



**National Occupational Standard for**  
Production Engineer

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Emhemmed Youssef	Engineering Manager	SIXRING Ltd
Hamidreza Mollahassani	Manufacturing Engineer	PerkinElmer
Ian Baillargeon	Director, Global Engineering	Acadian Seaplants Ltd
Junaid Allawala	Process Engineering Team Lead	Baylis Medical Company
Linh-Chi Nguyen	Mechanical Engineer	N/A withheld at participant's request
Louis-Phillipe Caron	R&D and Manufacturing Engineer	Spinologix
Luc Nguyen	Production Engineer	Sanofi
Mohamed Safiyullah	Manufacturing Engineer	Abbott Point of Care
Oliver Kuo	Engineer	Emergent BioSolutions
Sagar Kumart Rapeti	Operations Manager	Amico Lights Corporation
Shyra Khosla	Director of Operations	Innovere Medical
Syed Bilal Haider	Manufacturing Engineer	Phyton Biotech
Thomas Moore	Independent Consultant	Self Employed
Wu Ding	Chief Science Officer	Proventus

## 2 A COMPETENCY FRAMEWORK FOR INDIVIDUALS WORKING IN THE BIO-ECONOMY

### 2.1 What is a National Occupational Standard?

In Canada, National Occupational Standards are industry-developed and validated documents that identify and group tasks/competencies associated with a particular occupation. They also describe the knowledge and skills that a worker must demonstrate to be considered competent.

The former Alliance of Sector Councils (TASC) outlined 11 guiding principles for creating National Occupational Standards (NOS). NOS for the Canadian bio-economy meet all 11 principles and are developed to meet the current and future human capital management needs of the Canadian bio-economy.

### 2.2 How are we defining a competency?

We define a competency as *a set of related behaviors that describe successful performance in a designated area. It is a behavioural expression of how people integrate knowledge, skills, attributes, and attitudes to produce a value-adding result in a defined situation.*

The competency statement includes a description that integrates skills, knowledge, and actions into a sequence of activities that deliver a value-added product or service.

**Performance Indicators** is the term we use for the behaviours grouped under each competency that describe the level of mastery the incumbent role must demonstrate when executing a task.

For this project, we have organized the competencies into four categories.

**Core Competencies** are those competencies that describe the "essence of the role" — that is, they are the one to three most critical competencies that may be applicable across multiple roles in a function or job family. All levels of personnel in this function would typically share them. These competencies may also act as qualifiers that differentiate the function from other functions.

**Technical Competencies** are those competencies related to specific roles or professions that enable an individual to work, function, and succeed in that role. They address the various responsibilities that job incumbents encounter in a role. For example, a surgeon's technical competencies would encompass multiple surgical tools, techniques, and conditions that could be part of the position.

Similarly, technical competencies for a lawyer would contain various legal situations that they encounter in the context of a particular field of practice.


**Regulatory Competencies** are those competencies that describe compliance with prescribed practices and mandated obligations under applicable laws, regulations, and industry standards. They ensure that critical work processes are implemented and integrated into all work activities. They are of absolute importance where economic behaviours can impact human conditions.

**Personal/professional Competencies** are those competencies that enable an individual to be successful working with others and fulfilling their responsibilities in a work context. Personal and professional competencies are not necessarily role specific.

### 2.3 Levels of complexity of work

It is important to recognize how the complexity of work varies along an organizational continuum. At one end of this continuum is low-complexity, clearly-defined, task-driven work. At the other end of the continuum is work that is higher in complexity, not as well-defined, and requires higher-level thinking and decision-making skills and a greater degree of autonomy. Results are recognised over a longer period of time and are more difficult to assess.

