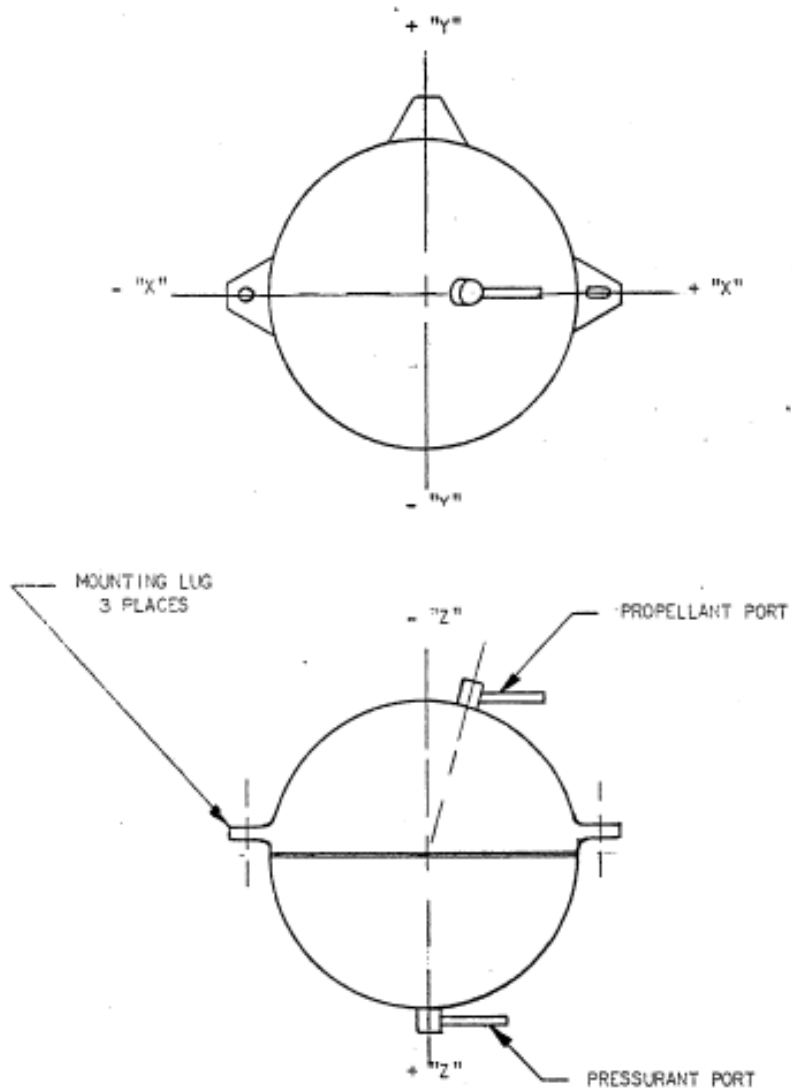


**QUALIFICATION ENVIRONMENTS**  
**FOR**  
**POSITIVE EXPULSION PROPELLANT TANK**  
**ATK P/N 80298-1**

# Configuration

FIGURE NO. 1  
CONFIGURATION & PORT LOCATION



**Table 1: P/N 80298-1 Positive Expulsion Propellant Tank Assembly Specifications**

| <b>Parameters</b>        | <b>Requirements</b>  |
|--------------------------|--|
| Operating Pressure       | 475 psid   |
| Proof Pressure           | 795 psig, Actual Proof:800 psig  |
| Burst Pressure           | 950 psig, Actual Burst: 1210   |
| External Pressure        | Not performed  |
| Internal Vacuum          | Not performed  |
| Material of Construction | Spherical Pressure vessel constructed of 6Al-4V titanium. Connection is made to the propellant and pressurant compartments through tube stubs. |
| Membrane Thickness       | 0.033"   |
| Tank Mount(s)            | Mounting is accomplished by Lugs Parallel with and adjacent to the mid-plane.  |
| Expulsion Efficiency     | 99.8 %   |
| Design Fill Fraction     | -  |
| Tank Capacity            | 5626.1 in <sup>3</sup>   |
| Internal Dimensions      | 22.14" Ø spherical   |
| Tank Weight              | Maximum tank weight is 30.0 lbs, Actual tank weight is 20.7lbs   |
| Propellant Capacity      | 170 lbs hydrazine  |
| Shell Leakage            | <1x10 <sup>-6</sup> std cc/sec He max, Actual:   |
| Failure Mode             | Burst  |
| Natural Frequency        | -  |
| Temperature Environment  | -  |
| On Orbit Life            | -  |

