

Crane and Hoisting Equipment Operator Common Core – Level 1

Crane and Hoisting Equipment Operator

Unit: A1 Learning About Work

Level: One

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

One sign that an apprentice has become competent in a task or technique is to be asked to share this knowledge. Jobsite skills-exchange has long been fundamental to trade-learning. Even trade veterans rely on peers to refine their knowledge and skill. The opportunity to benefit from this process, however, is shaped by complex factors that include jobsite 'politics' and industrial/construction deadlines. As adult trade-learners, apprentices at all levels of training must use their observational, listening and interpersonal skills to benefit from the JP's knowledge and experience. This requires understanding the trade's dynamics, as well as the roles and responsibilities which order workplace/jobsite work-life.

This unit profiles the trade's structure and scope as determined by the Apprenticeship and Certification Act, regulations, Provincial Advisory Committees and the National or Provincial Occupational Analysis from which the training standards are derived (core tasks and skill requirements), as well as its job-ladders and long-term career options and social competencies. This includes information about major areas of working knowledge, activities and interactions at work, and expansive and restrictive workplaces, stressing their application to apprenticeship on-the-job training.

A sound grasp of the roles, workplace relationships, and possibilities introduced in this unit are part of 'learning to learn' in Manitoba's apprenticeship system. Senior apprentices are later offered information about learning to *teach* in this system – a central and time-honored foundation of Trades journeywork.

Note: No percentage-weightings for test purposes are prescribed for this unit's objectives. Instead, a 'Pass/Fail' grade will be recorded for the unit in its entirety.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe structure and scope of the Crane and Hoisting Equipment Operator (Mobile Crane Operator, Boom truck Hoist Operator, Tower Crane Operator) trade.</p> <p>a. The Apprenticeship and Certification Act</p> <ul style="list-style-type: none"> • Apprenticeship and Certification Board and Provincial Advisory Committees • General and specific trade regulation • Policies regarding attendance, evaluation procedures, conduct and progression requirements (Apprenticeship Manitoba, Training provider) <p>b. Uses of the National Occupational Analysis (NOA) for Mobile Crane Operator and Tower Crane Operator, and the Provincial Occupational Analysis (POA) for Boom Truck Hoist Operator</p> <ul style="list-style-type: none"> • Technical training in-school curriculum • On-the-job record book of hours (Manitoba blue book) • Logbook of on-the-job task competencies 	n/a

- Examinations (level placement tests, final certification examinations)
- c. Opportunities and future career options
 - Generalists and specialists. The move toward specialization is well known to modern tradespeople. Some prefer to specialize and others want to do it all. Supervisory positions require a broad scope.
 - Lead hands and other immediate supervisors. Apprentices need to know how to become a lead-hand as much as they need to know the benefits and pit-falls of leadership between management and shop floor workers.
 - Geographic mobility. What does it mean to a construction/industrial worker to have to travel to find work? Are there more opportunities if they do? What are they? What are the draw-backs to being away from home for several weeks at a time?
 - Job hierarchies and innovations. What trade specific special training opportunities are available in your trade? Is there travel involved? Is there an opportunity to move up the ladder on a work crew as opposed to staying in the shop?

2. Describe two levels of workplace competency. n/a

- a. Job competencies related to workplace culture
 - Knowledge of workplace equipment and materials
 - Skills and techniques
- b. Social competencies related to workplace culture
 - Frame of reference for evaluation workplace events
 - Language of work
 - Workplace belief systems
 - Rules and meanings
 - Multiculturalism and equity in the workplace

3. Describe accommodation for apprentices with disabilities. n/a

- a. Technical training
 - Requirements
 - Roles and responsibilities
 - Services and information required by persons with disabilities
- b. On-the-job
 - Requirements
 - Roles and responsibilities
 - Services and information required by persons with disabilities

Crane and Hoisting Equipment Operator

Unit: A2 Trade Safety Awareness

Level: One

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

Safe working procedures and conditions, injury prevention, and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers, and employees. It is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to incidents or injury. It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe, and accident-free working environment. It is imperative to apply and be familiar with the Workplace Safety and Health Act and Regulations. As well, it's essential to determine workplace hazards and take measures to protect oneself, co-workers, the public, and the environment. Safety education is an integral part of trade apprenticeship training both in school and on-the-job. Unit content is supplemented throughout Technical Training by trade-specific information about trade safety hazards and precautions presented in the appropriate contexts of discussion and study.

Note: No percentage-weightings for test purposes are prescribed for this unit's objectives. Instead, a 'Pass/Fail' grade will be recorded for the unit in its entirety.

