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Dated: ***February 5, 1998***
Supersedes 450.xxxx
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National Weather Service

ENGINEERING DIVISION

REVISED SPECIFICATION FOR

BAROMETER, PRECISION DIGITAL

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U.S. DEPARTMENT OF COMMERCE
National Oceanic & Atmospheric Administration
National Weather Service
Silver Spring, Maryland 20910

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BAROMETER, PRECISION DIGITAL

1. SCOPE

The Precision Digital Barometer (PDB) covered by this specification is intended for use by the National Weather Service (NWS). The PDB will sense and continuously indicate:

A) The real-time atmospheric sensor pressure as required for meteorological and air safety purposes.

B) The real-time ***"Altimeter Setting"*** adjustable by an elevation correction input. Functionally this reading will be used to obtain the proper setting of aircraft altimeters on the ground at the location for which the pressure value was determined. ***See section 8.1 Terminology*.**

The PDB will automatically compensate for the effects of varying temperature. It will record and store the continuous historic atmospheric sensor pressure as required for meteorological purposes for a minimum period of 35 days. The stored and real-time data will be continuously accessible via a display panel or computer interface. The standard PDB will provide a method to enter or calculate the Pressure Reduction Ratio "r" and determine the resulting sea-level pressure for display. The PDB will also provide a method to calculate and display the Pressure Altitude and Density Altitude.

2. APPLICABLE DOCUMENTS

The following documents form an integral part of this specification to the extent specified herein:

NWS No. WS-N-SD001 (Rev. 11/4/70) Standard Nameplate
NWS No. WS- 399/3 (Rev. 4/25/57) Standard Panels
Manual of Barometry (WBAN) Volume I, First Edition - U.S. Government Printing Office Washington, D.C. 1963
Smithsonian Meteorological Tables ED6, Publication 4014, Sixth Edition - Robert J. List 1949
Drawing Requirements Manual, Ninth Edition - J.H. Lieblich and G. Whitmire, Global Engineering Documents, Colorado 1995
Guide to Meteorological Instruments and Methods of Observations OMM-No. 8, Secretariat of the World Meteorological Organization (WMO) Geneva, Switzerland 1983

3. REQUIREMENTS

3.1 Preproduction Model

A preproduction model of the Precision Digital Barometer shall be provided by the contractor. The PDB shall be complete and in compliance with all requirements contained in this specification. The preproduction model shall be manufactured and assembled by tools and methods that will be used in the quantity production of the instrument. A statement shall be provided that includes a detailed explanation of what was manufactured and assembled by tools and methods that will **not** be used in the quantity production of the instrument. The model instrument will be tested and throughly examined at a facility of the National Weather Service or approved agent. Upon approval, the model instrument will be accepted as a delivery of one (1) unit on the contract and retained in the ordering office. The contractor will then be advised in writing that they may proceed with quantity production. In the event the model is found to be not acceptable, it will be returned to the contractor's place of business for corrective action at the contractor's expense. The preproduction model shall be shipped to the ordering office in a container that meets the requirements of **Section 5.** of this document.

3.2 Materials

The PDB shall be made entirely of suitable corrosion resistant materials that will permit storage and use in the natural weather conditions of an exposed environment. The PDB shall be able to withstand routine exposure to acid rains, seacoast or salt laden environments, sunlight and extreme temperatures without damage from corrosion or deterioration of material with age.

Materials capable of supporting electrolytic action shall not be used in contact with each other. Any protective coatings that will crack, peel, chip, or scale under normal use or test conditions shall not be used. Within these limitations the materials selected for the construction of the PDB shall be the manufacturer's option.

3.3 Design

The manufacturer shall determine the details of design and construction, subject to the design and performance requirements specified in this document. Details of design and construction that are determined by the manufacturer shall conform to standard engineering practices as accepted by organizations such as ASME, Underwriters Laboratories, etc. The instrument shall meet all federal and state standards for devices of this type and shall specifically conform to all Federal Communications Commission (FCC) rules and regulations as applicable.

