

TOWER CRANE OPERATOR

2012

Trades and Apprenticeship Division

Division des métiers et de l'apprentissage

Labour Market Integration Directorate

Direction de l'intégration au marché du travail

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Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Interprovincial Program Guide (IPG) as the national curriculum for the occupation of Tower Crane Operator.

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards Red Seal Program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 22 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the CCDA embarked on a process for the development of national IPGs for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of the key activities in moving towards a more cohesive apprenticeship system.

With the support of Human Resources and Skills Development Canada (HRSDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.

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Adam Morin	Manitoba

In addition to the representatives above, various federal, provincial and territorial representatives contributed to the development of this document including the host province of Manitoba.

As this program guide will be amended periodically, comments or suggestions for improvement should be directed to:

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User Guide

According to the Canadian Apprenticeship Forum, the IPG is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the National Occupational Analysis (NOA), and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the NOAs and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans of training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The IPG does not dictate study materials, textbooks or learning activities to be used in delivery.

The IPG document includes a recommended leveling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

Structure

The IPG is divided into units. The unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Each unit consists of *Learning Outcomes* and *Objectives and Content*.

The *Learning Outcomes* are the specific performances that must be evaluated. Wording of the learning outcomes, "Demonstrate knowledge of..." acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which learning outcomes are evaluated; theoretically, practically or a combination of both.

User Guide *(continued)*

The *Objectives and Content* for the unit details the information to be covered in order to achieve the performances specified in the *Learning Outcomes*. These objectives can be either theoretical or practical in nature, based on the requirements identified through the industry consultation process. The learning activities used to cover the objectives are at the discretion of the jurisdiction; however, practically worded objective statements have been used where industry indicated a need for the apprentices to receive exposure to performing the task or skill outlined while attending technical training. For example, this exposure could be done through instructor demonstration or individual or group performance of the skill or task. This practical training will help to reinforce the theoretical component of the technical training.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The content listed within the IPG document is **not** intended to represent an inclusive list; rather, it is included to illustrate the intended direction for the objective. Content may be added or extended in jurisdictional training plans as required.

Jurisdictions are free to deliver the IPG units one at a time or concurrently, provided that all *Learning Outcomes* are met. The IPG does not indicate the amount of time to be spent on a particular unit as the length of time required to deliver the *Learning Outcomes* successfully will depend upon the learning activities and teaching methods used.

IPG Glossary of Terms

These definitions are intended as a guide to how language is used in the IPGs.

ADJUST	To put in good working order; regulate; bring to a proper state or position.
APPLICATION	The use to which something is put and/or the circumstance in which you would use it.
CHARACTERISTIC	A feature that helps to identify, tell apart, or describe recognizably; a distinguishing mark or trait.
COMPONENT	A part that can be separated from or attached to a system; a segment or unit.
DEFINE	To state the meaning of (a word, phrase, etc.).
DESCRIBE	To give a verbal account of; tell about in detail.
DEMONSTRATE	To provide a practical example or model through actions as well as words showing how a particular practice is to be performed.
EXPLAIN	To make plain or clear; illustrate; rationalize.
IDENTIFY	To point out or name objectives or types.
INTERPRET	To translate information from observation, charts, tables, graphs, and written material.
MAINTAIN	To keep in a condition of good repair or efficiency.
METHOD	A means or manner of doing something that has procedures attached to it.
OPERATE	How an object works; to control or direct the functioning of.

IPG Glossary of Terms *(continued)*

PROCEDURE	A prescribed series of steps taken to accomplish an end.
PURPOSE	The reason for which something exists or is done, made or used.
TEST	v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality. n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.
TROUBLESHOOT	To follow a systematic procedure but also often highly intuitive procedure which may involve trial-and-error to identify and locate a problem or malfunction, its cause and verify its remedy.

Essential Skills Profiles

Essential Skills are the skills needed for work, learning and life. They provide the foundation for learning all the other skills that enable people to evolve within their jobs and participate in workplace change.

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit HRSDC's Essential Skills website at:

<http://www.hrsdc.gc.ca/eng/workplaceskills/LES/profiles/profiles.shtml>

Profile Chart

OCCUPATIONAL SKILLS			
CRA-005 Safety	TCO-100 Introduction to Tower Cranes	CRA-010 Communications for Hoisting Operations	CRA-015 High Voltage Electrical Fundamentals
CRA-020 Trade Related Documents	CRA-025 Tools and Equipment	CRA-030 Fasteners and Retaining Devices	CRA-075 Introduction to Computerized Operational Aids
CRA-080 Job Planning	TCO-205 Access Equipment		
CRANE INSPECTION AND MAINTENANCE			
TCO-200 Tower Crane Components	TCO-210 Hydraulic Systems	TCO-215 Electrical Systems	TCO-220 Mechanical Systems
TCO-245 Continual Checks			
CRANE SET-UP, HOISTING CALCULATIONS AND LIFT PLANNING			
CRA-050 Load Weight Calculations I	CRA-055 Sling Configurations	CRA-070 Load Charts I	CRA-090 Load Weight Calculations II
TCO-225 Tower Crane Load Charts	TCO-230 Assembly and Disassembly	TCO-235 Positioning and Stabilizing Self-erecting Tower Cranes	TCO-240 Pre-lift Activities
RIGGING			
CRA-035 Wire Rope	CRA-040 Rigging Hardware	CRA-045 Introduction to Rigging and Hoisting	CRA-060 Lifting Theory and Forces
CRA-085 Advanced Rigging and Hoisting			
CRANE OPERATIONS			
CRA-065 Introduction to Crane Operations	TCO-250 Hammerhead Tower Crane Operation	TCO-255 Luffing Jib Tower Crane Operation	TCO-260 Self-Erecting Tower Crane Operation
TCO-265 Climbing and Lowering	TCO-270 Specialty Crane Operations		

Recommended Level Structure

CRA = Common Units to Mobile Crane Operators and Tower Crane Operator IPGs.
TCO = Specific Units to Tower Crane Operator IPG.

LEVEL 1					
Unit Code	Title	Page	Unit Code	Title	Page
CRA-005	Safety	17	CRA-045	Introduction to Rigging and Hoisting	29
TCO-100	Introduction to Tower Cranes	18	CRA-050	Load Weight Calculations I	31
CRA-010	Communications for Hoisting Operations	20	CRA-055	Sling Configurations	32
CRA-015	High Voltage Electrical Fundamentals	21	CRA-060	Lifting Theory and Forces	33
CRA-020	Trade Related Documents	23	CRA-065	Introduction to Crane Operations	34
CRA-025	Tools and Equipment	24	CRA-070	Load Charts I	36
CRA-030	Fasteners and Retaining Devices	25	CRA-075	Introduction to Computerized Operational Aids	38
CRA-035	Wire Rope	26	CRA-080	Job Planning	39
CRA-040	Rigging Hardware	27			
LEVEL 2					
Unit Code	Title	Page	Unit Code	Title	Page
TCO-200	Tower Crane Components	41	TCO-240	Pre-lift Activities	56
TCO-205	Access Equipment	43	TCO-245	Continual Checks	58
TCO-210	Hydraulic Systems	44	TCO-250	Hammerhead Tower Crane Operation	59
TCO-215	Electrical Systems	46	TCO-255	Luffing Jib Tower Crane Operation	60
TCO-220	Mechanical Systems	48	TCO-260	Self-erecting Tower Crane Operation	61
CRA-090	Load Weight Calculations II	50	TCO-265	Climbing and Lowering	62
TCO-225	Tower Crane Load Charts	51	CRA-085	Advanced Rigging and Hoisting	63
TCO-230	Assembly and Disassembly	53	TCO-270	Specialty Crane Operations	64
TCO-235	Positioning and Stabilizing Self-erecting Tower Cranes	55			

2012 NOA Sub-task to IPG Unit Comparison

NOA Sub-task		IPG Unit	
Task 1 – Performs safety-related functions.			
1.01	Uses personal protective equipment (PPE) and safety equipment.	CRA-005	Safety
		CRA-015	High Voltage Electrical Fundamentals
1.02	Maintains safe work environment.	CRA-005	Safety
Task 2 – Contributes to workplace organization.			
2.01	Communicates with others.	CRA-010	Communications for Hoisting Operations
2.02	Uses documentation.	CRA-020	Trade Related Documents
Task 3 – Performs pre-operational checks and regular inspections.			
3.01	Inspects structural components.	TCO-200	Tower Crane Components
3.02	Inspects mechanical components.	TCO-220	Mechanical Systems
3.03	Inspects lines and wire ropes.	CRA-040	Rigging Hardware
		CRA-035	Wire Rope
3.04	Inspects hydraulic system components.	TCO-210	Hydraulic Systems
3.05	Inspects electrical system components.	TCO-215	Electrical Systems
3.06	Inspects support components.	TCO-200	Tower Crane Components
3.07	Inspects track travel components.	TCO-200	Tower Crane Components
3.08	Inspects cab components.	TCO-200	Tower Crane Components
3.09	Inspects safety and access components.	TCO-200	Tower Crane Components
3.10	Completes inspection documentation.	CRA-020	Trade Related Documents
Task 4 – Performs continual checks.			
4.01	Monitors site conditions.	TCO-245	Continual Checks
4.02	Monitors lines and wire ropes.	TCO-245	Continual Checks
4.03	Monitors equipment performance and conditions.	TCO-245	Continual Checks
4.04	Monitors structural and support components.	TCO-245	Continual Checks
Task 5 – Performs minor crane maintenance.			
5.01	Maintains mechanical components.	TCO-220	Mechanical Systems
5.02	Lubricates wire ropes and crane components.	TCO-200	Tower Crane Components
Task 6 – Participates in tower crane assembly and disassembly.			
6.01	Participates in crane assembly.	TCO-230	Assembly and Disassembly

NOA Sub-task		IPG Unit	
6.02	Participates in crane disassembly.	TCO-230	Assembly and Disassembly
6.03	Transports self-erecting tower crane.	TCO-230	Assembly and Disassembly
6.04	Participates in assembly and disassembly of self-erecting tower cranes.	TCO-230	Assembly and Disassembly
Task 7 – Plans lifts.			
7.01	Interprets load charts.	CRA-070	Load Charts I
		TCO-225	Tower Crane Load Charts
7.02	Plans work procedures.	CRA-070	Load Charts I
		TCO-225	Tower Crane Load Charts
7.03	Prepares for specialty lifts.	CRA-085	Advanced Rigging and Hoisting
Task 8 – Inspects and maintains rigging equipment.			
8.01	Identifies deficiencies in slings and hardware.	CRA-040	Rigging Hardware
		CRA-035	Wire Rope
8.02	Lubricates slings and hardware.	CRA-040	Rigging Hardware
		CRA-035	Wire Rope
8.03	Stores rigging equipment.	CRA-040	Rigging Hardware
		CRA-035	Wire Rope
Task 9 – Manages rigging.			
9.01	Selects required rigging equipment.	CRA-040	Rigging Hardware
		CRA-035	Wire Rope
9.02	Rigs load.	CRA-045	Introduction to Rigging and Hoisting
9.03	Monitors rigging.	CRA-045	Introduction to Rigging and Hoisting
		CRA-085	Advanced Rigging and Hoisting
Task 10 – Performs pre-lift (warm-up) activities.			
10.01	Performs function test.	TCO-240	Pre-lift Activities
10.02	Confirms limits.	TCO-240	Pre-lift Activities
Task 11 – Operates tower cranes.			
11.01	Trolleys carriage.	CRA-065	Introduction to Crane Operations
11.02	Booms (luffs) up and down.	CRA-065	Introduction to Crane Operations
11.03	Swings (slews) jib.	CRA-065	Introduction to Crane Operations
11.04	Hoists load.	CRA-065	Introduction to Crane Operations
11.05	Travels crane.	CRA-065	Introduction to Crane Operations
11.06	Performs functions simultaneously.	CRA-065	Introduction to Crane Operations
Task 12 – Climbs (raises) tower cranes.			
12.01	Performs bottom-climbing procedures.	TCO-265	Climbing and Lowering
12.02	Performs top-climbing procedures.	TCO-265	Climbing and Lowering

