

Air Mode Active Containers Conditioning Performance

RATIONALE

This ARP specifies the test procedures and classification requirements for the conditioning performance of air mode active containers to ensure that the appropriate containers are selected for the effective air transportation of temperature sensitive cargoes. Operational constraints can be derived from the conditioning performance test results to further ensure that the conditioning performance enables temperature sensitive cargoes to be kept within specification during the ground handling phases and air transportation cycle.

FOREWORD

This SAE Aerospace Recommended Practice (ARP) outlines supplementary requirements for the testing and performance classification of Air Mode Active Containers of all sizes.

Throughout this ARP the minimum essential criteria are identified by use of the key word "shall". Recommended criteria are identified by use of the key word "should" and, while not mandatory, are considered to be of primary importance. Deviation from recommended criteria should only occur after careful consideration, extensive testing and thorough service evaluations have shown alternate methods to be satisfactory.

Nothing in this ARP shall in any way cancel or reduce the status of the specifications which determine airworthiness, industry compliance, ground handling or any other characteristics of the units.

This ARP refers to the conditioning performance of all air mode active containers irrespective of their size and designation and where the performance is a function of both the active and passive components of the container. It does not provide details concerning the thermal efficiency of passive (insulation only) containers.

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1. SCOPE

1.1 Purpose

This Aerospace Recommended Practice (ARP) defines a series of test procedures to determine the temperature conditioning performance of air mode containers with active conditioning systems, a classification system for air mode containers with active condition systems, a standard means of expressing conditioning performance within each classification and a standard means of documenting test results.

1.2 Field of Application

This ARP is intended to provide users, purchasers and operators with a single method for testing and documenting the conditioning performance of air mode containers with active conditioning systems. The test method identifies the limits of performance and autonomy at these limits.

The conditioning performance of an air mode container with active temperature control is a function of the performance of both passive features, such as insulation material, and active features, such as heating and / or cooling systems. This ARP applies only to air mode containers with active temperature control. ARP1523, Air Mode Insulated Containers – Thermal Efficiency Requirements is the applicable standard for air mode containers with only passive features.

This ARP organizes industry requirements for temperature sensitive transportation into three performance classes.

Class A, Frozen, covers a set point range of -25 °C to 0 °C.

Class B, Cool, covers a set point range 0 °C to 15 °C.

Class C, Room Temperature, covers a set point range 15 °C to 30 °C.

It is not necessary for the test subject to support the full range of performance classes but it shall support a set point within the range of at least one of the performance classes.

Within each performance class, this ARP mandates a set point to be used in the test procedures. The test procedures defined within this ARP may be repeated at alternative set points within the performance class range.

The mandatory set points within each performance class range are as follows:

Class A – Mandatory set point -20 °C.

Class B – Mandatory set point 5 °C.

Class C – Mandatory set point 20 °C.

In the event of a failure of the conditioning systems in an air mode active container the reversionary performance of the container is solely attributable to the passive features of the design and should be in compliance with ARP1523, Air Mode Insulated Containers – Thermal Efficiency Requirements.

2. REFERENCES

2.1 Applicable Documents

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 the 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.

2.1.1 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.

ARP1523 Air Mode Insulated Containers - Thermal Efficiency Requirements

2.1.2 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 8058 Air cargo - Insulated container - Thermal efficiency requirements

ISO 17025 General requirements for the competence of testing and calibration laboratories

ISO 6780 Flat pallets for intercontinental materials handling - Principal dimensions and tolerances

3. DEFINITIONS

Variable	Acronym	Description
Ambient temperature		The temperature outside the container
Air mode active container		Insulated air cargo container with cargo compartment conditioning system
Internal temperature		The temperature inside the container cargo compartment
Lower conditioning threshold	LCT	The lower temperature conditioning threshold once the negative conditioning tolerance is applied to the set point
Lower maintained duration	LMD	The autonomy at the lowest sustainable ambient temperature while maintaining internal temperature within range
Lower maintained limit	LML	The lowest ambient temperature where the container can regulate the internal temperature within range
Lower performance threshold	LPT	The maximum negative ambient temperature where the internal temperature drops below LCT
Mandatory set point	MSP	The conditioning system set point temperature
Negative ambient offset	NAO	Minimum negative ΔT needed for the conditioning system to regulate the internal temperature
Positive ambient offset	PAO	Minimum positive ΔT needed for the conditioning system to regulate the internal temperature
Upper conditioning threshold	UCT	The upper temperature conditioning threshold once the positive conditioning tolerance is applied to the set point
Upper maintained duration	UMD	The autonomy at the highest sustainable ambient temperature while maintaining internal temperature within range
Upper maintained limit	UML	The highest ambient temperature where the container can maintain the internal temperature within range
Upper performance threshold	UPT	The maximum positive ambient temperature where the internal temperature exceeds UCT
Unit Load Device	ULD	Device for grouping, transferring and restraining cargo for transit. It may consist of a pallet with a net or it may be a container.

4. TESTS

This ARP defines a series of test procedures to determine the temperature conditioning performance of air mode containers with active conditioning systems. The series of tests must be repeated for each performance class that is applicable to the container under test. Each test procedure within the test series is designed to identify critical performance characteristics of the container under test. The sequence of testing must be observed as the outcome of a test procedure is then used as setup parameters in the following test procedure.

The ARP mandates a test series, with a defined set point, in each of the applicable performance classes. Additional test series, at alternative set points, can be performed at the discretion of the supplier.

Optional, additional tests can be performed in compliance with the test procedures, with specified cargo loads, this however is outside the scope of the performance classification system.

4.1 Equipment

The following equipment is required to perform the test procedures in compliance with this ARP:

- A test facility with a climate chamber capable of:
 - Adequately accommodating the test subject and measurement equipment with additional free space to ensure the circulation of air within the chamber;
 - Controlling temperature with an accuracy of $\pm 3^{\circ}\text{C}$ throughout the chamber;
 - Ramping temperature with a stabilizing time of at most 1 hour;
 - Ramping temperature performance for cyclic testing with a maximum transitional time, from limit to limit, of 2 hours;
- Temperature sensors with a calibrated tolerance not to exceed $\pm 0.5^{\circ}\text{C}$;
- Humidity sensor with a tolerance not to exceed $\pm 3\%$ RH at 25°C in the range of 25 to 75 % RH;
- Data logging system with time stamp function and a sufficient number of data channels to support the requirements defined within the test setup.

All facilities and equipment shall be operated in compliance with ISO17025.

4.2 Test Setup

All tests are to be performed with an unloaded container.

To ensure air circulation under the container during the test and to eliminate thermal stabilization from the climate chamber floor, the container shall be placed in the climate chamber on a single layer of ISO 6780 compliant pallet(s) with an overall height not exceeding 200 mm (7.8 in).

The ambient air temperature shall be measured at a single point within the climate chamber that is as near to the centre, both vertically and horizontally, of the climate chamber as practical.

The ambient air temperature measurement sensor shall be placed in free space, without contact to any other surface, by a minimum of 100 mm in all directions and in unobstructed airflow within the climate chamber.

The container internal temperature measurement is performed as described in ARP1523.

The relative humidity of the test chamber shall be recorded for the duration of each test protocol.

The relative humidity sensor shall be placed in free space, without contact to any other surface, by a minimum of 100 mm in all directions and in unobstructed airflow within the climate chamber.

All temperature and humidity measurements shall be recorded at a sampling rate of 10 minutes.

4.3 Preconditioning

The inactive container should be preconditioned, with cargo doors open, to the MSP to eliminate the possibility of a temperature differential in the container structural mass distorting the test results.

Preconditioning duration is unspecified but the test facility shall ensure that the entire container is stabilized at the MSP.

Only once the container has stabilized at the MSP, may the container be readied for commencement of the test procedure by the closing of the cargo doors and the preparation and activation of the conditioning system.

4.4 Test Start Procedure

The test is commenced, following preconditioning, by initiating the chamber test procedure. The test is deemed to have started when the ambient temperature is in compliance with the Ambient Offset requirements for the test and the container measurement points are all within the LCT, UCT limits.

Temperature readings taken prior to the start conditions being met are discarded.

Once the start conditions are met, the container shall operate only on the power source specified in each test protocol.

4.5 Test End

Each test is considered to be concluded when the first inside air temperature measurement point reading exceeds the LCT or the UCT

4.6 Test Record

In addition to the inside and outside air temperature measurement readings, the following test data shall be recorded for each test protocol performed for inclusion in the Test Documentation:

The test facility used to perform the test protocol, including sufficient information to validate the climate chamber used and data acquisition equipment employed;

Copies of the calibration records for the climate chamber and data acquisition equipment used;

Verification of preconditioning to the MSP prior to commencement of each test protocol.

5. TEST PROTOCOL

The container shall be subjected to the following test series to determine the performance capabilities required to enable the classification of the containers conditioning performance.

The following tests are required to give input to the classification system. The tests are to be performed in the following sequence:

- Performance Thresholds:
 - Upper Performance Threshold (UPT) test;
 - Lower Performance Threshold (LPT) test;
- Maintained Limits:
 - Upper Maintained Limit (UML) test;
 - Lower Maintained Limit (LML) test;