

BID FORMMISSOURI DEPARTMENT OF TRANSPORTATION
GENERAL SERVICESPO Box 270, Jefferson City, MO 65102(Mailing Address)
830 MoDOT Drive, Jefferson City, MO 65109 (Physical Address)

REQUEST NO.	5-150616RW
DATE	June 3, 2015

SEALED BIDS, SUBJECT TO THE ATTACHED CONDITIONS WILL
BE RECEIVED AT THIS OFFICE UNTIL**2:00 PM, Central Time, June 16, 2015**AND THEN PUBLICLY OPENED AND READ FOR FURNISHING
THE FOLLOWING SUPPLIES OR SERVICES.**BID TO BE BASED F.O.B. MISSOURI DEPARTMENT OF
TRANSPORTATION**Submit net bid as cash discount stipulations will not be considered
Jefferson City, MO**SIGN AND RETURN BEFORE TIME SET FOR OPENING**

BUYER:	Robin Warren, Sr. General Services Specialist	BUYER TELEPHONE:	(573) 526-7929
BUYER EMAIL:	Robin.Warren@modot.mo.gov		

SUPPLIES OR SERVICES

MoDOT is seeking bids from qualified bidders whom can provide services for:

Automated Weather Observing Systems (AWOS) Maintenance Services with an effective date of
July 1, 2015 through June 30, 2016*****NOTE: It is the responsibility of the Bidder to access MoDOT's website in order to obtain any
and all addenda(s) issued during the course of this RFB process.****All questions regarding this RFB shall be submitted to the RFB Coordinator/Contact.****(SEE ATTACHED FOR CONDITIONS AND INSTRUCTIONS)***In compliance with the above Request For Bid, and subject to all conditions thereof, the undersigned bidder agrees to furnish and deliver
any or all the items on which prices were bid within the timeframe specified herein, after receipt of formal purchase order.*

Date:	_____	Firm Name:	_____
Telephone No.:	_____	Address:	_____
Fax No.:	_____		_____
Email Address:	_____	By (Signature):	_____
	_____	Type/Print Name	_____
		Title:	_____

MISSOURI DEPARTMENT OF TRANSPORTATION
SPECIFICATIONS

**AUTOMATED WEATHER OBSERVING SYSTEMS (AWOS) MAINTENANCE SERVICES
RFB 5-150616RW**

General

The Missouri Department of Transportation (hereinafter referred to as MoDOT) intends to secure a contract for Automated Weather Observing Systems (AWOS) Maintenance services.

Services

The contractor shall provide the following services for MoDOT's twelve (12) operational AWOS units in various areas of the state. The Federal Aviation Administration (FAA) requires maintenance services for these units. The Bidder may refer to Attachment A for a complete list of the AWOS sites and Attachment B for a list of airport contacts.

- The facilities shall be maintained in accordance with AC 150/5220-16D (Attachment C) and Operations and Maintenance Manual (OMM) (Attachment D).
- Only FAA authorized maintenance personnel can accomplish repairs on the facilities and return them to service following an outage resulting from a failure of the facility. All routine and non-routine tests, meter readings, and entries to FAA forms shall be performed only by technician(s) holding current FAA Verification Authority on the specific type equipment, as well as any applicable license required by the Federal Communications Commission (FCC)
- Special order parts will be provided by MoDOT and either drop shipped to the site or to the contractor.

Payment will be made on the basis of actual maintenance services performed. All cost of performing the contract is included in the payment made for the services performed.

Contract Period

The contract period is anticipated to begin July 1, 2015 through June 30, 2016. MoDOT shall have the right, at its sole option, to renew the contract for four (4) additional one-year periods, or any portion thereof. In the event MoDOT exercises such right, all terms and conditions, requirements and specifications of the contract shall remain the same and apply during the renewal period. Any changes shall be accomplished in writing with mutual agreement and signed by both parties to this contract.

Contract Price

All prices shall be firm and fixed. MoDOT shall not pay nor be liable for any other additional costs including but not limited to taxes, shipping charges, insurance, interest, penalties, termination payments, attorney fees, liquidated damages, etc. The contractor shall not invoice federal excise tax unless otherwise required under federal law or regulation.

Escalation Clause

In the event the contractor requests a price increase during the contract period, the contractor must provide a written request and documentation justifying the need for a price increase, and the amount of such price increase. MoDOT will review the contractor's written request and documentation, and decide if a price increase is to be granted at that particular time. The contractor shall understand and agree that MoDOT's decision shall be final and without recourse.

- a. No price increase shall be granted during the first 3 months of the contract period.

Bid Submittals

In addition to pricing, the Bidder shall supply the following information:

1. Experience. The bid must clearly identify the Bidder’s experience in offering the services requested in this Request for Bid (RFB) during the past five (5) years. The description should include a list of the agencies which your company has served or currently serves.
2. Personnel:
 - a. Indicate the name, location, telephone number, fax number and email address of the primary contact person for the Bidder.
 - b. Indicate the name(s) of all personnel who will deliver contract maintenance services.
 - i. **Bidder should include copies of current Verification Authorities for all employees who will conduct maintenance on MoDOT AWOS equipment.**
 - ii. **In the event of staffing changes for the awarded bidder during contract period, updated copies of current Verification Authorities will need to be supplied within 45 days.**
3. References. Bids should indicate the name, title and telephone number of at least one (1) client within the past three (3) years.
4. Each bid must be mailed or hand-delivered in a sealed package to the RFB Coordinator at the General Services Procurement Office. All questions regarding the RFB shall be submitted to the RFB Coordinator. All bids must be received at the General Services Procurement Office no later than **2:00 PM, Central Time, June 16, 2015.**

RFB Coordinator:
Robin Warren, Sr. General Services Specialist

Missouri Department of Transportation
General Services – Procurement

P.O. Box 270, Jefferson City, MO 65102 (Mailing Address)

830 MoDOT Drive, Jefferson City, MO 65109 (Physical Address)

PHONE: (573) 526-7929; FAX: (573) 526-1218

All bids must be received in a sealed package clearly marked “**AWOS Maintenance Services**”

Award

Award will be all or none based on the responsive bidder with the **lowest grand total of the original bid price for each site**. Renewal pricing will not be a factor in determining bid award.

MoDOT reserves the right to reject any and all bids or award the bid based on the best interest of MoDOT.

PRICING PAGE

The Bidder shall provide firm, fixed prices in the table below for the original contract period and maximum prices for each potential renewal period in accordance with the provisions and requirements stated elsewhere herein.

SIGN BELOW AND SUBMIT WITH ALL OTHER BID DOCUMENTATION

Price shall be based on a *cost per site/per month.*

Site Location	Original Bid	1 st Renewal	2 nd Renewal	3 rd Renewal	4 th Renewal
Hannibal	\$		\$		\$
Harrisonville	\$		\$		\$
Lebanon	\$		\$		\$
Malden	\$		\$		\$
Marshall	\$		\$		\$
Maryville	\$		\$		\$
Mexico	\$		\$		\$
Moberly	\$		\$		\$
Nevada	\$		\$		\$
Piedmont	\$		\$		\$
Sullivan	\$		\$		\$
Warsaw	\$		\$		\$
GRAND TOTAL	\$		\$		\$

HOURLY RATE: List the PER HOUR RATE for which payment would be sought for any additional work requested by MoDOT that is outside the scope of services associated with the bid.

\$ _____ -- hourly rate

Reimbursement shall be made to the Bidder for approved parts purchased for services performed outside the scope of work, where there is a cost is a savings benefit to MoDOT and parts are not proprietary through Vaisala.

Company _____

Signature _____

VENDOR INFORMATION & PREFERENCE CERTIFICATION FORM

Vendor Information

All bidders must furnish **ALL** applicable information requested below

Vendor Name/Mailing Address: Email Address:	Vendor Contact Information (including area codes): Phone #: Cellular #: Fax #:									
Printed Name of Responsible Officer or Employee:	Signature:									
For Corporations - State in which incorporated:	For Others - State of domicile:									
If the address listed in the Vendor Name/Mailing Address block above is not located in the State of Missouri, list the address of Missouri offices or places of business: If additional space is required, please attach an additional sheet and identify it as <u>Addresses of Missouri Offices or Places of Business.</u>										
M/WBE INFORMATION: List all certified Minority or Women Business Enterprises (<u>M/WBE</u>) utilized in the fulfillment of this bid. Include <u>percentages</u> for subcontractors and identify the M/WBE certifying agency: <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 33%;"><u>M/WBE Name</u></td> <td style="text-align: center; width: 33%;"><u>Percentage of Contract</u></td> <td style="text-align: center; width: 33%;"><u>M/WBE Certifying Agency</u></td> </tr> <tr> <td style="border-top: 1px solid black; border-bottom: 1px solid black;"> </td> <td style="border-top: 1px solid black; border-bottom: 1px solid black;"> </td> <td style="border-top: 1px solid black; border-bottom: 1px solid black;"> </td> </tr> <tr> <td style="border-top: 1px solid black; border-bottom: 1px solid black;"> </td> <td style="border-top: 1px solid black; border-bottom: 1px solid black;"> </td> <td style="border-top: 1px solid black; border-bottom: 1px solid black;"> </td> </tr> </table> If additional space is required, please attach an additional sheet and identify it as <u>M/WBE Information</u>		<u>M/WBE Name</u>	<u>Percentage of Contract</u>	<u>M/WBE Certifying Agency</u>						
<u>M/WBE Name</u>	<u>Percentage of Contract</u>	<u>M/WBE Certifying Agency</u>								

Preference Certification

All bidders must furnish **ALL** applicable information requested below

<u>GOODS/PRODUCTS MANUFACTURED OR PRODUCED IN USA:</u> If any or all of the goods or products offered in the attached bid which the bidder proposes to supply to the MHTC are not manufactured or produced in the "United States", or imported in accordance with a qualifying treaty, law, agreement, or regulation, list below, by item or item number, the country other than the United States where each good or product is manufactured or produced.	
Item (or item number)	Location Where Item is Manufactured or Produced
If additional space is required, please attach an additional sheet and identify it as <u>Location Products are Manufactured or Produced.</u>	
<u>MISSOURI SERVICE-DISABLED VETERAN BUSINESS:</u> Please complete the following if applicable. Additional information may be requested if preference is applicable. See below definitions for qualification criteria: Service-Disabled Veteran is defined as any individual who is disabled as certified by the appropriate federal agency responsible for the administration of veterans' affairs. Service-Disabled Veteran Business is defined as a business concern: <ol style="list-style-type: none"> a. Not less than fifty-one (51) percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than fifty-one (51) percent of the stock of which is owned by one or more service-disabled veterans; and b. The management and daily business operations of which are controlled by one or more service-disabled veterans. 	
<u>Veteran Information</u>	<u>Business Information</u>
Service-Disabled Veteran's Name (Please Print)	Service-Disabled Veteran Business Name
Service-Disabled Veteran's Signature	Missouri Address of Service Disabled Veteran Business

ATTACHMENT A

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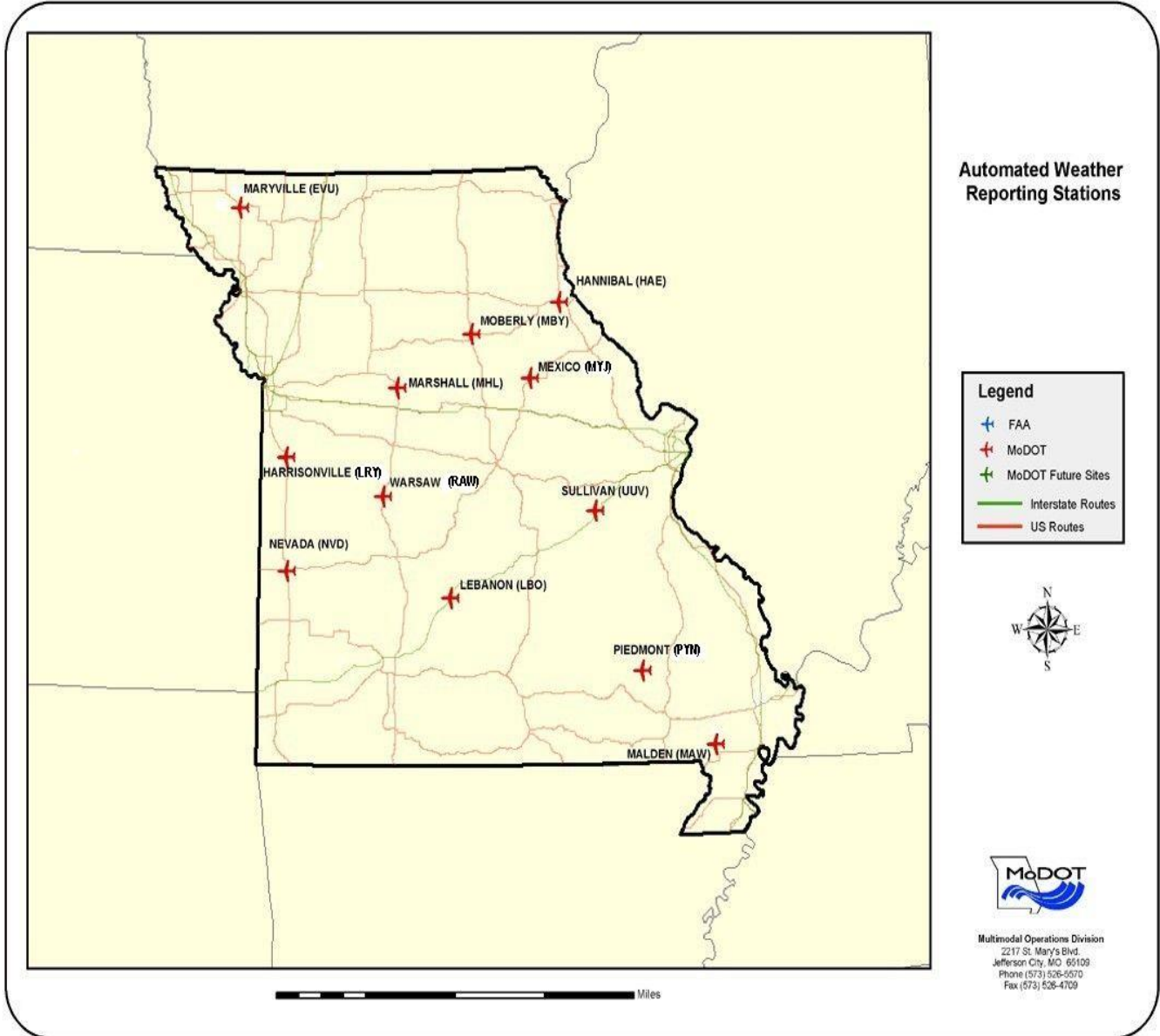
MoDOT AWOS Airport Sites



<u>Location</u>	<u>Name</u>	<u>County</u>	<u>FAA ID</u>	<u>Phone #</u>	<u>Radio Frequency</u>	<u>AWOS Type</u>
Hannibal	Hannibal Municipal	Marion	HAE	573-221-0111	120.775	AWOS-III-P-T
Harrisonville	Lawrence Smith Memorial	Cass	LRV	816-380-8900	119.975	AWOS-III-P-T
Lebanon	Floyd W. Jones - Lebannon	Laclede	LBO	417-532-2156	118.975	AWOS-III-P-T
Malden	Malden Municipal	Dunklin	MAW	573-276-4502	119.825	AWOS-III-P-T
Marshall	Marshall Memorial Municipal	Saline	MHL	660-886-2226	118.675	AWOS-III-PT
Maryville	Northwest Missouri Regional	Nodaway	EVU	660-562-8001	118.225	AWOS-III-P-T
Mexico	Mexico Memorial	Audrain	MYJ	573-581-2100	120.575	AWOS-III-P-T
Moberly	Omar N. Bradley	Randolph	MBY	660-269-8705	120.025	AWOS-III-P-T
Nevada	Nevada Municipal	Vernon	NVD	417-448-2700	119.175	AWOS-III-P-T
Piedmont	Piedmont Municipal	Wayne	PYN	573-223-7660	118.475	AWOS-III-P-T
Sullivan	Sullivan Regional	Franklin	UUV	573-468-4612	119.375	AWOS-III-P-T
Warsaw	Warsaw Municipal	Benton	RAW	660-438-5522	118.325	AWOS-III-P-T

ATTACHMENT A
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AWOS LOCATIONS



ATTACHMENT B

AIRPORT CONTACTS

AIRPORT MANAGERS & EMAIL ADDRESS

LOCATION	MANAGER	MANAGER PHONE	EMAIL
Hannibal	Mike Barron	573-221-3230	mbarron@classicaircraft.com
Harrisonville	James Green	816-380-5039	airport@ci.harrisonville.mo.us
Lebanon	Chris Heard	417-588-6098	cheard@lebanonmo.org
Malden	Barbara Crayne	573-276-2279	airport@maldenmo.com
Marshall	Bill Anderson	660-886-9855	municipalservices@mmuonline.net
Maryville	Kevin Rankin	660 582-2233	bubbs91@hotmail.com
Mexico	Jay Jacobi	573-581-0162	jacobi@maain.com
Moberly	Tom Sanders	660-263-4835	tsanders@cityofmoberly.com
Nevada	Jody Bryson	417-448-2752	anitajackson022@gmail.com
Piedmont	Bill McMurry	573-223-4528	billymc@cityofpiedmont.com
Sullivan	Larry Cuneio	573 468-2631	streets@fidmail.com
Warsaw	Tina Lomax	660-438-5522	cityclerk@welcometowarsaw.com

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ATTACHMENT C

Automated Weather Observing Systems (AWOS) for Non-Federal Application

Please refer to the Federal Aviation Administration's (FAA) Advisory Circular Number 150/5220-16D for information on the FAA standards for non-Federal AWOS. The below link will take the Bidder to the on-line posting of this circular.

http://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5220.16D.pdf

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Advisory Circular

U.S. Department
of Transportation

**Federal Aviation
Administration**

Subject: AUTOMATED WEATHER
OBSERVING SYSTEMS (AWOS) FOR
NON-FEDERAL APPLICATIONS

Date: 04/28/2011
Initiated by: AJW-14A

AC No: 150/5220-16D
Change:

1. **PURPOSE.** This advisory circular (AC) contains the Federal Aviation Administration's (FAA) standard for the non-Federal AWOS. This AC applies to anyone proposing to design, procure, construct, install, activate or maintain an AWOS.
2. **CANCELLATION.** AC 150/5220-16C, AWOS's for Non-Federal Applications, dated 12/13/99, is canceled.
3. **DEFINITION.** An AWOS is a computerized system that automatically measures one or more weather parameters, analyzes the data, prepares a weather observation that consists of the parameter(s) measured, provides dissemination of the observations and broadcasts the observation to the pilot in the vicinity of the airport, typically using an integral very high frequency (VHF) radio or an existing navigational aid (NAVAID), or Automatic Terminal Information Service (ATIS). Observations may also be available by telephone dial-up service. The Non-Federal AWOS is a Non-Federal facility as defined in Appendix 1 of the latest edition of FAA Order 6700.20.
4. **APPLICATION.** The provisions of this AC are effective immediately for all systems, or portions thereof, that are submitted for type certification or for previously type-certified systems that are submitted for modification of their type certification certificate. The maintenance intervals and commissioning and annual revalidation criteria identified in this AC apply effective immediately to all systems that have been type certified in the past. The criteria clarifying the use of the word *advisory* in broadcast messages apply effective immediately to all systems that have been type certified in the past. The criteria clarifying non-Federal technician qualifications and training as well as the FAA examination and certification/verification authority issuance process apply effective immediately to anyone seeking certification/verification authority.
5. **USE IN THE NATIONAL AIRSPACE (NAS).** An AWOS that has been manufactured, installed, and maintained according to the criteria in this AC may constitute a National Weather Service (NWS) approved source for weather information; may be approvable as a

source of weather information that partially satisfies aviation regulations as identified in Title 14 of the Code of Federal Regulations (14 CFR); may be eligible to receive a broadcast frequency assignment or permission to broadcast over a NAVAID; may be eligible (subject to additional criteria) to transmit its weather information, directly or indirectly, to the FAA for subsequent national dissemination and may be eligible for funding under Federal grant programs.

6. CONTENT OF THIS AC. Accordingly, this AC provides guidance about the program elements that should be incorporated into an AWOS. It provides the guidance and suggestions for one method, but not the only method, of complying with all pertinent regulations.

7. PRINCIPAL CHANGES. Changes the minimum preventative maintenance interval from 90 days to tri-annual (120 days). Clarifies information about connectivity to the FAA for national dissemination of AWOS data. Changes the Office of Primary Responsibility (OPR) for type certification from the Washington DC program office to the Oklahoma City Weather Processors and Sensors Team (AJW-14A). Makes word changes to clarify sentence meanings. Changes the precipitation occurrence and measurement from one category into two distinct categories: 1) Present Weather Detector/Sensor and 2) Rain Gauge. Adds criteria for Ultrasonic Wind sensors and an AWOS to Automatic Terminal Information System (ATIS) switch.

8. HISTORICAL INFORMATION ABOUT THE PREVIOUS CHANGE DATED 12/13/99. Provided clarification as to what system performance verification testing was, why it was important to have valid performance verification checks and references, and why these checks should be accomplished at acceptable intervals. Added minimum desired and maximum operating tolerances, references, performance checks, and intervals that support reliable system performance and user confidence. Provided an incentive for manufacturers to utilize valid verification techniques and technological improvements to enhance system reliability. Redefined AWOS wind sensor tolerances to be consistent with other FAA-approved wind sensors. Clarified information about type acceptance and maintenance documentation needs. Made word changes to clarify sentence meanings.

9. REQUESTS FOR INFORMATION. Further information concerning AWOS standards and the FAA type certification approval process may be obtained from:

AWOS Non-Federal Engineering Office
Weather Processors and Sensors Team (AJW-14A)
6500 S. MacArthur, Bldg 196
Oklahoma City, OK 73169
Telephone: (405) 954-8427



Brad Gee
Acting Director, Safety and Operations Support

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Chapter 1. INTRODUCTION

1.1. FUNCTIONAL DESCRIPTION. An AWOS automatically measures meteorological parameters, reduces and analyzes the data via computer, and broadcasts weather reports which can be received by aircraft operating up to 10,000 feet above ground level and 25 nautical miles (nm) from the AWOS. Pilots may use the certified weather information provided by the AWOS to partially fulfill the requirements of various regulations identified in Title 14 of the Code of Federal Regulations (14 CFR).

1.2. WEATHER SENSORS. The AWOS is a modular system utilizing a central processor which may receive input from several sensors. Five standard types of AWOS are defined in the following paragraphs a through e; however, an AWOS may be type certified with any combination of sensors. These five standard types are used throughout this AC and are recognized in other FAA Orders.

- a. AWOS A. The AWOS A system measures and reports altimeter only.
- b. AWOS I. The AWOS I system measures and reports wind data, e.g., speed, direction, and gusts; temperature; dew point; altimeter; and density altitude.
- c. AWOS II. The AWOS II system measures and reports all the parameters of AWOS I system plus visibility.
- d. AWOS III. The AWOS III system measures and reports all the parameters of AWOS II system plus precipitation accumulation (rain gauge) and cloud height. AWOS III can have optional sensors such as precipitation type/intensity (present weather, P) and/or thunderstorm/lightning (T). The addition of an optional sensor will change the designation to AWOS III P or AWOS III T, or AWOS III P/T.
- e. AWOS IV. The AWOS IV system measures and reports all the AWOS III P/T (i.e. AWOS III with both present weather and thunderstorm/lightning) parameters plus freezing rain (Z) and/or runway surface condition (R). The addition of an optional sensor will change the designation to AWOS IV Z, AWOS IV R, or AWOS IV Z/R.
- f. Any standard type certified AWOS may include additional sensors to suit individual airport needs. (For example, the AWOS AV consists of an AWOS A with a visibility sensor.) If the additional sensors are to be considered certified, they must meet the certification criteria of this AC and be installed, commissioned, inspected and maintained in accordance with this AC. All other sensors are considered advisory. Advisory sensors may not meet the criteria of this AC, may not be installed, maintained, or inspected in accordance with this AC and are not approved sources of weather information. Any advisory sensor values and parameters relying on an advisory sensor's

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values must be differentiated from certified parameters by being clearly identified as such and preceded by the word *advisory* in the voiced message. Any information preceded by the word *advisory*, regardless of its source, is considered advisory. When broadcast via radio or telephone, official weather information should be broadcast first, followed by the word *advisory* and then followed by all remaining weather information that is not from an approved weather source. Advisory information cannot be included in any portion of the outgoing METAR message.

1.3. OUTPUT MEDIA FOR AWOS WEATHER INFORMATION.

a. The output of the AWOS is reported by a computer-generated voice, which is transmitted to pilots over a discrete VHF transmitter or the voice output of a Navigational Aid (NAVAID). The transmission may be continuous or may be triggered by three clicks of a pilot's microphone on the AWOS broadcast frequency if the AWOS broadcasts over a VHF aeronautical advisory station frequency radio, e.g., UNICOM. System design may permit the transmission of the identification of a NAVAID by using the AWOS voice capability. In all cases where the voice output of a navigational aid is used, provision should be made so that the failure of an AWOS would in no way result in any failure of the NAVAID being used.

b. AWOS messages may be offered via other formats that the owner chooses to provide, including telephone dial-up service. An option allows type certified, commissioned AWOS III and AWOS IV data to be disseminated by the FAA nationally so that the weather information is available for forecasting and flight planning purposes. The connection type can be via an approved third party vendor or the state approved interface, e.g. the National Association of State Aviation Officials (NASAO), who provides the connection to the Weather Message Switching Center Replacement (WMSCR) for type certified, commissioned AWOS III or IV systems by the means of file transfer protocol (ftp). To contribute to this network, the AWOS should provide the data in a format that is compatible with the approved third party vendor or the state approved interface. The third party vendor or the state is responsible for all coordination with the WMSCR office.

c. The third party vendor or state agency that provides non-Federal AWOS weather information to the FAA for national dissemination would be required to sign a Memorandum of Understanding (MOU) with the WMSCR office that commits them:

(1) To convert the AWOS data to the current or future WMSCR format interface.

(2) To the current METAR format.

(3) To a reporting frequency, e.g., number of reports per hour, in accordance with criteria directed by the WMSCR office within the FAA.

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(4) To bear all communications, quality assurance, troubleshooting, and administrative costs to provide their non-Federal AWOS information to the WMSCR.

(5) To provide a point of contact for use by the FAA and others to report problems with the AWOS or with the communications link to the WMSCR. The point of contact would be available by telephone and responsive during normal business hours, and is encouraged to be responsive on a 24-hour a day basis.

d. The output of the AWOS weather observation is controlled by one of four modes of operation. Mode 1 is applicable to all systems; modes 2, 3, and 4 are applicable only to systems configured with an operator terminal (OT). Modes 3 and 4 require an agreement with the NWS to maintain a Non-Federal Observer (NF Obs) program to augment and backup the AWOS system.

(1) Mode 1, Full-time Automated Operation. In this mode, the AWOS operates 24 hours/day without any manual input. The automated weather observations are updated on a minute-by-minute basis. There is no weather observer input to the AWOS. However, a manual observing capability may be maintained as backup provided that an agreement exists with the National Weather Service (NWS) to maintain a manual observing capability such as Supplemental Aviation Weather Reporting Service (SAWRS).

(2) Mode 2, Full-time Automated Operation with Local Notice to Airmen (NOTAM). Operation in this mode is the same as Mode 1, with the addition of the capability to append a manually recorded NOTAM to the automated voice reports (see paragraphs 3.19.a.(1)(d) and 3.20. The airport manager is responsible for the timeliness and accuracy of the NOTAM information. This NOTAM is limited to aviation related information specific to the airport in accordance with the latest edition of FAA Order 7930.2, Notice to Airmen (NOTAM), and must not include commercial announcements such as fuel prices, lodging, etc. NOTAM information is heard on the local voice broadcast, it is not transmitted over the national network. There is no weather observer input.

(3) Mode 3, Full-time Automated Operation with Manual Weather Augmentation and Local NOTAM Option. Operation in this mode is the same as Mode 1 with the addition of the capability for a NWS certified weather observer to manually augment the automated observation by appending a weather entry to the observation during the weather observer duty hours. The observer duty hours should be published in the Airport/Facility Directory. The addition of a local NOTAM, per paragraph 1.3.c.(2), is also permitted in this mode of operation, provided there is no interference with the observer augmentation. The weather observer is responsible for the accuracy and timeliness of the added weather information. The weather to be added is limited to thunderstorms, all types of precipitation, and obstructions to vision. The weather parameters added by the observer is to be manually recorded and appended to the automated voice reports using the operator terminal (OT) and, as applicable, entered manually into the system for transmission over the national network. The procedures in the latest edition of the Federal Meteorological Handbook No. 1 (FMH-1), and the latest edition of FAA Order 7900.5, Surface Weather Observing, apply.

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(4) Mode 4, Part-time Manual Operation. Mode 4 is normally used for backup. This mode permits a NWS certified weather observer to enter a complete manual observation into the system. The procedures in the latest editions of FMH-1 and Order 7900.5 apply to the recording and formatting of these manual observations. As applicable, the manual observations are transmitted to the national network. Voice dissemination of the observations should be done manually using the OT. The manual observations include input from the automated AWOS outputs available to the weather observer on the OT display, to be modified in accordance with the latest edition of FAA Order 7900.5. For example, the manual observation includes manually derived ceiling/sky condition and visibility, using FMH-1 definitions, which differ somewhat from the AWOS algorithms. Temperature, dew point, wind direction/speed, and altimeter setting are the same and are used exactly as presented on the AWOS OT display or using FAA approved back-up instrumentation.

e. Aviation Routine Weather Report Format (METAR).

(1) All AWOS output must meet METAR format requirements. National network distribution of wind direction must be in *True* while local dissemination, e.g., radio and telephone, must be *Magnetic*.

(2) A current copy of the appropriate interface control document (ICD) can be obtained from the AWOS Non-Federal Engineering Office at the following address.

AWOS Non-Federal Engineering Office
Weather Processors and Sensors Team (AJW-14A)
6500 S. MacArthur, Bldg 196
Oklahoma City, OK 73169
Telephone: (405) 954-8427.

1.4. FAA's FACILITY PERFORMANCE AND INSPECTION RESPONSIBILITY. The General Aviation Revitalization Act of 1994 reaffirmed the FAA's responsibility and authority to regulate and inspect air navigation facilities, including aviation meteorological services. The establishment and maintenance of non-Federal facilities, including AWOS systems, are covered in the latest edition of FAA Order 6700.20, Non-Federal Navigational Aids and Air Traffic Control Facilities.

a. Chapters 3 and 4 of this AC provide the FAA's minimum acceptable commissioning and revalidation standards and references for a non-Federal AWOS system. Chapter 4 also provides the expected minimum checks and maximum maintenance intervals between checks.

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b. FAA-owned meteorological/AWOS equipment tolerances are found in the latest edition of FAA Order 6560.13, Maintenance of Aviation Meteorological Systems.

c. Non-Federal AWOS systems require on-site commissioning. In accordance with the latest edition of FAA order 6700.20, commissioning is required to be accomplished on-site by a qualified technician with the proper FAA verification authority and witnessed by a qualified FAA non-Federal inspector.

d. Non-Federal AWOS systems require annual on-site performance verification. In accordance with the latest edition of FAA Order 6700.20, this verification is required to be accomplished on-site by a qualified technician with the proper FAA verification authority and witnessed by a qualified FAA non-Federal inspector.

e. Verification is the written assurance that the facility, system, or service is providing the required/advertised service to the user. System performance checks are made to identify and correct changes or drifting of performance parameters and to provide documented assurance to the user of the validity of the published information.

f. If results of these checks are satisfactory, a maintenance technician with FAA verification authority will document this fact by making a system verification entry in the facility's FAA Form 6030-1, Facility Maintenance Log. If the checks are not satisfactory, the maintenance technician should make an appropriate entry in the Facility Maintenance Log and the system or individual sensor should not be used. (Maintenance logs should be retained on-site.) In addition, if the sensor affects the altimeter reading, the entire AWOS is to be removed from service and a NOTAM issued to document the system status. For any other sensor, the sensor is to be NOTAMed as unreliable or out of service. For guidance on Facility Maintenance Log entries, reference 300-PML, Paper Maintenance Log, and the latest edition of FAA Order 6040.15, National Airspace Performance Reporting Systems (NAPRS).

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Chapter 2. CERTIFICATION AND COMMISSIONING PROCESS

2.1. PROCESS OVERVIEW. In order to provide confidence in the quality of the meteorological data that the AWOS provides to users in the aviation community, the FAA has initiated a three-part AWOS quality assurance process consisting of type certification, site-specific commissioning and annual revalidation.

a. Type Certification. The manufacturer should provide the FAA with the test data and other system documentation to demonstrate that the AWOS system meets the criteria of this AC. Reference paragraph 2.2, Manufacturers Submittals for Type Certification Approval. Upon completion of all the requirements set forth in this AC, the FAA will grant type certification approval to the specific system configuration documented in the request.

b. Site-Specific Approval. Prospective sponsors, i.e., owners, wanting to install an AWOS system for public use should closely coordinate their plans with the FAA Service Center non-Federal Program Implementation Manager (PIM) or coordinator and follow the procedures provided. The latest edition of FAA Order 6700.20 requires that a Memorandum of Agreement (MOA) and an Operations and Maintenance Manual (OMM) be established between the sponsor and the FAA and agreed to, i.e., signed, prior to commissioning the AWOS for public use. The MOA/OMM is used to ensure that there is a mutual understanding of what is required to operate and maintain a commissioned AWOS system. After the AWOS is installed on-site, and the MOA/OMM is signed, the FAA conducts a commissioning ground inspection to verify that the system is located, installed and operating correctly and that the owner has the resources to maintain the system in proper operating condition. Reference paragraph 2.7 for information on facility commissioning. A flight inspection is required for NAVAIDS used for AWOS VHF dissemination. This process should be successfully completed for the AWOS to be commissioned by the FAA and to be authorized to operate.

c. FAA Inspections. Finally, in addition to the annual revalidation inspection, there may be periodic visits to the operational AWOS by the FAA and other technical representatives to verify that the system continues to operate correctly. Guidance for these visits may be found in paragraph 2.10, Ongoing System Validation, and Chapter 4, AWOS System Maintenance and Operating Requirements, of this AC, the facility MOA/OMM, and the latest edition of FAA Order 6700.20.

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2.2. MANUFACTURER SUBMITTALS FOR TYPE CERTIFICATION APPROVAL.

a. The AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) will grant type certification approval to an AWOS design after review and approval of three submittals from the manufacturer.

(1) The first submittal consists of test procedures and data sheets that demonstrate that the proposed AWOS configuration meets the criteria of this AC. This submittal should include a single matrix showing each specific requirement from this AC, cross-referenced to the specific location, e.g., paragraph, page, etc., within the manufacturer's submittal where the requirement has been addressed.

(2) The second submittal consists of warranty, training, and maintenance documents intended to support the AWOS system owner.

(3) The third submittal consists of a configuration control plan that identifies the components and options approved for use with the system.

b. Requests for type certification approval should be sent to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2).

c. Product approval (including type certification, commissioning, or annual revalidation) may be revoked or an individual site may be removed from service if:

(1) The equipment is not maintained or inspected in accordance with this AC.

(2) The equipment has an unacceptable failure rate.

(3) There is a deficiency that precludes or hampers valid performance verification of the system operation.

(4) Changes are made to the software, firmware or hardware without FAA approval.

(5) Transmitted data does not conform to the latest editions of the Federal Meteorological Handbook (FMH-1) or FAA Order 7900.5.

(6) The manufacturer fails to honor the warranty.

2.3. TEST PROGRAM. Chapter 3 of this AC contains the performance and testing standards for each component of the AWOS. The manufacturer should demonstrate compliance with these

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standards through performance testing where a test is specified or by analysis and inspection. The manufacturer provides all necessary equipment and bears all testing costs. Prior to performing tests the manufacturer should propose a test plan to the FAA containing detailed procedures for conducting the tests, as well as the name and location of the facility where the tests are to be conducted. Prior FAA review of the test plan should minimize the likelihood of improper test procedures that might result in rejection of the data. It is the responsibility of the manufacturer to provide credible test data to the FAA that is based on fact and representative of the equipment being type certified. Submissions should include all data collected during a test; data should not be omitted because it falls outside of the recommended acceptable limits of this AC. After completion of the tests, the manufacturer should reduce the data to an easily understood format to demonstrate conformity with this AC. If the manufacturer has previously performed testing, the test procedures and data sheets from these tests may be submitted for consideration. However, the FAA reserves the right to witness testing, request additional testing, and examine raw data.

2.4. SYSTEM DOCUMENTATION.

a. The manufacturer should submit one hard copy and one permanent media (CD, DVD or similar) electronic copy of the draft documentation described in this paragraph to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) for review and approval. The System Description Manual, Maintenance Manual, Installation and Checkout Manual, Operating Instructions Manual, applicable schematics, and Annual System Revalidation Plan Manual should be provided as separate manuals. These documents are intended to assist the AWOS owner in the installation, operation, and maintenance of the system. The items may be cross-referenced to avoid duplication, but the elements of each portion of each document should be clear. For example, the maintenance procedures that are performed during the annual system revalidation should be explicitly referenced.

b. After the FAA has approved these manuals, five permanent media (CD, DVD or similar) electronic copies and five hard copies of these approved documents should be submitted to the FAA as follows:

- (1) One electronic copy and one hard copy to:

AWOS Non-Federal Engineering Office
Weather Processors and Sensors Team (AJW-14A)
6500 S. MacArthur, Bldg 196
Oklahoma City, OK 73125

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(2) Four electronic copies and four hard copies to:

Non-Federal AWOS Program (AJW-163)
Orville Wright Bldg. (FOB10A)
800 Independence Ave., SW
Washington, DC 20591

c. The following documents must be submitted to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) and approved before type certification approval of any system or any system modification requiring a change in any of these documents will be granted. These documents are distributed to each FAA service area and other appropriate FAA offices to keep them apprised of all type certified systems, sensors, and changes. If a manufacturer modifies the initially approved configuration, the submission process must be repeated before type certification approval is granted for the modified system, and the system is offered for sale.

(1) System Description. The system description document should identify and catalog the hardware components to the level of the smallest field-replaceable unit (FRU) module and should describe system software and firmware. The principles of system operation should be described using schematics, block diagrams, flow diagrams and pseudocode as appropriate. Sensor processing should be described using pseudocode. For peripheral devices, the performance parameters should be included along with the name and address of the original manufacturer.

(2) Manufacturer's Maintenance Manual. The manufacturer's maintenance manual should contain a comprehensive maintenance program to be implemented by the owner to ensure reliable and accurate performance over the life of the system. As a minimum, the program should define all maintenance activities that are required within a period of 5 years and a recommended frequency, e.g., tri-annually, i.e. three times per year, annually for each operation. The following topics should be addressed in the Maintenance Manual.

(a) Maintenance Procedures. The maintenance procedures manual should contain a step-by-step procedure for each scheduled, i.e., periodic, and unscheduled, i.e., repair, maintenance operation. It should discuss calibration methods including the importance of using collocated National Institute Standards & Technology (NIST) traceable calibrated test equipment; troubleshooting procedures; suggested spare parts; and identify all test equipment required. This document should also include the detailed procedures, e.g., the keystrokes, the maintenance technician follows when using the operator terminal to perform maintenance on the system.

(b) System Performance Parameters. The system performance parameters manual should contain a complete listing of the test points, sensor outputs, waveforms, and other parameters which indicate system performance that may be measured in the field as described in Chapter 4. If

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these quantities are field adjustable, then an initial value for use during initial commissioning certification and an operating tolerance for use during the annual verification should be given. The key system parameters should also be identified; i.e., those values which best indicate system performance and to be checked most frequently. The frequency of scheduled maintenance action, e.g., tri-annually and annually, should also be given.

(c) Data Recording Forms. This manual should contain three types of forms designed to aid the system owner in recording the system performance data described in paragraph 2.4.b.

(i) The Comprehensive Facility Performance and Adjustment Data Form. This form is similar to FAA Form 6030-17, Technical Reference Data Record, and is an initial facility commissioning data form which should be completed at system commissioning and after major repair work, i.e., after a major component has been replaced. The form should contain the standards and tolerances of each component, all of the initial commissioning checks required, space to record the actual result of each performance check, and another space to enter the standard or reference value expected from each check.

(ii) The Technical Performance Record (TPR). The TPR is similar to FAA Form 6000-8, Technical Performance Record, and is a data record form that is used to record the results of performance checks accomplished during routine and non-routine maintenance visits. It may also be used as a checklist of all of the scheduled maintenance to be done at the facility during a specific routine scheduled maintenance (SM) visit, e.g., during a visit to accomplish scheduled tri-annual or annual performance maintenance (PM). The form should also include the standards and tolerances required to be measured with a space to record each result. It is to be used to record the actions during the tri-annual maintenance visit, the annual validation inspection, during non-routine maintenance performed to capture any changes to sensor or system parameters, and to log the results of tests conducted after an aviation accident. Separate forms may be established and used to cover different PM visits.

(iii) FAA Form 6030-1. The third form is the FAA Form 6030-1, Facility Maintenance Log. The FAA will provide this form. Instructions for its use should be included in the FAA/sponsor MOA/OMM. The maintenance log should be retained on site. All site visits should be documented on this form. It will provide a historical record of all maintenance actions accomplished on the AWOS. The technician should list all maintenance actions accomplished, e.g., tri-annual scheduled maintenance actions completed, dew point sensor replaced; any damage should be logged, e.g., bullet hole in vertical fin of the wind sensor, needs replacement; and any problem with the AWOS should be noted, e.g., dew point sensor disconnected, replacement required. When a system or component repair or adjustment has been accomplished, the maintenance technician should make a performance verification statement on this form. In all cases, the technician completing the action and making the form entry should be identified on the form. These forms also contain the date of the action, the facility name and location, and other identifying data. More information on completion of the Form 6030-1 may be found in the MOA/OMM or the latest edition of FAA Order 6700.20.

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d. Installation and Checkout Manual. This document should thoroughly describe the installation and checkout procedures to be followed by the technician at the installation site.

e. Operating Instructions (i.e., an Observer Handbook). This document should provide detailed instructions for a National Weather Service (NWS) certified weather observer to operate the system. This document should describe and provide instructions for operation in each of the four modes described in see paragraph 1.3.d, and it should explain the procedures when using the operator terminal to augment or to backup the AWOS, or to disseminate NOTAM information.

f. Training Program. The training program should consist of a summary of the knowledge and skills that a maintenance technician should possess to service the AWOS. This document should also propose a program to familiarize maintenance technicians with the maintenance and operation of the AWOS. The training program may be conducted on-site, at the factory, via home study, or by other means suggested by the manufacturer to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) for approval by the FAA. The training program should cover both concepts and practical performance. It should contain a written test that may be used to measure a person's knowledge of the system. The manufacturer should submit to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) two equivalent, comprehensive 50-question open book tests with answer sheets for approval. The two tests will be used interchangeably by the FAA to test the competence of a maintenance technician on the specific system. The FAA will administer the performance examination to any technician seeking verification authority on the specific system. This exam will require the technician to demonstrate the ability to accomplish all commissioning and annual reverification tasks.

g. Annual System Revalidation Plan. This plan should contain the recommended procedures to conduct an annual inspection of the facility to revalidate the system and document that it is in the approved configuration and operating within tolerance. Reference paragraph 2.10 for information on system revalidation.

h. Warranty. The manufacturer should submit to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) a statement certifying the following minimum warranty for the equipment:

This equipment has been manufactured and should perform in accordance with requirements of this AC. Any defect in design, materials, or workmanship which may occur during proper and normal use during a period of 1 year from date of installation or a maximum of 2 years from date of shipment should be corrected by repair or replacement by the manufacturer.

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2.5. CONFIGURATION CONTROL PLAN. Due to the modular nature of the AWOS, many system components such as sensors and peripheral devices may be interchangeable. Since type certification approval is given only to specific combinations of components, the manufacturer should establish a configuration control mechanism that would uniquely identify each FAA-approved system, its hardware, software and firmware components (including revision levels) and its documentation (including revision levels). Before type certification approval is granted, the manufacturer should submit a Configuration Control Plan to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) for approval.. The configuration control plan should explain and include the procedures for configuration control of all hardware, software, firmware and documentation. The identifying information for each system should be permanently inscribed on a system name plate. Changes to an approved configuration should be submitted for FAA approval to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2). The manufacturer may incorporate minor product improvement changes after notifying and obtaining approval from the FAA AWOS Non-Federal Engineering Office. Major changes, such as a sensor or a major hardware, software or firmware change should be fully supported by documentation and appropriate test data. Major changes normally require the assignment of a new configuration number. The FAA will determine the scope of the change, i.e., major vs. minor. Every change to an approved AWOS should be supported by revised configuration controlled documentation. The plan should also address:

- a. The manufacturer's arrangement for assigning a configuration identification number/symbol/etc., and the means used to identify which system components, e.g., hardware, software, firmware and documentation, are included in a particular system configuration.
- b. Procedures for notifying system owners of changes in the approved configuration of their AWOS.
- c. Procedures for identifying and maintaining a record of the configuration of each operational system that has been sold by the manufacturer.
- d. Procedures for the configuration control of documentation, to include procedures for issuing changes, numbering, and dating pages.

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2.6. PLANNING THE AWOS INSTALLATION.

a. All airport owners, sponsors, or other parties contemplating purchase and installation of a non-Federal AWOS should coordinate with the FAA before the equipment is ordered. The FAA Service Center non-Federal PIM is the official FAA point of contact in the Service Center Planning and Requirements Group and is responsible for the overall project coordination between the sponsor and other elements in the FAA. Airport sponsors desiring to obtain a grant under the Airport Improvement Program (AIP) to install an AWOS should also coordinate with the FAA Airport District Office that has jurisdiction over its specific geographical area. The FAA non-Federal Program Implementation Manager should coordinate the proposal with the Flight Procedures Office, Operations Support Group, Frequency Management Office, Airport District Office and other FAA offices as needed.

b. The selection of a voice outlet frequency for the AWOS is a critical issue. Therefore, it is advisable to coordinate with the FCC in the early planning stages of the facility, since there are a limited number of frequencies available for this purpose. (In accordance with the latest edition of FAA Order 90-42, Multicom frequencies are not intended for automated weather broadcasts.) The following order of frequency priority has been established by the FAA and should be used to the extent possible in establishing AWOS ground-to-air communications outlets.

(1) Assigned Automatic Terminal Information Service (ATIS) Frequency. At part-time towered locations, the AWOS utilizes the existing ATIS voice outlet frequency to provide weather information when the tower is closed. Frequency sharing coordination is discussed further in paragraph 3.21, AWOS ATIS Switch (AAS).

(2) VHF omnidirectional radio range (VOR) or VHF omnidirectional radio range/tactical air navigation (VORTAC) except Doppler VOR, with voice capability.

(3) The VOR/VORTAC must be located within 3 nautical miles (nm) of the airport and must not be used to broadcast other information such as Enroute Flight Advisory Service (EFAS).

(4) Nondirectional Radio Beacon (NDB) With Voice Capability. The NDB must be located within 3 nm of the airport. At locations where frequency congestion in the VHF air-ground band is not expected to be a problem, the use of an NDB should be considered as the fourth priority. The NDB frequency may have to be changed if the existing frequency is not in the 325 to 415 kilohertz (kHz) range.

(5) Any 25 kHz spaced discrete VHF air-ground communications channel in the air traffic control band (118-137 MHz). If an airport is equipped with an NDB or VOR/VORTAC, a request for a discrete frequency assignment should include a justification statement as to why it is not used for the AWOS transmission.

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c. The service volume for an AWOS voice outlet, excluding those broadcasts over existing ATIS systems, is normally limited to 10,000 feet above ground level and 25 nm from the AWOS. The FCC should approve requirements in excess of this value. Under no circumstances should the radius of the service volume exceed the terminal control area.

d. If the AWOS system proposed for installation does not meet the requirements of this AC or the radio does not meet the requirements of the FCC-approved standards, the FCC may not assign a broadcast frequency.

e. After an AWOS III or IV has been granted type certification approval and commissioned by the FAA, it becomes the weather source for the airport. Any existing manual weather observation program whose hours conflict with the AWOS III or IV should be terminated. However, as specified in paragraph 1.3.d, the AWOS owner may elect to maintain a manual observation capability to back up the AWOS in the event the system, or any critical parameter, e.g., windspeed/direction, ceiling/sky condition, visibility, altimeter setting, fails. In addition, the AWOS owner may elect to augment the AWOS output with observed parameters, e.g., thunderstorms or precipitation that are not within the capability of the AWOS. In these cases, the supplementary aviation weather reporting station (SAWRS) agreement with the NWS should be amended accordingly.

