Heavy Equipment Mechanics

NOC 7312

Introduction

Heavy-duty equipment mechanics repair, troubleshoot, adjust, overhaul and maintain mobile heavy-duty equipment used in construction, transportation, forestry, mining, oil and gas, material handling, landscaping, land clearing, farming and similar activities. They are employed by companies which own and operate heavy equipment, and by heavy equipment dealers, rental and service establishments, and railway transport companies and urban transit systems.

The most important Essential Skills for Heavy-duty Equipment Mechanics are:

- Problem Solving
- Digital Technology
- Oral Communication

Document Sections

A. Reading

Reading

Tasks	Complexity Level	Examples
		Heavy-duty Equipment Mechanics:
Typical	1 to 4	• read emails and text messages from customers, coworkers, supervisors and suppliers. (1) • read labels on oils, penetrating sprays and cleaning solvents to ensure proper use, for example, not using something that will eat through plastic or conduct electricity. (1)
Most Complex	4	• read work orders to determine repairs required on equipment. (2) • read memos and bulletins to learn about changes in company policies and operating procedures. (2) • read online blogs and forums to find help with unusual problems or hard-to-find parts. (2) • read health and safety information such as Material Safety Data Sheets (MSDS) to learn first aid measures, and how to handle materials safely. (2) • read installation instructions for parts and components. (2) • read health and safety regulations, for example, read updates to regulations requiring an alternate escape route from heavy equipment. (3) • read technical service bulletins issued by suppliers and manufacturers that describe particular problems and provide repair solutions, and to learn about recalls. This information may be integrated with information from service manuals. (3) • read instructions and repair and maintenance procedures in shop, operator and service manuals, both paper-based and online, that are specific to machines and equipment. For example, shop manuals provide information such as how to take apart and assemble complex wiring assemblies and pieces of equipment, torque specifications, and special tools required. Information may be integrated from different sections of the manuals or from different sources, for example, with a technical service bulletin, and requires background knowledge. (4)

Reading Summary

The symbol √ is explained in the Use of Symbols section.

	Purpose for Reading			
Type of Text	**To scan for specific information/To locate information**	**To skim for overall meaning, to get the 'gist'**	**To read the full text to understand or to learn**	**To read the full text to critique or to evaluate**
Forms	√	√	√	
Labels	√	√	√	
Notes, Letters, Memos	√	√	√	
Manuals, Specifications, Regulations	√	√	√	√
Reports, Books, Journals	√	√	√	

B. Document Use

Document Use

Tasks	**Complexity Level**	**Examples**
		Heavy-duty Equipment Mechanics:
Typical	1 to 3	• read labels, decals and icons on equipment. For example, scan icons on engine components to learn about scalding, pressure and electrical shock hazards. (1)
Most Complex	4	• view meters and digital readouts to locate data, such as energy readings, speeds, pressures, settings and error codes. (1) • read GPS screens and road maps to determine route and time to job sites for service calls. (2) • read electronic and paper-based parts and equipment catalogues to order parts and compare prices. (2) • complete safety inspection checklists for overhead cranes, forklifts and other equipment, hazard analysis forms, and other safety documents. (2)

		• complete workplace safety forms to report “near misses”, hazards and accidents. (2) • sketch diagrams to explain parts to customer or to show how a part was put together incorrectly or where a fault is in the metal. (2) • read and complete work orders and service reports that include a description of the problem and the work to be performed, parts replaced, number of hours, and recommendations for other work that may be needed. (2) • use reference material such as the Engineers’ Black Book to look up information such as decimal equivalents, conversion numbers, material coefficients, torque conversions and formulae, in complex tables. For example, can look up what the tap is if fabricating or pushing a rod into a thread sleeve. (3) • interpret graphs generated by computerized equipment, for example, scan graphs generated by scan tools to troubleshoot faults and establish the operating condition of vehicle components. (3) • read and interpret, both paper-based and online, diagnostic flowcharts, and complex multi-page 2D and 3D drawings and schematics that are graphic representations of electrical, electronic, hydraulic and pneumatic systems, and use colour coding, symbols, icons and abbreviations. Some experience and specialized knowledge is required to understand and gather all the relevant and required information. (4)

Document Use Summary

- Read signs, labels or lists.
- Complete forms by marking check boxes, recording numerical information or entering words, phrases, sentences or text of a paragraph or more. The list of specific tasks varies depending on what was reported.
- Read completed forms containing check boxes, numerical entries, phrases, addresses, sentences or text of a paragraph or more.
- Read tables, schedules or other table-like text.
- Obtain specific information from graphs or charts.
- Interpret information on graphs or charts.
- Recognize common angles such as 15, 30, 45 and 90 degrees.
- Draw, sketch or form common shapes such as circles, triangles, spheres, rectangles, squares, etc.
- Read schematic drawings (e.g. electrical schematics).
- Make sketches.
- Obtain information from sketches, pictures or icons (e.g., computer toolbars).

C. Writing

Writing

Tasks	Complexity Level	Examples
		Heavy-duty Equipment Mechanics:
Typical	1 to 3	• write emails and text messages to coworkers, supervisors and customers, for example, to update on status of a repair or to ask a question. (1)
Most Complex	3	• write reminder and brief notes, for example to inform co-workers about the status of repairs or from a phone conversation with a customer. (1) • may write a journal to keep track of jobs worked on including work order number, machine model and number, and notes specific to a job such as a customer complaint. (1) • write entries in equipment logbooks and files to update information on equipment such as number of hours of service, completed and required repairs, and to keep track of recurring and potential problems. (2) • write emails to technical support at manufacturers to request help with a repair, for example, request technical support to look at error codes from equipment to see if there is a recurring problem. (2) • complete work orders and service reports which include a description of the repair with details about what was done and why, parts repaired or replaced, and recommendations for further work. Recommendations describe needed repairs and causes for concern. Customers must be made aware of the condition of the equipment, for example, whether or not is safe to operate. For example, if a component fails there could be a liability issue. (3) • may write reports, for example, to explain work that will be reimbursed under manufacturer warranty programs. (3)

Writing Summary

The symbol √ is explained in the Use of Symbols section.

	Purpose for Writing						
Length	**To organize/ to remember**	**To keep a record/to document**	**To inform/ to request information**	**To persuade/ to justify a request**	**To present an analysis or comparison**	**To present an evaluation or critique**	**To entertain**
Text requiring less than one paragraph of new text	√	√	√				
Text rarely requiring more than one paragraph		√	√	√		√	
Longer text		√	√				

D. Numeracy

The symbol √ is explained in the Use of Symbols section.

Numeracy

Tasks	**Complexity Level**	**Examples**
√ Scheduling and Budgeting and Accounting √ Measurement and Calculation √	1 1to 3	Heavy-duty Equipment Mechanics: • calculate the number of service hours to determine when equipment is due for service such as an oil change. (Scheduling or Budgeting and Accounting) (1) • calculate the amount of time required to make repairs. (Scheduling or Budgeting and Accounting) (1) • take inventory of parts and supplies including oils, lubricants, bolts, filters and grinding and welding materials. (Scheduling or Budgeting and Accounting) (1) • use tape measures and calibrated jugs to take a variety of measures such as lengths of hoses, dimensions of

Data Analysis √ Numerical Estimation	1 to 3 2	equipment, and liquid volumes. (Measurement and Calculation) (1) • calculate fuel consumption in litres or gallons per hour. (Measurement and Calculation) (2) • measure torque in Newton-metres or foot-pounds and convert between systems. (Measurement and Calculation) (2) • measure and calculate pressure in pascals and psi (pounds per square inch) and convert between systems. (Measurement and Calculation) (2) • use specialized tools to take precise measurements. For example use micrometres or calipers to measure the dimensions of machine parts to thousands of an inch or in millimetres to determine wear when building, repairing or replacing a part. (Measurement and Calculation) (3) • calculate size and volume of cylinders and tanks to determine capacity in litres or gallons. May convert between SI and imperial measurement. (Measurement and Calculation) (3) • calculate weights to safely lift and move equipment and parts using an overhead crane. (Measurement and Calculation) (3) • compare readings from gauges including temperature, oil pressure, hydraulic pressure, and tachometers to determine they are within correct operating parameters. For example, very high oil pressure may indicate that the machine is losing oil or that the relief valve is stuck open. (Data Analysis) (1) • compare measurements of energy, dimension, speed, horsepower, temperature and torque to specifications, for example, compare measurements of worn parts to original specifications to determine if they need to be replaced. (Data Analysis) (1) • calculate average fuel and oil consumption rates to track the operating condition of equipment. (Data Analysis) (2) • analyse pressure, power, torque, compression and electrical energy readings to assess equipment performance and troubleshoot faults. For example, analyse series of energy readings produced by computerized engine analyzers to determine the cause of electrical faults. (Data Analysis) (3) • estimate the useful life remaining for parts, such as engines, tires, brakes and hoses. (Numerical Estimation) (2)

		• estimate the cost of a repair that includes the cost of parts, length of time and labour. (Numerical Estimation) (2)

Math Skills Summary

a. Mathematical Foundations Used

The symbol √ is explained in the Use of Symbols section.

Mathematical Foundations Used

Code	Tasks	Examples
		Number Concepts
√	Whole Numbers	Read and write, count, round off, add or subtract, multiply or divide whole numbers. For example, count number of bolts removed, to make sure the same number are replaced in the same arrangement.
√	Rational Numbers - Fractions	Read and write, add or subtract fractions, multiply or divide by a fraction, multiply or divide fractions. For example, measuring dimensions of equipment and materials using imperial measurement.
√	Rational Numbers - Decimals	Read and write, round off, add or subtract decimals, multiply or divide by a decimal, multiply or divide decimals. For example, measuring dimensions of equipment and materials in millimetres, or using calipers to measure in millimetres or thousandths of an inch.
√	Rational Numbers - Percent	Read and write percents, calculate the percent one number is of another, calculate a percent of a number. For example, hydraulic pump efficiencies are given in rated specifications with gallons per minute at X rpm. Heavy-duty equipment mechanics run the machine at that rpm to calculate the new percentage of efficiency and decide if the pump needs to be rebuilt. Brake wear is expressed as a percent.
√	Equivalent Rational Numbers	Convert between fractions and decimals or percentages. Convert between decimals and percentages. For example, convert from decimals of an inch to fractions of an inch.
		Patterns and Relations
√	Equations and Formulae	Use formulae by inserting quantities for variables and solving. For example, use a formula to check that the rate of flow in a hydraulic pump meets specifications. Use formulae to calculate volumes and capacities.
√	Use of Rate, Ratio and Proportion	Use a rate showing comparison between two quantities with different units. Use a ratio showing comparison between two quantities with the same units. Use a proportion showing comparison between two ratios or rates in

		order to solve problems. For example, measure and calculate to confirm gear ratios as they are given in a manual. Calculate fuel consumption in litres or gallons per hour. Using scale drawings.
		Shape and Spatial Sense
√	Measurement Conversions	Perform measurement conversions. For example, within a measurement system, such as convert decimal inches to fractions. Also convert between SI and imperial measurement including millimetres to inches, Newton-metres to foot-pounds, mega pascals to pounds per square inch (psi), and horsepower to watts.
√	Areas, Perimeters, Volumes	Calculate areas. Calculate perimeters. Calculate volumes. For example, measure and calculate a tire's loaded radius and circumference. May measure and calculate volumes per unit of time, for example, in hydraulic cylinders, volume and rate of flow.
√	Geometry	Use geometry. For example, take measurements and fabricate a part to repair a machine. For example, know where to locate a brace for optimum strength.

b. How Calculations are Performed

- In their heads.
- Using a pen and paper.
- Using a calculator.
- Using a computer.

c. Measurement Instruments Used

- Time. For example, using a clock or watch.
- Distance or dimension. For example, using calipers, tape measures and micrometres.
- Liquid volume. For example, using calibrated container or dipstick.
- Temperature. For example, using thermometers.
- Pressure. For example, using pressure gauges.
- Wattage. For example, using a multimetre.
- Angles. For example, using a protractor. May use magnetic angle gauge (not usual).
- Density. For example, using hydrometer.
- Use the SI (metric) measurement system.
- Using the imperial measurement system.

E. Oral Communication

Oral Communication

Tasks	Complexity Level	Examples
		Heavy-duty Equipment Mechanics:
Typical	2 to 3	• get information from the dispatcher about location of job and type of repair. (2) • share information with coworkers, for example provide assistance or ask for assistance with troubleshooting a difficult or unusual repair. (2) • participate in safety and toolbox meetings to discuss and learn about safety concerns, changes to operating procedures and projects. (2) • talk with operators to gather information and discuss equipment performance to determine equipment problems and help with troubleshooting. (2) • talk with customers to gather and clarify information about needed repairs, explain equipment maintenance procedures and discuss the results of inspections and repairs. (2) • ask questions and clarify information at in-house training sessions and courses put on by manufacturers. (2) • mentor apprentices by explaining how to do something and discussing possible solutions to troubleshooting. (2) • discuss work orders and assigned tasks with supervisors. For example, may ask for assistance with a difficult repair or handling a customer complaint. (2) • contact suppliers and parts distributors to order parts and materials, or to ask questions about parts for older equipment. (2) • Discuss difficult, unusual and recurring repairs with manufacturer technical support and ask for help with troubleshooting. (3) • Respond to customer complaints and frustrations including complaints about costs of repairs, concerns about the length of time for a repair and questions about the necessity of repair work. Need to be able to provide detailed information about the work being done and why it is needed. (3)
Most Complex	3	

Modes of Communication Used

- In person.

- Using a telephone.
- Using specialized communications signals, for example, hand signals and two-way radios.

Environmental Factors Affecting Communication

Shops and work sites have high noise levels that can interfere with oral communication due to running equipment. Heavy equipment mechanics wear hearing protection in the shop and at work sites. They use hand signals and two-way radios to communicate with other workers.

Oral Communication Summary

The symbol √ is explained in the Use of Symbols section.

Purpose for Oral Communication (Part I)						
Type	**To greet**	**To take messages**	**To provide/receive information, explanation, direction**	**To seek, obtain information**	**To co-ordinate work with that of others**	**To reassure, comfort**
Listening (little or no interaction)						
Speaking (little or no interaction)						
Interact with co-workers		√	√	√	√	
Interact with those you supervise or direct			√	√	√	
Interact with supervisor/manager			√	√	√	
Interact with peers and colleagues from other organization						
Interact with customers/clients/ public	√	√	√	√		
Interact with suppliers, servicers			√	√		
Participate in group discussion			√	√	√	
Present information to a small group						
Present information to a large group						

The symbols >, >> and >>> are explained in the Use of Symbols section.

Purpose for Oral Communication (Part II)						
Type	**To discuss (exchange information, opinions)**	**To persuade**	**To facilitate, animate**	**To instruct, instill understanding, knowledge**	**To negotiate, resolve conflict**	**To entertain**
Listening (little or no interaction)						
Speaking (little or no interaction)						
Interact with co-workers	√			√		
Interact with those you supervise or direct	√			√		
Interact with supervisor/manager	√					
Interact with peers and colleagues from other organization						
Interact with customers/clients/ public	√	√		√	√	
Interact with suppliers, servicers	√					
Participate in group discussion	√					
Present information to a small group						
Present information to a large group						

F. Thinking Skills

1. Problem Solving

Problem Solving

Tasks	Complexity Level	Examples
		Heavy-duty Equipment Mechanics:
Typical	1 to 3	• deal with an obvious problem where an easily accessible part needs to be replaced and is ordered and replaced. (1) • find that work is delayed because parts are unavailable or delivered late. They carry out other work until parts arrive. (1)
Most Complex	4	• troubleshoot and diagnose common problems with equipment using information from customers, manuals, diagnostic tools and experience. (2) • are unable to meet repair deadlines due to heavy workloads and projects that take longer than anticipated to complete. They ask service managers to prioritize repairs, enlist the help of co-workers and work overtime to complete high priority work. (2) • may find that parts, specifications or manuals are not readily available for older equipment. They will search online for information and parts, or may build the needed part. (3) • may encounter problems that are intermittent, difficult or unusual. They check with coworkers, refer to manuals and technical service bulletins, use diagnostic tools to access fault codes, use online forums, and contact technical support at manufacturing companies and suppliers. They also pay attention to noises, vibrations and smells. For example, with an intermittent problem they may try a simpler, cheaper fix first such as replacing a switch rather than the entire relay. (3) • deal with a problem with a hydraulic system that originates in an electrical system where adequate information is not readily available and correcting the problem requires several steps. (4)

2. Decision Making

Decision Making

Tasks	Complexity Level	Examples
		Heavy-duty Equipment Mechanics:
Typical	1 to 2	• decide the order of repair and maintenance jobs, for example, giving priority to smaller, simpler tasks that can be turned around quickly. (1)
Most Complex	3	• decide when to schedule repairs and maintenance for multiple pieces of equipment based on availability and other priorities. (2) • decide when to replace parts based on amount of wear and tear, and cost of replacement. (2) • decide the most efficient course of action to complete particular jobs, for example, decide upon the order of troubleshooting activities to efficiently diagnose faults. (3)

3. Critical Thinking

Critical Thinking

Tasks	Complexity Level	Examples
		Heavy-duty equipment mechanics:
Typical	1 to 3	• judge the accuracy of readings taken using equipment, such as scan tools. They compare readings to other indicators of performance such as vibrations and noises. (1)
Most Complex	3	• judge the condition of parts, materials and equipment. For example, they inspect gears and sprockets for signs of cracks, missing teeth and loose fit, and tires and belts for signs of cracks and exposed cords. (2) • evaluate performance of apprentices using criteria such as apprentices' abilities to diagnose and troubleshoot equipment problems, to locate information needed to solve a problem, and willingness to learn new skills. (2) • evaluate the quality of repairs. They consider the results of test drives and data from equipment, such as gas analyzers and dynamometers. (3) • assess used equipment for purchase based on equipment history, general appearance, number of equipment hours, maintenance and service records, and mechanic's professional experience. (3)

4. Job Task Planning and Organizing

Job Task Planning and Organizing

Complexity Level	Description
2	Own job planning and organizing: • May prioritize jobs for efficiency, taking care of routine and smaller jobs first to allow more time for complex repairs. They may be assigned jobs based on their areas of expertise. Most heavy-duty equipment mechanics work on one job at a time unless work is delayed until parts arrive or coworkers need assistance. There are disruptions to the work schedule, such as emergency jobs for customers who rely on equipment to complete a project. Disruptions may require rescheduling other jobs and workers depending on the size of the job. Heavy equipment mechanics may have to coordinate work with other mechanics to share tools and space. (2) Planning & organizing the work of others: • May assign tasks to apprentices and mechanics with less seniority or experience.

5. Significant Use of Memory

Examples

- remember previous problems and compare with a current situation to determine if a similar repair would work.
- remember details/sequences of several jobs in progress.
- remember the sequence of tasks on a machine they started overhauling weeks earlier, picking up where they left off and continuing the process.
- recognize customers by name and remember details about their equipment.

6. Finding Information

Finding Information

Tasks	Complexity Level	Examples
Typical	2 to 3	Heavy-duty Equipment Mechanics: • scan on-board computer screens to locate the area of a problem. (2) • use fault codes on a computer to isolate a problem. (3) • question coworkers, shop foremen and service managers who have experience working on a similar piece of equipment. Manuals may not be available for old pieces of

		equipment and this is often the first step in finding information. (3) • contact manufacturer technical support by email or phone to get help diagnosing a problem and information for how to fix it. It may take several contacts to solve the problem and come up with a solution. (3) • locate, integrate and use information from a number of sources including service manuals, both paper-based and online, websites and forums, technical service bulletins and other sources. (3)

G. Working with Others

Working with Others

Complexity Level	Description
2	Heavy-duty equipment mechanics mostly work alone but may assist another mechanic with heavier or more complex repairs. They coordinate the use of tools and shop equipment with other mechanics. They use coworkers, service managers and supervisors as resources in problem solving, diagnosing and laying out plans of actions. (2)

Participation in Supervisory or Leadership Activities

- Participate in formal discussions about work processes or product improvement.
- Have opportunities to make suggestions on improving work processes.
- Monitor the work performance of others.
- Inform other workers or demonstrate to them how tasks are performed.
- Orient new employees.
- Make hiring recommendations.
- Make hiring decisions.
- Assign routine tasks to other workers.
- Identify training that is required by, or would be useful for, other workers.

H. Digital Technology

Digital Technology

Tasks	Complexity Level	Examples
Typical	1 to 2	Heavy-duty Equipment Mechanics: • use calculators, mobile apps, and other electronic devices to complete numeracy-related tasks, such as calculating material requirements. (1) • use text messaging software to confirm appointments and arrival times with customers. (1) • use online catalogues and databases to order parts. (1) • write or draft an email for a warranty report. (1) • send or receive repair information by e-mail. (1) • assess shop, service and repair manuals on CD-ROMS and DVDs and websites. (2) • read online articles to maintain current knowledge of industry trends and practices. (2) • use the Internet to access training courses and seminars offered by manufacturers, suppliers, employers, trades schools and technical institutes. (2) • use search features and bookmark information in online manuals and websites. (2) • may use word processing programs to write letters to manufacturers and customers, which present the results of mechanical inspections. (2) • use databases to retrieve repair information, vehicle service histories and technical drawings. (2) • may use specialized industry databases to access job assignments, input information on new jobs, retrieve and review past service information and complete work orders. (2) • use blogs and forums to share troubleshooting ideas and methods for repair. (2) • use diagnostic equipment such as scan tools, gas analyzers and laptops, to determine operational data, such as horsepower, torque, pressure readings and air-to-fuel ratios. (2) • use scan tools and hand-held devices to access codes and other data from vehicle onboard sensors. (2)

Digital Technology Summary

- Use word processing
- Use databases
- Use communications software
- Use Internet browsers

I. Continuous Learning

Continuous Learning

Complexity Level	Description
2	Heavy-duty equipment mechanics need to update their skills and knowledge on a regular basis to keep up with changes in technology and equipment. (2)

How Learning Occurs

Learning may be acquired:

- As part of regular work activity.
- From co-workers.
- Through training offered in the workplace.
- Through reading or other forms of self-study.
    - at work.
    - on a worker's own time.
    - using materials available through work.
- Through off-site training
    - during working hours at no cost to the worker.
    - partially subsidized.

J. Additional Information

In addition to collecting information for this Essential Skills Profile, our interviews with job incumbents also asked about the following topics.

Physical Aspects

Heavy-duty equipment mechanics need to be in good physical condition as they use a wide variety of body positions including walking, bending, stooping, reaching, and climbing. They also lift and move heavy parts. They climb ladders to access equipment and operate overhand cranes and hoists.

Attitudes

The heavy-duty equipment mechanics interviewed felt that heavy-duty equipment mechanics should have a mechanical aptitude, and an interest in and a sense of how things work. They should also be willing and interested in learning new skills and technologies. Heavy-duty equipment mechanics should also enjoy problem solving and a diversity of tasks, and be able to "think outside of the box". They should not be easily frustrated when solutions to problems are not easily found. They need integrity and to be service-oriented. Heavy-duty equipment mechanics need to be versatile because of the wide range of equipment they work on. Working conditions vary widely from modern, comfortable shops to remote work sites.

Impact of Digital Technology

All essential skills are affected by the introduction of technology in the workplace. Heavy- duty equipment mechanics' ability to adapt to new technologies is strongly related to their skill levels across the essential skills, including reading, writing, thinking and communication skills. Technologies are transforming the ways in which workers obtain, process and communicate information, and the types of skills needed to perform in their jobs. In particular, heavy- duty equipment mechanics need a broad range of computer skills that are imperative to diagnosing and repairing sophisticated electronic vehicle systems. Workers need the skills to use increasingly complex, specialized, multi-functional databases, which can be used to access job assignments; input information on new jobs; retrieve and review past service information; retrieve repair information, vehicle service histories and technical drawings and schematics; and complete work orders.

Technology in the workplace further affects the complexity of tasks related to the essential skills required for this occupation. The sophisticated wiring systems found in heavy duty equipment has increased the complexity of wiring schematics and other diagrams. As well, workers may need to use diagnostic equipment (e.g. scan tools and gas analyzers) to determine operational data, such as horsepower, torque, pressure readings and air-to-fuel ratios. Workers can also calculate costs, material requirements, conversions, volumes and rates using web-based applications, and specialized automotive software and hand-held devices. For example, a heavy -duty equipment mechanic may use a hand-held device to access codes and other data from vehicle on-board sensors.

K. Notes

This profile is based on interviews with job incumbents across Canada and validated through consultation with industry experts across the country.

For information on research, definitions, and scaling processes of Essential Skills Profiles, please consult the Readers' Guide to Essential Skills Profiles.