Welding Technology
Primary Learning Outcomes Resource

Strand A: Trade Safety (A2)

WEL-GR-A1 Define Manitoba safety and health requirements.

WEL-GR-A1-1 **Define Manitoba safety and health requirements** under The Workplace Safety and Health Act and Regulations for **workers' rights,** including

- the right to know
- the right to participate
- the right to refuse
- the right to protection from reprisal

WEL-GR-A1-2 Define Manitoba safety and health requirements under The Workplace Safety and Health Act and Regulations for **workers' responsibilities,** including

- taking reasonable care to protect themselves and others
- using safety equipment properly
- following safety rules and procedures
- cooperating with safety representatives and supervisors

WEL-GR-A1-3 Define and describe Manitoba safety and health requirements under The Workplace Safety and Health Act and Regulations for

- the rights and responsibilities of **supervisors**
- the rights and responsibilities of **employers**

WEL-GR-A1-4 Define and describe workplace **safety and health programs** and the roles of workers, including

- safety and health committee
- participation in investigation and inspection process

WEL-GR-A1-5 Define and describe the Manitoba safety and health requirements for various **public agencies**, including

- Workplace Safety and Health (Enforcement)
- SAFE Work Manitoba (Prevention)

WEL-GR-A2 Identify, describe, and demonstrate personal protective equipment (PPE) requirements and standards in the workplace.

WEL-GR-A2-1 Identify 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-GR-A2-2 Describe 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-GR-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-GR-A2-4 Identify **hierarchy of control measures** and describe the requirements and standards, including

- elimination
- substitution
- engineering controls
- administrative controls
- personal protective equipment (PPE)

WEL-GR-A2-5 Describe each individual's responsibilities when using and managing **personal protective equipment** (PPE) at work or in training for **various roles**, including the

- employer
- supervisor
- worker
- teacher
- student

WEL-GR-A2-6 Describe requirements for **personal protective equipment** (PPE), including

- the name of the provider
- its proper maintenance
- required training
- the different types of gear
- procedures in place to guarantee regulations are upheld

WEL-GR-A3 Identify and describe the Workplace Hazardous Material Information System (WHMIS) and procedures.

WEL-GR-A3-1 Describe how various hazardous materials are **identified**, including

- classification
- safety data sheets (SDS)
- labelling
- training
- access to information

WEL-GR-A3-2 Describe what **suppliers and workplaces** must do when labelling hazardous products, including

- using safety symbols
- classifying chemicals

WEL-GR-A3-3 Identify various **safety data sheets** (SDS).

WEL-GR-A3-4 Identify various **chemical and biological hazards.**

WEL-GR-A3-5 Describe how to deal with **chemical and biological hazards** safely, including

- how to wash off spills
- moving dangerous materials
- storing them properly

WEL-GR-A4 Identify and describe safe work procedures (SWP).

WEL-GR-A4-1 Identify a **safe work procedure** (SWP) that outlines specific steps to safely perform a task, including

- hazard identification
- risk assessment
- control measures

WEL-GR-A4-2 Describe a **safe work procedure** (SWP), including

- purpose
- scope
- procedure
- training

WEL-GR-A4-3 Identify a hazard and describe the procedures to follow for managing **uncontrolled risks**, including

- unsecured tools or equipment
- improper use of machinery
- electrical hazards
- chemical exposure
- lack of personal protective equipment (PPE)

WEL-GR-A4-4 Describe the **process of developing** a safe work procedure (SWP), including

- gathering information
- identifying hazards
- implementing controls
- documenting steps
- training workers

WEL-GR-A5 Identify and describe injury prevention.

WEL-GR-A5-1 Identify, describe, and demonstrate the **SAFE acronym**.

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

WEL-GR-A5-2 Identify various **mental health risks** at work and school, for example:

- stress
- bullying
- violence

WEL-GR-A5-3 Describe how to prevent various **mental health risks**, including

- respectful communication
- implementation of clear policies
- access to support systems

WEL-GR-A5-4 Demonstrate how to reduce various **mental health risks** at work and school, such as by

- promoting respect
- offering support
- proactively identifying and managing issues such as stress or bullying

WEL-GR-A5-5 Identify various methods to prevent injuries among **young workers**, such as through

- completion of the Young Worker Readiness Certificate Course
- mandatory safety orientation and training
- supervision by experienced workers
- implementation of the SAFE Work Manitoba's young worker injury prevention strategy
- use of personal protective equipment (PPE)
- encouraging reporting of unsafe conditions
- promoting awareness of workers' rights

WEL-GR-A5-6 Describe various methods to prevent injuries among **young workers**, including

- selection of the appropriate method
- key features and characteristics
- application (its role or utility in specific scenarios)
- limitations in scope or performance

WEL-GR-A5-7 Identify various **chemical and biological hazards**, including

- dust
- fumes
- gases

WEL-GR-A5-8 Describe how to prevent various **chemical and biological hazards**, such as by

- using proper ventilation

- using safety gear
- using personal protective equipment (PPE)
- implementing safe handling procedures

WEL-GR-A5-9 Describe how to prevent various injuries related to **electrical safety**, including

- using proper tools
- turning off power before repairs
- following lockout/tagout steps to make sure machines cannot be turned on accidentally

WEL-GR-A5-10 Demonstrate how to safely shut off and lock electrical equipment using a **lockout/tagout** procedure.

WEL-GR-A5-11 Identify how to prevent various **fire injuries,** including

- identifying different types of fires
- identifying different kinds of fire extinguishers
- describing how to use fire extinguishers safely

WEL-GR-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-GR-A5-13 Identify various work-related **diseases and illnesses**, and describe how to prevent them, including examples such as

- asbestosis
- hearing loss
- carpal tunnel syndrome
- tendonitis
- lead poisoning

WEL-GR-A5-14 Identify various **muscle and joint injuries**, and describe how to prevent them by using ergonomics prevention methods, including

- good posture
- proper workplace setup

WEL-GR-A5-15 Identify various **confined spaces**.