**80298-1 was subjected to the following qualification tests:**

| <b>TEST SEQ.</b> | <b>TEST DESCRIPTION</b>                  |
|------------------|--|
| 1                | Acceptance Test                          |
| 2                | Acceleration Test                        |
| 3                | Internal (Diaphragm) Leakage Test        |
| 4                | External Leakage Test                    |
| 5                | Vibration Test                           |
| 6                | Internal Leakage Test                    |
| 7                | External Leakage Test                    |
| 8                | Diaphragm Integrity Test                 |
| 9                | Internal Leakage Test                    |
| 10               | Pressure Life Cycle Test                 |
| 11               | External Leakage Test                    |
| 12               | Water Expulsion Test                     |
| 13               | Internal Leakage Test                    |
| 14               | External Leakage Test                    |
| 15               | Burst Presssure Test                     |
| 16               | Post-Test Disassembly & Examination Test |

**This tank was requalified for vibration testing.**

**Note: The following tests are only listed in this document.**

- 1) Proof Pressure Test
- 2) Acceleration Test
- 3) Sinusoidal Vibration Test
- 4) Diaphragm Integrity Test
- 5) Pressure Life Cycle Test
- 6) Burst Pressure Test

**Proof Pressure Test**

**PSI** 2017 samfield avenue  
los angeles, cal. 90042  
**RESSURE SYSTEMS, INC.**

PSI REPORT NO. 56-000099  
APPENDIX "A", PAGE A-54

DATA SHEET "C"

