INTERMODAL MATERIÉL
AND
NAUTICAL/NUCLEAR ANALYSIS
IMANNA
LABORATORY INC.

515 Gus Hipp Blvd.
Rockledge, Florida 32955
Telephone (321) 632-2008
http://www.imanna.com

Post Office Box 560933
Rockledge, Florida 32956-0933
FAX (321) 690-3360
e-mail: info@imanna.com

CERTIFICATION TEST REPORT

Rev. 09/16

CERTIFICATION TEST REPORT
20992-1
S.O.S. AND SURVIVOR LOCATOR LIGHT
AQUA-SIRIUS, LONG RANGE STROBE
TO
TSO-C85b
FOR
LIFESAVING SYSTEMS CORPORATION

CUSTOMER:

LIFESAVING SYSTEMS CORP.
220 ELSBERRY RD.
APOLLO BEACH, FL 33572

MANUFACTURER OF TEST ARTICLE: LIFESAVING SYSTEMS CORP.

DATE: April 5, 2018

REPORT NO.: 20992-1
IMANNA JOB NO.: 20992
CUSTOMER P.O. NO.: 1792
CONTRACT: N/A
PAGES IN REPORT: 24

STATE OF FLORIDA
COUNTY OF BREVARD

ROBERT L. WHITE, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Robert L. White

SUBSCRIBED and sworn to before me this 5th day of April, 2018

Robert P. Silverio
Notary Public
State of Florida
My Commission Expires 08/25/2018
Commission No. FF 154271

IMANNA shall have no liability for damages of any kind to person or property, including special or consequential damages resulting from IMANNA's providing the service covered by the report.

IMANNA LABORATORY, Inc.
TEST BY

Robert White
PROJ. MANAGER

1. TEST ARTICLE

Thirty samples of a Lifesaving Systems Corp., AQUA-SIRIUS LRS (Long Range Strobe) light were received for testing. The light is an LED model encased in a plastic case and is powered by two AA 1.5V batteries. The LED, the battery, and all electrical circuitry are housed inside a plastic case. The actuation of the light is by water immersion / manual switch. During water activation the light is activated when, after the switch is put in the "ON" position, water contact with the contacts makes the electrical resistance between the exposed contacts long enough to activate the light. The light will activate in fresh or salt water. The light incorporates a push switch that will allow the light to be turned off after it is activated for functional testing, to move between operational modes, and for conserving the batteries during daylight hours. The operational modes are a traditional 60 flash/min. (3.5 nm) strobe light source and a single direction focused (10 nm) strobe light. The lights were tested with Alkaline and with Lithium batteries.



Figure 1: view of typical light in received test samples

2. PART NUMBER / MODEL NAME / ACTIVATION METHOD / LIGHT TYPE

641-LRS / "Aqua Sirius LRS" / water - switch activated / flashing strobe light source

3. REQUIREMENTS

To perform the Survivor Locator Light Tests in accordance with the requirements of TSO-C85b / DO-160G as stated in SAE AS4492 Standard.

4. PROCEDURES

The procedure used in performing this test program is IMANNA Laboratory, Inc. Test Procedure MMS-PFDC-3b. This procedure details the requirements and procedures specified in TSO-C85B, DO-160G Sections 6, 7, 8, 9, 10 and 14 and SAE AS4492 without additions or deletions for the parameters tested.

The sample numbers referenced in this report are sample numbers assigned by IMANNA to the samples in entire lot. Individual samples were then chosen randomly from the lot for the various tests.

5. RESULTS

The results of the tests performed indicate that the test article meets the Test requirements for Survivor Locator Lights stated by the FAA in TSO-C85b. Specific results of the various tests follow:

5.1 Operation and Waterproofness / Immersion Test

The Operation and Waterproofness Test outlined in SAE AS4492 Section 4.9.6 was conducted on three samples. The following procedure and steps were conducted on the test articles.

Three light samples (#15, #2, #29) were selected at random and subjected to the Operation and Waterproofness immersion test in accordance with SAE AS4492 Section 4.9.6. The samples were turned on and then submerged under one meter of fresh water at a temperature of 20°C ±3°C for a period of 8 hours. Each of the three lights remained fully functional during the duration of the test and following the test as well. Visual observations and weights taken of the lights prior to and following the immersion of the lights confirmed that there was no water penetration of the lights during the test.



Figure 2: view of the Operation and Water Immersion test samples

5.2 Luminous Intensity Test

The three light samples utilized in the Operation and Waterproof / Immersion Test (#15, #2, #29) were subjected to an immersion test in accordance with SAE AS4492 Section 4.3.1. The samples were turned on and then submerged under one meter of fresh water at a temperature of 2°C ±3°C for a period of 8 hours. Each of the three lights remained fully functional during the duration of the test and following the test as well. Following the 8 hour operational period the battery voltages for each light sample were recorded. The luminous

intensity was then measured in the upper hemisphere of the light using the battery voltages measured on the three lights (#15, #2, #29). The test was conducted using both alkaline and lithium batteries.

Battery Type	Sample #15 voltage (A3) and (L1)	Sample #2 voltage (A4) and L4)	Sample #29 voltage (A5) and (L5)
Alkaline (A)	2.25	2.42	2.42
Lithium (L)	2.86	2.89	3.02

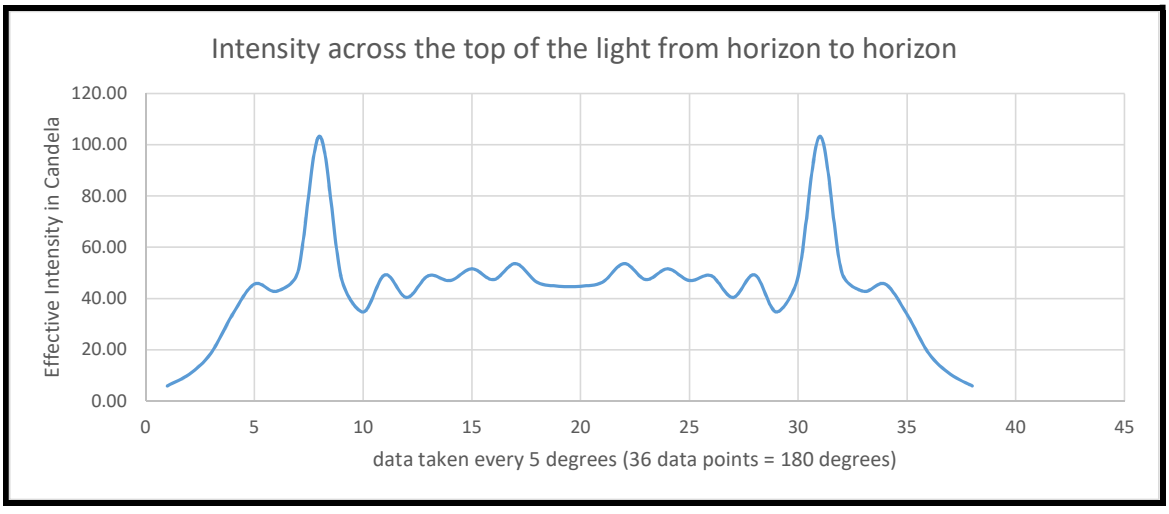
Voltages recorded at 8 hours operation.