2.7. FACILITY COMMISSIONING. The FAA should formally commission the AWOS facility before it becomes available for public use. After receiving approval of a broadcast frequency, the owner may procure and install the AWOS facility. At least 120 days prior to the anticipated commissioning date, the owner should notify the FAA Flight Procedures Office (FPO) so that routine revisions may be made to the instrument approach procedures. As the system approaches operational readiness, the owner should request a commissioning ground inspection by an FAA non-Federal inspector. This inspection should include participation by the owner or owner's maintenance representative. The commissioning inspection consists of the tests and checks identified in the following paragraphs, a review of the operations and maintenance documents on file at the facility, and the recording of the initial facility performance data which should be retained as commissioning documentation in the Facility Reference Data (FRD), or similar historic record locations.

a. Siting, Installation, and Commissioning.

(1) Siting. FAA form 7460-1, Notice of Proposed Construction or Alteration, must be filed on line through www.faa.gov for approval of the proposed AWOS location. This location should be in accordance with the siting criteria contained in the latest edition of FAA Order 6560.20, Siting Criteria for Automated Weather Observing Systems (AWOS). Following installation, the FAA Tech Ops District non-Federal inspector should also verify that the AWOS equipment is installed in accordance with the siting order and that the checkout procedures have been performed. Any exceptions to the siting order should be justified and documented in the OMM as being the best

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practical solution for meeting the intent of the siting criteria. Any discrepancies found during the inspection should be rectified before the facility can be commissioned.

(2) Installation. The AWOS is a permanent facility and is located, constructed, and installed in accordance with applicable code requirements. It should be installed by a technician who is fully qualified in electronic applications; has a working knowledge of the operation, testing, and maintenance of the AWOS; and is either a maintenance technician employed at the manufacturer's factory or has been certified by the FAA. The procedures in the FAA-approved Installation and Checkout Manual should be performed. Reference paragraph 2.4.d for a description of the manual.

(3) Commissioning. Once the AWOS has been properly installed in accordance with the siting criteria and demonstrates that it meets the criteria established by this AC, it is commissioned to operate in the National Airspace System (NAS).

b. Performance Test. The AWOS owner's FAA-approved maintenance representative should operate the system and measure all system performance parameters described in this AC and the manufacturer's Maintenance Manual. The initial commissioning data are witnessed by the FAA Non-Federal Inspector and recorded on Comprehensive Facility Performance and Adjustment Data forms, or other approved commissioning data forms and retained at the facility in the FRD as commissioning documentation.

c. Flight Inspection. All NAVAID facilities, e.g., VOR, NDB, used as a voice outlet to broadcast weather information should be flight inspected to assure that operation of the NAVAID has not been derogated. If, during flight inspection, it is determined that performance of the NAVAID has been affected, the AWOS should not be activated until the malfunction has been corrected, e.g., through modification or by employing a separate discrete frequency transmitter to broadcast the weather. An AWOS utilizing a discrete frequency transmitter is not required to undergo a flight inspection.

d. Notification of the Commissioning. Following successful completion of the commissioning inspection, the FAA non-Federal PIM should notify the necessary FAA Offices, e.g., NFDC, FPO, MOCC, national non-Federal office, etc., of the commissioning date, broadcast frequency, voice access telephone number, system owner, and maintenance arrangements.

e. Relocation of an AWOS. In the event that an AWOS is removed from service to be relocated, a decommissioning NOTAM should be issued, instead of a facility out-of-service NOTAM. After relocation, a complete facility commissioning inspection should be performed.

2.8. ON-SITE DOCUMENTATION. The following documentation should be kept and maintained at the AWOS facility. It should contain all pertinent up to date on-site documentation, including the

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following documentation. The FAA should review the documentation at the commissioning inspection and during annual revalidation.

a. Type Certification Approval. A copy of the FAA letter to the manufacturer granting type certification approval for the AWOS system design should be included. The subsystems should be inspected to verify that the installed AWOS configuration is consistent with the type certification approval that was given.

b. Frequency Allocation Approval. A copy of the frequency FCC station license that was obtained assigning the approved operating UHF and VHF frequencies if appropriate.

c. Manufacturer's Documentation. Copies of the AWOS operating instructions, manufacturer's Maintenance Manual, and System Description. When changes are made to the manufacturer's documents, the manufacturer should forward revisions to the AWOS owner who is responsible for inserting them into the appropriate on site documentation.

d. Operational Procedures. Site-specific operational procedures that set forth mandatory site procedures for both routine and nonscheduled situations should be kept at the AWOS site. These procedures may incorporate appropriate sections of the manufacturer's manuals. The following items should be covered.

(1) Physical security of the facility.

(2) Maintenance and operations by authorized persons, including who to notify if a weather parameter is discovered out of tolerance or other maintenance is necessary.

(3) Posting of licenses and signs.

(4) Notice to the FAA PIM or coordinator/inspector must be made when any AWOS service has been suspended, or when a critical weather parameter is out of tolerance.

(5) Keeping of station logs and other technical reports.

(6) Names, addresses, and telephone numbers of persons to be notified in the event of system failure.

(7) Procedures for periodic scheduled shutdown maintenance, including the office responsible for generating NOTAMs for routine or nonscheduled shutdowns.

(8) Procedures for amending or revising the site instructions.

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(9) Procedures to be followed to freeze the 96 hours worth of AWOS data that were gathered prior to the time of an aircraft accident or incident, and the procedures to be followed to retrieve these data files for off-line analysis. These procedures should describe the responsibility for accomplishing these actions. They should be accomplished immediately following an accident, incident, or upon the request of a member of the FAA or NTSB.

(10) Locations of AWOS components on the airport. This includes the result of the survey to establish the site elevation, the elevation of the barometric pressure sensors and a true North reference point.

(11) Copy of all software and firmware licenses with revision identification.

(12) A MOA signed by the owner and the FAA Service Area Technical Operations Director or designee. This memorandum should state that the owner agrees to maintain, repair, and modify the AWOS in accordance with the requirements, standards, or criteria governing AWOS, particularly those contained or defined in the agreed to FAA/Owner OMM. The owner understands that noncompliance with the specific site's FAA/Owner MOA/OMM may result in the AWOS's removal from service or decommissioning.

(13) A copy of any agreement with the NWS to maintain a SAWRS capability to augment or back up the AWOS.

e. Commissioning Documentation. The initial commissioning documentation form such as the Comprehensive Facility Performance and Adjustment Data form should be completed during commissioning to record initial values and the respective standard or reference values as described in Chapter 4.

2.9. MAINTENANCE PROGRAM. The maintenance program should cover a minimum period of 5 years as established in paragraph 2.4.c.(2), and should consist of properly trained personnel meeting all FCC and FAA requirements, adequate test equipment, and resources to fulfill the manufacturer's recommended scheduled maintenance and calibration procedures as defined in the manufacturer's Maintenance Manual. The maintenance program is the responsibility of the owner, but may only be performed by personnel meeting vendor specific, FAA and FCC requirements. A person meeting these maintenance requirements will be issued an FAA verification authority letter for the specific vendor's system.

a. Maintenance Personnel. The owner should show that the maintenance program adopted has qualified personnel available to maintain the AWOS system. The latest edition of FAA Order 6700.20, Non-Federal Navigational Aids and Air Traffic Control Facilities, contains the qualifications for maintenance technicians that maintain non-Federal facilities. They should have the

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special knowledge and skills needed to maintain the AWOS facility and should have completed the manufacturer's training program or the FAA-approved Concepts Bypass exam. They should be able to demonstrate proficiency in accomplishing the required maintenance procedures including validation of test equipment calibration, and using the specialized test equipment. The FAA will issue a vendor specific verification authority letter to the candidate maintenance person if he/she is able to meet the concepts and performance requirements of the AWOS system, and has a FCC general radiotelephone license for maintenance of the associated transmitter, discrete frequency (UHF or VHF) or aeronautical advisory station (Unicom).

b. Test Equipment. The owner should have available at the facility, at the time of commissioning, all test equipment required by the approved maintenance plan for maintenance and calibration of the facility. Test equipment must be capable of accurately measuring the appropriate performance parameters to verify technical standards and tolerances needed for facility verification, and must be collocated with the AWOS. Test equipment should be calibrated to NIST traceable standards in accordance with the calibration schedule submitted to and approved by the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) during type certification acceptance. In case an acceptable test equipment calibration schedule was not included, test equipment will be calibrated as per the test equipment manufacturer's recommendations. Test equipment calibration should be traceable to national standards, and proof of calibration, e.g., a current calibration sticker should accompany each piece of test equipment when it is being used. The test equipment should be available when required for commissioning, scheduled system maintenance and calibration, or for repairs following system failure. All measurements should be made with test equipment collocated with the AWOS equipment being measured.

c. Annual Performance/Configuration Revalidation. The owner should plan for complying with the manufacturer's recommended and FAA approved plan for annual system revalidation. This plan should identify the appropriate FAA Tech Ops Non-Federal District Office to notify to witness the on-site revalidation and include a list of the procedures to be followed during the on-site revalidation as well as the source of the FAA qualified non-Federal technician to perform the inspection.

2.10. ONGOING SYSTEM VALIDATION. To verify that the system is being properly maintained and that the system retains an approved configuration, the following ongoing validation program should be conducted.

a. Performance/Configuration Revalidation. An FAA Service Area non-Federal coordinator or inspector should perform an on-site verification inspection of each AWOS annually in accordance with the manufacturer's approved Annual System Revalidation Plan. This inspection should include the items in the following paragraphs, and the results should be recorded on an Annual Technical Performance Record form or on a Comprehensive Facility Performance and Adjustment Data form identified as being used for annual revalidation and retained on file at the facility.

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(1) Verify that the maintenance program is being followed and properly documented.

(2) Witness the owner's maintenance technician performance of a comprehensive check and calibration to verify that system performance is within the limits specified by the manufacturer's documentation and to ensure that every component of the system is operating properly.

(3) Verify that the AWOS configuration is the same as approved at the time of commissioning or as formally modified in accordance with approved configuration control procedures. Additionally, it should be determined that all mandatory configuration changes approved by the FAA have been accomplished and documented.

(4) Verify that a summary of all maintenance, hardware and software, performed since the last report is on file at the facility.

b. FAA Site Visits. FAA inspectors will periodically visit certified non-Federal AWOS facilities. During the visit, the FAA inspector will verify, with the assistance of the owner's maintenance technician, that the system operates within tolerance, that all maintenance tasks have been properly performed and documented, and that the FAA has approved the AWOS configuration. The inspector may review the facility's FAA Form 6030-1 log and other documentation to verify that scheduled and unscheduled maintenance has been accomplished and documented in accordance with this AC, the approved FAA/Sponsor MOA/OMM, the approved manufacturer's Maintenance Manual, and the approved annual system revalidation plan. The owner's maintenance technician holding FAA verification authority should provide access to the site and accomplish any tests on the facility requested by the FAA representative during the visit. The FAA will provide the sponsor a written inspection report following completion of the inspection. The FAA representative may visit the site with a sponsor's representative without the non-Federal technician's presence provided no tests or adjustments are planned or accomplished on the AWOS equipment.

c. Mandatory Configuration Changes. If the FAA determines that an AWOS system, or any element of the system, is providing data that could be in error, the FAA may direct the system manufacturer to issue a mandatory configuration change order to the owners of similar systems. The system owner should disable the appropriate part of the system and should request that the FAA issue a NOTAM describing the missing parameter and give an estimate of the time for which it will be disabled.

d. Unacceptable Failure Rate. Equipment that proves unreliable is to be removed from the type certification approval listing. The determination of unreliability should be based on judgment and experience with similar equipment. Where equipment is determined to have an unsatisfactory failure rate or is deficient in workmanship or materials, the manufacturer is to be notified in writing as to the basis for this determination. The manufacturer should then notify the FAA in writing as to

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its plan of action for resolving the issue. If the manufacturer does not resolve the problem within a reasonable time, the equipment would be removed from the type certification approval listing. The timeframe would, of necessity, be based on safety considerations and the nature of the problem. The FAA reserves the right to require the equipment to undergo any or all qualification and calibration tests when the equipment has been determined unreliable or deficient in design, materials, or workmanship. Owners of similar AWOS installations should be notified of any problems uncovered during this retesting through the configuration control procedure discussed in paragraph 2.10.c, and paragraph 2.5, Configuration Control Plan.

e. Note. Failure to meet the criteria of this AC may result in decommissioning the AWOS facility, i.e., withdrawal of the FCC license, and withdrawal of type certification approval.

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Chapter 3. PERFORMANCE AND TESTING SPECIFICATIONS FOR AWOS

3.1. GENERAL. This chapter contains the performance standards and testing specifications for components of the AWOS. Equipment should comply with these standards to establish partial compliance with the Code of Federal Regulations (CFR). However, some of the following tests are intended to be performed in a laboratory environment and may not be able to be duplicated in the field. Current standards and tolerances are those which were approved during type certification acceptance. These are intended only as guidelines based on standards approved at type acceptance. If a manufacturer has specified additional checks to be performed, requested and received approval for different checks to be performed, or specified that tighter tolerances be required, then these will be detailed by the manufacturer in the FAA-approved Maintenance Manual for that specific type-certified AWOS.

3.2. DEFINITIONS.

a. Root Mean Square Error (RMSE). RMSE is determined by comparing the output value with the true value of a parameter according to the following equation:

$$RMSE = \sqrt{\frac{\sum_{N=1}^N (T - M)^2}{N}}$$

Where:

N = Number of independent comparisons

M = Measured value

T = True value

(RMSE is in the same units as the measured and true values)

b. Time Constant. After a step change in the value of a parameter measured by a sensor, the time constant is the length of time it takes the sensor to register a given percentage (63 percent unless otherwise specified) of the change.

c. Resolution. The resolution of a sensor is the value of the least significant digit that is given as sensor output.

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d. Variance. For the purposes of this AC, variance is defined as the difference between the value of the reference sensor and the sensor under test.

e. Thunderstorm. For purposes of this AC, a thunderstorm occurs when a single cumulonimbus cloud (cell) generates one or more flashes of lightning which can be cloud-to-ground, in-cloud, or cloud-to-cloud. At any one time, a period of storm activity may consist of a number of thunderstorms or cells within the area surrounding the reference point.

3.3. GENERAL PERFORMANCE STANDARDS. This paragraph addresses aspects of performance that are applicable to the AWOS as a whole. The electromagnetic interference, transient, and lightning protection standards are also applicable to the entire system and are addressed in paragraphs 3.22 and 3.23.

a. Input Power. AWOS equipment should operate from a 120/240 V (± 10 percent), 60 Hz ac (± 5 Hz), 3-wire single-phase service.

b. Loss of Power. The AWOS system should return to normal operation without human intervention after a power outage. When power is restored, the system should not output erroneous data.

c. Wind Sensor Tower. If a separate tower is used for the wind sensor, daytime marking and nighttime lighting should be provided in accordance with the guidelines set forth in the latest edition of AC 70/7460-1, Specification for Obstruction Marking and Lighting.

(1) It should be lighted with a dual obstruction light L-810 fixture placed within five feet of the top of the tower. The two lamps on the L-810 should be wired in parallel. The standards for the L-810 fixtures may be found in latest edition of AC 150/5345-43, Specification for Obstruction Lighting Equipment. Use of a single light emitting diode (LED) obstruction light fixture is encouraged for efficiency and endurance.

(2) Since the nominal height for this tower is 30 to 33 feet and since most towers are manufactured in 10 foot sections, a waiver to AC 70/7460-1 has been granted to permit a six-band marking, with the bands alternating between aviation orange (the top band) and aviation white. This pattern will permit dip painting the tower at the factory without sacrificing the level of safety provided by the standard tower.

d. VHF Transmitter. It is the FAA policy that the output of the AWOS be transmitted on an existing NAVAID voice outlet whenever practical. When the AWOS is broadcast over a NAVAID, that NAVAID will be given a flight check during the initial commissioning procedure and will be given an annual flight check in conjunction with the annual AWOS verification. If there is no

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NAVAID available, then the output will be broadcast via a separate VHF transmitter that will be licensed by the FCC. The transmitter operates in the 118-137 MHz band on a frequency assigned by the FCC. The transmitter will have a FCC type-acceptance with the following operational parameters:

(1) Channel Spacing: 25 kHz

(2) Normal radio frequency (RF) Power Output: Nominal 2.5 watts (± 0.25 watts), at the transmitter output.

Note: Other transmitter powers between 1 and 10 watts may be authorized by the FCC based on unusual circumstances. However, the FCC license always lists the maximum effective radiated power authorized for any AWOS.

e. Coaxial Cable. The manufacturer should use coaxial cable with less than 3 dB line loss per 100 feet for cable runs exceeding 30-feet. The manufacturer may use coax with up to 10 dB loss per 100 feet for lines less than 30-feet long. All critical VHF radio parameters should be measured, using properly calibrated collocated test equipment, and recorded during initial and annual reverification checks. These measurements apply to both discrete frequencies as well as shared frequencies. Table 1, VHF Radio Specifications, provides the critical radio parameters.

Table 1. VHF Radio Specifications

Parameter	Specifications
Frequency stability	± 0.001 percent (-30° to +60° C)
Percentage of modulation of generated tone	65 percent to 95 percent
Voltage standing wave ratio (VSWR) at transmitter	3.0 to 1
VSWR at antenna for cable runs exceeding 50 feet	3.0 to 1
Line Loss for cable runs exceeding 50 feet	< 3 dB of line loss per 100 feet

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Table 1. VHF Radio Specifications (Continued)

Parameter	Specifications
Spurious and harmonic emission for cable runs exceeding 50 feet	80 dB down from the carrier minimum up to 90 percent modulation
Emission type	6A3E
Antenna	Omnidirectional
Occupied Bandwidth	No less than 99 percent of the emitted signal energy should be contained within a 25 kHz bandwidth

f. Generation of the NAVAID Identifier by the AWOS. When the AWOS message is broadcast over a NAVAID, the AWOS should be designed to provide both the NAVAID tone identifier and the AWOS weather data over the NAVAID frequency. The tone should be generated between every AWOS voiced weather message and should only be generated between messages. This design should eliminate the interference between the AWOS voice and the NAVAID generated tone identifier and provides for better identification of the NAVAID in marginal conditions. If this design is adopted, it is imperative that the NAVAID automatically return to using its internal tone generator to provide the identifier if the AWOS capability to provide the NAVAID identifier has been lost.

g. UHF Data Link Radio Transmitter. When a UHF radio is used to transfer data between components of the system, the transmitter will have FCC type-acceptance, and the power output should be limited to the minimum necessary to accomplish the job and should not exceed 1 watt. The FCC issues the license for the use of the facility and assigns the frequency. Frequency stability, deviation/percent modulation, VSWR, and initial/operating power output should be in accordance with FCC regulations and should be clearly defined in the manufacturer's Maintenance Manual. AM and FM data link radio transmitter specifications are contained in the latest edition of FAA Order 6560.13.

h. Data Link Radios. No data link radios authorized under Part 15 of the FCC rules identified in Title 47 of the Code of Federal Regulations (47 CFR, Part 15) or other unlicensed transmitters may be used in any part of a non-Federal AWOS system.

i. Code Requirements. The AWOS should be designed in accordance with applicable paragraphs of the latest edition of the National Electrical Code (NEC) and should be installed in accordance with local code requirements.

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3.4. OPERATING ENVIRONMENT. All AWOS equipment and sensors should demonstrate that they meet all operating tolerances under the operational environmental conditions described in this AC.

a. Site Elevation. From 100 feet below sea level to 10,000 feet above sea level.

b. Equipment Installed Indoors in a Conditioned Space.

(1) Temperature. From +40° to +105° F (+5° to +40° C).

(2) Relative Humidity. 5 percent to 90 percent (non-condensing).

c. Equipment Installed Outdoors.

(1) Temperature. Two operational environmental temperature ranges are defined for the outdoor equipment. Class 1 is the minimum environment all outdoor equipment must operate in. Class 2 is the harsh environment the outdoor equipment must operate in when installed in locations known to exceed the Class 1 criteria.

Class 1: -30° to +130° F (-35° to +55° C)

Class 2: -65° to +130° F (-55° to +55° C)

(2) Relative Humidity. 5 percent to 100 percent over the entire temperature range in increments of 10° C.

(3) Wind. Up to 85 knots.

(4) Hail. Up to 1/2 inch in diameter.

(5) Ice Buildup. Freezing rain rate equivalent to a buildup of 1/2 inch per hour, lasting for a period of 1 hour with up to 40 knot winds.

(6) Rain. Up to 3-inches per hour, with up to 40 knot winds.

3.5. MECHANICAL WINDSPEED AND DIRECTION SENSOR.

a. Performance Standard.

(1) Windspeed Sensor.

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(a) Range. The sensor should respond to a threshold of 2 knots and a maximum of at least 85 knots.

(b) Accuracy. The windspeed sensor should provide an accuracy of ± 2 knots up to 40 knots. Above 40 knots, RMSE should be within ± 5 percent.

(c) Resolution. The resolution should be 1 knot.

(i) Distance Constant. The distance constant should be less than 10 meters. The method for calculation is given in paragraph 3.5.b.(1)(b).

(ii) Threshold. 2 knots.

(2) Wind Direction Sensor. This sensor should be aligned to true north.

(a) Range. 1° to 360° in azimuth.

(b) Threshold. 2 knots.

(c) Accuracy. Within $\pm 5^\circ$ (RMSE)

(d) Resolution. To nearest 1° ; dead band not to exceed 7° wide.

(e) Time constant. Less than 2 seconds.

b. Performance Testing. Testing should be conducted in a calibrated wind tunnel, except for the wind direction accuracy test that is conducted on a bench test fixture. The windspeed sensor should be compared against a calibrated Pitot - static tube or transfer reference standard traceable to the National Institute of Standards and Technology (NIST).

(1) Windspeed.

(a) Accuracy and Resolution. The test is conducted under no rain conditions. Four full-test cycles (2-85 knots) should be conducted in increments of 2 knots between 2 and 10 knots, in increments of 10 knots between 10 and 80 knots, and at 85 knots. During these test runs, data should be gathered to demonstrate compliance with the requirements for accuracy and resolution. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

(b) Distance Constant. The distance constant should be computed according to the following formula:

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$$D = T \times W$$

Where:

D = Distant constant (in meters).

T = Time constant.

W = Windspeed (meters per second) in the wind tunnel.

The distance constant should be determined from an average of 10 runs, 5 runs each with the tunnel windspeed at 10 knots (5 meter/sec) and at 20 knots (10 meter/sec) with the sensor propeller speed at the zero at time zero. The distance constant should be less than 10 meters for the sensor to pass this test.

(2) Wind Direction.

(a) Accuracy. This test should be conducted on a bench test fixture under no rain conditions. The accuracy of the sensor should be checked at each 10° increment. The accuracy should be checked in 2° increments between 350° and 010°. A dead band of up to 7° wide is permissible. Two complete test cycles should be conducted, and RMSE accuracy should be within specified limits. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

(b) Time Constant. The time constant should be determined from an average of 10 runs, 5 runs each with the tunnel speed at 10 knots and at 20 knots. The vane should be displaced 10° from the indicated wind direction and released. The time constant should be less than 2 seconds to reach within 5° of the indicated wind direction.

3.6. ULTRASONIC WIND SENSOR.

a. Performance Standard.

(1) Windspeed.

(a) Range. The sensor should respond to a threshold of 1 knot and a maximum of at least 85 knots.

(b) Accuracy. The windspeed sensor should provide an accuracy of ± 1 knot up to 40 knots. Above 40 knots, RMSE should be within ± 3 percent.

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(c) Resolution. The resolution should be 1 knot.

(d) Distance Constant. The distance constant should be less than 1 meter. The method for calculation is given in paragraph 3.5.b.(1)(b).

(e) Threshold. 1 knot.

(2) Wind Direction Sensor. This sensor should be aligned to true north and withstand a windspeed of 85 knots without damage.

(a) Range. 0° to 359° in azimuth.

(b) Threshold. 1 knot.

(c) Accuracy. Within $\pm 3^\circ$ (RMSE)

(d) Resolution. To nearest 1°

b. Performance Testing. Testing should be conducted in a calibrated wind tunnel. The ultrasonic sensor should be compared against a calibrated pitot-static tube or transfer reference standard traceable to the National Institute of Standards and Technology. Ultrasonic anemometers should be tested in a wind tunnel for directions using a rotating base. The mounting base should be able to be rotated as the test progresses. The following test procedures should be used.

(1) Windspeed Accuracy and Resolution. The test is conducted under no rain conditions. Four full-test cycles (2-85 knots) should be conducted in increments of 2 knots between 2 and 10 knots, in increments of 10 knots between 10 and 80 knots, and at 85 knots. During these test runs, data should be gathered to demonstrate compliance with the requirements for accuracy and resolution. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

(2) Wind Direction Accuracy. The accuracy of the sensor should be checked at each 10° increment. The accuracy should be further checked in 2° increments between any 20° span. Two complete test cycles should be conducted, and RMSE accuracy should be within specified limits. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

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3.7. TEMPERATURE SENSOR.

a. Performance Standards. The sensor should be thermally isolated to accurately measure environments below:

- (1) Range. From -35° to $+55^{\circ}\text{C}$ (-30° to $+130^{\circ}\text{F}$) for Class 1 systems.
From -55° to $+55^{\circ}\text{C}$ (-65° to $+130^{\circ}\text{F}$) for Class 2 systems.
- (2) Accuracy. 1°F RMSE for the entire range of the sensor, with a maximum error of 2°F .
- (3) Resolution. Not greater than 1°F .
- (4) Time Constant. Not greater than 2 minutes.

b. Performance Testing.

(1) Accuracy. Temperature accuracy should be verified using a calibrated reference instrument traceable to the National Institute of Standards and Technology (NIST). The temperature sensor should be exercised through the full range of the device in 10°F increments. This 10° change in chamber temperature should be accomplished within 5 minutes of the test, and the sensor reading should be taken 5 minutes after the chamber temperature is stable. This test cycle should be performed a total of eight times or four times with two sensors in the chamber. These cycles should include two increasing and two decreasing temperature cycles without radiation heating and two increasing and two decreasing temperature cycles with radiation heating on the aspirated enclosure of 1.6 gram-calories per square centimeter per minute (1120 W/m^2). The accuracy of the sensor should be within 1°F (RMSE) for each test cycle, a total of 9 data points for each Class 1 system cycle; 11 data points for each Class 2 system cycle. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

(2) Time Constant. The sensor should be placed in a chamber and stabilized at 85°F . The temperature should be rapidly raised (within 1 minute) 5°F (to 90°F); the time constant should be 2 minutes or less. The same test should be repeated with a 5°F decrease in temperature within 1 minute. The time constant should be 2 minutes or less.

3.8. HUMIDITY SENSOR. A single thermal shield and aspirator unit may include both the humidity and temperature sensors.

a. Performance Standards.

- (1) Operating Range. From -50° to $+130^{\circ}\text{F}$

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(2) Sensor Protection. The humidity sensor should not be damaged if the sensor becomes excessively wet, e.g., from precipitation or from absorption of moisture after a loss of power. The humidity sensor probe should return to normal operation, without damage and without human intervention, within 30 minutes after the abnormal, excessively wet condition is alleviated, i.e., after precipitation ends, or after restoration of power.

(3) Resolution. Not greater than 1%.

(4) Time constant. Less than 2 minutes.

(5) Accuracy. The accuracy should be less than or equal to 5% of the measured value.

b. Performance Testing.

(1) Accuracy. All tests should be performed with the sensor in the aspirated enclosure supplied with the sensor. Temperature and relative humidity accuracy should be verified using calibrated reference instruments traceable to the National Institute of Standards and Technology. The data points given in paragraphs 3.9.b.(1) should be taken during four test runs, two with increasing humidity and two with decreasing humidity. This may be reduced to two test runs if two sensors are placed in the chamber. During the test run, the change in temperature/relative humidity should be accomplished within 5 minutes, and the sensor reading should be taken 5 minutes after the temperature and humidity have stabilized. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

(2) Time Constant. At ambient temperature and 50 percent relative humidity, change the humidity equal to a dew point increase of 5°F within 1 minute, and then decrease the humidity equal to a dew point decrease of 5°F within 1 minute. In each case, the time constant should be less than 2 minutes.

(3) Power Interruption. At ambient temperature and 90 percent relative humidity, with the sensor operating normally, disconnect the power from the sensor for a period of 1 hour. Power should then be reapplied and the sensor should return to normal operation and accuracy within 30 minutes.

3.9. DEW POINT SENSOR. A single thermal shield and aspirator unit may include both the dew point and temperature sensors.

a. Performance Standards.

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- (1) Operating Range. From -35° to $+55^{\circ}\text{C}$ (-30° to $+130^{\circ}\text{F}$) for Class 1 systems.
From -55° to $+55^{\circ}\text{C}$ (-65° to $+130^{\circ}\text{F}$) for Class 2 systems

(2) Dewcell Protection. If the dew point sensor is a dewcell, it should not be damaged if the sensor becomes excessively wet, e.g., from precipitation or from absorption of moisture after a loss of power. The dewcell probe should return to normal operation, without damage and without human intervention, within 30 minutes after the abnormal, excessively wet condition is alleviated i.e., after precipitation ends or after restoration of power.

- (3) Resolution. Not greater than 1°F .

- (4) Time constant. Less than 2 minutes.

- (5) Accuracy. The accuracy should be as follows. All errors are RMSE.

(a) 2°F dew point for dry bulb temperatures of $+30^{\circ}$ to $+90^{\circ}\text{F}$, 80 to 100 percent relative humidity, with a maximum error of 3°F at any dry bulb temperature.

(b) 3°F dew point for dry bulb temperature of $+30^{\circ}$ to $+120^{\circ}\text{F}$, 15 to 75 percent relative humidity, with a maximum error of 4°F at any dry bulb temperature.

(c) 4°F dew point for dry bulb temperatures of -20° to $+20^{\circ}\text{F}$, 25 to 95 percent relative humidity with a maximum error of 5° at any dry bulb temperature. The minimum dew point required is -30°F .

b. Performance Testing.

(1) Accuracy. All tests should be performed with the sensor in the aspirated enclosure supplied with the sensor. Temperature and dew point accuracy should be verified using calibrated reference instruments traceable to the National Institute of Standards and Technology. The data points given in paragraph 3.9.b.(1)(a) through 3.9.b.(1)(c) should be taken during four test runs, two with increasing humidity and two with decreasing humidity. This may be reduced to two test runs if two sensors are placed in the chamber. During the test run, the change in temperature/relative humidity should be accomplished within 5 minutes, and the sensor reading should be taken 5 minutes after the temperature and humidity have stabilized. The following data points should be demonstrated and the RMSE calculated to demonstrate the error in each category. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

- (a) With an error not to exceed 2°F (RMSE) dew point

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30°F temperature; 80, 90, 100 percent relative humidity
 60°F temperature; 80, 90, 100 percent relative humidity
 90°F temperature; 80, 90, 100 percent relative humidity

(b) With an error not to exceed 3°F (RMSE) dew point

30°F temperature; 15, 45, 75 percent relative humidity
 60°F temperature; 15, 45, 75 percent relative humidity
 90°F temperature; 15, 45, 75 percent relative humidity
 120°F temperature; 15, 40 percent relative humidity

(c) With an error not to exceed 4°F (RMSE) dew point

-30°F temperature; between 65 and 95 percent relative humidity
 0°F temperature; 25, 60, 95 percent relative humidity
 +20°F temperature; 25, 60, 95 percent relative humidity

(2) Time Constant. At ambient temperature and 50 percent relative humidity, change the dew point +5°F (within 1 minute), and then -5°F (within 1 minute). In each case, the time constant should be less than 2 minutes.

(3) Power Interruption. At ambient temperature and 90 percent relative humidity, with the sensor operating normally, disconnect the power from the sensor for a period of 1 hour. Power should then be reapplied and the sensor should return to normal operation and accuracy within 30 minutes.

3.10. PRESSURE SENSOR. Two or three pressure sensors should be provided for each AWOS system. All pressure sensors should have provisions for venting to the outside through a pressure port. Pressure variations due to airflow over the pressure port should be avoided. Sensor venting should be designed to avoid any damp pressure variation and oscillation due to pumping or breathing of the pressure sensor, venting, and porting equipment. Means should be provided to avoid insect nesting and moisture entrapment in the venting.

a. Performance Standards.

(1) Altitude Ranges. High pressure should be standard atmospheric pressure at -100 feet plus 1.5 inches of mercury (inHg) ($30.03 + 1.5 = 31.53$ inHg). Low pressure should be standard atmospheric pressure at +10,000 feet minus 3.0 inHg ($20.58 - 3.00 = 17.58$ inHg).

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(2) Pressure Range. Each sensor should be capable of measuring a pressure range at any fixed location (station) of +1.5 to -3.0 inHg from the standard atmospheric pressure at that location.

(3) Accuracy. The accuracy should be ± 0.02 inHg RMSE at all altitudes from -100 to +10,000 feet mean sea level (MSL), maximum error 0.02 inHg at any one pressure.

(4) Resolution. The resolution of the barometer should be displayed in 0.001 inHg increments or better.

(5) Differential Accuracy. Each sensor should exhibit an average differential accuracy of 0.02 inHg or less between a series of two pressure measurements taken from the same sensor 3 hours apart. Ambient temperature over this 3-hour period should not change more than 5°F. Ambient pressure should not vary more than 0.04 inHg (RMSE) over the 3-hour period.

(6) Maximum Drift With Time. Each sensor should be stable and continuously accurate within 0.02 inHg RMSE for a period of not less than 6 months. The maximum error should be 0.02 inHg.

b. Performance Tests.

(1) Accuracy. Each pressure sensor should successfully complete the following accuracy test. A calibrated barometer or transfer standard with an accuracy of at least 0.004 inHg, that is traceable to the National Institute of Standards and Technology (NIST), should be used as a standard during testing. Two test cycles should be performed on each pressure sensor. One test cycle is defined as running the sensor through the full pressure range at each of three ambient temperatures. Before taking measurements, allow sufficient time for the sensor to achieve steady state at each data point not to exceed 5 minutes. The RMSE should be within the specified limits. Tests demonstrating acceptable accuracy during environmental extremes as listed in paragraph 3.4 should be conducted.

(a) Pressure Range. The pressure sensors should be tested through the full range of performance, normally 17.5 to 32.0 inHg, in 1-inHg increments of both increasing and decreasing pressure.

(b) Temperature Range. The sensor should be tested at ambient (approximately +85°) and at the hot and cold extremes called for in the environmental requirements.

(2) Differential Accuracy. Differential accuracy, i.e., change in accuracy, of the pressure sensor should be tested at ambient temperature (approximately 85°F) and ambient barometric pressure.

(a) Take 14 measurements of pressure on the pressure sensor under test and 14 measurements of pressure on the reference barometer. These measurements should be taken about

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5 seconds apart and all 14 measurements should be completed within 90 seconds. This time should be called $t=0$.

(b) Repeat the 14 measurements on the pressure sensor under test and 14 measurements of pressure on the reference barometer after an elapsed time of 3 hours. The ambient temperature should have changed less than 5°F, and the ambient pressure should have changed not more than 0.1 inHg. This time should be called $t=3$.

(c) Compute the average reading of the reference barometer at $t=0$. Compute the average reading of the reference barometer at $t=3$. Determine the difference in the two averages. If the difference is greater than 0.1 inHg, or if the average difference between the reference and the test barometer at either $t=0$ or $t=3$ is greater than 0.02 inHg, repeat steps (a) and (b).

(d) Compute the 14 errors in reading between the sensor and reference barometer at $t=0$.

(e) Compute the 14 errors in reading between the sensor and reference barometer at $t=3$.

(f) Subtract the 14 $t=0$ errors from the 14 $t=3$ errors determined in steps (d) and (e). Preserve the order of subtraction such that the first $t=0$ error is subtracted from the first $t=3$ error. These differences are the changes in accuracy, i.e., the differential accuracy.

(g) Compute the average and standard deviation of the 14 changes in accuracy determined in step (f). The average differential accuracy should be no greater than 0.02 inHg. The standard deviation should be less than 0.004 inHg.

(3) Resolution. The manufacturer should demonstrate that the barometer resolution is displayed in 0.001 inHg increments or greater.

(4) Drift Over Time. Testing should be accomplished to determine maximum drift, paragraph 3.10.a.(6), over a 6-month period and should not exceed 0.02 inHg.

3.11. CLOUD HEIGHT SENSOR. The cloud height sensor should have a design range of at least 12,500 feet. The sensor should provide an output of at least three cloud layers representative of the sky conditions when surface visibilities are equal to or greater than 1/4 mile. The sensor should comply with the performance standards throughout its design range.

a. Performance Standards. The sensor should detect the height of atmospheric phenomena, i.e., clouds and obscuring phenomena aloft, or in the event the phenomena are surface based, e.g.,

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fog, provide an estimate of the contact height (CH) or vertical visibility (VV). CH is defined as the vertical height above ground at which visual reference to recognized lights or objects on the surface can be established sufficiently to permit visual determination of the ground plane and position. VV is defined as the vertical distance that an observer can see vertically into surface-based obscuring phenomena, e.g., dust, fog, sand, etc., or the height corresponding to the upper limit of the return of the ceilometer signal, or the height corresponding to the height at which a balloon would completely disappear during the presence of surface-based phenomena, i.e., an obscured sky. The sensor should have the capability of discriminating between a negative response, i.e., no hit, resulting from no phenomena within the sensor's design range, and a sensor error/fault. The sensor should not indicate a response, i.e., hit, that is not the result of the detection of atmospheric phenomena.

(1) Range. The sensor should measure cloud heights and the heights of obscuring phenomena aloft to a minimum of 12,500 feet.

(2) Accuracy. Under laboratory conditions, the sensor should provide an accuracy of 100 feet or 5 percent, whichever is greater.

(3) Resolution. Not greater than: 50-foot surface to 5,500 feet; 250 feet from 5,501 to 10,000 feet; 500 feet above 10,000 feet.

(4) Detection Performance. The sensor should perform within the limits specified in paragraphs 3.11.b.(2) and 3.11.b.(3).

(5) Sampling. The sensor should provide an output at least once every 30 seconds. However, to extend sensor life, this sampling rate may be reduced to provide at least one sample every 3 minutes when no cloud, obscuring phenomena aloft, or CH/VV values, i.e., hits, are detected for the preceding 15 minutes.

(6) Eye Safety. The cloud height sensor should be designed to conform to laser radiation Class IIIb as defined in ANSI-Z 136.1, Accessible Emission Limits for Laser Radiation, with the maximum accessible emission level applied to direct viewing without optical instruments excluding ordinary eye glasses. This document may be obtained from the American National Standards Institute, 1430 Broadway, New York, New York, 10018. Interlock device(s) in the laser power circuit should be provided to disable the laser when any doors are open or the cover is removed to prevent inadvertent exposure of the laser emission to the eyes of the technician or others. The interlock(s) may have a manual override in order that power can be purposely restored during maintenance.

(7) Laser Power Stability. The sensor should contain a self-check, self-adjusting feature that should maintain laser output power at the level necessary to sustain sensor detection and accuracy. When this adjustment can no longer provide the compensation necessary to maintain the sensor within specified operational limits, sensor operation should be terminated.

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(8) Optics Contamination. An air blower or other device should be used to reduce the contamination of the sensor optics. A signal should be generated to indicate the amount of optics contamination, thereby indicating the need for optics cleaning.

(a) Snow. The ceilometer window should demonstrate an ability to remain clear of snow under the condition of snow accumulating at a rate of 2 inches per hour for 1 hour at a temperature of 20°F.

(b) Ice. The ceilometer window should remain clear of ice for 60 minutes under conditions of freezing rain with a maximum accretion rate of ½-inch per hour radial thickness of clear ice.

b. Performance Testing.

(1) Accuracy Test. The signal should be projected horizontally to a target at known distances, two distances, separated by at least 1,000 feet, from 100 to 5,500 feet; two distances, separated by at least 1,000 feet, from 5,600 to 10,000 feet; and one distance beyond 10,000 feet. All range points should be within the accuracies specified in paragraph 3.11.a.(2). This test is a laboratory test conducted at full rated power output. It is not intended to be duplicated when the AWOS is installed in the field.

(2) Detection Tests Under Uniform Sky Conditions.

(a) Test Conditions. The sensor should be tested under the following conditions.

(i) Group A. Visibility greater than 3 miles, with a minimum of 10 percent of the data sets in each subgroup as shown in Table 2, collected with light precipitation, i.e., rain and snow, occurring, and a minimum of 10 percent with moderate precipitation, i.e., rain and snow, occurring.

Table 2. Group A Test Conditions

Subgroup	Cloud Height (feet)
1	100-700
2	800-1500
3	1600-3000
4	3100-5500

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5

5600-12500

(ii) Group B. Visibility equal to or less than 3 miles, but equal to or greater than 1 mile, with a minimum of 10 percent of the data sets in each subgroup as shown in Table 3, with light precipitation, i.e., rain and snow, occurring, and a minimum of 10 percent with moderate precipitation, i.e., rain and snow, occurring.

Table 3. Group B Test Conditions

Subgroup	Cloud Height (feet)
1	100-700
2	800-1500
3	1600-3000
4	3100-5500
5	5600-12500

(iii) Group C. Visibility equal to or greater than 1/4, but less than 1 mile, with a minimum of 10 percent of the data sets in each subgroup as shown in Table 4, collected with light precipitation, i.e., rain and snow, occurring, and a minimum of 10 percent with moderate precipitation, i.e., rain and snow, occurring.

Table 4. Group C Test Conditions

Subgroup	Cloud Height (feet)
1	100-700
2	800-1500
3	1600-3000
4	3100-5500
5	5600-12500

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(iv) Group D. Not more than 3/10 total sky coverage with the lowest cloud layer at 2,000 feet or higher under the visibility conditions shown in Table 5, with a maximum of 80 percent of the data in each subgroup collected under daytime conditions.

Table 5. Group D Test Conditions

Subgroup	Visibility (miles)
1	Equal to or greater than 1, but less than 3
2	Equal to or greater than 3, but less than 7
3	Equal to or greater than 7

(b) Collection of Test Data.

(i) A minimum of 25 data sets should be collected for each subgroup in Groups A through C, i.e., a minimum of 125 data sets should be collected under each group. However, if weather conditions at the test site over a period of 1 year make collection of at least 25 data sets in every subgroup impossible, the FAA should consider approval of a lesser number of data sets in the affected subgroups after analysis of available data. Further, for test data to be acceptable, a continuous test period should be selected to allow for collection of representative data.

(ii) Also, it should be clear that all data collected during the test period were considered. Any data not used should be explained. For example, if data analysis in a subgroup is truncated after 25 data sets are analyzed, this fact should be documented and explained.

(iii) One data set is defined as the second 10-minute period during which a uniform cloud or obscuration is detected by a rotating beam ceilometer (RBC) or is determined by a qualified weather observer. In order to be classified as a uniform cloud or obscuration, the RBC should continuously measure or a qualified weather observer should determine a cloud, obscuration aloft, or vertical visibility height for a 30-minute period that does not vary from its mean height by more than the variance shown in Table 6 more than 5 percent of the time.

(iv) A minimum of 25 data sets should be collected for each subgroup under Group D. One data set is defined as the second 10-minute period of any consecutive 30-minute period during which the cloud/sky coverage/visibility conditions specified for group D are met.

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Table 6. Criteria for Determining Uniform Cloud Layers

Mean Height (as determined by observer or as measured by RBC)	Variance (feet)
Equal to or less than 1,000 ft.	200
Greater than 1,000 ft., but equal to or less than 2,000 ft.	300
Greater than 2,000 ft., but equal to or less than 3,000 ft.	400
Greater than 3,000 ft., but equal to or less than 5,000 ft.	500
Greater than 5,000 ft., but equal to or less than 7,000 ft.	600
Greater than 7,000 ft., but equal to or less than 9,000 ft.	700
Greater than 9,000 ft., but equal to or less than 12,500 ft.	800

(c) Test Standards

(i) An FAA-approved cloud height indicator whose accuracy is traceable to an FAA or NWS approved and calibrated ceilometer standard, or observations taken by a qualified weather observer, should be the standard for determining heights and sky conditions.

(ii) An FAA-approved visibility sensor whose accuracy is traceable to an FAA standard should be the standard for determining visibilities.

(iii) Liquid precipitation measurements should be made using an FAA-approved 0.01 inch per tip tipping bucket precipitation gauge. Light precipitation is defined as one, but not more than two buckets tips in a 10-minute period. Moderate precipitation is defined as more than two, but not more than five tips in a 10-minute period. Heavy precipitation is defined as more than five tips in a 10-minute period. A qualified weather observer should determine the intensity of frozen precipitation.

(d) Criteria for Acceptance Under Uniform Sky Conditions.

(i) Groups A, B, and C Conditions. The mean height of the cloud, obscuration aloft, or vertical visibility measured by the RBC or determined by a qualified weather observer should be determined for each data set. The variance for each cloud, obscuration aloft, and CH/VV height, i.e., hit, detected by the candidate sensor in each data set should be computed. Eighty-eight percent of the data sets within a subgroup, e.g., 22 out of 25 minimum, should satisfy the following condition: 90 percent of the heights determined by the candidate sensor in each data set should agree with the mean height measured by the RBC or determined by a qualified weather observer within the

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variance limits as shown in Table 7, Criteria to Satisfy Groups A, B, and C Conditions. Negative responses, i.e., no hits by the candidate sensor, should be included as data points and considered to be outside the variance limits. Also, the no-hit percentage in each subgroup should not exceed 5 percent. The candidate sensor should successfully demonstrate the conditions in Table 7, Criteria to Satisfy Groups A, B, and C Condition, for each subgroup to pass this test. Failure of any subgroup constitutes failure of the test.

Table 7. Criteria to Satisfy Groups A, B, and C Conditions

Mean Height (as determined by observer or as measured by RBC)	Variance (feet) for Cloud and Obscuration Aloft Heights (feet)	Variance for CH/VV Values (feet)
Equal to or less than 1,000 ft.	200	400
Greater than 1,000 ft., but equal to or less than 2,000 ft.	300	600
Greater than 2,000 ft., but equal to or less than 3,000 ft.	400	800
Greater than 3,000 ft., but equal to or less than 5,000 ft.	500	1,000
Greater than 5,000 ft., but equal to or less than 7,000 ft.	600	1,200
Greater than 7,000 ft., but equal to or less than 9,000 ft.	700	1,400
Greater than 9,000 ft., but equal to or less than 12,500 ft.	800	1,600

(ii) Group D conditions. Not more than one false hit per data set in each subgroup. More than one false hit per data set should constitute failure of the test.

(3) Detection Tests Under Ragged Overcast or Obscured Sky Conditions.

(a) Heights, cloud/obscuration aloft or CH/VV, measured by the candidate sensor should be compared with heights measured by the RBC or determined by a qualified weather observer during ragged overcast or obscured sky conditions. Valid data should be that collected during overcast or obscured sky conditions below 12,500 feet as verified by an RBC hit percentage of 95 percent or more, or as determined by a qualified weather observer, during a 20-minute period. Negative responses, i.e., no hits, should be included as data points and considered to be outside the variance limits. Calculate the percent of heights, i.e., hits, by the candidate sensor falling within the ranges identified in paragraph 3.11.b.(3)(b) under each of the conditions specified in paragraph 3.11.b.(3)(c) with allowable height variances as specified as in Table 7. Data should be collected under as many of the conditions as possible; however, the FAA may accept less than the specified

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requirement after evaluation of the available data. For test data to be accepted, a continuous test period should be selected to allow for representative data collection. It should also be clear that all data collected during the test period were considered. Any data not used should be explained.

(b) Height ranges (as determined by RBC or qualified observer)

- (i) 100 - 700 feet
- (ii) 800 - 1,500 feet
- (iii) 1,600 - 3,000 feet
- (iv) 3,100 - 5,500 feet
- (v) 5,600 - 12,500 feet

(c) Conditions:

(i) No precipitation. Visibilities 1/4 to 1 mile, 1 to 3 miles, and greater than 3 miles.

(ii) Light or moderate precipitation (rain and snow). Visibilities 1/4 to 1 mile, 1 to 3 miles, and greater than 3 miles.

(iii) Heavy precipitation (rain and snow). Visibilities 1/4 to 1 mile, 1 to 3 miles, and greater than 3 miles.

(d) A minimum of 90 percent weighted average of the hits by the candidate sensor should fall within the range of the RBC or within the height range determined by a qualified weather observer. Also, the weighted negative response, i.e., no hit, percentage should not exceed 5 percent.

3.12. VISIBILITY SENSOR.

a. Performance Standards.

(1) Range. The visibility sensor should be capable of determining visibilities from less than 1/4 mile to 10 miles. A method of calibration traceable to the FAA-approved standards in paragraph 3.12.b should be provided.

(2) Resolution. In terms of equivalent visibility, the sensor should provide data to report visibility values as follows in statute miles: less than 1/4, 1/4, 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3, 4, 5, 7, 10 and greater than 10 miles. For information, refer to Federal Meteorological Handbook 1 (FMH-1).

