126-1.   DESCRIPTION

126-1.1 This item shall consist of furnishing and installing an FAA-approved Automated Weather
Observing System (AWOS) in accordance with this specification and FAA Advisory
Circular 150/5220-16 (latest revision), Automated Weather Observing Systems (AWOS)
for Non-federal Applications. The system shall be installed at the specified location and in
accordance with the dimensions and details shown in the plans and FAA Order 6560.20
(latest revision), Siting Criteria for Automated Weather Observing Systems (AWOS). This
item shall include the furnishing of all equipment, materials, services, and incidentals
identified in this specification necessary to place the system in operation to the satisfaction
of the Engineer and ready for commissioning by the Federal Aviation Administration.

126-2.   EQUIPMENT AND MATERIALS

126-2.1   GENERAL

A.   The AWOS and other equipment and material covered by FAA specifications
shall have the approval of the Federal Aviation Administration, Washington,
D.C., 20591, as listed in Advisory Circular 150/5345-1 (latest edition), prior to
bid opening.

B.   All other equipment and materials covered by other referenced specification shall be
subject to acceptance through the manufacturer's certification of compliance with the
applicable specification.

126-2.2   AWOS SYSTEM

The Automated Weather Observing System (AWOS) shall be an FAA (type certified)
system in accordance with Advisory Circular No. 150/5220-16 (latest edition) and
Order No. 6560.20 (latest edition) prior to bid opening, as supplied by:

DBT Transportation Services LLC
2655 Crescent Drive
Lafayette, CO 80026
1-844-343-8328
(970) 237-3541 Fax

          or

Approved Equal

126-2.3   GENERAL PERFORMANCE STANDARDS

A.   Input Power. AWOS equipment shall operate from a 120/240V AC (±10%), 60 Hz (±5 Hz), 3-wire single-phase source. The maximum service required shall be 30 amps. The AWOS enclosure shall be mounted in accordance with the manufacturer's specifications.

B.   Loss of power. The AWOS should return to normal operation without human intervention after a power outage. When power is restored, the AWOS should not output erroneous data. The system shall have the capability of operating from an Uninterruptible Power Supply (UPS) should one be required.

126-2.4   OPERATING ENVIRONMENT

All AWOS equipment shall meet the requirements for operating in a Class 1 environment, as defined by AC 150/5220-16 (latest edition).

126-2.5   AWOS SYSTEM AND SENSOR SPECIFICATIONS

The AWOS provided for this project shall meet the specifications and performance guidelines defined in AC 150/5220-16 (latest edition).

126-2.5.1   WIND SPEED SENSOR

A.   The wind speed sensor shall be an ultrasonic type with an output frequency which is proportional to wind speed. Periodic calibration shall not be required.

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

C.   Accuracy. The wind speed sensor should provide an accuracy of 2 knots or 10 percent RMSE, whichever is greater, with a maximum error of 15 percent at any speed.

D.   Resolution. The resolution should be one (1) knot.

E.   Distance Constant. The distance constant should be less than 10 meters.

F.   Threshold. Two (2) knots.

126-2.5.2   WIND DIRECTION SENSOR

A.   The wind direction sensor shall not require periodic calibration. This sensor should be aligned to true north and should withstand a wind speed of 85 knots without damage.

B.   Range. 1 degree to 360 degrees in azimuth.

C.   Threshold. 2 knots.

D.   Accuracy. Within 5 degrees (RMSE).

E.   Resolution. To nearest 10 degrees.

F.   Time constant. Less than 2 seconds.

126-2.5.3   AMBIENT TEMPERATURE SENSOR

A.   The sensor should be thermally isolated to accurately measure the environments below.

B.   Range. From -35 degrees to +55 degrees C (-30 degrees to +130 degrees F).

C.   Accuracy. One (1) degree F for the entire range of the sensor, with a maximum error of 2 degrees F.

D.   Resolution. Not greater than 1 degree F.

E.   Time Constant. Not greater than 2 minutes.

126-2.5.4   DEWPOINT SENSOR

A.   Dewpoint shall be derived utilizing temperature and relative humidity observations.

B.   Resolution. Not greater than 1 degree F.

C.   Time Constant. Less than 2 minutes.

D.   Accuracy. The accuracy should be as follows (all errors are RMSE):

1.   2 degrees F dewpoint for dry bulb temperatures of +30 degrees to +90 degrees F (80% to 100% relative humidity), with a maximum error of 3 degrees F at any dry bulb temperature.

