QUALIFICATION ENVIRONMENTS

FOR

PROPELLANT TANK ASSEMBLY

ATK P/N 80225-1

PSI 2017 camfield avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

FIGURE 1

SPECIMEN AXES AND PORT LOCATION

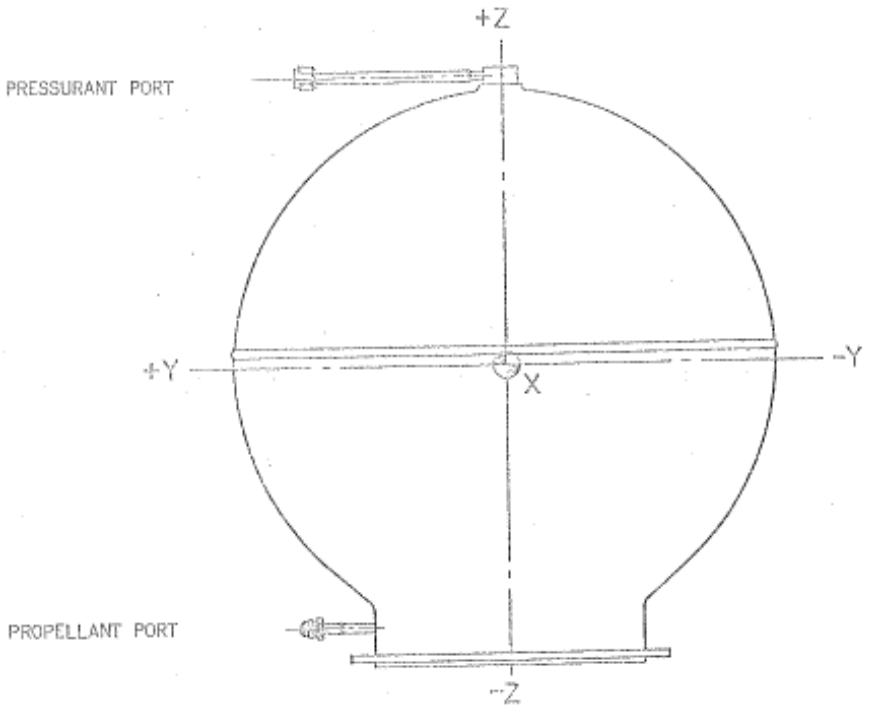


Table 1: P/N 80225 Propellant Tank Assembly

Specifications

Parameters	Requirements
Operating Pressure	psig
Proof Pressure	510 psig, Actual Proof: 520 psig
Burst Pressure	680 psig, Actual Burst: 680psig
External Pressure	Not tested
Internal Vacuum	Not tested
Material of Construction	Light weight spherical Titanium 6AL-4V pressure vessel with two ports (pressurant and propellant).
Membrane Thickness	0.019″
Tank Mount(s)	Mounted accomplished with a base mount.
Expulsion Efficiency	99.9%
Design Fill Fraction	-
Tank Capacity	1863.4 in^3
Internal Dimensions	15.450″ Ø spherical
Tank Weight	Maximum tank weight is 8.16 lbs, Actual tank weight is 7.4lbs
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	-

80225-1 was subjected to the following qualification tests:

Test Sequence Number	Description of Test
1	Examination of Product, Preliminary
2	Pre-Proof Volume
3	Proof
4	Post Proof Volume
5	Fixture Evaluation & Vibration
6	Internal He Leak (High Pressure)
7	Temperature Cycle
8	Internal He Leak (Low Pressure)
9	Internal He Leak (High Pressure)
10	External He Leak
11	Final Examination of Product
12	Weight Determination
13	Cleanliness
14	Sinusoidal & Random Vibration
15	Internal He Leak (High Pressure)
16	Shock
17	Internal He Leak (High Pressure)
18	Acceleration
19	Internal He Leak (High Pressure)
20	Spin Expulsion
21	Internal He Leak (Low Pressure)
22	Internal He Leak (High Pressure)
23	Temperature Cycle
24	Life Cycle
25	Internal He Leak (Low Pressure)
26	Internal He Leak (High Pressure)
27	External He Leak
28	Cleanliness Verification
29	Post Test Inspection
30	Burst Pressure

