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Operations and Services
Surface Observing Program (Land)*, *NDSPD 10-13

Instrument Requirements and Standards for the NWS Surface Observing Programs (Land)

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SUMMARY OF REVISIONS: This directive supersedes , NWSI 10-1302, "Instrument Requirements and Standards for the NWS Surface Observing Programs (Land)," dated September 30, 2002. Change: references to Regional Headquarters SOD Chief are removed and replaced by Regional Headquarters.

Signed by October 2, 2003
Gregory A. Mandt Date
Director, Office of Climate,
Water, and Weather Services

Instrument Requirements and Standards for the NWS Surface Observing Programs (Land)

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1. General. This instruction and attached appendices describe the requirements and standards for meteorological sensors used in the National Weather Service (NWS) staffed or managed surface observing programs. The standards are for sensor resolution, accuracy, siting and exposure. If standards can not be met by equipment in place, the standards should be achieved as stations are changed, equipment is installed, programs are modified, or new stations are established.

2. Standards for Sensors Used in the Observing Programs. The standards in this instruction pertain to individual instruments or meteorological sensors. For some automated systems, data collection platforms (DCP) integrate and disseminate sensor data. Any data provided by DCPs will meet standards set for the observing program the system supports.

2.1 Aviation Observing Program. The minimum standards for accuracy and resolution of sensors used by NWS staffed or managed aviation programs are established by Federal Meteorological Handbook No. 1 (FMH #1). All sensors used in the NWS staffed or managed aviation program will adhere to these standards. Appendix A contains a listing of the aviation observing program instrument requirements and standards.

2.2 Synoptic Observing Program. Sensors used for the Synoptic observation program will meet the standards of the aviation program. Appendix B contains a listing of the synoptic observing program instrument requirements.

2.3 Supplementary Observation Program. Sensors used for the Supplementary Observation (Supplementary Climatological Data and Supplementary Data Observations) program will meet the standards of the aviation program. All NWS offices will provide supplementary observations in support of national requirements in accordance with NWS Instruction (NWSI) 10-1301. Appendix C contains a listing of the supplementary observation program instrument requirements.

2.4 Climatic Observing Program. The accuracy and resolution standards of all sensors used in climate (i.e., Cooperative "a" network) observations support the recommendations of the World Meteorological Organization (WMO). Appendix D contains a listing of climatic observing program instrument requirements and standards.

2.5 Sunshine Duration Observing. All locations with a functioning sunshine sensor will provide the duration of sunshine in accordance with NWS Observing Handbook No. 7 (WSOH #7). Appendix D contains a description of instrument standards for the sunshine sensor.

3. Siting and Exposure of Meteorological Sensors. Standards will be followed as closely as possible to ensure uniformity of observations. Siting and exposure standards define and establish specifications and guidelines. The implementation of these should be flexible to achieve a balance between meteorological representativeness, space availability, and cost effectiveness.

Siting and exposure standards differ between the aviation and climate programs. Distinctions are necessary to address the unique requirements of each program.

3.1 Sensor Siting and Exposure for the Aviation Program. The NWS will follow the guidelines documented in the Federal Standard for Siting Meteorological Sensors at Airports (FCM-S4-1994, Washington DC, 1994). Siting and exposure standards for the synoptic and supplementary observing program instruments will follow the guidelines of the aviation program.

3.2 Sensor Siting and Exposure for the Climate Program. Strive to ensure uniformity of observations to meet national and international climatic observation requirements through implementation of the standards in Appendix F. Siting and exposure for the sunshine duration observing instruments will follow the guidelines of the climate program.

4. Visibility Charts. All aviation weather observing stations reporting visibility will have a visibility chart. If more than one location is used for visibility observations, a separate chart will be prepared for each location. The phrase "visibility chart" includes any documentation providing a graphical display identifying location and distance to day and nighttime visibility markers. The supervising official at the observing station is responsible for preparing and keeping the visibility charts current. The supervising Weather Forecast Office or Regional Headquarters will check visibility charts at the observing site for proper format and reasonableness during inspection visits.

5. Continuity of Climatological Data. As new instruments are introduced, studies to determine adjustment factors to account for differences between old and new sensors, gauges, and shelters should be made. The goal is to preserve the temporal continuity of station databases and make the change as seamless as possible in terms of the official climate record. The initiator of the change will be responsible for managing the studies. The results of the study will be documented and changes included in a station history file.

Appendix A - Instrument Requirements and Standards for the NWS Aviation Observing Program

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Exhibits:

1. General. This appendix provides minimum instrument requirements and sensor performance standards for conducting the NWS staffed and managed aviation observing program. The NWS aviation observing program policy will be conducted in accordance with NWS Instruction (NWSI) 10-1301. All backup instruments will meet the performance standards.

2. Commissioning Systems and Sensors. Activate and commission sensors of automated systems, that are procured and maintained by the NWS, before operational use. The commissioning of major systems, e.g., Automated Surface Observing System (ASOS), will be in accordance with NWS Directives System (NDS) instructions. Individual sensors in automated systems will not be commissioned prior to the commissioning of the entire system. The commissioning of stand-alone individual sensors will be accomplished in accordance with NDS instructions. Commissioning or certification of Federal and non-Federal Automated Weather Observing Systems (AWOS) are the responsibility of the Federal Aviation Administration (FAA).

3. Relocating of Systems or Sensors. Responsibility for managing and funding the relocation of observing systems or sensors rests with the agency requiring the move. Relocation of an ASOS will be approved by the ASOS Configuration Control Board before any move, in accordance with NWS Directives System (NDS) instructions.

4. ASOS Sensors. Details on sensors used at ASOS stations are given in the ASOS Site Technical Manual and the ASOS Users Guide.

5. Sensors for Determining Cloud Heights. The sensors used as cloud height indicators are:

   a. Laser-beam ceilometer either incorporated in an automated system or stand-alone.

   b. Balloons are required for use only at Supplementary Aviation Weather Reporting Stations (SAWRS) designated by the Regional Headquarters for daytime

observations. Use of lights with the balloons are authorized for night observations.

c. Ceiling lights (used at night). Ceiling lights are required for use only at SAWRS taking night observations, unless balloons with lights are available.

d. Procurement of ceiling lights and balloons for SAWRS is the responsibility of the SAWRS.

5.1 Requirement for Cloud Height Indicators. All NWS staffed or managed stations taking observations at airports with at least one precision approach runway will be equipped with a cloud height indicator.

Cloud Height Sensor Performance Standard		
Parameter	Accuracy	Range
Height of cloud base in feet	±3 Reportable Values	0 - 12,000 feet (minimum)
The resolution for sensors used as cloud height indicators is the reportable values for cloud heights as defined in the Federal Meteorological Handbook No. 1, Surface Weather Observations and Reports.		

Exhibit A-1. Cloud Height Sensor Performance Standard.

5.2 Required Backup Equipment for Cloud Heights. No backup equipment is required for reporting cloud heights. Cloud heights may be estimated in accordance with WSOH #7. If backup sensors are used, they will meet the cloud height indicator performance standard.

6. Sensors for Determining Pressure. All NWS staffed or managed stations will be equipped with an approved pressure sensor. All pressure sensors will be compared routinely following applicable procedures. Refer to Appendix F for procedures on comparisons. The following pressure sensors are approved for use at NWS staffed or managed locations.

a. ASOS/AWOS Pressure senors. At any location with a commissioned ASOS or an automated weather observing system (AWOS), the automated pressure sensors will be the barometric home station standard (HSS) for the aviation program.

b. Precision Digital Barometer (PDB). The PDB will be used as the barometric HSS for the upper-air program and other meteorological programs not associated with the ASOS. At NWS offices with both a surface observing program and an upper-air program, the ASOS will be the HSS for the surface observing program, and a PDB will be the HSS for the upper-air and other meteorological programs.

The PDB will be used by NWS staffed and NWS Contract staffed locations as a backup sensor to the ASOS.

c. Paroscientific Digiquartz model 760-16B. The Paroscientific model 760-16B is the traveling standard barometer directly traceable to the Primary Standard Barometer at the NWS National Pressure Standards Laboratory. The traveling standard will be:

(1) Used for comparing the ASOS pressure sensors by NWS electronics technicians.

(2) Used for comparisons with other pressure standards by NWS field operations staff.

(3) Returned to the NWS National Pressure Standards Laboratory annually for calibration.

d. Aircraft-type Altimeters. These sensors are authorized for use only at SAWRS locations. Unless otherwise designated by the Regional Headquarters , each SAWRS requires two of these sensors. It is the responsibility of the SAWRS to procure and ensure that these sensors remain properly calibrated according to standards in FAA Advisory Circular 91-14.

e. Precision Aneroid Barometers and Altimeter Setting Indicators. These sensors may be used in manual observing programs such as SAWRS, BSAWRS, SAWRS-II, A-Paid, and NF-Obs, at locations designated by the Regional Headquarters.

Pressure Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Station Pressure	Inches of Mercury	±0.02 inches of Hg	22-35 inches of Hg	0.005 inches of Hg
Altimeter Setting	Inches of Mercury	±0.02 inches of Hg	22-35 inches of Hg	0.01 inches of Hg
Sea-Level Pressure	Hectopascals	±0.68 hPa	800-1100 hPa	0.1 Hectopascals

Exhibit A-2. Pressure Sensor Performance Standard.

7. Temperature Sensors. All NWS staffed stations will have a temperature and dew point sensor meeting the performance standards. SAWRS designated by the Regional Headquarters are exempt from the required dew point sensor. The following temperature and dew point sensors may be used in the aviation program.

a. Hygrothermometer.

b. Thermometers. Liquid-in-glass or electronic.

c. Psychrometer. Liquid-in-glass or electronic.

Temperature/Dew Point Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Temperature	Degrees Celsius	±1.1 ±0.6 ±1.1	−62 to −50 −50 to +50 +50 to +54	0.1 0.1 0.1
Dew Point	Degrees Celsius	±2.2 ±1.7 ±1.1	−34 to −24 −24 to −01 −01 to +30	0.1 0.1 0.1

Exhibit A-3. Temperature/Dew Point Sensor Performance Standard.

8. Requirement for Backup Temperature Sensors. All NWS staffed or managed stations will have a backup temperature and dew point sensor(s). SAWRS designated by the Regional Headquarters are exempt from backup dew point sensors. Where the hygrothermometer or similar system is the station standard, it should be backed up with any of the items listed in section 7. A liquid-in-glass thermometer system will include spare thermometers.

9. Wind Measuring Sensors. All NWS staffed or managed stations will have a wind sensor meeting the performance standards. Wind measuring sensors should be mechanical, electrical, sonic, or other devices meeting the wind sensor performance standard.

Wind Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolut-ion**
Direction	degrees	±5 degrees when speed is ≥5 knots	1 to 360 degrees	10 degrees
Speed and Character	knots	±1 knot up to 10 knots ±10% above 10 knots	2 to 90 knots	1 knot
Wind Sensors used to support the aviation program will have the capability to generate a derivable 2 minute average wind speed and direction.				

Exhibit A-4. Wind Sensor Performance Standard.

10. Requirement for Backup Wind Measuring Sensors. No backup sensors are required for reporting winds. Backup wind direction and speed may be estimated. If backup sensors are used, they will meet the wind sensor performance standard.

11. Visibility Sensors. Visibility sensors are required at NWS staffed or managed automated observing stations.

Visibility Sensor Performance Standard			
Visibility from Standard Visibility Sensor	**Percentage of Data Within or Exceeding Given Range**		
	At least 80% Within	**No more than 18% Exceed**	**No more than 2% Exceed**
0 through 1 1/4	±1/4	±½	±1
1 ½ through 1 3/4	+1/4, −½	+1/2, −3/4	±1
2 through 2 ½	±½	±1	±1
3	+1/2, −1	±1	±1
4 through 10	±1 RV*	±2 RV*	±2 RV*
*RV = Reportable value, all other values in miles.			

Exhibit A-5. Visibility Sensor Performance Standard.

12. Precipitation Gauges. The NWS standard for measuring precipitation is the 8 inch non-recording precipitation gauge. All NWS staffed locations will have one. At NWS staffed locations, the 8 inch gauge will be used as back-up for ASOS. Precipitation gauges are not required at SAWRS.

Precipitation Gauge Performance Standard			
Parameter	**Accuracy**	**Range**	**Resolution**
Liquid Precipitation Accumulated Amount	±0.02 inches or 4 percent of hourly amount (whichever is greater)	0-10"/Hour	0.01 inches
Snow Depth	0 to 5 inches- ±0.5 inches >5 to 99 inches - ±1.0 inch	0 to 99 inches (auto)	1 inch
Freezing Precipitation	Detection occurs whenever 0.01" accumulates	0 to 40 inches	0.01 inches
Frozen Precipitation (water equivalent)	±0.04 inches or 1% of total accumulation	0 to 40 inches	0.01 inches

Exhibit A-6. Precipitation Gauge Performance Standard.

13. Snow Shields. At NWS staffed locations alter-type snow shields will be used on any operational or backup precipitation gauge at stations reporting data for climatology where the average annual snowfall is ten inches or more.

Appendix B - Instrument Requirements for the NWS Synoptic Observing Program

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1. General. This appendix provides minimum instrument requirements for conducting the NWS staffed or managed synoptic observing program. The synoptic observing program policy will be conducted in accordance with NWSI 10-1301. Sensor performance standards described in the exhibits of Appendix A are the minimum performance standards.

2. Instrument Requirements. NWS staffed or managed stations providing synoptic observations will have, as a minimum, the following instruments adhering to the performance standards of the aviation observing program:

a. Temperature sensors capable of providing ambient air temperature, dew point and daily maximum and minimum temperatures.

b. An approved NWS pressure sensor ,

c. a wind direction and speed system, and

d. an ASOS precipitation gauge, or a standard 8 inch precipitation gauge.

e. Other equipment may be added to the station as necessary to satisfy additional requirements.

Appendix C - Instrument Requirements for the Supplementary Observation Program

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1. General. This appendix provides minimum instrument requirements for conducting the NWS staffed supplementary observation program. The NWS supplementary observation program policy will be conducted in accordance with NWSI 10-1301. Sensor performance standards described in the exhibits of Appendix A are the minimum performance standards.

2. Instrument Requirements. NWS staffed stations providing supplementary observations will have, as a minimum, the following instruments adhering to the performance standards of the aviation observing program:

a. A maximum/minimum temperature system (MMTS) capable of providing air temperature and daily maximum and minimum temperatures.

b. A standard 8 inch precipitation gauge.

c. Snowsticks and snowboards at those stations subject to snowfall.

d. Other equipment may be added to satisfy additional requirements.

Appendix D - Instrument Requirements and Standards for the NWS Climate Observing Program

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Exhibits: Page

1. General. This appendix provides minimum instrument requirements and sensor performance standards for conducting the NWS staffed or managed climate observing program. The NWS climate observing program policy will be conducted in accordance with NWSI 10-1301. Sensors performance listed in the exhibits of this appendix are the minimum performance standards.

2. ASOS Sensors. Details on sensors used at ASOS stations are given in the ASOS Site Technical Manual and the ASOS Users Guide.

3. Temperature Sensors. The following temperature sensors may be used in the climate observing program:

a. Maximum/Minimum Temperature System (MMTS);

b. liquid-in-glass maximum and minimum thermometers;

c. An ASOS temperature sensor.

Climate Program Temperature/Dew Point Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Temperature	Degrees Fahrenheit	±2.0 ±1.0 ±2.0	−62 to -50 −50 to +122 +122 to +134	0.1 0.1 0.1
Dew Point	Degrees Fahrenheit	±4.0 ±3.0 ±2.0	−34 to −24 −24 to +30 +30 to +86	0.1 0.1 0.1

Exhibit D-1. Climate Program Temperature/Dew Point Sensor Performance Standard.

4. Precipitation Gauges. All NWS staffed or managed climate observation stations providing precipitation measurements will have a recording or non-recording precipitation gauge(s) that meets the performance standards.

Precipitation Gauge Performance Standard			
Parameter	**Accuracy**	**Range**	**Resolution**
Liquid Precipitation Accumulated Amount	±0.02 inches or 4 percent of hourly amount (whichever is greater)	0-10"/Hour	0.01 inches
Snow Depth	0 to 5 inches- ±0.5 inches >5 to 99 inches - ±1.0 inch	0 to 99 inches (auto)	1 inch
Freezing Precipitation	Detection occurs whenever 0.01" accumulates	0 to 40 inches	0.01 inches
Frozen Precipitation (water equivalent)	±0.04 inches or 1% of total accumulation	0 to 40 inches	0.01 inches

Exhibit D-2. Precipitation Gauge Performance Standard.

5. Other Sensors. Climate observing programs may have a requirement for other equipment. This equipment may include, but is not limited to:

a. Hygrothermographs
b. Soil thermometers
c. Evaporation sensors
d. Anemometers
e. Snowstakes
f. Snowsticks
g. River and lake gauges
h. Sunshine sensors

Soil Temperature Sensor Performance Standard		
Parameter	**Accuracy**	**Resolution**
Soil Temperature	±2 degrees Fahrenheit	1 degree Fahrenheit

Exhibit D-3. Soil Temperature Sensor Performance Standards

Wind Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Direction	degrees	±5 degrees when speed is ≥5 knots	1 to 360 degrees	10 degrees
Speed and Character	knots	±1 knot up to 10 knots ±10% above 10 knots	2 to 90 knots	1 knot
Wind Sensors used to support the aviation program will have the capability to generate a derivable 2 minute average wind speed and direction.				

Exhibit D-4. Wind Sensor Performance Standard.

Sunshine Sensor Performance Standard			
Parameter	**Accuracy**	**Resolution**	**Solar Flux Density Threshold**
Direct Insolation (sunshine duration) (exclusive of the effects of diffuse radiation)	±10%	1 minute	120 Watts/m^2

Exhibit D-5. Sunshine Sensor Performance Standard

Appendix E - Siting and Exposure Standards for the NWS Climate Observing Program

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1. General. This appendix provides sensor siting and exposure standards for conducting the NWS staffed or managed climate observing program. The NWS climate observing program will be conducted in accordance with NWSI 10-1301.

2. Pressure Sensors. Sensors will be located in climate controlled areas where they are free of jarring, vibration, and rapid temperature fluctuations.

3. Air Temperature Sensors. Specific permission to depart from the standards may be granted in writing by the Regional Headquarters and must be documented on the station information forms. Site the temperature sensor according to the following standards:

a. over level terrain (earth or sod) typical of the area around the station, and;

b. at least 100 feet from any extensive concrete or paved surface.

c. All attempts will be made to avoid:

(1) areas where rough terrain or air drainage are proven to result in nonrepresentative temperature data,

(2) areas where water tends to collect, and

(3) areas where drifting snow collects.

d. If the sensor is within a shelter, position the shelter so it opens to the north with the floor 4 to 6 feet above the surface. Shelters should be located no closer to an obstruction than four times the height of the obstruction.

e. In the case of remoted sensors not exposed in shelters, the air intake will be 4 to 6 feet above the surface. Remoted sensors should be located no closer to an obstruction than four times the height of the obstruction.

f. An object will be considered an obstruction if the object is greater than ten degrees in horizontal width as measured from the sensor and within 200 feet of the sensor.

4. Wind Sensors.

a. The wind sensor will be oriented with respect to true north. The site should be as level as possible.

b. The standard height above the ground for wind sensors is 33 feet. If local restrictions prevent installing the sensors at the 33-foot standard, install them no less than 20 feet above the ground.

c. The sensor height must be at least 15 feet above the height of any obstruction within 500 feet. If practical the sensor should be at least 10 feet higher than any obstruction between 500 and 1,000 feet of the sensor.

d. An object will be considered an obstruction if the object is greater than 10 degrees in horizontal width as measured from the sensor.

5. Precipitation Gauges. The exposure of the precipitation gauge is of primary importance in the accuracy of precipitation measurements, especially snowfall measurements. An ideal exposure would eliminate all turbulence and eddy currents, near the gauge, that tend to carry away the precipitation. The loss of precipitation in this manner tends to increase with wind speed and orifice height.

a. The orifice of the gauge will be horizontal and 3 to 5 feet above the surface. Exceptions must be granted by the Regional Headquarters in writing and described in the station information documentation.

b. The gauge site should have protection in all directions by objects of uniform height. Where the heights of the objects are uniform and the height of these objects and the distance from the gauge is generally uniform, their height above the gauge orifice should not exceed twice their distance from the gauge.

c. In open areas, the heights of obstructions above the orifice should not exceed twice their distance from the gauge.

6. Sunshine Sensors. Locate the sensor where there are no stationary obstructions reflecting sunlight or casting a shadow on the sensor.

7. Rooftop locations. Sensors will not be sited on rooftops, with the exception of sunshine or solar radiation sensors where the roof location may provide the best obstruction free location. Relocation of existing rooftop sensors will be accomplished as funds permit and after coordination with the Regional Headquarters.

Appendix F - Precision Digital Barometer Comparison Procedures

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This appendix provides procedures and the form for conducting barometer comparisons using the precision digital barometer.

Precision Digital Barometer Comparison Procedures

1. NWS Offices With an Upper Air Program. At the time of annual calibration, the NWS field office will receive a replacement PDB from the Office of Operational Systems, Engineering Division Maintenance Branch, at NWS headquarters, and notification to return the current PDB. The point of contact for replacement of these instruments is the Maintenance Branch, 301-713-1834.

A verification of the PDB readings will be conducted at least once every 6 months with the NWS Digiquartz Paroscientific Inc., model 760-16B Traveling Standard.

a. The verification will be done by comparing the sensor pressure of the PDB with the Traveling Standard.

b. The PDB and Traveling Standard will be positioned within 1 foot of each other in the vertical and 3 feet in the horizontal during the verification. The procedure will consist of two verification readings taken no less than 15 minutes apart. For each verification, the uncorrected sensor pressure will be read to the closest 0.001 inch of mercury (Hg). The verification will be documented using WS Form B11-11 (5-02).

c. If both readings are within 0.007 inch of Hg when compared to the Traveling Standard, no further action is required.

d. If either of the readings of the PDB deviates more than 0.007 inch of Hg from the Traveling Standard discontinue use of both instruments and consult with the regional surface program manager and the Maintenance Branch to determine which of the instruments may be deficient.

2. NWS Offices Without an Upper Air Program: The PDB will not be calibrated annually by the Pressure Standards Laboratory at these locations, but will be compared at least once every 6 months against the Traveling Standard.

a. The comparison will be done by comparing sensor pressure of the PDB with the Traveling Standard.

b. The PDB and the Traveling Standard will be within 1 foot of each other in the vertical and 3 feet in the horizontal during the comparison. The procedure will consist of two comparisons taken no less than 15 minutes apart. For each comparison, the uncorrected sensor pressure will be read to the closest 0.001 inch of Hg. The comparisons will be documented using WS Form B11-11 (5-02).

c. If both readings are within 0.02 inch of Hg when compared to the Traveling Standard, no further action is required.

d. If either of the readings of the PDB deviates more than 0.02 inch of Hg from the Traveling Standard, the PDB will be removed from service and returned to the NWS Pressure Standards Laboratory for recalibration.

e. Every 5 years the Maintenance Branch will inform each NWS field site of the 5-year recalibration through the delivery of a replacement PDB.

3. ASOS Backup. No correction will be applied to the PDB when used as the operational backup to ASOS. If for any reason the ASOS pressure data is not available, PDB readings for altimeter and sea level pressure will be read and used to backup those elements in the surface observation.

4. Notification Procedure. The Maintenance Branch will be notified immediately of any deficient instrument. A replacement PDB will be shipped via overnight delivery. The Maintenance Branch will maintain the computer storage disks containing station dependent data, including r-values. The data files from these disks will be entered into the PDB's memory by the Maintenance Branch prior to a new PDB being delivered to field locations. NWS field staff should verify station dependent data within the PDB's memory upon receipt of the PDB.

5. Summary Table.

Precision Digital Barometer Comparison Policy			
Program	**Function**	**Calibration**	**WFO Comparison Requirement**
NWS Offices with an Upper Air Program and No ASOS	Home Station Standard/ Operational Barometer	1) Initial calibration before deployment. 2) Annually after initial deployment. 3) Consultation with region and the Maintenance Branch if PDB deviates more than 0.007 inch from Traveling Standard.	A verification of the PDB readings will be conducted at least once every six months with the Traveling Standard.
NWS Offices with an Upper Air Program and Collocated with a commissioned ASOS	1) Home Station Standard/ Operational Barometer for Upper Air 2) Operational Backup to ASOS	1) Initial calibration before deployment. 2) Annually after initial deployment. 3) Consultation with region and the Maintenance Branch s more than 0.007 inch from Traveling Standard.	A verification of the PDB readings will be conducted at least once every six months with the Traveling Standard.
NWS Offices with an ASOS and no Upper Air Program	Operational Backup to ASOS	1) Initial calibration before deployment. 2) Recalibration every five years 3) Recalibration required if PDB deviates more than 0.02 inch from Traveling Standard.	The PDB will be compared at least once every six months with the Traveling Standard.
NWS Offices with no Upper Air and no ASOS Programs	Home Station Standard/ Operational Barometer	1) Initial calibration before deployment. 2) Recalibration every five years 3) Recalibration required if PDB deviates more than 0.02 inch from Traveling Standard.	The PDB will be compared at least once every six months with the Traveling Standard.

6. PDB Comparison/Verification Form

WS Form B11-11 (5-02)	U.S. Department of Commerce National Oceanic and Atmospheric Administration National Weather Service				Station:			
Precision Digital Barometer (PDB) Comparison/Verification Form (See detailed instructions for preparation of form on reverse side)					Station Elevation:	PDB Elevation:	Field Elevation (If applicable):	
Year/Quarter (1)	Traveling Standard Serial Number (2)	PDB Serial Number (3)	Readings from Traveling Standard (4)		Readings from PDB (5)		Differences from Traveling Standard (6)	
			1st reading (4a)	*2nd reading (4b)*	*1st reading* (5a)	*2nd reading (5b)*	*1st reading* (6a)	*2nd reading* (6b)

WS Form B11-11
(5-02)

Guide for Preparing Form

Headings: Enter Station name in plain language, e.g., WFO Green Bay, Wisconsin
Enter Location as Latitude/Longitude e.g., 44.29 North 88.08 West

Col. 1 Enter the year and quarter the comparison is made. The required verifications/comparisons should be made during the first month of each alternating quarter. The format for Year/Quarter should be consistent, e.g. 99/1st.

Col. 2 Enter the serial number for the Traveling Standard used to compare the PDB.

Col. 3 Enter the serial number of the PDB being compared.

Col. 4a Enter the first sensor pressure reading from the Traveling Standard to the closest 0.001 inch of Mercury (Hg), e.g., 30.014

Col. 4b Enter the second sensor pressure reading (taken at least 15 minutes away from the 1st reading) from the Traveling Standard.

Col. 5a Enter the first sensor pressure reading (taken at same time as reading in 4a) from the PDB to the closest 0.001 inch of Hg.

Col. 5b Enter the second sensor pressure reading (taken at same time as reading in 4b) from the PDB to the closest 0.001 inch of Hg.

Col. 6a Enter the difference between 4a and 5a to the closest 0.001 inch of Hg.

Col. 6b Enter the difference between 4b and 5b to the closest 0.001 inch of Hg.

For the upper air locations: Notify the regional surface observing manager and W/OSO321 at National Weather Service Headquarters if either 6a or 6b exceeds 0.007 inches of Hg.

For the non-upper air locations: Notify the regional surface observing manager and W/OSO321 at National Weather Service Headquarters if either 6a or 6b exceeds 0.02 inches of Hg.

Comparison/Verification Form (back side)

Exhibit - Consolidated Listing of Sensor Performance Standards

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1. Cloud Height Sensor Performance Standard.

Cloud Height Sensor Performance Standard		
Parameter	**Accuracy**	**Range**
Height of cloud base in feet	±3 Reportable Values	0 - 12,000 feet (minimum)
The resolution for sensors used as cloud height indicators is the reportable values for cloud heights as defined in the Federal Meteorological Handbook No. 1, Surface Weather Observations and Reports.		

