

University of Houston Master Specification

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SECTION 23 8220 - FANS, AIR INTAKES AND RELIEF VENTS

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information.

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified **in bold**.

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

Delete hidden text after this Section has been edited for the Project.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide supply and exhaust fans, air intakes, and relief vents as scheduled and indicated.
- B. Types: The types of fans, outside intakes and relief vents required for the project include, but are not limited to, the following:
 - 1. Centrifugal roof exhaust fans.
 - 2. Centrifugal upblast roof exhaust fans.
 - 3. Sidewall propeller exhaust fans.
 - 4. In-line exhaust/transfer fans
 - 5. Utility exhaust fans.
 - 6. Upblast smoke exhaust fans.
 - 7. Vane axial supply/exhaust fans.
 - 8. Air intakes.
 - 9. Relief vents.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:

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1. Acme.
2. Carnes Company, Inc.
3. Cooke.
4. Flakt Products, Inc.
5. Greenheck Fan Corporation.
6. Peerless.
7. Penn Ventilator Company.
8. Trane Company.
9. Woods Fan Division.

- B. AMCA Seals: Provide fans which are rated per AMCA standards and bear the AMCA-certified rating seal.
- C. Electrical Standards: Provide electric motors and products which have been listed and labeled by Underwriters' Laboratories, Inc. (UL) and comply with National Electrical Manufacturer's Association (NEMA) standards.

1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
1. Cut sheets clearly indicating fans, air intake and relief vent construction, dimensions, ratings, capacities, and accessories.
 2. Cut sheets on roof curbs clearly indicating dimensions, required roof openings, and flashing details.
 3. Fan curves with fan selection point clearly indicated.
 4. Fan drive selection calculations.
 5. Motor data as required in Section 23 0400 "Motors and Controllers."
 6. Additional information as required in Section 23 0300 Mechanical General Provisions."

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver fans, intakes, vents, and accessories carefully to avoid damage to material components, enclosure, and finish.
- B. Handle fans, intakes, vents, and accessories carefully to avoid damage to material components, enclosure and finish.
- C. Store fans, intakes, vents, and accessories in a clean, dry space, and protect from the weather.

PART 2 - PRODUCTS

2.1 GENERAL FAN REQUIREMENTS:

- A. Ratings: Fans shall be licensed to bear the AMCA-certified ratings seal. Ratings of fans shall be not less than the values shown on the Drawings, based on 69.8°F and 29.92" of Hg atmospheric pressure.
- B. Construction: Fan construction shall be in accordance with AMCA classes of construction for the intended duty. Fan wheels, shafts, and drives shall be statically and dynamically balanced at the factory as a unit. Balancing shall be factory-certified.

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- C. Motors: Fan motors shall be 1750 rpm open drip-proof (ODP) or totally-enclosed, fan-coded (TEFC) type as required for the application. Motors 5 hp and larger shall be energy efficient, high efficiency type. Motors shall be selected to be non-overloading with the fan provided. Refer to Section 15140 for additional motor requirements.
- D. Drives: Provide drives with a minimum belt horsepower capacity of 165% of the motor nameplate horsepower. All fans requiring 1-1/2 hp or larger motor shall include the fan drive selection calculations with the submittal. The selection calculations shall include the correction factor for arc of contact. The submittal data shall identify the source of the selection data.
- E. Motor Sheaves: Motor sheaves shall be Browning Type, MVP, or approved equal, adjustable type with double locking feature. Motor sheaves shall be selected for the rated fan rpm and shall be adjustable to as close as 10% above and below the rated fan speed. Provide fixed sheaves for all motors 3 hp and larger after proper speed has been determined during system balancing.
- F. Fan Sheaves: Provide nonadjustable sheaves with removable machined bushings. Sheaves shall be machined on all surfaces. Sheaves with over three grooves shall be dynamically balanced and the manufacturer shall so designate on each sheave. Fan sheaves with three grooves or less shall be statically balanced and weights required for balancing shall be welded to the sheaves. Manufacturers shall be Browning, Eaton, Yale and Towne, Dodge Manufacturing Company, or Fort Worth Steel and Machinery Company.
- G. Belts: Provide standard "V-groove" belts suitable for the service intended with the required capacities. The belts shall be closely matched and tagged prior to delivery to the job site. If the belts do not appear to be properly matched during operation, they shall be rechecked and, if necessary, replaced. Belts shall be as manufactured by Gates, Durkee-Atwood, Goodyear, Browning, or Uniroyal.
- H. Speed Control: All single-phase direct drive fans shall be provided with compatible internally mounted solid-state speed controllers, unless noted otherwise.
- I. Bearings: Provide SKF, Sealmaster, Timken or Fafnir, externally or internally-mounted, grease-lubricated, self-aligning ball bearings. Bearings shall have grease type Zerk fittings and shall be selected for a minimum B-10 life as defined by AFBMA of 200,000 hours, unless specified otherwise.
- J. Motor Mounts: Motors shall be mounted on an adjustable base rigidly supported on the fan and shall have extended shaft to accommodate the adjustable pitch sheave.

2.2 ROOF CURBS:

- A. General: Provide prefabricated, insulated aluminum roof curbs for all roof mounted fans. Curbs shall be of welded construction and roof-over-flashing type with build-in can't and a minimum overall height of 8" above roof surface, unless otherwise noted or required to meet code requirements. Roof curbs shall be Greenheck Model #GPS or approved equal for roof decks that are not surface insulated and Model #GPR or approved equal for roof decks that are surface insulated. Damper trays shall be provided to facilitate the mounting of the backdraft dampers, where specified or scheduled. Extended base curbs shall be provided when scheduled or required.

2.3 CENTRIFUGAL ROOF EXHAUST FANS:

- A. General: Provide Greenheck Model G, GB or approved equal ACME, Cook or Carnes centrifugal roof-mounted exhaust fans with capacities as scheduled.
- B. Construction: Fans shall be centrifugal, belt or direct driven as scheduled. Construction of the fan housing, fan wheel and inlet cone shall be aluminum. Wheels shall be aluminum, non-overloading

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backward curved, centrifugal type and shall be statically and dynamically balanced to assure smooth and vibration-free operation. The entire drive assembly shall be mounted on vibration isolators.

Fans shall be constructed to withstand winds up to 150 mph.

- C. Drives: The wheel shaft on belt drive models shall be ground and polished shafting mounted in heavy duty sealed pillow block bearings. Drives shall be sized for a minimum of 165% of driven horsepower. Pulleys shall be fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. An adjustable drive shall be used for balancing and then a fixed drive shall be provided.
- D. Motors: Motor and drives shall be isolated from the exhaust airstream and mounted on vibration isolators. Motors shall be of the heavy-duty type with permanently lubricated, sealed ball bearings. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]**
- E. Certification: All fans shall bear the AMCA ratings seals for both air flow and sound performance with bird screens in place.
- F. **[Coatings: Exhaust fans used for fume hood service shall have all fan parts exposed to the air stream coated with a high temperature acid resistant epoxy coating.]**
- G. Accessories: Provide all required accessories including, but not limited to: aluminum birdscreen, **[gravity (preferred) [motorized] backdraft dampers [with end switch]**, prefabricated insulated aluminum roof curb, factory-mounted and wired **[internal NEMA 1] [external NEMA 3R]** disconnect switch and solid state fan speed controllers (direct drive units only) with a conduit through the roof curb for field wiring.

