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METALWORK

Merit Badge Requirements

1) Read the safety rules listed in the Metalwork merit badge pamphlet. Describe to your counselor how to be safe while working with metal. Because this merit badge offers four options, show your counselor which additional safety rules apply to the discipline you choose and discuss them with your counselor.

2) Do the following:

A) Define the term **native metal**.
B) Define the term **malleable**.
C) Define the term **metallurgy**.
D) Define the term **alloy**.
E) Name two **nonferrous** alloys used by pre-Iron Age metalworkers, and name the metals that are combined to form these alloys.
F) Explain the term **ferrous**, and name three ferrous alloys used by modern metal workers.
G) Describe how to **work-harden** a metal.
H) Describe how to **anneal** a nonferrous and a ferrous metal.

3) Do the following:

A) Put a 45-degree bend in a small piece of 26- or 28-gauge sheet brass or sheet copper. Note the amount of effort that is required to overcome the yield point in this piece of metal.
B) Work-harden another piece of the same sheet brass or sheet copper, and then put a 45-degree bend in it. Note the amount of effort that is required to overcome the yield point.
C) Soften the same bent, work-hardened piece by annealing it, and then try to remove the 45-degree bend. Note the amount of effort that is required to overcome the yield point.
D) Join two small pieces of scrap metal using a hammered rivet. Repeat the process using a pop rivet.
E) Using a flatlock seam, join two pieces of scrap metal together with either lead-free solder or silver solder.
F) Make a temper color index from a flat piece of steel. Using hand tools, make and temper a center punch of medium-carbon or high-carbon steel.
G) Using metal cans, practice using the basic metalworking tools and techniques by making at least two tasteful objects that require cutting, bending, and edging.

4) Do ONE of the following:

A) Visit an experienced sheet metal mechanic, tinsmith, coppersmith, silversmith, jeweler, founder, or blacksmith at his or her workshop. You may select a skilled hobbyist or a professional. Ask permission to see the tools used and to examine examples of the work made at the shop. Inquire about the level of education required to become an apprentice craftsman.
B) If you have (or your counselor has) access to the Internet, explore metalworking occupations by conducting a Web search. With your counselor's help and guidance, find at least five metalworking-related Web sites. Print a copy of the Web pages and discuss them with your counselor.

When conducting your Web search, use keywords such as metallurgy, metalwork, spinning metal, metal fabrication, steel fabrication, aluminum fabrication, casting metal, pattern making, welding, forge welding, blacksmith, art metal, Artist Blacksmith Association of North America, farrier, brazing, goldsmith, machinist, or sheet metal mechanic.

5) After completing the first three requirements, complete at least ONE of the options listed below:

A) Option 1 – Sheet Metal mechanic/Tinsmith

1) Name and describe the use of the basic sheet metalworking tools.
2) Create a reasonably accurate sketch of two tasteful objects to make from sheet metal. Include each component's dimensions on your sketch.
3) Using patterns provided either by your counselor or made by you, make at least two tasteful objects out of 24- or 26-gauge sheet metal. Use a metal that is appropriate to the object's ultimate purpose.

A) Both objects must be constructed using cutting, bending, edging, and either soldering or brazing.
B) One object also must include at least one riveted component.
C) If you do not make your objects from zinc-plated sheet steel or tin-plated sheet steel, preserve your work from oxidation.

B) Option 2 – Silversmith

1) Name and describe the use of the basic tools used by a silversmith.

2) Create a reasonably accurate hand-drawn sketch of two tasteful objects to make from sheet silver. Include each component's dimensions on your sketch.

3) Using patterns either provided by your counselor or made by you, make at least two tasteful objects using 18- or 20-gauge sheet copper. If you already have prior silversmithing experience, you may substitute sterling silver, nickel silver, or lead-free pewter.

A) At least one object must include a sawed component you have made yourself.

B) At lest one object mush include a sunken part you have made yourself.

C) Both objects must include a soldered joint.

D) Clean and polish your objects.

C) Option 3 – Founder

1) Name and describe the use of the basic parts of a two-piece mold. Name at least three different types of molds.

2) Create a reasonably accurate sketch of two tasteful objects to cast in metal. Include the height, width and length on the sketch.

3) Do the following:

A) Using a pattern provided by your counselor and another one you have made yourself, make two molds. Position the pouring gate and vents yourself. *Do not use copyrighted materials as patterns.*

B) Make a casting using a mold provided by your counselor *and* make a casting using the mold that you have made. Use lead-free pewter when casting each mold.

C) Remove all evidence of gates, vents, and parting-line flash from your castings.

D) Option 4 – Blacksmith

1) Name and tell the use of the basic tools used by a blacksmith.

2) Make a reasonably accurate sketch of two tasteful objects to hot-forge. Include each component's dimensions on your sketch.

3) Using low-carbon steel at least ¼-inch thick, perform the following exercises:

A) Draw out by forging a taper.

B) Use the horn of the anvil by forging a U-shaped bend.

C) Twist steel by placing a decorative twist in a piece of square steel.

D) Use the edge of the anvil to bend metal by forging an L-shaped bend.

4) Using low-carbon steel at least ¼-inch thick, make at least two tasteful objects that require hot-forging.

A) Include a decorative twist on one object.

B) Include a hammer-riveted joint in one object.

5) Preserve your work from oxidation.

Requirement 1

Read the safety rules listed in the Metalwork merit badge pamphlet. Describe how to be safe while working with metal: _____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Requirement #5 asks that you choose 1 of the 4 options. Which option did you select? _____

Describe the additional safety rules that apply to the option you selected: _____
_____
_____
_____
_____
_____
_____
_____
_____
_____

__ Discuss all of the safety rules with your counselor.

Requirement 2

Define the following terms:

Native Metal: _____
_____
_____

Malleable: _____
_____
_____

Metallurgy: _____
_____
_____

Alloy: _____
_____
_____

Name two nonferrous alloys used by pre-Iron Age metalworkers:

1) _____ 2) _____

Name the metals that are combined to form alloy #1: _____

Name the metals that are combined to form alloy #2: _____

Explain the term "Ferrous": _____
_____
_____

Name 3 ferrous alloys used by modern metal workers:

1) _____ 2) _____ 3) _____

Describe how to "work-harden" a metal: _____
_____
_____
_____
_____

Describe how to "anneal" a nonferrous metal: _____
_____
_____
_____
_____

Describe how to "anneal" a ferrous metal: _____
_____
_____
_____
_____

Requirement 3

Put a 45-degree bend in a small piece of 26- or 28-gauge sheet brass or sheet copper. Note the amount of effort that is required to overcome the yield point in the unworked piece of metal. Describe: _____
_____
_____
_____
_____

Work-harden another piece of the same sheet brass or sheet copper, and then put a 45-degree bend in it. Note the amount of effort that is required to overcome the yield point. Describe: _____
_____
_____
_____
_____

Soften the same bent, work-hardened piece by annealing it, and then try to remove the 45-degree bend. Note the amount of effort that is required to overcome the yield point. Describe: _____
_____
_____
_____
_____

___ Join two small pieces of scrap metal using a hammered rivet. Show your work to your counselor.

___ Join two small pieces of scrap metal using a pop rivet. Show your work to your counselor.

Using a flatlock seam, join two pieces of scrap metal together with either lead-free solder or silver solder. Did you use Lead-free solder or silver solder? _____

___ Show this piece of work to your counselor.

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Make a temper color index from a flat piece of steel. Describe the process: _____

Using hand tools, make and temper a center punch of medium-carbon or high-carbon steel. Describe how you did this: _____

Using metal cans, practice using the basic metal working tools and techniques by making at least two tasteful objects that require cutting, bending, and edging.

For **Object 1**:

Describe what you made: _____

Describe the basic metal working tools and techniques used: _____

Describe the cutting, bending, and edging used on this object: _____

For **Object 2**:

Describe what you made: _____

Describe the basic metal working tools and techniques used: _____

Describe the cutting, bending, and edging used on this object: _____

Requirement 4

You have been given two options for this requirement. Select and complete ONE of them.

If you selected ***Option A***:

Visit an experienced sheet metal mechanic, tinsmith, coppersmith, silversmith, jeweler, founder, or a blacksmith at his or her workshop. You may select a skilled hobbyist or a professional.

Who's workshop did you visit? _____

What is their specialty? _____

Do they do this as a hobby or as a profession? _____

What kinds of tools did you see at the workshop? _____
_____
_____

What kinds or examples of work did you see at the workshop? _____
_____
_____

Inquire about the level of education required to become an apprentice craftsman. What did you learn? _____
_____
_____
_____
_____

If you selected ***Option B***:

Explore metalworking occupations by conducting a Web search. With your counselor's help and guidance, find at least five metalworking-related sites. Print a copy of the Web pages and discuss them with your counselor. Attach the printed pages to this worksheet.

When conducting your Web search, use keywords such as metallurgy, metalwork, spinning metal, metal fabrication, steel fabrication, aluminum fabrication, casting metal, pattern making, welding, forge welding, blacksmith, art metal, Artist Blacksmith Association of North America, farrier, brazing, goldsmith, machinist, or sheet metal mechanic.

Give a brief summary about what you found while doing your Web Search: _____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Requirement 5

You have been given 4 options for this requirement. Select and complete ONE of them.

If you selected ***Option 1 – Sheet Metal Mechanic/Tinsmith***:

Name and describe the use of the basic sheet metalworking tools:

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

___ Create a reasonably accurate sketch of two tasteful objects to make from sheet metal. Include each component's dimensions on your sketch. After you have created these two sketches, attach them to this worksheet and show them to your counselor.

Using patterns provided either by your counselor or made by you, make at least two tasteful objects out of 24- or 26-gauge sheet metal. Use a metal that is appropriate to the object's ultimate purpose.

** Both objects must be constructed using cutting, bending, edging, and either soldering or brazing.
** One object also must include at least one riveted component.
** If you do not make your objects from zinc-plated sheet steel or tin-plated sheet steel, preserve your work from oxidation.

Describe the first object you made: _____
_____
_____
_____

Describe the second object you made: _____
_____
_____
_____

Were both objects constructed using cutting, bending, edging and either soldering or brazing? YES NO

Did at least one of your objects include at least one riveted component? YES NO

Did you have to protect either of your objects from oxidation? YES NO

If you had to protect one of your projects from oxidation, explain how you did it: _____
_____
_____
_____

___ Show both of your objects to your counselor

If you selected ***Option 2 – Silversmith***:

Name and describe the use of the basic tools used by a silversmith:

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

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___ Create a reasonably accurate sketch of two tasteful objects to make from sheet silver. Include each component's dimensions on your sketch. After you have created these two sketches, attach them to this worksheet and show them to your counselor.

Using patterns provided either by your counselor or made by you, make at least two tasteful objects out of 18- or 20-gauge sheet copper. If you already have prior silversmithing experience, you may substitute sterling silver, nickel silver, or lead-free pewter.

** At least one object must include a sawed component you have made yourself.
** At least one object must include a sunken part you have made yourself.
** Both objects much include a soldered joint.
** Clean and polish your objects.

Describe the first object you made: _____
_____
_____
_____

Describe the second object you made: _____
_____
_____
_____

Did at least one object include a sawed component you have made yourself? YES NO

Did at least one object include a sunken part you have made yourself? YES NO

Did both objects include a soldered joint? YES NO

Explain the cleaning and polishing done on your objects: _____
_____
_____
_____

___ Show both of your objects to your counselor.

If you selected ***Option 3 – Founder***:

Name and describe the use of the basic parts of a two-piece mold:

Name of part: _____

Description of use: _____
_____
_____

Name of part: _____

Description of use: _____
_____
_____

Name of part: _____

Description of use: _____
_____
_____

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Name of part: _____

Description of use: _____
_____
_____

Name of part: _____

Description of use: _____
_____
_____

Name three different types of molds:

1) _____ 2) _____ 3) _____

___ Create a reasonably accurate sketch of two tasteful objects to cast in metal. Include the height, width and length on the sketch. After you have created these two sketches, attach them to this worksheet and show them to your counselor.

Using a pattern provided by your counselor and another one you have made yourself, make two molds. Position the pouring gate and vents yourself. *Do not use copyrighted materials as patterns.*

Describe the first mold you made: _____
_____
_____
_____

Describe the second mold you made: _____
_____
_____
_____

Make a casting using a mold provided by your counselor *and* make a casting using the mold that you have made. Use lead-free pewter when casting each mold.

Describe the first casting you made: _____
_____
_____
_____

Describe the second casting you made: _____
_____
_____
_____

Remove all evidence of gates, vents, and parting-line flash from your castings. Describe how you did this: _____
_____
_____
_____

If you selected ***Option 4 – Blacksmith***:

Name and tell the use of the basic tools used by a blacksmith:

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

Name of tool: _____

Description of use: _____
_____
_____

___ Make a reasonably accurate sketch of two tasteful objects to hot-forge. Include each component's dimensions on your sketch. After you have created these two sketches, attach them to this worksheet and show them to your counselor.

Using low-carbon steel at least 14-inch thick, perform the following exercises:

___ Draw out by forging a taper.

___ Use the horn of the anvil by forging a U-shaped bend.

___ Twist steel by placing a decorative twist in a piece of square steel.

___ Use the edge of the anvil to bend metal by forging an L-shaped bend.

Using low-carbon steel at least ¼-inch thick, make at least two tasteful objects that require hot-forging.

Describe the first object you made: _____
_____
_____
_____

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Describe the second object you made: _____
_____
_____
_____

Did at least one object include a decorative twist? YES NO

Did at least one object include a hammer-riveted joint in one object? YES NO

Describe how you protected your work from oxidation: _____
_____
_____
_____

___ Show both of your objects to your counselor.