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Multifamily Quality Control Inspector Job/Task Analysis and Report

September 2013

Corina M. Owens, Ph.D.
Professional Testing Inc.
Orlando, Florida

NREL Technical Monitor: Christina Larney

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Subcontract Report
NREL/SR-7A40-60537
September 2013

Contract No. DE-AC36-08GO28308

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This publication received minimal editorial review at NREL.

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Project Overview

The U.S. Department of Energy (DOE) Weatherization Assistance Program (WAP) and the National Renewable Energy Laboratory (NREL) have developed the Guidelines for Home Energy Professionals (Guidelines) project to support and promote high-quality energy upgrade work within the WAP.

The development of job/task analyses (JTAs) is one of three components of the Guidelines project and will allow industry to leverage these components to develop training resources, quality assurance protocols, accredited training programs, and professional certifications. The development of these foundational materials for the WAP, and for the home performance industry, will facilitate a growing, skilled home energy upgrade workforce that is able to meet the increasing demand for energy upgrade work while maintaining quality assurance for homeowners and employers.

NREL secured the services of Professional Testing, Inc. to develop JTAs and specifically to identify and catalog all of the tasks performed by individuals in each of the multifamily-specific job categories listed below, as well as the knowledge, skills, and abilities (KSAs) needed to perform the identified tasks.

- Multifamily Energy Auditor
- Multifamily Building Operator
- Multifamily Retrofit Project Manager
- Multifamily Quality Control Inspector

This report describes the JTA development process, provides a summary of the JTA validation study and an analysis of the study data, and contains a content outline and "developing a curriculum" (DACUM) chart for multifamily quality control inspectors.

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Introduction

Job/task analysis (JTA) is a procedure for analyzing the tasks performed by individuals in an occupation, as well as the knowledge, skills, and abilities (KSAs) necessary to perform those tasks. Specifically, a JTA can be defined as "any systematic procedure for collecting and analyzing job-related information to meet a particular purpose" (Raymond 2001, p. 372).

The use of JTAs (also known as job analysis, task analysis, practice analysis or role delineation) to define the content domain is a critical component in establishing the content validity of a training or examination program. Content validity refers to the extent to which the domain outline of the training or examination program overlaps with the important components (i.e.. KSAs) of a job.

A well-defined JTA includes participation by a representative group of subject matter experts (SMEs) who reflect the diversity within the job. Diversity refers to regional or job context factors and to SME factors, such as years of experience and education. Demonstration of content validity is accomplished through the practical experience of industry professionals and SMEs. The process is enhanced by the inclusion of larger numbers of industry professionals and SMEs who represent the diversity of the relevant areas of expertise via a validation study.

JTAs can be used for multiple purposes, including, but not limited to, job description, job classification, job evaluation, performance appraisal, training, worker mobility, workforce planning, efficiency, safety, and legal and quasi-legal requirements (Brannick et al. 2007). Job analyses are traditionally used by secondary and post-secondary educators, business or industry trainers, government or military trainers, and test developers. Although there are multiple methods for conducting JTAs, this project used the "developing a curriculum" (DACUM) method.

DACUM is an occupational analysis led by a trained facilitator, in which practitioners and SMEs in a specific occupation come together for a multiday workshop to provide input about the specific tasks, knowledge, and skills needed to perform their job. Modified small-group brainstorming techniques are used to obtain the collective expertise and consensus of the group. DACUM has proven to be a very effective method of quickly determining, at relatively low cost, the competencies or tasks that must be performed by persons employed in a given job or occupational area.

The DACUM chart that results from the DACUM analysis is a detailed portrayal of the skills and competencies involved in the occupation being studied. The DACUM analysis can be used as a basis for various aspects of education, training, and certification programs, including curriculum development, student learning, training needs assessments, worker performance evaluations, and competency test development.

Process for Selecting Subject Matter Experts

Professional Testing helped to establish the criteria for selecting the panel of SMEs and practitioners. Active practitioners and SMEs interested in participating in the study were invited to submit their credentials through a publicly announced online submission process. To be

eligible for participation in the JTA workshop, applicants had to be current, active practitioners and available to attend the entire workshop session in person.

A total of 136 applications were received for participation in the multifamily JTA workshops and of these, 126 were qualified as current practitioners in the multifamily energy upgrade industry. When applying, applicants provided rankings as to which job designation they preferred most and each applicant was considered for up to two JTA workshops. A total of 47 applicants were considered for the multifamily quality control inspector JTA workshop.

To create a representative panel of participants, Professional Testing, Inc. used specific ranking criteria including:

- Geographic (including regional/climatic) diversity
- Representation of a wide range of experience levels (novice to expert)
- No single organization or organization size dominated the group
- All sectors were represented with no single sector dominating (public versus private)
- Diversity of industry-related credentials, represented by the panelists.

Twelve applicants meeting the above criteria and with the highest rankings were selected to attend the multifamily quality control inspector JTA workshop.

A copy of the opportunity announcement that solicited applications for the multifamily JTA workshops is included in Appendix A.

Methods

Overview of Job Analysis Process

A job analysis or practice analysis is a foundational requirement of any valid credentialing program; it helps define the core knowledge areas, critical work functions, and skills that are common across a representative sampling of current practitioners or job incumbent workers. Empirical results from the job analysis provide examinees and the public the basis of a valid, reliable, fair, and realistic assessment that reflects the KSAs required for competent job performance. For existing credentials, a job analysis should be performed periodically to maintain the validity of the content on the exam.

Professional Testing, Inc. conducted a JTA workshop with a group of twelve SMEs to identify the duties, tasks, steps, and essential knowledge, skills, and attributes associated with the job performed by a multifamily quality control inspector.

Following the JTA workshop, Professional Testing, Inc. developed an online study to validate the initial results of the study and finalize a content outline. The online validation study was started by 53 participants and completed by 43 multifamily quality control inspectors across the United States.

Job/Tasks Analysis Workshop

The multifamily quality control inspector JTA workshop was held in Lakewood, Colorado, May 15–17, 2013.

The first day of the workshop consisted of an introduction to the DACUM process. A trained DACUM facilitator explained the JTA process and provided the SME panel with duty and task statement definitions. A duty reflects a large area of work for a specific profession; multiple tasks describe how to perform each duty.

The DACUM Philosophy

- **Practitioners can describe and define their jobs more accurately than anyone else.**
- **One of the most effective ways to define a job is to describe the tasks that practitioners perform.**
- **All jobs can be effectively and sufficiently described in the terms of the tasks that successful workers perform.**
- **All tasks, to be performed correctly, demand certain knowledge, skills, abilities, attributes, and tools.**

The introduction was followed by a discussion about multifamily quality control inspectors, more specifically the "who, how, what, and why" of the profession. The SME panelists compiled this information into a comprehensive list to capture key multifamily quality control inspector job components.

The next step was to identify duty (or domain) areas. The SME panelists identified duty areas, and facilitators wrote the duty areas on large index cards and placed them on a wall for the whole group to see. Once panelists reached consensus on the duty areas, they delineated each duty by identifying the required tasks. After all the tasks were identified, they were ordered sequentially and entered onto a spreadsheet.

On the second day of the workshop, the facilitators projected a spreadsheet that contained the identified duty areas and corresponding task statements. The facilitators asked the SMEs, while looking at the projected task list, to list the steps that occur under each task and to identify the KSAs, tools, equipment, and resources required to perform each task. This component of the job analysis process occupied the majority of time on the second day.

On the last day of the workshop, the SMEs finalized the remaining task statements and were asked to report how much of their time they spent on each of the duty and task areas. The SMEs rated each duty and task on the two-dimensional scale shown in Figure 1.

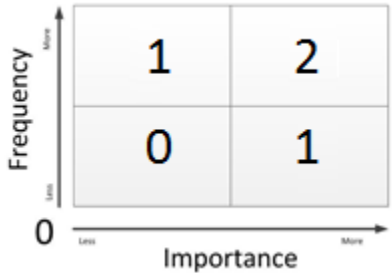

Figure 1. Two-dimensional scale for rating duties and tasks

The SMEs were asked to consider each task in terms of frequency and importance. Specifically, study respondents were asked to consider whether the tasks were performed more or less frequently as well as whether the tasks were more or less important to perform successfully as a minimally competent multifamily quality control inspector. The SMEs were asked to select a number from zero to two based on the two dimensions of frequency and importance.

The mean frequency and importance ratings were calculated for all of the SME panelists, and a preliminary content outline was developed.

As a final activity, the SMEs reviewed and finalized the following overarching job description for multifamily quality control inspectors:

> The multifamily quality control inspector is a building performance specialist who inspects installed energy conservation measures in multifamily buildings by observing and measuring building systems and components and analyzing building performance data to verify that project requirements are met.

The job profile that resulted from the JTA workshop is a detailed and graphical portrayal of a multifamily quality control inspector and is initially documented in the form of a draft job and task analyses report. The draft JTA report appears in Appendix B.

JTA Workshop Attendees

SME Panelists

Dan Cogan
Partner; Senior Engineer; Manager of Multifamily Quality Assurance Program
Taitem Engineering
Ithaca, NY

Noel Cotter
CTO
Luminalt Energy Corp.
San Francisco, CA

Kelly Cutchin
Technical Advisor
Simonson Management Services
Rockville, MD

Grant Dorris
Owner
Day One Ventures
Franklin, TN

Michael Edmonds
Project Manager/Inspector
ICAST
Lakewood, CO

Glen Grosardt
Inspector/Insulator/Instructor
International Association of Heat and Frost Insulators and Allied Workers
Cleves, OH

Kevin Grothe
Energy Specialist
Community Action Partnership of Ramsey and Washington Counties
Vadnais Heights, MN

Evan Hallas
Senior Energy Analyst
Taitem Engineering
Ithaca, NY

David Mountin
Senior Energy Analyst
TRC Companies
Ithaca, NY

John Neal
Energy Analyst
Association for Energy Affordability
Emeryville, CA

Logan Park
Project Manager
Richart Family, Inc.
Vancouver, WA

Bill Warren
Owner
BWES Building Science
Chapel Hill, NC

Meeting Facilitation

Professional Testing

Reed Castle, Ph.D.
Corina Owens, Ph.D.

Job/Task Analysis Validation Study

Validation of the JTA workshop outcome is perhaps the single most important component of the JTA development process. It provides an opportunity for other industry experts to verify the accuracy of the job profile as defined by the representative sample of practitioners (SME panelists).

Once the JTA document formulated at the workshop had been reviewed by NREL, the online study validation was launched to collect feedback on the frequency and importance ratings of the job tasks identified by the JTA workshop panelists and to capture any additional tasks and comments believed by respondents to pertain to the job of a multifamily quality control inspector.

A copy of the validation study announcement is included in Appendix C.

Development of Demographic Questions for the Online Validation Study

The first step in developing the online validation study was to identify key demographic questions to capture the representativeness of respondents and help evaluate the validity of responses. Each participant was asked 10 demographic questions:

1. What is the size of your organization?
2. In which state do you work?
3. In which sector do you currently work?
4. Which of the following jobs have you held in the multifamily (MF) building sector?
5. Which of the following categories best describes your current position?
6. How many years of experience have you had working as a multifamily building quality control inspector (total combined years)?
7. How many years of total experience do you have in the multifamily building industry (all jobs)?
8. What is your highest completed level of education?
9. To what professional societies/organizations do you belong?
10. What building performance credentials do you currently hold?

Development of Task-Rating Scales for the Online Validation Study

The second step in developing the online validation study was to identify the rating scales that survey participants use to rate the tasks performed by a multifamily quality control inspector. There are multiple models of rating scales used in job analyses; however, for the purposes of this study, two study scales were used: task frequency and importance.

Task frequency was chosen because tasks performed more often should receive more emphasis, as reported in Newman, Slaughter, & Taranath (1999). Task importance was chosen because it is the most common scale used to evaluate tasks for licensure or certification job analysis (Newman et al. 1999); moreover, as illustrated in the *Standards for Educational and Psychological Testing*

(American Educational Research Association 1999), "the content domain to be covered by a credentialing test should be defined clearly and justified in terms of the importance of the content for credential-worthy performance in an occupation or profession" (AERA, APA, NCME 1999, p. 161). The two rating scales are illustrated in Table 1.

Table 1. Rating Scales

Frequency How frequently is this task performed?	Importance How important is this task to the performance of the job?
1: Never	1: Not important
2: Perform occasionally	2: Somewhat important
3: Perform fairly often	3: Important
4: Perform very often	4: Very important

An overall rating scale was calculated using the following formula:

Overall rating scale = 2*Importance + Frequency

The overall rating scale was used to develop weights for the duties and tasks within the content outline.

Administration of the Online Validation Study

Study participants received an email invitation (with a URL link to the study) from NREL that (1) invited them to participate in a nationwide research study investigating the practices, characteristics, and activities of four multifamily building job categories and (2) encouraged them to take this opportunity to directly contribute to the development of the workforce for multifamily home energy upgrades.

The initial email invitation was sent June 19, 2013 to approximately 3,290 multifamily SMEs either directly from NREL, through the Guidelines e-newsletter mailing list, or through a Building Performance Institute, Inc. (BPI) mailing list. The announcement was also posted to DOE's Weatherization and Intergovernmental Program news website[1] (which received 25 page views during the validation study) and the Home Energy Pros Forum on July 1, 2013 (which received 235 page views on the Home Energy Pros Blog & Forum during the validation study).

Reminder notices were staggered and sent the weeks of July 8, 2013 and July 15, 2013, announcing the closing date of July 19, 2013. Approximately 1,450 reminder emails were sent directly to multifamily SMEs. In addition, Economic Opportunities Studies, Inc. (EOS) posted the announcement on its Facebook page, and it received 194 "likes" and an announcement was made during a DOE/EOS webinar on July 12, 2013 that was attended by 150 individuals.

