

High Volume Low-Speed Fan Comparison between Epoch and Geared HVLS Fans (12', 16', 20' and 24')

Highly Confidential



Send the Gearbox to Outer Space

By

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Executive Summary

A 13+point comparison is done between Epoch Direct Drive and Geared HVLS fans of diameters 12', 16', 20' and 24'. This paper recommends Epoch fans for reasons of twice the performance, twice the efficiency, three times the reliability, higher technology, much lower cost of acquisition, two times lower cost of operation, zero maintenance and make in India availability.

Abstract

This article presents a side by side comparison between Epoch HVLS fans and Geared HVLS fans. Published Specifications and Website information are taken into consideration. Parameters such as motor power, blade diameter, fan speed, current consumption, input voltage, power factor, torque, motor weight, number of blades, installation, etc. are compared between the various companies.

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. 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. However, 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 Epoch

HVLS fan and Geared HVLS Fans. Future articles will focus on more extensive comparisons between various HVLS fan platforms.

Introduction to Falco eMotors and Epoch Fans

Epoch 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 fans are manufactured in India by Falco eMotors in the city of Pune, Maharashtra. The technology has been developed in collaboration with some major US and Canadian companies specializing in the sale of HVLS fans.

Falco eMotors has a long history of innovation in the field of electric motors and drives with several patents granted and filed in the US. Falco's team has invented highly complex motors, drives, and systems for industrial as well as personalized transportation solutions. Falco's team is also an inventor of an extraordinary patented technology for electric bikes. Falco eMotors has invented the Most Powerful and Efficient HVLS Fan in the world. Falco eMotors' Products are exported to Europe and the US from India.

Epoch HVLS fans represent a significant technological breakthrough. Epoch fans operate silently and efficiently requiring no maintenance for years to come. With the least amount of energy consumption (40% more efficient than the best HVLS fan in the industry) and a sound signature of less than 35 dB, we are setting some serious world records. The motor and inverter

efficiency are close to 95% each, giving you a lightweight powerhouse which can move a ton of air at tremendous energy saving.

Introduction to Fans

Geared HVLS industrial fan platform is a solution driven by an induction motor with a gearbox. All these companies do not manufacture any of its components except for the final assembly of the fans. Motor controls are not power factor corrected and do not use space vector modulation which are the latest state of the art controls. The motor is controlled using standard VFD inverters available in the market such as Yaskawa, Schneider etc.

Table 1, 2, 3 and 4 below summarize the platforms comparing Epoch and Geared 12', 16', 20' and 24' fans.

Table 1: 12' Comparison

	Geared Fans	Epoch	Comments
<i>Fan Size in Diameter</i>	12 ft	12 ft	
	3.7 m	3.7 m	
<i>Number of Blades</i>	05	05	
<i>Power Consumption</i>	782 W	656 W	Lower Power Consumption
<i>Actual Amps at 230 Volts</i>	3 A	2.85 A	Lower Input Current
<i>Volt Amps Consumed</i>	1,564 VA	656 VA	Lower VA Consumption

<i>Power Factor</i>	<0.6	>0.95	<i>Highest Power Factor</i>
<i>Thrust</i>	125 N	195N	56% More Thrust
<i>Speed</i>	105 rpm	130 rpm	24% More RPM
<i>Output Power</i>	275W	531W	93% More Power
<i>Overall Efficiency</i>	35%	81%	Much Higher Efficiency
<i>Airflow</i>	70,424 cfm	3,59,000 cfm	Much More Airflow
<i>Maximum Velocity</i>	386 ft/min	478 ft/min	Much higher air velocity
	1.96 m/s	2.43m/s	
<i>Weight (No Mount)</i>	111 kgs	67 kgs	Almost Half the Weight
<i>Noise Level</i>	62.5 dBA	35 dBA	Almost Half the Sound
<i>CFM/W</i>	90	207	2.3 times
<i>Cost of operation</i>	1	0.43	57% Cheaper

Table 2: 16' Comparison

	<i>Geared Fans</i>	<i>Epoch</i>	<i>Comments</i>
<i>Fan Size in Diameter</i>	16 ft	16 ft	
	4.9 m	4.9 m	

<i>Number of Blades</i>	05	05	
<i>Power Consumption</i>	939 W	840 W	Lower Power Consumption
<i>Actual Amps at 230 Volts</i>	4.08 A	3.65 A	Lower Input Current
<i>Volt Amps Consumed</i>	1,878 VA	840 VA	Lower VA Consumption
<i>Power Factor</i>	<0.6	>0.95	Highest Power Factor
<i>Thrust</i>	141 N	198N	56% More Thrust
<i>Speed</i>	80 rpm	95 rpm	24% More RPM
<i>Output Power</i>	477W	795W	93% More Power
<i>Overall Efficiency</i>	51%	95%	Much Higher Efficiency
<i>Airflow</i>	127,033 cfm	4,11,722 cfm	Much More Airflow
<i>Maximum Velocity</i>	550 ft/min	653 ft/min	Much higher air velocity
	2.79 m/s	3.3m/s	
<i>Weight (No Mount)</i>	125 kgs	76 kgs	Almost Half the Weight
<i>Noise Level</i>	62.7 dBA	35 dBA	Almost Half the Sound

<i>CFM/W</i>	135	252	1.87 times more effective
<i>Cost of Operation</i>	1	0.53	47% Cheaper to run

Table 3: 20' Comparison

	<i>Geared Fans</i>	<i>Epoch</i>	<i>Comments</i>
<i>Fan Size in Diameter</i>	20 ft	20 ft	
	3.7 m	3.7 m	
<i>Number of Blades</i>	05	05	
<i>Power Consumption</i>	1460 W	920 W	Lower Power Consumption
<i>Actual Amps at 230 Volts</i>	5.6 A	4 A	Lower Input Current
<i>Volt Amps Consumed</i>	2,920 VA	920VA	Lower VA Consumption
<i>Power Factor</i>	<0.6	>0.95	Highest Power Factor
<i>Thrust</i>	280 N	297N	6% More Thrust
<i>Speed</i>	63 rpm	65 rpm	3% More RPM
<i>Output Power</i>	627 W	681W	9% More Power
<i>Overall Efficiency</i>	43%	74%	Much Higher Efficiency

<i>Airflow</i>	176,200 cfm	4,71,400 cfm	Much More Airflow
<i>Maximum Velocity</i>	505 ft/min	521 ft/min	Higher air velocity
	2.56 m/s	2.64m/s	
<i>Weight (No Mount)</i>	145 kgs	80 kgs	Almost Half the Weight
<i>Noise Level</i>	63.4 dBA	35 dBA	Almost Half the Sound
<i>CFM/W</i>	121	208	1.7 times more effective
<i>Cost of Operation</i>	1	0.58	42% Cheaper to run

Table 4: 24' Comparison

	<i>Geared Fans</i>	<i>Epoch</i>	<i>Comments</i>
<i>Fan Size in Diameter</i>	24 ft	24 ft	
	7.3 m	7.3 m	
<i>Number of Blades</i>	05	05	
<i>Power Consumption</i>	1486 W	1200 W	Lower Power Consumption
<i>Actual Amps at 230 Volts</i>	5.7 A	5.2 A	Lower Input Current
<i>Volt Amps Consumed</i>	2,972 VA	1200 VA	Lower VA Consumption

<i>Power Factor</i>	<0.6	>0.95	<i>Highest Power Factor</i>
<i>Thrust</i>	632 N	863N	<i>37% More Thrust</i>
<i>Speed</i>	53 rpm	62 rpm	<i>17% More RPM</i>
<i>Output Power</i>	577W	928W	<i>60% More Power</i>
<i>Overall Efficiency</i>	39%	77%	<i>Much Higher Efficiency</i>
<i>Airflow</i>	315,026 cfm	506,662 cfm	<i>60% More Airflow</i>
<i>Maximum Velocity</i>	497 ft/min	582 ft/min	<i>Much higher air velocity</i>
	2.52 m/s	2.95m/s	
<i>Weight (No Mount)</i>	157 kgs	100 kgs	<i>63% less Weight</i>
<i>Noise Level</i>	63.4 dBA	35 dBA	<i>Almost Half the Sound</i>
<i>CFM/W</i>	212	422	<i>2 times more effective</i>
<i>Cost of Operation</i>	1	0.5	<i>50% Cheaper to run</i>

Discussion on the Comparisons

In the tables above, we have highlighted in green the various advantages for each of the technologies. Let us discuss each of the items below.

Made in India

Epoch fans are made in India. It supports Prime Minister Sh. Narendra Modi's goal to make India a world-class manufacturing hub. Epoch fans employ state of the art technology. Their sales help employ several people in India in manufacturing and high technology areas.

Motor Technology

Epoch 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. Geared fan use off the shelf induction motors, gear boxes and inverters. Such a technology is destined to fail eventually because of the limited lifetime of gear boxes and extraordinary maintenance requirements.

Controls

Epoch fans use state of the art power factor corrected field-oriented controls with space vector modulation which further enhances the efficiency, reduces the cost of Manufacturing and operations significantly. Geared fans use non-power factor corrected poor harmonics VFDs which are known to destroy the power grid with extraordinary electric pollution. These VFDs are

known to draw utility current with very high harmonics causing significant loss of efficiency and increased cost of operation.

Power (Watts and hp)

The Output power of a fan is a good indicator of the amount of available airflow.

Cost/Watt

Epoch fans have built-in high-efficiency controls using power factor correction (PFC) with field-oriented controls (FOC) and space vector modulation (SVPWM). Geared employs non-power factor scalar controls. Consequently, the input current draw is high in comparison Epoch fans. Higher current draw can cause massive transmission losses and increase the cost/watt substantially. Epoch fans cost 0.9 paisa per watt whereas Geared fans cost 1.8 paisa per watt which is double the cost of Epoch fans.

Table 5 Cost per Watt Comparison for Epoch and Geared Fans (24')

	Epoch	Geared	Comments
Cost per 1kW	₹9.00	₹9.00	India Rupees
Assumed Voltage	230	230	V
Current	5.2	12.92	A
Time	1	1	Hour
kVAh	1.2	2.9	Consumption
Power Factor	0.97	0.50	Assumed
Total Cost of Operation for 1 Hour	₹10.8	₹26.1	Cost

Cost/Watt (Paisa)	0.9	1.8	Paisa
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Sound Level (dB) at Max Speed

Because Epoch fans use EDFS-PMSM technology with PFC-FOC-SVPWM controls, the sound levels at max speed are less than 35dB as compared to Geared 62+dB.

Power Factor Correction

There is no power factor correction built-in for Geared fans causing substantial power consumption during the fan operation. Epoch fans have built-in power factor correction.

Power Factor

Epoch fans operate with a 0.97 to 0.99 power factor resulting in significant efficiency and cost savings. Such is not the case for Geared fans. Input power factor is unknown and is assumed to be 0.5.

Smartphone Interface

Geared fans do not have a Smartphone interface for running or data logging. Epoch fans can be operated with a smartphone app.

Weight (kg)

Geared fans weigh almost twice of Epoch air fans. The weight difference indicates that Epoch technology is lighter.

RPM

Geared fans operate at lower rpms. Epoch fans operate at higher rpm throughout thereby producing substantially more airflow.

Air Flow (m3/s)

Epoch fans produce significantly more air flow than Geared fans.

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Estimated Daily kWh

Geared fans could potentially consume more than double power than the Epoch fans.

Operating Cost per Day (₹)

Operating cost per day for Epoch fans is almost half of those of geared fans.

Cost per Unit of Air Flow

Airflow is directly proportional to the output power. Airfoil technology is assumed to have a minimal impact from one manufacturer to the next as it is not a new area of science and technology. Based on the cost per watt number and airflow numbers, this cost is estimated to be 0.9 paisa and 1.8 paisa for Epoch and Geared fans respectively.

Estimated Cost of Acquisition (₹)

Geared fans are more expensive to acquire (higher CAPEX)

Input Voltage Range

Input voltage range for the Epoch fans is substantially more comprehensive. Although Epoch fans can operate from 180 to 277V input single phase input. Geared fans have an input voltage range of 208 to 230 VAC which is quite limited.

Dynamic Blade Adjustments

Epoch fans employ adjustable blade technology with droop down and uplift mechanism. Such blades can weather the rotational stresses efficiently as compared to stiff blades. Geared uses similar blades. Also, adjustable blades produce efficient and broader air flow area as speed increases as compared to rigid blades.

Analog Controls

Epoch fans come with analog controls with a built-in speed regulator for ease of operation. Such controls are not available with Geared.

Number of Blades

Both Fans comes with 5-blades.

IP Rating

Epoch fans are rated with an IP65 rating where Geared Fans are with an IP55

Design Safety Standards

Epoch fans are designed for UL507, UL1004 and UL508C safety standards. Geared fans are intended for the UL507 safety standard.

Safety Certifications

Epoch fans have undergone safety testing at Intertek laboratories in Dallas, Texas, USA. Epoch fans have UL507 and CE certification.

Life Expectancy

Epoch fans have a life expectancy of more than 100,000 hours.

Warranty

Geared fans offer a 3-year/2-year warranty. Standard warranty of Epoch fan is 2years, extended warranty is available.

Cost of Repair

Geared fans have a much high cost of repair because of imported nature of goods. Gearboxes have lower life expectancy because of mechanical friction. Every repair result in substantial downtime for

the customer. Such is not the case for Epoch fans. Epoch motors have a life expectancy of more than 100,000 hours, and because of local availability, fans can be serviced very quickly.

Lifetime Costs

Lifetime costs for Geared fans are incredibly high. Given the high-power consumption, the high cost of acquisition, the high cost of repair (yearly oil changes), very high level of noise (> 62 dB) and likelihood of a failure due to gearbox, lifetime costs for Geared fans are incredibly high.

Conclusion

This paper recommends Epoch fans for various reasons. Primary reasons being high performance, high efficiency high reliability, high technology, lower cost of acquisition, lower cost of operation, ease of operation and maintenance and make in India availability.