## SUBDIVISION G

## OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROLS

**Authority:** Sections. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), 9-83 (48 FR 35736), 1-90 (55 FR 9033), 6-96 (62 FR 111), or 5-2007 (72 FR 31159) as applicable; and 29 CFR part 1911.

Section 1910.94 also issued under 5 U.S.C. 553.

**NOTE:** The following Oregon-Initiated rules relate to 29 CFR 1910.94, **Ventilation**:

***437-002-0081 Oregon Ventilation Regulations.*** *In addition to and not in lieu of 29 CFR 1910.94, the following rules pertaining to ventilation apply in Oregon:*

***(1) Definitions.***

***(a) Administrative control*** *means the reduction of employee exposure to physical or chemical agents by control of the time of exposure to some period less than 8 hours in length.*

***(b) Harmful*** *or* ***hazardous,*** *as applied to the health effects of dusts, fumes, vapors, mists, gases, or any environmental condition, means any mechanical, infectious, toxic, or other action which is likely to produce medically determined injury or disease of exposed workers.*

***(c) Health hazard control measure*** *means the equipment or working arrangements designed to prevent the exposure of employees to harmful or hazardous situations. Such control measures may include, but are not limited to:*

***(A)*** *Ventilation systems;*

***(B)*** *Energy absorption system;*

***(C)*** *Personal protective equipment;*

***(D)*** *Air contaminant monitoring; and*

***(E)*** *Human biological monitoring.*

***(d) Local exhaust system*** *means a system of hoods, booths, or enclosures designed to remove contaminants at points of generation or release into the atmosphere connected by means of piping to airflow or suction producing equipment.*

***(e) Occupational health hazard*** *means those materials, processes, and atmospheric contaminants or energy concentrations which during normal or abnormal working conditions are likely to result in injury or illness to the unprotected employee.*

***(f) Ventilation, dilution*** *means ventilation provided to dilute the concentration of atmospheric contaminants in the atmosphere in all or part of the place of employment.*

***(g) Ventilation, general*** *means the provision of fresh air at the place of employment.*

***(h) Ventilation, local exhaust*** *means that type of ventilation in which suction is applied at the point of generation or release of atmospheric contaminants.*

***(i) Ventilation, natural*** *means ventilation designed to depend wholly upon relative air density, and includes the use of openable doors, windows, and other building apertures.*

***(2) Recirculation.*** *No air from any local exhaust system shall be recirculated, unless:*

***(a)*** *The inert dust contained therein has a Permissible Exposure Limit (PEL) equal to or greater than 10 milligrams per cubic meter as listed in Oregon Tables Z-1, Z-2, or Z-3 in OAR 437, Division 2/Z, OAR 437-002-0382, Oregon Rules for Air Contaminants. The inert dust concentration in such recirculated air shall not exceed 5 milligrams per cubic meter; or*

***(b)*** *The contaminant contained therein has a Permissible Exposure Limit (PEL) equal to or greater than 100 parts per million as listed in Oregon Tables Z-1, Z-2, or Z-3 of OAR 437, Division 2/Z, OAR 437-002-0382, Oregon Rules for Air Contaminants. The contaminant concentration in such recirculated air shall not exceed 25 percent of its PEL; or*

***(c)*** *The concentrations of contaminants in recirculated air do not exceed 25 percent of unity as calculated by the formula given in OAR 437-002-0382(4)(b), Oregon Rules for Air Contaminants, in Division 2/Z.*

***(3) Make-up Air.*** *Outside air equal in amount to the air removed by local exhaust systems shall be provided to replace air removed by an exhaust ventilation system.*

***(4) Air Contamination From Exhaust System.*** *The discharge from any exhaust system shall be such that no air contamination therefrom will enter any window, door, or other opening of any work area in quantities sufficient to create a harmful or hazardous work atmosphere.*

***(5) Use of Salamanders and Fuel-Burning Heating Devices.*** *Salamanders and other fuel-burning heating devices shall not be used in enclosed or inadequately ventilated spaces in which workers are employed unless such heating device is provided with a proper pipe, chimney, or enclosure to carry hazardous gases to the outside atmosphere.*

***(6) Local Exhaust Ventilation.*** *The capacity of a local exhaust system shall be calculated on the basis of all hoods, booths, and enclosures connected to the system being open, except where the system is so interlocked that only a portion of it can be operated at a given time, in which case the capacity shall be calculated on the basis that all the hoods in the group requiring the greatest volume rate of exhaust are open.*

***(7) Exhausting More Than One Substance.*** *Two or more operations involving more than one substance shall not be connected to the same exhaust system when a combination of the substances removed may constitute a fire hazard, or otherwise dangerous mixture.*

***(8) Exhausting Materials with Flammable Properties.*** *Those processes or operations which require local exhaust ventilation and generate materials with flammable properties shall be protected from sources of ignition.*

***(9) Removal of Collected Materials.*** *Collected materials shall be removed when necessary so as to maintain effective operation of the local exhaust system at all times.*

***(10) Disposal of Collected Materials.*** *Collected materials shall be disposed of in a manner which will not result in a hazard.*

***(11) Requirements for Reduction of Air Contaminant Concentrations.*** *A local exhaust system shall be in operation until all contaminants are reduced to concentrations at or below the Threshold Limit Values when any person is at risk.*

## §1910.94 Ventilation.

**(a) Abrasive blasting.**

**(1) Definitions applicable to this paragraph.**

**(i) Abrasive.** A solid substance used in an abrasive blasting operation.

**(ii) Abrasive-blasting respirator.** A respirator constructed so that it covers the wearer's head, neck, and shoulders to protect the wearer from rebounding abrasive.

**(iii) Blast cleaning barrel.** A complete enclosure which rotates on an axis, or which has an internal moving tread to tumble the parts, in order to expose various surfaces of the parts to the action of an automatic blast spray.

**(iv) Blast cleaning room.** A complete enclosure in which blasting operations are performed and where the operator works inside of the room to operate the blasting nozzle and direct the flow of the abrasive material.

**(v) Blasting cabinet.** An enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure.

**(vi) Clean air.** Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended periods of time.

**(vii) Dust collector.** A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.

**(viii) Exhaust ventilation system.** A system for removing contaminated air from a space, comprising two or more of the following elements *(a)* enclosure or hood, *(b)* duct work, *(c)* dust collecting equipment, *(d)* exhauster, and *(e)* discharge stack.

**(ix) Particulate-filter respirator.** An air purifying respirator, commonly referred to as a dust or a fume respirator, which removes most of the dust or fume from the air passing through the device.

**(x) Respirable dust.** Airborne dust in sizes capable of passing through the upper respiratory system to reach the lower lung passages.

**(xi) Rotary blast cleaning table.** An enclosure where the pieces to be cleaned are positioned on a rotating table and are passed automatically through a series of blast sprays.

**(xii) Abrasive blasting.** The forcible application of an abrasive to a surface by pneumatic pressure, hydraulic pressure, or centrifugal force.

