding plenums not installed in accordance with SMACNA Standards (See ASHRAE Terminology).

Air Duct Covering: Materials such as insulation and banding used to cover the external surface of a duct.

Air Filtration Device (AFD): A portable or transportable, self-contained blower assembly designed to move a defined volume of air equipped with one or more stages of particulate filtration. Depending on the mode of use, an AFD that filters (usually HEPA) and re-circulates air is referred to as an "air scrubber." One that filters air and creates negative pressure is referred to as a "negative air machine".

Air-Handling Unit (AHU): A packaged assembly, usually connected to ductwork, that moves air and may also clean and condition the air.

Central-Station Air-Handling Unit: Factory-made, encased assembly consisting of the fan or fans and other necessary equipment, that perform one or more of the functions of circulating, cleaning, heating, cooling, humidifying, dehumidifying, and mixing of air; does not include a heating or cooling source.

Cooling-Heating Unit: Unit that includes means for cooling and heating, and which may also include means for other air-handling unit functions. This could include ductless mini-split systems, packaged terminal air conditioner (PTAC), wall/window units, fan coil units (FCU), split systems, and other systems that provide heating and cooling in an environment.

Cooling Unit: Unit that includes means for cooling, and which may also include means for other air-handling unit functions.

Heating Unit: Unit that includes means for heating, and which may also include means for other air-handling unit functions.

Make-Up Air Unit: Factory-assembled fan-heater or cooling/dehumidifying unit that supplies tempered fresh air to replace air that is exhausted. Centrifugal or axial fans are used with direct gas-fired, electric, or water heater sections.

Ventilating Unit: Unit with means to provide ventilation, and which may also include means for other air-handling unit functions (See ASHRAE Terminology).

Air Scrubber: An air filtration device (AFD) using HEPA filtration configured to re-circulate air within a defined space.

Airside Surface: The internal surface of the HVAC system, associated ductwork, and components that air impacts while traveling through the HVAC system. This does not include open air plenums or interstitial cavities.

Air Systems Cleaning Specialist (ASCS): The ASCS designation is awarded by NADCA to industry professionals who satisfactorily complete a written certification examination testing knowledge of HVAC systems, cleaning standards, and best practices.

Ambient Air Cleaning: The process of removing particulate from indoor air outside of the HVAC system.

Antimicrobial: Describes an agent that kills or inactivates microorganisms or suppresses their growth.

Appropriate Negative Pressure: Implies enough negative pressure to satisfactorily prevent debris from entering the occupied space or leaving the contained area.

Assessment: A comprehensive review and evaluation of the HVAC system, or representative portions thereof, to make a preliminary determination of the need for cleaning, to write a scope of work for the cleaning and restoration project, recommend cleaning techniques, and to determine the environmental engineering controls required for the workspace, and any unique requirements.

Bioaerosols: Airborne particles of biological origin.

CAN: When the term *CAN* is used in this document, it signifies an ability or possibility open to a user of the document, and it means that a referenced practice or procedure is possible or capable of application but is not a requirement of the accepted "standard of care."

Chain of Custody Documentation: The chronological documentation or paper trail, showing the seizure, custody, control, transfer, analysis, and disposition of evidence, physical or electronic.

Cleaning: The removal of non-adhered substances.

Closure: (1) An access door or panel installed on the air duct or air-handling unit to create a permanent seal; (2) Device or material used in closing a service opening.

Coatings: See "Surface Treatments."

Coils: Devices inside an HVAC system that temper and/or dehumidify the air handled by the HVAC system. These include heat exchangers with or without extended surfaces through which water, ethylene glycol solution, brine, volatile refrigerant, or steam is circulated for the purpose of total cooling (sensible cooling plus latent cooling), or sensible heating of a forced-circulation air stream.

Collection Device: A HEPA-filtered machine designed primarily to collect debris, filter particulate, and discharge air back to the indoor environment, or a fan driven non-HEPA-filtered machine that is designed to collect debris and filter particulate while discharging the air outside the building envelope.

Components: See "HVAC System/Components".