Figure 1: Demonstrates how the level of complexity changes with the role responsibilities

Complexity Level	Examples of Work at Different Complexity Levels	Typical Roles/Titles
Most Complex	Construct and pursue worldwide strategic plans in large corporations.	CEOs of the largest trans-global corporations
	Construct and pursue worldwide strategic plans.	C-suite executives at multi-national organizations
	Lead the accumulated impact of multiple business units.	C-suite executive at large, multi-location organizations
	Optimize the function of a single business unit or corporate support staff.	General manager; plant manager
	Manage multiple, interdependent projects; balance resources among departments.	Engineering manager
	Plan and carry out sequential projects while considering contingencies and alternatives.	Maintenance manager
	Accumulate information to diagnose and anticipate problems; proactive; notice trends.	Maintenance technician
Least Complex	Follow predefined procedures; seek help when encountering an obstacle. The ability to anticipate problems is not expected.	Maintenance labourer

We define the complexity levels within the profiles at four levels:

**Foundational** — performance focus is on the execution of procedures and tasks involving own job role.

**Operational** — performance focus includes some discretion in the planning and executing of work. The work typically includes assessing the quality of the work outcomes and taking corrective action to ensure quality.

**Specialist** — performance focus is on translating goals and standards to team members and ensuring that work done under the person's responsibility area complies with all corporate standards.

**Strategic** — performance focus is on leading work and the accumulated impact of work in an independent business unit or across a whole organization. The impact of work at this level is often not visible until the medium to longer term.

The following example illustrates the different complexity levels within a profile.

<p><b>Competency Name: Research Ethics</b></p> <p><b>Competency Definition:</b> Exercises integrity and professionalism to ensure all research is performed responsibly in keeping with the ethical principles of beneficence and nonmaleficence.</p> <p>Competence at this level is demonstrated when the <b>Research Manager:</b></p>			
<p><b>Performance Indicators</b></p>			
Foundational	Operational	Specialized	Strategic
Diligently follows research procedures and protocols mandated by legitimate authorities and professional organizations.	Regularly monitors own actions and decisions to ensure they align with professional and organizational values.	Holds self and staff accountable to the organization's values, ensuring compliance with the policies and procedures related to scientific ethics and rules of conduct.	Fosters an organizational culture of integrity and ethical business practices by unwavering personal example.

## 2.4 Overview methodology for the development of national occupational standards

National occupational standards were developed using a multi-step process.

Step	Description	Result/Output
1	Identify critical roles in the bio-economy through primary and secondary research.	List of 50 key roles
2	Create draft profiles with critical competencies for the roles, performance, and knowledge indicators.	Draft profiles
3	Review the draft profiles with industry subject matter experts to refine the competencies, performance, and knowledge indicators.	Reviewed profile with design inputs from industry experts
4	Further validation and review by industry via online focus group.	Validated profiles by industry experts
5	Broader validation of the draft profiles via national online surveys.	Occupational Standards validated on a national level by experts from the different sectors
6	Addition of the Essential Skills and Canadian Language Benchmark (ES/CLB) ratings.	Nationally validated NOS profiles with ES/CLB profile for each NOS

### 3 PRODUCTION ENGINEER COMPETENCY FRAMEWORK

#### 3.1 Competency diagram for Production Engineer

Competencies		Complexity Level				Complexity Level Legend
		1	2	3	4	
<b>Core Competency</b>						<b>1. Foundational</b> <b>2. Operational</b> <b>3. Specialist/Manager</b> <b>4. Expert/Executive</b>
1	Production Process Design					
2	Production Optimization					
<b>Technical Competencies</b>						
3	Production Start-up and Commissioning					
4	Supply Chain Qualification					
5	Production Accounting					
<b>Industry Regulatory Competencies</b>						
6	Health, Safety and Environmental Management					
7	Product Safety Compliance Management					
<b>Personal and Professional Competencies</b>						
8	Leadership					
9	Communication					
10	Collaboration/Teamwork					
11	Technical Problem Solving					
12	Critical Thinking					

### 3.2 Definition of occupation

The Production Engineer is responsible for determining how a product will be manufactured, commissioning the manufacturing centre/plant, and continuously improving/optimizing the production process throughout the product life cycle in order to improve efficiency, lower costs, maintain or improve quality, and increase yields. They are also in charge of decommissioning and/or repurposing production equipment and technology at the end of a product life cycle.

