

**High Volume Low-Speed Fan
Comparison between Epoch 2.0 12-ft
and Greenheck DS-6 12-ft HVLS Fans**

by

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Executive Summary: A 30-point comparison is done between Epoch 2.0 and Greenheck DS-6 fans. This paper recommends Epoch 2.0 fans for reasons of high performance, efficiency, reliability, and technology. Also, lower cost of acquisition, operation and maintenance, and ready availability.

Abstract: This article presents a side by side comparison between Epoch 2.0 HVLS fans and Greenheck DS-6 fans. Published Specifications and Website information are taken into consideration. Parameters such as motor power, blade diameter, fan speed, input current, input voltage, power factor, torque, motor weight, number of blades, installation, etc. are going to be compared.

Introduction: Direct drive platforms for HVLS fans are gaining in popularity over the past few years. Several companies have launched their direct drive platforms since 2014 including MacroAir, BigAss, Greenheck, and Hunter Fans, etc. Several attempts have been made by other HVLS fan companies to manufacture direct drive fans. Most are either in the development stage or have experimented with various available direct drive platforms. Most of the manufacturers have an abysmal understanding of the characteristics of the motors and inverters required for HVLS fan performance. This paper limits its comparison between one type of Epoch 2.0 Ø 12 ft. HVLS fan and Greenheck DS-6 Ø 12 ft HVLS Fan.

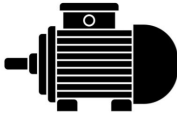
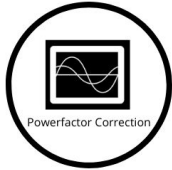
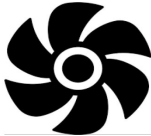



Epoch 2.0 Fans: Epoch 2.0 fans are built using expanded diameter fractional slot permanent magnet synchronous motor (EDFS-PMSM) technology. The motor is controlled using power factor corrected field-oriented controls with space vector modulation. Epoch 2.0 Fans have been developed by Falco eMotors located in the state of Virginia, USA. The technology has been developed in collaboration with some major US and Canadian companies specializing in the sale of HVLS fans. The company has several fan models available from 6-ft to 24-ft based on Epoch 0.5, 1.0, 2.0, and 3.0 motor platforms.














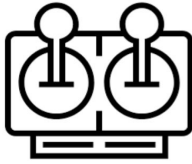


Greenheck DS-6 Fans: Greenheck fans manufacture both Commercial and Industrial fans. Greenheck fans Located in Wisconsin, USA. Greenheck fans use BLDC direct-drive motors to run the HVLS fan. Motor controls are not a power factor corrected. Air produced by the Greenheck fan is very less compared to the Epoch fans. Hence, the airflow and coverage area of the Greenheck fans are less. The maintenance cost and cost of repair of the Greenheck fan is very high.














The Below table summarized the difference between the fans and will show the best fan for your organization or workplace.

| Epoch 2.0 12-ft diameter HVLS fans | Parameters | Greenheck DS-6 12-ft HVLS fans |
|--|---|---------------------------------------|
| Latest Technology EDFS-PMSM motor Technology |  Motor Technology | BLDC motor |
| Yes |  Power factor Correction | No |
| 05 |  No. of Blade | 06 |
| Airfoil Design |  Blade Profile | Airfoil Design |
| Anodised Aluminium 6061- T6 |  Blade Material | 6005A-T6 extruded Aluminum |
| 1.5 hp |  Input Power | 1 HP (Very Low Power Fan) |

| | | |
|---|--|--|
| <p>200-264 V AC, 1 Phase, 50-60 HZ, OR AC 3PH 200-240V 50/60Hz or AC 3PH 380-480V 50/60Hz (3Ph Models are non-PF Corrected)</p> |  <p>Input Voltage</p> | <p>AC 1PH 200-240V 50/60Hz or AC 3PH 200-240V 50/60Hz or AC 3PH 380-480V 50/60Hz</p> |
| <p>90 Nm</p> |  <p>Torque</p> | <p>Very Low</p> |
| <p>130</p> |  <p>RPM speed</p> | <p>119 (Very Less Airflow)</p> |
| <p>< 35 dB</p> |  <p>Sound Level</p> | <p>49 dB</p> |
| <p>4.5 A</p> |  <p>Input Current @ 208V</p> | <p>Takes high amount of current therefore highly inefficient</p> |
| <p>Yes</p> |  <p>Forward and Reverse Option</p> | <p>Yes</p> |
| <p>7,000 Sq. ft. (650 Sq. m.)</p> |  <p>Coverage Area</p> | <p>14,500 Sq. ft. (1,347 Sq. m.) (Unverified Numbers)</p> |

| | | |
|---|---|--|
| 400,000 to 450,000 CFM |  Airflow | 71,900 CFM |
| 63 Kg/ 138 lbs |  Weight | 67 Kg/ 147 lbs (Inefficient and Heavy) |
| Available |  Color Options | Available |
| Yes |  BACnet controls | Yes |
| Power factor Corrected field-oriented Controls with space vector modulation (PFC + FOC + SVPWM) |  Controls | Wired and programmed variable frequency drive (VFD). |
| UL 507, UL 1004, UL 508C ETL Certified. |  Design Safety Standards | UL/cUL 507 Listed for Electrical |
| UL 507, CE (ETL Certified) |  Safety Certifications | UL 507 |

| | | |
|---|--|--|
| IP 65 |  IP Rating | No IP rating available. |
| Low |  Cost of Repair | High |
| Low |  Lifetime Cost | High |
| More than 100,000 hours |  Life Expectancy | Not mentioned |
| 15 Years Mechanical, 7 Years Electrical |  Warranty | 10 Years for Mechanical, 1 Year for Electrical |
| Yes |  Smartphone Interface | No |
| Yes |  Dynamic Blade Adjustment | No |
| Available |  Analog Control | Available |

| | | |
|-----------|--|-----|
| Yes |  Building management system Integration | Yes |
| Yes |  Touchscreen Console | Yes |
| CII Award |  Award | No |

Discussion on the Comparisons: In the table above, we have highlighted in green the various advantages for each of the companies. Let us discuss each of the items below.

1. Motor Technology: Epoch 2.0 Fans are built using expanded diameter fractional slot permanent magnet synchronous motor technology (EDFS-PMSM) which helps to improve efficiency and reduce the cost of HVLS fans dramatically. Greenheck DS-6 fans use BLDC direct drive motor technology.



Image: Epoch 2.0 motor

2. Power Factor Correction: There is no power factor correction built-in for Greenheck DS-6 fans causing substantial power consumption during the fan operation. Epoch 2.0 Fans have built-in power factor correction. Epoch 2.0 Fans operate with a 0.97 to 0.99 power factor resulting in significant efficiency and cost savings. Such is not the case for Greenheck DS-6 fans. The input power factor is unknown and is assumed to be 0.6 to 0.7.

3. Number of Blades: Epoch 2.0 12-ft. Fans come with a 5 blade configuration. Airfoil design of blades creates the highest airflow in the world. Blade design combines modern-day Aeronautics and wing structure of a Falcon to create a remarkably dynamic and efficient airflow at every speed. Greenheck fans come with 6 numbers of blades but the airflow and coverage area of the fan is very less compared to Epoch 2.0 12-ft. Diameter fans.

4. Blade Profile and Material: Blade profile for both the manufacturers are equivalent to airfoil blade design. Epoch blades are manufactured by using Anodized Aluminum 6061 T6. The material used for the blades is corrosion resistive. Also, the strength of the material is very high. Where Greenheck blades are manufactured by using 6005A-T6 extruded aluminum.

5. Power (Watts and hp): The Output power of a fan is a good indicator of the amount of available airflow. Greenheck DS-6 fans power is close to 1 hp against Epoch 2.0 fans 1.5 hp. Greenheck DS-6 fans produce 40% less air than Epoch 2.0 fans.

6. Input Voltage Range: The input voltage range for the Epoch 2.0 Fans is substantially more comprehensive. Although Epoch 2.0 Fans can operate from 180V to 277V input without any damage to the controls, the performance is guaranteed between 200 and 264V, single-phase input. Greenheck DS-6 fans have input voltage range options to operate on single-phase and three-phase. But the performance of the fan is not guaranteed while operating in such options.

7. Torque (Nm): Greenheck DS-6 fans using a BLDC motor which needs lots of power to operate, as its weight is also more than Epoch fan. The Torque given by the Greenheck fan is very low against Epoch 2.0 HVLS fan for \varnothing 12 ft. Because Torque is less it produces less air.

8. RPM: Greenheck DS-6 fans can operate at 119 rpm at room temperature. It is very low rpm and does not justify the airflow and coverage area claims in the datasheet.

HVLS Fan and Air Flow

In HVLS fans, generally, the volume of air supplied is given more weightage than the airflow speed. According to the paper effectiveness (cooling/destratification) of an HVLS fan is decided from the air velocity not fan speed or CFM(volume of air displaced). The air velocity of the main jet flow is of more significance than the volume of air moved, which is proved by using the ASHRAE thermal comfort tool. For air-flow of speed 29.5 to 590.6 fpm is needed to decrease the temperature of the skin of the workers working in the closed complex and reduce the temperature of the surrounding from 36 Celsius to 29 Celsius, Epoch 2.0 produces more than the required performance.

9. Sound Level (dB) at Max Speed: Because Epoch 2.0 Fans use EDFS-PMSM technology with PFC-FOC-SVPWM controls, the sound levels at max speed are less than 35dB as compared to other manufacturers. We have the quietest fan in the world.

10. Input Current (A): Greenheck fan draws more current versus 4.5A against Epoch 2.0 Fans. Greenheck fans are highly inefficient in terms of power consumption and airflow.

11. Forward and Reverse Operation: Forward and Reverse operation is available from both the manufacturers.

12. Coverage Area (m²): Epoch 2.0 Ø 12 ft fan covers 7,000 sq. ft area, whereas Greenheck DS-6 Ø 12 ft. fan covers 14,500 sq. ft. area. We are doubtful about this figure because they state only 1 hp power consumption. Less power produces less air.

13. Air Flow (m³/s): Epoch 2.0 fans produce the highest airflow 400,000 to 450,000 CFM, where Greenheck DS-6 fans produce 71,900 CFM. Epoch HVLS fans recorded the highest CFM amongst the competitors.

14. Weight (kg): Greenheck DS-6 fans weigh 67 Kg/147 lbs vs. 63 kg/138 lbs for Epoch 2.0 fans. The weight difference indicates that Epoch 2.0 technology is lighter than Greenheck DS-6 technology.

15. Optional color: Optional colors are available from both the manufacturers.

16. BACnet: BACnet control systems are available from both the manufacturers.

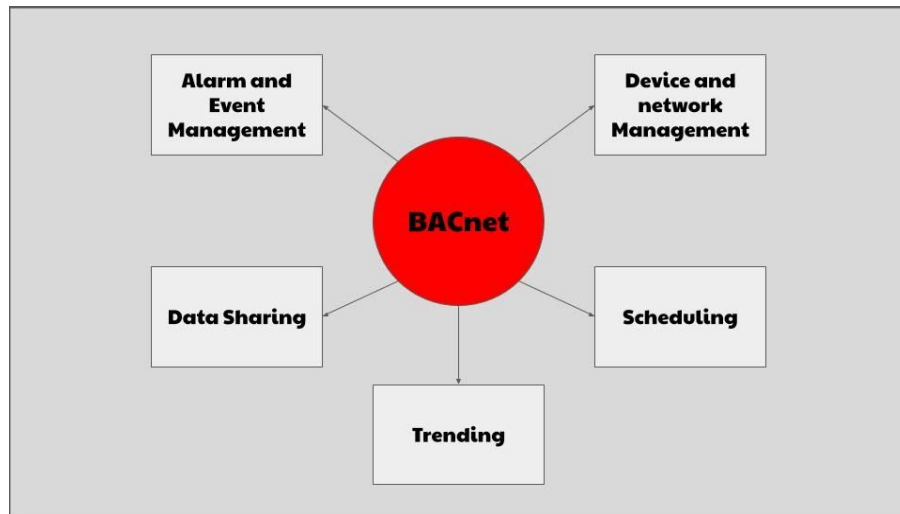


Image: Bacnet Control Features

17. Controls: Epoch 2.0 Fans use state of the art power factor corrected field-oriented controls with space vector modulation. Which further enhances efficiency, reduces the cost of manufacturing and operations significantly. Greenheck DS-6 fans use non-power factor corrected VFD controllers for their BLDC motors.

18. Design Safety Standards: Epoch 2.0 Fans are designed for UL507, UL1004, and UL508C safety standards (ETL certified). Greenheck DS-6 fans are intended for the UL507 safety standard.

19. Safety Certifications: Epoch 2.0 Fans have undergone safety testing at Intertek Laboratories in Dallas, Texas, USA. Epoch 2.0 Fans have UL507 and CE certification. Greenheck DS-6 fans have UL certification.

20. IP Rating: Epoch fans are rated with an IP65 rating. Where Greenheck fans do not have such certifications.

21. Cost of Repair: The cost of repair and maintenance of Greenheck DS-6 fans is very high as compared to Epoch HVLS fans.

22. Lifetime Costs: Lifetime costs for Greenheck DS-6 fans are incredibly high. Given the high-power consumption, cost of acquisition, cost of repair. The lifetime costs for Greenheck DS-6 fans are incredibly high.

23. Life Expectancy: Greenheck DS-6 fans do not disclose life expectancy. Epoch 2.0 Fans have a life expectancy of more than 100,000 hours.

24. Warranty: Epoch 2.0 Fans provides the highest warranty than the Greenheck DS-6 fan.

25. Smartphone Interface: Greenheck DS-6 fans do not have a Smartphone interface for running or data logging. Epoch 2.0 Fans can be operated with a smartphone application.



Image: Overview of Smartphone Application

26. Dynamic Blade Adjustments: Epoch 2.0 Fans employ adjustable blade technology with droop down and uplift mechanism. Such blades can weather the rotational stresses efficiently as compared to stiff blades. Greenheck DS-6 fans use rigid blades. Also, adjustable blades produce efficient and broader airflow areas as speed increases as compared to rigid blades.

27. Analog Controls: Epoch 2.0 Fans come with analog controls with a built-in speed regulator for ease of operation. Where Greenheck fans come with HVLS keypad control with LCD display. The Epoch 2.0 fan controller also has a built-in circuit breaker for added safety protection.

28. Fire Control Panel Integration: Fire control panel system integration is available from both the manufacturers.

29. Building Management System Integration: Standard building management system integration is available from both the manufacturers.

30. Touchscreen Console: Standard touchscreen controls are available from both the manufacturers.

31. Awards: Epoch fan manufacturer got the most innovative company award i.e. CII award amongst top companies in India. Greenheck fans do not have such a kind of award.



Award-winning moment

Energy Saving report for Epoch 2.0 12-ft HVLS fans

| | Epoch fans | Greenheck Fans | Savings (USD) |
|--------------------------------|------------|----------------|---------------|
| Quantity | 1 | 1 | |
| Fan diameter | 12 ft | 12 ft | |
| Pin (KW)@119 rpm | 550 | 750 | |
| Pin (KVAh) | 550 | 1500 | |
| Total (KW) | 0.55 | 0.75 | |
| Total (KVAh) | 0.55 | 1.5 | |
| Operational hours (daily) | 24 | 24 | |
| Daily Power Consumption (KWh) | 13.2 | 18 | |
| Daily Power Consumption (KVAh) | 13.2 | 36 | |
| Cost/ kwh in \$ | \$0.13 | \$0.13 | |
| Cost/ kVAh in \$ | \$0.13 | \$0.13 | |
| Daily cost (KWh) in \$ | \$1.72 | \$2.34 | \$0.62 |
| Daily cost (KVAh) in \$ | \$1.72 | \$4.68 | \$2.96 |
| Operational days (monthly) | 30 | 30 | |
| Monthly cost (KWh) in \$ | \$51.48 | \$70.20 | \$18.72 |
| Monthly cost (KVAh) in \$ | \$51.48 | \$140.40 | \$88.92 |
| Operational days (yearly) | 365 | 365 | |
| Yearly cost (KWh) in \$ | \$626.34 | \$854.10 | \$227.76 |
| Yearly cost (KVAh) in \$ | \$626.34 | \$1,708.20 | \$1,081.86 |

Conclusion: This paper recommends Epoch 2.0 Fans for various reasons. Primary reasons being high performance, efficiency, reliability, and World class technology with lower cost of acquisition, operation and maintenance.