Surfer Balancing Man

Legs

1) Find the 1/8” Diameter round bar and measure out 24” and mark with a pencil or marker (it is long because this is all of the pieces and it makes it easier to bend when it is long). Cut off using a hacksaw and put the material back where you found it.

2) Clamp your material close to the top of the vice and use a smooth file to flatten the round bar and deburr any sharp edges on both ends of material.

3) Mount the bending jig marked “LEG” in a vice to form your legs. Place the end of your round bar into the hole until it stops moving. Then bend the material over the top, around the angled “crotch” form, and down over the edge of the jig. Remove rod and inspect. If the bend is not enough or the last leg is not the right angle, reinstall in the jig and bend more.

4) Mount round bar in the vice and cut off the extra material from the leg so the length of the legs are the same. Re flatten and deburr with a smooth file.

Back

1) Flatten and deburr the end of the 1/8” Dia round bar with a smooth file in the vice.

2) Mount the jig marked “BACK” in a vice.

3) Place round bar material down into the jig until the material stops moving. Slightly bend the material around the round bar to give the back a slight arch (to first bend line on jig).

4) Measure out 25 mm with a pencil or marker and cut using a hacksaw. Remember to clamp material as close to the vice as possible to reduce vibrations and speed up the cutting.

5) Flatten and deburr the end of the material with a smooth file.

Arms

1) Flatten and deburr the end of the 1/8” Dia round bar with a smooth file in the vice.

2) Mount the jig marked “ARMS” in a vice.

3) Place round bar material between the dowel pins and bend the contour of the arms around the dowel pins as shown on jig.
4) Measure out length (65 mm or edge of jig as shown) and mark with a pencil or marker for your cut line.

5) Mount close to jaws in a vice and use a hacksaw to cut to length.

6) Flatten and deburr the end of the 1/8” Dia round bar with a smooth file in the vice.

Surfboard

1) Cut out paper template from page of handout. Cut carefully as this will be your template to shape your metal surfboard.

2) Measure out 4 1/4" (106 mm) of 1” x 1/8” flat bar metal, mark with a pencil.

3) Mount in a vice so your mark is close to the jaws of the vice and cut off with a hacksaw.

4) Mount the flat bar in a vice so the top surface just sits above the vice jaws.

5) Draw file the entire surface until the surface is uniform and shiny. Use a file card to clean the file if the file gets plugged with metal.

6) Wrap 60 grit emery cloth (sand paper on a roll) around the file and draw file until all of the file marks are sanded out and only 60 grit scratches are seen. Repeat this process with 80 grit, 120 grit, and 220 grit. Do not rush through the grits or you will have deep scratches that do not get removed. Work effort pays off here!

7) Flip over the flat bar and repeat steps 4-6 for the second side of the surfboard.

8) From this point on, you must use aluminum soft jaws to clamp your piece or else you will have jaw marks left in your piece from the vice. The aluminum soft jaws will not damage your hard work.

9) Cut out the surfboard paper template and use a glue stick to cover the entire paper template and the shiny clean piece of flat bar. Center the template and stick to flat bar making sure you center the paper template to the center of the flat bar. Using a marker (sharpie) trace the outline of the paper template so that the metal is marked to show the template in case the paper falls off.
10) Use a center punch and a hammer to accurately center punch the three holes to be drilled for the legs and the balancing rod.

11) Clamp the flat bar in a drill vice and set up the drill press with a 1/8” diameter drill. C Clamp the vice to the table once you have the drill centered over the center punch.

12) Drill the three holes completely through the material. Wait for the drill to stop spinning before setting up the next hole.

13) Set up a 1/4" drill bit and slightly drill the center hole so that there is a chamfer that is 1/4” in diameter. This is to allow room for the weld for the balancing rod from the underside which we can grind/file off flush to hide the weld on the topside.

14) Flip over the flat bar and drill the same size chamfer on the two outside holes (leg holes). These chamfers allow room for the weld for the legs on the underside so we can grind/file the weld flush on the underside.

15) Mount the flat bar in the vice so the square end is facing slightly up and the angled edge of the surfboard is straight down.

16) Use a hack saw and cut off the excess metal from the outside profile of the board. Repeat this until you have the four corners of the board roughly cut out. Do not cut into your paper template.

17) Grind the edges closer to the paper template profile using the bench grinder. Keep dipping your flat bar in the water quench bowl next to the grinder so you don’t burn your hands. Keep your fingers away from the spinning grinding wheel!

