



# **BUILDING PERFORMANCE INSTITUTE, INC.**

## TECHNICAL STANDARDS FOR THE AIR CONDITIONING AND HEAT PUMP PROFESSIONAL

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<b>MODULE</b>	<b>CATEGORY</b>	<b>STANDARD</b>	<b>METHOD OR TECHNIQUE</b>	<b>SPECIAL MATERIALS OR EQUIPMENT</b>	
<b>1</b>	<b>Health and Safety</b>				
1.1.1	Health and Safety	Personal	All technicians performing diagnostic tests, inspections, or installations, must have access to all necessary personal safety equipment required by OSHA.	Occupational Safety and Health Act	Hard hats, safety glasses, gloves, dust masks and/or respirators, as required
1.1.2	Health and Safety	Personal	Safety glasses and gloves must be worn when handling refrigerant or when brazing.	Occupational Safety and Health Act	Safety glasses and gloves
1.1.3	Health and Safety	Personal	Technicians must be trained in proper use and applications of all personal safety devices and must adhere to OSHA regulations when on the job site.	Occupational Safety and Health Act	OSHA standards
1.2.1	Health and Safety	Occupant	The building occupants must be informed of the likelihood of airborne contaminants (asbestos, fiberglass, mold, etc.) in the home during and after inspection and improvement of airflow to the AC or heating system.	NA	NA
1.3.1	Health and Safety	Electrical	Electrical power must be shut off before working on mechanical equipment.	Shut off switch or circuit breaker	NA
1.3.2	Health and Safety	Electrical	Electrical wiring for HP/AC units must be in compliance with relevant codes. Improper connections, wire sizing and other problems identified must be corrected prior to proceeding to system diagnostics or repairs.	National Electrical Code, state, and local codes	NA



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1.4.1	Health and Safety	Refrigerant	Refrigerant must be handled and stored in compliance with EPA Section 608 standards at all times, including charging, recovery, reclamation, storage, and transportation requirements.	U.S. Environmental Protection Agency, Clean Air Act, Section 608	Reclamation and storage equipment as required for each type of refrigerant used.
1.4.2	Health and Safety	Refrigerant	Only EPA certified technicians may install or service small residential (smaller than 5 ton capacity) central air conditioning or heat pump equipment.	U.S. Environmental Protection Agency, Clean Air Act, Section 608	EPA 608 Universal or Type 2 Certification



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<b>2 Installation</b>					
2.1.1	Installation	Design	Sizing for new and replacement central air conditioning and heat pump systems must be based on heating/cooling load calculations for the building using a recognized calculation method.	Whole house load calculation using ACCA's Manual J (or equivalent method)	ACCA's Manual J (or equivalent method)
2.1.2	Installation	Design	New and replacement air conditioning systems must be sized no larger than 115% (or the next nearest size available from the manufacturer) of total load at design conditions. (Systems must be sized based on load calculations referenced in <b>Section 2.1</b> )	Whole house load calculation using Air Conditioner Contractor's Association, Manual J (or equivalent method)	ACCA's Manual J (or equivalent method), Manufacturer's expanded performance tables
2.1.3	Installation	Design	New and replacement heat pump systems must be sized no larger than 125% (or next nearest size available from the manufacturer) of total load at design conditions. (Systems must be sized based on load calculations referenced in <b>Section 2.1</b> .)	Whole house load calculation using Air Conditioner Contractor's Association, Manual J (or equivalent method)	ACCA's Manual J (or equivalent method), Manufacturer's expanded performance tables
2.1.4	Installation	Design	When installing new systems or replacing the air-handler and/or the compressor unit for existing systems, the indoor evaporator coil must be correctly matched to the outdoor coil for the system according to the manufacturer's specifications or ARI standards.	Manufacturer's specifications, ARI standards	Manufacturer's specifications, ARI standards



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2.1.5	Installation	Design	Blower door test results are <b>recommended</b> to determine air leakage rates input into load calculations. Blower door ACH conversion: $ACH = CFM50 \div N$ (use lowest N-factor for the region). If using Manual J version 8, enter CFM50	Determine CFM50 based on single point blower door test.	.
2.1.6	Installation	Design	New ducted distribution systems must be designed to provide +/- 15% of room airflow requirements to satisfy calculated Btu loads for each room being conditioned.	Room-by-room load calculation and duct design using ACCA's Manual D or equivalent.	ACCA's Manual J and ACCA's Manual D (or equivalent)
2.1.7	Installation	Design	New ducted distribution system designs shall be based on the available external static pressure from the air handler, the pressure drop of external devices, the equivalent length of the runs, as well as the size, type and configuration of the ducts.	Room-by-room load calculation and duct design using ACCA's Manual D (or equivalent method).	ACCA's Manual J and ACCA's Manual D (or equivalent method)
2.1.8	Installation	Design	Airflow terminations for newly installed duct systems must have a documented design for proper spread and throw to effectively distribute heating/cooling to the room. Design throw must be between 80-120% of the distance to the furthest room surface (wall, ceiling, floor) from the termination.	Duct layout plan, blueprint, or equivalent documentation	Terminal Manufacturer's Specifications and ACCA's Manual T



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2.2.1	Installation	Airflow	For all new duct systems: <ul style="list-style-type: none"> <li>Measured heat pump airflow must be between 375-450 CFM/Ton, or within manufacturer's specifications when measured over a dry coil (<i>i.e.</i> tested in heating mode.)</li> <li>Measured air conditioner airflow must be at least 350 CFM/Ton unless the manufacturer specifies a lower airflow for the local design condition, when measured over a wet coil after a minimum of 15 minutes of run time.</li> </ul>	Refer to BPI standard (5.2.1) for airflow testing Manufacturer's specifications	Refer to BPI standard (5.2.1) for airflow testing Manufacturer's specifications
2.2.2	Installation	Airflow	For new systems (when not installing new ductwork): Air conditioner or heat pump airflow must be within the design parameters of the manufacturer's specifications with a minimum of 325 CFM/Ton before proceeding with refrigerant charge corrections based on the results of the appropriate charging tests.	Refer to BPI standard (5.2.1) for airflow testing Manufacturer's specifications	Refer to BPI standard (5.2.1) for airflow testing Manufacturer's specifications



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2.2.3	Installations	Airflow	For new systems (when not installing new ductwork): The contractor must attempt to bring the airflow within the ranges set in 2.2.1 by opening registers, opening dampers, changing blower speed, replacing filters, and removing obvious easily repaired kinks in flex duct systems. If the above repairs do not bring the unit into compliance, the contractor shall inform the customer that duct system revisions are necessary.	Refer to BPI standard 2.2.1 for new installations for acceptable airflow limits; manufacturer's specifications	Manufacturer's specifications
2.3.1	Installation	Duct Systems	New ducted distribution systems must provide for adequate return air pathways to minimize pressure imbalances in the conditioned space. Room to room pressure differences may not exceed 3 Pascals.	Room-by-room load calculation and post-installation pressure measurement	ACCA's Manual J (or equivalent method) and digital manometer
2.3.2	Installation	Duct Systems	Filter slots must be tightly covered and the cover must be easily removed for cleaning and/or replacement.	NA	Field manufactured covers can meet this standard. Tapes and other non-permanent devices do not meet the standard.

**Comment [JP1]:** I am not sure that this standard is necessary or that 3 pa. is the right number. But I can accept it if someone else can defend it.



