

THE METROLOGY JOB DESCRIPTION INITIATIVE NCSLI AND ASQ PARTNERING FOR THE FUTURE

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Talk to almost any person involved in the Metrology profession about new talent entering the profession and you will probably get the same response, “there are not enough young people entering the field to replace the many baby boomers getting ready to retire”. At the heart of this alarming observation is the lack of Metrology awareness amongst young adults poised to make career decisions which will in many cases determine their lifelong profession. To assist young adults in making well informed career decisions, educators frequently reference U.S. Department of Labor publications in order to provide information about professions as well as forecasts about future job growth. This paper will discuss the efforts of NCSLI and ASQ’s Measurement Quality Division (MQD) to increase awareness of the Metrology profession and thereby increase the likelihood young adults will pursue a career in Metrology.

STANDARD OCCUPATIONAL CLASSIFICATION SYSTEM

In 1999, at the prompting of ASQ Fellow Philip Stein, I initiated an effort to create a certification for calibration practitioners known as the Certified Calibration Technician (CCT) program. In preparation for presentation of the CCT program proposal to ASQ’s Certification Board I researched several publications and queried various industry related websites in order to extract information as to the number of folks in the calibration field who would be likely candidates to take the CCT exam (one of the prerequisites for the creation of an ASQ certification is that there is sufficient evidence of eligible candidates in the field for the proposed certification). I quickly became aware that information concerning Metrology occupation demographics was either non-existent or extremely fragmented. My research led me to the U.S. Department of Labor and Statistic’s Standard Occupational Classification (SOC) system, the most referenced source for occupation demographics. Visiting the SOC website I found that the SOC did not have specific job titles for Calibration Technician (Technician, Calibration), Calibration Engineer (Engineer, Calibration) and that job descriptions for job titles closely related to them were inaccurately communicating job expectations. In addition, the job title of Metrologist, though listed in the SOC, referenced a grossly inadequate job description.

I was able to estimate ‘ballpark’ demographics for the aforementioned job titles as qualified by expert opinion from senior calibration managers from industry and governmental agencies as well as NCSLI and ASQ MQD constituents for my CCT program proposal. During the course of compiling information from the SOC I learned that the Bureau of Labor Statistics would be soliciting input for updating the SOC in 2005 with a planned formal release in 2010. The last SOC update was completed in 2000.

I decided that something must be done to correct this disparity and that it would take the support of the U.S. Metrology community to do it.

STANDARD OCCUPATIONAL CLASSIFICATION (SOC) SYSTEM

The following is from the U.S. Department of Labor's SOC website at <http://stats.bls.gov/soc/home.htm>

'The Standard Occupational Classification (SOC) system is used by Federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of over 820 occupations according to their occupational definition. To facilitate classification, occupations are combined to form 23 major groups, 96 minor groups, and 449 broad occupations. Each broad occupation includes detailed occupation(s) requiring similar job duties, skills, education, or experience.'

The SOC Users Guide denotes:

The 2000 Standard Occupational Classification (SOC) System was developed in response to a growing need for a universal occupational classification system. Such a classification system allows government agencies and private industry to produce comparable data. Users of occupational data include government program managers, industrial and labor relations practitioners, students considering career training, job seekers, vocational training schools, and employers wishing to set salary scales or locate a new plant. It is used by federal agencies collecting occupational data, providing a means to compare occupational data across agencies. It is designed to cover all occupations in which work is performed for pay or profit, reflecting the current occupational structure in the United States.

From my research I knew the SOC's current job descriptions for calibration practitioners were inadequately communicating job expectations. Without accurate job descriptions in the SOC it is unlikely that prospective candidates would be steered into the Metrology field by educators. In addition, demographic information, such as how many folks are in the Metrology profession, how many folks are leaving the profession, etc., could not be accurately determined.

I contacted U.S. Department of Labor employees to better understand how the SOC was updated and used. I learned administrators responsible for the Bureau of Labor Statistics' Occupational Outlook Handbook use the SOC as a guide for directing their efforts. The Occupational Outlook Handbook is a nationally recognized source of career information, providing valuable assistance to individuals making decisions about their future work lives. The Occupational Outlook Handbook describes what workers do on the job, working conditions, the training and education required, average earnings as well as expected job prospects in a wide range of occupations. One SOC administrator suggested updating the SOC would be the first logical step to amend the Occupational Outlook

Handbook so that it accurately depicts calibration practitioner occupation information and associated demographics. The Occupational Outlook Handbook is revised every two years. The current 2006-7 edition was compiled based on 2000 SOC information.

