Approved American National Standard

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American National Standard for

Exhaust Systems for Grinding, Polishing, and Buffing

AIHA

Protecting Worker Health

A Publication by
American Industrial Hygiene Association

ANSI/AIHA Z9.6–2008

American National Standard — Exhaust Systems for Grinding, Polishing, and Buffing

Secretariat

American Industrial Hygiene Association

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American National Standard

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Contents

Figures Used in this Standard

Page

FOREWORD (This foreword is not part of the American National Standard/AIHA Z9.6–2008)

A standard for ventilation of grinding, polishing, and buffing equipment was originally developed by the Industrial Hygiene Codes Committee of the American Foundrymen's Association (now known as the American Foundrymen's Society, or AFS) and was approved by the Board of Directors of that organization on December 4, 1936. Realizing that grinding, polishing, and buffing equipment is used in many industries and wishing to make technical material used by the foundry industry more widely available, the American Foundrymen's Association submitted this standard to the American Standards Association (now ANSI) for approval as an American National Standard. ASA referred the standard to the Z9 Committee on Exhaust Systems, a canvas of interested parties was conducted by letter ballot, and the standard was issued as Z43.1–1941 on August 14, 1941.

The Dust Control Committee of the American Foundrymen's Society revised and updated the standard, submitted the revision to the American Standards Association, and it was reissued under the guidance of the Z9 committee as Z43.1–1966. ANSI withdrew the standard in 1988 when no further work was done on it. The Z9 Committee, however, believed it was important to maintain this consensus information and chartered a Z9.6 subcommittee in 1992 to rewrite Z43.1 as ANSI Z9.6. This new standard provides updated information on ventilation for grinding, polishing, and buffing operations that conforms to current accepted practices.

New technology and research continues to change this field and it is hoped that future versions of the standard will reflect this growth in knowledge. Suggestions for improvement are welcome. They should be sent to the American Industrial Hygiene Association, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031.

How to Use this Standard

The requirements of the standard beginning in Section 4 are presented in a two-column format. The left column presents the requirements of the standard; the right column provides clarification and explanation of the requirements.

Figures 1–15 are incorporated as part of the standard.

Standard requirements should be considered minimum criteria and can be adapted to the needs of the User establishment. Demonstrably equal or better approaches are acceptable. When deviating from the Standard, documentation should be provided.

The Standard is auditable by those trained in ventilation. An Audit Form is provided in the Appendix.

This standard was developed and approved for submittal to ANSI by the Z9 Accredited Standards Committee on Safety Standards for Exhaust Systems. Consensus was reached through a process involving the entire Z9 Committee in a series of reviews and in the final vote of approval. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the Z9 Committee had the following members:

L. DiBerardinis, Chair
J. Price, Vice Chair
Mili Mavely, Secretariat Representative

Organization Represented	*Name of Representative*
Alliance of American Insurers	S. Ecoff
American Chemical Society	D. Walters
American Conference of Governmental Industrial Hygienists	G. Knutson
American Automobile Manufacturers Association	G.M. Adams
American Foundrymen's Society	R. Scholz
American Glovebox Society	S. Crooks
American Society of Heating, Refrigerating, and Air Conditioning Engineers	T. Smith
American Society of Safety Engineers	P. Osley
Consolidated Edison of New York	G. Slintak
National Association of Metal Finishers	K.C. Hankinson
National Spray Equipment Manufacturers Association	D.R. Scarborough
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K. Paulson
J.M. Price
J.C. Rock
M. Rollins
J.W. Sheehy

Subcommittee Z9.6 on Exhaust Systems for Grinding, Polishing, and Buffing, which developed this standard, had the following members:

M. Rollins, Chair
L. Cook
G. Adams
R.L. Karbowski
D.J. Burton

American National Standard — Exhaust Systems for Grinding, Polishing, and Buffing

1 Scope and Application

1.1 Scope. The requirements and emission and exposure control principles described in this standard represent the minimum criteria intended 1) to protect the health of personnel engaged in and working in the vicinity of grinding, polishing, and buffing operations; and 2) to control contaminants generated by those operations.

1.2 Application. The Standard applies to processes, equipment and operations that use power-driven machinery to grind, polish, or buff a product without the use of a liquid coolant. Where liquid coolants are used, the coou User to control exposures, pooling of liquids, draining of ducts, use of mist eliminators, and so forth, that are not covered in the Standard.

1.3 Where federal, state, or local regulations or codes are more stringent, those regulations and codes shall have control.

2 Referenced Standards and Publications

2.1 General. The regulations, codes, standards, and guidelines cited in Sections 2.2, 2.3, and 2.4 contain provisions that through reference constitute provisions of this American National Standard. The related documents cited in 2.5 contain additional information but are not essential for complying with the requirements of this standard.

At the time of publication, the editions indicated were current. All standards and guidelines are subject to revision, and Users of this American National Standard are encouraged to consult the most recent editions of the standards and guidelines listed below.

2.2 American National Standards

ANSI/AIHA Z9.2–2006, *Fundamentals Governing the Design and Operation of Local Exhaust Systems.*

ANSI/AIHA Z9.7–2006, *Recirculation of Air from Industrial Process Exhaust Systems.*

ANSI/AIHA Z9.10–2007 *Fundamentals Governing the Design and Operation of Dilution Ventilation Systems in Industrial Occupancies.*

ANSI B7.1–2000, *The Use, Care, and Protection of Abrasive Wheels.*

ANSI/ASSE Z87.1–2003, *Occupational and Educational Personal Eye and Face Protection Devices.*

2.3 Occupational Safety and Health Administration Standards

Code of Federal Regulations, Title 29, Part 1910, Section 133, Eye and Face Protection.

Code of Federal Regulations, Title 29, Part 1910, Section 134, Respiratory Protection.

Code of Federal Regulations, Title 29, Part 1910, Subpart Z Toxic and Hazardous Substances.

2.4 Other Publications

Industrial Ventilation: A Manual of Recommended Practice, 26th Edition. Cincinnati, OH: ACGIH®, 2007.

Threshold Limit Values® for Chemical Substances and Physical Agents and Biological Exposure Indices®. Cincinnati, OH: ACGIH®. [Published annually]

2.5 Related Documents

Code of Federal Regulations, Title 29, Part 1910, Section 94 — Ventilation.

NFPA 70–2005, *National Electric Code.*

NFPA 91–2004, *Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.*

NFPA 651–1998, *Machining and Finishing of Aluminum and the Production and Handling of Aluminum Products.*

NFPA 68– 2002, *Explosion Prevention by Deflagration.*

NFPA 77–2007, *Recommended Practice on Static Electricity.*

NFPA 480–1998, *Storage, Handling and Processing of Magnesium Solids and Powders.*

NFPA 480 ROP–2002, *Storage, Handling and Processing of Metal Solids and Powders* (which is intended to include the standards shown below). [Note: NFPA 480 ROP has been proposed to incorporate older versions of NFPA 481-485 covering the processing of various metals. Older standards referenced here are valid until rescinded.]

NFPA 481–2000, *Production, Processing, Handling and Storage of Titanium.*

NFPA 482–1996, *Production, Processing, Handling and Storage of Zirconium.*

Ventilation *Requirements for Grinding, Buffing and Polishing Operations* (DHHS [NIOSH] Publication No. 75-207).

Hemeon's Plant and Process Ventilation, 3rd Edition. Boca Raton, FL: Lewis Publishers, 1999.

3 Definitions. The following paragraphs explain terms used in Standard paragraphs and figures.

3.1 Air Cleaning Equipment. A device or combination of devices for separating contaminants from the air handled by an exhaust ventilation system.

3.2 Balanced. In local exhaust systems a balanced system is one in which the desired air flowrate is achieved simultaneously in all branches of the system. Balance is usually achieved through good design, proper fitting and duct selection, and, when necessary, by the use of balancing dampers.

3.3 Branch duct. A duct connecting an exhaust hood to a main or submain duct.

3.4 Commissioning, Commissioning Plan. A process or plan in which an exhaust ventilation system's performance is identified, verified, and documented before, during, and after design, construction, or remodeling to assure proper operation and compliance with codes, standards, and user intentions. Commissioning ends when tests and demonstrations have verified that the system operates as intended. A commissioning agent is often used to administer the commissioning process, tailored to the needs of the system.

3.5 Contaminant. Also, **Air Contaminant, Stressor.** A substance (smoke, dust, fume, mist, vapor or gas) whose presence in air is harmful, hazardous, or a nuisance to humans.)

3.6 Control Velocity. Also, **Capture Velocity.** The velocity of air at a point in space sufficient to draw contaminants and contaminated air into an exhaust hood.

3.7 Cradle. A movable fixture, upon which the part to be ground or polished is supported.

3.8 Cut-off wheels. Wheels of metal or organic bonded abrasives used for sawing and cutting. These wheels may be of the non-reinforced, reinforced, heavily reinforced, or metal center type. Cut-off wheels have diameter, thickness, and hole size dimensions.

3.9 Design. The process that includes characterizing the interactions between emissions, workers, and the air; determining appropriate air flowrates, static pressures, and other operational parameters; specifying equipment and system components.

3.10 Designer. Persons charged with designing a ventilation system; may include mechanical engineers, industrial hygiene engineers, and others with design education and experience. See 3.9 for a definition of design.

3.11 Disc wheel: All power-driven, rotating discs faced with abrasive materials, artificial or natural, and used for grinding or polishing on the side of the assembled disc.

3.12 Document; to Document; Documentation. The formal process of planning and recording of the rationale for decisions made by the User, the designer, or others. Also, the written procedures developed for operating, testing, and maintaining an LEV system.

3.13 Ductwork. Elongated rigid or flexible enclosures used to convey air and entrained contaminants from one location to another.

3.14 Entry. The point at which a segment of ductwork (i.e., branch or submain) enters another segment of ductwork (i.e., submain or main); entry from a hood to a duct; and entry from a plenum to a duct. The “Entry loss” (or “hood entry loss, He”) is the static pressure loss of the hood or capture device. Formulas for entry losses are provided in Figures 1–15.

3.15 Exhaust Hood. Also, **Hood.** A shaped opening designed to capture or control air contaminants. The exhaust hood typically encloses, captures, receives, and/or removes emissions or contaminated air from process equipment enclosures, or directly from an emission source. The term also applies to exhaust ventilated enclosures, exhaust ventilated tools, and exhaust apparatus or devices attached or integral with, the process equipment.

3.16 Exhaust Rate. Also, **Exhaust Volume Flowrate, Air Flowrate, Q**. The air volume flowrate through an exhaust hood or in a duct. Usually in cubic feet per minute (cfm) or cubic meters per second (cms).

3.17 Exhaust System, Local Exhaust System, LEV System. A mechanical system for removing contaminated air from a space, comprised of one or more of the following elements: exhaust hood, ductwork, air cleaning equipment, exhauster or fan, and stack. An exhaust system operates as a functional entity and the performance of all parts is affected by the design and performance of all other parts.

3.18 Face Velocity. Average velocity of the air in the plane of a hood opening with a directional vector perpendicular to that plane.

3.19 Fan. Also, **Exhauster, Ejector.** Mechanical device used to provide pressure and move air through an LEV system.

3.20 Grinding, polishing, or buffing. The removal of material from or the finishing or polishing of a workpiece or part, using an abrasive tool. As the part is being ground, buffed or polished, particles are removed and leave the object at a high speed plus the tool is reduced in size and emits particles, all of which must be controlled.

3.21 Grinding wheel: All power-driven, rotating grinding or abrasive wheels except disc wheels as defined in this standard consisting of abrasive particles held together by artificial or natural bonds and used for peripheral grinding.

3.22 Hazardous materials: As defined in OSHA 29 CFR 1910.1200, *Appendix A, Hazard Communication.*

3.23 Hood. See Exhaust Hood.

3.24 Horizontal double-spindle disc grinder: A grinding machine carrying two power-driven, rotating, coaxial, horizontal spindles on the inside ends of which are mounted abrasive disc wheels used for grinding two surfaces simultaneously.

3.25 Horizontal single-spindle disc grinder: A grinding machine carrying an abrasive disc wheel on one or both ends of a power-driven, rotating single horizontal spindle.

3.26 IH, Industrial Hygiene, Industrial Hygienist. The profession devoted to the anticipation, recognition, evaluation and control of employee exposures to airborne contaminants. A CIH is an IH certified by the American Board of Industrial Hygiene.

3.27 LEV. Local Exhaust Ventilation; see Exhaust System.

3.28 Main duct: A duct connecting two or more branches to the air moving device or air cleaning device.

3.29 Makeup Air. Also, **Replacement Air, Supply Air.** Outside or acceptably clean air supplied to replace air that is exhausted through an LEV system. Makeup air commonly refers to building ventilation while replacement air refers to air replaced as part of the industrial process, but overlap occurs in usage.

3.30 Occupational Exposure Limit (OEL). A concentration of contaminant in air not to be exceeded in the breathing zone of employees. Published OELs include: Permissible Exposure Limit (PELs; established by OSHA) Workplace Environmental Exposure Levels (WEELs, sponsored by AIHA), Recommended Exposure Limits (RELs, sponsored by NIOSH), and threshold limit value (TLVs®; sponsored by ACGIH®). In some cases the user may develop in-house OELs (i.e., when published OELs are not available).

3.31 Polishing and buffing wheel: All power-driven, rotating wheels composed all or in part of textile fabrics, wood, felt, leather, or paper, and which may be coated with abrasives on the periphery of the wheel for purposes of polishing, buffing, and light grinding.

3.32 Portable grinder: Any power-driven, rotating grinding, polishing, or buffing wheel mounted in such manner that it may be manipulated and operated by hand.

3.33 Recirculated Air. Air that meets the requirements of ANSI/AIHA Z9.7–2007, *Recirculation of Air from Industrial Process Exhaust Systems.*

3.34 Replacement Air. See Makeup Air.

3.35 Scratch brush wheel: All power-driven, rotating wheels made from wire or bristles and used for scratch cleaning and brushing purposes.

3.36 Swing-frame grinder: Any power-driven, rotating grinding, polishing, or buffing wheel mounted in such a manner that the wheel with its supporting framework can be manipulated over stationary objects.

3.37 Slot Velocity. The average velocity of the air in the plane of the slot with a directional vector perpendicular to that plane.

3.38 Standard Conditions, Standard Dry Air. Air at 70°F (20°C) and 29.92 inches Hg (101,325 Pa; 14.696 psia) absolute pressure, with little or no moisture content, weighing 0.075 lbs/cu foot (1.2 kg/cu meter).

3.39 Standard, the Standard. Refers to this American National Standard: ANSI/AIHA Z9.6–2008.

3.40 Transport Velocity. The air velocity in ductwork required to prevent dry air contaminants from settling out in the ductwork; also, "scouring velocity," or "minimum duct velocity."

3.41 User. "User" refers to the person assuming immediate and ultimate responsibility for the application of the standard, e.g., the design, operation and/or maintenance of a ventilation system or a component of the system. “User “could include the employer, owner, foreman, architect, engineer, and/or other responsible persons, depending on the part of the standard being applied.

3.42. Velocity, V: The speed of air, usually in feet per minute (fpm) or meters per second (mps).

3.43 Velocity pressure, VP: The kinetic pressure in the direction of flow necessary to cause a fluid at rest to flow at a given velocity. It is usually expressed in inches of water gauge.

3.44 Vertical spindle disc grinder: A grinding machine having a vertical, rotating, power-driven spindle carrying a horizontal abrasive disc wheel.

3.45 Worker, Operator, Employee. Those using or operating grinding, polishing and buffing equipment covered by this Standard.

4 Hazardous Materials Exposure Control

4.1 To the maximum extent feasible, the concentration of air contaminants at the breathing zone of the operator and adjacent personnel shall be maintained, through engineering and administrative controls, at or below OEL concentrations permitted by the federal, state, or local agency having jurisdiction.

4 Hazardous Materials Exposure Control

4.1 Where technical and other feasibility issues make compliance with Section 4.1 impossible, the user should also comply with Section 4.2.

Grinding, buffing, and/or polishing of hazardous materials or objects with surface coatings containing hazardous materials, or when using abrasive wheels containing hazardous materials, may create airborne concentrations of those materials in the breathing zone of individuals which may be hazardous.

Examples of engineering controls include mechanical ventilation, isolation, substitution, automation and wet methods. Administrative controls include worker training and the use of appropriate work practices.

Permitted OEL exposure concentrations are found, for example, in OSHA 29 CFR 1910, Subpart Z Toxic and Hazardous Sub-stances. (The “OSHA PEL.”)

In the absence of legally mandated acceptable OEL concentrations, or when the User so elects, other consensus guidelines such as those established in the latest edition of the ACGIH® *Threshold Limit Values® for Chemical Substances and Physical Agents and Biological Exposure Indices®* Handbook can be used. See Section 2.4.

4.2 Feasible engineering and administrative control measures shall also be used to control over-exposures to the eyes, skin and gastro-intestinal systems of operators and adjacent personnel.

4.2 Skin exposure can lead to dermatitis and other skin diseases. Ingesting some metals (e.g., lead, arsenic, cadmium) can be as hazardous as being exposed through the pulmonary system. The eye is especially susceptible to high velocity particles. An industrial hygienist can assist in determining hazards and appropriate controls.

5 Personal Protective Equipment (PPE)

5.1 When conformance with Section 4 cannot be achieved by feasible engineering or administrative controls alone, appropriate PPE shall be provided.

5.1 Sections 5.2–5.4 provide specific PPE requirements.

In many cases, PPE should be used even when Section 4 can be complied with. The user should determine and document the need (or lack thereof) for the use of PPE.

5.2 When conformance to Section 4.1 cannot be achieved by engineering or administrative controls, appropriate respiratory protection shall be provided.

5.2.1 Respiratory Protection. Where respirators are provided, a respirator program that meets the requirements of OSHA 29 CFR 1910.134, Respiratory Protection, shall be implemented.

5.3 Eye Protection. Equipment to protect the eyes and face against contact with materials ejected from the grinding, polishing, and buffing operations shall be provided to the operator and others working adjacent to the operation.

5.3.1 Eye Protective Equipment shall conform to the requirements set forth in ANSI/ASSE Z87.1–2003 *Occupational and Educational Personal Eye and Face Protection Devices*, and OSHA 29 CFR 1910.133, Eye and Face Protection.

5.4 Skin Protection. Equipment and clothing to protect the skin against contact with materials associated with the grinding, polishing, and buffing operations shall be provided to the operator and others working adjacent to the operation, as needed.

5.4 Skin protection should be provided where skin exposure could result in dermatitis, abrasion, cuts, or absorption. An industrial hygienist can assist in determining skin-related hazards and protection.

6 Ventilation System Design and Operation

6.1 Local exhaust ventilation systems shall be designed, commissioned, constructed, balanced, operated and maintained in accordance with Sections 4-8 of ANSI/AIHA Z9.2–2006, *Fundamentals Governing the Design and Operation of Local Exhaust Systems* and ACGIH's *Industrial Ventilation — A Manual of Recommended Practice*, 26th Edition, Volumes 1 and 2.

6.2 Materials of construction shall be fire-resistant and protected from corrosion where required by the intended use.

6.3 Collection of Contaminants. All ventilation exhaust systems shall be provided with air cleaning devices as mandated by federal, state, or local regulations and as provided for in Section 9, ANSI/AIHA Z9.2–2006 *Fundamentals Governing the Design and Operation of Local Exhaust Systems.*

6.4 Recirculation of Exhaust Air. Any recirculation of exhaust air to the work environment shall be done in conformance with ANSI/AIHA Z9.7 - 2006, *Recirculation of Air from Industrial Process Exhaust Systems.*[2]

6.4.1 Makeup air used to replace exhausted air shall conform with the provisions of Section 6 of ANSI/AIHA Z9.2–2006, *Fundamentals Governing the Design and Operation of Local Exhaust Systems.*

6.5 Ongoing and Preventive Maintenance. A preventive maintenance program consisting of periodic inspection, adjustment, and lubrication of system components shall be instituted for each system. Components shall be serviced in accordance with the manufacturer's recommendations.

6.5.1 Maintenance programs shall conform with the provisions of Sections 11 and 13 of ANSI/AIHA Z9.2–2006, *Fundamentals Governing the Design and Operation of Local Exhaust Systems.*

6 Ventilation System Design and Operation

6.1 There are overlaps between these two major information sources. In the event of conflicting requirements, the more stringent should be used.

6.3 Users of this standard should contact the local air pollution control authority to determine air cleaning requirements and to obtain a permit.

6.4 The recirculation of exhaust air from grinding, polishing, and buffing processes is a potentially dangerous and/or hazardous practice. If done improperly, hazardous concentrations of air contaminants can be created in the work environment.

6.5 Maintenance. Proper operation of a system over time is dependent on regular and preventive maintenance. Effective maintenance will ensure that the system functions as designed and provides adequate capture and control of contaminated air.

6.6 Housekeeping. Dust on the floor, on enclosures, on adjacent horizontal surfaces, and in other locations shall be cleaned periodically.

6.6 Where toxic materials (e.g., heavy metals such as lead) are present in the dusts, care must be taken to avoid pulvation and over-exposures. Cleaning approaches using wet methods and/or a high efficiency particulate air (HEPA) filtered vacuum should be used.

7 Commissioning and Testing of Exhaust Ventilation Systems

7.1 Exhaust Systems. Exhaust ventilation systems for grinding, polishing, and buffing operations shall be commissioned, balanced and tested as described in Sections 12 and 14 of ANSI/AIHA Z9.2–2006, *Fundamentals Governing the Design and Operation of Local Exhaust Systems* and ACGIH®'s *Industrial Ventilation — A Manual of Recommended Practice*, 26th Edition: O&M (Volume 2).

7 Commissioning and Testing of Exhaust Ventilation Systems

7.1 After an exhaust system is installed, it should be tested initially and periodically to assure that it performs according to design or operating performance criteria, normally established before installation and during the commissioning process.

Performance criteria (e.g. "the flowrate should be 1,000 scfm; the hood static pressure should be 0.75" w.g.,) are useful because testing and measurements can confirm satisfactory performance.

Exhaust system components to be tested usually include the hood or exhausted tool or enclosure, the air cleaner, and the fan. Performance criteria should usually include such parameters as: hood static pressure; minimum air volume flowrate; average; minimum, and maximum hood face velocities; visual containment; measured containment performance factors; capture velocity; slot velocity; transport velocity; pressure drop across air cleaners; fan total pressure; motor amperage; and so forth, as appropriate.

8 Hoods and Enclosures

8.1 Hoods used in exhaust ventilation systems for grinding, polishing, and buffing operations shall be designed, constructed, commissioned, operated, tested and maintained in accordance with the requirements of Sections 7 and 11-14 of ANSI/AIHA Z9.2–2006, *Fundamentals Governing the Design and Operation of Local Exhaust Systems* and/or ACGIH®s *Industrial Ventilation — A Manual of Recommended Practice, 26th Edition: O&M (Volumes 1 and 2).*

8 Hoods and Enclosures

8.1 As noted in the Foreword, standard requirements should be considered minimum criteria and can be adapted to the needs of the User establishment. Demonstrably equal or better approaches are acceptable. When deviating from the Standard, documentation should be provided. Design criteria provided in Figures 1–15 have been used for many years and probably represent the "standard of care."

8.2 Grinding and Abrasive Cut-Off Wheel Hoods. Exhaust hoods and/or guards shall, as a minimum, adhere to requirements specified in ANSI B7.1–2000, The Use, Care, and Protection of Abrasive Wheels.

8.2. It is the dual function of grinding and abrasive cut-off wheel hoods to protect the operator from the hazards of bursting wheels, as well as to provide a means for the removal of contaminants generated.

8.2.1 Hoods and enclosures connected to exhaust systems shall be designed, located, placed and used so that particulate shall fall or be projected into the hoods in the direction of the airflow.

8.2.1 Due to the variety of work and types of grinding machines used, it may be necessary to design hoods adaptable to the particular machine in question. These hoods should be located as close as possible to the operation. Figures 1 through 3 are examples of hood applications to miscellaneous operations that illustrate this principle.

Note: Size hood opening to receive the entire stream of grinding emissions. The face velocity of the hood should be at least 200 fpm and could be as high as 1000 fpm.

8.2.2 No wheels, discs, straps, or belts shall be operated in such manner and in such a direction as to cause particulate to be thrown into the operator's breathing zone.

8.2.3 Exhaust hoods for floor stands, pedestals, and bench grinders shall be designed in accordance with Figures 4a and 4b.

8.2.3 The user may need to modify these design criteria to meet local needs. This clarification applies to all the requirements of Section 8.

8.2.3.1 The adjustable tongue shown in these figures shall be kept in working order and shall be adjusted to within 1/4-inch of the wheel periphery at all times.

8.2.3.1 The tongue has the important function of acting as a baffle in breaking up the peripheral air current surrounding the wheel, thereby permitting the air flowing into the hood to entrain the contaminants generated.

8.3 Swing-Frame Grinders. Swing-frame grinders shall be provided with exhaust booths.

8.3 The exhaust booth shown in Figure 5 provides appropriate criteria.

8.4 Portable Grinder Enclosures. Portable grinding operations, whenever the nature of the work permits, shall be conducted within a partial enclosure.

8.4 The grinding operation should be arranged so that the work is between the operator and the exhaust system and that contaminants generated are drawn away from the operators breathing zone. A turntable that allows the operator to maintain the flow of contaminant into the collector should be used where work permits.

In Figure 6, application of an enclosure to portable grinding operations is shown.

The user should provide documentation if "the nature of the work" does not allow the use of a partial enclosure.

8.4.1 The opening in the enclosure shall be no larger than is actually required in the operation, and an average face air velocity of not less than 200 feet per minute (fpm) shall be maintained.

8.5 Polishing and Buffing Hoods. Hoods for polishing, buffing, and scratch brush wheels shall be constructed as shown in Figure 7.

8.5 For large or irregular shaped work, hood designs can be modified to suit the conditions.

A typical hood design approach for large parts is shown in Figure 8.

8.5.1 When extremely wide wheels are necessary, the wheel shall be operated within a partial enclosure similar to the one shown in Figure 9.

8.6 Cradle Grinding and Polishing Operations. Cradle grinding and polishing operations shall be performed within a partial enclosure similar to the one shown in Figure 9.

8.6.1 The operator shall be positioned outside the working face of the opening of the enclosure.

8.6.2 The face opening of the enclosure shall not be any greater in area than that actually required for the performance of the operation.

8.6.3 The average air velocity into the working face of the enclosure shall not be less than 150 fpm.

8.7 Automatic Rotary and Straight Line Buffing and Polishing. Automatic rotary or straight line buffers or polishers involving multiple heads shall be ventilated by complete enclosures.

8.7.1 The average air velocity into the working face of the opening shall be not less than 250 fpm.

8.7.2 On straight line machines, where the work is fed via conveyor through the grinding/polishing operation, work shall be fed and received from the ends, and the top and sides of the conveyor shall be enclosed.

8.7.3 Exhaust volumes shown in Figures 10 and 11 shall be maintained to prevent contaminant from escaping the hood.

8.7.4 The enclosure shall be cleaned periodically.

8.8 Horizontal Single-Spindle Disc Grinder Hoods. Hoods for horizontal single-spindle disc grinders shall be constructed to conform with the hood shown in Figure 12.

8.8.1 There shall be a space between the back of the wheel and the hood, and a space around the periphery of the wheel of at least 1 inch, in order to permit the suction to act around the wheel periphery.

8.8.2 The opening on the side of the disc shall be no larger than is required for the grinding operation, but it shall never be less than twice the area of the branch duct.

8.9 Horizontal Double-Spindle Disc Grinder Hoods. Horizontal double-spindle disc grinders shall have a hood encircling the wheels and grinding chamber similar to that illustrated in Figure 13.

8.9.1 The openings for passing the work into the grinding chamber shall be kept as small as possible and shall never be less than twice the area of the branch ducts.

8.10 Vertical Spindle Disc Grinder Hoods. Vertical spindle disc grinders shall be encircled with a hood constructed so that the heavy particles are drawn off at the surface of the disc and the lighter dust is exhausted through a continuous slot at the top of the hood, as shown in Figure 14.

8.11 Grinding and Polishing Belt Hoods. Grinding and polishing belt hoods shall be constructed as close to the operation as possible.

8.7.2 The bottom may also be enclosed for additional containment, if appropriate cleanouts are provided.

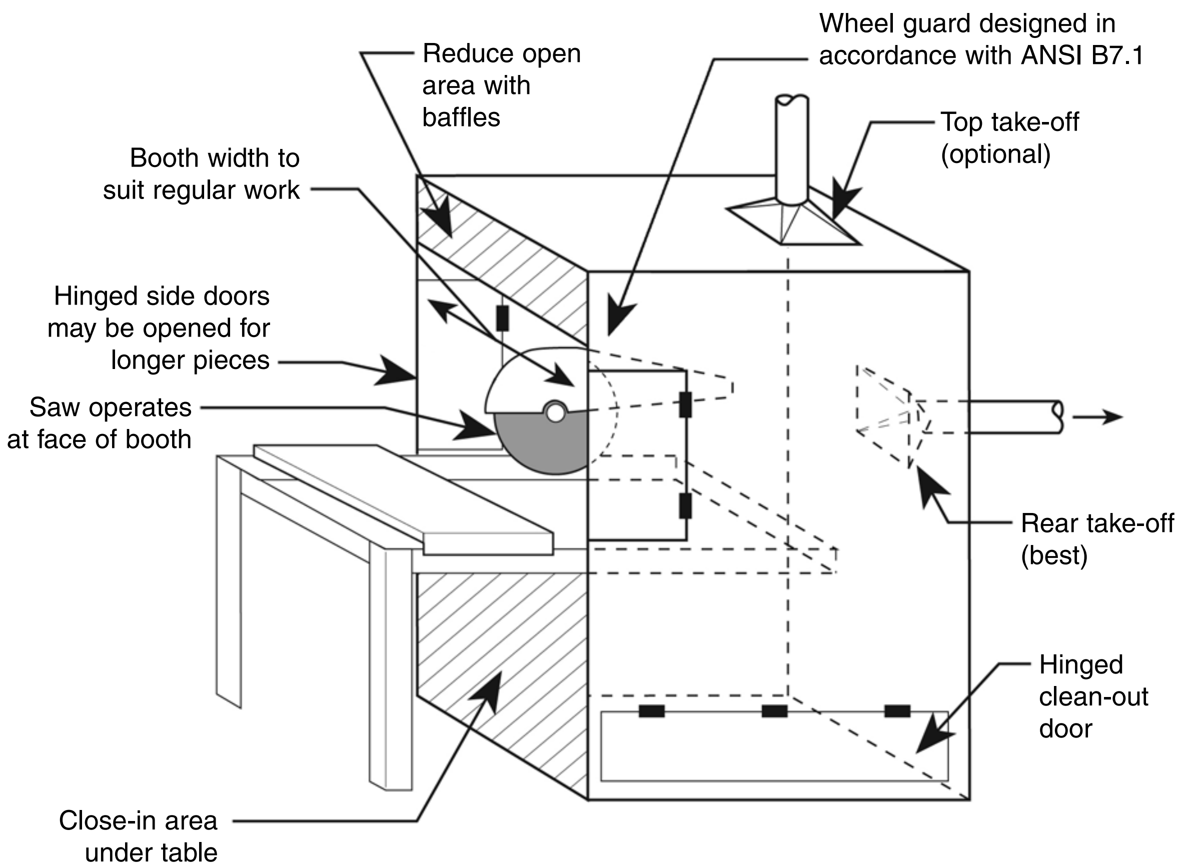
8.11 The hood should extend almost to the belt and 1-inch wide openings should be provided on either side. A typical hood for a belt operation is shown in Figure 15.

9 Dilution Ventilation Systems

9.1 Dilution or general exhaust ventilation systems used for the control of fugitive emissions from grinding, polishing, and buffing operations shall be designed, constructed, commissioned, balanced, operated, tested and maintained in accordance with the requirements of ANSI/AIHA Z9.10–2007 *Fundamentals Governing the Design and Operation of Dilution Ventilation Systems in Industrial Occupancies.*

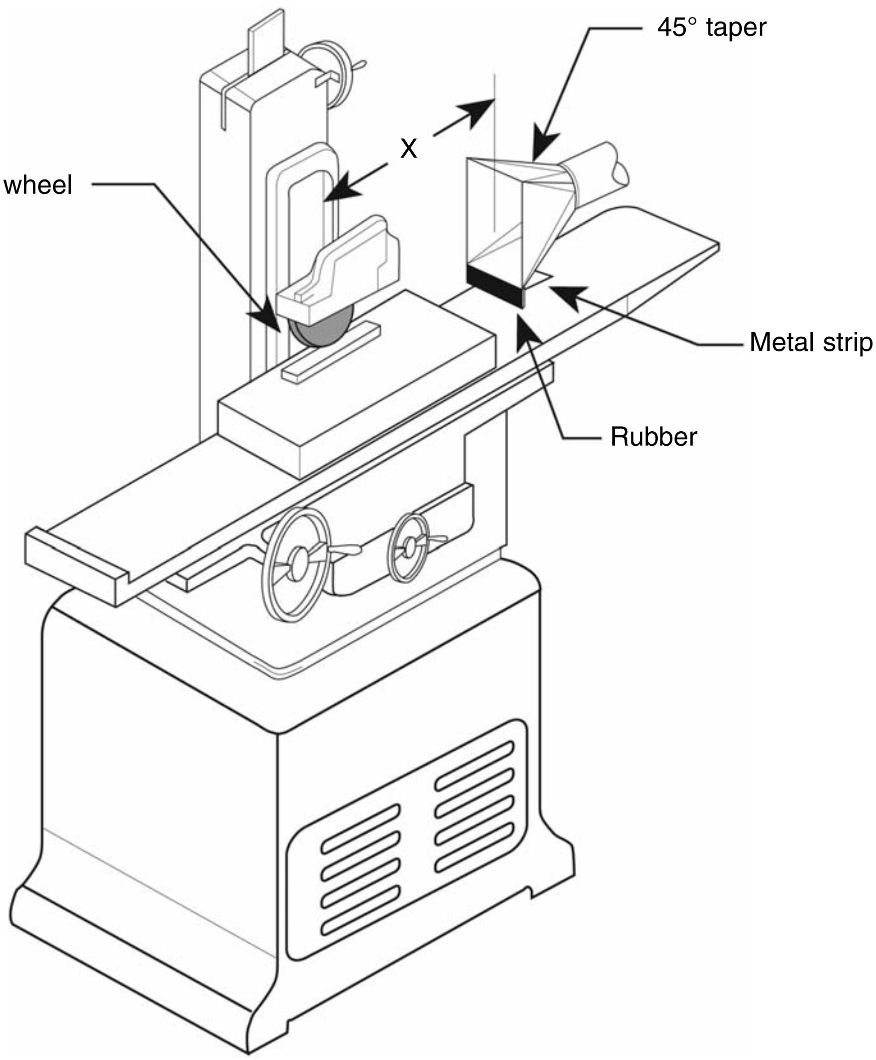
9 Dilution Ventilation Systems

9.1 Dilution or general exhaust ventilation is often used in conjunction with local exhaust systems. It is rarely used alone in these applications. Its primary usage is to control fugitive emissions that may not be controlled by the primary control equipment, e.g., the local exhaust system.



Q = 250 cfm/ft^2 of open face area
Minimum duct velocity = 4000 fpm
Entry loss
$h_e = 0.25\ VP_d$ for tapered take-off
$h_e = 0.50\ VP_d$ for straight take-off

Figure 1 — Abrasive cut-off saw. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



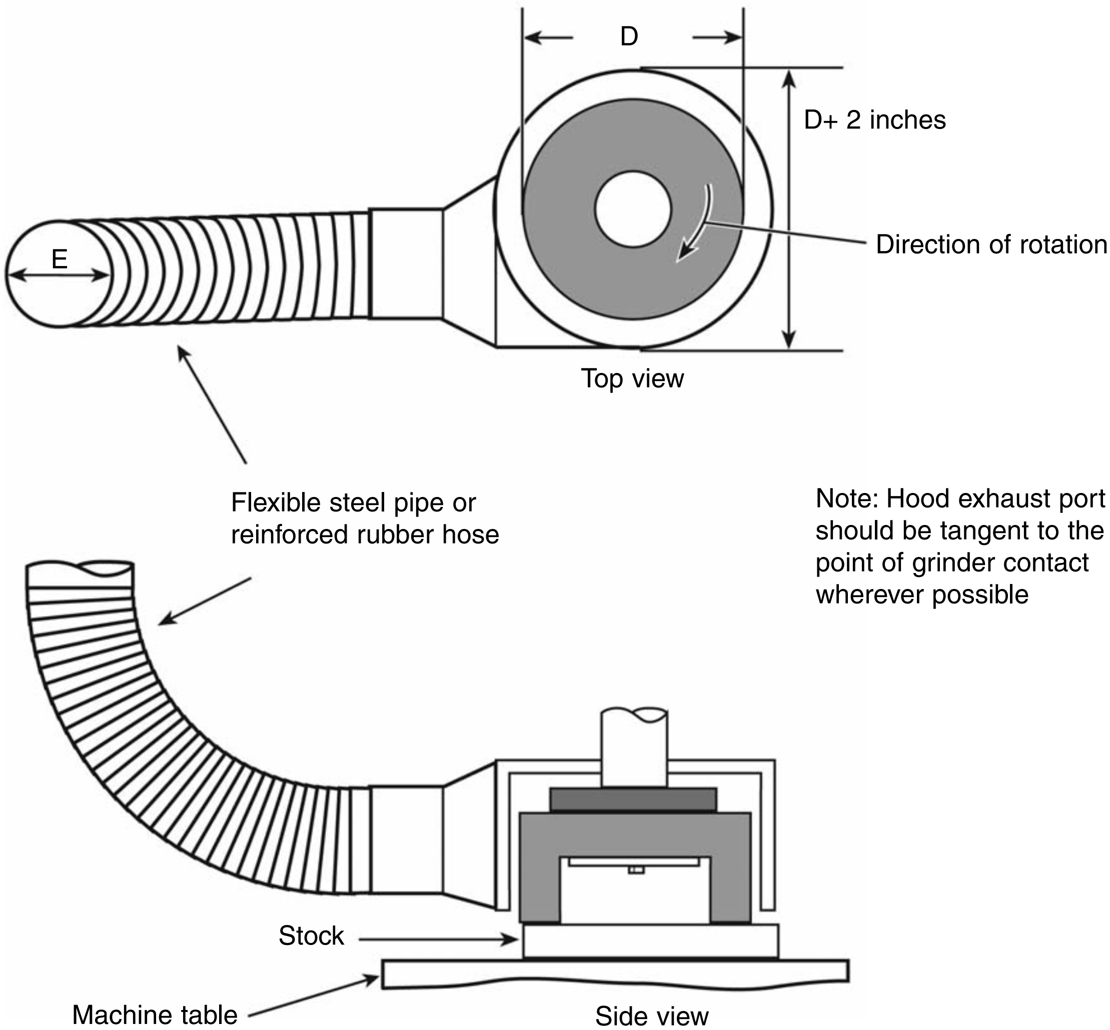
Example for:
X = 4 inch
A = 3 inch by 4.5 inch

V_s	Q, cfm
1000	52
2000	100
3000	160
4000	210
5000	260
6000	310
7000	360
8000	420
9000	470
10,000	520

$Q = 0.043\ V_s\ (10X^2 + A)$
Minimum duct velocity = 3500 fpm

$h_e = 0.25\ VP_d$
X = distance from hood face to center of wheel, ft
A = hood face area, ft^2
Vs = wheel speed, surface feet per minute (sfm)
= π (D/12) R
D = diameter in inches
R = rpm of grinding wheel

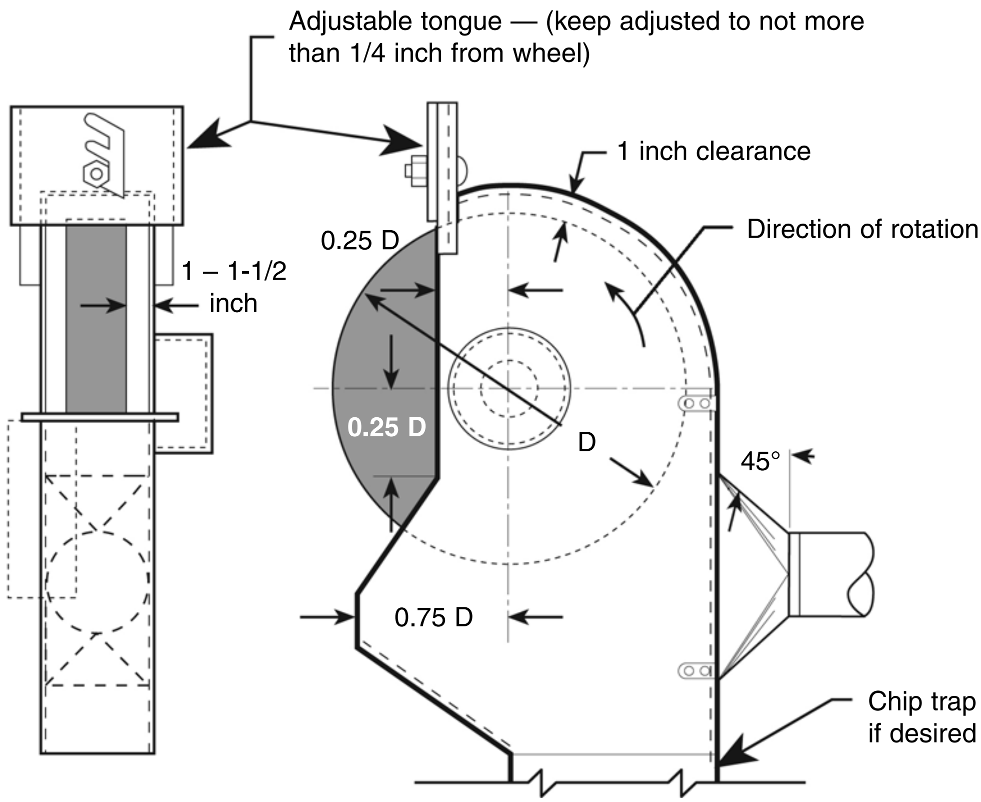
Figure 2 — Surface Grinder. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



Minimum duct velocity = 4000 fpm
Entry loss
$h_e = 0.45\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

Wheel diameter inches	Exhaust volume, cfm
up to 5	220
over 5 to 10	390

Figure 3 — Vertical spindle-cup wheel grinder exhaust hood.

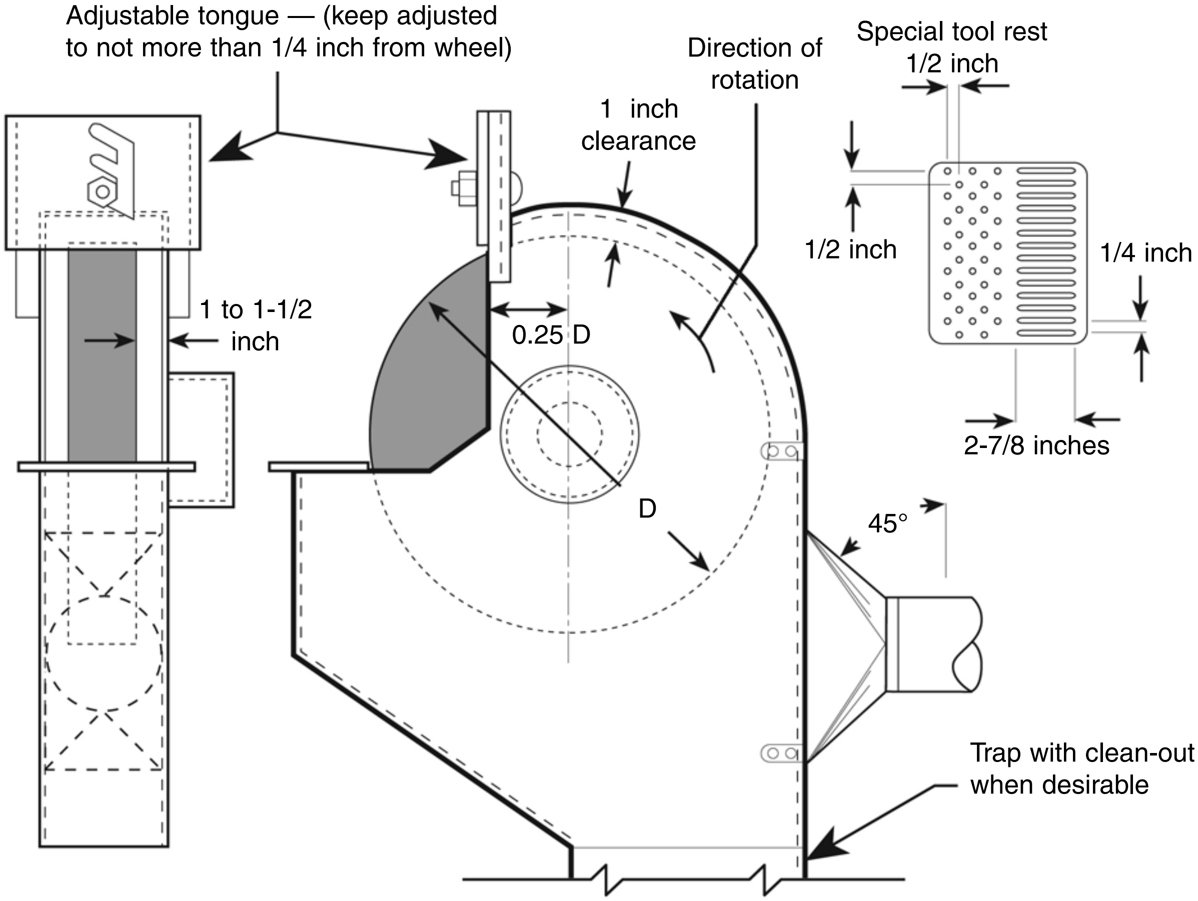


Exhaust flow rates, cfm

Wheel diameter inches	Wheel width inches	Good enclosure*	Poor enclosure
up to 5	1	220	220
over 5 to 10	1.5	220	300
over 10 to 14	2	300	500
over 14 to 16	2	390	610
over 16 to 20	3	500	740
over 20 to 24	4	610	880
over 24 to 30	5	880	1200
over 30 to 36	6	1200	1600

*Special hood and tool rest as shown, no more than 25 percent of the wheel exposed.
Minimum duct velocity = 4000 fpm
$h_e = 0.40\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

Figure 4a — Grinding wheel hood surface speeds less than or equal to 6500 SFPM. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]

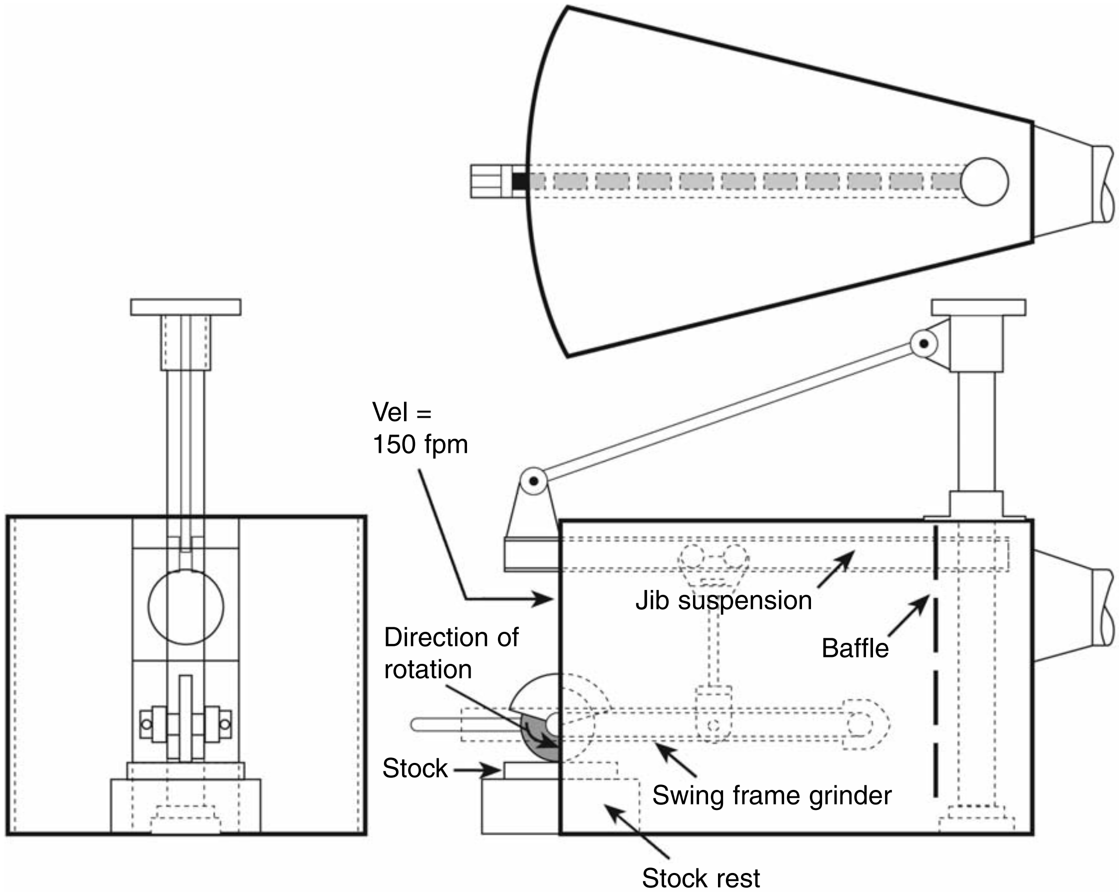


Exhaust flow rates, cfm

Wheel diameter inches	Wheel width inches	Good enclosure*	Poor enclosure
up to 5	1	220	390
over 5 to 10	1.5	390	610
over 10 to 14	2	500	740
over 14 to 16	2	610	880
over 16 to 20	3	740	1000
over 20 to 24	4	880	1200
over 24 to 30	5	1200	1600
over 30 to 36	6	1600	2000

