Grade 12C Advanced Metal Design Fabrication

Course Code	8489
Course Credit	1.0

Senior Years Technology Education Program

Discipline Overview

An approved technical-vocational education (TVE) program cluster comprises departmentally developed and/or approved courses in one specific trade or trained occupation that facilitates the transition from school to either post-secondary training (such as the training provided through Apprenticeship Manitoba) or entry into the workforce (often at an entry-level position).

When learners pursue their studies in an environment modelled after the workplace, they will acquire not only trade-related skills, but will also develop

- employability skills required to make an effective transition from school to work
- an understanding of career development and planning
- an understanding of the importance of becoming an autonomous, lifelong learner in order to adapt to the skills and knowledge needed in the future
- an awareness of safety in school, in the workplace, and at home
- an awareness of sustainability as it relates to the specific skilled trade area and society

Course Overview

In this course, learners will deepen their understanding of welding design and fabrication, building on the knowledge gained in the fundamental course. Learners will continue to expand their expertise in the welding profession, including safety practices, tools and equipment, and the selection and use of materials and consumables. This advanced course emphasizes more complex procedures and advanced welding design and fabrication.

This course focuses on the following units in the Apprenticeship Manitoba Level 1 technical training:

- A6 Material Handling and Access Equipment
- A7 Drawings and Welding Symbols
- A8 Weld Process and Quality Inspection I
- A10 Layout and Fabrication I

Manitoba

The learning outcomes in this course may not follow a fixed sequence, as they are organized to align with Apprenticeship Manitoba standards. Only the outcomes relevant to this course are included. A complete list of learning outcomes can be found in the primary learning outcomes resource.

Global Competencies in Welding Technology

Critical Thinking

Critical thinking in welding technology involves the intentional process of synthesizing and analyzing ideas using criteria and evidence, making reasoned judgments, and reflecting on the outcomes and implications of those judgments.

When critical thinking as a competency is applied in welding technology, learners

- find and use sources strategically, efficiently, and effectively for the design and management of projects
- evaluate sources for bias, relevance, and reliability for use in training and occupations
- analyze and synthesize ideas using criteria and evidence that demonstrate awareness of emerging trends
- reflect on sources and experiences from multiple perspectives
- enhance comprehension, clarify meaning, make connections, and expand experiences through questioning
- make judgments based on observation, experience, and evidence
- weigh criteria to apply safe practices and make ethical decisions

Creativity

Creativity in welding technology involves exploring and playing with ideas and concepts in order to represent thinking, solve problems, explore opportunities, and innovate in unique ways. It is the interaction between intuition and thinking.

When creativity as a competency is applied in welding technology, learners

- demonstrate initiative, open-mindedness, inventiveness, flexibility, and a willingness to take prudent risks in thinking through projects/processes and recognizing safety protocols
- demonstrate curiosity by exploring new ideas, possibilities, and emerging trends, as well as by asking relevant questions
- use theoretical and applied strategies by making adaptations and adjustments to solve a problem and generate innovative ideas

- enhance innovative ideas by building on the ideas of others
- create a plan for a project and adjust it as needed to achieve the goal of successfully meeting a learning outcome
- research, develop, test, and adapt designs and ideas, as well as build on prior knowledge to persevere through obstacles
- reflect by welcoming feedback from others to enhance the process

Citizenship

Citizenship in welding technology involves engaging and working toward a more equitable, compassionate, and sustainable world by developing and valuing relationships to self, others, and the natural world.

When citizenship as a competency is applied in welding technology, learners

- understand their own perspective on issues related to economies on a global, regional, and local level
- recognize discrimination, principles of equity, and human rights in their world
- explore the interconnectedness of self, the workplace, and the natural world
- welcome diverse viewpoints, experiences, and world views and how they contribute to building relationships and practices
- empathize with multiple viewpoints to better understand consumers, markets, workplaces, teams, and co-workers
- connect with others in responsible, respectful, and inclusive ways, both in person and in digital contexts
- realize their potential in contributing to the betterment of community near and far
- evaluate factors such as the impact of diversity, equity, and inclusion in the workplace, and propose solutions to support well-being
- make ethical choices to promote healthy and sustainable outcomes

Connection to Self

Connection to self in welding technology involves awareness of the related nature of emotional, intellectual, physical, social, cultural, and spiritual aspects of living and learning, and the responsibility for personal growth, well-being, and well-becoming.

When connection to self as a competency is applied in welding technology, learners

- recognize personal strengths, gifts, and challenges to support their learning and well-being
- come to know the factors that shape their identity through exploration

- use workplace skills and practices to enhance self-regulation, personal comfort, sense of well-being, and efficiency
- reflect on own decisions, effort, and experiences, and others' feedback for improvement
- set goals to strengthen their career and personal aspirations
- create a personal plan that reflects their career goals, encompassing their strengths and interests
- value and practise resilience as they work through mistakes and overcome obstacles
- adapt and modify their planning when presented with obstacles or new information
- recognize and embrace their role in lifelong learning, well-being, and well-becoming

Collaboration

Collaboration in welding technology involves learning with and from others and working together with a shared commitment to a common goal.

When collaboration as a competency is applied in welding technology, learners

- welcome diverse viewpoints, experiences, and world views, and appreciate how they contribute to building relationships and practices
- build on each other's ideas through discussion, sharing stories, models, and simulations, and incorporate this learning into practical applications
- value and put trust in others' contributions when working together to ensure safe practices
- formulate questions of themselves and others to generate new ideas and deepen understanding
- work through differences and show a willingness to compromise or change perspective by demonstrating effective conflict resolution practices/strategies and appropriate workplace etiquette and protocols
- co-construct understanding of current practices and emerging technologies
- commit to their roles to co-construct, design, and manage projects

Communication

Communication in welding technology involves interacting with others and allowing for a message to be received, expressed, and understood in multiple ways and for a variety of purposes.

When communication as a competency is applied in welding technology, learners

- express ideas while using workplace conventions and professionalism
- understand context, adapting to different audiences, and conveying information clearly and concisely
- understand how their words and actions shape their identity or have an impact
- understand protocols and practices and use them to understand and interpret messages
- seek to understand others' ideas and instructions through active listening and questioning
- recognize that diverse perspectives (of language, culture, age, etc.) can influence understanding
- make meaning and deepen understanding through their language and the languages of clients and colleagues
- build relationships through meaningful interactions using inclusive and respectful language, and correct terminology, both in person and in digital contexts
- recognize the benefits of communication to build community

Enduring Understandings

Explore career opportunities.

Technical-vocational education supports learners to understand the unique characteristics, scope, working conditions, and career opportunities of various occupations to make informed choices.

Create safe, healthy, and effective workspaces.