PROOF PRESSURE TEST

DATE: 12-28-82

PSI PART No. 80298-1

PSI SERIAL No. 0002

TEST EQUIPMENT: SHT

PSI PART NAME: PROPELLANT TANK

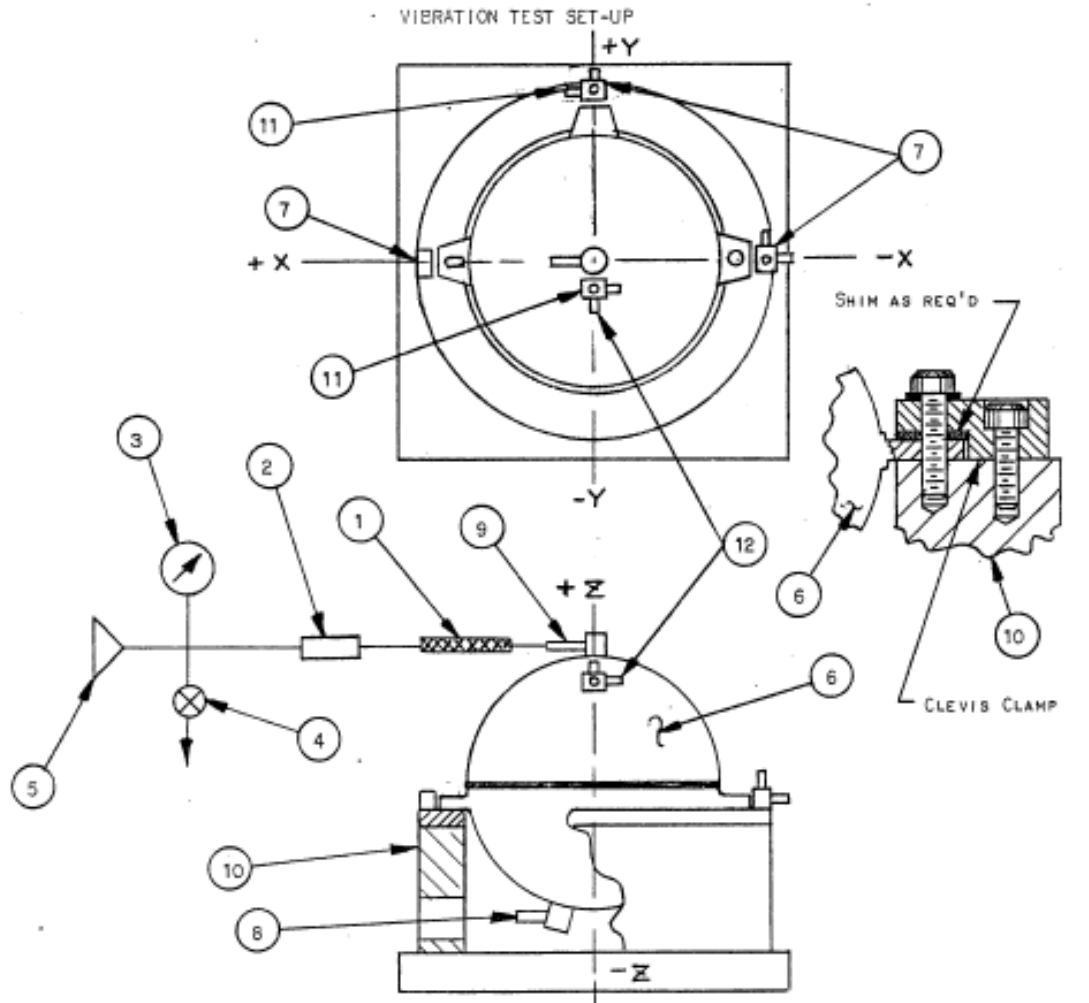
TEST MEDIA: DISTILLED/DEIONIZED WATER

|                               | <u>ACTUAL</u>   | <u>REQUIRED</u>          |
|-------------------------------|-----------------|--------------------------|
| SPECIMEN PRESSURE             | <u>800 PSIG</u> | <u>795, +10, -0 PSIG</u> |
| PRESSURE HOLD PERIOD          | <u>5.0 min.</u> | <u>5.0 MINUTES MIN</u>   |
| PRESSURE CYCLES               | <u>1</u>        | <u>1</u>                 |
| DISTORTION OR DAMAGE OBSERVED | <u>NONE</u>     |                          |

TESTED BY R. Lee DATE 12-28-82 SPECIMEN PASSED YES

## Vibration Test Set-Up

FIGURE NO. 6



- |                   |  |   |
|-------------------|--|---|
| 1. FLEXIBLE LINE  | 6. TEST SPECIMEN                       | 10. TEST FIXTURE  |
| 2. FILTER         | 7. CONTROL ACCELEROMETER LOCATIONS (3) | 11. TRI-AXIAL RESPONSE ACCELEROMETER LOCATIONS FOR FIXTURE EVALUATION       |
| 3. PRESSURE GAUGE | 8. PROPELLANT PORT                     | 12. RESPONSE ACCELEROMETER LOCATION FOR QUALIFICATION TEST (1 IN TEST AXIS) |
| 4. VENT VALVE     | 9. PRESSURANT PORT                     |   |
| 5. HELIUM SUPPLY  |  |   |

**Acceleration Test:**

**Acceleration Test – Filled and Presssurized**

| Test Axis  | "G" Test Level | Duration        |
|--|----------------|-----------------|
| +Z   | 15.0 G's       | 30 seconds min. |
| -Z   | 3.3 G's        | 15 seconds min. |
| +X and -X  | 5.0 G's        | 15 seconds min. |
| +Y and -Y  | 5.0 G's        | 15 seconds min. |
| 1) Propellant compartment filled with 170 lbm of distilled/deionized water |                |                 |
| 2) Pressurant compartment pressurized to 475 psig                          |                |                 |

