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ACCA Standard 9

STANDARD NUMBER: ANSI / ACCA 9 QIvp - 2016

HVAC Quality Installation Verification Protocols

Establishes Minimum Requirements for Verifying That Residential and Light Commercial HVAC Systems Meet the ANSI/ACCA 5 QI - 2015 *(HVAC Quality Installation Specification)* Standard.

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FORWARD

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Verification activities associated with the ANSI/ACCA 5 QI – 2015 (*HVAC Quality Installation Specification*) involve validating that an HVAC installation adheres to the QI Standard's requirements. Verification participants (Contractors, Verifiers, and Program Administrators) that observe this ACCA 9 QIvp Standard are satisfying the minimum requirements for ensuring that validation outcome.

It is recognized that a verification effort, which conducts a thorough inspection of every HVAC system installation for compliance to the QI Standard, provides the greatest confidence. However, this level of verification effort requires substantial resources and coordination activities; typically, a costly and burdensome process. The ACCA 9 QIvp Standard provides an approach to evaluate an HVAC system installation and optimize resources in terms of time and expenses.

Verification efforts are encouraged to address other operational and business issues such as, but not limited to:

- Contractor / Verifier requirements for entry into the program,
- Training requirements,
- Documentation processing, retention, and information confidentiality,
- Customer service policies/procedures,
- Proof of applicable building permits,
- Quality control/quality assurance plan,
- Applicable licensing and/or certifications.

The ACCA 9 QIvp Standard is for those who intend to protect the integrity, and promote the value, of properly installed and commissioned HVAC equipment through qualified and objective examination of specific elements related to the HVAC system installations. Such independent verification efforts need to observe consistent, transparent, and standardized procedures that accurately evaluate HVAC system designs, installations, and commissioning.

INTRODUCTION

[The Introduction is not part of the Standard. It is merely informative and does not contain requirements necessary for conformance to the Standard. It has not been processed according to the ANSI requirements for a standard, and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ACCA or ANSI.]

This document details the requirements, roles, and obligations for the participants in an organized effort which ensures that HVAC installations comply with the ANSI/ACCA 5 QI – 2015 (*HVAC Quality Installation Specification*) Standard. Those HVAC systems that comply with the QI Standard provide several benefits to building owners including: increased comfort, improved indoor air quality, energy-efficient equipment operation, and benchmarked design/start-up documentation.

The first portion of this document addresses the purpose, scope, verification levels, and details the minimum requirements for an HVAC system evaluation process. Two distinct levels of review are detailed:

1. Review of the HVAC system installation checklist and evaluate the recorded measurements for compliance to the QI Standard.
2. Field verification of measurements taken during the installation that validates specific aspects of the HVAC system's design and installation meet the requirements in the QI Standard.

The second portion of this document overviews the minimum requirements for the primary participants involved in a voluntary QI Verification Program: the Program Administrator, the Contractor, and the Verifier. The Contractor installs the HVAC system, the Program Administrator evaluates the HVAC system for conformity to the QI Standard (utilizing in-house or contracted Verifiers, and/or Program Administrator-approved Automated Validation Systems), and provides oversight to the overall effort.

Appendices provide additional information and recommendations that support a verification effort. Appendix A is a checklist that identifies specific installation/commissioning information sought from the installing HVAC Contractor. As a convenience to the user, Appendix B is a reprint of the required data points contained in Table 1 (*Quality Installation Required Documentation*) of the QI Standard. Appendix C identifies those elements that can be field verified even if certain elements of the verification are found to be out of specification. Appendix D provides guidance on incorporating sampling protocols into a Level 1 (installation checklist verification) and / or Level 2 (field verification) verification effort. Appendix E highlights skill sets needed by installing technicians and/or in-field verifiers to comply quality installations and inspections. Appendix F offers sample documentation, which demonstrates skill sets needed by installing Technicians and QI Verifiers. Appendix G provides a glossary of terms used in this Standard.

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EVALUATION PROTOCOLS

1. PURPOSE

This Standard specifies the protocols to verify that elements of a specific HVAC system installation comply with the ANSI/ACCA 5 QI - 2015 *HVAC Quality Installation Specification* ("QI Standard").

2. SCOPE

The verification protocols contained herein apply to installations of HVAC equipment / components in new and existing residential and commercial buildings that seek to demonstrate adherence to the requirements of the QI Standard.

3. VERIFICATION LEVELS

This document provides protocols for two levels of verification activities; the Program Administrator shall determine the level of oversight – Level 1 or Level 2 – needed to meet its programmatic objectives.[1]

3.1. Level 1 – Installation Checklist Review: A review of the HVAC contractor's installation checklist for a specific HVAC system.

3.1.1. The Contractor shall submit an installation checklist (see Appendix A for information to be provided) for each HVAC system that is intended to be verified to the QI Standard requirements.

3.1.2. The Program Administrator, and/or its approved Verifier(s), shall evaluate the information submitted in the installation checklist.

3.2. Level 2 – Installation Checklist Review and Field Verification: A review of the HVAC contractor's installation checklist for a specific HVAC system with field verification (e.g., measurements and observations) of the installation.

3.2.1. The Contractor shall submit an installation checklist (see Appendix A) for each HVAC system that is intended to be verified to the QI Standard requirements.

3.2.2. The Program Administrator, and/or its approved Verifier(s), shall evaluate the information submitted in the installation checklist.

3.2.3. As specified by the Program Administrator, the Contractor is to help facilitate the in-field review of the installation.

3.2.4. The Program Administrator, or its approved Verifier(s), shall field measure specific aspects of the HVAC system installation and record the findings.[2]

4. EVALUATION APPROACH

This Section contains the evaluation criteria for Level 1 (installation checklist review) and, as applicable to the programmatic effort, Level 2 (field verification) evaluations. When both an installation checklist review and a field verification are being undertaken, faults in one level need not preclude the evaluation of the other level if so supported by the Program Administrator. However, when faults remain unresolved (see §4.4) – in either Level 1 or Level 2 as applicable to the programmatic effort – it results in the HVAC system remaining out of compliance to the requirements in this Standard.

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[1] The Program Administrator shall have the discretion to allow communicating measurement tools / instrumentation to be utilized by the contractor (and/or verifier) to electronically record specific elements required by this standard. Additionally, the Program Administrator shall have the discretion to allow the usage of Automated Validation Systems for data collection, analysis, and/or verification requirements for part, or all, of the elements specified in this standard.

[2] The Program Administrator / Verifier shall have the discretion to conduct a field verification before the installation file review.

Level 1 – Installation Checklist Review: The contractor-prepared installation checklist shall be reviewed to ensure specific elements conform to requirements.

4.1.1. Installation Checklist Completeness: All required information is recorded.

4.1.2. Installation Checklist Accuracy: Provided data is consistent with the requirements in the QI Standard:

4.1.2.1. Load Calculation (Reference §3.2 of the QI Standard): The building's full load heat-loss/heat-gain load calculations are provided:

a. Total heating load
b. Sensible cooling load
c. Latent cooling load
d. Total cooling load

4.1.2.2. Equipment Capacity Selection (Reference §3.3 and §3.4 of the QI Standard): The equipment is sized per the tolerances specified in the QI Standard; comparing the provided HVAC equipment's full-speed capacity to the building's heating/cooling full-load requirements.

4.1.2.3. System Matching (Reference §3.5 of the QI Standard): The selected equipment shall be a matched system as evidenced by the AHRI reference number.

4.1.2.4. Airflow (Reference §4.1 of the QI Standard):

a. Contractor-recorded airflow is within 15% of the design airflow.
b. Contractor- recorded external static pressure (ESP) does not exceed OEM limits.
c. For equipment with new/modified duct systems: The contractor-measured ESP is not more that 25% or 0.10 iwc (whichever is greater) over the ESP used to design the duct system

4.1.2.5. Refrigerant Charge (Reference §4.3 of the QI Standard):

a. For superheat: Contractor-recorded superheat measurement is within ±5ºF of the OEM-specified superheat value.
b. For subcooling: Contractor-recorded subcooling measurement is within ±3ºF of the OEM-specified subcooling value.

4.1.2.6. Electrical (Reference §4.4 of the QI Standard): Contractor-measured line amperages and voltages are within OEM specifications.

4.1.2.7. On-rate for fuel-fired Equipment (Reference §4.5 of the QI Standard): Contractor-provided information indicates that on-rate is correct by combustion analysis or by clocking the gas meter and the contractor-recorded temperature rise is within nameplate temperature rise.

4.1.2.8. Combustion venting system (Reference §4.6 of the QI Standard): Contractor-provided information indicates that the vent system is properly sized, sloped, and supported.

4.1.2.9. System controls (Reference §4.6 of the QI Standard): Contractor-selected system controls support the functionality of the installed equipment.

4.1.2.10. Duct leakage testing (Reference §5.1 of the QI Standard): Contractor-provided measurements confirm that the maximum duct leakage does not exceed the tolerance in the QI Standard.

4.2. Level 2 – Field Verification: As applicable, the Program Administrator, or its approved Verifier, shall record field measurements / observations of the building construction and HVAC system installation and compare against the contractor-provided information in the installation checklist as well as applicable supporting documentation.[3] Additionally, verification measurements shall be used to evaluate conformance to the tolerances contained in the appropriate sections of the QI Standard.

[3] The contractor-prepared information – as detailed in ACCA 5 QI Table 1 (and included in Informative Appendix B) – is subject to review.

4.2.1. Load Calculation (Reference §3.2 of the QI Standard): Against contractor-provided Manual J8 Form J1 and Worksheet A, verify that elements from the load calculation are within tolerances for the actual/measured aspects of the physical building:
- 4.2.1.1. Ventilation load – The ventilation approach used in the load calculation is supported by applicable codes, standards, and load calculation procedure or equivalent.
- 4.2.1.2. Floor area – The floor area values used in the load calculation value must be within 10% of the field-measured values.
- 4.2.1.3. Window area – The window area values used in the load calculation must be within 10% of the field-measured values.
- 4.2.1.4. Skylights – The number of skylights used in the load calculation must match the number of skylights in the structure.
- 4.2.1.5. Home orientation – The building's compass orientation (e.g., North, East, etc.) used in the load calculation orientation shall be within 45 degrees of the field-determined orientation.
- 4.2.1.6. Exterior wall finish – load calculation finish must match actual building construction.
- 4.2.1.7. Ceiling/roof type – load calculation type must match actual building construction.
- 4.2.1.8. Floor construction – load calculation construction must match actual building construction.

4.2.2. Required field measurements: Measure and record the following elements using the approved methods and tolerances specified in the QI Standard and compare the field measurements to the contractor-provided values (annotate when tolerances are exceeded):
- 4.2.2.1. Airflow through the heat exchanger (Reference §4.1 of the QI Standard).
- 4.2.2.2. Water flow through the heat exchanger (Reference §4.2 of the QI Standard).
- 4.2.2.3. On-rate for fuel-fired equipment (Reference §4.5 of the QI Standard).
- 4.2.2.4. Duct leakage (Reference §5.1 of the QI Standard).
- 4.2.2.5. Airflow balance (Reference §5.2 of the QI Standard).
- 4.2.2.6. Water flow balance (Reference §5.3 of the QI Standard).

4.2.3. Required field observations:
- 4.2.3.1. Installed equipment (Reference §3.3 and §3.4 of the QI Standard): Confirm that the installed equipment model numbers match the model numbers listed on the installation checklist.
- 4.2.3.2. Combustion venting system (Reference §4.6 of the QI Standard): Confirm that the venting system for the installed equipment (and any orphaned fossil-fuel appliances) are per the requirements.
- 4.2.3.3. Control type: Ensure that the applied thermostatic control (or other) supports the appropriate stages of HVAC operation.

4.3. Mechanical failure: HVAC systems that fail to operate or suffer mechanical failure shall be re-tested after completion of repairs.

4.4. Faults (Deficiencies and Nonconformities): Two different types of faults can be identified during the verification: deficiencies and nonconformities. Figure 1 (*Examples of Deficiencies and Nonconformities*) provides descriptions of different deficiencies and nonconformities.
- 4.4.1. Corrected deficiencies, as encountered during the course of the verification process, shall be evaluated as passing elements.
- 4.4.2. Uncorrected nonconformities shall cause the HVAC system to require additional verification(s) to demonstrate compliance to the QI Standard upon completion of the remediation.

4.4.3. Non-standard faults and deficiencies: For faults that do not match the samples in Figure 1, the Program Administrator shall determine whether they are deficiencies or nonconformities.

4.4.4. Independent aspects of the faults: If a deficiency or nonconformity is encountered, then the remaining dependent elements shall not be verified until corrections have been effected.[4]

Figure 1: Examples of Deficiencies and Nonconformities to the QI Standard

QI Element	Deficiencies	Nonconformities
Ventilation (§3.1)	• Missing information that is provided during the verification process.	• No ventilation calculation performed. • The existing building does not reflect the values used in the ventilation calculation.
Load calculation (§3.2)	• Load calculation not initially found in installation file; restored during on-site visit • Error that does not affect equipment size.	• No load calculation performed. • Block load performed in lieu of room-by-room (if needed per §3.1 QI Standard). • The existing building does not reflect the values used in the load calculation performed...
Equipment sizing (§3.3)	• Missing information that is provided during the verification process.	• Heating capacity of selected equipment is insufficient to meet the design heat loss or exceeds the tolerances set in the QI Standard. • Cooling capacity exceeds the tolerances set in the QI Standard.
Equipment matching (§3.5)	• Missing information that is provided during the verification process.	• Improper equipment match (e.g., no AHRI certificate, no CEE directory listing, no OEM performance data, etc.).
Airflow (§4.1)	• Missing information that is provided during the verification process.	• Airflow not within the tolerances set in the QI Standard.
Water flow (§4.2)	• Missing information that is provided during the verification process.	• Water flow not within the tolerances set in the QI Standard.
Refrigerant charge (§4.3)	• Missing information that is provided during the verification process.	• Refrigerant charge exceeds the tolerances set in the QI Standard.
Electrical (§4.4)	• Immediately correctable installation mistakes (e.g., bare wire, loose grounding, etc.).	• Incorrect wire size. • Incorrect grounding. • Line voltage out of OEM specifications. • Component amp draw out of OEM specifications.
On-Rate (§4.5)	• Missing information that is provided during the verification process.	• Firing rate exceeds the tolerances set in the QI Standard. • Temperature rise exceeds the tolerances set in the QI Standard. • Oil nozzle flow rate exceeds the tolerances set in the QI Standard. • Oil pump pressure exceeds the tolerances set in the QI Standard.
Venting (§4.6)	• Immediately correctable strapping and support.	• Wrong vent size. • Wrong vent pipe material or classification. • Signs of condensate on vent system.
System controls (§4.7)	• Missing information that is provided during the verification process.	• Controls do not control all modes of operation. • Safety controls do not function as specified.
Duct leakage (§5.1)	• Duct installation is repaired. • Filter door seal is corrected.	• New or existing construction, duct leakage exceeds the tolerances set in the QI Standard.
Air balancing (§5.2)	• Missing information that is provided during the verification process.	• New or existing construction, residential or commercial, airflow not within the tolerances set in the QI Standard.
Hydronic balancing (§5.3)	• Missing information that is provided during the verification process.	• New or existing construction, residential or commercial, water flow not within the tolerances set in the QI Standard.
System documentation (§6.1)	• Missing information that is provided during the verification process.	• Missing copies of required information.
Building owner education (§6.2)	• Missing information that is provided during the verification process.	Missing copies of documents signifying: • Understanding of the sequence of operation. • Understanding of the maintenance requirements, owner's maintenance tasks, and maintenance contact information. • Understanding of the warranty coverage, owner's requirements, warranty contact information.

[4] Informative Appendix C (*QI Verification Elements Independent of Other Elements*) identifies the dependent/independent relationships of the varied elements within the QI Standard.

PROGRAMMATIC EFFORTS

This Section specifies the minimum requirements for programmatic verification efforts to establish that HVAC system installations meet the QI Standard.

5. PARTIES INVOLVED

5.1. The principal parties involved in an HVAC Quality Installation Verification Program are:
- 5.1.1. Program Administrator: The organization that establishes and maintains a verification effort and safeguards the objectivity of the program.
- 5.1.2. Verifier: The entity, or automated validation system, whether as an in-house operation to the Program Administrator or under contract to the Program Administrator, who evaluates that the HVAC installation complies with the QI Standard.
- 5.1.3. Contractor: the Company responsible for the installation of the HVAC system in compliance with the QI Standard.

5.2. General Obligations:
- 5.2.1. The Program Administrator shall:
  - 5.2.1.1. Develop, document, implement, and maintain programmatic policies and procedures that achieve the requirements of this Standard.
  - 5.2.1.2. Establish requirements for, and oversight of, Contractors and Verifiers (as applicable) who participate in the QI Verification Program.
  - 5.2.1.3. Undertake the verification activities, and/or authorize Verifiers and/or Automated Validation Systems to perform the verification roles.
  - 5.2.1.4. Have the option to utilize other recognized Implementing Parties who undertake certain programmatic requirements; such parties may or may not interact with Contractors and Verifiers.
- 5.2.2. Verifier shall:
  - 5.2.2.1. Comply with all applicable jurisdictional requirements for business/professional licenses, permits, and insurance.
  - 5.2.2.2. Perform an objective evaluation of the HVAC installation per Section 4.0 (*Evaluation Protocols*).
  - 5.2.2.3. Follow programmatic requirements as established by the Program Administrator.
- 5.2.3. Contractor shall:
  - 5.2.3.1. Comply with all applicable jurisdictional requirements for business/professional licenses, permits, and insurance.
  - 5.2.3.2. Ensure HVAC systems are installed to meet the QI Standard.
  - 5.2.3.3. Follow programmatic requirements as established by the Program Administrator.

6. QI VERIFICATION PROGRAM REQUIREMENTS

The Program Administrator's policies and procedures must address the following topics:

6.1. Program participation requirements: The program shall specify the requirements for Contractors and Verifiers (if so utilized) to participate in the program. These requirements include, but are not limited to:
- 6.1.1. Required training and certification(s).
- 6.1.2. Educational qualifications.
- 6.1.3. Licensing, registrations, and insurance.
- 6.1.4. Program training.

6.2. Information transfer protocols: The program shall specify the manner in which information about the installation, field measurements, and program documentation is transferred between the parties. Of special consideration are:

6.2.1. Method of information sharing.
6.2.2. Information completeness.
6.2.3. Information security.
6.2.4. Information transfer timelines.
6.2.5. Record keeping.

6.3. Quality control: The program shall conduct systematic quality control to protect the integrity and value of the program.
6.3.1. Program participation: The program must ensure that continued participation in the program is contingent on complying with programmatic policies and procedures.
6.3.2. Certification: The program has the discretion to issue certificates of compliance for HVAC installations that have been verified to be in compliance with the programmatic requirements.

6.4. Complaints and Appeals: The program must have, and adhere to, internal policies concerning the receipt, investigation, and resolution of complaints and appeals against the Program Administrator, Contractor, or Verifier.

APPENDIX A – HVAC SYSTEM INSTALLATION CHECKLIST

HVAC Designer Responsibilities:

- Complete the Administrative and Design portion for each system that is installed[1].
- Visit www.gacontractors.org/qa/existing-homes for more information.

1. ADMINISTRATIVE		**N/A**
1.1	Street Address:_____	
1.2	City:_____	
1.2.1	City Used for Manual J (from Table 1A or 1B): _____	☐
1.3	State:_____	
1.4	Zip:_____	
1.5	Area Served[2]: ☐ Whole house ☐ Bonus Room ☐ Master Suite ☐ Upstairs ☐ Downstairs ☐ Other:_____	
1.6	Permit number[3]: _____	☐
1.7	Authority Having Jurisdiction (AHJ)[4] _____	☐
1.8	Recognition[5]: ☐ RSI HVAC QI Certificate? ☐ ENERGY STAR Certified Home? ☐ Energy Rated Index Home?	
1.9	Certificate Distribution: ☐ Certificate to Homeowner?	☐
1.10	Customer Email Address: _____	☐
1.11	Builder Client Name _____	☐
1.12	HVAC Design report corresponding to this system has been collected from designer or builder? ☐ Yes ☐ No	☐
1.13	House Plan, per Item 1.6 of HVAC Design Report: _____	☐
1.14	Site-specific design: ☐ Yes ☐ No	☐
1.15	Group Design: ☐ Yes ☐ No	☐
1.16	Certificate Distribution: ☐ Certificate to Homebuilder?	☐
1.17	Builder Email Address: _____	☐
1.18	Output of **Replaced Heating** Unit[6]: _____ Btu/h	☐
1.19	Nominal Tonnage of **Replaced Cooling** Unit[7]: _____ Tons	☐
1.20	Documentation Confirmation Statement: Documents for this installation, as applicable, are available for review: Manual J heat loss / gain calculations, OEM expanded performance data, OEM Blower Tables, duct leakage measurements, and TAB records. (Name of Designer)[8] _____	
2. DESIGN		**N/A**
2.1 Heat Loss/Gain		
2.1.1	Conditioned Floor Area Served by Unit: _____ Sq. Ft.	-
2.1.2	Design Total Heat Loss[9]: _____ Btu/h	☐
2.1.3	Design Sensible Heat Gain[7]: _____ Btu/h	☐
2.1.4	Design Latent Heat Gain[7]: _____ Btu/h	☐
2.1.5	Design Total Heat Gain[10]: _____ Btu/h	☐
2.2 System Configuration		
2.2.1	Installed Equipment is[11]: ☐ Forced Air ☐ Split System ☐ Package Unit ☐ Ductless ☐ Geothermal ☐ Hydronic	
2.2.2	Split system[12]: ☐ Condenser and Coil ☐ Condenser and Fan Coil Unit	☐
2.2.3	Ductless[13]: ☐ One indoor unit ☐ Two indoor units ☐ Three or more indoor units	☐
2.3 Heating Equipment (If applicable)[14]		☐
2.3.1	**Primary** Heat Source[15]: ☐ Furnace ☐ Heat Pump (w/ Coil or Fan Coil Unit) ☐ Electric Furnace ☐ Boiler[16]	
2.3.2	Brand: _____	☐
2.3.3	Model Number: _____	☐
2.3.4	Serial Number: _____	☐
2.3.5	Output Capacity (Furnace: highest stage, Heat Pump – at design ODT)[17]: _____ Btu/h	☐
2.3.6	AHRI Reference Number[18]: _____	☐
2.3.7	Heating Efficiency: Furnace / Boiler _____ AFUE Heat Pump _____ HSPF	☐
2.3.8	Heating Stages: ☐ Single-Stage ☐ Two-Stage ☐ Multi-Stage[19]	☐
2.3.9	Fuel: ☐ Natural Gas ☐ Liquid Petroleum (LP) ☐ Oil	☐
2.3.10	Blower Motor: ☐ Single Speed (Permanent Split Capacitor [PSC]) ☐ Variable-Speed[20] (ECM or equivalent)	☐
2.3.11	**Secondary** Heat Source[21]: ☐ Furnace ☐ Supplemental Electric Resistance Heat	☐
2.3.12	Brand: _____	☐
2.3.13	Model Number: _____	☐
2.3.14	Serial Number: _____	☐
2.3.15	Output Capacity (highest stage)[22]: _____ Kw / Btu/h	☐
2.3.16	AHRI Reference Number[23]: _____	☐
2.3.17	Heating Efficiency: Furnace / Boiler _____ AFUE	☐
2.3.18	Heating Stages: ☐ Single-Stage ☐ Two-Stage ☐ Multi-Stage	☐

2.3.19	Fuel: ☐ Natural Gas ☐ Liquid Petroleum (LP) ☐ Oil	☐
2.3.20	Blower Motor: ☐ Single Speed (Permanent Split Capacitor [PSC]) ☐ Variable-Speed[24] (ECM or equivalent)	☐
2.3.21	Venting Type: ☐ Sealed Combustion ☐ Atmospherically Vented ☐ One-Pipe (fan powered exhaust)	☐
2.3.22	Selected heating equipment meets Manual S sizing tolerance: ☐ Pass ☐ Fail	☐
2.4 Cooling Equipment (If applicable)[25]		☐
2.4.1	Cooling System: ☐ Air Conditioner ☐ Heat Pump	
2.4.2	Condenser Brand[26]: _____	
2.4.3	Condenser Model Number: _____	
2.4.4	Condenser Serial Number: _____	☐
2.4.5	Indoor Unit[27]: ☐ Evaporator Coil ☐ Fan Coil Unit	
2.4.6	Indoor Unit Brand: _____	
2.4.7	Indoor Unit Model Number: _____	
2.4.8	Indoor Unit Serial Number: _____	☐
2.4.9	AHRI Reference Number[28]: _____	
2.4.10	Cooling Efficiency: _____ SEER _____ EER	
2.4.11	Nominal Capacity[29]: _____ Tons	
2.4.12	OEM Expanded Capacity (with specified indoor unit / at design airflow)[30]: _____ Btu/h	
2.4.13	Cooling Speeds: ☐ Single-Speed ☐ Two-Speed ☐ Variable-Speed	
2.4.14	Blower Motor: ☐ Single Speed (Permanent Split Capacitor [PSC]) ☐ Variable-Speed[31] (ECM or equivalent)	
2.4.15	Metering Device: ☐ TXV / EXV ☐ Fixed-bore (piston)	
2.4.16	Selected cooling equipment meets Manual S sizing tolerance: ☐ Pass ☐ Fail	
2.5 Accessories (If applicable)[32]		☐
2.5.1	Accessory: ☐ Pump (Hydronic / Geothermal)	☐
2.5.2	Brand: _____	☐
2.5.3	Model: _____	☐
2.5.4	Serial: _____	☐
2.5.5	Capacity: _____ GPH	☐
2.5.6	Accessory: ☐ Filter ☐ Humidifier ☐ De-humidifier ☐ UV light ☐ Other: _____	☐
2.5.7	Brand: _____	☐
2.5.8	Model: _____	☐
2.5.9	Accessory: ☐ Filter ☐ Humidifier ☐ De-humidifier ☐ UV light ☐ Other: _____	☐
2.5.10	Brand: _____	☐
2.5.11	Model: _____	☐
2.5.12	Accessory: ☐ Filter ☐ Humidifier ☐ De-humidifier ☐ UV light ☐ Other: _____	☐
2.5.13	Brand: _____	☐
2.5.14	Model: _____	☐
2.5.15	Accessory: ☐ Filter ☐ Humidifier ☐ De-humidifier ☐ UV light ☐ Other: _____	☐
2.5.16	Brand: _____	☐
2.5.17	Model: _____	☐
2.5.18	Accessory: ☐ Filter ☐ Humidifier ☐ De-humidifier ☐ UV light ☐ Other: _____	☐
2.5.19	Brand: _____	☐
2.5.20	Model: _____	☐
2.6 Airflow (If applicable)[33]		☐
2.6.1	Duct distribution system will be modified[34]: ☐ Yes ☐ No	
2.6.2	Design ESP[35]: _____ ESP	☐
2.6.3	OEM Maximum Allowable External Static Pressure[36]: _____ IWC	
2.6.4	Design Airflow – Heating: _____ CFM	
2.6.5	Design Airflow – Cooling: _____ CFM	
2.6.6	Design Fan Speed – Heating[37]: ☐ Hi ☐ Med- Hi ☐ Med ☐ Med-Lo ☐ Lo ☐ Variable-Speed	
2.6.7	Design Fan Speed – Cooling[38]: ☐ Hi ☐ Med- Hi ☐ Med ☐ Med-Lo ☐ Lo ☐ Variable-Speed	
2.6.8	Design Variable-Speed Fan Setting(s) (Speed tap or dip switch settings): _____	☐
2.7 Combustion Venting		☐
2.7.1	Venting is in compliance with: ☐ NFPA 54 ☐ NFPA 31 (Oil) ☐ IFGC ☐ AHJ	
2.7.2	If venting is per AHJ, provide name of jurisdiction[39]: _____	☐
2.7.3	System has dedicated combustion air from outside[40]: ☐ Yes ☐ No	
2.8 Controls		
2.8.1	Type of thermostat selected: ☐ Single-stage heat / Single-stage cool ☐ Two-stage heat / Single-stage cool ☐ Single-stage heat / Two-stage cool ☐ Multi-stage heat / multi-stage cool ☐ Variable-Speed	

HVAC Installer / Start – up Technician Responsibilities:

- Complete the Installation and applicable Distribution Aspects portion for each system that is installed[41].
- Visit www.qacontractors.org/qa/existing-homes for more information.

3. INSTALLATION		
3.1 Installed Equipment		
3.1.1	INSTALLED equipment and control are SAME as specified in Section 2: DESIGN: ☐ Yes ☐ No	
3.1.2	Furnace Brand:	☐
3.1.3	Furnace Model Number:	☐
3.1.4	Furnace Serial Number:	☐
3.1.5	Condenser Brand:	☐
3.1.6	Condenser Model Number:	☐
3.1.7	Condenser Serial Number:	☐
3.1.8	Coil/ Fan Coil Unit Brand:	☐
3.1.9	Coil/ Fan Coil Unit Model Number:	☐
3.1.10	Coil/ Fan Coil Unit Serial Number:	☐
3.2 Airflow[42]		☐
3.2.1	System must be tested in the mode with highest design airflow?[43] ☐ Heating ☐ Cooling	☐
3.2.2	Fan Speed[44]: ☐ Hi ☐ Med- Hi ☐ Med ☐ Med-Lo ☐ Lo ☐ Variable-Speed	☐
3.2.2.a	Airflow Procedure: ☐ ESP – Furnace, Fan Coil Unit, or Package Unit ☐ PD – Evaporator Coil Only	
3.2.3	Return / Entering Air Static Pressure[45]: _____ IWC	☐
3.2.4	Return / Entering Air test port location[46]: ☐ Return air plenum (pre-filter) ☐ Equipment cabinet (post-filter) ☐ Return air (filter) grille ☐ Before the coil (furnace–coil transition)	☐
3.2.5	Supply / Leaving Air Static Pressure[47]: _____ IWC	☐
3.2.6	Supply / Leaving Air test port location: ☐ Furnace limit switch sensor port ☐ Supply air plenum ☐ After the furnace (furnace – coil transition)	☐
3.2.7	External Static Pressure (ESP)[48]: _____ IWC	☐
3.2.8	Determine airflow using ESP and OEM performance data[49]: CFM	☐
3.2.9	Return and Supply Test Hole Locations marked and sealed: ☐ Pass ☐ Fail	☐
3.3 Refrigerant Charge – *Run system for a minimum of 10 minutes or until system operation is stable [50]*		☐
3.3.1	Refrigerant type: ☐ R-410A ☐ R-22	☐
3.3.2	Outdoor Temperature: _____ °F DB	☐
3.3.3 Subcooling: Test [51] DO NOT TEST COOLING MODE BELOW 60°*F outdoor air (OA) temperature*		☐
3.3.3.a	Measured Liquid Line Saturation Temperature: _____ °F DB	☐
3.3.3.b	Measured Liquid Line Pressure: _____ psig	☐
3.3.3.c	Liquid Line Temperature for the Corresponding Saturation Pressure 3.3.3.b[52]: _____ °F DB	☐
3.3.3.d	Calculated subcooling (3.3.3.a – 3.3.3.c): _____ °F DB	☐
3.3.3.e	OEM subcooling target[53]: _____ °F DB	☐
3.3.3.f	Subcooling deviation (3.3.3.e – 3.3.3.d): _____ °F DB	☐
3.3.4 Superheat Test:[54] DO NOT TEST COOLING MODE BELOW 55°*F OA temperature*		☐
3.3.4.a	Measured DB Temperature (taken at condenser)[55]: _____ °F DB	☐
3.3.4.b	Measured WB Temperature (as air enters evaporator)[56]: _____ °F WB	☐
3.3.4.c	Measured Suction Line Saturation Temperature (at condenser): _____ °F DB	☐
3.3.4.d	Measured Suction Line Pressure (taken at condenser): _____ psig	☐
3.3.4.e	Suction Line Temperature for the Corresponding Saturation Pressure 3.3.4.d[57]: _____ °F DB	☐
3.3.4.f	Calculated superheat (3.3.4.c – 3.3.4.e): _____ °F DB	☐
3.3.4.g	OEM superheat target[58]: _____ °F DB	☐
3.3.4.h	Superheat deviation:(3.3.4.g – 3.3.4.f): _____ °F DB	☐
3.3.4.i	Value 3.3.3.f is ≤ 3°F OR Value 3.3.4.h is ≤ 5°F ☐ Pass ☐ Fail	☐
3.3.4.j	OEM approved test procedure was used[59]: ☐ Pass ☐ Fail	☐
3.4 Electrical Measurements		
3.4.1	Indoor fan motor: _____ amperage _____ line voltage	☐
3.4.2	Inducer fan motor: _____ amperage _____ line voltage	☐
3.4.3	Condenser / Heat pump: _____ amperage _____ line voltage	☐
3.4.4	Outdoor fan motor: _____ amperage _____ line voltage	☐
3.4.5	Electrical measurements within OEM-specified tolerance of nameplate value ☐ Pass ☐ Fail	☐
3.5 On Rate Combustion[60] (When Fossil Fuel Equipment Is Installed)		☐
3.5.1	Combustion Appliance Startup Testing (All Appliances): Altitude De-rating Factor: _____	☐