NREL also made approximately 150 phone calls to the multifamily JTA workshop participants, applicants, and SME list members, encouraging people to participate and to inform other multifamily professionals. These calls were made on Thursday, July 11, 2013 and Friday, July 12, 2013 and on Monday, July 15, 2013 and Tuesday, July 16, 2013.

[1] http://www1.eere.energy.gov/wip/news.html

Notices announcing an extension of the validation study were sent on July 22, 2013 and July 23, 2013. These 6,363 emails were sent directly to SMEs, and several partnering organizations were asked to forward the extension notice; only SPEER (30), BPI (1,964), and EOS (4,300) confirmed they had forwarded the notice (their estimated numbers are included in the total above).

In addition to NREL's outreach, the Association for Energy Affordability, Inc. (AEA) made approximately 10 phone calls specifically to building operators asking for their participation; AEA's direct links to those working in the multifamily industry drove up the number of participants in the extended week of the study, enabling the minimum participation mark of 40 to be attained in the job designations of building operator, retrofit project manager, and quality control inspector.

In total, approximately 8,667 emails were sent to multifamily SMEs and to industry association members and mailing list affiliated with the multifamily retrofit industry over the course of the validation study. In addition, 604 contacts were made via page views, Facebook "likes," and the DOE/EOS webinar announcement. There is potential for significant overlap in these lists, and the multifamily SME contacts that NREL used are likely to be on at least one or two of the other lists and possibly more.

All of the study participants had access to internet-capable computers via their homes, places of employment, or public libraries. Any computer with a Web browser and a Web connection could be used to access the study.

The online study for the multifamily quality control inspector consisted of 32 job tasks separated into five content domains (or duty areas).

A copy of the online validation study is included in Appendix D.

Results

Online Validation Study

Study Respondent Demographics

The study respondents make up the study sample. The background and demographic portions of the validation study help determine how representative the study respondents are of the population of interest. The multifamily quality control inspector study sample consisted of 53 respondents, with 43 completing the survey.

Fifty-two participants answered the question about the size of their organizations. Of the 52 participants, 52% worked at organizations with fewer than 50 people, while the largest group of respondents (38%) worked at an organization with 51–500 people, as illustrated in Figure 2.

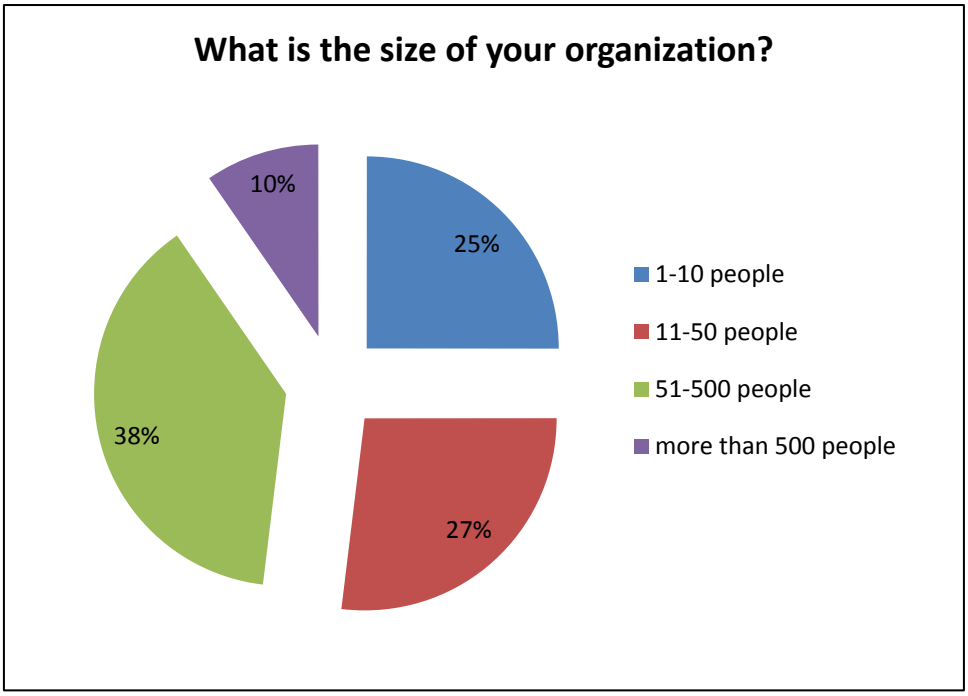

Figure 2. Sizes of organizations of respondents

Among the 52 participants who responded to the study, 19 states were represented, with five respondents indicating they worked in multiple states. It was determined that these results provided an adequate representation for the industry since 7 of the 8 U.S. mainland climate regions were represented by respondents. Table 2 contains the responses to this question and shows the geographic distribution of study respondents.

Table 2. States in Which Respondents Reported Working

States	Number of Respondents
Alaska	1
Arizona	1
California	10
Colorado	2
Maine	1
Massachusetts	1
Michigan	2
Minnesota	1
New Hampshire	1
New Mexico	1
New York	13
North Carolina	3
Ohio	2
Oregon	2
Rhode Island	1
Tennessee	1
Virginia	2
West Virginia	1
Wisconsin	1
Multiple States	5
Grand Total	52

Next, study respondents were asked to report the sector in which they worked at the time of the survey. The majority (62%) reported they worked in the private sector. Figure 3 shows the results of this question.

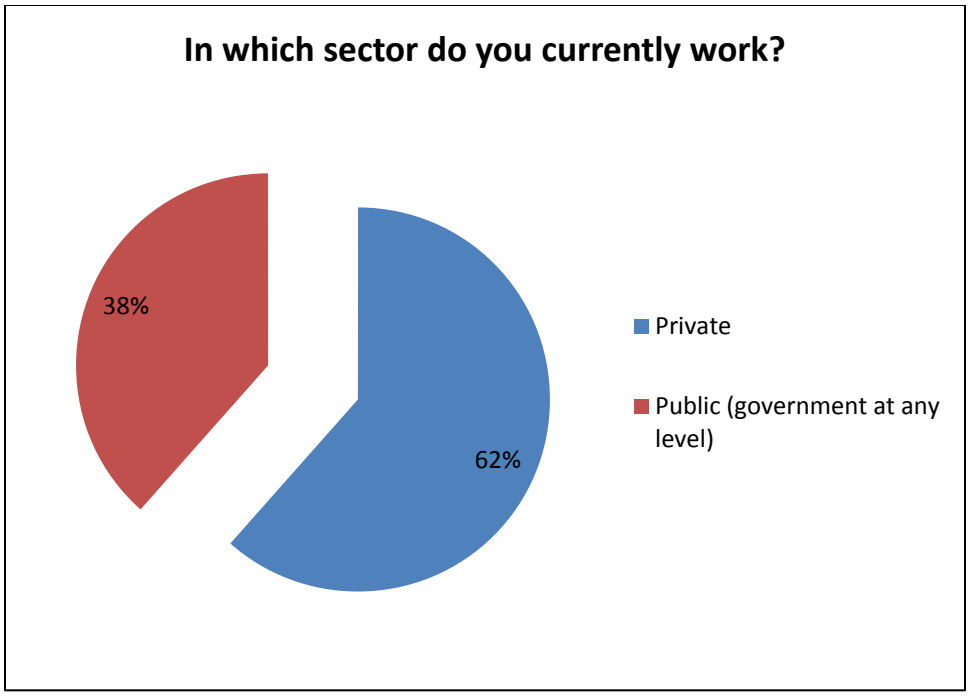

Figure 3. Sectors in which respondents were working

Study respondents were then asked what jobs they had held in the multifamily building sector. The majority (92%) indicated they had worked as a quality control inspector in the multifamily building sector. The distribution of different jobs is displayed in Figure 4. (Note that respondents could select multiple jobs so the total percentage exceeds 100%).

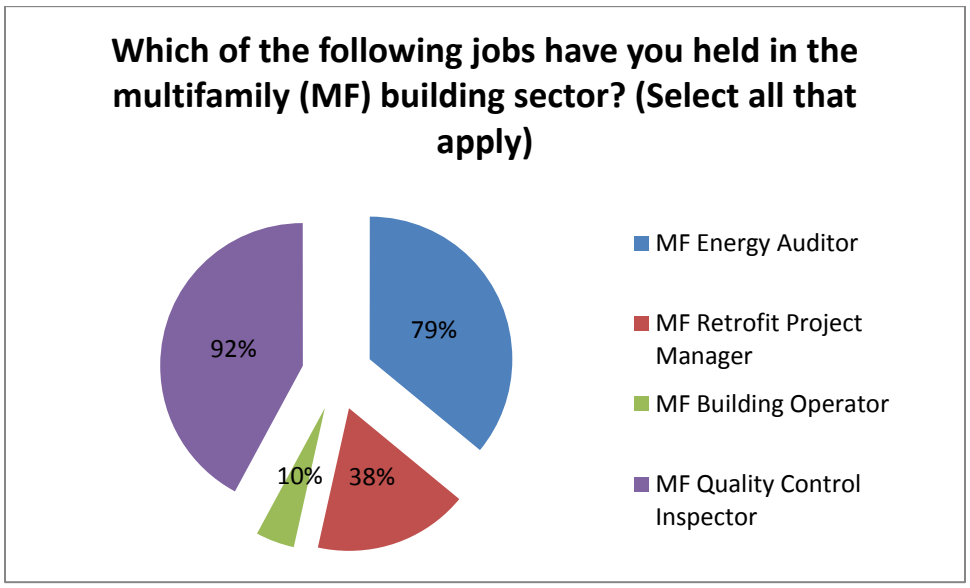

Figure 4. Jobs held by respondents in the multifamily building sector

When respondents were asked to categorize their current position, the majority (74%) selected "MF Building Quality Control Inspector Practitioner." The distribution of different categories is displayed in Figure 5.

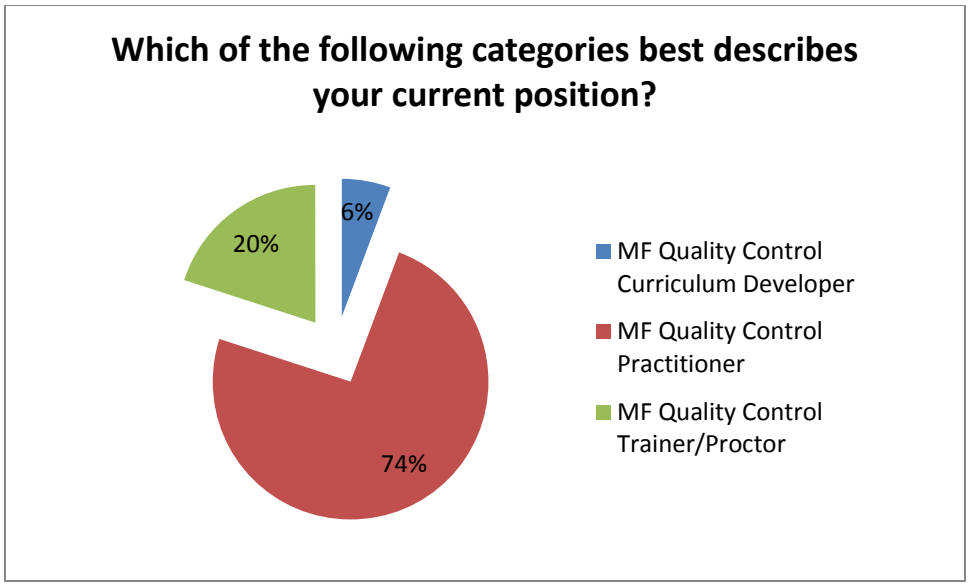

Figure 5. Categories of current jobs held by respondents

The study results suggest a wide range of experience from the participants working as multifamily quality control inspectors. However, the largest percentage of study respondents (55%) reported working five years or less as a multifamily quality control inspector. Figure 6 displays these results.

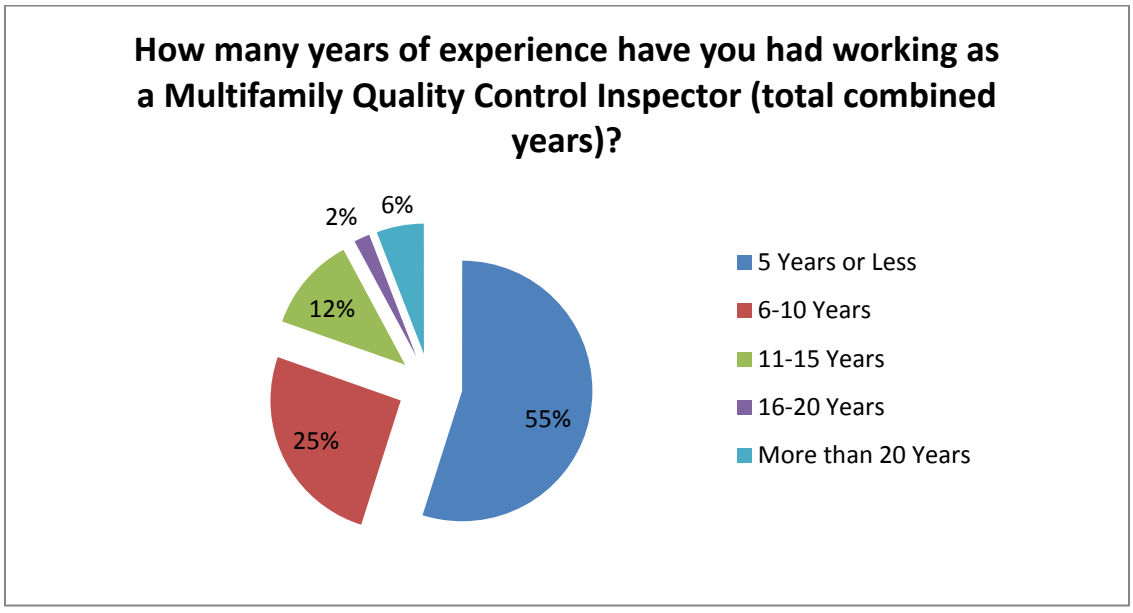

Figure 6. Years of experience respondents had as multifamily building quality control inspectors

The majority of respondents (58%) indicated they had less than 10 years of total experience in the multifamily building industry (all jobs). However, study respondents were well represented across all levels of experience in the multifamily building industry as a whole. Figure 7 displays these results.

