

PROTOFLIGHT ENVIRONMENTS
FOR
PROPULSION SUBSYSTEM PROPELLANT
TANK
ATK P/N 80484-1

Table 1: P/N 80484-1 Propulsion Subsystem Propellant Tank Specification Requirements

Parameters	Requirements
Operating Pressure	300 psig
Proof Pressure	375 psig , Actual: 390 psig
Burst Pressure	
Collapse Pressure	N/A
Reverse Pressure	
Material of Construction	Shell: Solution Treated and Aged (STA) 6AL-4V Titanium Heads Inlet/Outlet Ports: 6AL-4V titanium to 304L Stainless transition tubes .375" Ø
Membrane Thickness	0.039 inch
Tank Mount(s)	
Expulsion Efficiency	99.9%
Design Fill Fraction	
Tank Capacity	39,232.3 in ³
Internal Dimensions	42.980 " Ø spherical
Tank Weight	62 lbs max, Actual: 57.45 lbs
Propellant Capacity	
Shell Leakage	<1x10 ⁻⁶ std cc/sec He max, Actual: 7.8x10 ⁻⁸ scc/sec @ 318 psig
Failure Mode	
Natural Frequency	
Temperature Environment	
On Orbit Life	

Note: The original tank P/N 80352-1 was successfully qualified as described in Qualification Test Report 56-000145. The environments were very similar to those specified in 464-PROP-SPEC-0017. It shall be noted that tank rupture occurred at a 648 psig, which is considerable higher than is required by the SDO program (450 psig_

The Propellant Management Device (PMD) is designed specific for the SDO mission and is therefore different than the original qualified. To determine the new designed SDO PMD parameters a tank simulator with a rigid bottom and a Plexiglas top were fabricated and tested successfully. See 362-2, SDO Test Summary from PMD Development Tests.

From the test results established in the simulator program, the loads at the PMD/Tank interface were analyzed. The conclusion is that the current tank shell, p/n 80352-1 will meet the requirements of the SDO Program. See 326-3, SDO Tank Shell at PMD Interface Stress and Fracture Analysis.

The PMD analysis uses the environment specified in the specification 464-PROP-SPEC-0017 rev. D. The margins of the PMD Design are positive. See 362-4 & -5, SDO PMD Stress Analysis & Propellant Management Performance Report 54-000248

80484-1 was subjected to the following protoflight tests:

Test Sequence	Test Title
1	Examination of Product
2	Volume Determination
3	Proof Pressure Test
4	Post Proof Volumetric Capacity Test
5	External Leakage Test
6	Specimen Draining and Drying
7	External Leakage
8	Tank Assembly Bubble Point Test
9	Vibration: Dry Random Dry sine Wet Random Wet Sine
10	Tank Assembly Bubble Point Test
11	Acceleration Test
12	Drain and Dry Test Specimen
13	Tank Assembly Bubble Point Test
14	Drain and Dry Test Specimen
15	External Leakage Test
16	Penetrant & Radiographic Inspection
17	Radiographic Inspection of PMD & Weld Expulsion
18	Final Examination of Product
19	Cleanliness Verification
20	Preparation for Delivery