	Nameplate Temp. Rise Range: _____ °F DB; Measured Temp. Rise: _____ °F DB	
3.5.2	For Gas Appliances: Manifold Pressure: _____ IWC (gas) Orifice Size: _____ ft³/hr: _____	☐
3.5.3	For Oil Appliances: Oil Nozzle Size and Spray Angle: _____ ; Fuel Oil Class: ; Pump Pressure: _____ psig; Pump Flow: _____ GPH	☐
3.5.4	Combustion Analyzer[61]: CO (air free): _____ PPM Stack Temperature: _____ °F Efficiency: _____ % Outdoor Temp: _____ °F Draft Pressure: _____ Pa Explanation why combustion tests not performed: _____	☐
3.5.5	On-rate verified by Combustion Analysis or by clocking the meter _____ _____ ☐ Yes ☐ No	
3.6 Combustion Venting[62]		☐
3.6.1	Vent piping is properly sloped and supported? ☐ Pass ☐ Fail	☐
3.6.2	Vent piping is free of rust, oxidation, or soot? ☐ Pass ☐ Fail	☐
3.6.3	Vent piping is free of obstruction (not blocked)? ☐ Pass ☐ Fail	☐
3.6.4	After 5 minutes of operation (or as specified by the manufacturer), vent is drafting properly[63]. ☐ Pass ☐ Fail	☐
3.6.5	New installation has left an orphaned combustion appliance (water heater, furnace, or boiler). ☐ Yes ☐ No	☐
3.6.6	The orphaned appliance's vent system meets the code requirement. ☐ Pass ☐ Fail	☐
3.6.7	If Fail, provide explanation. _____	☐
3.6.8	Fuel line leakage test performed:[64] ☐ Pass ☐ Fail	☐
4. DISTRIBUTION ASPECTS		
4.1 Duct Leakage Testing[65]		☐
4.1.1	Duct Leakage Goal (New Home)[66]: ☐ ≤ 10% Total ☐ ≤ 6% Total ☐ Per AHJ _____	☐
4.1.2	Duct Leakage Goal (Existing Home)[67]: ☐ ≤ 20% Total ☐ 50% Improvement (Item 4.1.5 **required**) ☐ Per AHJ _____	☐
4.1.3	Duct Leakage Test Procedure: ☐ Duct Pressurization Test (CFM25) ☐ Airflow Comparison[68] ☐ SMACNA Air Leakage ☐ Per AHJ	
4.1.4	Recorded airflow measurements in Section 3.2 after duct sealing was performed?[69] ☐ Yes ☐ No	
4.1.5	Total Duct Leakage Pre-Installation[70]: _____ CFM25/CFM	☐
4.1.6	Total Duct Leakage Post-Installation: _____ CFM25/CFM	
4.1.7	Improvement (4.1.5 less 4.1.6, divided by 4.1.6)[71]: _____ % ☐ Pass ☐ Fail	☐
4.2 Test and Balance[72]		☐
4.2.1	Total Measured Supply Air (from all supply outlets): _____ CFM	
4.2.2	Total Measured Return Air (from all return inlets): _____ CFM	

Notes:

Designer Name: _____ Design Date: _____

Technician Name: _____ Start-up Date: _____

HVAC Contractor ID#: _____ Date Submitted: _____

HVAC SYSTEM INSTALLATION CHECKLIST NOTES:

1 This report is designed to collect information related to the ACCA 5 QI Standard (ANSI / ACCA 5 QI – 2015 *HVAC Quality Installation Specification*).

2 The area of the home served by the HVAC system documented on this checklist. If the home has one system – Whole House, if the home has more than one HVAC system – select the area served, or "Other" and enter the area served.

3 This item is not applicable if permits are not required by the Authority Having Jurisdiction (AHJ).

4 Where permits are required, provide the name of the AHJ, for example: City of Fairfax, VA.

5 Select the appropriate box or boxes, whether this checklist is for an RSI HVAC QI Certificate, or for an ENERGY STAR Certified Home, or both.

6 If the output capacity is not known, list the input capacity and listed efficiency rating. If the efficiency rating is not known, estimate the efficiency rating.

7 Provide the estimated nominal tonnage based on the model number of the unit being replaced. If the tonnage is not known, write the model number of the condenser being replaced.

8 The name of the designer is required: whether in ink upon a paper copy, or electronically in a mobile app. Upon request, the specified documentation must be provided per the time frame listed in the QA Contractor Program Requirements.

9 This field is required if a heating system is installed.

10 This field is required if a cooling system is installed.

11 Check all that apply.

12 Required if the equipment is a split system. Not required for: packaged units, or installations of a furnace-only, or a boiler-only.

13 For ductless, mini-split units, note the number of indoor units associated with the outdoor unit.

14 Section 2.3 is required when a heating system (or system with heating capability, e.g., heat pump) is installed. Otherwise, select N/A and move to next Section.

15 The equipment energized by thermostat's first call for heat (typically W1).

For furnace-only, or boiler-only, heating installations, this is the furnace or boiler.

For hybrid systems (typically a heat pump and a furnace), this is the heat pump.

If only the heat pump is being replaced (existing furnace to remain unchanged), then select "Heat Pump" and for Element 2.3.11 select N/A.

For heat pump with electric supplemental heat, this is the heat pump equipment.

16 All hot water heating equipment. Typically this is a boiler, equipment designed for comfort heating. Check this box if equipment designed primarily for domestic hot water is being used to heat water for indoor comfort.

17 For furnaces and boilers: List the OUTPUT capacity (not the nameplate input capacity).

For heat pumps: list the capacity of the equipment at the outdoor design temperature used to calculate the heat loss (see Manual J, Table 1A or 1B). This value is provided in the manufacturer's expanded performance data.

For ductless, mini-split units, or other variable-speed units (variable-speed compressor/IDB/condenser fan motor) with no catalogue of rated capacity, a statement from the manufacturer must be on file.

18 The AHRI reference number may be for the heating system only, or it may be for the both the heating and cooling systems.

19 Select if the heating system(s) provide(s) more than two stages of heat. For example a heat pump and two-stage furnace.

20 Variable-speed indoor blower motors refer typically to electronically commutated, or brushless, permanent magnet motors.

21 The equipment energized by thermostat's second call for heat (typically W2).

For hybrid systems (typically a heat pump and a furnace), this is the furnace.

For heat pump with electric supplemental heat, this is the supplemental electric heater.

If furnace only, or boiler only, then select N/A and move to next Section.

If the furnace, or boiler, has multiple levels of firing capacity (multiple stages), select N/A and move to next Section.

22 For furnaces, or boilers, that have multiple levels of firing capacity (multiple stages), the Designer must list the capacity of the equipment at the highest stage of heating.

23 For hybrid systems (heat pump & furnace), in which the Designer has separate AHRI reference numbers for both equipment types.

Not required for electric supplemental heat (select N/A, and move to next Element).

Not required for multi-stage furnaces or boilers.

24 Variable-speed indoor blower motors refer typically to electronically commutated, or brushless, permanent magnet motors.

25 Section 2.4 is required when a cooling system (or system with cooling capability, e.g., heat pump) is installed. Otherwise, select N/A and move to next Section.

26 For packaged equipment, enter the brand, model, and serial number in this Section.

27 The indoor unit is the counterpart to the condenser. It is accepted that the equipment may not be installed indoors.

28 The AHRI reference number may be for the cooling system only, or it may be for the both the heating and cooling systems.

29 Typically within the model number there is a reference to the equipment's nominal capacity (in thousands of Btu/h). This value is then divided by 12,000 to determine the tons of capacity. For example, the fictional Model# ABC-018, alludes to a capacity of 18,000Btu/h, 18,000 divided by 12,000 equals 1.5 – or 1.5 tons. Other typical tonnages are: 2.0, 2.5, 3.0, 3.5, 4.0, and 5.0.

Nominal tonnage is not the value derived from the manufacturer's expanded performance data.

30 The equipment manufacturer's expanded performance capacity should be based on the condenser model (2.4.3) and the indoor unit (2.4.7) at the design conditions (indoor and outdoor) from the Manual J heat loss / gain calculation and the design airflow for cooling (2.6.5).

31 Variable-speed indoor blower motors refer typically to electronically commutated, or brushless, permanent magnet motors.

32 For geothermal or hydronic systems, Elements 2.5.1 – 2.5.5 are required.

For all other system types, this Section is optional; it is provided as a resource, and may be completed at the Designer's discretion.

33 This Section is required for all forced air systems (except ductless systems).

For hydronic and ductless systems, select N/A and move to next Section.

Note: The design airflow needs to be corrected for elevation (for altitudes greater than 2500 feet above sea level). The air-density corrected CFM is the recorded 'design airflow'.

34 Duct modifications are the addition, elimination, or the re-sizing, of any portion of the duct system. Replacing a duct with the same size duct is excluded. Duct systems that are modified, must be balanced. To balance the duct system, the room loads must be known, so a room-by-room load calculation is required.

35 Found on the Manual D, Friction Rate Worksheet, line 1. For duct systems that have modifications, this necessitates a room-by-room heat loss/gain calculation (Section 2.1), and an associated duct design, which includes a design airflow and design static pressure (this is NOT the friction rate).

Note: The design ESP needs to be corrected for elevation (for altitudes greater than 2500 feet above sea level). The air-density corrected ESP is the recorded 'design ESP'.

For equipment replacement only, with no duct modifications, this element is not required.

36 Record the maximum static pressure allowed by the equipment manufacturer.

37 For PSC motors (Element 2.4.14), select the fan speed that the installer should select for the heating mode.

38 For PSC motors (Element 2.4.14), select the fan speed that the installer should select for the cooling mode.

39 Provide the name of the AHJ that established the venting requirements that are being used, for example: Fairfax County, VA.

40 Two-pipe sealed combustion systems, check Yes.

Combustion appliances in an outdoor closet with openings to outdoors, check Yes.
Combustion appliances in an indoor closet that is open to vented attic, check Yes.
One-pipe combustion appliances, check No.

41 This report is designed to collect information related to the ACCA's 5 QI Standard (ANSI / ACCA 5 QI – 2015 HVAC Quality Installation Specification). This information will be evaluated for compliance to the Standard's tolerances, and will provide a benchmark of the HVAC equipment performance for use as a reference in future maintenance and repairs.

42 Required if forced air is selected in Element 2.2.1. For hydronic and ductless systems, select N/A and move to next Section.

