UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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-- End of Section Table of Contents --

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 23 35 16.17 10

MECHANICAL ENGINE[AND WELDING FUME] EXHAUST SYSTEMS
05/20

****
NOTE: This guide specification covers the requirements for exposed flexible tubing, vehicle tailpipe and welding fume exhaust systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

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NOTE: The designer should be familiar with the current American Conference of Governmental Industrial Hygienists' "Industrial Ventilation: A Manual of Recommended Practice" and the applicable requirements in the most current editions of AHSRAE Handbooks before preparing the design.

The exhaust system layout, including all ductwork, ductwork components (including supports, hangars and anchors), flexible connections, cleanouts and test ports will be shown on the drawings.
****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.21	(2016) Nonmetallic Flat Gaskets for Pipe Flanges
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM E2016	(2020) Standard Specification for Industrial Woven Wire Cloth

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1520	(1999) Round Industrial Duct Construction Standards, 3rd Edition
SMACNA 1922	(2004) Rectangular Industrial Duct Construction Standards, 2nd Edition

1.2 SYSTEM DESCRIPTION

Construct, complete and operational, an exhaust system as specified herein. The exhaust system(s) shall provide adequate air exhaust quantities and velocities. All duct shall be properly sized for pressure loss and adequate velocity including locating intakes, ductwork size, layout, equipment and controls. Construction of the exhaust system shall be based on the referenced publications, and other provisions as specified herein. Furnish ductwork offsets, fittings, and any other accessories required, as specified, to provide a complete exhaust system installation and to eliminate interference with other construction. Controls shall be provided as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]
Exhaust System Installation; G[, [_____]]

SD-03 Product Data

Related Submittals
Ductwork Components; G[, [_____]]
Materials and Equipment
Spare Parts
Field Instructions
Final Acceptance Tests
Onsite Training; G[, [_____]]
Exhaust System Specialist; G[, [_____]]

SD-06 Test Reports

Final Acceptance Tests

SD-07 Certificates

Inspection; G[, [_____]]

SD-10 Operation and Maintenance Data

Exhaust System
Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit [3] [_____] copies of the Exhaust System Drawings, no later than [21] [_____] days prior to the start of exhaust system installation. The detail drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, installation instructions, complete duct, wiring, and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Also show proposed layout and anchorage of equipment and appurtenances, and equipment in relation to other parts of the work including clearances required for maintenance and operation.

1.4.2 Exhaust System Specialist

Submit the name and documentation of certification of the proposed Exhaust System Specialists, no later than [14] [_____] days after the Notice to Proceed and prior to the submittal of the exhaust system drawings and hydraulic calculations. The Exhaust System Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the exhaust systems(s). Submit the list no later than [7] [_____] days after the approval of the Exhaust System Specialist. The related submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Exhaust System Specialist when submitted to the Government. The Exhaust System Specialist shall be regularly engaged in the installation of the type and

complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all ductwork, flexible connections and pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data for each item of equipment and material specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit manufacturer's catalog data included with the Exhaust System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

b. Where an integrated, packaged exhaust system is furnished, all items will be the product of the system manufacturer. System component parts may be by other manufacturers. Equipment shall be supported by a service organization that is capable of responding to service calls within [four hours] [_____].

c. Asbestos and asbestos-containing products are not acceptable.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 EQUIPMENT GUARDS AND ACCESS

****

NOTE: Catwalks, ladders, and guardrails may be required. If so, select the applicable item and indicate on drawings. If not applicable, delete the entire last sentence.

****

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and

other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. [Catwalks,] [operating platforms,] [ladders,] [and] [guardrails] shall be provided where shown and shall be constructed according to Section [08 31 00 ACCESS DOORS AND PANELS][05 51 33 METAL LADDERS].

2.4 DUCTWORK COMPONENTS

****
NOTE: Provide duct access doors at regular intervals to facilitate the cleaning of duct systems for applications requiring clean air supplies, such as hospitals, laboratories, electronics servicing and similar activities.
****

2.4.1 General

Duct shall be constructed of [galvanized] [stainless steel] sheets of the minimum gauge thickness for ducts as required in [SMACNA 1922] [SMACNA 1520]. Ducts shall be constructed and sealed in accordance with [SMACNA 1922] [SMACNA 1520] for a negative pressure of [_____] Pa inch water gauge static pressure. Ducts, unless otherwise approved, shall be round with longitudinal lock seam and conform to the dimensions indicated. Ducts shall be straight and smooth on the inside with airtight joints. Where ducts with crimped ends are used to make up joints, the joints shall have crimp and bead. The bead shall provide a rigid stop for the mating open end to seat against. Steel spiral wound duct is not acceptable.

2.4.2 Fittings

Reducing fittings shall have a minimum of 1 mm increase in diameter per 8 mm 1 inch increase in diameter per 8 inches in length. Elbows shall have a centerline radius of not less than 1.5 times the diameter. Branches shall stub into mains at main expansion points at an angle of not more than 30 degrees with the centerline of the main duct in the direction of air flow, unless otherwise indicated or approved. Where riser ducts with single or multiple inlets are indicated, the riser duct shall connect into the bottom of the main duct at an angle as specified for branches. Where flexible connections connect to the main duct, the duct branch takeoff or stub shall be braced with approved metal straps or members.

2.4.3 Cleanout

Cleanout shall be provided on the end of the main ductwork opposite the end of the fan suction connection. The cleanout opening shall be sized to the approximate inside area of the duct. Removable airtight caps or flange type covers of minimum gauge thickness as the main duct shall be provided. Other cleanout openings shall be provided where indicated.

2.4.4 Apparatus Connections

Where sheet metal connections are made to fan suction and discharge, or where ducts of dissimilar metals are connected, an approved noncombustible flexible connection approximately 150 mm 6 inches wide shall be installed and securely fastened by zinc-coated steel clinch-type draw bands for

round ducts. For rectangular ducts the flexible connections locked to metal collars shall be installed using normal duct construction methods.

2.4.5 Duct Test Holes

Test holes with covers shall be provided where indicated, directed, or where necessary in ducts and plenums for using Pitot tubes for taking air measurements to balance the air systems.

2.4.6 Duct Sleeves and Framed Openings

Duct sleeves shall be provided for all round ducts 375 mm 15 inch diameter or less passing through floors, walls, ceilings, or roofs. Sleeves in non-load bearing walls shall be fabricated of 1.0 mm 20 gauge steel sheets conforming to ASTM A924/A924M. Sleeves in load-bearing walls shall be fabricated of standard-weight galvanized steel pipe conforming to ASTM A53/A53M. Round ducts larger than 375 mm 15 inch diameter and all square and rectangular ducts passing through floors, walls, ceilings, or roofs shall be installed through framed openings. Structural steel members for framed openings shall conform to ASTM A36/A36M. Framed openings shall provide 25 mm 1 inch clearance between the duct and the opening. Closure collars of galvanized steel not less than 100 mm 4 inches wide shall be provided on each side of walls or floors where sleeves or framed openings are provided. Collars for round ducts 375 mm 15 inch diameter or less shall be fabricated from 1.0 mm 20 gauge galvanized steel. Collars for round, square or rectangular ducts with minimum dimension over 375 mm 15 inches shall be fabricated from 1.2 mm 18 gauge galvanized steel.

2.5 EXHAUST HOSE SYSTEM

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NOTE: The following may be used as a guide in selecting materials based on maximum temperature for exhaust hose. A variety of hose is available that can handle various temperature as suitable for the application.

a. Galvanized steel, 315 degrees C 600 degrees F (for 0.3 mm 0.012 thickness).

b. Stainless steel, (for 0.3 mm 0.012 inch thickness) 540 degrees C 1000 degrees F.

c. Heat-resistant wire reinforced glass fiber and neoprene, 120 degrees C 250 degrees F.

d. Heat-resistant wire reinforced glass fiber and silicone, 315 degrees C 600 degrees F.

e. Heat resistant thermoplastic, reinforced with a layer of polyester rated for 149 degrees C 300 degrees F.

f. Double layered, chemically treated, woven glass fabric mechanically joined to an outer steel coil. Temperature resistance is to 815.5 degrees C 1500 degrees F.

Also of importance is that the design incorporate adjustment or shut-off dampers at each adapter or receptor.

****

2.5.1 Tailpipe Adapters

Adapters shall be of the tapered-cone type with spring clips or other suitable devices for exhaust pipe attachment. The adapter shall fit [_____] mm inch nominal diameter exhaust pipe.

2.5.2 Welding Fume Receptors

Welding fume receptors shall be constructed of not less than 1.0 mm 20 gauge thick aluminum and shall be equipped with 13 mm 1/2 inch mesh receptor screens; shall have swivel connections, and magnets on receptor base.

2.5.3 Flexible Exhaust Hose

Flexible exhaust hose shall be [0.30 mm 0.012 inch minimum strip thickness of stainless steel] [0.30 mm 0.012 inch minimum strip thickness of galvanized steel] [approved heat-resistant wire-reinforced glass fiber and neoprene tubing] [approved heat-resistant wire reinforced glass fiber and silicone tubing]. [Wye connectors shall be provided where shown]. Flexible tubing inside diameter and length shall be as shown. The tubing shall be connected to the bottom of the ductwork. A flanged connection shall be provided where the flexible tubing and overhead ductwork are joined. The flanged connection shall consist of steel flanges not less than 200 mm 0.078 inch thick, 3.175 mm 1/8 inch gasket. The gasket shall be suitable for the system design temperature shown, in accordance with ASME B16.21, full face or self-centering flat ring type. It shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). The flange shall be sized or designed to suit the hose as approved. [The connection of the neoprene hose may be installed with an approved hose clamp or as recommended by the manufacturer.]

2.5.4 Exhaust Hose Suspension System

The exhaust hose suspension system shall suspend the flexible tubing overhead when not in use; allowing it to be lowered to the operating level, when required. The suspension system shall be furnished complete with cable, and operating mechanism. The suspension system shall be [counter-weighted type]or [manually operated balancer type with safety ratchet lock or automatic brake having slip resistant hand grip].

2.6 DAMPERS

****

NOTE: Indicate the location of dampers and the types required. Details of the dampers will be shown on the drawings. Shutoff dampers may be shown on the drawings to be provided at each individual tailpipe exhaust adapter. The use of these dampers at inactive stations will reduce infiltration and may reduce the energy required for heating. When shutoff dampers are provided in the individual branch tailpipe adapters, the exhaust fan capacity shall be adjusted for systems which have four

stations. Systems having more than four branches provided with shutoff dampers shall have a fan capacity equal to four branches plus 50 percent of the capacity of the number of branches over four.
****

Dampers shall be of the type indicated and installed where shown. Dampers shall be of the circular disk type with quadrant locking device or blast gate type. Damper blades shall be not less than 1.6 mm 16 gauge thickness of stainless steel. Blast gate dampers shall be two piece construction with adjustable sliding gate and setscrew.

2.7 MATERIALS

Materials shall conform to the following requirements.

2.7.1 Screen

ASTM E2016, type and class as required for the application.

2.7.2 Iron and Steel Sheets

2.7.2.1 Galvanized Iron and Steel

ASTM A924/A924M, Coating Designation G90.

2.7.2.2 Uncoated Steel

ASTM A1011/A1011M, condition, and type best suited to intended use.

2.7.2.3 Stainless Steel

ASTM A167, Type 304.

2.7.3 Steel Structural Shapes

ASTM A36/A36M.

2.7.4 Solder Silver

AWS A5.8/A5.8M, brazing alloy; grade to suit application.

2.7.5 Solder

ASTM B32, composition to suit application.

2.7.6 Bolts and Nuts

Bolts and nuts, except as required for high temperature exhaust applications, shall be in accordance with ASTM A307. Bolts and nuts used for exhaust applications where the temperature of the bolt may rise above 200 degrees C 400 degrees F or used as flange bolts in corrosion resistant material shall be in accordance with ASTM A193/A193M Class 2. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307 or ASTM A193/A193M as applicable.

2.8 ELECTRICAL WORK

****

NOTE: Electrical characteristics, motor starter type, enclosure type, and maximum rpm should be shown on the drawings in the equipment schedules.

****

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 745 W 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 7.45 kW 10 hp or less. Adjustable frequency drives shall be used for larger motors.

2.9 AIR MOVING DEVICES

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NOTE: Drawings will indicate fan capacity, CFM total static pressure, sound/power level, arrangement, rotation, discharge and motor horsepower. Details for weather hoods and flashing and locations for bird screens and location of remote manual switches will be indicated on the drawings.

****

2.9.1 General

Fans shall be tested and rated in accordance with the standards of AMCA 210, Type "D" Ducted Inlet, Ducted Outlet Configuration. [Fans having a capacity of less than 200 L/s 400 cubic feet/minute will be directly connected to the motor shaft] [Where V-belt drives are used, such drives shall be designed for not less than 150 percent of the connected driving capacity, and motor sheaves shall be adjustable to provide not less than an overall 20 percent speed variation. Sheaves shall be selected to drive the fan at such speed as to produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable rails or bases]. Fans shall be provided with personnel screens or guards on both suction and supply ends except where ducts or dampers are connected to the fan. Fans and motors shall be provided with vibration isolation supports or mountings. Vibration isolation units shall be standard products with published load ratings, and shall be single rubber-in-shear, neoprene coated fiberglass, double rubber-in-shear springs, or springs under inertia base. Each fan shall be selected to produce the capacity required at the fan total pressure indicated. Standard AMCA arrangements shall be provided unless otherwise indicated and the rotation and discharge shall be as indicated. Fans

shall have nonoverloading characteristics. Fan housing shall be constructed with not less than 1.5 mm 16 gauge thickness of steel. Fan impellers shall be constructed to meet AMCA Spark Resistance "B" Classification and accurately balanced both statically and dynamically when installed in the assembled fan unit. Impeller and housing in the air stream shall be coated with neoprene, epoxy, phenolic resins, or otherwise be suitable to resist the corrosive gases and temperatures produced. Fans shall be free of objectionable vibration or noise. Certified performance curves indicating that the fan supplied will operate in its most efficient operating range will be provided. In addition, "sound power" ratings shall be furnished with each fan. Fans indicated to be mounted on exterior of building shall be provided with weatherproof covers for the motor drive unit or other weatherproofing as recommended by the manufacturer. Each fan shall be selected to produce the capacity required at the fan total pressure indicated. Weather hoods, flashing, and bird screens shall be provided where indicated.

2.9.2 Fans

****

NOTE: Refer to UFC 3-450-01, Noise and Vibration Control for Mechanical Equipment, for vibration criteria. Vibration isolation required should be shown and included in the appropriate schedule on the drawings.

****

The sound power level shall be as indicated and values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated. Fans shall be tested and rated according to AMCA 210. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than [150] [140] [120] percent of the connected driving capacity. Motor sheaves shall be variable pitch for 11 kW 15 hp and below and fixed pitch as defined by AHRI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance.

2.9.2.1 Protective Devices

Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be standard products with published loading ratings.

2.9.2.2 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically.

[Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 750 mm 30 inches. Fan blades for wheels over 750 mm 30 inches in diameter shall be backward-inclined or airfoil design]. These fans shall be suitable for the temperatures encountered. The fan shaft shall be provided with a heat slinger to dissipate heat buildup along the shaft. An access (service) door to facilitate maintenance shall be supplied with these fans. Fan wheels over 900 mm 36 inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Indirect drive fan wheels 900 mm 36 inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have [open] [dripproof] [totally enclosed] [explosion-proof] enclosures. [Motor starters shall be [manual] [magnetic] [across-the-line] [reduced-voltage-start] type with [general-purpose] [weather-resistant] [watertight] enclosure.] [Remote manual switch with pilot indicating light shall be provided where indicated.]

2.9.3 In-Line Centrifugal Fans

In-line centrifugal fans shall have welded tubular casings, centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Air shall enter and leave the fan axially. Inlets shall be streamline with conversion vanes to eliminate turbulence and discharge air flow smoothly. Fan bearings and drive shafts shall be enclosed and isolated from air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated or lubricative type with grease lines extending to the exterior of the housing. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Motors shall have [open] [dripproof] [totally enclosed] [explosion-proof] enclosure. Motor starters shall be [manual] [magnetic] across-the-line with [general-purpose] [weather-resistant] [explosion-proof] enclosure. [Remote manual switch with pilot indicating light shall be provided where indicated.]

2.10 FACTORY COATING

Equipment and component items, when fabricated from ferrous metal as defined by ASTM (or similar) standard, shall be factory finished with the manufacturers standard finish except that items located outside of building shall have weather-resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.3 INSPECTION

The Exhaust System Specialist shall (1) Inspect the exhaust system periodically during the installation. (2) Witness the final tests, and sign approval of the test results. (3) Certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 EXHAUST SYSTEM INSTALLATION

3.4.1 General Requirements

Welding and brazing shall conform to ASME BPVC SEC IX. Horizontal sections of the main duct shall be installed with the longitudinal lock seam on the top. Slip joints shall be sealed in accordance with [SMACNA 1922] [SMACNA 1520]. Riser duct shall be supported and anchored to the structure as indicated. Main duct shall be attached to the structural members of the building as recommended by [SMACNA 1922] [SMACNA 1520].

3.4.2 Building Surface Penetrations

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NOTE: Indicate penetration and sleeve and packing details on the drawings in accordance with TM-5-812-2, Section 07 84 00 FIRESTOPPING.

****

Sleeves or framed openings shall be utilized where duct penetrates building surfaces. Penetrations shall be sealed[, and fireproofed in accordance with Section 07 84 00 FIRESTOPPING]. The space between the sleeve or framed opening and the duct shall be packed with mineral wool or other approved material. Closure collars shall be installed around the duct on both sides of the penetrated surface. Collars shall fit tight against the building surfaces and snugly around the duct.

3.5 PIPE COLOR CODE MARKING

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NOTE: Designer will coordinate color code marking with Section 09 90 00 PAINTS AND COATINGS. Color code marking for piping which are not listed in Table I of Paragraph Pipe Color Code Marking of UFGS Section 09 90 00 will be added to the table.

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Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6 ONSITE TRAINING

Submit proposed Onsite Training schedule, at least [14] [_____] days prior

to the start of related training for the operating staff as designated by the Contracting Officer. The training period shall consist of a total [8] [_____] hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations. Submit [6] [_____] manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days [_____] prior to on-site training. The manuals shall include the manufacturer's name, model number, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. [Each service organization submitted shall be capable of providing [4] [_____] hour on-site response to a service call on an emergency basis.] Notify the Contracting Officer at least 14 days prior to date of proposed conduction of the training course.

3.7 FINAL ACCEPTANCE TESTS

Each exhaust system and inlet shall be balanced to produce the indicated air quantities within 10 percent at the conditions shown. Control devices shall be set to control at the points indicated or directed. Bearings shall be lubricated, and the speed, direction or rotation of each fan shall be checked. The running current of each motor shall be checked. Upon completion, and prior to acceptance of the installation, the exhaust system shall be tested at operating conditions to demonstrate satisfactory functional and operating efficiency.

a. Operating tests shall cover a period of not less than 2 hours for each system, and all tests shall be conducted in the presence of the Contracting Officer. If tests do not demonstrate satisfactory operation of the exhaust system, correct deficiencies and retest. Provide all instruments, facilities, and labor required to properly conduct the tests. The electricity required for testing will be furnished by the Government.

b. Submit [3] [_____] copies of the completed Final Acceptance Tests Reports, no later that [7] [_____] days after the completion of the Tests. All items in the Final Acceptance Report shall be signed by the Exhaust System Specialist. Submit proposed diagrams, instructions, and other sheets, concurrent with the Final Acceptance Test Procedures. Framed instructions under glass or in laminated plastic shall be posted where directed, including wiring and control diagrams showing the complete layout of the entire system. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

c. Submit proposed procedures for Final Acceptance Tests, no later than [14] [_____] days prior to the proposed start of the tests.

d. Submit proposed date and time to begin Final Acceptance Tests, with the Final Acceptance Test Procedures. Notification shall be provided at least [14] [_____] days prior to the proposed start of the test.

-- End of Section --