Automation and Control Technicians (NOC 2232)

Introduction

Automation and control technicians repair, maintain, calibrate, adjust, and install industrial measuring and controlling equipment. They are employed by pulp and paper processing companies, nuclear and hydro power generating companies, mining, petrochemical and natural gas companies, industrial instrument and other manufacturing companies, and by industrial instrument servicing establishments.

The three most important essential skills are:

1. Document Use
2. Thinking (Critical Thinking)
3. Oral Communication

Note: Each essential skills task is followed by a number in brackets, e.g., (2) This number reflects the estimated complexity rating for that task. The actual complexity rating may vary in some workplaces.

A. Reading	
Typical: 1 to 4	Most Complex: 4
Examples	

- Read reminders and short notes from co-workers, e.g., read notes from co-workers to learn about equipment faults. (1)
- Read short instructions written on signs, labels and packaging, e.g., read instructions on signs and electrical panel labels to learn how to avoid shock hazards. (1)
- Read short text entries on a variety of forms, e.g., read comments on work orders and job hazard assessment forms. (1)
- Read memos, e.g., read memos from supervisors to learn about changes to operating procedures and the status of projects. (2)
- Read sequenced instructions, e.g. read sequenced instructions to turn off programmable logic controller (PLC) inputs at specific internal relays. (2)
- Read notices and technical service bulletins, e.g., read technical service bulletins issued by manufacturers to learn about equipment malfunctions. (2)
- Read reports, e.g., read quality and incident reports to learn about equipment faults and required repairs. (3)
- Read trade magazine and website articles to learn about new products and stay informed about industry practices. (3)
- Read safety-related information, e.g., read workplace safety guidelines to learn about the hazards associated with products such as hydrogen sulphide and caustic sodas. (3)
- Read a variety of manuals and guides e.g., read procedure manuals and guides to learn how to install software, set up machinery and troubleshoot equipment faults. (3)
- Read and interpret electrical codes, standards and regulations, e.g., read provincial electrical safety code to learn required practices for electrical installations and repairs. (4)

Reading Summary				
Type of Text	**Purpose for Reading**			
	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	
Typical: 1 to 4	Most Complex: 4

Examples

- Identify symbols on labels, material packaging, technical drawings and equipment screens, e.g., locate Workplace Hazardous Materials Information System (WHMIS) symbols on product packaging to learn about the hazardous properties of chemicals. (1)
- Locate data, such as energy readings, speeds, pressures, settings and error codes, on gauges and digital displays. (1)
- Locate data from tags and labels, e.g., locate information such as dates and identification numbers from equipment lockout tags. (1)
- Locate data, such as parts numbers, in simple lists and tables. (1)
- Complete a variety of forms, e.g., complete work orders, equipment inspection forms and hazard assessment forms by checking boxes and entering data such as dates, times, part numbers, codes and quantities. (2)
- Study graphs and charts generated by computerized equipment, e.g., study circle charts to determine turbine speeds, turbine inlet temperatures, core temperatures and exit temperatures over set periods of time. (3)
- Locate data in tables, e.g., locate data such as specifications, classifications, material coefficients, quantities, identification numbers and costs in complex tables. (3)
- Use a variety of scale and assembly drawings, e.g., use scale and assembly diagrams of complex equipment components to plan installations and troubleshoot faults. (3)
- Use a variety of wiring, hydraulic, emission and vacuum system schematics, e.g., use control loop diagrams to locate system flows, processes, controllers and feedback sensors. (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.
√	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, e.g., read production schedules.
√	Enter information on tables, schedules or other table-like text.
√	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.
√	Interpret scale drawings, e.g., interpret floor plans or maps.
√	Take measurements from scale drawings.
√	Make sketches.
√	Obtain information from sketches, pictures or icons, e.g., locate computer toolbars.

C. Writing

Typical: 1 to 2	Most Complex: 3

Examples

- Write reminders and brief notes to co-workers, e.g., write brief notes to inform supervisors about the status of repair projects. (1)
- Write text entries in forms and log books, e.g., write short comments on work orders to describe completed work and inspection findings. (1)
- May write short email messages, e.g., write email messages to request information from suppliers. (2)
- May write short reports, e.g., write short reports to describe the outcomes of tailboard meetings (safety-related job briefings) and events leading up to workplace accidents. (2)
- May write procedures, e.g., write start-up and shut-down procedures to inform machine operators of how to control and operate equipment, and troubleshoot faults. (3)
- May write longer reports, e.g., write reports to outline the findings of an investigation to determine the cause of a major equipment fault. (3)

Writing Summary

Length	**Purpose for Writing**						
	To organize or remember	To keep a record or document	To inform or request information	To persuade or 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	
Typical: 1 to 3	Most Complex: 3
Examples	

Money Math

- Not a requirement for this occupation.

Scheduling, Budgeting and Accounting Math

- May schedule repair and maintenance tasks to make efficient use of time and to meet deadlines, e.g., schedule system upgrades and maintenance activities to coincide with annual plant shutdowns. (2)

Measurement and Calculation Math

- Take measurements and readings using basic measuring tools, e.g., measure the length of tubing using a tape measure. (1)
- Calculate material requirements, e.g., calculate the amount of cabling needed to install new equipment components. (2)
- Calculate summary measures, e.g., calculate the average length of time needed to process raw material. (2)
- Take a variety of precise measurements using specialized measuring tools, e.g., use micrometers to measure inside diameters of cylinder bores. (3)
- Calculate component values and specifications, e.g., use formulae to calculate resistances, airflows and eccentricities. (3)

Data Analysis Math

- Compare data, such as frequencies, speeds, electrical energies, temperatures and transfer rates, to normal ranges and specifications. (1)
- Evaluate sets of data collected from tests and simulations to troubleshoot faults, and assess equipment performance and the progression of wear. (3)
- Evaluate comparative data, e.g., evaluate differences in equipment specifications to determine the brand of equipment best suited to a particular application. (3)

Numerical Estimation

- Estimate the time required to complete equipment maintenance and repairs, e.g., consider the requirements of the tasks, the availability of parts and the time required to complete similar tasks in the past. (2)
- Estimate percentage of wear and useful life remaining for parts, such as pneumatic pumps.

Math Skills Summary	
a. Mathematical Foundations Used	
Whole Numbers	Read and write, count, round off, add or subtract, multiply or divide whole numbers, e.g., read numbers from gauges.

Integers	Read and write, add or subtract, multiply or divide integers, e.g., use an atmospheric gauge, which shows pressures below that of the atmosphere.
Fractions	Read and write, add or subtract fractions, multiply or divide by a fraction, multiply or divide fractions, e.g., use fractions when calculating flow.
Decimals	Read and write, round off, add or subtract decimals, multiply or divide by a decimal, multiply or divide decimals, e.g., record the cost of supplies in dollars and cents.
Percent	Read and write percents, calculate the percent one number is of another, calculate a percent of a numbers, e.g., calculate the percentage flow to maximum.
Equivalent Rational Numbers	Convert between fractions and decimals or percentages, e.g., convert from a decimal to a fraction when calculating flow.
Equations and Formulae	Solve problems by constructing and solving equations, e.g., use electrical formulae such as I/e = r (current over voltage = resistance); use a percentage-based formula for measuring the flow for all differential pressure instruments.
Use of Rate, Ratio and Proportion	Use rates, ratios and proportions, e.g., set equipment parameter settings to operate at specific rates and flows.
Measurement Conversions	Perform measurement conversions, e.g., convert oil products from gallons to litres.
Areas, Perimeters, Volumes	Calculate areas, perimeters and volumes, e.g., calculate the volume of a boiler.
Geometry	Use geometry, e.g., measure the angle of a lever; use angles and vector to balance fans and motors and turbines.
Summary Calculations	Calculate averages, e.g., compare the readings of a gauge over a period of months and draw conclusions about performance; compare production data from month to month and calculate average production over a year.

b. Measurement Instruments Used

Examples

- Time using clocks, watches or timers.
- Weight or mass using scales.
- Distance or dimension using wrenches.
- Liquid volume using calibrated containers.
- Temperature using industrial thermometers.
- Pressure using pressure gauges.
- PH using probes, meters and litmus paper.
- Electrical potential (volts) using multimeters.
- Wattage using multimeters.
- Flow using transmitters and regulators.

- Gas concentrations using chromatographs.
- Non-combustible and flue gas using oxygen and combustion meters.
- Viscosity using viscosity meters.
- Sulphur dioxide emissions using sulphur dioxide monitors.
- Level using torque tubes.
- Use the SI (metric) measurement system.
- Use the imperial measurement system.

E. Oral Communication

Typical: 1 to 3	Most Complex: 3

Examples

- Listen to alarms and buzzers generated by monitoring equipment, e.g., learn about system faults from alarms activated by monitoring sensors. (1)
- Listen to announcements made over public address systems. (1)
- Speak to suppliers to learn about products, prices and delivery schedules. (1)
- Exchange information with co-workers, e.g., speak with welders, machinists, electricians, mechanics and suppliers to discuss problems and evaluate potential solutions. (2)
- Talk to operators about equipment and machinery breakdowns, e.g., speak with operators to determine the probable cause of equipment failure. (2)
- Participate in group discussions, e.g., participate in tailboard meetings to discuss safe work practices and the outcome of a job hazard assessment. (2)
- Exchange technical repair and troubleshooting information, e.g., discuss unusual electronic control module faults with co-workers and help desk technicians. (3)
- Discuss systems designs with supervisors and engineers, e.g., discuss with engineers the optimal location of system components such as transmitters. (3)
- May make formal presentations to co-workers to explain quality monitoring and new equipment functions. (3)

Oral Communication Summary

Type	Purpose for Oral Communication (Part I)					
	To greet	To take messages	To provide or 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						

Type	Purpose for Oral Communication (Part II)					
	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	
Typical: 1 to 3	Most Complex: 3

a. Problem Solving

Examples

- Encounter equipment malfunctions, e.g., inform co-workers of the malfunction and use established troubleshooting sequences to isolate the fault. They repair the fault themselves or enlist the help of other tradespeople such as industrial electricians, or the manufacturer's technicians. (2)
- Experience delays due to a shortage of parts and supplies, e.g., inform co-workers of the delay, order the supplies and perform other work until the needed parts, materials and supplies arrive. (2)
- Are unable to repair equipment because specifications and instructions are unavailable, e.g., consult manufacturers, co-workers, suppliers and colleagues for advice and research websites to locate useable information. (3)

b. Decision Making

Examples

- Decide the order of tasks and their priorities, e.g., decide the order in which to perform equipment inspections. (1)
- Decide that pieces of equipment should be repaired rather than replaced, e.g., consider capital, material and labour costs. (2)
- Decide to shut down machines because of pending malfunctions, e.g., consider the cost associated with the unexpected shutdown and the risks if the equipment is not serviced. (3)
- Decide how to deal with emergencies, e.g., decide how to contend with serious equipment malfunctions that have the potential to injure workers and cause a significant amount of property and environmental damage. (3)

c. Critical Thinking

Examples

- Judge the accuracy of readings taken using equipment such as multimeters, probes and gauges, e.g., compare readings to other indicators of equipment performance such as vibration and noise. (1)
- Judge the condition of equipment by considering readings and the results of physical inspections. (2)
- Evaluate the severity of equipment faults, e.g., consider criteria such as readings, specifications and the risks to safety, property and the environment. (3)
- Assess the quality and neatness of installations, e.g., review test results, check the equipment for proper labeling and confirm that cables are properly anchored and connections are tight. They compare completed installations to drawings and other project documents to ensure equipment has been installed as planned. (3)

d. Job Task Planning and Organizing

Own Job Planning and Organizing

Automation and control technicians organize the most efficient use of their time within the framework of assigned tasks. Routine tasks are generally assigned by supervisors or dictated by a procedure established by the employer. Other work is performed in response to broken or malfunctioning systems and cannot be scheduled. They often have to re-prioritize tasks several times a day. Industrial electricians coordinate their work with other trades and production staff, each having different needs and priorities. (2)

Planning and Organizing for Others

They may organize the activities of apprentices and helpers to ensure that tools and equipment are used properly and that regulations established by employers, manufacturers and certifying bodies are followed. (2)

e. Significant Use of Memory

Examples

- Remember a system's basic parameters and operating tolerances.
- Remember the faults associated with error and trouble codes for various types of equipment.
- Remember previous repairs that give insight into current jobs of a similar nature.

f. Finding Information

Examples

- Learn about job hazards by inspecting job sites, reading hazard assessments, participating in safety briefings and speaking with co-workers. (2)
- Learn about the progress being made on repairs by reading email messages, logbook entries and equipment lockout forms and by talking to co-workers and equipment repairers. (2)
- Locate project specifications from drawings, work orders and specification sheets and by speaking with engineers and supervisors. (2)
- Find information about unusual equipment faults, e.g., talk to co-workers, such as machine operators, and conduct diagnostic tests to gather data. They collect additional data by taking measurements, running tests and trials and reviewing information generated by diagnostic equipment. (3)

G. Working With Others

Automation and control technicians often work independently. They may spend as much as 50 percent of their time in control and relay rooms, liaising with operators as needed to ensure instrumentation is properly maintained and emergencies are handled. They may need partners to carry out some functions, such as testing transmitters or boilers or installing control valves. They sometimes work in crews. For instance, teams of three or four workers may be needed to run new wires in plants.

Participation in Supervisory or Leadership Activities

√	Monitor the work performance of others.
√	Inform other workers or demonstrate to them how tasks are performed.

√	Orient new employees.
x	Make hiring recommendations.
√	Assign routine tasks to other workers.
x	Assign new or unusual tasks to other workers.
√	Identify training that is required by, or would be useful for, other workers.
x	Deal with other workers' grievances or complaints.

H. Digital Technology	
Typical: 1 to 2	Most Complex: 3
Examples	

Word Processing

- May use word processing software to prepare reports. (2)

Spreadsheet Software

- May use spreadsheet software, e.g., use spreadsheets to tally project costs. (2)

Bookkeeping, Billing and Accounting Software

- Not a requirement for this occupation.

Communication Software

- May use communication software to exchange email with customers, suppliers and help desk technicians. (2)

Data Bases

- Use databases to enter repair information and retrieve equipment maintenance histories. (2)
- Use databases to optimize workflow, e.g., use databases to access the maintenance schedules required by manufacturers. (3)
- Use databases to retrieve and print scale and assembly diagrams. (2)
- Use databases to acquire information about distributed control systems (DCSs) and programmable logic controllers (PLCs) inputs such has ranges, locations and alarm conditions. (2)

Graphics Software

- May use graphics software, e.g., use graphics software incorporated in scanning tools to access data displays such as signal values. (2)

Internet

- Use the Internet to access training courses and seminars offered by training institutions, unions, suppliers and employers. (2)
- Use Internet browsers and search engines to access technical service bulletins, electrical codes, specifications and troubleshooting guides. (2)
- May use the Internet to access blogs and web forums to seek and offer advice about the repair of electronic equipment. (2)
- Search Internet websites and navigate layers of menus to locate technical data, such as pin assignments on integrated circuit chips. (3)

Programming and System Design

- Use hand-held configurators to assist in the configuration of system components. (2)
- May install and service human-machine interfaces to permit interactions between human beings and computerized systems. (3)
- May install and service supervisory control and data acquisition (SCADA) systems to monitor and control industrial, infrastructure and facility-based processes. (3)
- May install and service distributed control system (DCS) software to control system parameters, such as speeds, outputs, pressures and temperatures. (3)
- May install and service programmable logic controllers (PLCs) to control the speeds and outputs of machinery. (3)

Other Digital Technology

- May use personal digital assistant (PDA) devices to complete numeracy-related tasks such as calculating material requirements. (1)
- Use hand-held electronic devices such oscilloscopes and multimeters to access operational data such as electrical readings. (1)
- Use hand-held communicators to read pressure, flow and instrumentation setup, and to calibrate transmitters and valve positioners. (1)

I. Continuous Learning

Automation and control technicians learn by taking courses such as the Industrial Safety Course, which covers topics such as how to use Air-Pak and supplied breathing. They also take courses on confined space entry, computer applications related to process control and Workplace Hazardous Materials Information System (WHMIS). They attend technical courses offered by suppliers' representatives, which cover the use of new equipment such as transmitter controls, process control equipment and analyzers. They may attend team leadership/communication seminars offered to workers in operations, maintenance and management. In addition, they learn through reading technical magazines.

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 worker's own time. • using materials available through work. • using materials obtained through a professional association or union. • using materials obtained on worker's own initiative.
√	Through off-site training • with costs paid by the worker.

J. Other Information

In addition to collecting information for this essential skills profile, interviews with job incumbents also covered the following topics.

Physical Aspects

Automation and control system technicians require good upper limb, multiple limb and hand-eye coordination. They stand, bend, stretch, balance and kneel when repairing and inspecting equipment. They require physical stamina and dexterity to work in locations with limited egress such as tanks and underground pits and tunnels. They use their sense of hearing, sight, smell and touch to determine the operating condition of parts and to detect faults. Colour vision is essential for work on colour coded wiring.

Attitudes

Automation and control technicians should be patient, tolerant and easy-going. It is important that they remain calm in stressful situations. They should be prepared to work long hours and be able to work alone.