

Candidate Guidebook Building Commissioning Professional (BCxP)



Certified



ISO/IEC 17024
Personnel Certification Program
#1139



RECOGNIZED PROGRAM

MEETS U.S. DEPARTMENT
OF ENERGY GUIDELINES

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I. About ASHRAE

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international membership society committed to the advancement of the arts and sciences of heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world. The Building Commissioning Professional (BCxP) certification program supports this Mission by validating job competency as understood in internationally recognized technical information, reflecting the best practices that lead our industry.

ASHRAE does not discriminate on the basis of race, color, sex, religion, disability, or national or ethnic origin in its policies, procedures, or eligibility requirements for its programs.



Purpose of the BCxP Certification

The BCxP certification program, an ANSI-Accredited Personnel Certification Program under ISO/IEC 17024 (#1139), validates competency *to lead, plan, coordinate and manage a commissioning team to implement commissioning processes in new and existing buildings.*

Value

As of July, 2020, over 3,000 ASHRAE certifications have been earned in these key built-environment fields: Building Operations | Commissioning | Energy Assessment | Energy Modeling | Healthcare Facility Design | High-Performance Building Design | HVAC Design. Recognized by over 35 national, state and local government bodies, ASHRAE certifications increasingly have become the must-have credential for built-environment professionals, employers and building owners.

With unique candidate metadata embedded, the BCxP [digital badge](#) shares information about a candidate's knowledge, skills and abilities, while guaranteeing enhanced visibility and recognition in electronic media.



The Building Commissioning Professional (BCxP) certification has been recognized by the U.S. Department of Energy (DOE) as meeting the Better Buildings Workforce Guidelines (BBWG). DOE recognition of this ASHRAE certification program positions the employers of BCxPs to compete for federal, state and local government body contracts calling for the services provided by these certified professionals. The NATIONAL INSTITUTE OF BUILDING SCIENCES is the

developer, publisher of and holder of copyright in the Guidelines.

About the Candidate Guidebook

The purpose of this guidebook is to provide information about the ASHRAE BCxP certification program. No information or material in this guide creates a contract between ASHRAE and an individual customer or organization. ASHRAE will do its best to apply the principles and provisions contained within this guidebook as written, but reserves the right to change those principles and provisions without actual notice. Nevertheless, ASHRAE will make reasonable efforts to notify customers of any changes.

II. BCxP Certification Eligibility & Application

Who Can Participate

Participation in the ASHRAE BCxP program requires that an applicant meet education and work experience eligibility requirements and successfully complete the program's examination. Membership in ASHRAE is not a prerequisite to participate in the program.

Completing and Submitting the Application

To participate in the ASHRAE Building Commissioning Professional (BCxP) program, a candidate must complete and submit an application. The application fee includes the fee to sit for the certification exam. Within a week after receiving an application, ASHRAE will notify the applicant by email either of acceptance and approval of the application or of denial of approval and the reason thereof.

Note: candidates must schedule and take the examination within 90 days of approval.

Overview of BCxP Eligibility Requirements

1. Education and Work Experience
2. Three (3) Commissioning Projects
3. Code of Ethics
4. Pass BCxP Certification Exam

Detailed Eligibility Requirements: BCxP Certification

1. Education and Work Experience

Applicants must document meeting one of the following combinations of education and work experience requirements.

Education	Experience
Licensed Architect or Professional Engineer	3 years' commissioning experience
Bachelor's Degree in building sciences* or equivalent military training/experience	5 years' commissioning experience
Associate/Technical/Vocational 2 year degree, non-building sciences bachelor's degree, or equivalent military training/experience	8 years' building industry experience**, with 5 of those years in commissioning experience
High school diploma or GED	10 years' building industry experience**, with 5 of those years in commissioning experience

*Building science education is defined as mechanical engineering, electrical engineering, construction science, construction management, architecture and other majors/fields of study designed to train people for careers in the building industry.

** Building industry experience is defined as design, construction, testing and commissioning, code enforcement and operations.

2. Three (3) Commissioning Projects

Document having participated in three commissioning projects. The projects may not include one- and two-family residential buildings. Over the projects, the applicant must have participated in at least six of the following activities:

1. Development of an OPR/CFR,
2. Develop commissioning plan,
3. Review of a design,
4. Perform field verification,
5. Oversee performance testing,
6. Correction of deficiencies,
7. Training,
8. Prepare commissioning report.

3. Code of Ethics

Applicants must agree to uphold and abide by a Code of Ethics, the tenets of which are set forth as follows:

1. Exercise a reasonable industry standard of care in the performance of professional duties.
2. Perform professional duties with trust, integrity, and honesty.
3. Hold paramount the health and safety of the public in the performance of professional duties.
4. Work in a manner consistent with all applicable laws and regulations; demonstrate integrity, honesty, and fairness in all activities; and strive for excellence in all matters of ethical conduct.
5. Act with integrity in any relationship that involves an employer or client and disclose fully to an affected employer or client any conflicts-of-interest resulting from business affiliations or personal interests.
6. Represent qualifications accurately and honestly.
7. Offer products and services only in areas where competence and expertise will satisfy the client and public need.
8. Agree to comply with and uphold all policies, procedures, guidelines, and requirements of the certification program; use the designation as authorized and only in the approved manner; acknowledge that the certificate and marks are the property of their respective owners; and return the certificate and discontinue use of the designation and marks when required to do so.
9. Accept responsibility for maintaining the credential through recertification and continuously uphold the Code of Ethics.
10. Voluntarily and immediately report any felony convictions or other legal dispositions that would constitute violations of this Code of Ethics that have not already been disclosed, regardless of when they occurred, and report any conditions that prohibit fulfillment of duties as set forth in the competency requirements.

4. Pass BCxP Certification Exam

The BCxP certification examination is a proctored, closed book/closed notes, two and one-half hours (2.5), 130-item multiple-choice exam. Applicants who self-attest that they are a non-native English speaker will receive an additional 30 minutes of testing time. These applicants will be asked to declare their native language and provide the name and email of a professional reference who can confirm the applicant is a non-native English speaker.

A candidate's score is based on 120 of the items; the other 10 items, which are interspersed throughout the examination, are included for trial purposes and are not scored.

The exam blueprint for the BCxP examination is provided in Appendix A.

The three cognitive levels tested on the BCxP examination are as follows:

1. Recall: The ability to remember or recognize specific information
2. Application: The ability to comprehend, relate, or apply knowledge to new or changing situations
3. Analysis: The ability to synthesize information from a variety of sources, determine solutions, and/or evaluate the usefulness of a solution

Please review sections IV. "Examination" and V. "Scheduling an Examination" of the BCxP Candidate Guidebook for additional related information.

Application Fees

ASHRAE Member: \$395.00; Nonmember: \$595.00

ASHRAE Member Exam Retake: \$175.00; Nonmember: \$225.00

ASHRAE Member Second Exam Retake \$395.00; Nonmember \$595.00

If an application is declined by ASHRAE or cancelled by the applicant, the amount of the fee, less \$50 to cover administrative costs, will be refunded to the applicant. Once an examination appointment has been made, candidates may not cancel their application.

Applicants who did not pass their initial CPMP exam may apply for the BCxP at the discounted "Exam Retake" fee.

ASHRAE retains the right to audit any and all applications at any time. If, at any time, the application information submitted is found to be inaccurate, the certification will be revoked, or examination results may be delayed or voided. In such cases, the application fee will not be refunded.

Candidate Responsibilities

Each candidate for the ASHRAE Building Commissioning Professional certification is responsible for the following:

- Submit a completed, signed application form and the application fee,
- Schedule an examination appointment within the 90-day eligibility period,
- Pay a reschedule or cancellation fee if the candidate chooses to cancel or reschedule an exam appointment,
- Comply with the rules for examination,
- Immediately notify ASHRAE of any suspected violations of the rules for examination,
- In the event of certification, successful candidates are required to inform the Certification Committee body, without delay, of matters that can affect their capability to continue to fulfill the certification requirements, or risk suspension or withdrawal of the certification,
- In the event a certificant's certification is suspended or revoked, she/he must return the certificate to ASHRAE. The certificant also must refrain from any further promotion of themselves as an ASHRAE Certified Professional and from future use of all references to an ASHRAE Certified status.

Personal Data

ASHRAE collects and maintains personal data in order to identify certification applicants, validate that the requirements for certification have been fulfilled and to maintain the security of the intellectual property in its exam item banks. Personal data will be maintained until which time it is no longer necessary in order to establish, exercise or defend legal claims.

ASHRAE aggregates exam candidate item responses for exam development and exam security purposes. Examinee responses to ASHRAE exam items are considered to be ASHRAE intellectual property with test security implications; therefore, such derived data are not subject to access, rectification, erasure or portability.

The exam development and delivery employees of ASHRAE vendor PSI Services Inc. (PSI) will have access to ASHRAE certification exam candidate personal data. In the event Certification applicant personal data must be transferred to and from a testing location inside the European Union, PSI Services Inc. (PSI) is self-certified under the Privacy Shield Framework to ensure consistency with General Data Protection Regulation requirements.

III. Examination

Examination Preparation

Neither participating in a preparatory activity nor purchasing a publication is a requirement for participating in the BCxP program or for enrolling to take the BCxP examination. However, candidates who choose to participate in preparatory activities or to purchase publications are responsible for ensuring that the timing of the activity or purchase aligns with the timing of the examination session for which the candidate has enrolled.

Resources available to help prepare for the BCxP certification and CPMP recertification as a BCxP examinations include, but are not limited to, the following:

- Job Task Analysis, Abbreviated (Appendix C) Building Commissioning Professional
- BCxP Practice Exam

Guidelines & Standards

Please see Table 9 in Appendix C: BCxP Job Task Analysis, Abbreviated

ASHRAE Learning Institute (ALI) Courses

- The Commissioning Process in New and Existing Buildings
- Commissioning for High-Performance Buildings

ASHRAE does not warrant that participation in or use of any of the above resources will guarantee successful completion of an examination. Nor does ASHRAE warrant that all information presented in all of the above resources is non-contradictory. However, ASHRAE will do its best to avoid testing contradictory, out-of-date, or inaccurate information.

Copyrighted Examination Questions

All examination questions are the copyrighted property of ASHRAE. It is forbidden under federal copyright law to copy, reproduce, record, distribute or display these examination questions by any means, in whole or in part. Doing so may subject you to severe civil and criminal penalties.

Score Report

All examinees receive a Score Report, which indicates a “Pass” or “Did Not Pass” result and a numerical score. U.S. examinees receive a paper Score Report immediately following the examination. Within five business days of taking their exam, international computer-based examinees will receive email notification from PSI Services, ASHRAE's exam delivery partner, that an unofficial Score Report is available for download. Pencil-and-paper examinees will receive such email notification within 4-6 weeks of taking their exam.

Successful Examinees

Successful examinees will be invited to claim their BCxP digital badge, which is the “certificate of certification,” within six weeks of their exam, and will be recognized on the ASHRAE website. Scores are not reported over the telephone, by electronic mail, or by facsimile.

The certificate of certification issued to successful examinees is the sole property of ASHRAE Certification; therefore, should a certification be suspended or revoked, the certificate shall be returned to ASHRAE Certification.

Successful examinees agree to the following conditions:

- Inform the Certification Committee, without delay, of matters that can affect their capability to continue to fulfill the certification requirements, or risk suspension or withdrawal of the certification.
- Make claims regarding “BCxP” certification only within the scope of the “BCxP” certification,
- Not to use the certification in such a manner as to bring ASHRAE certification into disrepute,
- Not to use the certificate in a misleading manner.

Examination Passing Score

When the BCxP Exam Subcommittee conducts a passing point study, the expert judgments of subject matter experts are used to produce and interpret results, and set the exam passing score.

Life-to-Date Pass Rate for First-Time Examinees through 6/2020: 76%

Score Needed to Pass BCxP Certification Exam: 83/120

Results Cancelled by ASHRAE

ASHRAE is responsible for the validity and integrity of the results they report. On occasion, occurrences such as computer malfunction or misconduct by a candidate may cause a result to be suspect. ASHRAE reserves the right to void or withhold examination results if, upon investigation, violation of its regulations is discovered.

Exam Retakes

Certification and recertification examinees who do not pass their exam may apply to retake their exam after a three-month wait period. The fee to apply to retake an ASHRAE certification examination is discounted a \$175 for ASHRAE members and \$225 for non-members. The fee for CPMPs to apply to retake the ASHRAE BCxP recertification examination is \$165 for ASHRAE members and \$220 for non-members. The fee for successive ASHRAE member and nonmember examination retakes will be at the full application fee amount.