WEL-GR-A5-16 Describe methods to prevent injuries during **confined space** entry.

WEL-GR-A6 Identify and describe injury response.

WEL-GR-A6-1 Describe how to **manage a scene** when responding to an injury, such as by

- staying calm
- keeping the area safe
- providing support until trained help arrives

WEL-GR-A6-2 Describe how to **report an injury**, including reporting the injury to

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

WEL-GR-A6-3 Demonstrate knowledge of the **locations of emergency safety equipment**, including

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

WEL-GR-A7 Demonstrate navigation of SAFE Work Manitoba website.

WEL-GR-A7-1 Demonstrate how to navigate SAFE Work Manitoba's website, and retrieve and apply resources from key content, including

- legislation
- bulletins
- templates
- shop talk
- other resources

Strand B: Career Education (A1)

WEL-GR-B1 Describe the structure and scope of the welding trade.

WEL-GR-B1-1 Describe opportunities and future **career paths** in a trade, including

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

WEL-GR-B1-2 Describe **The Apprenticeship and Certification Act**, including

- support training
- the board
- trade committees

- rules for each trade
- policies about attendance
- continuing training

WEL-GR-B1-3 Describe the **Red Seal Occupational Standard (RSOS)**, including

- how it helps with training
- tracking work hours
- preparing for tests in a trade

WEL-GR-B2 Describe the levels of workplace competency.

WEL-GR-B2-1 Describe **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-GR-B2-2 Describe 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

WEL-GR-B3 Describe accommodation for apprentices with accessibility requirements.

WEL-GR-B3-1 Describe **The Accessibility for Manitobans Act** and how it supports apprentices with accessibility, including

- customer service
- communication
- buildings
- transportation
- training at work

Strand C: Trade-Related Communications (A4)

WEL-GR-C1 Describe and demonstrate techniques for effective verbal and non-verbal communication.

WEL-GR-C1-1	Describe how to communicate clearly and respectfully with various people at school and/or work, using both **words and body language**.
WEL-GR-C1-2	Demonstrate how to communicate clearly and respectfully with various people at school and/or work, using both **words and body language**.

WEL-GR-C2 Identify workplace behaviours and communication that constitute bullying as defined by the Canadian Human Rights Act and jurisdictional human rights laws.

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

WEL-GR-C3 Demonstrate effective communication skills and practise active listening and response.

WEL-GR-C3-1	Demonstrate **effective communication and active listening**, including • listening carefully • responding clearly • using appropriate body language • asking questions • being open to feedback

WEL-GR-C4 Identify types of communication devices and describe their purpose and operation.

WEL-GR-C4-1	Identify various types of **communication devices**, including • telephones • two-way radios • computers • smartphones • tablets

WEL-GR-C4-2 Describe various purposes and operation of **communication devices**, such as their use for

- speaking
- sending messages
- sharing information

WEL-GR-C5 Demonstrate communication techniques using various communication devices.

WEL-GR-C5-1 Demonstrate good **communication skills** when using various communication devices to speak, send messages, or share information, including

- keeping the message concise
- articulating ideas precisely to avoid confusion
- remaining polite and professional

WEL-GR-C6 Identify types of trade-related documents and describe their applications.

WEL-GR-C6-1 Identify various **documents** used in trade, such as

- invoices
- shipping documents
- work orders
- cut lists
- order sheets

WEL-GR-C6-2 Describe various **documents** used in trade, such as

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

WEL-GR-C7 Describe the importance of communicating job requirements.

WEL-GR-C7-1 Describe the importance of clearly defining what a job entails so that each team member understands exactly what is expected of them.

Strand D: Trade-Related Mathematics (A5)

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

WEL-GR-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-GR-D1-2 Identify various **types of fractions**, including

- proper fractions
- improper fractions
- mixed fractions

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

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

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

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

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

WEL-GR-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-GR-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-GR-D2 Demonstrate how to communicate measurements.

WEL-GR-D2-1	Demonstrate how to **measure.**
WEL-GR-D2-2	Demonstrate how to **measure** using both **metric and customary** (imperial) measurement systems, such as by • measuring length • measuring materials
WEL-GR-D2-3	Demonstrate how to provide **measurements,** including how much the measurements can vary (e.g., bead width).

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

WEL-GR-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-GR-D3-2	Demonstrate how to calculate **Pythagorean theorem** ($a^2+b^2=c^2$) to find the length of one side of a right triangle (e.g., to determine if something is square).
WEL-GR-D3-3	Demonstrate how to calculate **volume** using various cylinders (e.g., how much concrete is needed to fill a round column).
WEL-GR-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-GR-D3-5	Demonstrate how to calculate various **angles**, including • complementary • supplementary • angle measurement
WEL-GR-D3-6	Demonstrate how to find the length of a **chord** (e.g., a straight line connecting two points on a circle).

WEL-GR-D4 Solve problems using ratio and proportion.

WEL-GR-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 liters of paint cover 10 m^2, then 4 liters 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-GR-D5 Solve trade-related algebraic problems involving simple equations and formulas.

WEL-GR-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-GR-E1 Identify, describe, and demonstrate an understanding of terminology associated with tools and equipment.

WEL-GR-E1-1 Identify **key terms** and **names** of various tools and equipment.

WEL-GR-E1-2 Describe the **names** and **purposes** of various tools and equipment.

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

WEL-GR-E2 Identify the various hazards associated with tools and equipment, and describe and demonstrate the related safe work practices.

WEL-GR-E2-1 Identify various tools and equipment **hazards**, 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-GR-E2-2 Describe various tools and equipment **safe work practices**, 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-GR-E2-3 Demonstrate **safe work practices** related to tools and equipment.

WEL-GR-E3 Identify, describe, and demonstrate tools and equipment, including their selection, characteristics, applications, and limitations.

WEL-GR-E3-1 Identify various **hand tools**.

WEL-GR-E3-2 Describe various **hand tools**, including

- selection of the appropriate tool
- 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-GR-E3-3 Demonstrate how to safely and properly use various **hand tools**.

WEL-GR-E3-4 Identify various tools used for **layout, measuring, and marking**.

WEL-GR-E3-5 Describe various tools used for **layout, measuring, and marking**, including

- selection of the appropriate tool 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-GR-E3-6 Demonstrate how to safely and properly use various tools used for **layout, measuring, and marking**.

WEL-GR-E3-7 Identify various **portable power tools**, including

- electric power tools
- hydraulic power tools
- pneumatic power tools

WEL-GR-E3-8 Describe various **portable power tools**, including

- selection of the appropriate portable power tool
- 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-GR-E3-9 Demonstrate how to safely and properly use various **portable power tools**.

WEL-GR-E3-10 Identify various **stationary power tools**, including

- drill press
- band saw
- pedestal grinder
- power roller
- belt sander
- cold cut saw

WEL-GR-E3-11 Describe various **stationary power tools**, including

- selection of the appropriate stationary power tool
- 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-GR-E3-12 Demonstrate how to safely and properly use various **stationary power tools**.

WEL-GR-E3-13 Identify various **stationary machinery**, including

- shear
- ironworker

WEL-GR-E3-14 Describe various **stationary machinery**, including

- selection of the appropriate stationary machinery
- 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-GR-E3-15 Demonstrate how to safely and properly use various **stationary machinery**.

WEL-GR-E3-16 Identify various **non-thermal cutting and grinding tools.**

WEL-GR-E3-17 Describe various **non-thermal cutting and grinding tools**, including

- selection of the appropriate non-thermal cutting and grinding 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-GR-E3-18 Demonstrate how to safely and properly use various **non-thermal cutting and grinding tools**.

Strand F: Materials and Consumables

WEL-GR-F1 Share and discuss Indigenous perspectives and environmental impacts.

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

WEL-GR-F2 Identify the various hazards associated with consumables and materials, and describe and demonstrate the related safe work practices.

WEL-GR-F2-1 Identify various **hazards** for welding consumables and material**,** including

- burns
- lifting
- flux dust

WEL-GR-F2-2 Describe 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-GR-F2-3 Demonstrate safe work practices related to **consumables and materials**.

WEL-GR-F3 Identify and describe organizing materials, including their characteristics, applications, and procedures.

WEL-GR-F3-1 Identify various types of **materials and consumables**, including

- base materials
- filler materials
- shielding gases
- flux
- consumable parts

WEL-GR-F3-2 Describe various types of **materials and consumables**, including

- selection of the appropriate materials or 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-GR-F3-3 Identify various ways to **collect materials** required, including

- cut list
- job specifications

WEL-GR-F3-4 Describe various ways to **collect materials**, including

- characteristics and key features
- application (i.e., role or utility in specific scenarios)

WEL-GR-F4 Identify and describe non-thermal cutting and grinding consumables, including their selection, characteristics, applications, and limitations.

WEL-GR-F4-1 Identify various **non-thermal cutting and grinding** consumables, including

- carbon steel

WEL-GR-F4-2 Describe various **non-thermal cutting and grinding** consumables, including

- selection of the appropriate non-thermal cutting and grinding 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-GR-F4-3 Identify various non-thermal cutting and grinding **disk and wheel types**, including

- abrasive
- composite
- carbide
- wire

WEL-GR-F4-4 Describe various non-thermal cutting and grinding **disk and wheel types**, including

- selection of the appropriate non-thermal cutting and grinding disk and wheel types
- 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-GR-F4-5 Identify various non-thermal cutting and grinding **consumable selection considerations**, including

- grade and thickness of material
- type of cut
- size and cut finish
- tool limitation

WEL-GR-F4-6 Describe various non-thermal cutting and grinding **consumable selection considerations**, including

- selection of the appropriate non-thermal cutting and grinding 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-GR-F5 Demonstrate how to safely and properly use various types of materials and consumables.

WEL-GR-F5-1 Demonstrate how to safely and properly use various types of materials and consumables.

Strand G: Material Handling and Access Equipment (A6)

WEL-GR-G1 Recognize, define, and demonstrate an understanding of terminology associated with material handling.

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

WEL-GR-G1-2 Explain an understanding of the **names** and **purposes** of various types of material handling.

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

WEL-GR-G2 Identify the various hazards associated with lifting, rigging, hoisting, and ladders, and describe and demonstrate the related safe work practices.

WEL-GR-G2-1 Identify various **lifting, rigging, or hoisting hazards**, and describe 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-GR-G2-2 Identify various **ladder hazards**, and describe **safe work practices**, including

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

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

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

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

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

- rigging devices
  - beam clamps
  - tag lines
  - spreader bar
  - load softeners
  - plate clamps

- slings
  - straps
  - chains

WEL-GR-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-GR-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-GR-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-GR-G4 Identify and explain material handling and access equipment, including their characteristics, application, and operation.

WEL-GR-G4-1 Identify various **material handling equipment**, including

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

WEL-GR-G4-2 Describe 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-GR-G4-3 Demonstrate how to safely and properly use various **material handling equipment.**

WEL-GR-G4-4 Identify various **access equipment**, including

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

WEL-GR-G4-5 Describe 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-GR-G5 Describe and demonstrate the procedures to select, maintain, and use lifting, rigging, and hoisting equipment.

WEL-GR-G5-1 Describe 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 = π x r^2 x h

WEL-GR-G5-3 Describe 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-GR-G5-4 Demonstrate how to **calculate sling angles** using a load chart.

WEL-GR-G5-5 Describe 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-GR-G5-6 Demonstrate how to calculate a **plan lift** and path of travel, and to confirm laydown area.

WEL-GR-G5-7 Describe 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-GR-G5-8 Demonstrate how to safely **cordon off** a work area.

WEL-GR-G5-9 Describe how to **secure various rigging** to objects, including

- single choker
- double-wrap choker
- basket

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

WEL-GR-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-GR-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-GR-G5-13 Describe 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-GR-G5-14 Describe 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-GR-G5-15 Describe 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-GR-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-GR-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-GR-H1 Recognize, explain, and demonstrate an understanding of terminology associated with drawing and welding symbols.

