Testing, Adjusting and Balancing HVAC Systems: An Overview of Certification Agencies

Fredrick Meyers and Theresa Pistochini

UCDAVIS
Western Cooling Efficiency Center

WCEC Technical Report
May 12, 2020

Recommended Citation

Meyers, Fredrick and Theresa Pistochini. "*Testing, Adjusting and Balancing HVAC Systems: An Overview of Certification Agencies.*" University of California Davis Western Cooling Efficiency Center. May 12, 2020

Acknowledgement

The research team acknowledges individuals who provided information through personal interviews and written comment for this whitepaper, including Ray Bert from the Associated Air Balance Council, Tiffany Suite from the National Environmental Balancing Bureau, Christopher Ruch from the National Energy Management Institute, and John Hamilton from the Testing, Adjusting and Balancing Bureau.

Contacts

Fredrick Meyers, UC Davis Western Cooling Efficiency Center, fnmeyers@ucdavis.edu

Theresa Pistochini, UC Davis Western Cooling Efficiency Center, tepistochini@ucdavis.edu

WCEC Technical Report

May 12, 2020

INTRODUCTION

Testing, adjusting, and balancing (TAB) is a process where air and hydronic flows in a building are measured, adjusted, and documented to meet design specifications and local building codes to ensure thermal comfort, indoor air quality, and system energy efficiency are optimized. In order to improve the quality of the TAB process, tests should follow a standardized methodology and be completed by a certified technician. TAB certified specialists use their knowledge and experience to verify, test, and adjust heating, ventilation, and air conditioning (HVAC) systems after installation or retrofit, during a building's commissioning process, or anytime evaluation of existing buildings is needed.

In this article, we will examine the benefits of using a certified contractor for TAB and describe the three main certifying agencies and differences between them. The three main certifying agencies are:

- Associated Air Balance Council (AABC)
- National Environmental Balancing Bureau (NEBB)
- Testing, Adjusting and Balancing Bureau (TABB)

State and local regulations for testing, adjusting, and balancing HVAC systems vary across the United States. The Building Code Assistance Project keeps track of which states have adopted the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings." This standard includes requirements for commissioning buildings and includes TAB requirements. Many states have adopted Standard 90.1 or its equivalent (Figure 1); however, there is considerable variation in the adoption of energy standards that include TAB requirements. A few examples below illustrate this variation:

- Colorado does not have statewide energy standards, but does work with counties to help them adopt the International Energy Conservation Code (IECC), which has TAB requirements, on a local level.
- New York adopted the IECC (except where otherwise approved by the local agency).
- California's mechanical code section 407.3 requires that ventilation systems "shall be balanced in accordance with the latest edition of standards published by [AABC, NEBB, or TABB]." In addition, California's Title 24 Building Energy Efficiency Standards (Part 6) requires acceptance testing of covered newly installed or retrofitted mechanical systems and that acceptance testing must be completed by Acceptance Test Technician Certification Providers (ATTCPs)[1].

[1] Acceptance testing must be completed by an ACTTCP once the California Energy Commission determines that sufficient certified technicians are available in the state.

Regardless of the local building codes, building owners will benefit from conducting TAB when commissioning new buildings and periodically for existing buildings. TAB improves energy efficiency of HVAC system operation, and the health and well-being of occupants by ensuring required ventilation rates for indoor air quality are met.

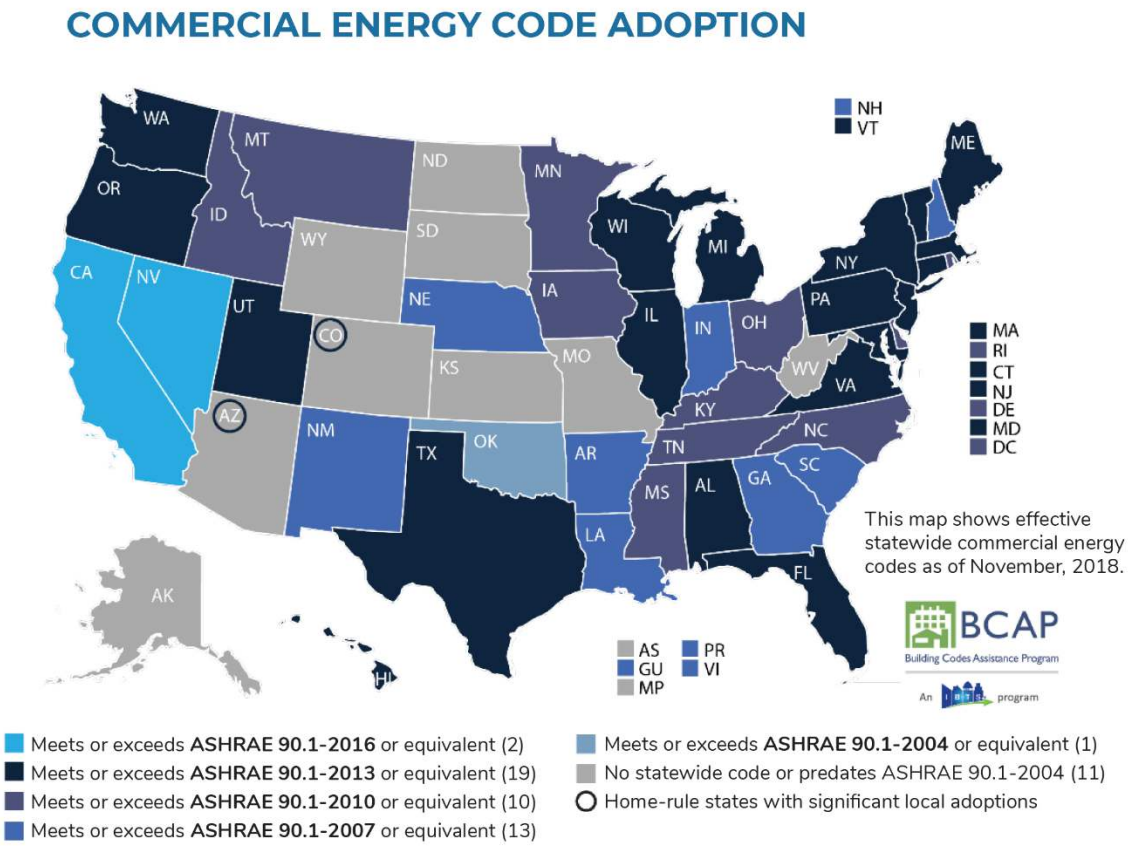

Figure 1: Energy code adoption in USA. TAB requirements are usually a section within the energy code [1].

WHY CERTIFY?

The certification process evolved from a market need to ensure that installed HVAC systems operate as intended and perform to design specification. A certified TAB contractor may even make design suggestions or adjustments depending on the differences between theoretical operation vs. the actual installation. The need for highly skilled technicians has increased with the complexity of HVAC systems, such as electronic controls, variable speed devices, and/or economizers. As a result, associations were established to standardize and train the industry for the benefit of building owners, architects, contractors, inspectors, and occupants.

Certification provides assurance to building owners that a particular contractor will meet a specified level of quality. While local regulations may not specify a particular certification, private organizations may write their own requirements beyond what building codes require. In this case, building owners can specify that a balancing procedure must follow a certain standard and/or be performed by a contractor with a specific certification.

The value of TAB certification, however, goes beyond meeting specifications. During interviews conducted by the UC Davis Western Cooling Efficiency Center (WCEC), TAB agencies expressed that certification serves as a verification that their employees have the knowledge and experience needed to complete on the job tasks. In addition, a technician with a certificate can use it to advance their career. In other words, passing a test and training course administered by a third-party provides mutual benefit to both employer and employee.

In addition to providing a baseline level of knowledge, a certifying agency helps contractors and technicians remain up-to-date with new practices. Advanced control systems, automated instruments, and new standards are constantly changing in the market. To support contractors and technicians, all the major certifying agencies provide regular training seminars and require a certain number of Continuing Education Credits (CECs) to maintain certification.

CERTIFICATION TYPES

While different agencies use different terminology, certification generally falls into one of three levels: technician, supervisor, or firm. The technician is responsible for actually performing the work and it is extremely important that this person be skilled in their job. The technician level certification is designed to ensure TAB is performed by a qualified individual who understands underlying processes. Additionally, the technician obtains skills for proper reporting of TAB results, understanding local codes, and how to take care of measurement equipment.

The supervisor level certification is intended for professionals in a leadership role who are responsible for the overall oversight and quality of the project. These individuals are expected to have a deep level of technical understanding and more work experience. Some certification agencies call this an “engineering level” certification.

Finally, the firm level certification is for the TAB company as a whole. The company is responsible for the actions of their technicians and supervisors. Requiring the firm to be certified is an additional level of accountability, since they must adhere to quality assurance programs to maintain the certification.

CERTIFICATION QUALITY

In a 2010 John Hamilton, Chief Operating Officer of TABB posed the question, “who certifies the certifier?” The American National Standards Institute (ANSI) developed a program for Accredited Standards Developers (ASD) that requires organizations to meet requirements on published standards. To quote their website, “It indicates recognition by a neutral party that the subject standards represent the consensus of materially affected and interested parties in the voluntary standards process [2].”

ANSI also maintains an “Accreditation Program for Personnel Certification Bodies” (ANSI/ISO/IEC 17024) which is an internationally recognized standard also used by the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC). This program requires a certification body to follow strict standards for organizational structure and disclose potential conflicts of interest to ensure certificates are awarded impartially. ANSI certified bodies with multiple testing centers are required to hold all individuals to equal standard, regardless of location. This ensures technicians from different regions are held to the same standard. Additionally, there are requirements for resources to be in place for maintaining examination equipment and training materials. This standard makes sure the certification process is appropriate for producing an individual who can competently perform the tasks outlined in the scope of certification. The 17024 accreditation requires the organization to follow ISO 9001 standards for “Quality Management Systems,” which is another strict and highly detailed internationally recognized document. TABB is the only ANSI accredited TAB certifying agency.

OVERVIEW OF MAIN CERTIFYING AGENCIES

There are currently three main test and air balance certification agencies in the United States. In this section, we summarize key features of each program, including program history, certification processes and requirements, and training opportunities. Table 1 summarizes the key features of these programs. Agencies are presented in alphabetical order.

Associated Air Balance Council (AABC)

AABC was founded in 1965 by H. Taylor Kahoe, George E Coultas, and the Sheet Metal Workers International Association who wanted to create an independent organization that could develop national standards for the TAB industry. AABC only certifies TAB firms that are not associated with a mechanical contractor, design firm, equipment manufacturer, or other organization that could potentially cause a conflict of interest [3]. This restriction limits the pool of eligible firms, so there are fewer AABC members compared to other certification organizations.

TAB Standards and Procedures

AABC is considered the first agency to create strict TAB standards and procedures. They have a strong focus on written specifications, which are published in the 550 page, ANSI-approved "AABC National Standards for Total System Balance," currently in its 7th edition. In addition, they publish field and training manuals, a video training series, and a quarterly journal. The AABC standards for TAB procedures are ASD accredited by ANSI.

Certification

The AABC certification process is not ANSI 17024 accredited. Instead, the board of directors maintains the certification process including the tests, standards, and operating procedures. Becoming an AABC certified firm requires a vetting process to ensure proper qualification and independence. The initial application includes financial disclosures, a notarized affidavit declaring independence, proof of equipment ownership, proof of current equipment calibration, a list of personnel with their qualifications, ten letters of recommendation (with at least five from a professional engineer), and two complete TAB reports. This packet is reviewed by the AABC board of directors and assigned to one director for a desk review. If this first stage is passed, AABC next performs an in-person visit, usually for 1.5 days and including visits to active or recently completed job sites. A firm must pass this stage before it can be approved to have eligible personnel sit for exams, the final step for AABC certification.

Qualified employees of certified firms may sit for exams to obtain their supervisor or technician certifications, which AABC refers to as Test and Balance Engineer (TBE) or Test and Balance Technician (TBT), respectively. A TBE is required to have 8 years of test and balance experience (an engineering degree may count for 4 of those years). A TBT needs 3 years of experience before they can take the 8 hour written exam. The TBE/TBT must remain in good standing with their employer and AABC to maintain their certificates.

Training

AABC does not have in-person training centers. AABC provides detailed, structured training materials such as the Technician Training Manual, hosts two meetings each year with educational and training seminars, and works with AABC firms to help them develop in-house training programs.

National Environmental Balancing Bureau (NEBB)

NEBB was founded in 1971 as a result of standards written in collaboration between the Mechanical Contractors Association and the Sheet Metal and Air Conditioning Contractors National Association (SMACNA). NEBB quickly grew and by 1977 had finished the second edition of their *Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems* publication. NEBB is now a separate organization from SMACNA and has grown to 25 regional chapters in the USA, Canada, and Australia.

TAB Standards and Procedures

NEBB's Procedural Standard for Testing Adjusting and Balancing of Environmental Systems is currently in its 9th edition. Similar to AABC and TABB, it establishes a uniform and systematic set of criteria for TAB. NEBB is ASD certified and publishes two standards for building commissioning that are ANSI approved. However, their TAB standards are not approved under the ANSI ASD program.

Certification

The NEBB certification process is not ANSI 17024 accredited. Instead, the board of directors maintains the certification process including the tests, standards, and operating procedures. The board of directors consists of 13 professionals from all disciplines that NEBB certifies. Five of those professionals make up a steering committee which helps guide NEBB's future and strategy [4].

To become a Certified Technician (CT), individuals must pass a NEBB TAB written exam. The written exam is a 3 hour, 100-113 multiple-choice test. NEBB partners with the Kryterion testing service to deliver the exam, which has 350 locations in the USA. Prior to taking the exam the applicant must have either a:

- High school diploma or GED with 4 years experience in TAB, or
- High school diploma or GED with 2 years experience and completion of the NEBB TAB technician course (or approved equivalent).

The supervisor level NEBB certification is referred to as the TAB Certified Professional (CP). To become a TAB CP, individuals must meet additional prerequisites that amount to a 4 year degree with 2 years of leadership experience or equivalent as summarized here:

- B.S. degree in engineering with 2 years leadership experience in TAB, or
- Associate degree in engineering with 4 years leadership experience, or
- Four years experience in TAB in addition to 4 years experience in a leadership role, or
- Four years experience in general HVAC work with an additional 4 years in TAB, 2 years in a leadership role, and an approved TAB training course.

The TAB CP is a written and practical examination intended to ensure the person supervising TAB work has the knowledge to plan a TAB procedure, make quick decisions, correct problems, and lead technicians. Additionally, a basic knowledge of controls is needed to help make corrections in the field. The written portion of the CP exam can be scheduled online, and the practical exam can be scheduled through one of the 25 NEBB regional chapters.

The NEBB certification for CPs and CTs is only valid when employed by a NEBB certified firm. To become a NEBB certified firm, additional eligibility requirements must be met, which include 6 letters of recommendation, calibrated equipment, at least one certified professional, an arbitration agreement, and more. Standards are enforced by the NEBB quality assurance

program, which may discipline firms who receive customer complaints. The discipline process and repercussions are governed by the "NEBB Operational Procedures" document as approved by the board of directors.

Training

NEBB has one "NEBB Tech" training location at their headquarters in Maryland and periodic seminars as listed on the events section of the NEBB website. In addition, regional chapters help certify and train local supervisors and technicians. NEBB offers standards publications, online training, and certifications for members. NEBB helps develop the community through a "Young Professionals" program that gives new engineers and contractors the ability to work directly with the NEBB board of directors, which allows them to learn from industry veterans.

Testing Adjusting, and Balancing Bureau (TABB)

Similarly, to AABC and NEBB, TABB was originally founded in collaboration with the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). However, unlike NEBB and AABC, they maintained that relationship and are still directly associated with SMACNA as well as the International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART) [5]. TABB develops the TAB standards and procedures and works with the following organizations to deliver materials and administer the tests:

- The International Training Institute (ITI) develops classes to assist SMART and SMACNA members in learning the material required to become certified. ITI offers apprentice and journeyman programs and other educational courses.
- National Energy Management Institute (NEMI) offers training for the supervisor level certification
- The International Certification Board (ICB) administers the tests and certifications.

TAB Standards and Procedures

The specific procedures TABB uses are developed in conjunction with SMACNA and published as the *TAB Procedural Guide*. This book covers everything a technician needs to balance an HVAC system, including planning, measurement, adjustment, and reporting and is adopted as the official TABB procedural guide.

Certification process

The TABB certification process administered by ICB is ANSI 17024 accredited, which is an internationally recognized standard for personnel certification bodies. To become TABB certified, a technician must apply, be approved, pass a written test, and pass a two-day long practical (hands-on) exam at an ITI training center (over 150 nationwide). There are no specific degree or work experience requirements; instead, competence in the subject matter is demonstrated through the ANSI accredited certification process.

TABB also offers a supervisor level ANSI 17024 accredited certification via a written test, which is intended for personnel who have more technical knowledge and desire a leadership role. The TABB Supervisor certification has prerequisites and there are four pathways to become eligible to take the exam:

- An engineering degree with 1 year of work experience, or
- An associates degree with 3 years of work experience, or
- A certified TABB technician with five years of work experience, or
- A certified TABB technician with three years of work experience and a letter of recommendation from employer, who must be a certified TABB Contractor.

The final level of certification is at the firm level, the "TABB Contractor" certification. These companies must adhere to strict quality standards and follow the TABB customer satisfaction procedure. This procedure is an agreement that any complaint about the firm's work must follow a strict process mediated by TABB, and the contractor may face repercussions after an investigation. Additionally, a TABB contractor must be an established organization that has completed at least three TAB projects, has five letters of recommendation, employs ICB certified technicians/supervisors, and maintains a calibrated set of TABB approved equipment.

Although independence is not required for membership, TABB firms have the option of taking extra steps to become certified as independent similar to the AABC firm certification. All firms are held to a strict code of conduct, and TABB reserves the right to decertify firms who violate these conditions.

Training

ITI offers training and training center development to over 150 SMART and SMACNA locations across the US and Canada. SMART apprentices (4-5 year apprenticeship programs) and journeymen receive training at these centers to support their employment and advancement in the HVAC and Sheet Metal Industry. These training programs include the option for varying degrees of specialization in TAB, service, and system start-up anywhere from a night class to a full TAB apprenticeship. To date, over 22 of the SMART training centers across the country have accredited TAB labs offering ANSI certifications in TAB and TAB related fields which been built to a national standard with consistency across the country so the exam process can be fair, equal, and defend-able across the country. Additionally, applicants have access to an online learning management system which includes study guides, quizzes, practice examinations, and resources.

NEMI provides additional training specifically focused on developing supervisor-level concepts. The TABB Supervisor training builds upon a high level of technical skill to prepare HVAC professionals for leadership and supervision. NEMI also offers classes for related disciplines, such as indoor air quality management, smoke control systems, sound and vibration, and commissioning.

Table 1. Summary of test and air balance certification programs

	AABC	NEBB	TABB
Standards ANSI ASD Approved	Yes	Yes	Yes
ANSI 17024 Accredited	No	No	Yes
		Prerequisites	
Technicians	3 years experience	4 years experience	Acceptance into apprenticeship program
Supervisors	8 years experience	6 years experience	5 years experience
Firms	• Independent from mechanical contractors, design firms, and equipment manufacturers. • 3 years in business • 10 letters of recommendation • Ownership of equipment and current certificates of calibration • Complete site visit/verification	• Employ certified professionals • 1 year in business • 6 letters of recommendation • Maintain equipment • Agree to arbitration and code of ethics	• Employ certified technicians and supervisors • Completion of at least three TAB projects • 5 letters of recommendation • Own and maintain a list of equipment • Adopt TABB customer satisfaction procedure • Be signatory to the union that contributes to NEMI
		Renewals	
Technicians	30 CECs** on a 3 year renewal cycle	Fee + 6 CECs** on a 2 year cycle	No Fee, 4 CEUs** on a 2 year cycle
Supervisors	60 CECs** on a 3 year renewal cycle	Fee + 12 CECs** on a 2 year cycle	Fee + 8 CEUs** on a 2 year cycle
Firms	1 year cycle	Maintain equipment, pay fee, keep employees certified, 2 year cycle	Maintain equipment, pay fee, keep employees certified, 1 year cycle
TAB Firm is Required to be Independent	Required	Not required	Optional
		Training	
Online	Yes (video courses)	Yes	Yes
Hands-on	No	Yes	Yes
Number of Training Centers	0	1	150+
		Exams	
Hands-on	No	Yes for CP level certification / No for CT level	Yes
Written	Yes	Yes	Yes
Number of Exam Centers	Locally proctored by 3rd party testing centers	25 plus online exams	150 plus online exams
Probationary period for new members	Yes	No	No
SMACNA/SMART Membership required	No	No	Yes
Quality assurance or arbitration program	Yes	Yes	Yes

***Continuing Education Credits (CECs) also called Continuing Education Units (CEUs) are a requirement to renew certification. For all agencies, 1 CEC is equal to 1 hour of professional development, which some exceptions.*

LOCAL AVAILABILITY OF CERTIFIED CONTRACTORS

Using a certified TAB firm has many benefits, but how do you find a contractor who holds the desired certification? The most direct way to locate a certified contractor is to use the tools provided on each of the certification agency's websites. These tools show the contact information of nearby firms who hold current certificates. A nationwide overview of the availability of certified firms is shown in Figure 2, Figure 3, and Figure 4. Predictably, there are more certified firms near cities and metropolitan areas, while rural parts of the US have fewer options. Still, much of the country is within driving distance of one or more certified TAB firms.

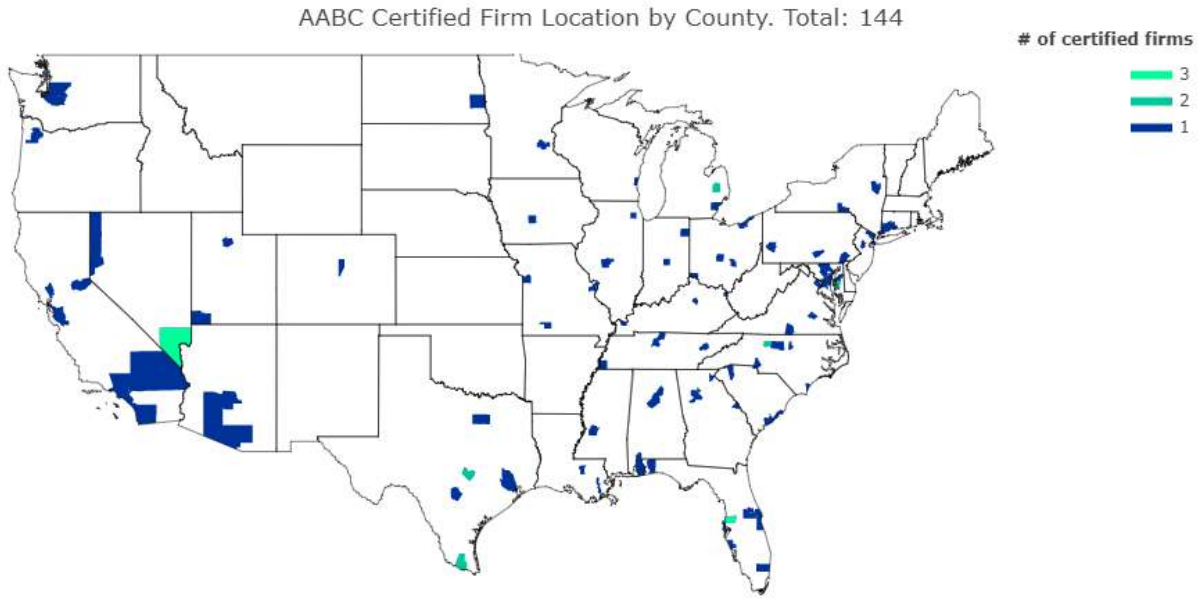

Figure 2: Map of AABC certified firms by county. Three firms in Hawaii not shown.

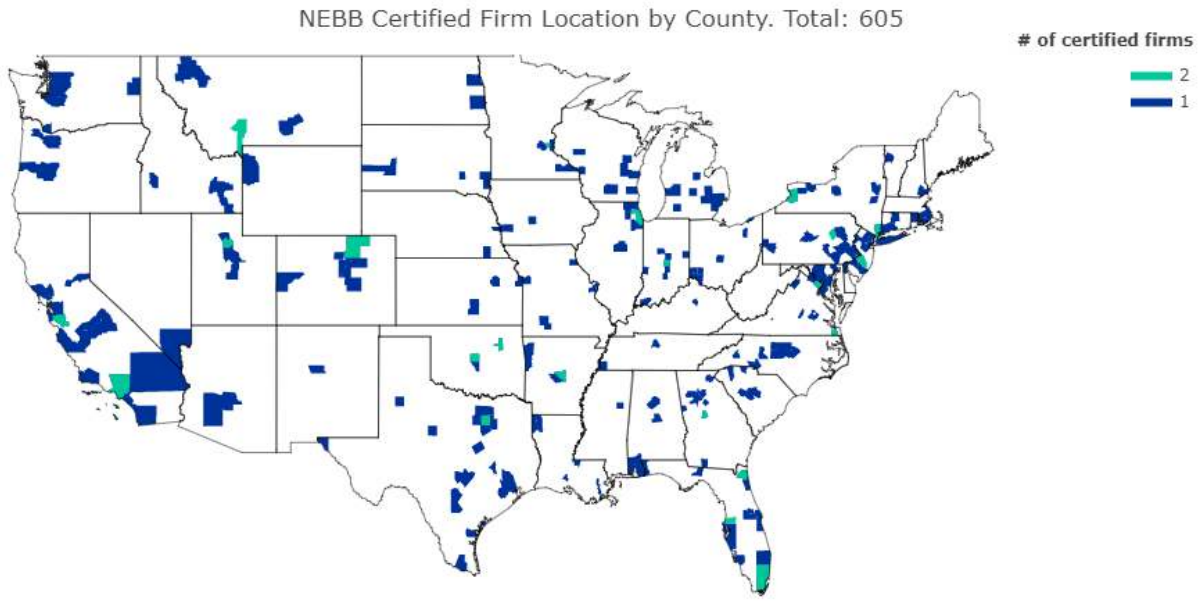

Figure 3: Map of NEBB certified firms by county. One firm in Alaska and five in Hawaii not shown.

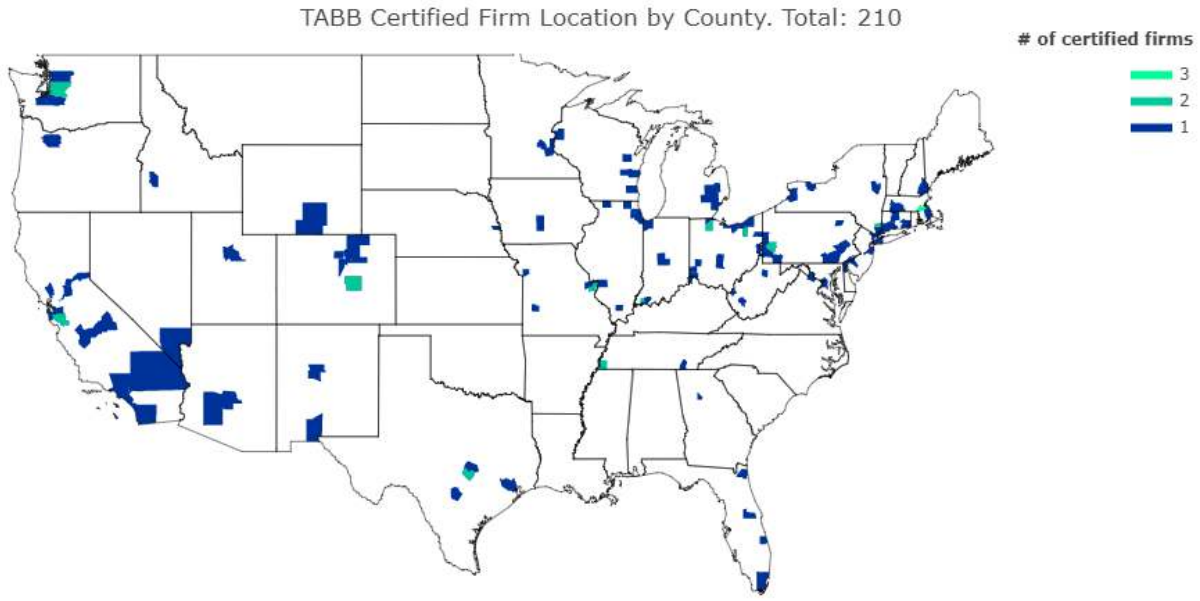

Figure 4: Map of TABB certified firms by county. One firm in Hawaii not shown.

SUMMARY

Building commissioning is a complex, multidisciplinary process that continues to evolve as a result of industry demands and building codes. Conducting proper testing, adjusting, and balancing as part of the commissioning process benefits the building owner and occupants by ensuring that the criteria specified in the building design are met. Beyond comfort, a balanced HVAC system will use less energy and provide better indoor air quality. Using a TAB contractor ensures quality work by requiring the contractor and technician to meet specific qualifications that are certified by a third-party.

In the future, TAB certifications are expected to become even more valuable. As building control systems become more complex, and new energy efficient equipment becomes standard, technicians will need more in-depth knowledge to balance HVAC systems. Additionally, local building codes are expected to evolve and become stricter as states move toward more ambitious energy efficiency goals. Building managers can stay ahead of the curve by making sure their TAB contractors are well qualified.

REFERENCES

[1] Building Code Assistance Project, “Commercial Code Status.” [Online]. Available: http://bcapcodes.org/code-status/commercial/. [Accessed: 08-Jan-2020].

[2] “Benefits of Accreditation.” [Online]. Available: https://www.ansi.org/standards_activities/domestic_programs/accreditation_as_developer/benefits?menuid=3. [Accessed: 31-Mar-2020].

[3] “Associated Air Balance Council – The world’s leading Leading Association of Independent Test & Balance Agencies.” [Online]. Available: https://www.aabc.com/. [Accessed: 09-Jan-2020].

[4] “International Certification, High Performance Building Systems | NEBB.” [Online]. Available: https://www.nebb.org/. [Accessed: 09-Jan-2020].

[5] “TABB Certified – Testing, Adjusting and Balancing Bureau.” [Online]. Available: https://www.tabbcertified.org/. [Accessed: 09-Jan-2020].