

**PROTOFLIGHT ENVIRONMENTS**

**FOR**

**STAR 2 OXIDIZER TANK**

**ATK P/N 80426-1**

**80426-1 was subjected to the following protoflight tests:**

<b>TEST SEQUENCE</b>	<b>TEST DESCRIPTION</b>
1	Examination of Product, Preliminary
2	Volumetric Capacity Measurement
3	Proof Pressure Test
4	Volumetric Capacity Measurement
5	Differential Pressure Test
6	Protoflight Vibration Testing
7	PMD Bubble Point Test
8	External Leak Test
9	Weld Quality Inspection
10	Mass Measurement
11	Final Visual Inspection
12	Final Cleanliness

### **Differential Pressure Test**

Measures the pressure differential between ullage and the tank outlet. The tank assembly pressure drop shall not exceed 5.0 psid at a maximum flow rate of 0.10 lbm/sec (0.72 gpm).

This differential pressure test measures the actual pressure drop at 0.10 lbm/sec (0.72 gpm) flow rate. The test shall start at 95% fill fraction.

## MEOP Calculation

The MEOP is defined as 300 psia (314.7 psig) at 50 °C (122 °F).

Temperature (°F)	MEOP Pressure (psig)	Proof Pressure (psig)	Correction Factor (ref.)
40°	336.7	417.0	1.070
43°	336.1	416.1	1.068
45°	335.6	415.5	1.066
48°	335.1	414.9	1.065
50°	334.4	414.1	1.063
53°	333.8	413.3	1.061
55°	333.1	412.5	1.058
58°	332.4	411.7	1.056
60°	331.8	410.9	1.054
63°	331.1	410.0	1.052
65°	330.5	409.2	1.050
70°	329.2	407.6	1.046
73°	328.5	406.8	1.044
75°	327.8	406.0	1.042
80°	326.5	404.3	1.038
83°	325.9	403.5	1.035
85°	325.0	402.5	1.033
90°	323.6	400.7	1.028
95°	322.3	399.1	1.024
98°	321.6	398.2	1.022
100°	320.9	397.4	1.020

## Sine Vibration (Wet)

Tank is filled with 492, +5/-0 lbs of PF 5060 test fluid and pressurized to MEOP.

### Protoflight Sine Vibration Levels

Axis	Frequency Range (Hz)	Acceleration (g)	Sweep Rate
<b>Wet Tank</b>			
Spacecraft Thrust (Z axis)	4 – 13.4	0.5 inch DA	4 oct/min
	13.4 – 50	15.5	
	50 - 100	5.0	
Spacecraft Lateral (X axis)	4 – 15.5	0.5 inch DA	
	15.5 – 50	10.6	
	50 - 100	4.5	
Spacecraft Lateral (Y axis)	4 – 8.4	0.5 inch DA	
	8.4 – 50	6.8	
	50 - 100	3.0	

#### Notes:

1. Sine input spectra may be notched to limit tank response to:  
Spacecraft thrust (Z axis): 15.5 g (-0, +5%)  
Spacecraft lateral (X axis): 10.6 g (-0, +5%)  
Spacecraft lateral (Y axis): 6.8 g (-0, +5%)
2. Test fixture modes under 200 Hz shall be identified so that the controller input can be notched to achieve the specified environment.
3. A low level (<0.5g) sine sweep survey from 4 to 100 Hz shall be performed prior to and after each vibration axis. Any resonant frequency shift greater than 5% or resonant magnitude change greater than 10% from pre to post low level surveys shall require review and approval by Orbital.
4. The following dynamic loads must be achieved even if it means raising the levels for the respective axes:  
Spacecraft thrust (Z axis): 15.5 g (-0, +5%)  
Spacecraft lateral (X axis): 10.6 g (-0, +5%)  
Spacecraft lateral (Y axis): 6.8 g (-0, +5%)

## Random Vibration

Tank is filled with 492, +5/-0 lbs of PF 5060 test fluid and pressurized to MEOP.

### Protoflight Random Vibration Levels

Axis	Frequency Range (Hz)	PSD Level (g <sup>2</sup> /Hz)
<b>Wet Tank</b>		
X, Y and Z	20	0.01
	20-50	+2.1 dB/oct
	50-600	0.01875
	600-2000	-1.6 dB/oct
	2000	0.01
Overall 5.4 G <sub>rms</sub> Duration: 60 seconds per axis		

Notes:

1. Random input spectra may be notched to limit tank response to:  
Spacecraft thrust (Z axis): 15.5 g (-0, +5%)  
Spacecraft lateral (X axis): 10.6 g (-0, +5%)  
Spacecraft lateral (Y axis): 10.6 g (-0, +5%)
2. Test fixture modes under 3000 Hz shall be identified so that the controller input can be notched to achieve the specified environment.
3. A low level random survey shall be performed prior to and after each vibration axis. Any resonant frequency shift greater than 5% or resonant magnitude change greater than 10% from pre to post low level surveys shall require review and approval by Orbital.
4. It is permissible to start with a -12dB survey, followed by -9 dB, -6 dB, and -3 dB runs as required prior to starting the full level vibration testing.