The following tests are listed in this document:

1) Proof Pressure Test
2) Temperature Cycle Test (I)
3) Sinusoidal & Random Vibration
4) Shock Test
5) Acceleration Test
6) Temperature Cycle Test (II)
7) Life Cycle Test
8) Burst Pressure Test

Proof Pressure Test

Tank is pressurized to 520 psig and held for ten minutes.

PSI 2007 sunfield avenue [illegible], calif 92040
PRESSURE SYSTEMS, INC.

PSI TEST PROCEDURE No. 50-000183
PAGE 29

REV	N/C	A	B			

DATA SHEET F

TEMPERATURE CYCLE TEST

(PARA. 4.7)

CUSTOMER ERNO — DATE 5-12-25

CUSTOMER P/N SK 365-011D — PART NAME PROPELLANT TANK ASSY.

CUSTOMER S/N 0002 — PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT SCALE E0290 CALIB EACH TEST

TEST MEDIA: ISOPROPYL ALCOHOL

	ACTUAL	REQUIREMENTS
TEMPERATURE	120 °F	118 ± 5°F
SIMULATED PROPELLANT LOAD	38 LBS	38 ± 2 LBS.
EXPULSION PRESSURE	320 PSIG	320, +10, -0 PSIG
NUMBER OF CYLES	ONE	1
AMOUNT OF RESIDUAL PROPELLANT	20 cc	RECORD
EXPULSION EFFICIENCY	99.9%	99% MINIMUM
TEMPERATURE	24 °F	25± 5°F
SIMULATED PROPELLANT LOAD	38 LBS	38 ± 2 LBS.
EXPULSION PRESSURE	320 PSIG	320, +10, -0 PSIG
NUMBER OF CYCLES	ONE	1
AMOUNT OF RESIDUAL PROPELLANT	23 cc	RECORD
EXPULSION EFFICIENCY	99.9%	99% MINIMUM

TESTED BY [signature] PSI 26 — DATE 5/12-25 — SPECIMEN PASSED ✓

PSI | 2017 camfield avenue los angeles, cal. 90040
PRESSURE SYSTEMS, INC.

REV	N/C	A				

DATA SHEET C

PROOF PRESSURE TEST

(PARA. 4.3)

DATE 5-6-75

PART NAME PROPELLANT TANK ASSY.

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT GAUGE ST0090 CALIB DUE 6-3-75

TEST MEDIA: DISTILLED, DEIONIZED WATER

	ACTUAL	REQUIREMENTS
TEST PRESSURE	520 PSIG	510 $\pm^{15}_{0}$ PSIG
PRESSURE HOLD PERIOD	10 MIN.	10 MINUTES
PRESSURE CYCLES	ONE	1
PRESSURIZATION RATE	200 PSIG/MINUTE	200 PSIG/MINUTE

TESTED BY Les Rose PSI 26 DATE 5-6-75 SPECIMEN PASSED Y

Temperature Cycle Test I

Tank is warmed up to a temperature of +120°F and cycled using an expulsion pressure of 320 psig. Two cycles total are performed.

PSI 2017 camfield avenue [illegible], calif 92040
PRESSURE SYSTEMS, INC.

PSI TEST PROCEDURE No. 50-000183
PAGE 29

REV	N/C	A	B				

DATA SHEET F

TEMPERATURE CYCLE TEST

(PARA. 4.7)

DATE 5-12-25

PART NAME PROPELLANT TANK ASSY.