DATA SHEET "A"  
 ACCELERATION TEST

DATE: 1-25-83

PSI PART No. 80298-1

PSI SERIAL No. 0002

TEST EQUIPMENT: 15-FOOT CENTRIFUGE  
C/N 04179F,

PSI PART NAME: PROPELLANT TANK

TEST MEDIA: DISTILLED/DEIONIZED WATER AND HELIUM

|                   | ACTUAL             | REQUIRED          |
|-------------------|--------------------|-------------------|
| SPECIMEN LOAD     | <u>170 LBS.</u>    | 170, +2, -0 LBS   |
| SPECIMEN PRESSURE | <u>470 PSIG</u>    | 475, +0, -10 PSIG |
| WATER RESISTIVITY | <u>17 MEG OHMS</u> | 500,000 OHMS MIN  |
| WATER PH          | <u>7.2</u>         | 5.5 - 8.0         |
| TORQUE FASTENERS  | <u>170 in/LBS.</u> | 170 ± 5 in/LBS    |

| AXES          | ACTUALS     |             |             |             | REQUIREMENTS |                           |
|---------------|-------------|-------------|-------------|-------------|--------------|---------------------------|
|               | +X          | -X          | +Y          | -Y          | +Z           | -Z                        |
| G-LEVELS      |             |             |             |             | <u>14.75</u> | 15.0 ± 1.5 G's            |
|               |             |             |             |             |              | <u>3.26</u> 3.3 ± .33 G's |
|               | <u>4.91</u> | <u>4.91</u> | <u>4.91</u> | <u>4.91</u> |              | 5.0 ± .5 G's              |
| TIME DURATION |             |             |             |             | <u>30</u>    | 30 SEC MIN.               |
|               | <u>15</u>   | <u>15</u>   | <u>15</u>   | <u>15</u>   |              | <u>15</u> 15 SEC. MIN.    |

TESTED BY G. PETERSEN DATE 1-25-83 SPECIMEN PASSED X



DATA SHEET "D"  
 SINUSOIDAL VIBRATION

DATE: 2-2-83  
 PSI PART No. 80298-1  
 PSI SERIAL No. 0002  
 PSI PART NAME: PROPELLANT TANK

OSCILLATOR

|                              | REQUIREMENT          | ACTUAL              |
|------------------------------|----------------------|---------------------|
| WEIGHT OF WATER IN SPECIMEN: | 170, +2, -0 POUNDS   | <u>170 LBS</u>      |
| SPECIMEN PRESSURE:           | 475, +0, -10 PSIG    | <u>470 PSIG</u>     |
| FASTENER TORQUE:             | 170, +5, -5 INCH LBS | <u>170 inch LBS</u> |
| WATER RESISTIVITY            | 500,000 OHMS MIN.    | <u>17 megohms</u>   |
| WATER PH                     | 5.5 - 8.0            | <u>7.2</u>          |

| X10 | FREQUENCY |      | D. A. | G RMS | SWEEP RATE<br>2.0 MINUTES/OCTAVE | DURATION 17.2<br>TOTAL MINUTES |
|-----|-----------|------|-------|-------|----------------------------------|--------------------------------|
|     | FROM      | TO   |       |       |                                  |                                |
| Y   | 5         | 10.5 | .5    |       | 2.0 OCT/MIN                      | 17.2 MINUTES                   |
|     | 10.5      | 2000 |       | 2.0   |                                  |                                |
|     |           |      |       |       |                                  |                                |
|     |           |      |       |       |                                  |                                |

\* USE A SEPARATE DATA SHEET FOR EACH AXIS.

| DATE   | TIME  | LOG ENTRIES      |
|--------|-------|------------------|
| 2-3-83 | 14:30 | COMPLETED Y AXIS |
|        |       |                  |

DATA SHEET "D"  
 SINUSOIDAL VIBRATION

DATE: \_\_\_\_\_

PSI PART No. 80298-1

PSI SERIAL No. 0002

PSI PART NAME: PROPELLANT TANK

TEST EQUIPMENT: BRUEL & KJAER SWEEP OSCILLATOR

|                              | REQUIREMENT          | ACTUAL              |
|------------------------------|----------------------|---------------------|
| WEIGHT OF WATER IN SPECIMEN: | 170, +2, -0 POUNDS   | <u>170 LBS</u>      |
| SPECIMEN PRESSURE:           | 475, +0, -10 PSIG    | <u>470 PSIG</u>     |
| STENER TORQUE:               | 170, +5, -5 INCH LBS | <u>170 INCH LBS</u> |
| WATER RESISTIVITY            | 500,000 OHMS MIN.    | <u>17 MEGOHMS</u>   |
| WATER PH                     | 5.5 - 8.0            | <u>7.2</u>          |

