



AEROSPACE RECOMMENDED PRACTICE

ARP5374™**REV. B**

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Superseding ARP5374A

(R) Method of Testing Pre-Conditioned Air Equipment

RATIONALE

Clarification and further explanation of the methods used. Minor editorials update.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) applies to Point-Of-Use, Central and Mobile Pre-Conditioned Air Equipment. It does not apply to aircraft mounted equipment.

1.1 Purpose

This document provides a consistent and uniform test method for determining the cooling and/or heating capacity of Pre-Conditioned Air (PCA) equipment.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS4262 Aircraft Ground Air Conditioning Service Connection

2.2 ANSI Publications

Copies of these documents are available online at <http://webstore.ansi.org>.

ANSI/ASHRAE 41.2-1987 (RA 92) Standard Methods for Laboratory Airflow Measurements

ANSI/ASHRAE 41.7-1984 (RA 91) Standard Method for Measurement of Flow of Gas

ANSI/ASHRAE 41.1-1986 (RA 91) Standard Method for Temperature Measurement

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SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/ARP5374B>

ANSI/ASHRAE 41.3-1989 Standard Method for Pressure Measurement

ANSI/ASHRAE 37-1988 Methods of Testing for Rating Unitary Air-Conditioning and Heat Pump Equipment

2.3 ASHRAE Publications

Available from ASHRAE Headquarters, 1791 Tullie Circle, NE, Atlanta GA 30329, Tel: 800-527-4723 (U.S. and Canada only) or 404-636-8400, www.ashrae.org.

ASHRAE Handbook of Fundamentals, Section 26, Weather Data

2.4 ARI Publications

Available from Air-Conditioning & Refrigeration Institute, 4100 North Fairfax Drive, Suite 200, Arlington, VA 22203, Tel: 703-524-8800, www.lightindustries.com/ARI.

ARI Standard 210/240 Unitary Air-Conditioning and Air-Source Heat Pump Equipment

2.5 ISO Publications

Available at <http://webstore.ansi.org/>

ISO 1034 Aircraft-Ground Air Conditioning Connection

ISO 9001 Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

3. TEST CONDITIONS

- 3.1 The test must be performed at the specified ambient conditions. If summer and/or winter ambient design conditions are not specified, then ASHRAE 0.4% cooling design dry-bulb and mean coincident wet-bulb shall be used for summer conditions and ASHRAE 99.6% winter design dry-bulb shall be used for winter conditions based upon the location where the equipment is to be used and operated.
- 3.2 PCA units with multiple selectable air flow rates shall be tested at each of the selectable air flow rates.
- 3.3 The airflow rate, corresponding static and total pressure, discharge air dry-bulb and discharge air wet-bulb temperatures, and location of measurements shall be specified.
- 3.4 Some aircraft now require sub-freezing discharge air temperatures at or below a specific humidity. If the requirement is specified as a discharge air dry-bulb temperature at a humidity level, this value may be converted to an equivalent dry and wet-bulb temperature to be consistent with the units in Table 1.
- 3.5 Pressures shall be reported in absolute values to account for changes in atmospheric pressure due to differences in altitude. If the pressures are reported in Absolute Values then the "Station Barometric Pressure" at the time of test must also be recorded and reported using the same units as used for the absolute values. (Note: as a reference 407.179 in or 10342.3 mm H₂O equals standard atmospheric pressure at sea level)
- 3.6 All test observations shall be within the tolerances specified in Table 1, as appropriate to the test methods and types of test equipment.

Table 1 - Test tolerances

Ambient dry-bulb temperature - °F (°C)	1.0 (0.5)
Ambient wet-bulb temperature - °F (°C)	0.5 (0.25)
Discharge air dry-bulb temperature - °F (°C)	1.0 (0.5)
Discharge air wet-bulb temperature - °F (°C)	0.5 (0.25)
Airflow rate – lb/min (kg/s)	2% of reading
Total Pressure – inches of water (Pa)	2% of reading
Static pressure - inches of water (Pa)	2% of reading

- 3.7 The discharge air dry-bulb and wet-bulb temperature shall be specified. The discharge air dry-bulb and wet-bulb temperatures shall be measured at the PCA unit discharge.

4. INSTRUMENTS

- 4.1 Instrumentation used for measurements in this test procedure shall comply with the calibration control method of 4.11 of ISO 9001, "Control of Inspection, Measuring and Test Equipment."

5. TEST METHOD - COOLING AND HEATING

5.1 Air-Enthalpy Method

In the air-enthalpy method, capacities are determined from measurements of entering and exiting wet- and dry-bulb temperatures and the associated mass air flow rate. This method is described in ASHRAE Standard 37-1988 identified in the reference section of this document.

- 5.2 The Air-Enthalpy Method calculates net cooling and heating capacities of the PCA unit being tested at the specified ambient conditions. In cooling mode the Air-Enthalpy method accounts for both sensible and latent cooling capacity. Since PCA units utilize 100% outside air, latent loads are almost always present. In heating mode only sensible heating is measured since the PCA units do not introduce any moisture to the air in heating mode.

- 5.3 All tests shall be performed with the outlet of the PCA unit connected to an airflow measurement device, not an aircraft.

6. AIRFLOW MEASUREMENTS

- 6.1 Airflow shall be measured at an appropriate distance downstream of the exit of the PCA unit in order to assure measurement accuracy. If airflow is measured downstream of the outlet of the PCA unit, it should be noted that airflow is effected by frictional losses due to hose type, layout, length, diameter, etc., and these variables should be specified.

- 6.2 Airflow measurements shall be made in accordance with ANSI/ASHRAE 41.2-1987 (RA 92) Standard Methods for Laboratory Airflow Measurements or ANSI/ASHRAE 41.7-1984 (RA 91) Standard Method for Measurement of Flow of Gas. Pitot tube traverse Note: In small diameter ducts (14 inch ID and less), Accurate traverse measurements may be difficult. Orifice plate Note: Orifice plates are typically more accurate than a pitot tube traverse, and require precise controls to achieve their advertised accuracy. or Nozzle or Venturi Note: Nozzle or Venturi flow measuring devices provide the most consistent and accurate measurements methods of airflow measurement are acceptable. The combined error should not exceed 2% of reading. The method of airflow measurement used shall be specified.

6.3 The airflow measurement shall be corrected for changes in air density due to variations in atmospheric pressure. The atmospheric pressure shall be measured and recorded at the location where airflow measurement is made. Please note this is Station Barometric or Atmospheric pressure and not Barometric pressure reduced to sea level as is used in weather forecasting. The air temperature and the static pressure at the point of flow measurement plus the Station Atmospheric pressure are used to accurately determine the density of the flowing air.

6.4 Airflow and corresponding pressure measurements shall be performed at the values specified.

6.5 If the PCA unit has dual outlets, airflow shall be measured from both outlets simultaneously, and from a single outlet at the specified airflow rates for each.

7. TEMPERATURE MEASUREMENTS - DRY-BULB AND WET-BULB

7.1 The following temperatures shall be recorded:

7.1.1 Ambient dry-bulb temperature

7.1.2 Ambient wet-bulb temperature

7.1.3 Discharge air dry-bulb temperature

7.1.4 Discharge air wet-bulb temperature

7.2 Temperature measurements shall be made in accordance with the latest issue of ANSI/ASHRAE Standard 41.1-1986 Standard Method for Temperature Measurement.

7.3 If the PCA unit has dual outlets, dry and wet-bulb temperatures shall be measured from each outlet. The preferred method of temperature measurement is Resistance Temperature Detector (RTD) method for dry-bulb measurements. Wet-bulb measurements may be made using a wet-bulb thermometer or an electronic equivalent.

7.4 Temperature measurements shall be made at the outlet(s) of the unit. If these measurements are made at locations other than the outlet(s), it should be noted and hose type, diameter, length, and construction details recorded.

8. PRESSURE MEASUREMENTS

8.1 The static air pressure shall be recorded at the outlet(s) of the unit. If static pressure is measured downstream of the outlet of the PCA unit, it should be noted that airflow is effected by frictional losses due to hose type, layout, length, diameter, etc., and these variables should be specified. Static pressure should be measured downstream of the PCA outlet because a vena contracta is formed immediately after the air passes through the outlet. 10 diameters would be an appropriate distance to be well past the vena contracta and into full bore streamlines. Typical outlet connections vary from 8 to 14 inches in diameter.

8.2 Pressure measurements shall be made in accordance with the latest issue on ANSI/ASHRAE Standard 41.3-1989 Standard Method of Pressure Measurement. Liquid manometer, a primary instrument, or a calibrated pressure gauge is the preferred method of measurement.

8.3 Static and total pressure shall be measured for each specified airflow rate from one and/or both outlet(s).

9. TEST PROCEDURES

9.1 The equipment under test shall be operated until stabilized conditions are attained, but for not less than one-half hour before capacity test data are recorded.

9.2 Data shall then be recorded at ten minute intervals until four consecutive sets of readings within the tolerances prescribed in Table 1 have been attained.