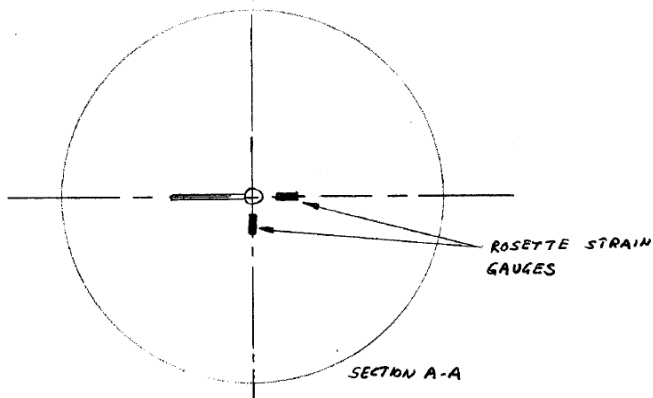
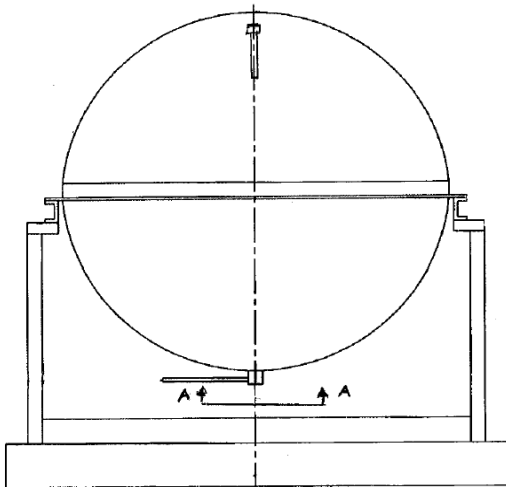
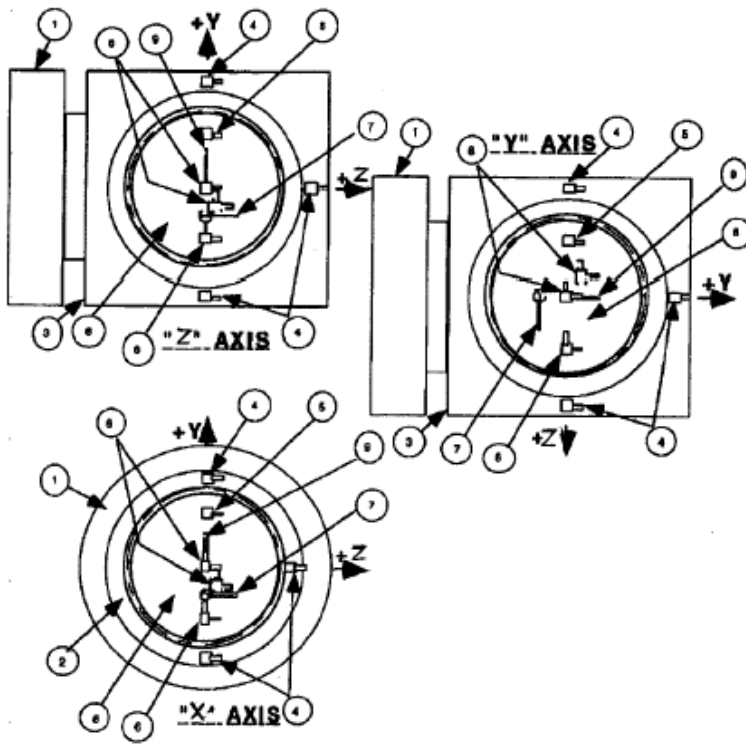
Note: The following tests are only included:

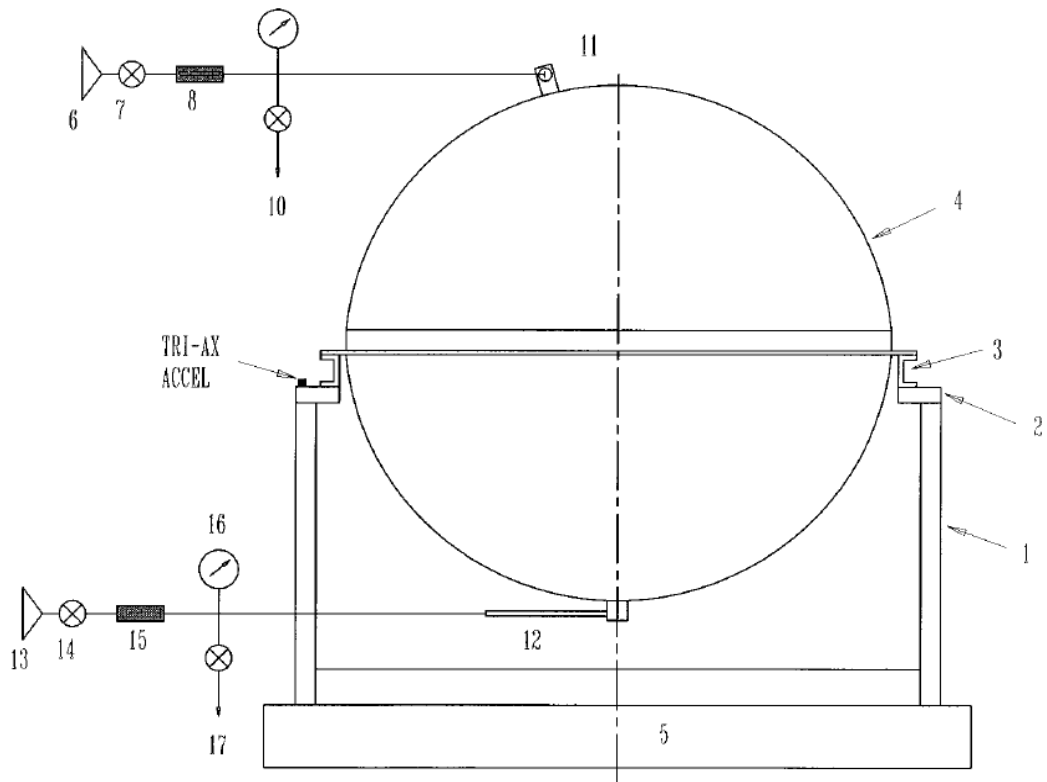
- 1) Proof Pressure Test
- 2) Sine Vibration Test
- 3) Random Vibration Test
- 4) Acceleration Test

Proof Pressure:

Performed at a pressure of 390 psig for a duration of 5 minutes.

Vibration Test Setup





1. TUBE
2. INTERFACE RING
3. MOUNT RING P/N 8590146
4. TANK
5. CENTRIFUGE TABLE
6. REGULATED NITROGEN SUPPLY
7. INLET VALVE
8. FILTER
9. PRESSURE GAUGE
10. VENT VALVE

11. PRESSURANT PORT
12. PROPELLANT PORT
13. DI WATER SUPPLY
14. INLET VALVE
15. FILTER
16. PRESSURE GAUGE
17. VENT VALVE

Random Vibration (Dry)

Protoflight Dry Random Vibration

AXIS	FREQUENCY (HZ)	PROTOFLIGHT LEVEL (g ² /Hz)
3 AXIS	20	0.01
	80	0.04
	350	0.04
	600	0.1
	850	0.1
	1250	0.07
	1500	0.013
	2000	0.01
	Overall	10.06 grms

- 1.) Test duration is 1 minute per axis.
- 2.) Pre "Dry Random" Sine Sweep - Conduct a dry signature sine sweep at .25g maximum from 5-2000 Hz. and 4 oct/min. The response limits shall be 10.71g axial and 4.375g lateral at the tank's net CG.
- 3.) Post "Dry Random" Sine Sweep – Repeat 2

Sine Vibration (Dry)

Protoflight Dry Sine Vibration

TEST AXIS	FREQUENCY (HZ)	PROTOFLIGHT Level (g)
Axial	5-30	1.25
	30-50	.38
Lateral	5-15	1.25
	15-30	3.75
	30-50	.63

- 1.) Limited to 0.5 inch maximum double amplitude
- 2.) Post Sine Dry Sweep – Exact to Pre “Dry Random” Sine Sweep procedure

Random Vibration (Wet)

Protoflight Wet Random Vibration

AXIS	FREQUENCY (HZ)	PROTOFLIGHT LEVEL (G ² /Hz)
ALL	20	.010
	2000	.010
	Overall	4.45 grms

- 1.) Test duration is 1 minute per axis.
- 2.) Tank is filled with 1385, +5/-0 lbs of water and pressurized to 309, +10/-0 psig
- 3.) Pre "Wet Random" Sine Sweep - Conduct a wet signature sine sweep at .25g from 5-2000 Hz with a sweep rate of 4 oct/min. The response limits shall be 10.71 axial and 4.375 lateral.
- 4.) Post "Wet Random" Sine Sweep – Repeat 3

Sine Vibration (Wet)

Protoflight Wet Sine Vibration

TEST AXIS	FREQUENCY (HZ)	PROTOFLIGHT LEVEL (g)
All		
	5-50	3.48g

- 1.) Limited to 0.5 inch maximum double amplitude
- 2.) Post Sine Sweep – Exact to Pre “Wet Random” Sine Sweep procedure

Acceleration Test

Axis	Qualification Level Case 1 (g)	Qualification Level Case 2 (g)
Axial (X) *	+10.711	-2.073
Lateral (Y)	+2.156	-2.156
Lateral (Z)	+2.309	-2.309

* Positive axial loads act such that the interface is in compression

- 1.) Tank loaded with 1385, +5/-0 lbs of water and pressurized to 309,+10/-0 psig.
- 2.) Tank angle is tilted 21.6° from center of the spin axis