

HOUSTON
Methodist[®]

SAN JACINTO HOSPITAL

3RD FLOOR WAITING

PROJECT MANUAL

Issued for Permit & Construction

22 March 2018

PWP Project No. 217-024

OWNER

Houston Methodist San Jacinto Hospital
4401 Garth Road
Baytown, Texas 77521
281-420-8600

ARCHITECT

PhiloWilke Partnership
11275 S. Sam Houston Parkway W., Suite 200
Houston, Texas 77031
832-554-1130

MEP ENGINEER

Smith Seckman Reid, Inc.
3700 W. Sam Houston Parkway, Suite 200
Houston, Texas 77042
713-784-8211

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Mechanical Compliance Certificate

Project Information

Energy Code: 2015 IECC
Project Title: Houston Methodist San Jacinto 3rd Floor or Waiting
Location: Baytown, Texas
Climate Zone: 2a
Project Type: Alteration

Construction Site:
4401 Garth Road
Baytown, TX 77521

Owner/Agent:
Houston Methodist San Jacinto
4401 Garth Road
Baytown, TX 77521

Designer/Contractor:
Chris St Cyr
Smith Seckman Reid, Inc.
3700 West Sam Houston Parkway
South
Suite 200
Houston, TX 77042
713-784-8211
cbmitchell@ssr-inc.com

Mechanical Systems List

Quantity System Type & Description

- 1 HVAC System 1 (Single Zone):
Heating: 1 each - Hydronic or Steam Coil, Unknown, Capacity = 133 kBtu/h
No minimum efficiency requirement applies
Fan System: Unspecified

Mechanical Compliance Statement

Compliance Statement: The proposed mechanical alteration project represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2015 IECC requirements in COMcheck Version 4.0.6.1 and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title

Signature

Date



03/22/2018



Inspection Checklist

Energy Code: 2015 IECC

Requirements: 0.0% were addressed directly in the COMcheck software

Text in the "Comments/Assumptions" column is provided by the user in the COMcheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

Section # & Req.ID	Plan Review	Complies?	Comments/Assumptions
C103.2 [PR2] ¹	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the mechanical systems and equipment and document where exceptions to the standard are claimed. Load calculations per acceptable engineering standards and handbooks.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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Section # & Req.ID	Footing / Foundation Inspection	Complies?	Comments/Assumptions
C403.2.4.5, C403.2.4.6 [FO9] ³	Snow/ice melting system sensors for future connection to controls. Freeze protection systems have automatic controls installed.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1 High Impact (Tier 1)	2 Medium Impact (Tier 2)	3 Low Impact (Tier 3)
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Section # & Req.ID	Plumbing Rough-In Inspection	Complies?	Comments/Assumptions
C404.5, C404.5.1, C404.5.2 [PL6] ³	Heated water supply piping conforms to pipe length and volume requirements. Refer to section details.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C404.6.3 [PL7] ³	Pumps that circulate water between a heater and storage tank have controls that limit operation from startup to <= 5 minutes after end of heating cycle.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C404.7 [PL8] ³	Water distribution system that pumps water from a heated-water supply pipe back to the heated-water source through a cold-water supply pipe is a demand recirculation water system. Pumps within this system have controls that start the pump upon receiving a signal from the action of a user of a fixture or appliance and limits the temperature of the water entering the cold-water piping to 104°F.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1 High Impact (Tier 1)	2 Medium Impact (Tier 2)	3 Low Impact (Tier 3)
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Section # & Req.ID	Mechanical Rough-In Inspection	Complies?	Comments/Assumptions
C402.2.6 [ME41] ³	Thermally ineffective panel surfaces of sensible heating panels have insulation \geq R-3.5.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.12 .1 [ME65] ³	HVAC fan systems at design conditions do not exceed allowable fan system motor nameplate hp or fan system bhp.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	See the Mechanical Systems list for values.
C403.2.12 .3 [ME117] ²	Fans have efficiency grade (FEG) \geq 67. The total efficiency of the fan at the design point of operation \leq 15% of maximum total efficiency of the fan.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.13 [ME71] ²	Unenclosed spaces that are heated use only radiant heat.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.3 [ME55] ²	HVAC equipment efficiency verified.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	See the Mechanical Systems list for values.
C403.2.6.1 [ME59] ¹	Demand control ventilation provided for spaces >500 ft ² and >25 people/1000 ft ² occupant density and served by systems with air side economizer, auto modulating outside air damper control, or design airflow $>3,000$ cfm.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.6.2 [ME115] ³	Enclosed parking garage ventilation has automatic contaminant detection and capacity to stage or modulate fans to 50% or less of design capacity.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.7 [ME57] ¹	Exhaust air energy recovery on systems meeting Table C403.2.7(1) and C403.2.7(2).	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.8 [ME116] ³	Kitchen exhaust systems comply with replacement air and conditioned supply air limitations, and satisfy hood rating requirements and maximum exhaust rate criteria.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.9 [ME60] ²	HVAC ducts and plenums insulated. Where ducts or plenums are installed in or under a slab, verification may need to occur during Foundation Inspection.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.9 [ME10] ²	Ducts and plenums sealed based on static pressure and location.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.9.1.3 [ME11] ³	Ductwork operating >3 in. water column requires air leakage testing.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

1 High Impact (Tier 1) 2 Medium Impact (Tier 2) 3 Low Impact (Tier 3)

Section # & Req.ID	Mechanical Rough-In Inspection	Complies?	Comments/Assumptions
C403.4.2.6 [ME26] ³	Chilled water plants with multiple chillers have capability to reduce flow automatically through the chiller plant when a chiller is shut down. Boiler plants with multiple boilers have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.4.4.6 [ME110] ³	Multiple zone VAV systems with DDC of individual zone boxes have static pressure setpoint reset controls.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	<i>See the Mechanical Systems list for values.</i>
C408.2.2.1 [ME53] ³	Air outlets and zone terminal devices have means for air balancing.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1 High Impact (Tier 1)	2 Medium Impact (Tier 2)	3 Low Impact (Tier 3)
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Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
C303.3, C408.2.5.3 [F18] ³	Furnished O&M manuals for HVAC systems within 90 days of system acceptance.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.2 [FI27] ³	HVAC systems and equipment capacity does not exceed calculated loads.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.4.1 [FI47] ³	Heating and cooling to each zone is controlled by a thermostat control. Minimum one humidity control device per installed humidification/dehumidification system.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.4.1.2 [FI38] ³	Thermostatic controls have a 5 °F deadband.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.4.1.3 [FI20] ³	Temperature controls have setpoint overlap restrictions.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.4.2 [FI39] ³	Each zone equipped with setback controls using automatic time clock or programmable control system.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C403.2.4.2.1, C403.2.4.2.2 [FI40] ³	Automatic Controls: Setback to 55°F (heat) and 85°F (cool); 7-day clock, 2-hour occupant override, 10-hour backup	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C408.2.1 [FI28] ¹	Commissioning plan developed by registered design professional or approved agency.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C408.2.3.1 [FI31] ¹	HVAC equipment has been tested to ensure proper operation.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C408.2.3.2 [FI10] ¹	HVAC control systems have been tested to ensure proper operation, calibration and adjustment of controls.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C408.2.4 [FI29] ¹	Preliminary commissioning report completed and certified by registered design professional or approved agency.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C408.2.5.1 [FI7] ³	Furnished HVAC as-built drawings submitted within 90 days of system acceptance.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

1 High Impact (Tier 1) 2 Medium Impact (Tier 2) 3 Low Impact (Tier 3)

Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
C408.2.5.3 [FI43] ¹	An air and/or hydronic system balancing report is provided for HVAC systems.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
C408.2.5.4 [FI30] ¹	Final commissioning report due to building owner within 90 days of receipt of certificate of occupancy.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1 High Impact (Tier 1)	2 Medium Impact (Tier 2)	3 Low Impact (Tier 3)
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**SECTION 01 23 00
ALTERNATES**

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

- A. Document 00 21 13 - Instructions to Bidders: Instructions for preparation of pricing for Alternates.
- B. Document 00 43 23 - Alternates Form: List of Alternates as supplement to Bid Form.

1.02 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

- A. Alternate No. 01 - (UNIT PRICE) Replacing air terminal units.
- B. Alternate No. 02 - (UNIT PRICE) Replacing controls to air terminal units.
- C. Alternate No. 03 - (UNIT PRICE) Replacing air outlets and inlets (supply diffusers and return registers).
- D. Alternate No. 04 - Supply air Ductwork and return plenum cleaning, see 23 01 30.51.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 01 30.51 - HVAC AIR DUCT CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components as a line item alternate.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Cash Allowance: Contractor must provide a line item alternate cash allowance for the work in this section.
- B. Unit Prices: Unit prices are included for measurement and payment for additional work required due to unforeseen conditions.

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, diffusers, grilles, registers, coils, and condensate drain pans; see NADCA ACR for more details.
 - 1. Supply air system is required to be cleaned as follows:
 - a. (enter specific supply systems to be cleaned)
 - 2. Return air system is required to be cleaned as follows:
 - a. (enter specific return systems to be cleaned)

1.04 REFERENCE STANDARDS

- A. NADCA ACR - Assessment, Cleaning and Restoration of HVAC Systems; 2014.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- D. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

1.06 QUALITY ASSURANCE

- A. Information Available to Contractor: Upon request, Owner will provide the following:
 - 1. One copy of original construction drawings of HVAC system.
- B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 - 1. Certified by one of the following:
 - a. NADCA, National Air Duct Cleaners Association: www.nadca.com
 - 2. Having minimum of three years documented experience.
 - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Follow Owner's Infection Control Risk Assessment (ICRA) Plan.
- E. Take precautions to prevent introduction of additional hazards into occupied spaces.
- F. Obtain Owner's approval of proposed temporary locations for large equipment.
- G. Designate a decontamination area and obtain Owner's approval.
- H. When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Owner as to these controls or containment.
- I. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.02 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning. Coordinate pre-balance readings with test and balance contractor as applicable.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.

3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.03 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.04 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.05 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.06 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.
- B. Coordinate testing and re-balancing of existing systems with test and balance contractor.

3.07 WASTE MANAGEMENT

- A. Double-bag all waste and debris in polyethylene bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 01 30.51

SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes requirements for:
 - 1. P.T. test plugs
 - 2. Pressure test kit
 - 3. Auto-flow balancing valves.
 - 4. Strainers

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - HVAC Piping
- B. Section 23 21 23 - HVAC Pumps

1.03 SUBMITTALS

- A. Submit product data for review in accordance with the requirements of Division 01 including:
 - 1. P.T. plugs
 - 2. Auto Flow balancing valves
 - 3. Strainers
- B. Operation and Maintenance Data

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of the products specified herein for a minimum of five years of documented experience.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. As noted in the individual product paragraphs.

2.02 P.T. TEST PLUGS

- A. Acceptable Manufacturers: Peterson Engineering or approved equal.
- B. Provide 1/4" solid brass pressure/temperature test plugs at locations shown on drawings.
- C. Provide N2 Nordel self-closing valve rated for 275 degrees F service.
- D. P.T. test plugs shall be installed at the following locations and elsewhere as shown on the drawings.
 - 1. Entrance and exit of building when connected to the chilled water central plant.
 - 2. At suction and discharge of pumps.
 - 3. At water inlet and outlet of heat exchanger.
 - 4. At water inlet and outlet of air handling unit coils.
 - 5. Adjacent to each pressure gauge and thermometer.

2.03 PRESSURE TEST KIT

- A. Acceptable Manufacturers: Bell & Gossett or Taco.
- B. Provide two complete portable pressure and temperature test kits to include at least the following:
 - 1. Prior to commissioning, provide the Owner one complete portable pressure and temperature test kit to include at least the following: pressure test gauge, necessary connector hoses, temperature test thermometer with adapter, shutoff and vent valves and carry case. Select thermometers and gauges to read mid-range of design operating temperatures and pressures where PT plugs are installed.

2. Pressure test gauge, necessary connector hoses, temperature test thermometer with adapter, shutoff and vent valves and carrying case. Select thermometers and gauges to read mid-range at design operating temperatures and pressures where PT plugs are installed.

2.04 AUTO-FLOW BALANCE VALVE

- A. Acceptable Manufacturers: Flow Design model AC, Griswold Isolator Series, or Victaulic Series 76.
- B. Valve shall contain a stainless steel spring cartridge.
- C. Spring cartridge valves shall have a 2-32 psi spring range.
- D. Factory set to automatically limit flow to within 5% of flow range. Pressure drop through valve shall not exceed 5 ft. for 2 inch size. Valves flow range shall be independently tested and certified by professional engineer.
- E. Provide with removable cartridge without the use of special tools or cutting piping. Provide two extended pete ports on each valve to clear insulation.
- F. Valve shall be constructed for 400 psig design at 250 degrees F. The flow cartridge shall have stainless steel internal parts. Machined threads shall be provided to adjust cartridge height without the use of shims or crimped sheet metal. Valve body shall be brass with brass ball valve and 'O' ring type union. All valves shall be factory leak tested.
- G. Provide integral union on the downstream side of the assembly.
- H. Refer to piping details for additional information.
- I. Provide valve with engraved tag attached indicating design flow, pressure, and flow characteristic of station.
- J. Provide electronic pressure (0-75 psi) and temperature (-10 - 230 deg F) test kit.

2.05 STRAINERS

- A. Acceptable Manufacturers: Elliott, Mueller, Keckley, or Wheatley.
- B. Cast semi-steel body or cast iron construction for steel piping and bronze body construction for copper piping; equipped with removable, Monel or stainless steel 20 mesh, water screen; maximum pressure drop 2 psi with free area at least four times area of pipe. Provide with blow-off outlet piped to nearest floor drain.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install hydronic specialty items in locations shown on drawings.
- B. Insulate any components subject to sweating or any hot or cold service in accordance with Section 23 07 00.
- C. Utilize manufacturer's instructions to install specialty items. Manufacturer's instructions must be adhered to for proper operation of air removal devices and flow control valves.
- D. Provide manual air vents at top of pipe risers and other locations where air can be trapped or collected.
- E. Pipe relief valve outlets and drain connections from hydronic systems to nearest floor drain.
- F. Support pump inlet and strainer fittings with floor mounted pipe and flange supports.
- G. Locate thermometers and pressure gauges no higher than 7 feet above finished floor elevation, positioned to be read from the floor.
- H. After systems are started up, placed in service and tested/adjusted to perform as designed, contractor shall provide competent representative to demonstrate proper operation and provide

instruction to maintenance personnel to include performance on both cooling and heating cycles.

- I. At a minimum, pressure gauges and thermometers shall be installed at the following locations:
 1. Suction and discharge of pumps.
 2. Water side, Inlet and outlet of heat exchangers.
 3. Water side, inlet and outlet of air handling units.
 4. Building entrance and exit on chilled water plant and chilled water systems.

END OF SECTION 23 21 16

SECTION 23 31 13 - SHEETMETAL DUCTWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rectangular Metal Ducts
- B. Round Ducts
- C. Double Wall Round and Flat-Oval Spiral Ducts

1.02 RELATED REQUIREMENTS

- A. Division 07 - Firestopping
- B. Division 09 - Painting and Coating
- C. Section 23 01 30.51 - HVAC Air Duct Cleaning
- D. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- F. Section 23 07 00 - HVAC Insulation
- G. Section 23 33 00 - Air Duct Accessories
- H. Section 23 33 19 - Duct Silencers
- I. Section 23 3600 - Air Terminal Units
- J. Section 23 3700 - Air Outlets and Inlets

1.03 REFERENCE STANDARDS

- A. ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.
- F. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2014.
- G. SMACNA 1972 - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.
- H. SMACNA 1966 - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2005.
- I. SMACNA 1767 - Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines; 2001.
- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- K. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.
- L. UL 2221 - Tests of Fire Resistive Grease Duct Enclosure Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Submit material/product data as described in Division 01.

- B. Shop Drawings: Provide shop drawings of sheet metal shop ductwork, as follows:
 - 1. Draw to a scale not less than 1/4-inch to one foot
 - 2. Provide sheet sizes equal to Contract Drawings
 - 3. Show duct sizes
 - 4. Show fitting details
 - 5. Show lighting and ceiling diffusers
 - 6. Show bottom of duct elevation above finished floor
 - 7. Show all manual and motorized dampers and associated access doors.
 - 8. Show HVAC equipment, all air terminal units, and air quantities.
- C. Coordinated Shop Drawings: Provide coordinated shop drawings for sheet metal work in mechanical equipment rooms, and other congested areas listed.
 - 1. Draw to a scale of 1/2 inch to 1 foot.
 - 2. Provide sheet sizes to match Contract Drawings.
 - 3. Show duct sizes.
 - 4. Show bottom duct elevations from finished floor.
 - 5. Show lighting, equipment, maintenance and operating clearances, HVAC piping, plumbing piping, medical gas piping, pneumatic tube system, conduit 3" and larger, and columns and beams with mounting heights.
 - 6. Show construction details of all fittings and connections to equipment.
 - 7. Show construction details of plenums and casing.
- D. Coordinated Shop Drawings shall be completed for all areas prior to installation of the major trades. The coordinated shop drawings are not required to be submitted except as noted above. A coordinated shop drawing attempt shall be submitted with any request to the owner or design team to assist with overhead coordination conflicts.
- E. Certifications: Provide a duct schedule, certified by an officer of the sheet metal fabrication subcontractor, that the ductwork conforms to SMACNA standards. For each sheet metal system furnished on the project include:
 - 1. System name
 - 2. Duct material
 - 3. Duct gauge
 - 4. SMACNA rectangular reinforcement number
 - 5. SMACNA intermediate reinforcement number
 - 6. SMACNA transverse reinforcement number
 - 7. Rod diameter and type
 - 8. Sealant type
 - 9. Attachment method
 - 10. Duct system design pressure
- F. Field Conditions
 - 1. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturer.
 - 2. Maintain temperature within acceptable range during and after installation of duct sealants.

1.05 QUALITY ASSURANCE

- A. Provide an installed duct system which will supply the air quantities indicated by the drawings and have the lowest possible friction loss with the least possible leakage loss. System static pressure loss for each system shall not exceed that which is indicated in the equipment schedule as external static pressure or in the fan schedule as static pressure and shall include the losses of all accessories. Friction losses shall be minimized by reduction in the number of offsets and elbows by pre-planning the duct system installation and coordination with other trades to prevent interferences. Maintain access to accessories requiring maintenance, service, and inspection. Radius elbows are preferred for turns to minimize friction, noise, and vibrations.

- B. Provide and/or construct materials, ductwork, joints, transformations, splitters, dampers, and access doors as specified herein for the sheet metal ductwork as shown on drawings.
- C. SMACNA Manual: Sheet Metal Tradesman shall have access on the construction site to "HVAC Duct Construction Standards". Comply with applicable provisions of the SMACNA Manual and more stringent requirements of this specification.
- D. Quality control involves not only the general performance requirements for air ducts, but also quality workmanship which includes layout pre-planning so that offsets, rises, falls, elbows, fittings, etc., are minimized or eliminated. General performance requirements for ducts include:
 - 1. Dimensional stability (shape deformation and strength)
 - 2. Containment of the air being conveyed (leakage control). See Part 3 of this specification for leakage testing.
 - 3. Vibration (fatigue and appearance)
 - 4. Noise (generation, transmission, or attenuation)
 - 5. Exposure (to damage, weather, temperature extremes, flexure cycles, wind, corrosive atmospheres, biological contamination, flow interruption or reversal, underground or other encasement conditions, combustion, or other in-service conditions)
 - 6. Support (alignment and position retention)
 - 7. Seismic restraint
 - 8. Thermal conductivity (heat gain or loss and condensation control)
- E. Provide galvanized duct materials which meet applicable requirements of local and state codes, whichever is the most stringent.
- F. Support ductwork in accordance with applicable requirements of local and state codes and details on drawings.
- G. Emboss fittings with material gauge, manufacturer, and type material.
- H. Sealers, liners, pre-insulated jackets and flexible ducts shall comply with a flame spread rating of 25 or less and a smoke developed rating of not over 50.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Sheet metal ductwork, angles, bar slips, hangers, and straps: Galvanized, prime quality steel sheets.
- B. Screws: Cadmium plated.
- C. Joint Sealers: water resistant, mildew and mold resistant.
 - 1. Suitable for indoor and outdoor use, fiber reinforced, with UV inhibitors.
 - 2. Surface burning characteristics: Flame spread of zero and smoke developed of zero when tested in accordance with ASTM E84.
 - 3. Suitable for use with flexible ducts and UL listed.
 - 4. Acceptable Products:
 - a. Substitutions: Not permitted.
 - 5. Pressure sensitive tape is not acceptable.
- D. Duct Sealing:
 - 1. All longitudinal and transverse joints, seams and duct sidewall penetrations, regardless of pressure classification, shall be sealed with duct sealer. Follow SMANCA Table 1-2, Seal Class A for all supply, return, exhaust, relief, and make-up air ductwork.
 - 2. See Leakage Testing of Installed Systems requirements in Part 3.
- E. Sheetmetal accessories: As specified in Section 23 33 00.

2.02 PRESSURE CLASSIFICATION

- A. Ductwork where maximum dimension is less than 97" shall be constructed based on applicable pressure classification in accordance with SMACNA Manual including sheetmetal gauge, reinforcement gauge and spacing.
- B. Construct the following for 1" pressure classification, Table 1- 4:
 - 1. Supply ductwork downstream of air terminal units
 - 2. Low pressure supply ductwork to reheat coils
 - 3. Low pressure supply, return, and outside air ductwork at fan coil units
- C. Construct the following for 2" pressure classification, Table 1- 5:
 - 1. Return ductwork
 - 2. Exhaust ductwork
 - 3. Make-up air ductwork
- D. Construct the following for 6" w.g. pressure classification Table 1-8:
 - 1. Supply ductwork and plenums downstream of supply fans up to air terminal units

2.03 RECTANGULAR DUCTWORK

- A. Transverse Joints:
 - 1. "S" and drive construction for 1" and 2" w.g. pressure classification.
 - a. Provide duct gauge and reinforcing angles in accordance with Table 1-11
 - 2. Duct Connection System: Connection system as manufactured by Ductmate or Nexus shall incorporate gasketed joints, metal cleats and bolted corners. Minimum metal gauge shall be 24 gauge. Connection systems may be used for all pressure classifications.
 - 3. For pressure classifications above 2", use double "S" joint up to 30" and companion angle or manufacturer's connection system above 30".
- B. Longitudinal Seams: Pittsburg Lock
- C. Transitions:
 - 1. Do not exceed 1" in 7" of slope for increase-in-area transitions.
 - 2. Do not exceed 1" in 4" of slope for decrease-in-area transitions, 1" in 7" is preferable.
 - 3. Do not exceed 45 degrees on the entering or leaving side for angle of transitions at connections to equipment without the use of approved turning vanes.
- D. Elbows:
 - 1. Fabricate ells using one of the following specifications: The fabrication methods are listed in order of preference. Use radius elbows where ever possible. Use square elbows only when available space prevents the use of radius elbows.
 - a. Unvaned, long radius elbow with the throat radius equal to 3/4 of the width of the duct and with a full heel radius.
 - b. Six inch throat radius with full radius, single thickness vanes and full heel radius. Maximum unsupported length of vanes shall be 36". Securely fasten vanes to runners. Secure vanes in stable position. Construct vane edges to project tangents parallel to duct sides.
 - c. Square elbows with airfoil, double thickness turning vanes.
 - 2. Turning vanes:
 - a. Acceptable manufacturers: Aero Dyne
 - b. Substitutions: Not permitted.
 - c. True airfoil design; smoothly-rounded entry nose with extended trailing edge. Generated sound power level shall not exceed 54 decibels in band 4 at 2000 FPM in a 24"x24" duct.
 - d. Fabricate assemblies with Aero Dyne Co. side rails; install vanes on design centers of 2.4 inches across the full diagonal dimension of the elbow.
 - e. Submit Aero Dyne product and performance data for review.

E. Branch Connections:

1. Pressure classification 2" and less:
 - a. Rectangular branch from rectangular main: 45 degree entry with all corners closed as shown in Figure 2-8
 - b. Round branches: Spin-in fitting without scoop.
 - c. Parallel flow branches: See Figure 2-7.
 - d. Space duct joints to avoid cutting them for branch take offs and outlet collars.
2. Pressure classification above 2":
 - a. Round branches: Conical round fittings only.
 - b. Rectangular branch from rectangular main: 45 degree entry with all corners closed as shown in Figure 2-8
 - c. Parallel flow branches: See Figure 2-7.
 - d. Space duct joints to avoid cutting them for branch take offs and outlet collars.

2.04 ROUND DUCTWORK

A. Applicable for pressure classification above 2".

B. Round Duct (Spiral Pipe) and Fittings:

1. Manufactured from galvanized steel meeting ASTM A653/A653M. Construction shall be in accordance with SMACNA HVAC Duct Construction Standards.
2. Use appropriate seams made to eliminate leakage based on pressures for which system has been designed. Longitudinal seam duct to have fusion welded butt seam.
3. Fittings and couplings shall have minimum gauges specified by SMACNA Manual.
4. Fittings shall have continuous welds along all seams. Divided flow fittings shall be manufactured as separate fittings, not as tap collars welded into spiral duct sections.
5. Ninety degree tees (conical) and 45 degree laterals (wye) up to and including 12" diameter tap size to have radiused entrance into the tap, produced by machine or press forming. Entrances to be free of weld build-up, burrs, or irregularities.
6. Elbows in diameters 3" thru 8" shall be two section stamped elbows. Other elbows shall be gored construction with all seams continuous welded. Fabricate to center line radius of 1.5 times the cross sectional diameter. Elbows, not die-stamped, shall be fabricated as follows:
 - a. Less than 30 degree angle: minimum 2 gores
 - b. Between 30 thru 60 degrees: minimum 3 gores
 - c. Over 60 degrees: minimum 5 gores
7. Two piece mitered elbows shall not be used.
8. Tees shall be conical. Saddle taps or straight tees shall not be used.
9. The leading edge of all vanes in ducts over 20" diameter shall be hemmed with 1/2" foldback. Turning vanes in ducts over 24" shall be reinforced by stays or sectional construction to limit unsupported length to 24". Vanes shall be a minimum of 20 gauge.
10. Reduction of divided flow fittings to conical span section in the 36 common reductions in sizes 4" thru 22".
11. Spun bellmouth connections are to be used at each round take-off from plenum.
12. Galvanized areas damaged by welding to be coated with corrosion resistant aluminum paint.

C. Couplings for Round Medium-Pressure Duct (over 2" w.g.):

1. Pipe-to-pipe joints shall be sleeve couplings, reinforced by rolled beads.
2. Pipe-to-fitting joints shall be slip-fit of projecting collar fitting into pipe.
3. Insertion length of sleeve coupling and fitting collar shall be 2" minimum.

PART 3 - EXECUTION

3.01 INSTALLATION, APPLICATION, ERECTION

- A. Do not exceed 45 degrees for easement transition angle.
- B. Seal all transverse and longitudinal joints and seams and duct wall penetrations with approved sealer in accordance with manufacturer's directions regardless of pressure class.
- C. Counterflash ductwork penetrating roof.
- D. Support round ducts from building structure with galvanized steel hangers in accordance with SMACNA. Secure hangers to masonry portion of building by means of inserts or other acceptable anchors.
- E. Secure hangers to steel structure members by means of C-clamps. Vertical risers, and other duct runs where methods of support specified above are not applicable, shall be supported by angle brackets as shown in SMACNA manual.
- F. Where appropriate based on duct weight, support rectangular ducts by minimum, 1" x 18 gauge, galvanized band iron or minimum 3/8" galvanized rod hangers attached to reinforcing angles and spaced same as reinforcing angles. Design hangers, reinforcing angles and other components to support weight of duct and insulation. Secure hangers to concrete beam or slab by adequately sized inserts, anchor shield and bolt, toggle bolt, or expansion bolt.
- G. Attach hangers to ductwork using sheet metal screws.
- H. Space hangers approximately 8' along the duct for ducts under 60". For ducts over 60" and larger and heavier sections, such as welded duct and sound absorbers, space hangers at approximately 4' intervals.
- I. Hangers and bracing used with ductwork shall be galvanized.
- J. Provide smooth insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. Provide metal collar equivalent in depth to insulation thickness. Access door locks and damper handles shall be free from mastic or sealant.
- K. In addition to the requirements above, add supplemental bracing as necessary to prevent sagging and drumming, and/or vibration.

3.02 CLEANING

- A. Clean mechanical system thoroughly to assure all foreign matter and dirt is removed.

3.03 AIR MOVING EQUIPMENT OPERATION DURING CONSTRUCTION

- A. The use of new or existing air handling units, fans, or other permanent air moving equipment during construction is prohibited unless approved by the owner in writing. If approved for use during construction, the following procedures shall be followed:
 - 1. The contractor shall protect the interior of all ductwork, air handling units, and other equipment from the accumulation of dirt and dust and other contaminants. If the permanent equipment cannot be adequately protected, temporary air moving/ conditioning equipment and distribution systems shall be utilized as required for finishing trades.
 - 2. Provide all specified filters in equipment to be operated as well as temporary filters on all return and exhaust air grilles, open ductwork, and transfer openings in the work area.
 - 3. The contractor shall remove all filters used during construction and replace them with new filters prior to test and balance work and prior to substantial completion.
 - 4. If the ductwork and/or equipment is found to be contaminated at any point during construction, an independent NADCA certified contractor shall be retained to clean the ductwork and/or equipment at the contractors expense. Refer to Section 23 01 30.51.
 - 5. System operating temperatures shall be maintained to avoid condensation on ductwork and equipment surfaces. New or existing insulation found damaged shall be replaced.

6. Coordinate use of air handling equipment with ICRA plan, if applicable. Maintain required pressure relationships in construction areas adjacent to occupied areas.

3.04 LEAKAGE TESTING OF INSTALLED SYSTEMS

- A. Test duct for leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Use prescribed test kit containing test blower, two U-tube manometers and calibrated curve attached to the orifice tube assembly.
- B. Pressure testing shall include taps/take-offs to air terminal units in medium pressure ductwork and taps/take-offs to air devices in supply, return, and exhaust ductwork.
- C. Pressurize all installed duct systems for each pressure class to maximum pressure for fabrication classification. The leakage amount shall not exceed the allotted amount for the pressure class or the allotted amount for that portion of the system as follows:
 1. 1" Pressure Class - Leakage Class 6; Max. Leakage Factor - 6.0 CFM/100 SF
 2. 2" Pressure Class - Leakage Class 6; Max. Leakage Factor - 9.4 CFM/100 SF
 3. 1" and 2" Pressure Class exhaust ductwork connected to or serving isolation rooms and bronchoscopy rooms shall be construction and tested as follows:
 - a. 1" Pressure Class - Leakage Class 3; Max. Leakage Factor - 3.0 CFM/100 SF
 - b. 2" Pressure Class - Leakage Class 3; Max. Leakage Factor - 4.7 CFM/100 SF
 4. 6" Pressure Class - Leakage Class 3; Max. Leakage Factor - 9.6 CFM/100 SF
- D. All ductwork shall be leak tested first before being enclosed in a shaft or above other inaccessible areas.
- E. Correct leaks found in excess of allowable limits. Retest until acceptable leakage is witnessed.
- F. Have test results available for review on a progressive and final basis. Include all test results in project closing file along with name, signature, and date of independent witness to testing. Test results shall show preliminary and final test results and include all calculations used to determine system compliance with the maximum specified leakage rate.

3.05 AIR TEST AND BALANCE

- A. Prepare the system for tests as specified in Section 23 05 93 and correct deficiencies found by the Test and Balance firm.
- B. Duct dimensions shown on drawings indicate inside clear dimensions. Make calculation allowances for duct requiring internal sound lining, or insulation to provide "inside clear" (IC) dimensions.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backdraft dampers - metal.
- B. Duct access doors.
- C. Duct test ports.
- D. Fire dampers.
- E. Smoke dampers.
- F. Combination fire and smoke dampers.
- G. Flexible duct
- H. Flexible duct connections.
- I. Volume control dampers.

1.02 RELATED REQUIREMENTS

- A. Division 07: Firestopping.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 31 13 - Sheetmetal Ductwork.
- D. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- B. SMACNA 1966 - HVAC Duct Construction Standards; 2005.
- C. UL 181 - Factory-Made Air Ducts and Air Connectors; 2013.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- E. UL 555 - Standard for Fire Dampers; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- F. UL 555S - Standard for Leakage Rated Dampers for Use in Smoke Control Systems; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- G. AMCA 511 - Certified Ratings Program-Product Rating Manual for Air Control Devices; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. Product Data: Submit manufacturer's product data for review. Include electrical characteristics and connection requirements where applicable.
- C. Project Record Drawings: Record actual locations of volume dampers, rated dampers, access doors, and test holes.

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

- A. Acceptable manufacturers: Louvers & Dampers, Nailor Industries, or Ruskin Company.
 - 1. Substitutions: Refer to Division 01.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together

in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; counter-balance adjustment device to permit setting for varying differential static pressure.

2.02 FIRE DAMPERS

- A. Acceptable manufacturers: Air Balance, Greenheck, Ruskin, or Nailor.
 - 1. Substitutions: Not permitted.
- B. Fabricate in accordance with NFPA 90A, UL 555, and as indicated.
- C. Material: Galvanized steel or 304 stainless steel to match adjacent ductwork.
- D. Dampers shall be curtain or multi-leaf type, 1-1/2 hour rated, suitable for horizontal or vertical mounting. Blades for curtain type dampers shall be stored out of the airstream.
- E. Dampers shall meet Class 1 leakage rates and be dynamic rated for closure against airflow up to 2000 FPM in low pressure systems and up to 4000 FPM in medium pressure systems.
- F. Dampers shall have a UL 555 differential pressure rating of 4 in. wg.
- G. Provide damper with fusible link causing the damper to lock in the closed position at 165 degrees F.
- H. Provide manufacturer's round to horizontal duct adapter as required.
- I. Maximum pressure drop shall be as follows:
- J. Damper pressure drop shall not exceed 0.05 in. wg. at 1500 FPM or 0.10 in wg. at 2000 FPM.
- K. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511.

2.03 SMOKE DAMPERS

- A. Acceptable manufacturers: Air Balance, Greenheck, Ruskin, or Nailor.
 - 1. Substitutions: Not permitted.
- B. Fabricate in accordance with NFPA 90A, UL 555S, and as indicated.
- C. Dampers: Single or multi-blade type, 1-1/2 hour rated, automatically operated by 120V electric actuator mounted outside the airstream unless noted otherwise. Actuator shall be adequately sized to open the damper within 15 seconds.
- D. Dampers shall be meet Class 1 leakage rates and be dynamic rated for closure against airflow up to 2000 FPM in low pressure systems and up to 4000 FPM in medium pressure systems.
- E. Provide two-position actuator. Damper shall fail normally closed.
- F. Provide manufacturer's round to horizontal duct adapter as required.
- G. Damper pressure drop shall not exceed 0.15 in. wg. at 1500 FPM or 0.25 in. wg. at 2000 FPM.
- H. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511.

2.04 COMBINATION FIRE AND SMOKE DAMPERS

- A. Acceptable manufacturers: Air Balance, Ruskin, Greenheck, or Nailor.
 - 1. Substitutions: Not permitted.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Dampers: Single or multi-blade type, 1-1/2 hour rated, automatically operated by 120V electric actuator mounted outside the airstream unless noted otherwise. Actuator shall be adequately sized to open the damper within 15 seconds.
- D. Dampers shall be meet Class 1 leakage rates and be dynamic rated for closure against airflow up to 2000 FPM and 4" w.g. in low pressure systems and up to 4000 FPM and 6" w.g. in medium pressure systems.

- E. Provide two-position actuator and with resettable link with open/closed indicator causing the damper to close at 165 degrees F. Damper shall fail normally closed.
- F. Provide manufacturer's round to horizontal duct adapter as required.
- G. Damper pressure drop shall not exceed 0.15 in. wg. at 1500 FPM or 0.25 in. wg. at 2000 FPM.
- H. Dampers shall bear the AMCA Certified Ratings Seal for Air Performance in accordance with AMCA 511.

2.05 SLEEVES FOR RATED DAMPERS

- A. Unless otherwise required by the authority having jurisdiction, sleeves for fire dampers, smoke dampers and combination fire and smoke dampers shall be provided by the damper manufacturer and be of rigid type construction recommended in Schedule 2 of SMACNA Publication for "Fire Damper and Heat Stop Guide for Air Handling Systems". Use 16 gauge for ducts 24" or less in diameter or either rectangular dimension and 14 gauge for ducts over 24". Provide minimum 18" long sleeves. Coordinate required length with wall thicknesses.
- B. Install 1-1/2"x1-1/2"x1/8" angle bar on four sides of sleeves and both sides of wall. Fasten angles to sleeve only. Do not fasten to the wall.

2.06 DUCT ACCESS DOORS

- A. Acceptable manufacturers: Ruskin, SEMCO, Greenheck, or Ward Industries.
 - 1. Substitutions: Refer to Division 01.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, provide minimum 1 inch thick insulation with minimum 24 gauge sheet metal cover on each side.
 - 1. Less Than 12 inches Square: Secure with sash locks.
 - 2. Up to 18 inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
 - 5. Latches shall permit easy removal of access door while maintaining positive closing and minimum leakage. Provide continuous sponge rubber gaskets for all doors.
- D. Provide insulated doors in ductwork for access to service equipment such as airflow measuring stations (each side), casing mounted coils (each side), control dampers, duct mounted coils (each side), duct mounted smoke detectors, humidifiers, rated dampers, and elsewhere as noted on drawings.
- E. Size access doors as follows:
 - 1. Duct sizes under 12": Door sized sufficient to service equipment or replace fusible link.
 - 2. Duct sizes 12" to 20": 12"x12" door.
 - 3. Duct sizes 20" to 36": 18"x18" door.
 - 4. Duct sizes above 36": 24"x24" door.
- F. Provide reinforced wire glass view windows (min. 12"x12") in access doors at humidifiers.
- G. Mount doors in rigid frame of at least 22 gauge formed galvanized steel or aluminum.
- H. Use angle iron bracing as required to make the door frame a rigid assembly.
- I. In accordance with NFPA 90A, identify each access door with minimum 1/2" high printed or stenciled letters as 'Fire Damper', 'Smoke Damper', or 'Combination Fire/Smoke Damper'.

2.07 DUCT TEST PORTS

- A. Temporary Test Port: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Repair insulation and vapor barrier.

- B. Permanent Test Port: Factory fabricated, air tight flanged fittings with screw cap equal to Carlisle PTP-1. Provide extended neck fittings to clear insulation.

2.08 FLEXIBLE DUCT

- A. Acceptable manufacturers: Atco, Flexmaster USA, Hart & Cooley, J.P. Lanburn, or Thermaflex.
 - 1. Substitutions: Refer to Division 01.
- B. Characteristics of flexible duct to air terminals:
 - 1. Approved as UL 181, Class 1 air duct.
 - 2. Meet requirements of ASTM C1071.
 - 3. Flame spread less than 25; smoke developed rating less than 50.
 - 4. Thermal conductance: minimum R-6.
 - 5. Perm rating: 0.05 perms per ASTM E96, Method A.
 - 6. Provide a minimum of three feet of flexible duct upstream of diffusers. Do not exceed six feet of length.
 - 7. Flexible duct shall meet standards of local building code.
- C. Seal off the insulation jacket at its ends and at joints with mastic, hardcast, or similar material. Replace flex if jacket is punctured.
- D. Complete insulation coverage up to the diffuser neck connection.
- E. Do not route flexible duct through corridor walls or fire or smoke rated partitions, barriers, or walls.
- F. No bends shall be made in flexible duct with the center line radius less than one and one-half duct diameter and only one bend may occur per four foot length of duct material.

2.09 FLEXIBLE DUCT CONNECTIONS

- A. Acceptable manufacturers: Carlisle, Durodyne, or Elgen.
 - 1. Substitutions: Refer to Division 01.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: NFPA 90A compliant, UL listed fire-retardant neoprene coated woven glass fiber fabric, minimum 28 oz. density.
 - a. Net Fabric Width: Approximately 3 inches wide.
 - 2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel. Provide aluminum or stainless steel metal as required to match ductwork material.

2.10 VOLUME CONTROL DAMPERS

- A. Acceptable manufacturers: Louvers & Dampers, Greenheck, McGill Airflow, Ruskin, or SEMCO.
 - 1. Substitutions: Refer to Division 01.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Splitter Dampers:
 - 1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
 - 2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
 - 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .
- D. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
 - 1. Fabricate for duct sizes up to 6 x 30 inch.
 - 2. Blade: 22 gauge, minimum.
 - 3. Frame: 18 gauge, minimum.

- E. Multi-Blade Damper: Fabricate of opposed blade pattern with 3V or airflow shaped blades and maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch, minimum.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
- G. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.11 MISCELLANEOUS PRODUCTS

- A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction equal to Carlisle Dynair Duct Protection Film. Use to cover all open ends of stored or hung ductwork during construction.
 - 1. Thickness: 2 mils.
 - 2. High tack water based adhesive.
 - 3. UV stable light blue color.
 - 4. Elongation before break: 325 percent, minimum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in locations specified and as shown on drawings in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 13 for duct construction and pressure class.
- B. Provide insulated doors in ductwork for access to service equipment such as airflow measuring stations (each side), control dampers, duct mounted smoke detectors, rated dampers, and elsewhere as noted on drawings.
- C. Provide insulated access doors in kitchen exhaust ducts for cleaning and inspection in accordance with NFPA 96.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- G. Provide balancing dampers at all points on supply, return, and exhaust systems where branches are taken from larger ducts.
- H. Use splitter dampers only where indicated.
- I. Where diffusers or grilles and registers are not provided with volume dampers, install spin-in fitting with balance damper in duct run-out.
- J. Provide all screws, bolts, nuts, inserts, and material required for attaching sheetmetal to duct, walls, floors, and ceilings.

3.02 TESTING

- A. Check work for satisfactory installation and performance.

- B. Insure that adequate access does in fact exist for rated dampers, that damper blade movement is not restricted, and that damper operator motors are not hindered in operation by proximity to walls or other objects.
- C. Check duct connections at access doors for air leakage or condensation. Correct deficiencies found.

END OF SECTION 23 33 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single duct terminal units.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- C. Section 23 05 23 - General Duty Valves for HVAC
- D. Section 23 05 29 - Hangers for HVAC Piping
- E. Section 23 05 53 - Identification for HVAC Piping and Equipment
- F. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- G. Section 23 07 00 - HVAC Insulation
- H. Section 23 09 13 - Instrumentation and Control Devices for HVAC
- I. Section 23 21 13 - Hydronic Piping
- J. Section 23 21 14 - Hydronic Specialties
- K. Section 23 31 13 - Sheetmetal Ductwork
- L. Section 23 33 00 - Air Duct Accessories
- M. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association; 2012.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- C. Acoustical Liner: Meet requirements of NFPA 90A, UL 181, and ASTM C665 as specified.
- D. Air Diffusion Council, ADC Standard 1062R2, Air Diffusing Equipment Test Code.
- E. Air Moving and Conditioning Association, AMCA Standard 210, Test Code for Air Moving Devices.
- F. SMACNA HVAC Duct Construction Standards; Current Edition.

1.04 SUBMITTALS

- A. Submit product data and required information in accordance with the provisions of Division 01.
- B. Product Data: Provide data indicating configuration, general assembly, materials used in fabrication, access door location and size, insulation thickness, density, and R-value. Include specific performance ratings that indicate unit ID, airflow setpoints, coil performance, air pressure drop, NC rating, and electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate support and hanging details, and service clearances required.
- D. Project Record Documents: Record actual locations of units.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.
- F. Substitutions: Refer to Division 1.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. See Division 01 for additional warranty requirements.
- B. Provide five year manufacturer warranty for air terminal units.

1.07 GUARANTEE

- A. Manufacturer guarantees resultant noise levels to be within NC rating published by manufacturer.

PART 2 PRODUCTS

2.01 SINGLE DUCT AIR TERMINAL UNITS

- A. Acceptable Manufacturers:
 - 1. Anemostat, Environmental Technologies (JCI), Krueger, Metalaire, Nailor, Price, Titus, and Trane.
- B. Basic Assembly:
 - 1. Casings: Minimum 22 gauge galvanized steel.
 - 2. Lining:
 - a. Dual Wall: Interior liner of minimum 22 gauge phosphatized steel covering the insulation. All cut edges of insulation shall be covered with metal flange. All wire penetrations shall be covered by grommets. High density, glass fiber insulation, 1" thick, 1.9 lb/cu.ft., R-Value of 4.2.
 - b. Insulation shall comply with the requirements of UL 181, NFPA 90A, and ASTM C665.
 - 3. Provide insulated gasketed access panel on bottom of terminal unit for access to internal air valve and heating coil inspection. Adjacent duct insulation shall not block access door.
 - 4. Leakage: Maximum 1% of maximum rated airflow at 1" wg. inlet static pressure.
 - 5. Multi-point, multi-axis flow ring or cross sensor at box inlet.
 - 6. Provide integral flow taps and calibration chart on each unit.
 - 7. Factory calibrate sensor and controller for maximum, minimum, heating, and unoccupied design airflow according to the air terminal unit schedule. Terminal units scheduled for constant volume operation shall be provided with controls capable of variable volume operation.
 - 8. Factory mount, wire, connect, calibrate, setup and test DDC controller, pressure transducer, and electronic damper actuator furnished to box manufacturer under Section 23 09 13. Damper actuators integral with terminal unit may be furnished by terminal unit manufacturer and operation coordinated with DDC controller.
- C. Actuator / Controls: Electronic - by Controls Contractor
 - 1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud with removable cover.
 - 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 1 percent of design air flow at 3 inches rated inlet static pressure. Damper position shall be indicated on the end of the shaft on the outside of the casing
 - 3. Controller to provide consistent air delivery within 5% of nominal airflow down to 25% of unit rated CFM, independent of changes in system static pressure.
 - 4. The actuator shall be directly coupled to the damper shaft.

- D. Attenuator:
 - 1. Where indicated, attenuators shall be provided as required to reduce the discharge and radiated NC levels to 35 or less based on selections made at 3.0" w.c. inlet static pressure.
 - 2. The attenuator lining shall match the specified air terminal unit lining.
 - 3. Provide attenuator on all air terminal units in the following spaces: patient rooms, offices, and procedure rooms or any additional space noted on drawings or schedules..
- E. Heating Water Coil:
 - 1. Selection criteria:
 - a. Unless noted otherwise, coils shall be selected at the scheduled heating water supply temperature to meet the scheduled performance criteria in the following priority: total capacity (BTUH), leaving air temperature, heating water return temperature.
 - b. Coils rows shall be selected to obtain the performance closest to the scheduled values while meeting the scheduled capacity and without exceeding the leaving air temperature.
 - 2. Construction:
 - a. Fins: Aluminum, maximum 10 fins per inch.
 - b. Tubes: 1/2 inch, 5/8 inch, or 7/8 inch seamless, copper tubes mechanically expanded into the fin collars; arranged for counter-flow of heating water.
 - c. Water velocity maximum 8 feet per second with water pressure loss not greater than indicated on the drawings.
 - d. Rows: Provide coil rows scheduled or as required to achieve scheduled performance.
 - 3. Coils shall be ARI certified and leak tested at 300 PSIG under water.
 - 4. Casing shall be minimum 22 gauge galvanized steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.
- C. Support units independently from structure. Do not support from adjacent ductwork.
- D. Connect to ductwork in accordance with Section 23 31 13.
- E. Provide insulation and engraved equipment nameplate as specified.
- F. Provide insulation in accordance with Section 23 07 13 and Section 23 07 19.
- G. Verify that electric power is available and of the correct characteristics.
- H. Coordinate control installations with temperature controls vendor.

3.02 CLEANING, TESTING, STARTUP, AND DEMONSTRATION

- A. Clean and test units in accordance with Section 23 05 00.
 - 1. Include flushing of connected piping and cleaning of water control valves.
- B. Start-up units, check for proper operation as a system with air handling unit, fan, and connected ductwork.
- C. Check for clear access to control panel, isolation valves, control valves, balancing valves, and access panels. Verify required working clearance for control panels.
- D. Prepare units for Test and Balance as required by Section 23 05 93, correct any deficiencies found and retest.
- E. Demonstrate operation of units as a complete system to maintenance personnel and instruct them in the operation, adjustment and repair of the system.

- F. Check connections to insure they are tight and without noticeable leakage. Correct any deficiencies found.

END OF SECTION 23 36 00

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 00 - Common Work Results for HVAC
- B. Section 23 33 00 - Air Duct Accessories
- C. Section 23 31 13 - Sheetmetal Ductwork
- D. Section 23 31 14 - Sheetmetal - Special Ductwork

1.03 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2012.
- B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006 (R2011).
- C. SMACNA 1966 - HVAC Duct Construction Standards; 2005.

1.04 SUBMITTALS

- A. Product Data: Submit product data for review. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- B. Samples: Submit two of each required air outlet and inlet type upon request.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Anemostat, Carnes, Krueger, Metalaire, Nailor, Price, or Titus unless noted otherwise.
- B. Substitutions: Refer to Division 01.
- C. Air devices shall meet these specifications and the requirements noted in the Air Distribution Device Schedule. Titus model numbers are not inclusive of all listed requirements.

2.02 SUPPLY DIFFUSERS

- A. Type S4 (based on Titus Omni)
 - 1. Plaque face diffuser with square deflection plate centered in a square housing, four way directional blow. Face panel shall not protrude more than 1/4" below the outside border of the diffuser backpan. Diffusers with a 12"x12" full face shall have no less than a 9"x9" face panel. Diffusers with a 24"x24" full face shall have no less than an 18"x18" face panel. For diffusers noted on drawings to be 2 or 3 way blow, provide blank off plates in diffuser. Provide panel, face and neck size scheduled.
 - 2. Material: Steel with baked acrylic finish.
 - 3. Color: White.
 - 4. Borders and mounting: Coordinate ceiling device frame type with architectural ceiling type.

5. Dampers: Provide ceiling diffusers complete with opposed blade volume dampers where diffuser is installed in inaccessible ceiling and spin-in fitting manual volume damper at branch ductwork tap is not accessible.
 6. Accessories: Insulated back panel
- B. Type S5 (based on Titus 300R)
1. Sidewall, double deflection register with 3/4" blade spacing and front blades parallel to the long dimension. Blades shall have steel friction pivots on both ends to allow individual blade adjustment without loosening or rattling. Provide panel, face and neck size scheduled.
 2. Material: Steel with baked acrylic finish.
 3. Color: White.
 4. Borders and mounting: 1-1/4" wide border on all sides with countersunk screw holes..
 5. Dampers: Provide opposed blade manual volume damper with matching finish behind register. Damper shall be adjustable through the front blades of the diffuser.
 6. Accessories: None.
- C. Provide concealed balancing damper regulator equal to Young Regulator Model 5020-CC where specified herein or indicated on drawings. Regulator shall contain a Bowden cable control assembly and be adjustable from the finished ceiling using a socket wrench. Adjustment fitting shall not protrude below the finished ceiling.

2.03 RETURN AND EXHAUST GRILLES

- A. Type R4 / E4 (based on Titus Omni)
1. Plaque face grille with square plate centered in a square housing. Face panel shall not protrude more than 1/4" below the outside border of the backpan. Grilles with a 12"x12" full face shall have no less than a 9"x9" face panel. Grilles with a 24"x24" full face shall have no less than an 18"x18" face panel. Provide panel, face and neck size scheduled.
 2. Material: Steel with baked acrylic finish.
 3. Color: White.
 4. Borders and mounting: Coordinate ceiling device frame type with architectural ceiling type.
 5. Dampers: Provide ceiling grilles complete with opposed blade volume dampers where diffuser is installed in inaccessible ceiling and spin-in fitting manual volume damper at branch ductwork tap is not accessible.
 6. Accessories: None
- B. Type R5 / E5 (based on Titus 355RL)
1. Sidewall grille with 35 degree fixed deflection blades spaced 1/2" apart. Refer to schedule for blade orientation. Provide face and neck size scheduled.
 2. Material: Steel with baked acrylic finish.
 3. Color: White.
 4. Borders and mounting: 1-1/4" wide border on all sides with countersunk screw holes..
 5. Dampers: Provide opposed blade manual volume damper with matching finish behind register. Damper shall be adjustable through the front blades of the grille.
 6. Accessories: Provide with piano hinged 1" filter frame and quarter turn fastener when noted on drawings. Hinge shall be located on right or left side of grille as required to allow frame door to fully open.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install accessories in accordance with manufacturer's published recommendations as well as applicable sections of SMACNA manual and other standards set forth in Part 1.

- C. Provide all screws, bolts, nuts, inserts, and material required for attaching sheet metal to duct, walls, floors, and ceilings.
- D. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- E. Where diffusers or grilles and registers are not provided with volume dampers, install spin-in fitting with balancing damper in duct runout.

3.02 TESTING

- A. Check work for satisfactory installation and performance.
- B. Check duct connections at air inlets and outlets air leakage or condensation. Correct conditions found.

3.03 INSPECTION

- A. Air inlets and outlets shall be clean and free from scratches and dents. Repair or replace damaged devices as required.

END OF SECTION 23 37 00

