NATIONAL AIR DUCT CLEANERS ASSOCIATION

NADCA

Introduction to HVAC System Cleaning Services

A GUIDELINE FOR
COMMERCIAL CONSUMERS

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Introduction to HVAC System Cleaning Services: A Guideline for Commercial Consumers

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Foreword

"Air duct cleaning" is the term most commonly applied to the work performed by professional heating, ventilating, and air conditioning (HVAC) system cleaning contractors. The term "air duct cleaning," however, is a misnomer because it implies that only the ductwork is to be cleaned. In order to obtain the most effective results, it is recommended that all portions of an HVAC system be cleaned.

A cooperative and mutually supportive client/contractor relationship is the key to coordinating a successful HVAC system cleaning project. One critical element of this relationship is good communication. Through clear, concise communications, duct cleaning contractors can provide their clients and the occupants of the facility to be cleaned with a clear understanding of the work to be undertaken and demonstrate that the project will be well managed. Clients, on the other hand, should clearly define the scope of work they desire. Duct cleaning contractors vary in their level of knowledge; therefore an assessment of the contractor's previous work experience relative to the scope of the project is recommended.

NADCA Standard *Assessment, Cleaning and Restoration of HVAC Systems (ACR),* is one of the tools that is used to determine the level of cleanliness a duct cleaning contractor has achieved at the completion of a project. The NADCA Standard is a performance-based document that defines acceptable cleanliness levels and provides three different methods for verifying or testing cleanliness. Properly used, the standard can facilitate the communication link between the contractor and the client. By specifying that work shall be performed in accordance with ACR, the client can define the specific level of cleanliness expected from the contractor. The NADCA Standard allows a professional understanding to be formed between both parties, laying stepping-stones to building a cooperative relationship and successful project.

The client's specifications should clearly define all areas where work is to be performed so that the contractor understands exactly what work falls within the scope of the project. Many HVAC system cleaning projects are closely tied to indoor air quality concerns. At the first client/contractor meeting, a clear understanding should be established as to what the exact role of the cleaning contractor will be, as well as the expected results of the cleaning process. The client's understanding of the difference between duct cleaning and indoor air quality is helpful in creating a smooth working relationship.

During the initial contact, a qualified HVAC system cleaning contractor should provide the client with valuable information when it comes to assessing the system, project coordination, knowledge of similar systems, cleaning techniques available, development of structured specifications, product knowledge, and a wide variety of other information. Knowledge of important topics such as the physiological and psychological impact the duct cleaning process will have on occupants is one indicator of a contractor's level of experience. Such issues should be discussed before the project is contracted.

Establishing a Game Plan

HVAC system cleaning projects require a game plan. Project length can vary from a few hours to six months or more. The size and scope of the project are the two key elements that will vary the length of time significantly. The scope of the project may be written by the client, an IAQ consultant, HVAC system cleaner, general contractor or by any number of other trade professionals. Even with a scope present, a contractor's primary responsibility is to always use Source Removal methods, in accordance with NADCA Standard ACR, during the entire cleaning process. For instance, the scope must contain language that requires the HVAC system cleaner to remove all particulate matter within the HVAC system.

The entire duct cleaning project will run best when an in-depth review is conducted to determine the expectations and results that both sides can realize. Addressing the following points will help in the project review process:

1.) Mechanical blue prints are a must to assess and complete a project successfully. In the event blue prints are not available, be prepared to conduct exhaustive preliminary research and on-site evaluations.

2.) Clear time lines are needed. The contractor must be informed of the specific times he will have access to the areas to be cleaned and availability of other resources within the building. The client should specify the time limits for project completion, but should make this determination in close cooperation with the contractor.

3.) Site preparation and evaluation must be conducted to develop a firm game plan, and to help determine appropriate environmental engineering controls to safeguard the indoor space.

4.) Any products used in the cleaning process (such as chemical surface treatments) should be discussed in depth. The client should approve and sign off on the use of such products. Contractors should be prepared to provide product information labels, material safety data sheets (MSDS) and any other relevant information requested by the client.

5.) Consultations with key people who will be in charge of the project are very important. Supervisors, managers, sub-contractors, security personnel, occupants and any other individuals who will interact with the contractor should be informed of the nature of the work to be performed and the work schedule.

6.) Specific duct cleaning techniques should be authorized. The contractor should familiarize the client with the cleaning equipment and techniques to be used and should obtain client authorization to utilize such equipment and techniques in the cleaning process.

7.) All safety and environmental concerns should be fully addressed prior to beginning the project.

8.) If there is an environmental consultant associated with the project, the HVAC system cleaning contractor and this specialist should meet and gain a clear understanding of each other's roles, responsibilities and expectations.

9.) If multiple contractors are being used on the same project, it is important to define a clear chain of command. The HVAC system cleaning contractor should be informed of to whom he reports on matters of day-to-day activity, progress, and project completion. The party responsible for verifying cleanliness should also be established in advance of project commencement.

The remainder of this document discusses in detail many of the principles described above. It is the intent of this guide to provide consumers of commercial HVAC system cleaning services with information needed to understand the procedures used in the cleaning process, select a qualified contractor, and manage a successful project.

Notice

All questions or other communications relating to this document should only be sent to NADCA Headquarters, 1518 K Street, N.W., Suite 503, Washington, DC 20005. You may also contact NADCA Headquarters for information about obtaining other NADCA documents, including the NADCA Standard ACR and a listing of qualified HVAC cleaning contractors in your area.

Users of this document should consult applicable federal, state and local laws and regulations. NADCA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws and this document may not be construed as doing so.

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Introduction to HVAC System Cleaning Services: A Guideline for Commercial Consumers

Introduction

A building's heating, ventilation, and air conditioning (HVAC) system provides conditioned air to occupied spaces within the facility. Typically, air from within an occupied space, along with fresh air drawn from outdoors, is drawn in through ductwork to an HVAC unit, where it is conditioned. Before the air gets to the unit, it usually passes through a filter designed to protect the mechanical equipment from becoming contaminated by large particles of dust and debris. Many filters commonly used today will not prevent the introduction of small particles of dust and debris from the air stream into the system. Over time, these deposits may form sizable accumulations.

In the course of normal building operations, the humidity level within the HVAC system can vary greatly. High humidity can combine with dust and debris in the system, often resulting in the growth of microbial contamination. In an HVAC system, microbial contamination (such as mold, fungus and their spores) may cause adverse health reactions among building occupants. Condensate drain pans and other system components often become heavily contaminated with fungal and bacterial slime

In order to maintain acceptable indoor air quality (IAQ), it is commonly recommended that mold, fungi, dust and other contaminants be cleaned out of the HVAC system. Cleaning HVAC systems provides many benefits. Cleaning lessens the likelihood of indoor air pollution in the building and may help to alleviate health and comfort complaints by occupants. Clean HVAC systems perform more efficiently, which may decrease energy costs. Well-maintained mechanical components are likely to last longer, reducing the need for costly HVAC system replacement or repairs.

With growing awareness of the dangers of indoor air pollution, public concern for the cleanliness of ventilation systems has led to a significant increase in demand for HVAC system cleaning services. Solving complex IAQ problems, however, often requires a team of multidisciplined professionals, such as mechanical contractors, filtration experts, test and balance specialists, industrial hygienists, and, of course, professional HVAC system cleaning contractors.

In most cases, HVAC system cleaning alone will not solve IAQ problems. It can, however, greatly reduce the threat of indoor air pollution when performed in conjunction with a program of regular building maintenance and IAQ evaluation. The U.S. Environmental Protection Agency (EPA) has published a comprehensive guide for building owners and managers that is designed to help reduce the risk of indoor air pollution. The publication, "Building Air Quality", (see *Recommended Reading)* provides guidelines that all owners and managers should use and implement in their facilities.

