
NAVFAC IGS-15950 (MAY 2002)

Preparing Activity: LANTNAVFACENGCOM Based on UFGS-15950N

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

SECTION 15950

HVAC TESTING/ADJUSTING/BALANCING

05/02

NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

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

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.

NOTE: Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the

technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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.

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

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

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

SMACNA HVACADLTM (1985) HVAC Air Duct Leakage Test Manual

1.2 DESCRIPTION OF WORK

The work includes and 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, on, under, between, and adjacent to buildings. Included is duct air leakage testing (DALT) on designated HVAC air distribution systems.

1.3 RELATED REQUIREMENTS

Perform work required by this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01310, "Administrative Requirements."

Requirements for price breakdown of HVAC TAB work are specified in Section 01200, "Price and Payment Procedures."

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

Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems under Section 15080, "Mechanical Insulation."

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, as specified below, 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. TAB team supervisor: TAB team engineer.
- d. TAB team technician: TAB team assistant.
- e. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.
- f. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system."
- g. 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.
- h. 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 Celcius plus 30 to minus 30 degrees Fahrenheit.
- i. 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 Celcius plus 15, minus 5 degrees Fahrenheit.

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.

1.5 DALT AND TAB WORK SYNOPSIS

The following is an overview of the HVAC DALT and TAB work effort covered by this section. Detailed requirements are specified in other paragraphs of this section.

1.5.1 Preliminary Work

- a. Contractor submits TAB agency and personnel qualifications.
- b. TAB agency and personnel, meet with the Contracting Officer's TAB representative.
- c. TAB agency submits design review report.
- d. TAB agency submits the Pre-Field TAB Engineering Report.

1.5.2 DALT Work

- a. Contractor notifies the Contracting Officer upon completion of the ductwork.
- b. Contractor submits the advanced notice of DALT field work.
- c. TAB agency accomplishes DALT field work.
- d. After completion of DALT field work, pre-final DALT report is submitted.
- e. Contracting Officer field checks DALT data.

1.5.3 Season 1 TAB Work

- a. Contractor submits Season 1 prerequisite HVAC work check out list certified as complete.
- b. Contractor submits advanced notice of commencement of Season 1 TAB field work.
- c. TAB agency accomplishes Season 1 TAB field work.
- d. TAB agency submits certified Season 1 TAB report.
- e. Contracting Officer conducts Season 1 field check.
- f. Contractor completes all TAB work except Season 2 TAB work.

1.5.4 Season 2 TAB Work

- a. Contractor submits the Season 2 prerequisite HVAC work check out list certified as complete.
- b. Contractor submits advanced notice of commencement of Season 2 TAB field work.
- c. TAB agency accomplishes Season 2 TAB field work.
- d. TAB agency submits certified Season 2 TAB report.
- e. Contracting Officer conducts Season 2 field check.
- f. Contractor completes all TAB work.

1.6 MINIMUM INSTRUMENTATION REQUIRED

1.6.1 Air Balance

- a. Inclined manometer calibrated in no less than 0.0005 in. of water 0.1 Pa divisions.
- b. Combination inclined and vertical manometer with minimum measuring range of 0 to 2490 Pa.
- c. Pitot tubes ,a 457 mm tube and a 1219 mm long tube.
- d. A tachometer, high quality, direct contact, self-timing type.
- e. Clamp-on ampere meter with voltage scales.
- f. Deflecting vane anemometer.
- g. Rotating vane anemometer.
- h. Thermal-type (hot-wire) anemometer.
- i. Dial and glass stem thermometers.
- j. Direct reading flow hood.

1.6.2 Water Balance

- a. Water-over-mercury manometer or a recently calibrated differential pressure gauge.
- b. 100 mm pressure gauges of the appropriate ranges and recently calibrated.
- c. Clamp on Ampmeter with voltage scales.

1.7 SUBMITTALS

NOTE:

Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item is required.

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. Recommended codes for Army projects are "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval. Codes following the "G" typically are not used for Navy projects. Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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

SD-06 Test Reports

- Certified 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
- Design review report; G
- Pre-field DALT preliminary notification; G
- Pre-field TAB engineering report; G
- Advanced notice for DALT field work; G
- Advanced notice for [Season 1] TAB field work; G
- Pre-TAB check out list [for Season 1]; G
- [Advanced notice for Season 2 TAB field work; G]
- [Pre-TAB check out list for Season 2; G]
- TAB Submittal and Work Schedule; G
- Pre-final DALT report; G

1.8 TAB SUBMITTAL AND WORK SCHEDULE

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.

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. Advanced Notice for DALT Field Work: At a minimum of 14 calendar days prior to commencement of the DALT work, submit the written advanced notice of DALT field work.]
- [g. DALT Field Work: Accomplish DALT field work.]
- [h. 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.]
- [i. DALT Work Field Check: 48 hours after verbal notification of DALT work completion, the field check shall commence.]
- j. Pre-TAB 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.

- [k. [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.
- l. Submit [Season 1]TAB Report: Within [15][_____] calendar days after completion of [Season 1]TAB field work, submit certified [Season 1] TAB report.
- m. [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.]
- n. Complete [Season 1]TAB Work: Prior to CCD, complete all TAB work[except Season 2 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 1 (TAB field work and TAB quality assurance accomplished in same trip).
Re-number remaining paragraphs appropriately.

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

NOTE: Choose one of the following options.

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.

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

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

1.9 QUALITY ASSURANCE

1.9.1 Modifications of References

Accomplish work in accordance with referenced publications 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."

1.9.2 TAB Personnel Qualification Requirements

1.9.2.1 Independent Qualified TAB Agency

The Contractor, as part of this contract, shall provide the services of a qualified testing organization to perform and manage the testing, adjusting and balancing (TAB) work[and the duct air leakage testing (DALT) work] on the HVAC systems].

The testing agency shall have been in business, satisfactorily performing HVAC testing and balancing work, for not less than three (3) years immediately prior to this solicitations's bid opening date. The agency shall have acceptably completed testing and balancing work for a minimum of three (3) HVAC systems of equivalent design, capacity, complexity, and size to this project's system. This TAB agency shall not be affiliated with any company participating in any other phase of this contract, including design, furnishing equipment, or construction.

1.9.2.2 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 have satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this solicitation's bid opening date.
- c. TAB Team Field Technicians: Technicians shall have satisfactorily assisted a TAB team supervisor in performance of TAB work in the field for not less than one year immediately preceding this solicitation's bid opening date.

1.9.3 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."

1.9.3.1 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 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 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.

1.9.3.2 TAB Agency

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

1.9.3.3 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 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. Full time supervision of DALT work.
- 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 of TAB Work.
- 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.

1.9.4 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.

For the TAB agency, submit the following documentation to Contracting Officer for approval; submit written proof that TAB agency and TAB agency personnel comply with the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."

- a. Independent qualified TAB agency:
 - (1) TAB agency: Provide the person's name and required documentation.
 - (2) TAB team supervisor: Provide the person's name and required documentation.
 - (3) TAB team technicians: Provide the persons' names and required documentation.
- 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.

1.9.5 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.

1.9.6 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.

1.9.7 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 proposed TAB data reporting forms, with the pre-field information listed below, filled in. The TAB reporting forms submitted shall be based on the list of requirements presented in Table 15950, "Master List of TAB Data Reporting Requirements", included at the end of this section. Modify and supplement this master list to ensure this pre-field TAB engineering report applies to this particular contract.

- (1) General Report Documents: Submit in accordance with Table 15950 requirements

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

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

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

- (5) Comply with Table 15950, and the following: provide a list of the types of instruments 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 (See Form 15950-1): 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.

1.9.8 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 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.
- d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.9.9 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 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, or in the system ductwork.

(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.

(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.

[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.]]

- [e. Duct Transverses: 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 the uniformity of the readings.]

- 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.

1.10 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: The decision/responsibility on whether, or not, to require leak testing in accordance with SMACNA HVACADLTM is the designers. Extensive duct systems having long runs and/or significant duct surface area should be tested. This should include both high velocity and low velocity duct systems. Simple duct systems having short runs of ductwork, or that are contained within the space served do not

warrant leak testing with SMACNA HVACADLTM. Also, low velocity round duct systems do not warrant testing. When SMACNA HVACADLTM testing method is used, the designer shall indicate on the drawings (in addition to the duct class, seal class, and leakage class) the leakage test pressure to be used to test ductwork, or duct sections. Refer to SMACNA HVACADLTM, Appendix B, "Sample Leakage Analysis" for guidance in determining leakage test pressures.

3.1 DALT PROCEDURES

3.1.1 DALT Field Work

3.1.1.1 Ductwork To Be DALT'd

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 on the drawings, 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

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. 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 Computer Room Conditioning

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

3.2.3.5 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.

3.2.3.6 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.

3.2.3.7 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.

3.2.3.8 Door Heaters

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

3.2.3.9 Exhaust Fans

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

3.2.3.10 Cooling Units

3.2.3.11 Unit Heaters

[3.2.3.12 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 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 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.

3.2.6 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 required by Form 15950-2, "TAB Data Report Forms" shall be reported, including refrigeration operational data.

3.2.6.4 Refrigeration Units

For refrigeration compressors/condensers/condensing units, data required by Form 15950-2, "TAB Data Report Forms", 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 large units, such as central built-up units and rooftop units, with capacities greater than 26 KW7.5 tons (90,000 Btu) cooling or greater than 2500 cfm air flow for heating or ventilation, coil capacity tests shall be conducted as follows:
 - (1) Measure airflow through the coil by Pitot tube traverse. Use anemometer coil traverse if the Pitot tube traverse is not possible.
 - (2) Set the water flow with the flow meter or another method.
 - (3) Measure and record the water pressure drop across the coil and compare to the design. Only rely upon pressure drop for flow determination if other means are impossible to obtain.
 - (4) Measure entering and leaving air dry bulb temperatures on all coils, then measure entering and leaving air wet bulb temperatures on all cooling coils. On these larger units, take multiple temperatures on a grid pattern (traverse style) and use the

average temperature.

(5) On water coils, measure the entering and leaving water temperatures at the same time as the air temperatures.

(6) Calculate the total coil capacity of the air side and record the KWbtu/hr.

(7) For water coils, calculate the l/sqpm by heat balance and compare to the flow meter reading. Flows should match within plus or minus 10 per cent.

(8) For steam coils, measure and record the entering steam pressure.

(9) For low temperature chilled water using Glycol, record the Glycol-mixture percentage for use in heat transfer calculations.

(10) Submit part-load coil performance data from the coil manufacturer converting test (actual) conditions to design conditions; the data shall be used for the purpose of verifying that the coils meet the indicated design capacity as follows:

a) Test (actual) capacity is the capacity measured in this procedure.

b) Actual and design capacity match if if the actual-load conditions equal design-load conditions.

c) Most likely, condition b), where actual load conditions match design conditions, will not occur. Therefore, a part-load condition will exist. Part-load data can be obtained from the manufacturer or simulated from computer programs on coils. The test conditions should be converted to design conditions to determine if the coil will meet the design capacity. Use coil conversion charts and tables to convert the test conditions to design conditions, and indicate in the report.]

b. [For small units, such as fan coils and unitary packages, with capacities equal to or less than 26 KW7.5 tons (90,000 Btu) cooling or equal or less than 2500 cfm air flow for heating and ventilating, coil capacity tests shall be conducted as follows:

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 required by Table 15950-2, "TAB Data Report Forms", shall be reported, including refrigeration operational data.

3.2.7.6 Refrigeration Units

For refrigeration compressors/condensers/condensing units, data required by Table 15950-2, "TAB Data Report Forms", shall be reported, including refrigeration operational data.

3.2.7.5 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 large units, such as central built-up units and rooftop units, with capacities greater than 26 KW7.5 tons (90,000 Btu) cooling or greater than 80 cu. meters per min.2500 cfm air flow for heating or ventilation, coil capacity tests shall be conducted as follows:

(1) Measure airflow through the coil by Pitot tube traverse. Use anemometer coil traverse if the Pitot tube traverse is not possible.

(2) Set the water flow with the flow meter or another method.

(3) Measure and record the water pressure drop across the coil and compare to the design. Only rely upon pressure drop for flow determination if other means are impossible to obtain.

(4) Measure entering and leaving air dry bulb temperatures on all coils, then measure entering and leaving air wet bulb temperatures on all cooling coils. On these larger units, take multiple temperatures on a grid pattern (traverse style) and use the average temperature.

(5) On water coils, measure the entering and leaving water temperatures at the same time as the air temperatures.

(6) Calculate the total coil capacity of the air side and record the KWbtu/hr.

(7) For water coils, calculate the l/sqpm by heat balance and compare to the flow meter reading. Flows should match within plus or minus 10 per cent.

(8) For steam coils, measure and record the entering steam pressure.

(9) For low temperature chilled water using Glycol, record the Glycol-mixture percentage for use in heat transfer calculations.

(10) Submit part-load coil performance data from the coil manufacturer converting test (actual) conditions to design conditions; the data shall be used for the purpose of verifying that the coils meet the indicated design capacity as follows:

(a) Test (actual) capacity is the capacity measured in this procedure.

(b) Actual and design capacity match if if the actual-load conditions equal design-load conditions.

(c) Most likely, condition b), actual load conditions match

design conditions, will not occur. Therefore, a part-load condition will exist. Part-load data can be obtained from the manufacturer or simulated from computer programs on coils. The test conditions should be converted to design conditions to determine if the coil will meet the design capacity. Use coil conversion charts and tables to convert the test conditions to design conditions, and indicate in the report.]

- [b. For small units, such as fan coils and unitary packages, with capacities equal to or less than 26 KW7.5 tons (90,000 Btu) cooling or equal or less than 80 cu. meters per min.2500 cfm air flow for heating and ventilating, coil capacity tests shall be conducted as follows:

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.

3.3 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.]

3.4 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 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 Retests

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.

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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(1) HVAC AND BUILD-UP UNITS

a) General

Louvers installed.....
Manual dampers open and locked.....
Automatic dampers set properly.....	|.....	|.....	|.....
Housing construction leakage.....	|.....	|.....	|.....
Access doors per plans and specs.....	|.....	|.....	|.....
Condensate drain piping and pan.....	|.....	|.....	|.....
Free from dirt and debris.....	|.....	|.....	|.....
Nameplate data clearly visible.....	|.....	|.....	|.....

b) Filters

Type / size / number correct.....	|.....	|.....	|.....
Clean.....	|.....	|.....	|.....
Blank-off plates installed.....	|.....	|.....	|.....
Frame leakage at a minimum.....	|.....	|.....	|.....

c) Coils (Hydronic - Water and Steam)

Size and rows.....	|.....	|.....	|.....
Fin spacing and condition.....
Obstructions and/or debris.....
Correct air flow direction.....

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PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

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PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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c) Coils (Hydronic - Water and Steam) (continued)

Correct piping connections and flow....
Valves open and set.....	.....	.....	.....
Vents and traps installed correctly....	.....	.....	.....
Provisions for TAB measurements.....	.....	.....	.....

d) Coils (Electric).....

Size and construction.,.....	.....	.....	.....
Airflow direction.....	.....	.....	.....
Duct connections.....	.....	.....	.....
Safety switches.....	.....	.....	.....
Obstructions.....	.....	.....	.....
Free from debris.....	.....	.....	.....
Contractors and disconnect switches....	.....	.....	.....
Electrical service and connections.....	.....	.....	.....
Nameplate data clearly visible.....	.....	.....	.....

e) Fans

Rotation.....	.....	.....	.....
Wheel clearance and balance.....	.....	.....	.....
Bearing and motor lubrication.....	.....	.....	.....
Drive alignment.....	.....	.....	.....

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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e) Fans (continued)

Belt tension.....
Drive set screws tight.....
Belt guards in place.....
Flex duct connector alignment.....	|.....	|.....	|.....
Proper unit / duct alignment.....	|.....	|.....	|.....
Starters and disconnect switches....	|.....	|.....	|.....
Electrical service and connections..	|.....	|.....	|.....
Nameplate data clearly visible.....	|.....	|.....	|.....

f) Vibration Isolation

Springs and compression.....	|.....	|.....	|.....
Base level and free.....	|.....	|.....	|.....

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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2) DUCT SYSTEMS

a) General

- Manual damper open and locked.....|.....|.....|.....|
- Damper adjustments accessible.....|.....|.....|.....|
- Access doors closed and tight.....|.....|.....|.....|
- Fire dampers open and accessible.....|.....|.....|.....|
- Terminal units open and set.....|.....|.....|.....|
- Registers/diffusers open and set.....|.....|.....|.....|
- Turning vanes in square elbows.....|.....|.....|.....|
- Provisions made for TAB tests.....|.....|.....|.....|
- System installed per plans and specs...|.....|.....|.....|
- All ductwork sealed.....|.....|.....|.....|

b) Architectural

- Windows installed and closed.....|.....|.....|.....|
 - Doors closed as required.....|.....|.....|.....|
 - Ceiling plenums installed/sealed.....|.....|.....|.....|
 - Access doors closed and tight.....|.....|.....|.....|
 - Air shafts/openings as required.....|.....|.....|.....|
-

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

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FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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3) PUMPS

a) Motors

Rotation.....
Lubrication.....
Alignment.....
Set screws tight.....
Guards in place.....
Tank level and controls.....	|.....	|.....	|.....
Starters and disconnects.....	|.....	|.....	|.....
Electrical service and connections.....	|.....	|.....	|.....

b) Piping

Correct flow.....	|.....	|.....	|.....
Correct connections.....	|.....	|.....	|.....
Leakage.....	|.....	|.....	|.....
Valves open and set.....	|.....	|.....	|.....
Strainers clean.....	|.....	|.....	|.....
Air Vented.....	|.....	|.....	|.....
Flexible connectors installed.....	|.....	|.....	|.....
Provisions made for TAB tests.....	|.....	|.....	|.....
System water clean.....

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

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PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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3) PUMPS (continued)

c) Bases

Vibration isolation.....
Grouting.....
Leveling.....

4) HYDRONIC EQUIPMENT

a) Boilers

Operating controls and devices.....	|.....|	|.....|	|.....|
Safety controls and devices.....	|.....|	|.....|	|.....|
Lubrication of fans and pumps.....	|.....|	|.....|	|.....|
Draft controls and devices.....	|.....|	|.....|	|.....|
Piping controls and devices.....	|.....|	|.....|	|.....|
Valves set and open.....	|.....|	|.....|	|.....|
Water make-up provisions.....	|.....|	|.....|	|.....|
Blowdown provisions.....	|.....|	|.....|	|.....|
Electrical connections.....	|.....|	|.....|	|.....|
Nameplate data clearly visible.....

b) Heat Exchangers

Correct flow and connections.....
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FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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4) HYDRONIC EQUIPMENT (continued)

b) Heat Exchangers (continued)

Valves open or set.....
Air vents or steam traps.....	|.....	|.....	|.....
Leakage.....	|.....	|.....	|.....
Provisions made for TAB tests.....	|.....	|.....	|.....
Nameplate data clearly visible.....	|.....	|.....	|.....

c) Cooling Towers and Evaporative Condensers

Correct flow and connections.....	|.....	|.....	|.....
Valves open or set.....	|.....	|.....	|.....
Leakage.....	|.....	|.....	|.....
Provisions made for TAB tests.....	|.....	|.....	|.....
Sump water level.....	|.....	|.....	|.....
Spray nozzles.....	|.....	|.....	|.....
Fan/Pump rotation.....	|.....	|.....	|.....
Motor/Fan lubrication.....	|.....	|.....	|.....
Drives and alignment.....	|.....	|.....	|.....
Guards in place.....	|.....	|.....	|.....
Starters and disconnects.....	|.....	|.....	|.....
Electrical connections.....	|.....	|.....	|.....
Nameplate data clearly visible.....	|.....	|.....	|.....

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready	Date	Certified
	Yes / No	Corrected	By

5) REFRIGERANT EQUIPMENT

Crankcase heaters energized.....	|.....	|.....	|.....
Operating controls and devices.....	|.....	|.....	|.....
Safety controls and devices.....	|.....	|.....	|.....
Valves open.....	|.....	|.....	|.....
Piping connections and flow.....	|.....	|.....	|.....
Flexible connectors.....	|.....	|.....	|.....
Oil level and lubrication.....	|.....	|.....	|.....
Alignment and drives.....	|.....	|.....	|.....
Guards in place.....	|.....	|.....	|.....
Vibration isolation.....	|.....	|.....	|.....
Starters/Contactors/Disconnects.....	|.....	|.....	|.....
Electrical connections.....	|.....	|.....	|.....
Nameplate data clearly visible.....	|.....	|.....	|.....

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready Yes / No	Date Corrected	Certified By
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6) HYDRONIC PIPING SYSTEM

Leak tested.....
Fluid levels and make-up.....
Relief or safety valves.....
Expansion tanks and air vents.....	|.....	|.....	|.....
Steam traps and connections.....	|.....	|.....	|.....
Strainers clean.....	|.....	|.....	|.....
Valves open and set.....	|.....	|.....	|.....
Provisions made for TAB tests.....	|.....	|.....	|.....
Systems installed per plans and specs.....	|.....	|.....	|.....

7) CONTROLS AND CONTROL SYSTEMS

Data centers.....	|.....	|.....	|.....
Outdoor/return Air/reset.....	|.....	|.....	|.....
Economizer set and tested.....	|.....	|.....	|.....
AHU Static pressure set.....	|.....	|.....	|.....
Room controls calibrated.....	|.....	|.....	|.....
VAV box regulators set to design.....	|.....	|.....	|.....
VAV box P.E. switches set.....	|.....	|.....	|.....
Proper end-of-line static pressure.....	|.....	|.....	|.....
VAV box reheats tested.....

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

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FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

Item	Ready	Date	Certified
	Yes / No	Corrected	By

8) OTHER CHECKS

Appropriate contractors notified of TABS...	|.....|	|.....|	|.....|
Preliminary data complete.....	|.....|	|.....|	|.....|
Test report forms prepared.....	|.....|	|.....|	|.....|

9) ADDITIONAL COMMENTS:

.....

.....

.....

.....

.....

NOTICE:

Completion and submission of this form indicates that the mechanical systems are complete and installed in accordance with plans and specifications. Delays and/or additional testing required after system corrections and/or modifications will result in additional charges to the contractor.

Submission of this checklist also constitutes permission for the TAB Agency to operate the mechanical equipment, adjust sheaves, and motor speeds and control set points as needed during the performance of the testing and balancing.

PRIME CONTRACTOR: _____ **DATE:** _____

MECHANICAL CONTRACTOR: _____ **DATE:** _____

CONTROLS CONTRACTOR: _____ **DATE:** _____

SHEET METAL CONTRACTOR: _____ **DATE:** _____

FORM 15950-1

PREREQUISITE CHECKLIST

Project _____ TAB Contractor _____

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

(1) General TAB Report Documentation

- a. Title page
- b. Certification page: including name, address, and telephone number of TAB agency; project name and location; government contract number; statement of system performance; TAB supervisor's printed name and certifying signature; report date.
- c. Table of contents
- d. System diagrams

(2) Air Handling Unit Data

a. Unit Data

1. Make/Model No.
2. Type/Size
3. Serial Number
4. Arrangement/Class
5. Discharge
6. Make Sheave
7. Sheave Diameter/Bore
8. Number Belts/make/size
9. Number Filters/type/size

b. Motor Data

1. Make/Frame
2. W/RPM
3. Volts/Phase/Hertz
4. Full load (F.L.) Amps
5. Make sheave
6. Sheave Diameter/Bore

c. Test Data (Design and Actual)

1. Total l/s
2. Total static pressure (S.P.)
3. Fan RPM
4. External S.P.
5. Motor Volts (each phase)
6. Motor Amps (each phase)
7. Outside Air l/s
8. Return Air l/s
9. Discharge S.P.
10. Suction S.P.
11. Reheat Coil S.P. drop
12. Cooling Coil S.P. drop
13. Preheat Coil S.P. drop
14. Filters S.P. drop
15. Outside Air Damper Position

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

16. Return Air Damper Position

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

(3) Coil Data

a. Coil Data

1. System Number
2. Location
3. Coil Type
4. No. Rows-Fins/in.
5. Manufacturer
6. Model Number
7. Face Area, m²

b. Test Data (Design and Actual)

1. Air Quantity, l/s
2. Air velocity, m/s
3. Pressure Drop, Pa
4. Outside Air, DB/WB
5. Return Air, DB/WB
6. Entering Air, DB/WB
7. Leaving Air, DB/WB
8. Air T change
9. Water Flow, l/s
10. Pressure Drop, kPa
11. Entering Water Temp.
12. Leaving Water Temp.
13. Water T change
14. Expansion Valve/ Refrig.
15. Refrig. Suction Pressure
16. Refrig. Suction Temp.
17. Inlet Steam Pressure

(4) Fan Data

a. Fan Data

1. Fan Number
2. Location
3. Service
4. Manufacturer
5. Model Number
6. Serial Number
7. Type Class
8. Motor Make/Style
9. Motor H.P./RPM/Frame
10. Volts/Phase/Hertz
11. F.L. Amps
12. Motor Sheave Make/Model
13. Motor Sheave Diameter/Bore
14. Fan Sheave Make
15. Fan Sheave Diameter/Bore

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

16. No. Belts/Size

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

(4) Fan Data (continued)

- b. Test Data
 - 1. L/s
 - 2. Fan RPM
 - 3. S.P. in/out
 - 4. Total S.P.
 - 5. Voltage (each phase)
 - 6. Amps (each phase)

(5) Traverse Data

- a. Static pressure
- b. Duct Size
- c. Duct Area
- d. All velocity readings
- e. Measured Average Velocity, m/s
- f. Measured Flow Rate, l/s
- g. Design Flow Rate, l/s
- h. System/Zone
- i. Location
- j. Static Pressure

(6) Air handler With Terminal box Outlet Data

- a. System / Box served
- b. Outlet Data
 - 1. Number
 - 2. Type
 - 3. Size
 - 4. Correction Factor
- c. Design, Preliminary, and Final flow rate (l/s),
for Air Handling Unit Outlets
- d. Design, Preliminary, and Final flow rate (l/s),
at maximum primary for Terminal Box Outlets
- e. Design and Actual flow rate at minimum primary,
for Terminal Box Outlets

(7) Terminal Box Data

- a. System served
- b. Box manufacturer
- c. Model / Type
- d. Box Data
 - 1. Box number
 - 2. Box size
- e. Design and actual Maximum primary flow, l/s

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

- f. P drop at maximum primary flow
- g. Design and actual Minimum primary flow, l/s
- h. P drop at minimum primary flow

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

(8) Gas/Oil Fired Heating Units Data

a. Unit Data

1. Unit number
2. System
3. Location
4. Make/Model
5. Type/Size
6. Serial Number
7. Type Fuel/Input
8. Output
9. Ignition type
10. Burner control
11. Volts/Phase/Hertz
12. Watts/RPM
13. F.L. amps
14. Drive data

b. Test Data (Design and Actual)

1. L/s
2. Entering/Leaving air temperature
3. Air temperature change T
4. Entering/Leaving air pressure
5. Air pressure drop P
6. Low fire input
7. High fire input
8. High limit setting
9. Operating set point

(9) Electric Coil Duct Heater Data

a. Coil Data

1. Coil number
2. System number
3. Location
4. Coil type
5. Stages
6. Manufacturer
7. Model number
8. Face area, m²

b. Test Data (Design and Actual)

1. Air flow rate, l/s
2. Minimum air velocity, m/s
3. Pressure drop, Pa
4. kW
5. Phase

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

6. Entering air DB/WB
7. Leaving air DB/WB
8. Air temp. change T

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

b. Test Data (Design and Actual) (Continued)

9. Volts, each phase
10. Amps, each phase
11. Limit-Cutout time
12. Limit-Cutout temperature
13. Flow Switch Check

(10) Packaged Chiller Data

- a. Unit number
- b. Location
- c. Manufacturer
- d. Model/Make
- e. Serial number
- f. Capacity
- g. Refrigerant
- h. Starter
- i. Heater size

j. Evaporator Data (Design and Actual)

1. Evaporator pressure and temperature
2. Entering and Leaving water pressure
3. Water pressure P
4. Entering and Leaving water temperature
5. Water temperature T
6. Flow, l/s

k. Compressor Data (Design and Actual)

1. Make/Model
2. Serial number
3. Suction pressure and temperature
4. Discharge pressure and temperature
5. Oil pressure and temperature
6. Voltage, each phase
7. Amperage, each phase
8. kW input
9. Crankcase heater amps
10. Low pressure cutout setting
11. High pressure cutout setting
12. Chilled water control setting
13. Condenser water control setting

l. Condenser Data (Design and Actual)

1. Condenser pressure and temperature
2. Entering and leaving water pressure
3. Water pressure P
4. Entering and leaving water temperature

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

- 5. Water temperature T
- 6. Flow, l/s

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

- m. Refrigeration Data (Design and Actual)
1. Oil level checked
 2. Oil failure switch differential
 3. Refrigerant level checked
 4. Relief valve setting
 5. Unloader set points
 6. Per cent cylinders unloaded
 7. Purge operation checked
 8. Bearing temperature
 9. Vane position
 10. Demand limit
 11. Low temperature cutout setting

(11) Package Rooftop, Heat Pump and Air Conditioning Unit Data

- a. Unit Data
1. System / Unit
 2. Location
 3. Make/Model number
 4. Type/Size
 5. Serial number
 6. Type filters/Size
 7. Fan sheave make
 8. Fan sheave diameter/bore
 9. Type heating section (Use section 3.3.1.8 or 3.3.1.9)
- b. Motor Data
1. Make/Frame
 2. Power, W / RPM
 3. Volts/Phase/Hertz
 4. F.L. amperage
 5. Make sheave
 6. Sheave diameter/bore
- c. Evaporator Data (Design and Actual)
1. Total flow, l/s
 2. Total static pressure, S.P.
 3. Discharge S.P.
 4. Suction S.P.
 5. Outside air, l/s
 6. Outside air temperature, DB/WB
 7. Return air, l/s
 8. Return air temperature, DB/WB
 9. Entering air temperature, DB/WB
 10. Leaving air temperature, DB/WB
 11. Fan RPM
 12. Voltage, each phase

