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# ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

*Subject:* AUTOMATIC REPORTING SYSTEMS - ALTIMETER SETTING AND OTHER OPERATIONAL DATA

1. PURPOSE. This advisory circular provides guidelines for the development and installation of automatic reporting systems for altimeter setting and other operational data intended for use in connection with IFR operations.

2. RELATED READING MATERIAL. Additional information on these reporting systems may be found in the following documents:

a. Federal Aviation Administration (FAA) documents:

(1) FAA-E-2267, Runway Visual Range Signal Data Converter System.
(2) FAA-E-2404, Transmissometer Set.
(3) FAA-STD-008, Installation and Siting.

Copies of these documents may be obtained from the Federal Aviation Administration, Airway Facilities Service, Systems Management Branch, AAF-740, 800 Independence Avenue, S.W., Washington, D.C. 20591.

b. Other documents:

(1) Radio Technical Commission for Aeronautics (RTCA) Document No. DO-160, Environmental Conditions and Test Procedures for Airborne Electronic/ Electrical Equipment and Instruments, dated February 28, 1975. Copies may be obtained from RTCA Secretariat, Suite 655, 1717 H Street, N.W., Washington, D.C. 20006.

(2) Federal Meteorological Handbook No. 1, Surface Observations. Copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

3. DISCUSSION.

a. Automatic systems for reporting altimeter setting and other operational data have been developed which can record and transmit data

directly to the pilot. The use of these automatic systems could enhance the accuracy and timeliness of reported data and also save considerable resources since manned observation and reporting facilities would not be required. The FAA has received requests from airport operators, manufacturers of automatic systems and from the operators of aircraft for guidance in the development and installation of these systems.

b. These requests indicate that FAA should provide specifications for consideration when developing and installing a reliable reporting system. The attached Specification deals not only with simple systems reporting only altimeter setting, but also with more sophisticated systems reporting various additional operational data.

4. GUIDANCE. Potential sponsors of an automatic system should consider the guidance in Appendix 1. Those desiring further FAA advice and guidance on the development, installation and use of an automatic observing and reporting system should contact the Flight Standards Division of the FAA Regional Office where the system is to be installed. This advice and guidance may include:

a. Discussion of system specifications, including variances from the appended guidelines.

b. Discussion of a plan to ensure proper monitoring and maintenance of the system.

c. Discussion of radio frequency assignment, discrete or otherwise.

d. Discussion of any other matter pertaining to the development, installation and use of an automatic reporting system.

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# SPECIFICATION FOR DEVELOPING AND INSTALLING AN AUTOMATIC REPORTING SYSTEM

1. SCOPE. This specification defines the functions, performance, characteristics, and sensor siting criteria of systems which collect, display, and disseminate altimeter setting and other data.

2. SPECIFICATIONS.

2.1 General Specifications. Systems built to this specification should, at a minimum, sense and output altimeter setting information. Visibility, wind, temperature, dewpoint, and other data may be included as options.

2.2 Sensors. If included, sensors which meet or exceed the following parameters should be used.

2.2.1 Barometric Pressure Sensors. The system should include two independent barometric pressure sensors.

(a) Each of the two pressure sensors should measure and output altimeter setting accurate to ±0.02 inches of mercury over the range of pressure variations required for the field elevation where the system is to be installed. An acceptable range of pressure variations is +1.5 and -3.0 inches of mercury, referenced to the standard day pressure at the field elevation.

(b) The class of pressure sensor used should be certified by an FAA certificated repair station or other agency acceptable to the Administrator, as being stable and continuously accurate within ±.02 inches of mercury for a period not less than 6 months. (AC 140-1 (current edition), Consolidated Listing of FAA Certificated Repair Stations, contains a list of instrument repair stations acceptable to the Administrator. Copies of AC 140-1 may be obtained by writing to the U.S. Department of Transportation, Publications Section, M-443.1, Washington, D.C. 20590).

(c) Within 60 days prior to installation or storage as a spare and thereafter at a minimum of the time period demonstrated in (b) (but not to exceed 2 years), each pressure sensor should be checked and certified as properly calibrated by an agency acceptable to the Administrator.

2.2.2 Visibility Sensor. The visibility sensor should consist of a transmissometer set as specified in FAA-E-2404, dated October 6, 1969. The sensor can be used to output either:

(a) Runway visibility in miles and fractions according to Table A3-7B or A3-7C of Federal Meteorological Handbook #1, depending on the baseline of the transmissometer (500 feet or 250 feet); or

(b) Runway visibility in feet which, for this application, may use medium intensity runway lights as well as high intensity runway lights.

2.2.3 Wind Direction Sensor.

(a) Accuracy: ±10°

(b) Range: 0 - 360°

(c) Resolution: 10°

2.2.4 Wind Speed Sensor.

(a) Accuracy: Below 20 knots ±2 knots
Above 20 knots ±10%

(b) Range: 0 - 80 knots

(c) Resolution: 1 knot

2.2.5 Temperature and Dewpoint Sensors. Temperature and dewpoint sensors should be capable of operating over the ranges expected at the airport where it is to be installed and meet the following accuracies:

(a) Temperature: -58° to 120°F ±1°F
-65° to -59°F ±1.5°F
-70° to -66°F ±2.0°F

(b) Dewpoint: 30° to 86°F ±2.0°F
-10° to +29°F ±3.0°F
-30° to -11°F ±4.0°F

2.3 Output Devices. At least one of the following output devices should be included.

2.3.1 Automated Voice Unit. An automated voice unit, if included, should provide intelligible English language voice output for radio transmission of the parameters measured by the system.

2.3.2 Displays. If either local or remote displays are provided, they should provide adequate resolution, illumination, legibility, and readability for the application intended. Information presented on displays should be useable by the pilot without need of conversion.

2.4 Data Processing. Data from those sensors included in the system should be processed as indicated below.

2.4.1 Wind.

(a) Wind Speed. Wind speed should be processed to output the equivalent of a 1-minute arithmetic average, in knots.

(b) Wind Direction. Wind direction should be processed to output the equivalent of a 1-minute arithmetic average, to the nearest 10° magnetic.

(c) Calm. When the wind speed is less than 2 knots the system may output "calm" instead of wind speed and direction.

(d) Gust. The system should keep track of the highest wind speed in the last 10 minutes. If the value of the highest wind speed in the previous 10 minutes is equal to or greater than 14 knots, and is more than 5 knots greater than the current minute's output wind speed, then the highest wind speed in the previous 10 minutes is considered a gust and is output as a gust value. This guideline applies to output of gust information by automated voice systems. If the wind values stated above are not met, the automated voice should not make any reference to gusts. However, digital displays, local or remote, are not required to meet this criteria and may output the highest wind speed in the previous 10 minutes in the space reserved for gusts, whether or not the above guidelines are met.

(e) Light and Variable. When the wind speed is 6 knots or less and the wind direction fluctuates by 60 degrees or more, the system may output "light and variable" instead of wind speed and direction.

2.4.2 Altimeter Setting. Altimeter setting should be determined from the pressure sensors. The system should compare output of one sensor with that of the other sensor to determine the difference between the two sensors. If the difference between sensors is less than or equal to 0.05 inches of mercury, then the system should output the lower of the two values. If the difference exceeds 0.05 inches, systems which include voice output should output "missing" for altimeter setting until the situation is corrected. Digital displays should indicate an error in altimeter setting by blanking the altimeter setting portion of the display or outputting "99.99" until the situation is corrected.

2.4.3 Temperature and Dewpoint. Temperature and dewpoint should be determined and output in degrees Fahrenheit.

2.4.4 Density Altitude. If temperature and pressure sensors are included, density altitude may be included as an output option. If included, density altitude should be determined within ±500 feet.

2.5 Automated Voice Output Format. Systems including automated voice as an output mode should output the voice message in the following format:

(a) Basic Output Format. (Name of city associated with airport), automated weather observed at (4 digit Greenwich time, 24-hour clock) Greenwich, temperature (F), dewpoint (F), wind (3 digit wind direction, degrees magnetic), at (1, 2, or 3, digit wind speed, knots), peak gusts (2 or 3 digit gust value, knots), altimeter (4 digit altimeter setting), runway (1 or 2 digit identifier), visibility (in fractions or whole and fraction of) miles.

An example is as follows: Frederick, automated weather observed at 1234 Greenwich, temperature 80, dewpoint 50, wind 180 at 25, peak gusts 35, altimeter 2999, runway 19, visibility 2 1/2 miles.

(b) Name of Airport. Where the name of the airport is commonly associated with a city, only the city name need be used. If more than one airport is located at the city in question, or the name of the only airport is not commonly associated with the city, then the name of the airport should be included following the name of the city.

(c) Gusts. If the criteria for gusts is not met, then the phrase "peak gusts" should be deleted.

(d) Missing Data. If for any reason any parameter normally measured by a particular system is missing, the system should output "missing" as in the following examples, instead of numerical values:

(1) Wind missing.

(2) Altimeter missing.

(e) Operational Messages. If the system includes a means to output operational messages, such as runway condition notices, the message should be appended to the end of the above report.

(f) Density Altitude. If included, density altitude should follow altimeter setting, as follows: altimeter 2999, density altitude 7500.

2.6 Sensor Siting Criteria.

2.6.1 Pressure Sensors. The pressure sensors can normally be installed in any available building on the airport which meets the environmental restrictions for the particular sensors used in the system. However, when used in a building with high-volume ventilation, heating and/or air-conditioning blower systems, the pressure sensors should be vented to a tube open to the exterior atmosphere and shielded from any airflow that might cause static pressure buildup to vary significantly from the outside atmospheric pressure.

2.6.2 Visibility Sensor. Siting and installation should be in accordance with applicable provisions of FAA-STD-008.

2.6.3 Wind Sensors. Wind sensors should be placed on the airport at a location which will provide the most representative wind information possible. The following are suggested as guidelines for mast and sensor placement.

(a) At least 20 feet and preferably 33 feet above the average ground level within 500 feet of the sensor site. Unless necessary by (b), (c), or (d) below, sensor height should not exceed 33 feet.

(b) At least 15 feet above all vegetation, buildings, etc., within 500 feet of the sensor.

(c) At least 10 feet higher than any obstruction farther than 500 but within 1,000 feet, if the included lateral angle (bearing) from the sensor to the ends of the obstruction is 10 degrees or more. For example, if a hangar is 1,000 feet from the sensor and is 175 feet long (as viewed from the sensor), it subtends an angle slightly greater than 10 degrees and the sensor should be at least 10 feet higher.

(d) If the included lateral angle determined in (c) is less than 10 degrees, the 15 feet required in (b) may be reduced by 5 feet for every 100 feet in excess of 500 feet horizontal distance from the sensor.

2.6.4 Temperature and Dewpoint Sensors. The temperature and dewpoint sensors should be placed at a representative location on the airport, mounted 6 feet above the terrain and protected from direct sunlight and long-wave radiation from the earth without preventing the flow of ambient air. It is recommended that the temperature and dewpoint sensors be collocated with the wind sensor.

2.7 Operating Conditions.

2.7.1 Indoor Operating Environment. The system should be designed to continue reliable operation over the range of environmental conditions expected at the airport where it is to be installed. The system (except for those sensors installed exterior to inhabited shelters) should be able to meet all functional and performance requirements while operating under the following conditions:

| | | |
|---|---|---|
| (a) | Temperature: | 50 to 120°F attended<br>14 to 120°F unattended |
| (b) | Relative Humidity: | 5% to 90% unattended<br>10% to 80% attended |
| (c) | Altitude: | sea level to 10,000 feet |

Vendors should either be able to demonstrate that their equipment does meet these specifications or be able to show why their equipment should not have

to meet the above specifications. If alternate specifications are accepted based upon a vendor's explanation, the vendor should satisfactorily demonstrate that the proposed equipment meets the alternate specifications.

2.7.2 Electrical Source. The equipment should be able to operate with a power source of alternating current (AC) as follows:

(a) Voltage: 105 to 125 volts, single phase

(b) Frequency: 60 Hz ±5%

2.7.3 System Self-Check. Each proposed system which automatically disseminates information directly to a pilot should contain self-checking features to improve output data reliability. The system should routinely and automatically:

(a) Check system circuitry for open or shorted leads.

(b) Apply test voltages or other test data to ensure proper operation of the system.

(c) Check sensor outputs for values above or below maximum and minimum values.

If any of the above checks indicate errors exist, then the system should automatically stop dissemination of the parameter in question. Systems which do not automatically disseminate information to pilots may be adequate without the above features, provided they incorporate adequate, built-in test features and simple procedures for manual testing by the system operator.

2.7.4 Start-Up After Power Failure. The vendor should demonstrate a procedure or a system design feature wherein a power failure will not introduce a hazard or cause erroneous distribution of data.

2.7.5 Induced Signal Interference. The system should be resistant to all induced electrical or electronic interference.

2.7.6 Dielectric. The insulation of wiring should withstand 1500 volts AC 60 Hz for a period of 1 minute.

3. TESTING.

3.1 Environmental Testing. In order to determine reliability of the system, the contractor should conduct environmental tests in accordance with RTCA Document No. DO-160, Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments, dated February 28, 1975. The appropriate tests are:

(a) Electrical and magnetic interference: category A, paragraph 19.0, DO-160.

(b) Power input variations: category A, paragraph 16.0, DO-160 (note change 400 Hz to 60 Hz).

(c) Low temperature: paragraph 4.4, DO-160 (at tempertures specified herein).

(d) High temperature: paragraph 4.5, DO-160 (at temperatures specified herein).

(e) Dielectric: the insulation of the wiring should be capable of withstanding, without breakdown, a potential of 1500 volts AC, 60 Hz for a period of 1 minute applied between current-carrying conductors and ground. The potential should not be applied to elements such as transistor, capacitors, etc., since this test is intended only to determine adequacy of insulation.

(b) Power input variations: category A, paragraph 16.0, DO-160 (note change 400 Hz to 60 Hz).

(c) Low temperature: paragraph 4.4, DO-160 (at tempertures specified herein).

(d) High temperature: paragraph 4.5, DO-160 (at temperatures specified herein).

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