

Mobile Crane Operators Job Analysis Update

Final Report

Prepared for the
National Commission for the Certification of Crane Operators
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Introduction

The original job analysis for mobile crane operators was conducted in 1995-96 by Professional Examination Services (PES). Using the information derived from that job analysis, PES worked with subject matter experts selected by the National Commission for the Certification of Crane Operators (NCCCO) to develop test specifications for each of the NCCCO written examinations. These test specifications have remained in effect since 1996, with only minor modifications.

The National Commission for the Certification of Crane Operators (NCCCO) determined that it was time to update the job analysis study. International Assessment Institute (IAI), which has provided psychometric consultation and related testing services to NCCCO since January 2001, was asked to conduct the job analysis update. The update is being undertaken in accordance with the 1999 revision of the *Standards for Educational and Psychological Testing* (American Educational Research Association, the National Council on Measurement in Education and the American Psychological Association). The *Standards* emphasize the concept of content validity and state that the evidence should include a description of the major job characteristics that the test is meant to sample, including the relative frequency, importance and criticality of the elements. The job analysis is used to ensure that the knowledge assessed in credentialing initiatives is in fact limited to those required for competent performance and serve a public protection function. Job analysis becomes the primary basis by which a credentialing agency establishes and defends the content validity of its credentialing requirements.

Subject Matter Experts

The initial step was the appointment of a Job Analysis Task Force comprised of Subject Matter Experts. Essential considerations in determining the Subject Matter Expert panel were that they be recognized for their expertise in the field of crane operations, be knowledgeable regarding the various conditions under which crane operators work, and be representative both geographically and in terms of specialties, of operators within the crane industry. NCCCO and IAI determined that the most effective group to serve as Subject Matter Experts would be the combined membership of the Written Examination Management Committee (WEMC) and the Practical Examination Management Committee (PEMC).

SME Training

For logistical purposes, it was decided that meetings of the Job Analysis Task Force would be held concurrently with the regularly scheduled meetings of the WEMC and PEMC. The following meetings were held:

- San Antonio, Texas - October 28 - 29, 2003
- Dayton, New Jersey - June 17 - 19, 2003
- Portland, Oregon - August 25 - 27, 2003
- Richfield, Ohio - October 27 - 29, 2003
- Wilmington, North Carolina - February 17 - 19, 2004
- Concord, California - April 26 - 28, 2004

The initial activity at the first meeting held in San Antonio, Texas was a presentation by Anthony W. Mitchell, Pd.D. of International Assessment Institute. The presentation covered the important role job analysis plays in the examination development process, the concept of content validity and the methodology which would be followed in conducting the job analysis. The SME's discussed the scope of the job analysis that would be conducted and undertook training in the job analysis process.

To make the most effective use of time, the procedure used at Task Force meetings was to have a computerized data file of the working version of any item or document projected on a large screen. As decisions were made by the SME's, statements, documents or items were added to, modified or deleted.

Identification of Tasks, Knowledge, Skill and Ability Statements

SME's were provided with a copy of the 1995 job analysis survey form and a copy of the current content outline for the CCO written examinations. SME's were asked to review each of the knowledge statements in the original survey and identify whether that knowledge statement should remain in the survey, be modified or deleted. They were also asked to suggest task or knowledge statements that should be added to the new survey. Task Force members were specifically asked to identify skills and abilities required of a crane operator.

The original survey had not included skill and ability statements. The Task Force felt it was important for the updated survey to include skill and ability statements for three reasons:

- to provide a foundation for the CCO practical examination.
- to identify those skills and abilities that can most appropriately be tested through a practical examination.
- to recognize that operating a crane clearly requires "hands-on" skills and abilities for safe and competent practice.

Pilot Testing

A job analysis survey instrument is typically pilot tested to make sure that the instructions and the task, knowledge, skill or ability statements are clearly stated and easily understood. However, given the similarity of the updated job analysis survey instrument to the original survey instrument and given the extensive input from the relatively large Task Force, it was determined that it was not necessary to pilot the survey beyond that of the Task Force members.

Survey Distribution

Task Force members discussed the size of the survey sample and suggested methods of obtaining a satisfactory response level. It was determined that at least 300 survey responses should be obtained. International Assessment Institute mailed 310 survey forms to a random sample of CCO certified crane operators throughout the U.S. In addition, more than 500 surveys were distributed at CCO test sites. The test site coordinators were instructed to invite a small number of certification candidates, (some of whom were already certified and seeking recertification and others who were seeking initial certification) to complete the survey. Typically, no more than 10% of the candidates at a test site were invited to participate. The survey was also placed on the NCCCO website.

As of March 1, 2004, three hundred and seven (307) surveys had been returned and are included in the statistical analysis. Tabulation of the importance, frequency and criticality scores on each of the KSA statements was undertaken. The demographic information provided by the respondents was also tabulated and analyzed.

Demographic Information

An analysis of the demographic information demonstrates that a broad cross section of the mobile crane industry is represented in the survey results.

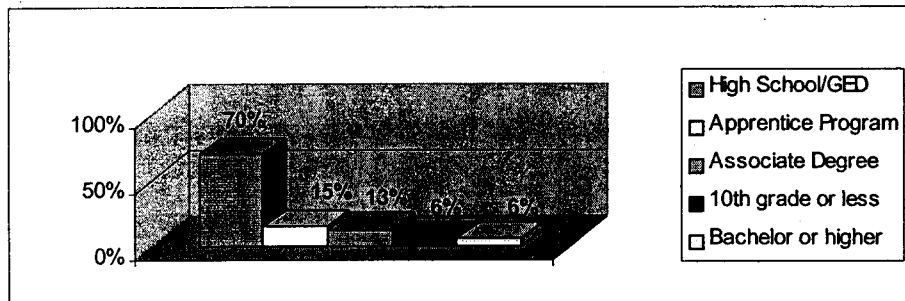
Certifications

Over half (52%) of the survey respondents were CCO Certified Crane Operators. Respondents who were currently CCO Certified Crane Operators were asked to identify in which specialties they are currently certified in:

- 62% were certified in Lattice Boom Crawler
- 58% were certified in Lattice Boom Truck
- 86% were certified in Large Telescopic
- 84% were certified in Small Telescopic

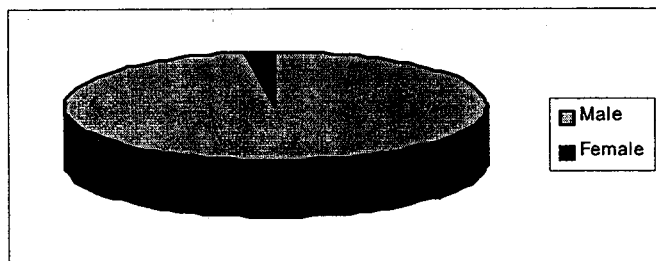
Education Level

The educational level of the Survey respondents was predominately High School/GED completion (70%). 21% had completed an Associate or Bachelors degree.



Gender

Gender representation was in line with expectations with 98% of respondents males and 2% females.



Job Analysis Results

The knowledge, skill and ability statements were presented in the survey in the four (4) content domains: Site, Operations, Technical Knowledge and Manufacturer's Load Charts.

In the survey instrument, Importance was described at four (4) levels:

1. Not Important - a lack of knowledge is unlikely to lead to accident or work disruption or a delaying of leaving work.
2. Somewhat Important - a lack of knowledge could lead to minor accident resulting in a work disruption or delay in completing the work.
3. Quite Important - a lack of knowledge could lead to a serious accident resulting in personal injuries or property damage.
4. Very Important - a lack of knowledge could lead to a serious accident resulting in a fatality or major property damage.

Respondents' were asked to circle 1,2,3, or 4 based upon on their expert judgement regarding the importance of each of the knowledge, skill or ability task statements.

In the survey instrument, Frequency was also described at four (4) levels:

1. Almost Never - maybe once a year.
2. Sometimes - at least monthly.
3. Quite Frequently - at least weekly.
4. Very Frequently - just about every day.

Respondents' were asked to circle 1,2,3, or 4 based upon their expert judgement regarding the frequency with which each of the knowledge, skill or ability statements is utilized in the job setting.

Appendix #2 shows the mobile crane survey results in terms of each of the knowledge, skill or ability statements. The number of respondents who selected 1,2,3,4 is identified. (For calculation purposes, the 1,2,3,4 was changed to 0,1,2,3.)

The updated job analysis survey contained sixty-seven (67) KSA statements. The Task Force discussed each statement to determine whether it should be included as part of the revised content outline.

- Thirty-six (36) statements were left unchanged,
- Eight (8) statements were deleted,
- Nineteen (19) statements were modified,
- Four (4) statements were moved to a different domain level.

The Task Force merged some statements in order to remove redundancies and deleted some statements where the KSA was either less important or where it did not add to the comprehensiveness of the content outline.

The following KSA statements were merged:

- K1.5 with K1.6
 - ▶ K1.5 - Know how to review planned operations and requirements with site supervision (i.e. signal person), to include determination of working height, boom length, load radius and travel clearance.
 - ▶ K1.6 - Know how to determine if there is adequate room for extension of crawlers or outriggers/stabilizers and counterweights.
 - ▶ Merged became K1.5 - Know how to review lift requirements with site supervision to include determination of working height, boom length, load radius, load weight, crane capacity, travel clearance, extension of crawlers or outriggers/stabilizers and counterweights.

- K1.4 with K1.7
 - ▶ K1.4 - Know how to identify and evaluate hazards associated with access to a construction site such as bridge clearance and grades.
 - ▶ K1.7 - Know how to identify site hazards such as boom interference and overhead and underground utilities.
 - ▶ Merged became K1.4 - Know how to identify and evaluate hazards associated with:
 - (a) access to job site.
 - (b) site hazards such as underground utilities.
 - (c) transportation clearances.

The following KSA statements were deleted:

- K2.4 - Know how to communicate at the site with management, crew and the signal person.
- K2.7 - Know how to react to changes in conditions that affect the safe operation of the crane.
- K3.4 - Know how to determine the manufacturer's recommended rope for the crane.
- K3.8 - Know the basics of machine power flow systems:

The revised content outline shows both the percentages and number of questions by content domain that will be on any given version of the Core examination. The revised content outline was approved by the Written Examination Management Committee at its meeting in Concord, California on April 29th, 2004.

CONTENT DOMAIN	PERCENTAGE	# OF QUESTIONS
Site	20% of exam	16 Questions
Operations	26% of exam	21 Questions
Technical Knowledge	28% of exam	22 Questions
Manufacturer's Load Charts	26% of exam	21 Questions

The Task Force was then asked to determine, based upon the changes made to the Core examination, whether what changes needed to be made in content outline for the specialty examinations. The Task Force determined that the current percentages for each of the content domains in the specialty examinations remains appropriate. Recommendations regarding changes to the CCO written examinations will be taken up by the CCO Written Examination Management Committee (WEMC). The revised content outline as it will appear in the CCO Candidate Handbook follows.

