Pathfinder Honour:

Trainer's Notes

Metal Craft

Instructions to Trainers / Instructors of this Honour

Thankyou for being involved with this Honour. These notes have been developed to assist in teaching / instructing this honour. We recognise that there is much more information available and we are grateful that you should share your expertise.

Please remember that Honours are designed to develop our Pathfinders in many ways; their interests, their knowledge and their relationship with their Saviour and Creator. Your enthusiasm and creativity will have a huge impact on those doing the honour.

To complete an Honour, the following (where applicable) must be completed satisfactorily:

- Physical and Practical Requirements.
- Honour Workbook.
- Honour Assessment Sheet. *(On SPD Honour Website but Leader's level access is required)*

Additional Reference Material

Acknowledgements

Please refer to acknowledgements throughout the text and the Bibliography on the final page.

Metal Craft Honour

INTODUCTION

This honour is intended to be heaps of fun. The objectives are to give participants:

- A basic knowledge of the physical properties and available shapes of the vast range of metal products. These can, with imagination and basic skill, be transformed into a metal-craft work-of-art or a useful object. There is a thrill in turning seemingly worthless junk into something useful or beautiful.
- The ability to use simple, commonly-used hand tools to create metal crafts.
- A knowledge of some of the myriad of simple metal crafts
- The satisfaction of creating their own crafts.

As such, <u>all the crafts of this honour can be created by hand tools</u>.

Although competent, approved folk may use them, there is no need for electric / air power-tools, welding / brazing / soldering equipment or metal forming / machining machinery. The exception is a battery powered drill which we class as a hand tool for this honour.

Metal Craft Honour Trainer's Notes_ Craft Ideas

We have compiled these ideas to help kick-start creativity. Examples include:

- Reflector Oven
- Silver Fish
- Tin-can-o-thorus

Please feel free to share with us any of your creations,

REQUIREMENT 1: Describe the various materials that can be used in Metal Craft.

This information is based on the Chapter *'Metals Used in Metalcrafting'* by Steven Morgenstern. Please see the Bibliography Section at the end of these Notes.

The following metals have been used since ancient times for metal crafts: gold, silver, copper, bronze, brass, aluminium and iron.

These metals have different properties. It is worthwhile understanding these, as it enables the most creative use and application.

Some basic definitions of metal properties

<u>An alloy</u> is a 'mixture' of two or more metals. Examples are brass and bronze. Nowadays metals are seldom used in their pure form.

<u>Annealing</u> is the process (usually using high-temperature heat) of 'softening' a metal to improve its malleability and ductility.

<u>Density</u> is the relationship of a metal's weight to its volume.

<u>Ductility</u> is the measure of how readily a metal can be extended permanently by a tensile (ie stretching force).

<u>Malleability</u> is the measure of how readily a metal can be hammered or pressured permanently into thin sheets without cracking.

<u>Nobility</u> is a metal's resistance to corrosion or chemical attack.

<u>Work Hardening.</u> When most metals are deformed, they 'work harden'. That is they lose their malleability and ductility.

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Properties of Metals:

Gold is an extremely dense, noble, bright yellow metal. In its pure form (24 carat) it is extremely malleable and ductile, however its wear properties are poor. It is usually alloyed with silver to give better wear properties.

Silver is a bright 'silver' metal with good malleability and ductility properties. It is often alloyed with copper. Silver tarnishes in the air due to the chemical reaction of silver with sulphur-based gases in the air. This gives its surface a grey and lacklustre appearance.

Copper is a beautiful reddish metal. When polished it has a bright lustre, but it tarnishes in air to a black-red colour. It is a very versatile metal for metal craft especially metal foil work. If worked extensively, it requires annealing. It can be readily soldered.

Brass and Bronze are alloys with copper the main constituent. Brass is an alloy of copper and zinc and has a yellow-red colour. Malleability and ductility is slightly less than pure copper. Bronze is an alloy of copper and tin and has a yellow-red (but more brown than brass) colour. Malleability and ductility is slightly less than brass. Bronze is often used for casting. Both brass and bronze require annealing and both tarnish to a dull golden colour. Both can be readily soldered.

Aluminium is a light metal, whitish and slightly less 'silvery' than silver. It does not tarnish as do silver and copper. When attacked by the air, a transparent film forms on the surface and adheres tenaciously. There are numerous alloys of aluminium; each with different properties. Generally speaking, aluminium is readily worked but work hardens and annealing is required. Aluminium is difficult to weld and cannot be soldered. Aluminium sheets and foil are readily available.

Iron is the main constituent of a vast range of iron and steel alloys. Strength, ductility, malleability are influenced by the amount of carbon present, alloying metals and the manner of heat treatment. Generally, low-carbon steels (ie soft iron, mild steel etc) are more readily worked than the high-carbon or complex alloys (ie stainless steels, hack saw blades etc). Corrosion (ie rust) is a major issue. Protection is achieved by applying a thin coating such as paint, zinc (ie galvanising), tin (tin plating) chrome etc. Generally, the low-carbon steels are more malleable and ductile than the high-carbon, complex steels and can be welded and brazed more readily.

Sources of Metal Craft Materials.

Shapes are innumerable: sheet, bar, rod, wire, strip, perforations and extrusions (especially aluminium).

For materials, such as gold and silver (if you rich enough) try jewellery suppliers.

Try craft suppliers for sheet copper / brass / bronze / aluminium.

For resourceful creative types of folk, check these out:

- Your own home, business or farm (tin cans, foil, galvanised iron, any other 'rubbish')
- Local Council recycling initiatives / services.
- Factory / workshops. These often generate off-cuts no longer any use to the business. As an illustration of generosity, a sheet-metal factory manager recently gave us a huge sheet of burnished aluminium for our Camporee. Even non-church people love to help those involved with young people.
- Metal Recyclers. They often sell by the kilogram at vastly reduced prices to new.

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REQUIREMENT 2: Describe the application, safe use and care of the following commonly used metal craft tools. Demonstrate an ability to use each properly:

The range of metal craft tools is huge. A list of the more common ones is as follows. With practice, these are all that are needed to create the metal crafts required of this honour.

Safety is always important. Trainers need to be alert to ensure the tools are used as intended and the appropriate personal protection equipment is always worn. Eyes and limbs are precious.

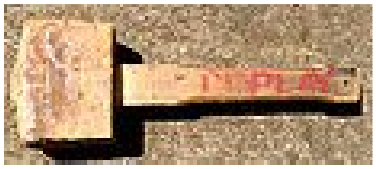
Care of equipment is common sense. Always use it as intended and keep it well maintained. Have a secure place to store it when not in use

a. Hammers

Hammers used in metal craft are of two types; those with hard heads made of high quality forged steel and those with soft heads. The hard heads are used for general work and a few vigorous blows usually completes the task; however the work piece may be damaged. There is a huge range of hammers, each designed for specific tasks. Weight ranges from a few grams up to several kilograms.

Ball Pane Hammer

Cross Pane Hammer



Wooden Mallet
http://en.wikipedia.org/wiki/Hammer

Ball Pane/Peen/Pein Hammer (a hard head hammer)
This is the standard all-purpose hammer for metal work. It has a spherical pane. Other names include Ball Peen & Ball Pein.

Cross Pane (ie Cross Pein)Hammer (a hard head hammer)
The pane is at right angles to the handle. It is useful for working in tight corners. Other names include Cross Peen & Cross Pein.

Wooden Mallet (typical of the soft hammers)
These hammers are used when damage is to be minimised. Instead of wood, the head may be made of leather, lead, brass or 'rubber'.

Care and Use of Hammers
Before use, check the head and handle for damage. Fix loose heads immediately. When using, take care not to damage yourself, the job or bystanders.

b. Tin Snips

Tin snips are used to cut thin sheet metal. They use the same principles as common scissors, but are able to handle thicker and harder material.

The range is huge, but essentially there are three different types; straight cutting in a straight line, left cutting snips (usually red) will cut in a curve to the left, and right cutting snips (usually green) will cut in a curve to the right.

In practical use the red snips pictured will be used in the right hand, for straight or curving cuts, with the base material to the right being cut neatly and the left hand will be pulling away a spiralling off-cut. The green snips work in the opposite fashion in the left hand, with the waste being on the right.

Left-cutting (red) and right-cutting (green) tin snips.
http://en.wikibooks.org/w/index.php?title=File:Left-right-snips.jpg&filetimestamp=20071207014314

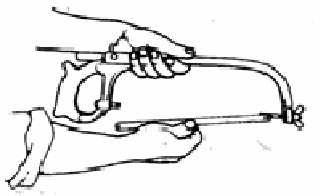
Care and Use of Tin Snips
Use them for what they are intended – light sheet metal, not wire etc. Note that the cut surfaces and resultant shards of metal are very sharp.

c. Punches

A punch is a hard metal rod with a shaped tip at one end and a blunt butt end at the other that is usually struck by a hammer. A variety of punches are used in engineering, but often the purpose is to form an impression of the tip on a work piece. You can also use a nail set, a pick, or even a nail (though a nail will make squarish holes) instead of a punch.

d. Hacksaws

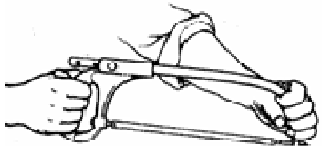
A hacksaw is a hand tool primarily used for cutting metal. It consists of a metal frame into which metal blades are inserted. The cheaper blades are made from high carbon steel. More durable and effective blades (also more expensive) are made from tool steel (HSS).



Inserting a hacksaw blade

Blades are usually classified as number-of-teeth-per-inch (TPI)

- 14 TPI – Mild steel sections and large sections
- 24 TPI – Brass, iron, copper etc
- 32 TPI – Sheet metal, piping etc



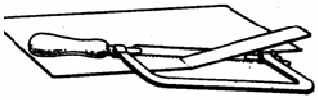
Using a hacksaw

Care and Use of Hacksaws

Blades are inserted with the teeth pointing away from the handle. Blade tension is achieved by tightening the butterfly nut.

Always ensure that the work is securely held in a vice or clamps.

As shown in the centre diagram, the cutting stroke is away from the body. This is accomplished by establishing a comfortable body posture and pushing away from the body using both hands. This is essential as hacksaw blades are easily broken. There is a cost to this as well as possible injury to the user. Note that cutting in a straight line is skill which requires practice.



Cutting a long section

The lower diagram shows the blade rotated 90 degrees for cutting a long section.

e. Pliers

There is a large range of pliers that are useful for making metal crafts. The red and yellow handled pliers are supplied by the Protector Alsafe Company; the vice grips shown below by Knipex

Combination Pliers (Multipurpose)

Multigrips (Readily Adjustable jaw opening)

Care and Use of Piers

Commonly used pliers are shown with a brief explanation for each.

Vice Grips (Adjustable jaw openings, jaws lock for clamping)

Side Cutters (Cutting wire)

Long Nose Pliers (Long reach, fine objects)

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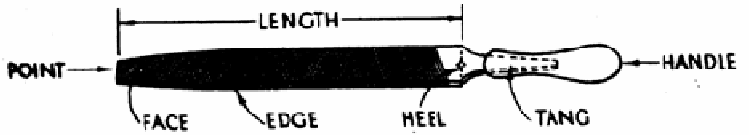
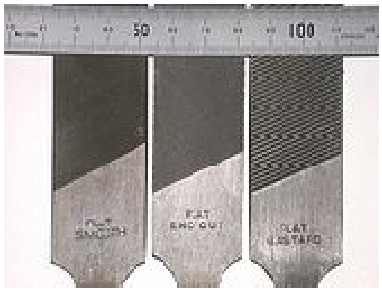
f. Files

Quality files are manufactured from high grade steel.

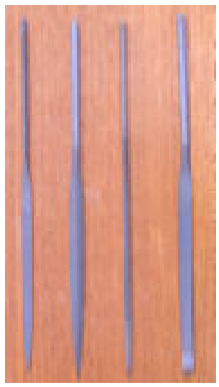




Flat Files

Files come in many shapes flat, round, half-round, three-cornered and square. File sizes also vary.

Files have forward-facing cutting teeth, running diagonally across the face of the file. These teeth range in size from coarse (for roughing-out work) to smooth (for finishing work).



Needle Files

Care and Use of Files

Files should always be used with a handle; otherwise the naked tang can injure the operator.

A file cuts most effectively when pushed over the work piece away from the body of the operator.

When a fine finish is required draw filing is often used. Draw filing involves laying the file sideways (ie perpendicular) on the work, and carefully pushing or pulling it across the work.

The grooves in a file may become clogged during use, causing the file to lose its cutting ability and trapped shavings can scratch the work surface. A file card or wire brush should be used regularly to clean the file. Pictures on right are sourced from:

http://en.wikibooks.org/w/index.php?title=File:FilesFlat-Smooth-2ndCut-Bastard.jpg&filetimestamp=20060204211637

g. Battery Powered Drills and Twist Drills

These drills are powered by a removable battery which clips onto the base of the drill and is removed for recharging.

Battery Powered Drill

Twist drills are used to drill holes (say up to 10mm diameter). For metal, it is only worthwhile to use drills of High Speed Steel. Skill is needed to correctly resharpen drills.

Other attachments include screwing bits, wire brushes etc

Source of Pictures

http://en.wikibooks.org/w/index.php?title=File:Titanium_nitride_coating.jpg&filetimestamp=20071121185122

http://en.wikibooks.org/w/index.php?title=File:Battdrill.jpg&filetimestamp=20050919051519

Care and Use of Battery Powered Drills and Twist Drills

To drill a hole, first use a centre punch to make a decent indent to mark the spot. Then clamp the job securely ensuring that, when the drill bit penetrates the other side of the job, it does not damage the vice etc. It is useful to have a scrap piece of wood under the job. Note. For larger holes it is useful to drill a small pilot hole (say 5mm) first.

Once the job is clamped, put on safety goggles and then place the drill bit in the indentation made by the centre punch. Ensure it is perpendicular to the job otherwise the drill bit may wander.

Gently squeeze the trigger on the drill. As more pressure is applied to the trigger, the drill will turn faster. If the bit wanders off the mark, stop and re-centre it. If it does it again, use the centre punch to knock a deeper indentation in the job.

IMPORTANT. When the drill penetrates to the other side, it will have a tendency to grab the job and spin it around. This can be dangerous, especially if it catches a finger. It may also break the drill bit. As you squeeze the trigger, gently press downward on the drill, but don't overdo it. If you press too hard, you risk breaking the drill bit

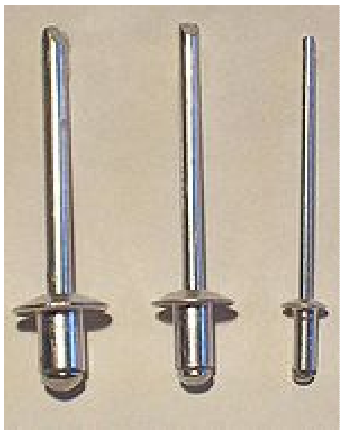
Continue to hold the bit perpendicular to the job. When the bit breaks through the other side of the job, keep the drill bit rotating for a few seconds. If you stop too soon, the hole will not be circular. It is best to drill part way into the scrap wood supporting the piece, as the side flutes on the drill bit will cut the sides of the hole, and this will help you make a round hole.

With the bit still turning, pull the drill bit out of the hole (it's easier to do when the bit is rotating).

Remember to keep the battery fully charged to prolong its life. Also always keep your drill bits properly sharpened.

h. Pop riveting tools

Pop rivets that are used for metal craft are made from flared aluminium tubes with a steel stem (or mandrel) through the centre. The stem has a small ball at the end (see bottom of picture) which has a diameter greater than that of tube. The rivet assembly is inserted into a hole drilled through the parts to be joined and a pop riveting tool is used to draw the mandrel into the rivet. The ball at the end of the mandrel expands the end of the rivet and the mandrel snaps.



Pop Rivets

For the low-stress situation of metal craft, rivets of 3.2 mm (ie 1/8 inch) diameter are usually adequate.

Care and Use of a Pop Riveting Tool

To set a pop rivet, place the rivet's tube fully into a pre-drilled hole of the specified diameter for the rivet. Ensure that the flared portion of the rivet is held firmly against the surface of piece to be riveted.

Open the handles of the riveting tool and place the nozzle of the riveting tool over the stem of the rivet.

Squeeze the handles together. You should be able to squeeze them until the rivet "pops", or the handles have travelled their full distance. If that happens, release the handle and squeeze again. The tool will grip the stem in a different place. You may need to repeat this a few times until the rivet pops.

After it pops, release the handle, and let the stem slide out of the tool's nozzle. A successful riveted joint depends on maintaining contact between the rivet's flared face and the material being riveted.

Dispose of the stems thoughtfully. (They are good at puncturing car tyres)

Source of Pictures

http://en.wikibooks.org/w/index.php?title=File:Blindnieten.JPG&filetimestamp=20051215213531
http://en.wikibooks.org/w/index.php?title=File:Blindrivettool.jpg&filetimestamp=20060907122443

Riveting Tool

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REQUIREMENT 3: Complete one project using metal foil tooling. Finish by antiquing and framing (These are not mandatory by SPD).

http://en.wikibooks.org/wiki/Adventist_Youth_Honors_Answer_Book/Arts_and_Crafts/Metal_Craft

Metal foil tooling is done by placing a piece of foil on top of a soft but firm surface and then making impressions with a stylus. The work surface can be a piece of scrap linoleum, leather, or crafting foam.

The stylus is often a small wooden stick with a point on it, but you can also use a ballpoint pen or a pencil. A dowel about the same diameter as a pencil can be sharpened with a pencil sharpener to make an effective stylus.

Place a drawing on top of the foil and trace it with the stylus, or draw the design free hand. Once the image has been impressed in the foil, it can be placed in a frame. You can use something as elaborate as a picture frame, or as simple as craft sticks glued together.

REQUIREMENT 3: Complete one project using a metal punch.

Draw your design on a piece of paper. It should be a simple line drawing with no shading. Then draw dots on the lines indicating where you will punch a hole. Fasten the drawing to a piece of sheet metal with tape. The sheet metal can be copper, tin, or aluminium. A tin can is OK as used by the author. See picture.

Place a piece of scrap timber on your work surface to protect it. Then place your sheet metal on top of this.

Carefully place the tip of the punch on one of the dots in your drawing and strike the punch with a hammer. It should take only one blow. Then move the punch to the next dot and repeat until you have punch a hole (or merely made an indention) on every dot in your drawing. Remove the paper and admire your work.

REQUIREMENT 4: Complete one project using drilling, riveting and bending of metal.

Baking with a reflector oven is a requirement of the Fire Building & Camp Cookery and Camping Skills IV honours.

This particular design folds flat for easy stowing in a backpack. It can be made from aluminium flashing, eight hinges, a pre-made grill, a drawer handle, some rivets, and a couple of nails

BIBLIOGRAPHY

Morgenstern, Steven. '*Metalcrafting Encyclopedia'*, Sterling Publishing Co Inc, New York, 1975

Slade, Richard. *'Take a Tin Can; How to Make Decorative Models'*, Faber & Faber, London, 1973.