AC & Heat Pump Professional

TESTING KNOWLEDGE LIST

THE SYMBOL OF EXCELLENCE FOR HOME PERFORMANCE CONTRACTORS

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1. AC & Heat Pump Testing Knowledge List

1.1 Building Science

1. Basic Terms & Definitions
    1. Airflow in buildings/ducts: CFM, CFM50, CFM 25, ACHn, ACH50
    2. Combustion efficiencies: AFUE, SSE
    3. Heat pump efficiencies: SEER, HSPF
    4. Room air-conditioner efficiency: EER
    5. Alternating/Direct Current
    6. AFUE
    7. SEER/EER
    8. Heat Transfer: Conduction, Convection, Radiation
    9. HSPF
    10. Carbon Monoxide (CO)
    11. Effective leakage area
    12. FPM (feet per minute)
    13. Area weighted R-value
    14. Spillage/Backdrafting
    15. Baseload/Seasonal Energy Consumption
    16. British thermal unit (BTU), BTU per hour (BTU/hr, BTUH)
    17. Condensation/condensate
    18. Sones
    19. Pressure differential
    20. Temperature differential
    21. Efficiency
    22. Emissivity
    23. Watt-hour/Watt
    24. R-Value and U-Value
    25. Ton of refrigeration
    26. Entrainment
    27. Total equivalent length
    28. Dehumidification/Humidification
    29. Inches of Water Column (iwc)/Pascals (Pa)
    30. Internal gains
    31. Hydrostatic pressure
    32. Whole-house ventilation: natural and mechanical
    33. Net free area
    34. Input capacity/Output capacity
    35. Equipment efficiency descriptors

36. Peak Electrical Demand
37. Permeability and perm rating
38. Vapor barriers/retarders
39. Building ventilation
40. Solar gain
41. IAQ (indoor air quality)
42. IEQ (indoor environmental quality)
43. Psychrometrics
44. Vented/Unvented combustion appliance
45. Atmospheric/Fan-assisted draft
46. Sealed/Open Combustion
47. Upflow/Downflow/Counterflow
48. Sensible/Latent Heat
49. Static Pressure Drop, Total External Static Pressure
50. Refrigerant
51. Superheat
52. Subcooling
53. psia
54. psig
55. Thermostatic Expansion Valve

1.2 AC or Heat Pump Systems and their interaction with other Building Systems

1. Principles of Energy, Air & Moisture
    1. Thermodynamics
    2. Factors that affect insulation performance
    3. Wind-driven house pressurization/depressurization
    4. Natural and Mechanical driving forces of infiltration/exfiltration
    5. Heat gain/loss
    6. BTU content of fuels
    7. Moisture transport mechanisms
    8. Principles of combustion
    9. Principles of refrigeration

2. Combustion Science
    1. Combustion products: Carbon dioxide (CO2), Carbon Monoxide (CO), Water Vapor (H2O)
    2. Oxygen (O2), Combustion air
    3. Sulfur dioxide (SO2)
    4. Combustion process
    5. Combustion air
    6. Combustion appliance zone (CAZ)
    7. Spillage/Backdrafting

8. Draft: Overfire/Chimney
9. Combustion appliance venting
10. Causes of CAZ depressurization
11. Worse Case Depressurization Test
12. Combustion Analysis
13. Steady State Efficiency
14. Effect of fuel overpressure/underpressure

3. Building Components
    1. Duct configurations and components
    2. Structural components of residential construction
    3. Thermal Boundaries and insulation applications
    4. Electrical components and safety considerations
    5. Refrigerant delivery systems and safety considerations
    6. Condensate system components and safety considerations
    7. Bulk water management components (drainage, plumbing, gutters, sumps, etc)
    8. Vapor barriers/retarders
    9. Radiant barrier principles and installations
    10. Understand/recognize heat and energy recovery ventilators
    11. Understand fenestration types and efficiencies
    12. Understand issues involved with basements, crawlspaces, and slabs
    13. Understand issues involved with conditioned space
    14. Understand issues involved with attics
    15. Understand issues involved with attached garages
    16. Understand issues involved with interstitial building cavities and bypasses
    17. Understand issues involved with ventilation equipment
    18. Understand basic heating equipment components, controls, and operation
    19. Understand basic DHW equipment components, controls and operation
    20. Identify common mechanical safety controls
    21. Identify insulation types and R-Values
    22. Understand various mechanical ventilation equipment and strategies

4. Conservation Strategies
    1. Understand appropriate applications for fenestration upgrades including modifications or replacement
    2. Understand appropriate insulation and air sealing opportunities for upgrades based on existing conditions
    3. Opportunity for ENERGY STAR lighting and appliances
    4. Identify duct sealing opportunities and applications
    5. Understand importance of air leakage control and remediation procedures
    6. Understand importance of air leakage control in conjunction with insulation performance / improvements
    7. DHW conservation strategies
    8. Heating & cooling efficiency applications

9. Proper Use of available resources to determine heating and cooling equipment sizing distribution system sizing
10. Appropriate application of insulation on the duct/pipe distribution system
11. Appropriate applications for sealed crawlspaces, basements and attics

5. Comprehensive Building Assessment Process
    1. Understand/recognize areas/topic of customer complaints to determine in interview
    2. Understand/recognize need for conducting appropriate diagnostic procedures
    3. Interaction between mechanical systems, envelope systems, and occupant behavior
    4. Understand basic mathematics and science

6. Subject Area – Design Considerations
    1. Appropriate insulation applications based on existing conditions
    2. Understand/recognize building locations where non-flammable materials must be used
    3. Understand/recognize building locations where opportunities for retrofit materials and processes are available
    4. Understand climate specific concerns
    5. Understand indoor environment considerations for the environmentally sensitive
    6. Understand impact of building orientation
    7. Understand impact of shading on loads
    8. Awareness for solar gain reduction in cooling climate
    9. Awareness for solar gain opportunities in heating climate
    10. Appropriate applications for sealed crawlspaces, basements and attics
    11. Determine basement air-sealing strategy dependent on the need for combustion air
    12. Interpretation and application of blower door test results

1.3 Measurement and Verification of Building Performance

1. Applied Diagnostics & Troubleshooting
    1. Application of measured air leakage test results
    2. Apply fundamental construction mathematics and unit conversions
    3. Measurement of wet/dry bulb temperatures
    4. Refrigerant charge analysis using superheat or subcooling method based on metering device
    5. Measurement of liquid/suction line temperatures
    6. Proper application for weighting in refrigerant change
    7. System capacity calculation
    8. Calculation of target superheat/subcooling
    9. Determine appropriate total system airflow
    10. Procedures for properly evacuating refrigerant system and determining integrity of the system with a vacuum test

11. Non condensable/mixed refrigerant test
12. Cleaning up a system that has been contaminated
13. Measurement and verification of no voltage drop across contacts
14. Measurement techniques for determining pressure drops across various refrigeration system components
15. Refrigerant cycle diagnostics
16. TXV Metering diagnostics
17. Proper methods for identifying/testing fuel leaks
18. Psychrometric evaluation
19. Spillage evaluation
20. Working knowledge of proper vent design and components
21. Draft testing
22. Blower door measurements
23. Duct leakage testing (total leakage and leakage to outside)
24. Pressure pan testing
25. CAZ depressurization
26. Carbon Monoxide measurements
27. Basic pressure diagnostic procedures including understanding "with respect to" (WRT)
28. Recognize contributing factors to performance/reliability/durability problems
29. Recognize contributing factors to efficiency problems
30. Combustion gas analysis and data interpretation/application
31. Measure and verify temperature rise/drop interpret results and apply corrective actions
32. Inspect for areas containing moisture or bulk water in undesirable locations
33. Check for proper duct system balance
34. Measure and verify individual register airflow and compare to design specifications
35. Coil inspection and appropriate actions
36. Determine fan cycle settings and sequence of operation
37. Visual evaluation of the distribution system
38. Ensure proper polarity and grounding of the heating system
39. Understand and inspect for basic safety
40. Understand and inspect vent/chimney applications

2. Tools and Equipment
    1. Proper applications and use of temperature measuring devices
    2. Appropriate equipment for identification of air distribution
    3. Proper applications and use of blower door equipment
    4. Fuel leak detection
    5. Proper application and use of carbon monoxide analyzer
    6. Methods of duct leakage testing and equipment
    7. Proper application and use of a pressure differential measuring device
    8. Proper application and use of refrigerant gauges

9. Proper application and use of pressure and temperature charts

1.4 BPI National Standards and Project Specifications

1. Comprehensive Building Assessment
    1. Understand applicability content and intent of BPI National Standards
    2. Understand applicability and intent of local/state/national
    3. Understand applicability and intent of industry good/best practices
    4. Understand applicability and intent of Home Performance with ENERGY STAR
    5. Understand hazards associated with knob and tube wiring and be able to determine if it is live using basic electrical inspection techniques

1.5 Optimizing the Installation, Operation, and Maintenance of Building Systems

1. Comprehensive Building Assessment
    1. Recognize need for airsealing measures and their impact on other building systems
    2. Recognize need for mechanical equipment improvements
    3. Understand blower door use for identifying critical air sealing areas
    4. Apply blower door test results and Building Tightness Limit (minimum ventilation requirements) in development of improvement strategies
    5. Understand needs for protective shielding and baffling for the preparation of insulation installation
    6. Verify installed airflow rates of ventilation devices
    7. Test and balance a supply/return ventilation system for optimal performance
    8. Apply appropriate strategies for assuring a thermal barrier/air barrier alignment occurs
    9. Working knowledge of various types of insulation and air sealing techniques and materials
    10. Using combustion safety testing results for appropriate actions
    11. Understand the impact on load associated with lighting and appliance retrofits

2. Appliances and Lighting
    1. Understand impact on load associated with lighting and appliance retrofits

1.6 Professional Ethics, Conduct & Communications

1. Conservation Strategies
    1. Present options for comprehensive conservation strategies that are consistent with sound building science practices
    2. Understand the implications of building performance improvements on occupants and other building systems/components
    3. Understand the implications of adding insulation without airsealing

4. Understand the impact of installed actions on cost benefit analysis guidance
5. Understand the non energy benefits of building performance improvements

2. Comprehensive Building Assessment
    1. Elements of effective oral communication with customer
    2. Elements of a documentation system
    3. Elements of effective written communication with customer

2. Standards of Reference

All BPI exams are based on a mixture of industry practices, axiomatic[1] concepts, and major standards of references. No singular source exists that could touch upon every aspect for what is considered testable. Conversely, there is no limit to the potential useful material found in print and online.

AC & Heat Pump

- ANSI/BPI-1200-S-2015 Standard Practice for Basic Analysis of Buildings
- Technical Standards for the AC & Heat Pump Professional

3. Contact Information

If you have any questions, comments, or concerns regarding the testing knowledge list please contact BPI's Certification Development department at certdev@bpi.org.

[1] An axiomatic concept is something implicit that requires no proof or explanation (e.g. – the sum of 2 and 2 is 4, or gravity states that if you drop something, it will fall to a lower level.