3.3.1 Design Requirements

The PDB shall be sufficiently rugged such that conditions incident to normal shipping (including air shipment in unpressurized cargo compartments of aircraft), installation, use and service shall not affect PDB serviceability, accuracy or stability. At a minimum, the PDB shall meet the following design requirements:

1. Sense and continuously display both the real-time atmospheric sensor pressure and the real-time ***"altimeter setting"(AS)*** using a common transducer(s).
2. Provide a method to enter and read the Pressure Reduction Ratio "r" as calculated from NWS station tables and display the resulting sea-level pressure as required for meteorologic purposes. When manually determined, the "r" value shall be entered as the calculated 4 digits to the right of the decimal point from the table. The ratio is always greater than unity, therefore, the "1" preceding the decimal shall be permanently placed in the computational software *(see requirement 24)*.
3. Provide a method to compute and display the Pressure Altitude and the Density Altitude.
4. Provide a display that has individual numerals that are no less than ½ inch (1.27 cm) in height, and are proportional and legible.
5. Provide a multiple scale unit measurement selection on the display. The units of measurement shall include inches of mercury (inHg), millimeters of mercury (mmHg), hectopascals (hPa), and kilopascals (kPa). The selected unit of measurement shall be prominently displayed to the right of the measurement.
6. Display at least 6½ digits (6 digits and a decimal point) for all available units of measurement and have a 0.0001 FS inHg resolution. For example 29.9215 inHg will be the barometric pressure to the $^{1}/_{10,000}$ th place and 6 significant digits; the equivalent measurement would be 1013.26 hPa to the $^{1}/_{100}$ th place and also 6 significant digits. Specific displayed resolution will vary with selected units of measurement and should be accurate to the final digit.
7. Record and store the historic atmospheric sensor pressure for a ***minimum*** period of 35 days. The 35-day period will be resettable at any selected time interval that is less than 35 days and shall include a timed sample mode selectable to a minimum 10 second interval. The PDB will also have an ON/OFF selectable burst mode, which when activated, will sense rapid changes in atmospheric pressure and automatically default to the minimum 10 second interval *(see section **3.3.5**)*. This data will be continuously accessible via a display panel and computer interface, and downloadable via a standard RS232 computer interface *(see section **3.3.4**)*.

8. Shall have a temperature sensor to be used in altimeter setting calculations.

9. Functionality and accuracy of the PDB shall not be affected by humidity or changes in air density.

10. Automatically compensate for the effects of varying temperature.

11. Performance parameters for onsite use shall be maintained over an operational external temperature range of -20° to 50° C (-4° to 122° F). Performance parameters for remote use shall be maintained over an operational external temperature range of -45° to 55° C (-50° to 130° F).

12. Have an atmospheric pressure range of 50 to 110 kPa (14.7 - 32.5 inHg) minimum.

13. Elevation range adjustment with restricted access for altimeter settings of -50 to 3750 meters (-165 to 12,300 feet) minimum. The elevation range adjustment increment shall be less than or equal to 0.15 meters or 0.5 feet. ***The elevation input shall be in both meters and feet.***

14. Accuracy of 0.01 % of full scale (FS) or better in any position or configuration.

15. Stability - Drift shall not exceed **0.009%** FS per year.

16. Hysteresis shall not exceed 0.005% FS.

17. Have an internal surge protected power supply that operates from a standard 115 ± 10 VAC power outlet. The power supply shall use a standard molded 2-pole, 3-wire grounding-type attachment plug (ANSI C73 Standard 5-15P).

18. Contain a self-charging internal battery backup capable of maintaining instrument power requirements for a minimum of 36 hours should facility power fail.

19. Warmup time of less than 1 minute prior to full operational status.

20. Perform continuous self-tests to ensure proper operation of all systems. This test(s) shall verify the proper operation of all operating system components, backup systems and the barometric transducer(s). The PDB shall employ a method to alert users to any malfunctions. Specific self-test methods shall be at the discretion of the manufacturer.

21. Provide a minimum of one 9-pin RS232 serial port for computer interface on the standard instrument (*see requirement 22*).

22. Be upgradable to support additional 9-pin RS232 serial ports for an ancillary input. Other additional ports shall be optional with the manufacturer *(See section **3.3.3**)*.

23. Be capable of supporting one optional variable ***bit*** modem, with a standard 4-wire RJ11 connector. The minimum acceptable ***bit*** rate for the standard instrument shall be 14,400 ***bits*** per second (bps).

