CHAPTER 6

ABRASIVE BLASTING FACILITIES

6-1 **FUNCTION.** Workers prepare the surface of aircraft, shipboard, mechanical, utility, and other equipment in abrasive blasting facilities for surface coating, welding, and other operations. This Chapter does not apply to temporary blasting enclosures.

6-2 **OPERATIONAL CONSIDERATIONS.** Silica sand is prohibited from use in fixed location enclosures. Avoid using agricultural media (e.g. peach pits, rice hulls, walnut shells). They are particularly susceptible to explosions.

6-3 **DESIGN CRITERIA**. Apply the general technical requirements of Chapter 2 and the specific requirements of this Chapter to ensure the proper function, operation and maintenance of an abrasive blasting facility. Use this information when assembling a specification package for an enclosure manufacturer or inspecting an enclosure already in place.

6-3.1 **Exhaust Air**. Determine the type of dust hazard and the minimum average air velocity through the blasting enclosure in accordance with 29 CFR 1910.94(a), *Abrasive Blasting*; ANSI Z9.4, *Abrasive Blasting – Ventilation & Safe Practices for Fixed Location Enclosures*, sections 4, 5, 6 and A7; NFPA 68, *Standard for the Processing and Finishing of Aluminum*; NFPA 69, *Standard on Explosion Prevention*; NFPA 70; NFPA 91; and NFPA 654. Refer to NFPA 65; NFPA 480, *Storage, Handling, and Processing of Magnesium*; NFPA 481, *Storage Handling and Processing of Titanium*; NFPA 482, *Storage, Handling, and Processing of Zinc*; and NFPA 485, *Storage, Handling, and Processing of Lithium* when blasting on materials containing aluminum, magnesium, titanium, zirconium and lithium, respectively.

6-3.2 **Blasting Cabinets**. Install baffles around air inlets to prevent abrasive material from escaping from the cabinet. Use a minimum inward air velocity of 2.54 m/s (500 fpm) at all operating openings. Discharge the exhaust air outside the building.

6-3.3 **Walk-in Blasting Enclosures**. Design the enclosure so that the air flows from either the ceiling to the floor (downdraft), Figure 6-1, or from one wall to the opposite wall (crossdraft), Figure 6-2, and the following:

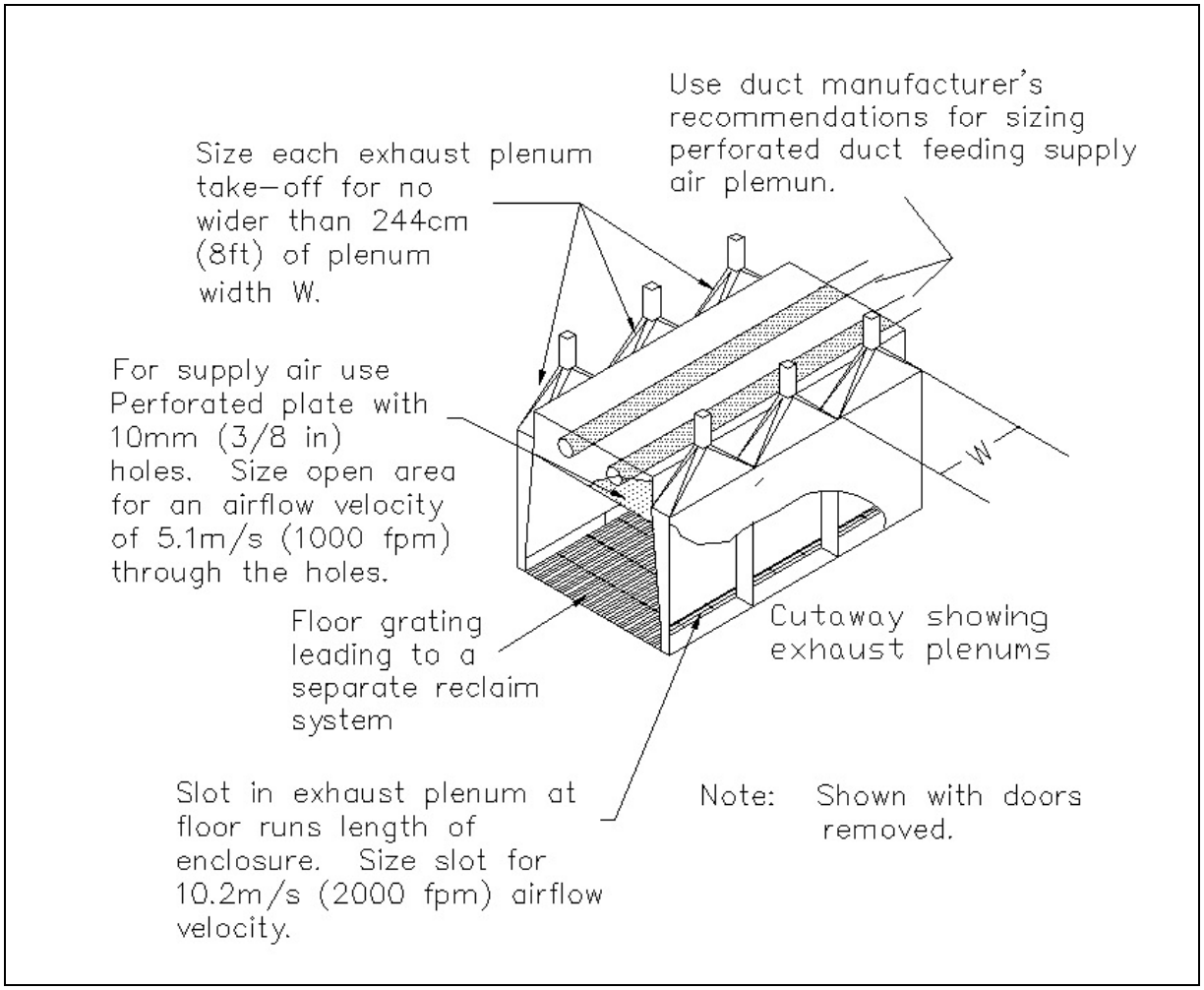
a. Consider the geometry of the room and how work pieces are positioned within the room, and the number of workers and their locations when selecting a downdraft or a crossdraft design.

b. Minimize the area of a blasting room to reduce the volumetric airflow rate. Allow at least 1.22 m (4 ft) of clearance between the work piece and the ceiling, walls, and doors of the room. Add extra clearance to accommodate internal fixtures such as tables and hoists.

c. Isolate the abrasive blasting rooms from other processes, functions and activities, whenever possible. Place blasting rooms outside, away from administration and other spaces. Protect the blasting room and related equipment from rainwater and moisture intrusion. As a minimum, put a roof or cover over the blasting room.

6-3.3.1 **Downdraft**. The downdraft design provides superior visibility. In addition, a downdraft design is preferred since contaminated air is usually drawn away from the worker's breathing zone. When more than one operator works in an enclosure, contaminated air generated from one operation is less likely to migrate into the other operator's breathing zone. Use a perforated plate with 9.53-mm (3/8-in) diameter holes, as shown in Figure 6-1, to uniformly distribute the airflow over the entire cross-section of the enclosure. Use a perforated duct inside the plenum to help evenly pressurize the plenum.

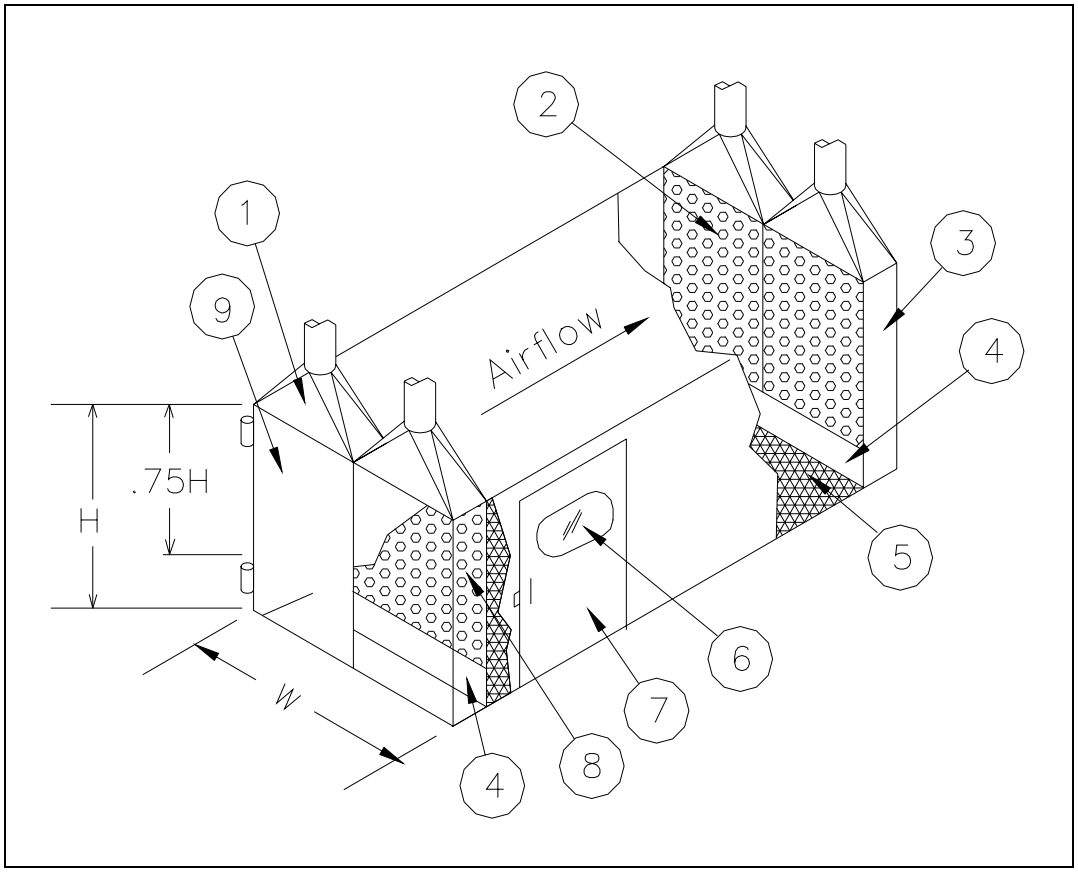
Figure 6-1. Downdraft blast enclosure.



6-3.3.2 **Crossdraft**. Consider the work locations of operators when positioning the replacement and exhaust air plenums. Do not allow any operator to blast upstream of coworkers. Use a perforated plate with 9.53 mm (3/8-in) diameter holes; see Figure

6-2, to uniformly distribute airflow over the entire cross-section of the enclosure.

Figure 6-2. Crossdraft blast enclosure.



NOTES:
1. For mechanically supplied replacement air, use maximum plenum take-off width of 2.44 m (8 ft). Plenum serves as material door.
2. Perforated plate with 9.53 mm (3/8-in) holes. Size open area for an airflow velocity of 10.16 m/s (2000 fpm) through holes.
3. Size the exhaust plenum for a maximum plenum velocity of 5.08 m/s (1000 fpm). Size any supply plenum for a maximum plenum velocity of 2.54 m/s (500 fpm).
4. Lift up flap to remove material from behind plenum.
5. Floor grating.
6. Observation window.
7. Personnel door.
8. Perforated plate, from floor to ceiling and wall-to- wall, with 9.53 mm (3/8-in) holes. Size open area for an airflow velocity of 5.080 m/s (1000 fpm) through holes.
9. Hinged plenum equipment doors.

6-3.4 **Access Doors and Observation Windows**. Provide an observation window and an access door in accordance with 29 CFR 1910.94(a)(3)(i)(d) and (e) and

ANSI Z9.4 sections 5.3 and 5.4. Position the observation window in the blast room walls and door as necessary so workers inside the room can be seen from outside the room at all times. Use several doors and windows in large rooms. Provide emergency exits on opposing walls. Make personnel and equipment doors operable from both inside and outside of the room.

6-3.5 **Air Cleaning Devices**. See paragraph 2-4.4. Design in accordance with 29 CFR 1910.94(a)(4)(iii) and ANSI Z9.4, section 6.3. Consider using a pulse-jet, pleated paper cartridge type dust collector and the following.

a. Replaceable explosion vents on the collector hoppers in accordance with NFPA-68.

b. Platforms leading to all elevated access hatches.

c. Fan located on the clean side of the collector.

d. Place dust collectors outside of the building for all blasting applications. NFPA 65 specifically requires that the air pollution equipment be located outside when blasting on aluminum or aluminum alloys.

6-3.6 **Recirculation**. Do not recirculate exhaust air when operations generate toxic materials. If exhaust air recirculation is permitted, design the system in accordance with the ACGIH IV Manual, ANSI Z9.4 (section 6.3) and ANSI Z9.7, 29 CFR 1910.1025 (lead), and 29 CFR 1910.1027 (cadmium). The outdoor air volumetric airflow rate must be sufficient to keep the contaminant below 25 percent of the MEC.

6-3.7 **Media Reclamation**. Design in accordance with 29 CFR 1910.94(a)(4)(ii) and ANSI Z9.4, section 6.2. Do not integrate the exhaust ventilation system with the media recovery system.

a. Protect the media recovery system and ductwork from moisture and rainwater intrusion to keep the media from caking and plugging up the system.

b. Use mechanical recovery systems such as rotary screw conveyors for heavy media (steel shot).

c. Consider using pneumatic recovery system instead of mechanical recovery system for plastic media.

6-3.8 **Ductwork**. See paragraph 2-4.1. Do not use spiral lock seam duct. Size the exhaust ductwork to maintain a minimum transport velocity of 17.8 m/s (3,500 fpm). Specify flat backed elbows per the ACGIH IV Manual, Chapter 5, Figure 5-25.

6-3.9 **Fans**. See paragraph 2-4.2. Use centrifugal fans with backward curved blades, whenever possible. Centrifugal fans with radial blades are less efficient, but still acceptable. Place the exhaust fan and the outlet ductwork outside of the building.

6-3.10 **Weather Stack Design and Location**. See paragraph 2-4.3 for design guidance.

6-3.11 **Replacement Air Ventilation Systems**. See paragraph 2-4.5. Design dedicated mechanically supplied replacement air systems to maintain room static pressures (relative to the atmosphere) ranging from -4.98 to -14.9 Pa (-0.02 to -0.06 in wg).

Blast booths often do not have mechanical replacement air. In this case, there is no control over the room static pressure for non-mechanical replacement air systems. The extra negative pressure reduces exhaust fan performance. If mechanically supplied replacement air is not feasible, ensure that the room static pressure and the resistance through filters and louvers are included when sizing the exhaust fan.

6-3.12 **Heating and Air Conditioning**. See paragraph 2-6.2

6-3.13 **System Controls**. Design system controls in accordance with paragraph 2-5 and the following.

a. Install static pressure sensors at locations that represent the average static pressure in each blasting room. This will enhance monitoring and maintenance of desired blasting room pressures.

b. Interlock the blasting tool power supply with the ventilation system's on-off switch. This will prevent the use of blasting tools without ventilation controls.

6-4 **SAFETY AND HEALTH CONSIDERATIONS.** See paragraph 2-7, 29 CFR1910.94(a)(5), and ANSI Z9.4, section 7, for general requirements. Consider the following.

6-4.1 **Respiratory Protection**. Follow the guidelines in 29 CFR 1910.94(a)(5) for respiratory protection requirements. The operator must wear a continuous-flow, air-line respirator that covers the head, neck, and shoulders. Consider providing each respirator hood with an adjustable, vortex-type climate control system.

6-4.2 **Air Supply and Air Compressors**. For large booths, consider providing multiple air hose connection points along the perimeter of the enclosure to accommodate work in various parts of the booth.

6-4.3 **Noise**. See paragraph 2-7.2. Carefully select the blast nozzle. Nozzle noise generation depends greatly on the discharge velocity. Consider using sound barriers or dampening materials on enclosure walls. Protect the dampening material

from abrasive blast as much as possible. Isolate the air compressor, media recirculation, and air pollution equipment to minimize noise exposure.