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(3) Accuracy. The sensor should agree with the transmissometer standards as shown in Table 8, Visibility Sensor Accuracy Requirement.

Table 8. Visibility Sensor Accuracy Requirement.

Reference Transmissometer Reading	Acceptable Sensor Variance
1/4 through 1-1/4 miles	± 1/4 mile
1-1/2 through 1-3/4 miles	+ 1/4, -1/2 mile
2 through 2-1/2 miles	± 1/2 mile
3 through 3-1/2 miles	+ 1/2, -1 mile
4, and greater than 4 miles	± 1 mile

(4) Time Constant. The time constant should not exceed 3 minutes.

(5) Ambient Light Sensor. The visibility sensor should contain an ambient light sensor, i.e., a photocell, to measure the ambient luminance within its field of view and generate a signal to the visibility sensor to indicate whether the ambient light level is day or night. It should indicate day for increasing illumination between 0.5 and 3 foot-candles (FC) and night for decreasing illumination between 3 and 0.5 FC. This sensor may be exposed to ambient light levels as high as 50 FC.

b. FAA-Approved Visibility Standards. The high visibility reference standard should be a visible light transmissometer(s) that uses a narrow band of light centered at 0.55 microns, 95 percent of the response within ± 0.03 microns of 0.55 microns, for visibility ranges to an extinction coefficient of 3 mile^{-1} . At higher extinction coefficients, an FAA-approved transmissometer(s) that includes some infrared radiation may be substituted as a standard. Comparisons with scatter-type instruments different from those being tested may be used to correct for small drifts in reference standard calibration.

c. Performance Tests. The visibility sensor should be tested using FAA-approved transmissometers as the reference standard.

(1) Accuracy Testing.

(a) At least 2 months of accuracy test data should be accumulated, assuring that a representative number of valid test points are experienced at each of the reporting increments provided in paragraph 3.12.a.(2), and under conditions of both with and without precipitation. All

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data collected during the test should be included in the test report. Any samples not included in determining the candidate sensor's accuracy should be fully explained. For example, data collected under inhomogeneous conditions may be excluded from the accuracy analysis, if so explained. The test data should consist of a number of independent samples of 10 minutes each, with at least 5 minutes between each sample. Samples should consist of visibilities from less than 1/4 mile, to greater than 10 miles, and should be weighted in the following ratio:

(i) 70 percent without precipitation, i.e., with fog, under clear conditions, and with approximately 5 percent of the data points collected under summer haze conditions

(ii) 30 percent with precipitation, e.g., 15 percent with rain, 15 percent with snow

(b) Eighty percent (overall weighted average) of the total of all sensor test data points should agree with the transmissometer standard within the allowed variances from less than 1/4 through 5 miles.

(c) Eighty percent of the sensor test samples that are obtained when the transmissometer reads greater than 5 miles should be 5 miles or greater.

(2) Time Constant Demonstration. Under conditions of 10-mile visibility, a technique should be used to reduce the sensor detector output to 1 mile or less. After the restriction is applied, the time constant should be measured to reflect the reduction of visibility. After a period of 10 minutes, the artificial restriction to visibility should be removed, and the sensor time constant should be measured to reflect the increase in visibility. The time constant should be equal to or less than 3 minutes.

(3) Ambient Light Sensor Testing. The manufacturer should demonstrate that the ambient light sensor complies with paragraph 3.12.a.(5) and the visibility output is updated accordingly when the light sensor changes status from day-to-night or night-to-day.

3.13. PRECIPITATION ACCUMULATION SENSOR. The term *precipitation* is defined as including all forms, i.e., liquid, freezing, frozen, or combinations thereof. The term *precipitation amount* is the liquid or liquid equivalent amount. There are generally two types of precipitation accumulation sensors, the tipping bucket rain gauge and the precision scale. The tipping bucket design measures every tip, e.g., 0.01 inches. The precision scale, sometimes referred to as an all weather precipitation accumulation gauge (AWPAG), measures the weight of the precipitation and reports it as inches of rain.

a. Performance Standards. The sensor should be capable of estimating the precipitation amount with a range of 0.01 to 5-inches per hour, with a resolution of 0.01 inches and an accuracy of 0.002 inches per hour (RMSE), or 4 percent of actual, whichever is greater.

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b. Performance Testing. The manufacturer should conduct a test program to demonstrate that the precipitation accumulation sensor(s) meet the performance requirements under the environmental conditions found in paragraph 3.4.

3.14. PRESENT WEATHER DETECTOR/SENSOR. The term *precipitation type* as used herein includes the following: rain, drizzle and snow. The precipitation type sensor should provide an indication of the type of precipitation occurring, or should output *precipitation* for any precipitation, e.g., liquid, freezing, frozen, or combinations thereof, when a type cannot be identified. However, recognizing that the sensor technology is not yet available to identify ice pellets and hail, a precipitation type sensor may qualify by identifying only rain, drizzle, and snow while outputting *precipitation* for those types not identified. The sensor unit may be designed as a separate unit or may be combined with the requirements of other parts of this AC, e.g., paragraph 3.12, Visibility Sensor, so that one unit fulfills the requirements of two or more paragraphs.

a. The sensor should identify the type of precipitation when the rate of precipitation equals or exceeds 0.002 inches per hour, with the goals for accuracy as follows:

(1) Within the temperature range of:

(a) +28°F to +38°F, identify precipitation type correctly as:

(i) Rain: 90 percent of the cases.

(ii) Drizzle: 80 percent of the cases.

(iii) Snow: 90 percent of the cases.

(b) Less than +28°F. Identify precipitation type correctly as snow in 99 percent of the cases.

(c) Greater than +38°F, identify precipitation type correctly as:

(i) Rain: 99 percent of the cases.

(ii) Drizzle: 90 percent of the cases.

(2) Priority: Only one precipitation type should be reported, with the reporting priority established in the following order.

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- (a) Snow.
- (b) Rain.
- (c) Drizzle.
- (d) Precipitation, unidentified.

b. Performance Tests. The manufacturer should conduct a test program to demonstrate that the sensor satisfies the performance standards under the environmental conditions in paragraph 3.4. As a minimum, the following test conditions should be satisfied.

(1) Prior to testing, the AWOS manufacturer should develop and submit a test plan to the FAA AWOS Non-Federal Engineering Office for approval at the address provided in paragraph 1.3.e.(2) The test plan should clearly outline the tests to be performed, it should define the capabilities of the sensor to be tested, and it should include a detailed description of the test procedures. It should contain a clear statement of pass/fail criteria. The test plan should identify the location(s) and the proposed time planned for the tests. All data collected during the test should be incorporated into the test report. Any data not included in determining the candidate sensor's compliance with the requirements of this circular should be fully explained.

(2) The test should be conducted in two phases. One phase should be conducted in a test chamber with varying conditions simulated to generate drizzle, rain, and snow. At least 9 events at various rates of accumulation should be simulated for each of these conditions to demonstrate the above requirements and the results should be included in the test report.

(3) The second phase of the test should be conducted at a location(s) and during times when there is a propensity for drizzle, rain, snow, hail, and ice pellets and where there is a qualified weather observer on duty. The test report should compare the performance of the sensor under test with the log maintained by the official observer at the test location. Hail and ice pellets as reported by the official observer should be reported as *precipitation*.

3.15. THUNDERSTORM DETECTION SENSOR OR NETWORK. This stand-alone sensor or thunderstorm detection network should detect the presence of a thunderstorm within 30 nm of an airport, should locate the thunderstorm, and should provide this data in such a form that the information can be incorporated into the AWOS display and voiced weather message.

a. Performance Standards.

(1) Range and direction. Thunderstorms within 30 nm of the reference point on the airport should be reported. Direction is expressed in compass octants for distances from 10 to 30 nm.

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(2) Resolution. The thunderstorm location should be defined within 1 nm of the location of the actual location of the thunderstorm/lightning.

(3) Accuracy.

(a) The standard detects strikes within 10 nm of the reference point:

(i) Detection Accuracy. Ninety percent of all thunderstorms identified and located within this area by the thunderstorm sensor/network standards should be detected by the thunderstorm sensor/network under test.

(ii) Location Accuracy. The location from each thunderstorm detected by the sensor standard within 10 nm of the reference point, and the corresponding thunderstorm detected by the sensor/network under test, should be computed. The RMSE of these locations accumulated during the test period should not exceed 3 nm.

(b) The standard detects strikes between 10 nm and 30 nm of the reference point:

(i) Detection Accuracy. Eighty percent of all thunderstorms identified and located within this area by the thunderstorm sensor/network standards should have been detected by the thunderstorm sensor/network under test.

(ii) Location Accuracy. The distance from each thunderstorm located by the sensor standard between 10 nm and 30 nm of the reference point, and the corresponding thunderstorm located by the sensor/network under test, should be computed. The RMSE of these distances accumulated during the test period should not exceed 6 nm.

(c) False Reports. Not more than 2 percent of all thunderstorms reported by the sensor under test should have been caused by sources other than a naturally occurring thunderstorm.

(4) Sensor/System Reporting to the AWOS. The thunderstorm sensor/network should update the AWOS once each minute.

b. Performance Tests. The manufacturer should conduct a test program to demonstrate that the thunderstorm sensor/network meets the performance standards under the environmental conditions identified in paragraph 3.4.

(1) Prior to Testing. The AWOS manufacturer should develop and submit a test plan to the FAA AWOS Non-Federal Engineering Office for approval at the address provided in paragraph 1.3.e.(2). The test plan should outline the tests to be performed, it should clearly define the

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capabilities of the sensor/network to be tested, and it should include a detailed description of, and the capabilities of, the method that should be used to prove that the sensor is performing in accordance with the performance standards provided in paragraph 3.15.a. It should define the criteria necessary for the standard(s), as well as the sensor/network under test, to recognize a thunderstorm. A clear statement of pass/fail criteria should be included. If the sensor/network proposed should only detect cloud-to-ground lightning or if it should detect other evidence of a thunderstorm, this fact should be clearly identified. The test plan should identify the locations and the proposed time planned for the tests. The test should be conducted in at least two locations, i.e., reference points, where there is a propensity for thunderstorms.

(2) Duration of the Test. The test should encompass a sufficient period of time to accomplish the following minimum detection/location events to prove that the sensor/network under test conforms to the requirements of this circular. A *thunderstorm day* is a day during which thunderstorm data are accumulated from the standard(s) and the sensor/network under test.

(a) Summer Environment. Thunderstorms should have been detected during at least 25 *thunderstorm days* during the summer months at a location where there is a high level of thunderstorms generated by summertime convection activity. It is desirable that at least 100 thunderstorms, i.e., cells, should have been detected and located by the standard(s) during the summer test.

(b) Winter Environment. Thunderstorms should have been detected during at least 10 *thunderstorm days* during the months of November through February at a cold weather location where there is a propensity for thunderstorms associated with mid-latitude winter storms. It is desirable that at least 20 thunderstorms, i.e., cells, should have been detected and located by the standard(s) during the winter test.

(3) Thunderstorm Detection Standards. All means available within the test area to identify and locate thunderstorms should be used. These thunderstorm detection standards should include:

(a) Qualified Weather Observer(s). Qualified weather observers should be used to identify and locate thunderstorms within the vicinity of the reference point. The observer should identify a thunderstorm in accordance with the criteria in FMH-1. The time and the estimated location (bearing and distance) should be logged when identifying the existence (beginning time) of a thunderstorm. Once a thunderstorm has been identified, observations should be recorded every 10 minutes. The ending time of the thunderstorm should be identified. The results of these observations should be plotted on a grid of approximately 3 nm squares, with the reference point in the center, and an area encompassing a circle with a radius of 10 nm. The scale of this plot should be the same as the scale of the radar echo plot. A plot should be made every 10 minutes. All plots for these tests, e.g., observer, radar, network, system/network under test, should be based upon the same time periods, e.g., beginning on the same minute.

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(b) Weather Radar. Weather radar may be used to identify and locate thunderstorms within the area under test. The radar antenna should be located within 30 nm of the reference point. Level three and greater intensity radar echoes should, by themselves, constitute the detection of a thunderstorm. Level two radar echoes, when correlated with another standard observation of a thunderstorm or with a report from the sensor/network under test, should constitute detection of a thunderstorm. However, if the sensor/network under test does not recognize a level two radar echo as a thunderstorm, and the level two echo is the only evidence of a thunderstorm, a thunderstorm should not be assumed to be present. Plots of the area under test from the radar screen should be made every 10 minutes and should depict levels two through six radar echoes. Plots should be made on a grid of approximately 3 nm squares with the reference point as the center. The highest intensity level should be marked in each grid square.

(c) Thunderstorm Network(s) as a Reference Standard. Network(s) may be used to identify and locate thunderstorms. Thunderstorms identified and located by a thunderstorm sensor network should be plotted on a grid identical to the grid used for the radar echo plot, i.e., approximately 3 nm squares on a 30 nm radius circle, with the reference point as the center. Plots should be made of the area under test every 10 minutes.

(d) Secondary Reference Systems. The use of secondary reference systems should be fully defined in the test plan.

(4) Execution of the Test. After the test plan is approved, the manufacturer should perform the test in accordance with the test plan. All data collected during the test should be included in the test results. Any data omitted from the results should be fully explained. Thunderstorms identified and located by the thunderstorm sensor/network under test should be plotted on a grid identical to the grid used for the radar echo plot, i.e., approximately 3 nm squares on a 30 nm radius circle, with the reference point as the center. Plots should be made of the area under test every 10 minutes. The test plan should establish the criteria for the system that is tested, as well as all of the sensor/network standards, to be operational. As a minimum, in order for a thunderstorm day to be counted in the test results, a qualified weather observer should take observations and the weather radar should be operational when testing.

(5) Test Report. A report should be prepared and submitted to the FAA AWOS Non-Federal Engineering Office by the AWOS manufacturer, in accordance with the requirements of this AC, to obtain type certification of its AWOS with a thunderstorm detection, location, and reporting capability. Data obtained during this test should be analyzed as follows.

(a) Within 10 nm of the reference point. The grid plots obtained from the sensor under test should be matched with the grid plots obtained from the standards, i.e., qualified weather observer, the weather radar, thunderstorm sensor network, etc., for each 10 minute increment.

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Thunderstorm occurrences should be matched as previously described in paragraphs 3.15.b.(3) and 3.15.b.(4), and anomalies explained.

(i) The number of test sensor/network identifications should be compared with the number of thunderstorms identified by the standards. The percentage detection accuracy should be computed and compared with the requirement in 3.15.a.(3)(a).

(ii) The number of test sensor/network identifications that are in the same or an adjacent 3 nm grid square as the thunderstorm identified by the observer/sensor/ network standard should be compared with the number of thunderstorms identified by the standards. The percentage location accuracy should be computed and compared with the requirement in paragraph 3.15.a.(3)(a).

(b) Between 10 nm and 30 nm of the reference point. The grid plots obtained from the sensor under test should be matched with the grid plots obtained from the standards, i.e., qualified weather observer, the weather radar, thunderstorm sensor network, etc., for each 10-minute increment. Thunderstorm occurrences should be matched and anomalies explained.

(i) The number of test sensor/network identifications should be compared with the number of thunderstorms identified by the standards. The percentage detection accuracy should be computed and compared with the requirements in paragraph 3.15.a.(3).

(ii) The number of test sensor/network thunderstorm identifications should be counted that are in the same, an adjacent, or in a grid square separated by one square from the 3 nm grid square where an observer/sensor/network standard located a thunderstorm. This number should be compared with the number of thunderstorms identified by the standards. The percentage location accuracy should be computed and compared with the requirements in paragraph 3.15.a.(3)(b).

(c) The number of thunderstorms identified by the sensor/network under test that cannot be matched with a thunderstorm identified by the standards, i.e., false signals, should be counted and compared with the total number of thunderstorms identified by the standards. The percentage of false signals should not be greater than the percentage identified in paragraph 3.15.a.(3)(c).

(6) Basis of the Reporting Algorithm. The AWOS sensor/system should locate and report a thunderstorm within one of 10 areas of a circle with the reference point as the center and a radius of 30 nm, as follows.

(a) Within a circle with a radius of 5 nm, with the reference point at the center.

(b) Within the circular area between 5 nm and 10 nm from the reference point.

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(c) Within one of eight 45-degree clockwise sectors of the circular area between 10 nm and 30 nm from the reference point, beginning with the 22.5 degree radial from the reference point.

(7) AWOS Report of a Thunderstorm (TS). The AWOS voice and data report should be in accordance with the criteria in FMH-1. This algorithm processes lightning strike data through a 15-minute moving window, i.e., each strike expires 15 minutes after it is received. With certain exceptions, the algorithm should report a thunderstorm when two lightning strikes have been received within the 30 nm radius circle within 15 minutes.

(a) Within the 5 nm radius, the voiced report is *TS at the airport*.

(b) Between 5 and 10 nm of the airport, the voiced report is *TS in the vicinity*.

(c) Between 10 and 30 nm of the airport, the thunderstorm is reported using the appropriate sector designation. For example, *LIGHTNING NORTHEAST; LIGHTNING SOUTHWEST AND NORTH; LIGHTNING EAST THROUGH SOUTH; or LIGHTNING ALL QUADRANTS*.

(d) When no activity is detected within the area, no report should be voiced.

(e) If the thunderstorm sensor/system is inoperative, the message should be *THUNDERSTORM DETECTION INOPERATIVE*.

3.16. FREEZING RAIN OCCURRENCE SENSOR. This sensor should be capable of detecting the occurrence of freezing rain.

a. Performance Standards. Freezing rain should be reported when a minimum 0.01 inch radial thickness freezing rain has accumulated.

(1) Accuracy.

(a) The sensor should correctly detect the occurrence of freezing rain 95 percent of the time.

(b) The sensor should not false alarm on frost. The sensor false alarm rate should not exceed 0.1 percent when there is rain at temperatures above 40°F, or when there is no precipitation. During snow, the false alarm rate should not exceed 1 percent.

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b. Performance Tests. The manufacturer should conduct a test program to demonstrate that the sensor meets the performance standards under the environmental conditions identified in paragraph 3.4. As a minimum, the following test conditions should be satisfied:

(1) Prior to testing, the AWOS manufacturer should develop and submit a test plan for approval to the FAA AWOS Non-Federal Engineering Office for approval at the address provided in paragraph 1.3.e.(2). The test plan should clearly outline the tests to be performed, it should define the capabilities of the sensor to be tested, it should include a detailed description of the test procedures, and it should contain a clear statement of pass/fail criteria. The test plan should identify the location(s) and the proposed time planned for the tests. All data collected during the test should be incorporated into the test report. Any data not included in determining the candidate sensor's compliance with the requirements of this circular should be fully explained.

(2) The test should be conducted in two phases. One phase should be conducted in a test chamber with varying conditions simulated to generate freezing rain. At least 25 freezing rain events, at various accumulation rates beginning at 0.01 inch per hour up to 0.5 inches per hour, should be simulated to demonstrate the requirements in paragraph 3.16.a.(1), and the results should be included in the test report. Additionally, at least 10 snow events at temperatures of 28°F or less and 10 rain events at temperatures of 40°F should be conducted at various accumulation rates to demonstrate that the sensor does not provide false reports. If false reports are generated during the tests, additional testing should be accomplished to demonstrate the requirements in paragraph 3.16.a.(1)(b).

(3) The second phase of the test should be conducted during the months of November through February at a location where there is a propensity for freezing rain and where there is a qualified weather observer on duty. The test report should compare the performance of the sensor under test with the log maintained by the official observer at the test location.

3.17. RUNWAY SURFACE CONDITION SENSOR. This sensor provides real-time information on runway conditions to alert the pilot if the runway is wet or if there are possible icing conditions.

a. Performance Standards. The sensor should be capable of detecting three runway conditions: dry runway, i.e., no perceptible moisture; wet runway, i.e., visible moisture on the surface; and possible freezing conditions, i.e., pavement temperature below freezing and moisture present on the surface.

b. Performance Testing.

(1) The testing should be performed on a sensor installed in a runway or other suitable pavement section which is free from chemicals, rubber buildup, or other contamination. The pavement temperature should be measured with an infra-red thermometer, or other approved method.

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The sensor should be accurate within $\pm 1^{\circ}\text{F}$ within the temperature band of 25° to 35°F . At least 10 observations should be made under each of the conditions in the following paragraphs.

(a) Dry Runway. No visible moisture is present on the sensor.

(b) Wet Runway. The sensor is damp, wet, or flooded, and the surface temperature is above 32°F .

(c) Possible Freezing Conditions. The sensor is damp, wet, flooded, covered with ice, or packed snow, while the surface temperature is at or below 32°F .

(2) The sensor should be operationally tested during an entire winter season. The sensor reports should be visually verified with consideration of the effects of wind and any chemicals on the surface, and should be accurate at least 80 percent of the time in each of the three conditions, i.e., dry, wet, and possible freezing.

3.18. AWOS DATA PROCESSOR. The four principal functions of the AWOS data processor are data acceptance, data reduction, data processing, and product dissemination both digital and voice. The processor typically accepts data inputs, performs various data reduction functions, implements the AWOS algorithms, and prepares weather observation reports. The processor should have the ability to provide a computer generated voice weather observation to a ground-to-air radio, e.g., VOR, NDB, VHF discrete, etc., for transmission to pilots. As an option, this voice message may also be provided to users via an integral automatic telephone-answering device.

a. Performance Standards.

(1) Data Reduction. The data reduction function consists of the processing of information prior to the actual algorithm processing. The AWOS data reduction software should include quality control checks to ensure that the data received are reasonable and complete and that the associated equipment is working properly before the weather algorithms are performed. The processor should perform the tasks identified in paragraphs 3.18.a.(1)(a) through 3.18.a.(1)(e). If data from any sensor are erroneous, functionally inoperative, or totally missing, e.g., the sensor loses power, etc., that parameter should be reported missing or removed from the weather observation outputs. The processor should continue to sample the data and, if the error condition is corrected, the weather parameter should be reinserted in the AWOS report. As an optional feature, an error indication light may be provided which should be located in an attended location and should be energized when a parameter is reported missing by the AWOS. If the examples of data reduction checks provided in paragraphs 3.18.a.(1)(a) through 3.18.a.(1)(e) are not applicable to a sensor's output, the manufacturer should propose suitable criteria. Additional criteria are encouraged.

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(a) Periodically check reference or calibration points within the system, e.g., reference voltage, aspirator airflow, sensor heater current, etc., to monitor system operation.

(b) Set upper and lower limits on the sensor output which correspond to the normal operating limits of the sensor or to the real-world limits of the site. This is a gross error check that should prevent reporting the presence of clouds below ground level, negative windspeed, etc. For example, set the temperature sensor's upper and lower limits to +130°F and -60°F.

(c) Set rate-of-change limits on the sensor's output. Determining the maximum acceptable change in temperature or signal characteristics allowable over a given period of time might set a rate-of-change limit.

(d) Examine the history of the sensor output to detect sensor problems. As an example, the mean and standard deviation of a sensor measurement may be calculated every hour and compared to established upper and lower limits. If the windspeed sensor has a mean greater than 3 knots but, a standard deviation less than 0.5 knot, the sensor has probably malfunctioned. Likewise, the wind direction sensor is probably inoperative if the windspeed is above 5 knots and the standard deviation is less than 1 degree. Other examples of data checks include consistently low windspeed, unvarying windspeed or direction, lack of visibility of more than 5 miles for long periods, a consistent cloud layer or a lack of clouds for long periods, and so forth.

(e) Recognize the absence of or longer than expected continual static data output for each sensor, examine the sensor without or after examining other sensor's outputs, and be able to diagnose a sensor malfunction. If the sensor is diagnosed as malfunctioning, its output should continue to be monitored, but its system output should be removed from use. For example, if the wind direction output does not vary for a long period of time, or if it does not move for a much shorter period of time while the windspeed indicates over 3 to 6 knots of wind motion, it would be assumed that the windspeed direction is frozen or otherwise inoperative. If the wind direction showed changing wind directions and yet, the windspeed sensor showed no windspeed changes for a set period, the windspeed sensor has probably failed.

(2) Weather Algorithms. The AWOS data processor should implement FAA algorithms to generate the elements of the weather observation (e.g. density altitude, wind gusts, variable wind directions, variable visibility, etc.). An observation should be generated each minute containing the current weather information for all the valid parameters observed by the AWOS. The algorithm output should adhere to FAA algorithm standards for output frequency of the specific product, e.g., 2-minute wind average, etc. If the output is to be supplied to the FAA for national dissemination, it should be in accordance with the appropriate ICD. Copies of the FAA algorithms and ICD's may be obtained from the AWOS Non-Federal Engineering Office for approval at the address provided in paragraph 1.3.e.(2).