Conditions: For the purpose of this Standard, Conditions 1, 2, and 3 are defined for indoor environments relative to microbial. Definitions for each condition are as follows:

Condition 1 (normal fungal ecology): An indoor environment that may have settled spores, fungal fragments or traces of actual growth whose identity, location, and quantity is reflective of a normal fungal ecology for a similar indoor environment (See ANSI/IICRC S520).

Condition 2 (settled spores or fungal fragments): An indoor environment which is primarily contaminated with settled spores or fungal fragments that were dispersed directly or indirectly from a Condition 3 area, and which may have traces of actual growth (See ANSI/IICRC S520).

Condition 3 (actual growth): An indoor environment contaminated with the presence of actual microbial growth, associated spores, and fungal fragments. Actual growth includes growth that is active or dormant, visible or hidden (See ANSI/IICRC S520).

Contact Vacuum: A collection device, usually portable, that uses a nylon brush nozzle attached to the end of its inlet air hose. The brush head is applied directly to a surface for mechanical agitation and cleaning.

Containment Area: An engineered space within a work area designed to control the migration of contaminants to adjacent areas during assessment or cleaning procedures.

Contaminant: Any substance not intended to be present within the HVAC system.

Damp Wiping - A process of wiping HVAC component surfaces that may be used on restoration projects.

Debris: Non-adhered substances not intended to be present within the HVAC system.

Duct Access Door: Fabricated metal barrier (hatch) by which a service opening is accessed or closed; designated for permanent installation and may be available pre-fabricated in a variety of sizes and configurations. Most utilize cam locks for securing the removable door from the permanently installed doorframe. Types of Duct Access Doors are listed below:

Flush Mount - fabricated door and door frame which extends into the duct and is externally flush with the outside duct wall.

Surface Mount - fabricated door and door frame which extends out from the surface of the outside duct wall.

Hinged - fabricated door and doorframe attached together with a hinge.

Sandwich - two-part closure device in which the two sides are mechanically fastened together on both sides of the duct wall at the perimeter of the service opening.

Spin Door - round access door and door frame installed by spinning the door frame into a round opening.

Duct Board: Rigid board composed of insulation material with one or both sides faced with a finishing material. The outer facing is normally a vapor barrier and can also be used as an air barrier.

Duct Liner: Insulation, usually fibrous glass, applied to the inside of a metal duct. It may be used for reasons of both thermal retention and sound attenuation.

Duct Wrap: Insulation designed for application on the exterior of ducts with all seams and joints sealed to provide a continuous vapor barrier.

Environmental Engineering Controls: Modifications to the work environment to permit safe operations and to prevent the escape or transfer of contaminants.

Fibrous Glass Insulation: A synthetic material typically used in HVAC components for the purpose of thermal retention and sound attenuation.

Friable: Easily crumbled or pulverized.

HEPA: High Efficiency Particulate Air. To be called a true HEPA filter, or certified HEPA filter, the filter will have a documented filtration efficiency of 99.97% at 0.3 micron-sized particles (US Department of Energy).

HVAC System/Components: The heating, ventilation, and air conditioning (HVAC) system/components includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning, and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts, the air-handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems. For purposes of this Standard, non-ducted open air plenums of all types and design are not considered part of the HVAC system.

Indoor Environmental Professional (IEP): An individual who is qualified by education, training and experience to perform an assessment of the fungal ecology of property, systems, and contents at the job site, create a sampling strategy, sample the indoor environment, interpret laboratory data, determine Condition 1, 2 and 3 status for the purpose of establishing a scope of work, and verify the return of the fungal ecology to a Condition 1 status.

Inspection: A gathering of information for use in making determinations and assessments.

Mastic: Material used to caulk, seal, or cement gaps and cracks in air duct connections and joints.

MAY: When the term *MAY* is used in this document, it signifies permission expressed by the document, and means that a referenced practice or procedure is permissible within the limits of this document but is not a requirement of the accepted "standard of care."

Mechanical Agitation: See "Agitation."

Mechanical Cleaning: Physical removal of contaminants and debris not intended to be present on internal HVAC system surfaces.

