MILITARY SPECIFICATION

TEST PROCEDURES FOR AIRCRAFT CABIN PRESSURIZING AND AIR CONDITIONING SYSTEMS

This specification has been approved by the Bureau of Aeronautics, Department of the Navy

1. SCOPE

1.1 This specification covers the testing of cabin pressurizing and air conditioning systems as installed in aircraft to demonstrate safety and satisfactory performance of the installation. The procedures outlined herein shall be followed, as applicable, for the testing of pressurized and non-pressurized aircraft.

2. APPLICABLE DOCUMENTS

2.1 The following specifications and publications, of the issue in effect on date of invitation for bids, form a part of this specification.

SPECIFICATIONS

MILITARY

MIL-T-5842A	Transparent Area, Anti-Ioing, Defrosting and Defogging Systems, General Specification for

PUBLICATIONS

AIR FORCE - NAVY AERONAUTICAL BULLETIN

No. 421	**Atmospheric Proprieties - Extreme Cold and Hot; Standard for Aeronautical Design**

(When requesting specifications, standards, drawings, and publications refer to both title and number. Copies of this specification and applicable specifications may be obtained upon application to the Commanding Officer, U. S. Naval Air Station, Johnsville, Pennsylvania, Attention Technical Records Division)

3. REQUIREMENTS

3.1 General test equipment and requirements.

3.1.1 Suitable instrumentation shall be installed to determine the weight flow of air the temperature differential, and the pressure drop throghh each of the major components of the systems, The accuracy of these measurements should be within plus or minus 5 percent.

3.1.2 System performance tests shall be conducted with a minimum of 75 percent of passenger and crew accommodations occupied during cooling tests and a maximum Of 30 percent of the passonger accommodations occupied during heating tests.

3.1.3 Instrumentation shall be provided to determine the temperature diatribution from forward to rear and top to bottom of all occupied spaces within the air plane.

3.2.4 Equipment shall be provided to determine the direction of flow and the

air volocities in all occupied compartmental of the aircraft under all conditions of : light.

3.1.5 A thorough investigation with regards to the cleanliness of air supplied to the cabin shall be made by collecting air namplate in an evacuated container and analyzing the contents in a laboratory. Sufficient samples shall be obtained to cover all flight conditions end and system operations undications under which it is possible for contamination to exist, Alternate methods of investigating cabin contamination must receive prior approval from the Bureau of ronautics.

3.1.6 Equipment shall be provided to determine the moisture content of the air in crew and passenger compartments of transport type aircraft,

3.2 General operation requirements for testing

3.2.1 Tests shall be conducted to demonstrate safe and satisfactory performance of the system and component equipments under the following conditions:

(a) Ground operation

(b) Transient flight (climb, dive, acceleration)

(c) Steady state, including minimum and maximum flight speeds.

3.2.2 Smoke or gas removal procedures shall be demonstrated to prove conclusively that proposed methods of elimination are adequate to clear all areas occupied by passengers and crew of hazardous concentrations of smoke or gas within a safe period of time. The removal of odors from galleys and sanitation areas shall be demonstrated during actual use of these facilities.

3.2.3 Tests on ventilating and cooling systems shall be conducted during the daytime to determine the adequacy of the system with full sun effect and with maximum daylight electrical load within the fuselage applied.

3.2.4 Tests on heating systems shall be conducted during night time to eliminate sun effect, and shall be conducted with minimum electrical lend applied within the aircraft cabin.

3.2.5 In the event that flights can not be made under the most critical design atmospheric temperatures, sufficient test data shall be obtained and an accurate extrapolation made to the design conditions. Unless otherwise specified in the airplane detail specification, the most critical design temperatures for air conditioning shall be those given in ANA Bulletin No. 421. The moisture content for the standard hot atmosphere shall be taken as .019 pounds of water per pound of dry air at all altitudes until saturation is reached, after which it shall be the saturation value corresponding to the design atmospheric temperature. The design atmospheric conditions called out in Specification MIL-T-5842 shall apply to flight testing of defogging and defrosting systems.

3.3 Instrumentation.-Test equipment utilized shall be fully described and illustrated by sketches in the test report.

3.3.1 Air flow measurement.

3.3.1.1 Sections of duct in the normal duct system, calibrated in place in the aircraft, shall be used to determine the air flow in each component part of the air conditioning system wherever possible.

3.3.1.2 Calibrated orifices or venturis may be used in duct systems where added pressure drop does not affect distribution or restrict air flow.

3.3.1.3 In the event callbrated sections of duct or orifices cannot be used, the use of calibrated pitot-static tubes is permissible, However, icing of the pitot heads and resulting erroneous data may oocur if this type of instrumentation is used downstream of refrigeration units.

3.3.1.4 All pressures shall be recorded simultaneously at regular intervals a common reference pressure shall be used for all pressures recorded.

3.3.2 Temperature measurements.

3.3.2.1 All true air temperatures shall be measured by the use of shielded thermocouples. Cabin temperatures shall be determined by use of unshielded thermocouples in order to include the effect of radiation. Duct and surface temperatures shall be determined by use of shielded thermocouples to minimize the effect of radiation.

3.3.2.2 All temperatures shall be recorded us near simultaneously as possible at regular intervals

3.3.2.3 Thermocouples shall be so located as to determine all temperatures necessary for complete evaluation of system operation.

3.3.3 Pressure measurements

3.3.3.1 All pressure taps shall be so located as to minimize the effect of turbulence caused by valves, elbows, or orifices installed in the system.

3.3.3.2 Pressire taps shall be so located as to determine all pressures required for a complete evaluation of system operation.

3.3.4 Humidity measurement.-Humidity measurements shall be taken within the cabin of transport aircraft at regular intervals using, a reliable type of psychromoter.

3.3.5 Air velocity measurements.

3,3*5,1 A suitable velometer shall be used to determine air velocities in passenger and crew compartments.

3.3.5.2 Air velocities across the cabin thermostat sensing element and temperature indicating instrument, if installed, shall be determined by use of a suitable velometer.

3.3.6 Time measurements. Time measurements shall be recorded continuously in order that rates of temperature and pressure changes and time intervals required to obtain stabilized conditions within the cabin can be noted.

4. QUAITY ASSURANCE PROVISIONS

4.1 Ground tests.

4.1.1 Safety tests.-The aircraft shall be inspected to determine that all cabin air entries are so located that no drain or exhaust of inflammable or noxious fluid and gases can enter the scoop during flight or on the ground during cross wind condition.

4.1.1.1 Combustion heater installations.

4.1.1.1.1 With an adjustable external power source connected to the airplane, the voltage shall be adjusted to that normally supplied by the aircraft system.

4.1.1.1.2 If the installation does not include blowers required for ground operation, external equipment required to supply in-flight conditions shall be attached,

4.1.1.1.3 With blowers in operation, the aircraft heating system shall be turned on and checked for normal operation. System shall be adjusted as required.

4.1.1.3.4 With system operating normally, the combustion air source shall be disconnected or deactivated, to determine that no unsafe condition will be created by loss of combustion air through failure of combustion air blower or icing of combustion air scoop in flight.

4.1.1.1.5 With system operating normally, the-ventilating air source shall disconnected or deactivated to determine that no unsafe condition will be created loss of ventilating air through failure of equipment or icing ofair inlet in light.

4.1.1.1.6 With system operating normally, deactivate or bypass the normal temperature control system to allow heater outlet air temperature to increase to the overheat switch setting. (Reduce ventilating air flow if required.) It shall be determined that no unsafe "condition exists at the temperature encountered and that overheat circuit functions properly.

4.1.1.1.7 With the system operating normally, gradually decrease the voltage applied to the aircraft until all of the components of the system cease to operate. t shall be determined that no unsafe condition is created due low voltage oporation

4.1.1.1.8 With the system turned on and all electrical power disconnected rom the aircraft (external blowers operating if used), reduce the voltage to 50 per- ent of the normal aircraft system voltage and reconnect to the aircraft. Gradually ncrease the voltage until all components are operating normally and it shall be etermined that no unsafe condition is created by low voltage condition.

4.1.1.1.9 Conditions required to cause the aircraft heater to backfire shall e created to determine that combustion air and exhaust systems are secure and adequate or the heater, These conditions may be created by reduction of combustion air flow or isconnecting the ignition system for a brief period of time. At least three substantial ackfires shall be created before considering the system adequate. Ducts and heater hall be inspected for damage after test.

4.1.1.2 Exhaust gas heat exchangers.-Engine exhaust gas heat exchanger instal- ations shall be tested to snow that no unsafe condition would be created by failure of he exhaust gas passage within the unit. One means of verification would be to ascertain hat pressures within the ventilating air passage are sufficient to prevent flow of xhaust gases into this passage.

4.1.2 Performance tests.

4,1,2.3 Ground tests shill be conducted on aircraft equipped with ground onditioning equipment to determine if satisfactory temperatures and air flow rates are btained. The air distribution shall be observed and flow rates measured to determine roper balance of the system, All temperatures, pressures, air velocities, and umidity (in transports specified in section 3 shall be recorded.

4.1.2.2 On pressurized aircraft, ground operation shall be tested or other- ise analyzed in order to determine the optimum configuration for comfort in hot eather while the airplane is taxiing or waiting take-off clearance.

4.1.2.3 Pressurized aircraft shall be pressurized to design differential to etermine the cabin leakage rate. Pressure controls, flow controls and all pressure elief valves shall be checked to ascertain that the units are operating properly and re within tolerance limits.

4.2 Flight tests.

4.2.1 Safety tests.

4.2.2.1 Smoke removal procedures shall be satisfactory demonstrated. protect all crew members and observers with suitable protective masks and discharge or manufacture sufficient smoke to fill the cabin. Smoke removal procedure shall be effected and the time required to remove smoke from crew and passenger compartments recorded. Smoke may be simulatated by using an aerosol type container charged with butyl tearate and Freon-12.

4.2.1.2 The fuel tank dumping procedure shall be carried out, and 't shall e demonstrated that no gases enter the air conditioning system during this operation. For pressurized aircraft, this test shall be conducted first with the cabin pressuriz-

ing system in normal operation and secondiy with the auxiliary ram air system in use.

4.2.1.3 The time required to dump cabin pressure shall be determined at several altitudes. Data showing the rate of pressure decay after actuation of the cabin safety valve shall be presented for each altitude investigated. These tests shall be conducted with maximum airflow entering the cabin from the conditioning system.

4.2.1.4 Operation of the cabin safety valve with regard to the prevention of excess positive and negative pressures within the cabin shall be thoroughly investigated.

4.2.3.5 It shall be demonstrated that faliure of the power source used for the temperature control and air flow control system components shall cause no hazard to the crew or passengers or affect safety of flight.

4.2,2.6 The safe operation of air locks in pressurized aircraft shall be satisfactorily demonstrated Pressure changes during decompression and recompression cycles shall be recorded.

4.2.2.7 In aircraft containing two or more pressurized compartment, it shall be demonstrated that the pressurization system will not create a hazard to personnel or an unsafe condition in the airplane if there is a loss of pressure in any one compartment,

4.2.2 Performance tests.- The following tests shall be conducted, in addition to any others deemed necessary, to demonstrate satisfactory performance of the cabin pressurizing and air conditioning system, During all test flights the cabin shall be observed for contamination and any occurrence shall be described in detail. controls for the system shall be set as required for optimum performance, however, the exact use made of' the controls during the flights shall, be described in detail. Test data shall be recorded as specified in section 3.

4.2.2.1 Take-off and accomplish a maximum-power climb to the normal cruise altitude. Data should be recorded beginning with the start of the take-off run.

4.2.2.2 Ply at normal cruise altitude with appropriate engine power settings until temperature, conditions within the cabin reach stabilization,

4.2.2.3 Determine the effect of changing the setting of the temperature control to points above and below the design setting. Record data until stabiliation is obtained.

4.2.2.4 Increase the altitude of the airplane to the combat or service ceiling, whichever is the highest. Operation of all equipment shall be observed and data recorded until stabilized conditions are obtained.

4.2.2.5 Descend the airplane at the maximum permissible rate to the minimum safe altitude and fly at this altitude until stabilized conditions within the cabin are obtained. Data shall be recorded at sufficient Intervals to permit an accurate evaluation of the performance of' all equipment.

4.2,2,6 Under the most critical combination of altitude and-speed; record data to show that the capacity and performance of the heating system is satisfactory. Demonstrate that the capacity of the heating system is adequate during a descent made with minimum engine power settings.

4.2.2.7 Under the most critical combination of altitude and speed, record data to show that the capacity of the cabin ventilating system is satsfactory. On prossurlzed aircraft, this test applies to the auxillary ram air ventilation system.

4.2.2.8 Under the most critical combination of altitude and speed, obtain data to show that the capacity of the cooling system is adequate.

4.2.2.9 This test applies only to VF type aircraft. At the altitude where

maximum speed (V_{MEX}) can be obtained, accelerate the airplane at maximum rate to its maximum velocity and record data to define the performance of the cooling system during this transient condition, If it is practicable, maintain the airplane at maximum power long enough to obtain stabilized temperature conditional or at least to establish the trend of the cabin temperature rise.

4.2.2.10 If the airplane is equipped with two or more cabin pressurizing sources, one pressure source shall be directed away from the cabin or operation stopped in order to determine if design cabin differential pressure can be maintained at the normal cruise altitude. Proper operation of the air conditioning and pressure control system shall be demonstrated in this condition.

4.2.2.11 On aircraft equipped with combustion heaters, locate an atmospheric temperature condition which will require intermittent or low output operation of the heater(s) to satisfy cabin heat demands, Continue to fly the airplane under this condition until stabilization of cabin temperature is obtained, Observe cabin temperature to detect cyclic variation.

4,2,2,12 During flight at normal cruise altitude the performance of the ventilation provisions for the galley and sanitation areas shall be tested as specified In Section 3.2.2.

4.2.2.13 Heating and ventilating installations in rotary wing aircraft shall. be satisfactorily demonstrated during all directions of flight and during hovering,

4,2,2 14 Heating and ventilating systems installed in airships shall be demonstrated satisfactorily for all conditions of flight, including hovering and tactical maneuvers.

4.3 Defogging and defrosting system tests for pressurized aircraft. -These tests shall be made when the sea level dew point temperature is as near as practicable to 85 degrees Fahrenheit, but no lower than 60 degrees Fahrenheit. The flights should be made during early morning or late evening when the dry bulb temperature is low.

4.3.1 Test procedure. The airplane shall be climbed to the lowest altitude at which a true atmospheric temperature of minus 65 degrees Fahrenheit exists. The airplane shall loiter at this altitude, at the minimum engine power netting required to maintain level flight, for a period of 30 minutes. A maximum rate of' descent dive with the lowest practicable engine power setting shall be accomplished to the safe minimum altitude, The airplane shall be descended through as much cloud as possible, particularly at low altitude.

4.3.2 The above test shall be repeated with the dive being made at the maximum allowable speed.

4.3.3 Tests shall be conducted with the system controls set for optimum performance, however, the exact use made of the controls during the flights shall be fully described.

4.3.4 The following test data shall be reported;

(a) See level dew point and dry bulb temperature during test flights.

(b) Cabin temperatures at head and foot level taken at regular intervals during the flight These temperatures must also be recorded immediately before and after descent.

(c) Defogging air temperature and temperatures at various locations of the inner surface of the transparancies,

(d) The condition of all transparancies during the flight. The condition shall be described in detail and illustrated by sketches.

