



The HVAC Inspection, Cleaning and Restoration Association

National Air Duct Cleaners Association

Guide Specification Section 230130.51 –

HVAC Air Distribution System Cleaning

User Guide

NADCA: The HVAC Inspection, Cleaning and Restoration Association, otherwise known as the National Air Duct Cleaners Association (NADCA), was formed in 1989 as a nonprofit association of companies engaged in the cleaning of HVAC systems. Its original mission was to promote source removal as the only acceptable method of cleaning and to establish industry standards for the association.

NADCA's mission has expanded to include qualified companies engaged in the inspection, cleaning and restoration of HVAC systems. NADCA supports members' success with standards, education, certification, marketing and advocacy to promote ethics and the highest quality services. The goal of the association is for its members to be the number one resource for consumers and other entities seeking air duct cleaning and HVAC inspection, cleaning and restoration.

NADCA's membership continues to grow each year, along with its training, education and certification opportunities for air systems cleaning specialists, mold remediators, HVAC inspectors and others. NADCA has also published industry standards, educational materials and other useful information for consumers and members alike. See www.nadca.com.

Guide Specification User Tips

A. Guidance on Developing the Scope of Work

1. The NADCA Guide Specification is a template and must be modified to accurately reflect project requirements, and account for the unique system variations within an individual building and cleaning project.
2. Users must complete the SUMMARY paragraph and subparagraphs, by inserting specific instructions and listing all HVAC components to be included in the project.
 - a. Project scope is often depicted graphically on drawings or sketches. When drawings or sketches are included among the contract documents, do not repeat the drawing information in this specification. While it is tempting to “amplify” the requirements by showing them on both the drawings and the specifications, the descriptions are not identical in both places, leading to confusion, Requests for Interpretation (RFIs), Contract Change Requests, and delay.

- b. Where possible, the drawings should show the arrangement of system components and equipment, locations, dimensions, and the extent of the work. The specifications should describe the administrative requirements, the products to be used, work procedures, and quality requirements.
 - c. This specification is written using abbreviated language, in imperative mood. As a result, unnecessary words are omitted, and sentences generally begin with a verb.
 - d. The phrase “The Contractor shall” does not appear in this specification because this specification is a set of requirements and instructions for the contractor to follow in order to complete the work satisfactorily.
 - 1. When the specification says “Clean HVAC system components,” that statement requires the Duct Cleaning Contractor to complete the work.
 - e. The word “all” is seldom, if ever used in this section, because the requirements of the section apply to everything within the contract scope, unless specified otherwise.
 - 1. There is no difference between “Clean duct on 3rd Floor, West Wing” and “Clean all duct on 3rd Floor, West Wing” For that reason, “all” is not used.
 - f. Articles like “a,” “an,” and “the” are not generally used in specifications.
 - 1. One exception to this rule is when referring to “the work,” which is the term used to denote the sum total of the products and actions required by the contract.
3. Below are 10 examples of a how a Scope of Work may read.
- a. Clean HVAC system components from point where air enters system to each point where air is discharged from system.
 - b. Clean HVAC system components as indicated on Drawings.
 - c. Clean existing supply, return and exhaust air ducts in building after building renovation is complete.
 - d. Clean supply and return air ducts serviced by AHU1 and AHU2.
 - e. Clean reheat coils and supply air ducts downstream of reheat coils that are located within construction area.
 - f. Clean air handlers and associated existing return air ducts after building renovation is complete.
 - g. Clean existing air ducts and new air ducts installed during construction phase.
 - h. Clean building exhaust systems that service floors 1 through 3 on West Wing.
 - i. Clean air handlers and air ducts that service North Building. Seal internally-lined supply air ducts with approved coating in accordance with manufacturer’s instructions. Seal edges and seams of internal duct liner in accordance with liner and sealant manufacturers’ instructions.

