

PROGRAM * PROGRAMME
EXCELLENCE
RED SEAL · SCEAU ROUGE

Interprovincial Program Guide

Heavy Equipment Operator (Excavator)

2016

**CANADIAN
STANDARD
OF EXCELLENCE
FOR SKILLED TRADES**



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Employment and
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Canada 

Heavy Equipment Operator (Excavator)

2016

Trades and Apprenticeship Division

Division des métiers et de l'apprentissage

Labour Market Integration Directorate

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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 Heavy Equipment Operator (Excavator).

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 Employment and Social Development Canada (EDSC), 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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Rob Ryl	British Columbia
Gary Snow	Newfoundland and Labrador

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

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 levelling 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.

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.
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.
PROCEDURE	A prescribed series of steps taken to accomplish an end.
PURPOSE	The reason for which something exists or is done, made or used.

IPG Glossary of Terms *(continued)*

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 to identify and locate a problem or malfunction and its cause.

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 adapt to 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 Employment and Social Development Canada's Essential Skills website at:

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

Profile Chart

COMMON OCCUPATIONAL SKILLS			
HEO-100 Safety	HEO-105 Tools and Equipment	HEO-110 Hoisting and Rigging	HEO-115 Communication
HEO-120 Survey Indicators – I	HEO-125 Slopes and Grades	HEO-130 Methods of Approach	HEO-135 Trade Related Documents
HEO-140 Soil Fundamentals	HEO-200 Survey Indicators – II	HEO-205 Drawings and Plans	
HEAVY EQUIPMENT (EXCAVATOR) INSPECTION AND BASIC MAINTENANCE			
HEO-145 Introduction to Heavy Equipment	HEO-150 Heavy Equipment Systems and Components	EXC-155 Scheduled and Preventative Maintenance	HEO-160 Pre- and Post-Operational Inspections
EXC-165 Troubleshooting and Basic Repairs			
COMMON HEAVY EQUIPMENT OPERATOR (EXCAVATOR) TASKS			
EXC-170 Attachments and Implements – I	HEO-175 Transportation of Equipment	HEO-180 Equipment Operation Safety	EXC-210 Attachments and Implements – II
HEO-185 Environmental Protection – I	HEO-215 Environmental Protection – II	EXC-190 Excavators – I	EXC-220 Excavators – II

Recommended Level Structure

HEO = Possible Common Units to Heavy Equipment Operator (Dozer), Heavy Equipment Operator (Excavator) and Heavy Equipment Operator (Tractor-Loader-Backhoe) IPG

EXC = Possible Specific Units to Heavy Equipment Operator (Excavator) IPG

Level 1			Level 2		
Unit Code	Title	Page	Unit Code	Title	Page
HEO-100	Safety	17	HEO-200	Survey Indicators – II	57
HEO-105	Tools and Equipment	20	HEO-205	Drawings and Plans	58
HEO-110	Hoisting and Rigging	21	EXC-210	Attachments and Implements –II	60
HEO-115	Communication	24	HEO-215	Environmental Protection – II	62
HEO-120	Survey Indicators – I	26	EXC-220	Excavators – II	64
HEO-125	Slopes and Grades	27			
HEO-130	Methods of Approach	28			
HEO-135	Trade Related Documents	30			
HEO-140	Soil Fundamentals	32			
HEO-145	Introduction to Heavy Equipment	34			
HEO-150	Heavy Equipment Systems and Components	35			
EXC-155	Scheduled and Preventative Maintenance	36			
HEO-160	Pre- and Post-Operational Inspections	38			
EXC-165	Troubleshooting and Basic Repairs	40			
EXC-170	Attachments and Implements – I	42			
HEO-175	Transportation of Equipment	44			
HEO-180	Equipment Operation Safety	46			
HEO-185	Environmental Protection – I	49			
EXC-190	Excavators – I	51			

2015 NOA Sub-task to IPG Unit Comparison

NOA Sub-task		IPG Unit	
Task 1 – Uses and maintains tools and equipment.			
1.01	Maintains hand and power tools.	HEO-105	Tools and Equipment
1.02	Maintains measuring and testing equipment.	HEO-105	Tools and Equipment
1.03	Uses grade checking and tracking instruments.	HEO-105	Tools and Equipment
1.04	Uses riggings and lifting equipment.	HEO-110	Hoisting and Rigging
1.05	Uses personal protective equipment (PPE) and safety equipment.	HEO-100	Safety
Task 2 – Maintains safe work environment.			
2.01	Assesses potential hazards.	HEO-100	Safety
		HEO-180	Equipment Operation Safety
2.02	Plans worksite safety strategies.	HEO-100	Safety
2.03	Secures unattended equipment.	HEO-100	Safety
2.04	Communicates with others.	HEO-115	Communication
2.05	Performs spill control procedures.	HEO-185	Environmental Protection – I
2.06	Performs sediment control procedures.	HEO-185	Environmental Protection – I
		HEO-215	Environmental Protection – II
2.07	Handles material.	HEO-100	Safety
Task 3 – Organizes work.			
3.01	Checks grade.	HEO-125	Slopes and Grades
3.02	Uses documentation.	HEO-135	Trade Related Documents
		HEO-205	Drawings and Plans
3.03	Interprets survey indicators and data.	HEO-120	Survey Indicators – I
		HEO-200	Survey Indicators – II
3.04	Determines method of approach.	HEO-130	Methods of Approach
Task 4 – Performs scheduled maintenance.			
4.01	Maintains heavy equipment operator (excavator) station.	EXC-155	Scheduled and Preventative Maintenance
4.02	Maintains undercarriage, drive train system, tracks, tires and rims.	EXC-155	Scheduled and Preventative Maintenance
4.03	Performs preventative maintenance.	EXC-155	Scheduled and Preventative Maintenance
4.04	Performs basic maintenance on attachments.	HEO-190	Excavators – I
		EXC-210	Attachments and Implements – II
		HEO-220	Excavators – II