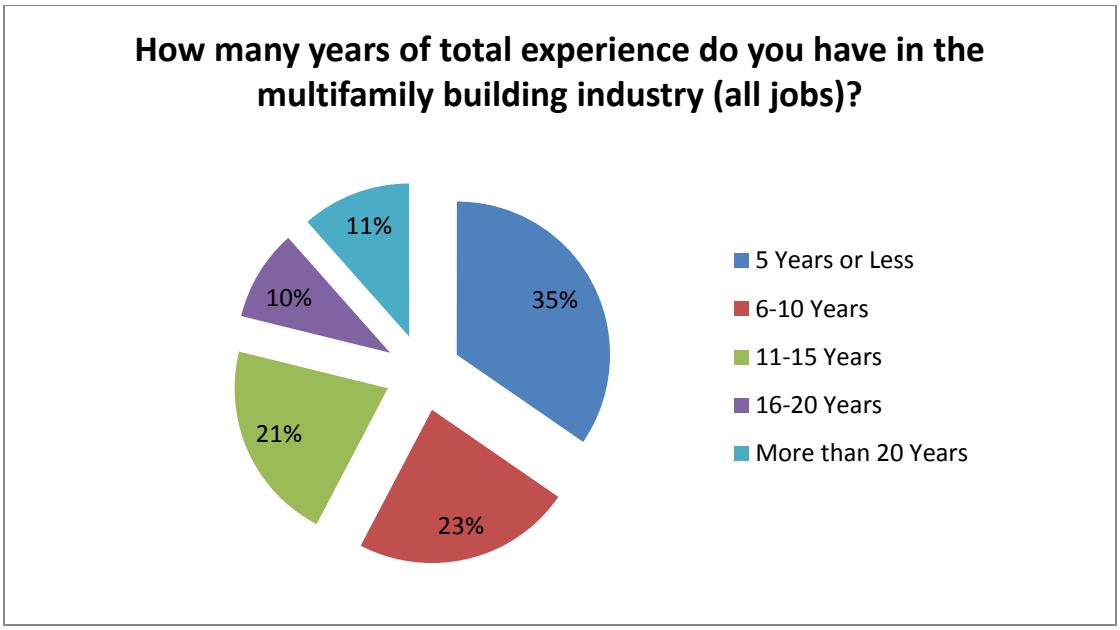

Figure 7. Years of experience respondents had in industry

Next, study respondents were asked to report their highest completed level of education. The majority (50%) indicated a bachelor's degree was their highest level of education. Figure 8 displays the results.

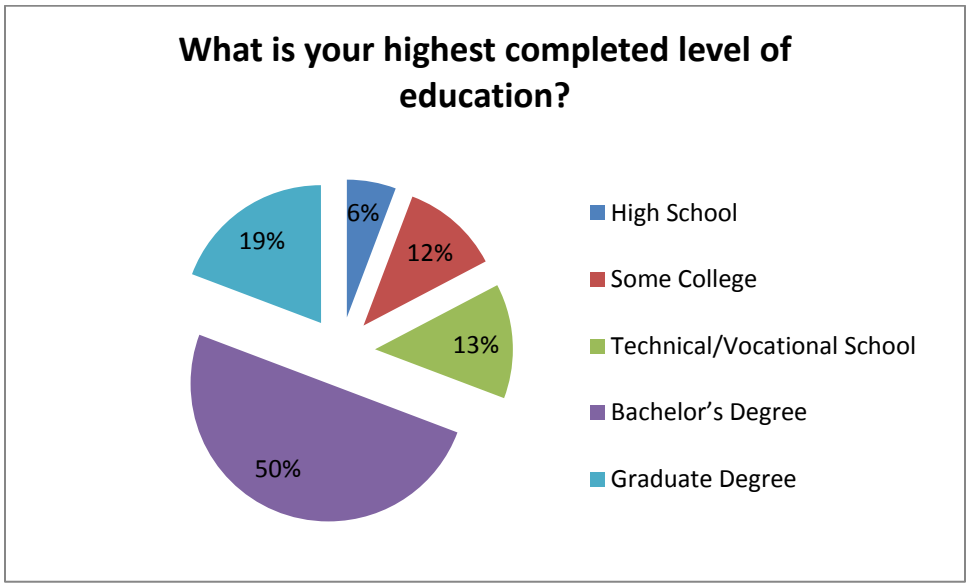

Figure 8. Highest levels of education completed by respondents

Study respondents were asked to report the professional societies and organizations they belonged to and were allowed to select more than one. The largest number of respondents (17) indicated they belonged to the U.S. Green Building Council (USGBC) while the other top two organizations were the Association of Energy Engineers (AEE) with seven respondents and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) with eight respondents, as illustrated in Table 3.

Table 3. Professional Societies and Organizations to which Respondents Belonged

Society or Organization	Number of Respondents
None	20
AABC Commissioning Group (ACG)	0
American Institute of Architects (AIA)	1
American Society of Civil Engineers (ASCE)	0
American Society of Mechanical Engineers (ASME)	0
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	8
APPA	0
Association for the Advancement of Cost Engineering (AACE)	0
Association for Facilities Engineering	0
Association of Energy Engineers (AEE)	7
Building Commissioning Association (BCA)	3
Building Owners and Managers Association (BOMA)	0
Construction Specifications Institute (CSI)	0
International Association of Plumbing and Mechanical Officials (IAPMO)	0
International Building Performance Simulation Association (IBPSA)	1
International Code Council (ICC)	1
International Facility Management Association (IFMA)	0
International Union of Operating Engineers (IUOE)	0
Institute of Electrical and Electronics Engineers (IEEE)	0
Laborers' International Union of North America (LIUNA)	0
National Fire Protection Association (NFPA)	0
National Institute of Building Sciences (NIBS)	2
Service Employees International Union	1
Sheet Metal Workers' International Association (SMWIA)	0
United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA)	0
United Brotherhood of Carpenters	0
United Steelworkers (USW)	0
U.S. Green Building Council (USGBC)	17
Other Professional Organizations	16

Study respondents were also asked about their current building credentials. The largest number of respondents (26) indicated they held the BPI Building Analyst credential, followed closely by

the 18 respondents who indicated they held the BPI Multifamily Professional credential. Table 4 provides the complete list of credentials and number of respondents who held each credential.

Table 4. Multifamily Building Credentials of Respondents

Credentials	Number of Respondents
None	7
AABC Commissioning Group Certified Commissioning Authority (CxA)	0
AABC Commissioning Group Certified Commissioning Technician (CxT)	0
American Society of Heating, Refrigerating and Air-Conditioning Engineers Building Energy Modeling Professional (BEMP)	0
American Society of Heating, Refrigerating and Air-Conditioning Engineers Commissioning Process Management Professional (CPMP)	0
American Society of Heating, Refrigerating and Air-Conditioning Engineers Operations and Performance Management Professional (OPMP)	0
Association for Facilities Engineering Certified Plant Engineer (CPE)	0
Association for Facilities Engineering Certified Plant Maintenance Manager (CPMM)	0
Association for Facilities Engineering Certified Plant Supervisor	0
Association of Energy Engineers Certified Building Energy Simulation Analyst (BESA)	0
Association of Energy Engineers Certified Building Commissioning Professional (CBCP)	0
Association of Energy Engineers Certified Energy Auditor (CEA)	3
Association of Energy Engineers Certified Energy Manager (CEM)	3
Association of Energy Engineers Existing Building Commissioning Professional (EBCP)	2
Association of Energy Engineers Energy Manager in Training (EMIT)	0
Association of Energy Engineers/Efficiency Valuation Organization Certified Measurement and Verification Professional	0
BOMI International Facilities Management Administrator (FMA)	0
BOMI International Real Property Administrator (RPA)	0
BOMI International Systems Maintenance Administrator (SMA)	0
BOMI International Systems Maintenance Technician (SMT)	0
Building Commissioning Association Certified Commissioning Professional (CCP)	0
Building Operator Certification – Level I (BOC Level I)	0
Building Operator Certification – Level II (BOC Level II)	0
BPI Energy Auditor	9
BPI Retrofit Installer	1
BPI Crew Leader	0
BPI Quality Control Inspector	4

Credentials	Number of Respondents
BPI Building Analyst	26
BPI Envelope Professional	15
BPI Residential Building Envelope Whole House Air Leakage Control Installer	1
BPI Manufactured Housing Professional	1
BPI Heating Professional	2
BPI Air Conditioned Heat Pump Professional	2
BPI Multifamily Professional	18
The City University of New York Energy Management and Indoor Air Quality Certification	0
Energy Audit Institute Commercial Energy Audit Certification	0
General Professional Accreditations Licensed Architect	0
General Professional Accreditations Professional Engineer (PE)	2
International Facility Management Association Facility Management Professional (FMP)	0
International Facility Management Association Certified Facility Manager (CFM)	0
National Energy and Sustainability Institute Commercial Energy Auditor Certification	0
National Environmental Balancing Bureau Building Systems Commissioning Certified Professional	0
National Environmental Balancing Bureau Retro Commissioning Certified Professional	0
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U.S. Green Building Council LEED AP ND	0
U.S. Green Building Council LEED AP O+M	1
U.S. Green Building Council LEED Green Associate	6
Other Building performance credential	14

Lastly, study respondents were asked how they heard about the study. The majority of study respondents (69%) indicated they heard about the study through direct email invitations, as illustrated in Figure 9.

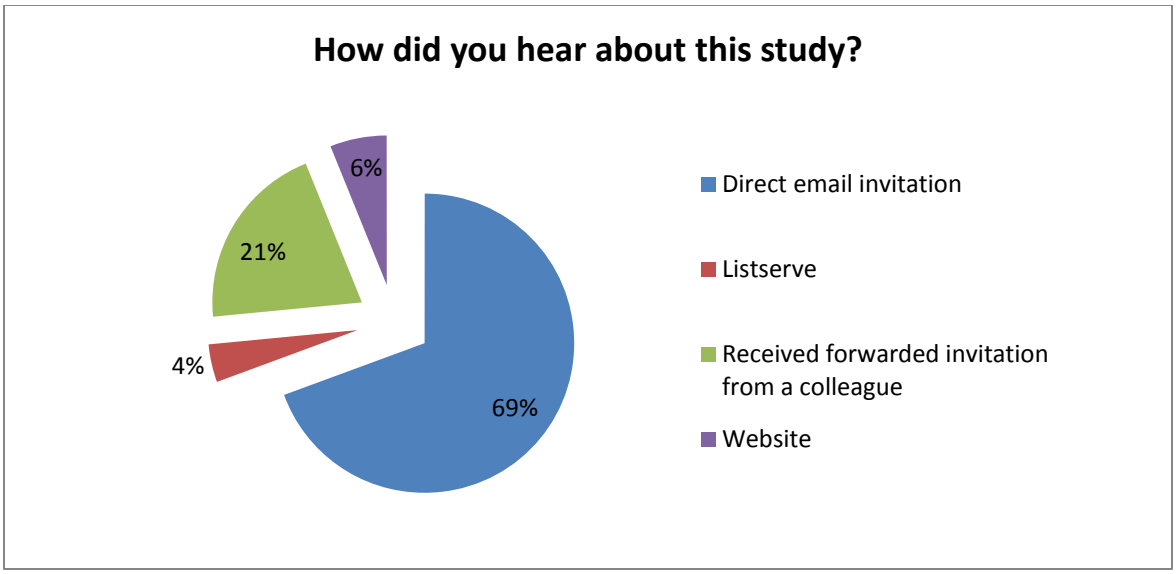

Figure 9. How respondents heard about this study

Overview of Study Respondents' Ratings for Task Statements

The mean ratings for task frequency ranged from 2.65 to 3.66, and the mean importance ratings ranged from 3.04 to 3.84. The standard deviation (SD) of the mean was calculated for each task to illustrate how closely the study responses tracked to each task mean. The smaller the SD, the more clustered the study responses are in relation to the mean and conversely, the greater the SD, the less clustered the study responses are in relation to the mean.

The standard error of the mean (SEM) was also computed for each of the task statements. The average of ratings of all tasks had a standard error of 0.14 (frequency ratings) and 0.11 (importance ratings), indicating that if the study were to be repeated with a different sample of study respondents the same results would be expected. Table 5 contains the results of the frequency and importance ratings as well as associated standard error of the means.