**(2) Dust hazards from abrasive blasting.**

**(i)** Abrasives and the surface coatings on the materials blasted are shattered and pulverized during blasting operations and the dust formed will contain particles of respirable size. The composition and toxicity of the dust from these sources shall be considered in making an evaluation of the potential health hazards.

**(ii)** The concentration of respirable dust or fume in the breathing zone of the abrasive-blasting operator or any other worker shall be kept below the levels specified in §1910.1000.

**(iii)** Organic abrasives which are combustible shall be used only in automatic systems. Where flammable or explosive dust mixtures may be present, the construction of the equipment, including the exhaust system and all electric wiring, shall conform to the requirements of American National Standard Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying, Z33.1-1961 (NFPA 91-1961), which is incorporated by reference as specified in §1910.6, and Subpart S of this part. The blast nozzle shall be bonded and grounded to prevent the build up of static charges. Where flammable or explosive dust mixtures may be present, the abrasive blasting enclosure, the ducts, and the dust collector shall be constructed with loose panels or explosion venting areas, located on sides away from any occupied area, to provide for pressure relief in case of explosion, following the principles set forth in the National Fire Protection Association Explosion Venting Guide, NFPA 68-1954, which is incorporated by reference as specified in §1910.6.

**(3) Blast-cleaning enclosures.**

**(i)** Blast-cleaning enclosures shall be exhaust ventilated in such a way that a continuous inward flow of air will be maintained at all openings in the enclosure during the blasting operation.

**(A)** All air inlets and access openings shall be baffled or so arranged that by the combination of inward air flow and baffling the escape of abrasive or dust particles into an adjacent work area will be minimized and visible spurts of dust will not be observed.

**(B)** The rate of exhaust shall be sufficient to provide prompt clearance of the dust-laden air within the enclosure after the cessation of blasting.

**(C)** Before the enclosure is opened, the blast shall be turned off and the exhaust system shall be run for a sufficient period of time to remove the dusty air within the enclosure.

**(D)** Safety glass protected by screening shall be used in observation windows, where hard deep-cutting abrasives are used.

**(E)** Slit abrasive-resistant baffles shall be installed in multiple sets at all small access openings where dust might escape, and shall be inspected regularly and replaced when needed.

***(1)*** Doors shall be flanged and tight when closed.

***(2)*** Doors on blast-cleaning rooms shall be operable from both inside and outside, except that where there is a small operator access door, the large work access door may be closed or opened from the outside only.

**(4) Exhaust ventilation systems.**

**(i)** The construction, installation, inspection, and maintenance of exhaust systems shall conform to the principles and requirements set forth in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, and ANSI Z33.1-1961, which are incorporated by reference as specified in §1910.6.

**(A)** When dust leaks are noted, repairs shall be made as soon as possible.

**(B)** The static pressure drop at the exhaust ducts leading from the equipment shall be checked when the installation is completed and periodically thereafter to assure continued satisfactory operation. Whenever an appreciable change in the pressure drop indicates a partial blockage, the system shall be cleaned and returned to normal operating condition.

**(ii)** In installations where the abrasive is recirculated, the exhaust ventilation system for the blasting enclosure shall not be relied upon for the removal of fines from the spent abrasive instead of an abrasive separator. An abrasive separator shall be provided for the purpose.

**(iii)** The air exhausted from blast-cleaning equipment shall be discharged through dust collecting equipment. Dust collectors shall be set up so that the accumulated dust can be emptied and removed without contaminating other working areas.

**(5) Personal protective equipment.**

**(i)** Employers must use only respirators approved by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84 to protect employees from dusts produced during abrasive-blasting operations.

**(ii)** Abrasive-blasting respirators shall be worn by all abrasive-blasting operators:

**(A)** When working inside of blast-cleaning rooms, or

**(B)** When using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure, or

**(C)** Where concentrations of toxic dust dispersed by the abrasive blasting may exceed the limits set in §1910.1000 and the nozzle and blast are not physically separated from the operator in an exhaust-ventilated enclosure.

**(iii)** Properly fitted particulate filter respirators, commonly referred to as dust-filter respirators, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust ventilation, or other means. The respirators used must be approved by NIOSH under 42 CFR part 84 for protection against the specific type of dust encountered.

**(A)** Dust-filter respirators may be used to protect the operator of outside abrasive-blasting operations where nonsilica abrasives are used on materials having low toxicities.

**(B)** Dust-filter respirators shall not be used for continuous protection where silica sand is used as the blasting abrasive, or toxic materials are blasted.

**(iv)** For employees who use respirators required by this section, the employer must implement a respiratory protection program in accordance with 29 CFR 1910.134.

**(v)** Operators shall be equipped with heavy canvas or leather gloves and aprons or equivalent protection to protect them from the impact of abrasives. Safety shoes shall be worn to protect against foot injury where heavy pieces of work are handled.

**(A)** Safety shoes shall conform to the requirements of American National Standard for Men's Safety-Toe Footwear, Z41.1-1967, which is incorporated by reference as specified in §1910.6.

**(B)** Equipment for protection of the eyes and face shall be supplied to the operator when the respirator design does not provide such protection and to any other personnel working in the vicinity of abrasive blasting operations. This equipment shall conform to the requirements of §1910.133.

**(6) Air supply and air compressors.** Air for abrasive-blasting respirators must be free of harmful quantities of dusts, mists, or noxious gases, and must meet the requirements for supplied air quality and use specified in 29 CFR 1910.134(i).

***437-002-0081(12) Removed and Reserved.***

**(7) Operational procedures and general safety.** Dust shall not be permitted to accumulate on the floor or on ledges outside of an abrasive-blasting enclosure, and dust spills shall be cleaned up promptly. Aisles and walkways shall be kept clear of steel shot or similar abrasive which may create a slipping hazard.

***437-002-0081(13) Blasting Nozzles.*** *In addition to and not in lieu of the provisions of 1910.94(a)(7), blasting nozzles shall be equipped with a deadman switch or other effective means to prevent hose and nozzle from whipping. A support shall be provided on which the nozzle may be mounted when not in use.*

**Stat. Auth.:** ORS 654.025(2) and 656.726(4).
**Stats. Implemented:** ORS 654.001 through 654.295.
**Hist:** OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92.

**(8) Scope.** This paragraph (a) applies to all operations where an abrasive is forcibly applied to a surface by pneumatic or hydraulic pressure, or by centrifugal force. It does not apply to steam blasting, or steam cleaning, or hydraulic cleaning methods where work is done without the aid of abrasives.

**(b) Grinding, polishing, and buffing operations.**

**(1) Definitions applicable to this paragraph.**

**(i) Abrasive cutting-off wheels.** Organic-bonded wheels, the thickness of which is not more than 1/48$^{th}$ of their diameter for those up to, and including, 20 inches in diameter, and not more than 1/60$^{th}$ of their diameter for those larger than 20 inches in diameter, used for a multitude of operations variously known as cutting, cutting off, grooving, slotting, coping, and jointing, and the like. The wheels may be "solid" consisting of organic-bonded abrasive material through- out, "steel centered" consisting of a steel disc with a rim of organic-bonded material molded around the periphery, or of the "inserted tooth" type consisting of a steel disc with organic-bonded abrasive teeth or inserts mechanically secured around the periphery.