Confidentiality

Information about candidates for testing and their examination results are considered confidential. Studies and reports concerning candidates will contain no information identifying any candidate, unless authorized by the candidate. By participating in the BCxP program, each person who earns and maintains this certification agrees to be listed on the ASHRAE public website. Only those individuals who are active BCxP certificants will be listed on the site.

Duplicate Score Report

Candidates may purchase additional copies of their results at a cost of \$25 per copy. Requests must be submitted to ASHRAE, in writing. The request must include the candidate's name, identification number, mailing address, telephone number, date of examination and examination taken. Submit this information with the required fee payable to ASHRAE in the form of a check, money order or cashier's check. Duplicate score reports will be mailed within approximately two weeks after receipt of the request and fee.

IV. Scheduling an Examination

When you receive email notification that your application has been approved, you also will receive instructions on how to schedule an examination appointment. Candidates may schedule their exam at a computer-based testing location, or as a remote online proctored exam at their home or office.

ASHRAE [Remote Online Proctored](#) examination is a safe, secure and convenient way to schedule and sit for your certification exam.

Remotely proctored exams may be scheduled up to 24 hours in advance and slots are available every half hour, based on availability. Exams at Test Centers may be scheduled up to 48 hours in advance and offer specific time slots based on the Test Center's schedule.

Refer to the chart below for Test Center scheduling.

If you schedule by 3:00 p.m. Central Time on...	Depending on availability, your examination may be scheduled as early as...
Monday	Wednesday
Tuesday	Thursday
Wednesday	Friday/Saturday
Thursday	Monday
Friday	Tuesday

Candidates will be allowed to take only the examination for which the appointment has been made. No changes in examination type will be made at the Test Center. **UNSCHEDULED CANDIDATES (WALK-INS) WILL NOT BE ADMITTED** to the Test Center.

Test Center Locations

Examinations are administered by computer at more than 300 Test Center locations in over 40 countries. TestCenter locations, at <https://www.ashrae.org/professional-development/ashrae-certification/certification-types>.

Holidays

No exams will be scheduled or administered on these United States holidays.

New Year's Day	Independence Day (July 4)	Christmas Eve Day
Martin Luther King Day	Labor Day	Christmas Day
Memorial Day	Thanksgiving Day (and the following Friday)	

Accommodations for Candidates with Disabilities

ASHRAE complies with the Americans with Disabilities Act and strives to ensure that no individual with a disability is deprived of the opportunity to take the examination solely by reason of that disability. ASHRAE will provide reasonable accommodations for candidates with disabilities. Candidates requesting special accommodations must complete a “Request for Testing Accommodations” form found on the “ASHRAE Certification Forms” webpage at <https://www.ashrae.org/education--certification/certification/ashrae-certification-forms>. ASHRAE recommends that Requests for Testing Accommodations be submitted by candidates prior to their applying for certification

Rescheduling an Examination Appointment

Candidates may reschedule an appointment for an examination by calling PSI/AMP at 888-519-9901 at least two business days prior to the scheduled testing session. (See following table.)

If the examination is scheduled on . . .	The candidate must reschedule the examination by the previous . . .
Monday	Wednesday
Tuesday	Thursday
Wednesday	Friday
Thursday	Monday
Friday	Tuesday

The first reschedule request with a two-day notice will be free; any additional reschedules will be at the full certification application fee. A candidate who wishes to reschedule their examination appointment, but fails to contact PSI/AMP at least two business days prior to the scheduled date, will forfeit the certification application fee and must reapply to sit for the examination.

Likewise, exam candidates who are absent for their scheduled examination appointment will forfeit the certification application fee and must reapply to sit for the examination.

Requesting an Extension

A candidate can extend the 90-day deadline for scheduling and taking an exam by emailing certification@ashrae.org at least two business days prior to the end of the 90-day deadline. ASHRAE will provide an extension of up to 45 days.

Inclement Weather, Power Failure or Emergency

In the event of inclement weather or unforeseen emergencies on the day of an examination, PSI/AMP will determine whether circumstances warrant the cancellation, and subsequent rescheduling, of an examination. If power to a Test Center is temporarily interrupted during an administration, your examination will restart where you left off and you may continue the examination.

Candidates may contact PSI/AMP’s Weather Hotline at 800-380-5416 (24 hours/day) or visit www.goAMP.com prior to the examination to determine if AMP has been advised that any Test Centers have been closed.

In order for PSI/AMP to be able to reschedule an exam missed due to sudden illness, exam candidates must provide a doctor’s note. Examination absences due to work commitments may not be rescheduled, nor will they be refunded.

V. On the Day of Your Examination

It is recommended that candidates report to the testing location or log in to their remote online proctored exam 15 minutes in advance of their scheduled testing time. **A CANDIDATE WHO ARRIVES MORE THAN 15 MINUTES AFTER THE SCHEDULED TESTING TIME WILL BE MARKED AS ABSENT, THEREBY FORFEITING THE ABILITY TO SIT FOR THE EXAM. SUCH ABSENT CANDIDATES WILL HAVE TO REAPPLY AT THE FULL APPLICATION FEE FOR ANOTHER OPPORTUNITY TO SIT FOR THE EXAM.**

When checking in to their Remote Online Proctored or Test Center exam, ASHRAE candidates must present a single, valid government-issued (either state, province or federal) identification card with current photograph and signature.

Acceptable forms of identification include: Driver's License, Identity card (non-driver license), Passport, Passport card, Green Card, Alien registration, Permanent resident card, or National identification card. The name on the identification presented must match the name on the candidate's certification exam registration.

Military IDs are not accepted.

Note: an admission photo will be taken prior to the exam session.

Candidates are prohibited from misrepresenting their identities or falsifying information to obtain admission to the testing room.

Security

ASHRAE and PSI/AMP maintain examination administration and security measures that are designed to ensure that all candidates are provided the same opportunity to demonstrate their abilities. While the exam administration and security measures for Test Center and Remote Online Proctored exams are largely identical, there are some differences.

The following security procedures apply during a Test Center examination:

- No cameras, notes, tape recorders, pagers, or cellular/smart phones are allowed in the testing room.
- You are encouraged to bring a non-programmable scientific calculator for the BCxP examination. Only silent, non-programmable calculators are permitted but they will not be provided for you.
- No guests, visitors, or family members are allowed in the testing room or reception areas.
- No personal items, valuables, or weapons are allowed in the testing room. Only keys and wallets may be taken into the testing room and securely stored in the soft locker provided at the Test Center. You are responsible for items left in other areas.
- Candidates may be subjected to a metal detection scan upon entering the examination room.
- No personal belongings will be allowed in the testing room. Use of a cellular/smart phone or other electronic device is strictly prohibited and will result in dismissal from the examination.
- You will be provided with scratch paper and a pencil to use during the examination. You must sign and return the scratch paper to the supervisor at the completion of testing, or you will not receive a score report. No documents or notes of any kind may be removed from the examination room. If you need a second piece of scratch paper, you need to ask the test proctor for another piece of paper and turn in the one you used before.
- PSI/AMP will provide U.S. examinees with ear plugs. International and pencil-and-paper examinees examinees may bring their own earplugs, though the proctor will need to inspect them.
- No questions concerning the content of the examination may be asked during the examination.
- Eating, drinking, or smoking will not be permitted in the testing room.

- You may take a break whenever you wish, but you will not be allowed additional time to make up for time lost during breaks.

The following security procedures apply during a Remote Online Proctored examination:

- No cameras, notes, tape recorders, pagers, or cellular/smart phones are allowed in the testing room.
- The wall behind the examinee and opposite the monitor must be bare, empty of pictures, open bookshelves or uncovered windows. Bookshelves may be covered with a plain sheet.
- You are encouraged to bring a non-programmable scientific calculator for the BCxP examination.
- No visitors or family members are allowed in the testing room.
- Use of a cellular/smart phone or other electronic device is strictly prohibited and will result in dismissal from the examination.
- Candidates may not use real paper as scratch paper. Instead, they may use a handheld, dry erase lapboard and marker, which must be erased at the conclusion of the exam. No documents or notes of any kind may be removed from the examination room.
- Candidates may not use ear plugs.
- No questions concerning the content of the examination may be asked during the examination.
- Eating, drinking, or smoking will not be permitted in the testing room.
- One (1) break up to five minutes long is allowed. The proctor must be notified and the clock will run.

Misconduct

Individuals who engage in any of the following types of conduct, either in the testing room or during a break, may be dismissed from the examination, their scores will not be reported, and their application fees will not be refunded. Examples of misconduct are when a candidate does the following:

- Creates a disturbance, is abusive, or is otherwise uncooperative,
- Displays and/or uses electronic communications equipment such as pagers, or cellular/smart phones,
- Gives or receives help or is suspected of doing so,
- Attempts to record examination questions or make notes,
- Attempts to take the examination for someone else,
- Or is observed with notes, books, or other aids.

Prior to attempting the certification examination, you will be given the opportunity to practice taking practice questions on the computer. The time you use for these practice questions is NOT counted as part of your certification examination time or result. When you are comfortable with the computer testing process, you may quit the practice session and begin the timed examination.

Certification Examination Tips

The practice questions should prepare you to navigate through the through the computer-based certification exam. Here are a few additional points to remember:

- Only one examination question is presented at a time. You may change your answer as many times as you wish during the examination time limit.
- If more than one answer seems correct, choose the best answer.
- Be sure to answer all questions, and bookmark the ones you want to double check later.
- Monitor your time.

Candidate Feedback

During the examination, candidates are permitted to submit online comments on any question. Comments will be reviewed, but individual responses will not be provided

At the conclusion of their exam, computer-based testing candidates will be invited to complete a survey. Pencil-and-paper examinees wishing to complete the survey however, must do so during the allotted examination time.

VI. BCxP Recertification: Eligibility & Application

Purpose

The purpose of recertification is to ensure that Certificants maintain a level of continuing competence through acceptable professional development and other in subject matter related to their certification.

Who Can Participate

Each BCxP certificant is required to renew their certification every three years. Membership in ASHRAE is not a prerequisite to recertify.

Deadlines

The renewal deadline is December 31 of the third year of certification. For example, a Certificant who earns a certification in 2020 will have a recertification deadline of December 31, 2023.

The certification of individuals who fail to submit renewal fees and a completed application by the December 31 deadline will expire. Individuals with expired certifications will be advised to cease using the specific certification designation after their names. The names of non-renewing Certificants will be removed from the list of Certificants on the ASHRAE website, and BCxP digital badges will appear as “expired.”

Non-renewing Certificants, however, may recertify during the three-month grace period from January 1 through March 31 immediately following the expiration of their certification. To do so, they must submit a completed recertification application.

Note: during the three-month grace period, PDHs may not be earned and applied toward the previous three-year certification period. After March 31, the grace period will conclude, non-renewing Certificants will no longer be able to renew their certification and the only way to regain the certification will be to reapply for certification and pass the certification examination. Extenuating circumstances, however, will be reviewed on a case-by-case basis by the Certification Committee.

Completing and Submitting the Application

To be eligible for renewal, BCxP Certificants must submit a completed application, which documents on the application to having met eligibility requirements, together with an application fee. Within a week of receiving an application, ASHRAE will notify the applicant by email either of acceptance and approval of the application or of denial of approval and the reason thereof.

Overview of Recertification Eligibility Requirements

1. Participation in One Commissioning Project
2. Code of Ethics
3. Professional Development Hours

Detailed Recertification Eligibility Requirements

1. Participation in One Commissioning Project

Participate in implementing the commissioning process for a minimum of one non-residential new or existing building over the current certification period.

2. Code of Ethics

Applicants must agree to uphold and abide by a Code of Ethics, the tenets of which are set forth as follows:

1. Exercise a reasonable industry standard of care in the performance of professional duties.
2. Perform professional duties with trust, integrity, and honesty.
3. Hold paramount the health and safety of the public in the performance of professional duties.
4. Work in a manner consistent with all applicable laws and regulations; demonstrate integrity, honesty, and fairness in all activities; and strive for excellence in all matters of ethical conduct.
5. Act with integrity in any relationship that involves an employer or client and disclose fully to an affected employer or client any conflicts-of-interest resulting from business affiliations or personal interests.
6. Represent qualifications accurately and honestly.
7. Offer products and services only in areas where competence and expertise will satisfy the client and public need.
8. Agree to comply with and uphold all policies, procedures, guidelines, and requirements of the certification program; use the designation as authorized and only in the approved manner; acknowledge that the certificate and marks are the property of their respective owners; and return the certificate and discontinue use of the designation and marks when required to do so.
9. Accept responsibility for maintaining the credential through recertification and continuously uphold the Code of Ethics.
10. Voluntarily and immediately report any felony convictions or other legal dispositions that would constitute violations of this Code of Ethics that have not already been disclosed, regardless of when they occurred, and report any conditions that prohibit fulfillment of duties as set forth in the competency requirements.

3. Professional Development Hours

Professional Development is a process used by certified persons to maintain and advance their competency in subject matter related to their certification. Acceptable PDHs may be earned in any country and in language. Fifty percent (50%) of the PDH requirement must come from "Third-party Continuing Education" and the other 50% from "Additional Qualifying PDH Options."

Third-party Continuing Education

Fifty percent (50%) of PDHs must be earned from third-party continuing education and include proof of attendance. These PDHs may be obtained from several sources, including:

- Webinars—1 PDH per hour of attendance
- Conference Session—1 PDH per hour of attendance
- Workshops—1 PDH per hour of attendance
- College Credit (traditional or online)—10 PDHs per college credit
- Training online or in person—1 PDH per hour of attendance

Additional Qualifying PDH Options

An additional 50% of PDHs must be earned from the following options, or combination of options:

1. Participate as a team member on a commissioning project of a non-residential new or existing building: 10 PDHs per project, up to 25 PDHs total. Note: this must be a different project from the "One Commissioning Project" requirement.

2. Continuing Education (CE): Only CE that includes proof of attendance from a third party qualifies. Up to 25 PDHs may be obtained from this option. CE includes education/training received and education/training given, and may be obtained from several sources, including:
 - Webinars—1 PDH per hour of attendance; 2 PDHs per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentation
 - Conference Presentation—1 PDH per hour of attendance; 2 PDHs per hour as presenter for the first presentation, then 1 PDH per hour for subsequent equivalent presentations
 - Workshops—1 PDH per hour of attendance; 2 PDHs per hour as presenter for the first presentation, then 1 point per hour for subsequent equivalent presentations
 - College Credit (traditional or online)—10 PDHs per college credit
 - Training online or in person—1 PDH per hour of attendance; 2 points per hour as a presenter for the first presentation, then 1 PDH per hour for subsequent equivalent presentations
3. Certification Test Development: Includes contributing to the development of the Building Commissioning Professional (BCxP) certification examination by participating in the following test development activities: job-task analysis study; item writing workshops; item review and/or passing score studies; 2 PDHs awarded for 1 hour of participation—up to 25 PDHs.
4. Regulatory Work: Participation in development or maintenance of regulatory standards. Participation includes providing testimony, official review, and/or appointment as a committee member. Includes regulatory compliance analysis and support lent to legislation/regulation for support of building commissioning professionals (not lobbying); 1 PDH awarded for 1 hour of participation—up to 10 PDHs.
5. Retest: Meet the current qualifications for and pass the certification exam: 25 PDHs.
6. Publications: Must be related to the industry, which is defined as design, construction, testing and commissioning, code enforcement and operations; published article in a peer-reviewed industry journal—5 PDHs per article, up to 10 PDHs.

Application Fees

On-time Discount (Application Received by Dec. 31)

ASHRAE Member: \$195.00; Nonmember: \$295.00

Grace Period (Application Received Jan. 1 - March 31)

ASHRAE Member: \$295.00; Nonmember: \$395.00

If an application is declined by ASHRAE, the amount of the fee, less \$50 to cover administrative costs, will be refunded to the applicant.

ASHRAE retains the right to audit at any time the recertification applications of renewed certificants. In such cases, certificants will be requested to provide supporting documentation of PDHs earned. Acceptable documentation may be a certificate of workshop completion, a copy of a publication or a college transcript. In the event the renewed certificant is unable to document having earned 50 acceptable PDHs, the renewed certification will be revoked and the recertification application fee will not be refunded.

Candidate Responsibilities

Each candidate for ASHRAE Building Commissioning Professional (BCxP) recertification is responsible for the following:

- Submit a completed, signed application form and the application fee,
- In the event of recertification, successful candidates are required to inform the Certification Committee body, without delay, of matters that can affect their capability to continue to fulfill the certification requirements, or risk suspension or withdrawal of the certification,
- In the event a certificant's certification is suspended or revoked, she/he must return the certificate to ASHRAE. The certificant also must refrain from any further promotion of themselves as an ASHRAE Certified Professional and from future use of all references to an ASHRAE Certified status.

Appendix A: BCxP Certification Exam Blueprint

Building Commissioning Professional (BCxP) Certification Examination Content Outline	Complexity Level and Number of Items			
	Recall	Application	Analysis	TOTALS
1. Managing Commissioning Projects	9	12	1	22
A. Track deficiencies (issues log).				2
B. Assess pass/fail criteria for functional test results.				4
C. Identify the scope of the project.				1-2
D. Develop a commissioning team.				1-2
E. Manage a commissioning budget.				1-2
F. Identify commissioning deliverables.				1-2
G. Participate in VE activities.				1-2
H. Review project documents.				1-2
I. Monitor the construction/project schedule.				1-2
J. Participate in project meetings.				1-2
K. Conduct commissioning meetings.				1-2
L. Facilitate risk Test as it relates to commissioning activities.				2
M. Identify tasks for completion of commissioning processes.				2
2. Preparing Commissioning Documentation	8	12	3	23
A. Create commissioning specifications.				1-2
B. Write system verification checklists.				2
C. Create FPTs.				4
D. Determine site visit protocols (logistics).				0
E. Develop issues logs.				1-2
F. Document commissioning meetings.				1-2
G. Write commissioning reports.				2
H. Create systems manuals.				1-2
I. Develop end of warranty review process.				1-2
J. Assist in developing the OPR/CFR.				1-2
K. Create system/equipment list.				1-2
L. Create commissioning process tracking metrics.				1-2
M. Develop the commissioning plan.				2
N. Develop commissioning schedules.				1-2
O. Develop communications plans.				1-2

Building Commissioning Professional (BCxP) Certification Examination Content Outline	Complexity Level and Number of Items			
	Recall	Application	Analysis	TOTALS
3. Conducting Commissioning Activities	8	15	5	28
A. Monitor commissioning construction activities.				7-8
B. Facilitate the acceptance phase.				7-8
C. Plan commissioning construction activities.				7-8
D. Facilitate the completion of construction checklists.				5
4. Managing Training Activities	2	3	0	5
A. Develop training plan.				2
B. Facilitate training coordination meeting.				1-2
C. Facilitate training activities.				1-2
D. Conduct training follow-up activities.				0
5. Completing Warranty Phase Activities	1	3	2	6
A. Measure energy performance.				3
B. Facilitate off-season testing.				1-2
C. Troubleshoot facility issues.				1-2
D. Facilitate end of warranty meeting.				1-2
6. Conducting Existing Building Commissioning	5	17	6	28
A. Conduct a building performance Test.				4
B. Prepare a CFR.				1-2
C. Conduct a systems Test.				4
D. Conduct a site investigation.				4
E. Recommend corrections and improvements.				4
F. Determine scope of project.				1-2
G. Oversee implementation of corrective measures.				4
H. Conduct performance verifications.				5
7. Conducting On-Going Commissioning	1	5	2	8
A. Measure IEQ performance.				1-2
B. Evaluate building systems performance.				1-2
C. Review building operating plan.				1-2
D. Review maintenance activities.				1-2
E. Accommodate space/function changes.				1-2
F. Implement corrective actions.				1-2
G. Publish measurement and performance results to stakeholders.				1-2
TOTAL	34	67	19	120

The light blue shading indicates that the task statement is not applicable at the complexity level indicated.

Appendix B: BCxP Job Task Analysis, Abbreviated

Job Task Analysis

Building Commissioning Professional

November 2013 — December 2014

Cynthia Woodley and Christine DePascale
Professional Testing, Inc.
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Executive Summary

This report describes the process for and results of a comprehensive Job Task Analysis (JTA) of Building Commissioning Professionals. This study was performed by Professional Testing on behalf of the National Renewable Energy Laboratory (NREL). The competency (domains, tasks, and associated knowledge) list, which defines the work performed by practitioners, was initially developed by a representative panel of practitioners during a meeting held on February 19–21, 2014, in Orlando, Florida. After the job tasks and associated knowledge and skills were identified, a validation survey was conducted of the findings of the JTA and the results of the validation study were reviewed by a representative panel of practitioners during a conference call held on June 6, 2014. The committee finalized the JTA and examination blueprints for the Building Commissioning credential scheme based on the survey results.

Once the JTAs were finalized, they were reviewed and approved by the CWCC Board of Direction contingent on approval of selected changes by the CWCC Scheme Committee. On a conference call held January 12, 2015, the CWCC Scheme Committee approved the changes and the JTA were finalized for release. With that approval and with transfer of the JTAs to the CWCC by NREL, the JTAs are available to the public from the CWCC web site at www.nibs.org/cwcc.

Acronyms

AHJ	Authority Having Jurisdiction
BAS	Building Automation System
BIM	Building Information Modeling
BOD	Basis of Design
BOP	Building Operating Plan
CFR	Current Facility Requirements
CMMS	Computerized Maintenance Management System
CSI	Construction Specification Institute
Cx	Commissioning
DACUM	Developing a Curriculum
DOE	U.S. Department of Energy
EB	Existing Building
ECM	Energy Conservation Measures
EHS	Environmental, health, and safety
FIM	Facility Improvement Measures
FPT	Functional Performance Testing
HVAC	Heating, Ventilation, and Air Conditioning
HVAC&R	Heating, Ventilation, Air Conditioning, and Refrigeration
IEQ	Indoor Environment Quality
IOM	Installation and Operation Manuals
JTA	Job Task Analysis
M&V	Measurement and Verification
NB	New Building

NIBS	National Institute of Building Sciences
NREL	National Renewable Energy Laboratory
O&M	Operations and Maintenance
OPR	Owner's Project Requirements
PFC	Prefunctional Checklists
PPE	Personal Protective Equipment
ROI	Return On Investment
SD	Standard deviation
SEM	Standard error of the mean
SME	Subject matter expert
TAB	Testing Adjusting Balancing
VE	Value Engineering

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1 Introduction

The National Renewable Energy Laboratory (NREL), in conjunction with the National Institute of Building Sciences (NIBS) and the U.S. Department of Energy (DOE), led a study to identify the critical duties and tasks required of Building Commissioning Professionals. Professional Testing, Inc., used the DACUM (Developing a Curriculum) process to conduct a Job Task Analysis (JTA) and identify the competencies.

A panel of subject matter experts (SMEs) was selected by NIBS and convened by Professional Testing for a 3-day meeting held February 19–21, 2014, in Orlando, Florida. The competencies identified during the meeting were then validated via a survey. This report reflects the completion and results of the study, and is organized with Section 2 containing the proposed final content outline, and the later sections containing the details of the JTA development process, including results of the validation survey.

2 Final Building Commissioning Professional DACUM/Job/Task Analysis

2.1 Building Commissioning Professional Job Description

The Building Commissioning Professional is an individual who leads, plans, coordinates and manages a commissioning team to implement commissioning processes in new and existing buildings.

2.2 Job/Task Analysis DACUM Chart for Building Commissioning Professional

A proposed content outline resulting from this Job/Task Analysis follows.

