

Method of Testing Pre-Conditioned Air Equipment

RATIONALE

The changes being made to the document will help improve the practice of communicating the overall cooling and heating system capacity when more than one stage of cooling or heating is required. Also noted some other important information required when evaluating the system.

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 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AS4262 Aircraft Ground Air Conditioning Service Connection

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2008 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

**TO PLACE A DOCUMENT ORDER:** Tel: 877-606-7323 (inside USA and Canada)  
Tel: 724-776-4970 (outside USA)  
Fax: 724-776-0790  
Email: [CustomerService@sae.org](mailto:CustomerService@sae.org)  
**SAE WEB ADDRESS:** <http://www.sae.org>

## 2.2 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, [www.ansi.org](http://www.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
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, 1791 Tullie Circle, NE, Atlanta, GA 30329, Tel: 404-636-8400, [www.ashrae.org](http://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 22209, Tel: 703-524-8800, [www.ari.org](http://www.ari.org).

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

## 2.5 ISO Publications

Available from International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, Tel: +41-22-749-01-11, [www.iso.org](http://www.iso.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 pressure, temperature and location of measurements shall be specified.
- 3.4 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

3.5 The discharge air dry-bulb temperature shall be specified. The discharge air temperature 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 Section 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 leaving wet- and dry-bulb temperatures and the associated 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.

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 the exit of the PCA unit. 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, orifice plate or nozzle type method 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 barometric pressure shall be measured and recorded at the location where airflow measurement is made.

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

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 that hose type, diameter, length, insulation, radiation, conduction, and friction affect the temperature and shall be considered.

## 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.

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 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.

## 10. TEST RESULTS

10.1 Results shall express quantitatively the effects produced upon air by the equipment tested. For given test conditions, the capacity test results shall include the following quantities as are applicable to cooling and/or heating:

a. total cooling capacity, Btu/h (W)

b. heating capacity, Btu/h (W)

c. airflow rate, lb/min (kg/s)

d. static pressure of air, in of water (Pa)

e. discharge air temperature, °F (°C)