Technical-vocational education provides learners with safe, healthy, and effective work practices and protocols that meet industry standards for technical competence and professionalism.

Navigate the world.

Technical-vocational education prepares learners with attitudes, skills, and knowledge to successfully navigate complex, competitive, and collaborative environments to develop an awareness of regulations, cultural competence, and ethical practices.

Experience connected and innovative learning.

Technical-vocational education readies learners to be entrepreneurial and innovative thinkers while making cross-curricular connections and transdisciplinary experiences (STEAM), utilizing industry standard digital tools and technologies, and fostering awareness of industry trends.

Promote inclusive and responsive systems.

Technical-vocational education promotes equity, diversity, and inclusion, is responsive to global challenges, and promotes environmental stewardship to prepare learners for an interconnected world.

Prepare for evolving economies.

Technical-vocational education equips learners with relevant and adaptable skills to become lifelong learners in an ever-changing world.

Learning Outcomes

With independence and an emerging ability to guide others, learners can achieve the following learning outcomes.

Strand A: Trade Safety (A2)

WEL-12C-A2 Recognize, explain, and demonstrate personal protective equipment (PPE) requirements and standards in the workplace.

WEL-12C-A2-1 **Recognize** various personal protective equipment (PPE), including

- eye protection
- face protection
- hearing protection
- foot protection
- head protection
- hand protection
- skin protection
- respiratory protection
- protective clothing
- fall protection (trade-specific)

WEL-12C-A2-2 **Explain** various personal protective equipment (PPE), including

- selection of the appropriate PPE
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-A2-3 **Demonstrate** how to use the required personal protective equipment (PPE), ensuring

- a proper fit
- a proper seal
- it is worn properly
- an understanding of the procedures for reporting any damage or malfunctions

WEL-12C-A5 Recognize and explain injury prevention.

WEL-12C-A5-1 Recognize, explain, and demonstrate the **SAFE acronym**.

- **S**pot the hazard
- **A**ssess the risk
- **F**ind a safer way
- **E**very day

WEL-12C-A5-12 Demonstrate knowledge of the **locations of various fire emergency safety equipment** and evacuation safety measures, including

- fire extinguisher
- alarm pull stations
- emergency exits
- muster points

WEL-12C-A6 Recognize and explain injury response.

WEL-12C-A6-2 Explain how to **report an injury**, including to

- a teacher or supervisor
- Workers Compensation Board of Manitoba (WCB)

WEL-12C-A6-3 Demonstrate knowledge of the **locations of various emergency safety equipment**, including

- first aid kit
- automated external defibrillator (AED)
- eyewash station

Strand B: Career Education (A1)

WEL-12C-B1 Explain the structure and scope of the welding trade.

WEL-12C-B1-1 Explain opportunities and future **career paths** in a trade, including

- becoming a specialist
- moving into leadership
- working in different locations
- growing with new technology

WEL-12C-B2 Explain the levels of workplace competency.

WEL-12C-B2-1 Explain **job competencies** workers and learners need to know related to **workplace culture**, including

- understanding tools and materials
- using the right skills to do the job well

WEL-12C-B2-2 Explain the **social competencies** workers and learners need to know related to **workplace culture**, including

- working well with others
- using appropriate language
- respecting different beliefs
- understanding workplace rules
- supporting fairness and inclusion

Strand C: Trade-Related Communications (A4)

WEL-12C-C1 Explain and demonstrate techniques for effective verbal and non-verbal communication.

WEL-12C-C1-1 Explain how to communicate clearly and respectfully with different people at school and/or work, using both **words and body language**.

WEL-12C-C1-2 Demonstrate how to communicate clearly and respectfully with different people at school and/or work, using both **words and body language**.

WEL-12C-C2 Recognize workplace behaviours and communication that constitute bullying, as defined by the Canadian Human Rights Act and jurisdictional human rights laws.

WEL-12C-C2-1 Recognize what **respectful workplace** values look like and what kinds of behaviour are considered bullying, harassment, or discrimination under Canadian law.

WEL-12C-C3 Demonstrate effective communication skills, and practise active listening and response.

WEL-12C-C3-1 Demonstrate **effective communication and active listening,** including

- listening carefully
- responding clearly
- using appropriate body language
- asking questions
- being open to feedback

Strand D: Trade-Related Mathematics (A5)

WEL-12C-D1 Use mathematical properties to solve problems involving whole, fractional, decimal, and percentage numbers, with an emphasis on trade-related problems.

WEL-12C-D1-1 Demonstrate how to solve math problems with both **positive and negative numbers**, indicating how the signs (+ or –) affect the answer, when

- adding
- subtracting
- multiplying
- dividing

WEL-12C-D1-2 Recognize various **types of fractions**, including

- proper fractions
- improper fractions
- mixed fractions

WEL-12C-D1-3 Explain various **types of fractions**, including

- a proper fraction has a smaller number on top (like $\frac{3}{4}$)
- an improper fraction has a bigger number on top (like $\frac{5}{3}$)
- a mixed fraction combines a whole number and a fraction (like $1\frac{2}{3}$)

WEL-12C-D1-4 Demonstrate how to add and subtract **fractions**.

WEL-12C-D1-5 Demonstrate how to multiply, divide, simplify (reduce), and expand **fractions.**

WEL-12C-D1-6 Demonstrate how to change a fraction into a **decimal** and a decimal into a fraction.

WEL-12C-D1-7 Demonstrate how to calculate **percentages** in trade situations, such as when

- material costs increase by 10%
- applying a 15% discount

WEL-12C-D1-8 Demonstrate how to apply the **order of operations** (BEDMAS) to solve trade-related math problems like calculating material quantities or cutting dimensions.

WEL-12C-D1-9 Demonstrate how to **solve roots and exponents** calculations in trade situations, such as

- figuring out the area (e.g., $4^2=16$)

WEL-12C-D2 Demonstrate how to communicate measurements.

WEL-12C-D2-1 Demonstrate how to **measure.**

WEL-12C-D2-2 Demonstrate how to **measure** using both **metric and customary** (imperial) measurement systems, such as when

- measuring length
- measuring materials

WEL-12C-D2-3 Demonstrate how to provide **measurements,** including how much the measurements can vary (e.g., bead width).

WEL-12C-D3 Solve trade-related problems using calculations for simple and complex geometric shapes.

WEL-12C-D3-1 Demonstrate how to find the **perimeter and area** of different shapes like triangles, rectangles, and combined shapes, such as by calculating

- the area to determine the amount of material required to build the project
- the perimeter to determine the length of a handrail

WEL-12C-D3-2 Demonstrate how to calculate the **Pythagorean theorem** ($a^2+b^2=c^2$) to find the length of one side of a right triangle to, for example, determine whether something is square.

WEL-12C-D3-3 Demonstrate how to calculate **volume** using various cylinders (e.g., how much concrete is needed to fill a round column).

