WELDING

(not a state fair project)

What you should learn as you begin welding:

1. Safety in welding
2. The different kinds of welding rods and their characteristics
3. The history of Arc Welding

HISTORY OF WELDING

Working with metal began when primitive people found that they could shape rocks by chipping them with other rocks. It was probably a primitive people who found the results pleasing, who took dull rocks (probably copper) and turned them into gleaming metal. It took sensitivity and curiosity to begin turning interesting and pretty stones into something new and sometimes useful objects for primitive man.

Excavations in Egypt indicate the use of copper as early as 4000 B.C. Welding began more than 3000 years ago when hot or cold metals were hammered to obtain a forge weld.

About 1300 B.C. the Philistines had four iron furnaces and a factory for producing swords, chisels, daggers, and spearheads. The famous Damascus swords and daggers were made in Syria about 1300 B.C. and were highly prized because of their strength and toughness.

By the time of the Roman Empire, the use of iron was common in Europe, due in large part to the high degree of skill of Belgian workers. By the eighth century the Japanese manufactured steel by repeated welding and forging. They produced the famous Samurai sword with blades of excellent quality and superior workmanship.

Blast furnaces were developed for melting iron about 1000-1200 A.D. The first cast iron cannon was produced in the early 1600's.

The Industrial Revolution in the mid-1800's brought more advances in the working of iron. The village blacksmith was probably our earliest "welder".

The demands of goods for World War I accelerated the development of methods of fabrication. Since that time, the welding industry has become one of the fastest growing industries in the world of work. Without welding, space exploration, jet aircraft, nuclear energy, bridges, pipelines and hundreds of other modern realities would be merely dreams.

Welding: Principals and Practices, by Raymond Sachs Charles A. Bennett Co., Inc. 1976

SAFETY IN ARC WELDING

An arc welder is not a toy and should be treated as a potentially hazardous piece of machinery.

However, if you follow safety rules and have adult supervision, you should be able to learn to use an arc welder safely.

*Some of the important safety precautions are outlined in the following paragraphs.

Avoiding Shock Hazards - The farm welder is normally supplied with current at 230 volts. It is important, therefore, that the wiring be done in an approved and safe manner. The output voltage of a limited-input farm-type welder that meets the standards of the National Electric Manufacturers Association does not exceed 65 volts. On some others, the maximum open-circuit voltage may be somewhat higher. Voltages of this order can be dangerous and it is important that the operator stand on dry footing when welding, and that he keep his body insulated from the electrode, any bare parts of the electrode holder, and the work. Be sure to open the main power switch before working on the welder or any of its connections.

Protecting Against Radiation From the Arc - The light rays given off by the arc are similar to those from the sun, but much more intense at close range. Therefore, in welding always use a face or head shield that is in good condition, and **NEVER, UNDER ANY CIRCUMSTANCES, LOOK AT THE ARC WITH THE NAKED EYE**. Exposures, even for a brief time, may cause eye burns that are exceedingly painful, although not permanently injurious. Do not strike an arc or weld when others are about without first being certain that they have protective equipment or will look in the opposite direction.

Treating Eye Burn - In case of eye burn, which feels like "hot sand in the eyes," the following treatment may be used:

Put a drop of 2 percent butyn in each eye and repeat in two hours if necessary. This is to relieve the pain. If butyn is not available, apply sweet oil once an hour until the acute burning sensation disappears. Take aspirin in ordinary doses to relieve pain. Afterwards, a few drops of 5 percent solution of argyrol may be applied to aid healing, but it should not be used more often than once in 5 or 6 hours. In severe cases of eye burn see a doctor.

Wearing Protective Clothing - Always wear suitable clothing when welding to give protection both against the rays of the arc and against spatter. Exposure to the arc usually causes a condition similar to sunburn, but often more severe. Therefore, wear a long- sleeved shirt, with collar and sleeves buttoned. Dark clothing is better than light. High-top shoes give better protection against particles of hot metal than low ones, and it is better to wear cuffless pants or pants with the cuffs turned down. Wear gloves, preferably of leather and of the gauntlet type, to protect the hands and wrists.