NOA Sub-task		IPG Unit	
Task 5 – Performs inspections.			
5.01	Performs pre-operational inspections.	HEO-160	Pre- and Post-Operational Inspections
5.02	Performs post-operational inspections.		
5.03	Completes daily equipment logbook.		
Task 6 – Performs basic heavy equipment operator (excavator) functions.			
6.01	Maintains control of equipment.	EXC-190	Excavators – I
6.02	Positions equipment for task.	EXC-190	Excavators – I
6.03	Monitors performance of equipment.	EXC-190	Excavators – I
6.04	Troubleshoots equipment problems.	EXC-165	Troubleshooting and Basic Repairs
6.05	Installs attachments.	EXC-170	Attachments and Implements – I
		EXC-190	Excavators – I
		EXC-210	Attachments and Implements – II
		EXC-220	Excavators – II
6.06	Performs emergency procedures.	HEO-100	Safety
		HEO-180	Equipment Operation Safety
		EXC-190	Excavators – I
		EXC-220	Excavators – II
6.07	Compacts material with attachments. (NOT COMMON CORE)		
6.08	Performs cut and fill operations.	EXC-220	Excavators – II
6.09	Clears snow and ice. (NOT COMMON CORE)		
Task 7 – Transports equipment.			
7.01	Prepares equipment for transportation.	HEO-175	Transportation of Equipment
7.02	Loads equipment and attachments for transportation.		
7.03	Assists in securing equipment for transportation.		
7.04	Unloads equipment and attachments.		
7.05	Drives equipment on roads.		
Task 8 – Operates excavators.			
8.01	Excavates trenches and ditches.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.02	Backfills trenches and excavations.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.03	Creates slopes.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.04	Creates mass excavations.	EXC-190	Excavators – I
		EXC-220	Excavators – II

NOA Sub-task		IPG Unit	
8.05	Clears land.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.06	Strips surface material.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.07	Stockpiles material.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.08	Places material.	EXC-220	Excavators – II
8.09	Lifts material.	EXC-190	Excavators – I
		EXC-220	Excavators – II
8.10	Loads trucks.	EXC-190	Excavators – I
8.11	Performs demolitions.	EXC-220	Excavators – II

LEVEL 1

Learning Outcomes:

- Demonstrate knowledge of personal protective equipment (PPE) and safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe operating procedures.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

2015 National Occupational Analysis Reference:

- 1.05 Uses personal protective equipment (PPE) and safety equipment.
- 2.01 Assesses potential hazards.
- 2.02 Plans worksite safety strategies.
- 2.03 Secures unattended equipment.
- 2.07 Handles material.

Objectives and Content:

1. Define terminology associated with PPE and safety equipment.
2. Identify workplace hazards and describe safe work practices and equipment.
 - i) personal
 - pressurized and hot fluids
 - pinch points
 - slips, trips and falls
 - ii) workplace
 - environment (surroundings)
 - traffic control (flagperson)
 - confined space
 - H₂S gas
 - powerline hazards/utilities
 - underground
 - overhead
 - iii) environmental
 - weather/climate effects
 - soil conditions

3. Interpret workplace safety and health regulations.
 - i) federal
 - Workplace Hazardous Material Information System (WHMIS)
 - Safety Data Sheets (SDS)
 - Transportation of Dangerous Goods (TDG)
 - ii) provincial/territorial
 - Occupational Health and Safety (OH&S)
 - First Aid
 - H₂S Alive
 - iii) municipal
 - iv) company policies
 - job safety analysis (JSA)
 - policies exceeding jurisdictional requirements

4. Identify types of PPE and describe their applications and procedures for use.

5. Identify types of safety equipment and describe their applications and procedures for use.
 - i) safety devices
 - seat belts
 - travel alarm
 - hydraulic lock outs and brakes
 - fire extinguishers
 - rollover protective structures (ROPS)
 - falling objects protective structures (FOPS)

6. Describe the procedures used to maintain and store PPE and safety equipment.

7. Describe the procedures used to safely mount and dismount equipment (three-point contact).

8. Describe the procedures used to secure unattended equipment.

9. Describe the procedures used to lock out and tag out equipment.

10. Describe the procedures used to store, use, transport and dispose of materials.
 - i) site
 - building/construction
 - spoils

- ii) hazardous
 - lubricants
 - coolants
 - fuel
11. Interpret soil types and explain how they affect strength and stability of trench walls.
 12. Describe the conditions that decrease trench wall stability.
 - i) vibration
 - ii) spoil surcharge
 - iii) weather/moisture
 - iv) equipment traffic
 13. Describe the procedures used to protect workers against cave-ins.
 - i) trench boxes
 - ii) shoring
 - iii) sloping
 14. Describe emergency procedures used while working in and around trenches.
 - i) emergency procedures
 - ii) safe access and egress
 15. Describe emergency and operational procedures used while working with or around utilities.
 - i) powerlines
 - ii) pipelines
 - iii) above ground utilities
 - iv) underground/buried utilities
 - v) after exposed underground utilities
 16. Describe the procedures used while working around moving equipment and vehicles.
 - i) blind spots
 - ii) site planning
 - iii) eye contact
 - iv) signaller

HEO-105 Tools and Equipment

Learning Outcomes:

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

2015 National Occupational Analysis Reference:

- 1.01 Maintains hand and power tools.
- 1.02 Maintains measuring and testing equipment.
- 1.03 Uses grade checking and tracking instruments.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to tools and equipment.
2. Identify types of hand tools and describe their applications and procedures for use.
3. Identify types of portable power tools and describe their applications and procedures for use.
4. Identify types of measuring and testing equipment and describe their applications and procedures for use.
5. Describe the procedures used to inspect, maintain and store tools and equipment.