24. Provide personal computer interface software for onsite and remote programming and interrogation. Interfaces shall use standardized protocols and formats. The software shall include onsite and remote historic data acquisition, the ability to enter/retrieve the Pressure Reduction Ratio "r" and/or temperatures to compute the resulting real-time atmospheric sensor pressure, the real-time ***altimeter setting*** (AS), sea-level pressure, the pressure altitude, and the density altitude.

25. Capable of withstanding pressures up to 1.2 times the full scale without damage to the PDB or affecting its performance.

26. Shall be made entirely of suitable corrosion resistant materials that will permit storage and use in the natural weather conditions of an exposed environment. The PDB shall be able to withstand routine exposure to acid rains, seacoast or salt laden environments, sunlight and extreme temperatures without damage from corrosion or deterioration of material with age. ***The PDB will be waterproof and designed for unmanned operation.***

27. Shall have a 12 volt DC terminal input for use as an external DC power source, a secondary backup power system. The PDB should not charge this external 12 volt power source.

28. Shall not be effected by the year 2000, millennium year end (Y2K) problem.

29. Shall have no fixed cables. Sealed connector should be used for connecting all cables. The only exemption should be for the temperature probe if a connector would render the probe un-operational. The location of the fixed connector should be placed on a non-resting surface.

30. Shall have a field replaceable battery, easily removed and replaced.

31. Shall have a stainless steel connector on the outside of the barometer for grounding.

32. Shall have two operating positions: display perpendicular or parallel to the ground. In these two configurations, the PDB should be stable and be able to support itself. The user should be able to quickly place the PDB down on a surface be able to take a pressure reading quickly.

33. Shall be no larger than 17.0"(43.18*cm)* x 9.5"(24.13*cm*) x 8.0"(20.32*cm)* [w *x* l *x* h] and be available in panel mounted and desktop cases. ***The manufacturer has the option of providing two separate cases or to provide a single case unit that will meet both the onsite and remote use requirements.*** The maximum weight of the standard instrument will be less than ***17.6 lbs (8kg)***.

3.3.2 Barometric Transducer

The Barometric Transducer unit(s) within the PDB shall strictly conform to requirements 9, 10, 11, 12, 14, 15, 16, 19, 25 and 26. Active supplemental devices to control the Barometric Transducer units' physical environment shall not be used. (An example of an unacceptable supplemental device would be a heater.) The Barometric Transducer(s) shall be field replaceable, easily removed and replaced.

3.3.3 Communication Interface Capability

The instrument described in this specification is intended to be extremely versatile, as such, the PDB should have several upgradable features. The standard instrument will have one 9-pin RS232 port, as described in design requirement 21, and be upgradable to support a minimum of two additional 9-pin RS232 serial ports for an ancillary input as described in design requirement 22. All instruments shall also be upgradable at anytime to support one variable ***bit*** modem as described in design requirement 23.

3.3.4 Software/*Hardware*

When designing the software for the PDB, routines for calculable parameters should consider possible upgrade paths and user convenience. ***The potential for upgrades must be incorporated into the base instrument. Upgrades should be similar to a Personal Computer, with slots for upgrades and peripherals.***

1. All software shall be user friendly, menu driven**,** and MS-DOS 6.22/Windows 3.11 or newer compatible.

2. The adjustable elevation correction input referred to in design requirement 13 shall only be adjustable via the interface software and shall be password protected.

3. In considering user convenience and upgrade paths, the software shall accept data input in multiple forms as described in requirement 24. A user shall be able to enter "r" as described in requirement 2 **and/or** enter the current average temperatures (TR and TS). The software shall then be able to read or calculate the Pressure Reduction Ratio "r" as entered or programed for that station and determine the resulting real-time atmospheric sensor pressure, the real-time ***altimeter setting*** (AS), sea-level pressure, the pressure altitude, and the density altitude. The Reduction Constant "C" and tables for the Pressure Reduction Ratio function are unique for each individual station.

4. The software shall be capable of automatic input from external temperature sensor(s) and manual temperature input. Manual temperature input shall be selectable via software and front panel. The PDB shall continuously log the average five-minute temperature (TR) and compute an average twelve-hour temperature (TS) to determine the resulting pressure parameters. Reprogramming shall not be necessary.

5. The software shall be capable of configuring a PDB to log five-minute temperature and diagnostic information. The format of the data file downloaded from the PDB should be in spaced-delimited ASCII format. This data should be in two or four columns depending on configuration. As follows:

- Date and time information, in the format: mm/dd/yyyy hh:mm:ss;
- Sensor pressure, in millibars;
- Measured temperature (TR), in Celsius;
- Diagnostic information.

