Crane Operator

Occupational Analysis Report

May 2010

Commission
de la construction
du Québec

The purpose of this report is to describe as accurately as possible the crane operator trade as currently practiced in Québec's construction industry. It is a record of discussions held by a group of workers who met for the occasion after industry partners recommended them to the Commission de la construction du Québec for their expertise in the trade.

The occupational analysis is a first step in the definition of the competencies required for practicing the trade. This report becomes one of the reference and decision-making tools used by the Commission for teaching and learning purposes.

The present report does not bind the Commission in any way. It has no legal effect and is meant as a reflection of discussions held on the date of the analysis workshop.

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The masculine gender is used generically
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APPROVAL

This occupational analysis was read and approved by Commission de la construction du Québec decision-makers and the following persons on the dates mentioned below:

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Committee on Vocational Training in the Construction Industry
March 31, 2011

Board of Directors
April 27, 2011

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INTRODUCTION

In early 2009, the Commission de la construction du Québec's (CCQ) Direction de la formation professionnelle launched a large-scale operation to review the occupational analyses[1] of all construction industry trades.

The CCQ undertook this operation for many reasons, particularly the following:

- the project to reform the construction workforce apprenticeship and management system, and the eventual design of qualitative apprenticeship booklets requiring a detailed description of each trade;
- the fact that most construction occupational analyses[2] had been conducted between 1987 and 1991 and had not been reviewed since;
- updates to vocational qualification examination question banks;
- implementation of Chapter 7 of the Agreement on Internal Trade (AIT) and of the Québec-France Understanding on the Mutual Recognition of Professional Qualifications.

These factors demonstrate the necessity of updating the occupational analyses in order to obtain a current and complete profile of the various trades.

The occupational analysis of the crane operator trade belongs to this context[3]. Its purpose is to describe the trade as currently practiced by journeymen in the construction industry. The present report was written in order to collate and organize the information gathered first during the occupational analysis workshop held in Laval on January 25 and 26, 2010, and then during a workshop held in Montreal on February 16, 2010. The second workshop aimed to gather data that could not be obtained at the first workshop because of the tasks performed by the crane operators in attendance[4].

This analysis aims to draw a portrait (tasks and operations) of the trade and its working conditions, and to identify the skills and behaviours required. The report of the occupational analysis workshop is an accurate reflection of the consensus reached by a group of workers in the trade. A special effort was made to include in this report all the data collected during the workshop and to ensure that the data accurately depict the realities of the trade analysed.

1. The terms "profession" and "trade" are considered synonymous.
2. Then called "work situation analyses".
3. This occupational analysis was conducted according to the *Cadre de référence et instrumentation pour l'analyse d'une profession* produced in 2007 by the ministère de l'Éducation, du Loisir et du Sport (Direction générale de la formation professionnelle et technique) and the Commission des partenaires du marché du travail, ministère de l'Emploi et de la Solidarité sociale.
4. At the first workshop, none of the participants said that they performed the "Build foundations and Supports" task or three of the tasks performed on tower cranes, i.e., the tasks involving transportation, assembly and disassembly of this type of cranes.

1. GENERAL CHARACTERISTICS OF THE TRADE

1.1 DEFINITION OF THE TRADE

According to the Regulation respecting the vocational training of workforce in the construction industry (Schedule A, article 3), the term “crane operator” means:

> Anyone:
>
> a) operates all types of cranes such as elevator cranes, tower cranes, suspended cranes, derrick cranes, self-propelled cranes on locomotives or truck-mounted on wheels or tracks, with hydraulic, electric, mechanical and electro-mechanical attachments;
>
> b) operates travelling cranes, boring machines, piledrivers and cranes equipped with piledriving equipment used to drive cement, tubular or other piles or sheetpiles.
>
> A crane operator also operates the above equipment when it is electrically-driven.

1.2 JOB TITLES

Two job titles may be used for designating persons practicing the trade:

- crane operator;
- jib-crane operator.

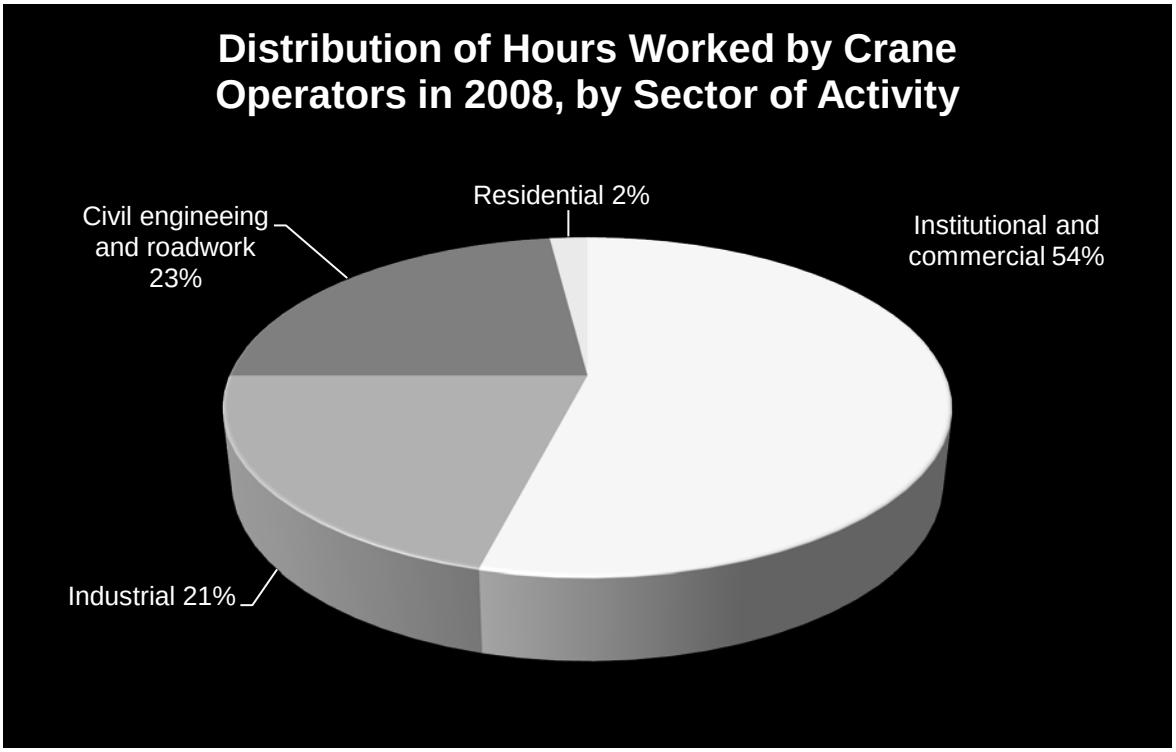
The job title “crane operator”, more representative of the trade, will be used in the present report.

1.3 SECTORS OF ACTIVITY

Crane operators are active, to varying degrees, in all four sectors of the construction industry:

- Institutional and commercial;
- Industrial;
- Civil engineering and roadwork;
- Residential.

The workload of crane operators in 2008 is distributed as follows:



According to the participants, the above distribution may vary with the economic context. Currently, the civil engineering and roads sector accounts for a large part of the activity. In the longer term, the industrial sector may gain the upper hand.

The participants also specified that some workers are specialized and do not go from one sector of activity to another.

1.4 FIELD OF PRACTICE

The trade's field of practice is the construction industry. The Act respecting labour relations, vocational training, and manpower management in the construction industry (R.S.Q., c. R-20) defines construction as follows:

> […] the foundation, erection, maintenance, renewal, repair, alteration and demolition work on buildings and civil engineering works carried out on the job site itself and vicinity including the previous preparatory work on the ground;

In addition, the word “construction” includes the installation, repair and maintenance of machinery and equipment, work carried out in part on the job site itself and in part in the shop, moving of buildings, transportation of employees, dredging, turfing, cutting and pruning of trees and shrubs and laying out of golf courses, but solely in the cases determined by regulation.

1.5 LEGISLATION AND REGULATIONS

Crane operators working in the construction industry are subject to:

- the Act respecting Labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20);
- the Regulation respecting the vocational training of workforce in the construction industry (R-20, r.6.2*)*;
- the four sector-based collective agreements for the construction industry;
- the National Building Code;
- the Quebec Building Code, Chapter I – “Building”;
- the Safety Code for the construction industry (R.Q. c. S-2.1, r.6);
- CSA standards Z150 and Z248;
- the laws and regulations of the ministère des Transports.

1.6 WORKING CONDITIONS[5]

The following information provides an overview of the conditions and context of the work of crane operators, as commented by the participants in the occupational analysis workshop. To obtain up-to-date and complete information that has legal effect, it is necessary to refer to the four collective agreements for the construction industry sectors.

Salary

The average annual salary of a journeyman crane operator was $57,335 in 2008.

5. The general data of working conditions is taken from the 2007-2010 collective agreements of the four construction industry sectors.

A journeyman's hourly wage varies slightly according to the sector of activity. At April 26, 2009, the daytime hourly wage was as follows:

	Industrial, Institutional and Commercial	Civil Engineering and Roadwork	Light Residential	Heavy Residential
Class A	$32.54	$32.52	$28.88	$32.50
Class B	$31.12	$31.21	$27.98	$31.19

Vacations and time off

Mandatory annual holidays of four weeks – two weeks in summer and two in winter at periods predetermined in collective agreements – are the general rule in the construction industry. To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow certain possibilities for changing the vacation periods prescribed by the general rule.

To these vacation periods are added eight not worked statutory holidays, as well as a lump sum for sick leaves not otherwise paid.

Pension plan

Construction industry workers participate in a pension plan. They retain their eligibility for this pension plan throughout their career in construction, even if they change employer, trade or sector.

Insurance

The group insurance plan (medications, illness, disability, death) is fully paid by employers. Workers (and their families, as the case may be) are eligible for it so long as they remain active in the construction industry and work the required number of hours, whether or not they change employer.

Physical requirements

The crane operator trade is practiced under various weather conditions. Physical fitness is essential. However, the work does not require exceptional strength. When it does, crane operators can obtain help. Movements must be measured, to avoid injury. Due to lengthy sitting positions and demanding assembly and disassembly work, backaches are common.

Cranes are often installed on very uneven ground, so crane operators often have to lift and move heavy loads (blockages). They also have to bend down and climb, which requires a certain agility.

Travel outside the city is frequent, particularly in the case of heavy-duty cranes. Occasionally, crane operators have to work in emergency situations, such as serious accidents – train derailment, viaduct collapse, etc.

The trade is practiced in concert with other construction and non-construction trades. Operator teams are usually encouraged to use the same crane at all times; their knowledge and skill in operating the machine have several advantages, such as saving time, reducing the number of errors, greater ease in assembling and disassembling the crane, etc.

Work schedules

A 40-hour work week from Monday to Friday is the general rule in all construction industry sectors. The daily limit is 8 hours a day, except in the light residential sector, where it can be 10 hours within a 40-hour week.

To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow many possibilities for changing the vacation periods prescribed by the general rule: compressed schedule, schedule shift, make-up time in light residential construction, etc. These special schedules confer flexibility to the work schedules in effect in the construction industry.

Crane operators are called upon to work for many hours in a row, sometimes at night and often on weekends. The schedule is variable and the work generally begins very early in the morning.

1.7 JOB MARKET ENTRY CONDITIONS[6]

To obtain the competency certificate-apprentice in the trade, candidates must present to the CCQ the original version of an academic transcript or apprenticeship transcript attesting that they have passed the course of study for the DEP in crane operation, as well as a guarantee of employment from an employer registered with the CCQ for at least 150 hours within a period of not more than three consecutive months.

In addition, with regard to the crane operator trade, since March 1, 1994 a competency certificate-journeyman or a competency certificate-apprentice cannot be renewed unless, in addition to the other conditions provided for in the regulation, the holder has demonstrated that he has passed either the *Safe Crane Operation* course dispensed by Quebec school boards or the examination related to that course, or an equivalent course dispensed outside Quebec.

The apprentice crane operator must have completed an apprenticeship period of 2,000 hours in order to be eligible for the provincial qualification examination that leads to obtaining the competency certificate-journeyman for the trade.

Credits are paid into the apprenticeship record book of an apprentice crane operator who has obtained his diploma.

1.8 PLACE OF WOMEN IN THE TRADE

Section 126.0.1 of the Act respecting labour relations, vocational training, and manpower management in the construction industry pertains to women's access to the construction industry: "The Commission, after consultation with the Commission des droits de la personne et des droits de la jeunesse, shall develop measures to favour the access of women to and their maintenance and greater representation on the labour market in the construction industry."

According to the CCQ[7], the proportion of women active in the trade is 0.7% (8 women out of 1,106 crane operators in 2008).

6. Other conditions than those listed below may apply, depending on candidates' particular situation, region, etc. For a complete list of the trade's entry conditions, see the Act respecting Labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20). We may also consult: http://www.ccq.org/E_CertificatsCompetence.aspx?sc_lang=en&profil=DevenirTravailleur
7. Commission de la construction du Québec, *Carrières construction*, 2009-2010 edition.

Although the trade is accessible to women, the crane operators consulted confirm that few women practice it. Women's low interest is reportedly explained by a fear of the physical requirements. Although today's cranes are more easily operated, the work still requires a certain physical strength. The work is very often done within a team, so co-workers can be asked for help, but when a crane operator is alone he must be able to do his work independently. One expert specified that men who practice the trade may also have physical limitations, such as a frail constitution, age or vertigo. Finally it was mentioned that working on tower crane is much less physically demanding.

It appears that in some cases, frequent travel poses an obstacle for women raising a family. However, work is also offered on stationary construction sites with a more fixed schedule.

Although the crane operators attending the workshop are open to the arrival of women in the trade, they recognize that in certain workplaces there remains prejudice against women who want to practice the trade.

1.9 CAREER PROSPECTS

Depending on their interests and abilities, crane operators who want to get ahead in their career and meet challenges seek work on a variety of cranes, more heavy-duty and more complex to operate. There is a certain interest in the new technologies. Crane operators are proud and want to demonstrate their skills and experience. Reputation is very important in this trade.

Whereas some crane operators go into business, unfortunately few persist. The equipment is very costly, competition is ferocious, and substantial resources are needed to wait for payments that are at times delayed.

1.10 DEVELOPMENT OF THE TRADE

According to the participants, the need for succession is considerable. Technological progress is introducing ever smaller, lighter machines, with longer and longer booms. The integration of electronic devices is changing the work of crane operators. Computers provide additional relevant indications. They reinforce evaluations made visually, by sound or by signals. Not all companies have converted to electronics, but the trend is undeniable.

The acquisition of higher-performance equipment – such as all-terrain tractors with telescopic boom (currently made by the Merlo company) anticipates a major transformation of the crane operator trade in some companies. The worry is that some job positions will be lost, replaced by others requiring more-extensive training.

1.11 IMPACT OF ENVIRONMENTAL STANDARDS ON THE PRACTICE OF THE TRADE

According to the participants, the new cranes require less greasing operations. Cleaner oils are used, less damaging to the environment. In the event of spills, better absorbent material is used. Crane operators are more aware of the consequences of their actions. They take means to minimize the impact of incidents, either by mitigating them on-site or by reporting them to those responsible for taking necessary action.

2. WORK DESCRIPTION

2.1 TASKS AND OPERATIONS

List of tasks

The following list presents the main tasks performed by crane operators. The order in which the tasks are presented does not necessarily reflect their importance in the trade. The work of crane operators has been divided into two sections according to the type of equipment used.

A. Conventional[8] and telescopic mobile cranes

Task 1 Perform daily preventive maintenance on a mobile crane
Task 2 Transport a mobile crane and its accessories[9]
Task 3 Assemble and install a mobile crane
Task 4 Move and install loads with a mobile crane
Task 5 Handle materials by means of a crane equipped with a clamshell or electromagnet
Task 6 Do foundation and support work
Task 7 Disassemble a mobile crane

B. Tower cranes

Task 8 Perform daily preventive maintenance on a tower crane
Task 9 Transport a tower crane's components
Task 10 Assemble and mount a tower crane by means of a mobile crane
Task 11 Move and install loads with a tower crane
Task 12 Disassemble a tower crane by means of a mobile crane

Table of tasks and operations

During the workshop, a table of tasks and operations performed by crane operators was proposed to the participants. The latter were asked to consider the trade in terms of a journeyman's full practice. Following discussions, modifications were made to the table. The final version is presented in the following pages.

8. The term "conventional" has been used in the trade for many years to designate this type of cranes; no other term, however correct, could replace it without creating confusion. We therefore chose to retain it.
9. To go to and from the construction site.

Table 2.1 Tasks and Operations

TASKS	OPERATIONS					
A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES						
TASK 1 PERFORM DAILY PREVENTIVE MAINTENANCE ON A MOBILE CRANE	1.1 Perform the usual checks	1.2 Report detected defects verbally and in writing	1.3 Make minor repairs, if applicable	1.4 Inspect and maintain rigging equipment	1.5 Keep the logbook up-to-date	1.6A Produce reports for the ministère des Transports, if applicable
	1.7 Lubricate mechanical components	1.8 Clean the crane				
TASK 2 TRANSPORT A MOBILE CRANE AND ITS ACCESSORIES	2.1 Consult the crane's assembly plan	2.2 Plan the crane's transportation	2.3 Gather and prepare components and equipment necessary for the work, if applicable	2.4 Load the crane on a float trailer, if applicable	2.5 Load components on trailers or float trailers, if applicable	2.6 Transport on the road the carrier part or the crane
	2.7 Park the carrier part or the crane at the appropriate location					
TASK 3 ASSEMBLE AND INSTALL A MOBILE CRANE	3.1 Find out the weight of the loads(s) to be hoisted	3.2 Determine rigging weight, the height and the operating range	3.3 Check the crane capacity while taking into account the loads to be hoisted	3.4 Determine one or more locations for the assembly and work	3.5 Check the ground's load-bearing capacity and the environmental obstacles	3.6 Unload the crane and components, if applicable
	3.7 Position the crane or the carrier part for assembly, if applicable	3.8 Delimit the crane's assembly area	3.9 Assemble the crane's components	3.10 Visually check the assembly	3.11 Raise the boom	3.12 Position the crane at the appropriate location, if applicable

TASKS	OPERATIONS					
A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES						
	3.13 Delimit the crane's operating area	3.14 Check the operation of safety devices	3.15 Enter parameters in the crane's computer, if applicable	3.16 Extend the boom, if applicable		
TASK 4 MOVE AND INSTALL LOADS WITH A MOBILE CRANE	4.1 Check the wind velocity and direction	4.2 Heat the crane's mechanical and hydraulic elements, if applicable	4.3 Position the boom over the load	4.4 Check the computer's parameters, if applicable	4.5 Consult the hoisting plan, if applicable	4.6 Provide or check the rigging equipment according to the load(s) to be hoisted
	4.7 Supervise the rigging	4.8 Attach the rigging equipment on a hook	4.9 Define the communication procedure	4.10 Hoist the load	4.11 Direct the load according to the signaller's instructions	4.12 Deposit the load or keep it suspended during the installation, according to the signaller's instructions
	4.13 Retract the boom, if applicable	4.14 Apply the safety brakes and, if applicable, deactivate the controls				
TASK 5 HANDLE MATERIALS BY MEANS OF A CRANE EQUIPPED WITH A CLAMSHELL OR ELECTROMAGNET	5.1 Check equipment operation and maintain it, if applicable	5.2 Install the equipment to the crane	5.3 Heat the crane's mechanical and hydraulic elements, if applicable	5.4 Delimit the work area	5.5 Define the communication procedure	5.6 Transport materials to the appropriate location
	5.7 Apply the safety brakes and, if applicable, deactivate the controls					

TASKS	OPERATIONS					
A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES						
TASK 6 DO FOUNDATION AND SUPPORT WORK	6.1a Heat the crane's mechanical elements	6.2a Install or check the hammer column and the accessories	6.3a Push in piles or sheet piles	6.4a Deposit the equipment on the ground, if applicable	6.5a Apply the safety brakes	
	6.1b Heat the crane's mechanical elements	6.2b Install or check the dynamic compaction equipment	6.3b Compact the soil	6.4b Deposit the equipment on the ground, if applicable	6.5b Apply the safety brakes	
	6.1c Heat the crane's mechanical elements	6.2c Install or check the bit equipment	6.3c Operate the bit	6.4c Deposit the equipment on the ground, if applicable	6.5c Apply the safety brakes	
TASK 7 DISASSEMBLE A MOBILE CRANE[10]	7.1 Retract the boom, if applicable	7.2 Delimit the location of disassembly	7.3 Position the crane at the appropriate location	7.4 Delimit the disassembly area	7.5 Lower the boom	7.6 Disassemble crane components

10. Disassembly is summarized here. In fact, it involves essentially the same operations as assembly (task 3), but in reverse order.

TASKS	OPERATIONS					
B. TOWER CRANES						
TASK 8 PERFORM DAILY PREVENTIVE MAINTENANCE ON A TOWER CRANE	8.1 Check all crane components	8.2 Lubricate mechanical components	8.3 Check crane operation	8.4 Report detected defects verbally and in writing	8.5 Make minor repairs	8.6 Keep the logbook up-to-date
	8.7 Clean the crane					
TASK 9 TRANSPORT A TOWER CRANE'S COMPONENTS	9.1 Consult the crane's installation plan	9.2 Plan the crane's transportation	9.3 Gather necessary components for the work and check their condition	9.4 Load components on trailers		
TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE	10.1 Delimit the crane's assembly area	10.2 Unload components	10.3 Erect tower sections	10.4 Assemble the turntable and mast, if applicable	10.5 Install electrical accessories	10.6 Hoist and fasten the turntable and mast to the tower, if applicable
	10.7 Assemble the main boom and the counter boom on the ground	10.8 Hoist and fasten the counter boom to the turntable	10.9 Install a counterweight to the counter boom, if applicable	10.10 Hoist and fasten the main boom to the turntable	10.11 Install counterweights to the counter boom	10.12 Install the hoist cable and cart cable
	10.13 Make a final inspection of all crane components	10.14 Adjust the limit switches	10.15 Perform a load test	10.16 Adjust the overload protector	10.17 Hoist the tower, if applicable	

TASKS	OPERATIONS					
B. TOWER CRANES						
TASK 11 MOVE AND INSTALL LOADS WITH A TOWER CRANE	11.1 Check the wind velocity and direction as well as the temperature	11.2 Define the communication procedure	11.3 Make sure all systems are adjusted and operate correctly	11.4 Enter parameters in the crane's computer, if applicable	11.5 Position the boom over the load	11.6 Ensure rigging quality
	11.7 Move and install the load according to the signaller's instructions	11.8 Turn the crane off				
TASK 12 DISASSEMBLE A TOWER CRANE BY MEANS OF A MOBILE CRANE	12.1 Delimit the disassembly area	12.2 Retract the tower, if applicable	12.3 Wind the trowel and cart cable, if applicable	12.4 Remove the counter boom counterweights	12.5 Detach the main boom and lower it to the ground	12.6 Remove the last counterweight to the counter boom, if applicable
	12.7 Turn the tower crane off[11]	12.8 Detach the counter boom and lower it to the ground	12.9 Disassemble the counter boom, if applicable	12.10 Disassemble the main boom	12.11 Detach the mast and turntable and lower them to the ground	12.12 Disassemble the tower section by section
	12.13 Remove the anchor plates, if applicable					

11. For certain crane models, operations 12.7 and 12.8 may be inverted.

Additional information on tasks and operations

The participants reported the absence of certain types of cranes in the table of tasks and operations. Thus, travelling cranes, trowels, mobile cranes installed on a fixed bridge on boats or barges, as well as gantry cranes, are reportedly not covered by the analysis.

The transportation mentioned in task 2 is done at the start of work toward the construction site and at the end of work. Occasionally, a mobile crane remains on the construction site for a lengthy period.

The sequence of task 3 operations, “Assemble and install a mobile crane”, may differ for certain common types of cranes. To that effect, the following sequence was also suggested:

TASK 3 ASSEMBLE AND INSTALL A MOBILE CRANE	3.1 Find out the weight of the loads(s) to be hoisted	3.2 Determine rigging weight, the height and the operating range	3.3 Check the crane capacity while taking into account the loads to be hoisted	3.4 Determine one or more locations for the assembly and work	3.5 Check the ground’s load-bearing capacity and the environmental obstacles	3.6 Delimit the crane’s assembly area
	3.7 Unload the crane and components, if applicable	3.8 Position the crane or the carrier part for assembly, if applicable	3.9 Assemble the crane’s components	3.10 Check the operation of safety devices	3.11 Enter parameters in the crane’s computer, if applicable	3.12 Raise the boom
	3.13 Position the crane at the appropriate location, if applicable	3.14 Delimit the crane’s operating area	3.15 Extend the boom, if applicable			

2.2 OPERATIONS, SUB-OPERATIONS AND CLARIFICATIONS

In the following pages are presented the sub-operations related to most operations[12], as well as clarifications made by the participants.

Table 2.2 Sub-Operations and Clarifications regarding Operations

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 1 PERFORM DAILY PREVENTIVE MAINTENANCE ON A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
1.1 Perform the usual checks	1.1.1 Check all fluids 1.1.2 Check the tires or tracks 1.1.3 Check the brakes, if applicable 1.1.4 Check the components to be transported on the road 1.1.5 Check all cables and their winding 1.1.6 Check electric, electronic, mechanical, hydraulic and pneumatic components 1.1.7 Check the ballast and block, if applicable 1.1.8 Check the crane's level, if applicable 1.1.9 Check the crane's structure	
1.2 Report detected defects verbally and in writing	1.1.1 Forward reports to the persons concerned	The participants mentioned hydraulic leaks as an example of defects.
1.3 Make minor repairs, if applicable	1.3.1 Replace lights 1.3.2 Tighten a hydraulic pipe's rings[13]	

12. The sequence of operations may vary.
13. The CCQ's Direction de l'application des conventions collectives has issued a notice that tightening hydraulic rings pertains to the trade of heavy equipment mechanic.

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 1 PERFORM DAILY PREVENTIVE MAINTENANCE ON A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
1.4 Inspect and maintain rigging equipment	1.4.1 Check the condition of each rigging component	Crane operators check breakages, cracks, stretches, fraying, and the presence of all components. Components may be strands, check valves, shackles, nylon slings, spacer beams, etc.
1.5 Keep the logbook up-to-date	1.5.1 Report to one's supervisor any defect or lack 1.5.2 Have repairs done depending on the urgency of the situation	
1.6 Produce reports for the ministère des Transports, if applicable		The reports referred to here are the following: – vehicle inspection report; – driver's daily log.
1.7 Lubricate mechanical components	1.7.1 Grease pulleys, boom foot pins, the crown, outriggers, the gear train, the boom's sliding parts and the carrier's mechanical components	
1.8 Clean the crane	1.8.1 Clean the windows 1.8.2 Clean the cab(s) 1.8.3 Remove excess grease 1.8.4 See to the crane's overall cleanliness	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 2 TRANSPORT A MOBILE CRANE AND ITS ACCESSORIES		
Operations	**Sub-Operations**	**Clarifications**
2.1 Consult the crane's assembly plan	2.1.1 Refer to manufacturer recommendations and engineering plans 2.1.2 Inquire about the recommendations of the person responsible for the work 2.1.3 Obtain information about the client's specific requirements	The client's specific requirements will enable the crane operator to determine the components he will need to do the work.
2.2 Plan the crane's transportation	2.2.1 Ensure that there is a sufficient number of trailers 2.2.2 Determine the itinerary 2.2.3 Comply with ministère des Transports regulations regarding the weight and size of components and the crane 2.2.4 Determine the components' order of transportation	
2.3 Gather and prepare components and equipment necessary for the work, if applicable	2.3.1 Check the condition and availability of each component and the equipment 2.3.2 Facilitate the access to required parts	The participants mentioned, as an example, boom sections, mattresses, counterweights, slings, specific tools, blocks, etc.
2.4 Load the crane on a float trailer, if applicable	2.4.1 Position the crane on the carrier 2.4.2 Secure the load	The crane may be positioned on the float trailer by its own means or with the help of another crane.
2.5 Load components on trailers or float trailers, if applicable	2.5.1 Install components according to transportation planning	
2.6 Transport on the road the carrier part or the crane	2.6.1 Make sure to have necessary documents, such as transportation permits	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 2 TRANSPORT A MOBILE CRANE AND ITS ACCESSORIES		
Operations	**Sub-Operations**	**Clarifications**
2.7 Park the carrier part or the crane at the appropriate location		It is important not to hinder surrounding traffic uselessly.
TASK 3 ASSEMBLE AND INSTALL A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
3.1 Find out the weight of the load(s) to be hoisted	3.1.1 Read manufacturer specifications 3.1.2 Consult the hoisting plan 3.1.3 Collect necessary information from the foreman	
3.2 Determine rigging weight, the height and the operating range	3.2.1 Consult the hoisting plan 3.2.2 Measure height and radius 3.2.3 Consult the crane blueprint	The participants mentioned that measurements of hoisting height and radius are taken with a measuring tape.
3.3 Check the crane capacity while taking into account the loads to be hoisted	3.3.1 Consult the load capacity chart 3.3.2 Take into consideration the type of work to be done	
3.4 Determine one or more locations for the assembly and work	3.4.1 Consult the person in authority on the premises 3.4.2 Give one's authorization	The crane operator is responsible for giving his authorization when the location is determined.
3.5 Check the ground's load-bearing capacity and the environmental obstacles	3.5.1 Look for manholes and electric wires 3.5.2 Check the possibility of establishing the rotation field 3.5.3 Check the soil's weight-bearing capacity	
3.6 Unload the crane and components, if applicable	3.6.1 Have the trailers approach at the appropriate location 3.6.2 Detach the components 3.6.3 Unload using the crane	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 3 ASSEMBLE AND INSTALL A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
3.7 Position the crane or the carrier part for assembly, if applicable		
3.8 Delimit the crane's assembly area	3.8.1 Determine a safe area 3.8.2 Install tape or barricades	
3.9 Assemble the crane's components	3.9.1 Choose the assembly method 3.9.2 Install the counterweight(s), boom, block and, if applicable, the fly jib 3.9.3 Connect the pendants	A crane may be assembled using another crane or manually.
3.10 Visually check the assembly	3.10.1 Check stop limiter system connections 3.10.2 Ensure that all pins are installed and locked	
3.11 Raise the boom	3.11.1 Perform hosting manoeuvres 3.11.2 Check that hoisting operations are proceeding well (detect potential jamming areas, ensure the correct position of block cables in pulleys)	Sub-operation 3.11.2 is performed by a person on the ground (second man, for example). If the crane operator is alone, he will climb down from the crane from time to time, to ensure that everything is proceeding well.
3.12 Position the crane at the appropriate location, if applicable	3.12.1 Move the crane according to the signaller's instructions 3.12.2 Level the crane 3.12.3 Stabilize the crane for adequate and safe hoisting	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 3 ASSEMBLE AND INSTALL A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
3.13 Delimit the crane's operating area	3.13.1 Determine the operating area 3.13.2 Place tape and barricades so as to cover the work area	This operation is necessary but not always easy to have observed. Often, although the crane operator has delimited his operating area, persons (passersby or workers) enter it; the crane operator cannot easily monitor everyone's comings and goings while working.
3.14 Check the operation of safety devices		The devices may be an anemometer, a boom stop, a scale, an electronic range limiting system, a computer, etc.
3.15 Enter parameters in the crane's computer, if applicable		The parameters are, for example, a user code, the number of counterweights, the length of outriggers, boom or fly jib, the fly jib angle, the number of block strands, etc.
3.16 Extend the boom, if applicable	3.16.1 Raise the boom at maximum to prevent friction on the telescopic sections 3.16.2 Extend the boom sections to the required length	
TASK 4 MOVE AND INSTALL LOADS WITH A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
4.1 Check the wind velocity and direction	4.1.1 Check the permitted wind speed limit for hoisting, according to boom length	Wind speed can be measured in metres/second, kilometres/second, miles/hour, etc.