There are several ways to clean an HVAC system. Recommended cleaning methods employ "Source Removal," the mechanical cleaning of system components to remove dirt and debris. Source removal methods employ vacuum units, compressed air, mechanical and hand brushes, and other tools to loosen dirt and debris and convey it to a containment device for proper disposal.

Source removal requires two key elements to be effective. The first element is a means of agitating the dust and debris within the HVAC system. The second element is the extraction of contaminants from the HVAC system. Removal methods must be capable of removing the foreign material to the levels specified within industry standards.

Air duct cleaning services have been available since the early 1900s. By the early 1970s, hundreds of air duct cleaning companies were thriving in America. The problem, however, was that many of these companies were utilizing inferior methods of cleaning. Often, they applied chemical encapsulants or dust abatement products over contaminants in air ducts to restrict the movement of these particles and render them "harmless" to building occupants. However, many such products were not proven safe for use in air handling systems.

In February of 1989, a group of air duct cleaning professionals banded together to help educate the public about the need for properly performed HVAC system cleaning services. They formed the National Air Duct Cleaners Association, Inc. (NADCA), and made it their goal to promote Source Removal methods of HVAC system cleaning.

Today NADCA is represented throughout the United States, and also has a substantial international membership. NADCA's involvement in programs held by the U.S. EPA, American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE), Indoor Air Quality Association (IAQA), and other environmentally conscious public and private sector organizations will help the association continue to be the leading authority in HVAC system cleaning.

Indoor Air Quality

IAQ can be defined as the nature of air as it affects the health and well-being of building occupants. Americans spend up to 90 percent of their time indoors. The amount of time spent indoors is a significant concern, given the fact that studies conducted by the EPA, the National Institute for Occupational Safety and Health (NIOSH), and others, show indoor pollutant levels may be 10 to 100 times higher than outdoor concentrations.

Indoor air pollution comes from a variety of contamination sources. Virtually everything in the indoor environment releases particles and/or gases. Common office supplies and equipment have been found to release potentially hazardous levels of chemicals. Clothing, furnishings, draperies, carpets and other fabrics contribute fibers and particulate debris to indoor air. Cleaning processes such as sweeping, dusting and vacuuming normally remove the larger particles of debris, but often increase the airborne concentrations of smaller particles. Cooking, gas and oil burning, and smoking also generate vast numbers of airborne particles and gases.

Adverse health effects associated with indoor air pollution range from minor discomfort, causing decreased worker productivity, to respiratory illness, cancer, and in the most extreme cases - death. Perhaps the most tragic and well publicized example of severe indoor air pollution was the 1976 outbreak of Legionnaire's disease in a Philadelphia hotel, where 29 people died from breathing air contaminated by bacteria that originated from the building's air conditioning system.

The term "Sick Building Syndrome" (SBS) was coined to describe buildings in which a percentage of the occupants experience acute health and comfort effects that are apparently linked to the time they spend in the building, but for which no specific cause can be identified. Physical symptoms of SBS may include eye, nose and throat irritation, headaches, dry cough, dry or itchy skin, dizziness, nausea, difficulty in concentrating, fatigue, and sensitivity to odors, Usually the symptoms associated with SBS disappear or significantly diminish when the occupant leaves the affected space.

In contrast to SBS, "Building Related Illness" (BRI) occurs when symptoms of diagnosable illnesses are identified (such as Legionnaire's disease, Pontiac fever, histoplasmosis, sinusitis, bronchitis, asthma, or dermatitis) and can be directly attributed to environmental agents in the air. Unlike SBS complaints, however, BRI symptoms generally do not disappear when the affected individual leaves the building or home.

In cases of BRI, the advice of a qualified health professional should be sought immediately.

While there are many sources of indoor air pollution, the source most frequently cited in scientific studies and surveys of building occupants is the HVAC system. Problems linked to the operation of HVAC systems accounted for one out of four complaints in a survey conducted by the Building Owners and Managers Association (BOMA). According to studies performed by the NIOSH, the largest single cause of SBS is some deficiency in the ventilation systems of occupied buildings – about 52 percent of the time.

HVAC systems are composed of many mechanical parts, reservoirs, and sometimes miles of complex ductwork, all of which collect dust and debris over time. Contaminants in ductwork can range from common nuisance dust and soil, to dead birds and rodents, rotting leaves, bacteria, fungi and mold. HVAC systems are a perfect breeding ground for biological contaminants due to their enclosed space, constant temperature, humidity and dirt as a nutrient source.

Reducing or controlling indoor air pollution usually involves one or more of several techniques: ventilating to dilute or exhaust the pollutants, filtering or air cleaning, reducing or removing sources of contaminants and emissions, testing and balancing of HVAC systems, and repair of duct leakage. Solving indoor air pollution problems may require a "multi-disciplinary" approach including specialists from a variety of fields.

The economic benefits of solving IAQ problems can be significant. Improving air quality can reduce worker absenteeism and increase productivity. The U.S. Government estimates that absenteeism cost more than $100 billion a year in lost productivity and medical costs, and medical researchers in the U.S. have found that 50 percent of absenteeism is due to upper respiratory problems – common symptoms in sick buildings.

Poor indoor air quality can be significantly improved. HVAC systems can be cleaned, ventilation rates increased, biological contaminants controlled, and filtration systems upgraded. Steps can also be taken to ensure that furnishings brought into the indoor environment do not release noxious gases. The results of such actions can provide a dramatic improvement in indoor air quality.

Contaminants

There are a wide variety of substances and materials that may be classified as a "contaminant" within an HVAC system. Contaminants may be organic or inorganic, and can take the form of solids, liquids, or gases. Some contaminants pose a significant health risk.

Within the scope of HVAC system cleaning, NADCA defines an HVAC system contaminant as, "Any substance not intended to be present that is located within the HVAC system." As the range of possible contaminants is seemingly endless under this definition, this guide limits the discussion to some of the very basic information regarding types of contaminants and associated health risks.

Pertinent Terms

- Aerosols - solid or liquid airborne particles
- Biological contaminants – bacteria, fungi (mold and mildew), viruses, animal dander, mites, insects, pollen, and the by-products of these elements.
- Bioaerosols – airborne particles of biological origin
- Debris – any solid material, including particulate substances and biological contaminants, in the HVAC system not intended to be present
- Fungi – any group of saprophytic and parasitic sporeproducing plants that lack chlorophyll, including: Molds, rusts, mildews, mushrooms, and yeasts

It is important to remember that most contaminants found within HVAC systems were not present upon initial installation of the system (however, many new HVAC systems contain some forms of contamination in the way of construction debris such as drywall dust, fire proofing substances and other construction materials). HVAC systems inherently collect debris over time, particularly if the filtration is inadequate. As such, an HVAC system can serve as a collection and distribution center for various indoor pollutants.

The most common contaminant found within an HVAC system is a common nuisance dust. Dust accumulations can become quite sizable over several years, or even less time when HVAC filtration is inefficient and building maintenance protocols are lax. It should be noted that the presence of a light film of dry dust is common within many HVAC systems and may not necessitate cleaning.

The presence of excessive dust accumulations within an HVAC system can lead to the development of biological contamination. An HVAC system can act as a source of bioaerosols by providing a hospitable environment for the growth of fungi and bacteria and then distributing the biologically contaminated air within the facility.

Human comfort constraints limit the use of temperature as a feasible means of controlling fungal growth. At a minimum, low levels of spores are always present in outdoor and indoor air. As such, effective control of fungal contamination within HVAC systems is a matter of minimizing the available nutrient sources (dust, dirt and debris) and regulating the moisture levels within the systems.

Biological contaminants within HVAC systems can cause discoloration around supply diffusers, odors, and deteriorate building materials. They may also lead to allergic and asthmatic reactions in susceptible individuals, as well as other health problems.

Areas within HVAC systems commonly containing microbial contamination include the condensate drain pan, areas downstream of cooling coils, and areas around humidifiers. The presence of dirt and debris and the moisture in these areas provide an ideal environment for microbial contaminants.

HVAC systems may distribute unpleasant odors. These odors may or may not originate within the HVAC system and, on occasion, can be extremely complicated problems to solve. Musty odors blowing out of supply vents may indicate mold and mildew within the HVAC system, but there could be other sources as well. An HVAC system cleaning contractor may be able to perform a site evaluation to determine possible odor sources, which may include the HVAC system.

Testing for Hazardous Materials

Depending on the usage and history of the building and the materials used to construct it, HVAC systems may become contaminated with hazardous materials. For example, older facilities in which asbestos was used in initial construction may have collected asbestos dust within their HVAC systems.

It is the building owner's responsibility to determine if hazardous materials are present in the HVAC systems prior to contracting for cleaning. If hazardous materials are known to be present, specifications should be written accordingly. A qualified party should perform testing for the presence of hazardous materials.

System Inspections

HVAC system inspections must be part of a building's overall indoor air quality management program. Systems should be cleaned when a cleanliness inspection indicates that the system is contaminated with a significant accumulation of particulate or microbiological growth. If the inspection shows that HVAC system performance is compromised due to contamination build-up, cleaning is necessary. Often HVAC systems become contaminated during construction activities within a building. Newly installed HVAC systems should be clean before operated.

HVAC systems should be routinely inspected for cleanliness by visual means. The table below is from NADCA Standard ACR. It provides a recommended inspection schedule for major HVAC components within different building use classifications defined by the Standard. The inspection intervals specified in Table 1 are minimum recommendations. The need for more frequent cleanliness inspections is subject to numerous environmental, mechanical and human influences. Geographic regions with climates having higher humidity, for example, will warrant HVAC system inspections on a more frequent basis, due to the increased potential for microbial amplification.

If the inspection of the air handling unit reveals contamination, then supply and return ductwork must be inspected at that time rather than in accordance with the intervals specified in Table 1.

Table 1
HVAC Cleanliness Inspection Schedule

Building Use Classification	Air Handling Unit	Supply ductwork	Return ductwork / Exhaust
Industrial	1 year	1 year	1 year
Residential	1 year	2 years	2 years
Light Commercial	1 year	2 years	2 years
Commercial	1 year	2 years	2 years
Healthcare	1 year	1 year	1 year
Marine	1 year	2 years	2 years

HVAC system component inspections should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected. The cleanliness inspection must be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering controls should be implemented.

The air handling unit (AHU) cleanliness inspection should consider all components within the unit, including filters and air bypass, heat and cooling coils, condensate pans, condensate drain lines, humidification systems, acoustic insulation, fan and fan compartment, dampers, door gaskets and general unit integrity. The supply duct cleanliness inspection should consider a representative portion of ductwork, controls, mixing / VAV boxes, reheat coils and other internal components. The return duct cleanliness inspection should consider a representative portion of return system components including but not limited to return ducts, dampers, return plenums, make-up air plenums and grilles.

Conditions Requiring Cleaning

According to ACR, HVAC system cleaning must be performed when any of the following conditions are found in the cleanliness inspection:

- Significant accumulations of contaminants or debris are visually observed within the HVAC system, and/or evidence of microbial growth is visually observed or confirmed by analytical methods.
- The HVAC system discharges visible particulate into the occupied space, or a significant contribution of airborne particles from the HVAC system into the indoor ambient air is confirmed.
- Heat exchange coils, cooling coils, air flow control devices, filtration devices, and air-handling equipment are determined to have restrictions, or contamination deposits that may cause system performance inefficiencies, air flow degradation, or that may significantly affect the design intent of the HVAC system.

Indoor air quality management plans that include preventative cleaning and maintenance are recommended to minimize recurring contamination within HVAC systems. Special consideration should also be given to buildings or residences with sensitive populations such as immune-compromised individuals, and specialized environments or buildings with sensitive building contents or critical processes.

Site Preparation

Site preparation is a key element in any successful HVAC system cleaning project. Site preparation occurs when the contractor and the client cooperatively review and evaluate all aspects of the HVAC cleaning process, as it relates to the facility and its occupants, and develop a strategy for safely and effectively managing the project.

A successful HVAC cleaning project can have many beneficial results, including reduced health risks, fire prevention, and increased system performance. On the other hand, an unsuccessful HVAC cleaning project can result in increased occupant exposure to contaminants and mechanical system malfunctions.

Project Assessment

According to NADCA Standard ACR, a “Project Assessment” must take place prior to commencing with cleaning work. The Project Assessment includes three steps: (1) Building Usage Classification; (2) HVAC Contamination Evaluation; and (3) Environmental Impact Assessment.

The HVAC Contamination Evaluation and the Environmental Impact Assessment must include a visual evaluation of representative sections of the HVAC components and the occupied spaces served by the HVAC system. This evaluation serves to assess conditions within the HVAC system and the physical integrity of system components and surfaces.

Information collected from the Project Assessment should be used to define the scope of the cleaning and restoration project, cleaning methods to be employed, the environmental engineering controls required for the workspace, and any unique project requirements.

As part of the Environmental Impact Assessment, the client and the contractor should conduct a walk-through, or site evaluation, to establish a specific, coordinated plan which details how each area of the building or home will be protected during the various phases of the project. The site evaluation should address such concerns as:

- Occupant safety and protection from contaminants.
- Building safety and security policies.
- Containment strategies for debris removed from the HVAC system and cross-contamination assessment.
- Protecting furniture, computers, photo copiers, and other office equipment.
- Specific and unique building-related issues.

Site preparation and evaluation can affect the psychological impact of HVAC system cleaning on a facility's occupants. A well executed site evaluation, leading to a well planned and coordinated cleaning project, will often result in the reduction of occupant stress related to the cleaning project or other indoor air concerns. A poorly executed site evaluation can have an adverse psychological impact on building occupants.

Facility occupants should be informed of cleaning schedules and of the expected results of the cleaning procedures. Occupants should be informed in detail of any disruptions to their daily routine well ahead of time. By keeping the occupants informed of several different aspects of the cleaning process, the contractor and client can reduce the likelihood of concerns and complaints relating to the project.

Occupant Safety & Protection from Contaminants

During the HVAC cleaning procedure, the most important concern should be the safety and well being of the facility's occupants, the facility itself, and the workers performing the cleaning services. Considering that one of the most commonly cited reasons for having ventilation systems cleaned is to safeguard the health and safety of building occupants, both the contractor and the client have a responsibility to ensure that the cleaning process does not expose occupants to new hazards.

Draw on the contractor's experience to locate and isolate potential problem areas before cleaning begins. When speaking strictly of the HVAC cleaning project, there are of course standard safety issues which arise and which a qualified contractor should be prepared to address and resolve (see Safety). When speaking of indoor air pollution problems, however, special consultants may be needed, with respect to occupant safety, to address larger concerns relating to the facility as a whole.

There are a few basic issues common to any HVAC system cleaning project that should always be resolved before work begins. These issues include the following:

- Special attention should be directed toward occupants known to have respiratory problems or other special health concerns or sensitivities.
- The specific work hours should be established and occupants should be informed of the work schedule.
- It should be determined if HVAC system components (blower wheels, supply or return grilles, etc.) will be transported within the facility and its

- occupied areas. If so, debris containment procedures must be in place while the equipment is being moved.

