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To: junkyard_projects@yahoogroups.com
Subject: RE: [JunkyardProjects] Welding Information

RCI Technological Education

Project Name — Stick Welding Basics

Design Brief: To set-up and safely use the stick welder.

Context: Safety is first in the workshop. Read and understand all of the safety rules before using any tool or machine.

Possible Solutions: Have instructor demonstrate (mandatory) the tool first. Have another student demonstrate the tool. Read the manual that comes with the tool (mandatory). Ensure that you have been certified "competent" by the instructor before you use the tool (mandatory).

Detail Design: The following are the steps to safe usage of the stick welder:

1. Ensure that the work area is clear of hazardous materials (i.e., oil, gas, rags, wood, plastic, etc.)
2. Do not weld if your pants are frayed or torn as the frayed or torn edges can smolder from the weld splatter.
3. Put on leathers (jacket and gloves) and welding hood.
4. Ensure that the welder is off.
5. Attach the ground clamp to either your work or the metal table your work will be laying upon.
6. Put a welding rod in the electrode holder securely.
7. Ensure the ventilation fans are turned on.
8. Hold the electrode away from any metal and turn the welder on.
9. Hold the electrode about 2" above your work and say aloud, "shields down" and close your welding hood.
10. Lower the electrode until it contacts your work using either the scratching or the tapping method to start the electrode.
11. Move slow and steady, holding the electrode at a 20 degree angle in the direction of travel.
12. Lift up to finish your weld and then open your hood.
13. Hold the electrode away from any metal and turn off the welder.
14. Using a chipping hammer, chip off the slag. Ensure your welding hood has either a clear visor. Otherwise, use safety goggles while chipping off slag.
15. Put leathers, hood, extra electrodes, etc. away.

Materials: welder, electrodes, leathers (jacket and gloves), shielded hood.

Commissioning: Were you successful in this project when you tried it out?

Evaluation: Did this project work as you expected it to?

Reflection: Did you enjoy this project? What were you most proud of? What would you do differently next time?

RCI Technological Education

Project Name — *Shielded Metal Arc Welding* (*SMAW*) Welding Theory

Design Brief: To understand *Shielded Metal Arc Welding* (**SMAW**) or "*stick*" welding theory.

Context: Safety is first in the workshop. Read and understand all of the safety rules before using any tool or machine.

Possible Solutions: Have instructor demonstrate (mandatory) the tool first. Have another student demonstrate the tool. Read the manual that comes with the tool (mandatory). Ensure that you have been certified "competent" by the instructor before you use the tool (mandatory).

Detail Design: The following are the steps to understanding stick welding theory:

Rod Identification

Coating on a Rod

Provides a shield for the arc against contamination from oxygen and nitrogen in the air, which will enter the weld during the molten state

Slag

Slag forms after the weld is made. It protects the metal during cooling and shapes the weld. It is removed after the weld has cooled with a slag hammer and/or a wire brush.

Rod I.D. (E-7014)

E Means Electrode (arc electric weld)

70 Tensile strength in 1000psi (70,000psi)

1 Welding position (all position – flat, downhand, horizontal, vertical, overhead)

4 Refers to the power supply (AC or DC polarity); coating contains and iron powder, 30% faster metal deposit than most rods, producing low splatter and easy slag removal, and less chance of sticking

- Fast fill and fast freeze electrode, used where high speed is necessary
- Easy to start
- Very good for mild steel

Rod Size and Length

Rods vary in size for different thicknesses of metals and the amperage being used. Typical rod length is 14"

Electrode Diameter (inches)	*Amperes*
3/32	80-100
1/8	110-150 (1/4" to 3/8" plate)
5/32	140-190
3/16	180-260
7/32	250-325
1/4	300-400

Arc Welding Basics

Arc Length

Keep the tip of the rod 1/8" off the base metal (i.e., the thickness of the rod)

Angle of Electrode

Perpendicular to the metal and 20º – 30º in the direction of travel.

Striking the Arc

Two methods to strike the arc are used: scratching and tapping.

Scratching is similar to striking a large match.

Tapping is a straight up and down tapping motion

Strike the arc by moving the electrode down until it touches the base metal. When a burst of light appears,

move the electrode up ¼", hold for a few seconds, then lower the electrode to 1/8" off the base metal.

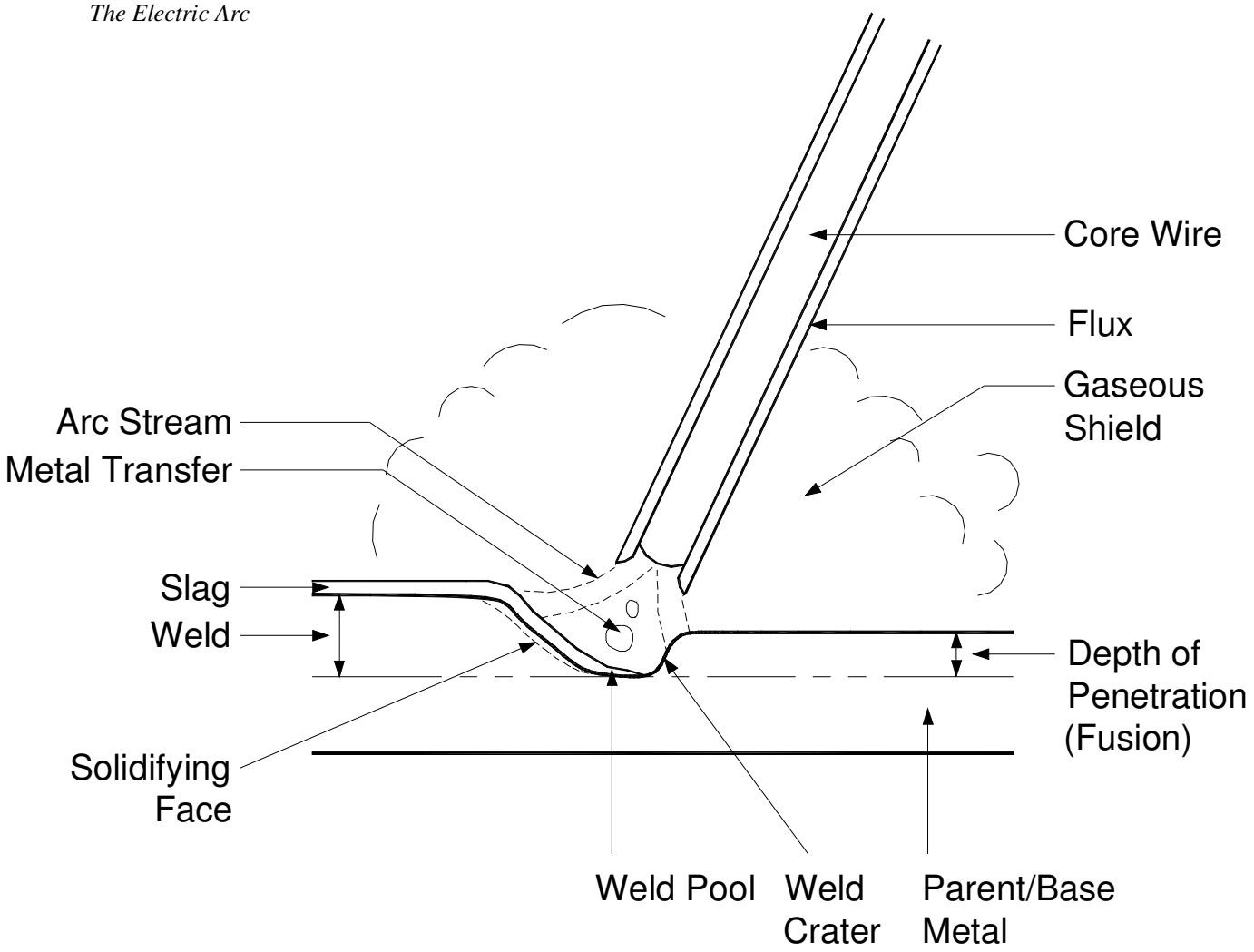
Types of Machines

There are three main types of machines used in arc welding.

1. An AC (Alternating Current) machine has the electric current flow in one direction but then reverses
   direction at regular intervals. This is a transformer-type machine (often called a "buzz box").
2. A DC (Direct Current) machine has the current flow in one direction only. This is a rectifier-type machine.
3. An AC/DC machine is a combination of the first two mentioned.

- DC welders permit the widest choice of electrodes and current range and the best arc stability. It is usually used for out-of-position welding (uphand, vertical, overhead, and horizontal), sheet metal work, pipe welding, hard surfacing, stainless welding, and more.
- AC welders have greater freedom from arc blow (a condition where the arc wanders while in corners on heavy plate or when using large rods – solution is to put ground closer to work and/or change the direction of travel), produce less splatter, and are lighter and smaller machines. They also require less electricity and require less maintenance. They are ideal for downhand welding on heavy plate using large electrodes. An AC transformer has an arc boost switch for easy arc starting.
- An AC/DC welder offers the advantages of both.

The Electric Arc



Materials: welder, electrodes, leathers (jacket and gloves), shielded hood.

Commissioning: Were you successful in this project when you tried it out?

Evaluation: Did this project work as you expected it to?

Reflection: Did you enjoy this project? What were you most proud of? What would you do differently next time?

