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USACE / NAVFAC / AFCESA / NASA **UFGS-23 08 00.00 20 (July 2007)**

Preparing Activity: NAVFAC **Superseding UFGS-23 08 00.00 20 (April 2007)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 19 March 2007

Latest change indicated by CHG tags
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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HVAC TESTING/ADJUSTING/BALANCING

07/07

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SECTION 23 08 00.00 20

HVAC TESTING/ADJUSTING/BALANCING
07/07

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NOTE: This guide specification covers the requirements for testing, adjusting, and balancing (TAB) of heating, ventilating, and cooling (HVAC) air and water distribution systems.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).
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NOTE: Following information shall be shown on project drawings:

1. A unique number or mark for each piece of equipment or terminal.

2. Air quantities at air terminals.

3. Air quantities and temperatures in air handling unit schedules.

4. Water quantities and temperatures in thermal energy transfer equipment schedules.

5. Water quantities and heads in pump schedules.

6. Water flow measurement fittings and balancing fittings.

7. Ductwork Construction and Leakage Testing Table which tabulates the duct seal requirements and duct leakage allowances for a given duct pressure class. This table is included in the file for Graphics for Unified Facilities Guide Specifications.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 203	(1990) Field Performance Measurements of Fan Systems

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.11	(2004) Octave- Band and Fractional-Octave-Band Analog and Digital Filters (ASA 65)
ANSI S1.4	(1983; R 2006) Sound Level Meters (ASA 47)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE HA IP	(2003) HVAC Applications Handbook, I-P

	Edition
ASHRAE HA SI	(2003) HVAC Applications Handbook, SI Edition

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002) National Standards for Total System Balance
AABC MN-4	(1996) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	(2006) Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB TABES	(2005) Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVACTAB	(2002, 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing
SMACNA Leakage Test Mnl	(1985, 1st Ed) HVAC Air Duct Leakage Test Manual

1.2 RELATED REQUIREMENTS

Requirements for price breakdown of HVAC TAB work are specified in Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES.

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES.

1.3 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS. The paragraph specifies that all contract requirements of this section shall be accomplished directly by a first tier subcontractor. No work required shall be accomplished by a second tier subcontractor.

1.4 DESCRIPTION OF WORK

The work includes test, adjust, and balance (TAB) of [new and existing] heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

1.4.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems under Section

23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.4.2 Water Distribution Systems

Systems shall be TAB'd in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEM. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd. Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. The ends of pipe insulation and the space between ends of pipe insulation and piping shall be sealed with waterproof vapor barrier coating. After completion of work under this section, the flow control valves and devices shall be insulated under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

[1.4.3 Phasing of Work

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NOTE: In the this paragraph, DALT work is specified. If DALT work is required for a given project, this reference to DALT and many others herein shall be deleted. This is facilitated by brackets locating these references to DALT work.
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This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase[in spite of the fact that there will be two seasons]. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, [and the DALT work,]the TAB work[and DALT work] shall be planned for, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, all approved reports shall be compiled and submitted as one document.

]1.5 DEFINITIONS

[a. DALT: Duct air leakage test

b. DALT'd: Duct air leakage tested]

c. Sound measurements terminology: Defined in AABC MN-1 or NEBB MASV.

d. TAB team supervisor: TAB team engineer.

e. TAB team technician: TAB team assistant.

f. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.

g. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system". An example of a "system" is a supply air handler with its duct system, which is its supply, return, and outside air ducts.

h. Out-of-tolerance data: Pertains only to field checking of [Certified Final DALT]or Certified TAB report. [When applied to DALT work, this phase means "a leakage rate measured during DALT

field checking which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class."] When applied to TAB work this phase means "a measurement taken during TAB field checking which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the certified TAB Report for a specific parameter."

i. Season of maximum heating load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated winter outdoor design dry bulb temperature plus 17.5 to minus 17.5 degrees Celsius plus 30 to minus 30 degrees Fahrenheit.

j. Season of maximum cooling load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated summer outdoor design dry bulb temperature plus 8, minus 3 degrees Celsius plus 15, minus 5 degrees Fahrenheit.

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NOTE: In the case where the winter outdoor design dry bulb temperature and the summer outdoor design dry bulb temperature are within 19.4 degrees C 35 degrees F of each other, the above two seasons requiring TAB work are reduced to one season requiring TAB work. Therefore, in the following specification paragraphs, the phrase "the Season 1" shall be replaced with "the" and all requirements for "Season 2" TAB work shall be deleted.
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1.6 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for

Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

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For LANTNAVFACENGCOM jobs, keep "G" for submittals.

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NOTE: Refer to the paragraph above entitled "Phasing of Work". If this paragraph applies to the construction contract, modify the entire "SUBMITTALS" paragraph by phasing (maybe by repeating the various submittals for each phase) to facilitate the submittal process.

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SD-06 Test Reports

[Pre-final DALT report; G]

[Certified Final DALT report; G]

Certified TAB report for Season 1; G

Certified TAB report for Season 2; G

Submit certified reports in the specified format including the above data.

SD-07 Certificates

Independent TAB agency personnel qualifications; G

[DALT and]TAB Submittal and Work Schedule; G

Design review report; G

[Pre-field DALT preliminary notification; G]

Pre-field TAB engineering report; G

Advanced notice for [Season 1] TAB field work; G

Prerequisite HVAC Work Check Out List [For Season 1]; G

[Advanced notice for Season 2 TAB field work; G]

[Prerequisite HVAC Work Check Out List For Season 2; G]

1.7 [DALT AND]TAB SUBMITTAL AND WORK SCHEDULE

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NOTE: The calendar day requirements specified should apply to many construction projects. However, the specifier, when preparing this paragraph for a specific contract shall review and modify this paragraph to suit the contract construction schedule. Season 1 may be the season of maximum heating load or maximum cooling load, depending upon construction schedule.

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Submit this schedule, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within [45] [_____] calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-[DALT/]TAB Meeting: Within [30] [_____] calendar days after the date of approval of the TAB agency and personnel, meet with the Contracting Officer's TAB representative.

Design Review Report: Within [60] [_____] calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

[Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, the Contractor shall notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the Contracting Officer's TAB representative (COTR) will select which of the project ductwork shall be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, the COTR's DALT field check work shall be scheduled with the Contracting Officer.

Submit Certified Final DALT Report: Within [15] [_____] calendar days after completion of successful DALT Work Field Check, submit certified [Season 1] TAB report.]

Pre-Field TAB Engineering Report: Within [_____] calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List [For Season 1] and Advanced Notice For [Season 1] TAB Field Work: At a minimum of [115] [_____] calendar days prior to CCD, submit [Season 1] prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of [Season 1] TAB field work.

****
NOTE: Choose one of the following options.
****

****
NOTE: Option 1: Normally, use the following four paragraphs, which requires two separate trips within Season 1 to the contract site by the TAB field team (the first for the TAB field work, the second for the TAB quality assurance work) with the certified TAB report submitted between trips. This is intended to give the design engineer time to review the certified TAB report before the field check of that report is conducted.
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[[Season 1] TAB Field Work: At a minimum of [90] [_____] calendar days prior to CCD, [and when the ambient temperature is within Season 1 limits,] accomplish [Season 1] TAB field work.

Submit [Season 1] TAB Report: Within [15] [_____] calendar days after completion of [Season 1] TAB field work, submit certified [Season 1] TAB report.

[Season 1] TAB Field Check: [30] [_____] calendar days after certified Season 1 TAB report is approved by the Contracting Officer, conduct [Season 1] field check.

Complete [Season 1] TAB Work: Prior to CCD, complete all TAB work [except Season 2 TAB work].]

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NOTE: Option 2: Use the following two paragraphs when the contract site is remote or the HVAC system is simple, and the specifier wants to reduce to one the number of trips to the contract site by the TAB field team within Season 1 (TAB field work and TAB quality assurance accomplished in same trip). Renumber remaining paragraphs appropriately.
****

[[Season 1] TAB Field Work: At a minimum of [90] [___] calendar days prior to CCD, [and when the ambient temperature is within Season 1 limits,] accomplish [Season 1] TAB field work; submit [Season 1] certified TAB report; and conduct [Season 1] field check.

Complete [Season 1] TAB Work: Prior to CCD, complete all TAB work [except Season 2 TAB work].]

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NOTE: Include the remaining submittals and items of work only if there is a season 2 TAB Work
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[Prerequisite HVAC Work Check Out List For Season 2 and Advanced Notice For Season 2 TAB Field Work: Within [150] [_____] calendar days after date of the commencement of the Season 1 TAB field work, submit the Season 2 prerequisite HVAC work check out list certified as complete and submit advance notice of commencement of Season 2 TAB field work.]