Objectives and Content:

Percent of Unit Mark (%)

1. Identify safety and health requirements.

n/a

- a. Overview of The Workplace Safety and Health Act ("the Act")
 - Rights and responsibilities of employees under the Act
 - Rights and responsibilities of employers under the Act
 - Rights and responsibilities of supervisors under the Act
- b. Fourteen (14) regulations
- c. Codes of practice
- d. Guidelines
- e. Right to refuse
 - Explanation of right to refuse process
 - Rights and responsibilities of employees
 - Rights and responsibilities of employers
 - Rights and responsibilities of supervisors under the Act

2. Identify personal protective equipment (PPE) and procedures.

n/a

- a. Employer and employee responsibilities as related to personal protective equipment.
- b. Standards: Canadian Standards Association (CSA), American National Standards Institute (ANSI) and guidelines

- c. Work protective clothing and danger if it fits poorly.
 - d. Gloves – Importance of proper glove selection (when handling chemicals, cold items, slivers, etc.)
 - e. Headwear – appropriate protective headwear when required and the approved type of headwear.
 - f. Eye protection – comparison and distinction of everyday eyeglasses, industrial safety glasses and safety goggles
 - g. Foot protection – when required according to safety standards
 - h. Hearing protection
 - Hazards of various noise levels (hearing protection must be worn)
 - Laws
 - Types of hearing protection
 - i. Respiratory protection – types, overview of proper selection
 - j. Fall protection – Manitoba requirements standards guidelines
 - ANSI (U.S.A. standards), etc.
 - k. Ladders and scaffolding
 - l. Safety principles for working with or around industrial trucks site-specific (forklifts, pallet trucks, etc.)
- 3. Identify electrical safety.** **n/a**
- a. Effects of electric current on the human body
 - b. Three factors that affect the severity of an electric shock
 - c. The effects of arc and blast on the human body and equipment
 - d. Work with energized equipment
- 4. Identify fire safety.** **n/a**
- a. Types of fires
 - b. Types of firefighting equipment
 - c. Classifications of fire extinguishers (A, B and C)
 - d. Location of fire extinguishers and fire exits
 - e. Fire alarms and drills
- 5. Identify ergonomics.** **n/a**
- a. Definition of ergonomics and conditions that may affect the body
 - Working postures
 - Repetition
 - Force
 - Lifting (simple safety procedures and precautions related to material handling procedures on how to lift carry and put down a load)
 - Tools
 - Identify tool and safety equipment
 - Causes of hand tool accidents
 - Equipment
- 6. Hazard recognition and control.** **n/a**
- a. Safe work practices
 - b. Basic risk assessment
 - c. Injury prevention and control measures
 - d. Identification of hazards involved in pneumatic tool use and explanation of how to guard against them
- 7. Hazard of confined space entry:** **n/a**
- a. Identification of a confined space
 - b. Hazards of a confined space
 - Physical

- Biological
- c. Working in a confined space
- d. Emergency response plan
- e. Self contained breathing apparatus (SCBA)

8. Identify First Aid/CPR: n/a

- a. Overview of First Aid Regulation
- b. Obligations of employers regarding First Aid
 - Who is certified to provide First Aid?
 - What to do while waiting for help?
 - Where is First Aid kit?
- c. Describe basic First Aid requirements and techniques
 - Scope and limits of First Aid intervention
 - Specific interventions (cuts, burns, abrasions, fractures, suffocation, shock, electrical shock, etc.)
 - What is it?
 - Interface with other services and agencies (eg. Workers Compensation claims)
- d. Describe basic Cardiopulmonary Resuscitation (CPR) requirements and techniques
 - How do you get certified?
 - Scope and limits of CPR intervention (include varieties of CPR certification)

9. Identify the safety requirements as they apply to WHMIS with emphasis on: n/a

- a. WHMIS is a system
- b. Provincial Regulation under The Workplace Safety and Health Act
 - Each province has a WHMIS regulation
- c. Federal Hazardous Products Act
- d. WHMIS generic training:
 - WHMIS defined and the format used to convey information about hazardous materials in the workplace
 - Information found on supplier and workplace labeling using WHMIS
 - Hazardous materials in accordance with WHMIS
 - Compliance with government safety standards and regulations
- e. Description of WHMIS (include varieties of WHMIS Certification)
 - Typology of WHMIS labels, symbols, and classifications
 - Scope and use of Materials Safety Data Sheets (MSDS)

