Skill Sheets for Agricultural Mechanics.

Iowa State Univ. of Science and Technology, Ames.
Dept. of Agricultural Education.

69
38p.

Dr. Thomas A. Hoerner, Agricultural Engineering
Department, Iowa State University, Ames, Iowa 50010
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Agricultural Education; Agricultural Engineering;
Agricultural Machinery; Secondary Education; Skill
Development; Units of Study (Subject Fields);
Vocational Agriculture; *Worksheets

This set of 33 skill sheets for agricultural
mechanics was developed for use in high school and vocational school
agricultural mechanics programs. Some sheets teach operational
procedures while others are for simple projects. Each skill sheet
covers a single topic and includes: (1) a diagram, (2) a step-by-step
construction or operational procedure, (3) abilities and
understandings taught, (4) materials needed, and (5) an evaluation
score sheet. These skill sheets can be used in conjunction with the
following instructional areas related to small engines and tractor
power: metals (cold or hot), electric motors, carpentry, basic
electricity, automatic controls, metal and concrete construction,
oxy-acetylene and arc welding, and agricultural machinery.

(Author/BP)
The materials contained herein were developed by the Agricultural Education Department, Iowa State University in cooperation with Consultants in Agricultural Education, Iowa State Department of Public Instruction.

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SKILL SHEETS FOR AGRICULTURAL MECHANICS

These skill sheets were developed for use in the high school and vocational school agricultural mechanics programs. Their main purpose is teaching specific skills or abilities related to agricultural mechanics. Individual skills should be taught before students are allowed to work on larger approved type projects requiring numerous skills. Many of the skills in this set can become part of the required activities phase of the agricultural mechanics program.

It is suggested that the skill sheets be used with the following instructional units:

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<td>2. Sharpening the Twist Drill Bit</td>
<td>Metals</td>
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<td>3. Cleaning and Servicing an Electric Motor</td>
<td>Electric Motors</td>
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<td>4. Tool Sharpening Gauge</td>
<td>Metals</td>
</tr>
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<td>5. Cleaning a Paint Brush</td>
<td>Carpenter</td>
</tr>
<tr>
<td>6. Concrete Float</td>
<td>Carpenter</td>
</tr>
<tr>
<td>7. Nail and Tool Carrier</td>
<td>Carpenter</td>
</tr>
<tr>
<td>8. Sharpening a Wood Chisel</td>
<td>Carpenter</td>
</tr>
<tr>
<td>9. Shoe Scraper with Concrete Base</td>
<td>Metal &amp; Concrete</td>
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<tr>
<td>10. Servicing the Spark Plug</td>
<td>Tractor Power &amp; Small Engines</td>
</tr>
<tr>
<td>11. Extension Cord</td>
<td>Basic Electricity</td>
</tr>
<tr>
<td>12. Magneto Coil-Condenser Tester</td>
<td>Tractor Power &amp; Small Engines</td>
</tr>
<tr>
<td>13. Sharpening a Plane Iron</td>
<td>Carpenter</td>
</tr>
<tr>
<td>14. Feed Scoop</td>
<td>Cold Metals</td>
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<tr>
<td>15. Cold Chisel</td>
<td>Hot Metals</td>
</tr>
<tr>
<td>16. Drawbar Hitch Pin</td>
<td>Metals &amp; Arc Welding</td>
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<td>17. Sawhorse</td>
<td>Carpenter</td>
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<td>18. Wiring the Time Delay Reley</td>
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</tr>
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<td>19. Rafter Layout</td>
<td>Carpenter</td>
</tr>
<tr>
<td>20. Use of the Torque Wrench</td>
<td>Tractors, Ag Machinery &amp; Small Engines</td>
</tr>
<tr>
<td>21. Photoelectric Control</td>
<td>Automatic Controls</td>
</tr>
<tr>
<td>22. Making Quality Welds</td>
<td>Arc Welding</td>
</tr>
<tr>
<td>23. Tool Sharpening Gage</td>
<td>Metals</td>
</tr>
<tr>
<td>24. Drill Bit, Bolt &amp; Washer Gauge</td>
<td>Metals</td>
</tr>
<tr>
<td>25. Chipping Hammer</td>
<td>Metals</td>
</tr>
<tr>
<td>Skill Sheets</td>
<td>Units</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>26. Welded &quot;C&quot; Clamp</td>
<td>Metals &amp; Arc Welding</td>
</tr>
<tr>
<td>27. The Electric Motor Nameplate</td>
<td>Electric Motors</td>
</tr>
<tr>
<td>28. Adjustable Safety Jack</td>
<td>Metals &amp; Arc Welding</td>
</tr>
<tr>
<td>29. Funnel</td>
<td>Metals</td>
</tr>
<tr>
<td>30. Case Hardening of Mild Steel</td>
<td>Metals</td>
</tr>
<tr>
<td>31. Oxy-Acetylene Welding Equipment</td>
<td>Oxy-Acetylene</td>
</tr>
<tr>
<td>32. Braze Welding Mild Steel</td>
<td>Oxy-Acetylene</td>
</tr>
<tr>
<td>33. The Arc Welding Molten Pool</td>
<td>Arc Welding</td>
</tr>
</tbody>
</table>

Each skill sheet consists of: (1) construction or operational procedures, (2) abilities and understandings taught, (3) a plan or drawing, (4) materials needed and (5) an evaluation score sheet.

The skill sheets included in this set were developed by Gary McVey, Herbert Hansen, Donald Ahrens, John Pothoven and Thomas A. Hoerner, Agricultural Engineering Staff members at Iowa State University.
READING THE MICROMETER

Operation Teach:

Understanding of

1. A. Identify the parts of the micrometer
2. U. The function of the various parts
3. U. The use of decimals and fractions in measurements
4. A. Convert fractions to decimals and decimals to fractions
5. A. Properly hold the micrometer
6. A. Feel a reading
7. A. Read the micrometer to the nearest one thousandths of an inch
8. A. Use the micrometer to measure flat, round or square stock

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Micrometer part identification (2 points per correct item)</td>
<td>20</td>
<td>______</td>
</tr>
<tr>
<td>2. Reading the micrometer</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>3. Determining the difference in the measurements of the practice cylinder (3-c) (plus or minus .001&quot; = 30 pts., + or - .002&quot; = 20 pts., + or - .003&quot; = 10 pts., greater than .004&quot; off correct reading = 0 pts.)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>4. Determining the reading of the micrometer inserts (5 pts. each)</td>
<td>10</td>
<td>______</td>
</tr>
<tr>
<td>5. Handling the micrometer</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>6. Attitude and work habits</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Name: ___________________________  Date: ____________  Grade: ________

Materials:
1. 1"-2" micrometer
2. two-step practice cylinder (top step between 1.75" and 2.00" lower step 1.25" to 1.75"")
SHARPENING THE TWIST DRILL BIT

Operational Procedures:
1. Dress grinding wheel with dressing tool
2. Hold drill bit against face of wheel at 59° angle on cutting lip
3. Carry drill bit up the wheel face by dropping end and rotating very slightly in clockwise direction
4. Make slow deliberate strokes, the full width of the cutting lip
5. Do not lower cutting lip below the horizontal position as this will round the cutting edge
6. When one lip is ground, rotate the drill one-half turn and grind the other lip
7. Use tool gauge to check equal lengths of lips, 59° angle cutting lip and 12-15° lip clearance
8. Test bit by boring hole in mild steel plate
9. Stop while drilling, turn drill press in reverse direction to release drill bit from hole. Note depth of cut of each lip
10. Make grinding corrections on drill bit as indicated by hole
11. Submit drill bit and metal for evaluation.

