

# Laboratory Exhaust Systems

Vektor®-HS, Vektor®-MS and Vektor®-CS

with Variable Geometry Nozzle



**VEKTOR**®



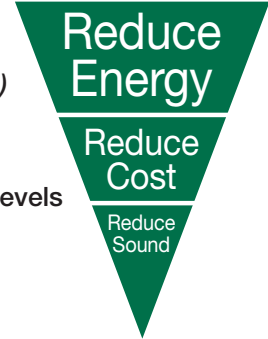
 **GREENHECK**  
Building Value in Air.

September  
2017

Greenheck's Variable Geometry Nozzle exhaust systems allow for the safe use of a variable frequency drive to adjust the lab exhaust fan flow based on actual system demand. As exhaust airflow adjusts through the high plume exhaust fans, our integral flow monitoring station and preprogrammed controls adjust the nozzle position to maintain a safe exit velocity per ANSI Z9.5. This is an ideal energy saving solution for laboratory and fume exhaust systems with high variability in peak and downtime demand such as school and university teaching laboratories.

## Benefits

- Maintains safe discharge velocity per design or ANSI Z9.5 (3000 ft./min. or 15.2 m/s)
- Integral flow monitoring with fan venturi
- Preprogrammed nozzle control to monitor fan airflow and adjust nozzle position
- Reduces or eliminates need for bypass air which can further reduce system sound levels
- Assists in overall sound reduction during non-peak conditions such as nights and weekends
- Typical payback less than two years and may be eligible for local utility rebates
- Quick single cable connection provides easy installation



	Vektor-HS	Vektor-MS	Vektor-CS
Wheel Type	Centrifugal (Backward Inclined)	Mixed Flow (Backward Curved)	Centrifugal (Backward Inclined or Airfoil)
Peak Airflow & Pressure (per fan)	26,000 cfm (44,200 m <sup>3</sup> /hr) 3.5 in. wg (870 Pa)	32,000 cfm (54,400 m <sup>3</sup> /hr) 10 in. wg (2,490 Pa)	32,000 cfm (54,400 m <sup>3</sup> /hr) 10 in. wg (2,490 Pa)
Drive Type	Belt drive	Direct or belt drive	Direct or belt drive
Housing Construction	Belts and drives sealed from contaminated airstream AMCA Spark B	Bifurcated housing isolates drive components from contaminated airstream AMCA Spark B or C	Drive components isolated from contaminated airstream AMCA Spark B or C
Fans Per Common Plenum	Up to 3	Up to 4	Up to 4
Construction	AMCA Spark B explosion resistant construction	AMCA Spark B or C explosion resistant construction	AMCA Spark B or C explosion resistant construction
Certifications	- AMCA Air Performance - Florida Product Approval & NOA Certification - UL 705 Listed for Electrical - Texas Department of Insurance RV-88	- AMCA Sound and Air Performance - UL 705 Listed for Electrical	- AMCA Sound and Air Performance - UL 705 Listed for Electrical - OSHPD-0503-10

Vektor Variable Geometry Nozzle Patents  
Manufactured by Greenheck Fan Corp. U.S. and Foreign Patents Pending



Vektor-HS, Vektor-MS and Vektor-CS are Listed for Electrical UL/cUL 705  
File no. 40001



Vektor-HS



Vektor-MS



Vektor-CS

**1** Variable Geometry Nozzle (VGN) with adjustable blades maintain a programmed discharge velocity.

- Durable blade edge seals
- Bearings are maintenance free
- Stainless steel axles

**2** Modulating actuators with position feedback are housed in weather tight enclosure and easily removable access panel.

**3** Sure-Aire™ non-invasive flow measurement uses pressure differential to provide accuracy within 3%.

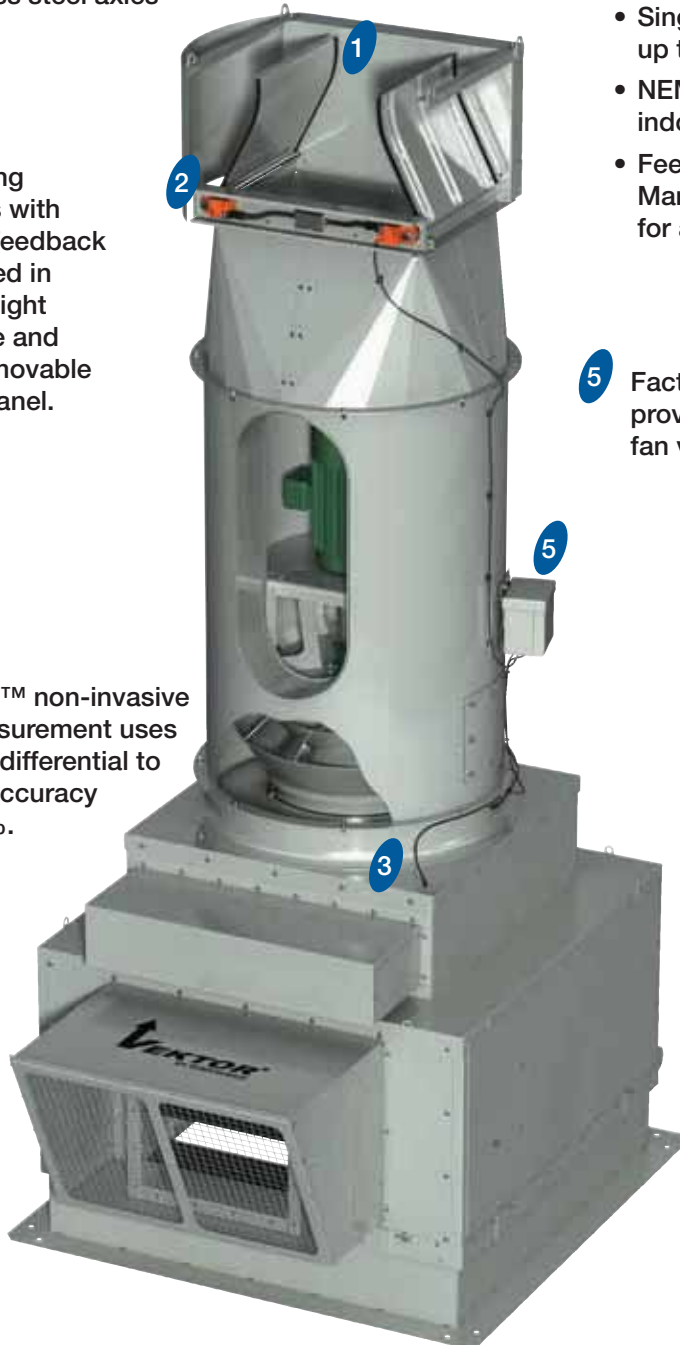
**4** Greenheck supplied VGN controller adjusts nozzle based on individual fan volume.

- Preprogrammed logic relates volume to velocity and actuator position
- Single controller can direct up to four fans
- NEMA-3R enclosure for indoor or outdoor mounting
- Feedback to Building Management System (BMS) for airflow and alarm



VGN Controller for Single or Multiple Fans

**5** Factory-mounted pressure transducer provides real-time electronic signal of fan volume.



### Velocity by Demand

The VGN Controller accepts input signal from Building Management System (BMS) for on-the-fly set point velocity adjustments.

- React to changing conditions such as wind speed, wind direction, or laboratory sensor readings.
- Velocity range of 2,000 to 4,000 fpm

*Fan speed controlled by BMS through VFD supplied by others.*

### All Vektor models:

- Meet ANSI and ASHRAE laboratory design standards
- Assemblies are vibration tested to AMCA standard 204-05
- Can withstand 125 mph (241 kph) windload without guy wires



## VAV Laboratory Exhaust Fan System Operation

Laboratory exhaust fans have requirements not found in general exhaust ventilation applications. These safety requirements increase overall energy consumption making laboratory exhaust fans notorious energy consumers.

