SECTION 23 – High Plume Induced Flow Dilution Exhaust Fans

SKYPLUME G1 EL - SERIES

(HIGH PLUME EXHAUST FAN SYSTEMS IN RUST PROOF CONSTRUCTION)

# Work Included

1. High Plume Induced Flow Dilution Exhaust Fans

## Related Sections

1. 23 34 00 – HVAC Fans
2. 23 34 43 – Laboratory High Plume Induced Flow Exhaust Fans
3. 23 31 00 – HVAC Ducts
4. 23 09 13 – Control Dampers

## References

1. AMCA -99-10 Standards Handbook.
2. AMCA 204-05 - Balance Quality and Vibration Levels for Fans.
3. AMCA 205-12 – Energy Efficiency Classification for Fans.
4. AMCA 210-07 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
5. AMCA 211-13 – Certified Ratings Program - Product Rating Manual for Fan Air Performance.
6. AMCA 260-13 - Laboratory Methods of Testing Induced Flow Fans for Rating.
7. AMCA 300-08 - Reverberant Room Method for Sound Testing of Fans.
8. AMCA 311-05 - Certified Ratings Program.
9. AFMBA - Method of Evaluating Load Ratings of Bearings (ASA - B3.11).
10. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
11. Applicable SMACNA - Medium Pressure Plenum Construction Standard.
12. ANSI Z9.5 - Laboratory Design.
13. ASHRAE - Laboratory Design Guide.
14. ASTM D4167-97 - Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
15. Applicable ASTM Standards
16. International Mechanical Code
17. ASTM-E84

## Intent

1. Purpose of the bid is to have installed a complete critical air exhaust system. It is intended to offer bidding a style of critical performance product and company with a proven history and record of performance. The specialized nature of certain components required for this project require compliance to specifications and in some instances, refer to various components by trade or manufacturers name. Whenever a proprietary (trade) name is used within this Specification Section, it is used for informational purposes to describe a standard of required function, dimension, appearance and quality. References to materials by trade name, make or model number shall not be construed as limiting competition. All bidders are required to bid on the named manufacturer in the BASE BID. The Contractor may at their option, elect to bid using the products and/or services of alternate manufacturers listed as ALTERNATES ON THE BID FORM.

## Alternates

1. Other High Plume Induced Flow Dilution Exhaust Fan systems will be considered only if a complete set of drawings and specifications detailing such equipment as it pertains to this project are submitted for evaluation ten (15) days prior to the bid date. The submission should include a list of five (5) operating installations within a reasonable distance to the jobsite. List should include the names and telephone numbers of the operating and owner personnel.
2. The technical contents of the submittal shall include mechanical and fluid calculations, equipment fabrication details, and system layout in plan and elevation views, warranties, installation and operating instructions.

**NOTE: This information must be submitted by a bidding contractor. Submittals will not be considered if provided directly by the alternate equipment manufacturer.**

1. Alternates meeting the terms and conditions of the bidding documents will be acknowledged prior to bidding by addendum. No alternates will be considered after the bid.
2. For any and all alternates approved in accordance with the above conditions, state the amount to be DEDUCTED from the BASE BID if an alternate Fiberglass High Plume Induced Flow Dilution Exhaust Fan system is being offered. No provision has been or will be made for ADDITIVE bids.

## Substitutions

1. No substitutions will be considered unless the specified product becomes unavailable due to no fault of the Contractor.

## Quality Assurance

1. Products and execution shall be in compliance with applicable codes and standards including those referenced above in Paragraph 1.2 REFERENCES
2. Installation shall be in compliance with Manufacturer’s recommendations and installation instructions.
3. Performance ratings shall conform to AMCA standard 205, 211, 260 and 311. All fans shall be licensed and bear the AMCA ratings seal for FEG ratings (AMCA 205), Air Performance (AMCA 210), Induced Flow for High Plume Dilution Fans, and Sound Performance (AMCA 300). Acceptable manufacturers whose equipment are not licensed to bear the AMCA seal for Sound, Air Performance and Induced Flow must submit performance tests conducted by an independent third party at a registered AMCA test facility, and certified for accuracy (stamped) by a registered professional engineer (at the manufacturers expense).
4. Fan shall be manufactured of spark resistant construction and conform to AMCA 99.
5. All fans prior to shipment shall be fully assembled and test run as a unit at the specified operating flow ratings or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204 “Balance Quality and Vibration Levels for Fans” to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic measuring equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained with the project file and a written copy shall be available upon request from the manufacturer.
6. The “EQUIPMENT MANUFACTURER” Shall be: SKYPLUME Technologies

## Submittals

1. Shop drawings including but not limited to following:
	1. General description
		1. Fan Type, Configuration, number of fans
		2. Provide fan Curves for each fan system at specified operating point(s), with volumetric flow, static pressure, and horsepower clearly plotted for performance review.
		3. Provide nozzle velocity of exhaust fan, total volumetric exhaust flow, discharge plume elevation(s) at specified crosswind velocity(s).
	2. Scale drawings including plan and elevation views
		1. Duct connections shown in each view
		2. Pertinent dimensions
		3. Dry weight and operating weight
	3. Component data
		1. Accessory items clearly itemized, including material type, size, and power information.
	4. Quality and Performance parameters
		1. AMCA Certification
		2. Adhere to quality assurance requirements set up by AMCA CERTIFCATION PROTOCOL as referenced in section 1.4.C, D, and E in this specification.
		3. Provide AMCA CERTIFIED FEG acceptable rating values

## Delivery, Storage and Handling

1. Fans, fan motors, and accessories, shall be protected from physical damage during delivery, storage and handling.
2. Fan openings shall be protected from dust, debris, and fluids.
3. Inlet and outlet connections, including vents and/or drains shall be capped to prevent foreign material entering the system.
4. Fans, including all system components shall be inspected to ensure no freight damage exists at time of delivery.

## Warranty

1. Fans shall be warranted by the Manufacturer to be free from defects in material and workmanship and perform as specified for a period of one year from date of startup or 15 months from date of site delivery whichever occurs first.
2. Extended warranty on failure do to rust on induction stack shall be honored to 25 years from date of purchase.

# Products

## General

1. All fans shall be rated in accordance with AMCA 210,260 and 300 certification standards.
2. Project-specific performance and construction requirements shall be as scheduled and supplied on project submittal drawings or as otherwise indicated in project submittal documents.
3. Bypass dampers, if with provided with fan system, shall comply with Section 23 09 13 – Control dampers. Not applicable to integral face and bypass dampers. Damper actuators shall be rated for Class 1 Division 1 Groups C and D.
4. Fans and stacks shall be designed and constructed so that the gas stream only contacts solid FRP surfaces.
5. All FRP will be 0-25 Flame spread as per ASTM-E84.
6. The complete system shall be designed to a wind load rating of 125 MPH.
7. All steel fasteners shall be 316 stainless steel.
8. Motor shafts will be fully protected from exposure to the gas stream by FRP shaft sleeves.
9. The fan shall be constructed spark resistant per AMCA Standards 99.
10. The fan arrangement will be based on AMCA 99 and will be Direct Drive AMCA arrangement #4.

## Air Performance

1. The performance ratings are to be in accordance with AMCA 260. No other performance standard or test will be accepted.
2. Fan manufactures catalog will be published and accessible from the AMCA web site certified ratings program.
3. Sound levels, horse power levels are not to exceed scheduled values.
4. Plume heights are to be calculated using the wind band volume by using the ASHREA Briggs effective plume height calculation and are not to be less than scheduled values.
5. Wind band volumes and velocities are not to be less than scheduled values and are derived from AMCA 260 testing.

## Fan Outlet Nozzle And Wind Band

1. The fan discharge will be fitted with a UV stabilized FRP exit nozzle and attached conical FRP wind-band.
2. The nozzle assembly will be designed to dilute outside air with the primary exhaust gas stream.
3. Dilution rates are to be achieved within the nozzle assembly and shall not be less than the scheduled rate.
4. The nozzle assembly will be supported by the fan housing without the need for guy wires or additional supports and the manufacturer will warranty the stack against failure due to rust for 25 years.
5. The outer surface of the nozzle and wind-band will be UV stabilized gel coat.
6. The nozzle assembly shall include a sound attenuating nozzle of tubular style with inner casing and liner, with absorptive aerodynamically shaped center body.
7. Sound attenuator Inlet shall include aerodynamic nose cone to allow for balanced non turbulent airflow.
8. Sound attenuator shall consist of 304 SS interior construction with UV protected fiberglass exterior for long term outdoor service

## Housing Construction

1. The fan housing is to be solid Fiberglass with resin impregnation throughout.
2. The outlet and inlet flanges are to be of heavy industrial quality.
3. All flanges are to have factory flat finishes.
4. The materials of construction will be premium quality vinyl ester resin and reinforcing glass throughout.
5. The entire surface exposed to the gas stream will be complete with a resin-rich corrosion barrier consisting of C-veil and a smooth finish.
6. The outer surface of the housing will be of a heavy UV stabilized gel coat.
7. The housing shall include a machined Teflon shaft seal to limit gas leakage.

## Steel Fan Base

1. The fan base is to be of a heavy-duty industrial quality design to minimize vibration and to ensure long life. The bearing shaft pedestal is to be constructed of heavy gauge steel.
2. The fabrication method is to be all welded.
3. After welding is complete, prior to the fan assembly, the fan base is to be sandblasted white and cladded with FRP to a total of 3/16” thickness.
4. The base is to be rust proof. Painted bases are not acceptable.

## Impeller Design and Construction

1. The impeller is to be of a high efficiency backward inclined design.
2. The materials of construction will be premium quality vinyl ester resin and reinforcing glass throughout.
3. The method of construction is to be fiberglass hand lay-up only.
4. The entire surface of the impeller exposed to the gas stream will be complete with a resin-rich corrosion barrier consisting of C-veil and a smooth finish.
5. The shaft is to be attached to the back -plate of the impeller by way of a taper lock bushing and a one piece cast sprocket hub.
6. The entire shaft attachment assembly is to be completely covered with a minimum 0.25"(6 mm) of FRP lay-up.

## Balancing And Testing

1. All fans shall be completely assembled and test run as a unit at the specified operating speed prior to shipment.
2. Balancing of the impeller shall be achieved only with the use of the identical material used to fabricate the impeller.
3. Balancing shall be in accordance with ASTM D-4167.
4. The fan shall be test run at operating speed and not shipped until vibration readings are within acceptable limits. Acceptable limits are as per G2.5.
5. Records shall be maintained and a written copy shall be available upon request

## Bearings

1. Bearings are to be ball bearing or spherical roller type located inside the motor.
2. The bearings are to be rated and designed for a minimum L-10 life of 200,000 hour.
3. The bearings are to be located out of the air stream.
4. The method of lubrication will be grease per the motor manufacturer's recommendations.

## Drive Arrangements

1. Available for Belt & Direct Drive Arrangements.
	1. V-belt drive shall be sized with a safety factor of 1.5 times the motor horsepower.
	2. An Adjustable base will be provided under the motor to permit setting the belt tensions.

## Guards

1. Weatherproof FRP guards complying with the OSHA standard will protect the shaft and V-belt drive.
2. Guards will be vented for proper motor ventilations.

## Plenum

1. The materials of construction will be as per the fan housing.
2. Dampers, controls and other options will be as detailed in the schedule.
3. Plenums are to be rust proof single wall FRP construction.
4. Plenum to be designed so that actuators are mounted out of the primary airstream.
5. One piece construction with a leak test showing zero leakage up to 20” positive pressure.
6. Dampers shall include actuating operators sized for torque conditions applicable to the damper size, damper flow, and static pressure.
7. Damper actuators serving fan isolation dampers shall be open/close 0-90 degree – 24V complete with explosion-proof housing – Belimo Model: AFBUP-S ACT-Spring.
8. Damper actuators serving plenum by-pass dampers shall be modulating 0-90 degree – 24V with 2-10v positioner complete with explosion-proof housing – Belimo Model: AFB24-SR ACT-Spring, 2-10V.
9. All Dampers shall be epoxy coated aluminum air foil blade suitable for light corrosion duty.
10. Fan Isolation dampers shall be Parallel Action Style.
11. Plenum By-Pass inlet damper(s) shall be Opposed Action Style.

## Motor

1. Premium/High Efficiency Motor shall be Foot mounted, TEFC, NEMA Standard 3-Phase Motors 60Hz, 230/460V with a 1.15 service factor.
2. The motor shall be Inverter Duty with Class F Insulation for up to 40 Deg. C Ambient Temperature for Continuous Duty.

## Shaft

1. Fan Shaft will be 1045 carbon Steel complete with the correct keyways to accept V-Belt Drive Selections
2. The Diameter of the shaft shall be sized to ensure that the critical speed of the fan is at least 25% above the fan operating speed.
3. Motor shaft will be 1045 carbon steel complete with the correct keyways to accept direct wheel/impeller mount selections.
4. The impeller side of the shaft shall be complete with an FRP shaft sleeve, which is bonded to the back-plate of the impeller and protrudes through the housing.
5. The shaft outside diameter shall mate with minimum clearance to a Teflon shaft seal for no metallic contact with airstream.

## Damper

1. Bypass Air Damper(s) shall be opposed blade, air foil design, constructed of either fiberglass reinforced plastic (FRP) or extruded Aluminum with Here-site Coating, with linkage hardware installed in the side frame. Rain hood to be attached with Bypass damper – FRP Construction with Stainless Steel Bird screen
2. Fan Isolation Damper(s) shall be parallel – blade, airfoil design, constructed of either fiberglass reinforced plastic (FRP) or extruded Aluminum with Here-site Coating, with linkage hardware installed in the side frame.