



50518 RR272 Spruce Grove, Alberta T7Y 1H6
Ph: 780-966-0362 • Gus@Rus-Tec.ca

Engineering Report

SUBJECT: THIRD PARTY MATTRESS TESTING

Date: June 14, 2020
Customer: GoodMorning.com Inc.
Prepared By: Rus-Tec Engineering

Rus-Tec Job #: 18-5055
File Name: 5055-8 Mattress Test Report
Revision #: 0

INTRODUCTION

In June 2020, GoodMorning.com commissioned Rus-Tec to provide independent 3rd party testing of multiple mattresses. Similar testing was done previously by Rus-Tec (5055-1,-2,-3,-4,-5,-6,-7) and Pure Mosaic (PMTM-4211-01 and PMTM-4320-01). Data from all test runs are represented in this document, as provided by GoodMorning.com from the previously validated reports. Rus-Tec followed testing procedures as directed by GoodMorning.com and attached in Appendix B. Below follows an overview of the testing procedures used as well as the results that they produced. Additional results can be found in Appendix A.

REFERENCE LOADS & TEST INFORMATION



Figure 1: Reference Load 1. Plastic 5 gallon water cooler bottle. Size: 10.75" diameter, 19.5" height, 42.3 lb weight



Figure 2: Reference Load 2. Spherical medicine ball. Size: 9" diameter, 10 lb weight

As specified by the testing methodology, all testing was completed in a room with a temperature range between 18°C and 25°C and a humidity range between 25% to 50%, in order to simulate the environment of a typical residence. Mattresses were placed on a drop cloth on a flat concrete floor such that the top and sides were unobstructed.

TEST 1 – MATTRESS FIRMNESS

Overview and Objective: Apply Reference Load 1 to the center of each subject mattress and measure the vertical displacement of each to establish their respective positions on a firmness (or “sinkage”) scale. A low relative vertical displacement shall indicate a firmer mattress, while a high relative vertical displacement shall indicate a softer mattress.

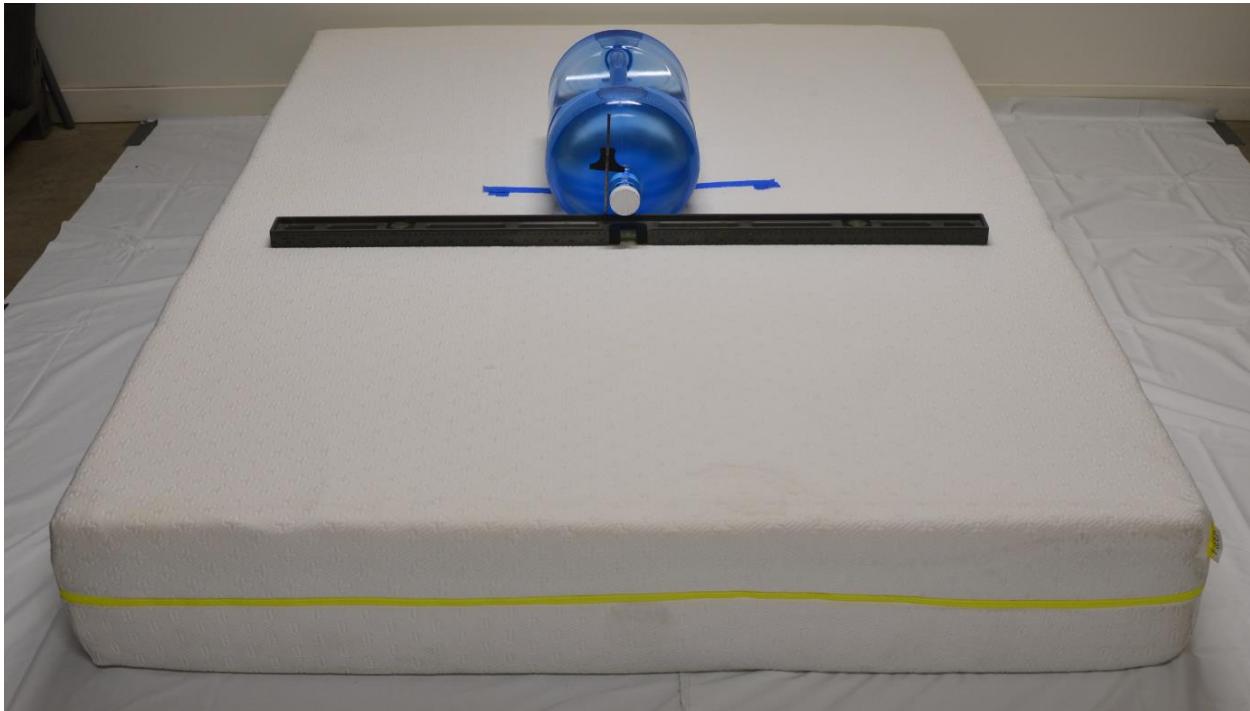


Figure 3: Typical setup for Test 1

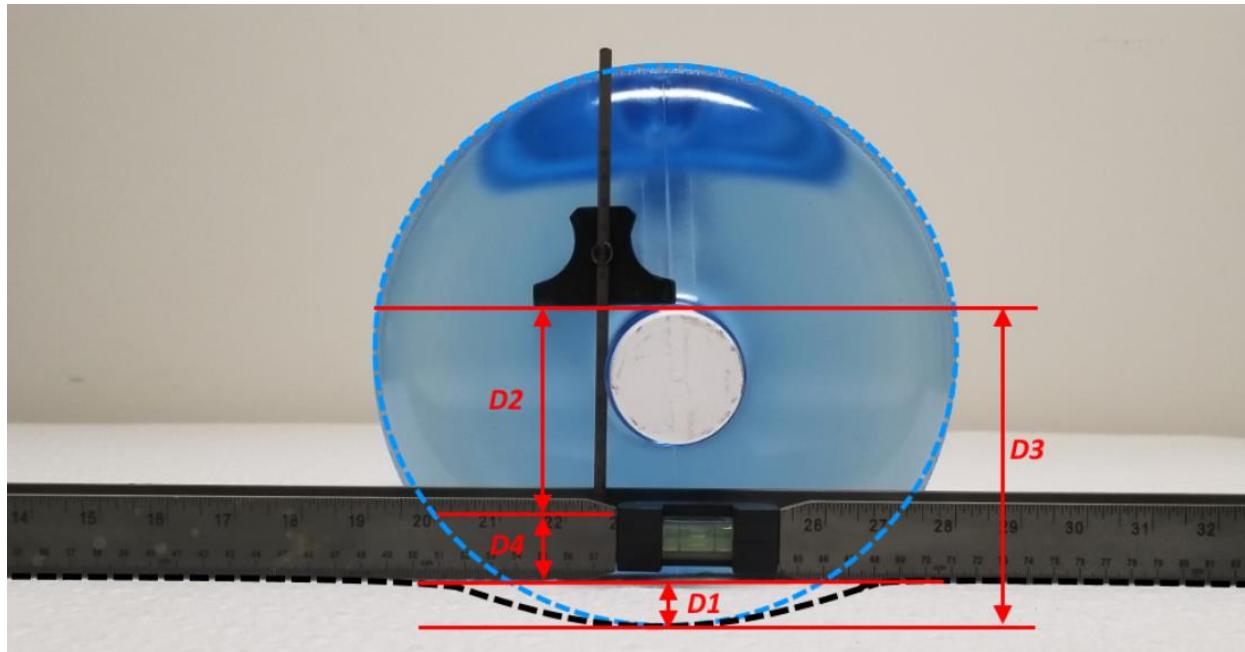


Figure 4: Deflection measurements for Test 1

Figure 4 shows the critical measurements taken for Test 1 in order to determine the vertical displacement with Reference Load 1 applied.

The vertical deflection value of interest for Test 1 is D_1 as defined below:

$$D_1 = D_3 - D_2 - D_4$$

D_2 = Measured (Deflection)

D_3 = 160 mm (Constant)

D_4 = varies (Constant)

The vertical displacement, D_1 can be found by inputting D_2 into the above expression.

TEST 2 – EDGE SUPPORTIVENESS

Overview and Objective: Apply Reference Load 1 to the edge each subject mattress and to measure the resultant vertical displacement of each to establish their respective positions on an “edge supportiveness” scale. A low relative vertical displacement shall indicate a mattress with more edge support, while a high relative vertical displacement shall indicate a mattress with less edge support.

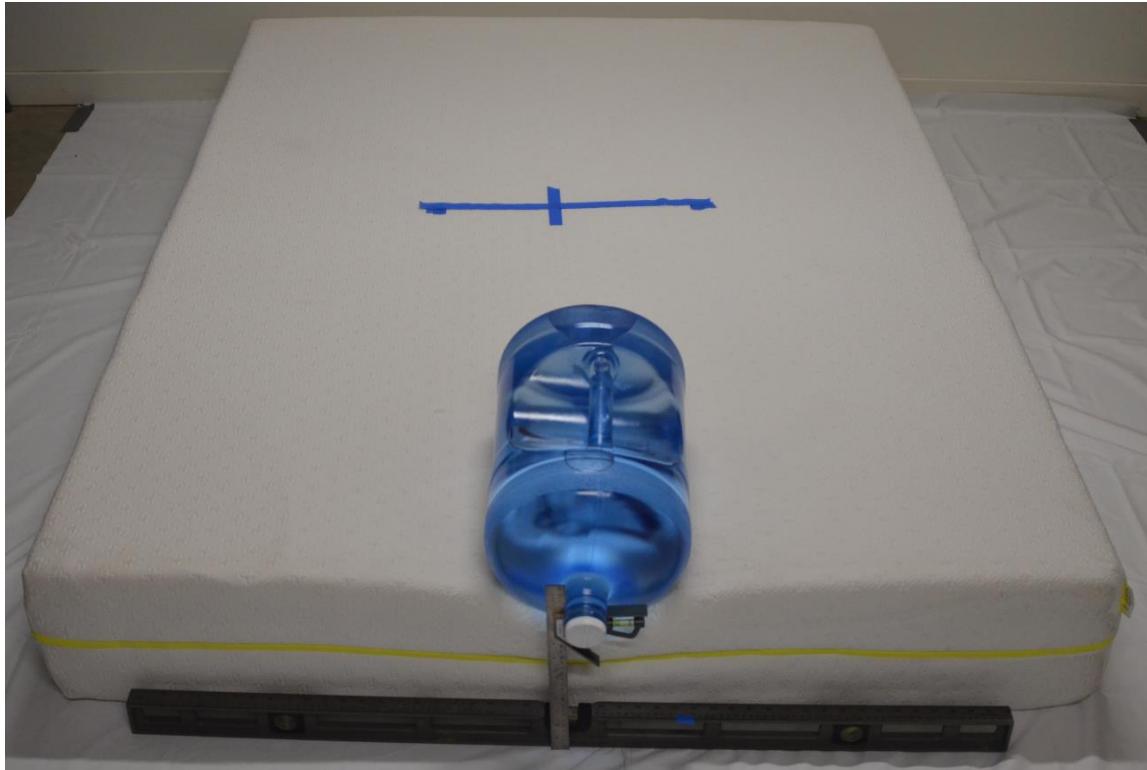


Figure 5: Typical setup for Test 2

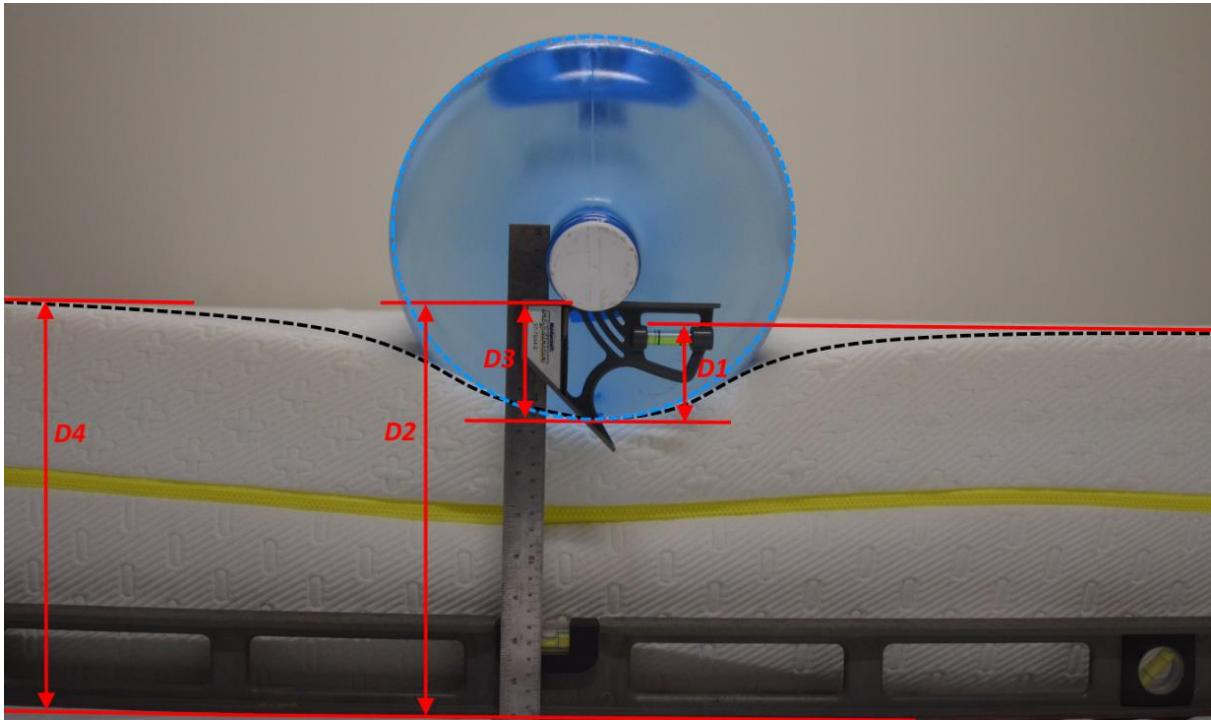


Figure 6: Deflection measurements for Test 2

The vertical deflection value of interest for Test 2 is D_1 as defined below:

$$D_1 = D_4 - (D_2 - D_3)$$

D_2 = Measured (Deflection)

D_3 = 104 mm (Constant)

D_4 = Measured (Mattress Height)



TEST 3 – MOTION ISOLATION

Overview and Objective: Apply a reference impulse to the top side of each subject mattress, representative of human movement on the mattress, and measure the resultant peak acceleration of a calibrated accelerometer placed on the mattress a fixed distance away from the epicenter of the impulse to establish their respective positions on a “motion isolation” scale. A high resultant peak acceleration shall indicate less motion isolation, while a low resultant peak acceleration shall indicate more motion isolation.

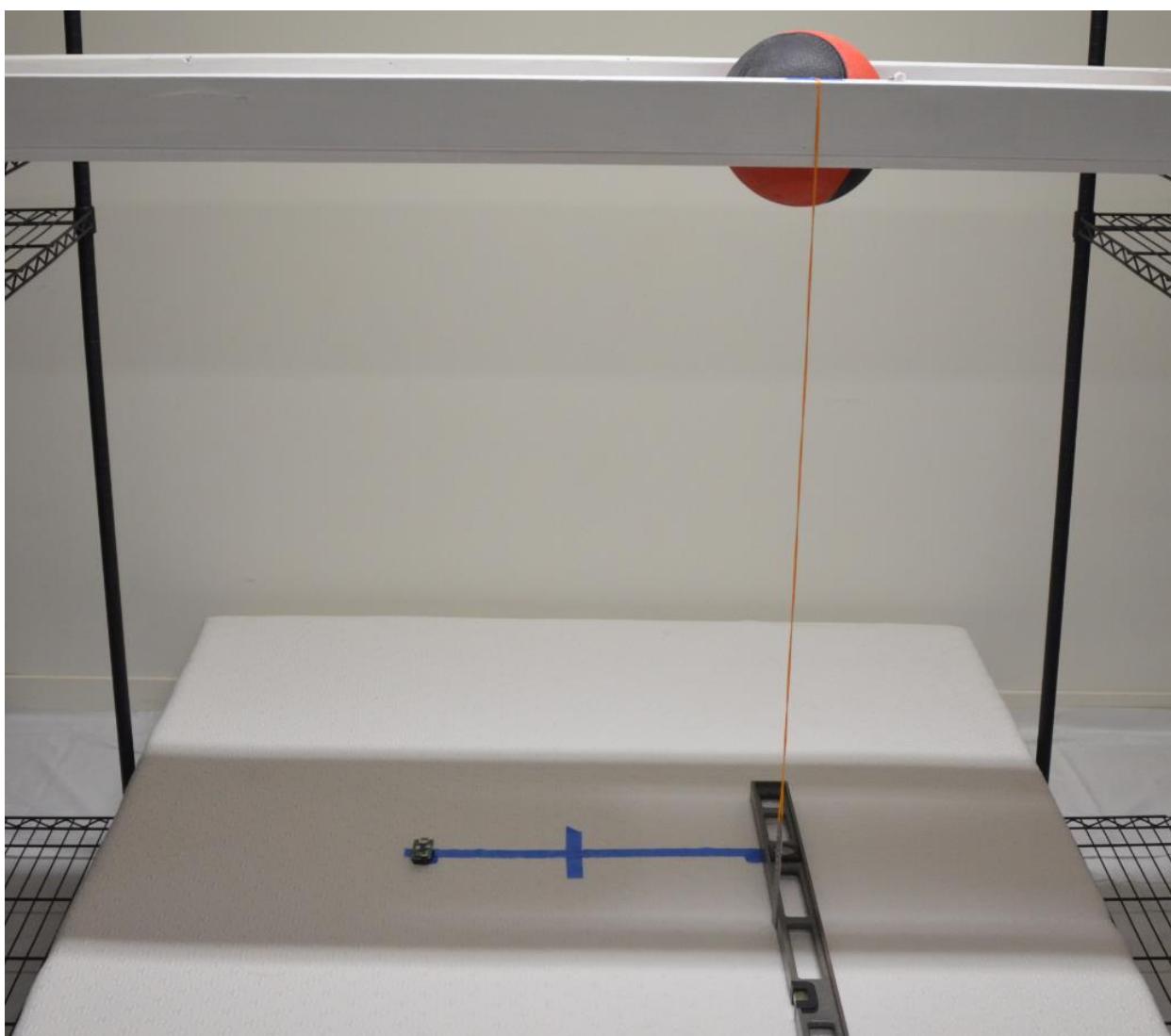


Figure 7: Typical setup for Test 3



Vector Magnitude Acceleration

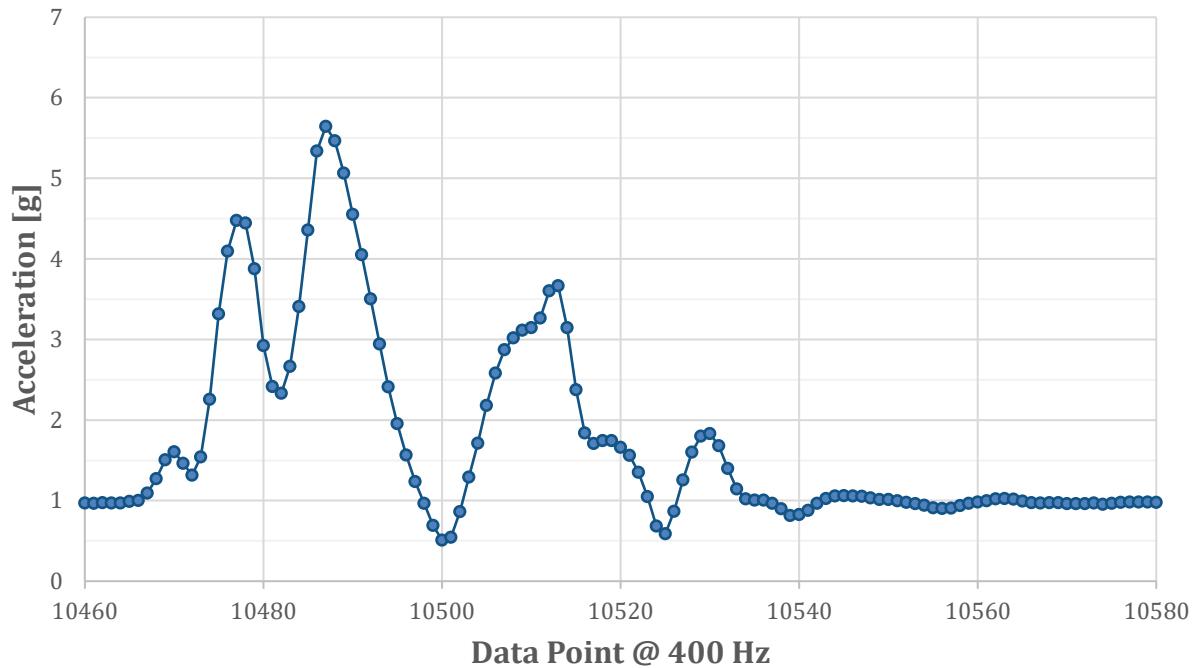


Figure 8: Example Vector Magnitude Acceleration of one ball drop

The vector magnitude of acceleration as shown above in Figure 8 is calculated using the expression shown below.

$$a = \sqrt{(x^2 + y^2 + z^2)}$$

The responsiveness of the mattress can be seen at one sleep point as a result of an impulse being applied at the second. In order to record this data, a digital accelerometer (ADXL345) was used and set to record data at 400 Hz (400 data points per second).

TEST 4 - BOUNCINESS

Overview and Objective: Drop a 10lb sphere (9" diameter) from a fixed distance on to the top side of each subject mattress and measure the resultant peak rebound height on its first bounce. A high resultant peak rebound height shall indicate more bounciness, while a low resultant peak height shall indicate less bounciness.

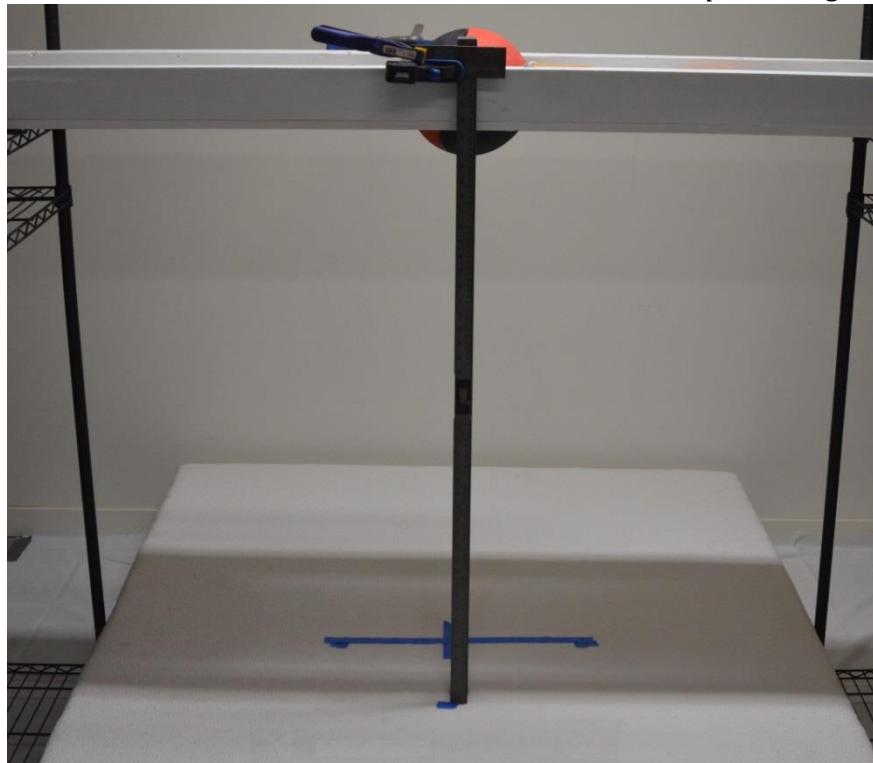


Figure 9: Typical setup for Test 4

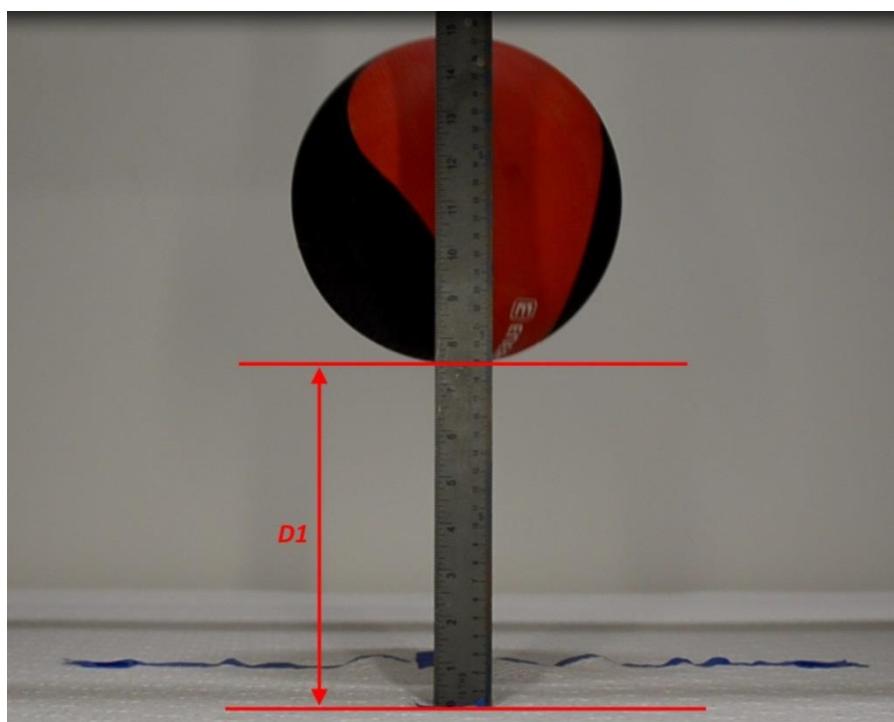


Figure 10: Rebound Measurement for Test 4



TEST 1 RESULTS

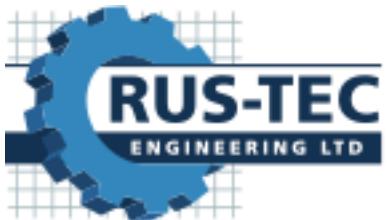
Table 1: Test 1 – Mattress Firmness

Mattress	Deflection			
	[mm]	[in]	Measured [mm]	Out of 10
1 Amerisleep AS3	68.8	2.71	70.0	5.2
2 Apollo	76.8	3.02	70.0	4.2
3 Bear	69.8	2.75	69.0	5.1
4 Bloom Cloud	64.3	2.53	74.5	5.8
5 Bloom Air	75.8	2.98	71.0	4.3
6 Bloom Earth	76.8	3.02	70.0	4.2
7 Bloom Mist	65.8	2.59	81.0	5.6
8 Casper (V1)	71.8	2.83	67.0	4.8
9 Casper (V2)	62.8	2.47	76.0	6.0
10 Casper (V3)	78.8	3.10	68.0	3.9
11 Casper (V4)	71.8	2.82	75.0	4.8
12 Casper Element	73.8	2.90	73.0	4.6
13 Casper Essential (V1)	67.8	2.67	79.0	5.4
14 Casper Essential (V2)	65.8	2.59	81.0	5.6
15 Casper Wave	57.8	2.27	89.0	6.6
16 Classic Brands (Thick)	56.8	2.24	82.0	6.8
17 Classic Brands (Thin)	46.8	1.84	92.0	8.1
18 Dormeo	76.8	3.02	70.0	4.2
19 Douglas (V1)	68.3	2.69	70.5	5.3
20 Douglas (V2)	57.8	2.28	81.0	6.6
21 Emma	67.8	2.67	79.0	5.4
22 Endy (V1)	76.3	3.00	62.5	4.3
23 Endy (V2)	51.8	2.04	87.0	7.4
24 Fleep (Soft)	69.3	2.73	69.5	5.2
25 Fleep (Firm)	50.3	1.98	88.5	7.6
26 Gotta Sleep (OMG)	81.8	3.22	65.0	3.6
27 Haven	48.8	1.92	98.0	7.8
28 Helix	61.8	2.43	77.0	6.1
29 iComfort	65.8	2.59	73.0	5.6
30 IKEA Foam	58.8	2.31	88.0	6.5
31 IKEA Spring	54.8	2.16	92.0	7.0
32 Juno	65.8	2.59	81.0	5.6
33 Layla (Soft)	75.8	2.98	63.0	4.3
34 Layla (Firm)	61.8	2.43	77.0	6.1
35 Leesa	76.3	3.00	62.5	4.3
36 Lucid	53.8	2.12	85.0	7.2
37 Luna	66.8	2.63	72.0	5.5
38 Mira (V1)	51.8	2.04	95.0	7.4
39 Mira (V2)	61.8	2.43	85.0	6.1
40 Nectar	76.8	3.02	70.0	4.2
41 Nora	58.8	2.31	80.0	6.5
42 Novaform	82.8	3.26	64.0	3.4
43 Novosbed Soft	79.3	3.12	59.5	3.9
44 Novosbed Soft (V2)	84.8	3.34	62.0	3.2
45 Novosbed Medium	68.3	2.69	70.5	5.3
46 Novosbed Medium (V2)	80.8	3.18	66.0	3.7
47 Novosbed Firm	59.3	2.33	79.5	6.5
48 Novosbed Firm (V2)	69.8	2.75	77.0	5.1
49 PolySleep	65.8	2.59	73.0	5.6
50 Puffy (V1)	78.8	3.10	60.0	3.9
51 Puffy (V2)	80.8	3.18	66.0	3.7
52 PerfectSense	61.8	2.43	85.0	6.1
53 Purple	66.8	2.63	72.0	5.5
54 Recore	72.8	2.86	74.0	4.7
55 Sealy Posturepedic	76.8	3.02	62.0	4.2
56 Serta Chinook	70.8	2.79	76.0	5.0
57 Silk + Snow	77.8	3.06	69.0	4.1
58 Simba (V1)	36.8	1.45	110.0	9.4
59 Simba (V2)	84.8	3.34	62.0	3.2
60 Spa Sensations	71.8	2.82	75.0	4.8
61 Structube	41.8	1.64	105.0	8.7
62 Tempur-Pedic	68.8	2.71	70.0	5.2
63 Tuft & Needle	66.8	2.63	72.0	5.5
64 Zinus	83.8	3.30	63.0	3.3



Table 2: Test 1 – Mattress Firmness - Hybrid Mattresses

Mattress		Deflection		Measured [mm]	Out of 10
		[mm]	[in]		
65	Brunswick	82.8	3.3	64.0	6.2
66	Hamuq	63.8	2.5	75.0	7.6
67	Kingsdown	80.8	3.2	66.0	6.3
68	Logan & Cove (Medium)	81.8	3.2	65.0	6.3
69	Logan & Cove (Firm)	62.8	2.5	76.0	7.7
70	Saatva	80.8	3.2	58.0	6.3
71	Silk + Snow Hybrid	66.8	2.6	80.0	7.4
72	Simmons Beautyrest Black	75.8	3.0	63.0	6.7
73	Springwall	68.8	2.7	78.0	7.2
74	Stearns & Foster	70.8	2.8	76.0	7.1



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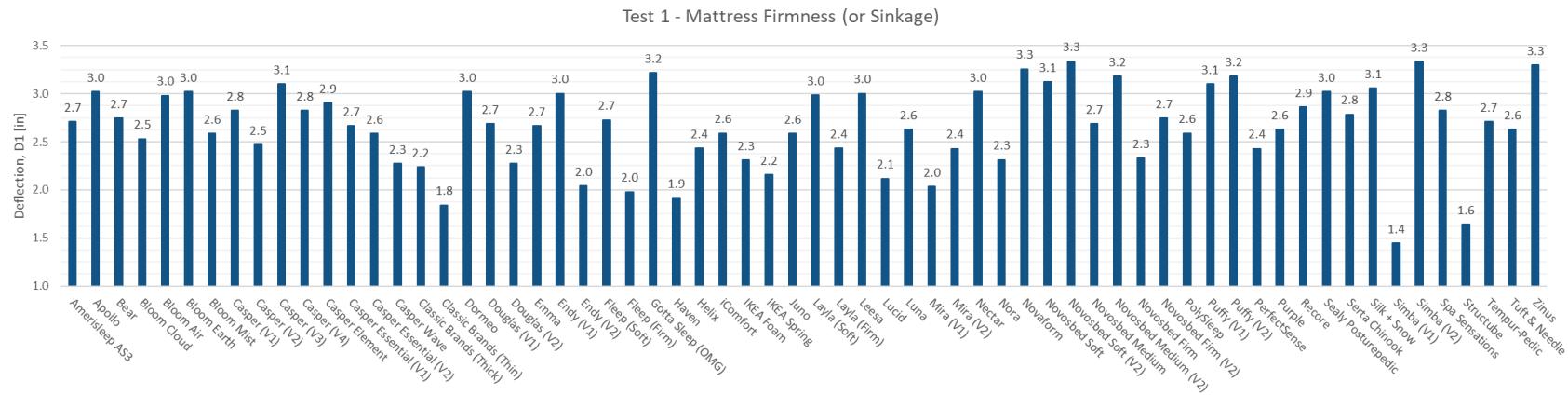


Figure 11: Test 1 – Mattress Firmness measuring how far Reference Load 1 deflects in the center of the mattress. A higher number indicates a softer mattress.

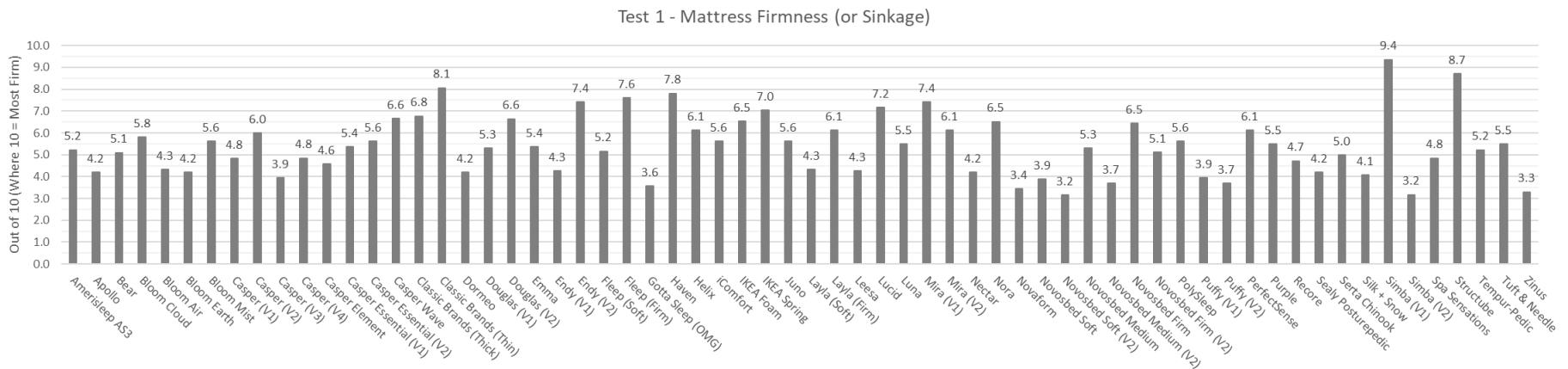
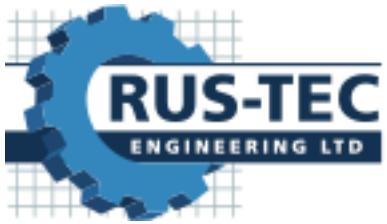


Figure 12: Test 1 – Mattress Firmness on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = most firm)



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Test 1 - Mattress Firmness (or Sinkage) Hybrid Mattresses

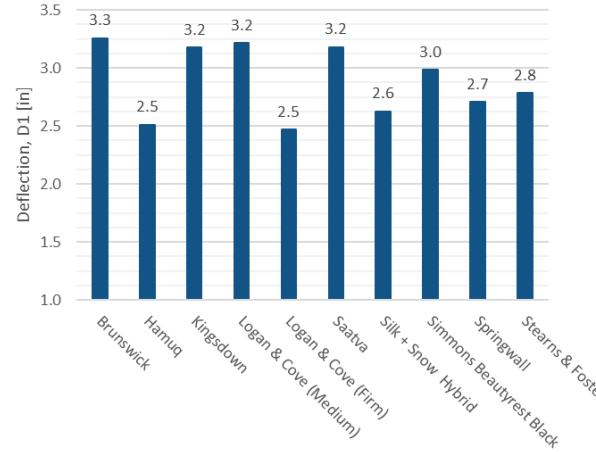


Figure 13: Test 1 – Mattress Firmness measuring how far Reference Load 1 deflects in the center of the mattress. A higher number indicates a softer mattress. Hybrid mattresses.

Test 1 - Mattress Firmness (or Sinkage)
Hybrid Mattresses

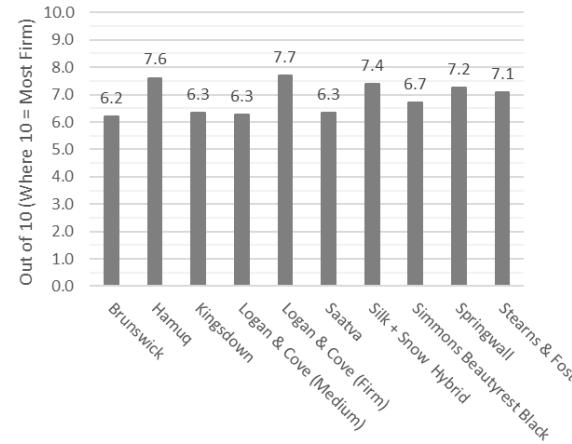


Figure 14: Test 1 – Mattress Firmness on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = most firm. Hybrid mattresses).



TEST 2 RESULTS

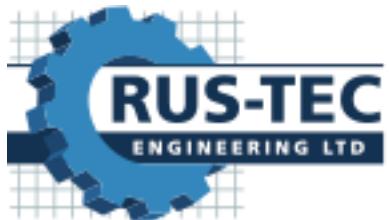
Table 3: Test 2 – Edge Supportiveness

	Mattress	Mattress Height, D4 [mm]	Mattress Height, D4 [in]	Measured Depth, D2 [mm]	Measured Depth, D2 [in]	Deflection, D1 [in] [mm]	Deflection, D1 [in] [in]	Out of 10
1	Amerisleep AS3	288	11.3	285	11.2	107.0	4.2	4.7
2	Apollo	307	12.1	285	11.2	126.0	5.0	3.1
3	Bear	235	9.3	241	9.5	98.0	3.9	5.4
4	Bloom Cloud	281	11.1	301	11.9	84.0	3.3	6.5
5	Bloom Air	227	8.9	254	10.0	77.0	3.0	7.1
6	Bloom Earth	201	7.9	213	8.4	92.0	3.6	5.9
7	Bloom Mist	227	8.9	248	9.8	83.0	3.3	6.6
8	Casper (V1)	249	9.8	268	10.6	85.0	3.3	6.5
9	Casper (V2)	233	9.2	198	7.8	139.0	5.5	2.1
10	Casper (V3)	285	11.2	288	11.3	101.0	4.0	5.2
11	Casper (V4)	260	10.2	261	10.3	103.0	4.1	5.0
12	Casper Element	240	9.4	235	9.3	109.0	4.3	4.5
13	Casper Essential (V1)	214	8.4	210	8.3	108.0	4.3	4.6
14	Casper Essential (V2)	271	10.7	279	11.0	96.0	3.8	5.6
15	Casper Wave	270	10.6	281	11.1	93.0	3.7	5.8
16	Classic Brands (Thick)	204	8.0	239	9.4	69.0	2.7	7.8
17	Classic Brands (Thin)	154	6.1	194	7.6	64.0	2.5	8.2
18	Dormeo	304	12.0	314	12.4	94.0	3.7	5.7
19	Douglas (V1)	258	10.2	276	10.9	86.0	3.4	6.4
20	Douglas (V2)	253	10.0	283	11.1	74.0	2.9	7.3
21	Emma	305	12.0	294	11.6	115.0	4.5	4.0
22	Endy (V1)	261	10.3	250	9.8	115.0	4.5	4.0
23	Endy (V2)	247	9.7	235	9.3	116.0	4.6	3.9
24	Fleep (Soft)	249	9.8	243	9.6	110.0	4.3	4.4
25	Fleep (Firm)	249	9.8	259	10.2	94.0	3.7	5.7
26	Gotta Sleep (OMG)	251	9.9	246	9.7	109.0	4.3	4.5
27	Haven	255	10.0	281	11.1	78.0	3.1	7.0
28	Helix	252	9.9	222	8.7	134.0	5.3	2.5
29	iComfort	302	11.9	324	12.8	82.0	3.2	6.7
30	IKEA Foam	178	7.0	195	7.7	87.0	3.4	6.3
31	IKEA Spring	237	9.3	259	10.2	82.0	3.2	6.7
32	Juno	196	7.7	185	7.3	115.0	4.5	4.0
33	Layla (Soft)	270	10.6	225	8.9	149.0	5.9	1.3
34	Layla (Firm)	270	10.6	271	10.7	103.0	4.1	5.0
35	Leesa	250	9.8	273	10.7	81.0	3.2	6.8
36	Lucid	254	10.0	292	11.5	66.0	2.6	8.0
37	Luna	256	10.1	275	10.8	85.0	3.3	6.5
38	Mira (V1)	200	7.9	218	8.6	86.0	3.4	6.4
39	Mira (V2)	245	9.6	288	11.3	61.0	2.4	8.4
40	Nectar	267	10.5	270	10.6	101.0	4.0	5.2
41	Nora	289	11.4	272	10.7	121.0	4.8	3.5
42	Novafirm	340	13.4	312	12.3	132.0	5.2	2.7
43	Novosbed Soft	286	11.3	276	10.9	114.0	4.5	4.1
44	Novosbed Soft (V2)	265	10.4	262	10.3	107.0	4.2	4.7
45	Novosbed Medium	307	12.1	311	12.2	100.0	3.9	5.2
46	Novosbed Medium (V2)	272	10.7	258	10.2	118.0	4.6	3.8
47	Novosbed Firm	293	11.5	316	12.4	81.0	3.2	6.8
48	Novosbed Firm (V2)	279	11.0	290	11.4	93.0	3.7	5.8
49	PolySleep	248	9.8	297	11.7	55.0	2.2	8.9
50	Puffy (V1)	246	9.7	248	9.8	102.0	4.0	5.1
51	Puffy (V2)	257	10.1	230	9.1	131.0	5.2	2.7
52	PerfectSense	255	10.0	265	10.4	94.0	3.7	5.7
53	Purple	242	9.5	236	9.3	110.0	4.3	4.4
54	Recore	285	11.2	309	12.2	80.0	3.1	6.9
55	Sealy Posturepedic	325	12.8	312	12.3	117.0	4.6	3.9
56	Serta Chinook	230	9.1	233	9.2	101.0	4.0	5.2
57	Silk + Snow	265	10.4	268	10.6	101.0	4.0	5.2
58	Simba (V1)	263	10.4	301	11.9	66.0	2.6	8.0
59	Simba (V2)	304	12.0	282	11.1	126.0	5.0	3.1
60	Spa Sensations	224	8.8	216	8.5	112.0	4.4	4.3
61	Structube	275	10.8	316	12.4	63.0	2.5	8.2
62	Tempur-Pedic	286	11.3	246	9.7	144.0	5.7	1.7
63	Tuft & Needle	251	9.9	270	10.6	85.0	3.3	6.5
64	Zinus	290	11.4	295	11.6	99.0	3.9	5.3



Table 4: Test 2 – Edge Supportiveness - Hybrid Mattresses

Mattress		Mattress Height, D4		Measured Depth, D2		Deflection, D1 [in]		Out of 10
		[mm]	[in]	[mm]	[in]	[mm]	[in]	
65	Brnswick	298	11.7	309	12.2	93.0	3.7	5.8
66	Hamuq	300	11.8	328	12.9	76.0	3.0	7.2
67	Kingsdown	369	14.5	355	14.0	118.0	4.6	3.8
68	Logan & Cove (Medium)	350	13.8	343	13.5	111.0	4.4	4.4
69	Logan & Cove (Firm)	352	13.9	390	15.4	66.0	2.6	8.0
70	Saatva	400	15.7	384	15.1	120.0	4.7	3.6
71	Silk + Snow Hybrid	284	11.2	285	11.2	103.0	4.1	5.0
72	Simmons Beautyrest Black	355	14.0	349	13.7	110.0	4.3	4.4
73	Springwall	232	9.1	288	11.3	48.0	1.9	9.5
74	Stearns & Foster	342	13.5	355	14.0	91.0	3.6	6.0



Engineering Report

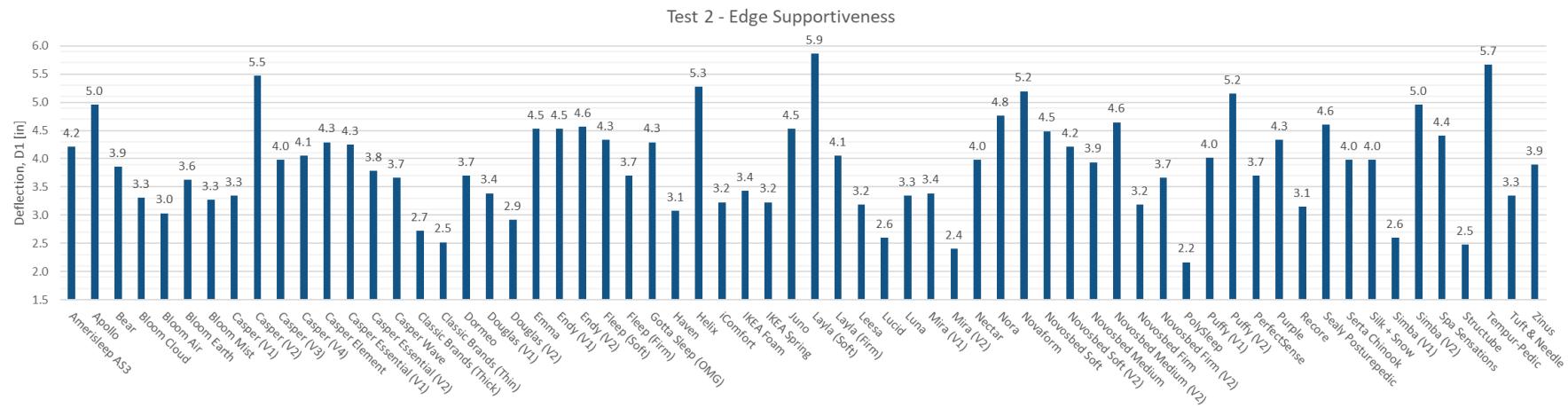


Figure 15: Test 2 – Mattress Firmness measuring how far Reference Load 1 deflects on the edge of the mattress. A higher number indicates a softer mattress.

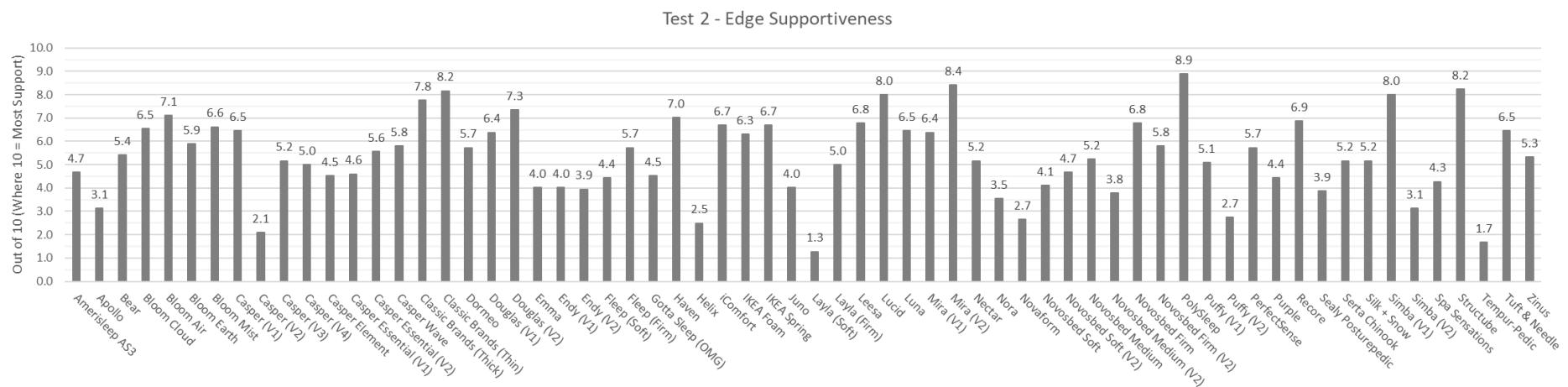
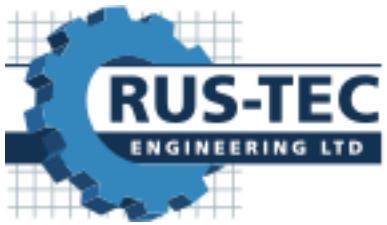


Figure 16: Test 2 – Mattress Firmness on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = most firm)



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Test 2 - Edge Supportiveness Hybrid Mattresses

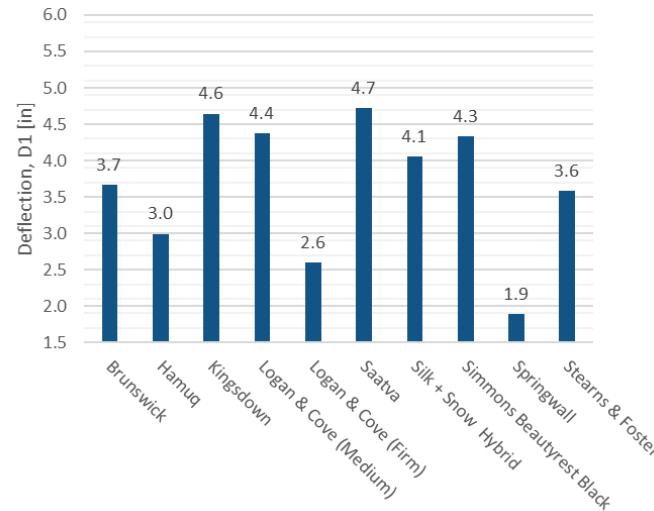


Figure 17: Test 2 – Mattress Firmness measuring how far Reference Load 1 deflects on the edge of the mattress. A higher number indicates a softer mattress. Hybrid mattresses.

Test 2 - Edge Supportiveness Hybrid Mattresses

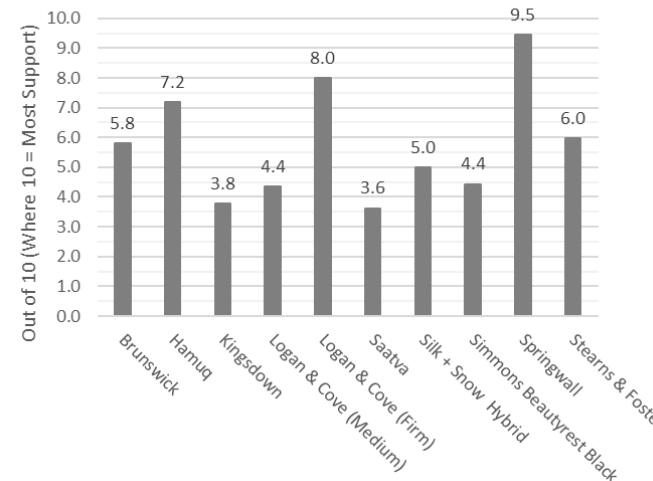


Figure 18: Test 2 – Mattress Firmness on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = most firm). Hybrid mattresses.



TEST 3 RESULTS

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Table 5: Test 3 – Motion Isolation

	Mattress	Average	Peak
		Acceleration	Out of 10
		[g]	
1	Amerisleep AS3	6.8	5.9
2	Apollo	2.3	8.6
3	Bear	5.1	6.9
4	Bloom Cloud	5.1	6.9
5	Bloom Air	5.9	6.5
6	Bloom Earth	4.5	7.3
7	Bloom Mist	5.9	6.5
8	Casper (V1)	8.7	4.8
9	Casper (V2)	6.1	6.4
10	Casper (V3)	4.8	7.1
11	Casper (V4)	4.8	7.1
12	Casper Element	6.9	5.9
13	Casper Essential (V1)	5.8	6.5
14	Casper Essential (V2)	5.3	6.8
15	Casper Wave	4.9	7.1
16	Classic Brands (Thick)	7.0	5.8
17	Classic Brands (Thin)	6.4	6.2
18	Dormeo	6.7	6.0
19	Douglas (V1)	3.3	8.0
20	Douglas (V2)	2.8	8.3
21	Emma	4.9	7.0
22	Endy (V1)	5.1	6.9
23	Endy (V2)	5.7	6.6
24	Fleep (Soft)	5.2	6.9
25	Fleep (Firm)	5.2	6.9
26	Gotta Sleep (OMG)	5.9	6.4
27	Haven	6.2	6.3
28	Helix	5.4	6.7
29	iComfort	4.4	7.4
30	IKEA Foam	8.6	4.8
31	IKEA Spring	4.8	7.1
32	Juno	6.3	6.2
33	Layla (Soft)	5.9	6.4
34	Layla (Firm)	5.8	6.5
35	Leesa	6.4	6.1
36	Lucid	5.4	6.8
37	Luna	6.6	6.1
38	Mira (V1)	5.3	6.8
39	Mira (V2)	3.4	7.9
40	Nectar	4.5	7.3
41	Nora	3.1	8.1
42	Novaform	3.0	8.2
43	Novosbed Soft	6.7	6.0
44	Novosbed Soft (V2)	4.5	7.3
45	Novosbed Medium	5.0	7.0
46	Novosbed Medium (V2)	5.3	6.8
47	Novosbed Firm	5.4	6.8
48	Novosbed Firm (V2)	5.4	6.8
49	PolySleep	3.3	8.0
50	Puffy (V1)	5.0	7.0
51	Puffy (V2)	6.1	6.3
52	PerfectSense	9.8	4.1
53	Purple	9.9	4.0
54	Recore	4.8	7.1
55	Sealy Posturepedic	6.5	6.1
56	Serta Chinook	4.4	7.4
57	Silk + Snow	3.9	7.6
58	Simba (V1)	6.2	6.3
59	Simba (V2)	5.7	6.6
60	Spa Sensations	7.1	5.7
61	Structube	5.9	6.5
62	Tempur-Pedic	4.3	7.4
63	Tuft & Needle	4.7	7.2
64	Zinus	4.3	7.4



Table 6: Test 3 – Motion Isolation - Hybrid Mattresses

Mattress		Average	Out of 10
		Peak Acceleration [g]	
65	Brunswick	5.5	6.7
66	Hamuq	6.0	6.4
67	Kingsdown	4.9	7.1
68	Logan & Cove (Medium)	5.1	7.0
69	Logan & Cove (Firm)	5.2	6.9
70	Saatva	5.2	6.9
71	Silk + Snow Hybrid	4.9	7.0
72	Simmons Beautyrest Black	3.6	7.8
73	Springwall	6.5	6.1
74	Stearns & Foster	4.1	7.6

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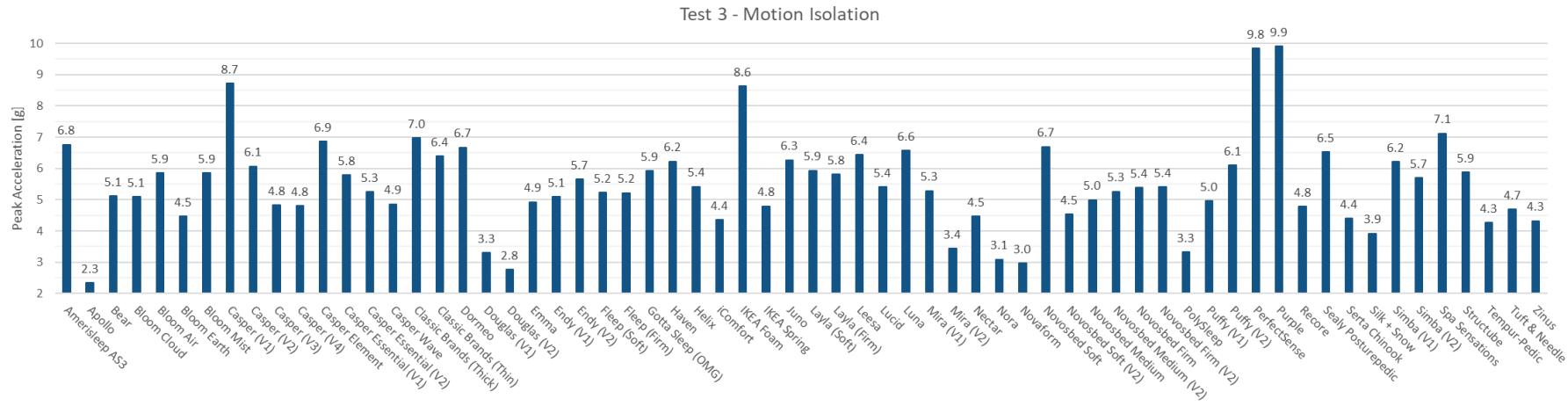


Figure 19: Test 3 - Peak Acceleration at one sleep point when Reference Load 2 is dropped on the other sleep point. Values shown are an average of 20 runs per mattress.

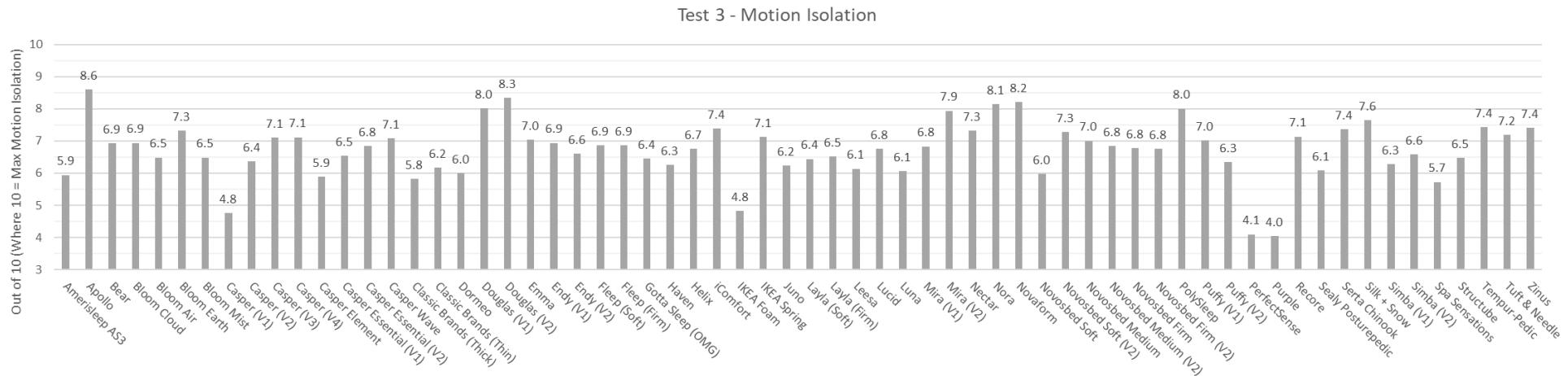
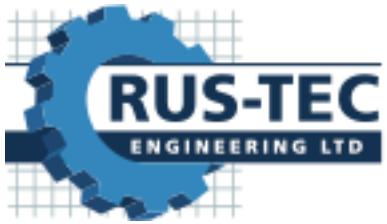


Figure 20: Test 3 – Motion Isolation on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = max motion isolation)



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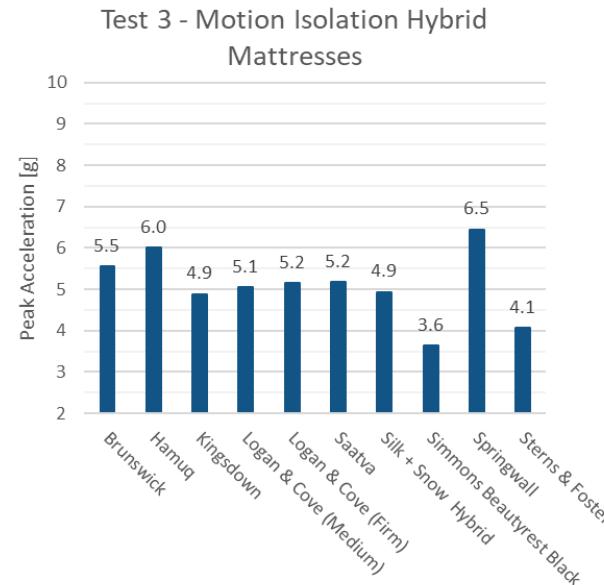


Figure 21: Test 3 - Peak Acceleration at one sleep point when Reference Load 2 is dropped on the other sleep point. Values shown are an average of 20 runs per mattress. Hybrid mattresses.

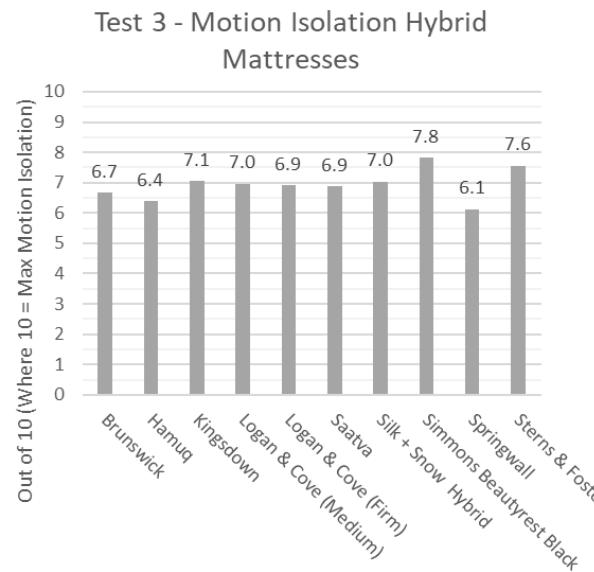


Figure 22: Test 3 – Motion Isolation on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = max motion isolation. Hybrid mattresses.



TEST 4 RESULTS

Table 7: Test 4 – Bounciness

Mattress		Rebound Height	Rebound Height	Rebound Height	Rebound Height	Out of 10
		Run 1, [in]	Run 2, [in]	Run 3, [in]	Average, [in]	
1	Amerisleep AS3	3.1	3.0	3.3	3.1	2.9
2	Apollo	1.8	1.8	1.5	1.7	2.0
3	Bear	3.8	3.8	3.9	3.8	3.3
4	Bloom Cloud	3.5	3.7	4.0	3.7	3.2
5	Bloom Air	3.4	3.3	3.4	3.3	3.0
6	Bloom Earth	5.3	5.1	5.1	5.2	4.1
7	Bloom Mist	3.6	3.5	3.5	3.5	3.1
8	Casper (V1)	4.9	5.0	5.1	5.0	4.0
9	Casper (V2)	5.0	4.9	5.0	5.0	4.0
10	Casper (V3)	3.5	3.5	3.5	3.5	3.1
11	Casper (V4)	6.3	6.3	6.3	6.3	4.8
12	Casper Element	8.8	8.6	8.8	8.7	6.2
13	Casper Essential (V1)	3.3	3.3	3.4	3.3	3.0
14	Casper Essential (V2)	4.3	4.1	4.3	4.2	3.5
15	Casper Wave	6.0	6.0	6.0	6.0	4.6
16	Classic Brands (Thick)	3.4	3.6	3.5	3.5	3.1
17	Classic Brands (Thin)	7.1	7.1	7.2	7.1	5.3
18	Dormeo	8.8	8.8	8.6	8.7	6.2
19	Douglas (V1)	5.5	5.7	5.5	5.6	4.3
20	Douglas (V2)	3.8	3.8	3.5	3.7	3.2
21	Emma	3.3	3.3	3.3	3.3	3.0
22	Endy (V1)	2.5	2.6	2.6	2.6	2.5
23	Endy (V2)	6.3	6.0	6.3	6.2	4.7
24	Fleep (Soft)	3.6	3.7	3.5	3.6	3.2
25	Fleep (Firm)	7.5	7.6	7.5	7.5	5.5
26	Gotta Sleep (OMG)	3.0	3.0	3.0	3.0	2.8
27	Haven	6.6	6.6	6.5	6.6	5.0
28	Helix	9.3	9.3	9.3	9.3	6.6
29	iComfort	1.8	2.0	1.8	1.8	2.1
30	IKEA Foam	9.6	9.5	9.8	9.6	6.8
31	IKEA Spring	12.3	12.1	12.3	12.2	8.3
32	Juno	2.6	2.6	2.6	2.6	2.6
33	Layla (Soft)	1.8	1.8	1.5	1.7	2.0
34	Layla (Firm)	4.5	4.4	4.5	4.5	3.7
35	Leesa	4.4	4.4	4.3	4.4	3.6
36	Lucid	3.4	3.5	3.4	3.4	3.1
37	Luna	3.3	3.4	3.4	3.4	3.0
38	Mira (V1)	5.4	5.4	5.5	5.4	4.3
39	Mira (V2)	4.8	4.5	4.8	4.7	3.8
40	Nectar	1.3	1.3	1.1	1.2	1.7
41	Nora	3.4	3.5	3.5	3.5	3.1
42	Novaform	0.6	0.8	0.6	0.7	1.4
43	Novosbed Soft	3.4	3.5	3.6	3.5	3.1
44	Novosbed Soft (V2)	1.6	1.6	1.8	1.7	2.0
45	Novosbed Medium	1.7	1.7	1.6	1.7	2.0
46	Novosbed Medium (V2)	2.1	2.1	2.1	2.1	2.3
47	Novosbed Firm	1.2	1.3	1.3	1.3	1.8
48	Novosbed Firm (V2)	3.3	3.1	3.3	3.2	2.9
49	PolySleep	3.5	3.8	3.6	3.6	3.2
50	Puffy (V1)	0.5	0.4	0.5	0.5	1.3
51	Puffy (V2)	4.1	4.1	4.3	4.2	3.5
52	PerfectSense	4.3	4.4	4.3	4.3	3.6
53	Purple	8.6	8.5	8.6	8.6	6.1
54	Recore	4.3	4.4	4.4	4.3	3.6
55	Sealy Posturepedic	5.4	5.4	5.4	5.4	4.2
56	Serta Chinook	4.4	4.3	4.3	4.3	3.6
57	Silk + Snow	2.5	2.5	2.5	2.5	2.5
58	Simba (V1)	5.5	5.5	5.6	5.5	4.3
59	Simba (V2)	5.8	5.5	5.8	5.7	4.4
60	Spa Sensations	12.5	12.6	12.5	12.5	8.5
61	Structube	9.0	9.0	9.0	9.0	6.4
62	Tempur-Pedic	1.1	1.1	1.0	1.1	1.7
63	Tuft & Needle	6.3	6.5	6.4	6.4	4.8
64	Zinus	1.5	1.5	1.4	1.5	1.9



Table 8: Test 4 – Bounciness - Hybrid Mattresses

Mattress		Rebound Height	Rebound Height	Rebound Height	Rebound Height	Out of 10
		Run 1, [in]	Run 2, [in]	Run 3, [in]	Average, [in]	
65	Brunswick	7.8	7.6	7.8	7.7	5.6
66	Hamuq	6.8	6.5	6.8	6.7	5.0
67	Kingsdown	5.4	5.3	5.3	5.3	4.2
68	Logan & Cove (Medium)	3.8	3.8	3.6	3.7	3.2
69	Logan & Cove (Firm)	7.5	7.8	7.6	7.6	5.6
70	Saatva	12.2	12.5	12.3	12.3	8.4
71	Silk + Snow Hybrid	7.5	7.5	7.5	7.5	5.5
72	Simmons Beautyrest Black	6.0	5.9	6.0	6.0	4.6
73	Springwall	13.6	13.8	13.6	13.7	9.2
74	Stearns & Foster	3.3	3.3	3.1	3.2	2.9



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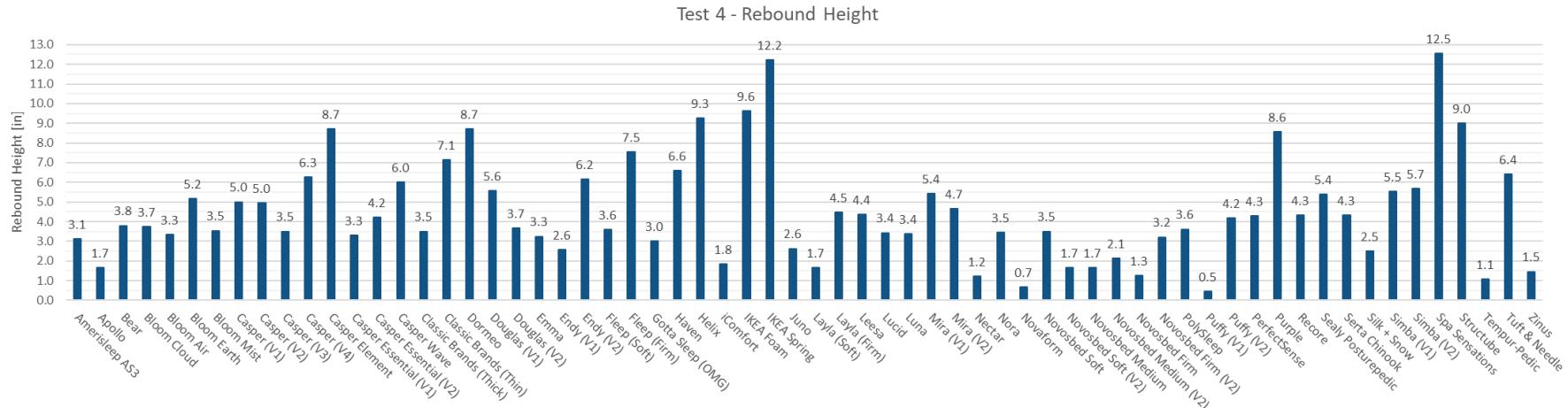


Figure 23: Test 4 - Rebound height of Reference Load 2 when dropped in the center of the mattress. Values shown are an average of 3 runs per mattress.

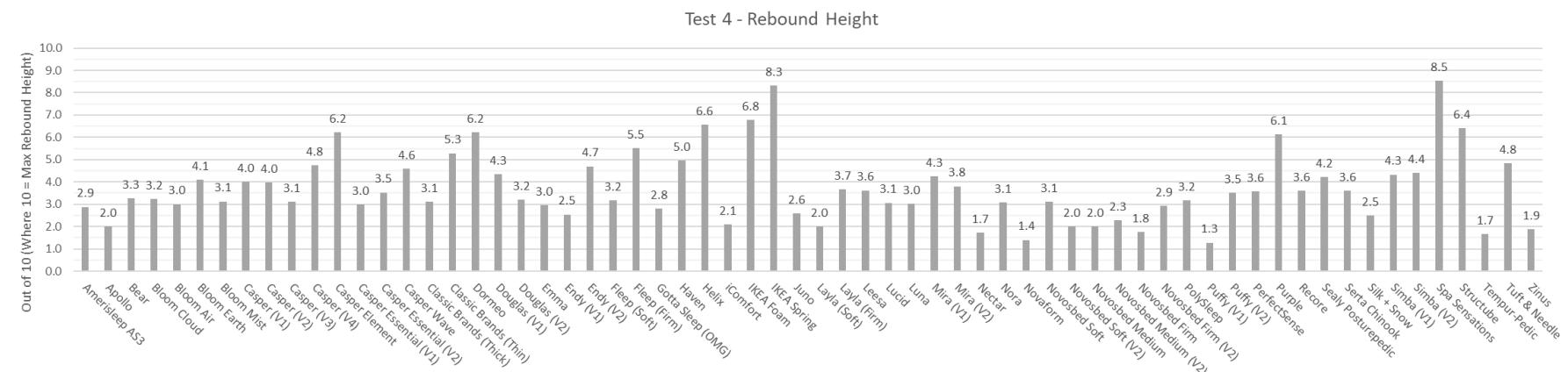


Figure 24: Test 4 – Rebound height on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = max rebound height)



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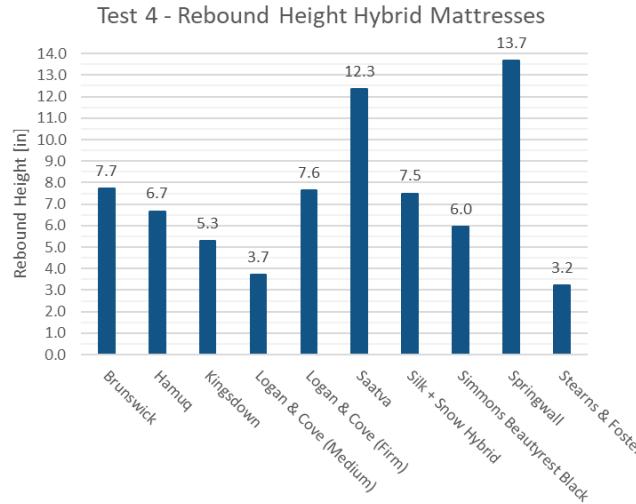


Figure 25: Test 4 - Rebound height of Reference Load 2 when dropped in the center of the mattress. Values shown are an average of 3 runs per mattress. Hybrid mattresses.

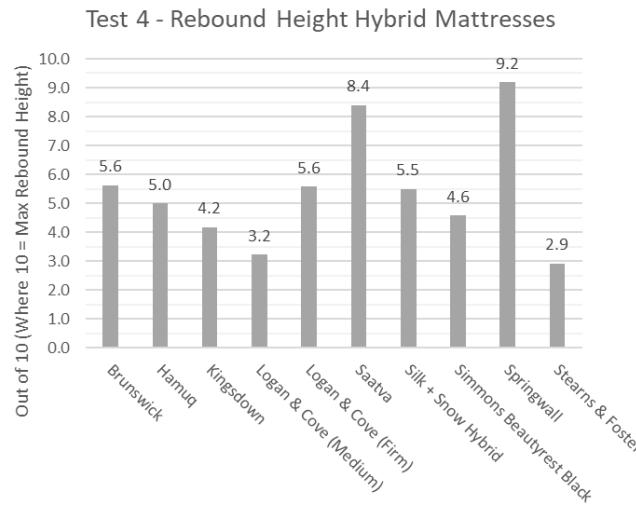


Figure 26: Test 4 – Rebound height on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = max rebound height). Hybrid mattresses.



CONCLUSION

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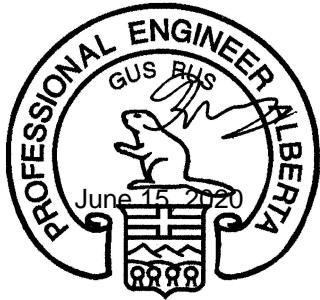
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We trust that the above and attached information is satisfactory. Please do not hesitate to contact the undersigned if you have any questions or require further information.

Sincerely,

Gus M. Rus, P.Eng

Rus-Tec Engineering Ltd.
P-12368





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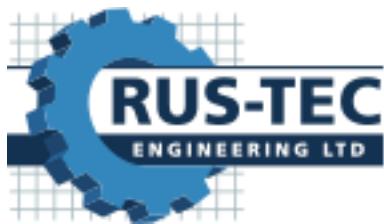
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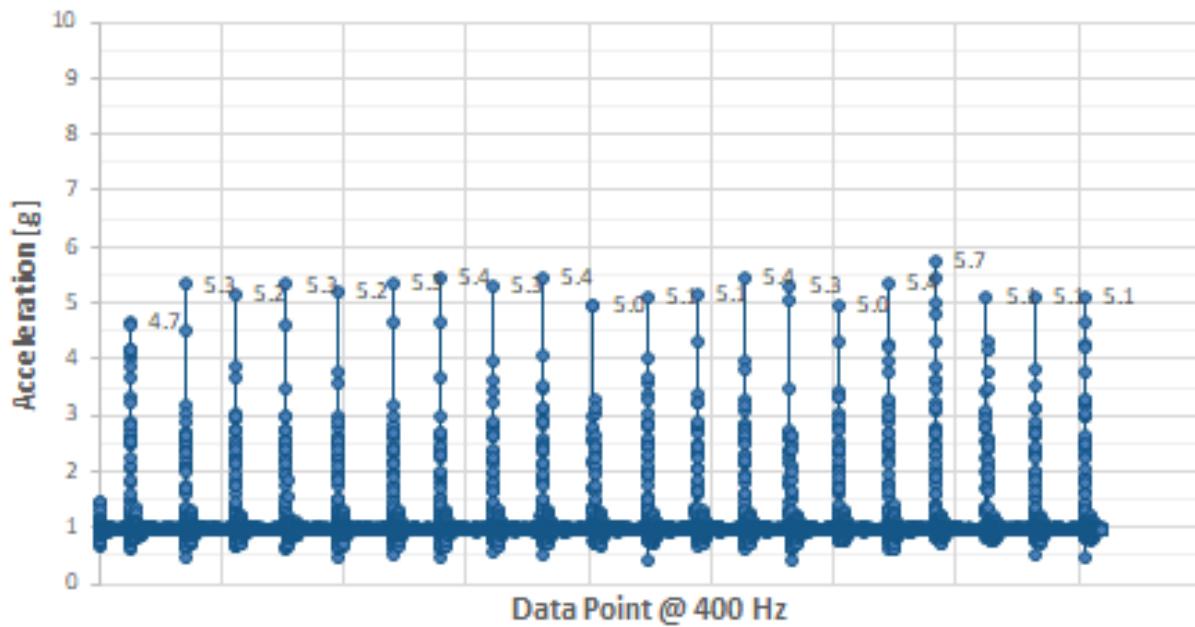


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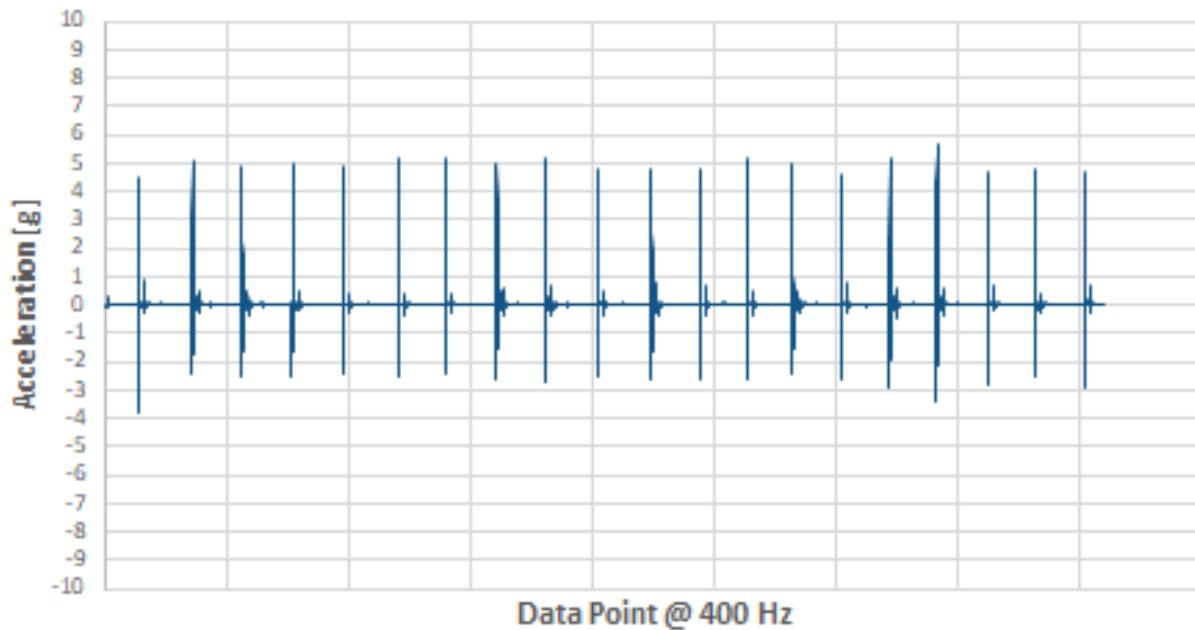
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TEST 3 – FLEEP (FIRM)

Vector Magnitude Acceleration - Fleep (Firm)

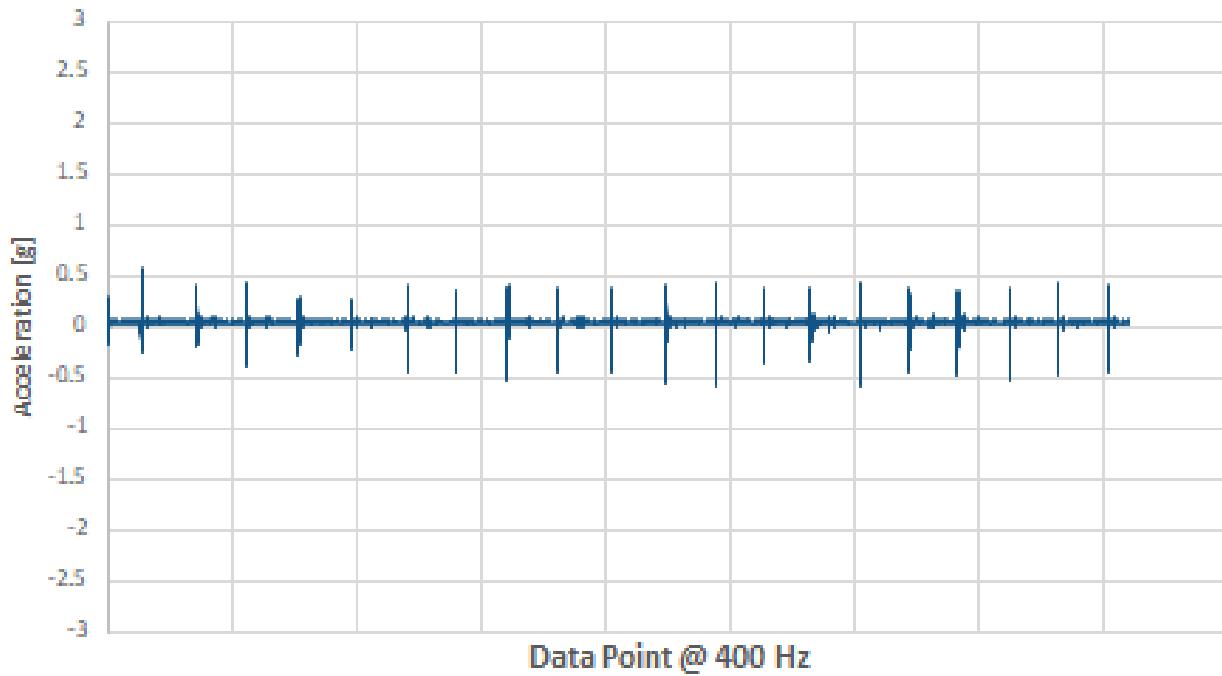


X Acceleration (Side to Side) - Fleep (Firm)

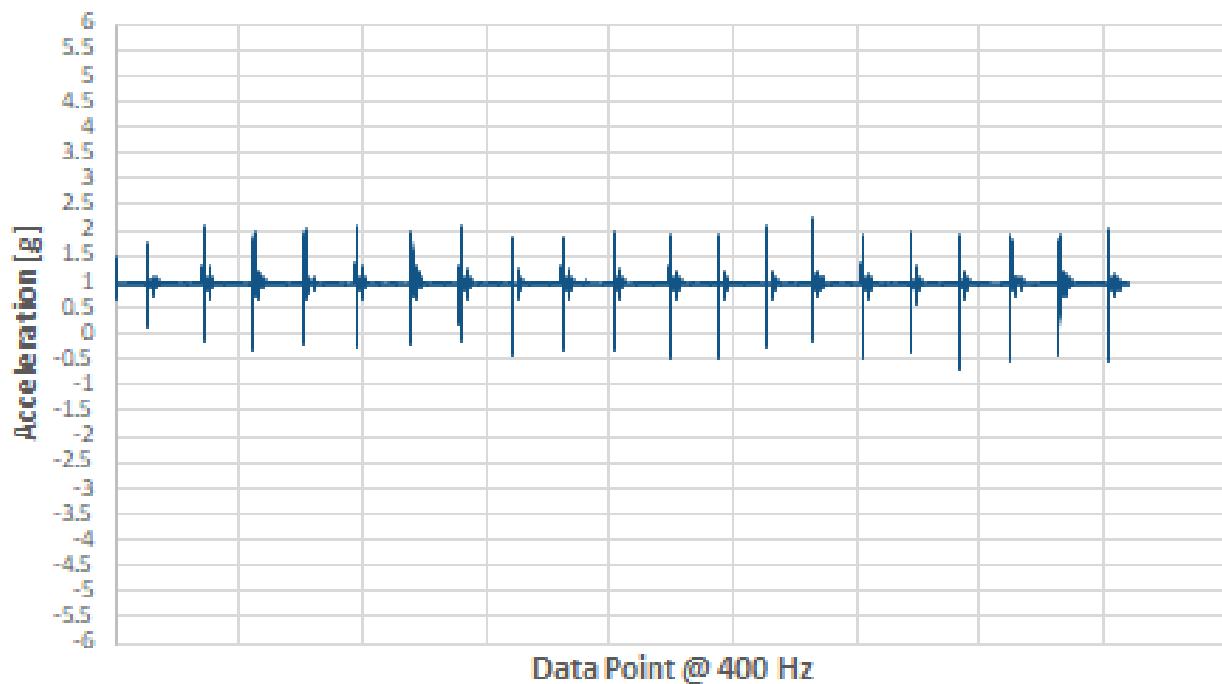




Y Acceleration (Head to Toe) - Fleep (Firm)



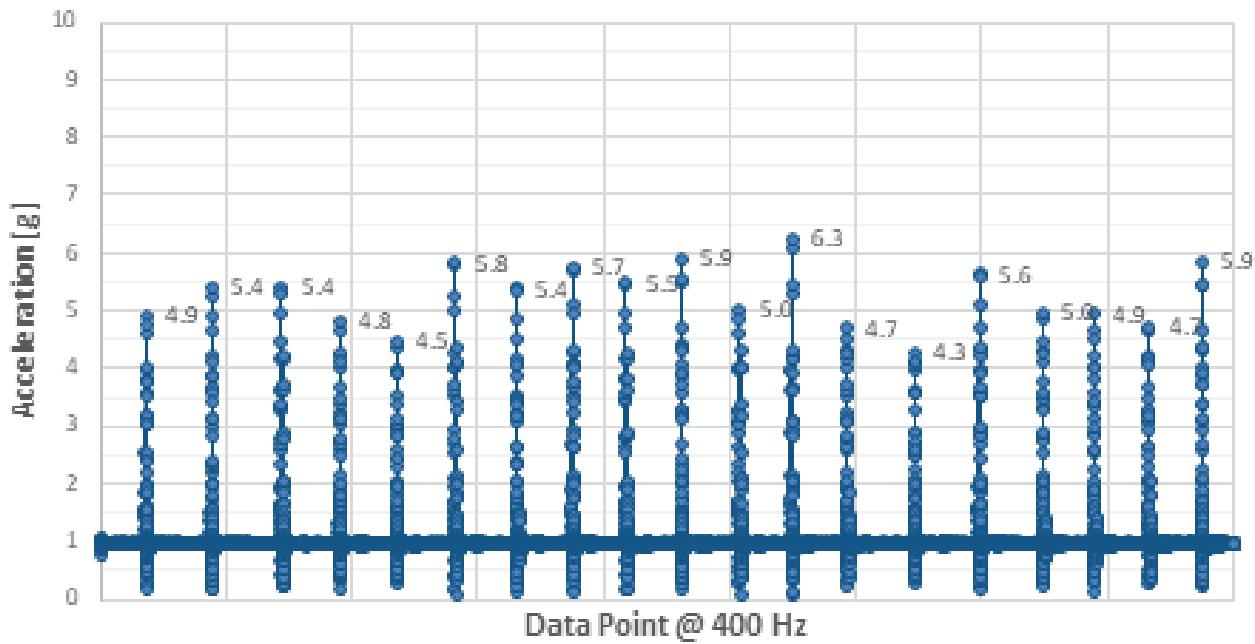
Z Acceleration (Up and Down) - Fleep (Firm)



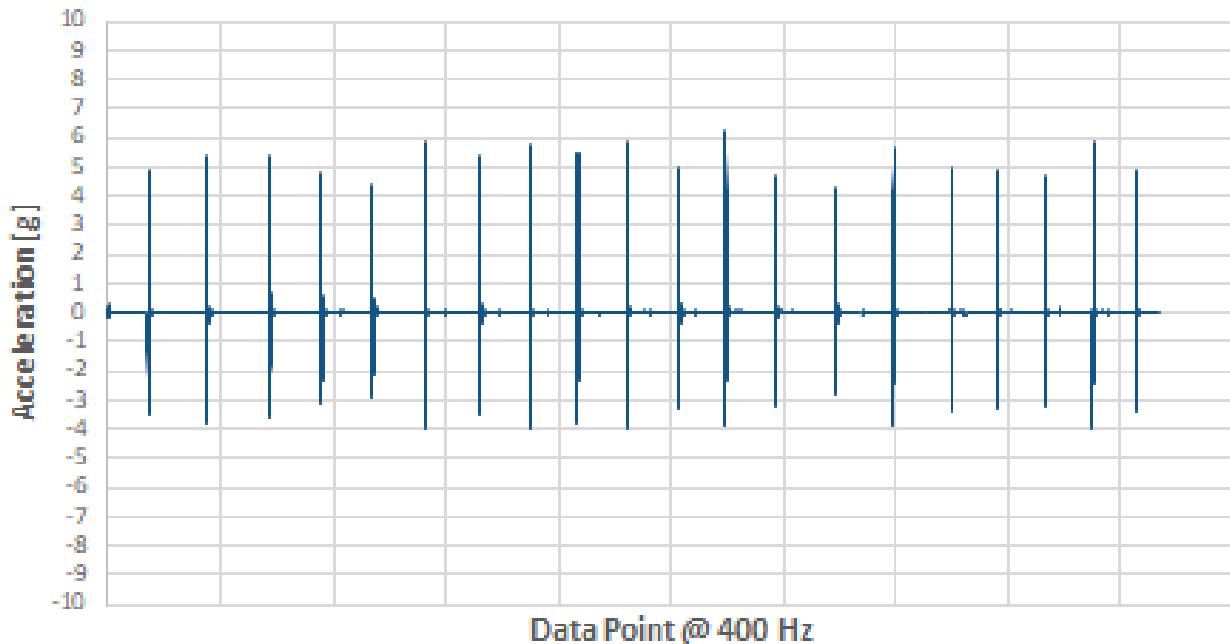


TEST 3 – FLEEP (SOFT)

Vector Magnitude Acceleration - Fleep (Soft)

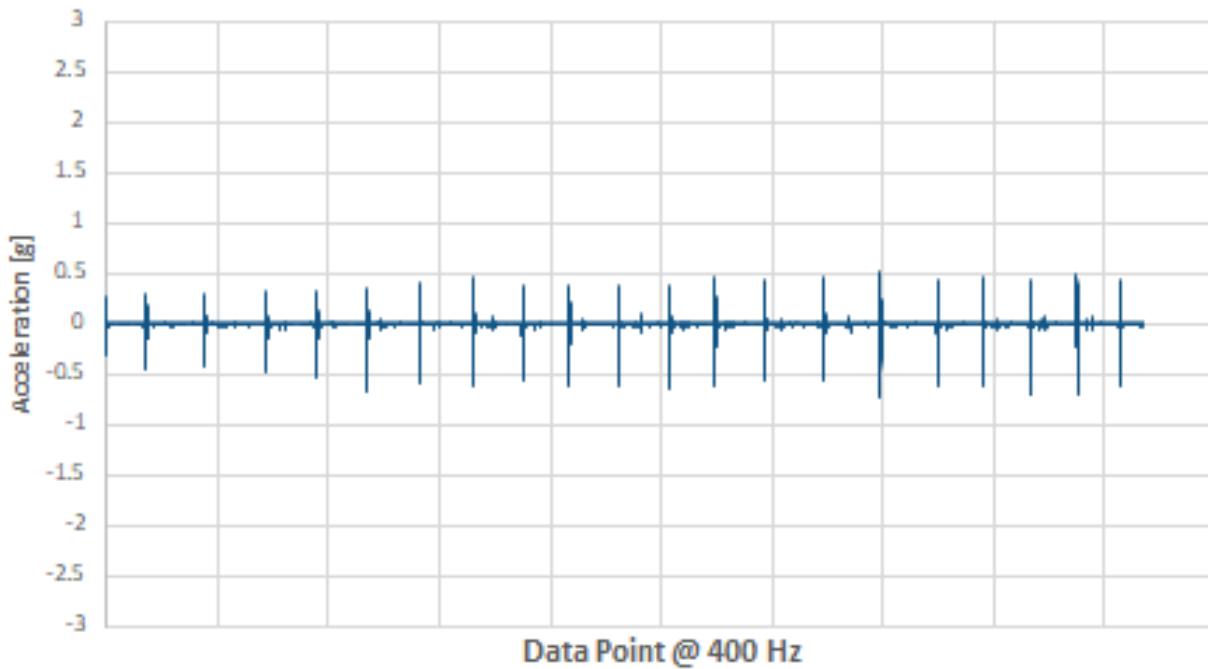


X Acceleration (Side to Side) - Fleep (Soft)

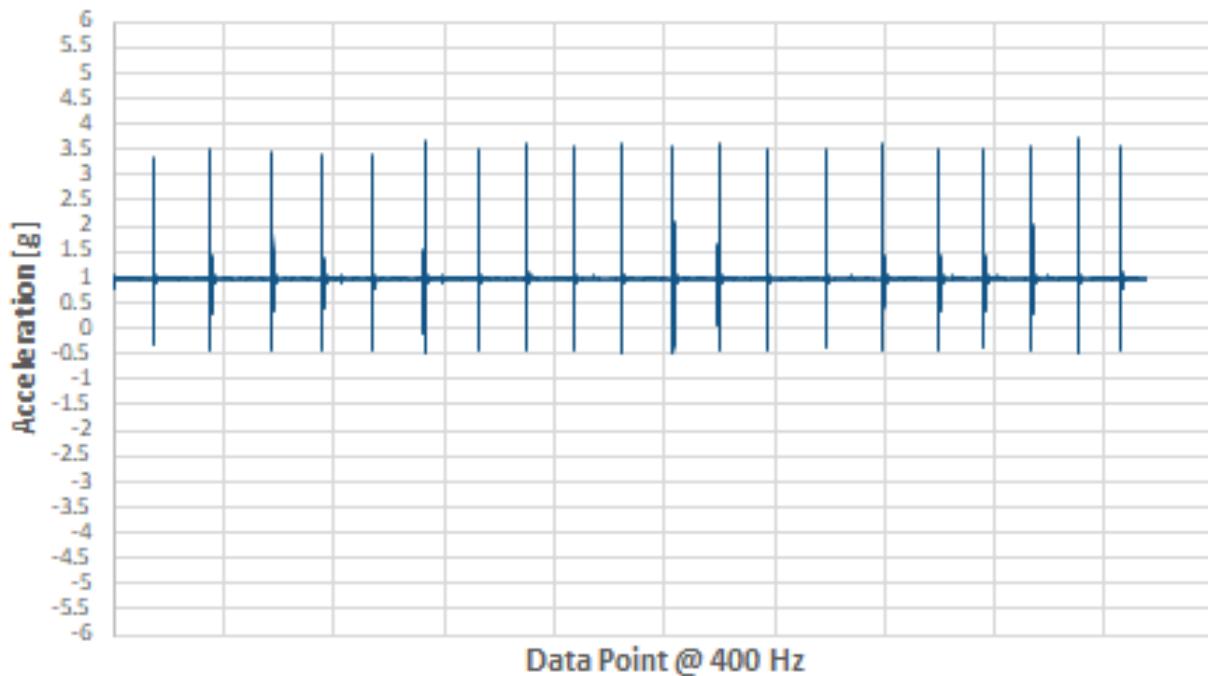




Y Acceleration (Head to Toe) - Fleep (Soft)



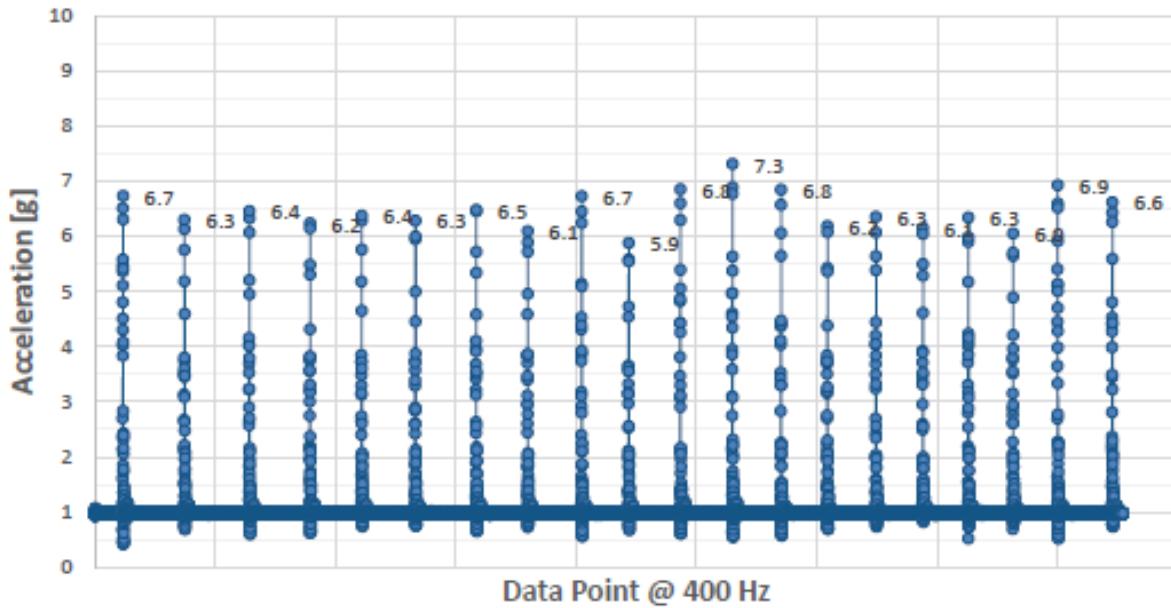
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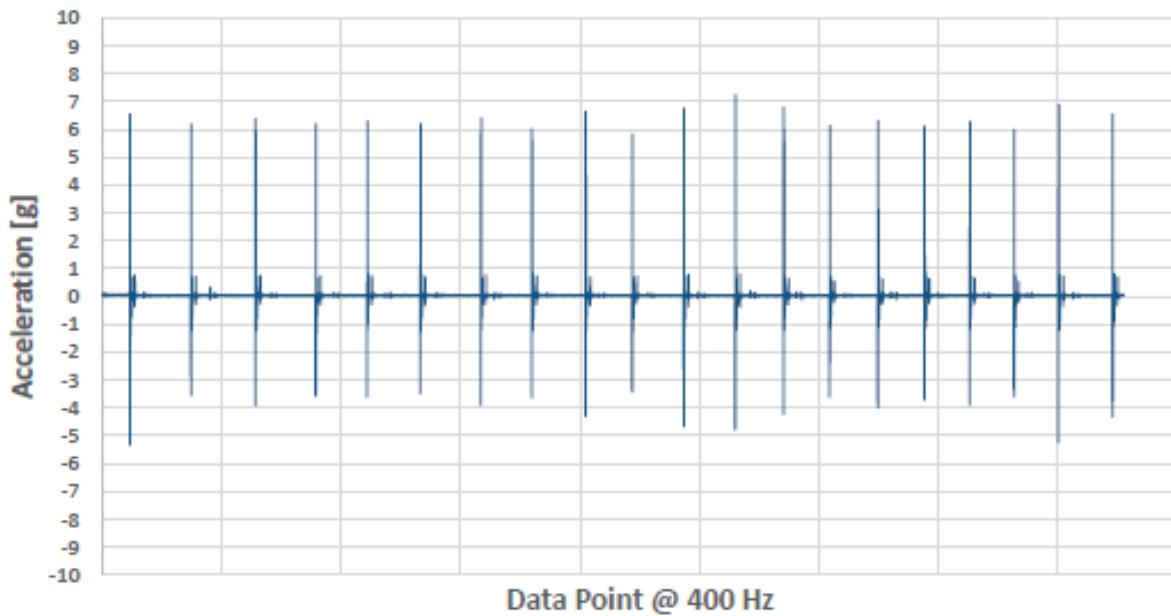


TEST 3 – LEESA

Vector Magnitude Acceleration - Leesa



X Acceleration (Side to Side) - Leesa

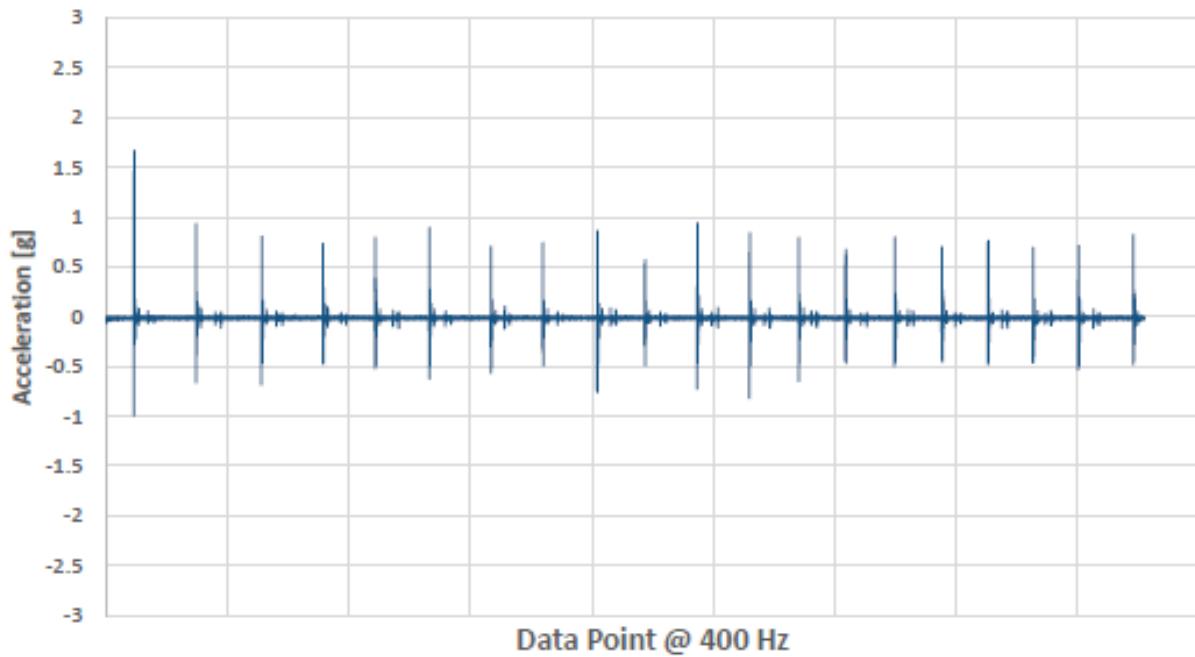




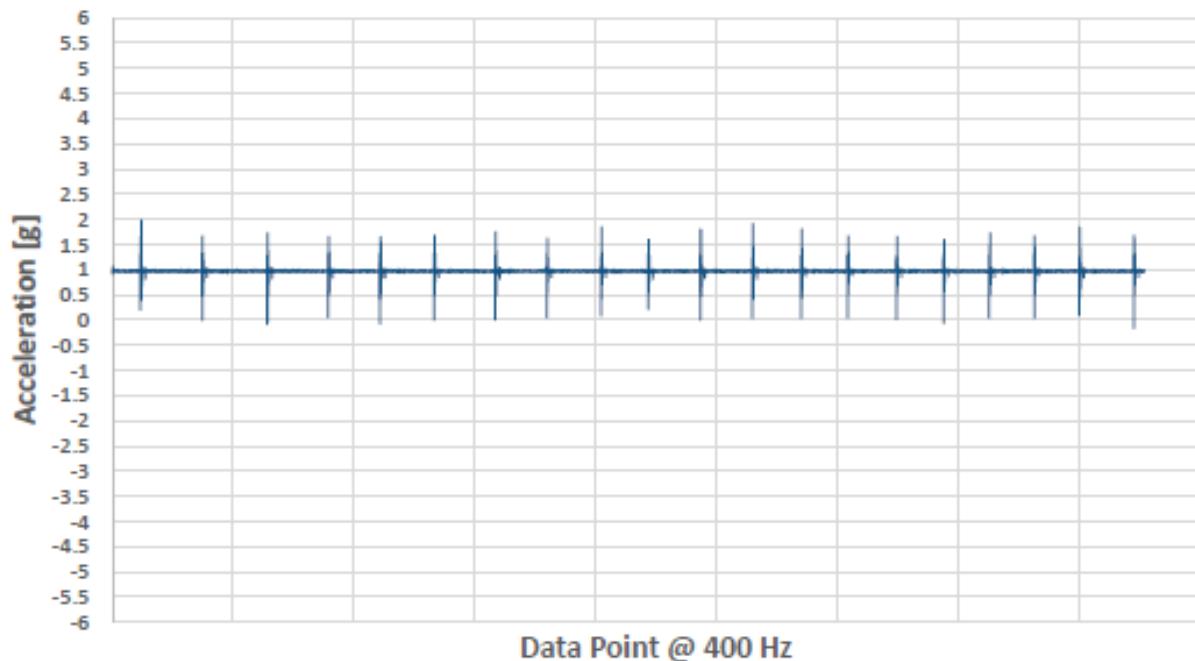
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Y Acceleration (Head to Toe) - Leesa



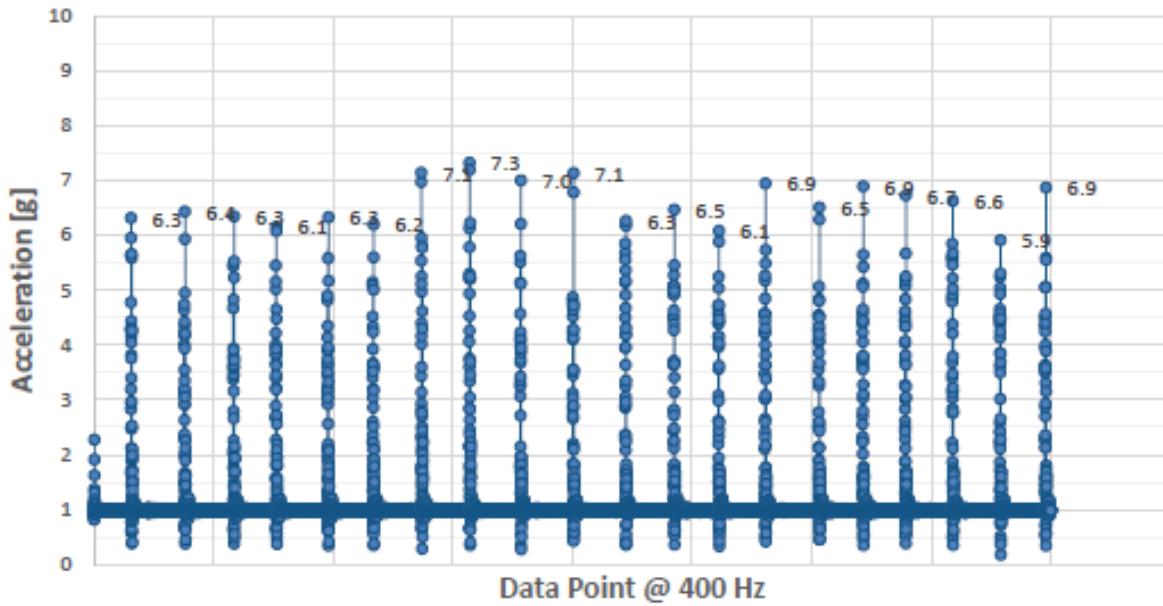
Z Acceleration (Up and Down) - Leesa



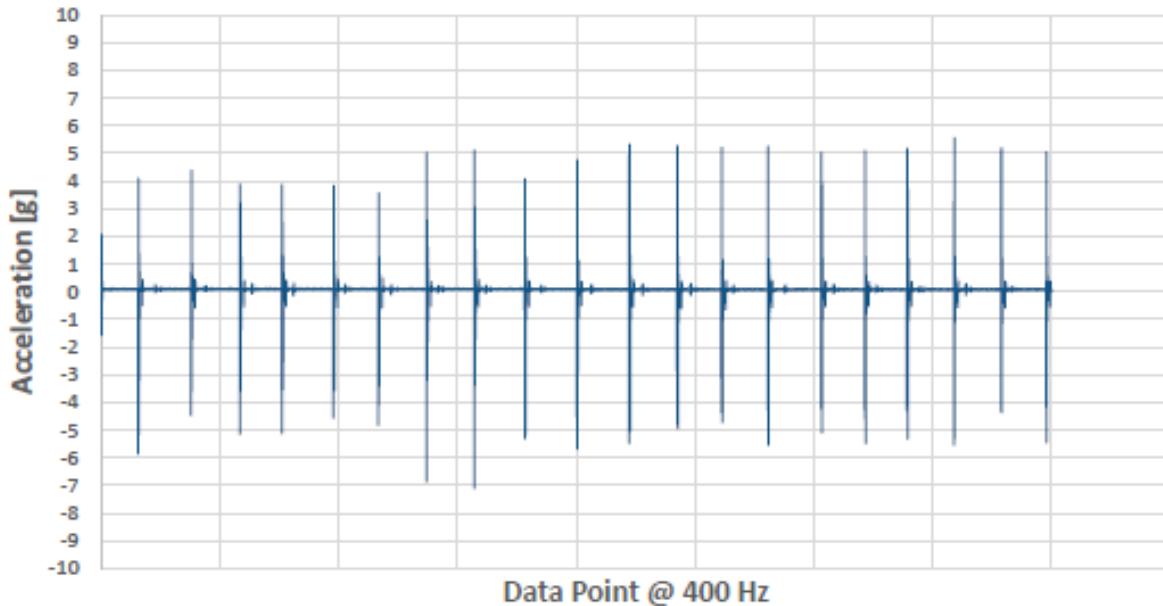


TEST 3 – LUNA

Vector Magnitude Acceleration - Luna

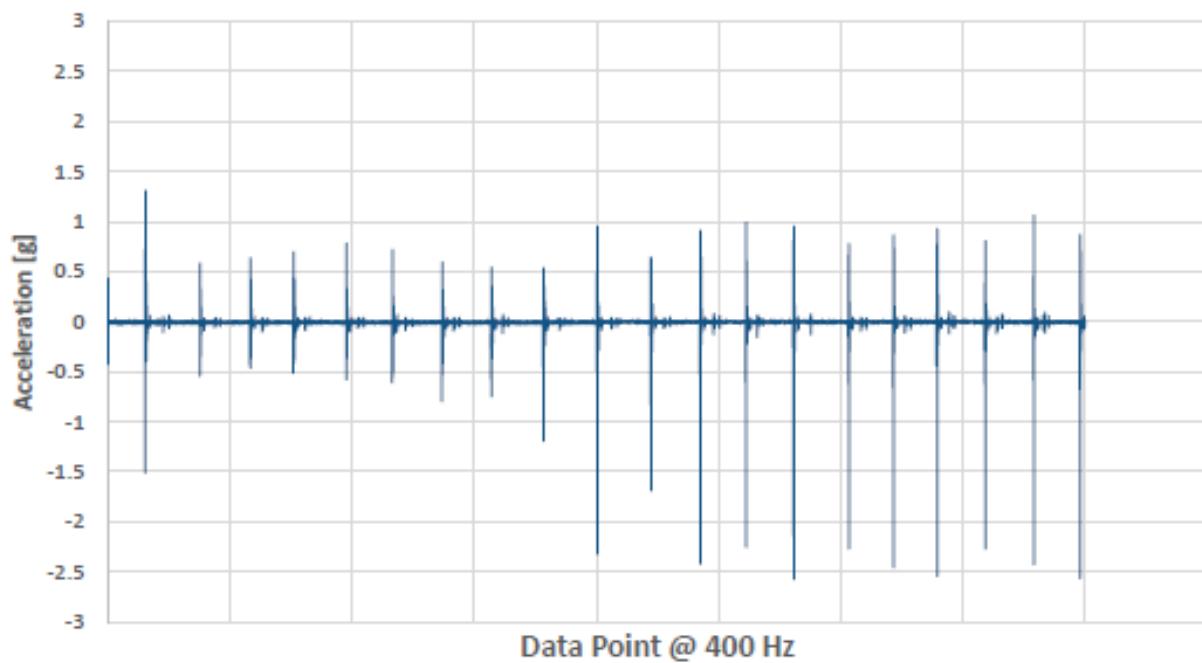


X Acceleration (Side to Side) - Luna

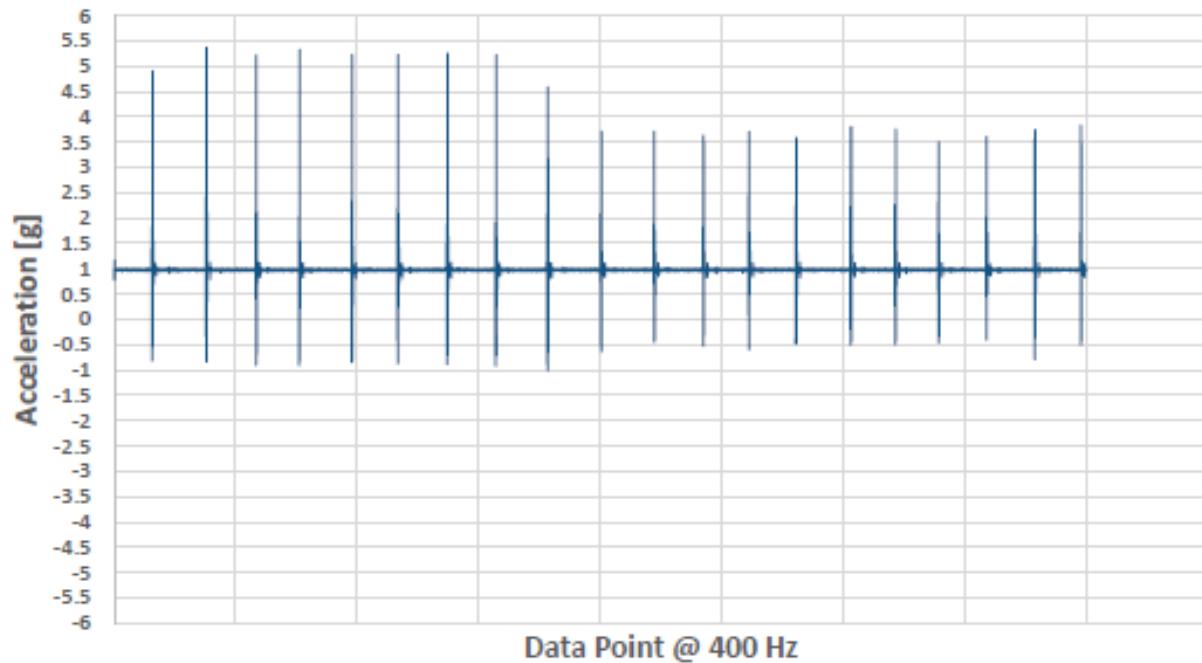




Y Acceleration (Head to Toe) - Luna

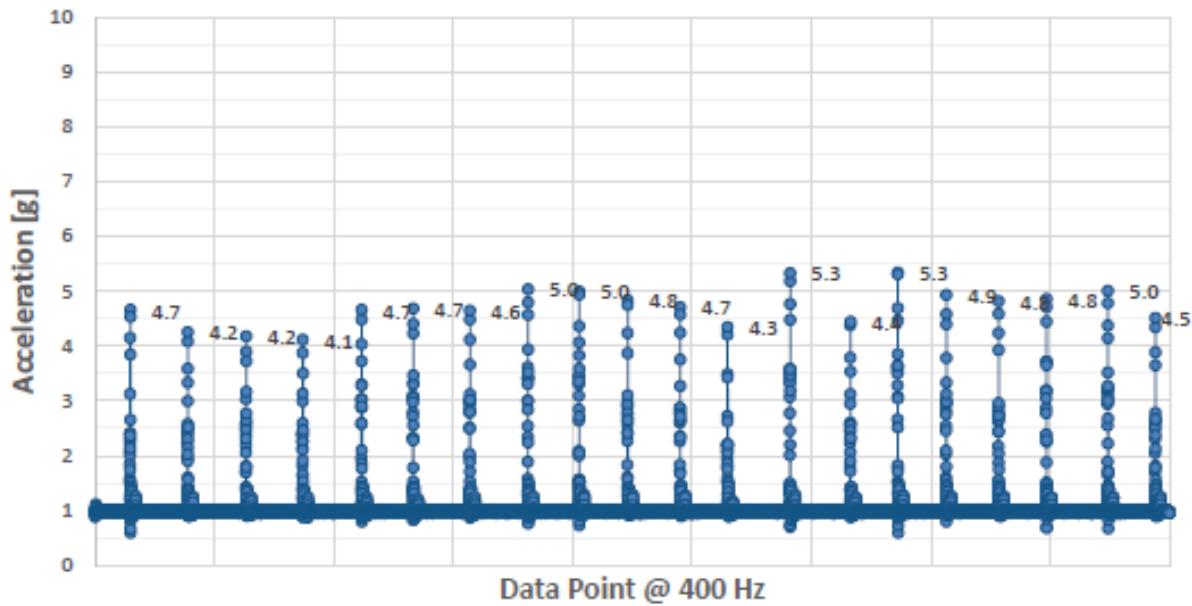


Z Acceleration (Up and Down) - Luna

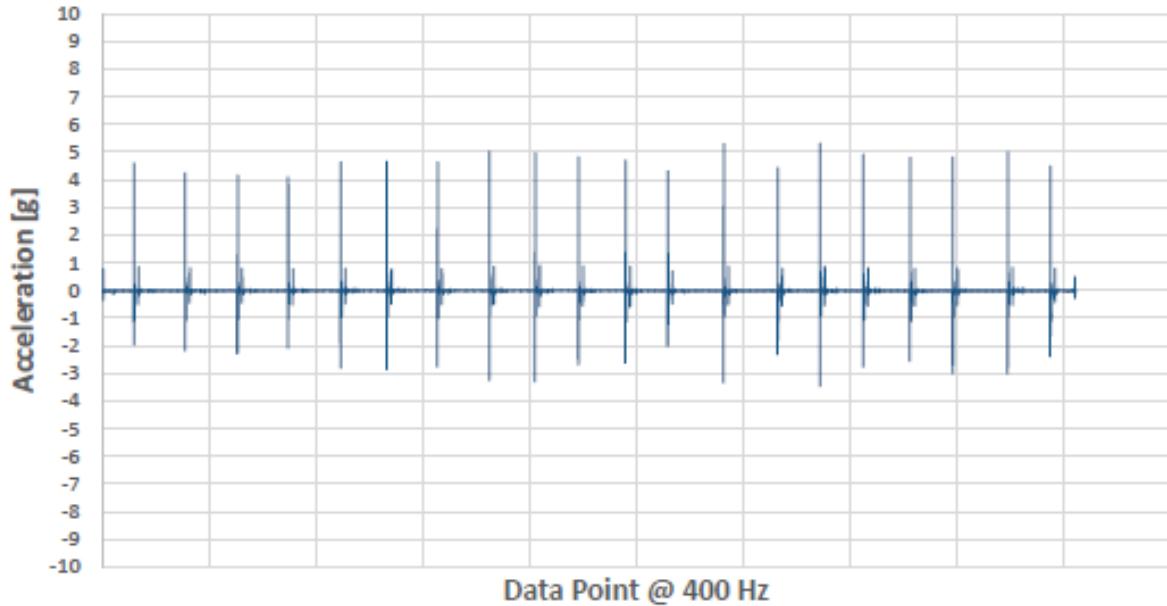


TEST 3 – TUFT & NEEDLE

Vector Magnitude Acceleration - Tuft & Needle

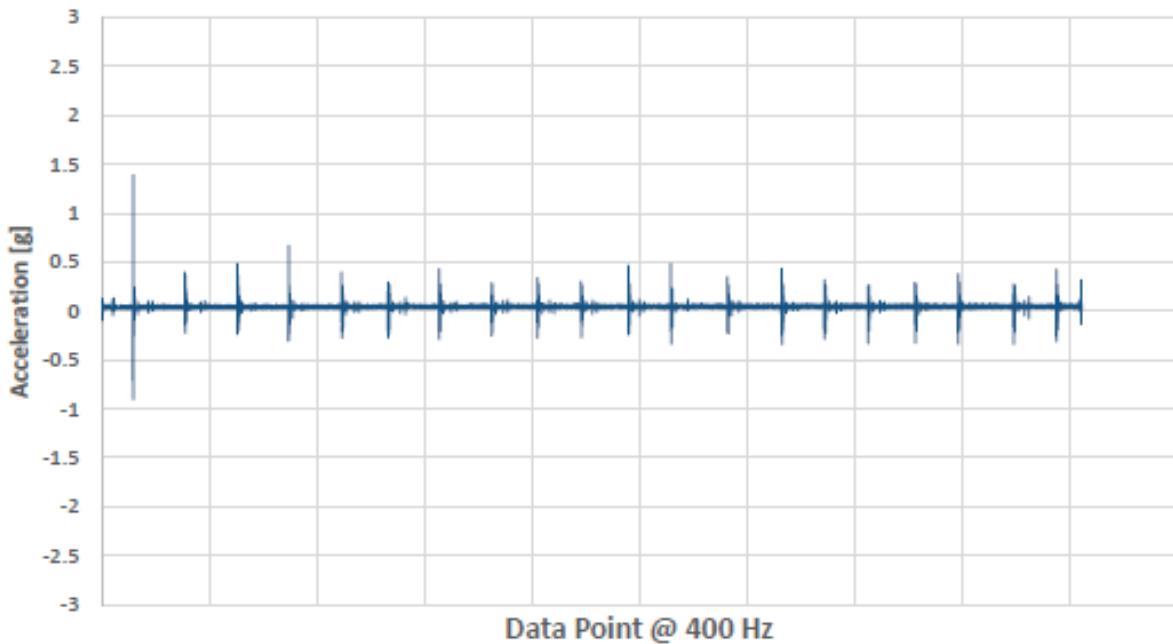


X Acceleration (Side to Side) - Tuft & Needle

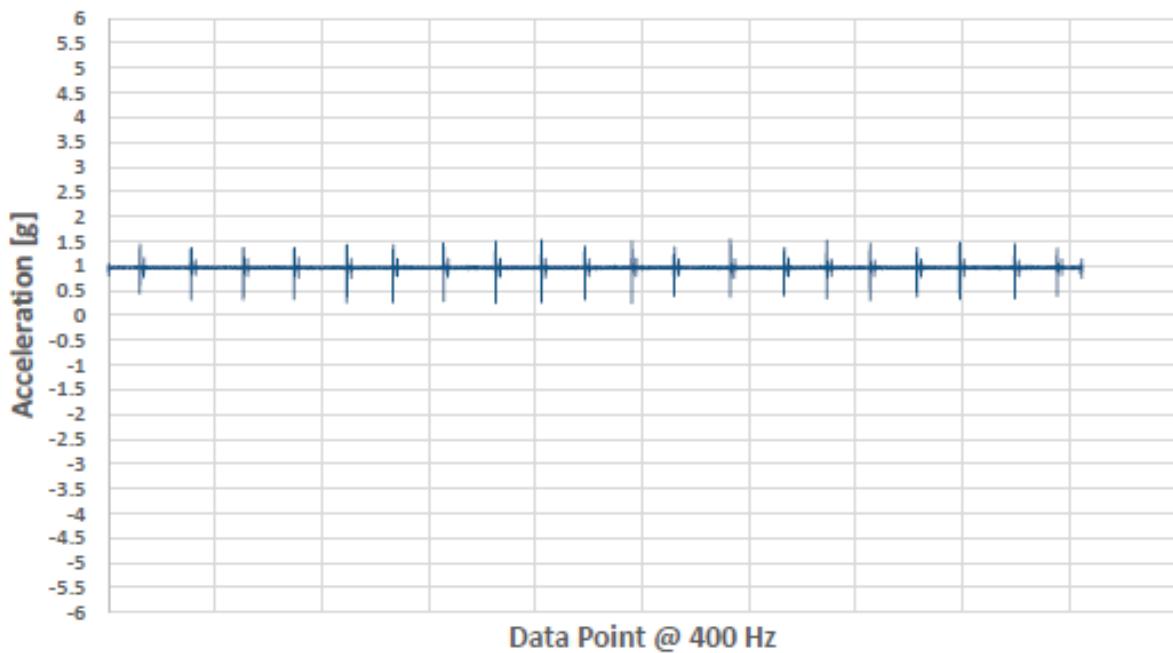




Y Acceleration (Head to Toe) - Tuft & Needle

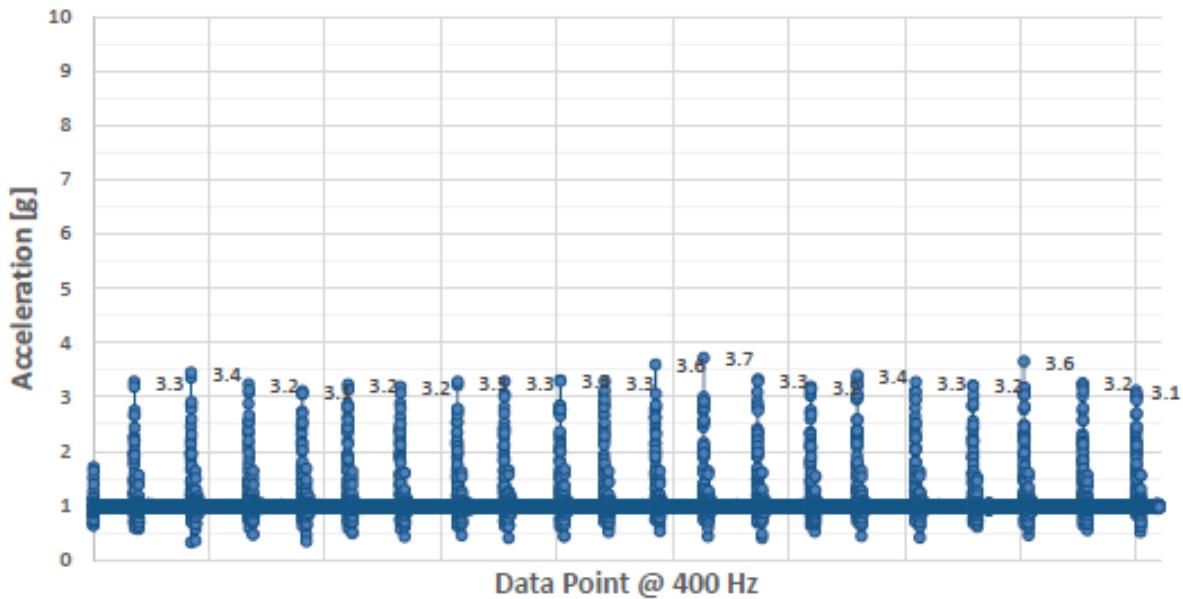


Z Acceleration (Up and Down) - Tuft & Needle

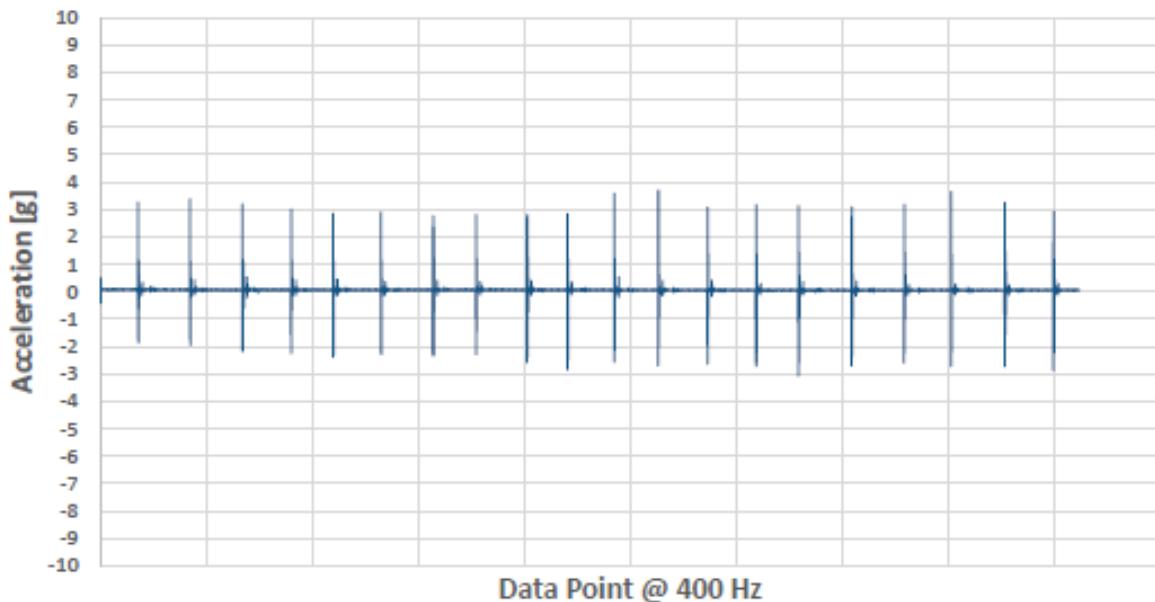


TEST 3 – DOUGLAS (V1)