Wearing Clean Goggles - When chipping slag or grinding, protect the eyes from flying particles with goggles.

Providing Ventilation - Always weld in a well-ventilated place. Fumes given off from welding are unpleasant and in some cases may be injurious, particularly when galvanized or zinc-coated parts are being welded. When it is necessary to weld in close quarters, use a fan to give forced ventilation.

Avoiding Fire Hazards - Do not weld around shavings, oil, grease, hay or feed, or other combustible or flammable materials where sparks might cause a fire. Keep the welding booth clean and free of scrap and rubbish.

Never weld or heat drums or other containers which have been used for storing gasoline, oil, or similar materials without first having them thoroughly cleaned. Even a trace of combustible materials remaining in the seams of a container can be vaporized by the heat of welding and cause a serious explosion and fire. Cleaning is done with high-pressure steam or with a

strong solution of caustic soda or washing powder, and is best entrusted to someone who is properly equipped and has had experience in such work. After a thorough cleaning, fill the container with water to within a few inches of the point of welding or heating, and keep it filled while the work is being done. Vent top of the container to allow the escape of heated air.

Current Setting for Mild Steel Electrodes

Diameter of Electrode	Amperes	Metal Thickness
1/16	20-40	1/16 to 1/8
3/32	30-80	1/8 to 5/32
1/8	80-130	3/16 to 1/4
5/32	120-180	1/4 to 3/8
3/16	140-240	3/8 to ½

Shopwork on the Farm by Mack M. Jones, McGraw-Hill Book Company

TRAINING INDIVIDUALS IN ARC WELDING

Arc welding is only one of many skills that an individual can learn during his lifetime. The importance of welding has increased rapidly to all phases of life.

As with other skills, the only reason for learning how to weld is to be able to put it to practical use in repairing or making equipment. To be useful, arc welds must be made so that they are strong and, therefore, they must be correctly made. The art of making welds correctly is learned by studying theory of welding, seeing actual demonstrations of correct methods, and by practicing these methods seriously. Welding skills can be mastered in a relatively short time.

Welding is a skill performed by many individuals in the county by joining two pieces of metal together by a third, the electrode, by the use of heat. The welding machines are a reverse-type transformer operating on 230 volts alternating current or direct current from a generator. The transformer steps down the volts to no more than 36 volts, while stepping up the amperes which supplies the heat for welding.

The welding positions are flat, vertical, horizontal and overhead. All welding should be performed in the flat position for best results. Overhead welding is the most difficult and should be avoided when possible.

The arc welder can be used for all types of welding and may be used (with the aid of a carbon arc torch) for brazing, soldering, heating and bending metal by flame produced by the carbon electrodes. You can cut metal, pierce holes and thaw frozen water pipes.

There are five essential steps in correct welding procedures:

1) Selection of proper electrode -- the diameter or size of the electrode is determined by the thickness of metal to be welded. Thin gauge metal would call for the use of either a 1/16 or 3/32 diameter electrode. The thicker the metal, the larger electrode you would use. The kind of metal to be welded will make a difference in the selection of an electrode. Mild steel can be welded with a general purpose electrode as E 6013, such as Fleetweld 57, manufactured

by Lincoln Welding Company. For carbon steel, use a low-hydrogen electrode or E 6016. The proper electrode should be selected for the metal being welded.

2) Correct ampere setting. The amp or heat setting is determined by the type and thickness of metal being welded and the size of electrode.

3) Arc length that is the distance the electrode is held above the metal being welded. For normal welding, a 1/8" arc length is about correct. For cast iron welding, a 3/16" to 1/4" arc length must be used.

4) Speed of travel. The important thing to watch while welding is the puddle of molten metal right behind the arc. Do not watch the arc itself. It is the looks of the puddle and the ridge where the molten puddle hardens or solidifies that indicate correct welding speed. The ridge should be approximately 3/8" behind the electrode.