Table 5. Means and Standard Errors of Frequency and Importance Task Ratings

Duties and Tasks	Frequency			Importance		
	Mean	SD	SEM	Mean	SD	SEM
Reviewing Project Documents						
Review Program Requirements	3.40	0.80	0.12	3.40	0.80	0.12
Review Building Performance Assessment	3.36	0.92	0.13	3.55	0.65	0.10
Review Scope of Work	3.66	0.70	0.10	3.79	0.46	0.07
Evaluate Projected Energy Savings	3.13	0.92	0.13	3.26	0.90	0.13
Review Building Plans/Specifications	3.17	0.94	0.14	3.36	0.79	0.12
Review Construction Documentation	3.04	1.02	0.15	3.28	0.95	0.14
Developing Quality Control Plan						
Determine Sampling Protocols	2.85	0.87	0.13	3.13	0.70	0.10

Duties and Tasks	Frequency			Importance		
	Mean	SD	SEM	Mean	SD	SEM
Determine Quality Control Test Requirements	2.92	1.05	0.15	3.38	0.74	0.11
Identify Roles and Responsibilities	2.71	1.07	0.15	3.04	0.91	0.13
Create Quality Control Inspection Checklist	3.00	0.99	0.14	3.34	0.79	0.11
Develop Quality Control Inspection Schedule	2.92	1.07	0.15	3.11	0.84	0.12
Communicate Quality Control Plan with Stakeholders	3.00	1.11	0.16	3.45	0.62	0.09
Conducting Pre-Installation Site Visits						
Participate in Pre-Installation Meeting	2.65	1.02	0.15	3.08	0.85	0.12
Conduct Walk-Thru	3.19	0.92	0.13	3.53	0.62	0.09
Update Quality Control Plan to Reflect Site Visit	2.72	1.12	0.16	3.13	0.88	0.13
Conducting Site Visits						
Evaluate Work Practices	2.91	0.85	0.13	3.09	0.73	0.11
Communicate Quality Control Expectations Throughout Site Visit	3.04	0.95	0.14	3.27	0.76	0.11
Inspect Water Conservation Measures	3.02	1.06	0.16	3.23	0.89	0.13
Inspect Building Insulation Measures	3.60	0.75	0.11	3.84	0.37	0.05
Inspect Mechanical Insulation Measures	3.24	1.00	0.15	3.60	0.65	0.10
Inspect Air Barrier	3.38	0.91	0.14	3.62	0.61	0.09
Inspect Window/Door installations	3.22	0.88	0.13	3.58	0.69	0.10
Inspect Domestic Hot Water Measures	3.40	0.86	0.13	3.64	0.57	0.09
Inspect Heating, Ventilation, and Air Conditioning System Measures	3.47	0.79	0.12	3.82	0.39	0.06
Inspect Control Measures	3.11	0.91	0.14	3.51	0.69	0.10
Inspect Lighting Measures	3.22	1.00	0.15	3.43	0.73	0.11
Perform Health and Safety Inspection	3.18	1.01	0.15	3.53	0.69	0.10
Inspect Appliance Measures	2.96	1.07	0.16	3.27	0.79	0.12
Reporting Quality Control Inspection Observations and Findings						
Organize Inspection Documents	3.44	0.89	0.13	3.53	0.69	0.10
Analyze Quality Control Inspection Data	3.33	0.88	0.13	3.56	0.72	0.11
Develop Inspection Report	3.24	1.05	0.16	3.56	0.78	0.12
Communicate Quality Control Inspection Results to Stakeholders	3.22	1.08	0.16	3.64	0.57	0.09

Reliability of Task Ratings

To determine the reliability of the frequency and importance task ratings, Cronbach's alpha was computed for both the frequency and importance scales. Cronbach's alpha ranges from zero to one and is affected by the number of questions and the number of respondents. An alpha value greater than 0.70 is considered acceptable, one greater than 0.80 is considered good, and one greater than 0.90 is considered excellent. For this study, the frequency scales had an alpha of 0.93 and the alpha for the importance scale was 0.92. These values indicate that the frequency and importance ratings for each of the tasks have excellent reliability and we can be confident that, as a whole, if these tasks were rated again by the same respondents the same results would be obtained.

Post-Validation Review Meeting Results

A subgroup of the original SME panel from the multifamily quality control inspector workshop was convened via webinar and conference call on August 9, 2013, to conduct the following activities:

- Ensure that sample group respondents participating in the study were representative of the profession as understood by the SME panel subgroup
- Review the tasks identified as having lower combined ratings (thus indicating they were ranked low in frequency, importance, or both) to determine whether the tasks should be removed
- Review study respondent comments to determine whether any tasks were missed during the JTA meeting
- Determine the final content outline

The post-validation study participants were as follows:

- Cogan, Dan
- Cutchin, Kelly
- Edmonds, Michael
- Grothe, Kevin
- Hallas, Evan
- Warren, Bill

Review of Study Respondent Demographics

The post-validation study meeting participants reviewed the demographic information associated with the study participants and determined that a representative sample of individuals responded to the study. In other words, the post-validation study meeting participants—after reviewing summarized demographic data for the respondents—felt that the group of respondents adequately reflected the profession.

Review of Low-Rated Tasks

The purpose of this activity was to direct SME attention to the tasks that were rated lower by the study respondents and to discuss those tasks to ensure they belonged on the final content outline. Tasks that had a combined mean frequency and importance rating around 9.00 (implying that the task is performed less than "fairly often" and is less than "important") were flagged for review during the post-study webinar.

The frequency and importance data was combined to form a single scale using the formula below:

Overall rating scale = 2*Importance + Frequency

Importance ratings were given extra weight in the combined scale. This is because while both frequency of task performance and task importance are both valuable rankings in certification credentialing examinations, importance is often thought of as having more bearing and therefore, should receive greater emphasis in the content outline. There were five tasks that received a 9.00 rating or lower (listed in italics), as illustrated in Table 6, and that were reviewed by the reconvened SME panelists.

Based on the frequency and importance ratings of the validation study, the post-validation study meeting participants decided to keep all five of the identified tasks, as they were determined to be important to the job of a multifamily quality control inspector and should therefore be included in the final content outline.

Table 6. Combined Means and Frequencies of Duties and Tasks

Duties and Tasks	Frequency Mean
Reviewing Project Documents	
Review Program Requirements	10.21
Review Building Performance Assessment	10.47
Review Scope of Work	11.23
Evaluate Projected Energy Savings	9.64
Review Building Plans/Specifications	9.89
Review Construction Documentation	9.60
Developing Quality Control Plan	
Determine Sampling Protocols	*9.10*
Determine Quality Control Test Requirements	9.68
Identify Roles and Responsibilities	*8.79*
Create Quality Control Inspection Checklist	9.68
Develop Quality Control Inspection Schedule	9.13
Communicate Quality Control Plan with Stakeholders	9.89
Conducting Pre-Installation Site Visits	

Duties and Tasks	Frequency Mean
Participate in Pre-Installation Meeting	*8.81*
Conduct Walk-Thru	10.26
Update Quality Control Plan to Reflect Site Visit	*8.98*
Conducting Site Visits	
Evaluate Work Practices	*9.09*
Communicate Quality Control Expectations Throughout Site Visit	9.59
Inspect Water Conservation Measures	9.48
Inspect Building Insulation Measures	11.29
Inspect Mechanical Insulation Measures	10.44
Inspect Air Barrier	10.62
Inspect Window/Door installations	10.38
Inspect Domestic Hot Water Measures	10.69
Inspect Heating, Ventilation, and Air Conditioning System Measures	11.11
Inspect Control Measures	10.13
Inspect Lighting Measures	10.09
Perform Health and Safety Inspection	10.24
Inspect Appliance Measures	9.50
Reporting Quality Control Inspection Observations and Findings	
Organize Inspection Documents	10.51
Analyze Quality Control Inspection Data	10.44
Develop Inspection Report	10.36
Communicate Quality Control Inspection Results to Stakeholders	10.51

Review of Missing Tasks and Additional Comments

Study respondents were given an opportunity to identify tasks they felt were missing from the content provided in the online validation study. Six respondents submitted tasks, and all such items are included in Table 7. The post-validation study meeting participants reviewed each task and determined whether the content was already covered in the existing DACUM chart or whether it was outside the scope of professional practice. If it was not covered, the SMEs were asked to add the task to the job description. All missing tasks identified by the study respondents were already addressed or outside the scope of the profession. To that end, no additional tasks were added.

Table 7. Tasks Identified by Study Respondents as Missing from the JTA Task List[a]

Missing Tasks
Deep green education /training for the people that live in these areas. They should understand what it all means and what role they play in making it work the way it is suppose to.
verification of radon mitigation measures water drainage plane (flashing) inspection verification of ventilation system, dwelling units & common areas (ASHRAE 62.1 & 62.2)
Reporting to funding agency
Trueing up the final measures as installed to the original building modeling from the audit to ensure that projected energy savings are accurate.
Evaluate inspection procedures and refine for the next job
Analyze building model/energy savings
Inspections should focus on clear identification of both pre-retrofit and post-retrofit conditions. This identification should include quantities, controls and O&M, and energy efficiency attributes of the before & after conditions. Quality control checks on energy savings assumptions should be conducted prior to renovations. The M&V plan, if needed, should be decided prior to renovations, and should follow IPMVP and ASHRAE Guideline 14 where feasible and applicable.
Deveope standards and training for each measure being performed. Develop a must get done on tsk list for crews to achieve defect free work. Develop task completion checklists to document defect free work,
How are change orders addressed? How is sub par workmanship or missed opportunities addressed and documented?
Pre-inspection of materials before being installed and verifying, materials, equipment, prior to installation.
Roofing Conditions & Cool Roof Solutions, Renewable Energy Applications, Ventilation Systems, Exterior & Moisture Conditions, and Shading Factors
Punchlist development and follow-up
Site visits prior to assesments to interface with property managers to establish desired assistance.
Process for QC inspection recipient to inform installers/project managers of QC results to create environment of continuous improvement.
Reviewing submittals
Post construction Analysis, Model reviews and discussions with involved parties re: ways of improving in the future and current hurdles.

[a] Tasks are noted in their original format, without edits, to maintain their integrity.

Lastly, study respondents were given an opportunity to provide additional comments. Six study respondents submitted comments, and all such items are included in Table 8. Upon reviewing the submissions, the post-validation study meeting participants determined that the comments specifically related to duties and tasks were already covered by the proposed content outline.

Table 8. Additional Comments Identified by Study Respondents[a]

Additional Comments
Often, scope detail/depth is determined by the client consistent standards can help to keep the client 'on track', especially if the standards are tied to incentives (Fed, State, Local or even MLS listings). For profit and gov't/HUD-owned facilities have different issues, such as bureaucratic layering on the one side and split incentives on the other.

Quality control does not work. We have tried. Building a quality driven defect free process does work. If we practiced quality control I do not think we would be able to survive because the re-works would kill us as long as we remain honest about our work.building in quality processes does work, protects our company and boosts profits.
You had a great panel develop this task report. They pretty well nailed it.
Incorporate the above missing tasks for a complete comprehensive assessments & upgrade commissioning solutions
I've worked on the NC Multifamily Wx project for two years at all levels
I was not able to determine if the intent of the survey was to identify the relative importance of the listed tasks (in comparison to each other) or to determine how much of the proposed task list was considered critical to performing a suitable QC inspection. If the goal was to rate the relative importance of the tasks that should have been stated more clearly and a baseline for comparison provided.

[a]Comments are noted in their original format, without edits, to maintain their integrity.

Final Weighting of Task List and Proposed Content Outline

The post-validation study meeting participants reviewed the results of the study weighting and compared the results to the proposed content outline that resulted from the original JTA meeting. Table 9 contains the content outline with the task weights proposed by the JTA panelists (column labeled SME Weights) and with the weighting from the validation study (column labeled Study Weights).

Table 9. Comparison of Validation Study Results with JTA SME Panelists Weights

Duties and Tasks	Overall Ratings	Study Weights	SME Weights
Reviewing Project Documents		19.1%	19%
Review Program Requirements	10.21	3.2%	4%
Review Building Performance Assessment	10.47	3.3%	3%
Review Scope of Work	11.23	3.5%	3%
Evaluate Projected Energy Savings	9.64	3.0%	3%
Review Building Plans/Specifications	9.89	3.1%	3%
Review Construction Documentation	9.60	3.0%	3%
Developing Quality Control Plan		17.6%	18%
Determine Sampling Protocols	9.10	2.9%	3%
Determine Quality Control Test Requirements	9.68	3.1%	3%
Identify Roles and Responsibilities	8.79	2.7%	3%
Create Quality Control Inspection Checklist	9.68	3.0%	3%
Develop Quality Control Inspection Schedule	9.13	2.8%	3%
Communicate Quality Control Plan with Stakeholders	9.89	3.1%	3%
Conducting Pre-Installation Site Visits		8.8%	8%
Participate in Pre-Installation Meeting	8.81	2.8%	2%

Duties and Tasks	Overall Ratings	Study Weights	SME Weights
Conduct Walk-Thru	10.26	3.2%	3%
Update Quality Control Plan to Reflect Site Visit	8.98	2.8%	3%
Conducting Site Visits		41.4%	42%
Evaluate Work Practices	9.09	2.8%	3%
Communicate Quality Control Expectations Throughout Site Visit	9.59	3.0%	3%
Inspect Water Conservation Measures	9.48	3.0%	3%
Inspect Building Insulation Measures	11.29	3.5%	4%
Inspect Mechanical Insulation Measures	10.44	3.3%	4%
Inspect Air Barrier	10.62	3.3%	3%
Inspect Window/Door installations	10.38	3.2%	3%
Inspect Domestic Hot Water Measures	10.69	3.3%	4%
Inspect Heating, Ventilation, and Air Conditioning System Measures	11.11	3.5%	3%
Inspect Control Measures	10.13	3.2%	3%
Inspect Lighting Measures	10.09	3.1%	3%
Perform Health and Safety Inspection	10.24	3.2%	3%
Inspect Appliance Measures	9.50	3.0%	3%
Reporting Quality Control Inspection Observations and Findings		13.1%	13%
Organize Inspection Documents	10.51	3.3%	4%
Analyze Quality Control Inspection Data	10.44	3.3%	3%
Develop Inspection Report	10.36	3.2%	3%
Communicate Quality Control Inspection Results to Stakeholders	10.51	3.3%	3%

After much discussion, the content outline and weighting were finalized taking into consideration the results of the JTA meeting together with those of the validation study. The SMEs decided to keep their suggested JTA workshop weights. The final content outline appears in Table 10 and provides an initial basis from which an assessment (e.g., a certification or licensure examination) may be constructed; it also provides curriculum developers with a model for aligning training with the core needs of the occupation.

Table 10. Final Content Outline for Multifamily Quality Control Inspectors

Duties and Tasks	Weighting
Reviewing Project Documents	19%
Review Program Requirements	4%
Review Building Performance Assessment	3%
Review Scope of Work	3%

Duties and Tasks	Weighting
Evaluate Projected Energy Savings	3%
Review Building Plans/Specifications	3%
Review Construction Documentation	3%
Developing Quality Control Plan	18%
Determine Sampling Protocols	3%
Determine Quality Control Test Requirements	3%
Identify Roles and Responsibilities	3%
Create Quality Control Inspection Checklist	3%
Develop Quality Control Inspection Schedule	3%
Communicate Quality Control Plan with Stakeholders	3%
Conducting Pre-Installation Site Visits	8%
Participate in Pre-Installation Meeting	2%
Conduct Walk-Thru	3%
Update Quality Control Plan to Reflect Site Visit	3%
Conducting Site Visits	42%
Evaluate Work Practices	3%
Communicate Quality Control Expectations Throughout Site Visit	3%
Inspect Water Conservation Measures	3%
Inspect Building Insulation Measures	4%
Inspect Mechanical Insulation Measures	4%
Inspect Air Barrier	3%
Inspect Window/Door installations	3%
Inspect Domestic Hot Water Measures	4%
Inspect Heating, Ventilation, and Air Conditioning System Measures	3%
Inspect Control Measures	3%
Inspect Lighting Measures	3%
Perform Health and Safety Inspection	3%
Inspect Appliance Measures	3%
Reporting Quality Control Inspection Observations and Findings	13%
Organize Inspection Documents	4%
Analyze Quality Control Inspection Data	3%
Develop Inspection Report	3%
Communicate Quality Control Inspection Results to Stakeholders	3%
Total	100%

The validation study confirmed that the job description for a multifamily quality control inspector developed and compiled by the 12 SME panelists was accurate and thorough. Specifically, the study validated the job-related tasks for a multifamily quality control inspector that had been identified by the SME panelist during the 3-day workshop.

Analysis of the study data (study respondents' frequency and importance ratings of these job-related tasks) also provides a benchmark to evaluate the weighting of the content outline that had been developed by the SME panelists. This analysis provides greater assurance that the final content outline produced as part of this multifamily quality control inspector JTA process can be used with confidence to develop credentialing programs and/or curriculum.

References

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1999). *Standards for educational and psychological testing.* Washington, DC: American Educational Research Association.

Brannick, M. T.; Levine, E. L.; Morgeson, F. P. (2007). *Job and work analysis: Methods, research and applications for human resource management*. Thousand Oaks, CA: Sage.

Newman, L.S.; Slaughter, R.C.; Taranath, S.N. (April 1999). *The selection and use of rating scales in task studies: A review of current job analysis practice.* Paper presented at the annual meeting of the National Council of Measurement in Education, Montreal, Canada.

Raymond, M.R. (2001). Job analysis and the specification of content for licensure and certification examinations. *Applied Measurement in Education 14*(4), 369–415.

Appendix A. Opportunity Announcement

The National Renewable Energy Laboratory (NREL) and Professional Testing, Inc. are seeking participants for **a three-day workshop in Denver, Colorado**, to inventory the tasks and skills that best define the common body of required knowledge for workers in the multifamily (MF) housing sector.

To facilitate development of these MF-specific JTAs/KSAs, Professional Testing, Inc. is seeking current industry practitioners who have **the experience and vision to help define and promote energy efficiency in the multifamily housing sector** by participating in these JTA/KSA development workshops. Interested individuals are invited to submit their credentials by Monday, April 1st.

Please note that each JTA/KSA workshop is anticipated to last three full days (excluding travel). Reimbursement for travel costs up to a fixed amount, a travel per diem, and an honorarium will be awarded to individuals selected for participation. Please visit http://proftesting.rapidinsites.com for additional project details, including how practitioners will be selected and where to direct project-related questions.

NREL and Professional Testing, Inc. are excited to facilitate this unique, foundational opportunity for industry practitioners to provide their expertise and insight during this important development process. Thank you for your time.

Sincerely,
The NREL Home Energy Professionals Project Team

If you have any questions or comments about this email bulletin, please contact workforce.guidelines@nrel.gov.

Appendix B. Job/Task Analysis for a Multifamily Quality Control Inspector

This appendix was developed as a result of the multifamily quality control inspector JTA workshop and served as the foundation for building the online validation study.

In addition to providing historical reference, this initial product of the JTA process profiles the job of a multifamily quality control inspector, and may also be used to develop training or examination content.

Multifamily Quality Control Inspector Job Description

The multifamily quality control inspector is a building performance specialist who inspects installed energy conservation measures in multifamily buildings by observing and measuring building systems and components and analyzing building performance data to verify that project requirements are met.

A proposed content outline resulting from this JTA follows.

Multifamily Quality Control Inspector Duty Areas

A	Reviewing Project Documents
B	Developing Quality Control Plan
C	Conducting Pre-Installation Site Visits
D	Conducting Site Visits
E	Reporting Quality Control Inspection Observations and Findings

This Job/Task Analysis used input from a broad group of industry practitioners and was facilitated by Professional Testing, Inc. for the National Renewable Energy Laboratory (NREL) and was funded by DOE's Weatherization Assistance Program (WAP).

Introduction

NREL secured the services of Professional Testing, Inc. to help develop a JTA for multifamily quality control inspectors.

JTA is a procedure for analyzing the tasks performed by individuals in an occupation, as well as the knowledge, skills, and abilities required to perform those tasks. Specifically, a JTA can be defined as "any systematic procedure for collecting and analyzing job-related information to meet a particular purpose" (Raymond 2001). JTA can be used to describe, classify, and evaluate jobs; ensure compliance with legal and quasi-legal requirements; develop training, promote worker mobility, plan workforces, increase efficiency and safety, and appraise performance (Brannick et al. 2007).

JTA is traditionally used by secondary and postsecondary educators; test developers; and business, industry, government, and military trainers to help identify core knowledge areas, critical work functions, and skills that are common across a representative sampling of current practitioners.

This project used the DACUM method to conduct a JTA. DACUM is an occupational analysis led by a trained facilitator, where practitioners in a specific occupation come together for a multiday workshop to provide input about the specific tasks, knowledge, and skills needed to perform their jobs.

This appendix provides draft results of the analysis and will form the basis for a subsequent "industry validation" phase, where a larger group of industry practitioners will evaluate the list of job-related tasks. This group will ensure that the identified tasks and weighting factors accurately represent the job of a multifamily quality control inspector. This step will also provide an opportunity for industry to identify any missed tasks or any that were included erroneously.

The content presented in this appendix was created by industry practitioners and is intended to portray the job of a multifamily quality control inspector as currently practiced.

Process for Selecting Subject Matter Experts

Professional Testing, Inc. helped to establish the criteria for selecting the DACUM panel of SMEs. To be eligible for the workshop panel, applicants were required to submit an electronic application and to demonstrate that they were active practitioners in their field. To create a representative panel of practitioners, Professional Testing, with NREL, established criteria to select SMEs from a larger applicant pool to ensure:

- Geographic (including regional/climatic) diversity
- Representation of a wide range of experience levels (novice to expert)
- No single organization or organization size dominated the group
- All sectors were represented with no single sector dominating (public versus private)
- Diversity of industry-related credentials, represented by the panelists.

Twelve applicants meeting the above criteria were selected to create the multifamily quality control inspector SME panel.

The DACUM Philosophy

- **Practitioners can describe and define their jobs more accurately than anyone else.**
- **One of the most effective ways to define a job is to describe the tasks practitioners perform.**
- **All jobs can be effectively and sufficiently described in terms of the tasks successful workers perform.**
- **All tasks, to be performed correctly, demand certain knowledge, skills, abilities, attributes, and tools.**

Job/Task Analysis Workshop

The multifamily quality control inspector JTA workshop was held in Lakewood, Colorado, May 15–17, 2013.

Day 1 consisted of an introduction to the DACUM process. The trained DACUM facilitator explained the JTA process and provided the SME panel with duty and task statement definitions. A duty reflects a large area of work for a specific profession; multiple tasks describe how to perform each duty.

The presentation then shifted to a discussion about multifamily quality control inspectors, more

specifically the "who, how, what, and why" of the profession. The SME panelists compiled this information into a comprehensive list to capture key multifamily quality control inspector job components.

The next step was to identify duty (or domain) areas. Once the SME panelists reached consensus on the duty areas, they delineated each duty by identifying the required tasks.

On Day 2, the facilitator projected a spreadsheet that contained the identified duty areas and corresponding task statements. The SMEs were asked to list the steps under each task and to identify the knowledge, skills, abilities, and tools needed to complete each task.

On Day 3, work concluded with the SMEs finalizing an overarching job description for multifamily quality control inspectors.

Results

This appendix presents aspects of a multifamily quality control inspector, as captured by the 12-member panel during the May 15–17, 2013, JTA workshop in Lakewood, Colorado. The tables that follow reflect job requirements and are meant to provide a clear understanding and detailed description of the work performed.

References

Brannick, M. T.; Levine, E. L.; Morgeson, F. P. (2007). *Job and work analysis: Methods, research and applications for human resource management*. Thousand Oaks, CA: Sage.

Raymond, M.R. (2001). Job analysis and the specification of content for licensure and certification examinations. *Applied Measurement in Education 14*(4), 369–415.

Nomenclature

Table B-1 provides a list of the acronyms and abbreviations used in this appendix. In addition to increasing the efficiency of communications, many technical and process acronyms are useful in memory retention and learning. Occupational acronyms are therefore of interest to trainers and curriculum designers.

Table B-1. List of Acronyms and Abbreviations

Nomenclature	Definition
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
DACUM	Developing a curriculum
ECM	Energy conversation measure(s)
EPA	Environmental protection agency
JTA	Job/task analysis
HUD	Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
MF	Multifamily

Nomenclature	Definition
MSDS	Material safety data sheet
OSHA	Occupational Safety and Health Administration
PPE	Personal protective equipment
QC	Quality control
SME	Subject matter expert
TAB	Testing, adjusting, and balancing

Proposed Content Outline

The SMEs rated the list of job-related tasks composing duties defined during the JTA workshop based on a two-factor scale: the importance of the duty area to overall job performance and the frequency with which duties are performed. The result is a weighted ranking of the duties and tasks known as a *content blueprint*. After reviewing the results of their ratings, SMEs were asked to make qualitative judgments as to how they would adjust the ratings to reflect their practice. However, the SMEs elected to keep the original weights.

The proposed content blueprint provides an initial basis from which an assessment (e.g., a certification or licensure examination) may be constructed and provides curriculum developers with a model to align training to the core needs of the occupation.

Table B-2. Proposed Content Outline for Multifamily Quality Control Inspectors

	Duties and Tasks	Weighting
A	Reviewing Project Documents	18.99%
1	Review Program Requirements	3.35%
2	Review Building Performance Assessment	3.21%
3	Review Scope of Work	3.35%
4	Evaluate Projected Energy Savings	3.07%
5	Review Building Plans/Specifications	2.93%
6	Review Construction Documentation	3.07%
B	Developing Quality Control Plan	18.16%
1	Determine Sampling Protocols	3.21%
2	Determine Quality Control Test Requirements	2.79%
3	Identify Roles and Responsibilities	2.79%
4	Create Quality Control Inspection Checklist	3.21%
5	Develop Quality Control Inspection Schedule	3.07%
6	Communicate Quality Control Plan with Stakeholders	3.07%
C	Conducting Pre-Installation Site Visits	8.24%
1	Participate in Pre-Installation Meeting	2.51%

	Duties and Tasks	Weighting
2	Conduct Walk-Thru	2.93%
3	Update Quality Control Plan to Reflect Site Visit	2.79%
D	Conducting Site Visits	41.76%
1	Evaluate Work Practices	2.93%
2	Communicate Quality Control Expectations Throughout Site Visit	3.07%
3	Inspect Water Conservation Measures	2.93%
4	Inspect Building Insulation Measures	3.35%
5	Inspect Mechanical Insulation Measures	3.35%
6	Inspect Air Barrier	3.35%
7	Inspect Window/Door installations	3.07%
8	Inspect Domestic Hot Water Measures	3.35%
9	Inspect Heating, Ventilation, and Air Conditioning System Measures	3.35%
10	Inspect Control Measures	3.35%
11	Inspect Lighting Measures	3.35%
12	Perform Health and Safety Inspection	3.21%
13	Inspect Appliance Measures	3.07%
E	Reporting Quality Control Inspection Observations and Findings	12.85%
1	Organize Inspection Documents	3.21%
2	Analyze Quality Control Inspection Data	3.21%
3	Develop Inspection Report	3.21%
4	Communicate Quality Control Inspection Results to Stakeholders	3.21%
		100.00%

Knowledge

The SMEs identified and categorized specific types of knowledge needed to be a proficient multifamily quality control inspector (Table B-3). General knowledge areas (calculations, basic measurements, and communications), although not exclusive to this occupation, were also identified using a group consensus process (Table B-4). The panelists concluded that a practitioner must master the knowledge in both tables to be competent as a multifamily quality control inspector.