- The down time for the HVAC system should be estimated, as well as the amount of time needed to return the building to its normal occupancy temperature after heating or cooling has been restored.

- If occupants are to work as cleaning is going on, steps should be taken to ensure that the movement of such people does not interfere with the contractor's ability. Any perceived conflicts between the contractor's equipment and personnel and the occupants' movement throughout the facility should also be resolved before the project begins.

- Special safeguards relating to the facility's security protocol as affected by the cleaning project must be established.

Unless specifically hired as an IAQ consultant, the HVAC system cleaning contractor's responsibility is to assure occupant safety with respect to the specific procedures and actions involved in the cleaning process itself. Consultations between the contractor and the client should address all of the above considerations. These types of issues may impact both the physical and psychological well being of facility occupants.

Environmental Engineering Controls

During HVAC system cleaning procedures, appropriate environmental engineering controls must be established to control contaminants associated with the project from migrating to other spaces in the building.

The effectiveness of environmental engineering controls may be demonstrated by appropriate monitoring. Monitoring is highly recommended in buildings containing sensitive environments or contents, when occupants have special health considerations, or when hazardous or biological contaminants within the system warrant such monitoring.

Many of the pollutants removed from a typical HVAC system are not considered hazardous waste; however, since testing and identification of contaminants within the system is rarely performed, it is wise to observe strict environmental containment strategies during any HVAC system cleaning project. In the absence of known hazardous contaminants, containment is important in ensuring that common dust and nuisance debris do not enter the occupied areas of a facility, as these contaminants are an IAQ concern.

The goal of any containment strategy is to move particulate substances and other debris in a controlled manner from the point of origin (i.e., the ventilation system) to the point of capture (i.e., the vacuum collection device) without allowing the escape of debris and the contamination of indoor spaces.

The type of equipment used by the contractor will have a strong influence on his ability to select and successfully implement containment strategies. For example, the amount of airflow (CFM), air velocity (FPM) and static pressure a vacuum collection device generates will have a direct bearing on the length of ductwork which can be cleaned from one hookup point while maintaining control over the debris being removed. Discussion of proposed containment strategies will provide a certain degree of insight into the contractor's ability to successfully manage the project.

One of the first issues to resolve is the location of the vacuum collection device. If the collection device is located outside of the facility, it must exhaust in a manner that will not allow contaminants to re-enter the facility. Care should also be taken to ensure that the release of debris outdoors does not violate any outdoor environmental standards, codes or regulations. If the collection device exhausts indoors, it must have functioning HEPA filtration in place at all times, as per NADCA Standard ACR. Clients may require contractors to have collection equipment DOP tested and certified to ensure HEPA filtration is maintained.

It is imperative that the contractor employs measures designed to prevent cross-contamination within the HVAC system and facility. Cross-contamination occurs when after cleaning one section of the system, it becomes re-contaminated by debris originating from another portion of the system.

In summary, the contractor and the client must both be fully confident that containment strategies have been defined for all aspects of the project. The overall success of the project may hinge on this important element.

Furniture, Flooring, Computers, Photocopiers and Other Electronic Equipment

All furniture and flooring in close proximity to the work area should be covered with clean protective coverings. Before beginning work in a new site, the occupants should be informed that protective coverings will be placed in their areas and that they should prepare the area accordingly. Unexpected changes to the work environment, like the movement of office furnishings and personal belongings, can be alarming to occupants.

Whenever possible, furniture that can be moved should be moved. This allows the contractor easier access to the work site. For increased productivity, it is a

good idea to temporarily relocate all fragile or breakable items.

Flooring, carpeted or tiled, should be well protected. Portable duct cleaning equipment is normally moved throughout the facility during the project.

The client and contractor should agree in advance as to the clean up requirements after each work period concludes. Sometimes building occupants will mistakenly think that pre-existing dirt was produced from the cleaning operations of the day before.

During site preparation, special attention should be given to all electronic devices within the facility. Many such devices are extremely sensitive to dust. In addition, some cleaning processes, such as coil cleaning, use water. Water must be kept clear of electronic devices.

Often the HVAC system cleaning contractor's workers will need to access areas of the system very close to electronic equipment, or perhaps will be required to work on areas directly above such equipment. Whenever possible, physically move electronic equipment away from where the contractor will be working. If equipment cannot be moved, it must be well covered and protected.

Cleaning Equipment Condition

An important environmental engineering control has to do with the cleanliness and physical appearance of the contractor's equipment. Any equipment brought into the facility should be exceptionally clean and in good working order.

Vacuum equipment must be clean and its cabinets must close securely. Improperly fitted cabinet seams are a potential contamination leakage source. Home made or in-house built equipment should be carefully scrutinized, especially for its ability acceptably contain debris. Equipment must be sealed when entering the facility.

Building Fire Safety & Security

Prior to the start of any HVAC cleaning project, both the client and the contractor should review the existing safety and fire evacuation procedures for the facility. Most HVAC systems have fire alarms built into the ductwork designed to detect smoke and heat. These systems are commonly disconnected during the cleaning process to prevent false alarms. Before disconnecting any fire safety system, all concerned parties should be informed of the plans, including the fire department and the facility's security and maintenance personnel. After each work period is finished and at the completion of the job, all fire safety systems should be reconnected and tested.

Along with protecting the indoor environment, the cleaning contractor and client must work together to resolve unusual security issues related to the project and facility. Projects which are conducted during off hours will require changes in the normal security routine of the building. Alarm system contractors and companies located within the facility need to be informed well in advance of any changes in facility security operations.

Security teams on larger facilities need to be advised that outside doors and windows may be opened and that the normal facility security for that work area may need to be altered.

Cross Contamination Assessment

As the site preparation progresses, a cross contamination assessment should be performed. This evaluation must take into consideration all actions taken during the cleaning process that have the potential to result in the release of HVAC contaminants into the occupied spaces of the facility.

One significant source of cross contamination may be the cleaning equipment itself. Equipment contaminated with pollutants from a previous cleaning project that is moved onto a new project can introduce new contaminants and hazards into the facility. The same can occur when contaminated equipment is moved from one site to another within the same facility.

Specific and Unique Building Related Items

Some facilities pose unique requirements with respect to site preparation. Depending on the activities taking place within the facility, the client and contractor may be challenged with establishing new protocols for issues such as protecting equipment, preventing cross contamination, or working with occupants.

In unique situations, the experience of the contractor is important to ensure a successful project. If the facility has special requirements it becomes essential to have a qualified contractor who can draw experience from a wide variety of previous projects.

Tools and Equipment

HVAC System Cleaning Tools

Qualified HVAC system cleaning contractors employ a variety of both power and hand tools on a typical cleaning project. For the purpose of this discussion, we will break them into three categories: Access Tools, Inspection Tools and Hand Cleaning Tools.

Access Tools

Access tools consist of devices used by technicians to create entry points in the HVAC system to facilitate inspection and cleaning. These access points may range from small holes (1 inch diameter or less) for optical imaging devices and small pneumatic cleaning equipment, to entry panels large enough to accommodate service personnel entry and bulkier equipment.

Most HVAC systems have few (if any) access points for inspection and cleaning. Service technicians will generally need to create access/entry points to perform their work. Special care should be given not to damage any components (coils, controls, etc.) of the air handling unit while making entry points.