To reduce costs, laboratories commonly utilize variable air volume (VAV) designs, but how the exhaust fan system is designed and controlled can mean additional energy cost reductions.

## Exhaust Fan System Options

### System with Bypass Damper

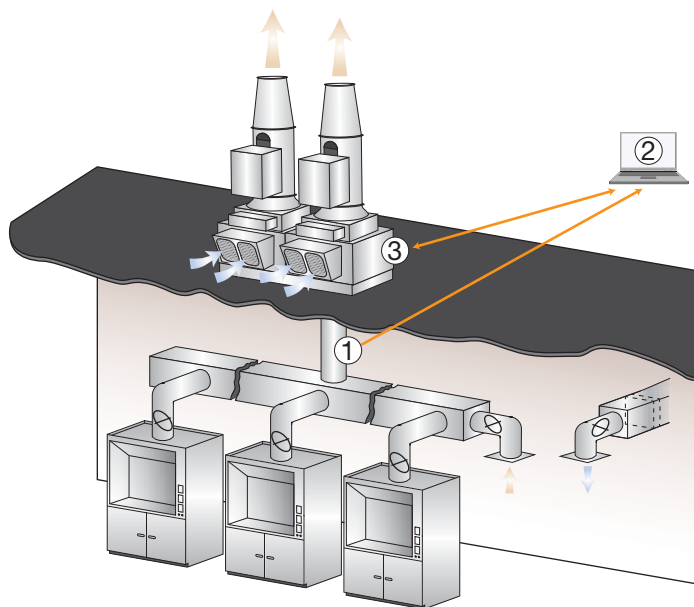
Fan speed and fan exhaust volume are held constant while the bypass air damper draws outdoor air and modulates to maintain a set static pressure in the ductwork as laboratory airflow demand varies.

#### Advantages:

- Constant plume height

#### Disadvantages:

- Constant fan volume without reduction in fan energy
- Controls for bypass damper



#### Operating Sequence

1. Static pressure sensor to detect system pressure changes\*
2. Building Management System (BMS) or controller monitors duct pressure\*
3. **Bypass Damper** - Signal to modulating bypass air damper to balance duct system pressure

OR

3. **VFD Control** - Signal to VFD adjusts fan volume to balance duct system pressure

\* Supplied by others

### System with VFD Control

Incorporates a variable frequency drive (VFD) to vary the exhaust fan motor speed, maintaining static pressure in the ductwork. The exhaust fan(s) and their discharge outlet nozzle(s) are sized such that the ANSI required 3,000 fpm discharge velocity is maintained at the lowest airflow from the laboratory. Fan operates at minimum velocity only during minimum lab flow and at higher velocity and horsepower in all other conditions.

#### Advantages:

- Maintains outlet velocity even at lowest performance

#### Disadvantages:

- Over sizes fan motor and electric wiring
- Higher first cost
- Higher sound levels
- Higher velocities and overall power requirements