Table B-3. Specialized Knowledge Required of Multifamily Quality Control Inspectors

Specialized Knowledge	
Air sealing materials	Air sealing measures
Appliance performance ratings	ASHRAE
Basic accounting	Best work practices

Specialized Knowledge	
Blower door testing	Reading Blueprints
Building construction types	Building insulation
Building maintenance	Building occupant schedule conflicts
Building operating procedures	Building performance assessment
Building schematics	Building science
Building specifications	Building system interactions
Building systems	Carbon dioxide sensors
CO safety issues	Carbon monoxide detector
Codes, standards, and regulations	Combustion safety
Combustion safety testing	Combustion testing
Common trade practices	Construction building types
Construction sequence	Control integration
Control systems	Controls
Data fields associated with various tests	Distribution systems
Domestic hot water system technologies	Draft test
ECM installation requirements	ECMs
Electrical safety	Emergency egress
Emergency lighting	Energy conservation technologies
Energy modeling	Engineering
EPA regulations	EPA requirements
Equipment specifications	Financial analysis
General trade practices	HVAC system technologies
Industry standards	Inspection sequence
Installation techniques	Insulation materials
Insulation measures	Life safety systems
Light fixture technologies	Lighting controls
Lighting levels	Manufacturer's installation requirements
Manufacturers' specifications	Measurement techniques
Mechanical insulation	Metering techniques
Multifamily building staffing structure	Multifamily notification rules
	Modeling software
Operations and maintenance	OSHA regulations
Performance test result parameters	Program guidelines
Program requirements	Quality control

Specialized Knowledge	
Sampling techniques	Site conditions
Smoke alarm installation and function	System controls
Testing equipment	Testing procedures
Testing protocols	Thermodynamics
Typical realized savings	Utility bill analysis
	Vent categories
Ventilation standards	Warranty language
Water conservation measures	Window performance ratings
Zonal testing	

Table B-4. General Knowledge Required of Multifamily Quality Control Inspectors

General Knowledge	
Calculations	
Change numbers from fractions into decimals and back	Change numbers from percentages into decimals and back
Collect information to solve a problem	Compare numbers
Figure averages	Make rough estimates
Measure angles	Multiply and factor algebraic expressions
Perform angular calculations	Perform math operations using exponential numbers
Perform math operations using signed (positive and negative) numbers	Perform math operations using single and multiple digit numbers
Perform mathematical operations with decimals	Perform mathematical operations with fractions
Perform simple math operations of addition	Perform simple math operations of division
Perform simple math operations of multiplication	Perform simple math operations of subtraction
Solve formula calculations with more than one unknown	Solve formula calculations with one unknown
Solve percent problems	Solve problems with graphs
Solve ratio problems	Solve right triangle problems using Pythagorean theorem
Transfer number sequences from a source into a column	Use a calculator
Basic Measurements	
Calculate the perimeter and areas of common figures	Convert measurements from one unit to another (English to Metric, etc.)
Estimate and approximate measurements	Find distances and directions on land maps
Find the dimensions of an object from a scale drawing	Make simple scale drawings
Measure area (square inches, square centimeters, etc.)	Measure board feet
Measure length to 1/16 of an inch	Measure linear distances (length, width, etc.)
Measure temperature to within 1 degree Fahrenheit	Measure volume (cubic inches, liters, etc.)
Read and apply coefficient measurements indicated in a table or chart	Read and use the scale of a drawing
Read measurements taken with common measuring tools	Read, interpret, and use size-scale relationships
Record measurements, using appropriate unit notations (feet, yards, etc.	Use tools to measure quantities and solve problems involving measurements
Communications	
Apply assertiveness	Ask questions

General Knowledge	
Communicate using the vocabulary/terminology of a related trade	Communicate with co-workers and/or business people in writing (letters, memos)
Communicate with co-workers and/or business people verbally (face-to-face)	Communicate with co-workers and/or business people verbally (telephone, radio)
Compare names	Evaluate options/alternatives
Evaluate solutions	Explain procedures
Find information in catalogs	Find information in references (machinery handbook, tap/drill charts, etc.)
Follow verbal job instructions	Listen
Participate in brainstorming	Present to others
Read and follow a map, chart, plan, etc.	Read and follow directions found in equipment manuals and code books
Read and interpret directions found on labels, packages, or instruction sheets	Read codes (building codes, electrical codes, standards, etc.)
Read drawings and specifications sheets	Read flowcharts
Read information from tables and graphs (bar, circle, etc.)	Read statistical data
Research information	Summarize information
Write reports	Write words and numbers legibly

Skills, Abilities, and Attributes

A proficient worker possesses key skills, abilities, and attributes that influence job success. Skills are developed through experience and training and may apply to a wide range of tasks; proper skills enable workers to perform their tasks with precision and quality.

Abilities and attributes are more fundamental than knowledge and skills; they represent underlying, enduring traits, both cognitive and physical, that support the successful performance of a wide range of job tasks.

The panelists identified task-specific skills and abilities, as well as broad attributes (e.g., analytic, creative, patient); to define the recommended traits a multifamily quality control inspector should possess (Table B-5).

Human resource professionals and job analysts often analyze skills, abilities, and attributes to compare jobs in terms of worker characteristics.

Table B-5. Skills, Abilities, and Attributes Required of Multifamily Quality Control Inspectors

Skills, Abilities, and Attributes	
Accuracy	Adaptable/Flexible
Analytical	Appropriate dresser
Assertiveness	Basic math
Blower door testing	Blueprint reading
Caring	Combustion safety testing
Combustion testing	Common sense
Communication	Compassionate
Comprehension	Computer
Confident	Conscientious
Cooperative	Courteous
Creative	Critical thinking
Customer-oriented	Dependable
Detail-oriented	Eager to learn new things
Editing	Empathetic
Energy metering	Energy modeling
Enthusiasm	Ethical
Fixture wattage calculations	Flexibility
Focused	Free of substance abuse
Friendly	Goal-oriented
Helpful	Honest
Industrious	Initiative
Integrity	Interpretation
Interviewing	Investigative
Lack of prejudice (bias)	Leader
Listening	Manage stress/pressure
Measurement	Methodical
Multitasking	Neat
Negotiation	Non-aggressive
Observation	Open-minded to change
Organizational	Patience
Persistence	Personable
Persuasive	Physical stamina
Planning	Positive attitude
Presentation	Pride in job

Skills, Abilities, and Attributes	
Problem-solving	Process oriented
Professional	Punctual
Quality focused	Read project timeline
Reading	Research
Research	Respectful
Responsible/accountable	Safety conscious
Scheduling	Self-control
Self-discipline	Self-esteem
Self-motivated	Sense of humor
Sensitive to thoughts of others	Social skills
Spatial Recognition	Spreadsheet
Tactful	Team player
Technical reading	Technical writing
Thermography	Time management
Tolerant	Training
Trustworthy	Work efficiently (resources)
Work efficiently (time)	
Zonal testing	

Physical Conditions

In any job, the environment in which tasks are completed and the specific physical requirements necessary to complete each task must be understood. Awareness of physical conditions is useful for a variety of purposes, including ergonomic design, safety analysis, and the identification of job elements that are deemed essential functions for compliance with the Americans with Disabilities Act.

Table B-6 contains the list of panelist-recommended physical conditions a multifamily quality control inspector should possess.

Table B-6. Physical Conditions Recommended for Multifamily Quality Control Inspectors

Physical Conditions	
Bend forward frequently	Carry heavy objects while climbing (ladders, scaffolding, etc.)
Carry objects of up to 50 pounds	Climb ladders, stairs, poles, etc. using legs and/or arms
Crawl or creep	Detect abnormal noises
Feel size, shape and temperature or texture of objects with the hands	Hear speech

Physical Conditions	
Hold or move objects using the fingers	Judge depth (the position and distance of objects) with the eyes
Lay on back	Lift 50 pounds maximum
Lift objects from ground to overhead level	Lift objects from ground to waist level
Lift objects from waist to overhead level	Pull objects with arms or hands
Push objects with arms or hands	Reach with arms and hands in any direction
See clearly at 20 feet or more (with/without optical assistance)	See clearly at 20 inches or less (with/without optical assistance)
Sit part of the time	Stand all of the time
Stand at all (could the work be performed from a sitting position?)	Stand part of the time
Stoop kneel or crouch	Talk
Walk	Work around or near high voltage power sources or equipment
Work at heights of 1 to 25 feet above ground or floor level	Work in a squatting position for more than 5 minutes per hour
Work in changing temperatures (in and out of buildings repeatedly)	Work in confined spaces
Work in damp places (high humidity, some standing water)	Work in dry places (lacking any natural moisture or humidity)
Work in dust, oils, fumes, or smells	Work in high temperatures (85 to 130 degrees Fahrenheit)
Work in low temperatures (0 to 45 degrees Fahrenheit)	Work in noisy places (85 decibels or higher with ear protection)
Work in one place (no change of work location)	Work in stale air (with some oxygen depletion)
Work inside	Work on slippery surfaces
Work outside	Work while standing on portable ladders
Work while standing on scaffolding	Work while wearing protective equipment (respirators, hoods, etc.)
Work with hands and arms over head level	Work with or near fiberglass or asbestos materials

Tools, Equipment, and Resources

Each occupation requires a unique set of support materials. It is important to identify the tools, equipment, and other tangible objects, as well as the resources (e.g., information technologies, codes, and standards) required for a worker to effectively accomplish tasks. Table B-7 lists the panelist-identified inventory of tools, equipment, and resources necessary to perform the identified tasks.

Table B-7. Tools, Equipment, and Resources Used by Multifamily Quality Control Inspectors

Tools, Equipment, and Resources	
General Tools, Equipment, and Resources	
Codes, standards and regulations	Calculator
Computer	Email
Energy modeling software	Engineering manuals
Equipment manuals	Field manuals
Inspection equipment	Inspection tools
Internet	Manufacturer's installation requirements
Manufacturers' specifications	Mode of transportation
Modeling software	MSDS
Paper	Pen
Phone	Photographs
PPE	Printer
Product data sheets	Program manual
Program guidelines	Program requirements
Program specifications	Rulers
Sampling protocol	Scales
Spreadsheet software	Test equipment manuals
Word processing software	
Inspection Equipment	
Anemometer	Ballast checker
Blower door	Camera
Combustion analyzer	Digital tape measure
Drill	Duct leakage testing equipment
Electrical outlet tester	Flashlight
Flow bag	Flow hood
Gas leak detector	Glass checker
Infrared Camera	Ladder
Light meter	Manometer
Mirror	Multimeter
Pipe caliber	Pressure pan
Relative humidity meter	Screwdriver
Set of wrenches	Smoke stick
Stopwatch	Tape measure

Tools, Equipment, and Resources	
Thermometer	
General Trade Practices	
Carpentry responsibilities	Change orders
Construction manager roles	Construction timelines
Contracts	Electrical responsibilities
Estimator roles	Foreman roles
General contractor roles	Insulation responsibilities
Laborer responsibilities	Mechanical responsibilities
Plumbing responsibilities	Project manager roles
Standard equipment	Standard installation methods
Standard materials	Standard tools
Sub-contractor roles	Trade workflow
Typical workflow (prep, rough, final, punch)	Worker roles
Personal Protective Equipment (PPE)	
Ear plug	Fall protection
First aid kit	Gloves
Hard hat	Personal carbon monoxide meter
Respirator	Safety glasses
Shoe booties	Tyvek suit
Work shoes	

DACUM Chart

The DACUM chart (Table B-8) is a tabular representation of the JTA. Capital letters identify major job duty areas. Numbers identify tasks, and lowercase letters identify the steps required to accomplish each task. Moving horizontally across the chart, adjacent columns detail (1) specialized knowledge, (2) skills and abilities, and (3) tools, equipment, and resources required to perform each task. The information contained in these columns is related to each task and does not necessarily correspond to a specific step.

The importance of the DACUM chart is to show the relationship between job tasks and the specialized knowledge, skills and abilities, and tools, equipment, and resources required to perform each task. This concept, called *job-relatedness*, is essential to compliance with key legal and professional validity standards pertaining to the use of JTA information in employee selection. Such information is also critical to the development of high-stakes assessments for occupational licensing and certification examinations.

The DACUM chart depicts the job element relationships associated with each task and can therefore easily be used to assess the relevance of current programs (curriculum), develop

instructional objectives and training content, sequence instructional materials, and develop examination, competency, and performance evaluation instruments.

