



## Flammability Test Plan,

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*Mi-171 GPMS Foresight MX System*

Project Number: CW19-409

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Document Number:	GPMS-1080
Revision :	IR
Date:	8/19/2020

## I. Revisions

Revision	Revision Date	Description
IR	8/19/2020	Initial Release
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		Approved By: <i>Michael Sutherland</i>

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**VI. References**

The following documents were used in the preparation of or in support of the showing of compliance for regulations applicable to this report.

**Table 1. Reference Documents**

Ref. No.	Document Number / Revision	Rev.	Document Title / Description
1.	AC29-2C	Chg. 8	Certification of Transport Category Rotorcraft
2.	DOT/FAA / AR-0012	N/A	Aircraft Materials Fire Test Handbook, dated April 2000
3.	LT-16705	A	Flammability Test Facility Procedures, Laz-Tec, LLC



## Section 1: Introduction

This test is conducted to ensure that the non-metallic materials used in the CW19-409, Mi-171 GPMS Foresight MX System meet the flammability requirements as defined by 14 CFR Part 29. This flammability test is in support of ODA Project CW19-409 for the Mi-171 GPMS Foresight MX System installation.

### 1.1: Modification Description

The modification in accordance with this STC provide for installation of the GPMS Foresight MX System in MiL Moscow Helicopter Plant – Joint Stock Company model Mi-171 rotorcraft.

The Foresight MX Condition Monitoring System is composed of the On-Board Computer Unit (OBCU), sensors, and sensor interfaces, where the system relies on a data bus to power the sensors and for sensor-OBCU data transfer.

The Foresight MX system collects and records the data for the following:

- Helicopter flight data monitoring
- Exceedance monitoring
- Rotorcraft vibration monitoring
- Condition monitoring of rotating components
- Engine performance monitoring

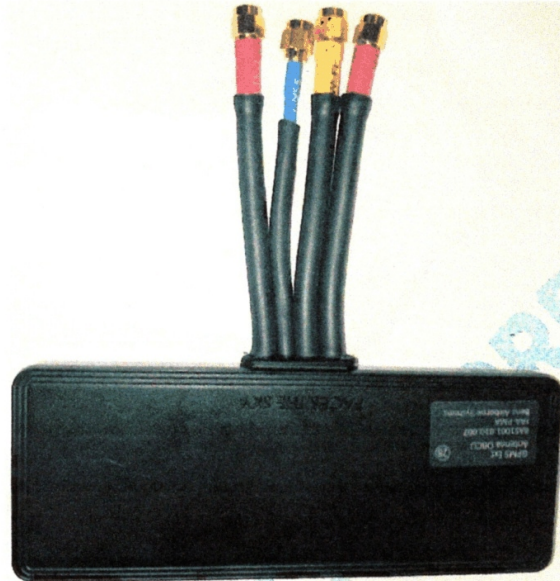


**Figure 1. Foresight MX Basic Equipment**

All data is recorded for monitoring purposes only, and is not presented to the pilot in any form. At the end of the mission (landing), the recorded data is automatically downloaded from the system. The operator then uses (compiles) the recorded data for operational diagnostics.



The only non-metallic item installed in the compartment interior is a Taoglas combination GNSS, LTE, and Wi-Fi low profile antenna, specifically part number 1001.010.007, shown below.



**Figure 2. Taoglas 1001.010.007 Antenna**

The antenna assembly consists of the antenna module and four (4) cable leads which provide signal to connected LRU's. In order to address compliance with the applicable flammability requirements of 14 CFR Part 29, the antenna module and cable leads will be tested separately to address compliance with 14 CFR 29.853(a)(2). The cable leads have been previously tested with passing results, and do not require re-test.

Refer to the Project Specific Certification Plan (GPMS-1010) for additional detail regarding the modification.

**Section 2: Regulatory Requirements**

This test plan addresses compliance with the following Title 14 Code of Federal Regulations (CFRs) regulation:

**Table 2 Applicable Airworthiness Requirements**

Reg.	Amdt.	Regulation Title	MOC
29.853(a)(1-4)	29-18	Compartment Interiors	GT
<b>Regulation Text</b>			
<p>[(a) The materials (including finishes or decorative surfaces applied to the materials) must meet the following test criteria as applicable:</p> <p>(1) Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self-extinguishing when tested vertically in accordance with the applicable portions of Appendix F of Part 25 of this chapter, or other approved equivalent methods. The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.</p> <p>(2) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, trays and galley furnishings, electrical conduit, thermal and acoustical insulation and insulation covering, air ducting joint and edge covering, cargo compartment liners, insulation blankets, cargo cover, and transparencies, molded and thermoformed parts, air ducting joints, and trim strips (decorative and chafing) that are constructed of materials not covered in paragraph (a)(3) of this section, must be self extinguishing when tested vertically in accordance with the applicable portion of Appendix F of Part 25 of this chapter, or other approved equivalent methods. The average burn length may not exceed 8 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than average of 5 seconds after falling.</p> <p>(3) Acrylic windows and signs, parts constructed in whole or in part of elastometric materials, edge lighted instrument assemblies consisting of two or more instruments in a common housing, seat belts, shoulder harnesses, and cargo and baggage tiedown equipment, including containers, bins, pallets, etc., used in passenger or crew compartments, may not have an average burn rate greater than 2.5 inches per minute when tested horizontally in accordance with the applicable portions of Appendix F of Part 25 of this chapter, or other approved equivalent methods.</p> <p>(4) Except for electrical wire and cable insulation, and for small parts (such as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, and small electrical parts) that the Administrator finds would not contribute significantly to the propagation of a fire, materials in items not specified in paragraphs (a)(1), (a)(2), or (a)(3) of this section may not have a burn rate greater than 4 inches per minute when tested horizontally in accordance with the applicable portions of Appendix F of Part 25 of this chapter, or other approved equivalent methods.</p>			
<b>Compliance Statement</b>			
<p>Testing will be conducted to show that the antenna meets the self extinguishing criteria of 14 CFR 29.853(a)(2) when tested viertically vertically in accordance with the applicable portion of Appendix F of Part 25.</p>			



<b>Reg.</b>	<b>Amdt.</b>	<b>Regulation Title</b>	<b>MOC</b>
29.1359(b)	29-0	Electrical system fire and smoke protection.	GT
<b>Regulation Text</b>			
(b) Electrical cables, terminals, and equipment, in designated fire zones, and that are used in emergency procedures, must be at least fire resistant.			
<b>Compliance Statement</b>			
There is no wiring or cable identified at this time which requires flammability testing in accordance with 14 CFR 29.1359(c). As such, the design complies.			

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### Section 3: Test Articles

Test articles to be tested are listed in Table 1 below. Test specimens shall be prepared as defined in the table below. A total of three test specimens of each type will be tested.

**Table 3 Test Materials**

Item #	Part Number (Description)	Description	Test Type	Test Coupon Definition	QTY	Test Card
1	1001.010.007	Antenna	12 Second Vertical	1 antenna module	3	TC-001

## Section 4: Test Facility

Testing will be conducted at Laz-Tec, LLC, located at 5500 Spur Cross Trail, Parker, CO, 80134.

## Section 5: Test Conformity

### 5.1: Test Article Conformity

As this project is being conducted as an "STC equivalent" project, there is no formal FAA/ODA conformity inspection. However, a statement will be provided by the Applicant, or Cert Works as an Agent, for the test articles verifying they meet the definition per this test plan prior to testing. A Cert Works Inspection subject matter expert will provide verification of the test articles prior to test.

## Section 6: Test Setup

### 6.1: Vertical Test Setup

The vertical test will be configured as follows (Ref. Aircraft Materials Fire Test Handbook, Chapter 1):

- Tests will be conducted in a draft-free cabinet fabricated in accordance with figures 1-1 to 1-2 of the referenced document.
- A Bunsen burner with a nominal 3/8 inch I.D. tube will be used for the test.
- Prior to testing, ignite the burner and set the flame height to 1½ inches.
- Using a calibrated thermocouple pyrometer, verify that the minimum flame temperature in the center of the flame is 1550° F. Record the flame temperature on the Test Data Sheet in Appendix A.
- Position the test specimen support frame so that the edge of the material being tested will be ¾-inch above the top of the burner and the flame will impinge on the midpoint of the lower edge of the front face of the test specimen.
- Extinguish the flame.

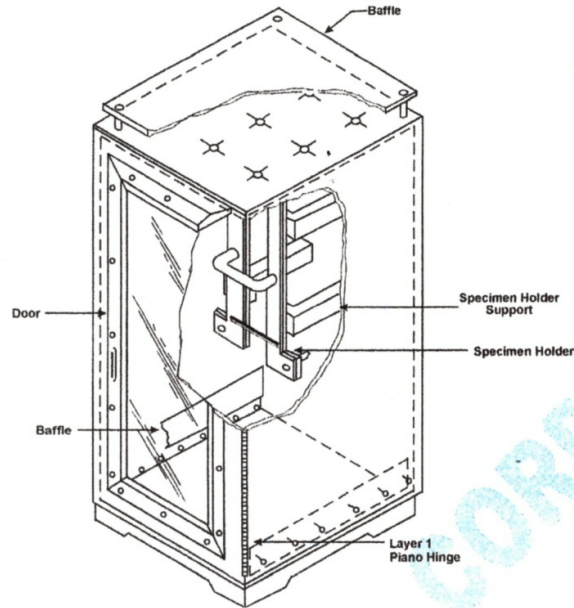


Figure 1 Sketch of Vertical Bunsen Burner Test Cabinet (Reference)