2.4 CENTRIFUGAL UPBLAST ROOF EXHAUST FANS: (DINING FACILITIES)

- A. General: Provide a Greenheck Model CUBE, CUBE-HP, or approved equal ACME or Cook upblast centrifugal roof-mounted exhaust fans with capacities as scheduled.
- B. Construction: Fans shall be of belt or direct drive as scheduled, upblast vertical discharge type. Construction of housing shall be heavy gauge aluminum. The wind band shall have a rolled bead and additional structural members for added strength.
- C. Wheels: The fan and wheel inlet cone shall be non-sparking aluminum and of the high performance, centrifugal blower type. Wheel shall be statically and dynamically balanced. Construction shall include a built-in grease drain.
- D. Motors and Drives: Motors and drives shall be isolated from the exhaust air stream and mounted on vibration isolators. Motors shall be of the heavy-duty type with permanently lubricated, sealed ball bearings. Air for cooling the motor shall be taken into the motor chamber by means of an air tube from a location free of discharge contaminants. The entire drive assembly and wheel, shall be mounted on vibration isolators as a unit and shall be removable through the support structure without dismantling the fan housing. The wheel shaft shall be mounted in heavy duty ball bearings. Drives shall be sized for 165% of driven horsepower. Pulleys shall be adjustable cast iron type, keyed to the fan and motor shafts. The entire drive assembly shall be mounted on rubber vibration isolators. Motors shall be 1750 rpm open dripproof (ODP) type of the horsepower and voltage scheduled. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]**
- E. Certification: All fans shall bear the AMCA Certified Ratings seal for both air and sound performance.
- F. Accessories: Provide all required accessories including, but not limited to: aluminum birdscreen, **[extended base to conform to NFPA 96 requirements for fan discharge a minimum of 40" above roof,]** fan UL-listed and labeled for grease removal (UL 762), **[grease drain connection and trap (for all kitchen hood exhaust fans),]** **[insulated motor heat baffle (for kitchen exhaust fans).]** **[gravity]**

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[motorized] backdraft dampers **[with end switch (for all fans except kitchen hood exhaust fans)]**, prefabricated insulated aluminum roof curb, factory-mounted and wired **[internal NEMA 1] [external NEMA 3R]** disconnect switch and solid state fan speed controllers on direct drive units.

2.5 SIDEWALL PROPELLER EXHAUST FANS:

- A. General: Provide Greenheck Model SDE, SDP, and SBP or approved equal ACME, Cook or Carnes sidewall propeller exhaust fans with capacities as scheduled.
- B. Construction: Fans shall be axial type, belt or direct driven as scheduled. Blades shall be die-formed and welded to a steel hub. A polished steel fan shaft shall be mounted in permanently-lubricated, sealed ball bearing pillow blocks. The drive frame assembly shall be formed steel. The fan panel shall have prepunched mounting holes, formed flanges with welded corners, and a deep formed venturi. Fans shall bear AMCA rating seals for air and sound performance.
- C. Motors: Motors shall be 1750 rpm open dripproof (ODP) type of the horsepower and voltage scheduled. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]**
- D. Accessories: Provide all required accessories including, but not limited to: mounting collar, factory-wired and mounted NEMA 1 disconnect switch, **[gravity] [motorized]** backdraft damper **[with end switch]**, and motor side fan guard (except on fans with reverse air flow).

2.6 IN-LINE EXHAUST/TRANSFER FANS:

- A. General: Provide Greenheck Model CSP, BCF, BSQ, BSQ-HP or DSQ or approved equal Acme or Cook in-line exhaust fans with capacities as scheduled.
- B. Construction: Fans shall be belt or direct driven in-line type with square heavy gauge galvanized steel housing with duct mounting collars shall have a galvanized or thermally fused epoxy finish. One or both sides shall be hinged and shall support the entire drive assembly and wheel allowing the assembly to swing out for cleaning, inspection, or service without dismantling the unit in any way. On belt drive models the motor shall be mounted on the hinged side exterior, isolated from the airstream. The motor shall be isolated from the airstream by a motor enclosure and shall draw cooling air from outside the fan housing.
- C. Wheels: The fan inlet shall be spun venturi throat overlapped by an aluminum backward inclined centrifugal wheel with spun cone for maximum performance. The fan wheel shall be statically and dynamically balanced.
- D. Insulation: The interior of the fan housing shall have one inch (1") thick, 3 PCF density internal sound absorbing fiberglass insulation to reduce operating noise levels.
- E. Drives: Motors shall be heavy duty type with permanently-lubricated, sealed ball bearings. The wheel shaft shall be ground and polished shafting mounted in heavy duty sealed pillow block bearings. Drives shall be sized for a minimum of 165% of driven horsepower. Pulleys shall be fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. An adjustable drive shall be used for balancing and then a fixed drive shall be provided. Motors shall be 1750 rpm open dripproof (ODP) type of the horsepower and voltage scheduled. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]**
- F. Wiring: Flexible wiring leads shall be installed in conduit from the fan motor to an externally mounted junction box, **[motor speed controller (single phase units only)]** and disconnect switch, permitting access for service without disconnecting field wiring.
- G. Certification: All fans shall bear the AMCA-certified ratings seal for both air and sound performance.