Example: 11/27/2000 19:30 1025.35 25 NONE

6. The PBD is intended to be a stand-alone instrument. The "front panel" or "face" of the PDB shall display **1)** the real-time atmospheric sensor pressure and **2)** the real-time altimeter setting continuously as described in Requirement 1; and shall provide **3)** direct user interface from the front panel to view any instrument parameter and enter any variable data which is not automatically computed or entered such as (TR) and (TS). User interface via any "remote" computer on or off site is intended for the convenience of NWS in down loading and up loading data. Password protected items need only be edited via computer interface.

7. The PDB should be capable of displaying calibration dates and site settings via the PDB display. The calibration dates should include calibration date and calibration due date only. Site settings information should include field elevation, station elevation and sensor elevation.

8. Items which require password protection shall include any data which an observer shall not be required to enter in the course of routinely determining $\mathbf{P_s}$, **AS**, P, P_a , SLP, DA and PA. These will include H_a , H_p , H_z , T_v. TR and TS shall be password protected ***if*** remotely polling an external temperature sensor, and tabled values for "r" shall be password protected ***if*** programed into any individual instrument. Otherwise, TR, TS, and "r" shall not be password protected and must be accessible from the front panel of the unit. NWS requires only one password per unit to protect "hard" data and the ability to change the password at any time.

3.3.5 Sample Intervals

The PDB shall record and store the historic atmospheric sensor pressure at any selected time interval less than 35 days. The timed sample mode shall be selectable from a maximum number of hours or minutes to a minimum 10 second sample interval. The 10-second sample interval shall be considered "continuous." In the burst sample mode, the PDB shall sense rapid changes in barometric pressure and automatically default to the burst sample interval mode. The "burst sample interval mode" shall be defined as the mode to which the system defaults any sample interval greater than continuous to the 10 second or "continuous" mode. The PDB shall remain in the burst sample interval mode for 20 minutes after the barometric pressure at the station returns to a moderate rate of change. The burst sample mode shall be ON/OFF selectable within the software.

A rise or fall at the rate of ***0.06 inHg or more per hour with a total change of at least 0.02 inHg at the time of the observation*** shall be considered a rapid change in pressure. ***These values are absolute.***

Concurrent pressure values may be condensed to reflect constant pressure over a period of time.

3.3.6 Computations

✎ Computations in English Units and must have agreement.

$$P_a = P \times 10^{(\ 0.00813 \times H_{za} / \overline{TR}\ )}$$

3.3.6.1 ***Field Pressure***
3.3.6.2 ***Station Pressure***

$$P_s = P \times 10^{(\ 0.00813 \times H_{zp} / \overline{TR}\ )}$$

3.3.6.3 ***Altimeter Setting***

$$AS = (\ Pa^{0.190263} + (1.313 \times 10^{-5}) \times H_a\ )^{5.25588}$$

With available five-minute average temperature input *(TR)* use:

$$AS = (\ P^{0.190263} + (1.313 \times 10^{-5}) \times H_z\ )^{5.25588}$$

else use:

$$SLP_{inHg} = (\ P_{s_{inHg}} \times\ r_{(TS)} + C)$$

3.3.6.4 ***Sea-Level Pressure***

$$DA = 145{,}442.16 \times (1 - (\frac{17.326 \times P_a}{\overline{TR}})^{0.235})$$

3.3.6.5 ***Density Altitude*** (*Output rounded to the nearest 100 feet)*

$$PA = 145{,}442.16 \times (1 - (\frac{P_a}{29.9213})^{0.190263})$$

3.3.6.6 ***Pressure Altitude*** (*Output rounded to the nearest 10 feet)*

3.3.6.7 *Pressure Reduction Constant*

(Recommended for low level stations and should not exceed 5.906 x 10^{-3} inHg or 0.2 hPa)

$$C = \frac{P_s}{53.35} x \frac{H_p}{T_v}$$

➥ Particular methods for determining reduction constants for stations that are not considered to be low level stations have not been recommended by the WMO. These stations use unique reduction methods that are regionally agreed upon and promulgated by WMO Secretariat. Therefore, C shall be password protected and equal to zero (0) unless otherwise specified during calibration.

