

CONSTRUCTION  
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CONSEIL SECTORIEL  
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# National Occupational Standards For Operating Engineers

## FOUNDATION SHORING OPERATOR





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Canada

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## **Introduction**

The Construction Sector Council (CSC) is one of 40 sector councils in Canada. Sector councils are industry-led, labour/management partnership organizations designed to address human resource development issues within specific industries.

The primary objective of the CSC is the development of a highly-skilled workforce and a safe workplace environment, contributing to the organizational productivity and individual prosperity of the members of the construction industry. The development of national occupational standards for operating engineer occupations is one of the many ways the CSC is meeting this objective.

The CSC acknowledges all of the subject matter experts who provided their valuable time and efforts toward the definition and validation of these national occupational standards. Without their combined contributions, the development of these occupational analyses (OAs) would not have been possible. A complete list of the subject matter experts can be found at the back of this document.

An OA has the following objectives:

- to identify and group the tasks performed by skilled workers in particular occupations
- to identify those tasks that are performed by skilled workers in every province and territory
- to develop instruments for use in the assessment and training leading to the certification of skilled workers
- to facilitate the mobility, in Canada, of trainees and skilled workers
- to supply employers and employees, and their associations, industries, training institutions, and governments with analysis of the tasks performed in particular occupations

Therefore, the standards define the skills, knowledge, and abilities required for an occupation and against which the qualifications of an individual in that occupation can be assessed.

The vision of the Construction Sector Council is to reach a point where operators who demonstrate the skills, knowledge, and abilities in the national occupational standards will possess the nationally recognized credentials and those credentials will assist the operator in obtaining employment anywhere in Canada.

## Foreword

Operating engineer occupations can be grouped into three broad areas—hoist and crane operators, construction heavy equipment operators, and industrial equipment operators. Within each of these broad categories, there are several operating engineer occupations.

### **1. *Hoist and Crane Operators***

Crane operators' work tends to be centred in the construction industry. Operators work on a broad range of building sites including high-rise residential, institutional, and commercial structures, as well as most large industrial sites and many types of heavy engineering projects. The Statistics Canada Labour Force Survey (LFS) identifies around 4,000 crane operators in the construction industry across Canada. There are cyclical variations in employment, with low levels below 3,000 jobs in the mid-1990s and peak levels near 5,000.

### **2. *Construction Heavy Equipment Operators***

Heavy equipment operators are largely concentrated in the construction industry. Operators work on a variety of jobs from residential, institutional, and commercial structures to most large industrial sites and most types of heavy engineering. The LFS identifies around 37,000 equipment operators employed in the construction industry across Canada. This occupation is one of the larger trades in the industry, comparable in size to the workforce for electricians, pipe trades, and masonry trades. There are cyclical variations in employment, with low levels below 27,000 jobs in the early 1990s and peak levels near 40,000.

### **3. *Industrial Equipment Operators***

Industrial equipment operators encompass a variety of occupations ranging from forklift operators and environmental workers to tractor trailer drivers. The demand for environmental workers is increasing as knowledge, awareness, and regulations proliferate. Forklift training has taken on added importance due to safety regulations that require trained or certified forklift operators.

The mobility and accessibility of operating engineers is difficult if not impossible if there are no jurisdictional agreements on national occupational standards. The project to develop occupational analyses for national occupational standards for 29 operating engineer occupations began in January 2004 and was completed in March 2005.

## **Development of the Occupational Analysis**

A draft analysis was developed by a knowledgeable team of consultants (process experts) who, with the assistance of a committee of subject matter experts in the field, identified all the tasks performed in the occupation. In order to facilitate an efficient and effective process, the 29 occupations were grouped according to commonalities. Profile meetings, with both process and subject matter experts, were held for each grouping between January and March 2004 in:

- Edmonton, Alberta
  - Excavating, Feb 5 & 6
  - Paving, Feb 9 & 10
- Morrisburg, Ontario
  - Grading, Feb 24 & 25
  - Crane and Hoisting, Mar 1 & 2
  - HAZMAT, Mar 3 & 4
  - Plant Operations, Mar 23 & 24
  - Concrete Pumping, Mar 25 & 26
- Montreal, Quebec
  - Hauling, Feb 26 & 27
- Vancouver, British Columbia
  - Utilities, Mar 16 & 17
  - Material Handling, Mar 18 & 19
- Quebec City, Quebec
  - Profile Completion Forum, Mar 29 – 31

The draft OAs were then distributed to more subject matter experts and stakeholders across Canada for review and input between June and September 2004. They were also posted on a website where subject matter experts were invited to provide feedback.

The combined input from the review was collated in October 2004. Recommendations were assessed and incorporated into the final draft, which included the identification of common core tasks performed in all occupations. Validation meetings were held for each grouping, with process and subject matter experts, between October 2004 and January 2005 in:

2004:

- Saskatoon, Saskatchewan
  - Utilities, Oct 20 – 22
  - Material Handling (including HAZMAT), Oct 26 – 29
- Halifax, Nova Scotia
  - Grading, Nov 2 – 5
- St John's, Newfoundland
  - Crane and Hoisting (including Concrete Pump), Nov 15 – 19
- Winnipeg, Manitoba
  - Excavating, Nov 23 – 25
  - Hauling, Nov 30 – Dec 3

2005:

- Vancouver, British Columbia
  - Paving, Jan 5 – 7
  - Plant Operations, Jan 10 – 12
- Victoria, British Columbia
  - Validation Forum, Feb 21 – 23

The OAs were then edited, translated, and published in both official languages.

## **Scope of the Occupational Analysis**

This occupational analysis identifies all of the tasks that a qualified operator must be able to perform. The performance of these tasks is dependent on a range of related activities, described in the body of the analysis as subtasks. The analysis is composed mainly of tasks that operators perform frequently, including such tasks as cleaning, driving, and maintenance.

Most operators have a range of experience on different types of equipment. Regardless of the type of equipment, the duties of the operator remain relatively constant. Accomplishment of the operator's tasks depends largely on knowledge of the equipment and its components, experience in a wide variety of situations, and an ability to determine the most appropriate means of proceeding with the work.

Though not described in the analysis, other important attributes of operators include mechanical aptitude, mathematical ability, excellent vision, and a high degree of physical coordination. Operators are also often called upon to perform their jobs in extremely difficult conditions.

Although this analysis is not a training document, it is worthwhile noting that aspiring operators may find it useful to reflect on their own abilities to deal with lengthy periods of physical restriction and isolation coupled with frequent subjection to pressures of time and productivity. Operators are often required to demonstrate the ability to concentrate for long periods of time while enduring physical discomfort and inclement weather conditions.

Heavy equipment is used in virtually every facet of the construction sector. In some cases, an operator may work for years on a single site, such as a plant, and may, during that time, operate only one type of equipment and therefore perform similar and relatively constant tasks. Operators who work for contractors may rarely work on the same site more than once and may perform a tremendous variety of tasks using a wide range of equipment types and sizes. The work of an operator often overlaps with that of other equipment operators.

## **Structure of the Occupational Analysis**

To facilitate the understanding of the nature of the occupation, the work performed is divided into the following divisions:

- A. BLOCK**            the largest division within the analysis and reflects a distinct operation relevant to the occupation
- B. TASK**             the distinct activity that, combined with others, makes up the logical and necessary steps the operator is required to perform to complete a specific assignment within a BLOCK
- C. SUBTASK**        the smallest distinct, measurable, and observable activities into which it is practical to divide any work activity; combined with other SUBTASKS, these fully describe the logical steps required to complete a TASK

The importance of a task describes the benefits that operators, employers, and the public receive as a result of an operator's ability to perform the task.

*Trends* are any shifts or changes that are occurring in the industry and affect the task.

*Supporting Knowledge and Abilities* are the elements of skill and knowledge that an individual must acquire to perform the task adequately.

*Tools and Supplies* are those items that are needed to perform the skill.

**Note: The tasks required to operate mobile cranes are described in other occupational analyses. This analysis focuses on additional tasks required when a competent operator uses a mobile crane to carry out foundation and shoring operations.**

**BLOCK A      EQUIPMENT**

**Task 1          Describes Equipment and Attachments**

This task is important because it helps to:

- use equipment and attachments properly and safely
- communicate with others using correct terms
- ensure that attachment is appropriate for task

Trends:

- There has been an increase in technology used in foundation and shoring attachments.

Subtasks	Supporting Knowledge and Abilities	<i>Tools and Supplies</i>
1.01      Describes types, components, and applications of foundation and shoring equipment	Knowledge of: <ul style="list-style-type: none"> <li>• manufacturers' specifications</li> <li>• types of foundations, such as friction pilings, end-bearing pilings (e.g., compacto, Franki piles)</li> <li>• components used for construction of foundations, such as caissons, H-beams, pipe piles, end plates</li> <li>• types of shoring, such as sheet piling, soldier piling, slurry wall</li> <li>• components used for construction of shoring, such as rakers, tie backs, whalers, lagging, anchors</li> <li>• materials used for foundations and shoring, such as concrete, steel, wood</li> <li>• function of shoring, i.e., to hold back earth and/or water</li> <li>• function of foundations, i.e., to support weight of structures</li> </ul>	<i>Manufacturers' manuals and literature</i>
1.02      Describes types and components of attachments used for foundation and shoring	Knowledge of: <ul style="list-style-type: none"> <li>• manufacturers' specifications</li> <li>• components of pile driving attachments, such as leads, kickers, hammers (e.g., vibrating, diesel, pneumatic, drop, electric), load blocks, cushion blocks</li> <li>• components of drill attachments, such as auger, bit, engine, telescopic pipe</li> </ul>	<i>Manufacturers' manuals and literature</i>

1.03	Describes crane modifications for foundation and shoring work	Knowledge of: <ul style="list-style-type: none"><li>• manufacturers' specifications</li><li>• engineering specifications</li><li>• applicable legislation</li><li>• modifications, such as attachment of power source and fuel tank</li><li>• impact of modifications on crane capacity</li></ul>	<i>Manufacturers' manuals and literature</i>
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**BLOCK B OPERATING PROCEDURES**  
**Task 2 Plans Work Procedures**

This task is important because it helps to:

- ensure proper placement of pilings and shoring
- prevent damage to attachments and equipment
- prevent injury to personnel
- ensure efficient use of time and equipment

Trends:  
 N/A

Subtasks	Supporting Knowledge and Abilities	Tools and Supplies
2.01 Assesses site hazards	Knowledge of: <ul style="list-style-type: none"> <li>• manufacturers' specifications</li> <li>• engineering specifications</li> <li>• company policies and procedures</li> <li>• applicable legislation, such as Occupational Health and Safety</li> <li>• authorities having jurisdiction</li> <li>• factors affecting stability of equipment</li> <li>• actual and potential hazards, such as underground utilities, restricted space, open excavations</li> </ul> Ability to: <ul style="list-style-type: none"> <li>• inspect site visually</li> <li>• identify unsafe site practices</li> <li>• find information about factors that affect stability</li> <li>• communicate with site personnel and authorities having jurisdiction</li> </ul>	<i>Manufacturers' manuals and literature, PPE, hearing protection, personal floatation device (PFD) for marine operations</i>
2.02 Discusses environmental concerns with site personnel	Knowledge of: <ul style="list-style-type: none"> <li>• company policies and procedures</li> <li>• applicable legislation</li> <li>• environmental concerns</li> <li>• site characteristics and boundaries</li> </ul> Ability to: <ul style="list-style-type: none"> <li>• identify environmental concerns, such as working in water, allowable noise levels, fuel and lubrication leaks</li> <li>• communicate questions and concerns to employer, site personnel, or authorities having jurisdiction</li> </ul>	<i>PPE, hearing protection, PFD for marine operations</i>

2.03	Confirms traffic patterns and procedures	<p>Knowledge of:</p> <ul style="list-style-type: none"><li>• traffic patterns and job specifications</li><li>• impact of other activities, such as traffic congestion</li><li>• hazards and obstructions, such as ramps, inclines, utilities</li><li>• warning signs and site markers, such as barricades required for open excavations, swing area</li></ul> <p>Ability to:</p> <ul style="list-style-type: none"><li>• plan or confirm traffic ways with consideration of hazards</li><li>• interpret warning signs and site markers</li><li>• ensure that barricades are in place</li></ul>	<i>PPE, hearing protection, PFD for marine operations</i>
2.04	Plans foundation and shoring tasks	<p>Knowledge of:</p> <ul style="list-style-type: none"><li>• manufacturers' specifications</li><li>• job and engineering specifications</li><li>• attachment capabilities</li><li>• hand signals and radio instructions</li></ul> <p>Ability to:</p> <ul style="list-style-type: none"><li>• review job and engineering specifications with site personnel</li><li>• determine duty cycle, i.e., performance of continuous and repetitive operations</li><li>• co-ordinate activities with site personnel</li></ul>	<i>Manufacturers' manuals and literature for foundation and shoring attachments, PPE, hearing protection, PFD for marine operations</i>

**BLOCK B OPERATING PROCEDURES**  
**Task 3 Performs Foundation and Shoring Operations**

This task is important because it helps to:

- prevent damage to property and equipment
- prevent injury to personnel
- fulfill job specifications
- co-ordinate foundation and shoring operations with other construction activities on site

Trends:

- There is increased due diligence when addressing safety issues and reducing hazardous work conditions.

Subtasks	Supporting Knowledge and Abilities	Tools and Supplies
3.01 Configures attachments for operation	<p>Knowledge of:</p> <ul style="list-style-type: none"> <li>• manufacturers' specifications for crane and attachments</li> <li>• company policy and procedures</li> <li>• applicable legislation, such as Occupational Health and Safety</li> <li>• attachment assembly</li> </ul> <p>Ability to:</p> <ul style="list-style-type: none"> <li>• assemble and mount attachments to crane</li> </ul>	<i>Manufacturers' manuals and literature for foundation and shoring attachments, PPE, basic tools and supplies, hearing protection, PFD for marine operations</i>
3.02 Ensures that work area is cleared of unauthorized personnel and equipment before starting tasks	<p>Knowledge of:</p> <ul style="list-style-type: none"> <li>• company policies and procedures</li> <li>• applicable legislation</li> <li>• safe operating procedures</li> <li>• safe limits approach</li> <li>• hand signals and radio instructions</li> </ul> <p>Ability to:</p> <ul style="list-style-type: none"> <li>• place or arrange for barriers, such as caution tape, pylons</li> <li>• communicate with site personnel</li> </ul>	<i>PPE, hearing protection, PFD for marine operations</i>
3.03 Performs drilling tasks	<p>Knowledge of:</p> <ul style="list-style-type: none"> <li>• manufacturers' specifications</li> <li>• job specifications</li> <li>• company policies and procedures</li> <li>• capacity of auger</li> <li>• material being drilled</li> <li>• hand signals unique to foundation and shoring, such as lead, kicker, pile, hammer</li> <li>• radio instructions</li> </ul>	<i>Manufacturers' manuals and literature for foundation and shoring attachments, PPE, basic tools and supplies, hearing protection, PFD for marine operations</i>

Ability to:

- install and position auger
- select appropriate drilling speed for type of material
- drill to auger's capacity
- pull auger
- deposit material from auger in specified location
- use and respond to hand signals and radio instructions

3.04 Performs pile driving tasks

Knowledge of:

- manufacturers' specifications
- job specifications
- company policies and procedures
- piling types
- pile driving attachment capabilities
- hand signals unique to foundation and shoring, such as lead, kicker, pile, hammer
- radio instructions

*Manufacturers' manuals and literature for foundation and shoring attachments, PPE, basic tools and supplies, hearing protection, PFD for marine operations*

Ability to:

- position boom with pile driving attachment over site marker or hole
- raise hammer up leads and position piling under hammer
- adjust batter (also known as angle) for driving
- engage hammer
- hammer piling to designated depth
- use and respond to hand signals and radio instructions

3.05 Installs shoring

Knowledge of:

- manufacturers' specifications
- job specifications
- company policies and procedures
- piling types
- pile driving attachment capabilities
- methods for shoring installation, such as thread sheet piling
- hand signals unique to foundation and shoring, such as lead, kicker, pile, hammer
- radio instructions

*Manufacturers' manuals and literature for foundation and shoring attachments, PPE, basic tools and supplies, hearing protection, PFD for marine operations*

Ability to:

- position piling
- position hammer over pile
- engage hammer
- maintain vertical line
- hammer piling to designated depth
- use and respond to hand signals and radio instructions

3.06 Performs extraction tasks

Knowledge of:

- manufacturers' specifications, such as capacity of equipment and attachment
- job specifications
- company policies and procedures
- impact of extraction tasks on equipment capacity
- safety precautions, such as secure auxiliary line to pile
- hand signals unique to foundation and shoring, such as lead, kicker, pile, hammer
- radio instructions

*Manufacturers' manuals and literature for foundation and shoring attachments, PPE, basic tools and supplies, hearing protection, PFD for marine operations*

Ability to:

- attach hammer to wire rope on crane
- position boom with hammer over location of piling to be removed
- clamp pilings with hammer
- engage hammer
- hoist hammer to extract pile
- swing pile
- place pile in designated location
- use and respond to hand signals and radio instructions

3.07 Inspects and maintains equipment and attachments affected by foundation and shoring operations

Knowledge of:

- manufacturers' specifications
- company policies and procedures
- components most affected, such as supply lines, diesel hammer, boom structure, wire rope
- effects of extreme conditions, such as need to inspect boom for structural damage, and to grease diesel hammer

*Manufacturers' manuals and literature for crane, PPE, basic tools and supplies, hearing protection, PFD for marine operations*

Ability to:

- identify defects and hazardous conditions through visual inspection
- select and use appropriate tools to make adjustments
- perform or arrange for repair and replacement of damaged or worn parts

### Asphalt Screed Operator DACUM Chart

Block	Task	Subtask				
<b>A. EQUIPMENT</b>	<b>1. Describes Equipment and Attachments</b>	1.01 Describes types, components, and applications of foundation and shoring equipment	1.02 Describes types and components of attachments used for foundation and shoring	1.03 Describes crane modifications for foundation and shoring work		
<b>B. OPERATING PROCEDURES</b>	<b>2. Plans Work Procedures</b>	2.01 Assesses site hazards	2.02 Discusses environmental concerns with site personnel	2.03 Confirms traffic patterns and procedures	2.04 Plans foundation and shoring tasks	
	<b>3. Performs Foundation and Shoring Operations</b>	3.01 Configures attachments for operation	3.02 Ensures that work area is cleared of unauthorized personnel and equipment before starting tasks	3.03 Performs drilling tasks	3.04 Performs pile driving tasks	3.05 Installs shoring
		3.07 Inspects and maintains equipment and attachments affected by foundation and shoring operations				

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Bernie Elliott, ON  
Alain Jacques, QC  
Frank Jones, BC  
Bruno Malbasa, MB  
Shawn McAdam, NB  
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Darrell Tremblay, BC  
Ron Ward, ON

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Harry Boon, NB  
Kevin Caines, NL  
Steve Deady, ON  
John Doherty, MB  
Joe Dowdall, ON  
Charlie Eddy, NL  
Oneil Lapointe, ON  
Marty McDonnell, AB

Craig McIntosh, BC  
Rae Munroe, ON  
Len Phelan, BC  
Len Poitras, SK  
Gary Snow, NL

### Plant Operations:

Reynold Amey, BC  
Roger Beck, NS  
Mervyn Benson, NS  
Vito DeFrancesco, ON  
Barry Dupres, MB  
Jeff Emino, NS  
Nelson Fowler, NB  
Rae Munroe, ON  
Peter Serrette, MB  
Kent Walker, ON

### HAZMAT:

Bernie Elliott, ON  
Frank Jones, BC  
Dan O’Keefe, BC  
Bruno Malbasa, MB  
John McIsaac, BC  
Tom Miller, ON  
Rae Munroe, ON  
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Bob Raymack, MB  
Randy Stegner, ON  
Bob Tytko, ON

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Mike Bruce, ON  
Kevin Caines, NL  
Steve Deady, ON  
Joe Dowdall, ON  
Charlie Eddy, NL  
Stan Fortune, ON  
Nelson Fowler, NB  
Wayne Hannah, ON  
Marty McDonnell, AB  
Craig McIntosh, BC  
Rae Munroe, ON  
Len Phelan, BC

Gary Snow, NL

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Archie Fontaine, BC  
Dan Johnson, MB  
Merv Marcynuk, MB  
Harold McBride, ON  
Robert Middleton, MB  
Rae Munroe, ON  
Vance Simpson, MB  
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Alain Jacques, QC  
Archie Fontaine, BC  
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David Alves, ON  
Gordon Biegler, AB  
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Frank Cardile, AB  
Peter Gamble, ON  
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