Electronic Assemblers, Fabricators, Inspectors and Testers:

NOC 9523

Introduction

Electronics assemblers and fabricators assemble and fabricate electronic equipment, parts and components. Electronics inspectors and testers inspect and test electronic and electromechanical assemblies, subassemblies, parts and components to ensure conformance to prescribed standards. They are employed in electronics manufacturing plants.

The most important Essential Skills for Electronic Assemblers, Fabricators, Inspectors and Testers are:

- Numeracy
- Problem Solving
- Document Use

Document Sections

- Reading
- Document Use
- Writing
- Numeracy
- Oral Communication
- Thinking Skills
    - Problem Solving
    - Decision Making
    - Critical Thinking
    - Job Task Planning and Organizing
    - Significant Use of Memory
    - Finding Information
- Working with Others
- Digital Technology
- Continuous Learning
- Notes

A. Reading

Reading

Tasks	Complexity Level	Examples
Typical	1 to 3	Electronic Assemblers, Fabricators, Inspectors and Testers: • read email from supervisors or the research department concerning changes in schedules, policies or procedures, rush orders or pilot runs. (1) , (daily)
Most Complex	4	• read notes on assembly drawings to learn where to use heat shrink tubing or to identify locations for gluing and soldering. (1) • read work order or purchase order forms giving details about customers and job specifications. (1) , (weekly) • read procedures which detail each of the steps in the assembly and testing process. (2) • read health and safety information to learn safe working procedures and changes in procedures. For example, they read Material Safety Data Sheets (MSDS) to learn safe handling and first aid procedures for hazardous materials. (2) • review government standards for fabricating electronic equipment. (2) , (weekly) • read standards for the electronic assembly industry that detail product acceptability requirements, such as the criteria for soldered components and assemblies. (3) • read equipment and operating manuals, specifying the proper assembly and testing procedures for electronic equipment. (3) , (weekly) • read software and hardware manuals to learn the functions of parts, system requirements, specifications for troubleshooting and to synthesize information which will aid in solutions to assembly problems. (4) , (frequently)

Reading Summary

The symbols >, >> and >>> are 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**
Typical	1 to 4	Electronic Assemblers, Fabricators, Inspectors and Testers: • read alphanumeric codes on boxes of electrical parts to verify the contents. (1)
Most Complex	4	• complete customer packing lists and read bar codes for products. (1) • complete checklists, documenting the results of tests and noting abnormalities. (1) • scan lists to double check parts and part numbers. (1) • match parts lists to specifications to ensure the correct parts are ordered. (1) • scan circuit board samples to check parts. Boards can range from simple to complex, for example, have up to 60 parts. (2)

		• read instruction and parts labels on cables and wires, testing equipment, computers and tools, showing the location of parts or brief user instructions. (1) • read product, parts and hardware lists to familiarize themselves with tolerances associated with the products. (2) , (daily) • read work orders to verify serial numbers and the completion of stages. (2) • refer to pictures and sketches provided by operations managers or lead hands to explain job specifications or procedures. (2) • complete schedules and time sheets to keep track of production, work hours and appointments with customers. (2) , (daily) • complete sheets which record test data and give directions to ship, hold or reject products. (2) , (daily) • complete pretest defect reports noting items to be sent to the repair department. (2) • locate information in tables and lists in online supplier catalogues to order parts. (2) • interpret test results in graph format such as temperature versus frequency or voltage over time to distinguish unacceptable from acceptable levels. (3) • interpret and take measurements from scale drawings and diagrams to compare, test or confirm specifications of system parts. (4) • read and integrate, diagrams, schematics, and assembly drawings and specifications to determine the correct assembly of electronic components and the location of parts. (4) , (frequently)

Examples

- Plot or construct bar or line graphs showing variances in temperature and voltage over a period of time. (daily)
- Make sketches showing a problem and its solution to explain to a customer how a repair job was done.

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. The list of specific tasks varies depending on what was reported.
- Read tables, schedules or other table-like text (e.g., read work shift schedules).

- Enter information on tables, schedules or other table-like text.
- Plot information on graphs (e.g. line, pie, bar).
- Obtain specific information from graphs or charts.
- Interpret information on graphs or charts.
- Construct or draw graphs or charts.
- Recognize common angles such as 15, 30, 45 and 90 degrees.
- Interpret scale drawings (e.g. blueprints or maps).
- Take measurements from scale drawings.
- Read assembly drawings (e.g. those found in service and parts manuals).
- 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
Typical	1 to 3	Electronic Assemblers, Fabricators, Inspectors and Testers: • write changes on material lists when the original lists are incorrect or incomplete. (1) , (daily) • write log book entries to record work completed and to inform the next shift of events. (1) , (daily) • write notes to other workers to clarify instructions, to describe the symptoms of problems to repair departments, or to summarize the work completed. (1) , daily) • write notes to their supervisors to specify the need for parts and process modifications, such as changing chips or sensor data. (2) , (occasionally) • may write emails to vendors to ask about problems they may have had with components. (2) • may write minutes for problem solving meetings. (2) , (occasionally) • write detailed nonconformity reports and test reports, describing defects found while testing. For example, testing reports describe what happened, how the board failed and the corrective action taken. (3)
Most Complex	3	

Writing Summary

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

Numeracy

Tasks	**Complexity Level**	**Examples**
> Money Math	2	Electronic Assemblers, Fabricators, Inspectors and Testers: • may calculate bills, including costs for materials and labour. (Money Math), (2) , (weekly)
> Scheduling, Budgeting & Accounting	1	• monitor schedules to determine how much work is still to be completed, ensuring that the time spent on jobs is within the time quoted to customers. (Scheduling, Budgeting & Accounting), (1)
>>> Measurement and	1 to 4	• measure parts and assembling equipment, such as the width of computer boards and lengths of cables, wires and bolts to compare them to specifications using SI (metric) and imperial

Calculation >> Data Analysis >>> Numerical Estimation	2 to 3 1 to 3	measurement. (Measurement and Calculation), (1) , (frequently) • take electronic measurements including voltage, resistance and current, to ensure that products meet quality standards. (Measurement and Calculation), (1) • measure amperage with an ammeter to check or calibrate circuits. (Measurement and Calculation), (2) • measure voltage against time using an oscilloscope to test circuits and locate faults. (Measurement and Calculation), (2) • may calculate capacitance. They multiply amps by time to get the charge. Measure voltage. Divide charge by voltage to get capacitance in Farads (F). (Measurement and Calculation), (2) • measure the input, output, reference voltages and radio frequency on data collection systems. (Measurement and Calculation), (3) , (daily) • when developing a prototype or manufacturing a product, may use basic trigonometry and geometry to calculate the angles at which specific component parts must be placed in relation to each other. (Measurement and Calculation), (4) • calculate average production amounts and the percentage of errors to plot in charts and share with staff at meetings. (Data Analysis), (2) • analyze patterns of input voltage values and the impact they have on voltage output values over time. (Data Analysis), (3) , (daily) • estimate expected ranges for volts, amps or frequencies. (Numerical Estimation), (1) , (daily) • estimate the lengths of wire needed for assemblies in order to cut the approximate amount. (Numerical Estimation), (1) • estimate the time required to complete a job in order to prepare bids. The estimate is based on past experience, the quality of products being manufactured and the labour involved. (Numerical Estimation), (3)

Math Skills Summary

a. Mathematical Foundations Used

The symbols >, >> and >>> are 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, recording whole numbers when measuring dimensions and resistance of parts or counting the number of defects, parts required or number of boards completed.
>>	Integers	Read and write, add or subtract, multiply or divide integers. For example, reading and recording negative values of electrical current with respect to the ground.
>>	Rational Numbers - Fractions	Read and write, add or subtract fractions, multiply or divide by a fraction, multiply or divide fractions. For example, using fractions when measuring and testing materials, component parts and finished products.
>>>	Rational Numbers - Decimals	Read and write, round off, add or subtract decimals, multiply or divide by a decimal, multiply or divide decimals. For example, totalling costs for parts and labour on bills or calculating electronic values, or calculating number of regular and overtime hours.
>>	Rational Numbers - Percent	Read and write percents, calculate the percent one number is of another, calculate a percent of a number. For example, using percent to indicate degrees of accuracy of instruments or to express the difference between actual readings and specifications for volts, amps and frequencies.
>>	Equivalent Rational Numbers	Convert between fractions and decimals or percentages. Convert between decimals and percentages. For example, converting ripple voltage to volts which is a conversion from percent to decimals.
>>	Other Real Numbers	Use powers and roots, scientific notation, significant digits. For example, calculating logarithmic functions and reading scientific notations on drawings and electronic ratings expressed in powers and roots. Calculating real numbers like square roots or powers in formulae used to design products.
		Patterns and Relations
>>	Use of Rate, Ratio and Proportion	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, using ratios to express capacities (e.g., 8,000:1); or testing whether systems achieve specified voltage input to voltage

		output ratios (e.g., 1:8). Using scale drawings.
		Shape and Spatial Sense
>	Measurement Conversions	Perform measurement conversions. For example, converting between centimetres and inches or inches and millimetres when measuring component and part sizes to assemble systems.
>	Geometry	Use geometry. For example, assembling parts of systems at right angles to other parts; using the Cartesian grid system for placing components; or recognizing angles on diagrams.
>	Trigonometry	Use trigonometry. For example, using trigonometry in designing and assembling products, determining lengths of sides and angles of triangles. Recognizing common angles.
		Statistics and Probability
>	Summary Calculations	Calculate averages. For example, calculating average voltages to ensure they do not exceed limits set out by government standards. Using tables, schedules or other table-like text. Using graphical presentations.

b. How Calculations are Performed

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

c. Measurement Instruments Used

- Time. For example, using a watch or clock.
- Weight or mass. For example, using a scale.
- Distance or dimension. For example, using a ruler, metre stick, tape measure, callipers, micrometers or laser levels.
- Temperature. For example, using a temperature gauge or temperature probe.
- Pressure. For example, using a torque wrench or a gauge.
- Wattage. For example, using a wattmeter.
- Volts. For example, using a voltmeter or an oscilloscope.
- Voltage, resistance and current using a multimeter, voltmeter, ammeter or ohmmeter.
- Number of oscillations or pulses per a length of time using an oscilloscope or frequency counter.
- dBm (decibels relative to one milliwatt) and dBW (decibels relative to one watt) using a watt meter.
- Angles. For example, using a corner or protractor.
- Use the SI (metric) measurement system.
- Using the imperial measurement system.

E. Oral Communication

Oral Communication

Tasks	Complexity Level	Examples
Typical	1 to 2	Electronic Assemblers, Fabricators, Inspectors and Testers: • may interact with suppliers to request and order electronic components and other materials. (1) • receive information from supervisors, lead hands and store operators regarding parts or job tasks, instructions for new products, or help with problem situations. (1) • interact with co-workers to learn the location of materials, to borrow tools, seek an opinion or ask how to complete a job. (1) , (daily) • update supervisors, lead hands and technicians about missing or incorrect parts. (2) • may explain to other workers how to assemble and test components. (2) • tell customers how to use and repair products that have been made for them. (2) • discuss parts, troubleshooting problems and changes to work assignments with other workers. (2) • as technical experts, may provide instruction to equipment operators. (2) • may interact with customers to get information on customer needs and to provide them with details of product specifications, upgrades and pricing. (2) • may chair meetings when acting as a project co-ordinator for a project. The progress of the project is discussed at these meetings. (3)
Most Complex	3	

Modes of Communication Used

- In person.
- Using a telephone.

Environmental Factors Affecting Communication

Noise from machinery and cooling fans can hinder communication. Electronics assemblers, fabricators, inspectors and testers may wait to speak to co-workers outside of work areas.

Oral Communication Summary

The symbols >, >> and >>> are 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
Typical	1 to 2	Electronic Assemblers, Fabricators, Inspectors and Testers: • may encounter part shortages, or find that the wrong parts have been installed on products or that parts are missing. They gather up the wrong parts and order new ones. (1)
Most Complex	3	• may find that some components have been assembled incorrectly on circuit boards. They check specifications and drawings, gather the correct stock and replace the components. (2) , (monthly) • may find, on testing equipment, that cable assemblies do not work. They check connections, placement of wires and soldering. They consult supervisors if the problem cannot be found. (2) • may find incorrect settings on equipment. They make corrections by referring to assembly manuals, checking repair databases or asking co-workers, supervisors and engineers for assistance. (2) • may face production delays when there has been a shortage of parts. They work with other units to get work back on schedule or reschedule tasks. (2) • may find that parts do not fit. They check lists to confirm that the right part number was used and, if necessary, substitute parts to reach solutions. (2) • may determine where faults are on circuit boards and where they are occurring in the assembly process, for example, during the surface mount stage or the wiring stage. Run different tests such as go/no go and procedural testing to determine where the fault is. Use past experience, testing results and reports, and specifications to narrow down possibilities. (3)

2. Decision Making

Decision Making

Tasks	Complexity Level	Examples
Typical	1 to 3	Electronic Assemblers, Fabricators, Inspectors and Testers: • decide whether to perform simple repairs rather than send products to repair departments and whether to scrap parts. (1) , (frequently)
Most Complex	3	• decide whether or not specifications and instructions for new products are sufficiently accurate and clear. If not, they may add notes to specifications to clarify the production process. (2) , (weekly) • decide which components require repair and whether to return products to their first assembly point. (2) , (daily) • decide which orders to fill first or what units should be built or tested next, considering who the customer is, how urgent the order is, if the necessary stock is available, how long it will take to acquire missing stock, which workers are available and the supervisor's priorities. (3) , (daily) • may make technical decisions regarding substitution of parts which are not available and the use of parts not specified in schematic drawings. (3)

3. Critical Thinking

Critical Thinking

Tasks	Complexity Level	Examples
Typical	2	Electronic assemblers, fabricators, inspectors and testers: • assess and test completed products to ensure they meet production specifications and standards. For example, they complete visual inspections matching completed circuit boards to drawings and sample boards, and tests using measuring instruments and electronic test equipment, such as oscilloscopes and multimeters. (2)

4. Job Task Planning and Organizing

Job Task Planning and Organizing

Complexity Level	Description
2	Own job planning and organizing: • Electronic assemblers, fabricators, inspectors and testers receive their work schedules from supervisors, based on customer demands and the availability of parts. They may change the order of job tasks to improve efficiency or because of shortage of or missing parts, bearing in mind deadlines for products. Work may be interrupted by questions from customers and staff, rush orders, other areas needing help and workers requiring training. Tasks are usually repetitive; however, work may be resumed easily after disruptions. At the beginning of the day, electronics assemblers, fabricators, inspectors and testers generally organize their tasks, using both online and paper-based task lists and work orders, and coordinate the sharing of tools or parts with other workers.

5. Significant Use of Memory

Examples

- remember numerical values obtained from tests until they can record them.
- memorize equipment settings and machine codes to enter into the computer. ~~(Daily)~~
- remember repair information from databases to discuss symptoms with service personnel or inspectors.
- remember layouts of different circuit boards for inspection purposes.

6. Finding Information

Finding Information

Tasks	Complexity Level	Examples
Typical	1 to 3	Electronic Assemblers, Fabricators, Inspectors and Testers: • refer to drawings in drawing storage bins before completing repairs. (1) , (daily) • call suppliers to find out about parts specifications. (1)
Most Complex	3	• ask co-workers, lead hands and supervisors for help, for example, with missing or incorrect parts. (1) • refer to electronic component data books, both paper-based and online, to find proper component operating

		characteristics and manufacturer specifications. (2) , (weekly) • consult engineers, research technicians, vendors and repair staff to learn more about job assignments and requirements. (2) • refer to assembly manuals, specifications, standards, and assembly or schematic drawings to find information about assembly procedures and other information such as soldering techniques. (3)

G. Working with Others

Working with Others

Complexity Level	Description
1	Electronic assemblers, fabricators, inspectors and testers work independently. In large companies, they are part of an assembly team and are responsible for one stage of production, for example, assembly, visual inspection, or testing. In smaller companies they may be responsible for a wider variety of tasks and may even be part of a design team.

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.
- Assign routine tasks to other workers.
- Assign new or unusual tasks to other workers.
- Identify training that is required by, or would be useful for, other workers.
- Deal with other workers' grievances or complaints.

H. Digital Technology

Digital Technology

Tasks	Complexity Level	Examples
		Electronic Assemblers, Fabricators, Inspectors and

Typical Most Complex	1 to 2 2	Testers: • program and set equipment by touching screens, responding to prompts and entering predefined codes. (1) • use other computer applications. For example, they may use computer-automated test software or computerized digital multimeters and oscilloscopes. (1) • may type reports and minutes of meetings. (2) • may use repair department databases to describe repair requests to service people and to locate parts. (2) • may enter figures into spreadsheets to keep track of parts, returns and production progress. (2) , (daily) • may send and receive email messages. (2) • may use software programs for designing, simulating and testing. (2)

Digital Technology Summary

- Use word processing.
- Use a database.
- Use a spreadsheet.
- Use computer-assisted design, manufacture or machining.
- Use communications software.
- Other

I. Continuous Learning

Continuous Learning

Complexity Level	Description
1	Electronic assemblers, fabricators, inspectors and testers mostly learn on the job. At larger companies they receive in-house training on new equipment, tools and procedures, including safety procedures. There may be seminars and workshops offered by suppliers. They may attend distribution shows to learn about new equipment and technology. They ask co-workers, supervisors and lead hands for information. They may look for information online including both electronic and hobbyist sites.

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
- Through off-site training

J. Other Information

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

Physical Aspects

Electronics assemblers, fabricators, inspectors and testers sit when doing diagnostics on computer or assembling products at work benches. They stand to perform inspection tests. They walk to various workstations and to the stock room. They may do some reaching and bending, such as lifting and carrying cables onto tables. They need fine-motor control and good hand-eye co-ordination to position, solder, align, and adjust small components.

Attitudes

Electronics assemblers, fabricators, inspectors and testers should be accurate, positive and eager to learn. They should have the patience to complete repetitive tasks, and the ability to work under pressure and pay attention to detail.

Impact of Digital Technology

All essential skills are affected by the introduction of technology in the workplace. Electronic Assemblers, Fabricators, Inspectors and Testers' 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. For example, the test data and results are collected and documented using technology. Workers communicate by email.

Technology in the workplace further affects the complexity of tasks related to the essential skills required for this occupation. Increased automation will affect how these workers problem solve incorrect assemblies and prioritize tasks during production delays. Workers need to learn how to use new test software and equipment.

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.