- j. Clean fan coil units in building. Clean cabinets, coils, and blowers located within fan coil units.
- k. Clean supply and return air ducts located on 23rd floor from point of connection to vertical riser in shaft to each duct termination point on 23rd floor.

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SECTION 230130.51 - NADCA HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 SUMMARY

In the Summary Article, concisely describe the work that the Duct Cleaning Contractor must perform. Be specific, but do not repeat requirements shown on Project Drawings. Instead, refer to the drawings to describe the extent of the work.

See “Guide Specification User Tips” on this Section’s introduction pages for guidance on describing the Scope of Work.

Include a brief description of special cleaning instructions. Describe special cleaning procedures and requirements in more detail later in this specification. Be brief and specific here regarding what to clean. The rest of the Specification will describe how to clean it.

A. Section includes:

1. **<Insert one or more brief statements describing scope of duct cleaning work>.**

The Related Requirements paragraph that follows is used when the duct cleaning work must be coordinated with other work that might not normally be associated with duct cleaning. For example, if duct cleaning must be completed before the carpeting is installed, then subparagraph 1 below might say: “09 68 16 Sheet Carpeting.”

If there are no unusual coordination requirements, delete the following paragraph and subparagraph.

B. Related Requirements

1. **<Insert specification section number and title for related work>.**

For projects that require firm, fixed pricing, delete the following Price and Payment Procedures Article.

For pricing arrangements other than firm, fixed price, retain and edit the appropriate following paragraphs to define the Price and Payment Procedures. Coordinate descriptions in this section with corresponding descriptions in Division 01 - General Requirements.

1.2 REFERENCES

Many aspects of this specification refer to ACR, The NADCA Standard. Do not repeat the information from ACR, The NADCA Standard in this specification.

A. Abbreviations and Acronyms: See ACR, The NADCA Standard.

B. Reference Standards:

1. Following current standards and publications of issues currently in effect form part of this specification to extent specified:
 - a. American National Standards Institute/Institute of Inspection Cleaning and Restoration Certification (ANSI/IICRC).
 - 1) ANSI/IICRC S520 - Standard for Professional Mold Remediation.
 - b. National Air Duct Cleaners Association (NADCA):
 - 1) [ACR, The NADCA Standard for Assessment, Cleaning & Restoration of HVAC Systems \(Current Version\)](#).
 - c. National Fire Protection Association (NFPA):
 - 1) NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - 2) NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - d. North American Insulation Manufacturers Association (NAIMA):
 - 1) Cleaning Fibrous Glass Insulated Air Duct Systems.
 - e. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - 1) HVAC Duct Construction Standards - Metal and Flexible.
 - f. Underwriters' Laboratories (UL):
 - 1) UL Standard 181 - UL Standard for Safety Factory-Made Air Ducts and Connectors.
 - 2) UL Standard 181A - UL Standard for Safety Closure Systems for Use with Rigid Air Ducts.
 - 3) UL Standard 181B - Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors
 - 4) UL Standard 723 - Standard for Test for Surface Burning Characteristics of Building Materials
 - g. US Green Building Council (USGBC):

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the Work of this section with the work of other trades, and the work of different contractors.

B. Precleaning Meeting:

1. Conduct precleaning meeting with representatives of Owner, Contractor, and facility occupants affected by cleaning work.
2. Coordinate meeting date with [Owner] [Construction Manager] < Insert title of Owner's Representative here >.

C. Sequencing:

1. Perform duct cleaning work after HVAC system construction and duct leakage testing are complete.

D. Scheduling:

1. Prepare and submit HVAC system cleaning activities schedule in according with Division 01 section describing project scheduling requirements.

1.4 SUBMITTALS

Action submittals are for components that require Owner approval before purchasing or proceeding with the work. Because new products are seldom furnished or installed as part of the scope of work for HVAC system cleaning, the following paragraph and subparagraphs are seldom required, and can generally be deleted.

When duct cleaning scope includes installation on new components, the Owner may require submittals of the following information to include in the facility maintenance records.

A. Action Submittals:

1. Product Data: Submit data for each product.
2. Shop Drawings.
3. Samples.

Informational submittals are frequently required for HVAC system cleaning work. The required submittal information is contained in the body of this section.

B. Informational Submittals:

1. Duct cleaning plan: Before commencing cleaning work, submit written work plan including following information:
 - a. Scope of Work identifying HVAC components to be cleaned or restored.
 - b. Itemize specific environmental engineering controls required for workspace, and special work requirements.
 - c. Detail cleaning work means and methods.
 - d. Name, contact information, and functional tasks performed by each representative of each firm and contractor involved with the work.
2. Manufacturer's Instructions: Submit cleaning agent product installation instructions.

3. Field Quality Control Submittals:
 - a. Submit laboratory analysis results if NADCA Vacuum Test is used for cleanliness verification.
 - b. Submit documentation detailing chain of custody for test samples if outside laboratories or testing agencies performed sample analysis or testing.
4. Qualification Statements: Show membership status, project experience, and certifications for:
 - a. HVAC Cleaning Contractor.
 - b. Supervisor.
 - c. Inspector.
 - d. Hygienist.
 - e. Testing Agency.

Closeout submittals represent information the Facility Owner will require for ongoing facility operation.

C. Closeout Submittals:

1. Record Documentation: Submit documentation verifying compliance with this specification for work performed. This documentation may include:
 - a. Completion of cleaning work, as verified by [Owner's] [Construction Manager's] <Insert Title of Inspector here> visual inspection and verification of cleanliness.
 - b. Photo images, HVAC plans and other supporting documents such as submittal forms for materials used and/or warranties or guarantees.
 - c. System areas found to be damaged or in need of repair.

Quality Assurance submittals represent items the Owner requires to verify that the HVAC System Cleaning Contractor has complied with the quality-related requirements of this section.

D. Quality Assurance:

1. Regulatory Agency Sustainability Approvals.
2. Qualifications.
 - a. Manufacturers.
 - b. Suppliers.
 - c. Fabricators.
 - d. Installers/Applicators/Erectors.
 - e. Testing Agencies.
 - f. Licensed Professionals.

1.5 QUALIFICATIONS

- A. HVAC System Cleaning Contractor: Current member of NADCA experienced in HVAC cleaning projects of similar size and complexity.
 - 1. Supervisor: Employ NADCA-certified Air Systems Cleaning Specialist (ASCS) responsible for project oversight.
 - 2. Inspector: Employ NADCA-Certified ASCS, or NADCA-Certified Ventilation Inspector (CVI) to perform site inspections.
- B. Licensing:
 - 1. Submit copy of proper licenses, required to legally perform work in **[State]** **[Province]** **[Municipality]** in which work is located.
 - 2. Comply with applicable federal, state, provincial, and local, rules, regulations, and licensing requirements.
 - 3. Comply with requirements of Authorities Having Jurisdiction.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Cleaning Agents:
- B. Water: Potable.

2.2 TREATMENT MATERIALS

- A. Antimicrobial Agents: Type recommended by [Owner's] Certified Industrial Hygienist (CIH), determined from biological contamination test results.
- B. Sealants:

2.3 DUCT LINER MATERIALS

- A. Duct Liner: Fibrous glass insulation [matching existing] [See Section 230713 "Duct Insulation."].
 - 1. Where replacing internal insulation, furnish materials conforming to UL, NFPA 90A, NFPA 90B and SMACNA standards.
 - 2. Match thickness and insulation thermal resistance of existing duct liner.

PART 3 - EXECUTION

Retain the following Article edit to list NADCA member contractors that will be considered for the work.

3.1 HVAC DUCT CLEANING CONTRACTORS

- A. NADCA Member Contractors:

3.2 EXAMINATION

The following Article makes reference to Certified Industrial Hygienists (CIH), but CIH requirements would be specified in a different section. This section does not include requirements for CIH work.

- A. HVAC System Assessment and Site Survey:

1. Before commencing work, assess HVAC system condition to determine appropriate engineering controls, safety measures, tools, equipment and cleaning products and methods required to complete the work.
2. Perform HVAC system assessment by ASCS, Certified Ventilation Inspector (CVI), or equivalent.
3. If microbial testing or sampling are required, [engage] [Owner will engage] services of technicians trained and acceptable to authorities having jurisdiction.

- B. Work Plans:

1. Project Schedule: Outline starting date, dates and times when work will take place, and completion date.
 - a. Determine sequence of cleaning each system or portion of the work and coordinate with work of other trades and activities.
2. Product Data and Safety Data Sheets: Product data submittals listing general use and specific chemical cleaning products and coatings used while performing the work, along with Safety Data Sheets for chemical products used to perform the work.
3. Safety Plan: Define responsibilities of each organization's designated representative involved with executing work plan throughout project.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- A. Protect existing structures, surfaces, and systems from damage resulting from duct cleaning work.
- B. Report damage caused by this work to [Owner] [Construction Manager] < Insert title of Owner's Representative here>.

3.4 HVAC SYSTEM PREPARATION

A. Service Openings:

1. Access duct cleaning work through existing or new service openings, allowing safe access and thorough cleaning throughout specified components.
2. Work through service openings sized to allow mechanical tool entry and visual inspection, as required for cleaning activities.
3. Where possible, work through existing service openings.
4. Where new service openings are required, install openings as follows:
 - a. Do not degrade structural, thermal, or functional system integrity, and comply with applicable SMACNA duct construction methods.
 - b. Install service openings complying with applicable UL and SMACNA standards, federal, state, and local code requirements, and requirements of Authorities Having Jurisdiction.
 - c. Where required, install duct access doors and service panels fabricated with materials complying with SMACNA and UL 723.
 - d. Where required, install tapes and mastics complying with UL 181A/B.
 - e. Where required, install closure panels fabricated from equivalent material and same or heavier gage.
 - f. Mechanically fasten closure panels over service openings with screws or rivets at perimeter, maximum [4 inches] [100 mm] spacing.
 - g. Fabricate closure panel to overlap duct opening perimeter, minimum [1 inch] [25 mm] .
 - h. Insulate closure panels to match adjacent duct interior and exterior surfaces.
 - i. Seal rigid fibrous glass duct systems in accordance with NAIMA recommended practices.
 - 1) Install closure techniques: UL Standard 181 or UL Standard 181A.
 - j. Close service openings installed in rigid fibrous glass ductwork and metal ductwork with fibrous glass liner with no exposed fibrous glass edges exposed to airstream.
5. Install service openings that can be reopened for future inspection or remediation.
 - a. Mark outside of duct and report service opening locations to Owner in project closeout documents.
6. Do not cut service openings into flexible duct.
 - a. Disconnect flexible duct at both ends as required for inspection and cleaning.
 - b. Reconnect flexible duct ends in accordance with SMACNA standards.

3.5 CLEANING EQUIPMENT MAINTENANCE AND USE

- A. Maintain equipment employed in work performance in good working order, consistent with equipment manufacturer's written instructions and applicable jurisdictional requirements.
- B. Clean and inspect equipment before bringing to work site.
- C. Do not introduce contaminants from cleaning equipment into indoor environment or HVAC system.
- D. Service equipment to limit possible HVAC system contamination from insufficient service equipment cleaning, and unsafe operating conditions for service personnel and building occupants.
- E. Perform activities requiring opening contaminated vacuum collection equipment on-site, including servicing or filter maintenance, in appropriate containment area or outside building.
- F. Clean and seal collection devices, vacuums and other tools and devices before relocating to different building areas, moving equipment through occupied spaces, and before removing equipment from building.
- G. Locate fuel-powered equipment to prevent combustion emissions and air exhaust emissions from entering building envelope.
 - 1. Monitor and manage equipment operation and location to prevent introduction of combustion emissions into occupied space.
- H. Furnish HEPA-filtered equipment with minimum collection efficiency of 99.97 percent at 0.3 micron particle size, when vacuum collection equipment exhausts within building envelope.

3.6 CLEANING - GENERAL

- A. Perform HVAC system cleaning in accordance with ACR, The NADCA Standard.
- B. Remove visible non-adhered substances.
 - 1. Clean HVAC components employing agitation device to dislodge contaminants from HVAC component airside surfaces, and then capturing contaminants with vacuum collection device.
 - a. Acceptable methods include those that do not damage integrity of ductwork and other system components, and does not damage porous surface materials including internal insulation and duct lining.
 - 2. Clean HVAC components using source removal mechanical cleaning methods designed to extract contaminants from within HVAC system components and safely remove contaminants from facility.
 - 3. Select source removal methods rendering HVAC system components visibly clean and capable of passing cleanliness verification methods as described in ACR, The NADCA Standard.

4. Do not employ cleaning method, or combination of methods, that can damage HVAC system components or negatively alter system integrity.
 5. Do not damage HVAC system and components with wet cleaning, power washing, steam cleaning and other wet process cleaning.
- C. Apply cleaning materials in accordance with manufacturer's instructions.
1. Do not apply cleaning agents or water to electrical, fibrous glass or other porous HVAC system components.
- D. Capture removed contamination and cleaning materials and legally dispose.
- E. Verify HVAC system surface and component cleanliness in accordance with ACR, The NADCA Standard.
- F. Particulate Collection:
1. Employ contaminant removal methods incorporating vacuum collection devices operated continuously during cleaning.
 - a. Connect vacuum collection device to component being cleaned through service opening.
 - b. Employ vacuum collection device of sufficient capacity to maintain areas being cleaned under negative pressure, containing debris and preventing contaminant migration to adjacent areas.
 2. When possible, discharge ducted exhaust air from vacuum collection devices outdoors, keeping discharge air clear of outdoor air intakes, operable windows, and other locations allowing outdoor air entry.
 - a. Do not violate outdoor environmental standards, codes or regulations.
 - b. Do not discharge unfiltered air from vacuum collection devices outdoors.
 3. When necessary to exhaust vacuum collection devices indoors, including hand-held and wet-vacuum machines, keep discharge air in work area, and provide machine air discharge HEPA filtration, rated at 99.97 percent collection efficiency for 0.3 micron particles and larger.

Retain the following paragraph and subparagraphs when the work includes AHU cleaning. Otherwise, delete.

3.7 AIR HANDLING UNIT (AHU) CLEANING

- A. Clean supply, **[return]** **[relief]**, and **[exhaust]** fans and blowers.
1. Clean blowers, fan housings, ducted plenums, scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies.
 2. Remove visible non-adhered substances in accordance with ACR, The NADCA Standard.
- B. Clean air handling unit (AHU) internal surfaces, components and condensate pans, and drains.

- C. Clean heat transfer coils, fans, condensate pans, drains and similar non-porous surfaces in conjunction with mechanical methods as described in ACR, The NADCA Standard.
- D. Control water spray and extraction are sufficient to collect debris and prevent water damage to HVAC components and surrounding equipment.
- E. Capture, contain, test and dispose of waste water generated while performing wet cleaning in accordance with applicable federal, state, and local regulations, and requirements of Authorities Having Jurisdiction.
- F. After cleaning, verify HVAC system component cleanliness in accordance ACR, The NADCA Standard.

Retain the following paragraph and subparagraph when the work includes air duct cleaning. Otherwise, delete.

3.8 AIR DUCT SYSTEMS:

- A. Clean airside surfaces of ducts to remove non-adhered substances.
- B. Access air duct interiors through service openings in system that are large enough to accommodate mechanical cleaning procedures and allow for cleanliness verification.
- C. Use mechanical agitation methods to remove non-adhered substances.
- D. Capture dislodged substances with vacuum collection device.
- E. Do not employ cleaning methods that damage HVAC components.
- F. Mark position of dampers and air-directional mechanical devices inside HVAC system prior to cleaning.
- G. When cleaning is complete, restore dampers and devices to their marked positions.
- H. After cleaning, verify cleanliness of HVAC system surfaces and components in accordance with ACR, The NADCA Standard.

Retain the following paragraph and subparagraph when the work includes AHU coil cleaning. Otherwise, delete.

3.9 AHU COILS

- A. Perform visual coil and drain pan inspection to determine whether Type 1 dry cleaning, or Type 2 wet cleaning is required.
- B. Employ cleaning methods rendering coil visibly clean in accordance with ACR, The NADCA Standard.
- C. Isolate coil from duct system during cleaning process. Do not allow removed particles to migrate to, or redeposit on, unintended areas.

- D. Apply coil cleaning products in accordance with manufacturer's published data and labeling.
- E. Clean and flush condensate drain pan and drain line. Verify proper drainage operation before and after cleaning.
- F. Apply cleaning methods and products that do not cause damage to, or erosion of, coil surface or fins.

3.10 TYPE 1 DRY CLEANING METHOD

- A. Operate HEPA-filtered negative air machines that discharge continuously during Type 1 cleaning process.
- B. Mechanically remove non-adhered substances and debris in accordance with ACR, The NADCA Standard.

3.11 TYPE 2 WET CLEANING METHOD

- A. Employ Type 2 wet cleaning method when visual inspection reveals suspect microbial matter on coil or drain pan. Access both upstream and downstream sides of each coil section for cleaning.
- B. Employ engineering controls required for coil cleaning in accordance with ACR, The NADCA Standard.
- C. Verify cleanliness after cleaning has been performed as described in ACR, The NADCA Standard.
- D. Perform Type 2 cleaning if adhered substances still remain on the coil or the coil is impacted after Type 1 cleaning has been completed and post-cleaning inspection has been performed.
- E. After cleaning, verify cleanliness of HVAC coils in accordance ACR, The NADCA Standard.

Retain the following paragraph and subparagraph when the work includes duct-mounted, inline coil cleaning. Otherwise, delete.

Retain the options in the following subparagraphs if the inline coils have drain pans. Otherwise, delete.

3.12 DUCT-MOUNTED INLINE COILS

- A. Perform visual inspection of coil [and drain pan] to determine whether Type 1 dry cleaning, or Type 2 wet cleaning is required.
- B. Employ cleaning methods which will render coil visibly clean in accordance with ACR, The NADCA Standard.

- C. Isolate coil from duct system during cleaning process. Do not allow removed particles to migrate to, or redeposit on, unintended areas.
- D. Apply coil cleaning products in accordance with manufacturer's published data and labeling.
- E. Clean and flush coil [, condensate drain pan and drain line. Verify proper drainage operation before and after cleaning].
- F. Apply cleaning methods and products that do not cause damage to, or erosion of, coil surface or fins.
- G. Type 1 Dry Cleaning Method:
 - 1. Operate negative air machines with HEPA-filtered discharge continuously during Type 1 cleaning process.
 - 2. Mechanically remove non-adhered substances and debris in accordance with ACR, The NADCA Standard.
- H. Type 2 Wet Cleaning Method:
 - 1. Employ Type 2 wet cleaning method when visual inspection reveals suspect microbial matter on coil or drain pan. Access both upstream and downstream sides of each coil section for cleaning.
 - 2. Employ engineering controls required for coil cleaning in accordance with ACR, The NADCA Standard.
 - 3. Verify cleanliness after cleaning has been performed as described in ACR, The NADCA Standard.
 - 4. Perform Type 2 cleaning if adhered substances still remain on the coil or the coil is impacted after Type 1 cleaning has been completed and post-cleaning inspection has been performed.
 - 5. Capture rinse water when cleaning duct mounted coils without drain pans. Do not allow water to remain in cleaned ductwork.
- I. After cleaning, verify cleanliness of HVAC coils in accordance ACR, The NADCA Standard.

Retain the following paragraph and subparagraph when the work includes electric resistance coil cleaning. Otherwise, delete.

3.13 ELECTRIC RESISTANCE COILS

- A. De-energize, lock out, and tag out power source to coil.
- B. Employ Type 1 dry cleaning methods.
- C. Employ cleaning methods which will render coil visibly clean in accordance with ACR, The NADCA Standard.
- D. Isolate coil from duct system during cleaning process. Do not allow removed particles to migrate to, or redeposit on, unintended areas.

- E. Apply coil cleaning products in accordance with manufacturer's published data and labeling.
- F. Apply cleaning methods and products that do not cause damage to, or erosion of, coil surface or fins.
- G. Type 1 Dry Cleaning Method:
 - 1. Operate negative air machines with HEPA-filtered discharge continuously during Type 1 cleaning process.
 - 2. Mechanically remove non-adhered substances and debris in accordance with ACR, The NADCA Standard.
- H. After cleaning, verify cleanliness of HVAC coils in accordance ACR, The NADCA Standard.

Retain the following paragraph and subparagraph when the work includes internal insulation and linings. Otherwise, delete.

3.14 INTERNALLY INSULATED DUCT SYSTEM COMPONENTS AND SOUND ATTENUATORS

- A. Employ cleaning methods that do not damage internal insulation or sound attenuating components, and that render system capable of passing cleanliness verification tests.
- B. Clean fibrous glass duct liner or duct board present in equipment or air ducts employing mechanical agitation methods to remove non-adhered substances.
- C. Do not create abrasions, breaks, or tears to fibrous glass liner or duct board surfaces.
- D. Maintain HVAC system under constant negative pressure when cleaning internal insulation components.
- E. Do not wet insulation components.
- F. Identify for replacement fibrous glass materials with evidence of damage, deterioration, delaminating, friable materials, biological growth, or moisture that cannot be restored by cleaning or resurfacing/coating.
- G. When required, remediate exposed, damaged insulation exposed to HVAC system air stream.
 - 1. Scrape insulation and adhesive residue from metal duct system component surfaces that have undergone degraded insulation removal.
 - 2. Remove loose, visible debris prior to installation of new insulation.

Retain the following paragraph if mold-contaminated duct liner was removed. Otherwise, delete.

- 3. Where biologically contaminated insulation was removed, apply antimicrobial agents to remove traces of contamination or abate mold in accordance with ANSI/IICRC S520.

Retain the following paragraph if restoration of duct lining is required. Otherwise, delete.

4. When replacement insulation installation is complete, verify that new fibrous glass surfaces are capable of compliance with NADCA cleanliness verification requirements.

3.15 SPECIAL TECHNIQUES

A. Engineering Controls:

1. Employ engineering controls to prevent contaminating surfaces outside work area.
 - a. Comply with government regulations, and industry standards and guidelines relevant to working in the facility environment in which the work is located.
 - b. Control odors, mists, and aromatic vapors during cleaning process.

B. Controlling Product Emissions:

1. Apply cleaning agents and other chemicals in accordance with manufacturer's recommended procedures and product application instructions, including exhaust ventilation.

C. Negative Duct Pressurization:

1. Throughout cleaning process, keep HVAC system and associated air ducts at negative differential pressure, relative to indoor non-work area.
2. Maintain negative pressure differential between portion of HVAC duct system being cleaned and surrounding indoor occupant spaces.
3. Continuously monitor and verify correct pressure differential.
4. When performing vacuum collection, employ negative air machine drawing air from equipment being cleaned.
5. When negative air machine is not fitted with HEPA filtration, duct exhaust air from negative air machine to outdoor location, keeping discharge air clear of outdoor air intakes, operable windows, and other locations where outdoor air enters building.
 - a. Do not violate outdoor environmental standards, codes or regulations by releasing debris.
 - b. Do not discharge unfiltered air from vacuum collection devices outdoors.