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 4 MOVE AND INSTALL LOADS WITH A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
4.2 Heat the crane's mechanical and hydraulic elements, if applicable	4.2.1 Perform necessary manoeuvres for heating the components	The components may be the hydraulic system, hoisting cylinder, brakes, cylinder, friction strips, etc.
4.3 Position the boom over the load	4.3.1 Communicate with the signaller 4.3.2 Move the hook to the specified location	The load may be constituted by, among other things, steel, wood, concrete, reinforcing steel or steel powder structures, machinery, tools, and even persons in a cradle.
4.4 Check the computer's parameters, if applicable	4.4.1 Ensure that there are no errors in the codes or parameters 4.4.2 Validate the data by measuring radiuses	
4.5 Consult the hoisting plan, if applicable	4.5.1 Consult the plan provided by an engineer or draftsman and approved by the boss or client	Occasionally, hoisting is done in tandem or even with several cranes. The operations remain the same. However, communications are then more complex and detailed.
4.6 Provide or check the rigging equipment according to the load(s) to be hoisted	4.6.1 Select shackles, slings and spacer beams 4.6.2 Check the condition of selected shackles, slings and spacer beams 4.6.3 Ensure the compliance of rigging capacity with the load to be hoisted	
4.7 Supervise the rigging	4.7.1 Ensure that the equipment is used correctly 4.7.2 Check the quality of work done by the team 4.7.3 Ensure that the load is strongly secured	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 4 MOVE AND INSTALL LOADS WITH A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
4.8 Attach the rigging equipment on a hook	4.8.1 Check the slings' crossing 4.8.2 Check sling overlaps	
4.9 Define the communication procedure	4.9.1 Choose the means of communication 4.9.2 Ensure the mutual understanding of the means of communication between signaller and crane operator	The participants specified the use of radio and visual or hand signals as a means of communication.
4.10 Hoist the load	4.10.1 Check boom deflection to remain within the operating area	
4.11 Direct the load according to the signaller's instructions		
4.12 Deposit the load or keep it suspended during the installation, according to the signaller's instructions	4.12.1 While waiting for instructions, ensure that the crane is in a safe position	
4.13 Retract the boom, if applicable	4.13.1 Raise the boom at maximum to prevent friction on sections to be retract 4.13.2 Retract all sections	
4.14 Apply the safety brakes and, if applicable, deactivate the controls	4.14.1 Engage the dog and anti-rotation latch (or brake) 4.14.2 Disengage the main clutch 4.14.3 Turn the necessary electric switches on 4.14.4 Cut power to the master key	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 5 HANDLE MATERIALS BY MEANS OF A CRANE EQUIPPED WITH A CLAMSHELL OR ELECTROMAGNET		
Operations	**Sub-Operations**	**Clarifications**
5.1 Check equipment operation and maintain it, if applicable	5.1.1 Put the appropriate cable on the crane according to the type of clamshell 5.1.2 Install the cable in the clamshell by connecting it to the clamshell's opening and closing system, if applicable 5.1.3 Check the condition of the cable, pulleys, attachment points and pivot points 5.1.4 Perform necessary greasing operations 5.1.5 Check the teeth and lip for closing 5.1.6 Check the attachment points, electric wire, generator and control	Sub-operations 5.1.1 to 5.1.5 pertain to the clamshell. Operation 5.1.6 pertains to the electromagnet.
5.2 Install the equipment to the crane	5.2.1 Install the bin's corner closer and holder fasteners 5.2.2 Install the hook in the hoist link on the electromagnet	Among the types of equipment mentioned by the participants are, in addition to the clamshell and electromagnet, cradles for persons and materials, machine cages, pallet forks, concrete buckets and waste boxes.
5.3 Heat the crane's mechanical and hydraulic elements, if applicable	5.3.1 Heat the friction strips 5.3.2 Heat the brake bands, if applicable	
5.4 Delimit the work area	5.4.1 Check ground conditions 5.4.2 Establish a safety zone 5.4.3 Install safety tape and cones to limit access	The crane operator must detect, within the operating area, the presence of wires and obstacles.
5.5 Define the communication procedure	5.5.1 Determine if the work is done visually or if it requires a signaller's assistance 5.5.2 Choose the means of communication with the signaller	The participants mentioned the use of visual signals and radio.

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES

TASK 5 HANDLE MATERIALS BY MEANS OF A CRANE EQUIPPED WITH A CLAMSHELL OR ELECTROMAGNET

Operations	Sub-Operations	Clarifications
5.6 Transport materials to the appropriate location	5.6.1 Place the materials on the ground or on other transportation equipment	Materials are defined as what is transported by the crane, i.e., bin contents: stones, salt, sugar, rice, etc.
5.7 Apply the safety brakes and, if applicable, deactivate the controls	5.7.1 Position the electromagnet on the ground 5.7.2 Turn the generator off 5.7.3 Position the clamshell 5.7.4 Disengage the controls 5.7.5 Apply the locking ratchet 5.7.6 Cut the engine and lock the crane	Sub-operations 5.7.1, 5.7.2 and 5.7.6 pertain to cranes equipped with an electromagnet. Sub-operations 5.7.3 to 5.7.6 inclusively pertain to cranes equipped with a clamshell.

TASK 6 DO FOUNDATION AND SUPPORT WORK

Operations	Sub-Operations	Clarifications
6.1a Heat the crane's mechanical elements	6.1.1 Make the traction and rotation friction strips slide 6.1.2 Raise and lower the trowels four or five times	
6.2a Install or check the hammer column and the accessories	6.2.1 Install and check pins and counterpins 6.2.2 Grease the pulleys and fasteners 6.2.3 Install and check the lead column, hammers, caps and the foot	The installation is done at the start of work, and checks are then made periodically during the work.
6.3a Push in piles or sheet piles	6.3.1 Control the fall speed 6.3.2 Apply standards for the number of strokes and the sinking depth at each stroke	
6.4a Deposit the equipment on the ground, if applicable	6.4.1 Ensure that there are no obstacles on the ground or in the air	
6.5a Apply the safety brakes	6.5.1 Engage the locking ratchets of the boom and trowels 6.5.2 Apply the rotation brakes (or latch)	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 6 DO FOUNDATION AND SUPPORT WORK		
Operations	**Sub-Operations**	**Clarifications**
6.1b Heat the crane's mechanical elements	6.1.1 Make the traction and rotation friction strips slide 6.1.2 Raise and lower the trowels four or five times	
6.2b Install or check the dynamic compaction equipment	6.2.1 Install the corner fastener on the compaction equipment	
6.3b Compact the soil		
6.4b Deposit the equipment on the ground, if applicable	6.4.1 Ensure that there are no obstacles on the ground or in the air	
6.5b Apply the safety brakes	6.5.1 Engage the locking ratchets of the boom and trowels 6.5.2 Apply the rotation brakes (or latch)	
6.1c Heat the crane's mechanical elements	6.1.1 Make the traction and rotation friction strips slide 6.1.2 Raise and lower the trowels four or five times	
6.2c Install or check the bit equipment	6.2.1 Install the corner fastener on the bit	
6.3c Operate the bit		
6.4c Deposit the equipment on the ground, if applicable	6.4.1 Ensure that there are no obstacles on the ground or in the air	
6.5c Apply the safety brakes	6.5.1 Engage the locking ratchets of the boom and trowels 6.5.2 Apply the rotation brakes (or latch)	

A. CONVENTIONAL AND TELESCOPIC MOBILE CRANES		
TASK 7 DISASSEMBLE A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
7.1 Retract the boom, if applicable	7.1.1 Retract the hydraulic boom 7.1.2 Position the crane safely 7.1.3 Disengage the main clutch	
7.2 Delimit the location of disassembly	7.2.1 Choose a safe location	
7.3 Position the crane at the appropriate location	7.3.1 Move the crane safely 7.3.2 Stabilize the crane	
7.4 Delimit the disassembly area	7.4.1 Secure the work area	To that effect, safety cones and tape are used.
7.5 Lower the boom	7.5.1 Place the boom at the designated location in the safety zone	
7.6 Disassemble crane components	7.6.1 Disassemble the cable, stop limiter system, support pulley, electric wire 7.6.2 Disassemble the fly jib, if applicable, and the boom 7.6.3 Attach a cable to each section to be handled 7.6.4 Disassemble counterweights, if applicable 7.6.5 Position the mast in its support or dolly 7.6.6 Retract the stabilizers 7.6.7 Tighten the supports (plates) 7.6.8 Disassemble the fly jib and pendants, if applicable 7.6.9 Lower harness and remove pendants 7.6.10 Disassemble in the recommended order the pendants, the boom head and sections, and the counterweights 7.6.11 Position or close the gantry crane 7.6.12 Complete the crane disassembly	Sub-operations 7.6.1 to 7.6.7 inclusively pertain to telescopic cranes. Sub-operations 7.6.8 to 7.6.12 inclusively pertain to conventional cranes. The crane disassembly process must meet ministère des Transports standards.

B. TOWER CRANES

TASK 8 PERFORM DAILY PREVENTIVE MAINTENANCE ON A TOWER CRANE

Operations	Sub-Operations	Clarifications
8.1 Check all crane components		The components may be: bolts, scale, welds, rotary table, pendants or guys, pins and counterpins, electric motor, cables, pulleys, the electric enclosure, hook, cart, etc.
8.2 Lubricate mechanical components		The components to be lubricated are: motor, cables, rotary table and hook, pulleys and cart.
8.3 Check crane operation	8.3.1 Make basic movements with the crane 8.3.2 Perform tests for each operation 8.3.3 Check the gears' operation 8.3.4 Make sure that frost has caused no damage (winter)	
8.4 Report detected defects verbally and in writing	8.4.1 Report mechanical and electrical failures	
8.5 Make minor repairs	8.5.1 Replace fuses and windshield wipers	
8.6 Keep the logbook up-to-date	8.6.1 Indicate the type of crane 8.6.2 Provide information by checking the appropriate boxes 8.6.3 Report failures	
8.7 Clean the crane	8.7.1 Clean the windows, cab and toer feet	

B. TOWER CRANES

TASK 9 TRANSPORT A TOWER CRANE'S COMPONENTS

Operations	Sub-Operations	Clarifications
9.1 Consult the crane's installation plan	9.1.1 Consult the plan developed by the engineer 9.1.2 Check crane components on the plan	
9.2 Plan the crane's transportation	9.2.1 Choose the type of trailers according to component sizes 9.2.2 Estimate the number of trailers required for transportation 9.2.3 Ensure the sufficient capacity of the mobile crane used for loading the tower crane on trailers	
9.3 Gather necessary components for the work and check their condition	9.3.1 Make sure that all tower crane parts and components are in good condition and operational 9.3.2 Check the tower bars, boom, counter boom, weld joints, etc.	
9.4 Load components on trailers	9.4.1 Follow the loading sequence 9.4.2 Ensure that loading is completed 9.4.3 Choose the appropriate mobile crane for the type of loading to be done	

TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE

The participants reported the market introduction of a new automated assembly crane. It is a tower crane but is mobile. Its assembly technique is somewhat different. The general view is that this type of crane has advantages, notably on small construction sites, by saving time. Its use is already widespread in Europe. We can expect its use to grow in the near future.

Operations	Sub-Operations	Clarifications
10.1 Delimit the crane's assembly area	10.1.1 Make sure to have the necessary space for the mobile and tower cranes and for assembly operations 10.1.2 Place the tape to delimit the work area	

B. TOWER CRANES

TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE

Operations	Sub-Operations	Clarifications
10.2 Unload components	10.2.1 Make sure to have the necessary space for putting down the components to be unloaded 10.2.2 Select appropriate slings 10.2.3 Install a tagline on each item to handle 10.2.4 Fasten the sections and components safely 10.2.5 Block the load 10.2.6 Detach the load 10.2.7 Put the components on the ground while following the assembly order	
10.3 Erect tower sections	10.3.1 Fasten, raise and secure the tower's first section on the concrete base's anchors 10.3.2 Fasten and raise the second section vertically and secure it (pins or nuts) on the first one 10.3.3 Repeat the manoeuvre until the turntable is put in place	
10.4 Assemble the turntable and mast, if applicable	10.4.1 Assemble and install footwalks and guardrails on the turntable	
10.5 Install electrical accessories	10.5.1 Connect the electric cable that powers the crane, if applicable	
10.6 Hoist and fasten the turntable and mast to the tower, if applicable	10.6.1 Fasten the load securely with a tagline 10.6.2 Put the turntable in place 10.6.3 Install the mast	These sub-operations are performed with a mobile crane. Depending on the type of crane, the mast may be linked to or separated from the turntable.

B. TOWER CRANES		
TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
10.7 Assemble the main boom and the counter boom on the ground	10.7.1 Fasten and move the boom base section 10.7.2 Place the boom base section on wood blocks and unfasten it 10.7.3 Insert the cart in the base boom section, if applicable 10.7.4 Fasten and assemble the next section at the end of the first one 10.7.5 Align the pin holes 10.7.6 Insert pins and counterpins 10.7.7 Repeat the steps until the boom is fully assembled 10.7.8 Assemble the pendants and fasten them on the mast 10.7.9 Assemble footwalks, guardrails and pendants for the counter boom, by means of the mobile crane	These sub-operations are performed with a mobile crane.
10.8 Hoist and fasten the counter boom to the turntable	10.8.1 Fasten the load with a tagline at the end of the counter boom 10.8.2 Raise the counter boom 10.8.3 Secure the counter boom to the turntable 10.8.4 Link the pendants (or guys) at the top of the mast, if applicable	
10.9 Install a counterweight to the counter boom, if applicable		For certain types of cranes, one or two counterweights must be installed before the boom is erected.

B. TOWER CRANES

TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE

Operations	Sub-Operations	Clarifications
10.10 Hoist and fasten the main boom to the turntable	10.10.1 Fasten the boom and install a tagline 10.10.2 Raise the boom 10.10.3 Fasten the boom to the turntable 10.10.4 Link the pendants (or guys) at the top of the mast	A team of workers receives the boom at the top of the tower to fasten it.
10.11 Install counterweights to the counter boom	10.11.1 Fasten and assemble the counterweights 10.11.2 Assemble the counterweights one at a time or, if applicable, two at a time	
10.12 Install the hoist cable and cart cable		
10.13 Make a final inspection of all crane components	10.13.1 Ensure that all pins and counterpins are in place 10.13.2 Tighten the tower's bolts, if applicable	
10.14 Adjust the limit switches	10.14.1 Adjust the cart's limit switch on the boom 10.14.2 Adjust the hoist hook's limit switch	
10.15 Perform a load test	10.15.1 Hoist the heaviest concrete block 10.15.2 Fasten the smallest concrete block to the largest one 10.15.3 Hoist to one foot from the ground 10.15.4 Adjust the rated capacity limiter so that it is triggered one foot from the ground 10.15.5 Put the blocks on the ground	

B. TOWER CRANES

TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE

Operations	Sub-Operations	Clarifications
10.16 Adjust the overload protector	10.16.1 Apply manufacturer specifications	
10.17 Hoist the tower, if applicable		

TASK 11 MOVE AND INSTALL LOADS WITH A TOWER CRANE

Operations	Sub-Operations	Clarifications
11.1 Check the wind velocity and direction as well as the temperature	11.1.1 Consult the crane manufacturer's manual 11.1.2 Decide whether it is appropriate to stop operations while taking recommendations into account	
11.2 Define the communication procedure	11.2.1 Choose the most effective procedure given the situation 11.2.2 Ensure that there is no interference between the crane operator and the signaller	The participants mentioned the use of visual signals and radio.
11.3 Make sure all systems are adjusted and operate correctly	11.3.1 Check the boom, hook, computer, retarder and motion limiters	
11.4 Enter parameters in the crane's computer, if applicable		
11.5 Position the boom over the load	11.5.1 Position the card above the load 11.5.2 Follow the signaller's instructions	

B. TOWER CRANES		
TASK 11 MOVE AND INSTALL LOADS WITH A TOWER CRANE		
Operations	**Sub-Operations**	**Clarifications**
11.6 Ensure rigging quality	11.6.1 Obtain information on the safety clip, slings, hook, chains and spacer beam 11.6.2 Check rigging identification plates 11.6.3 Ensure that the rigging is strong	
11.7 Move and install the load according to the signaller's instructions	11.7.1 Define a work procedure 11.7.2 Make sure there are no obstacles 11.7.3 Make sure no one is in the hoisting area 11.7.4 Hoist the load (above the obstacles) 11.7.5 Deposit the load at the prescribed location 11.7.6 Raise the hook	
11.8 Turn the crane off	11.8.1 Raise the hook near the stop limiter 11.8.2 Move the cart close to the tower 11.8.3 Put the crane in free swing mode 11.8.4 Press the stop switch	

B. TOWER CRANES		
TASK 12 DISASSEMBLE A TOWER CRANE BY MEANS OF A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
12.1 Delimit the disassembly area	12.1.1 Make sure to have sufficient space 12.1.2 Install safety cones and tape	
12.2 Retract the tower, if applicable	12.2.1 Check wind speed 12.2.2 Assemble the hoisting system near the turntable 12.2.3 Obtain a concrete block to balance the crane (block test) 12.2.4 Detach the section to be removed 12.2.5 Remove the section from the hoisting system 12.2.6 Retract the tower with the hydraulic cylinder 12.2.7 Put the counterweight on the ground 12.2.8 Lower the section that is outside the telescopic system 12.2.9 Repeat the steps for all tower sections	
12.3 Wind the trowel and cart cable, if applicable	12.3.1 Detach the hook 12.3.2 Move the cart close to the tower, if applicable 12.3.3 Unlock the cart tensioner 12.3.4 Fasten the cart 12.3.5 Undo the cable	
12.4 Remove the counter boom counterweights	12.4.1 Remove one counterweight at a time with the mobile crane 12.4.2 Lift each counterweight by one foot 12.4.3 Remove counterpins and safety pins 12.4.4 Remove each counterweight and lower it to the ground	

B. TOWER CRANES

TASK 12 DISASSEMBLE A TOWER CRANE BY MEANS OF A MOBILE CRANE

Operations	Sub-Operations	Clarifications
12.5 Detach the main boom and lower it to the ground	12.5.1 Install a tagline 12.5.2 Raise the boom 12.5.3 Detach the pendant(s) (or guy(s)) 12.5.4 Release the pendant(s) (or guy(s)) on the boom 12.5.5 Lower the boom to the necessary level for disassembly 12.5.6 Remove counterpins and pins fastening the boom to the tower 12.5.7 Lower the boom to the ground on wood blocks	
12.6 Remove the last counterweight to the counter boom, if applicable	12.6.1 Lift the counterweight by one foot 12.6.2 Remove counterpins and safety pins 12.6.3 Extend the counterweight and lower it to the ground	
12.7 Turn the tower crane off	12.7.1 Turn off the main switch at the base of the tower 12.7.2 Remove the fuses	
12.8 Detach the counter boom and lower it to the ground	12.8.1 Install a tagline 12.8.2 Disconnect the wires that link the counter boom to the turntable 12.8.3 Raise the counter boom 12.8.4 Detach the pendants (or guys) from the mast and release them on the counter boom 12.8.5 Lower the counter boom to the necessary level for disassembly 12.8.6 Remove counterpins and pins 12.8.7 Lower the counter boom to the ground on wood blocks	

B. TOWER CRANES		
TASK 12 DISASSEMBLE A TOWER CRANE BY MEANS OF A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
12.9 Disassemble the counter boom, if applicable	12.9.1 Remove the footwalks, if applicable 12.9.2 Lift the part to be separated 12.9.3 Place wood blocks under the part that remains on the ground 12.9.4 Remove counterpins and pins that link the two sections	
12.10 Disassemble the main boom	12.10.1 Detach all pendants from the boom 12.10.2 Lift one section at a time 12.10.3 Remove counterpins and pins 12.10.4 Disassemble the sections one by one 12.10.5 Repeat for all the sections	
12.11 Detach the mast and turntable and lower them to the ground	12.11.1 Fasten the mobile crane over the mast 12.11.2 Remove counterpins and pins linking the mast to the turntable, and unfasten them if applicable 12.11.3 Lower the mast to the ground 12.11.4 Fasten the mobile crane over the turntable 12.11.5 Remove pins fastening the turntable to the tower 12.11.6 Lower the turntable to the ground 12.11.7 Disassemble the turntable footwalks, if applicable	

B. TOWER CRANES		
TASK 12 DISASSEMBLE A TOWER CRANE BY MEANS OF A MOBILE CRANE		
Operations	**Sub-Operations**	**Clarifications**
12.12 Disassemble the tower section by section	12.12.1 Lower the main electric cable, if applicable 12.12.2 Fasten the mobile crane over the tower 12.12.3 Remove pins from the chosen section(s) 12.12.4 Lower the section(s) to the ground 12.12.5 Lay the section(s) on the ground	
12.13 Remove the anchor plates, if applicable	12.13.1 Fasten the crane to one plate at a time 12.13.2 Unbolt the plates from the base	

2.3 ACHIEVEMENT CONDITIONS

Data on achievement conditions were collected for the crane operator trade as a whole. The data pertain to aspects such as work areas, work instructions, health and safety hazards, reference documents consulted and material resources used.

Table 2.3 Achievement Conditions

ACHIEVEMENT CONDITIONS
Work areas[14]
Generally, the crane operators' work is done on construction sites of the four construction sectors of activity – institutional and commercial, industrial, residential, and civil engineering and roads. Operations that involve planning work, reading plans or collecting information are performed in construction site facilities, branches or company offices. Preventive maintenance is done in garages or on construction sites. The trade is usually practiced outdoors, in areas such as highways, roads or streets, forests, ports, barges or ships, buildings, waste sites, shopping centres, refineries, dams, etc. Crane operators are assigned to work on uneven ground, asphalt or any type of ground (soft, hard, frozen, snow-covered, etc.). At times, the work is done indoors, particularly in tunnels or plants, such as heavy water plants.
Level of autonomy
Crane operators work alone or in a team, depending on tonnage and crane complexity. This applies to driving, transporting, assembling and disassembling the machine. Operating the crane requires a signaller's assistance and other trades related to the work. As an example, the participants mentioned the team responsible for fastening and putting in place the materials to be handled. A construction site superintendent, foreman or team leader supervises the work. The crane operator may also have to refer to the engineer, company representative, client and, at times, a prevention officer. The participants emphasized several times the fact that the crane operator, although supervised, is responsible for decisions made while work is being done. His level of responsibility is therefore very high. He may have to oppose a refusal to work when work safety or quality is compromised.
Instructions
The first instructions come from the supervisor, client, or engineering plans. The crane operator is informed of the work assigned to him and of the construction site location and his itinerary. In crane rental companies, a dispatcher provides the crane operation with this information, whereas in other types of companies, the crane operator is informed by his supervisor. He must ensure to have on hand the required permits for moving and installing the crane, notably permits from the ministère du Transport and the municipalities concerned. Again, the crane operator reports to the on-site authority for supervised tasks.

14. Non-exhaustive list.

ACHIEVEMENT CONDITIONS
References
Among the documents to which crane operators have to refer, the participants mentioned engineering plans, manufacturer manuals, tables and diagrams, user guides for various cranes and their equipment, standards such as CSA Z150 and Z248, hoisting plans and loading plans. Crane operators have to consult and fill out logbooks and inspection logs.
Stress factors
Weather conditions, road contingencies when transporting the crane and equipment, frequent constraints in work areas, and the variety of soils on which the crane is installed constitute undeniable stress factors. More specifically, the participants mentioned the wind, including cross-winds, sudden storms, transportation delays, itinerary deviations, narrow work areas, and nearby high-tension wires. The work is done in a noisy environment. At times, a crane operator's vision is reduced by darkness or fog. The trade requires great precision and precautions to avoid damaging materials to be handled. Crane operators constantly monitor the comings and goings of people near their crane, such as other workers or pedestrians, in order to prevent accidents. They often have to report others' quality of work. Accordingly they have to ensure the solidness and stability of loads to be hoisted, and verify the quality of crane assembly. They must perform complex and precise material hoisting and moving operations. It goes without saying that communicating with the signaller and monitoring work teams or colleagues become paramount. It was also pointed out that good signallers are rare and that this situation raises the levels of difficulty and stress involved in the work of crane operators. Crane operators must also cope with the requirements of supervisors or clients. A crane operator can feel considerable pressure in exercising his right to refuse dangerous work and in justifying that exercise.
Raw materials, tools and equipment
In Annex 1 of the present report is a list of material resources used by crane operators in practicing their trade.
Health and safety sources of danger
A list of the main souces of danger involved in the crane operator trade's tasks and operations is drawn in Annex 2 of the present report. Applicable preventive measures are also listed.

2.4 PERFORMANCE CRITERIA

Performance criteria were collected for each task. They are used for assessing whether the tasks are performed satisfactorily. The criteria pertain to aspects such as the quantity and quality of work done, the observance of a work procedure, the attitudes adopted, etc.

It should be mentioned that some criteria may apply as well to tasks other than those for which they were chosen.

Table 2.4 Performance Criteria

At the outset, the participants agreed that the crane operator does not have the right to make errors; the consequences of a poor decision or a badly performed operation (anchoring, handling, etc.) are too serious. According to the participants, this assertion constitutes an overall performance criterion that applies to all tasks of the trade.

A. Conventional and telescopic mobile cranes

TASK 1 PERFORM DAILY PREVENTIVE MAINTENANCE ON A MOBILE CRANE
Performance Criteria
– Observance of occupational health and safety rules – Observance of the manufacturer's maintenance log – Meeting manufacturer specifications – Duly filled out logbook – Equipment cleanliness – Good general condition of the crane – Observance of health and safety rules – Correct and full inspection before starting
TASK 2 TRANSPORT A MOBILE CRANE AND ITS ACCESSORIES
Performance Criteria
– Observance of occupational health and safety rules – When planning transportation, taking into consideration all the conditions that can affect its success – Observance of ministère des Transports regulations – Solid anchoring – Logically scheduling the loading and transportation of components according to the crane's assembly sequence – Complete loading of necessary components – Observance of the highway code – Taking road constraints into consideration at all times when travelling

A. Conventional and telescopic mobile cranes

TASK 3 ASSEMBLE AND INSTALL A MOBILE CRANE

Performance Criteria

- Observance of occupational health and safety rules
- Checking the crane's weight systematically
- Complete verification of factors that could compromise the crane's installation in a given location (soil firmness, presence of pipes or electric wires, differences in level, etc.)
- Correct interpretation of the hoisting plan, if applicable, and of the assembly plan
- Reaching an applicable agreement with the on-site authority in the absence of a hoisting plan
- Observance of guidelines
- Responsible attitude
- Correctly estimating the level of hazard
- Observing the rules of other trades being practiced on the premises
- Sound choice of parameters according to the work to be done
- Parts well fastened at the correct locations
- Appropriate verification of crane capacity according to boom length

TASK 4 MOVE AND INSTALL LOADS WITH A MOBILE CRANE

Performance Criteria

- Observance of occupational health and safety rules
- Appropriately determining the operating radius according to the crane's rotation direction
- Observance of the hoisting plan, if applicable
- Effective and visible delimitation of the work area
- Complete verification of factors ensuring the safety of the load to be handled
- Appropriate choice of the procedure for communicating with the signaller
- Clearly and precisely communicating guidelines to work teams in place
- Making sound decisions given the constraints
- Skilful and precise manoeuvres
- Quick execution, but without haste
- Quality of the work done

TASK 5 HANDLE MATERIALS BY MEANS OF A CRANE EQUIPPED WITH A CLAMSHELL OR ELECTROMAGNET

Performance Criteria

- The same criteria as for task 4
- Observance of rules for handling chemicals
- Taking physical constraints into consideration in the presence of an electromagnet (interference with a pacemaker or hearing aid, for example)

A. Conventional and telescopic mobile cranes

TASK 6 Do foundation and support work

Performance Criteria

- Observance of occupational health and safety rules
- Following operational procedures
- Observance of equipment and machinery capacity
- Communicating effectively with the signaller
- Appropriate engine speed
- Correct cable tension: neither too slack nor too tight
- Observance of the engineer's procedures and instructions
- Observance of compaction standards
- Observance of standards for the number of strokes and the sinkage at each stroke
- Quick execution, but without haste

TASK 7 DISASSEMBLE A MOBILE CRANE

Performance Criteria

- Observance of occupational health and safety rules
- Appropriate planning of the assembly procedure
- Observance of the disassembly sequence
- Meeting manufacturer specifications
- Taking potential constraints into consideration
- Observance of health and safety rules

Note: The participants asked to refer to task 3, since task 7 is in reverse.

B. Tower cranes

TASK 8 PERFORM DAILY PREVENTIVE MAINTENANCE ON A TOWER CRANE
Performance Criteria
– Observance of occupational health and safety rules – Observance of the manufacturer's maintenance log – Meeting manufacturer specifications – Duly filled out logbook – Equipment cleanliness – Good general condition of the crane – Observance of health and safety rules – Correct and complete pre-start inspection
TASK 9 TRANSPORT A TOWER CRANE'S COMPONENTS
Performance Criteria
– Observance of occupational health and safety rules – Appropriate protection of equipment and components – Appropriate verification of anchoring strength – Sound choice of transportation methods and means according to the type of components – Systematic and precise signalling of breakages or problems to the persons concerned
TASK 10 ASSEMBLE AND MOUNT THE TOWER CRANE BY MEANS OF A MOBILE CRANE
Performance Criteria
– Observance of occupational health and safety rules – Effective communication with the transportation team – Systematically checking the weight of crane components – Correct interpretation of the assembly plan – Observance of guidelines – Responsible attitude – Correctly estimating the level of hazard – Observing the rules of other trades being practiced on the premises – Sound choice of parameters according to the work to be done – Parts well fastened at the correct locations – Appropriate verification of crane capacity according to boom length – Obtaining the engineer's certification upon assembly completion

B. Tower cranes

TASK 11 MOVE AND INSTALL LOADS WITH A TOWER CRANE
Performance Criteria
– Observance of occupational health and safety rules – Appropriately determining the operating radius according to the crane's rotation direction – Effective and visible delimitation of the work area – Complete verification of factors ensuring the safety of the load to be handled – Appropriate choice of the procedure for communicating with the signaller – Clearly and precisely communicating guidelines to work teams in place – Making sound decisions given the constraints – Skilful and precise manoeuvres – Quick execution, but without haste – Quality of the work done
TASK 12 DISASSEMBLE A TOWER CRANE BY MEANS OF A MOBILE CRANE
Performance Criteria
– Observance of occupational health and safety rules – Appropriate planning of the assembly procedure – Observance of the disassembly sequence – Meeting manufacturer specifications – Taking potential constraints into consideration – Choosing appropriate methods in specific situations – Observance of health and safety rules *Note: The participants asked to refer to task 10, since task 12 is in reverse.*

2.5 FUNCTIONS

Functions correspond to a set of related tasks. This set may be defined by the work's results or by a sequence of steps.

For the crane operator trade, five functions appear to stand out:

- a function regarding **crane maintenance**, and grouping the following tasks:
  - task 1: "Perform daily preventive maintenance on a mobile crane";
  - task 8: "Perform preventive maintenance on a tower crane";

- a function regarding **crane transportation**, and grouping the following tasks:
  - task 2: “Transport a mobile crane and its accessories”;
  - task 9: “Transport a tower crane’s components”;
- a function regarding **crane assembly and installation**, and grouping the following tasks:
  - task 3: “Assemble and install a mobile crane”;
  - task 10: “Assemble and mount a tower crane by means of a mobile crane”;
- a function regarding **load moving and installation**, and grouping the following tasks:
  - task 4: “Move and install loads with a mobile crane”;
  - task 5: “Handle materials by means of a crane equipped with a clamshell or electromagnet;
  - task 6: “Do foundation and support work”;
  - task 11: “Move and install loads with a tower crane”;
- a function regarding **crane disassembly**, and grouping the following tasks:
  - task 7: “Disassemble a mobile crane”;
  - task 12: “Disassemble a tower crane by means of a mobile crane”.

3. QUANTITATIVE DATA ON TASKS

3.1 OCCURRENCE

Occurrence data concern the percentage[15] of crane operators who perform a task in a given workplace. The data presented in the tables below are averages for the crane operators who participated in the workshop. However, they represent the allocation of time not only of the participants, but also of all crane operators working in the companies represented.

It should be mentioned that the quantitative data on tasks should be read as an indication only. They are estimates made at that moment by a working group, so their scope is not that of proven statistical data.

Table 3.1 Occurrence of Tasks

	Task	Occurrence
A. Conventional and telescopic mobile cranes		
1	Perform daily preventive maintenance on a mobile crane	95.4%
2	Transport a mobile crane and its accessories	85.8%
3	Assemble and install a mobile crane	89.2%
4	Move and install loads with a mobile crane	89.2%
5	Handle materials by means of a crane equipped with a clamshell or electromagnet	23.8%
6	Do foundation and support work	20.8%
7	Disassemble a mobile crane	85.4%
B. Tower cranes		
8	Perform preventive maintenance on a tower crane	15.4%
9	Transport a tower crane's components	0.86%
10	Assemble and mount the tower crane by means of a mobile crane	10.4%
11	Move and install loads with a tower crane	11.5%
12	Disassemble a tower crane by means of a mobile crane	3.1%

15. The percentage includes apprentices.

The above table shows clearly that a strong majority of crane operators practice all mobile crane tasks for the companies represented in the trade analysis workshop. However, few handle materials by means of a crane equipped with a clamshell or electromagnet or do foundation and support work.

3.2 WORK TIME

Work time, also expressed in percentages, represents the average time, on a **monthly** basis, allocated to each task by the crane operators consulted.

Table 3.2 Work Time Allocated to Each Task

	Task	Work Time
A. Conventional and telescopic mobile cranes		
1	Perform daily preventive maintenance on a mobile crane	6.1%
2	Transport a mobile crane and its accessories	8.1%
3	Assemble and install a mobile crane	8.2%
4	Move and install loads with a mobile crane	35.8%
5	Handle materials by means of a crane equipped with a clamshell or electromagnet	2.4%
6	Do foundation and support work	4.6%
7	Disassemble a mobile crane	12.4%
B. Tower cranes		
8	Perform preventive maintenance on a tower crane	1.8%
9	Transport a tower crane's components	0.1%
10	Assemble and mount the tower crane by means of a mobile crane	0.8%
11	Move and install loads with a tower crane	19.4%
12	Disassemble a tower crane by means of a mobile crane	0.7%

Most of crane operators' work time – 35.87% – involves moving and installing loads with a mobile crane. Transporting, assembling and disassembling cranes take up about 28.73% of the work time, so that only 6.97% is left for handling materials by means of a crane equipped with a clamshell or electromagnet, or for foundation and support work.

In comparing the percentage of time worked on mobile and tower cranes, we note that all the crane operators consulted spend on average 77.67% of their time working with mobile cranes, and 22.33% with tower cranes.

3.3 IMPORTANCE AND DIFFICULTY OF TASKS

The **importance** of a task is estimated according to the more or less harmful consequences of performing a task poorly or not at all. The importance is assessed according to the following scale:

1. Not important at all: Poor execution of the task has no consequences on the quality of the result, the costs, health and safety, etc.
2. Not very important: Poor execution of the task could result in minimal costs, an unsatisfactory result, injury or minor accident hazards, etc.
3. Important: Poor execution of the task could result in substantial additional costs, injuries, accidents, etc.
4. Very important: Poor execution of the task could have very substantial consequences in terms of costs, safety, etc.

A task's **difficulty** is assessed according to the following scale:

1. Very easy: The task involves little risk of error; it requires no notable physical or mental effort. Performing the task is less difficult than average.
2. Easy: The task involves a few risks of error; it requires minimal physical or mental effort.
3. Difficult: The task involves many risks of error; it requires a good physical or mental effort. Performing the task is more difficult than average.
4. Very difficult: The task involves a high risk of error; it requires substantial physical or mental effort. The task is among the most difficult in the trade.

The data presented in the table below are the average results for the crane operators who participated in the workshop.

Table 3.3 Importance and Difficulty of Tasks

	Task	Importance	Difficulty
A. Conventional and telescopic mobile cranes			
1	Perform daily preventive maintenance on a mobile crane	3.3	1.6
2	Transport a mobile crane and its accessories	3.2	2.5
3	Assemble and install a mobile crane	3.7	3.1
4	Move and install loads with a mobile crane	3.8	2.9
5	Handle materials by means of a crane equipped with a clamshell or electromagnet	3.1	3.0
6	Do foundation and support work	3.4	2.3
7	Disassemble a mobile crane	3.8	3.4
B. Tower cranes			
8	Perform preventive maintenance on a tower crane	3.3	1.6
9	Transport a tower crane's components	3.5	2.6
10	Assemble and mount the tower crane by means of a mobile crane	4.0	3.6
11	Move and install loads with a tower crane	3.8	2.6
12	Disassemble a tower crane by means of a mobile crane	3.7	3.4

4. KNOWLEDGE, SKILLS AND ATTITUDES

The occupational analysis enabled us to specify some of the knowledge, skills and attitudes necessary for performing the tasks. Those qualities are transferable, i.e., applicable to a variety of tasks and situations.

The following pages present the knowledge, skills and attitudes that, according to the workshop participants, are considered essential for performing the tasks of the crane operator trade.

4.1 KNOWLEDGE

Communication

Crane operators have to communicate with the employer, foreman or construction site superintendent, work teams (including workers in other trades), apprentices, etc. In addition to applying elementary rules of manners and respect, they have to reach agreements, explain facts, discuss and justify their decisions. In all those cases, they have to be diplomatic. It is necessary for them to have the skills to maintain good interpersonal relations.

It appears that a crane operator's reputation is essential in the workplace. He has to "make his name". He must demonstrate his expertise when his views differ from those of the client or supervisor in place, particularly when he refuses to work. Meeting manufacturer specifications, individual and collective safety, and taking the crane's capacity into account form the basis of some of the arguments to be made during disputes.

Crane operators must learn the remote means of communication (radio, signals) they use when working with a signaller.

In Québec, the language of work is French. However, still today, English terminology is commonly used for designating cranes, their components and accessories. In addition, some clients speak English to crane operators.

Documentation such as manufacturer charts and manuals is presented in English in most cases. The participants think that bilingualism is an asset and that it facilitates travel outside the province.

Some participants also mentioned that the employer's requirements are sometimes difficult to meet due to constraints or a poor assessment of the work to be done. In such cases, it is important to explain the situation to him clearly and precisely. Communication is then very important.

Mathematics

Crane operators have to take measurements and read the results on the ruler and protractor. The lengths of booms, fly jibs, radiuses and angles are the most common measurements to take. When the crane is equipped with an electronic system, the computer provides such data, but in other cases the crane operator has to take measurements.

Generally, load capacity information is provided by the client. Still, the crane operator must, in case of doubt, calculate using appropriate mathematical formulas. He must also make the required calculations for weight rigging. Finally, the use of international and imperial measurement systems is common, and the need to convert from one system to the other is inevitable.

Electronics

The new cranes are equipped with a computer. Crane operators have to read and enter parameters. Accordingly, they have to become familiar with electronic instruments and their software. They need basic knowledge to be able to interpret pictograms.

Physics

A knowledge of physics proves useful when the time comes to evaluate the effects of the wind forces influences. The participants also mentioned inertia, a water resistance on parts, and determining a load's centre of gravity.

Occupational health and safety rules

The trade involves some serious risks. The consequences of errors depend on the size and weight of loads. The crane operator must be vigilant not only for his safety, but also for that of work teams around the crane. His responsibility is paramount on the premises. He must monitor and verify the work of others, who are not always aware of the dangers involved in rigging.

For example, a poorly attached sling can have dramatic consequences. The crane operator must therefore know rigging techniques, since he has to verify their application. He must absolutely ensure the stability of loads. Accordingly, it is important that crane operators be made well aware of the importance of health and safety measures on the construction site.

Reading plans

In addition to crane assembly plans, crane operators interpret simple engineering plans and ensure their applicability. They are not authorized to modify the plans themselves; they must report errors to the engineer or have him approve suggested corrections.

Laws and regulations

The participants mentioned the regulations cited in Section 1.5, the WHMIS and rules specific to a construction site or work area, as well as municipal by-laws, particularly regarding permits to close streets or pedestrian walkways.

4.2 SKILLS

Skills are types of know-how. They are divided into three categories: cognitive, motor and perceptual.

Cognitive skills

Cognitive skills pertain to intellectual strategies applied in working. The main cognitive skills that crane operators need are the following:

- analytic skill and judgement;
- problem-resolution;
- decision-making and the ability to discuss and justify one’s decisions;
- anticipation of movements, travel, the progress of operations, sudden wind blasts, etc.;
- concentration.

Motor skills

Motor skills involve gestures and movements. The main motor skills that crane operators need are the following:

- eye-hand-foot coordination;
- the ability to react immediately; always being involved in the action;
- dexterity, for precise manœuvres;
- the ability to drive the crane.

Perceptual skills

Perceptual skills are sensory skills enabling a person to perceive by his senses what is happening in his environment. The main perceptual skills that crane operators need are the following:

- three-dimensional peripheral vision;
- spatial perception, to evaluate distance, height and depth;
- the ability to “feel the machine”, regarding its good operation or to anticipate its reactions;
- visual acuity;
- hearing and smell, to detect problems or breakages.

4.3 ATTITUDES

Attitudes are ways of acting, reacting and relating with others or with one’s environment. They involve personal skills. The main attitudes that crane operators need are the following:

- patience, given long waiting times;
- precision;
- self-confidence, without arrogance or showing off;
- self-control;
- punctuality and diligence;

- teamwork ability;
- autonomy;
- openness and acceptance regarding others' ideas;
- respect for others;
- judgement;
- sense of responsibility;
- discipline, to meet one's commitments, because being replaced is at times very difficult;
- prudence and prevention, while working quickly.

5. TRAINING SUGGESTIONS

At the vocational analysis workshop, the participants formulated a number of training suggestions. They are reproduced here, in no particular order.

Regarding initial training:

- the focus should be on practical learning activities. To that effect, outings should be organized teaching students to drive the crane on roads or downtown.
- Agreements could be reached between schools and contractors so that students could make real manœuvres with cranes on a construction sites. The nature of materials to be lifted should be varied and present more-complex situations, such as rigging heavier loads.
- Learning activities, for example assembling metal formwork panels, should be proposed that closely correspond to workplace realities. Contact with an actual work area would give students an opportunity to better perceive stress factors or constraints related to occupational health and safety.
- It would be appropriate to include tower cranes in the DEP curriculum.
- Some participants deplored the fact that the DEP curriculum does not offer driving courses leading to a class 1 permit. Currently, course requirements are limited to class 3 permits, which do not authorize one to drive a trailer truck. One expert mentioned that the required age for obtaining a class 1 permit is 21 years, which can exclude some students at the start of training.
- It would be useful to tighten the criteria for selecting students registering for crane operation training. Only those who demonstrate aptitudes for driving heavy machinery should be retained.
- Questions were raised about the relevance of including so many mathematical concepts in the evaluation process. Tests should contain more practical aspects, without completely abandoning mathematics, which should pertain to real calculation situations or measurements made in practicing the trade.

Regarding apprenticeships:

- The participant proposed an increase in the number of apprenticeship hours, from 2,000 to 4,000 hours. Among other things, this would enable apprentices to operate cranes with greater tonnage. They would also benefit from the journeyman's experience in completing their apprenticeship.
- A few participants suggested a specific apprenticeship period for tower cranes; work on this type of crane is reportedly sufficiently different to justify such a requirement. Indeed, the participants deplore that occasionally, a crane operator who holds a journeyman competency card but has never worked on a tower crane agrees to work on this type of crane, without additional training or supervision, thus risking his safety and that of others around him.
- Finally, a suggestion was made to reach an agreement with companies to establish a student mentoring system, an experience that would greatly benefit students.

Annexes

ANNEX 1

RAW MATERIALS, TOOLS AND EQUIPMENT

Table A.1 Raw Materials, Tools and Equipment

Devices, Machines and Heavy Equipment	
• Clamshell • Dragline bucket • Concrete block used as a counterweight or for the hoist test • Waste box • Hammer line • Utility line (auxiliary line, pall line, etc.) • Lift frame • Machine cage • Wood, metal and hard plastic blocks • Service truck • Tractor truck • Chain with hook • Waste oil recovery container • Container • Plywood • Crane weigher • Vox earphone® • Sling • Float trailer • Portable generator with welder • Concrete bucket • Automated assembly crane • Conventional tired crane • Truck crane (boom truck) • All-terrain crane • Telescopic crane	• Boom length and static radius indicator • Drum rotation indicator • Hook limit switch • Programmable range-limiting device • Shackle • White blade hammers • Vibrator hammer • Hydraulic vibrator hammer • Compaction sledgehammer • Wood mattress • Cradle • Pallet • Steel plate • Vibrated concrete panel • Fuel transfer pump • Wood pole • Vibrated concrete beam • Lifting beam • Portable radio • Platform trailer • Load binder • Steel pipe

Tools and Instruments	
• Socket adapter • Impact socket adapter • Solvent tub • Lead-light • Angle pinch bar • Pump oiler can • Tagline • Booster cable • Pen knife • Battery charger • Adjustable wrench • Pipe wrench • Combination wrench • Spanner wrench • toolbox • Calliper • Portable air compressor • Bole cutter • Cable cutter • Beam jack • Impact socket • Universal joint socket • Hexagon head socket • Acetylene and oxygen set • Funnel • Vise • Electric soldering iron • Threader • Pallet fork • Axe • Pressure gauge • Universal impact joint (square) • Steel pipe • Battery tester • Electric circuit tester	• Flashlight • Pressure washer • Scaling hammer • Air hammer • Sledgehammer • Cutting grinder (abrasive saw) • Mobile crane assembly kit (either in the toolbox or the service truck) • Carpenter’s hand level • Cable hoist (Tirfor®) • Power-operated hoist • Square shovel • Drill press • Electric drill • Fence pliers • Retaining ring pliers • Curved jaw vice-grip pliers • Crowbar • Glue gun (kit) • Gear oil pump • Impact extension cord • Square impact extension cord • Small angle grinder • Scale rule • Propane gas tank/cylinder • Riveter • Measuring tape • Hacksaw • Mechanic’s creeper • Spring cable tensioner • Load binder • Bench • Garage tripod • Wheeled garage jack • Hydraulic jack

Accessories and Light Equipment	
• Air accessory coupling tailpiece • Greasing adapter • Portable generator accessories • Double rubber hose • Air hose • Air bleed • Welding cable • Tire chain	• Oxygen/acetylene gas cylinder cart • Diesel heater • Stepladder • Tire pressure gauge • Grounding clamp • Quick coupler for manual coupling • Extension cord • Blower
Raw Materials	
• Acetylene and oxygen • Blocking adhesive • Wood alcohol • Diesel fuel • Wax and other polishing products • Rag • Solvent (Varsol®) • Covered electrode • Absorbent material kit • tin • Ether • Chemical fire extinguisher • Propane gas • Grease • Gear oil • Brake oil • Hydraulic oil	• Penetrating oil • Diesel engine oil • Gasoline engine oil • Vegetable oil • Hacksaw blade • Windshield wiper fluid • Cable lubricant • Gear lubricant • Grinder • Spray paint • Stone lighter • Battery • Refrigerant • Insulating tape • De-icing salt • Teflon

Small Tools and Accessories	
• Tie wraps (Ty-Rap®) • Broom • Bolts • Flexible hose • Iron wire • Nylon cable • Calculator • Pin • All-purpose collar • Electric lug • Pencil • Notepad • Nut • Metal drill • Spring dowel	• Counterpin • O ring • Steel file • Round file • Sledgehammer • Narrow shovel • Clawbar • Grease gun • Grease gun connection • Grease connections • Lockwasher • Cable clamp • Flat head screwdriver • Machine screw
Safety Equipment and Accessories	
• Reflective strips • Rubber bollards • Safety boots • Grounding cable and rod • Hard hat with safety strap • Safety belt • Ear plugs or shells • Lighting unit • Fire extinguisher • Gloves	• Safety harness • Strobe light • Safety glasses • Safety tape • Overalls • Frock • First-aid kit • Safety vest • Fire-retardant clothing • Visor

ANNEX 2

GRIDS OF OCCUPATIONAL HEALTH AND SAFETY ELEMENTS

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Table A.2 Description of Sources of Danger

No.	*Sources of Danger*	*Effects on Health and Safety*	*Means of Prevention and Protection*
1	Falls from heights of from the crane platform	• Fractures, bruises, permanent injuries, death	• Clean, slip-resistant and reject-free surfaces
2	Contact with overhead electric lines	• Electrification, burns, electrocution	• Observance of minimal distances, agreement with Hydro-Québec, and range-limiting devices
3	Crane or load overturn	• Bodily injuries, permanent injuries, death	• Adequate hoisting techniques, stable beds, observance of rated loads
4	Sling rupture	• Crashes, collisions, bodily injuries, death	• Checking the condition of slings • Good slinging and rigging techniques • Adequate use of slings
5	Moving parts	• Body injuries, particularly to hands, fingers and arms	• Covering with appropriate grills any re-entrant angles and parts that can catch parts of the body
6	Contact with controlled products (WHMIS)	• Burns, intoxications, leukemia, blindness, cancer	• Training sessions on hazardous products • Reading and understanding labels and safety data sheets of products used

Table A.3 Sources of Danger Related to Crane Operator's Tasks and Operations

Legend

0	The risk is nil.
+	The risk is low.
++	The risk is average.
+++	The risk is high.

Risk levels are noted according to exposure to hazards, not according to the gravity of effects on personal health and safety.

A. MOBILE CRANES

N°	Tasks and Operations	Fall from Height or from the Crane Platform	Contact with Overhead Electric Lines	Crane or Load Overturn	Sling Rupture	Moving Parts	Contact with Controlled Products (WHMIS)
TASK 1	**Perform daily preventive maintenance on a mobile crane**						
1.1	**Perform the usual checks**	**++**	**0**	**0**	**0**	**++**	**++**
1.1.1	Check all fluids	+	0	0	0	++	+++
1.1.2	Check the tires or tracks	+	0	0	0	++	+
1.1.3	Check the brakes, if applicable	+	0	0	0	++	+
1.1.4	Check the components to be transported on the road	+	0	0	0	++	+
1.1.5	Check all cables and their winding	+	0	0	0	++	+
1.1.6	Check electric, electronic, mechanical, hydraulic and pneumatic components	+	0	0	0	++	+
1.1.7	Check the ballast and block, if applicable	+	0	0	0	++	+
1.1.8	Check the crane's level, if applicable	+	0	0	0	++	+
1.1.9	Check the crane's structure	++	0	0	0	++	+
1.2	**Report detected defects verbally and in writing**	**0**	**0**	**0**	**0**	**0**	**0**
1.2.1	Forward reports to the persons concerned	0	0	0	0	0	0
1.3	**Make minor repairs, if applicable**	**+**	**0**	**0**	**0**	**++**	**++**
1.3.1	Replace lights	+	0	0	0	+	+
1.3.2	Tighten a hydraulic pipe's rings	+	0	0	0	+	+
1.4	**Inspect and maintain rigging equipment**	**+**	**0**	**0**	**0**	**++**	**+**
1.4.1	Check the condition of each rigging component	+	0	0	0	++	+
1.5	**Keep the logbook up-to-date**	**+**	**0**	**0**	**0**	**0**	**0**
1.5.1	Report to one's supervisor any defect or lack	0	0	0	0	0	0
1.5.2	Have repairs done depending on the urgency of the situation	+	0	0	0	+	+
1.6	**Produce reports for the ministère des Transports, if applicable**	**0**	**0**	**0**	**0**	**0**	**0**

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TASK 1	**Perform daily preventive maintenance on a mobile crane**						
1.7	**Lubricate mechanical components**	**+**	**0**	**0**	**0**	**++**	**++**
1.7.1	Grease pulleys, boom foot pins, the crown, outriggers, the gear train, the boom's sliding parts and the carrier's mechanical components	++	0	0	0	++	++
1.8	**Clean the crane**	**++**	**0**	**0**	**0**	**++**	**+++**
1.8.1	Clean the windows	+	0	0	0	++	++
1.8.2	Clean the cab(s)	+	0	0	0	++	++
1.8.3	Remove excess grease	+	0	0	0	++	+++
1.8.4	See to the crane's overall cleanliness	++	0	0	0	+	+++
TASK 2	**Transport a mobile crane and its accessories**						
2.1	**Consult the crane's assembly plan**	**0**	**0**	**0**	**0**	**0**	**0**
2.1.1	Refer to manufacturer recommendations and engineering plans	0	0	0	0	0	0
2.1.2	Inquire about the recommendations of the person responsible for the work	0	0	0	0	0	0
2.1.3	Obtain information about the client's specific requirements	0	0	0	0	0	0
2.2	**Plan the crane's transportation**	**0**	**0**	**0**	**0**	**0**	**0**
2.2.1	Ensure that there is a sufficient number of trailers	0	0	0	0	0	0
2.2.2	Determine the itinerary	0	0	0	0	0	0
2.2.3	Comply with ministère des Transports regulations regarding the weight and size of components and the crane	0	0	0	0	0	0
2.2.4	Determine the components' order of transportation	0	0	0	0	0	0
2.3	**Gather and prepare components and equipment necessary for the work, if applicable**	**+**	**0**	**0**	**0**	**+**	**+**
2.3.1	Check the condition and availability of each component and the equipment	+	0	0	0	+	0
2.3.2	Facilitate the access to required parts	+	0	0	0	+	0
2.4	**Load the crane on a float trailer, if applicable**	**++**	**0**	**++**	**++**	**+++**	**++**
2.4.1	Position the crane on the carrier	++	0	++	++	+++	++
2.4.2	Secure the load	+	0	+	+	+++	+
2.5	**Load components on trailers or float trailers, if applicable**	**++**	**0**	**0**	**0**	**+++**	**0**
2.5.1	Install components according to transportation planning	++	0	0	0	+++	0

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TASK 2	**Transport a mobile crane and its accessories**						
2.6	**Transport on the road the carrier part or the crane**	**0**	**+**	**+**	**+**	**+**	**+**
2.6.1	Make sure to have necessary documents, such as transportation permits	0	0	0	0	0	0
2.7	**Park the carrier part or the crane at the appropriate location**	**0**	**+**	**+**	**+**	**+**	**0**
TASK 3	**Assemble and install a mobile crane**						
3.1	**Find out on the weight of the load(s) to be hoisted**	**0**	**0**	**0**	**0**	**0**	**0**
3.1.1	Read manufacturer specifications	0	0	0	0	0	0
3.1.2	Consult the hoisting plan	0	0	0	0	0	0
3.1.3	Collect necessary information from the foreman	0	0	0	0	0	0
3.2	**Determine rigging weight, the height and the operating range**	**0**	**0**	**0**	**0**	**0**	**0**
3.2.1	Consult the hoisting plan	0	0	0	0	0	0
3.2.2	Measure height and radius	0	0	0	0	0	0
3.2.3	Consult the crane blueprint	0	0	0	0	0	0
3.3	**Check the crane capacity while taking into account the loads to be hoisted**	**0**	**0**	**0**	**0**	**0**	**0**
3.3.1	Consult the load capacity chart	0	0	0	0	0	0
3.3.2	Take into consideration the type of work to be done	0	0	0	0	0	0
3.4	**Determine one or more locations for the assembly and work**	**0**	**0**	**0**	**0**	**0**	**0**
3.4.1	Consult the person in authority on the premises	0	0	0	0	0	0
3.4.2	Give one's authorization	0	0	0	0	0	0
3.5	**Check the ground's load-bearing capacity and the environmental obstacles**	**0**	**0**	**0**	**0**	**0**	**0**
3.5.1	Look for manholes and electric wires	0	+	0	0	0	0
3.5.2	Check the possibility of establishing the rotation field	0	0	0	0	0	0
3.5.3	Check the soil's weight-bearing capacity	0	0	0	0	0	0
3.6	**Unload the crane and components, if applicable**	**++**	**+**	**++**	**++**	**++**	**+**
3.6.1	Have the trailers approach at the appropriate location	0	+	0	0	+	+
3.6.2	Detach the components	+	+	0	0	+++	+
3.6.3	Unload using the crane	++	+	++	++	++	+
3.7	**Position the crane or the carrier part for assembly, if applicable**	**+**	**+++**	**++**	**++**	**+**	**+**

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TASK 3	**Assemble and install a mobile crane**						
3.8	**Delimit the crane's assembly area**	**0**	**0**	**0**	**0**	**0**	**0**
3.8.1	Determine a safe area	0	0	0	0	0	0
3.8.2	Install tape or barricades	0	0	0	0	+	+
3.9	**Assemble the crane's components**	**++**	**+++**	**0**	**0**	**+++**	**+**
3.9.1	Choose the assembly method	0	0	0	0	0	0
3.9.2	Install the counterweight(s), boom, block and, if applicable, the fly jib	++	+++	0	0	+++	0
3.9.3	Connect the pendants	+	+++	+	+	+++	0
3.10	**Visually check the assembly**	**++**	**++**	**0**	**0**	**+++**	**0**
3.10.1	Check stop limiter system connections	++	++	0	0	+++	0
3.10.2	Ensure that all pins are installed and locked	++	++	0	0	+++	0
3.11	**Raise the boom**	**+**	**+++**	**+**	**+**	**0**	**0**
3.11.1	Perform hosting manoeuvres	+	+++	+	+	0	0
3.11.2	Check that hoisting operations are proceeding well (detect potential jamming areas, ensure the correct position of block cables in pulleys)	+	+++	+	+	0	0
3.12	**Position the crane at the appropriate location, if applicable**	**+**	**+++**	**+**	**+**	**0**	**0**
3.12.1	Move the crane according to the signaller's instructions	+	+++	+	+	0	0
3.12.2	Level the crane	+	+++	+	+	0	0
3.12.3	Stabilize the crane for adequate and safe hoisting	+	+++	+	+	0	0
3.13	**Delimit the crane's operating area**	**0**	**0**	**0**	**0**	**0**	**0**
3.13.1	Determine the operating area	0	0	0	0	0	0
3.13.2	Place tape and barricades so as to cover the work area	0	0	0	0	0	0
3.14	**Check the operation of safety devices**	**+**	**+++**	**+**	**+**	**0**	**0**
3.15	**Enter parameters in the crane's computer, if applicable**	**0**	**+++**	**0**	**0**	**0**	**0**
3.16	**Extend the boom, if applicable**	**+**	**+++**	**+**	**+**	**0**	**0**
3.16.1	Raise the boom at maximum to prevent friction on the telescopic sections	+	+++	+	+	0	0
3.16.2	Extend the boom sections to the required length	+	+++	+	+	0	0

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TASK 4	**Move and install loads with a mobile crane**						
4.1	**Check the wind velocity and direction**	**0**	**0**	**0**	**0**	**0**	**0**
4.1.1	Check the permitted wind speed limit for hoisting, according to boom length	0	0	0	0	0	0
4.2	**Heat the crane's mechanical and hydraulic elements, if applicable**	**0**	**0**	**0**	**0**	**++**	**+**
4.2.1	Perform necessary manoeuvres for heating the components	0	+++	0	0	+	0
4.3	**Position the boom over the load**	**+**	**+++**	**+**	**+**	**0**	**0**
4.3.1	Communicate with the signaller	+	+++	0	0	0	0
4.3.2	Move the hook to the specified location	+	+++	+	+	0	0
4.4	**Check the computer's parameters, if applicable**	**0**	**0**	**0**	**0**	**0**	**0**
4.4.1	Ensure that there are no errors in the codes or parameters	0	0	0	0	0	0
4.4.2	Validate the data by measuring radiuses	0	0	0	0	0	0
4.5	**Consult the hoisting plan, if applicable**	**0**	**0**	**0**	**0**	**0**	**0**
4.5.1	Consult the plan provided by an engineer or draftsman and approved by the boss or client	0	0	0	0	0	0
4.6	**Provide or check the rigging equipment according to the load(s) to be hoisted**	**+**	**+**	**0**	**0**	**0**	**0**
4.6.1	Select shackles, slings and spacer beams	+	+	0	0	++	0
4.6.2	Check the condition of selected shackles, slings and spacer beams	+	+	0	0	+	0
4.6.3	Ensure the compliance of rigging capacity with the load to be hoisted	+	+	0	0	+	0
4.7	**Supervise the rigging**	**++**	**+**	**+**	**+**	**+**	**0**
4.7.1	Ensure that the equipment is used correctly	++	+	+	+	++	0
4.7.2	Check the quality of work done by the team	++	+	+	+	++	0
4.7.3	Ensure that the load is strongly secured	++	+	+	+	+++	0
4.8	**Attach the rigging equipment on a hook**	**++**	**+**	**++**	**++**	**+++**	**0**
4.8.1	Check the slings' crossing	++	+	++	++	++	0
4.8.2	Check sling overlaps	++	+	++	++	++	0
4.9	**Define the communication procedure**	**0**	**0**	**0**	**0**	**0**	**0**
4.9.1	Choose the means of communication	0	0	0	0	0	0
4.9.2	Ensure the mutual understanding of the means of communication between signaller and crane operator	0	0	0	0	0	0
4.10	**Hoist the load**	**+**	**+++**	**+++**	**+++**	**+**	**0**
4.10.1	Check boom deflection to remain within the operating area	+	+++	+++	+++	+	0
4.11	**Direct the load according to the signaller's instructions**	**+**	**+++**	**+++**	**+++**	**+**	**0**