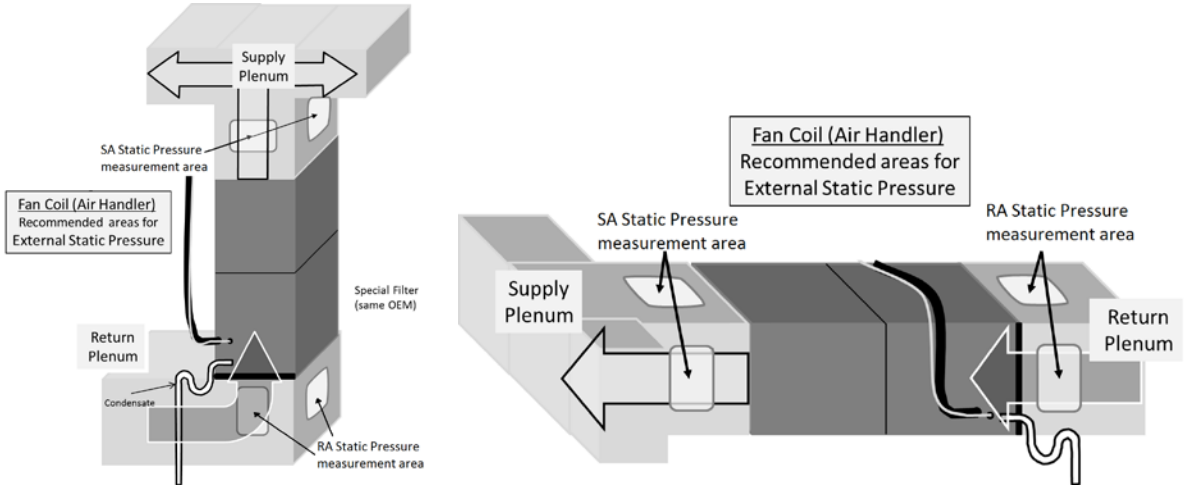
43 Airflow through the equipment must be tested in the mode with highest airflow (Section 2.6.4 or 2.6.5).

44 Select the fan speed setting that was used when the static pressures were recorded.

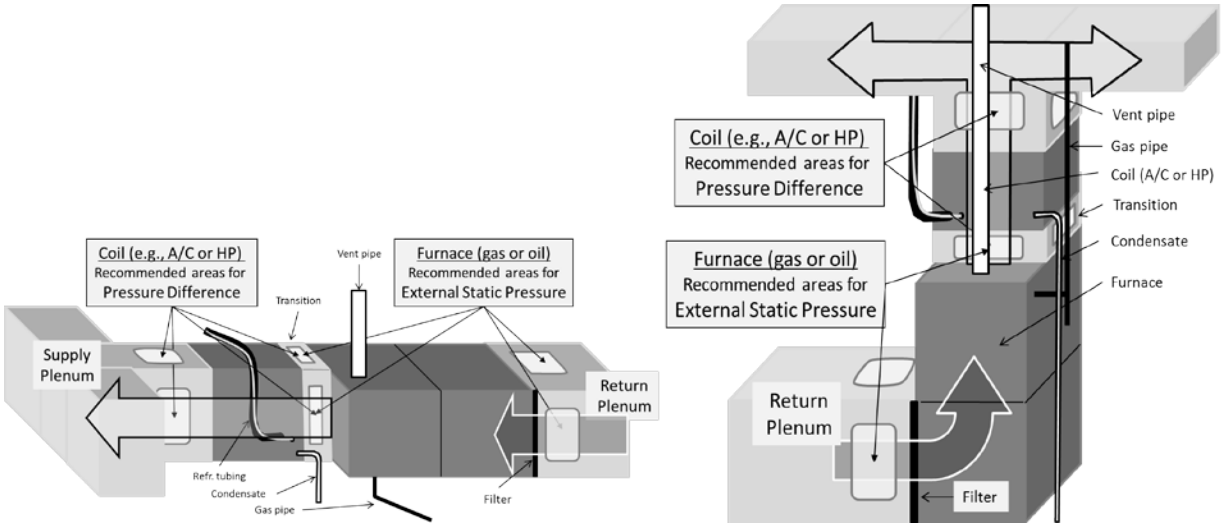
45 Return static measurement is used to calculate the external static pressure. For a furnace, fan coil unit, or package unit, it is measured in the airstream as it enters the OEM's box (equipment that has the blower assembly).

Entering static measurement is used to calculate the pressure difference across a coil; it is measured in the airstream as it enters the coil.

46 See illustrations for examples of locations to measure static pressure.



Note: For purposes of these Figures, the filter is included as part of the OEM box and therefore part of the pressure drop across the equipment.



Note: For purposes of these Figures, the filter is included as part of the OEM box and therefore part of the pressure drop across the equipment.

47 Supply static measurement is used to calculate the external static pressure. For a furnace, fan coil unit, or package unit, it is measured in the airstream as it leaves the equipment (that has the blower assembly).
Leaving static measurement is used to calculate the pressure difference across a coil; it is measured the in the airstream as it exits the coil.

48 External static pressure (ESP) equals the sum of the absolute values for the Return Air (RA) static pressure and the Supply Air (SA) static pressure.
EXAMPLE: RA = -0.2 iwc (Element 3.2.3), and SA = +0.4 iwc (Element 3.2.5), ESP = 0.6 iwc (the negative and positive signs are immaterial for this equation).
Pressure Difference across an evaporator coil, subtract the Leaving Air (LA) static pressure from the Entering Air (EA) static pressure.
EXAMPLE: EA = 0.400 iwc, and LA = 0.186 iwc, Pressure Difference is 0.214 iwc.

49 Refer to the equipment's blower table and based on the measured external static pressure and fan speed, record the corresponding airflow. In the example below, FC60-36, on medium fan speed at 0.6iwc = 1,035 CFM.

ABC Company Fan Coils								
Air Delivery – CFM (With Filter)								
Unit Size	Speed	External Static Pressure (inches water column)						
		0.1	0.2	0.3	0.4	0.5	0.6	0.7
FC60 - 024	High	1075	1040	995	945	895	840	760
	Med	950	925	895	845	795	740	660
	Low	850	825	780	740	685	635	560
FC60 - 036	High	1470	1415	1400	1285	1215	1120	995
	Med	1315	1280	1235	1180	1115	1035	930
	Low	1125	1110	1085	1045	995	915	830
Note: Airflow based on a dry coil at 120v with factory approved filter.								

Refer to the coil's pressure drop table and based on the measured pressure drop and the coil's condition (wet or dry), record the corresponding airflow. For evaporator coil model 2414, in wet condition, and a pressure difference of 0.214iwc = 700 CFM

PERFORMANCE DATA

COIL STATIC PRESSURE DROP (iwc)

UNIT SIZE	Standard CFM								
	400	500	600	700	800	900	1000	1100	1200
1814	Dry								
	0.078	0.114	0.156	0.198	0.253				
	Wet								
	0.096	0.138	0.183	0.213	0.277				
1917	Dry								
	0.042	0.060	0.080	0.102	0.128				
	Wet								
	0.055	0.076	0.104	0.127	0.158				
2414	Dry								
	0.070	0.103	0.143	0.182	0.233	0.290	0.354		
	Wet								
	0.089	0.128	0.171	0.214	0.265	0.336	0.413		
2417	Dry								
	0.048	0.068	0.090	0.112	0.140	0.170	0.203		

Note: For altitudes greater than 2,500 feet above sea level, calculated ESP needs to be corrected for elevation (i.e., air density impacts) before using OEM-provided performance data. Most OEM data is based on standard air

conditions (sea level: 69ºF temperature, 0.075 lb/ft^3 density, 29.92 inches of Hg barometric pressure); albeit, some OEMs do provide altitude-adjusted performance data (in which case, the measured ESP value can be used directly).

50 If the evaporator (indoor) coil uses a TXV, and the outdoor air temperature is below 55°F, then the refrigerant charge test does not need to be submitted to obtain a certificate.

If the outdoor air temperature is below 60°F and the evaporator (indoor unit) uses a fixed-bore metering device (e.g., a piston), then the equipment's refrigerant charge must be verified when the outdoor temperature is equal to or above 60°F.

51 Refrigerant subcooling testing is required for air conditioning and heat pump systems employing thermal expansion valves. Air conditioners and heat pumps employing fixed metering devices (e.g., fixed orifice, capillary tube, piston) are encouraged to record the measurements associated with subcooling; but, it is optional and not required. Heat pump systems installed at temperatures below 60°F (regardless of metering type) may complete this Section in the heating mode (Stage 1 heat mode) per OEM instructions.

52 Refer to the pressure temperature chart for the refrigerant being used.

53 Record the subcooling specified by the equipment manufacturer for the equipment being installed.

54 Refrigerant superheat testing is required for air conditioning and heat pump systems employing fixed metering devices (e.g., fixed orifice, capillary tube, piston). Air conditioners and heat pumps employing thermal expansion valves are encouraged to record the measurements associated with superheat; but, it is optional and not required. Heat pump systems installed at temperatures below 55°F (regardless of metering type) may complete this Section in the heating mode (Stage 1 heat mode) per OEM instructions.

55 DB (Dry Bulb) temperature at the condenser (outdoor) unit as measured by a thermometer. This temperature should be measured at the time that the final refrigerant charge adjustment was implemented, or when the charge was confirmed to be within the specified tolerance.

56 WB (Wet Bulb) temperature of the air at the equipment as measured by a sling psychrometer or hygrometer.

57 Refer to the pressure temperature chart for the refrigerant being used.

58 Record the superheat specified by the equipment manufacturer for the equipment being installed.

59 Documentation that defines this procedure, and records of the refrigerant measurements not recorded above, shall be available upon request.

60 If cooling only, and heat pump only, systems are installed, select N/A and move to next Section.

61 Oil and liquid propane (LP) systems need to use a combustion analyzer. For natural gas, use of a combustion analyzer is recommended, but it is optional and may be used at the discretion of the installer.

62 If a combustion appliance has been removed, yet another combustion appliance remains using the venting sized for both combustion appliances, then this Section shall be completed for the orphaned (remaining) appliance. If no combustion appliance is orphaned, and cooling only, or heat pump only, systems are installed, select N/A and move to next Section.

63 Signs of proper venting are visually observed (by use of a smoke bottle, or recently extinguished match). There must be no spillage, or back drafting, at any point around the draft diverter.

64 All accessible portions of the gas line, including the gas meter, have been checked. Signs of leaks have been reported for corrective action.

65 Not required for hydronic or ductless systems.

66 Duct leakage tolerances are based on measured airflow (3.2.8). Per the ACCA 5 QI Standard the following tolerances for duct leakage in a new home are: all ducts in conditioned space - 10% total duct leakage, any ducts in unconditioned space – 6% total duct leakage. A new home is a residence that:

- Is under construction, or that
- Has not yet been issued an certificate of occupancy by the AHJ, or if there is no AHJ, then
- It has not been deemed complete by the builder.

67 Duct leakage tolerances are based on measured airflow (3.2.8). Per the ACCA 5 QI Standard, the following tolerances for duct leakage in an existing home are: 20% total leakage, or reduce the total duct leakage by 50%. An existing home is one that has:

- Received a certificate of occupancy from the AHJ, if there is no AHJ, then
- Has been deemed complete by the builder, or
- Has been occupied.

68 Airflow comparison method that uses an airflow measurement device (AMD), to measure total return air at the grilles and total supply air at the diffusers/registers. Airflow through the equipment is compared to the total return air and supply air to determine total leakage.

EXAMPLE: Total Airflow at Supply registers = 950 Cfm (Element 4.2.1).
Total Airflow at Return grilles = 975 Cfm (Element 4.2.2).
Airflow through equipment = 1,000 Cfm (Element 3.2.8).
Supply Leakage = 1,000 Cfm – 950 Cfm = 50 Cfm.
Return Leakage = 1,000 Cfm – 975 Cfm = 25 Cfm.
Total Leakage = 50 Cfm (Supply) + 25 Cfm (Return) = 75 Cfm.

69 To ensure that airflow through the equipment meets the QI Standard, when duct sealing is complete, the airflow measurements in Section 3.1 must either be taken and recorded (after the duct sealing), or the original measurements must be confirmed as accurate, or modified as necessary.

70 Required only if 4.1.2 equals 50% Improvement.

71 Calculation required only if 4.1.2 equals 50% Improvement.

72 When air balancing is performed, records do not need to be attached, or sent to the QA Program. Air balancing records (like the sample Test and Balance Report at qacontractors.org/qa/resources), must be available upon request by the QA Program.

APPENDIX B – ACCA 5 QI - 2015 REQUIRED DOCUMENTATION

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As a convenience to the User, this Appendix reprints Table 1 from the QI Standard. No changes or new elements are contained herein from those contained in the QI Standard.

QI Standard Table 1 (*Quality Installation Required Documentation*)

	QI Standard Element	Approved Procedure	Reported Information
Design Aspects (§3.0 QI Standard)	§3.1 Ventilation	ASHRAE 62.1 or ASHRAE 62.2	✓ Ventilation rate based on building use ✓ Floor area ✓ Number of occupants ✓ Number of bedrooms ✓ Estimated infiltration
	§3.2 Load calculation	Manual J or Manual N or AHJ-approved equivalent	✓ Design conditions: ○ Outdoor temps ○ Latitude ○ Indoor temps ○ Grains diff. ○ Altitude ○ Infiltration ○ Orientation ○ Occupants ○ Duct load
			✓ Opaque building components (walls, ceilings, etc.) ○ Area of component ○ HTM of component
			✓ For windows: ○ Area ○ HTM ○ Heating U value ○ SHGC ○ Orientation ○ Overhang dimensions
			✓ Calculated loads: ○ Total heating ○ Sensible cooling ○ Total cooling ○ Latent cooling
	§3.3 & §3.4 Equipment capacity selection	Air Conditioner (from OEM performance data)	✓ Equipment model ✓ Outdoor ambient dry-bulb ✓ Indoor entering wet-bulb ✓ Indoor entering dry-bulb ✓ Airflow across the heat exchanger ✓ Equipment Sensible Capacity ✓ Equipment Latent Capacity
		Heat Pump (from OEM performance data)	✓ Equipment model ✓ Outdoor ambient dry-bulb ✓ Indoor entering wet-bulb ✓ Indoor entering dry-bulb ✓ Airflow across the heat exchanger ✓ Equipment Sensible Capacity ✓ Equipment Latent Capacity
		Geothermal Heat Pump (from OEM performance data)	✓ Equipment model ✓ Outdoor ambient dry-bulb ✓ Indoor entering wet-bulb ✓ Indoor entering dry-bulb ✓ Airflow across the heat exchanger ✓ Design water flow through the equipment ✓ Design ground temperature ✓ Equipment Sensible Capacity ✓ Equipment Latent Cap.
		Furnace (from OEM performance data)	✓ Equipment model ✓ Output Btu/H
		Boiler (from OEM performance data)	✓ Equipment model ✓ Output Btu/H
		Electric Heater (from OEM performance data)	✓ Equipment model ✓ Output Btu/H at rated kW and Volts / Amps
	§3.5 Matched systems	✓ AHRI Directory Certificate, or ✓ CEE Directory Certificate, or ✓ OEM Catalog Performance Data	

QI Standard Table 1 (*Quality Installation Required Documentation*)			
QI Standard Element		Approved Procedure	Reported Information
Equipment Aspects (§4.0 QI Standard)	§4.1 Airflow through the heat exchanger	OEM/Cfm external/total Static Pressure Drop and/or Coil Table	✓ Equipment fan speed setting ✓ Supply side SP ✓ Return side SP ✓ Design airflow ✓ Measured airflow (Fan flow based on measured ESP, voltage, and fan speed)
		OR	
		Duct system traverse	✓ Duct's inside dimensions ✓ Number of readings taken ✓ Average velocity ✓ Are ducts lined or internally insulated? ✓ Location of traverse test site ✓ Design airflow ✓ Measured airflow
		OR	
		Flow grid measurement	✓ Flow grid test site (e.g., unit filter rack, etc.) ✓ Altitude adjustment ✓ Air temperature adjustment ✓ Average air velocity ✓ Flow grid area ✓ Design airflow ✓ Measured airflow
		OR	
		Pressure matching method: Supply air pressure matching	✓ Supply duct static pressure, unit fan only ✓ Location of pressure reading ✓ Calibrated fan pressure at supply static pressure ✓ Design airflow ✓ Measured airflow (Calibrated fan flow at corresponding pressure)
		OR	
		Temperature rise method (**electric** heat only)	✓ Measured temperature rise (supply - return air temp) ✓ Measured volts (at electrical disconnect) ✓ Measured amps (at electrical disconnect) ✓ Annotate Single Ø or Three Ø heater ✓ Design airflow ✓ Measured airflow
		OR	
		Temperature rise method (**gas** heat only)	✓ Measured temperature rise (supply air - return air) ✓ Measured manifold pressure ✓ OEM-specified manifold pressure ✓ Measured gas flow (time for one revolution of meter) ✓ Fuel gas heating value (from the gas company) ✓Steady-state heating efficiency ✓ Design airflow ✓ Measured airflow
		OR	
		Temperature rise method (**oil** heat only)	✓ Measured temperature rise (supply air - return air) ✓ Nozzle size ✓ Nozzle flow rate ✓ Measured pump pressure ✓ Fuel oil heating value (from the oil company) ✓Steady-state heating efficiency ✓ Design airflow ✓ Measured airflow

QI Standard Table 1 (*Quality Installation Required Documentation*)			
	QI Standard Element	Approved Procedure	Reported Information
Equipment Aspects (§4.0 QI Standard)	§4.2 Water flow through the heat exchanger	Pressure drop method: Pressure at inlet and outlet	✓ Number of heat exchangers ✓ Total water volume measured ✓ Location of pressure drop reading ✓ Water flow inlet and outlet pressure ✓ Design water flow ✓ Measured water flow ✓ Antifreeze correction made? Measured specific gravity.
		OR	
		Water temperature change method	✓ Number of heat exchangers ✓ Airflow through the heat exchanger (e.g.: CFM needs to be verified for temperature rise to be correct) ✓ Location of temperature readings ✓ Design water flow ✓ Measured water flow ✓ Antifreeze correction made? Measured specific gravity.
		OR	
		Other OEM approved Method	✓ OEM directions available? ✓ Number of readings taken ✓ Location of test site ✓ Design water flow ✓ Measured water flow ✓ Other measurements as per OEM requirements
	§4.3 Refrigerant charge	Superheat	✓ Airflow over evaporator coil ✓ Refrigerant type ✓ Suction line pressure (at OEM specified location) ✓ Suction line temperature (at OEM specified location) ✓ Entering air temperature and humidity (at steady-state, about 15 minutes) ✓ Outdoor weather conditions (invalid below 55°F, unless specified by OEM) ✓ Expansion device type ✓ OEM-recommended superheat ✓ Measured superheat
		OR	
		Subcooling	✓ Airflow over evaporator coil ✓ Refrigerant type ✓ Liquid line pressure (at OEM-specified location) ✓ Liquid line temperature (at OEM-specified location) ✓ Entering air temperature and humidity (at steady-state, about 15 minutes) ✓ Outdoor weather conditions (invalid below 60°F, unless specified by OEM) ✓ Expansion device type ✓ OEM-recommended subcooling ✓ Measured subcooling
		OR	
		OEM-specified method	✓ List all applicable measurements taken and provide documentation substantiating this procedure for the HVAC system
	§4.4 Electrical requirements	✓ Measured & nameplate line voltage for each component ✓ Measured and listed control voltage ✓ Measured & nameplate line amperage for each component ✓ Measured and listed control amperage ✓ Ensure the equipment is properly grounded ✓ List line wire size and type ✓ List control wire size and type	

QI Standard Table 1 (*Quality Installation Required Documentation*)			
	QI Standard Element	Approved Procedure	Reported Information
Equipment Aspects (§4.0 QI Standard)	§4.5 On-Rate for fuel-fired equipment	Gas-fired equipment (Clocking the meter)	✓ Nameplate heating input ✓ Nameplate temperature rise ✓ Fuel gas heating value (from the gas company) ✓ Measured gas flow rate ✓ Measured temperature rise (supply air - return air)
		Gas-fired equipment (Combustion Analysis)	✓ Measured CO level (at high, medium & low fire) ✓ Fuel pressure at burner (at high, medium & low fire) ✓ Draft above draft hood or barometric pressure (at high, medium & low fire) ✓ Steam pressure or water temperature entering and leaving boiler, steam generator, or process heater ✓ Unit rate if meter is available
		Oil-fired equipment (Nozzle, pump pressure, temperature rise)	✓ Nozzle size and flow rate ✓ Measured temperature rise (supply air - return air) ✓ Nameplate temperature rise
		Oil-fired equipment (Combustion Analysis)	✓ Measured CO level (at high, medium & low fire) ✓ Fuel pressure at burner (at high, medium & low fire) ✓ Draft above draft hood or barometric pressure (at high, medium & low fire) ✓ Steam pressure or water temperature entering and leaving boiler, steam generator, or process heater ✓ Unit rate if meter is available
	§4.6 Combustion venting system	Category I per OEM instructions and NFGC	✓ Number and venting type (natural or fan assisted) of appliances in the venting system ✓ Number and type of offsets in venting system ✓ Altitude of installation (if de-rated for altitude) ✓ Total vent height (in feet) ✓ Total vent lateral length (in feet)
		OR	
		Category I per OEM instructions and IFGC Or per OEM and UMC	✓ Number and venting type (natural or fan assisted) of appliances in the venting system ✓ Number and type of offsets in venting system ✓ Altitude of installation (if de-rated for altitude) ✓ Total vent height (in feet) ✓ Total vent lateral length (in feet)
		Category II, III, or IV per OEM instructions	✓ Attach OEM instructions and list required measurements (typical measurements are similar to those for Category I vent system).
		OR	
		Category II, III, or IV per local code	✓ Attach local code and list required measurements (typical measurements are similar to those for Category I vent system).
	§4.7 System controls	Equipment controls	✓ Type of HVAC system ✓ Type of control ✓ Sequence of operation tested (heat, cool, fan, re-set controls, etc.)
		Safety controls	✓ Type of safety control (e.g., condensate overflow switch) ✓ Method of test (e.g., lifted float, or filled pan with water) ✓ Result of test (e.g., system stopped, compressor stopped)