D. Microbial Agents:

1. Apply antimicrobial agents only when active biological growth is reasonably suspected, or where unacceptable levels of biological contamination have been verified through testing.
2. Apply antimicrobial agents after removal of surface deposits and debris.
3. Apply antimicrobial agents in accordance with antimicrobial agent manufacturer's written recommendations and associated EPA registration listing.

3.16 FIELD QUALITY CONTROL

- A. Inspect work to verify cleanliness immediately after HVAC system component cleaning and prior to placing system in operation.
- B. Do not apply treatment, coating, or antimicrobial agent to cleaned HVAC system components until the work has been inspected and determined to be acceptable.
- C. Visual Inspection:
 - 1. When cleaning is complete, perform final inspection in presence of **[Owner]** **[Construction Manager]** **<Insert title of Owner's Representative here>**.
 - 2. Perform visual inspection of porous and non-porous HVAC system component surfaces. Verify HVAC system components are visibly clean as defined in ACR, The NADCA Standard.
 - 3. If no contaminants are evident through visual inspection, HVAC system components are considered clean and acceptable.
 - 4. If contaminants are evident through visual inspection, repeat cleaning system areas where contaminants are visible.
 - a. Notify **[Owner]** **[Construction Manager]** **< Insert title of Owner's Representative here >** to schedule cleanliness re-inspection.
- D. Surface Comparison Test for Porous Surfaces Only:
 - 1. If visual inspection of porous surfaces is inconclusive or disputed, then perform Surface Comparison Test in accordance with ACR, The NADCA Standard.
 - a. Attach vacuum brush to operating contact vacuum.
 - b. Employ contact vacuum with HEPA-filtered discharge, capable of achieving minimum 80 inches w.g. static lift and fitted with 2.5-inch diameter round nylon brush attached to 1.5-inch diameter vacuum hose.
 - c. Pass brush over surface test area four times.
 - d. Visually compare tested and untested surfaces to determine whether visible surface characteristics are detectable.
 - 2. When surface comparison test is complete, HVAC component surface is considered acceptably clean if there is no visually detectable difference between tested and untested surface characteristics.
- E. NADCA Vacuum Test for Non-Porous Surfaces Only:
 - 1. When required, perform Vacuum Test in presence of **[Owner]** **[Construction Manager]** **< Insert title of Owner's Representative here >**, and in accordance with ACR, The NADCA Standard.
 - 2. Apply NADCA Vacuum Test template to ducted airside of component's surface.
 - 3. Attach closed-face vacuum cassette with filter media to calibrated air sampling pump and pass closed-face of filter cassette over two 2 cm x 25 cm openings marked on template.
 - 4. The cassette shall be moved at a rate not greater than 5 cm per second (5 seconds per slot in each direction).When sampling is complete, prepare filter cassette and weigh it to determine total amount of debris collected.

5. Surface is considered acceptably clean, when net weight of debris collected on filter cassette is less than 0.75 mg/100 cm².

3.17 SYSTEM STARTUP

- A. Install closures over services access openings before allowing system restart for normal facility operation.
- B. When system is placed in operation, remove temporary filter elements after minimum 24 hours operation.

3.18 DISPOSAL OF JOB SITE DUCT CLEANING WASTE

- A. Seal HVAC system debris and removed contaminated materials in containers before removal from work area.
- B. Handle materials classified as hazardous by governmental agencies in accordance with applicable federal, state, and local, regulations and codes.
- C. Dispose of debris removed from HVAC system in accordance with applicable federal, state, and local requirements.

If it more clearly defines the Contractor's scope of work, attach equipment schedules, data tables, illustrations, or Owner's maintenance procedure forms to this specification section.

3.19 ATTACHMENTS

- A. Schedules.
- B. Tables.
- C. Illustrations.
- D. Forms.

END OF SECTION