****
NOTE: Choose one of the following options.
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****
NOTE: Option 1: Normally, use the following four paragraphs, which requires two separate trips within Season 2 to the contract site by the TAB field team (the first for the TAB field work, the second for the TAB quality assurance work) with the certified TAB report submitted between trips. This is intended to give the design engineer time to review the certified TAB report before the field check of that report is conducted.
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[Season 2 TAB Field Work: Within [180] [_____] calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field work.

Submit Season 2 TAB Report: Within [15] [_____] calendar days after completion of Season 2 TAB field work, submit certified Season 2 TAB report.

Season 2 TAB Field Check: [30] [_____] calendar days after the certified Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field check.

Complete Season 2 TAB Work: Within [15] [_____] calendar days after the completion of Season 2 TAB field data check, complete all TAB work.]

****
NOTE: Option 2: Use the following two paragraphs when the contract site is remote, or the HVAC system is simple, and the specifier wants to reduce to one the number of trips to the contract site by the TAB field team within Season 2 (TAB field work and TAB quality assurance accomplished in same trip). Renumber remaining paragraphs appropriately.
****

[Season 2 TAB Field Work: Within [180] [_____] calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish

[Season 2] TAB field work; submit [Season 2] certified TAB report; and conduct Season 2 field check.

Complete Season 2 TAB Work: Within [15] [_____] calendar days after the completion of Season 2 field data check, complete TAB work.]

1.8 QUALITY ASSURANCE

1.8.1 Modifications of References

Accomplish work in accordance with referenced publications of AABC or NEBB except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design Engineer" to mean the "Contracting Officer."

1.8.2 Certificates

1.8.2.1 Independent TAB Agency Personnel Qualifications

For agency proposed for approval, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction.

Submit the following, for the agency, to Contracting Officer for approval in compliance with paragraph entitled "TAB Personnel Qualification Requirements."

a. Independent AABC or NEBB certified TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader shall have satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician shall have satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications shall be current, and valid for the duration of this contract. Certifications which expire prior to completion of the TAB work, shall be renewed in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification shall not perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract shall be full-time employees of the TAB agency. No other personnel shall do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.8.2.2 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

[1.8.2.3 Pre-Field DALT Preliminary Notification

a. Notification: On completion of the installation of each duct system indicated to be DALT'd, the Contractor shall notify the Contracting Officer in writing within 7 calendar days after completion.]

1.8.2.4 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA HVACTAB data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which

instruments the choice will be made. The instrument key number shall be placed in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list shall be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB TABES, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" shall be provided for each separate system to be TAB'd.

1.8.3 Responsibilities

The Contractor shall be responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.8.3.1 Contractor

a. TAB personnel: Ensure that [the DALT work and]the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."

b. Pre-[DALT/]TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support [the DALT and]the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish [the DALT and]the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in [the DALT and]the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, the Contractor shall ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph "Pre-Field TAB Engineering Report" have been completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

[(3) DALT field checks for all systems are completed.]

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for [the commencement of the DALT field work and for]the commencement of the TAB field work.

[j. Insulation work: If DALT work is required, ensure that no insulation is shall not be installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.]

1.8.3.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "Independent TAB Agency Personnel Qualifications". The

work to be performed by the TAB agency shall be limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.8.3.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical [DALT and]TAB procedures and TAB team field work.

b. Pre-[DALT/]TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the [DALT or]TAB field work.

[e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.]

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

[h. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

****
NOTE: The number of workdays for the TAB supervisor's visit to the contract site for DALT work, shall be based on the size, number, type, and complexity of the HVAC system to be DALT'd.
****

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being

implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, sufficient evaluation shall be made to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of [one] [two] [_____] 8 hour workday[s] duration.]

[i. Certified Final DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

(2) Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.]

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

****
NOTE: The number of workdays for the TAB supervisor's visits to the contract work site for TAB work, shall be based on the size, number, type, and complexity of the HVAC system to be TAB'd.
****

****
NOTE: Choose one of the following options.
****

****
NOTE: Option 1: Normally, use the following two subparagraphs, which requires two separate trips within a season to the contract site by the TAB field team (the first for the TAB field work, the second for the TAB quality assurance work) with the certified TAB report submitted between the trips. This is intended to give the design engineer time to review the certified TAB report before the field check of that report is conducted.
****

[(1) TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of [one] [two] [_____] 8 hour workday[s] duration.]

[(2) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of [one] [two] [_____] 8 hour workday[s] duration. Review the TAB final report data and certify the TAB final report.]

****
NOTE: Option 2: Use the following subparagraph when the contract site is remote, or the HVAC system is simple, and the specifier wants to reduce to one the number of trips to the contract site by the TAB field team within a season (TAB field work and TAB

quality assurance accomplished in same trip).
****

[(1) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of [one] [two] [_____] 8 hour workday[s] duration. Review the TAB final report data and certify the TAB final report.]

k. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor shall submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency shall issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor shall attend and supervise [Season 1] [and Season 2] TAB field check.

1.8.3.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when [DALT field work or]TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.8.4 Test Reports

[1.8.4.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA Leakage Test Mnl. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct

tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section. The report shall be reviewed and certified by the TAB supervisor.

b. The TAB supervisor shall include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition, the DALT reports shall contain copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments shall have been calibrated within one year of the date of use in the field. Instrument calibration shall be traceable to the measuring standards of the National Institute of Standards and Technology.

c. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

]1.8.4.2 Certified TAB Reports

Submit Certified TAB Report for Season 1 and Certified TAB Report for Season 2 in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

****
NOTE: The design engineer shall list, in the paragraph below, those rooms, or zones, for which indoor dry bulb and wet bulb temperatures shall be compiled for the specified time duration. Include a sufficient number of rooms, or zones, in the listing to ensure correct evaluation of performance for the installed HVAC systems.
****

(1) [Specifier: List desired rooms and/or zones here]. Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.

(2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the

HVAC systems controls operating in fully automatic mode.

(3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the [Season I TAB Report] [Season I and Season 2 TAB Report].

****
NOTE: Paragraphs c., d., and e., below apply to air distribution systems to be TAB'd. Delete all of these paragraphs if no air distribution systems are in the project, or delete the paragraphs not applicable and edit the terminology of the remaining paragraphs to agree with the drawings.
****

[c. System Diagrams: Provide a system diagram in the TAB report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.]

[d. Static Pressure Profiles: Report static pressure profiles for air duct systems including: [_____]. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in addition to NEBB/AABC required data, the following:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

(4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.]

(5) Report static pressure drop across outside air and

relief/exhaust air louvers.

****
NOTE: Below, delete the period at the end of the sentence and delete the brackets for projects with large air moving systems, i.e., include in the specification the pressure readings in the additional listed duct locations for air moving systems 4720 L/S10000 CFM and larger.
****

(6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.[and also at the following locations:

Main Duct: Take readings at four locations along the full length of the main duct. Locations shall be at 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

Floor Branch Mains: Take readings at floor branch mains served by a main duct vertical riser.

Branch Main Ducts: Take readings at branch main ducts.

VAV Terminals: Take readings at inlet static pressure at VAV terminal box primary air branch ducts.

VAV Terminals, Fan Powered: Take readings at fan discharge and inlet static pressures for series and parallel fan powered VAV terminal boxes.]

****
NOTE: Delete the brackets below for large air moving systems, i.e., include in the specification the duct traverses for the branch mains for air moving systems 4720 L/S10000 CFM and larger.
****

e. Duct Trasverses: Report duct traverses for main [and branch main] supply, return, exhaust, relief and outside air ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with

that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor shall include, in the Certified TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor shall include, in the Certified TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.

1.9 PRE[-DALT/]TAB MEETING

****
NOTE: Inclusion of this meeting requirement in the specification shall be based on the complexity of the HVAC systems and the location of the contract site.
****

Meet with the Contracting Officer's TAB representative [and the designing engineer of the HVAC systems] to develop a mutual understanding relative to the details of the [DALT work and]TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

****
NOTE: It is the designer's decision/responsibility to decide whether, or not, to require duct air leak testing in accordance with this section. Subjecting duct systems to acceptance testing likely results in higher quality ductwork. Only very simple duct systems, such as low velocity ductwork within a single room, do not justify DALT testing. The designer shall indicate on the drawings a duct construction schedule that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. Refer to SMACNA Leakage Test Mnl, Appendix B, "Sample Leakage Analysis" for guidance in determining leakage test pressures.
****

[3.1 DALT PROCEDURES

3.1.1 Instruments and personnel

Provide instruments and consumables required to accomplish the DALT field work. Follow the same basic procedure specified below in paragraph titled

"TAB Field Work," which include maintenance of and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies.