2. Pressure Sensor Performance Standard.

Pressure Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Station Pressure	**Inches of Mercury**	**±0.02 inches of Hg**	**22-35 inches of Hg**	**0.005 inches of Hg**
Altimeter Setting	**Inches of Mercury**	**±0.02 inches of Hg**	**22-35 inches of Hg**	**0.01 inches of Hg**
Sea-Level Pressure	**Hectopascals**	**±0.68 hPa**	**800-1100 hPa**	**0.1 Hectopascals**

3. Air Temperature/Dew Point Sensor Performance Standard.

Temperature/Dew Point Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Temperature	**Degrees Celsius**	**±1.1** **±0.6** **±1.1**	**−62 to −50** **−50 to +50** **+50 to +54**	**0.1** **0.1** **0.1**
Dew Point	**Degrees Celsius**	**±2.2** **±1.7** **±1.1**	**−34 to −24** **−24 to −01** **−01 to +30**	**0.1** **0.1** **0.1**

4. Wind Sensor Performance Standard.

Wind Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Direction	**degrees**	**±5 degrees when speed is ≥5 knots**	**1 to 360 degrees**	**10 degrees**
Speed and Character	**knots**	**±1 knot up to 10 knots** **±10% above 10 knots**	**2 to 90 knots**	**1 knot**
Wind Sensors used to support the aviation program will have the capability to generate a derivable 2 minute average wind speed and direction.				

5. Precipitation Gauge Performance Standard.

Precipitation Gauge Performance Standard			
Parameter	**Accuracy**	**Range**	**Resolution**
Liquid Precipitation Accumulated Amount	**±0.02 inches or 4 percent of hourly amount (whichever is greater)**	**0-10"/Hour**	**0.01 inches**
Snow Depth	**0 to 5 inches- ±0.5 inches >5 to 99 inches - ±1.0 inch**	**0 to 99 inches (auto)**	**1 inch**
Freezing Precipitation	**Detection occurs whenever 0.01" accumulates**	**0 to 40 inches**	**0.01 inches**
Frozen Precipitation (water equivalent)	**±0.04 inches or 1% of total accumulation**	**0 to 40 inches**	**0.01 inches**

6. Soil Temperature Sensor Performance Standard**.**

Soil Temperature Sensor Performance Standard		
Parameter	**Accuracy**	**Resolution**
Soil Temperature	**±2 degrees Fahrenheit**	**1 degree Fahrenheit**

7. Visibility Sensor Performance Standard**.**

Visibility Sensor Performance Standard			
Visibility from Standard Visibility Sensor	**Percentage of Data Within or Exceeding Given Range**		
	At least 80% Within	**No more than 18% Exceed**	**No more than 2% Exceed**
0 through 1 1/4	**±1/4**	**±1/2**	**±1**
1 1/2 through 1 3/4	**+1/4, −1/2**	**+1/2, −3/4**	**±1**
2 through 2 1/2	**±1/2**	**±1**	**±1**
3	**+1/2, −1**	**±1**	**±1**
4 through 10	**±1 RV***	**±2 RV***	**±2 RV***
***RV = Reportable value, all other values in miles.**			

8. Sunshine Sensor Performance Standard.

Sunshine Sensor Performance Standard			
Parameter	**Accuracy**	**Resolution**	**Solar Flux Density Threshold**
Direct Insolation (sunshine duration) (exclusive of the effects of diffuse radiation)	**±10%**	**1 minute**	**120 Watts/m^2**

9. Climate Program Temperature/Dew Point Sensor Performance Standard.

Climate Program Temperature/Dew Point Sensor Performance Standard				
Parameter	**Units**	**Accuracy**	**Range**	**Resolution**
Temperature	**Degrees Fahrenheit**	**±2.0** **±1.0** **±2.0**	**–62 to –50** **–50 to +122** **+122 to +134**	**0.1** **0.1** **0.1**
Dew Point	**Degrees Fahrenheit**	**±4.0** **±3.0** **±2.0**	**–34 to –24** **–24 to +30** **+30 to +86**	**0.1** **0.1** **0.1**