2.	3 degrees F dewpoint for dry bulb temperatures of +30 degrees to +120 degrees F (15% to 75% relative humidity), with a maximum error of 4 degrees F at any dry bulb temperature.

3.	4 degrees F dewpoint for dry bulb temperatures of -20 degrees to +20 degrees F (25% to 95% relative humidity), with a maximum error of 5 degrees F at any dry bulb temperature. The minimum dewpoint required is -30 degrees F.

**126-2.5.5	PRESSURE SENSOR**

A.	Design. Two (2) pressure sensors should be provided for the AWOS system. The sensors shall not require heaters. Pressure sensors shall have provision for venting to the outside of the building where required. Each sensor shall have an independent venting interface.

B.	Pressure Range. The sensor should be capable of measuring a pressure range at any fixed location of +1.5 to -3.0 inHg from the standard atmospheric pressure at that location. High pressure should be standard atmospheric pressure at -100 feet plus 1.5 inHg (=31.565 inHg). Low pressure should be standard atmospheric pressure at +10,000 feet minus 3.0 inHg (=17.58 inHg).

C.	Accuracy. The accuracy should be 0.01 inHg RMSE at all altitudes from -100 to +10,000 feet mean sea level (MSL), maximum error 0.02 inHg at any one pressure.

D.	Resolution. The resolution should not be greater than 0.005 inHg.

E.	Differential Accuracy. The sensor should exhibit a differential accuracy of 0.01 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 degrees F; ambient pressure should not vary more than 0.1 inHg (RMSE) over the 3 hour period.

F.	Maximum Drift with Time. Each sensor should be stable and continuously accurate within 0.01 inHg RMSE for a period of not less than 6 months. The maximum error shall be 0.02 inHg.

**126-2.5.6	VISIBILITY SENSOR**

A.	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 transmissometer shall be provided.

B.	Resolution. In terms of equivalent visibility, the sensor should provide data to report visibility values as follows: less than 1/4, 1/4, 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3, 3-1/2, 4, 5, 7, and 10 miles.

C.   Time Constant. The time constant should not exceed 3 minutes.

D.   Accuracy. The sensor should agree with the transmissometer standards as follows:

Table 1. Visibility sensor accuracy requirements (all values in statute miles).

Reference Transmissometer Reading	Acceptable Sensor Variance
1/4 through 1.25	+ or - 1/4
1.5 through 1.75	+1/4, -1/2
2 through 2.5	+ or - 1/2
3 through 3.5	+1/2, -1
4 and greater than 4	+ or -1

E.   Ambient Light Sensor. The visibility sensor should contain an ambient light sensor to measure the ambient luminance within its field of view and to generate a signal to the visibility sensor to indicate whether the ambient light level is day or night. It shall 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.

F.   The AWOS system shall measure and store calibration constants on operator command when the visibility calibration is installed.

126-2.5.7   CLOUD HEIGHT SENSOR

A.   Range. The cloud height sensor shall measure cloud heights and the heights of obscuring phenomena aloft to a minimum of 12,500 feet. The sensor should provide an output of three cloud layers representative of the sky conditions when surface visibilities are equal to or greater than 1/4 mile.

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

C.   Resolution. Not greater than: 50 feet surface to 5,500 feet; 250 feet from 5,501 to 10,000 feet; 500 feet above 10,000 feet.

D.   Sampling. The sensor should provide an output at least once every 30 seconds. The sampling rate may be reduced to at least one sample every 3 minutes when no hits are detected for the preceding 15 minutes.

E.   Detection Performance. Meet or exceed the requirement of AC 150/5220-16 (latest edition).

F.   Eye Safety. The cloud height sensor should be designed to conform to ANSI-Z 136.1, Accessible Emission Limits for Laser Radiation, with Class 3b maximum accessible emission level applied to direct viewing without optical instruments

(excluding ordinary eye glasses). Interlock device(s) in the laser power circuit board 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.

G.   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.

> 1.   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 degrees F.

> 2.   Ice. The ceilometer window should remain clear of ice for 60 minutes under conditions of freezing rain with a maximum accretion rate of 1/2 inch per hour radial thickness of clear ice.

126-2.5.8   PRECIPITATION ACCUMULATION SENSOR

The sensor should be capable of measuring the precipitation amount with a range of 0.01 to 5 inches per hour. Precipitation amount is the liquid equivalent of all precipitation forms, i.e., liquid, freezing, frozen, or combinations thereof.

> A. Resolution. The resolution shall be 0.01 inches.

> B. Accuracy. The accuracy shall be 0.002 inches per hour (RMSE) or 4 percent of actual, whichever is greater.

126-2.5.9   PRECIPITATION TYPE AND INTENSITY SENSOR

A.   The Precipitation Type and Intensity Sensor shall provide an indication of the type of precipitation occurring and shall report the intensity of the precipitation.

B.   This sensor shall have the capability of identifying drizzle, rain, and snow. In the event of combinations of liquid and frozen precipitation, the sensor shall report "precipitation."

C.   During occurrences of precipitation, this sensor shall have the capability of reporting a precipitation intensity value. The sensor shall report intensity values as light, moderate, and intense.

126-2.5.10   THUNDERSTORM SENSOR

A.   This sensor shall detect the presence of a thunderstorm in the vicinity of an airport, should locate the thunderstorm, and should provide this data in such a format that the information can be incorporated in the AWOS voice and data weather message.

B.   This sensor shall not result in future fees, such as telephone or satellite service, to be incurred by the Owner.

C.   Range and direction. Thunderstorms within 30 nautical miles (nm) of the reference point on the airport shall be reported. Direction is expressed in compass octants (E, SE, S, etc.) for distances of 10 to 30 nm.

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

E.   The thunderstorm sensor shall provide a voice and data report in accordance with AC 150/5220-16 (latest edition).

F.   The thunderstorm/lightning data shall be capable of being graphically displayed at the operator terminal. The graphic display shall be broken down in 0-5 nm, 5-10 nm, and 10-30 nm sectors. Each sector or octant shall be color coded to indicate the presence of thunderstorm/lightning activity. The PC and color video monitor used to support the graphic display shall be provided by the contractor.

126-2.5.11   AWOS DATA PROCESSOR

A.   The AWOS data processor shall perform the following functions: data acceptance, data reduction, data processing, and product dissemination (digital and voice).

B.   The processor shall provide a computer-generated voice weather observation to a ground-to-air radio (VOR, NDB, or VHF discrete) for transmission to pilots.

C.   The processor shall have the capability to process observations from an unlimited number of sensors.

D.   The data reduction function shall consist of the processing of information prior to the actual algorithm processing. The AWOS data reduction software shall include quality control checks to ensure that the data received is accurate and complete and that the associated equipment is working properly before the weather algorithms are performed. If data from any sensor is erroneous or missing, (e.g., a sensor loses power, etc.), that parameter and all other parameters derived from the missing parameter shall be reported "missing" in the weather observation. The processor shall continue to sample data, and if the error condition is corrected, the weather parameter shall be reinserted in the AWOS report.

1. The processor shall periodically check reference or calibration points which correspond to the normal operating limits of the sensor.

2. The processor shall set upper and lower limits on the sensor output which correspond to the normal operating limits of the sensor.

126-2.5.12 OPERATOR TERMINAL (OT)

A. The OT shall have the capability to do product editing. This function allows an authorized observer to initiate or change any observation product. A specific "editing" password shall control access to this function. Manual entries of weather phenomena not automatically observed shall be placed in the remarks section of the observation and will not be included in the voice message. In the case of sensor failure or an incorrect AWOS output, an operator shall have the capability to replace the incorrect parameter value with a missing symbol.

B. The OT shall consist of a video display monitor with keyboard and audio speaker at the terminal building. The contractor/manufacturer shall provide all necessary interface equipment, video display monitor, keyboard and audio speaker. The audio speaker shall be provided with an on/off switch and volume control.

C. The system shall require the operator to enter a security code in response to system queries prior to allowing him/her to proceed with the entry of data.

D. Where an OT is used to modify the report, all manually entered data shall be automatically time tagged by the system. The data shall be valid until the next hourly or manually entered observation. In order to retain the manually entered data in the system, the operator shall be required to revalidate his/her entries hourly. The data shall be retained in the observation until the "on-the-hour" observation, when it must be revalidated.

126-2.5.13 VOICE SUBSYSTEM

A. The voice subsystem shall provide high quality, computer-generated speech for output of the AWOS observation. A high-level error-checking scheme shall be incorporated to prevent erroneous outputs. The voice subsystem should also provide the speech for the local ground-air radio broadcast and for telephone dial-up users. The system shall have the capability of hooking up to the dedicated phone line to be provided for the AWOS system.

B. The voice subsystem shall have the capability for the addition of a manually input voice message. This message will be voiced at the end of the computer-generated voice message. The programming of the manual input voice message shall be accomplished using a telephone type handset. The system shall have the capability of remotely programming a voice message via telephone. A security access code shall

prevent unauthorized use. The system shall automatically play back the recorded message and allow the user to reprogram, delete, or accept the message.

C.   The voice subsystem shall have the following features:

1.   The voice signal shall deliver a minimum of 1 milliwatt of power into a balanced 600-ohm line. The output amplitude shall be adjustable to nominal 0 db.

2.   The voice message shall 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 of the automated speech shall provide clear reception from telephone and ground-air radio transmitters.

5.   The format and sequence of the voice message shall be in accordance with FAA Order 7110.10, Flight Service Handbook. When any weather parameter is reported missing "MSG" due to a disabled or inoperative sensor, as determined by internal AWOS checks, the voice report shall be "(parameter) missing", e.g., "wind speed missing", "cloud height missing", etc. The UTC time of the observation will be given after the location identification.

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

7.   The system shall contain an automatic telephone answering device that will permit the user access to the voice message via the public telephone system. The incoming call shall be answered prior to completion of the second ring, and the audio signal in progress at the time the call is received shall be placed online. The voice subsystem shall automatically disconnect when the weather observation has been completely transmitted twice.

8.   Hook-up for telephone audio output on an assigned dial-up telephone number shall be provided by others. The phone line and hook-up for AWOS data communication is to be terminated at the AWOS tower.

9.   The AWOS shall have the capability for future connection to the AWOS Data Acquisition System (ADAS) in compliance with the AWOS/ADAS Interface Control Document. Telephone line will be provided by the Owner at a later date.

10.   The system shall contain a handset or audio speaker for monitoring the voice output from the operator terminal.

11.   The AWOS telephone answering device, as supplied to the Owner, shall have the capability to answer a single phone line.

126-2.5.14   VHF TRANSMITTER

It is FAA policy that the output of the AWOS will be transmitted on an existing navigational aid voice outlet whenever practical. If there is no navigational aid available, then the output will be broadcast via a separate VHF transmitter. The transmitter operates in the 118-136 MHz band. The upper limit of this band is planned to be extended to 137 MHz in the near future. The transmitter shall broadcast from the location of the AWOS processor at the AWOS tower site and must have an FCC type acceptance and have the following operational parameters:

A. Channel Spacing: 25 KHz

B. RF Power Output: Nominal 2.5 watts, at the transmitter 10 watts maximum

C. Frequency Stability: ± 0.001% (-30 to +60 degrees C)

D. Emission Type: 6K00A3E

E. Spurious and Harmonic Emissions: 80 db minimum up to 90% modulation

126-2.6   EQUIPMENT ENCLOSURE

AWOS components not designed for outdoor use shall be located in an indoor area as directed by the Owner and in accordance with manufacturer and FAA guidelines. Components used outdoors that are not weatherproof shall be located in a weatherproof enclosure. All outdoor enclosures will be aluminum NEMA 4 enclosures. All outdoor hardware shall be stainless steel.

126-2.7   **CONCRETE**

The concrete shall have a minimum twenty-eight (28) days compressive strength of 3,000 PSI, unless higher strengths are recommended by the equipment manufacturer.

126-2.8   **REINFORCING STEEL**

Reinforcing steel and bars shall be used in the tower and sensor foundations. AWOS manufacturers shall submit foundation drawings showing the use of these materials in the foundations.

126-2.9   **CONDUIT**

Conduit shall be used between the AWOS tower and sensor foundation(s) for both power and signal cables. The conduit shall meet the requirements of the national electrical code and local code.

126-2.10   **WIRE AND CONTROL CABLE**

Wire and control cables shall meet the requirements of the national electric code, local electric code, and the AWOS equipment manufacturer's recommendation. Control cables shall be the manufacturer's required number of pairs plus two spare pairs. All cables are to be individually shielded and suitable for direct earth burial.

126-2.11   **AWOS DATA LINK**

The AWOS will utilize an RF data link for transmitting AWOS data to the operator terminal. The voice shall originate at the tower site and broadcast via VHF discrete transmitter, NDB, or VOR.

126-2.12   **UNINTERRUPTIBLE POWER SUPPLY**

The Contractor shall provide a UPS to regulate power and provide a back-up power supply source for power outages. The UPS shall be capable of powering the AWOS for a minimum of one (1) hour.

126-2.13   **TOWER**

A.   A Rohn 45G self-supporting tower or approved equivalent shall be used. The tower shall not exceed the height specified in the project or manufacturer's drawings. The tower shall conform to all AWOS manufacturer's specifications.

B.   The tower shall be painted with a six-band marking with alternating bands of aviation surface orange (the top band) and white. The band widths shall be 1/6 of the height of the tower and perpendicular to the vertical axis of the tower. Paint and aviation

colors referred to in the specifications should conform to Federal Standards FED-STD-595, Colors as follows:

1. Orange Number 12197 (Aviation Surface Orange).

2. White Number 17875 (Aviation White).

The tower shall be primed in accordance with the manufacturer's specifications prior to painting.

C. A Dual L-810 obstruction light shall be placed within 5 feet of the top of the tower in accordance with FAA requirements and the manufacturer's plans and specifications. The two lamps on the L-810 shall be wired in parallel on a dedicated circuit.

126-2.14 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. Equipment (including electrical circuits and fiber optics modems) and personnel shall be protected from lightning surges and voltages, from power line transients and surges, and from other electromagnetic fields and charges. Lightning protection systems shall be designed and installed in accordance with the Lightning Protection Code, NFPA 780, and the manufacturer's recommendations for all equipment structures.

126-2.15 NADIN/WMSCR INTERFACE

The AWOS shall be capable of interfacing to the equipment of a vendor that is approved to download information through the National Airspace Data Interchange Network (NADIN) and into the Weather Message Switching Center Replacement (WMSCR). The second-tier vendors services are not part of this requirement.

126-2.16 TEST EQUIPMENT

The Contractor shall provide all necessary test equipment for FAA equipment certification and testing, but shall not be required to supply the Owner with any test equipment.

126-2.17 SPARE COMPONENTS

The Contractor shall provide the Owner with the manufacturer's minimum recommended spare components necessary to restore the AWOS to service following a malfunction.

126-2.18   MAINTENANCE AGREEMENT

The Contractor shall provide a one (1) year maintenance agreement that begins on the date of FAA commissioning. The maintenance agreement shall include all required inspections as defined by the AWOS manufacturer and all service required to restore the AWOS to service following a malfunction.