REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*
12-08-2020

2. REPORT TYPE
Final

3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE
Test Operations Procedure (TOP)
07-2-001 In-Flight Simulation Environmental Test

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHORS

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Redstone Test Center (RTC)
Climatic Test Division (TERT-ECC)
4500 Martin Road
Redstone Arsenal, AL 35898

8. PERFORMING ORGANIZATION REPORT NUMBER
TOP 07-2-001

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Policy and Standardization Division (CSTE-CI-P)
U.S. Army Test and Evaluation Command
6617 Aberdeen Boulevard
Aberdeen Proving Ground, MD 21005-5001

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
Same as item 8

12. DISTRIBUTION/AVAILABILITY STATEMENT

Distribution Statement A. Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Defense Technical Information Center (DTIC), AD No.:

14. ABSTRACT
The procedures in this Test Operations Procedure (TOP) describe a method for in-flight simulation of environments for small fixed wing aircraft, manned or unmanned. The test method simulates the temperature and humidity environment that the aircraft will experience in-flight, both the ascent to altitude and low temperature environment and the descent into a warm moist environment. Altitude is simulated by adjusting the airflow across the aircraft to provide an equivalent mass flow rate that the aircraft would be exposed to at altitude. This test method will be utilized when the size of the aircraft exceeds the available altitude chamber size.

15. SUBJECT TERMS
altitude, arctic environment, low temperature, simulated in-flight

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON / 19b. TELEPHONE NUMBER *(include area code)*
Unclassified	Unclassified	Unclassified	SAR	19	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39-18

(This page is intentionally blank.)

U.S. ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure 07-2-001 — 12 August 2020
DTIC AD No.

IN-FLIGHT SIMULATION ENVIRONMENTAL TEST

			Page
Paragraph	1.	SCOPE	2
	2.	FACILITIES AND INSTRUMENTATION	2
	2.1	Facilities	2
	2.2	Instrumentation	3
	3.	REQUIRED TEST CONDITIONS	3
	3.1	Operational Temperatures	3
	3.2	In-Flight Low Temperature	3
	3.3	In-Flight Low Temperature Dwell Time	4
	3.4	Simulated Air Speed Requirements	4
	3.5	Operation	4
	4.	TEST PROCEDURES	5
	4.1	Fan System Calibration	5
	4.2	Safety	5
	4.3	Test Procedure	6
	5.	DATA REQUIRED	8
	6.	PRESENTATION OF DATA	9
	6.1	Example - Test Parameters	9
	6.2	Presentation of Test Results	9
APPENDIX	A.	ABBREVIATIONS AND ACRONYMS	A-1
	B.	REFERENCES	B-1
	C.	APPROVAL AUTHORITY	C-1

*Approved for public release; distribution unlimited.

1. SCOPE.

a. The procedures in this Test Operations Procedure (TOP) describe a test method for In-Flight Simulation of Environments. The test method simulates the temperature and humidity environment that aircraft can experience, namely the startup, take-off, ascent to altitude, low temperature environment at altitude, and the descent into a warm moist environment. Altitude is simulated by adjusting the airflow across the aircraft to provide an equivalent mass flow rate that the aircraft would be exposed to at altitude. This test method will be utilized when the size of the aircraft exceeds size or capability of the available temperature altitude and humidity chamber. This test is not intended to address the effects of low pressure experienced at altitude. This test method should be tailored based on the possible worst case mission / flight scenarios to ensure that appropriate test conditions (e.g., temperatures, dwell periods, operational checks) are performed.

b. The following are some of the potential effects of the environment.

(1) Change of lubricant viscosity.

(2) Moisture buildup due to condensation experienced during the transition from cold altitude to warm moist.

(3) Moisture penetration in sealed areas.

(4) Internal stresses due to different coefficients of thermal expansion in bonded or adjacent materials.

(5) Fogging of optical windows.

(6) Electrical shorting of components due to condensation.

(7) Binding or loosening of moving parts.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

a. Chamber. A chamber is required to provide the temperature and humidity conditions. The chamber should be large enough to allow for air speed generation, the aircraft (test item), and aircraft in-flight fixtures. It should provide conditioned air and a system to remove exhaust gases.

b. Fan Systems. The fan systems are required to provide airflow across the aircraft. The system will include a means to vary the speed of the airflow. The fan systems will need to operate over a large range of temperatures (e.g., -54 to 49 °Celsius (°C) (-65 to 120 °Fahrenheit (°F)).

2.2 Instrumentation.

Devices for Measuring	Permissible Measurement Uncertainty/Control Tolerance
Temperature	Accuracy to within ± 1 °C (1.8 °F). Control tolerance to within ± 3 °C (5.4 °F).
Air speed	Accuracy to within ± 5 percent. Control tolerance to within ± 10 percent.
Humidity	Accuracy to within ± 2 percent. Control tolerance to within ± 5 percent[a].

[a] Depending on chamber control capability, it may be necessary to increase this control tolerance during the descent to a warm moist condition. A target of ± 8 percent can be used during this portion of the test.

3. REQUIRED TEST CONDITIONS.

3.1 Operational Temperatures.

a. The operational low temperature should be specified in the requirements document. It refers to the low temperature required to start and operate the system, typically at ground level. The daily low ambient air temperature of the Basic Cold (C1) climatic design type as defined by Military Handbook (MIL-HDBK)-310[1**] is typically selected. This value is -32 °C (-25 °F).

b. The warm moist landing temperature and humidity should also be defined. For the purposes of this test procedure, it is assumed to be 32 °C (90 °F) and 90 percent Relative Humidity (RH).

3.2 In-Flight Low Temperature.

The in-flight low temperature should be specified in the requirements document. More extreme low temperatures are experienced at flight altitudes and therefore lower temperatures are typically required during flight than for the operational low temperature. MIL-HDBK-310, Section 5.3.2.2, provides tables with extreme (1 percent and 10 percent) temperatures and associated densities at geometric altitudes. Tables with 0 through 80 kilometer (km) altitude profiles are provided for 1 percent and 10 percent extremes at 5 km, 10 km, 20 km, 30 km, and 40 km. These tables, along with knowledge of the flight characteristics of the aircraft, could be utilized to support generation of the in-flight low temperature test parameter.

** Superscript numbers correspond to Appendix B, References.

3.3 <u>In-Flight Low Temperature Dwell Time</u>.

The in-flight low temperature dwell time is the period of time that the system is required to operate at the simulated in-flight low temperature environment. This dwell time should be derived from either the time required to stabilize temperature, or the maximum time expected in-flight at the specified temperature, whichever is less. The maximum time expected in-flight at the low temperature will be determined by the aircraft endurance limitations.

3.4 <u>Simulated Air Speed Requirements</u>.

a. In this test, the altitude is simulated by adjusting the airflow across the aircraft to provide an equivalent mass flow rate that the aircraft would be exposed to at altitude. MIL-HDBK-310 Section 5.3.2.2 provides data used to determine the air density at low temperature and altitude. A linear regression calculation can be performed using the temperature versus density data for the appropriate altitudes and temperatures to determine the air density levels. The increase in air density due to the lowering of the chamber air temperature should also be taken into account. The resulting density ratio between the chamber air density and the simulated altitude density is used to adjust the fan speeds to provide the equivalent mass flow rate. A similar process is used for the descent to warm moist test condition using Section 5.3.2.1 of MIL-HDBK-310, and Table 520.5A-III in Military Standard (MIL-STD)-810H[2]. See the example included in Section 6 of this document. A staff meteorologist should be consulted to ensure appropriate understanding of the application of the data.

b. Air speed verification typically takes place prior to the testing with the aircraft not positioned in the air stream. For this verification, the sampling rate for wind speed measurements will be a minimum of four samples per second. The steady state (sustained) wind speeds will be verified by averaging the wind speeds over 10 seconds with the wind generation equipment controls held constant.

c. When the geometry of the aircraft is large and/or complex, the more difficult it is to provide a uniform wind speed over the test cross sectional area. The tester should employ the available wind generation equipment (fans, wind straighteners, ducting, etc.) to provide the best uniformity results over the aircraft. The wind speed uniformity (measured with a minimum of 10 seconds of averaged data at multiple points) should be ± 15 percent over the critical areas of the aircraft.

3.5 <u>Operation</u>.

a. Functional test procedures should be developed specifically for this test event. The test includes start-up procedures at low temperature, functional checks of systems at varying conditions, and simulated take-off/landing.

b. The start-up procedures at low temperature are often defined in the technical manual in the section entitled, “Operations Under Unusual Conditions”. These procedures may include special heating procedures for certain systems, special mechanical and visual checks, and other system specific procedures to address the low temperature environment.

c. As this test simulates In-Flight Testing, consideration should be given to the appropriate engine throttle settings to simulate the flight condition (take-off, ascent, loiter, descent, and landing) being simulated. Functional checks of items such as sensors, radar equipment, and weapon systems should be included at operationally appropriate conditions.

d. A fixture will be required to support and restrain the aircraft. The fixture should be analyzed to ensure sufficient restraint for wind loads and aircraft propulsion. The functional test procedures may require lifting the landing gear and should be addressed in the fixture design.

e. The angle of attack, the angle between the aircraft's reference line, and the oncoming flow, is an important consideration for the test design, especially for aircraft that have long operational periods with high angles of attack. The direction of the air flow may result in different thermal responses and effect the operation. Depending on the criticality, a fixed angle of attack may be chosen or the ability to vary the angle of attack incorporated into the support fixture.

4. TEST PROCEDURES.

4.1 Fan System Calibration.

a. The calibration of the simulated air speed equipment is critical to ensure that the aircraft is exposed to the required conditions. This is performed prior to placing the aircraft in the air stream. This may be an iterative process as the fan blade pitch, fan speed, duct size, and distance from the fan can all be adjusted to influence the air speed. Typically, after the fan and duct configuration is set, the fan speed is the variable that is adjusted to reach the required velocities. Calibration runs, with a range of fan speeds, are performed and a correlation table or equation between the fan speeds (or drive setting) and the wind velocities. This correlation will be used during the test to set the wind velocities.

b. Providing the proper wind speeds over the critical locations of the aircraft is necessary for a valid test. To ensure that these wind speeds are provided, the wind field generated by the fan system should be characterized. This characterization is typically performed by taking a two dimension array of wind velocity measurements at a set spacing at the location of the test item. This spacing is typically 0.3 meter (m) (1 foot (ft)) typical, 0.6 m (2 ft) maximum. See paragraph 3.4 for measurement sampling and uniformity requirements.

4.2 Safety.

a. Prior to the use of the fan systems or aircraft operation, it is critical to perform a Foreign Object Debris (FOD) sweep to ensure that (1) debris is not ingested by the fans or aircraft engine, and that (2) debris is not forced airborne by the wind causing impact to the aircraft or personnel.

b. During the operation of the fan systems, adequate safety controls should be implemented to include the following. This list is not intended to be normative or comprehensive, each facility should assess the safety risks associated with the specific equipment utilized and take appropriate measures.

(1) Screens on the intake side of the fans.

(2) Barriers preventing access to the fans from the intake side.

(3) Use of hearing protection or other means to mitigate the noise hazard.

(4) Eye protection to protect from blowing particles.

c. During the operation of the aircraft, adequate safety controls should be implemented to include the list below. This list is not intended to be normative or comprehensive, each facility should assess the safety risks associated with the specific aircraft system and take appropriate measures.

(1) Maintain keep out zones for propeller operation.

(2) Maintain keep out zones for radiation hazards (e.g., radars and transmitters).

(3) Use of hearing protection or other means to mitigate the noise hazard associated with engine operation.

(4) Carbon Monoxide and Oxygen sensors to ensure that the exhaust system is working properly.

d. A progression of increasing air speeds at the beginning should be utilized to reduce risk of damage to the aircraft in the event of insufficient restraint.

e. A progression of increasing throttle should be performed to ensure that aircraft has sufficient restraint. If the landing gear are actuated in the test, the restraint fixture will need to support the entire aircraft under loading from the air flow (wind) and the aircraft propulsion.