The Production Engineer may be involved in determining the steps and processes in manufacturing a product at scale, designing manufacturing cells/centres to optimize production resource use, designing new production tooling and equipment, qualifying vendors and suppliers in the production supply chain, detailing specifications for sub-components and materials, working with production personnel to improve production output, and serving as a technical resource for solving production problems.

They may serve as a point of contact for the media and represent their organization at industry forums and events:

Applicable To	Bio-Health	Agri-Bio	Bio-Industrial	Bio-Energy

The level of complexity of the role is:

Span of Complexity Levels	Foundational	Operational	Specialist/Management	Expert/Executive

### 3.3 Level of education, training or designations requirements

Typical Education Required	Secondary	College	Bachelor	Master	PhD
Typical Starting Experience	0–5 yrs.	5–10 yrs.	10–15 yrs.	15–20 yrs.	20+ yrs.

- Bachelor’s degree in engineering/P. Eng. is generally required (chemical, bio, mechanical, automated systems, electrical, or industrial engineering degrees are all applicable, depending on the type of product being manufactured)
- Minimum five years of experience in a manufacturing/production environment is typical
- PMP certification is an asset
- Strong understanding of Lean manufacturing principles and continuous improvement processes
- Strong understanding of quality management systems (QMSs) and the related standards and their interpretation
- Strong understanding of material handling and supply chain principles
- Experience with root cause analysis techniques to investigate and resolve production nonconformances
- Proficiency with applicable computer software packages for technical/engineering design and drawing, office productivity (Microsoft Office Suite), project management, and supply chain management software is generally required

### 3.4 Core competencies list for Production Engineer

#### 3.4.1 Production Process Design

Applies engineering and production knowledge to prepare detailed manufacturing plans for products to ensure that safety, quality, productivity, and cost/profitability targets are met.

Competency in this role is demonstrated when the individual:

- Designs, validates, implements, and maintains manufacturing processes and test operations according to product requirements, best practices, quality objectives, and cycle time.
- Performs risk analysis on processes during production design.
- Defines and documents processes that are efficient, scalable, reliable, and repeatable.
- Reviews hardware design of the products and provides feedback to design team in terms of optimizing design for manufacturability (DFM), production yield, and cycle time.
- Participates in supplier qualification activities to improve supplier quality and facilitate make/buy decisions in the production plan.
- Creates and implements processes that support a shift from prototyping to scale production.
- Where applicable, enables flexible manufacturing models (configure-to-order (CTO), engineer-to-order, mass production, etc.) including configuration design and management and concurrent design for manufacture and assembly.

**Knowledge required for competency at this level:**

- Strong, practical knowledge of product development, supply chain, planning, and quality control practices
- Knowledge of product design, fabrication, assembly, tooling, and materials
- Understanding of Design for Manufacturability (DFM), Design for Assembly (DFA), Design for Testability, and Design for Sustainability principles

### 3.4.2 Production Optimization

Applies knowledge of Lean production and quality management processes to collaborate with production facilities in support of the identification, development, and execution of the continuous improvement of production processes in order to reduce costs and improve production efficiency.

Competency in this role is demonstrated when the individual:

- Works as part of a multi-disciplinary team to identify improvement opportunities.
- Uses risk evaluation tools to investigate root causes of reoccurring issues and provide proper countermeasures.

- Completes equipment and process improvement analyses and prepares justifications for necessary capital equipment and other manufacturing equipment.
- Conducts ongoing process validation studies.
- Recommends and implements improvements to processes, technology, and interfaces that improve the effectiveness of the team.
- Works closely with quality department in reviewing any nonconformance returns from customers and implementing corrective actions/preventive actions (CAPA) to prevent reoccurrence.
- Implements process improvements and provides technical support to technicians and operators.

**Knowledge required for competency at this level:**

- Understanding of Lean manufacturing and continuous improvement tools and processes
- Understanding of Design for Manufacturability (DFM), Design for Assembly (DFA), and Design for Sustainability principles
- Understanding of Lean/Six Sigma theory and practices
- Knowledge of troubleshooting techniques and methods (5 Whys method, Ishikawa diagram, etc.)

## 3.5 Technical competencies list for Production Engineer

### 3.5.1 Production Start-up and Commissioning

Applies engineering expertise to design and commission the plant tooling and equipment necessary for production start-up and launch, as well as subsequent production at scale.