Table 1. Duties and Tasks of Building Commissioning Professional

Duties and Tasks			Final Weight	Final Items
A		Managing Commissioning Projects	18%	22
	1	Identify the scope of the project	~1%	1 to 2
	2	Develop a commissioning team	~1%	1 to 2
	3	Manage a commissioning budget	~1%	1 to 2
	4	Identify commissioning deliverables	~1%	1 to 2
	5	Participate in VE activities	~1%	1 to 2
	6	Review project documents	~1%	1 to 2
	7	Monitor the construction/project schedule	~1%	1 to 2
	8	Participate in project meetings	~1%	1 to 2
	9	Conduct commissioning meetings	~1%	1 to 2
	10	Track deficiencies (issues log)	2%	2
	11	Facilitate risk assessment as it relates to commissioning activities	2%	2
	12	Assess pass/fail criteria for functional test results	3%	4
	13	Identify tasks for completion of commissioning processes	2%	2
B		Preparing Commissioning Documentation	19%	23
	1	Assist in developing the OPR/CFR	~1%	1 to 2
	2	Create system/equipment list	~1%	1 to 2
	3	Create commissioning process tracking metrics	~1%	1 to 2
	4	Develop the commissioning plan	2%	2
	5	Develop commissioning schedules	~1%	1 to 2
	6	Develop communications plans	~1%	1 to 2
	7	Create commissioning specifications	~1%	1 to 2
	8	Write system verification checklists	2%	2
	9	Create FPTs	3%	4
	10	Determine site visit protocols (logistics)	0%	0
	11	Develop issues logs	~1%	1 to 2
	12	Document commissioning meetings	~2%	1 to 2

Duties and Tasks			Final Weight	Final Items
	13	Write commissioning reports	2%	2
	14	Create systems manuals	~1%	1 to 2
	15	Develop end of warranty review process	~1%	1 to 2
C		Conducting Commissioning Activities	24%	29
	1	Plan commissioning construction activities	~7%	7 to 8
	2	Monitor commissioning construction activities	~7%	7 to 8
	3	Facilitate the completion of construction checklists	3%	4
	4	Facilitate the acceptance phase	~7%	7 to 8
D		Managing Training Activities	4%	5
	1	Develop training plan	2%	2
	2	Facilitate training coordination meeting	~1%	1 to 2
	3	Facilitate training activities	~1%	1 to 2
	4	Conduct training follow-up activities	0%	0
E		Completing Warranty Phase Activities	5%	6
	1	Facilitate off-season testing	~1%	1 to 2
	2	Troubleshoot facility issues	~1%	1 to 2
	3	Measure energy performance	2%	3
	4	Facilitate end of warranty meeting	~1%	1 to 2
F		Conducting Existing Building Commissioning	23%	28
	1	Determine scope of project	~2%	1 to 2
	2	Conduct a building performance assessment	3%	4
	3	Prepare a CFR	~2%	1 to 2
	4	Conduct a systems assessment	3%	4
	5	Conduct a site investigation	3%	4
	6	Recommend corrections and improvements	3%	4
	7	Oversee implementation of corrective measures	3%	4
	8	Conduct performance verifications	4%	5
G		Conducting On-Going Commissioning	7%	8
	1	Measure IEQ performance	~1%	1 to 2
	2	Evaluate building systems performance	~1%	1 to 2
	3	Review building operating plan	~1%	1 to 2
	4	Review maintenance activities	~1%	1 to 2
	5	Accommodate space/function changes	~1%	1 to 2
	6	Implement corrective actions	~1%	1 to 2
	7	Publish measurement and performance results to stakeholders	~1%	1 to 2
Total			100%	120

Table 2. Areas of Specialized Knowledge Required for Building Commissioning Professional

Specialized Knowledge	
BAS or monitoring systems	Basic construction
BIM	Budgeting
Building maintenance	Building operations
Building sciences	Building systems (see Table 3)
Climate zone variations	CMMS
Commissioned systems knowledge	Construction contracting
Construction budgets and costs	Construction estimating
Construction documents and specifications	Construction methods and concepts
Construction management processes	Contract knowledge
Construction scheduling	Control systems
Controls theory and operations	Cx budgeting
Controls graphics	Cx processes and procedures
Cx manpower requirements	Cx schedules
Cx reporting documentation	Cx team member requirements
Cx sequence of events	Design documents
Data normalization (weather, days of the month, etc.)	Divisions used in construction specifications
Developing ROIs	Economic analyses
Documentation protocols	Energy management fundamentals
Energy calculations	Energy performance
Energy modeling	Engineering principles
Energy use analysis	Evidence collection
Environmental sustainability and efficiency goals	Facilities management
Expected equipment performance	Fault diagnostic knowledge
Failure mode analysis	General construction process knowledge
Functional testing procedures, equipment, and results	IEQ
How system components work together	Integration protocols
Incentive programs	Life-span cost and quality
Issue resolution process	Maintainability, access, and operational requirements
M&V methodologies	Maintenance issues
Maintenance contracts	Maintenance procedures and roles
Maintenance management systems	Manufacturers of Cx equipment
Manpower utilization	Metering
Needs assessment processes	Methodology to inspect systems
Occupancy impacts	O&M Procedures
OPR	Operations within the facility
Owner's operational configuration and personnel	Potential EHS hazards and risks
	Project documents
Prevailing commissioning pricing structures	Project management
Project knowledge	Project objectives, goals, and purpose
Project management process	Records/document management
Proportional balancing	Required construction and installation tests
Regression modeling	ROI analysis
Risk assessment and management	Sampling protocols and procedures
Safety practices	Scheduling
	Sequence of construction activities
Scope of work	Service contracts

Specialized Knowledge	
Sequence of operations	Space usage and occupancy schedules
Site safety	Spreadsheet development
Special tests (TAB, etc.)	Startup requirements
Submetering	Successful training outcomes
Substantial completion and final completion	System operations
Survey techniques	Systems engineering
Systems understanding	Systems interactions and integration
Test development	TAB
Testing equipment and procedures	Testing durations
Testing sequencing	Testing procedures
Testing, training, design, and construction requirements	Testing standards
Training facilitation	Training evaluation
Training plans	Training methodologies
Trend data	Trend analysis
Troubleshooting techniques	Troubleshooting methodologies
Unique requirements for facility usage	Typical site visit protocols
Utility rate structures and schedules	Utility bill structures
Various control technologies (new and legacy)	Utility rebate incentives
Warranties	Warranty provisions

Table 3. Building Systems Required for Building Commissioning Professional

Building Systems
Air distribution system
Access controls systems
Audiovisual systems
Automated windows and blinds systems
BAS
Building control system
Building envelope
Chilled water system
Combined heat and power system
Communication systems
Condenser water system
Conveying systems
Domestic hot water system
Electrical power quality monitoring system
Electrical power system and emergency power system
Emergency communication systems
Energy metering and monitoring system
Energy recovery system
Fire alarm system
Fire protection (sprinkler) system
Fuel oil system

Building Systems
Gray and black water systems
HVAC control system
HVAC system or HVAC&R system
Irrigation systems
Information technology systems
Laboratory gas system
Life safety system
Lighting control system
Lighting system
Low-temperature refrigeration system
Medical gas systems
Nurse call systems
Plumbing systems
Pneumatic tube systems
Potable cold water system
Public address systems
Pumps and pumping systems
Renewable energy system (combined heat and power, photovoltaics, wind, thermal, etc.)
Security systems
Smoke evacuation systems
Space scheduling systems
Steam and hot water system (heating)
Steam distribution system
Variable speed (frequency) drive system
Vertical transportation systems
Water distribution and control system

Table 4. Areas of General Knowledge Required for Building Commissioning Professional

General Knowledge
Calculations
Collect information to solve a problem
Perform simple math operations of addition
Perform simple math operations of subtraction
Perform simple math operations of multiplication
Perform simple math operations of division
Transfer number sequences from a source into a column
Compare numbers
Perform math operations using single and multiple digit numbers
Use a calculator
Perform mathematical operations with fractions
Perform mathematical operations with decimals
Make rough estimates
Figure averages
Perform math operations using signed (positive and negative) numbers
Solve ratio problems
Multiply and factor algebraic expressions
Solve problems with graphs
Solve percent problems
Change numbers from percentages into decimals and back
Change numbers from fractions into decimals and back
Solve formula calculations with one unknown
Perform math operations using exponential numbers
Measure angles
Basic Measurement
Record measurements using appropriate unit notations (feet, yards, etc.)
Read and use the scale of a drawing
Use tools to measure quantities and solve problems involving measurements
Measure temperature to within 1°F
Find the dimensions of an object from a scale drawing
Read measurements taken with common measuring tools
Read, interpret, and use size-scale relationships
Measure area (square inches, square centimeters, etc.)
Measure volume (cubic inches, liters, etc.)
Make simple scale drawings
Estimate and approximate measurements
Measure linear distances (length, width, etc.)
Find distances and directions on land maps
Calculate the perimeter and areas of common figures

General Knowledge
Basic Measurement (continued)
Read and apply coefficient measurements indicated in a table or chart
Measure weights using devices calibrated in pounds
Measure length to 1/4 of an inch
Measure length to 1/8 of an inch
Measure board feet
Convert measurements from one unit to another (English to metric, etc.)
Measure weights using devices calibrated in ounces
Measure length to 1/16 of an inch
Communications
Write reports
Ask questions
Communicate using the vocabulary/terminology of a related trade
Communicate with coworkers and/or business people verbally (face-to-face)
Communicate with coworkers and/or business people verbally (telephone, radio)
Listen
Communicate with coworkers and/or business people in writing (letters, memos)
Read and follow directions found in equipment manuals and code books
Read and interpret directions found on labels, packages, or instruction sheets
Read drawings and specifications sheets
Summarize information
Explain procedures
Follow verbal job instructions
Participate in brainstorming
Present to others
Read flowcharts
Research information
Write words and numbers legibly
Evaluate solutions
Find information in references (machinery handbook, tap/drill charts, etc.)
Read codes (building codes, electrical codes, standards, etc.)
Read information from tables and graphs (bar, circle, etc.)
Speak to large groups
Evaluate options/alternatives
Find information in catalogs
Read and follow a map, chart, plan, etc.
Apply assertiveness
Read statistical data
Compare names

Table 5. Skills and Abilities Required for Building Commissioning Professional

Ability to assess building performance	Ability to assess timeframes for construction and commissioning
Ability to communicate technical information to others	Ability to conduct a needs assessment
Ability to conduct a root cause analysis	Ability to create a matrix
Ability to create checklists	Scheduling skills
Ability to deal with difficult people	Ability to determine appropriate sampling procedures
Ability to determine manpower requirements from scope of work	Ability to prioritize
Ability to distinguish between systems, equipment, and components	Ability to identify specialty workers needed
Ability to read and interpret construction documents	Ability to interpret scope of work
Ability to interpret the TAB report	Ability to interpret trends
Ability to read and interpret utility bills, rate structures, and utility contracts	Ability to perform document discovery
Ability to photograph evidence	Ability to review controls graphics
Ability to serve as a mediator between owners, contractors, and others	Ability to train others
Ability to use collaborative meeting tools (e.g., web conferencing, teleconferences)	Ability to work with difficult people
Ability to write meeting minutes	Analytical skills
Basic math skills	Basic accounting skills
Commissioning plan development skills	Computer skills
Construction skills	Cost estimating skills
Documentation skills	Facilitation skills
Financial skills (ROI, etc.)	Follow-up techniques
Forensic skills	Interpersonal skills
Interviewing skills	Investigation skills
Leadership skills	Listening skills
Management skills	Meeting management skills
Multimedia skills	Negotiation skills
Organizational skills	Patience
Persistence	Physical attributes
Physical mobility	Plan reading skills
Presentation skills	Project management skills
Reading ability	Report writing skills
Research skills	Scheduling skills
Team building skills	Time management skills
Troubleshooting skills	Verbal communication skills
Written communication skills	

Table 6. Attitudes Required for Building Commissioning Professional

Critical thinker	Good time manager
Honest	Manage stress/pressure
Quality focused	Adaptable/flexible
Trustworthy	Free of substance abuse
Customer oriented	Initiative
Detail oriented/attention to detail	Lack of prejudice (bias)
Ethical	Leader
Integrity	Positive attitude
Organized	Respectful/empathetic
Common sense	Tactful
Analytic	Work efficiently (resources)
Professional	Work efficiently (time)
Responsible/accountable	Conscientious
Work in teams	Eager to learn new things/curiosity
Accurate/precise	Industrious
Persistent	Meticulous
Team player	Multitasker
Dependable	Self-motivated
Focused	Enthusiasm
Punctual	Goal oriented
Confident	Open to change
Pride in job	Tolerant
Safety conscious	Helpful
Self-control	Patience
Self-discipline	Social skills
Cooperative	Independent
Good listener	

Table 7. Physical Conditions Required for Building Commissioning Professional

Physical Conditions
Position—How important is it that one can . . .
Stand part of the time
Work in a squatting position for more than 5 minutes per hour
Bend forward frequently
Stoop kneel or crouch
Stand all of the time
Mobility—How important is it that one can . . .
Walk
Climb ladders, stairs, poles, etc. using legs and arms
Crawl or creep
Lifting—How important is it that one can . . .
Carry objects of up to 25 pounds
Lift objects from ground to waist level
Arm/Hand Use—How important is it that one can . . .
Reach with arms and hands in any direction
Feel size, shape, and temperature or texture of objects with the hands
Hold or move objects using the fingers
Work with hands and arms over head level
Hold or move objects using the hands but not the fingers
Pull objects with arms or hands
Push objects with arms or hands
Senses—How important is it that one can . . .
Talk
Hear speech
Detect abnormal noises
See clearly at 20 inches or closer (with/without optical assistance)
See and discriminate colors
Judge depth (the position and distance of objects) with the eyes
See clearly at 20 feet or further (with/without optical assistance)
Working Conditions—How important is it that one can . . .
Work outside
Work inside
Work while standing on portable ladders
Work while standing on scaffolding
Work at heights of 1 to 25 feet above ground or floor level
Work while wearing protective equipment (respirators, hoods, etc.)
Work in changing temperatures (in and out of buildings repeatedly)
Work in noisy places (85 decibels or higher with ear protection)
Work in confined spaces

Physical Conditions
Work around or near high-voltage power sources or equipment
Work around or near magnetic equipment or materials
Work at heights of 26 to 75 feet above ground or floor level
Work in high temperatures (85°–130°F)
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 on slippery surfaces
Work in one place (no change of work location)
Work in low temperatures (0°–45°F)
Work while sitting or standing on high roofs, overhangs, or I-beams
Handle hot or cold objects
Work at heights of 76 feet or higher above ground or floor level
Work in stale air (with some oxygen depletion)
Work in subzero temperatures (0°F and lower)

Table 8. Tools, Equipment, and Resources Required for Building Commissioning Professional

Attendance sheets	BAS
BOD	BOPs
Building operators	Building records and documents
CMMS	Codes, regulations, standards and guidelines (see Table 9)
Cx documentation and systems manuals	Cx guidelines and standards
Cx process scope	Cx progress reports
Cx team members	Computer and software (see Table 10)
Computerized control systems	Construction checklists
Construction drawings and documents	Construction management systems
CSI	Cx tools and equipment (see Table 11)
Energy coordinator or manager	Equipment lists
Evaluation form	Facility guides
Flipcharts and markers	Industrial hygienist
Instruction space (classrooms, etc.)	Integrated issues log
Internet	Issues resolution logs
Maintenance contracts	Maintenance staff
Manufacturers' data	Manufacturers' documentation
Manufacturers' guidelines and materials	O&M manuals
OPR	PPE (see Table 12)
Preventative maintenance schedule	Previous training programs
Project completion matrix	Project schedules
Project specifications	Record drawings
Safety plans	Scheduling software
Sign-in sheets	Site safety requirements
Specification development software (MasterSpec, etc.)	Staffing plans
Teaching equipment (projectors, etc.)	Teaching materials
Technology tools (see Table 13)	Training agendas
Training evaluation data (comments, surveys, etc.)	Training facilities
Training materials	Training records
Trend data	Utility bills
Utility meters	Utility rate data
Warranty documents	Writing instruments

Table 9. Codes, Standards, Regulations, and Guidelines Required for Building Commissioning Professional

Commissioning Standards and Guidelines	
ASHRAE Guidelines	
Guideline 0	The Cx Process
Guideline 1.1	HVAC&R Technical Requirements for the Cx Process
Guideline 1.5	The Cx Process for Smoke Control Systems
Guideline 0.2	The Existing Building Cx Process
ASHRAE Standards	
Standard 202	Cx Process for Buildings and Systems
Illuminating Engineering Society	
IES DG-29-11	The Cx process applied to lighting and control systems
NFPA - 3	Recommended Practice on Cx and Integrated Testing of Fire Protection and Life Safety Systems
ASHE Guidelines	Health Facility Cx Guidelines
NIBS	Guideline 3 -- Exterior enclosures
Sources of information	AABC Commissioning Group (ACG)
	Association of Energy Engineers (AEE)
	American Institute of Architects (AIA)
	American National Standards Institute (ANSI)
	Association of Physical Plant Administrators (APPA)
	Army Corp of Engineers
	Association of Healthcare Engineering (ASHE)
	American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
	American Society of Plumbing Engineers (ASPE)
	American Society of Testing and Materials (ASTM)
	Building Commissioning Association (BCA)
	California Commissioning Collaborative (CCC)
	California Energy Commission (CEC)
	Cost estimating guides
	Department of Energy (DOE)
	Energy Independence and Security Act (EISA 2007)
	Environmental Protection Agency (EPA)
	International Performance Measurement and Verification Protocol (EVO-IPMVP)
	Federal Energy Management Program (FEMA)
	Green Globes
General Services Administration Commissioning Guide	
International Code Council (ICC)	
Institute of Electrical and Electronics Engineers (IEEE)	
Illuminating Engineering Society	

Commissioning Standards and Guidelines	
	International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)
	National Environmental Balance Bureau (NEBB)
	National Electrical Code (NEC)
	National Electrical Contractors Association (NECA)
	National Electrical Testing Association (NETA)
	National Fire Protection Association (NFPA)
	National Institute of Building Sciences (NIBS)
	National Institute of Standards and Technology (NIST)
	Occupational Safety and Health Administration (OSHA)
	Portland Energy Conservation Inc. (PECI)
	Pacific Northwest National Laboratory (PNNL)
	Sustainable Airport Manual
	Testing and Balancing Bureau (TABB)

Table 10. Software for Building Commissioning Professional

Computer-aided drafting software
BIM and related software
BAS
Building energy modeling software
Computer-aided facility management
CMMS
Construction management software
Data analysis software
Energy management system
ENERGY STAR Portfolio Manager
Integrated work management system
Project management software
Scheduling management software
Spreadsheets/word processing/presentation (Microsoft)

Table 11. Commissioning Tools and Equipment Required for Building Commissioning Professional

General Tools	Specialized Tools
Adjustable pliers	Anemometer
Adjustable wrench	Balometer
Allen wrenches	Blower door test equipment
Channel locks	Boroscope
Combination wrenches	Calibration equipment
Extension magnet	Circuit tracer
Flashlight	Computer test equipment
Inspection mirror	Combustion analyzing instruments
Labeling machine	Digital thermometer (surface and air)
Ladders	Dosimeter
Laser levels	Electrical meters
Locking pliers	Flow meters
Lock-out/tag-out equipment	Gas analyzers
Markers	Hydrometer
Measuring devices	Hygrometer
Multimeter	Infrared thermometer
Nut drivers	Light meters
Pipe wrenches	Manometer
Pliers	Megohmmeter
Pocket knife	Moisture meter
Pocket level	Power analyzer
Rain gear	Psychrometers
Ratchets	Refractometer
Rubber mallet	Refrigerant gauges
Screw drivers	Refrigeration test equipment
Small power tools (hand electric drill)	Smoke stick
Socket sets	Sound meters
Square	Stroboscope
Stop watch	Tachometers
Tape measure	Temperature measuring device
Torque wrench	Thermal imaging camera
Wire Brush	Velometer
Wire cutters	Vibration analysis instrument
Wire nuts	

Electrical Tools	Testing and Balancing Tools (TAB)
Amp probe	Air data meter
Electrical gloves	Differential pressure gauges
Electrical multimeter	Flow hoods
Electrical tape	Flow measuring device
Electrically insulated tools	Flow tree
Fake smoke	Hydro data meter
Ground fault circuit interrupter-equipped extension cords	Magnehelic gauges
Plumbing Tools	Pitot tubes
Backflow preventer test equipment	Thermometers
Peppermint test equipment	
Pressure test plugs	

Table 12. PPE Required for Building Commissioning Professional

Arc flash protection (NFPA 70e)
Back protection
Dust masks
Eye protection/safety glasses
Face shield
Fall protection
Gloves
Hardhat
Hearing protection (plugs and muffs)
Respirator
Rubber boots
Safety harnesses
Vests
Work shoes (toe and shank protection)

Table 13. Technology Tools Required for Building Commissioning Professional

Technology Tools	
Computer with	Spreadsheet applications
	Internet access
	Word processing applications
	Data storage
	Graphics software
	External data storage/backup
Data gathering	Data loggers with sensors (t/h/kw/on-off)
	Thermal imaging
	Vibration analysis
	Direct digital controls
Smart phone with	Camera
	Internet access
	Two-way communications
	Video recording/transmitting
	Wifi access
Tablet computer	

Table 14. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Managing Commissioning Projects

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Identify the Scope of the Project					
Acquire scope of work documents	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Construction scheduling • Cx manpower requirements • Cx processes and procedures • Cx schedules • Cx sequence of events • Cx team member requirements • Records/document management • Scope of work 	<ul style="list-style-type: none"> • Management skills • Ability to read and interpret construction documents • Attention to detail • Computer skills • Plan reading skills • Project management skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Computer and software (see Table 10) • Safety plans
Develop list of tasks	X	X			
Review systems to be commissioned	X	X			
Identify type of building to be commissioned or recommissioned	X	X			
Identify deliverables	X	X			
Determine data/record management	X	X			
Develop a Cx Team					
Determine in-house team capabilities	X	X	<ul style="list-style-type: none"> • Construction contracting 	<ul style="list-style-type: none"> • Ability to deal with difficult people • Ability to determine manpower requirements from scope of work • Ability to identify specialty workers needed • Interpersonal skills • Organizational skills • Team building skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Commissioning team members
Determine required roles and responsibilities	X	X			
Identify stakeholders	X	X			
Identify contact information for project team members	X	X			
Identify needs for outside consultants	X	X			
Select commissioning team	X	X			
Identify service maintenance providers	X	X			
Determine information technology requirements for project	X	X			
Manage a Commissioning Budget					
Review fees	X	X	<ul style="list-style-type: none"> • Prevailing commissioning pricing structures 	<ul style="list-style-type: none"> • Scheduling skills • Management skills • Attention to detail • Basic accounting skills • Computer skills • Documentation skills • Project management skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • Safety plans
Review tasks	X	X			
Evaluate overall project budget	X	X			
Develop Cx project execution plan and timelines	X	X			
Recalibrate project plan	X	X			
Evaluate invoices from consultants	X	X			
Analyze costs against budget	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Account for project costs that might affect budget	X	X		<ul style="list-style-type: none"> • Verbal communication skills • Written communication skills 	
Assist contractors in developing their commissioning budgets	X	X			
Identify Cx Deliverables					
Identify building systems	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Cx processes and procedures 	<ul style="list-style-type: none"> • Ability to create a matrix • Scheduling skills • Computer skills • Time management skills • Written communication skills 	
Identify components and equipment associated with building systems	X	X			
Identify tasks associated with each component (what tests you will perform, etc.)	X	X			
Document deliverables	X	X			
Identify deliverable timeline and schedule	X	X			
Participate in VE Activities					
Conduct ROI analysis	X		<ul style="list-style-type: none"> • Construction budgets and costs • Economic analyses • OPR • ROI analysis • Scheduling 	<ul style="list-style-type: none"> • Cost estimating skills • Independence • Interpersonal skills • Negotiation skills • Presentation skills 	
Evaluate recommendations and alternatives	X				
Associate budgets with recommendations and alternatives	X				
Interpret value of impact on OPR	X				
Review Project Documents					
Review OPR/CFR	X	X	<ul style="list-style-type: none"> • BAS or monitoring systems • BIM • Building systems (see Table 3) • Construction documents and specifications • Construction scheduling • Contract knowledge • Design documents • Project documents • Sampling protocols and procedures • Sequence of operations 	Reading ability	Codes, regulations, standards, and guidelines (see Table 9)
Review BOD	X	X			
Review division of responsibilities	X	X			
Review other team member responsibilities	X	X			
Review legal contract documents	X	X			
Review design documents	X	X			
Design suggestions for modifications	X	X			
Verify project is to code	X	X			
Review BIM models	X				
Review submittals	X	X			
Review factory witness tests	X				
Review schedules	X	X			
Review sequence of operations	X	X			
Review training materials	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Review installation documents	X	X			
Review contractor startup reports	X	X			
Review mechanical acceptance testing forms	X	X			
Validate BAS software	X	X			
Review TAB report	X	X			
Review operation manuals	X	X			
Review record documents (as-builts)	X	X			
Review previous Cx reports		X			
Review utility bills		X			
Review maintenance records		X			
Review trend logs	X	X			
Review existing contracts (with utilities, chilled water, steam, etc.)		X			
Review O&M contracts	X	X			
Review BAS contracts	X	X			
Monitor the Construction/Project Schedule					
Obtain master construction schedule	X		<ul style="list-style-type: none"> • Scheduling • Sequence of construction activities • Testing sequencing 	<ul style="list-style-type: none"> • Ability to assess timeframes for construction and commissioning • Interpersonal skills • Negotiation skills 	<ul style="list-style-type: none"> • Scheduling software
Create project schedule		X			
Maintain project schedule		X			
Insert commissioning milestones and durations into master construction schedule	X				
Obtain updated schedules	X				
Attend construction/project meetings	X	X			
Communicate need for adjustments to schedules	X	X			
Participate in Project Meetings					
Attend prebid meetings	X		<ul style="list-style-type: none"> • General construction process knowledge 	<ul style="list-style-type: none"> • Interpersonal skills • Patience • Verbal communication skills • Written communication skills 	
Attend postbid meetings	X				
Attend construction progress meetings	X				
Attend training meetings	X				
Attend near-end-of-warranty meetings	X				
Review meeting minutes	X				

