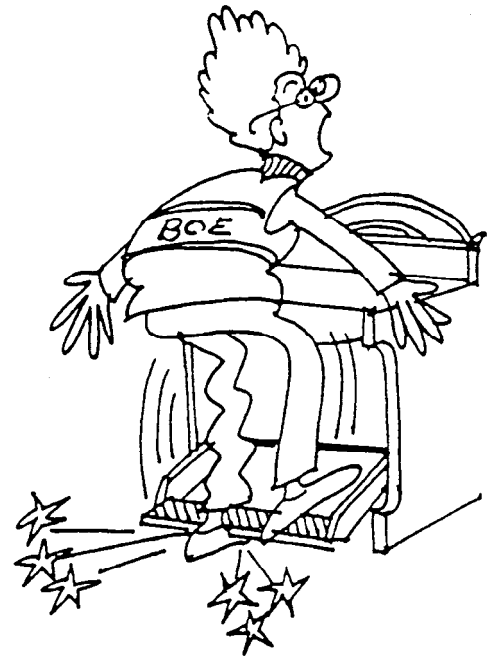
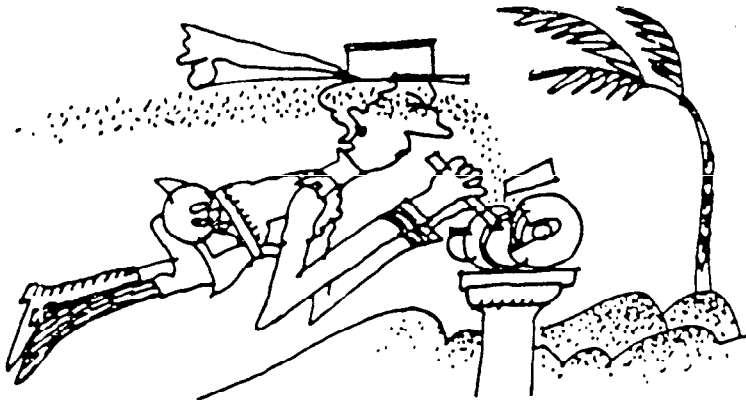


# Manufacturing Technologies



# Technology Education Safety Procedures and Recommendations For all Metals Classes

## Safety Pledge:

Read and discuss rules, have students and their parents sign the safety pledge. Students will return the pledge signed by parent we will then keep the pledge on file while the student is enrolled in Technology Education classes.

## General Safety:

Discuss general safety rules applicable to any shop or lab.

## Hand Tool Safety:

Discuss and demonstrate proper use of common hand tools used in the lab or shop.

## Machine Tool Safety:

Discuss and demonstrate key features, adjustments, purpose and safety concerns of the machines utilized in the course they are enrolled in. The class includes, but is not limited to, the following machines and power tools:

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> Pedestal grinder   | <input type="checkbox"/> Angle iron bender          | <input type="checkbox"/> Cornice break    |
| <input type="checkbox"/> Squaring shear     | <input type="checkbox"/> Spot welder                | <input type="checkbox"/> Barfolder        |
| <input type="checkbox"/> Ironworker         | <input type="checkbox"/> Box and panbrake – Whitney | <input type="checkbox"/> Vertical bandsaw |
| <input type="checkbox"/> Horizontal bandsaw | <input type="checkbox"/> Box and [an brake – Pexto  | <input type="checkbox"/> Drill press      |
| <input type="checkbox"/> Edwards shear      |   | <input type="checkbox"/> Abrasive chopasw |

## Guiding Principles for Metals

1. Safety glasses
  - add side shields to prescription glasses
  - safety glasses & goggles are meant to fit over prescription glasses
2. Clothing
  - covered footwear – no sandals or open toed shoes
  - remove baggy clothing, jewelry, etc.
  - wear appropriate clothes for the activity, i.e. no synthetics during welding, sweaters should be avoided, etc.
3. Proper behavior is mandatory.
4. Students will not use equipment without proper instruction or permission.

Students will be evaluated by tests and quizzes, performance evaluations, and observation by the instructor.

## Machine Tool List

This list is not exhaustive. Equipment and capacities may vary by school/lab.

### Pedestal Grinder

Equipment needed: wheel dresser

- Inspect wheel for voids/cracks . If voids/cracks are present, don't use
- Don't use if wheel is less than 1/2 orig. diameter
- Tool rest adjusted to 1/8" or less
- Tongue guard adjusted to 1/4" or less
- Use face shield & ear muffs
- Stand to side of wheel when starting/allow mach. to come to full speed before grinding
- Grind steel, sand aluminum
- Don't grind on side of wheel
- Use locking pliers for small parts
- Use the tool rest - start slow - work upwards
- Don't leave machine unattended while running
- Use a rotary wheel dresser or diamond tip wheel dresser to clean and true the wheel

### Squaring Shear

Equipment needed: 16 ga. Metal piece to square

- Capacity - Max. 16 ga. steel
- Minimum length = 4"
- Some metal may require helpers , but there is only one operator
- Foot pedal - Be careful of feet under the pedal!!
- Show hold down clamp, blade, back gauge

### Ironworker

- Capacity 35 tons = 3/8" mild steel x 14"; 1/2" x 10"; 5/8" x 6"
- Always check capacity chart
- Minimum length = 4"
- ALWAYS USE HOLD DOWN CLAMP!**
- Make sure no one is leaning on the machine when in use.

### Horizontal Bandsaw (Dry cutting)

- Capacity 7" x 11" @ 90 degrees, 5" x 6" @ 45 degrees
- Minimum length = 6" piece still in vise when finished cutting
- Check for proper blade - 3 teeth rule.
- Always clamp work ( note: Clamp screw works backwards) - show speed unloader
- Adjust the guide rollers/blade guide.
- Saw shuts off automatically

### **Edwards Shear**

- Capacity 3" x 1/2" flat; 7/8" squares, 1" rounds, 1/2" chain

### **Angle Iron Bender**

- Capacity 2" x 2" x 1/4"

### **Spotwelder**

- Capacity 3/16 total thickness
- Must have at least 2 thicknesses of metal
- Be sure to turn the pump on
- Set timer at 10 for 24 ga. CRS

### **Box and Pan Brake - Whitney**

- Capacity 20 ga.

### **Box and Pan Brake - Pexto**

- Capacity 16 ga.

### **Cornice Brake**

- Capacity 14 ga.

### **Barfolder**

- Capacity 24 ga. CRS

### **Vertical Bandsaw**

- Keep fingers and thumbs at least 2" away from blade

### **Drill Press**

- Swing of drill press #1 = 21", #2 = 15"
- Use a drill gauge to check for bit size
- Use a sharp bit
- Tighten all 3 holes in the 3 jaw chuck
- Match drill speed to drill
- Do not leave the key in the chuck!
- Center punch holes before drilling
- Start the drill press and adjust the speed while the machine is running
- Feed the bit at a constant rate
- Use oil as needed

## **Abrasive Chopsaw**

- Capacity @ 90 degrees = 5" pipe, 4.5" square tube, 4.5" x 6" rectangular tube, 5.5" angle
- Minimum length of the piece remaining in the vise after the cut = 6"
- Inspect the blade for nicks/voids/cracks
- Clamp work securely
- Let blade come to full speed
- Ease blade into work material

## **Topics that will require discussion...**

Slip roller

Mills

Disk sander

Surface grinder

Lathes

Vertical belt sander

Welding

- Oxy –cutting, welding
- Arc (S.M.A.W.)
- MIG (G.M.A.W.)
- TIG (G.T.A.W.)
- Plasma

Portable grinders/sanders

Throatless/Beverly shear

Hydraulic benders/Brake/Press brake

Bender/Hossfeld/Di-Acro

Manual/hydraulic square shear

Tank storage

Wire wheel/buffer

Liquids

- Thinners
- Solvents
- Paints
- Adhesives
- Petroleum products

# GENERAL SAFETY PRACTICES

## Shop Behavior

1. "Horse-play", running and the throwing of objects are dangerous practices in any shop and are forbidden at all times, and could cause dismissal from class.
2. Caution other students if you see a violation of a safety rule.
3. When using machines or hand tools, give the job at hand all of your attention.
4. Cooperate with your classmates in the student management program of your shop.
5. Each student is responsible for helping in shop cleanup.

## Clothing

6. Loose clothing, jewelry, and gloves are not to be worn while you are working with power tools.
7. Sharp, pointed tools or materials are not to be carried in clothing, Hold sharp points and sharp edges down.
8. Keep hair away from equipment in operation. Long hair must be tied up and back.

## Safety Glasses

9. Safety glasses must always be worn while working or watching others work in the shop.
10. Eye glasses must not be used in place of goggles or face shields, unless they have tempered lenses.
11. Face Shields must be used when using abrasive machines.
12. When compressed air is used for cleaning. wear eye protection. Take care to direct chips, shavings, and dust away from other students. NEVER ALLOW THE STREAM OF AIR TO COME IN CONTACT WITH YOUR BODY.

## Approval

13. Students are to operate only those machines for which they have received instruction and permission to operate.
14. When in doubt, ask your teacher. Do not depend upon the advice of another student.
15. Never operate power machines when the instructor is not in the shop.
16. Ask your teacher to approve all projects you plan to do.
17. All special setups must be checked by the teacher before the power is turned on.
18. Repairs are to be made on shop equipment only when permission has been given. Do not tamper with shop equipment.

### Safety Zones

20. Observe safety zones. Only the operator and teacher are permitted within the working area around a machine.
21. Don't lean on the machine. Stand clear
22. Disturbing another student while he is working is a dangerous practice.

### Unsafe Shop Conditions

23. If equipment is not working properly, shut it off and tell the teacher at once.
24. Report to the teacher all breakage or damage to tools, machinery, or equipment.
24. Guards and other safety devices are for the protection of the operator and must always be in place.
25. Keep floors, aisles, and passageways clear of stock, tools, and materials.
26. Wipe up immediately any liquids spilled on the floor.
27. Keep tools and materials from projecting over the edge of benches whenever possible.
28. A student who sees a dangerous situation must report it at once to the teacher.
29. The motion involved in striking or cutting must be done in a direction away from you and other students.
30. Compressed air should not be used to clean off machines, because it may cause damage to bearing surfaces.

### Electrical

31. The main power switches in the shop must be turned "on" or "off" ONLY by the teacher
32. Make certain your hands are completely dry before touching electrical switches, plugs, or receptacles.

### Fire

33. Oily or paint-filled rags must be placed in a covered metal container. Oily and greasy shop clothing must be stored in lockers. Never roll them up,
34. Gasoline, chemicals, kerosene, paints, lacquer, thinner, and other finishes or cleaning materials are to be used in a well-ventilated room; They are never be used near an open flame.
35. Never use water to put out an electrical or oil fire.
36. In case of fire in the shop:
  - a. Sound the alarm: FIRE!!!!
  - b. Turn off all electricity:
  - c. Put the fire out, if possible without injuring oneself.
37. Nothing shall be hung on fire extinguishers, and the area around them must be kept clear so that they may be reached without delay if fire breaks out.

### Injury

38. Every injury, no matter how slight, must be reported immediately to your teacher. Explain how it happened.
39. Lifting heavy objects may result in injury. Lift properly or get help, if necessary.

### Hand Tools

40. Be sure your hands are as free as possible of dirt, grease, and oil when using tools.
41. Use the proper type and size hand tool for the job.
42. Make sure that the tools you are going to use are sharp and in good condition.

43. Handle edged or pointed tools with care.
44. When using a sharp-edged tool, make sure the edge is pointed away from you and your classmates.
45. Clamp small work on a bench or in a vise when using a cold chisel, a hacksaw, or a screwdriver.
46. Never use a chisel, or punch, or hammer with a "mushroomed" head. Chips may fly off and injure someone.
47. Never use a file without a handle. - Be sure that the handle is properly secured to -the file.
48. Files are hard and brittle. They may break and cause an injury if they are used as a pry bar or a hammer.
49. Pass tools to classmates with the handles first.

### Machine Tools

50. Before operating a machine, you must pass the appropriate safety test.
51. Obtain permission from your teacher before using any power equipment.
52. Check all adjustments before starting a machine.
53. Make sure everyone is clear of the machine before starting it.
54. All necessary guards must be in place before using a machine.
55. Only one person may operate a machine at a time.
56. Only one operator should start the machine.
57. Remove all tools, materials, and rags from the machine before starting it.
58. Have the instructor check all special setups and new operations before -turning on the machine.
59. Think about your job while operating a machine. It is dangerous to talk when you are using power equipment.
60. The machine should be completely stopped with the power OFF prior to cleaning, oiling, or repairing. Always turn the power off before leaving a machine.



## Bench Metal Machines Safety Practices

### Horizontal Band

1. Cut no metal under six inches long and 3/8 of an inch thick.
2. Support ends of long pieces.
3. Be sure your work is clamped firmly before starting the saw.
4. When starting, stand to one side of the saw frame.
5. Never put extra pressure on the saw blade.
6. Turn power off before leaving machine.

### Drill Press

7. Be sure your cutting tool is sharp.
8. The cutting tool must be tight in the chuck.
9. Remove the chuck key or drift pin as soon as you finish using it.
10. Always use a vise or other clamping devices to hold your work.
11. Keep your hands away from the turning spindle.
12. Ease up on the pressure when the cutting tool starts to break through the material.
13. Back the cutting tool out, under power, as soon as the hole is drilled.
14. Wait until the cutting tool stops before brushing off chips or removing your work.
15. All special attachments must be checked by the instructor. (flycutter, hole-saws, long drills, etc.)
16. Long pieces should be always be on the left side of the drill press column.
17. Make adjustments only when the power is turned off.

### Portable Electric Drill

18. Be sure the switch is in the "off" position before plugging in the electric cord.
19. Hold the machine firmly.
20. Apply straight and steady pressure on the drill.
21. Make sure the drill comes to a complete stop - then rest it on its side.

### Drill Press

22. See that all guards are in place.
23. The tool rest must always be set as close as possible to the grinding wheel, no greater than 1/8".
24. Always wear a face shield when grinding.
25. Report a cracked or broken wheel to the instructor at once.
26. Keep rags away from the grinder.
27. Do not grind sheet metal on the grinder.
28. Get special permission from your instructor before grinding small objects.
29. Wait until the motor has reached full speed before grinding.
30. Never stand directly in front of the wheel.
31. Always keep your hands away from the grinding machine.
32. Hold your work so it will not be pulled out of or pushed into your hands.
33. Always hold large objects firmly against the tool rest.
34. Use the face of the wheel for grinding, never the side.
35. Keep work in motion across the face of the wheel.
36. Turn the power switch off after using the grinder.

### Buffer and Wire Wheel

37. Obtain permission before using the buffer.
38. Remove sweaters and jewelry and roll up your sleeves before operating the buffer.
39. Keep rags away from the wheel.
40. Always wear a face shield when using the buffer.
41. Hold work with both hands.
42. Stand to one side of the wheel.
43. Keep your hands away from the wheel.
44. Buff on the LOWER FRONT QUARTER of the wheel .
45. Buff flat pieces from the center towards the lower edge.
46. Always keep sharp edges pointed down.
47. Use the correct pressure against the wheel .
48. Turn off the power after using the machine.

### Sanding Machines

49. Always wear a face shield when using the sanding machine.
50. Do not use the sanding machine if the abrasive material is torn.
51. Work to be sanded must be held securely in both hands.
52. Keep fingers away from the abrasive material.
53. Feed stock into the moving abrasive with moderate pressure.
54. Use special care in sanding small or irregular pieces. (Check with instructor).
55. Sand on downward motion side of the disc sander.
56. Do not sand sheet metal.
57. Do not allow thin pieces of metal to get caught between the moving abrasive and the table.

# Machining Safety Practices

## Lathes

1. Obtain permission from your teacher before using the laths.
2. Roll sleeves above elbows and remove or fasten any loose clothes.
3. Make all adjustments only when the machine is at a complete stop.
4. Check to see that all guards are in place.
5. Be sure that all parts of the carriers will clear rotating parts during full length of cut.
6. Remove chuck key or wrench immediately after using.
7. Set tool on center of work to be turned.
8. Make sure that no one but you is inside the operator's zone.
9. Place your hands on the controls or at your sides except when filing or polishing.
10. Keep hands away from hot chips.
11. Use tools that are properly ground for the particular job.
13. Finish cuts that are close to the chuck or against a shoulder by hand feed.
14. Bring lathe to a complete stop before reversing.
15. Remove toolholder and tool post before filing or polishing.
16. Shut off power after using the lathe and stand by until the machine has stopped.
17. Clean machine and area.

## Between-center Turning Instructions

18. Use a lathe dog to drive the work.
19. Clamp tailstock securely.
20. Adjust and lubricate the tailstock center.

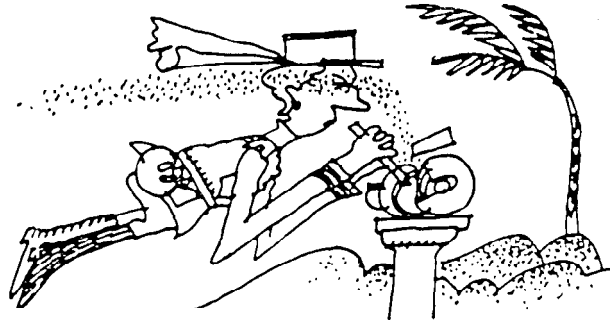
## Chuck and Faceplate Turning Instructions

21. Place a board under the chuck when threading it on or off the spindle. Keep your fingers clear.
22. Secure work firmly in the chuck.
23. Remove chuck key or wrench immediately after use.
24. Turn chuck or faceplate by hand through one full revolution.
25. Stand to one side of revolving faceplate.
26. Stop power feed before tool reaches jaws of chuck.

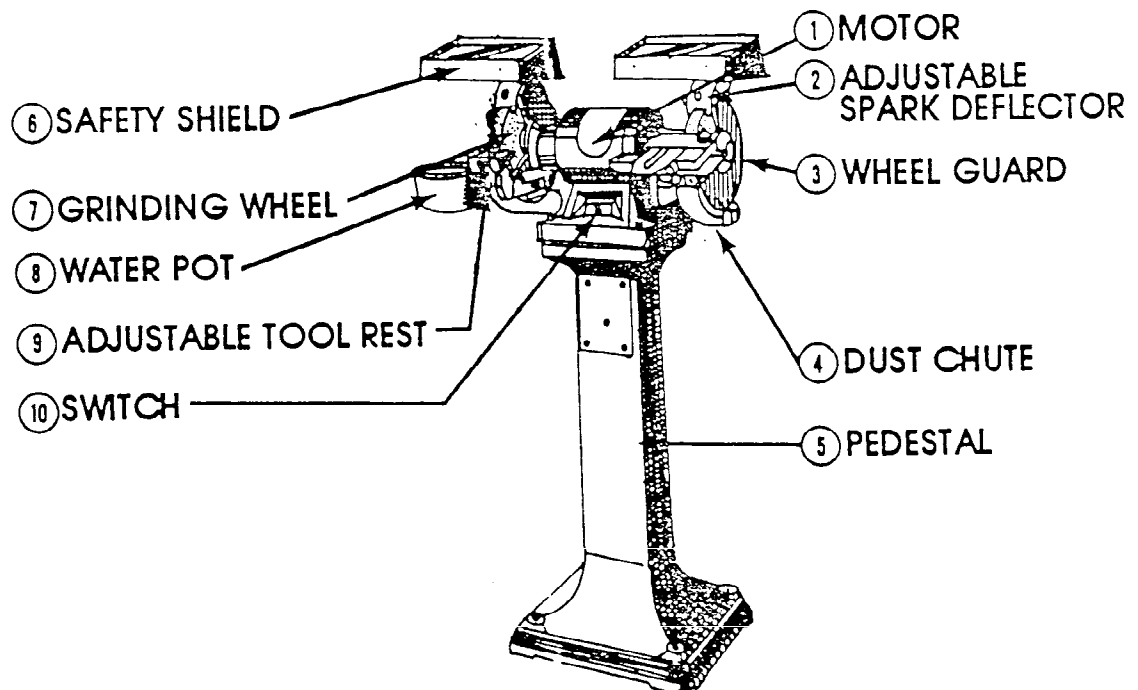
### Milling Machine

27. Obtain permission from your teacher before, using milling machine.
28. Make adjustments or setup only when machine is at a completely stopped. Check with the teacher.
29. Use correct fitting wrenches on machine parts.
30. Handle all cutters carefully.
31. Select the proper cutter; be sure it is sharp.
32. Use only a soft hammer or mallet to seat work against the parallels or the bottom of the vise.
33. Be sure that the job is securely fastened.
34. Set the machine for proper depth of cut.
35. Select the correct feed.
36. Make sure no one but you is inside the operator's zone.
37. Stand to one side of the machine.
38. Be sure that the cutter is turning in the proper direction.
39. Feed against or opposite to the direction or rotation of the cutter.
40. Use a brush to remove chips from the work area when the machine is at rest.
41. Keep the floor clean around the milling machine.
42. Turn off the power after using the milling machine; stop the cutter with the brake.
43. Release all automatic feeds.
44. Clean the machine and the area around it with a brush.
45. Place cutters on a piece of wood when not in use.

## Grinder Safety Practices



1. Eye protection must be worn at all times.
2. All guards must be properly adjusted.
3. The tool rest must be adjusted to no more than 1/8" from the wheel.
4. Do not grind on the side of the grinding wheel.
5. Spark arrestor or top guard must be within 1/8" of the wheel.
6. Small pieces should be held with a "vise grip" type pliers.
7. A wheel that is extensively worn or cracked should be replaced.
8. The glass safety shield should be replaced.
9. Stand to one side when starting the machine.



## Safety Test Grinder

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

### True or False:

- \_\_\_\_\_ 1. The tool rest should be adjusted to within 1/2" of the wheel.
- \_\_\_\_\_ 2. Eye protection is not always necessary when grinding.
- \_\_\_\_\_ 3. Once the OFF switch is in the off position, the operator may leave.
- \_\_\_\_\_ 4. The safety shield should be clean.
- \_\_\_\_\_ 5. Wheels that are out of balance may be used.
- \_\_\_\_\_ 6. The spark arrestor is not necessary if there is a glass safety shield.
- \_\_\_\_\_ 7. When grinding a small piece of steel, "vise grips" are advised.
- \_\_\_\_\_ 8. If there is a glass shield, eye protection is not required.

## Safety Test Grinder (key)

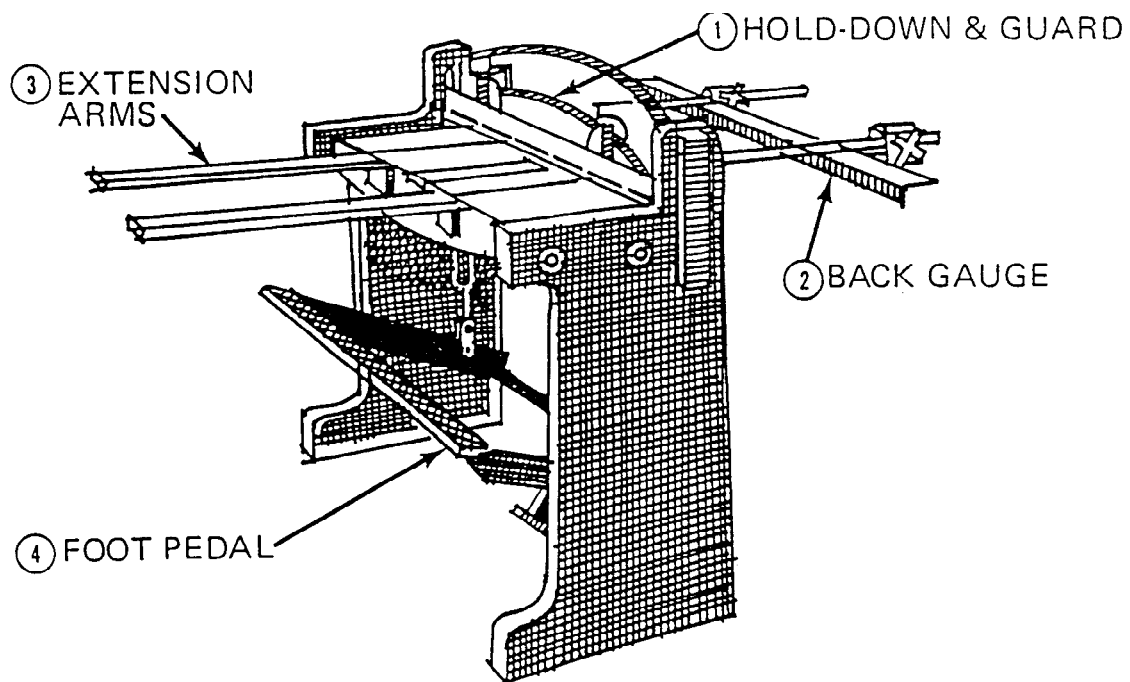
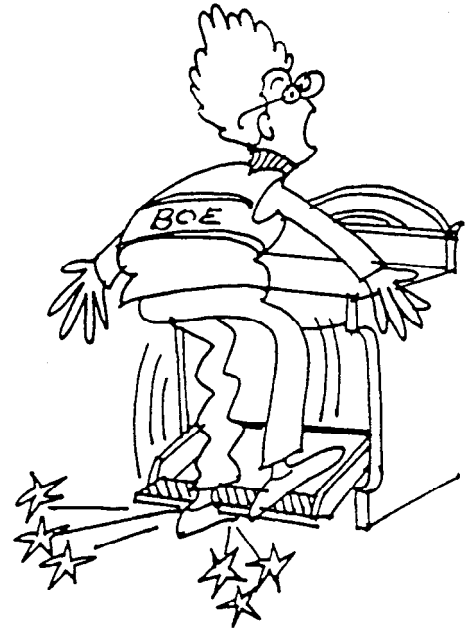
Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

### True or False:

- F \_\_\_\_\_ 1. The tool rest should be adjusted to within 1/2" of the wheel.
- F \_\_\_\_\_ 2. Eye protection is not always necessary when grinding.
- F \_\_\_\_\_ 3. Once the OFF switch is in the off position, the operator may leave.
- T \_\_\_\_\_ 4. The safety shield should be clean.
- F \_\_\_\_\_ 5. Wheels that are out of balance may be used.
- F \_\_\_\_\_ 6. The spark arrestor is not necessary if there is a glass safety shield.
- T \_\_\_\_\_ 7. When grinding a small piece of steel, "vise grips" are advised.
- F \_\_\_\_\_ 8. If there is a glass shield, eye protection is not required.

## Metal Squaring Shear Safety Practices

1. Check set up and machine before operating.
2. Never surpass the capacity of the machine.
3. Feed and operate from the front or operator's position.
4. Always keep your fingers away from the pressure bar and blade, a minimum of 4".
5. Keep the foot that is not being used out from under the treadle.
6. Allow small pieces to drop. Do not attempt to catch them.
7. Remove burrs before working. Gloves or pads are sheet metal, especially large pieces.
8. Place scraps or trimmings in metal waste container normal.
9. Whenever two people are needed to operate the shear, one shall be the operator, the other the helper.





## General Safety Test

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Unit 2, pp. 19-23

1. Why is the proper attitude so important in the shop?
2. Why is there danger in poking a fellow student for fun?
3. Why is it so important to avoid running in the shop?
4. What is meant by personal safety caution?
5. Why is it so important that every injury be reported no matter how slight?
6. What are two possible results of getting something in your eye?
7. Why should you avoid rubbing your eye if you do get something in it?
8. Why is it so important to wash your hands after handling chemicals or before eating?
9. What is the proper way to stand when lifting a heavy object?
10. How should a long object be carried by one man to protect fellow students?
11. How should stock be arranged to minimize danger of its falling?
12. Why is it important that guards be in place and working properly before operating power equipment?
13. What procedure should be followed if a guard is missing?
14. How should tools be stored to minimize hand injuries?
15. What hazard is there in using a steel hammer on hard steel parts?
16. What damage may be caused by using a screwdriver as a pry bar?
17. Why is it important to select the correct screwdriver for the job?
18. What is the disadvantage of an adjustable wrench?
19. What are the three most common cause of hand tool accidents?

\_\_\_\_\_  
Student Signature

### General Safety Test (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Unit 2, pp. 19-23

- Why is the proper attitude so important in the shop?  
**Work safety**
- Why is there danger in poking a fellow student for fun?  
**Students may get hurt**

- Why is it so important to avoid running in the shop?  
**You may fall and get hurt**
- What is meant by personal safety caution?  
**How you handle the machines**
- Why is it so important that every injury be reported no matter how slight?  
**So you get the proper first aid**
- What are two possible results of getting something in your eye?  
**1) blindness      2) partial loss of vision**
- Why should you avoid rubbing your eye if you do get something in it?  
**Pushes object deeper in the eye**
- Why is it so important to wash your hands after handling chemicals or before eating?  
**So you don't ingest them**
- What is the proper way to stand when lifting a heavy object?  
**Knees bent and back straight**
- How should a long object be carried by one man to protect fellow students?  
**Drag one end or get help**
- How should stock be arranged to minimize danger of its falling?  
**Neatly**
- Why is it important that guards be in place and working properly before operating power equipment?  
**So you don't get hurt**
- What procedure should be followed if a guard is missing?  
**Tell the teacher**
- How should tools be stored to minimize hand injuries?  
**Store tools neatly in a tool cabinet, sharp edges away from you**
- What hazard is there in using a steel hammer on hard steel parts?  
**Chips and sparks**
- What damage may be caused by using a screwdriver as a pry bar?  
**It could slip and hurt you**
- Why is it important to select the correct screwdriver for the job?  
**Better fit and won't slip**
- What is the disadvantage of an adjustable wrench?  
**Slip and damage hardware**
- What are the three most common cause of hand tool accidents?  
**1) wrong tool      2) dull tool      3) stupidity**

## Safety Test – Metals

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

- \_\_\_\_\_ 1. For any slight injury one should:
  - a. wrap it with a clean rag.
  - b. report it and have it treated.
  - c. apply turpentine.
  - d. not bother with it if it is small.
  
- \_\_\_\_\_ 2. Whenever there is the possibility of flying chips or grit be sure to:
  - a. turn the head away.
  - b. slow down the machine.
  - c. wear goggles.
  
- \_\_\_\_\_ 3. Oily rags should be:
  - a. kept in lockers.
  - b. placed in a open can.
  - c. put in a disposal can.
  - d. left lying about the shop.
  
- \_\_\_\_\_ 4. The working area around the machine may be occupied by only the operator and :
  - a. his helper.
  - b. an observer.
  - c. no one else.
  
- \_\_\_\_\_ 5. A machine operator's clothing should be:
  - a. protected from dirt.
  - b. loose for freedom of movement.
  - c. snug fitting.
  
- \_\_\_\_\_ 6. If it is necessary to leave a machine on for any reason:
  - a. ask another operator to watch it.
  - b. let it run until you return.
  - c. have the tool crib attendant take over.
  - d. shut off the operating switch.
  
- \_\_\_\_\_ 7. Interfering with or distracting the attention of the operator of a machine may cause him to:
  - a. lose valuable time.
  - b. ruin the job he is working on.
  - c. be caught in the moving machinery.
  - d. ram the work into the cutting tool.
  
- \_\_\_\_\_ 8. Fixed eye shields and guards on the cutting tools offer:
  - a. sufficient eye protection.
  - b. absolute safety to the operator.

- c. a good hand rest for the operator.
- d. inadequate substitute for goggles.

- \_\_\_\_\_ 9. The only persons authorized to start and stop the machine are the instructor and the:
- a. Safe person working on it.
  - b. student's helper.
  - c. tool crib attendant.
  - d. shop foreman.
- \_\_\_\_\_ 10. If the work on the machine becomes loose or jammed, or the machine stalls:
- a. call the instructor immediately.
  - b. quickly unjam the work.
  - c. immediately shut off the operating switch.
- \_\_\_\_\_ 11. Before starting a cut in the horizontal band saw the stock must be:
- a. free of burrs and flashing.
  - b. securely fastened to the vise.
  - c. round or square.
  - d. marked for length.
- \_\_\_\_\_ 12. In order to keep from breaking the blade when starting the cutting operation on the band saw, the:
- a. blade should be touching the stock.
  - b. hands should be kept off the carriage handle
  - c. blade should be at the top position.
  - d. cut should begin gradually.

- \_\_\_\_\_ 13. Using a file without a handle may result in:
- a. difficulty in guiding the file.
  - b. an uncomfortable grip.
  - c. a puncture wound from the pointed end.
  - d. running the file teeth over the hand.
- \_\_\_\_\_ 14. The treadle of the shear can cause serious injury to:
- a. hands place do the side guide.
  - b. the finger, if caught in the spring.
  - c. a foot under it.
  - d. the operator's shin bone.
- \_\_\_\_\_ 15. When working on a wire wheel, buffer or grinder, the operator must wear:
- a. an apron to protect his clothes.
  - b. a cap to keep dangerous grit out of his hair.
  - c. goggles or face shield to protect the eyes.
  - d. gloves as protection from sparks and grit.
- \_\_\_\_\_ 16. Very small work pieces should be:
- a. held in the fingers.
  - b. kept off the grinder.
  - c. gripped tightly with a pliers.
  - d. held only with gloves.
- \_\_\_\_\_ 17. Until the wheel, reaches full operating speed, it is unsafe to stand in:
- a. line with the rotation of the wheel.
  - b. back of the machine.
  - c. front of any grinding machine.
- \_\_\_\_\_ 18. Grinding on the side of a wheel may cause the :
- a. operator to slip and grind his hand.
  - b. grit and chips to go by the eye glass shield.
  - c. work to get hot and burn the fingers.
  - d. wheel to fracture and blow up.

- \_\_\_\_\_ 19. Safety and cleanliness around the machines is the first responsibility of the :
- a. safety foreman.
  - b. machine operator.
  - c. instructor.
  - d. clean-up crew.

True or False:

- \_\_\_\_\_ 21. Small pieces of material can be ground safely on a power grinder if held with the hand firmly.
- \_\_\_\_\_ 22. All injuries must be reported to the shop instructor for first aid attention.
- \_\_\_\_\_ 23. Cutting and sharp layout tools should be carried in the pockets, points down.
- \_\_\_\_\_ 24. Files, because of their length, make good pry bars.
- \_\_\_\_\_ 25. The grinder tool rest may be removed at times to speed your work.
- \_\_\_\_\_ 26. Goggles or face shields must be worn at all times when grinding, drilling, machining or working with molten metals.
- \_\_\_\_\_ 27. A safe habit to develop when starting the grinder is to stand to the side of the wheel.
- \_\_\_\_\_ 28. Small pieces of metal should be cut on the squaring shears.
- \_\_\_\_\_ 29. To speed up machine work, the operator should leave the machine run for the next person to use.
- \_\_\_\_\_ 30. Tossing a tool to a fellow shop student is permissible in this shop.
- \_\_\_\_\_ 31. Doing maintenance or adjusting a machine should never be attempted while the machine is running.
- \_\_\_\_\_ 32. The back pocket of your trousers is a handy and safe place to carry your tools.
- \_\_\_\_\_ 33. When operating a machine, you should shut it down before talking to another person.
- \_\_\_\_\_ 34. Sleeves should be rolled up and any loose clothing removed before operating power machinery.
- \_\_\_\_\_ 35. Shop clean-up is the responsibility of all students in this shop.
- \_\_\_\_\_ 36. Care of tools and equipment is the responsibility of the instructor only.
- \_\_\_\_\_ 37. Filings and metal chips may be removed safely from machines or benches with your bare hands.

\_\_\_\_\_ 38. All machines are designed to be safe to operate. Sometimes we, as operators, cause them to be dangerous by misuse.

\_\_\_\_\_ 39. Defective tools should not be used as they are unsafe.

## Safety Test – Metals (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

- b \_\_\_\_\_ 1. For any slight injury one should:
- a. wrap it with a clean rag.
  - b. report it and have it treated.
  - c. apply turpentine.
  - d. not bother with it if it is small.
- c \_\_\_\_\_ 2. Whenever there is the possibility of flying chips or grit be sure to:
- a. turn the head away.
  - b. slow down the machine.
  - c. wear goggles.
- c \_\_\_\_\_ 3. Oily rags should be:
- a. kept in lockers.
  - b. placed in a open can.
  - c. put in a disposal can.
  - d. left lying about the shop.
- c \_\_\_\_\_ 4. The working area around the machine may be occupied by only the operator and :
- a. his helper.
  - b. an observer.
  - c. no one else.
- c \_\_\_\_\_ 5. A machine operator's clothing should be:
- a. protected from dirt.
  - b. loose for freedom of movement.
  - c. snug fitting.
- d \_\_\_\_\_ 6. If it is necessary to leave a machine on for any reason:
- a. ask another operator to watch it.
  - b. let it run until you return.
  - c. have the tool crib attendant take over.
  - d. shut off the operating switch.
- c \_\_\_\_\_ 7. Interfering with or distracting the attention of the operator of a machine may cause him to:
- a. lose valuable time.
  - b. ruin the job he is working on.
  - c. be caught in the moving machinery.
  - d. ram the work into the cutting tool.
- d \_\_\_\_\_ 8. Fixed eye shields and guards on the cutting tools offer:
- a. sufficient eye protection.
  - b. absolute safety to the operator.



- c. a good hand rest for the operator.
  - d. inadequate substitute for goggles.
- a \_\_\_\_\_ 9. The only persons authorized to start and stop the machine are the instructor and the:
- a. Safe person working on it.
  - b. student's helper.
  - c. tool crib attendant.
  - d. shop foreman.
- c \_\_\_\_\_ 10. If the work on the machine becomes loose or jammed, or the machine stalls:
- a. call the instructor immediately.
  - b. quickly unjam the work.
  - c. immediately shut off the operating switch.
- b \_\_\_\_\_ 11. Before starting a cut in the horizontal band saw the stock must be:
- a. free of burrs and flashing.
  - b. securely fastened to the vise.
  - c. round or square.
  - d. marked for length.
- d \_\_\_\_\_ 12. In order to keep from breaking the blade when starting the cutting operation on the band saw, the:
- a. blade should be touching the stock.
  - b. hands should be kept off the carriage handle
  - c. blade should be at the top position.
  - d. cut should begin gradually.

- c \_\_\_\_\_ 13. Using a file without a handle may result in:
- a. difficulty in guiding the file.
  - b. an uncomfortable grip.
  - c. a puncture wound from the pointed end.
  - d. running the file teeth over the hand.
- c \_\_\_\_\_ 14. The treadle of the shear can cause serious injury to:
- a. hands place do the side guide.
  - b. the finger, if caught in the spring.
  - c. a foot under it.
  - d. the operator's shin bone.
- c \_\_\_\_\_ 15. When working on a wire wheel, buffer or grinder, the operator must wear:
- a. an apron to protect his clothes.
  - b. a cap to keep dangerous grit out of his hair.
  - c. goggles or face shield to protect the eyes.
  - d. gloves as protection from sparks and grit.
- c \_\_\_\_\_ 16. Very small work pieces should be:
- a. held in the fingers.
  - b. kept off the grinder.
  - c. gripped tightly with a pliers.
  - d. held only with gloves.
- a \_\_\_\_\_ 17. Until the wheel, reaches full operating speed, it is unsafe to stand in:
- a. line with the rotation of the wheel.
  - b. back of the machine.
  - c. front of any grinding machine.
- d \_\_\_\_\_ 18. Grinding on the side of a wheel may cause the :
- a. operator to slip and grind his hand.
  - b. grit and chips to go by the eye glass shield.
  - c. work to get hot and burn the fingers.
  - d. wheel to fracture and blow up.

- b \_\_\_\_\_ 19. Safety and cleanliness around the machines is the first responsibility of the :
- a. safety foreman.
  - b. machine operator.
  - c. instructor.
  - d. clean-up crew.

True or False:

- F \_\_\_\_\_ 21. Small pieces of material can be ground safely on a power grinder if held with the hand firmly.
- T \_\_\_\_\_ 22. All injuries must be reported to the shop instructor for first aid attention.
- F \_\_\_\_\_ 23. Cutting and sharp layout tools should be carried in the pockets, points down.
- F \_\_\_\_\_ 24. Files, because of their length, make good pry bars.
- F \_\_\_\_\_ 25. The grinder tool rest may be removed at times to speed your work.
- T \_\_\_\_\_ 26. Goggles or face shields must be worn at all times when grinding, drilling, machining or working with molten metals.
- T \_\_\_\_\_ 27. A safe habit to develop when starting the grinder is to stand to the side of the wheel.
- F \_\_\_\_\_ 28. Small pieces of metal should be cut on the squaring shears.
- F \_\_\_\_\_ 29. To speed up machine work, the operator should leave the machine run for the next person to use.
- F \_\_\_\_\_ 30. Tossing a tool to a fellow shop student is permissible in this shop.
- T \_\_\_\_\_ 31. Doing maintenance or adjusting a machine should never be attempted while the machine is running.
- F \_\_\_\_\_ 32. The back pocket of your trousers is a handy and safe place to carry your tools.
- T \_\_\_\_\_ 33. When operating a machine, you should shut it down before talking to another person.
- T \_\_\_\_\_ 34. Sleeves should be rolled up and any loose clothing removed before operating power machinery.
- T \_\_\_\_\_ 35. Shop clean-up is the responsibility of all students in this shop.
- F \_\_\_\_\_ 36. Care of tools and equipment is the responsibility of the instructor only.
- F \_\_\_\_\_ 37. Filings and metal chips may be removed safely from machines or benches with your bare hands.

T \_\_\_\_\_ 38. All machines are designed to be safe to operate. Sometimes we, as operators, cause them to be dangerous by misuse.

T \_\_\_\_\_ 39. Defective tools should not be used as they are unsafe.

## Safety Test Metal Technology I

### Test A

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

True or False:

#### **General Safety**

- \_\_\_\_\_ 1. Even though you are not working, you must wear safety glasses in the shop when others are working.
- \_\_\_\_\_ 2. Disconnect machines from power before changing blades or bits.
- \_\_\_\_\_ 3. Becoming distracted is the most common cause of injury while using power tools.
- \_\_\_\_\_ 4. If you don't really know how to do something, take your best shot.
- \_\_\_\_\_ 5. Horseplay is allowed if you have all of your work done.
- \_\_\_\_\_ 6. Carrying a sharp tool in your pocket would be considered safe.
- \_\_\_\_\_ 7. Sometimes a job will require two operators to run a machine.
- \_\_\_\_\_ 8. Each student is responsible for himself/herself and those around.
- \_\_\_\_\_ 9. Only major injuries need to be reported to the teacher.
- \_\_\_\_\_ 10. Safety glasses must be worn only when operating electrical machinery.
- \_\_\_\_\_ 11. Report all malfunctions or breakage to the teacher.
- \_\_\_\_\_ 12. It is OK to wear loose and baggy clothing when operating machinery.
- \_\_\_\_\_ 13. If you can't find a chisel or pry bar, you can just use a screw driver instead.
- \_\_\_\_\_ 14. You can operate a machine without the instructor's permission as long as you know how to use it.
- \_\_\_\_\_ 15. It is important to keep a safe distance between your hands and all moving parts of machine.
- \_\_\_\_\_ 16. It is ok to leave a machine running while you get your safety glasses as long as you do it quickly.
- \_\_\_\_\_ 17. Never talk to someone who is operating a machine.
- \_\_\_\_\_ 18. If you can't find a center punch, a scratch awl can be used in its place.
- \_\_\_\_\_ 19. It is O.K. to work with power tools and machines when you're tired.
- \_\_\_\_\_ 20. A clean lab is a safer area to work in.

#### **Ironworker**

- \_\_\_\_\_ 21. It is safe to cut material that is 2" in length
- \_\_\_\_\_ 22. Never hold the material down with your hands, use the hold down clamp instead.
- \_\_\_\_\_ 23. It is important to check the capacity of the machine before attempting to cut a piece of metal.
- \_\_\_\_\_ 24. Our ironworker generates a maximum pressure of 45 tons.

#### **Horizontal Bandsaw**

- \_\_\_\_\_ 25. The workpiece must be held securely in the vise
- \_\_\_\_\_ 26. The shortest piece of material that can be cut safely is 6".
- \_\_\_\_\_ 27. Proper blade selection would provide at least 3 teeth on the workpiece at all times.
- \_\_\_\_\_ 28. We have what is known as a "wet cutting" bandsaw.

### **Grinder**

- \_\_\_\_\_ 29. Never start the grinder while standing directly in front of the wheels.
- \_\_\_\_\_ 30. Always inspect the grinding wheels for cracks or voids before starting.
- \_\_\_\_\_ 31. The tool rest must be adjusted so that it is no more than 1/4" from the wheel.

### **Drill Press**

- \_\_\_\_\_ 32. The speed should be adjusted while the machine is off.
- \_\_\_\_\_ 33. It is important to clamp all work securely to the table or in a vise before drilling.
- \_\_\_\_\_ 34. The bigger the bit, the slower the speed.
- \_\_\_\_\_ 35. Only large holes require center punching before drilling.

### **Chop Saw**

- \_\_\_\_\_ 36. You must wear hearing protection when using the chopsaw.
- \_\_\_\_\_ 37. Always inspect the blade before using the saw.
- \_\_\_\_\_ 38. You may cut a piece of stock as small as 3".

### **Squaring Shear**

- \_\_\_\_\_ 39. Maximum capacity of the squaring shear is 18 gauge metal.
- \_\_\_\_\_ 40. No need to worry if your foot is below the treadle, because the treadle guard will prevent any injury.
- \_\_\_\_\_ 41. Hold the work tight against the side gauge to ensure a square cut.
- \_\_\_\_\_ 42. Large pieces of sheet metal may require two operators.

### **Bar Folder**

- \_\_\_\_\_ 43. Maximum capacity is 24 gauge metal.
- \_\_\_\_\_ 44. The Bar folder is used to make hems.

### **Cornice Brake**

- \_\_\_\_\_ 45. The green colored brake that we use as a cornice brake has a maximum capacity of 14 gauge metal.
- \_\_\_\_\_ 46. Two people can operate this machine at the same time.

### **Buffer/Wire Wheel**

- \_\_\_\_\_ 47. Use only the lower front 1/4 of the wheel.
- \_\_\_\_\_ 48. It is unsafe to angle the front edge of the work upward toward the wheel.

### **Box and Pan Brake**

- \_\_\_\_\_ 49. Maximum capacity of both box and pan brakes is 16 gauge metal.

### **Notcher**

- \_\_\_\_\_ 50. The maximum capacity is 16 gauge metal.

**Safety Test Metal Technology I (key)**  
Test A

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

True or False:

**General Safety**

- T \_\_\_\_\_ 1. Even though you are not working, you must wear safety glasses in the shop when others are working.
- T \_\_\_\_\_ 2. Disconnect machines from power before changing blades or bits.
- T \_\_\_\_\_ 3. Becoming distracted is the most common cause of injury while using power tools.
- F \_\_\_\_\_ 4. If you don't really know how to do something, take your best shot.
- F \_\_\_\_\_ 5. Horseplay is allowed if you have all of your work done.
- F \_\_\_\_\_ 6. Carrying a sharp tool in your pocket would be considered safe.
- F \_\_\_\_\_ 7. Sometimes a job will require two operators to run a machine.
- T \_\_\_\_\_ 8. Each student is responsible for himself/herself and those around.
- F \_\_\_\_\_ 9. Only major injuries need to be reported to the teacher.
- F \_\_\_\_\_ 10. Safety glasses must be worn only when operating electrical machinery.
- T \_\_\_\_\_ 11. Report all malfunctions or breakage to the teacher.
- F \_\_\_\_\_ 12. It is OK to wear loose and baggy clothing when operating machinery.
- F \_\_\_\_\_ 13. If you can't find a chisel or pry bar, you can just use a screw driver instead.
- F \_\_\_\_\_ 14. You can operate a machine without the instructor's permission as long as you know how to use it.
- T \_\_\_\_\_ 15. It is important to keep a safe distance between your hands and all moving parts of machine.
- F \_\_\_\_\_ 16. It is ok to leave a machine running while you get your safety glasses as long as you do it quickly.
- T \_\_\_\_\_ 17. Never talk to someone who is operating a machine.
- F \_\_\_\_\_ 18. If you can't find a center punch, a scratch awl can be used in its place.
- F \_\_\_\_\_ 19. It is O.K. to work with power tools and machines when you're tired.
- T \_\_\_\_\_ 20. A clean lab is a safer area to work in.

**Ironworker**

- F \_\_\_\_\_ 21. It is safe to cut material that is 2" in length
- T \_\_\_\_\_ 22. Never hold the material down with your hands, use the hold down clamp instead.
- T \_\_\_\_\_ 23. It is important to check the capacity of the machine before attempting to cut a piece of metal.
- F \_\_\_\_\_ 24. Our ironworker generates a maximum pressure of 45 tons.

**Horizontal Bandsaw**

- T \_\_\_\_\_ 25. The workpiece must be held securely in the vise
- T \_\_\_\_\_ 26. The shortest piece of material that can be cut safely is 6".
- T \_\_\_\_\_ 27. Proper blade selection would provide at least 3 teeth on the workpiece at all times.
- F \_\_\_\_\_ 28. We have what is known as a "wet cutting" bandsaw.

### **Grinder**

- T \_\_\_\_\_ 29. Never start the grinder while standing directly in front of the wheels.  
T \_\_\_\_\_ 30. Always inspect the grinding wheels for cracks or voids before starting.  
F \_\_\_\_\_ 31. The tool rest must be adjusted so that it is no more than 1/4" from the wheel.

### **Drill Press**

- F \_\_\_\_\_ 32. The speed should be adjusted while the machine is off.  
T \_\_\_\_\_ 33. It is important to clamp all work securely to the table or in a vise before drilling.  
T \_\_\_\_\_ 34. The bigger the bit, the slower the speed.  
F \_\_\_\_\_ 35. Only large holes require center punching before drilling.

### **Chop Saw**

- T \_\_\_\_\_ 36. You must wear hearing protection when using the chopsaw.  
T \_\_\_\_\_ 37. Always inspect the blade before using the saw.  
F \_\_\_\_\_ 38. You may cut a piece of stock as small as 3".

### **Squaring Shear**

- F \_\_\_\_\_ 39. Maximum capacity of the squaring shear is 18 gauge metal.  
F \_\_\_\_\_ 40. No need to worry if your foot is below the treadle, because the treadle guard will prevent any injury.  
T \_\_\_\_\_ 41. Hold the work tight against the side gauge to ensure a square cut.  
F \_\_\_\_\_ 42. Large pieces of sheet metal may require two operators.

### **Bar Folder**

- T \_\_\_\_\_ 43. Maximum capacity is 24 gauge metal.  
T \_\_\_\_\_ 44. The Bar folder is used to make hems.

### **Cornice Brake**

- T \_\_\_\_\_ 45. The green colored brake that we use as a cornice brake has a maximum capacity of 14 gauge metal.  
F \_\_\_\_\_ 46. Two people can operate this machine at the same time.

### **Buffer/Wire Wheel**

- T \_\_\_\_\_ 47. Use only the lower front 1/4 of the wheel.  
T \_\_\_\_\_ 48. It is unsafe to angle the front edge of the work upward toward the wheel.

### **Box and Pan Brake**

- F \_\_\_\_\_ 49. Maximum capacity of both box and pan brakes is 16 gauge metal.

### **Notcher**

- T \_\_\_\_\_ 50. The maximum capacity is 16 gauge metal.



## Safety Test Metal Technology I Test B

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

True or False:

### **General Safety**

- \_\_\_\_\_ 1. Each student is responsible for himself/herself and those around.
- \_\_\_\_\_ 2. Disconnect machines from power before changing blades or bits.
- \_\_\_\_\_ 3. Becoming distracted is the most common cause of injury while using power tools.
- \_\_\_\_\_ 4. It is important to keep a safe distance between your hands and all moving parts of a machine.
- \_\_\_\_\_ 5. Running in the metal shop is considered an unsafe act.
- \_\_\_\_\_ 6. Carry sharp tools point down.
- \_\_\_\_\_ 7. Even though you are not working, you must wear safety glasses in the shop when others are working. .
- \_\_\_\_\_ 8. If unfamiliar with a machine you should ask the teacher for help.
- \_\_\_\_\_ 9. Only major injuries need to be reported to the teacher.
- \_\_\_\_\_ 10. Safety glasses must be worn only when operating electrical machinery.
- \_\_\_\_\_ 11. Report all malfunctions or breakage to the teacher.
- \_\_\_\_\_ 12. It is OK to wear loose and baggy clothing when operating machinery.
- \_\_\_\_\_ 13. If you can't find a chisel or pry bar, you can just use a screw driver instead.
- \_\_\_\_\_ 14. You can operate a machine without the instructor's permission as long as you had training at the middle school.
- \_\_\_\_\_ 15. Throwing pieces of metal is OK as long as the instructor is not looking.
- \_\_\_\_\_ 16. You should never leave a machine that is still running or moving.
- \_\_\_\_\_ 17. Never talk to someone who is operating a machine.
- \_\_\_\_\_ 18. If you can't find a center punch, a scratch awl can be used in its place.
- \_\_\_\_\_ 19. Sometimes a job will require a helper, in addition to the operator, to run a machine.
- \_\_\_\_\_ 20. A clean lab is a safer area to work in.

### **Ironworker**

- \_\_\_\_\_ 21. It is safe to cut material that is 2" in length.
- \_\_\_\_\_ 22. The hold down clamp should only be used on large pieces that cannot be easily handled by the operator.
- \_\_\_\_\_ 23. It is important to check the capacity of the machine before attempting to cut a piece of metal.
- \_\_\_\_\_ 24. Our ironworker generates a maximum pressure of 35 tons.

### **Horizontal Bandsaw**

- \_\_\_\_\_ 25. The saw shuts off automatically when it has completed a cut.
- \_\_\_\_\_ 26. The shortest piece of material that can be cut safely is 6".
- \_\_\_\_\_ 27. Proper blade selection would provide at least 3 teeth on the workpiece at all times.

- \_\_\_\_\_ 28. We have what is known as a "dry cutting" bandsaw.
- \_\_\_\_\_ 29. You must wear a face shield when using the grinder.
- \_\_\_\_\_ 30. A grinding wheel should be replaced if it is worn to less than 1/2 of its original diameter.
- \_\_\_\_\_ 31. The tool rest must be adjusted so that it is no more than 1/8" from the wheel.

### **Drill Press**

- \_\_\_\_\_ 32. The speed should be adjusted while the machine is on.
- \_\_\_\_\_ 33. Only large pieces of metal must be clamped in place before drilling.
- \_\_\_\_\_ 34. 1/2" holes or larger require a pilot hole to be drilled first.
- \_\_\_\_\_ 35. Only large holes require center punching before drilling.

### **Chop Saw**

- \_\_\_\_\_ 36. You must wear hearing protection when using the chopsaw.
- \_\_\_\_\_ 37. A nicked or cracked blade could disintegrate and cause serious injury.
- \_\_\_\_\_ 38. It is important to listen to the saw to ensure the blade is not being overloaded. If the saw starts to "bog down" (lower pitch sound) you must release the pressure on the blade and allow the saw to come back to full speed.

### **Squaring Shear**

- \_\_\_\_\_ 39. Maximum capacity of the squaring shear is 16 gauge metal.
- \_\_\_\_\_ 40. Before cutting, always make sure that no one has their fingers near the blade or the pinch points.
- \_\_\_\_\_ 41. Large pieces of sheet metal may require two operators.
- \_\_\_\_\_ 42. The back gauge can be removed to accommodate longer pieces of sheet metal.

### **Bar Folder**

- \_\_\_\_\_ 43. Maximum capacity is 24 gauge metal.
- \_\_\_\_\_ 44. The Bar folder- can easily make a 90 degree bend up to 1 " in length.

### **Cornice Brake**

- \_\_\_\_\_ 45. The green colored brake that we use as a cornice brake has a maximum capacity of 14 gauge metal.
- \_\_\_\_\_ 46. Two people can operate this machine at the same time.

### **Buffer/Wire Wheel**

- \_\_\_\_\_ 47. Never place your hand opposite of end being worked on to avoid injury in the event of a kick-back.
- \_\_\_\_\_ 48. It is unsafe to angle the front edge of the work upward toward the wheel.

### **Box and Pan Brake**

- \_\_\_\_\_ 49. Maximum capacity of both box and pan brakes is 16 gauge metal.

### **Notcher**

- \_\_\_\_\_ 50. The maximum capacity is 16 gauge metal.

**Safety Test Metal Technology I (key)**  
Test B

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

True or False:

**General Safety**

- T \_\_\_\_\_ 1. Each student is responsible for himself/herself and those around.
- T \_\_\_\_\_ 2. Disconnect machines from power before changing blades or bits.
- T \_\_\_\_\_ 3. Becoming distracted is the most common cause of injury while using power tools.
- T \_\_\_\_\_ 4. It is important to keep a safe distance between your hands and all moving parts of a machine.
- T \_\_\_\_\_ 5. Running in the metal shop is considered an unsafe act.
- T \_\_\_\_\_ 6. Carry sharp tools point down.
- T \_\_\_\_\_ 7. Even though you are not working, you must wear safety glasses in the shop when others are working. .
- T \_\_\_\_\_ 8. If unfamiliar with a machine you should ask the teacher for help.
- F \_\_\_\_\_ 9. Only major injuries need to be reported to the teacher.
- F \_\_\_\_\_ 10. Safety glasses must be worn only when operating electrical machinery.
- T \_\_\_\_\_ 11. Report all malfunctions or breakage to the teacher.
- F \_\_\_\_\_ 12. It is OK to wear loose and baggy clothing when operating machinery.
- F \_\_\_\_\_ 13. If you can't find a chisel or pry bar, you can just use a screw driver instead.
- F \_\_\_\_\_ 14. You can operate a machine without the instructor's permission as long as you had training at the middle school.
- F \_\_\_\_\_ 15. Throwing pieces of metal is OK as long as the instructor is not looking.
- T \_\_\_\_\_ 16. You should never leave a machine that is still running or moving.
- T \_\_\_\_\_ 17. Never talk to someone who is operating a machine.
- F \_\_\_\_\_ 18. If you can't find a center punch, a scratch awl can be used in its place.
- T \_\_\_\_\_ 19. Sometimes a job will require a helper, in addition to the operator, to run a machine.
- T \_\_\_\_\_ 20. A clean lab is a safer area to work in.

**Ironworker**

- F \_\_\_\_\_ 21. It is safe to cut material that is 2" in length.
- F \_\_\_\_\_ 22. The hold down clamp should only be used on large pieces that cannot be easily handled by the operator.
- T \_\_\_\_\_ 23. It is important to check the capacity of the machine before attempting to cut a piece of metal.
- T \_\_\_\_\_ 24. Our ironworker generates a maximum pressure of 35 tons.

**Horizontal Bandsaw**

- T \_\_\_\_\_ 25. The saw shuts off automatically when it has completed a cut.
- T \_\_\_\_\_ 26. The shortest piece of material that can be cut safely is 6".
- T \_\_\_\_\_ 27. Proper blade selection would provide at least 3 teeth on the workpiece at all times.

- T \_\_\_\_\_ 28. We have what is known as a "dry cutting" bandsaw.  
T \_\_\_\_\_ 29. You must wear a face shield when using the grinder.  
T \_\_\_\_\_ 30. A grinding wheel should be replaced if it is worn to less than 1/2 of its original diameter.  
T \_\_\_\_\_ 31. The tool rest must be adjusted so that it is no more than 1/8" from the wheel.

### **Drill Press**

- T \_\_\_\_\_ 32. The speed should be adjusted while the machine is on.  
F \_\_\_\_\_ 33. Only large pieces of metal must be clamped in place before drilling.  
T \_\_\_\_\_ 34. 1/2" holes or larger require a pilot hole to be drilled first.  
F \_\_\_\_\_ 35. Only large holes require center punching before drilling.

### **Chop Saw**

- T \_\_\_\_\_ 36. You must wear hearing protection when using the chopsaw.  
T \_\_\_\_\_ 37. A nicked or cracked blade could disintegrate and cause serious injury.  
T \_\_\_\_\_ 38. It is important to listen to the saw to ensure the blade is not being overloaded. If the saw starts to "bog down" (lower pitch sound) you must release the pressure on the blade and allow the saw to come back to full speed.

### **Squaring Shear**

- T \_\_\_\_\_ 39. Maximum capacity of the squaring shear is 16 gauge metal.  
T \_\_\_\_\_ 40. Before cutting, always make sure that no one has their fingers near the blade or the pinch points.  
F \_\_\_\_\_ 41. Large pieces of sheet metal may require two operators.  
T \_\_\_\_\_ 42. The back gauge can be removed to accommodate longer pieces of sheet metal.

### **Bar Folder**

- T \_\_\_\_\_ 43. Maximum capacity is 24 gauge metal.  
T \_\_\_\_\_ 44. The Bar folder- can easily make a 90 degree bend up to 1 " in length.

### **Cornice Brake**

- T \_\_\_\_\_ 45. The green colored brake that we use as a cornice brake has a maximum capacity of 14 gauge metal.  
F \_\_\_\_\_ 46. Two people can operate this machine at the same time.

### **Buffer/Wire Wheel**

- T \_\_\_\_\_ 47. Never place your hand opposite of end being worked on to avoid injury in the event of a kick-back.  
T \_\_\_\_\_ 48. It is unsafe to angle the front edge of the work upward toward the wheel.

### **Box and Pan Brake**

- F \_\_\_\_\_ 49. Maximum capacity of both box and pan brakes is 16 gauge metal.

### **Notcher**

- T \_\_\_\_\_ 50. The maximum capacity is 16 gauge metal.

## METALS TEST

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

### Units 4-6 - Pages 41-58

1. In the United States, iron ore is found mostly in which three states?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Iron is combined with \_\_\_\_\_ to make steel.

3. What is the difference between pig iron and steel? \_\_\_\_\_

\_\_\_\_\_

4. How is hot rolled steel made? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. How is cold rolled steel made? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. List two advantages of cold rolled steel.

\_\_\_\_\_  
\_\_\_\_\_

7. What is the carbon content range of low carbon steel? \_\_\_\_\_

8. What is the carbon content range of medium carbon steel? \_\_\_\_\_

9. What is the carbon content range of high carbon steel? \_\_\_\_\_

10. High-speed steel cutting tools keep their hardness until about what temperature?

\_\_\_\_\_

### Unit 8 - Pages 69-73

16. A steel numbered 1045 has how much carbon in it? \_\_\_\_\_

17. What is the main alloying element in a steel numbered 4130? \_\_\_\_\_

18. What is the purpose of a spark test? \_\_\_\_\_

## METALS TEST (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

### Units 4-6 - Pages 41-58

1. In the United States, iron ore is found mostly in which three states?  
**MINNSEOTA, MICHIGAN, ALABAMA**
2. Iron is combined with **CARBON** to make steel.
3. What is the difference between pig iron and steel?  
**PIG IRON IS UPURIFIED**
4. How is hot rolled steel made?  
**ROLLED WHILE HOT (CHEAPER TO MAKE), COLOR IS BLUR-GRAY AND DULL**
5. How is cold rolled steel made?  
**ROLLED WHILE COLD (STRONGER, RUSTS FASTER, MORE EXACT, EXPENSIVE), COLOR IS SILVER-GRAY**
6. List two advantages of cold rolled steel.  
**MORE ACCURATE IN SIZE, CLEANER SMOOTHER FINISH**
7. What is the carbon content range of low carbon steel?  
**.05 - .30%      M1020      MILD STEEL BENDABLE**
8. What is the carbon content range of medium carbon steel?  
**.30 - .60%      M1045      TOUGH**
9. What is the carbon content range of high carbon steel?  
**.60 -1.5%      TOOL STEEL      BRITTLE      (drill bits – 10.95)**
10. High-speed steel cutting tools keep their hardness until about what temperature?  
**600 degrees F      pale blue**

Unit 8 - Pages 69-73

16. A steel numbered 1045 has how much carbon in it?      **.45%**
17. What is the main alloying element in a steel numbered 4130?      **CHROME**
18. What is the purpose of a spark test?  
    **TELLS WHAT KIND OF STEEL IT IS, i.e. HOW MUCH CARBON**

## FOUNDRY

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Units 56-59 - Pages 227-249

1. A \_\_\_\_\_ is a box like container in which the sand mold is made.
2. The upper section of the flask is called the \_\_\_\_\_.
3. The lower section of the flask is called the \_\_\_\_\_.
4. What is a strike-off bar used for? \_\_\_\_\_
5. What is a Riddle? \_\_\_\_\_
6. What is a sprue cutter? \_\_\_\_\_
7. What does a shake bag contain? \_\_\_\_\_
8. What kind of furnace is used for melting aluminum? \_\_\_\_\_
9. What are the 3 main ingredients of oil sand?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
10. What is the purpose of parting compound? \_\_\_\_\_  
\_\_\_\_\_
11. Patterns can be made from what materials? \_\_\_\_\_
12. Name 3 different types of patterns.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



13. What are 3 purposes of the gating system?

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14. What is the purpose of a riser? \_\_\_\_\_

15. At what temperature does aluminum melt? \_\_\_\_\_

16. What is used to measure the temperature of molten metal? \_\_\_\_\_

17. How are the gates and risers removed from a casting? \_\_\_\_\_

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### **Ramming a Mold**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_
14. \_\_\_\_\_
15. \_\_\_\_\_
16. \_\_\_\_\_
17. \_\_\_\_\_
18. \_\_\_\_\_
19. \_\_\_\_\_
20. \_\_\_\_\_
21. \_\_\_\_\_

### **Lightning Furnace**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

## FOUNDRY (KEY)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Units 56-59 - Pages 227-249

1. A **FLASK** is a box like container in which the sand mold is made.
2. The upper section of the flask is called the **COPE**.
3. The lower section of the flask is called the **DRAG**.
4. What is a strike-off bar used for? **REMOVE EXCESS SAND**
5. What is a Riddle? **SIFTER**
6. What is a sprue cutter? **TOOL TO CUT THE SPRUE HOLE**
7. What does a shake bag contain? **PARTING COMPOUND**
8. What kind of furnace is used for melting aluminum?  
**NATURAL GAS FIRE 320,000 BTU**
9. What are the 3 main ingredients of oil sand?  
**SAND, OIL, CLAY**
10. What is the purpose of parting compound?  
**PREVENTS SAND FROM STICKING TO PATTERN**
11. Patterns can be made from what materials?  
**ANY MATERIAL THAT HOLDS A SHAPE**
12. Name 3 different types of patterns.  
**SOLID/ONE PIECE, 2 PIECE, MATCHED PLATE**

13. What are 3 purposes of the gating system?  
**TRAPS SAND, ALLOWS HEAT TO ESCAPE, MINIMIZE SHRINKAGE**
14. What is the purpose of a riser? **SOAKS UP EXCESS HEAT**
15. At what temperature does aluminum melt?  
**1220 DEGREES, POUR AT 1400 DEGREES**
16. What is used to measure the temperature of molten metal? **PYROMETER**
17. How are the gates and risers removed from a casting? **HACKSAW**

### **Ramming a Mold**

1. Place drag on molding board with pins down
2. Place pattern on molding board face up
3. Dust pattern with parting compound
4. Riddle sand next to pattern and cover
5. Fill drag with sand and ram, edges first, then middle
6. Strike off excess sand
7. Cover drag with bottoming board and turn mold over
8. Put cope on drag
9. Plan sprue hole and mark with chalk
10. Dust with parting compound
11. Riddle with sand
12. Fill with sand and ram
13. Strike off cope
14. Cut sprue hole 1/2" into drag, use thumb as guide
15. Use stick to cut top of sprue hole "funnel" – no loose sand
16. Split mold in half, set cope to side on its side
17. Cut gates and runner – serve well 3/4" deep, runner 1/2" deep, gates 1/4" deep
18. Remove the pattern and blow the sand out
19. Place cope back on drag
20. Mark hour in sand, set on floor, 2 person pour
21. Clean up mess

### **Lightning Furnace**

1. Get permission form instructor (more than 45 min. needed)
2. Open hood and fill crucible with aluminum
3. Push start button and listen for buzzer
4. Add gas to number 4
5. Close the hood and adjust the flame

## SHEET METAL

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Unit 44-46 – Pages 171-183

1. List the most widely used materials in sheet metal.

\_\_\_\_\_

\_\_\_\_\_

2. Sheets used in metalwork are made of such materials as:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. What is galvanized sheet metal? \_\_\_\_\_

\_\_\_\_\_

4. What is the most common method of applying the zinc coating?

\_\_\_\_\_

5. What is the word that refers to the thickness of the sheet metal? \_\_\_\_\_

6. Galvanized sheet metal resists \_\_\_\_\_

7. Aluminum is a \_\_\_\_\_ metal.

8. Aluminum thickness is expressed two ways. List them.

\_\_\_\_\_

\_\_\_\_\_

9. Draw a single Hemm and state the 3 purposes it has. \_\_\_\_\_

\_\_\_\_\_

10. A pattern is also known as a \_\_\_\_\_

11. A \_\_\_\_\_ is used to mark the cutting lines on sheet metal.

12. List 4 types of patterns and tell what each is used for.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

13. List 3 types of sheet metal snips and tell what each is used for.

\_\_\_\_\_

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14. What is used to punch round holes in sheet metal? \_\_\_\_\_

15. What is the name of the shear used in cutting sheet metal?  
\_\_\_\_\_

16. Which side gauge should be used on the squaring shears? \_\_\_\_\_

17. List one safety precaution on the squaring shears.  
\_\_\_\_\_

## SHEET METAL (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Unit 44-46 – Pages 171-183

1. List the most widely used materials in sheet metal.  
**COLD STEEL, COPPER, GALVANIZED, ALUMINUM**
2. Sheets used in metalwork are made of such materials as:  
**ALUMINUM, BRASS, COPPER, GALVANIZED, STEEL, BRONZE, TIN**
3. What is galvanized sheet metal?  
**COLD ROLLED STEEL WITH A ZINC COATING (SNOWFLAKE APPEARANCE)**
4. What is the most common method of applying the zinc coating?  
**HOT DIPPING**
5. What is the word that refers to the thickness of the sheet metal?  
**GAUGE - THE HIGHER THE NUMBER, THE THINNER THE METAL**
6. Galvanized sheet metal resists **RUST AND OXIDATION**.
7. Aluminum is a **NONFERROUS** metal.
8. Aluminum thickness is expressed two ways. List them.  
**GAUGE AND DECIMAL THICKNESS**
9. Draw a single Hemm and state the 3 purposes it has.  
**SAFETY, STRENGTH, APPEARANCE**
10. A pattern is also known as a **LAYOUT**.
11. A **SCRATCH AWL** is used to mark the cutting lines on sheet metal.



12. List 4 types of patterns and tell what each is used for.  
**STRAIGHT LINE – LAY UP BOXES**  
**PARALLEL LINE – CYLINDERS**  
**RADICAL LINE – CONE SHAPE FUNNEL**  
**TRIANGULATION LINE – ONE SHAPE TO ANOTHER TRANSITION**
  
13. List 3 types of sheet metal snips and tell what each is used for.  
**COMBINATION SNIPS – USE ON 22 GAUGE OR LESS**  
**BULLDOG SNIPS – 16-18 GAUGE**  
**AVIATION SNIPS – CURVED LEFT (RED), CURVED RIGHT (GREEN) STRIAGHT (YELLOW) USED FOR HEAVY METAL UP TO 18 GAUGE**
  
14. What is used to punch round holes in sheet metal?  
**RADIAL CHASSIS PUNCH OR WHITING HAND PUNCH**
  
15. What is the name of the shear used in cutting sheet metal?  
**SQUARING SHEAR**
  
16. Which side gauge should be used on the squaring shears? **LEFT SIDE**
  
17. List one safety precaution on the squaring shears.  
**KEEP FINGERS CLEAR OF THE BLADE**

# Technology Education Safety Procedures and Recommendations For all Welding Classes

## Safety Pledge:

Read and discuss rules, have students and their parents sign the safety pledge. Students will return the pledge signed by parent we will then keep the pledge on file while the student is enrolled in Technology Education classes.

## General Safety:

Discuss general safety rules applicable to any shop or lab.

## Hand Tool Safety:

Discuss and demonstrate proper use of common hand tools used in the lab or shop.

## Machine Tool Safety:

Discuss and demonstrate key features, adjustments, purpose and safety concerns of the machines utilized in the course they are enrolled in. The class includes, but is not limited to, the following machines and power tools:

- Pedestal grinder
- Squaring shear
- Ironworker
- Horizontal bandsaw
- Edwards shear
- Angle iron bender
- Spot welder
- Box and Pan brake – Whitney
- Box and [an brake – Pexto
- Cornice break
- Barfolder
- Vertical bandsaw
- Drill press
- Abrasive chopasw

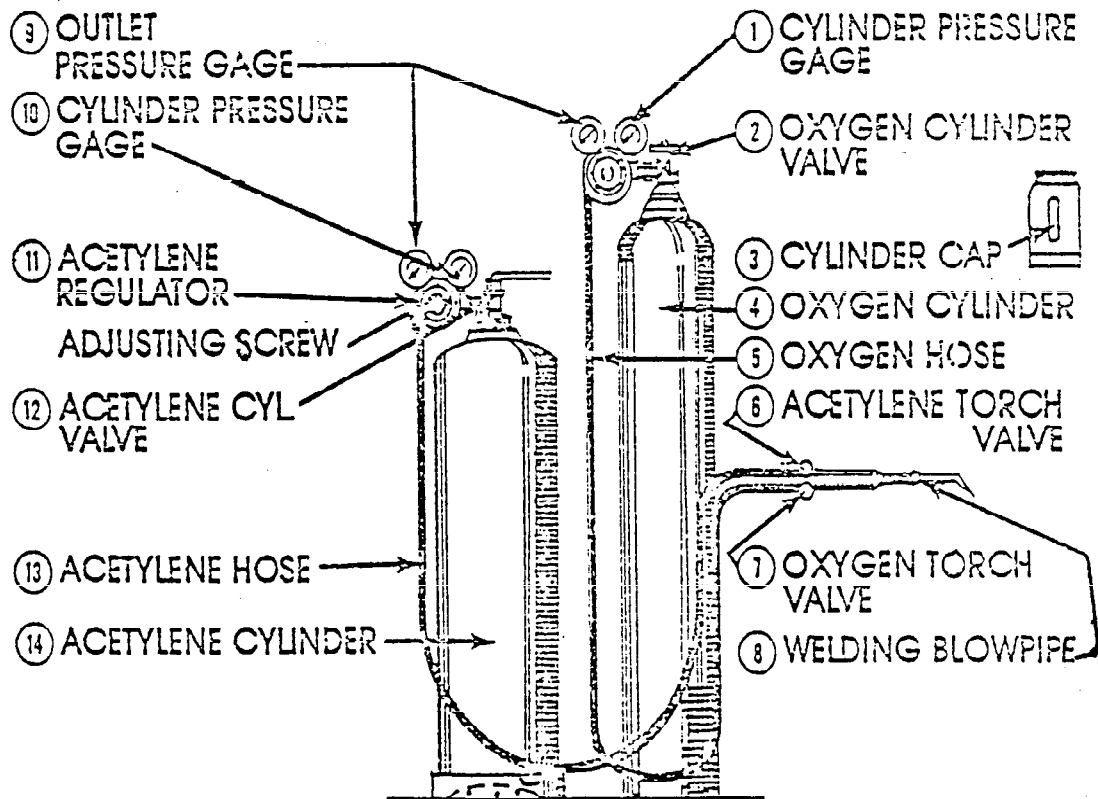
## Guiding Principles for Metals

1. Safety glasses
  - add side shields to prescription glasses
  - safety glasses & goggles are meant to fit over prescription glasses
2. Clothing
  - covered footwear – no sandals or open toed shoes
  - remove baggy clothing, jewelry, etc.
  - wear appropriate clothes for the activity, i.e. no synthetics during welding, sweaters should be avoided, etc.
3. Proper behavior is mandatory.
4. Students will not use equipment without proper instruction or permission.

Students will be evaluated by tests and quizzes, performance evaluations, and observation by the instructor.

## Oxy-Acetylene Welding

- Do not weld galvanized metal without proper ventilation.
- Do not allow oil to come in contact with hoses or other equipment.
- Gas bottles must be erect and secure at all times.
- Protective goggles and spark resistant clothing must be worn when welding.
- Do not weld or cut on a closed container without the instructor's permission.
- Confine all cutting and welding to the designated area of the shop.
- Turn off torch valves when finished with equipment.
- Keep the cylinder caps on the bottles when not in use.
- Turn off the gas and oxygen at tanks at the end of the class session.
- Bend the end of long welding rods to identify the hot end and reduce exposure to eye injury.

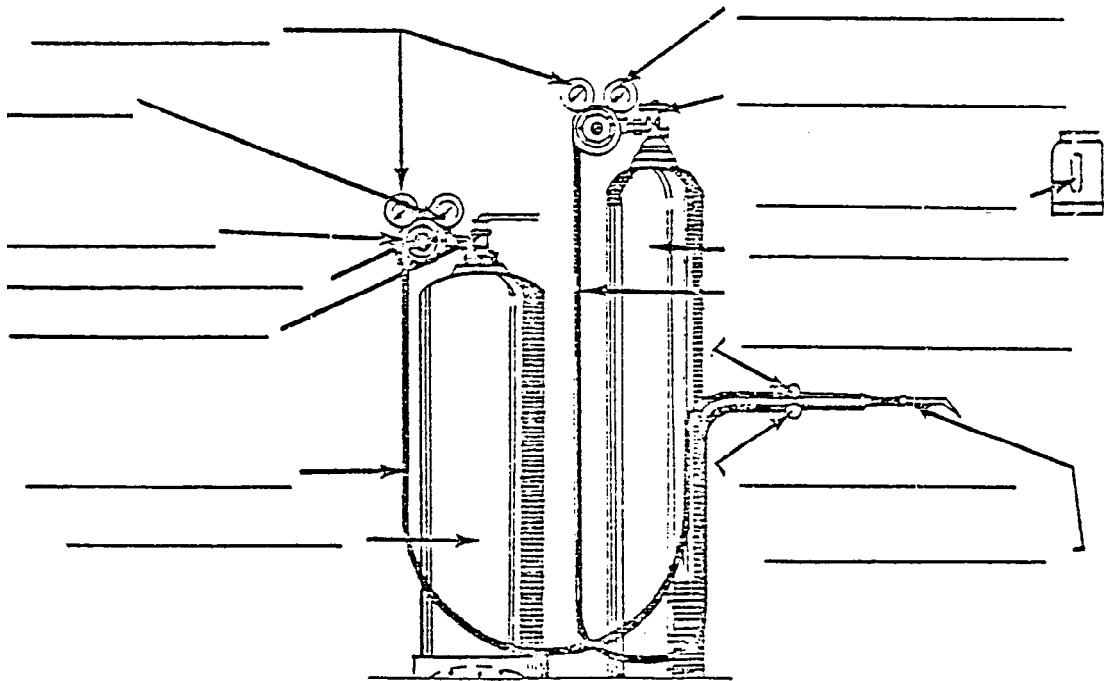


## Safety Test Oxy-Acetylene Welding

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

### True or False:

- \_\_\_\_\_ 1. Gas bottles may be laid on the floor when not in use.
- \_\_\_\_\_ 2. Closed containers are not hazardous to weld.
- \_\_\_\_\_ 3. The cylinder caps should be placed on all bottles when not in use.
- \_\_\_\_\_ 4. Eye protection must be worn for all welding, cutting and chipping.
- \_\_\_\_\_ 5. The equipment should not be wiped down with oily rags.

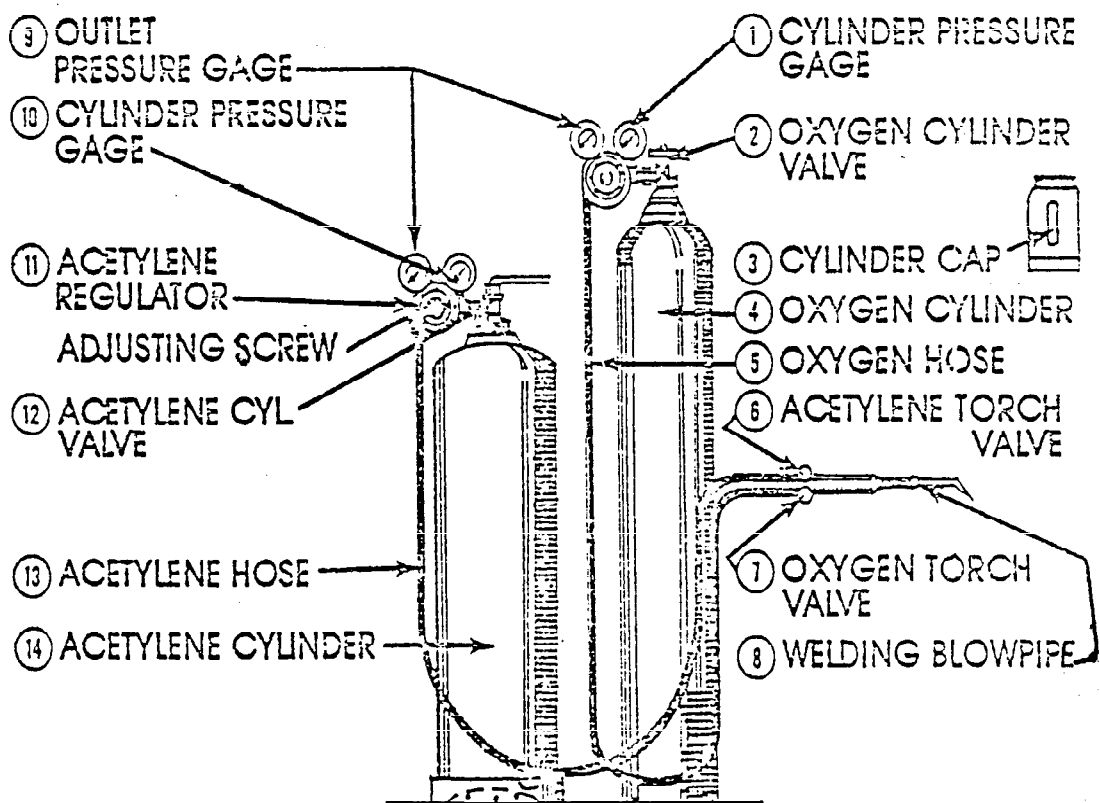


## Safety Test Oxy-Acetylene Welding (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

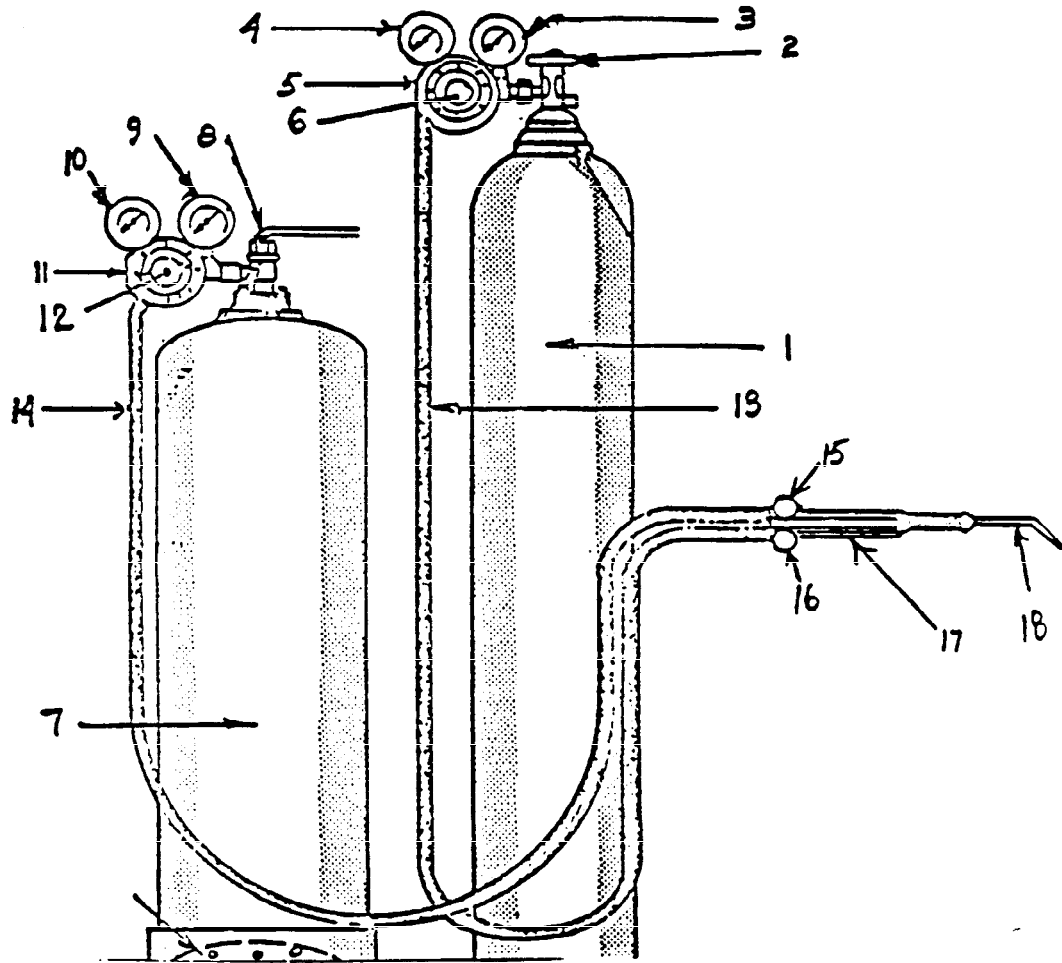
### True or False:

- F \_\_\_\_\_ 1. Gas bottles may be laid on the floor when not in use.
- F \_\_\_\_\_ 2. Closed containers are not hazardous to weld.
- T \_\_\_\_\_ 3. The cylinder caps should be placed on all bottles when not in use.
- T \_\_\_\_\_ 4. Eye protection must be worn for all welding, cutting and chipping.
- T \_\_\_\_\_ 5. The equipment should not be wiped down with oily rags.



# Oxy-Acetylene Welding

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

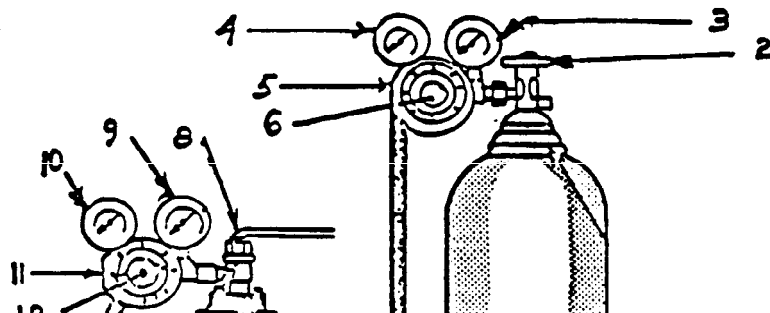


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## Oxy-Acetylene Welding (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Manufacturer



1. oxygen tank	2. oxygen tank valve
3. oxygen tank pressure gauge	4. oxygen working pressure gauge
5. oxygen regulator	6. oxygen regulator adjustment screw
7. acetylene tank	8. acetylene tank valve
9. acetylene tank pressure gauge	10. acetylene working pressure gauge
11. acetylene regulator	12. acetylene regulator adjustment screw
13. oxygen hose – green	14. acetylene hose – red
15. acetylene torch valve	16. oxygen torch valve
17. torch handle	18. torch tip

## WELDING TEST

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Unit 63 & 64 - Page 266-277

- .1. What is welding? \_\_\_\_\_  
\_\_\_\_\_
2. Draw and label 4 basic joint designs.
  
3. What is a bead? \_\_\_\_\_  
\_\_\_\_\_
4. Read the section on General Safety Precautions, every rule!
5. How much pressure is in a full tank of O<sub>2</sub>? \_\_\_\_\_
6. How much pressure is in a full tank of acetylene? \_\_\_\_\_
7. Acetylene is an explosive gas that becomes very unstable above \_\_\_\_\_ PSI.
8. What is used to clean welding tips? \_\_\_\_\_
9. What is the color of the O<sub>2</sub>? \_\_\_\_\_
10. What is the color of the acetylene hoses? \_\_\_\_\_
11. What kind of thread fittings does acetylene have?
12. When should welding safety goggles be worn? \_\_\_\_\_
13. What is used to light the gas torch? \_\_\_\_\_
14. What is the purpose of the copper coating on mild steel fusion rods? \_\_\_\_\_  
\_\_\_\_\_
15. What is another name for brazing rod? \_\_\_\_\_
16. Which gas burns? \_\_\_\_\_
17. What are the 3 types of flames?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



18. An oxidizing flame has too much what? \_\_\_\_\_

19. A carburizing flame has too much what? \_\_\_\_\_

20. What is a puddle? \_\_\_\_\_

21. Does the base metal melt in brazing? \_\_\_\_\_

22. What is the purpose of a flux in brazing? \_\_\_\_\_

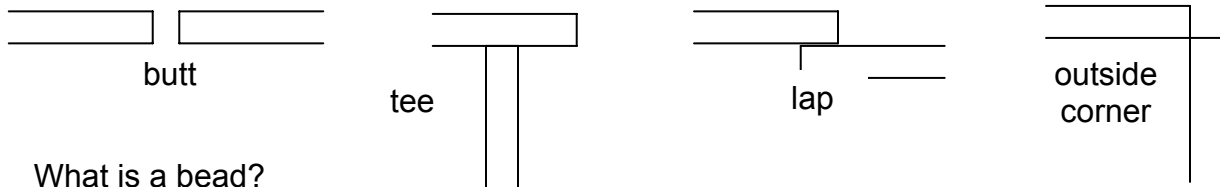
23. What happens when you add brazing rod when the base metal is not hot enough?  
\_\_\_\_\_

## WELDING TEST (key)

Name \_\_\_\_\_ Grade \_\_\_\_\_ Date \_\_\_\_\_

Unit 63 & 64 - Page 266-277

1. What is welding? **USE OF HEAT TO JOIN METAL**
2. Draw and label 4 basic joint designs.



3. What is a bead?  
**POD OF MOLTEN METAL PUSHED ALONG METAL, A CONTINUOUS PUDDLE**
4. **SKIP** the section on General Safety Precautions, every rule!
5. How much pressure is in a full tank of  $O_2$ ? **2200# PSI**
6. How much pressure is in a full tank of acetylene? **250# PSI**
7. Acetylene is an explosive gas that becomes very unstable above **15# PSI**.
8. What is used to clean welding tips? **BLOCK OF WOOD, THEN TIP CLEANER**
9. What is the color of the  $O_2$ ? **GREEN HOSE**
10. What is the color of the acetylene hoses? **RED HOSE**
11. What kind of thread fittings does acetylene have?  
**LEFT HAND, WITH A NOTCH IN THE NUT**
12. When should welding safety goggles be worn? **ALL THE TIME**
13. What is used to light the gas torch? **STRIKER, NO LIGHTERS**
14. What is the purpose of the copper coating on mild steel fusion rods? **PREVENT RUST**
15. What is another name for brazing rod? **BRONZE (GOLD)**
16. Which gas burns? **ACELELYNE**
17. What are the 3 types of flames?  
**OXIDIZING, CARBURIZING AND NEUTRAL (THE ONE WE USE)**
18. An oxidizing flame has too much what? **OXYGEN, MAKES HISSING SOUND**

19. A carburizing flame has too much what?  
**ACELELYNE, BIG WHITE FEATHER IN THE FLAME**
- 20 What is a puddle? **MOLTEN METAL**
21. Does the base metal melt in brazing? **NO, JUST BRONZE FILLER ROD**
22. What is the purpose of a flux in brazing? **CLEANS THE METAL**
- 23.What happens when you add brazing rod when the base metal is not hot enough?  
**BRONZE FORMS A BALL , IT DOESN'T SPREAD**