4.3 Test Procedure.

4.3.1 Preparation for Test.

a. Install the fan systems in the chamber and perform a calibration to determine the settings required to achieve the required air speeds.

b. Install temperature sensors on aircraft as described in the test plan. Secure sensor leads so that they will not be damaged during the application of the airflow.

c. Install the aircraft in the chamber such that the fan systems will provide airflow across the aircraft in the manner experienced in flight. Take photographs of the aircraft and setup.

d. Perform a visual inspection of the aircraft with special attention to stress areas. Photograph the aircraft and document any anomalies.

e. With the chamber at standard ambient conditions of 25 °C ± 10 °C (77 °F ± 18 °F), 20 percent to 80 percent RH, and site pressure in accordance with MIL-STD-810H, conduct a functional test of the aircraft. Document the results.

NOTE: These procedures can be performed in the most logical and expedient order.

4.3.2 In-Flight Simulation Environmental Test.

a. With the aircraft powered down and installed in the chamber, lower the chamber temperature to the required operational low temperature.

b. Allow the aircraft to soak until temperature stabilization at the operational low temperature has been achieved.

c. Following temperature stabilization, power on the aircraft and perform tailored functional test procedures.

d. Adjust the fan and aircraft throttle settings to replicate loiter flight speeds. Raise landing gear, as appropriate.

e. Ramp the chamber from the required operational low temperature to the required in-flight low temperature. Perform the temperature ramp at a rate not to exceed that which would be experienced during the maximum ascent rate. As the temperature ramps to the required in-flight low temperature, adjust the fan settings to provide the air speed based on the calculated equivalent mass flow rate. See paragraph 3.4.

f. Conduct an In-Flight Functional Verification Test in accordance with the functional procedures tailored for this test. This should include the operation of sensors, weapon checks, and any additional key functional requirements. See paragraph 3.5. Continue to operate in the environment for the time required in the test plan.

g. Ramp the chamber air temperature from the in-flight low temperature to the temperature at the corresponding flight altitude to begin the ramp to the warm moist condition. Perform the temperature ramp at no more than 1 °C/minute (min) (1.8 °F/min). This simulates flight from a region of low temperature weather to a region of warm weather. Ramp the air speed to the specified value to provide the equivalent mass flow rate.

h. Ramp the chamber air temperature from the warm altitude condition to the warm landing condition at the required ramp rate (determined by the aircraft maximum descent rate).

At 0 °C (32 °F), increase the humidity in the chamber at the maximum rate possible to the warm humid conditions of 32 °C (90 °F) and 90 percent RH. Maintain these conditions for the duration of this test. The intent is to provide the highest humidity level without causing precipitation in the chamber. As the temperature changes, adjust the air speed to provide the equivalent mass flow rate.

i. During this period of transition from in-flight low temperature (simulated altitude) to warm humid conditions of 32 °C (90 °F) and 90 percent RH, perform functional tests as required to confirm proper system operation.

j. After the chamber reaches 32 °C (90 °F) and 90 percent RH, follow the procedures to simulate the landing (lower landing gear). A period of operational checks may be appropriate here to simulate taxi following landing. Following the period of operational checks, power down the aircraft.

k. Ramp the chamber air temperature from 32 °C (90 °F) and 90 percent RH to standard ambient conditions. Perform the temperature ramp at the maximum rate but no more than 3 °C/min (5.4 °F/min).

l. Allow the aircraft to soak at standard ambient conditions until the functional part(s) of the aircraft with the greatest thermal lag has reaches 25 °C ± 10 °C (77 °F ± 18 °F).

4.3.3 Post-test Inspection and Functional Test.

a. Conduct a complete visual inspection of the aircraft with special attention given to stress areas, such as corners of molded cases. Document the general appearance/condition and provide photographs of specific physical anomalies (if any).

b. Conduct a functional test of the aircraft. Document the results.

5. DATA REQUIRED.

The following data are required.

a. A complete list of all test chamber, test equipment, and accessories used for this test, including (as applicable) the manufacturer name, nomenclature, part number, serial number, calibration date, and calibration due date.

b. Complete record of chamber temperature versus time, RH versus time, and air speed versus time.

c. Results of the functional testing, including log files and test team observations.

d. Photographs documenting the test configurations and aircraft condition.

e. Video documentation of the test showing the operation of the aircraft.

f. An air speed map of the test cross sectional area at a minimum of a 0.6 m x 0.6 m (2 ft x 2 ft) resolution.

6 PRESENTATION OF DATA.

All data product formats should be determined prior to test start by the test officer, evaluator, and customer.

6.1 Example - Test Parameters.

The test parameters should be determined through analysis prior to the start of testing. These test levels should be documented in the test plan and approved by the test officer, evaluator, and customer. The following provides examples of how test parameters should be documented:

a. Low Operational Temperature: -32 °C (-25 °F).

b. Low In-Flight Temperature: -51.6 °C (-61 °F).

c. Loiter Air Speed: 130 kilometers per hour (kph) (81 miles per hour (mph)).

6.2 Presentation of Test Results.

a. Figure 1 provides an example plot of linear regression of density vs. low temperature. To determine a relationship between the air density and temperature for the ascent to simulated low temperature and altitude, the data from the tables in Section 5.3.2.2 of MIL-HDBK-310 was used for the example. A linear regression of the temperature versus density data for 2 km through 8 km of the 1 percent values from the 5 km, 10 km, 20 km, and 30 km tables was performed. The range of geometric altitude is based on the consideration of the aircraft performance limits (both temperature and altitude).

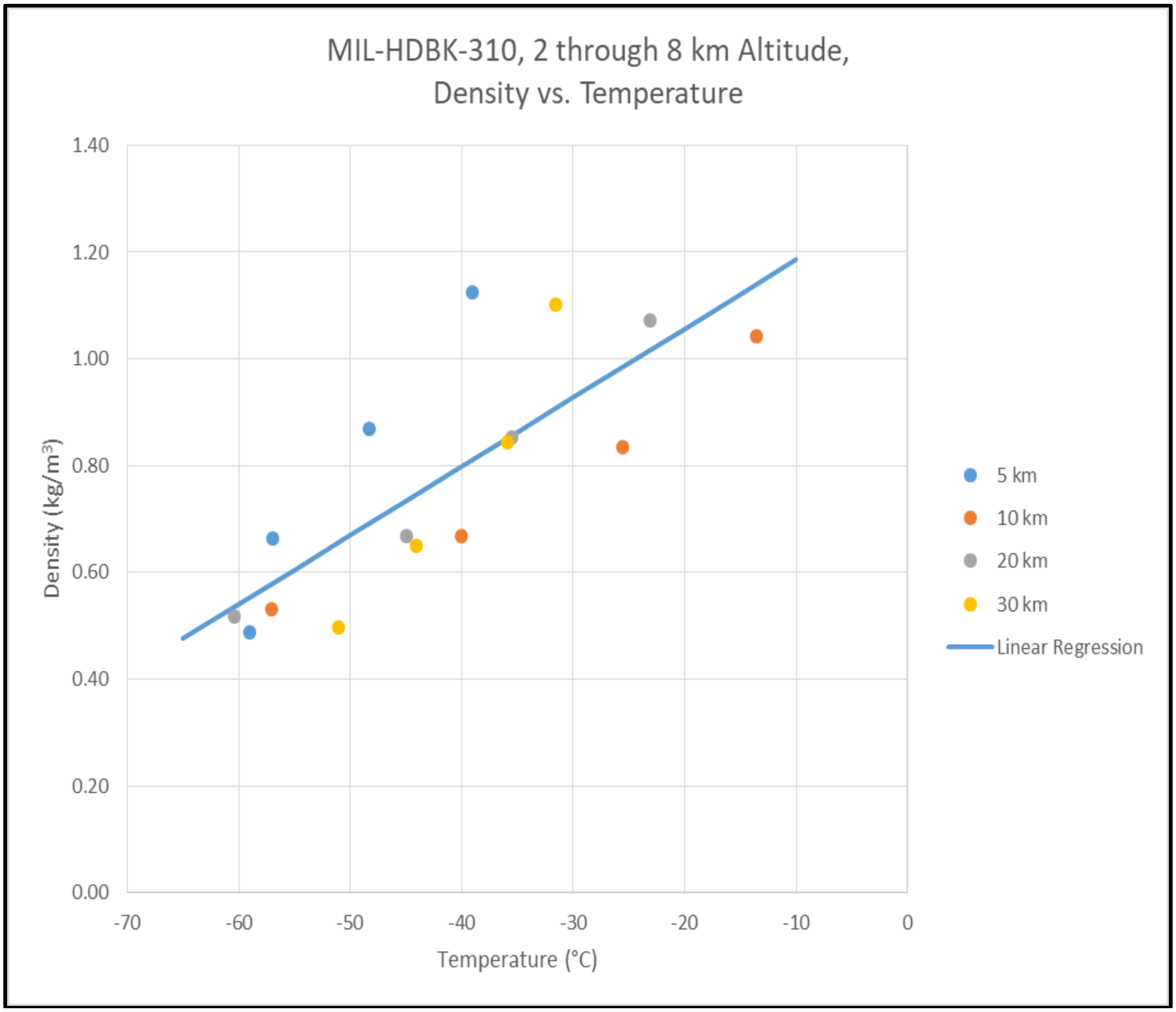

Figure 1. Linear regression of density vs. low temperature.

b. Table 1 provides an example of density ratio calculations. The air density in the chamber will vary based on temperature and pressure. This should be incorporated in the calculation of a density ratio. The density ratio is then used to determine the appropriate air speed to provide an equivalent mass flow over the aircraft.

TABLE 1. AIR SPEED REQUIREMENTS (LOWERING TEMPERATURE)

TEMPERATURE (°C)	TARGET DENSITY (kg/m^3)	DENSITY RATIO	AIR SPEED (mph)
-32	1.46	1.00	81
-38	0.82	0.55	44
-46	0.71	0.46	37
-51.6	0.64	0.40	32
kg/m^3 = kilogram per cubed meter			

c. A similar approach can be employed for the transition to warm moist conditions. As noted previously, interfacing with a staff meteorologist can provide insight into the expected worst-case environments that will inform the determination of the test profile.

d. An example of an air speed map is shown as Figure 2. The air speed maps for each air speed should be measured or calculated based on measured data. Fan systems typically provide a linear increase in air speed in relation to rotational speed of the fan blades. This relationship can be utilized to calculate the required fan settings for each air speed. A plot of temperature, humidity, and air speed should be included to document the test conditions achieved.

Wind Test: Wind Velocity Profile for the Front and Rear Face Exposures - 52 MPH Steady

Distance from Center (ft)

Height From Floor (ft)	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
12 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 ft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 ft	0	0.02	0	0	0	0	5.9	14	0	0	0	0	0	0	0	0	0	0	0	0	8.53	0	0	0	0	0	0	0	0	0	0
9 ft	6.24	17.1	22	18.9	9.885	11.4	24.6	29.8	16	8.95	12.3	18.4	15.1	11.6	6.62	9.29	14.1	15.7	6.83	12.9	24.1	19.3	13.2	6.46	11.1	16.8	15.7	13.6	8.62	8.53	12.5
8 ft	12.48	34.1	44	37.7	19.77	22.8	43.3	45.7	32	17.9	24.6	36.9	30.1	23.2	13.2	18.6	28.2	31.4	13.7	25.8	39.7	38.6	26.4	12.9	22.3	33.7	31.3	27.2	17.2	17.1	24.9
7 ft	19.1	46.3	58.3	46.8	27.31	34.6	53.2	60.6	44	29.6	37.9	56.2	50.1	37.3	25.8	39	53.5	44.9	27.1	33	51.9	53.5	39.3	29	34.9	49.2	46.4	40.7	27.6	27.1	40.8
6 ft	32.37	54.8	66.1	55.6	39.01	41.6	55.8	62	53.3	40.3	45.5	60.8	58.2	48.2	44.5	52	62.5	50.6	37.8	41.8	53.1	62.1	49.9	40.6	45.3	58.5	58.7	51.7	40.4	41.5	54.6
5 ft	44.32	56.4	61.6	61.8	52.19	47.6	52	53.8	57.2	52.3	52.5	55.1	61.9	55.6	52.2	52.3	62.5	50	49.7	49.3	48.9	61	57.4	53.7	51.2	56.6	64.2	56.6	51.3	55	62.5
4 ft	51.43	53	54.1	60.9	60.56	54.9	50.8	46	56.7	60.3	56.4	46.6	59.6	57.6	58	52.7	57.5	52.9	57.4	54.6	42.1	54	61	60.3	52.2	46.5	61.7	53.4	57	63.4	58.2
3 ft	57.66	59.2	53	53.2	55.365	57.3	52.8	44	50.3	57.7	54.4	28.4	36.3	28.8	29	26.4	28.7	26.4	33.1	30.9	39.8	48.9	55.7	56.2	47.9	41.6	52.1	47.1	52.5	57.2	52.6
2 ft	63.89	65.5	51.9	45.6	50.17	59.6	54.8	41.9	43.9	55.1	52.3	0	0	0	0	0	0	0	0	0	37.5	43.8	50.4	52.2	43.6	36.7	42.5	40.9	47.9	51	47
1 ft	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0	0	0	0	0	0	0	0	0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Measurements at 24 ft											Measurements at 11 ft									Measurements at 24 ft										

Test Area	
Average (MPH)	49.0
Max (MPH)	64.2
Min (MPH)	9.3

Figure 2. Air speed map example.

APPENDIX A. ABBREVIATIONS AND ACRONYMS.

ATEC	U.S. Army Test and Evaluation Command
DTIC	Defense Technical Information Center
°C	degrees Celsius
°F	degrees Fahrenheit
FOD	Foreign Object Debris
ft	foot
kg/m^3	kilogram per cubed meter
km	kilometer
kph	kilometers per hour
m	meter
MIL-HDBK	Military Handbook
MIL-STD	Military Standard
min	minute
mph	miles per hour
RH	Relative Humidity
RTC	U.S. Army Redstone Test Center
TOP	Test Operations Procedure

.

(This page is intentionally blank.)

APPENDIX B. REFERENCES.

1. MIL-HDBK-310, Department of Defense Handbook, Global Climatic Data for Developing Military Products, 23 June 1997.

2. MIL-STD-810H, Department of Defense Test Method Standard, Environmental Engineering Considerations and Laboratory Tests, 31 January 2019.

(This page is intentionally blank.)

APPENDIX C. APPROVAL AUTHORITY.

CSTE-CI 12 August 2020

MEMORANDUM FOR

Commander, U.S. Army Operational Test Command
Director, U.S. Army Evaluation Center
Commanders, ATEC Test Centers
Technical Directors, ATEC Test Centers

SUBJECT: Test Operations Procedure 07-2-001, In-Flight Simulation Environmental Test, Approved for Publication

1. Test Operations Procedure (TOP) 07-2-001, In-Flight Simulation Environmental Test, has been reviewed by the U.S. Army Test and Evaluation Command (ATEC) Test Centers, the U.S. Army Operational Test Command, and the U.S. Army Evaluation Center. All comments received during the formal coordination period have been adjudicated by the preparing agency.

2. Scope of the document. This TOP describes a test method for In-Flight Simulation of Environments. The test method simulates the temperature and humidity environment that aircraft can experience, namely the startup, take-off, ascent to altitude, low temperature environment at altitude, and the descent into a warm moist environment. Altitude is simulated by adjusting the airflow across the aircraft to provide an equivalent mass flow rate that the aircraft would be exposed to at altitude. This test method will be utilized when the size of the aircraft exceeds size or capability of the available temperature altitude and humidity chamber.

3. This document is approved for publication and has been posted to the Reference Library of the ATEC Vision Digital Library System (VDLS). The VDLS website can be accessed at https://vdls.atc.army.mil/.

4. Comments, suggestions, or questions on this document should be addressed to U.S. Army Test and Evaluation Command (CSTE-CI), 6617 Aberdeen Boulevard-Third Floor, Aberdeen Proving Ground, MD 21005-5001; or e-mailed to usarmy.apg.atec.mbx.atec-standards@mail.mil.

ZWIEBEL.MICHAEL.J.1229197289

MICHAEL J. ZWIEBEL
Director, Directorate for Capabilities Integration (DCI)

(This page is intentionally blank.)

Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Policy and Standardization Division (CSTE-CI-P), U.S. Army Test and Evaluation Command, 6617 Aberdeen Boulevard, Aberdeen Proving Ground, Maryland 21005-5001. Technical information may be obtained from the preparing activity: U.S. Army Redstone Test Center (RTC), Climatic Test Division (TERT-ECC), 7250 Briar Road, Redstone Arsenal, AL 35898. Additional copies can be requested through the following website: https://www.atec.army.mil/publications/documents.html, or through the Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.