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Conduct Cx Meetings					
Schedule meeting	X	X	<ul style="list-style-type: none"> • Cx processes and procedures • General construction process knowledge 	<ul style="list-style-type: none"> • Ability to use collaborative meeting tools (e.g., Web conferencing, teleconferences) • Ability to use collaborative meeting tools (e.g., Web conferencing, teleconferences) • Ability to write meeting minutes • Leadership skills • Organizational skills • Presentation skills • Written communication skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • Cx tools and equipment (see Table 11) • Internet
Prepare agenda for meeting	X	X			
Facilitate design Cx kickoff meeting	X				
Facilitate construction Cx kickoff meeting	X				
Facilitate Cx meetings	X	X			
Facilitate sequence of operation review meetings	X	X			
Write meeting minutes	X	X			
Distribute meeting minutes	X	X			
Track Deficiencies (Issues Log)					
Identify issues	X	X	<ul style="list-style-type: none"> • Building sciences • Building systems (see Table 3) • Construction documents and specifications • Engineering principles • General construction process knowledge • OPR 	<ul style="list-style-type: none"> • Ability to read and interpret construction documents • Ability to work with difficult people • Attention to detail • Computer skills • Forensic skills • Interpersonal skills • Troubleshooting skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Computer and software (see Table 10) • Construction management systems • Integrated issues log • PPE (see Table 12) • Site safety requirements
Characterize identified issue	X	X			
Participate in resolution process for identified issue	X	X			
Track identified issue	X	X			
Verify resolution of issues	X	X			
Resolve document issues	X	X			
Facilitate Risk Assessment As It Relates to Cx Activities					
Review Cx plan, testing approaches, and protocols	X	X	<ul style="list-style-type: none"> • Commissioned systems knowledge • Cx processes and procedures • Potential EHS hazards and risks • Project management process • Risk assessment and management 	<ul style="list-style-type: none"> • Basic accounting skills • Facilitation skills • Team building skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Manufacturers' documentation
Facilitate safety review	X	X			
Conduct integrative testing	X	X			
Monitor Cx schedules	X	X			
Monitor construction schedules	X				
Review communication protocols (e.g., two-way radios)	X	X			
Participate in risk mitigation	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Review budgets as related to Cx activities	X	X	<ul style="list-style-type: none"> • Safety practices • Testing equipment and procedures • Testing standards 		
Review project management for risk mitigation as related to Cx activities	X	X			
Assess Pass/Fail Criteria for Functional Test Results					
Document Cx team participants	X	X	<ul style="list-style-type: none"> • Functional testing procedures, equipment, and results • Sequence of operations • Systems interactions and integration • Trend analysis 	<ul style="list-style-type: none"> • Ability to read and interpret construction documents • Ability to interpret trends 	<ul style="list-style-type: none"> • BAS • Codes, regulations, standards, and guidelines (see Table 9) • Cx tools and equipment (see Table 11) • Technology tools (see Table 13)
Complete functional tests	X	X			
Review functional tests results	X	X			
Review issues log	X	X			
Recommend whether findings are compliant with OPR/CFR	X				
Send results to design authority					
Identify Tasks for Completion of the Cx Process					
Verify completion of resolution of issue log	X	X	<ul style="list-style-type: none"> • General construction process knowledge 	<ul style="list-style-type: none"> • Report writing skills • Ability to interpret scope of work 	<ul style="list-style-type: none"> • Project completion matrix • CMMS
Complete commissioning report	X	X			
Review owner's turnover criteria for commissioning project	X	X			
Schedule off-season mode testing	X				
Schedule end-of-warranty meeting	X				
Schedule off-season training	X				

Table 15. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Preparing Commissioning Documentation

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Assist in Developing the OPR/CFR					
Conduct interview with owner staff and commissioning team	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Climate zone variations • Environmental sustainability and efficiency goals • IEQ • Life-span cost and quality • Maintainability, access, and operational requirements 	<ul style="list-style-type: none"> • Ability to determine appropriate sampling procedures • Facilitation skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Construction drawings and documents • BOD • Codes, regulations, standards, and guidelines (see Table 9) • Cx documentation and systems manuals
Develop OPR/CFR criteria matrix for commissioned systems	X	X			
Assist in drafting OPR/CFR	X	X			
Review draft OPR/CFR	X	X			
Update OPR/CFR draft	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
			<ul style="list-style-type: none"> • Project objectives, goals, and purpose • Space usage and occupancy schedules • Unique requirements for facility usage 		<ul style="list-style-type: none"> • Cx process scope • Cx progress reports • Project schedules
Create a System/Equipment List					
Review Cx scope of work	X	X		<ul style="list-style-type: none"> • Ability to distinguish between systems, equipment, and components • Ability to read and interpret construction documents • Ability to perform document discovery • Computer skills • Organizational skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • CMMS
Review schedule of commissioned equipment	X	X			
Review drawings, specifications, and addenda	X	X			
Review existing building record documents		X			
Compare drawings, specifications, and BOD for compliance with OPR/CFR	X	X			
Identify systems and equipment	X	X			
Document selected systems and equipment	X	X			
Create a Cx Process Tracking Matrix					
Identify systems to be commissioned	X	X	<ul style="list-style-type: none"> • Cx processes and procedures • Scope of work • Systems engineering 	<ul style="list-style-type: none"> • Ability to read and interpret construction documents • Ability to use collaborative meeting tools (e.g., Web conferencing, teleconferences) • Computer skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Computer and software (see Table 10) • Construction drawings and documents • Cx tools and equipment (see Table 11) • Equipment lists • Project schedules • Project specifications
Identify tasks to be completed on each system	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Develop the Cx Plan					
Determine roles and responsibilities of Cx team members	X	X	<ul style="list-style-type: none"> • Cx processes and procedures 	<ul style="list-style-type: none"> • Analytical skills • Commissioning plan development skills • Project management skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9)
Provide contact list for Cx team members	X	X			
Establish communication protocol	X	X			
Establish document distribution protocols	X	X			
Provide detailed description of Cx process activities	X	X			
Develop schedule of Cx process activities	X	X			
Determine appropriate sampling procedures and methodology in collaboration with commissioning team	X	X			
Provide examples of documentation	X	X			
Document design documentation evaluation procedures	X	X			
Describe Cx process activities	X	X			
Describe system verification procedures	X	X			
Describe testing procedures performed by Cx team	X	X			
Describe systems integration testing procedures	X	X			
Develop training plan for systems being created	X	X			
Describe system manual requirements	X	X			
Describe site observation procedures and documentation	X	X			
Issue resolution log formats	X	X			
Describe Cx progress reports	X	X			
Provide list of systems to be commissioned	X	X			
Describe procedures to mitigate issues that are not compliant with OPR/CFR	X	X			
Issue draft Cx plan for review and comments	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Review Cx plan	X	X			
Update Cx plan	X	X			
Develop Cx Schedules					
Acquire scope of work	X	X	<ul style="list-style-type: none"> • Construction scheduling • Construction methods and concepts • Cx processes and procedures • Manpower utilization • Testing durations 	<ul style="list-style-type: none"> • Interpersonal skills • Negotiation skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • Computer and software (see Table 10)
Acquire project schedule	X	X			
Develop Cx duration schedules	X	X			
Assign sequence of activities	X	X			
Determine team assignments for activities	X	X			
Identify milestones	X	X			
Identify deliverables	X	X			
Identify critical path	X	X			
Create Cx schedule	X	X			
Work with contractor to integrate Cx schedule into construction/project schedule	X				
Identify resources that will be required	X	X			
Develop Communications Plans					
Determine meeting frequencies	X	X		<ul style="list-style-type: none"> • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • Computer and software (see Table 10)
Review the scope of work	X	X			
Obtain contact list	X	X			
Determine communication methods (phones, etc.)	X	X			
Establish distribution list	X	X			
Create Commissioning Specifications					
Review scope of work	X		<ul style="list-style-type: none"> • Cx processes and procedures • Divisions used in construction specifications • Sampling protocols and procedures 	<ul style="list-style-type: none"> • Interpersonal skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • CSI • Specification development software (MasterSpec, etc.)
Prepare project-specific commissioning specifications	X				
Review OPR	X				
Incorporate Cx specifications into the bid document	X				
Establish protocols for retesting and associated costs	X				
Establish sampling protocols	X				
Create sample Cx documents to include in specifications	X				

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Write System Verification Checklists					
Identify systems to be commissioned	X		<ul style="list-style-type: none"> • Building systems (see Table 3) • Construction methods and concepts • Methodology to inspect systems • Scope of work • Testing, training, design, and construction requirements 	<ul style="list-style-type: none"> • Ability to create checklists • Ability to read and interpret construction documents 	<ul style="list-style-type: none"> • Computer and software (see Table 10)
Review drawings, specifications, submittals, requests for information, and addenda	X				
Obtain IOMs	X				
Review IOMs	X				
Review details in drawings (schematics, one-line diagrams, etc.)	X				
Review sequence of operations	X				
Prepare draft checklists	X				
List materials, components, and installation techniques required by construction documents	X				
Conduct control point-to-point and positional checks and calibration	X				
Create FPTs					
Review sequence/modes of operations	X	X	<ul style="list-style-type: none"> • BAS or monitoring systems • Building systems (see Table 3) • Controls graphics • Controls theory and operations • How system components work together • Integration protocols • Trend analysis 	<ul style="list-style-type: none"> • Ability to interpret trends • Ability to review controls graphics 	<ul style="list-style-type: none"> • BAS • Computer and software (see Table 10) • Cx tools and equipment (see Table 11)
Review project documents	X	X			
Review BAS documents	X	X			
Review steps involved in performing FPTs	X	X			
Develop FPT steps	X	X			
Determine equipment and systems integration	X	X			
Develop acceptance criteria	X	X			
Conduct risk assessment	X	X			
Determine various scenarios for FPTs	X	X			
Determine load simulation equipment needed	X	X			
Determine equipment/tool/instrument requirements	X	X			
Determine Cx team members and their responsibilities	X	X			
Determine interface and integration requirements	X	X			
Determine timing and schedule for	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
execution of FPTs					
Determine precursors for testing (scheduling)	X	X			
Include safety tests and verify hardware or software driven per specifications	X	X			
Include alarms, notifications, and reports	X	X			
Determine trending criteria	X	X			
Determine Site Visit Protocols (Logistics)					
Review safety protocols and procedures	X	X	<ul style="list-style-type: none"> • Documentation protocols • Evidence collection • Typical site visit protocols 	<ul style="list-style-type: none"> • Ability to photograph evidence • Attention to detail • Curiosity • Interpersonal skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • PPE (see Table 12)
Review site access and security	X	X			
Review communication protocols	X	X			
Develop site visit schedules, durations, and intervals	X	X			
Collect evidence (digital photos, etc.)	X	X			
Determine documentation protocols	X	X			
Coordinate with contractor/site personnel	X	X			
Conduct previsit reviews of drawings, trends, etc.	X	X			
Determine site visit agenda (formal or informal)	X	X			
Distribute site visit agenda	X	X			
Identify goals of the site visit	X	X			
Create site visit (field) reports	X	X			
Determine distribution protocols for reports	X	X			
Determine deficiencies to be placed on issues logs	X	X			
Develop Issues Logs					
Determine if there is a separate design team log versus a construction log	X		<ul style="list-style-type: none"> • Spreadsheet development 	<ul style="list-style-type: none"> • Computer skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10)
Determine issues log format	X	X			
Determine conformity with design team punch lists	X				
Determine distribution list and protocols	X	X			
Determine feedback procedures	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Identify responsible parties for issues	X	X			
Document Cx Meetings					
Develop meeting agendas	X	X	<ul style="list-style-type: none"> • Construction management processes • Project knowledge 	<ul style="list-style-type: none"> • Computer skills • Facilitation skills • Meeting management skills • Presentation skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • Computer and software (see Table 10)
Develop list of meeting attendees	X	X			
Create sign-in sheets	X	X			
Determine meeting locations and logistics	X	X			
Prepare meeting minutes	X	X			
Set up conference call numbers	X	X			
Distribute meeting minutes	X	X			
Send out meeting invitations	X	X			
Write Cx Reports					
Compile all Cx documentation	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Cx processes and procedures • Cx reporting documentation • Required construction and installation tests • Special tests (TAB, etc.) • Startup requirements 	<ul style="list-style-type: none"> • Ability to interpret the TAB report • Computer skills • Interpersonal skills • Organizational skills • Presentation skills • Report writing skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • CMMS • Computer and software (see Table 10)
Determine deliverables	X	X			
Determine the distribution list	X	X			
Obtain documents from others (startup reports, TAB reports, special tests, etc.)	X	X			
Develop executive summary, including details of test results	X	X			
Create table of contents	X	X			
Determine report delivery method (pdf, paper, CMMS, etc.)	X	X			
Determine format for report (report body)	X	X			
Include in report location of OPR/CFR and BOD documents	X	X			
Include list of required deferred testing and off-season mode testing	X	X			
Include list of required deferred training	X				
Distribute draft Cx report for review	X	X			
Finalize Cx report	X	X			
Create Systems Manuals					
Collect O&Ms	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Manufacturers of Cx equipment • Owner's operational 	<ul style="list-style-type: none"> • Ability to assess building performance • Organizational skills • Verbal communication skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • Construction drawings and documents
Review sequence of operations	X	X			
Create facility guide/BOP (schedule, set points, etc.)	X	X			
Collect training materials	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Include original FPTs	X	X	<ul style="list-style-type: none"> configuration and personnel Sequence of operations Systems interactions and integration 	<ul style="list-style-type: none"> Written communication skills 	<ul style="list-style-type: none"> Facility guides Issues resolution logs Manufacturers' data Preventative maintenance schedule Training materials Training records Utility bills Warranty documents
Include blank FPTs for future use	X	X			
Include OPR/CFR	X	X			
Include BOD	X	X			
Include building and equipment specifications	X	X			
Include copies of warranties	X				
Include list of contractors and consultants	X	X			
Include training records	X	X			
Include copy of final Cx process plan	X	X			
Include copy of Cx design and submittal review reports	X				
Include copy of testing and startup reports	X				
Include copy of evaluation checklists	X	X			
Include copy of testing checklists for commissioned systems and assemblies	X	X			
Include copies of issues and resolutions logs	X	X			
Include copies of item resolution plan for any open items	X	X			
Obtain owner approval (sign-off)	X	X			
Include recommendations for ongoing Cx		X			
Identify spare parts list	X				
Develop End-of-Warranty Review Processes					
Identify Cx team members to participate	X		<ul style="list-style-type: none"> Substantial completion and final completion Warranty provisions 	<ul style="list-style-type: none"> Written communication skills 	<ul style="list-style-type: none"> Computer and software (see Table 10) Internet Warranty documents
Identify equipment/systems warranties	X				
Establish acceptance dates	X				
Identify modifications to facility systems	X				
Verify punch lists and issues log items are resolved	X				
Identify extended/voided warranties	X				
Verify owner and occupant satisfaction with building conditions	X				
Create end-of-warranty review report	X				

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
format					
Document warranty expiration dates	X				

Table 16. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Conducting Commissioning Activities

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Plan Cx Construction Activities					
Assist in updating OPR	X		<ul style="list-style-type: none"> • Basic construction • Building systems (see Table 3) • Project knowledge • Safety practices • Scope of work 	<ul style="list-style-type: none"> • Scheduling skills • Leadership skills • Organizational skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Cx tools and equipment (see Table 11)
Review BOD/request for information/SK addenda	X				
Review commissioning plan and schedule	X				
Update Cx plan	X				
Coordinate Cx activities with construction	X				
Review control sequencing	X				
Plan controls integration meeting (fire alarm, life safety, etc.)	X				
Plan BAS and TAB meetings	X				
Review TAB plan	X				
Align commissioning schedule with occupied schedule	X				
Schedule kickoff meeting	X				
Plan onsite access	X				
Plan responses to emergencies	X				
Monitor Cx Construction Activities					
Monitor TAB	X		<ul style="list-style-type: none"> • Building systems (see Table 3) • Construction documents and specifications • Construction methods and concepts • Proportional balancing 	<ul style="list-style-type: none"> • Ability to photograph evidence • Attention to detail • Documentation skills • Interpersonal skills • Physical attributes 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Cx tools and equipment (see Table 11) • PPE (see Table 12)
Monitor construction installations	X				
Conduct controls integration meeting (fire alarm, life safety, etc.)	X				
Coordinate BAS and TAB meetings	X				
Monitor site housekeeping conditions	X				
Monitor equipment storage conditions	X				

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Conduct site visits	X		<ul style="list-style-type: none"> • Site safety 	<ul style="list-style-type: none"> • Verbal communication skills • Written communication skills 	
Monitor compliance with manufacturers' installation requirements	X				
Witness special tests	X				
Attend progress and coordination meetings	X				
Check construction for damage, leaks, etc.	X				
Check maintenance access to building system components	X				
Check for maintainability of building system components	X				
Determine owner's requirements regarding coordination with AHJ	X				
Witness startup activities	X				
Facilitate the Completion of Construction Checklists					
Review mechanical testing forms (CA Title 24)	X		<ul style="list-style-type: none"> • Building systems (see Table 3) • Construction methods and concepts • Issue resolution process • Scope of work • Training methodologies 	<ul style="list-style-type: none"> • Computer skills • Construction skills • Interpersonal skills • Organizational skills • Persistence • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9) • Construction checklists • Writing instruments
Review other building system component testing forms	X				
Prepare construction checklists	X				
Train Cx team on construction checklists	X				
Conduct site observations back-check	X				
Review completion of construction checklists	X				
Identify issues needing resolution	X				
Facilitate issues resolution	X				
Track overall progress of construction checklists	X				
Facilitate the Acceptance Phase					
Witness/execute point-to-point checks	X		<ul style="list-style-type: none"> • Building systems (see Table 3) • Control systems • Failure mode analysis • Operations within the facility • Risk assessment and 	<ul style="list-style-type: none"> • Computer skills • Construction skills • Interpersonal skills • Organizational skills • Persistence 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • Manufacturers' guidelines and materials
Perform TAB verification to design tolerance requirements	X				
Conduct functional performance tests according to manufacturers' guidelines	X				
Set up/review trending	X				

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Perform integrated system testing	X		management	<ul style="list-style-type: none"> • Physical mobility • Verbal communication skills • Written communication skills 	
			<ul style="list-style-type: none"> • Safety practices 		
			<ul style="list-style-type: none"> • TAB 		
			<ul style="list-style-type: none"> • Trend analysis 		

Table 17. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Managing Training Activities

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Develop a Training Plan					
Review scope of work	X	X	<ul style="list-style-type: none"> • Building operations • Building systems (see Table 3) • Records/document management • Safety practices • Training methodologies 	<ul style="list-style-type: none"> • Ability to communicate technical information to others • Ability to serve as a mediator between owners, contractors, and others • Ability to train others • Empathy • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • BAS • Computerized control systems • Manufacturers' guidelines and materials • O&M manuals • PPE (see Table 12) • Previous training programs • Training agendas • Training facilities • Training materials
Review or request contractor's curriculum	X	X			
Discuss training expectations with owner	X	X			
Conduct gap analysis of capabilities of staff to identify needed training	X	X			
Identify stakeholders and roles and responsibilities	X	X			
Review project/construction documents	X				
Develop training schedule	X	X			
Identify needed training for specific individuals	X	X			
Identify resource and space requirements for training	X	X			
Identify other training logistics	X	X			
Identify manufacturers' training	X	X			
Prepare handouts and other training materials	X	X			
Identify training prerequisite materials such as O&M manuals and record drawings	X	X			
Identify training recording requirements (video, etc.) per specifications	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Verify instructor qualifications	X	X			
Coordinate training schedule (training and O&M startup are not on same day, etc.)	X	X			
Engage stakeholders in planning training activities	X	X			
Create training matrix of required training (logs, etc.)	X	X			
Look for opportunities to advance training	X	X			
Identify acceptance criteria	X	X			
Review O&M staff participation in FPTs	X	X			
Verify safety instruction is included where appropriate	X	X			
Identify off-season mode training requirements	X	X			
Facilitate the Training Coordination Meeting					
Review curriculum	X	X	<ul style="list-style-type: none"> • Building operations • Building systems (see Table 3) • Facilities management • Records/document management • Training methodologies 	<ul style="list-style-type: none"> • Facilitation skills • Interpersonal skills • Presentation skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Flipcharts and markers • Instruction space (classrooms, etc.) • Teaching equipment (projectors, etc.)
Introduce training plan	X	X			
Review agenda	X	X			
Inform participants about training	X	X			
Discuss roles and responsibilities for training	X	X			
Obtain syllabi for training	X	X			
Review training specifications	X	X			
Coordinate the owner's participation	X	X			
Finalize schedule	X	X			
Discuss acceptance criteria	X	X			
Plan for persistence					
Facilitate Training Activities					
Document training attendance	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Successful training outcomes • Training facilitation 	<ul style="list-style-type: none"> • Facilitation skills • Presentation skills • Team building skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 9) • Evaluation form • Instruction space (classrooms, etc.)
Implement the training plan	X	X			
Document owner training	X	X			
Verify the training is effective	X	X			
Interject whole-building and system knowledge pertaining to system to facilitate learning	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Coordinate integration of all parties involved in training	X	X			<ul style="list-style-type: none"> • Sign-in sheets • Teaching materials
Obtain copy of all training materials/videos to be placed into systems manual	X	X			
Determine requirements for supplemental materials	X	X			
Conduct off-season mode training	X	X			
Identify lessons learned related to training	X	X			
Conduct Training Follow-Up Activities					
Verify owner training has been completed	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Training evaluation • Training plans 	<ul style="list-style-type: none"> • Follow-up techniques • Interviewing skills • Organizational skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Attendance sheets • Building operators • Staffing plans • Training evaluation data (comments, surveys, etc.)
Evaluate effectiveness of training	X	X			
Verify training acceptance criteria were met	X	X			
Interview staff	X	X			
Distribute supplemental materials	X	X			
Ensure new personnel have completed training	X	X			
Verify accessibility of training materials	X	X			
Identify follow-up training requirements	X	X			
Submit archive training materials to owner	X	X			
Identify lessons learned related to training	X	X			

Table 18. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Completing Warranty Phase Activities

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Facilitate Off-Season Testing					
Facilitate incomplete or deferred tests	X		<ul style="list-style-type: none"> • Building systems (see Table 3) • Control systems • Failure mode analysis • Functional testing procedures, equipment, and results • Operations within the facility • Risk assessment and management • Safety practices • TAB • Trend analysis 	<ul style="list-style-type: none"> • Attention to detail • Computer skills • Construction skills • Interpersonal skills • Interviewing skills • Organizational skills • Persistence • Physical mobility • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • Manufacturers' guidelines and materials
Schedule tests when conditions are appropriate	X				
Identify participants	X				
Interview occupants	X				
Identify testing logistics (occupant convenience, etc.)	X				
Collect startup reports	X				
Review system manufacturer and verification checklists	X				
Update issues logs	X				
Document testing results	X				
Set up trends	X				
Analyze test data	X				
Troubleshoot Facility Issues					
Collect tenant complaint information	X		<ul style="list-style-type: none"> • Building systems (see Table 3) • Fault diagnostic knowledge • OPR • Systems understanding • Trend data • Troubleshooting techniques 	<ul style="list-style-type: none"> • Documentation skills • Forensic skills • Interviewing skills • Research skills • Troubleshooting skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11)
Query CMMS/work orders	X				
Review trend data and alarms	X				
Interview maintenance staff	X				
Interview building owners	X				
Review equipment for proper operation	X				
Document issues and resolutions	X				
Investigate and analyze issues	X				
Resolve issues or make recommendations for solutions	X				
Verify warranty issue resolution	X				
Verify completion of punch lists/issue logs					

