

QUALIFICATION ENVIRONMENTS
FOR
SPHERE – HELIUM STORAGE, MISSILE-BORNE
ATK P/N 80218-1

Table 1: P/N 80218 SPHERE – HELIUM STORAGE, MISSILE-BORNE**Specifications**

Parameters	Requirements
Operating Pressure	3400 psig
Proof Pressure	5000 psig, Actual Proof: 5000 psig
Burst Pressure	5700 psig, Actual Burst: 5700
External Pressure	Not tested
Internal Vacuum	Not tested
Material of Construction	Spherical titanium pressure vessel with a polar port in each hemisphere. The sphere is designed to contain helium at cryogenic temperatures.
Membrane Thickness	0.226"
Tank Mount(s)	
Expulsion Efficiency	-
Design Fill Fraction	-
Tank Capacity	7365 in ³
Internal Dimensions	24.67" Ø spherical
Tank Weight	Maximum tank weight is 79 lbs, Actual tank weight is 76 lbs
Propellant Capacity	-
Shell Leakage	<1x10 ⁻⁶ std cc/sec He max, Actual: 6.0x10 ⁻⁸ std cc/sec He @ 24 psia
Failure Mode	Burst
Natural Frequency	-
Temperature Environment	-
On Orbit Life	-

80218-1 was subjected to the following qualification tests:

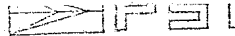
<u>TEST SEQUENCE NUMBER</u>	<u>DESCRIPTION OF TEST</u>
1	PRELIMINARY EXAMINATION OF PRODUCT
2	PROOF PRESSURE TEST
3	FINAL EXAMINATION OF PRODUCT
4	CLEANLINESS TEST
5	VIBRATION TEST
6	SHOCK TEST
7	LIFE TEST
8	BURST TEST
9	DESTRUCTIVE PRESSURE TEST

The following tests are listed in the report:

- 1) Proof Pressure & Cryogenic Proof Test
- 2) Vibration Test
- 3) Shock Test
- 4) Cycle Life Test
- 5) Burst Pressure Test
& Destructive Pressure Test

Proof Pressure Test & Cryogenic Proof Pressure Test

Tank is pressurized to 5000 psig and held for a test duration of a minute.
 For cryogenic temperature proof test, tank is cooled to a temperature of -320 F and
 pressurized to 5700 psig and held at maximum pressure for 65 seconds. No deformation
 was observed.

 Los Angeles, Cal. 90040
PRESSURE SYSTEMS, INC.

PSI TEST PROCEDURE NO. 20-000173
 PAGE 9

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DATA SHEET B
 PROOF PRESSURE TEST

DATE 11-13-74

PSI PART NUMBER 80218-1

PSI SERIAL NUMBER 0001

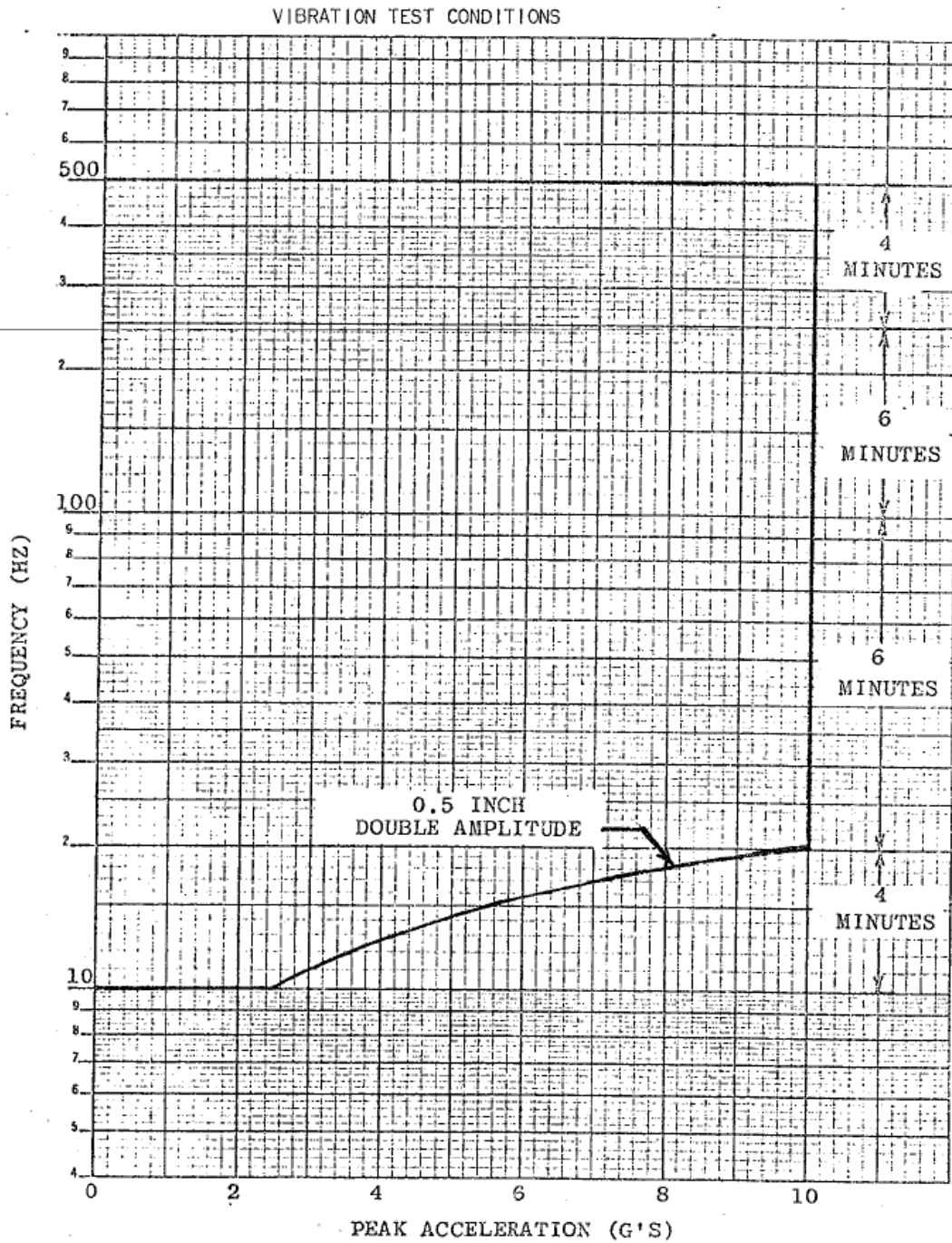
TEST PROCEDURE PARA. No. 4.2 DESCRIPTION: SPHERE, HELIUM STORAGE