3.3.6.8 *Temperature Relationships*

$$T_{\circ F} = 32° + \frac{9}{5} T_{\circ C}$$

4. QUALITY ASSURANCE PROVISIONS

$$T_{\circ R} = T_{\circ F} + 459.67°$$

$$T_{\circ K} = T_{\circ C} + 273.15°$$

4.1 Responsibilities for Inspection

Unless otherwise specified in the contract, the contractor is responsible for the performance and test requirements herein.

4.1.1 Test Documentation

Each PDB shall have a prepared "Test and Inspection Data" sheet that shall show the results of all tests and inspections. The data sheet shall show the test errors and inspection results. The data sheet shall also include the following information:

a) Serial number of the instrument.
b) National Weather Service stock number of the instrument.
c) Test dates.
d) Signature of the chief of the manufacturer's quality control section and date.
e) Type, model and last calibration date of the reference standard against which the instrument was compared.

Each data sheet shall be included with its respective instrument when being packed for shipment.

4.2 Quality Assurance Testing

The manufacturer shall test each individual complete and assembled instrument to ensure that all instruments presented for acceptance by NWS meet the requirements of this specification. The manufacturer shall provide a complete test plan and traceability to National Institute of Standards and Technology (NIST) standards. NWS reserves the right to observe any tests and procedures on instruments under this specification. Each PDB shall be visually and mechanically inspected upon receipt to determine the quality of materials, workmanship and its compliance with this specification. All PDBs will initially be tested by NWS or an appointed agent to verify that each instrument meets the specification criteria herein. Test parameters will be designed to determine if the instrument meets the specification criteria and shall be at the discretion of NWS. Upon meeting the test requirements satisfactorily, sample PDBs will be observed and continuously monitored in actual use for a minimum period of 24 months.

➥ The observation and monitoring period may be less depending upon the availability and reliability of NWS historic data for the specific barometric transducer provided within the unit.

5. PREPARATION FOR DELIVERY

5.1 Calibration

Prior to packing for shipment the contractor shall calibrate and adjust each PDB properly. Each PDB shall be in tolerance of all calibration requirements within this specification before packing for shipment and all precautions shall be taken to ensure that each is received as such. Any instruments requiring repairs beyond minor readjustment of the calibration setting shall be considered defective and are subject to the guarantee described in Section **6.**

5.2 Packing for Shipment

After proper calibration, each individual PDB shall be securely packed in a double strength, heavy duty, reinforced carton that shall be suitable for individual shipment by a common land or air carrier. Such a carton shall have the necessary inside dimensions to allow for a cushion of urethane foam enveloping the entire instrument to a minimum thickness of 65 mm (2.5 inches). The urethane foam cushion shall be molded or cut to fit snugly around all surfaces of the PDB and it shall be possible to remove the instrument without tearing or cutting the foam material so that it may be reused.

5.3 Bulk Packaging

The individually packed PDBs shall be shipped in bulk form by inserting several in a large container with additional padding material placed around the smaller cartons. Not more than four (4) PDBs shall be placed in a bulk container.

5.4 Marking for Shipment

a) Each individual PDB carton in 5.2 shall be prominently marked on the outside with the weather service stock number, name of the item and serial number of the instrument contained within. ***Additionally, each individual carton will be boldly marked with any special handling instructions and the statement "THIS SHIPPING BOX & PACKING MATERIAL ARE TO BE STORED AND MAINTAINED BY THE ACTIVITY IN CUSTODY OF THE ENCLOSED INSTRUMENT. REUSE THESE MATERIALS WHENEVER TRANSPORTING THE INSTRUMENT.***

b) Marking for shipment of the bulk containers shall be in accordance with requirements specified in the contract.

5.5 Pricing the Instruments

The manufacturer shall provide specific revised pricing information for the Precision Digital Barometer in the final proposal package. Revised final prices for prototype PDBs and bulk manufacture PDBs shall be described exactly as follows:

Prototype PDB (Including NRE)	**1^{+} unit**	**$cost/unit**
Total Production Instruments	**@ 1 to 10**	**$cost/unit**
	@ 11 to 25	**$cost/unit**
	@ 26 to 50	**$cost/unit**
	@ 51 to 100	**$cost/unit**
	@ 101 & above	**$cost/unit**

****More than one Prototype PDB may be requested in the initial purchase.***
*****Revised final pricing shall not exceed those quoted in the original proposal.***

