9 General operating rules

9.1 User’s responsibility
Competent, trained persons shall be assigned to the mounting, care, and inspection of abrasive wheels and grinding machines.

The abrasive wheel operator shall be fully instructed in the use, care and protection of abrasive wheels as defined in this Standard.

Any user who alters the wheel other than normal truing or dressing assumes the responsibility of the wheel manufacturer (see section 1.2.51, page 5).

E 9.1 User’s responsibility
More efficient grinding and reduction of wheel breakage will result when the user insists that only personnel with mechanical aptitude and a good knowledge of the contents of this Standard be assigned to the mounting, care, inspection and operation of abrasive wheels and grinding machines.

9.2 Airborne particulates control
The user shall install and operate grinding machines so that airborne particulates caused by the grinding operation shall not exceed threshold limit values. Steps shall be taken to control and dispose of the swarf in an approved and safe manner with respect to both health and environment.

E 9.2 Airborne particulates control
Control may be accomplished by such items as exhausts on wheel safety guards, collecting hoods, auxiliary exhaust collecting devices or approved dust respirators where dust collectors cannot be used.

These airborne particulates are generated during the grinding process by the workpiece, grinding wheel and coolant when used.

Refer to Part 1910, Subpart Z of OSHA Regulations for Threshold Limit Values and Listing of Toxic and Hazardous Substances.

E 9.3 Personal protective equipment
Operator and personal protection are basic requirements and are in addition to the other requirements of this standard, such as guards, speeds, etc. The Z87.1 Standard Practice for Occupational and Educational Eye and Face Protection provides the means for the selection and safe use of face and eye protective equipment. These plus adequate, well designed protective clothing will allow efficient and safer work.

9.3 Personal protective equipment

9.3.1 Eye and face protection
Safety goggles or safety spectacles shall be worn by all personnel exposed to grinding operations where dust, swarf, or flying particles are generated. Where the nature of the operation requires additional face protection, a face shield also shall be worn. Such safety devices shall be in accordance with ANSI Z87.1.

E 9.3 Personal protective equipment

9.3.2 Protective clothing
Protective clothing such as aprons, gloves, safety shoes, and others, shall be worn for protection from sparks, swarf, and flying particles when a grinding operation presents a hazard to the operator or adjacent personnel.
9.4  Wheel breakage
A cracked or damaged wheel shall not be used.

Wheel breakage shall be investigated by the user to determine and correct the cause. In the event of a wheel breakage which causes personal injury, the wheel manufacturer and the machine supplier should be notified immediately.

9.5  Wheel speed
It shall be determined at time of mounting a new wheel that spindle speed does not exceed the maximum operating speed marked on the wheel or wheel package. When a partly used wheel is remounted, spindle speed in revolutions per minute may exceed the maximum revolutions per minute marked on the wheel provided the maximum peripheral speed (surface feet per minute) established for the wheel when new is not exceeded. (See sections 1.2.97, page 11 and 1.2.72, page 8, for explanations and calculation of peripheral speed from revolutions per minute. Also, wheel speed conversion table, table 35, on page 132 may be helpful.)

9.5.1  Tensioned speed
It shall be determined at time of mounting a steel centered diamond cutting-off wheel that spindle speed is within +10%/-20% of the tensioned speed marked on the wheel.

9.6  Flanges
All grinding wheels or cutting-off wheels shall be mounted with flanges in accordance with the requirements listed in section 5, page 72.

E 9.4  Wheel breakage
Should an abrasive wheel be broken in service, an investigation must be made immediately by the user to be sure that any conditions at variance with the requirements contained in this Standard and State, Federal, or other laws are corrected.

The user should immediately isolate the machine and work area and notify the wheel maker and machine supplier. Corrections of adverse conditions should only be made following a complete investigation and recommendation by all parties concerned. This will help determine the cause of the breakage so that a recurrence of the trouble can be prevented.

E 9.5  Wheel speed
On some variable speed machines, spindle speed is governed by an interlock with the guard or some other device that allows the RPM to be increased as wheel diameter decreases. Care must be exercised to determine that such devices are in good working order to prevent the possibility of over-speeding and wheel breakage.

Machine suppliers usually offer maintenance literature which can be useful in preventing wheel failure caused by overspeed conditions. Variable pitch pulleys require continual maintenance to remain in proper working order.

E 9.5.1  Tensioned speed
If the steel centered cutting-off wheel is operated at a speed substantially different from the speed it was tensioned for, it will not run true, i.e., it may wobble or flutter. Therefore, the user must operate within the recommended speed range. Failure to do so could cause damage to or failure of the wheel's steel center leading to serious personal injury.

E 9.6  Flanges
Proper selection, use and maintenance of flanges are all essential factors in accordance with the requirements listed in section 5, page 72.
9.7 Safety guard
Grinding wheels shall not be operated on any machine which has had its safety guard removed.

At the completion of wheel mounting, the safety guard shall be in place and should be checked for condition and adjustment. All safety guard fasteners shall be in place and properly tightened. For portable machines, safety guards shall be inspected periodically. Safety guards shall be in good functional condition. Damaged, bent, and severely worn guards shall be replaced. A guard which has been subjected to a wheel breakage is likely to be weakened internally and shall not be reused. On all other grinders, guards may be repairable depending on the amount of damage suffered during the wheel breakage. It is the user’s responsibility to insure that a damaged guard is repaired or replaced to insure the machine is reconditioned to its original state and safe to be operated.

9.8 Starting the wheel
All abrasive wheels shall be run at operating speeds with the safety guard in place or in a protected enclosure for at least one minute before applying work. During this time no one shall stand in front of or in line with the wheel. (See section 4, page 50.)

This provision shall apply each time one of the following conditions occur:

a. a new wheel has been mounted;
b. a used wheel has been remounted.

9.9 Vibration
Vibration in a portable grinder mounted with a new grinding wheel may be caused by various conditions. The cause of unusual vibration shall be determined and corrected.

E 9.7 Safety guard
It is unsafe to operate any grinding machine with the wheel safety guard removed. Safety guards should never be removed to accommodate a wheel size or type that otherwise could not be mounted on the machine or to accommodate a situation where the guard might interfere with the grinding operation.

E 9.8 Starting the wheel
An abrasive wheel may be damaged in shipment or storage or the wheel may be subjected to improper, excessive stresses during mounting. Wheels which have been damaged or are under excessive stress are likely to fracture within the first minute of rotation at operating speed.

While this procedure is most important at the time when an abrasive wheel is mounted or remounted, damage may also occur to a wheel during a shut down of the machine on which it is mounted. The user should evaluate the circumstances and length of machine shut down to determine additional times that the operating rule should be followed.

E 9.9 Vibration
Some of the most common conditions of vibration are as follows:

a. worn bearings in the grinder;
b. a grinder spindle manufactured or worn undersize, causing an improper fit between the wheel and the spindle;
c. bent, burred or distorted flanges that result in an out-of-truth condition in the mounted grinding wheel, or flanges of improper size;
9.10 Balance

Out of balance wheels which set up vibrations can result in marred work surfaces, machine damage and also cause stresses which could contribute to wheel failure. Wheels which cannot be corrected for imbalance by the user shall not be used.

d. a grinding wheel which is excessively out of balance or which is excessively loose on a grinder spindle that is in dimensional tolerance;

e. use of a wheel type or size on a grinder for which is was not designed;

f. the characteristics of different grinding machines may cause a grinding wheel to vibrate differently when switched from one type of grinder to another.

These conditions may exist individually or in combination. Portable grinders with the wear problems listed above may appear to not show signs of vibration when run without a wheel. It requires the mass of the wheel mounted on the grinder to make these wear problems obvious.

If after mounting a new wheel on a portable grinder a condition of excess vibration occurs, the grinder should be stopped, the wheel removed, and the tool should be checked for the above conditions. After examining, repairing if necessary, and assuring that the tool is in good operating condition, mount another new wheel and see if the condition still persists. If the condition persists, do not use the wheel and contact the wheel supplier.

The inherent nature of the process of grinding produces some vibration. If a wheel that did not vibrate excessively when new vibrates excessively after it has been partially used, remove the wheel, examine the grinder for wear conditions listed above and mount a new wheel. If the grinder is in good operating condition and if the same vibration condition repeats, check with the supplier of the wheels to assure that you are using the proper wheel for your application.

E 9.10 Balance

On precision grinding machines equipped with balance adjustment devices, wheel/spindle assemblies should be corrected for imbalance by utilizing such devices.

When a grinding machine has no included precision balance adjustment device, balance must be accomplished by other means. Usually this means dressing or truing the wheel as shown in
9.11 Truing and dressing

Truing is the process of forming the abrasive wheel cutting surfaces in order to eliminate runout; to form the geometrical shape and to expose new sharp cutting edges of the abrasive grains.

Dressing is the process of removing bond material from around the cutting grains or diamonds in order to expose new, sharp cutting edges and to provide chip clearance for the material removal process.

A bonded abrasive wheel that cannot be trued shall not be used.

9.12 Wet grinding

When shutting down a wet grinding operation, the coolant should first be shut off and the wheel allowed to rotate until coolant has been spun out.

The strength of organic bonded wheels can be affected by coolants. The concentration and alkalinity of the coolant should be checked regularly and adjusted according to the recommendations of the coolant manufacturer.

9.13 Side grinding

Side grinding should only be performed with wheels designed for this purpose. Grinding on the flat sides of wheels designed for peripheral grinding may be dangerous and cause broken wheels. This does not preclude their use for illustration 80, page 113, or with other devices such as diamond dressers.

On wheels provided with “mount up” or “mount down” marks, the mounting of the wheel should be checked (see sections 1.2.55 and 1.2.56).

E 9.11 Truing and dressing

A method of dressing a wheel used in off-hand operation is shown in illustration 80. Note that the dresser should be supported on a work rest, and that the work rest should be adjusted away from the wheel so that the heel of the dresser may hook over the work rest and be guided by it as the dresser is moved evenly across the wheel surface.

“Bumping” a wheel with a heavy casting or other object is dangerous and will not dress a wheel properly.

Illustration 80 – A correct and incorrect method of dressing a wheel for off-hand operations

E 9.12 Wet grinding

Uneven accumulation of coolant can cause excessive out-of-balance in a wheel.

The concentration and alkalinity of coolants determines the degree to which they affect organic bonded wheels. To avoid injurious affect upon these wheels, it is important to follow the directions of the coolant manufacturer.

E 9.13 Side grinding

Straight grinding wheels of the Types 1, 5, 7, and 20 through 26 have limited side strength and are not supported to withstand high side pressure as may be generated by side grinding.
applications such as shoulder, contour and form grinding where it is recognized a limited amount of side grinding is performed. Extreme caution should be exercised not to use excessive side pressure or substantially reduce wheel width by side dressing.

However, these wheels may be used for a limited amount of shoulder, contour and form grinding as done on precision grinding machines, such as, Universal Centertype, centerless and internal grinders. Care must be exercised in these applications not to generate excessive side pressure due to high stock removal or large contact areas on the wheel side. Repeated side dressing which substantially reduces the wheel width and weakens the wheel shall be avoided.

Wheels designed for side grinding, such as Type 2 wheels and abrasive discs, are mounted with one flat side against a suitable steel machine plate to safely withstand side pressure.

Cutting-off wheels are thin and do not have great lateral strength. Care should be taken to avoid twisting, cocking, cramping, or exerting excessive pressure on the side of the wheel. This is particularly true on portable cutting-off machines where the work is held and the wheel is guided by hand or on operations where the work is not clamped. On such operations only reinforced wheels shall be used.

### 9.14 Lubrication

The machine spindle bearings shall be properly lubricated to prevent overheating or other conditions which might damage the abrasive wheel. Lubrication practices shall comply with the machine or equipment supplier’s recommended practices.

### 9.15 Machine maintenance

An employer shall maintain grinding equipment in a condition which will not create a hazard for an employee. The employer shall instruct an employee to report defective equipment to an employee supervisor. In the event of a wheel breakage, the grinder shall be inspected and returned to safe operating condition before being returned to service.

### 9.16 Work rests

An off-hand grinder shall be equipped with a work rest or other device which shall prevent the work piece from jamming between the abrasive wheel and the wheel guard.

E 9.14 Lubrication

Improperly lubricated spindle bearings will cause the mounting spindle to expand because of heat generated, thus exerting a stress in the arbor hole area.

Other adverse conditions related to improper lubrication can cause vibration which may result in a wheel being broken.

E 9.15 Machine maintenance

Proper machine maintenance procedures are one of the most important aspects of safety in the use of abrasive wheels. Particular attention should be placed on those components or parts which can affect the speed of a wheel, such as governors on air grinders, variable pitch pulleys, gear boxes, and rheostat or other type electrical controls.

E 9.16 Work rests

Jamming of the workpiece is a cause of wheel breakage and operator injury. Where work rests are not usable such machines should be identified by warning signs, locked out when not in use or closely supervised as to use.
The work rest or other device shall not contact the abrasive wheel any time and shall be properly maintained.

When work rests are used, the following conditions shall be maintained at all times:

1. The work rest shall be adjusted such that the gap between the work rest and the grinding surface of the abrasive wheel shall not exceed $\frac{1}{8}$ inch.
2. The work rest height shall be on the horizontal center line of the machine spindle.
3. The work rest shall not be adjusted while the abrasive wheel is rotating unless the work rest is designed to allow such adjustment.
4. The work rest shall be securely clamped after each adjustment.

When a work rest cannot be used in accordance with items 1 and 2 above, because of job requirements, the work rest can be adjusted, modified, or eliminated to accommodate the operation. In that circumstance, the user assumes all responsibility for this modification and the continued safe operation of the grinding machine. The user shall in this case provide a means for prohibiting the use of the grinder for other than the job for which the work rest was modified.

9.17 Large hole inorganic bonded wheels

Large hole inorganic bonded wheels (those with holes in excess of $\frac{1}{4}$ of the wheel diameter) should not be used on snagging operations.

E 9.17 Large hole inorganic bonded wheels

Since the cross-sectional strength of an abrasive wheel decreases as its diameter approaches its hole size, it is not safe to use large hole inorganic wheels for most snagging operations. Large hole inorganic bonded wheels cannot be manufactured with retaining media such as steel rings. (See section 1.2.84, page 9.)

9.18 Wheel discard size

The usable portion of an abrasive wheel shall be considered to be that portion which extends beyond the mounting flanges. A wheel shall not be worn down to a size which would allow the mounting flange assembly to contact the workpiece or workpiece holding fixture.

E 9.18 Wheel discard size

Wheels which have been removed from one operation may be remounted as a smaller diameter wheel on another operation or machine, provided that proper mounting, speed and guarding regulations are observed.
9.19 Wheel type for machine
The type of bonded abrasive wheel used on any machine or tool shall only be that type or types for which that machine or tool has been designed. The machine manufacturers' recommendations shall always be complied with concerning the type of wheel to be used and the machine or tool must have the proper guarding, mounting and maximum speed limiting devices in accordance with this standard.

9.20 Machine conversions
Bonded abrasive wheels may be used on machines or tools such as sanders which have been converted to a grinder in accordance with the machine or tool manufacturers' specifications and conforming to the provisions of this standard in respect to wheel design, guarding, mounting and speed.

9.21 Wheel specification
Bonded abrasive wheels shall only be used to grind materials for which the wheel composition is designed. The wheel manufacturers' recommendations must be followed regarding the kinds of material to be ground with any particular wheel.

E 9.19 Wheel type for machine
It is unsafe to use a type of bonded abrasive wheel on a machine or tool that the machine or tool is not intended for, such as using a cut-off wheel on a right angle grinder. Also, some sanding machines run at high speeds which are dangerous when used with certain bonded abrasive wheels. Although appropriate for the proper coated abrasive paper or cloth products, these machines may not be properly guarded nor have appropriate mounting devices for bonded abrasive wheels.

E 9.21 Wheel specification
It can be unsafe to use a bonded abrasive wheel to grind a material that it was not designed for since wheel breakage and injury can result.