18) Use soft jaws in a vice and clamp your flat bar so the edges are close to the jaws but sticking out enough to be filled. File the outside profile until it matches the template outline. Deburr sharp edges all around the board by changing the angle of the file as you go across the edge. Finish the edges all around with the emery cloth to desired finish.

Balancing Rod

1) Measure out 1" of the 1/8” Dia round bar and cut off with a hacksaw in a vice.

2) Flatten and deburr both ends of the new piece you cut and the rest of your 1/8” Dia round bar in a vice.

3) Use the bench grinder and grind a point on one end of the 3/4” long piece. This will be your balancing bar pivot. Save this for later.

4) Use the jig marked “BACK” to bend a curve into the end of the left over piece (should be 13” long, if not cut and file it) so it is roughly 60 degrees with a nice curve (up to bend line that is further on jig).

5) Use the LARGE diameter pipe and a vice grip locking plier to clamp the other end of the round bar to the circumference of the large diameter pipe so the bar can be wrapped around the pipe.

6) Bend the round bar around the outside diameter of the large pipe until it meets the end where you bent with the jig. Don’t worry if the round bar springs back a little.

Welding the Surfer Together

1) Setup the gas welder. Open the Acetylene main bottle valves 2 turns and the Oxygen all the way (counter clockwise). Open the Acetylene torch valve and open the regulator for 5 PSI flow and then close the torch valve. Repeat for the oxygen. Grab your gloves and green tinted face shield.

2) Position the legs and the back so that the back is centered and sitting flush against the legs. Use a magnet to hold the metal in the right position and make sure it is over the welding bricks.

3) Turn on the acetylene torch valve a little bit and start the torch with a striker. Open the acetylene valve until the smoke goes away. Open the Oxygen torch valve slowly until the long white flame cone just meets the shorter blue flame cone.

4) Heat the back and legs where they meet evenly until there is a dull orange glow. Place the brazing rod against the joint and reheat until the brazing rod melts and connects the two pieces. Wait a minute for it to cool before moving it. Pick up with pliers and quench in a bucket of water.

5) Setup the back so it is resting on a 3/8” plain washer. Position the arms on top in a way that looks pleasing to the eye and in the correct placement. Leave a little bit of the back sticking out so it looks like a neck. Use magnets to hold the position.

6) Braze the washer to the back and then braze the arms to the back. Wait a minute for it to cool and then quench in a bucket of water with pliers.

Welding the Balancing Bar and Surfer Together

1) Put the end of the balancing bar with the small tight curve into the underside of the surfboard so it is flush with the topside (topside of surfboard facing up). Use magnets to hold its position so it doesn't move when welding.

2) Carefully heat the balancing rod and surrounding surfboard area around the rod until both start to go shiny and look wet. Place a steel welding rod on top of the melted rod/puddle and continue to add material until the chamfer fills with weld. Quench in bucket of water.

3) Use an air grinder with a sanding attachment to sand the weld tack down until it is flush with the top surface of the surfboard. Clamp in a vice with the topside up and repeat the draw filing with the grits of sandpaper to completely hide the presence of the weld.
4) Install the legs of the welded surfer into the topside of the surfboard so the legs are flush with the bottom of the board (bottom facing up so you can weld it). Use magnets to hold its position.

5) Carefully heat the leg and surrounding surfboard area around the rod until both start to go shinny and look wet. Place a steel welding rod on top of the melted rod/puddle and continue to add material until the chamfer fills with weld. Repeat for the other leg. Quench in bucket of water.

Balancing Weight

1) Measure out 1 1/4" of 3/4" Diameter round bar and mark with a pencil/marker. Clamp in the horizontal band saw vice cut off (**very slow** feed to prevent breaking the blade/having an angled cut). Put material back in material rack where you got it from.

2) Ask for Mr. Jurica to help you on the lathe. Clamp the material in the chuck with 1/4" sticking out from the chuck jaws. Use the cutter to face the end of the material clean.

3) Flip over the end of the material and clamp in the chuck with 1/4" sticking out from the jaws. Face off the end of the material.

4) Drill the end of the material with a 1/4" center drill until the chamfer is about ¾ of the way down the angled edge of the center drill.

5) Drill through the material with a 1/8" drill bit. Always use cutting oil to prevent the drill from overheating and breaking in the hole! Make small cuts and remove drill from the hole every cut to clear any chips that are building up in the hole.

6) Remove material and clean up the lathe before leaving.

7) Use the wire wheel to clean up any rust or scale on the balancing weight. Watch your fingers and make sure you have a face shield on!

8) Slide the balancing weight onto the end of the balancing rod that is not curved so that the chamfered end is facing the end of the balancing bar.

9) Clamp the balancing bar in a vice (soft jaws) so the end of the balancing bar is straight up and away from the weight.

10) Use a ballpein hammer to peen (round over) the end of the weight. This will prevent the weight from coming off.

11) Use a skinny bar or tool to figure out where the balance point is on the balancing bar and mark with a pencil or marker. This will be where the balancing bar pivot will go.

12) Set up the gas welder.

13) Position the balancing bar on a welding brick so that it is 90 degrees from where it normally would sit (on it's side). The balancing bar must sit flat so put the weight and surfer off of the edge of the welding brick. Use a magnet and position the balancing bar pivot so it is where your balance mark is and sitting against the balancing bar with the sharp point pointing away from the bar.

14) Carefully heat the two pieces until they are glowing dull orange and braze them together. Wait a minute for them to cool before quenching in the bucket of water.

Base

1) Carefully cut out the paper template for the base. Apply glue stick to the entire paper surface and attach to a piece of 20 gauge sheet metal (in the plywood rack in the compound). Make sure the sheet metal is clean and not dusty or it will not stick. Try to line up the edge of the sheet metal with the edge of the paper template to minimize waste of metal.

2) Using the squaring shear, line up the edge of the blade with the edge of the paper template (look straight down on the blade to line it up) and stomp the foot pedal to cut (Watch your fingers!).

3) Repeat until all edges are cut off.

4) Using the box and pan brake, line up the bend line on the paper template and clamp down the hold down lever. Ensure the edges of the fingers are lined up with your bend line. Using the bend lever, slowly bend the sheet metal until it is at roughly 45 degrees. It is easier to bend it further than bend back so sneak up on the angle.

5) Clamp the jig marked base into a vice. Slide the pointy tip under the pipe where it is welded to the angle iron to hold the end. Bend the sheet metal until the curved sheet metal is about 180 degrees (the pointy tip should be centered over the center of the square base).

6) Unclamp the locking pliers. Grab a hammer and a center punch. Carefully center punch the top surface of the pointy end of the base while it is supported with the pipe so it doesn't get hammered flat and distort the shape. The exact place to center punch should be right over the center of the square base.

Adjusting your balance

To adjust the balance between the surfer and the weight, slightly bend the balancing bar so the weight is closer or farther from the pivot.

To adjust the side to side balance (the surfer rolls forward and it tips off the point), the curve of the balancing bar must be curved more. If the balancing bar is too straight, it will roll the surfer forward or backwards.

Final clean up and paint

1) Use smooth files and 220 grit emery cloth to clean up and deburr and sharp edges on all parts.

2) Use Wax and Grease remover to clean up all of the parts so the paint will stick.

3) Hang the pieces in the paint rack outside with welding wire.

4) ASK MR J what method of painting we are doing! If he says spray paint then use instructions below.

5) Shake the spray paint can for 2 mins. Keep the spray can away about 8 inches form your part. Make sure the arrow on the nozzle is pointed away from you. Aim the spray can just off the part, press the nozzle down, and smoothly move the spray over the part until you are off the part. Repeat with about a 50% over lap over the entire part. Do a light coat or else too much paint will go on to your part causing drips (runs). It is better to do several light coats.

6) Hold the spray can upside down and press nozzle until the colour of the mist goes clear. This prevents paint from drying in the nozzle and making the spray paint can useless.

7) Let dry over night to prevent finger prints in your paint.

8) Put your name on the bottom of your base and the bottom of the surfboard with the engraver.

9) Look back at your hard work and what you have made with your own hands and smile!!

Metal Sculpture Evaluation

Proportions & Shape (sculpture correctly represents projects desired look)	/10
Welds & Construction (all sharp burrs & edges are removed, gas welding/brazing)	/10
Overall Finish (sculpture has appropriate amount of work invested, board sanded uniformly)	/10
Balance (sculpture balances correctly both side to side and along length)	/10
Employability skills (use of class time, off of cell phone, helping others, wasted time?)	/10