6. GUARANTEES

Parts throughout the PDB shall be composed of quality materials and assembled with first class workmanship to enure that the instrument will be rugged and dependable. The entire PDB shall strictly adhere to the requirements described in this document and be fully guaranteed against faulty design, materials and workmanship for a minimum period of two (2) years. Should any defect occur, the defective instrument or instruments shall be repaired or replaced without cost to the government. If the contractor elects to have defective or replaced items returned to the contractors place of business, the contractor shall pay for transportation charges. The manufacturer shall guarantee spare parts availability for twenty years after the acceptance of the production PDB. ***The guarantee of spare parts availability implies that the manufacturer will continue to produce (or have access to) similar replacement parts which will be compatible with the PDB. The replacement parts must meet or exceed the original specification and must be approved by NWS prior to any change. The manufacturer will be obligated to guarantee the functionality of the PDB for twenty years without sacrifice to the integrity of the specification. The manufacturer shall also be responsible for the compatibility of all replacement parts and for providing them at a fair and reasonable price.***

The PDB shall meet these reliability, availability, and maintainability (RAM) requirements. A mean time between failures (MTBF) requirement of 22,000 hours with a mean time to repair (MTTR) of 30 minutes. The operational availability of the PDB shall be 99.9 % with respect to sensor pressure and altimeter setting when used indoors. Support of the PDB shall be in form of depot parts and repairs.

7. DOCUMENTATION

A comprehensive Engineering Drawings package shall be provided. The package shall conform to all requirements as described in the Drawing Requirements Manual, Ninth Edition - Global Engineering Documents, Colorado 1995. A complete parts list (PL) with the instrument manufacturer's part numbers, part manufacturer's part numbers and cross-reference numbers for alternate manufacturers shall be provided.

A comprehensive operation, maintenance**,** and repair manual shall be provided by the manufacturer.

8. DEFINITIONS

8.1 Terminology

Accuracy (of measuring instrument):
The ability of a measuring instrument to give indications approaching the true value of a measurand.

Accuracy of measurement:
The closeness of the agreement between the result of a measurement and the conventional true value of the measurand. The use of the term *"precision"* for accuracy should be avoided.

Altimeter Setting:
The pressure value to which an aircraft altimeter scale is set so it will indicate the altitude above mean-sea-level of the aircraft on the ground at the location for which the pressure value was determined ***(1)***. ***‣ The atmospheric sensor pressure corrected to or adjusted for altitude above mean-sea-level (2).***

Calibration:
The set of operations that establish, under specified conditions, the relationship between values indicated by a measuring instrument, measuring system or values represented by a material measure, and the corresponding known values of a measurand. Calibration **does not** imply any *adjustment* of the measuring instrument.

Correction:
The value which, added algebraically to the uncorrected result of a measurement, compensates for an assumed systematic error. The correction is equal in magnitude to the assumed systematic error and is subject to some uncertainty.

Density Altitude:
The pressure altitude corrected for virtual temperature deviations from the standard atmosphere.

Discrimination:
The ability of a measuring instrument to respond to small changes in the value of the stimulus.

Drift:
The slow variation with time of a metrological characteristic of a measuring instrument.

Error: *(of indication)* ***of a measuring instrument***
The indication of a measuring instrument minus the *conventional* true value of the measurand.

Field Pressure:
The atmospheric pressure computed for a specific elevation.

Field Elevation, **H_a:**
The officially designated field elevation (**H_a**) of an airport above mean sea level. It is the elevation of the highest point on any of the runways of the airport.
Full Scale**, FS:**

Is defined as the highest scale indication of measurement or maximum range.

Hysteresis:
Undesirable property of a measuring instrument whereby its response to a given stimulus is not generally repeatable. The inability of a measuring instrument to return to its original position after it has been stressed.

Precision:
The closeness of agreement between repeated test results. Best defined as repeatability.

Pressure Tendency:
The character and amount of atmospheric pressure change during a specified period of time.

Pressure Jump:
A rise in pressure exceeding 0.005 inHg per minute which totals 0.02 inHg or more.

Pressure Sensor Elevation:
The height of the pressure sensor above mean-sea-level.

Pressure Altitude:
The height of the standard atmosphere at which the station pressure would be observed.

Pressure Change:
The net difference between the pressure at the beginning and ending of a specified time interval.