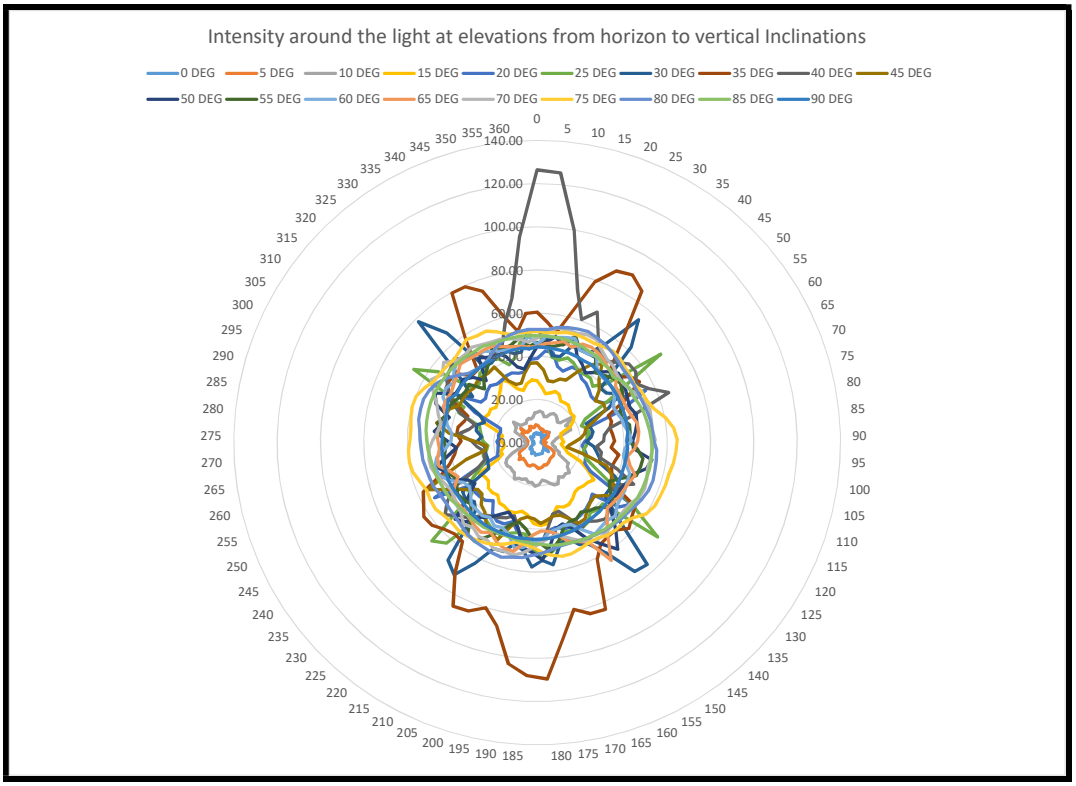
The light output of the light was recorded 360° around the light, and 180º from horizon-to-horizon across the top of the light using both of the recorded voltages.

The intensity readings measured on the both sets of samples indicated that the tested light produced at least 1.0 candela in the upper hemisphere of the light, at the voltages indicated above, over a continuous 8-hour operation period of +20°C ±3°C, in the following directions:

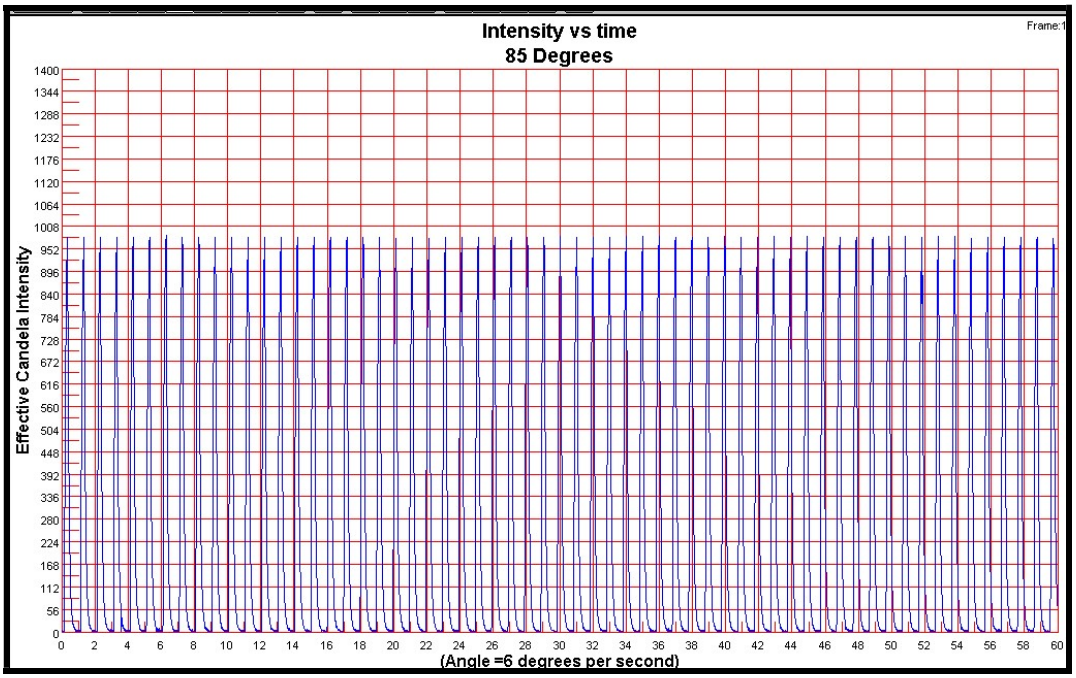
a) Minimum 1º beam centered on the horizon (±10º) over a minimum 300º of arc, centered on the horizontal plane, and with gaps of no more than 30º.

b) Minimum 1º beam width centered on the vertical (±10º).





Minimum Effective intensity measured was 1.51 Candela at the horizon.



Intensity taken in the high output cone directly above the light. With the center LED "ON".

5.3 Humidity Exposure Test

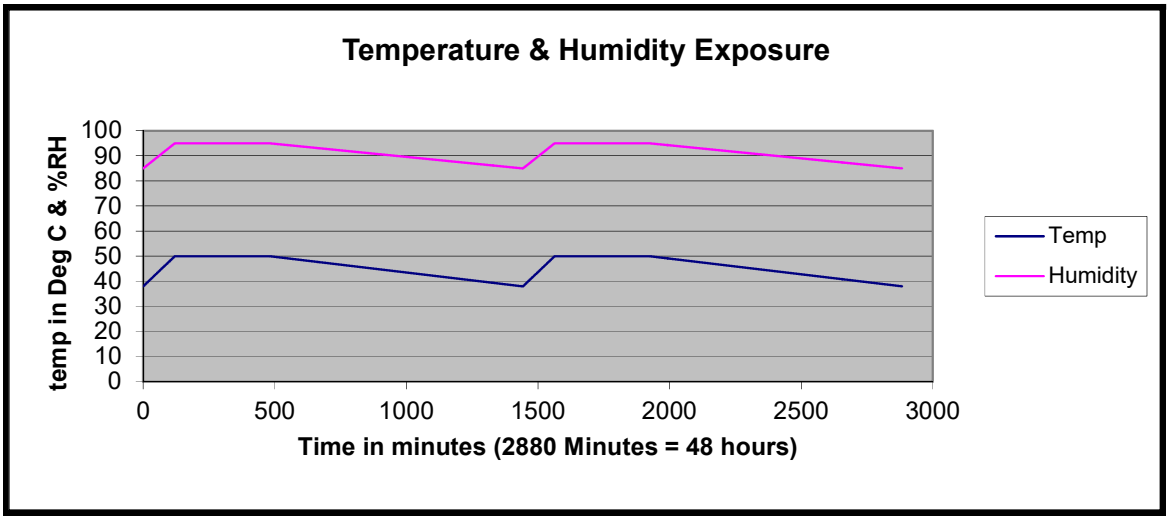
The humidity exposure test outlined in RTCA Document DO-160G, Section 6, Paragraph 6.3.1 (Category A- Standard Humidity Test) was conducted on three samples (#22, #17, #5). The following procedure and steps were conducted on the samples.

1. Stabilize the test item at 38±2°C and 85±4 %RH by holding the environment for a continuous period of 2 hours.
2. Over a two-hour period, raise the chamber temperature to 50±2°C and humidity to 95±4%RH.
3. Maintain the chamber temperature at 50±2°C and humidity at 95±4%RH for six hours.
4. During the next 16-hour period, decrease the temperature gradually to 38±2°C while maintaining the relative humidity at or above 85%RH.
5. Over a two-hour period, raise the chamber temperature to 50±2°C and humidity to 95±4%RH.
6. Maintain the chamber temperature at 50±2°C and humidity at 95±4%RH for six hours.
7. During the next 16-hour period, decrease the temperature gradually to 38±2°C while maintaining the relative humidity at or above 85%RH.
8. At the end of the exposure period, remove the test article from the test chamber and drain off (do not wipe) any condensed moisture. Within 15 minutes after the humidity cycle steps above are completed, turn the test article ON and verify operation.

At the end of the exposure period, all three of the lights functioned without any evidence of deterioration during the test exposure. None of the samples turned ON during the humidity exposure period, and each operated when switched on and placed in water after the exposure.



Figure 3: view of samples in the humidity chamber

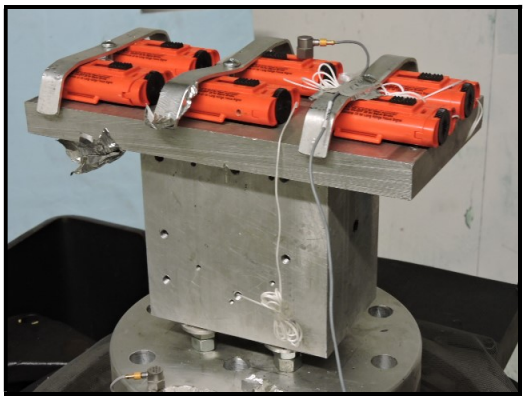


Screen shot of Temperature/Humidity recorder data.

5.4 Operation Shock and Crash Safety (Impact Test)

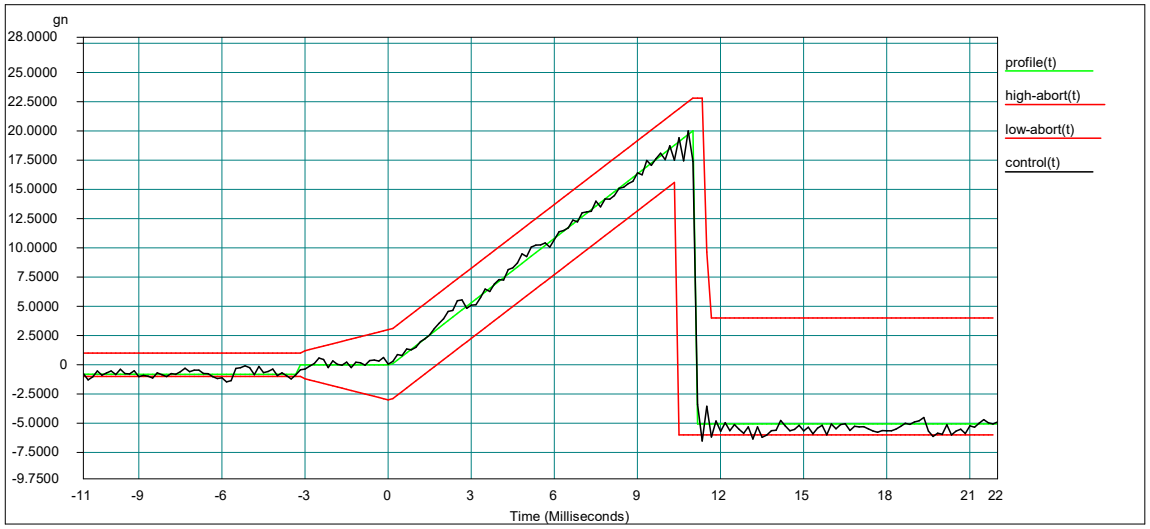
The Operational Shock and Crash Safety test outlined in RTCA Document DO-160G, Section 7, paragraph 7.3.1 was conducted on six samples, three containing alkaline batteries and three containing lithium batteries. The following procedure and steps were conducted on the test articles.

The six samples were attached to the platform of an impact shock table, turned on and subjected to12 impacts (three in each direction for two orthogonal axis). The impacts each had a peak acceleration of 20g's with a duration of 11 ms following a sine wave shape. Each light was tested while orientated both in the normal upright position and suspended upside down (positive shocks and negative shocks). No failures were observed to the lights. The lights were activated prior to the shock test and their operation was verified following the shock impacts showing each sample to be fully functional.



View of shock test orientation and battery immersion prior to and after test.

DUT: Life Saving Systems Light
Serial Number: 28, 10, 21
Project File Name: FAA SAW Tooth High g.prj X-Axis
Profile Name: 20g 11mSec Test Type: Classical Shock



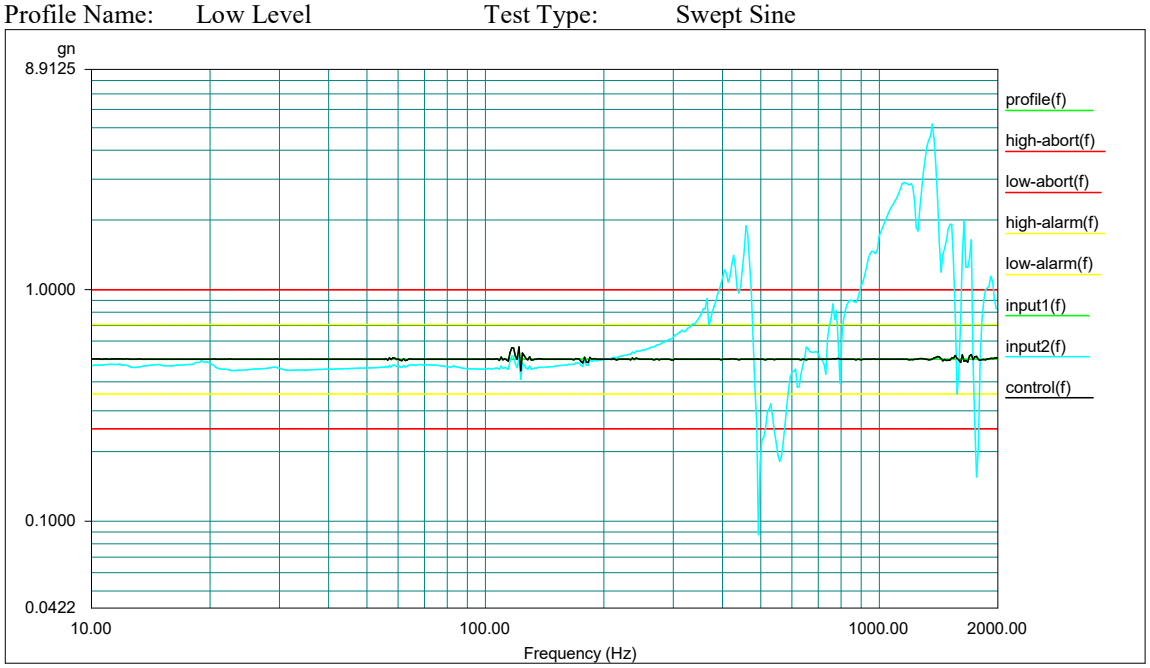
Level: 100 % Block Size: 2048 Elapsed Pulses: 12
Frame Time: 0.341333 Seconds
Control Peak: 19.997854 Control RMS: 2.697613 Full Level Elapsed Pulses: 3
dT: 0.000167 Seconds Demand Peak: 20.000000 Demand RMS: 2.661892
Remaining Pulses: 0
Pulse Type: Forward Terminal Sawtooth Amplitude: 20.000000
Pulse Width: 11.000000 ms

5.5 Vibration Test

The Vibration Test outlined in RTCA Document DO-160G, Section 8, Table 8-0 (Standard Vibration Test) was conducted on three samples. The following procedure and steps were conducted on the test articles.

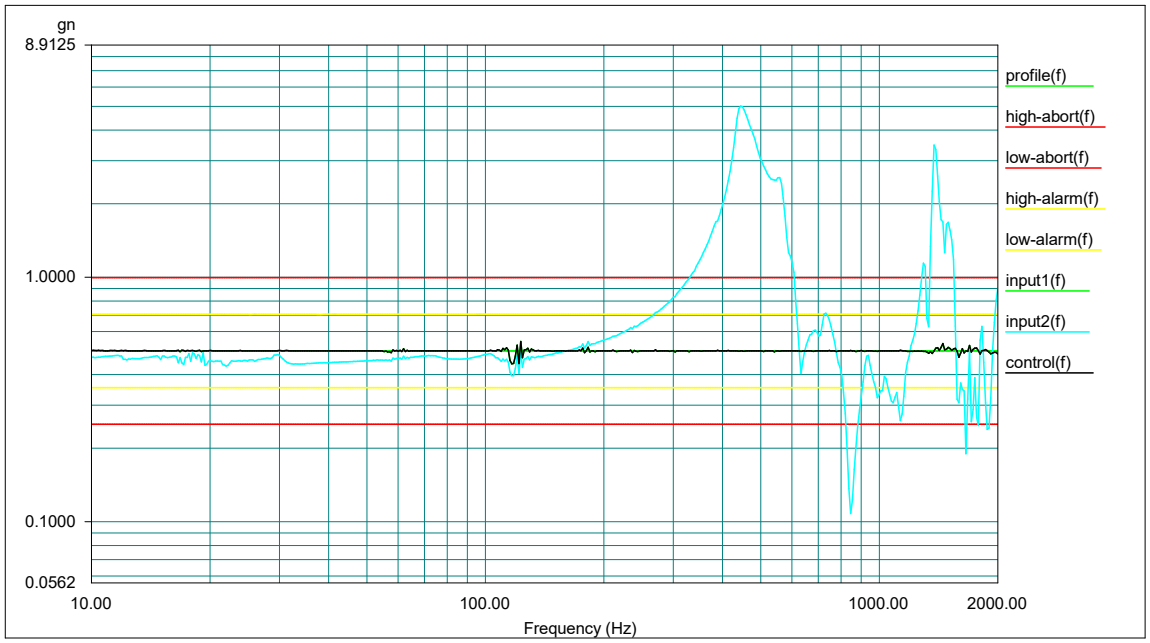
Three samples of the test article were mounted to the table of a vibration machine and subjected to the Standard Vibration Test Procedure-Fixed Wing Aircraft as stated in DO-160G, Section 8 using Table 8-0, and a random test procedure. The random frequency test was conducted for 1 hour for each of three orthogonal axes. The lights were verified by the test conductor that they remained functional during the entire test and continued to function following the entire exposure period by visual observation. The lights were activated prior to the vibration, and continued to be functional for the duration of the test. Following the test, a single point (marked on the light for repeatability) was checked for intensity and compared to the intensity prior to the test. The intensity was verified to be above the minimum required by the standard.

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Sine Scan Z.prj
Profile Name: Low Level Test Type: Swept Sine



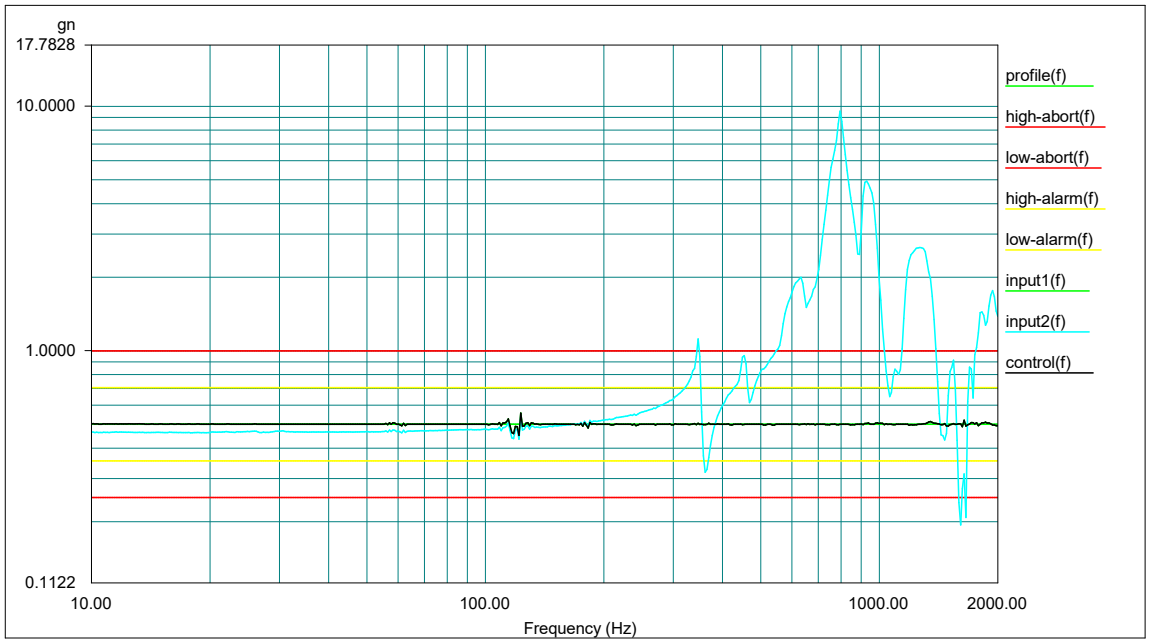
Level: 100 % Full Level Time: 00:07:39 Sweep Type: Logarithmic
Frequency: 10 to 2000 Hz Time Remaining: 00:00:00 Sweep Rate: 1 Oct/Min

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Sine Scan Y.prj
Profile Name: Low Level Test Type: Swept Sine



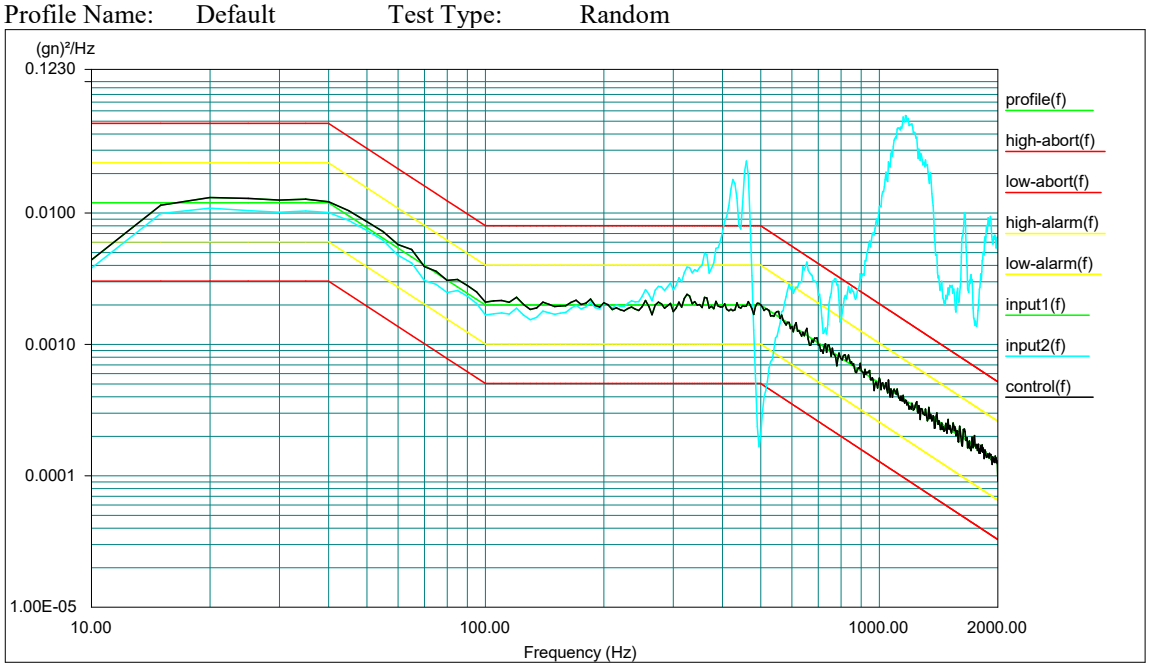
Level: 100 % Full Level Time: 00:07:39 Sweep Type: Logarithmic
Frequency: 10 to 2000 Hz Time Remaining: 00:00:00 Sweep Rate: 1 Oct/Min

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Sine Scan X.prj
Profile Name: Low Level Test Type: Swept Sine



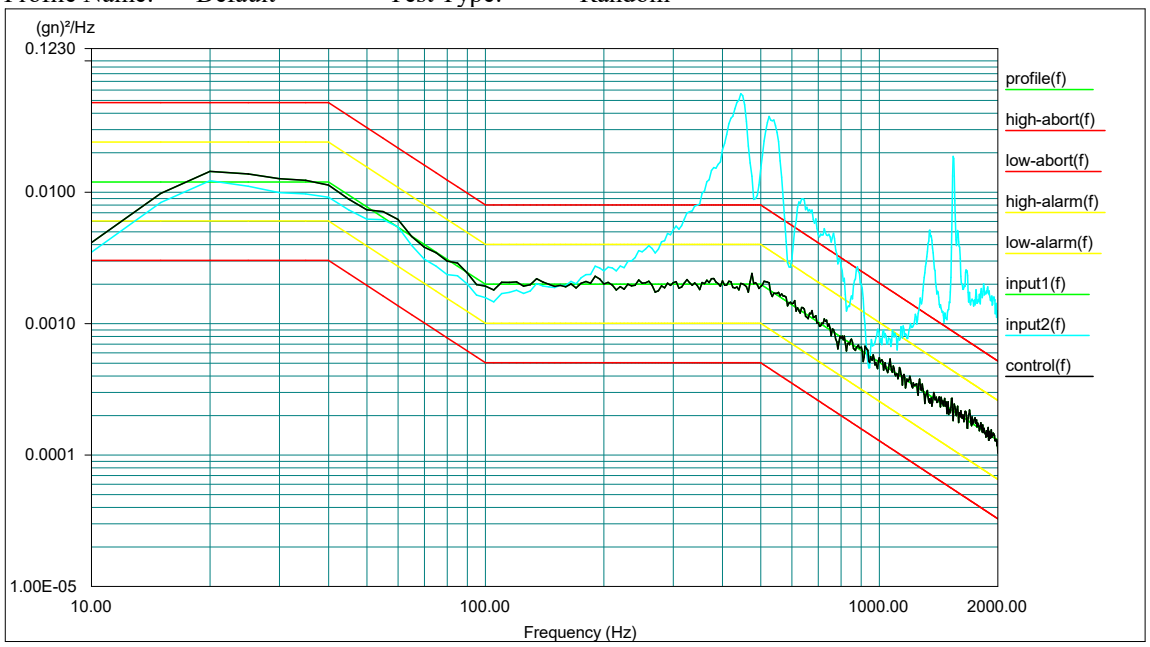
Level: 100 % Full Level Time: 00:07:39 Sweep Type: Logarithmic
Frequency: 10 to 2000 Hz Time Remaining: 00:00:00 Sweep Rate: 1 Oct/Min

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: RTCA DO160 1-48g.prj (X Axis)
Profile Name: Default Test Type: Random



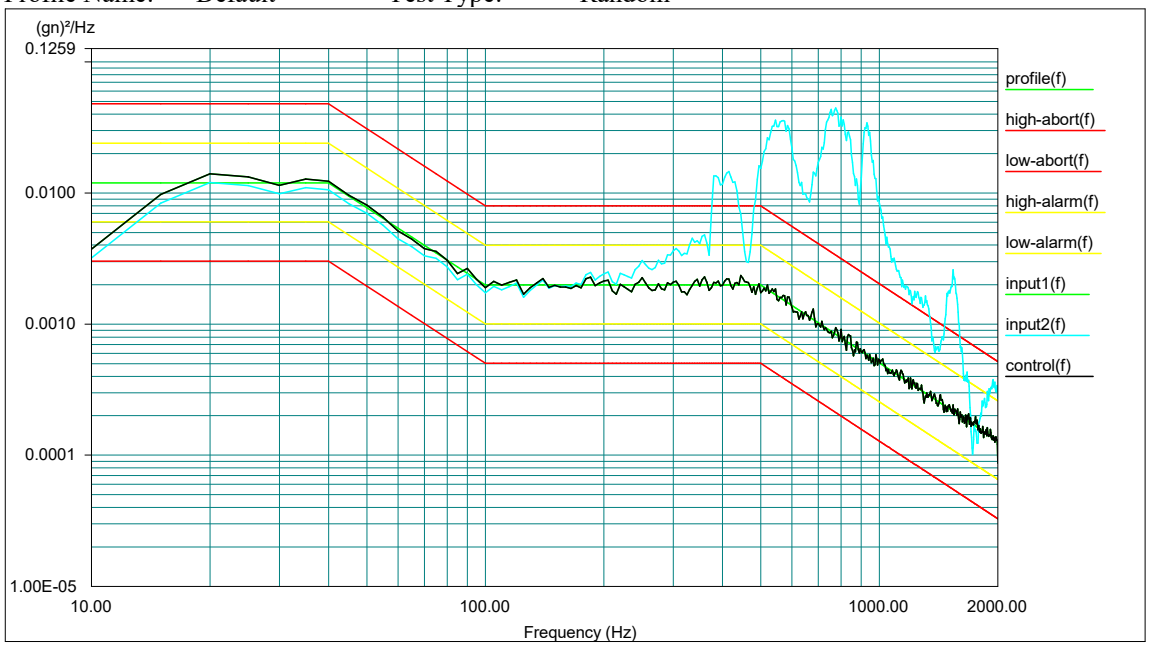
Level: 0 dB
Control RMS: 1.493972 gn Full Level Elapsed Time: 01:00:00 Lines: 400
Frame Time: 0.200000 Seconds
Demand RMS: 1.493205 gn Remaining Time: 00:00:00 DOF: 154
dF: 5.000000 Hz

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: RTCA DO160 1-48g.prj (Y Axis)
Profile Name: Default Test Type: Random



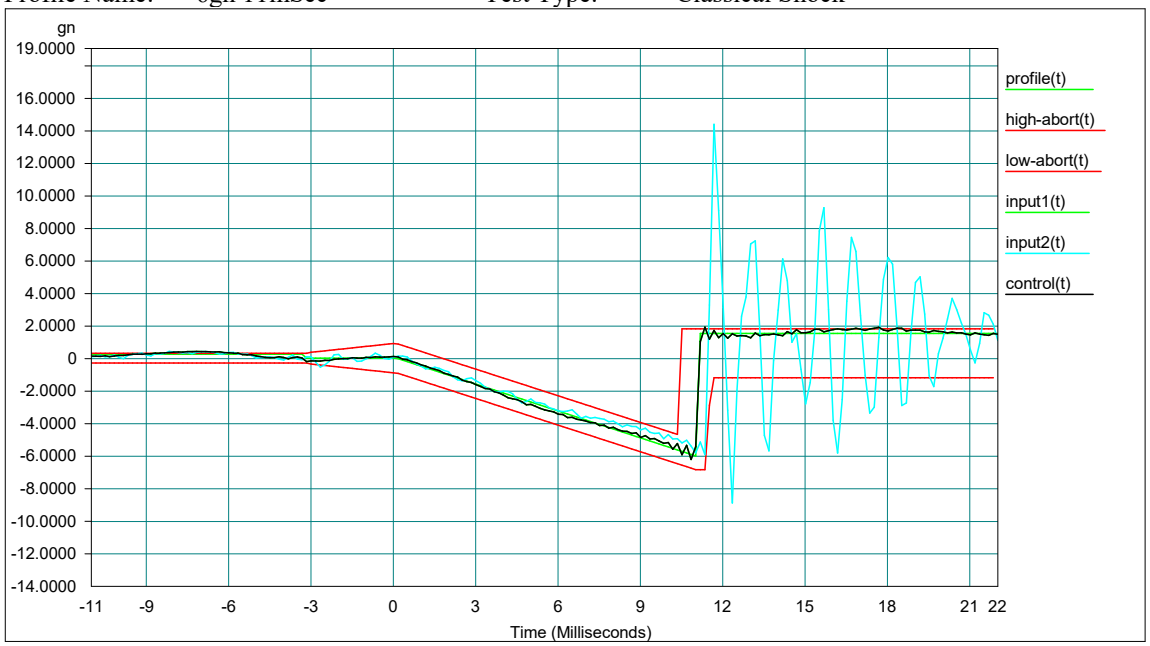
Level: 0 dB
Control RMS: 1.490537 gn Full Level Elapsed Time: 01:00:00 Lines: 400 Frame Time: 0.200000 Seconds
Demand RMS: 1.493205 gn Remaining Time: 00:00:00 DOF: 154 dF: 5.000000 Hz

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: RTCA DO160 1-48g.prj (Z Axis)
Profile Name: Default Test Type: Random



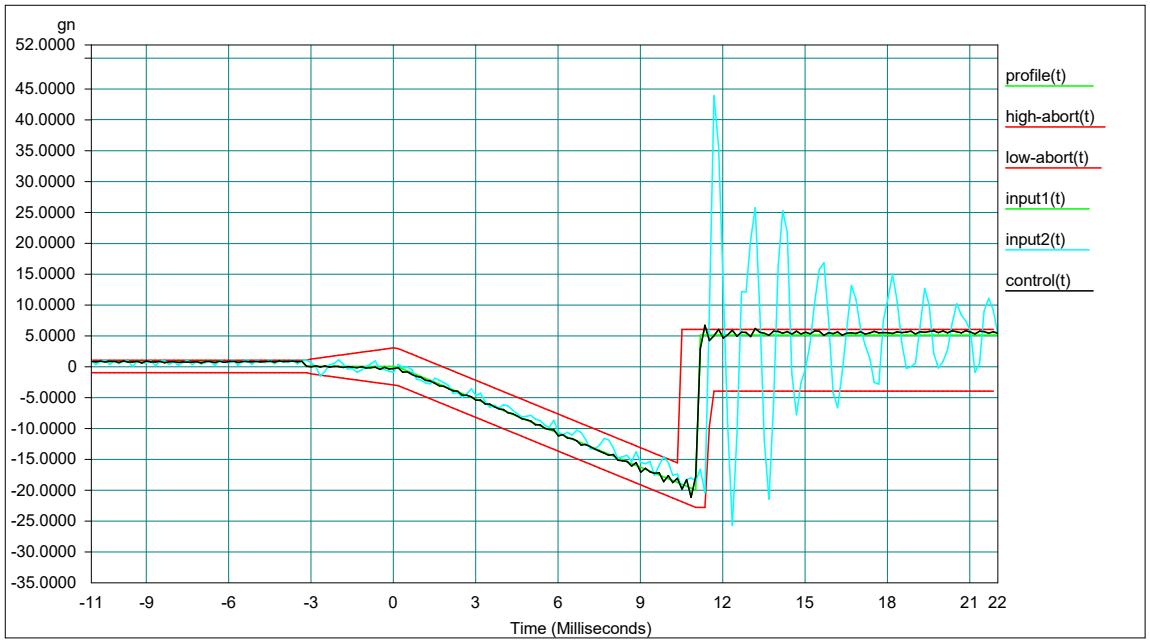
Level: 0 dB
Control RMS: 1.485058 gn Full Level Elapsed Time: 01:00:00 Lines: 400
Frame Time: 0.200000 Seconds
Demand RMS: 1.493205 gn Remaining Time: 00:00:00 DOF: 154
dF: 5.000000 Hz

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: 6G Shock Test (X Axis)
Profile Name: 6gn 11mSec Test Type: Classical Shock



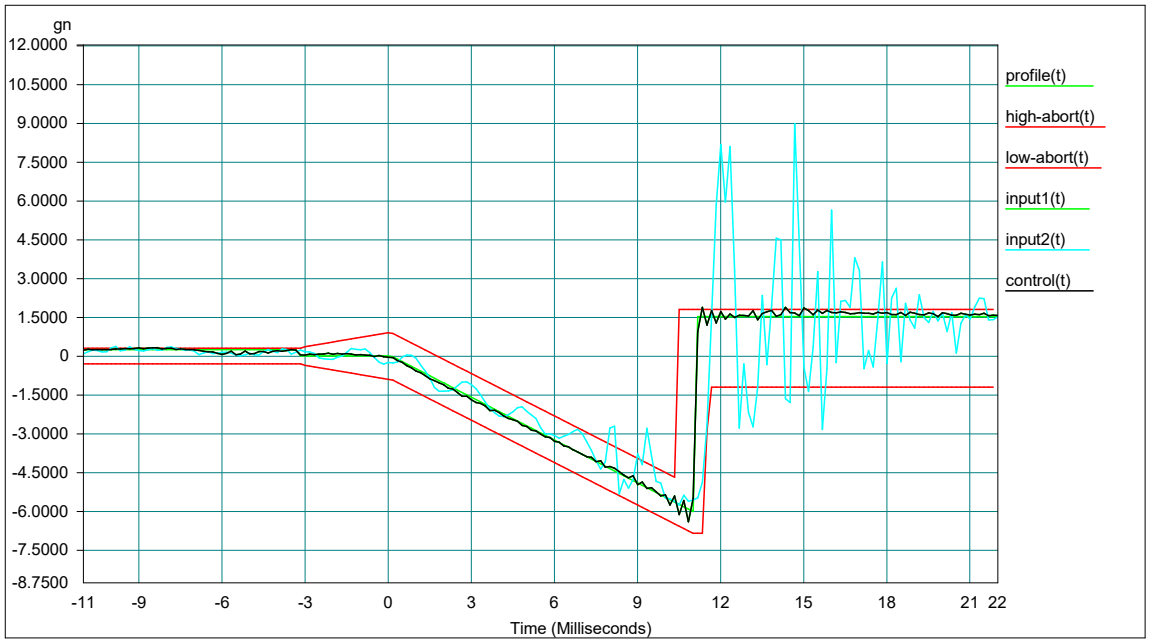
Level: 100 % Block Size: 2048
Elapsed Pulses: 19 Frame Time: 0.341333 Seconds
Control Peak: 6.219221 Control RMS: 0.815207
Full Level Elapsed Pulses: 6 dT: 0.000167 Seconds
Demand Peak: 6.000000 Demand RMS: 0.798568
Remaining Pulses: 0
Pulse Type: Forward Sawtooth Amplitude: 6.000000
Pulse Width: 11.000000 ms

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Shk 20g.prj (X Axis)
Profile Name: 20gn 11mSec Test Type: Classical Shock



Level: 100 % Block Size: 2048 Elapsed Pulses: 20
Frame Time: 0.341333 Seconds Control Peak: 21.164118
Control RMS: 2.710253 Full Level Elapsed Pulses: 6
dT: 0.000167 Seconds Demand Peak: 20.000000
Demand RMS: 2.661892 Remaining Pulses: 0
Pulse Type: Forward Sawtooth Amplitude: 20.000000
Pulse Width: 11.000000 ms

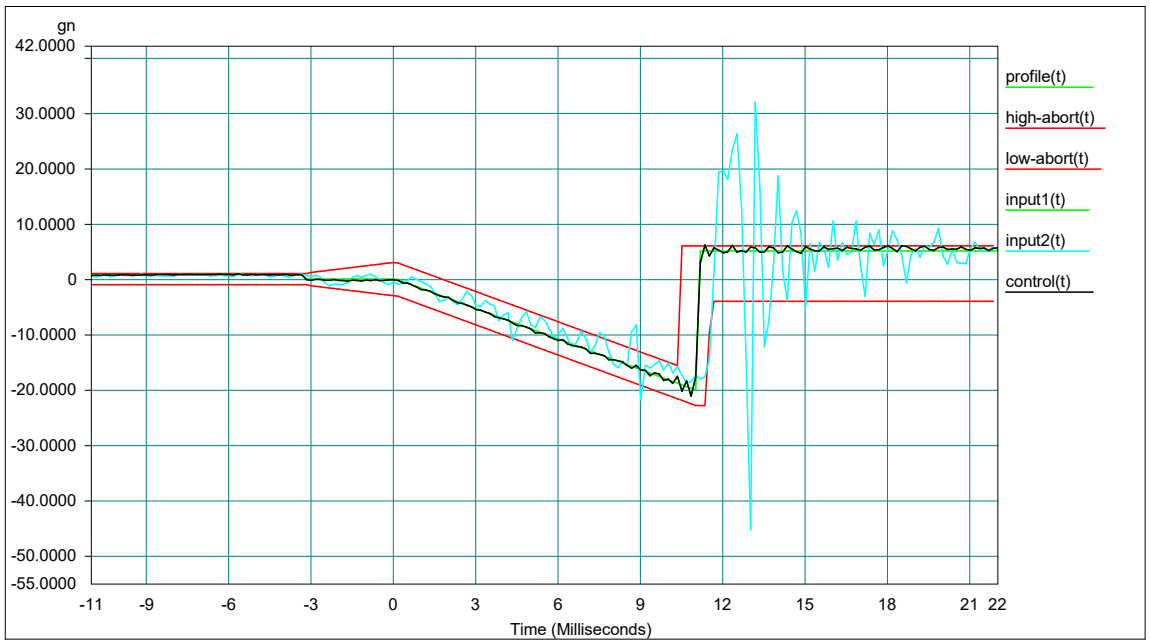
DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Shk 6G.prj (Y Axis)
Profile Name: 6gn 11mSec Test Type: Classical Shock



Level: 100 % Block Size: 2048 Elapsed Pulses: 19
Frame Time: 0.341333 Seconds Control Peak: 6.392862
Control RMS: 0.816357 Full Level Elapsed Pulses: 6
dT: 0.000167 Seconds Demand Peak: 6.000000
Demand RMS: 0.798568 Remaining Pulses: 0
Pulse Type: Forward Sawtooth Amplitude: 6.000000

Pulse Width: 11.000000 ms

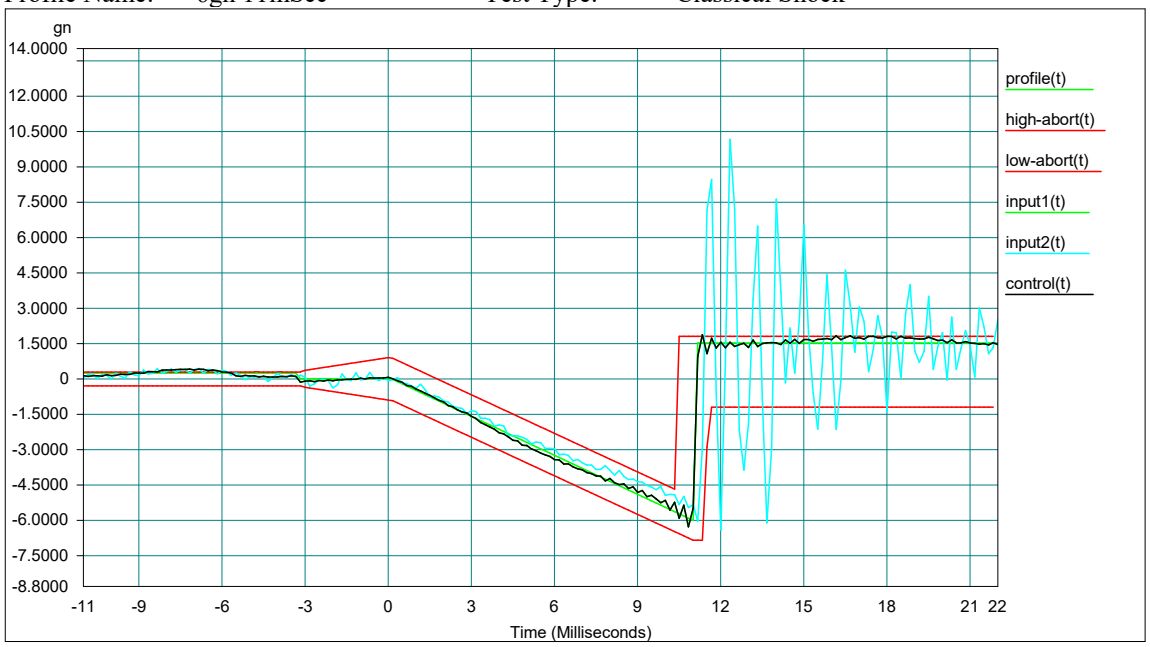
DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Shk 20g.prj (Y Axis)
Profile Name: 20gn 11mSec Test Type: Classical Shock



Level: 100 % Block Size: 2048 Elapsed Pulses: 20
Frame Time: 0.341333 Seconds Control Peak: 21.132910
Control RMS: 2.710814 Full Level Elapsed Pulses: 6
dT: 0.000167 Seconds Demand Peak: 20.000000
Demand RMS: 2.661892 Remaining Pulses: 0
Pulse Type: Forward Sawtooth Amplitude: 20.000000

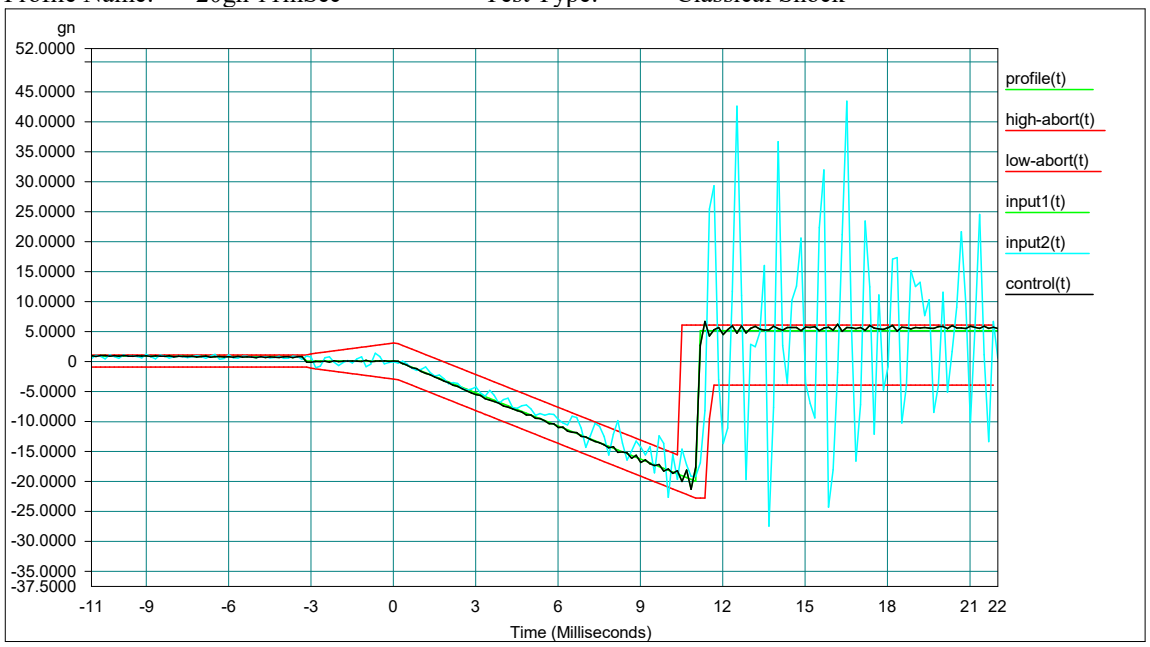
Pulse Width: 11.000000 ms

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Shk 6G.prj (Z Axis)
Profile Name: 6gn 11mSec Test Type: Classical Shock



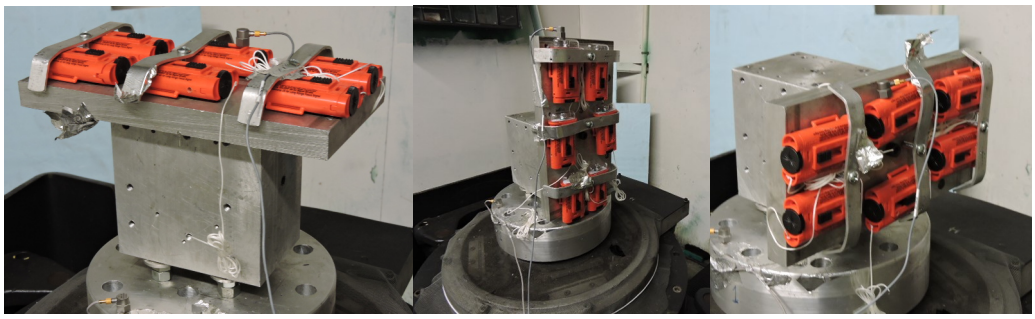
Level: 100 % Block Size: 2048 Elapsed Pulses: 19
Frame Time: 0.341333 Seconds Control Peak: 6.271832
Control RMS: 0.814395 Full Level Elapsed Pulses: 6
dT: 0.000167 Seconds Demand Peak: 6.000000
Demand RMS: 0.798568 Remaining Pulses: 0
Pulse Type: Forward Sawtooth Amplitude: 6.000000
Pulse Width: 11.000000 ms

DUT: Life Saving Systems PFD Flashing light
Serial Number: #1A,2A,3A,1L,2L3L
Project File Name: Life Saving Sys Shk 20g.prj (Z Axis)
Profile Name: 20gn 11mSec Test Type: Classical Shock



Level: 100 % Block Size: 2048 Elapsed Pulses: 20
Frame Time: 0.341333 Seconds Control Peak: 21.332211
Control RMS: 2.722113 Full Level Elapsed Pulses: 6
dT: 0.000167 Seconds Demand Peak: 20.000000
Demand RMS: 2.661892 Remaining Pulses: 0
Pulse Type: Forward Sawtooth Amplitude: 20.000000

Pulse Width: 11.000000 ms



View of axis orientations during the vibration and shock tests.

5.6 Explosion Proofness Test

The Explosion Proofness Test outlined in RTCA Document DO-160E, Section 9, Paragraph 9.7.1 was conducted on three samples using the procedure shown below.

.

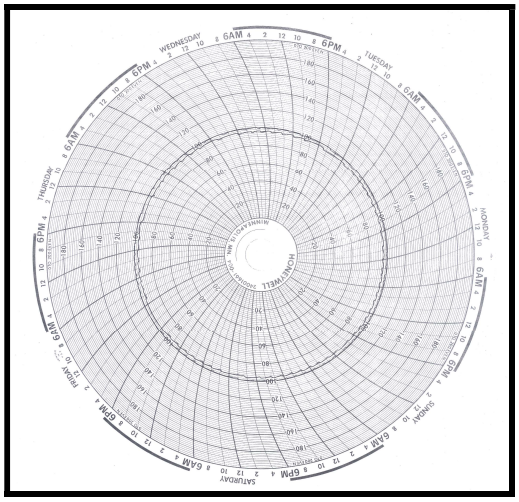
Three light samples were subjected to the explosion proofness test. Each of the three lights were prepared by drilling small holes for explosive mixture supply and sampling, and for a small spark source wire. The three lights were tested serially in a chamber. Each light body was filled with a mixture of Propane and Air (4.75±.25% Propane in Air) and the atmosphere inside the chamber was adjusted to contain the same mixture of Propane and Air as the test article. When the mixture inside the test article and the mixture inside the test chamber were both verified to the correct mixture percentages, the mixture inside the body was ignited. Ignition of the mixture inside the test article was verified, and the ignition of the mixture surrounding the test article (the primary chamber) was verified not to ignite / ignite for 5 cycles for each of the three lights. The mixture percentages were verified by a non-dispersive IR gas analyzer calibrated to read 0 to 10% Propane in Air without altering the mixture in the test article or the chamber. The mixtures were provided through a series of valves and flow meters to assure the mixture was homogeneous. The ignition of the mixture inside the body was verified by changes in the gas analyzer meter reading following the spark initiation. Any ignition of the mixture surrounding the test article is verified by visual observation of a pressure relief panel. Following the internal ignitions, the light bodies were inspected to identify any enclosure fractures or loss of case integrity. No damage was observed following the tests.



View of samples in the chamber for the Explosion Proofness test.

5.7 Salt Spray Test

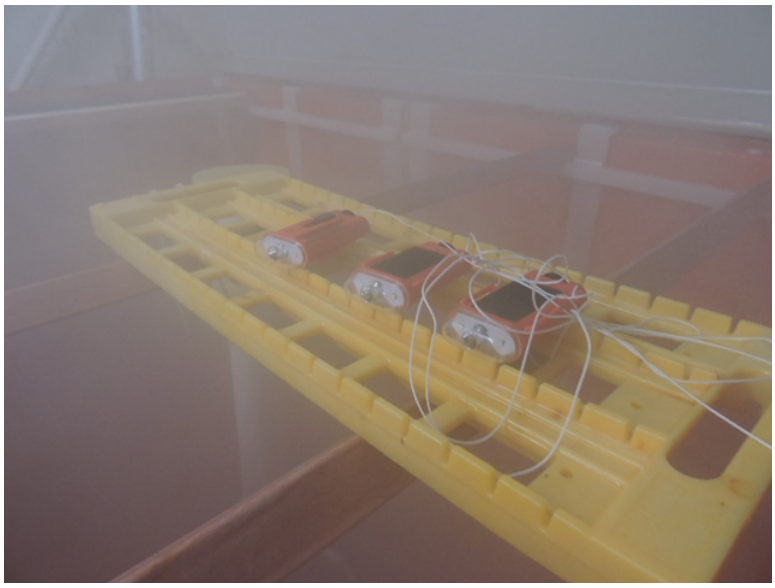
Three samples in the configuration that the device will be provided to the purchasing customer, were subjected to a 24-hour salt fog test in accordance with DO-160G, Section 14, Paragraph 14.3.6 (Category S). The temperature of the chamber during the test exposure period was 35°C ± 1°C.



Following the first salt fog exposure, the samples were removed from the chamber and dried at a temperature of 24°C ± 3°C and 45± 5% RH for 24 hours. Following the drying period, the 24-hours salt fog exposure was repeated, followed by a second drying period of 24-hours. No evidence of corrosion was observed on the test article samples following the 48-hour test period.



View of the typical test sample before the salt fog exposure test



View of the typical test sample during the salt fog exposure test

5.8 Flammability of Materials

The material of construction was tested in accordance with 14 CFR Section 25.853 by applying 14 CFR Part 25, Appendix F Part 1(a)(1)(v).

Sample	Burn Rates	Drip Extinguishment Time
Sample #1	1.25 in/min	0 sec
Sample #2	0.75 in/min	0 sec
Sample #3	1.00 in/min	0 sec

The material of construction for the light and battery pack burned at a rate of 1 inch per minute. The burn rate is less than 4 inches per minute and passes the burn rate test.

6. OBSERVATIONS AND COMMENTS

The results of the tests performed indicate that the supplied test article meets the requirements of TSO-C85b.

The results presented herein apply only to the test specimen as prepared and as tested on the date reported. All equipment used in the performance of these tests was calibrated to standards traceable to the N.I.S.T and/or verified at the time of the test using internationally recognized methods to validate the accuracy and repeatability of the values recorded or collected during the tests.

INSTRUMENTATION EQUIPMENT SHEET

Date: 1-15 to 4-3-18 **Job No.:** 20992-1 **Customer:** Life Saving Systems

Technician: Lowe / White **Test Area:** Vibe Room / Explosion Test Cell

Test Item Description: Survivor Locator Lights

INSTRUMENT	MFG	MODEL	RANGE	ACCURACY	CAL DATE	CAL DUE
Hydrocarbon Analyzer	IR Infrared Industries	IR - 208	0 to 10% Propane In Air	±0.1%	Each Use	
Temperature Indicator / Controller	Omega Eng'ring	i-Series	Multi	±0.03%	11-07-17	11-07-18
Digital Multimeter	Fluke	116 S/N: 36240013WS	Multi	±0.2%	10/31/17	10/31/18
Photometer	EG&G GAMMA SCIENTIFIC	DR2000	0 to 2000 Candela	±0.5% FS	05-24-17	05-24-18
Vibration System	Ling	390	5-2000 Hz @ 1" Displ. (3000lb)	Mfg.	*	*
Vibration Controller	Dactron	LASER-USB S/N 10896368	0 TO 10 volts	+/- 0.13mV (uncertainty)	03/30/17	03/30/19
Accelerometer	Endevco	42A14 S/N:10150	500G	03%	4-26-17	4-05-18
Temperature Humidity Chamber	Tenney	Tenney TH JR	-12 to +93.3°C	±0.1°C	11-07-17*	11-07-18
Temperature Chamber	Tenney	Tenney JR	-73 to +150°C	±0.1°C	11-07-17*	11-07-18
Salt Spray Chamber	Singleton	SCCH 64	85+/- 15ºF (Chamber) 50 to 150ºF (Tower)	±0.3%	11-07-17*	11-07-18
Temp/Humid Recorder	Honeywell	DR4300	0 to 100	±0.3%	11-07-17*	11-07-18

* monitor with calibrated instrument

Instrumentation Information Verified by: R White