

PART 1 - GENERAL

1.1 REFERENCES

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) Testing and Balancing Heating, Ventilating and Air Conditioning Systems

AABC TBP (1997) Test and Balance Procedures

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 203 (1990) Field Performance Measurements

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.4 (ASA 47) (1983; R 1994) Sound Level Meters

ANSI S1.11 (ASA 65) (1986; R 1993) Octave- Band and Fractional-Octave-Band Analog and Digital Filters

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

ASHRAE (1995) Handbook, HVAC Applications (Including Additions and Corrections for 1995, 1996)

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV (1994) Measurements and Assessment of Sound and Vibration

NEBB TABES (1991) Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA HVACADLTM (1985) HVAC Air Duct Leakage Test Manual

SMACNA HVACTAB (1993) HVAC Systems Testing, Adjusting and Balancing

1.2 RELATED REQUIREMENTS

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01320, "Construction Progress Documentation"

1.3 DESCRIPTION OF WORK

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

1.3.1 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 15080, "Mechanical Insulation."

1.3.2 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 15080, "Mechanical Insulation." 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 15080, "Mechanical Insulation."

1.4 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."
- h. Out-of-tolerance data: Pertains only to field checking of certified DALT or TAB report. The term is defined as a measurement taken during field checking which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the certified DALT or 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 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 15, minus 5 degrees Fahrenheit.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.5.1 SD-06, Test Reports

- a. Certified DALT report
- b. Certified TAB report for Season 1
- c. Certified TAB report for Season 2

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

1.5.2 SD-07, Certificates

- a. Independent TAB agency personnel qualifications
- b. Design review report
- c. Pre-field DALT preliminary notification
- d. Pre-field TAB engineering report
- e. Advanced notice for DALT field work
- f. Advanced notice for Season 1 TAB field work
- g. Pre-TAB check out list for Season 1
- h. Advanced notice for Season 2 TAB field work
- i. Pre-TAB check out list for Season 2
- j. TAB Submittal and Work Schedule
- k. Pre-final DALT report

1.6 TAB SUBMITTAL AND WORK SCHEDULE

Compliance with the following schedule is the Contractor's responsibility.

- a. Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.
- b. 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.
- c. Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

- d. 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.
- e. Pre-Field TAB Engineering Report: Within 30 calendar days after approval of the TAB Agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.
- f. DALT Field Work: Accomplish DALT field work.
- g. 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.
- h. 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.
- i. Submit Season 1 TAB Report: Within 15 calendar days after completion of Season 1 TAB field work, submit certified Season 1 TAB report.
- j. Pre-TAB 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.
- k. Submit Season 2 TAB Report: Within 15 calendar days after completion of Season 2 TAB field work, submit certified Season 2 TAB report.

1.7 QUALITY ASSURANCE

1.7.1 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."

1.7.2 Certificates

1.7.2.1 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; 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.

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

- a. Independent test and balance contractor meeting requirements specified for AABC or NEBB certified TAB agency or AABC or NEBB certified agency:

(1) TAB agency: AA13C registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification, or detailed listing of independent TAB firm qualifications.

(2) TAB team supervisor: Name and copy of AABC or NEBB TAB supervisor certificate and expiration date of current certification, or detailed experience listing of independent team leader.

(3) TAB team field leader: Name and documented evidence that the team field leader meets the qualification requirements.

(4) TAB team field technicians: Names and documented evidence that each field technician meets the qualification requirements.

(5) 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.

b. 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.

1.7.2.2 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.

1.7.2.3 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.

b. Duct to be DALTED: The Contracting Officer shall randomly select sections of the subject completed duct system for testing by the Contractor. From time of receipt of the Contractor's notification of duct system completion, the Contracting Officer shall provide the Contractor within 10 calendar days the selected locations of duct sections which are to be DALT'd.

c. DALT testing: All DALT testing shall commence within 48 hours of the official designation by the Contracting Officer of the ductwork to be DALT'd.

1.7.2.4 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.

d. 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.

1.7.3 TAB Personnel Qualification Requirements

1.7.3.1 Independent AABC or NEBB Certified TAB Agency

Provide services of a TAB agency certified by AABC or NEBB to perform and manage TAB work on HVAC air and water systems. This TAB agency shall not be affiliated with any company participating in any other phase of this contract, including design, furnishing equipment, or construction.

1.7.3.2 TAB Team Personnel

The 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.

a. TAB Team Supervisor: Supervisor shall be qualified by AABC or NEBB as a TAB supervisor or a TAB engineer.

b. TAB Team Field Leader: 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.

c. TAB Team Field Technician: 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.

1.7.4 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."

1.7.4.1 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 sheet metal 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 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 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 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 each event, 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.

1.7.4.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "TAB Personnel Qualification Requirements."

1.7.4.3 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 pre-field DALT plan or 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.

(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 two 8 hour workdays duration.

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

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

(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 8 hour workday 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 8 hour workday 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.

1.7.4.4 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.

1.7.5 Test Reports

1.7.5.1 Certified DALT Report

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA HVACADLTM. 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 Certified DALT Report shall contain copies 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.

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

1.7.5.2 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.

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 DX coils, hot water coils, 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, or in the system ductwork.
- (4) Report static pressure drop across air filters, or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors.

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.
- (6) Report supply, return, exhaust/relief, outside air duct static pressure readings, including 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.

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.

e. 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.

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

g. 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.

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

1.8 PRE-DALT/TAB MEETING

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

3.1 DALT PROCEDURES

3.1.1 DALT Field Work

3.1.1.1 Ductwork To Be DALT'd

DALT 10" W.G. class high pressure supply duct from each rooftop unit to VAV terminal units. From each duct system indicated to be DALT'd, the Contracting Officer 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 indicated to be DALT'd. Sections of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, or plenum ductwork are subject to DALT.

3.1.1.2 Testing

Leak test the HVAC air duct sections of each system as selected by the Contracting Officer. Use the duct class, seal class, leakage class and the leak test pressure data indicated above and in specification Section 15810, to comply with the procedures specified in SMACNA HVACADLTM. Testing shall be in accordance with the procedures specified in SMACNA HVACADLTM, except as supplemented and modified by this section.

3.1.1.3 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. DALT field work shall be monitored by the QC representative.

3.1.2 Data From DALT Field Work

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 be the final DALT report minus the TAB supervisor's review and certification. Verbally notify the Contracting Officer's TAB representative that the field check of the pre-final DALT report data can commence; give this verbal notice 48 hours in advance of when the field checking shall commence.

3.1.3 Quality Assurance for DALT Field Work

3.1.3.1 Field Checks

Field check for accuracy selected pre-final DALT report data in the presence of the Contracting Officer's TAB representative. 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. Pre-final report field checks may be conducted separately for each system to allow phased testing.

3.1.3.2 Additional Field Checks

If any of the duct sections checked for a given system are determined to be out-of-tolerance, testing for that section shall be terminated and the 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 DALTS report. A field check of the revised report data shall then be rescheduled with the Contracting Officer's TAB representative.

If any data on the DALT pre-final report form for a given duct section is out-of-tolerance, then data for one more 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.

3.1.3.3 Final Certified 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 final certified DALT Report.

3.1.3.4 Prerequisite for TAB Field Work

Upon completion of DALT work, and field checks and correction of outstanding items, including additional field checks, submit the final certified DALT report for Contracting Officer approval. No TAB field work shall commence prior to the completion and approval, for all systems, of the final certified DALT report field check.

3.2 TAB PROCEDURES

3.2.1 TAB Field Work

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 TBP, or NEBB TABES, and NEBB MASV or Equal, 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

TAB contractor shall balance RTU-1, 2, 3 & 4 and complete distribution system including low pressure ductwork and VAV Terminal units. Test and balance B-1 and HWP-1 & 2 and heating water distribution systems including terminal unit coils.

3.2.3.1 Packaged Rooftop Cooling Units

Packaged Rooftop units, including supply, exhaust and condenser fans, coils, ducts, plenums, mixing boxes, 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 Exhaust Fans

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

3.2.3.3 Unit Heaters

3.2.4 TAB Water Distribution Systems

3.2.4.1 Heating Hot Water

Heating hot water systems including boilers, pumps, coils, 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 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 duct chase and below rooftop units, including rooms overhead, rooms on the other side of side walls, and rooms beneath the mechanical room floor.
- c. RTU-1 System: Rooms: 360, 362, and 373
- d. RTU-2 System: Rooms: 339 & 329
- e. RTU-3 System: Room: 316 and 328
- f. RTU-4 System: Rooms: 331 & 332

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 Handbook noise criteria goals, if such mitigation is within the TAB team's control. State in the report the ASHRAE HA 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 (ASA 47), Type 1 or 2, and an octave band filter set complying with ANSI 51.11 (ASA 65). 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.

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 Packaged Rooftop Units 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 Coils

Heating and cooling performance capacity tests shall be reported for hot water, and DX 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 7.5 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 TBP, 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 TBP, 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 TBP, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

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.

3.2.8 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.

3.3 DATA FROM TAB FIELD WORK

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."

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.

3.4 QUALITY ASSURANCE FOR TAB FIELD WORK

3.4.1 Field Check

Test shall be made to demonstrate that capacities and general performance of air and water systems comply with the contract requirements.

3.4.1.1 Recheck

During field check, the Contractor shall recheck, in the presence of the Contracting Officer, random selections of data (water, air quantities, air motion, sound level readings) recorded in the certified report.

3.4.1.2 Areas Of Recheck

Points and areas of recheck shall be selected by the Contracting Officer.

3.4.1.3 Procedures

Measurement and test procedures shall be the same as approved for work for forming basis of the certified report.

3.4.1.4 Recheck Selections

Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

3.4.2 Re-tests

If random tests reveals a measured quantity which is out-of-tolerance, the report is subject to disapproval at the Contracting Officers discretion. In the event the report is disapproved, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and a new field check conducted at no additional cost to the Government.

3.4.3 Prerequisite for Approval

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

3.5 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.

3.6 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