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT SCALE E0290 CALIB EACH TEST

TEST MEDIA: ISOPROPYL ALCOHOL

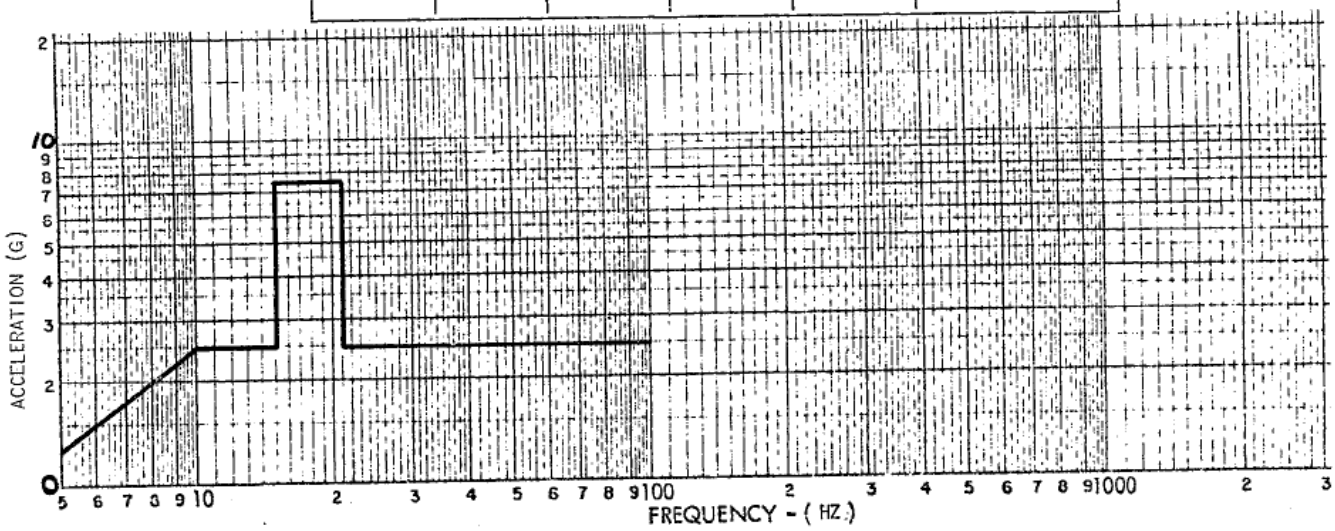
	ACTUAL	REQUIREMENTS
TEMPERATURE	120 °F	118 ± 5°F
SIMULATED PROPELLANT LOAD	38 LBS	38 ± 2 LBS.
EXPULSION PRESSURE	320 PSIG	320, +10, -0 PSIG
NUMBER OF CYLES	ONE	1
AMOUNT OF RESIDUAL PROPELLANT	20 cc	RECORD
EXPULSION EFFICIENCY	99.9%	99% MINIMUM
TEMPERATURE	24 °F	25± 5°F
SIMULATED PROPELLANT LOAD	38 LBS	38 ± 2 LBS.
EXPULSION PRESSURE	320 PSIG	320, +10, -0 PSIG
NUMBER OF CYCLES	ONE	1
AMOUNT OF RESIDUAL PROPELLANT	23 cc	RECORD
EXPULSION EFFICIENCY	99.9%	99% MINIMUM

TESTED BY [signature] PSI 26 DATE 5-12-25 SPECIMEN PASSED ✓

Sine Vibration (Wet)

SINUSOIDAL VIBRATION

Axis	Frequency		D. A. Inches	G Peak	Sweep Rate Minutes/Octave
	From	To			
All Axes X, Y & Z	5	10	0.5		0.5 min/oct
	10	15		2.5	
	15	21		7.5	
	21	100		2.5	



Tank is loaded with 50 ± 1 lbs of distilled, deionized water and pressurized to 320, +10/-0 psig with nitrogen gas.

PSI 2017 caulfield avenue los angeles, calif. 90064
PRESSURE SYSTEMS, INC.

