Scope, Job Analysis, and Exam Specification

for the

Testing, Adjusting, and Balancing Certifications

Document Version Control Table

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Exam Specification (Placeholder)

TABB Technician*

		*Passing Score:				TBD
	Domain Weight	Exam Items				
		Range			Unscored	
Domains	(%)	Min	Max	Scored	(Beta)	Total
1. Heat Flow	15					
2. Fans, Air Distribution, Devices & Systems	20					
3. Hydronic Equipment & Systems	15					
4. Electrical Systems	10					
5. Air System TAB Procedures	25					
6. Hydronic System TAB Procedures	15					
Total:	**100**					

TABB Supervisor*

		*Passing Score:				TBD
	Domain Weight	Exam Items				
		Range			Unscored	
Domains	(%)	Min	Max	Scored	(Beta)	Total
1. Heat Flow	15					
2. Fans, Air Distribution, Devices & Systems	25					
3. Hydronic Equipment & Systems	15					
4. Electrical Systems	10					
5. Air System TAB Procedures	20					
6. Hydronic System TAB Procedures	15					
Total:	**100**					

*Once beta testing is complete, analysis performed, and approved by technical committee and ICB Board, the passing score and other relevant information will be updated in this Section.

TABB Technician

Certification Exam

The certification written exam consists of 100 total items – ____ are scored; ____ are unscored (beta) to evaluate for possible inclusion on future exam versions. __ of __ is required for passing.

Scope of Certification

The TABB Technician is responsible for performing testing, adjusting, and balancing air and hydronic building environmental systems, which includes knowledge of heat flow dynamics, fan operations, air distribution components, electrical systems, hydronic flow dynamics, as well as proficiency in air TAB procedures and hydronic TAB procedures.

Guiding Documents

1. The TABB Technician is knowledgeable of:
    a. SMACNA HVAC Systems Testing Adjusting and Balancing Manual – Fourth Edition 2023
    b. SMACNA HVAC Systems Application – Second Edition 2010
    c. SMACNA HVAC Air Duct Leakage Test Manual - Second Edition 2012

Test Blueprint

The TABB Technician must be proficient in all categories of this Section, as demonstrated by passing a written and practical exam.

I. **Heat Flow (15% of exam)**
    a. Units of measurement
        i. Convert between temperature scales (e.g., Celsius, Fahrenheit, Kelvin, Rankine) and understand when conversion is appropriate to/from each scale.
    b. Heat Transfer
        i. Identify the different methods of heat transfer and how they are impacted by different variables.
        ii. Calculating heat given the variables of the situation.
        iii. Demonstrate understanding of R values and the impact on heat transfer through a medium or object.
        iv. Demonstrate understanding of how to calculate latent heat changes and its impact on capacity, temperature change, and humidity in a system.
        v. Demonstrate understanding of how to calculate sensible heat changes and its impact on capacity and temperature change in a system.
        vi. Demonstrate the ability to conduct a heat balance flow determination (e.g., 1st Law of Thermodynamics).
    c. Equipment heat flow
        i. Demonstrate the ability to calculate sensible and total heat in BTUs.
        ii. Convert between BTUs to other units of measurement (e.g., tonnage, Watts).
        iii. Understand the relative relationship between heat flow calculations.
    d. Refrigeration systems
        i. Demonstrate the ability to identify and explain the impact of heat, pressure, and volume differences in a system (e.g., 2nd Law of Thermodynamics).
        ii. Demonstrate understanding of the refrigeration cycle by identifying and explaining the purpose of its components.
    e. Psychrometrics
        i. Define the major properties of air.
        ii. Understand how temperature and moisture impact on the mixing of two airstreams.
        iii. Demonstrate understanding of the use of a psychrometric chart to determine relative

humidity, enthalpy, or dew point.

II. **Fans, Air Distribution, Devices, & Systems (20% of exam)**
    a. Fans
        i. Fan characteristics
            1. Identify the characteristics of different fan types (e.g., centrifugal, axial, special designs).
            2. Identify the components of different fan types (e.g., centrifugal, axial, special designs).
            3. Identify the applications of different fan types (e.g., centrifugal, axial, special designs).
        ii. Fan construction
            1. Demonstrate understanding of the different classes of fan construction by interpreting a fan chart.
            2. Demonstrate understanding of belt driven equipment by calculating drive changes.
            3. Calculate fan tip speed given the appropriate variables.
            4. Calculate brake horsepower given the appropriate variables (e.g., fan law 3, fan static efficiency).
        iii. Fan airflow & pressures
            1. Recognize and define static pressure.
            2. Recognize and define velocity pressure.
            3. Recognize and define total pressure.
            4. Demonstrate understanding of the relationships between the components of pressure and be able to calculate values based on those relationships.
        iv. Fan/system curve relationship
            1. Demonstrate proficiency in the use of fan laws.
            2. Plot operating points on a fan curve.
        v. Fan capacity ratings
            1. Identify conditions that impact system effect variables based on fan Installation vs. design intent.
            2. Determine total fan volume based on readings taken.
            3. Demonstrate understanding of fan inlet and outlet installations by recognizing proper installation and recommended criteria, and how it relates to field measurements (e.g., SMACNA).
    b. Air Distribution
        i. Air system components
            1. Identify the construction and operation characteristics of all terminal boxes.
            2. Identify the construction and operation characteristics of other airflow devices (e.g., volume dampers, variable volume outlets, chill beams).
        ii. Room air distribution
            1. Identify various factors of air distribution devices and their performance (e.g., registers).
    c. Air Systems
        i. Types of air systems
            1. identify different air systems based on schematics and components.
        ii. Air System Design
            1. Apply air system knowledge to review installation (e.g., pressure class).
            2. Determine the performance expectations of a system (e.g., fan operation, duct sizing).
            3. Demonstrate the ability to correctly call out basic design deficiencies relating to the system design (e.g., inlet size, noise, velocity).

III. **Hydronic Equipment & Systems (15% of exam)**

a. Hydronic Equipment
    i. Pumps
        1. Identify the characteristics of different pump types and hydronic components (e.g., circulator, closed coupled end, end suction, vertical in-line).
        2. Identify the components of different pump types and hydronic components (e.g., circulator, closed coupled end, end suction, vertical in-line).
        3. Identify the applications of different pump types and hydronic components (e.g., circulator, closed coupled end, end suction, vertical in-line).
    ii. Pump/Systems curve relationships
        1. Demonstrate proficiency in the use of pump laws.
        2. Plot operating points on a system curve (e.g., zero flow (block tight) test, full open flow).
        3. Describe common hydronic system factors (e.g., static suction lift, total dynamic head, NPSH, vortex, pump configurations).
        4. Calculate brake horsepower given the appropriate variables (e.g., pump law 3, pump efficiency).
    iii. Pump installation criteria
        1. Demonstrate understanding of pump inlet and outlet installations by recognizing proper installation and recommended criteria, and how it relates to field measurements (e.g., SMACNA).
    iv. Hydronic heating and cooling components
        1. Identify and describe the characteristics and components of various heating and cooling systems (e.g., boilers, chillers, heat exchangers, heat pumps, towers).
    v. Hydronic Systems
        1. Describe common hydronic systems and their piping arrangements (e.g., two pipe, three pipe, four pipe, direct return, reverse return, open and closed loop).

IV. **Electrical Systems (10% of exam)**
a. Electrical services
    i. Demonstrate a basic understanding of electrical systems as they apply to mechanical systems by using basic formulas and variables (e.g., Ohm's law).
    ii. Identify electrical services and components (e.g., single phase, three phase, transformers, voltage).
b. Motors
    i. Calculate motor performance given electrical readings and nameplate data (e.g., brake horsepower).
    ii. Identify motor control strategies and understand their characteristics and appropriate use (e.g., variable frequency drives, safeties, motor starters, electrically commuted motors).
c. Selection of instruments
    i. Apply knowledge of instrumentation and field application to select the correct instrument for assigned tasks.

V. **Air System TAB Procedures (25% of exam)**
a. Basic testing procedures
    i. Locate and assess the project documentation as it relates to the TAB scope.
b. Fan & system testing
    i. Gather all preliminary fan performance data (e.g., nameplate data, sheave, motor data, amps, volts, belt sizes).
    ii. Identify the appropriate option to measure a fan system and defend their selection of

methods.

c. Analysis of measurements
    i. Compare collected data to design intent of a system to identify discrepancies and determine appropriate adjustments.
    ii. Recognizes deficiencies in performance from design intent and makes recommendations for modifications to the system.
d. Air system balancing procedures
    i. Apply procedures and methods of balancing techniques for air systems including:
        1. Return & outside air settings.
        2. Stepwise method.
        3. Proportional balancing (ratio) method.
        4. Percentage of airflow design.
        5. Adjustments (e.g., fans, motors, dampers).
e. Specific balancing procedures
    i. Apply procedures and methods of balancing techniques for specific air systems including:
        1. Variable Air Volume (VAV) systems.
        2. Multi-zone systems.
        3. Induction unit systems.
        4. Dual duct systems.
        5. Systems with diversity.
f. Duct leakage testing
    i. Demonstrate the steps and procedures of duct leak testing according to the SMACNA leakage testing method.
    ii. Determine the test parameters, perform the calculations, and analyze the field results.
g. Selection of instruments
    i. Apply knowledge of instrumentation and field application to select the correct instrument for assigned tasks.

VI. **Hydronic System TAB Procedures (15% of exam)**

a. Hydronic systems measurement methods
    i. Selection of instruments
        1. Apply knowledge of instrumentation and field application to select the correct instrument for assigned tasks.
    ii. Hydronic system balancing procedures
        1. The candidate will apply procedures and methods of balancing techniques for hydronic systems including:
            - Two-pipe.
            - Three-pipe.
            - Four-pipe.
            - Direct return.
            - Reverse return.
            - Hot water heating.
            - Chilled water.
            - Condenser water.
            - Variable flow system.
            - Constant volume.

TABB Supervisor

Prerequisites

In addition to the eligibility requirements in Section 3.2 of this manual, the TABB Supervisor must meet one of the following criteria:

I. Hold a college/university degree in engineering with at least one year of experience in HVAC installation or design work,
II. Hold a two-year associate degree in HVAC with at least three years of experience in HVAC installation or design work,
III. Hold an ICB-certified TABB Technician certification with five or more years of experience in HVAC installation or design work (which may include apprenticeship), at least one of which must include testing, adjusting, and balancing (TAB) work, or
IV. Have at least three years' experience in TAB work and is recommended in writing for the exam by the applicant's employer. The applicant's employer must be an ICB-certified Contractor or be eligible to be an ICB-certified Contractor except only for the requirements to employ an ICB-certified Technician and/or an ICB-certified Supervisor.
V.

Certification Exam

The certification exam consists of 100 total items – ____ are scored; ____ are unscored (beta) to evaluate for possible inclusion on future exam versions. __ of __ is required for passing.

Scope of Certification

The TABB Supervisor oversees and coordinates the work of the TABB Technician and is knowledgeable of heat flow dynamics, fan operations, air distribution components, electrical systems, hydronic flow dynamics, as well as proficiency in air TAB procedures and hydronic TAB procedures. The TABB Supervisor also prepares the final report to ensure it includes all information required by the contract documents.

Guiding Documents

I. The TABB Supervisor is knowledgeable of:
    a. SMACNA HVAC Systems Testing Adjusting and Balancing Manual – Fourth Edition 2023
    b. SMACNA HVAC Systems Application – Second Edition 2010
    c. SMACNA HVAC Air Duct Leakage Test Manual - Second Edition 2012
    d. SMACNA HVAC Systems Duct Design – Fifth Edition 2023

Test Blueprint

The TABB Supervisor is expected to be knowledgeable and capable in the knowledge base outlined below. Each candidate seeking TABB Supervisor certification is expected to be knowledgeable in all areas for which the supervisor will have testing, adjusting, and balancing review and oversight responsibilities.

The TABB Supervisor should assure that the entire system has been tested, adjusted, and balanced within tolerances of the specifications, subject to the limitations of the installed HVAC system, and that all data submitted is accurate, using the most appropriate procedures that will result in the least possible resistance imposed on the balanced system.