Inspection Tools

HVAC cleaning contractors may utilize several types of visual inspection devices to evaluate the build up of debris and contamination within an HVAC system, monitor the cleaning process, and evaluate the success of the cleaning methods employed. Some common tools include:

- Hand-held mirror (usually on a telescoping handle)
- Direct-view "periscope" (mirror device with eyepiece for right angle viewing, often with light source attached)
- Optical Borescope
- Closed circuit television (CCTV) camera system
- Camera (35mm SLR, etc.)

Hand Cleaning Tools

"Hand cleaning tools" include simple brushes, scrappers, and a number of pneumatic agitation and cleaning devices, such as:

- Brushes (poly brushes and flexible extension rods or hand brushes - poly, wire, etc.)
- Rotary brushes (pneumatic and electric)
- Scrapers (putty knives, blade scrapers, trowels)
- Pneumatic tools (air snakes, air skippers, air whips, blow guns)

Accumulated debris is often loosened from ductwork and other HVAC system components by power brushing and/or manual brushing. Contractors use various types of brush heads (soft bristled to wire heads) depending on the surface to be cleaned. Brushing may include the use of hand-held brushes and scrapers for localized removal of surface accumulation. Loosened debris from this process is collected with a vacuum collection device or portable HEPA filtered hand vacuum. Various vacuum brush attachments may also be used for direct removal of debris from the interior of HVAC system components with hand held HEPA vacuums.

Pneumatic devices such as blowguns, air skippers and air whips are often utilized to drive agitated debris to the collection device. In all cases, the degree of agitation should correspond to the nature of the contamination being cleaned, as well as the type of HVAC system components. Fiber glass lined metal ductwork, flexduct, and ductboard can be damaged by overly-aggressive removal techniques and must be handled accordingly.

HVAC System Cleaning Equipment

Although numerous tools exist which are specific to the HVAC system cleaning industry, there are only a few types of heavy equipment used in the industry. This equipment, to a large extent, defines how the cleaning project will be conducted.

Vacuum Collection Devices

A vacuum collection device is a piece of equipment that is used to create negative pressure within the HVAC system of sufficient velocity to control the spread of contaminants during the cleaning process. These machines are also used to entrain airborne particles of debris in the airstream, which are then drawn to the collection device for safe containment prior to disposal.

Any vacuum collection device which exhausts indoors must be HEPA filtered. Those filters must have a DOP test number indicating that they have passed quality confirmation tests. It is the client's responsibility to ensure that the contractor's equipment meets this requirement.

There are two main types of vacuum collection devices: (1) Those mounted on trucks or trailers, and (2) portable units. Truck/trailer mounted equipment is

generally more powerful than portable equipment. However, portable equipment can often be brought directly into a facility, allowing the vacuum source to be located closer to the ductwork.

Compressed Air Sources

Many of the tools and devices that are used for HVAC system cleaning are pneumatically powered. This requires the use of large amounts of pressure supplied directly to the tools. The most common method of supplying this pressure is through the use of an air compressor. Gasoline or petroleum powered compressors must always be located outside of a facility, with precautions taken during site preparation to prevent fumes from entering the facility. Electric compressors of course can be located directly within the facility during the cleaning process. A third type of pressure supply used by some contractors is nitrogen gas.

Hand-Held HEPA Vacuums and Wet Vacuums

Hand vacuums are used quite commonly by HVAC cleaning contractors for a variety of tasks and are a common sight on any cleaning project. HEPA filtration is an absolute must for such vacuum cleaners, especially when "wet vacs" - vacuums designed to extract water as well as dry debris - are being used to clean microbial contaminants and sludge from the drain pan, evaporator coil, or other areas. Many wet vacs are not manufactured with HEPA filtration and clients should be aware of such equipment. Wet vacs that exhaust outside of the facility may not need to be HEPA filtered.

Equipment for Application of Liquid Surface Treatments

Paint sprayers are used to deliver a liquid treatment (such as an EPA registered sanitizing agent or a coating for duct liner) to a designated surface area within the HVAC system. A "Fogger" is sometimes used to spray a liquid mist within an HVAC system, but is generally not suitable for the application of coatings.

Access

In nearly all cases, the cleaning of HVAC systems requires gaining access to the system components. Often the system can be accessed through existing openings, such as vents, grills, and ductwork end caps. Air handlers and furnaces sometimes include factory installed access doors or removable panels. Additional access openings are often required at various points throughout the HVAC system to facilitate inspection and cleaning.

Cutting access openings into the HVAC system is often a concern of the client, who may fear that the structural integrity of the system will be compromised. It is critical that openings be constructed in strict accordance with industry standards such as the Sheet Metal and Air-conditioning Contractors National Association's (SMACNA) *HVAC Duct Construction Standards* and the North American Insulation Manufacturers Association's (NAIMA) *HVAC Duct Construction Standards.*

Regardless of the type of opening created, all access ports must share the following characteristics:

- Openings must be created so that they can be sealed air tight.
- Closures must not significantly hinder, restrict, or alter the air-flow within the system.
- Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
- Openings made on fibrous glass portions of the system must be constructed so that they do not leave any exposed fibrous glass edges within the system.
- Openings must not compromise the structural integrity of the system.
- Construction techniques used in the creation of openings should conform to requirements of applicable SMACNA and/or NAIMA standards.

There are generally two kinds of access openings made to facilitate the cleaning process - those which can be reopened and those which cannot. Removable access doors are generally used in locations where future access may be necessary, such as coil compartments, fire dampers, smoke detectors, and other frequently serviced components. Check local and state codes for any specific access requirements.

When permanent, removable access doors are not needed or required, various types of closures should be considered. Regardless of the type of closure used, all openings made to facilitate the inspection and/or cleaning must be sealed in accordance with industry standards and local codes using materials acceptable under those standards and codes. For specific recommendations and procedures for constructing permanent closures to access openings, see the documents listed under *Reference Sources* within this guide.

Cutting access openings into flex duct is not recommended. Rather, disconnect the duct from one end or the other as needed for proper cleaning and inspection.

Cleaning Methodologies

Currently there are several proven and successful methods, or combinations of methods, used throughout the world to clean HVAC systems. There is also a wide range and variety of air duct cleaning equipment and tools commercially available to cleaning contractors. Depending on many different factors, any given method and equipment selection may allow for cleaning to an acceptable cleanliness level. This section of *Introduction to HVAC System Cleaning Services* discusses the basic principles behind several different methods of cleaning.

NADCA does not endorse or recommend any single method of cleaning or type of equipment. Rather, NADCA recommends the use of source removal methods and equipment designed to clean HVAC systems to the cleanliness levels specified in NADCA Standard ACR and maintain all other requirements of the Standard. Each different cleaning method has its advantages and disadvantages, as discussed throughout this chapter.

One factor that often dictates the type of cleaning methods to employ is the region or climate in which the project is to take place. Humidity is often a major factor in selecting cleaning methods because of the types of contaminants generally found in areas with differing levels of moisture in the air. Regions with high humidity levels often see greater levels of microbial contamination, including mold, mildew, yeasts and bacteria. Such contaminants, as opposed to common nuisance dust, require more aggressive cleaning techniques, especially when addressing the HVAC unit itself.

Selecting the HVAC cleaning method to be employed on any given project is an important factor toward the successful completion of the job. In some cases, clients may wish to specify the use of specific methods and/or equipment that have proven successful on previous projects. In other cases, the client may wish to consult with several cleaning contractors in order to define acceptable equipment and methods within the project's specifications.