REV	N/C	A					

DATA SHEET A
SINUSOIDAL VIBRATION
(PARA. 4.2.8)

DATE 5-15-76

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT SEE LAB LOG

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	328

* AXIS	FREQUENCY FROM	FREQUENCY TO	D.A. INCHES	G PEAK	SWEEP RATE MINUTES/OCTAVE	DURATION TOTAL MINUTES
Z	5	10	0.5			
	10	15		2.5		
	15	21		7.5		
	21	100		2.5	0.5 MIN/OCT	2 MIN 15 SEC

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
		SEE LAB LOG

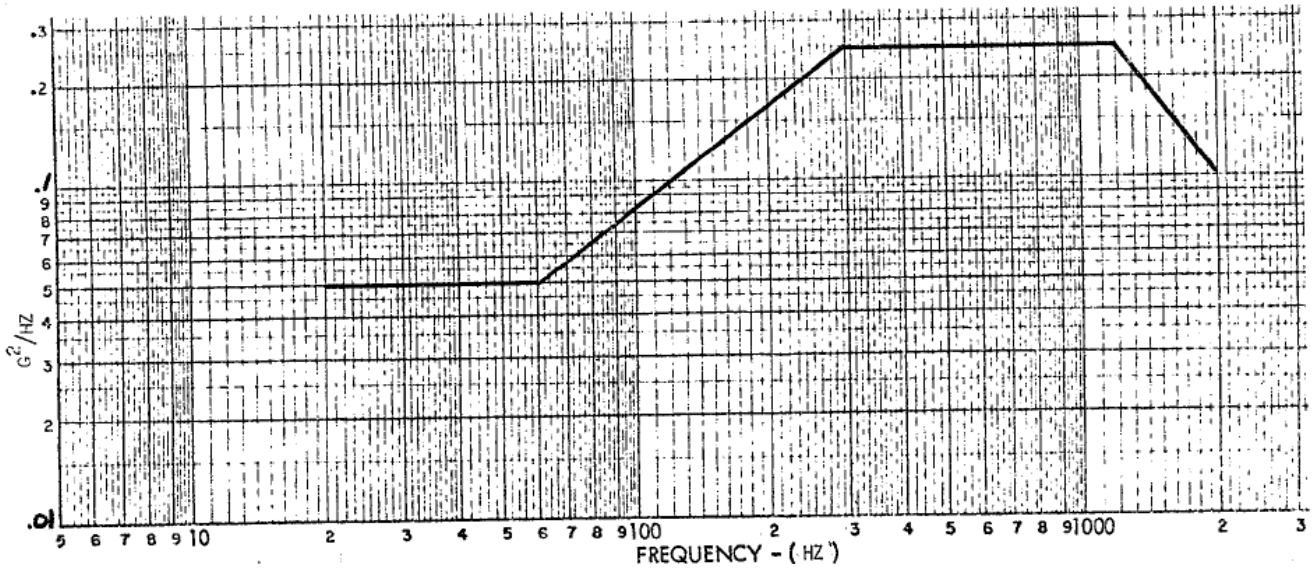
TESTED BY M.L. MUSTARD DATE 5-15-76 SPECIMEN PASSED X

Random Vibration (Wet)

RANDOM VIBRATION SPECTRUM

Axis	Frequency		Overall G rms	G^2/Hz	db/oct Roll Up	db/oct Roll Off
	From	To				
All	20	60		0.05		
Axes	60	300	19.6		+3 db/oct	
X, Y & Z	300	1200		0.25		
	1200	2000				-6 db/oct

DURATION: 2 MINUTES ON EACH AXIS



Tank is loaded with 50 ± 1 lbs of distilled, deionized water and pressurized to 320, +10/-0 psig with nitrogen gas.

PRESSURE SYSTEMS, INC.
2017 chenfield avenue
los angeles, cal. 90040

REV	N/C	A				

DATA SHEET 8

RANDOM VIBRATION

(PARA. 4.2.13)

DATE 5-15-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002 PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT SEE LAB LOG

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	

* AXIS	FREQUENCY FROM	FREQUENCY TO	G RMS	G^2/Hz	DB/OCT ROLL UP	DB/OCT ROLL OFF	RUN TIME
K	20	60		0.05			
	60	300			3.0		
	300	1200		0.25			2 MIN/
	1200	2000	19.6			6.0	AXIS

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
		SEE LAB LOG

TESTED BY M. L. MUSTARD DATE 5-15-75 SPECIMEN PASSED X

PSI 2017 camfield avenue los angeles, cal. 90040
PRESSURE SYSTEMS, INC.

PSI TEST PROCEDURE No. 50-000183
PAGE 27

REV	N/C	A				

DATA SHEET D

RANDOM VIBRATION

(PARA. 4.5.2)

DATE 5-7-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50.25
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	328

* AXIS	FREQUENCY FROM	FREQUENCY TO	G RMS	G^2/Hz	DB/OCT ROLL UP	DB/OCT ROLL OFF	RUN TIME
X	20	60		0.015			
	60	300			+3		
	300	1200		.0625			
	1200	2000	14.79			-6	30 SEC

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
5-7-75	1147	"X" AXIS TEST RUN
		START PRESS @ 328 PSIG
		STOP PRESS @ 327 PSIG

TESTED BY M. L. Mustard DATE 5-7-75 SPECIMEN PASSED yes

PSI 2017 camfield avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

REV	N/C	A				

DATA SHEET D

RANDOM VIBRATION

(PARA. 4.5.2)

DATE 5-7-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50.25
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	328

* AXIS	FREQUENCY FROM	FREQUENCY TO	G RMS	G^2/Hz	DB/OCT ROLL UP	DB/OCT ROLL OFF	RUN TIME
Y	20	60		.015			
	60	300			+3.0		
	300	1200		.0625			
	1200	2000	14.79			-6	30 SEC

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
5/7/75	1105	"Y" AXIS RANDOM RUN
		START PRESS @ 328 PSIG
		STOP PRESS @ 326 PSIG

TESTED BY M.R. Mustard DATE 5-7-75 SPECIMEN PASSED yes

PSI 2017 camfield avenue los angeles, cal. 90049
PRESSURE SYSTEMS, INC.

REV	N/C	A				

DATA SHEET D

RANDOM VIBRATION

(PARA. 4.5.2)

DATE 5-7-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50.25
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	328

* AXIS	FREQUENCY		G RMS	G^2/Hz	DB/OCT ROLL UP	DB/OCT ROLL OFF	RUN TIME
	FROM	TO					
Z	20	60		.015			
	60	300			+3.0		
	300	1200		.0625			
	1200	2000	9.79			-6.0	30 SEC

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
5-7-75	0945	RUN "Z" AXIS RANDOM.
		START PRESS @ 328 PSIG
		STOP PRESS @ 326 PSIG

TESTED BY M. L. Mustard DATE 5-7-75 SPECIMEN PASSED yes

PSI 2017 east field avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

REV	N/C	A				

DATA SHEET B

RANDOM VIBRATION

(PARA. 4.2.13)

DATE 5-15-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N A002

TEST EQUIPMENT SRELAB LOG

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	

* AXIS	FREQUENCY FROM	FREQUENCY TO	G RMS	G^2/Hz	DB/OCT ROLL UP	DB/OCT ROLL OFF	RUN TIME
Y	20	60		0.05			
	60	300			3.0		2 MIN/
	300	1200		0.25			AXIS
	1200	2000	19.6			6.0	

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
		SRELAB LOG

TESTED BY M. MUSTARD DATE 5.15.75 SPECIMEN PASSED X

PSI 2017 east field avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

REV	N/C	A				

DATA SHEET B

RANDOM VIBRATION

(PARA. 4.2.13)

DATE 5-15-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0003

TEST EQUIPMENT SEE LAB LOG

		ACTUAL
WEIGHT OF WATER IN SPECIMEN:	50 ± 1 POUNDS	50
SPECIMEN PRESSURE:	320 + 10 -0 PSIG	

* AXIS	FREQUENCY FROM	FREQUENCY TO	G RMS	G^2/Hz	DB/OCT ROLL UP	DB/OCT ROLL OFF	RUN TIME
Z	20	60		0.05			
	60	300			3.0		
	300	1200		0.25		6	2 MIN/ AXIS
	1200	2000	19.6			6.0	

* USE A SEPARATE DATA SHEET FOR EACH AXIS.