# Variable Geometry Nozzle (VGN) Performance

## System with VGN Control

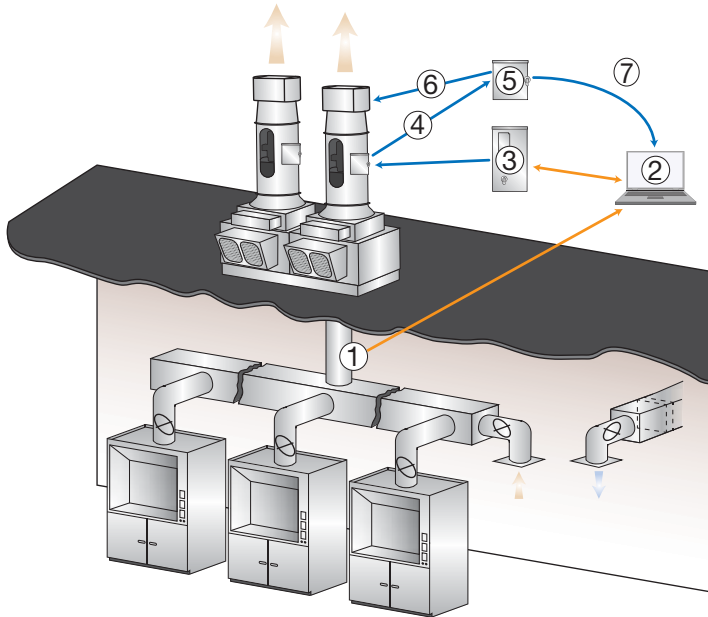
VGN technology works in conjunction with an exhaust fan, VFD and building management system to maintain a minimum outlet velocity as laboratory airflow demand changes. When airflow demand changes, the fan speed is adjusted through a VFD to maintain static pressure in the ductwork, and simultaneously the nozzle outlet area modulates by adjusting the two nozzle blades. By modulating the outlet area, a constant discharge velocity can be maintained. Exhaust system operates at varying RPM, volume and power.

### Advantages:

- Maintains outlet velocity even at lowest performance
- Lower sound levels at maximum volume
- Minimizes horsepower

### Disadvantages:

- Higher first cost



### Operating Sequence

1. Static pressure sensor to detect system pressure changes\*
2. Building Management System (BMS) or controller monitors duct pressure\*
3. Signal to VFD adjusting fan volume to balance duct system pressure
4. Sure-Aire™ flow measurement signal to VGN controller†
5. Nozzle controller†
6. Signal to variable geometry nozzle maintaining set discharge velocity†
7. Feedback sent back to BMS, including airflow and alarms

\* Supplied by others

† Supplied by Greenheck

## Performance Comparison Example

The following table contains information for fan selections made based on the three operating methods discussed. The selection criteria for these selections are as follows:

- Maximum airflow: 10,000 cfm
- External static pressure 1 in. wg
- Minimum airflow: 5,000 cfm
- Minimum discharge velocity of 3,000 fpm

Exhaust System	Fan Size/ Nozzle Dia. (in.)	Motor HP	Minimum Operating Point			Maximum Operating Point		
			Brake HP	Discharge Velocity (fpm)	dBA @ 5 ft.	Brake HP	Discharge Velocity (fpm)	dBA @ 5 ft.
Bypass Damper	24 / 24	5	4.9	3,185	78	4.9	3,185	78
VFD Control	24 / 17	10	2.1	3,165	70	9.3	6,329	80
<b>VGN Control</b>	<b>24 / Variable</b>	<b>5</b>	<b>1.82</b>	<b>3,000</b>	<b>70</b>	<b>4.38</b>	<b>3,000</b>	<b>77</b>

Selections were made using a direct drive, bifurcated inline laboratory exhaust fan with mixed flow impeller.

Vektor fans with the Variable Geometry Nozzle have a lower brake horsepower and reduced sound, while maintaining a safe nozzle discharge velocity.

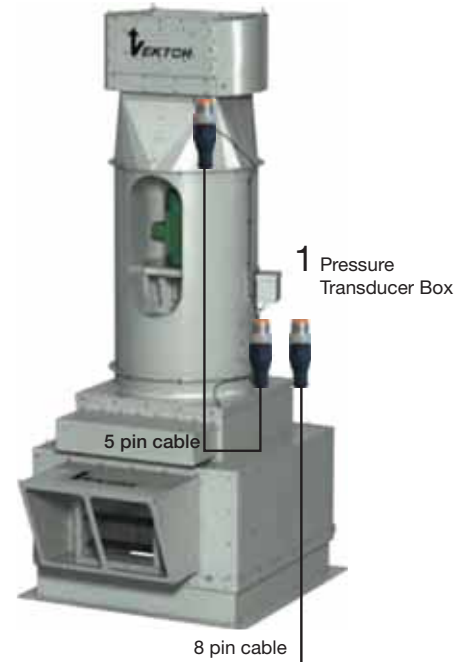
## Easy to Install – Save Time

- Greenheck supplied control cabling between nozzle, transducer and VGN controller
- Pin connectors for error free and easy connections
- Controller preprogrammed from factory
- One controller for up to four fans

## Wiring Overview



**2 VGN Controller Box**  
Mount VGN controller box upright with connectors down on structural support within 20 feet from center of fan plenum.



**3** Incoming Power Options:  
120V, 208V, 240V, 480V  
1PH, 15 Amp Circuit

**4**

VFD Connection:  
24 VAC fan run signal from VFD to **1FNRUN** and **+24V**  
NOTE: Repeat above steps for fan number 2, 3, 4 if applicable.

BMS Connection:  
Analog BMS Communications: (all hardwire connections)  
**Nozzle Feedback - connect to 1NZFB1 and COM, 1NZB2 and COM**  
**Fan Flow - connect to 1SURAR and COM**  
NOTE: Repeat above steps for fan number 2, 3, 4 if applicable  
**Alarm - connect to ALM1 and ALMCOM**

----- Field Wiring  
———— GFC Provided Cables

NOTE: Duct pressure modulation, fan speed, isolation damper and bypass damper control wiring is by others.

## Wired in Four Steps:

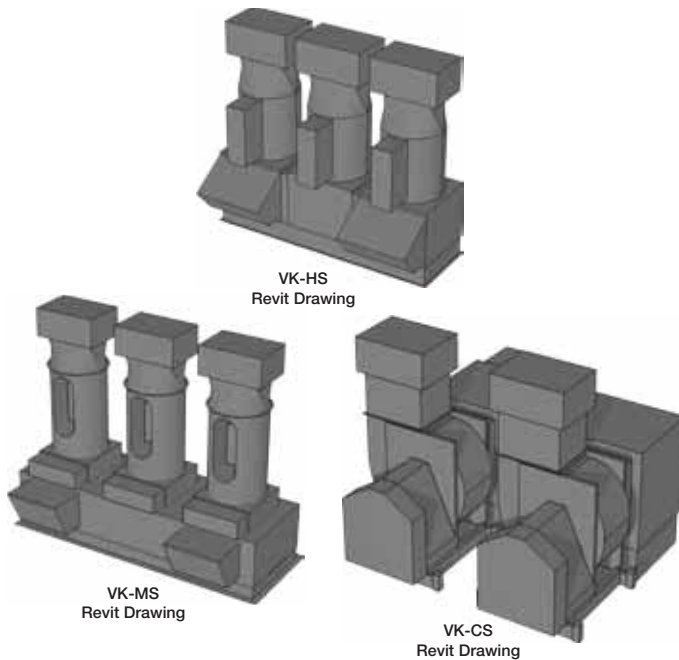
1. Connect 5 pin cable from nozzle to factory-mounted pressure transducer box (repeat step for number of fans installed). Mount provided adhesive cable clips every 12 inches down fan stack and secure cable.
2. Connect 8 pin cable from pressure transducer box to VGN control box. Repeat step for number of fans installed and connect as labeled 1, 2, 3, 4 for corresponding fan. Each fan is provided with (3) 10 meter cables; use as required.
3. Run power wiring in conduit to VGN controller box.
  - 24 VAC fan run contact
  - BMS communications
  - Proper incoming power
4. All wiring by others per local codes

Check out Greenheck's video  
**Vektor® Variable Geometry Nozzle (VGN) Quick Install Guide**  
at [greenheck.com/resources/library/videos](http://greenheck.com/resources/library/videos)



## Computer Aided Product Selection (CAPS®)

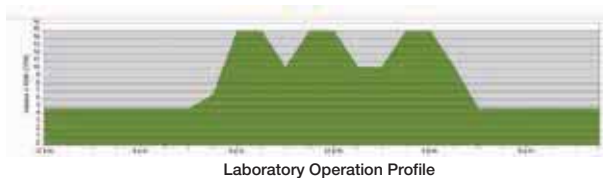
- Size options presented for side-by-side comparison
- Sort sizes by criteria such as fan RPM, energy consumption, sound levels and effective plume height at maximum and minimum operation
- Full submittal information, drawings, weight, fan curves and component details, print or PDF
- Revit® and scaled AutoCAD® drawings are downloadable as configured



## Operational Profile (CAPS®)

Evaluate energy savings and payback period based on expected usage with customizable 24-hour laboratory operation profile.

