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Picking The Right Ventilation Rate For Abrasive Blast Facilities

Selecting the right ventilation rate is a major component when designing and selecting components for an abrasive blast facilities.

There is a hierarchy of regulations, and consensus standards which mandates the ventilation rate. There are two primary Occupational Safety and Health Regulations which dictates the use of ANSI/AIHA Z9.4, titled “Abrasive-Blasting Operations – Ventilation and Safe Practices For Fixed Location Enclosures, these are:

> 1910.6(a)(1):
> The standards of agencies of the U.S. Government, and organizations which are not agencies of the U.S. Government which are incorporated by reference in this part, have the same force and effect as other standards in this part. Only the mandatory provisions (i.e., provisions containing the word "shall" or other mandatory language) of standards incorporated by reference are adopted as standards under the Occupational Safety and Health Act. and
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> Public Law 91-596, 84 STAT. 1590, 91st Congress, S.2193, December 29, 1970, as amended through January 1, 2004. (1), **SEC. 5. Duties**
> (a)(1): Each employer shall furnish to each of his employees’ employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
> (2): shall comply with occupational safety and health standards promulgated under this Act.

Any employer or facility owner considering the installation of an Abrasive Blasting Facility should first read this ANSI document. It may be purchased on-line at:

https://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2fAIHA%2fASSE+Z9.4-2011

This document covers a multitude of requirements in the design and construction of a Abrasive Blasting Facility, one of these elements is the Ventilation Rate inside the blast room. Ventilation Rates significantly impact the operator’s exposure to inhalation hazards more than OSHA mandated Permissible Exposure Limits, visibility in the room while blasting and the sizing of the dust collectors. The higher the ventilation rate the larger or more dust collectors need to be purchased, increasing the overall cost of the blasting facility. Table A-1 of this ANSI document provides the Minimum Design Ventilation for both downdraft and Cross draft rooms. While this article will address ventilation rates for downdraft rooms, it is important to understand these types of rooms are anomalies in the abrasive blasting industry. True downdraft rooms, in which all the air enters from the full ceiling and is reclaimed through the full floors. These types of room significantly increase the size or number of reclaim units necessary to reclaim usable media. The vast majority of abrasive blasting rooms built are Cross draft rooms which enable the ventilation of the air through as dust collector system without having to send it through the media reclaim system. Crossdraft rooms as significantly more cost efficient. Figure 1 below is referenced from this Table A-1 in ANSI Z9.4.

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TABLE A-1. Minimum Design Ventilation Air Volumes for Downdraft Blast-Cleaning Rooms and Ventilation Rates for Crossdraft Blast-Cleaning Rooms Occupied by Blasters[a]					
Type of Abrasives	Downdraft Blast-Cleaning Rooms (acfm/sq.ft.[b] for net floorspace (sq.ft.)[c]				Cross draft Blast-Cleaning Rooms (acfm/sq.ft[b] of cross-sectional area)
	0-100	100-200	200-300	>300	
1) Abrasives or material that may generate airborne asbestos fibers or free silica-containing dusts, coatings containing lead, chromates, or other similarly toxic compounds having permissible exposure limits of less than 1 mg/m^3	90	70	60	60	100
2) Abrasives or coating having permissible exposure limits from 1mg/m^3 to 5mg/m^3	60	50	40	35	80
3) Low toxicity material (such as abrasives of steel or aluminum oxide_ and contaminants (such as iron oxide scale) having permissible exposure limits of 5mg/m^3 or greater	40	35	30	20	60
4) Shot peening on clean metal with metal shot.	30	20	20	20	50

[a] Ventilation rates exceeding those in the table will depend on individual circumstances and should be determined so as to provide proper ventilation. Consideration should be given to higher rates when the composition of the workpiece is such that upon breakdown from the abrasive impact, toxic contaminants are release into the work area. Also, for Cross draft blast-cleaning rooms, use higher rates when one operator might be downwind of another. For zoned systems, base the air volumes on the area of the active zone(s)

[b] Denotes actual cubic feet per minute (acfm) per square foot (sq.ft.) and is also equivalent to the velocity of air past the operator.