WEL-12C-D3-4 Demonstrate how to find the **circumference** (distance around) and **area** (space inside) of a circle (e.g., cutting a circular metal plate).

WEL-12C-D3-5 Demonstrate how to calculate various **angles**, including

- complementary
- supplementary
- angle measurement

WEL-12C-D3-6 Demonstrate how to find the length of a **chord** (e.g., a straight line connecting two points on a circle).

WEL-12C-D4 Solve problems using ratio and proportion.

WEL-12C-D4-1 Demonstrate how to use **ratios and proportions** to solve problems, including

- direct proportion (e.g., as one value increases, the other also increases)
  - If 2 litres of paint cover 10 m^2, then 4 litres cover 20 m^2.

- indirect (inverse) proportion (as one value increases, the other decreases)
  - If four workers take six hours to complete a task, then two workers would take 12 hours.

WEL-12C-D5 Solve trade-related algebraic problems involving simple equations and formulas.

WEL-12C-D5-1 Demonstrate how to use **algebra** to solve problems, including

- manipulating equations: rearranging formulas
- isolating variables: solving for one unknown
- creating simple equations: writing a basic formula to represent a real problem (e.g., total cost = rate × hours)

Strand E: Tools and Equipment (A3)

WEL-12C-E1 Recognize, explain, and demonstrate an understanding of terminology associated with tools and equipment.

WEL-12C-E1-1 Recognize **key terms** and **names** of various tools, and equipment.

WEL-12C-E1-2 Explain the **names** and **purposes** of various tools and equipment.

WEL-12C-E1-3 Demonstrate an understanding of the **names** and **purposes** of various tools and equipment.

WEL-12C-E2 Recognize the various hazards associated with tools and equipment, and explain and demonstrate the related safe work practices.

WEL-12C-E2-1 Recognize various **hazards of tools** and equipment, including

- harmful noise levels
- lacerations caused by sharp tools or materials
- crush injury hazards
- moving parts on machines that can catch and trap hands or garments
- flying debris hazards

WEL-12C-E2-2 Explain how to **use tools and equipment safely**, including

- wearing appropriate personal protective equipment (PPE)
- inspecting tools and equipment before use
- using the correct tool for the job
- keeping the work area clean and organized
- following manufacturer instructions and safety guidelines
- disconnecting power tools when not in use or during maintenance

- reporting and removing damaged tools from service
- staying alert and avoiding distractions while working
- using guards and safety devices as intended
- storing tools properly after use

WEL-12C-E2-3 Demonstrate safe work practices related to tools and equipment.

Strand F: Materials and Consumables

WEL-12C-F1 Share and discuss Indigenous perspectives and environmental impacts.

WEL-12C-F1-1 Share and discuss an **Indigenous perspective** on material selection, emphasizing sustainability, respect for natural resources, and cultural significance, such as

- principles of the honourable harvest
- four sacred elements (earth, wind, water, fire)
- inviting an Elder to teach sustainability

WEL-12C-F1-2 Share and discuss the **environmental impact** of selecting and disposing of various materials.

WEL-12C-F2 Recognize the various hazards associated with consumables and materials, and explain and demonstrate the related safe work practices.

WEL-12C-F2-1 Recognize various **hazards** for welding consumables and materials, including

- burns
- lifting
- flux dust

WEL-12C-F2-2 Explain various **safe work practices** for consumables and materials, including

- wearing appropriate personal protective equipment (PPE)
- inspecting consumables and materials before use
- using the correct consumables and materials for the job
- keeping the work area clean and organized
- following manufacturer instructions and safety guidelines
- reporting and removing damaged consumables and materials from service
- staying alert and avoiding distractions while working
- storing consumables and materials properly after use

WEL-12C-F2-3 Demonstrate safe work practices related to **consumables and materials**.

Strand G: Material Handling and Access Equipment (A6)

WEL-12C-G1 Recognize, explain, and demonstrate terminology associated with material handling.

WEL-12C-G1-1 Recognize **key terms and names** of various types of material handling.

WEL-12C-G1-2 Explain the **names and purposes** of various types of material handling.

WEL-12C-G1-3 Demonstrate an understanding of the **names and purposes** of various types of material handling.

WEL-12C-G2 Recognize the various hazards associated with lifting, rigging, hoisting, and ladders, and explain and demonstrate the related safe work practices.

WEL-12C-G2-1 Recognize various **lifting, rigging, or hoisting hazards**, and explain safe work practices, including for the following:

- falls
- overhead and electrical power lines
- pinch/crush points
- surrounding area and lift conditions
- property and equipment damage

WEL-12C-G2-2 Recognize various **ladder hazards** and explain safe work practices, including

- 3-point contact
- slope
- load capacity label
- access
- egress

WEL-12C-G2-3 Demonstrate safe work practices relate to **lifting, rigging, hoisting, and ladders.**

WEL-12C-G3 Recognize, explain, and demonstrate lifting, rigging, and hoisting equipment, including their characteristics, applications, and operation.

WEL-12C-G3-1 Recognize standard crane and hoist **hand signals** used for lifting, rigging, and hoisting equipment, such as

- hoist

- lower
- stop
- emergency stop
- swing
- boom up
- boom down
- extend boom
- retract boom

WEL-12C-G3-2 Demonstrate standard crane and hoist **hand signals** used for lifting, rigging, and hoisting equipment.

WEL-12C-G3-3 Recognize various **tools and equipment used to lift** and move heavy loads safely, including

- rigging devices
  - beam clamps
  - tag lines
  - spreader bars
  - load softeners
  - plate clamps
- slings
  - straps
  - chains

WEL-12C-G3-4 Explain various **tools and equipment used to lift** and move heavy loads safely, including

- selection of the appropriate tools and equipment used to lift and move heavy loads safely
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-G3-5 Recognize various **methods** for lifting, rigging, and hoisting, including

- lifting: cranes, forklifts, hoists, jacks
- rigging: slings, shackles, hooks, spreader bars
- hoisting: hoists, winches, pulleys, jib cranes

WEL-12C-G3-6 Explain various **methods** for lifting, rigging, and hoisting, including

- selection of the appropriate methods for lifting, rigging, and hoisting
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-G4 Recognize and explain material handling and access equipment, including their characteristics, applications, and operation.

WEL-12C-G4-1 Recognize various **material handling equipment**, including

- rigging equipment
- hoisting and lifting equipment
- chain falls
- overhead and mobile cranes

WEL-12C-G4-2 Explain various **material handling equipment**, including

- selection of the appropriate material handling equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-G4-3 Demonstrate how to safely and properly use various **material handling equipment.**

WEL-12C-G4-4 Recognize various **access equipment**, including

- fall arrest harnesses
- anchor points
- ladders
- scaffolding
- aerial work platforms

WEL-12C-G4-5 Explain various **access equipment**, including

- selection of the appropriate access equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-G5 Explain and demonstrate the procedures to select, maintain, and use lifting, rigging, and hoisting equipment.

