**KROWN-L by Keystone – Fan Filter Unit with Integrated LED Lighting**

***Division 23 – Heating, Ventilating, and Air Conditioning***

***Section 23 37 13 – Diffusers, Registers, and Grilles***

The following specification is for a defined application. Keystone Clean Air Solutions would be pleased to assist in developing a specification for your specific need.

**PART 1 – GENERAL**

**1.01 Section includes**:

1. Fan Filter Unit

**1.02 Related Requirements**

1. Section 01 30 00 – Administrative Requirements
2. Section 01 40 00 – Quality Requirements
3. Section 01 60 00 – Product Requirements
4. Section 01 74 21 – Construction/Demolition Waste Management and Disposal
5. Section 01 78 00 – Closeout Submittals
6. Section 01 79 00 – Demonstration and Training
7. Section 23 31 00 – HVAC Ducts and Casings
8. Section 23 32 00 – Air Plenums and Chases

**1.03 Reference Standards**

A. ASHRAE Standard 55 – Thermal Environmental Conditions for Human Occupancy; 2013

B. ASHRAE Standard 70 – Method of Testing the Performance of Air Outlets and Air Inlets; 2006

C. ASHRAE Standard 170 – Ventilation of Health Care Facilities; 2008

D. ASTM D610 – Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2012

E. ASTM D714 – Standard Test Method for Evaluating Degree of Blistering of Paints; 2009

F. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2013

G. ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008

H. ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub; 2015

I. CSA Standard Z317.2-10 – Special Requirements for Heating, Ventilation, and Air-conditioning (HVAC) Systems in Health Care Facilities; 2010

J. IEST-RP-CC002.3 – Recommended Practice for Unidirectional-Flow of Clean Air Devices; 2009

K. SMACNA (SRM) – Seismic Restraint Manual Guidelines for Mechanical Systems; Sheet Metal and Air Conditioning Contractors’ National Association; 2008

L. UL Standard 507 – Standard for electric fans; 1999

M. UL Standard 723 – Standard for Test for Surface Burning Characteristics of Building Materials; 2008

N. UL Standard 900 – Standard for Air Filter Units; 2015

**1.04 Administrative Requirements**

A. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and efficient manner.

**1.05 Submittals**

A. See Section 01 30 00 – Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and sound power levels for each of the second through sixth octave bands in dBA.

C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication.

D. Certificates: Certify that air capacities, pressure drops, and selection procedures meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.

F. Project Record Documents: Record actual locations of units and control components.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements for additional provisions.

2. Extra Filters: Furnish one spare filter as required per component originally supplied with filters.

**1.06 Quality Assurance**

1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
2. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 Warranty**

1. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
2. Keystone Clean Air Solutions warrants that, at the time of shipment, the KROWN-L will be free from defects arising from manufacturing, workmanship, or a failure to adhere to Keystone Clean Air Solutions’ published catalog specifications and specified material. If Keystone Clean Air Solutions is notified in writing of any such defect within the following specified warranty periods, Keystone Clean Air Solutions will, at its sole option, repair, replace, or refund the purchase price paid by the Representative for the Product:

- LED: (7) years from the date of shipment

- Driver: (5) years from the date of shipment

- All other components and hardware: (1) year from the date of shipment

Such remedies are the exclusive remedies available under this warranty.