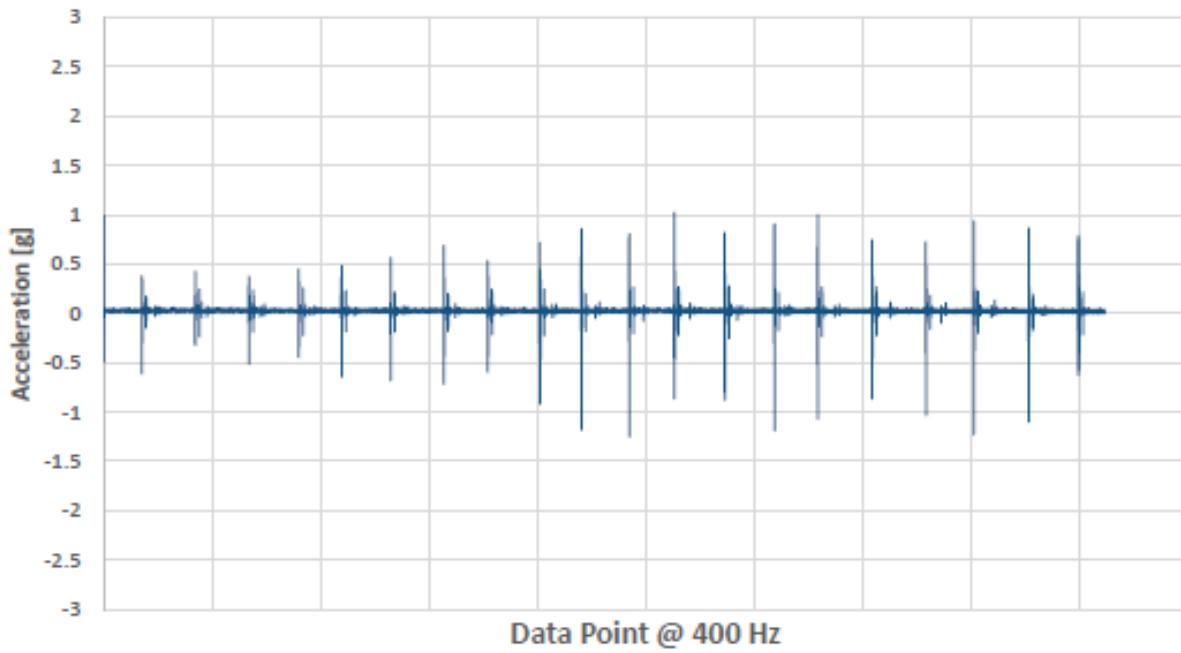
Vector Magnitude Acceleration - Douglas V1



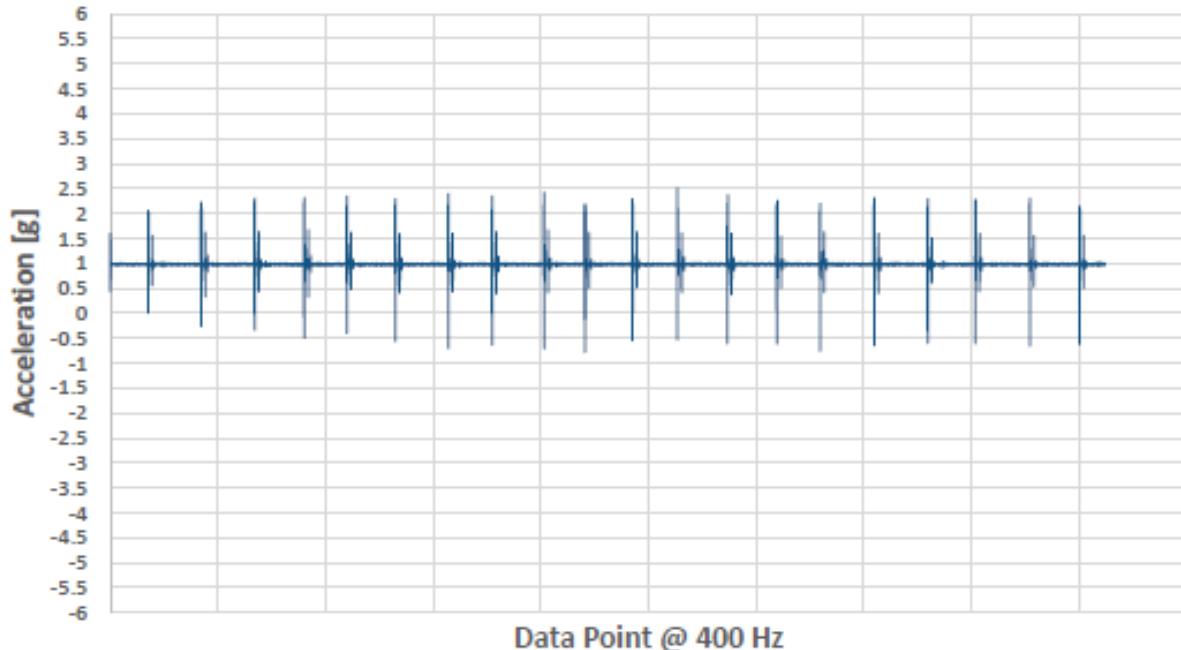
X Acceleration (Side to Side) - Douglas V1



Y Acceleration (Head to Toe) - Douglas V1



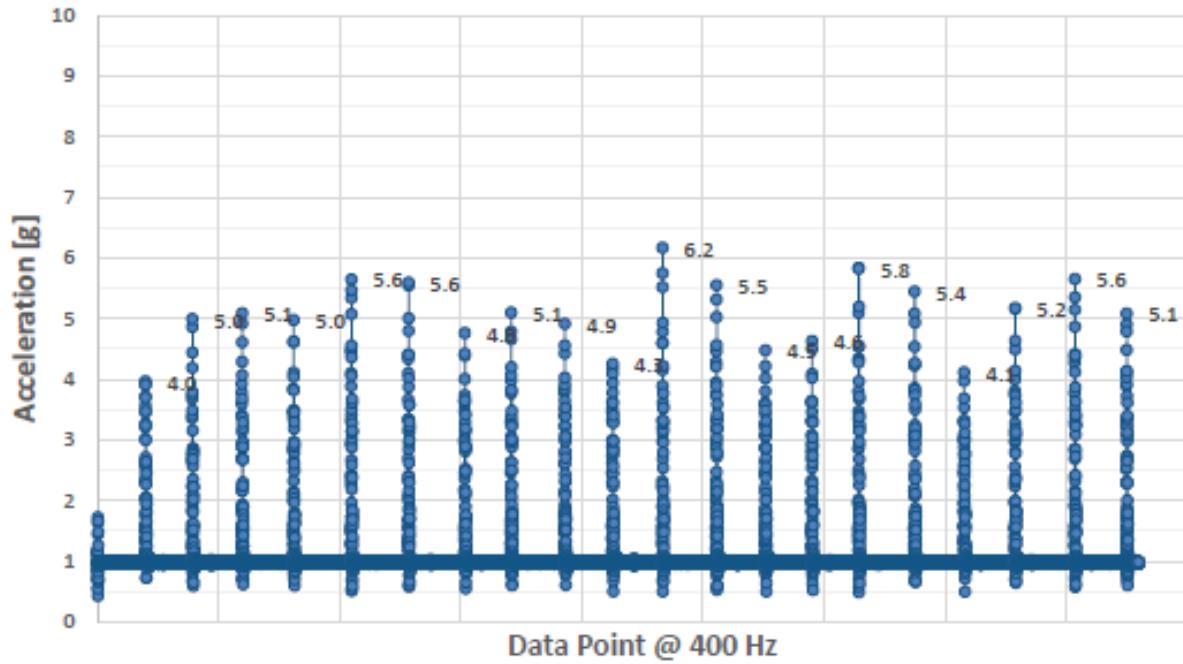
Z Acceleration (Up and Down) - Douglas V1



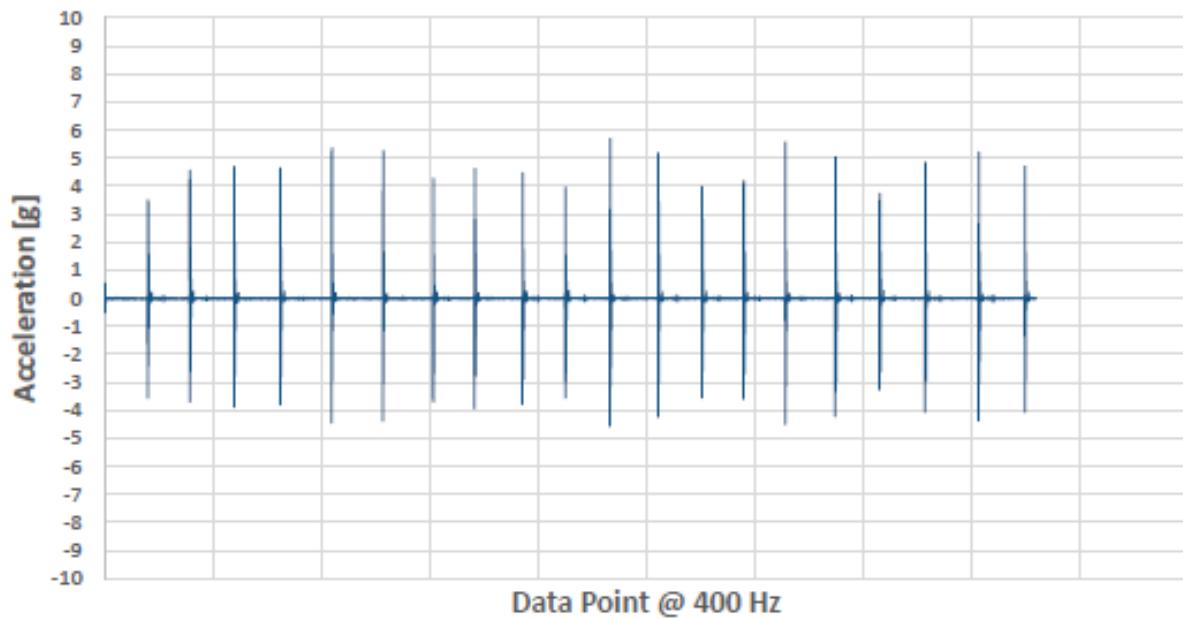


TEST 3 – ENDY

Vector Magnitude Acceleration - Endy

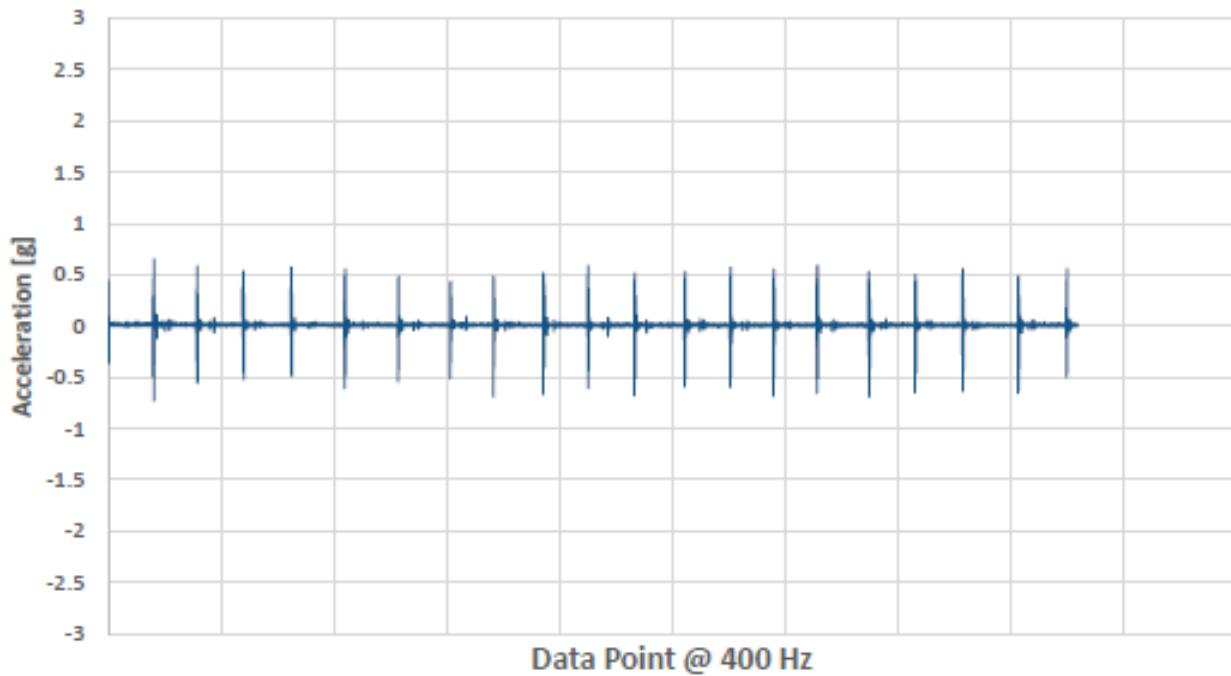


X Acceleration (Side to Side) - Endy

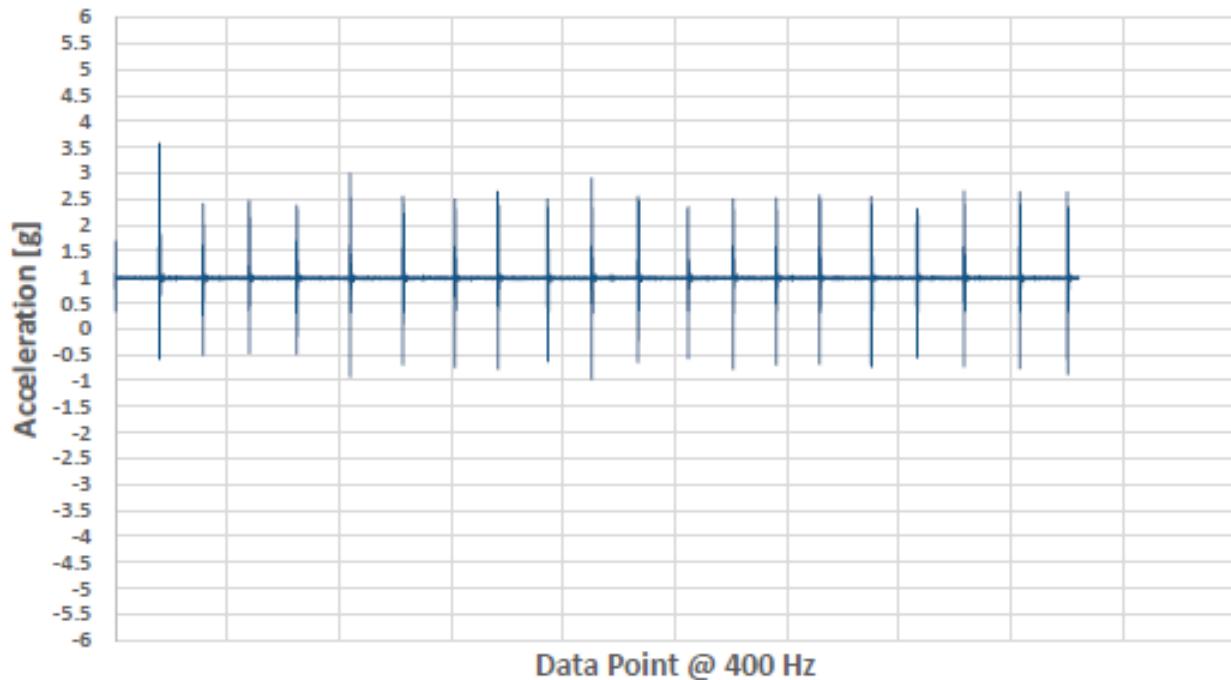




Y Acceleration (Head to Toe) - Endy



Z Acceleration (Up and Down) - Endy

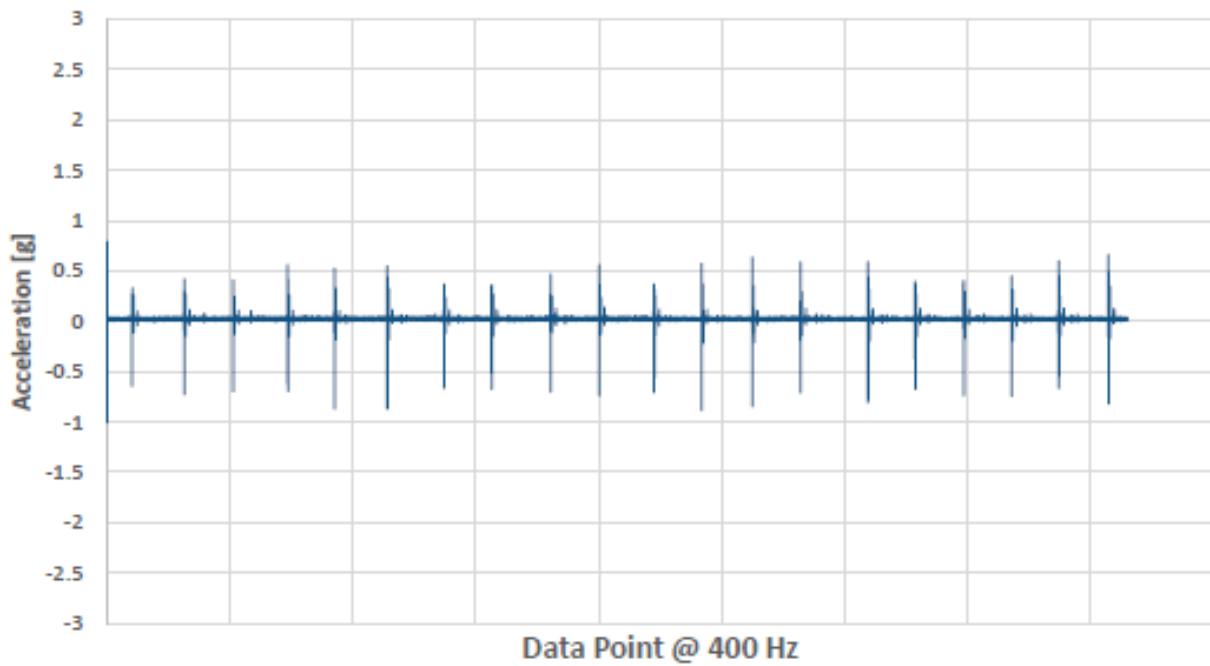




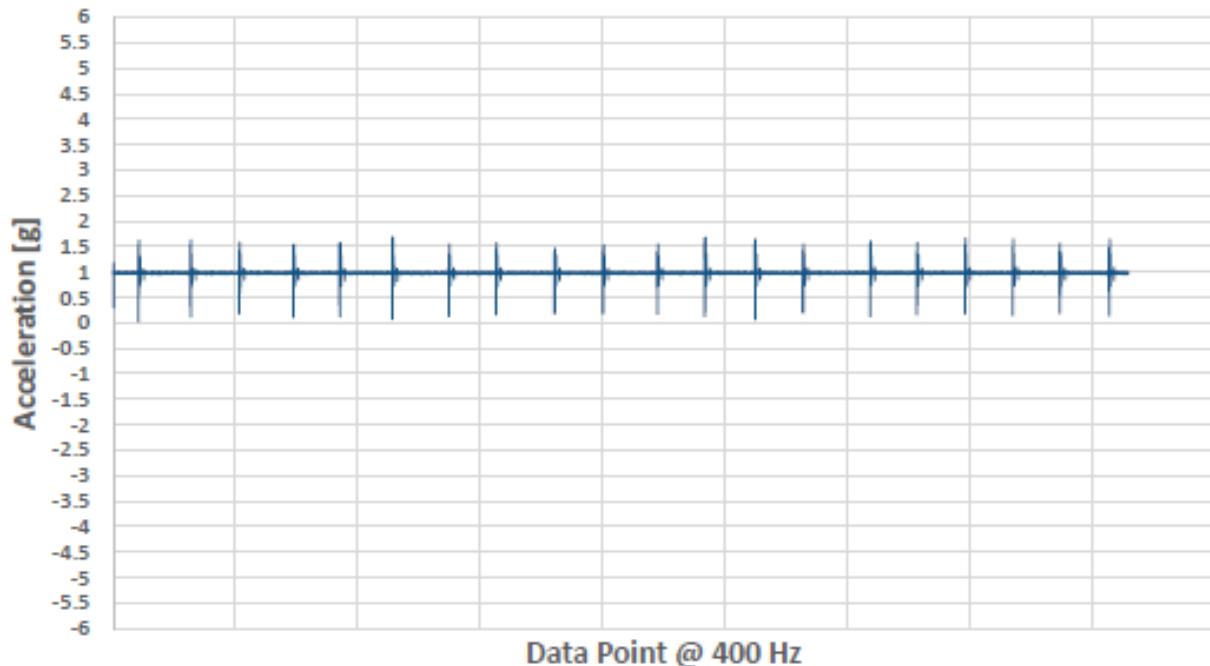
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Y Acceleration (Head to Toe) - Casper



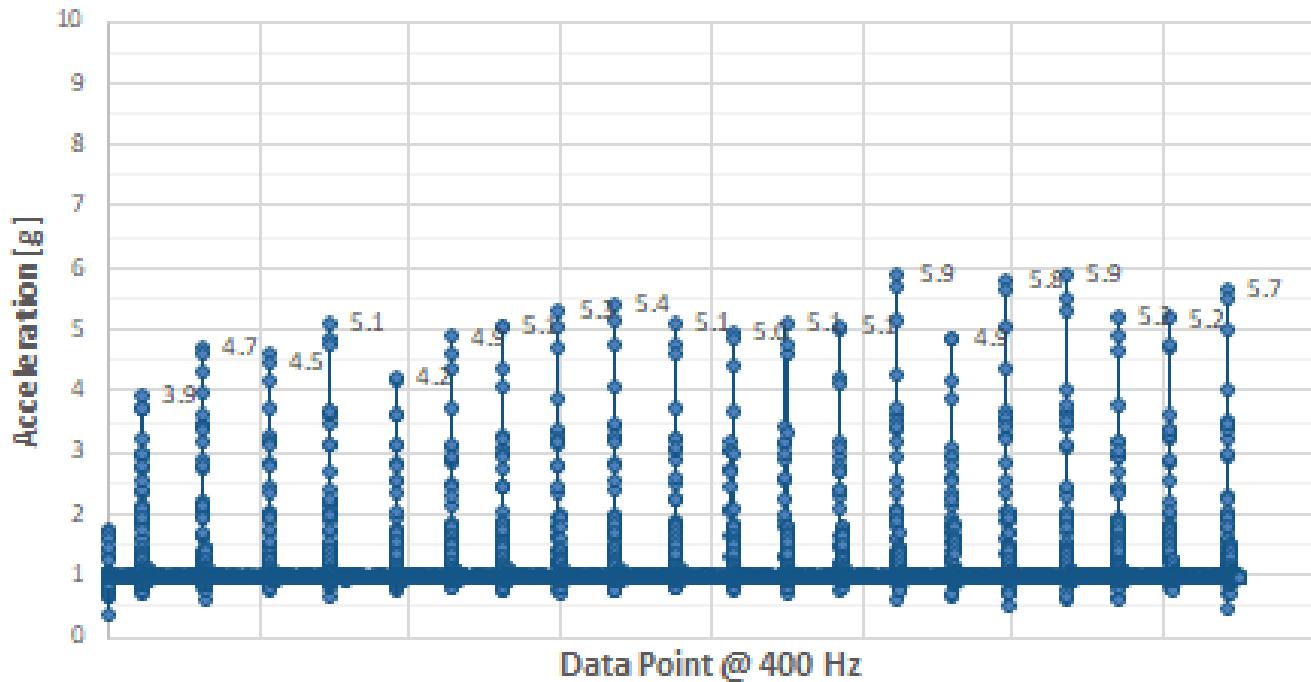
Z Acceleration (Up and Down) - Casper



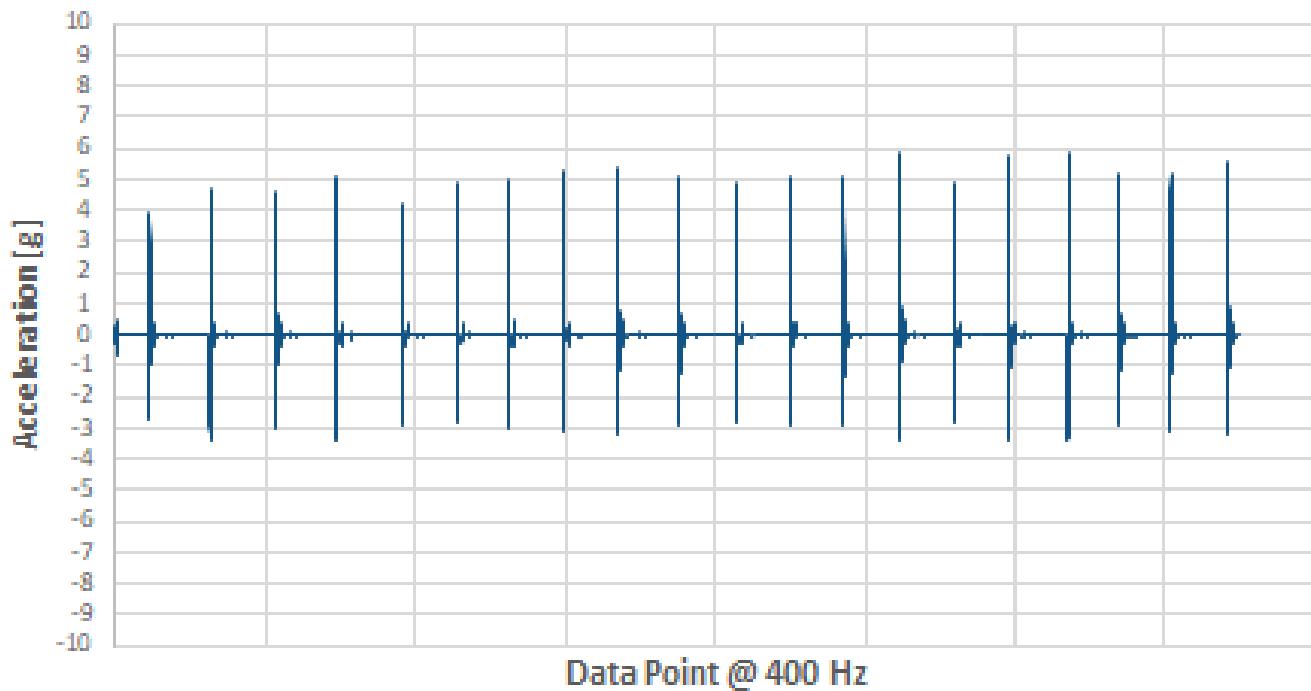


TEST 3 – BLOOM CLOUD

Vector Magnitude Acceleration - Bloom Cloud



X Acceleration (Side to Side) - Bloom Cloud

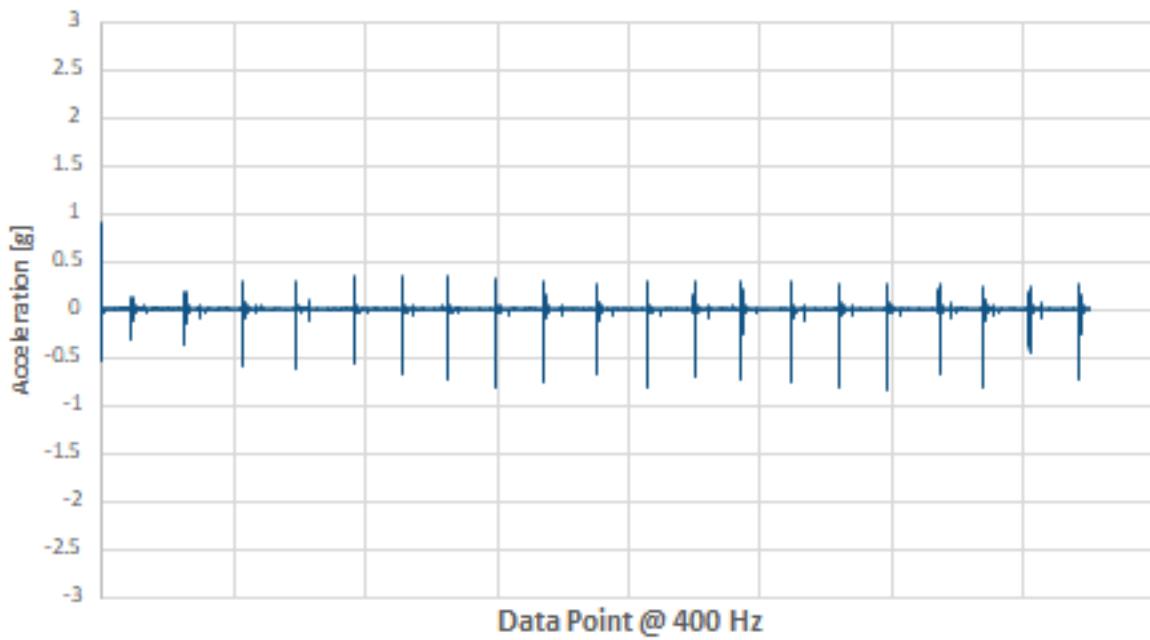




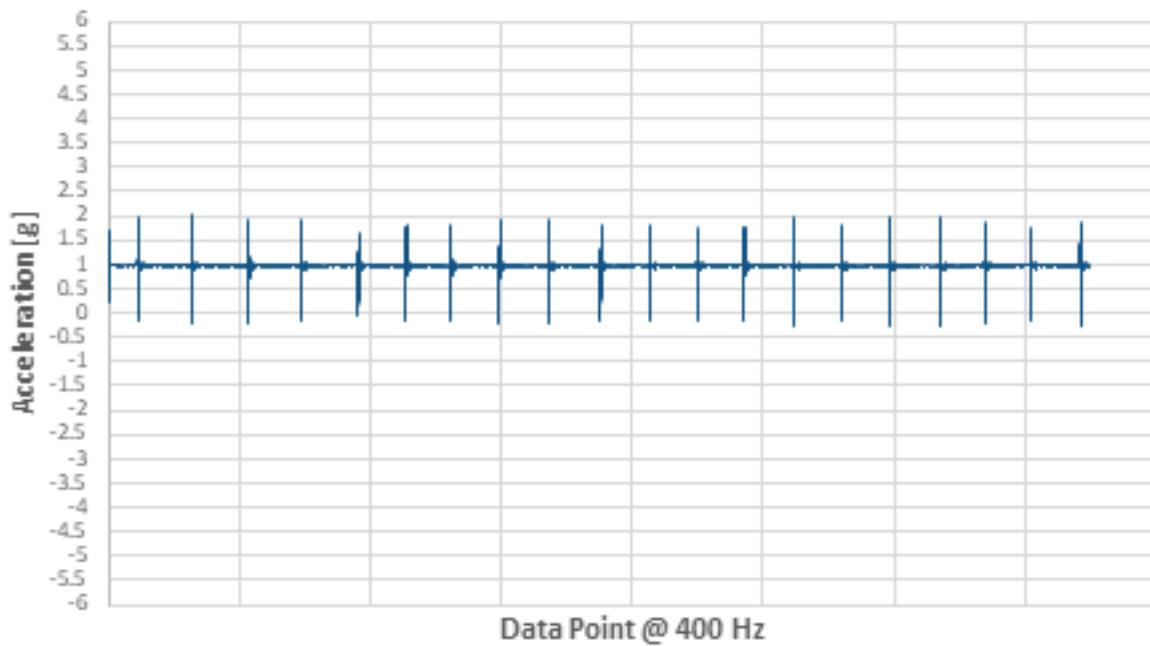
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Y Acceleration (Head to Toe) - Bloom Cloud



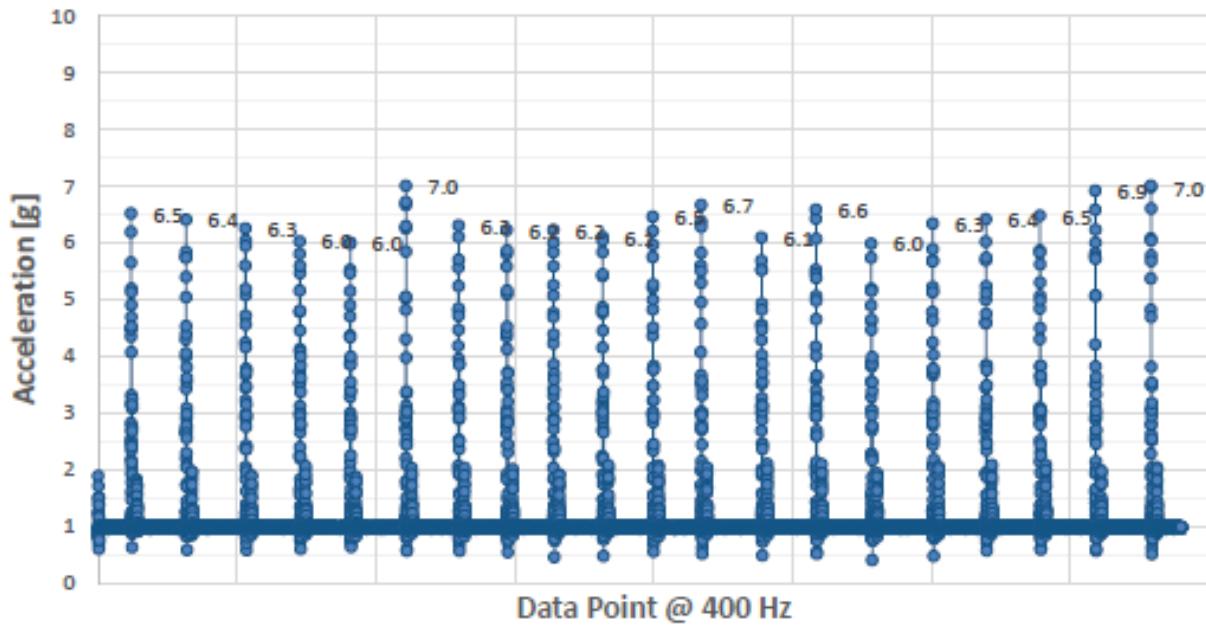
Z Acceleration (Up and Down) - Bloom Cloud



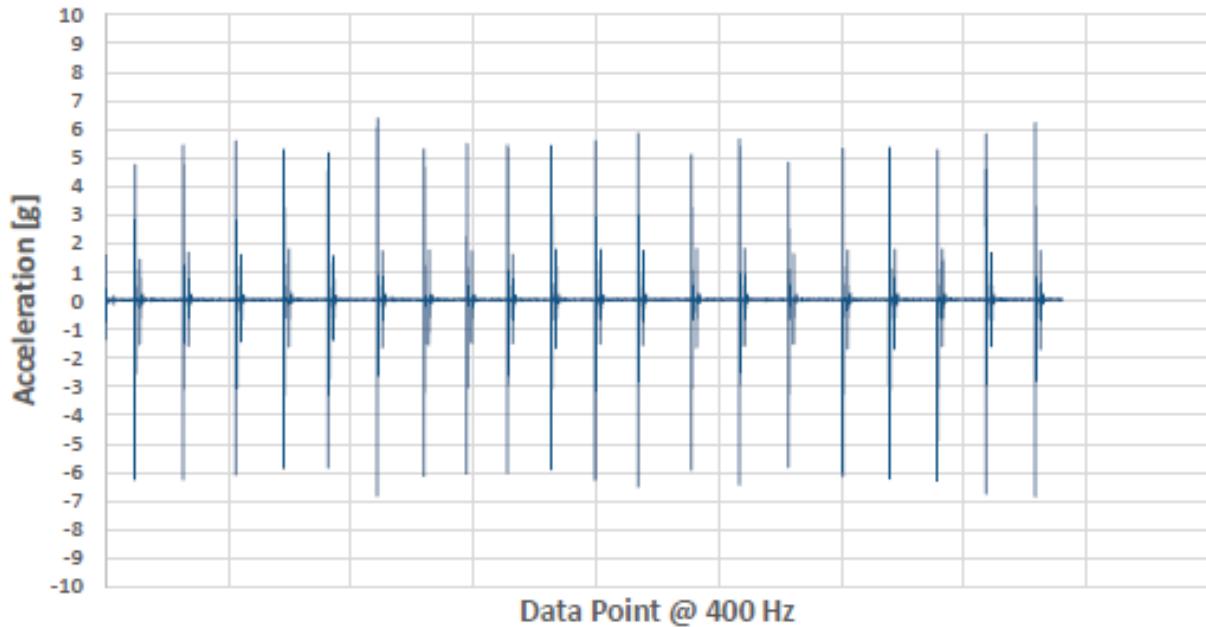


TEST 3 – CLASSIC BRANDS – THIN

Vector Magnitude Acceleration - Classic Brands - Thin

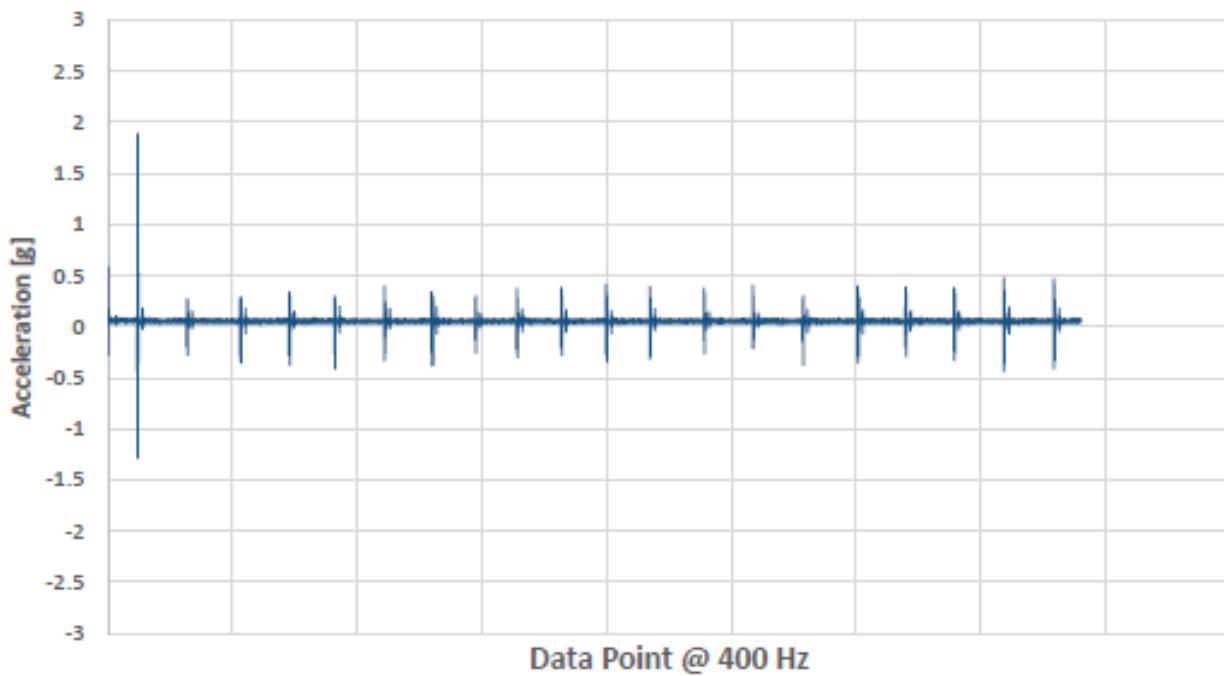


X Acceleration (Side to Side) - Classic Brands - Thin

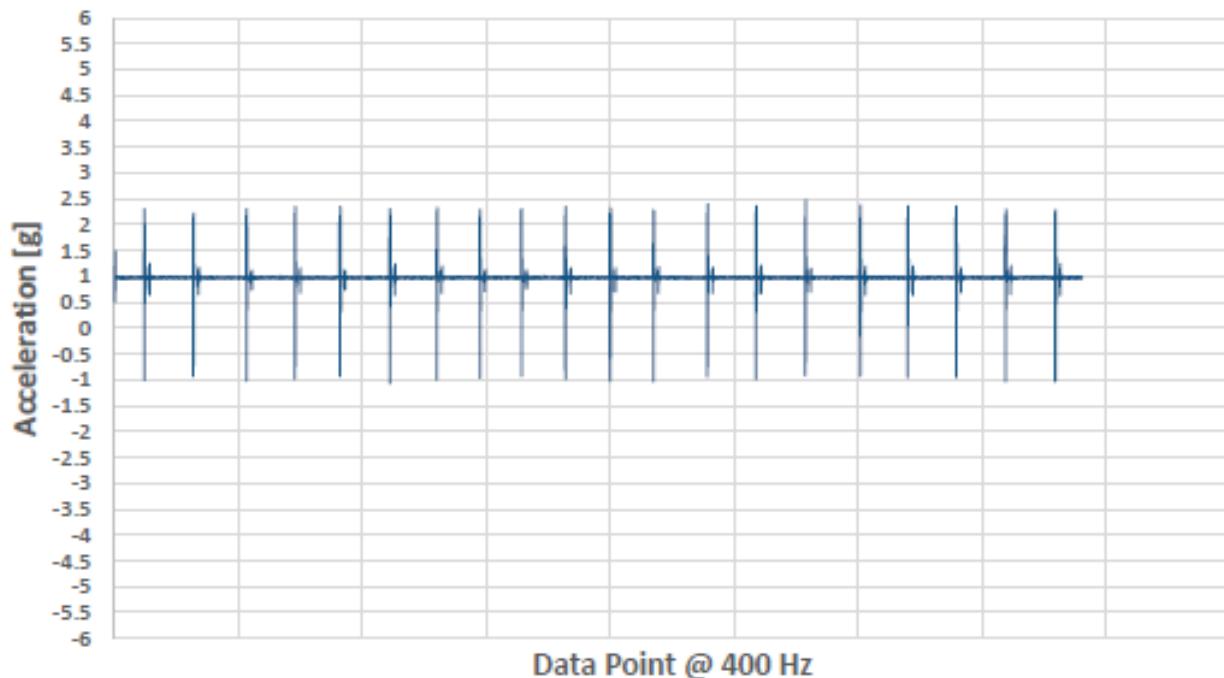




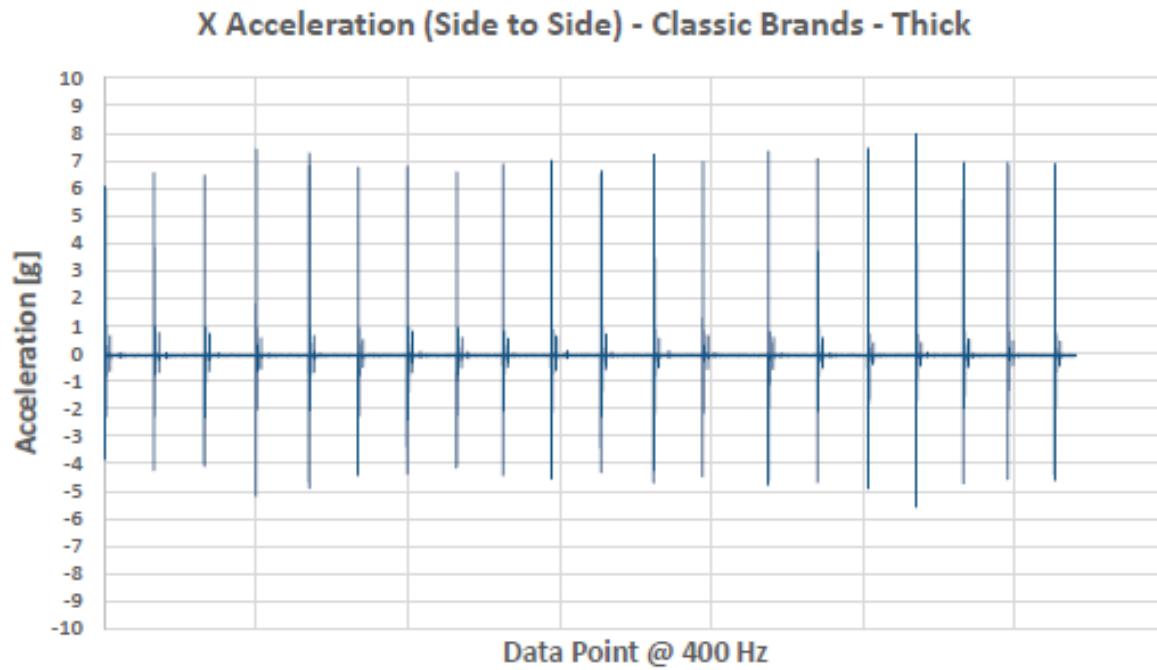
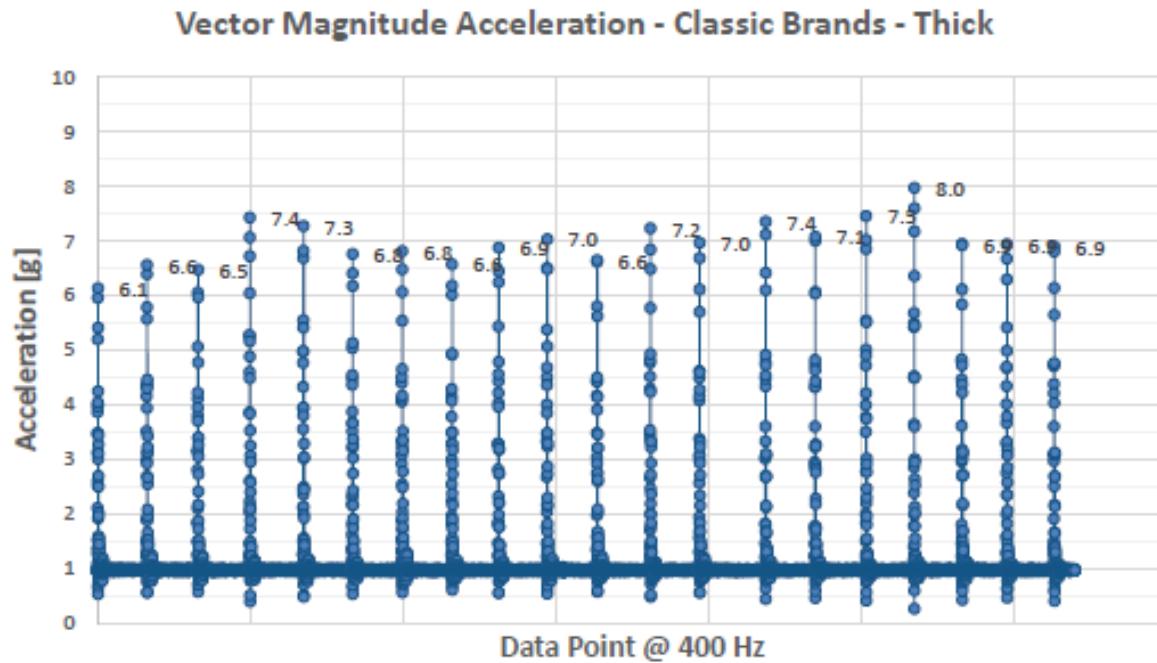
Y Acceleration (Head to Toe) - Classic Brands - Thin



Z Acceleration (Up and Down) - Classic Brands - Thin

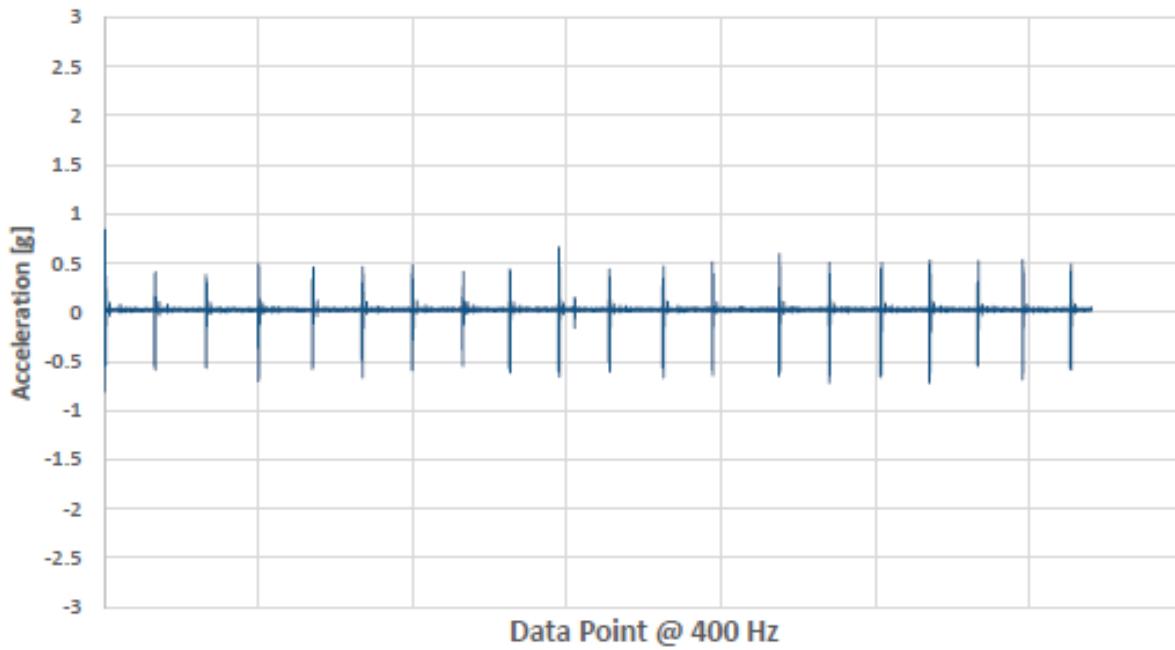


TEST 3 – CLASSIC BRANDS – THICK

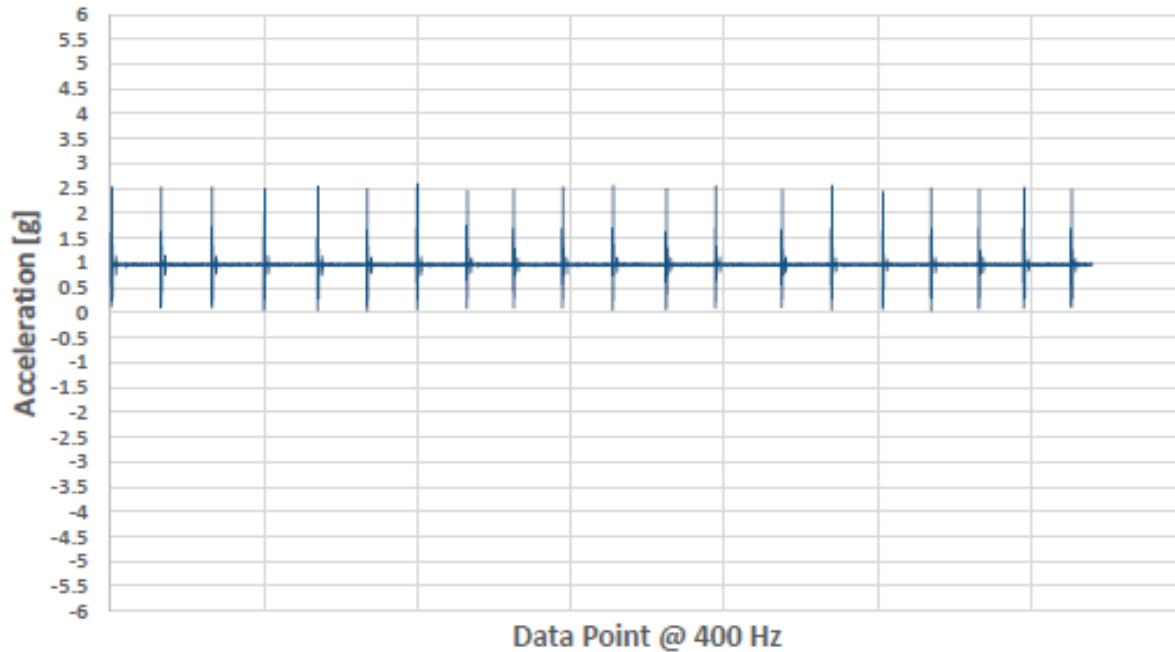




Y Acceleration (Head to Toe) - Classic Brands - Thick



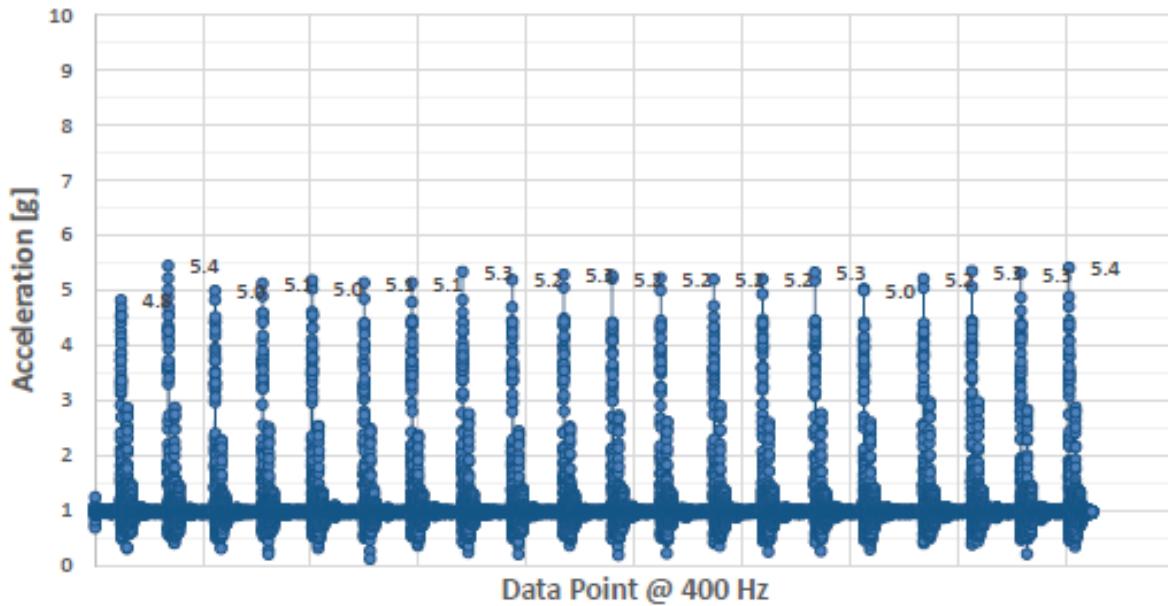
Z Acceleration (Up and Down) - Classic Brands - Thick



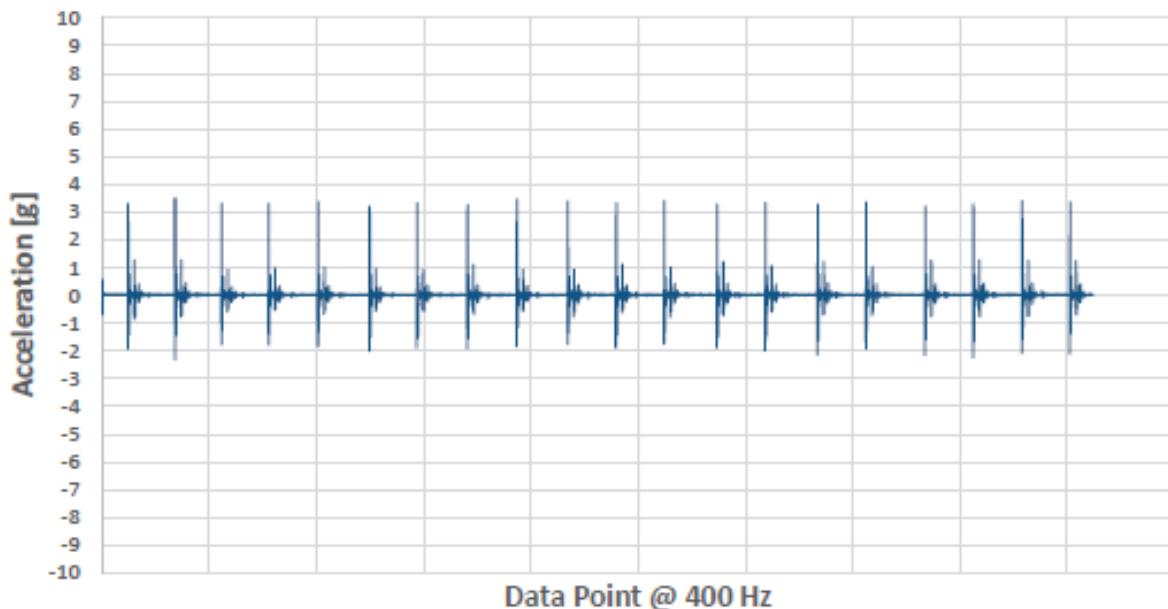


TEST 3 – SAATVA

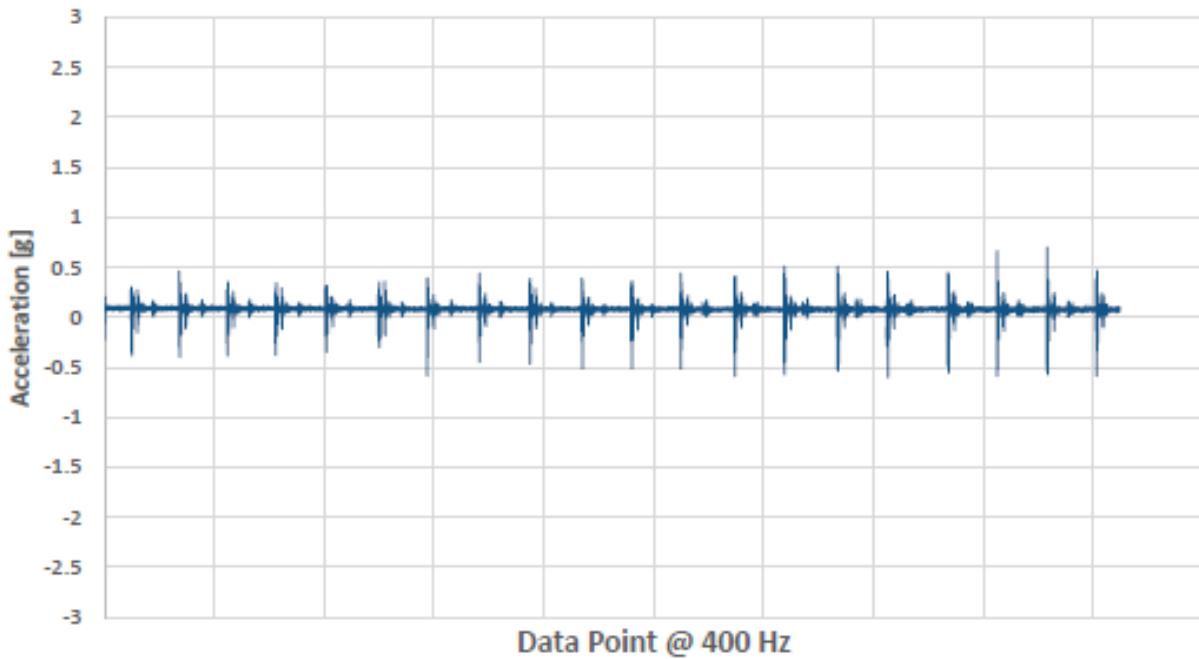
Vector Magnitude Acceleration - Saatva



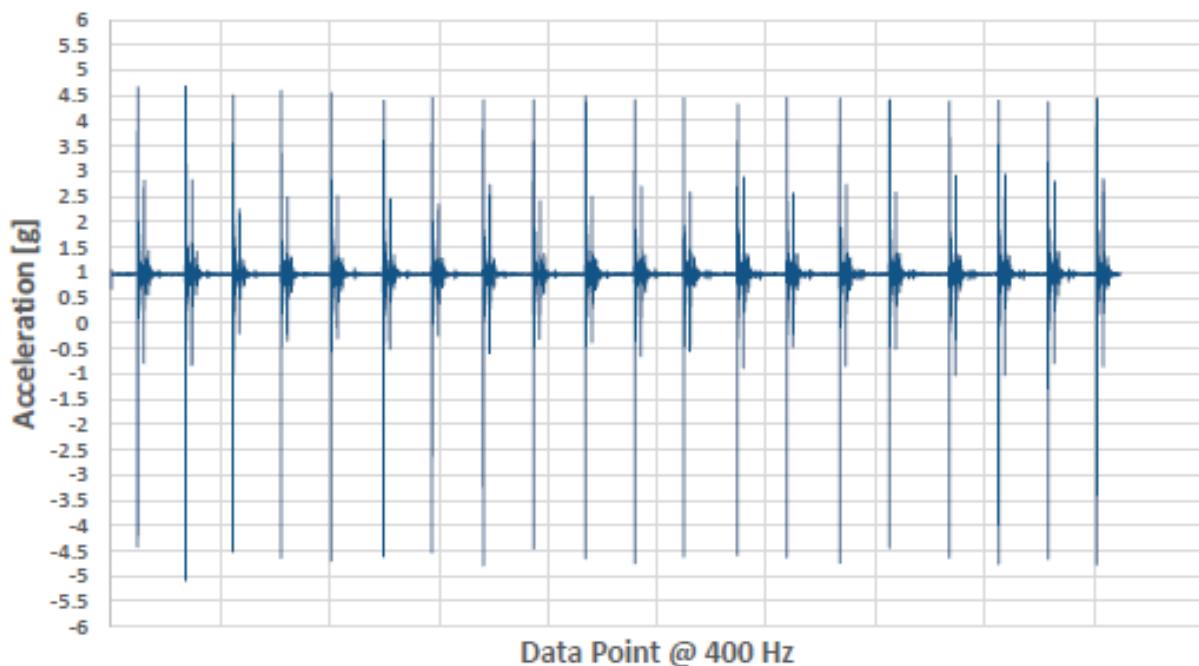
X Acceleration (Side to Side) - Saatva



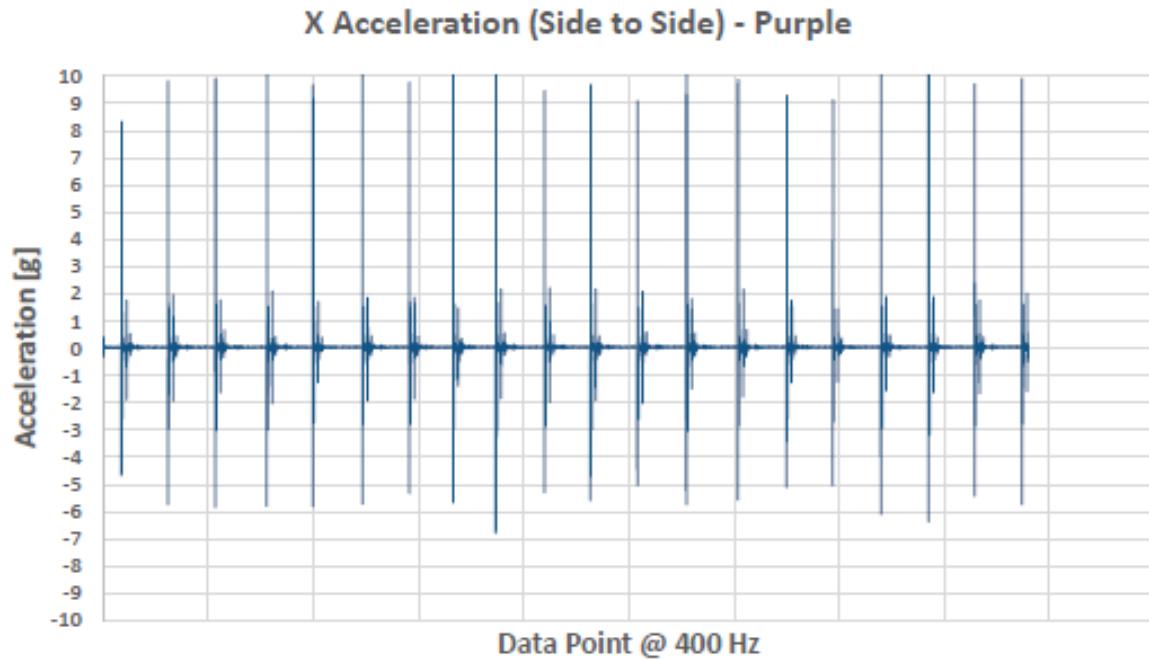
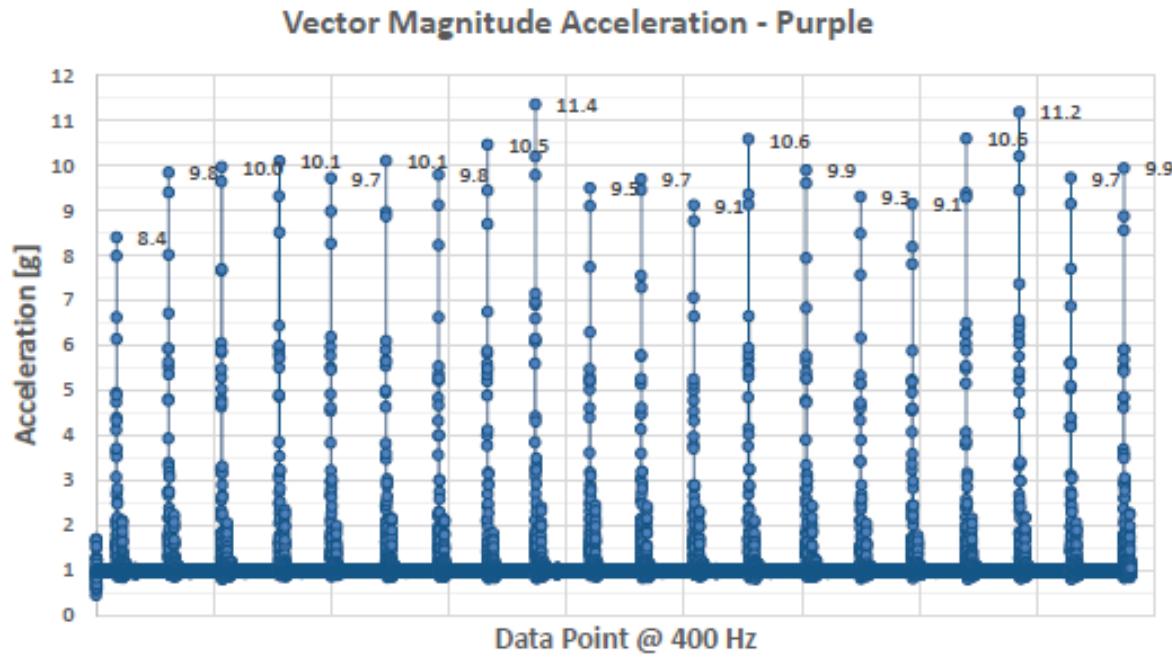
Y Acceleration (Head to Toe) - Saatva



Z Acceleration (Up and Down) - Saatva

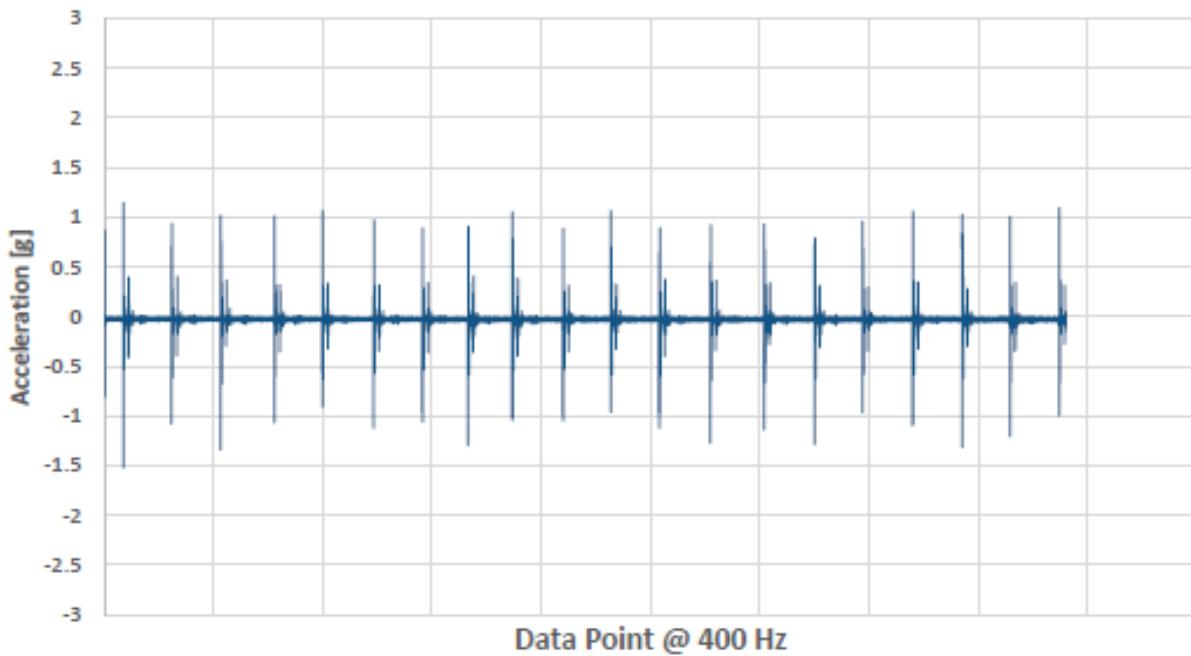


TEST 3 – PURPLE

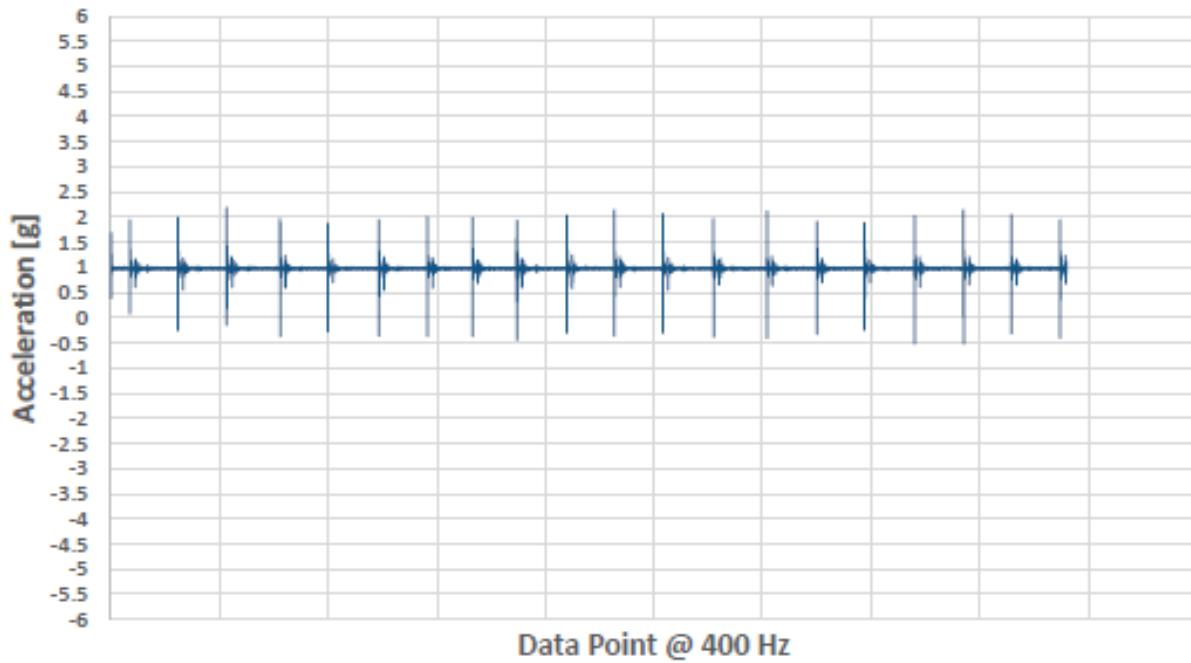




Y Acceleration (Head to Toe) - Purple

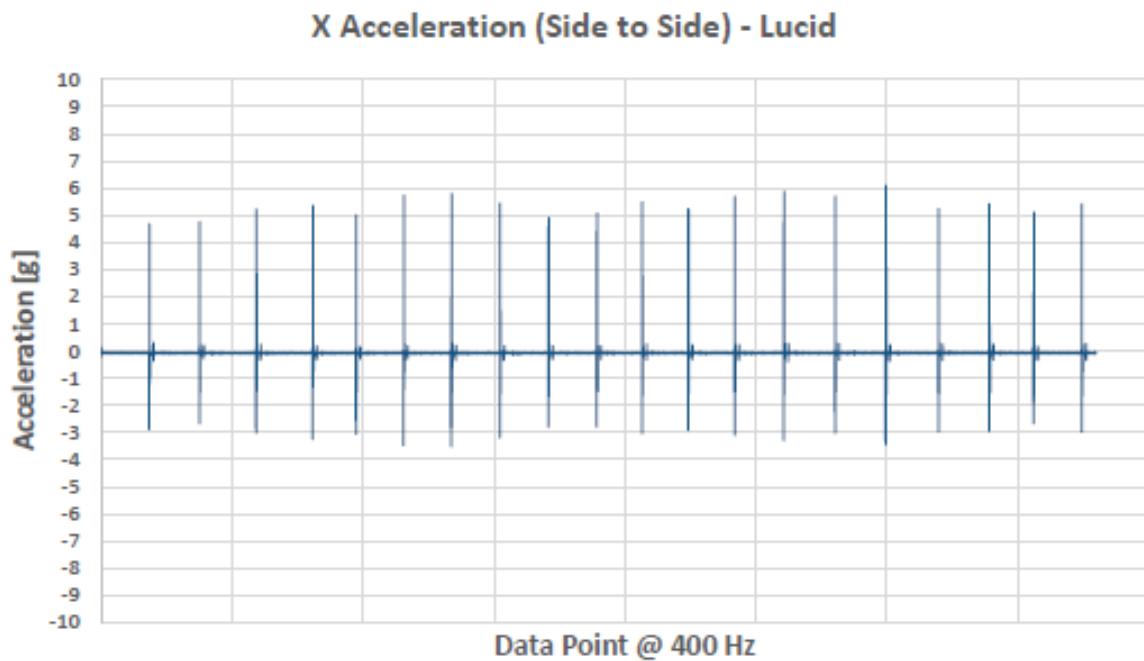
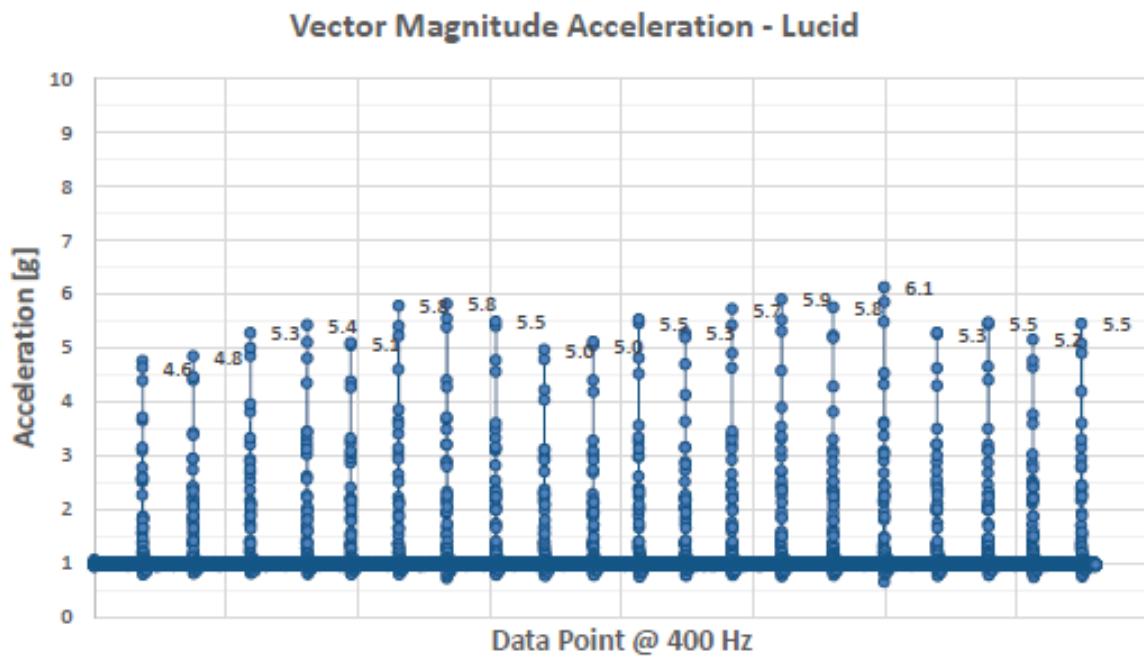


Z Acceleration (Up and Down) - Purple





TEST 3 – LUCID

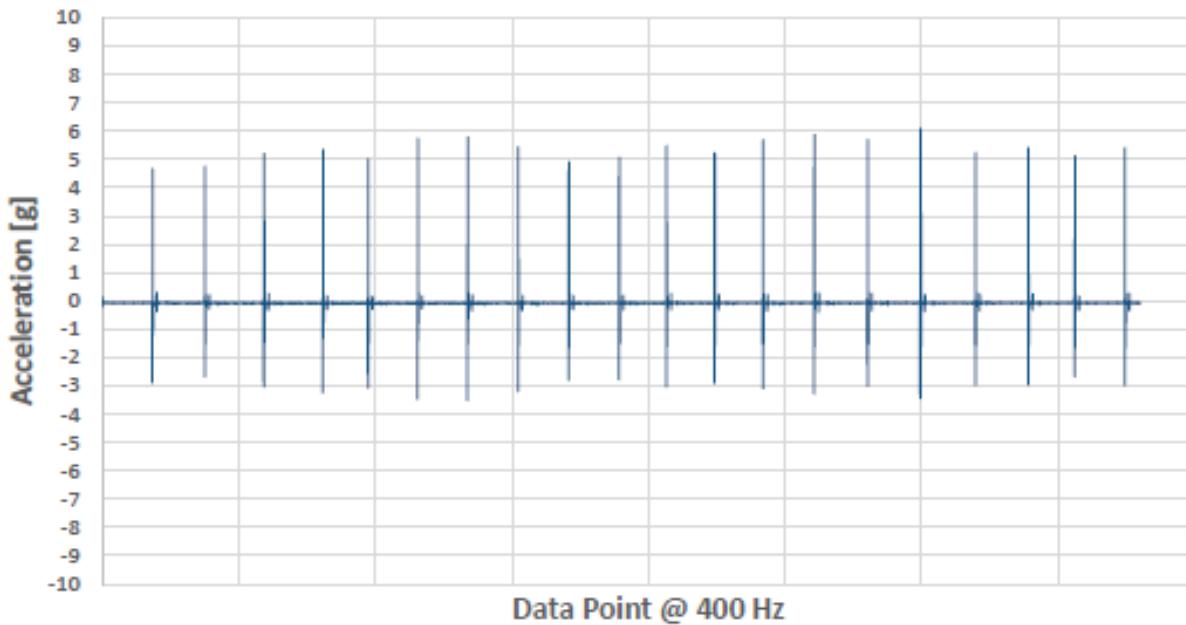




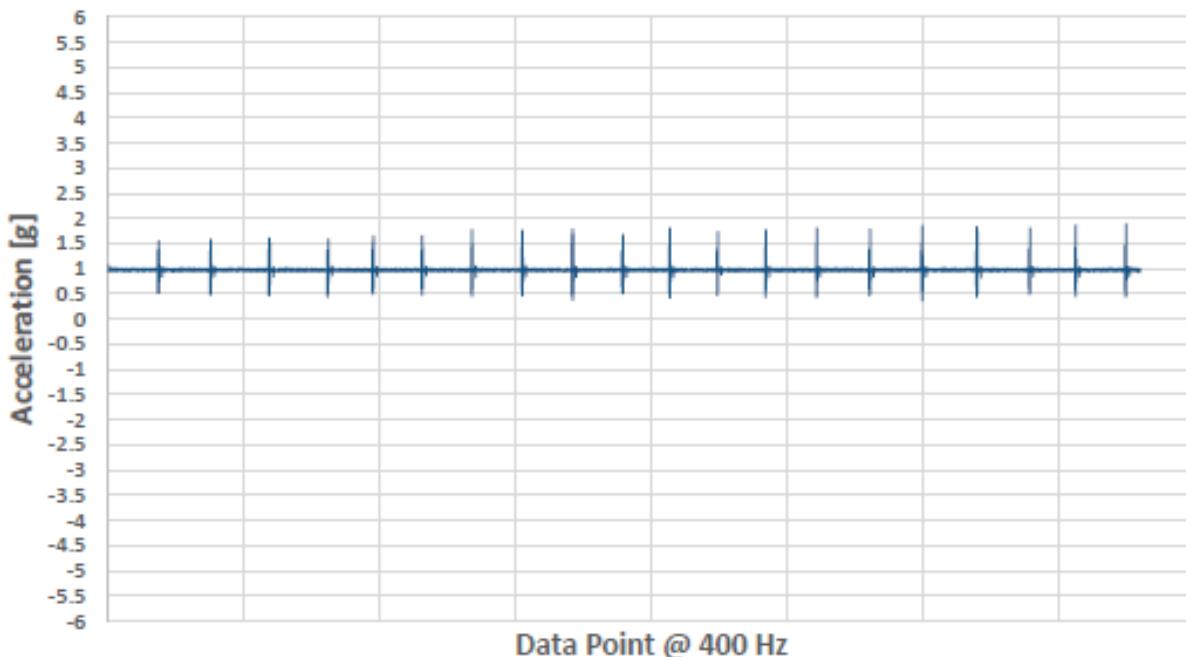
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X Acceleration (Side to Side) - Lucid

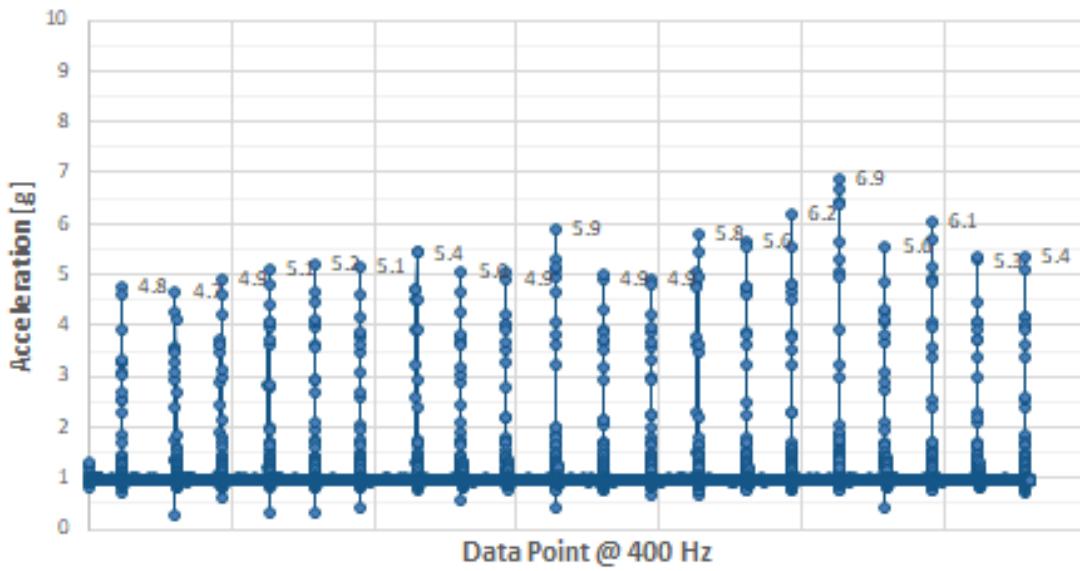


Z Acceleration (Up and Down) - Lucid

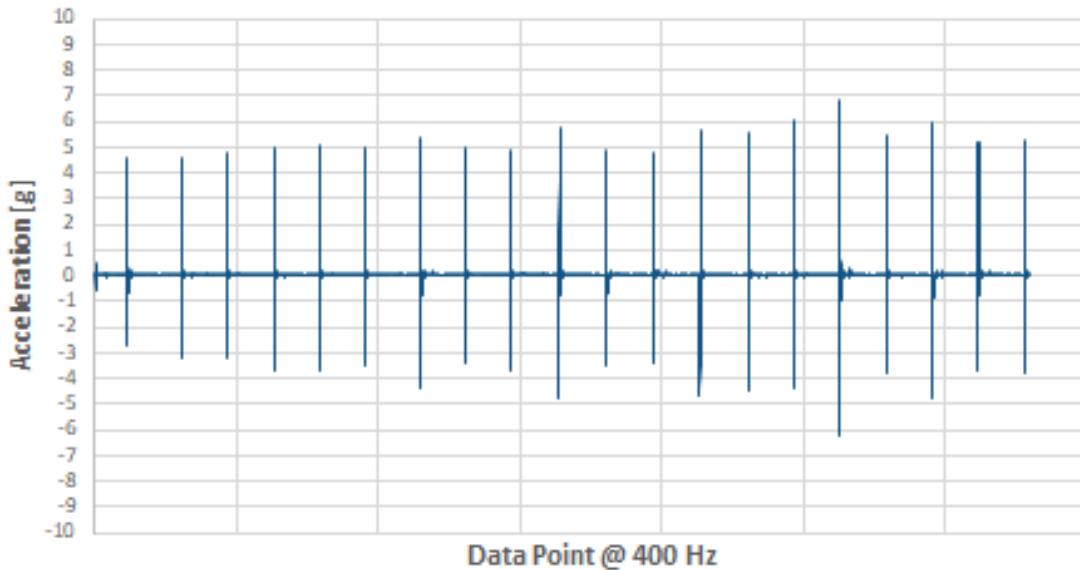


TEST 3 – NOVOSBED FIRM (V1)

Vector Magnitude Acceleration - Novosbed Firm (V1)

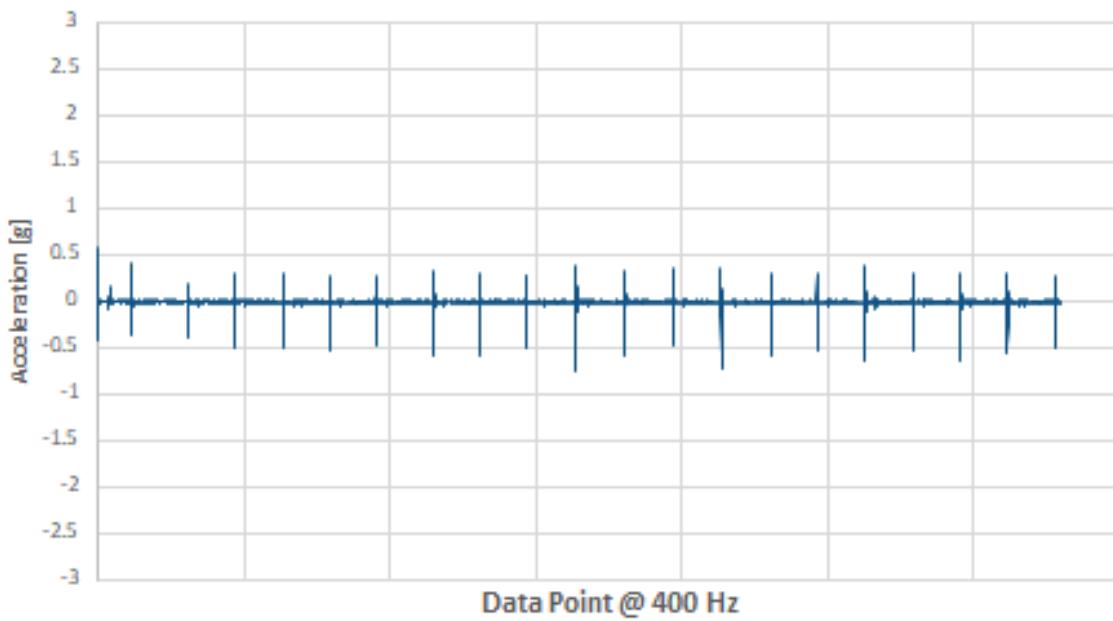


X Acceleration (Side to Side) - Novosbed Firm (V1)

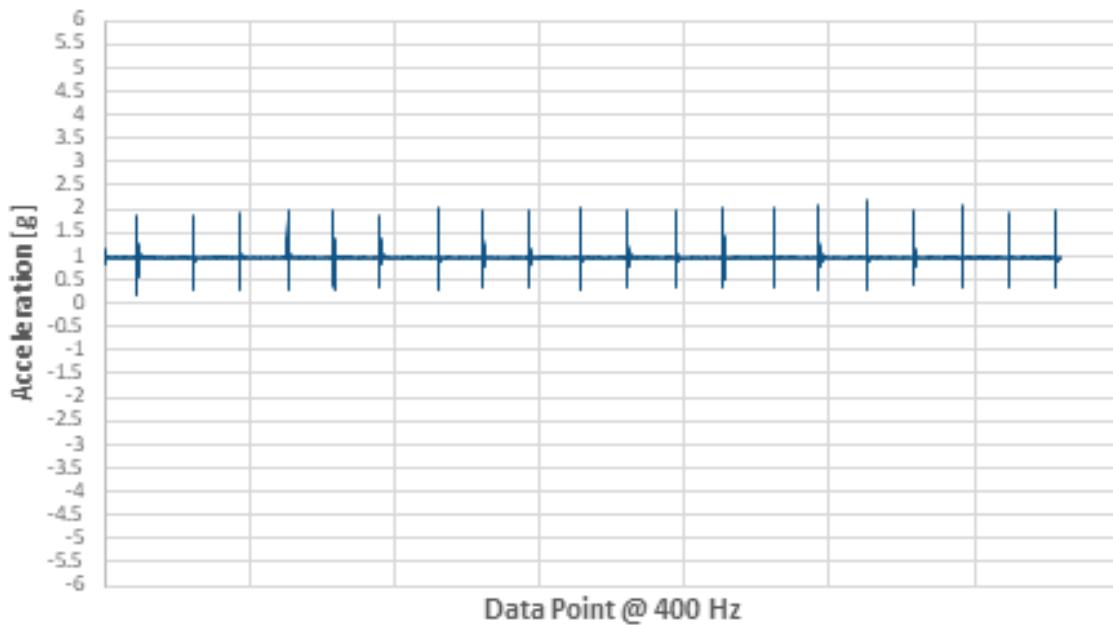




Y Acceleration (Head to Toe) - Novosbed Firm (V1)

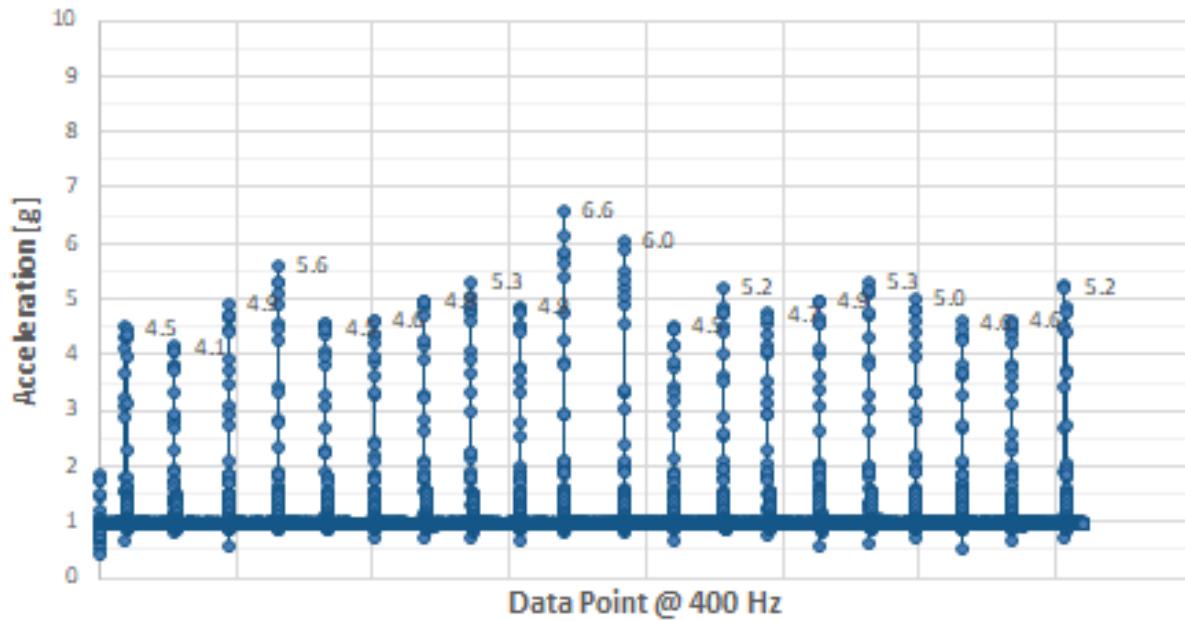


Z Acceleration (Up and Down) - Novosbed Firm (V1)

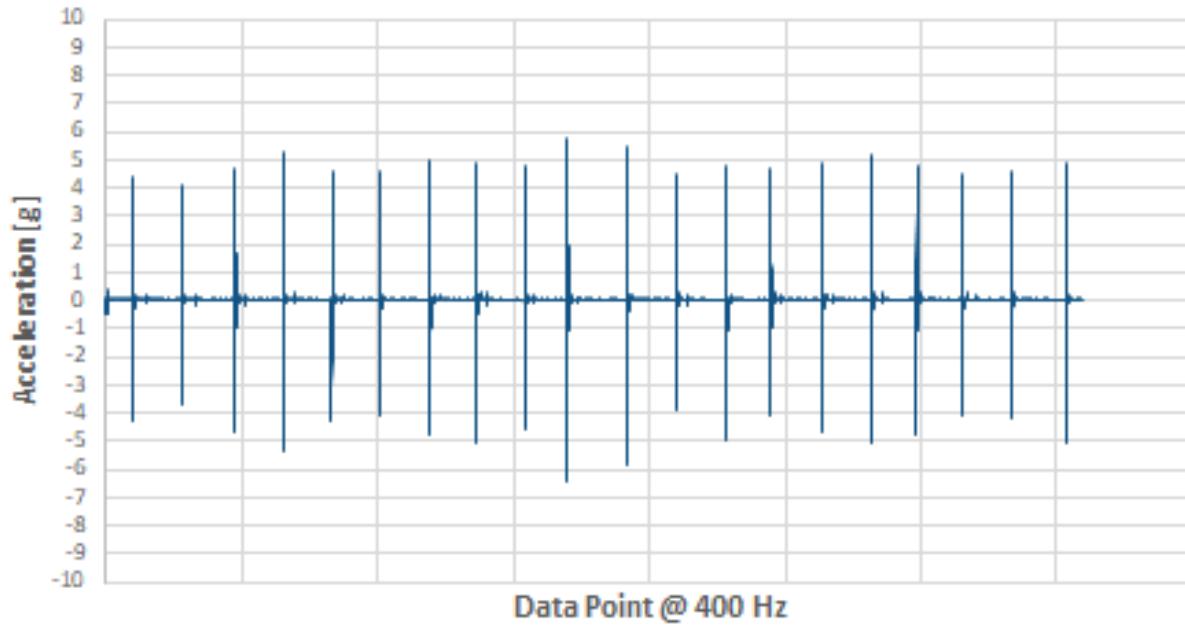


TEST 3 – NOVOSBED MEDIUM (V1)

Vector Magnitude Acceleration - Novosbed Medium (V1)

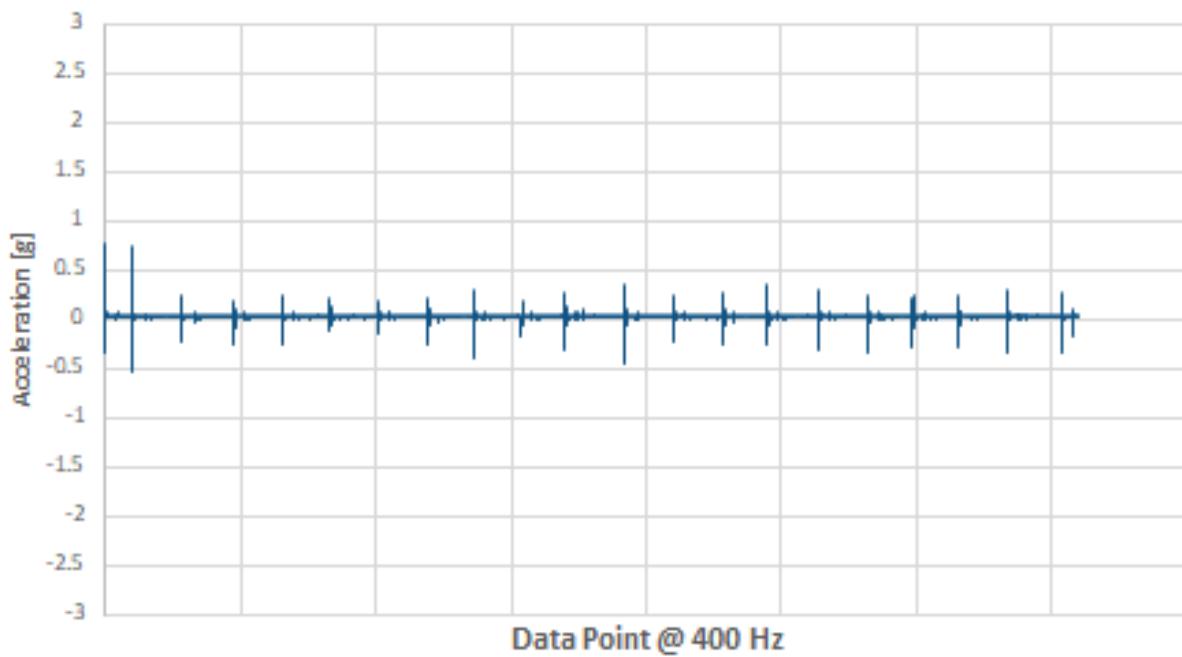


X Acceleration (Side to Side) - Novosbed Medium (V1)

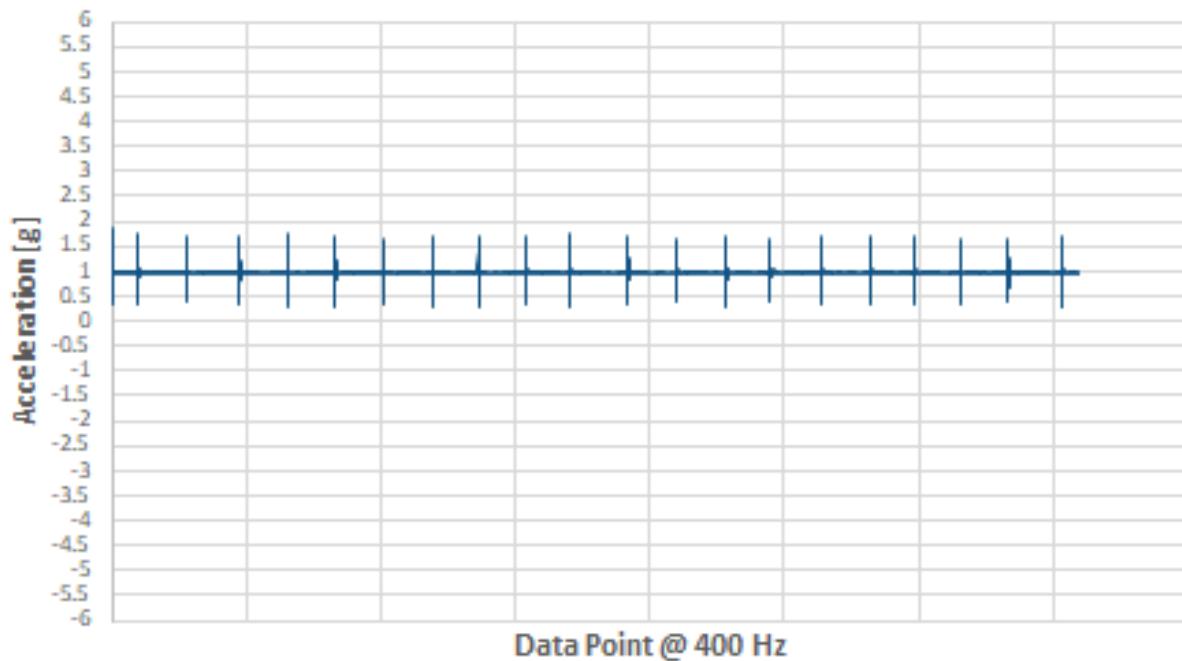




Y Acceleration (Head to Toe) - Novosbed Medium (V1)

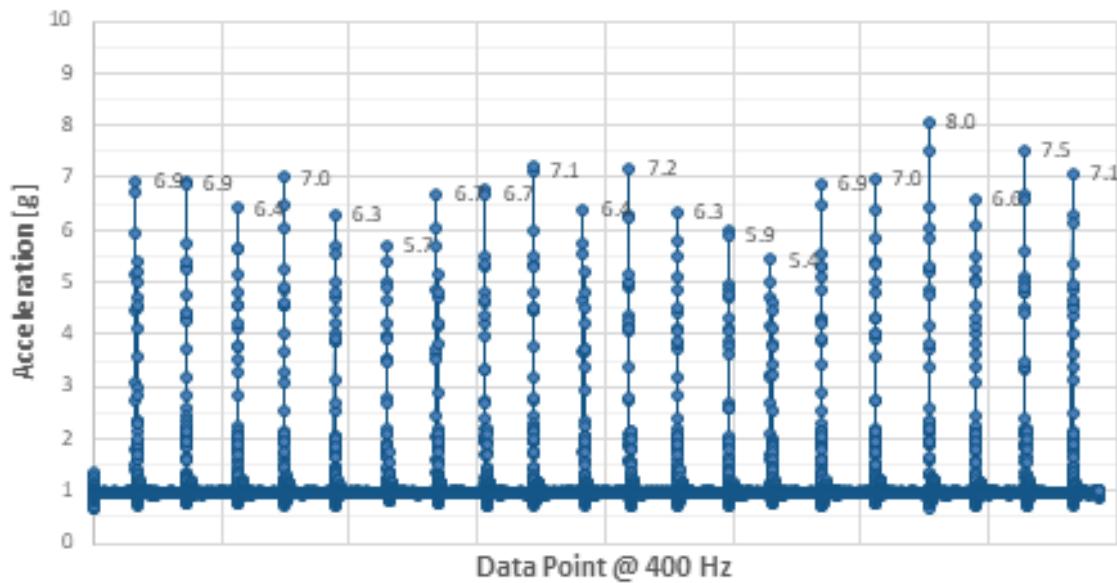


Z Acceleration (Up and Down) - Novosbed Medium (V1)

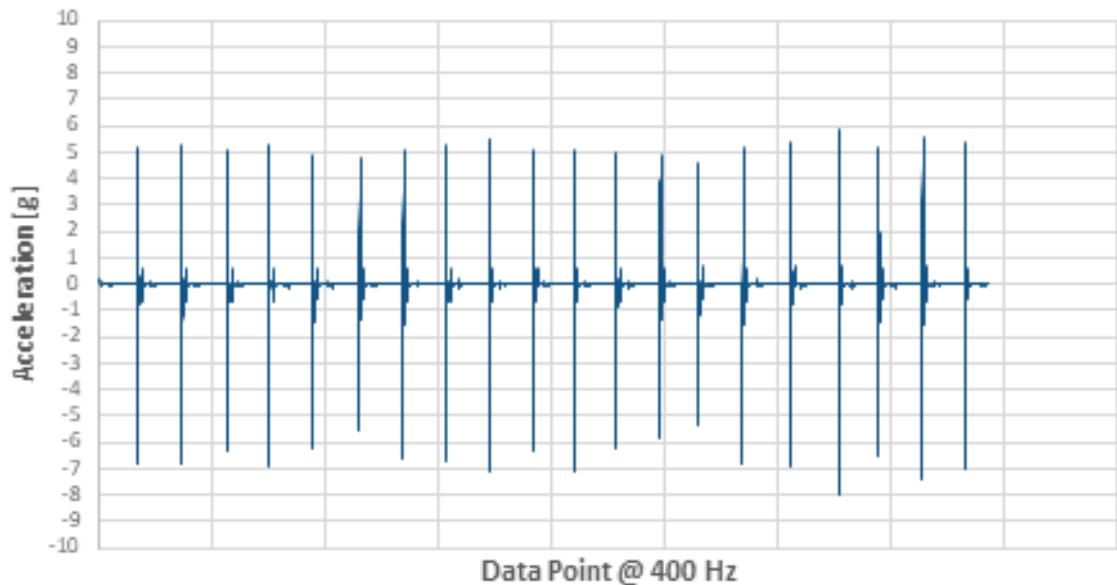


TEST 3 – NOVOSBED SOFT (V1)

Vector Magnitude Acceleration - Novosbed Soft (V1)

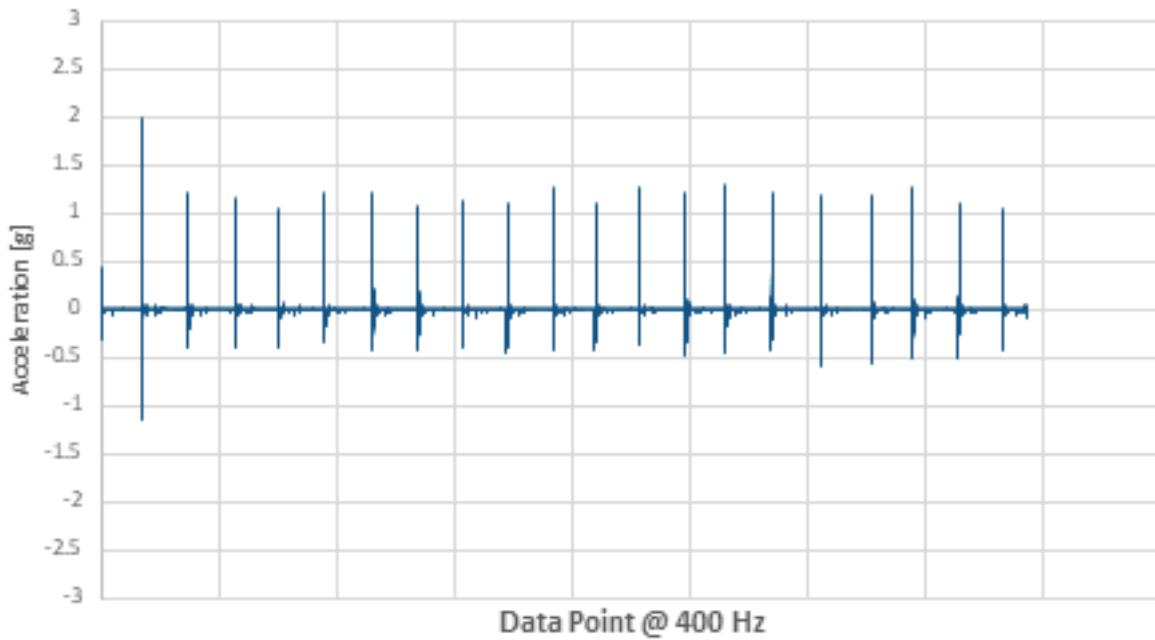


X Acceleration (Side to Side) - Novosbed Soft (V1)

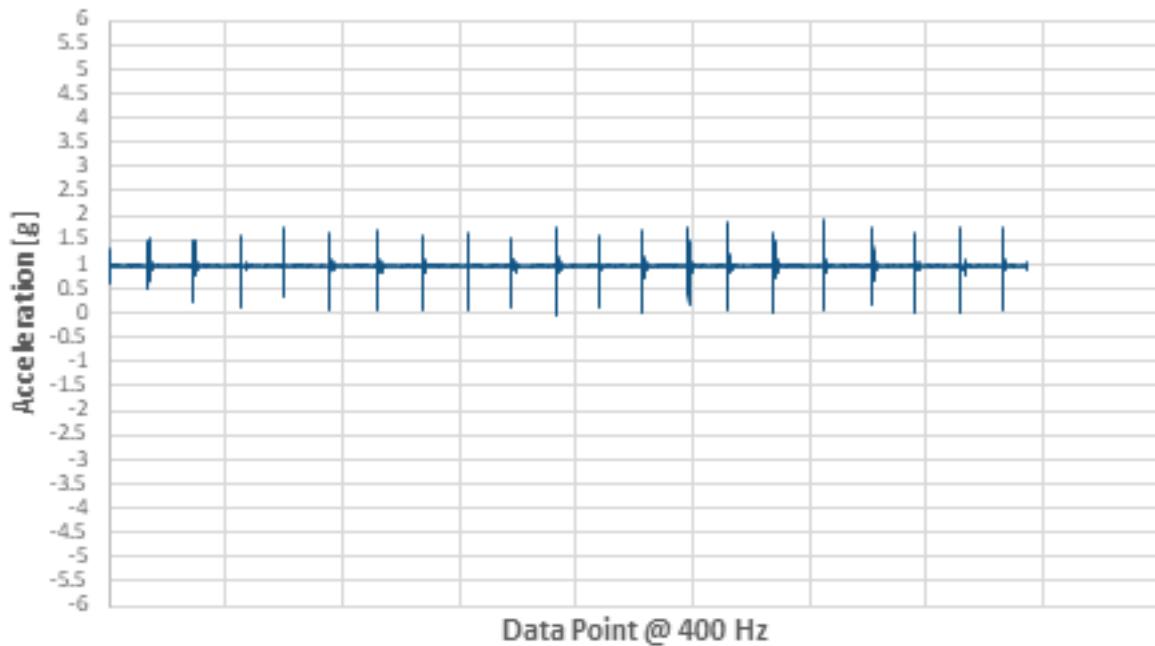




Y Acceleration (Head to Toe) - Novosbed Soft (V1)



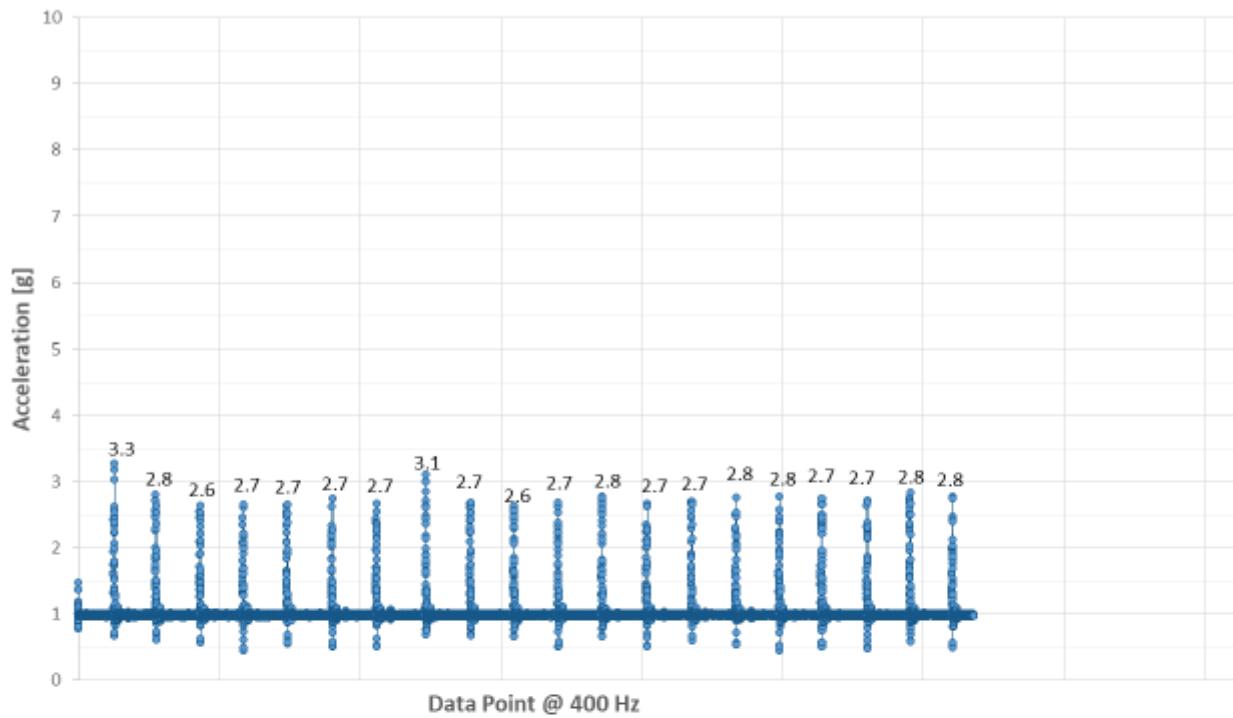
Z Acceleration (Up and Down) - Novosbed Soft (V1)





TEST 3 – DOUGLAS (V2)

Vector Magnitude Acceleration - Douglas V2

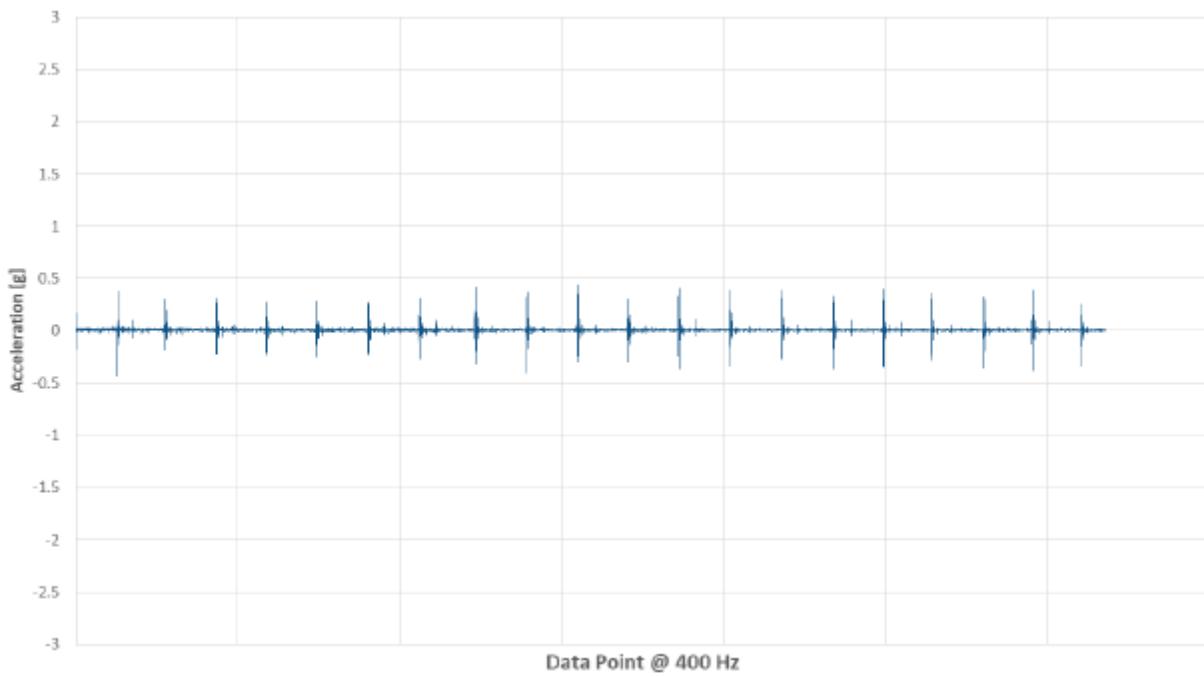




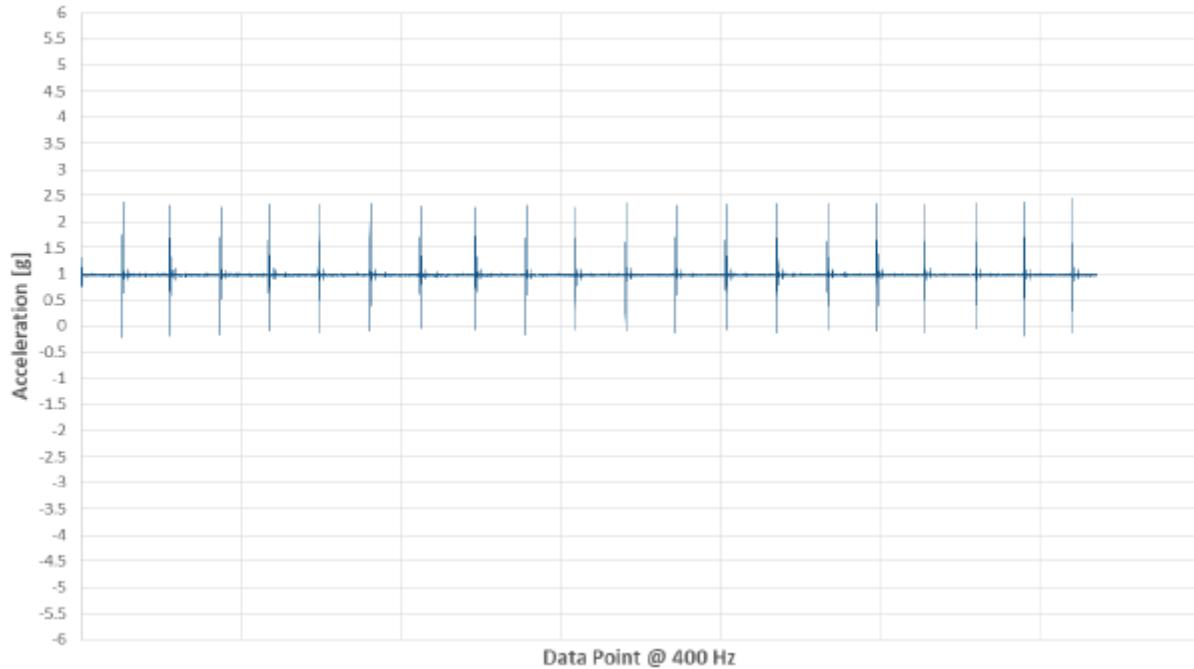
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Y Acceleration (Head to Toe) - Douglas V2

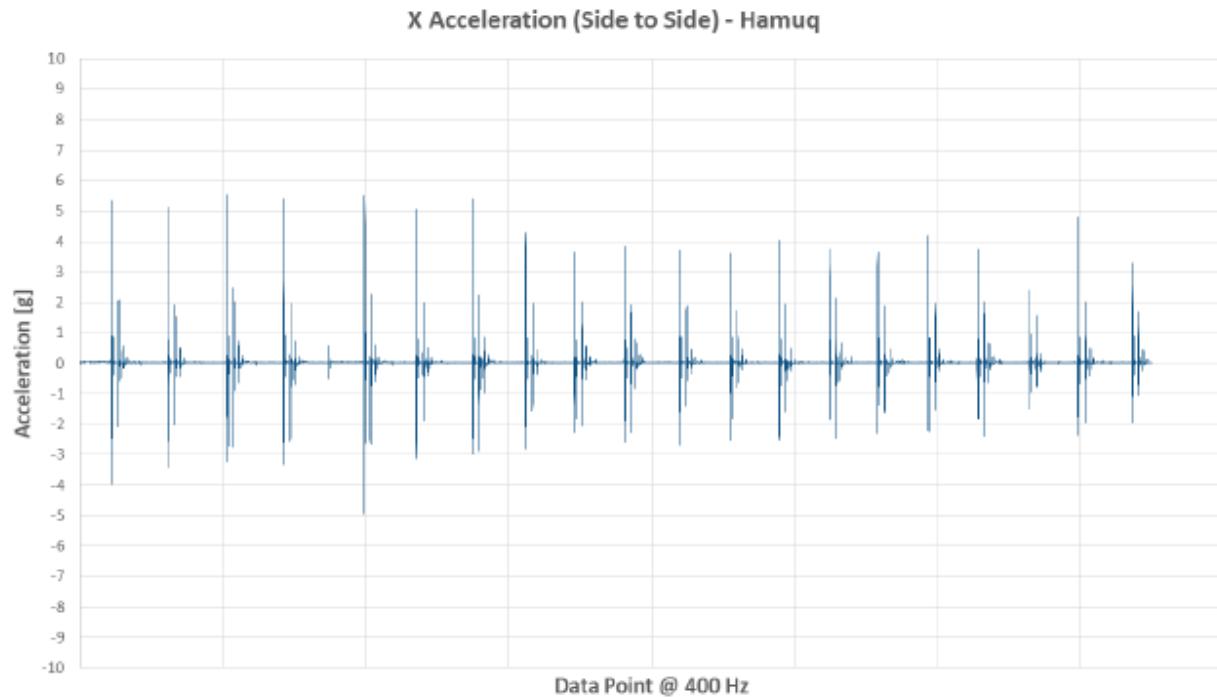
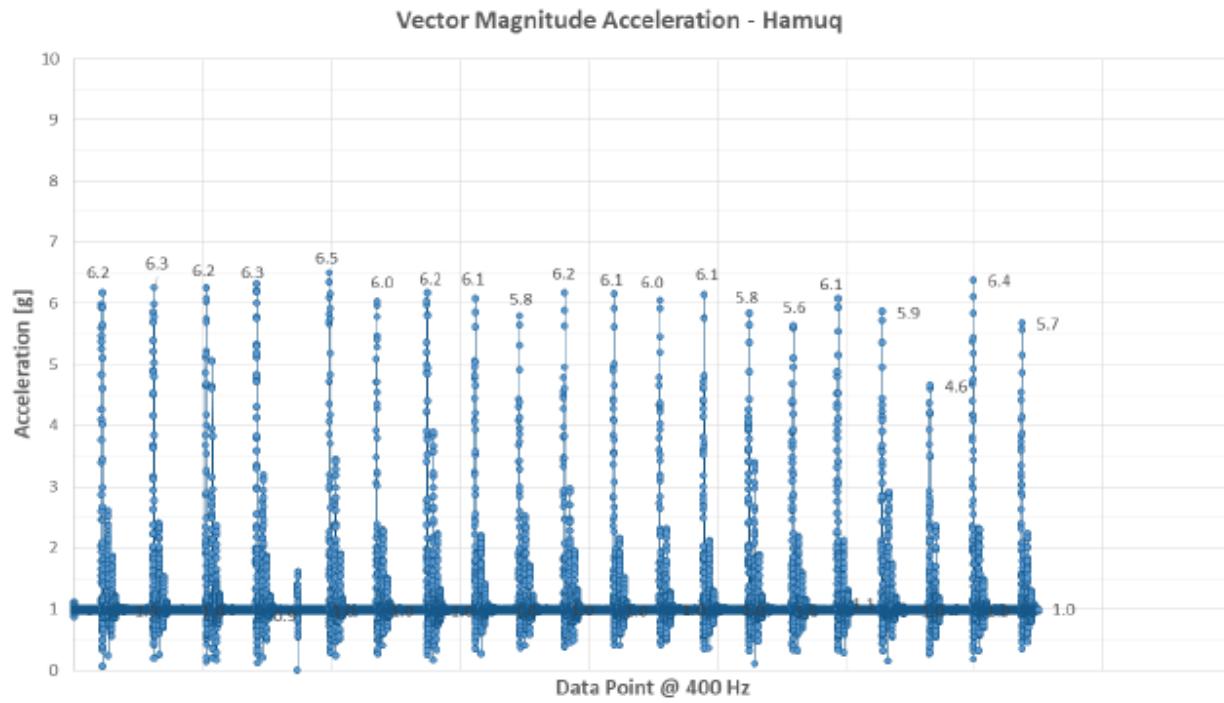


Z Acceleration (Up and Down) - Douglas V2





TEST 3 – HAMUQ

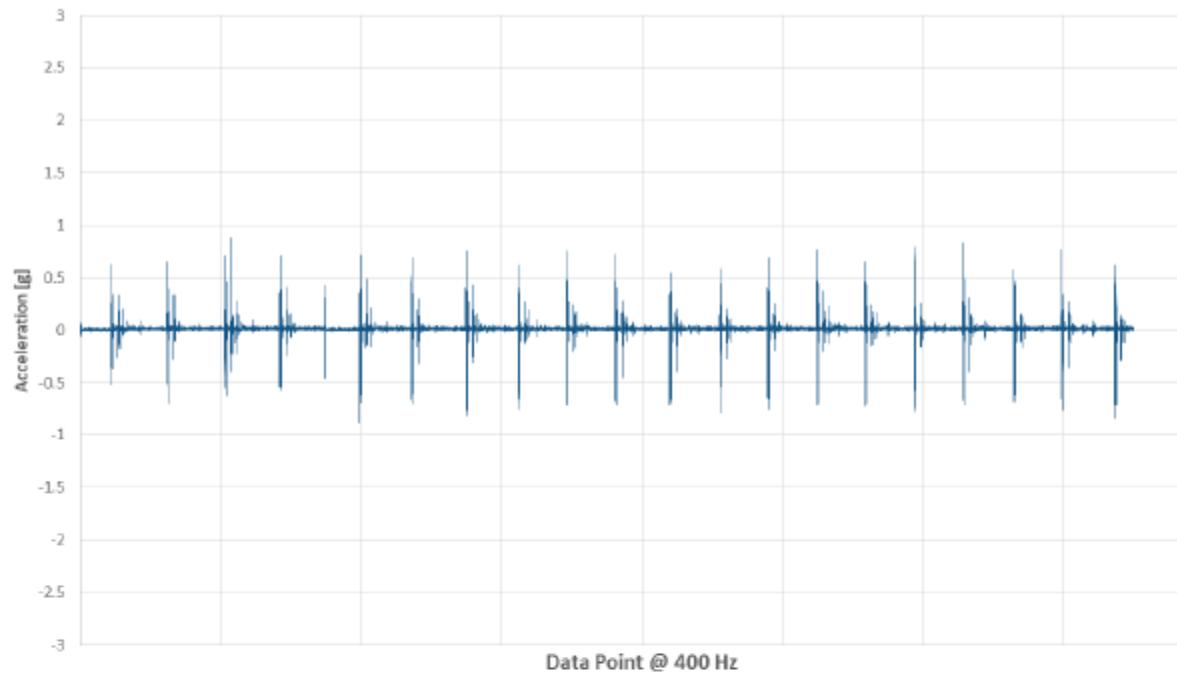




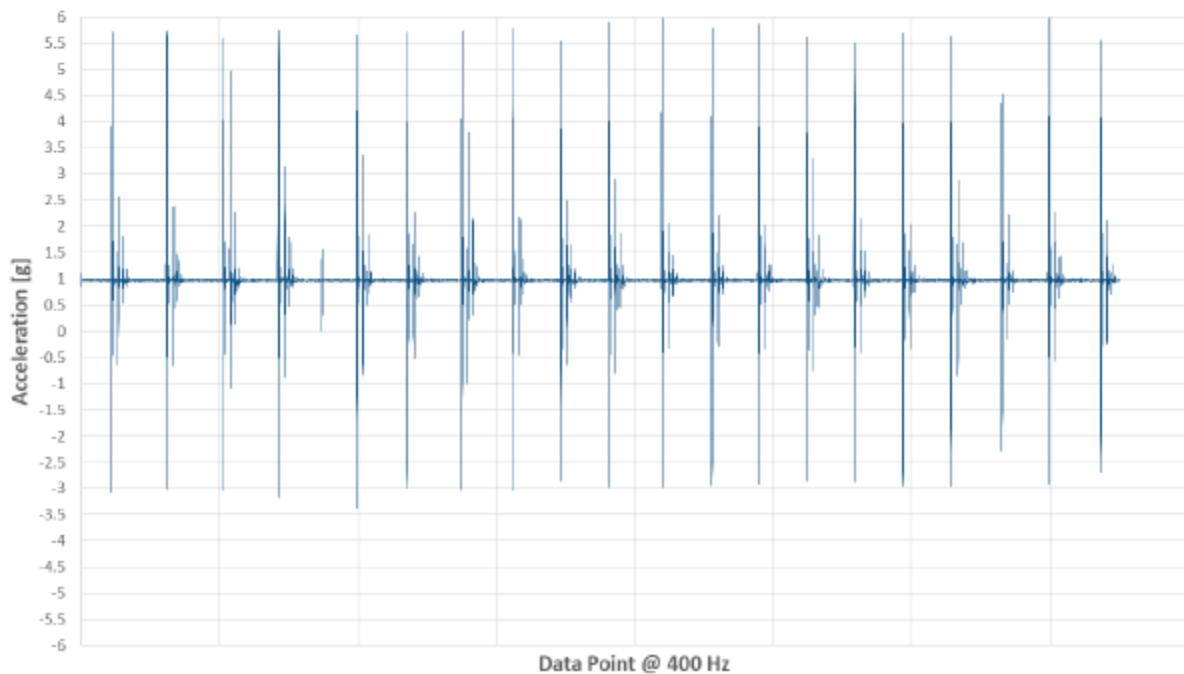
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Y Acceleration (Head to Toe) - Hamuq



Z Acceleration (Up and Down) - Hamuq

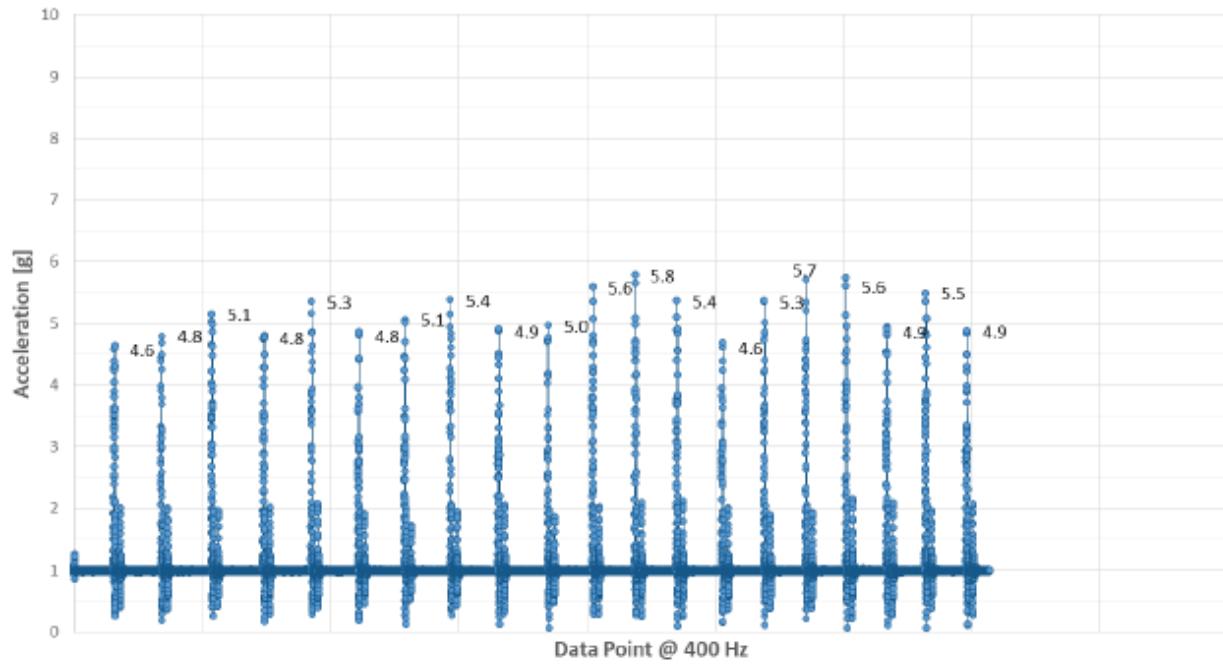




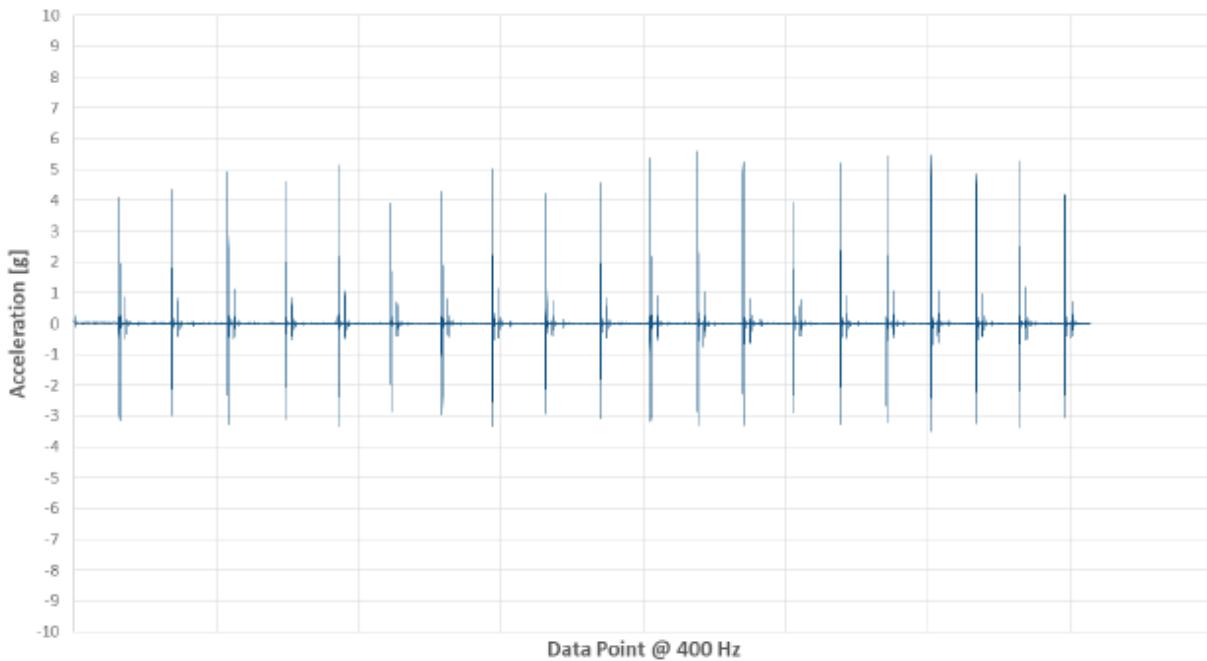
Engineering Report

TEST 3 – LOGAN & COVE

Vector Magnitude Acceleration - Logan & Cove



X Acceleration (Side to Side) - Logan & Cove

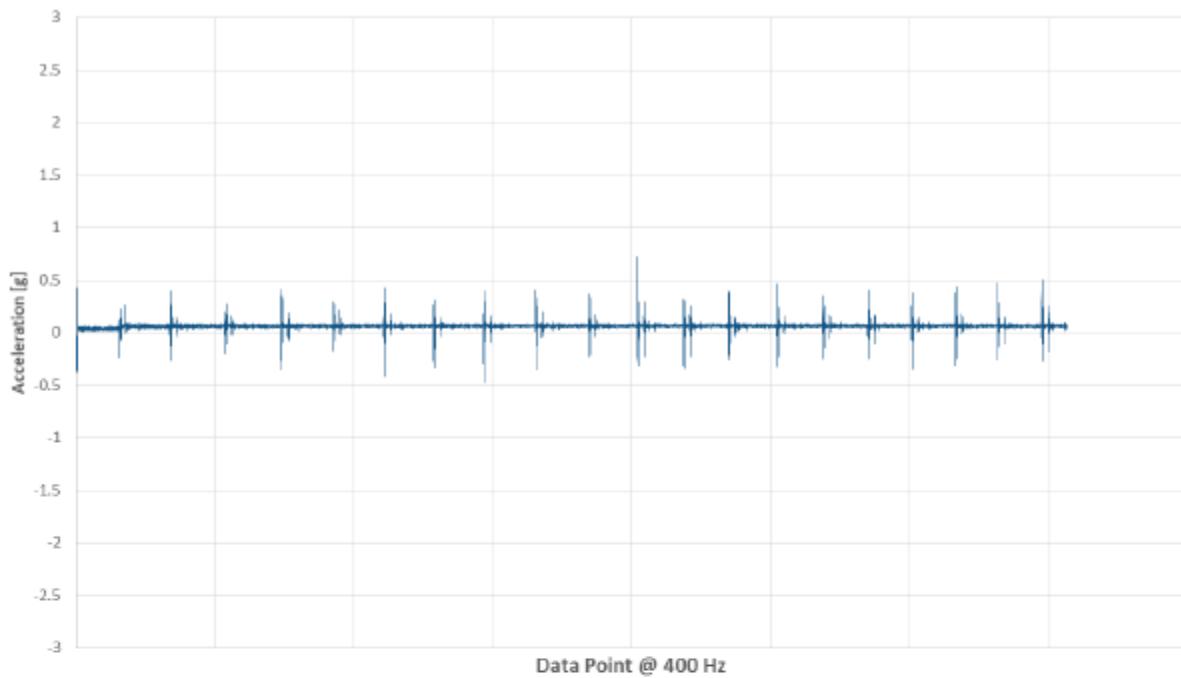




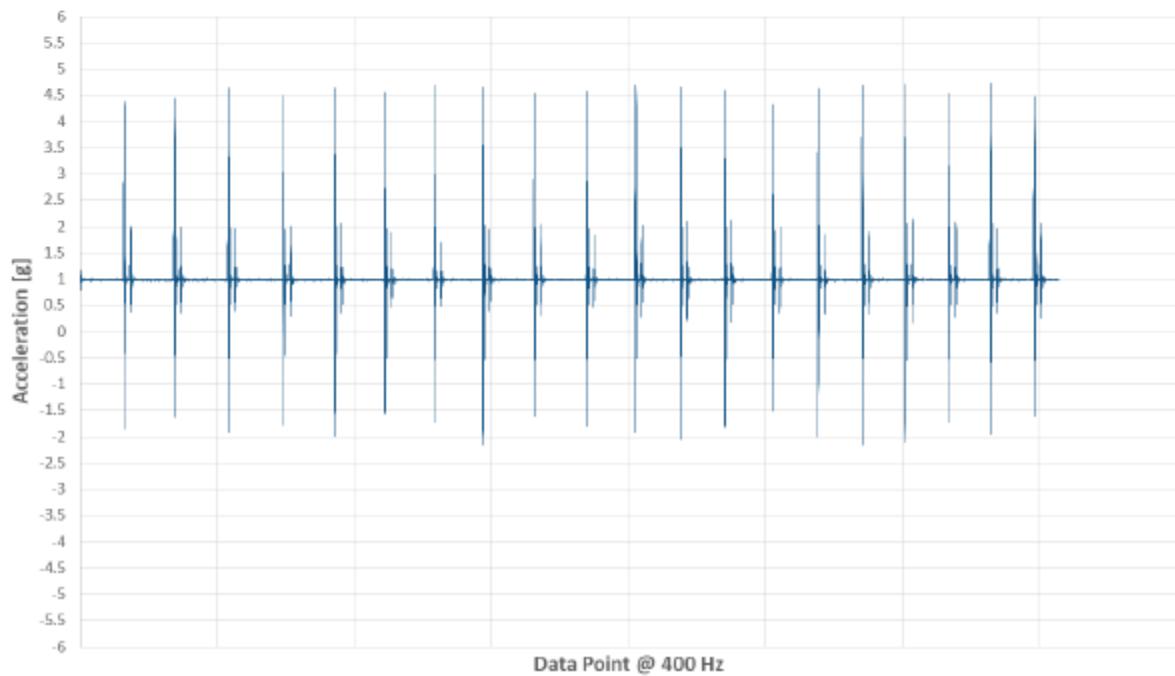
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Y Acceleration (Head to Toe) - Logan & Cove



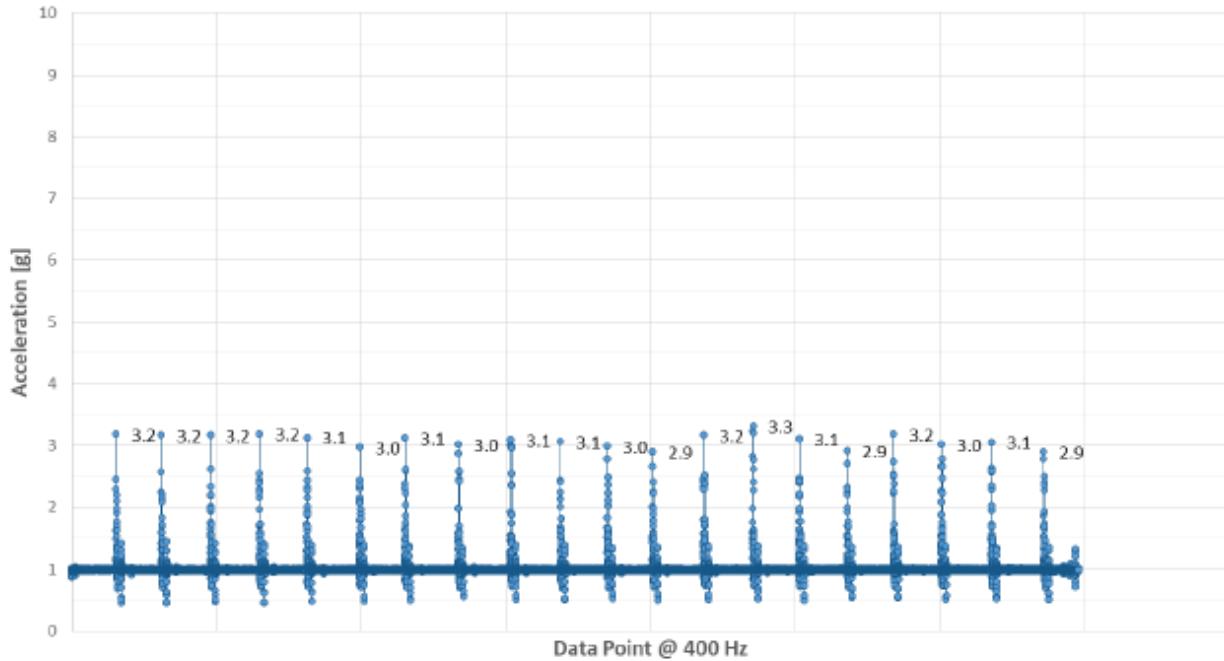
Z Acceleration (Up and Down) - Logan & Cove



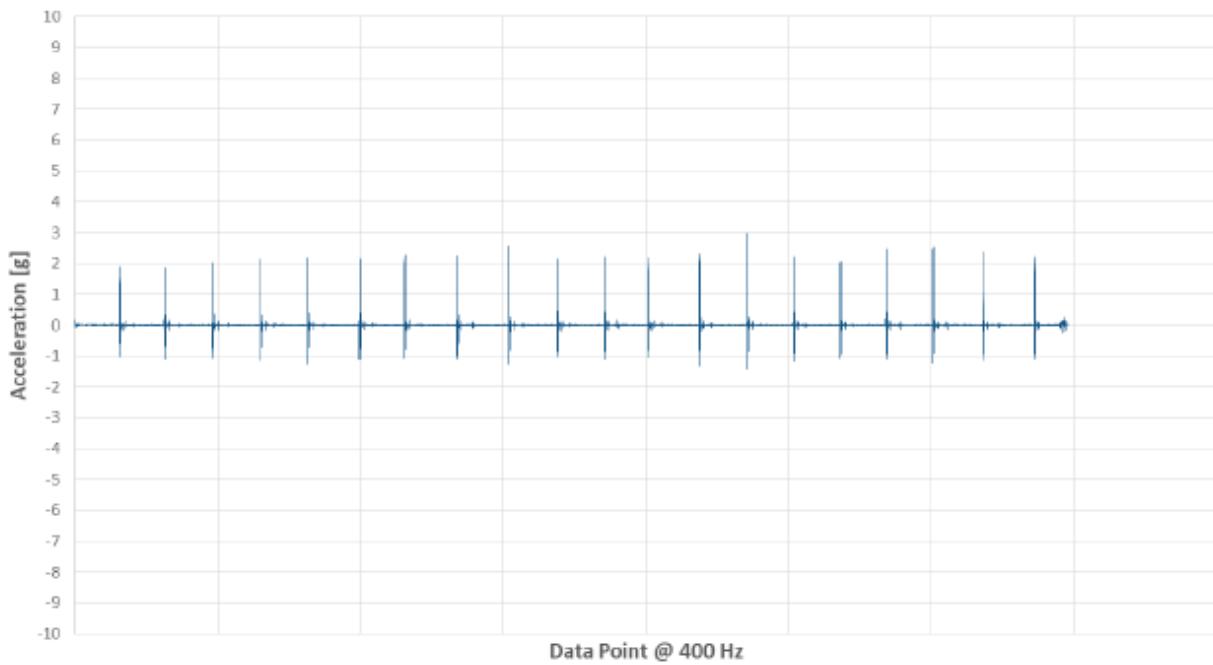


TEST 3 – NORA

Vector Magnitude Acceleration - Nora



X Acceleration (Side to Side) - Nora

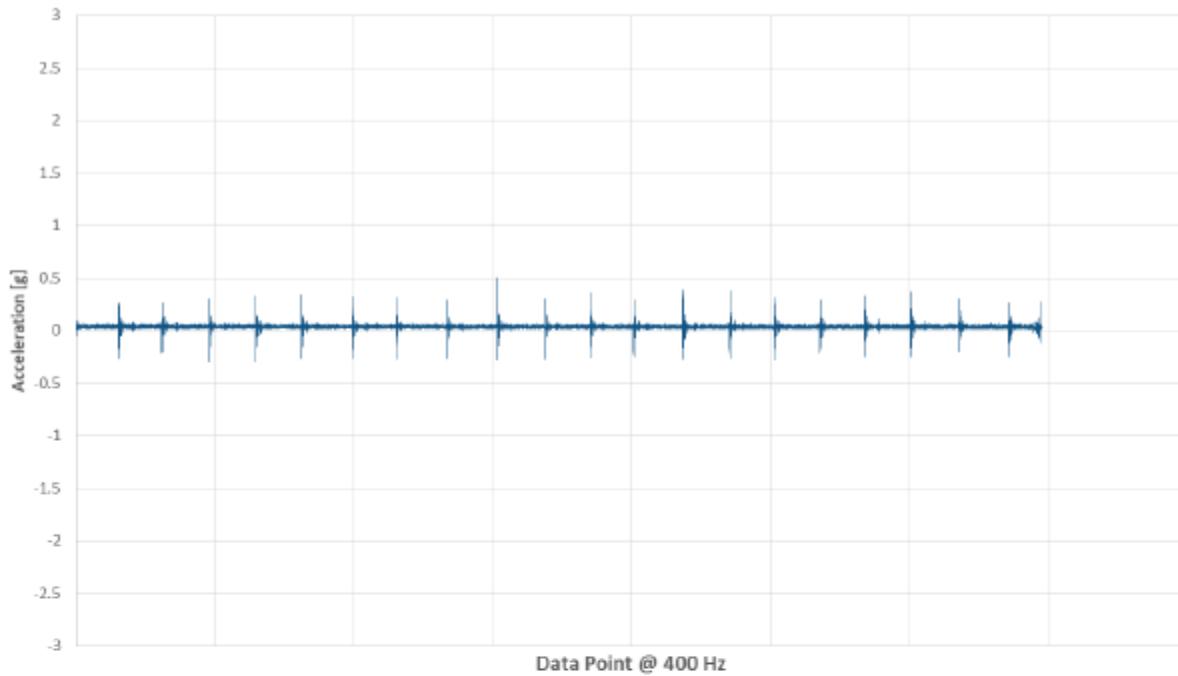




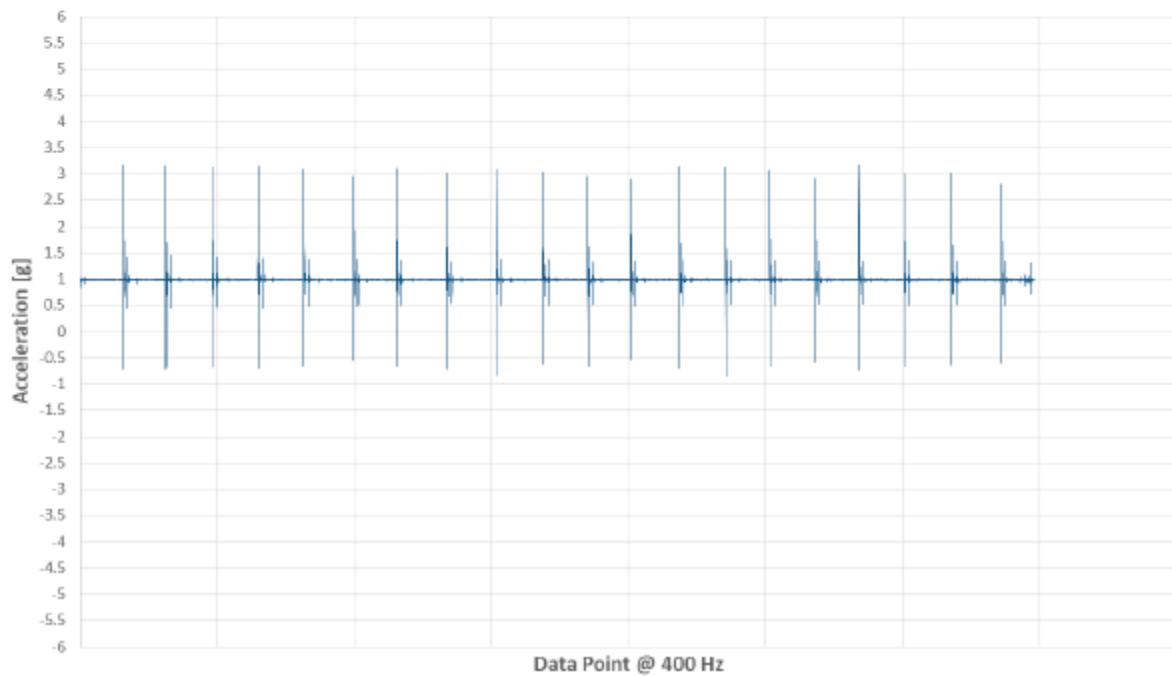
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Y Acceleration (Head to Toe) - Nora



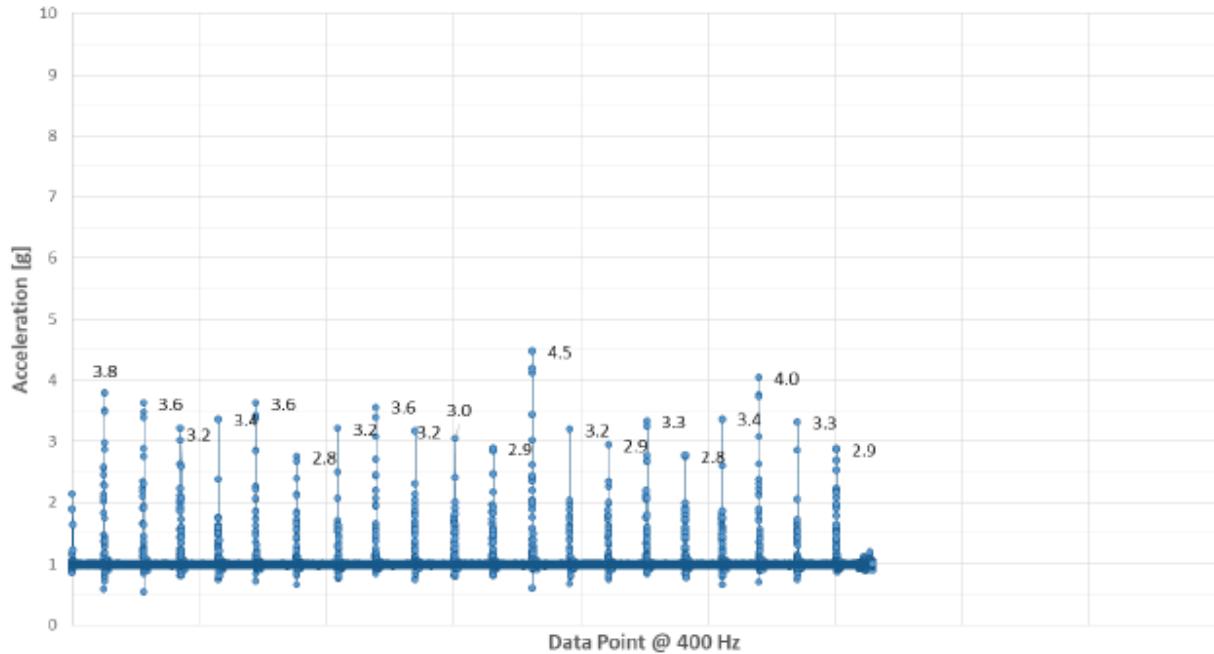
Z Acceleration (Up and Down) - Nora



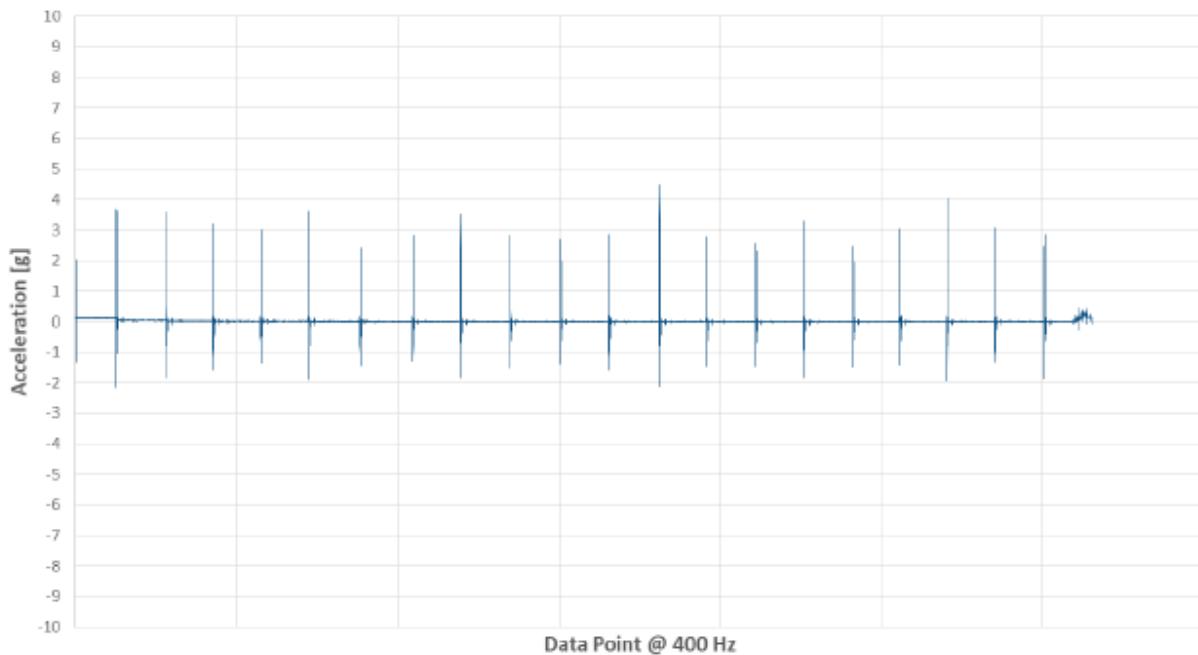


TEST 3 – POLYSLEEP

Vector Magnitude Acceleration - PolySleep



X Acceleration (Side to Side) - PolySleep

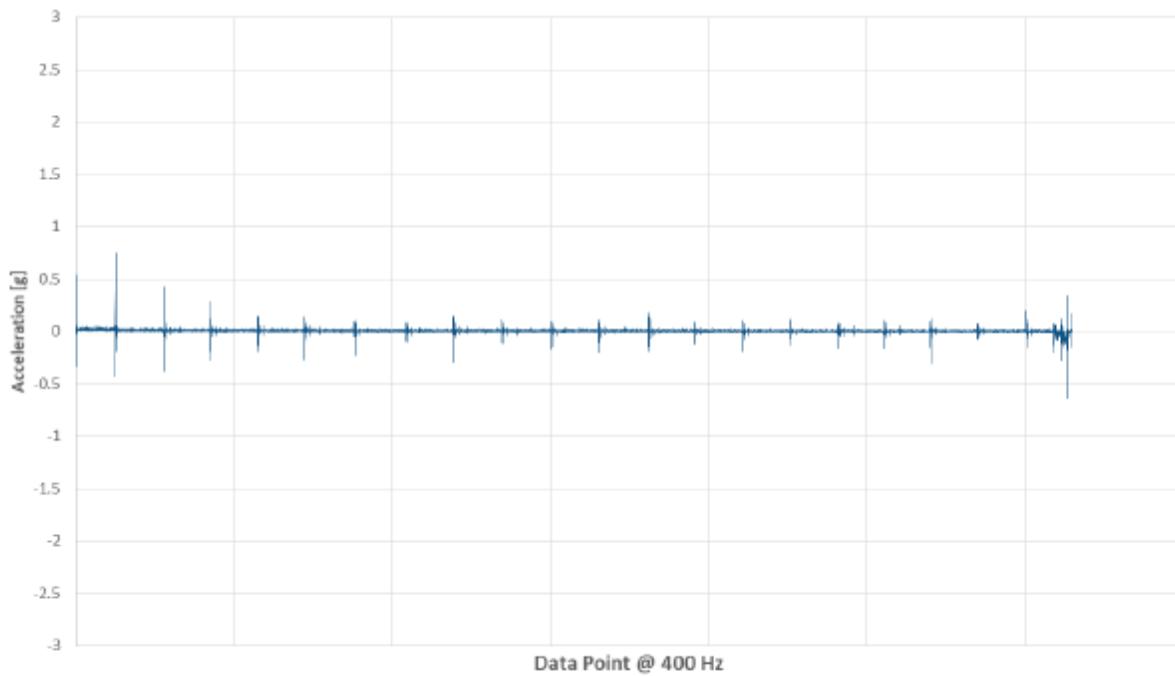




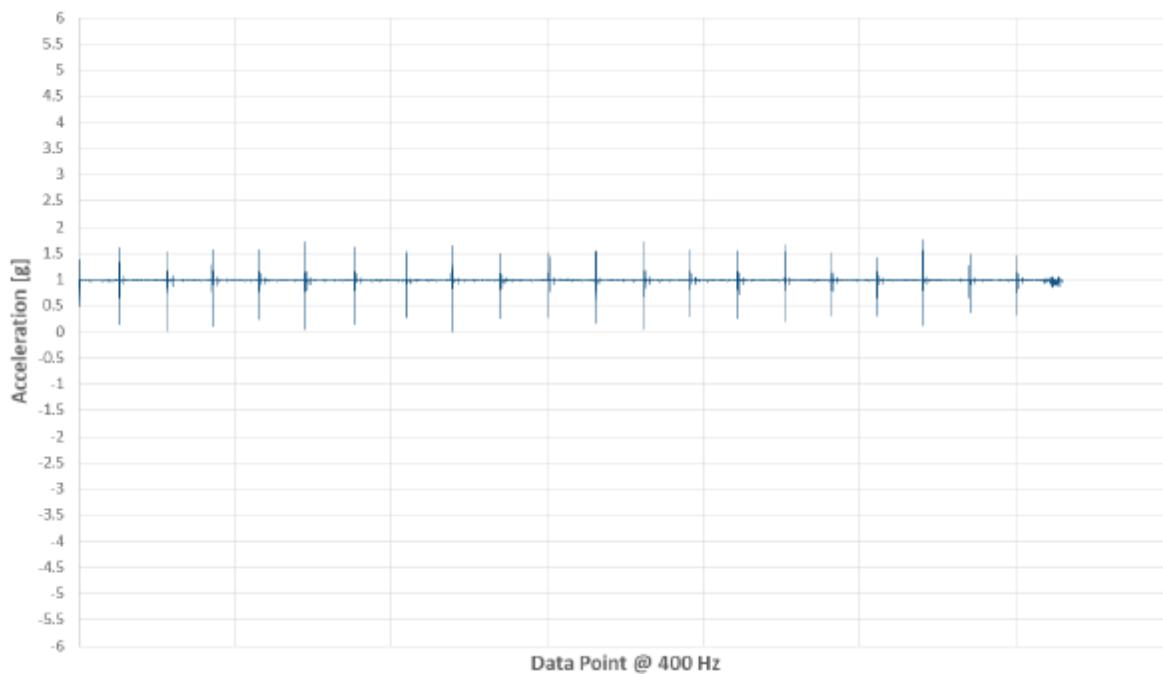
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Y Acceleration (Head to Toe) - PolySleep



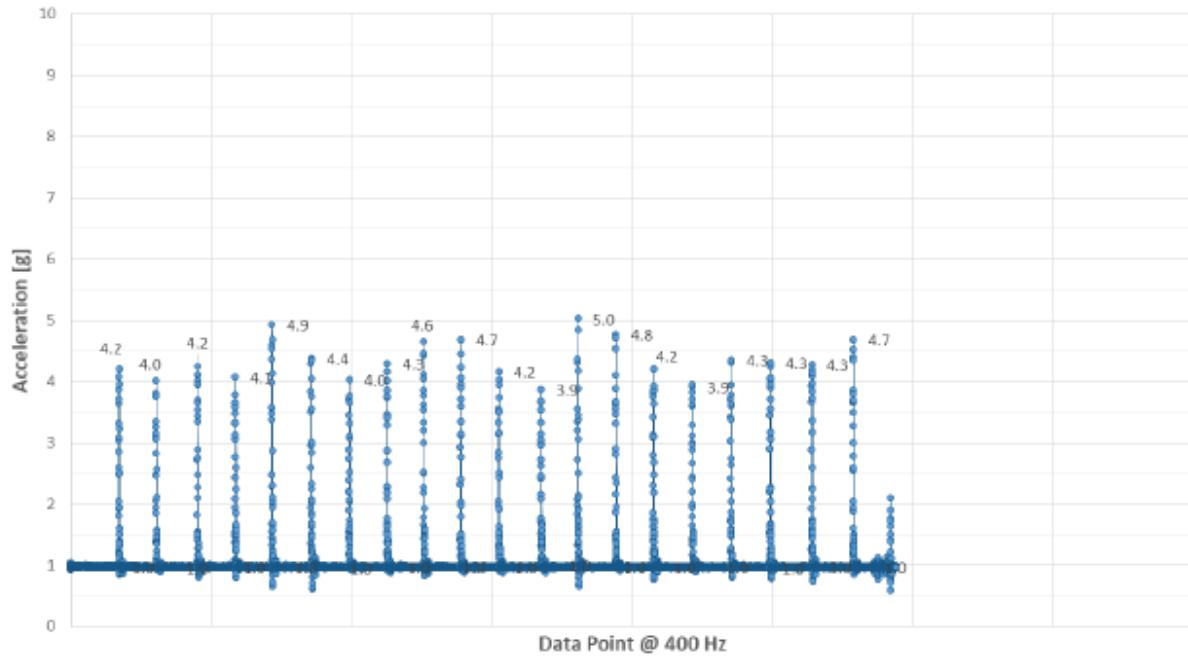
Z Acceleration (Up and Down) - PolySleep



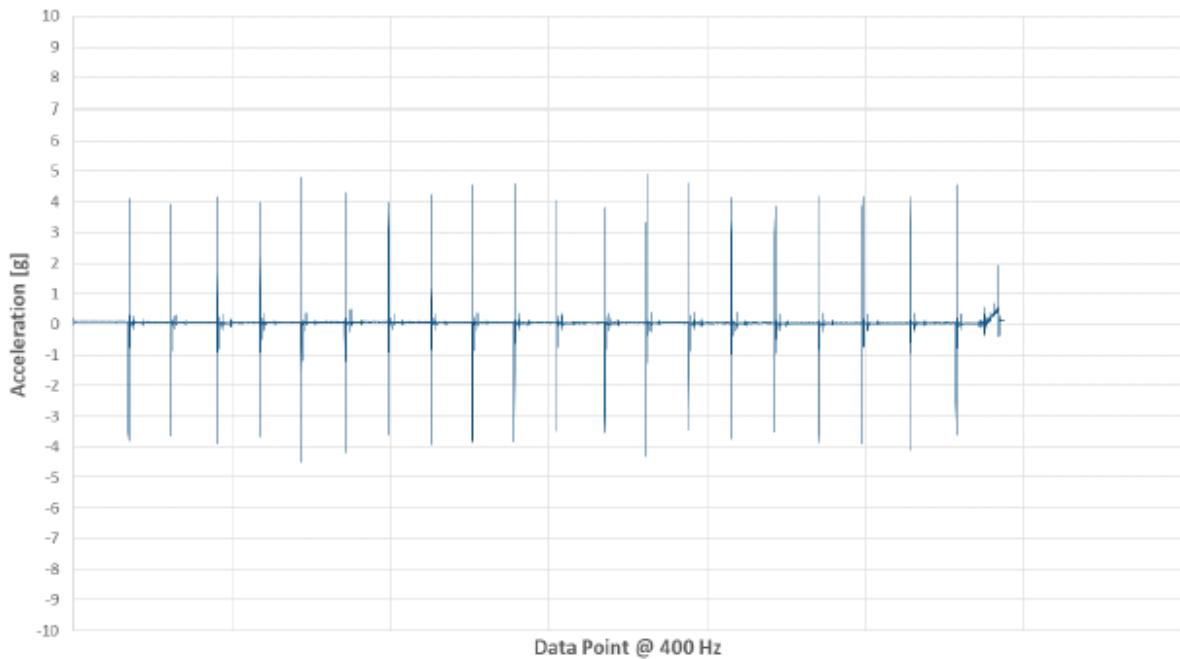


TEST 3 – iCOMFORT

Vector Magnitude Acceleration - iComfort



X Acceleration (Side to Side) - iComfort

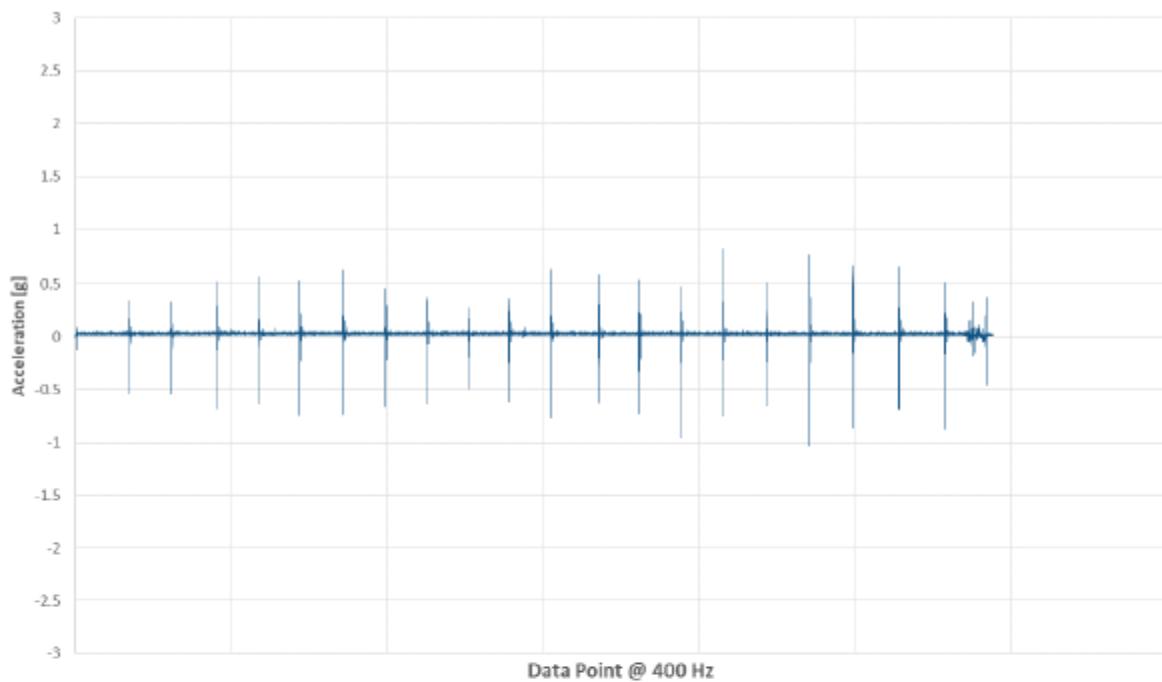




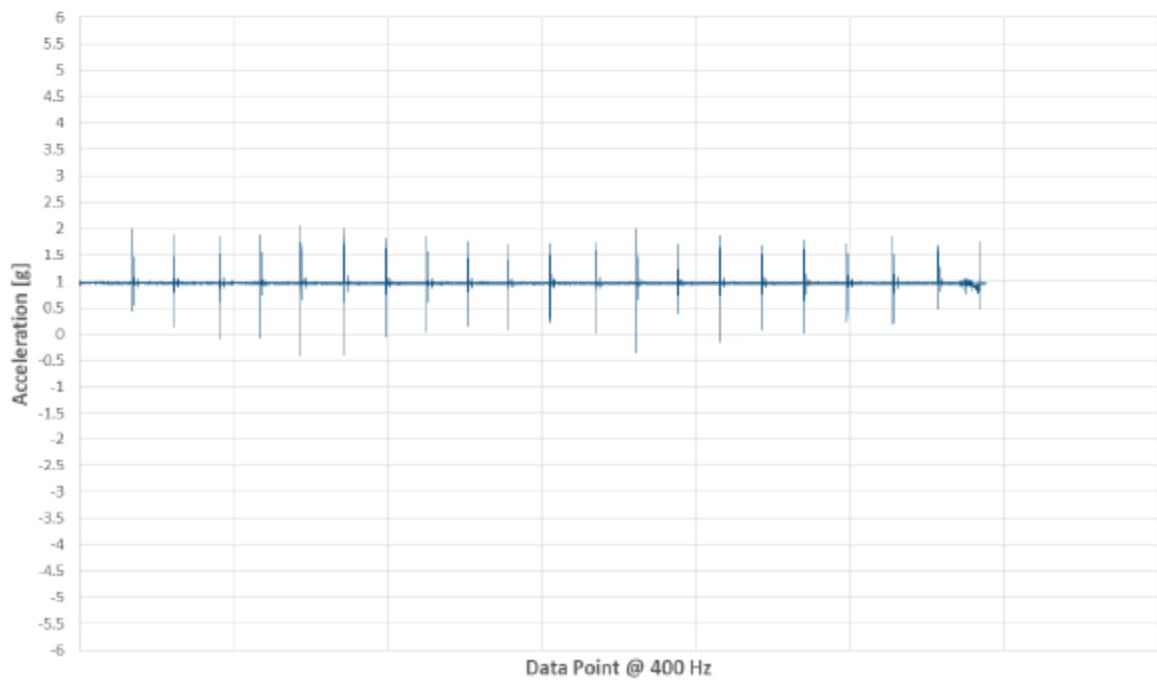
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Y Acceleration (Head to Toe) - iComfort



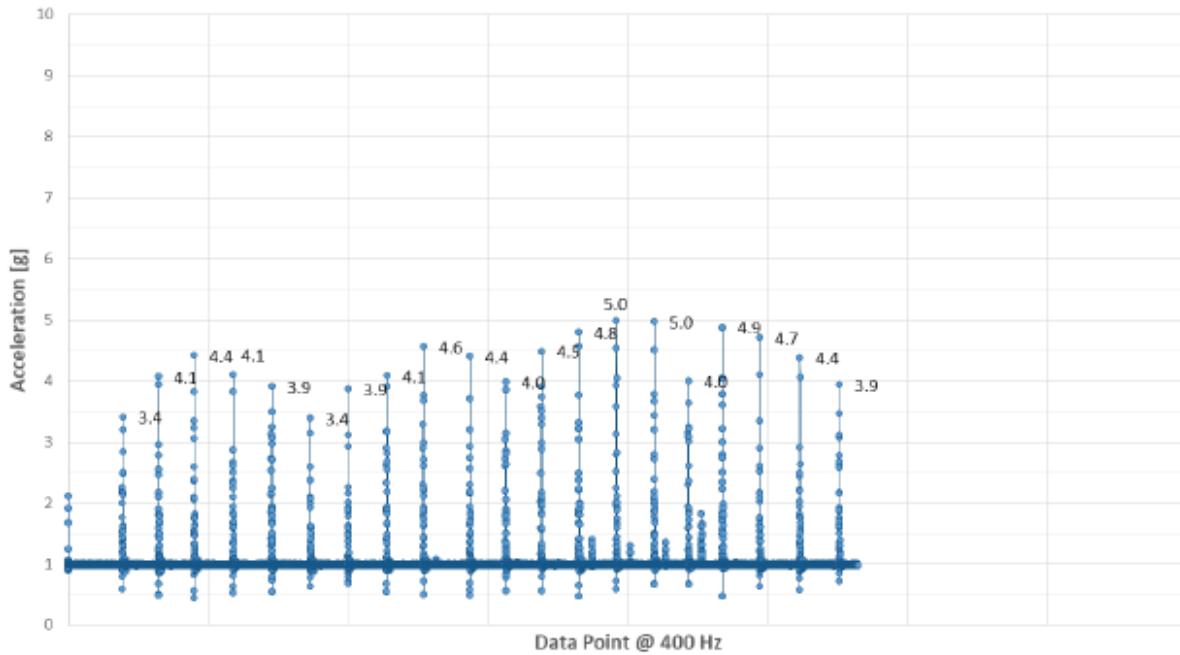
Z Acceleration (Up and Down) - iComfort



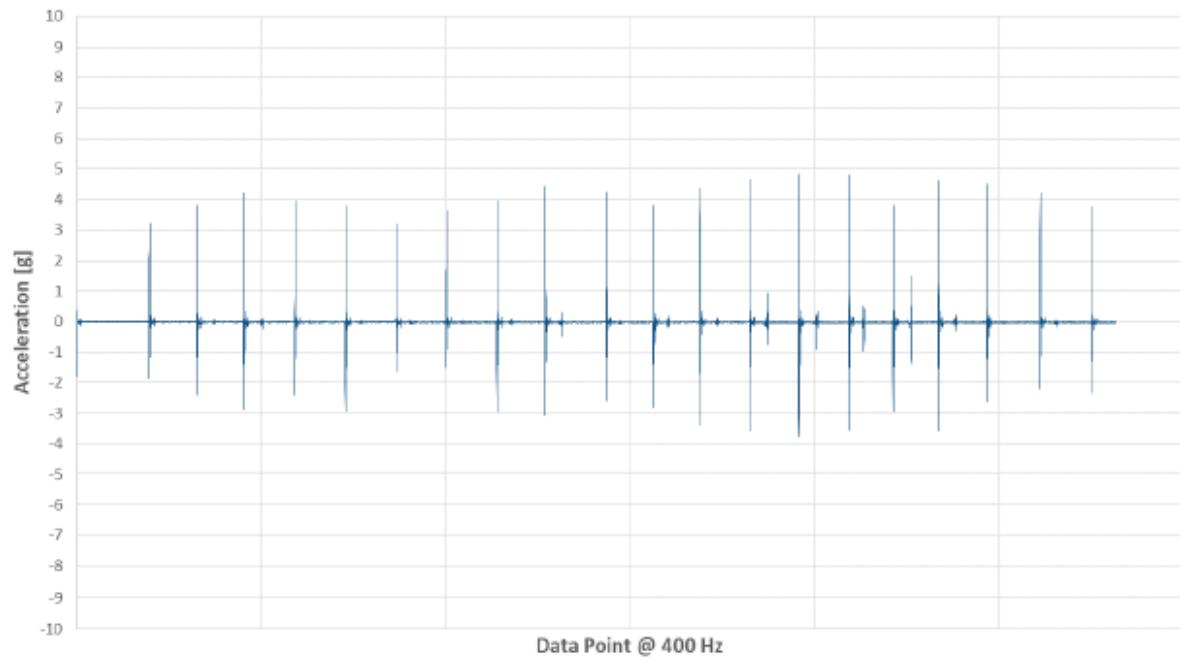


TEST 3 – TEMPUR-PEDIC

Vector Magnitude Acceleration - Tempur-Pedic



X Acceleration (Side to Side) - Tempur-Pedic

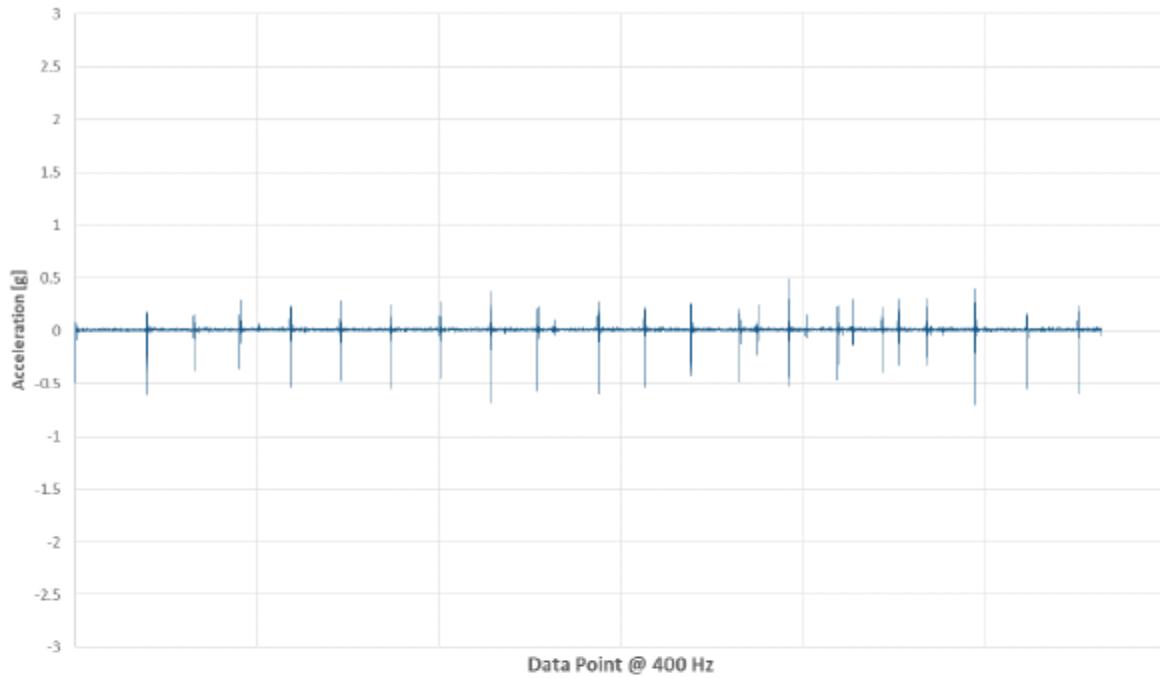




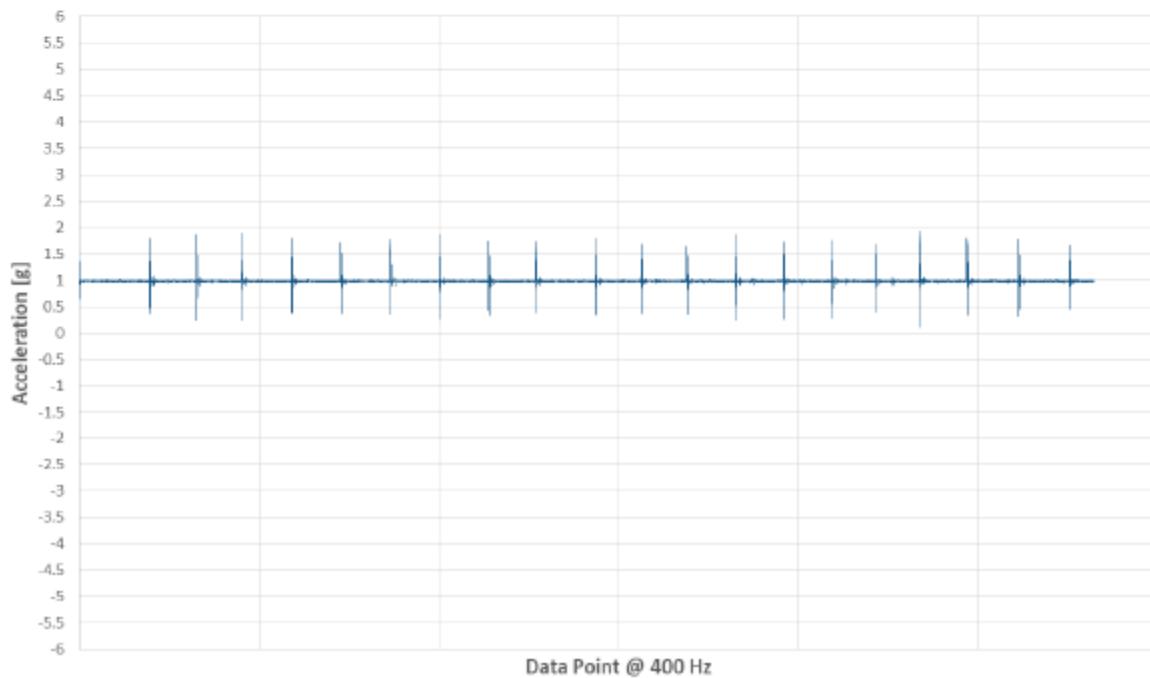
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Y Acceleration (Head to Toe) - Tempur-Pedic

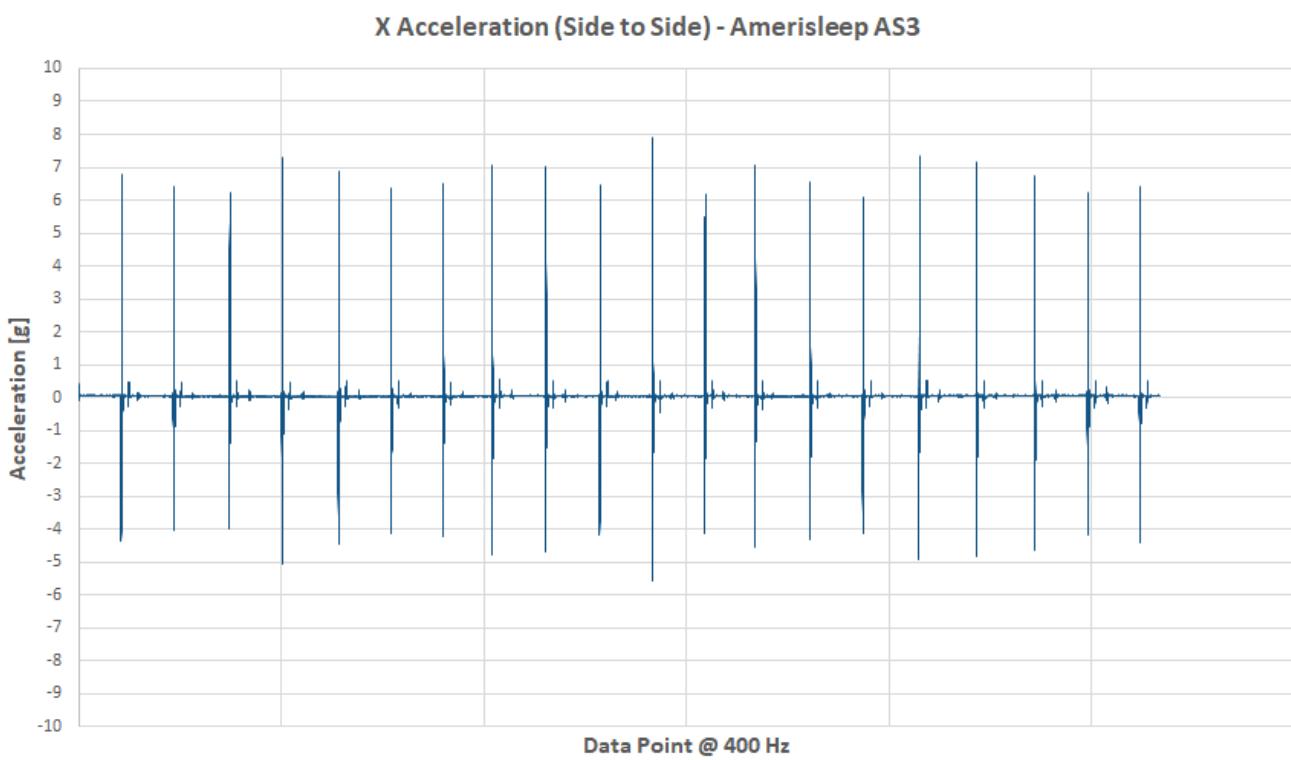
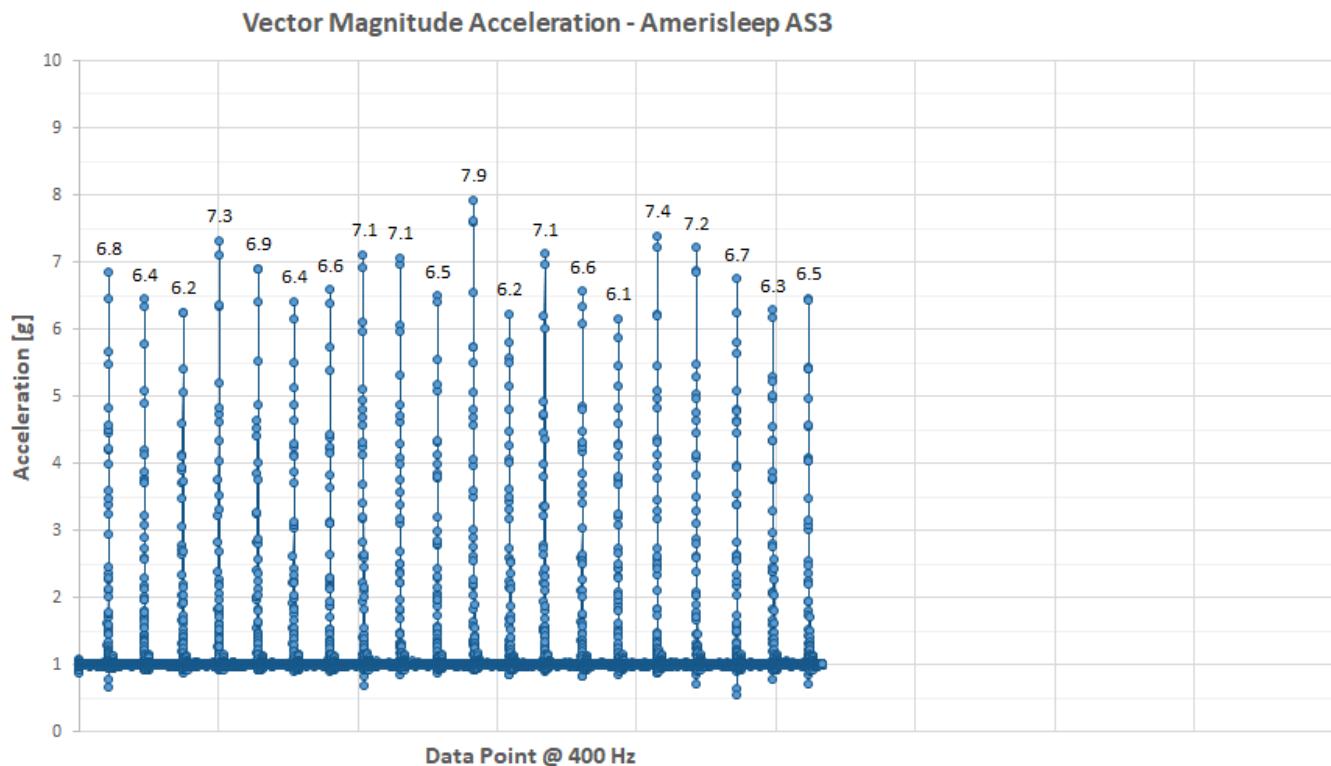


Z Acceleration (Up and Down) - Tempur-Pedic





TEST 3 – AMERISLEEP AS3

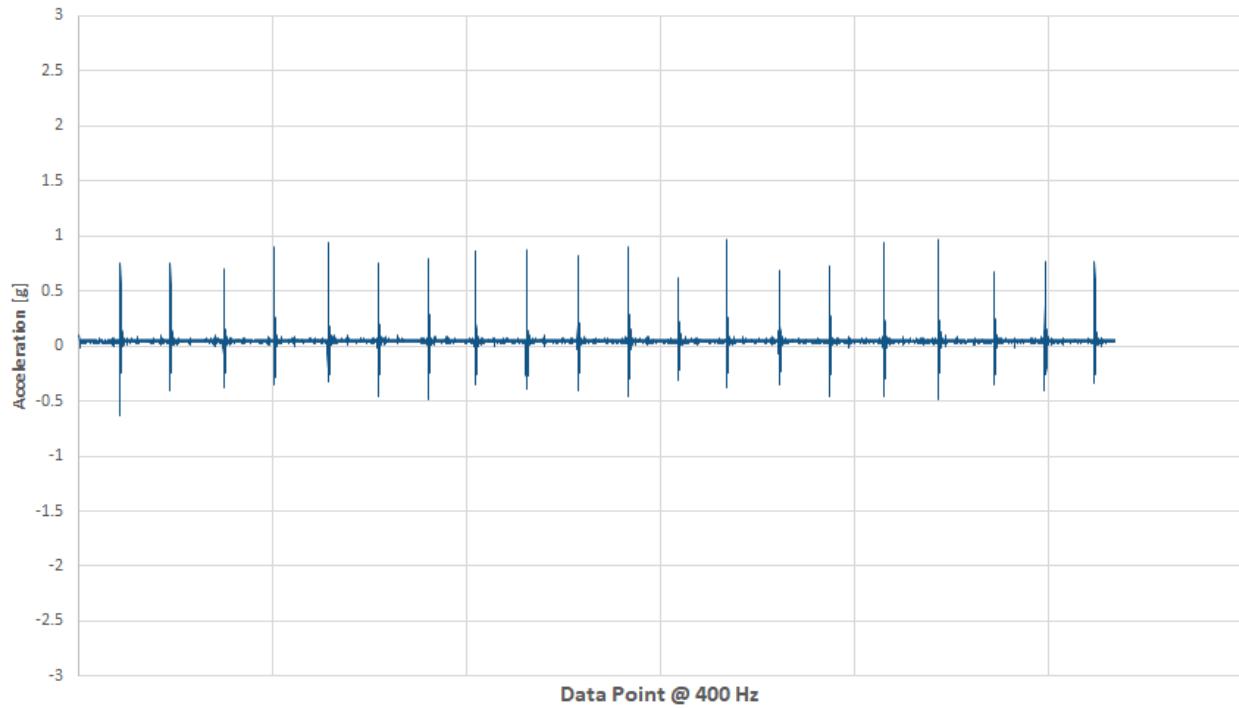




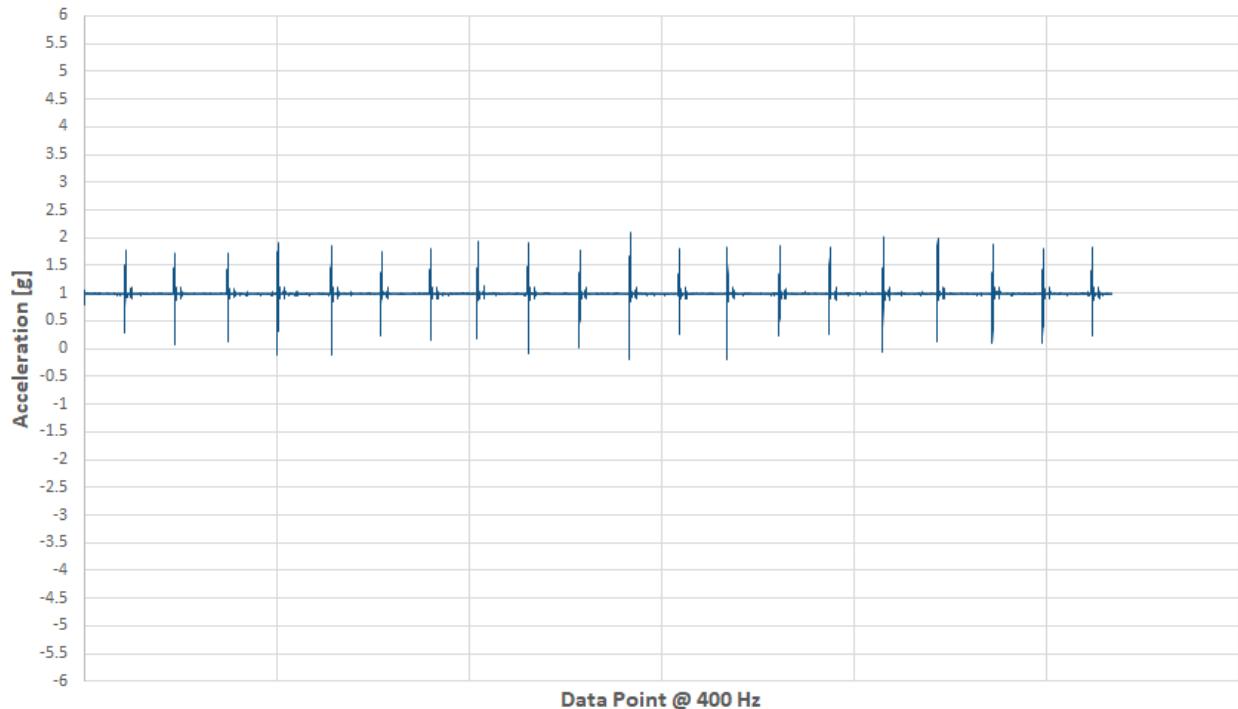
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Y Acceleration (Head to Toe) - Amerisleep AS3



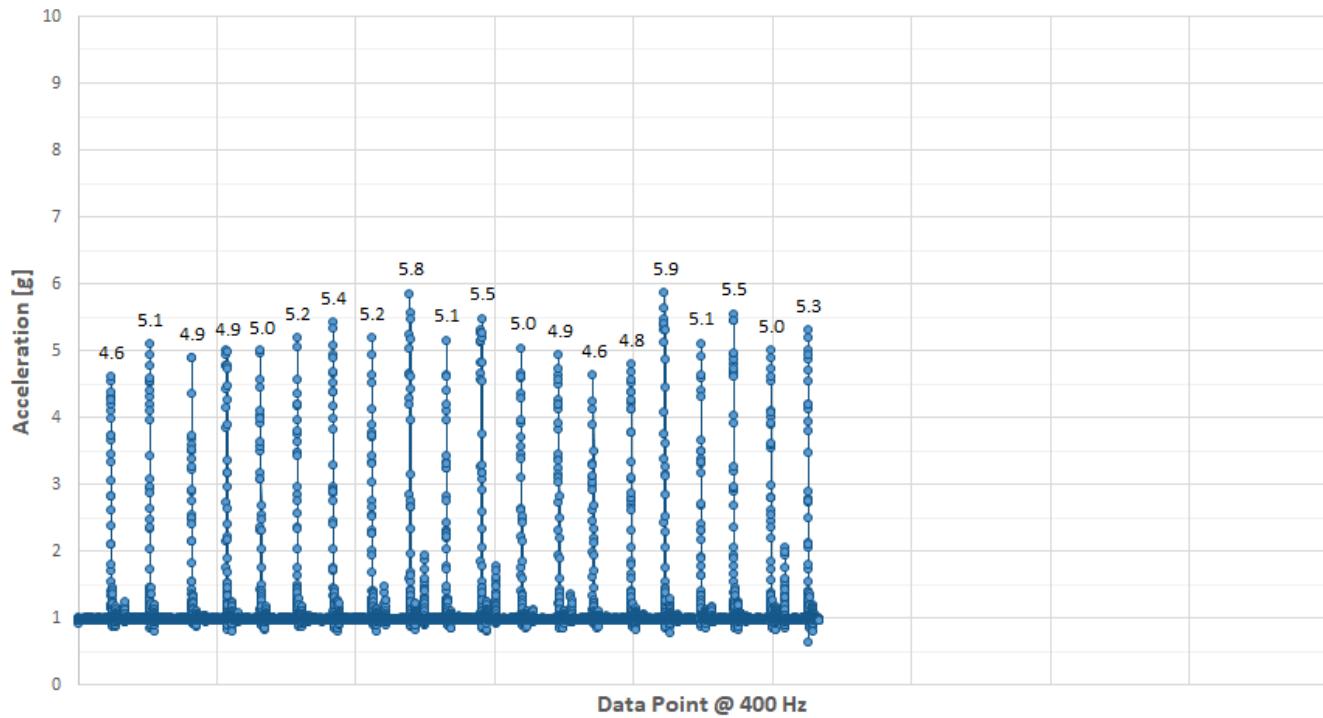
Z Acceleration (Up and Down) - Amerisleep AS3



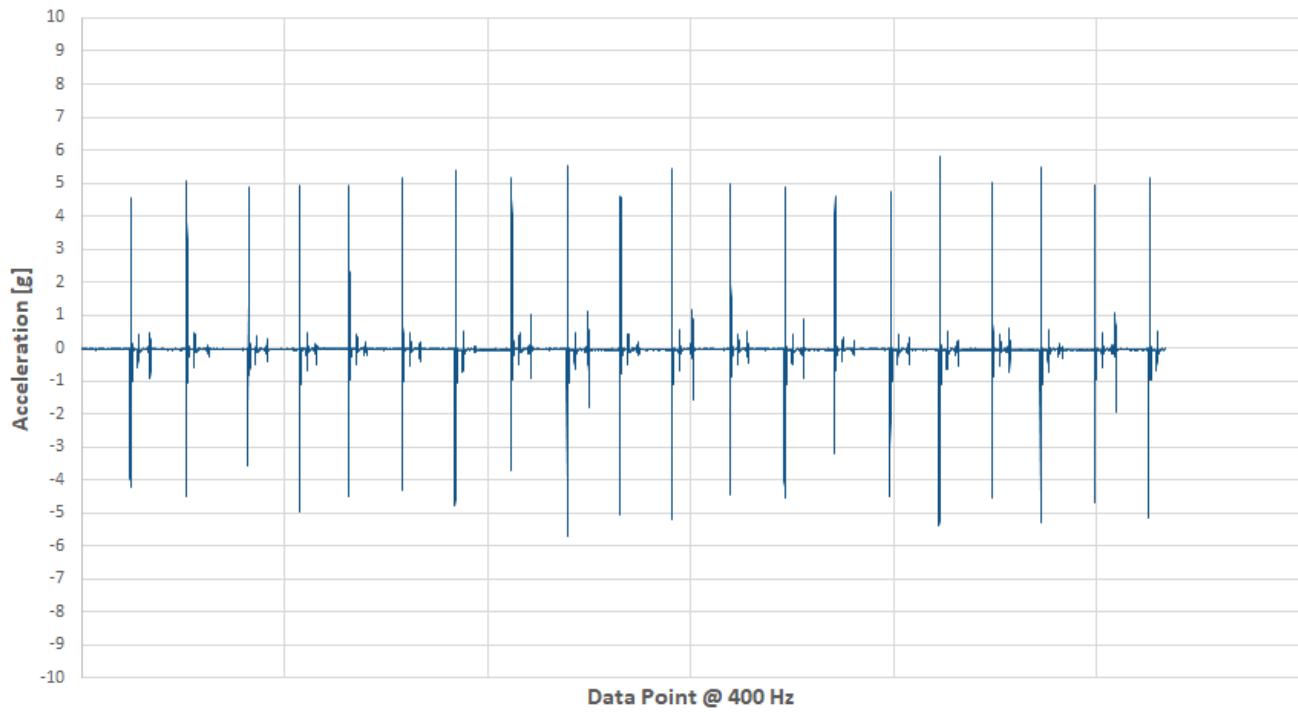


TEST 3 – BEAR

Vector Magnitude Acceleration - Bear



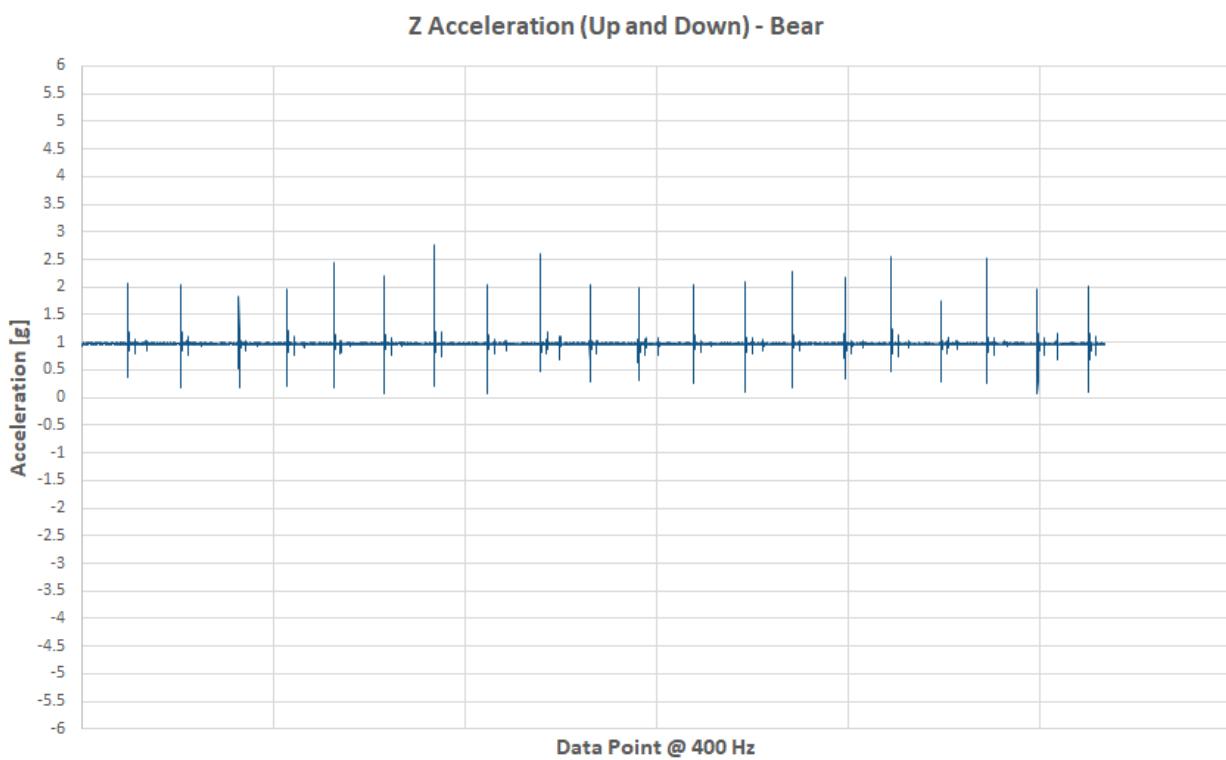
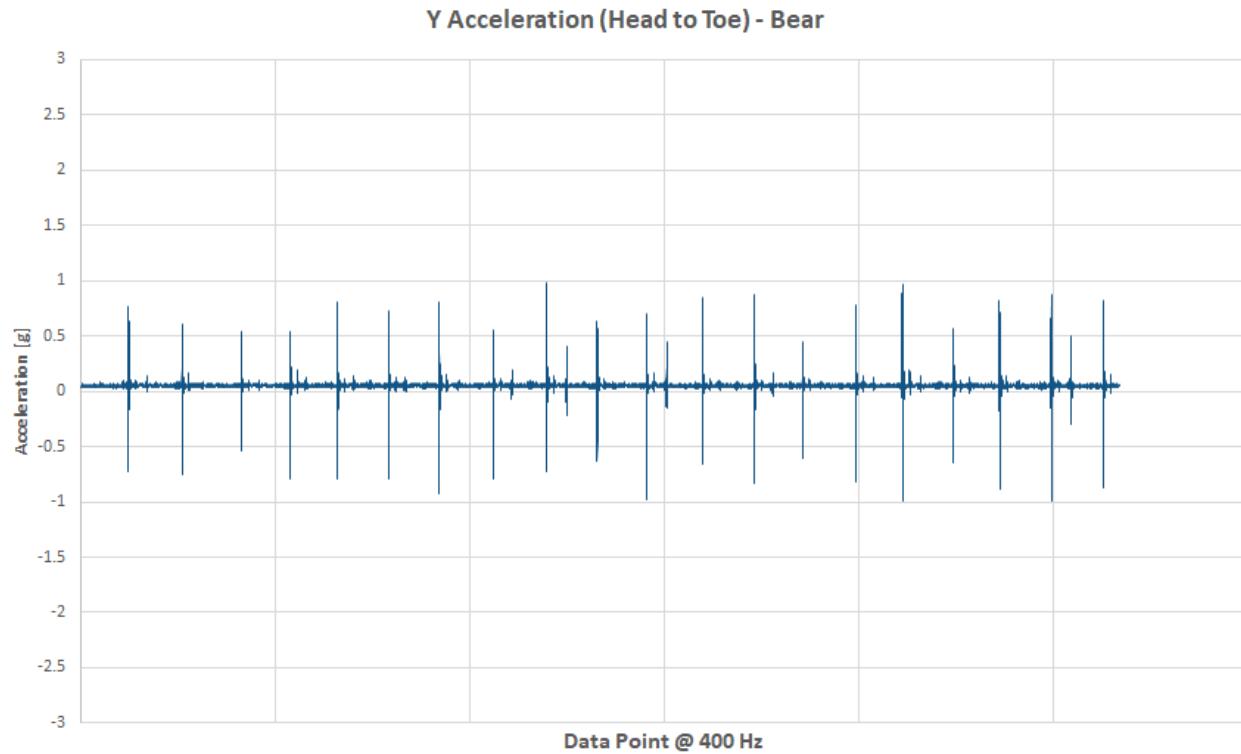
X Acceleration (Side to Side) - Bear





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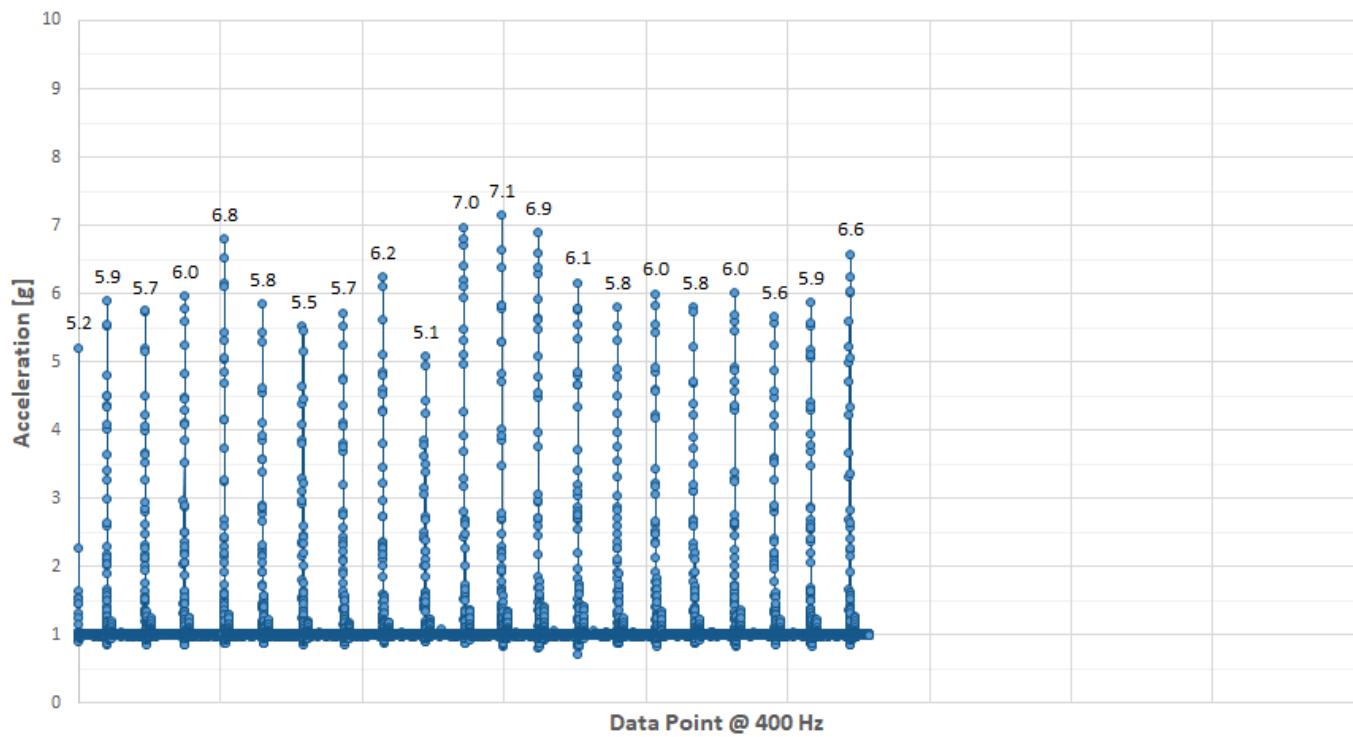
Engineering Report



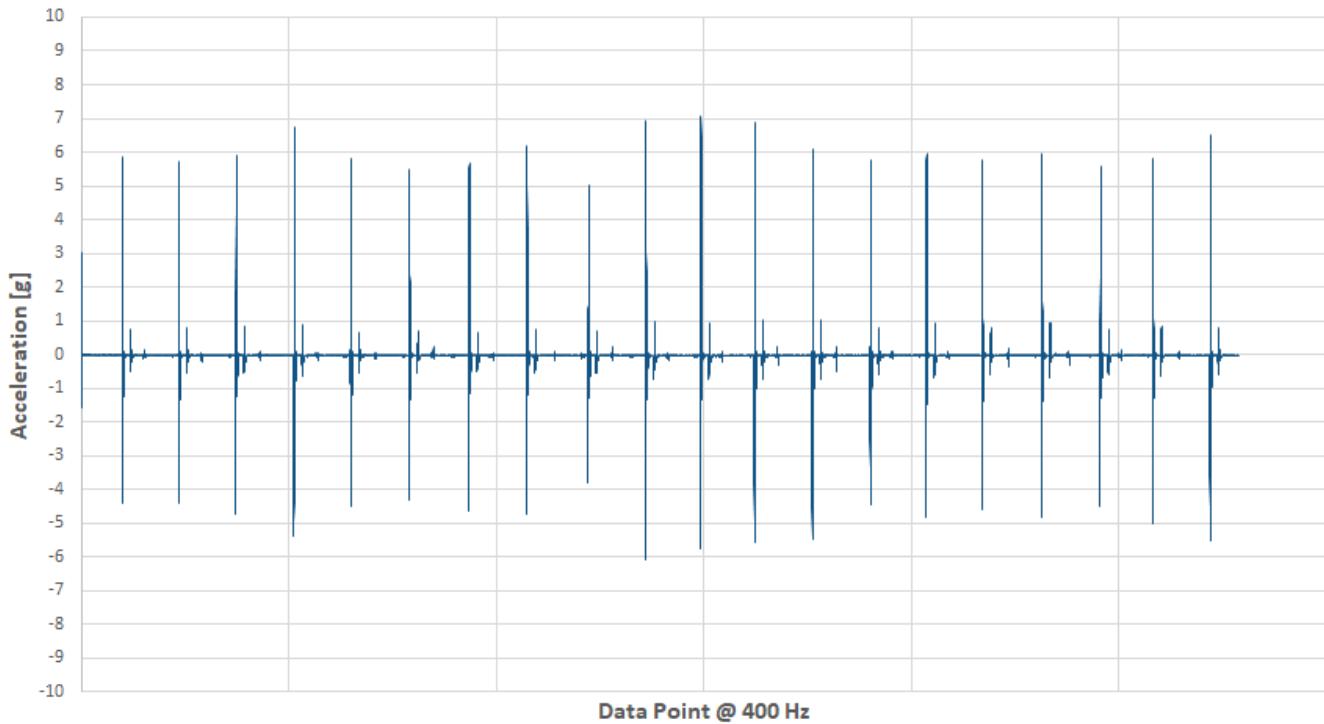


TEST 3 – CASPER (V2)

Vector Magnitude Acceleration - Casper (V2)



X Acceleration (Side to Side) - Casper (V2)

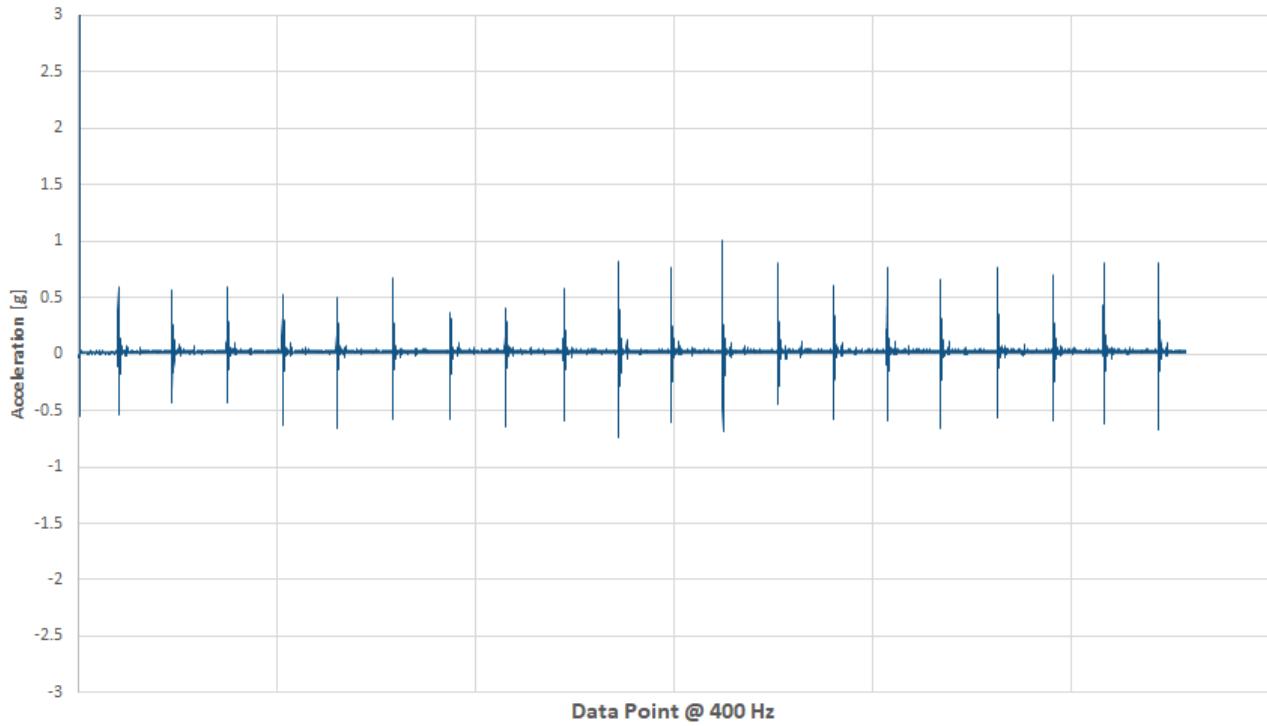




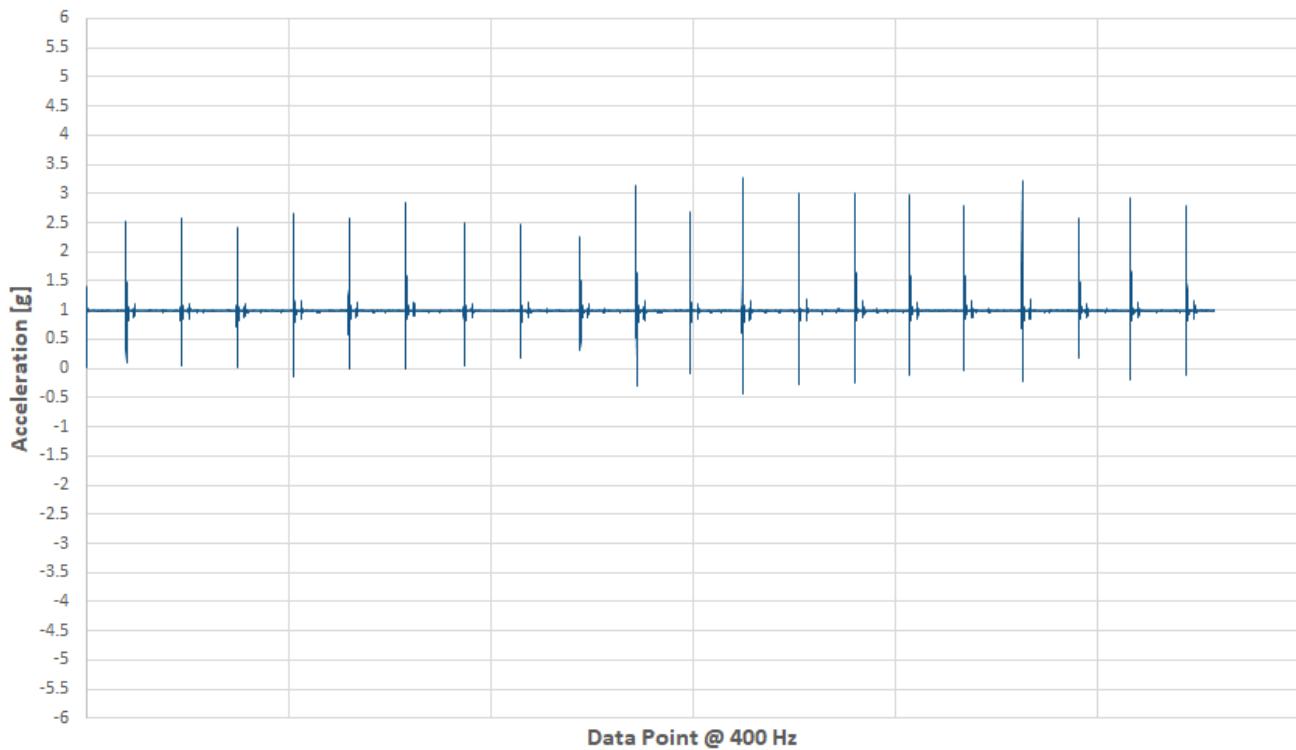
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Y Acceleration (Head to Toe) - Casper (V2)



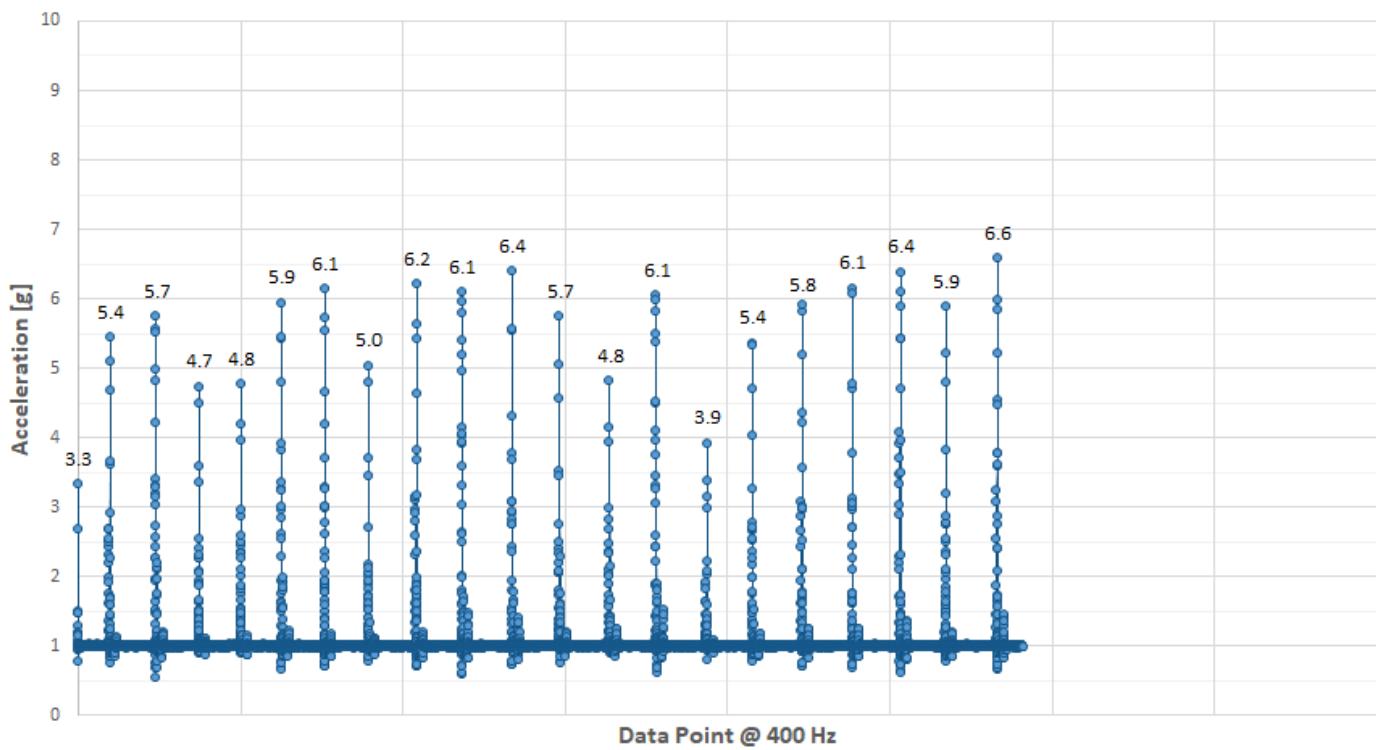
Z Acceleration (Up and Down) - Casper (V2)



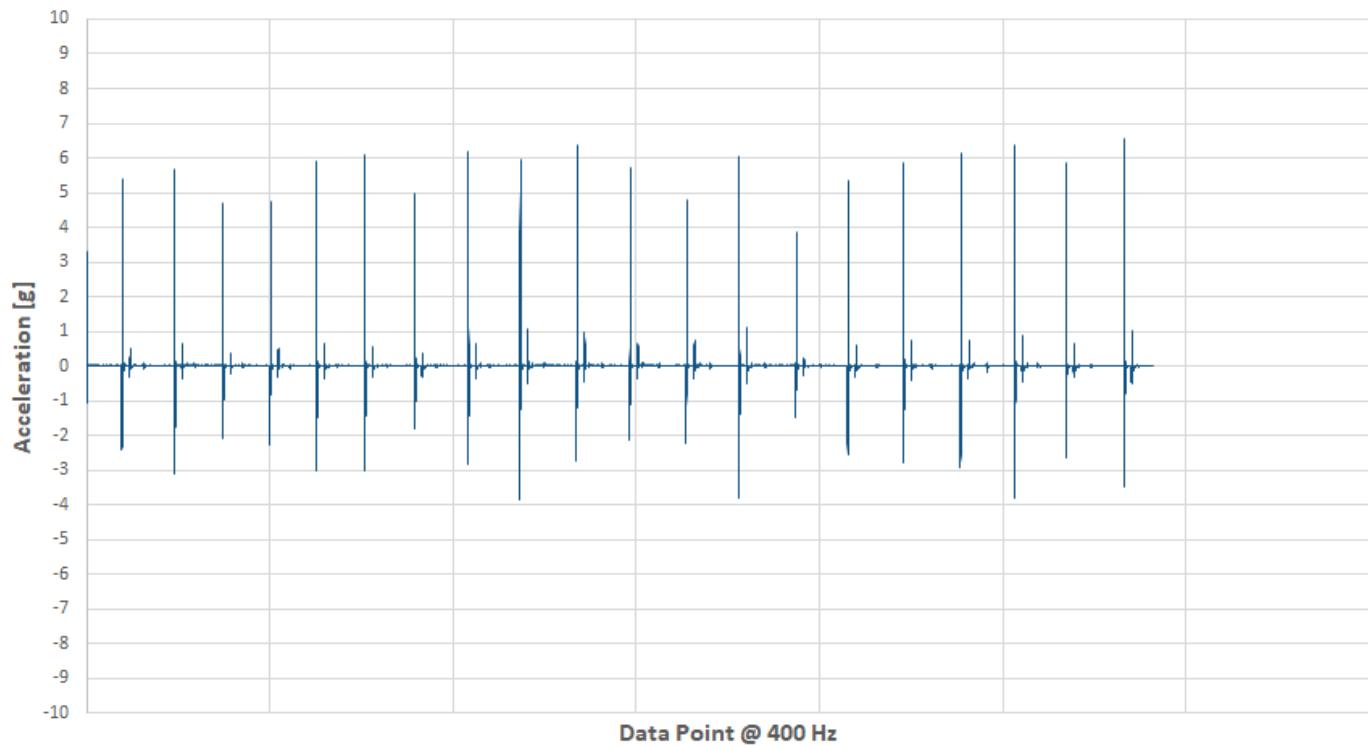


TEST 3 – ENDY (V2)

Vector Magnitude Acceleration - Endy (V2)

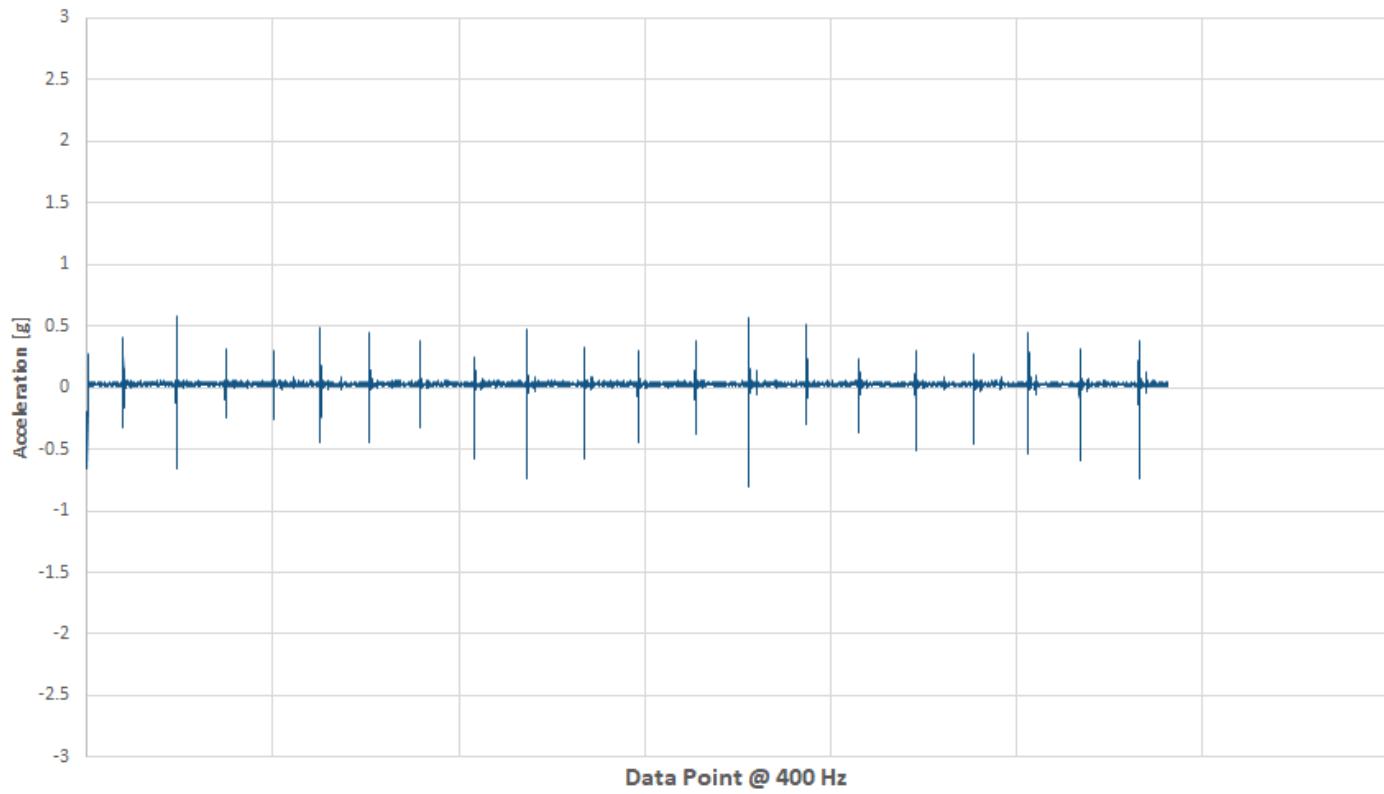


X Acceleration (Side to Side) - Endy (V2)

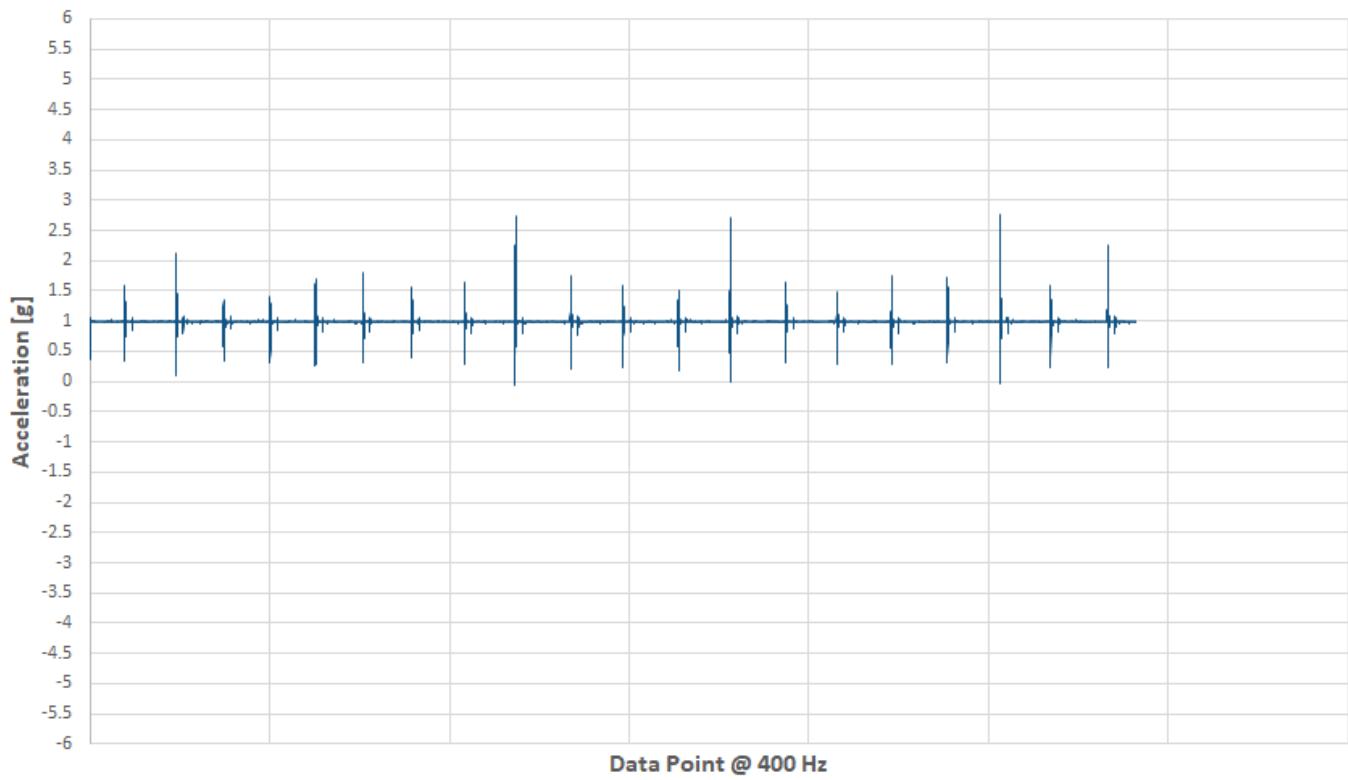




Y Acceleration (Head to Toe) - Endy (V2)