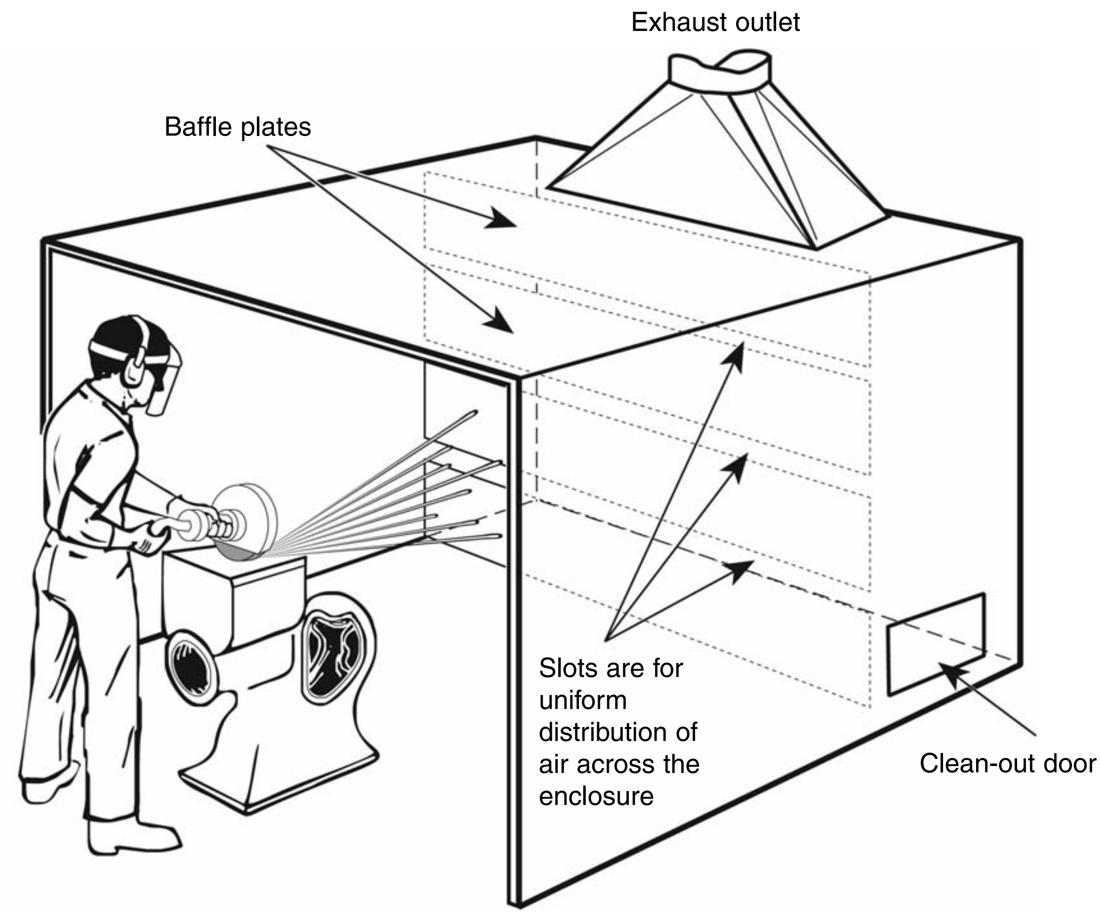
*Special hood and tool rest as shown, no more than 25 percent of the wheel exposed.
Minimum duct velocity = 4000 fpm
$h_e = 0.40\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

Figure 4b — Grinding wheel hood surface speeds greater than 6500 SFPM. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



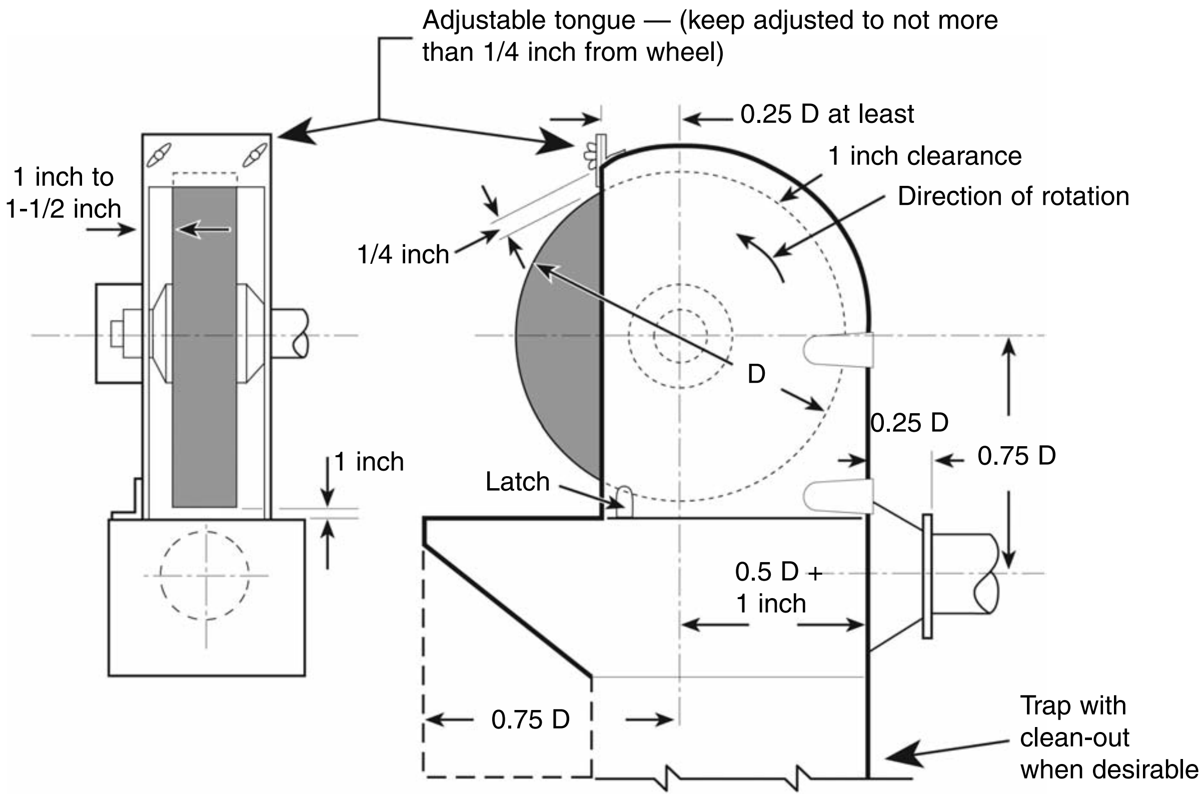
Baffle the front to reduce the opening as much as possible.
Minimum velocity at enclosure face is 150 ft/min
Entry loss = 0.45 VP_d for tapered take-off
Entry loss = 0.65 VP_d for straight take-off
Exhaust volume
150 cfm per ft^2 of opening for large (4–6 ft.) openings
200 cfm per ft^2 of opening for small (2–2.5 ft.) openings
Duct velocity
3500 fpm minimum
4500 fpm if material is wet or sticky

Figure 5 — Swing-frame grinder exhaust hood.



Minimum face velocity = 200 fpm
Entry loss
$h_e = 1.78\ VP_s + 1.0\ VP_d$

Figure 6 — Portable grinder work exhaust hood and branch duct connections.



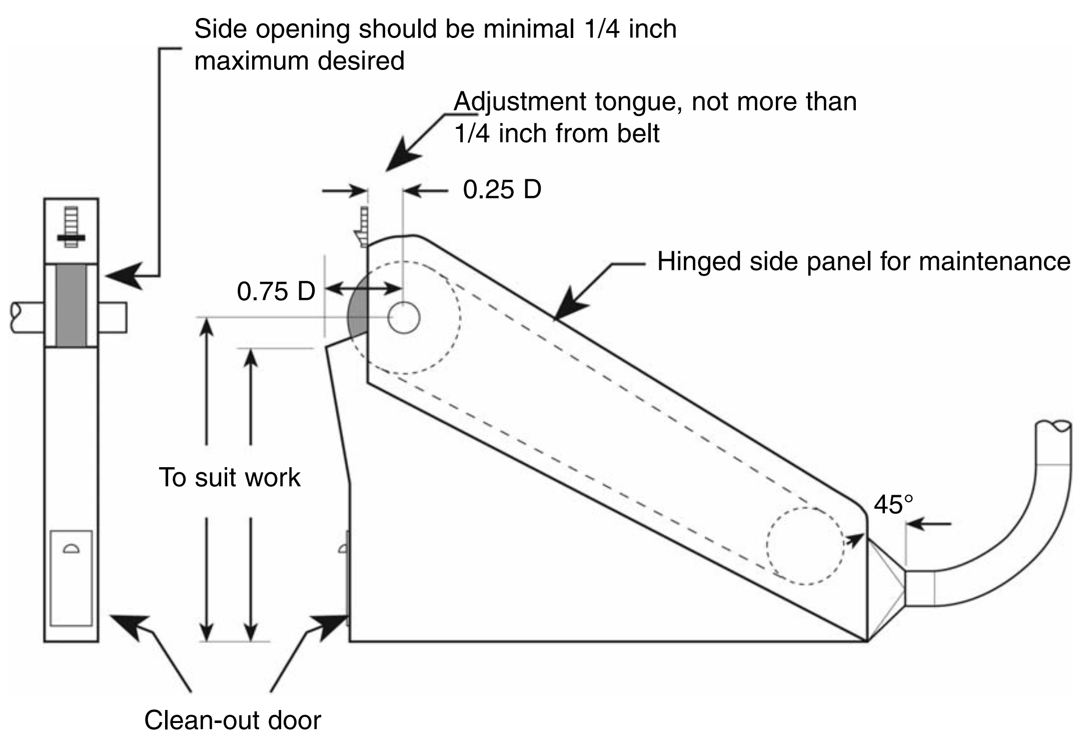
Wheel diameter inches	Wheel width inches	Exhaust flow rate cfm good* enclosure	Exhaust flow rate cfm poor enclosure
up to 9	2	300	400
over 9 to 16	3	500	610
over 16 to 19	4	610	740
over 19 to 24	5	740	1200
over 24 to 30	6	1040	1500
over 30 to 36	6	1200	2000

*Not more than 25% of the wheel is exposed.

Minimum duct velocity = 3500 fpm;
4500 fpm if wet or sticky
Entry loss
$h_e = 0.40\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

Note:
1. Consult applicable NFPA codes for prevention of fire and explosion.
2. Caution: Do not mix ferrous and nonferrous metals in the same exhaust system.

Figure 7 — Polishing and buffing hoods. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



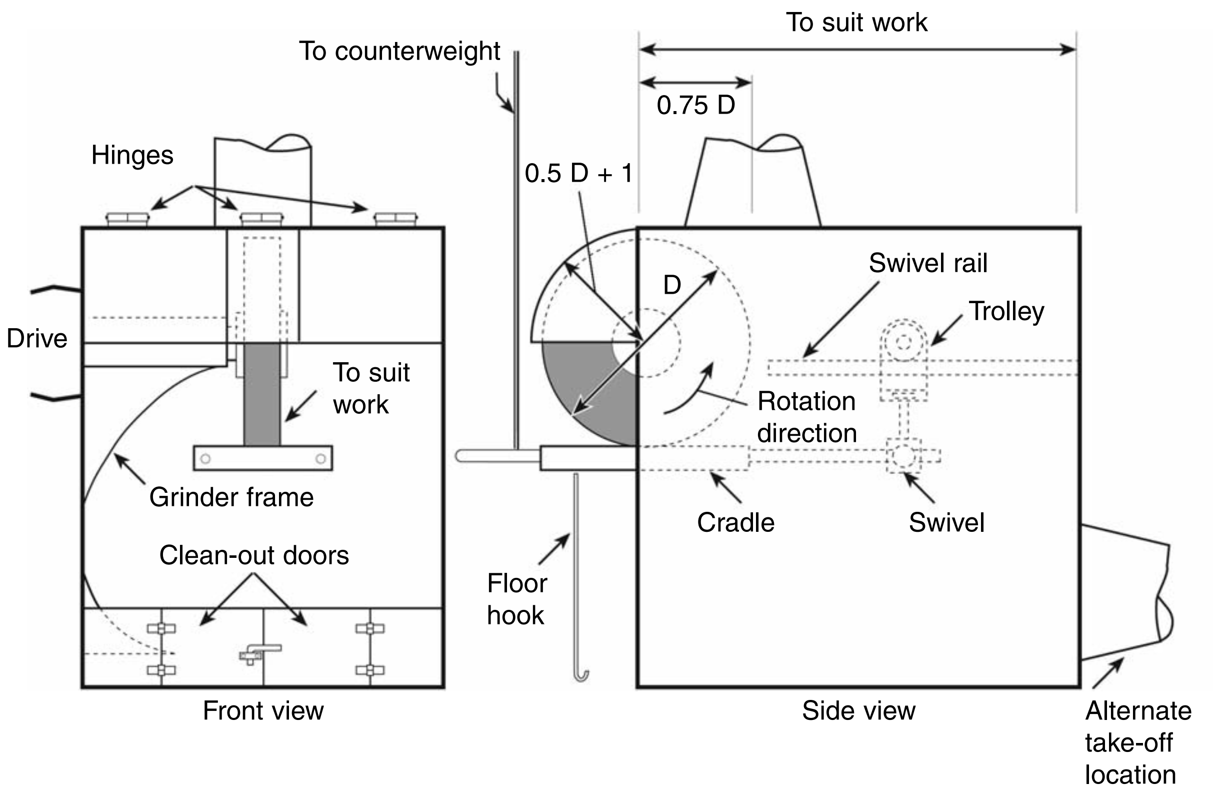
Belt width inches	Exhaust flow rate cfm good enclosure*	Exhaust flow rate cfm poor enclosure
1.5	220	300
2.0	390	610
3.0	500	740
4.0	610	880
5.0	880	1200
6.0	1200	1570

*Hood as shown; no more than 25% of the wheel exposed
$h_e = 0.40\ VP_d$

Minimum duct velocity = 3500 fpm; 4500 fpm if wet or sticky
Entry loss
$h_e = 0.40\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

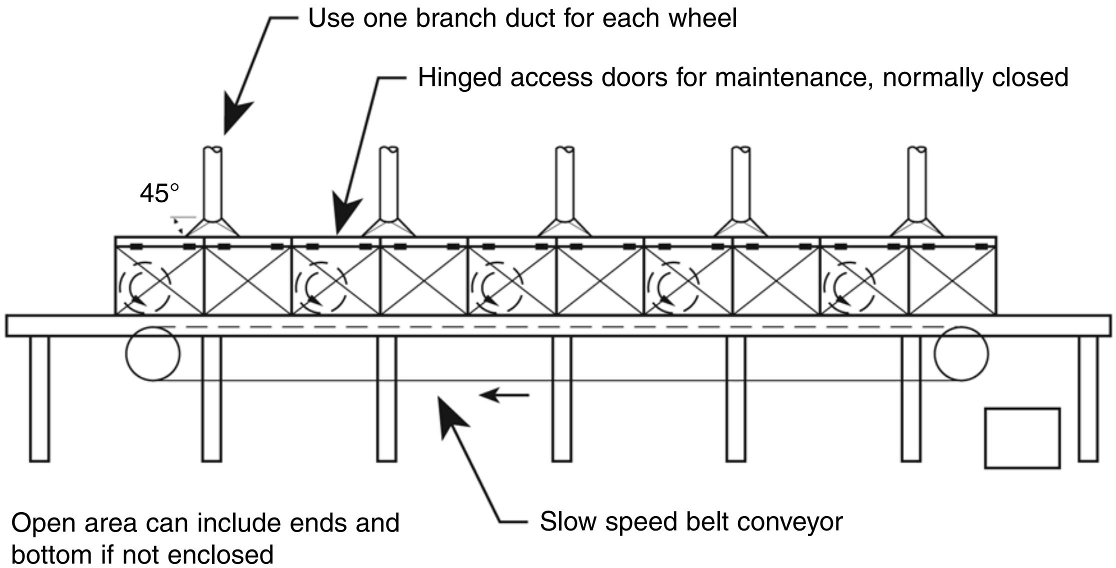
Note:
1. Consult applicable NFPA codes for prevention of fire and explosion.
2. For titanium, aluminum, and magnesium, elimnate hopper and use 5000 fpm through hood cross section.
3. Caution: Do not mix ferrous and nonferrous metals in the same exhaust system.

Figure 8 — Backstand idler polishing machine. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



Baffle the front to reduce the opening as much as possible.
Minimum velocity at enclosure face is 150 fpm
Entry loss = 0.45 VP_d for tapered take-off
Entry loss = 0.65 VP_d for straight take-off
Exhaust volume
150 cfm per ft^2 of opening for large (4–6 ft.) openings
200 cfm per ft^2 of opening for small (2–2.5 ft.) openings
Duct velocity
3500 fpm minimum
4500 fpm if material is wet or sticky

Figure 9 — Cradle polishing or grinding exhaust hood and branch duct connections.



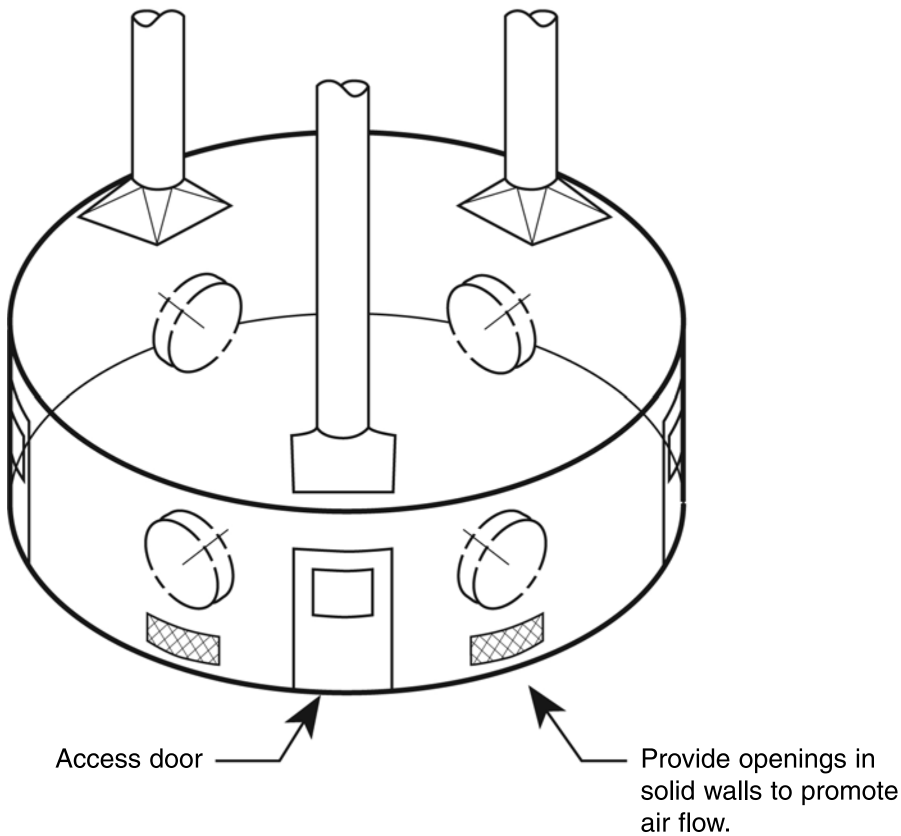
Q = 500 cfm/wheel, minimum
Not less than 250 cfm/ft² total open area

Minimum duct velocity = 3500 fpm; 4500 fpm if material is wet or sticky

$h_e = 1.78\ VP_d + 0.25\ VP_d$

Note:
1. Consult applicable NFPA codes for prevention of fire and explosion.
2. Caution: Do not mix ferrous and nonferrous metals in the same exhaust system.
3. Wheel adjustments on outside of enclosure.
4. For highly toxic material, enclose the return strand of the belt conveyor.
5. Inside of enclosure may have to be cleaned periodically.

Figure 10 — Automatic straight-line grinding and polishing. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