QI Standard Table 1 (*Quality Installation Required Documentation*)			
	QI Standard Element	Approved Procedure	Reported Information
Distribution Aspects (§5.0 QI Standard)	§5.1 Duct leakage	Duct pressurization test	✓ Qualitative assessment of outdoor wind conditions ✓ Calibrated fan connection point ✓ Duct pressure with reference to outside ✓ Orifice size and associated pressure table (if orifice is used) ✓ Pressure difference across the orifice (if orifice is used) ✓ Calibrated fan pressure ✓ Calibrated fan flow at reported pressure ✓ Duct leakage tolerance ✓ Measured duct leakage
		OR	
		Airflow Comparison method (Commercial only)	✓ Total measured supply CFM ✓ Total measured return CFM ✓ Airflow across the heat exchanger ✓ Duct leakage tolerance ✓ Measured duct leakage
		OR	
		Duct pressurization test per the authority having jurisdiction	✓ Attach local code and list required measurements (typical measurements are similar to those for other duct pressurization tests).
	§5.2 Airflow balance	Flow hood measurements	✓ Design airflow (for each duct terminal) ✓ Measured airflow (for each duct terminal)
		OR	
		Hot-wire or Rotary anemometer	✓ Terminal devices' air velocity ✓ Report terminal devices' Ak factor ✓ Design airflow (for each duct terminal) ✓ Measured airflow (for each duct terminal)
		OR	
		Pitot tube	✓ Duct's inside dimensions ✓ Number of readings taken ✓ Average velocity ✓ Location of traverse test site ✓ Design airflow (for each duct terminal) ✓ Measured airflow (for each duct terminal)

QI Standard Table 1 (*Quality Installation Required Documentation*)			
	QI Standard Element	Approved Procedure	Reported Information
Distribution Aspects (§5.0 QI Standard)	§5.3 Hydronic Balance	Manometer and probe	✓ Number of heat exchangers ✓ Total water volume measured ✓ Location of pressure drop reading ✓ Water flow inlet and outlet pressure ✓ Design water flow ✓ Measured water flow ✓ Correction factor for compounds other than water
		OR	
		Ultrasonic/Doppler flow meter	✓ Number of heat exchangers ✓ Total water volume measured ✓ Location of pressure drop reading ✓ Type of pipe and meter data sheets ✓ Design water flow ✓ Measured water flow ✓ Correction factor for compounds other than water
		OR	
		Pressure gauge	✓ Number of heat exchangers ✓ Total water volume measured ✓ Location of pressure drop reading ✓ Water flow inlet and outlet pressure ✓ Design water flow ✓ Measured water flow ✓ Correction factor for compounds other than water
		OR	
		OEM Specified Procedures	✓ OEM directions and related charts ✓ Total water volume measured ✓ Design water flow ✓ Measured water flow
Documentation and Education Aspects (§6.0 QI Standard)	§6.1 System Documentation	Required documentation	✓ Ventilation calculations ✓ Load calculations ✓ OEM performance data ✓ AHRI certificates ✓ Records of measurements ✓ Documented field data ✓ Equipment operation sequences ✓ Duct leakage tests ✓ Test and balance reports ✓ Customer education
		Relevant information	✓ Permits ✓ As-built drawings (including the type, size, and location of all underground heat geothermal heat exchange piping) ✓ Survey data ✓ Equipment submittals, ✓ Maintenance and operating instructions ✓ Equipment/contractor warranties
	§6.2 Customer Education	System operation	✓ Signed documentation from the customer or other written documentation
		Maintenance requirements	✓ Signed documentation from the customer or other written documentation
		Warranty procedures	✓ Signed documentation from the customer or other written documentation
		Contact information	✓ Signed documentation from the customer or other written documentation

APPENDIX C – QI VERIFICATION ELEMENTS INDEPENDENT OF OTHER ELEMENTS

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During the course of an in-field verification, it may be discovered that one or more elements are in noncompliance to the QI Standard. The verifier may opt to continue assessing the remaining elements. However, some elements are dependent on earlier measurements being correct and representative of the equipment's operation. Hence, if one element is suspect, it makes little sense to spend the effort to verify co-dependent items. Figure 2 below indicates (by checkmarks) which remaining elements can be independently assessed if a particular non-conformity is discovered.

QI Element with Non-conformities	Element(s) That Subsequently Can be Verified																
	§3.1 Vent	§3.2 Load Calc	§3.3 Equip Sel.	§3.4 Geo.	§3.4 Mtchd Sys.	§4.1 Air-flow	§4.2 H_2O flow	§4.3 Ref Chg	§4.4 Elect.	§4.5 On Rate	§4.6 Vent.	§4.7 Cntrl	§5.1 Duct Leak	§5.2 Air Bal	§5.3 H_2O Bal	§6.1 Sys Doc	§6.2 Ownr Ed
Ventilation (§3.1)				✓	✓	✓			✓			✓					✓
Load Calculation (§3.2)				✓	✓	✓			✓			✓					✓
Equipment Selection (§3.3)	✓	✓		✓	✓	✓											✓
Geothermal (§3.4)	✓	✓	✓		✓	✓											
System Matching (§3.5)	✓	✓	✓	✓													
Airflow (§4.1)	✓	✓	✓	✓	✓		✓		✓			✓					✓
Waterflow (§4.2)	✓	✓	✓	✓	✓	✓			✓			✓					✓
Refrigerant Charge (§4.3)	✓	✓	✓	✓	✓	✓	✓		✓	*	*	✓	✓	✓	✓		✓
Electrical[5] (§4.4)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓						✓
On Rate (§4.5)	✓	✓	✓	✓	✓	✓		*	✓			✓	✓		✓		✓
Venting (§4.6)	✓	✓	✓	✓	✓	✓		*	✓	✓		✓	✓		✓		✓
Controls (§4.7)	✓	✓	✓	✓	✓												✓
Duct Leakage (§5.1)	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓					✓
Air Balance (§5.2)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓				✓
Hydronic Balance (§5.3)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓					✓
System Doc. (§6.1)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓		
Building Owner Ed. (§6.2)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓		

* As applicable; as when an HVAC system uses a fossil fuel heating appliance with forced air cooling then these items shall be verified.

Figure 2: Independent QI Elements

[5] The extent and nature of the electrical deficiency will determine the effect on the subsequent testing. The Verifier will decide which, if any, additional items to inspect.

To use Figure 2, look to the first column to identify the nonconformity(ies). Then, move to the right along that same row to see which columns have checkmarks ("✓") and which do not. Those with checkmarks are independent elements and review of these will allow the QI verification process to continue. If there is not a checkmark, then there is some co-dependencies where the discovered nonconformity may have an influence on those unchecked boxes. Hence, incorrect, or non-representative assessments could result.

Example: Looking at Figure 2, if it is determined that the Airflow (QI Element §4.1) is out of conformity, then:

The QI Elements that can be verified include:

Ventilation,
Load Calculation,
Equipment Selection,
Geothermal,
System Matching,
Electrical, Controls, and
Owner Education.

The QI Elements that have dependency with Airflow, and therefore can be impacted by the incorrect airflow (resulting in suspect measurements/conclusions):

Refrigerant Charge,
On-Rate,
Venting,
Duct Leakage,
Air Balance,
Hydronic (water) Balance, and
System Documentation.

Note: In this example, airflow needs to be corrected so that all the dependent measurements can be undertaken and an assessment can be made as to whether the HVAC installation is per the requirements.

APPENDIX D – SAMPLING PROTOCOLS

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Verifying that HVAC systems are in compliance to the QI Standard is resource intensive. Therefore, this section provides guidance to Program Administrators who may choose to employ sampling in their Level 1 (Installation Checklist Verification) and / or Level 2 (Field Verification) efforts.

1. Sampling Approach: HVAC systems shall be selected for verifications in an independent manner which:
   1.1. Provides a representative sample of the submitted HVAC systems.
   1.2. Includes input from the Verifier's review of the installation checklist and, as applicable, field verifications.

2. Sampling Stages: Contractors shall advance or return to former sampling stages based on the results of their performance. For each Level 1 and/or Level 2 (if supported by the Program Administrator) installation:
   2.1. Stage 1 verification: Each submitted HVAC system shall have 100% verification.
   2.2. Stage 2 verification: HVAC systems, shall be verified at the following rate, the greater of either:
      2.2.1. One of every ten (1-10) submitted installations, or
      2.2.2. One submitted installation per quarter.
   2.3. Stage 3 verification: HVAC systems shall receive verification at the following rate, the greater of either:
      2.3.1. One of every thirty (1-30) submitted installations, or
      2.3.2. One submitted installation per year.

3. Advancing Proficiency Level: The Program Administrator shall have the discretion to advance the Contractor to less frequent sampling:
   3.1. From Stage 1 to Stage 2: After an installation has been verified to meet the Programmatic requirements.
   3.2. From Stage 2 to Stage 3: The Program Administrator shall set its policy for advancing to Stage 3.

4. Decreasing Proficiency Level: Contractors shall return to the previous sampling Stage when the HVAC system installation fails a verification.

Increasing Proficiency Level			
	Stage 1	Stage 2	Stage 3
Sampling	100%	One-in-ten (1-10)	One-in-thirty (1-30)
Decreasing Proficiency Level			
	From Stage 2 to Stage 1	From Stage 3 to Stage 2	
Sampling	Fail a single Stage 2 verification	Fail a single Stage 3 verification	

Figure 3: Sampling Summary

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APPENDIX E – FIELD PRACTITIONER SKILL SETS

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HVAC Professionals as well as in-field Verifiers need a basic skill set to design, install, commission, and ultimately verify that the mechanical systems are properly applied to a given building application. Figure 4 below seeks to provide guidance as to the needed skill sets to address the QI Standard requirements/

Applicable QI Section	Skill Set	
Basic Skills	Basic Skills	
	Basic math • Add • Subtract • Multiply • Divide	• Calculate area • Read a tape measure • Apply figures to algebraic formulas and perform functions to achieve answer
	Problem solving skills • Ability to read and understand written instructions • Ability to reason logically	• Ability to read and understand OEM installation instructions
	Equipment operation • Cycle equipment through all phases of operation (heat, cool, fan only, auxiliary, heat only)	• Operate emergency disconnects
	Mobility • Climb 10’ step ladder, hold a capture-hood, and record data • Able to lift 30 pounds	• Crawl in a 3’ tall, 20’ long crawlspace dragging a tool bag
	Interpersonal skills • Relates well to others	• Can present information clearly
§3.1 & 3.2 Ventilation / Load Calculations	Understands ventilation procedures in ASHRAE 62.1, ASHRAE 62.2, and ACCA Manual J	
	Understands heat loss/gain calculation methodologies • Heat transfer multipliers • Accepted defaults • Unacceptable defaults	• Space loads • System loads
	Understands principles of heat transfer • Hot – cold • Temperature difference • U Value / heat conductance	• R Value / insulation / heat resistance • Sensible & latent heat
	Understands building blueprints/plans • Images • Diagrams • Orientation	• Illustrations • Legends