3. Know how to pick, carry, swing and place the load smoothly and safely on rubber tires and on outriggers/stabilizers or crawlers (where applicable).
4. Know proper procedures and methods of reeving all wire ropes and methods of reeving multiple part lines and selecting the proper load block and/or ball.
5. Know standard hand signals as specified in ASME B30.5.
6. Know how to shut down and secure the crane properly when leaving it unattended, based on manufacturer's recommendations in both normal and emergency conditions.
7. Know the manufacturer's recommendations for operating in various weather conditions and understand how environmental conditions affect the safe operation of the crane.
8. Know how to verify the weight of the load and rigging prior to initiation of the lift.
9. Know how to determine where the load is to be picked up and placed and how to verify the radii.
10. Know basic load rigging procedures.
11. Know how to perform daily maintenance and inspection.
12. Know how to use the following operator aids:
 - (a) LMI,
 - (b) anti-two block device,
 - (c) boom angle indicator,
 - (d) rated load indicator,
 - (e) boom length indicators
13. Know which operations reduce crane capacity or require specific procedures or skill levels such as:
 - (a) multi-crane lifts,
 - (b) suspended personnel platforms,
 - (c) duty cycle operations,
 - (d) barge operations.
14. Know the proper procedures for operating safely under the following conditions:
 - (a) traveling with suspended loads,
 - (b) approaching two-blocking,
 - (c) operating near electric power lines,
 - (d) using suspended personnel platform,
 - (e) lifting loads from beneath the surface of the water,
 - (f) using various approved counterweight configurations,
 - (g) handling loads out of the operator's vision ("operating in the blind"),
 - (h) using electronic communications techniques, such as radios,

- (g) hook blocks and overhaul balls
- 5. Know the limitations of protective measures against electrical hazards.
- 6. Know the effects of load share and load transfer in multi-crane lifts.
- 7. Know the significance of the instruments, gauge readings and machine power systems.
- 8. Know the requirements of pre-operational inspections and maintenance.
- 9. Know the uses and limitations of all operational devices/aids.
- 10. Know how to calculate net capacity for the crane configuration using the applicable manufacturer's load chart.
- 11. Know how to use manufacturer-approved attachments and their effect on the cranes operation.
- 12. Know the principles of backward stability.
- 13. Know the effects of thermal expansion and contraction in hydraulic cylinders.

Domain 4: Manufacturer's Load Charts

- 1. Know the terminology necessary to use load charts.
- 2. Know how to ensure that the load chart is the appropriate chart for the machine in its particular application.
- 3. Know how to use capacity load charts. This includes knowing:
 - (a) the operational limitations of load charts and footnotes
 - (b) the difference between structural capacity and capacity limited by stability
 - (c) what is included in load chart capacity
 - (d) the range diagram and its relationship to the load chart
 - (e) the work area chart and its relationship to the load chart
 - (f) where to find and how to use the "parts-of-line" information
 - (g) the safe working load of hoist line
- 4. Know how to use the load chart together with the load indicators.

OPERATIONS

The skills and abilities defined within the content domain of Operations were all found to be included and tested as part of the practical examination for mobile crane operators.

Critically Score	Skill Ability Statement	Task Force Action Taken
7.72	SA2.21 - Ability to control load, empty hook.	This is tested in practical examination Tasks 1, 2 and 3.
8.03	SA2.22 - Ability to judge distances and clearances.	This is tested in practical examination Tasks 1, 3 and 4.
7.49	SA2.23 - Skill to regain control after loss of control.	The next three statements are inherent and integrated skills within all of the practical examination tasks.
7.96	SA2.24 - Ability to demonstrate hand, eye, and foot control.	
7.78	SA2.25 - Ability to maintain patience and composure in a stressful condition.	
8.31	SA2.26 - Ability to receive and properly execute standard hand signals.	This is tested in practical examination Task 2 - Hand Signals.
7.82	SA 2.27 - Ability to swing, hoist and boom at same time.	This is tested in practical examination in Tasks 1, 3 and 4.

TECHNICAL KNOWLEDGE

Critically Scores	Skill Ability Statement	Task Force Action Taken
6.82	SA3.20 - Ability to adapt to control characteristics of an unfamiliar crane in a reasonable amount of time.	This is covered as part of the fifteen minute familiarization period which each candidate is provided.
5.98	SA3.21 - Ability to drive a crane with/without dolly.	This was excluded from the content outline for logistical reasons and because it is frequently not the operators responsibility to drive the crane.