| G | FREQUENCY |      | D. A. | G RMB | SWEEP RATE<br>2.0 MINUTES/OCTAVE | DURATION 17.2<br>TOTAL MINUTES |
|---|-----------|------|-------|-------|----------------------------------|--------------------------------|
|   | FROM      | TO   |       |       |                                  |                                |
| Z | 5         | 10.5 | 1.5   |       | 2.0 OCT/MIN                      | 17.2 MINUTES                   |
|   | 10.5      | 2000 |       | 2.0   |                                  |                                |
|   |           |      |       |       |                                  |                                |
|   |           |      |       |       |                                  |                                |

\* USE A SEPARATE DATA SHEET FOR EACH AXIS.

| DATE   | TIME  | LOG ENTRIES      |
|--------|-------|------------------|
| 1-4-83 | 17:58 | COMPLETED Z AXIS |
|        |       |                  |

**Diaphragm Integrity Test:**

Pressurant compartment pressurized with nitrogen gas to 475, +10/-0 psig and held for 5, +1/-0 minutes.

**PSI** 2077 camfield avenue  
los angeles, cal. 90040  
**PRESSURE SYSTEMS, INC.**

PSI Report No. 56-000099  
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DATA SHEET "G"

DIAPHRAGM INTEGRITY TEST

DATE: 2-7-83

PSI PART NO. 80298-1

PSI SERIAL NO. 0002

TEST EQUIPMENT: GAUGE AIRCRAFT ST-0270 PSI PART NAME: PROPELLANT TANK

0-500 PSIG CALIB DUE 4-6-83

|                                | <u>TEST VALUE</u> | <u>REQUIREMENT</u>       |
|--------------------------------|-------------------|--------------------------|
| TEST MEDIA: NITROGEN GAS       |                   |                          |
| SPECIMEN PRESSURE              | <u>480 PSIG</u>   | <u>475, +10, -0 PSIG</u> |
| TEST HOLD PERIOD               | <u>5 MIN.</u>     | <u>5, +1, -0 MINUTES</u> |
| INDICATION OF DIAPHRAGM DAMAGE | <u>NONE</u>       | <u>NONE</u>              |

TESTED BY [Signature] DATE 2-7-83 SPECIMEN PASSED YES

✓

DATA SHEET "H"

INTERNAL (DIAPHRAGM) LEAKAGE

DATE: 2-7-83

PSI PART No. 80298-1

PSI SERIAL No. 0002

TEST EQUIPMENT: Gauge Ashcroft ST-0270 PSI PART NAME: PROPELLANT TANK

0-500 PSIG CALIB DUE 4-1-83, ASHCROFT ST-0270 0-100 PSIG CALIB DUE 4-1-83

| TEST MEDIA: HELIUM     | TEST VALUE      | REQUIRED VALUE                 |
|------------------------|-----------------|--------------------------------|
| STABILIZATION PRESSURE | <u>124 PSIG</u> | <u>120.0 ± 10.0 PSIG</u>       |
| STABILIZATION PERIOD   | <u>30 MIN.</u>  | <u>30 MINUTES MINIMUM</u>      |
| TEST PRESSURE          | <u>102 PSIG</u> | <u>100.0, + 5.0, -0 PSIG</u>   |
| TEST PERIOD @ 100 PSIG | <u>15 MIN.</u>  | <u>15.0, + 1.0, -0 MINUTES</u> |
| LEAKAGE @ 100 PSIG     | <u>0</u>        | <u>30.0 STD CC<br/>MAXIMUM</u> |
| TEST PRESSURE          | <u>16 PSIG</u>  | <u>15.0, +1, -0 PSIG</u>       |
| TEST PERIOD @ 15 PSIG  | <u>15 MIN.</u>  | <u>15, +1, -0 MINUTES</u>      |
| LEAKAGE @ 15 PSIG      | <u>0</u>        | <u>15.0 STD CC MAXIMUM</u>     |

TESTED BY: [Signature]

DATE 2-7-83

SPECIMEN PASSED Yes

**Pressure Life Cycle Test:**

|  |                   |                  |
|--|-------------------|------------------|
| Pressure of pressurant and propellant compartments | Hold              | Number of cycles |
| 475 +20/-0 psig                                    | 30 second minimum | 100              |

Pressurization and depressurization shall not exceed 100 psi per second.



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DATA SHEET "1"  
PRESSURE LIFE CYCLE

CUSTOMER: GENERAL DYNAMICS/CONVAIR DATE: 2-8-83  
 CUSTOMER PART No. 55-02461-1 PSI PART No. 80298-1  
 TEST PARA. No. 4.10 PSI SERIAL No. 0002  
 TEST EQUIPMENT: HEISE 0978 0-2000PSIG CALDNE 16-B PSI PART NAME: PROPELLANT TANK

TEST MEDIA: DISTILLED/DEIONIZED WATER

REQUIREMENTS

- A) PRESSURE: 475, +20, -0 PSIG
- B) PRESSURIZATION AND DE-PRESSURIZATION RATE: 100 PSI PER SECOND MAXIMUM
- C) PRESSURE HOLD PERIOD: 30 SECONDS MINIMUM

| CYCLE | PRESSURE | HOLD TIME | CYCLE | PRESSURE | HOLD TIME | CYCLE | PRESSURE | HOLD TIME |
|-------|----------|-----------|-------|----------|-----------|-------|----------|-----------|
| 1     | 480      | 30        | 18    | 482      | 30        | 35    | 480      | 30        |
| 2     | 482      | 30        | 19    | 481      | 30        | 36    | 480      | 30        |
| 3     | 480      | 30        | 20    | 478      | 30        | 37    | 480      | 30        |
| 4     | 480      | 30        | 21    | 478      | 30        | 38    | 480      | 30        |
| 5     | 478      | 30        | 22    | 480      | 30        | 39    | 480      | 30        |
| 6     | 480      | 30        | 23    | 480      | 30        | 40    | 480      | 30        |
| 7     | 480      | 30        | 24    | 480      | 30        | 41    | 480      | 30        |
| 8     | 480      | 30        | 25    | 478      | 30        | 42    | 480      | 30        |
| 9     | 490      | 30        | 26    | 481      | 30        | 43    | 482      | 30        |
| 10    | 480      | 30        | 27    | 480      | 30        | 44    | 480      | 30        |
| 11    | 480      | 30        | 28    | 480      | 30        | 45    | 480      | 30        |
| 12    | 480      | 30        | 29    | 480      | 30        | 46    | 480      | 30        |
| 13    | 480      | 30        | 30    | 480      | 30        | 47    | 480      | 30        |
| 14    | 480      | 30        | 31    | 480      | 30        | 48    | 480      | 30        |
| 15    | 480      | 30        | 32    | 480      | 30        | 49    | 480      | 30        |
| 16    | 480      | 30        | 33    | 480      | 30        | 50    | 480      | 30        |
| 17    | 480      | 30        | 34    | 480      | 30        |       |          |           |

DATA SHEET "J"  
 PRESSURE LIFE CYCLE

DATE: 2-8-83

PSI PART No. 80298-1

PSI SERIAL No. 0002

TEST EQUIPMENT: HEISE 0978, 0-2000PSI CALDUE 468 PSI PART NAME: PROPELLANT TANK

PRESSURE LIFE CYCLE (CONTINUED)

| CYCLE | PRESSURE | HOLD TIME | CYCLE | PRESSURE | HOLD TIME | CYCLE | PRESSURE | HOLD TIME |
|-------|----------|-----------|-------|----------|-----------|-------|----------|-----------|
| 51    | 480      | 30        | 68    | 482      | 30        | 85    | 480      | 30        |
| 52    | 480      | 30        | 69    | 480      | 30        | 86    | 480      | 30        |
| 53    | 492      | 30        | 70    | 480      | 30        | 87    | 480      | 30        |
| 54    | 482      | 30        | 71    | 482      | 30        | 88    | 480      | 30        |
| 55    | 480      | 30        | 72    | 482      | 30        | 89    | 482      | 30        |
| 56    | 480      | 30        | 73    | 482      | 30        | 90    | 480      | 30        |
| 57    | 480      | 30        | 74    | 482      | 30        | 91    | 480      | 30        |
| 58    | 485      | 30        | 75    | 482      | 30        | 92    | 480      | 30        |
| 59    | 485      | 30        | 76    | 484      | 30        | 93    | 478      | 30        |
| 60    | 485      | 30        | 77    | 480      | 30        | 94    | 480      | 30        |
| 61    | 485      | 30        | 78    | 480      | 30        | 95    | 480      | 30        |
| 62    | 480      | 30        | 79    | 480      | 30        | 96    | 480      | 30        |
| 63    | 480      | 30        | 80    | 480      | 30        | 97    | 480      | 30        |
| 64    | 480      | 30        | 81    | 480      | 30        | 98    | 480      | 30        |
| 65    | 480      | 30        | 82    | 482      | 30        | 99    | 478      | 30        |
| 66    | 480      | 30        | 83    | 480      | 30        | 100   | 490      | 30        |
| 67    | 480      | 30        | 84    | 480      | 30        |       |          |           |

TESTED BY D. Rembert DATE 2-8-83 SPECIMEN PASSED Yes

**Burst Pressure Test**

The minimum normalized burst pressure shall not be less than 950 psig.

The actual burst pressure was 1210 psig. The normalized burst pressure was 992 psi.



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DATA SHEET "0"  
BURST TEST

DATE: 2-2-84

PSI PART No. 80298-1

PSI SERIAL No. 0002

TEST EQUIPMENT: HEISE GAUGE (0978) 0-2000

PSI PART NAME: PROPELLANT TANK

PSIG CALIBRATION DATE 4-5-84

TEST MEDIA: DISTILLED/DEIONIZED WATER

|   | TEST VALUE         | REQUIRED VALUE             |
|---|--------------------|----------------------------|
| HOLD PRESSURE   | <u>960</u> PSIG    | <u>950, +20, -0</u> PSIG   |
| PRESSURE HOLD PERIOD  | <u>61</u> SEC      | <u>60, +10, -0</u> SECONDS |
| SPECIMEN TEMPERATURE  | <u>70</u> °F       | <u>NOT APPLICABLE</u>      |
| PRESSURIZATION RATE   | <u>170</u> PSI/MIN | <u>175</u> PSI/MIN (MAX.)  |
| ACTUAL BURST PRESSURE   | <u>1210</u> PSIG   | <u>NOT APPLICABLE</u>      |
| MINIMUM HEMISPHERE MATERIAL ULTIMATE STRENGTH (FROM DATA PACKAGE) | <u>180,000</u> PSI | <u>170000</u> PSI MINIMUM  |
| MINIMUM HEMISPHERE WALL THICKNESS (FROM DATA PACKAGE)             | <u>.036</u> INCHES | <u>.033</u> INCHES MINIMUM |
| TEMPERATURE CORRECTION FACTOR FOR (140°F) (FROM MIL-HDBK-5)       | <u>.950</u>        | <u>NOT APPLICABLE</u>      |
| TEST TEMPERATURE CORRECTION FACTOR (FROM MIL-HDBK-5)              | <u>1.0</u>         | <u>NOT APPLICABLE</u>      |
| NORMALIZED BURST PRESSURE (FROM EQUATION BELOW)                   | <u>992</u> PSI     | <u>950</u> PSIG MINIMUM    |

$$\text{CORRECTION BURST PRESSURE} = \frac{\left[ \text{ACTUAL BURST PRESSURE} \right] \left[ 170000 \right] \left[ .950 \right] \left[ .033 \right]}{\left[ \text{TEST TEMPERATURE CORRECTION FACTOR} \right] \left[ \text{ACTUAL MINIMUM ULTIMATE STRENGTH} \right] \left[ \text{ACTUAL MINIMUM WALL THICKNESS} \right]}$$