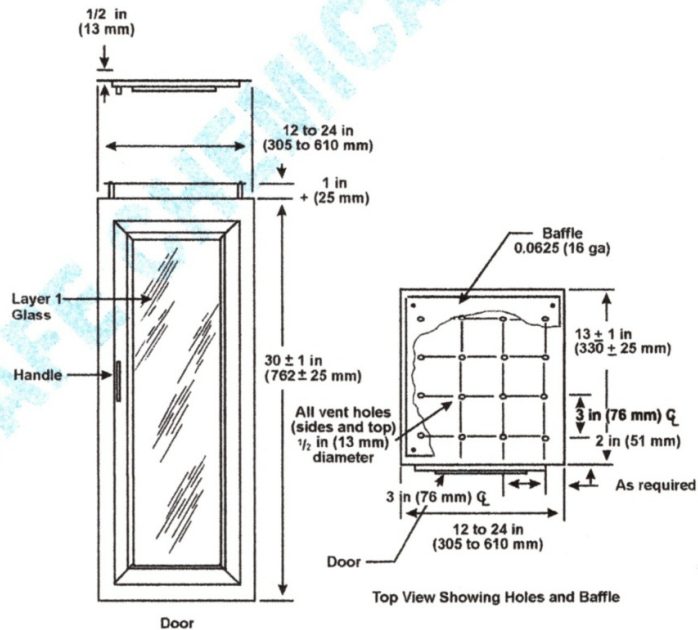


Figure 2 Front and Top View of Vertical Bunsen Burner Test Cabinet (Reference)



## 6.2: Test Instrumentation

The following instruments will be used in conducting the test:

- Thermocouple/thermometer, with minimum 0.1 degree F resolution.
- Timer (stopwatch) with minimum of 0.1 second measurements
- Ruler, graduated to at least 0.1 inch or (1/16 inch)
- Type K Thermocouple and Thermocouple Thermometer, up to at least 2000 °F, with minimum 1 degree measurements.

## 6.3: Test Specimen Conditioning

The three (3) test specimens of each material to be tested will be conditioned under the following criteria for 24 hours prior to test:

- Temperature: 70°F ±5°F
- Relative Humidity: 50% ±5%

One specimen will be removed at a time for testing; specimens will be removed immediately prior to testing. Alternatively, all three specimens may be removed at the same time if transported and stored in an airtight container; testing will be continuous and minimize exposure to temperature and humidity outside the conditioning window.

## 6.4: Data Collection

Data listed in the table below will be recorded manually on test cards (Appendix A); all other test data will be recorded electronically.

**Table 4 Test Data Collection**

Parameter	Unit (Resolution)	Equipment
Flame Application Time	Seconds (0.1)	Stopwatch
Flame Continuation	Seconds (0.1)	Stopwatch
Burn Length	Inches (0.1)	Rule
Flame Temp	°F (1.0)	Thermometer
Flame Height	Inches (0.1)	Wire Reference on Burner

## Section 7: Test Risk Assessment

### 7.1: Overall Test Risk Assessment

This test is conducted in a controlled laboratory environment. The testing involves fire and smoke related hazards. The following mitigation will be followed during the test:

1. Review of Test Plan.
2. Review of Test Apparatus and check for leaks, damage, wear, etc.
3. Testing to be conducted in area free of nearby combustibles.
4. Testing area will have ventilation.
5. Test Participants will utilize basic personal protective equipment; gloves, eye protection, and dust mask/respirator.
6. Appropriate Fire Extinguisher will be immediately available.

**Overall test risk is LOW.**

## 7.2: Emergency Procedures

In the event a test article burns in an uncontrolled manner, shut off the valve on the LPG tank if possible, exit the test facility immediately and call 911. Do not delay exiting solely to close the valve. For a minor fire, a fire extinguisher is located in the same room as the test chamber.

## Section 8: Test Procedures

### 8.1: Pre-Test Procedure

Test specimens will be:

1. Conditioned in accordance with Section 6.3: prior to testing. Conditioning log/records will be provided with the specimens.
2. Transported in an airtight container to the test chamber

### 8.2: Test Chamber Preparation

1. Inspect test chamber for safety.
2. Verify personal protective equipment, fire extinguisher, and test area are prepared for the testing.
3. Verify the gas supply is adequate for testing.

