

**PROTOFLIGHT ENVIRONMENTS**  
**FOR**  
**NFIRE PROPELLANT TANK ASSEMBLY**  
**ATK P/N 80462-1**



NFIRE PROELLANT TANK

ATK P/N 80462



**Table 1: P/N 80462-1 NFIRE Propellant Tank Assembly Specification Requirements**

<b>Parameters</b>	<b>Requirements</b>
Operating Pressure	420 psig
Proof Pressure	630 psig, Actual: 663 psig
Burst Pressure	524 psig, Actual: 669 psig
External Pressure	
Internal Vacuum	14.7 psid, Actual: 14.4 psid
Material of Construction	Pressure vessel with hemispherical ends and a cylindrical section constructed of 6AL-4V Titanium. Propellant and pressurant ports are ¼ inch diameter 3AL-2.5V titanium stubs.
Membrane Thickness	0.036 inch
Tank Mount(s)	Three (3) equally spaced circumferential tabs with threaded holes located on one of the hemispheres near the girth weld joint.
Expulsion Efficiency	
Design Fill Fraction	
Tank Capacity	9890.9 in <sup>3</sup>
Internal Dimensions	25" Ø x 29" cylindrical shape
Tank Weight	22.0 lbs max, Actual: 18.925 lbs
Propellant Capacity	253 lbs
Shell Leakage	<1x10 <sup>-6</sup> std cc/sec He, Actual: 3.6x10 <sup>-8</sup> scc/sec @ 270 psig
Failure Mode	Burst
Natural Frequency	
Temperature Environment	
On Orbit Life	

80462-1 was subjected to the following protoflight tests:

<b>Test Sequence</b>	<b>Test Description</b>
1.	Preliminary Inspection of Product
2.	Pre-Proof Volumetric Capacity, Ambient Proof Pressure, Visual Inspection, and Post-Proof Volumetric Capacity
3.	Pressure Drop Test
4.	Internal Vacuum Test
5.*	Bubble Point Test
6.*	External Leakage Test
7.	Dry Random Vibration Test and Visual Inspection
8.	Wet Static Load (Centrifuge) Test
9.*	Bubble Point Test
10.*	External Leakage Test
11.**	Radiographic Inspection
12.**	Dye Penetrant Inspection
13.	Mass Determination, Cleanliness Check and Visual Inspection
14.	Data Review

Note: The following tests are only listed

- 1) Pressure Log
- 2) Proof Pressure
- 3) Pressure Drop Test
- 4) Internal Vacuum Test
- 5) Dry Random Vibration Test
- 6) Wet Static Load Test

# Pressure Log

Pressure Systems, Inc.

Procedure No. 50-000618  
Page 50 Revision NE

## DATA SHEET "O" PRESSURE LOG

PSI Part No. 80462-11-11

PSI Serial No. 0001

Test Procedure Para. No. 3.15

PSI Part Name Propellant Tank

Item	Performing Department	Fluid Medium	Title of Test	Specification Pressure	Actual Pressure	Time at Pressure	Number of Cycles	Date
4.2	70 (S)	H <sub>2</sub> O	PROOF PRESSURE	663 <sup>+5</sup> <sub>-0</sub>	665	5.0 MIN	1	9-25-03
4.3	70 (S)	N <sub>2</sub>	PRESSURE DROP	420±10	426	70.0 MIN	1	9-25-03
4.6	70 (S)	He	EXTERNAL LEAK	420 <sup>+5</sup> <sub>-0</sub>	422	35 MIN	1	9-26-03
4.8	OP (S)	N <sub>2</sub>	WET STATIC LOAD	P0 <sup>+5</sup> <sub>-0</sub>	440	120 MIN	1	10-9-03
4.10	70 (S)	He	EXP. LEAK	420 <sup>+5</sup> <sub>-0</sub>	422	32 MIN	1	10-10-03

127

# Proof Pressure Test

Tank was subjected to a pressure of 663 psig for five minutes. One cycle was performed.

Pressure Systems, Inc.



Procedure No. 50-000618  
Page 35 Revision NC

## DATA SHEET "C" PROOF PRESSURE TEST

Date: 9-25-03  
 PSI Part No. 80462-11  
 Test Procedure Para. No. 4.2 PSI Serial No. 0001  
 Test Equipment GAGE, ST-1054 PSI Part Name: Propellant Tank  
CAL DATE 8-25-03, DUE 2-25-04  
TRANSDUCER - ST-1044 CAL DATE 8-25-03 DUE 2-25-04


Test Media: Distilled/Deionized Water

	Actual	Required
(1) Specimen Water Temperature	<u>70</u> Degrees F	Record
(2) Design Proof Pressure (= Pp) (From Paragraph 4.2.2.A)	<u>663</u> psig	Pp, +5, -0 psig
(3) Test Period	<u>5</u> Minutes	5 minutes, minimum
(4) Cycle	<u>1</u> Cycle	One (1) Cycle
(5) Visible Deformation	<u>NONE</u>	None

Inspected By [Signature]  Date 9-25-03 Tank Passed Yes  
 Witnessed By N/A  Date \_\_\_\_\_ Tank Failed NO

# Pressure Drop Test

Pressure Systems, Inc.


Procedure No. 50-000618  
Page 44 Revision 

## DATA SHEET "I" PRESSURE DROP TEST

Date: 9-25-03  
PSI Part No. 80462-11  
Test Paragraph No. 4.3 PSI Serial No. 0001  
Test Equipment: Gauge ST-0215 CAL 8-12-03 PSI Part Name: Propellant Tank  
DJE 2-13-04, ST-0713 CAL 6-16-03 DJE 12-7-03

Test Media: Distilled/Deionized Water

	Actual	Required
(1) Tank Pressure	420 Psig	420 +/- 10 psig
(2) Water Flow Rate	.95 GPM Lbs/sec (GPM)	0.132 lbs/sec (0.95 GPM) +/- 5 %
(3) Water Temperature	70 Degrees F	Record
(4) Inlet Pressure Gauge Reading (start of test)	421 Psig	Record
(5) Delta Pressure Gauge Reading (start of test)	4.8 Psid	12 psid maximum
(6) Inlet Pressure Gauge Reading (middle of test)	425 Psig	Record
(7) Delta Pressure Gauge Reading (middle of test)	6.0 Psid	12 psid maximum
(8) Inlet Pressure Gauge Reading (end of test)	426 Psig	Record
(9) Delta Pressure Gauge Reading (end of test)	6.1 Psid	12 psid maximum
(10) Residual Water, Specimen, & Fixture Weight	284.1 Lb	Record
(11) Residual Water Volume ((Paragraph 4.3.C)	24.96 Cu. In	49 cubic inches, maximum
(12) Damage or deformation	NONE	None Allowed

Tested By  Date 9-25-03 Tank Passed Yes  
Witnessed By N/A Date \_\_\_\_\_ Tank Failed NO

**Internal Vacuum Test**


Tank evacuated to a differential pressure of 14.7, +0/-0.5 psid and held for 30, +5/-0 seconds.

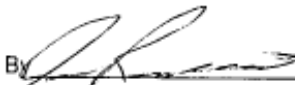


Pressure Systems, Inc.

Procedure No. 50-000618  
Page 36 Revision ~~NE~~ **A**

**DATA SHEET "D"  
INTERNAL VACUUM TEST**

Date: 9-25-03  
 PSI Part No. 80462-11  
 Test Procedure Para. No. 4.4 PSI Serial No. 0001  
 Test Equipment Gauge, ST-0369 PSI Part Name: Propellant Tank  
CAL DATE 9-24-03 DOE 3-24-04

	Results	Requirement
(1) Visual Inspection for Damage	NONE	None Allowed
(2) Safety Relief Valve Installed		Compliance
(3) External Pressure	14.4 Psid	14.7, +0, -.5 psid
(4) Duration	30 Seconds	30, +5, -0 seconds
(5) Cycle	1 Cycle	One (1) Cycle
(6) Visual Inspection for Damage	NONE	None Allowed

Inspected By   Date 9-25-03 Tank Passed Yes  
 Witnessed By NA  Date \_\_\_\_\_ Tank Failed NO



## Random Vibration Test (Dry)












**Random Vibration Levels (Dry)**

<b><u>Frequency</u></b> <b><u>(Hz) (Lateral)</u></b>	<b><u>PSD (g<sup>2</sup>/Hz)</u></b> <b><u>(Lateral)</u></b>	<b><u>Frequency</u></b> <b><u>(Hz) (Axial)</u></b>	<b><u>PSD (g<sup>2</sup>/Hz)</u></b> <b><u>(Axial)</u></b>
20	0.004	20	0.006
65	0.16	38	0.09
305	0.16	56	0.42
420	0.004	84	0.42
2000	0.0002	120	0.022
		480	0.022
		2000	0.0002
Overall Grms	6.84	Overall Grms	5.77