TEST EQUIPMENT - IF DIFFERENT FROM PARA. 3.4 TEST Console P-306 N/A,

TEST Gauge P-135L 11-27-74 & Stopwatch G-21L 9-16-75

	TEST VALUE	REQUIREMENT
<u>AMBIENT TEMPERATURE PROOF TEST</u>		
TEST MEDIA	<u>DISTILLED DEIONIZED WATER</u>	<u>DISTILLED, DEIONIZED WATER</u>
SPECIMEN TEST PRESSURE	<u>5000</u> PSIG	<u>5000 ±20</u> PSIG
TEST DURATION	<u>1</u> MIN.	<u>1 MINUTE</u> MINIMUM
TANK DRIED	<div style="border: 1px solid black; padding: 2px; display: inline-block;">PSI 26</div>	OPERATOR STAMP
TESTED BY <u>Les Rose</u>	<u>D. G. D.</u> <small>CONTRACT 300 - PQAR</small>	DATE <u>11-13-74</u> SPECIMEN PASSED <input checked="" type="checkbox"/> <div style="border: 1px solid black; padding: 2px; display: inline-block;">PSI 26</div>
WITNESSED BY <u>[Signature]</u>	DATE <u>11-13-74</u>	SPECIMEN FAILED <input type="checkbox"/>
<u>CRYOGENIC TEMPERATURE PROOF TEST</u>		
TEMPERATURE STABILIZATION PRESSURE	<u>900</u> PSIG	<u>750 ±250</u> PSIG
TEMPERATURE	<u>-320</u> °F	<u>-320 ± 20°</u> F
PROOF PRESSURE (GN ₂)	<u>5700</u> PSIG	<u>5700 ± 30</u> PSIG
PRESSURIZATION TIME	<u>9.2</u> MINUTES	<u>5 MIN.</u> MINIMUM
TIME AT MAXIMUM PRESSURE	<u>65</u> SECONDS	<u>60, +10, -0</u> SEC.
VISUAL EXAMINATION	<u>No Distortion</u>	<u>NO DISTORTION</u>

Sine Vibration (Dry)



Tank is pressurized to 3400 ± 30 psig.

Test is conducted in the X axis (axial) and the Y axis (lateral).

Tests are at temperatures of ambient and -320°F , $\pm 20^{\circ}\text{F}$.

PRESSURE SYSTEMS, (C.

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DATA SHEET A
VIBRATION TEST

DATE 3-17-75






PSI PART No. 80218-1

PSI SERIAL No. 0001

TEST PROCEDURE PARA. No. 4.1

DESCRIPTION SPHERE, HELIUM STORAGE

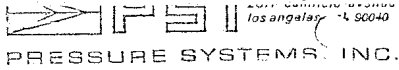
TEST EQUIPMENT LIST TO BE ATTACHED TO DATA SHEET

	TEST VALUE	REQUIREMENT
INTERNAL TEST MEDIA	<u>HELIUM</u>	HELIUM
<u>Y AXIS VIBRATION, AMBIENT</u>		
INTERNAL PRESSURE	<u>3400</u> PSIG	3400 ±30 PSIG
TEST TEMPERATURE	<u>87</u> °F	60° - 95°F
VIBRATION TEST (FIGURE 6)		OPERATOR STAMP
<u>Y AXIS VIBRATION, CRYOGENIC</u>		
INTERNAL PRESSURE	<u>3400</u> PSIG	3400 ±30 PSIG
TEST TEMPERATURE	<u>-320</u> °F	-320 ±20°F
VIBRATION TEST (AMBIENT INPUT)		OPERATOR STAMP
VIBRATION DATA PLOTS	 OPER. STAMP	ATTACHED TO DATA SHEET A
<u>X AXIS VIBRATION, AMBIENT</u>		
INTERNAL PRESSURE	<u>3420</u> PSIG	3400 ±30 PSIG
TEST TEMPERATURE	<u>82</u> °F	60° - 95°F
VIBRATION TEST (FIGURE 6)		OPERATOR STAMP
<u>X AXIS VIBRATION, CRYOGENIC</u>		
INTERNAL PRESSURE	<u>3400</u> PSIG	3400 ±30 PSIG
TEST TEMPERATURE	<u>-320</u> °F	-320 ±20°F
VIBRATION TEST (AMBIENT INPUT)		OPERATOR STAMP
VISUAL EXAMINATION		
TEMPERATURE	<u>62</u> °F	60° - 95°F
DAMAGE OR DISTORTION	<u>NONE</u>	NONE

Shock

Tank is subjected to a shock pulse of 100 ± 10 g's for 11 ± 2 milliseconds half sine wave form.

Tank is unloaded and unpressurized.