Table B-8. DACUM Chart for Multifamily Quality Control Inspectors

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
A	Reviewing Project Documents			
1	Review Program Requirements			
a	Acquire program documents	Program requirements Various programs	Analytical Basic math Research Technical reading	Calculator Computer Phone
b	Identify program goals			
2	Review Building Performance Assessment			
a	Review building performance assessment documentation	Codes, standards, and regulations Building construction types Building performance assessment Building science Building systems Control systems Modeling software Program requirements	Analytical Communication Energy modeling Investigative	Codes, standards, and regulations Computer Email Engineering manuals Internet Modeling software Phone Product data sheets Spreadsheet software Word processing software
b	Review building performance assessment model			
c	Review existing building conditions			
d	Review building performance assessment assumptions			
e	Interview building performance assessor			
f	Identify project goals			
g	Compare building performance assessment results to program requirements			
h	Report findings of building performance assessment review			
3	Review Scope of Work			
a	Review ECMs	ASHRAE Codes, standards, and regulations Building operating procedures Building performance	Analytical Computer Research	Computer Spreadsheet software
b	Identify recommended but deferred measures			
c	Review health and safety measures			
d	Review other planned work			
e	Verify project scope meets program goals			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
f	Document program requirements not met	assessment Building science Building systems Common trade practices Control systems ECMs Engineering OSHA regulations		
g	Review building regulation requirements			
h	Identify performance metric assumptions			
i	Review installation cost estimates			
4	Evaluate Projected Energy Savings			
a	Review existing conditions	Codes, standards, and regulations Building construction types Building performance assessment Building schematics Building science Building systems Control systems ECMs Financial analysis Modeling software Program requirements Typical realized savings	Analytical Blueprint reading Energy modeling	Codes, standards and regulations Modeling software Program requirements Spreadsheet software
b	Review projected energy savings calculations			
c	Review modeling software inputs			
d	Determine if projected energy savings meets program requirements			
e	Verify performance metric assumptions match savings calculations			
f	Document findings			
5	Review Building Plans/Specifications			
a	Verify building plans/specifications align with scope of work	Codes, standards, and regulations Building schematics Building science Building specifications	Blueprint reading Detail-oriented Measurement Research	Codes, standards, and regulations Computer Equipment manuals Photographs
b	Verify building plans/specifications align with performance metrics			
c	Document deficiencies			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
d	Document substitutions	Building systems General trade practices		Printer Product data sheets Program manual
6	Review Construction Documentation			
a	Compare contractor proposals to scope of work	Basic accounting Building schematics Building systems Construction building types General trade practices Program guidelines Quality control	Analytical Basic math Blueprint reading Communication Comprehension Critical thinking Detail-oriented Interviewing Organizational Research Technical reading	Codes, standards, and regulations Computer Engineering manuals Field manuals Internet Phone Product data sheets Program guidelines
b	Compare contractor proposals to building plans/specifications			
c	Review contractor invoices			
d	Review contractor submittals			
e	Identify deficiencies			
f	Review program submittals			
g	Review project photographs			
h	Verify construction documentation satisfies program guidelines			
i	Interview stakeholders			
j	Request additional documentation from stakeholders			
k	Document findings			
B	Developing Quality Control Plan			
1	Determine Sampling Protocols			
a	Review program quality control requirements	Building schematics Building systems Program guidelines Sampling techniques	Analytical Basic math Blueprint reading Computer Critical thinking	Computer Program requirements Spreadsheet software
b	Review final scope of work			
c	Review construction documentation			
d	Review manufacturer's recommended installation			
e	Review contractor's quality control reports			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
f	Review building plans/specifications		Detail-oriented Organizational	
g	Identify representative samples for inspecting			
2	Determine Quality Control Test Requirements			
a	Review contractor's test plan	Building maintenance Building systems Performance test result parameters Testing equipment Testing procedures	Analytical Critical thinking Detail-oriented Interpretation	Test equipment manuals
b	Compare contractor's test plan to contractual requirements			
c	Interpret contractor's test results			
d	Determine additional tests to be performed by contractor			
e	Determine tests to be performed by QC inspector			
f	Identify testing tools/instrumentation required			
3	Identify Roles and Responsibilities			
a	Determine points of contact for building access	General trade practices MF notification rules MF staffing structures	Assertiveness Communication Leadership Organizational Persistence Scheduling	Computer Internet Phone
b	Establish reporting lines of communication			
c	Identify who needs to be present during QC inspection			
d	Determine QC inspection team			
4	Create Quality Control Inspection Checklist			
a	Determine if QC inspection checklist exists	Building occupant schedule conflicts Construction sequence Data fields associated with various tests Site conditions Testing protocols	Analytical Critical thinking Detail-oriented Editing Flexibility Methodical Organizational Reading	Computer Spreadsheet software Word processing software
b	Develop data collection forms			
c	Create list of stakeholder questions			
d	Identify additional information to be acquired on site			
e	Incorporate sampling protocol into checklist			
f	Incorporate testing requirements into checklist			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
g	Incorporate project document review into checklist		Spreadsheet Technical writing	
h	Incorporate performance metrics into checklist			
5	Develop Quality Control Inspection Schedule			
a	Review project timelines	Construction sequence General trade practices Inspection sequence	Flexibility Patience Persistence Read project timeline Scheduling Time management	Computer
b	Incorporate required site visits			
c	Identify number of inspections			
d	Schedule inspection staff			
e	Identify changes to inspection timing			
f	Solicit feedback from stakeholders on schedule			
g	Create call back schedule			
h	Finalize QC inspection schedule			
6	Communicate Quality Control Plan with Stakeholders			
a	Confirm QC inspection schedule with stakeholders	Construction sequence General trade practices Inspection sequence	Communication	Computer Internet Phone
b	Convey standards work will be measured against to stakeholders			
c	Communicate access requirements to building staff			
d	Communicate who is required at inspections			
e	Update QC plan based on feedback from stakeholders			
C	Conducting Pre-Installation Site Visits			
1	Participate in Pre-Installation Meeting			
a	Present QC inspection plan	Codes, standards, and regulations	Communication Empathetic	Computer Mode of
b	Discuss project scope of work with stakeholders			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
c	Discuss access required for QC inspection	Building systems General trade practices MF building staffing structure	Leadership Listening Presentation	transportation Paper Pen
d	Identify contractor schedule			
e	Identify building occupants' concerns			
f	Record feedback			
2	Conduct Walk-Thru			
a	Inspect work areas	Building systems Construction building types ECM installation requirements General trade practices Testing procedures	Communication Critical thinking Detail-oriented Flexibility Leadership Observation Organizational Problem solving Spatial recognition	Inspection tools
b	Observe access points			
c	Confirm stakeholders are present			
d	Confirm building conditions match those used for work scope development			
e	Identify potential problems with proposed scope of work			
f	Identify missed opportunities for ECMs			
g	Document walk-thru findings			
h	Identify tools for subsequent inspections			
3	Update Quality Control Plan to Reflect Site Visit			
a	Review walk-thru findings	Building systems General trade practices	Communication Critical thinking Flexibility Planning Scheduling	Computer Internet Phone
b	Review inspection schedule			
c	Coordinate quality control plan updates with stakeholders			
D	Conducting Site Visits			
1	Evaluate Work Practices			
a	Compare in-progress work practices against regulations	Codes, standards, and regulations EPA regulations	Communication Interviewing Multitasking	Inspection equipment MSDS
b	Interview crew chief			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
c	Observe workers	General trade practices OSHA regulations	Observation Personable	PPE
d	Interview building occupants			
e	Interview building management			
f	Interview workers			
g	Document work practice findings			
h	Report work practice findings			
2	Communicate Quality Control Expectations Throughout Site Visit			
a	Inform appropriate staff on expected finished product	Codes, standards, and regulations General trade practices Manufacturer's installation requirements Program requirements	Assertiveness Communication Negotiation Persuasive Tactful	Codes, standards, and regulations Manufacturer's installation requirements Paper Pen
b	Provide technical guidance on expected finished product			
c	Provide overall assessment of observed conditions			
d	Report observed deficiencies			
e	Discuss corrective actions			
f	Identify resolution for deficiencies			
g	Conduct debriefing			
h	Document communications			
i	Confirm installed measures do not negatively affect existing building systems			
3	Inspect Water Conservation Measures			
a	Observe water conservation measures	Best work practices Codes, standards, and regulations Industry standards Manufacturers'	Accuracy Basic math Critical thinking Detail-oriented Investigative	Codes, standards, and regulations Inspection tools Manufacturers' specifications
b	Measure performance of water conservation installation			
c	Verify installed water conservation measures meet performance metrics			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
d	Evaluate operations and maintenance plan	specifications Measurement techniques Program guidelines Water conservation measures	Measurement Observational Problem-solving	PPE Program specifications Sampling protocol
e	Document water conservation inspection findings			
4	Inspect Building Insulation Measures			
a	Observe insulation installations	Best work practices Codes, standards, and regulations Building insulation Building science Industry standards Insulation materials Insulation measures Manufacturers' specifications Measurement techniques Program guidelines Thermodynamics	Accuracy Basic math Critical thinking Detail-oriented Investigative Measurement Observation Problem-solving Thermography	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program specifications Sampling protocol
b	Measure insulation levels			
c	Verify insulation installations meet performance metrics			
d	Document findings from insulation installations inspection			
5	Inspect Mechanical Insulation Measures			
a	Observe insulation installations	Best work practices Codes, standards, and regulations Building science Industry standards Insulation materials Insulation measures Manufacturers' specifications Measurement techniques	Accuracy Basic math Critical thinking Detail-oriented Investigative Measurement Observation Problem-solving Thermography	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program specifications Sampling protocol
b	Measure insulation levels			
c	Verify insulation installations meet performance metrics			
d	Document findings from insulation installations inspection			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
		Mechanical insulation Program guidelines Thermodynamics		
6	Inspect Air Barrier			
a	Observe air sealing measures	Air sealing materials Air sealing measures Blower door testing Codes, standards, and regulations Building science Industry standards Manufacturers' specifications Measurement techniques Program guidelines Zonal testing	Accuracy Basic math Blower door testing Critical thinking Detail-oriented Investigative Measurement Observation Problem-solving Zonal testing	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program specifications Sampling protocol
b	Measure air leakage			
c	Verify air sealing installations meet performance metrics			
d	Document findings from air sealing inspection			
7	Inspect Window/Door Installations			
a	Observe window/door installations	Best work practices Blueprints Codes, standards, and regulations Industry standards Installation techniques Manufacturers' specifications Program guidelines Window performance ratings	Accuracy Basic math Blueprint reading Critical thinking Detail-oriented Investigative Measurement Observation Problem solving	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program specifications Sampling protocol
b	Evaluate window/door installations			
c	Verify window/door installations meet performance metrics			
d	Evaluate operations and maintenance plan			
e	Document findings from window/door installations inspection			
8	Inspect Domestic Hot Water Measures			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
a	Observe hot water installations	Best work practices Codes, standards, and regulations Carbon monoxide Combustion safety Combustion testing Controls Distribution systems Domestic hot water system technologies Draft test Industry standards Installation techniques Manufacturers' specifications Program guidelines Testing procedures Vent categories	Accuracy Basic math Combustion safety testing procedures Combustion testing Communication Critical thinking Detail-oriented Interviewing Investigative Measurement Observation Problem solving	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program specifications Sampling protocol
b	Evaluate hot water installations			
c	Review startup documents			
d	Perform combustion testing			
e	Verify hot water installations meet performance metrics			
f	Interview operating engineer			
g	Evaluate operations and maintenance plan			
h	Document findings from hot water installations inspection			
9	Inspect Heating, Ventilation, and Air Conditioning System Measures			
a	Observe HVAC system measures	Best work practices Codes, standards, and regulations Carbon monoxide Combustion safety Combustion testing Controls Distribution systems	Accuracy Basic math Combustion safety testing procedures Combustion testing Communication Critical thinking Detail-oriented Interviewing	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program requirements
b	Interview operating engineer			
c	Evaluate performance of HVAC systems			
d	Evaluate operations and maintenance plan			
e	Review TAB reports	Draft test	Investigative	Sampling protocol

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
f	Review startup documents	HVAC system technologies Industry standards Installation techniques Manufacturers' specifications Operations and maintenance Program guidelines Testing procedures Vent categories	Measurement Observation Problem-solving Training	
g	Measure duct leakage			
h	Measure ventilation			
i	Perform combustion testing			
j	Verify installed HVAC systems meet performance metrics			
k	Document HVAC inspection findings			
10	Inspect Control Measures			
a	Observe control installations	Best work practices Codes, standards, and regulations Control integration Industry standards Manufacturers' specifications Measurement techniques Operations and maintenance Program guidelines System controls Testing procedures	Accuracy Basic math Communication Critical thinking Detail-oriented Interviewing Investigative Measurement Observation Problem-solving Training	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program requirements Sampling protocol
b	Interview operating engineer			
c	Review control measure documents			
d	Review control strategy			
e	Review sequence of operation			
f	Confirm proper operation of controls			
g	Verify installed control settings meet performance metrics			
h	Evaluate operations and maintenance plan			
i	Document control inspection findings			
11	Inspect Lighting Measures			
a	Observe lighting installations	Codes, standards, and regulations Electrical safety Industry standards	Accuracy Basic math Communication Detail-oriented	Codes, standards, and regulations Inspection tools Manufacturers'
b	Interview maintenance staff			
c	Measure performance of lighting system installation			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
d	Verify installed lighting system meet performance metrics	Light fixture technologies Lighting controls Lighting levels Manufacturers' specifications Measurement techniques Program guidelines	Fixture wattage calculations Interviewing Measurement Observation	specifications PPE Program specifications Sampling protocol
e	Verify proper operation of lighting controls			
f	Review lighting control strategy			
g	Evaluate operations and maintenance plan			
h	Document lighting inspection findings			
12	Perform Health and Safety Inspection			
a	Observe health and safety conditions	Building science Carbon dioxide sensors Carbon monoxide detector Combustion safety testing Electrical safety Emergency Egress Emergency lighting EPA requirements Life safety systems OSHA regulations Smoke alarm Ventilation standards	Combustion safety testing Communication Critical thinking Detail-oriented Interviewing Investigative Observation Problem solving Training	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program requirements Sampling protocol
b	Observe health and safety installations			
c	Perform required health and safety testing			
d	Verify health and safety installations meet requirements			
e	Report unsafe conditions			
f	Evaluate operations and maintenance plan			
g	Report health and safety inspection observations and findings			
13	Inspect Appliance Measures			
a	Observe appliance installations	Appliance performance ratings Best work practices Codes, standards, and regulations Installation techniques Manufacturers' specifications	Accuracy Basic math Critical thinking Detail-oriented Energy metering Investigative Measurement Observation	Codes, standards, and regulations Inspection tools Manufacturers' specifications PPE Program specifications
b	Verify appliance installations meet performance metrics			
c	Evaluate operations and maintenance plan			
d	Document findings from appliance installations inspection			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
		Metering techniques Program guidelines		Sampling protocol
E	Reporting Quality Control Inspection Observations and Findings			
1	Organize Inspection Documents			
a	Collect inspection documents	Equipment specifications Program requirements Warranty language	Communication Detail-oriented Organizational Research Technical writing	Computer Spreadsheet software Word processing software
b	Identify scope of work substitutions			
c	Collect equipment specifications			
d	Identify missing information from QC plan			
e	Acquire missing information			
2	Analyze Quality Control Inspection Data			
a	Compare inspection findings to required performance metrics	Building system interactions Building systems ECMs Energy conservation technologies Energy modeling Financial analysis General trade practices Utility bill analysis	Analytical Communication Detail-oriented Energy modeling Organizational Research Technical writing	Computer Energy modeling software Spreadsheet software Word processing software
b	Recalculate energy savings based on inspection findings			
c	Verify installed scope of work meets program requirements			
d	Evaluate success of work scope implementation			
e	Determine need for additional site visits			
f	Identify process improvements			
g	Identify current or planned capital improvements that affect ECM scope			
3	Develop Inspection Report			
a	Formulate overall assessment of work status	Building systems ECMs Energy conservation	Analytical Communication Detail-oriented	Computer Spreadsheet software
b	Document deficiencies			
c	Document proposed corrective actions			

	Duties, Tasks, and Steps	Special Knowledge	Skills and Abilities	Tools, Equipment, and Resources
d	Document accepted corrective actions	technologies General trade practices	Organizational Research Technical writing	Word processing software
e	Complete required program documentation			
f	Document missed opportunities			
4	Communicate Quality Control Inspection Results to Stakeholders			
a	Deliver report to stakeholders	Building systems Program requirements	Communication Confident Detail-oriented Leadership Presentation Process oriented Technical writing	Computer
b	Review report with stakeholders			
c	Finalize report			
d	Recommend process improvements			

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Appendix C. Announcement of the Multifamily Job/ Task Analysis Online Validation Study

June 19, 2013

Professional Testing, Inc. and the National Renewable Energy Laboratory invite you to participate in a nationwide research study, validating the practices, characteristics, and activities of four multifamily building job categories. This is your opportunity to directly contribute to the development of the multifamily home energy upgrade workforce.