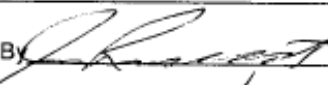

**DATA SHEET "G"**  
**DRY RANDOM VIBRATION TEST (SHEET 1 OF 4)**


	Date: <u>10-3-03</u>
	PSI Part No. <u>80462-11</u>
Test Procedure Para. No. <u>4.7</u>	PSI Serial No. <u>0001</u>
Test Equipment <u>GAGE ST-0270</u> <u>CAL 8-13-03, DUE 2-3-04</u>	PSI Part Name: <u>Propellant Tank</u>
<u>TORQUE WRENCH NTS ID 64657F CAL 11-06-02 DUE 11-06-03</u>	

VIBRATION AXIS: X, Dry Random

	PSI Check-off
1. Verify vibration axis.	
2. Verify the tank is properly installed in test fixture per Figure 7 and tubes are secured.	
3. Verify that the tank is dry & empty.	
4. Verify that the three (3) bolts are torqued to 250-400 in-lbs above running torque before the start of the test. Note if dry film lubricant was used, type, & brand name or specification number. Verify bolts were torqued in two stages.	
5. Verify that the control and response accelerometers are properly installed and photographs are taken of the set-up and all accelerometers.	
6. Verify the tank is properly pressurized during vibration test. Record test temperature <u>74</u> °F and test pressure (25, +/- 5 psig) <u>26 psig</u> .	
7. Verify the vibration test is properly conducted.	
8. Verify that the tank is depressurized after vibration testing.	
9. Verify all data reduction requirements are met.	
10. Verify all pressure cycles are recorded on Data Sheet "O" – Pressure Log.	
11. Verify no damage to tank after each axis of vibration testing.	

Notes: \_\_\_\_\_

Tested By   Date 10-3-03 Tank Passed YES

Witnessed By N/A  Date \_\_\_\_\_ Tank Failed NO



**DATA SHEET "G"**  
**DRY RANDOM VIBRATION TEST (SHEET 2 OF 4)**

Date: 10-3-03

PSI Part No. 80462-11

Test Procedure Para. No. 4.7

PSI Serial No. 0001

Test Equipment SEE SHEET 1 OF 4

PSI Part Name: Propellant Tank

VIBRATION AXIS: Y, Dry Random

1. Verify vibration axis.
2. Verify the tank is properly installed in test fixture per Figure 7 and tubes are secured.
3. Verify that the tank is dry & empty.
4. Verify that the three (3) bolts are torqued to 250-400 in-lbs above running torque before the start of the test. Note if dry film lubricant was used, type, & brand name or specification number. Verify bolts were torqued in two stages.
5. Verify that the control and response accelerometers are properly installed and photographs are taken of the set-up and all accelerometers.
6. Verify the tank is properly pressurized during vibration test. Record test temperature 74 °F and test pressure (25, +/- 5 psig) 26 Psig psig.
7. Verify the vibration test is properly conducted.
8. Verify that the tank is depressurized after vibration testing.
9. Verify all data reduction requirements are met.
10. Verify all pressure cycles are recorded on Data Sheet "O" – Pressure Log.
11. Verify no damage to tank after each axis of vibration testing.

**PSI  
Check-off**

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>

Notes: \_\_\_\_\_

Tested By [Signature] Date 10-3-03 Tank Passed Yes

Witnessed By N/A Date \_\_\_\_\_ Tank Failed No

**DATA SHEET "G"**  
**DRY RANDOM VIBRATION TEST (SHEET 3 OF 4)**

[Empty rectangular box for identification]

Date: 10-3-03

PSI Part No. 80462-11

Test Procedure Para. No. 4.7

PSI Serial No. 0001

Test Equipment: SEE SHEET 1 OF 4

PSI Part Name: Propellant Tank


VIBRATION AXIS: Z, Dry Random


1. Verify vibration axis.
2. Verify the tank is properly installed in test fixture per Figure 7 and tubes are secured.
3. Verify that the tank is dry & empty.
4. Verify that the three (3) bolts are torqued to 250-400 in-lbs above running torque before the start of the test. Note if dry film lubricant was used, type, & brand name or specification number. Verify bolts were torqued in two stages.
5. Verify that the control and response accelerometers are properly installed and photographs are taken of the set-up and all accelerometers.
6. Verify the tank is properly pressurized during vibration test. Record test temperature 74 °F and test pressure (25, +/- 5 psig) 26 PSIG psig.
7. Verify the vibration test is properly conducted.
8. Verify that the tank is depressurized after vibration testing.
9. Verify all data reduction requirements are met.
10. Verify all pressure cycles are recorded on Data Sheet "O" – Pressure Log.
11. Verify no damage to tank after each axis of vibration testing.