[c] Square feet

Figure 1

This table is known as a performance specification, it simply states what the air velocity must be when moving through the blast facility. For example to obtain the air velocity in a facility in which the combined abrasive and substrate inhalation contaminate has a permissible Exposure Limit of 5mg/m^3 or greater, the designer must find the vertical cross sectional area of the room and multiply it by 60 ft/min. To illustrate:

When designing for a cross draft room of 10 foot wide, by 10 foot high by a 15 foot long room, your ventilation rate must be:

(10 ft) X (10 ft) X (60 ft/min) = 6000 ft^3/min.

If you extend your room to 100 feet long, but keep your width and height the same, your ventilation rate remains the same, i.e.:

(10 ft) X (10 ft) X (60 ft/min) = 6000 ft^3/min

Now let's consider changing the width and height of the room to 20 feet high and 15 feet wide, and also shorting the room to 5 feet long, the ventilation rate would be:

(20 ft) X (15 ft) X (60 ft/min) = 18,000 ft^3/min

The ventilation rate for Crossdraft rooms are dependent on the width and height of the room only and you can make the room as long as you want.

Downdraft rooms, which as I stated are anomalies, use the length and Width of the room to calculate the ventilation rates.

A final note in calculating the ventilation rate in a blast room, whether or not you can deduct the volume of the item being blasted in your ventilation calculations. Unless your item being blasted extends from the front of your blast room to the back, the air velocity in the open area in the front and back is identical to the dimensions of the room. It is true the velocity increases as it passes the item being blasted, but it will be slower in front of the item and behind it. Some manufacturers of blast facilities will convert the ventilation rate to room changes and then remove the volume of the object being blasted to obtain a new ventilation rate. However, this is not what the standard addresses. The standard addresses air speed through the complete room. Keeping the room changes the same does not keep the air speed the same. Clemco recommends calculating your ventilation rates based on an empty room to assure compliance with ANSI 9.4. It is the buyer's or employer's responsibility to comply with the OSHA regulations cited above. Deducting the volume of the item being blasted is tempting but does not strictly adhere to this ANSI standard.

The final issue many end-users or designers have is selecting from the four options for Cross draft rooms shown in ANSI table A-1.

Option 1, citing a minimum Cross draft ventilation of 100 ft/min is used primarily for applications in which hazardous substances such as asbestos-fibers, hexavalent chromium or lead is being removed from the substrates. Except for crystalline silica sand, there are no known common abrasives which will require 100 ft/min or greater by their selves. If highly hazardous substances are being removed from the substrate the employers must consider additional regulations such as the crystalline silica, lead, asbestos, or hexavalent chromium, OSHA regulations before designing the ventilation rates. These hazardous substances may require air speeds above 100 ft/min stated in the table. Footnote “a” at the bottom of the table addresses air speeds greater than 100 ft/min.

Option 2, citing a minimum Cross draft ventilation of 80 ft/min is also used primarily for applications in which there are hazardous substances being removed from the substrates, these may include coal tars, or epoxies. Employers should obtain the Safety Data Sheets for the coatings being removed to determine if the Permissible exposure Limits are between 1mg/m^3 to 5mg/m^3. If Coal Slags are used as an abrasive the employer should be aware of the amount of Beryllium in this abrasive. OSHA has issued new Beryllium standards which may require the use of this higher ventilation rate.

Option 3, is by far the most common required ventilation rate. Like the other options on this table, the ventilation rate is based on the permissible exposure limit of the combined hazardous inhalation substances in the air. Option three allows for any inhalation hazards which has a permissible exposure limit of 5mg/m^3 or above. It is used with the most common recyclable materials, such as steel, aluminum oxides, plastics, and modified corn starches. Single use media, such as garnet or crushed glass fall into this option. As stated above, Silica sand or coal slag may not fall into this option and higher ventilation rates may be required. Treating substrates such as rust, latex, acrylic, enamel paints, powder coating normally fall into this option. Obtaining the Safety Data Sheet for both the abrasive and substrate being removed should tell you if the permissible exposure limits are above 5mg/m^3.

Option 4, is only used when peening on clean substrates with metal shot. If you are not using the blast facility for peening operations with metal shot, you cannot design for a Crossdraft ventilation for 50 ft/min.

Inhalation hazards generated by abrasive blasting can lead to chronic and debilitating lung diseases and even death. Employers should assure the design of their abrasive blasting facilities meet the minimum ventilations rates stated in ANSI Z9.4.