Q = 500 cfm/wheel, minimum
Not less than 250 cfm/ft² total open area

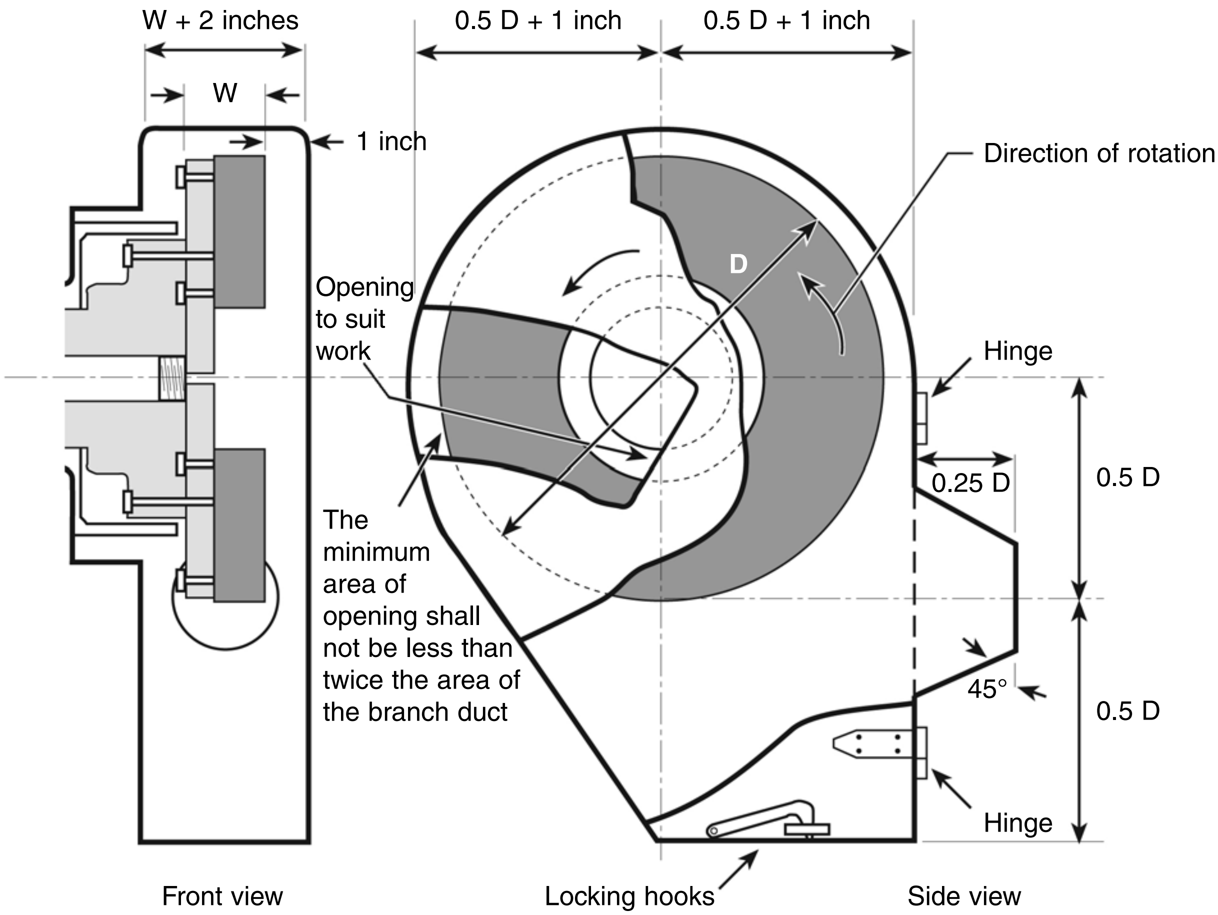
Minimum duct velocity = 3500 fpm; 4500 fpm if material is wet or sticky

$h_e = 1.78\ VP_d + 0.25\ VP_d$

On small, 2 or 3 spindle machines, one take-off may be used.

Note:
1. Consult applicable NFPA codes for prevention of fire and explosion.
2. Caution: Do not mix ferrous and nonferrous metals in the same exhaust system.
3. Inside of enclosure may have to be cleaned periodically.

Figure 11 — Automatic rotary grinding and polishing. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]

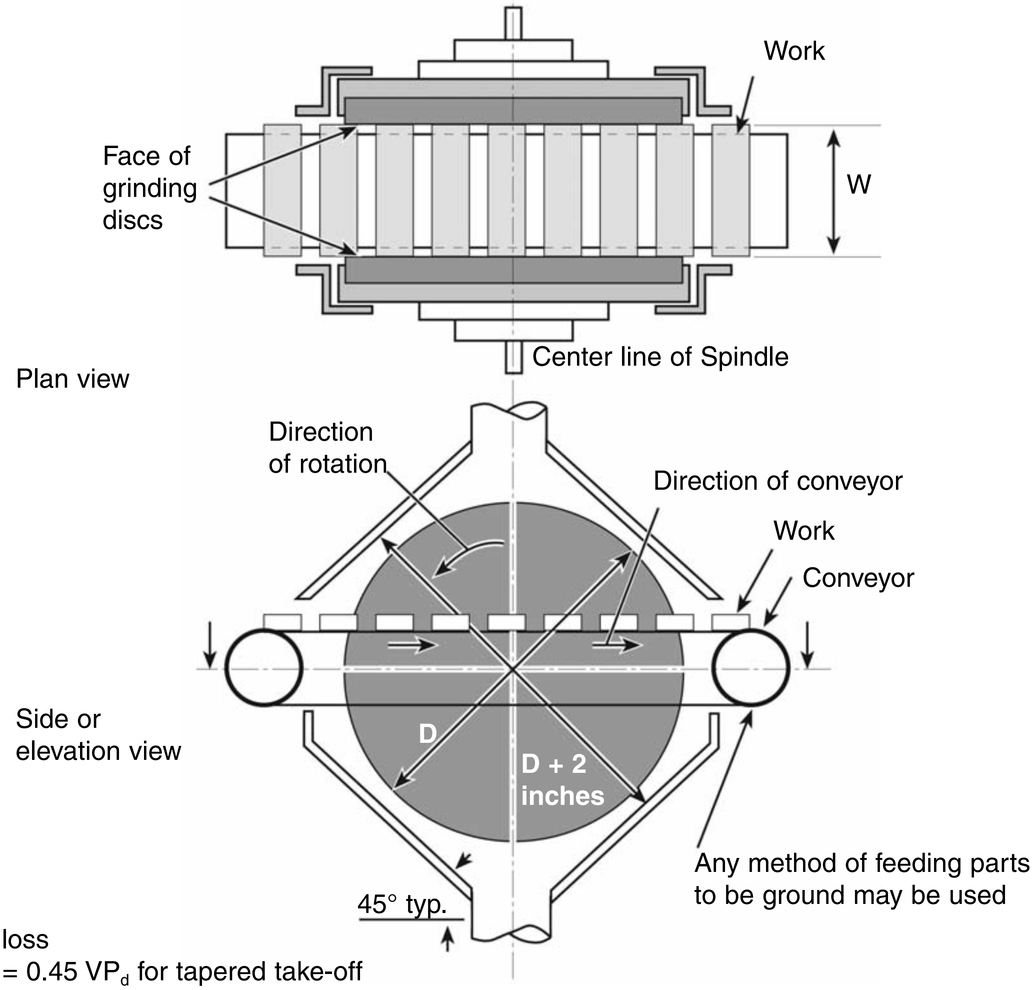


Minimum duct velocity = 4000 fpm
Entry loss
$h_e = 0.45\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

Wheel diameter inches	Volume exhausted, ft^3
up to 12	220
over 12 to 19	390
over 19 to 30	610
over 30 to 36	880

Note: If grinding wheels are used for disc grinding purposes, hoods must conform to structural strength and materials as described in American National Standard for the Use, Care, and Protection of Abrasive Wheels, ANSI B7.1.

Figure 12 — Horizontal single-spindle disc grinder exhaust hood and branch duct connections.



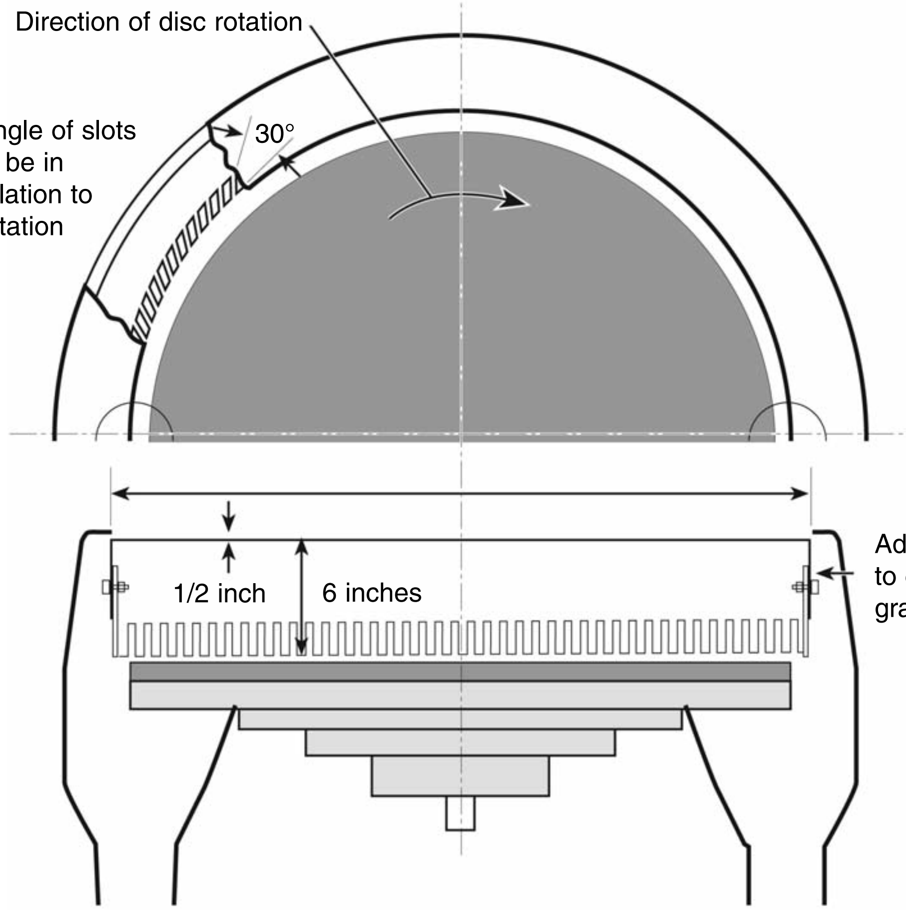
Entry loss
$h_e = 0.45\ VP_d$ for tapered take-off
$h_e = 0.65\ VP_d$ for straight take-off

Design as separate hoods for multiple take-offs

Disc diameter inches	Number of exhaust take-off	Volume exhausted (ft^3) at 4500 fpm
up to 19	1	610
over 19 to 25	1	880
over 25 to 30	1	1200
over 30 to 53	2	2000
over 53 to 72	4	6300

Note
When width "W" permits, exhaust ducts should be near as possible to heaviest grinding.

Figure 13 — Horizontal double-spindle disc exhaust hood and branch duct connections. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]



Duct velocity = 4000 fpm minimum
Slot velocity = 2000 fpm minimum — 0.5 inch slot width
Entry loss: $h_e = 1.0\ VP_s + 0.5\ VP_d$

Disc diameter inches	50% or more of disc covered		disc not covered	
	No.*	exhaust flow rate, cfm	No.*	exhaust flow rate, cfm
up to 20	1	500	2	780
over 20 to 30	2	780	2	1500
over 30 to 53	2	1800	4	3500
over 53 to 73	2	3100	5	6000

*Number of exhaust outlets around periphery of hood or equal distribution provided by other means.

Figure 14 — Vertical spindle disc grinder exhaust hood and branch duct connections. [From ACGIH®, *Industrial Ventilation: A Manual of Recommended Practice*, 26th Edition. Copyright 2007. Reprinted with permission.]