

CURRICULUM OUTLINE

Boilermaker

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CURRICULUM OUTLINE

BOILERMAKER



STRUCTURE OF THE CURRICULUM OUTLINE

To facilitate understanding of the occupation, this standard contains the following sections:

Description of the Boilermaker trade: An overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Boilermaker trade: Some of the trends identified by industry as being the most important for workers in this trade

Essential Skills Summary: An overview of how each of the 9 essential skills is applied in this trade

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard

Elements of harmonization of apprenticeship training: includes number of levels of apprenticeship, total training hour and recommended apprenticeship levels

Sequencing of apprenticeship training topics and related subtasks: a chart which outlines the model for apprenticeship training sequencing and a cross-reference of the sub-tasks covered by each topic

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities

Task: distinct actions that describe the activities within a major work activity

Task Descriptor: a general description of the task

Sub-task: distinct actions that describe the activities within a task

Recommended apprenticeship level: as part of the interprovincial discussions on harmonization, this is the recommended level of apprenticeship technical training where this sub-task would be trained

Essential Skills: The most relevant essential skills for this sub-task

Knowledge:

Learning Outcomes: describes what should be learned relating to a sub-task while participating in technical or in-school training

Learning Objectives: topics to be covered during technical or in-school training in order to meet the learning outcomes for the sub-task

Range Variables: elements that provide a more in-depth description of a term used in the learning outcomes, or learning objectives

Appendix A – Acronyms: a list of acronyms used in the standard with their full name

Appendix B – Tools and Equipment: a non-exhaustive list of tools and equipment used in this trade

Appendix C – Glossary: definitions or explanations of selected technical terms used in the standard

A complete version of the occupational standard, which provides additional detail for the trade activities, skills and knowledge can be found at www.red-seal.ca

DESCRIPTION OF THE BOILERMAKER TRADE

“Boilermaker” is this trade’s official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by a boilermaker whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Boilermaker	✓	✓	✓		✓		✓	✓	✓				
Construction Boilermaker				✓		✓				✓			

Boilermakers construct, fabricate, weld, assemble, install, erect, alter, maintain, repair, dismantle, demolish and test steam generators, boilers, economizers, air heaters, de-aerators, induction draft (ID) and forced draft (FD) fans, tanks, pollution control devices and systems, duct systems, furnaces, reactors, water towers and reservoirs, penstocks, scroll casing, stacks and other related components and parts, as well as their access structures and assemblies, including all types of structural and plate work on dust, air, gas, steam, oil, water and other liquid-tight containers. Boilermakers work from engineer-approved drawings to fabricate components from steel or other materials. They calculate, select and attach rigging and work with cranes and other hoisting devices to lift components into place. The systems must be tested for leaks and other defects and deficiencies to ensure they are operating safely and efficiently.

Boilermakers require a good understanding of welding methods and procedures. However, while welding is a component of this trade, jurisdictions may or may not permit certain welding processes without further certification.

Boilermakers are employed in industries that are governed by various codes and standards in metal fabricating, construction, shipbuilding, petroleum, mining, smelting and power generation (e.g. hydro, nuclear, thermal, solar, tidal). They may be employed in construction and maintenance in a variety of industrial workplaces such as pulp mills, water treatment plants, steel mills, cement, chemical, fertilizer and potash plants, breweries, ship yards, offshore platforms, mines and power generation and co-generation stations, as well as ethanol, oil and gas extraction facilities, upgraders and refineries where the installation, repair, and maintenance, or demolition of the above equipment is required.

Boilermakers use both hot and cold working methods to shape steel components and other materials to form boilers, tanks and vessels. They must use various metal forming machines such as plate shears, punch presses and bending rolls. Tools such as levels, wedges, grinders and cutting torches are used to lay out, fit and smooth edges so the parts fit together. They also use a variety of test equipment and measuring devices.

Their work is performed indoors or outdoors and may be at extreme heights or underground. The work environment of boilermakers can expose them to hazards and conditions such as vibration, excessive noise, fumes, asbestos and other toxic environments, confined spaces, extreme temperatures, and radiation.

Key attributes for people entering this trade are: good hand-eye coordination, mechanical aptitude and manual dexterity. Boilermakers must possess the full range of knowledge, abilities and skills required of the trade including an understanding of mechanical drawings along with mathematical aptitudes. They also require strength and stamina to work with heavy components and equipment. It is common in this

trade to travel for work opportunities; therefore, boilermakers must adapt to frequently changing work environments. It is also common in this trade to work long hours and many consecutive shifts.

This analysis recognizes similarities with the work of metal fabricators, industrial mechanics (millwrights), steamfitters/pipefitters, ironworkers and welders.

With experience, boilermakers may act as mentors and trainers to apprentices in the trade. They may also advance to supervisory positions, quality assurance inspectors and safety personnel.

TRENDS IN THE BOILERMAKER TRADE

Tools and Equipment

The use of tools such as automated welding equipment, automated cutting and fitting equipment and advanced lifting/hoisting systems means that some fabrication procedures are becoming more efficient and safer.

Technology and Work Processes

New technologies such as automated welding and advanced non-destructive testing / non-destructive evaluation (NDT/NDE) technologies (e.g. digital x-rays, austenitic ultrasonic testing, phased array) require boilermakers to know new testing, fitting and preparation techniques.

There is a trend towards using rope access systems to perform inspections.

New technologies in tube extraction provide greater efficiency during repair and maintenance processes.

Due to new crane and transport technology, many larger components and vessels are delivered to the site as complete modules rather than being assembled on site. More of the boilermakers' fabrication is now done in a shop environment.

Safety and Environmental Considerations

New components and technology to reduce emissions are increasingly being installed in facilities such as power plants, gas plants, coal plants and smelters. Boilermakers are responsible for the fabrication, field construction, erection, installation, maintenance and repair of these components.

New technology that has been introduced to improve work safety includes personnel monitoring through radio frequency technology.

There is new legislation emerging for the use of green energy as well as safety. Corporate policy to address reducing liability issues is increasingly common.

Employers and employees are jointly responsible for the safety of all in the workplace. Jurisdictional requirements and legislation is being more stringently enforced. Due to safety regulation, in area where hazards exist, employees may be required to wear a personal Global Positioning System (GPS) tracking device.

Training and Upgrading

There is a greater emphasis and requirement for additional licenses, certificates and training for specific trade qualifications such as welding, rigging, machinery operation and safety. Specialized training for specific tasks such as hydraulic bolt torquing and hydraulic stud tensioners as well as increased rigging skills is becoming common.

Because boilermakers are responsible for working on energy-producing systems, it is very important that they are adaptable and keep up-to-date with changes and new technology that may emerge in this area. A very specific skill set is required for nuclear power refurbishments. Due to the increase in power demands, specialized training for renewable energy, nuclear power, hydro-electric power plants and gas-fired generation will be required. With the increase in volume of oil and gas as a supplier of industrial work, there is a possible change in training requirements.

Also, with changes in specific sectors such as mining and carbon capture, boilermakers may require a specialized skill set.

ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

A series of CCDA-endorsed tools have been developed to support apprentices in their training and to be better prepared for a career in the trades. The tools can be used independently or with the assistance of a tradesperson, trainer, employer, teacher or mentor to:

- understand how essential skills are used in the trades;
- learn about individual essential skills strengths and areas for improvement; and
- improve essential skills and increase success in an apprenticeship program.

The tools are available online or for order at: <https://www.canada.ca/en/employment-social-development/programs/essential-skills/profiles.html>.

The essential skills profile for the boilermaker trade indicates that the most important essential skills are **document use**, **numeracy** and **oral communication**.

The application of these skills may be described throughout this document within the competency statements which support each subtask of the trade. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at www.red-seal.ca.

READING

Boilermakers read and interpret summaries of toolbox meetings, short notes from co-workers about work activities and directions on product labels. They also read company policies and procedures, as well as code books, collective agreements and Safety Data Sheets (SDS). Boilermakers also read reference books such as metal trades handbooks, crane and rigging handbooks and training manuals.

DOCUMENT USE

Boilermakers locate information in various tables, bills of lading, work procedures, code books, load charts, SDS and equipment catalogues. They interpret various drawings such as rigging, fabrication (prints) and shop drawings to identify work to be completed. They may also make scale drawings.

WRITING

Boilermakers may write work-related notes to co-workers and keep personal logbooks to record daily activities noting information such as hours worked, tasks completed, problems encountered, observations and concerns. They may also write production plans to sequence and schedule tasks. Boilermakers may complete job safety analysis (JSA) reports, health and safety report forms as well as hazard or near-miss report forms.

NUMERACY

Boilermakers schedule their daily work activities. They determine the total weight of materials to be hoisted and use formulas to calculate the working load limit (safe work load) of various wire and fibre ropes. They also measure tube wall thicknesses and calculate tube expansion using formulas. They measure angles to cut tubing or pipe to specifications. They use geometry such as bisecting angles and constructing circles using chords to lay out materials for vessels. Boilermakers use data analysis math to ensure code requirements are met by cross referencing measurements on drawings with industry specifications. They also estimate tube/pipe lengths to perform rough cuts, materials needed for a job and the weight of a load to be lifted. They may also estimate how many workers and hours are required to complete a job. Boilermakers work with both the imperial and metric measurement systems, and therefore must be able to convert between the two systems.

ORAL COMMUNICATION

Boilermakers discuss safety issues with colleagues and supervisors during daily toolbox meetings. They interact with supervisors to get direction and discuss technical issues, health and safety concerns, timelines and personnel matters. They may consult with draftspersons, quality control officers and engineers to discuss problems with fabrication drawings (prints) such as code violations, technical challenges and design flaws. They may also consult with union representatives.

Boilermakers are often required to use personal protective equipment (PPE) such as ear protection, Self-Contained Breathing Apparatus (SCBA), respirators and full face masks which may impede communication. Boilermakers also work in situations where visibility is restricted. Communication is also challenging because boilermakers often work in confined spaces or in towers, out of hearing range. This necessitates the use of hand signals or two-way radios.

THINKING

Boilermakers use critical thinking skills to perform diagnostics, trouble-shooting and problem solving tasks. They may suggest a more feasible timeframe when dealing with tight timelines and while coordinating with other trades. They also determine and implement actions to address hazardous job conditions. For example, they may choose appropriate safety equipment, isolate an area, or call other trades to facilitate assigned tasks.

WORKING WITH OTHERS

Due to the potentially dangerous nature of their work, working with others is a critical skill. Often a boilermaker-welder is paired with a boilermaker-mechanic to form a skilled team. Boilermakers may also work in larger team situations and with other tradespeople. They should be able to communicate effectively, complete the tasks assigned to them and integrate their work with that of the other trades. They must be self-disciplined, ensuring that work done independently is accurate and completed within prescribed time limits.

DIGITAL TECHNOLOGY

Boilermakers may use digitized programmable equipment such as scientific calculators, digital levels and lasers. They may also use application equipment (robotics) and computer-controlled equipment such as welding overlays and computer numerical controlled (CNC) cutting machines. Boilermakers may use computer-assisted training tools such as on-line programs, simulators, or software packages for health and safety training. They may also use computer-aided design (CAD) software.

