Laboratory Exhaust Systems

Vektor®-HS, Vektor®-MS and Vektor®-CS

with Variable Geometry Nozzle



GREENHECK
Building Value in Air.

December
2014

Vektor®-HS, Vektor®-MS and Vektor®-CS

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Greenheck's Vektor-HS, MS and CS utilize variable geometry nozzles (VGN) to safely reduce the energy costs of the exhaust fans on a variable volume lab exhaust system. Vektor VGN systems safely apply a variable frequency drive to control the fan speed, while our Sure-Aire, non-invasive airflow monitoring system and integral control position our aerodynamic nozzle blades to attain the desired nozzle velocity. Our system is capable of reducing fan energy costs by 50% or more based on the variability of exhaust requirement within the lab system.

Benefits



- Maintains safe discharge velocity per design or ANSI Z9.5 (3000 ft./min. *or 15.2 m/s)*
- Preprogrammed control to monitor fan exhaust and adjust nozzle position
- Assists in overall sound reduction during non-peak conditions such as nights and weekends
- Fan turndown during non-peak operating times reduces sound
- Reduces or eliminates need for bypass air which can further reduce system sound levels
- Typical payback less than two years and may be eligible for local utility rebates
- Weatherproof nozzle design effectively sheds snow and ice

	Vektor - HS	Vektor - MS	Vektor - CS
Wheel	Centrifugal wheel	High efficiency mixed flow wheel	Centrifugal backward inclined or airfoil wheel
Performance	Per fan volumes up to 24,000 cfm (40,700 cmh) and pressure to 3.5 in. wg (875 Pa)	Per fan volumes up to 38,500 cfm (65,400 cmh) and pressure to 8 in. wg (2,000 Pa)	Per fan volumes up to 38,500 cfm (65,400 cmh) and pressure to 8 in. wg (2,000 Pa)
Drive Type	Belt drive	Direct or belt drive	Direct or belt drive
Housing	Belts and drives sealed from contaminated airstream	Bifurcated housing completely isolates any drive components from contaminated airstream for increased safety during maintenance	Drive components out of airstream; motor at roof deck level; distributed weight load
Fans Per Common Plenum	Up to 3	Up to 6	Up to 6
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 - OSHPD (Seismic) - NOA Certification - UL 705 Listed for Electrical	- AMCA Sound and Air Performance - UL 705 Listed for Electrical	- AMCA Sound and Air Performance - UL 705 Listed for Electrical

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

c UL US LISTED

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



Vektor-HS



Vektor-MS



Vektor-CS

Variable Geometry Nozzle System

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



Variable geometry nozzle with adjustable blades maintain a programmed discharge velocity.

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

Building Management System signals VFD to adjust fan speed to match ventilation demand	
Option 1	**Option 2**
VFD and integral controller supplied by Greenheck. Preprogrammed controller logic relates volume to velocity and actuator position. Signals adjustment to nozzle actuator. 	Required VFD not supplied by Greenheck
	VGN controller from Greenheck. Preprogrammed logic relates volume to velocity and actuator position. 

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

Pressure transducer provides real-time electronic signal of fan volume.



Labeled terminal strip for easy wiring connections.



All Vektor models:

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

Variable Geometry Nozzle System

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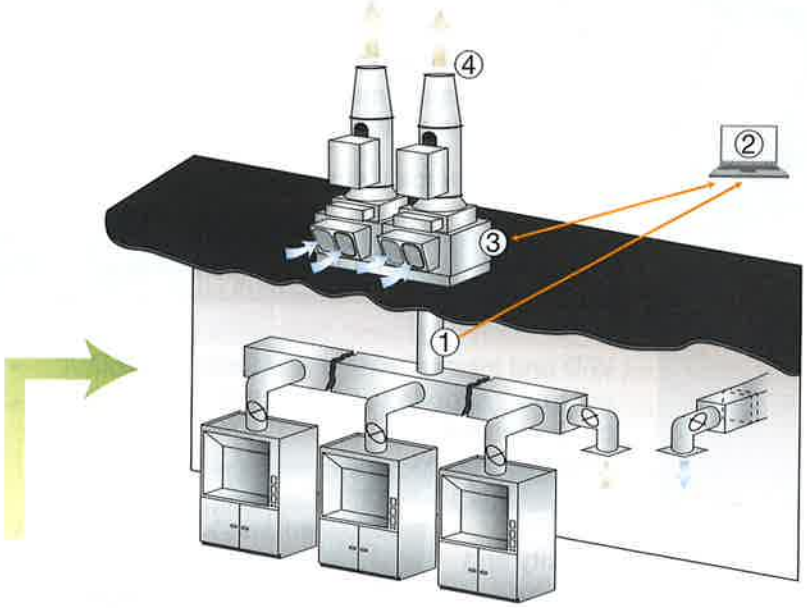
A variable air volume laboratory reduces operational expenses by managing exhaust flows and the conditioned make-up air. The two layouts below illustrate how a system using a variable geometry nozzle system operates differently than a traditional exhaust system on a VAV laboratory.



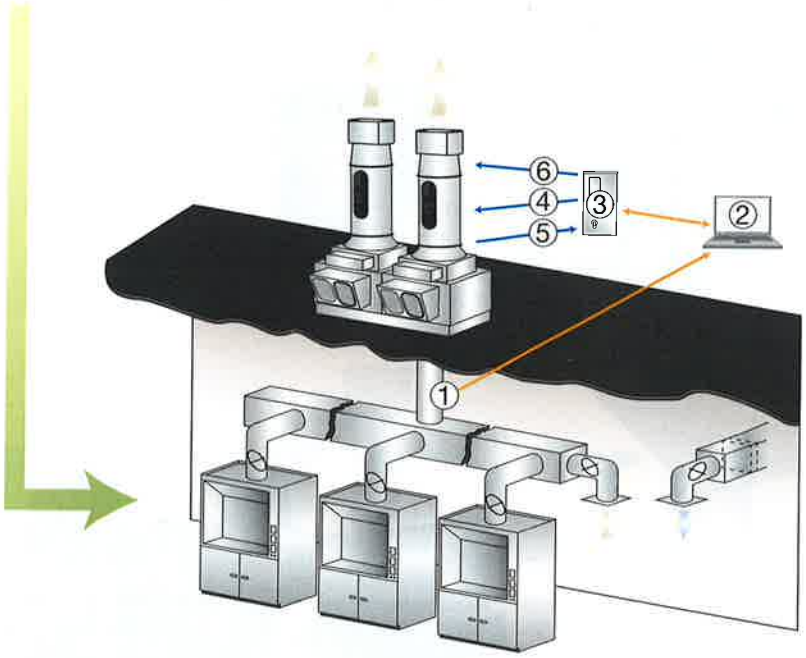
Laboratory exhaust flow rates vary through their application or building requirements. Examples of factors that influence the exhaust volume:

- Maintaining room pressurization (positive or negative) relative to adjacent rooms
- Occupancy level
- Sash position / hood operation
- Night setback mode
- Emergency spill condition
- Room temperature, humidity

VAV Laboratory - Traditional Exhaust

Bypass damper adjusts to maintain pressure. Fan operates at constant RPM, volume and power.

1. Static pressure sensor to detect system pressure changes
2. Building Management System (BMS) or controller monitors duct pressure
3. Signal to modulating bypass air damper to balance duct system pressure
4. Constant outlet area and velocity

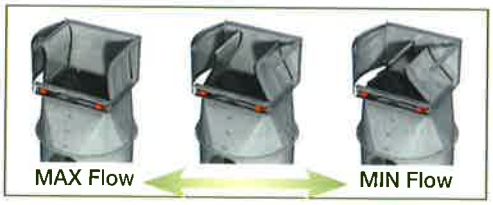


Automatic Nozzle Positioning to maintain constant discharge velocity with variable fan flow. The energy required to move bypass air in a traditional system is saved.

VAV Laboratory - with Variable Geometry Nozzle

Nozzle blades adjust to maintain constant discharge velocity. Fan operates at varying RPM, volume and power.

