

Abrasive Grinding Wheels



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- Welcome to abrasive grinding wheels training. This training is for all employees who operate abrasive grinding wheels on the job.
- Abrasive grinding wheels can be found in almost every industrial workplace. If not used for production, they can almost always be found in the maintenance department. Many people also have abrasive wheel grinders in their home workshops.
- Because these machines are so common, people often underestimate their hazards. And that's a serious mistake, because grinders can be extremely hazardous and cause terrible injuries to those who are not cautious.

Session Objectives

You will be able to:

- Identify grinder hazards
- Understand guarding requirements
- Select necessary PPE
- Adjust work rests, replace wheels, and conduct a ring test
- Inspect grinders properly before use
- Work safely on abrasive grinding wheels

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The main objective of this session is to focus on the hazards of abrasive grinding wheels as well as guarding requirements and safe work practices for both fixed and portable grinders. By the time this session is over, you will be able to:

- Identify grinder hazards;
- Understand guarding requirements;
- Select necessary PPE;
- Adjust work rests, replace wheels, and conduct a ring test;
- Inspect grinders properly before use; *and*
- Work safely on abrasive grinding wheels.

What You Need to Know

- OSHA regulations
- Types of grinders and wheels
- Wheel guarding and work rests requirements
- Required PPE
- Wheel replacement and testing
- Inspection procedures and safe work practices

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During the session, we'll discuss:

- OSHA regulations for fixed and portable abrasive grinding wheels;
- Types of grinders and wheels;
- Wheel guarding and work rests requirements;
- Required PPE;
- Wheel replacement and testing; *and*
- Inspection procedures and safe work practices.

OSHA Requirements

- Design specifications
- Guarding
- Safe operation
- Inspection of equipment
- Repairs and maintenance

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The OSHA regulations for abrasive grinding wheels are long and detailed. Although you may not need to read the whole standard word for word, you do need to understand its basic requirements.

- The regulations spell out design specifications for both wheels and guards. **Except for the point of operation, the wheel must be totally enclosed by a guard. OSHA also requires guarding to be within certain distances from wheels.**
- The regulations also describe the procedures for safely operating a grinder. **Safe operation begins with an inspection. OSHA requires employers to inspect grinders before they are put into service. It also requires operators to inspect the abrasive grinding wheels they work on again before each use.**
- **And, OSHA specifies how certain repairs and maintenance must be made to grinding tool components such as guards and flanges. If the repair does not meet the requirements, the part must be discarded and replaced.**

Think about the OSHA regulations for a moment and make sure you understand the basic requirements.

OSHA Violations

- OSHA's list of most frequently violated standards
- Abrasive wheel exposure limits
- Abrasive wheel work rests

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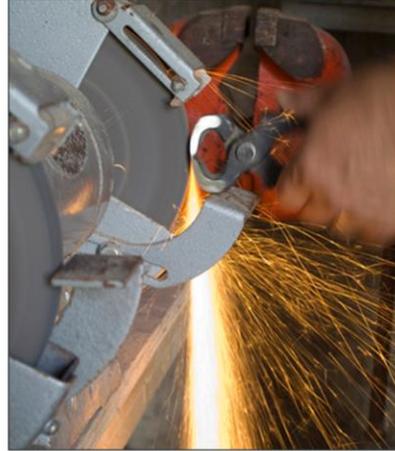
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It's important for you to understand the requirements of the regulations so that you can help the company comply with OSHA rules.

- **The abrasive grinding wheel regulations often rank among OSHA's most frequently violated standards.**
- For example, the section of the standard that refers to abrasive wheel exposure limits seems to frequently hit OSHA's top 10 list. **This part of the standard requires that guarding around the wheel be adjusted as the wheel shrinks in size with use. Guarding must remain within a certain distance of the wheel in order to prevent a part of your body from contacting the surface of the wheel and to protect you if the wheel disintegrates.**
- **The section on abrasive wheel work rests is another frequently violated part of the regulations.** The work rest must be adjusted so that it is within a certain distance from the grinding wheel to prevent the object being worked on from being pulled between the wheel and the work rest.

Grinding Wheel Hazards

- Hand injuries from the moving wheel
- Eye injuries from flying chips and exploding wheels



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As we said at the beginning of the session, people often fail to appreciate how hazardous abrasive grinding wheels can be. There are four principal hazards associated with these machines.

- Hands and fingers can be caught by the spinning grinding wheel and ground down to the bone, mangled, or even cut off. In fact, hand and finger injuries are probably the most common type of injury associated with the use of grinding wheels. Most often, injuries occur when hands get too close to the spinning wheel while the operator is trying to grind a small object. Other injuries occur when operators try to adjust the wheel or its guards while the wheel is still moving.
- Eye injuries are another all-too-common grinding wheel injury. The purpose of an abrasive grinding wheel is to remove small chips or particles from material. Although most small chips and particles hit the ground, there's a good chance that they could bounce up and strike the operator in the eye. Also, on rare occasions, the abrasive grinding wheel could disintegrate and basically explode into the operator. Chunks of disintegrating grinding wheels have blinded some workers.

Grinding Wheel Hazards (cont.)

- Hearing damage from the noise
- Respiratory ailments from dust and fumes



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- Noise is another hazard associated with abrasive grinding wheels. The noise level depends on the material you're working on as well as what type of grinding wheel you're using. If you perform grinding operations throughout the workday, you're likely to be overexposed to noise and could suffer hearing loss unless you use the proper hearing protection.
- Last, but not least, on the list of grinding wheel hazards is inhalation of dust and fumes generated from grinding operations. Again, the amount of hazardous dust depends on the material you're grinding. Metal grinding is more likely to emit hazardous dusts and fumes. Inhaling these airborne particles can cause respiratory ailments unless you're wearing proper protection.

Types of Grinders

- Bench and pedestal grinders
- Portable grinders
- Edge or circumference used for grinding
- Flat side of wheel used for grinding



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Now let's talk about the different types of grinders you might use on the job or at home.

- Bench and pedestal grinders are stationary grinders that are mounted. They are usually larger than portable grinders. Stationary grinders are used to grind pieces of material, which are held against the grinding wheel by the operator.
- Portable grinders are handheld power tools that are typically smaller than stationary grinders. The operator holds the grinder against the material.
- Most grinders are designed so that the edge or circumference of the grinding wheel is used to do the work on the material.
- Some grinders, however, are designed so that the flat side of the grinding wheel is used to do the work on the material.

Think about the kinds of grinders you've used on the job or at home. Consider the type of grinder you'd choose for different kinds of jobs.

Types of Wheels

- Cutting off wheel
- Abrasive wheel
- Organic wheel
- Inorganic wheel
- Vitrified wheel
- Wire brush and buffing wheels



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There are also different types of wheels for different kinds of work.

- A cutting off wheel is generally steel centered with diamond abrasive or organic bonded abrasives.
- An abrasive wheel is a cutting tool consisting of abrasive grains held together by organic or inorganic bonds. Diamond and reinforced wheels are included.
- An organic wheel is bonded by an organic material such as resin, rubber, shellac, or other similar bonding agent.
- An inorganic wheel is bonded by an inorganic material such as clay, glass, or other similar bonding agent.
- A vitrified bonded wheel, which is a kind of inorganic wheel, is bonded with clay, glass, porcelain, or related ceramic material.
- Other types of wheels sometimes used on grinders include wire brush and buffing wheels that are usually used for cleaning materials.

Think about the different types of wheels you've used. Consider the type of wheel you'd choose for different kinds of jobs.

Wheel Speed

- Surface feet per minute (SFPM)
- $0.262 \times \text{diameter in inches} \times \text{revolutions per minute (RPM)}$
- 12" wheel at 1,000 RPM = 3,144 SFPM
- 24" wheel at 1,000 RPM = 6,288 SFPM



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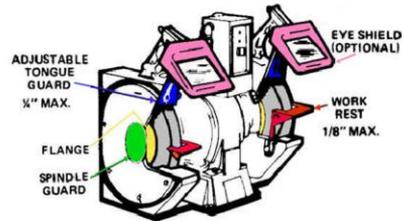
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Wheel speed is another issue with which you need to be familiar.

- Surface feet per minute, or SFPM, is the distance in feet that any one abrasive grain on the edge or peripheral surface of a grinding wheel travels in 1 minute. The faster the SFPM, the more damage the wheel can do to your hand or finger if either comes in contact with the surface of the spinning wheel.
- The formula used to determine SFPM is 0.262 times the diameter of the wheel in inches times the revolutions per minute, or RPM.
- For example, a 12-inch-diameter wheel on a spindle moving at 1,000 RPM will have a surface speed of 3,144 SFPM.
- A 24-inch-diameter wheel on a spindle moving at 1,000 RPM will have a surface speed of 6,288 SFPM.

Typical Guarding

- Heavy metal enclosure
- Cover spindle, nut, and flange
- Side guards cover 75% of wheel diameter
- Adjustable tongue guard must be positioned within 1/4" of the surface of the grinding wheel



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Perhaps the most important feature of an abrasive grinding wheel from a safety point of view is the guarding, which helps protect you from injury.

- OSHA regulations require abrasive wheel grinders to have an enclosure that is designed to restrain the pieces of the grinding wheel in the event the wheel breaks during operation. In most cases, this enclosure is made of heavy metal. This guard also protects you from accidentally touching the spinning wheel and being injured.
- Side guards are also required, and they must cover the spindle, nut, and flange projection in order to protect you from this spinning equipment.
- Side guards must also cover 75 percent of the wheel diameter. Again, this is intended to contain a large area of a broken wheel as well as to prevent you from accidentally touching the spinning wheel.
- The top of a grinding wheel's point of operation is guarded by an adjustable tongue guard that can be moved as the grinding wheel becomes smaller and smaller through use. The adjustable tongue guard is designed to prevent pieces of a disintegrating wheel from shooting out the top part of the enclosure opening and striking you while you work. The tongue guard must always be positioned within one-quarter inch of the surface of the grinding wheel.

Do you know how to properly adjust the tongue guard on the grinders you use?

Band-Type Guard

- Flat side of wheel is used to grind
- Back and edges of wheel are guarded
- Inside of band is free of projections
- Inside edge is less than 1" from edge of wheel
- Wheel protrudes slightly beyond guard

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- Another type of guarding is the band-type guard. Band-type guards are used on grinders that are designed so that the flat side of the wheel, instead of the edge or circumference of the wheel, is used to grind.
- With this type of guarding the back and edges of the wheel are guarded to prevent you from accidentally touching the wheel and being injured. Band-type guards also protect you from broken pieces of a disintegrating wheel.
- The bands must be connected with bolts and welds in such a way that the insides of the bands are free of projections.
- That's because the inside edge must be less than 1 inch from the outside edge of the wheel.
- The wheel should not protrude much beyond the guard. This guard should be adjustable so that, as the wheel becomes thinner with use, the guard can be adjusted backward to allow the wheel to always stick out slightly beyond the guard.

If you use grinding wheels with this type of guard, do you know how to adjust them properly?

Flanges

- Used to mount most abrasive wheels
- Transmit torque from spindle to wheel
- At least 1/3 of wheel diameter
- Made of strong and rigid material
- Must be replaced when bearing surface becomes worn, warped, or damaged

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Now let's consider another important part of an abrasive grinding wheel—the flanges.

- Flanges are used to mount most abrasive wheels to the grinder.
- Flanges transmit torque from the motor-powered spindle to the grinding wheel. In other words, the flanges are necessary to make the wheel spin.
- Flanges must be at least one-third the diameter of the wheel in order to evenly distribute the pressure the flange applies to the wheel. Too much pressure in a small area will damage the wheel.
- Flanges may be made of steel, cast iron, or other material of equal or greater strength and rigidity.
- Flanges must be replaced when the bearing surface—the surface that contacts the wheel—becomes worn, warped, sprung, or damaged. Any warping or wear will prevent the flange from applying pressure evenly, which could damage the wheel.

Can you locate the flanges on the grinders you use? Do you inspect them regularly for wear or damage?

Blotters

- Compressible washers
- Used between flanges and wheel surface
- Ensure uniform distribution of flange pressure
- Cover entire contact area of flange

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Blotters are another part of a grinder with which you should be familiar.

- Blotters are compressible washers that can be made of a number of different materials.
- They are used between the flanges and the wheel surface on most grinding tools. Some grinders don't require blotters.
- Blotters ensure uniform distribution of flange pressure against the wheel.
- In order to perform that important function, blotters must be sized so that they cover the entire area where the flange contacts the wheel.

Work Rest

- Supports material being worked on
- Is adjustable for wheel wear
- Must be less than 1/8" away from wheel
- Large gap could cause jamming and injuries



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One other very important part of an abrasive grinding wheel is the work rest.

- The work rest is a small surface that supports a piece of material you're working on while you hold it against the grinding wheel. The rest supports the material and prevents the wheel from "kicking" it down.
- The work rest is adjustable so that it can be moved as the grinding wheel wears down with use.
- The work rest must be positioned less than one-eighth inch away from the surface of the grinding wheel.
- If the gap between the wheel and the work bench is any larger than this, the piece being worked on could be pulled down by the grinding wheel and jammed between the wheel and the work rest. A jammed piece could damage the grinding wheel or injure your hands or fingers.

Work Rest (cont.)

- Positioned just below wheel's center
- Secured in position
- Replaced when worn or damaged

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- The work rest should be positioned so that its top is just below the horizontal center of the grinding wheel. In this position, the work piece can be easily held against the downward spinning wheel. If the rest is positioned above the horizontal center of the wheel, the piece is more difficult to hold against the wheel and could be ejected or kicked back by the wheel, which could cause an injury.
- After making any adjustments to the position of the work rest, make sure it is tightly secured in position so that it can't move when the grinder is in use.
- Over time, the work rest will become worn and damaged. Inspect the work rest regularly for cracks or other obvious damage; replace it when necessary.

Do you know how to properly adjust the work rest on the grinders you use? Proper adjustment is very important to your safety.

Abrasive Wheel Grinder Basics

- Do you understand the information presented in the previous slides?



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- Now it's time to ask yourself if you've understood the information presented so far. It's important for you to know about the OSHA regulations, the hazards of abrasive grinding wheels, the types of grinders and grinding wheels, and guarding requirements.

Let's continue now to the next slide and talk about the type of personal protective equipment you should use when operating an abrasive grinding wheel.

Required PPE

- Safety glasses with side shields or goggles
- Face shield
- Respirator



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OSHA and the company both require the use of personal protective equipment to protect against the abrasive grinding wheel hazards we discussed at the beginning of the session.

- You must wear safety glasses with side shields or safety goggles when working on an abrasive wheel grinder to protect your eyes from flying chips and dust. You also need eye protection in the event a wheel disintegrates and broken pieces escape the wheel guarding.
- A face shield is required in addition to eye protection when the job you're doing is likely to create a large number of chips and particles.
- Respiratory protection is also required to protect you from dusts and fumes that could harm your respiratory system. The type of respirator depends on the material you're grinding.

Required PPE (cont.)

- Hearing protection
- Gloves



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- In addition to eye, face, and respiratory protection, you also need hearing protection to protect your ears from the noise generated by grinding operations. You may choose to wear ear plugs, canal caps, or ear muffs, depending on the amount of noise. Ear muffs generally provide the best protection, but ear plugs work well, too, in most cases.
- Although gloves will protect your hands from the sharp edges and burrs of the material that you're grinding, they should be worn with caution. If your hands must be close to the wheel—for example, if you're working on a small piece of material—do not wear gloves. The spinning wheel could grab a glove and pull your hand into the grinder.

Think about the personal protective equipment you use when working on an abrasive grinding wheel. Are you always properly protected on the job as well as in your home workshop?

Work Clothes and Grooming

- No oversized shirts or sweatshirts
- No unzipped shirts, sweaters, or jackets
- No long sleeves with unbuttoned cuffs
- No dangling jewelry
- No loose long hair



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Along with all the things we've discussed that you should do when working with abrasive grinding wheels, there are also some things you should *not* do. For example:

- Do not wear oversized shirts or sweatshirts that could hang down near the grinding wheel. They could get grabbed by the spinning grinding wheel and pull your hand, arm, or other part of your body into the grinder.
- Do not leave shirts, sweaters, or jackets unzipped or unbuttoned while working on a grinder.
- Do not leave long sleeves unbuttoned.
- Do not wear dangling or loose jewelry such as watches, bracelets, or long necklaces that could be grabbed by the grinder.
- Do not let long hair hang down near a grinding wheel. Be sure to carefully tie back long hair when working on a grinder.

Replacing Grinding Wheels

- Disconnect power source
- Be sure wheel's rated speed is greater than machine's maximum speed
- Handle wheel carefully
- Inspect wheel for cracks or damage



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Now let's talk about replacing grinding wheels.

- Before replacing a wheel or doing any maintenance on a fixed or portable grinder, be sure to disconnect the power. This may be as simple as unplugging the grinder or flipping an electrical disconnect switch to the "off" position. In some cases, you may need to lock out the electricity at the power source—generally the circuit breaker.
- Before installing a new wheel, check to make sure the wheel's rated speed is greater than the machine's maximum spindle speed. If the wheel's rated speed is lower than the machine's maximum speed, the grinding wheel could become damaged and disintegrate.
- Be sure to handle wheels carefully. Avoid dropping them or banging them against equipment. Wheels are easily damaged, and can be dangerous when damaged.
- Before mounting a grinding wheel, inspect it carefully for any signs of damage. We'll talk more about inspections in a few minutes.

Think about the proper procedure for mounting a grinding wheel. If you are uncertain about how to do this correctly, check with your supervisor.

Ring Test

- Check for hidden wheel cracks
- Use a light, nonmetallic tool to gently tap the dry, clean wheel
- Metallic “ping” means wheel is OK
- Dull thud means wheel is cracked

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Besides conducting a visual inspection of new grinding wheels to look for damage, you also need to conduct a ring test.

- A ring test is a simple test that allows you to check for hidden cracks in a grinding wheel.
- To conduct the test, make sure the wheel is clean and dry. Then use a light, nonmetallic tool, such as a screwdriver handle or wooden mallet, to gently tap the flat side of the dry, clean wheel about 45 degrees on each side from the vertical centerline and about 1 or 2 inches from the edge. It’s important to make sure the wheel is free from dirt; otherwise, the sound might deaden.
- The tap on a good wheel should produce a clear metallic “ping.” Note, however, that organic bonded wheels do not emit the same clear metallic ring as vitrified and silicate wheels.
- If the sound is like a dull thud, the wheel is probably cracked and should not be used.

Do you perform the ring test to check for hidden cracks before installing new grinding wheels?

Grinder Inspections

Make sure:

- Grinder is securely mounted
- Wheel is mounted securely
- Guards are in place
- Power transmission motor is covered
- Work rest is positioned correctly
- Work rest is in good condition

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Now let's turn our attention to a very important subject—grinder inspections.

- When you inspect a bench or pedestal grinder, make sure it is securely mounted. Never use a bench grinder that is not mounted, but just sitting on a bench. It could move or fall and strike you while operating.
- Make sure that the wheel is also securely mounted. To be sure, try to wiggle the wheel with the power disconnected.
- Check all the wheel guards. Make sure the wheel is completely enclosed according to the requirements of the specific grinding tool you're using. Remember, the wheel should be adequately enclosed to prevent accidentally touching any part of the wheel except at the point of operation. Also make sure the flange and spindle are properly guarded.
- Make sure the power transmission unit and the motor are adequately covered to prevent your accidentally touching moving parts.
- And check the work rest to make sure it is properly positioned. Remember, it should be slightly lower than the horizontal centerline of the wheel, and it must be within one-eighth inch of the wheel.
- Also check to make sure the work rest is in good condition.

Grinder Inspections (cont.)

Make sure:

- Wheel is evenly worn
- Wheel has no nicks, cuts, or cracks
- Flanges are in good condition
- Work area is clear of combustibles
- Electrical connections are in good condition
- Dust collection system is working

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- When inspecting an abrasive wheel grinder, you also need to look at the wheel and make sure it's evenly worn. Uneven wear could be an indication that the wheel is spinning off center.
- Disconnect the power source and manually rotate the wheel to check for nicks, cuts, or cracks.
- Check the flanges, too, to make sure they are in good condition, and not worn, warped, sprung, or damaged.
- Don't forget to make sure that your immediate work area is clear of combustible materials. Sparks from grinding metal materials could ignite paper, cardboard, rags, sawdust, trash, and other combustibles.
- Check all electrical connections before you turn on the grinder, and make sure cords and plugs are in good condition and connections are tight.
- And finally, if your grinder has a dust collection or exhaust system, make sure it's working properly. If the system is connected to a bag, make sure the bag isn't full and doesn't have a leak.

Safe Grinder Operation

- Make sure you're wearing required PPE
- Turn on the wheel while standing off to the side
- Allow the grinder to come to full speed

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The last item on our training agenda today is safe grinder operation. Although this information comes at the end, it is one of the most important parts of the whole session.

- The first rule of safe operation is to make sure that you're wearing all required PPE and that it's in good condition and fits properly.
- Before using a grinder, turn it on while standing off to the side. A damaged wheel is most likely to disintegrate in the first few seconds after being turned on.
- Always allow the grinder to come to full speed before applying the material to the wheel.

Safe Grinder Operation (cont.)

- Stand in a balanced position
- Keep firm control of the grinder or material
- Do not extend yourself or overreach



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- Another important rule of safe operation is to make sure you can stand in a balanced position when grinding. You don't want to lose your footing and fall against the grinder. A balanced position is especially important when using a portable grinder.
- Be certain you have firm control of a portable grinder. Use two hands because it might kick back at first. When using a stationary grinder, keep a firm grip on the material you are grinding.
- Do not extend yourself or overreach when using a grinder because you won't be in a balanced position and you won't have a firm grip. Position yourself close to the object that needs grinding. This is especially true when using a portable grinder because it might be rather heavy.

Think about the procedures for safely operating an abrasive grinding wheel. Do you always work safely with grinders, even at home?

PPE, Inspections, and Safe Work Practices

- Do you understand the information presented in the previous slides?



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- Now it's time to ask yourself if you've understood the information presented in the previous slides. It's important for you to know how to select necessary personal protective equipment, how to change and test wheels, how to inspect an abrasive wheel grinder before use, and how to work safely.

Let's wrap up this session on abrasive grinding wheels now with some key points to remember.

Key Points to Remember

- Make sure you understand abrasive grinding wheel hazards
- Always wear required PPE
- Inspect the grinder and wheel before each use
- Adjust the tongue guard and work rest properly
- Take precautions when starting and operating abrasive grinding wheels

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- Make sure you understand abrasive grinding wheel hazards;
- Always wear required PPE;
- Inspect the grinder and wheel before each use;
- Adjust the tongue guard and work rest properly; *and*
- Take precautions when starting and operating abrasive grinding wheels.

This concludes the abrasive grinding wheel training session.

Now take the quiz on Abrasive Grinding Wheels for credit.