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TASK 4	**Move and install loads with a mobile crane**						
4.12	**Deposit the load or keep it suspended during the installation, according to the signaller's instructions**	**+**	**+++**	**+++**	**+++**	**+**	**0**
4.12.1	While waiting for instructions, ensure that the crane is in a safe position	+	+++	+	+	+	0
4.13	**Retract the boom, if applicable**	**+**	**+++**	**+**	**+**	**+**	**0**
4.13.1	Raise the boom at maximum to prevent friction on sections to be retract	+	+++	++	++	+	0
4.13.2	Retract all sections	+	+++	+	+	+	0
4.14	**Apply the safety brakes and, if applicable, deactivate the controls**	**+**	**++**	**+**	**+**	**+**	**0**
4.14.1	Engage the dog and anti-rotation latch (or brake)	+	++	+	+	+	0
4.14.2	Disengage the main clutch	+	+	+	+	+	0
4.14.3	Turn the necessary electric switches on	+	+	+	+	+	0
4.14.4	Cut power to the master key	+	+	+	+	+	0
TASK 5	**Handle materials by means of a crane equipped with a clamshell or electromagnet**						
5.1	**Check equipment operation and maintain it, if applicable**	**+++**	**++**	**0**	**0**	**+++**	**0**
5.1.1	Put the appropriate cable on the crane according to the type of clamshell	+++	++	0	0	+++	0
5.1.2	Install the cable in the clamshell by connecting it to the clamshell's opening and closing system, if applicable	+++	++	0	0	+++	0
5.1.3	Check the condition of the cable, pulleys, attachment points and pivot points	++	++	0	0	+++	0
5.1.4	Perform necessary greasing operations	++	++	0	0	++	++
5.1.5	Check the teeth and lip for closing	++	++	0	0	+++	+
5.1.6	Check the attachment points, electric wire, generator and control	+++	++	0	0	+++	0
5.2	**Install the equipment to the crane**	**+++**	**++**	**0**	**0**	**+++**	**0**
5.2.1	Install the bin's corner closer and holder fasteners	+++	++	0	0	+++	0
5.2.2	Install the hook in the hoist link on the electromagnet	+++	++	0	0	+++	0
5.3	**Heat the crane's mechanical and hydraulic elements, if applicable**	**++**	**++**	**0**	**0**	**++**	**++**
5.3.1	Heat the friction strips	++	++	0	0	++	++
5.3.2	Heat the brake bands, if applicable	++	++	0	0	++	++

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TASK 5	**Handle materials by means of a crane equipped with a clamshell or electromagnet**						
5.4	**Delimit the work area**	**+**	**0**	**0**	**0**	**+**	**0**
5.4.1	Check ground conditions	+	0	0	0	0	0
5.4.2	Establish a safety zone	+	0	0	0	+	0
5.4.3	Install safety tape and cones to limit access	+	0	0	0	+	0
5.5	**Define the communication procedure**	**0**	**0**	**0**	**0**	**0**	**0**
5.5.1	Determine if the work is done visually or if it requires a signaller's assistance	0	0	0	0	0	0
5.5.2	Choose the means of communication with the signaller	0	0	0	0	0	0
5.6	**Transport materials to the appropriate location**	**+**	**+++**	**+++**	**+++**	**+**	**0**
5.6.1	Place the materials on the ground or on other transportation equipment	+	+++	+++	+++	+	0
5.7	**Apply the safety brakes and, if applicable, deactivate the controls**	**+**	**+**	**+**	**+**	**0**	**0**
5.7.1	Position the electromagnet on the ground	+	+	+	+	0	0
5.1.2	Turn the generator off	+	+	+	+	0	0
5.7.3	Position the clamshell	+	+	+	+	0	0
5.7.4	Disengage the controls	+	+	+	+	+	0
5.7.5	Apply the locking ratchet	++	+	+	+	+	0
5.7.6	Cut the engine and lock the crane	++	+	+	+	+	0
TASK 6	**Do foundation and support work**						
6.1a	**Heat the crane's mechanical elements**	**+**	**0**	**+**	**+**	**++**	**++**
6.1.1a	Make the traction and rotation friction strips slide	+	0	+	+	++	++
6.1.2a	Raise and lower the trowels four or five times	+	0	+	+	++	+
6.2a	**Install or check the hammer column and the accessories**	**++**	**+**	**+**	**+**	**+++**	**0**
6.2.1a	Install and check pins and counterpins	++	+	+	+	+++	0
6.2.2a	Grease the pulleys and fasteners	++	+	+	+	+++	0
6.2.3a	Install and check the lead column, hammers, caps and the foot	++	+	+	+	+++	0
6.3a	**Push in piles or sheet piles**	**+**	**++**	**++**	**++**	**0**	**0**
6.3.1a	Control the fall speed	+	++	++	++	0	0
6.3.2a	Apply standards for the number of strokes and the sinking depth at each stroke	+	++	++	++	0	0
6.4a	**Deposit the equipment on the ground, if applicable**	**+**	**++**	**+**	**+**	**0**	**0**
6.4.1a	Ensure that there are no obstacles on the ground or in the air	+	+	+	+	0	0

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TASK 6	**Do foundation and support work**						
6.5a	**Apply the safety brakes**	**+**	**+**	**+**	**+**	**0**	**0**
6.5.1a	Engage the locking ratchets of the boom and trowels	+	+	+	+	0	0
6.5.2a	Apply the rotation brakes (or latch)	+	+	+	+	0	0
6.1b	**Heat the crane's mechanical elements**	**+**	**0**	**+**	**+**	**++**	**++**
6.1.1b	Make the traction and rotation friction strips slide	+	0	+	+	++	++
6.1.2b	Raise and lower the trowels four or five times	+	0	+	+	++	+
6.2b	**Install or check the dynamic compaction equipment**	**++**	**+**	**+**	**+**	**+++**	**0**
6.2.1b	Install the corner fastener on the compaction equipment	++	+	+	+	+++	0
6.3b	**Compact the soil**	**+**	**++**	**++**	**++**	**0**	**0**
6.4b	**Deposit the equipment on the ground, if applicable**	**+**	**++**	**+**	**+**	**0**	**0**
6.4.1b	Ensure there are no obstacles on the ground or in the air	+	+	+	+	0	0
6.5b	**Apply the safety brakes**	**+**	**+**	**+**	**+**	**0**	**0**
6.5.1b	Engage the locking ratchets of the boom and trowels	+	+	+	+	0	0
6.5.2b	Apply the rotation brakes (or latch)	+	+	+	+	0	0
6.1c	**Heat the crane's mechanical elements**	**+**	**0**	**+**	**+**	**++**	**++**
6.1.1c	Make the traction and rotation friction strips slide	+	0	+	+	++	++
6.1.2c	Raise and lower the trowels four or five times	+	0	+	+	++	+
6.2c	**Install or check the bit equipment**	**++**	**+**	**+**	**+**	**+++**	**0**
6.2.1c	Install the corner fastener on the bit	++	+	+	+	+++	0
6.3c	**Operate the bit**	**+**	**++**	**++**	**++**	**0**	**0**
6.4c	**Deposit the equipment on the ground, if applicable**	**+**	**++**	**+**	**+**	**0**	**0**
6.4.1c	Ensure there are no obstacles on the ground or in the air	+	+	+	+	0	0
6.5c	**Apply the safety brakes**	**+**	**+**	**+**	**+**	**0**	**0**
6.5.1c	Engage the locking ratchets of the boom and trowels	+	+	+	+	0	0
6.5.2c	Apply the rotation brakes (or latch)	+	+	+	+	0	0
TASK 7	**Disassemble mobile cranes**						
7.1	**Retract the boom, if applicable**	**+**	**+++**	**+**	**+**	**0**	**0**
7.1.1	Retract the hydraulic boom	+	+++	+	+	0	0
7.1.2	Position the crane safely	+	+++	+++	+++	0	0
7.1.3	Disengage the main clutch	+	+++	+++	+++	0	0
7.2	**Delimit the location of disassembly**	**+**	**0**	**0**	**0**	**0**	**0**

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TASK 7	**Disassemble mobile cranes**						
7.2.1	Choose a safe location	+	0	0	0	0	0
7.3	**Position the crane at the appropriate location**	**+**	**+++**	**+++**	**+++**	**0**	**0**
7.3.1	Move the crane safely	+	+++	+++	+++	0	0
7.3.2	Stabilize the crane	+	+++	+++	+++	0	0
7.4	**Delimit the disassembly area**	**+**	**0**	**0**	**0**	**0**	**0**
7.4.1	Secure the work area	+	0	0	0	0	0
7.5	**Lower the boom**	**+**	**+++**	**++**	**++**	**0**	**0**
7.5.1	Place the boom at the designated location in the safety zone	+	+++	++	++	0	0
7.6	**Disassemble crane components**	**+++**	**+++**	**++**	**++**	**+++**	**0**
7.6.1	Disassemble the cable, stop limiter system, support pulley, electric wire	++	+++	++	++	+++	0
7.6.2	Disassemble the fly jib, if applicable, and the boom	++	+++	++	++	+++	0
7.6.3	Attach a cable to each section to be handled	+++	+++	++	++	+++	0
7.6.4	Disassemble counterweights, if applicable	+++	+++	++	++	+++	0
7.6.5	Position the mast in its support or dolly	++	+++	++	++	+++	0
7.6.6	Retract the stabilizers	++	+++	++	++	+++	0
7.6.7	Tighten the supports (plates)	++	+++	++	++	+++	0
7.6.8	Disassemble the fly jib and pendants, if applicable	++	+++	++	++	+++	0
7.6.9	Lower harness and remove pendants	++	+++	++	++	+++	0
7.6.10	Disassemble in the recommended order the pendants, the boom head and sections, and the counterweights	++	+++	++	++	+++	0
7.6.11	Position or close the gantry crane	++	+++	++	++	+++	0
7.6.12	Complete the crane disassembly	+++	+++	++	++	+++	0

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N°	Tasks and Operations	Fall from Height or from the Crane Platform	Contact with Overhead Electric Lines	Crane or Load Overturn	Sling Rupture	Moving Parts	Contact with Controlled Products (WHMIS)
TASK 8	**Perform preventive maintenance on a tower crane**						
8.1	**Check all crane components**	**++**	**+**	**0**	**0**	**+++**	**0**
8.2	**Lubricate mechanical components**	**++**	**+**	**0**	**0**	**+++**	**++**
8.3	**Check crane operation**	**++**	**+++**	**++**	**++**	**0**	**0**
8.3.1	Make basic movements with the crane	++	+++	++	++	0	0
8.3.2	Perform tests for each operation	++	+++	++	++	0	0
8.3.3	Check the gears' operation	++	+++	++	++	0	0
8.3.4	Make sure that frost has caused no damage (winter)	++	+++	++	++	0	0
8.4	**Report detected defects verbally and in writing**	**++**	**0**	**0**	**0**	**0**	**0**
8.4.1	Report mechanical and electrical failures	+	0	0	0	0	0
8.5	**Make minor repairs**	**+++**	**++**	**0**	**0**	**+++**	**++**
8.5.1	Replace fuses and windshield wipers	+++	++	0	0	++	++
8.6	**Keep the logbook up-to-date**	**0**	**0**	**0**	**0**	**0**	**0**
8.6.1	Indicate the type of crane	0	0	0	0	0	0
8.6.2	Provide information by checking the appropriate boxes	0	0	0	0	0	0
8.6.3	Report failures	0	0	0	0	0	0
8.7	**Clean the crane**	**++**	**+**	**+**	**+**	**++**	**++**
8.7.1	Clean the windows, cab and tower feet	++	+	+	+	++	++
TASK 9	**Transport a tower crane's components**						
9.1	**Consult the crane's installation plan**	**0**	**0**	**0**	**0**	**0**	**0**
9.1.1	Consult the plan developed by the engineer	0	0	0	0	0	0
9.1.2	Check crane components on the plan	0	0	0	0	0	0
9.2	**Plan the crane's transportation**	**0**	**0**	**0**	**0**	**0**	**0**
9.2.1	Choose the type of trailers according to component sizes	0	0	0	0	0	0
9.2.2	Estimate the number of trailers required for transportation	0	0	0	0	0	0
9.2.3	Ensure the sufficient capacity of the mobile crane used for loading the tower crane on trailers	0	0	0	0	0	0
9.3	**Gather necessary components for the work and check their condition**	**+**	**0**	**0**	**0**	**++**	**+**
9.3.1	Make sure that all tower crane parts and components are in good condition and operational	+	0	0	0	++	0
9.3.2	Check the tower bars, boom, counter boom, weld joints, etc.	+	0	0	0	++	0

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N°	Tasks and Operations	Fall from Height or from the Crane Platform	Contact with Overhead Electric Lines	Crane or Load Overturn	Sling Rupture	Moving Parts	Contact with Controlled Products (WHMIS)
TASK 9	**Transport a tower crane's components**						
9.4	**Load components on trailers**	**++**	**++**	**++**	**++**	**+++**	**0**
9.4.1	Follow the loading sequence	++	++	+	+	+++	0
9.4.2	Ensure that loading is completed	++	++	++	++	+++	0
9.4.3	Choose the appropriate mobile crane for the type of loading to be done	0	0	0	0	0	0
TASK 10	**Assemble and mount the tower crane by means of a mobile crane**						
10.1	**Delimit the crane's assembly area**	**0**	**0**	**0**	**0**	**+**	**0**
10.1.1	Make sure to have the necessary space for the mobile and tower cranes and for assembly operations	0	0	0	0	0	0
10.1.2	Place the tape to delimit the work area	0	0	0	0	+	+
10.2	**Unload components**	**++**	**+++**	**++**	**++**	**+++**	**0**
10.2.1	Make sure to have the necessary space for putting down the components to be unloaded	++	+++	++	++	+++	0
10.2.2	Select appropriate slings	++	+++	++	++	+++	0
10.2.3	Install a tagline on each item to handle	++	+++	++	++	+++	0
10.2.4	Fasten the sections and components safely	++	+++	++	++	+++	0
10.2.5	Block the load	++	+++	++	++	+++	0
10.2.6	Detach the load	++	+++	++	++	+++	0
10.2.7	Put the components on the ground while following the assembly order	++	+++	++	++	+++	0
10.3	**Erect tower sections**	**+++**	**+++**	**+++**	**+++**	**+++**	**0**
10.3.1	Fasten, raise and secure the tower's first section on the concrete base's anchors	+++	+++	+++	+++	+++	0
10.3.2	Fasten and raise the second section vertically and secure it (pins or nuts) on the first one	+++	+++	+++	+++	+++	0
10.3.3	Repeat the manoeuvre until the turntable is put in place	+++	+++	+++	+++	+++	0
10.4	**Assemble the turntable and mast, if applicable**	**+++**	**+++**	**+++**	**+++**	**+++**	**0**
10.4.1	Assemble and install footwalks and guardrails on the turntable	+++	+++	+++	+++	+++	0
10.5	**Install electrical accessories**	**+++**	**+++**	**+++**	**+++**	**+++**	**0**
10.5.1	Connect the electric cable that powers the crane, if applicable	+++	+++	+++	+++	+++	0
10.6	**Hoist and fasten the turntable and mast to the tower, if applicable**	**+++**	**+++**	**+++**	**+++**	**+++**	**0**
10.6.1	Fasten the load securely with a tagline	+++	+++	+++	+++	+++	0
10.6.2	Put the turntable in place	+	+++	+++	+++	+++	0
10.6.3	Install the mast	+	+++	+++	+++	+++	0