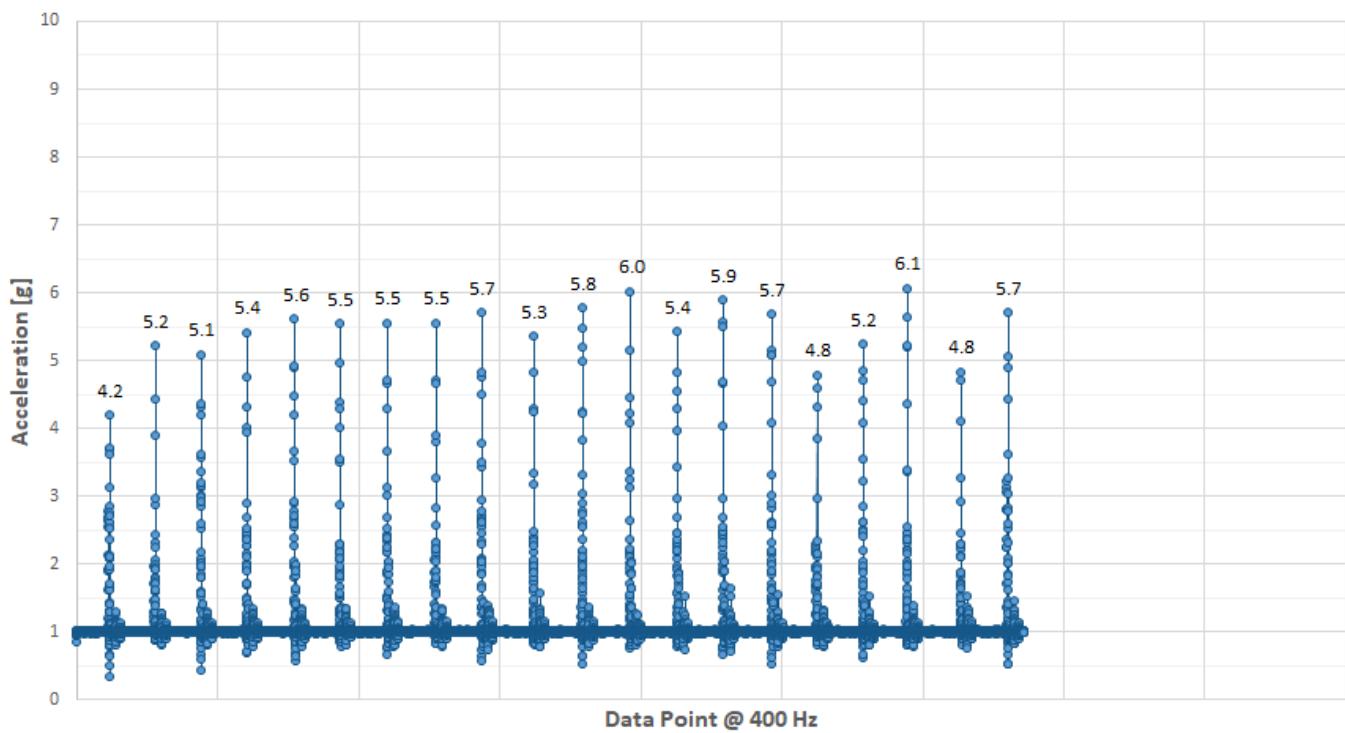


Z Acceleration (Up and Down) - Endy (V2)

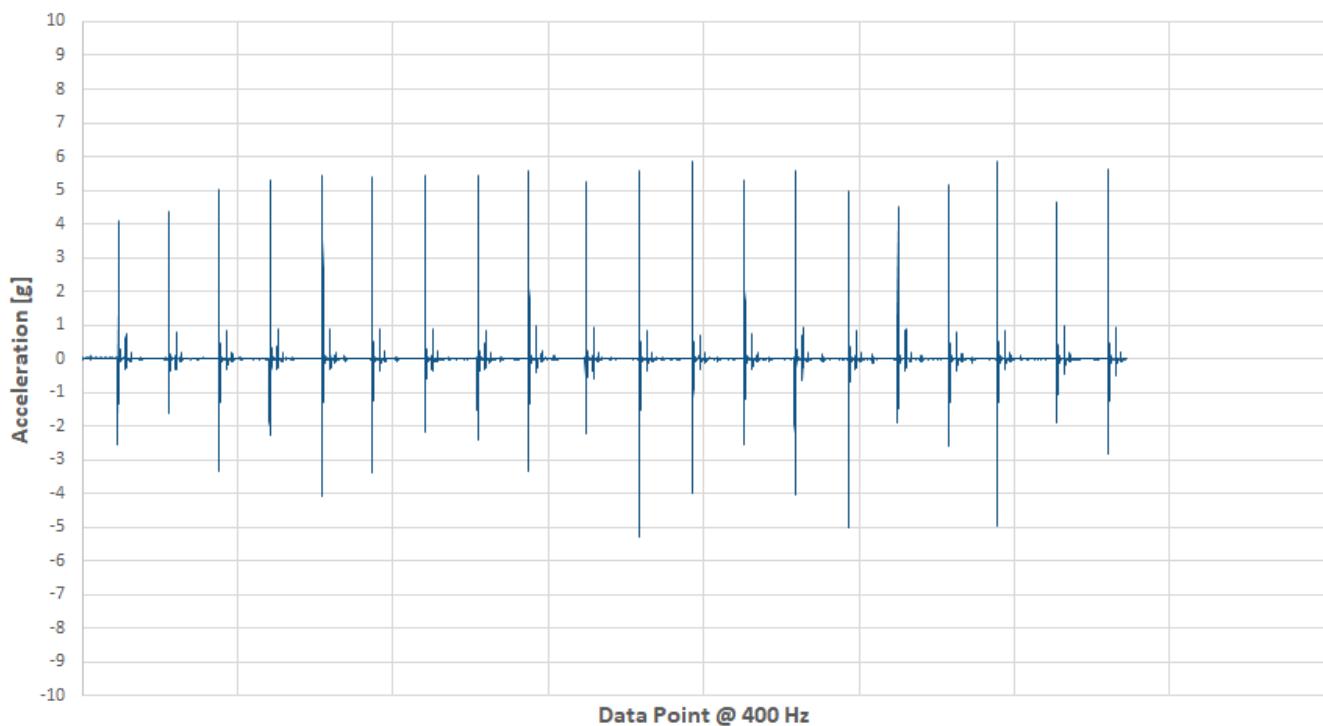


TEST 3 – HELIX

Vector Magnitude Acceleration - Helix



X Acceleration (Side to Side) - Helix

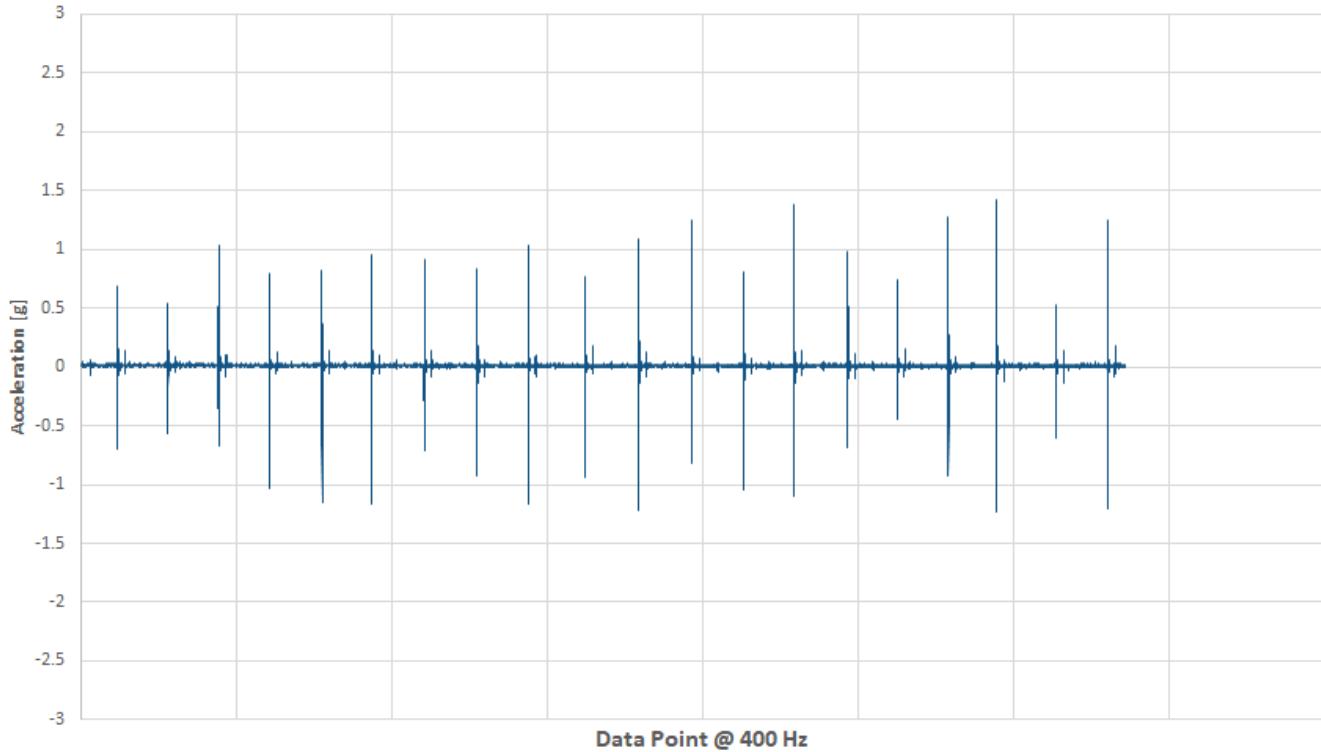




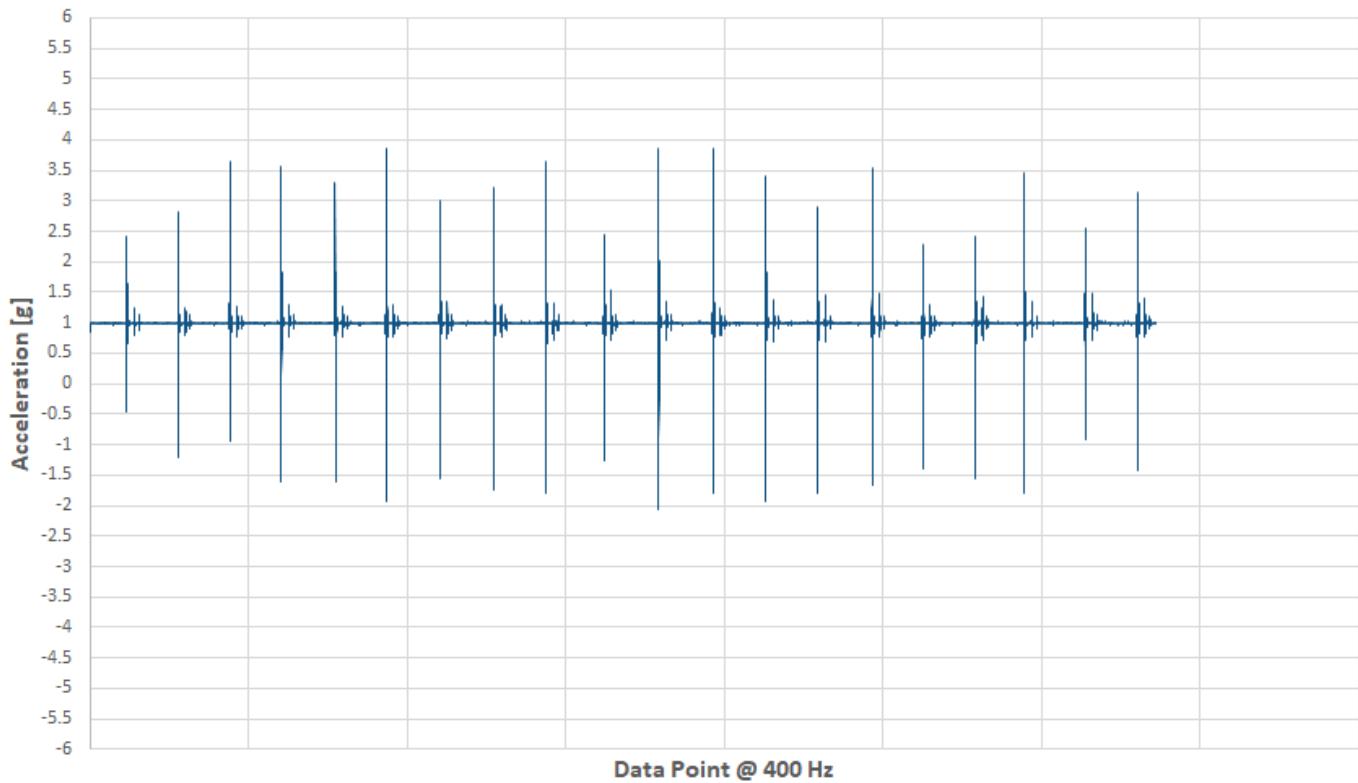
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Y Acceleration (Head to Toe) - Helix



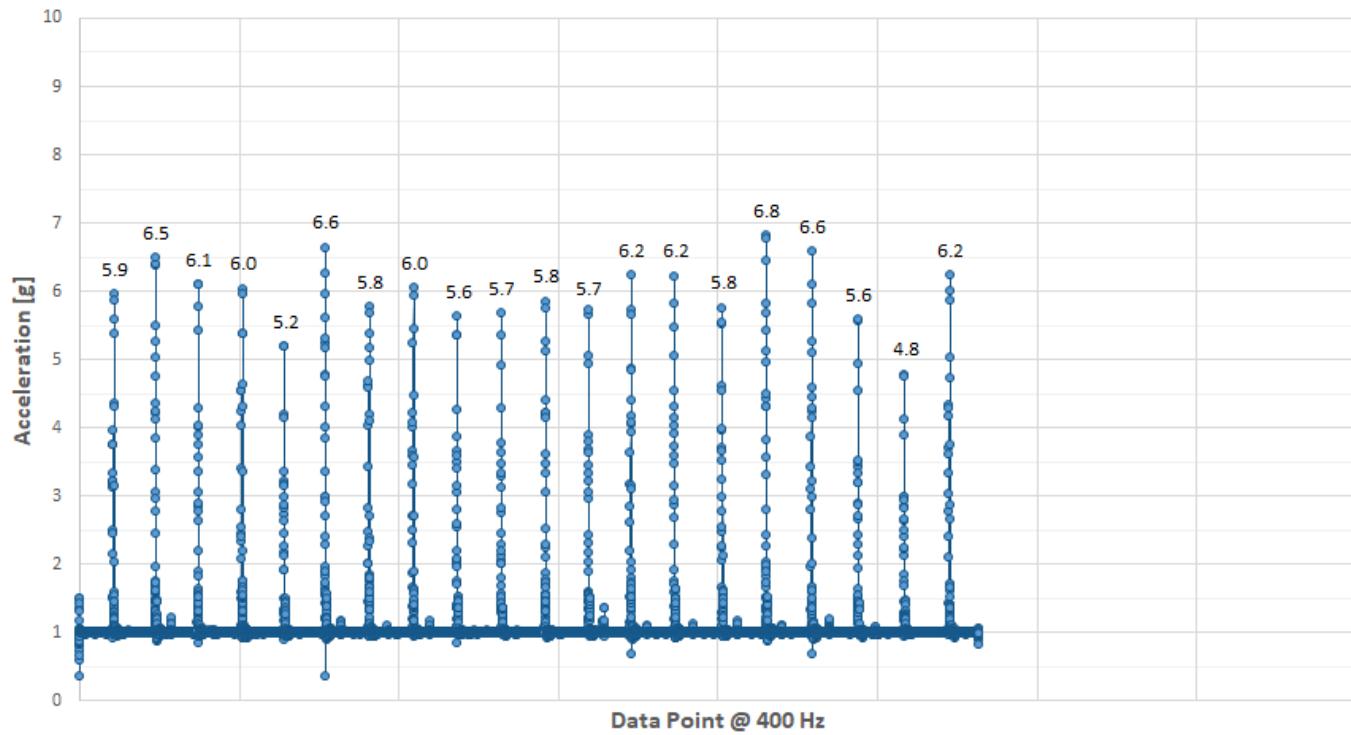
Z Acceleration (Up and Down) - Helix



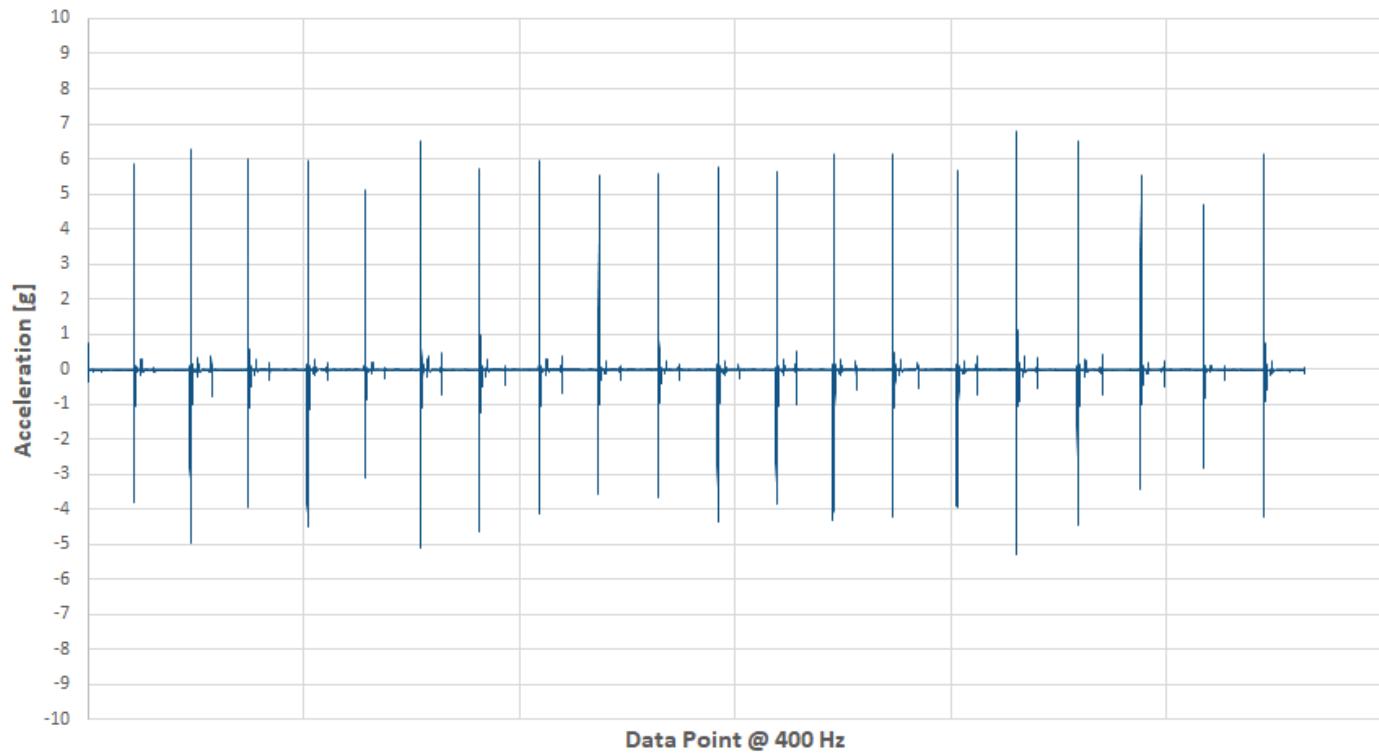


TEST 3 – LAYLA (SOFT)

Vector Magnitude Acceleration - Layla (Soft)

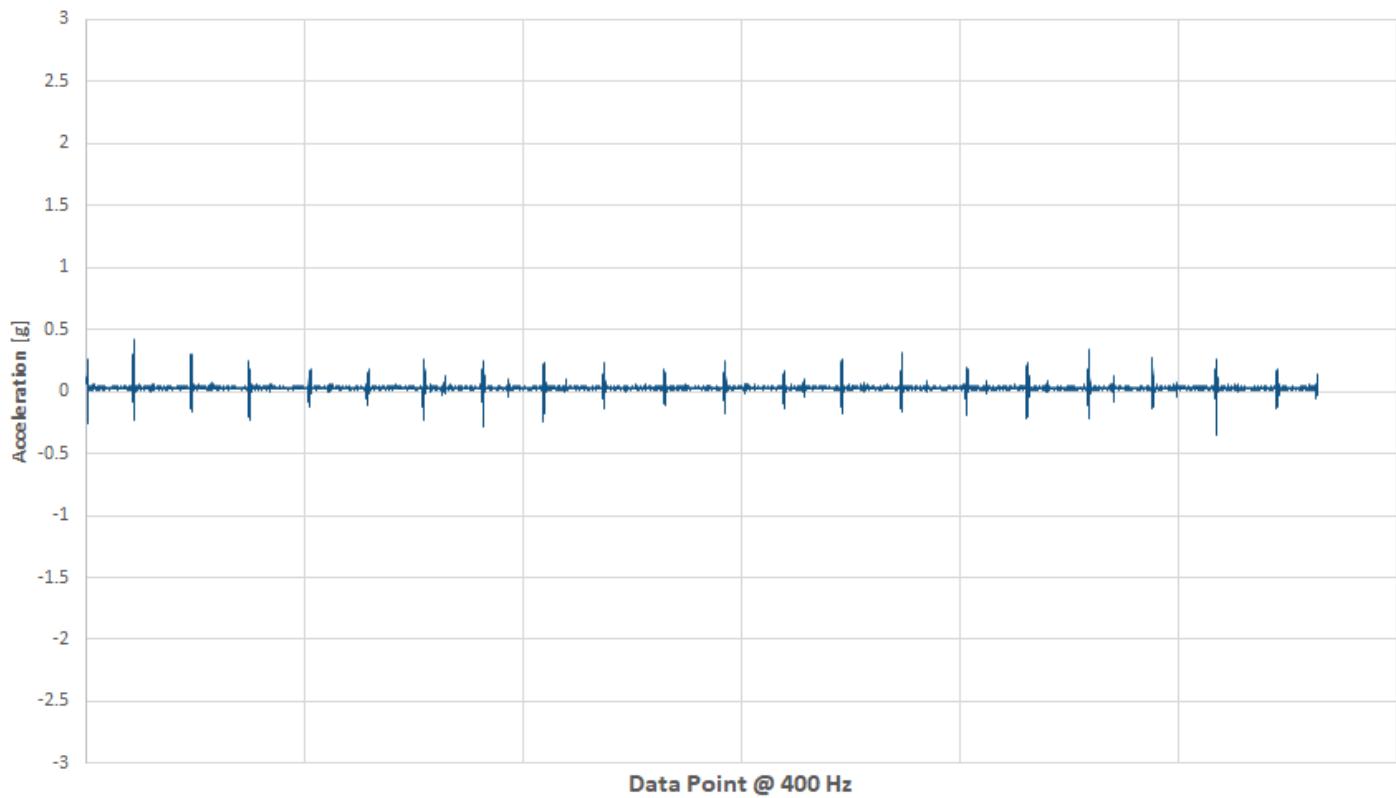


X Acceleration (Side to Side) - Layla (Soft)

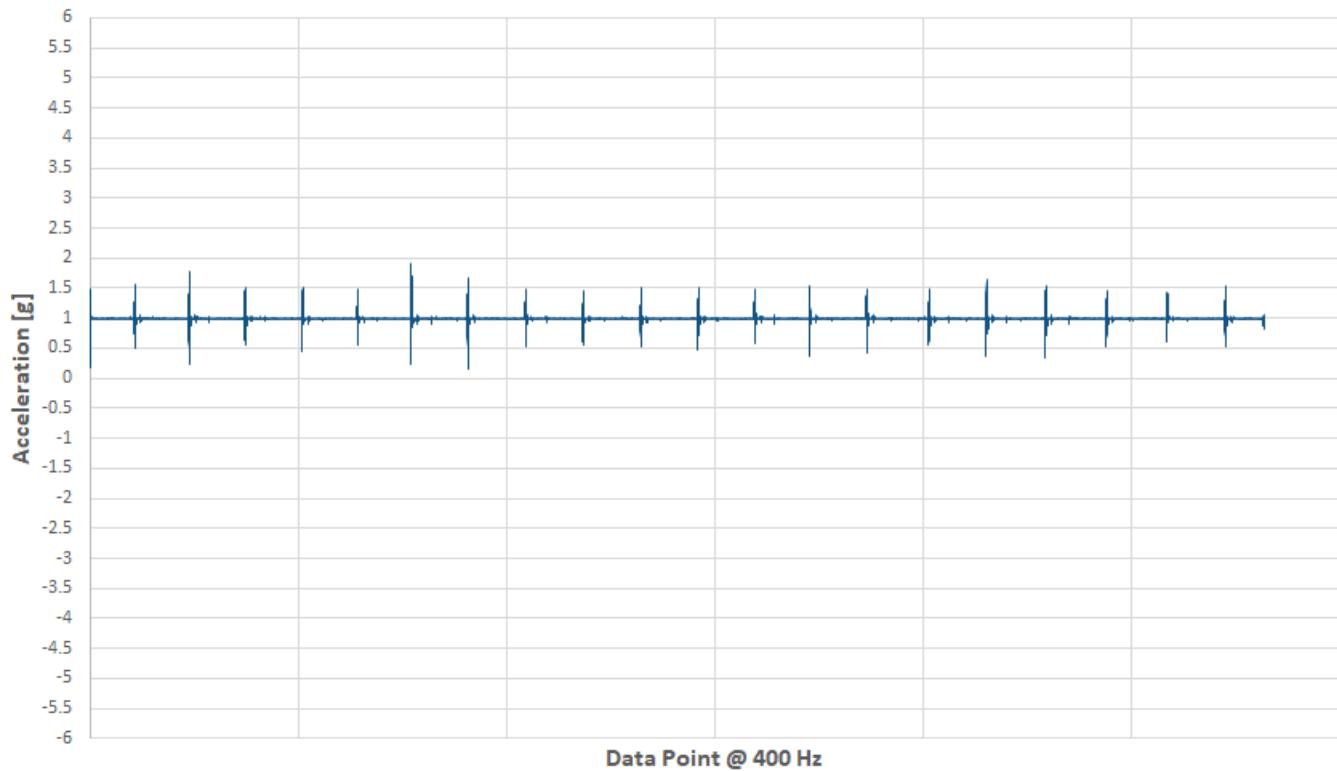




Y Acceleration (Head to Toe) - Layla (Soft)



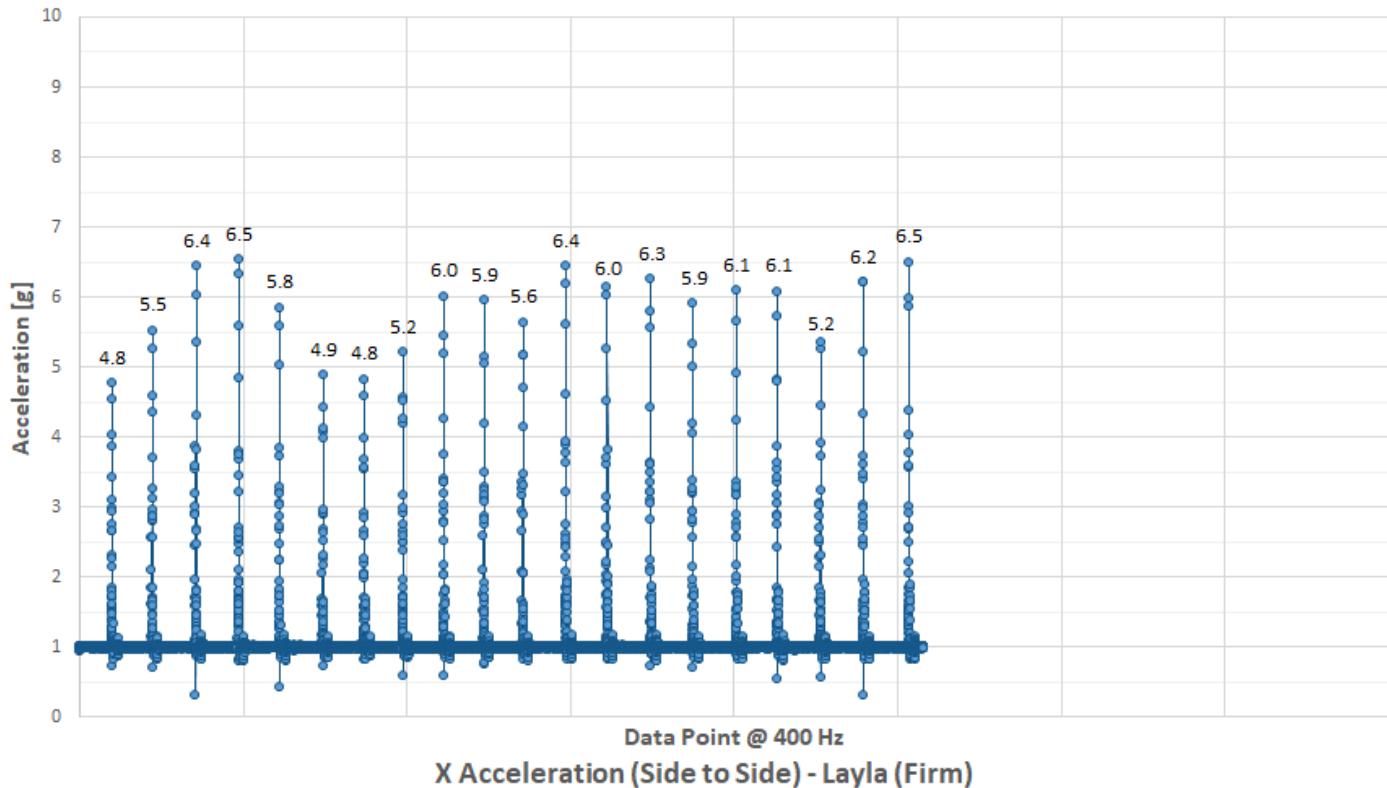
Z Acceleration (Up and Down) - Layla (Soft)



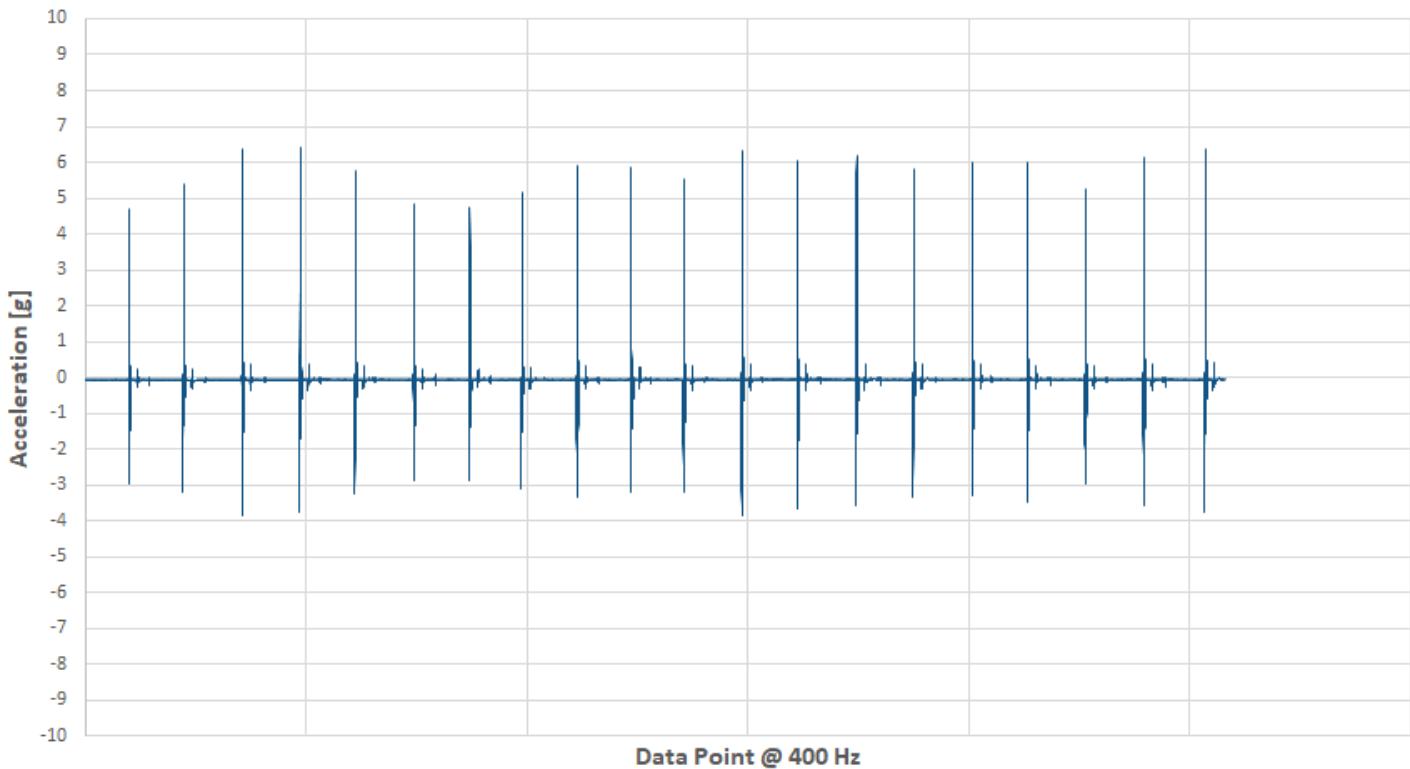


TEST 3 – LAYLA (FIRM)

Vector Magnitude Acceleration - Layla (Firm)



X Acceleration (Side to Side) - Layla (Firm)

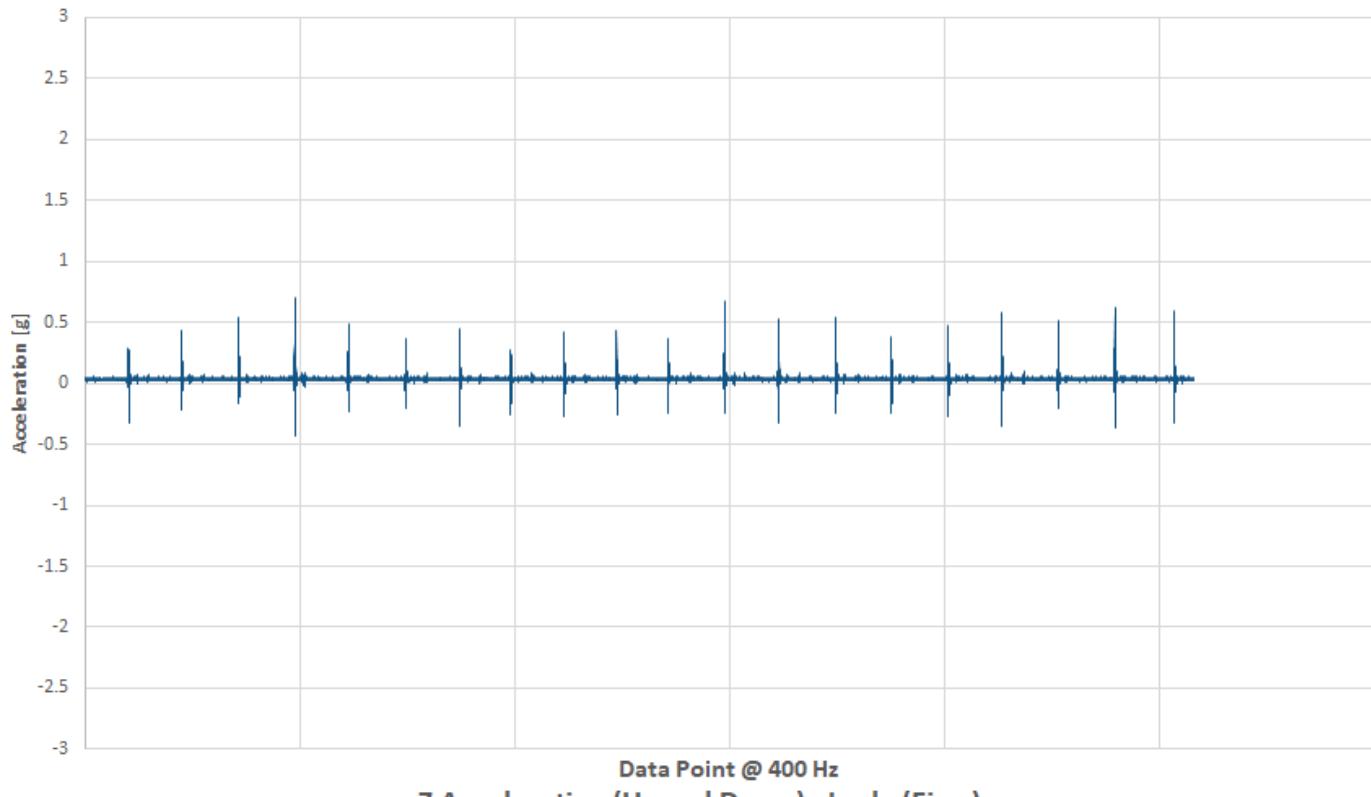




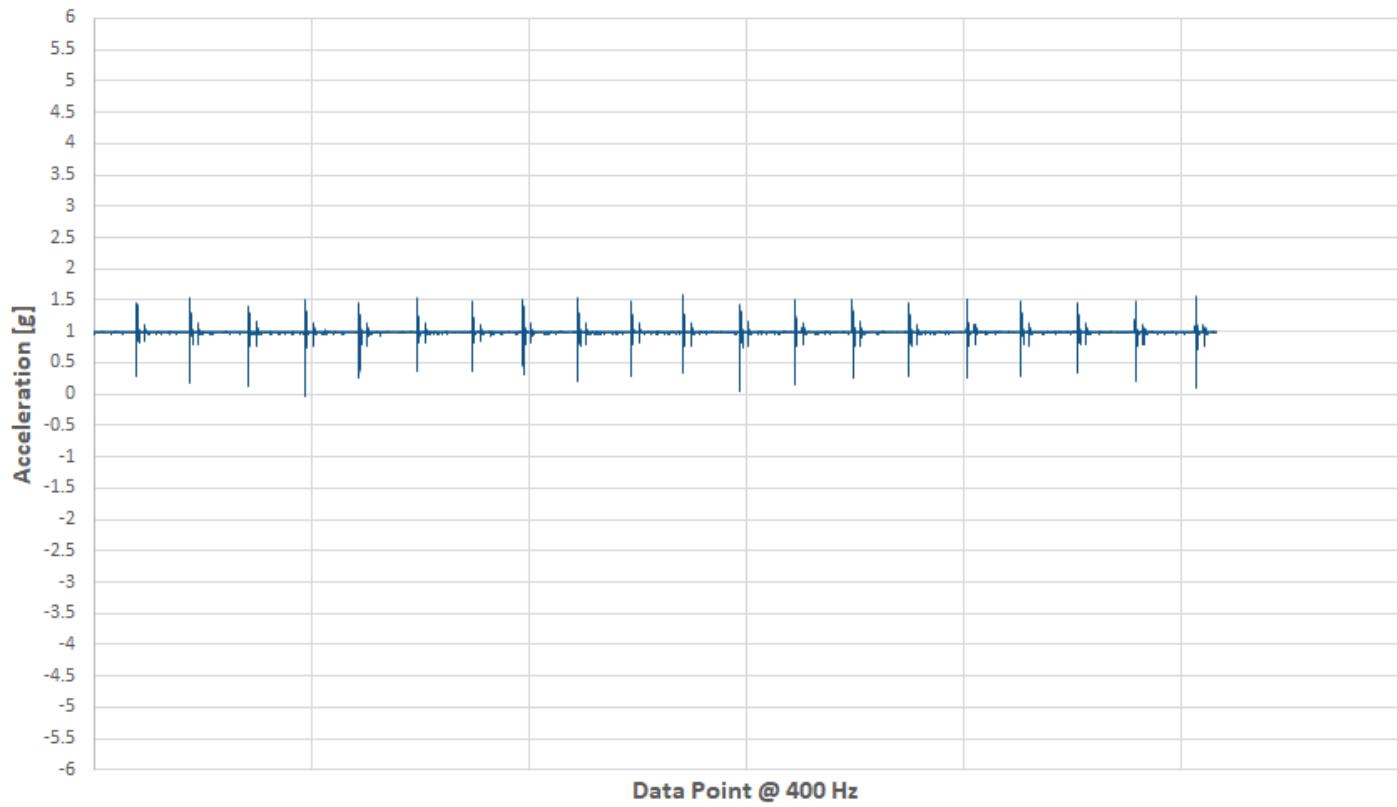
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Y Acceleration (Head to Toe) - Layla (Firm)



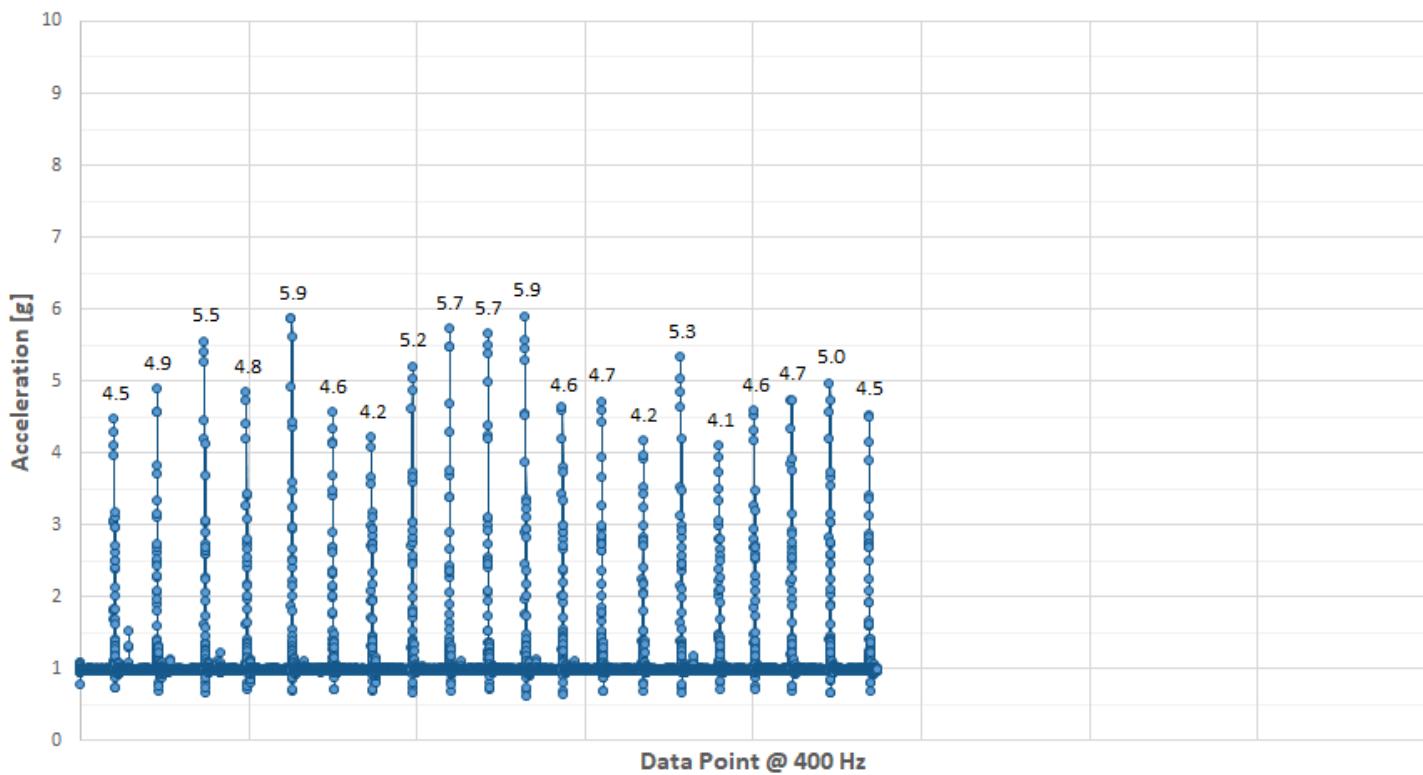
Z Acceleration (Up and Down) - Layla (Firm)



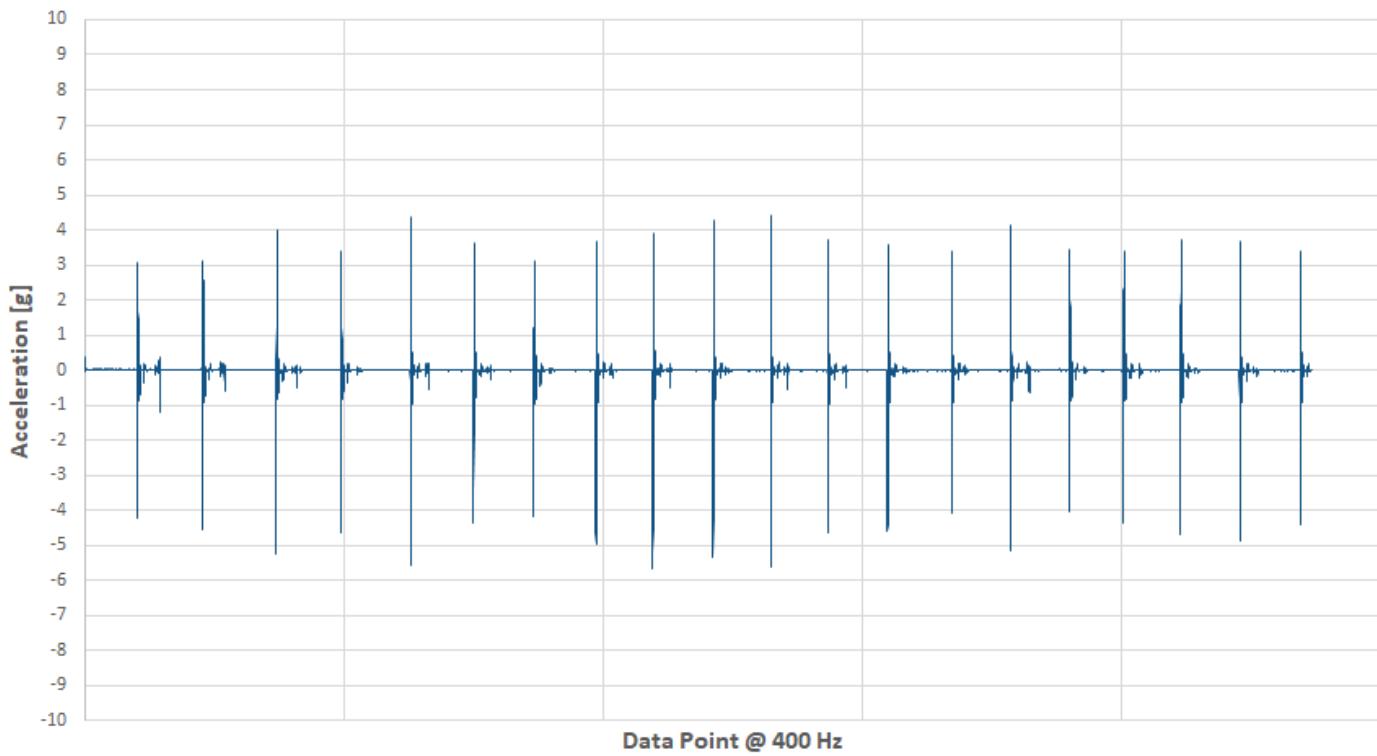


TEST 3 – PUFFY

Vector Magnitude Acceleration - Puffy

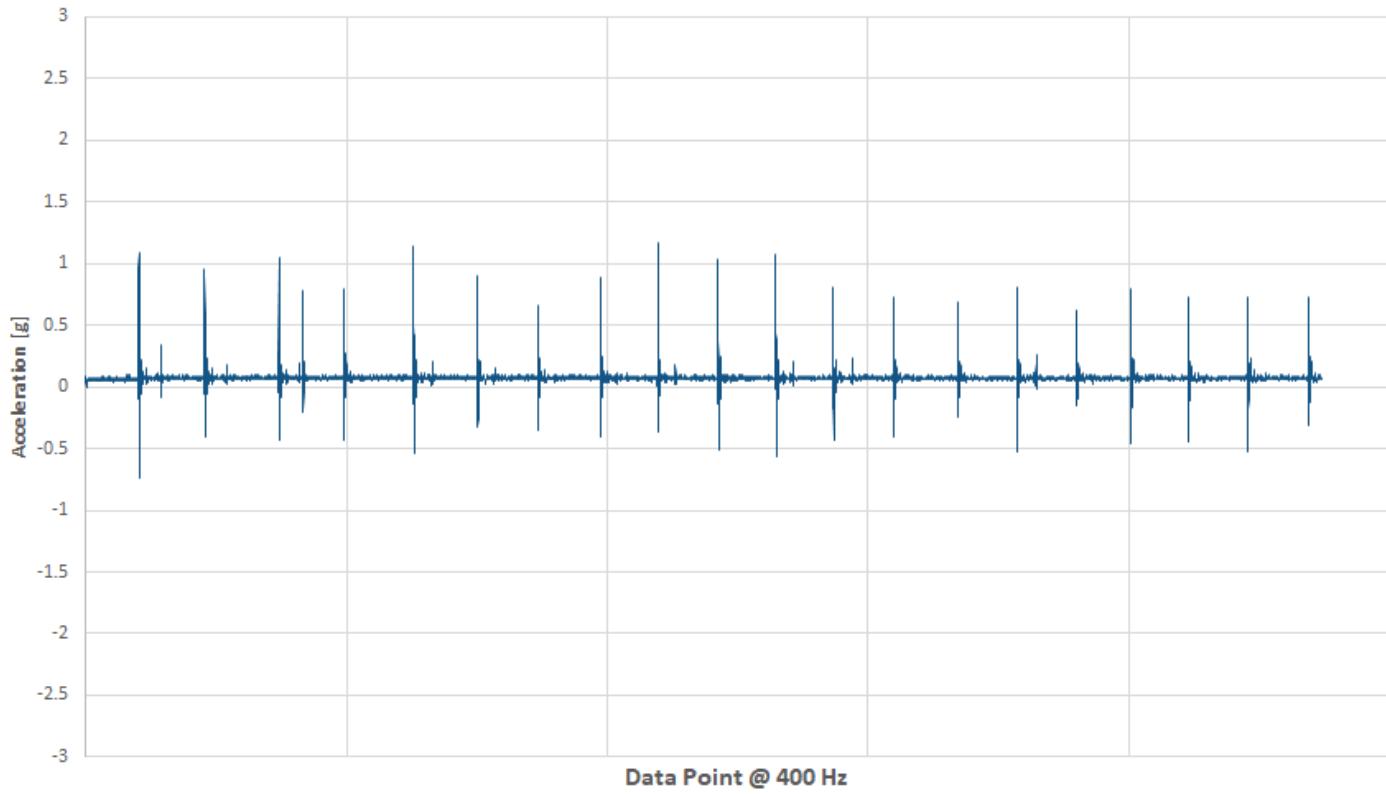


X Acceleration (Side to Side) - Puffy

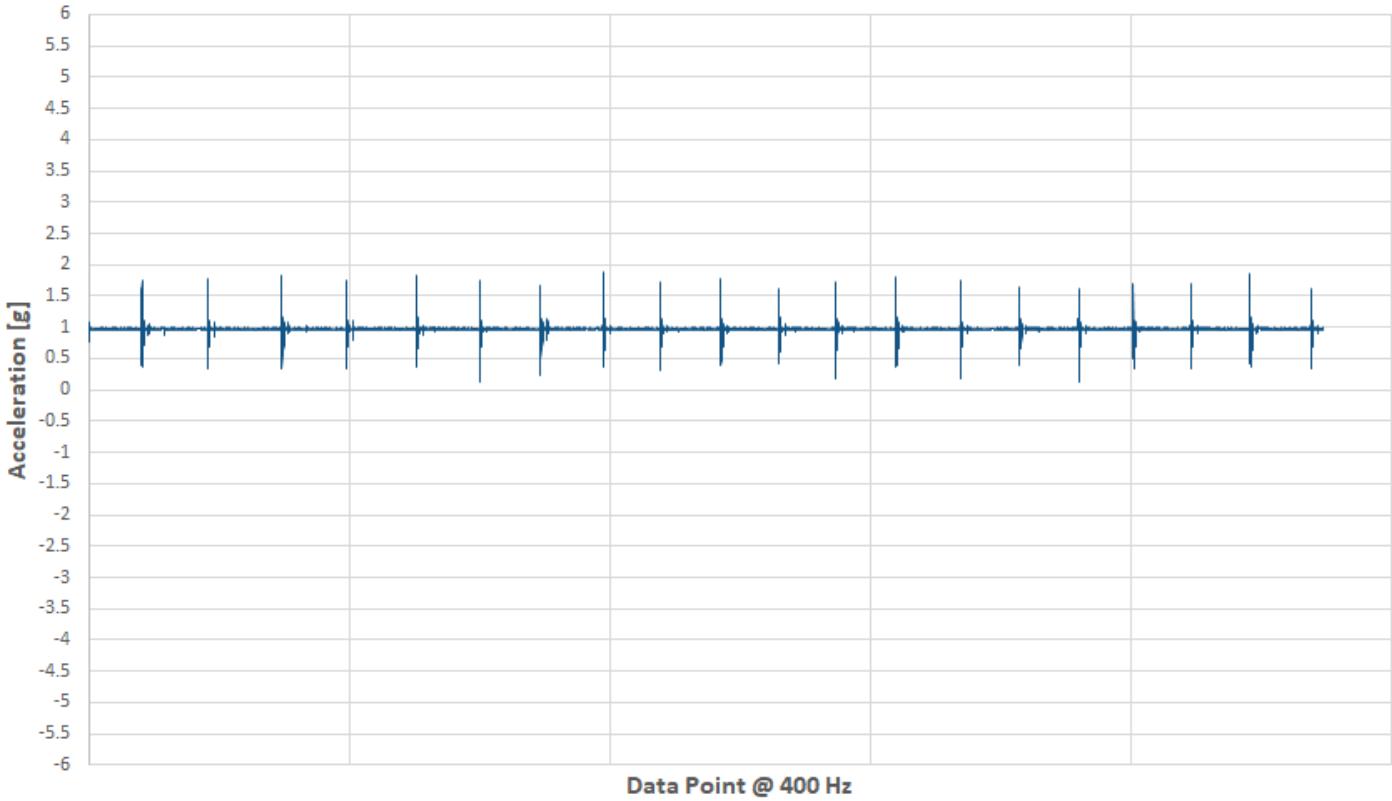




Y Acceleration (Head to Toe) - Puffy



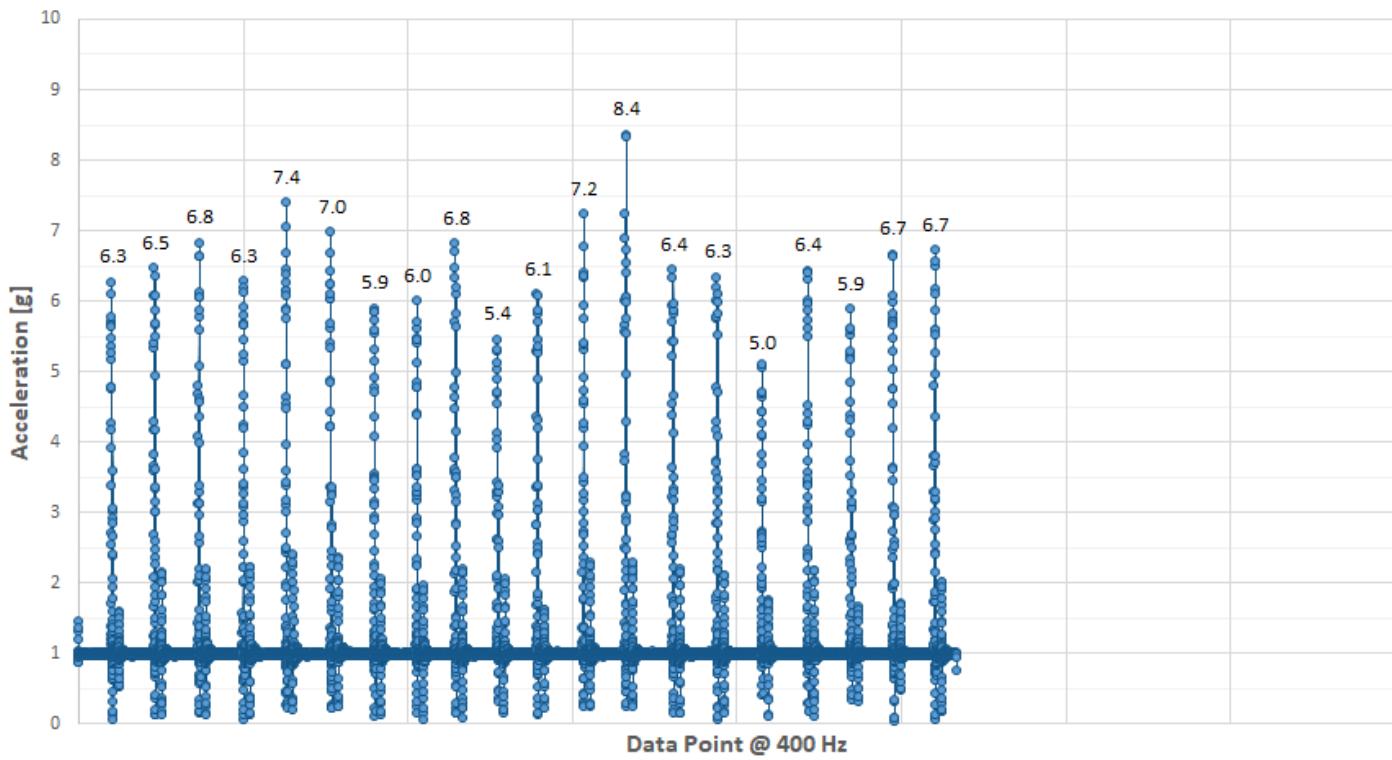
Z Acceleration (Up and Down) - Puffy



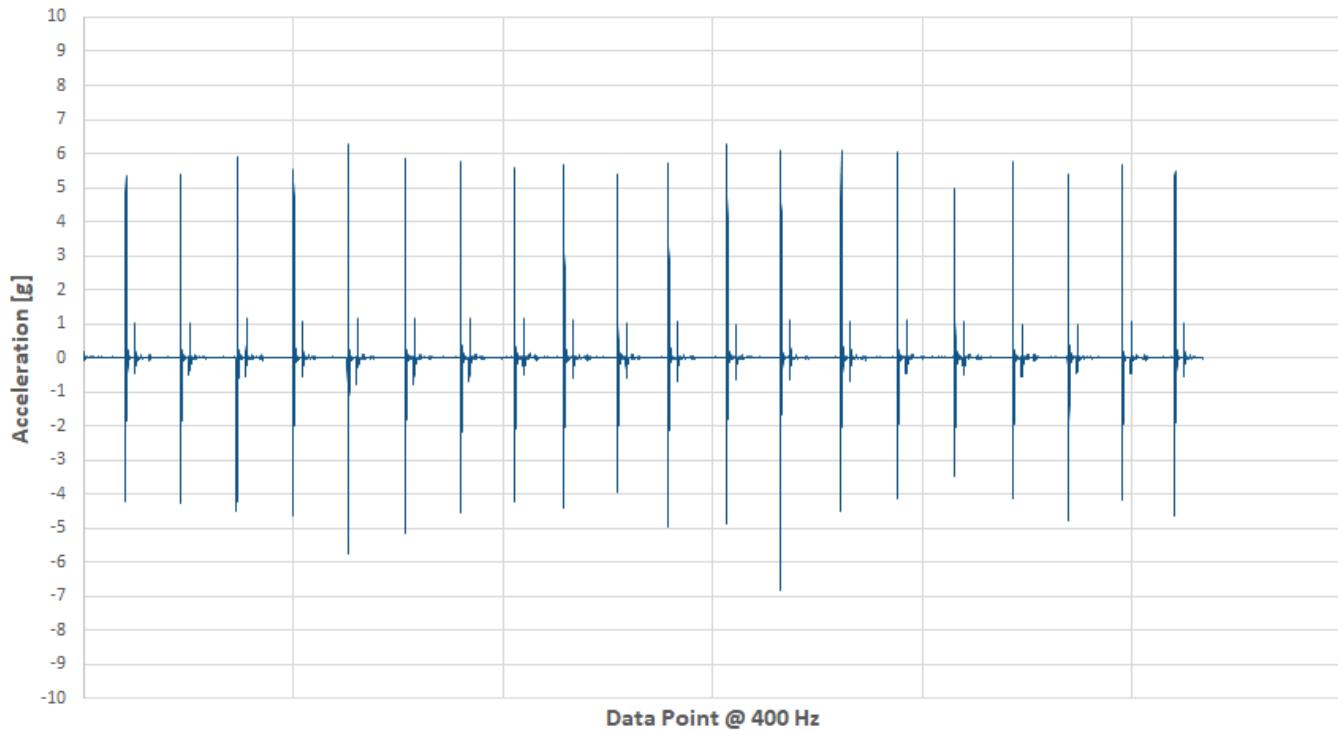


TEST 3 – SEALY POSTUREPEDIC

Vector Magnitude Acceleration - Sealy Posturepedic

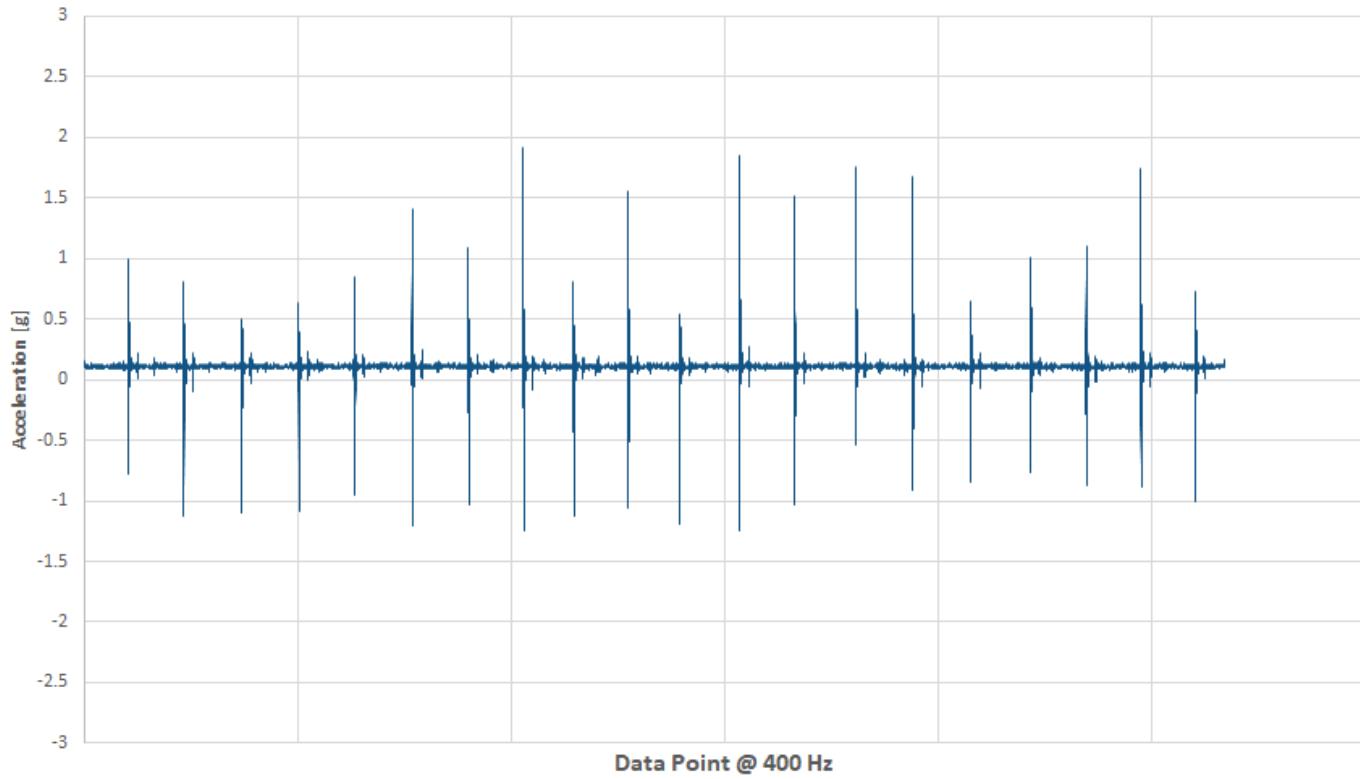


X Acceleration (Side to Side) - Sealy Posturepedic

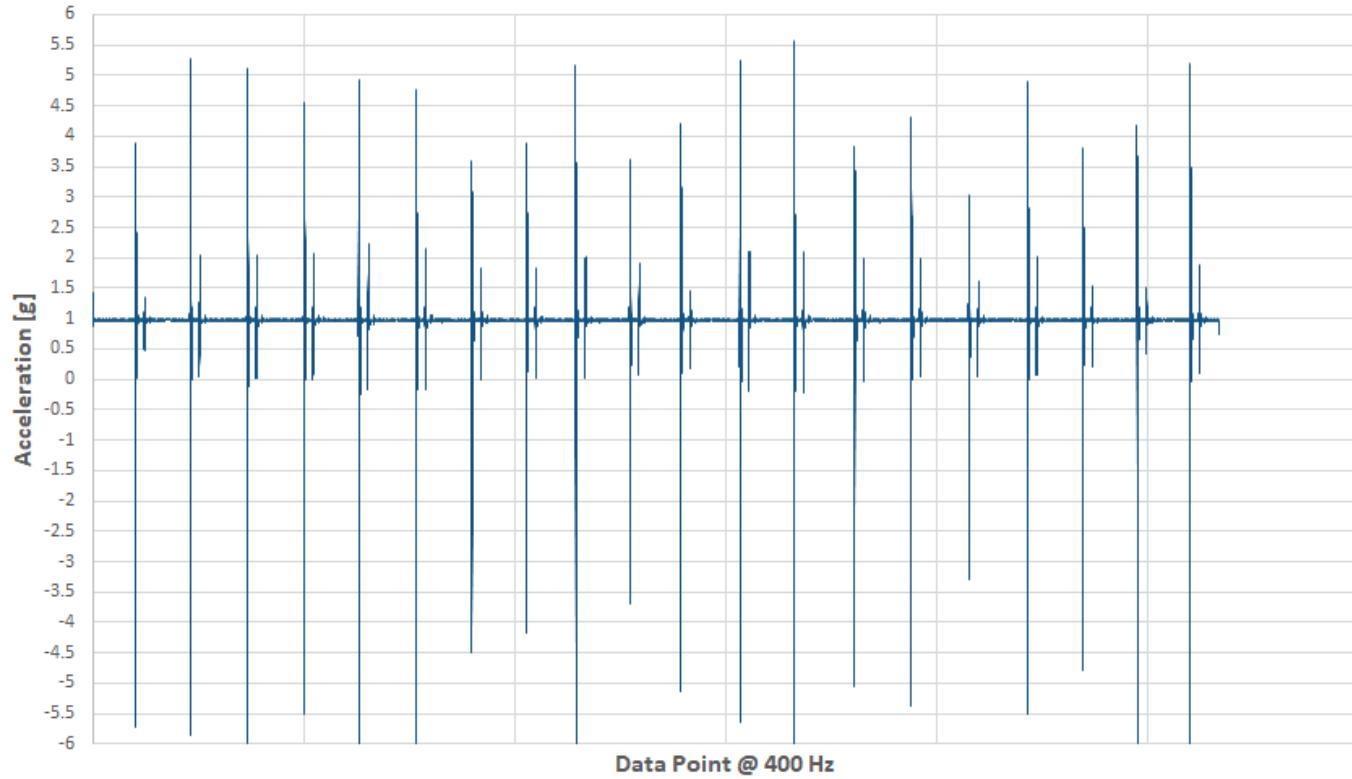




Y Acceleration (Head to Toe) - Sealy Posturepedic



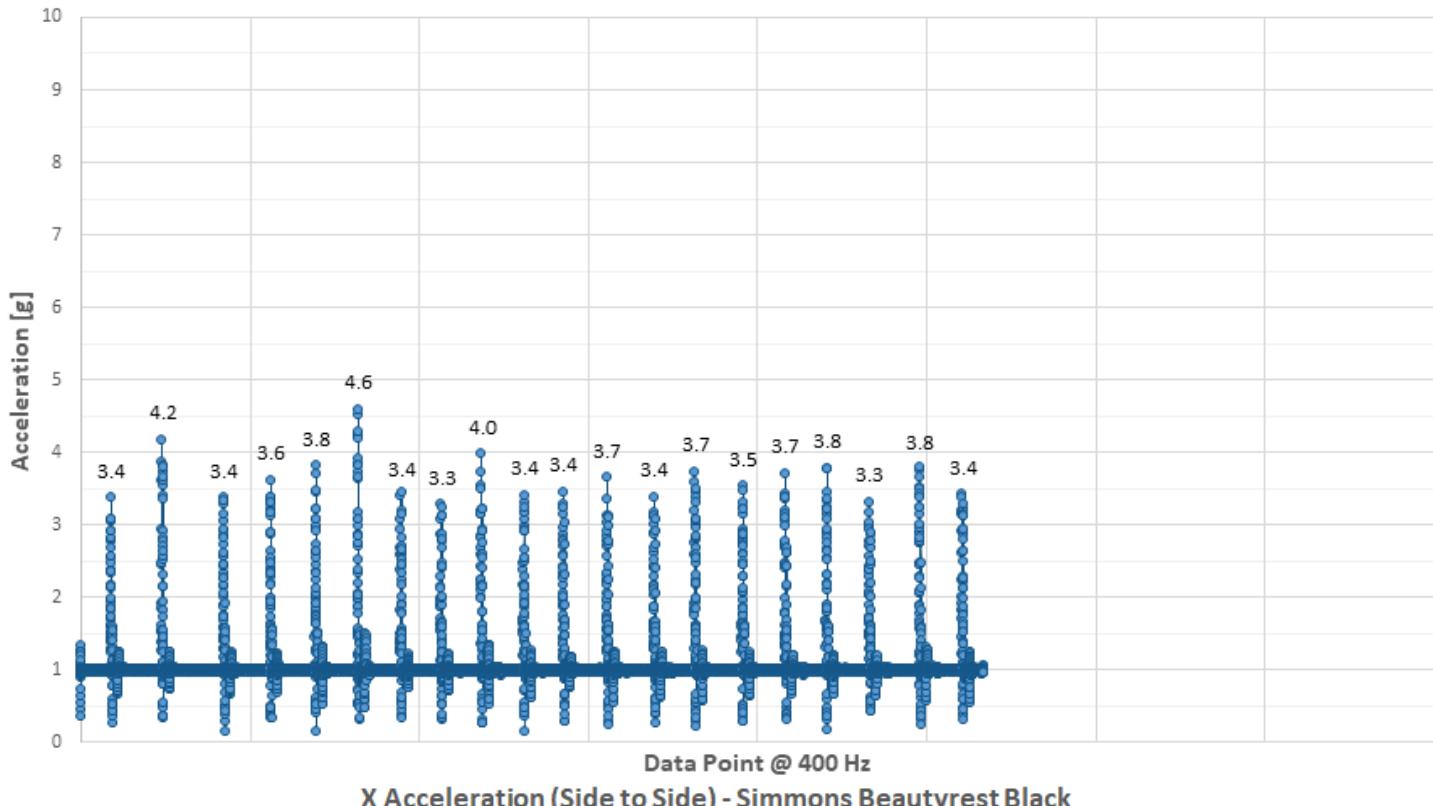
Z Acceleration (Up and Down) - Sealy Posturepedic



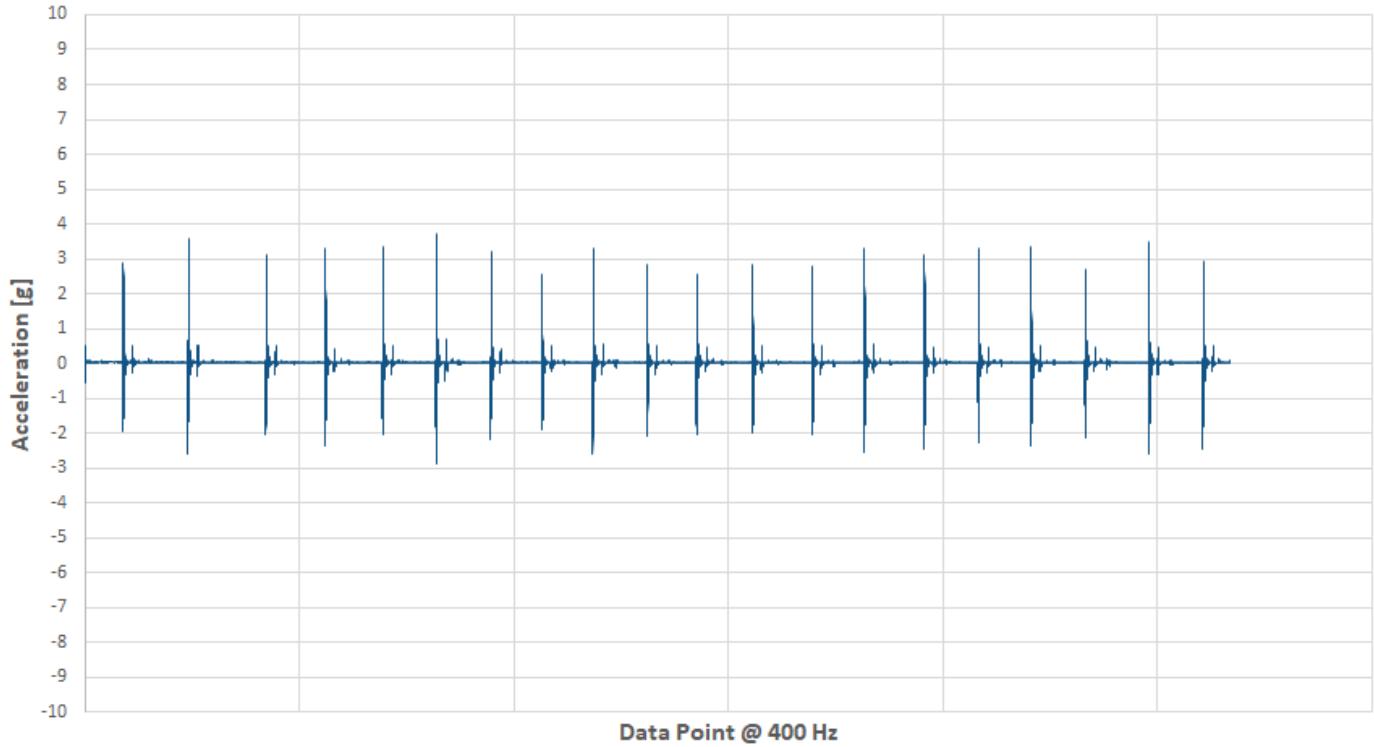


TEST 3 – SIMMONS BEAUTYREST BLACK

Vector Magnitude Acceleration - Simmons Beautyrest Black

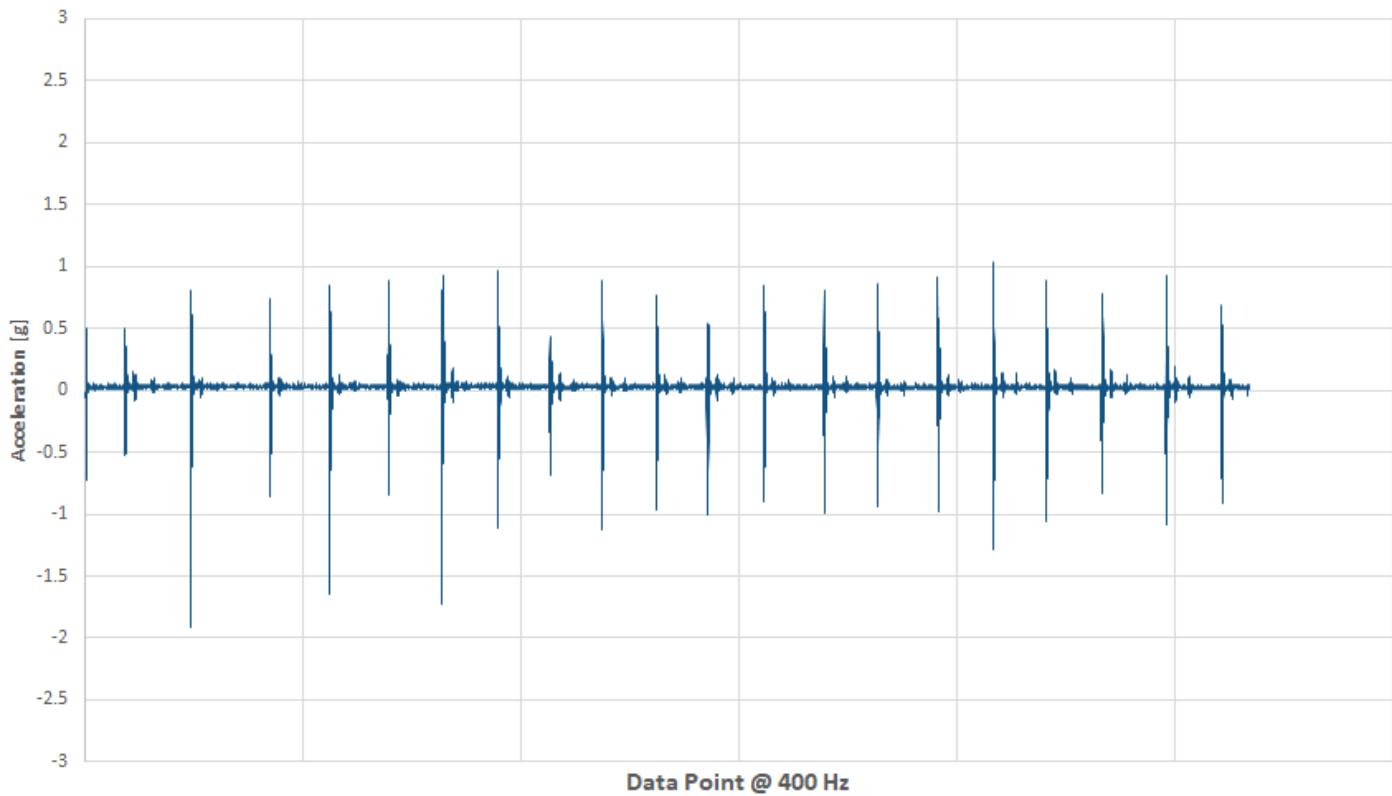


X Acceleration (Side to Side) - Simmons Beautyrest Black

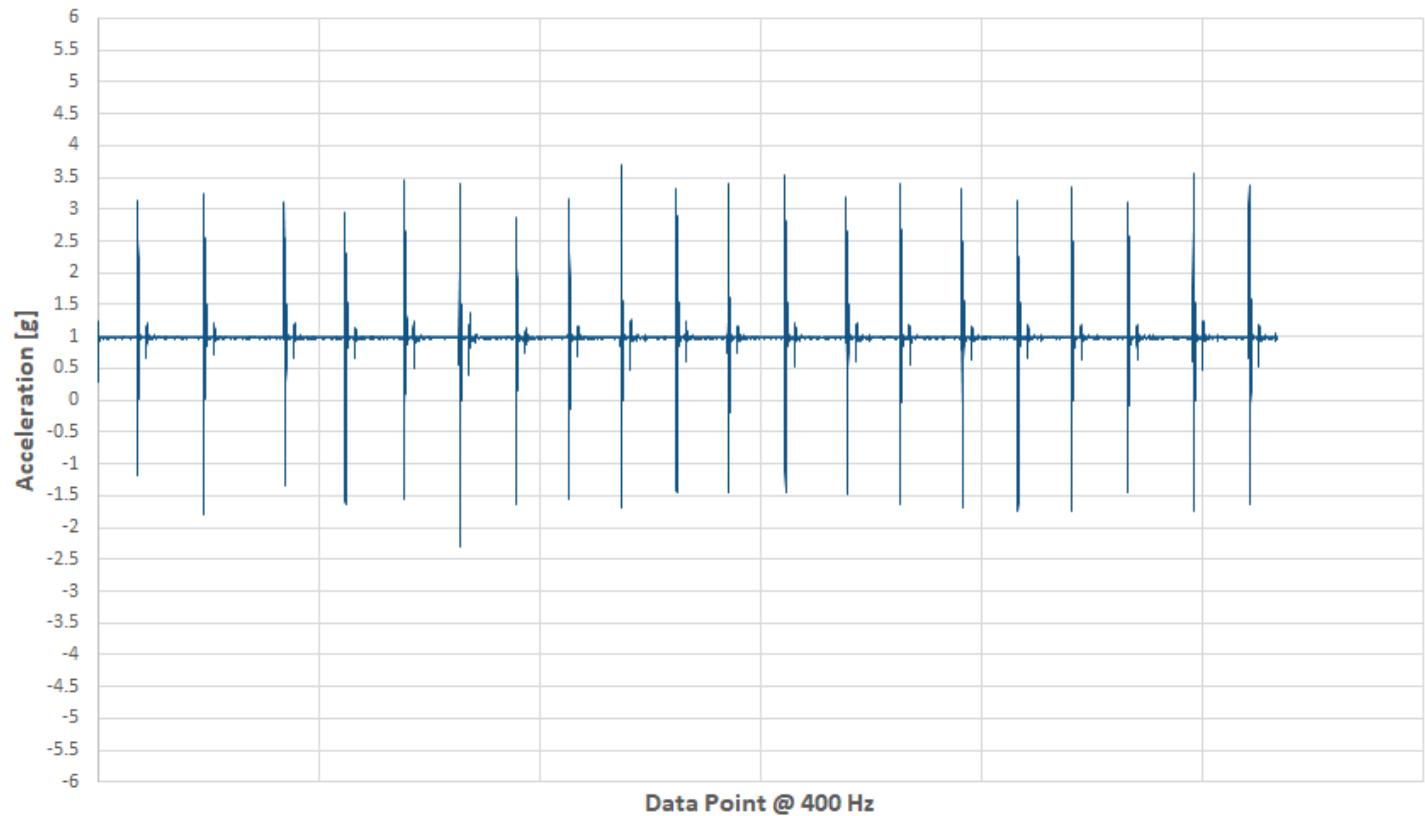




Y Acceleration (Head to Toe) - Simmons Beautyrest Black



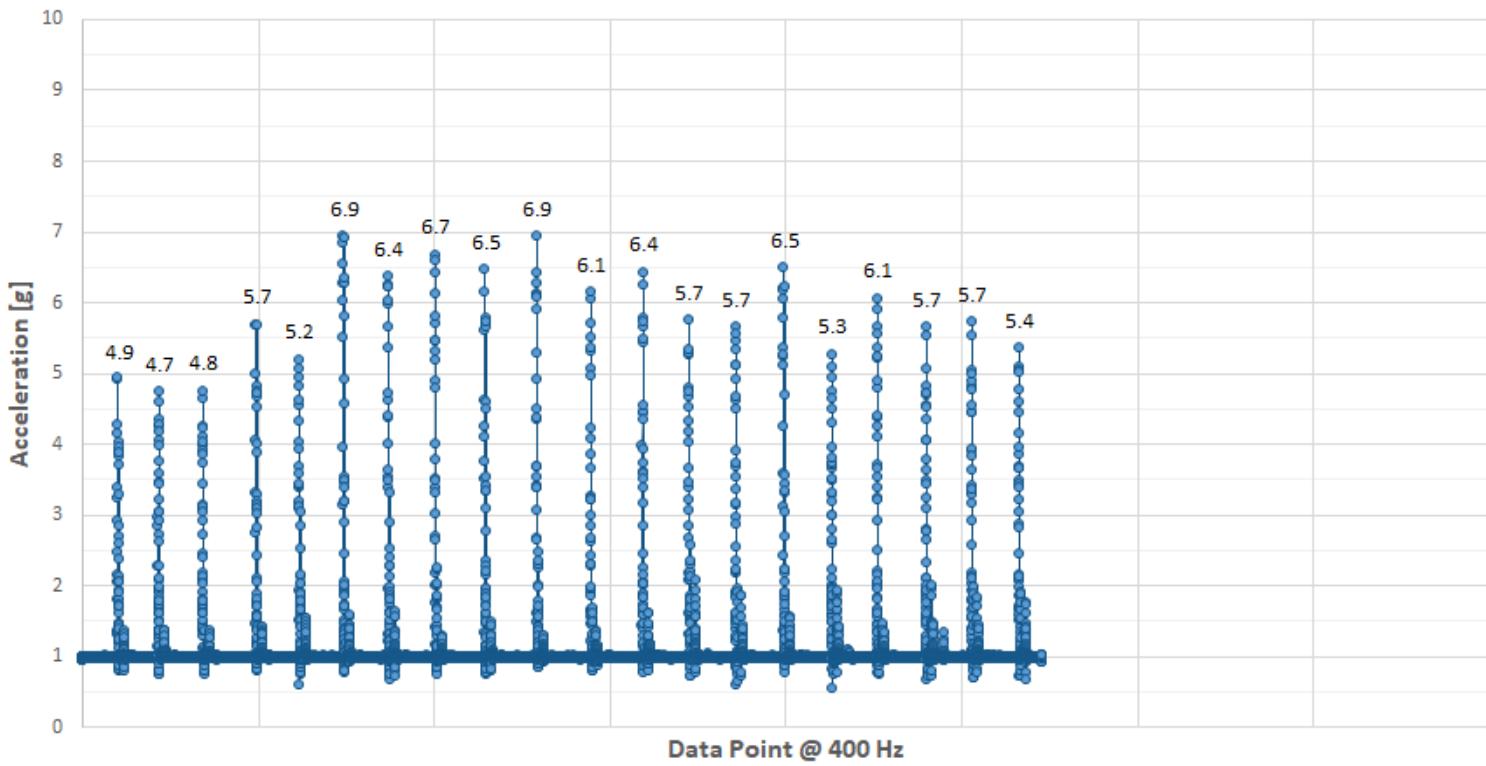
Z Acceleration (Up and Down) - Simmons Beautyrest Black



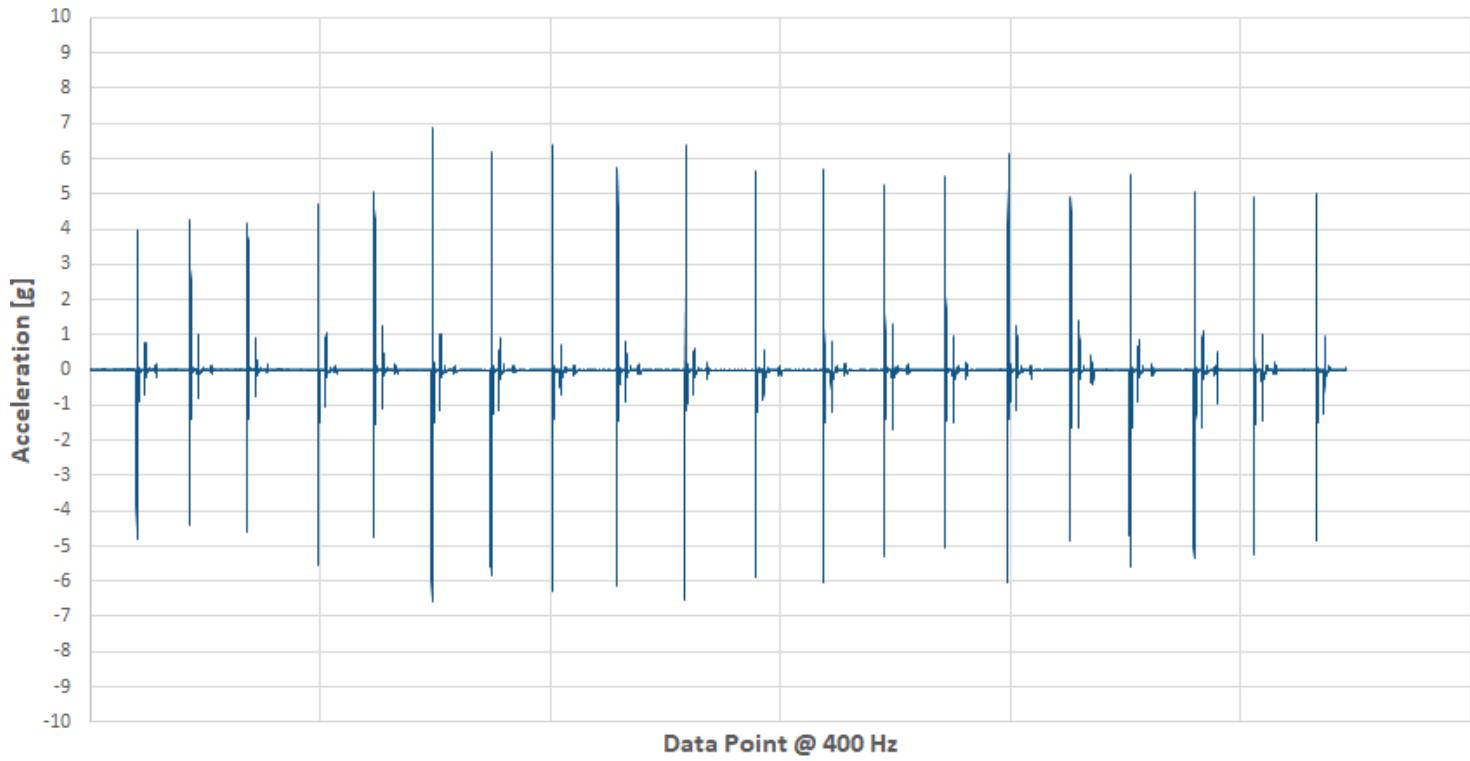


TEST 3 – BLOOM AIR

Vector Magnitude Acceleration - Bloom Air



X Acceleration (Side to Side) - Bloom Air

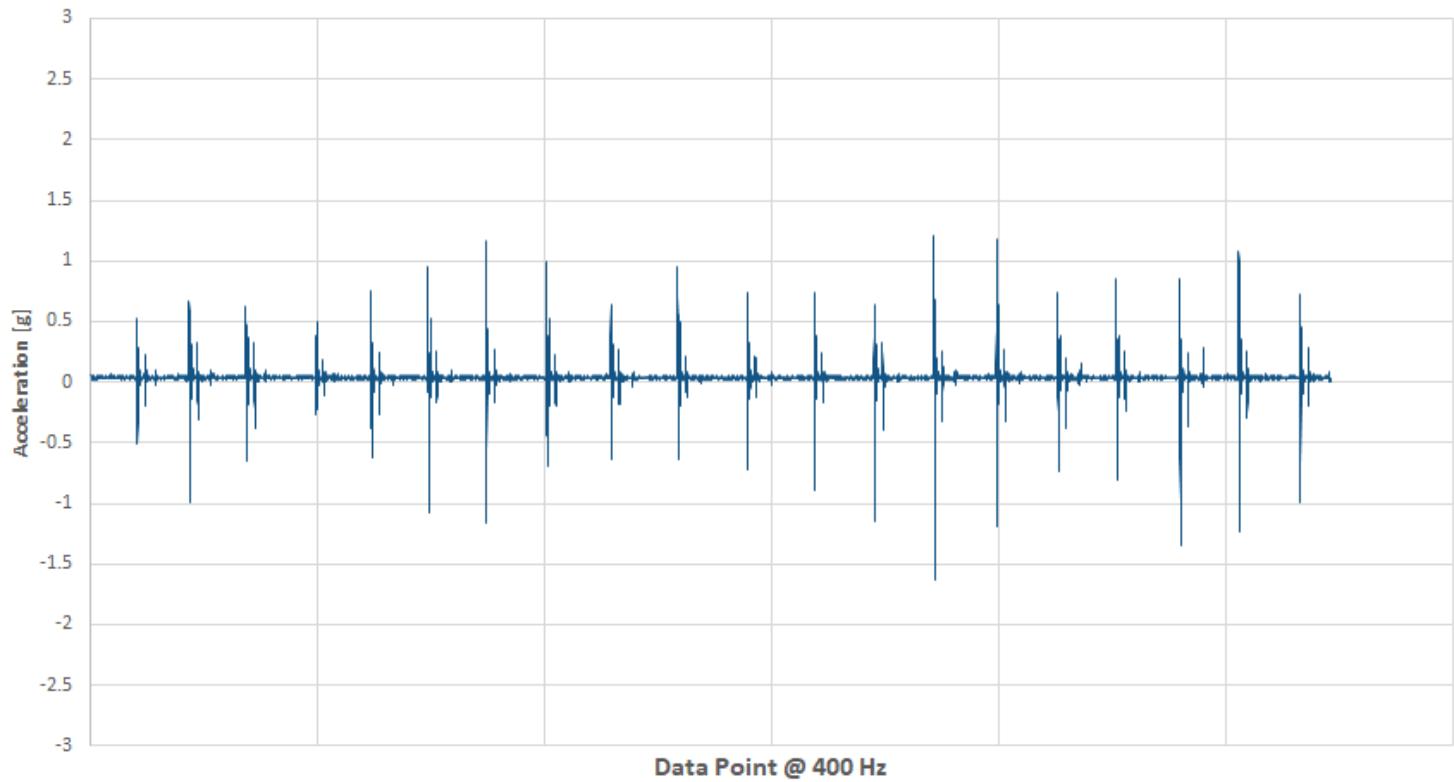




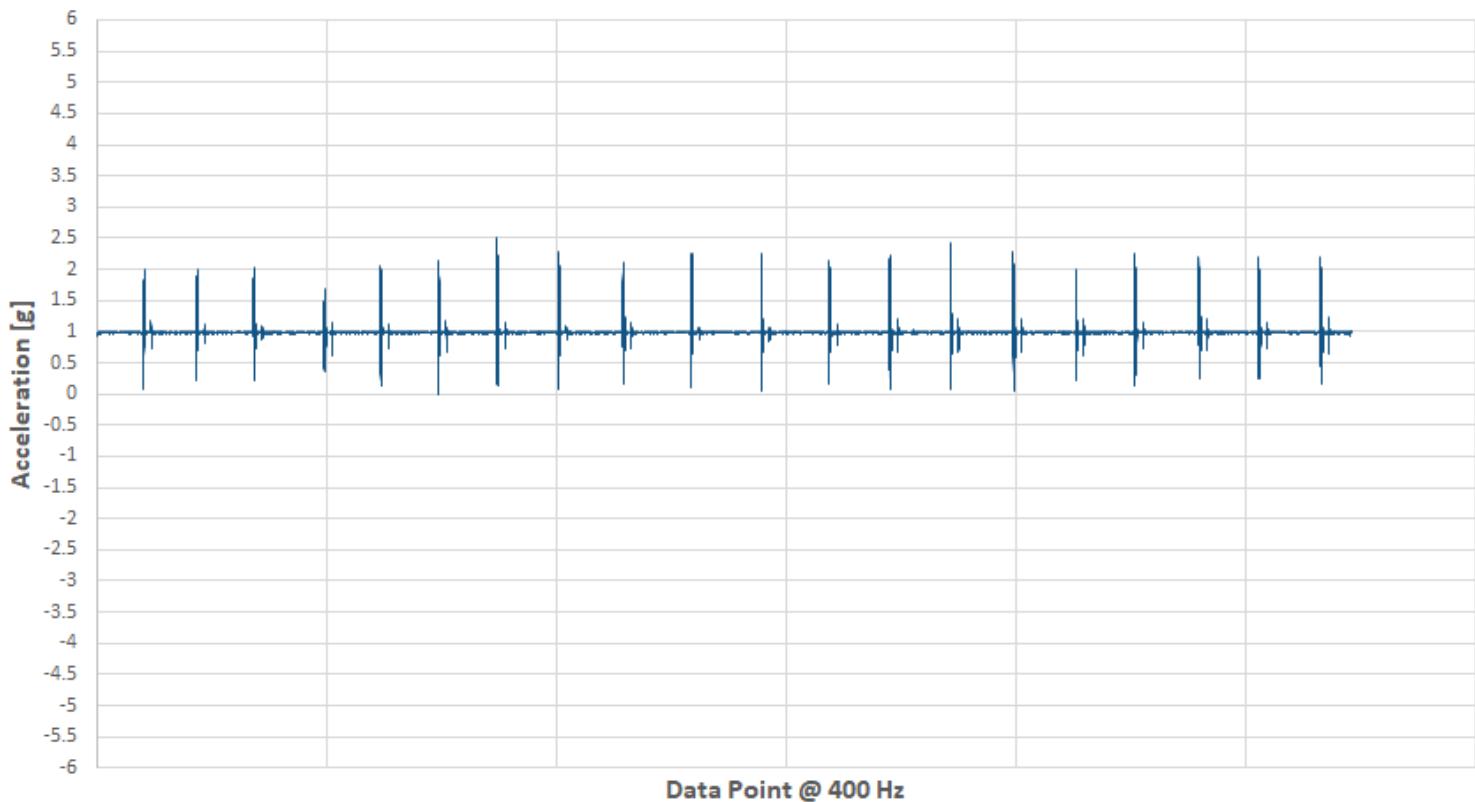
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Y Acceleration (Head to Toe) - Bloom Air

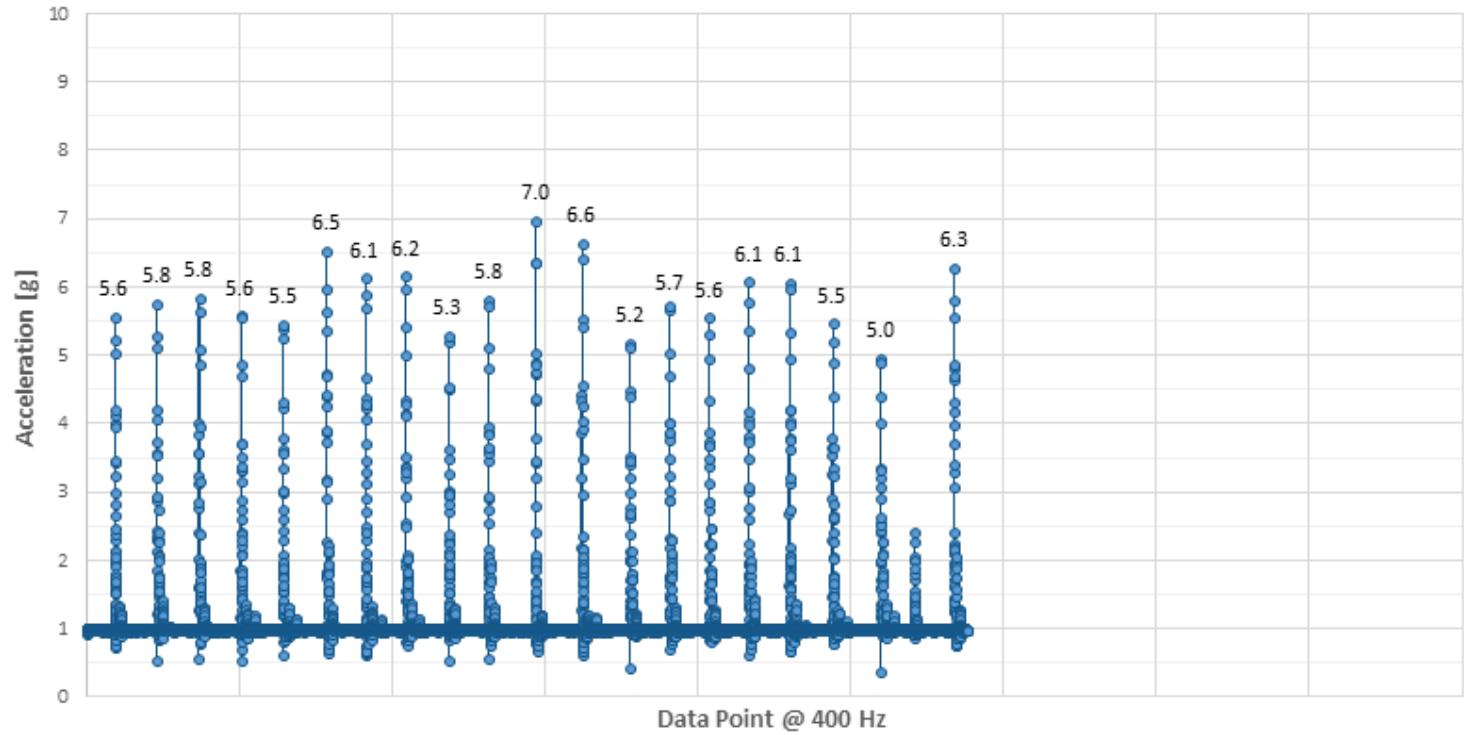


Z Acceleration (Up and Down) - Bloom Air

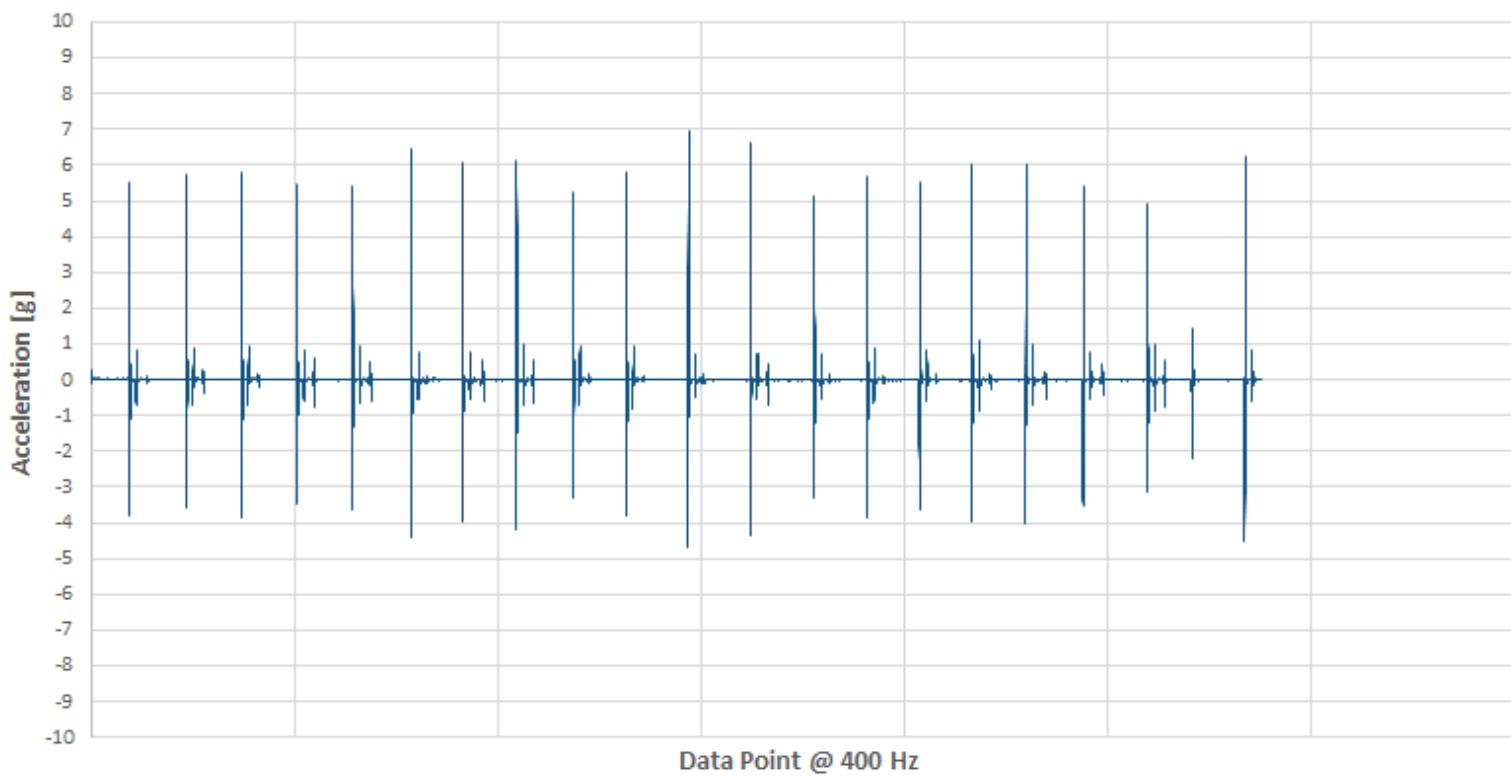


TEST 3 – BLOOM MIST

Vector Magnitude Acceleration - Bloom Mist

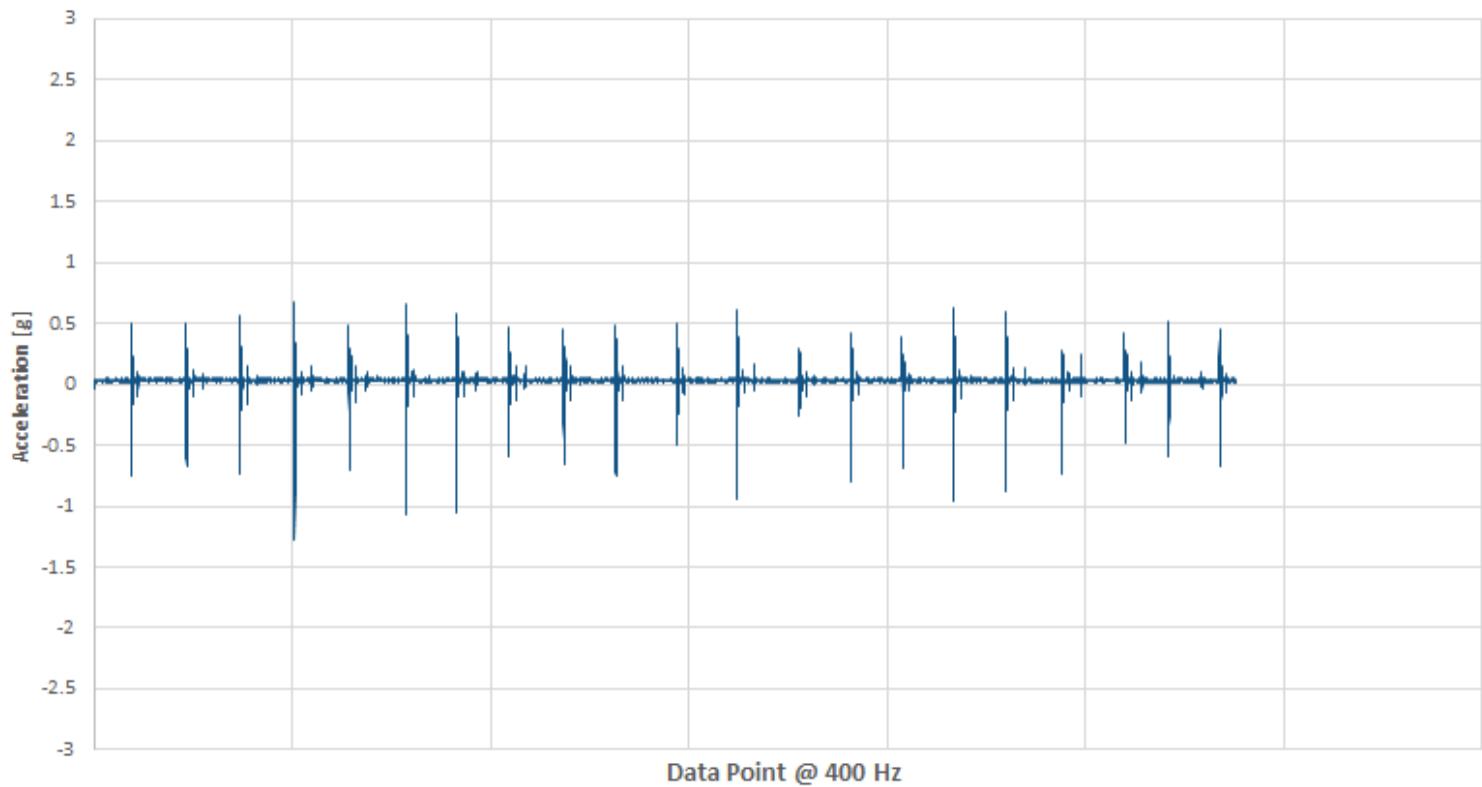


X Acceleration (Side to Side) - Bloom Mist

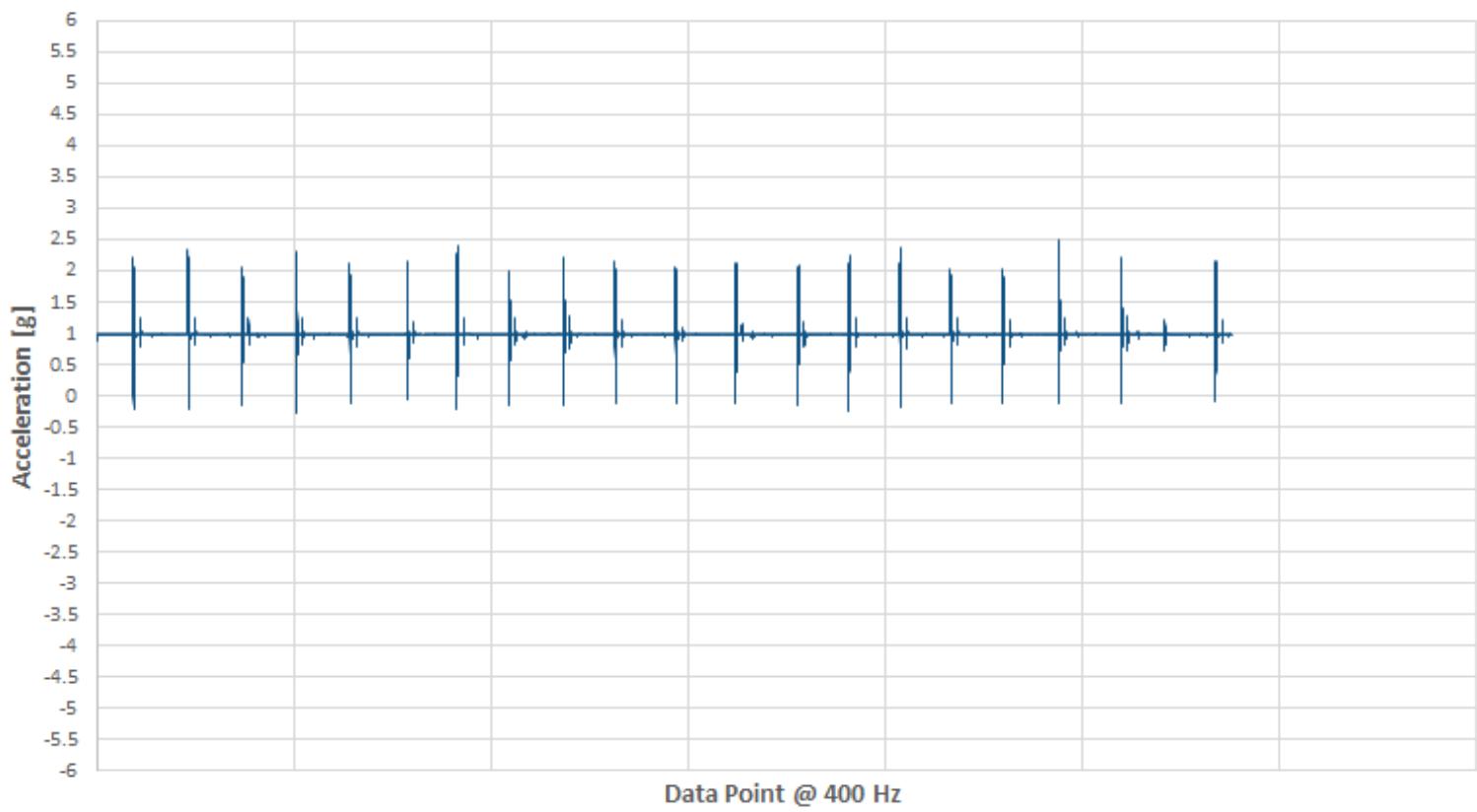




Y Acceleration (Head to Toe) - Bloom Mist

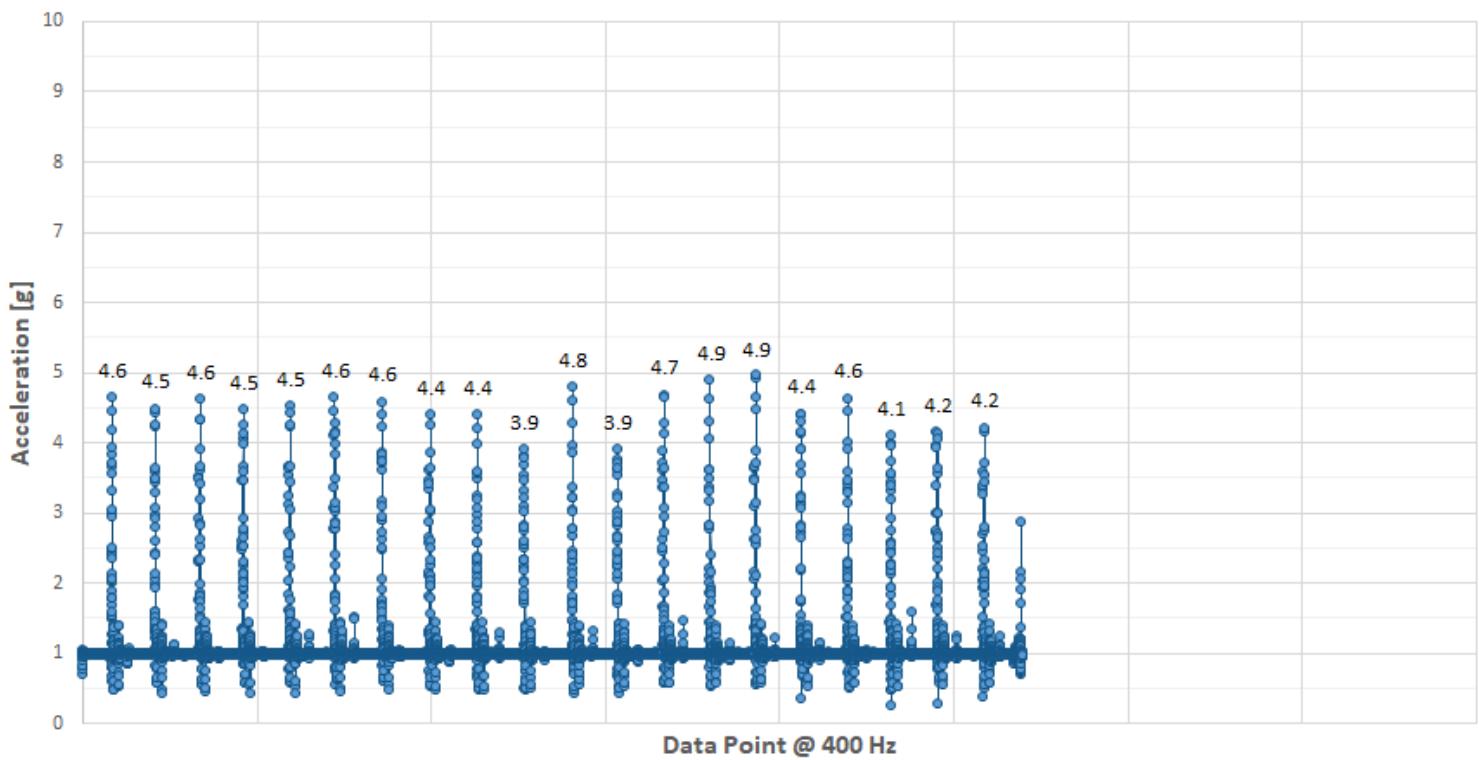


Z Acceleration (Up and Down) - Bloom Mist

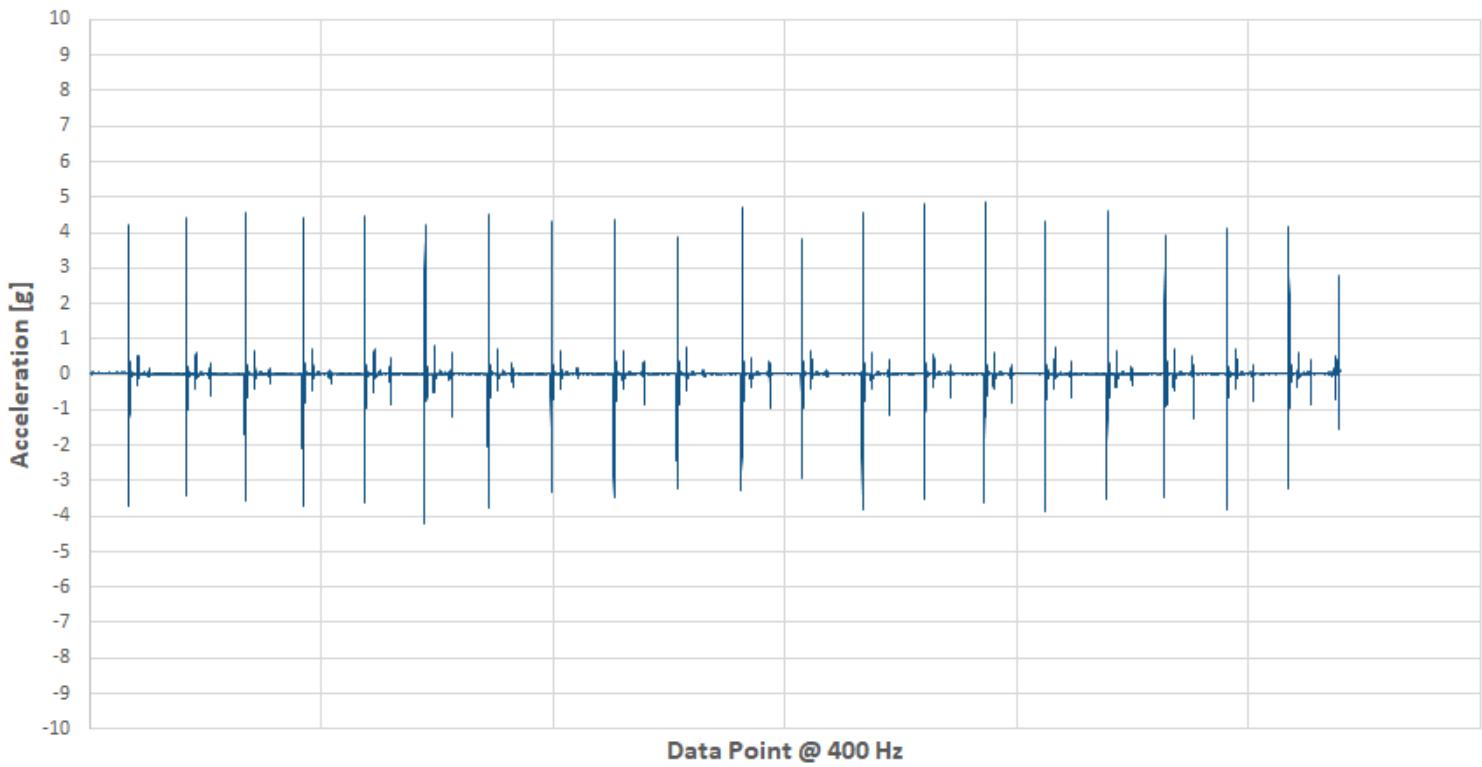


TEST 3 – BLOOM EARTH

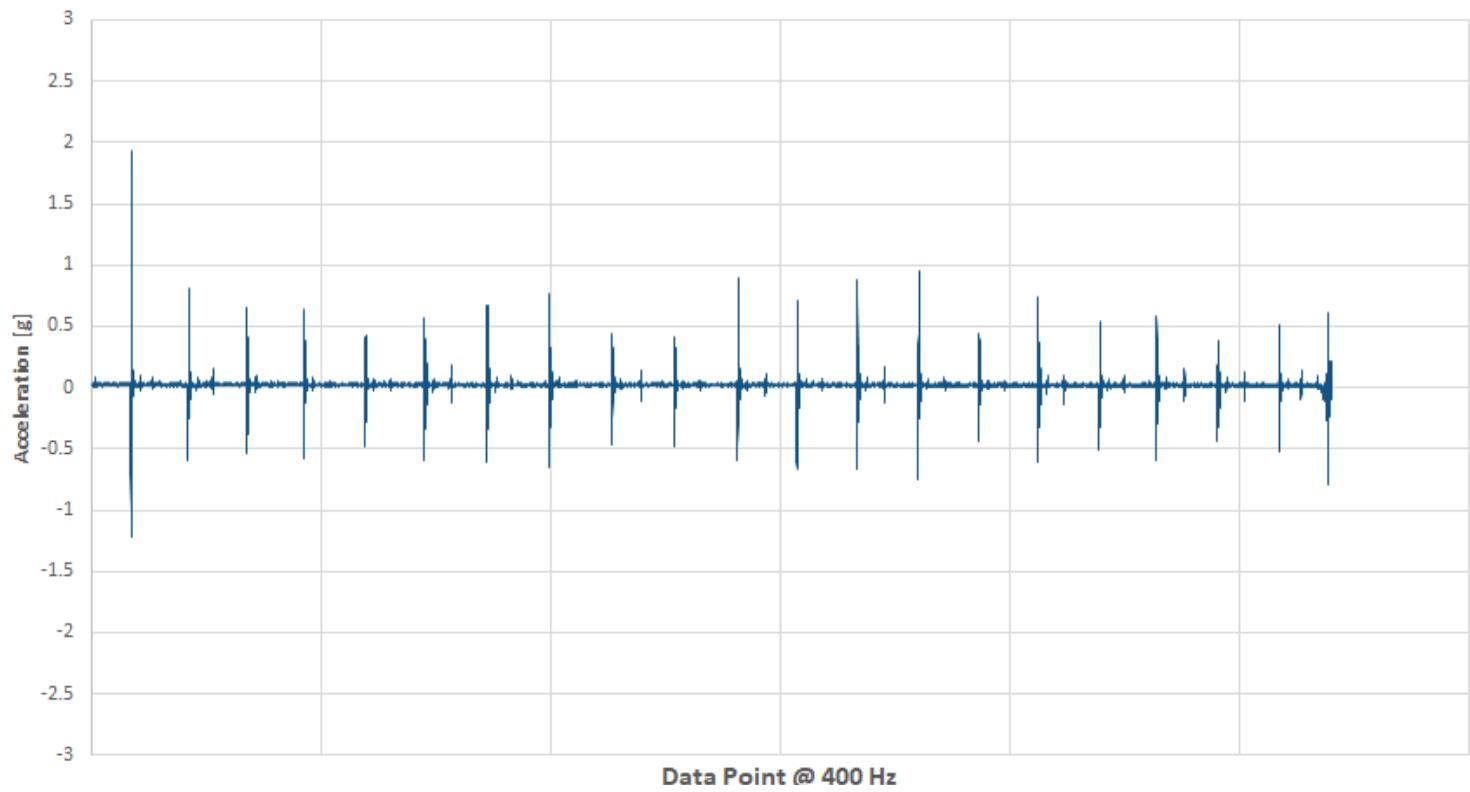
Vector Magnitude Acceleration - Bloom Earth



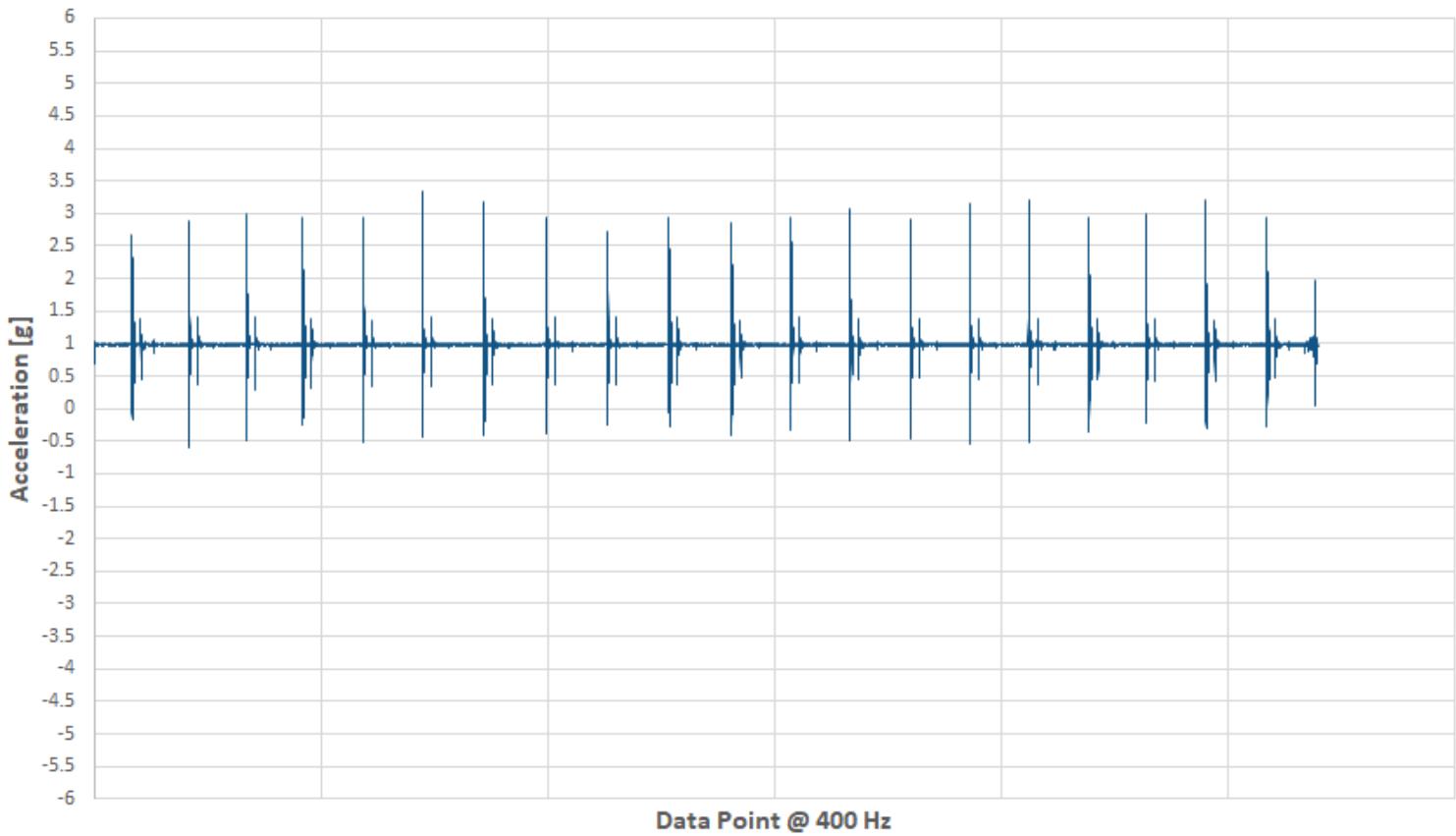
X Acceleration (Side to Side) - Bloom Earth



Y Acceleration (Head to Toe) - Bloom Earth

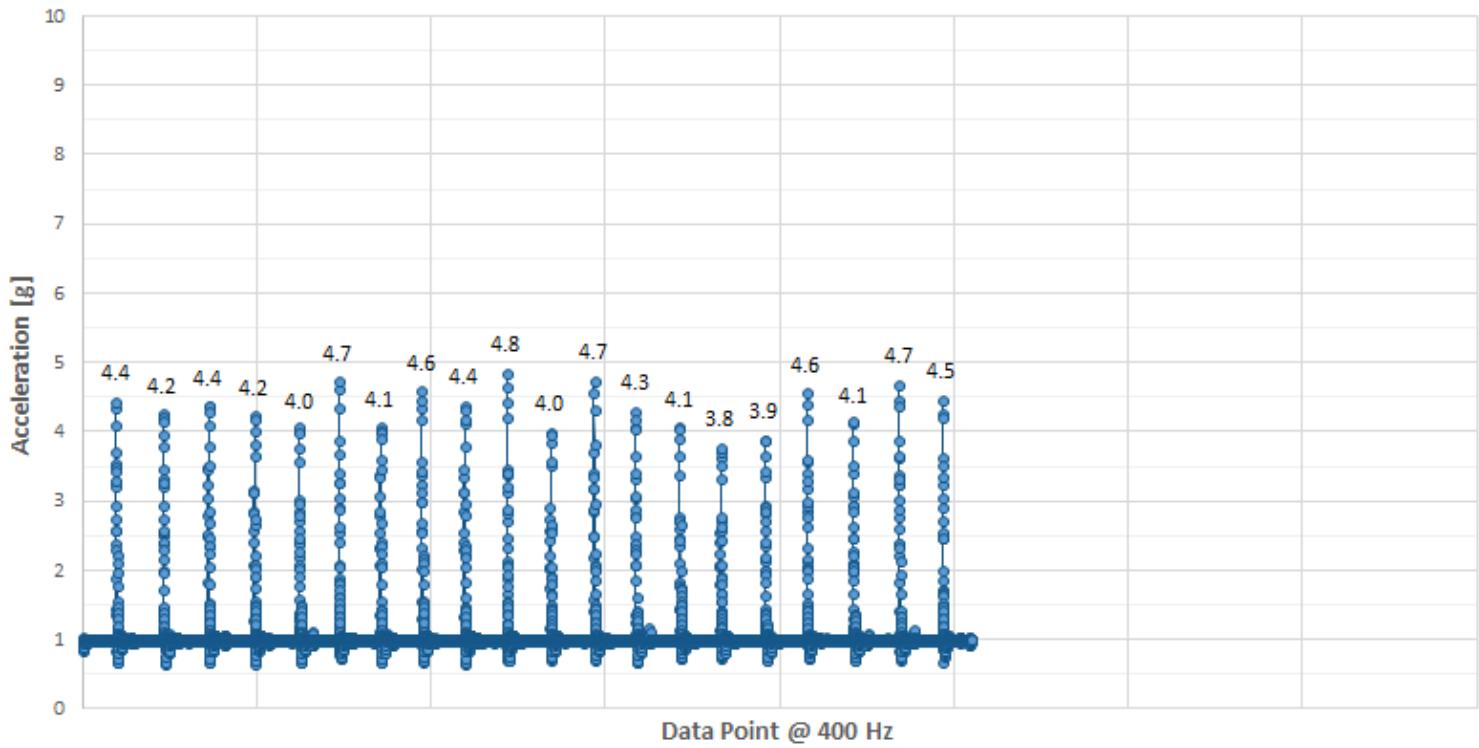


Z Acceleration (Up and Down) - Bloom Earth

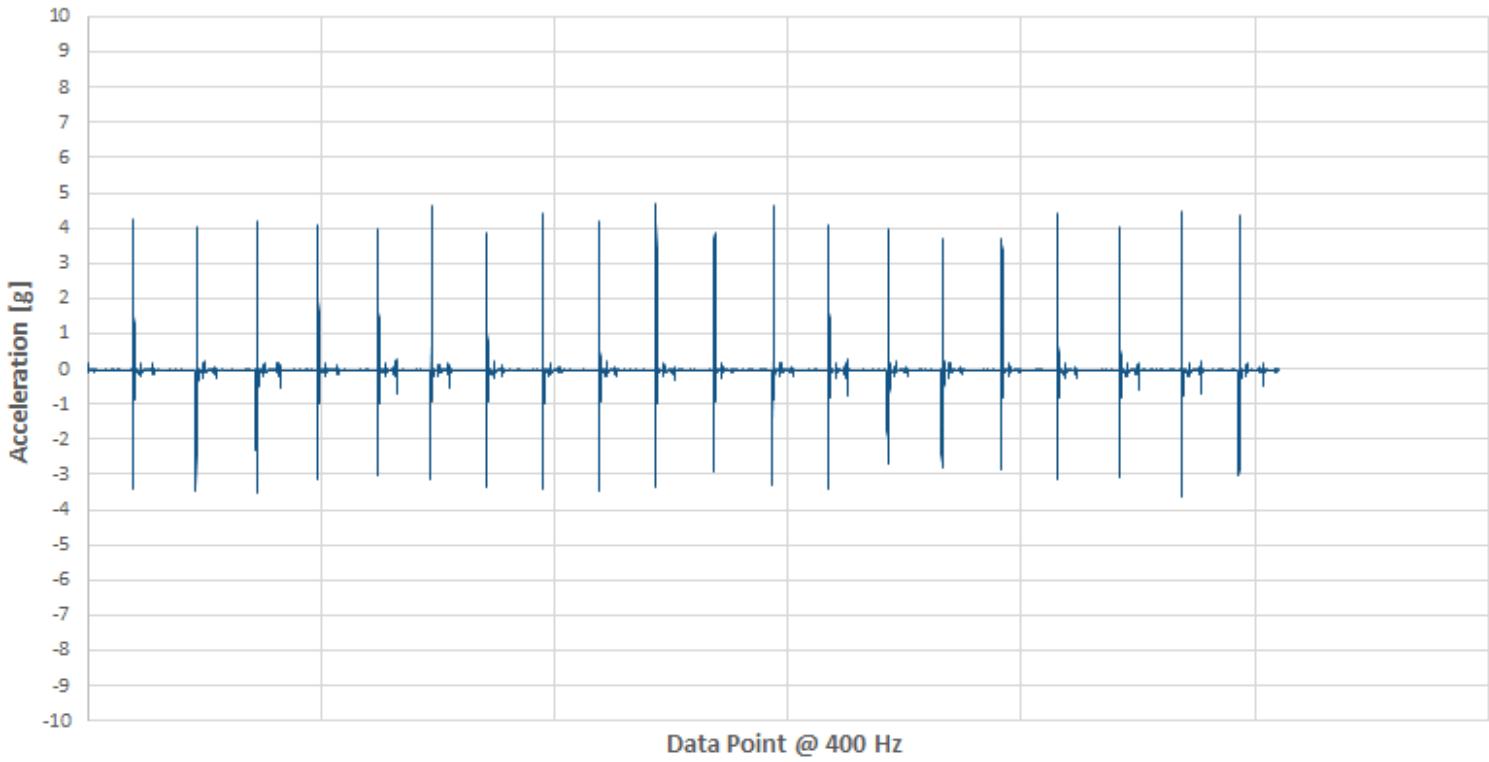


TEST 3 – ZINUS

Vector Magnitude Acceleration - Zinus



X Acceleration (Side to Side) - Zinus

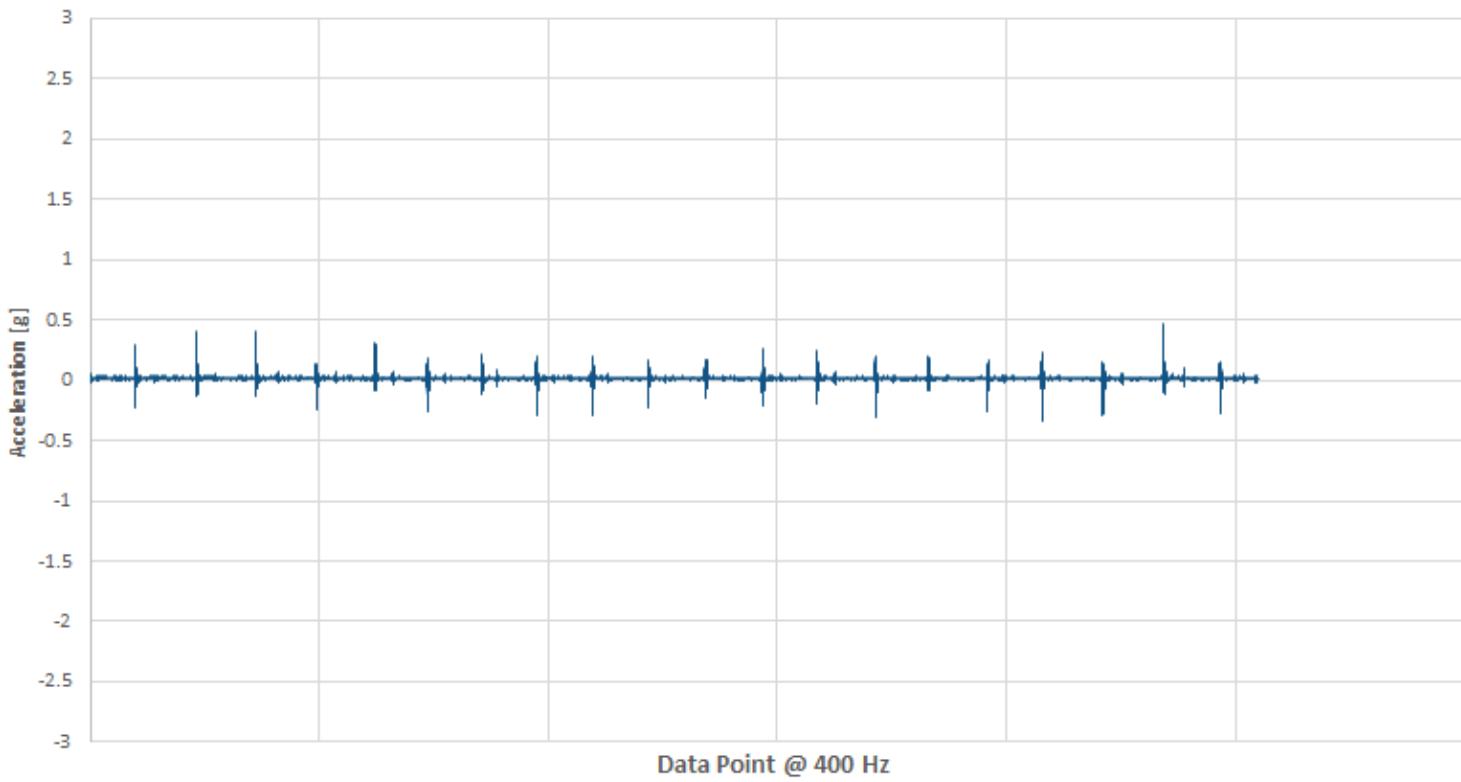




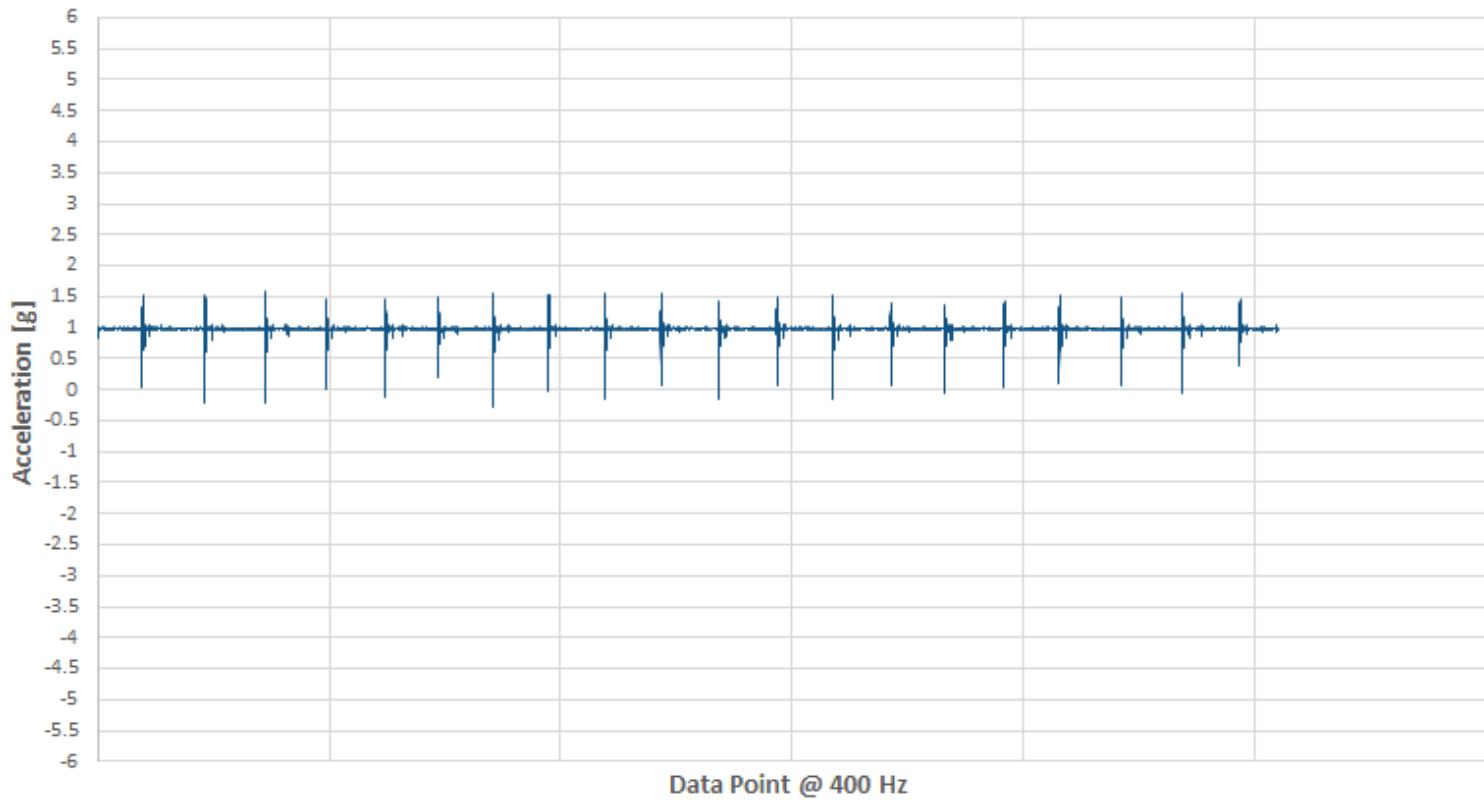
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Y Acceleration (Head to Toe) - Zinus

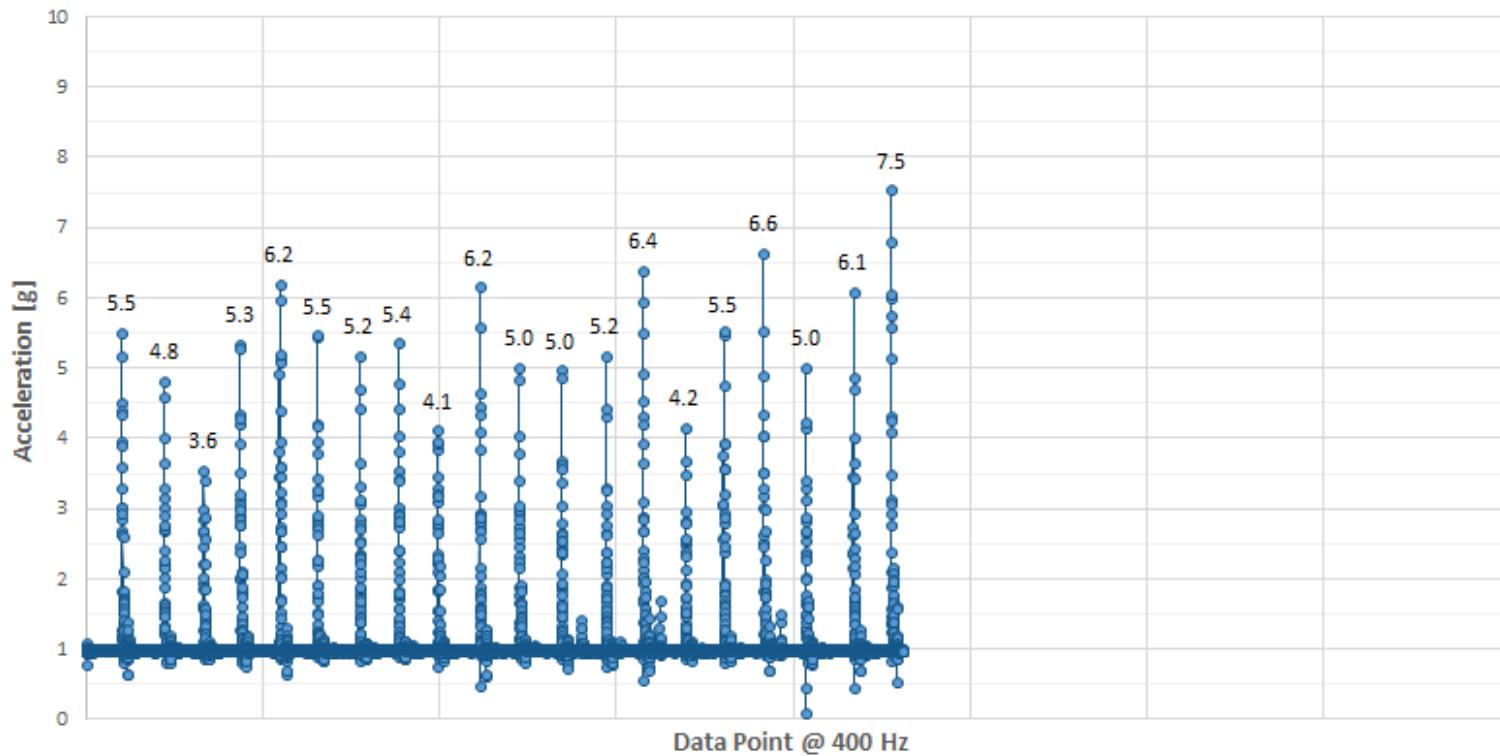


Z Acceleration (Up and Down) - Zinus

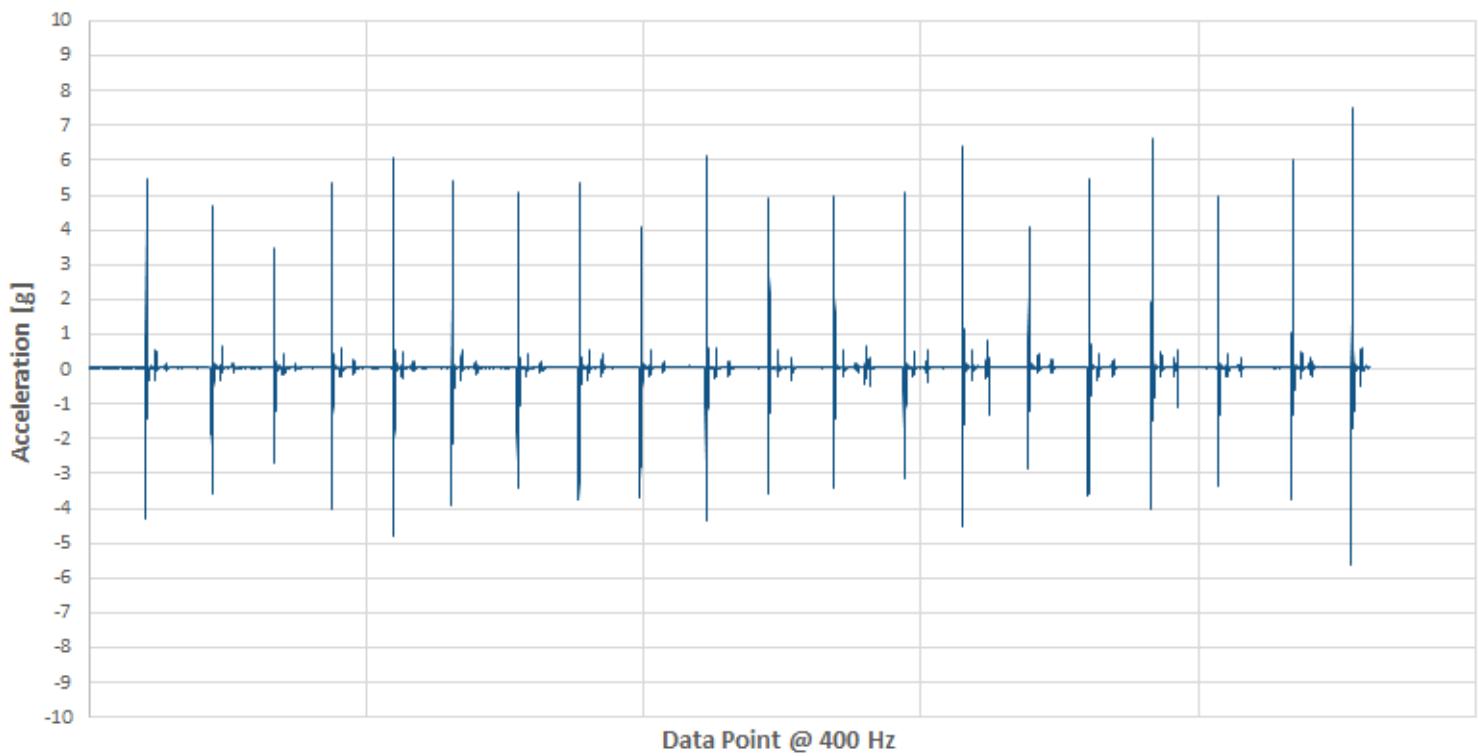


TEST 3 – NOVOSBED FIRM (V2)

Vector Magnitude Acceleration - Novosbed Firm (V2)

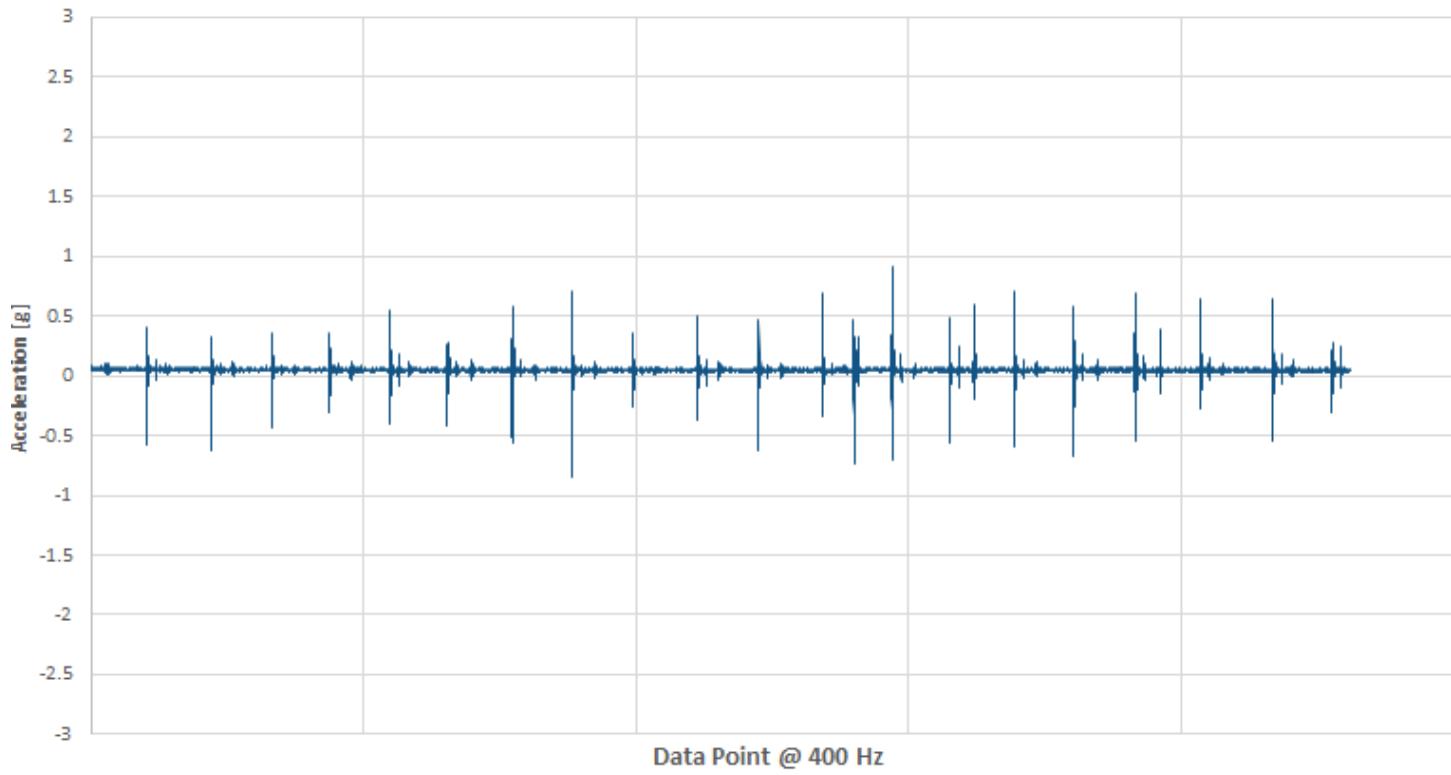


X Acceleration (Side to Side) - Novosbed Firm (V2)

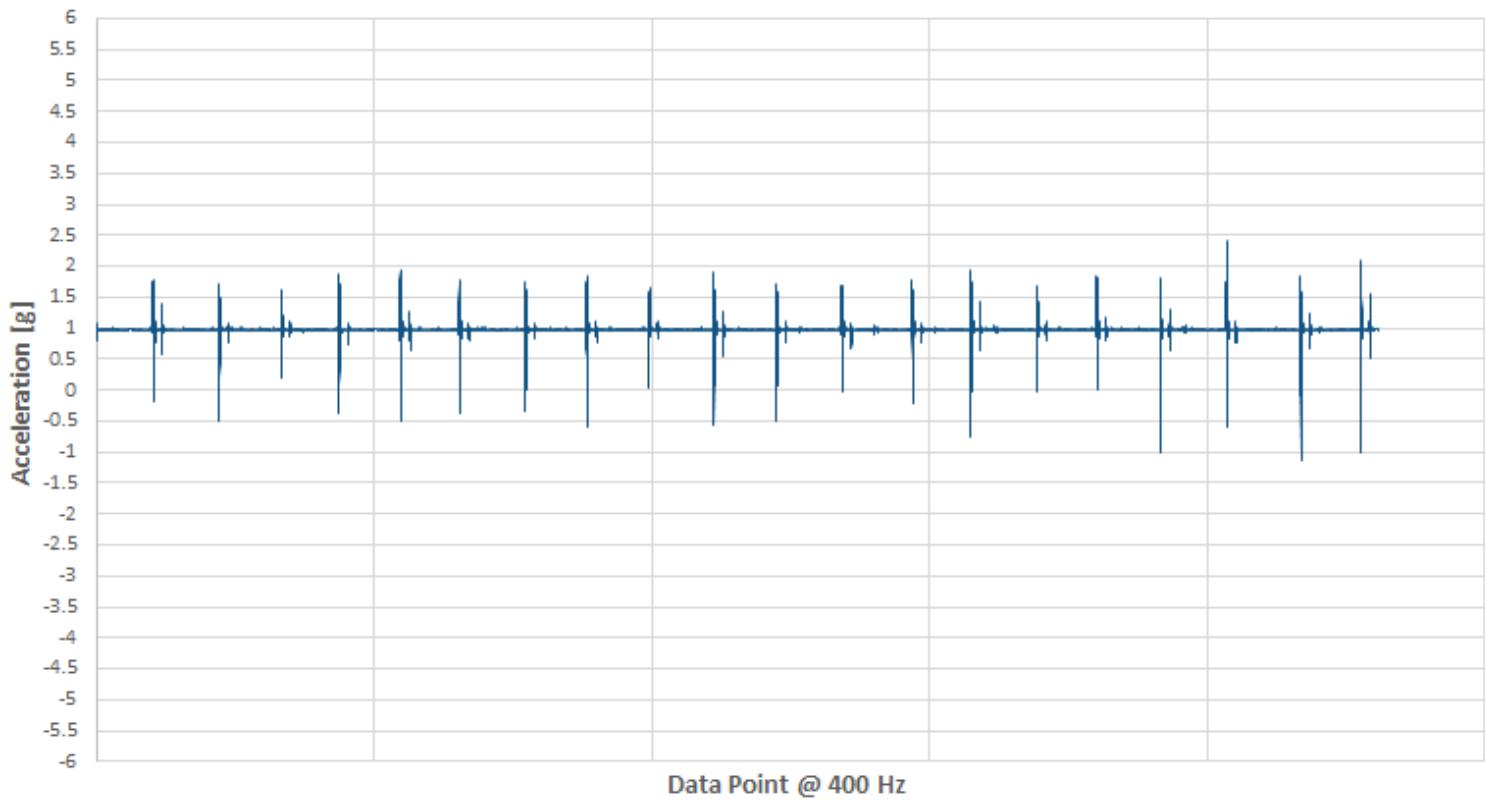




Y Acceleration (Head to Toe) - Novosbed Firm (V2)



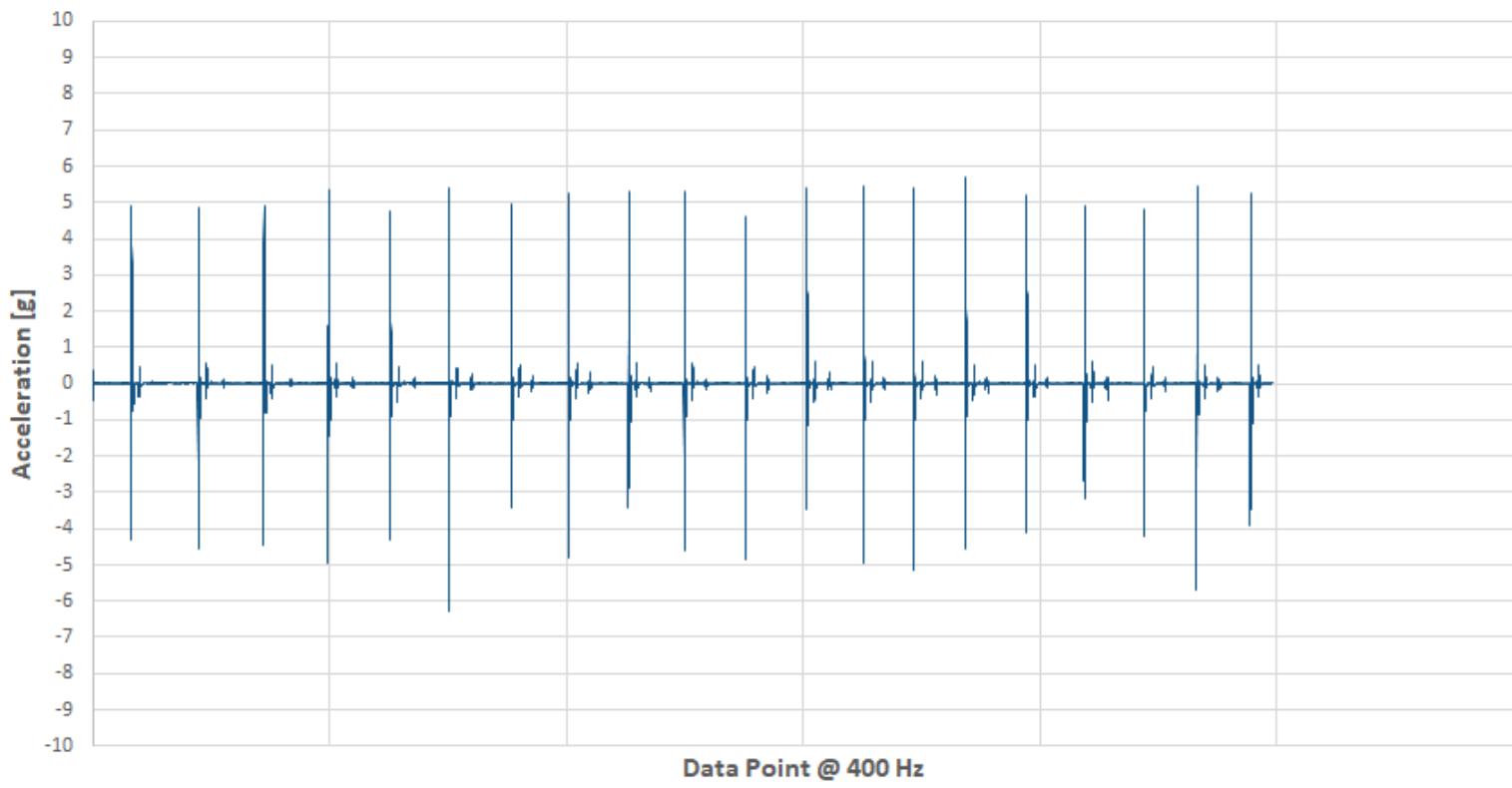
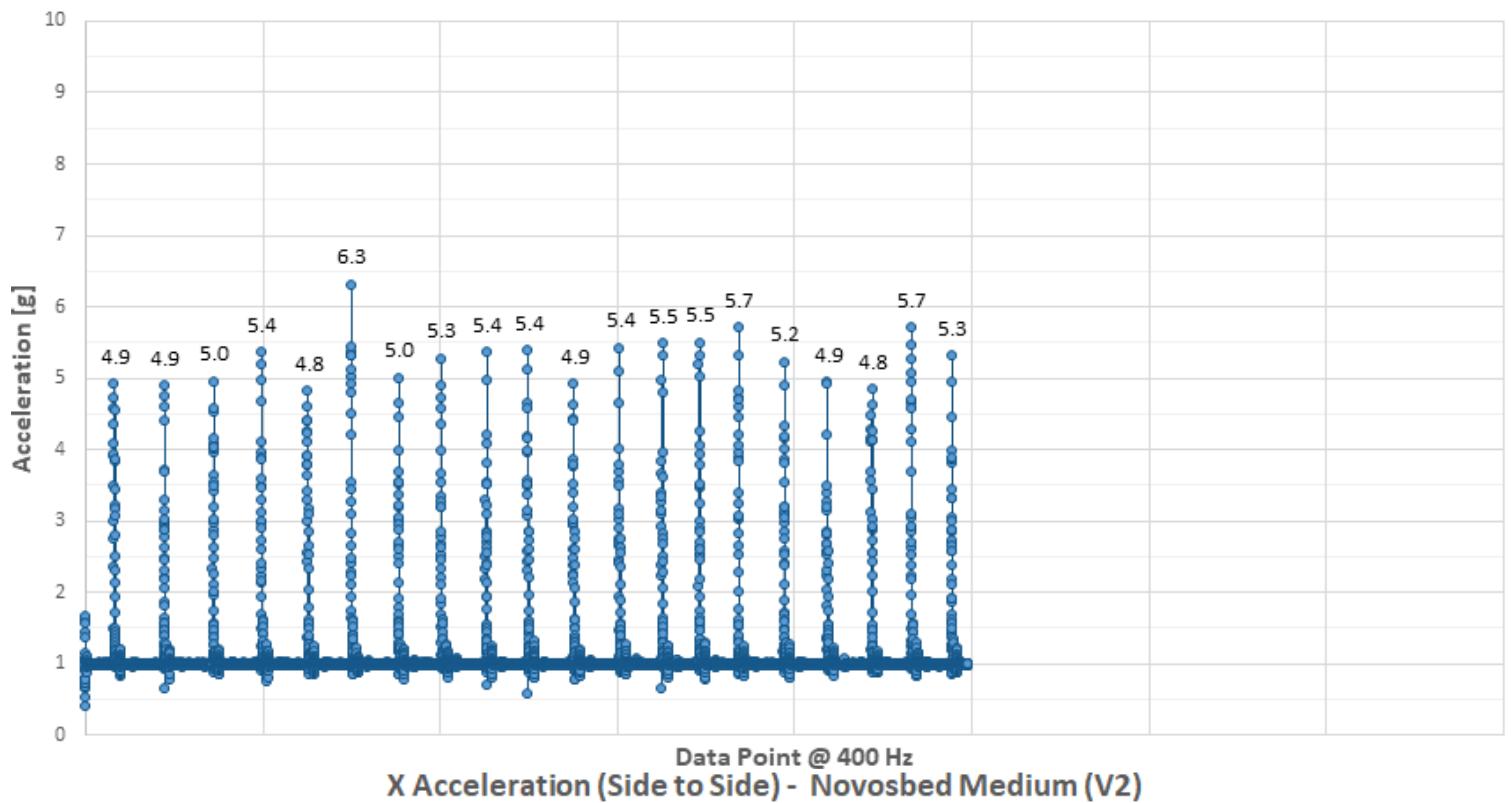
Z Acceleration (Up and Down) - Novosbed Firm (V2)





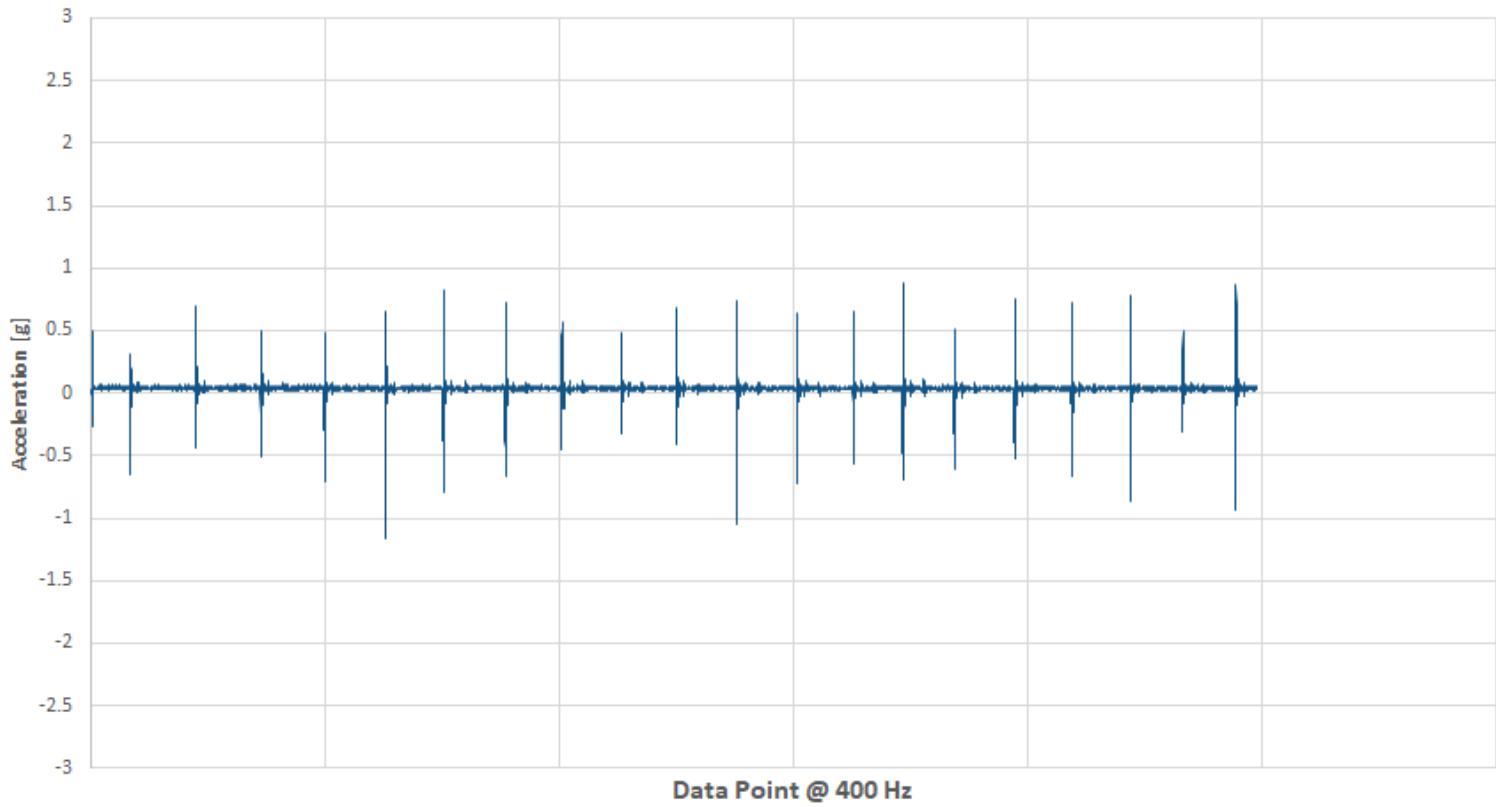
TEST 3 – NOVOSBED MEDIUM (V2)

Vector Magnitude Acceleration - Novosbed Medium (V2)

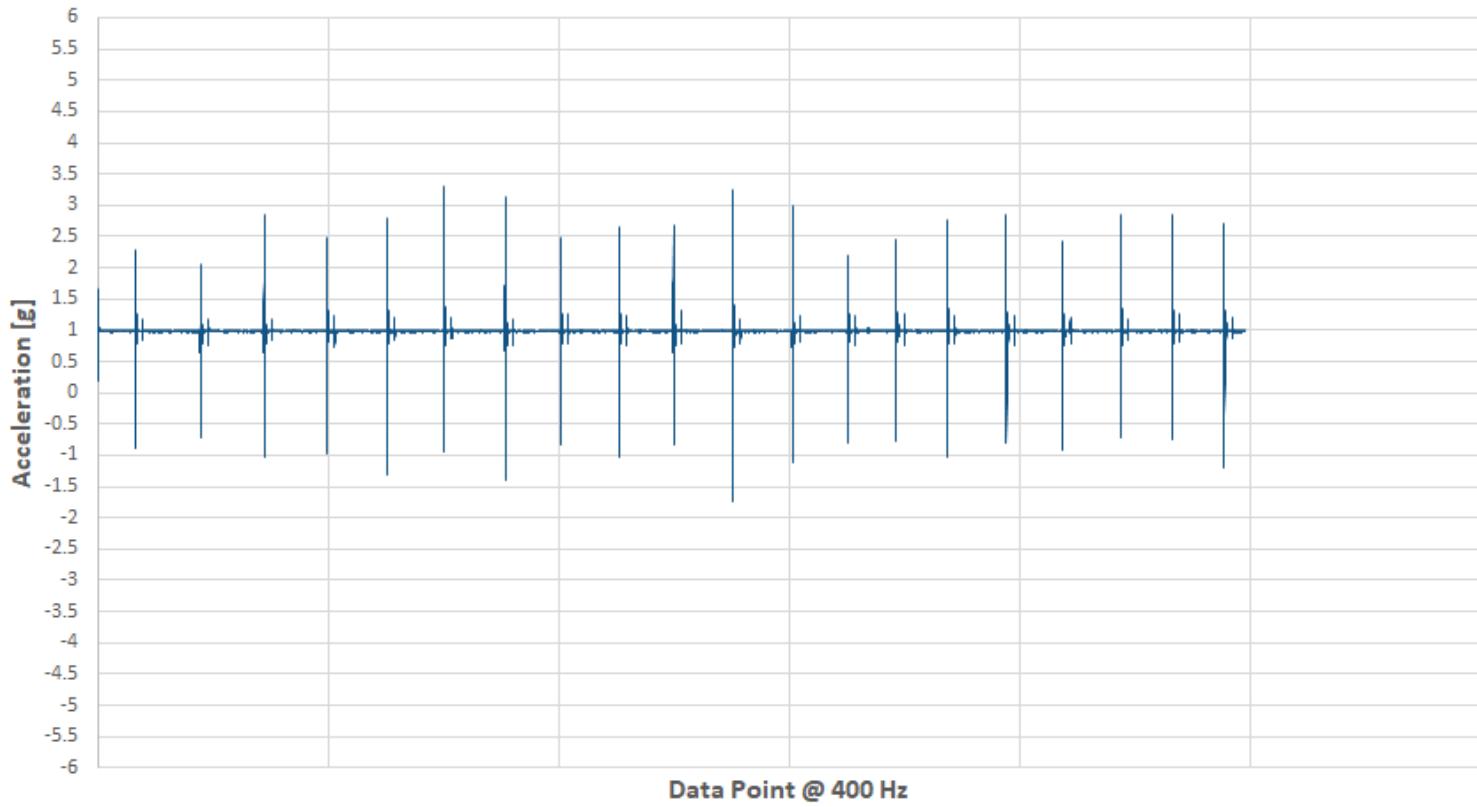




Y Acceleration (Head to Toe) - Novosbed Medium (V2)

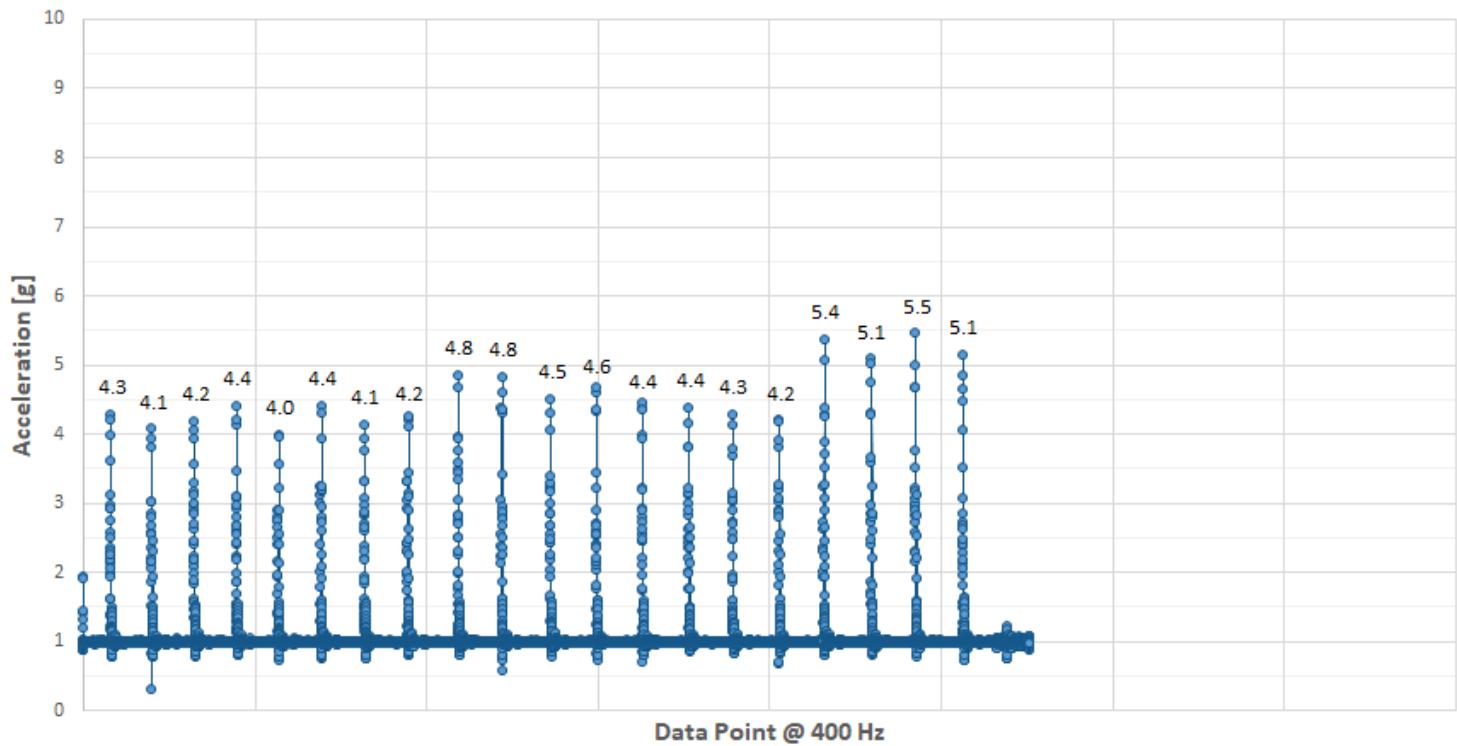


Z Acceleration (Up and Down) - Novosbed Medium (V2)

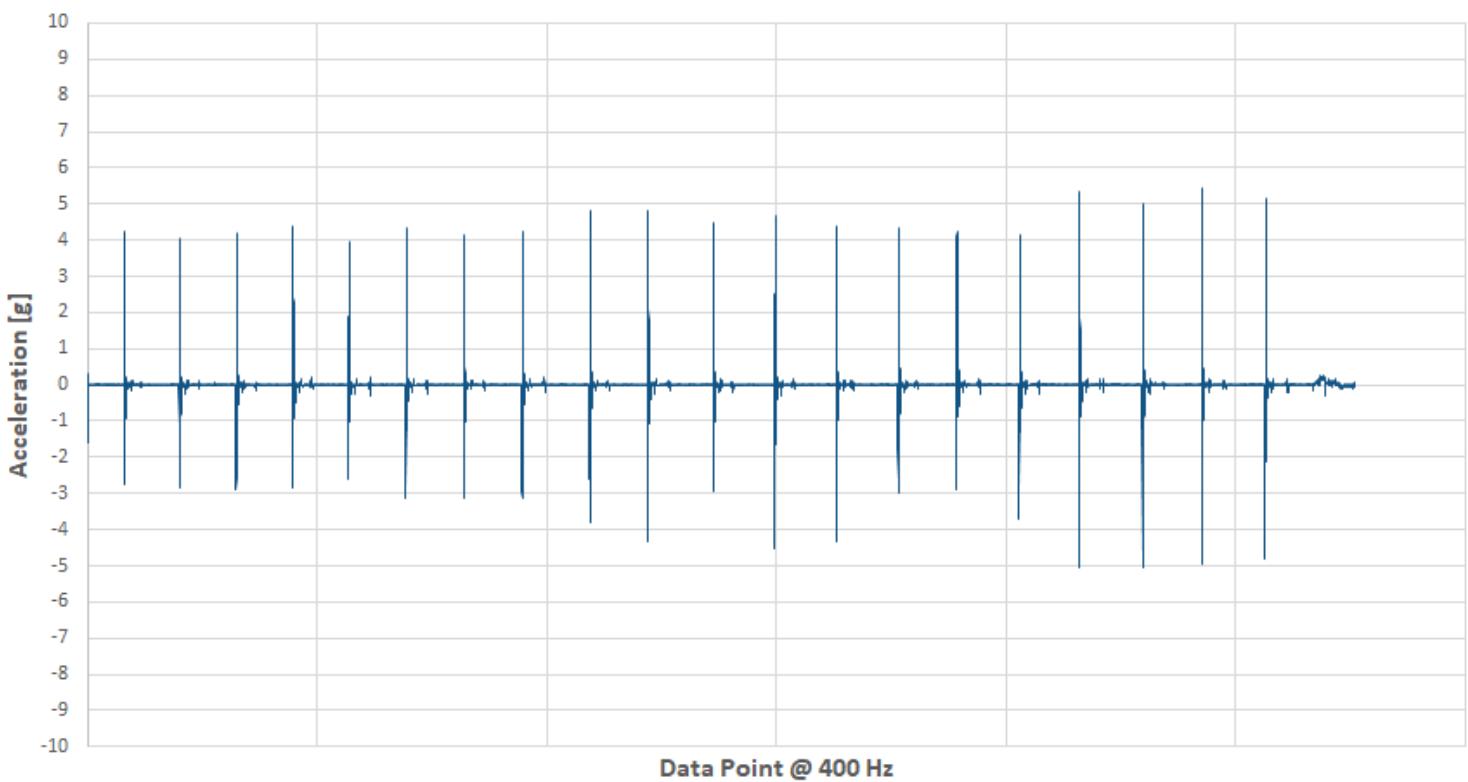


TEST 3 – NOVOSBED SOFT (V2)

Vector Magnitude Acceleration - Novosbed Soft (V2)

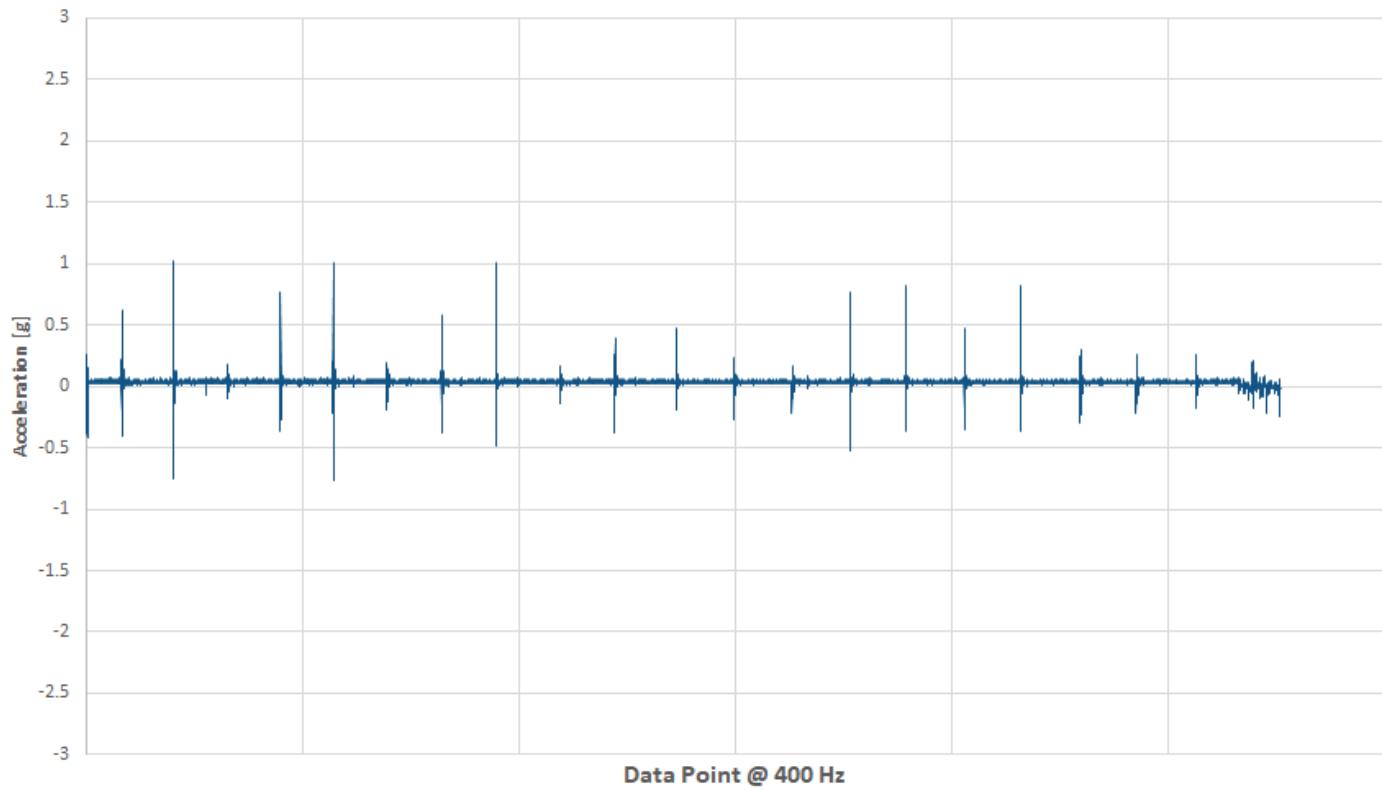


X Acceleration (Side to Side) - Novosbed Soft (V2)

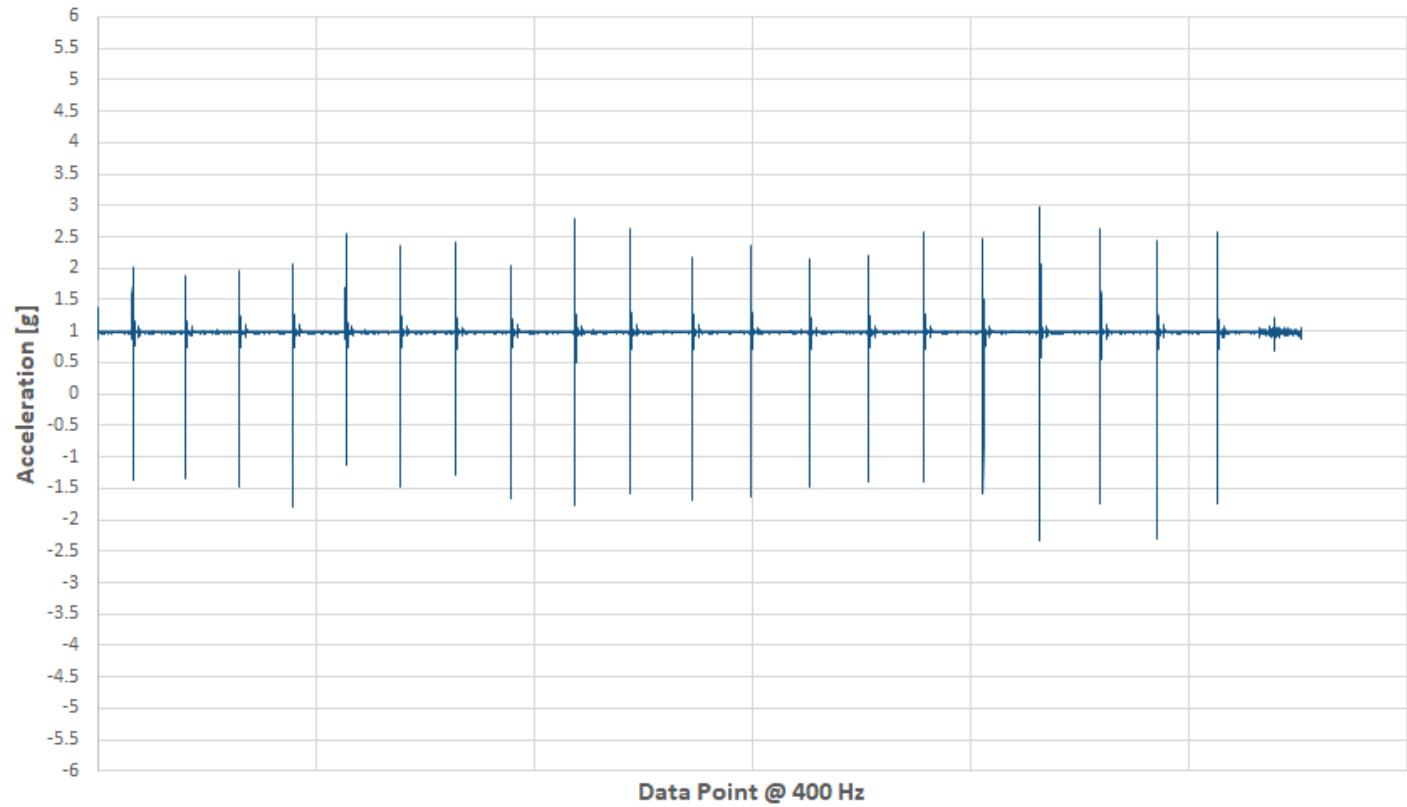




Y Acceleration (Head to Toe) - Novosbed Soft (V2)



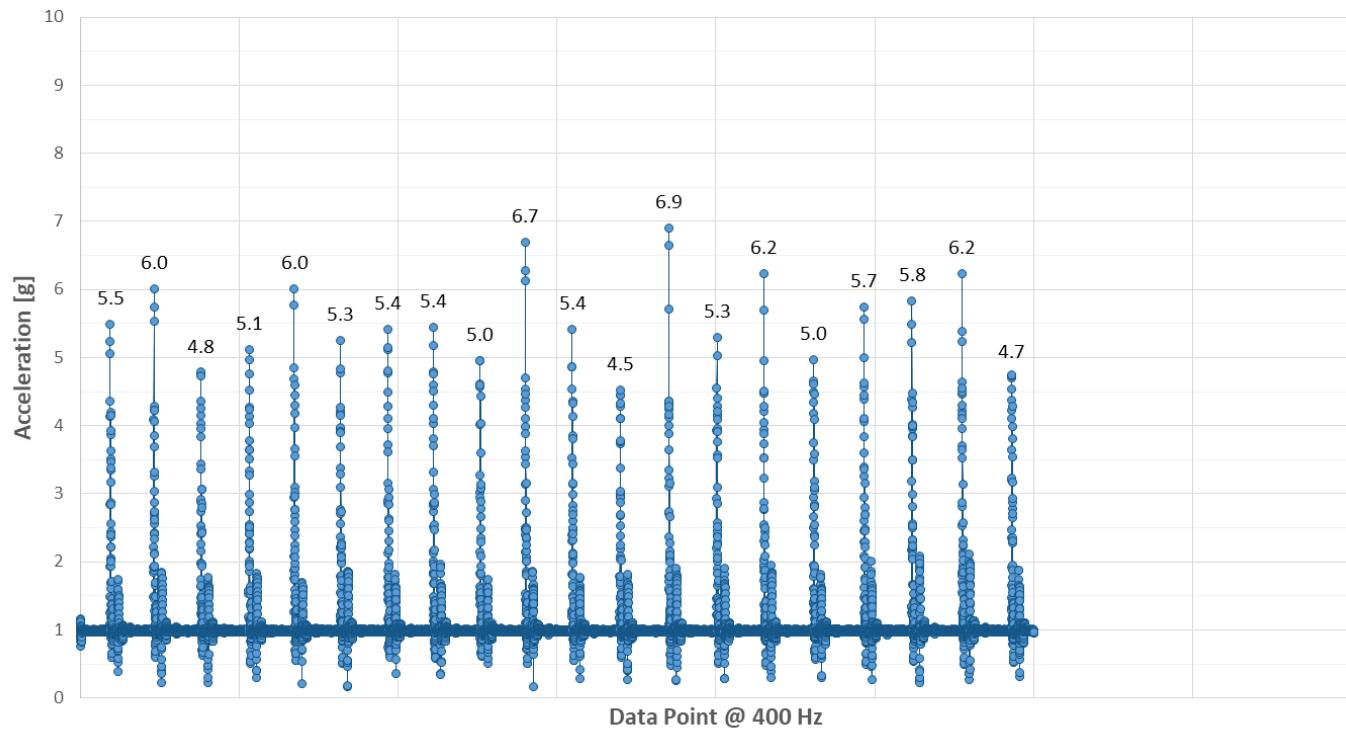
Z Acceleration (Up and Down) - Novosbed Soft (V2)



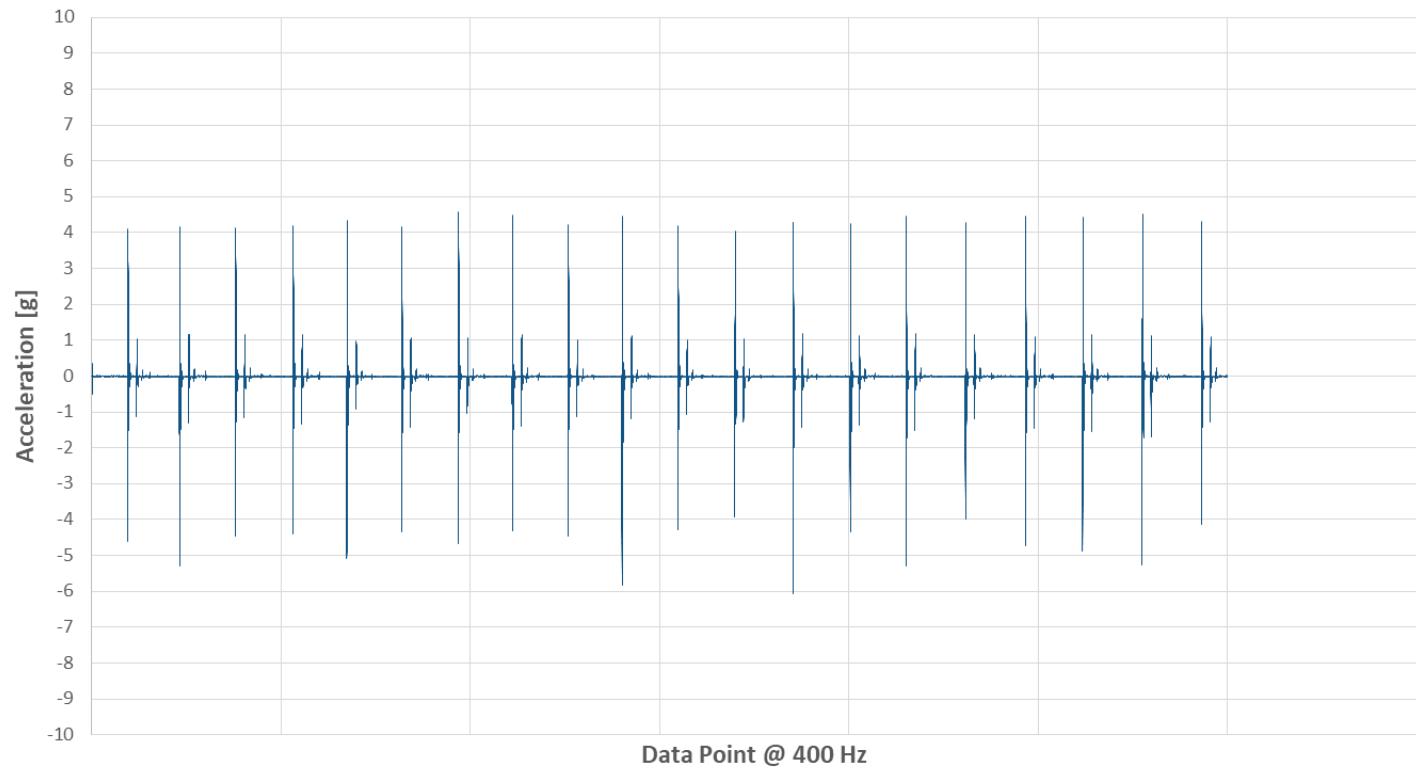


TEST 3 – BRUNSWICK

Vector Magnitude Acceleration - Brunswick



X Acceleration (Side to Side) - Brunswick

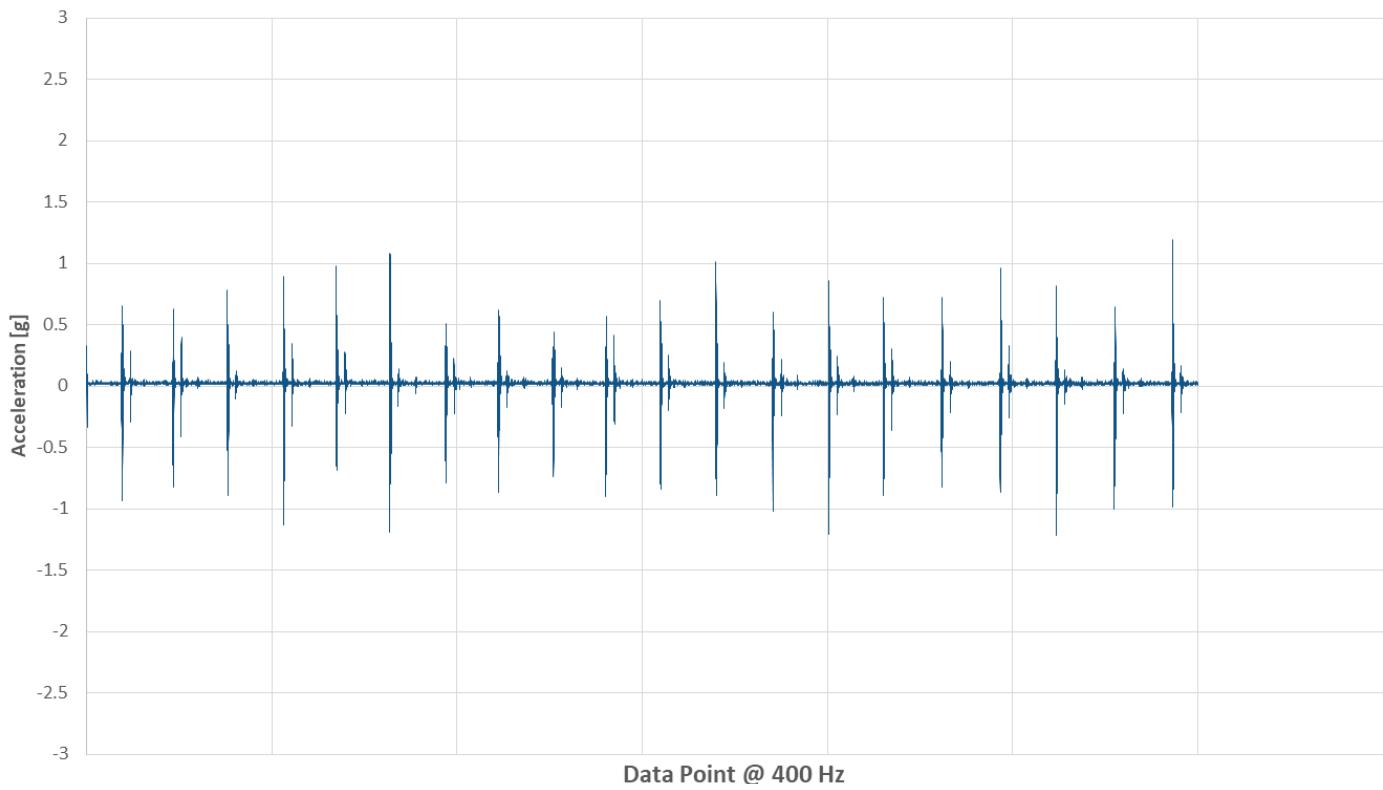




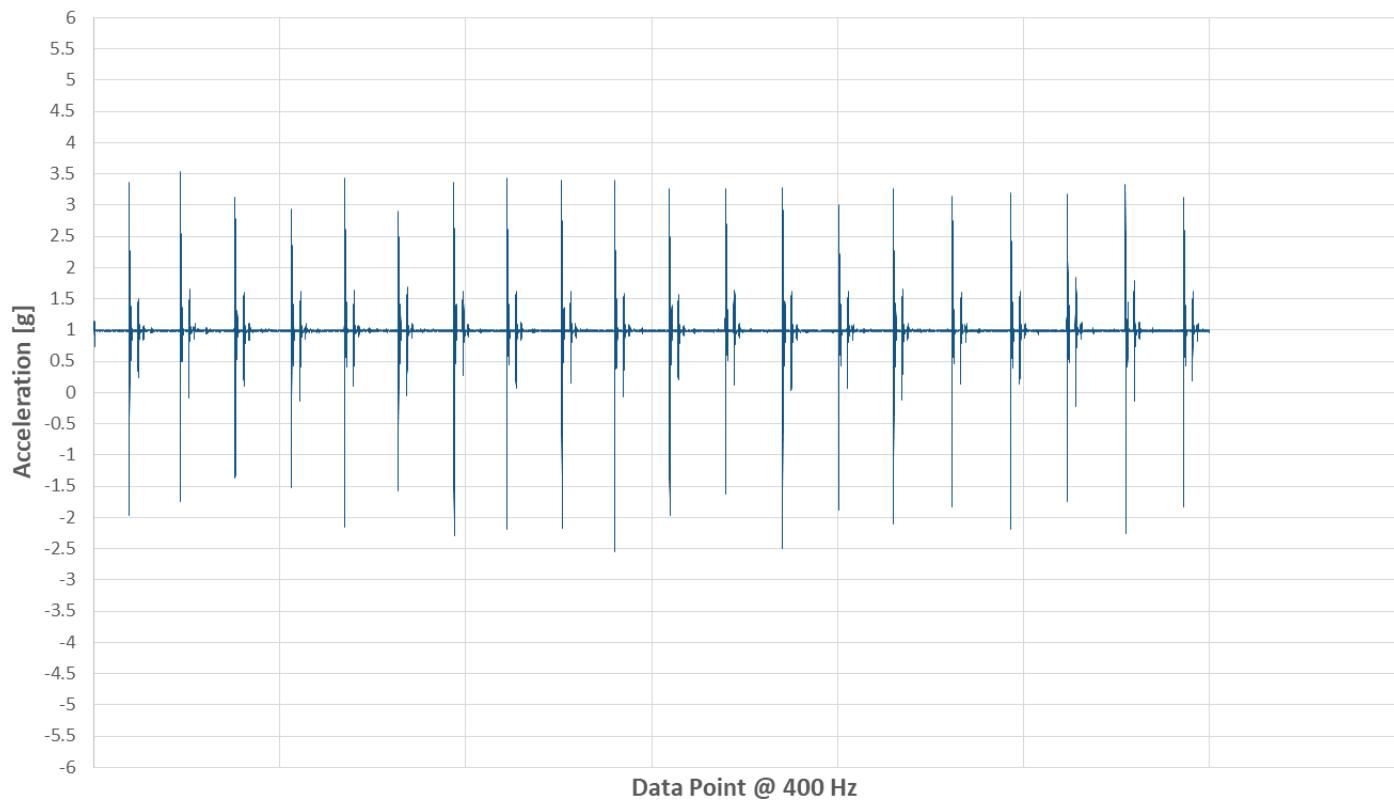
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Y Acceleration (Head to Toe) - Brunswick



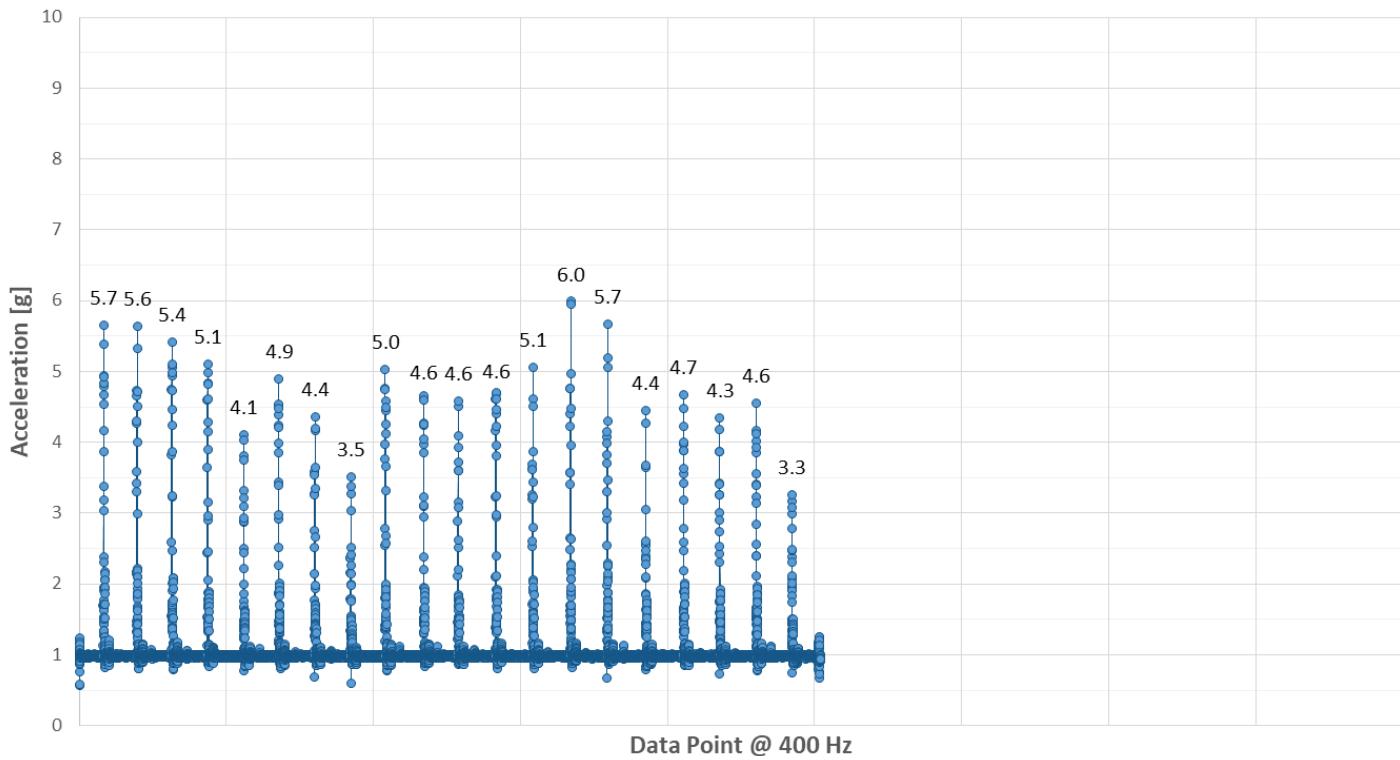
Z Acceleration (Up and Down) - Brunswick



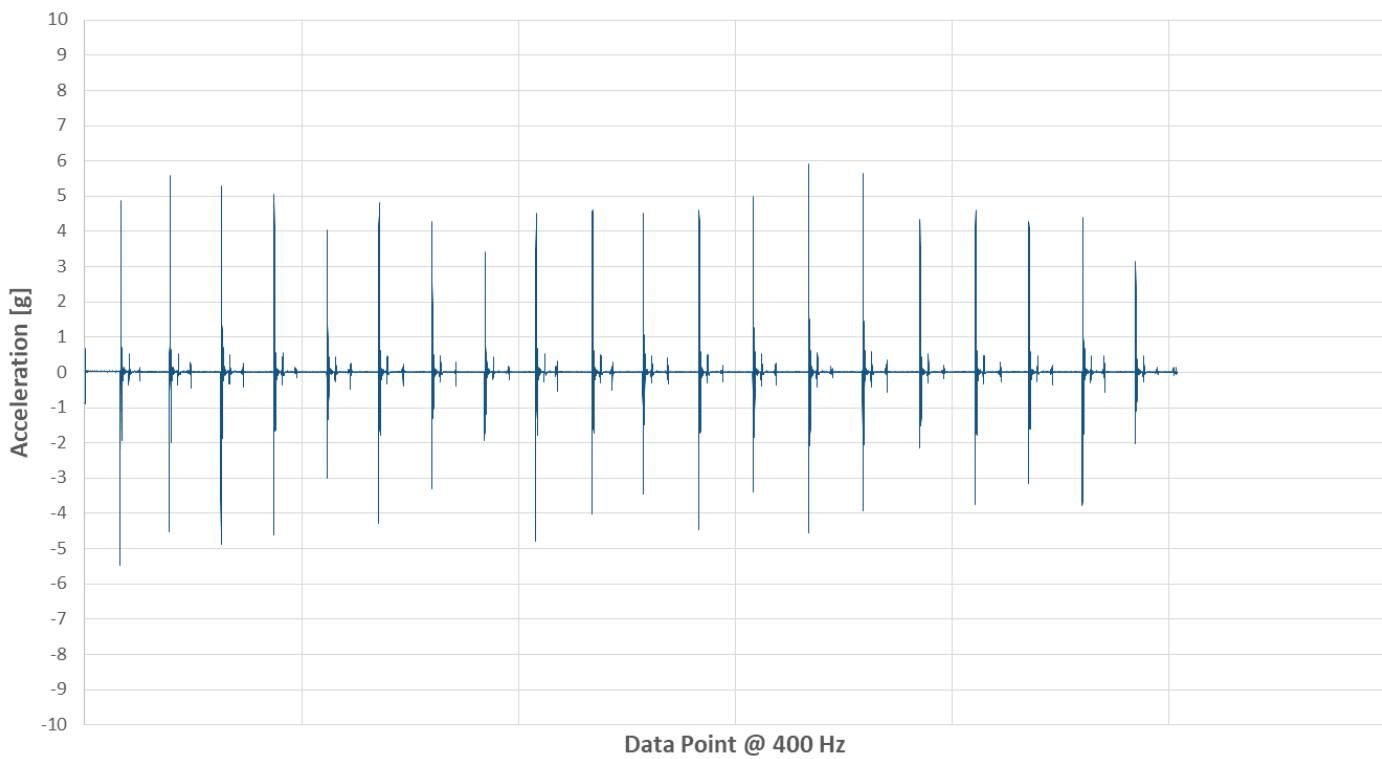


TEST 3 – RECORE

Vector Magnitude Acceleration - Recore

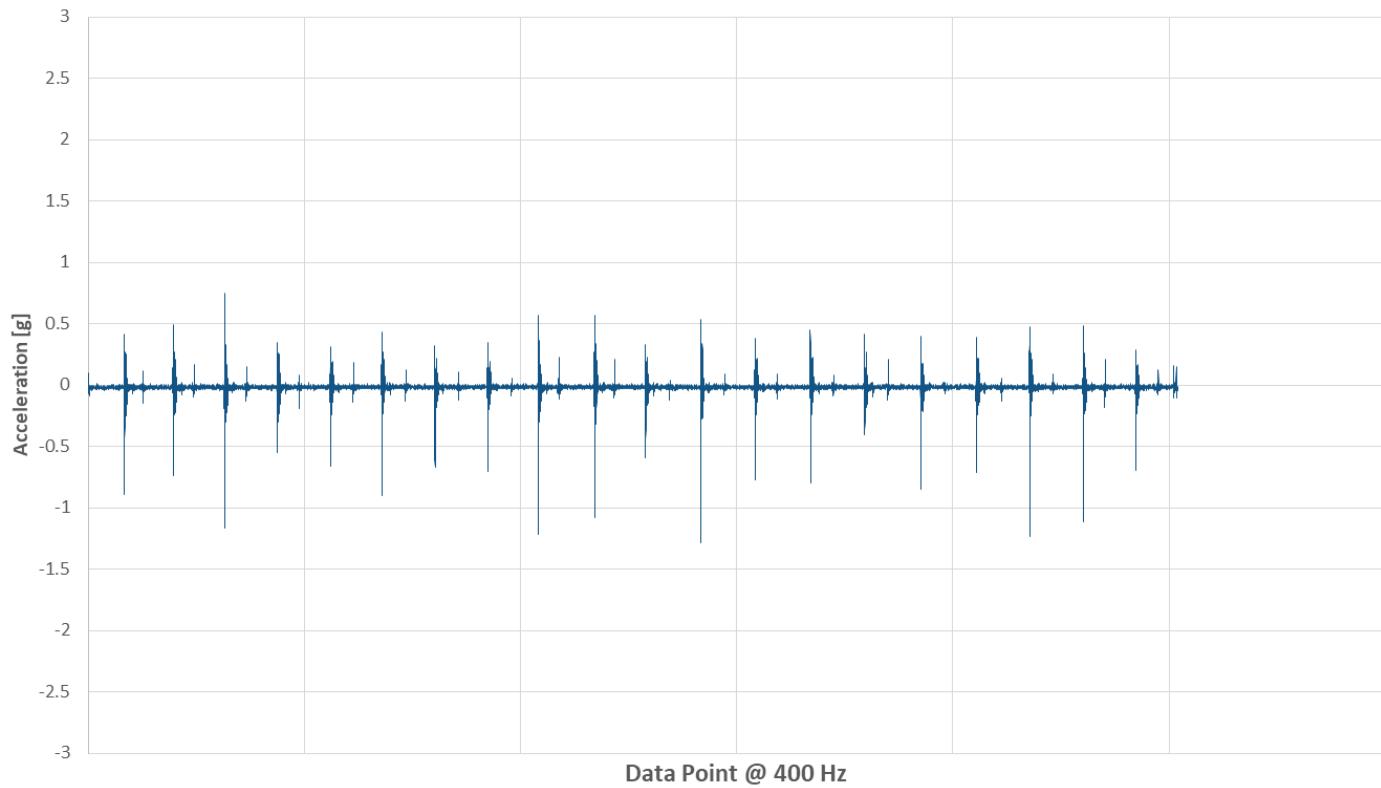


X Acceleration (Side to Side) - Recore

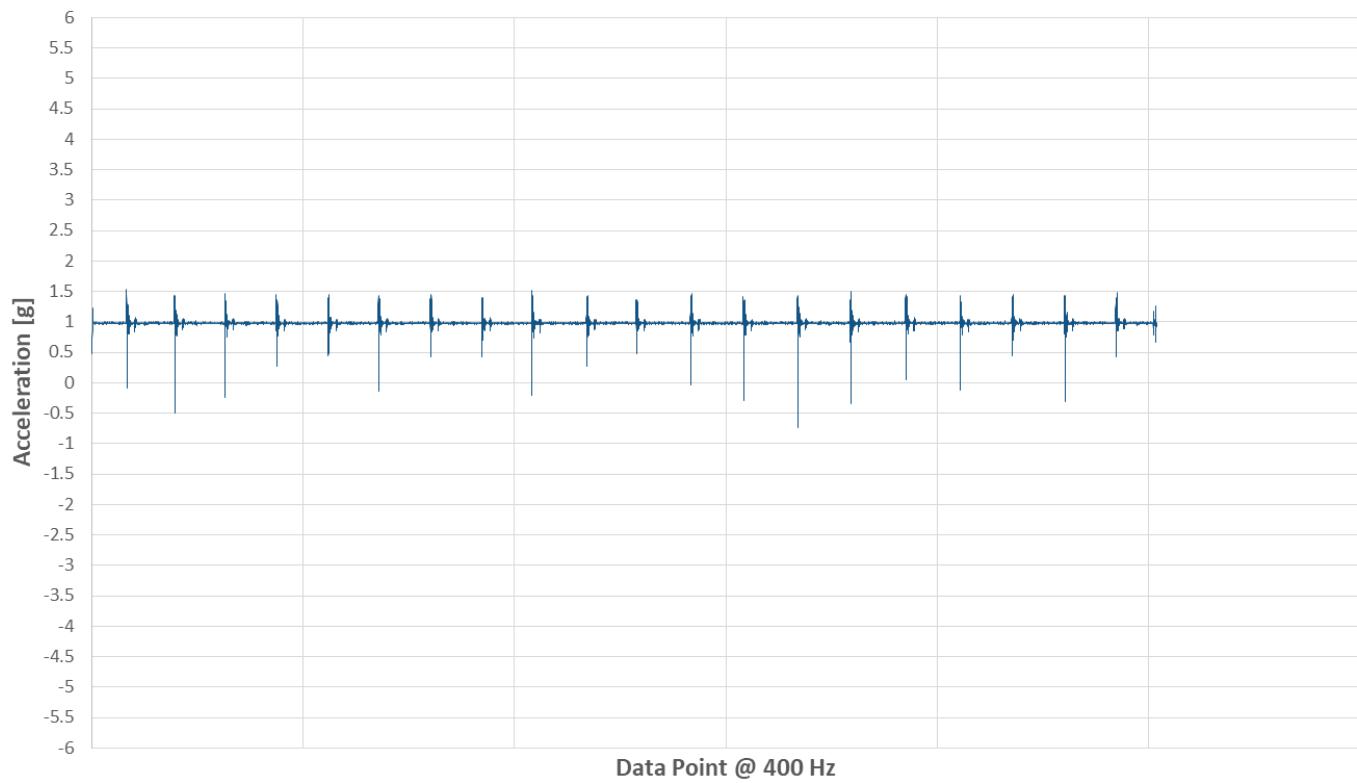




Y Acceleration (Head to Toe) - Recore



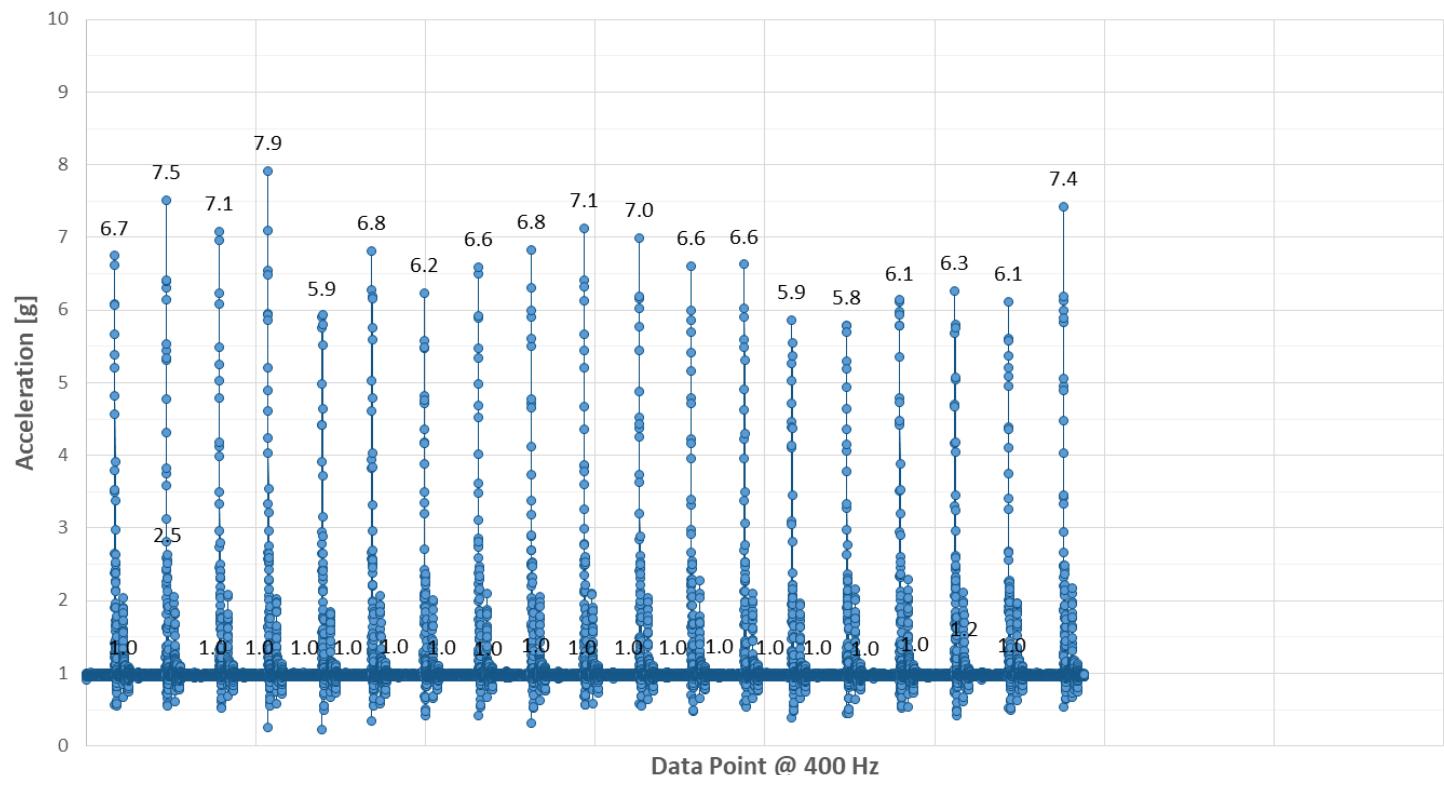
Z Acceleration (Up and Down) - Recore



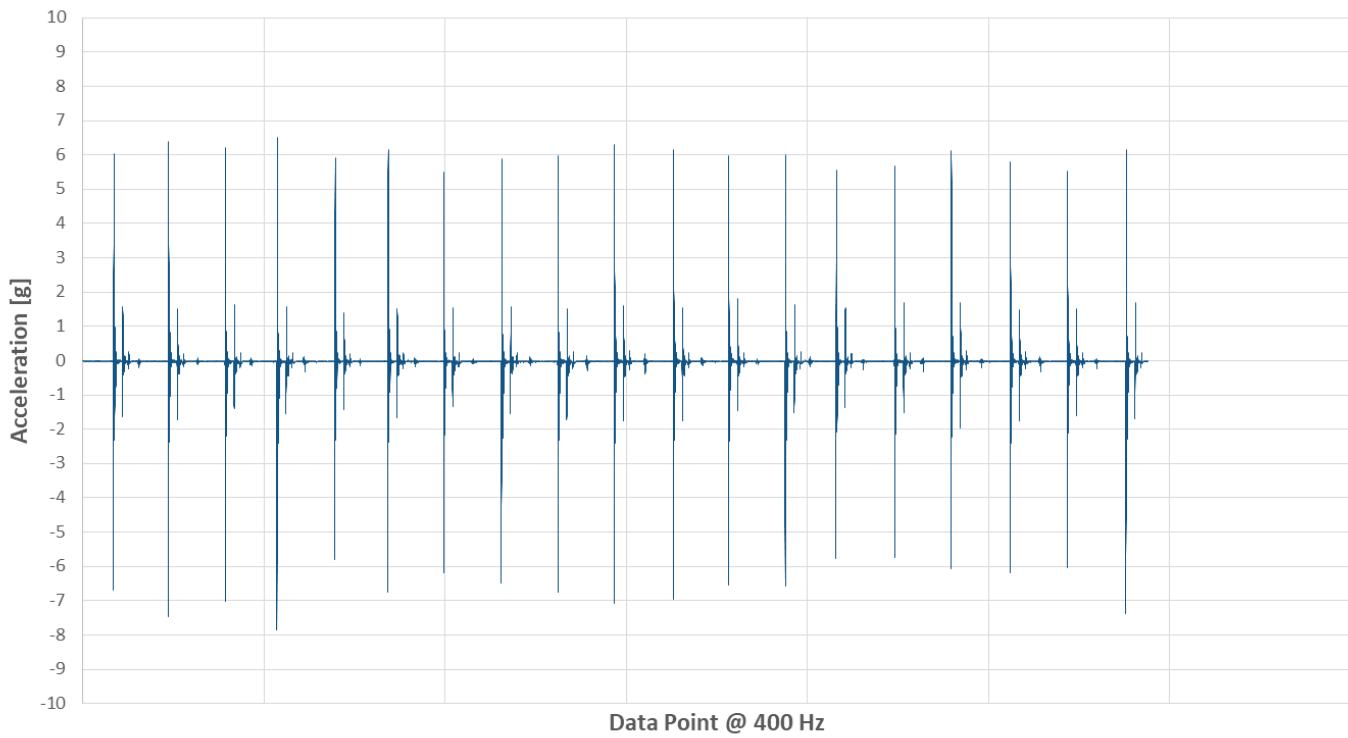


TEST 3 – DORMEO

Vector Magnitude Acceleration - Dormeo



X Acceleration (Side to Side) - Dormeo

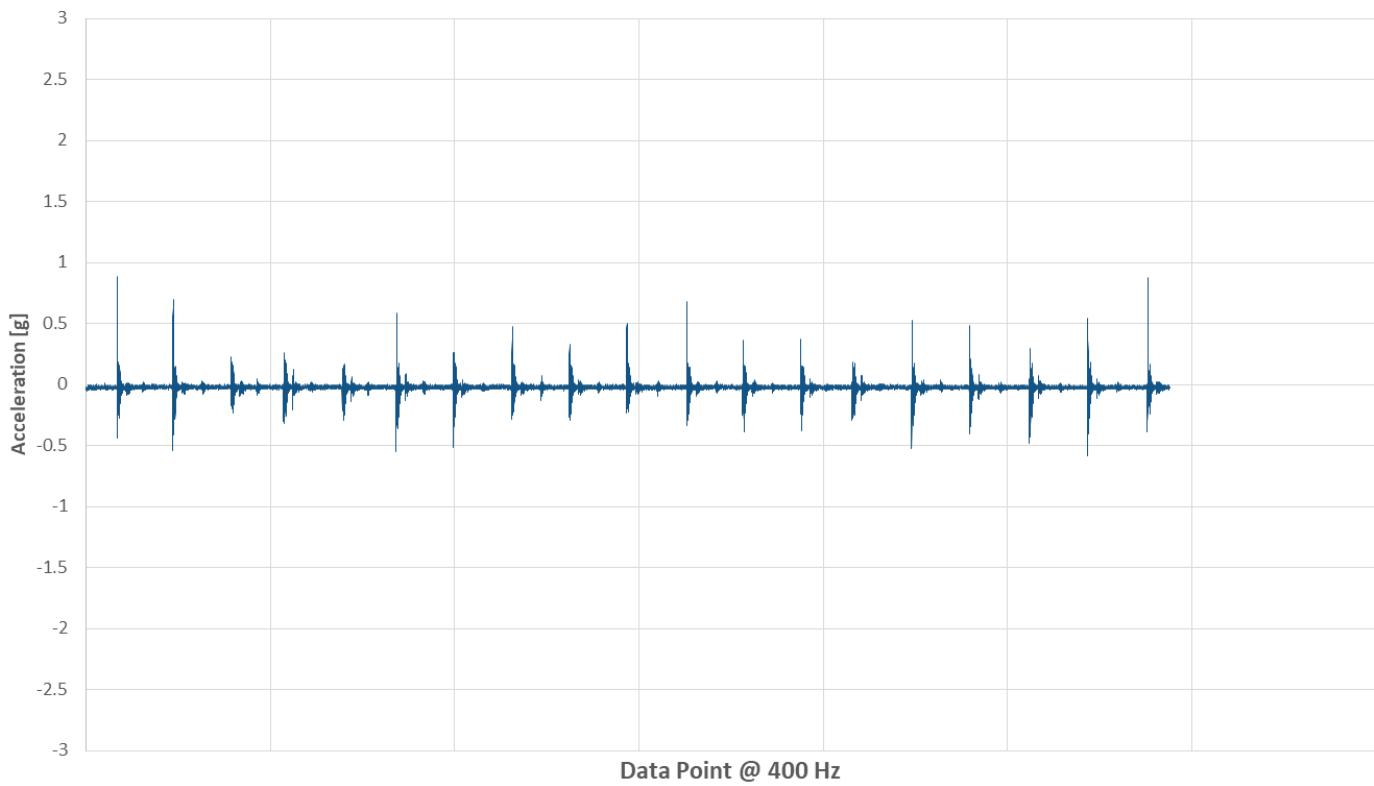




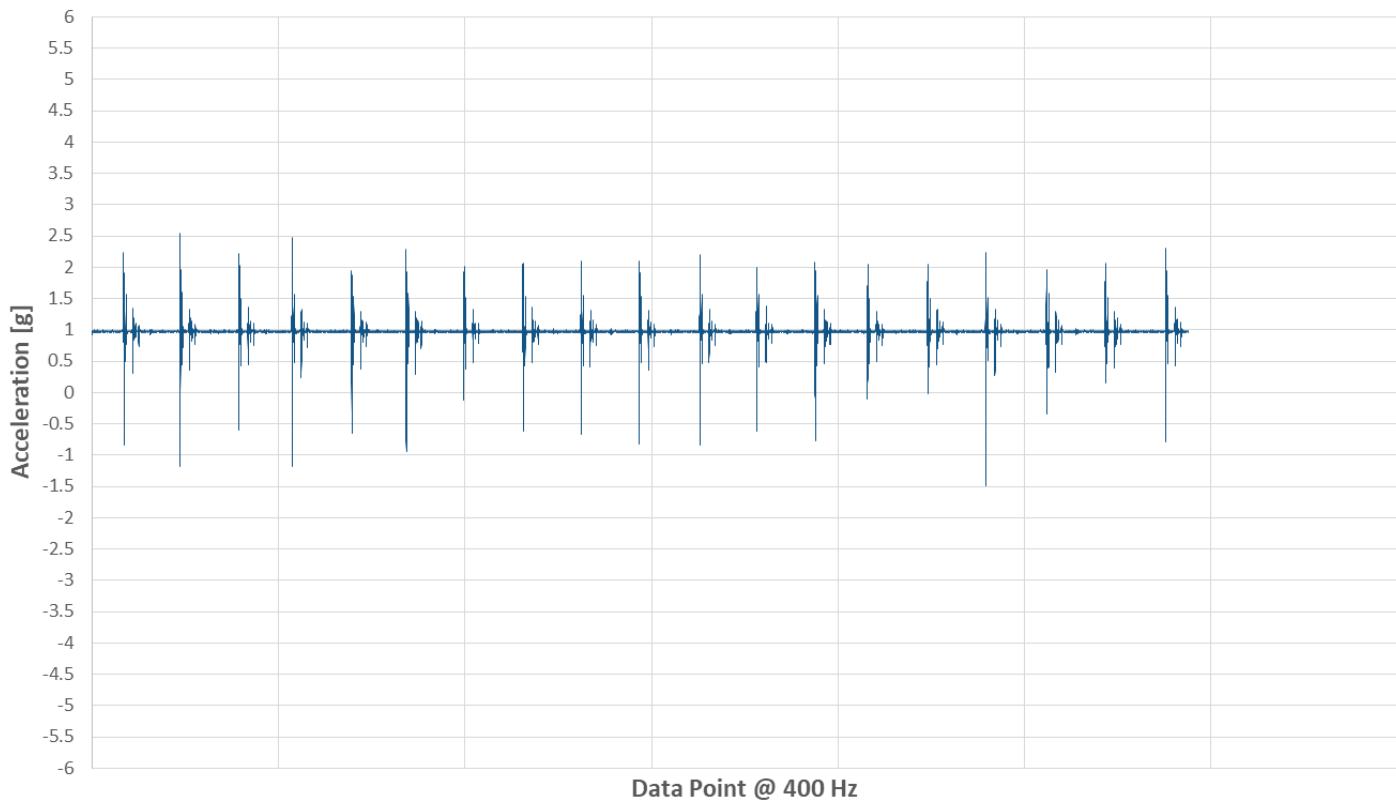
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Y Acceleration (Head to Toe) - Dormeo



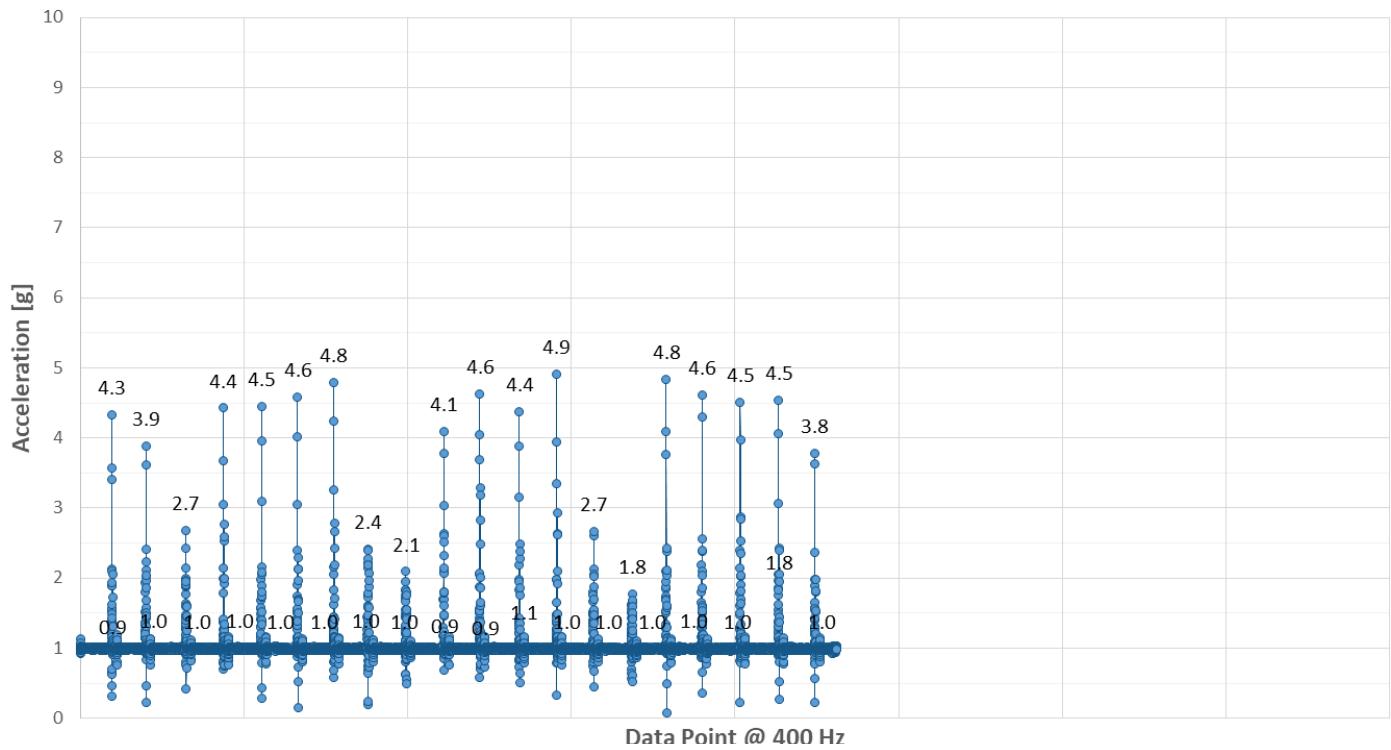
Z Acceleration (Up and Down) - Dormeo



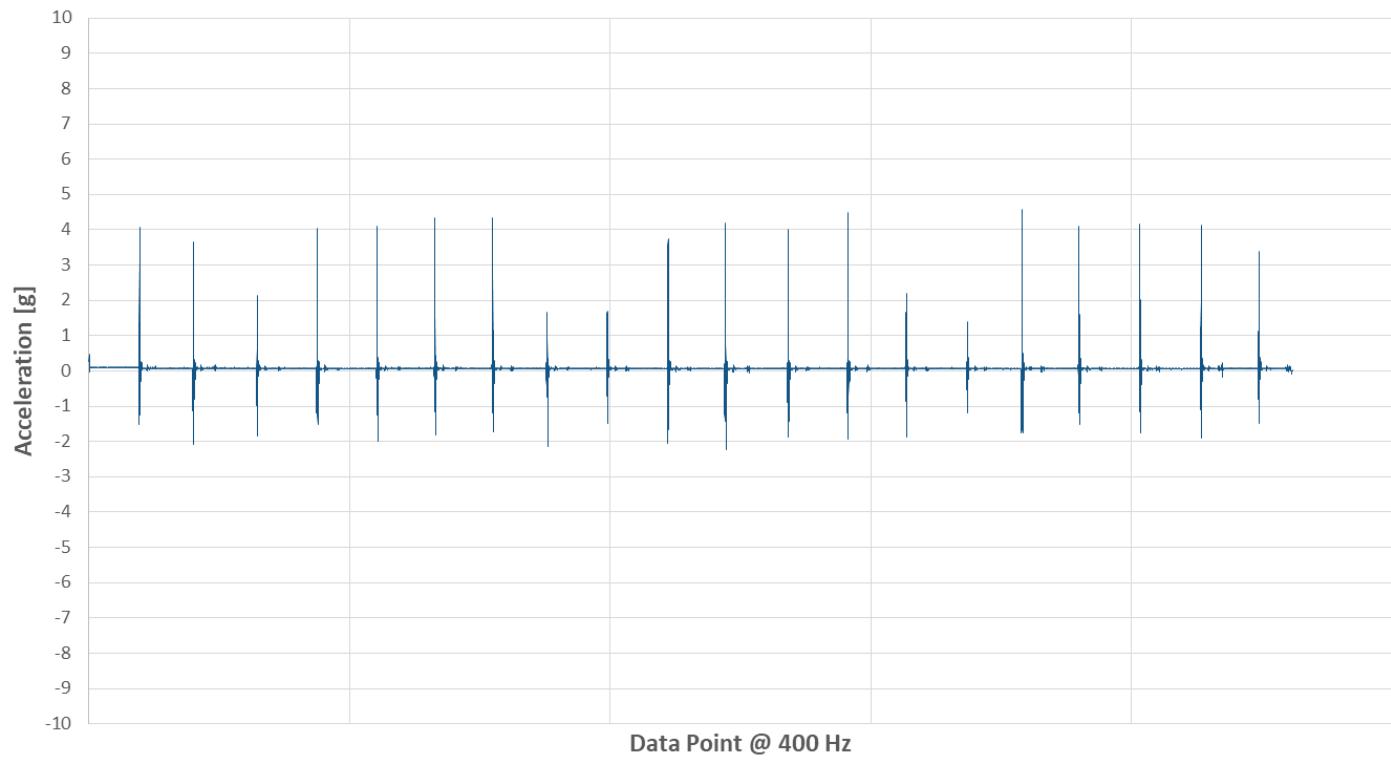


TEST 3 – SILK + SNOW

Vector Magnitude Acceleration - Silk + Snow



X Acceleration (Side to Side) - Silk + Snow

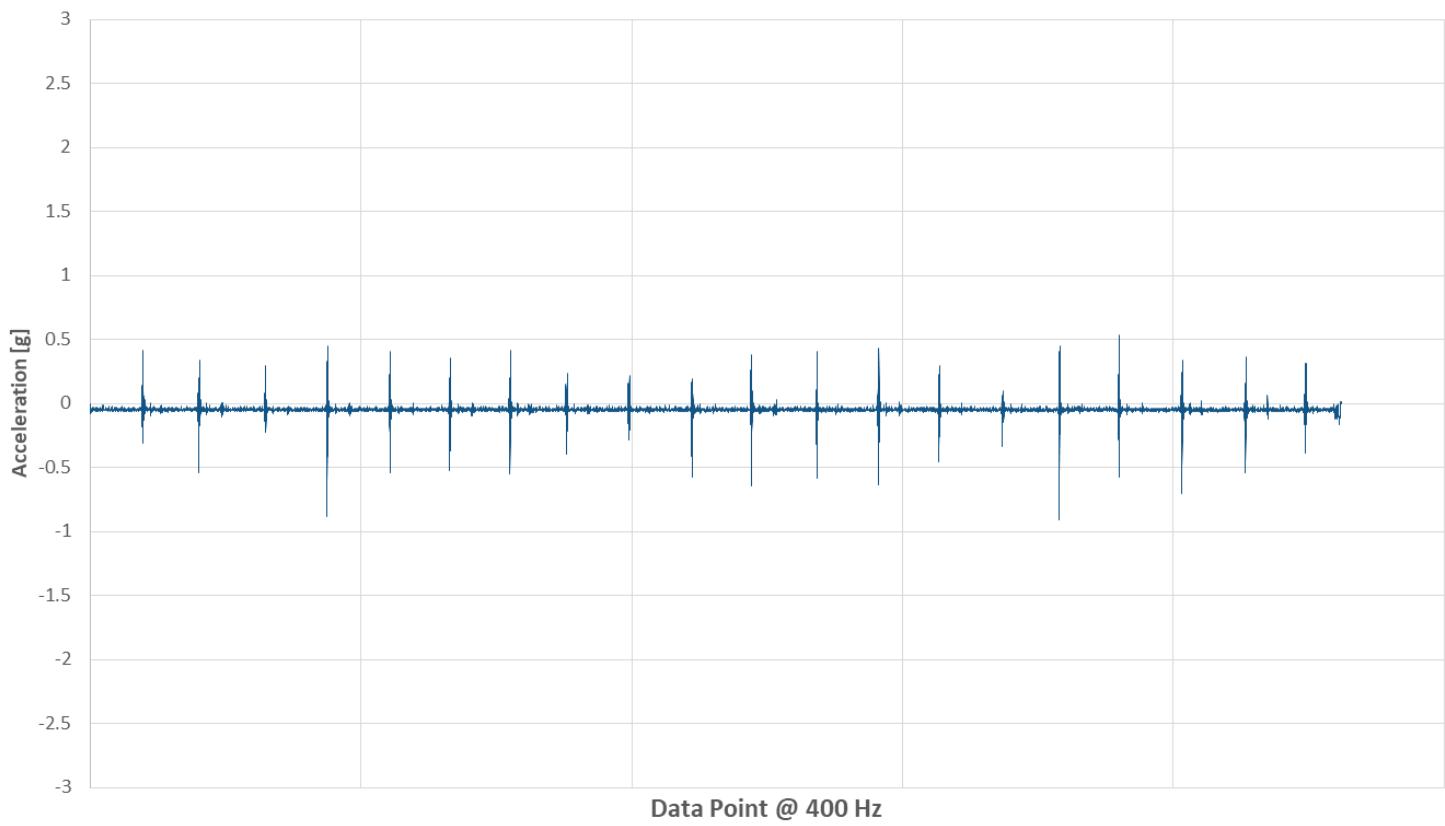




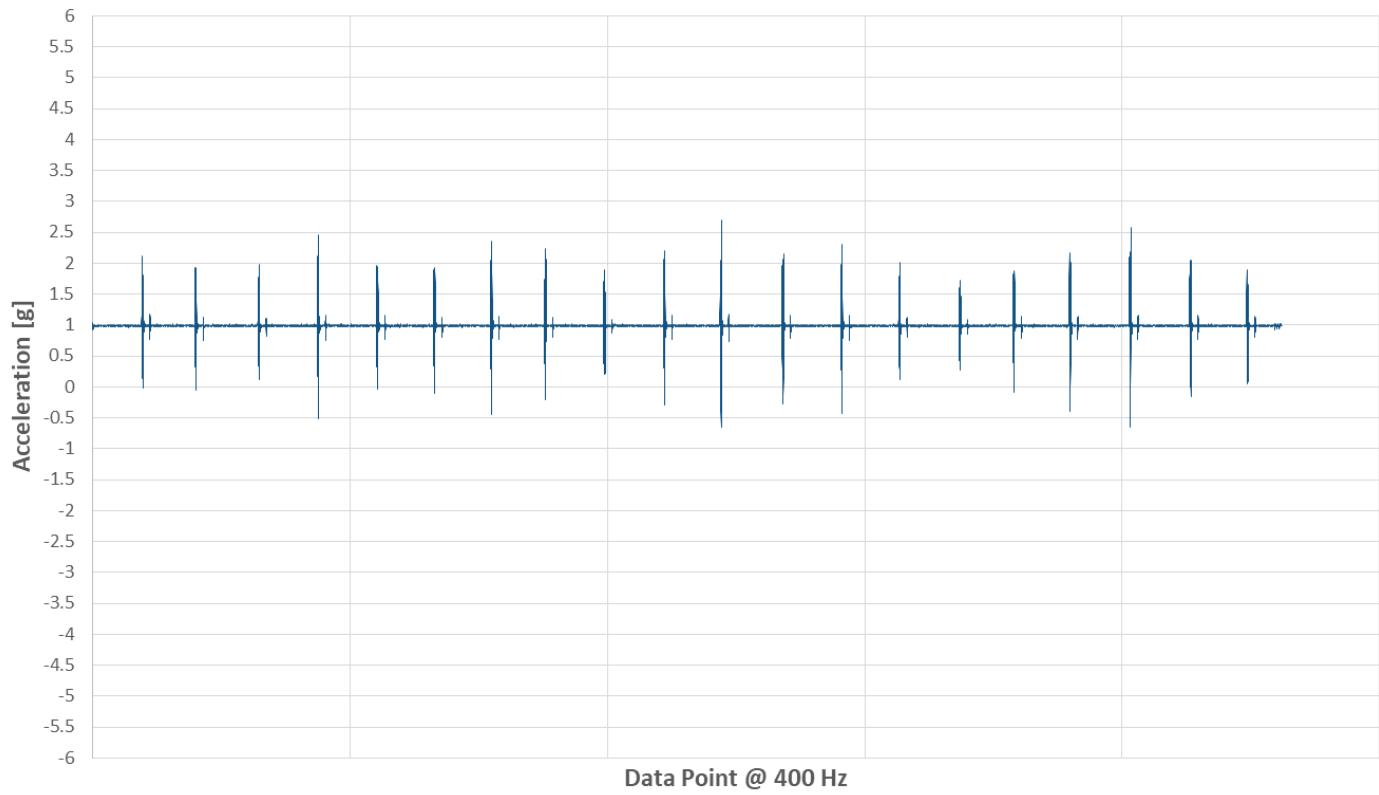
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Y Acceleration (Head to Toe) - Silk + Snow