CONTINUOUS LEARNING

Technical upgrading is offered by companies when new products, procedures and equipment are introduced. Boilermakers may take courses on the job or at community colleges, or access on-line programs. However, one of the most practical ways for boilermakers to gain new expertise is to learn on the job from more experienced co-workers, mentors or supervisors. It is common for boilermakers to also have welding certification.

TASK MATRIX

BOILERMAKER

A - PERFORMS COMMON OCCUPATIONAL SKILLS

Task A-1 Performs safety-related functions	A-1.01 Uses personal protective equipment (PPE) and safety equipment 1,3	A-1.02 Maintains safe work environment 1,3	A-1.03 Monitors confined spaces 1
Task A-2 Uses tools, equipment and work platforms	A-2.01 Uses hand tools 1	A-2.02 Uses power tools 1,2,3	A-2.03 Uses shop equipment 1,2,3
	A-2.04 Uses cutting and welding tools and equipment 1,2,3	A-2.05 Uses work platforms and access equipment 1,2,3	A-2.06 Uses aerial work platforms 1,2,3
Task A-3 Organizes work	A-3.01 Organizes project tasks and procedures 1,2,3	A-3.02 Uses drawings and specifications 1,2,3	A-3.03 Handles materials and components 1,2,3
	A-3.04 Demobilizes site 1,2		
Task A-4 Uses communication and mentoring techniques	A-4.01 Uses communication techniques 1,3	A-4.02 Uses mentoring techniques 3	
Task A-5 Performs cutting and welding activities	A-5.01 Cuts material 1,2	A-5.02 Prepares joints for fitting 1,2,3	A-5.03 Fits joints 1,2,3
	A-5.04 Performs tack welds 1	A-5.05 Performs basic welding 1,2,3	A-5.06 Performs advanced welding

B - PERFORMS RIGGING AND HOISTING

Task B-6 Plans lift	B-6.01 Determines load 1,2,3	B-6.02 Performs pre-lift analysis 3	B-6.03 Selects rigging and hoisting equipment 1,2,3
	B-6.04 Secures lift area 1		
Task B-7 Rigs load	B-7.01 Inspects rigging equipment 1,2	B-7.02 Fabricates rigging equipment 3	B-7.03 Attaches rigging equipment to load 1,2
Task B-8 Hoists load	B-8.01 Inspects hoisting equipment 1,2	B-8.02 Assembles hoisting equipment 2,3	B-8.03 Performs hoisting operations 1,2,3
	B-8.04 Secures load before rigging removal 2		
Task B-9 Performs post-lift activities	B-9.01 Conducts post-lift inspection 1,2	B-9.02 Disassembles hoisting equipment 1,2,3	B-9.03 Maintains rigging equipment 1

C - COMPLETES NEW CONSTRUCTION

Task C-10 Performs fabrication	C-10.01 Lays out components for fabrication 1,2,3	C-10.02 Cuts components for fabrication 1,2	C-10.03 Forms components for fabrication 2,3
	C-10.04 Constructs components 1,2,3		

Task C-11 Assembles and fits vessels and components	C-11.01 Aligns vessels and components 2,3	C-11.02 Fits vessels and components 2,3	
Task C-12 Fastens components	C-12.01 Bolts components 1,2	C-12.02 Expands tubes 2,3	C-12.03 Lays up fibreglass 2

D - PERFORMS REPAIRS, MAINTENANCE, UPGRADING AND TESTING

Task D-13 Services vessels and components	D-13.01 Inspects vessels and components for defects 2	D-13.02 Prepares vessels and components for servicing 1,2,3	D-13.03 Repairs vessels and components 2,3
	D-13.04 Performs preventative maintenance and upgrades 2,3	D-13.05 Tests materials, vessels and components 2,3	
Task D-14 Removes vessels and components	D-14.01 Dismantles vessels and components 2,3	D-14.02 Removes materials 3	

ELEMENTS OF HARMONIZATION OF APPRENTICESHIP TRAINING

1.Trade name

The official Red Seal name for this trade is Boilermaker.

2.Number of Levels of Apprenticeship

The number of levels of technical training recommended for this trade is 3.

3.Total Training Hours during Apprenticeship Training

The total hours of training, including both on-the-job and in-school training for this trade is 5400.

SEQUENCING OF APPRENTICESHIP TRAINING TOPICS AND RELATED SUBTASKS

These Topic Titles are accompanied by the subtasks and their reference number contained in this Curriculum Outline. The topics in the shaded cells represent those that are covered “in context” with other training.

Level 1	Level 2	Level 3
	Safety-Related Functions	Safety-Related Functions
	Communication and Mentoring	
Safety-Related Functions 1.01 Uses PPE and safety equipment 1.02 Maintains safe work environment 1.03 Monitors confined spaces		
Tools, Equipment and Work Platforms 2.01 Uses hand tools 2.02 Uses power tools 2.03 Uses shop equipment 2.04 Uses cutting and welding tools and equipment 2.05 Uses work platforms and access equipment 2.06 Uses aerial work platforms	Tools, Equipment and Work Platforms 2.02 Uses power tools 2.03 Uses shop equipment 2.04 Uses cutting and welding tools and equipment 2.05 Uses work platforms and access equipment 2.06 Uses aerial work platforms	Tools, Equipment and Work Platforms 2.02 Uses power tools 2.03 Uses shop equipment 2.04 Uses cutting and welding tools and equipment 2.05 Uses work platforms and access equipment 2.06 Uses aerial work platforms
Organizes Work 3.01 Organizes project tasks and procedures 3.02 Uses drawings and specifications 3.03 Handles materials and components 3.04 Demobilizes site	Organizes Work 3.01 Organizes project tasks and procedures 3.02 Uses drawings and specifications 3.03 Handles materials and components 3.04 Demobilizes site	Organizes Work 3.01 Organizes project tasks and procedures 3.02 Uses drawings and specifications 3.03 Handles materials and components
Communication and Mentoring Techniques 4.01 Uses communication techniques		Communication and Mentoring Techniques 4.01 Uses communication techniques 4.02 Uses mentoring techniques

Level 1	Level 2	Level 3
<p>Cutting and Welding Activities</p> <p>5.01 Cuts materials 5.02 Prepares joints for fitting 5.03 Fits joints 5.04 Performs tack welds 5.05 Performs basic welding</p>	<p>Cutting and Welding Activities</p> <p>5.01 Cuts materials 5.02 Prepares joints for fitting 5.03 Fits joints 5.05 Performs basic welding</p>	<p>Cutting and Welding Activities</p> <p>5.02 Prepares joints for fitting 5.03 Fits joints 5.05 Performs basic welding</p>
<p>Rigging and Hoisting</p> <p>6.01 Determines load. 6.03 Selects rigging and hoisting equipment 6.04 Secures lift area 7.01 Inspects rigging equipment 7.03 Attaches rigging equipment to load 8.01 Inspects hoisting equipment 8.03 Performs hoisting operations. 9.01 Conducts post-lift inspection 9.02 Disassembles hoisting equipment 9.03 Maintains rigging and hoisting equipment</p>	<p>Rigging and Hoisting</p> <p>6.01 Determines load 6.03 Selects rigging and hoisting equipment 7.01 Inspects rigging equipment 7.03 Attaches rigging equipment to load 8.01 Inspects hoisting equipment 8.02 Assembles hoisting equipment 8.03 Performs hoisting operations 8.04 Secures load before rigging removal 9.01 Conducts post-lift inspection 9.02 Disassembles hoisting equipment</p>	<p>Rigging and Hoisting</p> <p>6.01 Determines load 6.02 Performs pre-lift analysis 6.03 Selects rigging and hoisting equipment 7.02 Fabricates rigging equipment 8.02 Assembles hoisting equipment 8.03 Performs hoisting operations 9.02 Disassembles hoisting equipment</p>
<p>Fabrication</p> <p>10.01 Lays out components for fabrication 10.02 Cuts components for fabrication 10.04 Constructs components</p>	<p>Fabrication</p> <p>10.01 Lays out components for fabrication 10.02 Cuts components for fabrication 10.03 Forms components for fabrication 10.04 Constructs components</p>	<p>Fabrication</p> <p>10.01 Lays out components for fabrication 10.03 Forms components for fabrication 10.04 Constructs components</p>
<p>Fastens Components</p> <p>12.01 Bolts components</p>	<p>Fastens Components</p> <p>12.01 Bolts components 12.02 Expands tubes 12.03 Lays up fibreglass</p>	<p>Fastens Components</p> <p>12.02 Expands tubes</p>
<p>Vessels and Components (Introduction)</p> <p>13.02 Prepares vessels and components for servicing</p>	<p>Vessels and Components (Assemble and Fit)</p> <p>11.01 Aligns vessels and components 11.02 Fits vessels and components</p>	<p>Vessels and Components (Assemble and Fit)</p> <p>11.01 Aligns vessels and components 11.02 Fits vessels and components</p>

Level 1	Level 2	Level 3
	<p>Vessels and Components (Service)</p> <p>13.01 Inspects vessels and components for defects</p> <p>13.02 Prepares vessels and components for servicing</p> <p>13.03 Repairs vessels and components</p> <p>13.04 Performs preventative maintenance and upgrades</p> <p>13.05 Tests materials, vessels and components</p>	<p>Vessels and Components (Service)</p> <p>13.02 Prepares vessels and components for servicing</p> <p>13.03 Repairs vessels and components</p> <p>13.04 Performs preventative maintenance and upgrades</p> <p>13.05 Tests materials, vessels and components</p>
	<p>Vessels and Components (Removal)</p> <p>14.01 Dismantles vessels and components</p>	<p>Vessels and Components (Removal)</p> <p>14.01 Dismantles vessels and components</p> <p>14.02 Removes materials</p>

MAJOR WORK ACTIVITY A

Performs common occupational skills

TASK A-1 Performs safety-related functions

TASK DESCRIPTOR

Boilermakers must be familiar with the care and use of personal protective equipment (PPE) and safety equipment. Maintaining a safe work environment is the responsibility of all workers. Specialized safety training is integral to performing many work functions.

Boilermakers must monitor confined spaces to ensure the safety of workers doing repairs or construction.

A-1.01 Uses personal protective equipment (PPE) and safety equipment

Apprenticeship Level 1,3

Essential Skills Oral Communication, Continuous Learning, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.01.01L	demonstrate knowledge of PPE and safety equipment , their applications , maintenance, storage and procedures for use	identify types of PPE and safety equipment
		describe applications and limitations of PPE and safety equipment
		describe PPE and safety equipment operations
		describe the procedures used to inspect, maintain and store PPE and safety equipment
		identify training requirements for PPE and safety equipment
A-1.01.02L	demonstrate knowledge of regulatory requirements pertaining to PPE and safety equipment	identify on-site safety locations and requirements
		identify and interpret the regulatory requirements and responsibilities

describe the roles and responsibilities of employers and employees with respect to the selection and use of **PPE** and **safety equipment**

describe workplace safety and health regulations related to the use of **PPE** and **safety equipment**

RANGE OF VARIABLES

PPE includes: respirators, hard hats, safety glasses, CSA-approved boots, welding helmets, goggles/shields, safety harnesses, fire retardant clothing, hearing protection equipment, head protection, gloves, first aid kit, radioactive protective equipment

safety equipment includes: fire extinguishers, fall arrest system, barrier tape, fresh air breathing equipment, air movers, safety showers, eyewash stations, wind socks, confined space rescue equipment

applications include: hazardous locations, height, confined spaces

on-site safety locations include: first aid stations, safety showers, eye wash stations, muster points

A-1.02 Maintains safe work environment

Apprenticeship Level	1,3
Essential Skills	Oral Communication, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.02.01L	demonstrate knowledge of regulatory requirements pertaining to maintaining a safe work environment	describe federal, provincial/territorial and municipal health and safety acts and regulations
		identify the location of Safety Data Sheet (SDS) documents
		define and describe what is meant by a WHMIS labels and distinguish between supplier and workplace labels and other means of identification
		describe the roles and responsibilities of employer, supplier and worker described in WHMIS
		identify certification requirements
A-1.02.02L	demonstrate knowledge of documentation pertaining to workplace safety	explain how WHMIS applies to and is implemented in the workplace
		describe safety analysis cards , their purpose and application
A-1.02.03L	demonstrate knowledge of the Occupational Health and Safety Act, Regulation and Code	describe the Workers' Compensation Board, jurisdictional and OH&S injury reporting requirements

A-1.02.04L	demonstrate knowledge of safe work practices	describe company safety policies and procedures
		describe good housekeeping practices
		describe site-specific emergency procedures
		identify common causes of accidents in the work environment
A-1.02.05L	demonstrate knowledge of safe handling of hazardous materials	identify safe disposal and recycling procedures for hazardous materials
A-1.02.06L	demonstrate knowledge of workplace hazards	identify workplace hazards
		identify fire hazards existing in the work environment
		identify classes of fires and the extinguishing medium in each case
		describe operation of fire-extinguishing equipment for extinguishing various classes of fires
		identify reactive chemicals
		identify hazardous gases
		describe prevention methods of hazards

RANGE OF VARIABLES

regulatory requirements include: Transportation of Dangerous Goods (TDG), WHMIS, OH&S

safety analysis cards include: field level risk assessment (FLRA), job safety analysis (JSA), pre-safety inspection (PSI), lift plans, hazard assessments (HA)

hazardous materials include: asbestos, silica, ceramic fibers

hazards include: fire hazards, electrical shocks, gaseous environment, flying debris, arc flashes, plant operations, mobile equipment on-site, overhead cranes, spills, chromium, manganese, vanadium, asbestos, radiation

A-1.03 Monitors confined spaces

Apprenticeship Level

1

Essential Skills

Document Use, Working with Others, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.03.01L	demonstrate knowledge of legislation and regulations pertaining to confined space entry	identify legislation and regulations pertaining to confined space entry
A-1.03.02L	demonstrate knowledge of confined spaces	identify locations requiring the monitoring of confined spaces

	define confined spaces
	identify potential hazards of confined spaces and entry into them
	identify types of gases and their properties
	describe site-specific requirements for monitoring confined spaces
	identify confined space monitoring equipment
	describe considerations to preplan confined space entry
	explain confined space rescue procedures
	identify methods for securing confined spaces
	identify de-energization and lock out procedures

RANGE OF VARIABLES

locations include: vessels, trenches, boilers, tanks, duct work, precipitators, stacks

hazards include: improper isolation of confined space, lack of ventilation, inert gases, leaking oxy-fuel hoses and valves, triggering explosions, sludge in confined space, lack of respiratory protection, presence of toxic or flammable material, improper rescue procedures, lack of natural ventilation, oxygen deficiency or enrichment, exceeding lower and upper explosive limits

hazards of confined spaces include: various gases and surrounding conditions

types of gases include: chlorine, carbon monoxide, hydrogen sulfide, nitrogen, argon, oxygen, acetylene, propane, sulphur dioxide

confined space monitoring equipment includes: air horns, radios, flashlights, identification vests, gas monitors, rescue plans

preplan includes: atmospheric testing and monitoring, procedures, code of practice, safety equipment and clothing, ground-fault interrupters, explosion-proof lighting, rescue equipment

securing confined spaces includes: signage, tape, barricades, barriers, locks, hole covers

TASK A-2 Uses tools, equipment and work platforms

TASK DESCRIPTOR

Boilermakers must use and maintain hand, power, cutting and welding tools and shop equipment in order to perform the duties of the trade. Boilermakers may work at heights necessitating the set-up, operation and maintenance of work platforms and access equipment.

A-2.01 Uses hand tools

Apprenticeship Level 1

Essential Skills Numeracy, Thinking, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.01.01L	demonstrate knowledge of hand tools , their applications and procedures for use	identify types of hand tools , their applications and operating and maintenance procedures
		identify types of measuring tools, their applications, and operating and maintenance procedures
		explain the setup of transits
		explain the process to transfer elevation points using a water level
		describe the process of precision measuring using a micrometer (Metric and Imperial)
		identify types of layout tools, their applications, and operating and maintenance procedures
		describe the use of threading equipment for the production and repair of internal and external threads
A-2.01.02L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect and tag hand tools
		identify criteria for replacement, repair or removal of hand tools

RANGE OF VARIABLES

hand tools - See Appendix (Tools and Equipment)

A-2.02**Uses power tools**

Apprenticeship Level	1,2,3
Essential Skills	Document Use, Thinking, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.02.01L	demonstrate knowledge of power tools and components , their applications and procedures for use	identify types of power tools and components their applications and operating and maintenance procedures identify hazards related to the use of power tools describe installation procedures for grinding discs or stones describe the applications of grinders describe the use of threading equipment for the production and repair of internal and external threads
A-2.02.02L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect power tools and components identify criteria for replacement, repair or removal of power tools

RANGE OF VARIABLES

power tools include: grinders, pneumatic torque wrenches, milling guns, drills, reamers, tube expanders, hydraulic expanders, impact wrenches, hammer drills, pipe threading and cutting equipment, hydraulic jacks and rams, hydraulic torque wrenches, hydraulic tensioners

components include: blades, bits, taps and dies

hazards include: airline rupture, hydraulic line ruptures, electrical faults, pinch points, projectiles, improper grinding disc selection

applications of grinders include: clean torch-cut edges, remove tacks/burrs, cut material, wire brush (remove layers of paint, rust, etc.), regrind chisels and punches

A-2.03**Uses shop equipment**

Apprenticeship Level	1,2,3
Essential Skills	Document Use, Reading, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.03.01L	demonstrate knowledge of shop equipment , their applications and procedures for use	identify types of shop equipment , their applications and operating and maintenance procedures identify hazards related to the use of shop equipment describe the power roll operations, and identify calculations that need to be made for forming describe roll and brake capacity and allowances and proper direction to roll or bend describe power press brake operations for forming describe the methods of positioning dies for specific operations identify types of stationary drills and components, their applications and operating and maintenance procedures
A-2.03.02L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect shop equipment identify criteria for replacement, repair and locking out shop equipment

RANGE OF VARIABLES

shop equipment includes: burning tables, radial drill presses, brake presses, shears, power rolls, ironworkers, positioning equipment, pedestal grinders, bandsaws

hazards include: hydraulic/pneumatic line ruptures, electrical faults, pinch points, projectiles, moving materials

A-2.04**Uses cutting and welding tools and equipment**

Apprenticeship Level	1,2,3
Essential Skills	Thinking, Document Use, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.04.01L	demonstrate knowledge of cutting and welding tools and equipment , their applications and procedures for use	identify types of cutting and welding tools and equipment , their applications, and operating and maintenance procedures
		identify hazards related to cutting and welding practices
		identify types of cutting processes
		identify types of welding processes
A-2.04.02L	demonstrate knowledge of certification requirements	identify certification requirements for cutting and welding tools and equipment
A-2.04.03L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect cutting and welding tools and equipment
		identify criteria for replacement or repair of cutting and welding tools and equipment

RANGE OF VARIABLES

cutting and welding tools and equipment include: welding machine, power supply, oxy-fuel system, plasma arc cutting (PAC) system, high pressure water cutting system, oxygen lance, arc air gouger, carbon arc cutting-air (CAC-A) (gouger)

hazards include: burns, fume and particulates inhalation, explosions, radiation exposure, suffocation

A-2.05**Uses work platforms and access equipment**

Apprenticeship Level	1,2,3
Essential Skills	Thinking, Reading, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.05.01L	demonstrate knowledge of work platforms and access equipment , their applications, limitations and procedures for use	<p>identify types of work platforms and access equipment and describe their characteristics, limitations and applications</p> <p>describe the set-up of work platforms</p> <p>describe the procedures used to erect and dismantle work platforms and access equipment</p> <p>describe the procedures used to inspect, maintain and store work platforms and access equipment</p>
A-2.05.02L	demonstrate knowledge of safe work practices pertaining to work platforms and access equipment	identify hazards and describe safe work practices pertaining to work platforms and access equipment
A-2.05.03L	demonstrate knowledge of regulatory requirements pertaining to work platforms and access equipment	<p>identify certification for the use of work platforms and access equipment</p> <p>identify and interpret federal, provincial/territorial, municipal and site-specific regulations pertaining to work platforms and access equipment</p>

RANGE OF VARIABLES

work platforms and **access equipment** include: ladders, suspended scaffolding, needle beams, modular platforms, tank scaffolding

A-2.06**Uses aerial work platforms**

Apprenticeship Level	1,2,3
Essential Skills	Oral Communication, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.06.01L	demonstrate knowledge of aerial work platforms , their applications, limitations and procedures for use	<p>identify types of aerial work platforms and describe their characteristics, limitations and applications</p> <p>describe the operating procedures and safe work practices pertaining to aerial work platforms</p> <p>identify and describe the use of anchor points</p> <p>identify work site environment conditions and the impact on aerial work platform setup and operation</p> <p>describe a rescue plan and back-up features for aerial work platform operation failure</p>
A-2.06.02L	demonstrate knowledge of regulatory requirements pertaining to aerial work platforms	<p>identify and interpret federal, provincial/territorial, municipal and site-specific regulations pertaining to aerial work platforms</p> <p>identify the training and certification requirements for the use of aerial work platforms</p>

RANGE OF VARIABLES

aerial work platforms include: scissor lifts, telescoping man lifts, swing stages, articulating booms

TASK A-3 Organizes work

TASK DESCRIPTOR

In order to organize their work, boilermakers must be able to use documents and drawings to retrieve information and visualize the information in three dimensions. Proper handling and identification of materials is important to ensure that all required material is well-organized and available for the job completion.

A-3.01 Organizes project tasks and procedures

Apprenticeship Level	1,2,3
Essential Skills	Document Use, Reading, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.01.01L	demonstrate knowledge of the elements involved in planning and organizing job tasks and procedures	identify sources of information relevant to organizing job tasks and procedures
		describe the considerations to plan and organize job tasks and procedures
		describe the sequence of job tasks and procedures
		identify all tools, equipment and materials required for job tasks
		identify requirements to coordinate with other trades
		estimate the time required to complete each task
		describe the function of project scheduling tools

RANGE OF VARIABLES

sources of information include: drawings, specifications, client requirements, codes

considerations include: available space, schedule/sequence, permits, hazards assessment, personnel, tools and equipment, materials and supplies, storage location

A-3.02**Uses drawings and specifications**

Apprenticeship Level	1,2,3
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.02.01L	demonstrate knowledge of drawings , their use and interpretation	identify types of drawings
		identify the common parts of a drawing and the information contained within
		describe procedures for finishing a component from an interpreted drawing
		describe how to create a bill of materials for a component from information found on a drawing
		outline an order of assembly to complete a component
		identify the various types of specifications
		identify symbols found on technical drawings
		determine types, sizes, shapes, and grades of materials required from the drawings
		identify technological tools for drawings and specifications
A-3.02.02L	demonstrate knowledge of calculations relevant to drawings	calculate conversions between metric and imperial systems

RANGE OF VARIABLES

drawings include: fabrication, assembly, structural, detail, engineered lift drawings, erection, as-builts

information includes: scale, not to scale, colour code, legend, title blocks, current revisions, bill of materials, IFC stamp

components include: saddles, nozzles, skirts, shells, ladders, internals, heads

specifications include: measurements, weights, tolerances, grades of material, welding criteria

symbols include: welding, steel designation, fasteners, tubes, plates, studs, fibreglass, nuts, bolts

materials include: tubes, plates, studs, fibreglass, nuts, bolts, expanded metals

technological tools include: computer aided design (CAD), tablets, digital photography

A-3.03 Handles materials and components

Apprenticeship Level	1,2,3
Essential Skills	Oral Communication, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.03.01L	demonstrate knowledge of type, properties and handling requirements of materials and components	describe space constraints
		identify types of metals
		identify materials and components
		interpret the designations for pipe and tube
		identify various types, grades and size of bolts, studs and screws
		identify standard fittings , their sizing, designation, function and pressure rating
A-3.03.02L	demonstrate knowledge of safe handling practices for materials and components	describe safety requirements for handling material and components
		describe safety requirements for storing gas cylinders and hazardous materials

RANGE OF VARIABLES

materials include: tube and pipe, plates, welded bar grating, expanded metals

components include: ladders, platforms, saddles, manifolds, heads, shells

metals include: white cast iron, gray cast iron, carbon steels, alloy steels, stainless steel, copper, aluminum, clad steel

standard fittings include: nozzles, couplings, tees, elbows, flanges (including slip-on and weld neck), blind flanges, blanking plates, plugs, valves (backflow, check)

A-3.04 Demobilizes site

Apprenticeship Level	1,2
Essential Skills	Document Use, Oral Communication, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.04.01L	demonstrate knowledge of the procedure to demobilize a site	describe inventory practices for demobilizing a site
		describe steps necessary to restore a site to its operational state

TASK A-4 Uses communication and mentoring techniques

TASK DESCRIPTOR

Learning in the trades is done primarily in the workplace with tradespeople passing on their skills and knowledge to apprentices, as well as sharing knowledge amongst themselves. Apprenticeship is, and always has been about mentoring – learning workplace skills and passing them on. Because of the importance of this to the trade, this task covers the activities related to communication in the workplace and mentoring skills.

A-4.01 Uses communication techniques

Apprenticeship Level	1,3
Essential Skills	Oral Communication, Thinking, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-4.01.01L	demonstrate knowledge of trade terminology	define terminology used in the trade
A-4.01.02L	demonstrate knowledge of effective communication practices	describe the importance of using effective verbal and non-verbal communication with people in the workplace
		identify sources of information to effectively communicate
		identify communication and learning styles
		describe effective listening and speaking skills
		identify personal responsibilities and attitudes that contribute to on-the-job success
		identify the value of diversity in the workplace
		identify communication that constitutes harassment and discrimination

RANGE OF VARIABLES

people in the workplace include: other tradespeople, colleagues, apprentices, supervisors, clients, authorities having jurisdiction, manufacturers

sources of information include: regulations, codes, occupational health and safety requirements, authorities having jurisdiction requirements, drawings, specifications, company and client documentation

learning styles include: visual (seeing it), auditory (hearing it), kinesthetic (doing it)

personal responsibilities and attitudes include: asking questions, working safely, accepting constructive feedback, time management and punctuality, respect for authority, good stewardship of materials, tools and property, efficient work practice

harassment includes: objectionable conduct, comment or display made either on a one-time or continuous basis that demeans, belittles, or causes personal humiliation or embarrassment to the recipient or others

discrimination is prohibited based on race, national or ethnic origin, colour, religion, age, sex, sexual orientation, marital status, family status, disability or conviction for which a pardon has been granted

A-4.02 Uses mentoring techniques

Apprenticeship Level	3
Essential Skills	Oral Communication, Thinking, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-4.02.01L	demonstrate knowledge of strategies for learning skills in the workplace	describe the importance of individual experience
		describe the shared responsibilities for workplace learning
		determine one's own learning preferences and explain how these relate to learning new skills
		describe the importance of different types of skills in the workplace
		describe the importance of essential skills in the workplace
		identify different learning needs and strategies to meet learning needs
		identify strategies to assist in learning a skill
A-4.02.02L	demonstrate knowledge of strategies for teaching workplace skills	identify different roles played by a workplace mentor
		describe the steps involved in teaching skills
		explain the importance of identifying the point of a lesson
		identify how to choose an appropriate time to present a lesson

	explain the importance of linking the lessons
	identify the components of the skill (the context)
	describe considerations in setting up opportunities for skill practice
	explain the importance of providing feedback
	identify techniques for giving effective feedback
	describe a skills assessment
	identify methods of assessing progress
	explain how to adjust a lesson to different situations

RANGE OF VARIABLES

essential skills are: reading, writing, document use, oral communication, numeracy, thinking, working with others, digital technology, continuous learning

learning needs include: learning disabilities, learning preferences, language proficiency

strategies to assist in learning a skill include: understanding the basic principles of instruction, developing coaching skills, being mature and patient, providing feedback

steps for teaching skills include: identifying the point of the lesson, linking the lesson, demonstrating the skill, providing practice, giving feedback, assessing skills and progress

TASK A-5 Performs cutting and welding activities

TASK DESCRIPTOR

Boilermakers use various processes to cut material and to prepare and fit joints. They perform tack welding to temporarily join components. For the purpose of this standard, basic welding is non-structural and not pressure welding.

Final welding and more advanced welding procedures may be performed by qualified boilermaker-welders as allowed by jurisdictional regulations.

A-5.01 Cuts material

Apprenticeship Level	1,2
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.01.01L	demonstrate knowledge of <i>materials</i> to be cut	select and prepare <i>material</i> to be cut
		identify processes associated with cutting alloy steels or ferrous or non-ferrous metals
A-5.01.02L	demonstrate knowledge of cold-cutting processes, their associated equipment and accessories	identify the different <i>cold-cutting techniques</i>
		describe <i>cold-cutting techniques</i> and common cutting faults
		describe the process of manual cutting on material of various thickness
		describe cutting/threading of pipe using manual and mechanical process
A-5.01.03L	demonstrate knowledge of hot-cutting processes, their associated equipment and accessories	identify the different <i>hot-cutting techniques</i>
		describe the process to perform flame cutting
		describe the process to light a torch
		list the different types of <i>flames</i>
		explain and demonstrate the set-up of oxy-fuel equipment
		explain the procedure to check for leaks
		identify the characteristics of oxygen and fuel gas cylinders

	explain the construction and purpose of a manifold system
	identify and select fuel gases for manual and automatic flame cutting of carbon steel
	identify and describe regulator types, purposes, and their correct adjustments and care
	describe the assembly, installation and maintenance of hoses, fittings and flashback arrestors
	explain and demonstrate the setting of oxy-fuel pressures, balancing and flame adjustments
	list the causes of backfires and flashbacks
	describe the design, maintenance, selection and operation of oxy-fuel tips
	describe the set-up and operation of CAC-A (carbon arc cutting-air) equipment (gouger)
	describe the set-up and operation of plasma arc cutting equipment

RANGE OF VARIABLES

material includes: metals (alloy steels, ferrous or non-ferrous metals, carbon steels), fiberglass, composites

cold-cutting techniques include: shear, milling, band saw, hack saw, carbide tooth blade

hot-cutting techniques include: flame cutting, plasma arc, CAC-A (gouger), abrasive disc

flames include: oxidizing, carbonizing, neutral

A-5.02 Prepares joints for fitting

Apprenticeship Level	1,2,3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.02.01L	demonstrate knowledge of processes of preparing joints for fitting	identify welded joint preparation and joint tolerances from drawings determine if metal conditions require cleaning

		describe the process to lay out and fit up joints
A-5.02.02L	demonstrate knowledge of regulatory requirements pertaining to components	identify codes and standards related to components

A-5.03 Fits joints

Apprenticeship Level	1,2,3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.03.01L	demonstrate knowledge of joint fitting techniques and procedures	identify various types of <i>joints</i> describe fitting methods and procedures describe procedures for <i>joint</i> spacing (gap)
A-5.03.02L	demonstrate knowledge of regulatory requirements pertaining to fitting components	identify codes and standards related to fitting components

RANGE OF VARIABLES

joints include: groove type (U, V, J, bevel), B-C-T-E-L (butt, corner, tee, edge, lap)

A-5.04 Performs tack welds

Apprenticeship Level	1
Essential Skills	Working with Others, Oral Communication, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.04.01L	demonstrate knowledge of process to perform tack welds	identify parent material to be tacked describe the procedures for <i>tacking operations</i> identify welding codes and symbols
A-5.04.02L	demonstrate knowledge of regulatory requirements pertaining to tack welds	identify codes and standards related to tacking components

RANGE OF VARIABLES

tacking operations include: joint spacing, holding or clamping devices, number and spacing of tack welds, pre-setting/distortion allowances of joint member, current type, amperage and polarity, hot tacks

A-5.05 Performs basic welding

Apprenticeship Level 1,2,3

Essential Skills Document Use, Thinking, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.05.01L	demonstrate knowledge of basic welding processes, their associated equipment and accessories	identify welding processes to be applied
		describe the elements and sequence of welding processes
		identify arc welding machines
		identify welding machine accessories
		explain electrode classification and rod coating (flux)
		explain the relationship between rod diameter and amperage settings
		identify common weld faults
		list the functions of slag
		identify polarity settings and their applications
		describe grounding techniques and methods
A-5.05.02L	demonstrate knowledge of welding codes and symbols	describe the storage requirements of low hydrogen electrodes
		explain welding procedures to minimize distortion
		explain pre- and post- heat processes
A-5.05.03L	demonstrate knowledge of regulatory requirements pertaining to welding processes	identify welding codes and symbols
		interpret symbols for groove welds
		identify codes and standards related to welding processes

RANGE OF VARIABLES

welding processes include: shielded metal arc welding (SMAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), flux cored arc welding (FCAW)

arc welding machines include: AC transformer, AC/DC rectifier, components of an AC and DC generator, inverter power source

welding machine accessories include: various types and sizes of electrode holders and cables, cable lugs, quick connectors, ground clamps, remotes, wire feeders

weld faults include: porosity, inclusion, undercut, cold lapping, lack of penetration, incomplete fusion, under bead cracking

A-5.06 Performs advanced welding

Apprenticeship Level

Essential Skills Document Use, Thinking, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.06.01L	demonstrate knowledge of advanced welding procedures, their associated equipment and accessories	identify advanced welding process to be applied
		describe the elements and sequence of welding processes
		describe the damming and purging process and identify when it applies
		describe polarity settings and their applications
A-5.06.02L	demonstrate knowledge of electrode classifications	explain the effects of alloy additions to the coating for arc welding electrodes
A-5.06.03L	demonstrate knowledge of welding codes and symbols	interpret welding symbols and documentation
		interpret symbols for grooves
		interpret supplementary symbols
A-5.06.04L	demonstrate knowledge of regulatory requirements pertaining to welding procedures	identify codes and standards related to advanced welding procedures

RANGE OF VARIABLES

welding processes include: shielded metal arc welding (SMAW), gas metal arc welding (GMAW), GTAW, flux cored arc welding (FCAW)

MAJOR WORK ACTIVITY B

Performs rigging and hoisting

TASK B-6 Plans lift

TASK DESCRIPTOR

Boilermakers plan lifts to ensure that safe rigging and hoisting practices are followed to avoid personal injury and equipment damage.

B-6.01 Determines load

Apprenticeship Level	1,2,3
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-6.01.01L	demonstrate knowledge of load requirements	list properties of load to be lifted that need to be considered
B-6.01.02L	demonstrate knowledge of calculations and related factors to determine load weight	identify formulas to determine load weight
		calculate load weight
		identify related factors for calculations and load weight

RANGE OF VARIABLES

properties of load to be lifted include: dimensions, shape, weight, centre of gravity

related factors include: reference materials, catalogs, drawings, bills of lading

B-6.02 Performs pre-lift analysis

Apprenticeship Level	3
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-6.02.01L	demonstrate ability to perform pre-lift analysis	describe inspection of area surrounding lift list signaling methods used during rigging and lifting list delegation of responsibilities for personnel describe the dry run procedures
B-6.02.02L	demonstrate understanding of rigging and hoisting	identify type of lifts and procedures identify lift hazards explain effects of sling angle when preparing for hoisting/lifting operations
B-6.02.03L	demonstrate knowledge of regulatory requirements pertaining to rigging, hoisting/lifting and moving equipment	interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving equipment

RANGE OF VARIABLES

signaling methods include: verbal, two-way radios, hand signals

personnel include: supervisor, operators, signaler, riggers, tag line persons

type of lift includes: simple, tandem, critical

lift hazards include: overhead obstacles, boom interference, ground conditions, swing path, powerlines

B-6.03**Selects rigging and hoisting equipment**

Apprenticeship Level	1,2,3
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-6.03.01L	demonstrate knowledge of rigging, hoisting/lifting and moving equipment, their applications, limitations and procedures	define terminology associated with rigging, hoisting/lifting and moving equipment
		identify types of rigging, hoisting /lifting and moving equipment and accessories, and describe their applications, limitations and procedures
		identify the factors to consider when selecting rigging, hoisting/lifting and moving equipment
		define and describe wire rope characteristics
		describe and demonstrate the testing and strength reductions of knots and splices
		define and describe the construction, grades and applications of natural fibre and synthetic ropes
		interpret rigging tag information
B-6.03.02L	demonstrate knowledge of regulatory requirements pertaining to rigging, hoisting/lifting and moving equipment	interpret jurisdictional regulations pertaining to rigging, hoisting/lifting operations and moving equipment
B-6.03.03L	demonstrate knowledge of calculations required to select rigging, hoisting/lifting and moving equipment	explain effects of sling angles when preparing for hoisting/lifting operations
		calculate rigging, hoisting/lifting and moving equipment capacities
		interpret crane charts
		identify swing zone and swing clearance
		identify and interpret applicable tables and charts for slings and attachments
		interpret manufacturers' specifications or the specifications certified by a professional engineer
		define and describe WLL formulas, factors and reductions for natural fibre, synthetic fibre and wire ropes

RANGE OF VARIABLES

rigging equipment includes: slings, blocks, hardware, hooks, rollers, softeners, below the hook lifting devices (i.e., spreader, equalizer beams)

hoisting equipment includes: cranes, TirusTM, tuggers, chain falls, come-alongs, jacks

factors include: weight being hoisted, radius and distance to be lifted, parts of line used, hoisting location

wire rope characteristics include: types of steel used for wire ropes, lays and their advantages, wire rope cores, classifications, constructions, WLL, wire rope faults and removal criteria, care and handling of wire rope

rigging tag information includes: date, size, capacity, material

B-6.04 Secures lift area

Apprenticeship Level 1

Essential Skills Writing, Working with Others, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-6.04.01L	demonstrate knowledge of rigging, hoisting/lifting and moving equipment, their applications, limitations and procedures for use	define terminology associated with rigging, hoisting/lifting and moving equipment
B-6.04.02L	demonstrate knowledge of safety practices related to rigging, hoisting/lifting and moving operations	describe the procedures used to ensure the work area is safe for lifting identify hazards and describe sources for safe work practices pertaining to rigging, hoisting/lifting and moving operations
B-6.04.03L	demonstrate knowledge of jurisdictional regulations pertaining to rigging, hoisting/lifting and moving equipment	interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving equipment

RANGE OF VARIABLES

procedures used to ensure the work area is safe for lifting include: installing and tagging barriers, assessing ground conditions, ensuring that work area is not congested or obstructed for emergency access, limiting approach, obtaining required permits

sources for safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' specifications

TASK B-7 Rigs load

TASK DESCRIPTOR

Rigging is an integral part of the boilermaker trade. Rigging equipment is used so that loads or personnel can be hoisted in a safe and secure manner.

B-7.01 Inspects rigging equipment

Apprenticeship Level	1,2
Essential Skills	Thinking, Document Use, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-7.01.01L	demonstrate knowledge of inspection procedures pertaining to rigging equipment	identify rigging equipment, their components, applications, limitations and procedures for use
		describe a walk-around inspection of a rigging system
		identify removal criteria for damaged rigging equipment, components or attachment points
B-7.01.02L	demonstrate knowledge of jurisdictional regulations pertaining to the inspection of rigging equipment	describe inspection requirements for rigging equipment
		identify jurisdictional regulations and manufacturers' specifications for inspection and removal of rigging equipment

B-7.02 Fabricates rigging equipment

Apprenticeship Level	3
Essential Skills	Reading, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-7.02.01L	demonstrate knowledge of the process to fabricate rigging equipment	identify different <i>fabrication methods</i>
		describe limitations to fabricating rigging equipment

identify **rigging equipment that can be fabricated** according to engineered specifications

interpret jurisdictional regulations regarding fabrication of rigging equipment

RANGE OF VARIABLES

fabrication methods include: cutting, welding

fabrication methods do not include: makeshift rigging which is fabricated rigging that is not engineer approved

rigging equipment that can be fabricated includes: lifting lugs, spreader bars

B-7.03 Attaches rigging equipment to load

Apprenticeship Level 1,2

Essential Skills Document Use, Thinking, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-7.03.01L	demonstrate knowledge of the procedures to attach rigging equipment to a load	list and describe requirements and specifications involved in rigging
		describe function, advantages and limitations of various hitches and configurations
		define types and functions of knots, bends and hitches
		identify the purpose and demonstrate the ability to tie knots, bends and hitches
		describe splicing of natural fibre and synthetic fibre ropes
		perform back splice, side splice and short splice
		define, describe and demonstrate the ability to apply material handling attachments
		identify attachment points
		identify jacking points and equipment
		identify rolling equipment and placement

RANGE OF VARIABLES

hitches and configurations include: basket, choker, bridle hitch, vertical hitch

knots, bends and hitches include: bowline, self-centering bowline, running bowline, clove hitch, half hitch, reef (square) knot, timber hitch, rolling hitch, sheet bend, fisherman bend

material handling attachments include: hooks and shackles, wire rope clips, eyebolts, chains, additional industry attachments

TASK B-8 Hoists load

TASK DESCRIPTOR

Hoisting a load is lifting the equipment or components into place according to a lift plan. In many cases, it is a team effort involving operators, signallers, riggers and supervisors. It is important that boilermakers participate in hoisting operations for safety and to ensure that personnel, equipment and components are protected during the operation.

B-8.01 Inspects hoisting equipment

Apprenticeship Level	1,2
Essential Skills	Thinking, Document Use, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.01.01L	demonstrate knowledge of process to inspect hoisting equipment	list and describe the elements of a walk-around inspection in a hoisting system
		describe the procedures used to inspect hoisting equipment
		identify hoisting equipment, their components, applications, limitations and procedures for use

RANGE OF VARIABLES

hoisting equipment includes: cranes, TirforsTM, tuggers, chain falls, come-alongs, jacks, blocks

B-8.02 Assembles hoisting equipment

Apprenticeship Level	2,3
Essential Skills	Reading, Thinking, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of the procedures used to assemble hoisting equipment	describe the basic procedures for the placement, assembly and installation of hoisting equipment and components
		identify hoisting equipment , their components , applications, limitations and procedures for use
		interpret load charts, lift radius and boom length

RANGE OF VARIABLES

procedures include: spooling cable on a drum, preparing ground, reeving a block, assembling crane components, mounting tuggers

hoisting equipment includes: cranes, blocks, strand jacks, tuggers, jack and roll equipment

components include: boom, tracks, counterweight, reeving, outrigger boxes, gantry, jib

B-8.03 Performs hoisting operations

Apprenticeship Level	1,2,3
Essential Skills	Working with Others, Oral Communication, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.03.01L	demonstrate knowledge of hoisting procedures and their associated equipment, applications, limitations and procedures for use	describe hoisting and load moving procedures
		list the topics discussed in pre-lift meetings
		list and describe types, parts and configurations of mobile cranes
		describe uses and safe working practices for hoisting equipment
		identify the function, advantage and limitations of various slings and sling arrangements

		identify slings and hitches used for hoisting materials
		describe the use and location for slings, tag lines and sling configurations on loads for hoisting
		determine the centre of gravity for different types of loads
B-8.03.02L	demonstrate knowledge of the use of hoisting communication	list and demonstrate hand signals used for moving equipment and hoisting
		describe methods and precautions in using hand signals
		describe and demonstrate voice communications on a two-way radio
		list precautions used in voice communication
B-8.03.03L	demonstrate knowledge of engineered lifts	interpret engineered lift drawings
		identify the requirements and regulations for a tandem and critical lift, and hoisting personnel
B-8.03.04L	demonstrate knowledge of safety practices related to rigging, hoisting/lifting and moving operations	identify hazards and describe safe work practices pertaining to rigging, hoisting/lifting and moving

RANGE OF VARIABLES

hoisting equipment includes: forklifts, hoists, come-alongs, tuggers, TirusTM, chainfalls

loads include: smooth heavy loads, long flexible loads, off balance loads, heavy fragile units, finished or coated loads, large surface area (sail)

B-8.04 Secures load before rigging removal

Apprenticeship Level 2

Essential Skills Oral Communication, Thinking, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.04.01L	demonstrate knowledge of the procedures to secure a load before rigging removal	identify the function, advantage and limitations of various slings and sling arrangements
		identify and describe the location of sling configurations on loads for hoisting

		identify and describe procedures to secure a load
B-8.04.02L	demonstrate knowledge of jurisdictional regulations pertaining to rigging	interpret jurisdictional regulations pertaining to rigging

RANGE OF VARIABLES

procedures include: dunnage, cribbing, guylines, lashing

TASK B-9 Performs post-lift activities

TASK DESCRIPTOR

Post-lift inspections and disassembly of hoisting equipment are done after the lift is completed. Boilermakers continually maintain rigging and hoisting equipment to ensure personnel safety, optimal operation of the equipment and to avoid equipment damage.

B-9.01 Conducts post-lift inspection

Apprenticeship Level	1,2
Essential Skills	Oral Communication, Working with Others, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-9.01.01L	demonstrate the ability to conduct post-lift inspections	list and describe the elements of inspections done after each lift list and describe the elements of inspections done after job completion

B-9.02 Disassembles hoisting equipment

Apprenticeship Level	1,2,3
Essential Skills	Thinking, Oral Communication, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-9.02.01L	demonstrate knowledge of the procedure to disassemble hoisting equipment and its associated components	describe the disassembly of hoisting equipment identify hoisting equipment requiring disassembly

	describe the procedures for crane boom removal and disassembly
	identify crane components
	describe storage procedures and conditions
	identify rigging and hoisting equipment required to do disassembly
	describe break-down procedures and sequences

RANGE OF VARIABLES

hoisting equipment includes: tuggers, mobile cranes, strand jacks, jacks, tower cranes, gantry cranes

crane components include: matting, counterweights, gantries, boom sections, jib, pads and mats

B-9.03 Maintains rigging equipment

Apprenticeship Level	1
Essential Skills	Reading, Document Use, Writing

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-9.03.01L	demonstrate knowledge of procedures to maintain rigging equipment	describe maintenance requirements for rigging equipment
		describe storage procedures for rigging equipment
		identify jurisdictional regulations pertaining to maintaining rigging equipment
		describe the best practices for the care and handling of fibre and wire ropes

MAJOR WORK ACTIVITY C

Completes new construction

TASK C-10 Performs fabrication

TASK DESCRIPTOR

Fabrication is the creation of the components from stock material following specific instructions from a drawing or a concept. The fabrication process includes layout, cutting, forming and assembly of components. Most components are built in a shop and transported to the jobsite; however, fabrication can also occur in the field.

C-10.01 Lays out components for fabrication

Apprenticeship Level	1,2,3
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.01.01L	demonstrate knowledge of the procedure to lay out material and components for fabrication and the associated tools and equipment	identify, select and use measuring, checking and layout tools
		identify types of materials to be used and components being fabricated
		describe the various layout methods
		avoid material waste through pre-planning
C-10.01.02L	demonstrate knowledge of calculations required to lay out components	describe how to develop a template using parallel lines and radial line development
		calculate dimensions of squares, rectangles and circles for layout
C-10.01.03L	demonstrate knowledge of drawing interpretation	calculate orientation, alignment and projections
		layout and fabricate components from drawings
		read a drawing to determine the materials required and layout template or components

read a drawing and identify the **components** listed for fabrication

list and describe the abbreviations applicable to layout and development

RANGE OF VARIABLES

components include: ladders, platforms, davits, headers, pipe turns, offsets, ducts, cylinders, cones, pressure vessel shells, support structures

layout methods include: parallel-line, triangulation, radial-line development, mathematical formulas, geometric construction

C-10.02 Cuts components for fabrication

Apprenticeship Level 1,2

Essential Skills Document Use, Numeracy, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.02.01L	demonstrate knowledge of procedures used to cut components for fabrication and their associated tools and equipment	identify and describe cutting tools and equipment and list their uses and limitations
		describe cutting using manual and mechanical processes
		describe the process of cutting material of various thickness
		identify and describe oxy-fuel cutting equipment
		explain the set-up of oxy-fuel cutting equipment
		define the principle of the oxy-fuel gas cutting process
		identify the characteristics of oxygen and fuel gas cylinders
		explain the purpose of a manifold system
		identify and select fuel gases for manual and automatic oxy-fuel cutting of carbon steel
		identify and describe regulator types, purposes, and their adjustments and care
		describe the construction and maintenance of hoses, fittings and flashback arrestors

		explain and demonstrate the setting of oxy-fuel pressures, balancing and flame adjustments
		list the causes of backfires and flashbacks
		describe the design, maintenance, selection and operation of oxy-fuel tips
		describe the setup and operation of CAC-A (carbon arc cutting-air) equipment (gouger)
		describe the setup and operation of PAC (plasma arc cutting) equipment
		describe cutting processes involved in cutting alloy steels and non-ferrous metals
		perform pipe cutting to size using a pipe cutter or oxy-fuel cutting process
		explain the correct procedure to check for leaks
		identify cutting issues
C-10.02.02L	demonstrate knowledge of procedures used to thread components for fabrication and their associated tools and equipment	identify and describe threading tools and equipment and list their uses and limitations
		describe threading of pipe using manual and mechanical processes

RANGE OF VARIABLES

cutting issues include: incorrect tip type, poor cut quality, incorrect speed, incorrect heat, incorrect tip angle, incorrect pressures, faulty and dull equipment

C-10.03 Forms components for fabrication

Apprenticeship Level	2,3
Essential Skills	Thinking, Numeracy, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.03.01L	demonstrate knowledge of procedures to form components and their associated tools and equipment	identify the tools and equipment required to fabricate components
		describe methods used to identify fabricated components and assemblies

		identify forming methods
C-10.03.02L	demonstrate knowledge of drawing interpretation	interpret dimensions, symbols and abbreviations on drawings

RANGE OF VARIABLES

forming methods include: rolling, bending, braking, controlled heating

C-10.04 Constructs components

Apprenticeship Level	1,2,3
Essential Skills	Working with Others, Thinking, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.04.01L	demonstrate knowledge of the procedures to construct components and their associated tools and equipment	interpret dimensions, symbols and abbreviations on drawings
		list fastening, securing and joining methods
		identify required tools and equipment specific to fastening method and specifications

RANGE OF VARIABLES

fastening methods include: welding, bolting (torqueing, tensioning), rigging, riveting

securing methods include: clamping, dogging, bracing, lashing, spiders

joining methods include: welding, bolting, riveting

TASK C-11 Assembles and fits vessels and components

TASK DESCRIPTOR

Boilermakers assemble, align and fit vessels and components in sections or modules according to applicable codes and standards prior to final installation. They align the components and vessels at the desired location. Fitting ensures the proper placement of the vessels and components prior to fastening them in place.

C-11.01 Aligns vessels and components

Apprenticeship Level	2,3
Essential Skills	Thinking, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.01.01L	demonstrate knowledge of the procedures to align vessels and components and their associated tools and equipment	identify alignment tools and equipment and their functions and limitations
		describe the layout and fit-up of bottom, shell, roof and openings
		describe the preparation, fit-up and alignment of horizontal and vertical seams
		describe orientation, elevation and projection methods and procedures
C-11.01.02L	demonstrate knowledge of drawing interpretation	interpret information from approved drawings and specifications
		identify reference points according to approved drawings and specifications

RANGE OF VARIABLES

vessels include: drums, exchangers, towers, tanks

components include: manway, cleanout doors, water or fluid draw-off elbow, draw-off sump, inlet outlet, overflow venting, walkway, stairway, ladders, nozzles, support structures

alignment tools and equipment include: transits, water levels, plumb bobs, dogs, lugs, shims, key plates, strongbacks, key channels, wedges, u-bars

C-11.02 Fits vessels and components

Apprenticeship Level	2,3
Essential Skills	Document Use, Numeracy, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.02.01L	demonstrate knowledge of the procedures to fit vessels and components and their associated tools and equipment	identify and describe assembly requirements and procedures
		describe fitting methods and procedures
		list tools and equipment used to fit vessels and components and their functions and limitations

RANGE OF VARIABLES

tools and equipment include: levels, dogs, wedges, hammers, rigging, key plates, pry bars, strongbacks

TASK C-12 Fastens components

TASK DESCRIPTOR

Boilermakers use several techniques to fasten components during construction. This is a required task in order to complete the final installation. A small component of this task may include working with fiberglass.

C-12.01 Bolts components

Apprenticeship Level	1,2
Essential Skills	Document Use, Working with Others, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-12.01.01L	demonstrate knowledge of the techniques used to bolt components and their associated tools and equipment	identify types, grades and sizes of bolts
		identify types of gaskets and flanges
		identify types of lubricants

identify types of **torqueing and tensioning equipment**

describe bolting and torqueing sequence

RANGE OF VARIABLES

tools and equipment include: torque wrenches, impact wrenches, pneumatic torque guns, hydraulic torque wrenches, tensioning and torqueing equipment, hammer wrenches

grades are specified by: CSA, ASTM, American Iron and Steel Institute (AISI), American National Standards Institute (ANSI), ASME

torqueing and tensioning equipment includes: pneumatic torque wrench, hydraulic torque wrench, electric torque wrench, hydraulic tensioning system, pumps

C-12.02 Expands tubes

Apprenticeship Level 2,3

Essential Skills Document Use, Numeracy, Working with Others

KNOWLEDGE

Learning Outcomes

Learning Objectives

C-12.02.01L	demonstrate knowledge of the techniques used to expand tubes and their associated tools and equipment	define expansion theory and describe techniques to expand tubes
		define terms associated with tube hole arrangement
		describe the process of tube rolling
		identify types of baffles and describe their function and installation procedures
		identify tube sheet layouts and state their preference of application
		describe different types of exchanger heads
		list and describe factors to consider in tube expanding procedures for condensers and exchangers
		list the basic steps associated with tube installation
		state the recommended tube expansion sequences with reference to tube sheet layout, its area and shape
		describe how to measure the inside diameter of a tube
		determine the recommended percentage wall reduction for ferrous and non-ferrous materials

		list recommended lubricants
		identify the optimum length of expanded seat
		describe the reason for grooved seats
		list and describe the uses and limitations of tube equipment
		identify the factors affecting the quality of an expanded joint
		describe the operational relationship of the mandrel and rolls
		describe the purpose of bell rolls
		describe the purpose and process of tube beading
		identify and define the propulsive type of expander
		explain the principle involving explosive tube expansions
		describe tube flaring using flaring tools
C-12.02.02L	demonstrate knowledge of calculations required when expanding a tube	calculate the expanded diameter (final ID) of a tube

RANGE OF VARIABLES

terms include: circumferential pitch, ligament space, removal space, longitudinal pitch, diagonal pitch

exchanger heads include: channel and removable cover, bonnet, channel integral with tube sheet, pull through and floating head, outside packed floating head

factors to consider in tube expanding include: tube sheet layout, number of tubes, type of metals, length of tubes, diameter of tube (OD), material wall thickness (MWT) tube sheet or header thickness, expansion required, lubrication

tube equipment includes: tube guide, compressor, air motor, electric motor tube end mills, tube expanders, fly cutters, tube cutters, tube cleaners, tube removal tools, micrometers, gauges, torque wrench

factors affecting the quality of an expanded joint include: surface of hole, roundness of hole, cleanliness of hole, expansion past the inner edge of tube sheet, overheating, roller speed, mechanical properties of tube and tube sheet, lubrication or lack of it, overexpansion

C-12.03 Lays up fiberglass

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-12.03.01L	demonstrate knowledge of the procedures used to lay up fiberglass and the associated tools and materials	describe procedures involved in fiberglass lay-up
		identify types and grades of fiberglass materials
		describe mixing and curing procedures
		identify accelerators, retarders and promoters
		identify certification requirements
		describe the handling and storage process for the chemicals required to assemble fiberglass pipe and vessels
		describe the process of drilling
		describe the process of bolting
		describe process for handling and mixing resins, catalysts and associated chemicals
		describe safety considerations for handling and mixing resins, catalysts and associated chemicals
		describe the process of cutting
		describe the process of grinding
		describe the process of laminating glass
		identify and describe the resins and fiberglass materials required for lay-up and repairs
		describe the uses of fiberglass in tanks, silos, stacks, scrubbers, breeching and piping
		define the purpose of fiberglass materials
		describe the process to facilitate repairs on round and flat surfaces
		list and describe the tools and materials used for preparation and assembly
		list and describe measuring equipment

		list and describe <i>lay-up equipment</i>
C-12.03.02L	demonstrate knowledge of drawing interpretation	interpret specification drawings

RANGE OF VARIABLES

procedures involved in fiberglass lay-up include: tight fit-up, sanding saturate mat, stagger cut lengths, mix resin and catalyst, apply surface veil, remove air, sand entire weld, apply resin and air dry mix application method, hand lay-up, spray lay-up, cutting, fitting, surface preparation, hot patches

types and grades of fiberglass materials include: cloth, resins, fillers

fiberglass materials include: polyester resins, catalysts, promoters, surfacing veil, mat, woven roving, acetone, methylene chloride, air dry additive, filler

measuring equipment includes: paper or plastic mixing cups, mixing sticks, plastic bucket graduated for measuring resin, glass for measuring promoters and catalysts, mixing pails

lay-up equipment includes: surfacing veil, matting, woven roving

MAJOR WORK ACTIVITY D

Performs repairs, maintenance, upgrading and testing

TASK D-13 Services vessels and components

TASK DESCRIPTOR

Boilermakers help to ensure the proper operation of vessels and components by verifying their integrity, repairing or replacing them as needed as per code regulations. Modifying and upgrading existing systems entails replacing components and materials to improve performance or reliability, and can be done during scheduled and unscheduled maintenance. Sometimes, vessels and components cannot be repaired and need to be replaced.

Boilermakers need to know when rigging, fitting and cranes are needed to accomplish the tasks.

Inspecting and testing are important to identify defective and worn components to ensure that the system has been constructed or repaired properly.

D-13.01 Inspects vessels and components for defects

Apprenticeship Level 2

Essential Skills Document Use, Thinking, Oral Communication

KNOWLEDGE

Learning Outcomes

Learning Objectives

D-13.01.01L demonstrate knowledge of inspection procedures to detect defects in **vessels** and **components**

list common **vessel defects** and **component defects**

explain the causes of common **vessel defects** and **component defects**

describe inspection procedures of the **vessels** and **components**

identify **material** composition of a **vessel** or **component**

RANGE OF VARIABLES

vessels include: furnaces, boilers, condensers, tanks, vats, bins, exchangers, reactors, towers, stacks, penstocks, economizers, precipitators, scrubbers, drums, evaporators, digesters and air heaters

components include: curtains, electrodes, tubes and tube bundles, headers, trays and hardware in towers, stairways, support structures, screens, hoppers, ductwork, platforms, ladders, breeching and expansion joints

vessel defects include: dents, cracks, corrosion, gouges, weld defects, arc strikes, flat spots, crowning, wear

component defects include: missing hardware, dents, cracks, corrosion, gouges, undercut, arc strikes, flat spots, dog legs, crowning, foreign objects

material includes: mild steel, stainless steel, galvanized steel, aluminum, alloy

D-13.02 Prepares vessels and components for servicing

Apprenticeship Level 1,2,3

Essential Skills Document use, Thinking, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.02.01L	demonstrate knowledge of procedures used to prepare for service of vessels and components	identify vessels and components to be serviced
		list tools needed to complete the task at hand
		describe vessel isolation procedures
		identify fasteners and fastening methods required to complete the task at hand
		interpret required changes as detailed in engineer-approved drawings and specifications of vessels and components

RANGE OF VARIABLES

vessel isolation procedures include: hot bolting, odd bolting, line-break, blanking/blinding, purging

fastening methods include: bolting, welding, expanding, riveting

D-13.03 Repairs vessels and components

Apprenticeship Level	2,3
Essential Skills	Working with Others, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.03.01L	demonstrate knowledge of procedures to prepare vessels and components for repair	explain and select preparation methods
D-13.03.02L	demonstrate knowledge of procedures to hoist material into place in order to repair vessels and components	list hoisting/lifting and moving equipment and explain the advantages and drawbacks of each piece of equipment for a repair situation
D-13.03.03L	demonstrate knowledge of procedures to fit material to vessels and components for repair	describe fitting tools and methods used to fit new components for a repair and explain the advantages and drawbacks of each method for a repair situation
D-13.03.04L	demonstrate knowledge of procedures to fasten material to vessels and components for repair	describe fastening methods used to fasten new components for a repair and explain the advantages and drawbacks of each method for a repair situation

RANGE OF VARIABLES

preparation methods include: cleaning, grinding, chipping, buffing, welding, sand blasting, cutting, milling, gouging, water jet cutting, blanking/blinding

vessels include: furnaces, boilers, condensers, tanks, vats, bins, exchangers, reactors, towers, stacks, penstocks, economizers, precipitators, scrubbers, drums, evaporators, digesters and air heaters

components include: curtains, electrodes, tubes and tube bundles, headers, trays and hardware in towers, stairways, support structures, screens, hoppers, ductwork, platforms, ladders, breeching and expansion joints

hoisting/lifting and moving equipment includes: chainfall, come-along, Tirfor™, shackles, slings, crane, tugger, rope, gin wheel, lugs, engineered high line

fitting tools include: dogs and wedges, screw dogs, bull pins, key plates, hickey bars, pinch bars, U-bars, drift pin, sledge hammer, finger bars, welder, level

fastening methods include: bolting, welding, gluing, riveting, tack welding

D-13.04 Performs preventative maintenance and upgrades

Apprenticeship Level	2,3
Essential Skills	Thinking, Oral Communication, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.04.01L	demonstrate knowledge of preventative maintenance and upgrade procedures	identify vessels and components to be maintained
		describe preventative maintenance procedures
		describe upgrading procedures
		describe cleaning methods and their advantages and drawbacks
		identify tube defects
		identify compatible materials when selecting replacement hardware or components

RANGE OF VARIABLES

vessels include: furnaces, boilers, condensers, tanks, vats, bins, exchangers, reactors, towers, stacks, penstocks, economizers, precipitators, scrubbers, drums, evaporators, digesters and air heaters

components include: curtains, electrodes, tubes and tube bundles, headers, trays and hardware in towers, stairways, support structures, screens, hoppers, ductwork, platforms, ladders, breeching and expansion joints

cleaning methods include: scraping, buffing, chipping, high pressure washing (chemical, water), sandblasting, grinding, sweeping, vacuuming

tube defects include: wear, dents, bends, corrosion, leaks, cracks, legs, rupture

D-13.05 Tests materials, vessels and components

Apprenticeship Level	2,3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.05.01L	demonstrate knowledge of procedures to test materials, vessels and components	describe types of destructive testing (DT)
		describe types of non-destructive testing (NDT)
		explain the difference between DT and NDT

	identify vessels and components to be tested
	identify inspection methods and procedures
	describe the process, application, end results, advantages and drawbacks of NDT

RANGE OF VARIABLES

destructive testing includes: tensile test, impact test, bend test

non-destructive testing includes: visual, magnetic particle, radiographic, ultrasonic, dye penetrant, hydrostatic, vacuum box, pneumatic

vessels include: furnaces, boilers, condensers, tanks, vats, bins, exchangers, reactors, towers, stacks, penstocks, economizers, precipitators, scrubbers, drums, evaporators, digesters and air heaters

components include: curtains, electrodes, tubes and tube bundles, headers, trays and hardware in towers, stairways, support structures, screens, hoppers, ductwork, platforms, ladders, breeching and expansion joints

TASK D-14 Removes vessels and components

TASK DESCRIPTOR

Boilermakers remove vessels and components to be repaired or replaced. Removing equipment, vessels and components allows easier access and facilitates maintenance and repairs. Obsolete vessels and components also need to be dismantled, demolished or removed.

D-14.01 Dismantles vessels and components

Apprenticeship Level	2,3
Essential Skills	Working with Others, Thinking, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-14.01.01L	demonstrate knowledge of dismantling procedures related to vessels and components	describe dismantling methods and procedures
		describe demolition methods and procedures
		identify vessels and components that can be re-used
		describe lifting, hoisting, handling and storage methods and procedures

D-14.01.02L	demonstrate knowledge of safe work practices related to the dismantling of vessels and components	identify hazards and describe safe work practices when dismantling vessels and components
		list factors to consider when analyzing the integrity of components or attachment points

RANGE OF VARIABLES

vessels include: furnaces, boilers, condensers, tanks, vats, bins, exchangers, reactors, towers, stacks, penstocks, economizers, precipitators, scrubbers, drums, evaporators, digesters and air heaters

components include: curtains, electrodes, tubes and tube bundles, headers, trays and hardware in towers, stairways, support structures, screens, hoppers, ductwork, platforms, ladders, breeching and expansion joints

safe work practices include: tie off tools, follow rigging plan, plan access to the work, establish lift zone around vessel, ensure isolation points of vessels or equipment to be removed

factors include: steel strength, rust, corrosion, weight of vessel (buildup of residue, fly ash, water retention)

D-14.02 Removes materials

Apprenticeship Level	3
Essential Skills	Document Use, Working with Others, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-14.02.01L	demonstrate knowledge of procedures related to the removal of materials	describe the process to plan the removal of material
		describe process and factors for sorting material to be removed
D-14.02.02L	demonstrate knowledge of regulatory requirements pertaining to the disposal of waste materials	dispose of waste material according to work plan and jurisdictional requirements

APPENDIX A

ACRONYMS

AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAC-A	Carbon arc cutting- Air
CAD	Computer-aided design
CNC	Computer Numerical Controlled
CSA	Canadian Standards Association
DT	Destructive testing
FCAW	Flux cored arc welding
FLRA	Field level risk assessment
GMAW	Gas metal arc welding
GTAW	Gas tungsten arc welding
HA	Hazard assessments
IFC	Issued for Construction
JSA	Job safety analysis
LPI	Liquid penetrant inspection
MPI	Magnetic particle inspection
MWT	Material wall thickness
NDE	Non-destructive evaluation
NDT	Non-destructive test
OH&S	Occupational Health and Safety
PAC	Plasma arc cutting
PAUT	Phased array ultrasonic testing
PMI	Positive material identification
PPE	Personal Protective Equipment
PSI	Pre-safety inspection
SAW	Submerged arc welding
SABA	Supplied Air Breathing Apparatus
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheet
SMAW	Shielded metal arc welding
TDG	Transportation of Dangerous Goods
UT	Ultrasonic test
VT	Visual test
WHMIS	Workplace Hazardous Materials Information System
WLL	Working load limits

APPENDIX B

TOOLS AND EQUIPMENT

Personal Protective Equipment and Safety Equipment

atmospheric testing equipment	leather protective clothing and gloves
coveralls (fire retardant, acid-resistant, plastic oversuit, disposable)	personal atmospheric monitoring device
CSA protective footwear (site approved)	respirator (half mask and full face)
cutting goggles	safety glasses, safety goggles and mono goggles, spoggles
dust masks	self-contained breathing apparatus (SCBA) and supplied air breathing apparatus (SABA)
ear plugs and ear muffs	side shields
explosion-proof lights	smoke eaters and ventilation systems
fall arrest equipment (lanyards, harnesses, retractable lanyards, tripods)	tarpaulins
fire extinguishers	warning tape, tags, signs, barricades
grinding shields	welding lenses
ground fault interrupter	welding screens
hard hat	welding shields
head lamp	whip checks and pins
kevlar gauntlets and gloves	

Welding Equipment

anti-spatter spray	penlight and batteries
chipping hammer	power sources (welding machines) with auxiliary equipment for welding processes such as SMAW, FCAW, GMAW, GTAW and SAW
electrode holders (whips/stingers)	pre-heating torch and equipment,
electrode ovens (stationary/portable)	purge hoses
electrode pouch	purge paper
files	regulators
fire-retardant blankets	remote amperage controls
ground clamps	stud welding equipment
hand wire brush (mild steel and stainless steel)	temperature (“temp”) sticks
inspection mirror	welding cable
leather welding shield	welding cable “y” connectors
orbital welders	welding electrodes

Cutting Tools and Equipment

Hand Types

bolt cutters
files
hacksaw and blades
handsaw
metal-cutting chisels
metal-cutting snips

pipe/tube cutters
knife
scissors
tap and die sets
utility knife

Powered Types

abrasive cut-off saw
band saw
circular saw
grinders (air and electric)
nibblers
power shears

reciprocating saw
track saw
tube milling machine
abrasive water jet cutter
water jet cutter

Fuel Cutting Equipment

oxygen lance

Oxy-Fuel Cutting Equipment

adapters
burning and heating tips
flashback arrestors
friction lighters (strickers)
manifold systems
manual cutting torches
oxy-fuel cart

oxy-fuel couplings and wrenches
oxy-fuel cylinders
oxy-fuel hoses and repair kits
radiograph and related equipment
regulators
tip cleaners

Plasma-Arc Cutting Equipment

air line
compressed air source
power supply with cables and torch

regulators
replacement ceramic cups, gouging tips and tips

Carbon Arc Cutting-Air (CAC-A)

air-arc gouger
air and power supply
air line

carbon-cutting electrodes (round/flat)
replacement electrode holder
replacement insulators

Measuring Tools

angle and radius gauges
callipers/dividers
combination square
compass
compound tube gauge
drill point gauge
folding rule
framing squares
measuring tapes

micrometers
scale rule
sliding T-bevel
steel tapes
string line
telescoping gauge
vernier calliper
laser measuring tools

Marking and Layout Tools

ball peen hammer
chalk
chalk-line
contour marker
dividers
dye
engineer's level
felt pen
laser level
lumber crayon
paint brush
paint marker
piano wire

plumb bob
prick/center punch
protractor
scribe and awl
soapstone and holder
spirit level
squares
steel letter/number set
straight edge
trammel points
transit (theodolite)
water level
wrap-around

Hand Tools

Holding Tools

bar clamp
bench vice
C-clamp
end-cut pliers (nippers)
hammer wrench holder
lineman pliers
locking wrench pliers

needle-nose pliers
pipe vise
side-cutter pliers
sliding clamp (bessey clamp)
slip-joint pliers
water-pump (utility) pliers/channel lock pliers

Holding/Turning Tools

adjustable wrench
back-up (piper) wrench
box-end wrench
chain wrench

open-end wrench
pipe wrench
ratchet and socket wrench sets
screwdrivers

Holding/Turning Tools (continued)

combination wrench
hammer (slug) wrench
hex keys
industrial (pulling) wrench
spud wrench
strap wrench
torque wrench

Fitting Tools

4 lb. hammer
alignment pins
bull pin
clamping angles
claw hammer
dogs and screw dogs
drift pin
flange spreader
hickey bar
hose clamps
hydraulic jack
hydraulic ram
key plates and blank nuts
metal-cutting chisel
non-sparking hammer
pin punch
pry bar
shims and wedges
sledge hammers
soft-face hammer (lead-face)
steel, brass and wood wedges
strongbacks
wall-banger™

Hydraulic and Pneumatic Tools and Equipment

air chippers
air compressor
air grinders
air hammers
air movers
air manifolds/receiver
air supply hose
air utility hoist (air tugger)
drills
bundle puller
filters/oilers
hydraulic nut splitter
hydraulic and pneumatic tensioning equipment
hydraulic rams and jacks
hydrostatic test pump
hydraulic and pneumatic torque wrench
impact wrenches/sockets
milling machine
needle scalers
piper
pneumatic torque guns
regulator
sand blasting equipment
rolling motor

Electric-Powered Tools and Equipment

brake press
CNC tables
cut-off saw
circular saw
die grinder
drills/presses
hammer drill
impact wrench (electric and battery)
induction heat gun
ironworker
jigsaw
nibblers

Electric-Powered Tools and Equipment (continued)

electric screwdriver	punch
electric supply panel	reciprocating saw
exhaust fans	rolls
extension cords	shears
floodlights	string/trouble light
grinders	

Rigging and Hoisting Equipment

air mats	load binders and steamboat ratchets
beam clamps	machine rollers
beam trolleys	plate clamps
blocks (tackle, wire rope, snatch)	rigging belt
chain falls	shackles
come-along	slings (wire rope, round sling, fibre material, chain, synthetic web, wire/chain mesh)
cranes (truck-mounted, lattice-boom, hydraulic, tower, overhead)	softeners
equalizer plates	spreader and equalizer beams
equalizer sheaves	strand jacks
fibre rope	swivel hoist ring
headache ball	telescoping boom forklift
hooks/latches	terminal end connections for wire rope (clips, sockets)
jacks (hydraulic, screw, air bags)	Tirfor™ jacks
industrial machine skates	tuggers
links, swivels, rings, thimbles, eye bolts	wire rope

Tube Removal/Expansion Tools and Equipment

air motor with adapter sleeves	internal tube cutters (revolution tube cutter, fly cutter)
beading tool	knockout toolsplitting chisels
collapsing tools	torque controlled rolling motor
expansion accessories (e.g., driving links, universals, gear drive)	tube end mill
expanders for boilers and heat exchangers	tube plugs
flaring/belling tools	tube pulling spear
hydraulic stub puller	tube wall reducing tool
induction heat gun	hydraulic expander

Tube Preparation/Installation Tools

bevel gun
die grinder with variety of stones
brass, lead and plastic hammer
files
flapper wheels/emery cloth
hand/power brushes (twist)
peening tool
serrating tool
tube cut-off saw
tube guide
tube hole reamer
track saw

Tools and Equipment for Fibreglass

aluminum-serrated rollers
barrel heater
brooms
carborundum grinding discs (16-36 grit)
catalyst dispenser
fibreglass material cutting tools
grinder with flexible disc back
heat lamps
kilo scale
masking tape
mohair rollers
paint brushes
pizza disc
plastic buckets
putty knife
resin spray gun/hoses
roll of cardboard
shovels
wooden mixing spatulas

Scaffolding and Access Equipment

aerial work platforms
aluminum framed platform
aluminum planks
boom lifts
bosun chair
electrical articulated boom lift
electrical scissor lifts
electrical vertical lifts
end frames
extension ladder
floats (angel's wings)
gas powered articulated boom lift
gas powered scissor lifts
ladder jack scaffolds
ladders
mechanical scaffolds
ramps
rolling scaffolds
sawhorses
scissor-lift
stationary scaffolds
stepladders
swing stages
temporary access/freight elevator
tube and clamps
rope access equipment

APPENDIX C

GLOSSARY

bag house	enclosure through which dust particles are collected as exhaust gases pass through a fabric filter
blast furnace	a smelting furnace into which compressed hot air is driven to complete the first stage in the production of all iron-based metals
boiler	a closed vessel in which water is heated, steam is generated, steam is superheated, or any combination thereof, under pressure or vacuum by the application of heat from combustible fuels, electricity or nuclear energy
boom	the main component of a crane used to carry the hoisting tackle
breeching (gas flue)	a transition component from the convection box to the flue
catalyst	an additive that accelerates a chemical reaction
chain fall	a hand/pneumatic/ electric-operated chain hoist
coke oven	tightly sealed unit to keep out air so coal cannot burn; rather it “bakes” with an intense heat up to 2100°F to produce coke
come-along	ratchet-type tool with a chain and hook used for pulling
confined space	an enclosed or partially enclosed and possibly hazardous working area that is not intended for continuous human occupancy that has limited access and egress and where the atmosphere may change during activities
dog	a tool used with a wedge or screw to fit up components
ductwork	a passage for air and gas flow
ferrous	metals dominated by iron in their chemical composition (i.e., carbon and low alloy steels)
fiberglass	glass reinforcement material (i.e., chopped strand mat, woven roving)
hydrostatic test	a strength and tightness test of a closed pressure vessel by water pressure
lashing	a wire rope fastened to itself to temporarily hold a component in position or to safety it until it is fastened
metallurgy	involves the science of producing metals from elements and the reaction of these metals to many different activities and situations
non-ferrous	metals that contain little or no iron in their chemical composition (e.g., aluminum, copper)
outriggers	extendable beams attached to a crane base mounting that rest on supports at the outer ends and provide a means of stabilizing the crane
oxy-fuel cutting	a group of cutting processes used to sever metals by means of the chemical reaction of oxygen with the base metal at elevated temperatures
parts of line	the number of individual ropes or cables supporting a travelling block in a tackle system
penstock	conveys water from the reservoir to the generating unit such as in a hydro-electric dam
plasma-arc cutting	an arc cutting process that severs metal by melting a localized area with a constricted arc and removing the molten material with a high velocity jet of hot, ionized gas issuing from the orifice
pneumatic test	a strength and tightness test of a closed air pressure vessel by air pressure

precipitator	an electrostatic filter that separates particulate matter from exhaust gasses
promoter	an additive used with rapid-cure resins to reduce excessive exothermic heat build-up
purge	involves using one gas to displace another gas in an enclosed space or system
resin	a polyester (vinylester) solid usually dissolved in styrene, but when mixed with a catalyst, forms a rigid thermoset plastic
scrubber	an apparatus used to remove solids from gases by entrainment in water
shackle	an anchor-shaped or u-shaped component with a pin that is used in rigging
sling	a wire rope or other material with eyes spliced on each end
spreader bar	beam used for hoisting trusses or long loads; also used to equalize the weight and to keep the load, such as tank plate, from buckling
stack	a vertical conduit used to discharge combustion products to the atmosphere
stove	used to heat air to speed combustion
swing stage	a suspended scaffold
tackle	an assembly of ropes and sheaves arranged for lifting, lowering and pulling
tag line	a length of rope used to control a load during lifting or lowering
Tirfor™	manual or pneumatic pulling machine
tower crane	a power-operated fixed or slewing tower that provides elevation and support for its jib
tube expanding	the pressure-tight joint formed by enlarging a tube end in a tube seat
tugger	a pneumatic or electric winch used for hoisting in tight areas where a crane is impractical
vacuum box test	a non-destructive test designed to find leaks in welded lap joints of a storage tank floor; soapy water is applied to the joint, then the air is removed from the sealed see-through box creating a vacuum and exposing the leaks
vessel	a container designed to contain liquids, gases, or solids
water cutting	a process of using a jet of water under high pressure to sever through a variety of construction materials
water level	flexible clear tubing partially filled with water or glycol used to determine the elevation of an object in relation to a known elevation