NOA Sub-task		IPG Unit	
Task 13 – Performs specialty tower crane operations.			
13.01	Participates in multi-crane lifts.	TCO-270	Specialty Crane Operations
13.02	Operates in multi-crane site.	TCO-270	Specialty Crane Operations
13.03	Hoists personnel.	TCO-270	Specialty Crane Operations
Task 14 – Shuts down and secures tower cranes.			
14.01	Secures crane while leaving controls.	CRA-065	Introduction to Crane Operations
14.02	Secures crane while unattended.	CRA-065	Introduction to Crane Operations
14.03	Secures crane for extended periods.	CRA-065	Introduction to Crane Operations

LEVEL 1

CRA-005

Safety

Learning Outcomes:

- Demonstrate knowledge of safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

Objectives and Content:

1. Identify types of personal protective equipment (PPE) and clothing and describe their applications and limitations.
2. Describe the procedures used to care for and maintain PPE.
3. Identify hazards and describe safe work practices.
 - i) personal
 - ii) workplace
 - job hazard assessment procedures
 - energy state awareness (electrical and mechanical)
 - isolation and de-energizing procedures
 - lockout/tagout
 - confined space awareness
 - fire
 - heights (fall prevention and fall arrest)
 - first aid
 - iii) environmental
 - discharge/spills
 - weather conditions
4. Identify and describe workplace safety and health regulations.
 - i) federal
 - Workplace Hazardous Material Information System (WHMIS)
 - Transportation of Dangerous Goods (TDG)
 - Canadian Standards Association (CSA)
 - ii) provincial/territorial
 - Occupational Health and Safety (OH&S)
 - iii) municipal

TCO-100

Introduction to Tower Cranes

Learning Outcomes:

- Demonstrate knowledge of tower cranes, their characteristics and applications.
- Demonstrate knowledge of the procedures used to configure tower cranes and their components.

Objectives and Content:

1. Define terminology associated with tower cranes.
2. Identify hazards and describe safe work practices pertaining to tower cranes.
3. Identify types of tower cranes and describe their characteristics and applications.
 - i) hammerhead
 - ii) luffing
 - iii) self-erecting
 - iv) stationary
 - v) traveling
 - vi) climbing
4. Identify types of tower crane jibs and describe their characteristics and applications.
 - i) hammerhead/fixed
 - ii) luffing
5. Identify types of tower crane masts and describe their characteristics and applications.
 - i) mono
 - ii) transitional
 - iii) inner/outer
 - iv) top/bottom climbers
 - v) telescopic
6. Identify types of tower crane bases and describe their characteristics and applications.
 - i) base slab
 - ii) rail mounted

- iii) crawler mounted
 - iv) truck mounted
 - v) outrigger
 - vi) cruciform
7. Describe the procedures used to configure tower cranes and their components.
 8. Describe the procedures used to inspect and maintain tower cranes.

CRA-010

Communications for Hoisting Operations

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of communication devices, their purpose and operation.
- Demonstrate knowledge of the procedures used to communicate during hoisting operations.

Objectives and Content:

1. Identify audiences and describe techniques for effective verbal and non-verbal communication.
 - i) apprentices
 - ii) other tradespersons
 - iii) colleagues
 - iv) supervisors
 - v) clients
 - vi) general public
 - vii) inspectors/investigators
 - viii) emergency responders
2. Identify and interpret applicable hand signals used during craning operations.
3. Identify types of communication devices and describe their purpose and operation.
 - i) portable and stationary radios
 - ii) mobile phones and mobility devices
 - iii) computers
 - iv) crane horn
4. Describe the procedures used to communicate during hoisting operations.
5. Explain the purpose of a site communication plan.
6. Describe the importance of communicating job requirements.

CRA-015 High Voltage Electrical Fundamentals

Learning Outcomes:

- Demonstrate knowledge of induced currents, power line hazards and high voltage electrical equipment.
- Demonstrate knowledge of the procedures used to operate cranes near high voltage electrical equipment.
- Demonstrate knowledge of the procedures used when contact occurs with high voltage electrical equipment.

Objectives and Content:

1. Define terminology associated with induced currents, power lines and high voltage electrical equipment.
2. Identify hazards and describe safe work practices when operating cranes near sources of induced currents, power lines and high voltage electrical equipment.
 - i) personal
 - PPE
 - ii) workplace
 - transmission towers
 - overhead conductors
 - underground conductors
 - limits of approach
 - grounding factors
 - iii) environmental
 - lightning
 - induced currents
3. Interpret codes, standards and regulations pertaining to operating cranes near high voltage electrical equipment.
4. Interpret signage related to high voltage electrical equipment.
5. Describe the procedures used to operate cranes near high voltage electrical equipment.

6. Describe the procedures used when contact occurs with high voltage electrical equipment.

CRA-020 Trade Related Documents

Learning Outcomes:

- Demonstrate knowledge of trade related documents and their use.
- Demonstrate knowledge of the procedures used to complete documentation.

Objectives and Content:

1. Identify types of trade related documents and describe their applications.
 - i) manufacturers' specifications
 - load charts
 - manuals
 - ii) codes and standards
 - federal
 - provincial
 - municipal
 - iii) reference materials
 - iv) work orders
 - v) drawings
 - vi) permits
 - vii) maintenance schedules
 - viii) maintenance records
 - ix) log books
 - x) lift plans
 - xi) policies
 - site
 - company
 - xii) job hazard assessment
2. Describe the procedures used to prepare and/or complete applicable trade related documents.

CRA-025 Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to the use of tools and equipment.
2. Identify types of hand tools and describe their applications and procedures for use.
3. Describe the procedures used to inspect, maintain and store hand tools.
4. Identify types of power tools and describe their applications and procedures for use.
 - i) electric
 - ii) hydraulic
 - iii) pneumatic
 - iv) fuel powered
5. Describe the procedures used to inspect, maintain and store power tools.
6. Identify types of torches and describe their applications and procedures for use.
 - i) oxyacetylene
 - ii) propane
7. Describe the procedures used to inspect, maintain, hoist and store torches.
8. Identify types of measuring equipment and describe their applications and procedures for use.
9. Describe the procedures used to inspect, maintain and store measuring equipment.
 - i) calibration

Learning Outcomes:

- Demonstrate knowledge of fasteners and retaining devices, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with fasteners and retaining devices.
2. Identify hazards and describe safe work practices pertaining to fasteners and retaining devices.
3. Identify tools and equipment relating to fasteners and retaining devices and describe their applications and procedures for use.
4. Identify types and grades of fasteners and describe their applications.
 - i) bolts
 - ii) nuts
 - iii) washers
 - lock
 - flat
 - iv) pins
5. Identify types of retaining devices and describe their applications.
 - i) cotter pins
 - ii) snap rings
 - iii) R clips
6. Describe the procedures used to remove and install fasteners and retaining devices.
7. Explain torque values and their applications.
 - i) manufacturers' specifications
 - lubricated
 - dry

CRA-035 Wire Rope

Learning Outcomes:

- Demonstrate knowledge of wire ropes, their applications, limitations and procedures for use.
- Demonstrate knowledge of the procedures used to install, monitor, inspect, maintain, store and dispose of wire ropes.

Objectives and Content:

1. Define terminology associated with wire ropes.
2. Identify hazards and describe safe work practices pertaining to wire ropes.
3. Identify tools and equipment relating to wire ropes and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to wire ropes.
5. Identify types of wire ropes and describe their applications, limitations and procedures for use.
 - i) rope construction
 - ii) standing
 - iii) running
6. Describe the procedures used to select, install and connect wire ropes.
7. Describe the procedures used to monitor wire ropes during lifting operations.
8. Describe the procedures used to troubleshoot wire rope issues.
9. Describe the procedures used to inspect, maintain and store wire ropes.
10. Describe the procedures used to dispose of damaged wire ropes.

CRA-040 Rigging Hardware

Learning Outcomes:

- Demonstrate knowledge of rigging hardware, their applications, limitations and procedures for use.
- Demonstrate knowledge of the procedures used to install, monitor, inspect, maintain, troubleshoot, store and dispose of rigging hardware.

Objectives and Content:

1. Define terminology associated with rigging hardware.
2. Identify hazards and describe safe work practices pertaining to rigging hardware.
3. Identify tools and equipment relating to rigging hardware and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to rigging hardware.
5. Identify types of rigging hardware and describe their applications, limitations and procedures for use.
 - i) hooks
 - ii) tag lines
 - iii) shackles
 - iv) slings
 - v) spreader bars
 - vi) equalizer beams
 - vii) specialized lifting devices
6. Describe the procedures used to select, install and connect rigging hardware.
7. Describe the procedures used to monitor rigging hardware during lifting operations.
8. Describe the procedures used to troubleshoot rigging hardware.
9. Describe the procedures used to inspect, maintain and store rigging hardware.

10. Describe the procedures used to dispose of damaged rigging hardware.

Learning Outcomes:

- Demonstrate knowledge of rigging and hoisting applications.
- Demonstrate knowledge of basic rigging and hoisting techniques.

Objectives and Content:

1. Define terminology associated with rigging and hoisting.
2. Identify hazards and describe safe work practices pertaining to rigging and hoisting.
3. Identify codes, standards and regulations pertaining to rigging and hoisting.
 - i) training and certification requirements
4. Interpret information pertaining to rigging and hoisting found on drawings and specifications.
 - i) lift plans
 - ii) manufacturers' specifications
5. Identify types of knots, hitches and splices used with fibre ropes and describe their applications and the procedures used to tie them.
6. Identify types of hitches used with slings and describe their applications and procedures for use.
 - i) Diameter to diameter (D to d) ratio with wire rope slings
7. Describe the procedures used to ensure the work area is safe for hoisting.
 - i) supervision of lift
 - ii) securing work area
 - iii) communication
8. Identify the factors to consider when rigging material/equipment for hoisting.
 - i) load characteristics
 - ii) workplace environment
 - chemical hazards
 - grounding requirements

iii) weather conditions

CRA-050 Load Weight Calculations I

Learning Outcomes:

- Demonstrate knowledge of the weight of basic shaped loads.
- Demonstrate knowledge of centre of gravity.