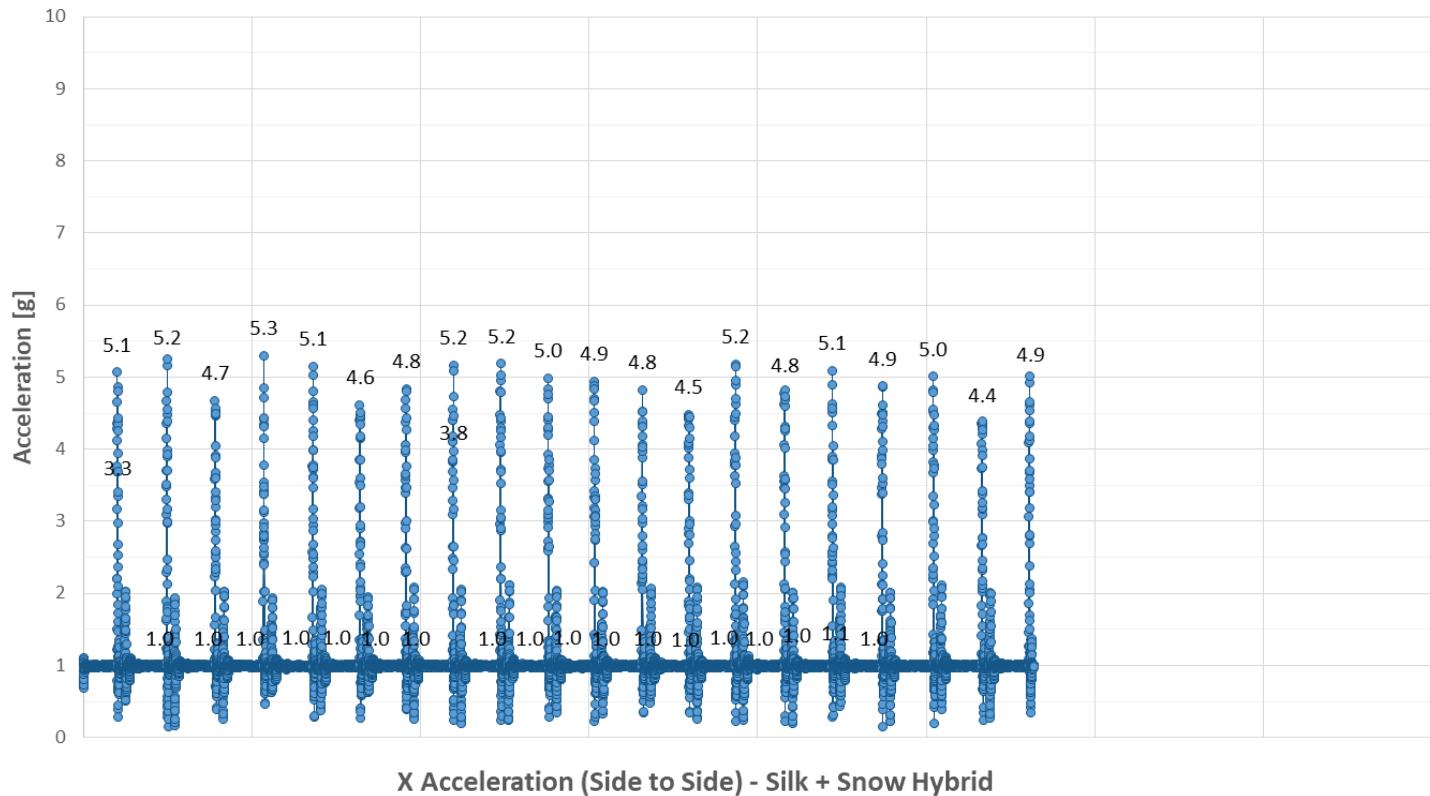
Z Acceleration (Up and Down) - Silk + Snow



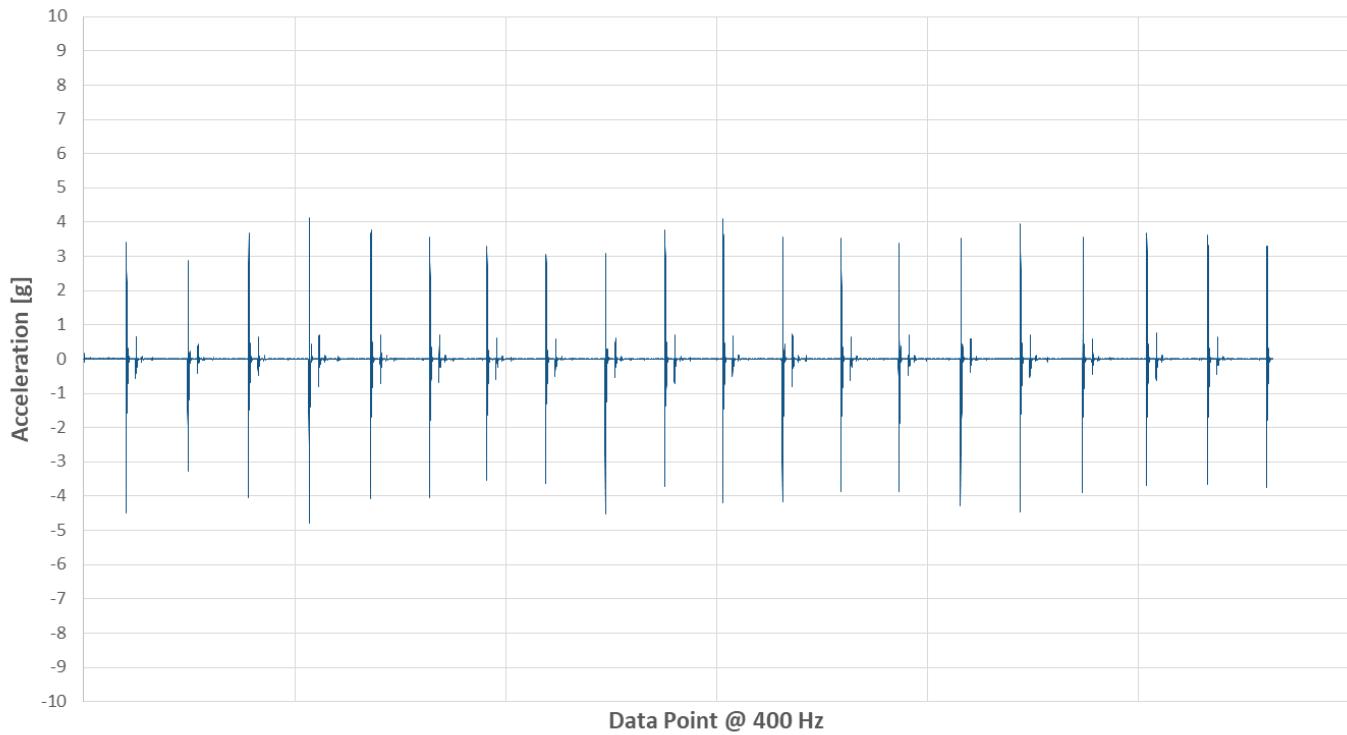


TEST 3 – SILK + SNOW HYBRID

Vector Magnitude Acceleration - Silk + Snow Hybrid



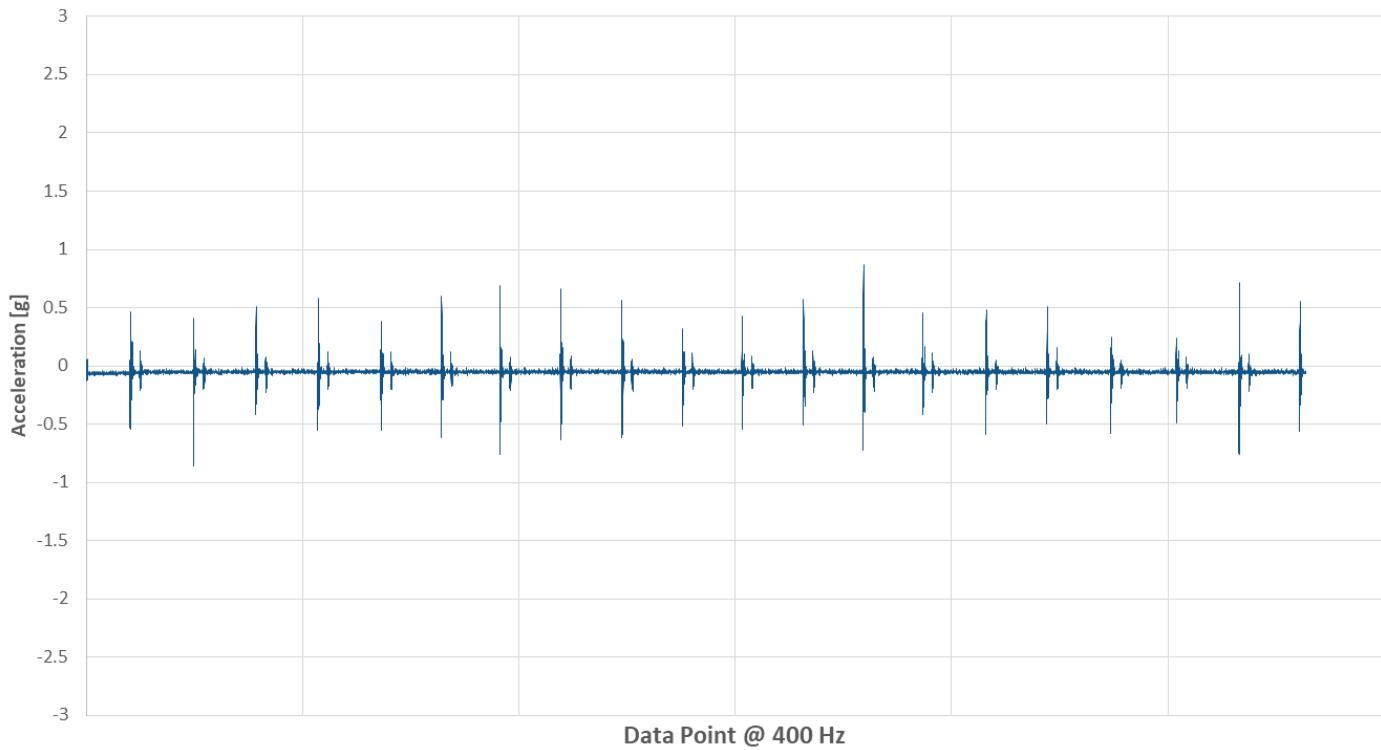
X Acceleration (Side to Side) - Silk + Snow Hybrid



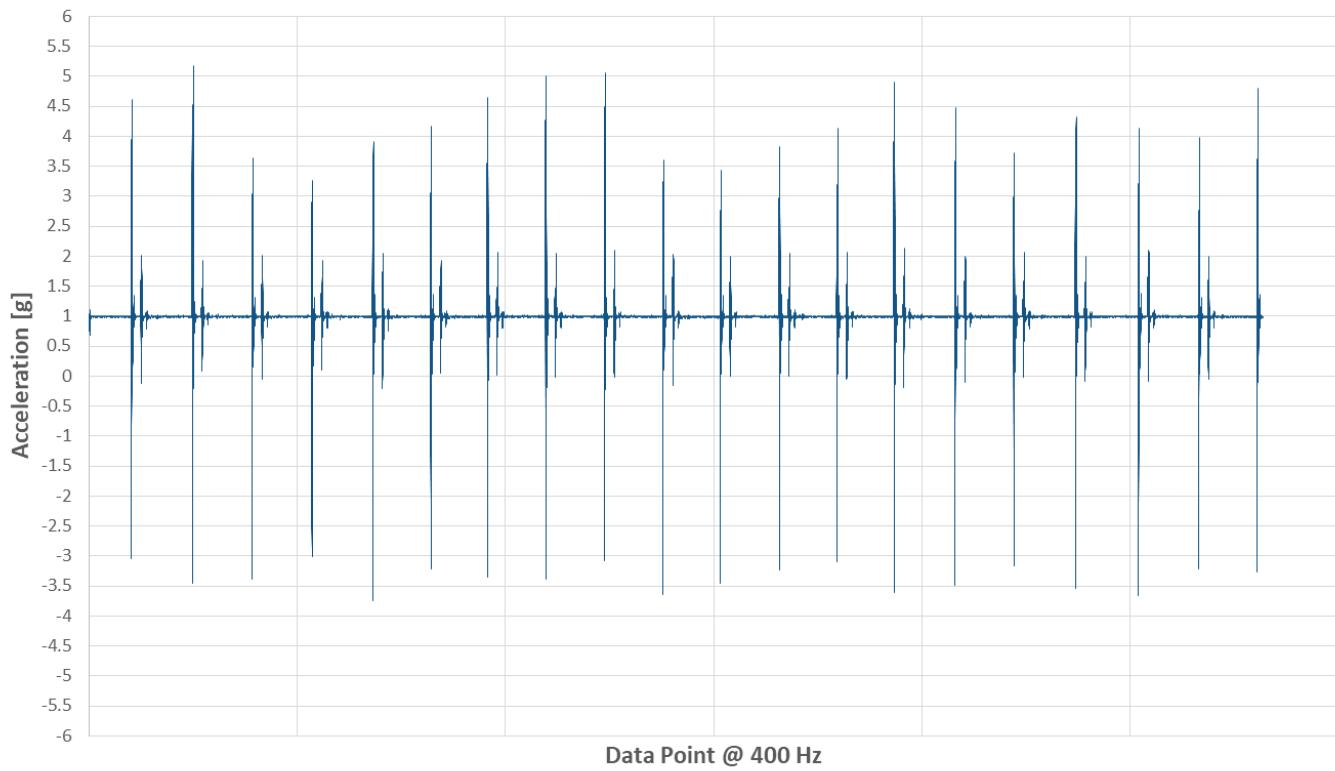
Data Point @ 400 Hz



Y Acceleration (Head to Toe) - Silk + Snow Hybrid



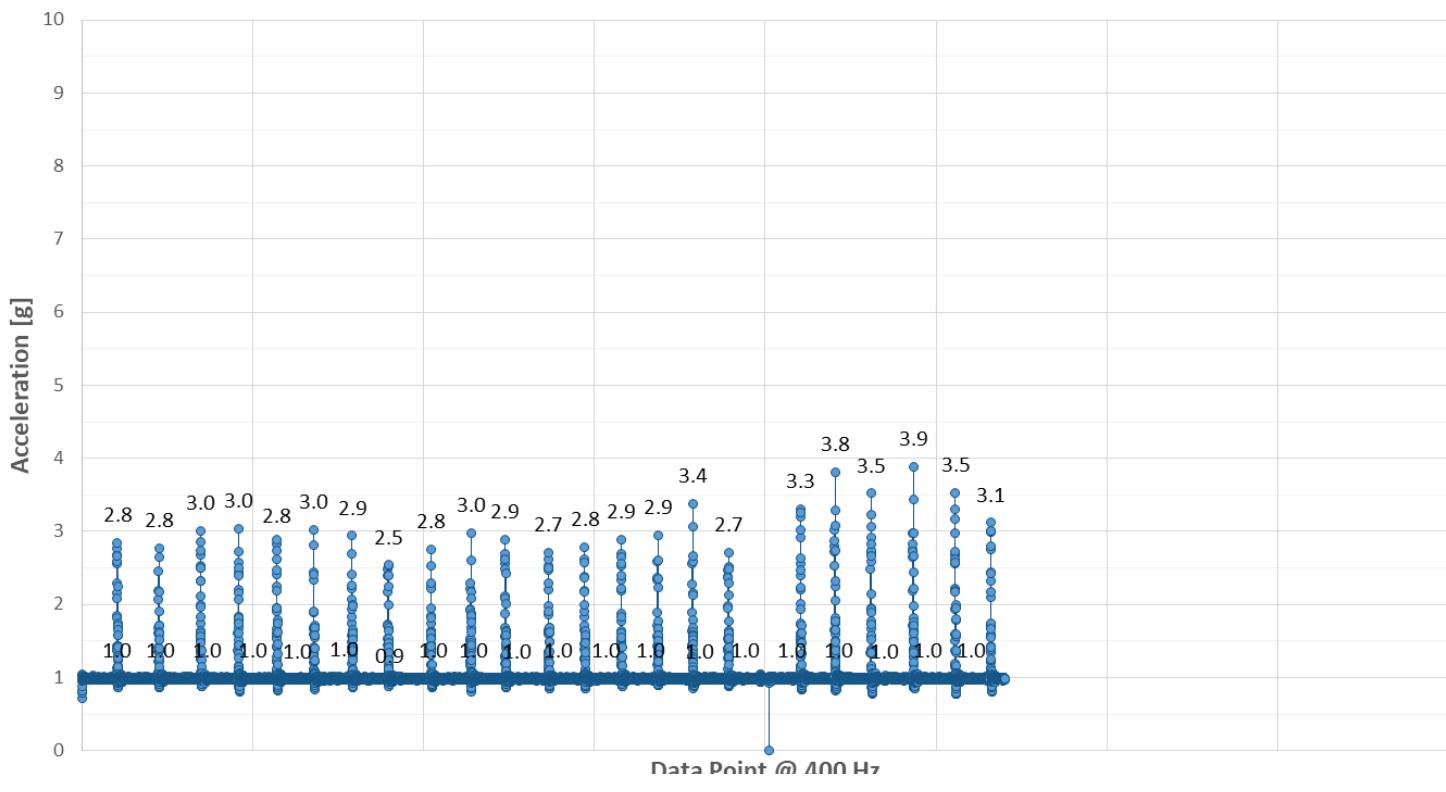
Z Acceleration (Up and Down) - Silk + Snow Hybrid



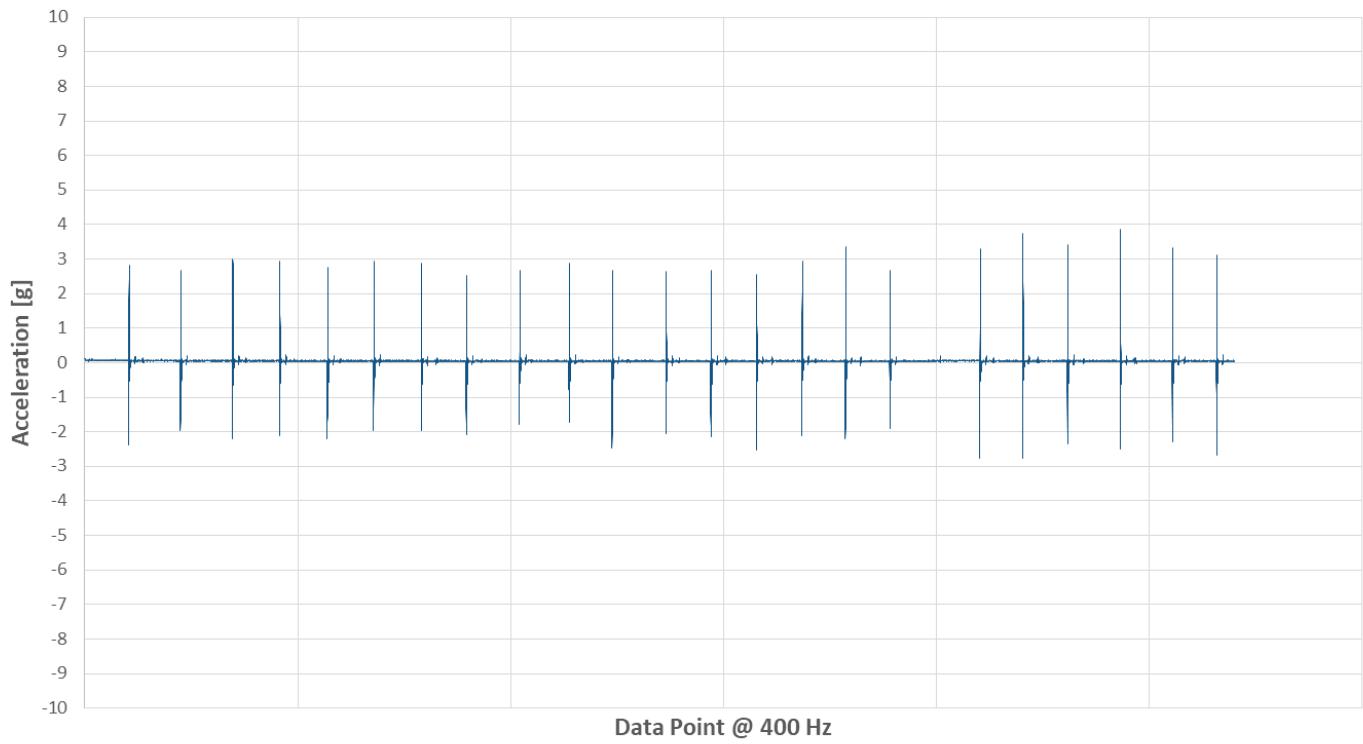


TEST 3 – NOVAFORM

Vector Magnitude Acceleration - Novaform



X Acceleration (Side to Side) - Novaform

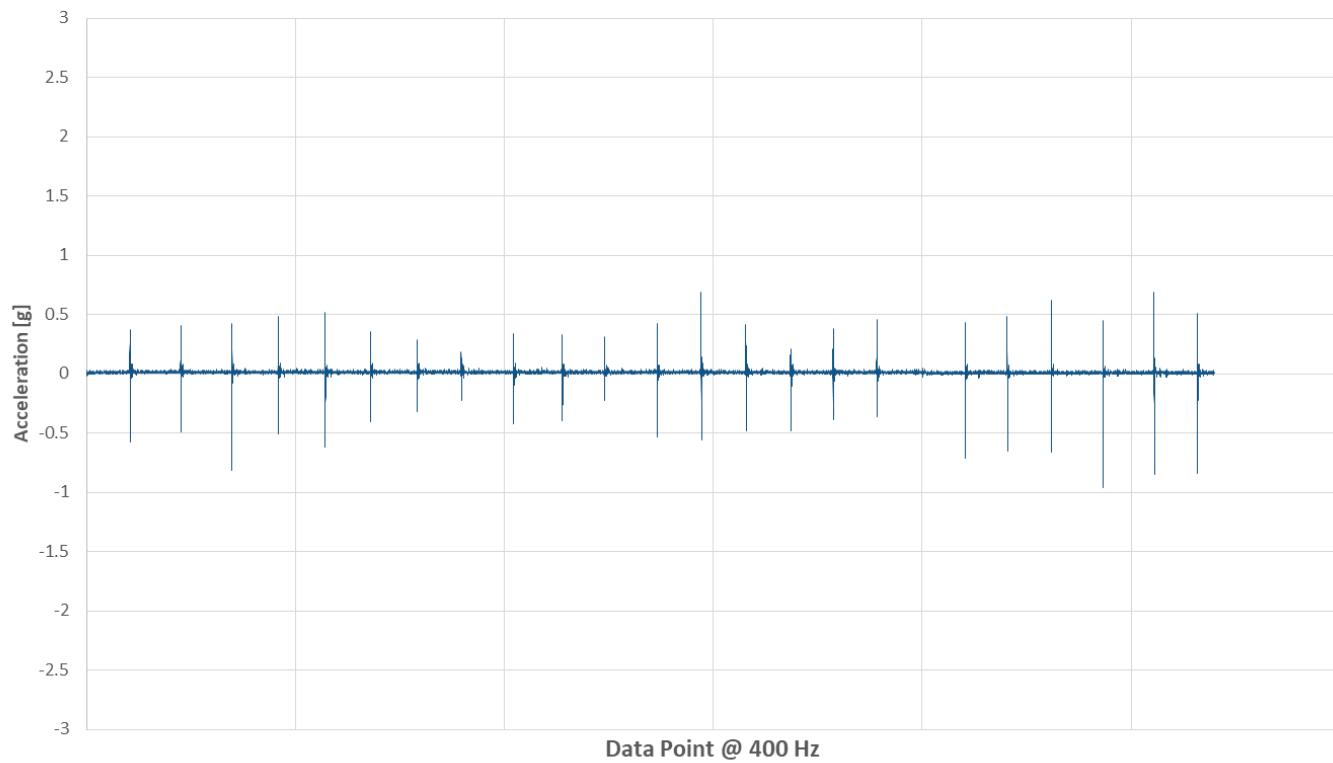




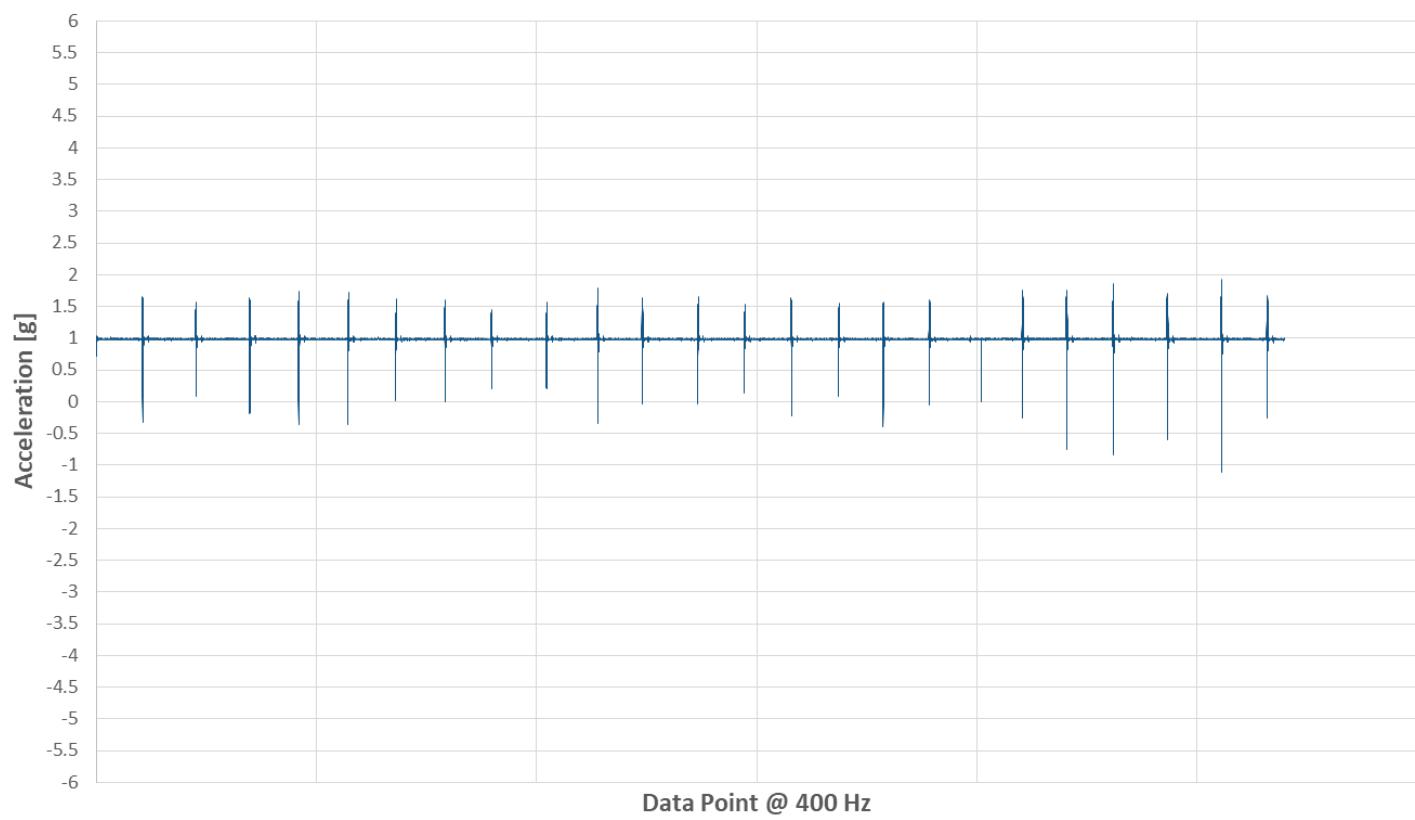
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Y Acceleration (Head to Toe) - Novaform



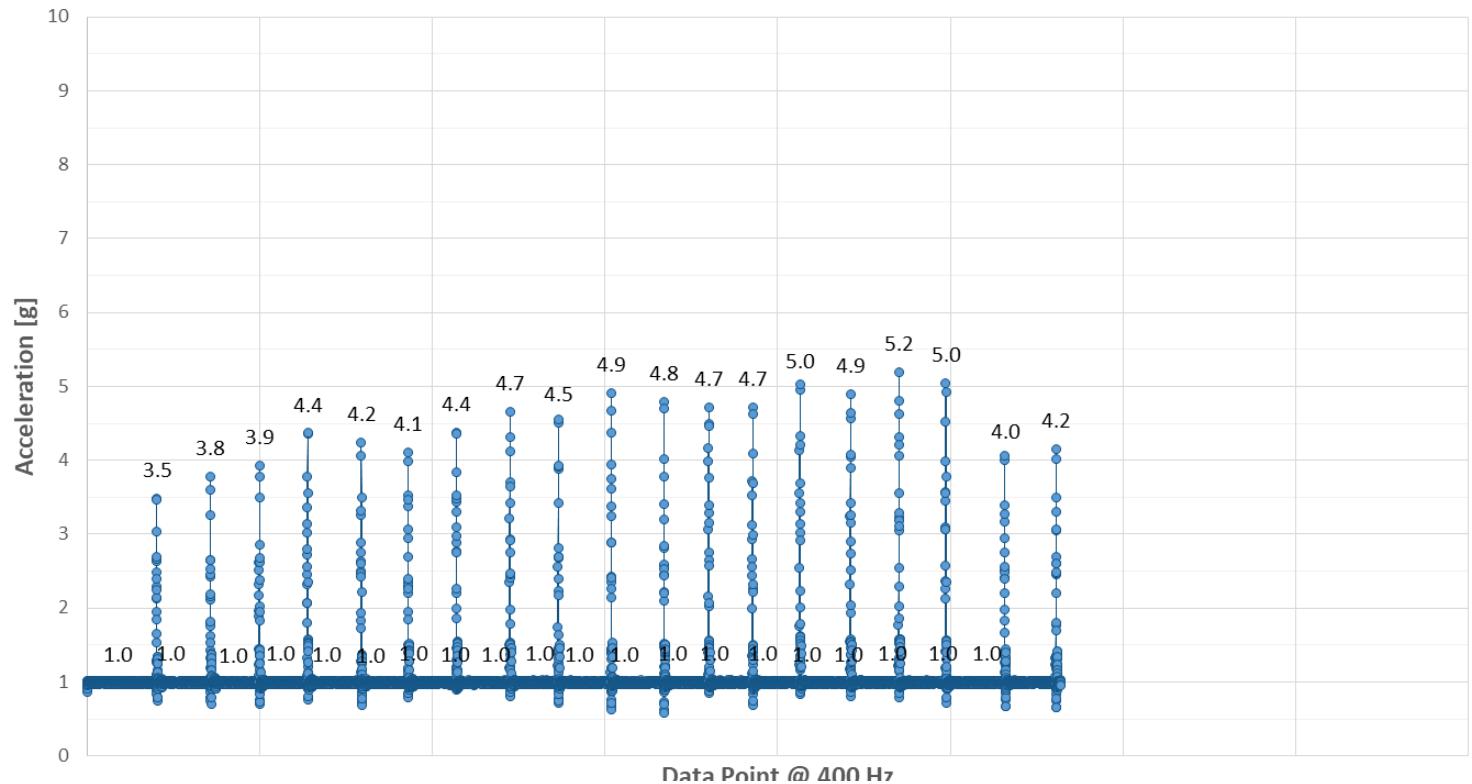
Z Acceleration (Up and Down) - Novaform



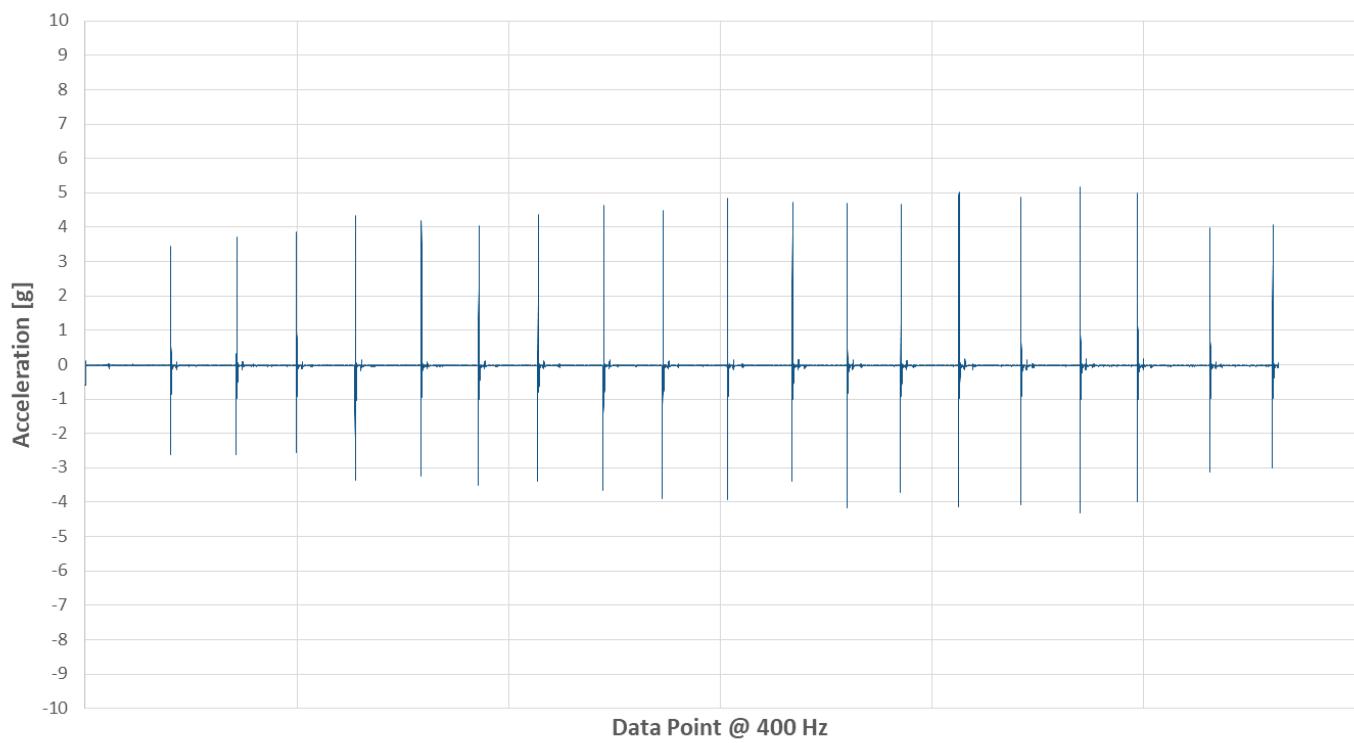


TEST 3 – NECTAR

Vector Magnitude Acceleration - Nectar



X Acceleration (Side to Side) - Nectar

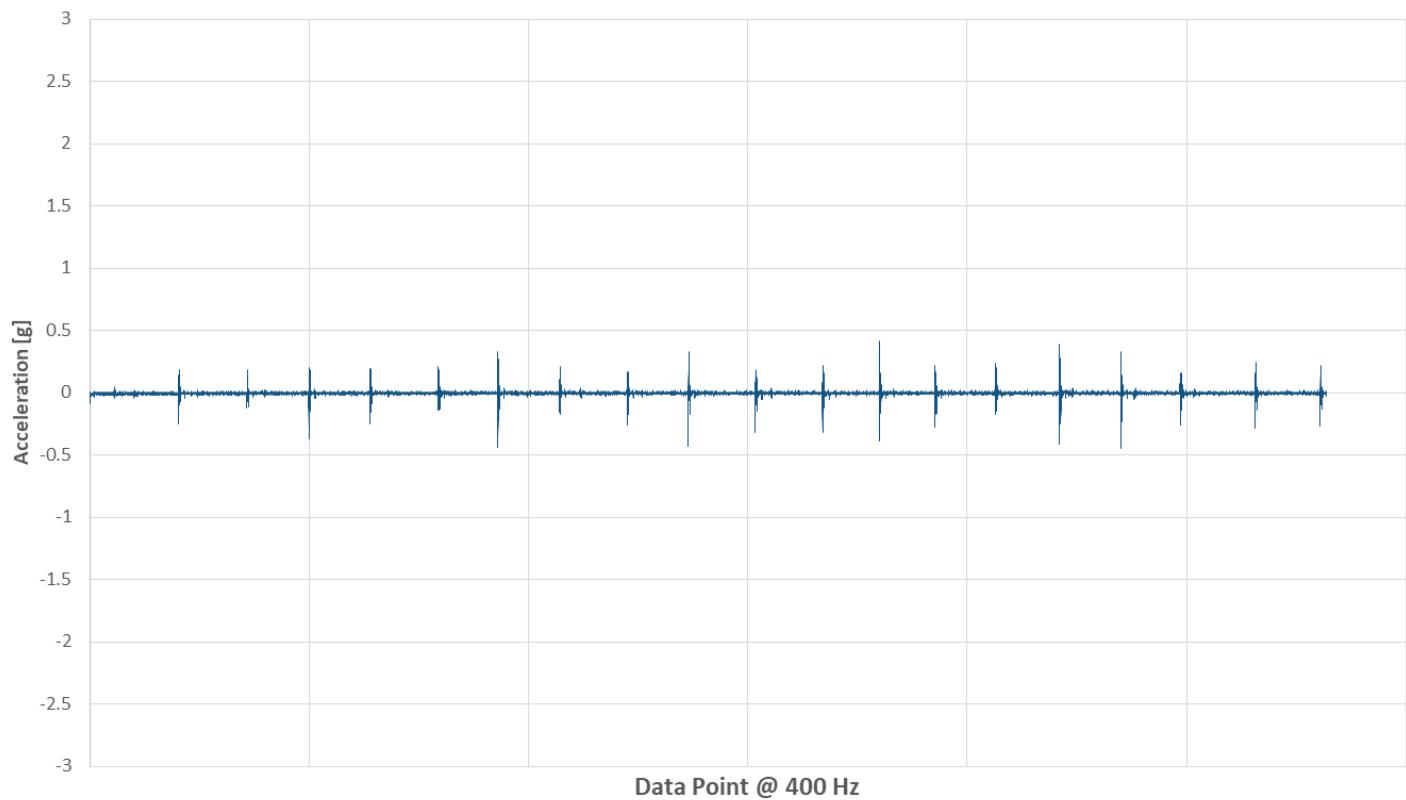




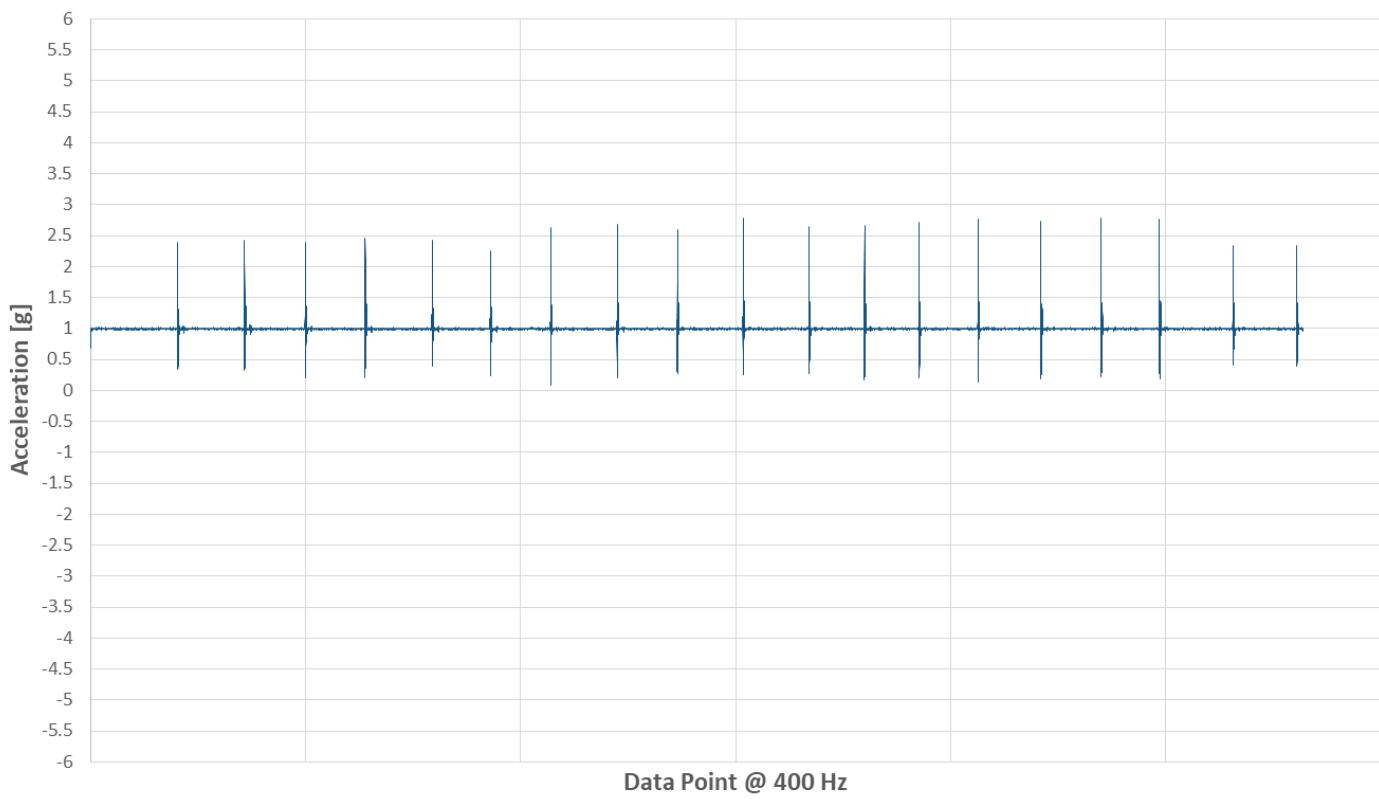
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Y Acceleration (Head to Toe) - Nectar



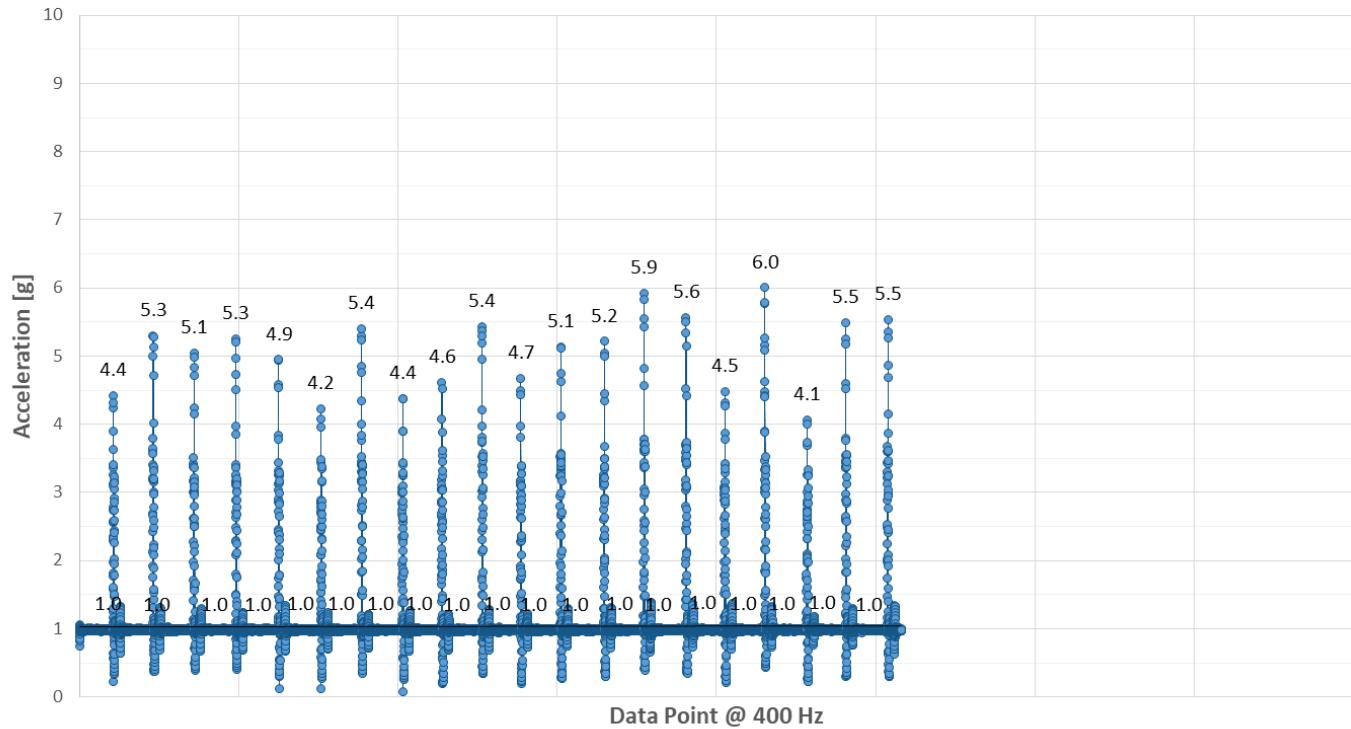
Z Acceleration (Up and Down) - Nectar



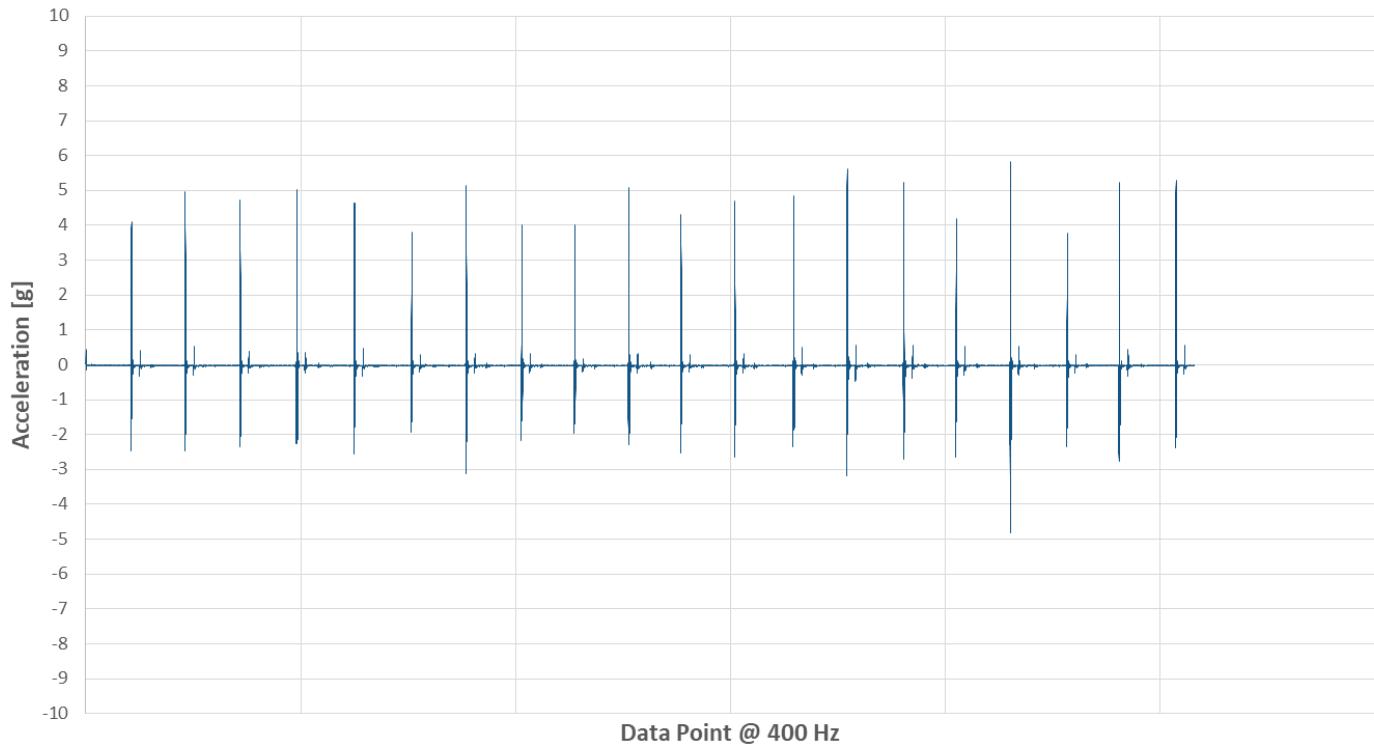


TEST 3 – LOGAN & COVE MEDIUM

Vector Magnitude Acceleration - Logan & Cove Medium



X Acceleration (Side to Side) - Logan & Cove Medium

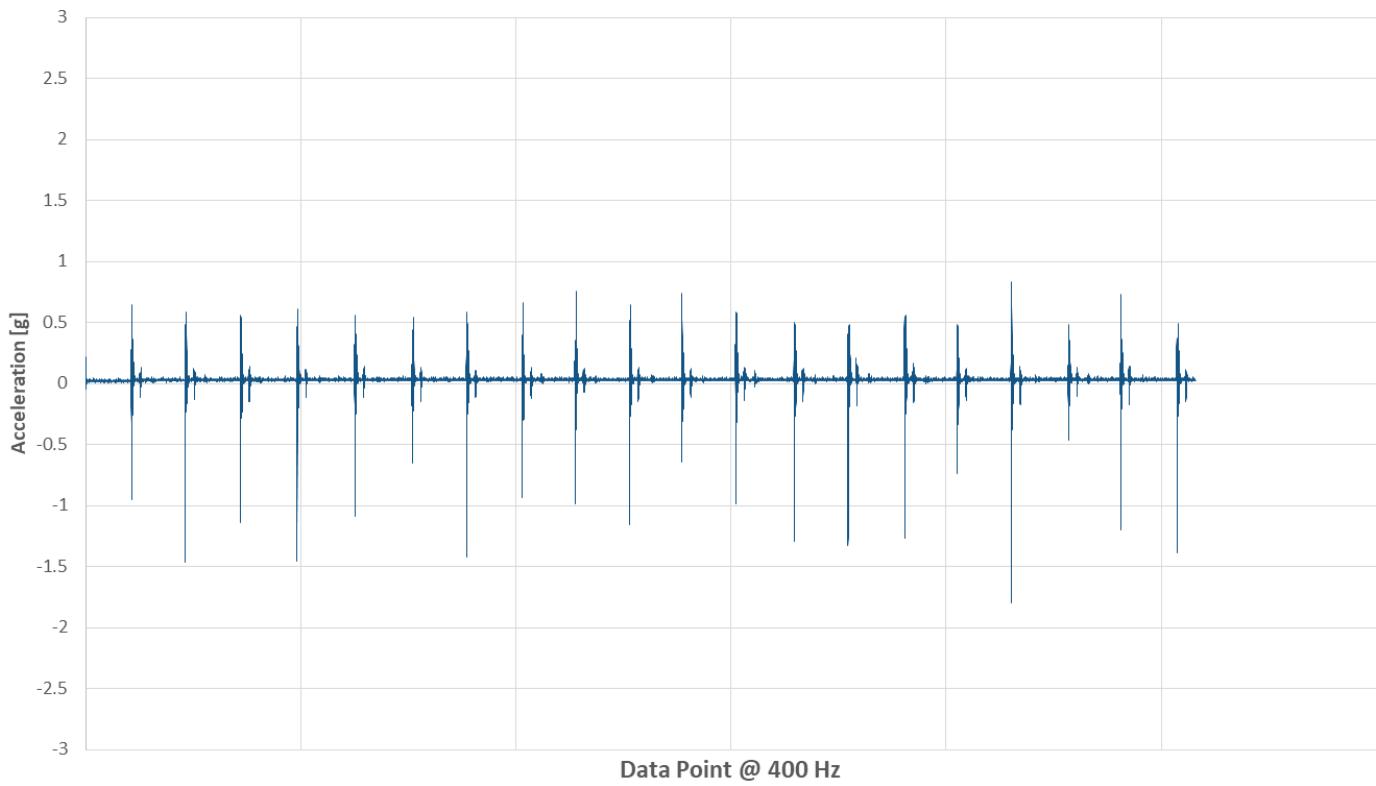




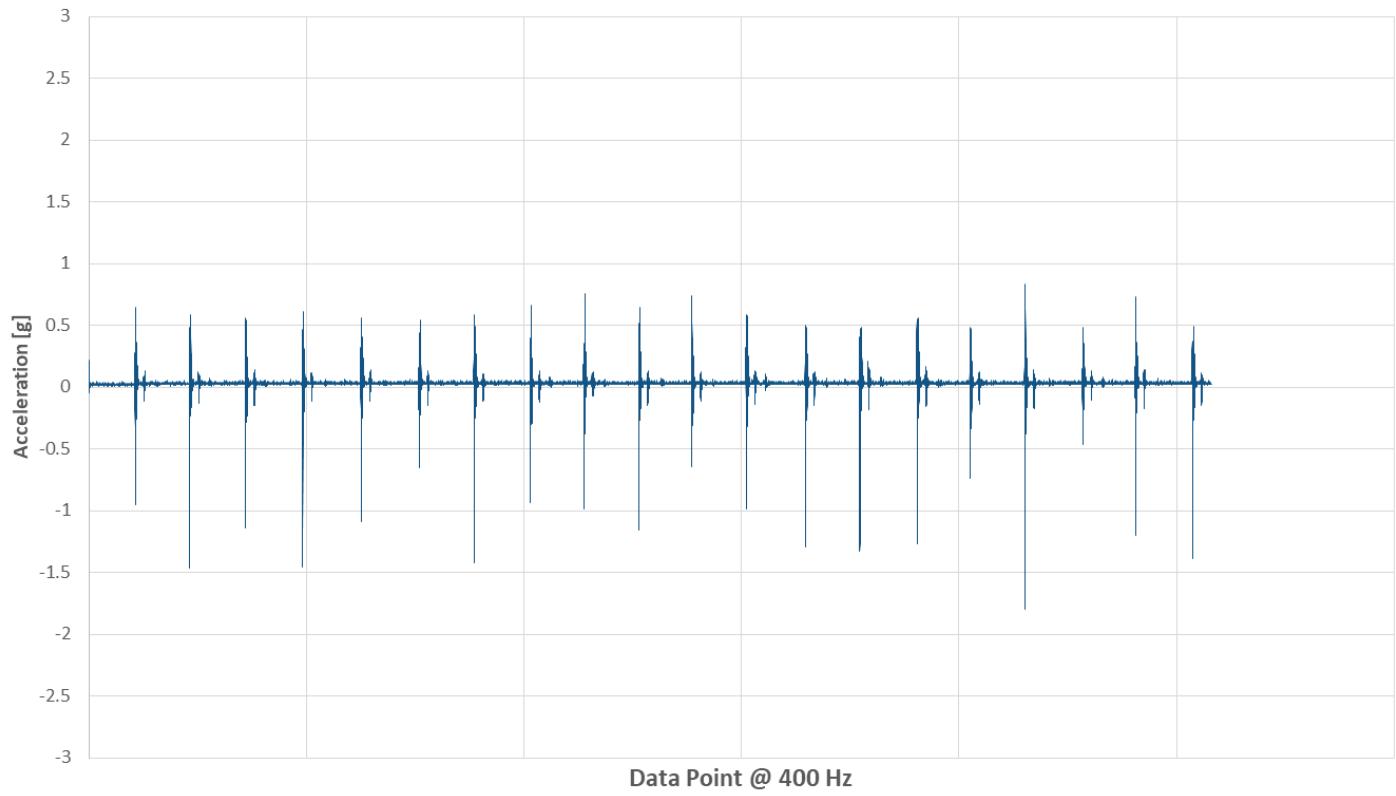
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Y Acceleration (Head to Toe) - Logan & Cove Medium



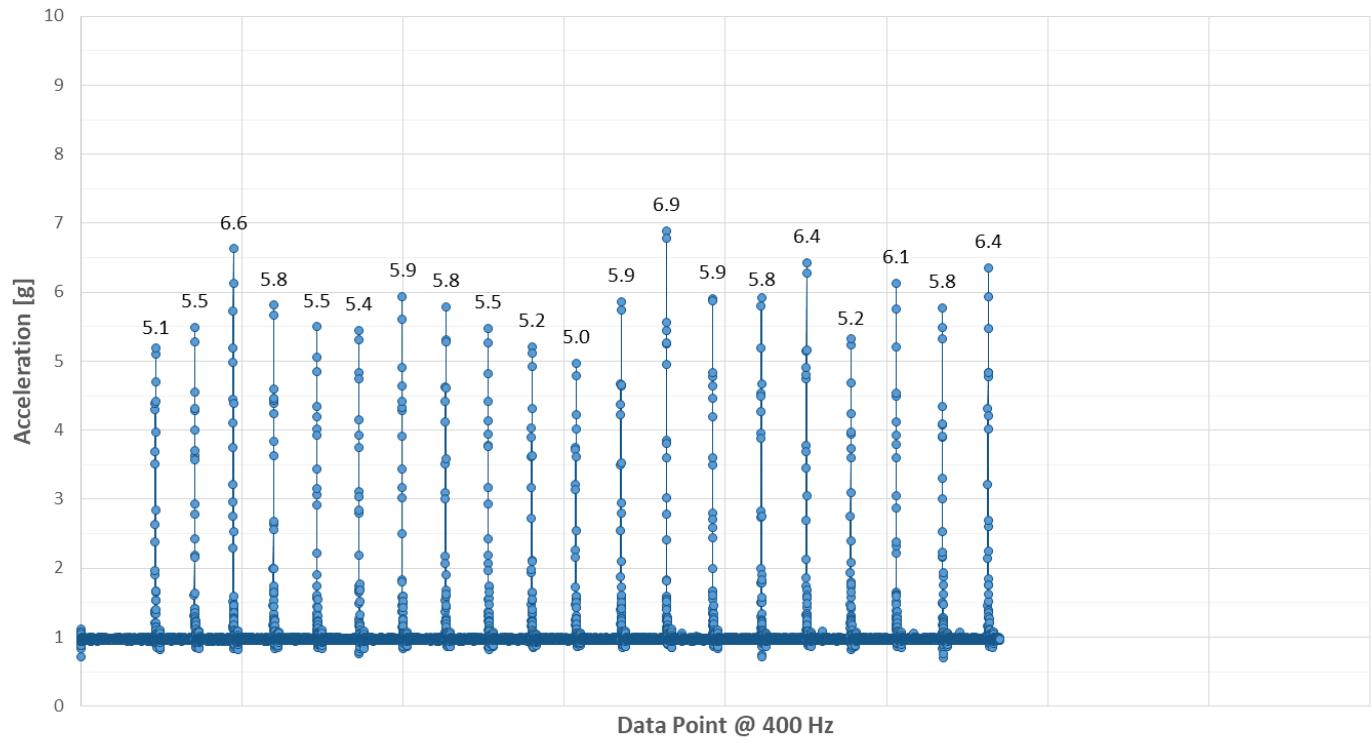
Y Acceleration (Head to Toe) - Logan & Cove Medium



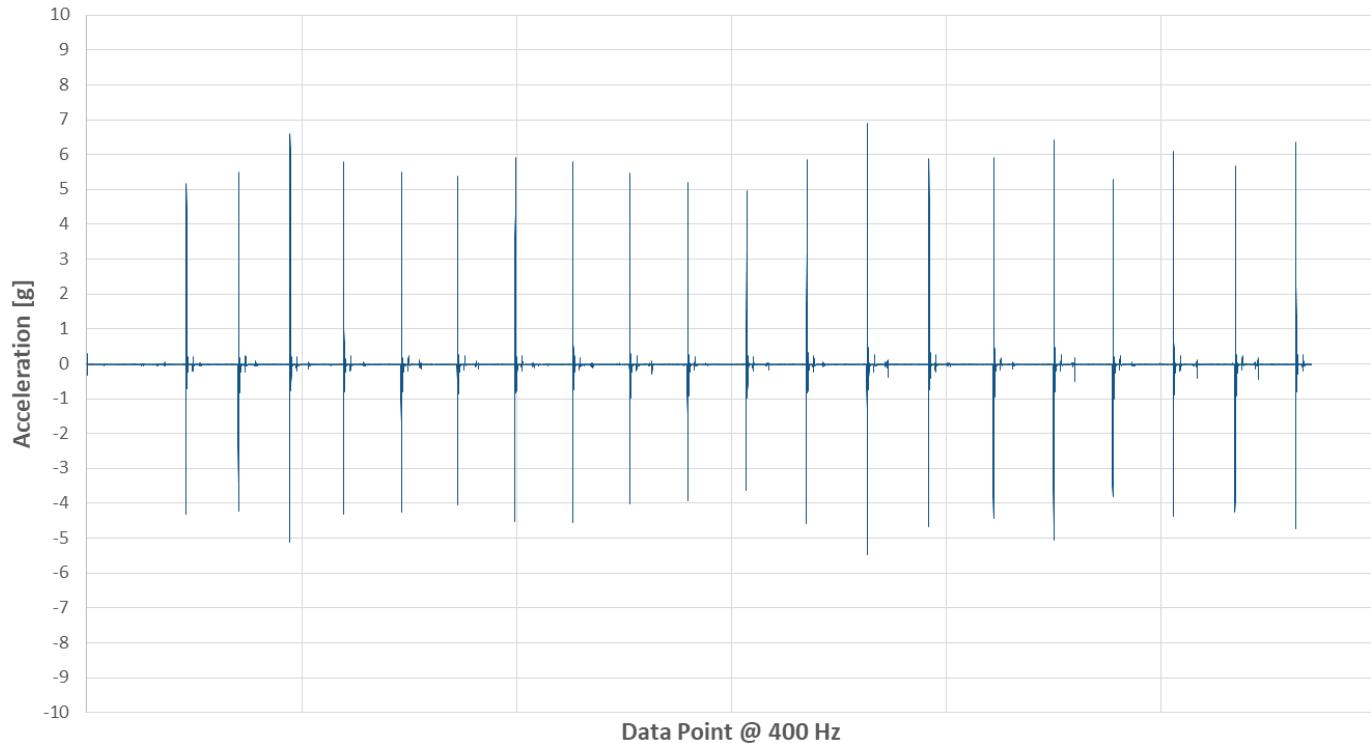


TEST 3 – CASPER ESSENTIAL

Vector Magnitude Acceleration - Casper Essential



X Acceleration (Side to Side) - Casper Essential

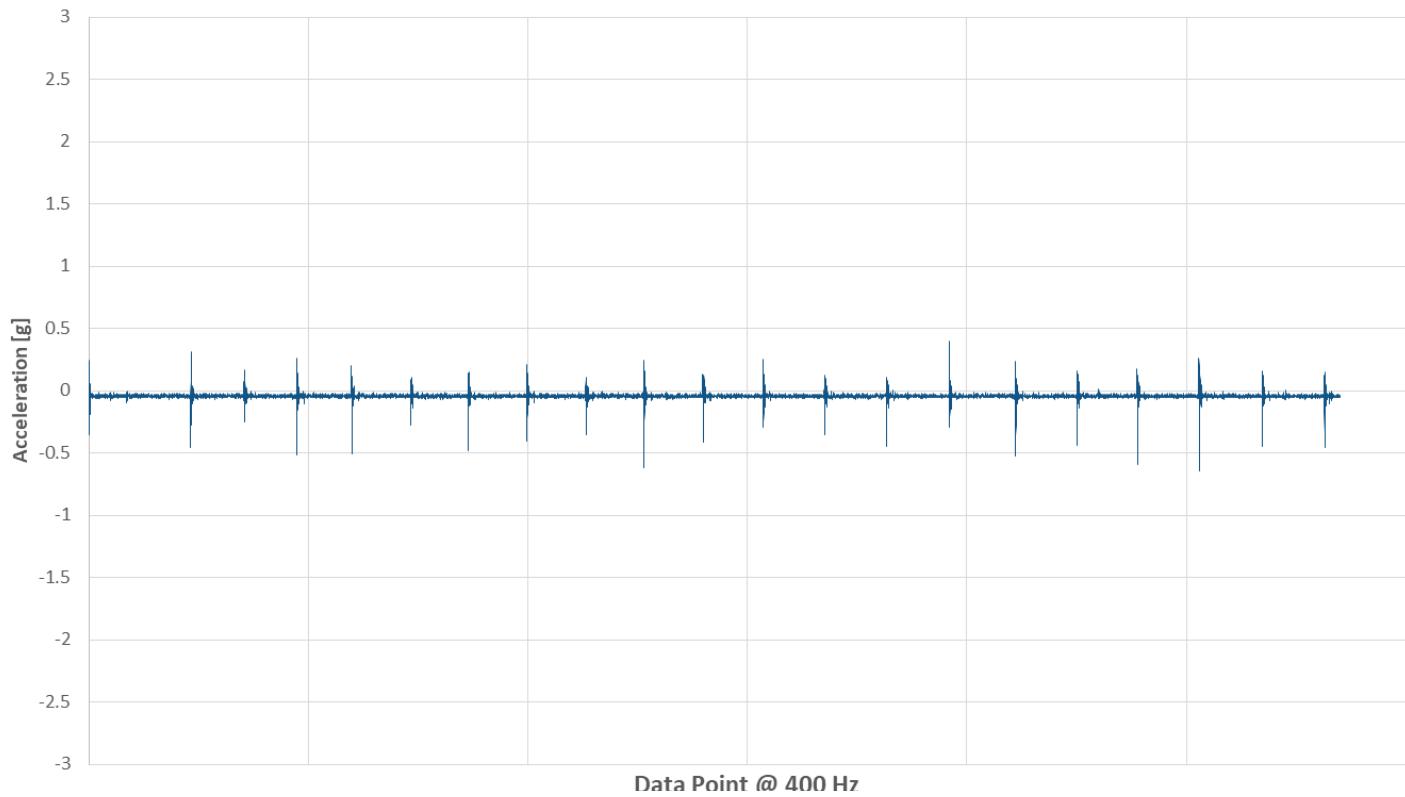




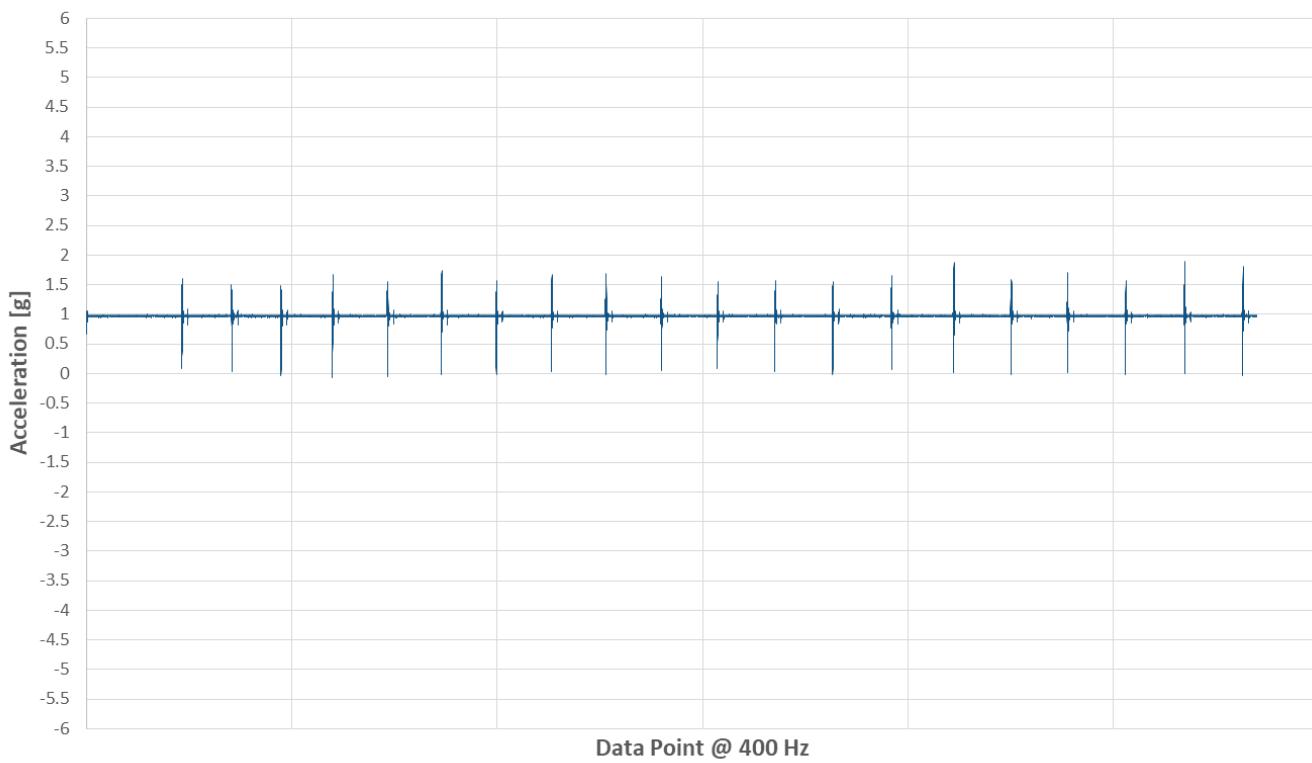
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Y Acceleration (Head to Toe) - Casper Essential



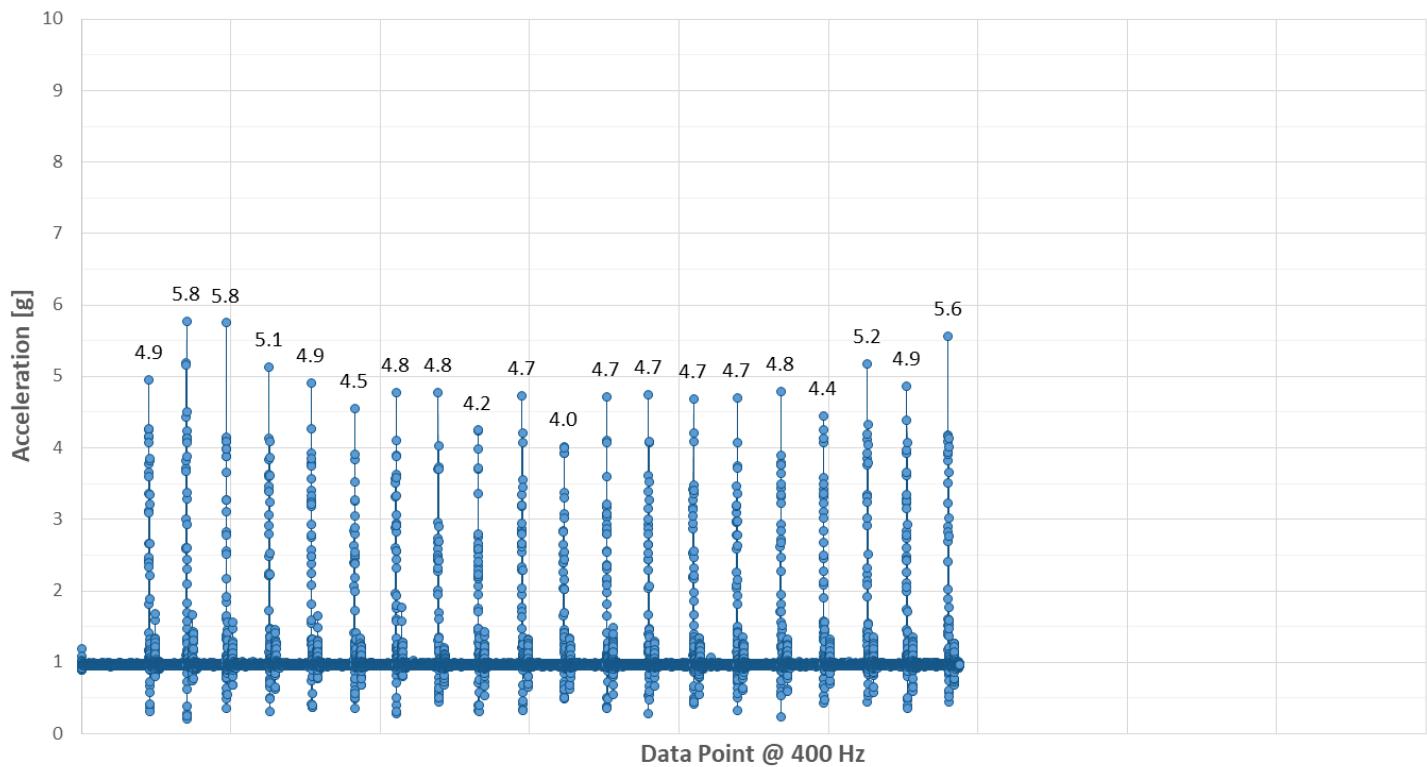
Z Acceleration (Up and Down) - Casper Essential



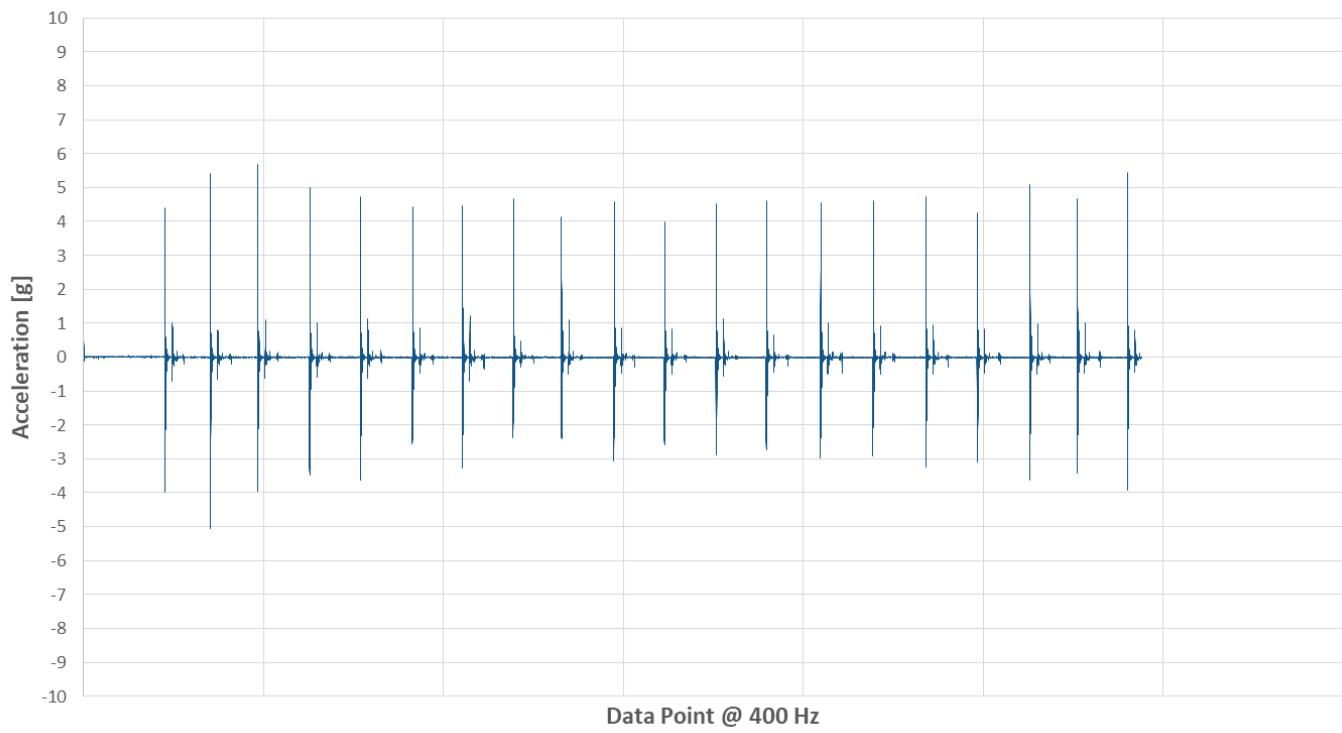


TEST 3 – CASPER WAVE

Vector Magnitude Acceleration - Casper Wave



X Acceleration (Side to Side) - Casper Wave

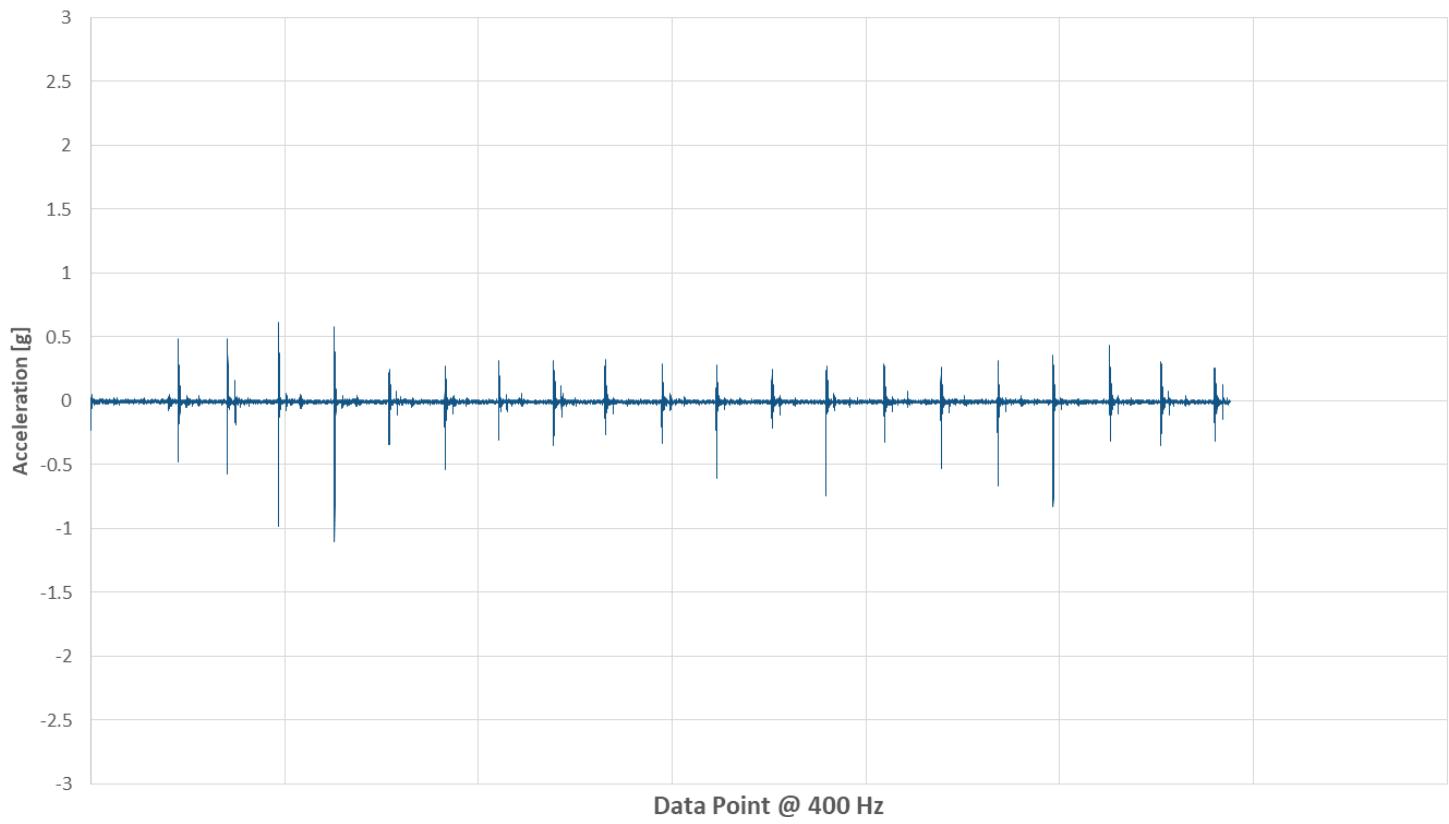




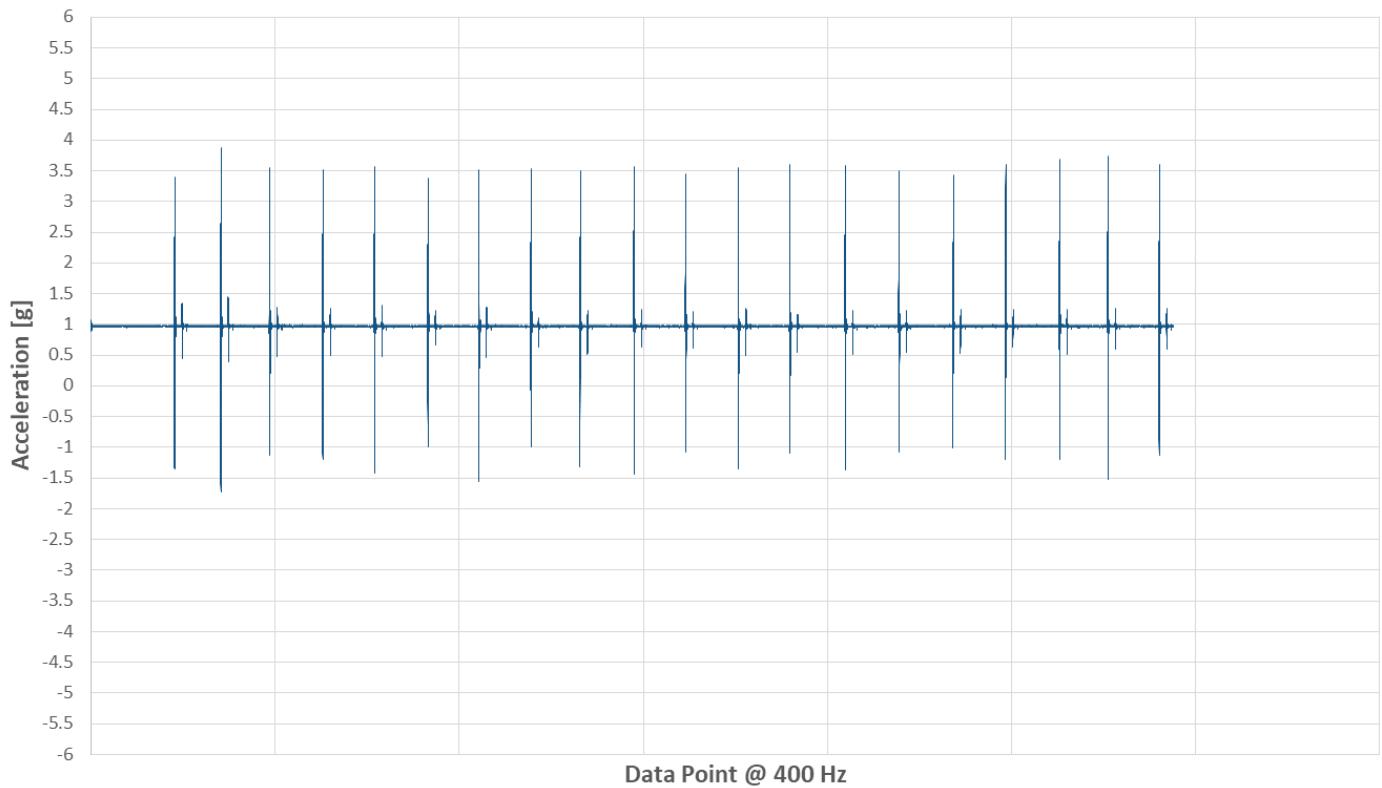
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Y Acceleration (Head to Toe) - Casper Wave

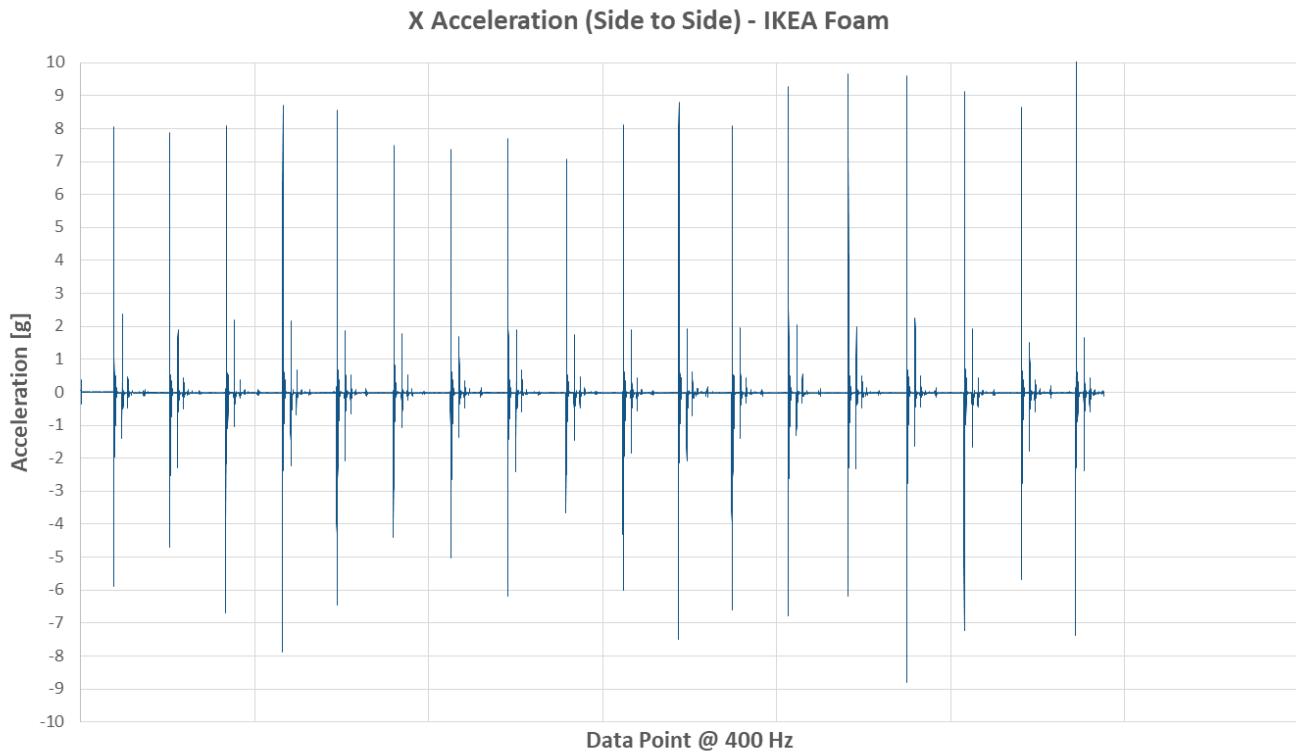
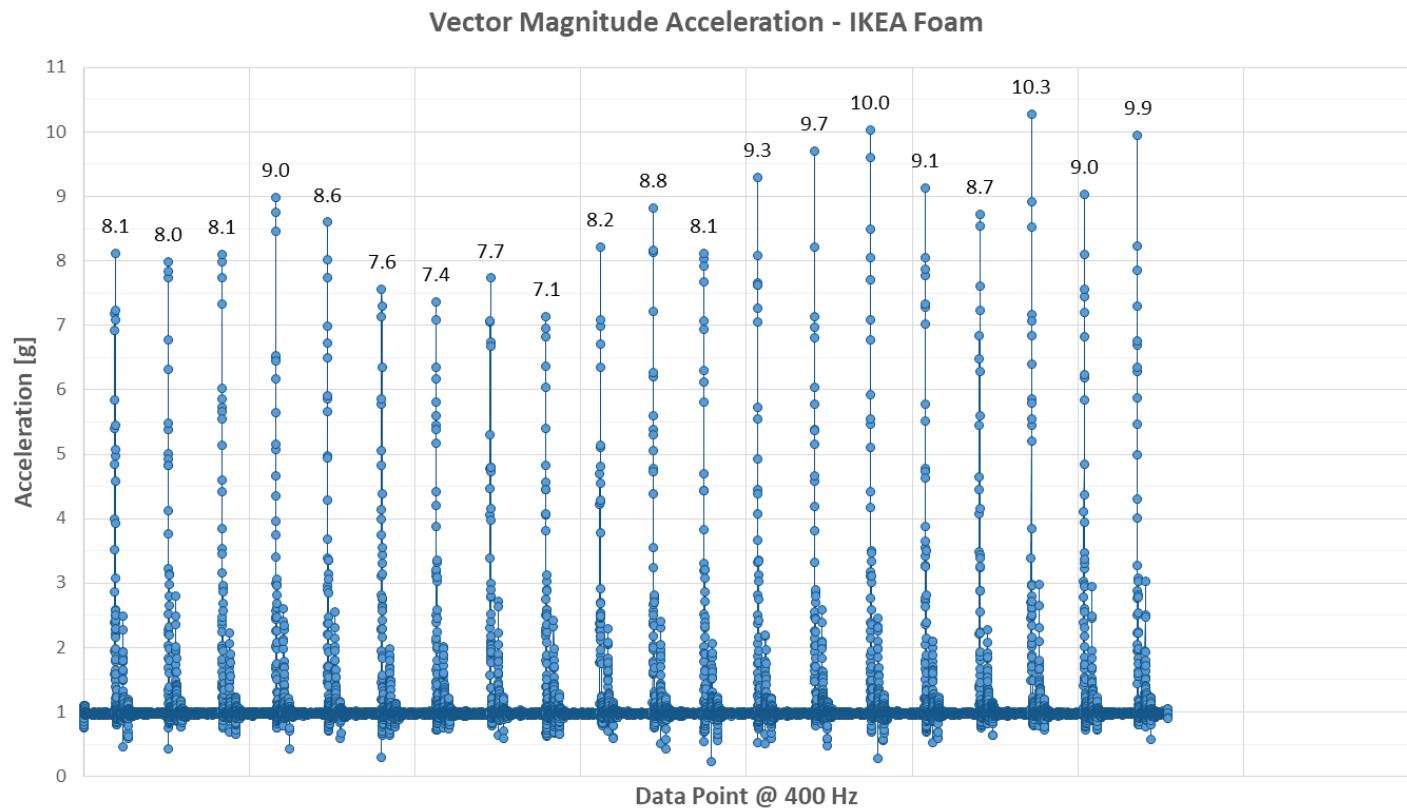


Z Acceleration (Up and Down) - Casper Wave



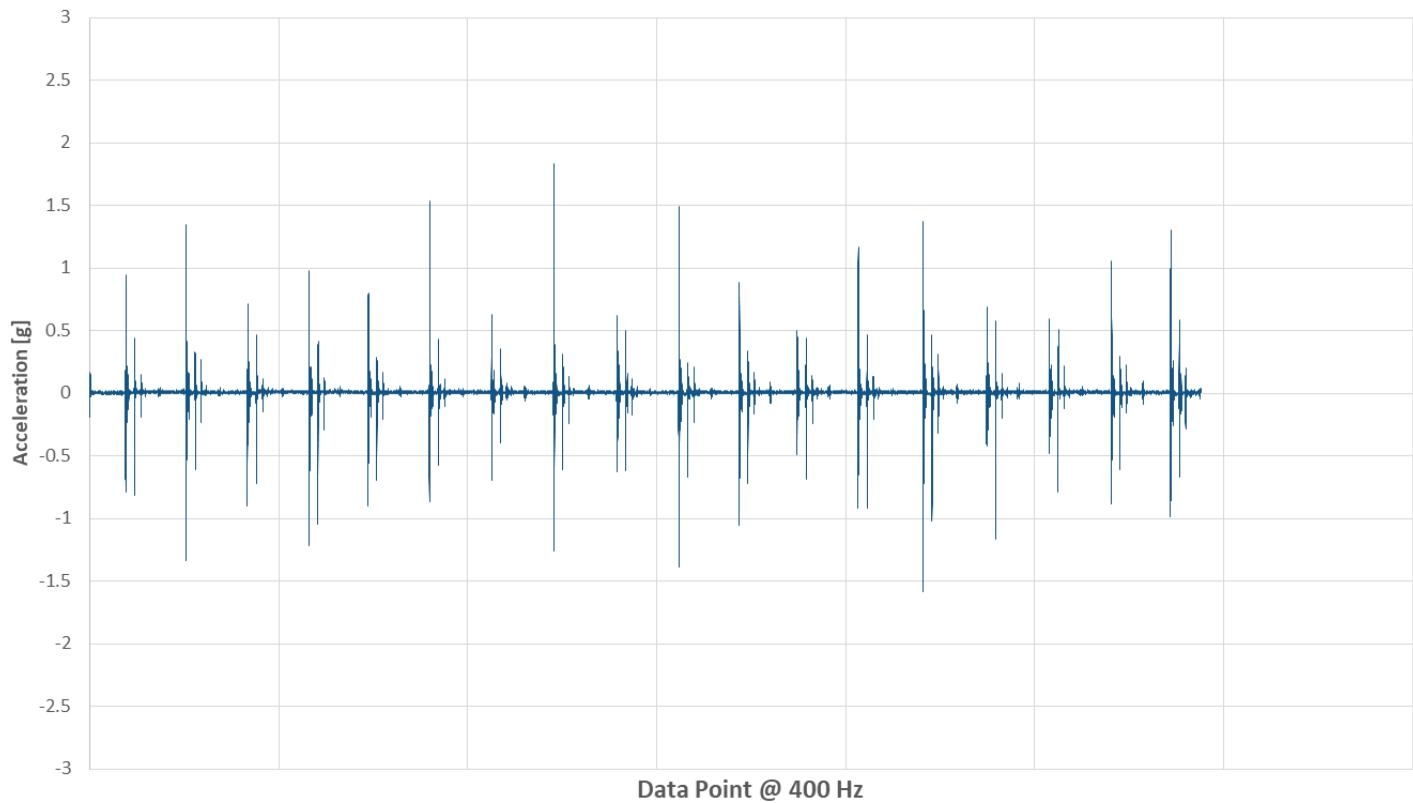


TEST 3 – IKEA FOAM

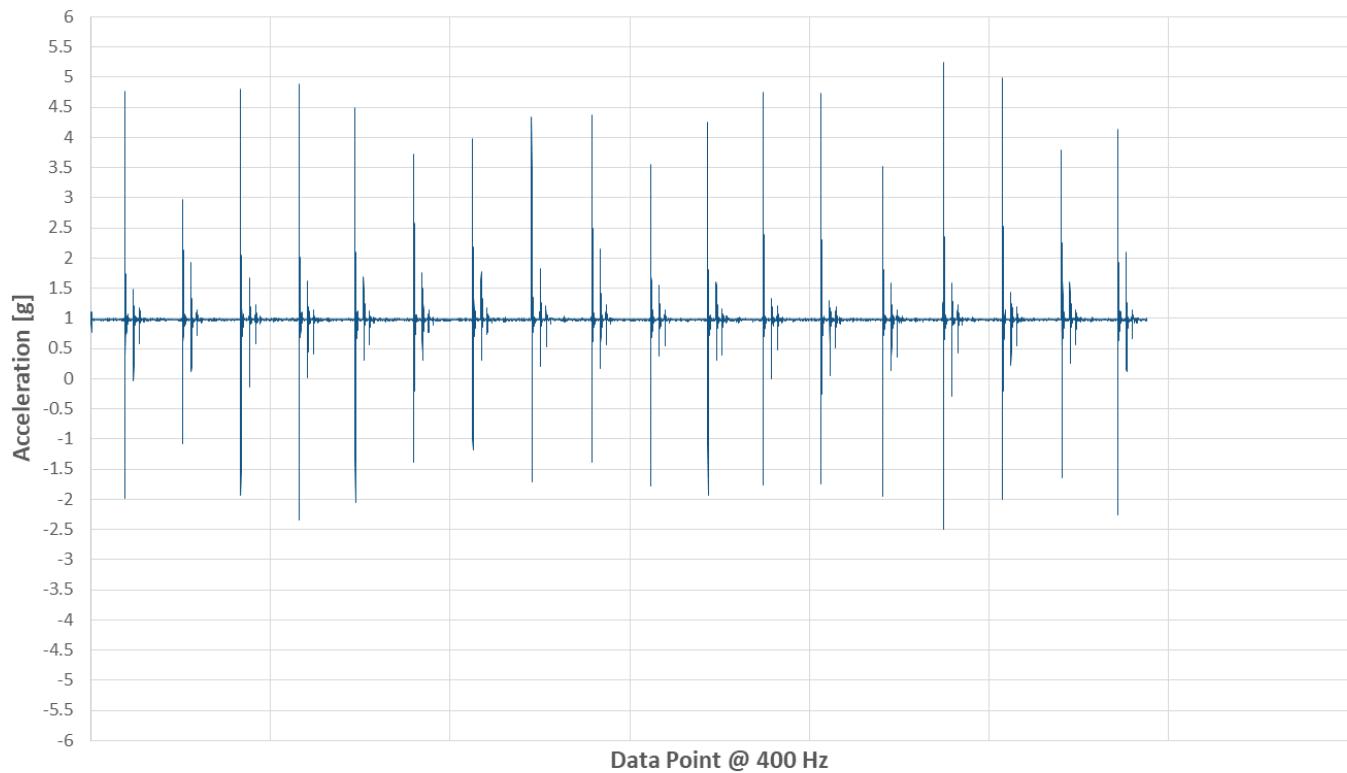




Y Acceleration (Head to Toe) - IKEA Foam



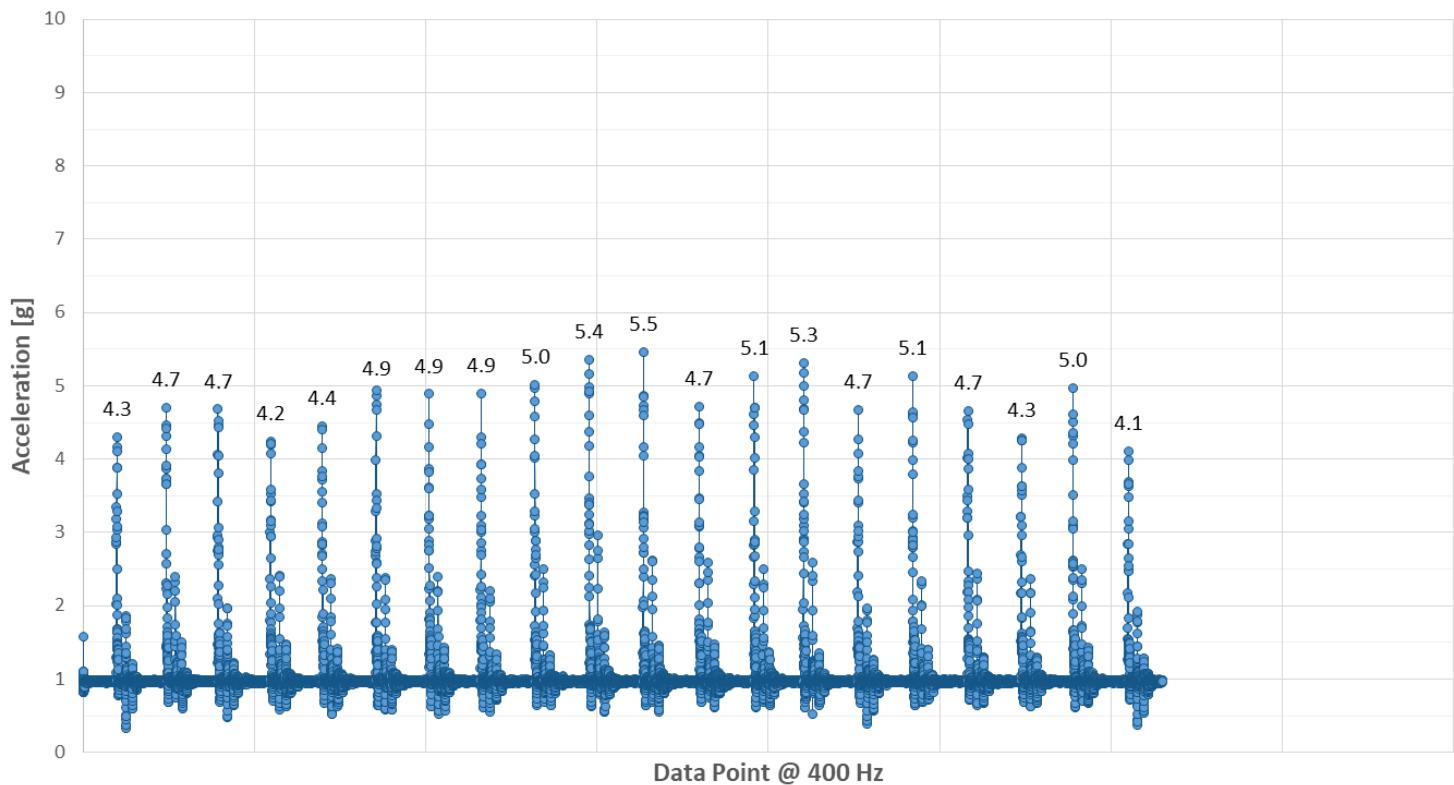
Z Acceleration (Up and Down) - IKEA Foam



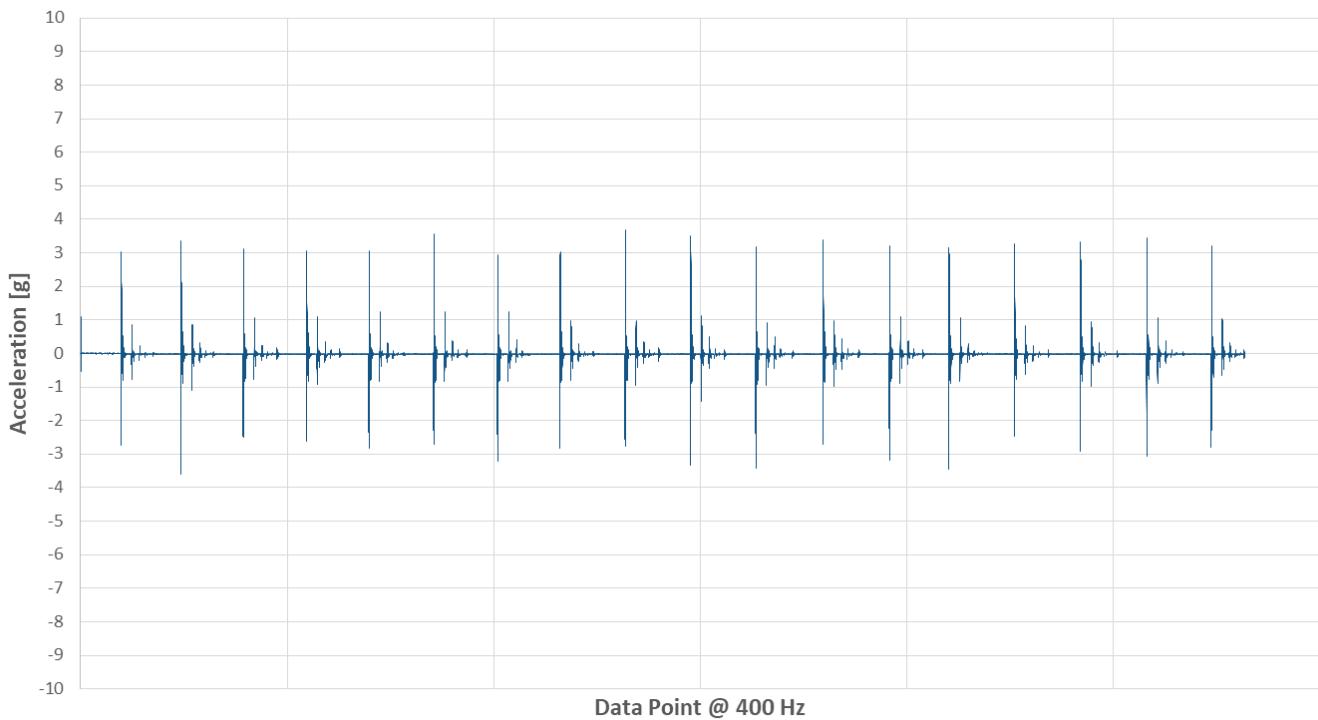


TEST 3 – IKEA SPRING

Vector Magnitude Acceleration - IKEA Spring



X Acceleration (Side to Side) - IKEA Spring

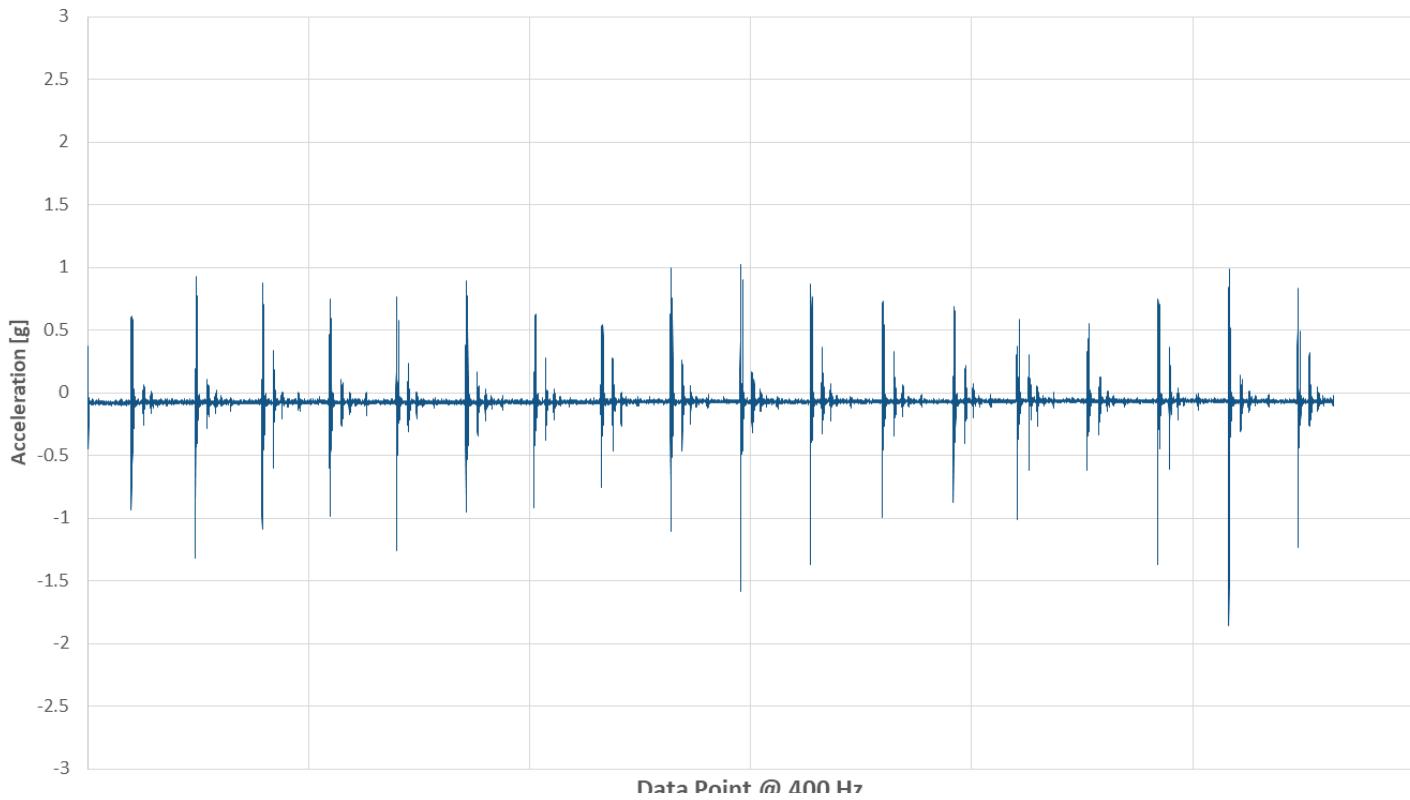




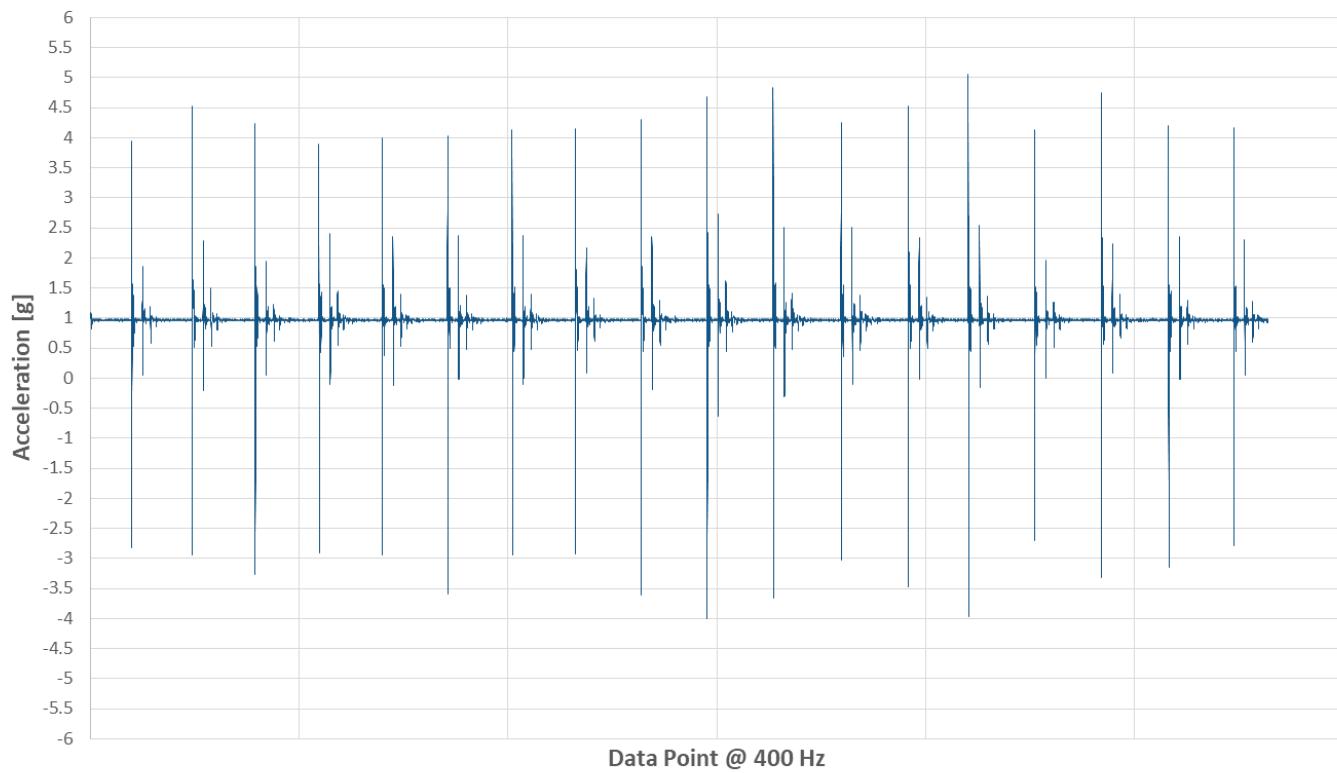
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Y Acceleration (Head to Toe) - IKEA Spring



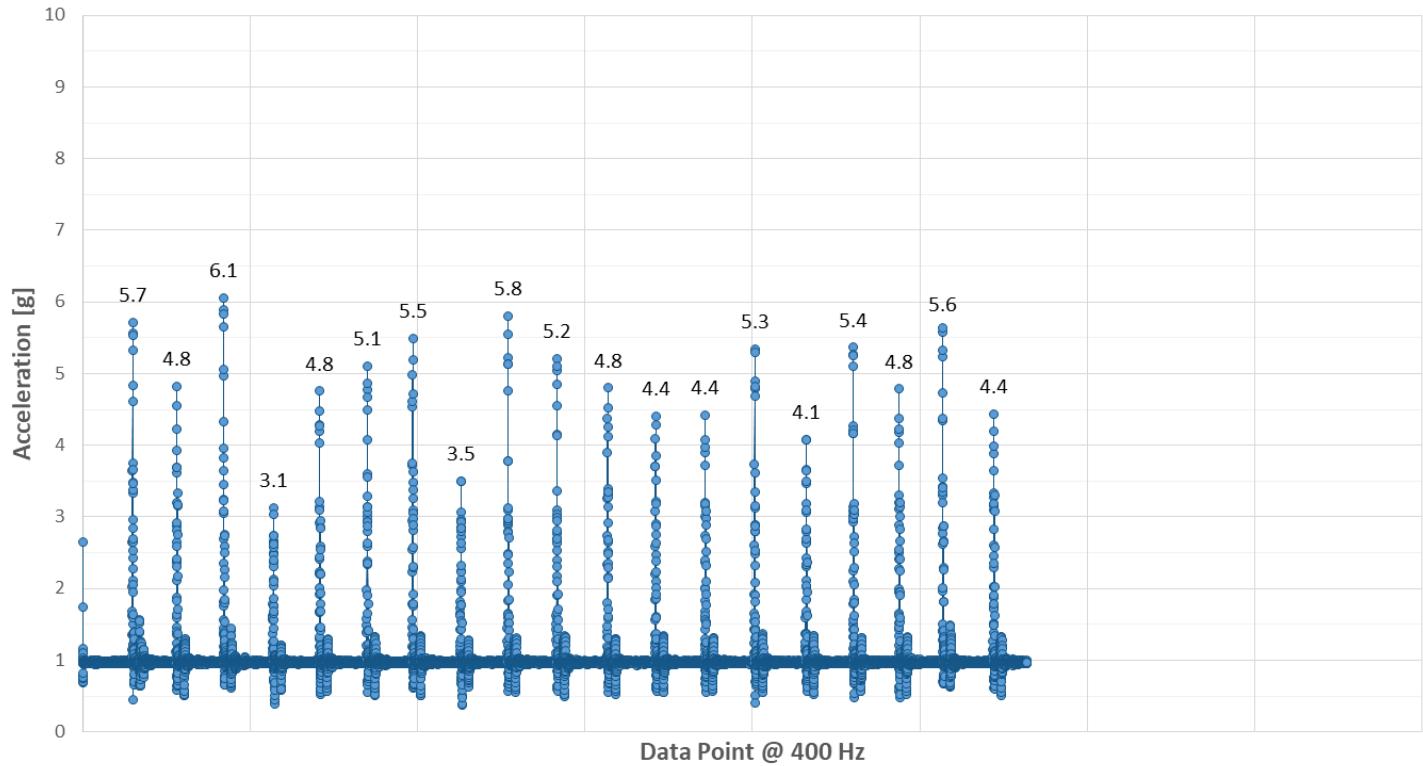
Z Acceleration (Up and Down) - IKEA Spring



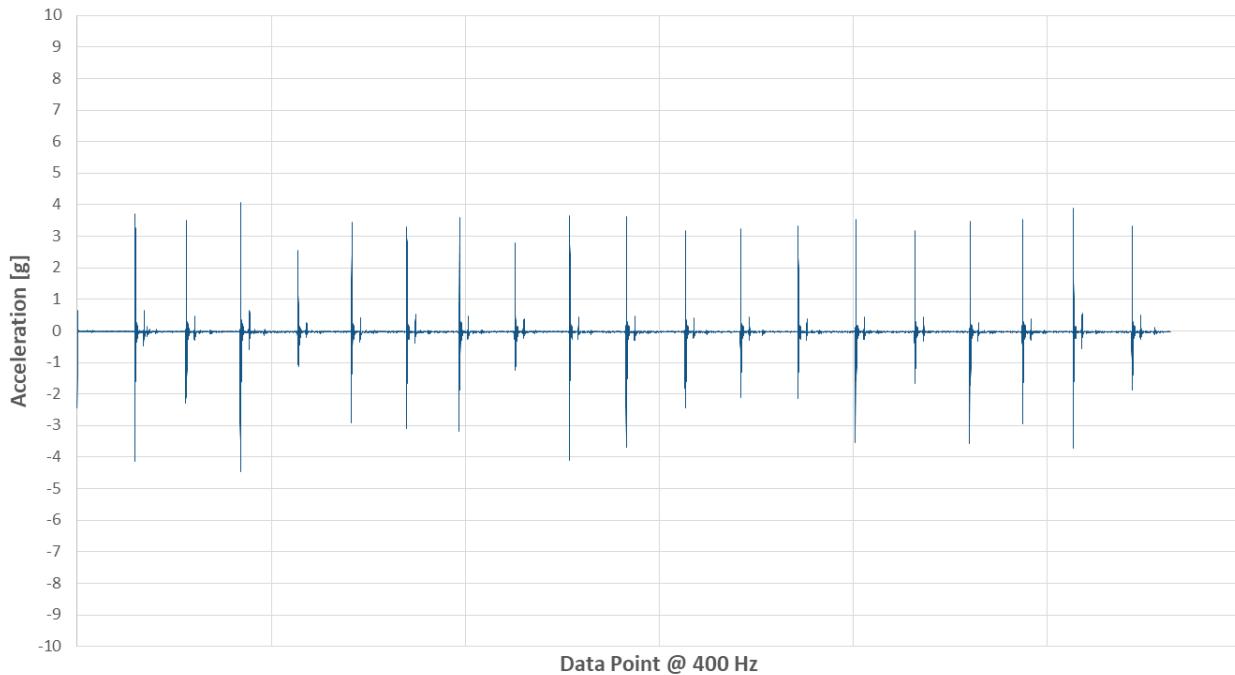


TEST 3 – KINGSDOWN

Vector Magnitude Acceleration - Kingsdown



X Acceleration (Side to Side) - Kingsdown

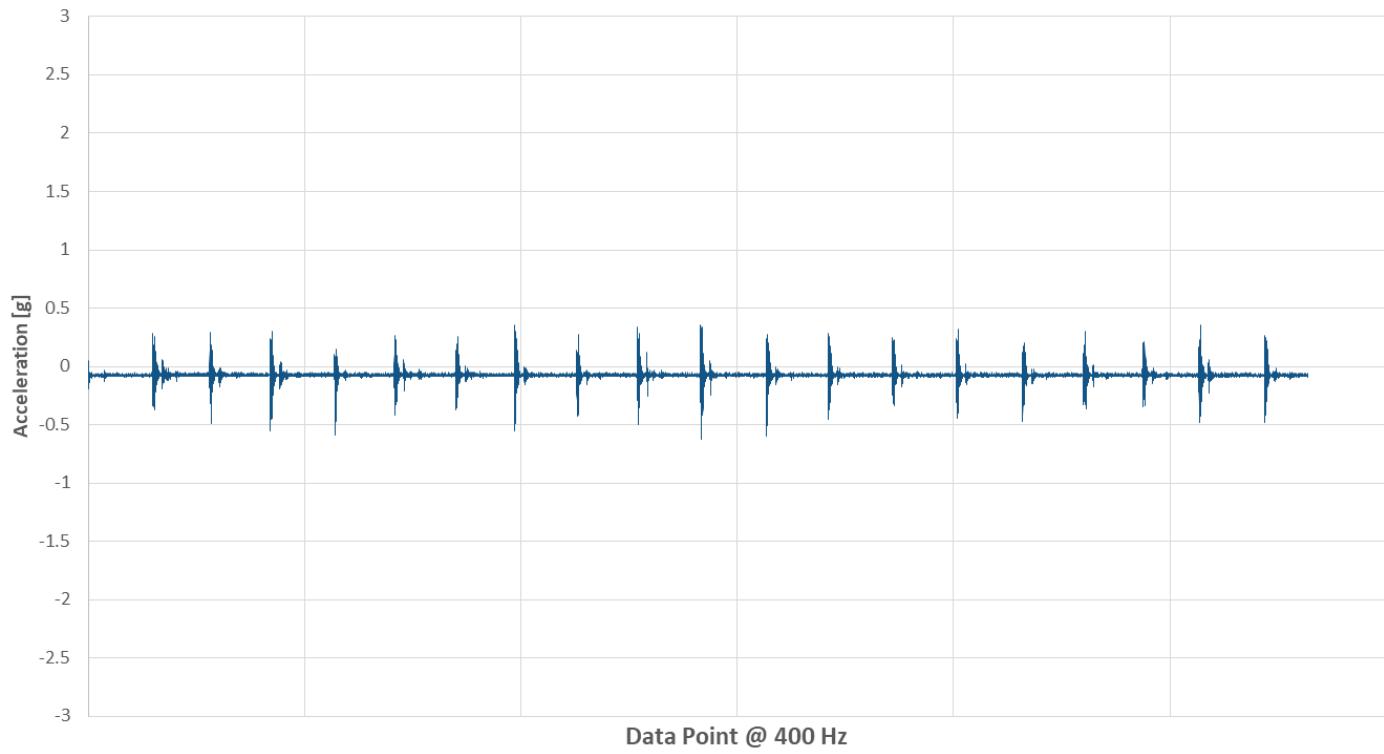




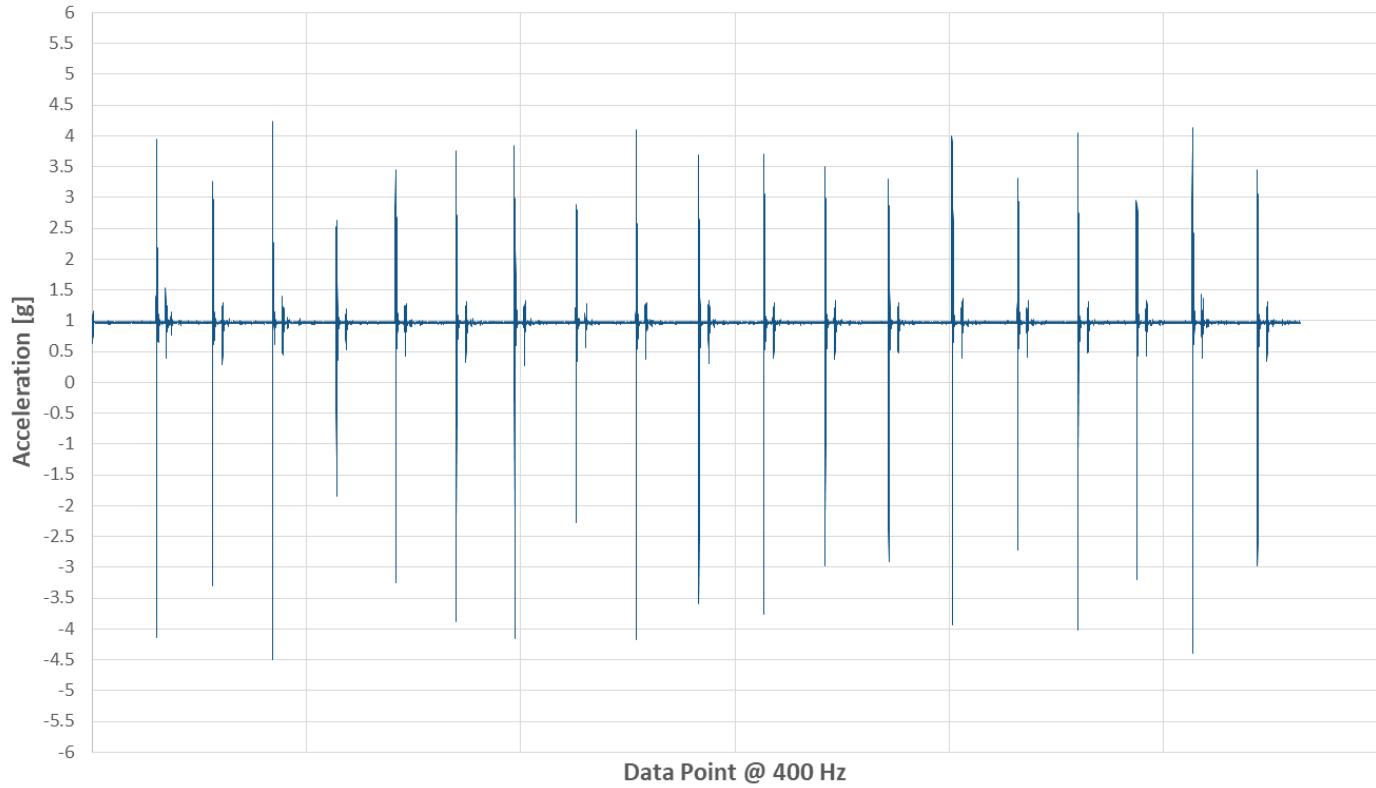
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Y Acceleration (Head to Toe) - Kingsdown



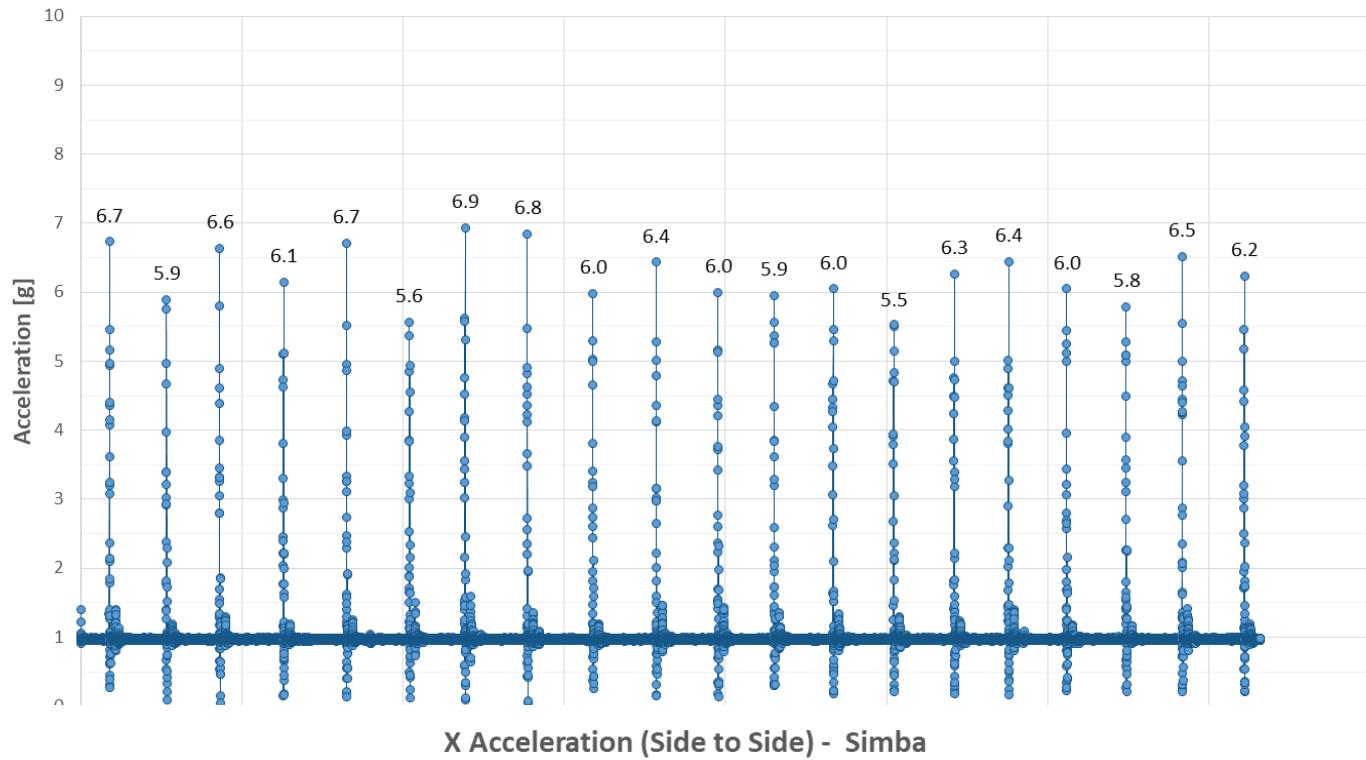
Z Acceleration (Up and Down) - Kingsdown



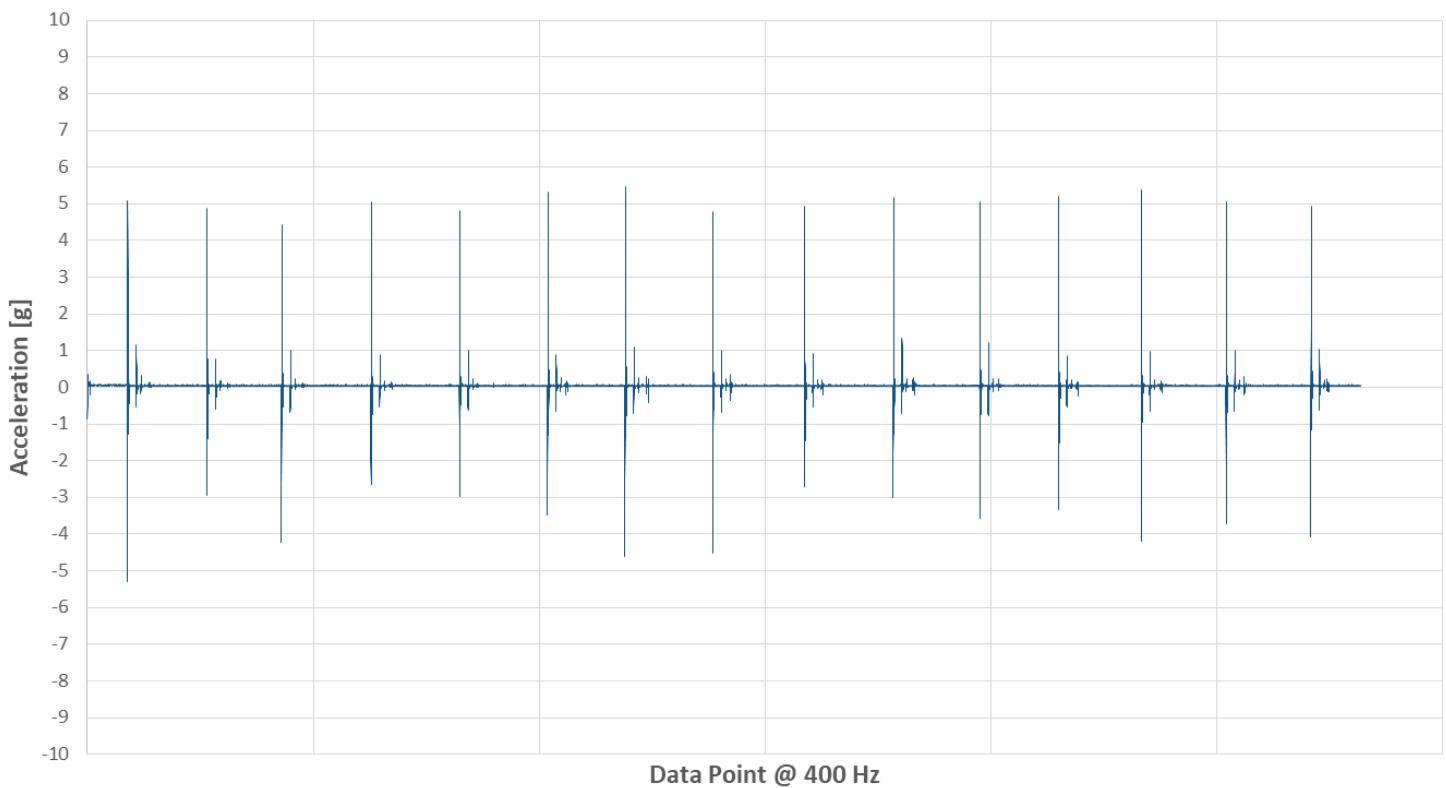


TEST 3 – SIMBA

Vector Magnitude Acceleration - Simba



X Acceleration (Side to Side) - Simba



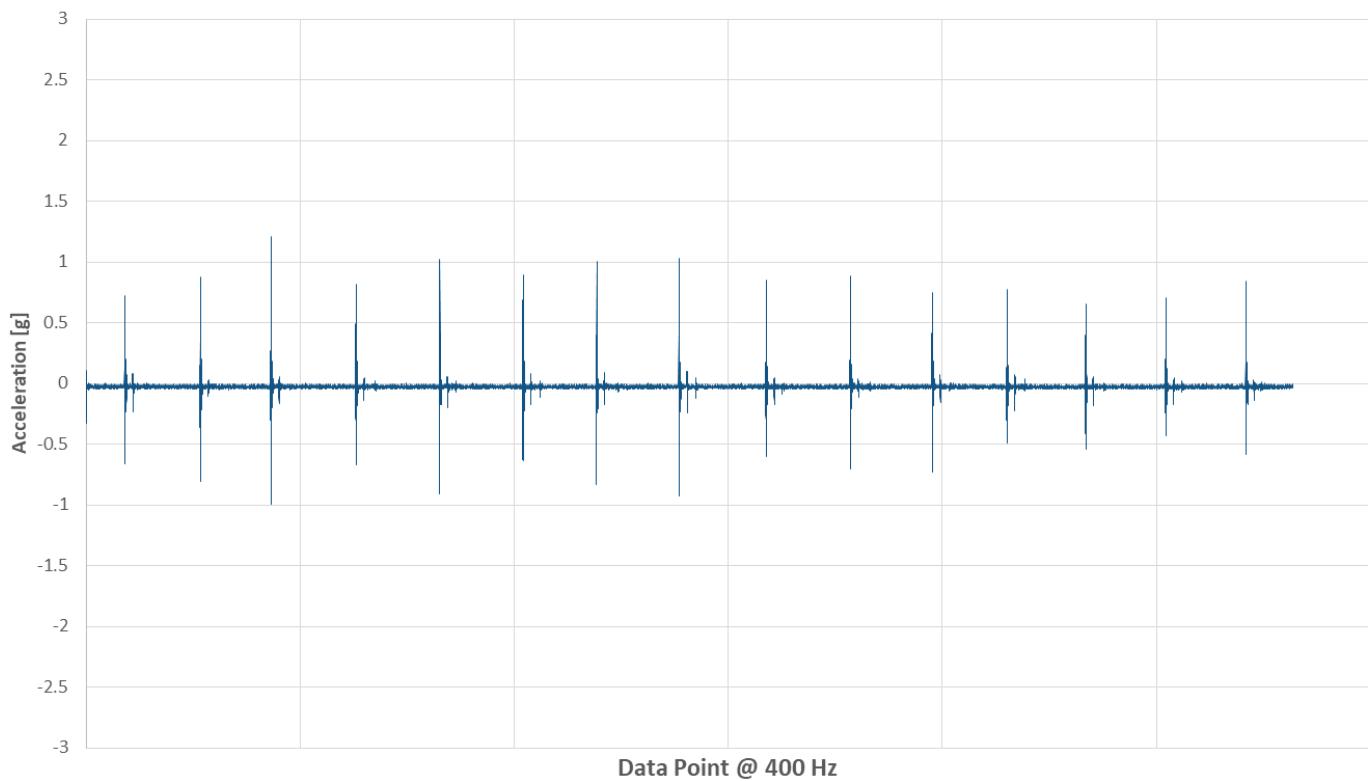
Data Point @ 400 Hz



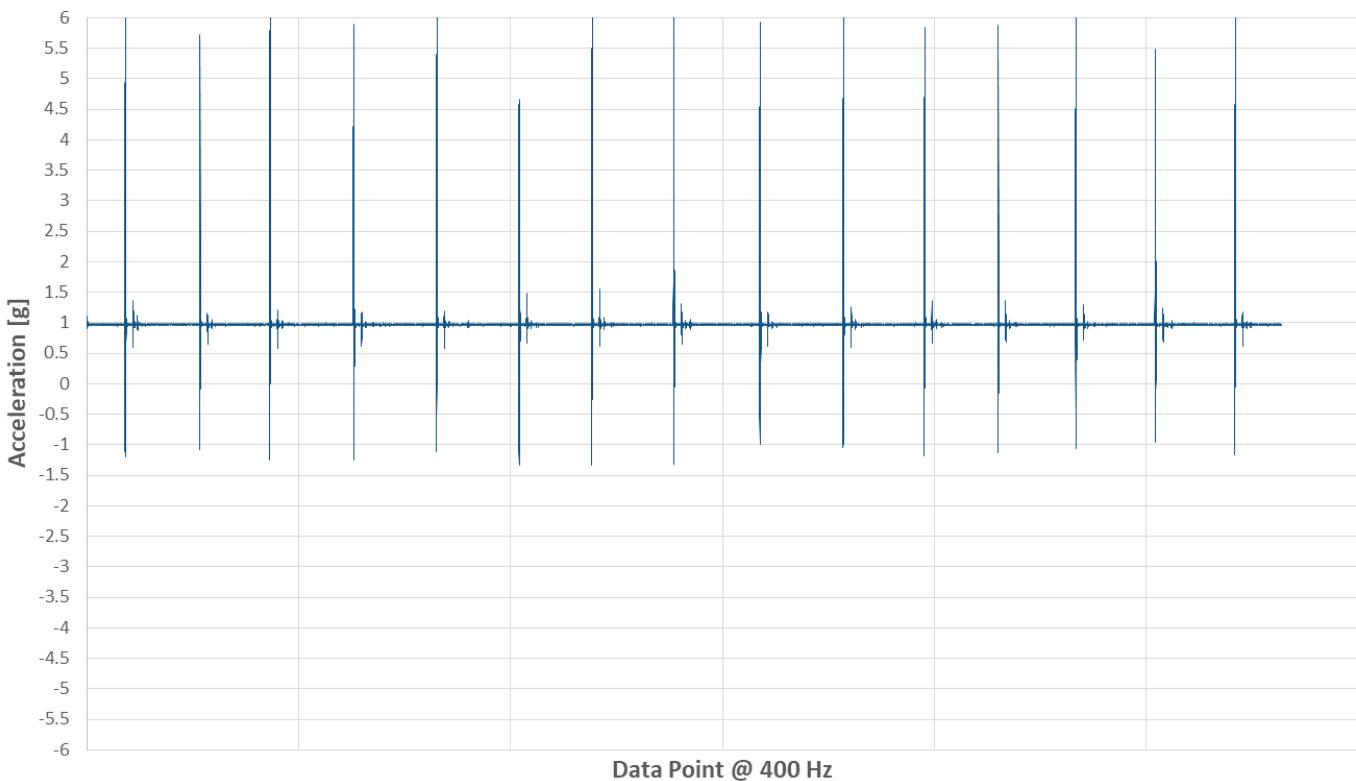
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Y Acceleration (Head to Toe) - Simba



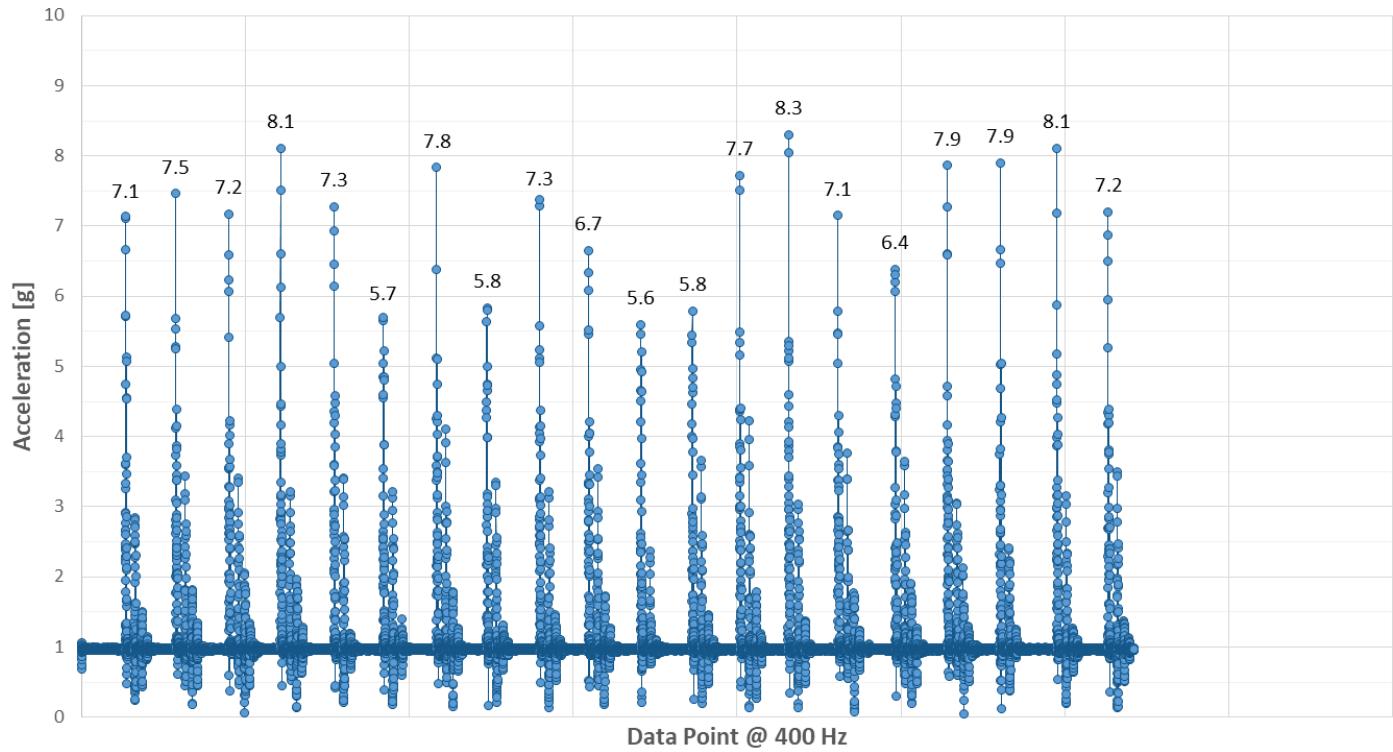
Z Acceleration (Up and Down) - Simba



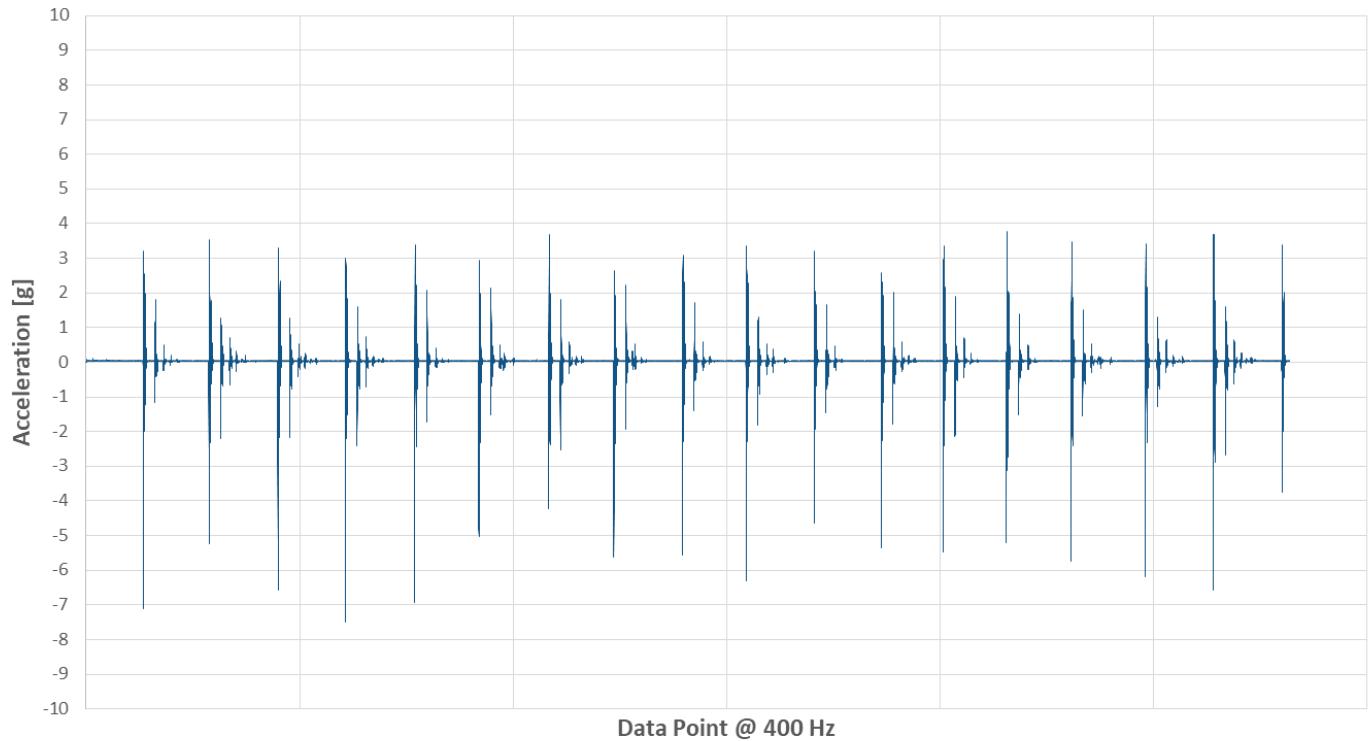


TEST 3 – SPA SENSATIONS

Vector Magnitude Acceleration - Spa Sensations



X Acceleration (Side to Side) - Spa Sensations

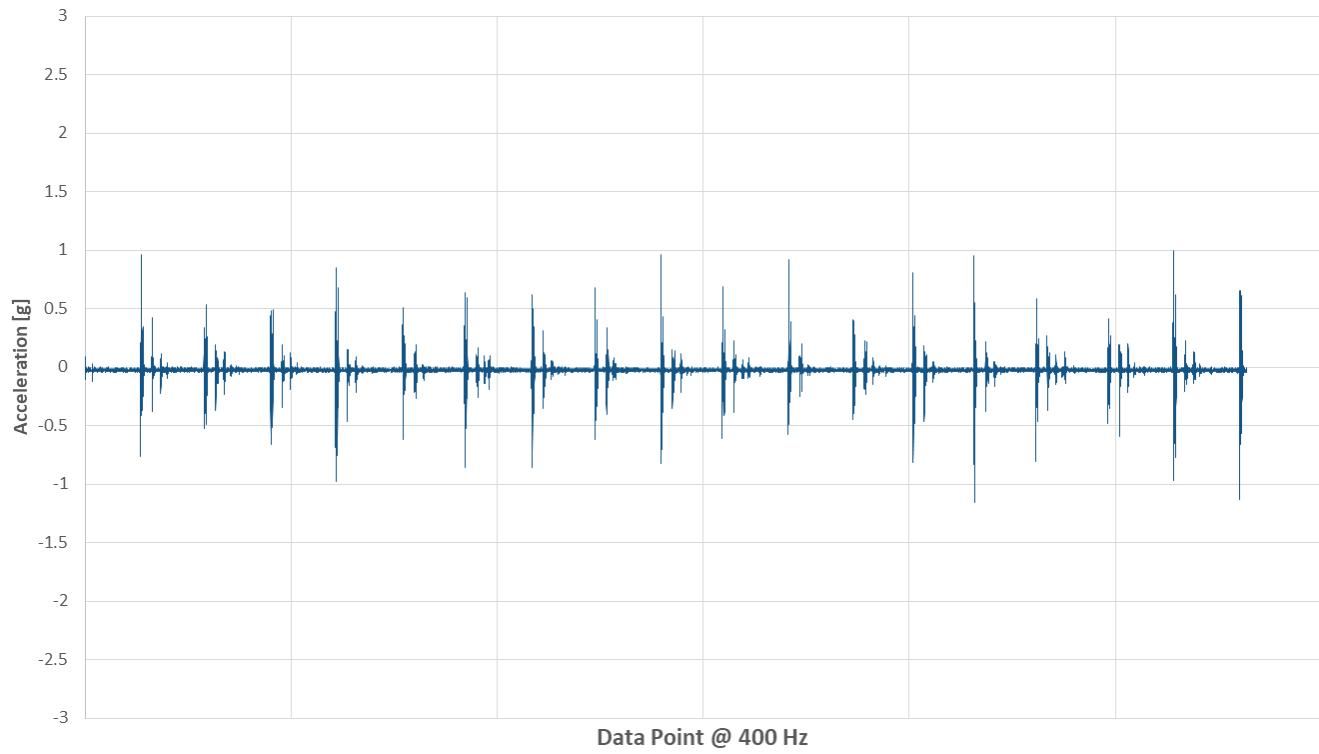




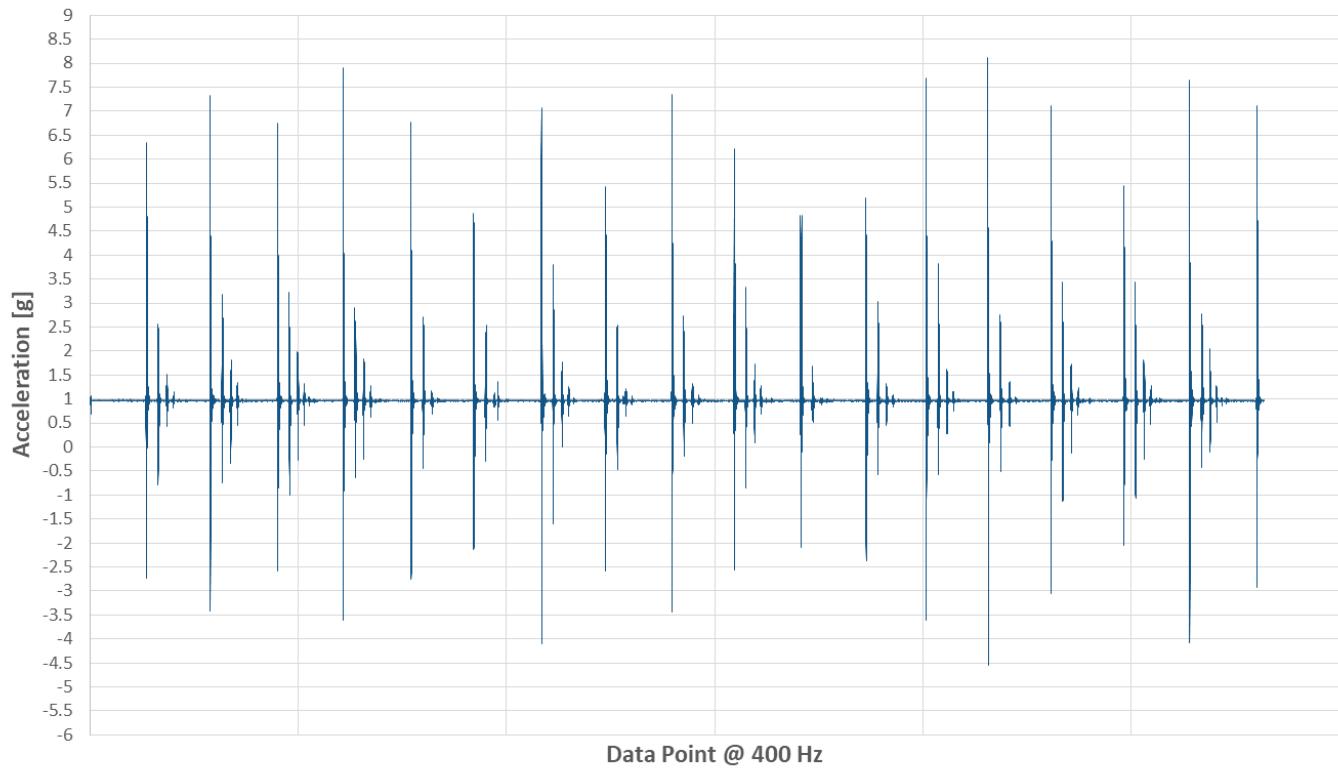
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Y Acceleration (Head to Toe) - Spa Sensations



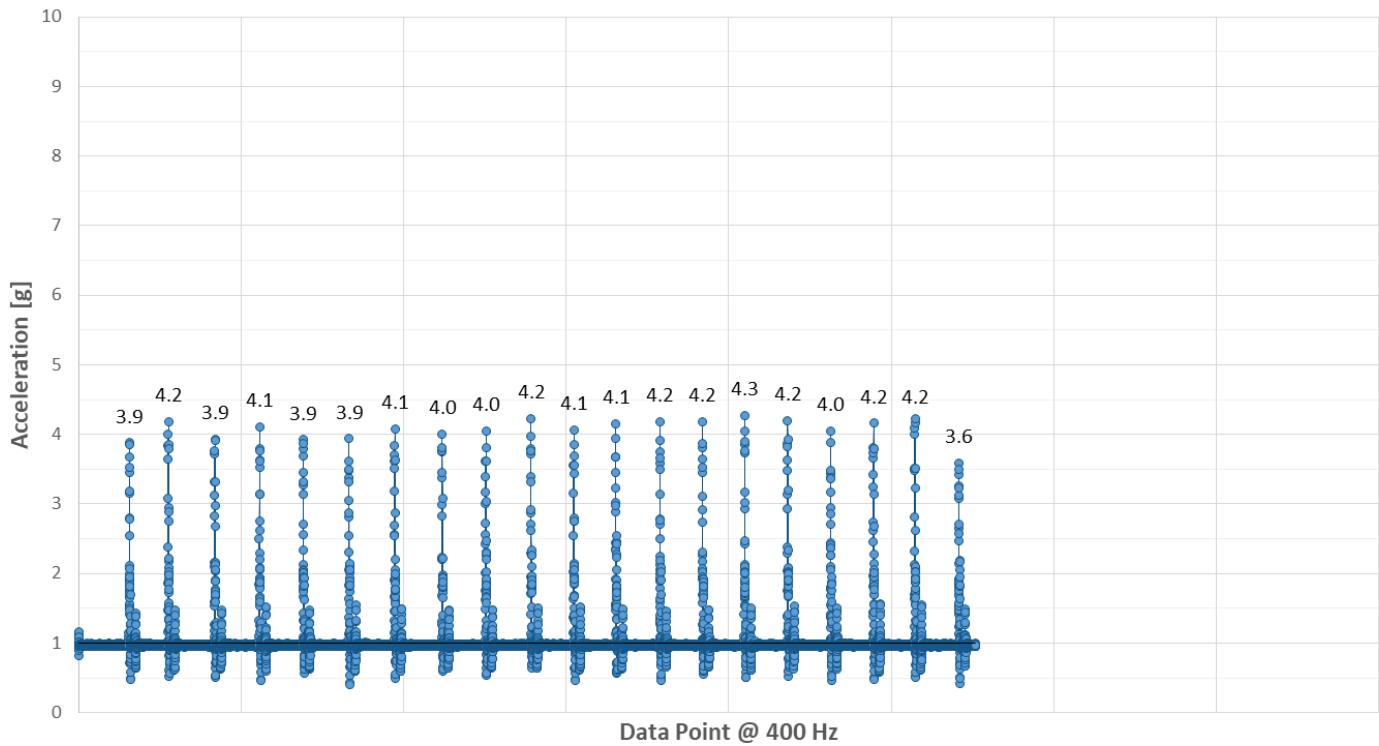
Z Acceleration (Up and Down) - Spa Sensations



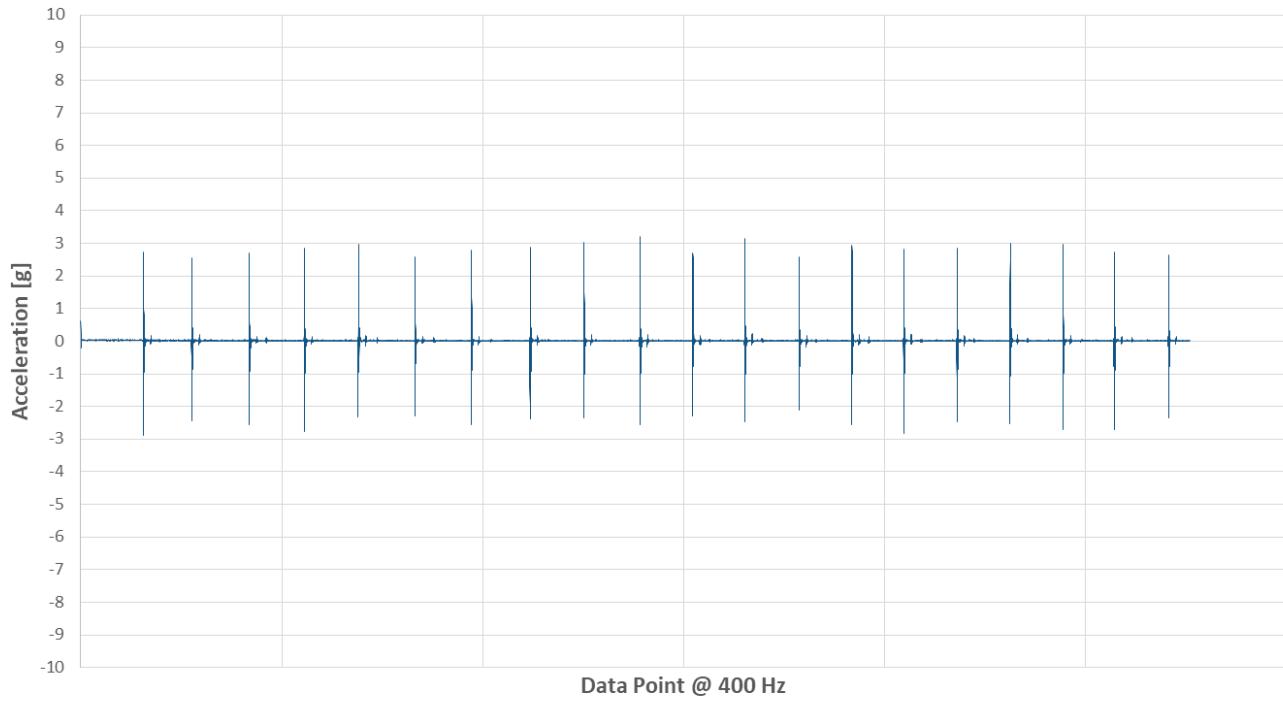


TEST 3 – STEARNS & FOSTER

Vector Magnitude Acceleration - Stearns & Foster



X Acceleration (Side to Side) - Stearns & Foster

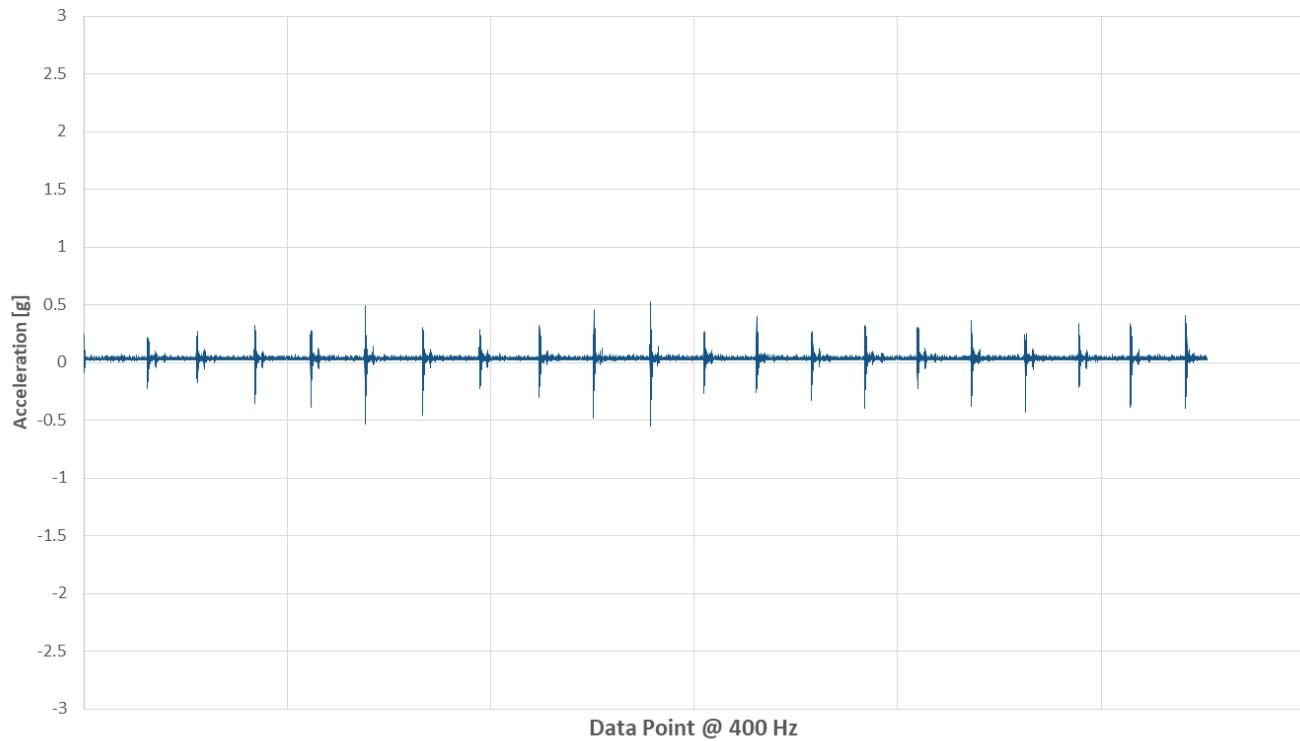




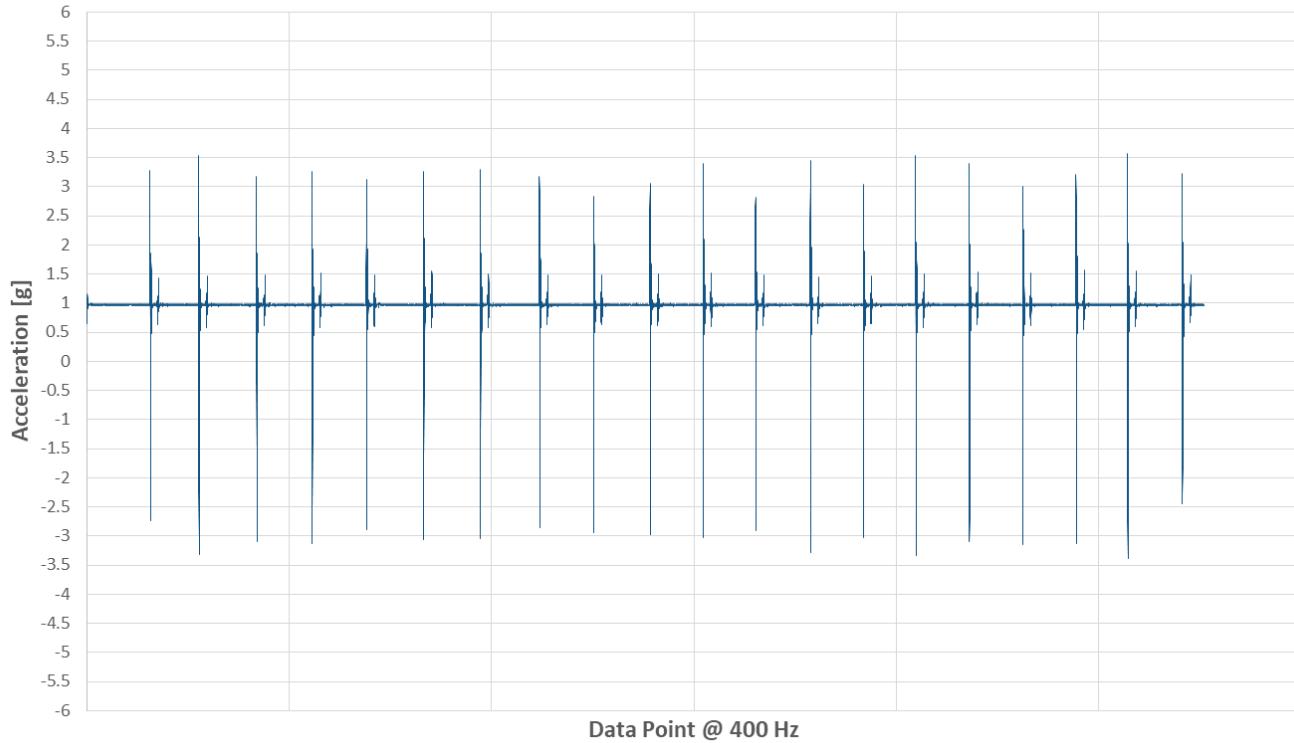
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Y Acceleration (Head to Toe) - Stearns & Foster



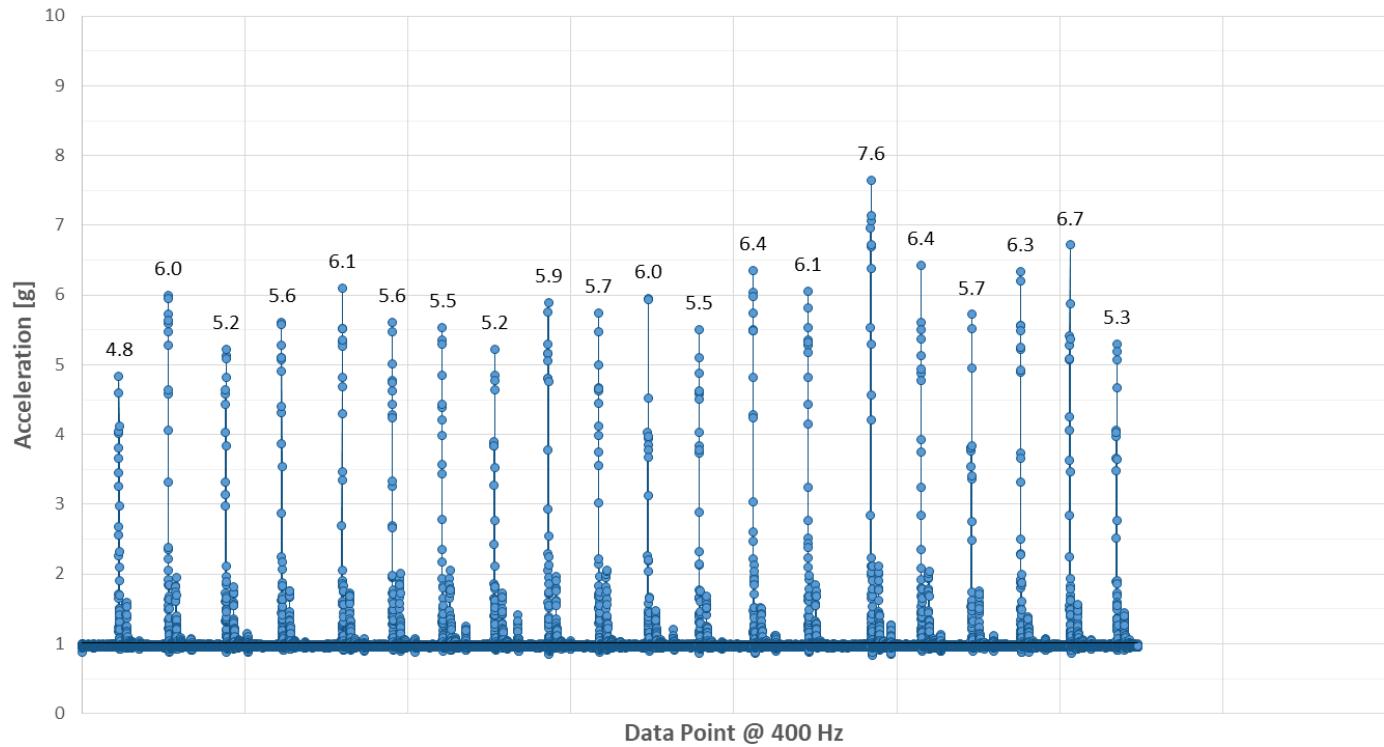
Z Acceleration (Up and Down) - Stearns & Foster



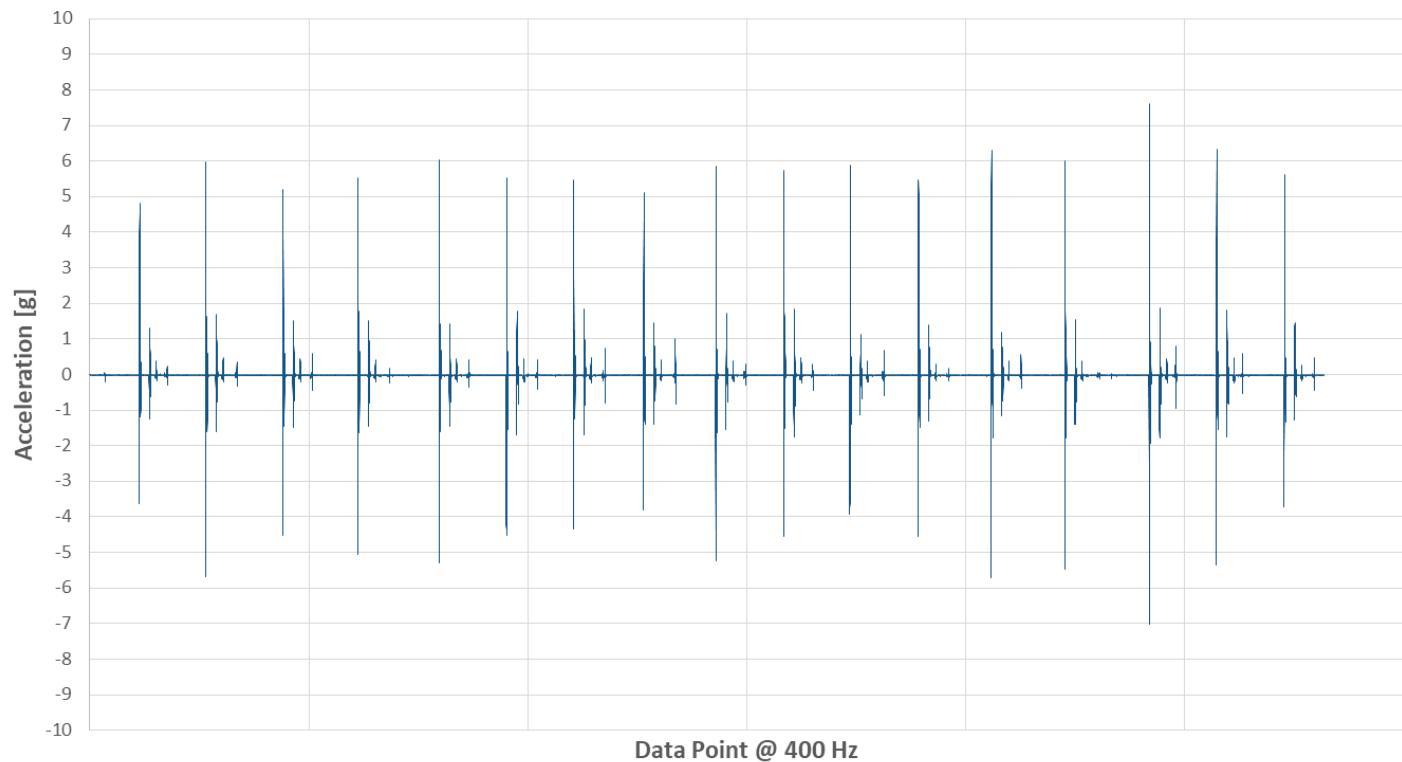


TEST 3 – STRUCTUBE

Vector Magnitude Acceleration - Structube



X Acceleration (Side to Side) - Structube

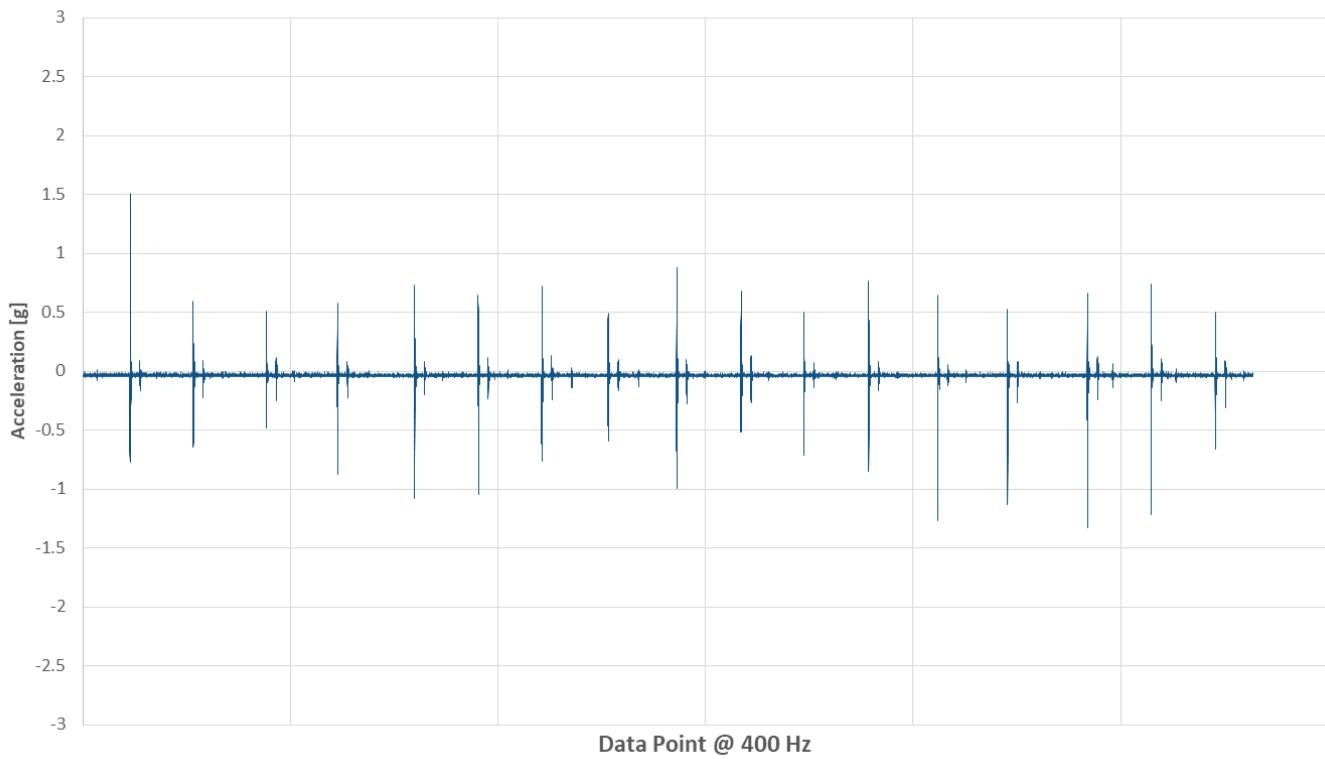




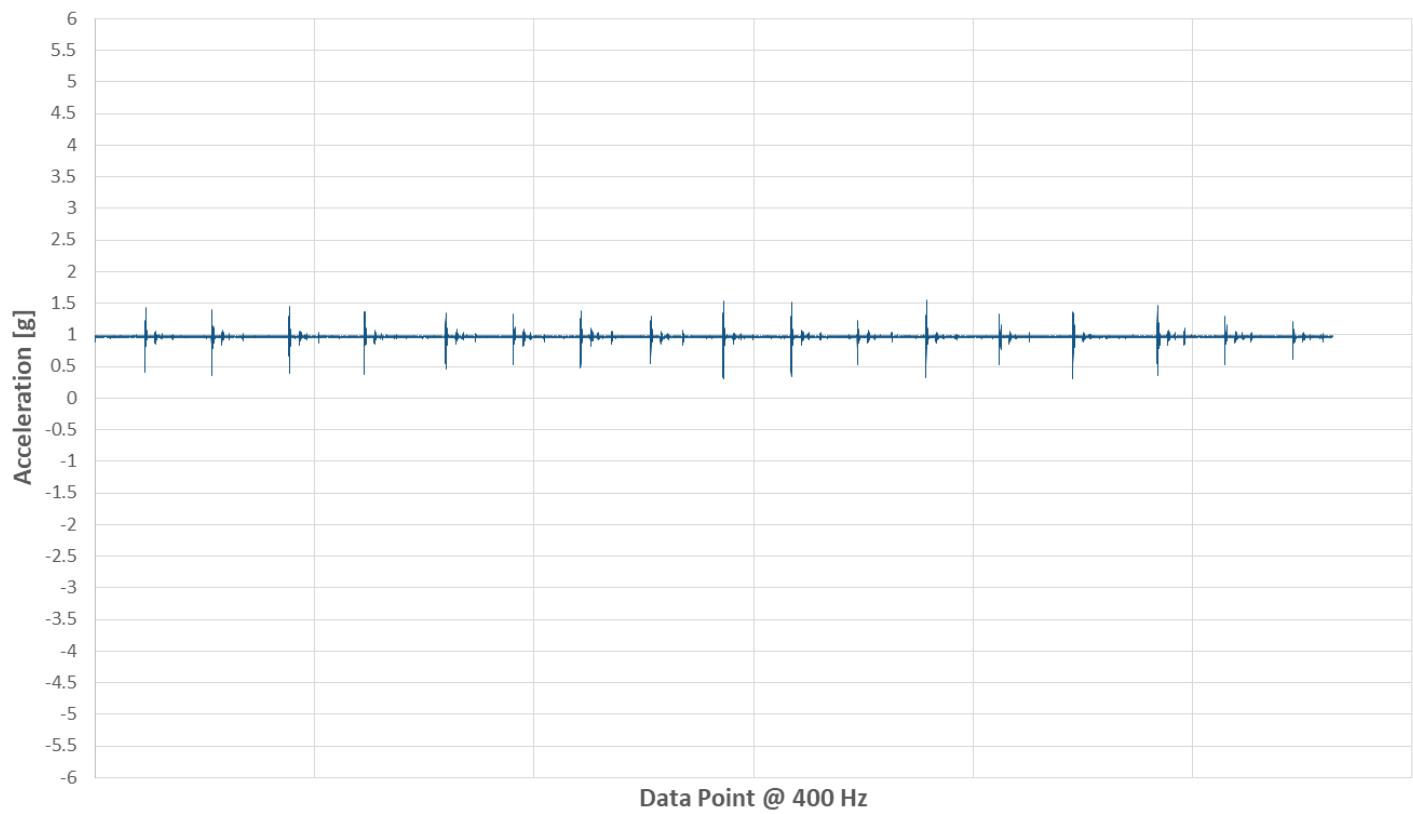
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Y Acceleration (Head to Toe) - Structube



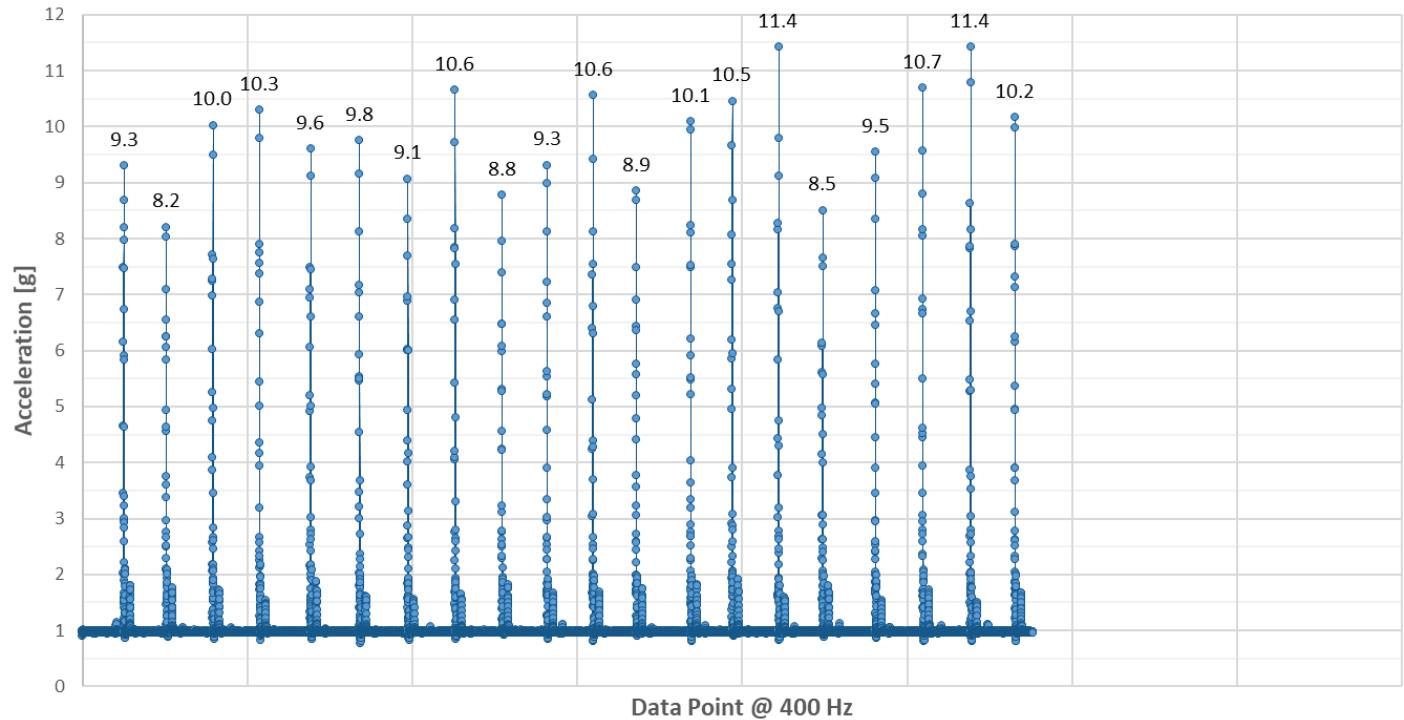
Z Acceleration (Up and Down) - Structube



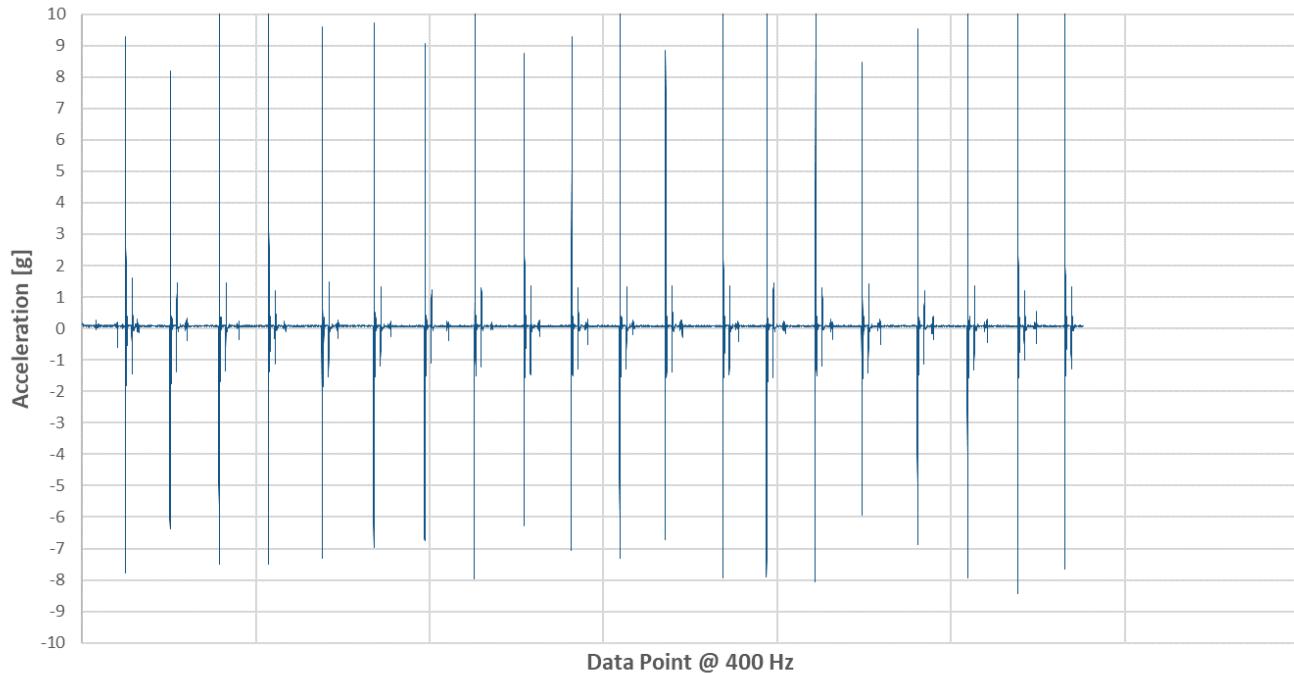


TEST 3 – PERFECTSENSE

Vector Magnitude Acceleration - PerfectSense



X Acceleration (Side to Side) - PerfectSense

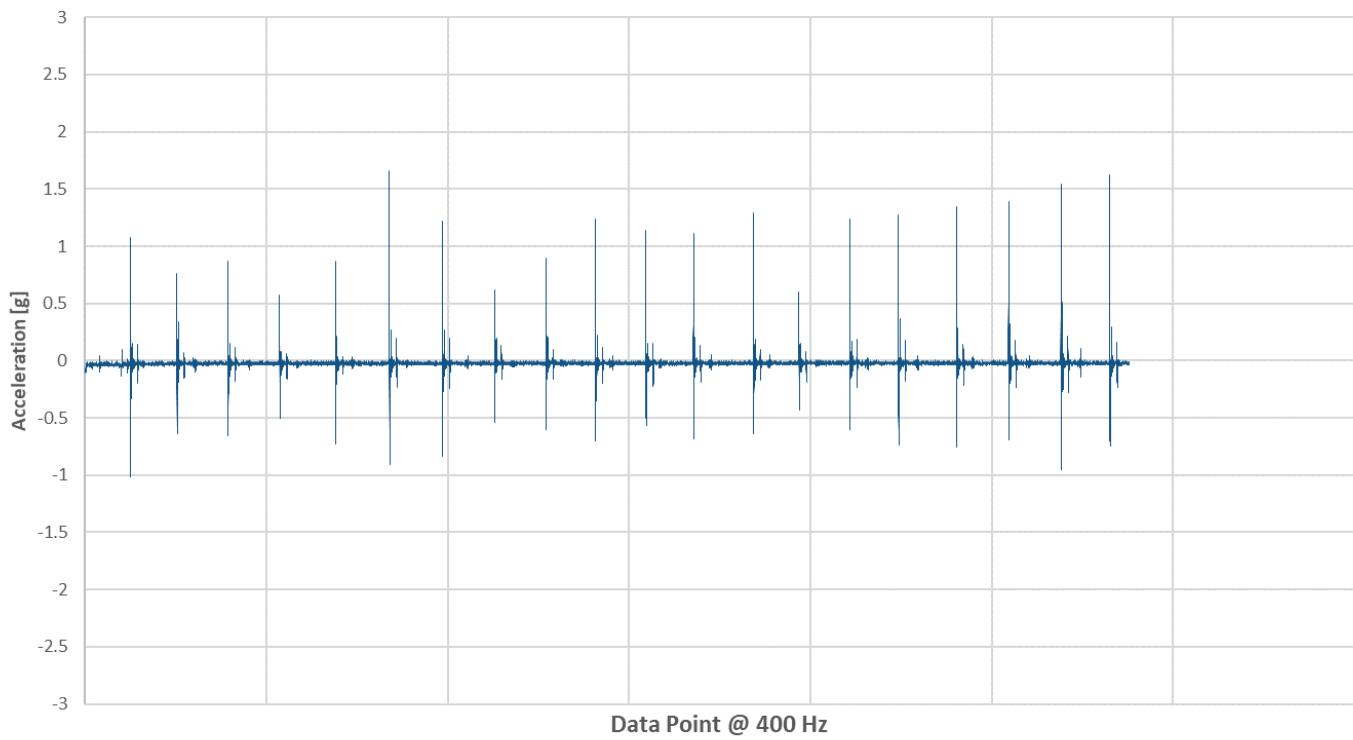




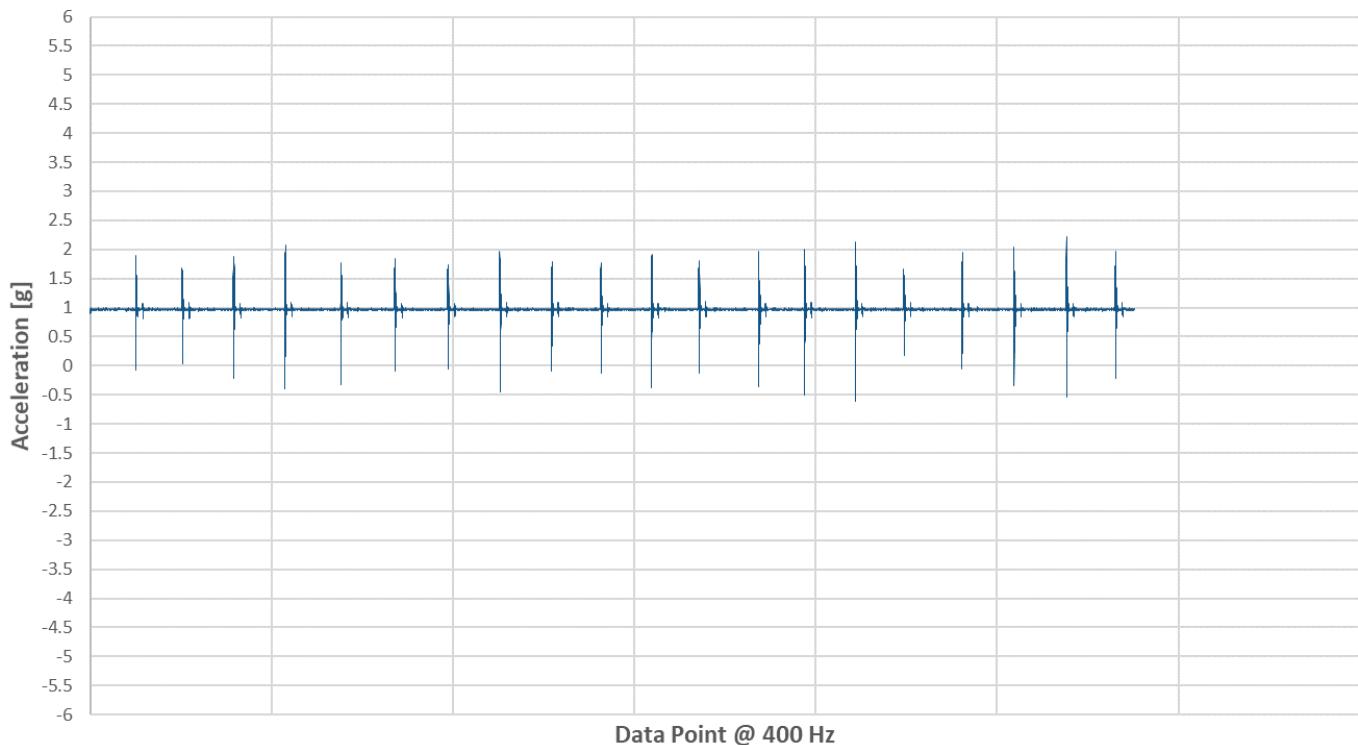
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Y Acceleration (Head to Toe) - PerfectSense



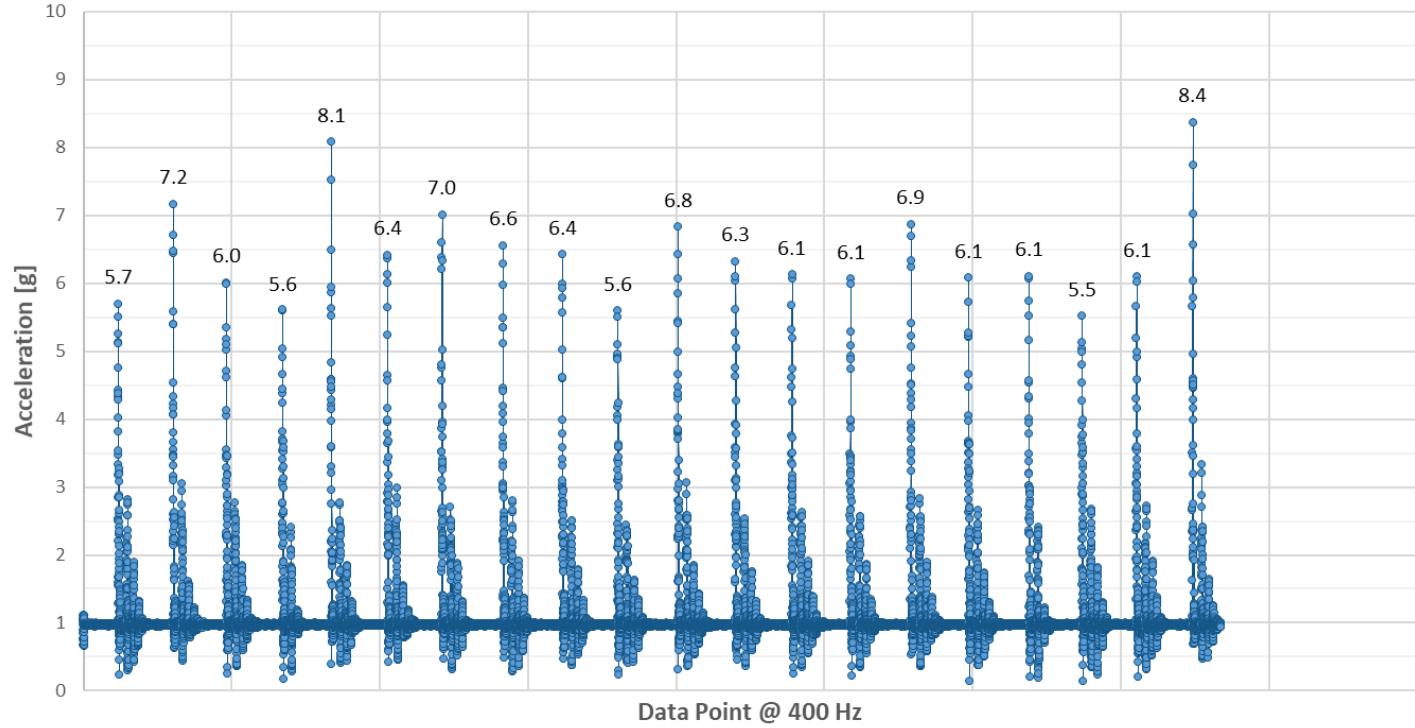
Z Acceleration (Up and Down) - PerfectSense



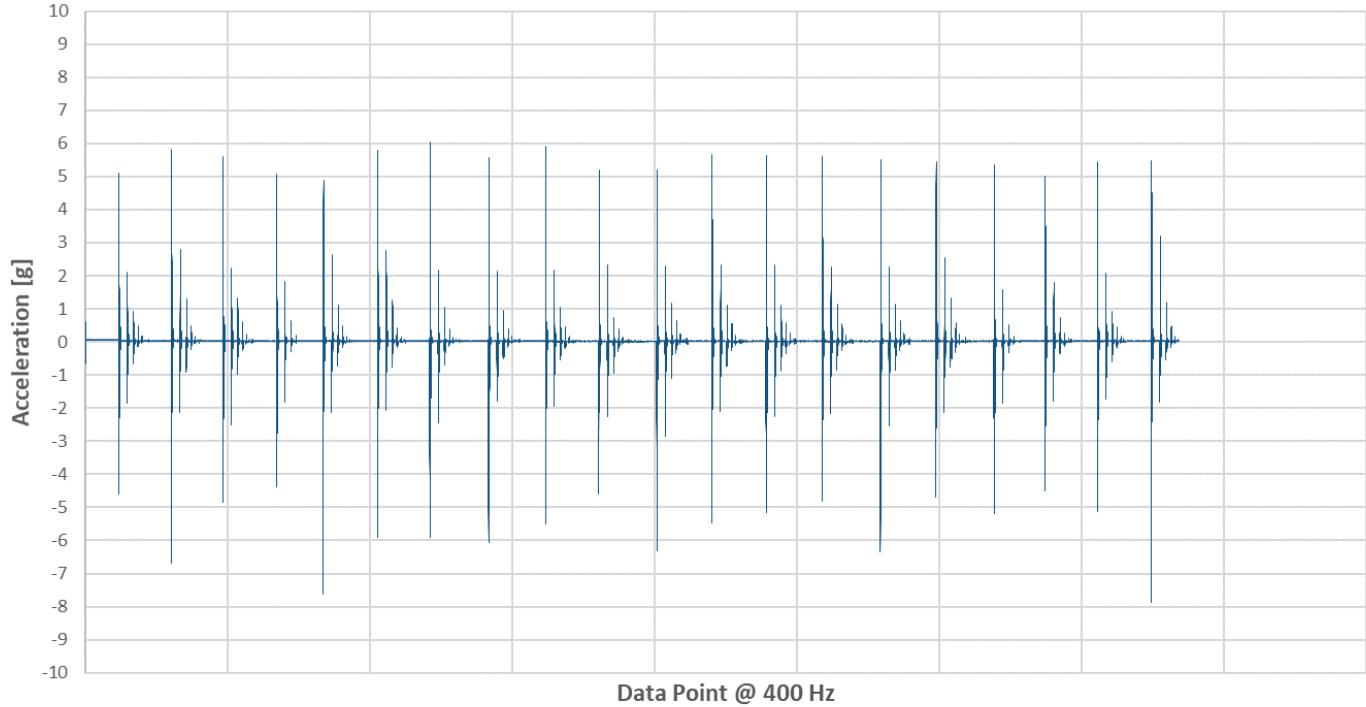


TEST 3 – SPRINGWALL

Vector Magnitude Acceleration - Springwall



X Acceleration (Side to Side) - Springwall

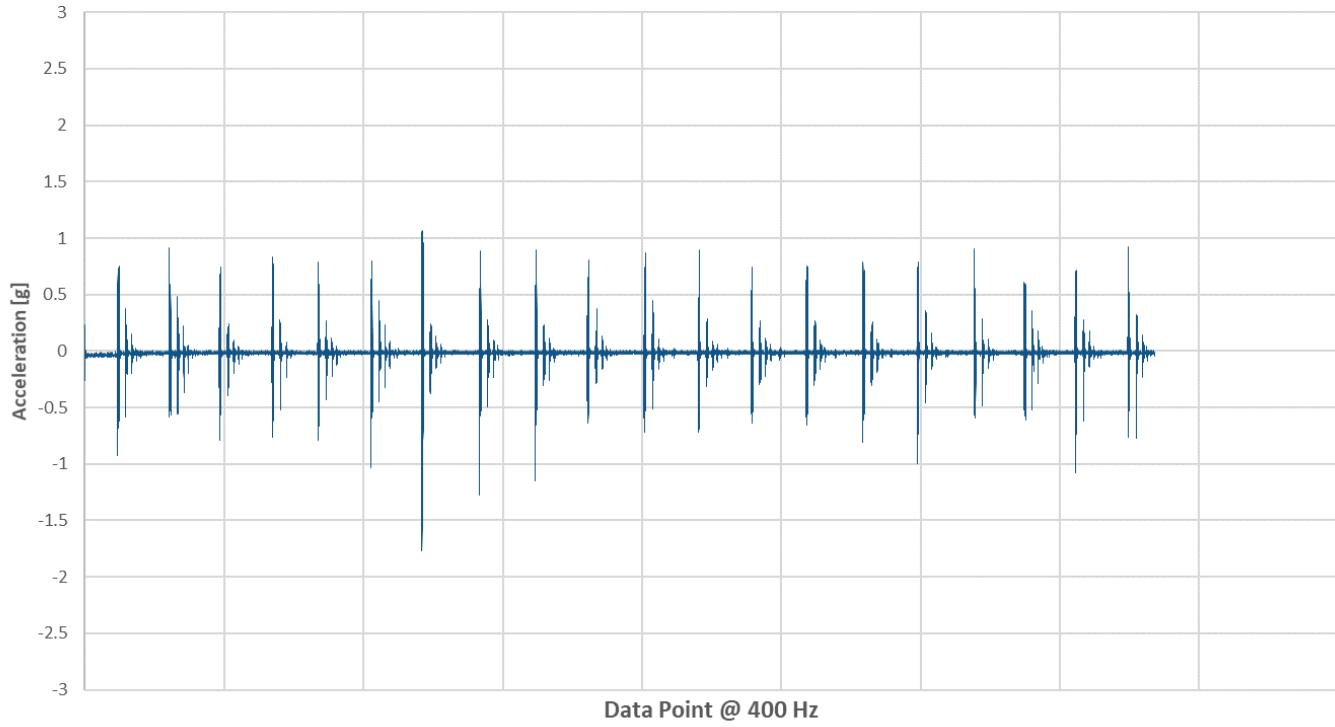




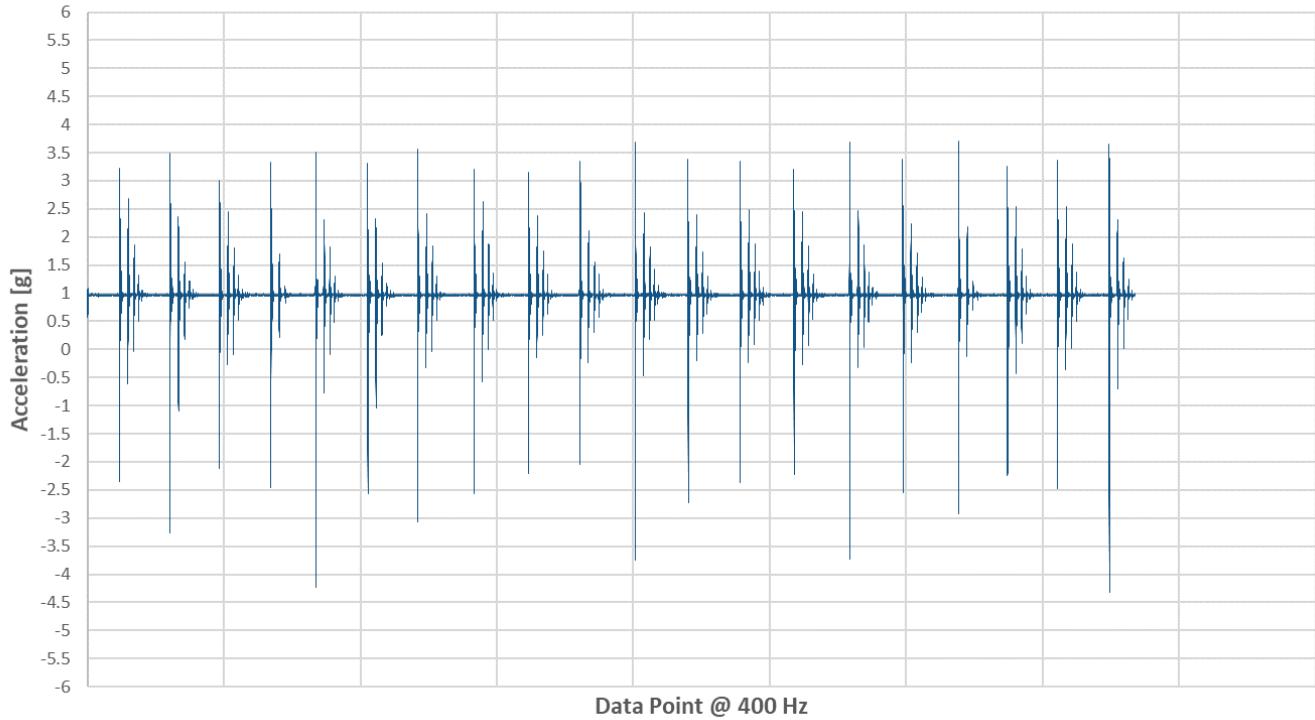
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Y Acceleration (Head to Toe) - Springwall



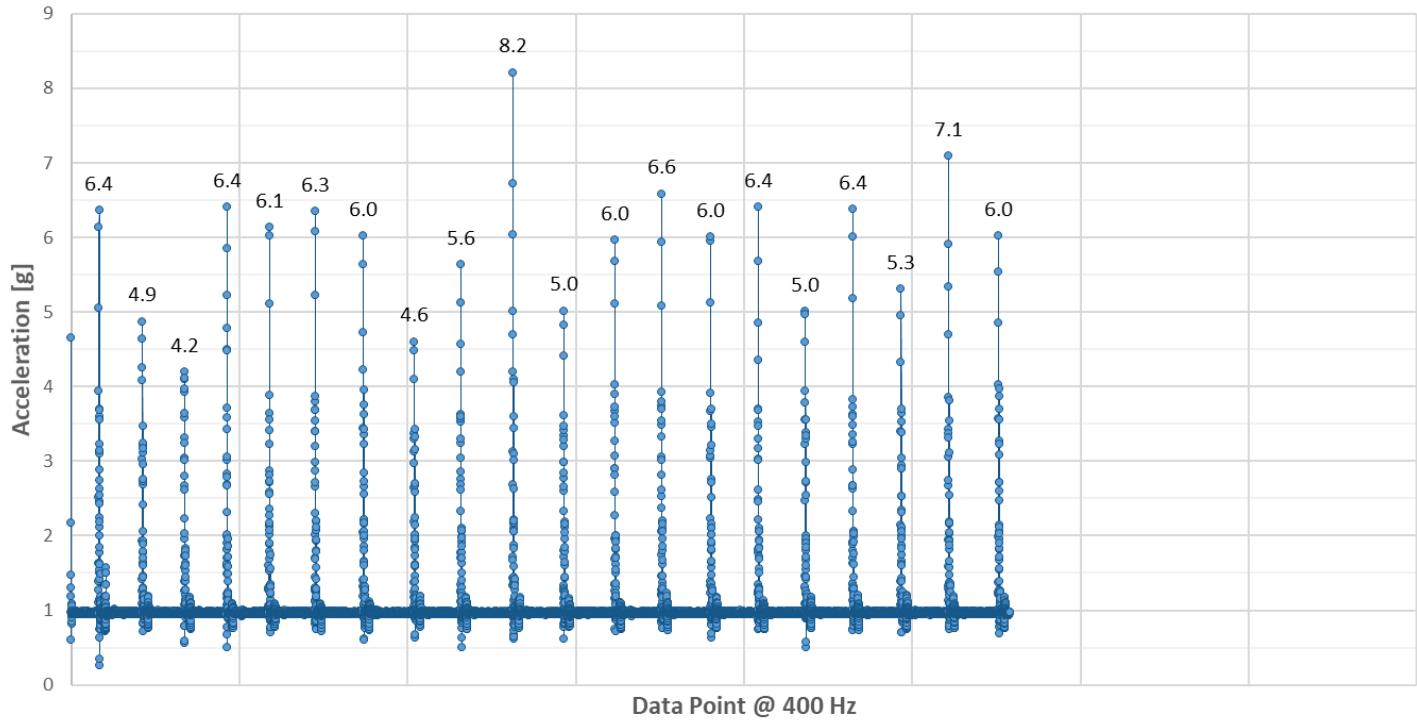
Z Acceleration (Up and Down) - Springwall



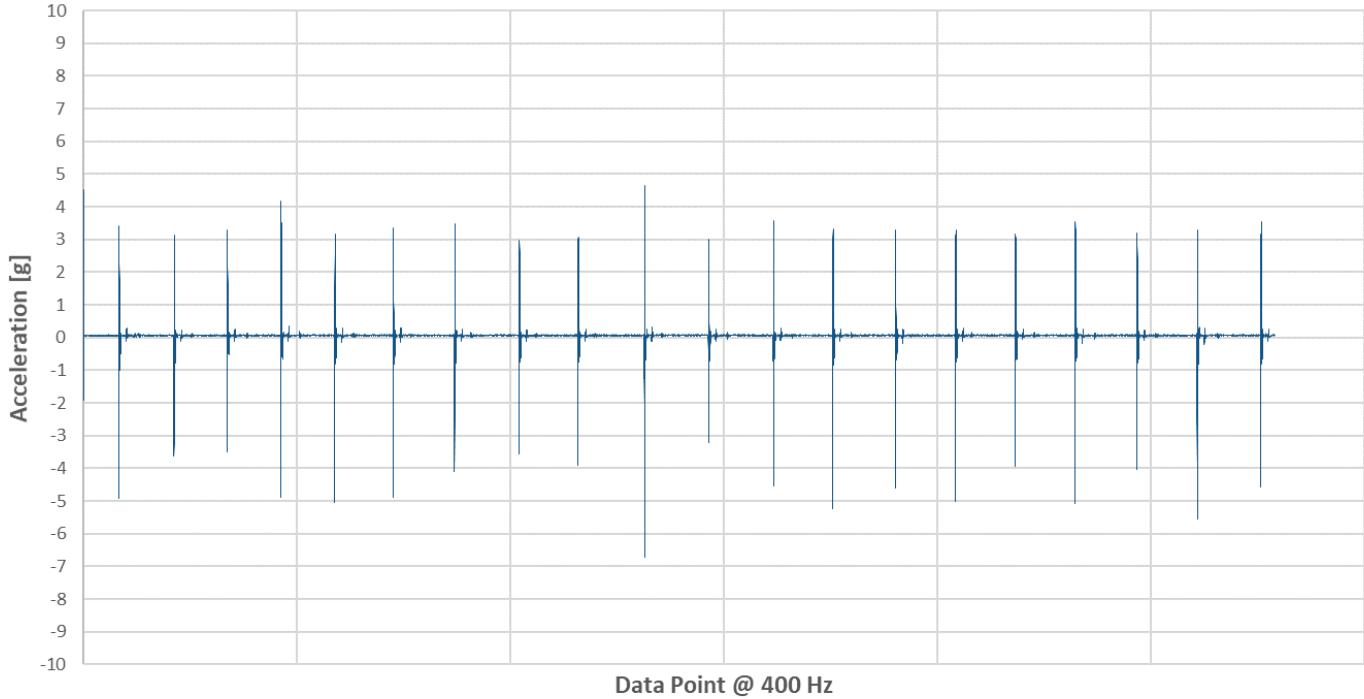


TEST 3 – GOTTA SLEEP (OMG)

Vector Magnitude Acceleration - Gotta Sleep (OMG)



X Acceleration (Side to Side) - Gotta Sleep (OMG)

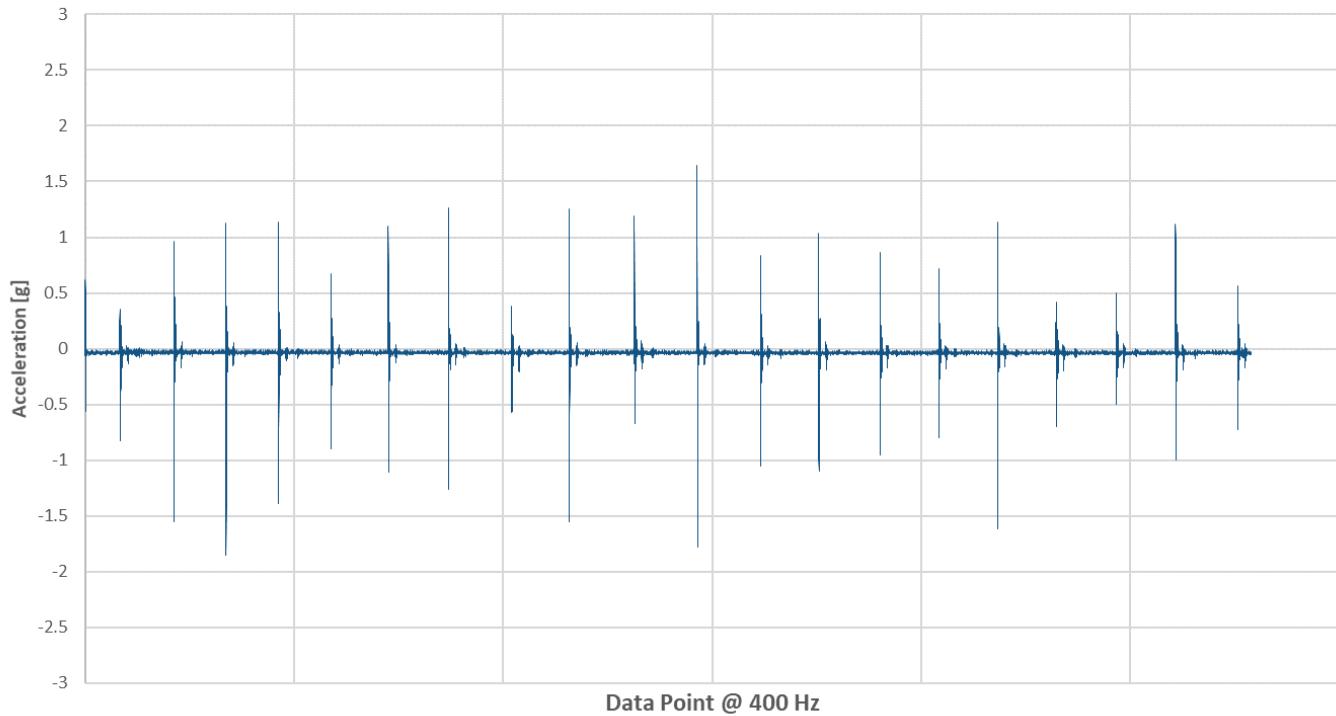




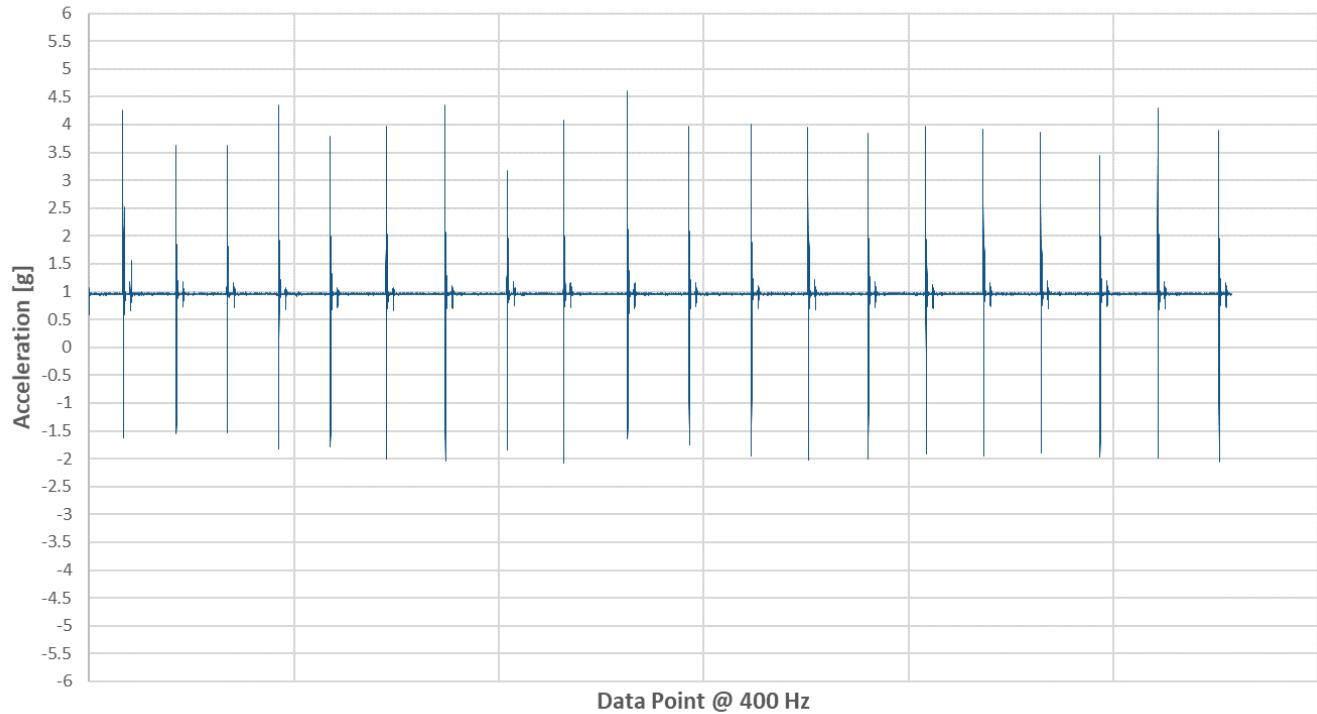
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Y Acceleration (Head to Toe) - Gotta Sleep (OMG)



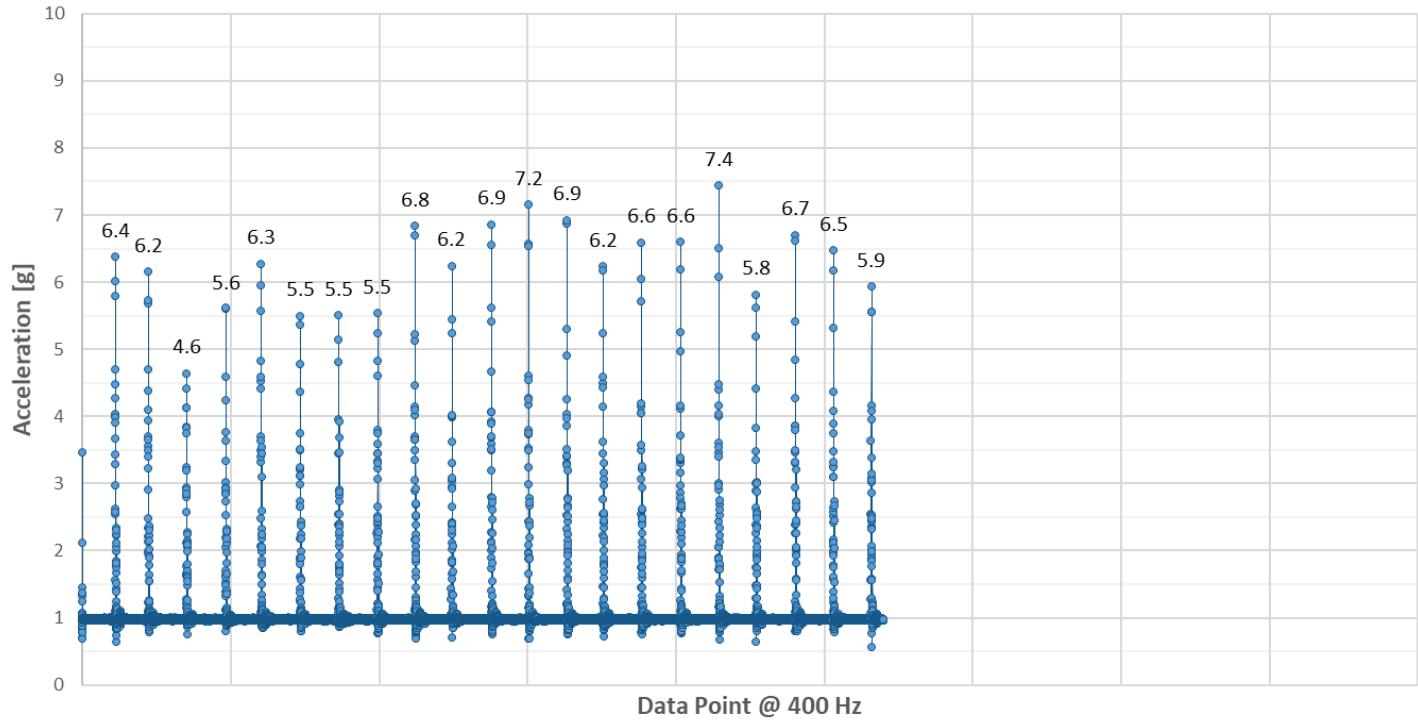
Z Acceleration (Up and Down) - Gotta Sleep (OMG)



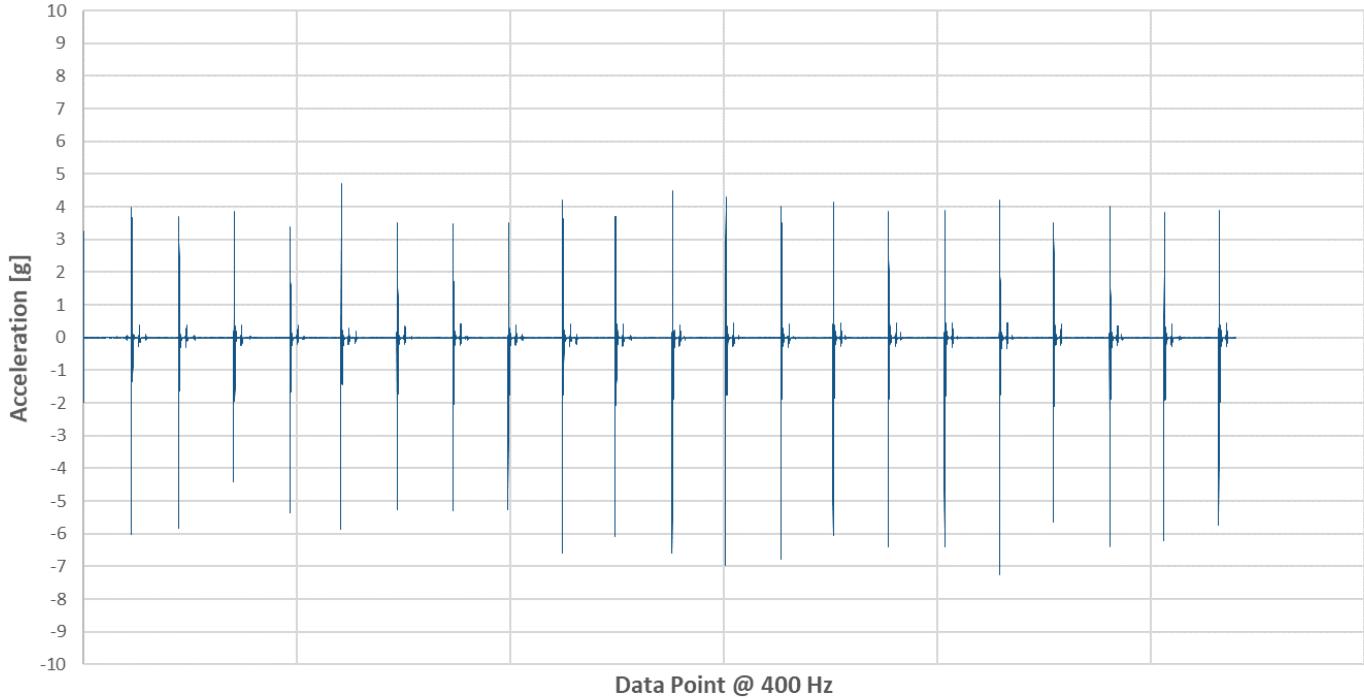


TEST 3 – JUNO

Vector Magnitude Acceleration - Juno



X Acceleration (Side to Side) - Juno

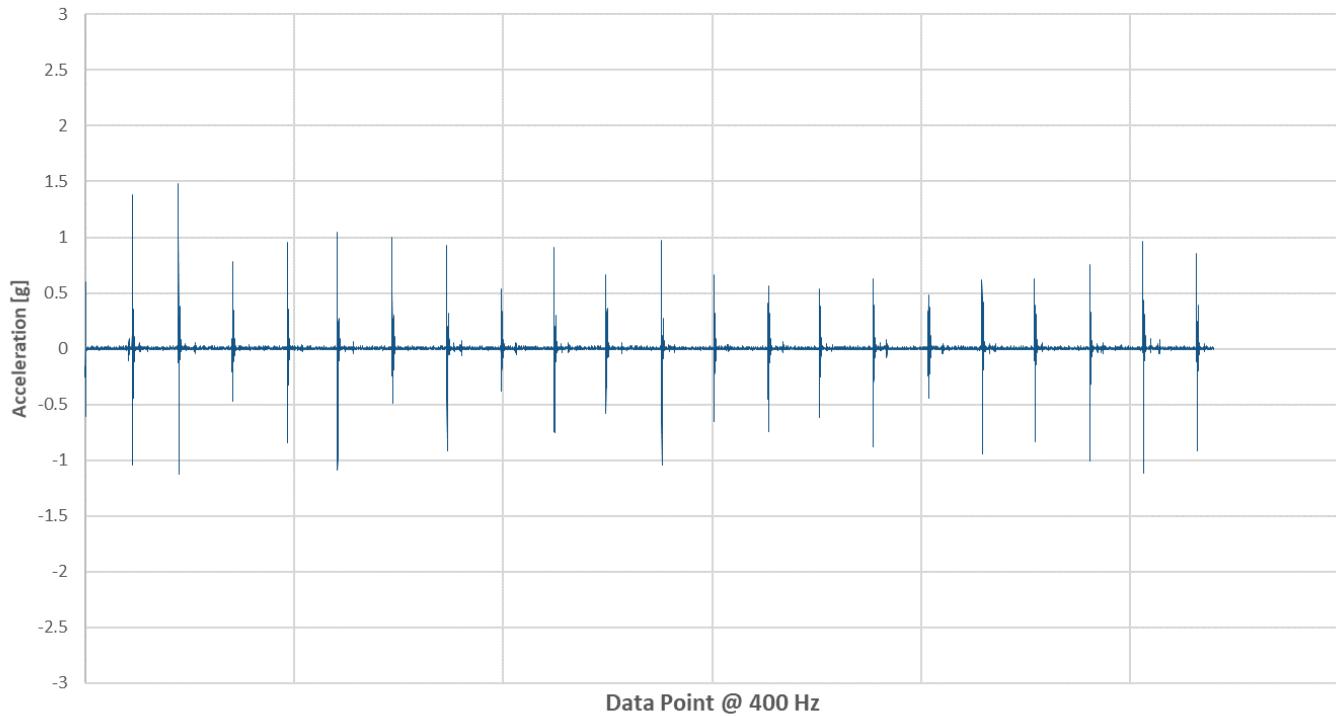




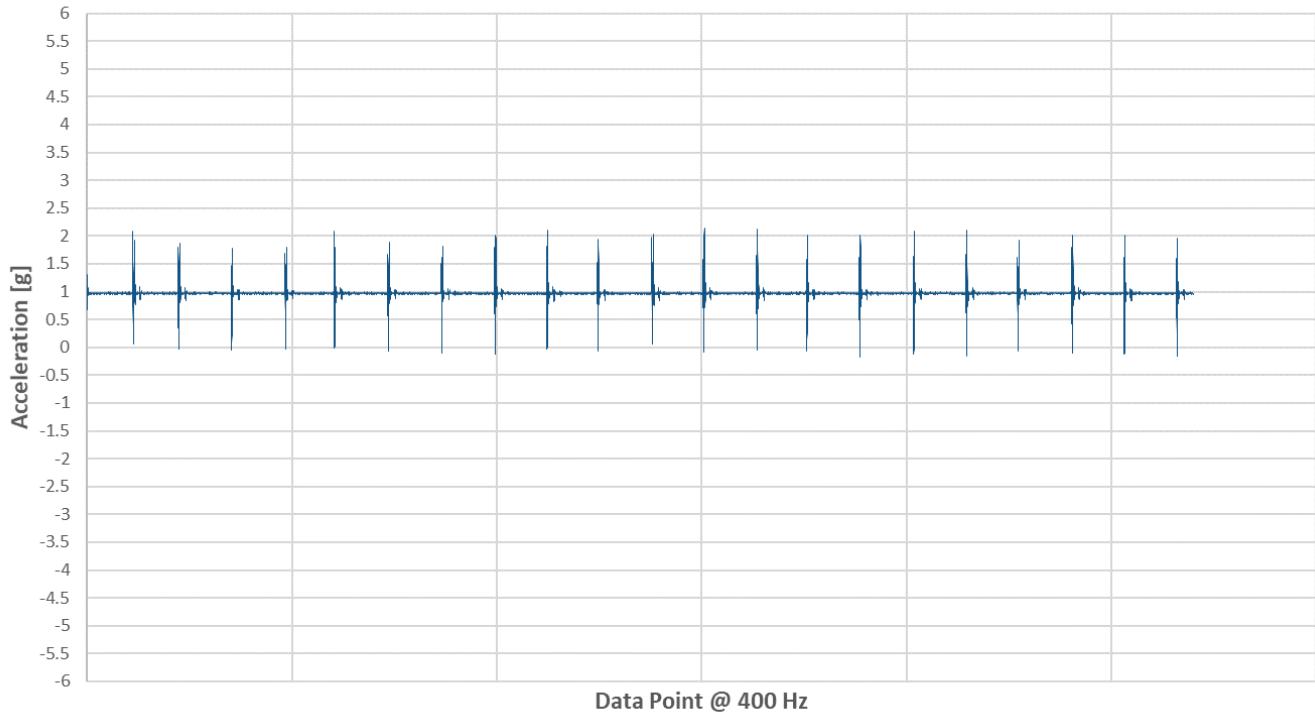
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Y Acceleration (Head to Toe) - Juno



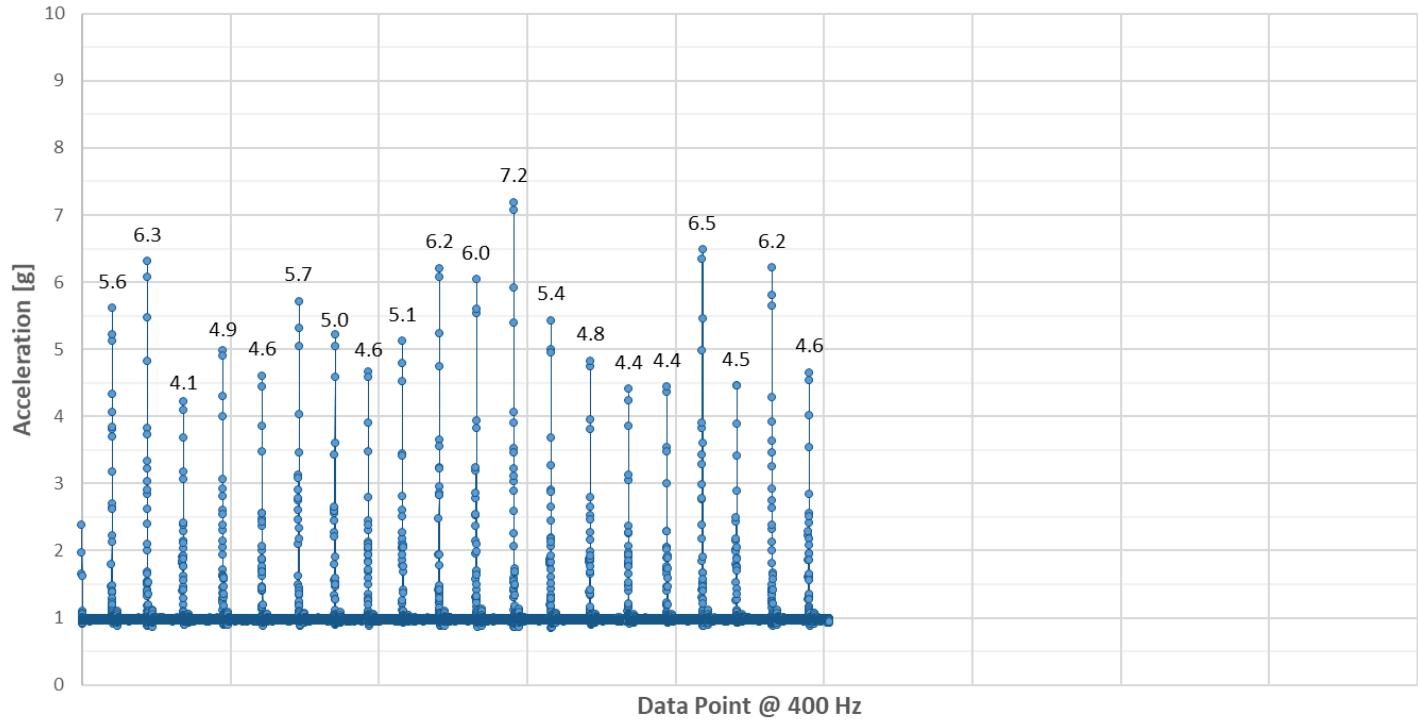
Z Acceleration (Up and Down) - Juno



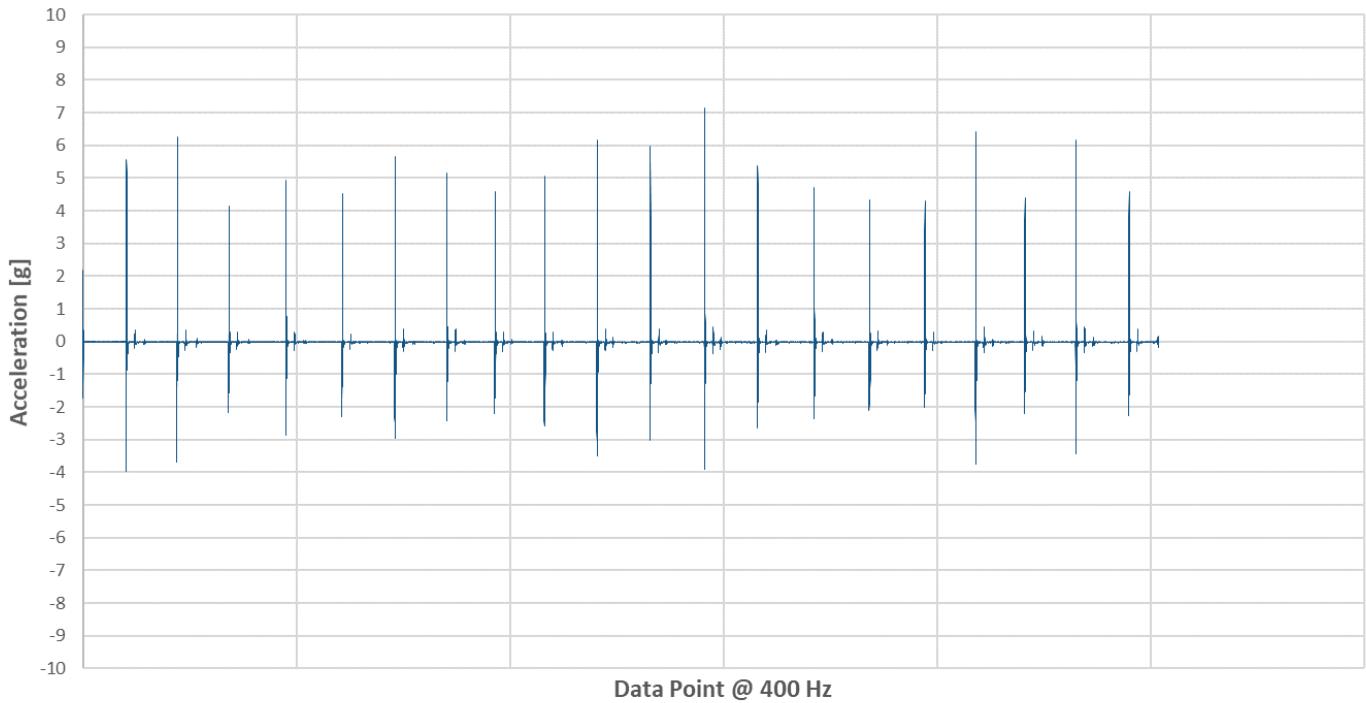


TEST 3 – MIRA

Vector Magnitude Acceleration - Mira



X Acceleration (Side to Side) - Mira

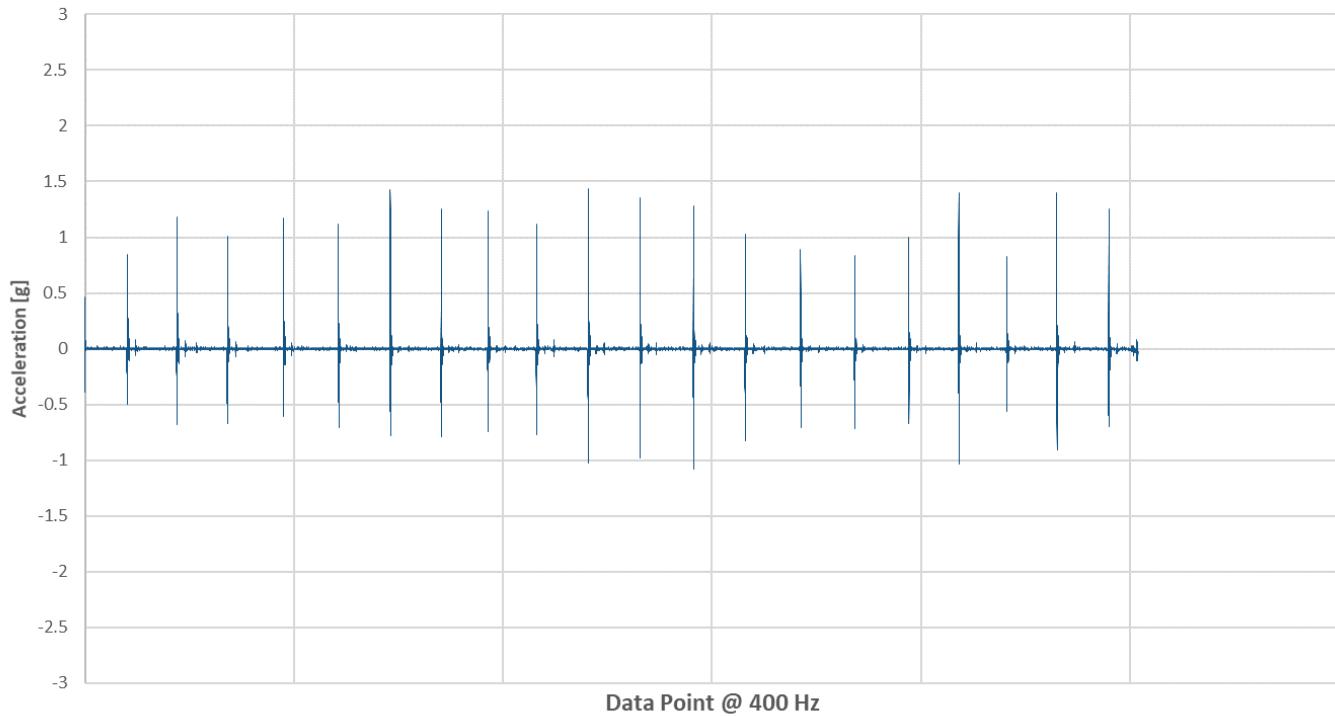




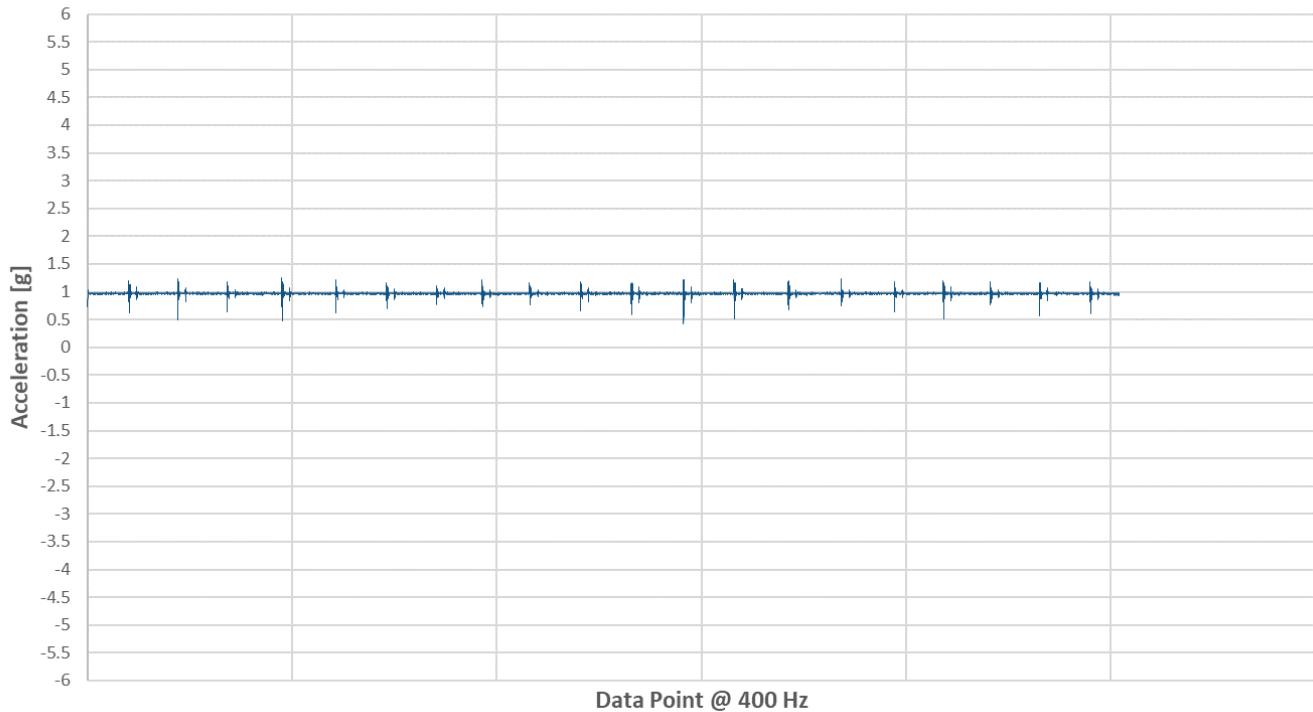
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Y Acceleration (Head to Toe) - Mira