### 8.3: Vertical Test Procedure

The vertical test will be conducted as follows (Ref. Aircraft Materials Fire Test Handbook, Chapter 1). A minimum of three samples of each material must be tested, and the results averaged.

- Verify that the test articles have been conditioned to  $70^{\circ} \pm 5^{\circ}\text{F}$  and 50%  $\pm 5\%$  relative humidity for a minimum of 24 hours.
- Remove one test article at a time from the conditioning environment.
- Position the specimen in the support frame of the vertical test stand.
- Ignite the burner.
- Move the burner into position such that the flame is applied to the midpoint of the lower edge of the front face of the test specimen and start the timer.
- Extinguish the flame after 12 seconds, or 60 seconds, as applicable.
- Observe the behavior of the specimen after the burner flame is extinguished, and continue timing for as long as the material continues to burn.

#### 8.3.1: Vertical Test Pass/Fail Criteria

The material is considered to pass this test if all of the following criteria are met:

- The average burn length may not exceed 8 inches for the 12 second test, or 6 inches for the 60 second test
- The average flame time after removal of the flame source may not exceed 15 seconds
- Drippings from the test specimen may not continue to flame after falling for more than an average of 5 seconds for the 12 second test or 3 seconds for the 60 second test

#### **8.4: Post Test Procedures**

The samples tested will be fully identified. Verify all required data is completed on test cards.

### **Section 9: Conclusion**

The testing contained in this test plan will demonstrate that the materials tested meet the criteria per the applicable regulations listed in Table 2 by showing that the tested materials meet the flammability requirements of 14 CFR Part 29 as applicable to the materials used in the Mi-171 GPMS Foresight MX system installation. Test results will be documented in GPMS-1090, Flammability Test Report, Mi-171 GPMS Foresight MX System.

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**APPENDIX A: Test Cards**

Test Card No.	Topic	Test Date/Time
TC-001	12 Second Vertical Flammability Test, 14 CFR 29.853(a)(2)	

<b>COUPON PART NO:</b>	1001.010.007
<b>DESCRIPTION:</b>	Antenna
<b>TEST METHOD</b>	DOT/FAA/AR-00/12, Aircraft Materials Fire Test Handbook, Chapter 4, 12 second vertical test.
<b>14 CFR COMPLIANCE</b>	14 CFR 29.853(a)(2)
<b>PASS/FAIL CRITERIA</b>	The material is considered to pass this test the following criteria are met: <ul style="list-style-type: none"> <li>The average burn length may not exceed 8 inches for the 12 second test, or 6 inches for the 60 second test</li> <li>The average flame time after removal of the flame source may not exceed 15 seconds</li> <li>Drippings from the test specimen may not continue to flame after falling for more than an average of 5 seconds for the 12 second test or 3 seconds for the 60 second test</li> </ul>
<b>GENERAL NOTES</b>	Tests were conducted using the flammability test equipment maintained by Laz-Tec, LLC, located at 5500 Spur Cross Trail, Parker, CO, 80134. Calibration data for the Senonics Minnow-TH temperature and humidity data logger, S/N 3870, and the Digi-Sense type K thermocouple temperature meter, S/N 170620872 are maintained by Laz-Tec, LLC. The instruments were verified to be in calibration at the time of the testing.

**CONDITIONING DATA**

DATE	TIME	TEMPERATURE	HUMIDITY
<b>IN:</b>		F	%
<b>OUT:</b>		F	%
<b>FLAME TEMP:</b>	F		

SAMPLE ID	Self-extinguish - Yes/No	Extinguish Time (seconds)	Drip Extinguish Time (seconds)	Burn Length (inches)	PASS/ FAIL
3-1					
3-2					
3-3					
Avg					

Test conducted by: \_\_\_\_\_

Date: \_\_\_\_\_

**Appendix B – Reference Information**



Micro Wire Transmission Systems, Inc.  
8 Ewing Place  
Essex Junction, VT 05452

CERTIFICATE OF COMPLIANCE

Micro Wire Transmission Systems, Inc. certifies that all products listed below meet or exceed the applicable product specifications.

Customer: GPMS

PO Number: 11196

Part Numbers: 1001.010.007, Antenna Qty 1

Date: 07/29/2020

Rick Ricard  
Operations Manager

Micro Wire Transmission Systems, Inc.  
8 Ewing Place  
Essex Junction, VT 05452

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