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DATA SHEET B
SHOCK TEST

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DATE 3-18-75

PSI PART No. 80218-1

PSI SERIAL No. 0001

TEST PROCEDURE PARA. No. 4.2

DESCRIPTION SPHERE, HELIUM STORAGE

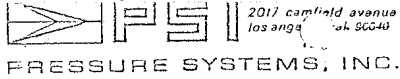
TEST EQUIPMENT LIST TO BE ATTACHED TO DATA SHEET

	TEST VALUE	REQUIREMENT
TEST MEDIA	<u>AIR</u>	<u>AIR</u>
TEST TEMPERATURE	<u>63 °F</u>	<u>60 to 95°F</u>
<u>Y AXIS SHOCK</u>		
PULSE	<u>-Y 98 G +Y 98 G G</u>	<u>100 ± 10G</u>
DURATION	<u>11MS 11MS M SEC</u>	<u>11 ± 2 M SEC</u>
<u>Z AXIS SHOCK</u>		
PULSE	<u>-Z 100 +Z 98 G</u>	<u>100 ± 10G</u>
DURATION	<u>11 11 M SEC</u>	<u>11 ± 2 M SEC</u>
<u>X AXIS SHOCK</u>		
PULSE	<u>-X 108 +X 108 G</u>	<u>100 ± 10G</u>
DURATION	<u>10 10 M SEC</u>	<u>11 ± 2 M SEC.</u>
<u>VISUAL EXAMINATION</u>		
DAMAGE OR DISTORTION	<u><i>[Signature]</i> NONE</u>	<u>NONE</u>
TESTED BY	<u><i>[Signature]</i></u>	DATE <u>3-18-75</u> SPECIMEN PASSED <u>X</u>

Life Cycle

Tank is pressurized to 3400 ± 30 psig and held for a 30, +5/-0 second period. Number of cycles is 400.

Tank's temperature is -320°F, ±20°F.



PSI TEST PROCEDURE No. 50-0001/4
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DATA SHEET C
LIFE TEST

DATE 3-23-75


PSI PART No. 80218-1

PSI SERIAL No. 0001

TEST PROCEDURE PARA. No. 4.3

DESCRIPTION SPHERE, HELIUM STORAGE

TEST EQUIPMENT LIST TO BE ATTACHED TO DATA SHEET

	<u>TEST VALUE</u>	<u>REQUIREMENT</u>
TEST MEDIA	<u>LN2</u>	LIQUID NITROGEN
TEMPERATURE STABILIZATION PRESSURE	<u>800</u> PSIG	750 ± 250 PSIG
TEST TEMPERATURE	<u>-320</u> °F	-320 ± 20°F.
<u>PRESSURE CYCLE</u>		
MAXIMUM PRESSURE	<u>3400</u> PSIG	3400 ± 30 PSIG
TIME AT MAXIMUM PRESSURE	<u>31</u> SEC	30, +5, -0 SEC
MINIMUM PRESSURE	<u>100</u> PSIG	100 PSIG MAXIMUM
NUMBER OF PRESSURE CYCLES	<u>400</u> CYCLES	400 CYCLES
<u>VISUAL EXAMINATION</u>		
TEMPERATURE	<u>70</u> °F	60 - 95°F
DAMAGE OR DISTORTION	<u>NONE</u>	NONE
TESTED BY <u>M. H. H.</u>  DATE <u>3-24-75</u> SPECIMEN PASSED <input checked="" type="checkbox"/>		

Burst Pressure & Destructive Pressure

Tank is submerged in 170°F deionized water and pressurized to 5700 ± 30 psig. Pressure is maintained for a 60 second hold period.

Tank is immersed in liquid nitrogen for a temperature of -320°F.

Tank is pressurized to 7100 ± 50 psig and maintained for a 60, +10/-0 second period.

Tank is pressurized to 9500 ± 50 psig and maintained for a 60, +10/-0 second period.

Tank is then brought to ambient conditions, and rupture occurs at 6700 psig.

DATA SHEET D
 BURST PRESSURE TEST

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DATE 3-25-75



PSI PART No. 80218-1

PSI SERIAL No. 0001

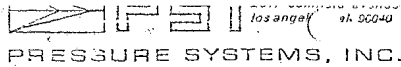
TEST PROCEDURE PARA. No. 4.4

DESCRIPTION SPHERE, HELIUM STORAGE

TEST EQUIPMENT LIST TO BE ATTACHED TO DATA SHEET

	TEST VALUE	REQUIREMENT
TEST MEDIA	<u>DI H₂O</u>	<u>D.I. WATER</u>
TEMPERATURE STABILIZATION PRESSURE	<u>850</u> PSIG	<u>750 ± 250</u> PSIG
TEST TEMPERATURE	<u>176</u> °F.	<u>170°+10°, -0°</u> F.
TEST PRESSURE	<u>5700</u> PSIG	<u>5700 ± 30</u> PSIG
PRESSURIZATION RATE	<u>5.8</u> PSIG/SEC	<u>50</u> PSIG/SEC MAX
TIME AT TEST PRESSURE	<u>62</u> SEC	<u>60, +10, -0</u> SEC
TANK DRAINED AND DRIED		<u>OPERATOR STAMP</u>
TESTED BY <u>J.V. Halar</u> 	DATE <u>3-25-75</u>	SPECIMEN PASSED <u>YES</u>
WITNESSED BY <u>[Signature]</u>	DATE <u>3-25-75</u>	SPECIMEN FAILED <u>NO</u>
PENETRANT INSPECTION OF TANK EXTERNAL SURFACE, EXCEPT THREADED BOSSES	OPER. STAMP	NO DEFECTS ALLOWED
TESTED BY <u>S.T. Gomez</u>	DATE <u>3/26/75</u>	SPECIMEN PASSED <u>✓</u>

Destructive Pressure Test



TEST PROCEDURE No. 50-000174
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DATA SHEET E

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DESTRUCTIVE PRESSURE TEST

DATE 3-28-75

PSI PART No. 80218-1

SERIAL No. 7104168001

PSI SERIAL No. 0001

TEST PROCEDURE PARA. No. 4.5

DESCRIPTION SPHERE, HELIUM STORAGE

TEST EQUIPMENT LIST TO BE ATTACHED TO DATA SHEET

CRYOGENIC TEST	TEST VALUE	REQUIREMENT
TEST MEDIA	<u>LN₂</u>	LIQUID NITROGEN
TEMPERATURE STABILIZATION PRESSURE	<u>900</u> PSIG	750 ± 250 PSIG
TEST TEMPERATURE	<u>-320</u> °F	-320 ± 20°F
TEST PRESSURE 1	<u>7140</u> PSIG	7100 ± 50 PSIG
PRESSURIZATION RATE	<u>900</u> PSIG/MIN	1000 PSIG/MIN MAX
TIME AT TEST PRESSURE 1	<u>67</u> SECONDS	60, +10, -0 SEC
TEST PRESSURE 2	<u>9500</u> PSIG	9500 ± 50 PSIG
PRESSURIZATION RATE	<u>950</u> PSIG/MIN	1000 PSIG/MIN MAX
TIME AT TEST PRESSURE 2	<u>62</u> SECONDS	60, +10, -0 SEC
TESTED BY <u>M.O. HAH</u>	DATE <u>3-28-75</u>	SPECIMEN PASSED <input checked="" type="checkbox"/>
WITNESSED BY <u>[Signature]</u>	DATE <u>3-28-75</u>	SPECIMEN FAILED <input type="checkbox"/>
AMBIENT TEMPERATURE RUPTURE TEST	TEST VALUE	REQUIREMENT
TEST MEDIA	<u>D.I. WATER</u>	D.I. WATER
TEST TEMPERATURE	<u>62</u> °F	60 TO 95°F
PRESSURIZATION RATE	<u>45</u> PSIG/SEC	50 PSIG/SEC MAX
RUPTURE PRESSURE	<u>6700</u> PSIG	RECORD
TESTED BY <u>M.O. HAH</u>	DATE <u>3-30</u>	SPECIMEN PASSED <input checked="" type="checkbox"/>