INITIATIVE PROPOSAL

In early 2004 I presented a proposal I called the Metrology Job Description (MJD) initiative to the NCSLI Board of Directors and ASQ MQD officers. The proposal contained the following key elements:

1. Compile job descriptions from the U.S. Metrology / calibration industry for calibration Technicians, Calibration Engineers and Metrologists
2. Identify topics of commonality derived from submitted job descriptions for Calibration Technician, Calibration Engineer and Metrologist
3. Develop survey items for soliciting input on topics of commonality from U.S. Metrology calibration industry regarding applicability, agreement, etc.
4. Send out survey
5. Compile and summarize survey results
6. Generate 3 to 5 sentence descriptive narratives i.e. job descriptions, from survey results to submit to the 2005 SOC for Calibration Technician, Calibration Engineer and Metrologist

The NCSLI Board of Directors and ASQ MQD officer unanimously approved the proposal. NCSLI created the 163.1 sub-committee, Working Group on Standard Occupation Classifications, under the auspices of NCSLI Education and Training Committee to oversee the initiative. ASQ MQD officers agreed to fund the initiative (administration costs). The 163.1 sub-committee members, hereby referred to as the core team, were selected from NCSLI and ASQ MQD constituents;

- Jay Bucher – Promega Corporation
- Christopher L. Grachanen (Project Leader) - Hewlett-Packard Company
- Shawn B Mason - St. Jude Medical
- Gloria J Neely – US Navy, Naval Surface Warfare Center
- Graeme C. Payne - GK Systems, Inc.
- Don Ruth - US Army TMDE
- Howard Zion – Transcat

The proposal was submitted to Professional Examination Services (PES) of New York, NY for administration. PES was chosen based upon a proven track record of success, having been instrumental in administering the job analysis survey during the creation of ASQ's Certified Calibration Technician (CCT) program. After contacting PES with the proposal they agreed with the concept and submitted the following roadmap:

Step 1. Solicit job descriptions

PES will work with the project leader to identify parameters for soliciting job descriptions from the U.S. metrology/calibration industry for three specific titles:

Calibration Technician, Calibration Engineer, and Metrologist. The project leader will disseminate the request for job descriptions. PES will review the submitted descriptions and select up to 25 for each job title, such that they provide broad representation of the metrology/calibration industry in terms of organization type, geographic representation, organization size, etc. If additional job descriptions are needed to fill categories of representation, the project leader will solicit targeted descriptions.

Step 2. Identify commonalities and differences in job descriptions

PES will analyze the selected job descriptions to identify commonalities and differences in the descriptions for Calibration Technician, Calibration Engineer, and Metrologist. PES will prepare a draft summary of the job elements for the three positions and distribute it via e-mail to the core team for review and comment. PES will work with the project leader to finalize the job elements.

Step 3. Develop and pilot test survey

PES will develop and pilot test a brief web-based survey instrument including job elements that may be specific to Calibration Technicians, Calibration Engineers, and Metrologists in order to solicit input from industry representatives regarding the job elements. Ratings for the job elements might focus on uniqueness to Metrology and by whom they are performed. The survey will also contain a demographic background questionnaire and an open-ended comments section. PES recommends that members of the core team nominate individuals to participate in the survey pilot test.

Step 4. Disseminate survey

PES will disseminate a link to the online survey to a sample not to exceed 1000. The project leader will be responsible for providing PES with the e-mail addresses of the survey sample. PES will consult with the project leader to identify the participants.

Step 5. Analyze survey data

PES will compile and summarize the survey results and present them to the core team for review and comment.

Step 6. Generate job descriptions

PES will create 3 to 5 sentence descriptive narratives (i.e. job descriptions) from survey results to submit to the 2005 SOC for Calibration Technician, Calibration Engineer, and Metrologist. PES will circulate the descriptions to the core team for review and comment and incorporate their feedback into revised job descriptions as appropriate.

PES's roadmap proposal was accepted by the core team and work on the first step of the MJD initiative commenced.

METROLOGY JOB DESCRIPTION SURVEY

The first step in the MJD initiative roadmap required collecting job requirements from industry, academia and government agencies in order to determine commonality for the occupations of Calibration Technician, Calibration Engineer, and Metrologist. To this end Craig Gulka, NCSLI's business manager, sent a broadcast e-mail to NCSLI constituents soliciting job descriptions for Calibration Technician, Calibration Engineer and Metrologist. The same was sent by ASQ headquarters to ASQ MQD constituents. The e-mails requested that job descriptions be sent electronically to PES administrators.

Within a few weeks hundreds of jobs descriptions had been collected from calibration professionals throughout the U.S. These job descriptions were used to identify topics of commonality which became the basis of a test survey. Once the test survey was tweaked and approved by the core team, an open invitation was sent to NCSLI and ASQ MQD constituents to take the survey. Over 600 calibration professionals throughout the U.S. participated in the survey. These results were then reviewed and summarized by PES as follows:

I. Education and Experience Requirements¹

Calibration Technician

Education: Technical school or military (PMEL)
training Experience: 0 to 2 years

Required skills and abilities:

- Determine the kind of measurement tools and equipment needed to do a job.
- Perform routine maintenance and calibration on equipment and determine when and what kind of calibration and maintenance is needed.
- Use mathematics to solve measurement related problems.
- Conduct tests and inspections of products, services, or processes to evaluate quality or performance.
Determine causes of measurement errors and decide what to do about it.
- Choose the right mathematical methods or formulas to solve a problem.
- Apply measurement science principles to specific problems to produce answers that make sense.
- Recognize when a measurement is wrong or is likely to go wrong.

Calibration Engineer

Education: Associate's or Bachelor's Degree
Experience: 3 or more years

¹ For all positions, years of experience can be substituted for education.

Metrologist

Education: Bachelor's degree or military (PMEL) training

Experience: 5 or more years

II. Essential Knowledge and Desired Knowledge²

Calibration Technician

Essential Knowledge	Desirable Knowledge
Algebra	Trigonometry
Basic computer skills	Electronics – advanced (circuit analysis)
Electronics – basic	Measurement sciences

Calibration Engineer

Essential Knowledge	Desirable Knowledge
Algebra	Trigonometry
Basic computer skills	Calculus
Electronics – basic	Computer programming
Measurement sciences	Physics
Statistics – basic	Electronics – advanced (circuit analysis)
Technical writing	Engineering – electrical
Quality Management Systems (ISO 9000 Series)	Engineering – mechanical
	Statistics – advanced (ANOVA, DOE, gage R & R)

Metrologist

Essential Knowledge	Desirable Knowledge
Algebra	Analytic Geometry
Basic computer skills	Physics
Electronics – basic	Electronics – advanced (circuit analysis)
Measurement sciences	Geometric dimensioning and tolerancing
Statistics – basic	
Technical writing	
Quality Management Systems (ISO 9000 Series)	

² Essential knowledge was selected by >65% of survey respondents, desirable knowledge was selected by 51 – 65% of survey respondents.

III. Essential Responsibilities for Calibration Technicians, Calibration Engineers, and Metrologists

Responsibility	Calibration Technician	Calibration Engineer	Metrologist
1. Calibrate inspection, measurement, and test equipment (IM&TE) in one of the following disciplines - electrical, dimensional, optical, physical/mechanical, chemical - in order to ensure compliance with published specifications.	•	•	•
2. Maintain primary and/or intrinsic calibration standards.	•	•	•
3. Maintain secondary and/or working calibration standards.	•	•	•
4. Develop calibration procedures and methods, according to detailed specifications, blueprints, drawings, and other technical requirements.		•	•
5. Collect, compile, measure, summarize, and record data gathered during calibration.	•	•	•
6. Analyze measurement data for identifying abnormalities, trends and/or predicting future values.	•	•	•
7. Identify IM&TE out-of-tolerance conditions and perform corrective action via adjustments, component replacement, correction factors, etc.	•	•	•
8. Identify and correct measurement errors, as applicable.	•	•	•
9. Prepare calibration reports and certificates.	•	•	•
10. Inspect and evaluate new calibration standards for proper operation before releasing to calibration laboratory.		•	•
11. Recommend IM&TE for use in measurement applications.	•	•	•
12. Recommend standards for use in calibration applications.		•	•
13. Adapt existing calibration equipment, standards, and techniques to accomplish unique measurements tasks for which they are not principally used.	•	•	•