Evaluation Score Sheet

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cutting lip angle 59°</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2. Cutting lips equal length</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>3. Lip clearance 12-15°</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4. Correct angle between dead center and cutting lip, chisel edge angle, 120-135°</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Smoothness of grinding surface, lip to heel</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6. Bit cuts spiral chips</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. Hole drilled is correct size</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Work habits and attitude</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Total points</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: 1 - Drill drill bit 3/8"-1/2"

Operation Teaches (Understanding of . . . .)
1. Correct grinding wheel for sharpening drill bits.
2. A. Dress a grinding wheel
3. U. Drill bit types and sizes
4. U. Measurements to check when sharpening a drill bit
5. A. Make measurements on drill bit with tool gauge
6. A. Hold drill bit at 59° to grinding wheel face
7. A. Sharpen drill bit to attain chisel edge angle, 120-135° and 12-15° lip clearance
8. A. Secure bit in drill press chuck
9. A. Layout and center punch metal
10. A. Secure metal in drill press vise
11. A. Bore hole in mild steel

Name: ____________________________
Date: _________ Grade: _________
CLEANING AND SERVICING AN ELECTRIC MOTOR

**Materials**
1. An electric motor needing to be cleaned and serviced
2. Tools for disassembling an electric motor
3. A paint brush, motor cleaning solvent and pan to wash parts

**Operation Teaches** (Ability to...
(Understanding of...
1. A. disconnect a motor from an electrical source
2. A. correctly mark motor frame and end bells
3. U. importance of carefully removing the end bells so as to not damage leads or motor windings
4. A. remove rotor from motor without damaging the centrifugal switch or motor brushes
5. U. correct type solvent to use in cleaning an electric motor
6. A. thoroughly clean and dry all motor parts
7. A. identify and inspect parts for wear or damage
8. A. reassemble motor parts in reverse order of disassembly and tighten end bell bolts
9. A. lubricate motor using correct type and amount of lubrication
10. A. connect motor to power source

**Evaluation Score Sheet**

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correctly disconnecting motor from electrical source-mark leads</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2. Correctly marking end bells</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3. Carefully removing end bells in correct order</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. Selecting correct solvent for cleaning motor</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5. Thorough cleaning and drying of motor parts</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6. Inspection and identification of parts-make repairs</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>7. Correct reassembling of motor, rotor free to turn</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Proper type and amount of lubrication used on motor</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9. Connecting motor to power source-motor runs properly</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>10. Work habits and attitude</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total points</strong></td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation Procedure**
1. Disconnect motor leads at terminal cover plate. Note position of leads on terminals
2. Remove motor frame from mount or machine
3. Wipe all dirt from outside of motor
4. Mark end bells with center punch-one mark on end bell and motor frame on terminal connection end. Use 2 marks on other end
5. Remove end bell bolts
6. Using a wood block or soft-faced hammer remove end bell containing starting switch or brush ring
7. Remove motor and other end bell
8. Clean all motor parts with motor solvent. Do not use gasoline. Use carbon tetrachloride only in a well ventilated area. Avoid soaking the winding or leads
9. Dry all parts with a cloth or compressed air
10. Identify and examine all parts for wear, damage or loose connections-make necessary repairs
11. Reassemble motor in reverse to disassembly. Tighten end bell bolts evenly checking to see that motor turns freely
12. Lubricate motor bearing with the oil or grease used upon type motor used and connect electric leads and wire to starting switch

**Name**

**Date**
TOOL SHARPENING GAUGE

Construction Procedure:
1. Measure and scribe outline on stock with a 1/6" rule.
2. Cut out tool gauge with hacksaw.
3. Use flat file to cut wood chisel slot.
4. Use taper file to cut cold chisel vee.
5. Position and drill 1/4" hole at narrow end of gauge.
6. Measure and scribe a 1" rule by 1/16" graduations.
7. Cut rule indicator marks with cold chisel.
8. Polish for final finish.

(Ability to)

Construction Teaches (Understanding of)
1. U. selection of flat stock.
2. A. measure and transfer outline of gauge to stock.
3. A. scribe outline on metal with awl.
4. A. use the correct hacksaw blade to select for cutting stock.
5. A. to use the hacksaw.
6. A. the correct files to select for filing slot and vee.
7. A. cut the slot with the flat file.
8. A. cut a vee with the taper file.
9. A. the need for center punching before drilling.
10. A. use of the center punch.
11. A. fastening metal before drilling.
12. A. adjust speed and use of the drill press.
13. A. calibrate and indicate rule marks on metal.
14. A. set rule marks in metal with the cold chisel.
15. A. correct grinding wheels and setting of tool rest.
17. A. use abrasive wheel and emery cloth to polish gauge.

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Length of gauge</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2. Width of narrow end</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3. Width of wide end</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4. Angle of wood chisel slot</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>5. Vee position for cold chisel angle</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6. Angle for drill cutting edge</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>7. Accuracy of the 1&quot; rules</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Angle for drill tip clearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9. Hole centered</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10. Accuracy</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>11. Attitude and work habits</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Total Points

9
CLEANING A PAINT BRUSH

**Materials:**
1. Used paint brush in need of cleaning
2. Bucket or can for cleaning
3. Solvent
4. Detergent
5. Wrapping paper and string

**Operation Teaches (Understanding of...**
1. U. types of paint brushes
2. U. the importance of using a clean brush when painting
3. A. to select and use the correct solvent
4. A. to remove all paint from the bristles of brush in cleaning
5. U. the safe use of cleaning solvents
6. A. to remove solvent from bristles with soap and water
7. U. the proper method to store a brush
8. A. to wrap a brush properly for storage

**Evaluation Score Sheet**

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Selecting of proper solvent</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2. Removal of excess paint using lip of can</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3. Properly seal paint can</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4. Working solvent into bristles</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>5. Draining solvent from brush</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6. Removing solvent with soap and water</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>7. Properly drying brush</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Wrapping brush in paper</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9. Safety in using solvents</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>10. Work habits and attitude</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Total Points**

Name ____________________________
Date ____________________________ Grade ________
CONCRETE FLOAT

Construction Procedure:
1. Lay out and cut base to dimension
2. Chamfer base edges
3. Lay out and cut outside dimensions of handle
4. Drill and cut hole in handle
5. Chamfer edges of handle
6. Locate handle, drill pilot holes for screws
7. Fasten handle to board with glue and 2-1/2" No. 9 wood screws
8. Sand float, apply one coat of linseed oil

Bill of Materials
1 - 1" x 6" x 1' white pine board
1 - 1" x 3" x 9" white pine board
2 - 1-1/2" #9 FH bright wood screws
1/4 pint linseed oil

Construction Teaches
(Ability to.................)
1. A. Measure accurately
2. A. Use the table, radial arm or hand saw
3. A. Principles of jointer operation
4. A. Properly use the jointer
5. A. Drill holes in wood
6. A. Use the saber saw
7. A. Use a wood chisel
8. A. Correct wood auger bit sizes
9. A. Drill pilot holes for screws
10. A. Drive screws
11. A. Use the 1/4" drill
12. A. Finish and treat with linseed oil

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correct length and width of base</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2. Base of square</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Chamfers smooth, even, correct dimensions</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. Correct handle dimensions</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>5. Hole in handle is smooth</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6. Handle centered on base</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. Screws properly countersunk</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. General appearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9. Work habits and attitude</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>
Construction Procedure:
1. Lay out material from cutting list
2. Cut parts to dimension
3. Bevel bottom of tray
4. Bore holes for handle in ends
5. Assemble to check dimensions
6. Prepare screw holes
7. Disassemble and mix glue
8. Apply glue, assemble with nails and screws
9. Clean excess glue from joints
10. Allow glue to set
11. Sand and finish joints
12. Paint

Construction Teaches:
1. Read a plan and prepare a cutting list.
2. Measure and mark distances.
3. Correct saw and saw blade to use.
4. Use a saber, jig or band saw.
5. Use brace and bit or electric drill and bit.
6. Correct nail and screw selections.
7. Correct glue and wood adhesive selection.
8. Correct sanding methods.
11. Apply paint, clean and store brushes.

Evaluation Score Sheet:

<table>
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<tr>
<th>Item</th>
<th>Points</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Correct dimensions</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2. Square corners &amp; joints</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3. Edges square and smooth</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>4. Placement of nails &amp; screws</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5. Finish and painting</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>6. Overall appearance</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>7. Attitude &amp; work habits</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
SHARPENING A WOOD CHISEL

Operational Procedure:
1. Select correct grinding wheel for tool sharpening, dress grinding wheel.
2. Place the wood chisel between the left forefinger and the thumb, and the forefinger against the outside edge of the tool rest.
3. Push the chisel forward between the forefinger and thumb of the left hand until it is at the proper angle with the grinding wheel.
4. Make sure the grinding stone is turning down toward the chisel.
5. Hold the chisel firmly in the left hand and slide the left forefinger from left to right along the tool rest for a guide until the entire width of the edge has been ground almost to a wire edge.
6. At the same time use the right hand to apply pressure and help guide the chisel.
7. To keep the cutting edge square with the sides, stop the strokes when the back edge of the chisel passes beyond the edge of the grinding wheel about one-third of the width of the wheel.
8. Check the bevel with the tool gauge frequently during the grinding to see that it is being ground to a 25-degree angle.
9. Hold the chisel against the whetstone moving it back and forth, making sure the heel and toe of the hollow ground bevel are touching the stone.
10. Add oil to whetstone as needed.
11. Continue whetting until a sharp edge is obtained.
12. Remove the wire edge by turning the chisel over and taking a few strikes with the chisel flat against the stone.