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2.3.3	Installation	Duct Systems	NA	Duct mastic, mesh tape, UL 181 compliant tape
2.4.1	Installation	Refrigerant	Manufacturer's Specifications	Manufacturer's Specifications



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2.4.2	Installation	Refrigerant	Refrigerant lines and indoor coil must be purged with inert gas during brazing to prevent oxidation.	NA  Nitrogen
2.4.3	Installation	Refrigerant	New systems must be evacuated to 500 microns or less. Isolate the system from the vacuum pump and let it sit. The micron gauge should not rise more than 300 microns (or the manufacturer's specified limit, whichever is less) in 5 minutes above the initial vacuum level.	NA  Analog or Digital Micron Gauge
2.4.4	Installation	Refrigerant	Proper charge must be verified using the superheat or sub-cooling method. When weather conditions do not allow for proper AC testing (super-heat or sub-cooling), the charge may be "weighed in". The charge must be calculated according to the manufacturer's specifications	Use super-heat method for non-TXV systems.  Use sub-cooling method for TXV systems.  Temperature gauge and thermocouples to measure wet and dry bulb temperatures, P/T gauges appropriate to refrigerant being used, P/T charts, manufacturer's instructions



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2.5.1	Installation	Controls	Heat pump controls shall stage the compressor based heating first, followed by one or more stages of back-up heating. The first stage of heating shall not include electric resistance heating	Activate Stage 1 and verify that unit is heating and electric resistance elements are not operating
2.5.2	Installation	Controls	If the rated SEER or HSPF for the unit is dependent on a particular option (Thermostatic Expansion Valve and/or Time Delay Relay) that option must be installed.	Manufacturer's Specification
2.6.1	Installation	Commissioning	Newly installed AC and heat pump systems must be run through a heating and/or cooling cycle as noted in <b>2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.4.4, 2.5.1, and 3.1.1</b> to verify proper performance of airflow, charge, controls, room pressures, and delivery of heating/cooling to the living space These parameters can be verified singly or in groups.	Refer to BPI standards for measuring charge, airflow, and room pressures; manufacturer's specifications



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<b>3 Commissioning</b>					
<b>3.1.1</b>	Commissioning	Airflow	New ducted distribution systems require register airflows to be measured and verified. The system shall deliver +/- 20% of design airflows for each conditioned room. Deviations from design criteria greater than 20% must be corrected	ACCA's Manual J and ACCA's Manual D (or equivalent method)	Flow capture hood (or equivalent measurement device)
<b>3.2.2</b>	Commissioning	Duct Systems	Duct tightness for newly installed duct systems must meet or exceed the requirements set forth in the EPA standards for Energy Star Ducts. The sum of supply and return leakage measured at 25 Pascals of pressure shall be no more than 10% of the measured system airflow . (Example: With a measured 1200 CFM system airflow, the total duct leakage may not exceed 120 CFM25.)	Refer to BPI standards for duct leakage and airflow testing methods	Refer to BPI standards for duct leakage and airflow testing methods



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<b>4</b>	<b>Service and Repair</b>				
4.1.1	Service	Duct Systems	Sheet metal and flexible ductwork shall be mechanically fastened and sealed at all connections. Sealing shall use duct mastic or similar product designed for sealing ducts. Duct tape is not an allowable duct sealing material. UL standard (UL 181, UL 181A, or UL 181B) duct tape may be used only at the plenum connection to the air handler cabinet.	NA	Duct mastic, mesh tape, UL 181 compliant tape
4.1.2	Service	Duct Systems	Filter slots must be tightly covered and the cover must be easily removed for cleaning and/or replacement.	NA	Field manufactured covers can meet this standard. Tapes and other non-permanent devices do not meet the standard.



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4.2.1	Service	Refrigerant	Refrigerant charge may not be added to a system with leaks. If refrigerant was previously added and unit has undercharge, the system must be tested for leaks following established protocols for leak detection. Leaks must be repaired or the client must be informed that the system cannot be charged.	Manufacturer's specifications	P/T charts, P/T gauges appropriate to the refrigerant being used, charging equipment, leak detecting equipment
4.2.2	Service	Refrigerant	Refrigerant charge corrections must be verified using the appropriate charge measurement method (superheat or sub-cooling) Air conditioner or heat pump airflow must be within the design parameters of the manufacturer's specifications with a minimum of 325 CFM/Ton before proceeding with refrigerant charge corrections based on the results of the appropriate charging tests. If airflow adjustments are made the refrigerant charge test must be rerun.	Manufacturer's Specifications	P/T charts, P/T gauges appropriate to the refrigerant being used