WEL-12C-G5-1 Explain how to **calculate load** dimensions and weight of various materials, accounting for material type, shape, and size, such as

- a steel rod is 2 metres long and has a diameter of 0.1 metres
  - weight = volume x density
  - volume = $\pi \times r^2 \times h$

WEL-12C-G5-2 Demonstrate how to **calculate load** dimensions and weight of various materials, accounting for material type, shape, and size.

WEL-12C-G5-3 Explain how to **calculate sling angles** using a load chart, such as by

- looking up the angle on the chart
- finding the corresponding load factor
- multiplying the actual load weight by the load factor to find the tension in each sling

WEL-12C-G5-4 Demonstrate how to **calculate sling angles** using a load chart.

WEL-12C-G5-5 Explain how to calculate a **plan lift** and path of travel, and to confirm laydown area, such as by

- calculating the planned lift
- determining the path of travel
- confirming the laydown area

WEL-12C-G5-6 Demonstrate how to calculate a **plan lift** and path of travel, and to confirm laydown area.

WEL-12C-G5-7 Explain how to **cordon off** a work area, such as by setting up barriers and signs to keep unauthorized people out and to ensure safety for workers and the public.

WEL-12C-G5-8 Demonstrate how to safely **cordon off** a work area.

WEL-12C-G5-9 Explain how to **secure various rigging** to objects, including

- single choker
- double-wrap choker
- basket

WEL-12C-G5-10 Demonstrate how to safely **secure various rigging** to objects.

WEL-12C-G5-11 Explain how to attach **tag lines** to a load to guide and control it safely while it is being lifted or moved, such as by

- selecting the appropriate tag line
- inspecting the tag line for damage
- ensuring proper length for safe distance

- attaching the tag line to a secure point on the load
- using appropriate knots or fasteners
- positioning oneself in a safe location
- maintaining clear communication with the lift operator
- using smooth, controlled movements
- avoiding wrapping the line around one's body
- detaching the tag line safely after placement
- storing the tag line properly after use

WEL-12C-G5-12 Demonstrate how to attach **tag lines** to a load and use it to safely guide a load while it is being lifted.

WEL-12C-G5-13 Explain the appropriate blocks (**dunnage**) and padding (**softeners**) to safely set down a load in a chosen spot without damaging the load or the surface.

WEL-12C-G5-14 Explain how to safely **set down a load** in a chosen spot by using materials like wood blocks (dunnage) and padding (softeners) to protect the load and the surface.

WEL-12C-G5-15 Explain how to safely **move a load** from one place to another and keep an eye on it the whole time to make sure it stays balanced and does not shift or fall.

WEL-12C-G5-16 Demonstrate how to **move a load** from one place to another while keeping it steady and watching for any problems like swinging or shifting.

WEL-12C-G5-17 Demonstrate how to safely **set down a load** in a chosen spot without damaging the load or the surface.

Strand H: Drawings and Welding Symbols (A7)

WEL-12C-H1 Recognize, explain, and demonstrate an understanding of terminology associated with drawing and welding symbols.

WEL-12C-H1-1 Recognize **key terms** and **names** of various drawing and welding symbols.

WEL-12C-H1-2 Explain the **names** and **purposes** of various drawing and welding symbols.

WEL-12C-H1-3 Demonstrate an understanding of the **names** and **purposes** of various drawing and welding symbols.

WEL-12C-H2 Recognize, explain, and demonstrate welding symbols.

WEL-12C-H2-1 Recognize various uses of **welding symbols**, including

- type of weld
- type of joints
- size of weld
- field or shop weld
- contour symbols
- finish symbols
- reference line, arrow, and tail
- backing

WEL-12C-H2-2 Explain various uses of **welding symbols**, including

- selection of the appropriate welding symbols
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-H2-3 Demonstrate an understanding of various **welding symbols**, including

- types
- location
- information (tail at end of reference line)
- sequence

WEL-12C-H3 Recognize, explain, and demonstrate the use of drawings.

WEL-12C-H3-1 Recognize various types of **blueprints**, including

- assembly drawings
- shop and fabrication drawings
- site drawings
- engineered drawings

WEL-12C-H3-2 Explain various types of **blueprints**, including

- selection of the appropriate type of blueprint
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-H3-3 Recognize various types of **drawing views**, including

- section view
- detail view

- orthographic view
- isometric view

WEL-12C-H3-4 Explain various types of **drawing views**, including

- selection of the appropriate drawing view
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-H3-5 Recognize various types of **documentation**, including

- codes
- specifications
- change orders
- requests for information (RFI)

WEL-12C-H3-6 Explain various types of **documentation**, including

- selection of the appropriate documentation
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-H3-7 Recognize various **drawing conventions**, including

- alphabet of lines
- reference numbers, symbols, and abbreviations
- units of measurement (metric/imperial)
- scaling
- title block and legend
- notes, specifications, and schedules

WEL-12C-H3-8 Demonstrate how various **drawing conventions** use special rules to make them easy to read, including

- lines that indicate what is visible or hidden
- symbols and abbreviations that save space and explain parts
- units that indicate if the drawing is in inches or millimetres
- scale that indicates how big or small the drawing is compared to real life
- title blocks that indicate who made the drawing and what it is for
- notes and schedules that give extra details like materials or deadlines

WEL-12C-H3-9 Demonstrate an understanding of **various drawings**, including

- assembly drawings
- shop and fabrication drawings
- site drawings

WEL-12C-H4 Demonstrate welding take-off using various types of drawings to interpret and extract information.

WEL-12C-H4-1 Demonstrate **welding take-off using various types of drawings** to interpret and extract information, including

- recognizing quantities
- recognizing materials
  - type
  - thickness
- recognizing weld requirements
  - welding symbols
  - weld position
  - filler or electrode
- generating a cut list

Strand I: Weld Process and Quality Inspection (A8)

WEL-12C-I1 Recognize, explain, and demonstrate an understanding of terminology associated with weld processes and quality inspection.

WEL-12C-I1-1 Recognize **key terms and names** of various weld processes, and of quality inspection.

WEL-12C-I1-2 Explain the **names and purposes** of various weld processes, and of quality inspection.

WEL-12C-I1-3 Demonstrate an understanding of the **names and purposes** of various weld processes, and of quality inspection.

WEL-12C-I2 Recognize the various hazards associated with weld processes and quality inspection, and explain and demonstrate the related safe work practices.