(e) The cloud conditions encountered during the' flight,

(f) Speed, altitude and duration of' any extra flying required to clean the transparancies at the end of the dive.

4.3.5 In the event of' unsatisfatory results, necessery changes shall be made to the system, and the tests repeated untii satisfactory performance is obtailned.

4.4 Defogging and defrosting system tests for non-pressurized, aircraft. It shall be demonstrated that defogging and defrosting systems installed in non-prossurizod aircraft meet the operation requirements called out in Specification MIL-T-5042 for non-combat type aircraft. These-teats may be conducted in conjunction with evaluation of the cabin air conditioning? system, however, test data shall show satisfactory performance for the atmosphoric conditions specified in MIL-T-58420

4.5 Pressure suit system tests. -Porformanoc of the system for air conditioning and pressurizing pilot's and crowman's pressure suits shall, be satisfactorily demonstrated. The ubility of the system to maintain inlet air flow. and temperatures within the specified limits shall be demonstrated during steady rate and transient conditions of airplane and system oporation when the cabin is pressurizod. With the cabin depressurizod at the maximum operating altitude of the airplane, the ability of the system to maintain suit pressure and ventilating air flow at the specified level shall be demonstrated. Test data such as temperatures, pressures and airflows shall be recorded at frequent intervals, and comments from test personnel wearing the suits shall be included in the test report, These tests should utilize the suit intended for service we in the airplane being tested.

4.6 Test report. The manufacturer shall furnish a complete report covering all teats. This report shall include an introduction, brief description of system, instrumontation end tests, complete data on atmospheric conditions (including mount of cloud coverage), results, discussion, conclusion and an appendix containing all data and curves necessary to completely analyze the operation of the system. ,

4.6.1 Special reports.-Special reports shall be submitted immediately whenever defects requiring major modifications are disclosed by the tests.

5. PREPARATION FOR DELIVERY

(Not Applicable)

6. NOTES

6.1 Intendod use.-This specification covers the testing of cabin pressurising und air conditioning systems as installed in aircraft, including defogging and defrosting, for the purpose of:

(a) Demonstrating safety of the installation.

(b) Demonstrating performance of the installation.

(1) Aircraft duct and distribution systems.

(2) System capacities.

(3) Defogging and defrosting systems.

(4) Individual components and equipment items.

(c) Obtaining data for future design.

PATENT NOTICE. -When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Goverment thereby hours no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in Bray manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto,

MILITARY SPECIFICATION

TEST PROCEDURES FOR AIRCRAFT ENVIR0NMENTAL SYSTEMS

This amendment form a part of MIL-T-18606 (AER) dated 31 March 1955 and has been approved by the Naval Air System Command, Department of the Navy.

By this amendment basic MIL-T-18606 (AER) is changed to MIL-T-18606(AS) and throughout the specification, Bureau of Aeronautics shall be changed to Naval Air Systems Command.

Page 3.: Delete specification title and substitute the title of this amendment,

Page 1, paragraph 1.1: Delete and substitute:

"This specification covers the testing of tine enviromental system as installed in aircraft to demonstrate safety and satisfactory performance or the installation. The procedures outlined herein shall be followed, as applicable, for the testing of pressurized and non-pressurized aircraft."

Page 1, paragraph 2.1, after "Commanding Officer": Delete and substitute:

"Naval Supply Depot, Code 105, 5801 Tabor Avenue,
Philadelphia, Pennsylvania 19120"

Page 1, paragraph 3.1.1: At the end of first sentence, add: "and at the duct outlets to all electronic equipments and equipment bays.

Page 1, paragraph 3.1.3: Add:

"and within all electronic equipment bays and conpartments."

Page 3, paragraph 3.3.6; Line 3: Delete:

"Within the cabin"

Page 5, paragraph 4.2.2, line 3: Delete:

"cabin pressurizing and air conditioning," and substitute "environmental"

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