3.1.2 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the Contracting Officer's technical representative (COTR) shall randomly select sections of each completed duct system for testing by the Contractor. The sections selected shall not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT shall include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

3.1.3 Testing

Duct air leak test (DALT) the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA Leakage Test Mnl. Testing shall be in accordance with the procedures specified in SMACNA Leakage Test Mnl, except as supplemented and modified by this section. In spite of specifications of SMACNA Leakage Test Mnl to the contrary, ductwork of construction class of 746 Pa3-inch water gauge static pressure and below shall be DALT'd if indicated to be DALT'd. Complete DALT work on the COTR selected ductwork within 48 hours after the particular ductwork was selected for DALT. DALT work shall be conducted separately for large duct systems to enable the DALT work to be completed in 48 hours.

3.1.4 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Certified Final DALT Report. TAB supervisor's shall review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the Contracting Officer's TAB representative that the field check of the Pre-final DALT Report data can commence.

3.1.5 Quality Assurance - Contracting Officer DALT Field Checks

Field check for accuracy selected Pre-final DALT Report data in the presence of the Contracting Officer's TAB representative (COTR). For each duct system, conduct field checks on 50 percent of the duct sections DALT'd. The TAB team field leader shall be present full-time when DALT field checking is conducted.

3.1.6 Additional Field Checks

If any of the duct sections checked for a given system are determined to be out-of-tolerance, data checking for that section shall be terminated and the associated Pre-final DALT Report data for the given system shall be disapproved. The Contractor shall make the necessary corrections and prepare a revised Pre-final DALT Report. A field check of the revised report data shall then be rescheduled with the Contracting Officer's TAB representative.

Further, if any data on the DALT Pre-final DALT report form for a given

duct section is out-of-tolerance, then data for one additional duct section, preferably in the same duct system, shall be field checked as specified herein. The DALT'd duct section to be field checked shall be in addition to the original 50 percent of duct sections to be field checked.

3.1.7 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, certify and submit the Certified Final DALT Report to the Contracting Officer for approval.

3.1.8 Prerequisite for TAB Field Work

No TAB field work shall commence prior to the completion and approval, for all systems, of the Certified Final DALT Report.

]3.2 TAB PROCEDURES

3.2.1 TAB Field Work

****
NOTE: For those projects having only a single certified TAB report, delete the last sentence of the following paragraph.
****

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Conduct TAB work, including maintenance and calibration of instruments, measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES, and NEBB MASV, except as supplemented and modified by this section. Provide instruments and consumables required to accomplish the TAB work.

Air systems and water systems shall be proportionately balanced and reported in the [Season 1] certified TAB report. [The only water flow and air flow reporting which can be deferred until the Season 2 will be that data which would be affected in terms of accuracy due to outside ambient conditions].

3.2.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. Test ports required for testing by the TAB engineer shall be located in the field by the TAB engineer during TAB field work. It shall be the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

[3.2.3 TAB Air Distribution Systems

****
NOTE: Specifier shall edit, delete, and add to the paragraphs below to ensure that air distribution systems indicated on project drawings are listed for TAB work. Specifier shall explicitly identify new and existing systems and components which are to be TAB'd. Particular care should be exercised in

defining existing systems and components. Specify the systems identically to labeling and terminology used on project drawings.

****

3.2.3.1 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.2.3.2 Fan Coils

Fan coil unit systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

3.2.3.3 Rooftop Air Conditioning

Rooftop air conditioning systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

3.2.3.4 Return Air Fans

Return air fan system including fan ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.2.3.5 Makeup Air Units

Makeup air unit systems including fans, coils, ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.2.3.6 Heating and Ventilating Units

Heating and ventilating unit systems including fans, coils, ducts, plenums, roof vents, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.2.3.7 Door Heaters

Door heater systems, including fans, coils, and diffusers.

3.2.3.8 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.2.3.9 Cooling Units

3.2.3.10 Unit Heaters

3.2.3.11 Cabinet Heaters

][3.2.4 TAB Water Distribution Systems

****

NOTE: Specifier shall edit, delete, and add to the paragraphs below to ensure that water distribution

systems indicated on project drawings are listed for TAB work. Specifier shall explicitly identify new and existing systems and components which are to be TAB'd. Particular care should be exercised in defining existing systems and components. Specify the systems identically to labeling and terminology used on project drawings.

****

3.2.4.1 Chilled Water

Chilled water systems including chillers, condensers, cooling towers, pumps, coils, system balance valves and flow measuring devices.

3.2.4.2 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.2.4.3 Dual Temperature Water

Dual temperature water systems including boilers, converters, chillers, condensers, cooling towers, pumps, coils, and system balancing valves, and flow measuring devices.

][3.2.5 Sound Measurement Work

3.2.5.1 Areas To Be Sound Measured

In the following spaces, measure and record the sound power level for each octave band listed in ASHRAE HA SI ASHRAE HA IP Noise Criteria:

a. All HVAC mechanical rooms, including machinery spaces and other spaces containing HVAC power drivers and power driven equipment.

b. All spaces sharing a common barrier with each mechanical room, including rooms overhead, rooms on the other side of side walls, and rooms beneath the mechanical room floor.

****

NOTE: The designer/specifier shall select representative non-mechanical rooms which are occupied by any personnel and are served by each type of primary HVAC air moving system and HVAC water moving systems. Include rooms served by like primary systems which have significantly different sound affecting configurations. List, in the subparagraphs below, the rooms to be sound measured that will accomplish the aforementioned sound assessment philosophy. List the rooms by terminology identical to labeling indicated on drawings.

****

[c. AHU No. 1 System: Rooms: [_____]]

[d. [_____] System: Rooms: [_____]]

[e. [_____] System: Rooms: [_____]]

3.2.5.2 Procedure

At the time the sound level is measured, each room shall be unoccupied, except for TAB team, and all HVAC systems that would cause noise in the room shall be operating in their noisiest mode. Record the sound level (dB) in each octave band. Attempt to mitigate the sound level and bring the level to within the specified ASHRAE HA SI ASHRAE HA IP noise criteria goals, if such mitigation is within the TAB team's control. State in the report the ASHRAE HA SI ASHRAE HA IP noise criteria goals. If sound level cannot be brought into compliance, provide written notice of the deficiency to the Contractor for resolution or correction.

3.2.5.3 Timing

Sound levels shall be measured at times prescribed by AABC or NEBB.

3.2.5.4 Meters

Measure sound levels with a sound meter complying with ANSI S1.4, Type 1 or 2, and an octave band filter set complying with ANSI S1.11. Measurement methods for overall sound levels and for octave band sound levels shall be as prescribed by NEBB.

3.2.5.5 Calibration

Sound levels shall be calibrated as prescribed by AABC or NEBB except that calibrators emitting a sound pressure level tone of 94 dB at 1000 hertz (Hz) are also acceptable.

3.2.5.6 Background Noise Correction

Determine background noise component of room sound (noise) levels for each (of eight) octave bands as prescribed by AABC or NEBB.

****
NOTE: Choose one of the following options.
****

****
NOTE: Choose the text immediately below or the text below entitled "TAB Work On Performance Tests Within Seasonal Limitations." Use the text immediately below in the case where the winter outdoor design dry bulb temperature and the summer outdoor design dry bulb temperature are within 19.4 degrees C 35 degrees F of each other. This will reduce the number of trips to the contract site from two (one per season) to one for performance testing by the TAB field team. Use the second option, in the other cases.
****

][3.2.6 TAB Work on Performance Tests Without Seasonal Limitations

3.2.6.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution

systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the [heating systems] [and] [cooling systems].

3.2.6.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.

3.2.6.3 Water Chillers

For water chillers, data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.

3.2.6.4 Refrigeration Units

For refrigeration compressors/condensers/condensing units, data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.

3.2.6.5 Coils

Heating and cooling performance capacity tests shall be reported for [hot water], [chilled water], [DX] [and steam coils] for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

[a. For Central station air handlers with capacities greater than 26,370 Watts7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, capacity tests shall be conducted in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing".

Entering and leaving wet and dry bulb temperatures shall not be determined by single point measurement, but shall be the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; the data shall be used for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).]