Objectives and Content:

1. Define terminology associated with determining the weight of basic shaped loads.
2. Explain the importance of determining the weight of a basic shaped load and its relevance in lifting operations.
3. Identify the considerations used to determine the weight of basic shaped loads.
 - i) volume of object
 - ii) weight of material
 - iii) weight of rigging
4. Perform calculations to determine load weights for basic shapes.
 - i) cubes and boxes
 - ii) cylinders and pipes
5. Describe the procedures used to determine centre of gravity in basic shaped loads.

Learning Outcomes:

- Demonstrate knowledge of sling configurations, their characteristics and applications.
- Demonstrate knowledge of working load limits (WLL).

Objectives and Content:

1. Define terminology associated with slings.
2. Identify hazards and describe safe work practices pertaining to slings.
3. Identify types of sling configurations and describe their characteristics and applications.
4. Explain sling angles and their effect on sling capacities.
5. Describe the procedures used to determine sling angle.
6. Perform calculations to interpret the load on slings used at an angle.
 - i) equal length
 - ii) bridles
7. Describe the procedures used to determine the appropriate sling size for a given load.
8. Identify the considerations used to determine WLLs.
 - i) manufacturers' specifications
 - ii) codes and standards
 - iii) rigging applications
9. Perform calculations to determine WLLs of slings.
 - i) wire rope
 - ii) chains
 - iii) synthetic web
 - iv) synthetic fibre

Learning Outcomes:

- Demonstrate knowledge of lifting theory and forces.
- Demonstrate knowledge of units of measure and symbols relating to lifting plans and load charts.

Objectives and Content:

1. Define terminology associated with lifting and forces.
 - i) forces exerted on the crane
 - ii) forces exerted by the crane
 - iii) forces exerted on the load
2. Explain the principles of leverage and describe the mechanical advantage.
3. Identify types of leverage systems used in craning operations.
 - i) class 1 lever
 - ii) class 2 lever
 - iii) class 3 lever
4. Explain the relationship between leverage and crane stability.
5. Identify units of measure and symbols pertaining to lifting plans and load charts.
6. Explain the centre of gravity of the load and its impact on lifting.
7. Identify and describe lift studies and lift plans.
8. Perform leverage calculations.

Learning Outcomes:

- Demonstrate knowledge of basic crane operations and their applications.
- Demonstrate knowledge of the procedures used to perform pre- and post-operational inspections.
- Demonstrate knowledge of the procedures to perform basic crane operations.

Objectives and Content:

1. Define terminology associated with crane operations.
2. Identify hazards and describe safe work practices pertaining to crane operations.
 - i) personnel
 - ii) equipment
 - iii) environmental
3. Interpret codes, standards and regulations pertaining to crane operations.
4. Interpret charts, drawings and specifications pertaining to crane operations.
 - i) manufacturers' specifications
5. Identify basic crane operations and describe their characteristics and applications.
 - i) raising/lowering load
 - ii) swinging crane
 - iii) raising/lowering boom
 - iv) operating telescopic boom
 - v) outriggers
 - vi) extendable counterweights
 - vii) travelling
 - viii) functioning simultaneously
 - ix) travelling trolley
6. Identify the considerations and requirements for selecting cranes and their associated components and accessories.

7. Identify and describe lift studies and lift plans.
8. Identify and describe the procedures used to perform operational inspections.
 - i) function tests
9. Describe the procedures used to achieve repairs and maintenance.
10. Describe the procedures used to perform basic craning operations.
11. Describe the effects of weather conditions on crane operations.
12. Describe the procedures used to secure cranes before leaving them unattended.
 - i) short-term
 - ii) long-term

CRA-070 Load Charts I

Learning Outcomes:

- Demonstrate knowledge of basic load charts, their characteristics and applications.
- Demonstrate knowledge of crane capacity, crane component capacity and working radius for basic lifting operations.

Objectives and Content:

1. Define terminology associated with load charts.
 - i) gross capacity
 - ii) net capacity
 - iii) gross load
 - iv) net load
2. Identify codes, standards and regulations pertaining to load charts.
3. Identify parts of a load chart and describe their characteristics and applications.
 - i) notes
 - factors affecting capacity
 - ii) capacity charts
 - radius
 - boom length
 - boom angle
 - between listed values
 - iii) range diagram
 - iv) technical data
4. Interpret data from load charts required to plan lifts.
 - i) parts of line
 - ii) quadrants of operation
 - iii) capacity reductions for various configurations
5. Identify factors that influence crane capacity in basic lifting operations and describe their impact.
 - i) temperature
 - ii) wind conditions

- iii) crane configuration
6. Interpret basic load chart data and determine crane capacities for various configurations.

Learning Outcomes:

- Demonstrate knowledge of crane computers, their applications and procedures for use.
- Demonstrate knowledge of integrated computerized components, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with computerized operational aids and integrated computerized components.
2. Identify hazards and describe safe work practices pertaining to the use of computerized operational aids and integrated computerized components.
3. Identify types of computerized operational aids and integrated computerized components and describe their applications and procedures for use.
 - i) computer assisted safety devices
 - ii) load moment indicators (LMI)
 - central unit
 - load transducers or load cells
 - boom length and angle transducers
 - anti-two block
 - display (inside cab)
 - iii) load-monitoring devices
 - iv) maintenance monitors
 - v) range limiting devices
4. Describe the procedures used to set up computerized operational aids for crane operation.
 - i) manufacturers' specifications

CRA-080 Job Planning

Learning Outcomes:

- Demonstrate knowledge of the procedures used to plan and organize job tasks.

Objectives and Content:

1. Identify sources of information relevant to job task planning.
 - i) supervisor
 - ii) documentation
 - lift plans
 - iii) drawings
 - iv) related professionals
 - v) clients
 - vi) manufacturers
2. Identify codes, standards and regulations pertaining to job planning.
3. Describe the considerations to plan and organize job tasks.
 - i) permits
 - ii) personnel
 - iii) risk assessment
 - iv) scheduling
 - v) tools and equipment
 - vi) load weights
 - vii) company/site policy
4. Identify the sequence of job tasks to be performed.

LEVEL 2

TCO-200 Tower Crane Components

Learning Outcomes:

- Demonstrate knowledge of tower crane components, their characteristics and applications.
- Demonstrate knowledge of procedures used to troubleshoot, maintain, inspect and store tower crane components.

Objectives and Content:

1. Define terminology associated with tower crane components.
 - i) hammerhead
 - ii) luffing
 - iii) self-erecting
2. Identify hazards and describe safe work practices pertaining to tower crane components.
3. Interpret codes, standards and regulations pertaining tower crane components.
 - i) manufacturers' specifications
 - ii) CSA Z248
 - iii) jurisdictional regulations
4. Identify types of tower crane components and describe their characteristics and applications.
 - i) structural
 - ii) support
 - iii) track or travel
 - iv) cab
 - v) safety/access
5. Describe the procedures used to inspect connections of tower crane components and their accessories.
6. Describe the procedures used to troubleshoot tower crane components and accessories for various configurations.

7. Describe the procedures used to inspect, maintain and store tower crane components and their accessories.

Learning Outcomes:

- Demonstrate knowledge of access equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of procedures used to inspect and maintain access equipment.

Objectives and Content:

1. Define terminology associated with access equipment.
2. Identify hazards and describe safe work practices pertaining to access equipment.
3. Identify codes, standards and regulations pertaining to access equipment.
 - i) training and certification requirements
 - ii) jurisdictional requirements
4. Identify types of access equipment and describe their characteristics and applications.
 - i) ladders
 - ii) catwalks
 - iii) scaffolding
5. Identify types of fall protection and fall arrest equipment and describe their applications and procedures for use.
6. Describe the procedures used to erect and dismantle access equipment.
 - i) manufacturers' specifications
 - ii) professional engineer specifications
7. Describe the procedures used to inspect and maintain access equipment.
 - i) manufacturers' specifications

TCO-210 Hydraulic Systems

Learning Outcomes:

- Demonstrate knowledge of hydraulic systems, their purpose and operation.
- Demonstrate knowledge of hydraulic system components, their characteristics and applications.
- Demonstrate knowledge of the procedures used to inspect, maintain and troubleshoot hydraulic systems and their components.

Objectives and Content:

1. Define terminology associated with hydraulic systems.
2. Identify hazards and describe safe work practices pertaining to hydraulic systems and their components.
3. Identify tools and equipment relating to hydraulic systems and their components and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to hydraulic systems.
5. Explain the power transfer principles of hydraulic systems.
6. Identify types of hydraulic systems and describe their purpose and operation.
 - i) closed centre
 - ii) open centre
7. Identify hydraulic system components and describe their characteristics and applications.
 - i) pumps
 - ii) lines
 - iii) cylinders
 - iv) motors
 - v) fluid reservoir and fluid
 - vi) valves
 - vii) pressure gauges

8. Describe the procedures used to troubleshoot hydraulic systems and their components.
9. Describe the procedures used to maintain hydraulic systems and their components.
10. Describe the procedures used to inspect hydraulic systems and their components.

TCO-215 **Electrical Systems**

Learning Outcomes:

- Demonstrate knowledge of electrical systems, their purpose and operation.
- Demonstrate knowledge of electrical system components, their characteristics and applications.
- Demonstrate knowledge of procedures used to inspect, maintain and troubleshoot electrical systems and their components.

Objectives and Content:

1. Define terminology associated with electrical systems.
2. Identify hazards and describe safe work practices pertaining to electrical systems and their components.
3. Identify tools and equipment relating to electrical systems and components and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to electrical systems.
 - i) training and certification requirements
 - ii) manufacturers' specifications
5. Identify types of electrical systems and describe their purpose and operation.
 - i) digital
 - ii) analog
 - iii) control voltage
 - iv) supply voltage
6. Identify electrical system components and describe their applications.
 - i) limit switches
 - ii) grounding
 - iii) supply cables
 - iv) disconnect switches
 - v) strain relief devices (power cable supports)
 - vi) power supply
 - vii) motors
 - viii) digital drives

7. Describe the procedures used to troubleshoot electrical systems and their components.
8. Describe the procedures used to maintain electrical systems and their components.
9. Describe the procedures used to inspect electrical systems and their components.

Learning Outcomes:

- Demonstrate knowledge of mechanical systems, their purpose and operation.
- Demonstrate knowledge of mechanical system components, their characteristics and applications.
- Demonstrate knowledge of procedures used to inspect, maintain and troubleshoot mechanical systems and their components.

Objectives and Content:

1. Define terminology associated with mechanical systems.
2. Identify hazards and describe safe work practices pertaining to mechanical systems and their components.
3. Identify tools and equipment relating to mechanical systems and components and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to mechanical systems.
5. Identify types of mechanical systems and describe their purpose and operation.
6. Identify mechanical system components and describe their applications.
 - i) winches
 - ii) sheaves
 - iii) slewing drives
 - iv) brakes
 - v) gear boxes
 - vi) mechanical safety devices
 - vii) trolley components
7. Describe the procedures used to troubleshoot mechanical systems and their components.
8. Describe the procedures used to maintain mechanical systems and their components.
 - i) lubricate

- ii) torque bolts
 - iii) mark bolts
9. Describe the procedures used to inspect mechanical systems and their components.

Learning Outcomes:

- Demonstrate knowledge of the procedure to determine weight of irregular shaped loads.
- Demonstrate knowledge of the procedure to determine the centre of gravity.

Objectives and Content:

1. Define terminology associated with determining the weight of irregular shaped loads and centre of gravity of objects.
2. Explain the importance of determining the weight of irregular shaped loads and centre of gravity and their relevance in lifting operations.
3. Identify the considerations used to determine the weight of irregular shaped loads and their centre of gravity.
 - i) volume of object
 - ii) weight of materials
 - iii) weight of rigging
4. Perform calculations to determine load weights for irregular shaped loads.
5. Perform calculations to determine centre of gravity in irregular shaped loads.

Learning Outcomes:

- Demonstrate knowledge of tower crane load charts, their characteristics and applications.
- Demonstrate knowledge of tower crane capacity, tower crane component capacity and working radius for lifting operations.

Objectives and Content:

1. Define terminology associated with tower crane load charts.
2. Explain the principles of tower crane load charts.
 - i) CSA Z248
 - ii) jurisdictional regulations
3. Identify parts of a tower crane load chart and describe their characteristics and applications.
 - i) notes
 - ii) capacity charts
 - iii) range diagram
 - iv) technical data
 - v) factors reducing capacity
4. Interpret data from tower crane load charts required to plan lifts.
 - i) reeving requirements
 - ii) parts of line
 - iii) quadrants of operation
 - iv) capacity reductions for various configurations
5. Identify factors that influence tower crane capacity in lifting operations and describe their impact.
 - i) size and/or weight of load
 - ii) sail area of lift
 - iii) temperature
 - iv) wind conditions

6. Interpret load chart data and determine tower crane capacities for various configurations.

Learning Outcomes:

- Demonstrate knowledge of tower cranes and their associated components.
- Demonstrate knowledge of the procedures used for the assembly and disassembly of tower cranes and their components.

Objectives and Content:

1. Define terminology associated with the assembly and disassembly of tower cranes.
2. Identify hazards and describe safe work practices pertaining to the assembly and disassembly of tower cranes.
3. Identify tools and equipment relating to the assembly and disassembly of tower cranes and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to the assembly and disassembly of tower cranes.
 - i) permits
5. Interpret charts, drawings and specifications relating to the assembly and disassembly of tower cranes.
 - i) manufacturers' specifications
 - ii) professional engineer specifications
6. Identify tower crane components requiring assembly and disassembly.
 - i) mast/tower
 - ii) boom/trolley
 - iii) counter-jib
 - iv) counter-weight
 - v) apex/tower top
7. Describe the procedures used to assemble tower cranes and their components.
8. Describe the procedures used to disassemble tower cranes and their components.

9. Describe the procedures used for the assembly and disassembly of specialty equipment and their attachments.
10. Describe the procedures used to transport tower crane components and self-erecting tower cranes.

Learning Outcomes:

- Demonstrate knowledge of the procedures used in the positioning and stabilizing of self-erecting tower cranes.

Objectives and Content:

1. Define terminology associated with of self-erecting tower crane positioning and stabilizing.
2. Identify hazards and describe safe work practices pertaining to of self-erecting tower crane positioning and stabilizing.
3. Identify tools and equipment relating to of self-erecting tower crane positioning and stabilizing and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to of self-erecting tower crane positioning and stabilizing.
 - i) safe limits of approach
 - energized conductors (overhead and buried)
 - proximity to other structures or equipment
 - excavations
 - public areas
5. Interpret information pertaining to self-erecting tower crane positioning and stabilizing found on drawings and specifications.
 - i) manufacturers' specifications
 - ii) professional engineer specifications
6. Describe the procedures used for proper self-erecting tower crane positioning and stabilizing.

TCO-240

Pre-lift Activities

Learning Outcomes:

- Demonstrate knowledge of the steps required for pre-lift activities.
- Demonstrate knowledge of procedures used to perform pre-lift (warm-up) activities.
- Demonstrate knowledge of the procedures used to prepare worksite for tower crane operations.

Objectives and Content:

1. Define terminology associated with pre-lift planning.
2. Identify hazards and describe safe work practices pertaining to pre-lift planning.
3. Identify tools and equipment relating to pre-lift planning and activities and describe their applications and procedures for use.
4. Interpret codes, standards and regulations pertaining to pre-lift planning.
 - i) jurisdictional requirements
 - ii) job site/company policies
5. Interpret information pertaining to lifting operations found on drawings and specifications.
 - i) lift plans
 - ii) manufacturers' specifications
6. Identify the considerations and requirements for completing pre-lift planning.
 - i) risk assessment (job site hazard analysis)
 - ii) site assessment
 - site/soil conditions
 - crane access
 - obstructions
 - electrical hazards
 - iii) worksite preparation
7. Identify the requirements and describe the procedures used to perform pre-lift (warm-up) activities.

- i) function tests
 - logbook
 - ii) confirming limits
 - load moment indicator
 - iii) troubleshooting techniques
8. Describe the procedures used to prepare worksite for crane operations.
9. Describe the procedures used to perform final site inspection.

TCO-245 Continual Checks

Learning Outcomes:

- Demonstrate knowledge of the procedures used to perform continual checks.

Objectives and Content:

1. Define terminology associated with continual checks.
2. Identify hazards and describe safe work practices pertaining to performing continual checks.
3. Identify tools and equipment relating to continual checks and describe their applications and procedures for use.
4. Explain continual checks, their purpose and applications.
5. Identify crane components requiring continual checks.
6. Describe the procedures used to perform continual checks.
 - i) monitor
 - site conditions
 - running lines
 - hoist lines
 - standing ropes
 - gauges and warning systems
 - supporting base
 - weather conditions
7. Describe the procedures used to document deficiencies found during continual checks.

Learning Outcomes:

- Demonstrate knowledge of hammerhead cranes, their applications and operation.
- Demonstrate knowledge of the procedures used to operate hammerhead cranes and their attachments.

Objectives and Content:

1. Define terminology associated with hammerhead crane operations.
2. Identify hazards and describe safe work practices pertaining to hammerhead crane operations.
 - i) personnel
 - ii) equipment
 - iii) environmental
3. Interpret codes, standards and regulations pertaining to hammerhead crane operations.
 - i) site specific
 - ii) jurisdictional regulations
4. Interpret charts, drawings and specifications pertaining to hammerhead crane operations.
 - i) lift plans
 - ii) manufacturers' specifications
5. Describe the procedures used to operate hammerhead cranes and their attachments.

Learning Outcomes:

- Demonstrate knowledge of luffing jib cranes, their applications and operation.
- Demonstrate knowledge of the procedures used to operate luffing jib cranes and their attachments.

Objectives and Content:

1. Define terminology associated with luffing jib crane operations.
2. Identify hazards and describe safe work practices pertaining to luffing jib crane operations.
 - i) personnel
 - ii) equipment
 - iii) environmental
3. Interpret codes, standards and regulations pertaining to luffing jib crane operations.
 - i) site specific
 - ii) jurisdictional regulations
4. Interpret charts, drawings and specifications pertaining to luffing jib crane operations.
 - i) lift plans
 - ii) manufacturers' specifications
5. Describe the procedures used to operate luffing jib cranes and their attachments.

Learning Outcomes:

- Demonstrate knowledge of self-erecting tower cranes, their applications and operation.
- Demonstrate knowledge of the procedures used to operate self-erecting tower cranes and their attachments.

Objectives and Content:

1. Define terminology associated with self-erecting tower crane operations.
2. Identify hazards and describe safe work practices pertaining to self-erecting tower crane operations.
 - i) personnel
 - ii) equipment
 - iii) environmental
3. Interpret codes, standards and regulations pertaining to self-erecting tower crane operations.
 - i) site-specific
 - ii) jurisdictional regulations
4. Interpret charts, drawings and specifications pertaining to self-erecting tower crane operations.
 - i) lift plans
 - ii) manufacturers' specifications
5. Describe the procedures used to operate self-erecting tower cranes and their attachments.

Learning Outcomes:

- Demonstrate knowledge of climbing and lowering components and their applications.
- Demonstrate knowledge of the procedures used for climbing and lowering operations.

Objectives and Content:

1. Define terminology associated with climbing and lowering.
2. Identify hazards and describe safe work practices pertaining to climbing and lowering.
3. Interpret codes, standards and regulations pertaining to climbing and lowering.
4. Interpret charts, drawings and specifications relating to climbing and lowering.
5. Identify types of climbing and lowering components and describe their applications.
6. Identify the considerations and requirements for climbing and lowering tower cranes.
 - i) length of power supply cable
 - ii) environment
 - iii) weather
 - iv) balance
 - v) manufacturers' specifications
7. Describe the procedures used to perform bottom-climbing operations.
8. Describe the procedures used to perform top-climbing operations.
9. Describe the procedures used to perform lowering operations.

Learning Outcomes:

- Demonstrate knowledge of non-routine rigging and lifts, their applications, limitations and procedures.
- Demonstrate knowledge of non-routine rigging and lift techniques.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to non-routine rigging and lifts.
2. Interpret codes, standards and regulations pertaining to non-routine rigging and lifts.
3. Identify types of non-routine rigging and lifts and describe their applications.
4. Identify types of non-routine lift attachments and describe their applications, limitations and procedures for use.
5. Describe the procedures used to determine the centre of gravity of a load.
6. Describe the procedures used to determine tension.
 - i) snatch blocks
 - ii) attachment points
 - iii) unequal length slings
7. Describe the procedures used to perform non-routine lifts.
8. Describe the importance of critical lift plans.

Learning Outcomes:

- Demonstrate knowledge of specialty crane operations, their characteristics and applications.
- Demonstrate knowledge of the procedures used to perform specialty crane operations.

Objectives and Content:

1. Define terminology associated with specialty crane operations.
2. Identify hazards and describe safe work practices pertaining to specialty crane operations.
3. Interpret codes, standards and regulations pertaining to specialty crane operations.
4. Interpret charts, drawings and specifications pertaining to specialty crane operations.
5. Identify specialty crane operations and describe their characteristics and applications.
 - i) multi-crane lifts
 - ii) hoisting personnel
 - iii) evacuation procedures
 - iv) critical capacity lifts
 - v) professional engineer specifications
6. Describe the procedures used to attach equipment to cranes for specialty operations.
7. Describe the procedures used to perform specialty crane operations.