5) Correct angle of electrode. When welding in flat, vertical or in the overhead position, hold the electrode at a slight angle in the direction of travel.

When striking an arc, you can either use the scratching or tapping method. The scratching method is like striking a match. Whatever method you use, do not raise the electrode too far above the metal being welded or you must start over.

In order to see the finished weld or bead, you must chip the skag from the bead with a chipping hammer.

Carbon arc welding is performed by using the carbon torch attached to the welder and carbon electrodes. The carbons will produce heat only as a flame depending on what you are welding. You can solder tin by using a single carbon electrode coated with copper instead of welding rods. You can braze weld, cast weld or heat and bend metal with the aid of a carbon arc torch.

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Exhibit Requirements:
-All poster exhibits must be displayed horizontally, sized 22" x 28" foam-core board or poster board mounted on a firm backing, and covered in clear plastic or other transparent material.
-All posters and display boards must include a reference list indicating where information was obtained, giving credit to the original author, to complete the 4-H member's exhibit. This reference list should/might include web site links, people and professionals interviewed, books, magazines, etc. It is recommended this reference list be attached to the back of a poster or display board, or included as part of the display visible to the public. A judge is not to discredit an exhibit for the manner in which references are listed.

Beginner Grades 3-5:
Exhibit a poster on the topics for the grade you just completed.

- Grade 3: Welding Safety Equipment
- Grade 4: Types of Welders
- Grade 5: Types of Welding Rods

Intermediate Grades 6-8:
Exhibit a poster on the topics for the grade you just completed.

- Grade 6: Uses of Welding or Why Weld?
- Grade 7: Careers associated with Welding
- Grade 8: Weld and Exhibit the following:
    1. Begin with a piece of mild steel flatiron (5"x8"x1/2") onto which you will weld: a) a row of straight beads, b) a row of weave beads, c) a row of hard face weave beads.
    2. Weld two (2) pieces of flatiron in a "T" joint to the original flatiron. Do the corner weld vertically. The vertical corner weld should be at least 4" long. Weld the two pieces to the original flatiron with either straight or weave beads.
    3. Butt weld another piece of flatiron 3x5x1/4" to the original piece of flatiron.
    4. Lap weld another piece of flatiron 3x5x1/4" to the original piece of flatiron.
    5. Weld your initials and the year on the back of the original piece of flatiron.
    6. Label and identify each weld.
    7. Overall Appearance and Neatness

***See additional supplement for Intermediate and Advanced Welding for more project resources.**

Advanced Grades 9-12:
In the Beginner and Intermediate Divisions of 4-H Welding you learned:

1. Safety practices in Arc Welding.
2. The different kinds of welding rods and their characteristics.
3. The history of Arc Welding.
4. The different welding beads.
5. The different welding joints.

You should review the above information before beginning your project for Advanced Welding. Advanced Welding is for those members who have welded several times and who are ready to repair or make an article.

REQUIREMENTS

1. Weld a minimum of three times.
2. Repair at least 1 item which requires welding at your home or farm.

EXHIBIT

One item that you have made or repaired. If it is a repaired item, indicate clearly the repairs you made. If it is an item you made, indicate its use, how long it took to make, and whether it is your original design. No items should exceed 3' x 3' unless you contact the Extension Office prior to Fair and get permission to bring it.
(This is to enable us in planning building space needs and tables needed.)

The item may be useful, decorative or artistic. REMEMBER: Make or repair an item worthy of your time and efforts. Be proud of what you exhibit. The following criteria will be used for judging:

1. Quality of the welds used.
2. Appropriateness of the welds used.
3. Quality of the joints made (if any).
4. Appropriateness of joints selected (if any)
5. Usefulness of the item made.
6. Overall appearance and neatness.

***See additional supplement for Intermediate and Advanced Welding for more project resources.**

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