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(3) System Output. The system should generate the output listed in paragraph 3.18.a.(3)(a) with the other system outputs being provided at the manufacturer's option.

(a) Computer-generated voice transmitted to pilots over radio, e.g., VOR, NDB, discrete frequency, etc.

(b) Optional telephone port for dial-up service.

(c) Optional output port for a video display.

(d) Optional input/output port for an operator terminal.

(e) Optional output port to the national weather network, i.e., type certified, commissioned AWOS III or IV only.

(4) Remote Maintenance Monitoring (RMM). All systems should include a dial-up or Ethernet input/output port that provides remote access to archived and real-time operational, i.e., weather reports, and maintenance data. This port should be used by properly authorized personnel to remotely enable or disable the system, or a specific sensor(s), or to set the clock, etc. The maintenance program should be designed to utilize this RMM capability to effectively and efficiently maintain the proper operation of the AWOS. Monitoring of the system should be performed by properly authorized personnel to regularly review and analyze the archived operational and maintenance data. The monitor should determine that all system parameters are being correctly reported, and that the real time clock is within the specified tolerance.

(5) Real-Time Clock. The processor should generate time as coordinated universal time (UTC). Typically, days, hours, minutes, and seconds are provided as a system output for use in system displays, computer-generated voice output, etc. The day should be expressed in the Gregorian calendar. Hours and minutes should be indicated numerically from 0000 to 2359. The clock function should be accurate within 15 seconds each month compared to an official time source, e.g., WWV. For those type certified, commissioned systems whose output is provided to the national weather network, i.e., AWOS III or IV only, AWOS clock errors in excess of 5 minutes may result in rejection of all data.

(6) Power Outage. The system should return to normal operation without human intervention after a power outage. The system should not output erroneous data when power is restored, and all weather parameters should achieve normal indications or should indicate *missing* within 30 minutes.

(7) Data Archiving. The processor should retain a record of the automated weather reports, as well as the data entered through the keyboard, for use by accident investigators. The interval

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between archived reports should not be more than 20 minutes, and the report should be retained for at least 96 hours (4 days), i.e., 96 hours of data are archived on a first in, first out sequence. A method should be provided for the local or RMM retrieval of archived reports using a removable media, e.g., floppy disk, CD, DVD or similar, or a permanent record, e.g., a hard copy print out, and the operator should be able to suspend the updates of the archived weather reports to freeze the data until retrieval may be accomplished.

(8) System Constants. The following system constants should be either permanently installed in the processor at the factory or protected from unauthorized or accidental modification so that they may not be changed after initial adjustment at the site without proper authorization from the factory.

(a) Elevation of the pressure sensors (MSL) at the installation site.

(b) Magnetic variation of the installation site to the nearest degree.

(c) AWOS facility identification.

(d) Algorithm constants.

(e) Alert criteria, including site unique criteria. The airport manager or other individual responsible to airport management may change this feature locally.

(f) System and sensor software and firmware revision level identification.

b. Performance Testing. System processing validation tests should be performed in three stages.

(1) Fixed and variable data sets should be provided to exercise the processor over the full range of possible sensor inputs and should include various over range and abruptly changing data to check the data reduction quality control routines. Smaller data subsets should be run with the processing unit operating in extreme environmental conditions.

(2) Analog data sets, or digital data sets if sensor output is digital, corresponding to the digital data in paragraph (1) above should be input at the sensor input ports to verify accurate and correct operation of the data acquisition process.

(3) A full complement of actual sensor devices should be connected to the processor through the data collection unit if part of the design, and driven by actual or simulated weather conditions to verify accurate and correct operation of the entire AWOS unit. The sensors should have passed their individual performance/acceptance tests. Data outputs from the AWOS data

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processor should meet the same standards of accuracy as have been established for the sensors in their individual parts of this document.

3.19. OPERATOR TERMINAL (OT). The OT should include a video display terminal and keyboard, as well as a microphone and speaker that permit the manual addition of a voice message to the end of the computer generated voice message. It is an optional component of the AWOS. It is normally a part of an AWOS installed at a facility with a qualified weather observer.

a. Performance Standards.

(1) Product Augmentation. The product augmentation function allows an observer to initiate or change any observation product. A specific editing password should control access to this function. Manual entries of weather phenomena not automatically observed should be placed in the remarks section of the observation. A qualified weather observer should have the capability to:

(a) Prepare a manual observation using the latest known weather parameters.

(b) Manually prepare a corrected observation, either from scratch or by editing a previously disseminated product still accessible in memory.

(c) Turn off report processing for a sensor in case the sensor fails or outputs incorrect data, which in turn places a missing symbol in that field.

(d) Manually edit any observation before release for dissemination by overriding the AWOS parameters, or cancellation of AWOS parameters, addition of new data, or cancellation of the entire product.

(e) Add to the voice message. Typically, the OT should have the capability to manually input a voice message, 30 seconds minimum, to the end of the computer-generated voice message when the AWOS is installed at a nontowered airport. However, when installed at a towered airport, the AWOS should have the capability to manually input a voice message, i.e., weather remarks plus NOTAM information, of at least 90 seconds duration to the end of the computer-generated message.

(2) Security. If an OT is a part of the AWOS system, it should be designed to prevent unauthorized persons from entering data into the system. The system should require the operator to enter a User ID and Password or a successive series of codes prior to allowing him/her to proceed with the entry of data.

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(3) Periodic Data Validation. Where an OT is used to modify the weather report, all manually entered data should be automatically time tagged by the system. The data should be valid until the next hourly or manually input observation. In order to retain the manually entered data in the system, the operator should be required to revalidate his/her on-the-hour observation. If no data is to be changed, the operator should be able to accomplish the revalidation using a simple procedure. The data should then be tagged with a new 1-hour limit. If the AWOS is installed at a towered airport and has the capability for input of at least 90 seconds of voice to the end of the weather observation as described in paragraph 3.19.a.(1)(e), the manually entered NOTAM information should not be automatically time tagged by the system. This NOTAM is limited to aviation related information specific to the airport and must not include commercial announcements such as fuel prices, lodging, etc. The NOTAM information is heard on the local voice broadcast, VHF or phone.

b. Performance Testing. The AWOS manufacturer should test the OT to demonstrate that the unit:

- (1) Displays the most current AWOS observation.
- (2) Retrieves archived data.
- (3) Has an editing capability to include rejection of erroneous inputs.
- (4) Should provide maintenance diagnostics data and perform maintenance diagnostics when called for in the system design.
- (5) Has adequate AWOS/OT communications security.
- (6) Has a manual voice entry capability.

3.20. VOICE SUBSYSTEM. The voice subsystem should provide high quality computer-generated speech for output of the AWOS observation. The voice subsystem should also provide the speech for the local ground-air radio broadcast and for telephone dial-up users. An optional feature is the capability for the addition of a manually input, i.e., analog, voice message from the OT at the end of the computer-generated voice message described in paragraph 3.19.a.(1)(e).

a. Performance Standards. The voice subsystem should have the following features.

- (1) The voice output should be a balanced, low-impedance driver providing a minimum of one milliwatt of power into a 600-ohm line. The output amplitude should be adjustable to a nominal 0 dBm output or a nominal minus 13 dBm output. (dBm is the measured power level in decibels)

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(2) The voice message should be output continuously with approximately a 5-second delay between the completion of one message and the beginning of the next.

(3) If the voice message is in process of output when the new AWOS observation is received, the output message should be completed without interruption. Voice transmission of the new AWOS observation should begin upon completion of the next delay time.

(4) The quality, i.e., clarity and phrasing, of the automated speech should provide high intelligibility when broadcasting using telephone and ground-air radio transmitters.

(5) The format and sequence of the voice message should be in accordance with latest edition of Order 7110.10, Flight Services Handbook. The document may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. When any weather parameter is reported missing or omitted due to a disabled or inoperative sensor, as determined by internal AWOS checks, the voice report should be (*parameter*) *MISSING*; e.g., *WINDSPEED MISSING*; *CLOUD HEIGHT MISSING*; etc. The UTC time of the observation should be given after the location identification. The word *advisory* should precede all weather information that comes from or is derived from advisory sensors. In accordance with the latest edition of the Aeronautical Information Manual, the word *test* should follow the words *automated weather observation* when the system is not in commissioned status.

(6) If the valid data update is not received prior to the start of the next voice transmission, the last valid data set received should be used to compose the voice message. Failure to receive a data update for more than 5 minutes should result in the termination of the voice output and generation of a failure message. In this event, the AWOS should output the message: (*station identification*) *automated weather observing system temporarily inoperative*.

(7) As an option, the voice system may contain an automatic telephone answering device that should permit user access to the voice message via the public telephone system. The incoming call should be answered prior to completion of the second ring, and the audio signal in progress at the time the call is received should be placed on line. The voice subsystem should automatically disconnect when the weather observation has been completely transmitted twice. Typically, the telephone-answering device should have the capability to answer five calls at a time with no loss of audio signal strength or intelligibility. The minimum requirement is that the system answers a single call.

(8) The voice system should contain a headset/speaker jack for monitoring the voice output.

(9) The voice quality should not be degraded when output on a VOR, NDB, or other NAVAIID.

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b. Performance Testing. As a minimum, the manufacturer should demonstrate the following voice unit capabilities.

(1) A capability to generate all combinations of words corresponding to possible AWOS output reports.

(2) The ability to detect communication transmission errors, data loss, and that it should cease voice transmission after loss of updates.

(3) It should respond to dial-up requests for voice data.

(4) If the OT is offered as an option, it should transmit manually input voice messages at the end of the AWOS observation.

(5) The frequency response of the computer-generated speech, i.e., voice quality, should be compatible with the frequency of the intended transmission medium, i.e., VOR, NDB, VHF radio or telephone.

3.21. AWOS ATIS SWITCH (AAS). There is only one discrete VHF frequency per site to broadcast weather information. A need exists for airports equipped with an ATIS to switch to an automated AWOS broadcast during non-operational hours. An AAS should provide the means to safely switch between the audio from an AWOS or an ATIS to be fed to a single VHF transmitter. A current copy of the complete AAS criteria can be obtained from the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2).

a. Performance Standards. The AAS should have the following features.

(1) The voice output should be a balanced, low-impedance driver providing a minimum of one milliwatt of power into a 600-ohm line. The output amplitude should be adjustable to a nominal 0 dBm output or a nominal minus 13 dBm output.

(2) The AAS should have circuitry or isolation transformers built in so as to not load the sources.

(3) The AAS should have the circuitry built in to adjust the output volume to the VHF transmitter.

(4) The quality (clarity and phrasing) of the automated speech should not be degraded after passing through the AAS.

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(5) As an option, the AAS may provide phone line switching between the AWOS message and the ATIS recording.

b. Performance Testing.

(1) The AAS manufacturer should demonstrate that the device does not interfere with the operation of AWOS or ATIS.

(2) The AAS should demonstrate that the aural/audio quality of the output signal is the same as the input aural/audio quality for both the AWOS and the ATIS.

3.22. ELECTROMAGNETIC INTERFERENCE (EMI) PROTECTION. The AWOS should be designed to minimize susceptibility to EMI and operate successfully in the complex electromagnetic environment of an airport. The AWOS should not cause interference to existing systems. Should interference caused by the AWOS occur, the system must be shutdown until the problem is resolved by the owner/installer/manufacturer.

3.23. TRANSIENT AND LIGHTNING PROTECTION. AWOS equipment should be protected against damage or operational upset due to lightning-induced surges on all sensor input lines, sensor supply lines, and incoming power and data communications lines as well as audio and keying circuits when transmission of the voice message is provided by other than an integral VHF transmitter. Equipment, including the electrical circuits of fiber optics modems, and personnel should be protected from lightning currents and voltages; from power line transients and surges; and from other electromagnetic fields and charges. AWOS manufacturers are encouraged to design and install lightning protection systems in accordance with this AC, as well as the latest editions of FAA Standard FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment and the Lightning Protection Code, NFPA 780, for all equipment and structures. NFPA 780 may be obtained from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269.

a. General.

(1) Cone of Protection. All equipment, including antennas, sensors, and obstruction lights that are tower mounted, should be within a maximum 45 degrees cone of protection provided by an air terminal. The air terminal should be connected to the earth electrode grounding system. The structure of steel towers may serve the function of down conductors provided the air terminal and grounding cable connections are made as defined herein.

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(2) Materials. All materials should be Underwriters Laboratory (UL)-approved for the purpose used, except where specific requirements or exceptions given herein apply. Down conductors should be a soft-drawn stranded, bare copper cable weighing approximately 215 pounds per 1,000 feet. Down conductors should always be routed in a downward direction and bends should have an 8-inch or greater radius. Down conductors should be attached to the tower at approximately 3-foot intervals. Substantial electrical and mechanical connections are required between air terminals and down conductors, and between down conductors and the below grade earth electrode grounding system.

b. Earth Electrode Grounding System. New earth grounding systems should be provided and installed, or existing earth grounding systems should be upgraded as necessary. These grounding systems should consist of driven ground rods or buried plates and buried interconnecting cables. All site grounding conductors should terminate or directly connect to the earth ground system. Buried cables should interconnect adjacent earth grounding systems within 30 feet of each other. The earth electrode grounding system configurations should depend upon the geological conditions at the site, with very extensive systems justifiable in areas with high soil resistivity and frequent lightning damage. Ground rods should be copper clad steel, UL-approved, 10-foot minimum length, 3/4-inch minimum diameter, pointed end or coupling type, as necessary. Tops of driven rods should be at least 18 inches below grade level. Separation between rods at a site should be at least equal to their driven depth and preferably at twice their depth where space permits. Grounding plates should be 20-gauge minimum sheet copper and at least 2 feet by 2 feet in size. Grounding cables used to interconnect ground rods or plates should be bare copper of the same size as the largest down conductor required for the site. Grounding cables should be installed a minimum of 18 inches below grade level. All steel materials used to anchor guy wires should be interconnected using split bolt connectors and No. 6 AWG bare copper grounding wire. Similar bonding jumpers should be connected around guy wire couplings and fittings. Where driven poles or foundation piers are required to support towers, earth grounding cables should be installed.

c. Grounding. Grounding should be provided to conduct lightning charges, power faults, and unbalanced currents, to eliminate static and electromagnetic charges, and to provide an equal potential reference for the operation of equipment. All metallic structures, enclosures, conduit, cable armor, and conductor shielding should have a direct, identified path to the earth electrode grounding system. The grounding path should be provided by a separate grounding conductor or by bonding metallic structures or enclosures with a separate conductor to the earth electrode grounding system. All grounding conductors should be routed as directly as possible without loops, excess length, or sharp, i.e., less than 8-inch radius, bends. All equipment enclosures, housings, cases, cabinets, and racks should be grounded by an equipment grounding conductor provided and installed in accordance with the latest edition of the National Electrical Code, NEC (NFPA 70), except that conduit and other power circuit enclosures should not be used to serve the purpose. A separate equipment grounding conductor should be provided and installed with each power circuit. The neutral conductors for power circuits should not be grounded in or by any equipment or at any point in the system, except at service entrances as defined by the NEC. At service entrances and at main

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disconnect circuit breaker boxes serving this purpose, the power neutral conductor and the equipment grounding conductor should be common and connected directly to the earth electrode grounding system. The grounding electrode conductor should be unspliced and routed separately without loops, excess length, or sharp, i.e., less than 8-inch radius, bends. All signals transmitted by interface lines or landlines should be balanced two-wire signal lines or an individual ground return conductor should be routed with each signal line. A third wire may be routed with two-wire signal lines to serve as ground return or reference. The outer conductors for all coaxial, twinaxial, and triaxial cable should be grounded at equipment, antennas, and bulkheads and not isolated at any point.

d. Bonding. Bonding is the mechanical and electrical connection of metal materials, wires, and cables for the low impedance conduction of currents and electromagnetic energy. The effectiveness of lightning protection, transient protection, grounding and shielding depends upon the quality of bonding connections. Therefore, high quality bonding should be designed and implemented into the AWOS and its installations.

e. Shielding. Shielding should be provided to protect equipment and interface lines, i.e., all signal data, control, monitoring, power lines, and cables, from lightning currents and discharges. Shielding should also provide for the containment of interference and signals produced by equipment and to protect susceptible equipment from related environmental signals and interference.

f. Conductor Segregation, Separation, and Routing. The segregation, separation, and routing of all lines, cables, and conductors should be designed by the installer to minimize the coupling of lightning currents, transients, surges, and interference. AC power lines, signal lines, and grounding cables should be segregated and routed separately and not installed in the same trench or conduit. The parallel routing of these types of cables should be avoided and, where necessary, should conform to the latest edition of the NFPA-780 code. To the extent feasible, all crosses should be at right angles.

g. Transient and Surge Suppression. All transients and surge arrestors, circuits, and suppressors required at service entrances to existing buildings and shelters, and components required for the system and equipment should be furnished and installed by the manufacturer.

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Chapter 4. AWOS SYSTEM MAINTENANCE AND OPERATING REQUIREMENTS

4.1. INTRODUCTION. This chapter, along with the information in Chapter 3, provides the FAA's minimum desired and maximum acceptable operating standards, tolerances, and references for a commissioned non-Federal AWOS system. It also provides the minimum checks that should be made and the maximum intervals between checks.

4.2. SYSTEM PERFORMANCE VERIFICATION TESTING. System performance verification testing is accomplished to ensure that the system is meeting its desired performance parameters and assure others that it is doing so.

a. To be able to ensure and assure, the AWOS manufacturer should provide an accurate, reliable system through type certification acceptance procedures and, then, the system owner should maintain the systems by accomplishing valid performance verification checks at sufficient intervals to maintain user confidence in the system's performance.

b. To provide and maintain a system that the user accepts as a source of dependable and reliable information, the system owner, in the presence of a qualified FAA non-Federal inspector, should accomplish valid system performance verification checks and be able to compare the results to National Institute of Standards and Technology (NIST) traceable standards.

c. The FAA recognizes that practical and economic considerations impact the accomplishment of system verification testing, but if compromise is necessary, it needs to be decided on the side of performance assurance and user safety.

d. If additional background information about the FAA's maintenance or preventive maintenance concepts for FAA-owned systems is desired, please refer to the latest editions of FAA Order 6700.20 or Order 6000.15, General Maintenance Handbook for Airway Facilities.

4.3. NON-FEDERAL AWOS STANDARDS, TOLERANCES, AND REFERENCES.

a. Non-Federally owned AWOS systems are not expected to meet tighter tolerances than are required for similar FAA-owned AWOS equipment. FAA-owned meteorological AWOS equipment tolerances are found in the latest edition of FAA Order 6560.13.

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b. Table 9 provides non-Federal AWOS standards, tolerances, and references for use during commissioning and annual revalidation.

c. If a manufacturer has specified and received approval from the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) for tighter tolerances to be met, these will be checked and recorded as found.

d. The maximum operating tolerances provided in Table 9 should be used during initial commissioning and annual revalidation to demonstrate that the AWOS meets the minimum commissioning and operating requirements for each parameter.

Table 9. Standards, Tolerances, and References

Check	Reference or Standard	Desired Initial Tolerance	Maximum Operating Tolerance
Obstruction Lights	Visual	All lighted	At least one lit
Mechanical Windspeed (with moving parts)	WS calibrator for WS ref. & bearings	Ref. speed ± 1.5 knots	Ref. speed $\pm 5\%$
Mechanical Wind Direction (with moving parts)	Align vane with ref. direction benchmark.	± 3 degrees	± 5 degrees
Ultrasonic Windspeed	N/A	Less than 0.5 knots with calibrator	Less than 0.5 knots with calibrator
Ultrasonic Wind Direction	Align with ref. direction benchmark.	± 3 degrees	± 5 degrees
Temperature	Compare with Std.	± 1 degree F	± 2 degrees F

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Check	Reference or Standard	Desired Initial Tolerance	Maximum Operating Tolerance
Dew Point	Compare with Std.	± 2 degrees F	± 3 degrees F
Humidity	Compare with Std.	±2%	±5%
Day/Night	Manual result	Block optics & see vis distance chg	Block optics & see vis distance chg
Visibility	Vis. Cal. standard ref.	± 3 percent of ref.	± 3 percent of ref.
Tipping Bucket	Manual check	2 tips=2 counts, level bucket	2 tips = 2 counts, level bucket
Ceiling	Manual observation/ PIREP	± 50 ft.	±100 ft.
Barometer	Compare with Std.	± .02 inHg	± .02 inHg
System Clock (Time)	Compare with UTC, GPS or WWV	± 15 sec.	± 45 sec.
VHF Transmitter Frequency	Assigned frequency	± 1 kHz	Same as initial
VHF Transmitter Output Power	2.5 watts	± 0.25 watts	Same as initial

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Check	Reference or Standard	Desired Initial Tolerance	Maximum Operating Tolerance
VHF Transmitter Modulation	80%	65% to 95%	Same as initial
VHF Transmitter VSWR (at transmitter)	1.0 : 1	3.0 : 1	Same as initial
UHF Radios (throughout system) Frequency	Assigned frequency	± 2 kHz	Same as initial
UHF Radios (throughout system) Output Power	1.0 watt	± 0.25 watt	Same as initial
UHF Radios (throughout system) Frequency Deviation	2.2 kHz	± 0.5 kHz	Same as initial
UHF Radios (throughout system) VSWR (at transmitter)	1.0 : 1	3.0 : 1	Same as initial
Failed, inoperative sensor check. (This is not a sensor accuracy check)	Inoperative sensor output indication should go <i>missing</i> .	Remove any sensor input, check that OUTPUT goes <i>missing</i> .	Same as initial, within type accepted period

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4.4. PREVENTIVE MAINTENANCE (PM) CHECKS AND SCHEDULES.

a. Minimum Tri-Annual Preventive Maintenance (PM) Checks. The following preventive maintenance checks should be accomplished by the assigned maintenance technician holding verification authority in accordance with manufacturer's provided and FAA approved maintenance manual at tri-annual intervals, not to exceed 155 days.

(1) Visit facility and accomplish a visual inspection to ensure integrity of the AWOS equipment and site location.

(2) Visual check of obstruction lights.

(3) Visually inspect all sensors and AWOS assemblies. Clean all sensors, lenses, and other parts, as needed.

(4) Check all sensors for accuracy of readings with respect to existing conditions. For the barometer, the PM a comparison with an associated weather reporting station is appropriate. An associated weather reporting station is defined as any one of the following:

- the National Weather Service (NWS),
- a limited aviation weather reporting station (LAWRS),
- a commissioned Automated Surface Observing System (ASOS),
- a commissioned Automated Weather Observing System (AWOS),
- a commissioned Automated Weather Sensor System (AWSS),
- a Contract Weather Observer (CWO),
- a calibrated hand-held digital barometer/altimeter,
- a calibrated pressure transfer standard, or
- a flight service station.

For sites having a precision approach the associated weather reporting station must be within 10 nautical miles of the facility and windspeed must not exceed 12 knots at either facility, gusts must not exceed 15 knots, and the difference in elevation between the two facilities must not exceed 100 feet. For non-precision approach locations, the factors are 25 nautical miles, 15 knots windspeed, 20 knots gust, and 200 feet (61 meters). The station's temperature at both precision and non-precision approach locations must be within 30 °F of the standard atmosphere temperature for the station's elevation.

(5) Check video display terminal, keyboard, and archiving.

(6) Check system time and reset as needed.

(7) Check AWOS telephone operation.

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(8) Aurally check AWOS radio transmission.

(9) Make other checks as necessary or requested by the manufacturer or the FAA to ensure continued reliable operation of the specific system equipment involved.

b. Minimum initial and annual verification checks. The following preventive maintenance checks should be accomplished in accordance with manufacturer's provided and FAA approved maintenance manual by the assigned maintenance technician holding verification authority for the system during initial commissioning checks and on an annual basis. The acceptable tolerances are identified in Table 9. Annual PM is scheduled on a 12 month interval and should be accomplished during the month it is scheduled or, if necessary, during the preceding or following month. The maximum tolerance is ± 31 days from the scheduled annual verification check.

(1) Accomplish all tri-annual preventive maintenance checks.

(2) Mechanical Wind Direction. Check freedom of movement manually.

(3) Mechanical Windspeed. Check freedom of movement and a reference speed near the mid-to-upper-range of the sensor. Record both the windspeed reference and sensor readings.

(4) Ultrasonic Windspeed and Direction. Check the manufacturer's defined reference condition of the sensor. Record both the reference and the sensor's readings.

(5) Temperature. Compare against a collocated calibrated standard. Compare and record both the standard temperature read and the AWOS temperature read.

(6) Dew point/Humidity. Compare against a collocated calibrated standard. Compare and record both the standard humidity/dew point and the AWOS dew point.

(7) Aspirator Fan (if present). If the fan fails, the temperature and dew point sensor readings should go *missing*. Record SAT or UNSAT operation.

(8) Barometer. Compare system barometer readings against a collocated calibrated standard. Record standard and barometer readings. Compute the standard altimeter reading and compare to the AWOS altimeter reading.

(9) Visibility. Compare visibility readings to blocked receiver and calibration device reference readings. Record all readings and references. Check day/night sensor to see if it changes state and actually changes visibility distance indicated.

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(10) Heated Tipping Bucket. Ensure sensor is clean and level and number of tips recorded equals number of tips generated. Record number of tips used as a reference and number of tips reported.

(11) Present Weather. Ensure that present weather sensor is operating properly. The only check that can be accomplished is to spray water in the space between the heads and verify that it reports precipitation.

(12) Ceilometer. Check reference target distance if system is designed to enable this check. Reflect transmitted signal back into receiver to check system for minimum ceiling. Record reading seen and reading expected. If needed, blocking the receiver may check the maximum ceiling. In addition, local pilot reports may be used to verify performance.

(13) Missing Sensor. Check that a frozen or inoperative sensor will have its output reported *missing* and removed from the national network and local outputs.

(14) Remarks Capabilities. Enter test remarks, ensure they are accepted and provided to user, and then delete.

(15) VHF Transmitter Operation. Check frequency, power output, VSWR, percent of modulation, and aural/audio quality.

(16) UHF Transmitter Operation. Check frequency, power output, VSWR, and percent of modulation.

(17) Telephone. Check to ensure it answers on second ring; is clear; provides two complete messages and disconnects; and verify aural/audio quality.

(18) UHF Transmitter/Transceiver (if used). Check frequency, power output, VSWR, percent of modulation, receiver sensitivity, receiver quieting, etc.

(19) Other Sensors. Check other sensors, e.g., freezing rain, runway surface, or thunderstorm, as required.

(20) Other Checks. Make other checks requested by the manufacturer, the sponsor, or the FAA as required by the specific system. To obtain valid references ensure the readings continue to meet these references.

c. Triennial Verification Checks. The following maintenance checks should be accomplished by the assigned maintenance technician holding verification authority for the system during initial commissioning checks and on a triennial (3 year) basis. Triennial maintenance should be accomplished in accordance with manufacturer's provided and FAA approved maintenance manual

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during the month it is scheduled or, if necessary, during the preceding or following month. The maximum tolerance is 90 days from the scheduled maintenance event.

(1) Mechanical Wind Direction. Check direction accuracy by holding vane on reference direction mark. Record the wind direction reference and the wind direction read.

(2) Ultrasonic Wind Direction. Check direction accuracy on reference direction mark. Record the wind direction reference and the wind direction read.

4.5. REQUESTING EXCEPTIONS TO MINIMUM MAINTENANCE REQUIREMENTS.

a. Manufacturers are encouraged to improve system reliability, accuracy, and verification method testing. A manufacturer may request an exception or variance from an FAA minimum desired maintenance check or interval. The request should include supportive documentation showing performance information obtained during actual field use of the system or sensor. The manufacturer should submit requests and supporting documentation with regard to paragraph 2.4 of this AC to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2). The FAA may also reevaluate these checks and intervals with respect to actual documented system performance.

b. The FAA's intent is to ensure that dependable AWOS systems are provided for our users. The FAA will strive to issue type certification approval only to systems that meet functional needs and recommend that they be maintained in a manner that will provide user confidence. The FAA encourages cooperation in that endeavor from the manufacturers and system owners.

c. The FAA will review these requests with respect to the actual documented field performance data and, at the same time, with an understanding of and proper regard for system assurance documentation needs. Manufacturers are to understand that it is the FAA's intent to improve system reliability and reduce maintenance costs. Also, the FAA may not be able to approve a request because of the need for the manufacturer to provide recurring system assurance documentation.

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Appendix 1**APPENDIX 1. ACRONYMS USED IN THIS ADVISORY CIRCULAR**

AAS	AWOS ATIS Switch
AC	Advisory Circular
AIP	Airport Improvement Program
ANSI	American National Standards Institute
ATIS	Automatic Terminal Information Service
AWOS	Automated Weather Observing System
AWPAG	All Weather Precipitation and Accumulation Gauge
CFR	Code of Federal Regulations Part 14 contains the aviation regulations. Part 47 contains the FCC regulations.
CH	Contact Height
dBm	Represents a measured power level in decibels relative to 1 milliwatt
EFAS	Enroute Flight Advisory Service
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FC	Foot-Candles
FCC	Federal Communications Commission
FMH-1	Federal Meteorological Handbook No. 1
FMO	Frequency Management Office
FPO	Flight Procedures Office
FRD	Facility Reference Data
FRU	Field Replaceable Unit
FTP or ftp	File Transfer Protocol
GPS	Global Positioning System
ICD	Interface Control Document
inHg	Inches of Mercury
METAR	Aviation Routine Weather Report
MOA	Memorandum of Agreement
MOCC	Maintenance Operations Control Center
MOU	Memorandum of Understanding
MSL	Mean Sea Level
NAS	National Airspace System
NAVAID	Navigational Aid
NDB	Nondirectional Radio Beacon
NEC	National Electrical Code
NF Obs	Non-Federal Observer
NFDC	National Flight Data Center
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology

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Appendix 1**APPENDIX 1. ACRONYMS USED IN THIS ADVISORY CIRCULAR (Continued)**

NM or nm	Nautical Mile
Non-Fed	Non-Federal
NOTAM	Notice to Airmen
NWS	National Weather Service
OMM	Operations and Maintenance Manual
OPR	Office of Primary Responsibility
OT	Operator Terminal
PIM	Program Implementation Manager
PIREP	Pilot Report
PM	Preventive Maintenance
RBC	Rotating Beam Ceilometer
RMM	Remote Maintenance Monitoring
RMSE	Root Mean Square Error
SAWRS	Supplementary Aviation Weather Reporting Station
SM	Scheduled Maintenance
TS	Thunderstorm
UHF	Ultra High Frequency
UTC	Coordinated Universal Time
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio
VOR	VHF Omnidirectional Radio Range
VORTAC	VOR Tactical Air Navigation
VV	Vertical Visibility
WMSCR	Weather Message Switching Center Replacement
WS	Windspeed
WWV	National Institute of Standards and Technology Time Standard Radio Station

ATTACHMENT D

Part I. OPERATIONAL REQUIREMENTS

The following requirements must be met to operate a facility in the National Airspace System (NAS). Failure to comply with these requirements will result in withdrawal of approval for use of the facility.

1. LICENSING:

a. Facility: The Federal Communications Commission (FCC) license is to be conspicuously posted at the facility. The normal period of the station license is **10 years**, after which time it must be renewed. **FCC Form 601** may be obtained from the FCC office or web site. Each application must contain a statement indicating that the FAA has been notified and the date of notification. Renewal applications must be made at least 180 days prior to expiration. **Copies** of the **application** and the **new license** when received must be provided to the **FAA Kansas City Technical Support Center (FAA KC TSC)**. This can be addressed as: **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215**.

b. Maintenance Technician: The equipment must be operated and maintained only by persons that meet FCC licensing requirements and are approved by the FAA.

(1) A general class radiotelephone operator license satisfies the FCC requirement. A copy of this license must be provided to the **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215**.

(2) FAA approval will be granted following the successful completion of both of the following:

a. FAA or FAA-approved manufacturer's school or satisfactory completion of a concept examination administered by a representative of the FAA. It is to be understood that the satisfactory completion of the concept examination precludes the necessity of the resident training.

b. A performance examination to be given by a representative of the FAA.

(3) A Letter of Technical Verification will be provided by the FAA stating that these requirements have been met.

2. NOTICE TO AIRMEN:

A Notice to Airmen (**NOTAM**) contains the establishment, condition, or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. Deviation from normal operation or failure of this facility is to be promptly and accurately publicized by a **NOTAM**. The sponsor and the technician responsible for the equipment maintenance must be notified immediately of reports concerning irregular operation of this facility by pilots or other persons detecting the irregularity. The sponsor or the authorized representative must ensure that a **NOTAM** has been filed through the **Mid-States Operations Control Center (MOCC) at 1-800-322-8879** and report the facility interruption(s). The **MOCC** will ensure that appropriate notifications including **NOTAMS** are completed. When the facility is returned to service and verified, the **NOTAM** will be cancelled after notifying the **MOCC**.

3. SHUTDOWN FOR ROUTINE MAINTENANCE:

Maintenance should be performed only when the following conditions exist:

a. Interruption should be confined to visual flight rules (VFR) conditions, daylight hours, and periods of light traffic when possible, or when ATC has given clearance for a facility on an alternate runway.

b. The interruption of service must be coordinated with the **MOCC at 1-800-322-8879**. Notification should be made so that the notice of shutdown or interruption will be published in advance of the proposed interruption. Facilities must not be shut down without Air Traffic (AT) approval.

(1) Request for schedule shutdowns shall provide a minimum of five (5) hours advance notification. Facilities **will not** be shutdown without **MOCC** approval.

(2) Request for emergency shutdown shall provide a minimum of one (1) hour of notification when possible.

A **NOTAM** must be in effect announcing the scheduled interruption and the facility **will not** be shutdown until that specified time has arrived. The advance notification of the interruption will state a specific period of time for the interruption to occur.

c. Unscheduled interruption of service shall be reported to the **MOCC at 1-800-322-8879** immediately. The facility identification signal must be disabled while maintenance is being performed.

4. PILOT REPORTS:

The sponsor must remove the facility from service immediately upon receipt of **two successive pilot reports** (PIREPS) of malfunctioning. The facility will remain out of service until the proper operation can be confirmed by the facility Nonfederal technician and/or flight inspection aircraft if necessary.

5. REQUIRED SUPPORT ITEMS:

a. The sponsor must provide FAA approved test equipment needed for maintenance of the facility. Test equipment used to measure key performance parameters must be calibrated in accordance with the schedule in the Facility Manufacturers' Instruction Book or the Test Equipment Instruction Book. If the calibration instruction for the test equipment is not available, the test equipment shall be calibrated at least annually. All test equipment calibration must be accomplished with standards traceable to the National Institute of Standards and Technology.

b. There must be a stock of spare parts sufficient to make possible prompt replacement of components that fail or deteriorate in service.

6. EMERGENCIES:

a. Military: In a case of a national defense alert, the facility must adhere to the directions received from the **MOCC** and must remain in such status until official notice is received that the alert is over.

b. Aircraft Accident: Part III of this manual provides guidance in case of an aircraft accident.

7. ADJUSTMENT OF EQUIPMENT THROUGH REMOTE MAINTENANCE MONITORING (RMM):

Any Nonfederal facility having RMM uplink adjustment capability must have an associated printer, which documents all maintenance activities. This printer must make a record for the review of visiting FAA personnel of all logons and equipment adjustments, which may be initiated from a remote terminal. Printouts will be maintained a minimum of 2 years before being discarded.

PART II. MAINTENANCE REQUIREMENTS

8. GENERAL:

a. The facility must be maintained in accordance with FAA Advisory Circular 150/ 5220-16D, FAA Order 6560.13C, Manufacturer's Instruction Books, Maintenance Technical Handbooks, and/or other FAA approved requirements. FAA Standards and Tolerances will be used. If they do not exist, then the Manufacturer's Handbook will be used. However, if there is a conflict between requirements published in various documents, **the order of precedence shall be FAA Advisory Circular(s), FAA Order(s), and Manufacturers' Instruction Books.**

Note: The maintenance schedules and requirements contained in these publications are to be considered the minimum level of maintenance in accordance with FAA Advisory Circular 150/ 5220-16D and this document.

b. The FAA must be responsible for providing FAA forms and appropriate FAA publications required for maintenance of the facility. These forms will be made available by the **FAA KC TSC** at no charge. These forms may also be available on the FAA web site.

c. If a verified maintenance technician is not assigned or if the maintenance schedules as set forth in FAA approved maintenance procedures are not adhered to, the equipment must be removed from service unless the sponsor or designated representative has coordinated the exact circumstances with the FAA.

d. Facility Reference Data File (FRDF) must be completed by the owner or the owner's representative at the time of the facility commissioning. One copy must be kept in the permanent records of the facility and one copy must be sent to the **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215**. The sponsor or the sponsor's representative must revise the data after any major repair, modernization, or retuning to reflect an accurate record of facility operation and adjustment. In the event the data is revised, the owner or the owner's representative must notify **FAA KC TSC** of such revisions and forward copies of the revisions to the **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215** within **10 working days**.

e. Facility Maintenance Log, FAA Form 6030-1:

(1) This log is a permanent record of all of the activities required to maintain the facility. Log entries must be clear, complete, concise, and recorded in universal time code (UTC). The entries must include all malfunctions encountered in maintaining the facility, including information on the kind of work and adjustments made, equipment failures, causes (if determined), and corrective action taken. In addition, the entries must include statements describing periodic maintenance activities required to maintain the facility, facility verification statements, and NOTAM information. The original maintenance logs must be retained at the facility for a period of 3 years. A copy of the log pages must be sent to the **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215**. These records must be received within **20 calendar days** of the scheduled facility maintenance/restoration.

(2) Among the most important entries in the facility maintenance log are those indicating the verification status of a system, subsystem, or equipment. For the purpose of this OMM, the word "certification" used in FAA directives must be synonymous with "verification." Verification statements must be entered in the facility maintenance log (FAA Form 6030-1) in accordance with appropriate FAA directives and orders. A verification statement must be made before returning a system, subsystem, or equipment to service, if the performance of the facility has changed and whenever maintenance work that has been performed may have affected verification parameters.

Only those persons possessing current verification authority are authorized to perform maintenance and verify the facility. No other persons shall be permitted to adjust and/or perform work on the facility or make entries in the facility log records.

Note: Specific instruction for entries in the Facility Maintenance Log (FAA Form 6030-1) is found in the latest version of FAA Order 6000.15E, General Maintenance Handbook for National Airspace System (NAS) Facilities, par. 241, 246, and 248.

f. **Technical Performance Record**, FAA Form 6000 Series contains a record of system parameters recorded during each scheduled visit to the facility. The sponsor or the sponsor's representative must keep the original page of the technical performance record at the facility and send a copy to the **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215**. These records must be received within **20 calendar days** of the scheduled facility maintenance/restoration.

g. Improvement in maintenance procedures or equipment modifications must be funded and incorporated by the sponsor following approval by the FAA. An addendum to the OMM, approved by the FAA, must be completed if necessary.

h. The sponsor must submit any proposed modifications to the facility to the **FAA KC TSC, Nonfederal Facilities Coordinator, 14015 West 95th St, Lenexa, KS 66215** for approval and must not permit any modifications to be performed without specific FAA approval. Neither the equipment nor antenna will be replaced or relocated without prior FAA approval. No construction is to be planned in the vicinity that may alter or affect the facility without first coordinating with the FAA. Status monitor receivers must not be removed or relocated without FAA approval.

i. Vegetation, snow depth, and other potential obstructions to accuracy of the facility operations must be controlled in accordance with applicable FAA handbooks.

9. PHYSICAL SECURITY:

The facility must be kept locked at all times. Protection must be provided to ensure that unauthorized personnel do not have access to the equipment.

10. FLIGHT INSPECTIONS:

Flight inspections will be performed as stipulated in FAA Handbook AOP 8200.1, United States Standard Flight Inspection Manual. The sponsor must provide ground-to-air communications on 135.85 or 135.95 megahertz for flight inspection when required. The maintenance technician must participate in this inspection if required by the FAA. Those activities requiring flight inspection are outlined in the FAA Maintenance Technical Handbooks and Orders.

11. GROUND INSPECTIONS:

a. FAA ground inspection will be accomplished on a periodic basis. Prior notification of ground inspection will be given to the facility technician, identified by this OMM, after coordination with the sponsor. The Nonfederal technician shall participate in the technical inspection. Failure to meet the technical standards for equipment maintenance may be grounds for cancellation of NOTAMing the facility out-of-service and/or decommissioning of the AWOS.

b. The FAA may conduct a follow-up inspection when a facility may have been a factor in an aircraft accident/incident (see Part III).

12. SAFETY:

Occupational Safety and Health Administration (OSHA) requirements should be followed to ensure personnel safety. Vegetation must be controlled to allow access to the facility.

13. NAPRS DATA: (To be provided.)

PART III. AIRCRAFT ACCIDENT/INCIDENT PROCEDURES

14. FACILITY CHECKLIST:

a. Specific information is required for each facility removed from service as identified by the accident AFAAR or designee.

Log Data Uploaded :(If automated logging authorized)

Date: _____ Time: _____ Initials _____

b. Complete the following initial items:

(1) List the facility that has been identified to be returned to service. The restoration can be accomplished via certification and/or operational status check.

Facility: _____ **Ident:** _____

(2) Identify the non-Federal technician who last verified the facility, and the observer:

(a) Record below the name of the non-Federal technician who last verified the facility or equipment.

1. **Facility** _____

2. **Non-Federal technician who last verified the facility.**

(b) The AFAAR must designate an observer to witness the technical evaluation of the facility of equipment.

1. Has an observer been assigned by the AFAAR?

YES _____ **NO** _____

2. If the answer is **NO**, contact the appropriate FAA control center.

Observer's Name _____

Observer's Title _____

Observer's Phone # _____

(3) Upon arriving at the facility, log the following information:

(a) Arrival date and time at facility. _____

(b) Reason for facility visit. _____

(c) Current weather conditions (not at time of accident/incident) at facility. This is your “unofficial” observation of the general weather conditions upon your arrival at the facility. See the following example text.

Examples of typical initial log entries: (not necessary to use word-for word).

2310 arrived site to initiate verification and/or restoration of facility in a post-aircraft accident/incident.

2315 presently, the weather conditions are overcast and snowing with 2 feet of snow on the ground.

2316 found GS was operating on commercial power with no alarms of transfers indicated. Air Traffic reported no pilot reports of malfunction on this facility during last (XX) hours. Where XX = the appropriate number of hours.

c. Initiate action to verify and restore facility if directed by the AFAAR.

(1) If a facility is remotely monitored, contact the monitoring point and ask if there have been any short duration alarms or facility transfers indicated. Document findings in the facility maintenance log.

(2) If the facility is shutdown, record the status of the equipment in the facility log. Reset the equipment, and MAKE NO ADJUSTMENTS. If the facility fails to restore to normal after resetting, notify the accident AFAAR immediately for further instructions. If the facility resets successfully, continue with the next step.

(3) Immediately record as-found technical data (see sub-paragraph d. below), MAKING NO ADJUSTMENTS. IF OUT OF TOLERANCE CONDITIONS ARE FOUND, notify the accident AFAAR immediately for further instructions.

(4) If a flight inspection has been requested, MAKE NO ADJUSTMENTS prior to commencing the flight inspection, and then make only those adjustments requested by flight inspection personnel.

(5) Once as-found technical data has been recorded (see sub-paragraph d. below), and any flight inspection activities have been completed, corrective in support of facility restoration may begin. Record as-left technical data (see sub-paragraph d. below).

(6) Verify the facility as required and initiate restoration coordination. Record all activities in the facility maintenance log.

d. Documentation of the condition of the facility.

(1) Technical performance parameters must be recorded accurately on the appropriate FAA form, Technical Performance Record (TPR). For remotely monitored facilities, all data required to support a verification judgment MUST be captured and a hard copy retained. If the equipment involved is operational, a set of as-found readings or screens MUST be recorded prior to any corrective maintenance, followed by recording a set of as-left readings or screens.

(2) Authentication of Technical Readings: An authentication statement MUST be entered immediately below each set (as-found, as-left) of parameter values, on each TPR form, and/or on each screen printed, identifying whether the values are as-found or as-left. The authentication statement is not necessary on copies of electronic log pages. If no adjustment or other maintenance was accomplished, a single statement will suffice. The authentication statement to be used on each set of readings on each TPR and each page of remotely monitored data is as follows:

I certify that the above post-accident/incident data is a true record of the (facility or equipment type) parameter values (screens) (as-found, as-left, or as-found and as-left) at the date and time indicated.

Nonfederal Technician:

Observer:

Signature _____

Signature _____

Name _____

Name _____

Title _____

Title _____

NOTE: In the above authentication statement, compose, select, or modify the text in parentheses as appropriate. Example: I certify that the above is a true record of the **XYZ Localizer** parameter **values as-found at the date and time indicated.**

(3) Terminate each TPR page that contains accident/incident data in accordance with FAA Order 6000.15.

e. Completion:

(1) Confirm restoration coordination is complete.

(2) This completes the facility restoration process.

PART IV. NON-FEDERAL FACILITY DATA

1. Facility:

- a. Type Automated Weather Observing System (AWOS)
- b. Identifier _____
- c. Facility Name _____
- d. Airport Name _____
- e. Location (City & State) _____
- f. Facility Address _____
- g. Site Elevation (MSL in ft) _____
- h. Antenna Elevation (MSL in ft) _____
- i. Latitude _____
- j. Longitude _____
- k. Frequency/Phone _____
- L. FCC License Power 2.5 Watts Modulation Class FAB
- m. License Number _____
- n. License Expiration Date See FCC station license

2. Equipment:

- a. Equipment Manufacturer _____
- b. Equipment Model _____
- c. Internal Monitor/Shutdown: Yes _____ No _____
- d. External Monitor/Status: Yes _____ No _____
- e. Transmitter Manufacturer _____
- f. Transmitter Model _____
- g. Transmitter Antenna Type/Model _____
- h. Standby Power (Type) _____

3. Contacts:

a. Sponsor _____

b. Sponsor's Representative:

(1) Name/Title _____

(2) Telephone Work/Home _____

(3) Address _____

(4) Name/Title _____

(5) Telephone Work/Home _____

(6) Address _____

(7) Name/Title _____

(8) Telephone Work/Home _____

(9) Address _____

c. Verified Maintenance Technician:

(1) Name _____

(2) Telephone Work/Home _____

(3) Address _____

(4) FCC License Number _____

(5) Name _____

(6) Telephone Work/Home _____

(7) Address _____

(8) FCC License Number _____

(9) Name _____

(10) Telephone Work/Home _____

(11) Address _____

(12) FCC License Number _____

(13) Name _____

(14) Telephone Work / Home _____

(15) Address _____

(16) FCC License Number _____

d. Person in charge of monitoring location:

(1) Name _____

(2) Telephone _____

(3) Location Address _____

(4) Monitoring Hours _____

e. Federal Aviation Administration:

(1) Associated ARTCC/Telephone _____ N/A _____

(2) Associated AFSS/FSS Telephone _____ N/A _____

f. Submit required forms to appropriate Airway Facilities Office:

(1) Name FAA KC TSC, Nonfederal Facilities Coordinator

(2) Address 14015 West 95th Street

Lenexa, KS 66215

g. FAA telephone number contacts for aircraft accidents:

(1) Mid-States OCC 1-800-322-8879

ATTACHMENT 1

FACILITY EQUIPMENT PERFORMANCE STANDARDS AND TOLERANCES

FACILITY TYPE: AWOS

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Chapter 4. AWOS SYSTEM MAINTENANCE AND OPERATING REQUIREMENTS

4.1. INTRODUCTION. This chapter, along with the information in Chapter 3, provides the FAA's minimum desired and maximum acceptable operating standards, tolerances, and references for a commissioned non-Federal AWOS system. It also provides the minimum checks that should be made and the maximum intervals between checks.

4.2. SYSTEM PERFORMANCE VERIFICATION TESTING. System performance verification testing is accomplished to ensure that the system is meeting its desired performance parameters and assure others that it is doing so.

a. To be able to ensure and assure, the AWOS manufacturer should provide an accurate, reliable system through type certification acceptance procedures and, then, the system owner should maintain the systems by accomplishing valid performance verification checks at sufficient intervals to maintain user confidence in the system's performance.

b. To provide and maintain a system that the user accepts as a source of dependable and reliable information, the system owner, in the presence of a qualified FAA non-Federal inspector, should accomplish valid system performance verification checks and be able to compare the results to National Institute of Standards and Technology (NIST) traceable standards.

c. The FAA recognizes that practical and economic considerations impact the accomplishment of system verification testing, but if compromise is necessary, it needs to be decided on the side of performance assurance and user safety.

d. If additional background information about the FAA's maintenance or preventive maintenance concepts for FAA-owned systems is desired, please refer to the latest editions of FAA Order 6700.20 or Order 6000.15, General Maintenance Handbook for Airway Facilities.

4.3. NON-FEDERAL AWOS STANDARDS, TOLERANCES, AND REFERENCES.

a. Non-Federally owned AWOS systems are not expected to meet tighter tolerances than are required for similar FAA-owned AWOS equipment. FAA-owned meteorological AWOS equipment tolerances are found in the latest edition of FAA Order 6560.13.

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b. Table 9 provides non-Federal AWOS standards, tolerances, and references for use during commissioning and annual revalidation.

c. If a manufacturer has specified and received approval from the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2) for tighter tolerances to be met, these will be checked and recorded as found.

d. The maximum operating tolerances provided in Table 9 should be used during initial commissioning and annual revalidation to demonstrate that the AWOS meets the minimum commissioning and operating requirements for each parameter.

Table 9. Standards, Tolerances, and References

Check	Reference or Standard	Desired Initial Tolerance	Maximum Operating Tolerance
Obstruction Lights	Visual	All lighted	At least one lit
Mechanical Windspeed (with moving parts)	WS calibrator for WS ref. & bearings	Ref. speed ± 1.5 knots	Ref. speed $\pm 5\%$
Mechanical Wind Direction (with moving parts)	Align vane with ref. direction benchmark.	± 3 degrees	± 5 degrees
Ultrasonic Windspeed	N/A	Less than 0.5 knots with calibrator	Less than 0.5 knots with calibrator
Ultrasonic Wind Direction	Align with ref. direction benchmark.	± 3 degrees	± 5 degrees
Temperature	Compare with Std.	± 1 degree F	± 2 degrees F

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Check	Reference or Standard	Desired Initial Tolerance	Maximum Operating Tolerance
Dew Point	Compare with Std.	± 2 degrees F	± 3 degrees F
Humidity	Compare with Std.	±2%	±5%
Day/Night	Manual result	Block optics & see vis distance chg	Block optics & see vis distance chg
Visibility	Vis. Cal. standard ref.	± 3 percent of ref.	± 3 percent of ref.
Tipping Bucket	Manual check	2 tips=2 counts, level bucket	2 tips = 2 counts, level bucket
Ceiling	Manual observation/ PIREP	± 50 ft.	±100 ft.
Barometer	Compare with Std.	± .02 inHg	± .02 inHg
System Clock (Time)	Compare with UTC, GPS or WWV	± 15 sec.	± 45 sec.
VHF Transmitter Frequency	Assigned frequency	± 1 kHz	Same as initial
VHF Transmitter Output Power	2.5 watts	± 0.25 watts	Same as initial

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Check	Reference or Standard	Desired Initial Tolerance	Maximum Operating Tolerance
VHF Transmitter Modulation	80%	65% to 95%	Same as initial
VHF Transmitter VSWR (at transmitter)	1.0 : 1	3.0 : 1	Same as initial
UHF Radios (throughout system) Frequency	Assigned frequency	± 2 kHz	Same as initial
UHF Radios (throughout system) Output Power	1.0 watt	± 0.25 watt	Same as initial
UHF Radios (throughout system) Frequency Deviation	2.2 kHz	± 0.5 kHz	Same as initial
UHF Radios (throughout system) VSWR (at transmitter)	1.0 : 1	3.0 : 1	Same as initial
Failed, inoperative sensor check. (This is not a sensor accuracy check)	Inoperative sensor output indication should go <i>missing</i> .	Remove any sensor input, check that OUTPUT goes <i>missing</i> .	Same as initial, within type accepted period

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4.4. PREVENTIVE MAINTENANCE (PM) CHECKS AND SCHEDULES.

a. Minimum Tri-Annual Preventive Maintenance (PM) Checks. The following preventive maintenance checks should be accomplished by the assigned maintenance technician holding verification authority in accordance with manufacturer's provided and FAA approved maintenance manual at tri-annual intervals, not to exceed 155 days.

(1) Visit facility and accomplish a visual inspection to ensure integrity of the AWOS equipment and site location.

(2) Visual check of obstruction lights.

(3) Visually inspect all sensors and AWOS assemblies. Clean all sensors, lenses, and other parts, as needed.

(4) Check all sensors for accuracy of readings with respect to existing conditions. For the barometer, the PM a comparison with an associated weather reporting station is appropriate. An associated weather reporting station is defined as any one of the following:

- the National Weather Service (NWS),
- a limited aviation weather reporting station (LAWRS),
- a commissioned Automated Surface Observing System (ASOS),
- a commissioned Automated Weather Observing System (AWOS),
- a commissioned Automated Weather Sensor System (AWSS),
- a Contract Weather Observer (CWO),
- a calibrated hand-held digital barometer/altimeter,
- a calibrated pressure transfer standard, or
- a flight service station.

For sites having a precision approach the associated weather reporting station must be within 10 nautical miles of the facility and windspeed must not exceed 12 knots at either facility, gusts must not exceed 15 knots, and the difference in elevation between the two facilities must not exceed 100 feet. For non-precision approach locations, the factors are 25 nautical miles, 15 knots windspeed, 20 knots gust, and 200 feet (61 meters). The station's temperature at both precision and non-precision approach locations must be within 30 °F of the standard atmosphere temperature for the station's elevation.

(5) Check video display terminal, keyboard, and archiving.

(6) Check system time and reset as needed.

(7) Check AWOS telephone operation.

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(8) Aurally check AWOS radio transmission.

(9) Make other checks as necessary or requested by the manufacturer or the FAA to ensure continued reliable operation of the specific system equipment involved.

b. Minimum initial and annual verification checks. The following preventive maintenance checks should be accomplished in accordance with manufacturer's provided and FAA approved maintenance manual by the assigned maintenance technician holding verification authority for the system during initial commissioning checks and on an annual basis. The acceptable tolerances are identified in Table 9. Annual PM is scheduled on a 12 month interval and should be accomplished during the month it is scheduled or, if necessary, during the preceding or following month. The maximum tolerance is ± 31 days from the scheduled annual verification check.

(1) Accomplish all tri-annual preventive maintenance checks.

(2) Mechanical Wind Direction. Check freedom of movement manually.

(3) Mechanical Windspeed. Check freedom of movement and a reference speed near the mid-to-upper-range of the sensor. Record both the windspeed reference and sensor readings.

(4) Ultrasonic Windspeed and Direction. Check the manufacturer's defined reference condition of the sensor. Record both the reference and the sensor's readings.

(5) Temperature. Compare against a collocated calibrated standard. Compare and record both the standard temperature read and the AWOS temperature read.

(6) Dew point/Humidity. Compare against a collocated calibrated standard. Compare and record both the standard humidity/dew point and the AWOS dew point.

(7) Aspirator Fan (if present). If the fan fails, the temperature and dew point sensor readings should go *missing*. Record SAT or UNSAT operation.

(8) Barometer. Compare system barometer readings against a collocated calibrated standard. Record standard and barometer readings. Compute the standard altimeter reading and compare to the AWOS altimeter reading.

(9) Visibility. Compare visibility readings to blocked receiver and calibration device reference readings. Record all readings and references. Check day/night sensor to see if it changes state and actually changes visibility distance indicated.

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(10) Heated Tipping Bucket. Ensure sensor is clean and level and number of tips recorded equals number of tips generated. Record number of tips used as a reference and number of tips reported.

(11) Present Weather. Ensure that present weather sensor is operating properly. The only check that can be accomplished is to spray water in the space between the heads and verify that it reports precipitation.

(12) Ceilometer. Check reference target distance if system is designed to enable this check. Reflect transmitted signal back into receiver to check system for minimum ceiling. Record reading seen and reading expected. If needed, blocking the receiver may check the maximum ceiling. In addition, local pilot reports may be used to verify performance.

(13) Missing Sensor. Check that a frozen or inoperative sensor will have its output reported *missing* and removed from the national network and local outputs.

(14) Remarks Capabilities. Enter test remarks, ensure they are accepted and provided to user, and then delete.

(15) VHF Transmitter Operation. Check frequency, power output, VSWR, percent of modulation, and aural/audio quality.

(16) UHF Transmitter Operation. Check frequency, power output, VSWR, and percent of modulation.

(17) Telephone. Check to ensure it answers on second ring; is clear; provides two complete messages and disconnects; and verify aural/audio quality.

(18) UHF Transmitter/Transceiver (if used). Check frequency, power output, VSWR, percent of modulation, receiver sensitivity, receiver quieting, etc.

(19) Other Sensors. Check other sensors, e.g., freezing rain, runway surface, or thunderstorm, as required.

(20) Other Checks. Make other checks requested by the manufacturer, the sponsor, or the FAA as required by the specific system. To obtain valid references ensure the readings continue to meet these references.

c. Triennial Verification Checks. The following maintenance checks should be accomplished by the assigned maintenance technician holding verification authority for the system during initial commissioning checks and on a triennial (3 year) basis. Triennial maintenance should be accomplished in accordance with manufacturer's provided and FAA approved maintenance manual

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during the month it is scheduled or, if necessary, during the preceding or following month. The maximum tolerance is 90 days from the scheduled maintenance event.

(1) Mechanical Wind Direction. Check direction accuracy by holding vane on reference direction mark. Record the wind direction reference and the wind direction read.

(2) Ultrasonic Wind Direction. Check direction accuracy on reference direction mark. Record the wind direction reference and the wind direction read.

4.5. REQUESTING EXCEPTIONS TO MINIMUM MAINTENANCE REQUIREMENTS.

a. Manufacturers are encouraged to improve system reliability, accuracy, and verification method testing. A manufacturer may request an exception or variance from an FAA minimum desired maintenance check or interval. The request should include supportive documentation showing performance information obtained during actual field use of the system or sensor. The manufacturer should submit requests and supporting documentation with regard to paragraph 2.4 of this AC to the AWOS Non-Federal Engineering Office at the address provided in paragraph 1.3.e.(2). The FAA may also reevaluate these checks and intervals with respect to actual documented system performance.

b. The FAA's intent is to ensure that dependable AWOS systems are provided for our users. The FAA will strive to issue type certification approval only to systems that meet functional needs and recommend that they be maintained in a manner that will provide user confidence. The FAA encourages cooperation in that endeavor from the manufacturers and system owners.

c. The FAA will review these requests with respect to the actual documented field performance data and, at the same time, with an understanding of and proper regard for system assurance documentation needs. Manufacturers are to understand that it is the FAA's intent to improve system reliability and reduce maintenance costs. Also, the FAA may not be able to approve a request because of the need for the manufacturer to provide recurring system assurance documentation.

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Appendix 1

Appendix 1. Certification Requirements

System and Subsystem Certification.

System and subsystem certification is event based and relies on independent judgment about the quality and scope of specific advertised services being provided to a user. Event based certification ties the certification judgment to the decision to place a system or subsystem into service.

a. ATO personnel with certification authority must perform event based system and subsystem certification. The following events define when certification is required, regardless of whether it affects a certification parameter:

- (1) Prior to commissioning.
- (2) Upon request following aircraft accident/incidents.
- (3) Following adjustment to any certification parameter regardless of whether an interruption was required.
- (4) Prior to restoration following any flight inspection requiring on-site personnel.
- (5) Prior to restoration following any modification.
- (6) Prior to restoration following any maintenance task that required an interruption or would have required an interruption to a facility without redundancy.
- (7) Prior to restoration following any corrective maintenance activity required to restore a facility to operation.

b. System and subsystem certification is not required when a facility is restored to operation by restoration of power, initialization, or reset, and no other action was taken.

c. Some NAS systems contain user interface controls that can cause a certification parameter to be adjusted beyond its tolerance or limit. Such adjustments will not void the certification.

ATTACHMENT D

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6560.13C CHG 2
Appendix 1**Appendix 1. Certification Requirements (Continued)**

Table 4. Automated Weather Observing System (AWOS)

Advertised Service	Certification Parameter	Reference Paragraph
<p>NOTE: Maintenance on a certified sensor shall require re-certification of only parameters affected until the next scheduled system certification.</p>		
a. Measurement of windspeed	Windspeed system accuracy	344a, b
b. Measurement of wind direction	Wind direction system overall accuracy	345a
c. Measurement of temperature	Temperature sensor accuracy	346
d. Measurement of dew point (calculated from relative humidity)	Relative humidity sensor accuracy	347
e. Measurement of barometric pressure	Pressure sensor accuracy (both sensors)	348a, b
f. Measurement of visibility	Visibility sensor calibration error	350
g. Measurement of rainfall	Rainfall measurement	351
h. Measurement of light level day/night	Equipment operation	352
i. ADAS Interface Check (if present)	AWOS transmits and receives every minute	354d
<p>NOTE: To be performed every three years:</p>		
j. Alignment of sensor base	Alignment accuracy	345a
<p>CERTIFICATION BASED ON EVENTS: Events are defined in Order 6000.15 and are provided only as reference data of appendix 1, paragraph 1 of this order.</p>		
<p>PERSON RESPONSIBLE FOR CERTIFICATION: Airway transportation system specialist with certification authority</p>		
<p>CERTIFICATION ENTRY IN FACILITY MAINTENANCE LOG: AWOS certified</p>		

ATTACHMENT D

Missouri Highways and Transportation Commission
Standard Bid Provisions, General Terms and Conditions and Special Terms and Conditions

STANDARD SOLICITATION PROVISIONS

- a. The solicitation for the procurement of the supplies referenced therein, to which these "Standard Bid Provisions, General Terms and Conditions and Special Terms and Conditions" are attached, is being issued under, and governed by, the provisions of Title 7 – Missouri Department of Transportation, Division 10 – Missouri Highways and Transportation Commission, Chapter 11 – Procurement of Supplies, of the Code of State Regulations. The Missouri Highways and Transportation Commission (**MHTC**), acting by and through its operating arm, the Missouri Department of Transportation (**MoDOT**), draws the Bidder's attention to said 7 CSR 10-11 for all the provisions governing solicitation and receipt of bids/quotes and the award of the contract pursuant to this solicitation.
- b. All bids/quotes must be signed with the firm name and by a responsible officer or employee. Obligations assumed by such signature must be fulfilled.

GENERAL TERMS AND CONDITIONS

Definitions

Capitalized terms as well as other terms used but not defined herein shall have the meaning assigned to them in section 7 CSR 10-11.010 Definition of Terms.

Nondiscrimination

- a. The Contractor shall comply with all state and federal statutes applicable to the Contractor relating to nondiscrimination, including, but not limited to, Chapter 213, RSMo; Title VI and Title VII of Civil Rights Act of 1964 as amended (42 U.S.C. Sections 2000d and 2000e, *et seq.*); and with any provision of the "Americans with Disabilities Act" (42 U.S.C. Section 12101, *et seq.*)
- b. **Sanctions for Noncompliance:** In the event of the Contractor's noncompliance with the nondiscrimination provisions of this contract, MHTC shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:
 - i. withholding of payments to the Contractor under the contract until the Contractor complies, and/or,
 - ii. cancellation, termination or suspension of the contract, in whole or in part.

Contract/Purchase Order

- a. By submitting a bid/quote, the Bidder agrees to furnish any and all equipment, supplies and/or services specified in the solicitation documents, at the prices quoted, pursuant to all requirements and specifications contained therein.
- b. A binding contract shall consist of: (1) the solicitation documents, amendments thereto, and/or Best and Final Offer (BAFO) request(s) with any changes/additions, (2) the Contractor's bid response, and (3) the MHTC's acceptance of the bid by post-award contract or purchase order.
- c. A notice of award does not constitute an authorization for shipment of equipment or supplies or a directive to proceed with services. Before providing equipment, supplies and/or services, the Contractor must receive a properly authorized notice to proceed and/or purchase order.

Applicable Laws and Regulations

- a. The contract shall be construed according to the laws of the State of Missouri. The Contractor shall comply with all local, state, and federal laws and regulations related to the performance of the contract. The exclusive venue for any legal proceeding relating to or arising, out of the contract shall be in the Circuit Court of Cole County, Missouri.
- b. The Contractor must be registered and maintain good standing with the Secretary of State of the State of Missouri, Missouri Department of Revenue, and other regulatory agencies, as may be required by law or regulations. Prior to the issuance of a purchase order and/or notice to proceed, the Contractor may be required to submit to MHTC a copy of their current Authority Certificate from the Secretary of State of the State of Missouri and/or a copy of their Certificate of No Tax Due from the Missouri Department of Revenue.
- c. Prior to the issuance of a purchase order and/or notice to proceed, all **out-of-state** Contractors **providing services** within the state of Missouri must submit to MHTC a copy of their current Transient Employer Certificate from the Missouri Department of Revenue, in addition to a copy of their current Authority Certificate from the Secretary of State of the State of Missouri.

Executive Order:

The Contractor shall comply with all the provisions of Executive Order 07-13, issued by the Honorable Matt Blunt, Governor of Missouri, on the sixth (6th) day of March, 2007. This Executive Order, which promulgates the State of Missouri's position to not tolerate persons who contract with the state engaging in or supporting illegal activities of employing individuals who are not eligible to work in the United States, is incorporated herein by reference and made a part of this Agreement.

- 1) "By signing this Agreement, the Contractor hereby certifies that any employee of the Contractor assigned to perform services under the contract is eligible and authorized to work in the United States in compliance with federal law."
- 2) In the event the Contractor fails to comply with the provisions of the Executive Order 07-13, or in the event the Commission has reasonable cause to believe that the contractor has knowingly employed individuals who are not eligible to work in the United States in violation of federal law, the Commission reserves the right to impose such contract sanctions as it may determine to be appropriate, including but not limited to contract cancellation, termination or suspension in whole or in part or both.
- 3) The Contractor shall include the provisions of this paragraph in every subcontract. The Contractor shall take such action with respect to any subcontract as the Commission may direct as a means of enforcing such provisions, including sanctions for noncompliance.

Preferences

- a. In the evaluation of bids/quotes, preferences shall be applied in accordance with 7 CSR 10-11.020(7). Contractors should apply the same preferences in selecting subcontractors. The attached document entitled "**VENDOR INFORMATION AND PREFERENCE CERTIFICATION FORM**" must be completed and returned with the solicitation documents.
- b. Bidders are encouraged to obtain minority business enterprise (MBE) and women business enterprise (WBE) participation in this work through the use of subcontractors, suppliers, joint ventures, or other arrangements that afford meaningful participation for M/WBEs. Bidders are encouraged to obtain 10% MBE and 5% WBE participation.

Missouri Highways and Transportation Commission
Standard Bid Provisions, General Terms and Conditions and Special Terms and Conditions

Cancellation of Contract

The MHTC may cancel the Contract at any time for a material breach of contractual obligations or for convenience by providing Contractor with written notice of cancellation. Should the MHTC exercise its right to cancel the contract for such reasons, cancellation will become effective upon the date specified in the notice of cancellation sent to the Contractor.

Bankruptcy or Insolvency

Upon filing for any bankruptcy or insolvency proceeding by or against the Contractor, whether voluntarily, or upon the appointment of a receiver, trustee, or assignee, for the benefit of creditors, the Commission reserves the right and sole discretion to either cancel the Agreement or affirm the Agreement and hold the Contractor responsible for damages.

Warranty

The Contractor expressly warrants that all equipment, supplies, and/or services provided shall: (1) conform to each and every specification, drawing, sample or other description which was furnished to or adopted by the MHTC, (2) be fit and sufficient for the purpose expressed in the solicitation documents, (3) be merchantable, (4) be of good materials and workmanship, and (5) be free from defect.

Status of Independent Contractor

The Contractor represents itself to be an independent Contractor offering such services to the general public and shall not represent itself or its employees to be an employee of the MHTC. Therefore, the Contractor shall assume all legal and financial responsibility for taxes, FICA, employee fringe benefits, workers' compensation, employee insurance, minimum wage requirements, overtime, etc., and agrees to indemnify, save and hold the MHTC, its officers, agents and employees harmless from and against any and all losses (including attorney fees) and damage of any kind related to such matters.

Non-Waiver

If one of the parties agrees to waive its right to enforce any term of this Contract, that party does not waive its right to enforce such term at any other time or to enforce any or all other terms of this Contract.

Indemnification

The Contractor shall defend, indemnify and hold harmless MHTC, including its members and department employees, from any claim or liability whether based on a claim for damages to real or personal property or to a person for any matter relating to or arising out of the Contractor's performance of its obligations under the contract awarded pursuant to this solicitation.

Missouri Highways and Transportation Commission
Standard Bid/Proposal Provisions, General Terms and Conditions and Special Terms and Conditions

SPECIAL TERMS AND CONDITIONS

Tax Exempt Status:

MHTC is exempt from paying Missouri Sales Tax, Missouri Use Tax and Federal Excise Tax. .

Insurance

The Contractor shall maintain or cause to be maintained at Contractor's own expense commercial general liability, automobile liability, worker's compensation insurance against negligent acts, errors or omissions of the Contractor, or its subcontractors and anyone directly or indirectly employed by any of them. Any insurance policy required as specified in this Section shall be written by a company that is licensed and authorized to issue such insurance in the state of Missouri and shall provide insurance coverage for not less than the following limits of liability:

- 1) General Liability: Not less than \$500,000 for any one person in a single accident or occurrence, and not less than \$3,000,000 for all claims arising out of a single occurrence;
- 2) Automobile Liability: Not less than \$500,000 for any one person in a single accident or occurrence, and not less than \$3,000,000 for all claims arising out of a single occurrence;
- 3) Missouri State Workmen's Compensation policy or equivalent in accordance with state law.

Upon request from the Commission, the Contractor shall provide the Commission with certificates of insurance evidencing the required coverage and that such insurance is in effect.

Prohibition Of Employment Of Unauthorized Aliens:

- a. **Non-employment of Unauthorized Aliens:** Pursuant to Section 285.530, RSMo., no business entity or employer shall knowingly employ, hire for employment, or continue to employ an unauthorized alien to perform work within the State of Missouri. As a condition for the award of any contract or grant in excess of five thousand dollars by the State or by any political subdivision of the State to a business entity, or for any business entity receiving a state-administered or subsidized tax credit, tax abatement, or loan from the state, the business entity shall:
 - 1) By sworn affidavit and provision of documentation, affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with the contracted services. E-Verify is an example of a federal work authorization program. The business entity must affirm its enrollment and participation in the E-Verify federal work authorization program with respect to the employees proposed to work in connection with the services requested herein by providing acceptable enrollment and participation documentation consisting of **completed** copy of the E-Verify Memorandum of Understanding (MOU). For business entities that are not already enrolled and participating in a federal work authorization program, E-Verify is available at http://www.dhs.gov/files/programs/gc_1185221678150.shtm
 - 2) By sworn affidavit, affirm that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. A copy of the affidavit referenced herein is provided within this document, attached as Exhibit A.
- b. **Proof of Lawful Presence For Sole Proprietorships and Partnerships:** If the business entity is a sole proprietorship or partnership, pursuant to Section 208.009, RSMo., each sole proprietor and each general partner shall provide affirmative proof of lawful presence in the United States. Such sole proprietorship or partnership is eligible for temporary public benefits upon submission by each sole proprietor and general partner of a sworn affidavit of his/her lawful presence on the United States until such lawful presence is affirmatively determined, or as otherwise provided by Section 208.009, RSMo. A copy of the affidavit reference herein is provided within this document, attached as Exhibit B.

Official Holidays

- a. The following days shall be construed as **official holidays** under the terms of the contract:

January 1	New Year's Day
Third Monday in January	Martin Luther King, Jr.'s Birthday
February 12	Lincoln's Birthday
Third Monday in February	Washington's Birthday
May 8	Truman's Birthday
Last Monday in May	Memorial Day
July 4	Independence Day
First Monday in September	Labor Day
Second Monday in October	Columbus Day
November 11	Veteran's Day
Fourth Thursday in November	Thanksgiving Day
December 25	Christmas Day

- b. When any of the above **holidays falls** on a **Sunday**, the holiday will be observed on the following **Monday**; when any of the above **holidays falls** on a **Saturday**, the **holiday** will be observed on the immediately preceding **Friday**.

Liquidated Damages

- a. In the event the successful Contractor fails to deliver the services within the time specified, the Department and the public will sustain damages because of such delay in delivery, the exact extent of which would be difficult to ascertain, and in order to liquidate such damage in advance it is agreed that the **sum of \$100 per day** for each assessable calendar day on which the service has not been completed, is reasonable and the best estimate which the parties can arrive at as liquidated damages, and it is therefore agreed that said amount will be withheld from payments due the Contractor or otherwise collected from the Contractor as liquidated damages.
- b. **Saturdays, Sundays, holidays and days whereas the Department has suspended work** shall not be assessable days.

