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# STUDY GUIDE

## BASIC SHOP SAFETY

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

DATE OF INSTRUCTION: \_\_\_\_\_

1. Get your instructors' permission before you use any of the equipment in the shop. You must have permission to use the tools and equipment.
2. Don't use any of the equipment until you've been shown how to use it correctly and safely. Be sure you understand the instructions before you use any of the equipment.
3. Use the equipment *only* when the instructor is in the shop.
4. Don't wear clothing with open pockets. Don't wear pants with cuffs or rolled pant legs. Avoid wearing anything that may have "traps" for live embers and sparks.
5. Avoid wearing loose clothes. Keep shirts tucked in and sleeves rolled down and buttoned. Loose clothing is dangerous; it can become caught or tangled in a moving machine or tool, or it could catch on sharp corners or a piece of equipment. Wear clothes that fit properly.
6. Wear protective shoes. Wear hard, high top shoes or boots. Wear shoes or boots with non-slip, insulating soles and heels.
7. Wear a cap. If your hair is long, tuck it neatly under the cap to keep it out of the way of flames, sparks or embers.
8. Always use the recommended eye protection. Use the safety goggles, face shield welding goggles and welding hoods whenever they are required, even if you are only watching.
9. Wear approved protective clothing whenever it is required. Wear treated leather gloves with gauntlets, an approved, treated apron or protective jacket, and a cap whenever your personal safety requires it.
10. Don't wear jewelry in the shop. Remove rings, watches, bracelets or necklaces.
11. Whenever you work with electricity, be sure your hands are dry and be sure you're standing on a dry floor.
12. Keep tools, equipment, your clothing and your hands free of oil or grease. Oil, grease and welding *don't mix*. The combination of oil or grease with the welding gases or with sparks from arc welding can cause an explosion or a fire, or both.
13. Don't use tools or equipment that are in any way damaged, defective or broken. Tell the instructor about any tools or equipment that are not in safe, working condition.
14. Use the right tool for the work. Use the tools *only* for what they were designed to do, and use the right *size* tool.
15. Carry pointed or sharp tools with the point or edge held down toward the floor. This will help avoid injuries if you bump into something or if someone bumps into you.
16. Always use tongs or vise grips to handle small work you're welding. *Severe* burns could result from holding it with your hands, even if you're wearing gloves. (Acetylene combined with oxygen produces one of the *hottest known flames!*)
17. When they're not being used, return tools to their proper storage area. Don't leave tools lying around the shop.
18. Don't let anyone distract you while you work. You have to think about what you're doing. And, don't distract others while they're operating the equipment or welding.
19. Some of the equipment may have a marked safety zone. Whether there is a specific safety zone or not, stay clear when someone is using power tools or welding equipment. Also, make sure others stay clear when you're using any of the equipment.

**STUDY GUIDE**BASIC SHOP SAFETY  
second pageNAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_

20. Work only in well ventilated areas. Oxygen and acetylene are flammable and, under some conditions, explosive. Also, both oxyacetylene welding and arc welding produce toxic fumes when coatings, fluxes and base metals are heated. Work areas must be well ventilated.
21. Gas flames and electric arcs produce harmful ultraviolet and infrared radiation. You must wear welding goggles or a welding hood with the *correct filter lenses* for the work you're doing.
22. Arc welding must be done in a shielded area to protect others in the shop from the intense light and radiation. (If the work can't be shielded properly, make sure others stay out of the area.)
23. Keep flammable or combustible materials out of the shop. Avoid any possible risk of fire or explosion.
24. Clean up any spills, dirt or scraps. Don't leave anything around that someone could slip on or trip over.
25. Keep used rags in an approved, covered metal container. Damp, dirty or oily rags can begin to burn by spontaneous combustion. The heat produced by oxidation is enough to start a fire.
26. Know where the fire extinguishers are located and read the instructions on the extinguishers. Know what types of fires the extinguishers are for and know how to use them in an emergency.
27. Keep aisles and work surfaces clean and clear of any tools or materials that aren't in use. Keep drawers and cabinet doors closed.
28. Avoid the risk of a serious back injury, muscle or tendon injuries. Lift properly. Lift with your *legs*, not with your back. If you have to lift something large or heavy, get help. Don't try to do it alone; ask someone to help you.
29. Handle oxygen and acetylene cylinders very carefully. Never bang them around or drop them; keep cylinders upright and secured with a strap or a chain, and be sure there's a valve-protection cap on cylinders that aren't in use.
30. Don't fool around in the shop. There are no exceptions to this; don't *ever* play around in the shop area!
31. Report all accidents, near accidents or injuries to the instructor immediately.
32. These are *not* all the safety regulations and procedures that apply to working in the shop. Each operation has its' own, specific safety precautions. Be sure you understand *all* the necessary safety procedures for the work you are doing. Be safe, not sorry.

# STUDY GUIDE

## OXYACETYLENE WELDING SAFETY - PART ONE

NAME: \_\_\_\_\_  
 CLASS OR PERIOD: \_\_\_\_\_  
 DATE OF INSTRUCTION: \_\_\_\_\_

1. Don't use any of the equipment until you've been shown how to use it correctly and safely. All welding procedures must be demonstrated to you. Be sure you understand the instructions clearly. If you're not sure about something, or if you don't understand it, check with the instructor.
2. The clothes you wear in the shop are very important to your safety. Some clothing is made of material that will burn, smolder or melt when an ember or sparks fall on it. Wear *only* clothing that is fire-proof or fire-resistant. (Wool or leather are often recommended.)
3. Wear clothing with long sleeves and a high collar. This will help protect you from heat, sparks, embers, *and* infra-red and ultra-violet radiation. Keep sleeves rolled down and buttoned and close the collar.
4. Avoid clothes with pockets. If there are pockets, keep them buttoned or secured shut. Sparks can fall into loose or open pockets and you could be burned.
5. Wear pants with no cuffs and keep the pant legs rolled down. Cuffs or rolled pant legs are traps for sparks and embers.
6. Remove jewelry such as rings, watches, bracelets or necklaces.
7. Wear a cap over your hair. If your hair is long, be sure it's tucked securely under the cap. Keep your hair protected and out of the way.
8. Wear hard, high top shoes or boots to protect your feet from burns or falling metal scraps. The shoes or boots should have heels and soles made of non-skid, insulating material.
9. If you're welding or torch-cutting an area above you or overhead, protect your ears. Wear a welding helmet or ear plugs made of wool, rubber or cotton.
10. Always wear approved fire-resistant protective gloves with gauntlets when you're welding or torch cutting.
11. Never wear clothes that are oily or greasy. Oil or grease are dangerous when they are combined with oxygen gas. The combination can cause an explosion.
12. Eye protection is *essential!* Use welders' goggles or a welding helmet with the correct filter lenses for the welding or cutting operation. Be sure you wear the proper eye protection *before* you light the torch.
13. Wear safety goggles or a face shield when grinding, scaling or cleaning welds. A face shield is recommended.
14. Work *only* in a well ventilated area. The gases used for welding can be explosive *and* they can be hazardous to breathe. There are also fumes from coatings, fluxes and base metals which are very toxic. Weld *only* in an area that provides plenty of fresh air and ventilation.
15. Keep the work area clear of tools, materials or equipment that aren't being used. Avoid clutter that could get in your way or cause an accident.
16. Never weld anything on the floor or on any other concrete surface. If the concrete gets hot it may crack or explode.
17. Never weld a *sealed* container. The air trapped in a sealed container will expand as it gets hot and the container could explode.
18. Never weld or flame-cut a container that held gasoline, oil, solvent or any other combustible, hazardous liquids.
19. Keep flammable material away from the work area. Avoid any fire hazards. Never weld in an area where there are explosive or flammable gases or fumes.



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OXYACETYLENE WELDING  
SAFETY - PART ONE  
second page

NAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_

20. Clean up any spills immediately. Keep the floor, work surfaces, materials and equipment clean and clear of any spilled liquids.
21. Keep used rags in an approved, covered metal container. Damp, oily rags can begin to burn by spontaneous combustion. The heat produced by oxidation is enough to start a fire.
22. Know where the fire extinguishers are located and read the instructions posted on the extinguishers.
23. Keep the tools and equipment away from open flames, embers, sparks, heat or slag.
24. Report any unsafe condition to your instructor. Your safety and the safety of everyone in the shop depends on maintaining safe conditions *at all times*.
25. Oxygen and acetylene cylinders must always stand upright. To keep them from falling or rolling, these cylinders must always be secured with a cable or a chain.
26. Before moving a cylinder, close the cylinder valve and remove the regulator. Then, cover the cylinder valve with a valve protection cap. Valve protection caps should always be hand tightened.
27. An empty cylinder must be marked "empty". Use chalk to mark cylinders, or hang a sign on the cylinder that indicates that the cylinder is empty. All empty cylinders must be clearly identified as "empty".
28. *Never* try to charge an empty cylinder with a full one.
29. Cylinders that are not in use must be capped. Whether a cylinder is full or empty, it must have a valve protection cap on it.
30. Handle cylinders *very* carefully when you move them. Avoid the risk of damage to the cylinder or to the valves or plugs.
31. Never store cylinders near heat, flame or sparks. Also avoid storing cylinders in direct sunlight *or* in extreme cold, ice or snow.
32. Don't handle cylinders with oily, greasy hands or gloves.
33. Keep cylinders away from oil or grease, or other combustible materials.
34. If you can't open a cylinder valve with the "T" wrench, tell your instructor. Don't use any additional tools to open a cylinder valve. If you can't turn the "T" wrench by hand, tell the instructor.
35. The space between you and the cylinders must always be kept clear. In an emergency, you may have to close both valves *immediately*.
36. Always use the correct tool for the work. A wrench must always be used for opening or closing a hose connector or a regulator connector. Never use pliers or vise-grips. Always use a wrench.

# STUDY GUIDE

## OXYACETYLENE WELDING SAFETY - PART TWO

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

DATE OF INSTRUCTION: \_\_\_\_\_

37. Never try to use a cylinder without a regulator.
38. The oxygen regulator and the acetylene regulator are *not* interchangeable; they can not and must not be substituted or exchanged. Use *only* the correct regulator for the tank.
39. The hoses on the welding equipment are not interchangeable. Oxygen hoses are coded *green*. (Think of oxygen, fresh air, and *green* grass or trees.)
40. Acetylene hoses are coded *red*. (Think of danger or "red alert": red = acetylene.)
41. The connectors on these hoses are not interchangeable. Oxygen connectors have "right-hand" threads. This means that to close or tighten them, they are turned in a *clockwise* direction.
42. Acetylene connectors have "left-hand" threads. This means that to close or tighten them, they are turned in a *counter-clockwise* direction.
43. Another difference between oxygen and acetylene connectors is that acetylene connectors are *notched* to make them easier to identify. *Acetylene* connectors are *notched*. Oxygen connectors are smooth.
44. Be sure there are no leaks in any of the cylinder connections or hose connections.
45. *Never* test for leaks with a match or a torch lighter! Hose connections can be tested for leaks with a mixture of detergent and water. Bubbles will appear if there is a leak in the line.
46. Never use oil or grease on the connectors. They do not have to be lubricated. Oil or grease will *explode* when combined with oxygen. Keep the connectors clean and free of oil, grease or any other substances.
47. Don't handle the welding equipment if your hands are dirty, oily or greasy.
48. Both cylinders must be fitted with regulators. Each regulator has *two* gauges. One gauge will show how much pressure there is in the cylinder. That is the *cylinder pressure gauge*.
49. There is a *line pressure gauge* on each of the two regulators on the cylinders. The line pressure gauge shows how much oxygen or how much acetylene pressure will reach the torch.
50. Be sure both cylinder pressure gauges and both line pressure gauges are working properly and accurately. Your safety depends on accurate use of cylinder pressure and line pressure.
51. Each cylinder has a valve to release oxygen or acetylene to the regulator. These are the *cylinder valves*.
52. Each regulator has a valve called a *regulator pressure screw*.
53. Open, or release, the *regulator pressure screws* before you open the cylinder valves. (This is very important. See your instructor if you don't understand this clearly.)
54. Whenever you open a cylinder valve, stand to one side of the regulator gauges. Don't stand directly in front of the gauges. The sudden pressure could cause the gauges to burst. Stand off to the side as you open the cylinder valve, and always open the valves slowly and gradually.
55. The acetylene cylinder valve should not be opened more than 1 full turn. This is so it can be closed quickly in an emergency. If the cylinder requires a "T" wrench to turn the cylinder valve, keep the "T" wrench in place.



56. Most welding can be done with 5 psi to 7 psi acetylene line pressure. The size of the welding tip in the torch will determine the correct pressure. But, whatever type of tip you're using, the acetylene line pressure should *never* go over 15 psi.
57. The cylinder pressure gauge on the acetylene cylinder shows how much acetylene is in the cylinder. Never use an acetylene cylinder with less than 25 psi pressure.
58. Open the oxygen cylinder valve slowly, all the way. Check the cylinder pressure gauge. Do not use an oxygen cylinder with less than 50 psi pressure.
59. The oxygen line pressure should be set to the correct pressure for the size and type of welding tip you're going to use. Check with your instructor to be sure you use the correct pressure.
60. Never let any acetylene or oxygen soak into your clothes. Either one of them could ignite or explode.
61. Keep the welding torch aimed *away* from your body. Aim it toward the work before you light it. (A reminder: put on your welding goggles or welding helmet before you light the torch.)
62. Before lighting the torch, "purge" the lines by "cracking" the torch valves. This means clearing the lines by opening each of the torch valves for a moment and closing them again, immediately. This helps clear the lines of dirt, dust or other material that may clog the lines.
63. Never use matches or a cigarette lighter to ignite the torch. Use a friction lighter.
64. Don't use a hot or molten weld to relight a torch that has gone out. It could cause a "pocket ignition". The gases that were released while the torch was out could ignite or explode. Use the friction lighter to relight the torch.
65. A torch that is improperly handled can "backfire". To avoid a backfire, don't let the tip touch the weld and don't let the tip overheat. Be sure the tip is fastened tightly and use the right gas pressures.
66. A "flashback" is much more serious than a backfire. A flashback means the flame is burning inside the torch, or even inside the hoses. If this happens, close the torch oxygen valve *immediately*. Then close the acetylene valve. Don't try to relight the torch. Report the flashback to your instructor.
67. If you have to lay down a torch, even for a moment, *turn it off*. Never lay down a lighted torch.
68. Use the correct size flame for the size welding tip that's in the torch. If you need a larger or smaller flame, change the tip.
69. Keep the hoses clear of sharp edges or heated metals. Protect the hoses from being damaged or cut. Keep hoses away from embers and sparks.
70. When you're finished with the work, turn off the torch with the torch valves. Close the cylinder valves next, and the regulator pressure screws last. The equipment should be shut down in this order: torch valves first, cylinder valves next, and regulator pressure screws last.
71. After the equipment has been shut down, release the pressure in the hoses by opening the torch valves. Then, close them again.
72. Never fool around in the shop or while you're handling welding equipment! There are no exceptions to this; don't *ever* play around in the shop.
73. These are *not* all the safety precautions you will need to understand in order to work safely under all conditions. Be sure each operation has been demonstrated to you and that you understand the procedures shown to you.



# Step by Step Procedure for Starting and Shutting Down Oxyacetylene Torches

## STARTING THE TORCHES

- Step 1 Turn on Oxygen Tank valve completely and Acetylene Tank valve 1/4 to 1/2 of a turn.
- Step 2 Crack open Acetylene torch valve and set the regulator to the correct line pressure. (4-5 psi)
- Step 3 Close the Acetylene torch valve.
- Step 4 Crack open the Oxygen torch valve and set the regulator to the correct line pressure (10 psi for welding, 20 psi for cutting)
- Step 5 Close the Oxygen torch valve.
- Step 6 Crack open the Acetylene torch valve and using a striker light the torch and adjust the Acetylene to get a clean burning flame, no smoke.
- Step 7 Open Oxygen torch valve until you get a neutral flame, sharp centre cone.

## SHUTTING DOWN THE TORCHES

- Step 1      Close the Acetylene torch valve.
- Step 2      Close the Oxygen torch valve.
- Step 3      Close the Oxygen and Acetylene tank valves.
- Step 4      Crack open the Oxygen torch valve and drain the Oxygen line until both the line and tank pressure gauges read zero. Close Oxygen torch valve.
- Step 5      Crack open the Acetylene torch valve and drain the Acetylene line until both the line and tank pressure gauges read zero. Close Acetylene torch valve.
- Step 6      Wrap up the hoses around the cart handles.
- Step 7      Loosen the regulator adjusting screws from both the Oxygen and Acetylene regulators to relieve the pressure on the regulator diaphragm.

# STUDY GUIDE

## ARC WELDING SAFETY

### PART ONE

NAME: \_\_\_\_\_  
 CLASS OR PERIOD: \_\_\_\_\_  
 DATE OF INSTRUCTION: \_\_\_\_\_

1. You must have your instructors' permission before using *any* of the arc welding equipment. Be sure to get permission, first, before you operate any of the equipment.
2. Use the equipment *only* when the instructor is in the shop. The instructor must be present when the equipment is being operated.
3. Don't use any of the welding equipment until you've been shown how to do it correctly and safely. All procedures *must* be demonstrated to you. If you're not sure about an operation or if you don't completely understand it, check with the instructor.
4. The clothes you wear in the shop are very important to your safety. Some clothing is made of material that will burn, smolder or melt when embers or sparks fall on it. Wear *only* clothing that is fire-proof or fire-resistant. (Wool or leather are often recommended.)
5. Never wear oily, greasy clothing. Oil stains or grease stains can easily catch fire near heat and sparks. Also, keep your hands free of oil or grease.
6. Avoid loose clothing. Keep shirts tucked in and sleeves buttoned down.
7. Wear clothing with long sleeves and a high collar. This will help protect you from heat, sparks, infra-red and ultra-violet radiation. Keep sleeves rolled down and buttoned and close the collar.
8. Avoid wearing clothes with loose, open pockets or pants with cuffs. Don't roll up sleeves or pant legs. Open pockets, cuffs, rolled up sleeves or pants, can be "traps" for sparks and burning embers.
9. Remove jewelry such as rings, watches, bracelets or necklaces.
10. Wear a cap, and if your hair is long, tuck it securely under the cap.
11. Wear hard, high top shoes or boots with insulating, non-skid soles and heels. Protect your feet from burns and from falling metal parts. The insulating soles and heels will help protect you from electric shock.
12. If you're welding overhead, wear a fire-proof hat and fireproof earplugs or ear protectors. Falling sparks and embers can burn your head and ears if you are not protected.
13. While welding, wear approved, treated gloves with gauntlets and a treated leather apron or jacket. These protective clothes will help guard you against the infra-red and ultra-violet radiation.
14. Eye protection is *essential!* When you're welding, you *must* wear an approved welding helmet or hood. The welding helmet must have the correct filter lens installed in it. The shade of the filter lens will depend on the size of the electrode and the amount of amperage to be used. (Check with your instructor.)
15. Be sure the filter lens in the welding helmet is in good condition and clean.
16. Never strike an arc unless your welding helmet and filter lens are in place. Failure to protect your eyes can result in severe eye injury and possible blindness.
17. Wear safety goggles or a face shield when grinding, scaling or cleaning welds.



**STUDY GUIDE**

ARC WELDING SAFETY

PART ONE

second page

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

18. Work *only* in well ventilated areas. Toxic gases, smoke and dust may be produced by the welding. Be sure there is plenty of fresh air and a system to exhaust the toxic gas and smoke.
19. Never weld a sealed container or a container that held any hazardous material or liquids. Never weld sealed pipes.
20. Never weld near flammable or explosive materials, gases or fumes.
21. Know where the fire extinguishers are located and read the instructions posted on the extinguishers. Be familiar with the types of fires on which the extinguishers are to be used.

# STUDY GUIDE

## ARC WELDING SAFETY

### PART TWO

NAME: \_\_\_\_\_  
 CLASS OR PERIOD: \_\_\_\_\_  
 DATE OF INSTRUCTION: \_\_\_\_\_

22. Be sure you're standing on a dry floor and that your hands are dry when you operate the welding unit. The low voltage used for arc welding is fairly safe *unless* you stand on a wet floor or handle the equipment with wet or damp hands.
23. Before you switch on the power to the welding unit, check the cables, cable lugs, and cable connectors. Be sure they are all fastened tightly. A loose connection can cause overheating and fire.
24. Check the ground connections. The work *must* be properly grounded. Be sure the ground clamp is in place and firmly secured.
25. Be sure the insulating shields on the electrode holder are in place and in good condition.
26. Check the cables to be sure they're dry and free of oil or grease. Also be sure they're in good condition; be sure the insulation isn't cracked, worn or damaged.
27. Lay the cables where they won't be tripped over or damaged. If the cables are on the floor, be sure the floor is dry.
28. Always keep welding cables away from power supply cables or other power lines.
29. Turn on the welding unit when you're ready to use it, and turn it off again as soon as you've finished using it. Don't leave it turned on when it's not in use.
30. Be sure the screens or curtains are in place before you begin welding. The other people in the shop must be protected from the flash when you weld.
31. Warn everyone in the area before you strike an arc.
32. Use the right type and size electrode for the work you're doing.
33. Don't touch an electrode with your bare hands after you have welded with it. The electrode tip gets *very* hot and you could burn yourself severely.
34. Don't leave electrodes or electrode stubs lying on the floor. They roll, and it's very easy to slip on them and fall.
35. The tip of the electrode should never touch *anything* except the surface of the metal that's being welded.
36. Don't hold the welding rod in the same hand with which you raise or lower your welding helmet. There may be metal parts on the helmet, and if the welding rod touches one of these parts it could arc and cause a burn or an eye injury.
37. If the welding unit gets hot, or if the cables, ground clamp, cable lugs, terminals or electrode holder get hot, turn off the welding unit and check with your instructor. Don't use the equipment if it isn't working properly.
38. The metal you're welding will get very hot. Allow it to cool before you touch it. Use tongs or large pliers to hold the work or move it while it is hot.
39. Keep the work area clean and clear of clutter and unused tools.
40. Don't play around! The welding shop is definitely *not* the place for fooling around.
41. If there's an accident, a near-accident, or an injury, report it to the instructor immediately.
42. Report any unsafe condition to your instructor. Your safety and the safety of others in the shop depends on maintaining safe conditions *at all times*.



# STUDY GUIDE

## DRILL PRESS SAFETY

NAME: \_\_\_\_\_  
 CLASS OR PERIOD: \_\_\_\_\_  
 DATE OF INSTRUCTION: \_\_\_\_\_

1. Tuck your hair neatly under a cap when you operate a drill press. Even reasonably short hair can get caught in the turning bit or chuck, and the result could be a very serious injury.
2. Don't wear loose clothes. Button down sleeves or roll them up neatly. Tuck in shirts.
3. Wear eye protection. Use a face shield or safety goggles when you operate the drill press.
4. Be sure the belt and pulley safety guard is in place. Never operate a drill press unless this guard is in place.
5. Make sure the table is adjusted so the clearance hole in the table is lined up directly under the drill bit. This will prevent drilling into the table surface.
6. Secure the table locking clamp firmly to prevent the table from shifting or sliding down the column.
7. Check the drill speed before you operate the drill. Use the right speed for the work. The correct speed will depend on the type of material to be drilled and the size and type of bit to be used.
8. Be sure the drill bit is sharp, straight and in good condition.
9. Don't try to tighten the chuck by hand. Use the chuck key to fasten the cutting tool in the chuck.
10. Always check twice to be sure you have removed the chuck key before turning on the drill press.
11. Use clamps to hold the work firmly on the table.
12. Keep your hands out of the area directly under the drill bit.
13. Don't allow the drill bit to overheat. Don't use too much pressure; don't force the cut. Use a machining lubricant when necessary.
14. When it's cutting, the drill bit will get hot enough to cause a severe burn if you touch it. Allow the bit time to cool before you handle it.
15. Turn the drill press off before you make any changes or adjustments. Turn it off and wait for it to come to a complete stop, then make the changes.
16. Never try to stop the drill by hand. Always let it coast to a stop.
17. Don't leave a drill while it's still running. Turn it off and stay with it until it has come to a complete stop.
18. Don't use your hands to clear away chips, metal turnings or dust. Use a rag or a brush to clean the work and the table.





# 11

## STUDY GUIDE PEDESTAL GRINDER SAFETY

NAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_  
DATE OF INSTRUCTION: \_\_\_\_\_

1. Always wear a face shield or goggles when operating a grinder or a wire buffer.
2. Don't wear any jewelry. Remove your watch, rings, bracelets or necklaces.
3. Loose clothing can get caught in the grinder. Keep clothes tucked in and keep shirt sleeves buttoned down or rolled up neatly out of the way.
4. If your hair is long, wear a cap over it. Long hair can get caught in the grinder. Tuck your hair neatly under a cap.
5. Before turning on the grinder, check the wheel. The grinding stone must be in good condition and clean. Don't use the grinder if the wheel is worn, damaged, cracked, clogged or defective in any way. If there's anything wrong with the grinder, tell your instructor; don't use it.
6. Always use the tool rest. Never try to grind free-handed. Be sure the tool rest is adjusted properly. The tool rest should be adjusted for the correct angle *and* it should be set close to the wheel. The tool rest should be 1/8" from the face of the wheel.
7. If you need to adjust the tool rest, make the adjustments with the grinder turned off and completely stopped.
8. There should be a transparent safety shield on the grinder. Be sure the safety shield is in the correct position and that it is clear and clean.
9. Check the coolant pan to be sure there is water in it.
10. Stand to one side when you switch on the grinder. Stand off to the side until it comes up to full speed. If a wheel is damaged or defective, it can fly apart as it comes up to full speed.
11. If the grinder starts to shake or vibrate, or if it doesn't sound right, move to one side and turn it off immediately.
12. Never use the side of the wheel for grinding. Always grind on the face of the wheel.
13. Use pliers or vise-grips to hold small objects or parts. Don't hold small objects with your fingers when you grind; your fingers will be dangerously close to the wheel. Also, small objects can be pulled in the area between the wheel and the tool rest, and draw your fingers into the wheel.
14. Some grinders include a wire buffing wheel. When buffing small objects, use pliers or vise-grips to hold the objects.
15. Always buff on the lower part of the wheel. Buff *with* the rotation; don't hold the object against the upper part of the wheel or against the rotation. It could be kicked back or kicked out of your hands.
16. Don't buff a sharp corner or a leading edge. The wire wheel can catch sharp corners and edges and kick the object out of your hands.
17. Use a light, steady pressure against the wheel. Too much pressure can damage the grinding wheel, it can damage the edge that is being ground, and it can be dangerous.
18. Grind or buff in short intervals. Prolonged, continuous grinding will heat the material enough to burn you. Interrupt the grinding or buffing to allow the material to cool, or dip it in the coolant pan. Protect yourself against burns when using the grinder or buffer.
19. Never use a rag to hold an object while buffing or grinding. Never wear gloves. Rags or gloves can be pulled into the wheel and pull your hands with them.



**STUDY GUIDE****PEDESTAL GRINDER SAFETY**  
second page

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

20. Keep your hands and fingers away from the wheel while it is moving.
21. Never test the results with your fingers. You could cut yourself *and* burn yourself.
22. When you're finished, turn off the grinder and stay with it until it has come to a complete stop.
23. Wash your hands to remove the grains of abrasive and the metal particles. Don't touch your face or wipe your eyes until you have thoroughly washed your hands.
24. The pedestal grinder is a fairly small, simple power tool. Don't let this fool you: Misuse of the grinder can cause injuries as serious as those caused by misusing larger, more complicated equipment. Use the grinder with care and respect.

14

# REGULATOR

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

DATE OF INSTRUCTION: \_\_\_\_\_

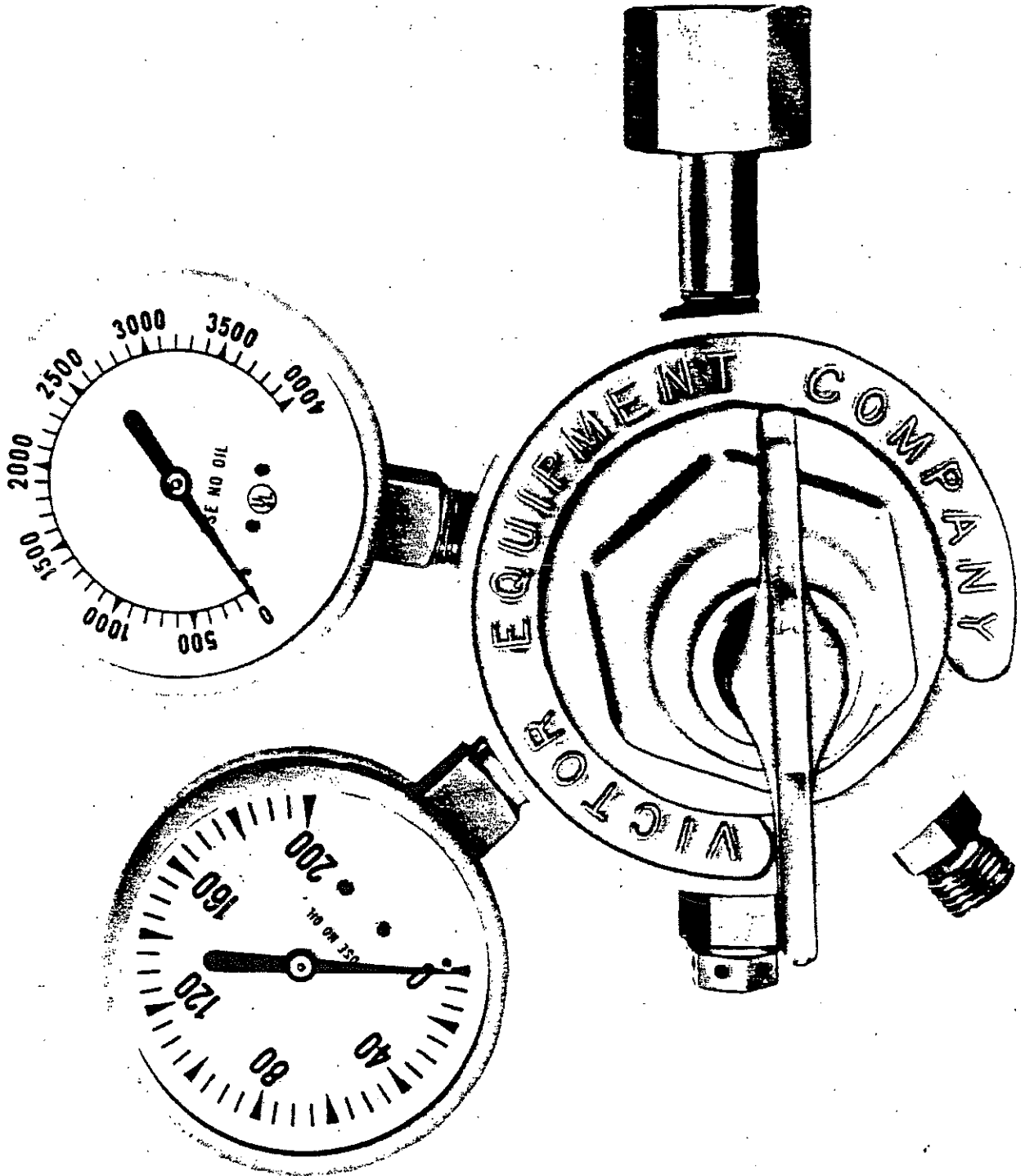


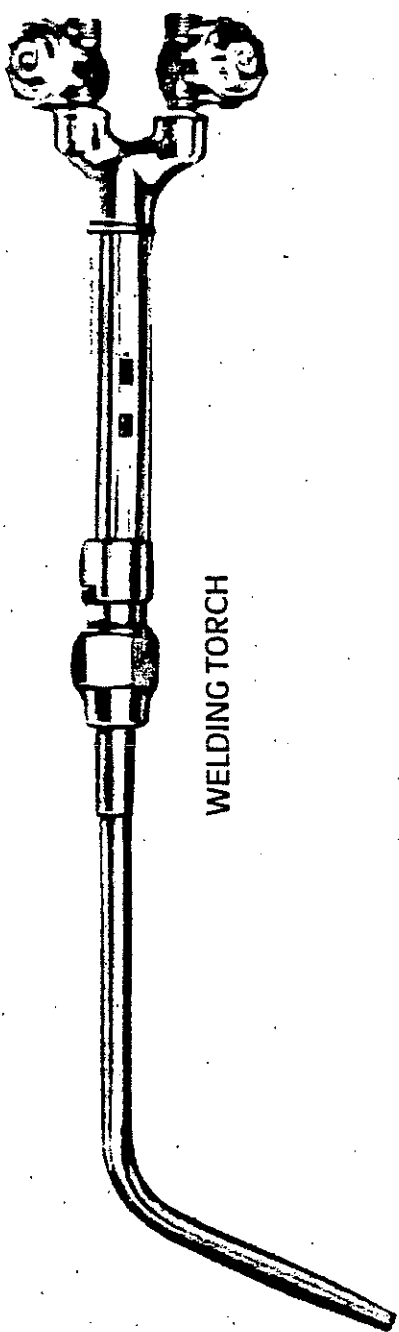
ILLUSTRATION: REGULATOR 14  
WELDING



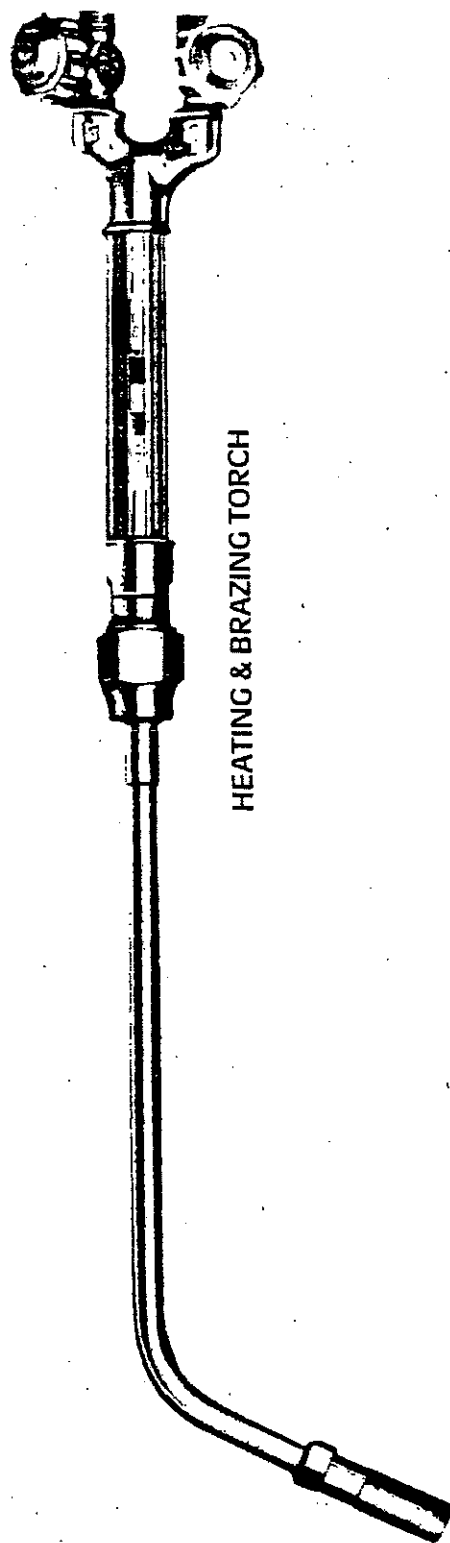
**15**

**TORCHES**

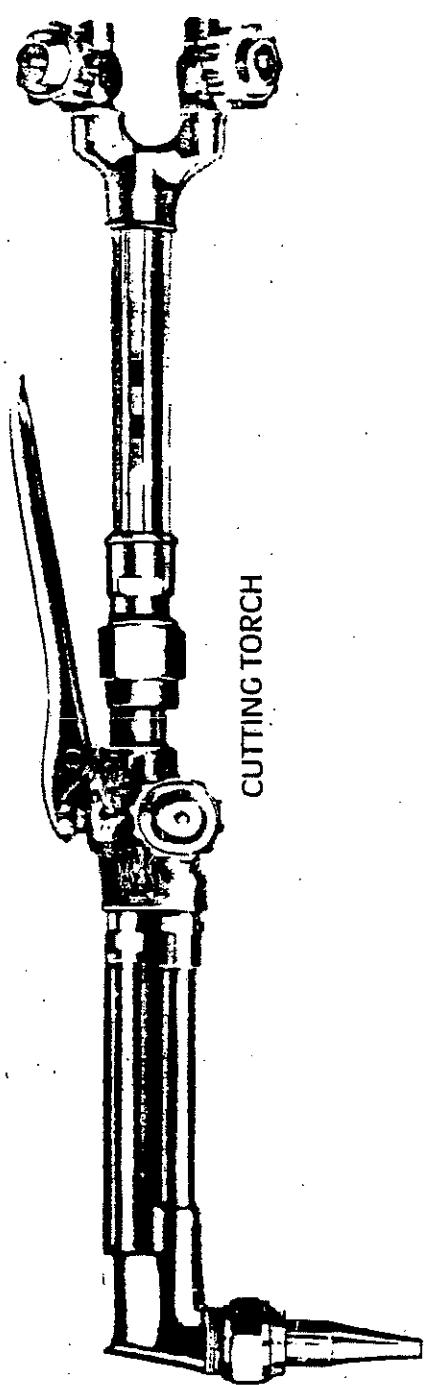
NAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_  
DATE OF INSTRUCTION: \_\_\_\_\_



WELDING TORCH



HEATING & BRAZING TORCH



CUTTING TORCH

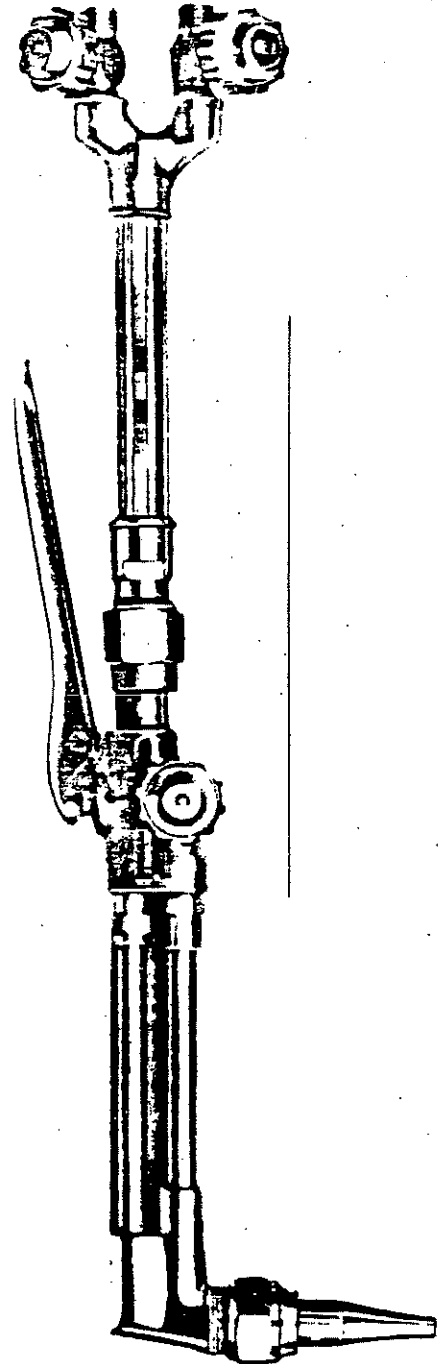
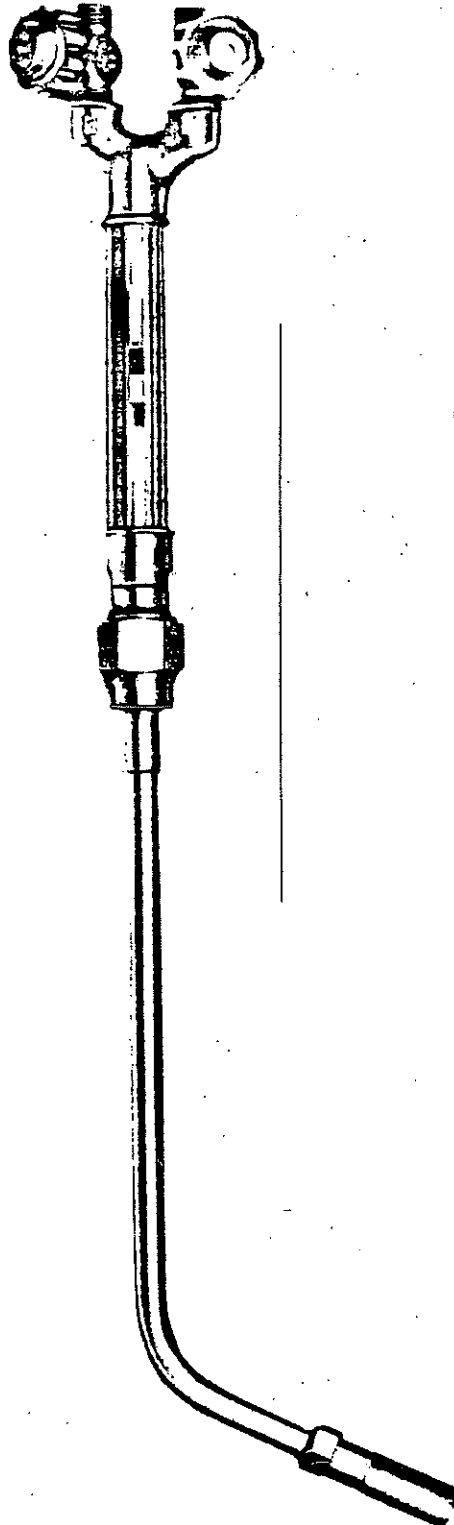
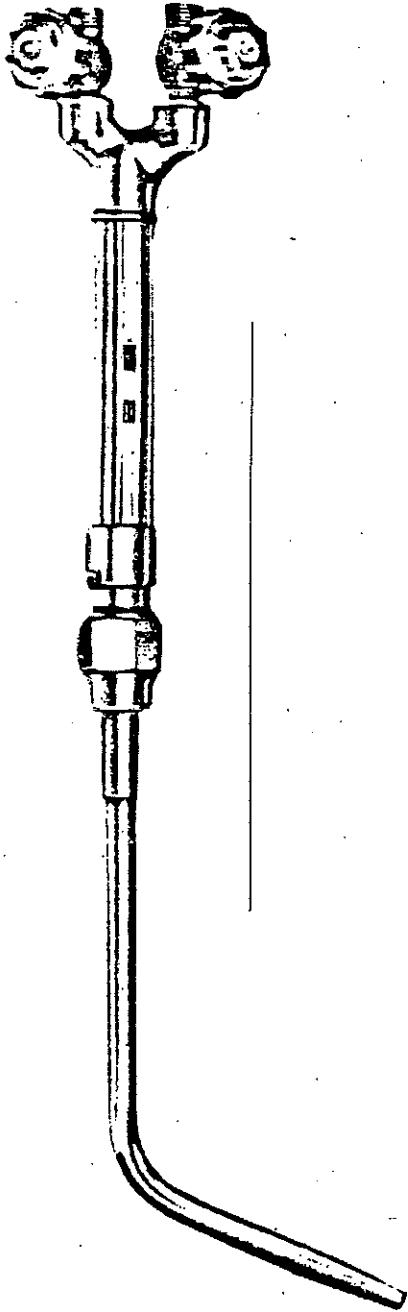
15

TORCHES

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

DATE OF INSTRUCTION: \_\_\_\_\_



**16**

**TORCH &  
REGULATOR  
NOMENCLATURE**

NAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_  
DATE OF INSTRUCTION: \_\_\_\_\_

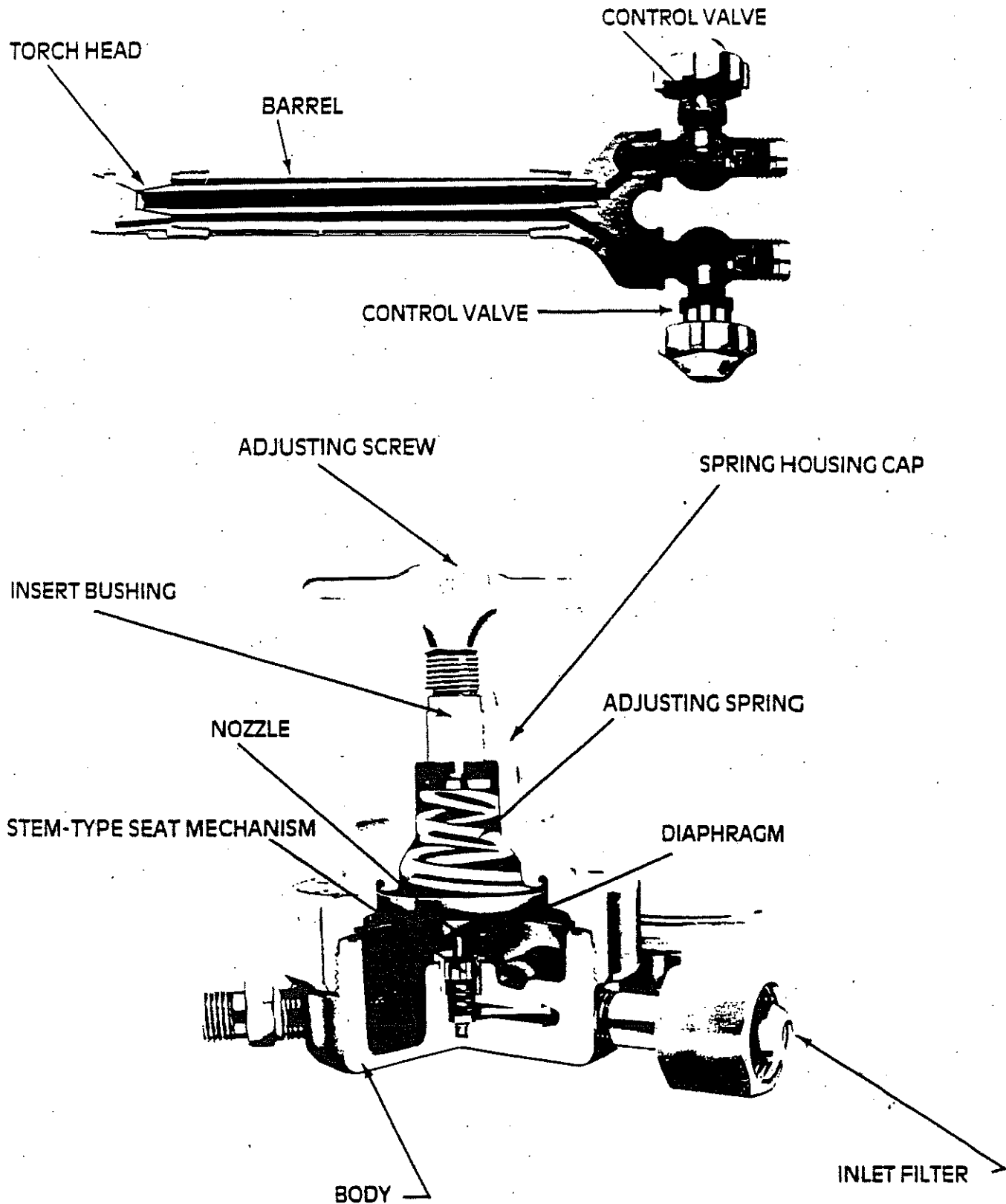


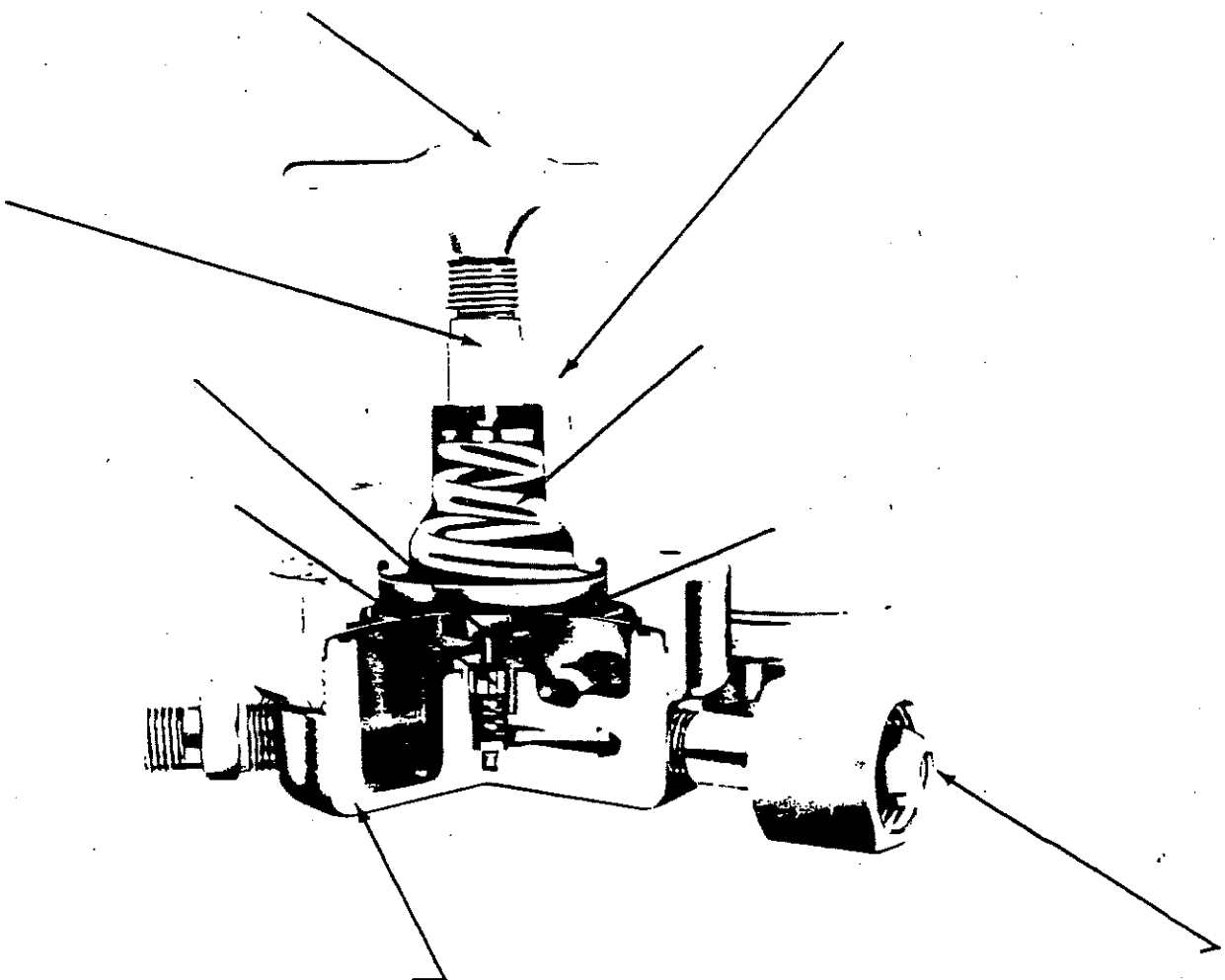
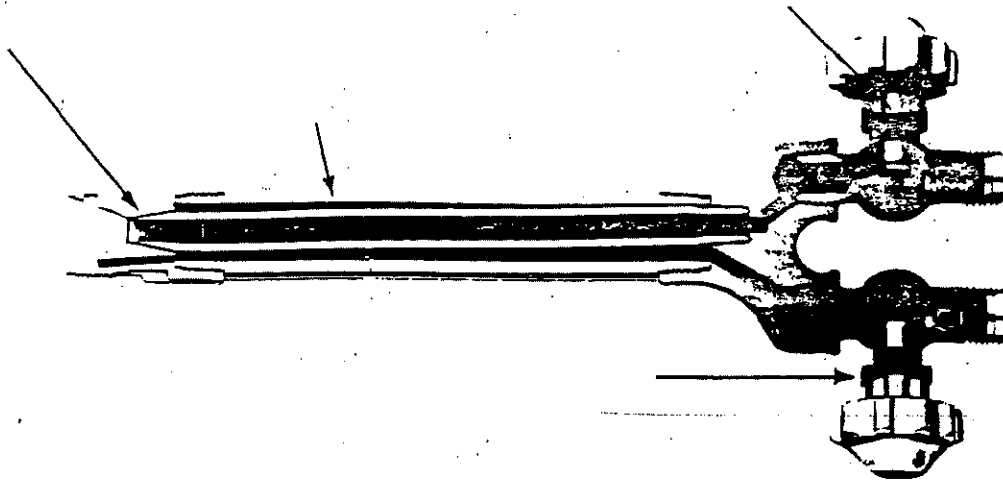
ILLUSTRATION: TORCH AND REGULATOR NOMENCLATURE 16  
WELDING

OVER

**16**

**TORCH & REGULATOR  
NOMENCLATURE**

NAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_  
DATE: \_\_\_\_\_ SCORE: \_\_\_\_\_

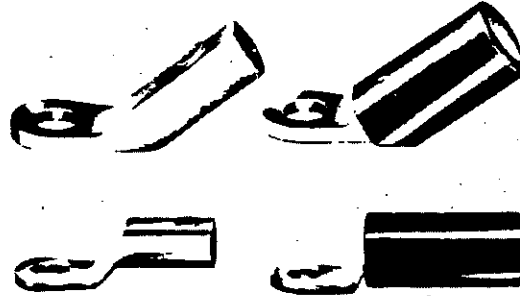




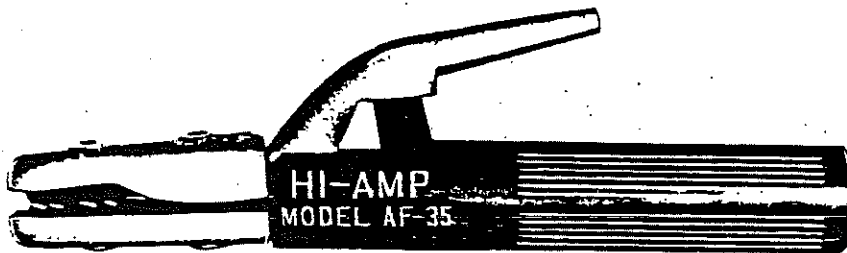
**17**

**CLAMPS  
CABLE LUGS, ETC.**

NAME: \_\_\_\_\_  
CLASS OR PERIOD: \_\_\_\_\_  
DATE OF INSTRUCTION: \_\_\_\_\_



CABLE LUGS



ELECTRODE HOLDER



GROUND CLAMP



CABLE CONNECTOR

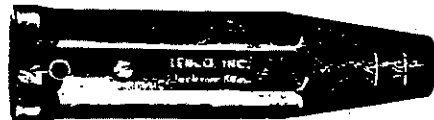
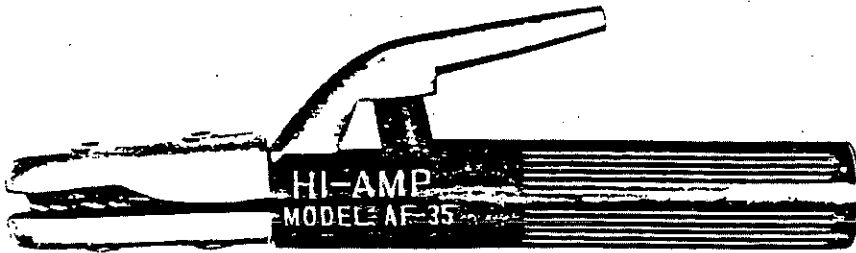
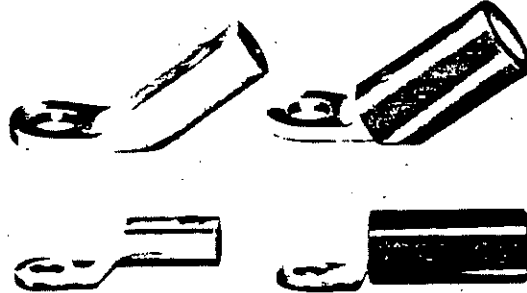
17

CLAMPS  
CABLE LUGS, ETC.

NAME: \_\_\_\_\_

CLASS OR PERIOD: \_\_\_\_\_

DATE OF INSTRUCTION: \_\_\_\_\_



**22****STUDY GUIDE****METAL LATHE SAFETY**

NAME \_\_\_\_\_

BLOCK : \_\_\_\_\_

1. Always wear eye protection. The lathe can throw off sharp, hot metal at high speed that can be quite hazardous.
2. Wear short sleeve shirts. Loose sleeves can catch on rotating work and quickly pull your hand or arm into harm's way.
3. Tuck in your shirt to prevent it from getting caught in the feed and lead screws which are right by your hips.
4. Remove watches, necklaces, chains, rings and other jewellery.
5. Tie back long hair so it can't get caught in the rotating work.
6. Always double check to make sure your work is securely clamped in the chuck or between centers before starting the lathe.
7. Get in the habit of removing the chuck key immediately after use. The chuck key can be a lethal projectile if the lathe is started with the chuck key in the chuck.
8. Keep your fingers clear of the rotating work and cutting tools. This sounds obvious, but often people are tempted to break away metal spirals as they form at the cutting tool.
9. Avoid reaching over the spinning chuck. For filing operations, hold the tang end of the file in your left hand so that your hand and arm are not above the spinning chuck.
10. Before the lathe is turned on rotate the chuck by hand to make sure the jaws of the chuck are not going to hit the tool rest or any other stationary part of the lathe.
11. Keep metal lathe cutting tools sharp. Do not use damaged or broken metal lathe cutting tools.
12. Material that extends more than twice its diameter out of the chuck should be supported on the tailstock.
13. Follow recommended specifications for speeds of rotation and feed and depth of cut for the metal being turned.
14. Do not measure work or attempt to adjust a chuck or work piece while it is rotating. DO NOT attempt to adjust or remove tools when in operation.
15. When finished, clean the metal lathe work area. Use a brush, rather than your fingers or hands, to sweep up waste metal shavings, and cuttings.
16. Use extreme caution if your stock extends through the headstock. Others have been injured by trying to steady the protruding end (don't do this), or by bumping into it accidentally as they pass by.

## Calculating Cutting Speeds

Cutting speeds (CS) are given in feet per minute (fpm), while the work speed is given in revolutions per minute (rpm). Thus, the peripheral speed of the work (CS) must be converted to rpm in order to determine the lathe speed required. The following formula can be used:

$$\text{rpm} = \frac{\text{CS} \times 4}{D}$$

rpm = revolutions per minute

CS = cutting speed of the particular metal being turned in feet per minute

D = diameter of the work in inches

Material to be cut	Roughing cut 0.01" to 0.020" 0.25 mm to 0.50 mm feed		Finishing cut 0.001" to 0.010" 0.025 mm to 0.25 mm feed	
	fpm	mpm	fpm	mpm
Cast iron 70	70	20	120	36
<b>Steel</b>				
Low carbon	130	40	160	56
Medium carbon	90	27	100	30
High carbon	50	15	65	20
<b>Tool steel</b> (annealed)	50	15	65	20
<b>Brass—yellow</b>	160	56	220	67
<b>Bronze</b>	90	27	100	30
<b>Aluminum*</b>	600	183	1000	300

The speeds for rough turning are offered as a starting point. It should be all the machine and work will withstand. The finishing feed depends upon the finish quality desired.

\* The speeds for turning aluminum will vary greatly according to the alloy being machined. The softer alloys can be turned at speeds upward of 1600 fpm (488 mpm) roughing to 3500 fpm (106 mpm) finishing. High silicon alloys require a lower cutting speed.

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## TEST

### SHEET METAL MACHINES

NAME: \_\_\_\_\_

BLOCK: \_\_\_\_\_

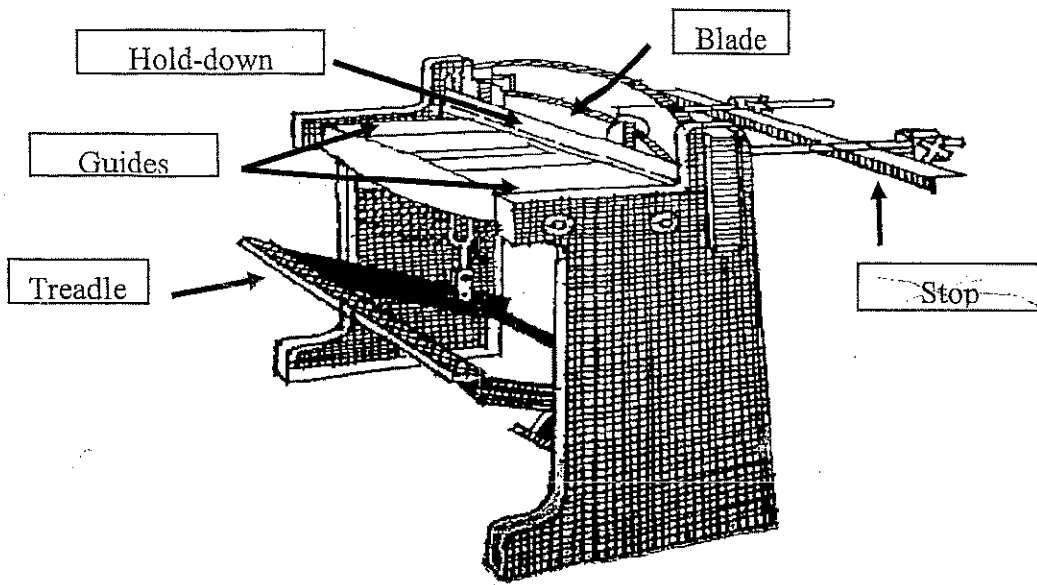
#### Foot Shear

#### Box and Pan Brake

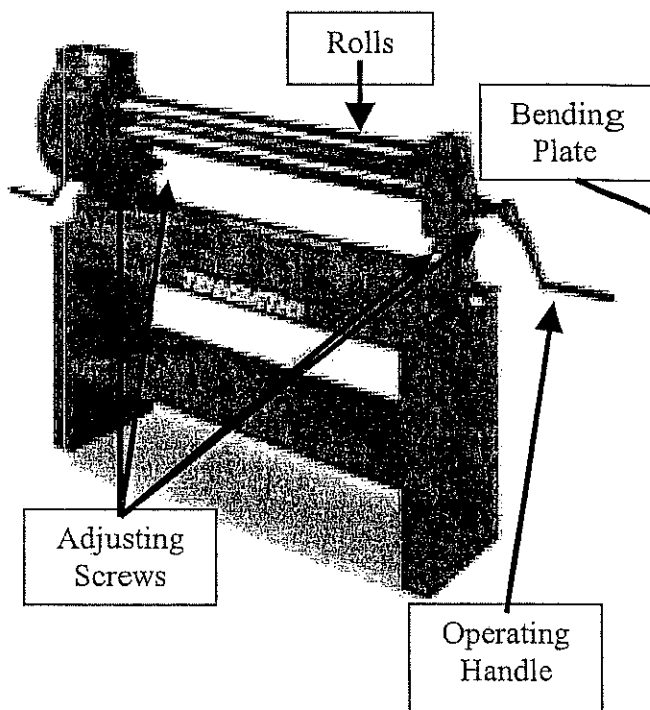
#### Slip Roller

1. Obtain permission from the instructor before operating any machinery.
2. Feed and operate from the front or operator's position. Never operate when someone else is behind the shear.
3. Keep your fingers at least 4" away from the hold-down guard and blade.
4. Keep the shear table free of loose tools and materials.
5. Don't place your feet under the treadle. Keep feet clear of the foot pedal.
6. Whenever 2 people are needed, one shall be the operator, the other the helper.
7. Cut only sheet metal, wire will ruin the blade.
8. Allow pieces to drop; don't try to catch them.
9. Wear gloves when handling large pieces of sheet metal.
10. Never bend, roll, crimp metal that exceeds the capacity of the machine. Use only sheet gauges the machine is designed to work with.
11. Keep hands and fingers clear of clamps, jaws, and rotating parts.
12. Make all rolls and bends with even pressure and steadily.
13. Work with only one piece of metal at a time.
14. Remove burrs from the metal before attempting to work it in the machine.
15. Obtain help when working large pieces of stock.
16. Never force levers or handles.

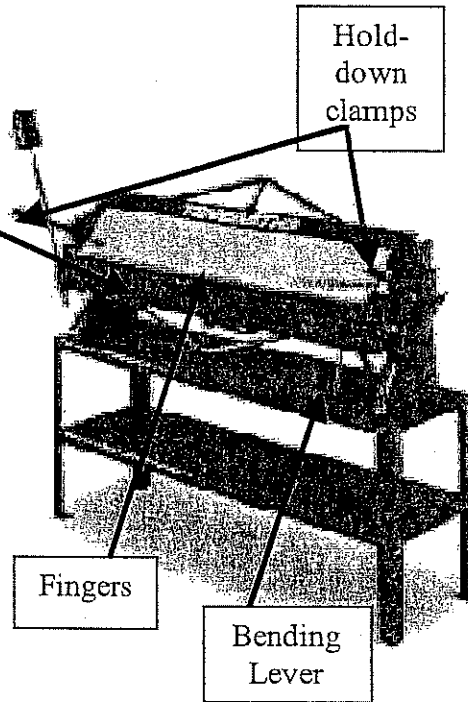
## FOOT SHEAR



## SHEET METAL ROLLER (SLIP ROLL)



## BOX AND PAN BREAK



**25**

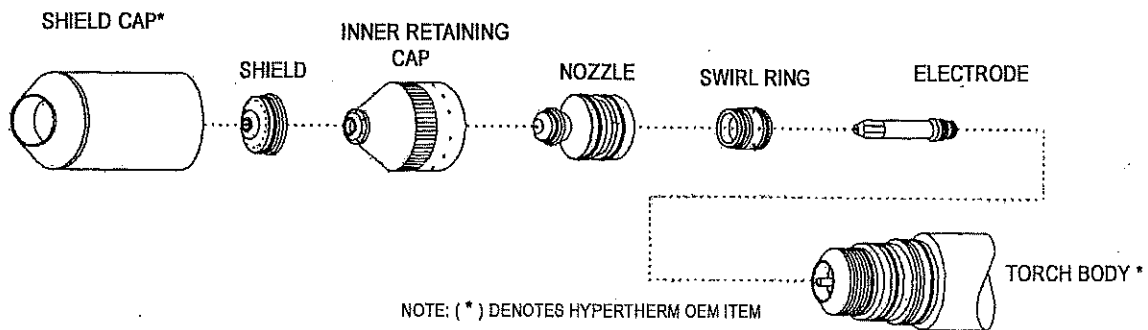
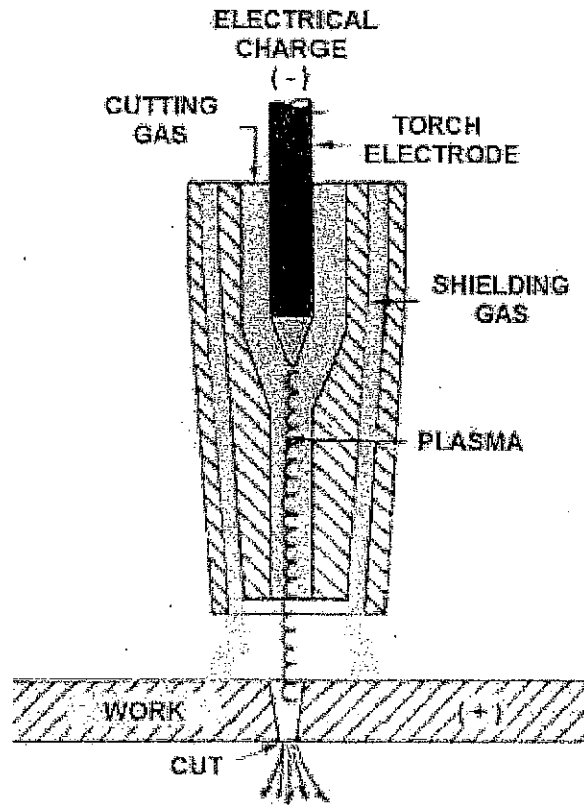
## **SAFETY RULES**

### **Plasma Cutter**

**NAME:** \_\_\_\_\_

**BLOCK:** \_\_\_\_\_

1. Ask your instructor for permission before you use the plasma cutter.
2. The plasma cutting arc creates hot sparks which can cause a fire or a burn. Protect yourself by wearing flame-resistant jackets, aprons and gloves.
3. Wear eye protection with the correct filter lenses and only work behind safety screens.
4. The area needs to be well ventilated to protect you from harmful fumes and gases.
5. Point the torch tip away from your body and toward the work piece. Never point it at yourself
6. Remove all flammable materials from the work area.
7. Don't cut containers that have held any chemicals.
8. Check the cables to make sure they don't have tears, holes, rips or cracks.
9. Only plasma cut while standing on a dry surface. Water and electricity don't mix.
10. Never put your hand in the path of a cut. Keep your hands away from the tip. Touching live electrical parts can cause fatal shocks or severe burns
11. Turn off or disconnect the power when changing the tips, electrodes, or heat shields.
12. Use clamps to hold your work in place. Don't attempt to catch any falling pieces.
13. Double-check that the ground clamp is in place but don't put it on the part that will fall.
14. Remove lighters or matches from your pockets.
15. After cutting parts will be hot. Use pliers and gloves.
16. Don't leave things that are hot lying around where someone might touch them.



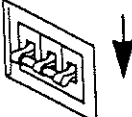








# WARNING:


## OPERATION

### INSTALLING TORCH CONSUMABLES

		<b>WARNING</b> <b>INSTANT-ON TORCHES</b> <b>PLASMA ARC CAN CAUSE INJURY AND BURNS</b>
		Plasma arc comes on immediately when the torch switch is activated. The plasma arc will quickly cut through gloves and skin. Make sure power is off before changing consumables.

		<b>WARNING</b> <b>INSTANT-ON TORCHES</b> <b>PLASMA ARC CAN CAUSE INJURY AND BURNS</b>
Plasma arc comes on immediately when the torch switch is activated. The plasma arc will quickly cut through gloves and skin.		<ul style="list-style-type: none"><li>• Keep away from the torch tip.</li><li>• Do not hold the workpiece, and keep your hands clear of the cutting path.</li><li>• Never point the torch toward yourself or others.</li></ul>

		<b>WARNING</b> <b>SPARKS AND HOT METAL CAN INJURE EYES AND BURN SKIN</b>
When firing the torch at an angle, sparks and hot metal will spray out from the nozzle. Point the torch away from yourself and others.		

	<b>NOISE CAN DAMAGE HEARING</b>
Prolonged exposure to noise from cutting or gouging can damage hearing.	
<ul style="list-style-type: none"><li>• Use approved ear protection when using plasma system.</li><li>• Warn others nearby about the noise hazard.</li></ul>	



## PLASMA ARC CAN CAUSE INJURY AND BURNS

### Instant-On Torches

Plasma arc comes on immediately when the torch switch is activated.

The plasma arc will cut quickly through gloves and skin.

- Keep away from the torch tip.
- Do not hold metal near the cutting path.
- Never point the torch toward yourself or others.



## ARC RAYS CAN BURN EYES AND SKIN

**Eye Protection** Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.

- Use eye protection in accordance with applicable national or local codes.
- Wear eye protection (safety glasses or goggles with side shields, or a welding helmet) with appropriate lens shading to protect your eyes from the arc's ultraviolet and infrared rays.

**Skin Protection** Wear protective clothing to protect against burns caused by ultraviolet light, sparks and hot metal.

- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.

**Arc Current**  
Up to 100 A  
100-200 A  
200-400 A  
Over 400 A



Lens Shade	
AWS (USA)	ISO 4850
No. 8	No. 11
No. 10	No. 11-12
No. 12	No. 13
No. 14	No. 14

**Cutting Area** Prepare the cutting area to reduce reflection and transmission of ultraviolet light:

- Paint walls and other surfaces with dark colors to reduce reflection.
- Use protective screens or barriers to protect others from flash and glare.
- Warn others not to watch the arc. Use placards or signs.



## GROUNDING SAFETY

**Work Cable** Attach the work cable securely to the workpiece or the work table with good metal-to-metal contact. Do not connect it to the piece that will fall away when the cut is complete.

**Work Table** Connect the work table to an earth ground, in accordance with appropriate national or local electrical codes.

### Input Power

- Be sure to connect the power cord ground wire to the ground in the disconnect box.
- If installation of the plasma system involves connecting the power cord to the power supply, be sure to connect the power cord ground wire properly.
- Place the power cord's ground wire on the stud first, then place any other ground wires on top of the power cord ground. Fasten the retaining nut tightly.
- Tighten all electrical connections to avoid excessive heating.

## COMPRESSED GAS EQUIPMENT SAFETY

- Never lubricate cylinder valves or regulators with oil or grease.
- Use only correct gas cylinders, regulators, hoses and fittings designed for the specific application.
- Maintain all compressed gas equipment and associated parts in good condition.
- Label and color-code all gas hoses to identify the type of gas in each hose. Consult applicable national or local codes.

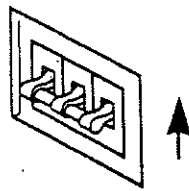


## GAS CYLINDERS CAN EXPLODE IF DAMAGED



Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.



- Handle and use compressed gas cylinders in accordance with applicable national or local codes.
- Never use a cylinder that is not upright and secured in place.
- Keep the protective cap in place over valve except when the cylinder is in use or connected for use.
- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use a hammer, wrench or other tool to open a stuck cylinder valve.



**TURN ON POWER**



①  Position the power switch to ON.



**CHECK INDICATOR LIGHTS**



①   Check that the POWER ON lamp is illuminated.

  Check that the OK lamp is illuminated.

②   Check that the remaining indicator lamps are **NOT** illuminated.

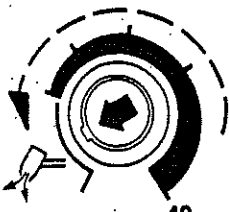
 


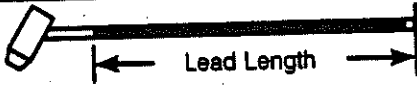
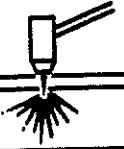

 

See Section 5 for details.

**ADJUST GAS PRESSURE AND CURRENT SETTING**


①  Turn the current adjustment knob to the gas test setting.

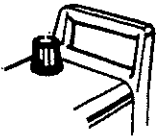
②    

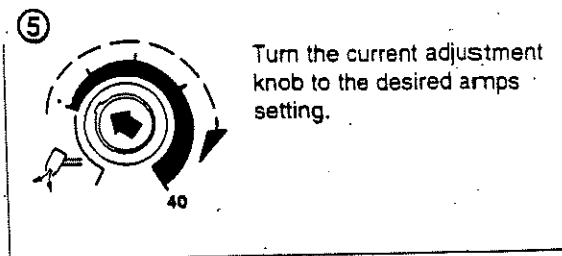
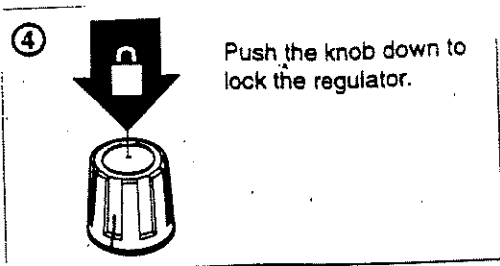
	15 ft 4.5 m	25 ft 7.5 m	50 ft 15 m
	72 psi 5.0 BAR	72 psi 5.0 BAR	78 psi 5.4 BAR
	50 psi 3.4 BAR	55 psi 3.8 BAR	60 psi 4.2 BAR

PHX600.18

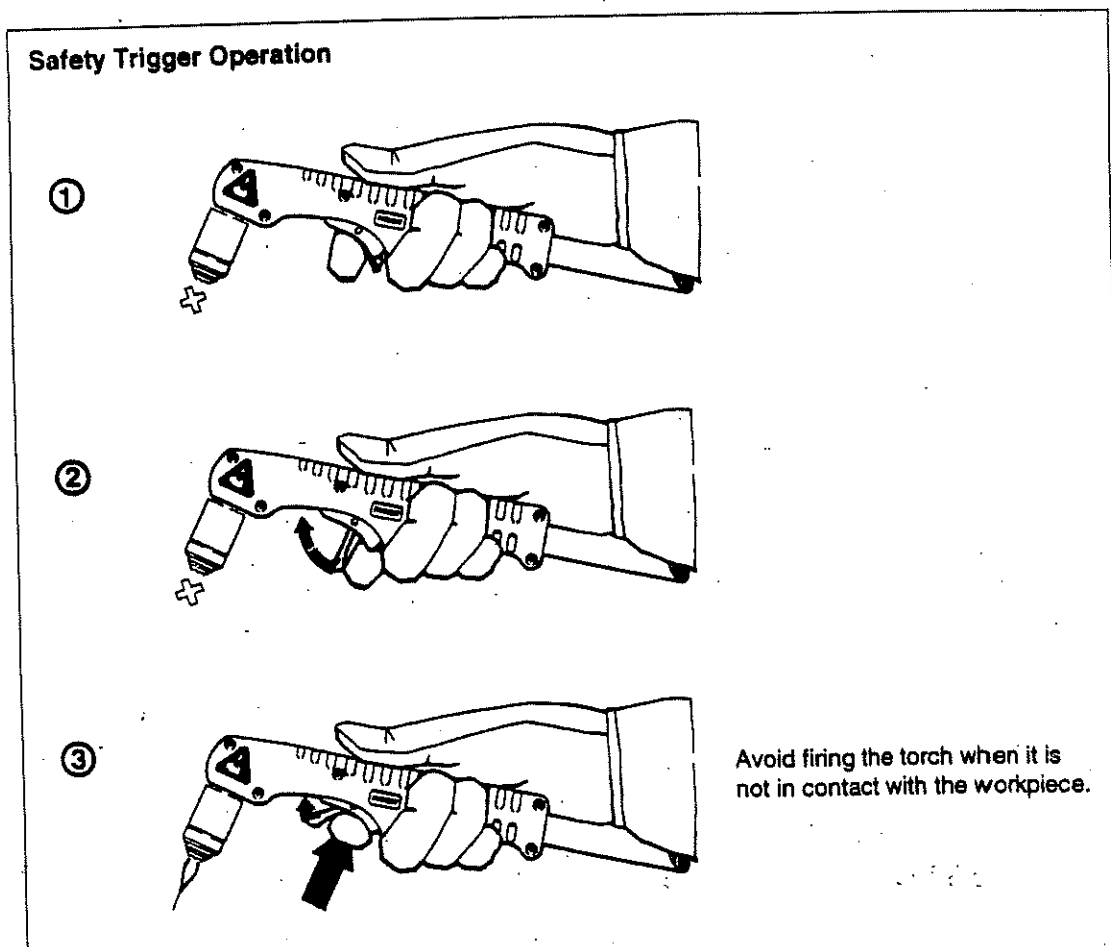
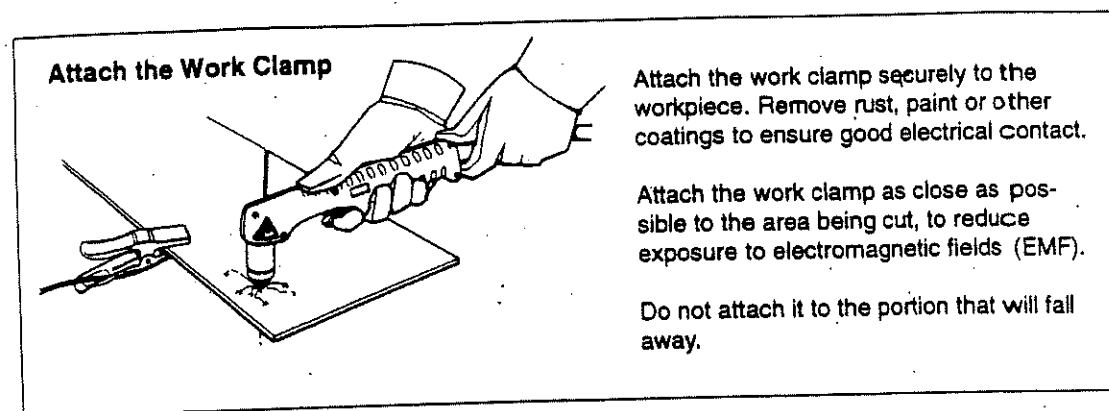
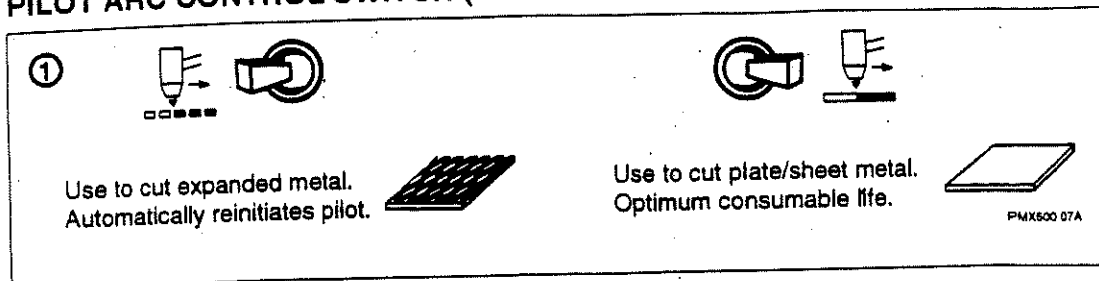
- Look at the pressure gauge and check that the correct gas pressure is set.
- If the correct gas pressure is set, proceed to ⑤.
- If the gas pressure requires adjustment, proceed to ③.

③  Pull the regulator knob up to unlock.

 Turn the regulator knob to obtain the correct pressure.

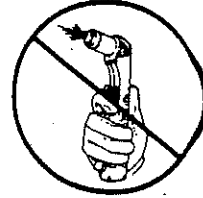


### PILOT ARC CONTROL SWITCH (208-240/480 VOLT ONLY)

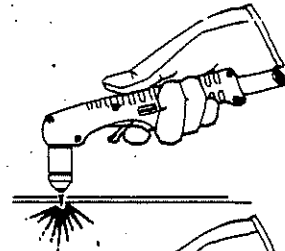


## Hand Torch Cutting Technique

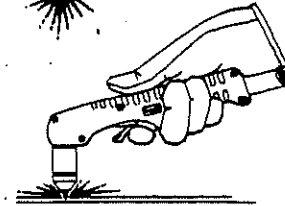
Firing the torch unnecessarily reduces nozzle and electrode life.



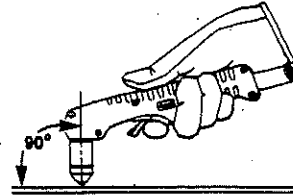
When cutting, make sure that sparks are exiting from the bottom of the workpiece.



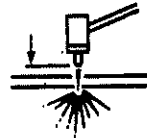
If sparks are spraying up from the workpiece, you are moving the torch too fast, or without sufficient power.



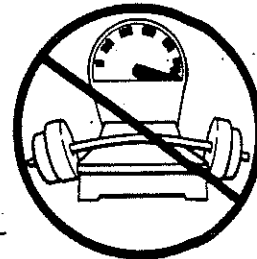
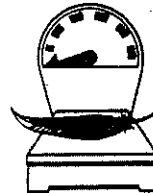
Hold the torch nozzle at a vertical position and watch the arc as it cuts along the line.



**Unshielded Consumables.** Maintain an approximate 1/16 inch / 1.5 mm torch-to-work distance.

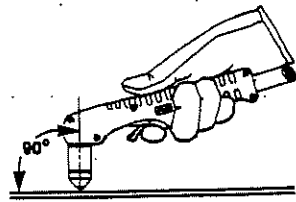


**Shielded Consumables.** Do not push down on the torch when cutting. Lightly drag the torch across the workpiece to maintain a steady cut.

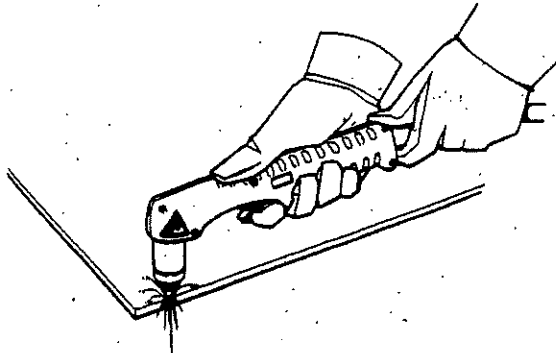


- Pulling the torch through the cut is easier than pushing it.
- To cut thin material, reduce the amps until you get the best quality cut.
- For straight-line cuts, use a straight edge as a guide. To cut circles, use a template or a radius cutter attachment.

Starting a Cut from the Edge of the Workpiece

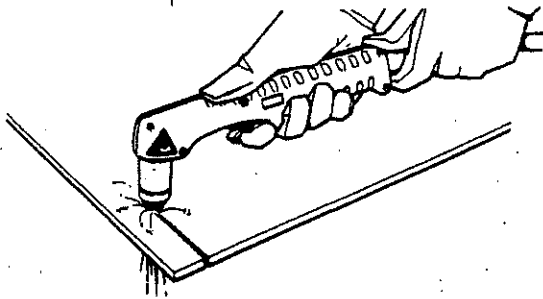


Hold the torch nozzle vertical at the edge of the workpiece.



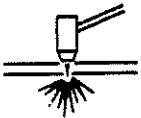
Start cutting from the edge of the workpiece.

Pause at the edge until the arc has completely cut through the workpiece.

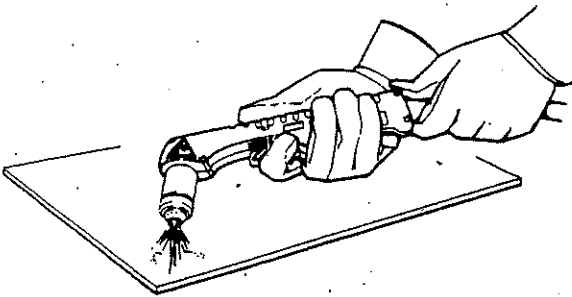


Then, proceed with the cut.

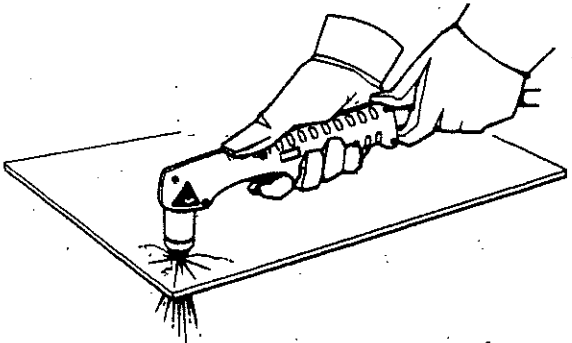
Piercing



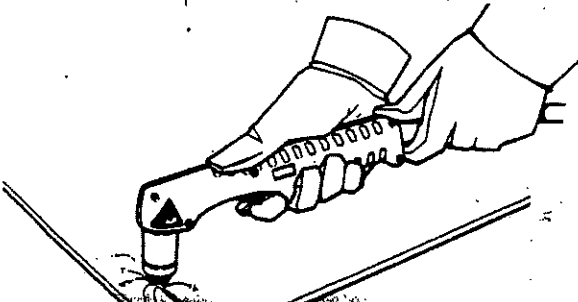
Hold the torch so that the nozzle is within 1/16 inch / 1.5 mm from the workpiece before firing the torch.



Fire the torch at an angle to the workpiece, then slowly rotate it to an upright position.



When sparks are exiting from the bottom of the workpiece, the arc has pierced through the material.



When the pierce is complete, proceed with the cut.

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## STUDY GUIDE

### METAL POWER SAWS

NAME : \_\_\_\_\_

BLOCK : \_\_\_\_\_

1. Disconnect the power when fixing the saw or replacing blades.
2. Check that the blade is in good condition.
3. Ensure that blade speed, tension and tracking are properly adjusted.
4. Adjust the arm guide rollers as close as possible to the stock.
5. The blade guide must be set to just clear the top of the work piece.
6. Be sure the coolant is flowing over the stock.
7. Keep the floor free of coolant-water and metal.
8. Clamp work piece firmly into the vice.
9. Long material must be supported. Supports for long stock should be no higher than the vise to prevent pinching the blade.
10. Adjust blade guards to cover unused portion of blade.
11. Ensure hands are away from the blade, and then turn the machine on. Use a stick, block of wood or a machine vise to feed the work piece into the saw.
12. Allow the upper head assembly to come down slowly until the teeth are cutting the material.
13. Turn off the machine if the blade is to be lifted out of an uncompleted or jammed cut. Never adjust the metal cutting band saw while it is running.
14. Wait until the blade stops completely before removing scrap pieces.
15. Stop the saw immediately if the blade develops a 'click'.
16. Chatter is a sign that something is loose, or speeds/feeds are excessive.
17. If the saw cuts too slowly or binds, replace the blade; never push down on the cutting head while it is cutting.
18. Never leave the saw unattended while in operation.