RCI Technological Education

Project Name — Welding Processes

Design Brief: To understand the various types of welding processes.

Context: Safety is first in the workshop. Read and understand all of the safety rules before using any tool or machine.

Possible Solutions: Have instructor demonstrate (mandatory) the tool first. Have another student demonstrate the tool. Read the manual that comes with the tool (mandatory). Ensure that you have been certified "competent" by the instructor before you use the tool (mandatory).

Detail Design: The following are the common types of welding processes:

The most popular processes are *Gas Metal Arc Welding* (**GMAW**), sometimes called *MIG* welding and *Gas Tungsten Arc Welding* (**GTAW**) sometimes referred to as *TIG* welding. A third process, *Shielded Metal Arc Welding* (**SMAW**) *or stick welding*.

SMAW — Shielded Metal Arc Welding or Stick Welding
SMAW is an electric arc welding process in which heat for welding is generated by an electric arc between a covered metal electrode & the base metal. The electrode coating provides shielding. The welding equipment for this process is currently the most inexpensive of the methods described here. However, electrodes do create some inefficiency, such as stub loss & a slag coating, which must be removed.

GTAW — Gas Tungsten Arc Welding or Tig Welding
Tig Welding is easily performed on a variety of metals. It generally requires little or no post weld finishing. It is an electric welding process in which heat for welding is generated by an electric arc between the end of a non-consumable tungsten electrode & the base metal. Filler metal may be added, if necessary. An inert shielding gas supplies shielding for the arc. (Inert gas creates a protective atmosphere around the welding in process).

GMAW — Gas Metal Arc Welding or Mig Welding
Gas metal arc welding is quick & easy on thin-gauge metal as well as heavy plate. It generally calls for little post weld cleanup. GMAW is an electric arc welding process where heat is produced by an arc between a continuously fed filler metal electrode & the base metal. Shielding is obtained from an externally supplied gas or gas mixture. The two most common types of GMAW are:

- **Short Circuit Transfer** — The arc is broken or short circuited with each drop of metal & restarted. Short circuiting transfer is not used with aluminum welding.

- **Spray Transfer** — Metal is transferred across the arc creating a continuous spray of fine droplets of metal. These droplets are projected down to the base metal.

Materials: welder, electrodes, leathers (jacket and gloves), shielded hood.

Commissioning: Were you successful in this project when you tried it out?

Evaluation: Did this project work as you expected it to?

Reflection: Did you enjoy this project? What were you most proud of? What would you do differently next time?

RCI Technological Education

Project Name — Mr. Ferguson's Tips

Design Brief: To understand the tips to make work better in the shop.

Context: Safety is first in the workshop. Read and understand all of the safety rules before using any tool or machine.

Possible Solutions: Have instructor demonstrate (mandatory) the tool first. Have another student demonstrate the tool. Read the manual that comes with the tool (mandatory). Ensure that you have been certified "competent" by the instructor before you use the tool (mandatory).

Detail Design: The following are some of Mr. Ferguson's shop tips. They are meant to be helpful hints. See the equipment Owner's Manual or your notes for all safety and operational information. Here are tips on the following seven topics:

- MIG Welding
- Aluminum MIG Welding
- Self-Shielded Flux Cored Welding
- TIG Welding
- Stick Welding
- Plasma Cutting
- Resistance Welding

MIG Welding

1. Along with practice, practice, practice, remember safety, safety, safety!
2. Although most manuals recommend wire stickout (from nozzle to steel) of 1/8-in. to 1/4-in., I recommend using as little stickout as possible. When filling in a big gap or hole, I allow up to 1/2-in. of stickout.
1. When welding thin gauge, allow more wire stickout — even up to 3/4-in. Use the push, or forehand, method because you don't want very much penetration.
2. Forehand welding allows you to see better with shallow penetration. Although difficult to see because of the nozzle, backhand welding is smooth and gives the best penetration.
3. Use the correct wire type for the base metal being welded. Use stainless steel wires for stainless steel, aluminum wires for aluminum, and steel wires for steel.
4. Use the proper shielding gas. CO_2 is good for penetrating welds on steel, but may be too hot for thin metal. Use 75% Argon/25% CO_2 for thinner steels. Use *only* Argon for aluminum. You can use a triple-mix for stainless steels (Helium + Argon + CO_2).
5. Although you cannot have air blowing around because it displaces your shielding gas, make sure you have some ventilation. Your body need oxygen NOT carbon dioxide: don't breath the Argon gas mixture!
6. MIG ain't worth a dang on paint, dirt, rust, oil, and grease.
7. Put the work clamp as close as possible to the work piece. You'll have a better circuit, which will give you a better weld.
8. For best control of your weld bead, keep the wire directed at the leading edge of the weld pool.
9. When welding out of position (vertical, horizontal, or overhead welding), keep the weld pool small for best weld bead control, and use the smallest wire diameter size you can.
10. Relax your hand and watch the puddle. Watch your travel speed, gun angle, and temperature. The thinner the steel, the faster the travel speed.
11. Skip weld — weld a couple of inches at the beginning, middle, end, and then come back — when you want to control distortion. If you weld a long seam all at once, you are likely to warp the steel.
12. Clean the gun liner and drive rolls occasionally, and keep the gun nozzle clean of spatter. Replace the contact tip if blocked or feeding poorly.
13. Keep the gun straight as possible when welding, to avoid poor wire feeding.