Time	Lab Exhaust Volume (CFM)	Fan Operating Volume (CFM)	Bypass Air (Per Fan) (CFM)	Fan Operating Power (hp)	SAVVE System Volume (CFM)	SAVVE System Power (hp)	Fixed Discharge System Volume (CFM)	Fixed Discharge System Power (hp)
12:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
1:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
2:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
3:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
4:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
5:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
6:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57



## eCAPS® Engineer Application Suite

eCAPS is an online fan and louver selection tool designed specifically for HVAC engineers. It includes online fan and louver selection and a Toolbox with helpful guides, system effects simulator, and online fan courses.



eCAPS guides you to choose the best value fan or louver without needing to know a lot about HVAC or our specific model names. It's quick, easy and Greenheck's eCAPS ensures your selection is the most appropriate for your application.

- Fume Exhaust "Application Based" selections in eCAPS guide you through the key selection criteria
- Browser based - no installation, no admin rights required, always updated
- Fast - easy in, easy out - provides just enough information to populate a schedule
- Revit® and AutoCAD® drawings



## Complete fan system AMCA Licensed

- AMCA Licensed as a complete assembly including discharge nozzle
- Performance testing of air movement, energy consumption, and sound levels



Vektor-HS



Vektor-MS



Vektor-CS

# VEKTOR® Family of Lab Exhaust Systems

**High Plume** - Effective means of creating a discharge plume height to prevent re-entrainment of chemical exhaust fumes into make-up air systems.



### Vektor-H

- High Plume Discharge Nozzle
- Centrifugal wheel
- Compact design / sealed airstream components
- Up to 26,000 cfm and 4 in. wg



### Vektor-MH

- High Plume Nozzle
- Mixed flow wheel / bifurcated housing
- Compact design
- Up to 47,000 cfm and 11 in. wg



### Vektor-CH

- High Plume Nozzle
- Centrifugal wheel
- Up to 56,000 cfm and 12 in. wg

**High Plume Dilution** - Fan design that entrains and mixes outside ambient air into the exhaust airstream prior to exiting out the windband discharge. Potentially hazardous exhaust or exhaust fumes are diluted and dispersed quickly.



### Vektor-MD

- High Plume Discharge Nozzle with Entrainment and Dilution
- Mixed flow wheel / bifurcated housing
- Compact design
- Up to 83,000 cfm and 11.5 in. wg



### Vektor-CD

- High Plume Discharge Nozzle with Entrainment and Dilution
- Centrifugal wheel
- Highest efficiency / easy service design
- Up to 122,000 cfm and 13.5 in. wg

**High Plume Variable Geometry Nozzle (VGN)** - The discharge area automatically adjusts to maintain a constant discharge velocity and remain compliant to design codes. VGN maximizes effective plume heights during periods of reduced flow and lower discharge velocity fixed nozzles.



### Vektor-HS

- VGN discharge nozzle technology
- Variable volume flow – constant velocity discharge
- Centrifugal wheel
- Up to 26,000 cfm and 3.5 in. wg



### Vektor-MS

- VGN discharge nozzle technology
- Variable volume flow – constant velocity discharge
- Mixed flow wheel / bifurcated housing
- Up to 32,000 cfm and 10 in. wg



### Vektor-CS

- VGN discharge nozzle technology
- Variable volume flow – constant velocity discharge
- Centrifugal wheel
- Up to 32,000 cfm and 10 in. wg

## Our Commitment

*As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.*

Specific Greenheck product warranties are located on [greenheck.com](http://greenheck.com) within the product area tabs and in the Library under Warranties.



Prepared to Support Green Building Efforts