1. Static pressure sensor to detect system pressure changes
2. Building Management System (BMS) or controller monitors duct pressure
3. Signal to VFD adjusts fan speed to maintain duct system pressure
4. Signal to fan motor changing Hz and fan RPM
5. Sure-Aire fan volume measurement signal to VGN controller
6. Signal to variable geometry nozzle maintaining set discharge velocity



Variable Geometry Nozzle System Benefits

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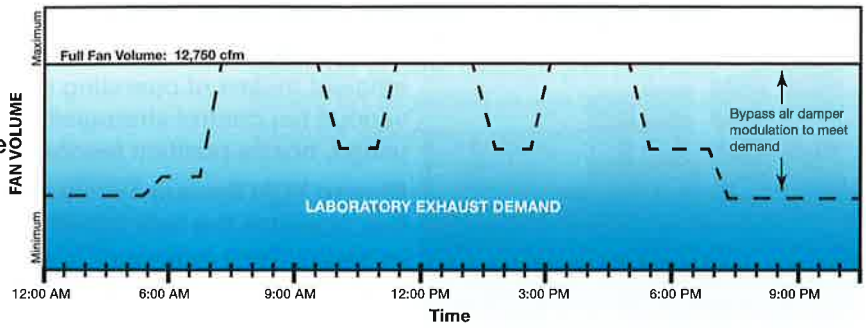
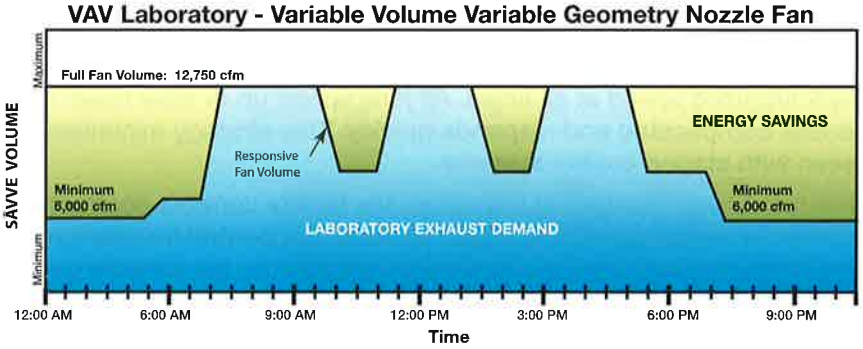
Operational profiles show that demand in exhaust flow varies throughout the day. The traditional VAV system uses a constant volume exhaust fan with a modulating bypass air damper to maintain duct static pressure, discharge velocity and plume height.

A variable geometry nozzle system matches the fan performance to the space while maintaining safety in the laboratory. With a variable geometry nozzle, fan speed reductions result in lower energy costs, discharge velocity is maintained, sound levels are lower and plume rise is maximized.

VAV Laboratory - Constant Volume Fan



VAV Laboratory - Variable Volume Variable Geometry Nozzle Fan



Why not just use a VFD on a traditional system instead of modulating a bypass damper?

Operating a VFD alone to adjust fan speed accomplishes energy savings, but has two unintended consequences; discharge velocities below ANSI Z9.5 minimums and lower plume heights, resulting in possible re-entrainment of exhaust air into the make-up air system. The table below compares performance results of same sized fans using different fan discharge types or control strategies. Orange values: Indicate lower performance and velocities that are less than ANSI minimums. **Green values:** Indicate superior performance or compliance to ANSI minimum discharge velocity of 3,000 ft./min.

Traditional Variable Volume System Utilizing Bypass Air Dampers and Fixed Diameter Discharge Nozzles								
Size 27, Mixed Flow High Plume	Laboratory Demand	System Operation	Nozzle Diameter	Outlet Velocity (ft./min.)	Fan RPM	Power (hp)	Effective Plume Height* (ft.)	Outlet Sound (dBA @ 5 ft.)
	Full 12,750 cfm @ 4.0 in. wg	Max fan speed, bypass damper closed	28 inch	3000	1622	13.62	37.9	85
	Minimum 6,000 cfm @ 4.0 in. wg	Max fan speed, bypass damper open	28 inch	3000	1622	13.62	37.9	85
		Reduced fan speed, using VFD	28 inch	1412	1221	6.11	20.7	75
Variable Volume System Utilizing Variable Geometry Nozzle								
Size 27, Mixed Flow VGN	Laboratory Demand	System Operation	Nozzle Diameter	Outlet Velocity (ft./min.)	Fan RPM	Power (hp)	Effective Plume Height* (ft.)	Outlet Sound (dBA @ 5 ft.)
	Full 12,750 cfm @ 4.0 in. wg	Max fan speed, variable geometry nozzle at maximum open area	28 inch	3000	1622	13.62	37.9	85
	Minimum 6,000 cfm @ 4.0 in. wg	Reduced fan speed using VFD	19 inch	3000	1272	6.89	30.4	75

* Effective plume height includes physical height of the fan plus plume rise calculated using the ASHRAE 2011 Geometric Method with a 10 mph cross wind, surface roughness of 0.03

Variable Geometry Nozzles:

- Reduce power consumption vs. constant velocity at minimum operation
- Reduce sound dBA
- Maintains outlet velocity with higher effective plume height vs. fixed discharge nozzle with VFD

Control Strategies ... Greenheck Can Help



Greenheck has tested multiple control strategies to determine the most efficient means of operating a variable geometry nozzle system. The various fan control strategies operate to provide real-time motor energy usage, nozzle position feedback, and airflow values.

Staged VGN System – A multiple fan exhaust system employing logic that operates the fans based on exhaust demand. On reaching an individual fan's maximum or minimum capacity, the next fan is turned on or off respectively. All operating fans run at the same speed. Staged control strategies can provide for the most energy savings as fans that are not required are off during lower demand periods.

Synchronized VGN (floating) System – A multiple fan exhaust system with all fans operating at a synchronized speed at all times. All fans speed up or slow down in response to demand. The control staging is less complicated and responds quickly. This strategy minimizes pressure variations in the duct as may be seen with staged control systems.

For the desired method of operation, the facility controls contractor programs the BMS or laboratory controller to manage the exhaust system. The control installation manual is utilized as a guide to set-up and link the controller into the system and incorporate the variable geometry nozzle operation.

Every system includes an installation and operation manual for electronic controls detailing information on a single fan system, multiple staged fans and multiple synchronized (floating) fans. Items covered are controls start-up procedure, sequence of operation, flow charts for each strategy, and terminal connection points allowing for seamless integration into building management systems.

A thoroughly tested system

Variable geometry nozzle



- Bearings for adjustable blades are maintenance free
- Self-cleaning feature allows debris or snow to pass out on each side of the blades
- Actuator cabinet designed for all season weather protection with an easily removable cover to connect and inspect actuators
- UV and chemical resistant blade seals are replaceable from outside the contaminated airstream

Controller cabinet



- Controller cabinet (with VFD or standalone) is UL electrical rated and mounted in NEMA 3R rated enclosure

Complete fan assembly testing

- Complete fan assembly is factory tested to AMCA 204 vibration limits
- Analysis for undue vibration in all three planes (x,y,z) with measurements available on request

Service and installation ease



- Controller and VFD with optional remote mounting. Greenheck's VFD includes a removable user interface.
- Factory mounted terminal strip in transducer panel labeled with connection points for easy hook-up to external devices
- Sure-Aire transducer and the controller are preprogrammed at the factory
- VFD with integral controller utilizes BACnet™ communication protocol (LonWorks® optional)



The Greenheck Vektor Advantage

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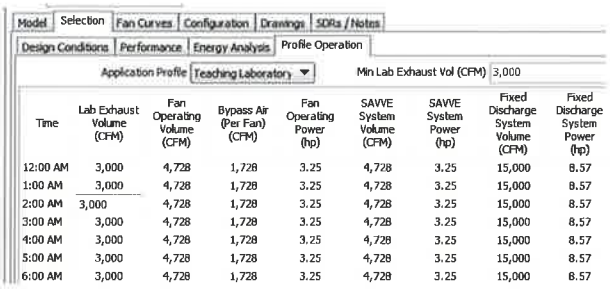
Computer Aided Product Selection (CAPS)

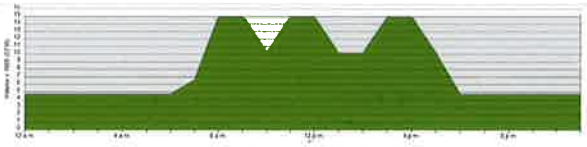
- Size options presented for side-by-side comparison
- Sort sizes by criteria such as fan RPM, energy consumption, sound levels and effective plume height at maximum and minimum operation
- Full submittal information, drawings, weight, fan curves and component details, print or PDF
- Revit® and scaled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

Operational Profile (CAPS)

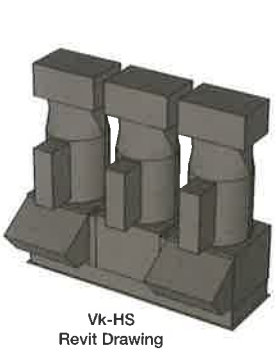
Evaluate energy savings and payback period based on expected usage with customizable 24-hour laboratory operation profile.



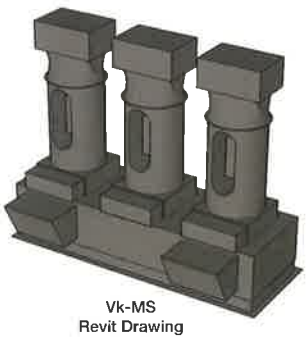
Time	Lab Exhaust Volume (CFM)	Fan Operating Volume (CFM)	Bypass Air (Per Fan) (CFM)	Fan Operating Power (hp)	SAVVE System Volume (CFM)	SAVVE System Power (hp)	Fixed Discharge System Volume (CFM)	Fixed Discharge System Power (hp)
12:00 AM	3,000	4,728	1,728	3.25	4,728	3.25	15,000	8.57
1:00 AM	3,000	4,728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



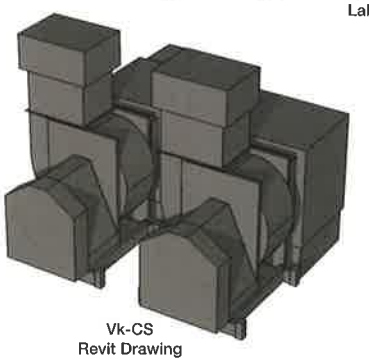
Laboratory Operation Profile



Vk-HS
Revit Drawing



Vk-MS
Revit Drawing



Vk-CS
Revit Drawing









Single Source Supplier

- Manufacturer of the fans, wheels, housings, plenums, dampers, and coils
- All system components are designed and integrated for life safety laboratory exhaust applications
- Control of the manufacturing process and maintaining high quality standards
- Single source responsibility with over 65 years of HVAC experience
- Installations throughout the U.S.

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 24,000 cfm and 3.5 in. wg



Vektor-MH
- High Plume Nozzle
- Mixed flow wheel / bifurcated housing
- Compact design
- Up to 60,000 cfm and 8 in. wg



Vektor-CH
- High Plume Nozzle
- Mixed flow wheel / bifurcated housing
- Compact design
- Up to 60,000 cfm and 8 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 is diluted and dispersed quickly.



Vektor-MD
- High Plume with Entrainment and Dilution
- Mixed flow wheel / bifurcated housing
- Compact design
- Up to 80,000 cfm and 8 in. wg



Vektor-CD
- High Plume Discharge Nozzle with Entrainment and Dilution
- Centrifugal wheel
- Highest efficiency / easy service design
- Up to 120,000 cfm and 14 in. wg

High Plume Variable Geometry Nozzle - Constant discharge velocity for variable volume applications. Discharge area changes to maintain constant discharge velocity and remain compliant to design codes. VGN maximizes effective plume heights during periods of reduced flow



Vektor-HS
- Variable geometry discharge nozzle
- Variable volume flow – constant velocity discharge
- Centrifugal wheel
- Up to 24,000 cfm and 3.5 in. wg



Vektor-MS
- Variable geometry discharge nozzle
- Variable volume flow – constant velocity discharge
- Mixed flow wheel / bifurcated housing
- Up to 38,500 cfm and 8 in. wg



Vektor-CS
- Variable geometry discharge nozzle
- Variable volume flow – constant velocity discharge
- Mixed flow wheel / bifurcated housing
- Up to 38,500 cfm and 8 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 within the product area tabs and in the Library under Warranties.

U.S. GREEN BUILDING COUNCIL MEMBER

Prepared to Support Green Building Efforts

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P.O. Box 410 • Schofield, WI 54476-0410 • Phone (715) 359-6171 • greenheck.com

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