If you are a practitioner in one or more of the four multifamily building job categories listed below, please complete the corresponding study as soon as possible (by the end of June is preferable). Your participation should take approximately 20–30 minutes, and individuals may complete more than one validation study, if applicable.

This validation study is the next step in developing Job Task Analyses (JTAs), which will help define the duties, tasks, and skills needed to perform each of the jobs listed below.

- Multifamily Energy Auditor
- Multifamily Retrofit Project Manager
- Multifamily Building Operator
- Multifamily Quality Control Inspector

Please note: The above studies should only be completed by professionals who have actual job experience or who have trained those performing the job, specifically for multifamily buildings.

Your participation is voluntary and individual responses will be kept confidential. Your responses will be combined with those from other respondents and used to improve the job descriptions for the multifamily building energy upgrade workforce.

Additionally, we would greatly appreciate any help you could provide in sharing this request with other individuals and stakeholder groups who also participate in the specified multifamily job categories.

The comment period will remain open until July 19, 2013. You may direct any questions to workforce.guidelines@nrel.gov. Thank you in advance for your participation in this important process.

Sincerely,

The NREL Multifamily JTA Project Team

If you have any questions or comments about this email bulletin, please contact workforce.guidelines@nrel.gov.

Appendix D. Validation Study

Multifamily QC Inspector JTA Validation Study

Welcome

Professional Testing and the National Renewable Energy Laboratory (NREL) are asking for your participation in an industry study critical to the profession of Multifamily Building Quality Control (QC) Inspector. The goal of the study is to determine the essential tasks that describe the role of today's Multifamily QC Inspector.

While Multifamily QC Inspectors work in a variety of settings and specialties, this study depends on your individual experience and opinion relating to your role as a Multifamily Building QC Inspector.

The study is divided into three sections:

Demographic information - The first step in completing this study is to provide demographic information. The information you provide in this section will be used to ensure that a representative sample of responses is received, thus providing a better understanding of the variations that occur in performing the job of Multifamily QC Inspector.

Task ratings - The second section presents the tasks performed by Multifamily QC Inspector. The tasks are organized into five performance domains: Reviewing Project Documents; Developing Quality Control Plan; Conducting Pre-Installation Site Visits; Conducting Site Visits; and Reporting QC Inspection Observations and Findings. You will be asked to rate each task on two scales: (1) the frequency of task performance and (2) the importance of the task to overall job performance.

Additional comments - A panel of subject matter experts (SMEs), representing diverse backgrounds, education, and work environment experiences in multifamily quality control inspection, identified this list of important tasks. However, if after completing the study you feel that there are critical tasks that were not included, you will have an opportunity to identify additional tasks.

The definition of a multifamily building for purposes of this study is: any dwelling that contains living units, which share one or more building systems.

Your responses will be kept confidential, and we appreciate your participation. If you have any difficulty accessing or completing this study, please contact us at cowens@proftesting.com or call (800) 330-3776.

To begin, click on the Next button below.

Multifamily QC Inspector JTA Validation Study

Demographics

Please answer the following demographic questions. Your responses will be kept confidential and this information will only be used for statistical purposes.

What is the size of your organization?

- ◯ 1-10 people
- ◯ 11-50 people
- ◯ 51-500 people
- ◯ more than 500 people

In which state do you work?

In which sector do you currently work?

- ◯ Public (government at any level)
- ◯ Private

Which of the following jobs have you held in the multifamily (MF) building sector?

(Select all that apply)

- ☐ MF Energy Auditor
- ☐ MF Retrofit Project Manager
- ☐ MF Building Operator
- ☐ MF Quality Control Inspector
- ☐ Other (please specify)

Which of the following categories best describe your current position?

- ◯ MF Quality Control Practitioner
- ◯ MF Quality Control Curriculum Developer
- ◯ MF Quality Control Trainer/Proctor
- ◯ Other (please specify)

Multifamily QC Inspector JTA Validation Study

How many years of experience have you had working as a Multifamily Quality Control Inspector (total combined years)?

- ◯ None
- ◯ 5 Years or Less
- ◯ 6-10 Years
- ◯ 11-15 Years
- ◯ 16-20 Years
- ◯ More than 20 Years

How many years of total experience do you have in the multifamily building industry (all jobs)?

- ◯ None
- ◯ 5 Years or Less
- ◯ 6-10 Years
- ◯ 11-15 Years
- ◯ 16-20 Years
- ◯ More than 20 Years

What is your highest completed level of education?

- ◯ Some High School
- ◯ High School
- ◯ Some College
- ◯ Technical/Vocational School
- ◯ Bachelor's Degree
- ◯ Graduate Degree

To what professional societies/organizations do you belong?

(Select all that apply)

- [ ] None
- [ ] AABC Commissioning Group (ACG)
- [ ] American Institute of Architects (AIA)
- [ ] American Society of Civil Engineers (ASCE)
- [ ] American Society of Mechanical Engineers (ASME)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- [ ] APPA
- [ ] Association for the Advancement of Cost Engineering (AACE)
- [ ] Association for Facilities Engineering
- [ ] Association of Energy Engineers (AEE)
- [ ] Building Commissioning Association (BCA)
- [ ] Building Owners and Managers Association (BOMA)
- [ ] Construction Specifications Institute (CSI)
- [ ] International Association of Plumbing and Mechanical Officials (IAPMO)
- [ ] International Building Performance Simulation Association (IBPSA)
- [ ] International Code Council (ICC)
- [ ] International Facility Management Association (IFMA)
- [ ] International Union of Operating Engineers (IUOE)
- [ ] Institute of Electrical and Electronics Engineers (IEEE)
- [ ] Laborers' International Union of North America (LIUNA)
- [ ] National Fire Protection Association (NFPA)
- [ ] National Institute of Building Sciences (NIBS)
- [ ] Service Employees International Union
- [ ] Sheet Metal Workers' International Association (SMWIA)
- [ ] United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA)
- [ ] United Brotherhood of Carpenters
- [ ] United Steelworkers (USW)
- [ ] U.S. Green Building Council (USGBC)
- [ ] Other (please specify)

What building performance credentials do you currently hold?

(Select all that apply)

- [ ] None
- [ ] AABC Commissioning Group Certified Commissioning Authority (CxA)
- [ ] AABC Commissioning Group Certified Commissioning Technician (CxT)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers Building Energy Modeling Professional (BEMP)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers Commissioning Process Management Professional (CPMP)
- [ ] American Society of Heating, Refrigerating and Air-Conditioning Engineers Operations and Performance Management Professional (OPMP)
- [ ] Association for Facilities Engineering Certified Plant Engineer (CPE)
- [ ] Association for Facilities Engineering Certified Plant Maintenance Manager (CPMM)
- [ ] Association for Facilities Engineering Certified Plant Supervisor
- [ ] Association of Energy Engineers Certified Building Energy Simulation Analyst (BESA)
- [ ] Association of Energy Engineers Certified Building Commissioning Professional (CBCP)
- [ ] Association of Energy Engineers Certified Energy Auditor (CEA)
- [ ] Association of Energy Engineers Certified Energy Manager (CEM)
- [ ] Association of Energy Engineers Existing Building Commissioning Professional (EBCP)
- [ ] Association of Energy Engineers Energy Manager in Training (EMIT)
- [ ] Association of Energy Engineers/Efficiency Valuation Organization Certified Measurement and Verification Professional
- [ ] BOMI International Facilities Management Administrator (FMA)
- [ ] BOMI International Real Property Administrator (RPA)
- [ ] BOMI International Systems Maintenance Administrator (SMA)
- [ ] BOMI International Systems Maintenance Technician (SMT)
- [ ] Building Commissioning Association Certified Commissioning Professional (CCP)
- [ ] Building Operator Certification – Level I (BOC Level I)
- [ ] Building Operator Certification – Level II (BOC Level II)
- [ ] BPI Energy Auditor
- [ ] BPI Retrofit Installer
- [ ] BPI Crew Leader
- [ ] BPI Quality Control Inspector
- [ ]

- [ ] BPI Building Analyst
- [ ] BPI Envelope Professional
- [ ] BPI Residential Building Envelope Whole House Air Leakage Control Installer
- [ ] BPI Manufactured Housing Professional
- [ ] BPI Heating Professional
- [ ] BPI Air Condiditioned Heat Pump Professional
- [ ] BPI Multifamily Professional
- [ ] The City University of New York Energy Management and Indoor Air Quality Certification
- [ ] Energy Audit Institute Commercial Energy Audit Certification
- [ ] General Professional Accreditations Licensed Architect
- [ ] General Professional Accreditations Professional Engineer (PE)
- [ ] International Facility Management Association Facility Management Professional (FMP)
- [ ] International Facility Management Association Certified Facility Manager (CFM)
- [ ] National Energy and Sustainability Institute Commercial Energy Auditor Certification
- [ ] National Environmental Balancing Bureau Building Systems Commissioning Certified Professional
- [ ] National Environmental Balancing Bureau Retro Commissioning Certified Professional
- [ ] Northwest Energy Education Institute Energy Management Certification (EMC)
- [ ] Testing, Adjusting, and Balancing Bureau Certified Commissioning Contractor (CCC)
- [ ] Testing, Adjusting, and Balancing Bureau Certified Commissioning Supervisor (CCS)
- [ ] University of California, Davis Professional Certification in Energy Resource Management
- [ ] The University of Wisconsin, Madison Commissioning Process Certification
- [ ] U.S. Green Building Council LEED AP BD+C
- [ ] U.S. Green Building Council LEED AP Homes
- [ ] U.S. Green Building Council LEED AP ID+C
- [ ] U.S. Green Building Council LEED AP ND
- [ ] U.S. Green Building Council LEED AP O+M
- [ ] U.S. Green Building Council LEED Green Associate
- [ ] Other (please specify accreditation and conferring organization)

Multifamily QC Inspector JTA Validation Study

How did you hear about this study?

- ◯ Listserve
- ◯ Direct email invitation
- ◯ Received forwarded invitation from a colleague
- ◯ BLOG
- ◯ Website
- ◯ Other (please specify)

Multifamily QC Inspector JTA Validation Study

Task Ratings

Below is a list of tasks performed by **Multifamily QC Inspectors**.

The tasks are organized into five performance domains: Reviewing Project Documents; Developing Quality Control Plan; Conducting Pre-Installation Site Visits; Conducting Site Visits; and Reporting QC Inspection Observations and Findings.

In this section you will rate each task on two dimensions – *Frequency* and *Importance* – according to the rating scales below:

FREQUENCY - Rate each task statement based on the average frequency that you perform the task:

Never perform
Occasionally perform
Perform fairly often
Perform very often

IMPORTANCE - Rate each task statement based on how important the task is to the performance of the job:

Not important
Somewhat important
Important
Very important

(To answer, use your mouse to click the down arrow to reveal a set of options. Then select an option for both Frequency and Importance. To change your selection, click on another option in the drop down menu.)

Reviewing Project Documents:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Review Program Requirements		
Review Building Performance Assessment		
Review Scope of Work		
Evaluate Projected Energy Savings		
Review Building Plans/Specifications		
Review Construction Documentation		

Multifamily QC Inspector JTA Validation Study

Developing Quality Control Plan:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Determine Sampling Protocols		
Determine Quality Control Test Requirements		
Identify Roles and Responsibilities		
Create Quality Control Inspection Checklist		
Develop Quality Control Inspection Schedule		
Communicate QC Plan with Stakeholders		

Conducting Pre-Installation Site Visits:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Participate in Pre-Installation Meeting		
Conduct Walk-Thru		
Update Quality Control Plan to Reflect Site Visit		

Multifamily QC Inspector JTA Validation Study

Task Ratings

Below is a list of tasks performed by **Multifamily QC Inspectors**.

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Not important
Somewhat important
Important
Very important

(To answer, use your mouse to click the down arrow to reveal a set of options. Then select an option for both Frequency and Importance. To change your selection, click on another option in the drop down menu.)

Multifamily QC Inspector JTA Validation Study

Conducting Site Visits:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Evaluate Work Practices		
Communicate Quality Control Expectations Throughout Site Visit		
Inspect Water Conservation Measures		
Inspect Building Insulation Measures		
Inspect Mechanical Insulation Measures		
Inspect Air Barrier		
Inspect Window/Door installations		
Inspect Domestic Hot Water Measures		
Inspect HVAC System Measures		
Inspect Control Measures		
Inspect Lighting Measures		
Perform Health and Safety Inspection		
Inspect Appliance Measures		

Reporting QC Inspection Observations and Findings:

	Frequency - How frequently is this task performed?	Importance - How important is the task to the performance of the job?
Organize Inspection Documents		
Analyze QC Inspection Data		
Develop Inspection Report		
Communicate QC Inspection Results to Stakeholders		

Multifamily QC Inspector JTA Validation Study

Additional Comments

Are there any tasks that are missing from this survey?

- ◯ No
- ◯ Yes

If yes, what?

Would you like to provide any additional comments?

- ◯ No
- ◯ Yes

If yes, what?

Multifamily QC Inspector JTA Validation Study

Thank you!

You have completed the study. Professional Testing, Inc. and NREL would like to thank you for taking the time to participate in the Multifamily Quality Control Inspector JTA development process. Your input is much appreciated!

If you have any questions about the Multifamily JTA Project, please contact NREL at workforce.guidelines@nrel.gov.