10. Identifying and controlling hazards: n/a

- a. Basic control measures (injury prevention)
- b. Safe work procedures
- c. Explanation on the importance of industrial housekeeping
- d. Employer responsibilities
- e. How and where to store materials
- f. Safety measures related to walkways, stairs and floor openings
- g. Explanation of how to protect the worker and others when working in traffic paths

Crane and Hoisting Equipment Operator

Unit: A3 Trade Regulatory Environment

Level: One

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about trade regulatory environment. The unit covers the main components of the trade regulatory environment, the standards regulating crane operation and the regulations governing the use and transport of equipment.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe the main components of the trade regulatory environment.	35%
a. Agencies for inspection and enforcement <ul style="list-style-type: none">• Workplace Safety and Health	
b. Process of inspection and enforcement	
c. Federal regulations	
d. Provincial act and regulations	
2. Describe the standards regulating crane operation.	45%
a. Canadian Standards Association (CSA) Z-150	
b. American Society of Mechanical Engineers (ASME) standards	
c. Industry standards <ul style="list-style-type: none">• Employer• Union	
d. Manufacturer's standards <ul style="list-style-type: none">• Operation and maintenance manuals• Load charts	
3. Describe the regulations governing the use and transport of equipment.	20%
a. Regulatory bodies and their regulations <ul style="list-style-type: none">• Federal• Provincial• Municipal	
b. Scope and specific details pertaining to: <ul style="list-style-type: none">• Weights• Dimensions• Equipment transportation• Inspection and enforcement• Route restrictions	

- Logbooks

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Unit: A4 Introduction to Hoisting Equipment

Level: One

Duration: 42 hours

Theory: 28 hours

Practical: 14 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about hoisting equipment. The unit begins with coverage of the types of hoisting equipment. Part of the unit covers basic scientific principles associated with the trade. Finally, the unit covers power trains, suspension and hydraulic systems.

Objectives and Content:

**Percent of
Unit Mark (%)**

1. **Describe types of hoisting equipment.**
 - a. Mobile cranes
 - Rough-terrain (RT)
 - All-terrain (AT)
 - Crawler
 - Truck mount
 - Lattice boom
 - Telescopic boom
 - Hydraulic
 - Friction/conventional
 - Special attachments and applications
 - b. Tower cranes
 - Hammerhead
 - Flat-top
 - Luffing jib
 - Self-erecting
 - Climbing
 - Rail-mounted
 - Jack knife
 - c. Boom trucks
 - Articulated boom
 - Telescopic boom
 - d. Other hoisting equipment
 - Overhead crane
 - Gantry crane
 - Tugger winch
 - Material hoist
 - Derricks

15%

- 2. Describe leverage and stability, and other basic scientific principles associated with the trade. 35%**
- a. Key terms
 - b. Gravitational centers
 - c. Dynamics of load leverage
 - Areas of operation
 - Impacts of upper-works rotation
 - Effect of load on booms
 - Effect of pendant angle on booms
 - d. Stability rating
- 3. Describe power trains and suspension systems. 30%**
- a. Steering systems
 - b. Suspension systems
 - c. Air brake systems
 - d. Wheels and tires
 - e. Diesel systems
 - Types of diesel engines
 - Diesel engine components
 - Explanation of diesel engine mechanics
 - Air intake systems
 - Fuel delivery
 - Turbochargers and superchargers
 - f. Electrical systems
 - Charging systems
 - Starting systems
 - Batteries
 - g. Transmissions and drive trains
 - h. Inspection and maintenance
- 4. Describe hydraulic systems. 20%**
- a. Power transfer through hydraulic systems
 - Pascal's Law
 - b. Application of hydraulics
 - c. Hydraulic system components
 - d. Inspection and maintenance

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Unit: A5 Trade Math I

Level: One

Duration: 14 hours

Theory: 14 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about trade math. The unit covers relevant mathematical operations and trade-related calculations, and their applications to load charts.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe/Perform relevant mathematical operations.	30%
a. Basic operations	
b. Order of operations	
c. Fractions and decimals	
d. Ratios and proportions	
e. Conversion and units of measurement	
f. Area, volume and density	
g. Basic geometry	
h. Use of electronic calculator	
2. Perform trade-related calculations.	45%
a. Load weights	
b. Load distribution	
c. Load angle factor	
d. Safe Working Load (SWL) / Working Load Limit (WLL)	
3. Describe the use of trade math pertaining to the use of load charts.	25%
a. Calculate crane capacities	
b. Determine maximum radii	
c. Determine required parts of line	

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Unit: A6 Load Chart I

Level: One

Duration: 42 hours

Theory: 35 hours

Practical: 7 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about load charts. This unit covers the use of load charts, crane configuration and load moment indicator (LMI) configuration. This unit also covers calculation of crane capacities.

Objectives and Content:

**Percent of
Unit Mark (%)**

1. Describe use of load charts.

20%

- a. Terminologies, principles and applications
 - Determine unit of measurement used
 - Boom length, boom angle and boom point elevation
 - De-rating
 - Values between chart listings
 - Calculate percentage of gross load
- b. Determining load weights
- c. Parts of line
 - Type, weight and capacity of wire rope
 - Permissible single line pull
- d. Range of diagrams
- e. Areas of operation
- f. Stability versus structural capacity
- g. Manufacturer's notes and restrictions
- h. Selection of load rating chart
- i. Factors affecting capacity
 - Equipment type, configuration and condition
 - Load characteristics
 - Geological and atmospheric conditions
 - Duty cycle

2. Determine crane configuration.

15%

- a. Supporting base
 - Outrigger position
 - On rubber configurations
 - Track width/position
 - Tower crane base considerations

- b. Optional equipment
 - Boom type
 - Boom tip
 - Auxiliary winch
 - High mast
 - Tower attachment
 - Other optional equipment
- c. Boom extensions
 - Fixed jib
 - Luffing jib
 - Auxiliary boom point
- d. Counterweight configuration
- e. Boom/jib length and required suspension
- f. Tower height and bracing

3. Perform calculation of crane capacities. 50%

- a. Main boom capacities without attachments
- b. Main boom capacities with attachments
- c. Boom extension capacities
 - Stability capacity check

4. Describe load moment indicator (LMI) configuration. 15%

- a. Terminology and types
 - Integrated
 - Aftermarket
 - Warning device
 - Function-limiting device
- b. Components
- c. Configuration process
- d. Calibration
- e. Inspection, testing and maintenance

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Unit: A7 Lift Planning I

Level: One

Duration: 21 hours

Theory: 7 hours

Practical: 14 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about lift planning. This unit covers lift planning and preparation considerations, site preparation procedures, and selection and configuration of equipment procedures.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe considerations for lift planning and preparation.	40%
a. Site characteristics	
b. Equipment configurations	
• Types of equipment	
• Setup and assembly	
c. Engineered drawings	
• Interpretation of engineered drawings	
• Use of engineered drawings	
2. Describe procedures for site preparation.	30%
a. Site hazard assessment	
b. Responsibilities of operator	
c. Responsibilities of employer	
d. Responsibilities of site owner/general contractor	
3. Describe procedures for selection and configuration of equipment.	30%
a. Selection of equipment	
• Operating limitations	
• Manufacturer's specifications	
• Site characteristics	
• Logistics considerations	
b. Identification of load characteristics	
• Calculation of gross load	
• Surface area of load	
• Rigging requirements	

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Unit: A8 Crane Assembly, Disassembly and Transport

Level: One

Duration: 21 hours

Theory: 7 hours

Practical: 14 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about crane assembly, disassembly and transport. This unit covers the general requirements for transporting crane equipment, and the procedures for assembly and disassembly of mobile and tower cranes.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe general requirements for transporting crane equipment.	25%
a. Loading/unloading and transporting	
• Highway	
• Barge	
• Railway	
• Special requirements specific to crane type	
b. Driving equipment on public roadways	
2. Describe and perform procedures for assembly and disassembly of mobile cranes.	50%
a. Mobilization/demobilization	
• Counterweights	
• Boom and jib components	
• Rope routing and terminations	
• Car body, track and house	
• Outriggers and pads	
b. Manufacturer's specifications and procedures	
3. Describe procedures for assembly and disassembly of tower cranes.	25%
a. Tower crane engineering and major components	
b. Securement of crane on footing (and/or rail base)	
c. Assembly and disassembly	
• Counterweights	
• Jib and counter-jib components	
• Rope routing and terminations	
• Specialized tools and equipment	
d. Manufacturer's specifications and procedures	

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Unit: A9 Rigging I

Level: One

Duration: 35 hours

Theory: 14 hours

Practical: 21 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about rigging. The unit begins with coverage of rigging hardware and tools, and wire rope types and applications. Part of the unit covers reeving and rigging procedures for handling materials. Finally, the unit covers specialty rigging procedures.

Objectives and Content:

**Percent of
Unit Mark (%)**

1. **Describe rigging hardware and tools.**
 - a. Sling types, attributes and applications
 - Wire rope
 - Synthetic
 - Chain
 - Others
 - b. Attachments and connections
 - Hooks
 - Shackles
 - Eye bolts and lugs
 - Turnbuckles
 - Rings, links and swivels
 - c. Hoisting mechanisms
 - Drums and winches
 - Load blocks and downhaul
 - Sheaves
 - Friction coefficient
 - d. Hoisting tools
 - Lever hoist
 - Chain hoist
 - Block and tackle (fiber rope)
 - e. Material handling devices
 - Pallet forks
 - Material baskets
 - Plate clamps
 - f. Spreader and equalizer beams
 - g. Rigging equipment inspection
 - Daily visual inspection

35%

- Periodic inspection
- Documentation

2. Describe wire rope types and applications. 20%

- Rope construction and nomenclature
- Characteristics of wire rope types
- Inspection and maintenance of wire ropes
 - Criteria for removal from service
- Safe working load
 - Catalogue breaking strength
 - Safety factor
- Hoisting ropes
 - Installation
 - Seizing
 - Minimum drum windings
- End fittings and connections
 - Types and terminology
 - Termination efficiency
 - Flemish eye splice
 - Cable clips
- Hazards and precautions
 - Elongation of wire rope
 - Handling and storage
 - Cutting techniques

3. Describe rigging procedures for handling materials. 30%

- Sling configurations
 - Basic hitches
- Safe working load of rigging components
 - Share of load calculations
 - Load angle factor
 - D/d ratio
- Load characteristics
 - Weight of load
 - Center of gravity
 - Structural considerations
- Special requirements for non-standard loads
 - Imbalanced loads
 - Fragile loads
 - Flexible loads
 - Dynamic center of gravity
- Transferring loads
- Use of taglines

4. Describe reeving. 15%

- Reeving principles
 - Mechanical advantage
 - Friction coefficient
- Reeving methods and applications
 - Lacing
 - Skip reeving
 - Square reeving
 - Changing parts of line on tower crane

c. Block-and-tackle

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Unit: A10 Hoisting Equipment Operation

Level: One

Duration: 49 hours

Theory: 14 hours

Practical: 35 hours

Overview:

This unit is designed to provide the apprentice with introductory knowledge about hoisting equipment operation. The unit begins with coverage of the responsibilities of hoisting personnel, crane setup, and pre-operational inspection and maintenance procedures. Part of the unit covers basic operation procedures specific to crane type. Finally, the unit covers procedures for leaving cranes unattended.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe responsibilities of hoisting personnel.</p> <ul style="list-style-type: none"> a. Roles of personnel involved b. Hazards and precautions in vicinity of crane operations c. Communications and lines of sight 	10%
<p>2. Describe and perform pre-operational inspection and maintenance procedures.</p> <ul style="list-style-type: none"> a. Daily visual inspections <ul style="list-style-type: none"> • Structural components • Mechanical systems b. Operational checks c. Housekeeping d. Periodic inspection and certification e. Preventative maintenance f. Records and documentation 	20%
<p>3. Describe and perform crane setup.</p> <ul style="list-style-type: none"> a. Review unit <i>A7 Lift Planning I</i>. b. Characteristics and suitability of ground <ul style="list-style-type: none"> • Ground bearing pressure • Weight distribution in regards to area of operation c. Procedures for outrigger use <ul style="list-style-type: none"> • Bearing pad construction and sizing • Ground bearing pressure • Ground bearing capacity d. Crane leveling procedures <ul style="list-style-type: none"> • Methods of level verification • Leveling crane on outriggers 	20%

- Leveling crane on tracks
- e. Considerations regarding crane configuration
 - Order of setup operations

4. Describe and perform basic operational procedures. 20%

- a. Determine load characteristics
- b. General hoisting
 - Operational controls and applications
 - Boom/tower deflection
 - Load control
 - Simultaneous functions
 - Monitoring of systems and conditions
 - Operating limitations
 - Manufacturer's specifications and procedures
- c. Crane direction
 - Hand signals
 - Radio communications
 - Other
- d. Special considerations
 - Operating near high voltage
 - Operating in inclement weather conditions
 - Jobsite obstructions
 - Precision hoisting
 - Environmental considerations
 - Duty cycle operations
 - Personnel hoisting
 - Emergency shutdown procedures
 - Evacuation procedures

5. Describe and perform basic operational procedures specific to crane type. 20%

- a. Mobile crane
 - Indoor operations
 - On-rubber operations
 - Pick and carry operations
 - Marine applications
- b. Tower crane
 - Contact avoidance systems
 - Weathervane
 - Test weight

6. Describe and perform procedures for leaving cranes unattended. 10%

- a. Long term
- b. Short term
