
PART 1 - GENERAL**1.1 RELATED SECTIONS**

- .1 Section 21 05 01 - Common Work Results for Mechanical.
- .2 Section 23 05 01 - Use of HVAC Systems During Construction.

1.2 PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICES

- .1 Engage and pay for services of independent testing laboratory in accordance with the general informations for the work.

1.3 REFERENCE STANDARDS

- .1 National Air Duct Cleaners Association (NADCA).
 - .1 ACR Standard, 2006 edition: Assessment, Cleaning and Restoration of HVAC Systems.
- .2 North American Insulation Manufacturers Association (NAIMA).
 - .1 NAIMA 2005, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.
- .3 United States Environmental Protection Agency (US EPA).
 - .1 US EPA 1999, 40 CFR Parts 152 and 156.

1.4 DEFINITIONS

- .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
 - .1 Rigid supply and return ductwork;
 - .2 Flexible ductwork;
 - .3 Mixing plenum boxes;
 - .4 Return air plenums including ceiling plenums;
 - .5 Diffusers, registers and terminal units;
 - .6 Dampers and controls.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Site Evaluation: conduct site visit 2 weeks before start of work to establish specific co-ordinated video survey and cleaning plan to establish specific co-ordinated video survey and cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.
 - .1 Organize and lay out plan for video survey and identify camera and cleaning apparatus insertion points.
 - .2 Ensure plan identifies sequence and schedule of survey and cleaning operations for each individual HVAC system and for complete facility.
 - .1 Take account of elbows, bends, turning vanes, dampers, transitions, take-offs.
 - .3 Departmental Representative to review cleaning plan one week minimum prior to start of work.
 - .1 Proceed with survey and cleaning work only after receiving written approval from Departmental Representative.
- .2 Scheduling: Hours of Operation: complete work during non-business hours as follows:
 - .1 Monday to Thursday between 18:00 hours and 07:00 hours.
 - .2 Friday from 18:00 h to Monday at 07:00 h.
 - .3 Hours of operation are subject to change with 12 hours notice.
- .3 Project Co-ordination: assign Project Co-ordinator to oversee air duct cleaning processes.
 - .1 Provide Departmental Representative with contact information of Project Co-ordinator including: name, telephone number, cell phone number.
- .4 Security: Departmental Representative will pay costs and provide security escort at times requested on Contractor's submitted work schedule.
 - .1 Cancellation of security escort requires 72 hours minimum written notice.
 - .2 Failure to cancel security escort requirements 72 hours minimum before scheduled event will result in Contractor paying for security costs.
- .5 Damaged or broken equipment and components found during initial testing and inspection will be repaired or replaced by Departmental Representative.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit video survey and cleaning plan developed during site evaluation.
 - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.
 - .2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements for antimicrobial agents or coatings.
- .4 Testing Laboratory Services: submit name and address of laboratory engaged for work of this Section.
 - .1 Submit laboratory analysis report of particulate collection indicating:
 - .1 Location of collection;
 - .2 Particulate grade;
 - .3 Particulate size;
 - .4 Percentage concentration of individual particulates in each sample.
- .5 US EPA Registration: submit verification of EPA Registration of antimicrobial agent.
- .6 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility, as described in PART 3 - CLEANING - Waste Management.

1.7 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Post Cleaning Inspection Report: submit four copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
 - .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems with drawings, sketches identifying systems cleaned;

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- .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Identification of points where samples were collected and type of analysis used for each collection;
 - .6 Identification of each sample collected;
 - .7 Comments complete with photographs of each sampling location and other observed system features;
 - .8 Identify systems tested, observations, actions taken and recommendations for future maintenance.
- .3 Record post cleaning video survey: submit two copies of video survey DVD media, and include on video survey following:
- .1 Areas tested for particulate analysis or microbial growth evaluation;
 - .2 Areas of special interest and location;
 - .3 Special internal features;
 - .4 Problems such as broken or damaged controls or components;
 - .5 Ensure system tested, locations, observations, actions taken and recommendations are clearly identified in French and English on video using text or voice over.
- .4 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility.

PART 2 - PRODUCTS**2.1 ANTIMICROBIAL AGENT**

- .1 Use antimicrobial agents registered with US EPA-40 CFR.

2.2 AIR DUCT CLEANING EQUIPMENT

- .1 Manually propelled full contact brushes:
 - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
 - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.

- .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- .2 Brushes: manually propelled with integrally-mounted drive or other polypropylene or nylon bristles.
 - .1 Ensure motor has capacity to continue to push brush after bristles are distorted.
 - .2 Replace worn and ineffective brushes when required.

2.3 HEPA FILTER EVACUATION FAN

- .1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.

2.4 HEPA VACUUM UNIT

- .1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.
 - .1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

PART 3 - EXECUTION

3.1 GENERAL INFORMATION ON CLEANING WORK

- .1 Clean all rigid low pressure ducts, flexible conduits, distribution and inlet plenums, and mixing boxes located within the work area delimited by the temporary wall identified by note 4 on the drawings. See mechanical and architectural plans for temporary wall location.

3.2 PREPARATION

- .1 Close down HVAC system.
- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
 - .1 Control devices;
 - .2 Fire and smoke control dampers;

- .3 Balancing dampers: indicate and record positions for resetting;
- .4 Air volume control boxes: indicate and record positions for resetting;
- .5 Fire alarm devices;
- .6 Monitoring devices and controls.

3.3 EXAMINATION / PRE-CLEANING INSPECTION

- .1 Verification of Conditions:
 - .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
 - .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
- .2 Evaluation and Assessment:
 - .1 Identify location and type of internal components.
 - .2 Identify extent of potential problems.
 - .3 If toxic or hazardous materials or deposits are suspected after initial inspection immediately stop work and inform Departmental Representative.
 - .1 Do not proceed further with inspection operations until written approval from Departmental Representative.

3.4 PARTICULATE COLLECTION

- .1 Before starting duct cleaning, identify locations for sample collection and collect particulate samples.
- .2 Take samples from interior surfaces of HVAC system using sterile wipes for submission to independent testing laboratory.
 - .1 For each HVAC system collect four samples at the locations indicated by the Departmental Representative.

3.5 LABORATORY ANALYSIS

- .1 Ensure independent testing laboratory has demonstrated experience in work associated with air duct cleaning.

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- .2 Ensure Super Electron Microscope (SEM) is used for analyzing and determining components of particulate collection samples:
 - .1 Identify components by grade and size;
 - .2 Report findings including percentage concentration of components to Departmental Representative.
- .3 Proceed with HVAC System Cleaning only after laboratory analysis test results have been received.
- .4 Ensure cleaning technicians have safety equipment appropriate for toxic or hazardous conditions identified by laboratory analysis before proceeding with cleaning operations.

3.6 DUCT CLEANING

- .1 Do duct cleaning in accordance with NADCA ACR Standard.
- .2 Clean all ducts and plenums located inside the work area limited by the temporary wall.
- .3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
- .4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.
- .5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 m².
- .6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 m².
- .7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.
 - .1 Pass brushes through sections as often as necessary to achieve required cleanliness.
 - .2 Change brush sizes as required to ensure positive contact with duct and component interiors.
 - .3 Clean corners and pockets where dirt and debris can accumulate.
- .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.

- .9 Advise Departmental Representative 72 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.

- .1 Departmental Representative will pay for costs of deactivation of fire alarm and smoke detector system.

3.7 ACOUSTICALLY LINED DUCTWORK CLEANING

- .1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices.
 - .1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.
 - .2 Monitor cleaning process progress by onboard camera.

3.8 COMPONENTS AND EQUIPMENT CLEANING

- .1 Brush and vacuum air mixing terminal units.
- .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Departmental Representative for cleaning.
 - .1 Clean equipment and components in place only if there is no hazard to adjacent materials.
- .3 Proceed to next section in cleaning sequence only after written approval from Departmental Representative.
- .4 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Departmental Representative:
 - .1 Dampers;
 - .2 Turning vanes;
 - .3 Controls;
 - .4 Sensor bulbs;
 - .5 Fire alarms;
 - .6 Smoke detectors.

3.9 ANTI MICROBIAL APPLICATION

- .1 Apply antimicrobial agents when fungal growth is suspected.

- .2 Apply antimicrobial agents after removal of surface deposits and debris.
 - .1 Verify air duct interiors are free from deposits and debris by visual inspection.
 - .2 Report findings to Departmental Representative.
 - .3 Proceed with application of antimicrobial agents after written approval from Departmental Representative.
- .3 Apply antimicrobial agents in accordance with manufacturer's written instructions and US EPA 40 CFR registration and listing.
- .4 Manual or robotic spray antimicrobial agents directly onto interior surfaces of HVAC air duct system.
 - .1 Do not use fog mist for downstream surfaces.

3.10 FIELD QUALITY CONTROL/FINAL INSPECTIONS

- .1 Post Cleaning Inspection: carry out final inspection using robotic camera and other visual inspection methods after final cleaning has been completed.
 - .1 Carry out video survey as directed by Departmental Representative.
 - .2 Include in final survey areas inspected by Departmental Representative prior to cleaning.
 - .3 Identify on HVAC system record drawings access points used for inspection and cleaning.
 - .4 Re-collect and analyse particulates collected at same locations where original samples were collected before cleaning.
 - .5 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

3.11 SYSTEM STARTUP

- .1 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.

3.12 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION