Stage 5 - Industrial Technology Metal – Mark it out

## Summary

This unit is intended to be delivered at the start of the Industrial Technology Metal course, addressing the content in the Core Module: Metal 1. It introduces students to the materials, tools and techniques used within the metals industry. This is done through the delivery of projects with increasing difficulty and the associated theory to support student learning.

## Duration

8 weeks Detail: 24 hrs – 6 hrs a fortnight

## Outcomes

* **IND5-1** identifies, assesses, applies and manages the risks and WHS issues associated with the use of a range of tools, equipment, materials, processes and technologies
* **IND5-3** identifies, selects and uses a range of hand and machine tools, equipment and processes to produce quality practical projects
* **IND5-4** selects, justifies and uses a range of relevant and associated materials for specific applications
* **IND5-6** identifies and participates in collaborative work practices in the learning environment
* **IND5-7** applies and transfers skills, processes and materials to a variety of contexts and projects
* **IND5-8** evaluates products in terms of functional, economic, aesthetic and environmental qualities and quality of construction
* **IND5-9** describes, analyses and uses a range of current, new and emerging technologies and their various applications

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## Unit overview

This unit is designed to expose students to a range of practical experiences using sheet metal, while addressing the content from the Core Module Metal 1. The focus throughout the unit is accuracy, quality and safety. This should be emphasised at all stages of program delivery in both practical and theory components. It should be noted that the delivering teacher has the capacity to change projects and experiences to cater for school and student need within the school context.

## Resources overview

### Physical resources

* Student work booklet
* Teacher work booklet
* Aluminium sheet for soft jaws
* Galvanised steel sheet cut into 600 x 600 squares for toolbox
* Workshop access
* Computer room access

### Websites

* Aboriginal Steel Art (ASA) – [aboriginalsteelart.com](http://www.aboriginalsteelart.com/)
* [nipponsteel.com - Hot-Rolled Steel Sheets and Coils Manufacturing Processes](http://www.nipponsteel.com/en/product/sheet/process/)
* [The difference between ferrous and non-ferrous metals](https://www.youtube.com/watch?v=JIX_vFh5llA) (duration 2:32)
* [What is an alloy?](https://www.youtube.com/watch?v=9LHDSB1n11k) (duration 6:44)
* [Steel Manufacturing - Including Blast Furnace and BOS](https://www.youtube.com/watch?v=otVFDo9YSM8)(duration 18:06)

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| Content | Teaching and learning | Evidence of learning | Adjustments and registration |
| **Week 1*** recognise and comply with WHS signage
* select and use specialist terminology in context
* prepare design and production folios to describe the management and processes undertaken in the production of practical projects
 | **Teacher**:* introduces students to the unit of work
* directs discussion on the requirements of the course, expectations and standards to be met. Emphasis should be placed on safety, accuracy and quality. Where possible, using exemplars to explain work to be covered
* identifies the Work Health and Safety (WHS) signage around the workshop and reinforces the rules regarding behaviour and following safe working protocols
* uses individual questioning and open ended responses to check learner understanding
* introduces students to the Glossary within the Introduction to Metals unit, explains that it is to be completed over the duration of the unit

**Students:*** take part in class discussion on what is to be achieved and why
* provide responses to questions when directed
* begin filling in glossary.

**Possible adjustments:*** assessment through questioning or workbook can be edited to remove descriptions and students fill in details from discussion
* editing of the booklet to remove descriptors from the glossary and have students write in their own descriptions
* remove selected pictures and have students physically draw items into the glossary
* partial removal of words from glossary description to create a closed passage
* leave the booklet as it is and have students use highlighters to identify key features.
 | * Students demonstrate understanding of the course requirements through responses to questioning.
* Students are observed complying with WHS signage such as using the correct PPE and following the safe working protocols in the workshop
* Students use specialist terminology in the completion of their glossaries.
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| * identify and investigate factors influencing design in metal, for example:
* use a range of metals in the production of practical projects
* identify properties and applications of a range of metals and metal products, for example:
 | **Teacher:*** introduces the Design and Production Process and explains it's importance in the development of quality designs
* leads discussion specifically on evaluation, the need for ongoing evaluation and how this can influence the overall process. Emphasis should remain on accuracy and quality of production.
* leads discussion on the differences between ferrous and non-ferrous metals
* uses a range of different metals to demonstrate the differences between the two including the use of a magnet to determine whether they are ferrous or non-ferrous
* introduces [The difference between ferrous and no-ferrous metals](http://www.youtube.com/watch?v=JIX_vFh5llA) (duration 2:32) and [What is an alloy?](http://www.youtube.com/watch?v=9LHDSB1n11k) (duration 6:44) videos which explain the differences and what they are
* demonstrates the different characteristics of materials when alloyed, for example a piece of solder.

**Students:*** engage in discussion on the use of evaluation as a tool for continual improvement
* discuss the differences between each type of ferrous and non-ferrous metals and the advantages of alloying materials.
 | * Students are able to demonstrate their ability identify the properties of a range of metals through the completion of the student workbook
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| **Week 2 – 3*** demonstrate safe workshop practices and procedures
* safely use and maintain hand, power and machine tools
* select and use personal protective equipment (PPE) when working with tools, materials and machines
* use and adjust a range of hand tools in the production of practical projects
 | **Teacher:** * leads discussion and demonstration of common metalworking hand tools, power tools, plant and equipment relevant to sheet metal fabrication such as:
	+ marking out tools
	+ manual cutting and shaping tools
	+ bending and forming tools
* explains specific manufacturing processes that they can be used for, including the Work Health and Safety concerns associated with each tool.

**Students:*** complete any relevant safety tests that have not been completed prior to this section.

**Possible adjustments:*** delivery of this section of the booklet can be chunked, completed as required when tools and machines specific to a project are used or set as a homework task. Delivery does not need to be stand alone
* assessment can include playing 'equipment bingo' by naming an item and the first to identify it and hold it up wins. Extra reward given if they can link it to the Glossary.
 | * Students demonstrate their understanding of the safe and correct use of tools and equipment through the completion of workshop safety tests.
* Students are observed during practical activities using the correct PPE and following the safe operating procedures for a range of tools and equipment.
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| * demonstrate safe workshop practices and procedures
* select and use personal protective equipment (PPE) when working with tools, materials and machines
* use and/or modify existing designs when completing projects
* select metals and metal profiles for specific applications
* measure and mark out materials from a project drawing with accuracy and precision
* apply techniques and equipment for the cutting, shaping and forming of sheet metal
* use and adjust a range of hand tools in the production of practical projects
* read and interpret plans and/or materials lists to prepare materials for the completion of projects
 | **Teacher:*** introduces the task of making a set of soft jaws using aluminium sheet metal
* directs discussion on the requirements of the task, expectations and standards to be met. Emphasis should be placed on safety, accuracy and quality
* demonstrates how to read and interpret the plans provided in the student booklet and how to generate a template from cardboard
* reinforces the correct use of equipment by demonstrating how to mark out the soft jaws on the sheet metal
* demonstrates the correct order and safe method for forming the soft jaws using the bending equipment available

**Students:*** follow along with demonstration answering questions as required by the teacher
* mark out and cut out a cardboard template to check accuracy of their layout and measurements
* submit template to teacher to check for accuracy
* mark out soft jaws on sheet metal supplied by the teacher
* use template to double check accuracy of marking out, then use appropriate tools to cut out, file and shape the soft jaws until they match the example, are free of sharp edges and safe to use
* evaluate their finished soft jaws using the scaffold provided.

**Possible adjustments:*** students can use the template to mark around on the sheet metal if they are struggling with the marking out process
* prior to folding the soft jaws the teacher can demonstrate the use of number and letter stamps and students can follow the instructions to stamp their initials or names into the reverse side or top face of the soft jaws
* students who complete their soft jaws faster could use the same material to make a simple key ring tag which could then be etched, powder coated, sprayed or anodised depending on the equipment available at the school.
 | * Students understanding of the task is demonstrated through observing them work, through the completion of the relevant section of their workbook and safety tests and through the submission of the paper template and finished product.
* Students are able to follow plans to accurately mark out and cut up the sheet metal for their soft jaws whilst minimising waste and using offcuts where available or appropriate.
* Students are observed during practical activities using the correct PPE and following the safe operating procedures for a range of tools and equipment.
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| **Week 4** * investigate a range of career paths in the metal industry
 | **Teacher:*** introduces the topic of careers within the Metal Industry
* leads discussion on Metal based industries and professions. Use a 'Brainstorm' cognitive organiser on the board to list responses and areas it fits into within society.

**Students:*** engage in discussion and answer teacher directed questioning to elicit further responses
* use responses to fill in sections on pp16-17
* complete career research task.

**Possible adjustments:*** assessment via questioning or editing the workbook
 | * Students demonstrate an understanding of the employment opportunities within the metal industry through their responses in class.
* Students demonstrate their ability to investigate a specific career in the metal industry through the submission of their report.
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| * investigate advanced manufacturing techniques to assist in the production of projects
* compare industrial production processes to those used in the classroom
 | **Teacher:*** introduces a Careers Case Study - Indigenous Perspective and Influence
* directs students to the [Aboriginal Steel Art website](https://www.aboriginalsteelart.com/) and gets them to complete the work on Page 19 of the booklet, focusing on the work of Wayne “Liwingu” McGinness
* leads a discussion on how the artist uses his skills to create imaginative art pieces, specifically looking at the nature of the material and how it is manipulated to his purpose
* compares the potential methods of fabrication between what the artist most likely uses and what is available in the school workshop.

**Students:** * explore the artist’s career background and skills that he has developed through work within industry
* discuss the appropriate use of imagery and societal or cultural considerations when designing.

**Possible adjustments:*** questions within the work booklet may be answered as an independent research task, small group task or whole class discussion.
 | * Completed career case study demonstrates students understanding of the industrial processes and advanced manufacturing techniques potentially used in industry.
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| **Week 5 – 7*** identify properties and applications of a range of metals and metal products
* modify the properties of metals through heat-treatment processes
* describe the processes and materials used in the production of steel
* identify renewable and non-renewable resources in metal industries
 | **Teacher:*** leads discussion about, and demonstration of, different steel types and applications and how to identify them. For example common mild steel that still has scale on it from the hot forming process as opposed to bright steel which has been cold rolled resulting in work hardening and no scale
* uses a range of metal samples to show and explain the different processes used such as heat treatment for specific applications such as tool steel
* introduces the video, [Steel Manufacturing - Including Blast Furnace and BOS](https://www.youtube.com/watch?v=otVFDo9YSM8) for students to watch, including pausing the video to direct them to make notes in the corresponding section of their work booklet or summarise the information for them on the board
* facilitates a student centred discussion on the different aspects of steel production. Focus the discussion on recycling of materials, consumption of raw materials and financial and environmental impacts of steel production
* projects or shares the flowchart of steel production from [nipponsteel.com/en/product/sheet/process/](http://www.nipponsteel.com/en/product/sheet/process/) for students to copy in their work booklets.

**Students:*** watch the video on [Steel Manufacturing - Including Blast Furnace and BOS](https://www.youtube.com/watch?v=otVFDo9YSM8)
* answer questions in work booklets when prompted to by the teacher on pp20-22
* record the flowchart of steel production on page 21 in the student work booklet.

**Possible activities:*** Using an old hand file demonstrate heat treated steels. Do this by showing the tang end of file which has been normalised (see heat marks) to soften for safety (handle end not brittle, won’t fail if pushed with too much force). Show by either by bending without snapping and/or using another file to show that the normalised area will cut/file the tang but won’t cut/file the body of the file.
 | * Students are able to successfully identify the individual elements that make up the different steel types
* Students demonstrate their understanding by completing all activities in their student workbooks to a high standard.
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| * demonstrate safe workshop practices and procedures, for example:
* describe elementary first aid procedures
* use and/or modify existing designs when completing projects
* identify properties and applications of a range of metals and metal products
* measure and mark out materials from a project drawing with accuracy and precision
* apply techniques and equipment for the cutting, shaping and forming of sheet metal
* apply a variety of joining methods
* recognise and comply with WHS signage
* produce developments of sheet metal projects
* calculate quantities and costs of materials and components used in the completion of projects
 | **Teacher:*** introduces and explains the requirements of the toolbox unit, student expectations and standards to be met. Emphasis should be placed on safety, accuracy and quality
* models the correct use of use of PPE and other safety conventions, such as the handling of sheet material and correct first aid in the case of injury
* demonstrates the reading and interpretation of the plans provided to mark and cut out the components necessary to make the toolbox
* uses a series of prepared partially completed components to demonstrate the steps of manufacturing using appropriate tools and equipment
* explicitly links each process demonstrated to the marking criteria provided
* uses open ended questioning to check student understanding of the processes and procedures being demonstrated.

**Students:*** respond to questions and open ended responses to check learner understanding
* follow the steps demonstrated to produce their toolbox
* complete the tables in their work booklet at the same time as they make their toolbox
* calculate the total area of material required.
 | * Students use appropriate specialist terminology in the recording of the construction process in their workbooks.
* Students are observed during practical activities using the correct PPE and following the safe operating procedures for a range of tools and equipment.
* Students are able to follow plans to accurately mark out and cut up components for their toolbox whilst minimising waste.
* Students are able to accurately calculate the amount of material required to fabricate their toolbox.
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| **Week 8*** evaluate the impact of design and work practices/processes on the quality of finished projects
* prepare design and production folios to describe the management and processes undertaken in the production of practical projects
 | **Teacher:*** provides explanation of what evidence is and how it can be collected
* leads discussion on what the evidence might look like for the questions posed for the sheet metal toolbox.

**Students:*** discuss ideas for different evidence and what it would show in relation to the Sheet Metal Toolbox
* record evidence and self-reflection in booklets.

**Possible adjustments:*** students who finish early can use the offcuts to make spinner toys
* extra material could be provided to allow advanced students to customise and add features such as sliding trays or other holders.
 | * Students effectively evaluate the success of their own project using the criteria and scaffolds provided.
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## Evaluation

Evaluation of learning activities should be an ongoing process that happens throughout the delivery of this unit. Teachers should document their evaluation of learning activities throughout the program. The space provided below is to evaluate the overall unit of work.

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