Materials: Grinding Wheel
Dull Chisel
Whetstone and No. 10 Oil

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. One ground face, concave</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2. Even width of bevel</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Correct angle</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. Cutting edge square to shank</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Uniform whetting face</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6. Wire edge removed</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. Sharp cutting edge</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>8. Work habits and attitude</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Operation Teaches:
1. Understanding of
2. Ability to

1. U. When to sharpen the chisel
2. U. The proper angle of the bevel
3. U. Correct grinding wheel for sharpening
4. A. Properly dress the grinding wheel
5. A. Properly sharpen the chisel
6. U. Results of excess pressure when grinding
7. U. Tempering of tool steel
8. U. Selection and purpose of the whetstone
9. A. Use the whetstone
10. A. Remove the wire edge using the whetstone

Name: ____________________________
Date: ____________________________
Grade: ____________________________
Construction Procedure:
1. Measure and cut metal pieces
2. Bend each leg square, use heat and vise
3. Round the top of each 6" leg by grinding
4. Mark and center punch for holes
5. Drill holes in legs and center piece for 3/16" bolts
6. Bolt legs and center piece together, cut off excess bolt and rivet the end
7. Construct form for the concrete base from 1" x 2" and 1/2" plywood material
8. Oil form with paraffin base or #10 oil
9. Mix concrete and place about 3/4" in the form
10. Place metal scraper in the center and fill form with concrete
11. Spade concrete around the edges and trowel surface
12. Remove form, set concrete base in water 3-7 days
13. Paint metal parts of scraper

Bill of Material:
1 - 1/4" x 1" x 30" mild steel strap
4 - 3/16" x 1" R.H. stove bolts
1-1/4 quarts cement, 2-1/2 quarts sand,
2-1/2 quarts crushed stone, one quart water
1 - 10-1/2" x 13-1/2" x 1/2" exterior plywood for form base
1 - 1" x 2" x 44" white pine, form lumber

Evaluation Score Sheet:
1. Dimensions of metal unit
2. Dimensions and squareness of concrete form
3. Location of scraper in base
4. Concrete finish and curing
5. Overall appearance
6. Attitude and work habits

<table>
<thead>
<tr>
<th></th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions of metal unit</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Dimensions and squareness of concrete form</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Location of scraper in base</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Concrete finish and curing</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Overall appearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Attitude and work habits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
DEPARTMENT OF AGRICULTURAL ENGINEERING
IOWA STATE UNIVERSITY
TAH 1068

SERVICING THE SPARK PLUG

Part Identification:
1. ___________________  9. ___________________
2. ___________________ 10. ___________________
3. ___________________ 11. ___________________
4. ___________________ 12. ___________________
5. ___________________ 13. ___________________
6. ___________________ 14. ___________________
7. ___________________ 15. ___________________
8. ___________________ 16. ___________________

Operational Procedure:
1. Identify parts of the spark plug
2. Remove plug after cleaning plug-well
3. Remove oily deposits from plugs with cleaning solvent
4. Check condition of the porcelain (good – fair – poor)
5. Remove carbon deposits from plugs
6. Blow away all foreign matter
7. File electrodes until surfaces are flat
8. Determine plug type, (hot – normal – cold)
9. Determine proper spark gap
10. Regap plug using correct gauge
11. Check plug reach
12. Check plug gasket condition (good – fair – poor)
13. Determine proper torque: in. lbs. ______, ft. lbs. ______
14. Tighten plug with torque wrench to recommended torque

Materials: Fouled plugs, gauges, files, wire brushes, & cleaning solvent.

FACTS ABOUT SPARK PLUGS & ENGINES, Champion Spark Plug

Operation teaches: (Ability to...
(Understanding of...
1. U How a spark plug functions
2. U The parts of the spark plug
3. A Recognize fouled plug
4. A Clean the plug
5. A File the electrodes
6. A Properly gap the spark plug
7. A Use the wire gap gauge
8. A Use the torque wrench
9. A Recognize a bad plug gasket
10. U Hot and cold type plugs

Evaluation Score Sheet:
Points Possible Earned
1. Parts of plug properly identified 16 ______
2. Oil removed and threads cleaned 4 ______
3. Condition of porcelain 5 ______
4. Carbon deposits removed 10 ______
5. Electrodes properly filed 10 ______
6. Spark plug heat range 5 ______
7. Correct gauge for gapping used 10 ______
8. Plugs properly gapped 15 ______
9. Proper reach used 5 ______
10. Gasket condition 5 ______
11. Determining torque for plug 5 ______
12. Plug correctly torqued in engine 10 ______

Total 100 ______

Job sheet prepared in cooperation with Randy Rumery and Dean Bartel

Name ____________________________
Date ____________________ Grade ______
Construction Procedure:
1. Determine length of cord holder. Suggest 1 x 4 x 18' 
2. Bevel 4 edges of board 
3. Shape brackets to hold electrical conductor 
4. Locate electrical box on mounting board 
5. Attach electrical box to board using 4, 3/4" No. 8 screws 
6. Cut 10 - 16 feet of 16-3 S.J rubber covered conductor with ground for cord 
7. Wire grounded, fused receptacle as shown in drawing 
8. Place receptacle in box, add cover plate and tighten box connector 
9. Locate and attach brackets to board 
10. Connect grounded cap (male plug) 
11. Paint extension cord holder and box 
12. Insert fusetron, assume 8 amp load __________ fusetron size.

Bill of Material
1. Pine board 1 x 4 x 18" 
2. Mounting brackets, 1/8 x 1/2" x 5" mild steel 
3. 2" x 4" Handy box, 1-1/2" deep 
4. Fused, grounded receptacle (SRU) 
5. Fusetron fuse 7-1/2 - 10 amp range 
6. Grounded cap (male plug) 
7. 3/4" Box connector 
8. 3/4" No. 8 Round head Wood Screws 
9. 10' - 16' Rubber covered type S or S.J, 16 - 3 stranded conductor with ground

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible Points</th>
<th>Earned Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correct measurements</td>
<td>10</td>
<td>__________</td>
</tr>
<tr>
<td>2. Mounting brackets</td>
<td>5</td>
<td>__________</td>
</tr>
<tr>
<td>3. Attachment of brackets and box</td>
<td>10</td>
<td>__________</td>
</tr>
<tr>
<td>4. Fused, grounded receptacle properly connected</td>
<td>25</td>
<td>__________</td>
</tr>
<tr>
<td>5. Connection of grounded cap</td>
<td>15</td>
<td>__________</td>
</tr>
<tr>
<td>6. Selection of correct fusing element</td>
<td>15</td>
<td>__________</td>
</tr>
<tr>
<td>7. Quality of finish, painting</td>
<td>10</td>
<td>__________</td>
</tr>
<tr>
<td>8. Attitude and work habits</td>
<td>10</td>
<td>__________</td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td>__________</td>
</tr>
</tbody>
</table>

Name ___________________________ Date ___________ Grade _________

Construction Teaches: (Understanding of __________)
1. A Shape mounting board 
2. A Use metal shears, drill press and drills 
3. U Selection of electrical conductors and caps 
4. U Grounded, fused receptacles 
5. U 120 and 240 volt circuits 
6. A Properly wire fused receptacle 
7. U Proper grounding of extension cords 
8. U Types and sizes of fuses for specific applications 
9. A Select correct type and size of fusing element 
10. A Attach grounded cap to extension cord 
11. A Paint extension cord holder

(Ability to __________)
**Operational Procedure:**

1. Remove coil and condenser from engine or disconnect all leads except ground.
2. Inspect coil and condenser for physical damage and loose connections.
3. Connect coil-condenser tester to power.
4. **Coil Testing** - Determine type and number of coil. Connect to coil as shown in Fig. 1.
5. Adjust COIL SET to calibration index using a good coil or according to coil set by manufacturer's. **Coil Set**
6. Place SELECTOR in COIL position.
7. Read meter on coil or upper scale. If coil is good a minimum meter reading of 5 must be obtained. Meter reading — **Coil evaluation** (good - fair - poor)
8. Move switch to OFF, disconnect leads.
9. **Condenser Testing** - Determine type and number of condenser. Manufacturer's specifications for capacity limits, MFD.
10. Connect tester primary leads to condenser as shown in Figure 2.
11. Move switch to MFD position.
12. Read meter on MFD. Reading in MFD — **Condenser evaluation** (good - fair - poor)
13. A full scale reading indicates a shorted or leaking condenser, a zero reading indicates an open condenser.
14. Place selector on TEST for leakage test. A good condenser will take an initial charge noted by a single flash in the neon lamp. Leaky condensers will be noted by a continuous glow or flashing on or off.
15. Move switch to OFF, disconnect leads.
16. Condenser evaluation (good - fair - poor)
17. Reconnect coil and condenser, if needed replace with new coil or condenser.
18. Request instructor evaluation.

**Materials:**
1. Coil-condenser tester, King Model 603, or equivalent.
2. Small engine with coil and condenser.
3. Coils and condensers of known quality or capacity.
4. References to determine manufacturer's specifications for coils and condensers to be tested.

**Operation Teaches (Ability to . . .)**

1. U. basic function of the coil and condenser in the electrical system.
2. A. detect damage to coil or condenser.
3. A. properly connect tester for coil test.
4. U. proper coil setting to test coil.
5. A. read scale on tester and evaluate quality or condition of coil.
6. A. properly connect tester for condenser test.
7. U. condenser capacities in microfarads.
8. A. read scale on tester and evaluate quality or condition of coil.
9. A. test condenser for leakage.
10. A. properly replace and connect coil and condenser in engine electrical system.

**Evaluation Score Sheet:**

<table>
<thead>
<tr>
<th>Points Possible Earned</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tester correctly connected for coil test</td>
<td>15</td>
</tr>
<tr>
<td>2. COIL SET properly calibrated according to manufacturer</td>
<td>5</td>
</tr>
<tr>
<td>3. Coil meter reading accurate (±1 division)</td>
<td>10</td>
</tr>
<tr>
<td>4. Accurate evaluation of condition of coil</td>
<td>15</td>
</tr>
<tr>
<td>5. Tester correctly connected for condenser test</td>
<td>15</td>
</tr>
<tr>
<td>6. Manufacturer's specifications for condenser capacity</td>
<td>5</td>
</tr>
<tr>
<td>7. MFD meter reading accurate</td>
<td>10</td>
</tr>
<tr>
<td>8. Test for condenser leakage</td>
<td>10</td>
</tr>
<tr>
<td>9. Accurate evaluation of condition of condenser</td>
<td>15</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
SHARPENING A PLANE IRON

Operational Procedures:
1. Dress the grinding wheel, remove plane iron from hand plane
2. Hold the plane iron against the face of the grinding wheel at a 25°-30° angle
3. Move the plane iron from side to side to obtain an evenly ground edge
4. Dip plane iron in water to prevent overheating and loss of temper
5. Grind until all nicks are removed and a bevel twice the thickness of the plane iron is obtained
6. Hold the plane iron to the whetstone with toe and heel in contact
7. Move the plane iron back and forth against the whetstone
8. Add oil to the whetstone as needed
9. Continue whetting until a sharp edge is obtained
10. Remove the wire edge by turning the plane iron over and taking a few strokes with the plane iron flat against the stone using a sideways motion
11. Replace plane iron in plane, test sharpness by edge planing of pine or other softwood
12. Present plane with plane iron installed to instructor for evaluation

Materials:
1. Plane iron in need of sharpening
2. Grinder with a tool rest and proper wheel
3. Whetstone and oil

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bevel has one face</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2. Bevel twice the thickness of the plane iron</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Cutting edge is square to side</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. All nicks removed</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Whetting bevel is even</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6. Wire edge removed</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. Sharp cutting edge</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>8. Plane iron properly installed in hand plane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Work habits &amp; attitude</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

(Ability to . . . . . . . .
Operation Teaches: (Understanding of . . . . . .
1. U. Proper grinding wheel for sharpening plane irons
2. A. Dress a grinding wheel
3. U. Measurements to check when sharpening a plane iron
4. A. Hold plane iron to grinding wheel face at correct angle
5. U. Whetstone selection and purposes
6. U. Importance of using oil on the whetstone
7. A. Use a whetstone properly
8. A. Remove a wire edge
9. A. Hold plane iron to the whetstone at correct angle
10. A. Properly replace plane iron in hand plane

Grade: ____________________________
DEPARTMENT OF AGRICULTURAL ENGINEERING  
IOWA STATE UNIVERSITY  
TAH 1468

FEED SCOOP  
BEST COPY AVAILABLE

Construction Procedure:
1. Lay out and cut sheet metal and wood end
2. Cut and bore holes in strap iron, 1/8" x 1" x 9"
3. Cut light steel tubing, 1/2" x 5-1/2" for handle  
   (Note a 3/4" dowel rod may be used instead of  
   steel tubing)
4. Bend bottom sheet metal to fit end
5. Drill holes for screws and handle bolt
6. Screw metal to wood end
7. Heat and bend iron strap
8. Rivet on iron strap
9. Weld nuts in ends of tubing
10. Attach handle with 1/4" x 6-1/2" bolt
11. Finish and paint handle, bracket and wood end

Bill of Materials
1 - 10" x 14", 22 or 24 gauge galvanized sheet metal  
1 - 3/4" x 6" x 6" hardwood board  
1 - 1/8" x 1" x 9" hot rolled mild steel  
1 - 1/2" x 5-1/2" light steel tubing  
1 - 1/2" x 6-1/2" bolt  
2 - 1/4" nuts  
2 - 3/16" rivets  
6 - 3/4" #6 blued R.H. screws  
1/2 pint paint for end, handle and hand bracket

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correct overall dimensions</td>
<td>20</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>2. Sheet metal edges smooth, not sharp</td>
<td>10</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>3. Metal screwed to wood end</td>
<td>10</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>4. Handle bracket - bend and riveting</td>
<td>20</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>5. Nut welded in handle</td>
<td>10</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>6. Assembly and painting</td>
<td>20</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>7. Attitude and work habits</td>
<td>10</td>
<td>______</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td>______</td>
<td></td>
</tr>
</tbody>
</table>

Name ____________________________  
Date ____________________________  
Grade ____________________________
Bill of Material

1 - 1/2" x 5" octagon tool steel, .7 - .8 percent carbon content

Name ___________________________

Date ___________________________

Grade __________________________

Construction Procedure:
1. Heat outer 2-1/4" of stock to a uniform cherry-red color
2. Place one side against anvil face. Using drawing blows, work to shape rapidly starting at end and work back to 2-1/4" taper
3. Finish to 3/16" at tip and 5/8" width. Do not work below a dull-red color
4. Anneal - heat to cherry-red and cool slowly (12-24 hours) in lime or sand
5. File and polish forged faces - Do not grind
6. Temper with water: (Practice on old cold chisel)
   a. heat 2" to 3" of tip to uniform cherry-red color
   b. cool 3/4" to 1" until drops cling to tip when removed from water
   c. move tip to avoid cracks at water line
   d. quickly remove scale with steel brush or file
   e. observe color changes - quench lower 1/4" on purple color. Color order is light straw, dark straw, brown, purple, dark blue and light blue
7. Grind cutting edge to 60° angle. Use tool gauge to check angle
8. Chamfer end opposite point approximately 1/2" by 7/16" to prevent mushrooming

Construction Teaches:
(Ability to
Understanding of)
1. U. Carbon content of tool steel
2. A. Determine carbon content by spark test
3. A. Forge cold chisel
4. U. Purpose of annealing metal
5. U. Purpose of hardening metal
6. A. Distinguish tempering colors and determine heat range
7. U. Correct color for cooling metal to complete tempering process
8. A. To temper metal
9. A. To grind cutting edge on grinder
10. A. To chamfer on grinder
11. U. Use of cold chisel on metal
12. A. To cut metal with the cold chisel

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correct dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Chisel is 5-1/2&quot; long</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>b. True taper and correct length</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>c. Chamfer dimensions and squareness</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>d. Cutting edge is 5/8&quot; x 3/16&quot;</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>e. Cutting edge ground to 60° - edges even and straight</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2. Tempering - tip correct hardness</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>3. Overall appearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. Attitude and work habits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
DEPARTMENT OF AGRICULTURAL ENGINEERING
IOWA STATE UNIVERSITY

TAH 1668

DRAWBAR HITCH PIN

Construction Procedure:
1. Determine length of handle; I.D. + Thickness x 3.14
2. Shape handle around 2" pipe, use vise as bending aid
3. Cut pin to length
4. Drill hole and shape end of pin
5. Weld washer to pin
6. Place handle on pin and weld
7. Remove slag and clean with steel brush

Bill of Material
1 - 1/4" x 8" M1020 hot rolled round
1 - 3/4" flat washer
1 - 3/4" x 6" round, C1042 cold rolled or C1045 hot rolled

Evaluation Score Sheet:
<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Length of pin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Tapered area smooth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Washer square to pin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Washer spaced correctly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Weld on washer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Round handle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Handle centered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Weld on handle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Hole centered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Attitude and work habits</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Points: ___

Date: __________

Grade: __________

(Ability to .............
Construction teaches (Understanding of .............
1. U. Difference between low and medium carbon steel
2. U. Difference between hot and cold rolled steel
3. A. Determine length of handle
4. A. Measure distances
5. U. Correct hacksaw blade to select
6. A. Use the hacksaw
7. U. Need to center punch before drilling
8. A. Use center punch
9. U. Need to secure metal before drilling
10. A. Secure metal in drill vise
11. U. Need for correct drill speed
12. A. Adjust and use drill press
13. U. Correct grinding wheels and bolts
14. A. Adjust tool rests on grinders
15. A. Grind pin end
16. U. Correct electrode selection
17. A. Weld on handle and washer

Name: __________
SAWHORSE

Construction Procedure:
1. Lay out legs and beam with framing square
2. Cut leg angles and notch beam
3. Assemble with scaffold nails
4. Brace legs to desired measurements using temporary braces
5. Cut permanent leg braces, tack in place
6. Pre-bore screw holes in legs and braces
7. Disassemble, apply glue to legs, joints and braces
8. Assemble with temporary braces
9. Check measurements with framing square
10. Insert screws, remove temporary braces
11. Wipe off excess glue, allow glue to set
12. Finish with plane or sandpaper and paint

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Dimensions</em> - 20</td>
<td></td>
</tr>
<tr>
<td>Sawhorse height</td>
<td>8</td>
</tr>
<tr>
<td>Spread of legs</td>
<td>8</td>
</tr>
<tr>
<td>Beam extension</td>
<td>4</td>
</tr>
<tr>
<td><em>Angles</em> - 28</td>
<td></td>
</tr>
<tr>
<td>90° beam end to horizontal 4</td>
<td>6</td>
</tr>
<tr>
<td>Centerline, equal spread</td>
<td>6</td>
</tr>
<tr>
<td>of legs</td>
<td></td>
</tr>
<tr>
<td>Bevel, bottom of legs</td>
<td>8</td>
</tr>
<tr>
<td>All legs on floor</td>
<td>8</td>
</tr>
<tr>
<td><em>Joint Preparation</em> - 24</td>
<td></td>
</tr>
<tr>
<td>4 leg joints</td>
<td>12</td>
</tr>
<tr>
<td>2 outside braces</td>
<td>6</td>
</tr>
<tr>
<td>2 inside braces</td>
<td>6</td>
</tr>
<tr>
<td><em>Assembly and Finish</em> - 28</td>
<td></td>
</tr>
<tr>
<td>Screws, nails and glue</td>
<td>10</td>
</tr>
<tr>
<td>properly used</td>
<td></td>
</tr>
<tr>
<td>Finish</td>
<td>8</td>
</tr>
<tr>
<td>Work habits and attitude</td>
<td>10</td>
</tr>
<tr>
<td>Total points</td>
<td>100</td>
</tr>
</tbody>
</table>

Bill of Material

1. 2" x 4" x 3'0" Const. Douglas Fir
2. 1" x 4" x 9'0" #2 White Pine
3. 1" x 8" x 2'6" #2 White Pine
4. 24 - 1-1/2" #9 Bright P.H. Screws
5. 1 pint of paint, desired color
6. 4 oz. of Resorcinol Resin or Casein Glue

Step-by-Step Layout Procedure:
Bult. 165, Sawhorse Layout with the Framing Square, Holoar Publications, 1305 Tiller Lane, St. Paul, Minnesota - 75c
Wiring The Time Delay Relay

Part Identification:
1. 
2. 
3. 
4. 
5. 
6. 
7. 

Operation Teaches: (Ability to . . .
(Understanding of . . .
1. A. Identify the parts of the time delay
2. B. The function of the various parts
3. C. The use of metals with different linear expansion
4. D. Properly wire a time delay relay
5. E. The various applications of the time delay relay
6. F. To determine the type of relay by observing the coding
7. G. Use safe work habits with electrical connections and wiring

Operational Questions:
1. Complete the part identification section.
2. Determining the type of relay
   A. List the code found on the relay
      a / b / c
   B. What does the code relate:
      a.
      b.
      c.
   C. Observe the contact points on the 115C15. Are they together or are they apart?
   D. Observe the contact points on the 115NO15. Are they together or are they apart?
3. Wiring the 115C15 delay relay
   A. Connect using the diagram in the time delay exercise. What is the maximum load that can be used directly with this relay?
   B. Energize the circuit. Does the bulb light immediately?
   C. Does the bulb come on or does it go off after the heater element gets warm?
   D. De-energize the circuit. Now energize the circuit, does the bulb come on immediately? Why?
4. List specific applications for both the NO and NC type relay

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Points</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Part Identification</td>
<td>28</td>
</tr>
<tr>
<td>2. Operational Questions</td>
<td>22</td>
</tr>
<tr>
<td>3. Correct Wiring Relay</td>
<td>25</td>
</tr>
<tr>
<td>4. Observing Safety Proced.</td>
<td>15</td>
</tr>
<tr>
<td>5. Attitude and Work Habits</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL 100</td>
<td></td>
</tr>
</tbody>
</table>

Materials:
1-115N015 Time Delay Control
1-115C15 Time Delay Control
1-Light Bulb and Socket
3-Black Leads
2-White Leads

Job sheet prepared in cooperation with Allan Petersen.

NAME _______________________________ GRADE ________

DATE ____________
Rafter Layout Teaches: (Understanding of.....)

1. U... name building parts
2. A... name parts of square
3. U... uses of framing square
4. A... to calculate pitch
5. A... to layout rafter with step method
6. U... of common rafter tables
7. A... layout rafter using rafter tables
8. A... layout rafter with tail and w/o tail
9. A... layout rafter with and w/o ridgeboard

Score Sheet:
1. Identification 15 pts.
2. Pitch 15 pts.
4. Rafter layout on 2 x 4 15 pts.
5. Plumb cut 5 pts.
7. Tail 5 pts.
8. Length of rafter with
   a. Shapleigh 10 pts.
   b. Stanley 10 pts.
9. Exactness and work habits 10 pts.
Total Score 100 pts.

Materials Needed:
1. 2x3 scale framing square
2. Framing square
3. Shapleigh & Stanley rafter tables
4. Suitable lumber for layout

Identification:
1. ____________________ 9. ____________________
2. ____________________ 10. ____________________
3. ____________________ 11. ____________________
4. ____________________ 12. ____________________
5. ____________________ 13. ____________________
6. ____________________ 14. ____________________
7. ____________________ 15. ____________________
8. ____________________

Layout Procedure:
1. Identify parts of building
2. Identify parts of framing square
3. Calculate pitch
4. Layout rafter at bottom of page with
   step method No of Steps
5. Layout rafter w/o tail with
   Shapleigh & Stanley tables:
   Shapleigh length
   Stanley length/ft run
   Total length
6. Layout rafter with tail:
   Length of tail
USE OF THE TORQUE WRENCH

Operation Teaches: (Understanding of ... (Ability to ........)
1. U torque measurement
2. U run-down resistance
3. U set or seizure
4. A identify parts of torque wrench
5. A convert inch pounds to foot pounds
6. A select proper torque setting
7. A properly hold and use torque wrench

Score Sheet:

<table>
<thead>
<tr>
<th>Points</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identification</td>
<td>6</td>
</tr>
<tr>
<td>2. Selection of correct torque setting</td>
<td>15</td>
</tr>
<tr>
<td>3. Conversion of foot to inch pounds</td>
<td>15</td>
</tr>
<tr>
<td>4. Conversion of inch to foot pounds</td>
<td>15</td>
</tr>
<tr>
<td>5. Correct wrench setting</td>
<td>15</td>
</tr>
<tr>
<td>6. Proper torque on bolt or spark plug</td>
<td>25</td>
</tr>
<tr>
<td>7. Exactness and work habits</td>
<td>7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
</tr>
</tbody>
</table>

Identification:
1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Operating Procedure:
1. Select torque setting
2. Convert readings as necessary
3. Set correct reading on wrench
4. Select correct socket
5. Measure run-down resistance
6. Add run-down resistance to torque setting
7. Set corrected reading on wrench
8. Correct for set or seizure
9. Torque bolt or plug to proper reading
10. Convert 960 inch pounds to foot pounds = ft. lbs
11. Convert 30 foot pounds to inch pounds = in. lbs

Materials Needed:
1. Torque wrenches
2. Correct size sockets
3. Small gas engines or other equipment which requires torque measurement

NAME ____________________________
DATE ___________________________ SCORE __________

25
Part Identification:
1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Operation Teaches: (Ability to......  
(Understanding of......  
1. A. Identify parts of photoelectric control  
2. U. How a photoelectric cell operates  
3. U. Applications of a photoelectric control  
4. A. Correctly wire the control into a lighting circuit  
5. A. Select proper control for specific application  
6. A. Observe and use safe working habits with electrical wiring  

Materials:
1. Photoelectric control mounted on board with connection leads  
2. Light bulb and socket  
3. White leads, No. 18 stranded  
4. Black leads, No. 18 stranded  

Evaluation Score Sheet:
1. Part Identification: 
2. Control Spec. Questions: 
3. Control Operation: 
4. Correct wiring of control: 
5. Observing Safety Proceed.: 
6. Attitude and Work Habits: 

TOTAL: 100

Name: ____________________________
Date: ________________    Grade: ________________

Department of Agricultural Engineering  
Iowa State University  
TAH 2169  

Photoelectric Control

Operational Procedure:
1. Complete the part identification section.  
2. Specifications of control (Remove Control Cover)  
   A. What is the voltage rating of the control? ______ volts.  
   B. What is the maximum rating in watts of this control? ______ watts.  
   C. Approximately how many 100 watt lights could this device control at one time without damage to it? ______ lights.  
   D. What is the purpose of the louver inside the glass lens? _______  
   E. Is the control switch in a NO or NC position when not connected to a power source? _______  
   F. Could this control be used to directly control a 1/2 h.p. motor? ________ Why, or why not? ________  

3. Operation of control - Briefly describe how this control operates when connected to a power source and to a load as light strikes the photo cell. ______  

4. Wiring the control in a circuit.  
   A. Connect using the diagram as shown.  
   B. Place the control in a well lighted area. Energize the circuit. Does the bulb light? ________  
   C. Cup your hand over the glass lens, does the bulb light or go off? ________  
   D. If you desired the bulb to come on at dusk or early evening rather than at darkness, would you open or close the louver adjustment? ________  

5. List specific application for this control. ________  

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[Diagram of a photoelectric control with parts labeled 1 through 7]
Welding Exercise:
3 beads
2 butt welds
2 fillet welds

Note: Welds may be turned in separately for grading or may be fabricated into project as shown.

Operation Teaches: (Ability to ..... (Understanding of ..... 
1. Use Types of Welds
2. Use Types of Joints
3. Use Types of Electrodes
4. Use Effects of Distortion
5. Use Correct Electrode
6. Use Correct Amperage
7. Use Correct Joint Preparation
8. Use Correct Safety Equipment

Materials:
2 - 4"x4"x4" Steel plates
1 - 2"x4"x4" Steel plate
E6011, E6013, or E7018 Electrodes

Evaluation Score Sheet:
<table>
<thead>
<tr>
<th>Points Possible Earned</th>
<th>Points Possible Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Three beads</td>
<td>30</td>
</tr>
<tr>
<td>2. Two butt welds</td>
<td>20</td>
</tr>
<tr>
<td>3. Two fillet welds</td>
<td>20</td>
</tr>
<tr>
<td>4. Freedom from spatter</td>
<td>5</td>
</tr>
<tr>
<td>5. Freedom from distortion</td>
<td>5</td>
</tr>
<tr>
<td>6. Exercise-Electrode Sel.</td>
<td>15</td>
</tr>
<tr>
<td>7. Work habits-attitude</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

A. Steps in Selection of Materials and Procedures in Welding
1. Examine base metal
   - type of metal, carbon content, thickness
   - type of weld, type of joint, appearance desired, strength needed, position of the weld.
2. Select correct electrode
   - Electrode number, electrode size
3. Select correct amperage
4. Select correct joint preparation
   - Cleaning, veeing, clamping
5. Select correct safety equipment
   - Safety glasses, helmet with No. 10 eye shield, leather gauntlet gloves, hard finish clothing.

B. Steps in Making the Weld
1. Strike the arc - Scratch or tap method
2. Pre-heat - Hold long arc until molten pool is desired size.
3. Lay the bead - (a) Electrode angle -- 15° from vertical in direction of travel; (b) Arc length - 1/16" to 1/8" makes frying sound; (c) Speed of travel - watch width (2 X electrode dia.), height and shape of molten pool.
4. Fill the Crater: E6013 - shorten the arc, reverse direction, pull out from rear of pool; E6011 - raise electrode slowly

Electrode Selection -- Common Farm Electrodes
1. E6011  6. Special Electrodes
2. E6013  a. Est
3. E7018  b. Cutrod
4. ENI    c. Chamferrod
5. Hardsurfacing

Exercise—Electrode Selection
Given the following situations, select the correct electrode:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Electrode</th>
<th>Size</th>
<th>Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thinner metals -(1/8&quot;)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good appearance desired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor fit of joint</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thicker metals (3/8&quot;)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirty and rusty metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep penetration desired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium carbon steels (1/4&quot;)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High quality bead desired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High strength desired</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name

Date  Grade
Gage can be used to measure:
1. Cold chisel cutting angle
2. Twist drill, cutting edge angle and length
3. Twist drill, lip clearance

Bill of material:
1-7/8" x 4-1/16" x 3/32"
(aluminum or brass (aluminum is easier to work))

### Construction procedure:
1. Square one corner of aluminum or brass stock.
2. Measure and scribe outline on stock with awl.
3. Mark graduations with awl.
4. Cut out tool gage with hacksaw. (Use protective blocks on each side when cutting in vice.)
5. Dress to the lines with file, bevel corners.
6. Use corner file to cut chisel vee.
7. Polish with steel wool.
8. Submit to instructor for evaluation.

### Construction teaches:
(Ability to . . .
Understanding of . . .
1. U. Selection of the correct material
2. U. Selection of the correct hacksaw blade
3. U. Selection of the correct files
4. U. Correct methods of finishing and polishing stock
5. A. Measure and transfer outline of gage to stock
6. A. Scribe outline on metal with awl
7. A. To calibrate and indicate rule marks on metal
8. A. To correctly use the hacksaw
9. A. To correctly use the metal file
10. A. To do draw filing
11. A. To cut a vee with a taper file
12. A. To finish flat stock

### Evaluation score sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Length of gage</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2. Width of narrow end</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Width of wide end</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. Vee position for cold chisel angle</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Angle for drill cutting edge</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6. Accuracy of the 1&quot; and 1/2&quot; rules</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. Angle for drill lip clearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Correct angle and size of bevel corners</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>9. Finish</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>10. Attitude and work habits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
DRILL BIT, BOLT AND WASHER GAUGE

Construction Procedure:
1. Measure and scribe outline on stock.
2. Cut out with hacksaw.
3. Use flat file to file all edges.
4. Measure out and center punch for holes.
5. Select bit, position and drill holes.
6. Measure and scribe lines for inside diameter gauges.
7. Cut marks with cold chisel.
8. Measure and scribe 4" rule in 1/4" graduations.
9. Cut marks with cold chisel or other sharp tool.
11. Mark in numbers identifying size of gauges and rule.
   Use engraving, metal stamp set, or paint on numbers.

Construction Teaches: (Understanding of ..............)
1. U. Selection of flat stock.
2. A. Read plans, measure and scribe.
3. A. Use awl.
5. A. Use hacksaw.
6. U. Correct file selection and operation.
7. A. File correctly.
8. U. Need for center punching and securing metal for drill.
9. A. Selection of proper bit sizes.
10. A. Adjust and operate drill press.
11. A. Measure and scribe gauge and rule marks.
13. A. Use abrasive wheel and emery cloth for finishing.
14. A. Use engraving tool, metal stamps, or line painting techniques.

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible Points</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Length of right side</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2. Length of left side and lip</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Angle of bottom</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4. Width of top</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5. Correct placement of holes</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6. Accuracy of inside of diameter gauge</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>7. Accuracy of rule marks</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>8. Number identification</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9. Finish</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10. Attitude and work habits</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bill of Material
1 - 2 1/4 x 6 1/4 - 3/32" stainless steel, mild steel, brass or 1/8" aluminum

Gauge Applications:
1. Drill bit size (series of holes) Used to determine the size of a bit or bolt.
2. Inside diameter (points on bottom and left side). To measure inside diameter of hole to determine size of bolt and size of given washer.
3. Bolt length (graduated rule on left). To determine length of bolt required, a given bolt, and the threads on a given bolt.
Construction Procedure:
1. Cut head with oxyacetylene torch
2. Grind head to shape
3. Cut round stock to length and bend handle
4. Fusion weld or braze handle
5. Hardsurface head ends with oxyacetylene torch
6. Reshape head ends

Construction teaches (Understanding of)
1. A. To read dimensions
2. A. To layout a project
3. U. Oxyacetylene cutting principles
4. A. To cut metal with oxyacetylene torch
5. A. To bend handle to shape
6. U. Fusion welding or brazing
7. A. Fusion weld or braze
8. V. Hardsurfacing principles
9. A. Apply hardsurfacing with the oxyacetylene torch
10. U. Grinder wheels, belts and files
11. A. Shape ends of head

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Length of head</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2. Length of handle</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Shape of handle</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. T per on head ends</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Brazing or welds</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6. Hardsurfacing</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>7. Overall appearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Attitude and work habits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total Points</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bill of Material
1 - 1/2" x 1" x 5 1/2" M.S.
1 - 3/8" x 15" H.R. round M.S.
(an old chisel or punch could be used for the head)

Name: __________________________
Date: ________________ Grade: _____
Bill of Material

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; x 1&quot; x 6&quot; H.R. mild steel</td>
<td>1</td>
</tr>
<tr>
<td>1/2&quot; x 1&quot; x 2 1/4&quot; H.R. mild steel</td>
<td>1</td>
</tr>
<tr>
<td>1/2&quot; x 1&quot; x 3 1/4&quot; H.R. mild steel</td>
<td>1</td>
</tr>
<tr>
<td>1/4&quot; x 1&quot; x 1 1/4&quot; H.R. mild steel</td>
<td>1</td>
</tr>
<tr>
<td>1/4&quot; x 3 1/4&quot; C.R. round</td>
<td>1</td>
</tr>
<tr>
<td>1/2&quot; x 7&quot; rod</td>
<td>3</td>
</tr>
<tr>
<td>1/2&quot; nuts</td>
<td>1</td>
</tr>
<tr>
<td>3/8&quot; washer</td>
<td>1</td>
</tr>
<tr>
<td>#12 x 1/2&quot; machine screw</td>
<td>1</td>
</tr>
</tbody>
</table>

Construction Procedure:

1. Measure and cut all materials
2. Thread 1/2" bolt, run on two nuts
3. Center bolt end
4. Drill pilot hole and tap for #12 x 1 1/2" m. screw
5. Place washer on bolt, braze bolt into threads
6. Braze nut to washer
7. C. punch, bore handle hole for snug fit
8. Install handle, weld if necessary
9. Bevel metal at sections AA
10. Arc weld at AA, BB and DD
11. Clean welds, prepare for grading

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Points Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurements of frame</td>
<td>20</td>
</tr>
<tr>
<td>Welds, arc</td>
<td>15</td>
</tr>
<tr>
<td>Brazing</td>
<td>5</td>
</tr>
<tr>
<td>Centering of handle</td>
<td>5</td>
</tr>
<tr>
<td>Nut attachment to bolt</td>
<td>5</td>
</tr>
<tr>
<td>Squareness</td>
<td>20</td>
</tr>
<tr>
<td>Quality of threads</td>
<td>10</td>
</tr>
<tr>
<td>Work habits</td>
<td>20</td>
</tr>
</tbody>
</table>

Name ____________________________
Date ____________________________ Grade _______
THE ELECTRIC MOTOR NAMEPLATE

Part Identification:

1. ___________________________ 8. ___________________________
2. ___________________________ 9. ___________________________
3. ___________________________ 10. ___________________________  
4. ___________________________ 11. ___________________________
5. ___________________________ 12. ___________________________ 
6. ___________________________ 13. ___________________________
7. ___________________________ 14. ___________________________

Operational Procedure:

1. Complete the part identification section.
2. What other phase might be found on the motor nameplate?
3. If this motor did not have a built-in overload protection device, what size and type fuse should be used for protection on 120 volts?  
   Type _______ Size _______
4. How would a motor having 50°C rise differ from this motor? ________________________________________________________________________________________________________________________________________________________________________________________________________________________
5. What would a service factor of 1.25 indicate on an electric motor? ________________________________________________________________________________________________________________________________________________________________________________________________________________________
6. What other cycles per second might be found on electric motors?
7. Using the below formula, what is the locked rotor amperage for this motor on 120 volts? ________________________________________________________________________________________________________________________________________________________________________________________________________________________
   Locked KVA = \( \frac{1000 \times HP \times KVA/HP}{1.60 \times Volts} \)
   KVA/HP for various codes are:
   1. 7.1-8.0, K = 8.0-9.0 & 1. = 9.0-10.0
8. Compute the wattage for this electric motor on 120 volts ____ watts, on 240 volts ____ watts.
9. What other types of enclosures are commonly found on electric motors? ________________________________________________________________________________________________________________________________________________________________________________________________________________________
10. Collect the following data from an electric motor on your home farm or one provided by your instructor.

<table>
<thead>
<tr>
<th>Type</th>
<th>Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP</td>
<td>Locked KVA code</td>
</tr>
<tr>
<td>Cycle</td>
<td>Temperature rise</td>
</tr>
<tr>
<td>Volts</td>
<td>RPM</td>
</tr>
<tr>
<td>Amperage</td>
<td>Duty cycle</td>
</tr>
<tr>
<td>Service factor</td>
<td>Type enclosure</td>
</tr>
<tr>
<td>Thermal Protection</td>
<td>Type bearings</td>
</tr>
</tbody>
</table>

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible Points</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Identification (2 pts/item)</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Operational Questions (3 pts/item)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Information from Motor</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Attitude and Work Habits</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Skill sheet developed by Lee Stence and edited by Thomas A. Hoerner.
ADJUSTABLE SAFETY JACK

Construction Procedure:
1. Measure and cut metal to dimensions
2. Heat 3/8" rod in forge. Use hammer and anvil to form a 1" I.D. eye. Grind end to taper
3. Form 1/2" handle as shown with 4-1/2" spread
4. Drill 3, 3/8" holes in 2" pipe at 9", 10", and 11". Make 10" hole perpendicular to others
5. Drill 6, 7/16" holes in 1-1/2" pipe at 1-1/2" intervals. Start 3" from the bottom
6. Weld handle to 2" pipe as shown
7. Weld channel and safety plate to pipes as shown. (You may use standard pattern for non-skid feature)
8. Chip welds, grind rough edges, clean metal, and paint desired color
9. Attach chain and pin to handle

Bill of Material:
1 - 1/4" x 6" x 6" safety plate for base
2 - 2" x 12" standard black iron pipe, 2.375" O.D.
1 - 1-1/2" x 17-1/2" standard black pipe, 1.90" O.D.
1 - 3" structural channel 4" depth, .18" web thickness, 1.580" flange
1 - 1/2" x 8" mild steel rod for handle
1 - 3/8" x 8" mild steel rod for pin
1 - 12" chain
1 pint desired color primer and paint

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Base metal cut square</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2. Holes centered and to dimension</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>3. Eye pin formed to dimension</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4. Pipes, plate and channel at 90 degree angle</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Weld appearance, penetration</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6. Painting</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. Overall appearance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Attitude and work habits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

Name: ______________________  Date: ____________  Grade: ____________
**Funnel**

**Construction Procedures:**

1. Lay out pattern for body and spout on stiff paper or on the sheet metal. Allow 1/2" for a lock joint seam, and 1/4" for lap joint on the spout.

2. Trace pattern on sheet metal with scribes or dividers, cut out with tin snips, aviation snips or electric shears.

3. Fold edges of the body in opposite directions to form a lock joint.

4. Hook folded edges together and set with hand groover to make a tight seam.

5. Form spout over a stake, and solder the lap joint.

6. Peen a small flange on large end of spout and drop it into the body.

7. Solder the spout in place. Inside and out.

8. Solder the seam of the body.

9. Form a ring with the wire and fasten to the upper edge of the body.

10. Remove flux and dress rough edges for grading.

**Bill of Material**

1 pc - 10" x 12" No. 26 or 28 gauge galvanized metal

1 pc - No. 14 steel wire, 3" long (optional)

**Evaluation Score Sheet:**

<table>
<thead>
<tr>
<th>Points Possible</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Measurements</td>
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</tr>
<tr>
<td>Lock Seam</td>
<td>10</td>
</tr>
<tr>
<td>Lap Seam</td>
<td>10</td>
</tr>
<tr>
<td>Soldering</td>
<td>10</td>
</tr>
<tr>
<td>Top, Round</td>
<td>10</td>
</tr>
<tr>
<td>Spout, Round</td>
<td>10</td>
</tr>
<tr>
<td>Overall Appearance</td>
<td>10</td>
</tr>
<tr>
<td>Attitude &amp; Work Habits</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td></td>
</tr>
</tbody>
</table>
CASE HARDENING OF MILD STEEL

Steel Temperature Diagram

Temperatures of steel (°F)

(A) 2800°
(B) 1650°
(C) 1333°
(D) 2050°
(E) 1000°
(F)

Colors of steel

Percent Carbon

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8

Identification of parts of diagram

A. __________________________
B. __________________________
C. __________________________
D. __________________________
E. __________________________
F. __________________________
G. __________________________
H. __________________________

Case Hardening Procedure

1. Clean the stock to be hardened
2. Place carburizing compound in flat metal pan
3. Heat stock with oxy-acetylene torch to 1650°F (bright red)
4. Submerge stock in carburizing compound until a fused shell is formed on stock
5. Re-heat stock to 1650°F
6. Quench stock in water using a scrubbing motion
7. Spark test surface of stock to check carbon content
8. Use file to check surface for hardness

Evaluation Score Sheet

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible</th>
<th>Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification (5 each)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Carbon content of surface</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Hardness of surface</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Evidence of clean stock</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Safety and work habits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Name __________________________ Grade __________

Date __________________________
Materials: One portable oxy-acetylene welding unit.

Operational Procedure:
1. Complete the part identification section.
2. Answer the following questions:
   a. What is the capacity in cubic feet of the common oxygen cylinder? cu.ft. Of the common (no. 4) acetylene cylinder? cu.ft.
   b. What is the full cylinder pressure in psi at 70°F of the oxygen cylinder? psi Of the acetylene cylinder? psi.
   c. On which gages (by letter in the picture) can the cylinder pressure be read for oxygen, for acetylene.
   d. What is the letter of the gages indicating the line or working pressure for oxygen, for acetylene.
   e. List the pressure range on the high pressure gages for oxygen to , for acetylene to .
   f. What is the pressure range on the working pressure gage for oxygen to , for acetylene to .
   g. What is the common color of hoses and equipment for oxygen, for acetylene.
   h. List the type of threads for equipment and connections for oxygen, for acetylene.
   i. What is the maximum working pressure for safe operation for acetylene? psi.
   j. Describe the purpose of the fusible plugs and bursting disc on the cylinders.
   k. Describe the recommended method for checking for leaks.
3. On the back of this sheet list the complete procedure for set up and connection of the oxy-acetylene welding unit.

Skill sheet developed by Dean Ludwick and edited by Thomas A. Hoefer.
Operational Procedure:

1. Complete part identification & direction of travel arrow on drawing.
2. Select base metal to be used—1/16" to 1/8" thick and 2" x 4".
3. Mechanically clean metal 1/4" to 1/2" on edges to be butted together.
4. Select braze welding rod, either bare or flux coated, 1/8" in diameter.
5. If bare rod used, select correct powdered braze welding flux.
6. Position pieces of mild steel; make sure they fit tightly together.
7. Using a neutral flame, (O-5#, A-5#) preheat base metal to cherry red, approximately 1600°F.
8. Chemically clean metal by applying brazing flux with rod to area where braze welding rod is to adhere. Keep temperature of base metal at 1600°F.
9. Tin surface of weld by applying a thin coating of braze welding rod. Use forehand technique as shown in drawing. Manipulate rod and flame so that base metal melts rod. Overheating rod will cause zinc to be burned away.
10. Keep temperature of base metal at approximately 1600°F. Complete weld by manipulating braze welding rod and flame back and forth as the weld is moved down the metal surfaces. Build up weld to approximately 1/16" thick and 1/2" wide.
11. Allow weld to cool slowly.
12. Clean excess flux from weld by buffing or maul.
13. Test weld by placing in vise to edge of base metal. Bend to 90° angle, away from bottom or back of weld. Weld should not break away from base metal.
14. Submit completed weld for instructor evaluation.

Materials:
Oxy-acetylene welding unit.
Braze welding rod, bare or flux coated, 1/8" diameter.
Braze welding flux if using bare rod.
Two - 2" x 4" x 1/16" to 1/8" steel plates.

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mechanically cleaning of metal</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2. Proper selection of rod and flux</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. Use of equipment, pressures and flame</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4. Chemically cleaning of base metal</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. Manipulation of braze welding rod and blowpipe tip</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6. Uniformity of weld</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>7. Strength of weld</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8. Appearance of weld</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9. Safe work habits and attitudes</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Operation Teaches: (Ability to........)
(Understanding of...
1. U. The braze welding process.
2. A. Select braze welding rod and flux.
3. A. Safely operate oxy-acetylene unit.
5. A. Select proper flame.
6. A. To chemically clean base metal.
7. A. To tin base metal.
8. A. To manipulate blowpipe tip and braze welding rod in building up weld.

Name: ________________________________
Date: ___________________________ Grade ________
THE ARC WELDING PROCESS

Part Identification:
1. ____________ 6. ____________
2. ____________ 7. ____________
3. ____________ 8. ____________
4. ____________ 9. ____________
5. ____________

Operational Procedure:
1. Complete the part identification of the arc welding process illustrated to the left.
2. Study the two methods of striking the arc.
3. Identify the two methods illustrated.
4. Which method is probably the easiest for the beginner?
5. Which method is recommended when welding on an AC machine?
6. Explain why a long arc should be held momentarily when beginning a weld?
7. Shortening the arc length causes the amperage to increase - decrease.
8. List the 4 characteristics that most influence the quality of an arc weld.
   a. ____________
   b. ____________
   c. ____________
   d. ____________
9. Establishing the molten pool:
   a. Select an E6011 or E6013 electrode and a piece of mild steel 1/4" thick and 2" x 4".
   b. Select an arc welding machine and set the amperage at 100-115 amps.
   c. Dress safely and properly for arc welding.
   d. Using the two methods of striking the arc, establish the molten pool and complete two short arc welded beads 1/2" to 1" in length following the characteristics discussed in item 8.
   e. Clean slag from welds and evaluate beads and quality of molten pool.
10. Complete 3 beads 1 1/2" to 2" in length practicing the techniques and methods of striking the arc discussed. Submit beads for evaluation.

Evaluation Score Sheet:

<table>
<thead>
<tr>
<th>Item</th>
<th>Points Possible</th>
<th>Points Earned</th>
</tr>
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<tbody>
<tr>
<td>1. Part Identification (2 pts)</td>
<td>18</td>
<td>____________</td>
</tr>
<tr>
<td>2. Methods of striking the arc</td>
<td>5</td>
<td>____________</td>
</tr>
<tr>
<td>3. Questions 4-8 (1 pt)</td>
<td>8</td>
<td>____________</td>
</tr>
<tr>
<td>4. Quality of molten pools</td>
<td>25</td>
<td>____________</td>
</tr>
<tr>
<td>5. Arc beads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Uniformity</td>
<td>10</td>
<td>____________</td>
</tr>
<tr>
<td>b. Speed of travel</td>
<td>8</td>
<td>____________</td>
</tr>
<tr>
<td>c. Length of arc</td>
<td>8</td>
<td>____________</td>
</tr>
<tr>
<td>d. Proper amperage</td>
<td>8</td>
<td>____________</td>
</tr>
<tr>
<td>6. Safe working habits</td>
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<tr>
<td>Total</td>
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Date: ____________ Grade: ____________