Learning Outcomes:

- Demonstrate knowledge of hoisting and rigging equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of basic hoisting and rigging techniques.
- Demonstrate knowledge of the procedures used to perform hoisting operations.
- Demonstrate knowledge of calculations required when performing hoisting operations.

2015 National Occupational Analysis Reference:

1.04 Uses rigging and lifting equipment.

Objectives and Content:

1. Define terminology associated with hoisting and rigging.
2. Identify hazards and describe safe work practices pertaining to hoisting and rigging.
3. Interpret acts and regulations pertaining to hoisting and rigging.
 - i) training requirements
 - ii) Occupational Health and Safety (OH&S)
4. Identify types of rigging equipment and accessories, and describe their applications, limitations and procedures for use.
 - i) ropes
 - ii) slings
 - iii) chains
 - iv) hooks
 - v) spreader bars
 - vi) shackles
 - vii) tag lines
5. Identify the factors to consider when selecting rigging equipment.
 - i) load characteristics
 - ii) environment
 - iii) safety factor

6. Identify the considerations when rigging material and equipment for hoisting.
 - i) load characteristics
 - ii) equipment and accessories
 - iii) environmental factors
 - iv) anchor points/attachment locations
 - v) sling angles
 - vi) machine capacity/load chart

7. Identify types of knots, hitches, and splices, and describe the procedures used to tie them.
 - i) bowline
 - ii) running bowline
 - iii) square/reef
 - iv) half-hitch

8. Identify types of hoisting equipment and accessories, and describe their applications and procedures for use.
 - i) come-alongs
 - ii) chainfalls

9. Describe the procedures used to inspect, maintain and store hoisting and rigging equipment.

10. Describe the effect of sling angle on the working load limit (WLL) when preparing for hoisting operations.
 - i) strain
 - ii) capacity

11. Describe the procedures used for attaching rigging equipment to the load.

12. Identify and interpret basic hand signals used for hoisting.

13. Identify and describe procedures used to communicate during hoisting and rigging operations.
 - i) hand signals
 - ii) electronic communications
 - iii) audible/visual

14. Describe the procedures used to ensure the work area is safe for hoisting.

15. Interpret the lift plan and describe the procedures used to perform a lift.
 - i) determine load weight and dimensions
 - ii) identify machine capacity
 - iii) determine rigging requirements
 - iv) determine communication methods
 - v) perform pre-lift checks
 - vi) determine placement of load
 - vii) perform lift
 - viii) perform post-lift inspection

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of communication equipment and their applications.
- Demonstrate knowledge of customer service techniques.

2015 National Occupational Analysis Reference:

2.04 Communicates with others.

Objectives and Content:

1. Define terminology associated with effective communication practices.
2. Describe effective communication practices.
 - i) clear, concise writing
 - ii) active listening
 - iii) questioning
3. Explain the importance of effective communication practices.
 - i) customers
 - ii) co-workers
 - iii) related industry people
 - manufacturers
 - suppliers
 - consultants
4. Describe the factors and barriers that affect communication.
 - i) physiological (hearing loss)
 - ii) psychological (mood)
 - iii) site conditions (background noise, weather)
5. Identify the types of communication methods and equipment, and describe their applications and etiquette.
 - i) verbal
 - ii) written
 - iii) hand signals
 - iv) body language
 - v) equipment
 - cell/satellite phones

- 2-way radios
 - horns
 - emerging technologies
6. Explain the importance of the coaching and mentoring relationship between journey person and apprentice.
 7. Explain the importance of quality customer service, quality workmanship and professionalism.
 - i) barriers to quality customer service
 - ii) customer needs and common methods for meeting them
 - iii) characteristics and importance of a positive attitude
 8. Describe the methods used to interact with customers, address complaints and resolve conflicts.

HEO-120 Survey Indicators – I

Learning Outcomes:

- Demonstrate knowledge of the use of basic survey equipment.

2015 National Occupational Analysis Reference:

3.03 Interprets survey indicators and data.

Objectives and Content:

1. Define terminology associated with surveying.
2. Interpret basic abbreviations, symbols and markings pertaining to surveying found on stakes.
 - i) centerline
 - ii) offsets
 - iii) stations
 - iv) benchmarks
 - v) geodetic station
3. Identify types of grade checking and tracking instruments and describe their applications.
 - i) string line
 - ii) auto level
 - laser levels
 - iii) measuring tapes
 - iv) surveyor's level
 - v) hand/sight level
4. Identify types of stakes and describe their applications.
5. Describe the procedures used to verify survey grade elevation and location.
 - i) set-up instrument
 - ii) establish instrument height
 - iii) transfer information at job site

HEO-125 Slopes and Grades

Learning Outcomes:

- Demonstrate knowledge of slopes and grades.
- Demonstrate knowledge of calculating slope ratios and percentages.

2015 National Occupational Analysis Reference:

3.01 Checks grade.

Objectives and Content:

1. Define terminology associated with slopes and grades.
2. Interpret information pertaining to slopes and grades found on drawings and specifications.
3. Identify types of measuring tools used to establish grade levels and describe their applications and procedures for use.
4. Describe the procedures used to calculate the slope ratio or percentage.
5. Describe the procedures used to check grade.

HEO-130 **Methods of Approach**

Learning Outcomes:

- Demonstrate knowledge of methods of approach.

2015 National Occupational Analysis Reference:

3.04 Determines method of approach.

Objectives and Content:

1. Define terminology associated with methods of approach.
2. Identify hazards and safe work practices pertaining to determining methods of approach.
 - i) underground obstacles
 - gas lines
 - water mains
 - storm lines
 - sewer lines
 - communication lines
 - ii) overhead obstacles
 - building protrusions
 - roof overhangs
 - overhead powerlines
 - bridges and overpasses
3. Interpret drawings and specifications to determine methods of approach.
4. Identify considerations for machine selection and describe their limitations.
 - i) size
 - ii) dimensions
 - iii) capacity
 - iv) attachments
5. Identify types of methods of approach.
 - i) parallel
 - ii) perpendicular
 - iii) bench
 - iv) ramps

6. Identify the considerations used to determine methods of approach.
 - i) site conditions
 - soil
 - waterways
 - terrain
 - ii) environmental conditions
 - iii) weather conditions
 - iv) traffic

Learning Outcomes:

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

2015 National Occupational Analysis Reference:

3.02 Uses documentation.

Objectives and Content:

1. Define terminology associated with trade related documents.
2. Interpret regulations and standards pertaining to the operation of heavy equipment.
 - i) manufacturers' recommendations
 - ii) Occupational Health and Safety requirements (OH&S)
 - iii) employer requirements/Safe Operating Procedures (SOP)
3. Identify types of trade related documents and describe their applications.
 - i) manufacturers' specifications
 - ii) work orders
 - change
 - job
 - material
 - iii) logbooks
 - service / maintenance log
 - daily work log
 - time card
 - iv) pre / post-operation documentation
 - v) reports/forms
 - hazard assessments/JSA
 - accident/incident
 - toolbox/tailgate meeting documents
 - Worker's Compensation
 - equipment defect
 - vi) maintenance/service records

- vii) stock/inventory records
 - stockroom
 - job site
 - equipment

- 4. Describe the procedures used to complete trade related documents.
 - i) complete the information at the required intervals
 - ii) follow company policies, manufacturers' specifications and legislative/regulatory requirements

Learning Outcomes:

- Demonstrate knowledge of the types of soils suitable for construction and their characteristics.
- Demonstrate knowledge of swelling and compaction principles and their associated calculations.

Objectives and Content:

1. Describe soil characteristics.
 - i) load bearing
 - ii) density
 - iii) adhesion/cohesion
 - iv) shearing resistance
 - v) water resistance
 - vi) plasticity
 - vii) elasticity
 - viii) gradation
 - ix) texture
 - x) structure
 - xi) consistency
 - xii) colour
2. Identify soil types and describe their applications and characteristics.
 - i) cohesive
 - clay
 - silt
 - ii) granular
 - sand
 - gravel
 - iii) organic
 - top soil
3. Describe methods used to determine soil suitability.
 - i) feel
 - ii) visual
 - iii) smell
 - iv) soil report
 - v) construction requirements/specifications

4. Identify types of aggregates and describe their characteristics and applications.
5. Explain swell and compaction factors and describe their associated calculations.
6. Describe the procedures used to control water.
 - i) dams and berms
 - ii) ditches and swales
 - iii) pumps

HEO-145 Introduction to Heavy Equipment

Learning Outcomes:

- Demonstrate knowledge of heavy equipment.

Objectives and Content:

1. Define terminology associated with heavy equipment used in various sectors of the industry.
2. Identify hazards and describe safe work practices pertaining to the operation of heavy equipment.
 - i) tipping axis
 - ii) centre of gravity
 - iii) stability
 - iv) overhead obstructions
 - v) underground obstructions
3. Interpret acts and regulations pertaining to the use of heavy equipment.
 - i) licencing and permitting
 - ii) road regulations (highway traffic act)
 - iii) insurance requirements
 - iv) Occupational Health and Safety (OH&S)
4. Identify types of heavy equipment and describe their capabilities, advantages and limitations.
 - i) tractor-loader-backhoes (TLBs)
 - ii) dozers
 - iii) excavators
 - tracked
 - wheeled
 - other complimentary equipment
 - skid steer
 - compactors
 - haulage truck
 - loader
 - grader

Learning Outcomes:

- Demonstrate knowledge of heavy equipment systems and components, and the theory behind their function.

Objectives and Content:

1. Define terminology associated with heavy equipment systems and components.
2. Identify hazards and describe safe work practices pertaining to the inspection and operation of heavy equipment.
3. Identify types of heavy equipment systems and components, and describe their applications, characteristics and limitations.
 - i) engine systems
 - oil
 - cooling
 - fuel
 - air induction
 - exhaust (tier 4 emissions requirements)
 - ii) lubrication systems
 - iii) hydraulic systems
 - vi) drive systems
 - transmission and final drive
 - hydrostatic drive
 - v) undercarriage
 - vi) braking systems
 - vii) electrical systems
 - viii) ground engaging equipment and attachments
 - xi) steering systems
4. Explain the basic theory behind the function of heavy equipment systems and components.

Learning Outcomes:

- Demonstrate knowledge of scheduled maintenance procedures.
- Demonstrate knowledge of preventative maintenance procedures.

2015 National Occupational Analysis Reference:

- 4.01 Maintains heavy equipment operator (excavator) station.
- 4.02 Maintains undercarriage, drive train system, tracks, tires and rims.
- 4.03 Performs preventative maintenance.

Objectives and Content:

1. Define terminology associated with scheduled and preventative maintenance of heavy equipment (excavator) and attachments.
2. Identify hazards and describe safe work practices pertaining to the performance of scheduled and preventative maintenance.
3. Interpret acts, regulations and manufacturers' specifications pertaining to the performance of scheduled and preventative maintenance.
4. Identify tools and equipment used to perform scheduled and preventative maintenance, and describe their applications and procedures for use.
5. Identify systems and components that require scheduled and preventative maintenance.
 - i) engine systems
 - oil
 - cooling
 - fuel
 - air induction
 - exhaust (tier 4 emissions requirements)
 - ii) lubrication system
 - iii) hydraulic systems
 - iv) drive systems
 - transmission and final drive
 - hydrostatic drive
 - v) braking systems
 - vi) electrical systems

- vii) attachments and ground engaging components
 - viii) operator station
 - ix) undercarriage/drive train system
 - x) tracks, tires and rims
 - xi) steering systems
6. Describe the procedures used to maintain heavy equipment operator station.
 7. Describe the procedures used to maintain heavy equipment drive train system/undercarriage, tracks, tires and rims.
 8. Describe the procedures used to maintain attachments used on heavy equipment (excavator).
 9. Describe the procedures used to perform preventative maintenance on heavy equipment (excavator) systems.
 - i) check, change and fill oils and fluids
 - ii) clean and change filters
 - iii) grease fittings
 - iv) rotate and change teeth and cutting edges

Learning Outcomes:

- Demonstrate knowledge of pre-operational inspection procedures.
- Demonstrate knowledge of post-operational inspection procedures.

2015 National Occupational Analysis Reference:

- 5.01 Performs pre-operational inspections.
- 5.02 Performs post-operational inspections.
- 5.03 Completes daily equipment logbook.

Objectives and Content:

1. Define terminology associated with pre- and post-operational inspections.
2. Identify hazards and describe safe work practices pertaining to pre- and post-operational inspections.
3. Interpret acts, regulations, manufacturers' specifications and company policies pertaining to pre- and post-operational inspections.
4. Identify systems and components that require pre- and post-operational inspections.
 - i) engine compartment
 - ii) air intake/exhaust systems
 - iii) transmission systems
 - iv) swing reduction system
 - v) electrical system
 - vi) hydraulic system
 - vii) braking system
 - viii) steering system
 - ix) ground engaging components and attachments
 - x) undercarriage/drive train system
 - xi) tracks, tires and rims
 - xii) operator station
 - xiii) safety equipment
 - seat belt
 - wiper and washer (if required)
 - horn
 - backup alarm

- lights
 - first aid kit
 - emergency shutdown and fire suppression system
 - fire extinguisher
- xiv) swing drive fluid level
5. Identify the tools and equipment used to perform pre- and post-operational inspections, and describe their applications and procedures for use.
 6. Describe the procedures used to perform pre-operational inspections.
 7. Describe the procedures used to perform post-operational inspections.
 8. Describe the procedures used to complete daily equipment logbook during pre- and post-operational inspections.

Learning Outcomes:

- Demonstrate knowledge of basic troubleshooting techniques.
- Demonstrate knowledge of basic repair procedures.

2015 National Occupational Analysis Reference:

6.04 Troubleshoots equipment problems.

Objectives and Content:

1. Define terminology associated with troubleshooting and repairing heavy equipment (excavator).
2. Identify hazards and describe safe work practices pertaining to troubleshooting and repairing heavy equipment (excavator).
3. Interpret policies and standards pertaining to troubleshooting and repairing heavy equipment (excavator).
 - i) company policies
 - ii) manufacturers' specifications
 - iii) operator's repair limits as set out by regulation and legislation
4. Interpret information found on drawings and schematics pertaining to troubleshooting and repairing heavy equipment (excavator).
5. Identify tools and equipment used to troubleshoot problems with heavy equipment (excavator).
6. Identify tools and equipment used to perform basic repairs on heavy equipment.
7. Identify potential failures, symptoms and indicators of failure.
 - i) noise
 - ii) vibration
 - iii) odours
 - iv) cracks
 - v) leaks
 - vi) loss of performance
 - vii) unintended motions
 - viii) starting issues

8. Describe the procedures used to troubleshoot problems with heavy equipment (excavator).
9. Interpret codes and warning signs/symbols observed in the operator station.
10. Describe the procedures used to tow vehicles.
 - i) operational
 - ii) non-operational
11. Describe the procedures used to perform basic repairs on heavy equipment (excavator).
 - i) adjust tracks
 - ii) change tires
 - iii) change teeth and cutting edges
 - iv) replace track pads
 - v) change hydraulic hose
 - vi) change fuel and air filters
 - vii) replace fuses
 - viii) change grease fittings

Learning Outcomes:

- Demonstrate knowledge of standard heavy equipment attachments (excavator) and implements.
- Demonstrate knowledge of the procedures to remove and install standard heavy equipment (excavator) attachments and implements.

2015 National Occupational Analysis Reference:

6.05 Installs attachments.

Objectives and Content:

1. Define terminology associated with standard heavy equipment (excavator) attachments and implements used in various industries.
 - i) road building
 - ii) heavy construction
 - iii) land clearing
2. Identify hazards and describe safe work practices pertaining to the installation, operation and removal of standard heavy equipment (excavator) attachments and implements.
3. Interpret acts, regulations, manufacturers' specifications and company policies pertaining to the use of standard heavy equipment (excavator) attachments and implements.
4. Identify tools and equipment used to install and remove standard attachments and implements, and describe their applications and procedures for use.
5. Identify types of standard heavy equipment (excavator) attachments and implements, and describe their applications and limitations.
 - i) rock breaker
 - ii) buckets
 - iii) blades
 - iv) mulcher-heads
 - v) rippers
 - vi) thumbs
 - vii) packers

6. Describe the procedures used to communicate with the operator when installing and using standard attachments and implements.
7. Describe the procedures used to install and remove standard heavy equipment (excavator) attachments and implements.
8. Describe the procedures used to maintain standard heavy equipment (excavator) attachments and implements.
9. Describe the procedures used to operate heavy equipment (excavator) equipped with standard attachments and implements.

Learning Outcomes:

- Demonstrate knowledge of the procedures to load and unload equipment, attachments and implements for transportation.

2015 National Occupational Analysis Reference:

- 7.01 Prepares equipment for transportation.
- 7.02 Loads equipment and attachments for transportation.
- 7.03 Assists in securing equipment for transportation.
- 7.04 Unloads equipment and attachments.
- 7.05 Drives equipment on roads.

Objectives and Content:

1. Define terminology associated with loading/unloading and transportation of equipment.
2. Identify hazards and describe safe work practices pertaining to loading/unloading and transportation of equipment.
3. Interpret acts and regulations pertaining to the loading/unloading and transportation of equipment.
 - i) licencing and permitting
 - ii) road regulations
4. Identify requirements pertaining to loading/unloading and transportation of equipment.
 - i) signage
 - slow vehicle
 - over dimensions
 - pilot vehicle
 - dangerous goods placards
 - ii) lighting
 - beacons
 - 4-way flashers
 - escort vehicle
 - iii) cleaning of debris

5. Identify considerations when preparing equipment for transportation.
 - i) types of trailer and their limitations
 - ii) height, weight and width of equipment
 - iii) weight and size of attachments and implements
 - iv) position of equipment on trailer
 - v) changes to centre of gravity
 - vi) securement

6. Describe the procedures used to prepare equipment for transportation.
 - i) clean equipment
 - ii) remove attachments, implements and components as required
 - iii) install planking
 - iv) rigging and hoisting

7. Describe the procedures used to load equipment, attachments, implements and components for transportation.

8. Describe the procedures used to secure equipment, attachments, implements and components for transportation.

9. Describe the procedures used to unload equipment, attachments, implements and components.

Learning Outcomes:

- Demonstrate knowledge of hazards and conditions pertaining to the operation of heavy equipment.
- Demonstrate knowledge of the procedures to safely operate heavy equipment.

2015 National Occupational Analysis Reference:

- 2.01 Assesses potential hazards.
- 6.06 Performs emergency procedures.

Objectives and Content:

1. Define terminology associated with the safe operation of heavy equipment.
2. Identify hazards and describe safe work practices pertaining to the operation of heavy equipment.
 - i) personal
 - physiological states
 - psychological states
 - operational malpractice
 - operating unsafe equipment
 - operating equipment unsafely
 - training
 - ii) workplace
 - weight restrictions on infrastructure
 - bridges
 - false work
 - dock/wharf
 - parking garage
 - enclosed areas
 - underground work
 - stability of excavations and trenches
 - utilities
 - site traffic and personnel
 - iii) equipment
 - mechanical failures
 - machine capacity
 - machine stability
 - hot surfaces

- pressurized components
 - rotating components
 - crushing/pinching
 - iv) weather conditions
 - v) soil conditions
3. Interpret acts, regulations, requirements and policies pertaining to the safe operation of heavy equipment.
- i) federal
 - ii) provincial/territorial
 - iii) municipal
 - iv) manufacturers' specifications
 - v) company policies
4. Identify safe operating clearances.
- i) overhead/underground
 - ii) sides
 - iii) forward
 - iv) rearward
5. Identify the conditions to be considered when determining equipment operating clearances.
- i) configuration
 - extended
 - retracted
 - ii) attachments
 - iii) extensions
 - iv) swing and reach
 - v) height and reach restriction devices
 - vi) centre of gravity
 - tipping axis
6. Identify information required before digging.
- i) work permits
 - ii) locates
 - iii) hazard assessment/JSA
 - iv) soil analysis

7. Describe the procedures used to safely shut down and secure heavy equipment.
 - i) ground elevated equipment
 - ii) block elevated equipment
 - iii) use parking brakes/wheel chocks
 - iv) chain or secure non-operational components
 - v) emergency procedures

Learning Outcomes:

- Demonstrate knowledge of methods to minimize environmental impacts.
- Demonstrate knowledge of spill control techniques.
- Demonstrate knowledge of sediment control techniques.

2015 National Occupational Analysis Reference:

- 2.05 Performs spill control procedures.
- 2.06 Performs sediment control procedures.

Objectives and Content:

1. Define terminology associated with environmental protection.
2. Identify environmental hazards and describe safe work practices and equipment.
 - i) personal
 - ii) workplace
 - iii) surroundings
 - iv) equipment
3. Interpret acts and regulations pertaining to the protection of the environment.
 - i) *Fisheries Act*
 - ii) *Environmental Protection Act*
 - iii) jurisdictional legislation
 - water
 - natural resources
4. Explain environmental impacts as they relate to the use of heavy equipment.
 - i) emissions
 - ii) pollution
 - soil
 - air
 - water
 - noise
 - iii) sedimentation
 - effects on plants and wildlife/fish
 - effects on waterways

- iv) spills
 - fuel/oil
 - contaminated sites

- 5. Identify types and sources of spills or leaks.
 - i) broken or leaking lines
 - ii) mechanical failures
 - iii) sewage
 - iv) chlorination and flushing
 - v) improper storage and handling of fuels and oils

- 6. Describe the procedures used to prevent and control spills.

- 7. Describe the procedures used to clean-up spills.

- 8. Identify methods used to control sediment.
 - i) divert water
 - ii) provide filtration
 - silt fences
 - filter cloths
 - hay bales
 - iii) apply surface protection
 - mulch/straw
 - erosion control blankets
 - sod

- 9. Describe the procedures used to minimize impacts on the environment.
 - i) soil
 - ii) air
 - iii) water
 - iv) noise

EXC-190 Excavators – I

Learning Outcomes:

- Demonstrate knowledge of excavators, their attachments and components.
- Demonstrate knowledge of standard procedures to operate excavators.

2015 National Occupational Analysis Reference:

- 4.04 Performs basic maintenance on attachments.
- 6.01 Maintains control of equipment.
- 6.02 Positions equipment for task.
- 6.03 Monitors performance of equipment.
- 6.05 Installs attachments.
- 6.06 Performs emergency procedures.
- 8.01 Excavates trenches and ditches.
- 8.02 Backfills trenches and excavations.
- 8.03 Creates slopes.
- 8.04 Creates mass excavations.
- 8.05 Clears land.
- 8.06 Strips surface material.
- 8.07 Stockpiles material.
- 8.09 Lifts material.
- 8.10 Loads trucks.

Objectives and Content:

1. Define terminology associated with excavators.
2. Identify hazards and describe safe work practices pertaining to the operation of excavators.
 - i) personal
 - three-point contact
 - ii) worksite
 - emergency procedures
 - lock-out and tag-out
 - site traffic and personnel
 - iii) work environment (surroundings)
 - iv) equipment

3. Interpret acts and regulations pertaining to the operation of excavators.
 - i) licencing and permitting
 - ii) road regulations
 - iii) restrictions
 - iv) Occupational Health and Safety (OH&S)

4. Identify types of excavators and describe their applications, characteristics and limitations.

5. Identify the components of excavators.

6. Identify considerations when operating excavators.
 - i) road/site conditions
 - slopes
 - rough terrain
 - soil stability
 - ii) centre of gravity
 - tipping axis
 - iii) pinch points
 - iv) obstacles
 - powerlines
 - utilities
 - bridges
 - over/underpasses
 - culverts
 - v) visibility
 - vi) machine limitations
 - configuration
 - stability
 - vii) right-of-way

7. Describe the procedures used to operate excavators.
 - i) pre-start
 - ii) start up
 - iii) cycle controls/warm up
 - iv) equipment control
 - operating mode
 - adjustments
 - centre of gravity
 - clearances
 - travel mode
 - manoeuvring

- v) performance monitoring
 - vi) positioning for work
 - set-up location
 - stabilization
 - vii) basic functions
 - curl and dump bucket
 - raise and lower boom
 - extend and retract dipper stick
 - swing
 - move forward, reverse, stop, pivot turn, gradual turn and counter rotate
 - engage auxiliary function
 - viii) parking
 - check position (OMM)
 - lower bucket
 - lock-out hydraulics
 - ix) shut down
 - position
 - parking
 - cool down
 - securing
8. Describe the procedures used to install and uninstall standard attachments used with excavators.
 9. Describe the procedures used to operate and maintain standard attachments used with excavators.
 10. Describe the procedures used when creating and using a bench.
 11. Describe the procedures used to strip and stockpile materials using excavators.
 12. Describe the procedures used to create mass excavations using excavators.
 13. Describe the procedures used to create slopes and ditches using excavators.
 14. Describe the procedures used to clear land using excavators.
 - i) stumps
 - ii) brush
 - iii) roots
 15. Describe the procedures used to excavate trenches using excavators.

16. Describe the procedures used to backfill trenches and excavations using excavators.
17. Describe the procedures used to lift materials using excavators (basic hoisting).
 - i) lightweight
 - ii) simple rigging
 - iii) basic calculations
18. Describe the procedures used to load haulage units using excavators.
19. Describe the procedures used to operate excavators on roads.
20. Identify methods of communication used when operating excavators.
21. Describe procedures used when travelling with an excavator.
22. Explain the importance of quality workmanship and professionalism when operating excavators.

LEVEL 2

Learning Outcomes:

- Demonstrate knowledge of survey indicators and data interpretation.

2015 National Occupational Analysis Reference:

3.03 Interprets survey indicators and data.

Objectives and Content:

1. Identify types of specialized measuring tools used to establish grade levels and describe their applications and procedures for use.
 - i) Global Positioning System (GPS)
 - ii) emerging technologies
 - iii) auto and laser levels
2. Describe the procedures used to read and record survey grade stake information.
3. Describe the procedures used to transfer survey grade stake information.
4. Describe the procedures used to set-up and use grade checking and tracking instruments.
 - i) string lines
 - ii) auto level
 - laser level
 - iii) measuring tapes
 - iv) boning rods

Learning Outcomes:

- Demonstrate knowledge of drawings and plans and their applications.
- Demonstrate knowledge of the procedures to interpret and extract information from drawings and plans.

2015 National Occupational Analysis Reference:

3.02 Uses documentation.

Objectives and Content:

1. Define terminology associated with drawings and plans.
2. Identify types of drawings.
 - i) civil
 - ii) mechanical
 - iii) structural
 - iv) sketches
3. Describe applications of civil drawings and site plans.
 - i) utility
 - ii) road building
 - iii) marine
 - iv) land clearing
 - v) pipeline
4. Identify the views found on drawings.
 - i) plan
 - ii) profile
 - iii) section
5. Identify the parts of a drawing and describe their purpose and applications.
 - i) lines
 - ii) legend
 - iii) symbols and abbreviations
 - iv) title block
 - v) notes and specifications
 - vi) orientation

6. Describe metric and imperial systems of measurement.
7. Interpret and extract information from drawings and specifications.
 - i) method of approach
 - ii) profile of aggregate types
 - iii) material requirements

EXC-210 Attachments and Implements – II

Learning Outcomes:

- Demonstrate knowledge of specialized heavy equipment (excavator) attachments and implements.
- Demonstrate knowledge of the procedures to remove and install specialized heavy equipment (excavator) attachments and implements.

2015 National Occupational Analysis Reference:

- 4.04 Performs basic maintenance on attachments.
- 6.05 Installs attachments.

Objectives and Content:

1. Define terminology associated with specialized heavy equipment (excavator) attachments and implements used in the road building, heavy construction and land clearing industries.
2. Identify hazards and describe safe work practices pertaining to the installation, operation and removal of specialized heavy equipment (excavator) attachments and implements.
3. Interpret acts, regulations, manufacturers' specifications and company policies pertaining to the use of specialized heavy equipment (excavator) attachments and implements.
4. Identify tools and equipment used to install and remove specialized attachments and implements, and describe their applications and procedures for use.
5. Identify types of specialized heavy equipment (excavator) attachments and implements, and describe their applications and limitations.
 - i) grapples
 - ii) long-reach dipper stick
 - iii) shears
 - iv) pile driver
 - v) brushcutter
6. Describe the procedures used to install and remove specialized heavy equipment (excavator) attachments and implements.

7. Describe the procedures used to maintain specialized heavy equipment (excavator) attachments and implements.
8. Describe the procedures used to operate heavy equipment (excavator) equipped with specialized attachments and implements.

Learning Outcomes:

- Demonstrate knowledge of the procedures to stabilize soil.
- Demonstrate knowledge of the procedures to control sedimentation.

2015 National Occupational Analysis Reference:

2.06 Performs sediment control procedures.

Objectives and Content:

1. Define terminology associated with sedimentation and soil stabilization.
2. Identify workplace hazards and describe safe work practices and equipment pertaining to sedimentation and soil stabilization.
 - i) personal
 - ii) workplace
 - iii) environmental
 - iv) equipment
3. Interpret acts and regulations pertaining to the protection of the environment.
 - i) *Fisheries Act*
 - ii) *Environmental Protection Act*
4. Describe the procedures used to stabilize soil.
 - i) maintain existing vegetation
 - ii) use erosion control blankets
 - iii) place rock on unstable slopes
 - iv) install riprap/gabions
 - v) leave buffer zones
5. Describe the procedures used to control sediment.
 - i) divert water
 - ii) provide filtration
 - silt fences
 - filter cloths
 - hay bales

- iii) apply surface protection
 - mulch/straw
 - erosion control blankets
 - sod

EXC-220

Excavators – II

Learning Outcomes:

- Demonstrate knowledge of excavators, their attachments and components.
- Demonstrate knowledge of specialized procedures to operate excavators.

2015 National Occupational Analysis Reference:

- 4.04 Performs basic maintenance on attachments.
- 6.05 Installs attachments.
- 6.06 Performs emergency procedures.
- 6.08 Performs cut and fill operations.
- 8.01 Excavates trenches and ditches.
- 8.02 Backfills trenches and excavations.
- 8.03 Creates slopes.
- 8.04 Creates mass excavations.
- 8.05 Clears land.
- 8.06 Strips surface material.
- 8.07 Stockpiles material.
- 8.08 Places material.
- 8.09 Lifts material.
- 8.11 Performs demolitions.

Objectives and Content:

1. Define terminology associated with excavators.
2. Identify hazards and describe safe work practices pertaining to the operation of excavators.
 - i) personal
 - three-point contact
 - ii) worksite
 - emergency procedures
 - lock-out and tag-out
 - site traffic and personnel
 - iii) environment
 - iv) equipment
3. Interpret acts and regulations pertaining to the operation of excavators.
 - i) licencing and permitting
 - ii) road regulations

- iii) restrictions
 - iv) Occupational Health and Safety (OH&S)
4. Describe the procedures used to install and uninstall specialized attachments used with excavators.
 5. Describe the procedures used to operate and maintain specialized attachments used with excavators.
 6. Describe the procedures used to strip, segregate and stockpile materials using excavators.
 7. Describe the procedures used to place and spread materials in lifts, while maintaining grade according to indicators, using excavators.
 8. Describe the procedures used to create mass excavations, while maintaining grade according to indicators, using excavators.
 9. Describe the procedures used to create slopes and ditches, while maintaining grade according to indicators, using excavators.
 10. Describe the procedures used to clear land of rocks, trees and buildings using excavators.
 11. Describe the procedures used to excavate trenches, while maintaining grade according to indicators, using excavators.
 12. Describe the procedures used to backfill trenches and excavations where utilities and other obstructions exist, using excavators.
 13. Describe the procedures used to lift materials using excavators (advanced hoisting).
 - i) load chart calculations
 - ii) maximum lifting capacity
 - iii) advanced rigging
 14. Describe the procedures used to perform cut and fill operations, while maintaining grade according to indicators, using excavators.

15. Describe the procedures used to perform demolitions using excavators.
16. Explain the importance of quality workmanship and professionalism when operating excavators.