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

13. Amperage, each phase

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

d. Condenser Data (Design and Actual)

1. Refrigerant type/kg
2. Compressor manufacturer/number
3. Compressor model/serial number
4. Low ambient control
5. Suction pressure and temperature
6. Condenser pressure and temperature
7. Crankcase heater amperage
8. Compressor voltage, each phase
9. Compressor amperage, each phase
10. Low and High pressure cutout settings
11. Number of fans and fan RPM
12. Condenser fan, W / l/s
13. Condenser fan voltage and amperage

(12) Compressor and Condenser Data

a. Unit Data

1. Unit number
2. Location
3. Manufacturer
4. Model/Serial number
5. Compressor manufacturer
6. Compressor model/serial number
7. Refrigerant type/kg
8. Low ambient control

b. Test Data (Design and Actual)

1. Suction pressure and temperature
2. Condenser pressure and temperature
3. Oil pressure and temperature
4. Voltage, each phase
5. Amperage, each phase
6. kW input
7. Crankcase heater amperage
8. Number of fans, fan RPM, and fan l/s
9. Fan motor make, frame, fan W
10. Fan motor voltage and amperage
11. Duct inlet and outlet static pressure
12. Entering and leaving air temperature, D.B.
13. Entering and leaving condenser water temperature
14. Entering and leaving condenser water pressure
15. Control setting
16. Unloader set points
17. High and Low pressure cutout setting

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

(13) Heat Exchanger and Converter Data

a. Unit Data

1. Unit number
2. Location
3. Service
4. Rating, W
5. Manufacturer
6. Model number and serial number

b. Test Data (Design and Actual)

1. Steam

- a) Pressure , kPa
- b) Flow, kg/s

2. Primary Water

- a) Entering and Leaving temperature
- b) Temperature T
- c) Entering and Leaving pressure
- d) Pressure P
- e) Flow, l/s

(13) Heat Exchanger and Converter Data (Continued)

3. Secondary Water

- a) Entering and Leaving temperature
- b) Temperature T
- c) Entering and Leaving pressure
- d) Pressure P
- e) Flow, l/s
- f) Control set point
- g) Exchanger Circuiting

(14) Pump Data

a. Design Data

1. Pump number
2. Location
3. Service
4. Manufacturer
5. Model and Serial number
6. Flow, l/s and Head, m
7. Required NPSH
8. Pump RPM
9. Impeller Diameter
10. Motor manufacturer/frame
11. Motor, W/RPM
12. Volts/Phase/Hertz
13. F.L. amperage

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

14. Seal type

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

b. Actual Data

1. Discharge pressure at full flow
2. Discharge pressure at no flow
3. Suction pressure at full flow
4. Suction pressure at no flow
5. Differential pressure at full flow
6. Differential pressure at no flow
7. Circuit setter size, P, l/s
8. Circuit setter type and set point
9. Voltage, each phase
10. Amperage, each phase

(15) Balance Valve and Flow Meter Data

- a. System/Unit
- b. Location
- c. Service
- d. Size
- e. Model
- f. Design flow, l/s
- g. Actual valve set point
- h. Actual valve pressure drop
- i. Actual flow, l/s

(16) Boiler Data

a. Unit Data

1. Unit number
2. Location
3. Manufacturer
4. Model and Serial number
5. Type/Size
6. Fuel/Input
7. Number of passes
8. Ignition type
9. Burner control
10. Volts/Phase/Hertz

b. Test Data (Design and Actual)

1. Operating pressure and temperature
2. Entering and Leaving temperature
3. Number of safety valves/size
4. Safety valve setting
5. High limit setting
6. Operating control setting
7. High and Low fire set point
8. Voltage, each phase
9. Amperage, each phase

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

TABLE 15950

MASTER LIST OF TAB DATA REPORTING REQUIREMENTS

b. Test Data (Design and Actual) (Continued)

- 10. Draft fan, voltage and amperage
- 11. Manifold pressure
- 12. Output, kW
- 13. Safety controls check

(17) Instrumentation Calibration Report

- a. Instrument identification and serial number and key
 - b. Measuring range
 - c. Application
 - d. Dates of use
 - e. Calibration test date
-

-- End of Section --