Figure 4: Field Practitioner Skill Sets

Applicable QI Section	Skill Set
§3.3 Equipment Selection	Understands OEM performance data: • Operating conditions • Basic equipment nomenclature • Equipment capacity at field conditions
	Understands QI sizing guidance: • AC, heat pump, furnace, boiler • Cooling dominated climate • Heating dominated climate
§3.5 Matched Systems	Can identify a matched set in the AHRI database
	Can identify a matched set in the CEE directory
	Can identify a matched set using OEM performance data
	Can identify equipment to ensure what is specified is what is installed
4.1& 4.2 Airflow/water flow (heat exchanger)	Knowledge of: • Airflow dynamics • Fan laws
	Knowledge of airflow/water flow tools: • Calibrated fan • Manometer • Static pressure probe • Thermometer • Anemometer (hotwire or vane/rotary style) • Flow grid • Pitot tube • Use a multi-meter
	Knowledge of airflow/water flow procedures: • Section a duct for a traverse • Pressure matching • "Clock" a gas meter • Blower/pump curve data
§4.3 Refrigerant Charge	Possess EPA 608 Certification (Type II, III, or Universal)
	Ability to convert a temperature to a pressure or vice versa for a given refrigerant (Knowledge of pressure temperature chart)
	Ability to select the correct manifold gauge set for the refrigerant tested
	Ability to read pressure on a manifold gauge set for the refrigerant tested
	Ability to connect refrigerant hoses to a Schrader valve
	Ability to read a thermometer
§4.4 Electrical	Knowledge of electrical components
	Knowledge of electrical measurement instruments
	Knowledge of electrical measurements: • Volts • Amps
	Knowledge of electrical codes: • Fuses • Wire sizing
§4.5 On-rate	Knowledge of: • Gas pressure • Fuel nozzle sizes • Nozzle orientation • Manifold pressure • Fuel pump pressure • Measure temperatures
§4.6 Combustion Venting	Knowledge of pertinent information relating to: • National Fuel Gas Code venting tables • OEM instructions for Type I, II, III, and IV appliances • Vent connections • Vent strapping and supporting • International Fuel Gas Code venting tables • Local codes for Type I, II, III, and IV appliances • Different types of vent pipe/materials

Figure 4: Field Practitioner Skill Sets, cont.

APPENDIX F – DOCUMENTATION THAT DEMONSTRATE TECHNICIAN / VERIFIER COMPETENCY

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The credibility of HVAC installation and verification efforts depend on the Technicians' and Verifiers' ability to confidently and professionally observe the requirements in this document and in the underlying QI Standard. Figure 5 offer examples of documents that demonstrate knowledge in the skills needed for applying the QI requirements. Program Administrators may accept these examples as an indication of a Technician's / Verifier's proficiency in each requirement area of the QI Standard.

It should be noted that this list of acceptable documentation is neither exhaustive nor comprehensive. These are provided for guidance purposes.

Applicable QI Section	Acceptable Documentation
	Basic Skills High School diploma or equivalency, Demonstrated ability to perform physical requirements: climb, lift, etc.
QI §3.1 & 3.2 Ventilation and Load Calculations	ACCA HVAC Design for Quality Installation Certification, or ASHRAE Certificate, or Documentation from an accredited HVAC technical school or program*, or Education Program for Instructor Certification (EPIC) certificate, or TABB certificate, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §3.3 Equipment Selection	ACCA HVAC Design for Quality Installation Certificate, or Documentation from an accredited HVAC technical school or program*, or Education Program for Instructor Certification (EPIC) certificate, or Manufacturer's training, or TABB certificate, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §3.4 Geo-thermal	Documentation from an accredited HVAC technical school or program*, or National Ground Water Association Certification, or Geothermal Heat Pump Consortium Certification.
QI §3.5 Matched Systems	ACCA HVAC Design for Quality Installation Certificate, or Documentation from an accredited HVAC technical school or program*, or Education Program for Instructor Certification (EPIC) certificate, or Manufacturer's training, or TABB certificate, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §4.1 & §4.2 Airflow Water flow (through heat exchanger)	Documentation from an accredited HVAC technical school or program*, or AABC certification, or ACCA certification, or NBI certification, or NEBB certification, or NATE Air Distribution service level certification, or TABB certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
* Documentation or supplemental information (e.g., course syllabus) should demonstrate knowledge was tested for this element of the QI Standard.	

Figure 5: Acceptable Documentation Demonstrating a Verifier Skill Set

Applicable QI Section	Acceptable Documentation
QI §4.3 Refrigerant Charge	ACCA qTech Certificate, or EPA 608 certification and one of the following: Documentation from an accredited HVAC technical school or program*, or NATE AC or HEAT Pump Service certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §4.4 Electrical	ACCA qTech Certificate, or Contractor's license (if required by authority having jurisdiction), or Documentation from an accredited HVAC technical school or program*, or Any NATE service level certification, or TABB certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §4.5 On-rate	ACCA qTech Certificate, or NATE service level Gas or Oil certification, or Documentation from an accredited HVAC technical school or program*, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §4.6 Combustion Venting	Documentation from an accredited HVAC technical school or program*, or ACCA qTech Certificate, or NATE Gas or Oil service level certification, or National Fuel Gas Code certification, or TABB certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §4.7 System Controls	ACCA qTech Certificate, or Any NATE service level certification, Documentation from an accredited HVAC technical school or program*, or OEM certification, or TABB certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §5.1 Duct Leakage	Documentation from an accredited HVAC technical school or program*, or AABC certification, or ACCA qTech Certificate, or NBI certification, or NEBB certification, or NATE Air Distribution service level certification, or TABB certification, or HERS certification, or BPI Heating Specialist certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
QI §5.2 & §5.3 Airflow /Hydronic Balance	Documentation from an accredited HVAC technical school or program*, or AABC certification, or ACCA qTech Certificate, or NBI certification, or NEBB certification, or NATE Air Distribution service level certification, or TABB certification, or State or Municipal-recognized Journeyman or higher HVAC Mechanic or equivalent certification*.
* Documentation or supplemental information (e.g., course syllabus) should demonstrate knowledge was tested for this element of the QI Standard.	

Figure 5: Acceptable Documentation Demonstrating a Verifier Skill Set (continued)

APPENDIX G – DEFINITIONS

[This Appendix is not part of the Standard. It is merely informative and does not contain requirements necessary for conformance to the Standard. It has not been processed according to the ANSI requirements for a standard, and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ACCA or ANSI.]

ACCA: Air Conditioning Contractors of America.

Airflow Measurement Device (AMD): A device/system used to measure airflow entering or exiting an opening (e.g. supply register, return grill, local exhaust fan). Some AMDs can also be used to measure duct leakage[6] via a duct (de)pressurization test through a calibrated fan or orifice.

AHRI: Air Conditioning, Heating, and Refrigeration Institute.

Appeal: Request by a building owner or contractor for reconsideration of any adverse decision[7] made by the Program Administrator, or Verifier, related to the verification of an HVAC installation.

Automated Validation System: An approach – specifically approved and authorized by the Program Administrator that automates portions (or all) of the process related to record measurement data and site information, and/or analyze the data, and/or produce a finding/evaluation report to be used as a verification acceptance determination. Such systems run the gamut from simple data collection schemes, to smart systems, and eventually to expert systems.

Building owner: The person or entity responsible for purchasing an HVAC system; either for a new building, or to replace an existing system. The building owner may be the designated operator or manager of a commercial building, the landlord of a rental property, or a homeowner. The building owner shall be the prime point of contact for the building.

CEE: Consortium for Energy Efficiency.

Commission; Commissioning: At the time of equipment start-up, measurements and tests are undertaken and documented to verify that the HVAC equipment is functioning as designed.

Complaint: Expression of dissatisfaction, other than appeal.

Contractor: The entity responsible for the installation and/or commissioning of HVAC systems in accordance to this Standard.

Deficiency: A fault, or omission, found during the QI verification that a contractor was able to readily resolve.

Expert System: An industry recognized automated approach that uses a knowledge base and internal software procedures to evaluate the relationships of QI-applicable HVAC elements (e.g., operating conditions inside and outside, equipment capacity vs. building load requirements at design conditions, refrigerant charge, combustion analysis tests, airflow and/or water flow across the heat exchanger(s), supply and return air and/or water volumes, duct leakage, etc.) and correlates compliance to the requirements in the QI Standard:

Implementing Party(ies): An entity authorized by the Program Administrator to undertake certain requirements of the programmatic effort. An example is a utility (Implementing Party) that is administering requirements under a voluntary program, such as one of the ENERGY STAR™ Programs (Program Administrator).

Installation file: A portfolio of documentation pertinent to the HVAC system installation. Examples include, but are not limited, to the pertinent items listed in §6.0 of the QI Standard.

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[6] Some AMDs can be used to measure duct leakage. The process to measure duct leakage includes: duct registers/grilles are sealed, a fan is attached to one opening of the duct system (typically at the air handler cabinet), the AMD fan pressurizes the ducts to a specific setting, and the amount of air flowing through the AMD fan is quantified. There are a number of commercially available devises/systems that provide this functionality.

[7] Examples of adverse decisions include: refusal to accept an application, refusal to proceed with a verification, verification results are incomplete/incorrect.

Matched System: A set of compatible HVAC units (i.e., combinations of evaporators, condensers, fan-coils, heat pumps, furnaces, boilers) that have been rated by AHRI, or are in the CEE directory, or are certified by the OEM, to deliver the specified capacity under the design conditions.

Nonconformity: A fault, or omission, found during the QI verification that prevents the HVAC system from meeting the QI Standard.

Original equipment manufacturer (OEM): The entity responsible for the design, manufacturer, and rating of HVAC equipment or components.

Program Administrator: The entity that defines, manages, and provides control over the programmatic requirements and subsequent verification process to ensure HVAC installations comply with the requirements in the QI Standard.

QI Standard: The ANSI/ACCA 5 QI – 2015 (*HVAC Quality Installation Specification*) Standard. The American National Standard that details the minimum requirements for the installation of unitary HVAC systems in residential and light commercial buildings.

Smart System: An automated approach that supports the measurement/assessment process needed to determine compliance to the Standard. A smart system could incompletely assess compliance to the Standard for all aspects of the requirements, or for a limited number of elements (e.g., refrigerant charge, airflow, etc.) it can fully assess compliance to the Standard.

Standard Air Conditions: Defined as having a density of 0.075 lb/ft^3, which equates to air density at sea level (barometric pressure of 29.92 inches) and either saturated air at 60ºF or dry air at 69ºF dry bulb. Since the performance of HVAC equipment is commonly states at "standard air" conditions, catalog performance data cannot be used directly for higher altitude applications.

Verification review: An evaluation performed by a Program Administrator, its authorized Verifier, or via a recognized Automated Validation System to ensure a specific HVAC system complies with the installation requirements in the QI Standard.

Verifier: The entity responsible for verifying that a specific HVAC installation system complies with the QI Standard. Verifiers may be one person, or an organization, which provide an unbiased review and/or testing of specific HVAC system's installation.

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