There is an inherent danger in requiring the use of specific types of equipment and methods. That danger is the possible exclusion of other methods that may allow for a more complete and economical cleaning project. Therefore, clients should consider specifying cleanliness levels expected at the conclusion of the project, cleanliness verification procedures, and safety and containment considerations. Leave the choice of equipment and specific cleaning methods to the prospective contractor. In such cases, the client must require and verify that cleaning is performed in complete accordance with all provisions of NADCA Standard ACR.

Regardless of how cleaning methods and equipment are selected for a given project, there is no guarantee of success without some form of cleanliness verification. NADCA Standard ACR defines three separate cleanliness verification methods: Visual Inspection, Surface Comparison Testing, and the NADCA Vacuum Test. One or more should be incorporated into any project specification. An independent third party consultant may perform verification of cleanliness. In some cases, however, the client or his representative may wish to perform the final cleanliness verification. It may be viewed as a conflict of interest for a cleaning contractor to verify the cleanliness of his or her own work.

Vacuum Collection

The vacuum collection device is perhaps the most commonly used piece of equipment in the HVAC system cleaning industry. The following questions should be considered in the selection or specification of vacuum collection equipment:

- Is there accessibility into the facility to be cleaned? Can the vacuum collection device be brought close enough to the system to perform its function successfully?
- Where does the collection device discharge exhaust air, and where is the debris safely collected and stored? Has equipment designed to exhaust within the building envelope been DOP certified for HEPA-quality filtration?
- Has the contractor calculated whether equipment that must remain on the ground level will generate sufficient air flow, air velocity and static pressure?
- Has the equipment been well maintained and serviced?
- Where will the vacuum collection device be stored during off hours?
- Is there accessibility within the facility to power sources? Some equipment runs on electricity of various voltages and amps.
- Does the equipment comply with industry standards (i.e., NADCA Standard ACR)?

The vacuum collection device is critical to maintain control of debris within the HVAC system during cleaning. In any HVAC system these types of vacuums become invaluable in maintaining the purity of the indoor environment. Although HVAC systems can be cleaned

through a variety of methods, without the use of an acceptable collection device the following may result:

- Polluting the indoor environment.
- Improper movement or removal of contaminants.
- Cross contamination of the facility.

The size of the HVAC system and its ductwork, the type of duct construction, and the types of contaminants within the system all need to be considered when trying to determine the velocity of air movement needed to entrain particulate into the air stream within the system and deliver it to the collection device.

A vacuum collection device alone will not get an HVAC system clean. The use of methods and tools designed to agitate debris adhered to surfaces within the system, in conjunction with the use of vacuum collection device(s), is required to clean HVAC systems.

Brushing

In "brushing" a cleaning technician will use any of several types of hard or soft bristle brushes to physically agitate the debris adhered to a surface within the HVAC system. The cleaner may employ a wide variety of brush types on any given project, depending upon the type of duct to be cleaned and the type of contaminants present. Some brush systems rotate mechanically.

Currently no standards exist to define the effects of different types of brushes and bristles on various duct surfaces. It is accepted that metal ductwork with no internal liner can withstand very aggressive brushing techniques. Fiber glass liner and ductboard can be effectively cleaned with brushes incorporating soft bristles and by using less aggressive techniques. Determining whether or not fibrous glass surfaces can be safely and effectively cleaned requires experience both with the component surfaces and the equipment.

Compressed Air Washing

Air washing is a mechanical means to agitate and dislodge particulate from the interior surfaces of an HVAC system. The selection of a particular type of agitation device should be based on two primary factors: (1) The type of debris present within the system; and (2) the type of material used in the construction of the area to be cleaned. Certain types of debris, such as light dust, may be dislodged and moved by a variety of agitation methods. Heavier debris, such as animal carcasses, nails and screws may require more aggressive agitation methods or physical removal.

Metallic and some plastic HVAC system surfaces can be effectively cleaned using aggressive agitation methods and tools. More fragile components, specifically those constructed of fibrous glass, may require the use of less abrasive agitation devices in order to protect the structural integrity of the construction material. In either case, the use of mechanical agitation devices is essential in ensuring an acceptable level of cleanliness.

Hand or Contact Vacuuming

Hand or contact vacuuming is a method of HVAC system cleaning that incorporates agitation and vacuum collection principles into one operation. Basically, the procedure involves the use of canister-type vacuums with extension hoses and brush attachments that are used by cleaning technicians who physically vacuum debris off surfaces within the HVAC system. All hand vacuums should be HEPA filtered in order to prevent the spread of contaminants within indoor spaces.

Hand vacuuming is often used for the cleaning of HVAC system components constructed with fibrous glass materials, because the method allows for direct removal of debris with controlled agitation of the HVAC system surfaces. Hand vacuuming is also effective in removing debris located deep within the porous surfaces of fibrous glass components.

Hand vacuums are often used to vacuum debris off coils before the coils are chemically or pressure wash cleaned. Some hand vacuums can also be used as wet vacuums for cleaning drain pan sludge and removing standing water.

Hand Washing

Sometimes the most effective way to clean a component or section of an HVAC system is hand washing. This procedure is just what its name implies -washing components by hand. Hand washing usually involves hand tools such as brushes, sponges or damp cloths; the cleaning technician literally wipes clean a designated area. It is important to ensure that liquids are not applied to porous components such as fibrous glass, and that no chemical residues are left in the system during hand washing.

Power Washing

One effective method of cleaning certain components within an HVAC system is power washing. Power washing involves the use of mechanical equipment able to spray a jet of water onto a specific area. Some of the components frequently cleaned by power washing include:

- Cooling and reheat coils.
- Blower wheels, fans and their housings
- Evaporator and condensing coils.
- Condensate drain pan.

- Some types of filters
- Grilles, registers, and diffusers

In limited instances, it may be possible to power wash metallic air ducts. Generally, such procedures are not acceptable due to the serious possibility of cross contamination. Water leaking through ductwork can damage ceiling tiles and other indoor items, and also allows contaminants from within the ductwork to enter the occupied spaces of the facility.

When using power washing procedures, the following concerns must be addressed.

- Regardless of where power washing equipment is used, *it is critical to ensure that fibrous glass components do not get exposed to water.* This can result in irreparable damage.
- Always make sure there is proper containment of the run-off water. Disposal of wash water is also an important concern. Consult your local water quality management agency to learn if wash water may be disposed of through public sewer systems.
- Use special safety procedures. High-pressure water can be very dangerous. At a minimum, cleaning technicians must wear goggles and skin protection. All power washing equipment, and any other electrical equipment used in close proximity to the power washing area, must have GFCI (ground fault circuit interruption) protection.

Break Down And Clean Up

When all cleaning has been finished, it is time to break down equipment and clean up the site. These procedures can have a psychological impact on building occupants. The cleaning contractor is responsible for making sure that all equipment is removed from a facility in a manner that will not cause cross-contamination.

Clean up of the facility can be addressed two ways: Short-term jobs require total breakdown and clean up directly after completion; long-term jobs require clean up on a shift by shift basis, or as movement progresses through the facility. When contracting for services, the client should be certain to address what level of clean up is expected at the end of each cleaning cycle and at the completion of the project.

Some projects require extensive cleaning of all horizontal surfaces after an area has been completed. This is due to the fact that occupants of the facility tend to mistakenly think any pre-existing debris on a horizontal surface still there when the project is done actually resulted from the cleaning itself. On well-coordinated projects, regular building cleaning will be scheduled at the time of the completion of the project.

An important item to address before the project begins is disposal of debris removed from the HVAC system. Often the client takes responsibility for this detail, and the specific responsibility should be spelled out in any contracts between the client and the contractor.

Surface Treatments

A “surface treatment” is a chemical product applied to an interior surface within an HVAC system. Prior to the application of any surface treatment into an HVAC system, visible contaminants should be thoroughly extracted via source removal methods and in accordance with NADCA Standard ACR where applicable.

There are two general types of surface treatments, both are discussed below.

Anti-microbial Materials

Anti-microbial materials (such as sanitizers and disinfectants) are products designed to control microbial contamination. It is absolutely critical that any antimicrobial treatment introduced within an HVAC system is EPA *registered* specifically for use in HVAC systems. Some contractors may propose to use a product EPA registered for "hard surface applications" to eliminate microbial contamination, mistakenly believing that any product with such a registration is safe to use. Many products, such as some hospital strength disinfectants, are in fact EPA registered for hard surface applications, but should only be used within HVAC systems when the EPA registered product label cites HVAC system applications as acceptable.

Treating microbial contamination within HVAC systems is a two-phase procedure. The first step employs normal source removal processes designed to expose a clean, hard non-porous surface. The second step requires the saturation of the clean surface with a sanitizer or disinfectant. After a contact time listed on the product label, the chemical must be washed off with potable water, if so instructed on the EPA approved product label. HVAC cleaning contractors may use any of several different chemical products to treat biological contamination within HVAC systems. It should be noted that there are no EPA registered anti-microbial products for use on porous HVAC system surfaces.

Encapsulants, Coatings & Insulation Repair Products

Coatings and insulation repair products are designed to repair damaged or degraded HVAC system component surfaces. There has always been controversy regarding the use of coatings in the HVAC system cleaning process. This controversy has resulted from both the misuse and misapplication of products.

Some coatings also have anti-microbial properties. In such cases, as with other anti-microbial treatments, EPA registration that specifically includes use within HVAC systems should be verified. EPA registration limits the anti-microbial claims to preservation of the coating from microbial degradation

In certain instances, the integrity of fibrous glass HVAC system components may begin to degrade. This may be caused by improper installation, poor maintenance, or water damage. Coatings and insulation repair products may be used on fibrous glass surfaces to restore surface integrity. The restoration of the fibrous glass material surfaces may negate the need for costly system replacement.

Surface treatments, including both anti-microbial products and coatings, are commonly used in warm, humid climates. The primary reason is that high humidity can lead to the promulgation of microbial growth. Excessive water gain within HVAC systems can also damage fibrous glass components.

Regardless of the type of surface treatment to be used, consumers are advised to obtain Material Safety Data Sheets (MSDSs) and applicable EPA registration verification before any chemicals are introduced into the HVAC system.

In all cases manufacturers' instructions for the safe use, including mixing and application, of surface treatments must be strictly followed.

Safety

The Occupational Health and Safety Act of 1970 was drafted by the U.S. Congress to provide uniform and comprehensive provisions for workplace safety. The Act is administered by the Occupational Safety and Health Administration (OSHA) under the U.S. Department of Labor. This chapter is intended as only a general introduction to a few specific safety issues. In addition to the safety areas discussed below, several other safety standards set by OSHA may apply to HVAC system cleaning projects. Any individual or business entity should consult with an attorney or qualified professional safety consultant for advice concerning specific, individual circumstances related to OSHA and safety topics.

Confined Spaces

OSHA regulation 1910.146, "Permit Required Confined Space", applies to some HVAC systems and is the only OSHA regulation with shared liability for both the employer and host employer. This regulation defines the conditions that constitute a confined space as well as all precautions, training, and record keeping that must be followed in keeping with the policy.

Before HVAC systems are cleaned, it should be determined if confined spaces exist and if permit required spaces exist. If permit required spaces are present, the client should require a copy of the contractor's confined space policy and training logs, as well as ensure that the contractor employs all necessary measures to adhere with this regulation.

Chemical Hazard Communication

HVAC system cleaning projects may require the use of various chemicals. Exposure to many chemicals, at certain levels, can cause or contribute to many serious health problems. OSHA has issued a rule called, "Hazard Communication." The basic goal of the standard is to be sure employers and employees know about work hazards and how to protect themselves. The standard makes sure that the hazards of all chemicals used in U.S. workplaces are evaluated, and that this hazard information is transmitted to affected employers, employees and customers.

Chemical manufacturers are required to convey the hazard information about their products by means of labels on containers and MSDSs. All workers must have a hazard communication program in place to protect them and inform them about the products they use. Information must be provided, at a minimum, through labels on all containers, MSDS's, and training.

Employers must develop, implement and maintain at the workplace a written, comprehensive hazard communication program that includes provisions for container labeling, collection and availability of material safety data sheets, and an employee training program. It also must contain a list of the hazardous chemicals in each work area, the means the employer will use to inform employees of the hazards of non-routine tasks, and the hazards associated with chemicals in unlabeled pipes.

Control of Hazardous Energy

OSHA's standard called, "Control of Hazardous Energy (Lockout/Tagout)", helps safeguard workers from hazardous energy while they are servicing or performing maintenance on machines and equipment. The standard identifies the practices and procedures necessary to shut down and lock out or tag out machines and equipment. The standard is therefore commonly referred to as the "lockout/tagout" standard. The lockout/tagout standard applies to all HVAC system cleaning projects. It serves to prevent accidents resulting from the unexpected start up or the release of stored energy that could cause injuries.

Respirators

Respiratory protection is recommended whenever cleaning-related work is being performed on the HVAC system. Respirators are available in various sizes, shapes and configurations. Their primary purpose is to protect the worker's health and well being. All respirators must meet OSHA, NIOSH and American National Standards Institute (ANSI) standards.

HVAC system cleaning is the business of dislodging particulate that has remained in a static condition for a long period of time. It is therefore essential to maintain constant vigilance over all cleaning projects when it comes to proper respirator use. Whenever a duct or HVAC unit is accessed, viewed, inspected or cleaned, proper respiratory protection is needed.

Personal Protective Equipment

HVAC system cleaning technicians face a variety of on-the-job safety concerns. By providing workers with adequate safety equipment and training, contractors can minimize the risks of the workers' exposure to job hazards. Such preventative measures are a benefit to both the contractor and his client.

Codes and Standards

HVAC system cleaning contractors should be well-versed in a number of codes and standards pertaining to the construction and maintenance of HVAC systems. Several are discussed below:

NADCA Standard ACR

In December of 1992, the National Air Duct Cleaners Association set its first Standard: NADCA 1992-01, *Mechanical Cleaning of Non-Porous Air Conveyance System Components.* Soon thereafter, compliance with the Standard became a mandatory requirement of NADCA membership.

In 2002, NADCA adopted a brand new Standard for its membership: *Assessment, Cleaning, and Restoration of HVAC Systems* (ACR). Like its predecessor, ACR compliance became mandatory for all members. ACR evolved from guidelines, standards, and research originating NADCA and other organizations dedicated to HVAC system hygiene. This Standard establishes criteria for evaluating the cleanliness of HVAC systems, for cleaning and restoring systems to a hygienic state, and for verifying that acceptable cleanliness levels have been achieved.

ACR provides recommended inspection frequencies for HVAC systems. Items that should be evaluated during inspections are detailed to assist users of this Standard in determining when cleaning may be necessary.

In the assessment sections, ACR describes the areas of the HVAC system to be evaluated for cleanliness condition and the types of contaminants that may be found. Assessment information may then be used to select environmental engineering controls to protect the indoor environment during cleaning. The Guideline section of the Standard provides examples of several types of containment mechanisms that may be employed on an HVAC system cleaning project to control the migration of contaminants.

In the cleaning and restoration sections, ACR defines acceptable cleaning methods and criteria for cleaning tools and equipment. Cleaning encompasses the removal of contaminants in order to restore HVAC systems to an acceptable cleanliness level. Restoration requires additional actions beyond cleaning to bring system conditions to an acceptable level.