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N°	Tasks and Operations	Fall from Height or from the Crane Platform	Contact with Overhead Electric Lines	Crane or Load Overturn	Sling Rupture	Moving Parts	Contact with Controlled Products (WHMIS)
TASK 10	**Assemble and mount the tower crane by means of a mobile crane**						
10.7	**Assemble the main boom and the counter boom on the ground**	**+**	**+++**	**+++**	**+++**	**+++**	**0**
10.7.1	Fasten and move the boom base section	+	+++	+++	+++	+++	0
10.7.2	Place the boom base section on wood blocks and unfasten it	+	+++	+++	+++	+++	0
10.7.3	Insert the cart in the base boom section, if applicable	+	+++	+++	+++	+++	0
10.7.4	Fasten and assemble the next section at the end of the first one	+	+++	+++	+++	+++	0
10.7.5	Align the pin holes	+	+++	+++	+++	+++	0
10.7.6	Insert pins and counterpins	+	+++	+++	+++	+++	0
10.7.7	Repeat the steps until the boom is fully assembled	+	+++	+++	+++	+++	0
10.7.8	Assemble the pendants and fasten them on the mast	+	+++	+++	+++	+++	0
10.7.9	Assemble footwalks, guardrails and pendants for the counter boom, by means of the mobile crane	+	+++	+++	+++	+++	0
10.8	**Hoist and fasten the counter boom to the turntable**	**+**	**+++**	**+++**	**+++**	**+++**	**0**
10.8.1	Fasten the load with a tagline at the end of the counter boom	+	+++	+++	+++	+++	0
10.8.2	Raise the counter boom	+	+++	+++	+++	+++	0
10.8.3	Secure the counter boom to the turntable	+++	+++	+++	+++	+++	0
10.8.4	Link the pendants (or guys) at the top of the mast, if applicable	+++	+++	+++	+++	+++	0
10.9	**Install a counterweight to the counter boom, if applicable**	**+++**	**+++**	**+++**	**+++**	**+++**	**0**
10.10	**Hoist and fasten the main boom to the turntable**	**+++**	**+++**	**+++**	**+++**	**+++**	**0**
10.10.1	Fasten the boom and install a tagline	++	+++	+++	+++	+++	0
10.10.2	Raise the boom	++	+++	+++	+++	+++	0
10.10.3	Fasten the boom to the turntable	+++	+++	+++	+++	+++	0
10.10.4	Link the pendants (or guys) at the top of the mast	+++	+++	+++	+++	+++	0
10.11	**Install counterweights to the counter boom**	**+**	**+++**	**+++**	**+++**	**+++**	**0**
10.11.1	Fasten and assemble the counterweights	+	+++	+++	+++	+++	0
10.11.2	Assemble the counterweights one at a time or, if applicable, two at a time	+	+++	+++	+++	+	0
10.12	**Install the hoist cable and cart cable**	**+**	**+++**	**+++**	**+++**	**+++**	**0**
10.13	**Make a final inspection of all crane components**	**+++**	**+++**	**+++**	**+++**	**+**	
10.13.1	Ensure that all pins and counterpins are in place	+++	+++	+++	+++	+	
10.13.2	Tighten the tower's bolts, if applicable	+++	+++	+++	+++	++	

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N°	Tasks and Operations	Fall from Height or from the Crane Platform	Contact with Overhead Electric Lines	Crane or Load Overturn	Sling Rupture	Moving Parts	Contact with Controlled Products (WHMIS)
TASK 10	**Assemble and mount the tower crane by means of a mobile crane**						
10.14	**Adjust the limit switches**	**++**	**++**	**+++**	**+++**	**++**	**0**
10.14.1	Adjust the cart's limit switch on the boom	++	++	+++	+++	++	0
10.14.2	Adjust the hoist hook's limit switch	++	++	+++	+++	++	0
10.15	**Perform a load test**	**+**	**+++**	**+++**	**+++**	**+**	**0**
10.15.1	Hoist the heaviest concrete block	+	+++	+++	+++	+	0
10.15.2	Fasten the smallest concrete block to the largest one	+	+++	+++	+++	+	0
10.15.3	Hoist to one foot from the ground	+	+++	+++	+++	+	0
10.15.4	Adjust the rated capacity limiter so that it is triggered one foot from the ground	+	+++	+++	+++	+	0
10.15.5	Put the blocks on the ground	+	+++	+++	+++	+	0
10.16	**Adjust the overload protector**	**+**	**+++**	**+++**	**+++**	**++**	**0**
10.16.1	Apply manufacturer specifications	+	+++	+++	+++	++	0
10.17	**Hoist the tower, if applicable**	**+**	**+++**	**+++**	**+++**	**+**	**0**
TASK 11	**Move and install loads with a tower crane**						
11.1	**Check the wind velocity and direction as well as the temperature**	**0**	**0**	**0**	**0**	**0**	**0**
11.1.1	Consult the crane manufacturer's manual	0	0	0	0	0	0
11.1.2	Decide whether it is appropriate to stop operations while taking recommendations into account	0	0	0	0	0	0
11.2	**Define the communication procedure**	**0**	**0**	**0**	**0**	**0**	**0**
11.2.1	Choose the most effective procedure given the situation	0	0	0	0	0	0
11.2.2	Ensure that there is no interference between the crane operator and the signaller	0	0	0	0	0	0
11.3	**Make sure all systems are adjusted and operate correctly**	**+**	**+++**	**++**	**++**	**0**	**+**
11.3.1	Check the boom, hook, computer, retarder and motion limiters	+	+++	++	++	0	0
11.4	**Enter parameters in the crane's computer, if applicable**	**+**	**0**	**0**	**0**	**0**	**0**
11.5	**Position the boom over the load**	**+**	**+++**	**++**	**++**	**0**	**0**
11.5.1	Position the card above the load	+	+++	++	++	0	0
11.5.2	Follow the signaller's instructions	+	+++	++	++	0	0
11.6	**Ensure rigging quality**	**+**	**0**	**0**	**0**	**0**	**0**
11.6.1	Obtain information on the safety clip, slings, hook, chains and spacer beam	+	0	0	0	0	0
11.6.2	Check rigging identification plates	+	0	0	0	+	0
11.6.3	Ensure that the rigging is strong	+	0	0	0	+	0

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TASK 11	**Move and install loads with a tower crane**						
11.7	**Move and install the load according to the signaller's instructions**	**+**	**+++**	**+++**	**+++**	**0**	**0**
11.7.1	Define a work procedure	+	+++	0	0	0	0
11.7.2	Make sure there are no obstacles	+	+++	0	0	0	0
11.7.3	Make sure no one is in the hoisting area	+	+	0	0	0	0
11.7.4	Hoist the load (above the obstacles)	+	+++	+++	+++	0	0
11.7.5	Deposit the load at the prescribed location	+	+++	+++	+++	0	0
11.7.6	Raise the hook	+	+++	++	+++	0	0
11.8	**Turn the crane off**	**+**	**+++**	**+**	**+**	**0**	**0**
11.8.1	Raise the hook near the stop limiter	+	+++	+	+	0	0
11.8.2	Move the cart close to the tower	+	+++	+	+	0	0
11.8.3	Put the crane in free swing mode	+	+++	+	+	0	0
11.8.4	Press the stop switch	+	+++	+	+	0	0
TASK 12	**Disassemble a tower crane by means of a mobile crane**						
12.1	**Delimit the disassembly area**	**0**	**0**	**0**	**0**	**0**	**0**
12.1.1	Make sure to have sufficient space	0	0	0	0	0	0
12.1.2	Install safety cones and tape	0	0	0	0	0	0
12.2	**Retract the tower, if applicable**	**+**	**+++**	**+++**	**+++**	**0**	**0**
12.2.1	Check wind speed	+	0	+++	+++	0	0
12.2.2	Assemble the hoisting system near the turntable	+	+++	+++	+++	0	0
12.2.3	Obtain a concrete block to balance the crane (block test)	+	+++	+++	+++	0	0
12.2.4	Detach the section to be removed	+	++	+++	+++	0	0
12.2.5	Remove the section from the hoisting system	+	++	+++	+++	0	0
12.2.6	Retract the tower with the hydraulic cylinder	+	+++	+++	+++	0	0
12.2.7	Put the counterweight on the ground	+	+++	+++	+++	0	0
12.2.8	Lower the section that is outside the telescopic system	+	+++	+++	+++	0	0
12.2.9	Repeat the steps for all tower sections	+	+++	+++	+++	0	0
12.3	**Wind the trowel and cart cable, if applicable**	**+**	**++**	**+++**	**+++**	**++**	**0**
12.3.1	Detach the hook	+	++	+++	+++	++	0
12.3.2	Move the cart close to the tower, if applicable	+	++	++	++	0	0
12.3.3	Unlock the cart tensioner	+	++	++	++	++	0
12.3.4	Fasten the cart	+	++	++	++	++	0
12.3.5	Undo the cable	+	++	++	++	+++	0
12.4	**Remove the counter boom counterweights**	**+**	**+++**	**+++**	**++**	**++**	**0**
12.4.1	Remove one counterweight at a time with the mobile crane	+	+++	+++	+++	++	0

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TASK 12	**Disassemble a tower crane by means of a mobile crane**						
12.4.2	Lift each counterweight by one foot	+	+++	+++	+++	+	0
12.4.3	Remove counterpins and safety pins	+	+++	+++	+++	++	0
12.4.4	Remove each counterweight and lower it to the ground	+	+++	+++	+++	++	0
12.5	**Detach the main boom and lower it to the ground**	**+**	**+++**	**+++**	**+++**	**++**	**0**
12.5.1	Install a tagline	+	+++	+++	+++	++	0
12.5.2	Raise the boom	+	+++	+++	+++	0	0
12.5.3	Detach the pendant(s) (or guy(s))	++	+++	+++	+++	++	0
12.5.4	Release the pendant(s) (or guy(s)) on the boom	++	+++	+++	+++	++	0
12.5.5	Lower the boom to the necessary level for disassembly	++	+++	+++	+++	0	0
12.5.6	Remove counterpins and pins fastening the boom to the tower	++	+++	+++	+++	++	0
12.5.7	Lower the boom to the ground on wood blocks	++	+++	+++	+++	0	0
12.6	**Remove the last counterweight to the counter boom, if applicable**	**++**	**+++**	**+++**	**+++**	**+**	**0**
12.6.1	Lift the counterweight by one foot	++	+++	+++	+++	+	0
12.6.2	Remove counterpins and safety pins	++	+++	+++	+++	+	0
12.6.3	Extend the counterweight and lower it to the ground	++	+++	+++	+++	+	0
12.7	**Turn the tower crane off**	**++**	**+++**	**+++**	**++**	**0**	**0**
12.7.1	Turn off the main switch at the base of the tower	+	+++	+++	+++	0	0
12.7.2	Remove the fuses	+	+++	+++	+++	+	++
12.8	**Detach the counter boom and lower it to the ground**	**++**	**+++**	**+++**	**+++**	**++**	**0**
12.8.1	Install a tagline	+++	+++	+++	+++	++	0
12.8.2	Disconnect the wires that link the counter boom to the turntable	+++	+++	+++	+++	++	0
12.8.3	Raise the counter boom	++	+++	+++	+++	0	0
12.8.4	Detach the pendants (or guys) from the mast and release them on the counter boom	++	+++	+++	+++	++	0
12.8.5	Lower the counter boom to the necessary level for disassembly	++	+++	+++	+++	0	0
12.8.6	Remove counterpins and pins	++	+++	+++	+++	++	0
12.8.7	Lower the counter boom to the ground on wood blocks	++	+++	+++	+++	0	0
12.9	**Disassemble the counter boom, if applicable**	**+++**	**+++**	**+++**	**+++**	**+**	**0**
12.9.1	Remove the footwalks, if applicable	+++	+++	+++	+++	+	0
12.9.2	Lift the part to be separated	+++	+++	+++	+++	+	0

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TASK 12	**Disassemble a tower crane by means of a mobile crane**						
12.9.3	Place wood blocks under the part that remains on the ground	+++	+++	+++	+++	++	0
12.9.4	Remove counterpins and pins linking the two sections	++	+++	+++	+++	++	0
12.10	**Disassemble the main boom**	**++**	**+++**	**+++**	**+++**	**++**	**0**
12.10.1	Detach all pendants from the boom	++	+++	+++	+++	0	0
12.10.2	Lift one section at a time	++	+++	+++	+++	++	0
12.10.3	Remove counterpins and pins	++	+++	+++	+++	++	0
12.10.4	Disassemble the sections one by one	++	+++	+++	+++	++	0
12.10.5	Repeat for all the sections	++	+++	+++	+++	++	0
12.11	**Detach the mast and turntable and lower them to the ground**	**++**	**+++**	**+++**	**+++**	**++**	**0**
12.11.1	Fasten the mobile crane over the mast	++	+++	+++	+++	++	0
12.11.2	Remove counterpins and pins linking the mast to the turntable, and unfasten them if applicable	++	+++	+++	+++	++	0
12.11.3	Lower the mast to the ground	++	+++	+++	+++	0	0
12.11.4	Fasten the mobile crane over the turntable	++	+++	+++	+++	++	0
12.11.5	Remove pins fastening the turntable to the tower	++	+++	+++	+++	++	0
12.11.6	Lower the turntable to the ground	++	+++	+++	+++	0	0
12.11.7	Disassemble the turntable footwalks, if applicable	++	+++	+++	+++	++	0
12.12	**Disassemble the tower section by section**	**+++**	**+++**	**+++**	**+++**	**++**	**0**
12.12.1	Lower the main electric cable, if applicable	+++	+++	+++	+++	0	0
12.12.2	Fasten the mobile crane over the tower	+++	+++	+++	+++	++	0
12.12.3	Remove pins from the chosen section(s)	+++	+++	+++	+++	++	0
12.12.4	Lower the section(s) to the ground	+++	+++	+++	+++	0	0
12.12.5	Lay the section(s) on the ground	+++	+++	+++	+++	0	0
12.13	**Remove the anchor plates, if applicable**	**+++**	**+++**	**+++**	**+++**	**++**	**0**
12.13.1	Fasten the crane to one plate at a time	+++	+++	+++	+++	++	0
12.13.2	Unbolt the plates from the base	+++	+++	+++	+++	++	+