I. **Heat Flow (15% of exam)**
    a. Heat Transfer
        i. Identify the different methods of heat transfer and how they are impacted by different variables.
        ii. Calculate heat given the variables of the situation.
        iii. Demonstrate understanding of R values and the impact on heat transfer through a medium or object.

iv. Demonstrate understanding of how to calculate latent heat changes and its impact on capacity, temperature change, and humidity in a system.
v. Demonstrate understanding of how to calculate sensible heat changes and its impact on capacity and temperature change in a system.
vi. Demonstrate the ability to conduct a heat balance flow determination (e.g., 1st Law of Thermodynamics).

b. Equipment heat flow
   i. Demonstrate the ability to calculate sensible and total heat in BTUs.
   ii. Convert between BTUs to other units of measurement (e.g., tonnage, Watts).
   iii. Understand the relative relationship between heat flow calculations.

c. Refrigeration systems
   i. Demonstrate the ability to identify and explain the impact of heat, pressure, and volume differences in a system (e.g., 2nd Law of Thermodynamics).
   ii. Demonstrate understanding of the refrigeration cycle by identifying and explaining the purpose of its components.

d. Steam systems
   i. Demonstrate understanding of the steam system by identifying and explaining the purpose of its components.

e. Psychrometrics
   i. Define the major properties of air, and how they apply to the overall heat transfer cycle.
   ii. Understand how temperature and moisture impact on the mixing of two airstreams.
   iii. Demonstrate understanding of all values on the psychrometric chart, and how they can be applied to calculate needed values (i.e., sensible, latent, and combination.)

II. **Fans, Air Distribution, Devices, & Systems (20% of exam)**

a. Fans
   i. Fan characteristics
      1. Identify the characteristics of different fan types (e.g., centrifugal, axial, special designs).
      2. Identify the components of different fan types (e.g., centrifugal, axial, special designs).
      3. Identify the applications and limitations of different fan types (e.g., centrifugal, axial, special designs).
   ii. Fan construction
      1. Demonstrate proficiency of the different classes of fan construction by interpreting a fan chart.
      2. Demonstrate proficiency of belt driven equipment by calculating drive changes.
      3. Calculate fan tip speed given the appropriate variables.
      4. Calculate brake horsepower given the appropriate variables and evaluate it against performance curves (e.g., fan law 3, fan static efficiency).
   iii. Fan airflow & pressures
      1. Recognize, define, and analyze static pressure.
      2. Recognize, define, and analyze velocity pressure.
      3. Recognize, define, and analyze total pressure.
      4. Demonstrate proficiency of the relationships between the components of pressure and be able to calculate values based on those relationships.
   iv. Fan/system curve relationship
      1. Demonstrate proficiency in the use of fan laws.
      2. Plot operating points on a fan curve and determine operating characteristics vs. system design.
      3. Plot a system curve by using measurement of static pressure and airflow.

v. Fan capacity ratings
    1. Demonstrate an understanding of the engineering selection of fans by evaluating external static pressure or total static pressure and design (i.e., TFP, CFM).
    2. Calculate the impact of nonproper installation by using system effect factors.
    3. Identify conditions that impact system effect variables based on fan installation vs. design intent.
    4. Determine total fan volume based on readings taken.
        1. Demonstrate understanding of fan inlet and outlet installations by recognizing proper installation and recommended criteria, and how it relates to field measurements (e.g., SMACNA).

b. Air Distribution
    i. Air system components
        1. Analyze the construction and operation characteristics of all terminal boxes, recognize improper applications, and generate recommendations for remediation.
        2. Analyze the construction and operation characteristics of other airflow devices (e.g., volume dampers, variable volume outlets, chill beams).
    ii. Room air distribution
        1. Analyze various factors of air distribution devices and their performance, recognize improper applications, and generate recommendations for remediation (e.g., registers).

c. Air Systems
    i. Analyze different air systems based on schematics and components, recognize improper applications, and generate recommendations for remediation.

d. Air System Design
    i. Use common design practices to apply air system knowledge to review installation (e.g., pressure class).
    ii. Analyze the performance expectations of a system to determine that it is capable of being adjusted to the design intent (e.g., duct sizing, dampers).
    iii. Demonstrate the ability to analyze design deficiencies relating to the system design, recognize improper applications, and generate recommendations for remediation (e.g., inlet size, noise, velocity).

III. **Hydronic Equipment & Systems (15% of exam)**
a. Hydronic Equipment
    i. Pumps
        1. Identify the characteristics of different pump types and hydronic components, recognize improper applications, and generate recommendations for remediation (e.g., circulator, closed coupled end, end suction, vertical in-line).
        2. Identify the components of different pump types and hydronic components, recognize improper applications, and generate recommendations for remediation (e.g., circulator, closed coupled end, end suction, vertical in-line).
        3. Identify the applications of different pump types and hydronic components, recognize improper applications, and generate recommendations for remediation (e.g., circulator, closed coupled end, end suction, vertical in-line).

ii. Pump/Systems curve relationships
    1. Demonstrate proficiency in the use of pump laws.
    2. Plot and analyze operating points on a system curve (e.g., zero flow (block tight) test, full open flow).
    3. Analyze and calculate the effects of common hydronic system factors (e.g., static suction lift, total dynamic head, NPSH, vortex, pump configurations).
    4. Calculate brake horsepower given the appropriate variables and analyze the effects (e.g., pump law 3, pump efficiency).

iii. Pump installation criteria
    1. Demonstrate understanding of pump inlet and outlet installations by recognizing proper installation and recommended criteria, and how it relates to field measurements, and make recommendations for remediation (e.g., SMACNA).

iv. Hydronic heating and cooling components
    1. Identify and describe the characteristics and components of various heating and cooling systems, recognize improper applications, and generate recommendations for remediation (e.g., boilers, chillers, heat exchangers, heat pumps, towers).

v. Hydronic Systems
    1. Describe common hydronic systems and their piping arrangements, recognize improper applications, and generate recommendations for remediation (e.g., two pipe, three pipe, four pipe, direct return, reverse return, open and closed loop).
    2. Demonstrate proficiency in the design concepts of hydronic systems by reviewing provided designs and determining viability of the system to achieve designed intent (e.g., closed loop, open loop, pump selection, pressure drop).

IV. **Electrical Systems (10% of exam)**

a. Electrical services
    i. Demonstrate a proficiency with electrical systems as they apply to mechanical systems by using basic formulas and variables (e.g., Ohm's law).
    ii. Identify electrical services and components and recognize improper applications (e.g., single phase, three phase, transformers, voltage).

b. Motors
    i. Calculate motor performance given electrical readings and nameplate data (e.g., brake horsepower).
    ii. Identify and analyze motor control strategies, and understand their characteristics and appropriate use (e.g., variable frequency drives, safeties, motor starters, electrically commuted motors).

c. Selection of instruments
    i. Apply knowledge of instrumentation and the field application to oversee the selection and use of the correct instrument to meet the specifications for each job.

V. **Air System TAB Procedures (20% of exam)**

a. Fan & system testing
    i. Analyze all preliminary fan performance data to design (e.g., nameplate data, sheave, motor data, amps, volts, belt sizes).
    ii. Identify the appropriate option to measure a fan system and defend their selection of methods.

b. Analysis of measurements
    i. Compare collected data to design intent of a system to identify discrepancies and determine appropriate adjustments.

ii. Recognizes deficiencies in performance from design intent and makes recommendations for modifications to the system.

c. Air system balancing procedures
   i. Apply procedures and methods of balancing techniques for air systems including:
      1. Return & outside air settings.
      2. Stepwise method.
      3. Proportional balancing (ratio) method.
      4. Percentage of airflow design.
      5. Adjustments (e.g., fans, motors, dampers).

d. Specific balancing procedures
   i. Apply procedures and methods of balancing techniques for specific air systems including:
      1. Variable Air Volume (VAV) systems.
      2. Multi-zone systems.
      3. Induction unit systems.
      4. Dual duct systems.
      5. Systems with diversity.
      6. Special/Process exhaust air systems.

e. Duct leakage testing
   i. Demonstrate the steps and procedures of duct leak testing according to the SMACNA leakage testing method.
   ii. Plan and validate the test parameters, perform the calculations, and analyze the field results.

f. Selection of instruments
   i. Apply knowledge of instrumentation and the field application to oversee the selection and use of the correct instrument for each job.

VI. **Hydronic System TAB Procedures (15% of exam)**

a. Hydronic systems measurement methods
   i. Selection of instruments
      1. Apply knowledge of instrumentation and field applications to oversee the selection and use of the correct instrument to meet the specifications for each job.
   ii. Hydronic system balancing procedures
      1. The candidate will generate procedures and methods of balancing techniques for hydronic systems including:
         - Two-pipe.
         - Three-pipe.
         - Four-pipe.
         - Direct return.
         - Reverse return.
         - Hot water heating.
         - Chilled water.
         - Condenser water.
         - Variable flow system.
         - Constant volume.

b. Analysis of measurements
   i. Compare collected data to design intent of a system to identify discrepancies and determine appropriate adjustments.
   ii. Recognizes deficiencies in performance from design intent and makes recommendations for modifications to the system.