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Measure Energy Performance					
Assist with calibrating energy model	X		<ul style="list-style-type: none"> • Energy management fundamentals • Energy modeling • Expected equipment performance • OPR • Submetering • Utility rate structures and schedules 	<ul style="list-style-type: none"> • Ability to read and interpret utility bills, rate structures, and utility contracts • Computer skills • Basic math skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • Cx tools and equipment (see Table 11) • Energy coordinator or manager • Utility bills • Utility meters
Review utility data	X				
Establish actual building energy performance baseline	X				
Evaluate submeter trends	X				
Evaluate M&V	X				
Review energy performance tracking program	X				
Analyze power factor performance	X				
Make system improvement recommendations	X				
Optimize building performance					
Facilitate the End-of-Warranty Meeting					
Interview owner, occupants, and operators	X		<ul style="list-style-type: none"> • Building operations • Building systems (see Table 3) • CMMS • IEQ • O&M procedures • Warranties 	<ul style="list-style-type: none"> • Interviewing skills • Listening skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • Building records and documents • Computer and software (see Table 10) • Cx tools and equipment (see Table 11) • Maintenance staff • OPR • Warranty documents
Review systems manuals and systems operations	X				
Review the warranty matrix	X				
Participate in lessons learned	X				
Review CMMS systems	X				
Create attendance list	X				
Review service contracts	X				
Prepare meeting minutes	X				
Distribute documentation, including minutes	X				
Create agendas	X				
Distribute agendas	X				
Assess occupant comfort	X				
Conduct IEQ assessment	X				
Schedule meeting and invite attendees	X				
Review BOPs, schedules, and set points	X				
Update the Cx report (addenda or supplemental report)	X				
Update systems manuals	X				

Table 19. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Conducting Existing Building Commissioning

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Determine the Scope of the Project					
Determine project goals and objectives		X	<ul style="list-style-type: none"> • M&V methodologies • Building systems (see Table 3) • Cx budgeting • Cx processes and procedures • Energy performance • Incentive programs • Needs assessment processes 	<ul style="list-style-type: none"> • Ability to conduct a needs assessment • Analytical skills • Interviewing skills • Organizational skills • Verbal communication skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11)
Interview owner		X			
Determine scope of work		X			
Analyze building, systems, and equipment		X			
Prioritize goals and objectives		X			
Determine if incentive funding is available		X			
Determine M&V requirements		X			
Determine metering requirements		X			
Develop existing Cx team		X			
Conduct a Building Performance Assessment					
Review available building documentation		X	<ul style="list-style-type: none"> • Budgeting • Building operations • Building systems (see Table 3) • Energy use analysis • Maintenance procedures and roles • Utility bill structures 	<ul style="list-style-type: none"> • Computer skills • Interpersonal skills • Interviewing skills • Basic math skills • Research skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • BAS • Cx tools and equipment (see Table 11) • O&M manuals
Request and review CFR		X			
Obtain utility bills		X			
Identify missing system documentation		X			
Begin outlining CFR if one does not exist		X			
Research systems where documentation does not exist		X			
Obtain BOP		X			
Review other specialized facility-specific documents and reports (asbestos, containment plans, infection control plans, etc.)		X			
Conduct ENERGY STAR performance analysis		X			
Obtain and review previous Cx reports		X			
Establish existing building performance baselines		X			
Inspect equipment		X			
Determine building automation capabilities		X			
Evaluate single point-of-failure analysis		X			
Establish Cx team		X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Estimate improvement potentials		X			
Interview occupants and O&M staff		X			
Review recent modifications and upgrades					
Prepare a CFR					
Identify specific building systems and equipment		X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Engineering principles • Maintenance contracts • Safety practices • Service contracts • System operations 	<ul style="list-style-type: none"> • Analytical skills • Written communication skills 	<ul style="list-style-type: none"> • BOPs • Codes, regulations, standards, and guidelines (see Table 9)
Determine operations strategies, parameters, set points, and schedules		X			
Determine space allocation and usage		X			
Determine emergency and safety modes of operation		X			
Determine performance goals		X			
Determine training requirements		X			
Determine operations team schedule		X			
Determine occupancy levels and schedules					
Conduct a Systems Assessment					
Review building systems		X	<ul style="list-style-type: none"> • Building operations • Building systems (see Table 3) • CMMS • Maintenance contracts • Maintenance issues 	<ul style="list-style-type: none"> • Interviewing skills 	<ul style="list-style-type: none"> • Codes, regulations, standards, and guidelines (see Table 9)
Identify deferred maintenance issues		X			
View operating procedures		X			
Review previously identified or known operating failures		X			
Identify FIMs/ECMs		X			
Create master log of deficiencies		X			
Identify new and recently upgraded equipment/systems		X			
Conduct field check of control sensor calibration		X			
Review alarm logs		X			
Review reports associated with fire life safety		X			
Review systems to verify compliance with applicable life safety codes		X			
Review maintenance contracts		X			
Review troubleshooting logs		X			
Review controls contracts		X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Deploy data loggers		X			
Determine locations for data loggers		X			
Review CMMS		X			
Finalize list of equipment to be tested		X			
Walk facility with O&M and facility management staff		X			
Conduct a Site Investigation					
Review functional performance testing procedures with building operations team		X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Risk assessment and management • Safety practices • Sequence of operations • Test development • Testing procedures • Trend analysis • Troubleshooting methodologies 	<ul style="list-style-type: none"> • Ability to conduct a root cause analysis • Ability to train others • Analytical skills • Attention to detail • Interpersonal skills • Investigation skills • Negotiation skills • Research skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11)
Conduct functional performance testing		X			
Download data loggers		X			
Analyze data logger data		X			
Identify equipment and system issues		X			
Develop testing strategies for building and systems		X			
Conduct root cause analysis		X			
Analyze results from FPTs and determine if additional tests are required		X			
Implement quick fixes if approved		X			
Update master list of deficiencies		X			
Update development of FIMs and ECMs		X			
Recommend Corrections and Improvements					
Develop FIMs and ECMs		X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Construction estimating • Construction scheduling • Developing ROIs • Energy calculations • Occupancy impacts • Risk assessment and management • Utility rebate incentives 	<ul style="list-style-type: none"> • Ability to prioritize • Computer skills • Financial skills (ROI, etc.) • Interpersonal skills • Management skills • Basic math skills • Presentation skills • Report writing skills • Time management skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • Cx tools and equipment (see Table 11)
Calculate benefits of implementing measures		X			
Determine ROI		X			
Determine execution schedule and personnel		X			
Determine budgets and potential for incentives		X			
Develop scope for recommendations, FIMs, and ECMs		X			
Present recommendations to owner and O&M staff		X			
Determine responsibilities of stakeholders for maintenance/repairs/ improvements		X			
Prioritize corrections and improvements		X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Determine action plan with owner		X			
Determine training requirements		X			
Update M&V requirements		X			
Oversee the Implementation of Corrective Measures					
Manage implementation of FIM or ECM projects		X	<ul style="list-style-type: none"> • BAS or monitoring systems • Building systems (see Table 3) • Construction scheduling • Cx processes and procedures 	<ul style="list-style-type: none"> • Scheduling skills • Analytical skills • Interpersonal skills • Physical attributes • Research skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • BOPs • Codes, regulations, standards and guidelines (see Table 9) • Cx tools and equipment (see Table 11)
Commission corrections		X			
Implement low-cost/no-cost items		X			
Develop schedules		X			
Update CFR		X			
Update BOP		X			
Conduct training of operators, owners, and occupants		X			
Optimize controls operating parameters or set points		X			
Conduct Performance Verifications					
Review trending/data loggers		X	<ul style="list-style-type: none"> • Building systems (see Table 3) • M&V methodologies • Metering • Scope of work • Utility rate structures and schedules • Various control technologies (new and legacy) 	<ul style="list-style-type: none"> • Analytical skills • Report writing skills 	<ul style="list-style-type: none"> • BOPs • Codes, regulations, standards and guidelines (see Table 9) • Cx tools and equipment (see Table 11)
Redeploy data loggers		X			
Obtain new measurements		X			
Compile improvement matrix		X			
Review utility data and submeters		X			
Compare current data to original preproject baseline		X			
Interview occupants		X			
Calculate actual and projected savings		X			
Summarize lessons learned		X			
Update CFR		X			
Update BOP		X			
Review and conduct additional training		X			
Prepare draft report for comments		X			
Prepare final report		X			
Assist in obtaining incentives		X			
Make recommendations for ongoing Cx		X			

Table 20. Duties, Tasks, Steps, Specialized Knowledge, Skills, Abilities, Tools, Equipment, and Resources Required for Conducting Ongoing Commissioning

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Measure IEQ Performance					
Conduct occupant survey	X	X	<ul style="list-style-type: none"> • BAS or monitoring system • Control systems • IEQ 	<ul style="list-style-type: none"> • Interviewing skills 	<ul style="list-style-type: none"> • Cx tools and equipment (see Table 11) • Industrial hygienist
Obtain IEQ measurements	X	X			
Review BAS trend logs	X	X			
Review complaints	X	X			
Prepare IEQ draft report	X	X			
Evaluate Building Systems Performance					
Obtain and review utility bills	X	X	<ul style="list-style-type: none"> • Building systems (see Table 3) • Control systems • Data normalization (weather, days of the month, etc.) • Energy management fundamentals • Maintenance management systems • Regression modeling 	<ul style="list-style-type: none"> • Ability to manage resources • Basic math skills • Presentation skills • Written communication skills 	<ul style="list-style-type: none"> • CMMS • Codes, regulations, standards, and guidelines (see Table 9) • Computer and software (see Table 10) • Cx tools and equipment (see Table 11) • Trend data • Utility bills • Utility rate data
Review BAS trend logs	X	X			
Review submetering data	X	X			
Compare current baseline to past and industry baselines	X	X			
Review maintenance logs	X	X			
Review CMMS work orders	X	X			
Perform normalized data analysis	X	X			
Identify major changes	X	X			
Report degradation of savings	X	X			
Review the Building Operating Plan					
Conduct analysis of current BOP to original BOP	X	X	<ul style="list-style-type: none"> • Building operations • Building maintenance 	<ul style="list-style-type: none"> • Interpersonal skills • Verbal communication skills 	<ul style="list-style-type: none"> • BOPs
Identify changes	X	X			
Update BOP	X	X			
Review training activities	X	X			
Review Maintenance Activities					
Review CMMS	X	X	<ul style="list-style-type: none"> • CMMS • Maintenance contracts • Maintenance procedures and roles • Survey techniques 	<ul style="list-style-type: none"> • Interviewing skills • Verbal communication skills • Written communication skills 	<ul style="list-style-type: none"> • CMMS • Maintenance contracts • O&M manuals
Review O&M contract	X	X			
Review maintenance plans	X	X			
Survey occupants/tenants	X	X			
Interview maintenance personnel	X	X			
Conduct field investigation to determine deferred maintenance items	X	X			

Duties, Tasks, and Steps	NB	EB	Specialized Knowledge	Skills and Abilities	Tools, Equipment, and Resources
Accommodate Space/Function Changes					
Identify space/function changes	X	X	<ul style="list-style-type: none"> • BAS or monitoring systems • Building systems (see Table 3) • Facilities management 	<ul style="list-style-type: none"> • Ability to read and interpret construction documents 	<ul style="list-style-type: none"> • BAS • Codes, regulations, standards, and guidelines (see Table 9) • Computer and software (see Table 10) • OPR • Record drawings
Update OPR/CFR	X	X			
Review as-built drawings	X	X			
Review BAS for updates	X	X			
Recommend system modifications	X	X			
Implement Corrective Actions					
Identify corrective actions	X	X	<ul style="list-style-type: none"> • BAS operations • Building systems (see Table 3) • Facilities management • Project management 	<ul style="list-style-type: none"> • Attention to detail 	<ul style="list-style-type: none"> • BAS • Codes, regulations, standards, and guidelines (see Table 9) • Computer and software (see Table 10) • Cx tools and equipment (see Table 11) • OPR
Conduct follow-up training	X	X			
Change BAS parameters	X	X			
Repair equipment deficiencies	X	X			
Update the BOP	X	X			
Commission major system modifications	X	X			
Publish Measurement and Performance Results to Stakeholders					
Prepare progress reports	X	X		<ul style="list-style-type: none"> • Multimedia skills • Presentation skills • Report writing skills 	<ul style="list-style-type: none"> • Computer and software (see Table 10) • Internet
Distribute reports to stakeholders	X	X			
Meet with stakeholders	X	X			
Present results	X	X			