WEL-12C-I2-1 Recognize various **gas cylinder hazards**, including

- explosions
- displacement of oxygen (asphyxiation)

WEL-12C-I2-2 Explain the safe work practices for **gas cylinder hazards**, including safety data sheets (SDS).

WEL-12C-I2-3 Recognize various **final product hazards**, including

- cuts
- particulate projection/sparks
- dust particulate inhalation
- toxic chemicals

WEL-12C-I2-4 Explain various safe work practices related to **final product hazards**.

WEL-12C-I2-5 Recognize various hazards related to **controlling temperature of weldments**, including

- electrical shock
- burns

WEL-12C-I2-6 Explain various safe work practices related to **controlling temperature of weldments**.

WEL-12C-I2-7 Demonstrate safe work practices related to **weld processes and quality inspection.**

WEL-12C-I3 Interpret jurisdictional codes, regulations, and job specifications pertaining to weld processes and quality inspection.

WEL-12C-I3-1 Understand and apply the rules and job requirements that relate to how welding is done and how its quality is checked, based on the laws and standards in a specific area.

WEL-12C-I4 Recognize and explain welding consumables and gas cylinders, including their characteristics, applications, and storage.

WEL-12C-I4-1 Recognize various **welding consumables**, including

- electrodes
- welding wires
- welding fluxes

WEL-12C-I4-2 Explain various **welding consumables**, including

- selection of the appropriate welding consumable
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I4-3 Recognize various **gas cylinder** product types and identification, including

- fuel gas
- oxygen gas
- inert gas
- active gas

WEL-12C-I4-4 Explain various **gas cylinder** product types and identification, including

- selection of the appropriate gas cylinder product type
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I5 Demonstrate how to safely and properly use welding consumables and gas cylinders.

WEL-12C-I5-1 Demonstrate how to safely and properly use welding consumables and gas cylinders.

WEL-12C-I6 Recognize and explain welding processes, including their selection, characteristics, and applications.

WEL-12C-I6-1 Recognize various **welding processes**, including

- shielded metal arc welding (SMAW)
- flux-cored arc welding (FCAW)
- metal-cored arc welding (MCAW)
- gas metal arc welding (GMAW)
- gas tungsten arc welding (GTAW)

WEL-12C-I6-2 Explain various **welding processes**, including

- selection of the appropriate welding process
- characteristics and key features
- application (i,e, its role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-I6-3 Recognize various welding **power sources**, such as

- transformer
- transformer-rectifier
- inverter
- engine-driven

WEL-12C-I6-4 Explain various welding **power sources**, such as

- selection of the appropriate welding power source
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-I6-5 Recognize various **welding polarities**, such as

- direct current electrode negative (DCEN)
- direct current electrode positive (DCEP)
- alternating current (AC)

WEL-12C-I6-6 Explain various **welding polarities**, such as

- selection of the appropriate welding polarity
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-I7 Recognize and explain marking welds and material types, including their characteristics, and applications.

WEL-12C-I7-1 Recognize various **material types**, including

- ferrous
- non-ferrous

WEL-12C-I7-2 Explain various **material types**, including

- selection of the appropriate material type
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I7-3 Recognize various **identification markings**, including

- heat numbers
- grain direction
- lot and job numbers
- material grade

WEL-12C-I7-4 Explain various **identification markings**, including

- selection of the appropriate identification markings
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-I7-5 Recognize various **marking devices**, such as

- paint markers
- soapstone

- chalk
- steel stamps
- tagging systems
- laser markers

WEL-12C-I7-6 Explain various **marking devices,** including

- selection of the appropriate marking device
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I7-7 Recognize various **personalized welder identifications**, including

- initials
- numbers

WEL-12C-I7-8 Explain various **personalized welder identifications**, including

- selection of the appropriate personalized welder identifications
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-I9 Recognize and explain final product finishing, including its characteristics and applications.

WEL-12C-I9-1 Recognize various **tools and equipment** related to final product finishing, including

- grinders
- wire wheels
- buffers

WEL-12C-I9-2 Explain various **tools and equipment** related to final product finishing, including

- selection of the appropriate finishing tools and equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I9-3 Recognize various **weld discontinuities** related to final product finishing, including

- porosity
- undercut
- cold lap
- excess or incomplete penetration

WEL-12C-I9-4 Explain various **weld discontinuities** related to final product finishing, including

- their identification
- their characteristics
- their effects on the final product
- correction of weld discontinuities on the final product finishing

WEL-12C-I9-5 Recognize various **undesirable materials** related to final product finishing, including

- oils
- oxides

WEL-12C-I9-6 Explain various **undesirable materials** related to final product finishing, including

- their identification
- their characteristics
- their effects on the final product
- correction of undesirable materials on the final product finishing

WEL-12C-I9-7 Recognize various **surface imperfections** related to final product finishing, including

- welding spatter
- gouges
- stray arc strikes
- sharp edges
- plate clamp gouges
- miscellaneous defects

WEL-12C-I9-8 Explain various **surface imperfections** related to final product finishing, including

- their identification
- their characteristics
- their effects on the final product
- correction of surface imperfections on the final product finishing

WEL-12C-I9-9 Recognize various **specific finishes** related to final product finishing, including

- coatings
- pickling
- machining
- blasting

WEL-12C-I9-10 Explain various **specific finishes** related to final product finishing, including

- selection of the appropriate product finish
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-I10 Recognize and explain quality inspection, including its characteristics and applications.

WEL-12C-I10-1 Recognize various quality inspection **tools and equipment**, including

- magnifying lenses
- inspection mirrors
- flashlights

WEL-12C-I10-2 Explain various quality inspection **tools and equipment**, including

- selection of the appropriate quality inspection tools and equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I10-3 Recognize various quality inspection **measuring devices**, including

- fillet weld gauge
- depth gauge
- hi-lo gauge
- bridge cam gauge
- steel rulers

WEL-12C-I10-4 Explain various quality inspection **measuring devices**, including

- selection of the appropriate quality inspection measuring device
- characteristics and key features

- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-I10-5 Recognize various quality inspection **material defects**, including

- surface irregularities
- laminations
- surface contamination

WEL-12C-I10-6 Explain various quality inspection **material defects**, including

- their identification
- their characteristics
- their effects on the final product
- correction of fabrication defects on the final product

WEL-12C-I10-7 Recognize various quality inspection **fabrication defects**, including

- improper fit-up
- misalignment
- distortion
- incorrect dimensions and orientation

WEL-12C-I10-8 Explain various quality inspection **fabrication defects**, including

- their identification
- their characteristics
- their effects on the final product
- correction of surface imperfections on the final product finishing

WEL-12C-I10-9 Recognize various quality inspection **weld discontinuities**, including

- porosity
- undercut
- cold lap
- excess or incomplete penetration

WEL-12C-I10-10 Explain various quality inspection **weld discontinuities**, including

- their identification
- their characteristics
- their effects on the final product
- correction of weld discontinuities on the final product

WEL-12C-I10-11 Recognize various quality inspection **surface imperfections**, including

- welding spatter
- gouges
- stray arc strikes
- sharp edges

WEL-12C-I10-12 Explain various quality inspection **surface imperfections**, including

- their identification
- their characteristics
- their effects on the final product
- correction of fabrication defects on the final product

Strand J: Thermal Cutting and Gouging (A9)

WEL-12C-J1 Recognize, explain, and demonstrate an understanding of terminology associated with thermal cutting and gouging.

WEL-12C-J1-1 Recognize key terms and names of various **types of thermal cutting and gouging**.

WEL-12C-J1-2 Explain the names and **purposes** of various types of thermal cutting and gouging.

WEL-12C-J1-3 Demonstrate an understanding of the **names and purposes** of various types of thermal cutting and gouging.

WEL-12C-J2 Recognize the various hazards associated with thermal cutting and gouging, and explain and demonstrate the related safe work practices.

WEL-12C-J2-1 Recognize various **oxy-fuel gas cutting (OFC) hazards**, and explain safe work practices, including for the following:

- fumes
- sparks
- burns
- eye hazards
- high pressure cylinders
- maximum safe working pressures
- regulator blowouts
- critical explosion level

WEL-12C-J2-2 Recognize **plasma arc cutting (PAC) hazards** and explain safe work practices, including for the following:

- fumes
- burns
- noise
- electrical shocks
- sparks
- radiation

WEL-12C-J2-3 Recognize **air carbon arc cutting and gouging (CAC-A) hazards**, and explain safe work practices, including for the following:

- fumes
- sparks
- burns
- noise
- electrical shocks
- radiation
- molten materials

WEL-12C-J2-4 Demonstrate **safe work practices** related to thermal cutting and gouging.

WEL-12C-J3 Recognize and explain oxy-fuel gas cutting (OFC) equipment.

WEL-12C-J3-1 Recognize various oxy-fuel gas cutting (OFC) base **metals and metallurgy**, such as

- metals
  - carbon steel (mild steel)
  - low-alloy steel
  - wrought iron
- metallurgy
  - oxidation behaviour
  - thermal conductivity
  - carbon content

WEL-12C-J3-2 Explain various oxy-fuel gas cutting (OFC) base **metals and metallurgy**, including

- selection of the base metals and metallurgy
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J3-3 Recognize various oxy-fuel gas cutting (OFC) types of **regulators**, including

- single-stage and two-stage
- low pressure and high pressure

WEL-12C-J3-4 Explain various oxy-fuel gas cutting (OFC) types of **regulators**, including

- selection of the appropriate regulator
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J3-5 Recognize various oxy-fuel gas cutting (OFC) types of **oxy-fuel gases**, including

- acetylene
- oxygen
- natural gas
- propane

WEL-12C-J3-6 Explain various oxy-fuel gas cutting (OFC) types of **oxy-fuel gases**, including

- selection of the appropriate oxy-fuel cutting types
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J3-7 Recognize various oxy-fuel gas cutting (OFC) oxygen and **high pressure fuel cylinders**, such as

- acetylene cylinder
- propane cylinder
- MAP-Pro gas cylinder

WEL-12C-J3-8 Explain various oxy-fuel gas cutting (OFC) oxygen and **high pressure fuel cylinders**, including

- selection of the appropriate fuel cylinders
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J3-9 Recognize various oxy-fuel gas cutting (OFC) **types of flames**, including

- neutral
- carburizing
- oxidizing

WEL-12C-J3-10 Explain various oxy-fuel gas cutting (OFC) **types of flames**, including

- selection of the appropriate OFC type of flame
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J3-11 Recognize various oxy-fuel gas cutting (OFC) **torch components**, including

- torch bodies
- hoses
- tips
- flashback arrestors
- reverse flow check valves

WEL-12C-J3-12 Explain various oxy-fuel gas cutting (OFC) **torch components**, including

- selection of the appropriate OFC torch components
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J3-13 Recognize various manual and mechanized **torch cutting systems**, including

- bevellers
- track cutters

WEL-12C-J3-14 Explain various manual and mechanized **torch cutting systems**, including

- selection of the appropriate manual and mechanized torch cutting systems
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J3-15 Recognize various oxy-fuel gas cutting (OFC) **factors** of oxy-fuel cutting and gouging, including

- heat input
- base metal and thickness

WEL-12C-J3-16 Explain various oxy-fuel gas cutting (OFC) **factors** of oxy-fuel cutting and gouging, including

- selection of the appropriate OFC factors of oxy-fuel cutting and gouging
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J4 Explain and demonstrate the procedures to cut and gouge, using oxy-fuel cutting (OFC) processes.

WEL-12C-J4-1 Explain and demonstrate the process to **set up** oxy-fuel cutting (OFC) start-up equipment.

WEL-12C-J4-2 Explain and demonstrate the process to **ignite fuel** gas and **adjust torch** valves according to type of flame for oxy-fuel cutting (OFC) equipment.

WEL-12C-J4-3 Explain and demonstrate the process to **pre-heat** material to a kindling point to initiate a cut with oxy-fuel cutting (OFC) equipment.

WEL-12C-J4-4 Explain and demonstrate the process to perform a **cut** with oxy-fuel cutting (OFC) equipment.

WEL-12C-J4-5 Explain and demonstrate the process to recognize and correct **defects** with oxy-fuel cutting (OFC) equipment.

WEL-12C-J4-6 Explain and demonstrate the process to adjust and maintain **travel speed** and **torch angle** with oxy-fuel cutting (OFC) equipment.

WEL-12C-J4-7 Explain and demonstrate the process to recognize and correct **backfire** and **flashback** conditions with oxy-fuel cutting (OFC) equipment.

WEL-12C-J4-8 Explain and demonstrate the process to **shut down** equipment and purge oxy-fuel cutting (OFC) equipment.

WEL-12C-J5 Recognize and explain plasma arc cutting (PAC) equipment, components, and consumables.

WEL-12C-J5-1 Recognize various types of plasma arc cutting (PAC) **equipment**, including

- power source
- track and pipe bevelling cutters
- manual
- semi-automatic
- automatic
- shields
- compressor

WEL-12C-J5-2 Explain various types of plasma arc cutting (PAC) **equipment**, including

- selection of the appropriate PAC equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J5-3 Recognize various plasma arc cutting (PAC) **components**, including

- heat shield
- torch bodies
- hoses
- work lead clamp

WEL-12C-J5-4 Explain various plasma arc cutting (PAC) **components**, including

- selection of the appropriate PAC components
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J5-5 Recognize various plasma arc cutting (PAC) **consumables**, including

- electrodes
- constricting nozzles (tips)
- coolant level for liquid-cooled equipment

WEL-12C-J5-6 Explain various plasma arc cutting (PAC) **consumables**, including

- selection of the appropriate PAC consumables
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J5-7 Recognize various types of plasma arc cutting (PAC) **compressed air equipment**, including

- driers
- filters

WEL-12C-J5-8 Explain various types of plasma arc cutting (PAC) **compressed air equipment**, including

- selection of the appropriate PAC compressed air equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J5-9 Recognize various types of plasma arc cutting (PAC) **equipment to aid cutting**, including

- stand-off
- circle cutting attachments
- drag nozzle

WEL-12C-J5-10 Explain various types of plasma arc cutting (PAC) **equipment to aid cutting**, including

- selection of the appropriate PAC cutting aids equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J6 Explain and demonstrate the procedures to cut and gouge using plasma arc cutting (PAC) processes.

WEL-12C-J6-1 Explain and demonstrate the process to **set up** plasma arc cutting (PAC) equipment, including

- visually inspecting for damage
- assembling consumables on torch head
- connecting torch to power source
- setting up regulator
- attaching work lead clamp to base metal
- adjusting power supply

WEL-12C-J6-2 Explain and demonstrate the process to **set operating parameters** used to cut and gouge with plasma arc cutting (PAC) equipment, including

- amperage
- air pressure
- travel speed
- verify for cut defects

WEL-12C-J6-3 Explain and demonstrate the process to perform **cutting and gouging** with plasma arc cutting (PAC) equipment, including

- starting up equipment
- maintaining travel speed and torch angle

WEL-12C-J6-4 Explain and demonstrate **techniques** used to cut and gouge with plasma arc cutting (PAC) equipment, including

- initiating the arc and cut
- starting at the correct stand-off distance

WEL-12C-J6-5 Explain and demonstrate the process to **diagnose malfunctions** with plasma arc cutting (PAC) equipment, including

- low air pressure
- poor work lead connection

WEL-12C-J7 Recognize and explain air carbon cutting (CAC-A) equipment and consumables, including their characteristics, applications, and operation.

WEL-12C-J7-1 Recognize various air **carbon cutting (CAC-A) equipment**, including

- power source
- current type
- duty cycle
- compressor

WEL-12C-J7-2 Explain various air **carbon cutting (CAC-A) equipment**, including

- selection of the appropriate CAC-A equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J7-3 Recognize the various **components** of air carbon cutting (CAC-A) equipment, including

- hoses
- electrode holder
- cables
- work lead clamp

WEL-12C-J7-4 Explain the various **components** of air carbon cutting (CAC-A) equipment, including

- selection of the appropriate components of CAC-A equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J7-5 Recognize the various **carbon electrodes** used with air carbon cutting (CAC-A) equipment, including

- coated
- non-coated
- flat
- round
- half-round
- alternating current (AC)
- direct current (DC)

WEL-12C-J7-6 Explain the various **carbon electrodes** used with air carbon cutting (CAC-A) equipment, including

- selection of the appropriate carbon electrodes used with CAC-A equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-J7-7 Recognize various air carbon cutting (CAC-A) **defects**, including

- copper and carbon deposits
- poor gouge quality

WEL-12C-J7-8 Explain various air carbon cutting (CAC-A) **defects**, including

- their identification
- their characteristics
- their effects on the final product
- correction of material defects

WEL-12C-J7-9 Recognize various air carbon cutting (CAC-A) **applications**, including

- depth and width of gouge
- removing material

WEL-12C-J7-10 Explain various air carbon cutting (CAC-A) **applications**, including

- selection of the appropriate CAC-A applications
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-J8 Explain and demonstrate the procedures to cut and gouge using air carbon cutting (CAC-A) processes.

WEL-12C-J8-1 Explain and demonstrate the process to **set up** air carbon cutting (CAC-A) equipment, including

- visually inspecting for damage
- attaching components to power source
- attaching components to air supply
- attaching work lead clamp to base metal

WEL-12C-J8-2 Explain and demonstrate the process to set the **operating parameters** for air carbon cutting (CAC-A) equipment, including

- setting amperage
- adjusting regulator
- verifying operating parameters and electrode selection

WEL-12C-J8-3 Explain and demonstrate the process to perform **cutting and gouging** with air carbon cutting (CAC-A) equipment, including

- starting up CAC-A equipment
- inserting electrode into holder
- maintaining electrode to work angle
- adjusting carbon electrode stick-out during use
- maintaining travel speed
- recognizing defects after gouging
- cleaning material
- shutting down equipment

WEL-12C-J9 Demonstrate the procedures to cut and gouge using thermal processes.

WEL-12C-J9-1 Explain and demonstrate the process to **cut and gouge** using **oxy-fuel gas cutting** (OFC) equipment, including

- straight cuts
- circular cuts
- bevel cuts
- internal shaped cuts

WEL-12C-J9-2 Explain and demonstrate the process to **cut and gouge** using **plasma arc cutting** (PAC) equipment, including

- straight cuts
- circular cuts
- bevel cuts
- internal shaped cuts

WEL-12C-J9-3 Explain and demonstrate the process to **cut and gouge** using air **carbon arc cutting** (CAC-A) equipment, including

- removing welds
- gouging practice plates
- gouging and removing backing plates

Strand K: Layout and Fabrication (A10)

WEL-12C-K1 Recognize, explain, and demonstrate an understanding of terminology associated with layout and fabrication.

WEL-12C-K1-1 Recognize **key terms** and **names** associated with layout and fabrication.

WEL-12C-K1-2 Explain the **names** and **purposes** associated with layout and fabrication.

WEL-12C-K1-3 Demonstrate an understanding of the **names** and **purposes** associated with layout and fabrication.

WEL-12C-K2 Recognize the various hazards associated with layout and fabrication, and explain and demonstrate the related safe work practices.

WEL-12C-K2-1 Recognize layout and fabrication **hazards** and explain **safe work practices**, including

- pinch points
- debris
- cuts
- burns

WEL-12C-K2-2 Demonstrate **safe work practices** related to layout and fabrication.

WEL-12C-K3 Recognize and explain template development and transferring dimensions from drawings to materials, including their selection, characteristics, applications, and procedures.

WEL-12C-K3-1 Recognize various **layout, measuring, and marking** tools.

WEL-12C-K3-2 Explain various **tools** used for layout, measuring, and marking, including

- selection of the appropriate tools used for layout, measuring, and marking
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K3-3 Demonstrate how to safely and properly use various **layout, measuring, and marking tools**.

WEL-12C-K3-4 Recognize various template **materials**, including

- metal, wood, cardboard, and paper
- fire resistance and durability

WEL-12C-K3-5 Explain various template **materials**, including

- selection of appropriate template materials
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K3-6 Recognize various types of **templates**, including

- hole-punching templates
- wraparounds
- cutting templates
- arc templates (sweeps)

WEL-12C-K3-7 Explain various types of **templates**, including

- development of the template

- selection of appropriate templates
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K3-8 Recognize various **template information**, including

- part numbers
- layout information
- material required

WEL-12C-K3-9 Explain various **template information**, including

- development of the template information
- selection of appropriate template information
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K3-10 Recognize a **starting point, working point, axis**, and how to transfer dimensions from drawings to materials, including

- centre lines
- hole locations

WEL-12C-K3-11 Explain a **starting point, working point, axis**, and how to transfer dimensions from drawings to materials, including

- selection of the starting and working points, and the axis
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K3-12 Recognize various basic **dimensions** to be transferred from drawing to templates.

WEL-12C-K3-13 Explain how to transfer basic **dimensions** from drawings to templates to materials.

WEL-12C-K3-14 Demonstrate how to safely and properly use various template processes.

WEL-12C-K4 Recognize, explain, and demonstrate preparing materials to fabricate components, including their selection, characteristics, applications, and procedures.

WEL-12C-K4-1 Recognize various **material types** used to fabricate components.

WEL-12C-K4-2 Explain various **material types** used to fabricate components, including

- selection of the appropriate materials used to fabricate components

- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K4-3 Recognize various fabrication **tools and equipment.**

WEL-12C-K4-4 Explain various fabrication **tools and equipment**, including

- selection of the appropriate layout and fabrication tools or equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K4-5 Demonstrate how to safely and properly use various **fabrication tools and equipment**.

WEL-12C-K4-6 Recognize various layout and fabrication **digital layout tools**, including

- calipers
- levels
- measuring devices

WEL-12C-K4-7 Explain various layout and fabrication **digital layout tools**, including

- selection of the appropriate layout and fabrication digital layout tools
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K4-8 Demonstrate how to safely and properly use various layout and fabrication **digital layout tools**.

WEL-12C-K4-9 Recognize various **procedures to safely prepare material** for assembly, including

- drill

- punch
- form
- grind
- thermal process

WEL-12C-K4-10 Explain various **procedures to safely prepare material** for assembly, including

- selection of the appropriate procedures to prepare materials for assembly
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K4-11 Recognize various **procedures to safely prepare a weld area**.

WEL-12C-K4-12 Explain various **procedures to safely prepare a weld area**, including

- selection of the appropriate procedure to safely prepare a weld area
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K4-13 Recognize various procedures to **prepare edges** for assembly, including

- square edges
- bevel edges

WEL-12C-K4-14 Explain various procedures to **prepare edges** for assembly, including

- selection of the appropriate procedure to prepare edges for assembly
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K4-15 Recognize various **cleaning abrasive** techniques, including

- grind
- sand
- wire wheel
- file
- chemical

WEL-12C-K4-16 Explain various **cleaning abrasive** techniques, including

- selection of the appropriate cleaning abrasive technique
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K5 Recognize and explain fitting components for welding, including their characteristics and applications.

WEL-12C-K5-1 Recognize various types of base **metals** for welding.

WEL-12C-K5-2 Explain various types of base **metals** for welding, including

- selection of the appropriate base metals
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K5-3 Recognize various **pre-heating** requirements when fitting components for welding.

WEL-12C-K5-4 Explain various **pre-heating** requirements when fitting components for welding, including

- selection of the appropriate pre-heating requirement
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K5-5 Recognize various **tacking methods** for welding, including pre-setting.

WEL-12C-K5-6 Explain various **tacking methods** for welding, including

- selection of the appropriate tacking method
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K5-7 Recognize various methods to control **expansion and contraction** for welding, including

- tacking sequence
- gussets

- strongbacks
- heat sinks

WEL-12C-K5-8 Explain various methods to control **expansion and contraction** for welding, including

- selection of the appropriate method to control expansion and contraction
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-12C-K6 Recognize and explain welding component assembly, including selection, characteristics, applications, and procedures.

WEL-12C-K6-1 Recognize various welding **tools and equipment**, including

- hi-lo gauge
- jigs and fixtures
- clamps
- wedges
- alignment tools

WEL-12C-K6-2 Explain various welding **tools and equipment**, including

- selection of the appropriate welding tools and equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

WEL-12C-K6-3 Demonstrate how to safely and properly use various **welding tools and equipment**.

WEL-12C-K6-4 Recognize various welding assembly **constraints**, including

- building size
- equipment limitations

WEL-12C-K6-5 Explain various welding assembly **constraints**, including

- their identification
- their characteristics
- their effects on the final product
- correction of welding assembly constraints

WEL-12C-K6-6	Recognize various welding **assembly** sequences.
WEL-12C-K6-7	Recognize various welding **assembly** sequences, including • development of the welding assembly sequence • selection of the appropriate welding assembly sequence • characteristics and key features • application (i.e., role or utility in specific scenarios) • limitations in scope or performance
WEL-12C-K6-8	Recognize various welding set **gaps and alignments**.
WEL-12C-K6-9	Recognize various welding set **gaps and alignments**, including • selection of appropriate welding set gaps and alignments • selection of the appropriate welding assembly sequence • characteristics and key features • application (i.e., role or utility in specific scenarios) • limitations in scope or performance
WEL-12C-K6-10	Recognize various welding **fits, placements, and adjustment** components.
WEL-12C-K6-11	Explain various welding **fits, placements, and adjustment** components.
WEL-12C-K6-12	Recognize welding **fasteners**, including • bolts • clips
WEL-12C-K6-13	Explain welding **fasteners**, including • selection of the appropriate welding fastener components • selection of the appropriate welding assembly sequence • characteristics and key features • application (i.e., role or utility in specific scenarios) • limitations in scope or performance • procedures for conducting a thorough inspection • procedures for regular maintenance • guidelines for proper storage
WEL-12C-K6-14	Recognize how to verify **assembly** throughout all stages.
WEL-12C-K6-15	Explain how to verify **assembly** throughout all stages.

WEL-12C-K7 Demonstrate and perform the procedures used to lay out and prepare components for welding.

WEL-12C-K7-1	Demonstrate various procedures used to lay out and prepare **components** for welding, including a paper/cardboard template.
WEL-12C-K7-2	Demonstrate various procedures used to lay out and prepare **materials** for welding, including • angle iron • square tube
WEL-12C-K7-3	Demonstrate various **fabrication procedures** used to lay out and prepare materials for welding, including • mitre cut • fit • square • tack • quality control
WEL-12C-K7-4	Demonstrate how to verify assembly throughout all stages.

Curriculum Implementation Resources

Curriculum implementation resources are frequently added. You are encouraged to visit the website regularly.