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- H. Accessories: Provide all required accessories including, but not limited to: Duct mounted automatic acting gravity type backdraft dampers of same size as fan housing, hanging support isolators with door side perpendicular to mounting surface, solid state fan speed controllers (direct drive units only) and belt guard for belt driven fans.

2.7 UTILITY EXHAUST FANS:

- A. General: Provide Greenheck Model SFD or approved equal Peerless or Trane utility exhaust fans with capacities as scheduled.
- B. Construction: Fans shall be belt or direct driven, single width, single inlet centrifugal blowers with discharge arrangement as shown on the drawings. The blower housing shall be of continuously welded construction which can be adjusted for discharge position. Housing supports shall have formed flanges and prepunched mounting holes. The blower wheel shall be steel of the forward curved type and shall be statically and dynamically balanced. A polished steel fan shaft shall be mounted in ball bearing pillow blocks. Bearings shall be grease lubricated.
- C. Finish: Entire exterior of the fan assembly shall be phosphatized, primed and finished with a baked enamel. **[Laboratory exhaust fans shall have a factory applied epoxy corrosion resistant coating applied to all surfaces exposed to the air stream.]**
- D. Motors: Motors for interior mounted fans shall be open dripproof (ODP) type and motors for exterior mounted fans shall be totally enclosed fan cooled (TEFC). Motors shall be 1750 rpm type of the horsepower and voltage scheduled. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]**
- E. Accessories: Provide all required accessories including, but not limited to: Vented weather hood with expanded metal outlet guard, access doors, shaft seals, factory-mounted and wired NEMA **[1]** **[3R]** disconnect switch, felt tipped automatic aluminum backdraft dampers, vibration isolators, belt guard, drain connections and weather hoods (where required).

2.8 UTILITY EXHAUST FANS:

- A. General: Provide Greenheck Model SFB, SWB, or approved substitution Peerless or Trane exhaust fans with capacities and discharge arrangement as scheduled and shown on the Drawings.
- B. Configuration: Fans shall be a belt drive, single width, single inlet utility vent set with forward curved or backward inclined centrifugal fan wheel as scheduled.
- C. Housing: The fan housing and inlet cones shall be constructed of heavy gauge steel with lock-formed seams to prevent leakage. Housing supports and drive frame shall be constructed of welded steel members to prevent vibration and rigidly support the fan shaft and bearings.
- D. Wheels: Fan wheels shall be constructed of formed steel blades securely attached to the wheel backplate and cone. Each wheel and shaft shall be statically and dynamically balanced.
- E. Fan Shafts: Fan shafts shall be precision tuned, ground and polished steel shafts, sized so that the first critical speed is a minimum of 25% over the maximum operating speed. Fan shaft shall have pillow block bearings. All fan bearings shall be factory-lubricated and equipped with standard hydraulic grease fittings. Extended lube lines shall be furnished where bearings are not accessible and shall terminate on the outside of drive end of each unit including extension to allow greasing without removal of drive guard.