**(ii) Belts.** All power-driven, flexible, coated bands used for grinding, polishing, or buffing purposes.

**(iii) Branch pipe.** The part of an exhaust system piping that is connected directly to the hood or enclosure.

**(iv) Cradle.** A movable fixture, upon which the part to be ground or polished is placed.

**(v) Disc wheels.** All power-driven rotatable discs faced with abrasive materials, artificial or natural, and used for grinding or polishing on the side of the assembled disc.

**(vi) Entry loss.** The loss in static pressure caused by air flowing into a duct or hood. It is usually expressed in inches of water gauge.

**(vii) Exhaust system.** A system consisting of branch pipes connected to hoods or enclosures, one or more header pipes, an exhaust fan, means for separating solid contaminants from the air flowing in the system, and a discharge stack to outside.

**(viii) Grinding wheels.** All power-driven rotatable 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.

**(ix) Header pipe (main pipe).** A pipe into which one or more branch pipes enter and which connects such branch pipes to the remainder of the exhaust system.

**(x) Hoods and enclosures.** The partial or complete enclosure around the wheel or disc through which air enters an exhaust system during operation.

**(xi) Horizontal double-spindle disc grinder.** A grinding machine carrying two power-driven, rotatable, coaxial, horizontal spindles upon the inside ends of which are mounted abrasive disc wheels used for grinding two surfaces simultaneously.

**(xii) Horizontal single-spindle disc grinder.** A grinding machine carrying an abrasive disc wheel upon one or both ends of a power-driven, rotatable single horizontal spindle.

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

**(xiv) Portable grinder.** Any power-driven rotatable grinding, polishing, or buffing wheel mounted in such manner that it may be manually manipulated.

**(xv) Scratch brush wheels.** All power-driven rotatable wheels made from wire or bristles, and used for scratch cleaning and brushing purposes.

**(xvi) Swing-frame grinder.** Any power-driven rotatable grinding, polishing, or buffing wheel mounted in such a manner that the wheel with its supporting framework can be manipulated over stationary objects.

**(xvii) 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.

**(xviii) Vertical spindle disc grinder.** A grinding machine having a vertical, rotatable power-driven spindle carrying a horizontal abrasive disc wheel.

**(2) Application.** Wherever dry grinding, dry polishing or buffing is performed, and employee exposure, without regard to the use of respirators, exceeds the permissible exposure limits prescribed in §1910.1000 or other sections of this part, a local exhaust ventilation system shall be provided and used to maintain employee exposures within the prescribed limits.

**(3) Hood and branch pipe requirements.**

**(i)** Hoods connected to exhaust systems shall be used, and such hoods shall be designed, located, and placed so that the dust or dirt particles shall fall or be projected into the hoods in the direction of the air flow. No wheels, discs, straps, or belts shall be operated in such manner and in such direction as to cause the dust and dirt particles to be thrown into the operator's breathing zone.

**(ii)** Grinding wheels on floor stands, pedestals, benches, and special-purpose grinding machines and abrasive cutting-off wheels shall have not less than the minimum exhaust volumes shown in Table G-4 with a recommended minimum duct velocity of 4,500 feet per minute in the branch and 3,500 feet per minute in the main. The entry losses from all hoods except the vertical-spindle disc grinder hood, shall equal 0.65 velocity pressure for a straight takeoff and 0.45 velocity pressure for a tapered takeoff. The entry loss for the vertical-spindle disc grinder hood is shown in Figure G-1 (following §1910.94(b)).

**Table G-4 - Grinding and Abrasive Cutting-Off Wheels**

| Wheels diameter (inches) | Wheel width (inches) | Minimum exhaust volume (feet$^3$/min.) |
|---|---|---|
| To 9 …… | 1 1/2 | 220 |
| Over 9 to 16 …….. | 2 | 390 |
| Over 16 to 19 …… | 3 | 500 |
| Over 19 to 24 …… | 4 | 610 |
| Over 24 to 30 …… | 5 | 880 |
| Over 30 to 36 …… | 6 | 1,200 |

For any wheel wider than wheel diameters shown in Table G-4, increase the exhaust volume by the ratio of the new width to the width shown.

Example:

If wheel width = 4 1/2 inches, then

$$\frac{4.5}{4} \text{ x } 610 = 686 \,(\textit{rounded}\ 690).$$

**(iii)** Scratch-brush wheels and all buffing and polishing wheels mounted on floor stands, pedestals, benches, or special-purpose machines shall have not less than the minimum exhaust volume shown in Table G-5.

**Table G-5 – Buffing and Polishing Wheels**

| Wheel diameter (inches) | Wheel width (inches) | Minimum exhaust volume (feet$^3$/min.) |
|---|---|---|
| To 9 …… | 2 | 300 |
| Over 9 to 16 …… | 3 | 500 |
| Over 16 to 19 …….. | 4 | 610 |
| Over 19 to 24 …….. | 5 | 740 |
| Over 24 to 30 …….. | 6 | 1,040 |
| Over 30 to 36 ……... | 6 | 1,200 |

**(iv)** Grinding wheels or discs for horizontal single-spindle disc grinders shall be hooded to collect the dust or dirt generated by the grinding operation and the hoods shall be connected to branch pipes having exhaust volumes as shown in Table G-6.

**Table G-6 – Horizontal Single-Spindle Disc Grinder**

| Disc diameter (inches) | Exhaust volume (feet.$^3$/min.) |
|---|---|
| Up to 12 | 220 |
| Over 12 to 19 | 390 |
| Over 19 to 30 | 610 |
| Over 30 to 36 | 880 |

**(v)** Grinding wheels or discs for horizontal double-spindle disc grinders shall have a hood enclosing the grinding chamber and the hood shall be connected to one or more branch pipes having exhaust volumes as shown in Table G-7.

**Table G-7 – Horizontal Double Spindle Disc Grinder**

| Disc diameter (inches) | Exhaust volume (ft.$^3$/min.) |
|---|---|
| Up to 12 | 610 |
| Over 19 to 26 | 880 |
| Over 26 to 30 | 1,200 |
| Over 30 to 52 | 1,770 |
| Over 53 to 72 | 6,280 |

**(vi)** Grinding wheels or discs for vertical single-spindle disc grinders shall be encircled with hoods to remove the dust generated in the operation. The hoods shall be connected to one or more branch pipes having exhaust volumes as shown in Table G-8.

**Table G-8 – Vertical Spindle Disc Grinder**

| Disc diameter (Inches) | One-half or more of disc covered | | Disc not covered | |
|---|---|---|---|---|
| | Number[1] | Exhaust foot$^3$/min. | Number[1] | Exhaust foot$^3$/min. |
| Up to 20 | 1 | 500 | 2 | 780 |
| Over 20 to 30 | 2 | 780 | 2 | 1,480 |
| Over 30 to 53 | 2 | 1,770 | 4 | 3,530 |
| Over 53 to 72 | 2 | 3,140 | 5 | 6,010 |

[1] Number of exhaust outlets around periphery of hood, or equal distribution provided by other means.