Separate sections of ACR were written to address unique considerations for biological contaminants and the cleaning of fiber glass insulation. Additional sections explain requirements for creating service openings within HVAC systems; safety and health considerations for remediation workers, employees, and occupants; and procedures for monitoring cleaning projects as they progress.

The final section of the standard provides methods to verify HVAC system cleanliness. Three separate methods are defined.

ACR goes further than any previous NADCA document by not only providing detailed requirements for managing HVAC system cleaning projects, but also defining conditions that mandate cleaning. It is written to assist consumers, facility administrators, engineers, contractors, architects, or HVAC project design consultants.

New materials covered in the standard include pre- and post-assessment, project design issues such as necessary containment and engineering controls, and other important aspects of successful HVAC management. ACR includes information on the essential elements of assessing the need for, designing, implementing, and verifying the success of an HVAC system cleaning project. The document is written for commercial, industrial, healthcare, and residential applications.

ACR represents NADCA's continued commitment to being the indoor environmental industry's authoritative source for information related to HVAC system cleaning. ACR reflects an international collaboration of HVAC cleaning organizations working together to create a document that is globally relevant.

Copies of ACR are available through NADCA Headquarters in Washington, DC (see *Reference Sources).*

NADCA Standard 05

The Standard defines methods and materials to be used when creating a service opening or access panel. Such openings are used to facilitate inspection and cleaning of the HVAC system. Standard 05 addresses several different types of service openings, as well as different HVAC system construction materials (metal, fiber glass, etc.) and the kinds of service openings that are acceptable. The Standard concludes with a "how to" guide for installing service openings.

Copies of NADCA Standard 05 are available through NADCA Headquarters in Washington, DC (see *Reference Sources).*

Other NADCA Publications

In addition to the previously discussed Standards, NADCA has created a few guidance documents that should be of interest to you.

Understanding Microbial Contaminants in HVAC Systems explores how mold and fungi contamination grow within systems, methods and techniques for remediating biological contaminants, and related issues such as the use of sanitizers and anti-microbial surface treatments.

NADCA General Specifications for the Cleaning of Commercial HVAC Systems is a "generic" specification. It is broad-based and encompasses most of the areas that a complete specification for commercial HVAC system cleaning would include. It must be modified, however, to match the unique variations of a specific project. Persons writing their own project requirements can use the specification as a model or template.

The *NADCA Membership Directory* includes listings for all of the association's Certified Regular Member companies, International Members, Associate Members and Affiliate Members.

For more information about these publications, contact the NADCA office in Washington, DC. The *NADCA General Specification* and the *NADCA Membership Directory* are available at no cost and can be found at the NADCA Internet Web site - www.nadca.com

ASHRAE Standard 62

This ASHRAE Standard does influence the HVAC system cleaning industry, however, no specific references are made within it to HVAC system cleaning or any activity routinely undertaken during the cleaning process. Although ASHRAE Standard 62 does not directly affect the process of HVAC system cleaning, it does relate closely to indoor air quality and ventilation. For this reason, HVAC cleaning contractors should have a working knowledge of its contents.

NFPA Standard 90-A

The National Fire Protection Association (NFPA) Standard 90-A discusses the materials that may be used in the construction of ventilation systems.

All construction materials, insulating materials, coatings or any other element introduced and designed to remain within the ventilation system should adhere to these requirements.

SMACNA Standards

SMACNA has developed numerous guidance documents and standards governing the fabrication and installation of HVAC systems.

HVAC system cleaning routinely requires installation of access doors or panels, as well as the dismantling of ductwork and other system components in order to thoroughly clean the system. Contractors should understand and adhere to SMACNA documents including their "HVAC Duct Construction Standard."

NAIMA's HVAC Duct Construction Standard

NAIMA represents the manufacturers of flexible duct liners and ductboard. NAIMA has produced several documents designed to aid in the proper fabrication, installation, and maintenance of their members' products. These recommendations include cutting into and patching or sealing lined ductwork and ductboard, as well as cleaning practices for fibrous glass interior HVAC surfaces. No service of the HVAC system should result in unrepaired damage to the surface coating or substrate.

Reference Sources

The documents listed below were used as reference sources for this guide. It is recommended that consumers of commercial HVAC system cleaning services use these documents as reference sources as well.

Indoor Air Quality Information Clearinghouse
U.S. Environmental Protection Agency
P.O. Box 37133
Washington, DC 20013
1 (800) 4384318 / FAX (301) 588-3408

- *The Inside Story: A Guide to Indoor Air Quality*
- *Building Air Quality: A Guide for Building Owners and Facilty Managers*

National Air Duct Cleaners Association
1518 K Street, N.W., Suite 503
Washington, DC 20005
(202) 737-2926 / FAX (202) 347-8847 / E-mail nadca@aol.com /Web site www.nadea.com

- *NADCA Standard ACR, Assessment, Cleaning and Restoration of HVAC Systems*
- *NADCA Standard 05-1997, Requirements for the Installation of Service Openings in HVAC Systems*
- *Understanding Microbial Contamination in HVAC Systems*
- *NADCA General Specifications for the Cleaning of Commercial HVAC Systems*

National Air Filtration Association
1518 K Street, N.W., Suite 503
Washington, DC 20005
(202) 628-5328 / FAX (202) 638-4833

- *NAFA Guide to Air Filtration,* (ISBN 1-884152-00-7).

North American Insulation Manufacturing Association
44 Canal Plaza, Suite 310
Alexandria, VA 22314
703/684-0084
FAX: 703/684-0427

- *Fibrous Glass Duct Construction Standards. 1993.*

Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 22021
(703) 803-2980

- *HVAC Duct Construction Standards – Metal and Flexible*

U.S. Department of Labor
Occupational Health & Safety Administration
Room N3651
200 Constitution Ave., N.W.
Washington, DC 20210
(202) 219-6666

- *All About OSHA,* (OSHA 2056)
- *Control of Hazardous Energy*, (OSHA 3120)
- *Respiratory Protection*, (OSHA 3079)
- *Installation Checklist for Openings in HVAC Systems.* (OSHA 3084)
- *Personal Protective Equipment*, (OSHA 3077)

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
(404) 636-8400

- *Ventilation for Acceptable Indoor Air Quality.*

Guidelines For Selecting a Qualified Contractor

Asking prospective contractors the following questions will assist consumers of commercial HVAC system cleaning services in selecting a qualified contractor.

1. Can the company show proof of NADCA membership and certification? Please visit www.nadca.com.
2. How long has the contractor been in the commercial HVAC system cleaning business?
3. Can the contractor provide you with evidence of the current Worker's Compensation and General Liability Insurance coverage? (Ask for Certificate of Insurance)
4. Does the contractor posses the proper licenses that are required by your city or state to perform the work they are proposing? (Not all cities or states require licenses – visit www.nadca.com to find out).
5. Can the contractor provide you with 3 to 5 customer references with phone numbers for projects of similar size and scope of work which they provided service in the last year?
6. Does the contractor have written safety, respiratory, and confined space programs in addition to OSHA compliance reports?
7. Will the contractor provide you with a means to conduct a visual inspection at any time during the cleaning? (Mirror and flashlight, camera or other remote visual systems)
8. Will the contracting company actually do the work? (Some companies subcontract the work to independent contractors. You will want to apply these guidelines for subcontractors as well.)
9. Will the company be assigning an Air Systems Cleaning Specialist (ASCS) to your project that will be responsible for the complete project?
10. If there is any remediation of mold or other biological contamination does the company have a Ventilation System Mold Remediator (VSMR) on staff.