Responsibility	Calibration Technician	Calibration Engineer	Metrologist
14. Apply engineering knowledge to the design and development of calibration methods, fixtures, and IM&TE not commercially available.		•	•
15. Develop, document, and maintain calibration systems and procedures, based on principles of measurement science, technical analysis of measurement problems and accuracy and precision requirements.		•	•
16. Perform uncertainty evaluation and analysis for measurement standards and associated measurement processes.		•	•
17. Design and document measurement reference material for laboratory use.		•	•
18. Conduct technical audits of the calibration laboratory to verify traceability of standards and compliance with published standards and guidelines.		•	•
19. Develop software for calibrating IM&TE.*		•	•
20. Develop software for the maintenance of calibration standards.*		•	•
21. Develop, implement, and maintain the calibration laboratory's quality systems per published standards and guidelines.		•	•
22. Train subordinates in calibration concepts and procedures.	•	•	•
23. Perform technical assessments for personnel performance reviews.		•	•
24. Perform laboratory housekeeping.	•	•	•
25. Maintain laboratory recognition/accreditation.	•	•	•
26. Provide technical advice to other departments of the organization.	•	•	•

* May be performed, but not in all positions.

IV. Extent to Which Knowledge is Required³ for Entry-Level Calibration Technicians, Calibration Engineers, and Metrologists

Knowledge	Calibration Technician	Calibration Engineer	Metrologist
Algebra	•	•	•
Trigonometry	•	•	•
Analytic geometry	•	•	•
Calculus		•	•
Basic computer skills (word processing, spreadsheets)	•	•	•
Computer programming		•	•
Physics	•	•	•
Electronics – basic	•	•	•
Electronics – advanced (circuit analysis)	•	•	•
Engineering – electrical		•	
Engineering – mechanical		•	•
Engineering – systems			
Measurement sciences	•	•	•
Geometric dimensioning and tolerancing	•	•	•
Statistics – basic	•	•	•
Statistics – advanced (ANOVA, DOE, gage R & R)		•	•
Technical writing	•	•	•
Quality Management Systems (ISO 9000 Series)	•	•	•

³ Grey indicates 35% to 55%, 51% to 65% for light blue, and greater than 65% for red of respondents indicating that the knowledge is essential at entry level.

METROLOGY JOB DESCRIPTIONS

Upon completing summarization of the results of the Metrology job description survey, PES started the task of writing brief job descriptions for Calibration Technician, Calibration Engineer and Metrologist based on the summarized data. Draft descriptions were sent to the core team for review. Suggestions / recommendations from the core team were incorporated into the draft job descriptions as applicable. The finalized job descriptions were submitted to the SOC for inclusion, along with a brief narrative describing how these descriptions were developed from industry, academia and governmental agencies input, is as follows:

Calibration Technician

Apply knowledge of measurement science, mathematics, physics, and electronics to calibrate inspection, measurement, and test equipment (IM&TE) in the electrical, dimensional, optical, physical, mechanical, environmental, and/or chemical disciplines to ensure measurement accuracy. Identify and utilize appropriate measurement procedures. Perform corrective actions to address identified measurement problems. Adapt equipment, standards, and procedures to accomplish unique measurements. Maintain calibration standards. Perform laboratory and/or departmental housekeeping.

Calibration Engineer

Apply measurement science, mathematics, physics, and engineering to design and develop systems, equipment, and methods for calibrating electrical, dimensional, optical, physical, mechanical, environmental, and/or chemical inspection, measurement, and test equipment (IM&TE). Analyze and solve calibration problems using advanced mathematical and engineering knowledge. Use statistics to analyze measurement standards and processes. May develop software to assist in calibration laboratory and/or departmental processes. Recommend calibration standards and IM&TE. Maintain calibration laboratory and/or quality systems. Perform laboratory and/or departmental administration and management.

Metrologist

Apply measurement science, mathematics, and physics to develop, document, and maintain calibration systems, procedures, and methods for electrical, dimensional, optical, physical, mechanical, environmental, and/or chemical inspection, measurement, and test equipment (IM&TE) based on analysis of measurement problems, and accuracy and precision requirements. Evaluate new calibration methods and procedures. Use statistics to analyze measurement standards and processes. Recommend calibration standards and IM&TE. Maintain calibration laboratory and/or departmental accreditation, and quality systems. Perform laboratory and/or departmental administration and management.

I would like to thank the members of the MJD initiative core team, ASQ MQD officers, Georgia Harris and the good folks at PES for their help and support. I especially would like to acknowledge the inspiration and vision of the late Phil Stein whose wisdom and mentoring motivated me to pursue the CCT program development and subsequently the MJD initiative.