**PART 2 – PRODUCTS**

**2.01** **Fan Filter Unit with Integrated LED Lighting**

1. Basis of Design: Keystone Clean Air Solutions, Inc.
2. Fan Filter Unit: Model KROWN-L
3. General:
   1. The fan filter unit shall be supplied to provide unidirectional supply air at controlled discharge velocities. The units shall include integrated high performance LED lighting and a high efficiency HEPA or ULPA filter.
   2. Modules sizes, electrical characteristics, efficiencies, capacities, and options shall be as scheduled on the drawings.
4. Fan Filter Unit with Integrated LED Lighting [Keystone Model KROWN-L]:
   1. Performance:
      1. The unit shall provide filtered air tested at an average velocity of 90 fpm (+/- 15 fpm) measured 12 inches from the face of the unit in accordance with IEST-RP-CC0022.2.
      2. The room sound level shall be less than 56 dBA when measured at 30 inches from the filter face at 90 fpm average face velocity in accordance with IEST-RP-CC0022.2.
      3. The unit is to be factory sealed and tested to assure leakage is consistent with the filter.
   2. Construction:
      1. Plenum material shall be:
         1. 14 GA (0.064 thick) Aluminum
      2. Face material shall be:
         1. Extruded aluminum with translucent perforated polycarbonate
      3. System shall include integrated LED lighting and certified to meet UL507/CSA C22.2 No.113 standard for electric fans.
      4. The diffuser plenum shall feature four (4) eyebolts at each plenum corner for securing the unit to structural supports above the ceiling. Each eyebolt shall be capable of supporting 75 lbs.
      5. The 13% free-area translucent perforated polycarbonate distribution plate shall be secured to the face using quarter-turn fasteners with anti-slip, snap-in retainers and stainless steel retainer cables for ease of installation and removal.
      6. Inlet: standard round or optional square collar for non-ducted applications.
   3. Integrated Lighting:
      1. Each KROWN-L module shall include integrated LED lighting, mounted to not interfere with the airflow of the system. LED strip lights and fluorescent tubes directly in the airflow path are not acceptable.
      2. The entire perforated face of the KROWN-L shall be fully equalized with light. Separate LED channels separating laminar diffusers or embedded into the diffuser frames are not acceptable.
      3. LED lighting shall have an efficiency greater than 90 lumens per watt, and lighting power shall be equivalent to 25 watts per meter for individual LED strip lighting.
      4. LED lighting shall be IP67 rated and not susceptible to dust and liquid cleaning agents.
      5. LED lighting shall achieve Color Rendering Index (CRI) of 90 or higher.
      6. LED lighting shall be rated for L80 > 60,000 hours based on LM-80 testing.
      7. LED lighting shall be certified to meet UL2108 and meet fire/smoke ratings of UL2043.
      8. Photometric IES files, achieved with a type-C Goniometer, shall be available to validate lighting performance.
      9. LED lighting shall be paired with drivers supplied from the integrated laminar flow diffuser assembly manufacturer. Driver shall be capable of 10% dimming, and PWM dimming shall meet IEEE1789.
      10. LED driver shall comply with UL8750/CSA 22.2 No. 223-M91.
      11. LED driver shall achieve Total Harmonic Distortion (THD) < 20% at maximum power
   4. Filters:
      1. Filter type shall be (**select one**):
         1. High Efficiency Particulate Air (HEPA) filter shall provide 99.99% efficiency on .30 μm particulate, with an initial pressure drop of 0.54” wg at 90 fpm.
         2. Ultra-Low Penetration Air (ULPA) filter shall provide 99.9995% efficiency on .12 μm particulate, with an initial pressure drop of 0.66” wg at 90 fpm.
      2. Filter shall be room side removable and replaceable, mounted in an extruded aluminum frame with an integral cavity filled with a urethane gel to provide leak-tight seal between the filter frame and the border.
      3. Filter shall be UL 900 classified.
      4. Filter pack depth shall be 2.0”.
      5. Filter media shall be borosilicate micro-fiberglass.
   5. Plenum Finish shall be:
      1. All aluminum components shall have B12 White baked-on powder coat finish.
         1. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
         2. The paint film thickness shall be a minimum of 2.0 mils.
         3. The finish shall have a hardness of 2H.
         4. The finish shall withstand a minimum salt spray exposure of 1000 hours.
         5. The finish shall have an impact resistance of 80 in-lb.
      2. All aluminum components shall have mill finish.
   6. Face and frame finish shall be:
      1. All aluminum components shall have White B12 Standard baked-on powder coat finish.
         1. The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
         2. The paint film thickness shall be a minimum of 2.0 mils.
         3. The finish shall have a hardness of 2H.
         4. The finish shall withstand a minimum salt spray exposure of 1000 hours.
         5. The finish shall have an impact resistance of 80 in-lb.
   7. Fan:
      1. The centrifugal type fan shall be supplied with rubber mounts to isolate the motor/blower assembly from the diffuser plenum.
      2. Fans are to be of metal construction with a direct drive (**select one**):
         1. Forward curved impeller
         2. Backward curved impeller
      3. Plastic construction shall not be acceptable.
   8. Electrical Systems:
      1. Separate fan and lighting power connections.
      2. Transformers shall be included where required for motor and unit operation.
      3. A factory supplied disconnect switch shall be provided for disconnection of power on both the fan and the LED power connections.
   9. Fan Motor:
      1. The fan motor shall be (**select one**):
         1. Electrically Commutated Motor (ECM):

### Constant Torque Program

* 1. A constant torque program shall be provided to allow the ECM to vary the airflow with fluctuations in both upstream static pressure and filter pressure drop.
  2. The constant torque program shall prevent unexpected motor operation or motor shutdown due to upstream static pressure fluctuations.
  3. The constant torque program shall be used for ducted applications where fluctuations in upstream pressure may occur.

### Constant Flow Program

1. A constant flow program shall be provided to allow the ECM to compensate for fluctuations in both upstream static pressure and filter pressure drop, providing constant airflow.
2. The constant flow program shall be used for non-ducted applications where the inlet static pressure is zero or slightly negative.
   * 1. Fan motor shaft directly connected to fan and isolated from casing to prevent transmission of vibration.
     2. Fan motor shall have internal thermal and overload protection.
     3. Fan motor shaft shall be directly connected to the fan impeller, and isolated from casing to prevent transmission of vibration.
     4. Motor/blower access shall be top and room side accessible on units with room side replaceable filters
     5. Fan motor shall be supplied with a motor speed controller (**select one**):
        1. ECM standard speed controller
           1. The ECM speed controller shall operate on 24 VAC supply voltage.
           2. The ECM speed controller shall have dual outputs to control up to two motors simultaneously.
           3. The ECM speed controller shall be supplied with a BAS interface to accept 2-10 VDC signal for variable speed remote control, as well as be able to remotely shut off via BAS signal.
        2. BACnet Flow Controller:
           1. The BACnet Flow Controller shall be supplied to facilitate adjustment or monitoring of the following parameters through the building networks:

Airflow rate

Motor rpm

Motor hours

Filter status

Filter pressure drop displayed in inches of water

Filter hours

Filter reset

* 1. Options:
     1. Pre-filter (**select one**):
        1. Non-ducted units:
           1. Unit shall be provided with a MERV 4 washable pre-filter.
           2. Unit shall be provided with a MERV 8 pre-filter.
        2. Ducted units:
           1. Unit shall be provided with a MERV 4 washable pre-filter with side access filter housing.
           2. Unit shall be provided with a MERV 8 pre-filter with side access filter housing.
     2. Fan Power cord (**select one**):
        1. An eight foot (2.4 m) power cord shall be supplied for use with a 115 V power supply on the fan control side.
        2. A six foot (1.8 m) power cord shall be supplied for use with a 277 V power supply on the fan control side.
     3. Wall-mounted ECM speed controller:
        1. The wall-mounted ECM speed controller shall operate on 24 VAC supply voltage.
        2. The wall-mounted ECM speed controller shall be supplied with a BAS interface to accept 2-10 VDC signal for variable speed remote control, as well as be able to remotely shut off via BAS signal.
        3. The wall-mounted ECM speed controller shall be capable of daisy chain connections to connect and control thirty (30) fan filter units simultaneously.
     4. Filter and motor status shall be communicated by (**only available with BACnet Flow Controller, select one**):
        1. Status over BACnet

The unit shall be field wired according to the manufacturer’s instructions.

* + - 1. Status over BACnet and Indicator LED

The unit shall be field wired according to the manufacturer’s instructions.

The LED indicator light shall be visible from the occupied area without opening the diffuser. The LED shall be green to indicate normal operation.

The LED shall turn from green to red when the motor is not in operation.

The LED shall turn from green to flashing red when the motor is in operation, and when the unit static pressure is below 0.1” wg.

The LED light shall turn from green to yellow when the pressure drop across the filter exceeds the specified limit.

* + 1. The factory- calibrated motor BAS signal shall close a dry contact to generate a BAS signal when the motor is not operating.
    2. Unit shall be field wired to the terminal block according to manufacturer’s instructions.
    3. Aerosol test system:
       1. A room-side accessible aerosol test system shall be provided for injecting aerosol challenge into the diffuser to allow the filter to be scanned for leaks during commissioning or after filter replacement.
    4. BACnet daisy chaining (**only available with BACnet Flow Controller, select one**):
       1. 12 Foot RJ45 networking cable for BACnet daisy chain connection.
       2. 35 Foot RJ45 networking cable for BACnet daisy chain connection.

**PART 3 – EXECUTION**

**3.01 Examination**

A. Verify that conditions are suitable for installation.

B. Verify that field measurements are as shown on the drawings.

**3.02 Installation**

1. Install in accordance with manufacturer’s instructions.
2. See drawings for the size(s) and locations of fan filter unit inlets.
3. Support components individually from structure in accordance with SMACNA (SRM).
4. Do not support components from ductwork.
5. Connect to ductwork in accordance with Section 203 31 00.

**3.03 Adjusting**

1. Ensure supply air to the fan filter units by performing pitot traverse of the main supply duct.
2. Balance outlets according to manufacturer’s recommendations.
3. Verify that field measurements are as shown on the drawings.

**3.04 Field Quality Control**

1. See Section 01 40 00 – Quality Requirements for additional requirements.

**3.05 Cleaning**

1. See Section 01 74 19 – Construction Waste Management and Disposal for additional requirements.

**3.06 Closeout Activities**

1. See Section 01 78 00 – Closeout Submittals for closeout documentation requirements.
2. See Section 01 79 00 – Demonstration and Training for additional requirements.

**END OF SECTION 23 37 13**