**PSI  
Check-off**

<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>

Notes: \_\_\_\_\_




Tested By [Signature]  Date 10-3-03 Tank Passed YES

Witnessed By N/A  Date \_\_\_\_\_ Tank Failed NO

**DATA SHEET "G"  
 DRY RANDOM VIBRATION TEST (SHEET 4 OF 4)**

Date: 10-3-03  
 PSI Part No. 80462-11  
 Test Paragraph No. 4.7 PSI Serial No. 0001  
 Test Equipment: SEE NTS EQUIPMENT LIST PSI Part Name: Propellant Tank


**RANDOM VIBRATION, PROTOFLIGHT LEVEL TESTS**

Axis	Date Completed	Test Temperature	Test Pressure	Frequency (Hz)	PSD		Overall gRMS	Test Duration	Accept/Reject
					(G <sup>2</sup> /Hz)	dB/oct			
X	10-3-03	74°	26 PSI	20 - 2000	.16	-	6.84	60 sec.	
Y	10-3-03	74°	26 PSI	20 - 2000	.16	-	6.94	60 sec.	
Z	10-3-03	74°	26 PSI	20 - 2000	.42	-	5.77	60 sec.	

Fill in "N/A" as required.

Attach vendor log and response data sheets for all data collected. Vendor may use other data sheets and attach them to this sheet, but the top of this data sheet shall be completed and this data sheet shall be signed.

Notes: \_\_\_\_\_

Tested By [Signature]  Date 10-3-03 Tank Passed Y.S.  
 Witnessed By N/A  Date \_\_\_\_\_ Tank Failed NO

### **Wet Static Load (Centrifuge) Test**

Tank is loaded with 251.3 – 253.5 lbs of distilled, deionized water. Tank is pressurized to 440, +5/-0 psig. Two runs are performed with different orientations (propellant out and pressurant out). Acceleration levels of about 13.79 G(s) are achieved.



### **Acceleration Test**





**DATA SHEET "H"  
WET STATIC LOAD (CENTRIFUGE) TEST**

Date: 10-9-03  
 PSI Part No. 80462-11  
 Test Paragraph No. 4.8 PSI Serial No. 0001  
 Test Equipment: Gauge ST-0270 PSI Part Name: Propellant Tank  
CAL - 8-13-02, DUE 2-3-04  
TORQUE WRENCH NTS ID 64657F CAL 11-06-02 DUE 11-6-03

	Actual	Required
(1) Specimen Loading (Water)	252.0 Lb	251.3 – 253.5 pounds (114 – 115 kilograms)
(2) Specimen Pressure	440 Psig	Po, +5, -0 psig
(3) Bolt Torque to 250 – 400 inch-pounds above running in two stages. Note if dry film lube was used.	350 inch LBS	Compliance
(4) All instrumentation installed & photographed	Yes	Compliance
(5) Test Orientation (first run)	PROPELLANT OUT	
(6) Test Duration (first run)	60 Seconds	60 seconds, minimum
(7) Test Orientation (second run)	PRESSURANT OUT	
(8) Test Duration (second run)	60 Seconds	60 seconds, minimum
(9) Specimen Damage or Distortion	NONE	None Allowed

Run Number	Centrifuge Arm Distance, inches	Centrifuge RPM	Acceleration Level, G	Adjusted Acceleration Level, If Required
1	177"	52	13.6	NA
2	200"	49	13.64	NA

Tested By [Signature] Date 10-9-03 Tank Passed Yes  
 Witnessed By N/A Date \_\_\_\_\_ Tank Failed NO

# ACCELERATION

CUSTOMER: PRESSURE SYSTEMS, INC.	MJO: 373-2837
TEST ITEM: PROPELLANT TANK	DATE: 10/9/03
PART NUMBER: 80462-11	SN: 0001
SPECIFICATION:	PARAGRAPH(S):
PHOTOGRAPHS: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	AMBIENT TEMPERATURE: 70° °F

Axis	Radius (inches)	RPM Required	RPM Actual	Accel. Level (g) Required	Accel. Level (g) Actual	Duration Required (Seconds)	Duration Actual (Seconds)			
1	2	3	4	5	6	7	8	9	10	REMARKS
Incl. Foot out, 45°	177"	52.36	52.0	13.79	13.6	60	60			
Hess-Foot out, 45°	200"	49.26	49.0	13.79	13.65	60	60			
GENERAL TEST NOTES:										
TESTED BY: TERRY WYBENNEK      DATE: 10/9/03      WITNESS: _____      DATE: _____										
ENGINEER: DAVE SCHUSTER      NTS QA: _____      GOVT QAR: _____										

FUL 21.53, REV. 1

PAGE \_\_\_\_\_ OF \_\_\_\_\_

PSI CERT # 30984



