Optiline Fan Array™

The optimum number of fans for every application

The Optimum in

- **Sound**
- **Energy**
- **Size**
- **Redundancy**
- **Reliability**

Energy Labs was GREEN before GREEN was cool

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Energy Labs Inc

Energy Labs Inc

Introduction

Energy Labs was the first manufacturer to use rated fans in an array. Our 20+ years of research and testing has resulted in today's Optiline Fan Array™ which offers the industry's best combination of **quiet operation, energy efficiency, reliability, modularity, and maintenance simplicity**.

Extensive testing in our own AMCA accredited Laboratory with the use of CFD modeling allows us to provide fan arrays that consistently deliver predictable performance with minimum noise and vibration at a cost that represents the best value in the industry.

Unlike manufacturers that assume that the more fans, the better, Energy Labs always seeks to determine the optimum number of fans for each application. The Optiline Fan Array™ – the Optimum selection for efficiency, reliability, redundancy, size, sound level, and cost.

Optiline Fan Array™

The Optiline Fan Array™ fills the performance gap between large direct drive fans and fan arrays utilizing smaller, less efficient fans.

Advantages of Optiline Fan Array™:

- More efficient than fan arrays which utilizes smaller fans and motors
- Optimizes motor operation by running closer to 1800 RPM.
- Quieter than larger fans
- Shorter fan section lenght than larger fans
- Better airflow distribution than single fan
- Requires less space for service than a large fan
- Fan redundancy

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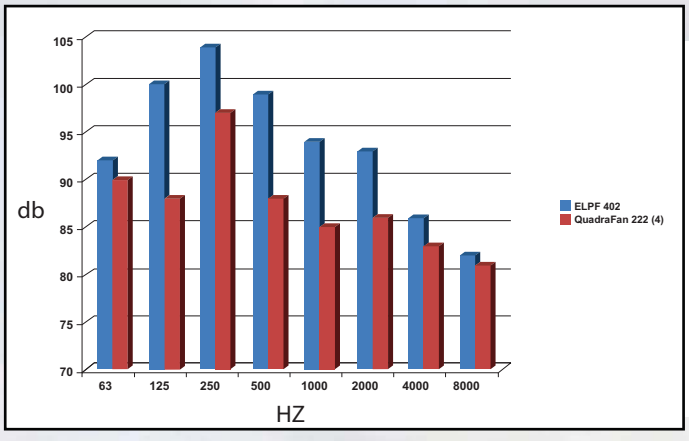
Engineering/modeling/testing = Best multiple fan system

Energy Labs engineers use Fluid Dynamics software for modeling the airflow patterns of different fan systems. This technology allows them to "see" how the air moves, its velocity, direction and, most importantly, the areas of turbulence. This modeling and analysis shows us important information, such as, the optimum distances from the fans where uniform airflow begins.

A byproduct of air movement is noise and fan frame vibration. Software tools are used to analyze the fan frame design to minimize low frequency vibration that can "travel" through a building's structural members.

After completing the computer simulations we manufacture prototypes and test them extensively in our AMCA Accredited Test Facility*. Extensive testing ensures accurate performance data for the Optiline Fan Array™ system.



This chart shows the 22.0" Optiline Fan Array™ sound power levels in comparison with a single 40" fan.

Optiline Fan Array™ Acoustics

All fans have a peak noise level that occurs at the blade pass frequency. Compared to a large single fan, multiple smaller fans operate at higher speeds to move the same volume of air and consequently have a higher blade pass frequency. This higher frequency sound is more easily muted in acoustically absorbent materials.

• Optiline Fan Array™ operates in a carefully designed and manufactured sound-absorbing compartment. These fan compartments contain sound absorbing material placed for maximum sound reduction and minimal effect on the air moved by the fan.

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Motor Speed and Longevity

• Larger fans in Optiline Fan Array™ systems operate at speeds that are closer to the Standard 1800 RPM.

• Standard 1800-RPM motors are readily available and are the most cost effective in the market.

• Smaller fans in other systems often operate at much higher speeds (90Hz), which leads to premature motor failure.

Vibration Control

• Each Optiline Fan Array™ fan frame is individually spring-isolated to minimize vibration in the frame structure.

• Optiline Fan Array™ fan bases are constructed of welded structural steel. This contributes to long, quiet life and resonance-free operation.

• Cast Frame motors are always used to minimize resonance in the fan system.

Optiline Fan Array™ Reliability

• Overall system reliability is a function of many items. In general terms, while multiple fans offer have many benefits in certain applications, they do add complexity, and actually reduce system reliability. More is certainly not always better in this case. Systems that arbitrarily use a large number of small diameter fans actually have a lower system reliability than a system designed with fewer fans. Increased failure rates of small horsepower motors compared to larger horsepower motors are just one factor.

The table to the right compares a 16 fan and a 4 fan design and shows it cost over $30,000 more to maintain and repair the 16 fan system.

Energy Labs believes there is an optimum number of fans for each application and set of job requirements. Only by analyzing total energy use (including actual motor efficiencies), sound requirements, maintenance costs, space considerations and system redundancy issues, can the designer select the optimum number of fans be selected.

Part quantities	pair	array	Notes
N_{motor}	4	16	quantity of motors
$N_{contactor}$	4	16	quantity of contactors
$N_{circuit\text{-}breaker}$	4	16	quantity of circuit-breakers (thermal type)
N_{fuse}	4	16	quantity of fuses
$N_{transducer}$	4	16	quantity of transducers
Generic failure rates			
$\lambda_{g\text{-}motor}$	2.4	2.4	from MIL-HDBK-217F, Appx. A, pg. A-9, section 12.1
$\lambda_{g\text{-}contactor}$	0.89	0.89	from MIL-HDBK-217F, Appx. A, pg. A-9, section 13.1
$\lambda_{g\text{-}circuit\text{-}breaker}$	0.23	0.23	from MIL-HDBK-217F, Appx. A, pg. A-9, section 14.5
$\lambda_{g\text{-}fuse}$	0.02	0.02	from MIL-HDBK-217F, Appx. A, pg. A-10, section 22.1
Quality factors			
$\pi_{Q\text{-}motor}$	1	1	from MIL-HDBK-217F, Appx. A, pg. A-11, (reports as "N/A")
$\pi_{Q\text{-}contactor}$	9	9	from MIL-HDBK-217F, Appx. A, pg. A-11
$\pi_{Q\text{-}circuit\text{-}breaker}$	8.4	8.4	from MIL-HDBK-217F, Appx. A, pg. A-11
$\pi_{Q\text{-}fuse}$	1	1	from MIL-HDBK-217F, Appx. A, pg. A-11, (reports as "N/A")
$\lambda_{g\text{-}fan}$	49.47	197.87	failures per 10^6 hours (approx. 114 years)
	0.11	0.43	failures per 3 months
	0.21	0.85	failures per 6 months
	0.43	1.71	failures per 1 year
	0.85	3.42	failures per 2 years
	1.71	6.84	failures per 4 years
	3.42	13.68	failures per 8 years
	6.84	27.35	failures per 16 years
$t_{failure\ fix\ time}$	16	16	average total hours to investigate, identify, fix failure of fan
$r_{cost\ per\ hour}$	100	100	average rate in dollars per hour
$C_{cost\ per\ fix}$	1600	1600	total dollars for one failure fix
	$ 171	$ 684	failure fix cost per 3 months
	$ 342	$ 1,368	failure fix cost per 6 months
	$ 684	$ 2,735	failure fix cost per 1 year
	$ 1,368	$ 5,471	failure fix cost per 2 years
	$ 2,735	$ 10,942	failure fix cost per 4 years
	$ 5,471	$ 21,883	failure fix cost per 8 years
	$ 10,942	$ 43,766	failure fix cost per 16 years

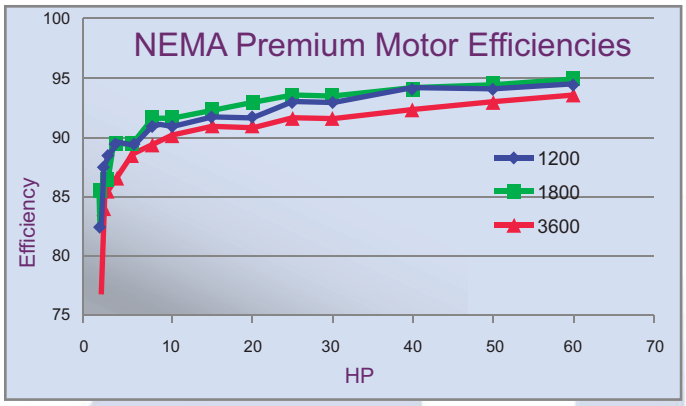
System Energy

The smaller motors used on smaller fans are inherently less efficient, as is revealed in virtually every motor catalog, and by the U.S. Dept. of Energy, which shows that even at partial loads a larger motor is more efficient than a smaller one.

A quick look at the minimum motor efficiencies in NEMA MG-1 will quickly show that larger motors are more efficient than smaller motors.

The aerodynamic efficiency of large fans is greater than smaller fans, due to the larger size of the fan blade. As such, the derived higher system efficiency of the Optiline Fan Array™, delivers operational, cost savings to you.

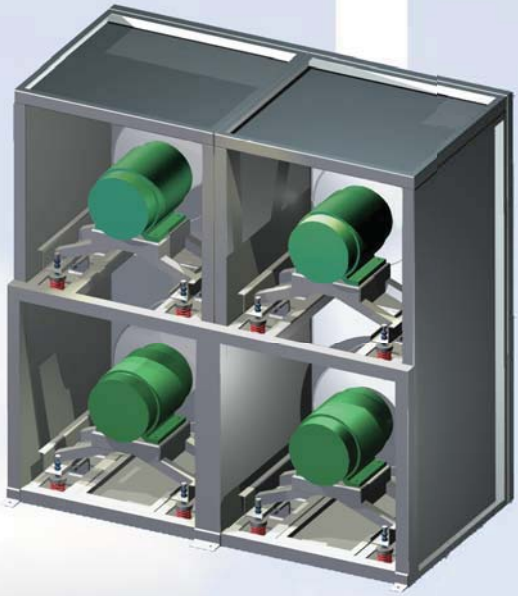
Most Optiline Fan Array™ selections use 4 pole, (1800rpm) motors which have a higher efficiency than the 3600-rpm motors often used with smaller fans.



Redundancy

Optiline Fan Array™ offers the end user reliability through multiple redundancies: In case of fan failure the system can be designed to automatically ramp-up the operational fans to meet your airflow requirements.

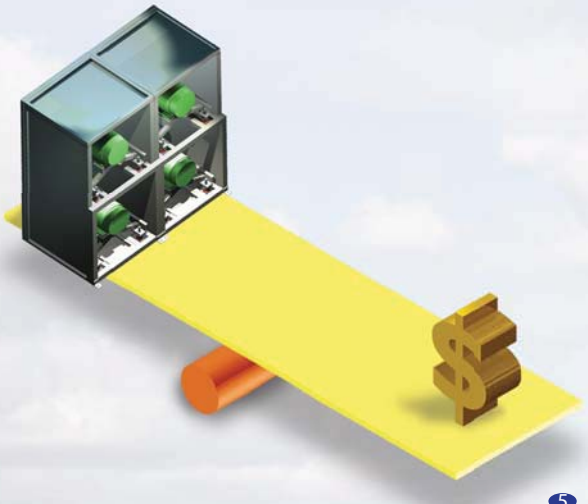
There is also an optional isolation damper which will close the inlet of the non-operational fan to prevent recirculation.



Cost Competitive

Here's why Optiline Fan Array™ System Units are 15 to 20% less expensive than those using more of smaller fans:

- Fewer fans and motors.
- Fewer inlet or discharge dampers for flow isolation
- Fewer parts in the electrical system and less complex wiring.
- Fewer parts in control system and less complex wiring.
- Fewer mechanical components.



Chosing the Optimum Number of Fans
How many fans should a system have?

Consider these facts;

• Smaller fans typically have static efficiencies in the mid to high 60% range. Larger fans may be selected for many applications with efficiencies of 70% or higher.
• Motor efficiencies improve significantly as motors increase in size. Motors below 7.5 Hp in many case are 10% less efficient than a larger motor.
• System redundancy can usually be handled easily by any fan configuration utilizing 4 or more fans. Fan selections are less than peak motor RPM allow the operating fans to increase in speed as needed to maintain desired airflow.
• Cabinet length can decrease as the number of fans increases, however height and width increase dramatically. Actual job conditions need to be analyzed if space is a prime consideration
• Smaller fans typically create noise in higher octave bands than larger fans, making attenuation easier.

Only by analyzing total energy use, sound requirements, maintenance costs, space considerations and system redundancy issues, can the designer select the optimum number of fans for each system.

Contact your Energy Labs Sales representative for the Optimum answer for your application.

Fan Shut_off Device

When a fan fails, the performance of the system is significantly reduced due to air flowing back through the failed fan. Energy Labs' Flo-valve can prevent this efficiency loss. Automatic or manually operated versions are available. Automatic versions are enabled through current monitoring controls.

For the best in fan isolation specify Energy Labs Flo-valve. This system with a high quality spun disk and machined hub is designed to minimize airflow obstruction in the fan inlet. Testing in Energy Labs AMCA Accredited Laboratory* shows that fans operating with flo-valves have lower sound power levels than a fan operated with inlet dampers.

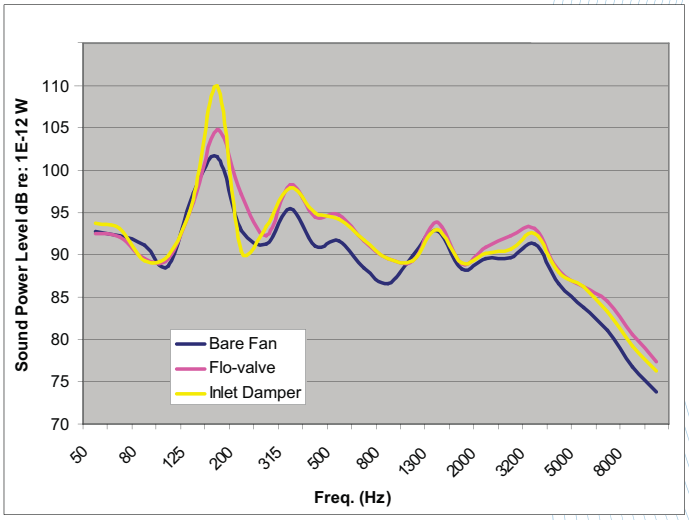


Fig. 3
Comparison of outlet sound power level in each of three test configurations

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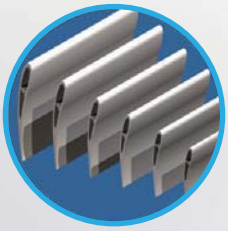
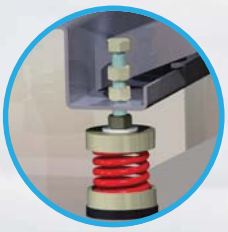
Construction Features



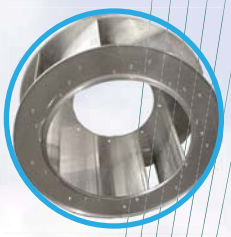
• High-efficiency airfoil fan blades

• Premium high-efficiency cast-frame motors

• Highly engineered sound attenuators



• Seismic Rated Spring Isolation



• Class 2 and Class 3 all aluminum fully welded wheel construction for maximum corrosion resistance and light weight

• Flo-valve, available for shutoff of individual fans in case of failure

• Cast aluminum fan hub
Lighter weight of fan wheel, longer life on motor bearings

• Welded fan frame and sound compartment

Energy Labs Line Card

Custom Air Handling Units

Capacities from 500 to 200,000 CFM; With Chilled water
Glycol
DX
Hot water
Steam coils

Custom Air Handling Units

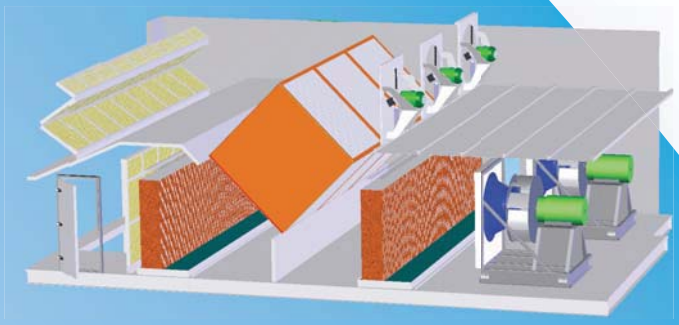
Thermal Brake construction
Hi Efficiency injected foam panels.
Capacities from 500 to 200,000 CFM.

Indirect / Direct Evaporative Cooling Systems

Capacities from 2,000 to 100,000 CFM.
304 stainless-steel housing.
High efficiency air to air heat exchanger.

Energy Recovery Systems

With Heat Exchangers or Heat Wheels.



Custom Air Cooled DX Units

Air cooled condensing units are available from 15 to 140 tons.
Integrated controls.
R410a and R134a refrigerants.
Copeland Scroll
and screw compressors.

Custom Evap. Condensing Units

Available from 50 to 300 tons.
Integrated controls.
R410a and R134a refrigerants.
Copeland Scroll and screw compressors.

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For more information including detailed product specifications, and specific requirements for special applications, please cont
your local sales representatives.