[b. For units with capacities of 26370 Watts7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

The apparent coil capacity shall be determined by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; the calculations shall be submitted with the coil reports.]

****
NOTE: Choose the text immediately below, or the text above entitled "TAB Work On Performance Tests Without Seasonal Limitations." Refer to technical note immediately above. The text immediately below requires one trip each for Seasons 1 and 2.
****

][3.2.7 TAB Work on Performance Tests With Seasonal Limitations

3.2.7.1 Performance Tests

Accomplish proportionate balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and balancing of the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

3.2.7.2 Season Of Maximum Load

Visit the contract site for at least two TAB work sessions for TAB field measurements. [Visit the contract site during the season of maximum heating load] [and] [visit the contract site during the season of maximum cooling load], the goal being to TAB the operational performance of the [heating systems] [and] [cooling systems] under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the [heating systems] [and] [cooling systems].

3.2.7.3 Sound Measurements

Comply with paragraph entitled "Sound Measurement Work," specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

3.2.7.4 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.

3.2.7.5 Water Chillers

Water chillers: For water chillers, data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.

3.2.7.6 Refrigeration Units

For refrigeration compressors/condensers/condensing units, data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.

3.2.7.7 Coils

Heating and cooling performance capacity tests shall be reported for [hot water], [chilled water], [DX] [and steam coils] for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For Central station air handlers with capacities greater than 26,370 Watts7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, capacity tests shall be conducted in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Entering and leaving wet and dry bulb temperatures shall not be determined by single point measurement, but shall be the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; the data shall be used for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 26370 Watts7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

   The apparent coil capacity shall be determined by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; the calculations shall be submitted with the coil reports.

]3.2.8 Workmanship

Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the design values, that is, the values specified or indicated on the contract documents.

3.2.9 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.2.10 Data From TAB Field Work

****
NOTE: Choose one of the options below.
****

****
NOTE: Option 1: Normally, use the following paragraph, which requires two separate trips within a season to the contract site by the TAB field team (the first for the TAB field work, the second for the TAB quality assurance work) with the certified TAB report submitted between the trips. This is intended to give the design engineer time to review the certified TAB report before the quality assurance field check of that report is conducted.
****

[After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."]

****
NOTE: Option 2: Use the following paragraph when the contract site is remote or the HVAC system is simple, and the specifier wants to reduce to one the number of trips to the contract site by the TAB field team within a season. (TAB field work and TAB quality assurance accomplished in same trip).
****

[After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship" of this section.

Prepare the report neatly and legibly; the pre-final TAB report shall be the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the Contracting Officer's TAB representative that the field check of the Certified TAB report data can commence; give this verbal notice 48 hours in advance of when the field checking shall commence. Do not schedule field check of the Certified TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Contracting Officer.]

3.2.11 Quality Assurance - Contracting Officer TAB Field Checks

3.2.11.1 Field Check

During field check, the Contractor shall check, in the presence of the Contracting Officer's TAB representative, random selections of data (water, air quantities, air motion, sound level readings) recorded in the Certified TAB Report. Points and areas of field checks shall be selected by the Contracting Officer's TAB representative. Measurement and test procedures shall be the same as approved for TAB work for the Certified TAB Report. Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

3.2.11.2 Additional Field Checks

If any of the data checked for a given HVAC field check group are determined to be out-of-tolerance, data checking for all affected data for that group shall be terminated and the affected TAB report data for the given group shall be disapproved. The Contractor shall make the necessary corrections and prepare a revised Certified TAB Report. A field check of the revised report data shall then be rescheduled with the Contracting Officer's TAB representative.

Further, if any data on the Certified TAB Report for a given field check group is out-of-tolerance, then data for one additional field check group shall be field checked as specified herein. This increase field check work shall continue until out-of-tolerance data ceases to to be found. This additional field checking is up and above the original 25 percent of the of reported data entries to be field checked.

If there are no more of the similar field check group, additional field checking from another, but different, type of field check group shall be checked.

3.2.11.3 Prerequisite for Approval

Compliance with the field checking requirements of this section is a prerequisite for the final Contracting Officer approval of the certified TAB report submitted.

3.3 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, splitters, and dampers so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

3.4 MARKING OF TEST PORTS

The TAB team shall permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior side of the duct insulation. The location of test ports shall be shown on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --