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The Basics of Fan Sound

Fan sound is a very important consideration in the selection and application of fans. In spite of this, fan sound continues to be one of the most misunderstood topics in the air handling industry.

In an effort to provide a better understanding and point of reference on how fan sound is developed, rated, applied and controlled; this is the second article in a series of four articles covering this topic.

Part 1 - *Understanding the Development of Fan Sound Data and the Product Line Rating Process* (FA/120-02)

Part 2 - ***The Basics of Sound*** (FA/121-03)

Part 3 - *Radiated Sound* (FA/122-03)

Part 4 - *Sound Criteria, Attenuation Techniques and Preventive Measures to Limit Sound Problems* (FA/123-03)

This article discusses the nature of sound, sound terminology, different methods of rating fans for sound and typical calculations that most people take for granted due to computerization.

What is sound?

We are all aware that energy comes in many different forms; light, heat, electrical, nuclear, sound etc. However, unlike the others, sound is characterized as a form of energy resulting from vibrating matter. As the matter vibrates, it creates waves in the surrounding medium (air, water, metal etc.) that have alternating compressions and rarefactions. In air, this represents a very small change in the barometric pressure to which our ear drums react. Our ears distinguish one sound from another by its loudness and pitch. Loudness is the amplitude or amount of sound energy reaching our ears. Pitch is the relative quality of the frequency content made up of pure tones as well as broadband sounds. We typically use the pitch to identify the source of a sound. However, both the loudness and pitch may vary depending upon where we are located relative to the sound and the surrounding environment.

What is fan sound?

Fan sound represents a characteristic combination of frequencies made up of many different individual components. It is a by-product of many different aerodynamic mechanisms going on inside the fan. Some of these include vortex shedding, eddy formations, turbulence and discrete tones such as the blade frequency. There are also various combinations of mechanical sound coming from drives, motors, bearings etc. All of these logarithmically combine to form a sound spectrum recognizable to the ear as being a fan.

This concept is illustrated in Figure #1. The lower sound spectrum is one-third octave band sound level data from a twenty-four inch airfoil fan. Note that there are individual peaks that are prevalent at various frequencies. These peaks

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correspond to the sound contribution of individual components such as the blade frequency, motor, drives or even a panel resonance from the scroll. It is these tones that our ears characterize as fan sound. Please remember, fan sound comes from a number of sources, aerodynamic as well as mechanical.

By convention, fan sound is presented on an octave band basis in accordance with ANSI standards. This makes dealing with sound less burdensome by using eight numbers versus twenty-four to define the frequency spectrum. However, when one-third octave band sound values are logarithmically added together into octave bands, the resulting sound level is higher but the individual peaks are not graphically identifiable in the new spectrum. This does not mean that they are no longer there. Your ear will still hear the tones, but the method of presentation smooths over the appearance of individual component contribution in the data. The octave band data can be further simplified to a one number system such as LwA or dBA, sones etc. However, with each simplification in the method of presentation, the identification of specific components is further reduced.

Defining fan sound

It is easier to understand fan sound using the graphical format illustrated in Figure #1. Using this figure as a reference, each of the rating parameters will be discussed. It is important to understand the concepts presented since they apply equally well for all fan sound data, not just for this specific example.

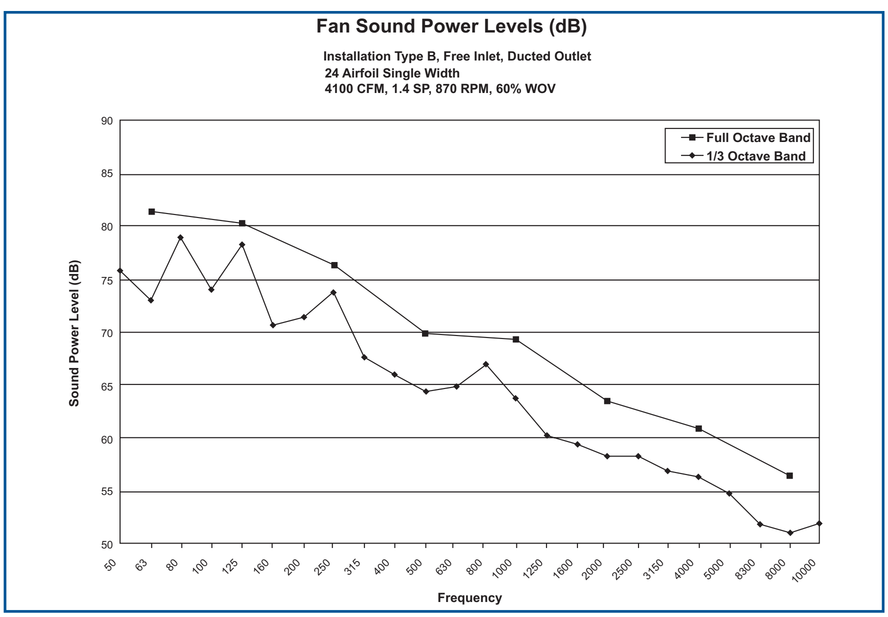
Sound power versus sound pressure

The difference between sound power and sound pressure is critical to the understanding of this subject. Most industrial and commercial ducted fan catalog data is presented in sound power levels in each of eight octave bands. However, some commercial and residential non-ducted catalog sound data is presented on a sound pressure basis using a single number rating system such as dBA or sones.

Energy for light, heat, electrical and most fan sound is provided referenced to the watt. The power produced by a light bulb, a heater or a fan are an indicator of the power produced by the source independent of the distance from the source or the environment in which it is located. As an example, a sixty watt light bulb consumes sixty watts no matter where it is screwed in. Fan sound power is the same.

Fan sound power is determined through tests conducted in accordance with AMCA Standard 300, "Reverberant Room Method for Sound Testing of Fans". Test results are provided in sound power levels in dB referenced to ten to the minus twelve watts in each of eight octave bands. This is the sound produced by the fan at its source and is independent of the fans environment.

Sound pressure levels represent the energy a microphone or our ears would receive and depends upon the distance from the source as well as the acoustical environment of the listener (room size, construction materials, reflecting surfaces,



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etc.). Sound pressure levels are provided in dB referenced to the microbar (.0002) or twenty micropascals.

Installation type

Published sound ratings are presented at the fan inlet, fan outlet or total sound power for the following installation types. It is important to know the installation type that best matches the actual application because sound levels are not the same for each installation.

Installation Type	Configuration
A	Free Inlet, Free Outlet
B	Free Inlet, Ducted Outlet
C	Ducted Inlet, Free Outlet
D	Ducted Inlet, Ducted Outlet

Fan designation

The size and design of the fan must be identified.

Fan rating

The AMCA Certified Ratings Program has a seal for "air" and a seal for "air and sound". A sound rating cannot exist by itself. It must have a corresponding aerodynamic rating because sound is a function of the fan rating point.

Loudness/ amplitude

Because sound loudness is referenced to very small numbers and there also is a very wide range, it is much more convenient to use the decibel. The decibel is a dimensionless number expressing in logarithmic terms the ratio of a quantity to a reference quantity. As an example, one dB represents the threshold of hearing.

Sound Power (dB) =
10 log (sound power [watts]/10-12)

Sound Pressure (dB) =
20 log (sound pressure [microbars]/.0002)

Sones

An alternative loudness description is sones. Sones follow a linear scale, that is, 10 sones are twice as loud as 5 sones. Use the following formula to convert sones to decibels.

dBA = 33.2 Log10 (sones) + 28,
Accuracy +/- 2dBA

LwA and dBA respectively are sound power and sound pressure rating systems for most industrial and commercial fan equipment. A third single number system is used for non-ducted propeller fans and power roof ventilators called the sone. A sone is a term of loudness perceived by the ear related to a frequency of 1,000 Hz. The sone is a sound pressure term at a distance of five feet from the fan and is linear to the human ear.

Calculating sones from sound pressure level is outlined in ANSI Standard 3.4. A loudness index is obtained from a graph or calculated using a formula in the standard. The total loudness is calculated from another formula. (See example 1.) The application of sones is outlined in AMCA Publication 302.

Frequency

Frequency is the number of pressure variations per second expressed in Hertz. One cycle per second equals one Hertz. The human ear can perceive sound between 20 Hz. and 20,000 Hz. However, fan sound is dominant between 50 Hz. and 10,000 Hz. Therefore, there is no reason to deal with frequencies outside of this range.

This frequency range for test purposes has been divided into twenty-four individual bands called one-third octave bands. Three one-third octave bands when logarithmically combined

Example 1

Calculation of sones

AMCA octave band no.	1	2	3	4	5	6	7	8
Sound pressure level	64	67	63	62.5	58.5	53.5	50	45.5
Loudness index	2.11	4.00	4.10	4.75	4.45	3.95	3.80	3.50

Sones = .3 (2.11+4.00+4.10+4.75+4.45+3.95+3.80+3.50) + .7 (4.75) = 12.5

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together form an octave band. An octave band is the interval between any two frequencies having a 2:1 ratio. As an example, the center frequency for the first octave band is 63 Hz. The center frequency for the second octave band is 125 Hz, third is 250 Hz. and so on up to the eighth octave band with a center frequency of 8000 Hz. The abscissa of Figure #1 illustrates the relationship between band numbers and frequency for both one-third and full octave bands.

Perceiving fan sound levels

It is important to maintain a common sense approach to looking at fan sound. Many people look at sound levels in too strict a manner without maintaining an overall perspective of their significance. From an accuracy standpoint, fan sound levels are less accurate than aerodynamic performance ratings. AMCA 300 indicates that tolerances of +/- six dB are possible in the first octave band and +/- three dB in the remaining octave bands. When comparing sound levels a difference of three dB is barely perceptible to the human ear. A difference of five dB is enough to make a distinction as to which is louder. It takes a difference of ten dB between two sound levels to make one sound twice as loud as the other.

When looking at sound levels it is very hard to relate that sound level to a typical source; ie, something we know. Simply to provide some perspective of the loudness of some sounds, the following table contains typical sound categories and corresponding sound levels.

Sound Category	Sound Pressure (dB)
Threshold of Pain	140
Threshold of Discomfort	120
Conversational Speech	60
Threshold of Hearing	0

Typical sound calculations

Catalog sound power levels are provided in each of eight octave bands. Sometimes it becomes necessary to take these values and convert them to other conditions. The following sections provide guidance and examples of the most common types of calculations.

Combining sound levels

The addition of sound levels must be done on a logarithmic basis, not arithmetic. Fortunately, computers are readily available to access Greenheck's Computer Aided Selection Program (CAPS), however, this addition can be done quickly and easily by hand as well. It involves a very simple process which is performed over and over again. The chart on page 5 illustrates the amount two sound levels contribute to each other based upon the difference between them. (See examples 2 and 3.) If two sound levels are identical, the combined sound is three dB higher than either. If the difference is ten dB, the highest sound level completely dominates and there is no contribution by the lower sound level.

Sound pressure level considerations

It has been repeatedly emphasized that sound power level values are independent of the distance and acoustical environment. On the other hand, sound pressure levels are a function of the location of the source as well as the listener. To estimate sound pressure levels requires a detailed knowledge of many different parameters. Since fan manufacturers have no idea where their fans or the ultimate listener are located, they are not in a position to calculate sound pressure levels for most applications. However, over the years, in order to provide users with some idea of what sound pressure levels might be expected, a "default set of assumptions" have been made which may or may not match the actual application. This default set of assumptions have been well accepted by users to the point where many catalogs contain sound levels based upon sound pressure. The following sections outline the default assumptions and the calculation process used to obtain various catalog sound pressure levels.

Default assumptions

The following assumptions are universally used in making sound pressure level predictions.

Point source

This assumes that the listener is far enough away from the fan to consider it a point source. This is

The Basics of Fan Sound, continued from page 4

consistent with most theoretical calculations made in acoustics. The key emphasis is that the listener is not in what is called the near field.

Directivity factor

It is assumed that the fan is mounted on a floor, ceiling or wall. Therefore, it can also be assumed that there is one reflecting surface that bounces the sound waves back towards the listener. This is referred to a directivity factor of two.

Hemispherical radiation pattern

Consistent with the directivity factor, it is assumed that the sound radiates from the fan in a hemispherical radiation pattern. A spherical radiation pattern would mean that the sound radiates equally in all directions from the fan and does not have a reflecting surface.

Straight line distance

It is assumed that the sound travels in an uninterrupted straight line from the fan to the listener. In other words, the listener can look directly at the fan and see it. No ductwork is between the fan and listener. Typically a distance of five feet is selected as being reasonable.

Free field conditions

It is assumed that the sound is free to radiate outwardly in an uninterrupted manner and is not reflected from any other surface other than the floor or ceiling it is mounted upon. The sound is free to just go and go.

Sound increased based upon the difference between two sounds

dB difference between two levels	0	1	2	3	4	5	6	7	8	9	10
dB added to the higher level	3	2.5	2	2	1.5	1.5	1	1	.5	.5	0

Procedure:

- Select the highest level
- Subtract the next highest level from the highest
- Using the difference, go to the chart and find the addition to the highest level
- Add this to the highest level
- The result is the logarithmic sum of the two levels

Example 2

Combining two sound spectrums

AMCA Band No.	1	2	3	4	5	6	7	8
Spectrum A	82	80	73	70	69	66	60	53
Spectrum B	79	77	71	68	67	64	59	52
Absolute Difference	3	3	2	2	2	2	1	1
Added to Highest	2	2	2	2	2	2	2.5	2.5
Combined Sound Level	84	82	75	72	71	68	62.5	55.5

Example 3

Combining an octave band spectrum into a single number

AMCA Band No.	1	2	3	4	5	6	7	8
Spectrum A	81	80	76	70	69	64	61	57

Note: If more than two numbers are being combined, use the previous sum as the highest number to combine with the next highest number. This is illustrated below.

Procedure:

The highest number is 81, the next highest is 80, the difference is 1, the adder is 2.5, the combined number is 83.5, the next highest number is 76, the difference is 7.5, the adder is .5, the combined sum is 84, the next highest is 70, the difference is 14, the adder is 0. Therefore, the single combined number for this spectrum is 84 dB.

Constant difference between sound power and sound pressure

Based upon all of the previous assumptions, (five feet away from a point source in a hemispherical free field) it is possible to calculate the difference between sound power and sound pressure. This means that the sound pressure level is 11.5 dB lower than the sound power level regardless of octave band.

A weighting

Sound pressure levels which are heard by the human ear are

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based upon the "A" scale. There is a constant set of weighting factors illustrated in the following table to approximate the response of the human ear. (Refer to AMCA Publication 303-79.)

It is important to realize that "A" weighting numbers are fully meaningful only when applied to sound pressure values. "A" weighting factors are sometimes applied to sound power levels which are then combined into a single number (LwA). This provides a single number for comparison between fans when sound power spectrums are provided. The LwA number cannot be verified by measurements in the field.

"A" weighting factors

AMCA octave band no.	1	2	3	4	5	6	7	8
"A" weighting factor	-25	-15	-8	-3	0	+1	+1	-1

Typical sound level calculations

Several sound level quantities can be calculated using combinations of the previous information. These are illustrated in examples 4, 5, and 6.

Summary

Knowing values of fan sound is vitally important. They should be obtained for every fan selection and compared to available acceptance criteria up front in the design stages. This will help provide the assurance necessary for a successful application.

Example 4

Single number sound power level (LwA)

AMCA octave band no.	1	2	3	4	5	6	7	8
Sound power level	75.5	78.5	74.5	74	70	65	61.5	57
"A" weighting	-25	-15	-8	-3	0	+1	+1	-1
LwA by octave band	50.5	63.5	66.5	71	70	66	62.5	56

Combining into a single number (LwA) = 75.5 dB

Example 5

Calculating sound pressure levels

AMCA octave band no.	1	2	3	4	5	6	7	8
Sound power level	75.5	78.5	74.5	74	70	65	61.5	57
Delta power pressure	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Sound pressure level	64	67	63	62.5	58.5	53.5	50	45.5

Example 6

Calculating single number sound pressure level (dBA)

AMCA octave band no.	1	2	3	4	5	6	7	8
Sound power level	75.5	78.5	74.5	74	70	65	61.5	57
Delta power pressure	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Sound pressure level	64	67	63	62.5	58.5	53.5	50	45.5
"A" weighting	-25	-15	-8	-3	0	+1	+1	-1
"A" weighted pressure	39	52	55	59.5	58.5	54.5	51	44.5

Combining into a single number (dBA) = 64 dB

ARI Certified vs. Non-Certified Performance Ratings of Energy Recovery Wheels

Engineers rely heavily on manufacturers' performance data for product selection. The quality of the data needs to be ensured so engineers can meet their design intentions and can accurately compare products from different manufacturers. For these reasons, our industry has developed product certified ratings programs through organizations such as AMCA and ARI.

Why are certified ratings so important? Unfortunately, history has consistently demonstrated that product performance data that is not certified overstates actual performance. This article shows the magnitude to which performance may be overstated, specifically with respect to energy recovery wheels.

Greenheck's Energy lab

To help set the stage for this discussion, it is appropriate to understand Greenheck's role in the development of ARI standard 1060 (Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment) and the reputation of our energy lab. Like many other manufacturers, Greenheck participated in the development of the ARI standard and corresponding certification program. But unlike any other manufacturer, Greenheck's state-of-the-art energy lab was used to help calibrate the air-to-air heat exchanger lab for Intertek Testing Services (ITS), the organization which performs ARI certification tests. When ITS was evaluating laboratories to perform a series of round-robin tests to confirm the accuracy and repeatability of their lab for the purposes of ARI certification testing, they relied on just two other labs. One was at the National Renewable Energy Lab (NREL). The other was at Greenheck.

As part of our ongoing evaluation of the market, Greenheck has tested manufacturers' wheels that are listed in the ARI Certification Directory, as well as manufacturers' wheels that are not included in the directory. Energy recovery wheels from around the world were tested, including manufacturers from the U.S., India, Japan and Germany. We found that the wheels that are ARI Certified matched the ratings shown in the manufacturers' literature within ARI program tolerances. On the flip side, we found the performance of wheels from manufacturers who chose not to participate in the ARI Certification program to be significantly lower than catalogued.

Non-ARI Certified test results

The chart on page 1 shows the catalogued total energy recovery effectiveness and the actual effectiveness as measured by the Greenheck lab for four

Non-ARI Certified Energy Recovery Wheels

	Catalogued Total Effectiveness %	Actual Total Effectiveness %	Difference (% points)
Manufacturer A	83	68	-15
Manufacturer B	77	36	-41
Manufacturer C	76	61	-15
Manufacturer D	91	79	-12

These results are from real manufacturers that are currently promoting and selling their products in the marketplace. As a courtesy, actual company names have been omitted.

ARI Certified vs. Non-Certified Performance Ratings of Energy Recovery Wheels continued from page 7

manufacturers of non-ARI Certified wheels. The differences range between 12 and 41 percentage points, with an average difference of 21 percentage points.

At least one of these manufacturers claims "independent certification in accordance with ARI 1060". This actual performance data combined with some deceptive marketing language clearly emphasizes the importance of an ARI certification program for energy recovery wheels.

Ensure "ARI Certified" in specifications

There is a seemingly small, but very important difference in specification wording of ARI Certified and non-ARI Certified wheels. Some examples are listed as follows:

Non-ARI Certified language

- Tested in accordance with ARI 1060.
- Independently tested in accordance with ASHRAE Standard 84 and ARI standard 1060.
- Independently certified in accordance to ARI 1060.

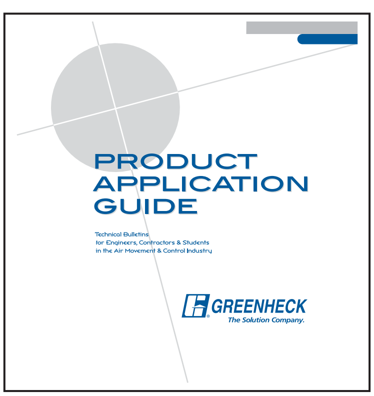
ARI Certified language

- ARI certified and listed in the ARI 1060 Directory of Certified Air-to-Air Energy Recovery Ventilation Equipment.

Keep in mind that ARI is the only HVAC industry accepted certification organization for air-to-air energy recovery ventilation equipment. Digging into other claims of independent certification typically result in not so independent testing and reporting methods.

Summary

The HVAC industry has gone to great lengths to help ensure proper product performance through the development of formal certification programs. This helps consulting engineer's design with confidence and ensures that building owners receive HVAC systems that operate as specified. Unfortunately, not all manufacturers participate in our industry's formal certification programs and, as a result, often sell equipment that does not operate up to cataloged performance. Protect yourself and your clients by including the appropriate certification language in your specifications. For air-to-air heat exchangers, accept only ARI certified products that are listed in the ARI 1060 Certified Directory of Products.



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Spark Resistant Construction (SRC)

One of the critical uses for ventilation equipment is the movement of potentially explosive gases. Engineers and designers who specify these systems must exercise caution when selecting their equipment to ensure continuous and safe system operation. This article will help develop an understanding of SRC along with how and when these types of products should be applied.

Where is SRC used?

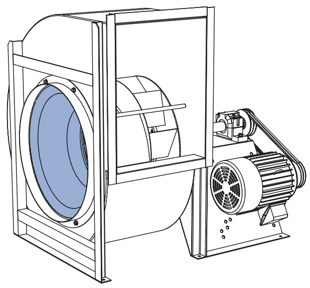
Although the term "explosion proof" is commonly used when referring to some enclosures for electric motors and disconnect switches, there is no such thing as an explosion-proof fan. When referring to fan construction, "spark resistant" is used. SRC is commonly used in systems where a spark in the airstream could cause fumes or contaminants in the airstream to ignite. Common applications include paint booths, chemical storage areas, and lab fume exhaust systems.

How is SRC defined?

The Air Movement and Control Association International (AMCA) has developed recommendations and guidelines for the selection and construction of air handling equipment which is used for potentially explosive airstreams. This guide, known as AMCA Standard 99-0401 Classifications of Spark Resistant Construction, defines three levels for spark resistant construction: Spark A, B, and C. The ultimate goal is to avoid physical contact between two ferrous materials.

Type C spark

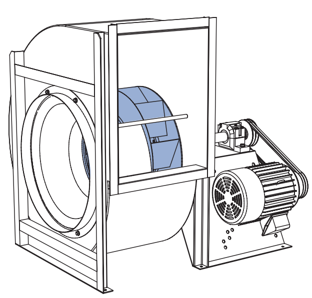
Type C offers a minimal level of spark resistance and only requires that possible contact between stationary and rotating components be reduced. Typically, this construction includes the use of an aluminum inlet cone and an aluminum rub ring. The aluminum inlet cone will be the first point of fan wheel contact if there is a mechanical failure. The aluminum rub ring placed at the opening of the housing where the shaft passes, protects against contact of the steel fan shaft and steel fan housing.



Type: C Cost: Low
Protection: Minimal

Type B spark

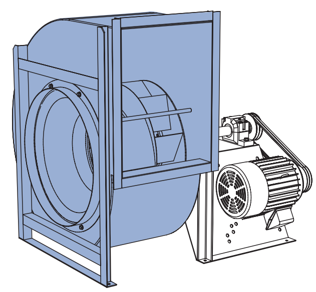
Type B requires that the impeller be constructed of non-ferrous materials, and that the fan components in the airstream be assembled in a manner that reduces the possibility of contact between any stationary and rotating component. Typically, this is satisfied with the use of an aluminum wheel and an aluminum rub ring. If there is a mechanical failure of the fan, the aluminum wheel will contact a steel inlet cone. Similar to Spark C construction, the aluminum rub ring will protect against contact of the steel fan shaft and steel fan housing.



Type: B Cost: Moderate
Protection: Better

Type A spark

Type A provides the highest degree of spark resistance, requiring that all fan components in the airstream be constructed of a non-ferrous material and that they be assembled in a manner such as to reduce the possibility of contact between any stationary and rotating component. The most common practice to meet Spark A requirement is to construct all of the fan's airstream components from aluminum. This includes the housing, wheel, inlet cone and any fasteners used in the airstream. In addition, an aluminum sheath is required to cover the steel fan shaft, or the



Type: A Cost: High
Protection: Best

Spark Resistant Construction (SRC) continued from page 9

shaft is to be constructed from monel.

As noted in the descriptions of spark A, B, and C construction, aluminum is the preferred nonferrous material. Alternative materials that are used for spark resistant construction include plastics, fiberglass, and Monel.

The Intent of spark resistant construction

Although SRC, as defined by AMCA, was originally set up to be used with housed centrifugal blowers, many manufacturers currently market other types of fans with the same SRC designations. Scroll type centrifugal fans typically offer higher levels of protection when compared to inline fans primarily because the bearings are located outside of the housing. The protection of internally mounted bearings on inline fans presents special problems.

For tube axial fans, meeting AMCA spark requirements is aided by the location of the impeller. Typically, tube axial fans are constructed with the impeller at the discharge of the fan, which keeps the bearing enclosure under negative pressure. This means that during fan operation ambient air is drawn through the bearing compartment and exhausted into the airstream.

For tubular centrifugals, the impeller is located at the inlet of the fan housing. This creates a situation where the bearing enclosure is under pressure. It is imperative that the bearing chamber be sealed tightly to prevent flammable fumes from escaping the fan.

Which type should I use?

The main criteria to keep in mind are whether the airstream will be normally hazardous, or not normally hazardous. A normally hazardous airstream may require type A or B. A fan handling gases that are not normally hazardous might be of construction type B or C.

When comparing SRC fans to standard steel construction, a higher degree of protection also comes at a higher price.

An example of a system that is not normally hazardous would be a high school chemistry lab. Although a spark resistant construction is warranted for this application, the degree of spark resistance would lessen as ambient classroom air dilutes the flammable materials. When the level of construction is in question, go with the higher degree of protection. One example might be a paint booth that is handling a normally hazardous airstream when the booth is in use. For the majority of paint booth applications, Spark B is required.

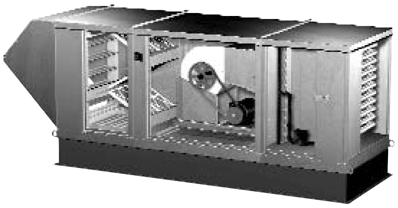
Equally important to the fan selection is the choice of electrical components such as the motor and disconnect switch, if required. The selection of this equipment is generally based on the environment surrounding the fan system and caution should be exercised here as well. For additional information on the selection of these components, refer to Product Application Guides FA/107-00 (Explosion Resistant Disconnect Switches) or FA/113-01 (Motors for Ventilation Products).

Keep in mind that having a safe SRC fan system does not end with the fan selection, purchase, and installation. Proper maintenance and regular inspection of SRC fans is important. The US Bureau of Mines along with others has shown that aluminum impellers rubbing on steel which has been allowed to rust may result in high intensity sparking.

Summary

Although factory representatives can help suggest what might best serve their customer, ultimately it is up to the system designer to specify appropriate levels. If needed, Greenheck's engineers are also available to provide additional assistance.

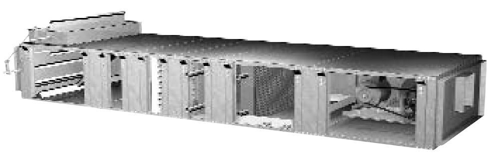
What's new at Greenheck



Make-Up Air Indirect gas-fired unit

Greenheck's new Model IGX-HV is an indirect gas-fired make-up air unit for heating and ventilating applications. While the primary function of this product is to heat (and potentially cool) a space to maintain the desired temperature, it is also capable of providing outside air to meet ASHRAE-62 or local ventilation requirements.

Model IGX-HV provides economical heating and ventilating at airflows up to 15,000 cfm. Eight mixing box control options and five thermostat options provide a wide range of ventilation and return air functions and settings, including four "economizer" cooling control options using outdoor air. Greenheck's gas-fired furnaces are 80% thermal efficient and feature a unique "post purge cycle" which runs the combustion fan after the unit is shut down to vent corrosive hot air and moisture out of the heat exchanger.



Modular Small Cabinet Fan

The modular Small Cabinet Fan is designed for air conditioning and/or heating buildings or specified spaces. It was developed to meet low cost commercial applications, such as schools, medical facilities, and office buildings. This product (Model MSCF) can be specified in 8 sizes ranging from 11 inches to 26 inches tall making it the lowest profile unit on the market in every cfm category.

Performance ranges from 250 cfm to 4700 cfm and static pressures up to 4-in. wg. Standard features described in the brochure include modular design, double-wall construction; insulated double-sloped stainless steel drain pans, internal spring isolation and dual access doors. Model MSCF can be configured in various ways with these available modules: chilled water or DX cooling, hot water heating, steam, pre-filters, access plenums and mixing boxes.

Laboratory Exhaust System

Greenheck's new tubular centrifugal laboratory exhaust system, Model TCB-LE is a cost effective, single-source alternative to standard field built-up fan and stack assemblies. A high velocity exhaust cone incorporated in the TCB-LE displaces hazardous or noxious laboratory fumes high above the roof, preventing contamination at the roof level and minimizing re-entry into the building's make-up air system. An optional bypass air plenum is used for variable volume exhausts and can also be used to add ambient air to the exhaust, further diluting the fumes and provide additional exhaust displacement.

The system bears the AMCA Seal for sound and air performance, meets ANSI Z9.5 and ASHRAE guidelines, and is suitable for flow applications from 500 to 24,000 cfm per fan.

What's new at Greenheck

New, Improved Plenum Fans

Greenheck's new plenum fan (Model QEP) has a 12-bladed, airfoil wheel that leads the industry with the lowest overall sounds levels and the highest mechanical efficiencies. The QEP also offers more configurations to handle your unique applications.

The QEP is ideal for custom or built-up air handling applications in schools, offices, and manufacturing environments where owners require low sound and energy savings. All Greenheck QEP fans are licensed to bear the AMCA seal for both inlet and outlet sound and air performance.

Miami-Dade approved Severe Duty Louvered Enclosure

Greenheck has taken hurricane protection to the next level by offering the only Miami-Dade County approved Severe Duty Louvered Enclosure (SDLE) on the market. (Notice of Acceptance number is 03-0422.05) The SDLE meets the stringent performance requirements established by the South Florida Building Code: Miami-Dade County test protocols TAS 201 (Large Missile Impact Test), TAS 202 (Uniform Static Air Pressure Test) and TAS 203 (Cyclic Wind Loading).

The SDLE is available in two designs — as an intake/exhaust penthouse for roof penetrations and a powered ventilation unit to protect roof top equipment. The SDLE has a structural steel frame, steel curb with mounting flange and is shipped fully assembled.

For more information on these products, contact your local Greenheck representative, or visit greenheck.com

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