6-4.4 **Hygiene Facilities**. Provide change rooms and shower following guidelines such as OSHA regulations, DOD, or Branch Service requirements.

CHAPTER 7

WOOD SHOP FACILITIES

7-1 **FUNCTION.** Wood shops differ in size and function. Use the design criteria in this chapter as a general guideline for developing ventilation systems for wood shops.

7-2 **OPERATIONAL CONSIDERATIONS.** A properly designed ventilation system will control the dust level within the shop. Exposure to wood dust may lead to health problems. The accumulation of wood dust can create explosion and fire hazards. Even if a ventilation system is installed to collect most of the dust, manual cleaning at each machine and throughout the shop is still necessary. Restrict woodworking exhaust systems to handling only wood dust. Do not connect any other process that which could generate sparks, flames, or hot material to a woodworking exhaust system.

7-3 **FLOOR PLAN LAYOUT.** Contact the shop personnel who will be working with the machinery to get their input on workflow and specific equipment. Design the ventilation system to complement equipment layout and minimize housekeeping.

7-4 **DESIGN CRITERIA.** Design the facility using general technical requirements in Chapter 4 of this UFC, NFPA 664, *Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities* and the specific requirements in this chapter.

7-4.1 **Exhaust Air System**. Calculate the system capacity on the basis that the system operates with all hoods and other openings, such as floor sweeps, open. Refer to the ACGIH IV Manual, Chapter 10, for determining the exhaust flow rate for specific wood shop machines.

7-4.1.1 **System Layout**. Lay out the system to meet the shop requirements. Consider locating machines with the greatest hood resistance as close as possible to the fan. In most cases, ductwork is located along the ceiling and walls; however, running ductwork under removable grates or panels in the floor may reduce duct lengths and leave more working space around machinery. Refer to NFPA 650, *Pneumatic Conveying Systems for Handling Combustible Particulate Solids* and 664 for information on wall penetrations and clearances.

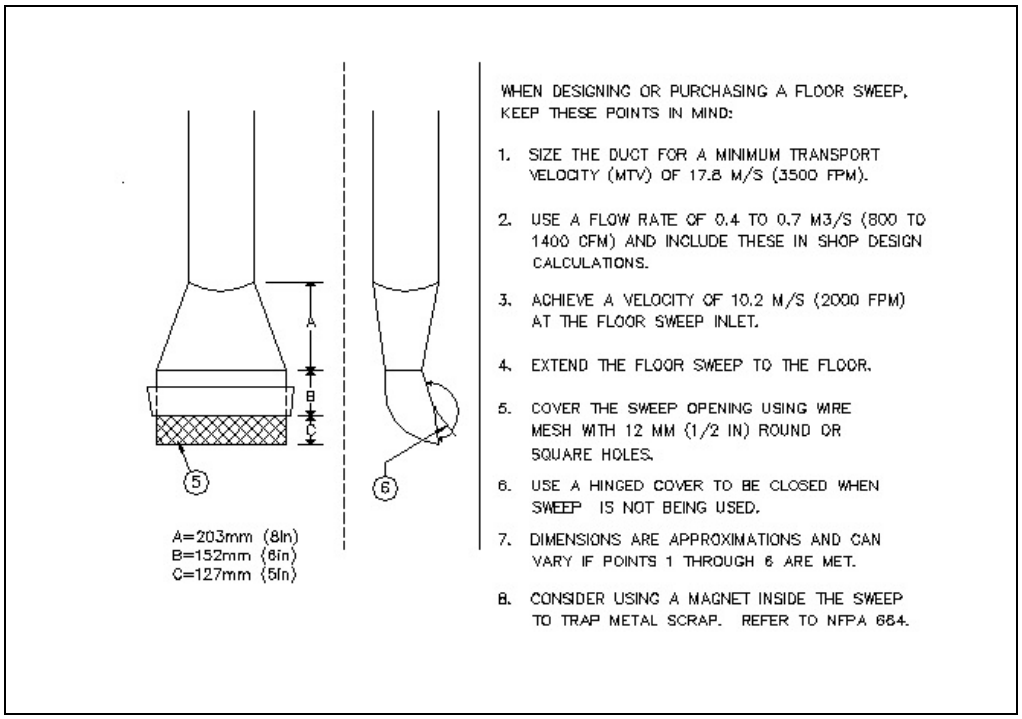
7-4.1.2 **Plenum Exhaust System**. An alternative to the tapered system is a plenum system, described in the ACGIH Manual, Chapter 5. A plenum system allows equipment to be move equipment in the shop and may be more efficient. Ducts can be added or removed, as equipment needs change. See the ACGIH IV Manual Chapter 5 for further considerations.

7-4.2 **Hood Design**. Provide a hood for each operation that produces dust. This includes sawing, shaping, planing, and sanding operations. Design and position all hoods so the wood dust will fall, be projected, or be drawn into the hood in the direction

of the airflow. Construct hoods of noncombustible materials. Ensure the hoods do not interfere with worker operations. In some cases, the exhaust hood may be utilized as a safety guard. Refer to the ACGIH IV Manual, Chapter 10 for woodworking hood designs. Modify the drawings as necessary to meet the specific equipment and process requirements.

7-4.3 **Floor Sweeps**. If the design includes floor sweeps, include a means, such as magnetic separators, to prevent scrap metal from entering the system. Figure 7-1 shows a basic floor sweep design. The floor sweep is only opened during shop clean up. If the system design calculations indicate that, when opened, the floor sweep provides a transport velocity of less than 17.78 m/s (3,500 fpm,) design the system to include floor sweeps in the normally opened position without a hinged cover.

Figure 7-1. Floor sweep



7-4.4 **Ductwork**. See paragraph 2-4.1 for general ductwork design. See NFPA 664 for specific requirements on wood shop ductwork construction. Size the ductwork to maintain a minimum transport velocity as specified in the ACGIH IV Manual, Chapter 10, Woodworking. Use only metal ductwork and conductive flexible hose. Bond and ground all ductwork in accordance with NFPA 664. The ductwork must be designed on the basis that all hoods and other openings connected to the system are open.

7-4.5 **Blast Gates**. Provide blast gates only for the specific purpose of balancing the airflow. Do not use blast gates to isolate equipment from the exhaust system with the intent to reduce the overall airflow requirement. When possible, install blast gates on horizontal runs and orient the gate so the blade is on the top half of the duct and opens by pulling the blade towards the ceiling. When possible, blast gates

must be installed at a location not easily accessible to shop personnel. After final balancing and acceptance, secure the blade and mark its position so that it can be returned to the balanced position if inadvertently moved. When the blast gate cannot be placed out of the reach of shop personnel, then lock the blade in position. For example, drill a hole through the body and blade of the gate and then insert a bolt and tack weld it.

7-4.6. **Duct Support.** If sprinkler protection is provided in the duct, horizontal ductwork must be capable of supporting the weight of the system, plus the weight of the duct half-filled with water or material being conveyed, whichever has the higher density.

7-4.7 **Clean Out Panels**. See paragraph 2-4.1.

7-4.8 **Exhaust Fans**. See paragraph 2-4.2.

7-4.9 **Weather Stack Design and Location**. See paragraph 2-4.3.

7-4.10 **Air Cleaning Devices**. See paragraph 2-4.4. Locate the air-cleaning device outside the building.

7-4.11 **Heating and Air Conditioning**. Provide heating and cooling according to MIL-HDBK-1003/3.

7-5 **SAFETY AND HEALTH CONSIDERATIONS.** See paragraph 2-7 and the following items.

a. Refer to section 7.2.2 of ANSI O1.1, *Woodworking Machinery, Safety Requirements* for personal protective equipment.

b. Provide a means for separately collecting and disposing of any metal scrap such as nails, band iron, or any wood containing metal. Do not use the woodshop ventilation system to pick up these materials.

c. Avoid the use of wood painted with paints containing lead, hexavalent chromium, cadmium, or coated with wood preservatives. Otherwise, consult an industrial hygienist to determine the exposure level and the level of respiratory protection needed.

d. Use sharp and clean blades at the correct feed rate to generate less heat. The generated heat can raise the wood or wood-containing product to ignition temperature that could start a fire.