Competency in this role is demonstrated when the individual:

- Investigates new manufacturing processes and plans implementation, including acquisition of new equipment and/or facilities.
- Reviews equipment specification and selection and supervises installation and successful start-up of new assembly line or equipment.
- Researches new equipment for ergonomic improvement.
- Evaluates the feasibility of modifying existing manufacturing plant equipment.

- Supports training for new equipment and processes.
- Develops and improves processes that enhance effective manufacturing and new product introduction, including bills of material (BOM's), routing creation, and engineering change control.

**Knowledge required for competency at this level:**

- Understanding of manufacturing processes
- Understanding of tooling and machinery for plant operations
- Understanding of ergonomic principles
- Knowledge of cellular manufacturing principles

### 3.5.2 Supply Chain Qualification

Applies knowledge of quality management systems (QMSs) to assist supply chain management personnel in the vetting and qualification process for suppliers of necessary components, materials, and services required for production at scale.

Competency in this role is demonstrated when the individual:

- Actively engages with supply chain personnel to participate in qualification activities.
- Conducts engineering assessments of existing and potential suppliers to determine their suitability for inclusion in the supply chain.
- Leverages technical competency and engineering knowledge to identify supplier capability and facilitates make/buy decisions in the production process.
- Assists suppliers in improving quality and reliability processes to optimize the overall supply chain performance.

**Knowledge required for competency at this level:**

- Knowledge of supply chain excellence processes and techniques
- Knowledge of ISO and other QMS standards and processes
- Knowledge of traceability requirements

### 3.5.3 Production Accounting

Applies knowledge of production/managerial accounting processes in order to develop and improve performance metrics for production lines, creating managerial visibility into production performance and variances.

Competency in this role is demonstrated when the individual:

- Provides detailed costs for purchase of new or revised equipment including alternative options and comparisons.
- Monitors actual costs during production to provide sales departments with necessary information for preparing accurate quotes and estimating profit margins on orders.
- Delivers significant materials cost savings by establishing procedures for identifying and eliminating duplicate part demands in installation plans.
- Creates performance metrics to evaluate line efficiency/effectiveness.

**Knowledge required for competency at this level:**

- General understanding of managerial/production accounting processes
- General understanding of company budgeting and control processes
- General understanding of capital cost accounting processes

## 3.6 Industry regulatory competencies list for Production Engineer

### 3.6.1 Health, Safety and Environmental Management

Participates in the company health, safety, and environmental (HSE) management program within their department and works in accordance with company standards and jurisdictional and industry requirements in order to ensure that HSE performance meets expectations.

Competency in this role is demonstrated when the individual:

- Reviews and comments on the environmental impact assessment studies.
- Ensures their mandatory personal HSE training and certifications are maintained.

- Follows and enforces HSE rules.
- Participates in HSE audits and reports, as required.
- Reports HSE incidents.
- Addresses variances in HSE performance as directed by HSE specialists.
- Liaises with other departments and external resources on HSE best practices.

**Knowledge required for competency at this level:**

- Knowledge of company HSE policies and procedures
- Knowledge of recycling methods and requirements
- Knowledge of environmental impact regulations
- Knowledge of hazardous materials regulations
- Knowledge of energy conservation practices
- Knowledge of company HR and performance/discipline policies and practices

### 3.6.2 Product Safety Compliance Management

Participates in development and implantation of policies and processes to ensure compliance with applicable product safety regulations.

Competency in this role is demonstrated when the individual:

- Develops production processes to ensure requirements for material traceability are enforced.
- Audits product safety compliance during line start-up and commissioning activities and addresses discrepancies and variances.
- Holds subordinate leaders accountable for maintaining product safety compliance.
- Liaises with other departments and external resources to understand and implement product safety and traceability best practices.

**Knowledge required for competency at this level:**

- Knowledge of all relevant product safety, labeling, and traceability regulations

### 3.7 Personal and professional competencies list for Production Engineer

#### 3.7.1 Leadership

Contributes to an effective engineering team by fostering a positive, collaborative work culture that delivers measurable value to internal and external stakeholders and contributes to the achievement of business goals and objectives.

Competency in this role is demonstrated when the individual:

- Leads by example.
- Ensures team members' contributions are valued and recognized.
- Fosters an environment of shared responsibility.
- Encourages full participation by the group in matters that will impact their work.
- Actively participates in the development of the culture within the group.

**Knowledge required for competency at this level:**

- Knowledge of ethical leadership principles
- Knowledge of department roles and responsibilities
- Understanding of motivational techniques
- Cultural awareness

#### 3.7.2 Communication

Uses appropriate written, verbal, and non-verbal communication and listening techniques to clearly communicate upwards, downwards, and laterally within the organization in order to ensure understanding and enable execution for the successful achievement of organizational goals and performance metrics.

Competency in this role is demonstrated when the individual:

- Follows through on communications to ensure understanding.
- Translates technical language to make it understandable for different stakeholder groups.
- Actively questions to ensure mutual understanding.
- Uses appropriate mediums for communication to ensure understanding and action..
- Applies written and oral communication devices (analogy, metaphor, symbolism, etc.) to increase understanding.

**Knowledge required for competency at this level:**

- Knowledge of writing techniques
- Knowledge of oral communication and presentation principles and techniques
- Knowledge of questioning principles and techniques
- Understanding of the principles of cross-cultural communication

### 3.7.3 Collaboration/Teamwork

Actively participates in or leads multi-disciplinary, inter/intra-departmental teams in order to generate ideas and solutions, solve problems, and improve overall organizational performance.

Competency in this role is demonstrated when the individual:

- Acts with integrity.
- Takes ownership (responsibility and accountability) for their actions.
- Actively engages with others to seek and honour their expertise and opinions.
- Applies active listening and emotional intelligence techniques to ensure others are valued.
- Encourages broad discussion and sharing of ideas in order to generate innovative solutions.
- Works collaboratively with different groups to ensure all opinions are heard before making decisions.
- Resolves conflicts and solves problems between stakeholders to ensure project success.
- Openly gives credit to the ideas and participation of others.

- Takes ownership (responsibility and accountability) if things go wrong.

**Knowledge required for competency at this level:**

- Knowledge of Emotional Intelligence principles and processes
- Knowledge of teamwork and collaboration principles
- Knowledge of group problem-solving and decision-making principles
- Understanding of group dynamics
- Knowledge of effective communication principles
- Knowledge of conflict resolution techniques

### 3.7.4 Technical Problem Solving

Applies experience and specific knowledge to act as a technical resource and key decision maker in solving technical problems related to production and manufacturing. This can include reactive problem solving (fixing things that have gone wrong) and proactive problem solving (developing mitigating actions and modifying procedures and processes to ensure the problems do not occur/reoccur).

Competency in this role is demonstrated when the individual:

- Actively engages with other team members when issues and problems occur.
- Creates an environment where problems are willingly identified and solved.
- Takes responsibility and “owns” problems within the department.
- Applies systems thinking and troubleshooting/root cause analysis principles to fully understand complex technical problems and generate appropriate solutions.

**Knowledge required for competency at this level:**

- Knowledge of systems thinking
- Knowledge of root cause analysis principles and processes

- Knowledge of collaboration and team decision-making principles

### 3.7.5 Critical Thinking

Analyzes data to reach objective conclusions, defends position on complex issues, clarifies issues, and transfers ideas to new contexts, ensuring recommendations are supported by relevant facts, in order to facilitate improved decision-making.

Competency in this role is demonstrated when the individual:

- Reviews policies and procedures to ensure they are clear and easy to understand.
- Develops frameworks to help improve data analysis and decision-making efficiency and impacts.
- Guides others to ensure critical thinking principles are engaged when approaching their own work.

#### **Knowledge required for competency at this level:**

- Knowledge of decision-making frameworks
- Knowledge of analysis frameworks

## 3.8 Essential Skills for Production Engineer

Essential Skills (ES) are foundational skills required for all types of work. They are not technical skills, but the core skills people need to acquire knowledge and complete workplace tasks and daily activities.

Understanding the ES requirements for a role can allow individuals to compare their skills to those required, assist training/learning providers in developing appropriate supports to ensure ES levels are developed during training, and provide employers with an additional tool for determining who/how to place in particular roles.

Human Resources and Skills Development Canada has defined Essential Skills as follows:

- Reading
- Document Use

- Numeracy, which is further divided into:
  - Money math; Scheduling, budgeting, and accounting math; Measurement and calculation math; Data analysis math.
  - Several different factors related to estimations, including the presence of a set procedure, the number of items being estimated, the consequences of errors in estimation, the amount of information missing, and the accuracy required.
- Writing
- Oral Communication
- Thinking Skills, which are further divided into:
  - Problem Solving
  - Decision Making
  - Critical Thinking
  - Job Task Planning and Organizing
  - Finding Information
  - Significant Use of Memory
- Digital Skills
- Working with Others
- Continuous Learning

**Most of the ES have levels based on complexity, and a role can be analyzed to determine the appropriate levels of ES. The exceptions are noted below:**

- "Working with Others" does not have a complexity rating: it simply describes the ways in which the role would be required to interact with other people, either internally within the organization or externally (i.e., with clients, customers, or the public).
- "Continuous Learning" does not have a complexity rating: it describes the types of learning expected in the context of the role (e.g., on the job, being mentored by others, formal training as part of the job, etc.).

*NOTE: as of January 2020, ESDC was undertaking a comprehensive review of ES with the intent of adding additional skills, refining existing ones (particularly digital skills) and better aligning ES with similar approaches used in other countries. However the detail was not finalized in time to be used, therefore the profiles developed for this project follow existing standards as of December 2019.*

### 3.9 Canadian Language Benchmark for Production Engineer

Canadian Language Benchmarks (CLB) are a 12-point scale for task-based language proficiency descriptors which were originally developed as a guide for measuring the teaching and assessment of English as a Second Language (ESL) learners in Canada. Since they were originally developed, the Canadian Centre for Language Benchmarks (CCLB) has continued to refine CLB, and it now includes scales for both English and French language proficiency.<sup>1</sup>

The CLB has been validated against both the Common European Framework for Language (CEFL) and the American Council for the Teaching of Foreign Languages (ACTFL) benchmarks and is considered accurate for high-stakes evaluation<sup>2</sup>.

The ES levels for Oral Communication were developed with reference to the Canadian Language Benchmarks<sup>3</sup>. Comparative work to determine the alignment between the CLB and other Essential Skills has been ongoing, with recent work providing additional alignment with the ES for Oral Communication in both spoken and listening domains, Reading, Writing, and Document Use.<sup>4</sup>

CCLB has developed a set of crossover tables that align CLB ratings with ES ratings for reading, writing oral communication and document use.

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<sup>1</sup> Centre for Canadian Language Benchmarks. Theoretical Framework for The Canadian Language Benchmarks And *Niveaux De Compétence Linguistique Canadiens*. CCLB. Ottawa 2015. p8

<sup>2</sup> Centre for Canadian Language Benchmarks. Canadian Language Benchmarks: English as a Second Language for Adults, CCLB. Ottawa 2012 p.II

<sup>3</sup> Essential Skills Research Group. Readers Guide to the Essential Skills. ESDC. Ottawa ND. p57

<sup>4</sup> Canadian Centre for Language Benchmarks. Relating Canadian Language Benchmarks to Essential Skills: A Comparative Framework. 2015, p3

Production Engineer ES/CLB Profile

Essential Skills	Equivalent CLB Level	ES Level				
		1	2	3	4	5
Reading	Reading: 11–12	1	2	3	4	5
Document Use	Reading: 11–12 Writing: 11–12	1	2	3	4	5
Writing	Writing: 9	1	2	3	4	5
Oral Expression	Speaking: 11–12 Listening: 11–12	1	2	3	4	5
Numeracy	n/a	1	2	3	4	5
Thinking Skills – Problem Solving	n/a	1	2	3	4	
Thinking Skills – Decision Making	n/a	1	2	3	4	
Thinking Skills – Job/Task Planning and Organizing	n/a	1	2	3	4	
Thinking Skills – Significant Use of Memory	n/a	Types 1,2,3				
Thinking Skills – Finding Information	n/a	1	2	3	4	
Digital Skills	n/a	1	2	3	4	5
Working with Others	n/a	See Below				
Continuous Learning	n/a	See Below				

## Explanation of the Essential Skills and the Canadian Language Benchmark for Production Engineer

### Reading: ES 5 CLB: 11–12

Production Engineers read and interpret a wide variety of dense and complex technical and scientific documentation, including studying research papers and articles in peer-reviewed journals, vendor and component manufacturer documentation, materials specifications, technical and engineering standards, design documents, and commercial documentation (contracts, proposals, patents, etc.) to glean information that can be used to develop and optimize manufacturing processes.

### Document Use: ES 5 CLB: Reading: 11–12, Writing: 11–12

Production Engineers access and interpret information from a wide variety of complex digital and paper-based sources and use the information gathered to make inferences and draw conclusions within their area of specialization. The information they interpret may be textual, graphical, and/or numerical in nature, and they must synthesize and summarize information to inform their own work as well as to inform decisions by others in the organization.

### Writing: ES 4 CLB: 9

Production Engineers compose technical and engineering reports related to manufacturing processes and optimization. They document operating procedures for manufacturing departments and create plans for commercializing products. They write internal memos and other routine correspondence aimed at a variety of audiences.

### Oral Expression: ES 4 CLB: Speaking: 11–12, Listening: 11–12

Production Engineers work within an interdisciplinary team and must be adept at communicating complex technical information to a wide variety of audiences both inside and outside the organization. They contribute to peer forums, provide information to inform the decisions of senior managers and other stakeholders, instruct junior personnel in techniques and technologies, and solicit feedback from research project staff and stakeholders. Additionally, they make presentations to senior management, negotiate with external vendors and providers, instruct others on production processes and techniques, and may be called upon to communicate the details of production technologies and optimization processes to non-technical audiences.

**Numeracy: ES 4 (Money Math: n/a, Scheduling, Budgeting and Accounting: 3, Measurement & Calculation: n/a, Data Analysis: 4)**

Production Engineers are responsible for formulating and tracking departmental budgets as well as tracking expenditures for ongoing projects. In the course of their work they will conduct complex calculations with a wide array of dependent and independent variables. In many cases they will analyze data to predict future results in a climate of uncertainty, where the consequences of mistakes can be dire. They develop operating metrics to determine production efficiency, establish tolerances for quality control practices, and use predictive algorithms to develop pre-emptive maintenance and life-cycle cost optimization strategies for production assets.

**Thinking Skills:**

Thinking skills are subdivided into five domains:

- Thinking Skills — Problem Solving
- Thinking Skills — Decision Making
- Thinking Skills — Job/Task Planning and Organizing
- Thinking Skills — Finding Information
- Thinking Skills — Significant Use of Memory

- **Thinking Skills — Problem Solving: ES 4**

Production Engineers solve complex, multi-variate problems in the course of their work. They deal with problems of a scientific and technical nature, where the interactions of variables may be unknown or unpredictable, and they must develop a process for solving these problems in order to optimize the outcomes.

- **Thinking Skills — Decision Making: ES 4**

Production Engineers analyze, synthesize, and evaluate arguments, information, and data and must exercise sound judgement in deciding between alternative courses of action. The decisions they make can have significant and severe financial consequences for their organization, and the decisions are difficult and extremely costly to reverse.

- **Thinking Skills — Job/Task Planning and Organizing: ES 4**

Production Engineers plan their own work, taking into account the availability of shared resources and the potential scheduling conflicts with others. They plan and direct the work of their departments, setting priorities and allocating and managing limited resources to optimize their value. They have wide discretion over the what and how of their work and are expected to manage their time to meet specific milestones in a project schedule. They work within an interdisciplinary team to execute projects that will impact the future profitability of their organization.

- **Thinking Skills — Finding Information: ES 4**

Production Engineers collect, analyze, and interpret data from a wide array of multidisciplinary scientific and technical resources in the course of their work. Information must be collected and synthesized in order to be used.

- **Thinking Skills — Significant Use of Memory: Types 1, 2, 3**

Production Engineers must memorize, retain, and use information through one or all of the following methods:

- Purposeful memorization of procedures, codes, parts numbers, memorization through repetition (Type 1)
- Remembering information for brief periods, e.g., minutes or hours (Type 2)
- Unique events in which learning occurs from exposure (Type 3)

### **Digital Skills: ES 4**

Production Engineers utilize standard office productivity software tools (Word processing, spreadsheets, presentations, etc.), electronic communication tools (email, text, instant messaging, video conferencing, etc.), and a variety of data retrieval and analysis tools and technologies in the performance of their duties. They develop, test, and implement software programs and code for production systems and troubleshoot production problems using specialized and sophisticated data analysis and modeling software, and use other specialized digital tools to design, test, and document production processes.

**Working with Others: Work Contexts 2, 3 & 4**

The following work contexts and functions are relevant to the Production Engineer role:

- Works independently (Work Context 2)
- Works jointly with a partner or helper (Work Context 3)
- Works as a member of a team (Work Context 4)

**They may also be involved in supervisory or leadership activities, as follows: Functions 1–5 & 8–12**

- Participate in formal discussions about work processes or product improvement (S/L Function 1)
- Have opportunities to make suggestions on improving work processes (S/L Function 2)
- Monitor the work performance of others (S/L Function 3)
- Inform other workers or demonstrate to them how tasks are to be performed (S/L Function 4)
- Orient new employees (S/L Function 5)
- Select contractors and suppliers (S/L Function 8)
- Assign routine tasks to other workers (S/L Function 9)
- Assign new or unusual tasks to other workers (S/L Function 10)
- Identify training that is required by or would be useful for other workers (S/L Function 11)
- Deal with other workers' grievances or complaints (S/L Function 12)

**Continuous Learning: Types of Learning 1, 2, 3 How Learning Occurs: 1, 2, 3, 4, 5, 6**

Type of learning may include:

- Training in job-related health and safety (Type 1)
- Obtaining and updating credentials (Type 2)
- Learning about new equipment, procedures, products, and services (Type 3)

The learning may occur:

- As part of regular work activity (Context 1)
- From coworkers (Context 2)

- Through training offered in the workplace (Context 3)
- Through other forms of self-study (Context 4):
  - At work
  - On worker's own time
  - Using materials available through work
  - Using materials obtained through a professional association or union
  - Using materials obtained through worker's own initiative
- Through offsite training (Context 5):
  - During working hours at no cost to the workers
  - Partially subsidized
- With costs paid by the worker (Context 6)

## 4 REFERENCES

### Gathering the data

The development of the National Occupational Standards started with a review of existing information for the role. This review process included: referencing books, job postings, websites, articles, and BioTalent Canada's existing skills profiles to create the first draft. After several iterations via written feedback, focus groups and a national survey with subject matter experts, the National Standards were developed. The following are sources consulted during the creation of the **Production Engineer** profile:

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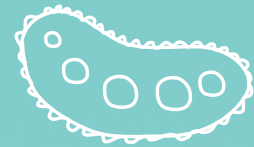
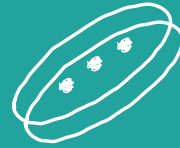
“Job Description Manufacturing Engineer Job.” Biomerics , <https://biomerics.com/wp-content/uploads/Manufacturing-Engineer-Job-Description.pdf>.

LinkedIn, <https://www.linkedin.com/>.

Indeed, <https://ca.indeed.com/>.

During the research period, several job posting boards were reviewed for this profile.

# You already have a stellar team. Here's how to enhance their key skills.



## PROFESSIONAL DEVELOPMENT

- Essential Skills Fundamentals
  - Introduction to the Bio-economy, Reading, Writing, Numeracy, Document Use, Communication, Collaboration, Problem Solving
- Technical Skills Fundamentals
  - Scientific Report Writing, GLP, GCP, GMP, QA/QC



*Give your team the BioReady™ Edge*

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