
USACE / NAVFAC / AFCEA / NASA UFGS-23 05 93.00 10 (April 2006)

Preparing Activity: USACE Replacing without change
UFGS-15990A (November 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

Latest change indicated by CHG tags

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SECTION 23 05 93.00 10

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS 04/06

NOTE: This guide specification covers the requirements for the testing, adjusting, and balancing (TAB) of all heating, ventilating and air conditioning systems.

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

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

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

NOTE: This specification will be used on all projects which include new HVAC systems or modifications to existing HVAC systems. The "Design Agent's Representative" will be a member of the HVAC design team, i.e. from the AE or Engineering Division. The "Design Agent's Representative" will actively participate in the process, including review of all submittals contained herein and participation in TAB verification. The planning and programming of either Title II services or in-house support will be required for the participation of the "Design Agent's Representative".

1.1 REFERENCES

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

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

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

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2002) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES (2005) Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

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

SMACNA HVACTAB (2002, 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing

1.2 SUBMITTALS

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

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

submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

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

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

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms[; G][; G, [_____]]

[Three] [_____] copies of the TAB Schematic Drawings and Report Forms, no later than [21] [_____] days prior to the start of TAB field measurements.

SD-03 Product Data

TAB Related HVAC Submittals

A list of the TAB Related HVAC Submittals, no later than [7] [_____] days after the approval of the TAB Specialist.

TAB Procedures[; G][; G, [_____]]

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Systems Readiness Check

Proposed date and time to begin the Systems Readiness Check, no later than [7] [_____] days prior to the start of the Systems Readiness Check.

TAB Execution[; G][; G, [_____]]

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification[; G][; G, [_____]]

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report[; G][; G, [_____]]

A copy of the Design Review Report, no later than [14] [_____] days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check[; G][; G, [_____]]

A copy of completed checklists for each system, each signed by the TAB Specialist, at least [7] [_____] days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report[; G][; G, [_____]]

[Three] [_____] copies of the completed TAB Reports, no later than [7] [_____] days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report[; G][; G, [_____]]

[Three] [_____] copies of the completed TAB Verification Report, no later than [7] [_____] days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-07 Certificates

Ductwork Leak Testing

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

TAB Firm[; G][; G, [____]]

Certification of the proposed TAB Firm's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than [21] [____] days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC, NEBB or TABB against the proposed TAB Firm shall be described in detail.

TAB Specialist[; G][; G, [____]]

Certification of the proposed TAB Specialist's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than [21] [____] days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC, NEBB, or TABB against the proposed TAB Specialist shall be described in detail.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.	SMACNA's Procedures
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.	Field Readiness Check & Prelim. Field Procedures

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All

recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

NOTE: Where the size or complexity of the HVAC system(s) warrant, include in the project specification the bracketed requirement specifying that the TAB firm be certified for "building systems commissioning".

The TAB Firm shall be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including [TAB of environmental systems] [the performance of clean rooms and clean air devices] [building systems commissioning] [and] [the measuring of sound and vibration in environmental systems]. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of the mechanical subcontractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC, an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval.

Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist shall participate in the commissioning process specified in Section 23 08 00.00 10 COMMISSIONING OF HVAC SYSTEMS.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

NOTE: The planning and programming of either Title II services or in house support will be required where the participation of a design team member is required for TAB during construction.

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a [Design Review Report](#) individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 [TAB RELATED HVAC SUBMITTALS](#)

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 [TAB SCHEMATIC DRAWINGS AND REPORT FORMS](#)

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 DUCTWORK LEAK TESTING

NOTE: Delete this paragraph when Ductwork Leak
Testing is not required by Section 23 00 00 AIR
SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST
SYSTEM.

The TAB Specialist shall witness the Ductwork Leak Testing specified in
Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
and approve the results as specified in Paragraph TAB RELATED HVAC
SUBMITTALS.

3.5 TESTING, ADJUSTING, AND BALANCING

3.5.1 TAB Procedures

NOTE: Where specific TAB Procedures are not covered
in the TAB Standard and the designer feels that the
level of complexity of the HVAC system or the
critical nature of the area served warrants,
procedures should be developed and added to this
paragraph. During the TAB of kitchen exhaust hoods,
incorrect building air flows may affect the
performance of fans. Opening of kitchen entrance
doors may produce correct exhaust hood air flows
while closed doors yield deficient readings. TAB of
kitchen exhaust hoods should be performed after
make-up air flows are balanced and with the kitchen
exhaust hoods should be performed after make-up air
flows are balanced and with the kitchen entrance
doors both opened and closed.

Step by step procedures for each measurement required during TAB Execution
shall be provided. The procedures shall be oriented such that there is a
separate section for each system. The procedures shall include measures to
ensure that each system performs as specified in all operating modes,
interactions with other components (such as exhaust fans, kitchen hoods,
fume hoods, relief vents, etc.) and systems, and with all seasonal
operating differences, diversity, simulated loads, and pressure
relationships required.

3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete,
including installation and operation of controls, and that all aspects of
the facility that have any bearing on the HVAC systems, including
installation of ceilings, walls, windows, doors, and partitions, are
complete to the extent that TAB results will not be affected by any detail
or touch-up work remaining. The TAB Specialist shall also verify that all
items such as ductwork and piping ports, terminals, connections, etc.,
necessary to perform TAB shall be complete during the Systems Readiness
Check.

3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

3.5.4 TAB Verification

NOTE: Where, on projects with a small number of TAB measurements, it is impractical to specify a percentage of measurements to be verified, this paragraph should be modified to specify the number of measurements.

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a [TAB Verification Report](#). The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 [_____] percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten [_____] percent for verification. If over 20 [_____] percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --