KSC: Certification Approval Request (CAR) Package

CAR No.	01-33-340247-001		
CR No.	33-340247-001		
Top Assy Dwg No.	G070-340247-001		
Effectivity	EI 3 & 4 ONLY		
Revision	Basic	**Date:**	12/08/09

Model No. - Config. No. & S/N:	**Authority / Directive**
H70-0679-11-003 & -12-004	TAD 30050 R1
Part / Model Name: FIXTURE ASSEMBLY – OMS RCS POD, LIFTING SET	
System: 33 - GSE	**Prepared By:** R. Mraz

Revision History

Revision	Date	Technical Reason for Change

Assys/Parts Certified		Certification Method		
Assy/Part Number(s)	Qty	Testing	Analysis	Similarity
G070-340247-001	2	X	X	X

Test(s) / Analysis Summary (check boxes where applicable)

The test and / or analysis described by the Test Agency Report and / or Engineering Analysis Report were conducted in accordance with approved procedures and fulfill CR requirements.	☒
Any test failures have been adequately corrected and, where required, corrections have been made effective for deliverables.	☒
Data is adequate and supports conclusions.	☒
The test(s) and data gathering were witnessed by: Jay Steckman – Boeing GSE 321-799-7258	☒
The Test Agency Report is acceptable as is (no Engineering Analysis Report required).	☐

Reports Reviewed (see attached)

Document ID	Rev. Date	Agency
Test Agency Report 01-TAR-33-340247-001	12/7/09	United Space Alliance
Engineering Analysis 01-EAR-33-340247-001	12/8/09	Boeing

Comments

Submittal / Concurrence			Concurrence			Approval	
Contractor		**Date**	**NASA KSC**		**Date**	USA Systems Engr.	**Date**
Design Engr.	R A Mraz	1/4/10	Systems Engineering		1/8/10		1-8-10
Design Engr.		1/6/10					
Orbiter Engr.		1-6-10				USA Subsystem Area Mgr.	
Project Engr.		1/6/10	Project Engineering		1/11/10		1/8/10
Project Engr.						Technical Approval	
Reliability Engr.		1/7/10	Reliability & Safety Engr.		1/11/10	Subsystem Mgr.	Date
Safety Engr.				DON SPRATT			1-18-10
Stress Engr.	Hui-Tran Lin	1/7/10					

KSC: Engineering Analysis Report (EAR)

EAR No.	01-EAR-33-340247-001
CAR No.	01-33-340247-001
Part No.	G070-340247-001
Effectivity	EI 3 & 4 ONLY
Date	12/08/09

Prepared By: R. Mraz (321-861-4743) **Contractor:** Boeing

1.0 Certification Requirements Review:

Certification will include be performed on the addition of electrical hardware to the G070-340247-001 ROTATOR ASSY - LIFTING FIXTURE; APS POD See Figure 3 – Equipment Usage G070-340247-001:
(1) G070-340248-001 (ME183-0105-0001) - Force Sensing Clevis Pin
(1) G070-340248-002 (ME183-0105-0001) - Force Sensing Clevis Pin
(1) G070-340249-001 - Cable Assy.-Force Sensing Clevis Pin (3W1)
(1) G070-340249-002 - Cable Assy.-Force Sensing Clevis Pin (3W2)
(1) G070-340098-001 - Digital Indicator Assy (2W1)
(1) G070-340098-002 - Digital Indicator Assy (2W2)
(1) G070-340091-001 - Safety Barrier Assy
(1) G070-320049-002 - Facility Ground Cable Assy.

Analysis will include stress analysis of the G070-340248-001/-002 Force Sensing Clevis Pins and will show that the addition of electrical hardware is NFPA 70 (National Electrical Code) Class I Division 2 Group C compliant for use within 5 feet of the OMS Pods.

Testing will show that the load pins will display the applied load within +/- 10 %.

Similarity will be used to show that serial number 004 is made identically to serial number 003 and is certified by similarity.

2.0 Test / Analysis Objectives:

Testing:

Testing will be performed on the instrumented electrical hardware modification to demonstrate that the tensile and compressive load data will be accurately displayed within 10 % of the applied load in support of OMS Pod installation or removal operations.

Analysis:

Analysis will verify that the GSE can withstand a maximum compressive or tension load of 1000 lbs with a minimum Factor of Safety of 4 to 1 on Ultimate or 2 to 1 on Yield strength of the material. Analysis will demonstrate that the G070-340247-001 Lifting Fixture, Rotator Assembly Electrical Components are rated “intrinsically safe” for use in hazardous location Class I Division 2 Group C. Stress analysis of the Force Sensing Clevis Pins will show the hardware has been designed to meet or exceed minimum strength requirements as defined in SW-E-0002 and SD74-SH-0002B.

3.0 Certification Analysis / Similarity Logic & Details:

Similarity:

The PMN H70-0679, (Fixture Assy – OMS RCS Pod, Lifting Set) modification’s Effectivity is End Items S/N 003 & 004. The electrical hardware modification to the G070-340247-001 Lifting Fixture, Rotator Assembly described within this CR was performed on S/N 003. Satisfaction of this CR for S/N 003 shall be the basis for certification of S/N 004 by similarity.

Analysis:

See 01-EAR-33-340247-001 Attachment 1 for Stress Analysis.

See 01-EAR-33-340247-001 Attachment 2 for intrinsic safety analysis.

4.0 Test Summary & Details:

The objective of the certification test was to apply loads of 100 - 3000 lbs. compression and tension to the Force Sensing Clevis Pins (G070-340248-001/-002) using fixture tool (T-7523821) on the Instron machine. The 2 Digital Readout Indicators (G070-340098-001/-002) were then verified to be reading within +/- 10% of the applied load.

There are 2 load pins in each end item (See figure 1 – Test Setup). The certification test fixture (T-7523821) can only accommodate one pin at a time, therefore two runs of compression and two runs of tension were performed. See figure 2 - Load Pin Orientation. Each run started at 100 lbs (either compression or tension) and was incremented by 100 lbs up to 3000 lbs. The load was then relaxed in 100 lbs increments until the load was again down to 100 lbs. See 01-TAR-33-340247-001 Attachment 2 for readings.

5.0 Identification of Hardware Experiencing Anomalies:

During post test data review 6 anomalies were noted in the tension and compression readings at 100 and 200 lbs tension and compression. The following readings are greater than the +/- 10 % pass/fail criteria of the CR:

Readout Part Number	Test Type	Target	Actual Reading	% Error
G070-340098-001 Lower Load Pin	Tension	100 lbs	112 lbs	13.13 %
	Compression	200 lbs	218 lbs	10.10 %
	Compression	100 lbs	115 lbs	13.86 %
G070-340098-002 Upper Load Pin	Tension	200 lbs	218 lbs	10.10 %
	Tension	100 lbs	114 lbs	15.15 %
	Compression	100 lbs	100 lbs	14.14 %

6.0 Failure Resolution & Test Anomaly Explanation:

After further data review (See 01-EAR-33-340247-001 Attachment 3), it can be shown that each tension and compression cycle exhibits load hysteresis. During the 'pull' portion of the tension and compression tests, errors ranged from 5.05% to 8.08% of actual load applied at 100 lbs. However, during the 'relax' portion of the tension and compression tests, errors ranged from 13.13% to 15.15% at 100 lbs. No errors were noted above 200 lbs compression or tension. These low end values are not in the working load being monitored by the customer. The customer is concerned with the load at approximately 1000 lbs compression and tension. The errors seen at 1000 lbs compression and tension are between 2.78% and 6.00% and are well within the +/-10% acceptable error.

7.0 Test / Analysis Conclusion & Results:

Testing shows that the load pins exhibit some hysteresis at the low end of the load range and should not be considered reliable below 200 lbs compression or tension.

Stress analysis shows that there is a factor of safety of 9.0 (≥ 4.0) on the load pins and are acceptable for use.

Analysis shows that the load pins are designed to be compatible with the Class I Div 2 environment and are acceptable for use when the readouts (G070-340098-001/-002) and intrinsic barrier box (G070-340091-001) are kept 36 inches above the work platforms.

8.0 Formal Certification Recommendations:

Boeing recommends the units to be certified for use in the OPF except that readings below 200 lbs compression or tension are not valid. Operational controls should be put in place by adding OMI / TPS Cautions stating that values below 200 lbs are not reliable. Operation controls also are needed to place the readout units (G070-340098-001/-002) and intrinsic barrier (G070-340091-001) 36 inches above work platforms (See GF70-430679 EO A04).

9.0 Reference: (Test Procedure No. & Date)

01-TAR-33-340247-001 Dated 12/7/09

KSC: EAR (Cont'd)

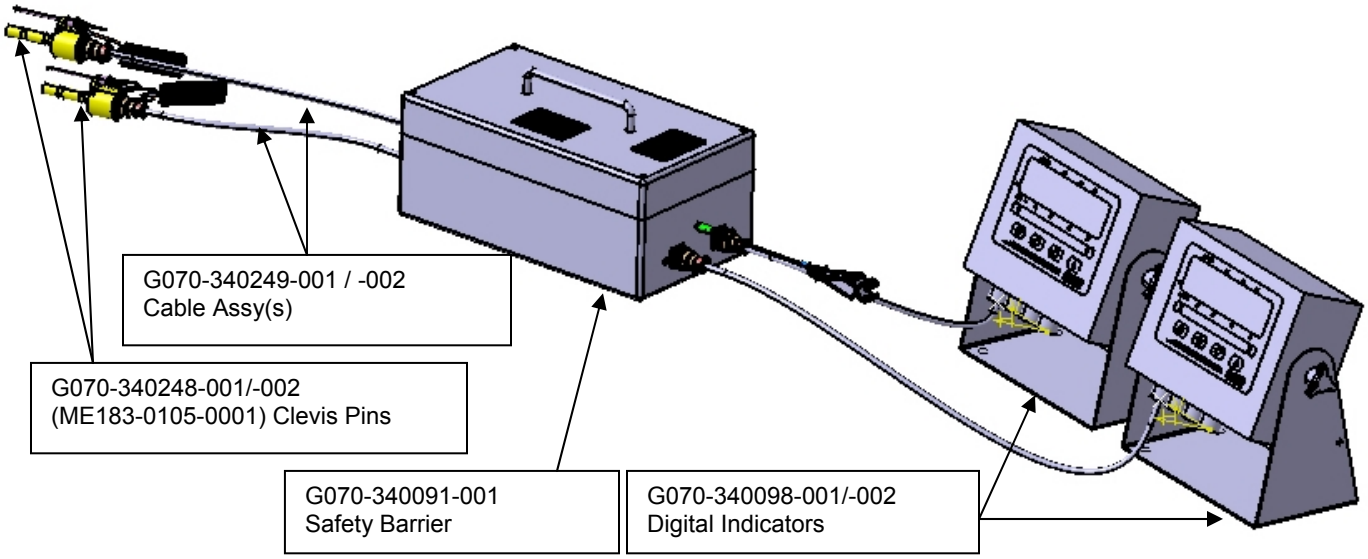


Figure 1 – Test Setup

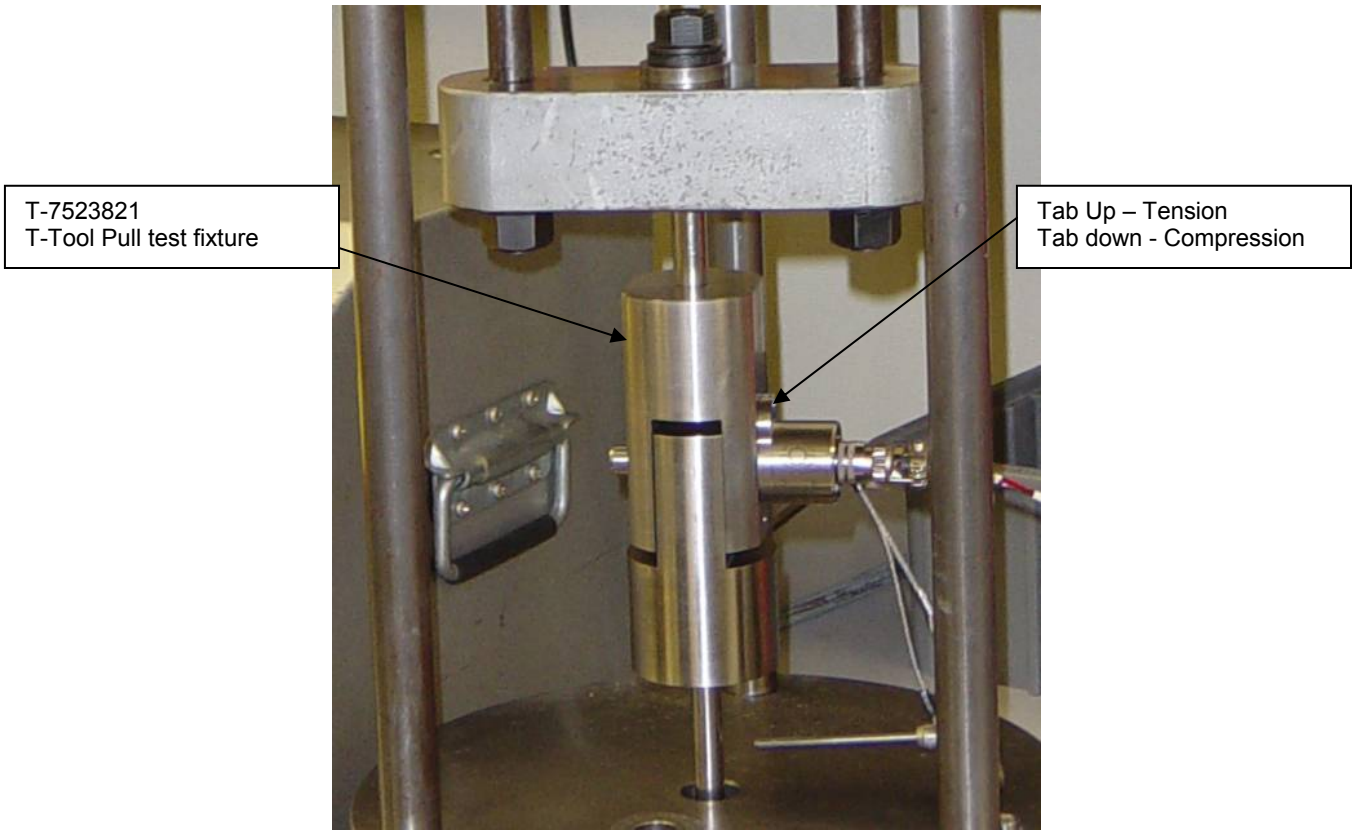


Figure 2 – Load Pin orientation (tension shown)

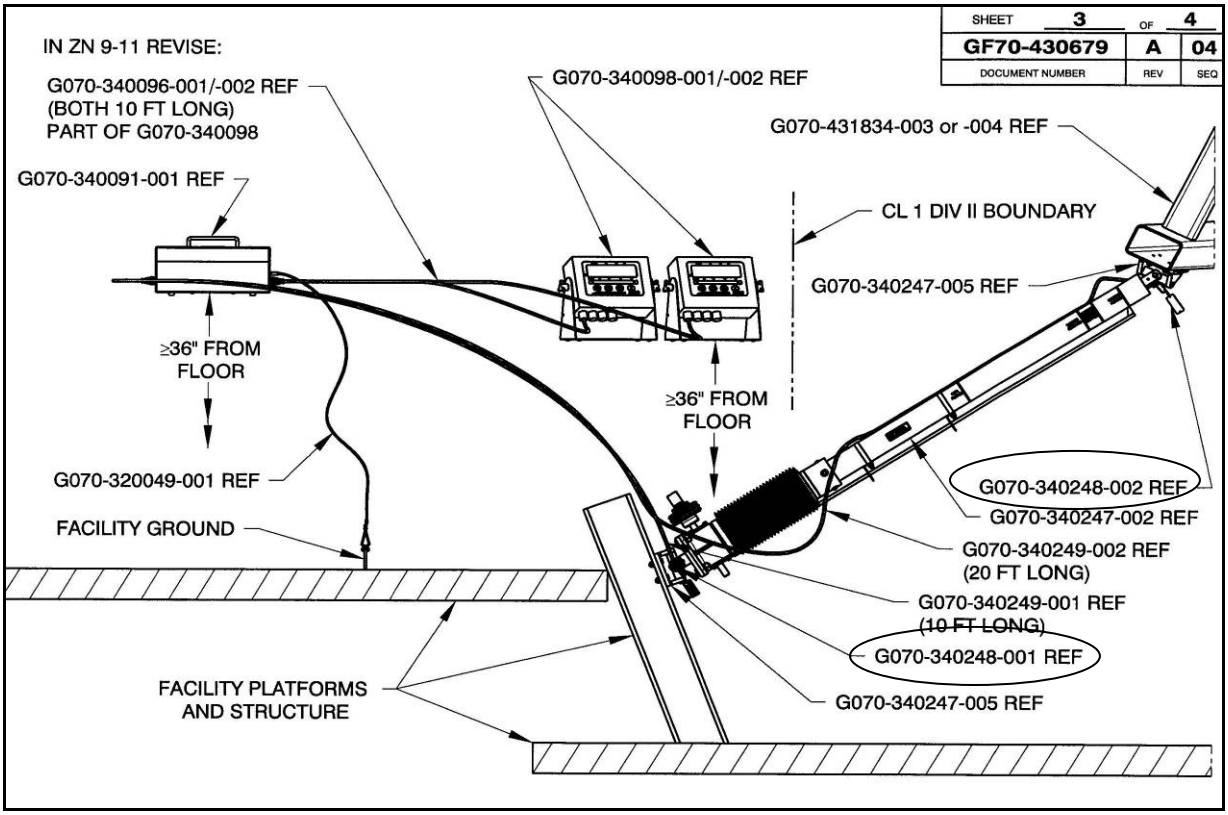


Figure 3 - Equipment Usage G070-340247-001

9/4/2008

Proofload = 6000 lbs.
= 200% Design Load

Design Load = $\frac{6000}{2}$
= 3000 lbs.

with $F.S._u = 3$

Ultimate Capacity = 9000 lbs.

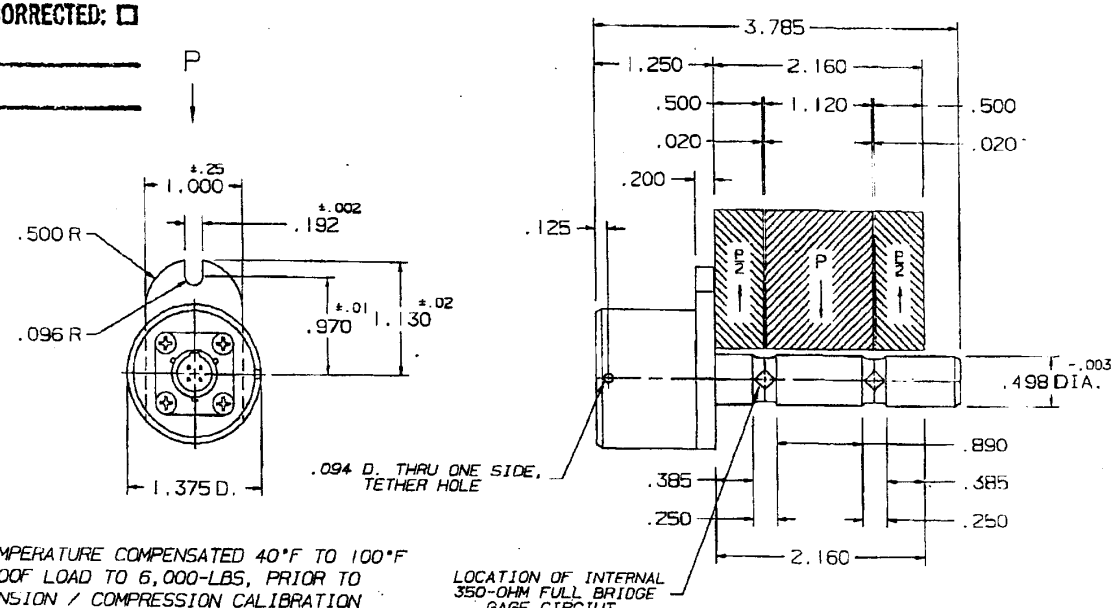
Maximum Load Seen
on Rotator Screw
= 1000 lbs

Factor of Safety
for this application
$= \frac{9000}{1000} = 9.0 \geq 4.0$

O.K. to use

H. Liu, Boeing-K212

APPROVED AS IS: ☐
APPROVED AS CORRECTED: ☐
SIGNED: _____
DATED: _____



NOTE:
- TEMPERATURE COMPENSATED 40°F TO 100°F
- PROOF LOAD TO 6,000-LBS, PRIOR TO TENSION / COMPRESSION CALIBRATION
- 3 TO 1 STATIC FACTOR OF SAFETY BASED ON MATERIAL U.T.S.
- IN-PLACE CALIBRATION RECOMMENDED
OTHER SPECIFICATIONS PER ME183-0105 REV A

U.S. Pat. No. 3,695,096

RECEPTACLE: (BENDIX)
PT02H 8-4P

SHEAR LOAD PRODUCES SIGNAL POLARITY INDICATED
- RED, + EXCITATION (A)
- BLK, - EXCITATION (D)
- GRN, + SIGNAL (B)
- WHT, - SIGNAL (C)

FOR: UNITED SPACE ALLIANCE

TOLERANCES NOT SPECIFIED:
DIMENSIONS:
FRACTIONS ± 1/64
DECIMALS .X ± .1 .XX ± .02 .XXX ± .010
ANGLES ± 1°
MACHINED SURFACES:
SURFACE FINISH 63-MICRO-IN.
CONCENTRICITY .001-IN. TIR
SQUARE / PARALLEL .002-IN./FT. TIR

HEAT TREAT:
H-1000
Rc 43-46
205 KSI UTS

CLEVIS PIN
±3000-LBS. 1.5-mV/V(NOM)

MATERIAL:
STAINLESS STEEL
13-8 Mo

STRAINSERT COMPANY

DRAWN: BSS DATE: 11-23-07
CHECKED: MT DATE: 11/26/07
WAS: SCALE: NOTED OR FULL
FINISH: NONE
018899-100-1-B

THIS PRINT IS THE PROPERTY OF STRAINSERT COMPANY AND SHALL BE RETURNED UPON REQUEST. ITS CONTENTS SHALL BE HELD CONFIDENTIAL, SHALL NEITHER BE COPIED NOR DISCLOSED TO OTHERS, AND SHALL BE USED FOR THE SOLE PURPOSE OF DOING BUSINESS WITH STRAINSERT COMPANY.

Intrinsic safety analysis of the G070-340247-001 ROTATOR ASSY - LIFTING FIXTURE; APS POD is limited to the addition of the following equipment shown in Figure 1 – Operational Usage below:

(1) G070-340248-001 (ME183-0105-0001) - Force Sensing Clevis Pin
(1) G070-340248-002 (ME183-0105-0001) - Force Sensing Clevis Pin
(1) G070-340249-001 - Cable Assy.-Force Sensing Clevis Pin (3W1)
(1) G070-340249-002 - Cable Assy.-Force Sensing Clevis Pin (3W2)
(1) G070-340098-001 - Digital Indicator Assy (2W1)
(1) G070-340098-002 - Digital Indicator Assy (2W2)
(1) G070-340091-001 - Safety Barrier Assy
(1) G070-320049-002 - Facility Ground Cable Assy

Two situations need to be analyzed for Class I Division 2 compliance:

1. Any equipment located within 5 feet of a potential hazardous commodity source shall be classified as Class I Division 2 per Figure 2 item B. From figure 1, this includes the G070-340248-002 upper load pin and G070-340249-002 cable connected to the OMS Pod handling fixture.
2. Any equipment located within 25 feet of this source shall be classified as Class I Division 2 up to 36 inches above floor level or solid platform per Figure 2 item C. From figure 1, this includes all other equipment including the G070-340248-001 (ME183-0105-0001) - Force Sensing Clevis Pin, G070-340249-001 - Cable Assy.-Force Sensing Clevis Pin (3W1), G070-340249-002 - Cable Assy.-Force Sensing Clevis Pin (3W2), G070-340098-001 - Digital Indicator Assy (2W1), G070-340098-002 - Digital Indicator Assy (2W2), G070-340091-001 - Safety Barrier Assy and G070-320049-002 - Facility Ground Cable Assy.

Analysis:

1. The regulatory requirement for equipment within the 5 foot hazard zone is called out in Factory Mutual Class Number 3611 - Approval Standard for Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2, Hazardous (Classified) Locations. The document states as a definition that nonincendive equipment is equipment having electrical/electronic circuitry that is incapable, under normal operating conditions, of causing ignition of a specified flammable gas-, vapor-, or dust-air mixture of fibers or flyings due to arcing or thermal means. There are a handful of companies that supply equipment that meets these standards. This design uses equipment from Pepperl-Fuchs to safe the G070-340248-002 upper load pin and the G070-340249-002 cable. The load pins and cable enter the hazard zone along the G070-340247-002: ROTATOR ASSY - LIFTING FIXTURE; APS POD and are safed through the Z966.F and Z961.F intrinsic barriers which are part of G070-340091-001: SAFETY BARRIER ASSY; FORCE SENSING CLEVIS PIN; H70-0679. (Ref page 3, Figure 9.53)
2. From figure 1, the G070-340248-001, G070-340249-001, G070-340249-002, G070-340098-001, G070-340098-002, G070-340091-001 and G070-320049-002 will be operationally controlled to be at least 3 feet above floor level or solid platform

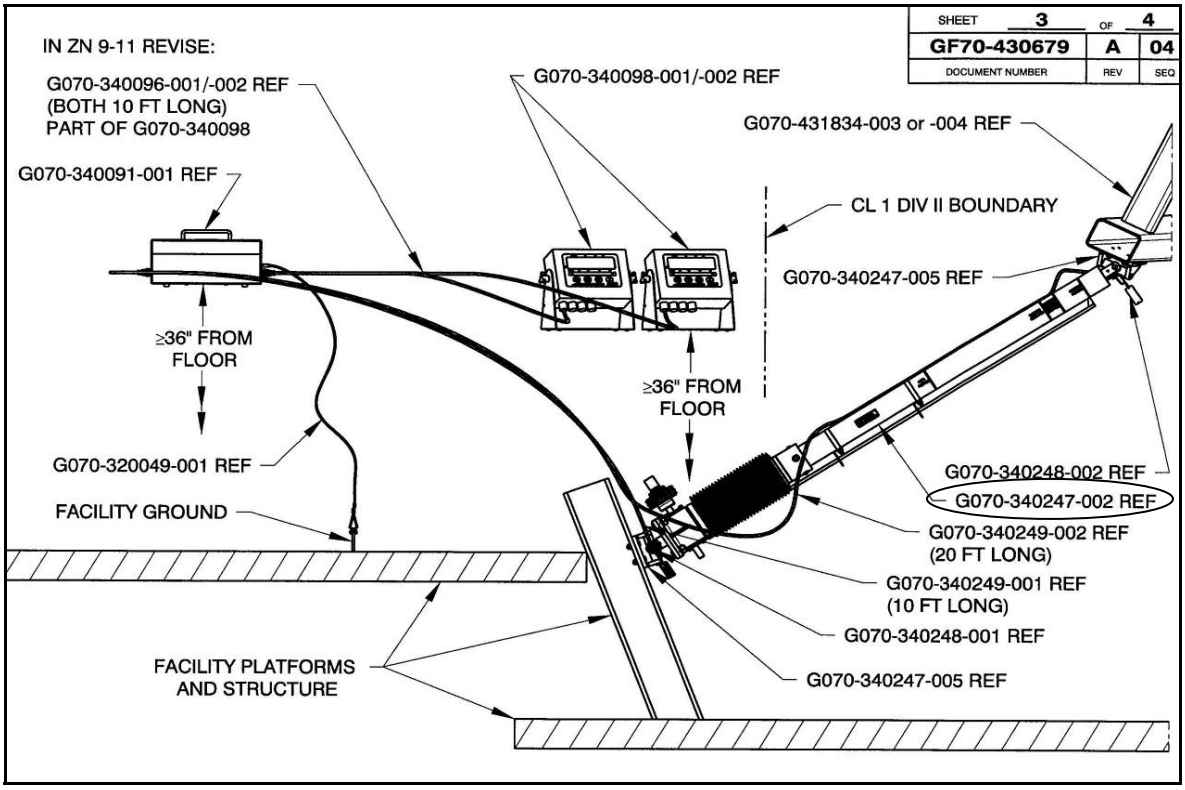


Figure 1 – Operational Usage

4. AREAS CLASSIFIED CLASS I, DIVISION 2 ARE AS FOLLOWS:

A. A LOCATION WHERE VOLATILE FLAMMABLE LIQUIDS OR FLAMMABLE GASES ARE HANDLED, PROCESSED, OR USED, BUT IN WHICH THE LIQUIDS,VAPORS,GASES WILL NORMALLY BE CONFINED WITHIN CLOSED CONTAINERS OR CLOSED SYSTEMS FROM WHICH THEY CAN ESCAPE ONLY IN CASE OF ACCIDENTAL RUPTURE OR BREAKDOWN OF SUCH CONTAINERS OR SYSTEMS, OR IN CASE OF ABNORMAL OPERATION OF EQUIPMENT OR IN WHICH IGNITABLE CONCENTRATIONS OF GASES OR VAPORS ARE NORMALLY PREVENTED BY POSITIVE MECHANICAL VENTILATION AND WHICH MIGHT BECOME HAZARDOUS THROUGH FAILURE OR ABNORMAL OPERATION OF THE VENTILATING EQUIPMENT OR THAT IS ADJACENT TO A CLASS I, DIVISION I LOCATION AND TO WHICH IGNITABLE CONCENTRATIONS OF GASES OR VAPORS MIGHT OCCASIONALLY BE COMMUNICATED UNLESS SUCH COMMUNICATION IS PREVENTED BY ADEQUATE POSITIVE-PRESSURE VENTILATION FROM A SOURCE OF CLEAN AIR AND EFFECTIVE SAFEGUARDS AGAINST VENTILATION FAILURE ARE PROVIDED. (SEE SECTION 500-5(B) OF THE NEC)

B. WITHIN A FIVE (5) FEET RADIUS OF VALVES, RELIEF VALVES, DISCONNECTS, FLANGES, FLEX HOSES OR OTHER AREAS WHERE LEAKAGE OF FLAMMABLE LIQUIDS (MMH) COULD OCCUR ABOVE FLOOR LEVEL (NFPA 497, FIGURE 3-8.3 & 3-8.4).

C. WITHIN A TWENTY FIVE (25) FEET RADIUS OF VALVES, RELIEF VALVES, DISCONNECTS, FLANGES, FLEX HOSES OR OTHER AREAS WHERE LEAKAGE OF FLAMMABLE LIQUIDS (MONO METHYL HYDRAZINE [MMH]), COULD OCCUR AT FLOOR LEVEL AND AT THREE (3) FEET ABOVE FLOOR LEVEL OR SOLID PLATFORM (NFPA 497, FIGURE 3-8.3 & 3-8.4).

D. UP TO EIGHTEEN (18) INCHES ABOVE ENTIRE HIGH BAY FLOOR (NFPA 70, 513-3(b)).

E. WITHIN A THREE (3) FEET RADIUS OF RELIEF VALVES, DISCONNECTS, FLANGES, FLEX HOSES OR OTHER AREAS WHERE LEAKAGE OF FLAMMABLE LIQUIDS (MMH) COULD OCCUR AND 18" ABOVE GRADE EXTENDING OUT TEN (10) FEET. (NFPA 497, FIGURE 3-8.14)

F. WITHIN A FIFTEEN (15) FEET RADIUS OF HYDROGEN VENTS (NFPA 497, FIGURE 3-8.27)

G. WITHIN FIVE (5) FEET RADIUS OF ALL HAZARDOUS VENT DISCHARGE (NFPA 497, FIGURE 3-8.17)

Figure 2 - 80K61590 LC39 OPF HB-1, 2, & 3 PERMANENT HAZ AREA CLASSIFICATIONS – Excerpt

Strain Gauges

Zener Diode Barriers

The Z966.* zener barrier supplies a 350 strain gauge bridge with the necessary excitation voltage while the optional Z964.* supplies the power supply with a voltage sense input for increased accuracy. The millivolt signal is transferred to the safe area through the Z961.* These barriers are connected in a "quasi-floating" configuration for the best possible signal integrity when using zener barriers.

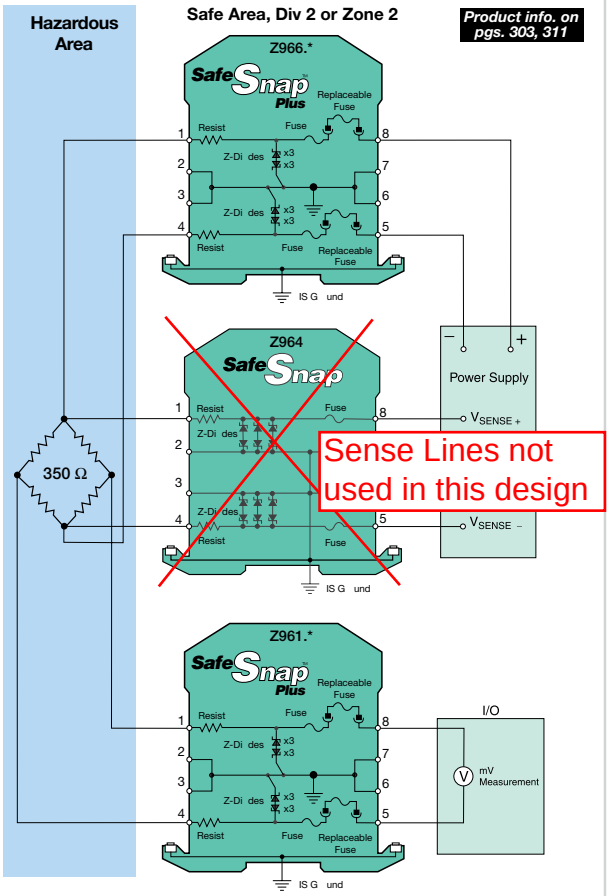


Figure 9.53

Note: SafeSnapPlus zener barriers are designed with replaceable fuses which is denoted by an "F" at the end of the model number. SafeSnap zener barriers have internal fuses.

Isolated Barriers

Isolated Strain Gauge Current Transmitter

This figure illustrates a galvanically isolated strain gauge transmitter barrier. With its 3-way isolation between power supply, input and output, this barrier provides a highly accurate means of supporting strain gauge applications within a hazardous location. The strain gauge can be connected in either a 4- or 6-wire configuration depending on the required accuracy. The strain gauge excitation voltage, mV signal range, tare value and current output range are all field selectable on the barrier.

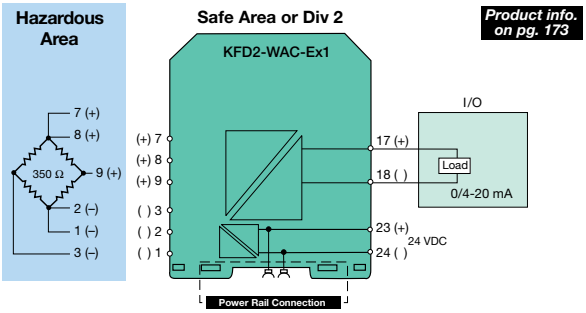


Figure 9.54

Note: Contact Pepperl+Fuchs regarding the availablity of the new KFD2-WAC2-Ex1 strain gauge converter.

Vibration Monitoring

Zener Diode Barriers

This figure illustrates an example of a zener diode barrier and a vibration monitor in the hazardous area. The vibration monitor outputs a voltage signal, which is referenced to the positive supply, proportional to the vibration waveform at frequencies up to 4 kHz. Therefore, a negative polarity barrier is required and the positive side of the power supply must be grounded.

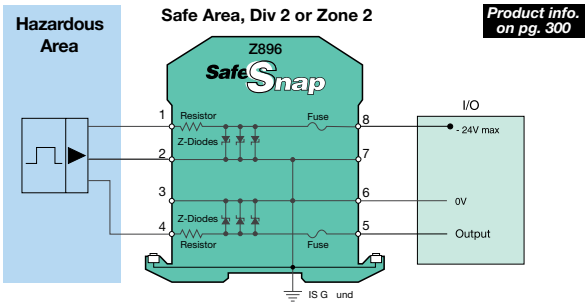


Figure 9.55

Tension - Pull

Target Load	G070-340098-001 Actual	G070-340098-001 Readout	G070-340098-001 % Error	G070-340098-002 Actual	G070-340098-002 Readout	G070-340098-002 % Error
100	99	107	8.08%	99	104	5.05%
200	200	211	5.50%	200	210	5.00%
300	302	319	5.63%	298	314	5.37%
400	401	421	4.99%	400	421	5.25%
500	499	522	4.61%	504	525	4.17%
600	598	623	4.18%	602	627	4.15%
700	702	727	3.56%	701	728	3.85%
800	802	828	3.24%	803	833	3.74%
900	900	928	3.11%	905	936	3.43%
1000	1009	1037	2.78%	1010	1042	3.17%
1100	1098	1126	2.55%	1107	1140	2.98%
1200	1202	1228	2.16%	1203	1236	2.74%
1300	1302	1328	2.00%	1309	1342	2.52%
1400	1412	1437	1.77%	1409	1441	2.27%
1500	1494	1518	1.61%	1509	1541	2.12%
1600	1605	1630	1.56%	1609	1641	1.99%
1700	1714	1736	1.28%	1707	1739	1.87%
1800	1794	1815	1.17%	1801	1832	1.72%
1900	1907	1925	0.94%	1908	1929	1.10%
2000	2000	2017	0.85%	2015	2045	1.49%
2100	2112	2128	0.76%	2107	2135	1.33%
2200	2216	2229	0.59%	2207	2235	1.27%
2300	2308	2317	0.39%	2306	2332	1.13%
2400	2418	2429	0.45%	2395	2421	1.09%
2500	2519	2525	0.24%	2508	2531	0.92%
2600	2609	2615	0.23%	2606	2631	0.96%
2700	2709	2711	0.07%	2712	2733	0.77%
2800	2808	2808	0.00%	2821	2841	0.71%
2900	2919	2920	0.03%	2906	2924	0.62%
3000	3011	3006	-0.17%	3003	3019	0.53%

Tension - Relax

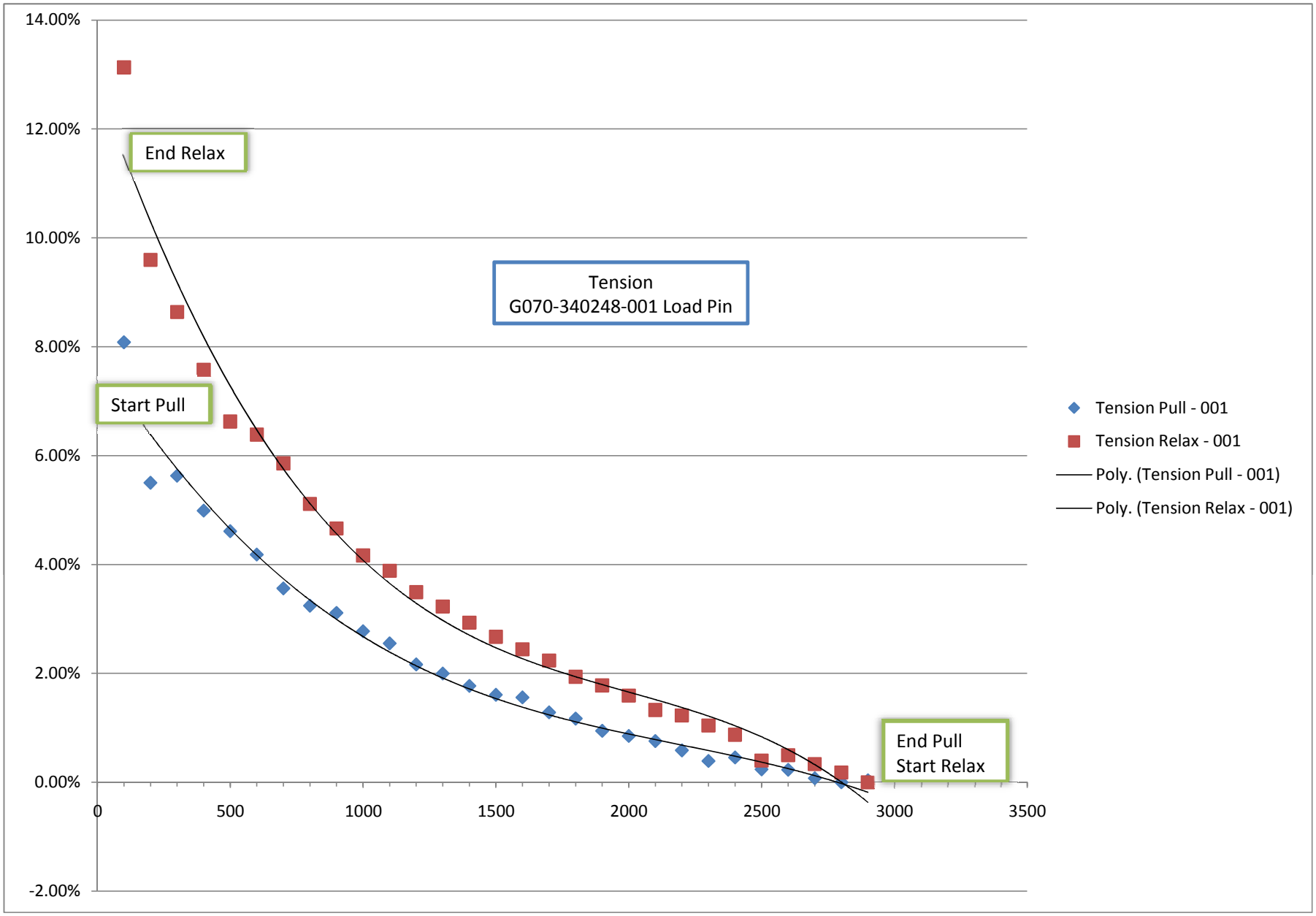
Target Load	G070-340098-001 Actual	G070-340098-001 Readout	G070-340098-001 % Error	G070-340098-002 Actual	G070-340098-002 Readout	G070-340098-002 % Error
100	99	112	13.13%	99	114	15.15%
200	198	217	9.60%	198	218	10.10%
300	301	327	8.64%	297	325	9.43%
400	396	426	7.58%	400	433	8.25%
500	498	531	6.63%	505	544	7.72%
600	595	633	6.39%	601	643	6.99%
700	700	741	5.86%	693	738	6.49%
800	802	843	5.11%	800	848	6.00%
900	901	943	4.66%	906	955	5.41%
1000	1008	1050	4.17%	1006	1058	5.17%
1100	1107	1150	3.88%	1096	1149	4.84%
1200	1203	1245	3.49%	1210	1263	4.38%
1300	1301	1343	3.23%	1310	1355	3.44%
1400	1398	1439	2.93%	1403	1455	3.71%
1500	1497	1537	2.67%	1503	1554	3.39%
1600	1597	1636	2.44%	1611	1665	3.35%
1700	1700	1738	2.24%	1706	1757	2.99%
1800	1807	1842	1.94%	1812	1862	2.76%
1900	1912	1946	1.78%	1897	1948	2.69%
2000	2010	2042	1.59%	2008	2057	2.44%
2100	2108	2136	1.33%	2118	2160	1.98%
2200	2201	2228	1.23%	2207	2246	1.77%
2300	2300	2324	1.04%	2304	2347	1.87%
2400	2404	2425	0.87%	2399	2439	1.67%
2500	2504	2514	0.40%	2513	2549	1.43%
2600	2611	2624	0.50%	2595	2628	1.27%
2700	2698	2707	0.33%	2696	2726	1.11%
2800	2805	2810	0.18%	2809	2835	0.93%
2900	2914	2914	0.00%	2897	2919	0.76%

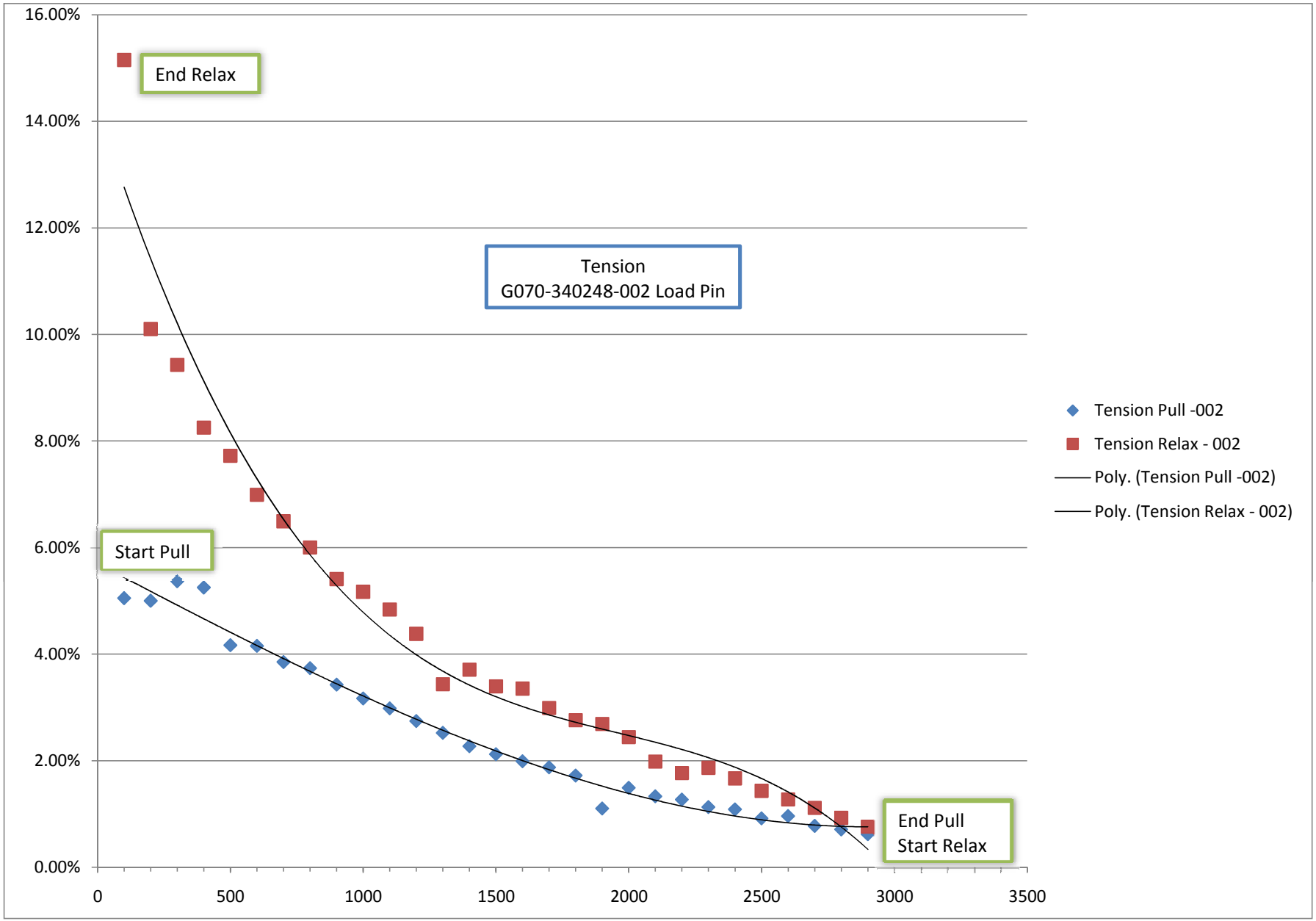
Compression - Pull

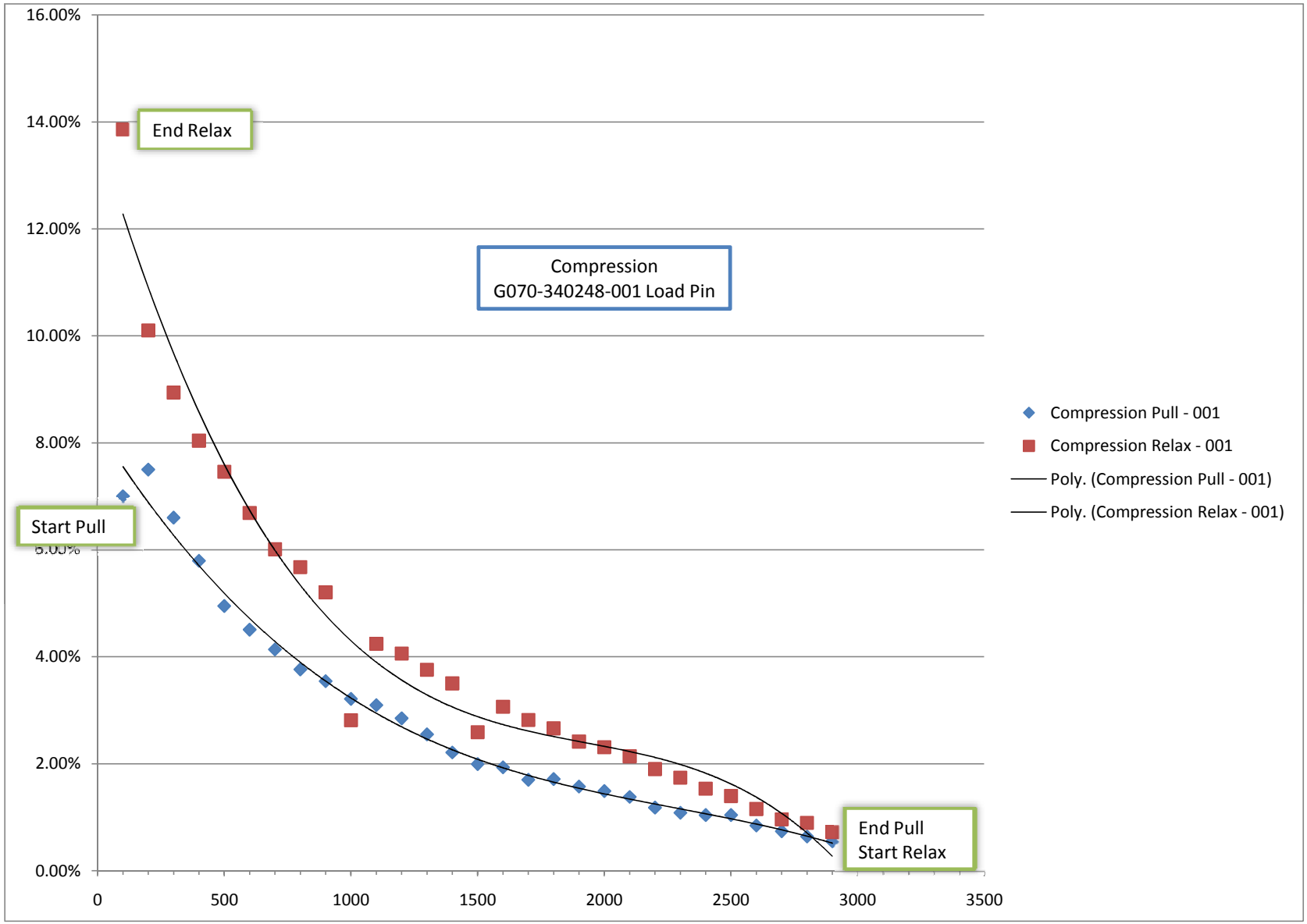
Target Load	G070-340098-001 Actual	G070-340098-001 Readout	G070-340098-001 % Error	G070-340098-002 Actual	G070-340098-002 Readout	G070-340098-002 % Error
100	100	-107	7.00%	101	-107	5.94%
200	200	-215	7.50%	201	-212	5.47%
300	303	-323	6.60%	302	-319	5.63%
400	397	-420	5.79%	403	-427	5.96%
500	505	-530	4.95%	497	-524	5.43%
600	599	-626	4.51%	602	-635	5.48%
700	701	-730	4.14%	704	-740	5.11%
800	797	-827	3.76%	798	-838	5.01%
900	903	-935	3.54%	900	-941	4.56%
1000	996	-1028	3.21%	1002	-1046	4.39%
1100	1098	-1132	3.10%	1109	-1155	4.15%
1200	1193	-1227	2.85%	1205	-1252	3.90%
1300	1294	-1327	2.55%	1302	-1351	3.76%
1400	1402	-1433	2.21%	1400	-1450	3.57%
1500	1505	-1535	1.99%	1503	-1554	3.39%
1600	1603	-1634	1.93%	1604	-1656	3.24%
1700	1705	-1734	1.70%	1704	-1758	3.17%
1800	1808	-1839	1.71%	1810	-1864	2.98%
1900	1905	-1935	1.57%	1908	-1964	2.94%
2000	2013	-2043	1.49%	2004	-2060	2.79%
2100	2101	-2130	1.38%	2100	-2154	2.57%
2200	2203	-2229	1.18%	2207	-2260	2.40%
2300	2308	-2333	1.08%	2298	-2353	2.39%
2400	2402	-2427	1.04%	2404	-2459	2.29%
2500	2498	-2524	1.04%	2500	-2553	2.12%
2600	2599	-2621	0.85%	2606	-2660	2.07%
2700	2710	-2730	0.74%	2706	-2760	2.00%
2800	2813	-2831	0.64%	2815	-2868	1.88%
2900	2908	-2924	0.55%	2911	-2964	1.82%
3000	3005	-3020	0.50%	3012	-3063	1.69%

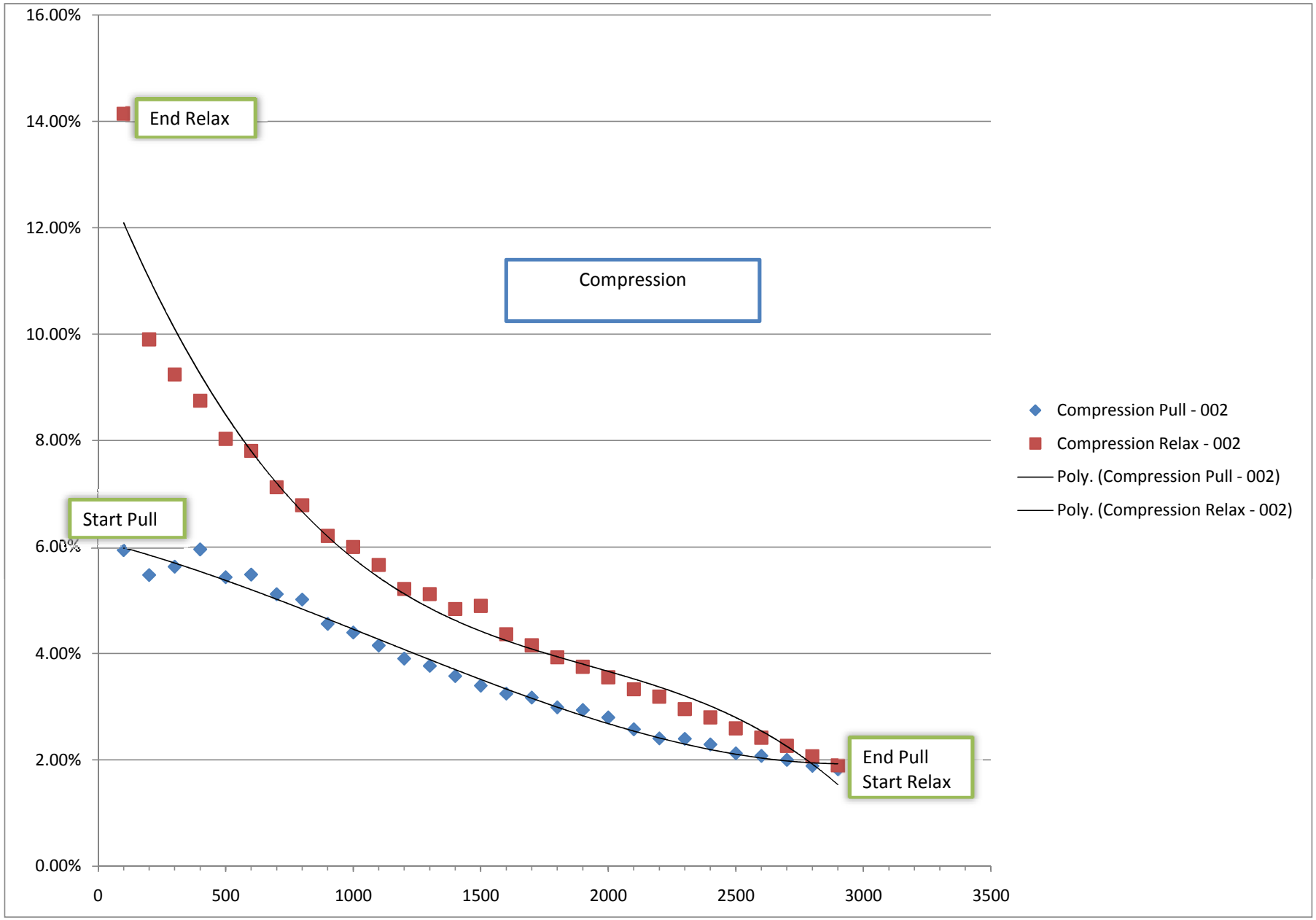
Compression - Relax

Target Load	G070-340098-001 Actual	G070-340098-001 Readout	G070-340098-001 % Error	G070-340098-002 Actual	G070-340098-002 Readout	G070-340098-002 % Error
100	101	-115	13.86%	99	-113	14.14%
200	198	-218	10.10%	202	-222	9.90%
300	302	-329	8.94%	303	-331	9.24%
400	398	-430	8.04%	400	-435	8.75%
500	496	-533	7.46%	498	-538	8.03%
600	598	-638	6.69%	602	-649	7.81%
700	699	-741	6.01%	702	-752	7.12%
800	793	-838	5.67%	796	-850	6.78%
900	903	-950	5.20%	902	-958	6.21%
1000	995	-1023	2.81%	1000	-1060	6.00%
1100	1108	-1155	4.24%	1095	-1157	5.66%
1200	1207	-1256	4.06%	1209	-1272	5.21%
1300	1304	-1353	3.76%	1310	-1377	5.11%
1400	1399	-1448	3.50%	1407	-1475	4.83%
1500	1507	-1546	2.59%	1492	-1565	4.89%
1600	1599	-1648	3.06%	1605	-1675	4.36%
1700	1703	-1751	2.82%	1710	-1781	4.15%
1800	1804	-1852	2.66%	1808	-1879	3.93%
1900	1906	-1952	2.41%	1894	-1965	3.75%
2000	1993	-2039	2.31%	1999	-2070	3.55%
2100	2104	-2149	2.14%	2105	-2175	3.33%
2200	2210	-2252	1.90%	2196	-2266	3.19%
2300	2302	-2342	1.74%	2303	-2371	2.95%
2400	2413	-2450	1.53%	2396	-2463	2.80%
2500	2507	-2542	1.40%	2509	-2574	2.59%
2600	2600	-2630	1.15%	2607	-2670	2.42%
2700	2713	-2739	0.96%	2696	-2757	2.26%
2800	2795	-2820	0.89%	2808	-2866	2.07%
2900	2904	-2925	0.72%	2900	-2955	1.90%


14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
-2.00%
0
500
1000
1500
2000
2500
3000
3500
End Relax
Start Pull
Tension
G070-340248-001 Load Pin
End Pull
Start Relax
Tension Pull - 001
Tension Relax - 001
Poly. (Tension Pull - 001)
Poly. (Tension Relax - 001)


16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0
500
1000
1500
2000
2500
3000
3500
End Relax
Tension
G070-340248-002 Load Pin
Start Pull
End Pull
Start Relax
Tension Pull -002
Tension Relax - 002
Poly. (Tension Pull -002)
Poly. (Tension Relax - 002)


16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0
500
1000
1500
2000
2500
3000
3500
End Relax
Compression
G070-340248-001 Load Pin
Start Pull
End Pull
Start Relax
Compression Pull - 001
Compression Relax - 001
Poly. (Compression Pull - 001)
Poly. (Compression Relax - 001)


16.00%
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0
500
1000
1500
2000
2500
3000
3500
End Relax
Compression
Start Pull
End Pull
Start Relax
Compression Pull - 002
Compression Relax - 002
Poly. (Compression Pull - 002)
Poly. (Compression Relax - 002)

KSC: Test Agency Report (TAR)

TAR No.	01-TAR-33-340247-001		
CAR No.	01-33-340247-001		
Part No.	G070-340247-001		
Effectivity	EI 3 & 4 ONLY		
Revision	Basic	**Date:**	12/07/09

Performing Agency:	**Location Address:**	**Contact Person:**
United Space Alliance	8550 Astronaut Blvd. Cape Canaveral, Fl. 32920-4304	Lois Y. Hardy **Telephone:** 321-799-5588

1.0 Test Objective:

Testing was performed on the G070-340247-001 ROTATOR ASSY - LIFTING FIXTURE; APS POD instrumented electrical hardware modification to demonstrate that the tensile and compressive load data was accurately displayed in support of OMS Pod installation or removal operations per the CR test No. 33-340247-001.

The detailed objective of the certification test was to apply loads of 100 - 3000 lbs. to the Force Sensing Clevis Pins using fixture tool (T-7523821) on the Instron machine, verifying that the 2 Digital Readout Indicators were within +/- 10% of the applied load.

2.0 Test Hardware Description:

The modification of the G070-340247-001 ROTATOR ASSY - LIFTING FIXTURE; APS POD consists of the addition of the following hardware:

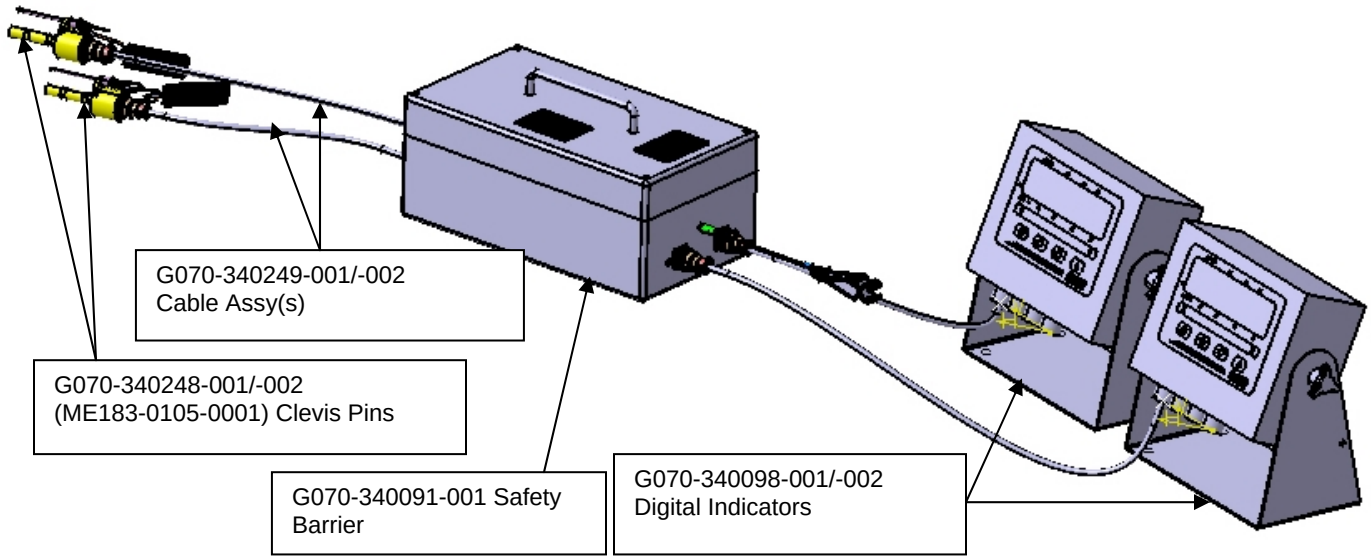
(1) G070-340248-001 (ME183-0105-0001) - Force Sensing Clevis Pin
(1) G070-340248-002 (ME183-0105-0001) - Force Sensing Clevis Pin
(1) G070-340249-001 - Cable Assy.-Force Sensing Clevis Pin (3W1)
(1) G070-340249-002 - Cable Assy.-Force Sensing Clevis Pin (3W2)
(1) G070-340098-001 - Digital Indicator Assy (2W1)
(1) G070-340098-002 - Digital Indicator Assy (2W2)
(1) G070-340091-001 - Safety Barrier Assy
(1) G070-320049-002 - Facility Ground Cable Assy.

Instron Calibration data:

10,000 lb Instron Load Cell – Calibration data, #Y22678 _ September 28, 2010

Instron - Calibration data, #Y22671 _ September 28, 2010

T-7523821 T-Tool Pull test fixture – based on Clevis Pin manufacturers recommendations (Strain Cert)



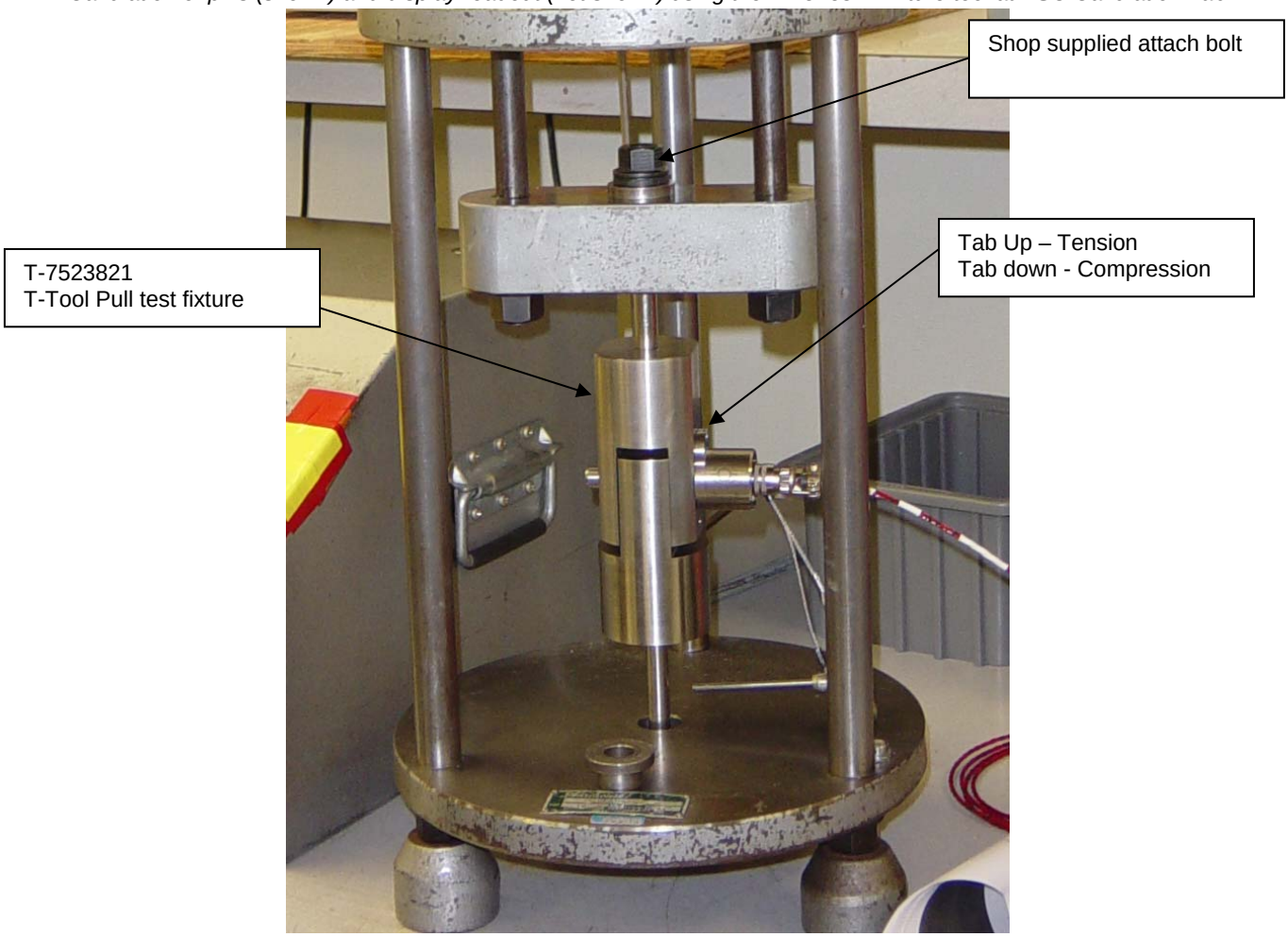
Test fixture requirement:

The G070-340248-001 / -002 Load Pins interface to the G070-340247-001 Rotator Assy on each end of the assembly at the G070-340247-004 Weld Assy and the -005 Pivot Assy. The T-7523821 test fixture was made to the dimensions of the G070-340247-004 & -005 therefore simulating the installation. (see ***Attachment 1*** for test fixture drawing)

3.0 Test Set-Up Description:

Prior to testing, all equipment was sent to CIF for calibration. The test set-up at the United Space Alliance NSLD consisted of the above noted test hardware and associated test equipment and instrumentation necessary to perform the required test. An additional fixture was fabricated to attach to the T-7523821 tool to the Instron Load Cell. Tensile loads are obtained with the Clevis Pin tab facing up (in direction of pull force, shown). Compressive loads are obtained with the Clevis Pin tab facing down (in opposite direction of pull force, not shown).

Calibration of pins (shown) and display readout (not shown) using the T-7523821 fixture tool at KSC Calibration Lab



Certification testing was performed on an Instron machine at the NSLD using the same T-7523821 T-Tool Pull test fixture.

KSC: Test Agency Report (TAR)

TAR No.	01-TAR-33-340247-001		
CAR No.	01-33-340247-001		
Part No.	G070-340247-001		
Effectivity	EI 3 & 4 ONLY		
Revision	Basic	**Date:**	12/07/09

4.0 Test Procedure: (as run for validation)

- Verify batteries are charged in G070-370098-001/-002 Display Unit (minimum 24 hour charge).
- Load to be applied in Tension (tab up) from 100 to 3000 lbs. then back to 100 lbs per CR test # 33-340247-001 table.
- Load to be applied in Compression (tab down) from 100 to 3000 lbs. then back to 100 lbs per CR test # 33-340247-001 table.
- A passing measurement is a reading within +/- 10% of the actual compression or tension load being applied.

Example table

Applied Load (+/- 1%) lbs	TENSION			COMPRESSION		
	Actual Load (lbs)	Readout G070-340098-001 (lbs)	Readout G070-340098-002 (lbs)	Actual Load (lbs)	Readout G070-340098-001- (lbs)	Readout G070-340098-002- (lbs)
100.0 +/- 1.0						
200.0 +/- 2.0						

5.0 Failure / Variance from Test Procedures / Details of Anomalies:

One of the terminal connection tabs on battery was broken off; the tab was filed down and reconnected. No test failures.

Post test data review shows 6 data points outside the +/- 10 % pass/fail criteria of the test.

Readout Part Number	Test Type	Target	Actual Reading	% Error
G070-340098-001 Lower Load Pin	Tension	100 lbs	112 lbs	13.13 %
	Compression	200 lbs	218 lbs	10.10 %
	Compression	100 lbs	115 lbs	13.86 %
G070-340098-002 Upper Load Pin	Tension	200 lbs	218 lbs	10.10 %
	Tension	100 lbs	114 lbs	15.15 %
	Compression	100 lbs	100 lbs	14.14 %

The out of tolerance measurements can be shown to be caused by hysteresis in the load pins and will be discussed in the EAR.
See 01-EAR-33-340247-001 for explanation of the out of tolerance readings.

6.0 Test Results and Data:

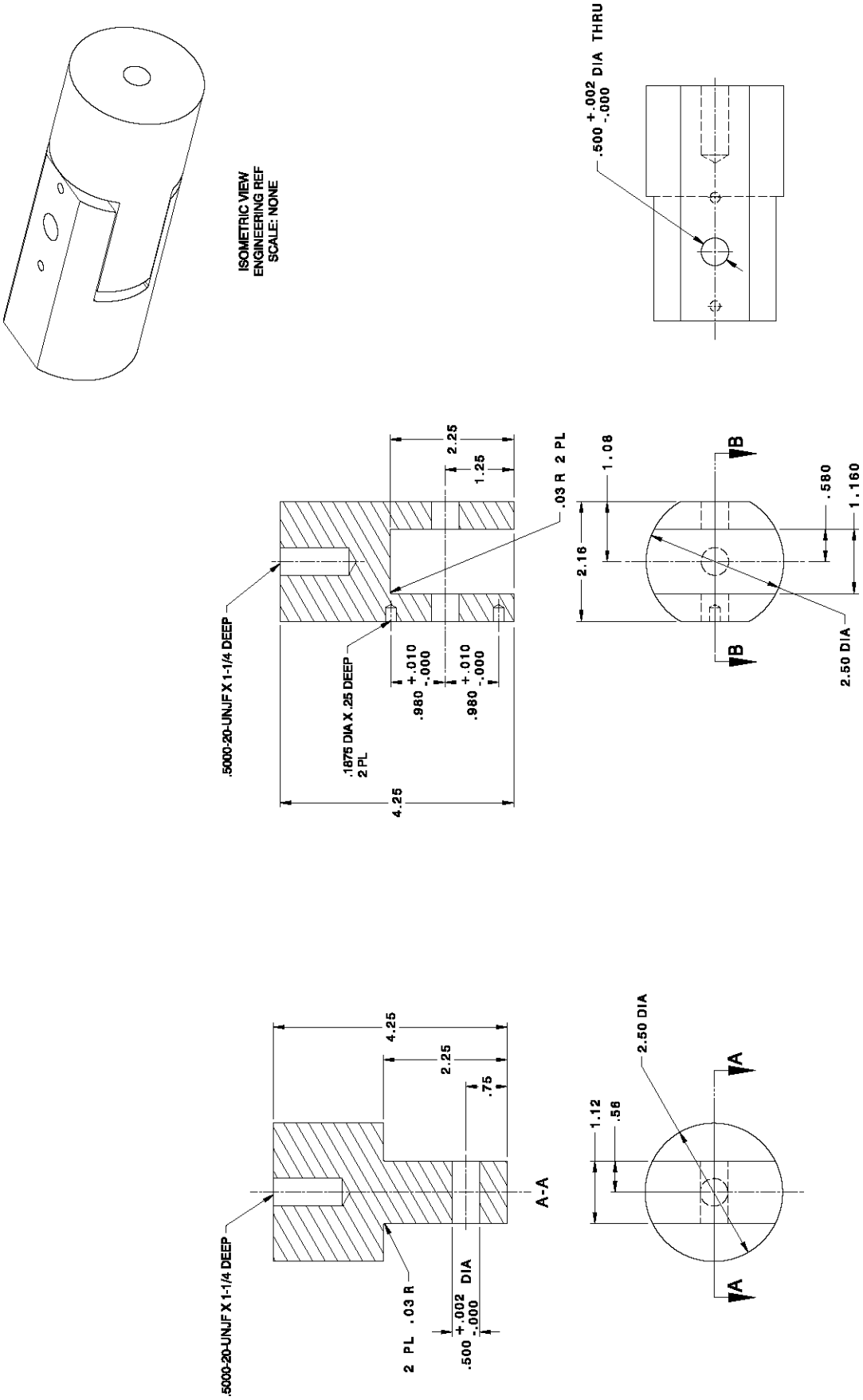
All test points passed the +/- 10% pass fail criteria except for the above noted readings.

Test report and data provided from Certification No. 33-340247-001 is shown in ***Attachment 2, pg 1 & 2.*** The data in spread sheet form is shown in ***Attachment 2, pg 3.***

7.0 Laboratory Notes:

None reported

01-TAR-33-340247-001 Attachment #1
Revision: Basic
Date: 12/7/09
(Test fixture drawing, Tool # T-7523821)



6.0 Description of Required Testing and Pass / Fail Criteria:

Load to be applied in Tension from 100 to 3000 LBS then back to 100 LBS per the following table
Load to be applied in Compression from 100 to 3000 LBS then back to 100 LBS per the following table
Verify batteries are charged in G070-340098-001/-002 Display Unit.
A passing measurement is a reading within +/-10% of the actual compression or tension load being applied

Table 1 - Compression and Tension Readings

Applied Load (+/- 1%) lbs	TENSION				COMPRESSION			
	Actual Load (lbs)		Readout G070-340098-001 (lbs)	Readout G070-340098-002 (lbs)	Actual Load (lbs)		Readout G070-340098-001- (lbs)	Readout G070-340098-002- (lbs)
100.0 +/- 1.0	99	99	107	104	100	101	-107	-107
200.0 +/- 2.0	200	200	211	210	200	201	-215	-212
300.0 +/- 3.0	302	298	319	314	303	302	-323	-319
400.0 +/- 4.0	401	400	421	421	397	403	-420	-427
500.0 +/- 5.0	499	501	522	525	505	497	-530	-524
600.0 +/- 6.0	598	602	623	627	599	602	-626	-635
700.0 +/- 7.0	702	701	727	728	701	704	-730	-740
800.0 +/- 8.0	802	803	828	833	797	798	-827	-838
900.0 +/- 9.0	900	905	928	936	903	900	-935	-941
1000.0 +/- 10.0	1009	1010	1037	1042	996	1002	-1028	-1046
1100.0 +/- 11.0	1098	1107	1126	1140	1098	1109	-1132	-1155
1200.0 +/- 12.0	1202	1203	1228	1236	1193	1205	-1227	-1252
1300.0 +/- 13.0	1302	1309	1328	1342	1294	1302	-1327	-1351
1400.0 +/- 14.0	1402	1409	1437	1441	1402	1400	-1433	-1450
1500.0 +/- 15.0	1494	1509	1518	1541	1505	1503	-1535	-1554
1600.0 +/- 16.0	1605	1609	1630	1641	1603	1604	-1634	-1656
1700.0 +/- 17.0	1714	1707	1736	1739	1705	1704	-1734	-1758
1800.0 +/- 18.0	1794	1801	1815	1832	1808	1810	-1839	-1864
1900.0 +/- 19.0	1907	1908	1925	1929	1905	1908	-1935	-1964
2000.0 +/- 20.0	2000	2015	2017	2045	2013	2004	-2043	-2060
2100.0 +/- 21.0	2112	2107	2128	2135	2101	2100	-2130	-2154
2200.0 +/- 22.0	2216	2207	2229	2235	2203	2201	-2229	-2260
2300.0 +/- 23.0	2308		2317	2332	2308	2298	-2333	-2353
2400.0 +/- 24.0	2418		2429	2421	2402	2404	-2427	-2459
2500.0 +/- 25.0	2519		2525	2531	2498	2500	-2524	-2553
2600.0 +/- 26.0	2609		2615	2631	2599	2606	-2621	-2660
2700.0 +/- 27.0	2709		2711	2733	2710	2706	-2730	-2760
2800.0 +/- 28.0	2808		2808	2841	2813	2815	-2831	-2868
2900.0 +/- 29.0	2919		2920	2924	2908	2911	-2924	-2964
3000.0 +/- 30.0	3011		3006	3019	3005	3012	-3020	-3063
2900.0 +/- 29.0	2914		2914	2919	2904	2900	-2925	-2955
2800.0 +/- 28.0	2805		2810	2835	2795	2808	-2820	-2866
2700.0 +/- 27.0	2698		2707	2726	2713	2696	-2729	-2757
2600.0 +/- 26.0	2611		2624	2628	2600	2601	-2630	-2670
2500.0 +/- 25.0	2504		2514	2549	2507	2509	-2542	-2574

2) RUN
2306
2395
2508
2606
2712
2821
2906
3003
2897
2809
2696
2545
2513
2) RUN

Table 2 (cont.) - Compression and Tension Readings

Applied Load (+/- 1%) lbs	TENSION				COMPRESSION			
	Actual Load (lbs)		Readout G070-340098-001 (lbs)	Readout G070-340098-002 (lbs)	Actual Load (lbs)		Readout G070-340098-001- (lbs)	Readout G070-340098-002- (lbs)
2400.0 +/- 24.0	2404	2399	2425	2439	2413	2396	-2450	-2463
2300.0 +/- 23.0	2300	2304	2324	2347	2302	2303	-2342	-2371
2200.0 +/- 22.0	2201	2209	2228	2246	2210	2196	-2252	-2266
2108 2100.0 +/- 21.0	~~2108~~	2118	2136	2160	2104	2105	-2149	-2175
2000.0 +/- 20.0	2010	2008	2042	2057	1993	1999	-2039	-2070
1900.0 +/- 19.0	1912	1897	1946	1948	1906	1894	-1952	-1965
1800.0 +/- 18.0	1807	1812	1842	1862	1804	1808	-1852	-1879
1700.0 +/- 17.0	1700	1706	1738	1757	1703	1710	-1751	-1781
1600.0 +/- 16.0	1597	1611	1636	1665	1599	1605	-1648	-1675
1500.0 +/- 15.0	1497	1503	1537	1554	1507	1497	-1546	-1565
1400.0 +/- 14.0	1398	1403	1439	1455	1399	1407	-1448	-1475
1300.0 +/- 13.0	1301	1310	1343	1355	1304	1310	-1353	-1377
1200.0 +/- 12.0	1203	1210	1245	1263	1207	1209	-1256	-1272
1100.0 +/- 11.0	1107	1096	1150	1149	1108	1095	-1155	-1157
1000.0 +/- 10.0	1008	1006	1050	1058	995	1000	-1093	-1060
900.0 +/- 9.0	901	906	943	955	903	902	-950	-958
800.0 +/- 8.0	802	800	843	848	793	796	-838	-850
700.0 +/- 7.0	700	693	741	738	699	702	-741	-752
600.0 +/- 6.0	595	601	633	643	598	602	-638	-649
500.0 +/- 5.0	498	505	531	544	496	498	-533	-538
400.0 +/- 4.0	396	400	426	433	398	400	-430	-435
300.0 +/- 3.0	301	297	327	325	302	303	-329	-331
200.0 +/- 2.0	198	198	217	218	198	202	-218	-222
100.0 +/- 1.0	99	99	112	114	101	99	-115	-113

01-TAR-33-340247-001 Attachment #2
Revision: Basic
Date: 12/7/09
(Certification Pass/Fail Criteria)

	Tension								Compression					
	G070-340098-001			G070-340098-002					G070-340098-001			G070-340098-002		
Target Load	Actual	Readout	% Error	Actual	Readout	% Error		Target Load	Actual	Readout	% Error	Actual	Readout	% Error
100	99	107	8.08%	99	104	5.05%		100	100	-107	7.00%	101	-107	5.94%
200	200	211	5.50%	200	210	5.00%		200	200	-215	7.50%	201	-212	5.47%
300	302	319	5.63%	298	314	5.37%		300	303	-323	6.60%	302	-319	5.63%
400	401	421	4.99%	400	421	5.25%		400	397	-420	5.79%	403	-427	5.96%
500	499	522	4.61%	504	525	4.17%		500	505	-530	4.95%	497	-524	5.43%
600	598	623	4.18%	602	627	4.15%		600	599	-626	4.51%	602	-635	5.48%
700	702	727	3.56%	701	728	3.85%		700	701	-730	4.14%	704	-740	5.11%
800	802	828	3.24%	803	833	3.74%		800	797	-827	3.76%	798	-838	5.01%
900	900	928	3.11%	905	936	3.43%		900	903	-935	3.54%	900	-941	4.56%
1000	1009	1037	2.78%	1010	1042	3.17%		1000	996	-1028	3.21%	1002	-1046	4.39%
1100	1098	1126	2.55%	1107	1140	2.98%		1100	1098	-1132	3.10%	1109	-1155	4.15%
1200	1202	1228	2.16%	1203	1236	2.74%		1200	1193	-1227	2.85%	1205	-1252	3.90%
1300	1302	1328	2.00%	1309	1342	2.52%		1300	1294	-1327	2.55%	1302	-1351	3.76%
1400	1412	1437	1.77%	1409	1441	2.27%		1400	1402	-1433	2.21%	1400	-1450	3.57%
1500	1494	1518	1.61%	1509	1541	2.12%		1500	1505	-1535	1.99%	1503	-1554	3.39%
1600	1605	1630	1.56%	1609	1641	1.99%		1600	1603	-1634	1.93%	1604	-1656	3.24%
1700	1714	1736	1.28%	1707	1739	1.87%		1700	1705	-1734	1.70%	1704	-1758	3.17%
1800	1794	1815	1.17%	1801	1832	1.72%		1800	1808	-1839	1.71%	1810	-1864	2.98%
1900	1907	1925	0.94%	1908	1929	1.10%		1900	1905	-1935	1.57%	1908	-1964	2.94%
2000	2000	2017	0.85%	2015	2045	1.49%		2000	2013	-2043	1.49%	2004	-2060	2.79%
2100	2112	2128	0.76%	2107	2135	1.33%		2100	2101	-2130	1.38%	2100	-2154	2.57%
2200	2216	2229	0.59%	2207	2235	1.27%		2200	2203	-2229	1.18%	2207	-2260	2.40%
2300	2308	2317	0.39%	2306	2332	1.13%		2300	2308	-2333	1.08%	2298	-2353	2.39%
2400	2418	2429	0.45%	2395	2421	1.09%		2400	2402	-2427	1.04%	2404	-2459	2.29%
2500	2519	2525	0.24%	2508	2531	0.92%		2500	2498	-2524	1.04%	2500	-2553	2.12%
2600	2609	2615	0.23%	2606	2631	0.96%		2600	2599	-2621	0.85%	2606	-2660	2.07%
2700	2709	2711	0.07%	2712	2733	0.77%		2700	2710	-2730	0.74%	2706	-2760	2.00%
2800	2808	2808	0.00%	2821	2841	0.71%		2800	2813	-2831	0.64%	2815	-2868	1.88%
2900	2919	2920	0.03%	2906	2924	0.62%		2900	2908	-2924	0.55%	2911	-2964	1.82%
3000	3011	3006	-0.17%	3003	3019	0.53%		3000	3005	-3020	0.50%	3012	-3063	1.69%
2900	2914	2914	0.00%	2897	2919	0.76%		2900	2904	-2925	0.72%	2900	-2955	1.90%
2800	2805	2810	0.18%	2809	2835	0.93%		2800	2795	-2820	0.89%	2808	-2866	2.07%
2700	2698	2707	0.33%	2696	2726	1.11%		2700	2713	-2739	0.96%	2696	-2757	2.26%
2600	2611	2624	0.50%	2595	2628	1.27%		2600	2600	-2630	1.15%	2607	-2670	2.42%
2500	2504	2514	0.40%	2513	2549	1.43%		2500	2507	-2542	1.40%	2509	-2574	2.59%
2400	2404	2425	0.87%	2399	2439	1.67%		2400	2413	-2450	1.53%	2396	-2463	2.80%
2300	2300	2324	1.04%	2304	2347	1.87%		2300	2302	-2342	1.74%	2303	-2371	2.95%
2200	2201	2228	1.23%	2207	2246	1.77%		2200	2210	-2252	1.90%	2196	-2266	3.19%
2100	2108	2136	1.33%	2118	2160	1.98%		2100	2104	-2149	2.14%	2105	-2175	3.33%
2000	2010	2042	1.59%	2008	2057	2.44%		2000	1993	-2039	2.31%	1999	-2070	3.55%
1900	1912	1946	1.78%	1897	1948	2.69%		1900	1906	-1952	2.41%	1894	-1965	3.75%
1800	1807	1842	1.94%	1812	1862	2.76%		1800	1804	-1852	2.66%	1808	-1879	3.93%
1700	1700	1738	2.24%	1706	1757	2.99%		1700	1703	-1751	2.82%	1710	-1781	4.15%
1600	1597	1636	2.44%	1611	1665	3.35%		1600	1599	-1648	3.06%	1605	-1675	4.36%
1500	1497	1537	2.67%	1503	1554	3.39%		1500	1507	-1546	2.59%	1492	-1565	4.89%
1400	1398	1439	2.93%	1403	1455	3.71%		1400	1399	-1448	3.50%	1407	-1475	4.83%
1300	1301	1343	3.23%	1310	1355	3.44%		1300	1304	-1353	3.76%	1310	-1377	5.11%
1200	1203	1245	3.49%	1210	1263	4.38%		1200	1207	-1256	4.06%	1209	-1272	5.21%
1100	1107	1150	3.88%	1096	1149	4.84%		1100	1108	-1155	4.24%	1095	-1157	5.66%
1000	1008	1050	4.17%	1006	1058	5.17%		1000	995	-1023	2.81%	1000	-1060	6.00%
900	901	943	4.66%	906	955	5.41%		900	903	-950	5.20%	902	-958	6.21%
800	802	843	5.11%	800	848	6.00%		800	793	-838	5.67%	796	-850	6.78%
700	700	741	5.86%	693	738	6.49%		700	699	-741	6.01%	702	-752	7.12%
600	595	633	6.39%	601	643	6.99%		600	598	-638	6.69%	602	-649	7.81%
500	498	531	6.63%	505	544	7.72%		500	496	-533	7.46%	498	-538	8.03%
400	396	426	7.58%	400	433	8.25%		400	398	-430	8.04%	400	-435	8.75%
300	301	327	8.64%	297	325	9.43%		300	302	-329	8.94%	303	-331	9.24%
200	198	217	9.60%	198	218	10.10%		200	198	-218	10.10%	202	-222	9.90%
100	99	112	13.13%	99	114	15.15%		100	101	-115	13.86%	99	-113	14.14%