**(vii)** Grinding and polishing belts shall be provided with hoods to remove dust and dirt generated in the operations and the hoods shall be connected to branch pipes having exhaust volumes as shown in Table G-9.

**Table G-9 – Grinding and Polishing Belts**

| Belts width (inches) | Exhaust volume ($ft.^3$/min.) |
|---|---|
| Up to 3 | 220 |
| Over 3 to 5 | 300 |
| Over 5 to 7 | 390 |
| Over 7 to 9 | 500 |
| Over 9 to 11 | 610 |
| Over 11 to 13 | 740 |

**(viii)** Cradles and swing-frame grinders. Where cradles are used for handling the parts to be ground, polished, or buffed, requiring large partial enclosures to house the complete operation, a minimum average air velocity of 150 feet per minute shall be maintained over the entire opening of the enclosure. Swing-frame grinders shall also be exhausted in the same manner as provided for cradles. (See Figure G-3)

**(ix)** Where the work is outside the hood, air volumes must be increased as shown in American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960 (section 4, exhaust hoods).

**(4) Exhaust systems.**

**(i)** Exhaust systems for grinding, polishing, and buffing operations should be designed in accordance with American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

**(ii)** Exhaust systems for grinding, polishing, and buffing operations shall be tested in the manner described in American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

**(iii)** All exhaust systems shall be provided with suitable dust collectors.

**(5) Hood and enclosure design.**

**(i)**

**(A)** It is the dual function of grinding and abrasive cutting-off wheel hoods to protect the operator from the hazards of bursting wheels, as well as to provide a means for the removal of dust and dirt generated. All hoods shall be not less in structural strength than specified in Tables O-1 and O-9 of §1910.215.

**(B)** Due to the variety of work and types of grinding machines employed, it is necessary to develop hoods adaptable to the particular machine in question, and such hoods shall be located as close as possible to the operation.

**(ii)** Exhaust hoods for floor stands, pedestals, and bench grinders shall be designed in accordance with Figure G-2. The adjustable tongue shown in the figure shall be kept in working order and shall be adjusted within 1/4-inch of the wheel periphery at all times.

**(iii)** Swing-frame grinders shall be provided with exhaust booths as indicated in Figure G-3.

**(iv)** Portable grinding operations, whenever the nature of the work permits, shall be conducted within a partial enclosure. 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 shall be maintained.

**(v)** Hoods for polishing and buffing and scratch-brush wheels shall be constructed to conform as closely to Figure G-4 as the nature of the work will permit.

**(vi)** Cradle grinding and polishing operations shall be performed within a partial enclosure similar to Figure G-5. The operator shall be positioned outside the working face of the opening of the enclosure. The face opening of the enclosure should not be any greater in area than that actually required for the performance of the operation and the average air velocity into the working face of the enclosure shall not be less than 150 feet per minute.

**(vii)** Hoods for horizontal single-spindle disc grinders shall be constructed to conform as closely as possible to the hood shown in Figure G-6. It is essential that there 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. The opening on the side of the disc shall be no larger than is required for the grinding operation, but must never be less than twice the area of the branch outlet.

**(viii)** Horizontal double-spindle disc grinders shall have a hood encircling the wheels and grinding chamber similar to that illustrated in Figure G-7. The openings for passing the work into the grinding chamber should be kept as small as possible, but must never be less than twice the area of the branch outlets.

**(ix)** Vertical-spindle disc grinders shall be encircled with a hood so constructed that the heavy dust is drawn off a surface of the disc and the lighter dust exhausted through a continuous slot at the top of the hood as shown in Figure G-1.

**(x)** Grinding and polishing belt hoods shall be constructed as close to the operation as possible. The hood should extend almost to the belt, and 1-inch wide openings should be provided on either side. Figure G-8 shows a typical hood for a belt operation.

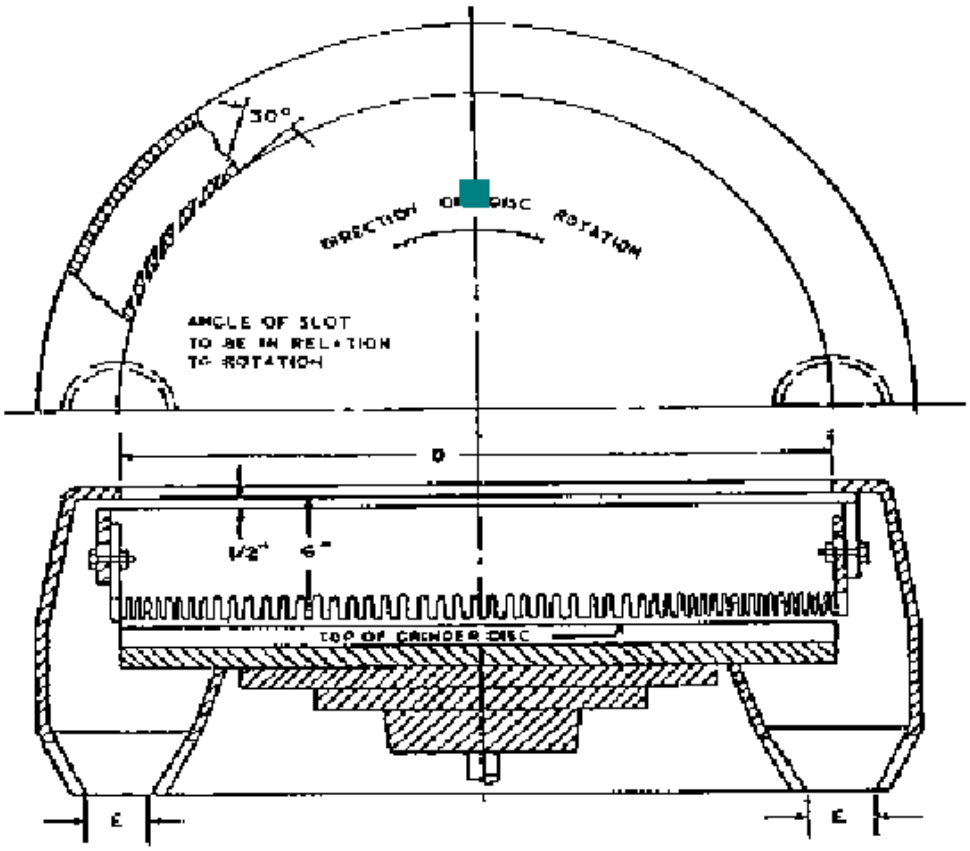


**Figure G-1**
**Vertical Spindle Disc Grinder Exhaust Hood and Branch Pipe Connections**

| Dia *D*. inches | | Exhaust *E* | | Volume exhausted at 4,500 ft/ min ft3/min | Note |
|---|---|---|---|---|---|
| Min. | Max. | No. Pipes | Dia. | | |
| ..... | 20 | 1 | 4 1/4 | 500 | When one-half or more of the disc can be hooded, use exhaust ducts as shown at the left. |
| Over 20 | 30 | 2 | 4 | 780 | |
| Over 30 | 72 | 2 | 6 | 1,770 | |
| Over 53 | 72 | 2 | 8 | 3,140 | |
| ..... | 20 | 2 | 4 | 780 | When no hood can be used over disc, use exhaust ducts as shown at left. |
| Over 20 | 20 | 2 | 4 | 780 | |
| Over 30 | 30 | 2 | 5 1/2 | 1,480 | |
| Over 53 | 53 | 4 | 6 | 3,530 | |
| | 72 | 5 | 7 | 6,010 | |

Entry loss = 1.0 slot velocity pressure + 0.5 branch velocity pressure.
Minimum slot velocity = 2,000 ft/min – 1/2-inch slot width.

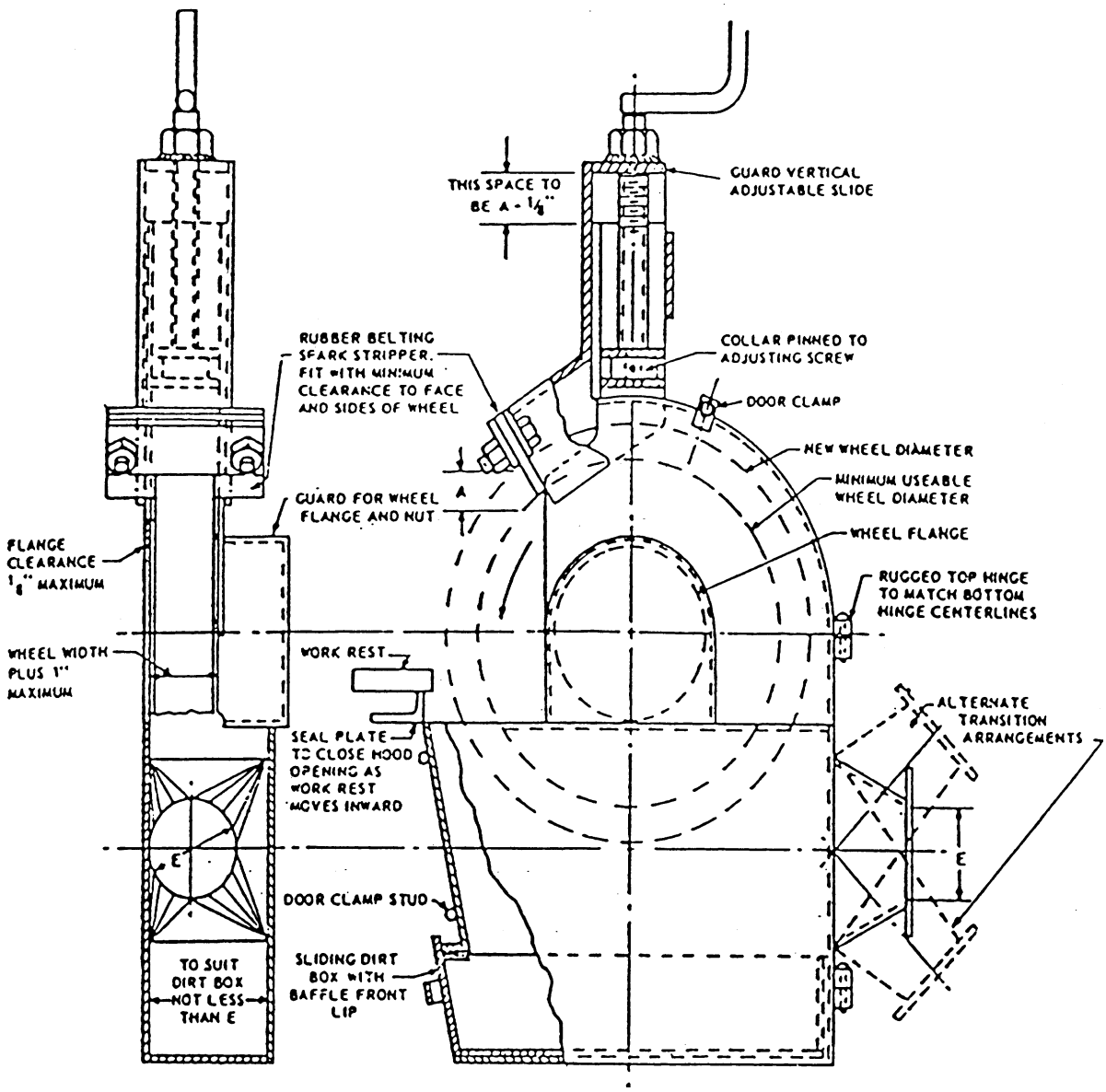


**Figure G-2**
**Standard Grinder Hood**

| Wheel dimension, inches | | | Exhaust outlet inches *E* | Volume of air at 4,500 ft/min |
|---|---|---|---|---|
| Diameter | | Width, Max | | |
| Min = *d* | Max = *D* | | | |
| | 9 | 1 1/2 | 3 | 220 |
| Over 9 ..... | 16 | 2 | 4 | 390 |
| Over 16 ..... | 19 | 3 | 4 1/2 | 500 |
| Over 19 ..... | 24 | 4 | 5 | 610 |
| Over 24 ..... | 30 | 5 | 6 | 880 |
| Over 30 ..... | 36 | 6 | 7 | 1,200 |

Entry loss = 0.45 velocity pressure for tapered takeoff; 0.65 velocity pressure for straight takeoff.

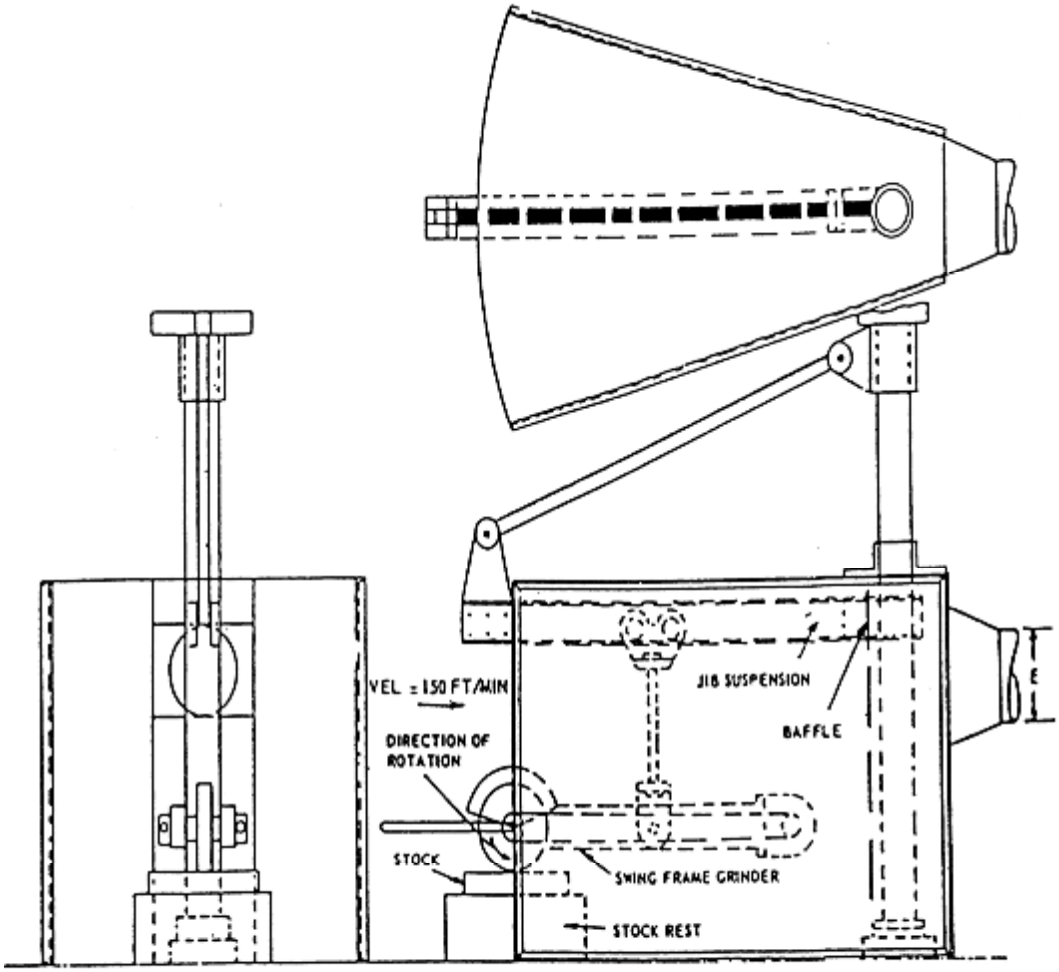


**Figure G-3**
**A Method of Applying an Exhaust Enclosure to Swing-Frame Grinders**

**NOTE: Baffle to reduce front opening as much as possible**

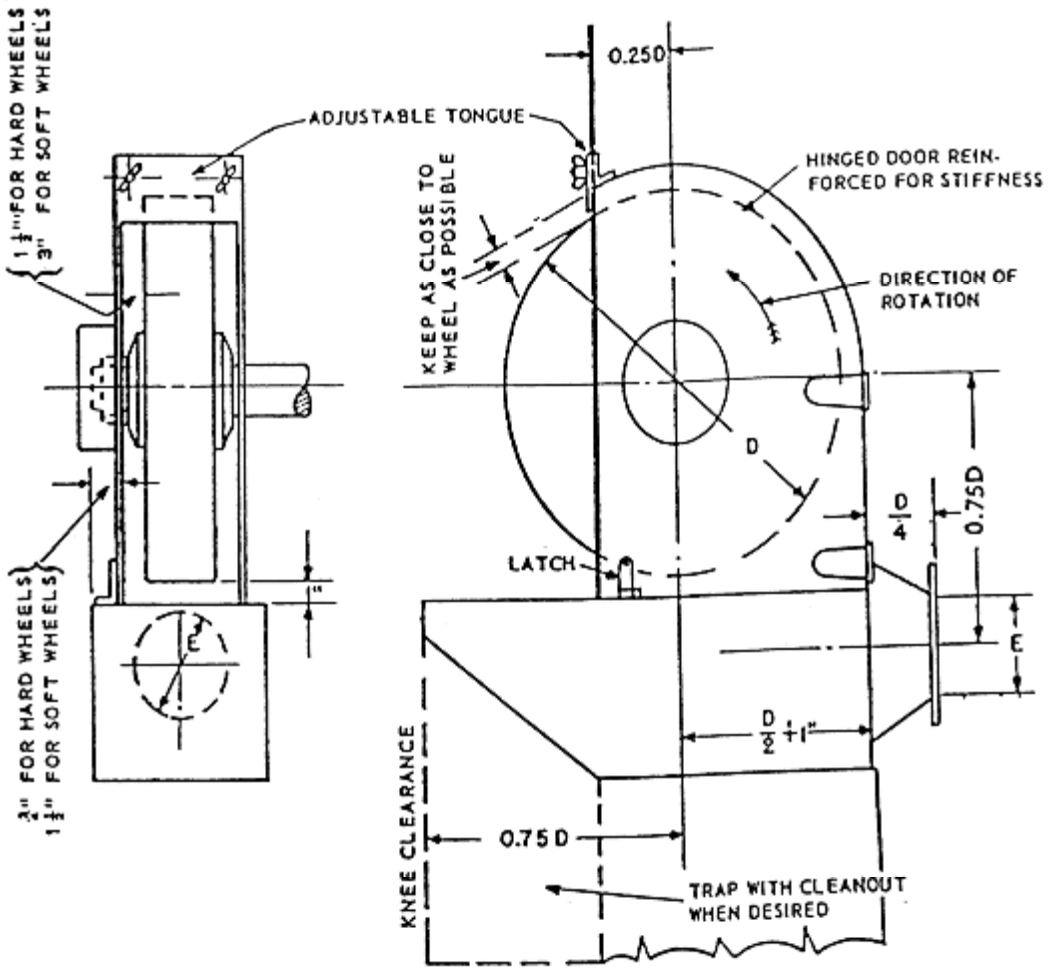


**Figure G-4**

**Standard Buffing and Polishing Hood**

| Wheel dimension, inches | | | Exhaust outlet inches $E$ | Volume of air at 4,500 ft/min |
|---|---|---|---|---|
| Diameter | | Width, Max | | |
| Min = $d$ | Max = $D$ | | | |
| | 9 | 2 | 3 1/2 | 300 |
| Over 9 ..... | 16 | 3 | 4 | 500 |
| Over 16 ..... | 19 | 4 | 5 | 610 |
| Over 19 ..... | 24 | 5 | 5 1/2 | 740 |
| Over 24 ..... | 30 | 6 | 6 1/2 | 1,040 |
| Over 30 ..... | 36 | 6 | 7 | 1,200 |

Entry loss = 0.15 velocity pressure for tapered takeoff; 0.65 velocity pressure for straight takeoff.

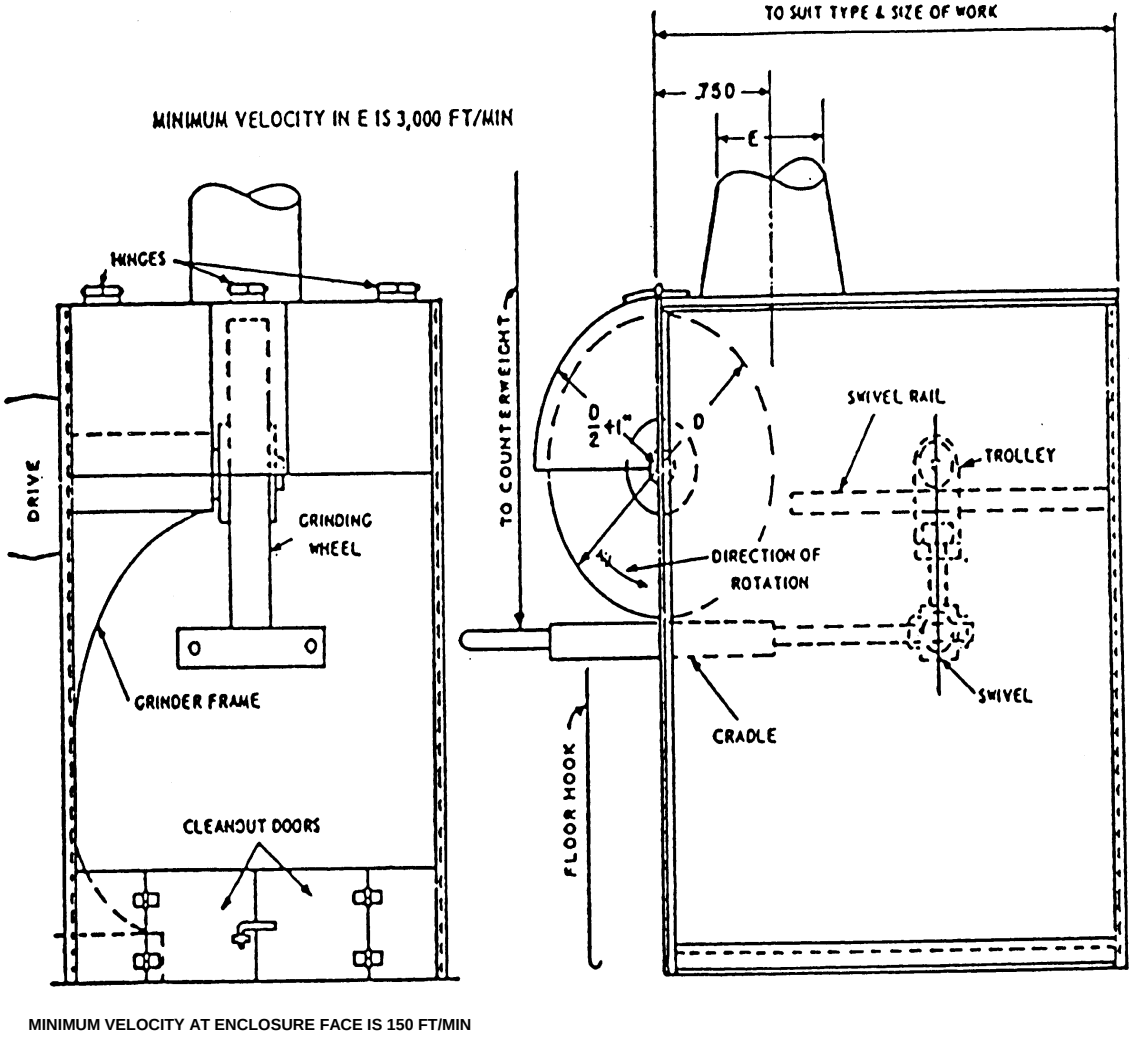


**Figure G-5**

**Cradle Polishing or Grinding Enclosure**

Entry loss = 0.45 velocity pressure for tapered takeoff

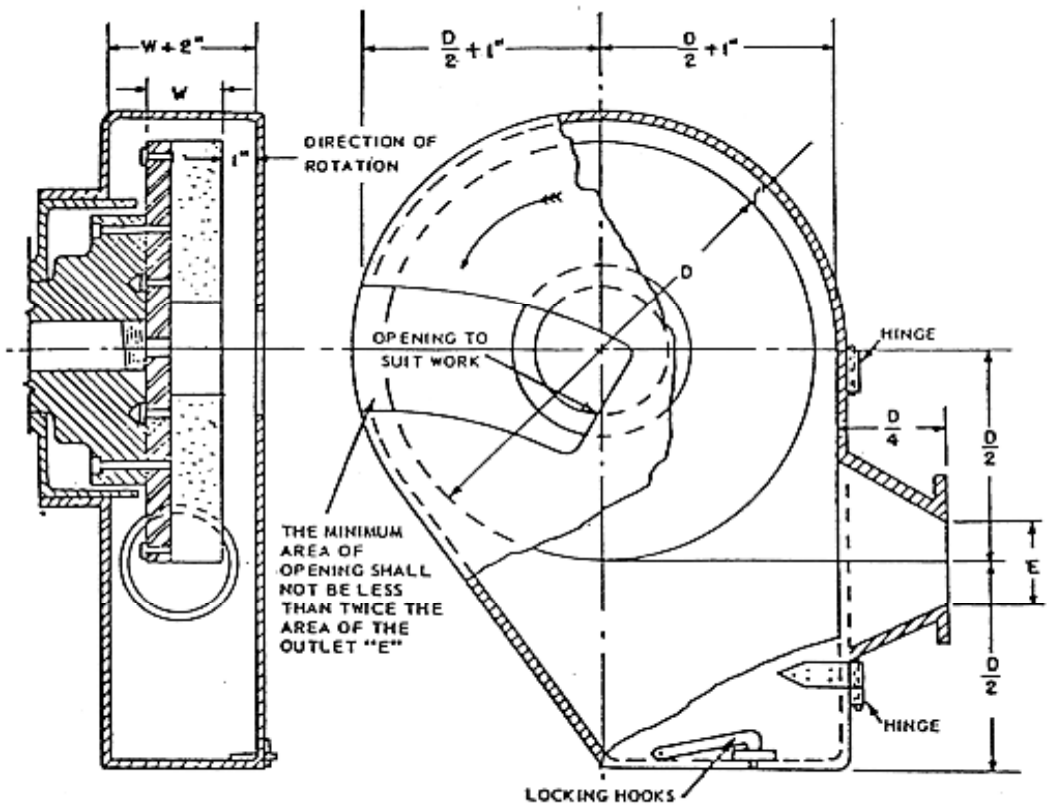


**Figure G-6**

**Horizontal Single-Spindle Disc Grinder Exhaust Hood and Branch Pipe Connections**

| Dia *D*, inches | | Exhaust *E*, dia. inches | Volume exhausted at 4,500 ft/min ft3/min |
|---|---|---|---|
| **Min.** | **Max.** | | |
| | 12 | 3 | 220 |
| Over 12 | 19 | 4 | 390 |
| Over 19 | 30 | 5 | 610 |
| Over 30 | 36 | 6 | 880 |

**Note:** If grinding wheels are used for disc grinding purposes, hoods must conform to structural strength and materials as described in 9.1.

Entry loss = 0.45 velocity pressure for tapered takeoff.

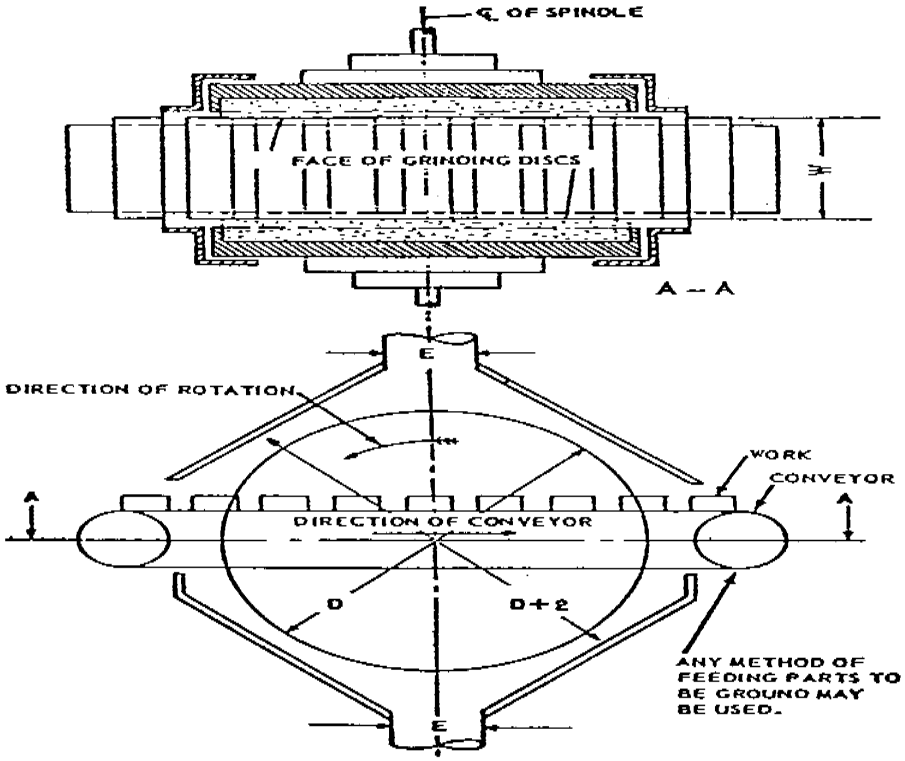


**Figure G-7**

**Horizontal Double-Spindle Disc Grinder Exhaust Hood and Branch Pipe Connections**

| Disc. dia. inches | | Exhaust *E* | | Volume exhausted at 4,500 ft/ min ft3/min | Note |
|---|---|---|---|---|---|
| Min. | Max. | No Pipes | Dia. | | |
| | 19 | 1 | 5 | 610 | |
| Over 19 | 25 | 1 | 6 | 880 | When width "W" permits, exhaust ducts should be as near heaviest grinding as possible. |
| Over 25 | 30 | 1 | 7 | 1,200 | |
| Over 30 | 53 | 2 | 6 | 1,770 | |
| Over 53 | 72 | 4 | 8 | 6,280 | |

Entry loss = 0.45 velocity pressure for tapered takeoff.

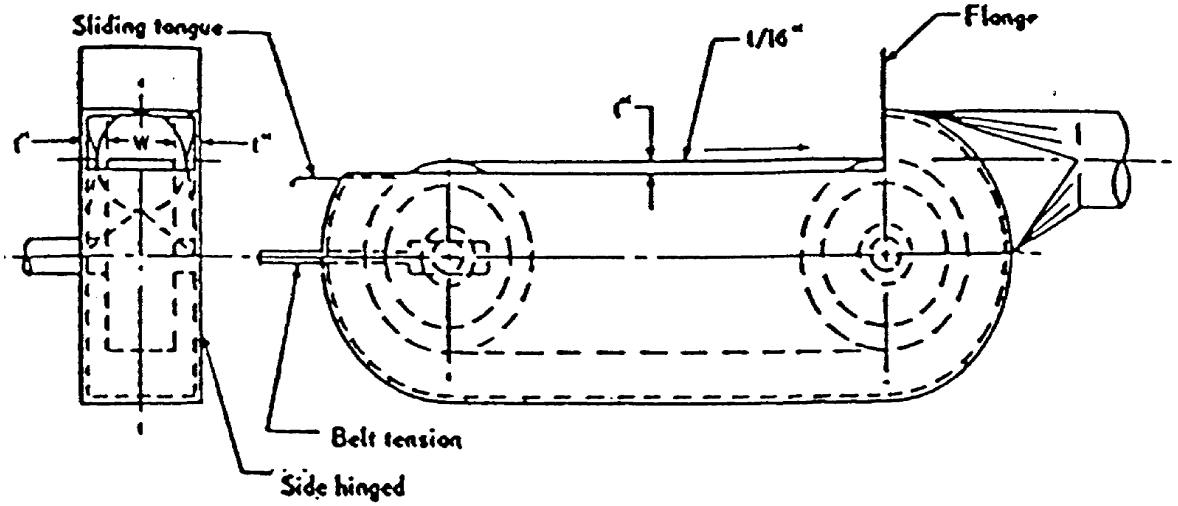


**Figure G-8 – A Typical Hood for a Belt Operation**

| Belt width W. inches | Exhaust volume, ft.1/min |
|---|---|
| Up to 3..... | 220 |
| 3 to 5..... | 300 |
| 5 to 7..... | 390 |
| 7 to 9..... | 500 |
| 9 to 11..... | 610 |
| 11 to 13..... | 740 |

Minimum duct velocity = 4,500 ft/min branch, 3,500 ft/min main.
Entry loss = 0.45 velocity pressure for tapered takeoff; 0.65 velocity pressure for straight takeoff.

**(6) Scope.** This paragraph (b), prescribes the use of exhaust hood enclosures and systems in removing dust, dirt, fumes, and gases generated through the grinding, polishing, or buffing of ferrous and nonferrous metals.

**(c) Removed. In Oregon, 437-002-0107, Spray Finishing, in Division 2/H applies.**

**(d) Removed.**

[39 FR 23502, June 27, 1974, as amended at 40 FR 23073, May 28, 1975; 40 FR 24522, June 9, 1975; 43 FR 49746, Oct. 24, 1978; 49 FR 5322, Feb. 10, 1984; 55 FR 32015, Aug. 6, 1990; 58 FR 35308, June 30, 1993]

**Stat. Auth.:** ORS 654.025(2) and 656.726(4).
**Stats. Implemented:** ORS 654.001 through 654.295.
**Hist:** OR-OSHA Admin. Order 2-1992, f. 2/6/92, ef. 5/1/92 (all except .95).
OR-OSHA Admin. Order 4-1997, f. 4/2/97, ef. 4/2/97.
OR-OSHA Admin. Order 3-1998, f. 7/7/98, ef. 7/7/98.
OR-OSHA Admin. Order 8-1999, f. 8/6/99, ef. 8/6/99
OR-OSHA Admin. Order 3-2003, f. 4/21/03, ef. 4/21/03.
OR-OSHA Admin. Order 7-2008, f. 5/30/08, ef, 5/30/08.