MODULE	CATEGORY	STANDARD	METHOD OR TECHNIQUE	SPECIAL MATERIALS OR EQUIPMENT	
4.3.1	Service	Airflow	System airflow must be measured and <ul style="list-style-type: none"> <li>Measured heat pump airflow should be between 375-450 CFM/Ton, or within manufacturer's specifications when measured over a dry coil (<i>i.e.</i> tested in heating mode.)</li> <li>Measured air conditioner airflow should be at least 350 CFM/Ton unless the manufacturer specifies a lower airflow for the local design condition, when measured over a wet coil (<i>i.e.</i> tested in cooling mode after a minimum of 15 minutes of run time.).</li> </ul>	Refer to BPI standards for airflow testing methods (5.2.1)	Refer to BPI standards for airflow testing methods (5.2.1)
4.3.2	Service	Airflow	For existing systems: The contractor must attempt to bring the airflow within the ranges set in 4.3.1 by opening registers, opening dampers, changing blower speed, replacing filters, and removing obvious easily repaired kinks in flex duct systems. If the above repairs do not bring the unit into compliance, the contractor shall inform the customer that indoor coil cleaning or duct system revisions are necessary.	Refer to BPI standards for new installations for acceptable airflow limits; manufacturer's specifications	Manufacturer's specifications



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4.3.4	Service	Airflow	If repairs are made that effect airflow, the system airflow shall be measured before and after repairs are completed.	Refer to BPI standard (5.2.1) for airflow testing	Refer to BPI standard 5.2.1



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<b>5</b>	<b>Diagnostic Tests</b>				
5.1.1	Diagnostic Tests	Electrical	Existing wiring systems must be inspected for safe installation and compliance with applicable codes. This inspection should include, but is not limited to: <ul style="list-style-type: none"> <li>• Checking for obvious loose connections</li> <li>• Visual inspection of contactor contacts to verify good condition (no pitting, etc.)</li> <li>• Properly sized wire gauge as required by the circuit amp draw</li> </ul>	NEC, state, and local electrical codes	NA
5.1.2	Diagnostic Tests	Electrical	Voltage drop across contacts and relays may not occur. If a voltage drop is measured, the source must be located and corrected.	NA	Voltmeter
5.2.1	Diagnostic Tests	Airflow	System airflow may be measured using a metered and calibrated pressurization device, a metered and calibrated flow plate, or a flow capture hood designed for the flow range anticipated.	Refer to product manufacturer's instructions for proper diagnostic applications.	Duct Blaster™ (or equivalent), Flow Grid™ (or equivalent), or low-flow flow capture hood
5.3.1	Diagnostic Tests	Duct Systems	Pre- and Post-installation duct leakage shall be measured any time that duct sealing is part of the work-scope to verify the success of the installation.	Refer to BPI standards for duct leakage testing methods.	Refer to BPI standards for duct leakage testing methods.

Comment [JP2]: I think this should go in the service section

Comment [JP3]: I think this should go in the service section



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5.3.2	Diagnostic Tests	Duct Systems	When quantifying duct leakage, a measurement system that includes a metered and calibrated duct pressurization device shall be used.	Duct Blaster™ total leakage test (or equivalent method); refer to BPI standards for approved system airflow measurement methods	Duct Blaster™ (or equivalent testing device)
5.4.1	Diagnostic Tests	Refrigerant	Refrigerant charge may be measured using the following methods: <ul style="list-style-type: none"> <li>• Use sub-cooling method for TXV equipped systems</li> <li>• Use superheat method for non-TXV equipped systems</li> </ul> (Alternative manufacturer-specific procedures may be allowable. Submit alternative procedures to BPI for review and approval.) If airflow is changed, the refrigerant charge must be retested.	Use super-heat method for non-TXV systems.  Use sub-cooling method for TXV systems.	Temperature gauge and thermocouples to measure wet and dry bulb temperatures, P/T gauges appropriate to refrigerant being used, P/T charts, manufacturer's instructions

