SECTION 233300 - AIR DUCT ACCESSORIES

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Backdraft and pressure relief dampers.

Barometric relief dampers.

Manual volume dampers.

Control dampers.

Fire dampers.

Ceiling radiation dampers.

Smoke dampers.

Combination fire and smoke dampers.

Corridor dampers.

Flange connectors.

Duct silencers.

Turning vanes.

Remote damper operators.

Duct-mounted access doors.

Duct access panel assemblies.

Flexible connectors.

Duct security bars.

Duct accessory hardware.

* + - * 1. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

Retain one of two subparagraphs below.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

* + - * 1. Sustainable Design Submittals:
				2. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

Special fittings.

Manual volume damper installations.

Control-damper installations.

Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

Duct security bars.

Retain subparagraph below if equipment includes wiring.

Include diagrams for power, signal, and control wiring.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

Retain "Source quality-control reports" paragraph below if retaining "Source Quality Control" paragraph in "Duct Silencers" Article.

* + - * 1. Source quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fusible Links: Furnish quantity equal to [**10**] <**Insert number**> percent of amount installed.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Comply with NFPA 90A and NFPA 90B.
				2. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
			2. BACKDRAFT AND PRESSURE RELIEF DAMPERS

Copy this article and re-edit for each type of backdraft and pressure relief damper.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Greenheck Fan Corporation.

Lloyd Industries, Inc.

NCA Manufacturing, Inc.

United Enertech.

Approved equivalent.

* + - * 1. Description: Gravity balanced.
				2. Performance:

Maximum Air Velocity: [**1000 fpm**] [**1250 fpm**] [**2000 fpm**] [**3000 fpm**] <**Insert value**>.

Maximum System Pressure: [**1 inch wg**] [**2 inches wg**] [**3 inches wg**] [**6 inches wg**] <**Insert value**>.

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and the manufacturer to have obtained the proper license from AMCA, in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCA 511.**]

Leakage:

Retain "Class IA," "Class I," "Class II," or "Class III" subparagraph below. Energy codes may require a specific damper leakage class and motorized damper operation. If multiple leakage rates are required, retain all applicable subparagraphs, and identify leakage class on Drawings or schedule.

Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.

* + - * 1. Construction:

Frame:

Hat shaped.

[**16-gauge- thick, galvanized sheet steel**] [**10-gauge- thick, galvanized sheet steel**] [**0.093-inch- thick extruded aluminum**] [**18-gauge- thick stainless steel**] <**Insert value and frame material type**>, with welded or mechanically attached corners[**and mounting flange**].

Blades:

Multiple single-piece blades.

[**Center**] [**Off-center**] [**End**] pivoted, maximum 6-inch width, [**16-gauge- thick, galvanized sheet steel**][**0.050-inch- thick aluminum sheet**] [**26-gauge Type 304 stainless steel**] [**noncombustible, tear-resistant, neoprene-coated fiberglass**] <**Insert value and blade material type**> with sealed edges.

Blade Action: Parallel.

* + - * 1. Blade Seals: [**Felt**] [**Vinyl foam**] [**Extruded vinyl, mechanically locked**] [**Neoprene, mechanically locked**].
				2. Blade Axles:

Material: [**Nonferrous metal**] [**Galvanized steel**] [**Plated steel**] [**Stainless steel**] [**Nonmetallic**] [**Aluminum**].

Diameter: [**0.20 inch**] <**Insert dimension**>.

* + - * 1. Tie Bars and Brackets: [**Aluminum**] [**Galvanized steel**].
				2. Return Spring: Adjustable tension.
				3. Bearings: [**Steel ball**] [**Brass sleeve**] [**or**] [**synthetic pivot bushings**].

Energy codes may require a motorized damper actuator. For single-source responsibility, verify availability and retain "Damper Actuator - Electric" or "Damper Actuator - Pneumatic" paragraph below. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Damper Actuator - Electric:

Electric - [**120 V ac**] [**24 V ac**].

UL 873 plenum rated.

[**Two position**] [**Fully modulating**] [**with fail-safe spring return**].

Sufficient motor torque [**and spring torque**]to drive damper fully closed with adequate force to achieve required damper seal.

Minimum 90-degree drive rotation.

Clockwise or counterclockwise drive rotation as required for application.

Environmental Operating Range:

Temperature: Minus 40 to plus 130 deg F.

Humidity: 5 to 95 percent relative humidity noncondensing.

Environmental Enclosure: NEMA 2.

Actuator to be factory mounted and provided with a single-point wiring connection.

* + - * 1. Damper Actuator - Pneumatic:

Operated by 0 to 20 psig pneumatic signal.

[**Two position with**] [**Fully modulating with positioner and**] fail-safe spring return.

Sufficient power and spring force to drive damper fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Actuator to be factory mounted.

* + - * 1. Controllers, Electrical Devices, and Wiring:

Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Electrical Connection: [**115 V, single phase, 60 Hz**] [**24 V, 60 Hz**] <**Insert values**>.

* + - * 1. Accessories:

Retain accessories as needed for application.

Adjustment device to permit setting for varying differential static pressure.

Counterweights and spring-assist kits for vertical airflow installations.

Chain pulls.

Screen Mounting:

[**Front**] [**Rear**] mounted in sleeve.

Sleeve Thickness: 20 gauge minimum.

Sleeve Length: 6 inches minimum.

Screen Material: [**Galvanized steel**] [**Aluminum**].

Screen Type: [**Bird**] [**Insect**].

90-degree stops.

* + - 1. BAROMETRIC RELIEF DAMPERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Cesco Products; a division of MESTEK, Inc.

Greenheck Fan Corporation.

Lloyd Industries, Inc.

NCA Manufacturing, Inc.

United Enertech.

Approved equivalent.

* + - * 1. General Requirements:

Suitable for horizontal or vertical mounting.

Maximum Air Velocity: [**1000 fpm**] [**1250 fpm**] [**2000 fpm**] [**2500 fpm**] <**Insert value**>.

Maximum System Pressure: [**2 inches wg**] [**3 inches wg**] [**6 inches wg**] [**10 inches wg**] <**Insert value**>.

* + - * 1. Construction:

Frame: Hat shaped, [**16-gauge- thick, galvanized sheet steel**] [**13-gauge- thick, galvanized sheet steel**] [**0.093-inch- thick extruded aluminum**] [**18-gauge- thick stainless steel**] [**18-gauge- thick stainless steel**] <**Insert value and frame material type**>, with welded corners or mechanically attached[**and mounting flange**].

Blades:

Multiple, [**16-gauge- thick, galvanized sheet steel**] [**0.050-inch- thick aluminum sheet**] [**26-gauge Type 304 stainless steel**].

Maximum Width: 6 inches.

Action: Parallel.

Balance: Gravity.

[**Eccentrically**] [**Off-center**] [**End**] pivoted.

Blade Seals: [**Vinyl**] [**Neoprene**].

Blade Axles: [**Galvanized steel**] [**Nonferrous metal**] [**Plated steel**] [**Stainless steel**] [**Nonmetallic**].

Tie Bars and Brackets:

Material: [**Aluminum**] [**Galvanized steel**].

Rattle free with 90-degree stop.

Bearings: [**Synthetic**] [**Stainless steel**].

* + - * 1. Pressure Adjustment: Return spring or counter weight with adjustable tension.
				2. Accessories:

Flange on intake.

Adjustment device to permit setting for varying differential static pressures.

<**Insert accessories**>.

* + - 1. MANUAL VOLUME DAMPERS

Indicate dampers on Drawings. If both standard and low-leakage volume dampers are required, identify each damper type on Drawings.

* + - * 1. Standard, Steel, Manual Volume Dampers:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Aire Technologies, Inc.; a DMI company.

Cesco Products; a division of MESTEK, Inc.

Greenheck Fan Corporation.

United Enertech.

Approved equivalent.

Performance:

Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

Construction:

Linkage out of airstream.

Suitable for horizontal or vertical airflow applications.

Frames:

Hat-shaped, [**16-gauge- thick, galvanized sheet steel**] [**18-gauge- thick stainless steel**].

Mitered and welded corners.

Flanges for attaching to walls and flangeless frames for installing in ducts.

Blades:

Multiple or single blade.

Parallel- or opposed-blade design.

Stiffen damper blades for stability.

[**Galvanized**] [**Stainless**] steel; 16 gauge thick.

Blade Axles: [**Galvanized steel**] [**Stainless steel**] [**Nonferrous metal**].

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Oil-impregnated stainless steel sleeve**] [**Stainless steel sleeve**].

Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

Tie Bars and Brackets: Galvanized steel.

Locking device to hold damper blades in a fixed position without vibration.

Retain "Standard, Aluminum, Manual Volume Dampers" paragraph below for aluminum ducts. Coordinate with "Installation" Article and Section 233113 "Metal Ducts."

* + - * 1. Standard, Aluminum, Manual Volume Dampers:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Cesco Products; a division of MESTEK, Inc.

McGill AirFlow LLC.

RoofGoose Vent.

United Enertech.

Approved equivalent.

Performance:

Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

Construction:

Linkage out of airstream.

Suitable for horizontal or vertical airflow applications.

Frames:

Hat-shaped, 0.10-inch- thick, aluminum sheet channels.

Flanges for attaching to walls and flangeless frames for installing in ducts.

Blades:

Multiple or single blade.

Parallel- or opposed-blade design.

Stiffen damper blades for stability.

Retain "Roll-Formed Aluminum Blades" or "Extruded-Aluminum Blades" subparagraph below.

Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

Blade Axles: [**Galvanized steel**] [**Stainless steel**] [**Nonferrous metal**].

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Stainless steel sleeve**].

Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

Tie Bars and Brackets: Aluminum.

Locking device to hold damper blades in a fixed position without vibration.

* + - * 1. Low-Leakage, Steel, Manual Volume Dampers:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Greenheck Fan Corporation.

Lloyd Industries, Inc.

United Enertech.

Approved equivalent.

Performance:

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and manufacturer to have obtained the proper license from AMCA in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCA 511.**]

Leakage:

Retain "Class IA," "Class I," or "Class II" subparagraph below. Energy codes may require a specific damper leakage class. If multiple leakage rates are required, retain all applicable subparagraphs, and identify leakage class on Drawings or schedule.

Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

Construction:

Linkage: Out of airstream.

Suitable for horizontal or vertical airflow applications.

Frames:

Hat, U, or angle shaped.

Thickness: [**16-gauge galvanized sheet steel**] [**18-gauge stainless steel**].

Mitered and welded corners.

Flanges for attaching to walls and flangeless frames for installing in ducts.

Blades:

Multiple or single blade.

Parallel- or opposed-blade design.

Stiffen damper blades for stability.

[**Galvanized**] [**Stainless**], roll-formed steel; 16 gauge thick.

Blade Edging Seals:

Retain one of first two subparagraphs below.

[**Closed-cell neoprene**] [**PVC**].

Inflatable seal blade edging or replaceable rubber seals.

Blade Jamb Seals: [**Flexible metal compression type**] [**Felt**] [**Vinyl**] [**Neoprene**].

Blade Axles: [**Galvanized steel**] [**Stainless steel**] [**Nonferrous metal**].

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Oil-impregnated stainless steel sleeve**] [**Stainless steel sleeve**].

Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

Tie Bars and Brackets: [**Galvanized steel**] [**Aluminum**].

Locking device to hold damper blades in a fixed position without vibration.

Retain "Low-Leakage, Aluminum, Manual Volume Dampers" paragraph below for aluminum ducts. Coordinate with "Installation" Article and Section 233113 "Metal Ducts."

* + - * 1. Low-Leakage, Aluminum, Manual Volume Dampers:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Lloyd Industries, Inc.

McGill AirFlow LLC.

United Enertech.

Approved equivalent.

Performance:

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and manufacturer to have obtained the proper license from AMCA, in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCA 511.**]

Leakage:

Retain "Class IA," "Class I," or "Class II" subparagraph below. Energy codes may require a specific damper leakage class. If multiple leakage rates are required, retain all applicable subparagraphs, and identify leakage class on Drawings or schedule.

Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

Construction:

Linkage out of airstream.

Suitable for horizontal or vertical airflow applications.

Frames:

Hat, U, or angle shaped.

Thickness: 0.08-inch aluminum sheet channels.

Flanges for attaching to walls and flangeless frames for installing in ducts.

Blades:

Multiple or single blade.

Parallel- or opposed-blade design.

Retain "Roll-Formed Aluminum Blades" or "Extruded-Aluminum Blades" subparagraph below.

Roll-Formed Aluminum Blades:0.072-inch thick aluminum sheet.

Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

Blade Edging Seals:

Retain one of two first subparagraphs below.

[**Closed-cell neoprene**] [**PVC**].

Inflatable seal blade edging or replaceable rubber seals.

Blade Jamb Seals: [**Flexible metal compression type**] [**Felt**] [**Vinyl**] [**Neoprene**].

Blade Axles: [**Galvanized steel**] [**Stainless steel**] [**Nonferrous metal**].

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Oil-impregnated stainless steel sleeve**] [**Stainless steel sleeve**].

Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

Tie Bars and Brackets: [**Galvanized steel**] [**Aluminum**].

Locking device to hold damper blades in a fixed position without vibration.

* + - * 1. Jackshaft:

Size: [**0.5-inch**] [**1-inch**] diameter.

Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

* + - * 1. Damper Hardware:

Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.

Include center hole to suit damper operating-rod size.

Include elevated platform for insulated duct mounting.

* + - 1. CONTROL DAMPERS

Retain this article if motorized volume-control dampers are not specified in Section 230923.12 "Control Dampers."

If multiple control-damper types are required, copy this article and re-edit for each type; assign each type a drawing designation, and indicate each type on Drawings.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Greenheck Fan Corporation.

Lloyd Industries, Inc.

McGill AirFlow LLC.

United Enertech.

Approved equivalent.

* + - * 1. General Requirements:

Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.

Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

* + - * 1. Performance:

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and manufacturer to have obtained the proper license from AMCA, in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCA 511.**]

Leakage:

Retain "Class IA," "Class I," "Class II," or "Class III" subparagraph below. Energy codes may require a specific damper leakage class and motorized damper operation. If multiple leakage rates are required, retain all applicable subparagraphs, and identify leakage class on Drawings or schedule.

Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.

Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.

Velocity: Up to [**3000 fpm**] <**Insert velocity**>.

Temperature: Minus 25 to plus 180 deg F.

Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

* + - * 1. Construction:

Linkage out of airstream.

Suitable for horizontal or vertical airflow applications.

Frames:

Hat, U, or angle shaped.

[**0.08-inch- thick extruded aluminum**] [**16-gauge- thick, galvanized sheet steel**] [**18-gauge- thick stainless steel**].

[**Mitered and welded**] [**Interlocking, gusseted**] corners.

Flanges for attaching to walls and flangeless frames for installing in ducts.

Blades:

Multiple blade with maximum blade width of [**6 inches**] [**8 inches**].

If retaining multiple options in first subparagraph below, indicate location of each on Drawings.

[**Parallel**] [**Opposed**]-blade design.

[**Galvanized steel**] [**Stainless steel**] [**Aluminum**].

[**16-gauge- thick single skin**] [**or**] [**14-gauge- thick air foil dual skin**].

Blade Edging Seals:

Retain one of first two subparagraphs below.

Replaceable [**Closed-cell neoprene**] [**PVC**].

Inflatable seal blade edging, or replaceable rubber seals.

Blade Jamb Seal: Flexible stainless steel, compression type.

Blade Axles: 1/2-inch diameter; [**galvanized**] [**stainless**] steel.

Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Oil-impregnated stainless steel sleeve**] [**Stainless steel sleeve**].

Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

For single-source responsibility, verify availability and retain "Damper Actuator - Electric" or "Damper Actuator - Pneumatic" paragraph below. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Damper Actuator - Electric:

Electric - [**120 V ac**] [**24 V ac**].

UL 873, plenum rated.

[**Two position**] [**Fully modulating**] [**with fail-safe spring return**].

Sufficient motor torque [**and spring torque**]to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Minimum 90-degree drive rotation.

Clockwise or counterclockwise drive rotation as required for application.

Environmental Operating Range:

Temperature: Minus 40 to plus 130 deg F.

Humidity: 5 to 95 percent relative humidity noncondensing.

Environmental enclosure: NEMA 2.

Actuator to be factory mounted and provided with a single-point wiring connection.

* + - * 1. Damper Actuator - Pneumatic:

Operated by 0 to 20 psig pneumatic signal.

[**Two position with**] [**Fully modulating with positioner and**] fail-safe spring return.

Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Actuator to be factory mounted.

* + - * 1. Controllers, Electrical Devices, and Wiring:

Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Electrical Connection: [**115 V, single phase, 60 Hz**] [**24 V, 60 Hz**] <**Insert values**>.

* + - 1. FIRE DAMPERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

Greenheck Fan Corporation.

United Enertech.

Approved equivalent.

If both types of dampers are required in "Type" paragraph below, indicate location of each on Drawings.

* + - * 1. Type: [**Static**] [**and**] [**dynamic**]; rated and labeled in accordance with UL 555 by an NRTL.

Retain first paragraph below for dynamic fire dampers.

* + - * 1. Closing rating in ducts up to [**4-inch wg**] <**Insert value**> static pressure class and minimum [**2000 fpm**] <**Insert value**> velocity.

If both 1-1/2- and 3-hour ratings are required in "Fire Rating" paragraph below, indicate location of each rating on Drawings.

* + - * 1. Fire Rating: [**1-1/2**] [**and**] [**3**] hours.

Type 304 stainless steel dampers are available for corrosive atmospheres.

* + - * 1. Frame: [**Curtain type with blades inside airstream**] [**Curtain type with blades outside airstream**] [**Multiple-blade type**] [**Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream**]; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
				2. Mounting Sleeve: Factory- or field-installed, [**galvanized sheet**] [**stainless**] steel; gauge in accordance with UL listing.
				3. Mounting Orientation: Vertical or horizontal as indicated.
				4. Blades: Roll-formed [**galvanized sheet steel**] [**stainless steel**], [**interlocking**] [**full-length steel blade connectors**]. Material gauge is to be in accordance with UL listing.

Not all manufacturers use blade locks for horizontal units.

* + - * 1. Horizontal Dampers: Include blade lock and stainless steel closure spring.
				2. Heat-Responsive Device:

Retain one of two subparagraphs below. If multiple temperature ratings are required, indicate location of each heat-responsive-device rating on Drawings.

Replaceable, [**165 deg F**] [**212 deg F**] <**Insert temperature**> rated, fusible links.

[**Electric**] [**Pneumatic**], [**resettable**] [**replaceable**] link and switch package, factory installed, [**165 deg F**] [**and**] [**212 deg F**] <**Insert temperature**> rated.

* + - 1. CEILING RADIATION DAMPERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Aire Technologies, Inc.; a DMI company.

Greenheck Fan Corporation.

United Enertech.

Approved equivalent.

* + - * 1. General Requirements:

Labeled according to UL 555C by an NRTL.

Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

* + - * 1. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction; gauge in accordance with UL listing.
				2. Blades: Galvanized sheet steel with refractory insulation; gauge in accordance with UL listing.

If multiple temperature ratings are required in "Heat-Responsive Device" paragraph below, indicate location of each heat-responsive-device rating on Drawings.

* + - * 1. Heat-Responsive Device: Replaceable, [**165 deg F**] [**212 deg F**] <**Insert temperature**> rated, fusible links.

UL has classified many damper designs ranging from 1/2 to 5 hours. Common values are included in "Fire Rating" paragraph below. Select damper to match specific ceiling system. If multiple ratings are required, indicate location of each heat-responsive-device rating on Drawings.

* + - * 1. Fire Rating: [**1**] [**2**] [**3**] <**Insert number**> hour(s).
			1. SMOKE DAMPERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Aire Technologies, Inc.; a DMI company.

CL WARD & Family Inc.

Greenheck Fan Corporation.

United Enertech.

Approved equivalent.

* + - * 1. General Requirements:

Label to indicate conformance to UL 555 and UL 555S by an NRTL.

Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.

Unless otherwise indicated, use parallel-blade configuration.

Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

Factory install damper actuator by damper manufacturer as integral part of damper assembly. Coordinate actuator location, mounting, and electrical requirements with damper manufacturer.

* + - * 1. Performance:

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and manufacturer to have obtained the proper license from AMCA, in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCA Publication 511.**]

Leakage:

Retain "Class IA," "Class I," or "Class II" subparagraph below. NFPA establishes maximum smoke damper leakage not to exceed Class II. Energy codes may require a specific damper leakage Class.

Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.

Velocity: Up to [**3000 fpm**] <**Insert velocity**>.

Temperature: Minus 25 to plus 180 deg F.

Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

* + - * 1. Construction:

Suitable for horizontal or vertical airflow applications.

Linkage out of airstream.

Frame:

Hat shaped.

[**Galvanized sheet steel**] [**Stainless steel**], with [**welded**] [**interlocking, gusseted**] [**or**] [**mechanically attached**] corners[**and mounting flange**].

Gauge in accordance with UL listing.

Vertical blades are available for special applications.

Blades:

Roll-formed, horizontal, [**v-groove**] [**airfoil**], [**galvanized sheet steel**] [**stainless steel**] [**extruded aluminum**].

Maximum width and gauge in accordance with UL listing.

Blade Edging Seals:

Silicone rubber.

Blade Jamb Seal: Flexible stainless steel, compression type.

Blade Axles: 1/2-inch diameter; [**galvanized steel**] [**stainless steel**]; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Oil-impregnated stainless steel sleeve**] [**Stainless steel sleeve**].

Retain "Mounting Sleeve" paragraph below if mounting sleeve is required.

* + - * 1. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application[**with factory-furnished silicone caulking**]; gauge in accordance with UL listing.

NFPA requires motorized damper actuator to be factory installed on all smoke dampers. Retain "Damper Actuator - Electric" or "Damper Actuator - Pneumatic" paragraph below and coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Damper Actuator - Electric:

Electric - [**120 V ac**] [**24 V ac**].

UL 873, plenum rated.

Designed to operate in smoke-control systems complying with UL 555S requirements.

[**Two position**] [**Fully modulating**] with fail-safe spring return.

Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Minimum 90-degree drive rotation.

Clockwise or counterclockwise drive rotation as required for application.

Environmental Operating Range:

Temperature: Minus 40 to plus 130 deg F.

Humidity: 5 to 95 percent relative humidity noncondensing.

Environmental Enclosure: NEMA 2.

Actuator to be factory mounted and provided with single-point wiring connection.

* + - * 1. Damper Actuator - Pneumatic:

Operated by 0 to 20 psig pneumatic signal.

Designed to operate in smoke-control systems complying with UL 555S requirements.

[**Two position with**] [**Fully modulating with positioner and**] fail-safe spring return.

Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Actuator to be factory mounted.

* + - * 1. Controllers, Electrical Devices, and Wiring:

Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Electrical Connection: [**115 V, single phase, 60 Hz**] [**24 V, 60 Hz**] <**Insert values**>.

* + - * 1. Accessories:

Retain applicable features in subparagraphs below.

Auxiliary switches for [**signaling**] [**fan control**] [**or**] [**position indication**].

[**Momentary test switch**] [**Test and reset switches**], [**damper**] [**remote**] mounted.

Retain "Smoke Detector" subparagraph below if smoke damper is to be provided with integral smoke detector.

Smoke Detector: Integral, factory wired for single-point connection.

* + - 1. COMBINATION FIRE AND SMOKE DAMPERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

Greenheck Fan Corporation.

United Enertech.

Approved equivalent.

* + - * 1. General Requirements:

Label to indicate conformance to UL 555 and UL 555S by an NRTL.

Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.

Unless otherwise indicated, use parallel-blade configuration.

Available combination fire and smoke dampers include automatic-reopening types and types with electrothermal links that require link replacement after activation. Manufacturers offer additional features for engineered smoke-control system dampers.

* + - * 1. Closing rating in ducts up to [**4-inch wg**] <**Insert value**> static pressure class and minimum [**2000 fpm**] <**Insert value**> velocity.

If both 1-1/2- and 3-hour ratings are required in "Fire-Rating" paragraph below, indicate location of each rating on Drawings.

* + - * 1. Fire Rating: [**1-1/2**] [**and**] [**3**] hours.
				2. Performance:

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and manufacturer to have obtained the proper license from AMCA, in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCE Publication 511.**]

Leakage:

Retain "Class IA," "Class I," or "Class II" subparagraph below. NFPA establishes maximum smoke damper leakage not to exceed Class II. Energy codes may require a specific damper leakage class.

Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

Pressure Drop: 0.05 in. wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.

Velocity: Up to 3000 fpm.

Temperature: Minus 25 to plus 180 deg F.

Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

Type 304 stainless steel dampers are available for corrosive atmospheres.

* + - * 1. Construction:

Suitable or horizontal or vertical airflow applications.

Linkage out of airstream.

Frame:

Hat shaped.

[**Galvanized sheet steel**] [**Stainless steel**], with [**welded**] [**interlocking, gusseted**] [**or**] [**mechanically attached**] corners[**and mounting flange**].

Gauge is to be in accordance with UL listing.

Blades:

Roll-formed, horizontal, [**v-groove**] [**airfoil**], [**galvanized sheet steel**] [**stainless steel**] [**extruded aluminum**].

Maximum width and gauge in accordance with UL listing.

Blade Edging Seals:

Silicone rubber.

Blade Jamb Seal: Flexible stainless steel, compression type.

Blade Axles: 1/2-inch- diameter; [**galvanized steel**] [**stainless steel**]; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.

Bearings:

[**Oil-impregnated bronze**] [**Molded synthetic**] [**Oil-impregnated stainless steel sleeve**] [**Stainless steel sleeve**].

Retain "Mounting Sleeve" paragraph below if mounting sleeve is required.

* + - * 1. Mounting Sleeve:

Factory installed, galvanized sheet steel.

Length to suit wall or floor application[**with factory-furnished silicone caulking**].

Gauge in accordance with UL listing.

* + - * 1. Heat-Responsive Device:

Retain one of two subparagraphs below for either fusible or resettable links.

Retain one of two temperature options in first subparagraph below for temperature-rated links to suit application requirements. Second option is standard.

[**Resettable**] [**Replaceable**], [**165 deg F**] [**212 deg F**] rated, [**fusible links**] [**fire-closure device**].

[**Electric**] [**Pneumatic**] resettable [**link**] [**device**] and switch package, factory installed, rated.

Coordinate master control panel with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Master control panel for use in dynamic smoke-management systems.

NFPA requires motorized damper actuator to be factory installed on all smoke dampers. Retain "Damper Actuator - Electric" or "Damper Actuator - Pneumatic" paragraph below and coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Damper Actuator - Electric:

Electric - [**120 V ac**] [**24 V ac**].

UL 873, plenum rated.

Designed to operate in smoke-control systems complying with UL 555S requirements.

[**Two position**] [**Fully modulating**] with fail-safe spring return.

Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Minimum 90-degree drive rotation.

Clockwise or counterclockwise drive rotation as required for application.

Environmental Operating Range:

Temperature: Minus 40 to plus 130 deg F.

Humidity: 5 to 95 percent relative humidity noncondensing.

Environmental Enclosure: NEMA 2.

Actuator to be factory mounted and provided with single-point wiring connection.

* + - * 1. Damper Actuator - Pneumatic:

Operated by 0 to 20 psig pneumatic signal.

Designed to operate in smoke control systems complying with UL 555S requirements.

[**Two position with**] [**Fully modulating with positioner and**] fail-safe spring return.

Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Actuator to be factory mounted.

* + - * 1. Controllers, Electrical Devices, and Wiring:

Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Electrical Connection: [**115 V, single phase, 60 Hz**] [**24 V, 60 Hz**] <**Insert values**>.

* + - * 1. Accessories:

Retain applicable features in subparagraphs below.

Auxiliary switches for [**signaling**] [**fan control**] [**or**] [**position indication**].

[**Momentary test switch**] [**Test and reset switches**], [**damper**] [**remote**] mounted.

* + - 1. CORRIDOR DAMPERS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Cesco Products; a division of MESTEK, Inc.

Ruskin Company.

United Enertech.

Approved equivalent.

* + - * 1. General Requirements:

Label to indicate conformance to UL 555 and UL 555S by an NRTL.

Label to indicate conformance to NFPA 90A by an NRTL.

* + - * 1. Closing rating in ducts up to [**4-inch wg**] <**Insert value**> static pressure class and minimum [**2000 fpm**] <**Insert value**> velocity.
				2. Fire Rating: [**1**] [**1-1/2**] [**2**] hours.
				3. Performance:

"AMCA Certification" subparagraph below requires test results to be verified by AMCA staff and manufacturer to have obtained the proper license from AMCA, in order for the products to bear AMCA's Certified Ratings Seal for air performance, air leakage, or both. Consult manufacturers.

[**AMCA Certification: Test and rate in accordance with AMCA Publication 511.**]

Leakage:

Retain "Class IA," "Class I," or "Class II" subparagraph below. NFPA establishes maximum smoke damper leakage not to exceed Class II. Energy codes may require certain dampers to maintain low leakage.

Class 1A: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.

Class 1: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

* + - * 1. Construction:

Frame: Hat shaped, galvanized sheet steel, with [**welded**] [**interlocking, gusseted**] [**or**] [**mechanically attached**] corners[**and mounting flange**]; gauge in accordance with UL listing.

Vertical blades are available for special applications.

Blades: Roll-formed, horizontal, [**interlocking**] [**overlapping**], galvanized sheet steel; gauge in accordance with UL listing.

Retain "Mounting Sleeve" paragraph if mounting sleeve is required.

* + - * 1. Mounting Sleeve:

Factory installed, galvanized sheet steel.

Length to suit wall or floor application[**with factory-furnished silicone caulking**].

Gauge in accordance with UL listing.

* + - * 1. Heat-Responsive Device:

Retain one of two subparagraphs below for either fusible or resettable links.

Retain one of two temperature options in first subparagraph below for temperature-rated links to suit application requirements. Second option is standard.

[**Resettable**] [**Replaceable**], [**165 deg F**] [**212 deg F**] rated, [**fusible links**] [**fire-closure device**].

[**Electric**] [**Pneumatic**] resettable [**link**] [**device**] and switch package, factory installed, rated.

NFPA requires motorized damper actuator to be factory installed on all smoke dampers. Retain "Damper Actuator - Electric" or "Damper Actuator - Pneumatic" paragraph below. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Damper Actuator - Electric:

Electric - [**120 V ac**] [**24 V ac**].

UL 873, plenum rated.

Designed to operate in smoke-control systems complying with UL 555S requirements.

Two position with fail-safe spring return.

Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Minimum 90-degree drive rotation.

Clockwise or counterclockwise drive rotation as required for application.

Environmental Operating Range:

Temperature: Minus 40 to plus 130 deg F.

Humidity: 5 to 95 percent relative humidity noncondensing.

Environmental enclosure: NEMA 2.

Actuator to be factory mounted and provided with single-point wiring connection.

* + - * 1. Damper Actuator - Pneumatic:

Operated by 0 to 20 psig pneumatic signal.

Designed to operate in smoke-control systems complying with UL 555S requirements.

Two position with fail-safe spring return.

Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.

Maximum 15-second full-stroke closure.

Actuator to be factory mounted.

* + - * 1. Controllers, Electrical Devices, and Wiring:

Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Electrical Connection: [**115 V, single phase, 60 Hz**] [**24 V, 60 Hz**] <**Insert values**>.

* + - * 1. Accessories:

Retain applicable features in subparagraphs below.

Auxiliary switches for [**signaling**] [**fan control**] [**or**] [**position indication**].

[**Momentary test switch**] [**Test and reset switches**], [**damper**] [**remote**] mounted.

* + - 1. FLANGE CONNECTORS

If permitted by authorities having jurisdiction, flange connectors can substitute for slip-and-drive connections for smoke dampers.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

Ductmate Industries, Inc; a DMI company.

Approved equivalent.

* + - * 1. Description: [**Add-on**] [**or**] [**roll-formed**], factory fabricated, slide-on transverse flange connectors, gaskets, and components.
				2. Material: Galvanized steel.
				3. Gauge and Shape: Match connecting ductwork.
			1. DUCT SILENCERS

Duct silencers may be required in some acoustic applications. With testing-verified performance, they can attenuate sound better than many duct design features for which performance is only approximated. See the Evaluations.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

McGill AirFlow LLC.

Price Industries.

Ruskin Company.

Approved equivalent.

* + - * 1. General Requirements:

Factory fabricated.

Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

Retain subparagraph below if selected silencers bear AMCA Certified Rating Seal.

Bearing AMCA's Certified Ratings Seal for prefabricated silencer sound and air performance.

* + - * 1. Shape:

Rectangular straight with splitters or baffles.

Round straight with center bodies or pods.

Rectangular elbow with splitters or baffles.

Round elbow with center bodies or pods.

Rectangular transitional with splitters or baffles.

* + - * 1. Rectangular Silencer Outer Casing: ASTM A653, [**G90**] [**G60**], galvanized sheet steel, [**0.034 inch**] [**0.040 inch**] <**Insert dimension**> thick.
				2. Round Silencer Outer Casing: ASTM A653, [**G90**] [**G60**], galvanized sheet steel.

Sheet Metal Thickness for Units up to 24 Inches in Diameter: [**22 gauge**] <**Insert value**> thick.

Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: [**20 gauge**] <**Insert value**> thick.

Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: [**18 gauge**] <**Insert value**> thick.

Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: [**16 gauge**] <**Insert value**> thick.

* + - * 1. Inner Casing and Baffles: ASTM A653, [**G90**] [**G60**] galvanized sheet metal, [**22 gauge**] <**Insert value**> thick, and with [**1/8-inch-**] <**Insert dimension**> diameter perforations.
				2. Special Construction:

Suitable for outdoor use.

High transmission loss[**to achieve STC 45**] <**Insert value**>.

* + - * 1. Connection Sizes: Match connecting ductwork unless otherwise indicated.
				2. Principal Sound-Absorbing Mechanism:

Controlled impedance membranes and broadly tuned resonators without absorptive media.

[**Dissipative**] [**Film-lined**] type with fill material.

Fill Material: [**Inert and vermin-proof fibrous material, packed under not less than 5 percent compression**] [**Inert and vermin-proof fibrous material, packed under not less than 15 percent compression**] [**Moisture-proof nonfibrous material**].

Erosion Barrier: Polymer bag enclosing fill, heat-sealed before assembly.

In "Lining" subparagraph below, Mylar and Tedlar are brand names of products manufactured by E.I. du Pont de Nemours and Co.

Lining: [**None**] [**Mylar**] [**Tedlar**] [**Fiberglas cloth**] <**Insert material**>.

* + - * 1. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

Joints: [**Lock formed and sealed**] [**Continuously welded**] [**or**] [**flanged connections**].

Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.

Reinforcement: Cross or trapeze angles for rigid suspension.

* + - * 1. Accessories:

If multiple ratings are required in first subparagraph below, indicate location of each rating on Drawings.

Integral [**1-1/2**] [**3**]-hour fire damper with access door.[**Access door to be high transmission loss to match silencer.**]

Factory-installed end caps to prevent contamination during shipping.

Removable splitters.

Airflow-measuring devices.

* + - * 1. Source Quality Control:

Test in accordance with ASTM E477.

Testing [**of mockups**]to be witnessed by [**Architect**] [**Director’s Representative**].

Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least [**2000 fpm**] <**Insert value**> face velocity.

Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or [**6-inch wg**] <**Insert value**> static pressure, whichever is greater.

If Project has more than one type or configuration of duct silencer, delete "Capacities and Characteristics" paragraph below and schedule this information for each duct silencer on Drawings.

* + - * 1. Capacities and Characteristics:

Configuration: [**Straight**] [**90-degree elbow**] <**Insert configuration**>.

Shape: [**Rectangular**] [**Round**].

Attenuation Mechanism: [**Acoustical glass fiber**] [**Acoustical glass fiber with protective film liner**] [**Helmholtz resonator mechanism with no internal media**].

Maximum Pressure Drop: [**0.35 inch wg**] <**Insert value**>.

Casing:

Attenuation: [**Standard**] [**High transmission loss**].

Outer Material: [**Galvanized steel**] [**Stainless steel**] [**Aluminum**].

Inner Material: [**Galvanized steel**] [**Stainless steel**] [**Aluminum**].

Velocity Range: <**Insert fps**> to <**Insert fps**>.

End Connection: [**1-inch slip joint**] [**Flange**].

Length: <**Insert inches**>.

Face Dimension:

Width: <**Insert inches**>.

Height: <**Insert inches**>.

Face Velocity: <**Insert fpm**>.

Dynamic Insertion Loss: <**Insert dBA**>.

Generated Noise: <**Insert dBA**>.

Accessories:

Access door.

Birdscreen.

* + - 1. TURNING VANES
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Aero-Dyne Sound Control Co.

CL WARD & Family Inc.

Ductmate Industries, Inc; a DMI company.

Approved equivalent.

Retain "Manufactured Turning Vanes for Metal Ducts" and "Manufactured Turning Vanes for Nonmetal Ducts" paragraphs below for manufactured turning vanes. Delete for turning vanes fabricated by Installer.

* + - * 1. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

* + - * 1. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
				2. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
				3. Vane Construction:

Retain one of two subparagraphs below.

[**Single**] [**Double**] wall.

Single wall for ducts up to [**48 inches**] <**Insert dimension**> wide and double wall for larger dimensions.

* + - 1. REMOTE DAMPER OPERATORS
				1. Manufacturers: Subject to compliance with requirements, provide products by the following:

United Enertech.

Approved equivalent.

* + - * 1. Description: Cable system designed for remote manual damper adjustment.
				2. Tubing: [**Brass**] [**Copper**] [**Aluminum**].
				3. Cable: [**Stainless steel**] [**Steel**].
				4. Wall-Box Mounting: [**Recessed**] [**Surface**].
				5. Wall-Box Cover-Plate Material: [**Steel**] [**Stainless steel**].
			1. DUCT-MOUNTED ACCESS DOORS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

Ductmate Industries, Inc; a DMI company.

United Enertech.

Approved equivalent.

* + - * 1. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

Door:

Double wall, rectangular.

Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

[**24-gauge- thick galvanized steel**] [**or**] [**0.032-inch thick aluminum**] [**or**] [**24-gauge- thick stainless steel**] <**Insert value**> door panel.

Vision panel.

Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.

Fabricate doors airtight and suitable for duct pressure class.

Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

24-gauge- thick galvanized steel or 0.032-inch- thick aluminum <**Insert value**> frame.

Number of Hinges and Locks:

Access Doors Less Than 12 Inches Square: No hinges and two sash locks.

Access Doors up to [**18 Inches**] Square: [**Two hinges**] [**Continuous**] and two sash locks.

Access Doors up to 24 by 48 Inches: [**Three hinges**] [**Continuous**] and two compression latches[**with outside and inside handles**].

Access Doors Larger Than 24 by 48 Inches: [**Four hinges**] [**Continuous**] and two compression latches with outside and inside handles.

* + - * 1. Pressure Relief Access Door:

Door and Frame Material: Galvanized sheet steel.

[**24-gauge- thick galvanized steel**] [**or**] [**0.032?inch- thick aluminum**] [**or**] [**24-gauge- thick stainless steel**] <**Insert value**> door panel.

Door: [**Single wall**] [**Double wall with insulation fill**] with metal thickness applicable for duct pressure class.

Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

Retain first subparagraph below if pressure is not indicated on Drawings.

Factory set at [**3.0 to 8.0 inches wg**] [**10 inches wg**] <**Insert value**>.

Doors close when pressures are within set-point range.

Hinge: Continuous piano.

Latches: Cam.

Seal: Neoprene or foam rubber.

Insulation Fill: [**1-inch-**] <**Insert dimension**> thick, fibrous-glass or polystyrene-foam board.

* + - 1. DUCT ACCESS PANEL ASSEMBLIES

Retain this article for access panels in fire-rated duct systems, such as exhaust ducts for commercial kitchen hoods.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

Ductmate Industries, Inc; a DMI company.

Approved equivalent.

* + - * 1. Access panels used in cooking applications:

Labeled compliant to NFPA 96 for grease duct access doors.

Labeled in accordance with UL 1978 by an NRTL.

* + - * 1. Panel and Frame: Minimum thickness [**16-gauge carbon**] [**16-gauge stainless**] <**Insert value and steel type**> steel.
				2. Fasteners: [**Carbon**] [**Stainless**] steel. Panel fasteners shall not penetrate duct wall.
				3. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
				4. Minimum Pressure Rating: [**10 inches wg**] <**Insert value**> positive or negative.
			1. FLEXIBLE CONNECTORS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

Ductmate Industries, Inc; a DMI company.

DynAir; a Carlisle Company.

Approved equivalent.

* + - * 1. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
				2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
				3. Materials: Flame-retardant or noncombustible fabrics.
				4. Coatings and Adhesives: Comply with UL 181, Class 1.

Coordinate first five paragraphs below with "Installation" Article. Delete "Metal-Edged Connectors" paragraph if Contractor is allowed to shop fabricate metal-edged connector or if metal-edged connector is not necessary.

* + - * 1. Metal-Edged Connectors: Factory fabricated with a fabric strip [**3-1/2 inches**] [**5-3/4 inches**] <**Insert dimension**> wide attached to two strips of 2-3/4-inch- wide, [**0.028-inch-**] <**Insert dimension**> thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

Connector fabric in "Indoor System, Flexible Connector Fabric" paragraph below is unsuitable for exposure to sun, weather, or corrosive environments. It is suitable for system temperatures from minus 10 to plus 200 deg F (minus 23 to plus 93 deg C).

* + - * 1. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

Minimum Weight: [**26 oz./sq. yd.**]<**Insert value**>.

Tensile Strength: 480 lbf/inch in the warp and [**360 lbf/inch**] <**Insert value**> in the filling.

Service Temperature: Minus 40 to plus 200 deg F.

Connector fabric in "Outdoor System, Flexible Connector Fabric" paragraph below is suitable for exposure to sun, weather, and system temperatures from minus 10 to plus 250 deg F (minus 23 to plus 121 deg C).

* + - * 1. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

Minimum Weight: [**24 oz./sq. yd.**] <**Insert value**>.

Tensile Strength: 530 lbf/inch in the warp and [**440 lbf/inch**] <**Insert value**> in the filling.

Service Temperature: Minus 50 to plus 250 deg F.

Connectors in "High-Temperature System, Flexible Connectors" paragraph below are suitable for system temperatures from minus 25 to plus 500 deg F (minus 32 to plus 260 deg C).

* + - * 1. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

Minimum Weight: [**16 oz./sq. yd.**] <**Insert value**>.

Tensile Strength: 285 lbf/inch in the warp and [**185 lbf/inch**] <**Insert value**> in the filling.

Service Temperature: Minus 67 to plus 500 deg F.

Connectors in "High-Corrosive-Environment System, Flexible Connectors" paragraph below are suitable for systems handling corrosive gases with temperatures from minus 20 to plus 500 deg F (minus 29 to plus 260 deg C).

* + - * 1. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

Minimum Weight: [**14 oz./sq. yd.**] <**Insert value**>.

Tensile Strength: 450 lbf/inch in the warp and [**340 lbf/inch**] <**Insert value**> in the filling.

Service Temperature: Minus 67 to plus 500 deg F.

Retain "Thrust Limits" paragraph below for flexible connection at high-pressure fan discharge.

* + - * 1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

Minimum Additional Travel: 50 percent of the required deflection at rated load.

Lateral Stiffness: More than 80 percent of rated vertical stiffness.

Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

Elastomeric Element: Molded, oil-resistant rubber or neoprene.

Coil Spring: Factory set and field adjustable for a maximum of [**1/4-inch**] <**Insert dimension**> movement at start and stop.

* + - 1. DUCT SECURITY BARS

Indicate location of duct security bars on Drawings and detail their design and mounting regardless of field or factory fabrication. Note that this Section does not include security registers or security grilles. See Section 233713.43 "Security Registers and Grilles."

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Price Industries.

United Enertech.

Approved equivalent.

* + - * 1. Description: [**Field-fabricated**] [**Factory-fabricated and field-installed**] [**Field- or factory-fabricated and field-installed**] duct security bars.
				2. Configuration:

[**Flat frame of 2 by 1/4 inch**] [**Angle frame of 2-1/2 by 2-1/2 by 1/4 inch**] <**Insert values**>.

Sleeve: [**0.1345-inch**] [**3/16-inch**] <**Insert size**>, [**continuously welded**] [**bent**] steel frames with [**1-by-1-by-3/16-inch**] [**1-1/2-by-1-1/2-by-1/8-inch**] <**Insert size**> angle frame [**factory welded to one end**] [**furnished loose for field welding on other end**]. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.

Horizontal Bars: [**1/2 inch**] [**2 by 1/4 inch**] <**Insert dimensions**>.

Vertical Bars: [**1/2 inch**] [**3/4 inch**] [**1 inch**] [**2 by 1/4 inch**] <**Insert dimension(s)**>.

Bar Spacing: [**6 inches**] <**Insert dimension**>.

Mounting: [**Metal deck or roofing**] [**Bolted or welded**] [**Bolted or welded with masonry anchors**] [**Ductwork or other framing**] [**Poured in place or set with concrete block**] [**Welded or bolted to one wall (one side only**] [**Bar extends 6 inches into wall**].

* + - 1. DUCT ACCESSORY HARDWARE
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

CL WARD & Family Inc.

United Enertech.

Approved equivalent.

* + - * 1. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
				2. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
			1. MATERIALS
				1. Galvanized Sheet Steel: Comply with ASTM A653.

Galvanized Coating Designation: [**G60**] [**G90**].

Exposed-Surface Finish: Mill phosphatized.

* + - * 1. Stainless Steel Sheets: Comply with ASTM A480, Type 304, and having a [**No. 2**] <**Insert finish designation**> finish for concealed ducts and <**Insert finish designation**> finish for exposed ducts.
				2. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
				3. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
				4. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
				5. Tie Rods: Galvanized steel, [**1/4-inch**] <**Insert dimension**> minimum diameter for lengths 36 inches or less; [**3/8-inch**] <**Insert dimension**> minimum diameter for lengths longer than 36 inches.
1. EXECUTION
	* + 1. INSTALLATION
				1. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
				2. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

Compliance with ASHRAE/IES 90.1 restricts the use of nonmotorized backdraft dampers and requires motorized control dampers for specific types of applications.

* + - * 1. Install [**backdraft**] [**control**] dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
				2. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

To minimize duct noise generated by volume dampers, SMACNA recommends locating dampers at least two duct diameters from fittings and as far away as possible from outlets.

* + - * 1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

Coordinate subparagraphs below with Section 233113 "Metal Ducts."

Install steel volume dampers in steel ducts.

Install aluminum volume dampers in aluminum ducts.

* + - * 1. Set dampers to fully open position before testing, adjusting, and balancing.
				2. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
				3. Install fire[**and smoke**] dampers in accordance with UL listing.
				4. Duct security bars:

Retain first subparagraph below if shop- or field-constructed security bars are acceptable.

Construct duct security bars from [**0.164-inch**] <**Insert dimension**> steel sleeve, continuously welded at all joints, and [**1/2-inch-**] <**Insert dimension**> diameter steel bars, [**6 inches**] <**Insert dimension**> o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld [**2-1/2-by-2-1/2-by-1/4-inch**] <**Insert dimensions**> steel angle to four sides and both ends of sleeve.

Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

Secure duct security bar assembly to building structure [**as detailed**] [**as indicated in manufacturer's installation instructions**].

* + - * 1. Connect ducts to duct silencers [**with flexible duct connectors**] [**rigidly**].
				2. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

On both sides of duct coils.

Upstream[**and downstream**] from duct filters.

At outdoor-air intakes and mixed-air plenums.

At drain pans and seals.

Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

Retain first three subparagraphs below to provide access for duct cleaning.

At each change in direction and at maximum [**50-ft.**] <**Insert value**> spacing.

Upstream[**and downstream**] from turning vanes.

Upstream or downstream from duct silencers.

For grease ducts, install at locations and spacing as required by NFPA 96.

Control devices requiring inspection.

Elsewhere as indicated.

* + - * 1. Install access doors with swing against duct static pressure.

Sizes in "Access Door Sizes" paragraph below are from one manufacturer's literature. SMACNA lists only three sizes, 12 by 12 inches, 16 by 20 inches, and 24 by 24 inches, but makes no recommendations for applications. Indicate location and type of each access door on Drawings.

* + - * 1. Access Door Sizes:

One-Hand or Inspection Access: 8 by 5 inches.

Two-Hand Access: 12 by 6 inches.

Head and Hand Access: 18 by 10 inches.

Head and Shoulders Access: 21 by 14 inches.

Body Access: 25 by 14 inches.

Body plus Ladder Access: 25 by 17 inches.

Coordinate first paragraph below with Section 230553 "Identification for HVAC Piping and Equipment."

* + - * 1. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
				2. Install flexible connectors to connect ducts to equipment.
				3. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
				4. Install duct test holes where required for testing and balancing purposes.

Retain paragraph below for thrust limits on flexible connections for fans.

* + - * 1. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
			1. FIELD QUALITY CONTROL
				1. Tests and Inspections:

Operate dampers to verify full range of movement.

Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.

Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.

Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.

Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300