14. Use both hands to steady the gun when you weld. Do this whenever possible. (This also applies to Stick and TIG welding, and plasma cutting.)
15. A drag or pull gun technique will give you a bit more penetration and a narrower bead. A push gun technique will give you a bit less penetration, and a wider bead.
16. Your machine should sound like bacon frying when it is set right on short circuit.
17. The more you burn, the more you'll learn. Do it right the first time. Cutting corners usually results in problems that have to be corrected.
18. Above all, have fun!

Aluminum MIG Welding

1. The best feeding of wire for aluminum is done with a spool gun. If you can't use a spool gun, use the shortest gun possible and keep the gun as straight as possible. Use Argon only for shielding gas. Only use a push gun technique when welding aluminum.
2. If you are having feeding problems, one thing you can try is a contact tip that is one size bigger than your wire.
3. The most common wire type is ER4043 for all-purpose work. ER5356 is a stiffer wire (easier to feed), and is used when more rigid, higher-strength weld properties are needed.
4. Clean the aluminum before welding, to remove the oxide layer. Use a stainless steel wire brush used only for cleaning aluminum.
5. Fill the crater at the end of the weld to avoid a crack. One way to do this is to dwell in the weld pool for a second at the end of the weld.

Self-Shielded Flux Cored Welding

1. Use a drag (pull) gun technique.
2. Keep the wire clean and dry for best weld results.
3. The weld is similar to Stick welding, in that a layer of slag must be removed from the weld after welding. Use a chipping hammer and a wire brush.
4. Self-shielded Flux Cored does not need shielding from an external cylinder of shielding gas. (The shielding is in the wire.) This makes it good for outside work, where external shielding gas could be blown away.
5. Self-shielded Flux Cored is generally harder to accomplish on thin metals than MIG welding.

TIG Welding

1. Good process for thin metal — very clean process producing good looking welds.
2. Use Argon shielding for steel, stainless, and aluminum.
3. Use DC-Straight Polarity (DCEN) for steel and stainless. Use AC for aluminum.
4. Always use a push technique with the TIG torch.
5. Match the tungsten electrode size with the collet size.
6. Aluminum — use a pure tungsten, AWS Class EWP (green identifying band). Will form a balled-end in AC.
7. Steel and stainless steel — use a 2% thoriated tungsten, AWS Class EWTH-2 (red identifying band). Prepare a pointed-end for DCEN welding.

Stick Welding

1. Use a drag technique for most applications.
2. Take precautions with flying materials when chipping slag.
3. Keep electrodes clean and dry — follow manufacturer¹s recommendations.
4. Common steel electrodes:
5. Penetration: DCEN — Least penetration; AC — medium (can be more spatter also); DCEP — most penetration.

Plasma Cutting

1. Clean, dry, oil-free air is important.
2. Stay at recommended air pressure (more air is not necessarily better!)

3. Touch torch tip gently to workpiece.
4. When initiating a cut, start on the end of material and ensure arc has completely penetrated metal before proceeding further.
5. When completing cut, pause at the end to assure severance.
6. Torch should be perpendicular to workpiece.
7. Work cable should be attached as close to workpiece cut as possible.
8. If you can see the arc coming through the bottom of the cut metal, it will eliminate guessing if your travel speed is correct.

Resistance Welding (Spot Welding)

1. Resistance welding is not recommended for aluminum, copper, or copper alloys. Use for steel and stainless steel only.
2. For more heat (amperage output), use shorter tongs.
3. For units without a heat control, tong length can be used for a control. For instance, for thin metals where you want less heat, longer tongs can be used.
4. Keep in mind that longer tongs can bend, and you may lose pressure at the weld.
5. For the metals being welded, make sure there is no gap between the pieces — this will weaken the weld.
6. Keep the alignment of the tongs straight, so that the tips touch each other exactly. Also, maintain a proper pressure adjustment — not too much or too little pressure.
7. When you need one side of the weld to have good appearance, you can flatten (machine) the tip somewhat on that side.
8. Clean the tips on a regular basis, or you will lose output (amperage). Dress the tips with a proper tip dresser.