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

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

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

WEL-GR-H2 Recognize, explain, and demonstrate welding symbols.

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

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

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

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

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

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

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

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

- section view
- detail view
- orthographic view
- isometric view

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

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

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

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

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

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

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

- assembly drawings
- shop and fabrication drawings
- site drawings

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

WEL-GR-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-GR-I1 Identify, describe, and demonstrate an understanding of terminology associated with weld processes and quality inspection.

WEL-GR-I1-1	Identify **key terms** and **names** of various weld processes, and of quality inspection.
WEL-GR-I1-2	Describe the **names** and **purposes** of different weld processes, and of quality inspection.
WEL-GR-I1-3	Demonstrate an understanding of the **names** and **purposes** of different weld processes, and of quality inspection.

WEL-GR-I2 Identify the various hazards associated with weld processes and quality inspection, and describe and demonstrate the related safe work practices.

WEL-GR-I2-1	Identify various **gas cylinder hazards**, including • explosions • displacement of oxygen (asphyxiation)
WEL-GR-I2-2	Describe the safe work practices for **gas cylinder hazards**, including safety data sheets (SDS).
WEL-GR-I2-3	Identify various **final product hazards**, including • cuts • particulate projection/sparks • dust particulate inhalation • toxic chemicals
WEL-GR-I2-4	Describe safe work practices related to **final product hazards**.
WEL-GR-I2-5	Identify various hazards related to **controlling temperature of weldments**, including • electrical shock • burns
WEL-GR-I2-6	Describe safe work practices related to **controlling temperature of weldments**.
WEL-GR-I2-7	Demonstrate safe work practices related to **weld processes and quality inspection**.

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

WEL-GR-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-GR-I4 Identify and describe welding consumables and gas cylinders, including their characteristics, applications, and storage.

WEL-GR-I4-1 Identify various **welding consumables**, including

- electrodes
- welding wires
- welding fluxes

WEL-GR-I4-2 Describe 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-GR-I4-3 Identify various **gas cylinder** product types and identification, including

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

WEL-GR-I4-4 Describe 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-GR-I5 Demonstrate how to safely and properly use welding consumables and gas cylinders.

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

WEL-GR-I6 Identify and describe welding processes, including their selection, characteristics, and applications.

WEL-GR-I6-1	Identify various **welding processes**, including • flux-cored arc welding (FCAW) • metal-cored arc welding (MCAW) • gas metal arc welding (GMAW)
WEL-GR-I6-2	Describe various **welding processes**, including • selection of the appropriate welding process • characteristics and key features • application (i.e., role or utility in specific scenarios) • limitations in scope or performance
WEL-GR-I6-3	Identify various welding **power sources**, such as • transformer • transformer-rectifier • inverter • engine-driven
WEL-GR-I6-4	Describe 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-GR-I6-5	Identify various **welding polarities**, such as • direct current electrode negative (DCEN) • direct current electrode positive (DCEP) • alternating current (AC)
WEL-GR-I6-6	Describe 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-GR-I7 Identify and describe marking welds and material types, including their characteristics and applications.

WEL-GR-I7-1 Identify various **material types**, including

- ferrous
- non-ferrous

WEL-GR-I7-2 Describe 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-GR-I7-3 Identify various **identification markings**, including

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

WEL-GR-I7-4 Describe 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-GR-I7-5 Identify various **marking devices**, such as

- paint markers
- soapstone
- chalk
- steel stamps
- tagging systems
- laser markers

WEL-GR-I7-6 Describe various **marking devices,** including

- selection of the appropriate marking devices
- 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-GR-I7-7 Identify various **personalized welder identifications**, including

- initials
- numbers

WEL-GR-I7-8 Describe 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-GR-I8 Identify and describe controlling temperature of weldments.

WEL-GR-I8-1 Identify various tools and equipment for **controlling temperature** of weldments, including

- insulation
- heating tip (rose bud)
- heavy duty propane torch (tiger torch)
- induction heating coils
- rod ovens

WEL-GR-I8-2 Describe various **tools and equipment** for controlling temperature of weldments, including

- selection of the appropriate tools and equipment for controlling temperature of specific weldments
- 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-GR-I8-3 Identify controlling temperature of various **measuring devices**, including

- temperature sticks
- thermocouples
- pyrometers

WEL-GR-I8-4 Describe controlling temperature of various **measuring devices**, including

- selection of the appropriate 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-GR-I9 Identify and describe final product finishing, including its characteristics and applications.

WEL-GR-I9-1 Identify various **finishing tools and equipment** related to final product finishing, including

- grinders
- wire wheels
- buffers

WEL-GR-I9-2 Describe 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-GR-I9-3 Identify various **weld discontinuities** related to final product finishing, including

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

WEL-GR-I9-4 Describe 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-GR-I9-5 Identify various **undesirable materials** related to final product finishing, including

- oils
- oxides

WEL-GR-I9-6 Describe 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-GR-I9-7 Identify various **surface imperfections** related to final product finishing, including

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

WEL-GR-I9-8 Describe various final product finishing **surface imperfections**, including

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

WEL-GR-I9-9 Identify various **specific finishes** related to final product finishing, including

- coatings
- pickling
- machining
- blasting

WEL-GR-I9-10 Describe 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-GR-I10 Identify and describe quality inspection, including its characteristics and applications.

WEL-GR-I10-1 Identify various quality inspection **tools and equipment**, including

- magnifying lenses
- inspection mirrors
- flashlights

WEL-GR-I10-2 Describe 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-GR-I10-3 Identify various quality inspection **measuring devices**, including

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

WEL-GR-I10-4 Describe various quality inspection **measuring devices**, including

- selection of the appropriate quality inspection measuring devices
- 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-GR-I10-5 Identify various quality inspection **material defects**, including

- surface irregularities
- laminations
- surface contamination

WEL-GR-I10-6 Describe various quality inspection **material defects**, including

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

WEL-GR-I10-7 Identify various quality inspection **fabrication defects**, including

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

WEL-GR-I10-8 Describe various quality inspection **fabrication defects**, including

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

WEL-GR-I10-9 Identify various quality inspection **weld discontinuities**, including

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

WEL-GR-I10-10 Describe 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-GR-I10-11 Identify various quality inspection **surface imperfections**, including

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

WEL-GR-I10-12 Describe various quality inspection **surface imperfections**, including

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

WEL-GR-I10-13 Identify various quality inspection **non-destructive testing**, including

- radiography
- ultrasonic
- liquid penetrant
- magnetic particle examination
- hydro
- phased array

WEL-GR-I10-14 Describe various quality inspection **non-destructive testing**, including

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

WEL-GR-I10-15 Identify various quality inspection **destructive testing**, including

- bend and tensile strength
- etching
- impact
- hardness

WEL-GR-I10-16 Describe various quality inspection **destructive testing**, including

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

WEL-GR-I11 Demonstrate how to safely and properly use weld processes and quality inspections.

WEL-GR-I11-1 Demonstrate how to safely and properly use weld processes and quality inspections.

Strand J: Thermal Cutting and Gouging (A9)

WEL-GR-J1 Identify, describe, and demonstrate an understanding of terminology associated with thermal cutting and gouging.

WEL-GR-J1-1 Identify **key terms** and **names** of various types of thermal cutting and gouging.

WEL-GR-J1-2 Describe the **names** and **purposes** of various types of thermal cutting and gouging.

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

WEL-GR-J2 Identify the various hazards associated with thermal cutting and gouging, and describe and demonstrate the related safe work practices.

WEL-GR-J2-1 Identify **oxy-fuel gas cutting (OFC) hazards** and describe 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-GR-J2-2 Identify **plasma arc cutting (PAC) hazards** and describe safe work practices, including for the following:

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

WEL-GR-J2-3 Identify **air carbon arc cutting and gouging (CAC-A) hazards** and describe the safe work practices, including for the following:

- fumes
- sparks
- burns
- noise

- electrical shocks
- radiation
- molten materials

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

WEL-GR-J3 Identify and describe oxy-fuel gas cutting (OFC) equipment.

WEL-GR-J3-1 Identify 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-GR-J3-2 Describe 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-GR-J3-3 Identify various oxy-fuel gas cutting (OFC) types of **regulators**, including

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

WEL-GR-J3-4 Describe 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-GR-J3-5 Identify various oxy-fuel gas cutting (OFC) types of **oxy-fuel gases**, including

- acetylene

- oxygen
- propane

WEL-GR-J3-6 Describe 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-GR-J3-7 Identify various oxy-fuel gas cutting (OFC) oxygen and **high-pressure fuel cylinders**, such as

- acetylene cylinder
- propane cylinder
- MAPP-Pro gas cylinder

WEL-GR-J3-8 Describe 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-GR-J3-9 Identify various oxy-fuel gas cutting (OFC) **types of flames**, including

- neutral
- carburizing
- oxidizing

WEL-GR-J3-10 Describe 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-GR-J3-11 Identify various oxy-fuel gas cutting (OFC) **torch components**, including

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

WEL-GR-J3-12 Describe 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-GR-J3-13 Identify various manual and mechanized **torch cutting systems**, including

- bevellers
- track cutters

WEL-GR-J3-14 Describe 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-GR-J3-15 Identify various oxy-fuel gas cutting (OFC) **factors** of oxy-fuel cutting and gouging, including

- heat input
- base metal and thickness

WEL-GR-J3-16 Describe various oxy-fuel gas cutting (OFC) **factors** of oxy-fuel cutting and gouging, including

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

WEL-GR-J4 Describe and demonstrate the procedures to cut and gouge using oxy-fuel cutting (OFC) processes.

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

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

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

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

WEL-GR-J4-5 Describe and demonstrate the process to identify and correct **defects** with oxy-fuel cutting (OFC) equipment.

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

WEL-GR-J4-7 Describe and demonstrate the process to identify and correct **backfire** and **flashback** conditions with oxy-fuel cutting (OFC) equipment.

WEL-GR-J4-8 Describe and demonstrate the process to **shut down** equipment and purge oxy-fuel gas cutting (OFC) equipment.

WEL-GR-J5 Identify and describe plasma arc cutting (PAC) equipment, components, and consumables.

WEL-GR-J5-1 Identify various types of plasma arc cutting (PAC) **equipmen**t, including

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

WEL-GR-J5-2 Describe various 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-GR-J5-3 Identify various plasma arc cutting (PAC) **components**, including

- heat shield
- torch bodies

- hoses
- work lead clamp

WEL-GR-J5-4 Describe 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-GR-J5-5 Identify various plasma arc cutting (PAC) **consumables**, including

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

WEL-GR-J5-6 Describe 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-GR-J5-7 Identify various types of plasma arc cutting (PAC) **compressed air equipment**, including

- driers
- filters

WEL-GR-J5-8 Describe 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-GR-J5-9 Identify various types of plasma arc cutting (PAC) **equipment to aid cutting**, including

- stand-off
- circle cutting attachments
- drag nozzle

WEL-GR-J5-10 Describe 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-GR-J6 Describe and demonstrate the procedures to cut and gouge using plasma arc cutting (PAC) processes.

WEL-GR-J6-1 Describe 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-GR-J6-2 Describe 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-GR-J6-3 Describe 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-GR-J6-4 Describe 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-GR-J6-5 Describe and demonstrate the process to **diagnose malfunctions** with plasma arc cutting (PAC) equipment, including

- low air pressure
- poor work lead connection

WEL-GR-J7 Identify and describe air carbon cutting (CAC-A) equipment and consumables, including their characteristics, applications, and operation.

WEL-GR-J7-1 Identify various **air carbon cutting (CAC-A) equipment**, including

- power source
- current type
- duty cycle
- compressor

WEL-GR-J7-2 Describe 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-GR-J7-3 Identify the various **components** of air carbon cutting (CAC-A) equipment, including

- hoses
- electrode holder
- cables
- work lead clamp

WEL-GR-J7-4 Describe 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-GR-J7-5 Identify 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-GR-J7-6 Describe 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-GR-J7-7 Identify various air carbon cutting (CAC-A) **defects**, including

- copper and carbon deposits
- poor gouge quality

WEL-GR-J7-8 Describe various air carbon cutting (CAC-A) **defects**, including

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

WEL-GR-J7-9 Identify various air carbon cutting (CAC-A) **applications**, including

- depth and width of gouge
- removing material

WEL-GR-J7-10 Describe 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-GR-J8 Describe and demonstrate the procedures to cut and gouge using air carbon cutting (CAC-A) processes.

WEL-GR-J8-1 Describe 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-GR-J8-2 Describe 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-GR-J8-3 Describe 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
- identifying defects after gouging
- cleaning material
- shutting down equipment

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

WEL-GR-J9-1 Describe 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-GR-J9-2 Describe 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-GR-J9-3 Describe 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-GR-K1 Recognize, explain, and demonstrate an understanding of terminology associated with layout and fabrication.

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

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

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

WEL-GR-K2 Recognize the various hazards associated with layout and fabrication, and describe and demonstrate the related safe work practices.

WEL-GR-K2-1 Identify layout and fabrication **hazards** and describe **safe work practices**, including

- pinch points
- debris
- cuts
- burns

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

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

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

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

- selection of the appropriate tools 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-GR-K3-3 Demonstrate how to safely and properly use various **layout, measuring, and marking tools**.

WEL-GR-K3-4 Recognize various template **materials**, including

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

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

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

WEL-GR-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-GR-K3-8 Recognize various **template information**, including

- part numbers
- layout information
- material required

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

- centre lines
- hole locations

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

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

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

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

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

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

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

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

- calipers
- levels
- measuring devices

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

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

- drill
- punch
- form
- grind
- thermal process

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

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

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

WEL-GR-K4-13 Recognize various procedures to **prepare edges** for assembly, including:

- square edges
- bevel edges

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

- grind
- sand
- wire wheel
- file
- chemical

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

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

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

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

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

- tacking sequence
- gussets
- strongbacks
- heat sinks

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

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

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

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

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

- building size
- equipment limitations

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

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

WEL-GR-K6-6 Recognize various welding **assembly** sequences.

WEL-GR-K6-7 Explain various welding **assembly** sequences, including

- development of the 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-GR-K6-8 Recognize various welding set **gaps and alignments**.

WEL-GR-K6-9 Explain various welding set **gaps and alignments**, including

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

WEL-GR-K6-10 Recognize various welding **fits, placements, and adjustment components**.

WEL-GR-K6-11 Explain various welding **fits, placements, and adjustment components**.

WEL-GR-K6-12 Recognize various welding **fasteners**, including

- bolts
- clips

WEL-GR-K6-13 Explain various welding **fasteners**, including

- selection of the appropriate welding fastener
- 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-GR-K6-14 Recognize how to verify **assembly** throughout all stages.

WEL-GR-K6-15 Explain how to verify **assembly** throughout all stages.

WEL-GR-K7 Demonstrate and perform the procedures used to layout and prepare components for welding.

WEL-GR-K7-1 Demonstrate various procedure used to layout and prepare **components** for welding, including a paper/cardboard template.

WEL-GR-K7-2 Demonstrate various procedures used to lay out and prepare **materials** for welding, including

- angle iron
- square tube

WEL-GR-K7-3 Demonstrate various **fabrication procedures** used to layout and prepare materials for welding, including

- mitre cut
- fit
- square

- tack
- quality control

WEL-GR-K7-4 Demonstrate how to verify **assembly** throughout all stages.

Strand L: Shielded Metal Arc Welding (A11)

WEL-GR-L1 Recognize, explain, and demonstrate an understanding of terminology associated with shielded metal arc welding (SMAW).

WEL-GR-L1-1 Recognize the **key terms and names** associated with shielded metal arc welding (SMAW).

WEL-GR-L1-2 Explain the **names and purposes** associated with shielded metal arc welding (SMAW).

WEL-GR-L1-3 Demonstrate an understanding of the **names and purposes** associated with shielded metal arc welding (SMAW).

WEL-GR-L2 Identify the various hazards associated with shielded metal arc welding (SMAW), and describe and demonstrate the related safe work practices.

WEL-GR-L2-1 Recognize shielded metal arc welding (SMAW) **hazards** and explain **safe work practices**, including

- fumes, electrical shocks, burns, and flying debris
- ultraviolet (UV), infrared, and visible light rays
- falling objects, falling hazards, and fire hazards
- setting equipment operating parameters

WEL-GR-L2-2 Demonstrate safe work practices related to **shielded metal arc welding (SMAW) processes**.

WEL-GR-L3 Interpret codes, standards, and regulations, and apply welding symbols and information pertaining to shielded metal arc welding (SMAW).

WEL-GR-L3-1 Understand the rules and guidelines for welding, and use the correct symbols and information when working with shielded metal arc welding (SMAW).

WEL-GR-L4 Recognize and explain shielded metal arc welding (SMAW).

WEL-GR-L4-1 Recognize various shielded metal arc welding (SMAW) **weld types**, including

- fillet
- groove
- plug

- slot
- surfacing

WEL-GR-L4-2 Explain various shielded metal arc welding (SMAW) **weld types**, including

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

WEL-GR-L4-3 Recognize various shielded metal arc welding (SMAW) **weld positions**, including

- flat
- horizontal
- vertical-up
- vertical-down
- overhead

WEL-GR-L4-4 Explain various shielded metal arc welding (SMAW) **weld positions**, including

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

WEL-GR-L4-5 Recognize various shielded metal arc welding (SMAW) **joint configurations**, including

- butt
- tee
- edge
- corner
- lap

WEL-GR-L4-6 Explain various shielded metal arc welding (SMAW) **joint configurations**, including

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

WEL-GR-L5 Recognize and explain shielded metal arc welding (SMAW) equipment and consumables, including their characteristics and applications.

WEL-GR-L5-1 Recognize various shielded metal arc welding (SMAW) **equipment**, including

- operating principles
- machine options: arc force and hot start
- process fundamentals

WEL-GR-L5-2 Explain various shielded metal arc welding (SMAW) **equipmen**t, including

- selection of the appropriate SMAW 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-GR-L5-3 Recognize various shielded metal arc welding (SMAW) equipment **components**, including

- work lead clamps and electrode holders
- cables and remote controls
- polarity

WEL-GR-L5-4 Explain various shielded metal arc welding (SMAW) equipment **components**, including

- selection of the appropriate SMAW equipment 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-GR-L5-5 Recognize various shielded metal arc welding (SMAW) equipment **power sources**, including

- constant current (CC)
- inverters, rectifiers, generators, and transformers
- duty cycle and amperage

WEL-GR-L5-6 Explain various shielded metal arc welding (SMAW) equipment **power sources**, including

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

WEL-GR-L5-7 Recognize various shielded metal arc welding (SMAW) **materials**, including

- ferrous and non-ferrous metals
- materials that can and cannot be welded

WEL-GR-L5-8 Explain various shielded metal arc welding (SMAW) **materials**, including

- selection of the appropriate SMAW 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-GR-L5-9 Recognize various shielded metal arc welding (SMAW) **electrodes and welding rods**, including

- position
- tensile strength
- flux coating composition
- f-numbers
- metric and imperial electrode designations
- storage

WEL-GR-L5-10 Explain various shielded metal arc welding (SMAW) **electrodes and welding rods**, including

- selection of the appropriate SMAW electrodes and welding rods
- 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-GR-L6 Explain and demonstrate procedures to set up shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1G)/horizontal fillet (2F) applications.

WEL-GR-L6-1 Explain and demonstrate various procedures to determine **parameters** for shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications, including

- welding procedure specification (WPS)
- welding procedure data sheet (WPDS) and application

WEL-GR-L6-2 Explain and demonstrate various procedures to select machine **settings** for shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications, including polarity.

WEL-GR-L6-3 Explain and demonstrate various procedures to **adjust amperage** for shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications, including

- base metal thickness
- electrode type and size

WEL-GR-L6-4 Explain and demonstrate various procedures to **connect** electrode holders and work lead clamps for shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications.

WEL-GR-L6-5 Explain and demonstrate various procedures to **attach** work lead clamps to base metal for shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications.

WEL-GR-L6-6 Explain and demonstrate various procedures to **verify** setup for shielded metal arc welding (SMAW) equipment for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications, including welding a test piece with the same base metal, electrode, and position.

WEL-GR-L7 Explain and demonstrate the procedures for shielded metal arc welding (SMAW) for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications.

WEL-GR-L7-1 Explain and demonstrate various electrode **manipulation** techniques with shielded metal arc welding (SMAW) for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications, including

- whip

- backhand and forehand
- weave
- stringer

WEL-GR-L7-2 Explain and demonstrate how to **maintain** travel speed, electrode angle, and heat inputs with shielded metal arc welding (SMAW) for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications.

WEL-GR-L7-3 Explain and demonstrate how to repair weld **discontinuities and defects** with a shielded metal arc welding (SMAW) for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications.

WEL-GR-L8 Demonstrate the procedures for shielded metal arc welding (SMAW).

WEL-GR-L8-1 Demonstrate various procedures for **fillet** weld assembly for shielded metal arc welding (SMAW), including

- mild steel
- all positions
- E-4918 (E-7018)

WEL-GR-L8-2 Demonstrate various procedures for **groove** weld assembly for shielded metal arc welding (SMAW), including

- mild steel
- flat groove (1G)
- E-4310 (E-6010) root
- E-4918 (E-7018) hotpass, fill and cap

Strand M: Semi-Automatic Wire Feed Welding (A12)

WEL-GR-M1 Recognize, explain, and demonstrate an understanding of terminology associated with semi-automatic wire feed welding processes.

WEL-GR-M1-1 Recognize the **key terms and names** associated with semi-automatic wire feed welding processes, including

- flux-cored arc welding (FCAW)
- metal-cored arc welding (MCAW)
- gas metal arc welding (GMAW)

WEL-GR-M1-2 Explain the **names and purposes** associated with semi-automatic wire feed welding processes, including

- flux-cored arc welding (FCAW)

- metal-cored arc welding (MCAW)
- gas metal arc welding (GMAW)

WEL-GR-M1-3 Demonstrate an understanding of the **names and purposes** associated with semi-automatic wire feed welding processes, including

- flux-cored arc welding (FCAW)
- metal-cored arc welding (MCAW)
- gas metal arc welding (GMAW)

WEL-GR-M2 Recognize the various hazards associated with semi-automatic wire feed welding, and explain and demonstrate the related safe work practices.

WEL-GR-M2-1 Recognize semi-automatic wire feed welding process **hazards** and explain **safe work practices**, including

- burns, electrical burns, and electrical shocks
- ultraviolet, infrared, and visible light rays
- asphyxiation, ozone, and phosgene gases
- pinch points, falling objects, and moving parts

WEL-GR-M2-2 Demonstrate safe work practices related to **semi-automatic wire feed welding processes.**

WEL-GR-M3 Interpret jurisdictional codes and regulations pertaining to semi-automatic wire feed welding.

WEL-GR-M3-1 Understand and follow the local rules and safety **standards** that apply to semi-automatic wire feed welding.

WEL-GR-M4 Recognize and explain equipment, components, shielding, and consumables for flux-cored arc welding (FCAW), metal-cored arc welding (MCAW), and gas metal arc welding (GMAW), including their characteristics, applications, and operation.

WEL-GR-M4-1 Recognize various equipment **power sources** for FCAW, MCAW, and GMAW, including

- constant voltage (CV) capable machines
- inverters
- rectifiers
- generators

WEL-GR-M4-2 Explain various equipment **power sources** for FCAW, MCAW, and GMAW, including

- selection of the appropriate power sources for FCAW, MCAW, and GMAW
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-GR-M4-3 Recognize various equipment **components** for FCAW, MCAW, and GMAW, including

- air-cooled guns
- water-cooled guns
- nozzles
- contact tips
- wire feeders
- voltage sensing wire feeders
- drive rolls
- gas diffusers
- liners
- work lead clamps
- regulators/flow meters
- shielding gas lines

WEL-GR-M4-4 Explain various equipment **components** for FCAW, MCAW, and GMAW, including

- selection of the appropriate equipment components for FCAW, MCAW, and GMAW
- 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-GR-M4-5 Recognize various **shielding gases** for FCAW, MCAW, and GMAW, including

- mixed gases
- carbon dioxide (CO_2)
- argon
- helium

WEL-GR-M4-6 Explain various **shielding gases** for FCAW, MCAW, and GMAW, including

- selection of the appropriate shielding gas for FCAW, MCAW, and GMAW
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-GR-M4-7 Recognize various **wire types** for FCAW, MCAW, and GMAW, including

- solid
- tubular wire
- self-shielded

WEL-GR-M4-8 Explain various **wire types** for FCAW, MCAW, and GMAW, including

- selection of the appropriate wire type for FCAW, MCAW, and GMAW
- 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-GR-M4-9 Recognize various **modes of transfer** for FCAW, MCAW, and GMAW, including

- short circuit
- globular
- spray
- pulse spray

WEL-GR-M4-10 Explain various **modes of transfer** for FCAW, MCAW, and GMAW, including

- selection of the appropriate mode of transfer for FCAW, MCAW, and GMAW
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

WEL-GR-M5 Explain and demonstrate the procedures to weld using flux-cored arc welding (FCAW), metal-cored arc welding (MCAW), and GMAW processes for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications.

WEL-GR-M5-1 Explain various FCAW, MCAW and GMAW equipment and components, and demonstrate the procedures to follow **before operating**, including

- recognizing damage and defects
- required maintenance

WEL-GR-M5-2 Explain how to **set up** FCAW, MCAW, and GMAW equipment, and demonstrate the procedures to follow, including

- setting machine settings
- setting polarity
- assembling gun components and connecting to wire feeder
- connecting regulator to gas supply and gas hose to wire feeder
- installing wire roll in wire feeder
- feeding wire through drive rolls, liner, and gun
- clipping end of wire for stick-out
- adjusting wire drive roll tension
- attaching work lead clamp to base metal
- verifying setup

WEL-GR-M5-3 Explain how to set up FCAW, MCAW, and GMAW **operating parameters**, and demonstrate the procedures to follow, including

- determining parameters
- setting wire feed speed and voltage
- setting gas flow rate
- verifying setup

WEL-GR-M5-4 Explain and demonstrate the procedures to **preform welds** using GMAW processes for flat groove (1G)/horizontal groove (2G) and flat fillet (1F)/horizontal fillet (2F) applications, including

- starting up equipment
- starting arc and manipulating electrode
- performing wire manipulation techniques
- performing tacking, backstepping, and sequencing techniques
- adjusting travel speed and angle
- stopping arc
- removing slag using tools
- recognizing weld discontinuities and defects
- determining cause of weld discontinuities and defects

- repairing weld discontinuities and defects
- restarting arc
- finishing weld
- shutting down equipment

WEL-GR-M5-5 Explain and demonstrate the procedures to **preform welds** using FCAW and MCAW processes for flat groove (1G) and flat fillet (1F) applications, including

- starting up equipment
- starting arc and manipulating electrode
- performing wire manipulation techniques
- performing tacking, backstepping, and sequencing techniques
- adjusting travel speed and angle
- stopping arc
- removing slag using tools
- recognizing weld discontinuities and defects
- determining cause of weld discontinuities and defects
- repairing weld discontinuities and defects
- restarting arc
- finishing weld
- shutting down equipment

WEL-GR-M6 Perform the procedures for semi-automatic wire feed welding.

WEL-GR-M6-1 Demonstrate the **procedures for flux-cored arc welding** (FCAW) or **metal-cored arc welding** (MCAW) semi-automatic wire feed welding, including

- E491T-9 (E71T-1) FCAW
- E49C-6 (E70C-6) MCAW
- diameter = 0.045

WEL-GR-M6-2 Demonstrate the **procedures for gas metal arc welding** (GMAW) semi-automatic wire feed welding, including

- fillet weld assembly all positions
- ER49S-6 (ER70S-6)
- diameter = 0.035

Strand N: Welder Practical Examination (A13)

WEL-GR-N-1 Demonstrate cuts welds using oxy-acetylene process.

WEL-GR-N-1-1 Safely demonstrate various **cut welds** using oxy-acetylene process, including

- mild steel test plate
  - 120mm x 125mm x 12mm
- freehand straight-angled cut
  - 30° angle of cut
- freehand circular cut
  - locate hole position
  - 90° cut
  - to accept 25mm round bar
- freehand coping cut
  - to accept a 120mm channel
- following provided drawing and specifications
- testing procedure
  - visual examination

WEL-GR-N-2 Demonstrate groove weld assembly using shielded metal arc welding (SMAW).

WEL-GR-N-2-1 Safely demonstrate various **groove welds** using shielded metal arc welding (SMAW), including

- groove weld assembly
  - mild steel
- weld position
  - flat groove (1G)
- electrode
  - E-4312 (E-6012) root
  - E-4918 (E-7018) hotpass, fill and cap
- following provided drawing and specifications
- testing procedure
  - visual examination
  - destructive bend test

WEL-GR-N-3 Demonstrate groove fillet weld assembly using gas metal arc welding (GMAW).

WEL-GR-N-3-1 Safely demonstrate various **groove fillet** welds using gas metal arc welding (GMAW), including

- base metal
  - mild steel plate
- weld position
  - flat groove (1G)
  - flat fillet (1F)
- wire
  - ER49S (ER70S)
  - diameter = 0.035
- follow provided drawing and specifications
- testing procedure
  - visual examination
  - destructive bend test