Mechanically Fasten: To affix two or more objects together through the use of screws, clamps, locks, or straps. (contrast with mastic or tape)

Microbial Contamination: The presence of past or current active indoor microbial growth, the identity, location, and amplification of which are not reflective of a normal microbial ecology for an indoor environment, which may produce adverse health effects, cause damage to materials, and adversely affect the operation or function of building systems.

Negative Air Machine: A HEPA-filtered air filtration device designed primarily for collecting particulate and limiting particulate migration while controlling workspace pressure differentials. These machines may or may not be ducted outside the building envelope.

Negative Duct Pressurization: A pressure differential inside the duct being cleaned relative to the indoor non-work area. (see 4.1).

Non-Adhered Substance: Any material not intended or designed to be present in the HVAC system, and which can be removed by cleaning and restoration procedures as described in Section 4 of ACR, The NADCA Standard.

Non-Porous HVAC System Component: Any component of the HVAC system in contact with the air stream that is not capable of penetration by water or air, such as sheet metal, aluminum foil, or polymetric film used to line flexible duct.

Open Air Plenum: Intended non-ducted air pathways formed in building cavities, voids, and spaces outside of the occupied zone of the building. By design, it facilitates airflow between the HVAC equipment and the occupied space of a building.

Panel: Fabricated section of metal making up the structural shell of a piece of mechanical equipment.

Particulate: Any non-adhered substance present in the HVAC system that can be removed through use of an agitation device as defined in ACR, The NADCA Standard.

Permanent: The life of the system.

Porous HVAC System Component: Any component of the HVAC system in contact with the air stream that is capable of penetration by either water or air. Examples include, but are not limited to, fibrous glass duct liner, fibrous glass duct board, sound attenuated duct, wood, and concrete.

Preliminary Determination: A conclusion drawn from the collection, analysis, and summary of information obtained during an initial inspection to identify areas of moisture intrusion and actual or potential microbial growth and the need for assistance from other specialized experts (ANSI/ IICRC S520).

Pressure Drop: (1) Loss in pressure, as from one end of a refrigerant line to the other, from friction, static, heat, etc.; (2) Difference in pressure between two points in a flow system, usually caused by frictional resistance to fluid flow in a conduit, filter or other flow system (See ASHRAE Terminology).

RECOMMEND: When the term *RECOMMEND(ED)* is used in this document, it means the practice or procedure is advised or suggested but is not a requirement of this Standard.

Requirement: Mandatory practice for compliance with this Standard.

Restoration: To bring back to, or put back into, a former or original state.

SDS: Safety Data Sheet

Seal: To make secure against leakage by a fastener, coating, or filler.

Service Panel: Used for closing a service opening in an HVAC system.

SHALL: The word *SHALL* shall be understood as denoting a mandatory requirement. The criterion for conformance to this Standard requires that there be no deviation when *SHALL* is used.

Source Removal: The mechanical cleaning process by which contaminants such as particulate, debris, and surface contamination are physically dislodged from HVAC system components and removed using vacuum collection equipment. This method aims to eliminate contaminants at their point of origin, preventing their re-entrainment into the air stream or migration into occupied spaces.

Standard of Care: Practices common to reasonably prudent members of the trade who are recognized in the industry as qualified and competent.

Surface Comparison Testing: A test used to determine the cleanliness of porous HVAC component surfaces (See Section 5.3 of this Standard).

Surface Treatment (non-antimicrobial): Coating or treatment designed to repair surface defects or modify surface characteristics.

Vacuum Collection Equipment: See "Collection Device."

Visibly Clean: A condition in which the interior surfaces of the HVAC system are free of non-adhered substances.

Visual Inspection: Visual examination, with the naked eye, of the cleanliness of the HVAC system/components.

Wet Process Cleaning: Any method of mechanical cleaning of HVAC components that utilizes water and/ or liquid chemicals as part of the process (e.g. power washing, steam cleaning, hand washing).

Reference Documents and Resources

ACCA: Air Conditioning Contractors of America (acca.org)

ACGIH: American Conference of Governmental Industrial Hygienists (acgih.org)

- Bioaerosols: Assessment and Control

AIHA: American Industrial Hygiene Association (aiha.org)

AMCA: Air Movement & Control Association (amca.org)

ANSI: American National Standards Institute (ansi.org)

- NADCA Energy Efficiency and Air Quality Case Study

IESO/RIA 6001 Evaluation of Heating, Ventilation and Air Conditioning (HVAC) Interior Surfaces to Determine the Presence of Fire-Related Particulate as a Result of a Fire in a Structure

ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ashrae.org)

- ASHRAE/ACCA S-180, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
- ASHRAE Standard 62.1 Ventilation and Acceptable Indoor Air Quality
- ASHRAE Standard 62.2 Ventilation and Acceptable Indoor Air Quality in Residential Buildings
- ASHRAE/ASHE Standard 170 Ventilation of Health Care Facilities.

ASTM International: American Society for Testing and Materials (astm.org)

- C1071–00 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
- E84-24 Standard Test Method for Surface Burning Characteristics of Building Materials

EPA: United States Environmental Protection Agency (epa.gov)

- Building Air Quality Guide
- Mold Remediation in Schools and Commercial Buildings Guide

IAQA: Indoor Air Quality Association (iaqa.org)

IICRC: Institute of Inspection, Cleaning and Restoration Certification (iicrc.org)

- ANSI/IICRC S500, Standard for Professional Water Damage Restoration
- ANSI/IICRC S520 Standard for Professional Mold Remediation
- ANSI/IICRC S590 Standard for Assessing HVAC Systems Following a Water, Fire, or Mold Damage Event

IKECA: International Kitchen Exhaust Cleaning Association (ikeca.org)

- ANSI/IKECA C10-2021 Standard for the methodology for cleaning commerical Kitchen Exhaust Systems, 2nd Edition

NADCA: National Air Duct Cleaners Association (nadca.com)

- ACR, The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems - 2006 Edition
- ACR, The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems – 2013 Edition
- ACR, The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems – 2021 Edition
- NADCA Position Paper: Inspection and Cleaning of Open Air Plenums in HVAC Systems
- NADCA Position Paper: Using Chemical Products in HVAC Systems
- General Specifications: Understanding Microbial Contamination in HVAC Systems
- Safety Manual
- Standard 03, Requirements for Testing Vacuum Collection Equipment
- Standard 05, Requirements for the Installation of Service Openings in HVAC Systems

NAIMA: North American Insulation Manufacturers Association (insulationinstitute.org)

- AH 122 Cleaning Fibrous Glass Insulated Air Duct Systems
- AH 116 Fibrous Glass Duct Construction Standards
- AH110 An Essential Component of Indoor Environmental Quality…Fiberglass HVAC Insulations

New York City Department of Health and Mental Hygiene

- Guidelines on Assessment and Remediation of Fungi in Indoor Environments

NFPA: National Fire Protection Association (nfpa.org)

- NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems
- NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems

NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

NIOSH: National Institute for Occupational Safety and Health (cdc.gov/niosh)

Manual of Analytical Methods, Fifth Edition

RIA: Restoration Industry Association (restorationindustry.org)

IESO/RIA 6001 Evaluation of Heating, Ventilation and Air Conditioning (HVAC) Interior Surfaces to Determine the Presence of Fire-Related Particulate as a Result of a Fire in a Structure

SMACNA: Sheet Metal and Air Conditioning Contractors' National Association (smacna.org)

HVAC Duct Construction Standards – Metal and Flexible,

UL: Underwriter Laboratories, Inc (UL.com)

UL 181, Factory-Made Air Ducts and Air Connectors

UL 181A, Closure Systems for Use with Rigid Air Ducts and Air Connectors

UL 181B, Closure Systems for Use with Flexible Air Ducts and Air Connectors

UL 723, Test for Surface Burning Characteristics of Building Materials

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Mt. Laurel, NJ 08054
Fax: 856-439-0525
Email: cmcwilliams@nadca.com

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