DATE	TIME	LOG ENTRIES
		SEE LAB LOG

TESTED BY M.L. MUSTARD DATE 5-15-75 SPECIMEN PASSED X

Shock Test

Tank is subjected to 3 shock pulses of half sine wave form having an amplitude of 100 ± 10g's. Duration of the pulse is 0.5 ± 0.1 ms.

Tank is loaded with 50 ± 1 lbs of distilled, deionized water and pressurized to 320, +10/-0 psig with nitrogen gas.

PSI 2017 camfield avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

REV	N/C	A			

DATA SHEET D

SHOCK TEST

(PARA. 4.4)

DATE 5-19-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT

TEST MEDIA: DISTILLED, DEIONIZED WATER & GN_2

	ACTUAL			REQUIREMENTS
AXES:	X	Y	Z	
SIMULATED PROPELLANT LOAD	50	50	50	50 ± 1 LBS.
SPECIMEN PRESSURE	326	322	326	320, +10, -0 PSIG
SHOCK G's	110	100	100	100 ± 10 G's
SHOCK DURATION	0.5	0.5	0.5	0.5 ± 0.1 MS
NUMBER OF SHOCK PULSES	3	3	3	3

TESTED BY C. Wallace DATE 5-19-75 SPECIMEN PASSED X

Acceleration

Tank is subjected to the following G levels for 1 minute duration in both directions in each of the three axes.

X - X Axis	7.2 ± .7 G's
Y - Y Axis	7.2 ± .7 G's
Z - Z Axis	18 ± 1.8 G's

Tank is loaded with 50 ± 1 lbs of distilled, deionized water and pressurized to 320, +10/-0 psig with nitrogen gas.

PSI 2017 cumfield avenue los angeles, cal. 90040
PRESSURE SYSTEMS, INC.

REV N/C A

DATA SHEET E

ACCELERATION TEST

(PARA. 4.6)

DATE 5-20-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002 PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT

TEST MEDIA: GN_2 & DISTILLED, DEIONIZED WATER

		ACTUAL						REQUIREMENT
	AXES:	+X	-X	+Y	-Y	+Z	-Z	
1)	WT. OF WATER IN SPECIMEN	50	50	50	50	50	50	SEE LOG.
2)	PRE-TEST INTERNAL PRESSURE	320psig	320psig	320psig	320psig	320psig	320psig	320, +10, -0 PSIG
3)	G LEVELS	7.2	7.2	7.2	7.2			7.2±.7G's
						18.0	18.0	18 ± 1.8G's
4)	DURATION	1	1	1	1	1	1	1, +.5,-0M

TESTED BY G.L. Roberts (AETL) DATE 5-20-75 SPECIMEN PASSED X

Temperature Cycle Test

The tank's temperature is reduced to -40°F ± 5°F and stabilized for 8, +1 hours.

The tank's temperature is then raised to 150°F ± 10°F and stabilized for 8, +1 hours.

PSI 2017 camfield avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

PSI TEST PROCEDURE No. 50-000184
PAGE 38

REV	N/C	A					

DATA SHEET H

TEMPERATURE CYCLE TEST

(PARA. 4.11)

DATE 5-21-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT TEMP CONTROLLER SN 631344 CALIB DUE 6-16-75

	ACTUAL	REQUIREMENTS
LOW TEMPERATURE		
SPECIMEN TEMPERATURE	-41 °F	-40 ±5°F
TIME AT TEMPERATURE	8 HR.	8 +1 HOURS
HIGH TEMPERATURE		
SPECIMEN TEMPERATURE	150 °F	150, ± 10°F
TIME AT TEMPERATURE	8 HR	8 +1 HOURS
EXPULSION EFFICIENCY		
SIMULATED PROPELLANT LOAD	38	38 ± 2 LBS.
EXPULSION CHARGE	320	320, +10, -0PSIG
RESIDUAL PROPELLANT	5 cc	RECORD
EXPULSION EFFICIENCY	99.9 %	99% MINIMUM

TESTED BY Les Rose PSI 26 DATE 5-21-75 SPECIMEN PASSED ✓

Life Cycle Test

Test performed at 12°F ± 4°F. Tank is loaded with 38.2 ± 2 lbs of isopropyl alcohol and pressurized to 320, +10/-0 psig. Tank is then drained and vented. Number of cycles is 50.

Test performed at 130°F ± 4°F. Tank is loaded with 38.2 ± 2 lbs of isopropyl alcohol and pressurized to 320, +10/-0 psig. Tank is then drained and vented. Number of cycles is 50.

PSI | 2017 eastfield avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

REV	N/C	A				

DATA SHEET J

LIFE CYCLE TEST

(PARA. 4.12)

DATE 5-27-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N 0002

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT SCALE E0270 CALIB EACH TEST
GAUGE ST 0334 CALIB DUE 11-27-75

TEST MEDIA: LOW TEMPERATURE – ISOPROPYL ALCOHOL

	ACTUAL	REQUIREMENTS
SPECIMEN TEMPERATURE	12 °F	12 ± 4°F
SIMULATED PROPELLANT LOAD	38 lbs	38 ± 2 LBS.
EXPULSION CHARGE	320 PSIG	320, +10, -0PSIG
NUMBER OF CYCLES	50 CYCLES	50

TEST MEDIA: HIGH TEMPERATURE – ISOPROPYL ALCOHOL

	ACTUAL	REQUIREMENTS
SPECIMEN TEMPERATURE	130 °F	130 ± 4°F
SIMULATED PROPELLANT LOAD	38 lbs	38 ± 2 LBS.
EXPULSION CHARGE	320 PSIG	320, +10, -0PSIG
NUMBER OF CYCLES	50 CYCLES	50

TEST MEDIA: EXPULSION EFFICIENCY – ISOPROPYL ALCOHOL @ AMBIENT TEMP.

	ACTUAL	REQUIREMENTS
SIMULATED PROPELLANT LOAD	38 lbs	38 ± 2 LBS.
EXPULSION CHARGE	320 PSIG	320, +0, -0PSIG
RESIDUAL PROPELLANT	7 cc	RECORD
EXPULSION EFFICIENCY	99.9%	99% MINIMUM

TESTED BY Les Pine PSI 26 DATE 5-28-75 SPECIMEN PASSED ✓

Burst Pressure

The requirement for the minimum burst pressure is 680 psig. Tank is held at pressure for 20 seconds.

The tank was not ruptured, thus no actual burst pressure.

PSI 2031 camfield avenue los angeles, calif. 90040
PRESSURE SYSTEMS, INC.

PSI TEST PROCEDURE NO. 50-000189
PAGE 42

REV	N/C	A				

DATA SHEET M

BURST PRESSURE TEST

(PARA. 4.18)

DATE 5-30-75

PART NAME PROPELLANT TANK ASSEMBLY

CUSTOMER S/N _____

PSI P/N 80225-1

PSI S/N 0002

TEST EQUIPMENT GAUGE ST 0090 CALIB DUE 6-3-75

TEST MEDIA: DISTILLED, DEIONIZED WATER

		ACTUAL	REQUIREMENTS
	HOLD PRESSURE	680 PSIG	680, +0, -10
"A"	PRESSURE HOLD PERIOD	20	20 ± 10 SECONDS
	RUPTURE PRESSURE	N/A	681 PSIG MINIMUM

TESTED BY Les Rose PSI 26 DATE 5-30-75 SPECIMEN PASSED ✓