CANADA
4-H Saskatchewan

Welding

Activity
Guide

4-H Motto

'Learn To Do By Doing'

4-H Pledge

'I pledge
My Head to clearer thinking,
My Heart to greater loyalty,
My Hands to larger service,
My Health to better living,
For my Club, my community and my country'

CANADA
4-H Saskatchewan

4-H Grace

(Tune of Auld Lang Syne)

We thank thee, Lord, for blessings great
On this, our own fair land.
Teach us to serve thee joyfully,
With head, heart, health and hand

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Agriculture et Agroalimentaire Canada

AGRICULTURE COUNCIL OF SASKATCHEWAN INC.

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Welding 101

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1. Meet, Greet, and Goals

Time Estimate 15 Minutes

Meeting
Skill Building

About
This is the time for you to begin to get to know your members and for members to get to know each other. It is also an opportunity for members to work on setting goals.

Materials
- Pencil or Pen
- Meet, Greet, and Goals Worksheet found at the end of the Reference Book

Instructions

Either have members write down the questions from the worksheet in their notebooks or else photocopy the worksheet and have them fill in the blanks.

Give members time to write down answers to each of the questions.

Help members set realistic goals for things they will learn and do during this project (and then help them work towards achieving their goals throughout the project).

Have members introduce themselves to the club and share their answers to why they are interested in welding and if they have past experience.

Discussion/Questions

You can make this discussion period more interesting by having members share things like where they're from and one interesting fact about themselves.

Choose whether or not you would like members to share any other answers from the worksheet. Some people may prefer to be more private about personal goals, while others may benefit from saying goals out loud and some may being inspired by hearing goals that others have set. If you don't have members share goals, have them hand the worksheet in so that you can read it over and then return to them.

Goal setting is an important skill so return worksheet to members to so that they can reflect back on them throughout the project and at the end of the year to see if they met all of their goals.

Meet, Greet and Goals Worksheet

Name: _____

Have you ever welded before? _____

If so, what have you done? _____

_____

_____

_____

_____

Why are you interested in welding? _____

_____

_____

_____

_____

_____

What are five things you hope to learn by taking this project?

1 _____

_____

2 _____

_____

3 _____

_____

4 _____

_____

5 _____

_____

2. Here a Weld, There a Weld, Everywhere a Weld

Time Estimate 15 Minutes

Meeting or Home
Knowledge Building

About
Discovery of how many things around us are made of metal so we can begin to appreciate how important welding is.

Materials
- Pencil or Pen

Instructions

Have members work individually or divide into groups. Assign each member/group a room in a house, school or workplace. If you have many members/groups you could also a assign particular business. Have them brainstorm (and write down) a list of everything that could possibly be in that room that is made of metal and is held together by welds.

Have members share list with club and allow other members to add possible objects to the list.

Discussion/Questions

Try to assign rooms that will have plenty of welded objects in them. Some good choices of rooms and examples of things in those rooms are:

Kitchen –fridges, stoves, microwave, toasters, dishes, pots and pans, sink and faucets, soup ladles, coffee pot, water bottles, kettle, cans of food, cookie sheets and cooling racks

Office – telephones, computers, filing cabinets, flash drives, lamps, pens, staplers, chairs, desks, hole punch, bookshelves and supports, garbage bins, photocopiers, scanners, fax machines, printers

Bathroom – electric shavers, curling irons, blow-dryers, faucets and stops on tubs and sinks, the inner workings of a toilet, towel bars and hooks, toilet paper roll holder, hairspray bottles and brushes

Don't forget to overlook welded things that most rooms have in common like lighting fixtures, door handles and window pulls.

3. Chocolate Welding

Time Estimate 20 Minutes + Time for Chocolate to Solidify

Meeting or Home Knowledge Building

About

A look at how welding can make things stronger, by comparing the strength of a bridge made of a single plank and a box girder bridge, made of several pieces welded together.

Resources

http://www.twiprofessional.com/fab-futures/educational-outreach/welding-with-chocolate/

http://www.twiprofessional.com/fab-futures/educational-outreach/resources-for-teachers/

http://www.twi.co.uk/news-events/videos/chocolate-welding/

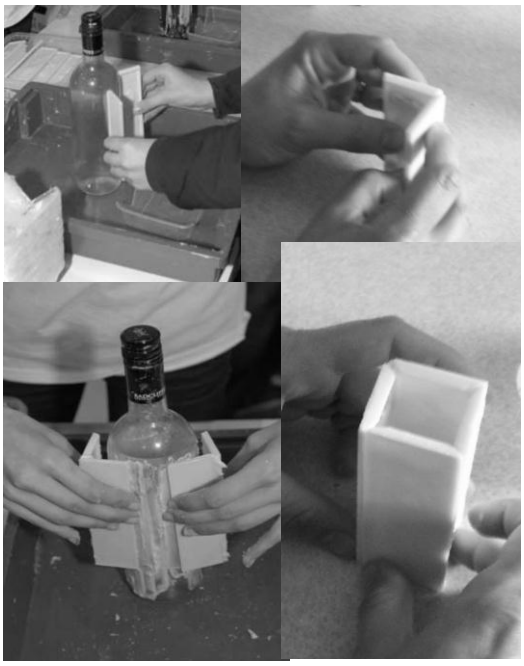
http://www.youtube.com/watch?v=L9PBwtL1Ybw&feature=youtu.be&YouTube%2520Welding%2520with%2520Chocolate

Materials

- Hot water (and a kettle or other means to heat it)
- Straight-edged glass bottle (wine bottle works well)
- At least 5 chocolate bars (most be solid – no grooves for easily braking off pieces)
- Small weights (if you don't have small weights, try rolls of coins or pieces of metal)
- 2 drinking glasses with flat bottoms (there is a risk of glass breaking by weights falling on them – sturdy plastic glasses are best)
- A jig (optional) made by cutting two right-angles into a plastic box or container
- A fridge (optional)
- A plastic ruler (optimal)

Instructions

To demonstrate how much stronger welding can make objects, weld a box girder bridge made of chocolate bars and compare it to the strength of a plank (single chocolate bar). The heat source to create our welds is hot water.



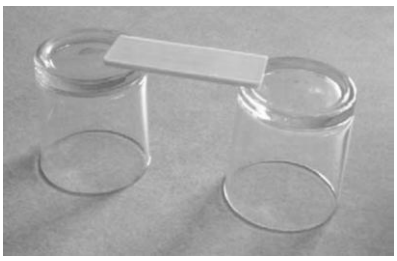
1. Place hot water into glass bottle.

   Hold the edges of chocolate bars against the bottle until they melt slightly.

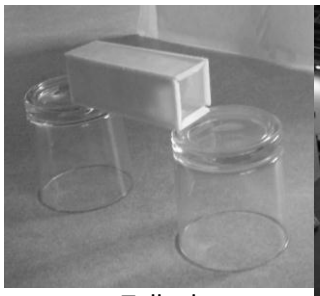
2. Press the melted edges together in a right angle and leave to cool. This is half the box section. If you've made a jig, leave it to cool in the jig. Make another half section the same way.

3. When both half sections have cooled, melt the remaining long edges and press them together to form the box section. Leave to cool (in the jig if you have it) for at least 20 minutes, or put in a fridge to speed up the process.

4. First see how strong a plank bridge is. Place two drinking glasses upside down and then set an unwrapped chocolate bar between the glasses, creating a bridge. Begin to load your bridge with weights, carefully adding a little at a time. Make sure that the bridge is loaded in the middle free span part of the bridge. If you are using coins, you may need to take them out of the rolls in order to add weight that is light enough for the plank to support. Take note of how much weight you loaded when the bridge breaks.



5. Once your box girder has properly cooled (the edges have solidified) it's time to test it. Examine the box girder before you begin. Take note of whether or not it is joined perfectly all along each edge, if there is some distortion causing the beam not to be perfectly square. Talk about how these factors may affect the strength of the bridge. Then, place the box girder between the two glasses and begin to load with weights. See how much more weight the box girder can take than the plank before it breaks.



Discussion/Questions

How much weight did the plank bridge hold?

The box girder is made from four bars so it should hold at least four times the load that the plank bridge did? Did it? How much more weight did the box girder hold? Can you imagine how much more it would have held if the welds were perfect? Why did it hold so much more?

The box girder held so much more weight because the box shape makes the beams much stronger. A tall thin beam is stiffer than a wide flat beam made of the exact same material. You can demonstrate this with a plastic ruler. If you hold the ruler horizontally you will see that it is easy to bend. Yet if you take the same ruler and turn it on edge it is very difficult to make it bend at all. Like this, the box girder bridge carries most of its load on the two sides, which are thin, tall, stiff beams making the bridge much stronger than a plank.

4. Finding Metal for Projects

Time Estimate 20 Minutes

Meeting or Home
Knowledge Building

About

To keep costs down for members, try sourcing free metal that can be used for practice pieces as well as for projects. There may be many community minded businesses and people who work with metal that have metal scraps and cut offs that they would be willing to donate.

Materials

- Pencil or Pen
- Paper
- Telephone and/or Computer

Instructions

Look through the manual and activity book in advance so that you know which type of metal pieces will and will not work for the needed practice pieces. In Unit 5 members will start working on actual projects. You can decide in advance which projects members will do, or you when you get to Unit 5, members can decide which projects they are interested in. In that case, they could do this activity again at that time to source the needed metal.

Together, have members create a thought map of people and business that work with metal. The thought map could include things like farmers, muffler shops, a variety of repair and fabrication shops, and so on.

From that thought map, create a list of the specific people and business in your community that work with metal. Assign each person/business to a member so that they can contact them to ask if they have any cutoffs/scraps to donate. Help members create a script to aid them in their phone conversations.

Have members pick up the metal and bring it to the next meeting.

Discussion/Questions

A phone script could look something like this:

"Hi, my name is _____. I'm doing a 4-H welding project and hoping that you would be interesting in donating some metal. We are looking for metal that we can practice on as well as some to build projects with. Do you have any scraps or cutoffs that you think we might be able to use?" If yes "Thank- you, when would I be able to come pick it up?"

Prepare members for questions that they may be asked and how to answer them. For example "what is 4-H?", "what kind of metal are you looking for?", "I have _____ type of metal, is that what you want?" "I have_____, is that too big/small?"

Make sure to let members know specifically what type of metal and sizes will/won't work.

Suggest that members call businesses right after school, as they will have more success if calling during business hours. If members cannot reach businesses by phone, have them send emails instead.

Are there any community news letters that you could put a notice in, asking for donations?

Are there other businesses that don't work with metal, but support 4-H in your community? Would they be willing to donate money towards the cost of purchasing metal and other materials (like electrodes)?

5. Parts of a Helmet

Time Estimate 10 Minutes

Meeting
Demo -Knowledge Building

About
Members see the components that make up a welding helmet and learn how to change a filter in a fixed shade helmet.

Materials
- Fixed shade welding helmet

Instructions

Take apart a fixed shade helmet.

Tell members the name of each part and its purpose.

Demonstrate how to properly put the helmet back together and how to carefully clean lenses.

Also, let members know that once they put the helmet back together, they should hold it up to a light to make sure that there is no light leaking in. Light leaking in, means that light from the arc can get through and burn your eye.

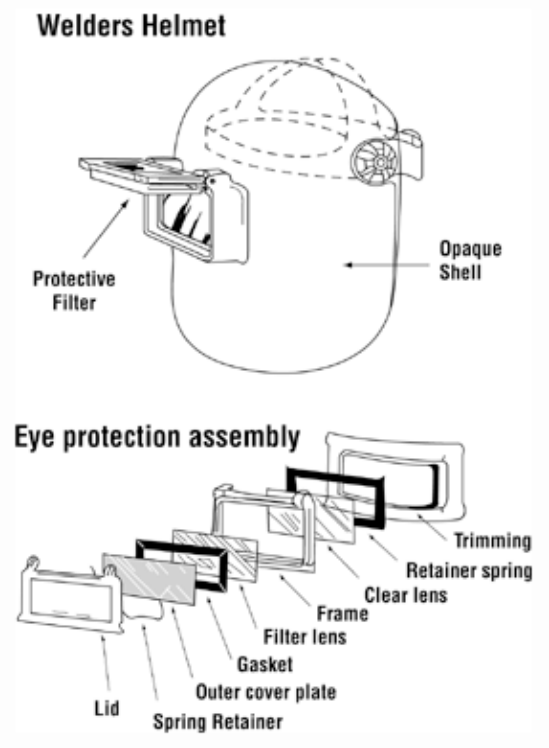
Point out the knobs at the side of the helmets that you can adjust to change how easy/hard it is to flip down the helmet with a head nod.

Have members take apart the helmet and put it back together themselves (check for leaks when finished)

Discussion/Questions

Can you find the number on the filter lens that tells you what shade number it is? What number is it?

Can you put the helmet back together properly? Is there a clear lens on either side of the shade lens?



6. Types of Helmets

Time Estimate 10 Minutes

Meeting or Fieldtrip
Demo -Knowledge Building

About
A look at the different types of helmets available to welders and the different features of each.

Materials

- A variety of welding helmets; at least one fixed shade and helmet and one auto-darkening helmet

Instructions

Present a variety of helmets to members and point out the different features.

Point out the knobs at the side of the helmets that you can adjust to change how easy/hard it is to flip down the helmet with a head nod. And demonstrate how to carefully clean lenses.

Allow members to try on helmets so they can experience the differences themselves.

Discussion/Questions

Discuss pros and cons of each. This is especially important if members need to purchase their own helmets.

Point out the standard features of an auto-darkening helmet (dial on the side to adjust filter shade) and that they can either be battery powered or solar powered. Both options are good, except with battery you need to make sure the batteries don't die. Talk about the other features that auto-darkening helmets come with. Emphasize that if they are buying a helmet, one with standard features will meet all of their needs.

If you do not have access to a variety of helmets to demonstrate, arrange a trip to a store that sells welding protective gear so that members have an opportunity to see the differences.

Remind members to bring a welding helmet with them to the next meeting if there isn't enough helmets for everyone.

7. The Good and the Bad

Time Estimate 15 Minutes

Meeting
Knowledge Building

About

Members learn to tell the difference between acceptable and inacceptable welding gear.

Materials

- Acceptable welding gear. Things like gauntlet gloves, safety goggles, safety glasses with side shields, skull cap, leather apron, ear plugs, ear muffs, leather work boots, coveralls and pants made of leather, wool, denim or thick cotton, long sleeve shirts and jackets made of leather, wool, denim or thick cotton, and so on.
- Unacceptable welding gear. Things like leather gloves that only come up to wrist, gloves made of material other than leather, gloves with holes in them, baseball cap, toque, running shoes, sandals, shorts, otherwise appropriate clothing that has holes or frays, v-neck shirt, any clothing made of synthetic material, pants with cuffs, clothes with grease stains on them and so on.

Instructions

Lay out all gear. One at a time, have members pick out an article that is either acceptable or inacceptable to wear while welding.

Have members give the reason for their choice.

Discussion/Questions

Don't forget to have members check the tags on clothing to check for material content.

If members are struggling with reasons and choices be sure to help them. This is not a quiz, but a learning experience.

Does anyone think they'll have difficulty finding proper protective gear to wear to the next meeting? Suggest which stores in your area might supply the needed gear and to also check tags on existing clothing , as they might find some of what they need in their own closet.

Remind members to wear proper clothing and bring needed gear with them to next meeting.

8. The Right Gear

Time Estimate 15 Minutes

Meeting
Knowledge Building

About
An opportunity to look at the different types of protective gear available.

Materials

- A variety of acceptable welding gear. Things like gauntlet gloves, safety goggles, safety glasses with side shields, skull cap, leather apron, ear plugs, ear muffs, leather work boots, coveralls and pants made of leather, wool, denim or thick cotton, long sleeve shirts and jackets made of leather, wool, denim or thick cotton, and so on.

Instructions

Lay out gear.

Point out each piece and what it is/why it's is appropriate to wear while welding.

Allow members, to feel, try on and check tags. You could even have members dress you or another member head to toe so they have a better of idea what a proper welder should look like.

Discussion/Questions

Make sure members know what to look for when picking out or shopping for welding clothing and gear.

Remind them to wear proper clothing and bring needed gear to next meeting.

If you do not have access to a variety of appropriate clothing to demonstrate, arrange a trip to a store that sells welding protective gear so that members have an opportunity to see in person what proper clothing looks like.

9. Gear Guide

Time Estimate 15 Minutes

Meeting or Home
Knowledge Building

About
Create a poster for the shop of required protective gear needed to weld in.

Materials

- Bristol Board or other paper for creating a poster
- Markers and/or Pens
- Tape (optional) to hang poster when finished

Instructions

Have members work as a group to create a poster for the shop with all of the required gear they MUST be wearing to use a welder.

Discussion/Questions

Be sure that no required gear has been left off of the list, so that members can use this is as a checklist before starting a welder.

Why is each piece on the list required? (choose whether or not to add these reasons to the poster)

If you are using a shared shop space, make sure to bring the poster back to each meeting so it can be displayed as a reminder to members.

10. At the Store

Time Estimate 40 Minutes + Travel

Fieldtrip
Knowledge Building

About
A fieldtrip to a local store to look at, and try on, welding gear.

Materials
- A local store that sells welding supplies
- A way to get members to the store

Instructions

Organize a fieldtrip to a local welding supply shop. Make sure to choose one that will have a variety of protective gear available.

It is a good idea to call the store before your group plans to go. Maybe they will even have an experienced employee who could help show members around and answer questions.

Have members try on gear to find out what fits and what they would prefer to wear.

Consider making the trip more entertaining by having a fashion show to model the protective gear. Don't forget to have an announcer to explain what models are wearing and why it's important!

Discussion/Questions

Which eye protection do you prefer glasses or goggles? Which is most comfortable?

Which helmet do you prefer? Which is most comfortable? Have you taken into consideration how heavy it is? How big the lens is? Can you see out of the lens properly (is it too high or low for you to see out of?

Are you able to find a pair of gloves that fits your hands properly?

11. WHMIS I.D.

Time Estimate 5 Minutes

Meeting or Home
Knowledge Building

About
Practice identifying WHMIS symbols.

Materials
- Photocopy of WHMIS ID Worksheet for each member

Instructions

Have members match WHMIS symbols with their correct definition.

Review correct answers and then give examples of some of the things in the shop that contain some of these symbols. For example, “Compressed Gas” symbol on oxyacetylene cylinders.

WHMIS I.D. Worksheet

Draw lines to connect each image to its correct definition.

a. Compressed gas

b. Flammable and combustible material

c. Materials causing immediate and serious toxic effects

d. Bio hazardous infectious material

e. Materials causing other toxic effects

f. Corrosive material

g. Dangerously reactive material

h. Oxidizing material

12. Rules of the Shop

Time Estimate 15 Minutes

Meeting
Knowledge Building

About
In order to help the safety rules become second nature, create a poster of the rules that need to be followed at 4-H meetings while working in the shop.

Materials
- Bristol board or other paper for creating a poster
- Markers and/or Pens
- Tape (to hang poster when finished)

Instructions

Together, develop "THE SHOP RULES" to be followed at each 4-H meeting.

Have members contribute rules and write them down on a poster that can be displayed at each meeting. Be sure to add rules to the list that members may have overlooked. Some suggestions for rules are: keep the shop clean, check for/remove flammables, never look at an arc without a helmet, keep your head out of the smoke, only weld on the welding table, never put oil or grease on any part of a welding project, double check your ground clamp, pick up metal with pliers, clean up when finished, if at all uncertain, don't do it; ask questions, no rough housing.

Have members also write down the list of rules in their personal notebooks.

Discussion/Questions

Discuss why the different protective gear and shop rules are important.

Will safety rules be different when you're welding in your own shop, then when you're welding here?

Are there some safety rules that are more important than others?

What could happen if we don't follow the safety rules?

If you are using a shared shop space make sure to bring the poster back to every meeting and hang in a place where members will see it. Feel free to add more rules to the list as the project progresses.

The Shop Rules

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

10 _____

11 _____

12 _____

13 _____

14 _____

15 _____

16 _____

17 _____

18 _____

19 _____

20 _____

13. Safety Video

Time Estimate 30 Minutes

Meeting or Home
Skill Building

About
Members create a safety video to help reinforce the importance of safety procedures and to help build communication and public speaking skills.

Materials

- Video recording device (digital camera, iPhone, video camera, etc)
- Welding protective gear and/or welding shop
- Pencil and Paper

Instructions

Divide members into pairs or groups and instruct them to write, practice and record their own safety video. The video can be from the perspective of either a commercial business selling safety equipment or as an instructional safety video for peers.

Members can focus on general safety, or one specific aspect of welding safety like "how to avoid electric shock," "how to protect your eyes when welding," "how to check for and remove flammable objects before welding," and so on.

Discussion

If someone (a member or leader) has access to a computer with video editing capabilities and the desire to edit the video into one conclusive safety video, allow them to do so. Present the edited video at the next meeting.

Consider playing the edited video at achievement day.

14. Team Tent Building

Time Estimate 30 Minutes

Meeting
Skill Building

About
Each member is assigned a part of their body as unusable and must set up a tent together. Members develop team building and communication skills while discovering the importance of following rules in injury prevention.

Materials

- A tent, disassembled
- Objects and props to render body parts useless

Instructions

Assign each member a part of their body that has been rendered useless. Use props to create the mock injury and prevent them from using that body part. For example, one member is blindfolded so they can't see, one has thumbs taped to hands so thumbs can't be used, one wears headphones with music playing covered by earmuffs so they can't hear, one has one or both arms tied to body so they can't use them, and so on.

Have "injured" members work in teams to set up a tent.

Discussion/Questions

Which injury made it most difficult to help set up the tent with?

What else in our daily lives would be made more difficult with one of these injuries?

How could each of these injuries occur when welding? What other injuries could we receive while welding if we don't follow the safety rules?

How can following the rules prevent these injuries?

How might we feel if we received one of these injuries because we chose not to follow a rule?

15. Shop Tour

Time Estimate 20 Minutes

Meeting
Knowledge Building

About
Tour of the welding shop, so members can begin to identify with safety practices and become familiar with common welding tools.

Materials
- Access to the welding shop

Instructions

Take members into the shop and show them around.

Point out the various safety features and tools you've already talked about.

Make sure the tour includes a discussion of what to do in case of emergency and where exits and fire extinguishers are located.

Discussion/Questions

Can anyone tell what kind of ventilation the shop has?

Have you seen anything in the shop that has WHMIS symbols on them?

Are there any hazards in the shop that need to be taken care of before beginning to weld?

16. Question Toss

Time Estimate 20 Minutes

Meeting
Knowledge Building

About

A game, similar to hot potato, used to review important information.

Materials

- An assortment of balls *or* Empty, clean and dry plastic bottles (pop bottles work great)
- Tape and Pen

Instructions

This activity can be done at any time during the meetings. It's a great way to review material covered, and to refresh the memory as to what was covered in previous meetings.

In advance, prepare the balls or bottles with questions that pertain to the information covered so far in the project. See following page for suggestions of questions and answers that pertain to Unit 1. These are just suggestions; feel free to make up your own.

Write questions on to tape and attach tape to bottles/balls. (one question/ball)

Have members gather in a circle. Toss one ball/bottle to members at a time and have them read out the question and answer it. If they don't know the answer, have them quickly pass on the ball to another member until someone answers it correctly. Correctly answered balls can be dropped into the middle of the circle.

The amount of balls/bottle you chose to toss will depend on how many members you have. You should have enough balls/bottles that every member gets to answer at least 1-2 questions.

Discussion

Were there any questions that where tough/tricky?

Review questions and answers that members got stuck on.

Try to choose questions that are appropriate to the age/ability of your members. For example, use more multiple questions or questions with a yes/no answer if your members are younger. And questions that require a definition or explanation type answer for older members.

Question Toss – Unit 1 Question and Answer Suggestions

1. What is the fume plume? *the cloud rising from the arc containing harmful fumes and contaminants*
2. Should you try to keep your head in or out of the fume plume? *out*
3. What do you need to wear to protect your eyes from harmful radiation? *a welder's helmet*
4. Is it okay to look at an arc without a helmet on? *no*
5. Name one type of natural material that is okay to wear while welding. *wool, leather, denim, or cotton*
6. Is it okay to wear prescription glasses instead of safety glasses? *no*
7. What is the name of the object that we were on our head to protect our hair and scalp from burning? *skull cap*
8. What should we use to pick hot metal up with? *pliers*
9. What is welder's flash? *a condition that happens to welders who don't properly protect their eyes*
10. What is an auto-darkening helmet? *it automatically darkens when an arc is struck*
11. Name two things we could wear to protect our ears from loud noises. *ear muffs or ear plugs*
12. Which is stronger, a plank bridge or a box girder bridge? *box girder*
13. If we only have a quick job to do, is it okay to weld in shorts and a t-shirt? *no*
14. Which type of shoe is good to wear while welding? A running shoe or a loafer? *Neither*
15. What must you wear under your helmet to protect eyes from flying debris? *safety glasses or goggles*
16. Why should we avoid wearing synthetic material while welding? *they melt*
17. What is the name of the long gloves we should wear while welding? *gauntlet glove*
18. Which type of helmet has a dial to adjust the filter shade? *auto-darkening helmet*
19. The welding area should be kept free of _____. *flammables, wet conditions etc.*
20. What do the letters in WHMIS stand for? *Workplace Hazardous Materials Information System*
21. Does wearing wet gloves or clothing increase your risk of receiving an electric shock? *yes*
22. What should you wear on your feet while welding? *work boots*
23. What should be fastened to the welding table, so we avoid electric shock? *ground clamp*
24. True or False. All metal turns red when it is too hot to touch? *False*

Unit 2
All About Arc

Activities:

17. Learn the Lingo Crossword
18. Learn the Lingo Wordsearch
19. Learn the Lingo Word Match
20. How it all Comes Together – Mandatory
21. Name That Part
22. Striking an Arc – Mandatory
23. Connect the Dots
24. Clean-up Duties – Mandatory
25. Question Toss
26. Cartoon Safety

17. Learn the Lingo Crossword

Time Estimate 15 Minutes

Meeting or Home
Knowledge Building

About
A more challenging word game to help members learn welding terminology introduced in Unit 1 and 2.

Materials
- Photocopy of Learn the Lingo Crossword (on pg.) for each member
- Pen or Pencil

Instructions

Hand out crossword to each member and have them complete it individually or complete it as a group.

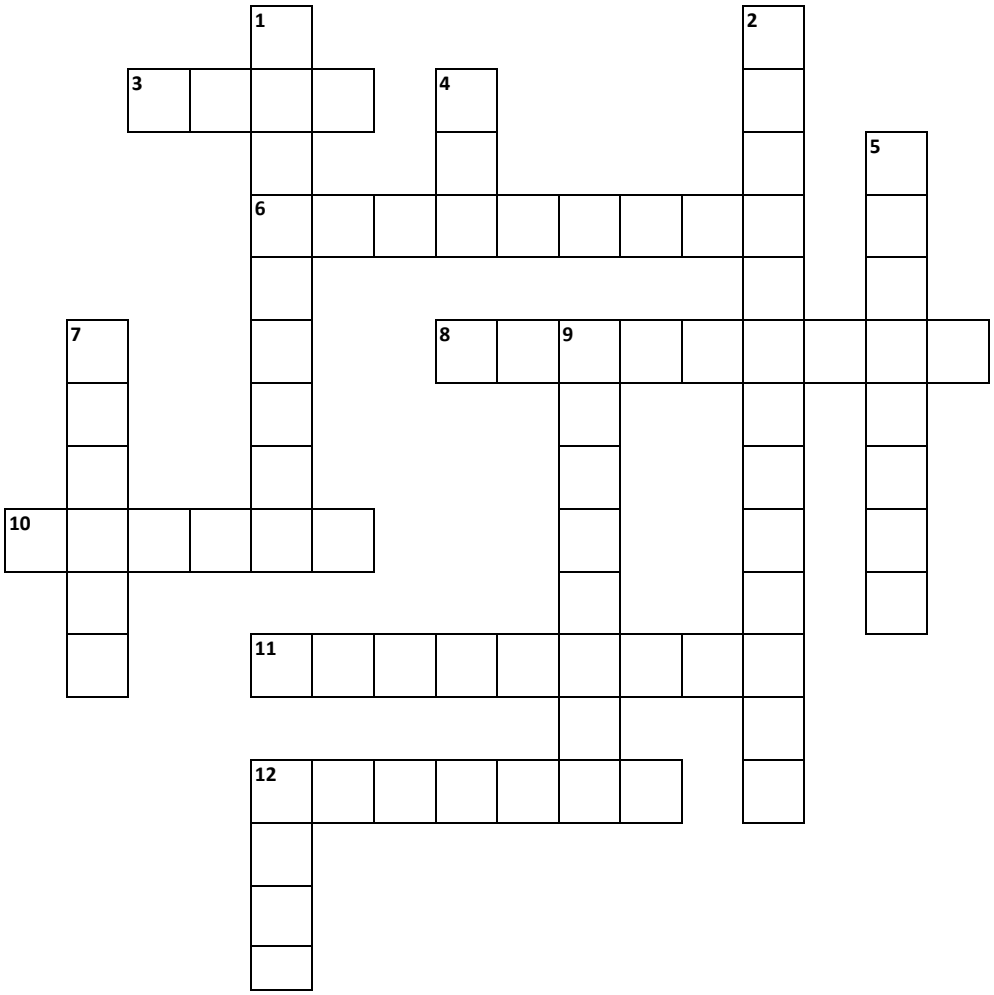
Review correct answers when finished which are listed at the back of the book.

Discussion

If members are younger or having difficulty filling in the crossword, provide them with this wordlist:

Arc, Soapstone, Flux, Stinger, Amperage, Slag, Pliers, Electrode, Fume plume, Flammable, Helmet, Gauntlet, Direct Current

Learn the Lingo Crossword



Across

3. The coating found on the outside of the electrode.
6. The metal rods used in arc welding, made of wire core and flux coating.
8. This is used to mark areas to be welded so that they can be seen while helmet is on.
10. Wear this to protect your eyes from harmful rays while welding.
11. The name for types of materials that can easily catch on fire.
12. Another name for the electrode holder.

Down

1. The visible column of fume that rises from the spot being welded. (2 words)
2. DC stands for this. (2 words)
4. The bright spark caused by electricity jumping between electrode and base metal.
5. Type of long gloves to be worn while welding.
7. Use these to pick up hot pieces of metal.
9. The amount of electrical current that flows through a circuit.
12. The waste material left on the weld that must be chipped off.

18. Learn the Lingo Wordsearch

Time Estimate 15 Minutes

Meeting or Home
Knowledge Building

About
A word game that helps members become more familiar with welding terminology introduced in Unit 1 and 2.

Materials
- Photocopy Learn the Lingo Word Search for each member
- Pen or Pencil

Instructions

Hand out crossword to each member and have them complete it.

Help members who are unable to complete it by pointing out words.

Learn the Lingo Word Search

s	e	f	u	m	e	p	l	u	m	e	e	d	w
h	s	g	w	e	l	d	e	r	d	a	e	b	e
s	e	l	b	a	c	t	a	e	e	r	e	w	l
s	s	l	a	y	y	n	u	d	g	p	l	i	d
l	s	t	m	g	c	e	o	e	a	l	g	r	i
e	a	t	i	e	y	r	a	l	r	u	g	e	n
l	l	t	l	t	t	r	r	r	e	g	t	b	g
y	g	s	e	c	u	u	c	e	p	s	a	r	c
b	y	p	e	m	d	c	l	g	m	e	h	u	i
n	t	l	a	t	e	m	e	s	a	b	a	s	r
r	e	m	m	a	h	g	n	i	p	p	i	h	c
y	f	l	u	x	h	r	g	e	g	w	c	c	u
c	a	c	d	c	e	u	t	e	l	w	e	a	i
r	s	y	p	m	l	h	h	a	s	f	e	s	t

acdc
amperage
arc length
base metal
bead
cables
chipping hammer
current
duty cycle
earplugs
electrode
flux
fume plume
helmet
metal
safety glasses
slag
welder
welding circuit
wire brush

19. Learn the Lingo Word Match

Time Estimate 15 Minutes

Meeting or Home
Knowledge Building

About
To become more familiar with common welding terms covered in Unit 1 and 2, members match the correct words to their definitions.

Materials
- Photocopy of Learn the Lingo Wordsearch (on pg.) for each member
- Pen or Pencil

Instructions

Hand out crossword to each member and have them complete it individually or complete it as a group.

Review correct answers when finished.

Learn the Lingo Word Match

Match the correct words to their definitions.

_____	Duty cycle	A. The shaded lens in a helmet that protects your eyes from arc rays.
_____	Welding table	B. This is used to chip slag off of weld beads.
_____	Ventilation	C. The number of minutes a welder can be operated for without needing to cool down.
_____	Natural	D. The movement of air through a workplace to keep harmful fumes and gases away from welder.
_____	Welder's flash	E. The power source for arc welding.
_____	Filter lens	F. The part of the welding circuit that attaches to the base metal or welding table.
_____	Ground clamp	G. The electrical path in welding where the current flows.
_____	Auto-darkening	H. You place a workpiece on this metal surface to do all of your welding.
_____	Chipping hammer	I. Condition that occurs when eyes are exposed (even briefly) to the light emitted by arc.
_____	Base metal	J. The metal or alloy being welded. Also called workpiece.
_____	Welding circuit	K. The type of helmet that darkens as soon as an arc is struck.
_____	Welding machine	L. The type of material that a welder's clothing must be made out of.

20. How It All Comes Together

Time Estimate 30 Minutes

Meeting
Demo - Knowledge Building

About
An in depth shop tour, where members see and practice properly setting up the welder and circuit.

Materials
- Access to welding shop, machine and all components of welding circuit (including base metal)

Instructions

Take members into the shop to show them the welding machine and circuit.If you did not already do a shop tour (activity 15 from Unit 1), do that now before you proceed. This tour should include a discussion of what to do in case of emergency and where exits and fire extinguishers are located. Point out the various safety features and tools you've already talked about.

Take members to the welder and identify all of its different parts (on/off switch, amperage adjustment control, amperage indicator, polarity switch, and the electrode and ground terminals). Be sure to also point out the power disconnect switch and how to operate it. Demonstrate how to turn the machine on/off, how to adjust and read amperage and how to switch polarity.

Show members the rest of the welding circuit (the cables, electrode holder, ground clamp, welding table and electrode) and how to properly set the circuit up.

To engage the members more, have them take turns changing the amperage setting, switching polarity, properly attaching clamps to their respective places, and properly placing electrode in stinger. You could even have them volunteer to explain how arc welding works, and use the equipment to demonstrate.

Discussion/Questions

It's important for members to begin feeling comfortable with the machine and how to use it. Take your time properly explaining how to operate the welding equipment and ask if there are questions.

Which part of the circuit takes the current back to the machine? Why is this called grounding?

How do we know what amperage we're welding with?

Which position is the power disconnect switch when it is on, allowing electricity to flow to welder?

21. Name That Part

Time Estimate 30 Minutes

Meeting or Home
Knowledge Building

About
A fill in the blank activity, to aid in the remembrance of the parts of the welding machine and circuit.

Materials
- Photocopy the Name That Part Diagrams for each member
- Pen or Pencil

Instructions

Hand out diagrams to each member and have them fill in the blanks or work as a group to group to fill in the blanks.

Review correct answers when finished. Answers are on page 29 and 30 of the Reference Book.

Discussion

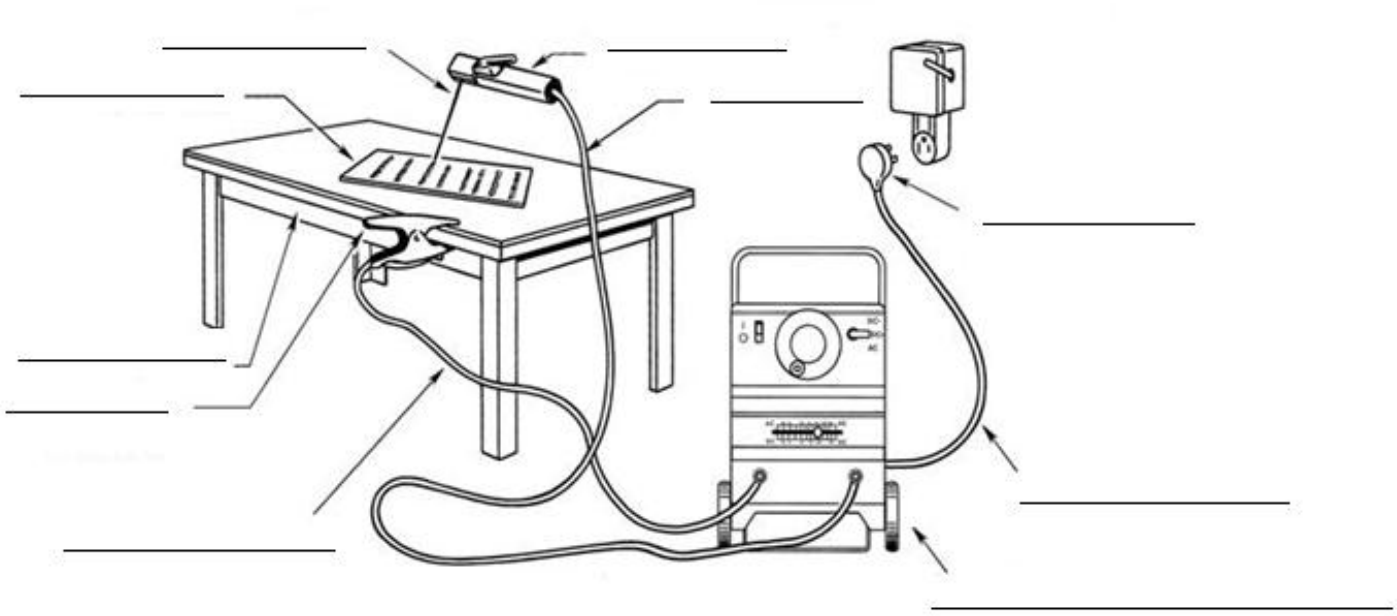
If your members are younger, or if they are having difficulty, provide them with this word list:

Polarity Switch, On/off switch, Amperage adjustment control, Amperage indicator, Ground terminal, Electrode terminal, Power disconnect switch, Electrode lead (cable), Ground lead (cable), Electrode holder/stinger, Electrode, Base Metal (workpiece), Ground clamp, Welding table, Power source (welding machine/welder),

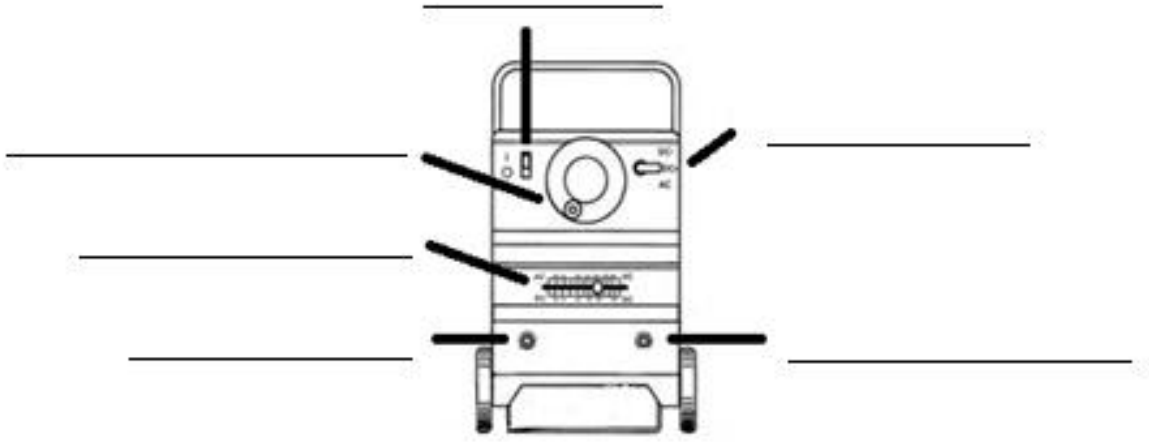
When reviewing the correct answers reiterate what different parts do by asking members which part does what or by just reminding them yourself.

Name that Part Fill-in-the-Blank

Welding Circuit



Welding Machine



22. Striking an Arc

Time Estimate 1 Hour

Meeting
Demo – Learn to do by Doing

About
Members learn how to strike an arc and are given time to practice both techniques.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

First, in the classroom, use a pencil or electrode (not attached to welder) to demonstrate both the scratching and tapping technique to strike an arc. Be sure to point out the correct electrode tip to base metal distance and what angle to hold the electrode at. (90° to direction of travel and then 20-30° tilted towards direction of travel)

Then have everyone gear up and head out to the welding shop. If you haven't given members a shop tour, or demonstrated how to set up the welding machine and circuit, do that before continuing. See activity 20.

With your welder on, demonstrate again both techniques for striking an arc talking members through the process. Give tips on how to properly hold stinger. (Two hands, with left hand steadying the right)

Then, set up members on machines so that they can practice striking an arc themselves. Give them the correct electrodes and let them know what amperage to set the machine at. Have them follow the steps for getting ready to weld, on page 32 of the Reference Book.

Let members pick either striking technique to start with. Using that technique have them practice starting the arc, holding it, and then breaking it until they are able to easily strike the arc on the first try. Once they can do that, have them do the same thing using the other technique.

Circulate around the shop as members are practicing. Learning how to weld can be discouraging, so it's important to get around to each member and offer suggestions, pointers, and any aid needed. If necessary, assist the member by guiding their hand with your own while striking the arc.

Discussion/Questions

Which technique did you find easiest? Why? Did you come across any difficulties? Where you able to solve them yourself?

Was it easier to start an arc with a new electrode, or one that has been partially used?

What do you do when an electrode “freezes?”

What can you do to let others know when you are striking an arc? Why would you want to do this?

23. Connect the Dots

Time Estimate 30 Minutes

Meeting or Home or Shop
Skill Building

About
A fun activity to practice striking an arc and allowing a weld puddle to form.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes
- Soapstone or other marking tool
- Paper and Pen/pencil

Instructions

Have members pick a simple shape or image that could be made into a connect-the-dots image. If members need inspiration as to what image to draw, here's a list to get them going: moon, star, heart, fish, football, dog bone, skull, a block letter of the alphabet, candy cane, Christmas tree, snowman, ghost, bat, wrench, hammer, saw, balloon, party hat, house, umbrella, palm tree

Have members draw their image on a paper, and locate where the dots would have to go, in order for someone else to draw the image correctly by only using the dots as reference. (this image should be large in scale, since the dots will be created by weld beads will be fairly large)

Using soapstone (or other marking tool), have members transfer the points where the dots would have to go on to a piece of scrap metal. The only thing that should be drawn on to the scrap metal at this point are the dots, not the lines connecting the dots.

Have members take scrap metal with its markings into the shop and make a weld bead on each of the dots they marked. This is great practice for starting an arc and sustaining it long enough for a weld bead to form.

Once finished have members number the dots correctly so that when connected in that order, the desired image would be created. If you wish, have members pass their connect-the-dot image to other members to see if, when completed, it really does create the correct image.

24. Clean-Up Duties

Time Estimate **15** Minutes

Meeting
Knowledge Building

About
A review of how to properly clean up and the end of a welding day.

Materials
- Access to welding shop

Instructions

At the end of the meeting (end of workday in the shop) go over the checklist on page 35 of the Reference Book with members. Add any duties to the checklist that need to be done in the shop, that are not on the list.

Take members out to the shop and point out all of the different things that need to be cleaned up, and demonstrate how to do it properly (if needed). Be sure to indicate where hot pieces of metal should be left.

Discussion/Questions

What are the dangers of leaving the shop at the end of the day without completing the clean-up checklist? Who are you endangering? What injuries could occur?

How can cleaning up extend the life of the equipment?

25. Question Toss

Time Estimate **20** Minutes

Meeting
Knowledge Building

About

A game, similar to hot potato, used to review important information.

Materials

- An assortment of balls *or* Empty, clean and dry plastic bottles (pop bottles work great)
- Tape and Pen

Instructions

This activity can either be done at either the end of a meeting, the beginning of the meeting, or at both the start and end of meetings. It's a great way to review material covered, and to refresh the memory as to what was covered in previous meetings.

In advance, prepare the balls or bottles with questions that pertain to the information covered so far in the project. See following page for suggestions of questions and answers that pertain to Unit 2. These are just suggestions; feel free to make up your own, and to add in questions from past Units.

Write questions on to tape and attach tape to bottles/balls. (one question/ball)

Have members gather in a circle. Toss one ball/bottle to members at a time and have them read out the question and answer it. If they don't know the answer, have them quickly pass on the ball to another member until someone answers it correctly. Correctly answered balls can be dropped into the middle of the circle.

The amount of balls/bottle you chose to toss will depend on how many members you have. You should have enough balls/bottles that every member gets to answer at least 1-2 questions.

Discussion

Were there any questions that where tough/tricky?

Review questions and answers that members got stuck on.

Try to choose questions that are appropriate to the age/ability of your members. For example, use more multiple questions or questions with a yes/no answer if your members are younger. And questions that require a definition or explanation type answer for older members.

Question Toss – Unit 2 Question and Answer Suggestions

1. Name one method that can be used to strike an arc? *scratching or tapping*
2. What happens when electrical current is forced across an open gap? *heat is created*
3. Should base metal be cleaned before welding? *yes*
4. What is the power source for SMAW welding? *the welding machine or welder*
5. Should you lift your helmet up as soon as an electrode "freezes?" *no*
6. Is 1 centimeter too long of an arc length? *yes*
7. What does AC stand for? *alternating current*
8. What is another name for a welding rod? *electrode*
9. What is the coating on an electrode called? *flux*
10. What do we need to chip off of a weld bead? *slag*
11. About when did arc welding start to be used in industry? *the early 1900's or around 1910*
12. What type of current does the welding machine in the shop produce? *either AC, DC or AC/DC*
13. If a welder has a duty cycle of 30%, how many minutes can it run at its highest amperage before needing to cool down? *3*
14. Do you always need to check your welder for damage before welding? *yes*
15. True or False. Before arc welding was invented there was no other way to weld metals? *false, a forge was used to heat metal and was then hammered together*
16. What does SMAW stand for? *shielded metal arc welding*
17. Is electric arc welding the same thing as shielded metal arc welding? *yes*
18. True or False? It is okay to leave a welder on, and leave cables laying around, once you're done welding for the day. *false, it is very dangerous to do this*
19. The welding area should be kept free of _____. *flammables, wet conditions etc.*
20. Does the flux release gases as it is melted? *yes*
21. If you lift your electrode too high off the base metal, what happens? *the arc goes out*
22. Does it matter which technique you use to strike an arc? *no, you should use the one that works best for you.*

26. Cartoon Safety

Time Estimate **20** Minutes

Meeting or Home
Knowledge Building

About
A scavenger hunt type game.

Materials
- Pen/pencil and Paper
- Pencil crayons or Markers (optional)

Instructions

Now that members are more familiar with the shop, the welding machine, and how things work it's a good time to review safety again. Members should have a better idea of do's and don'ts and what could happen if safety precautions aren't taken.

Have members make cartoons depicting unsafe welding practices. They can either make a single image displaying the unsafe practice, or a cartoon strip.

If members are having difficulty thinking of an idea of what to draw, help them get inspired. (Review some safety do's and don'ts and what could happen if safety rules are not followed.)

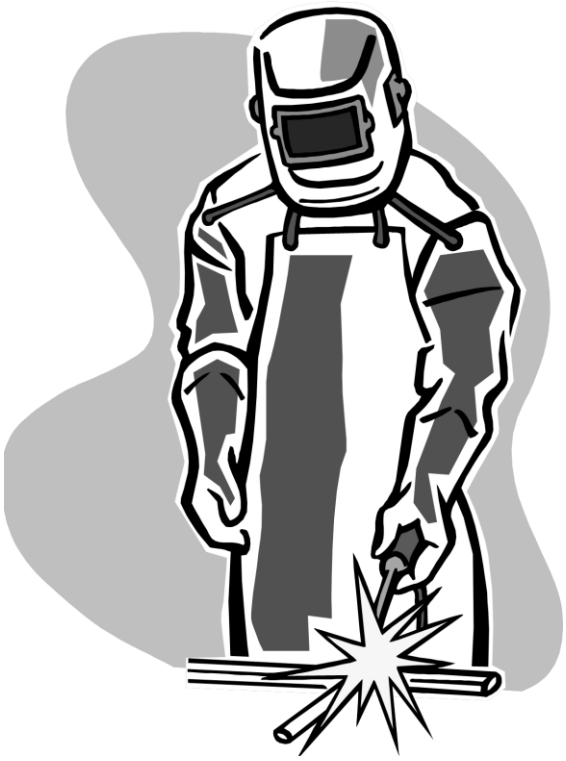
Display in shop if desired, or keep and display at Achievement Day.

Discussion/Questions

What could happen in the cartoon(s) if a safety rule is not followed?

Could something more severe happen?

Unit 3
Ready, Set, Weld



Activities:

27. Good Weld Cheat Sheet – Part 1-4
28. See How It's Done
29. Too Long, Too Short
30. Tilted This Way or That
31. Too Hot, Too Cold
32. Too Fast, Too Slow
33. All the Wrong Beads
34. Start, Stop, Re-Start
35. Straight as Can Be
36. Pad Practice
37. Written in ~~Stone~~ Metal
38. Bead Art
39. How-to Video

27. Good Weld Cheat Sheet: Part 1-4

Time Estimate 5-10 Minutes / Chapter (30 Minutes Total)

Meeting or Home Knowledge Building

About

Unit 3 covers a lot of information before the members are able to put what they've learned into practice. This can be over whelming and make key points of the lesson hard to remember once they get out into the shop. This activity gets them creating a cheat sheet as they go along, outlining the most important points from each chapter. This review not only helps with memory, but also serves as a great reference tool once they start running beads.

Materials

- Pen or Pencil
- Photocopy "Good Weld Cheat Sheet" for every member (or have them write in on a piece of paper)

Instructions

Part 1: Have members work as a group to fill in the blanks in the first box of the "Good Weld Cheat Sheet" which covers correct arc length.

Part 2: Have members work as a group to fill in the blanks in the second box of the "Good Weld Cheat Sheet" which covers electrode angles.

Part 3: Have members work as a group to fill in the blanks in the third box of the "Good Weld Cheat Sheet" which covers correct amperage setting.

Part 4: Have members work as a group to fill in the blanks in the last box of the "Good Weld Cheat Sheet" which covers correct travel speeds

Discussion

Have members keep the filled out cheat sheet, so that when they are having difficulty producing a good weld bead they can use it as a tool to resolve the issue.

Make sure that as members work together to fill in the blanks that they are filling them in correctly. An incorrect answer could lead to a lot of confusion and frustration later on. Answers can be found at the back of the manual.

Good Weld Cheat Sheet

If the bead is….	If the bead is…
…the arc length is too short	…the arc length is too long.
If I hear a _____ sound the arc length is correct.	
If I hear a _____ sound the arc length is too short.	
If I can see the arc "jumping around" the arc length is _____.	

When running a stringer bead you should hold the electrode so that the arc force will push the puddle in a way that the weld will _____.
The correct travel angle for running a stringer bead is_____.

If the bead…	If the bead…
…the amperage is too low.	…the arc length is too long.
If I see charring on electrode's flux or if I burn through the base metal the amperage is _____.	
If it is difficult to strike the arc the amperage is _____.	

If the bead…	If the bead…
…the travel speed is too slow.	…the travel speed is too fast.
If my beads are not uniform I am not travelling at a _____ speed.	
If I burn through my work I am travelling _____.	

28. See How It's Done

Time Estimate 40 Minutes

Meeting
Skill Building

About
Members are given their first opportunity to see how a weld bead is formed and then are able to try welding stringer beads for themselves.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes.

Instructions

Do a dry run demonstration to show how to properly run a stringer bead*. As you demonstrate, be sure to verbally point out what you're doing (keeping the correct arc length, holding the electrode at the correct angle and moving the electrode at a constant and correct speed).

Have everyone gear up and head out to the shop. With your welder on, demonstrate again how to run a proper stringer bead, talking members through the entire process. Also show how to chip off slag (which will reveal the weld bead).

Have members go to their respective welders and try their hand at running stringer beads. (Let them know which electrodes to use and the corresponding amperage setting.)

Circulate the shop as members are practicing. Learning how to weld can be discouraging, so it's important to get around to each member and offer suggestions, pointers, and any aid needed. If necessary, assist the member by guiding their hand with yours so they can experience what running a good weld bead is like.

After you feel that everyone has had a chance to run a bead or two, gather them in the shop and move on to Activities 29 thru 32, where you will go through each different technique separately.

Discussion/Questions

Did you come across any difficulties? Where you able to solve them yourself?

Did you find re-starting a partially burned electrode challenging? What can we do to make re-starting easier?

Why is it important to be able to run a good quality weld bead?

Do you feel as though the beads you just ran where good quality, strong beads?

How short were you able to get the electrode before you had to get a new one?

*Dry runs should be demonstrated in the classroom first with a pencil or electrode, before heading out to the shop. This way, all members can see clearly what the technique looks like. (Sometimes, in the shop crowded around a welding table, it can be tricky for a member to see clearly what the leader is demonstrating, and even more challenging once helmets are down).

29. Too Long, Too Short

Time Estimate 40 Minutes

Meeting
Demo – Learn To Do By

About
Members are given their first opportunity to see how a weld bead is formed and then are able to try welding stringer beads for themselves.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes.

Instructions

If you haven't done Activity 28 (See How It's Done) please complete before proceeding with this activity. It's important that members have been shown what a good weld bead looks like, how to make one and have had the opportunity to run a bead before they explore specific techniques.

Gather members in shop and demo arc length, talking members through the process and technique. Run part of the weld with arc length too long, part with arc length too short, and the rest with the correct arc length. Chip off the slag so that the bead can be seen. Point out the parts of the weld bead with its corresponding arc lengths (too short, too long, and correct), so that members are able to visually identity the flaws that make up a poor bead.

Have members go to their respective welders and try experimenting with different arc lengths. Have them run at least three different beads. One with arc length too long, one with arc length too short, and one with what they feel is the correct arc length.

Circulate the shop, making sure to check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have.

When you feel that everyone has had a chance to run the three different beads, gather them in the shop for a discussion.

Discussion/Questions

What happened when your arc length was too short/too long?

What faults does your bead that was run with too short/too long of an arc length have?

Do you feel that you were able to create a bead using a correct arc length? How can you tell?

30. Tilted This Way or That

Time Estimate 25 Minutes

Meeting
Demo – Learn To Do By

About
Members experiment with electrode angles.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

If you haven't done Activity 28 (See How It's Done) please complete before proceeding with this activity. It's important that members have been shown what a good weld bead looks like, how to make one and have had the opportunity to run a bead before they explore specific techniques.

Gather members in shop and demonstrate electrode angle, talking members through the process and technique. Run part of the weld with too high of a travel angle, too low of a travel angle, and the rest with the correct travel angle. Chip off the slag so that the bead can be seen. Point out the parts of the weld bead with its corresponding angles (too high, too low, and correct), so that members are able to visually identity the flaws that make up a poor bead. Also, point out what a correct work angle of 0° looks like.

Have members go to their respective welders and try experimenting with different electrode angles. Have them run at least three different beads as demonstrated.

Circulate the shop, making sure to check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have.

When you feel that everyone has had a chance to run the three different beads, gather them in the shop for a discussion.

Discussion/Questions

What happened when you held the electrode too high/too low?

Do you feel that you were able to create a bead using a correct arc length? How can you tell?

31. Too Hot, Too Cold

Time Estimate 25 Minutes

Meeting
Demo – Learn To Do By

About
Members experiment with amperage setting.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

If you haven't done Activity 28 (See How It's Done) please complete before proceeding with this activity. It's important that members have been shown what a good weld bead looks like, how to make one and have had the opportunity to run a bead before they explore specific techniques.

Gather members in shop and demonstrate amperage setting. Run part of the weld with amperage too high, amperage too low, and the rest with the correct amperage. Chip off the slag so that the bead can be seen. Point out the parts of the weld bead with its corresponding amperage setting (too high, too low, and correct), so that members are able to visually identity the flaws that make up a poor bead.

Have members go to their respective welders and try experimenting with the amperage setting. First, have them slowly turn down the amperage down 5-10 amps at a time, stopping to weld part of a bead each time they turn the setting down. Have them keep turning it down in increments like this, until they can notice a definite difference. Continue to have them lower amps until they can no longer produce enough heat to melt the base metal. Then, have them set the machine back at its original amperage and adjust amps in opposite direction, turning the setting up by 5-10 amps at a time until they notice a definite difference (the electrode covering will burn black, the bead will be flat with a lot of splatter, and the base metal will become very hot).

Circulate the shop, to check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance experiment with both settings, gather them in the shop for a discussion.

Discussion/Questions

What happened when your amperage was too high/too low?

What faults does your bead have when run with too high/too low amperage setting have?

32. Too Fast, Too Slow

Time Estimate 25 Minutes

Meeting
Demo – Learn To Do By

About
Members experiment with arc length.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

If you haven't done Activity 28 (See How It's Done) please complete before proceeding with this activity. It's important that members have been shown what a good weld bead looks like, how to make one and have had the opportunity to run a bead before they explore specific techniques.

Gather members in shop and demonstrate travel speed, talking members through the process and technique. Run part of the weld with too fast of a travel speed, part with too slow of a travel speed, and the rest with the correct speed. Chip off the slag so that the bead can be seen. Point out the parts of the weld bead with its corresponding speeds (too fast, too slow, and correct), so that members are able to visually identity the flaws that make up a poor bead.

Have members go to their respective welders and try experimenting with different travel speeds. Have them run at least three different beads. One going too fast, one too slow, and one at what they feel is the correct speed.

Circulate the shop, check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance to run the three different beads, gather them in the shop for a discussion.

Discussion/Questions

What happened when your travel speed was too fast/too slow?

What faults does your bead have when run too fast/too slow of a travel speed have?

Do you feel that you were able to create a bead using a correct speed? How can you tell?

33. All the Wrong Beads

Time Estimate 45 Minutes

Meeting
Skill Building

About
On one plate, members run six different stringer beads, each formed by using a different improper technique. Members can then try to match others beads with the faulty technique used.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Have members go to their respective welders and on once piece of steel, make six different stringer beads. Each stringer bead should be made by using one incorrect technique for the entirety of its length. They should end up with one weld made with current too low, one with current too high, one with arc length too short, one with arc length too short, one made with speed to fast and one made with speed too slow. (Too make things more interesting have them lay the beads in a random order so that they will be more challenging to identify later on.)

Circulate the shop, check in with every member to see how they are making out and field any questions they may have. Once everyone has made their six different beads gather as a group.

Divide members into pairs or small groups and see if they can correctly identify which faulty technique their partner used to form each bead. Have pairs/groups report back to entire group about their findings. If desired, keep plates, label and display at Achievement Day.

If you wish to take this activity further, you can cut plates in half so that members can inspect the penetration and quality of each weld. This is a great way to help them understand why making a good quality weld is so important. (You can even make a well formed, quality weld and cut it half so that members can see the difference.) You could also take the plates, grind and polish smooth and etch with a dilute solution of nitric acid and have members inspect the welds again and discuss their findings.

Discussion/Questions

Where you able to identify which beads where made by which improper technique? How could you tell?

What weaknesses do each of these beads have? How does proper technique form a bead that is strong?

34. Start, Stop, Re-Start

Time Estimate 35 Minutes

Meeting
Demo – Learn To Do By

About
Members practice re-starting beads properly (so that the crater is filled and the bead appears seamless).

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Gather members in shop and demonstrate how to re-start an interrupted bead, talking members through the process and technique. Be sure to point out the need to chip off slag and clean weld properly before re-starting and that an interrupted bead is one that has a crater left at the end that will be filled when you go back to finish the bead. Point out that when they come back and fill this crate, they just need to extinguish the arc by withdrawing the electrode.

Have members go to their respective welders and try restarting interrupted beads. Have them lay beads first in a ___ ___ ___ pattern up and down their practice plate, laying a bead about 5 cm long, leaving a 5cm gap, and then laying another bead 5 cm. Then, have them clean off the slag and go back and fill in all the gaps. Challenge them to try and make it impossible to tell where the beads were started and stopped.

Circulate the shop, check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance to re-start a few beads, gather them in the shop for a discussion.

Discussion/Questions

Is it noticeable where the bead was re-started?

How can we ensure that the spot where we re-started the bead will be just as strong as everywhere else? Is there a way we can tell if we successfully re-started a bead, without sacrificing strength of the bead?

Do you feel like you would be able to re-start an interrupted bead while working on an actual project?

35. Straight as Can Be

Time Estimate 35 Minutes

Meeting
Skill Building

About
Members practice running straight beads

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes
- Soapstone

Instructions

Have members go to their respective welders and challenge them to run a weld bead as straight as possible. Have them first draw some straight lines with soapstone and a straight edge and then have them try free-handing a straight line without a soapstone line to follow. Have them use up one electrode per/line (or as an extra challenge have them see if they can re-start an interrupted bead while maintaining a straight line).

Circulate the shop, making sure to check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance to make at least one bead following soapstone line and one free hand , gather them in the shop for a discussion.

If you have a group, who you think would do well with a competition, compare beads with a straight edge to see who was able to make the straightest bead.

Discussion/Questions

Did you find a difference in straightness between beads run following a soapstone line and not? Even if they were just as straight did you find it easier to see what you were doing when following the soapstone? Does this make you want to use soapstone as a tool when welding?

Is running a straight bead an important skill? How could a crooked bead (or a bead placed not precisely where we want it) affect the strength of a joint welded together (do you think there would be different penetration along the joint)?

What makes running a straight bead difficult? (unsteady hands, not being in a comfortable position?)

36. Pad Practice

Time Estimate 40 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members practice building pads. Excellent practice for successfully running good weld beads (which will help with all future welding) and is a useful skill to learn for repairing worn out parts.

Materials

- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Electrodes and Scrap metal plate (10cm x 5cm works well but use what you have readily available)

Instructions

Gather members in shop and demonstrate how to weld a pad. Run a straight bead along the edge of the plate. Chip the bead free of slag before running another pass (this must be done for each pass to that slag will not be trapped in the weld). Run a second bead parallel to the first, overlapping it about one third, making sure fusion is between the plate and the previous bead.

Instruct members to continue running beads like this along the entirety of the plate. Beads should all be the same height with no excessive dip (depression/valley) between them. As successive beads are run, a smooth, flat weld surface will result. Each bead should be finished properly so that no crater is left at the end of the plate. Once the beads have been run one direction along the entire plate, clean all welds properly and then turn plate 90° to run beads in the same manner in the other direction (at right angles to the first layer). Continue doing this to build up a weld pad. Challenge the members to try to build up the plate in such a way that the edges stay square and straight.

Have members go to their respective welders and try building a pad in this manner. Have them use soapstone if they need it to help them run straight beads. Circulate the shop, making sure to check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance to build at least two layers of their pad, gather them in the shop for a discussion.

If desired, save pads and display at Achievement Day. (If this is the case, you may want to allow members to take pad home to finish it, or finish when going through Unit 8.)

Discussion/Questions

When might it be necessary to use this padding skill? (It is often necessary to build up surfaces with one or more layers of weld deposit…you can rebuild a worn surface with padding.) Give examples.

What did you find challenging in this exercise and how did you overcome that challenge?

Do you think you've created a strong pad and that you could use this technique to properly repair worn parts?

As an option to take this activity further, you could saw through the pads (with a hacksaw) to check for pinholes, pores and slag inclusions. (Do not quench in water before doing this, as it will make the metal difficult to saw through.) Once sawed in half, if we wish to inspect the pad further, grind the cut surface and etch with nitric acid to observe fusion between beads, layers, and plate. (see note in intro re: nitric acid)

Do you feel that laying all of these beads has helped us improve our welding technique at all? (projects and other activities will be more successful with all of this practice…which should help us feel more comfortable and able to produce good welds)

37. Written in ~~Stone~~ Metal

Time Estimate 25 Minutes

Meeting
Skill Building

About

A fun activity where members write their names by running stringer beads on metal plates. Good practice for successfully running weld beads.

Materials

- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal plate (appropriate in size to name being written) and Electrodes
- Soapstone

Instructions

Have members use soapstone to write out their name on a metal plate. Then, have them go to their respective welders and try running a stringer bead along the soapstone lines so that their name is written in metal with the beads.

Circulate the shop, check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance to write their name, gather them in the shop for a discussion.

If some members finish before others, have them try writing there name again with all capital or lower case letters, or handwriting instead of printing. You could also challenge them to grab a different piece of scrap metal and practice letters that aren't in their name that might be more difficult (like an "s" for example) or attempt their last name in addition to their first.

If desired, save finished name plates and display at Achievement Day.

Discussion/Questions

Did you find it more/less difficult to run beads that are not straight, around curves and starting and stopping in the correct place?

Did you think about moving the plate, instead of your body to weld around curves, etc? Which do you think is easier moving the plate or moving your body?

If desired, save name art and display at Achievement Day.

38. Bead Art

Time Estimate 25 Minutes

Meeting
Skill Building

About

A fun activity where members make 2D art by running stringer beads on metal plates. Good practice for successfully running weld beads and in being creative.

Materials

- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal plate and Electrodes
- Soapstone

Instructions

Have members use soapstone to draw out any sort of image on a metal plate. Then, have them go to their respective welders and try running a stringer bead along the soapstone lines so that their art comes to life with the weld beads. If members are in need of some creative inspiration for their drawings suggest themes that everyone could follow (Halloween, Christmas, animals etc.) or have the group brainstorm ideas together of what might be possible to create with weld beads (a simple landscape, an animal, a skull, or even something that is just abstract designs).

Circulate the shop, check in with every member to see how they are making out and offer suggestions or corrections and field any questions they may have. When you feel that everyone has had a chance to complete an art piece, gather them in the shop for a discussion.

Discussion/Questions

Did you find aspects of the image difficult to create with a weld bead? Do you think this activity helped you with your welding technique?

Did it turn out to look like you imagined it would? If you were to do it again, would you design a different image?

If desired, save name art and display at Achievement Day.

39. How-to Video

Time Estimate 40 Minutes

Meeting
Skill Building

About

Members create instructional videos demonstrating skills they've been developing in Unit 3. This helps develop skills from this unit and aids in building public speaking and communication skills.

Materials

- Video recording device (digital camera, smartphone, video camera, etc)
- Pencil and Paper
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Divide members into pairs or groups and instruct them to write, practice and record their own instructional video. Have each team pick which skill they would like to demonstrate in their video. It should be a skill/technique they learned in Unit 3 like how to tell if you're using the correct arc length, what is the correct way to hold the electrode, how to tell if you're traveling at the correct speed, how to re-start a bead and so on.

It is suggested that members record these videos while mock-welding (with the welders off). Have them pretend to weld and describe what we would see if we were doing the skill correctly/incorrectly. If you do have filter shields that can be held in front of the camera, you may allow members to record welding. You may find it a more successful activity to just mock-weld, having members describe the technique as they demonstrate.

If possible, play each video for the group to watch (will need a television or computer). If not possible, have someone (member or leader) combine the videos into one continuous instructional video and play at the next meeting. Videos can be played at Achievement Day. (If you choose to do this, you may want to edit the videos and put them all on the same DVD.)

Discussion

What were the challenges in creating your own instructional video? Do you think a beginner welder would be able to watch the video and understand what the proper welding technique are?

Unit 4
Examining Electrodes

Activities:

40. Ways to Weld
41. Examining Electrodes
42. Electrode Code
43. Testing the Difference
44. How-To Video
45. Question Toss

40. Ways to Weld

Time Estimate 15 Minutes

Meeting
Demo – Knowledge Building

About
An activity to get members familiar with different welding positions and to start thinking about when they would weld in each of those positions.

Materials
- Two metal plates
- Chalkboard and Chalk (optional)

Instructions

Manually hold two plates in various welding positions pointing out the joint that is formed that would require welding. (This helps members in visualizing how it would be welded.) Have members tell you which position the pieces you're holding require welding in. Try to demo a lap joint, butt joint and T-joint in each of the different welding positions. It may seem like trick questions if you form different joints in each position, but this is recommended so that the members don't associate a welding position only with the one joint you demonstrated in that position.

Next, either in the classroom, in the shop or outside, point to various things, asking if they were broken, what position would be used to fix it. If you're in a welding shop and there are projects and repairs around the shop waiting to be completed, these are the best examples to use in your questioning. Remind members that it is easier to weld in the flat position, so if the object can be turned to be welded in the flat position, then this is the most correct answer. Depending on where you are, it might be difficult to find enough metal things around to use for examples. If that's the case, try posing the questions like this "if this object (ceiling tile, pencil, etc) was made of metal, and broke here (point to spot), what position would we need to weld it in?" or something like "If the door was made of metal, and we wanted to weld it shut so that it couldn't be opened, what welding positions would need to be used?"

Lastly, if you weren't able to find many objects to weld that were out of position, together have the group brainstorm a list of things/repairs that would need to be done in each of the vertical, horizontal and overhead positions. If you have a chalkboard, you can make a column on the board for each of the positions and write the repairs in their respective column as they are suggested.

41. Examining Electrodes

Time Estimate 15 Minutes

Meeting
Demo – Knowledge Building

About
A look into different electrodes, their uses, and how to I.D them.

Materials
- An assortment of different electrodes

Instructions

Pass out a different electrode to each member and keep one for yourself to demonstrate with.

Point out where the AWS number is located on the electrode and have members find the number on their own. Go around the room, having each member tell the group what number is written on their electrode.

Review what the first two digits of the AWS number stand for (tensile strength, which is those numbers x1000 psi). Have each member report to the rest of the group what the tensile strength of their electrode.

Review what the second last digit stands for (position of that electrode can be used in) and what the three potential numbers in this spot represent (1 = all positions, 2 = flat and horizontal fillet, 3 = flat position only). Have each member report to the rest of the group what position the electrode they have can be used in.

Review that the last two digits in combination tells us a great deal about the electrode. Briefly go over every electrode that you've passed out to members, describing a key feature or two about it and when they might choose to use it for a welding operation.

Discussion/Questions

Why do we need to know how to identify different electrodes? Why is it necessary to have the right electrode for the weld you'll be making?

42. Electrode Code

Time Estimate 15 Minutes

Meeting
Knowledge Building

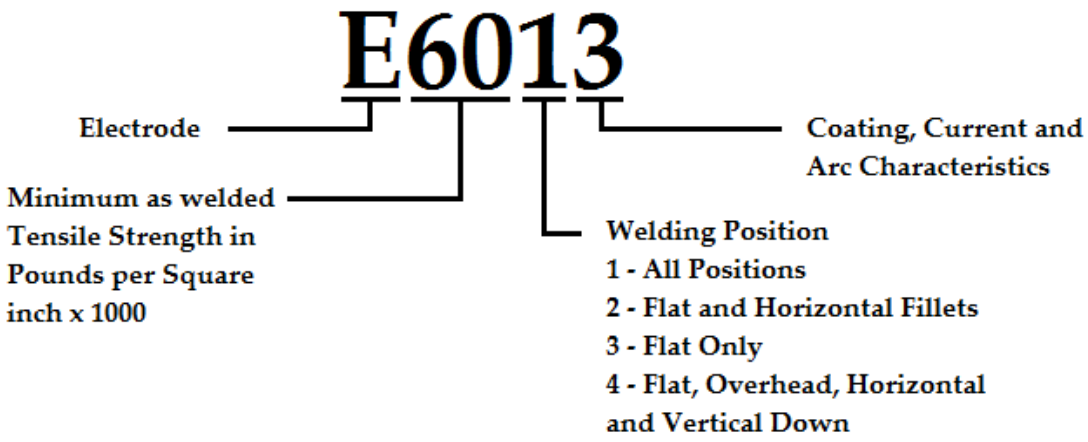
About
Members create a poster that illustrates how to read an electrode number.

Materials
- Bristol board or other paper for creating a poster
- Markers and/or Pens
- Tape (optional) to hang poster when finished

Instructions

Have members create a poster that can be hung in the shop with a diagram of an electrode number. Have them label each digit of the electrode number with what it represents. The poster will serve as a quick reference.

The diagram should look something like this:



Discussion/Questions

Does this chart tell us enough about electrodes to help us read the AWS number?

If we can properly read the AWS number, can we properly select an electrode? What else will help us to choose the right electrode?

Where can we find the other information needed to help us choose the right electrode for the job?

43. Testing the Difference

Time Estimate 30 Minutes

Meeting
Skill Building

About
An opportunity to experience the difference between electrodes by welding with them.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal
- A variety of electrodes for each member

Instructions

Pass out a variety of different electrodes to each member (2-5 each). If available, it's preferable to use the electrodes discussed in Unit 4 (E6010, E6011, E6013, E7018, and E7024). For each electrode you distribute, let members know the polarity and amperage that each should be used with.

Members try using different electrodes to see if they notice the difference welding with them.

Have members go to their respective welders and try experimenting with the different electrodes. Have them run a bead with each of the different electrodes. Ask them to pay special attention to the way each electrode handles and the differences between one electrode to the next.

Circulate the shop, check in with every member to see how they are making out and to make sure that they are using the correct amperage and polarity for each specific electrode. When you feel that everyone has had a chance to make a bead with each of the different electrodes, gather them for a discussion.

Discussion/Questions

Could you notice a difference between the different electrodes? Do the different electrodes produce different looking beads?

Was there an electrode that you preferred to use? Why? What characteristics did you find that made an electrode easier or more difficult to operate?

Now that we know how each electrode handles, do you think you could find a time/place that it would be beneficial to choose to use one electrode over the other?

44. How-To Video

Time Estimate 40 Minutes

Meeting
Skill Building

About

Members create instructional videos demonstrating skills and knowledge they've been developing in Unit 4. This helps develop skills from this unit and aids in building public speaking and communication skills.

Materials

- Video recording device (digital camera, smartphone, video camera, etc)
- Pencil and Paper
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Divide members into pairs or groups and instruct them to write, practice and record their own instructional video. Have each team pick which skill they would like to demonstrate in their video. It should be a skill/technique they learned in Unit 4 like what the different polarities are and how to switch polarity on a machine, how to I.D an electrode by using its AWS number, how to properly handle/store electrodes (or what not to do with your electrode), or in choosing the correct electrode for the job (for example they could find something that is welded or needs to be welded and describe which electrode would be best to choose for welding it).

If possible, play each video for the group to watch (will need a television or computer). If not possible, have someone (member or leader) combine the videos into one continuous instructional video and play at next meeting. Videos can be played at Achievement Day. (If you choose to do this, you may want to edit the videos and put them all on the same DVD.)

Discussion

What were the challenges in creating your own instructional video? Do you think a beginner welder would be able to watch the video and learn about electrodes?

45. Question Toss

Time Estimate 20 Minutes

Meeting
Knowledge Building

About

A game, similar to hot potato, used to review important information.

Materials

- An assortment of balls *or* Empty, clean and dry plastic bottles (pop bottles work great)
- Tape and Pen

Instructions

This activity can either be done anytime during the meeting. It's a great way to review material covered, and to refresh the memory as to what was covered in previous meetings.

In advance, prepare the balls or bottles with questions that pertain to the information covered so far in the project. See following page for suggestions of questions and answers that pertain to Unit 4. These are just suggestions; feel free to make up your own, and to add in questions from past Units.

Write questions on to tape and attach tape to bottles/balls. (one question/ball)

Have members gather in a circle. Toss one ball/bottle to members at a time and have them read out the question and answer it. If they don't know the answer, have them quickly pass on the ball to another member until someone answers it correctly. Correctly answered balls can be dropped into the middle of the circle.

The amount of balls/bottle you chose to toss will depend on how many members you have. You should have enough balls/bottles that every member gets to answer at least 1-2 questions.

Discussion

Were there any questions that where tough/tricky?

Review questions and answers that members got stuck on.

Try to choose questions that are appropriate to the age/ability of your members. Use more multiple questions or questions with a yes/no answer if your members are younger. And questions that require a definition or explanation type answer for older members.

Question Toss – Unit 4 Question and Answer Suggestions

1. What does the "E" written on an electrode stand for? *that the electrode is for electric arc welding*
2. True or False. In order to weld you NEED to have a machine with both AC and DC polarities? *false*
3. Should the base metal of joints be cleaned before welding? *yes*
4. True or False. Power sanding is the best and only way to clean joints before welding? *false*
5. Do you multiply the first two digits of an electrode number by 100, 1000, or 10,000 to find its tensile strength? *1000*
6. If the second last digit of an electrode is a 3, what position can the electrode be used in? *flat*
7. What does DC stand for? *direct current*
8. How many different DC polarities are there? *two*
9. Could you produce a good weld if flux on the electrode is cracked or chipped? *no*
10. Which electrode could you use if you were unable to properly clean base metal? *6010 or 6011*
11. What can you do to save electrodes that get wet? *dry them in an oven*
12. True or false. You select the size of the electrode according to the thickness of metal being welded? *true*
13. True or false. No matter what you're welding, the bigger the electrode the better? *false*
14. Is the size of the electrode measured by the diameter of its flux coating and wire core, or just by its wire core? *just wire core*
15. What do the first two numbers on an electrode stand for? *strength of deposited weld metal*
16. In which polarity does the current direction constantly switch back and forth, AC or DC? *yes*
17. Does arc blow happen when using AC machines? *no*
18. If you don't know what type of metal you're working with, are there tests that exist to help identify it? *yes*
19. What does the second last digit on an electrode stand for? *the position it can be used in*

Unit 5
Working with Welds

Activities:

46. Which Joint is Which
47. Find the Joint
48. What's in a Weld?
49. Welding a Butt Joint
50. Welding a T-Joint
51. Welding a Lap Joint
52. Skill Plate
53. Welding with Weaves
54. Pad Practice with Weaves
55. Making Multiple Passes
56. Working with Contraction Forces
57. Defeating Distortion
58. How-To Video

46. Which Joint is Which

Time Estimate 20 Minutes

Meeting
Knowledge Building

About
Members practice joint identification and develop an idea of when each would be used.

Materials
- Samples of the 5 different joints found in welding
- Bristol Board or other paper for creating a poster
- Markers and/or Pens
- Tape (optional) to hang poster when finished

Instructions

In advance, using metal plates, weld samples of the different joints you find in welding (butt, lap, corner, edge and T-joints). Display these joints for members to see, asking if they can identify each one.

As a group, or in pairs/small groups, have members create a poster(s) of types of joints. Depending on how many members you have, either make one poster for each of the joints or have all the joints on one poster. On the poster have members draw the joint, label it, and provide a list of different parts and repairs that would need to be made using this joint (which should be brainstormed by the members making the poster).

If desired hang posters and/or save them to be displayed at Achievement Day.

Discussion/Questions

Was there one joint that was easier/harder to make a list of things that could be made/repaired by using that joint?

Which joint do you think is the most commonly used/least commonly used? Why do you think that is?

Do you think that all of these joints could be welded in any welding position?

Which type of joint do you think will be easiest to weld?

47. Find the Joint

Time Estimate 20 Minutes

Meeting
Knowledge Building

About
Members examine a piece of equipment to see if they can identify the different joints used in its construction.

Materials
- Samples of the 5 different joints found in welding
- Access to a piece of equipment made of metal (or any area that contains things made of metal)

Instructions

In advance, using metal plates, weld samples of the different joints you find in welding (butt, lap, corner, edge and T-joints). Display these joints for members to see, asking if they can identify each one.

Next, take the members to examine a piece of farm or construction equipment so that they can examine it. If you don't have access to such equipment, take the members on the tour of the shop or somewhere else where you'll find objects that are made of metal.

Have members identify the different joints used in the construction of the piece of equipment. To take the activity further, also have members suggest what welding position the joint could've been welded in. You can also have members speculate on how (the order in which) the equipment was constructed.

Discussion/Questions

Were all five joints identified in the piece of equipment? Why do you think some joints are rarely used when constructing equipment?

What was the most commonly used joint on the piece of equipment? Why do you think this joint is used so often in welding?

Do you suspect that some joints are harder to make than others? Which joint do you think is fastest and easiest to weld?

If you had a drawing of this piece of equipment would you be able to plan in advance the order it was constructed? Where would you start and why?

48. What's In a Weld?

Time Estimate 15 Minutes

Meeting
Demo - Knowledge Building

About
Members identify the different components that make up a weld.

Materials
- Samples of the 5 different joints found in welding
- Bristol board and markers (optional)

Instructions

In advance prepare a variety of different joints found in welding (at least one made with a groove weld and one made with a fillet weld). Either pass the samples around, or have members come close enough so that they can see the weld clearly.

Using your samples as reference, point out the different parts of the weld, for both a fillet weld and a groove weld. Be sure to point to all of the parts described in Unit 5 (Root of the weld, root face, groove face, root edge, root opening, bevel angle, groove angle, leg of a fillet weld, and size, face, and toe of a weld.) Make sure to point out that many of these components are different when comparing a groove weld and a fillet weld.

If desired, pass out the samples to the members and have them correctly label each part of the weld. If you would like, labeled welds can be displayed at Achievement Day.

If desired have members make a poster (as a group, or in pairs/small groups), of the components that make up a weld. Hang posters and/or save for Achievement Day.

Discussion/Questions

Is it important that we know what the different parts of the weld are called?

How will being able to identify the parts of a weld help us when we are welding?

49. Welding a Butt Joint

Time Estimate 30 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members are shown how to weld a square butt joint and are given the opportunity to weld the joint on their own.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates (approx. 4-6 mm thick) and Electrodes

Instructions

Do a dry run demonstration to show how to weld a square butt joint. As you demonstrate be sure to verbally point out what you're doing (holding the electrode at the correct angles etc.).

Have everyone gear up and head out to the shop. This time, with your welder on, demo again how to weld a square butt joint, first by tack welding the two plates in the correct position and then running stringer beads on both sides of the joint. Talk members through the entire process as you weld the joint. Demonstrate using a straight stringer bead only (since we haven't covered weaves yet). Be sure to point out the correct space to leave between the two plates and that both sides of the seam need to be welded so the two welds meet with each other in the middle of the plates.

Have members go to their respective welders and try their hand at welding a butt joint. Make sure that members use plates that are the correct thickness to be properly welded from both sides. If members have trouble making their two welds meet, they probably need to use a higher amperage. Circulate the shop, checking in with every member, to offer pointers and corrections. When you feel that everyone has had a chance to make a butt joint, gather them in the shop for a discussion.

If desired, have members save their best butt joint, and display at Achievement Day. If you do, make a skill plate and display the skill plate at Achievement Day instead.

Additional to this activity, you can test butt joints for strength, testing after one pass or after both passes. Remember to let the welds cool to room temperature on their own before testing them. (Quenching metal destroys some of its qualities). Try to break the butt joints apart by bending them in a vise. If you are able to break the weld apart, examine where it was the weakest and where it held the longest. Also check for penetration. (Did each of the weld passes penetrate 50% the entire way along the joint?)

Discussion/Questions

When might we use a butt joint?

What did you find challenging while making this joint?

Did anyone use soapstone to highlight the edges of the joint? Do you think using soapstone like this can make welding joints easier?

Why is good/full penetration so important?

If we weren't able to make a pass penetrate 50% into the joint, what could we do differently next time to ensure that it does?

50. Welding a T-Joint

Time Estimate 30 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members are shown how to weld a T- joint and are given the opportunity to weld the joint on their own.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates (approx. 4-6 mm thick) and Electrodes

Instructions

Do a dry run demonstration to show how to weld a T-joint. As you demonstrate, be sure to verbally point out what you're doing (holding the electrode at the correct angles etc.).

Have everyone gear up and head out to the shop. With your welder on demonstrate again how to weld a T-joint. First show how to tack weld the two plates in the correct position with good fit-up (also pointing out that the vertical plate back should lean back slightly, so that as the joint cools/shrinks it will be perpendicular to bottom plate.) Then run a stringer bead along the joint. Talk members through the entire process as you weld the joint. Demonstrate using a single pass stringer bead only (since we haven't covered weaves or multiple passes yet). Be sure to point out the correct arc length and what happens if you use the incorrect electrode angles.

Have members go to their respective welders and try their hand at welding a T-joint. Make sure that members use plates that are the correct thickness to be properly welded with a single pass fillet weld. Circulate the shop, checking in with every member, to offer pointers and corrections. When you feel that everyone has had a chance to make a T-joint, gather them in the shop for a discussion.

If desired, have members save their best T-joint, and display at Achievement Day. If you do, make a skill plate and display the skill plate at Achievement Day instead.

If you wish to take this activity further, you can do so by testing T-joints for strength and penetration. It's easier to test for strength with single fillet welds (as opposed to double fillet welds). Remember to let the welds cool to room temperature on their own before testing them. (Quenching metal destroys some of its qualities). To test for penetration, use a hack saw to saw through the joints so it can be seen how well the weld penetrated into the corner. The bead should have even penetration into each plate and completely into the corner.

To test for strength, place a plate in the vise and try to break the upright piece off with a hammer to see how well the weld holds. If you are able to break the weld apart, examine where it was and where it held the longest.

Discussion/Questions

When might we use a T-joint?

What did you find challenging while making this joint?

Did anyone use soapstone to highlight the edges of the joint? Do you think using soapstone like this can make welding joints easier?

Why is good/full penetration so important?

Why is good fit-up important?

Why does running a weld on both sides of the joint (making a double fillet) make the joint stronger?

If we weren't able to make a pass that penetrated into the corner of the joint, what could we do differently next time to ensure that it does?

51. Welding a Lap Joint

Time Estimate 30 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members are shown how to weld a lap joint and are given the opportunity to weld the joint on their own.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates (approx. 4-6 mm thick) and Electrodes

Instructions

Do a dry run demonstration to show how to weld a lap joint. As you demonstrate be sure to verbally point out what you're doing (holding the electrode at the correct angles etc.).

Have everyone gear up and head out to the shop. With your welder on demonstrate again how to weld a lap joint, first by tack welding the two plates in the correct position with good fit-up and then running a stringer bead along the joint. Talk members through the entire process as you weld the joint. Demonstrate using a single pass stringer bead only (since we haven't covered weaves or multiple passes yet). Be sure to point out the correct arc length, how to be careful of not burning the top edge, and what happens if you use the incorrect electrode angles.

Have members go to their respective welders and try their hand at welding a lap joint. Make sure that members use plates that are the correct thickness to be properly welded with a single pass fillet weld. Circulate the shop, checking in with every member to offer pointers and corrections. When you feel that everyone has had a chance to make a lap joint, gather them in the shop for a discussion.

For Achievement Day you can have members save their best lap joint and display it. If you do, make a skill plate and display the skill plate at Achievement Day instead.

If you wish to take this activity further, you can do so by testing T-joints for strength. It's easier to test for strength with single fillet welds (as opposed to double fillet welds). Remember to let the welds cool to room temperature on their own before testing them. (Quenching metal destroys some of its qualities). Place a plate in the vise and try to break the other plate off with a hammer to see how well the weld holds. If you are able to break the weld apart, examine where it was weakest and where it held the longest. The bead should have even penetration into each plate and completely into the corner.

Discussion/Questions

When might we use a lap joint?

What did you find challenging while making this joint?

Did anyone use soapstone to highlight the edges of the joint? Do you think using soapstone like this can make welding joints easier?

Why is good/full penetration so important?

Why is good fit-up important?

Why does running a weld on both sides of the plates (making a double fillet) make the joint stronger?

If we weren't able to make a pass that penetrated into the corner of the joint, what could we do to differently next time to ensure that it does?

52. Skill Plate

Time Estimate 30 Minutes

Meeting
Skill Building

About
Members weld one plate that contains all three of the joints they've learned how to weld: a butt joint, a lap joint and a T-joint.

Materials

- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates (4 per person – approximately 150mm x 50mm x 5mm in size) and Electrodes

Instructions

In this activity members will take four separate plates and weld them into one plate that demonstrates all of the skills they have learned so far in the project. The plate will contain a T-joint, a butt joint and a lap joint.

Show members what their finished "skill plate" should look like.

Provide the members with the correct plates required to complete the "skill plate" and have a group discussion regarding the best order to make the welds in, or if the order of welding matters in this instance. This is good practice for when they start working on their own projects and have to make this decision for themselves.

Have members go to their respective welders and complete their own "skill plate" using single pass stringer beads to weld all joints. Check with every member to offer pointers and corrections. When you feel that everyone has had a chance complete a "skill plate," gather them in the shop for a discussion.

The skill plates can be displayed at Achievement Day. If you do have members display them at Achievement Day you may want to also have them label each joint.

Discussion/Questions

Do you think the order you welded the joints made this task easier or harder? Could there have been a better way to go about it?

When you envision the projects that you're going to be working on, do you think that you can complete them by using these 3 joints?

53. Welding with Weaves

Time Estimate 30 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members are given the opportunity to try their hand at it making different weave beads.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Do a dry run demonstration to show how to make all of the different weaves described in Unit 5. As you demonstrate, be sure to verbally point out what you're doing.

Have everyone gear up and head out to the shop. With your welder on, demonstrate again how to make each of the different weaves talking members through the process of making each weave. Be sure to point out the slight pause at the edge of the weaves, the correct width a weave should be, and how to make a smooth, uniform bead.

Have members go to their respective welders and practice making each of the weave beads. Challenge them to practice the weaves they have the most trouble with until they can make a uniform bead. Check with every member and offer pointers and/or corrections. When you feel that everyone has had a chance to make a weld pass with each of the weaves, gather them in the shop for a discussion.

If you wish to take this activity further, you can do so by testing the weaves for penetration. Have members run a stringer bead next to a few different styles of weave beads. Cut the plate in half to examine how deeply the different welds penetrated the plate.

Discussion/Questions

Is there a style of weave you prefer to use? Why did you find this one easier to make a weld bead with? What made the other weaves more challenging? Is there a weave that is "better" than the others?

Can you think of examples of when we'd need to use weave beads? Is there a time that you might choose one bead over another, even if it's not the weave you preferred using?

Which weave bead to you think penetrated the plate deepest? Why?

54. Pad Practice with Weaves

Time Estimate 40 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members practice building pads with weave beads. Excellent practice for successfully running good weld beads is a useful skill to learn for repairing worn out parts.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Electrodes and Scrap metal plate (approx. 10cm x 5cm in size)

Instructions

Gather members in shop and demonstrate how to weld a pad by using a weave pass. Run a straight weave bead along the edge of the plate. Chip the bead free of slag before running another pass (this must be done for each pass so that slag will not be trapped in the weld). Run a second bead parallel to the first, overlapping it about one third, making sure fusion is between the plate and the previous bead.

Instruct members to continue running beads like this along the entirety of the plate using whichever weaving method they prefer. Beads should all be the same height with no excessive dip between them. As successive beads are run, a smooth, flat weld surface will result. Each bead should be finished properly so that no crater is left at the end of the plate. Once the beads have been run one direction along the entire plate, clean all welds properly and then turn plate 90° to run beads in the same manner in the other direction (at right angles to the first layer). Continue doing this to build up a weld pad. Challenge the members to try to build up the plate in such a way that the edges stay square and straight. The end goal is to build up a plate so that it is about 20-25 cm thick. If members are looking for an extra challenge have them run a different weave bead on each layer (but only one type of weave per layer, so that all the beads on one layer are the same size).

Have members go to their respective welders and build a pad in this manner. Check with every member and offer pointers and corrections. When you feel that everyone has had a chance to build at least two layers of their pad, gather them in the shop for a discussion.

As an option to take this activity further, you could saw through the pads (with a hacksaw) to check for pinholes, pores and slag inclusions. (Do not quench in water before doing this, as it will make the metal difficult to saw through.) Once sawed in half, if we wish to inspect the pad further, grind the cut surface and etch with nitric acid to observe fusion between beads, layers, and plate. (see note in intro re: nitric acid)

If desired, save pads and display at Achievement Day. (If this is the case, you may want to allow members to take pad home to finish it, or finish when going through Unit 8.)

Discussion/Questions

When might it be necessary to use this padding skill? (It is often necessary to build up surfaces with one or more layers of weld deposit…you can rebuild a worn surface with padding.) Give examples.

What did you find challenging in this exercise and how did you overcome that challenge?

Do you think you've created a strong pad and that you could use this technique to properly repair worn parts?

Do you feel that laying all of these beads has helped us improve our welding technique at all? (projects and other activities will be more successful with all of this practice…which should help us feel more comfortable and able to produce good welds)

If you had members make a pad in Unit 3 using stringer beads ask them which they found easiest and why? Which did they find took less time?

55. Making Multiple Passes

Time Estimate 30 Minutes

Meeting
Demo – Learn To Do By Doing

About
Members are shown how to make a 3-pass fillet weld and are given the opportunity to weld the joint on their own.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates (thicker than 6mm) and Electrodes

Instructions

Place several pieces of metal with varying thickness in front of the members. Ask them which plates they think would be appropriate to weld with a 3-pass fillet weld, and which ones would need more or less passes to complete. Once the correct plates have been picked for a 3-pass fillet and members are clear on why those plates are appropriate; demonstrate how to weld a fillet joint with 3 passes and you demo, be sure to verbally point out what you're doing (holding the electrode at the correct angles, etc.).

Have everyone gear up and head out to the shop. With your welder on, demonstrate again how to weld multiple passes. Talk members through the entire process as you weld the joint. First show that the root pass is made exactly the same as when welding a single pass T-joint. Then show how the 2nd and 3rd passes are laid so that they each cover part of the succeeding pass and tie in with the pass metal. Be sure to point out the correct electrode angles for each pass.

Have members go to their respective welders and try their hand at welding a 3-pass T-joint. Make sure that members use plates that are the correct thickness to be properly welded with a -pass fillet weld. Check with every member and offer pointers and corrections. When you feel that everyone has had a chance to complete 3 passes, gather them in the shop for a discussion.

Members can save their best 3-pass fillet weld and display them at Achievement Day.

If you wish to take this activity further, you can do so by testing T-joints for strength and penetration. It's easier to test for strength with single fillet welds (as opposed to double fillet welds). Remember to let the welds cool to room temperature on their own before testing them. (Quenching metal destroys some of its qualities). To test for penetration, use a hack saw to saw through the joints so it can be seen how well the weld penetrated into the corner.

The bead should have even penetration into each plate and completely into the corner. To test for strength, place a plate in the vise and try to break the upright piece off with a hammer to see how well the weld holds. If you are able to break the weld apart, examine where it was weakest and where it held the longest.

Discussion/Questions

How do we know when we need to make more than one pass?

What did you find challenging when making three passes?

Where you able to make a smooth looking weld?

Where you able to make both leg lengths the same size? Why is this important?

Do you think a different electrode (either number or size) would make welding a 3-pass fillet more or less difficult?

56. Working with Contraction Forces

Time Estimate 30 Minutes

Meeting
Skill Building

About
Members practice placing T-joints out of position so that once welding the contraction forces pull the plates into the correct position.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates and Electrodes

Instructions

Have everyone gear up, go to their respective welders and weld a single fillet T-joint, tacking the plates at right angles to each other before beginning. Have them lay a continuous bead without using any of the anti-distortion techniques discussed in Unit 5: Working with Welds – Chapter 4: Distortions. Depending on the thickness of plates, have them leave this as a single-pass weld, or make it into a 3-pass weld. Regardless of number of passes, this must only be a single fillet weld (weld only placed on one side of the joint).

Allow the plates to cool. Once cooled, have members examine the plates to see if they are still joined at right angles to each other. Normally, the joint will have closed, so the plates are creating an angle that is less than 90°. Explain that the amount the joint closed is the amount that you should tack the vertical plate leaning backwards out of alignment. Doing so will allow the contraction forces to pull the plates to form the desired 90° angle as it cools. Demonstrate with two plates how this out-of-alignment tack-weld will look.

Have members return to their welders and weld a single fillet T-joint again, but this time tacking the vertical plate leaning back before beginning. Allow the plates to cool. Once cooled, have members examine the plates to see if they are still joined out of place or if the plates have been pulled so they are at right angles to each other.

Discussion/Questions

Did fitting-up the plates out-of-alignment result in a joint with the plates in correct positions? If not, did you lean the vertical plate too far back/not back far enough?

How come plates change position as they are welded?

57. Defeating Distortion

Time Estimate 30 Minutes

Meeting
Skill Building

About
Members practice the different techniques used to control or eliminate distortion and compare which technique worked the best.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Metal plates and Electrodes

Instructions

Assign each member a different technique, or a combination of techniques, that can be used to prevent distortion. (Techniques listed on page 79-81 of the Reference Book). Do a dry run demonstration to show how each of the techniques you've assigned are properly executed. As you demonstrate, be sure to verbally point out what you're doing.

Have everyone gear up, go to their respective welders and make a T-joint using their assigned technique. Make sure that all of the members are using plates of the same thickness so that an accurate comparison of techniques can be done. Check with every member and offer pointers and corrections. When you feel that everyone has had a chance to make a T-joint using the technique that was assigned, gather them in the shop for a discussion. Have members present their welded plate to the rest of the group, explaining which technique they used. Then have them examine all of the different joints to see how much, or how little, distortion each plate has.

Discussion/Questions

Which technique worked best at eliminating distortion? Why do you think this technique worked so well?

Do you think we could eliminate distortion even more if we used a combination of many of these techniques? Which combination do you think would work the best?

58. How-To Video

Time Estimate 40 Minutes

Meeting
Skill Building

About

Members create instructional videos demonstrating skills and knowledge they've been developing in Unit 5. This helps develop skills from this unit and aids in building public speaking and communication skills.

Materials

- Video recording device (digital camera, smartphone, video camera, etc)
- Pencil and Paper
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Divide members into pairs or groups and instruct them to write, practice and record their own instructional video. Have each team pick which skill they would like to demonstrate in their video. It should be a skill/technique they learned in Unit 5 like how to identify different joints and the parts of a weld, how to weld a butt joint, T-joint or lap joint, how to make different weave beads, how to make a weld with multiple passes or on the different techniques that can be used to eliminate distortion.

If possible, play each video for the group to watch (will need a television or computer). If not possible, have someone (member or leader) combine the videos into one continuous instructional video and play at next meeting. These videos can also be shown at Achievement Day. (If you choose to do this, you may want to edit the videos and put them all on the same DVD.)

Discussion

What were the challenges in creating your own instructional video? Do you think a beginner welder would be able to watch the video and then be able to go out into the shop and successfully complete the skill demonstrated in the video?

Unit 6
Working with Welds

Activities:

59. Mastering a New Skill
60. How-To Video
61. Larger than Life Dice

59. Mastering a New Skill

Time Estimate 40 Minutes

Meeting
Demo – Learn To Do By Doing

About
When members encounter a new joint or welding position while working on their projects, they come here to practice the new welding skills before using it in their projects.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

When a member encounters a weld that they haven't learned how to do yet, have them stop, read in the manual how to complete the weld and then help them to complete this activity. When one member needs to learn a new weld, it is up to you to decide if you have everyone stop and learn the new weld or just have the one individual learn how to do it. This decision will depend on the size of your group, how far along everyone is, and whether or not most of the group will encounter this new weld or not while working on their projects.

First, do a dry run demonstration to show how to weld the new joint and position. As you demonstrate, be sure to verbally point out what you're doing. Next, have member(s) gear up and head out to the shop. With your welder on, demonstrate again how to make the weld, talking member(s) through the entire process.

Have member(s) go to their respective welders and first practice this new technique on a solid plate. Have them try using various weaves as they complete the weld so that they can experience the difference and decide which one will work best for them.

After they have practiced this new technique on a solid plate, have them set up two plates to create a joint that is similar to the one they will need to complete in their project. Have them practice the weld again creating the correct joint with the two plates. Check in with member(s) as they are welding to offer pointers and corrections. When you feel they are able to successfully complete the weld, give them the go-ahead to go back to working on their project (using the new technique to complete required weld). Members can save the plate for Achievement Day.

If you wish to take this activity further, have a discussion using the questions below and/or break the plates apart to check for fusion and penetration. Depending on what you have available, breaking the plates apart may be most easily done after the first pass.

Discussion/Questions

V-Groove Butt Joints:

- With the edge preparation you chose, were you able to get full penetration?
- Why is full penetration important?
- Did you change the size of the electrode as you completed the weld? Why/why not?
- When welding this joint what did you find most challenging?
- How did you overcome this challenge?
- How many passes did you use to complete this weld?
- Do you think you could have completed it with less passes?
- Were you able to determine by yourself how to prepare and set up this joint? If so, what were the determining factors? If not, do you think that next time you would be able to?

Corner Joints:

- Corner joints are welded similar to V-groove butt joints. But unlike butt joints they need no edge preparation. Why is this?
- What is the easiest welding position to make corner joints in? Can they be made in other positions as well?
- When welding this joint what did you find most challenging? How did you overcome this challenge?
- How many passes did you use to complete this weld? Do you think you could have completed it with less passes?

Edge Joints:

- How thick was the material you used to make your edge joint? Could you see how this could be easier or harder to do with material made of a different thickness?
- What is the easiest welding position to make edge joints in? Can they be made in other positions as well?
- When welding this joint what did you find most challenging? How did you overcome this challenge?
- Why should edge welds only be used on material that is not subject to heavy loads?

Sheet Metal Welding:

- What two things help to make sheet metal successful? (*faster speed and less penetration*)
- How thick does material need to be to be considered “sheet metal?”
- When welding with sheet metal what did you find most challenging? How did you overcome this challenge?
- Where you able to identify on your own which was the correct electrode to use with sheet metal? If not, do you think now that you have more knowledge you would be able to pick the correct electrode for the job?

Whipping Motion:

- Were you able to determine the correct speed to make your whipping motion so that the puddle solidified and you still avoided trapping slag in your bead?
- What did you find most challenging about welding with a whipping motion? How did you overcome this challenge?
- When do you think using a whipping motion might come in handy? Is there a time when using a whipping motion is not appropriate?
- What is the difference between a weave and a whipping motion?

Forehand Welding:

- When and why would we want to use forehand welding?
- What makes a deeper penetrating weld; forehand or backhand welding? Do you know why these two techniques produce welds that penetrate differently?
- What did you find most challenging about welding forehand? How did you overcome this challenge?

Horizontal Welding (all joints):

- If making a joint were you able to get full penetration? If not, what could you do to ensure you get full penetration the next time you try? Why is full penetration important?
- How do you know you were using the right electrode for the job at hand?
- What did you find most challenging about welding horizontally? How did you overcome this challenge?
- How many passes did you use to complete this weld? Do you think you could have completed it with less passes?
- What did you do to overcome the effect of gravity on your weld bead?

Vertical Welding (up and down, all joints):

- Were you able to get full penetration? Why is full penetration important?
- Did you experiment with many types of weaves to find out which one worked best for you? Which one worked best and why?
- As you completed multiple passes did you change which weave bead you used on successive passes? Why/why not? Does changing the way we lay the bead make welding easier or faster?
- How do you know if a weld should be done with vertical-up or vertical-down welding?
- When welding this joint what did you find most challenging? How did you overcome this challenge?
- How many passes did you use to complete this weld? Do you think you could have completed it with less passes?
- Were you able to find the correct amperage, electrode angle, and arc length to make a successful weld? How did you know you had these things correct?
- Were you able to determine by yourself how to prepare and set up this joint? If so, what were the determining factors? If not, do you think next time you would be able to?

- If we have the choice, why should we choose to do things in the flat position instead of in the vertical position?
- If done properly, is there a difference in strength between a weld done in the flat position and a weld done out of position?

Overhead Welding (all joints):

- Were you able to get full penetration? Why is full penetration important?
- Did you experiment with the speed and length of your whipping motion? What was a sign that you were making your whipping motion correctly?
- As you completed multiple passes did you use a weaving motion to complete the weld? Why/why not?
- When welding this joint what did you find most challenging? How did you overcome this challenge?
- How many passes did you use to complete this weld? Do you think you could have completed it with less passes?
- Were you able to find the correct amperage, electrode angle, and arc length to make a successful weld? How did you know you had these things correct?
- Were you able to determine by yourself how to prepare and set up this joint? If so, what were the determining factors? If not, do you think that next time you would be able to?
- If we have the choice, why should we choose to do things in the flat position instead of in the overhead position? If you have the choice to turn an overhead weld into a vertical weld, is that a better option?
- If done properly, is there a difference in strength between a weld done in the flat position and a weld done out of position?

60. How-To Video

Time Estimate 40 Minutes

Meeting
Skill Building

About

Members create an instructional video that demonstrates and explains how to complete the newest welding skill that they've been developing. This not only helps in continuing to develop this new skill, but also aids in building public speaking and communication skills.

Materials

- Video recording device (digital camera, smartphone, video camera, etc)
- Pencil and Paper
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Divide members into pairs or groups and instruct them to write, practice and record their own instructional video. The video should explain how to successfully complete the newest skill they learned in Unit 6.

If possible, play each video for the group to watch or have someone (member or leader) combine the videos into one continuous instructional video and play at next meeting. If desired, play videos at Achievement Day. (If you choose to do this, you may want to edit the videos and put them all on the same DVD.)

Discussion

What were the challenges in creating your own instructional video? Do you think a beginner welder would be able to watch the video and then be able to go out into the shop and successfully complete the demonstrated weld?

61. Larger Than Life Dice

Time Estimate 40 Minutes

Meeting
Skill Building

About
Members weld a cube to create giant dice.

Materials

- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Square metal plates (6 per person, approx. 4-6 mm thick) and Electrodes

Resources

- Starting at 3:27 into the video found at:
- http://www.weldingtipsandtricks.com/mig-welding-project.html
- or at:
- http://www.youtube.com/watch?v=6oJTePBp0-Q

Instructions

Gather members in shop and explain that they will be welding metal dice. As a group, discuss how this can be completed, what the best welding sequence is and how they can fit up the cube to have a successful experience. This is good practice for when they start working on their own projects and have to make these types of decisions for themselves.

Demonstrate how to properly weld a six-sided cube using corner welds to complete all of the joints. Because they'll be welding a closed container that would blow out under the heat and pressure built up during the welding process, be sure to drill the holes to represent the numbers on the dice before welding the cube.

Provide the members with the correct plates required to build their cube and have them drill out all of the holes that will represent the numbers on the dice. (Either provide them with a 9-hole template to do this -*see video in resources*- or have them make the template themselves.)

Once the members have drilled all of the required holes have them go to their respective welders and weld their dice. Check with every member and offer pointers and corrections. When you feel that everyone has had a chance to complete a dice gather them in the shop for a discussion.

The dice can be display at Achievement Day.

If you'd like to take a welding break, you can also engage the members in a larger-than-life dice game, like yahtzee.

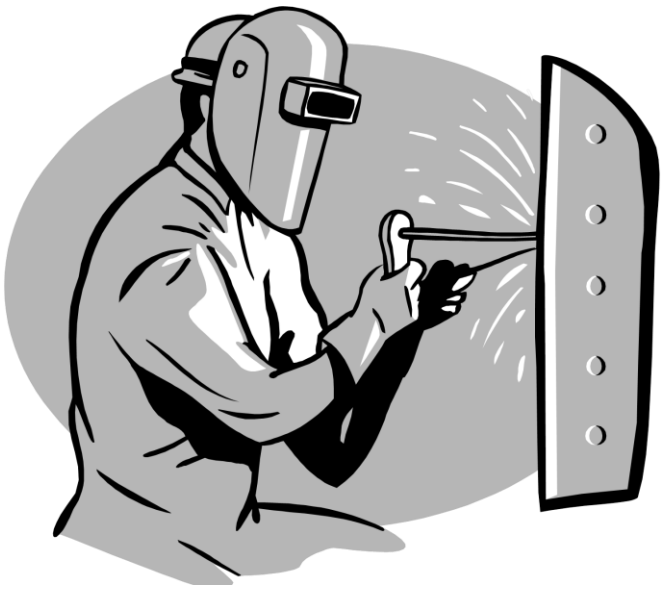
Discussion/Questions

Do you think the order you welded the joints made this task easier or harder? Could there have been a better way to go about it?

What was the most challenging part of welding a cube like this? Is there something you could have done when you encountered this challenge to make the task easier?

Why did we pre-drill the holes in the dice before we began welding the cube together? What would have happened if we hadn't drilled any holes?

Unit 7
Perfecting Your Technique



Activities:

62. Whip It
63. Back and Forth
64. Strength Testing
65. Fault Finding
66. Good Vs. Bad

62. Whip It

Time Estimate 20 Minutes

Meeting
Demo – Learn To Do By Doing

About
When members encounter the need to weld with a whipping motion, they come here to practice the technique before using it to complete parts of their projects.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

When a member is in need of learning how to weld with a whipping motion, have them stop, read the manual about the technique used and then help them to complete this activity. When one member needs to learn to use a whipping motion, it is up to you to decide if you have everyone stop and learn the new technique or just have the one individual learn how to do it. This decision will depend on the size of your group, how far along everyone is, and whether or not most of the group will encounter the need to weld with a whipping motion or not while working on their projects.

First, do a dry run demonstration to show how what the whipping motion should look like. As you demonstrate, be sure to verbally point out what you're doing, how far away you whip the electrode and how long you pause before returning the electrode to the puddle. Next, have member(s) gear up and head out to the shop. With your welder on demonstrate the whipping motion again, talking the member(s) through the techniques being used.

Have member(s) go to their respective welders and practice welding with a whipping motion a solid plate. Once they've mastered this technique in the flat position have them practice it out of position.

Check with the member(s) as they are welding to offer pointers and corrections. When you feel they are able to successfully complete a weld using a whipping motion, give them the go-ahead to go back to working on their project (using the new technique to complete required weld).

Discussion/Questions

Why is the whipping motion useful for making out of position welds?

How did you know if you were whipping at the correct speed and pulling the electrode away at the correct length?

63. Back and Forth

Time Estimate 20 Minutes

Meeting
Demo – Learn To Do By Doing

About
When members encounter the need to use forehand welding, they come here to practice the technique before using it to complete parts of their projects.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

When a member is in need of learning how to forehand weld, have them stop, read in the manual about the technique used and then help them to complete this activity. When one member needs to learn how to forehand weld, it is up to you to decide if you have everyone stop and learn the new technique or just have the one individual learn how to do it. This decision will depend on the size of your group, how far along everyone is, and whether or not most of the group will encounter the need to forehand weld or not while working on their projects.

First, do a dry run demonstration to show how to forehand weld. As you demonstrate, be sure to verbally point out what you're doing. Next, have member(s) gear up and head out to the shop. With your welder on demonstrate again how to forehand weld, talking member(s) through the techniques being used.

Have member(s) go to their respective welders and practice forehand welding a solid plate. Challenge them to weld down the plate using backhand and then switch to forehand to weld back up the plate, making a seamless transition between the two.

Check in with member(s) as they are welding to offer pointers and corrections. When you feel they are able to successfully forehand weld, give them the go-ahead to go back to working on their project (using the new technique to complete required weld).

Discussion/Questions

Why might forehand welding create deeper penetrating welds?

What characteristics of forehand welding make it the go-to method when making vertical-up weld passes?

64. Strength Testing

Time Estimate 30 Minutes

Meeting
Knowledge Building

About
Members are given the change to destroy welds to test for strength and examine more closely for proper penetration and fusion.

Materials

- A variety of different joints that members have welded over the course of the project.
- Devices that can be used for testing (hacksaw, vice and hammer, etc.)
- Personal Protective Gear

Instructions

Have members bring forth joints that they've welded throughout the project. Ask them to choose ones that they think are welded well and ones that they think were welded poorly so that they can be compared against each other. If there are not enough joints from past activities to do tests on have members weld joints that they are most comfortable making so that testing can be done on them.

Use destructive testing methods to break apart/saw apart the joints (whatever ones you have available to you in the shop). This can be a really fun activity for members to engage in and encourage them to take safety precautions as they're having fun breaking things apart.

Once the welds have been broken, gather members around to examine them and have a discussion around proper penetration and fusion.

Discussion/Questions

Drive home the point during your discussion that it's so much easier to take the time to make a good weld in the first place than to deal with joints unexpectedly falling apart. The weld's main purpose is to hold two pieces of metal together so if it's not strong enough to hold the pieces of metal for their intended purpose than it isn't a quality weld. Remind them that if a weld is worth making in the first place, it is worth making well and that poor welds may be faster to make but will cost you more time in the long run.

Can you imagine how inconvenient, or even disastrous, using poor quality welds to join metal could be? The joint could fall apart or break at any time.

Can you speculate as to what techniques were used in the good quality welds as compared with the ones that we found to be poor quality?

Were the joints you welded as good of quality as you thought they were? If not, what do you think you could do to improve the quality of your welds?

65. Fault Finding

Time Estimate 30 Minutes

Meeting
Skill Building

About
Members examine faulty or "troubled" welds and brainstorm why the weld didn't work out and discuss possible welding solutions.

Materials
- A variety of incorrectly executed welds

Instructions

Bring in an assortment of samples that were welded incorrectly. This could be samples of welds that have failed, joints that were welded incorrectly (but have not failed yet), or simply weld beads on a solid plate that were put there using improper technique.

Display the samples so that members can examine them. For failed joints, have the members identify why the welds have failed, if they can be fixed, and how they could have prevented the problem in the first place. For improperly welded joints that haven't failed yet, have members identify what was improperly done and how the weld could have been made to be better quality and if there's anything that can be done at this point to improve the quality and strength of the joint. For weld beads that were made with improper technique, have members identify which improper techniques were used, and how they should have been made.

66. Good Vs. Bad

Time Estimate 40 Minutes

Meeting
Skill Building

About
Members weld a joint using good welding technique and then weld a joint using one bad welding technique and then compare the strength and quality of both joints against each other.

Materials
- Access to welding shop, SMAW machine and Personal Protective Clothing/Gear
- Scrap metal and Electrodes

Instructions

Assign an improper way to weld to each member (one member welds with too low amperage, one with too large of a root gap, one with too long of an arc length, etc.)

Have members go to their respective welders and make one joint using the improper technique assigned and then another joint using proper technique.

After the welds have cooled, perform strength tests on all the pairs of joints. Have members observe the difference in strength and quality between the one they welded properly and the one they welded with poor technique.

Discussion/Questions

Which poor technique do you think resulted in the worst quality weld? Why do you think this is?

After doing this activity, do you think that if you know you've made an error in one of your welds while working on your projects that you will take the time to grind it out and try again?

Answer Sheets

Activity 11: WHIMS I.D.

Activity 17: Learn the Lingo Crossword

Activity 18: Learn the Lingo Wordsearch

Activity 19: Learn the Lingo Word Match

Activity 27: Good Weld Cheat Sheet: Part 1-4

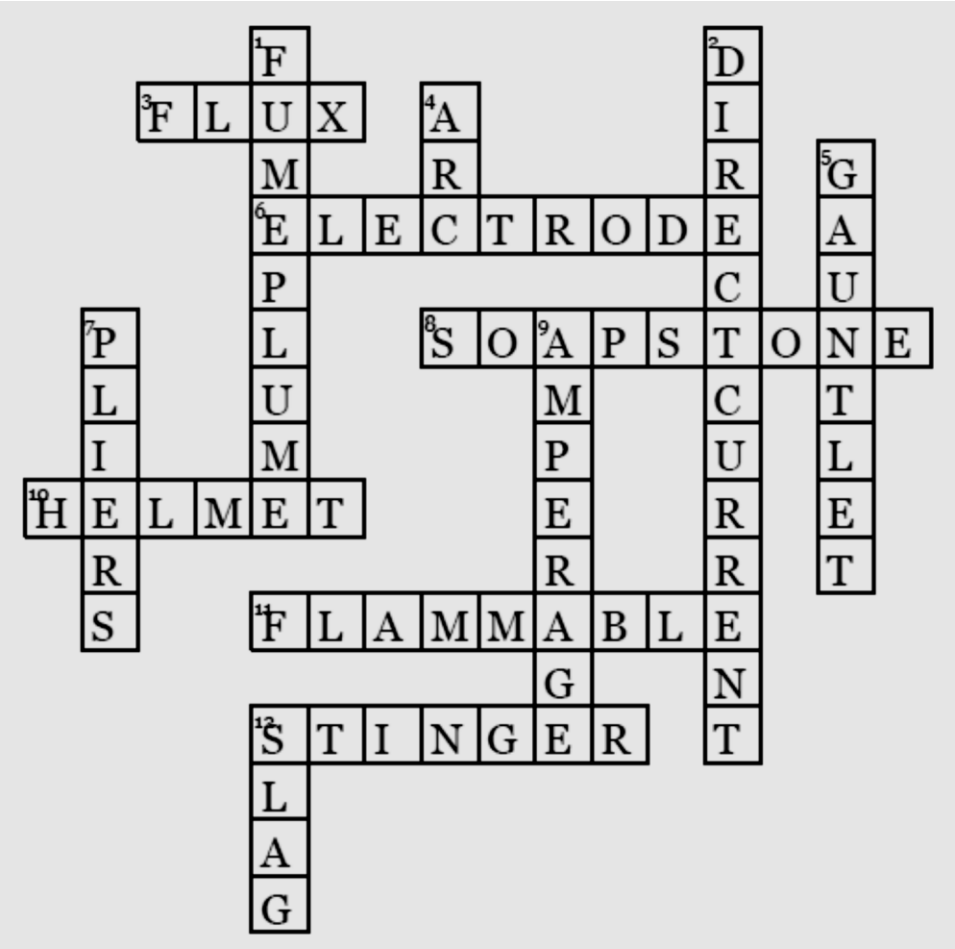
Answers to WHMIS I.D. WorkSheet

Activity 11: WHMIS ID Worksheet

b, 2. e. 3. h, 4. c, 5. g, 6. a. 7. d, 8. f

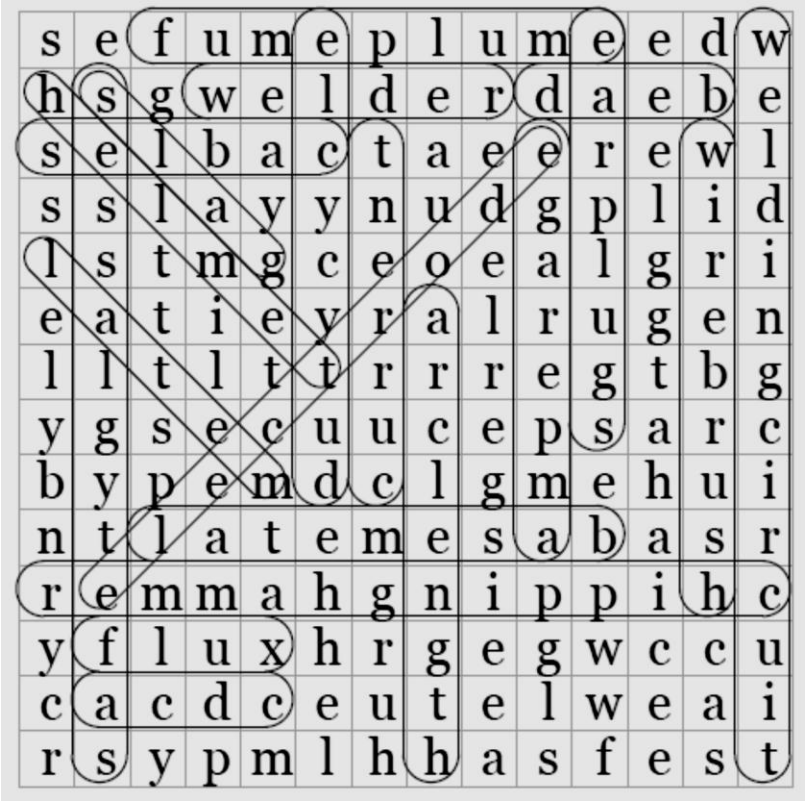
Answers to Learn the Lingo Crossword

Activity 17: Learn the Lingo Crossword



Answers to Learn the Lingo Wordsearch

Activity 18: Learn the Lingo Wordsearch



s	e	f	u	m	e	p	l	u	m	e	e	d	w
h	s	g	w	e	l	d	e	r	d	a	e	b	e
s	e	l	b	a	c	t	a	e	e	r	e	w	l
s	s	l	a	y	y	n	u	d	g	p	l	i	d
l	s	t	m	g	c	e	o	e	a	l	g	r	i
e	a	t	i	e	y	r	a	l	r	u	g	e	n
l	l	t	l	t	t	r	r	r	e	g	t	b	g
y	g	s	e	c	u	u	c	e	p	s	a	r	c
b	y	p	e	m	d	c	l	g	m	e	h	u	i
n	t	l	a	t	e	m	e	s	a	b	a	s	r
r	e	m	m	a	h	g	n	i	p	p	i	h	c
y	f	l	u	x	h	r	g	e	g	w	c	c	u
c	a	c	d	c	e	u	t	e	l	w	e	a	i
r	s	y	p	m	l	h	h	a	s	f	e	s	t

Answers to Learn the Lingo Word Match

Activity 19: Learn the Lingo Word Match

C, H, D, L, I, A, F, K, B, J, G, E

Answers to Good Weld Cheat Sheet: Part 1-4

Activity 27: Good Weld Cheat Sheet: Part 1-4

Good Weld Cheat Sheet Answers

If the bead is…. ***Is irregularly shaped*** ***Has slag trapped in it*** ***Has irregularly spaced ripples*** …the arc length is too short	If the bead is… ***Is uneven*** ***Is wide and flat*** ***Has excessive spatter around it*** ***Has undercut (making slag difficult to remove)*** …the arc length is too long.
If I hear a ***sharp, crackling*** sound the arc length is correct.	
If I hear a ***hissing*** sound the arc length is too short.	
If I can see the arc "jumping around" the arc length is ***too long***.	

When running a stringer bead you should hold the electrode so that the arc force will push the puddle in a way that the weld will ***stack up and build***.
The correct travel angle for running a stringer bead is***20-30°***.

If the bead… ***Is narrow*** ***Is irregularly shaped*** ***Is piled up or overlapping*** …the amperage is too low.	If the bead… ***Is flat*** ***Has excessive spatter around it*** ***Has undercut (making slag difficult to remove)*** …the arc length is too long.
If I see charring on electrode's flux or if I burn through the base metal the amperage is ***too high***.	
If it is difficult to strike the arc the amperage is ***too low***.	

If the bead… ***Is too wide and too high*** ***Has too many ripples*** ***Piles up and overlaps*** …the travel speed is too slow.	If the bead… ***Is thin and stringy*** ***Has a v-shaped ripple*** ***Has undercut*** …the travel speed is too fast.
If my beads are not uniform I am not travelling at a ***consistent/uniform*** speed.	
If I burn through my work I am travelling ***too slowly***.	

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