Rapid Pressure Change:
A rise or fall in station pressure at the rate of 0.06 inHg or more per hour with a total change of at least 0.02 inHg at the time of the observation shall be considered a rapid change in pressure.

Reference Standard:
A local standard, generally of the highest metrological quality available at a location, from which the measurements made at that location are derived.

Repeatability:
The degree of closeness to which an instrument indicates the value of successive measurements under identical conditions.

Reproducibility:
The degree of closeness to which an instrument indicates the value of successive measurements using identical methods under different conditions.

Resolution:
A quantitative expression of the ability of an indicating device to meaningfully distinguish the smallest increments of an indicated value. Resolution is sometimes referred to as “least count.”

Sea-level Pressure:
The atmospheric pressure at mean-sea-level, either directly measured or obtained by the empirical reduction on station pressure to sea level. Where the Earth’s surface is above sea level, it is

assumed that the atmosphere extends to sea level below the station and that the properties of that equivalent column of air are related to conditions observed at the station.

Sensor:
The part of a measuring instrument which responds directly to the measured quantity.

Sensor Pressure:
The atmospheric pressure derived from the sensor(s).

Sensitivity:
The smallest change in the value of a variable being measured, to which the instrument will respond.

Stability:
The ability of a measuring instrument to maintain constant metrological characteristics.

Standard Atmosphere:
A hypothetical vertical distribution of atmospheric temperature, pressure and density, which by international agreement (International Civil Aviation Organization [ICAO], 1952) is considered to be representative of the atmosphere for pressure-altimeter calibrations and other purposes.

Station Elevation, **H_p:**
The officially designated height above sea level to which station pressure pertains. It is generally, but not always the same as field elevation (**H_a**) at an airport station.

Station Pressure:
The atmospheric pressure at the assigned station elevation.

8.2 Symbols

hPa	- hectopascal
mbar	- millibar
kPa	- kilopascal
mmHg	- millimeters of mercury
inHg	- inches of mercury

8.3 Variables

AS = Altimeter Setting (*inHg)*
C = Pressure reduction constant given in *inHg* (Site Specific)
$\boldsymbol{H_a}$ = Field Elevation (*Ft*)
$\boldsymbol{H_p}$ = Station Elevation (*Ft*)
$\boldsymbol{H_z}$ = Sensor Elevation (*Ft*)
$\boldsymbol{H_{za}}$ = $H_z - H_a$
$\boldsymbol{H_{zp}}$ = $H_z - H_p$
P = Sensor Pressure (*inHg*)
$\boldsymbol{P_a}$ = Field Pressure (*inHg*)
$\boldsymbol{P_s}$ = Station Pressure (*inHg*)
r = Pressure reduction ratio given as a function of *TS* (unique for each station & *unitless*)
SLP = Sea-level pressure (*inHg*)
TR = Five-minute average ambient temperature in degrees Rankine (*R°*)
TS = Twelve-hour average ambient temperature in degrees Fahrenheit (*F °*)
$\boldsymbol{T_v}$ = Mean annual normal value of virtual station temperature in Rankine (*R°*)

8.4 Constants

1 kPa	=	10	hPa	1 hPa	=	0.1	kPa
1 kPa	=	7.50062	mmHg	1 hPa	=	0.750062	mmHg
1 kPa	=	0.2953	inHg	1 hPa	=	0.02953	inHg
1 mmHg	=	0.133322	kPa	1 inHg	=	3.38639	kPa
1 mmHg	=	1.333224	hPa	1 inHg	=	33.86389	hPa
1 mmHg	=	0.03937	inHg	1 in	=	25.4	mmHg
1 hPa	=	1	mb				

a) The constants, millimeters of mercury and inches of mercury, are assumed to be at standard temperature and gravity.
b) Value of standard gravity: 980.665 $^{cm}/_{s^2}$ or 32.174 $^{ft}/_{s^2}$.
c) Value of standard temperature: 0°C or 32°F
d) Value of standard temperature at sea-level: 15°C or 59°F
e) Value of barometric pressure at sea-level 1013.25 hPa or 29.2913 in Hg
f) Standard lapse rate in the troposphere = 0.0065°C per m′ or 0.00356616°F per ft′
g) Gas constant for 1 gram of dry air = 2.870531 x 10^6 cm^2/sec^2 °K