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- F. Drives: V-belt fan drives with variable pitch motor sheave shall be selected for 150% of motor horsepower and anti-static belts shall be furnished. Drive guards shall have accessible opening to read rpm.
- G. Motors: Fan motors shall be ball bearing 1750 rpm open dripproof (ODP) type for indoor use and shall have electrical characteristics as scheduled. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]** Motor base shall be equipped with adjustable base rails.
- H. Finish: The entire fan assembly shall be phosphatized and painted with the manufacturers standard paint finish.
- I. Certification: Fan performance shall be based on tests conducted in accordance with AMCA Standard 210 test code for air moving devices. Fans shall be licensed to bear the AMCA Certified Rating Seal for air performance.
- J. Accessories: Provide all required accessories including, but not limited to, belt guard, access door, **[gravity] [motorized] backdraft damper [with end switch], [inlet] [discharge] guard[, drain connection] and [a motor and drive weather load].**
- 2.9 UPBLAST SMOKE EXHAUST FANS:
- A. General: Provide Greenheck Model TAUB-HT or approved substitution roof-mounted up-blast tube axial smoke exhaust fans capable of operating for a minimum of 4 hours at an exhaust air temperature of 500°F.
- B. Construction: Fan housing shall be constructed of heavy gauge welded steel and shall be designed for curb mounting using a curb cap with an integral flanged venturi inlet. The fan housing shall have a reinforced steel wind band and outlet screen from discharge damper protection. Bearing and motor supports shall be constructed of structural steel shapes and welded to the fan housing. A ventilated weatherproof motor cover shall be provided.
- C. Dampers: Provide spring-loaded steel butterfly damper on the fan discharge. Damper shall be gasketed in the closed position to minimize leakage and be provided with damper stops to maintain proper damper position when the fan is operating. The damper shall be held closed by a resettable McCabe type electrothermal link which shall open the damper at 165°F ambient temperature or upon a 120-volt signal on fan start-up.
- D. Fans: Propeller construction shall be fabricated steel, with the fan hub key locked to the fan shaft. Fans and shafts shall be statically and dynamically balanced.
- E. Fan Shafts: Fan shafts shall be precision tuned, ground and polished steel shafts, sized so that the first critical speed is a minimum of 25% over the maximum operating speed. Fan shaft shall have pillow block bearings. All fan bearings shall have a minimum B-10 life as defined by AFBMA of 25,000 hours, factory-lubricated and equipped with standard hydraulic grease fittings. Extended lube lines shall be furnished where bearings are not accessible and shall terminate on the outside of drive end of each unit including extension to allow greasing without removal of drive guard. Heat slingers shall be mounted on the fan shaft to dissipate heat from the fan shaft and draw cooling air over the bearings, shaft, and drive.
- F. Drives: V-belt fan drives with variable pitch motor sheave shall be selected for 150% of motor horsepower and anti-static belts shall be furnished. Drive guards shall have accessible opening to read rpm. Belt and bearing tubes shall be constructed of welded heavy gauge steel and provided with ventilation for proper cooling of belts, bearings, and drives.

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- G. Motors: Fan motors shall be ball bearing 1750 rpm open dripproof (ODP) type for indoor use and shall have electrical characteristics as scheduled. Motor base shall be equipped with adjustable base rails.
- H. Finish: The entire fan assembly shall be phosphatized and painted with the manufacturers standard paint finish.
- I. Certification: Fan performance shall be based on tests conducted in accordance with AMCA Standard 210 test code for air moving devices. Fans shall be licensed to bear the AMCA Certified Rating Seal for air performance.
- J. Accessories: Provide all required accessories including, but not limited to, an outlet screen, bolted access door, and a factory-mounted and wired heavy duty NEMA 3R disconnect switch.

2.10 VANE AXIAL SUPPLY/EXHAUST FANS:

- A. General: Provide Woods of Colchester Limited or approved equal belt or direct driven in-flight controllable pitch and manually adjustable fixed pitch vane axial type supply and exhaust fans of the type, size, and capacity scheduled.
- B. Ratings: The fan shall deliver the volume and pressure specified in the fan schedule when tested in accordance with AMCA Standard 210.
- C. Casings: The fan casing will consist of two sections, each 3/16-inch minimum thickness mild steel, joined with bolted flanges. The motor will be supported by the fabricated steel structure of 3/16-inch minimum thickness welded to one of the ducts. The other duct will be removable for access to the impeller. Drilled flanges will be provided for attachment of accessories or ductwork. The casing shall have an integral support frame and plate for mounting the motor on direct drive fans and internal bearing supports and an external motor mounts on belt drive fans. The casing and drilled flanges shall be hot dip galvanized.
- D. Fan Impellers: The impeller hub shall be cast in high strength heat-treated aluminum alloy precision-machined and balanced. Blades shall be of aerofoil section cast from silicon aluminum alloy and mounted on thrust bearings with grease retaining features such that the bearings shall be fully submersed in grease. All hub and blade materials shall be examined by X ray before machining. The manufacturer shall have available, laboratory evidence that impeller hubs and blades are suitable designed for normal running conditions and that fluctuating stresses in use are sufficiently low to ensure that no premature failure will occur due to metal fatigue.
- E. Fixed Adjustable Pitch Fans: The fan impeller pitch angle shall be manually adjustable in the field.
- F. In-flight Controllable Fans: The impeller blades shall be actuated in flight by an internal pneumatic actuator built into the hub and providing stepless control of the blade pitch angle. A pilot positioner shall be provided to ensure minimum control hysteresis. Where scheduled, the fan blades shall be reversible in-flight to reverse the airflow direction through the fan. A blade angle indicator shall be provided on the outside of the fan housing. The pneumatic operator shall be factory-adjustable to control fan blade angle from minimum to maximum pitch from a 3 to 15 psi pneumatic signal **[and for pitch reversing, where applicable]**.
- G. Balancing: After assembly the fan shall be dynamically balanced while on anti-vibration mountings giving over 90% isolation. The balance standard shall be in accordance with ISO 2372;1974 Quality Grade C for Class II machines. Maximum vibration velocity shall not exceed 0.14 in/sec r.m.s. on 60 Hz supplies over the full pitch angle range, when measured at the fan mounting feet.

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- H. Certification: The fan manufacturer shall supply a test certificate for each fan showing the voltage, current, frequency, kilowatts input, degree of balance and control characteristic (actuator movement against control signal). The fan pitch angle for adjustable fixed pitch fans shall be adjusted at the factory to meet scheduled conditions.
- I. Characteristics: The aerodynamic design of the fan shall be such that the maximum power absorbed by the impeller occurs within the normal working range such that the fan has a non-overloading characteristic.
- J. Impeller Attachment: The impeller shall be secured to the motor or fan shaft by a key and keyway. Axial location shall be provided by a collar or a shoulder on the drive shaft together with a retaining washer and a screw fitted into a tapped hole in the end of the shaft. The screw shall be locked in position.
- K. Direct Drive Motors: Motors shall be totally enclosed fan cooled (TEFC) with Class F insulation and 1.15 service factor. Motor bearings shall be selected for a minimum L-10 life of 20,000 hours. Grease lubrication lines shall be brought to outside of the fan casing and labeled. Motor wiring shall be factory-extended to a junction box installed on the outside of the fan housing.
- L. Belt Drive Motors: Fan motors shall be ball bearing 1750 rpm open dripproof (ODP) type for indoor use and shall have electrical characteristics as scheduled. **[Motors 1 hp and larger shall be of the high efficiency, energy efficient type.]** Motor base shall be equipped with adjustable base rails.
- M. Belt Drives: V-belt fan drives with variable pitch motor sheave shall be selected for 150% of motor horsepower and anti-static belts shall be furnished. Drive guards shall have accessible opening to read rpm.
- N. Fan Shafts: Fan shafts shall be precision tuned, ground and polished steel shafts, sized so that the first critical speed is a minimum of 25% over the maximum operating speed. Fan shaft shall have pillow block bearings. All fan bearings shall be factory-lubricated and equipped with standard hydraulic grease fittings. Extended lube lines shall be furnished where bearings are not accessible and shall terminate on the outside of drive end of each unit including extension to allow greasing without removal of drive guard.
- O. Accessories: Provide all required accessories including, but not limited to:
 - 1. Inlet bell mouth fittings with guards.
 - 2. Outlet guard.
 - 3. Outlet cone.
 - 4. Inlet and outlet attenuators.
 - 5. Flange mounted flexible connections.
 - 6. Horizontal or vertical mounting brackets as required for isolated fan mounting.

2.11 AIR INTAKES:

- A. General: Provide ACME or approved equal Greenheck, Cook or Carnes roof-mounted air intakes with capacities as scheduled.
- B. Construction: Construction of the housing shall be aluminum. Intakes shall be constructed to withstand winds up to 150 mph.
- C. Accessories: Provide all required accessories including, but not limited to: aluminum birdscreen, gravity or motorized (as scheduled) backdraft dampers and prefabricated insulated aluminum roof curb.

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2.12 RELIEF VENTS:

- A. General: Provide ACME or approved substitution Greenheck, Cook or Carnes roof-mounted air relief vents of the type and capacities as scheduled.
- B. Construction: Construction of the housing shall be aluminum. Vents shall be constructed to withstand winds up to 150 mph.
- C. Accessories: Provide all required accessories including, but not limited to: aluminum birdscreen, gravity or motorized (as scheduled) backdraft dampers and prefabricated insulated aluminum roof curb.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. General: Installer shall examine conditions under which fans, outside intakes, and relief vents are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

- A. General: Install fans, outside intakes, and relief vents where shown, in accordance with manufacturer's written instructions and recognized industry practices to ensure that fans, outside intakes, and relief vents comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.
- B. Curb-mounted Fans: All fans mounted on roof curbs shall be securely attached to the roof curb with appropriate fasteners located 8-inches on center with a minimum of two fasteners per side by this Contractor. The roof curb shall be securely attached to the building structure by the General Contractor.
- C. Insulation: Refer to Section 23 0548 "Vibration Isolation" for fan insulation requirements.
- D. Housekeeping Pads/Vibration Isolation: Refer to Section 23 0300 "Basic Materials and Methods" and Section 23 0548 "Vibration Isolation" for applicable requirements.

3.3 COORDINATION:

- A. General: This Contractor shall be responsible for coordinating installation requirements and provisions with the work of other Divisions and the General Contractor.
- B. Coordinate all required fan motor horsepower, voltages and locations with Electrical Contractor prior to purchase.
- C. **All fans with 2000 cfm or greater airflow shall have a firestat with manual reset set to open at 50°F, above maximum system operating temperature to interrupt electric current to the fan motor in case of fire. Firestat shall be furnished and installed by [this Contractor with wiring of firestat by the Electrical Contractor.] [the Temperature Controls Subcontractor. Refer to Division 25 for control requirements].**
- D. Coordinate all roof mounted fan curb openings with General Contractor prior to roofing installation.

3.4 START-UP SERVICES:

- A. General: The fan supplier shall provide fan checkout, start-up, testing and adjusting of system components for the vane axial fan systems. The fan supplier shall also train the Owner's Engineer in the proper operation and maintenance of these fans.

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3.5 TESTING:

- A. General: Test and adjust all installed fans to verify proper operation as specified herein and as recommended by the manufacturers. Where specified hereinabove, start-up, testing, and adjustment shall be provided by a representative of the equipment supplier.
- B. Refer to Section 23 0593 "Testing, Adjusting and Balancing" for additional start-up, testing, and adjustment requirements.

3.6 IDENTIFICATION:

- A. Refer to Section 23 0300 "Basic Materials and Methods" for applicable painting, nameplates, and labeling requirements.

END OF SECTION 23 8220