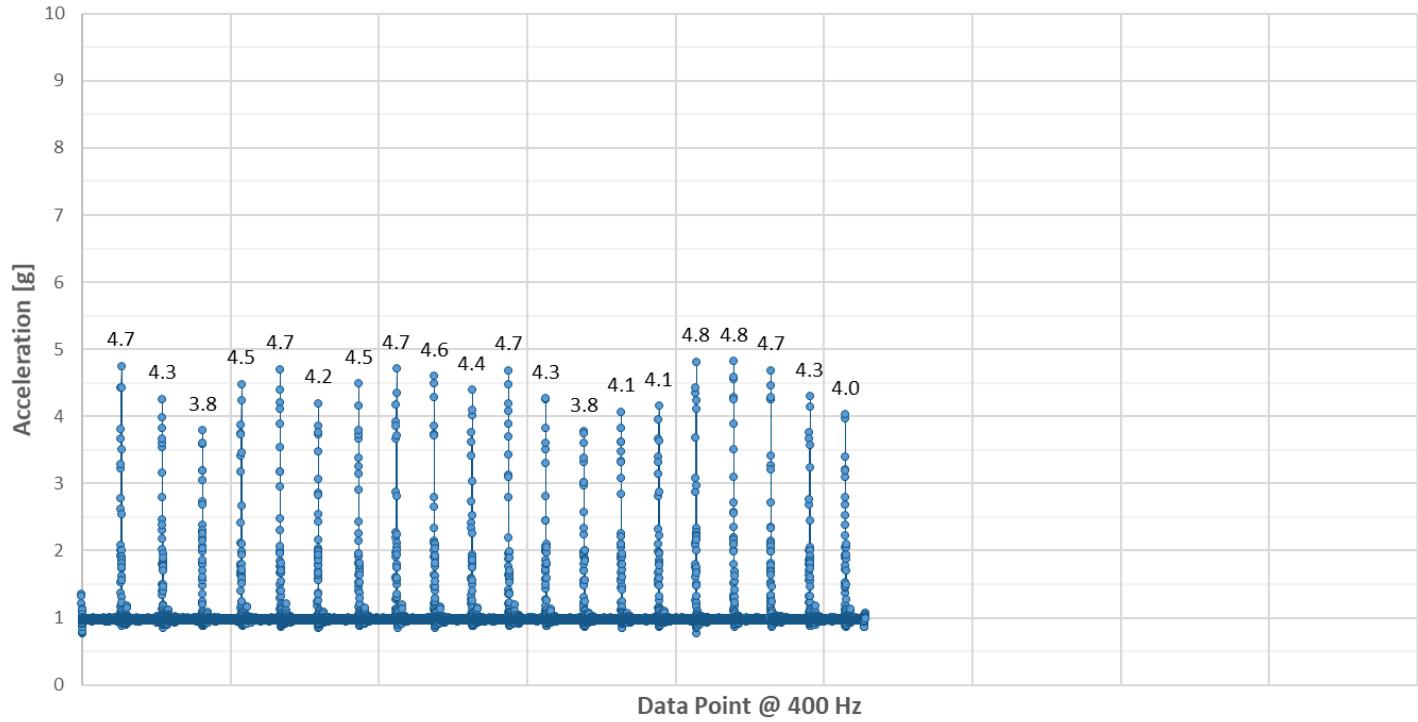
Z Acceleration (Up and Down) - Mira



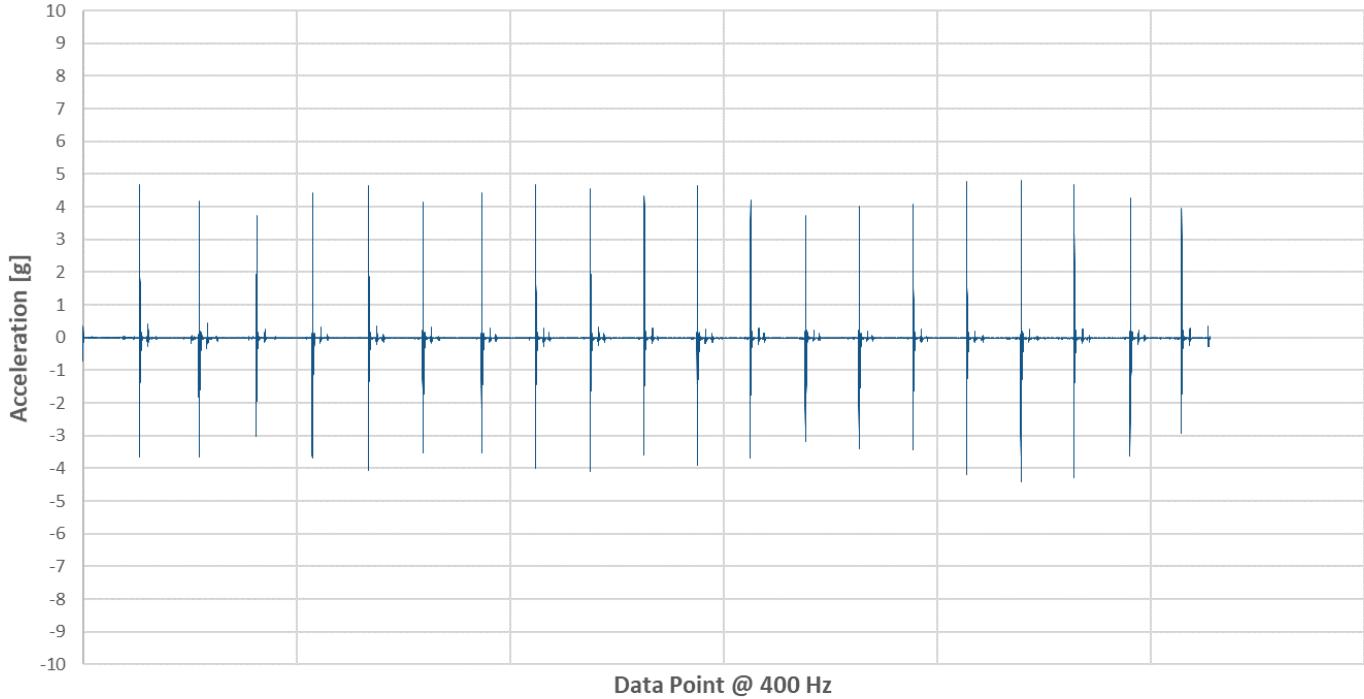


TEST 3 – SERTA CHINOOK

Vector Magnitude Acceleration - Serta Chinook



X Acceleration (Side to Side) - Serta Chinook

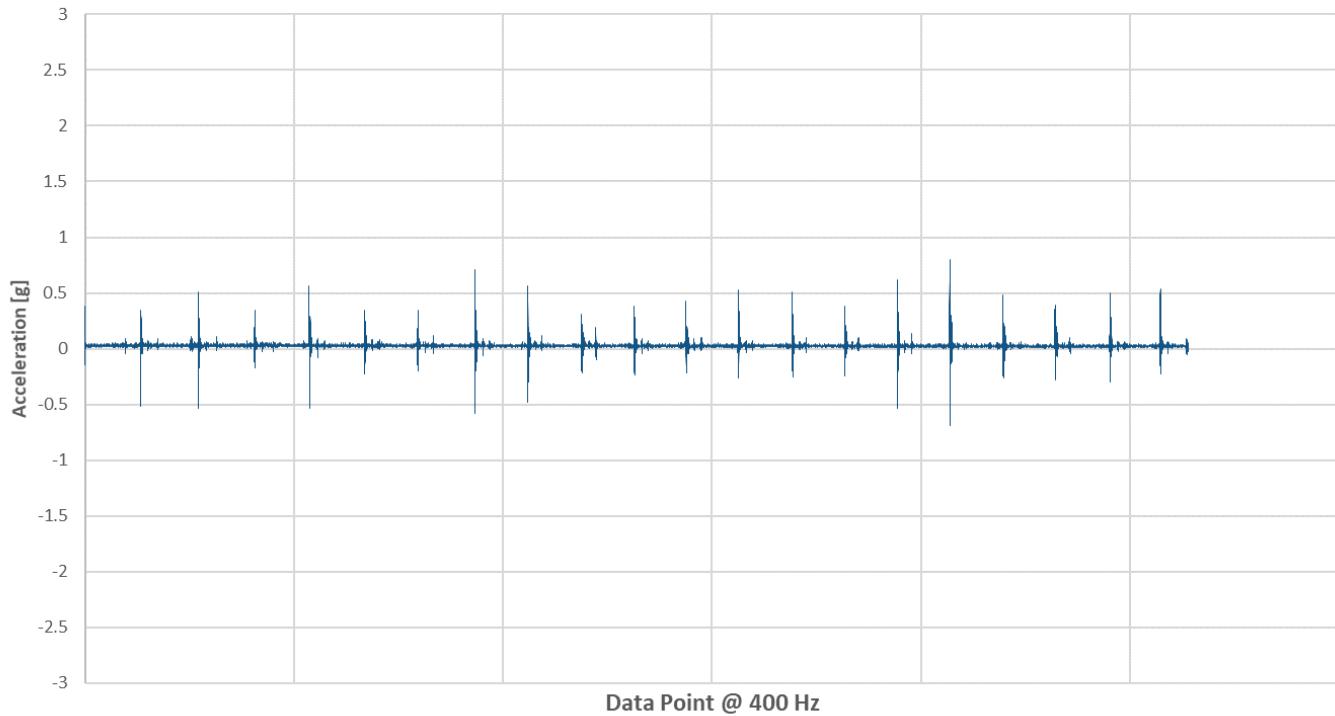




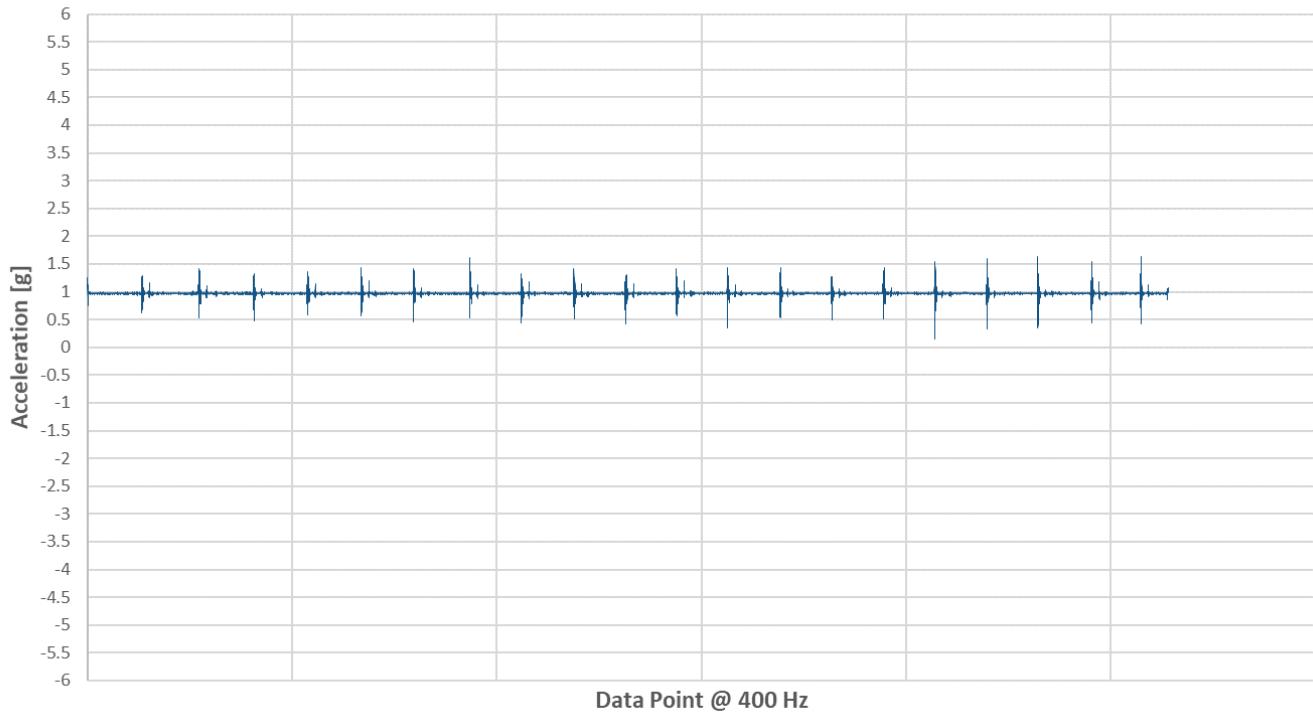
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Engineering Report

Y Acceleration (Head to Toe) - Serta Chinook



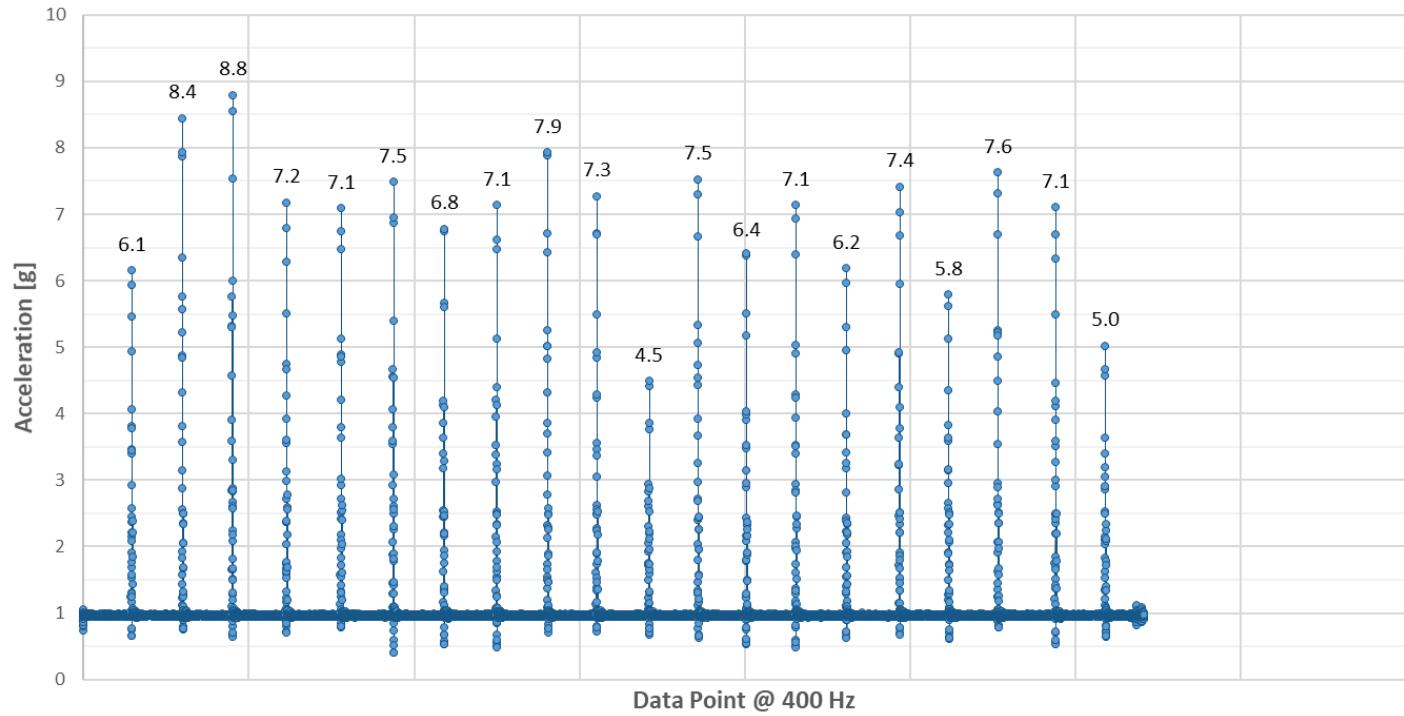
Z Acceleration (Up and Down) - Serta Chinook



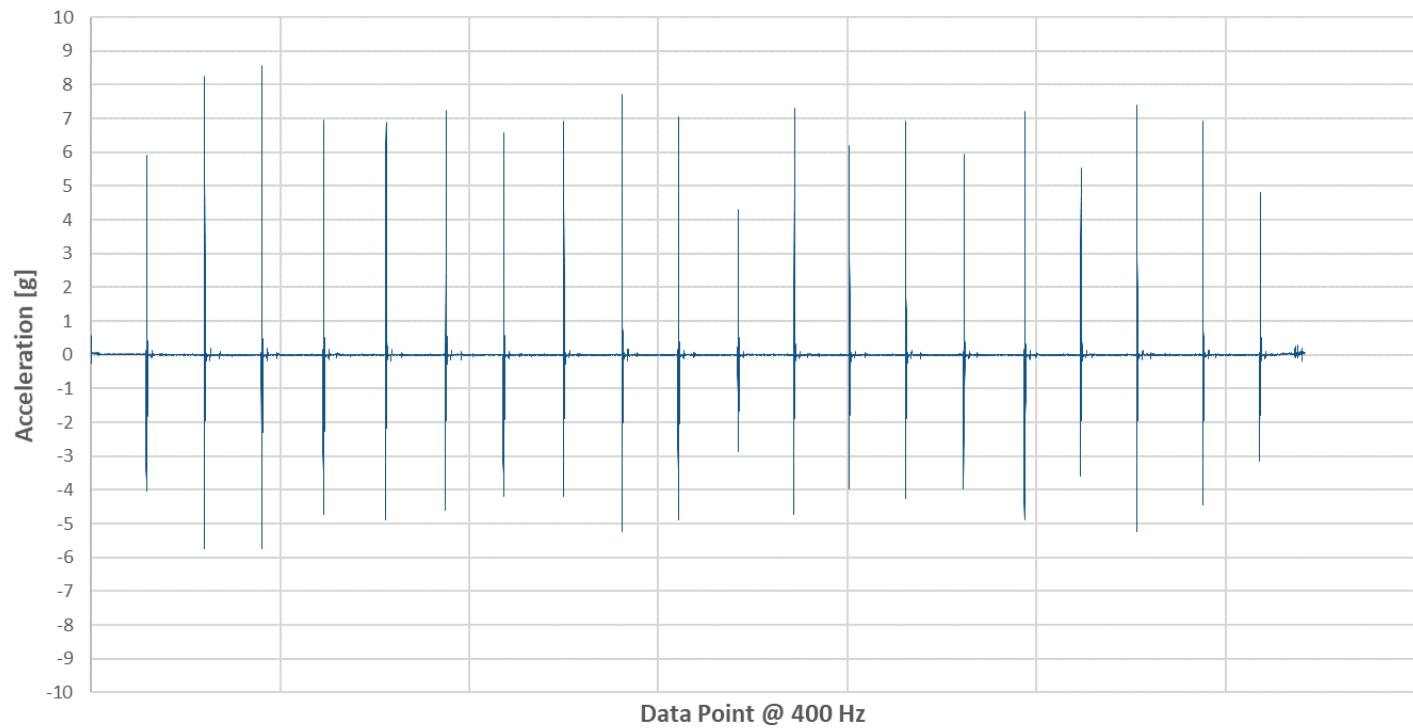


TEST 3 – PENNY

Vector Magnitude Acceleration - Penny



X Acceleration (Side to Side) - Penny

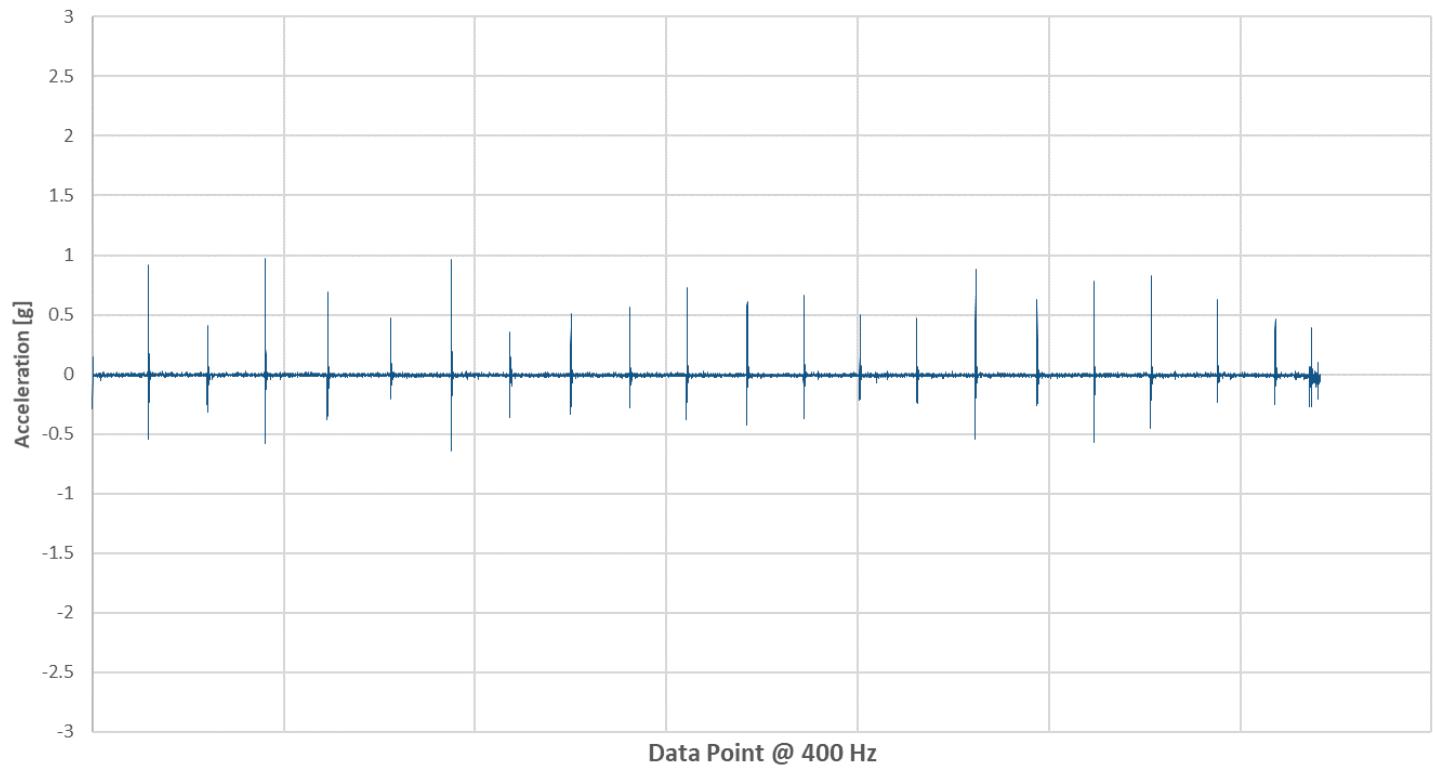




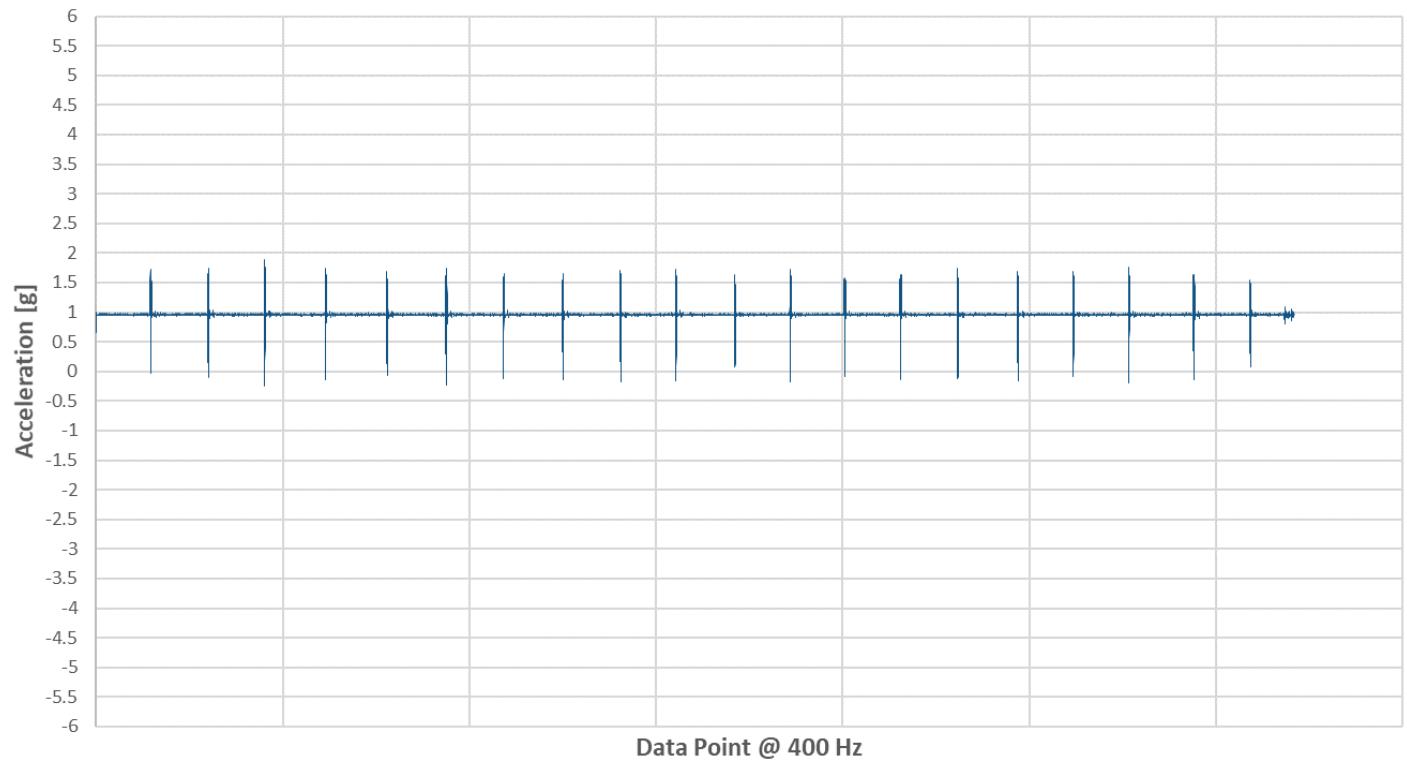
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Y Acceleration (Head to Toe) - Penny



Z Acceleration (Up and Down) - Penny



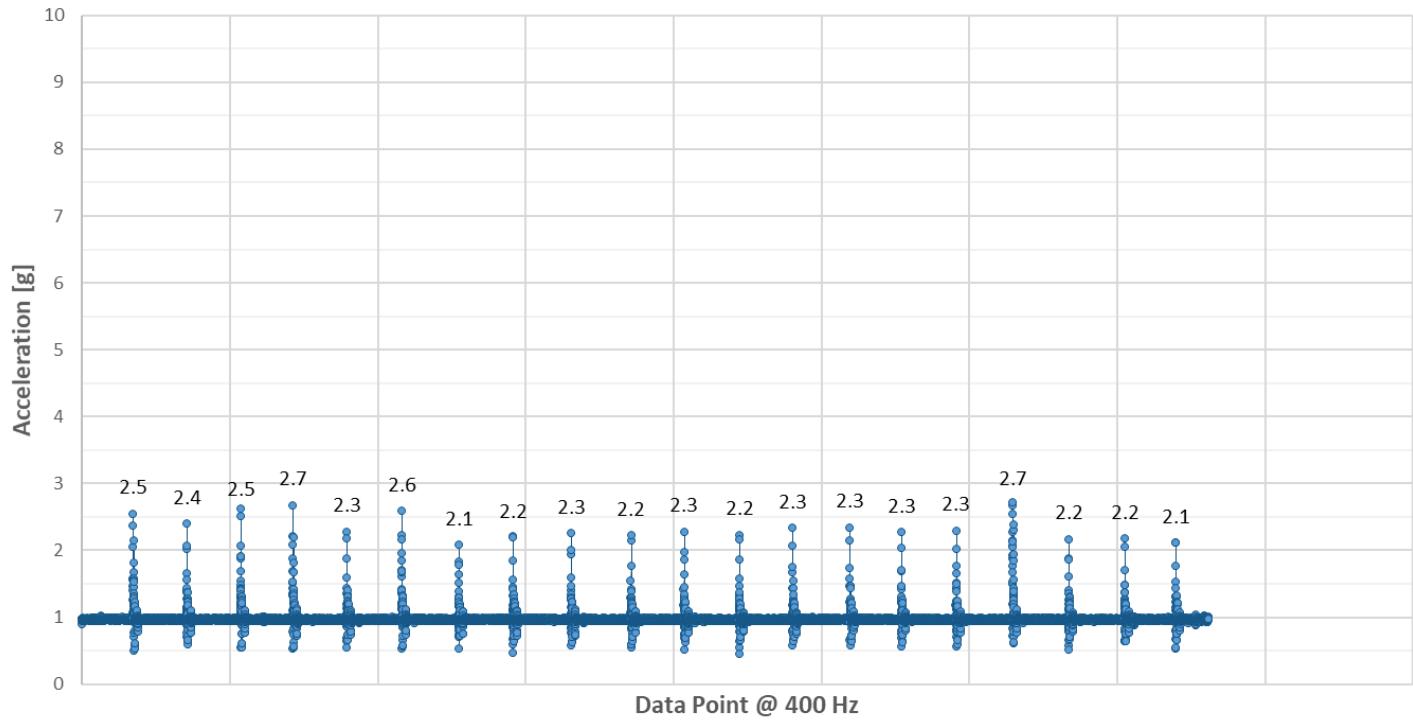


TEST 3 -APOLLO

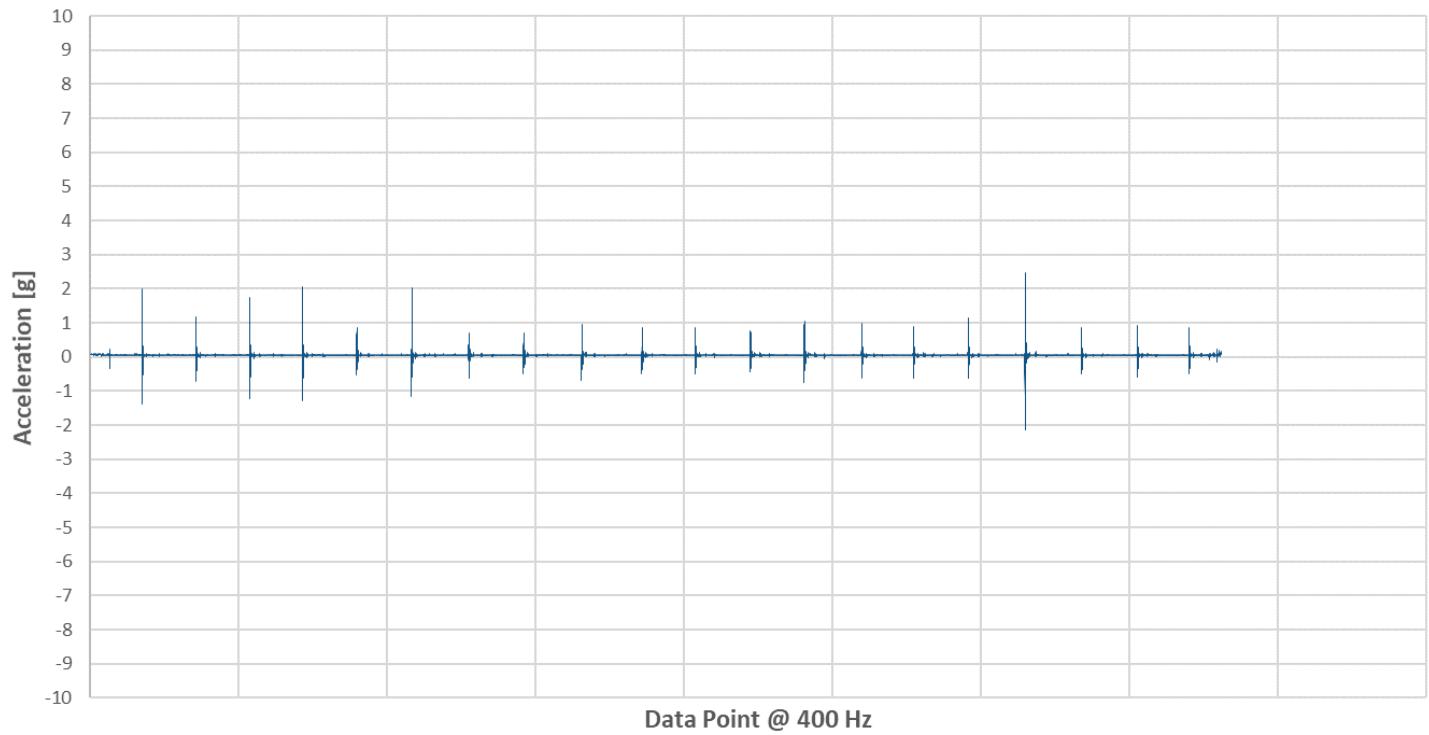
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Engineering Report

Vector Magnitude Acceleration - Apollo



X Acceleration (Side to Side) - Apollo

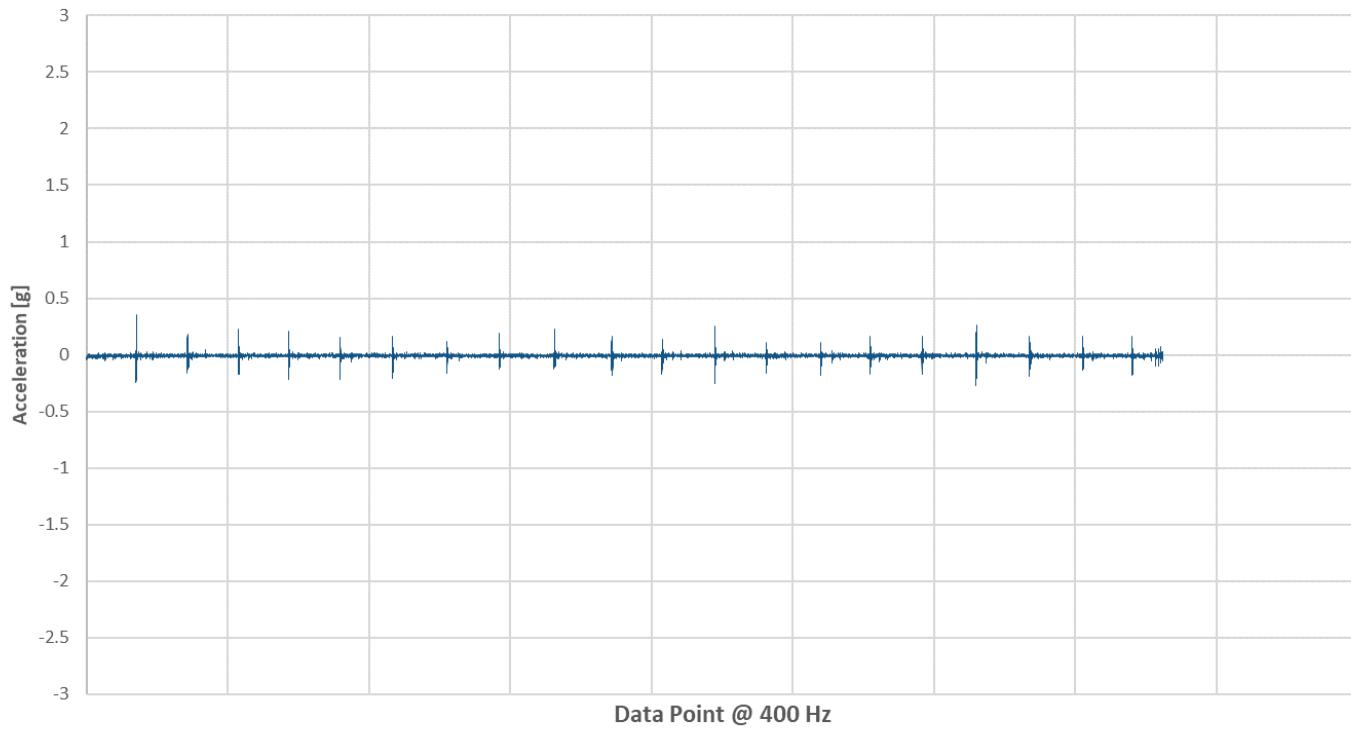




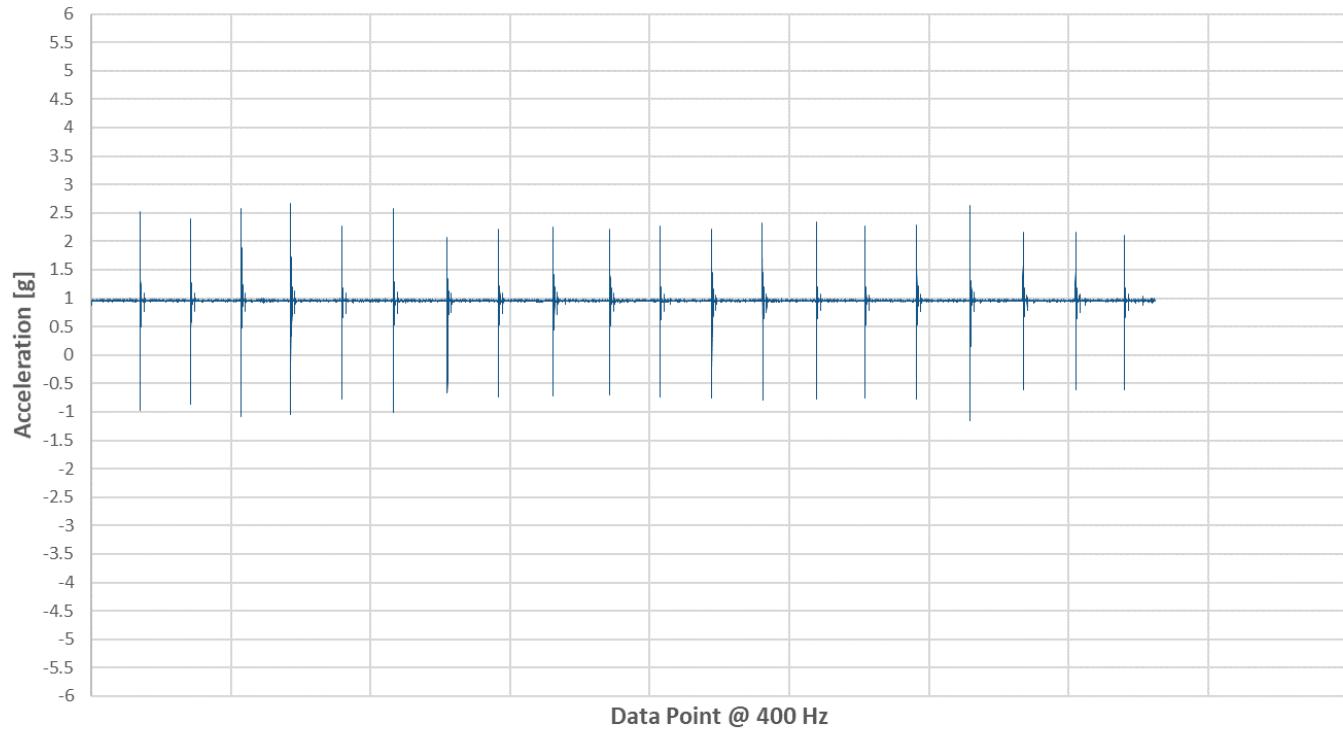
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Y Acceleration (Head to Toe) - Apollo



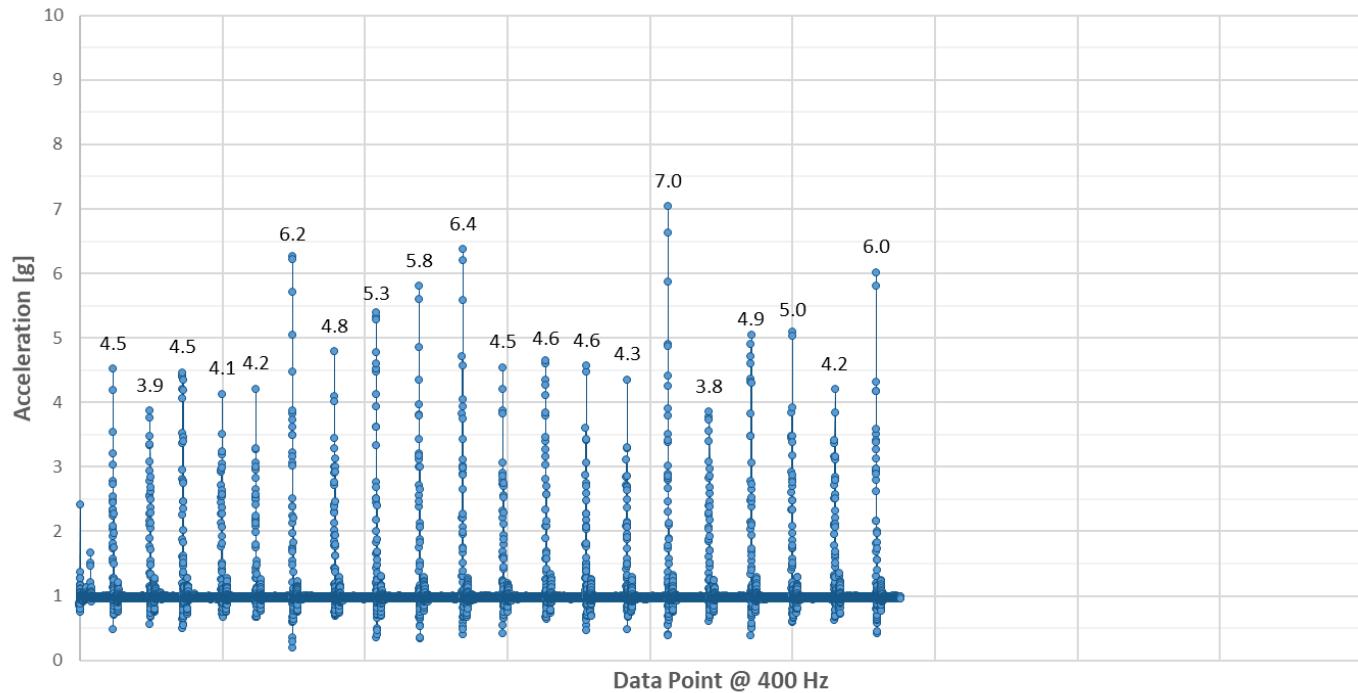
Z Acceleration (Up and Down) - Apollo



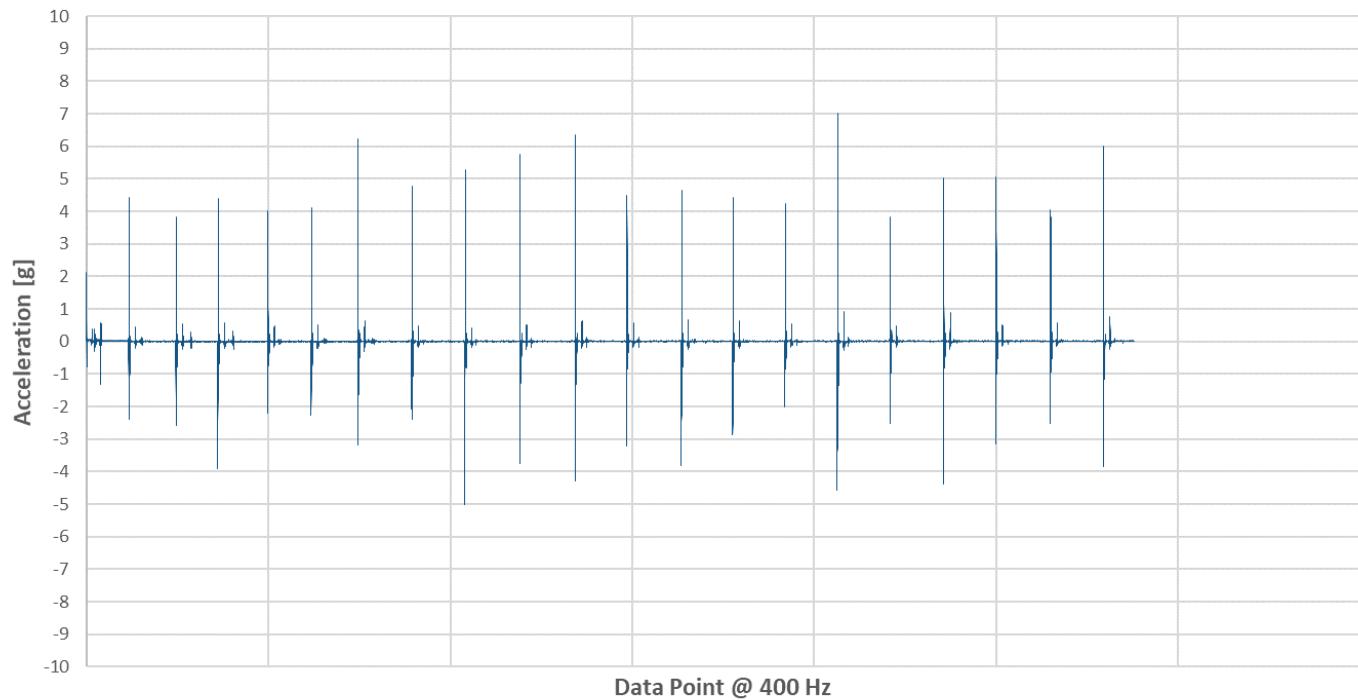


TEST 3 -EMMA

Vector Magnitude Acceleration - Emma



X Acceleration (Side to Side) - Emma

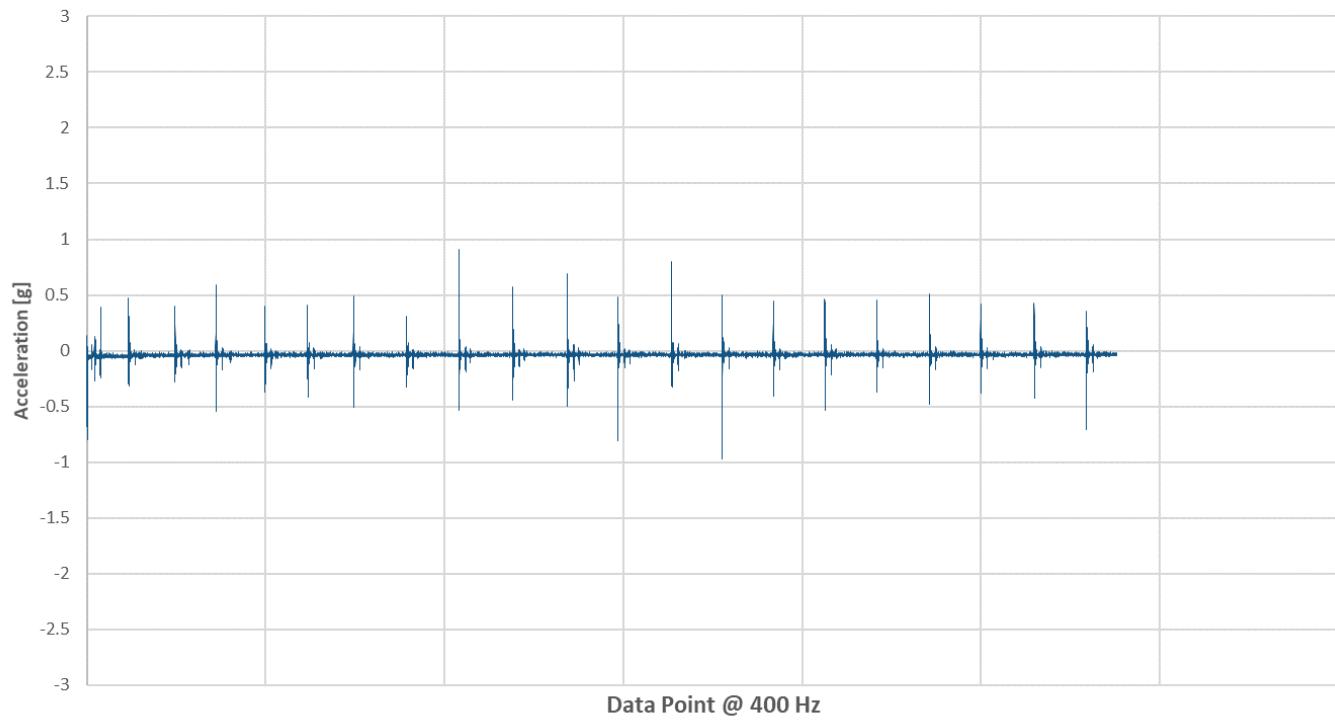




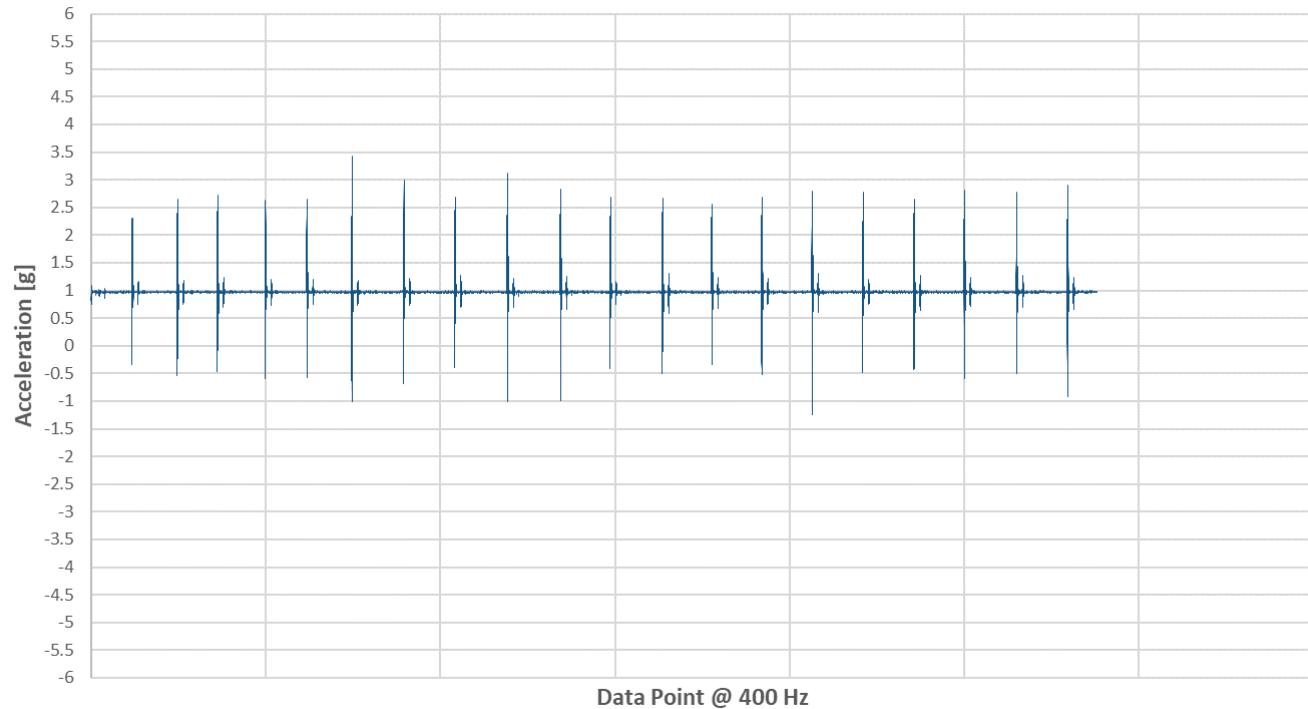
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Y Acceleration (Head to Toe) - Emma



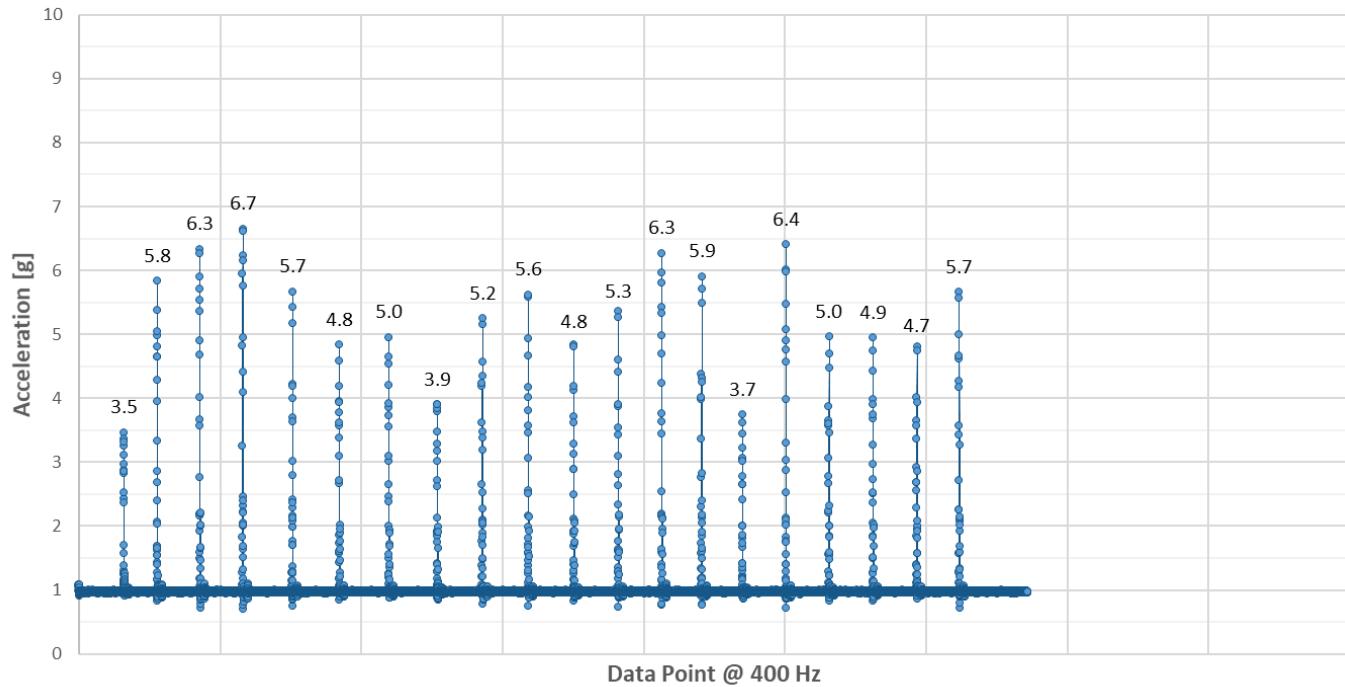
Z Acceleration (Up and Down) - Emma



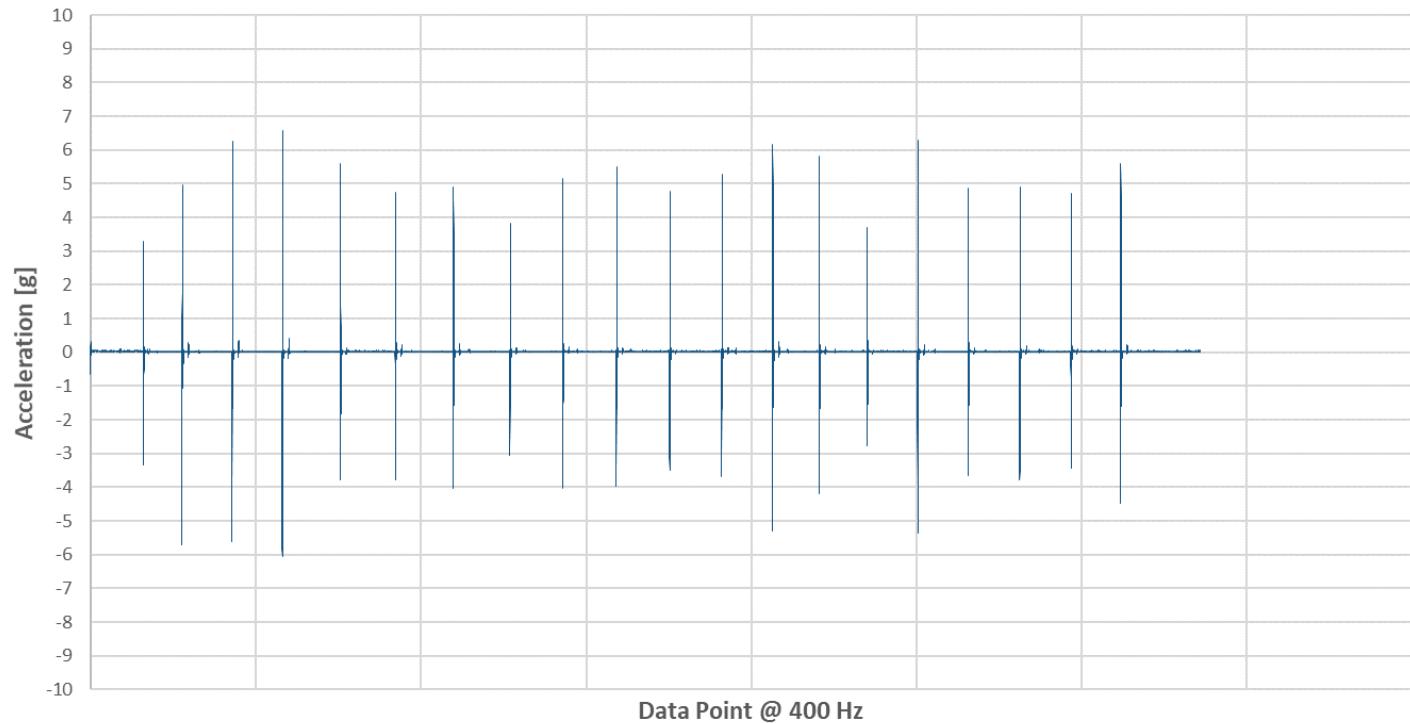


TEST 3 -CASPER ESSENTIAL (V2)

Vector Magnitude Acceleration - Casper Essential (V2)



X Acceleration (Side to Side) - Casper Essential (V2)

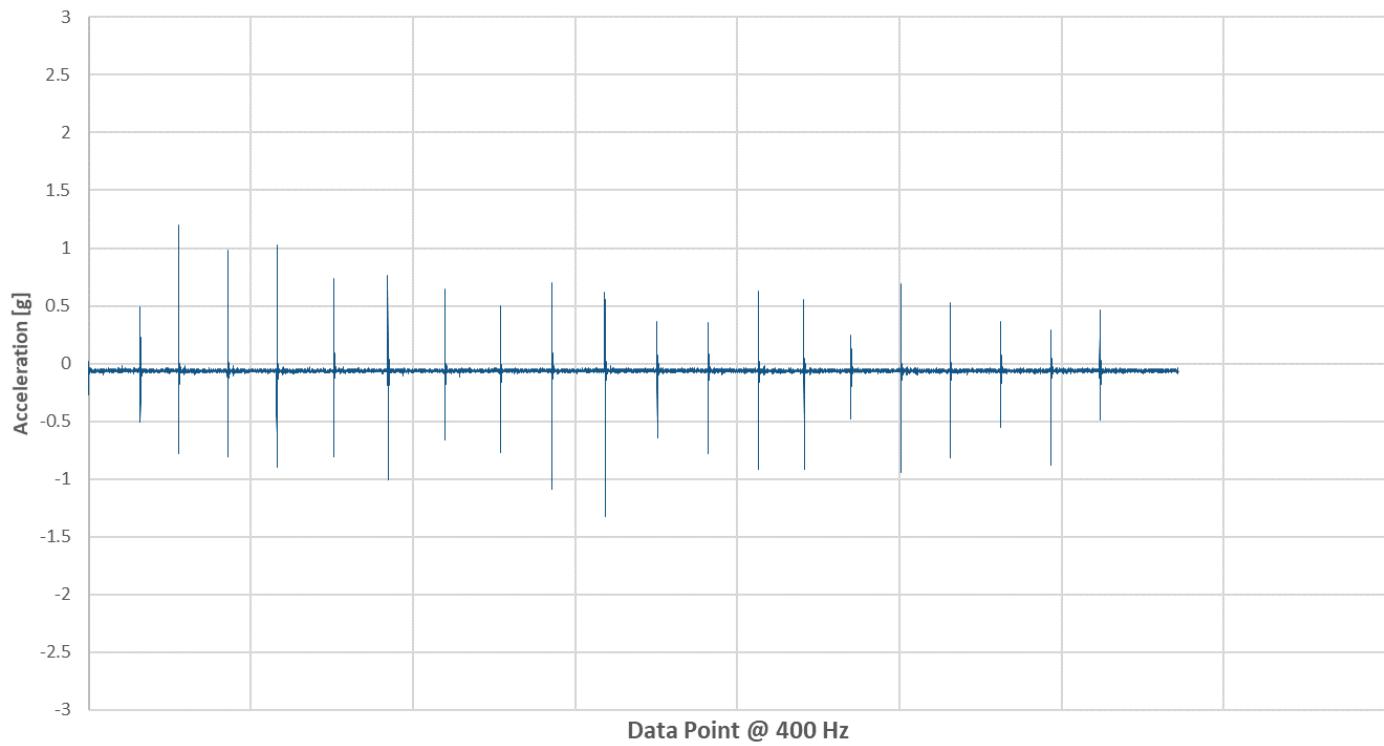




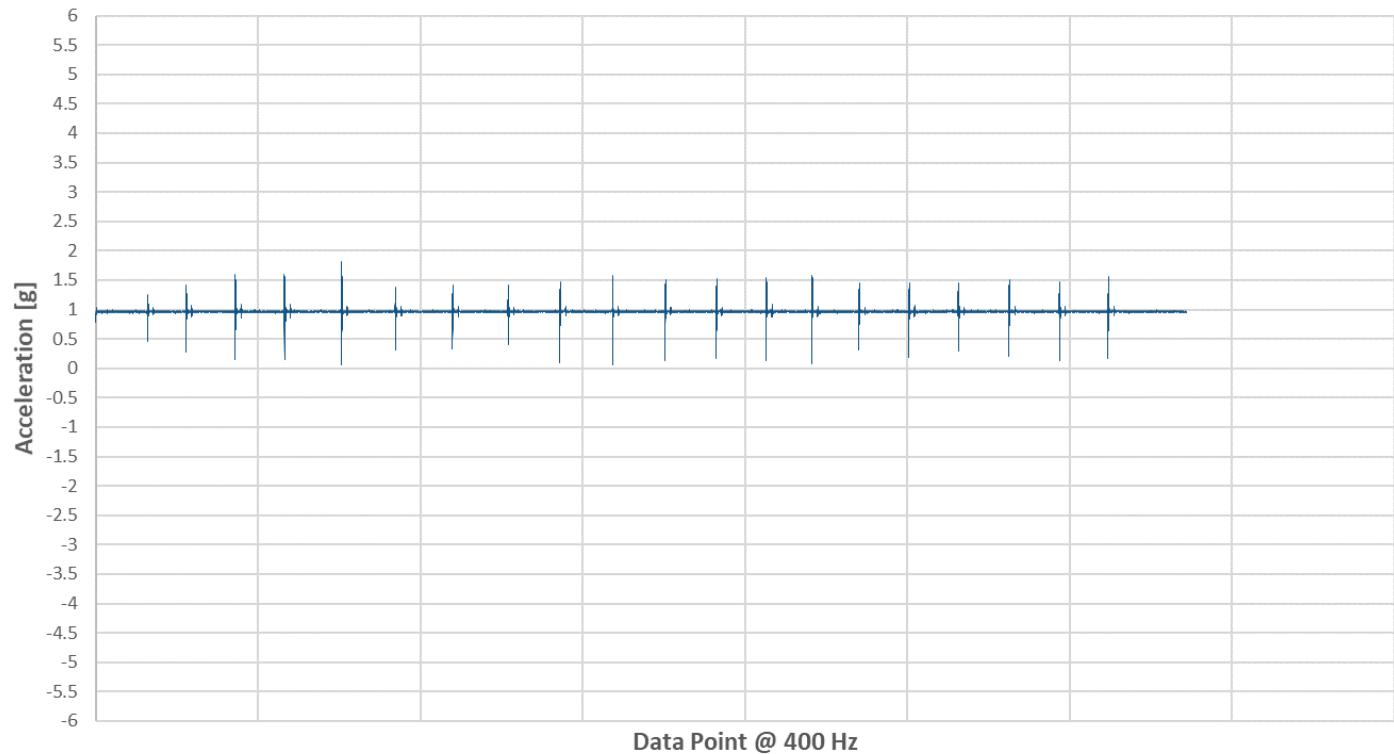
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Y Acceleration (Head to Toe) - Casper Essential (V2)



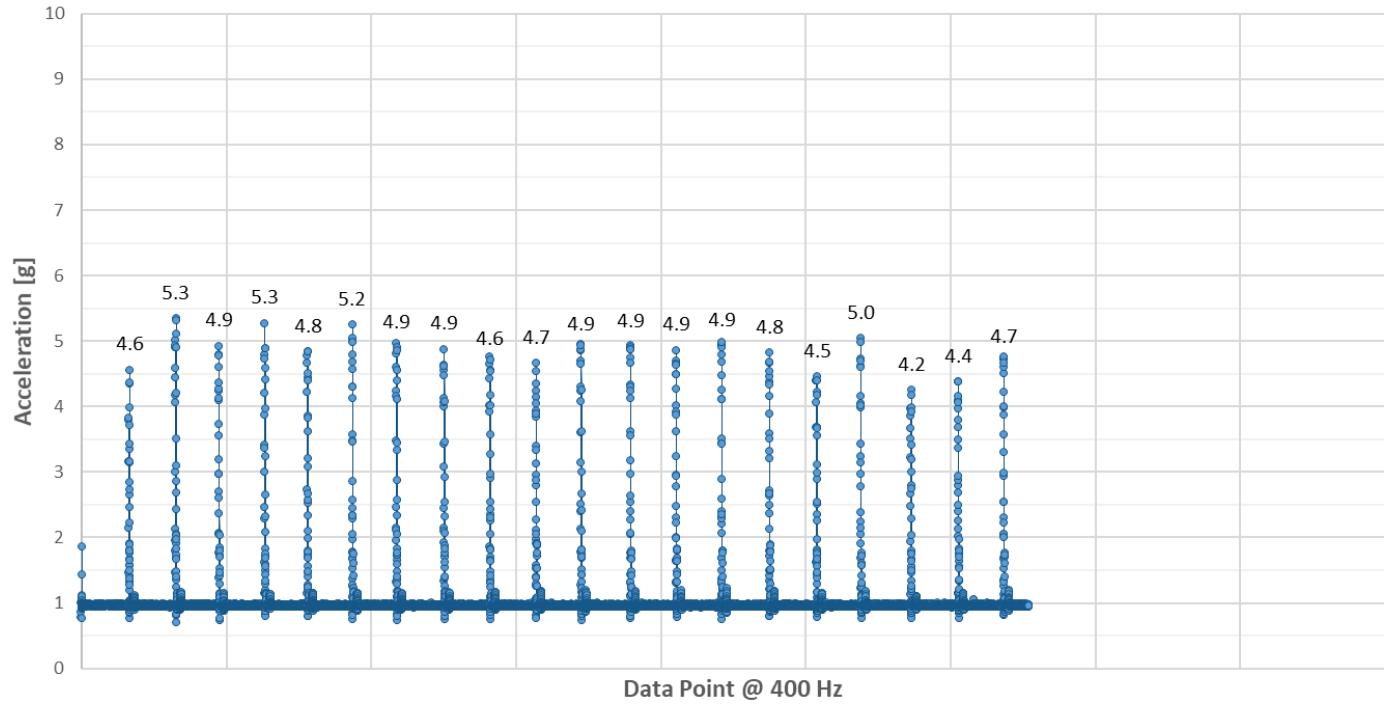
Z Acceleration (Up and Down) - Casper Essential (V2)



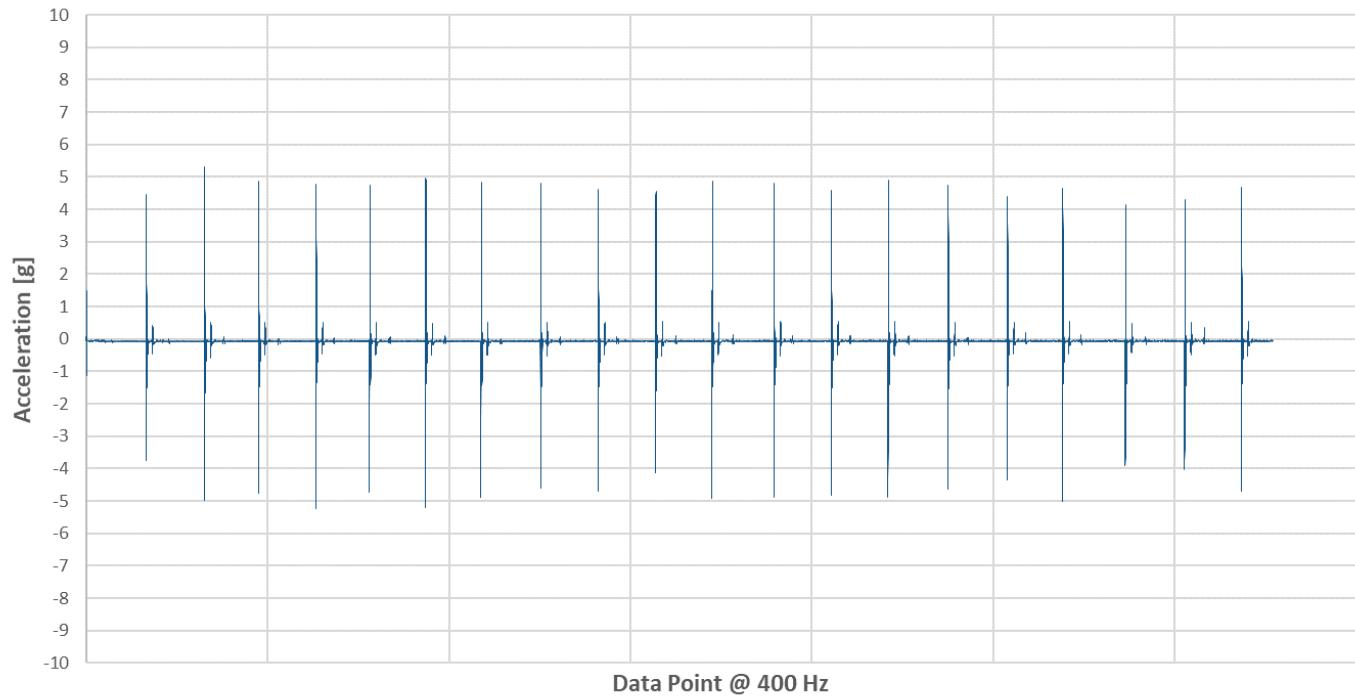


TEST 3 -CASPER (V3)

Vector Magnitude Acceleration - Casper (V3)



X Acceleration (Side to Side) - Casper (V3)

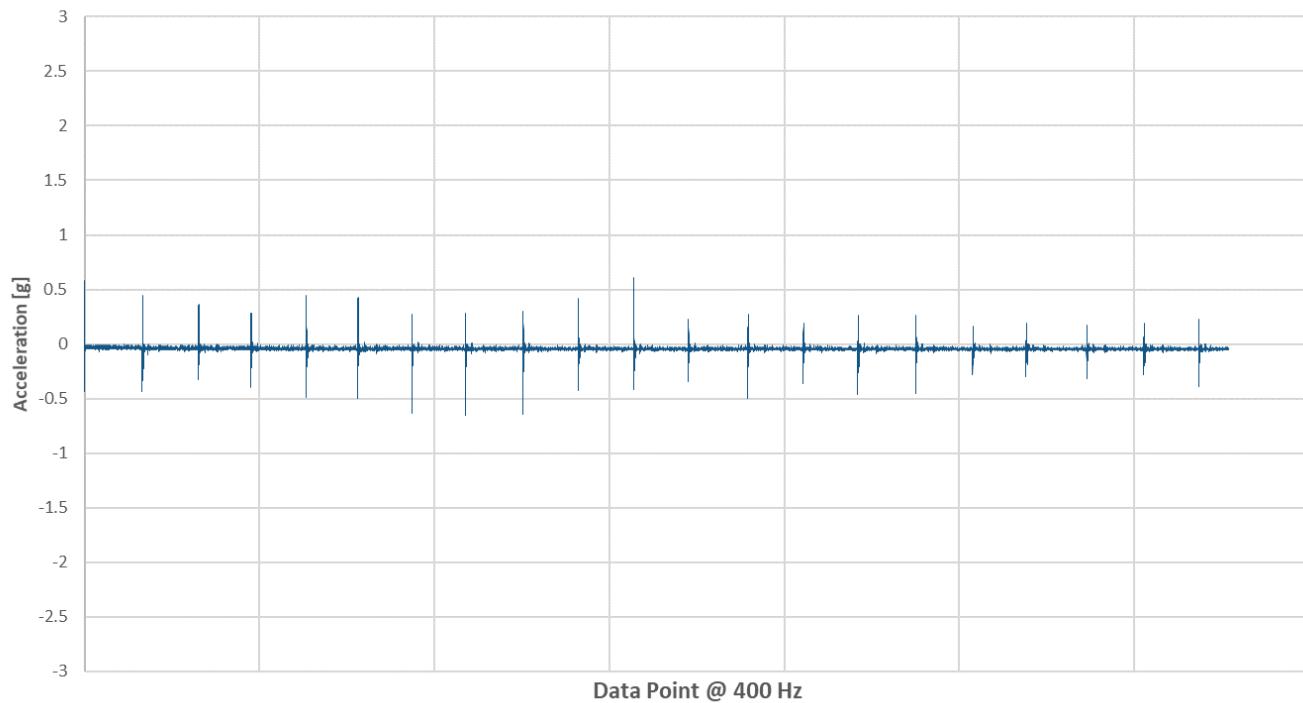




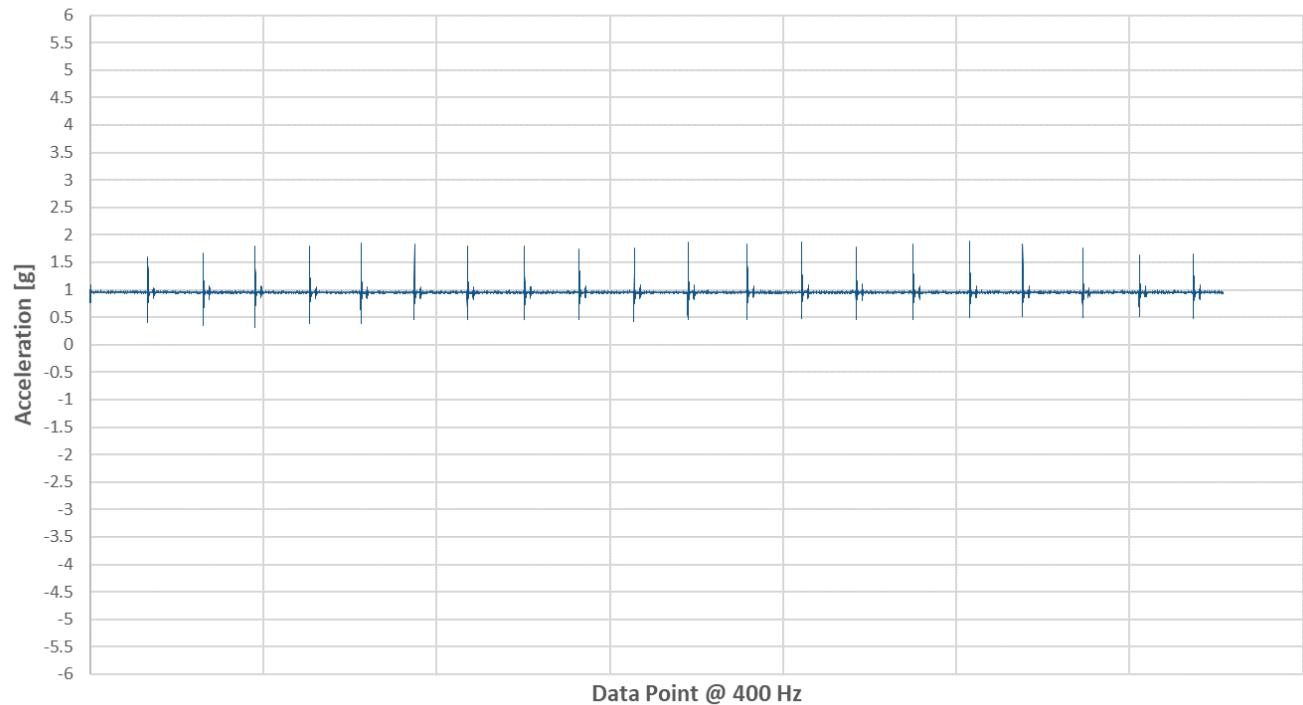
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Y Acceleration (Head to Toe) - Casper (V3)



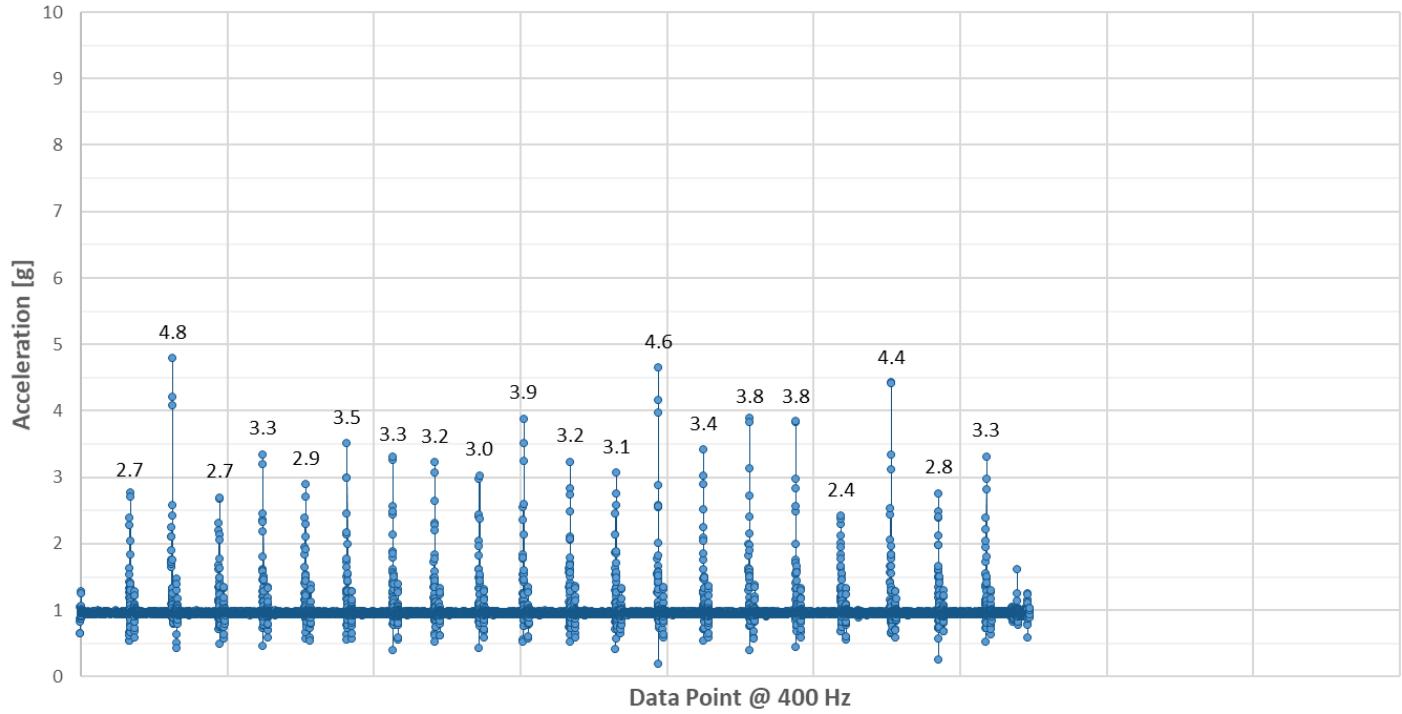
Z Acceleration (Up and Down) - Casper (V3)



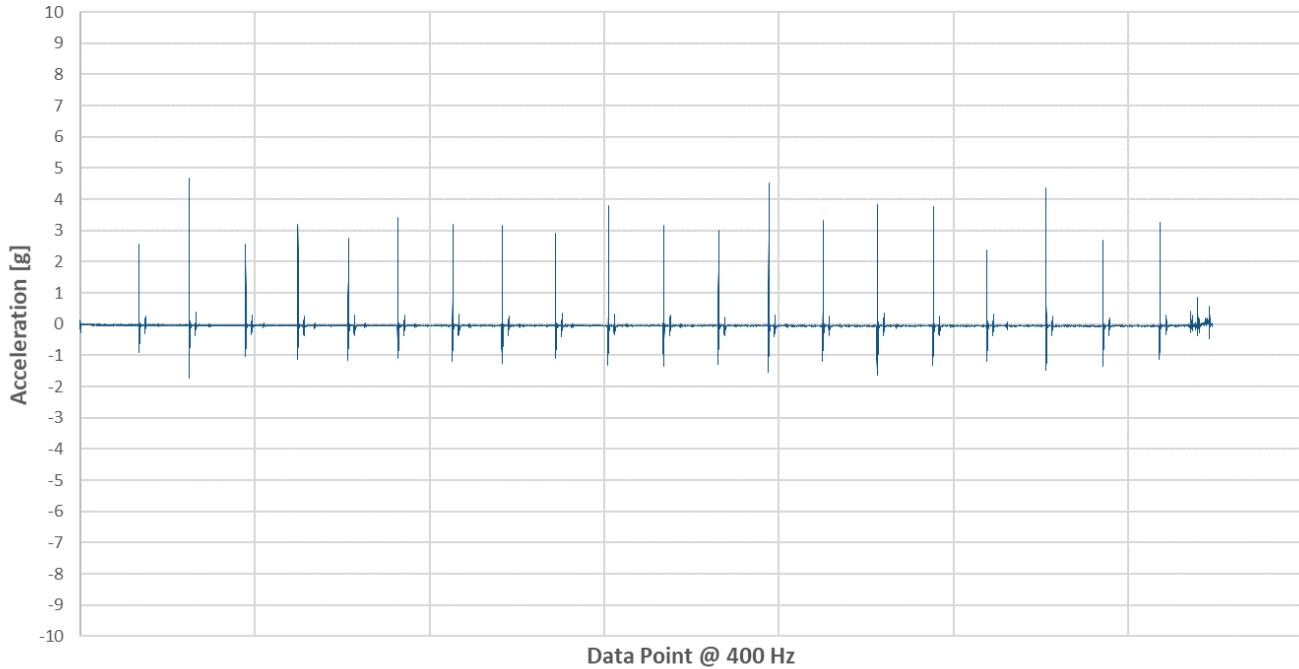


TEST 3 – MIRA (V2)

Vector Magnitude Acceleration - Mira (V2)



X Acceleration (Side to Side) - Mira (V2)

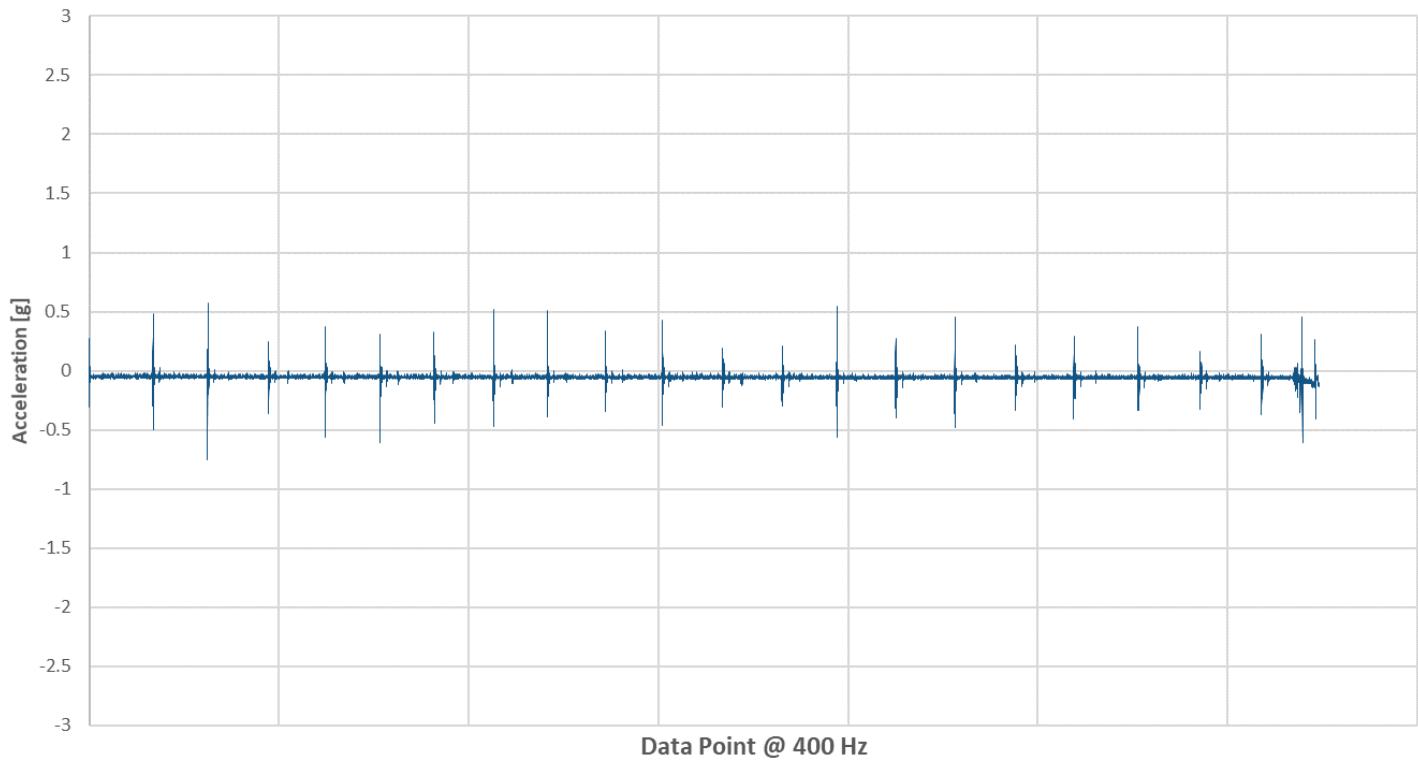




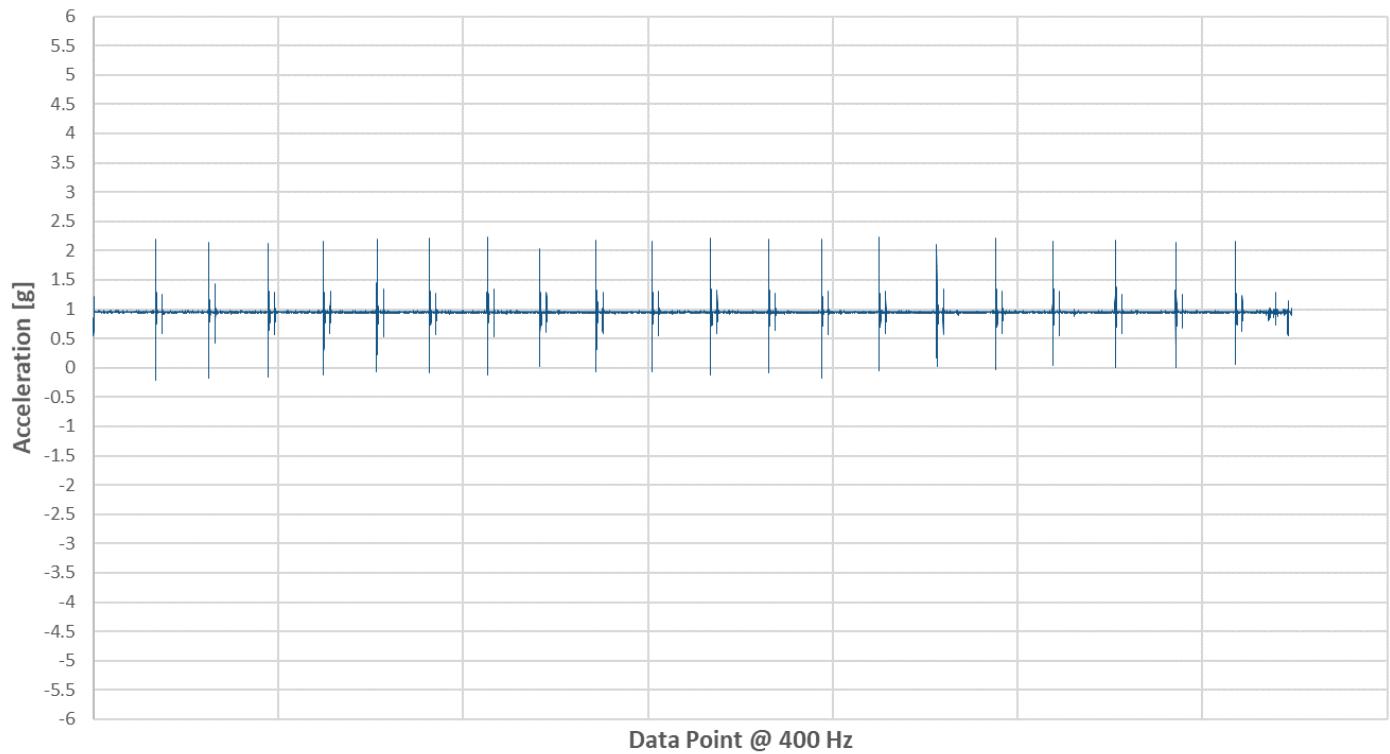
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Y Acceleration (Head to Toe) - Mira (V2)



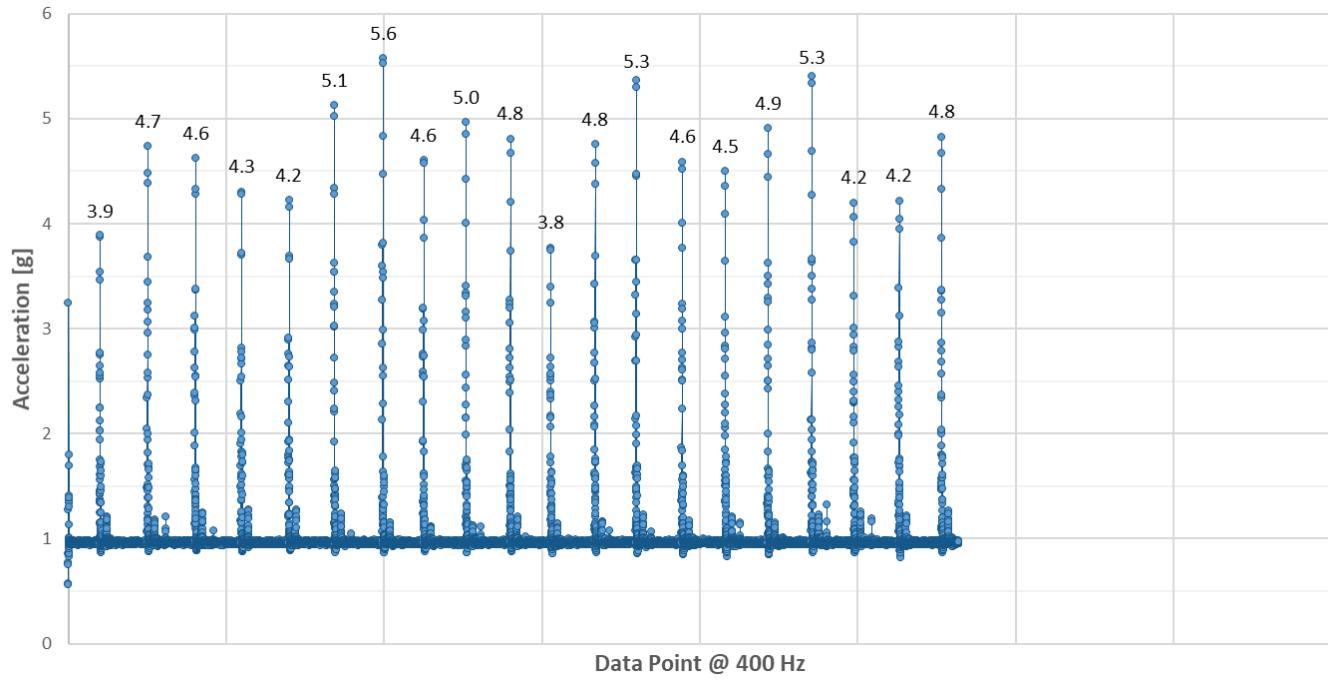
Z Acceleration (Up and Down) - Mira (V2)



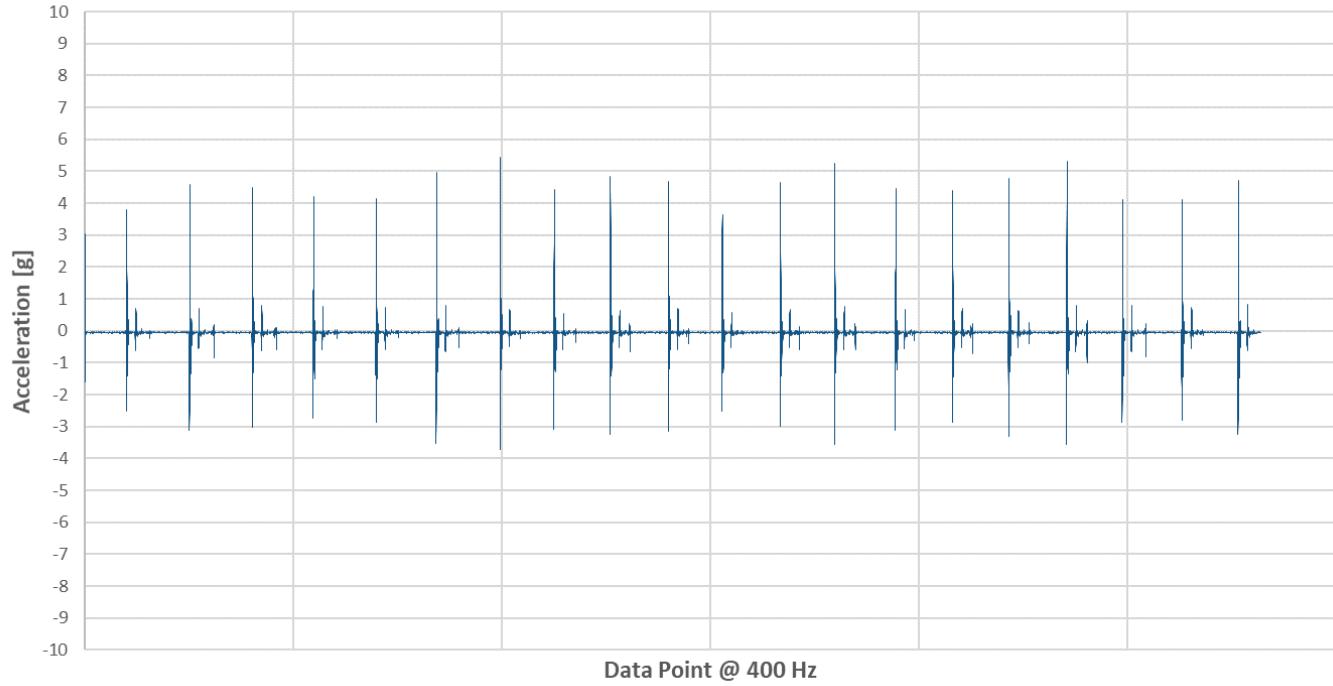


TEST 3 – CASPER (V4)

Vector Magnitude Acceleration - Casper (V4)



X Acceleration (Side to Side) - Casper (V4)

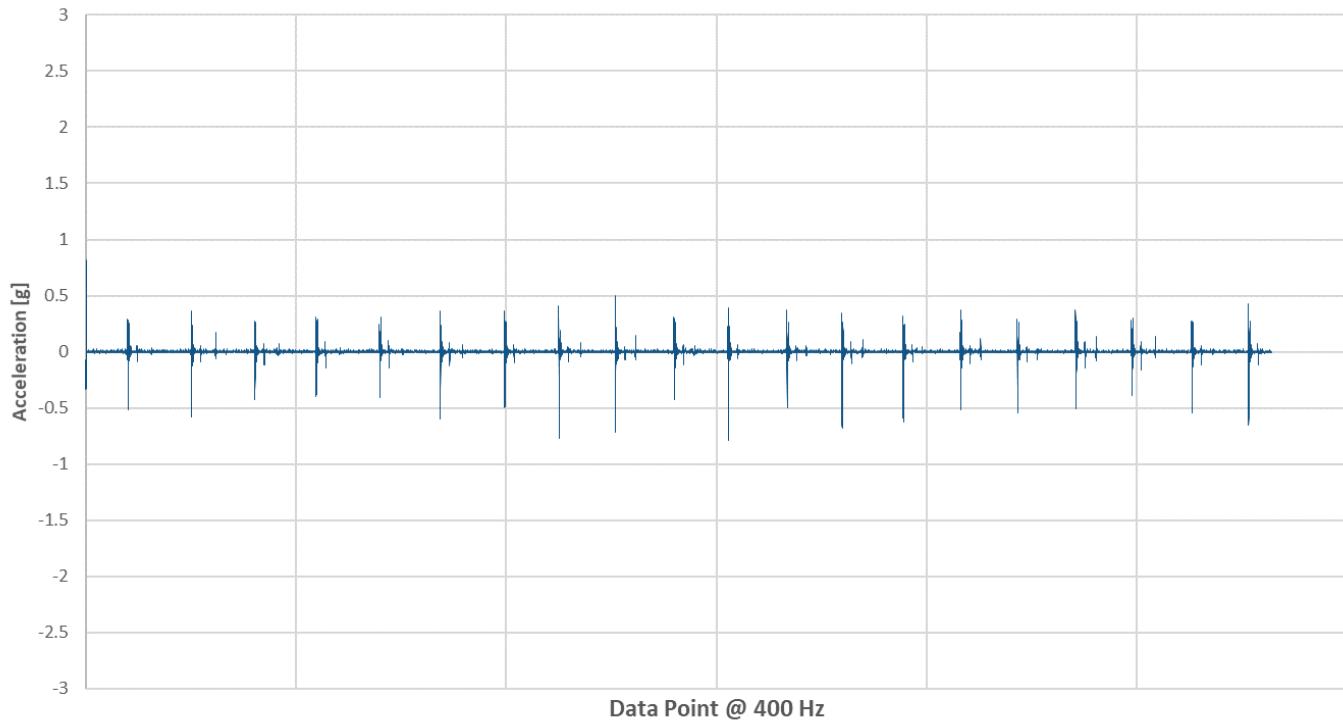




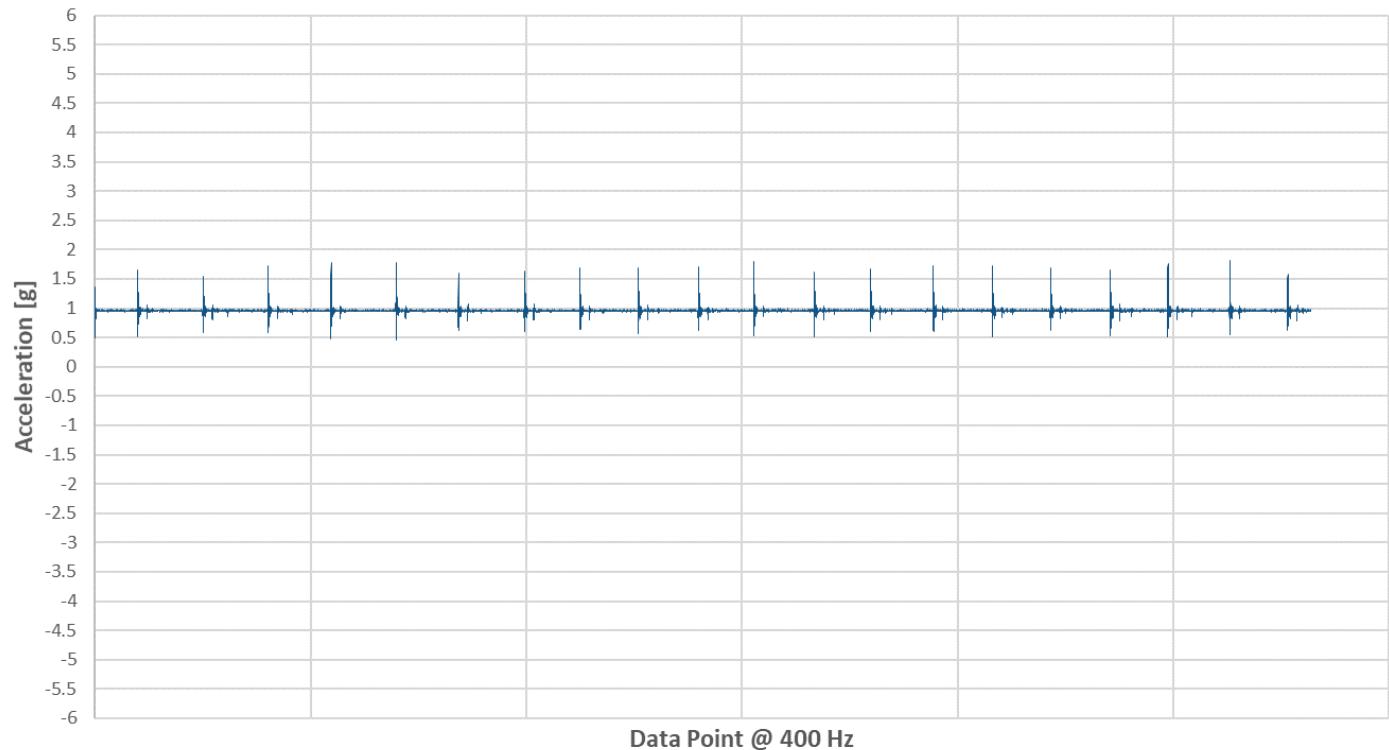
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Y Acceleration (Head to Toe) - Casper (V4)



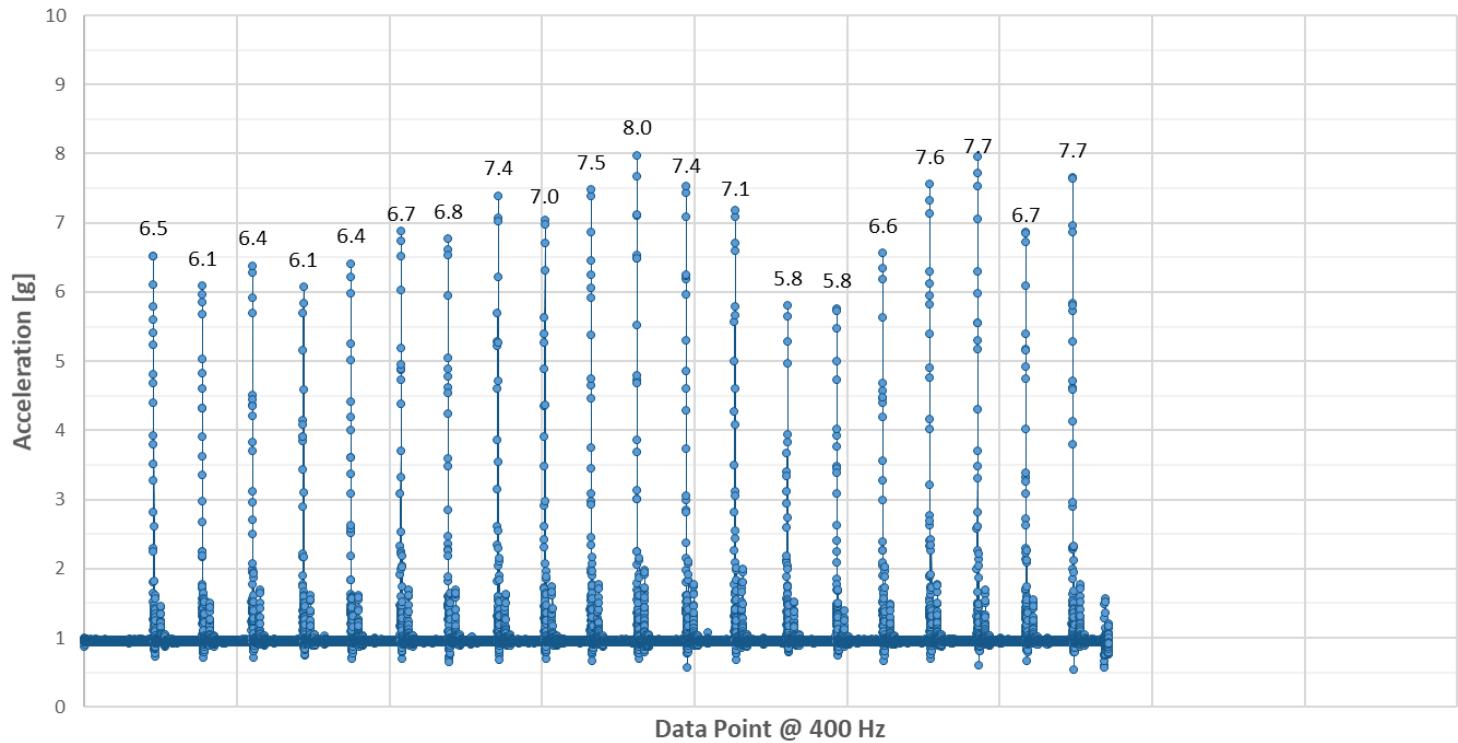
Z Acceleration (Up and Down) - Casper (V4)



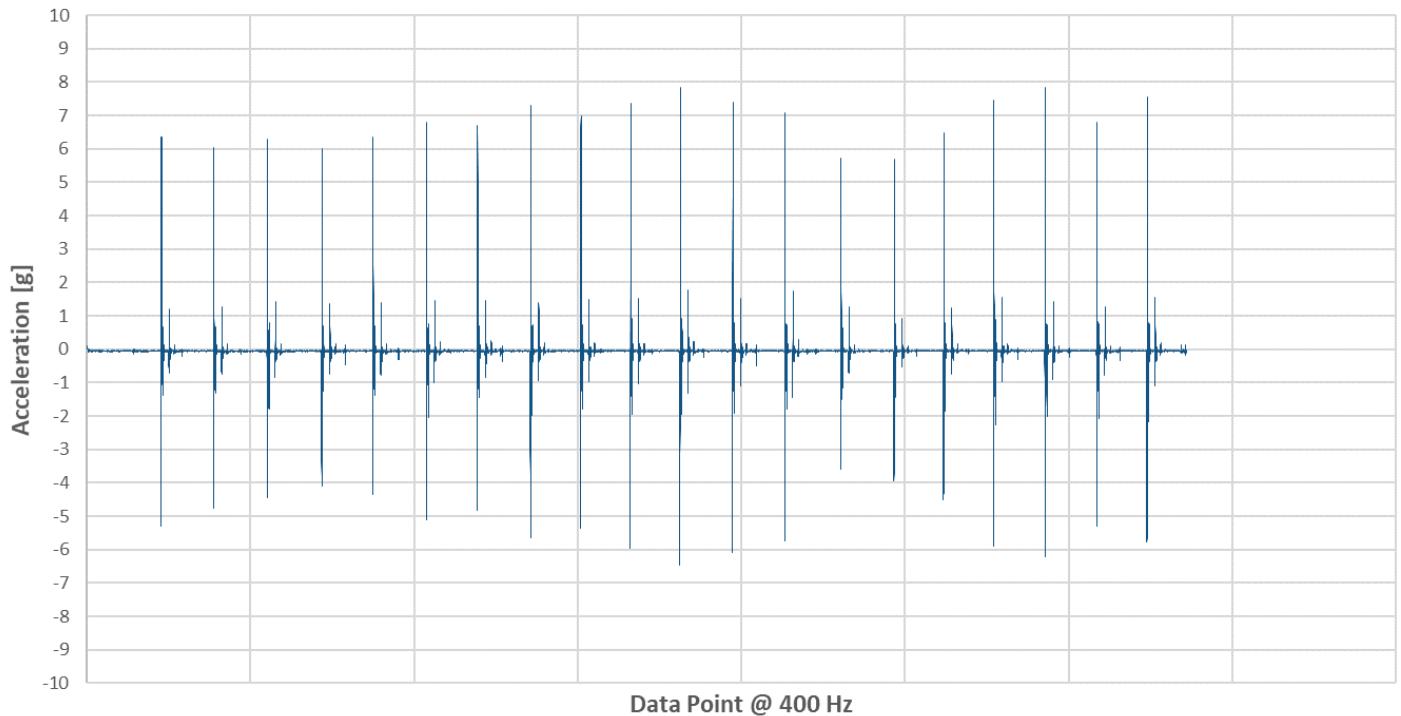


TEST 3 – CASPER ELEMENT

Vector Magnitude Acceleration - Casper Element



X Acceleration (Side to Side) - Casper Element

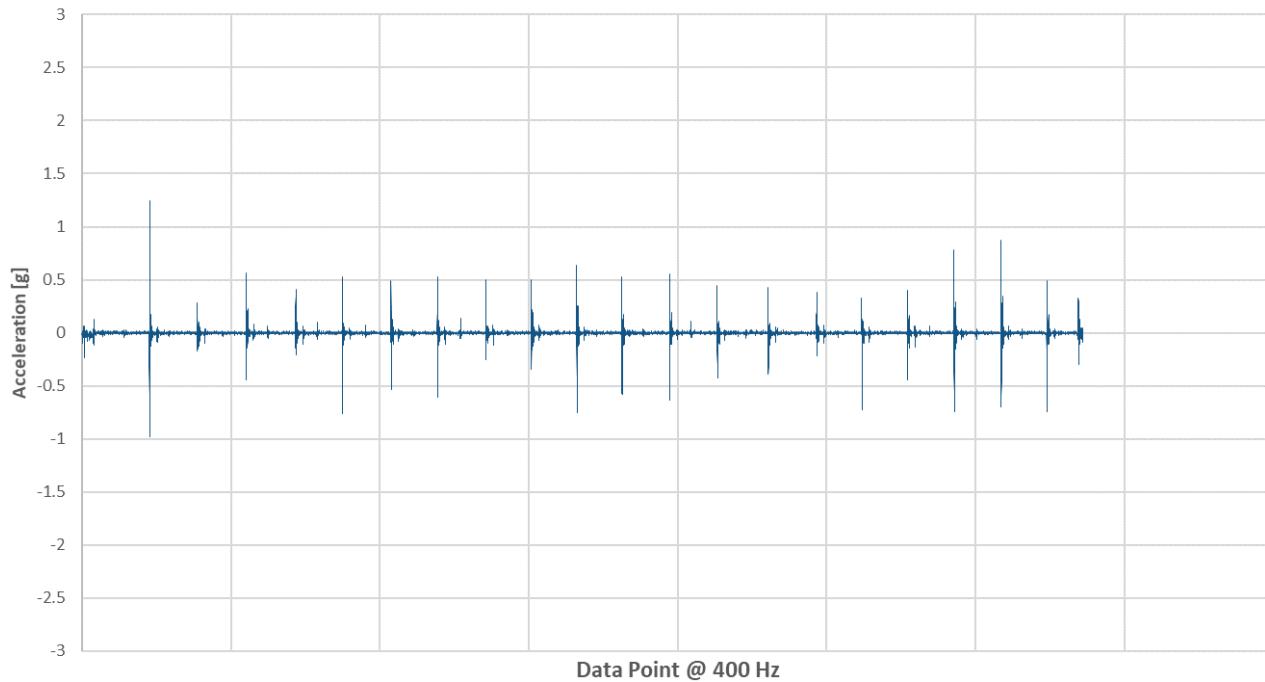




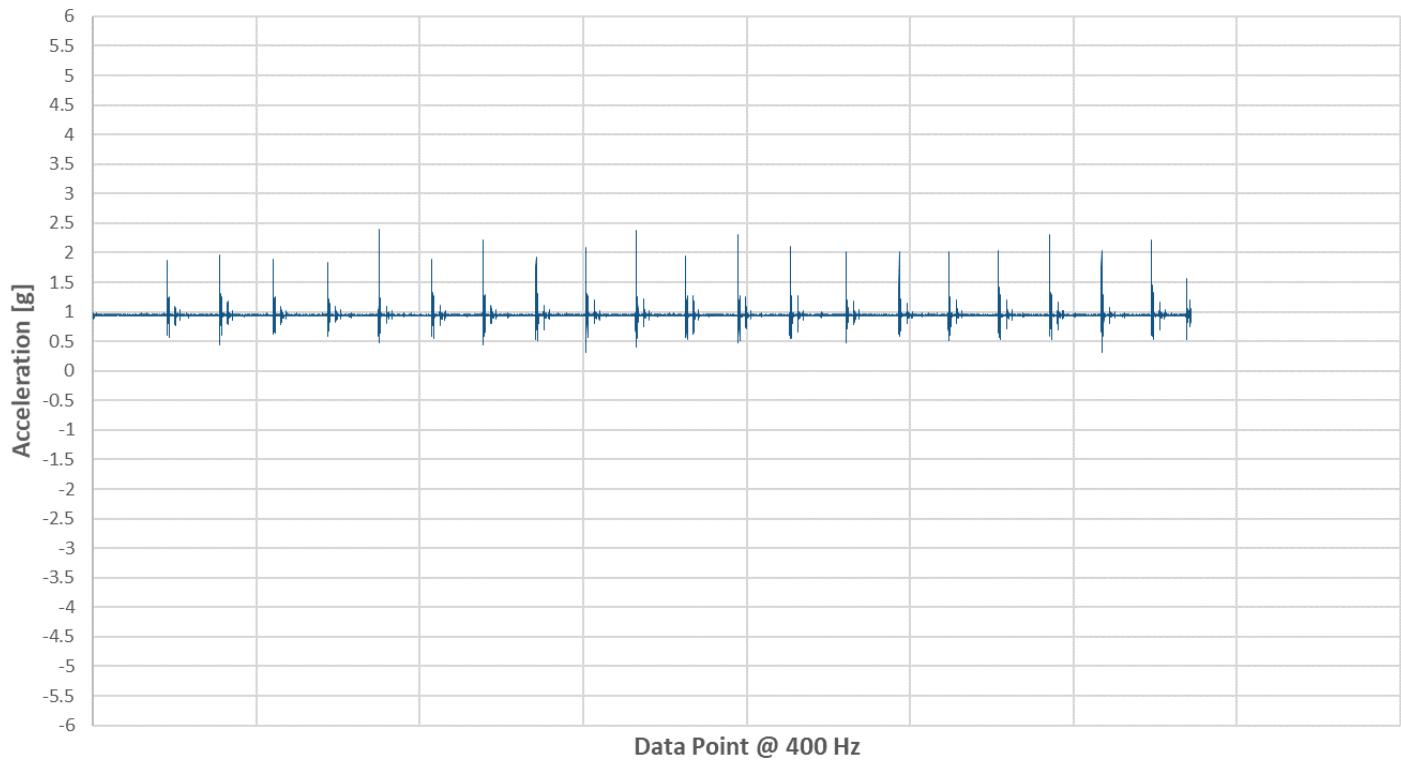
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Y Acceleration (Head to Toe) - Casper Element



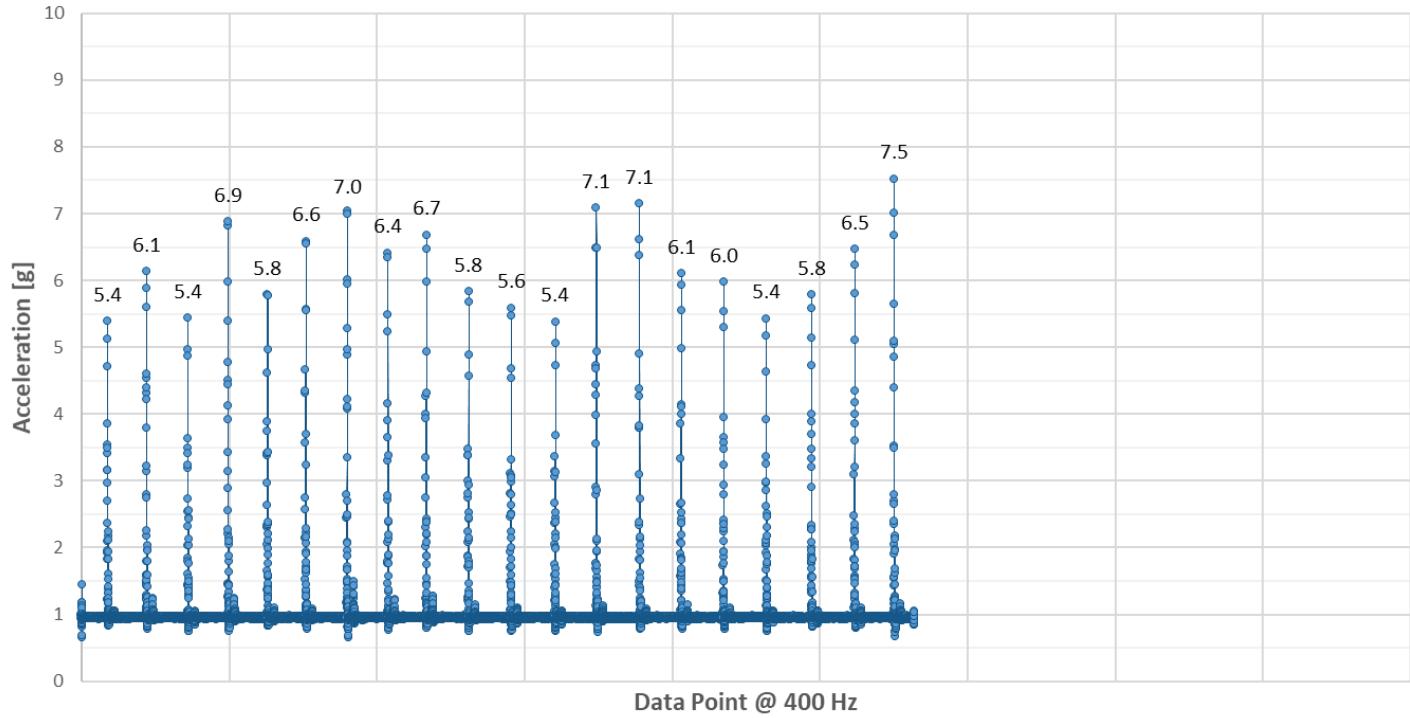
Z Acceleration (Up and Down) - Casper Element



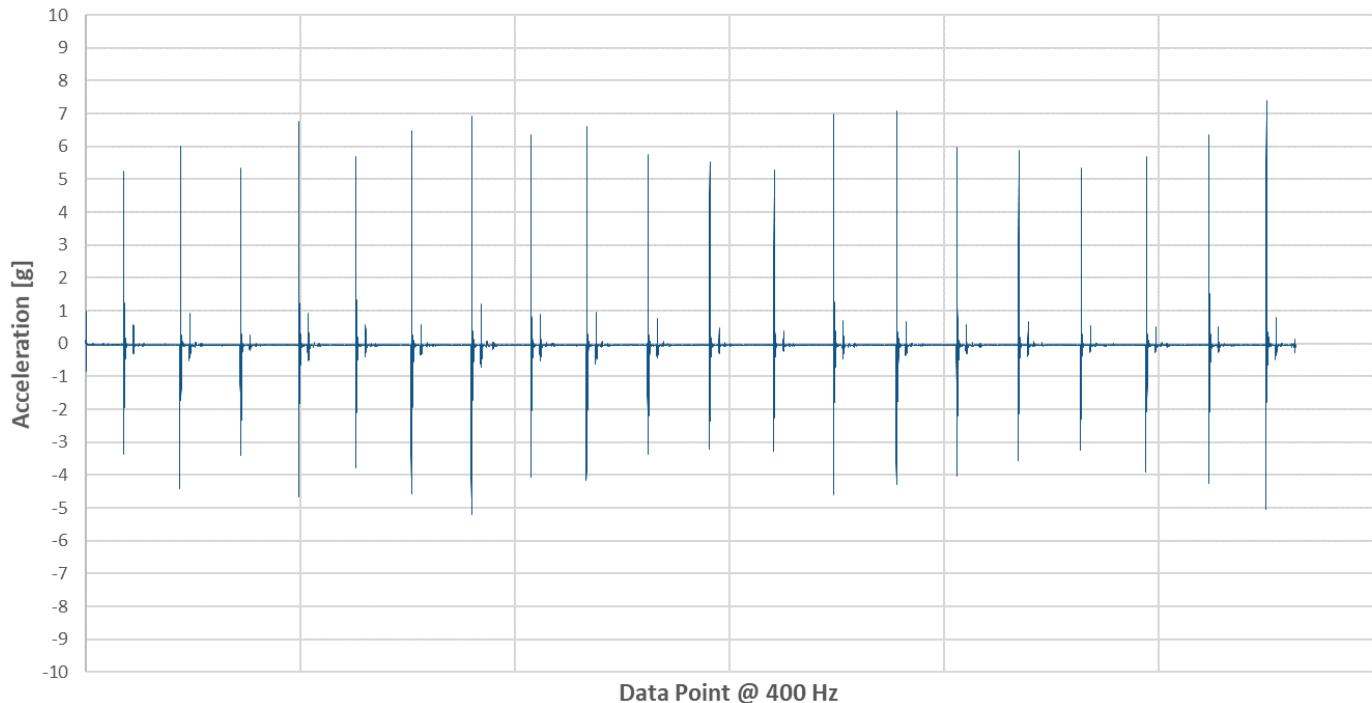


TEST 3 – HAVEN

Vector Magnitude Acceleration - Haven



X Acceleration (Side to Side) - Haven

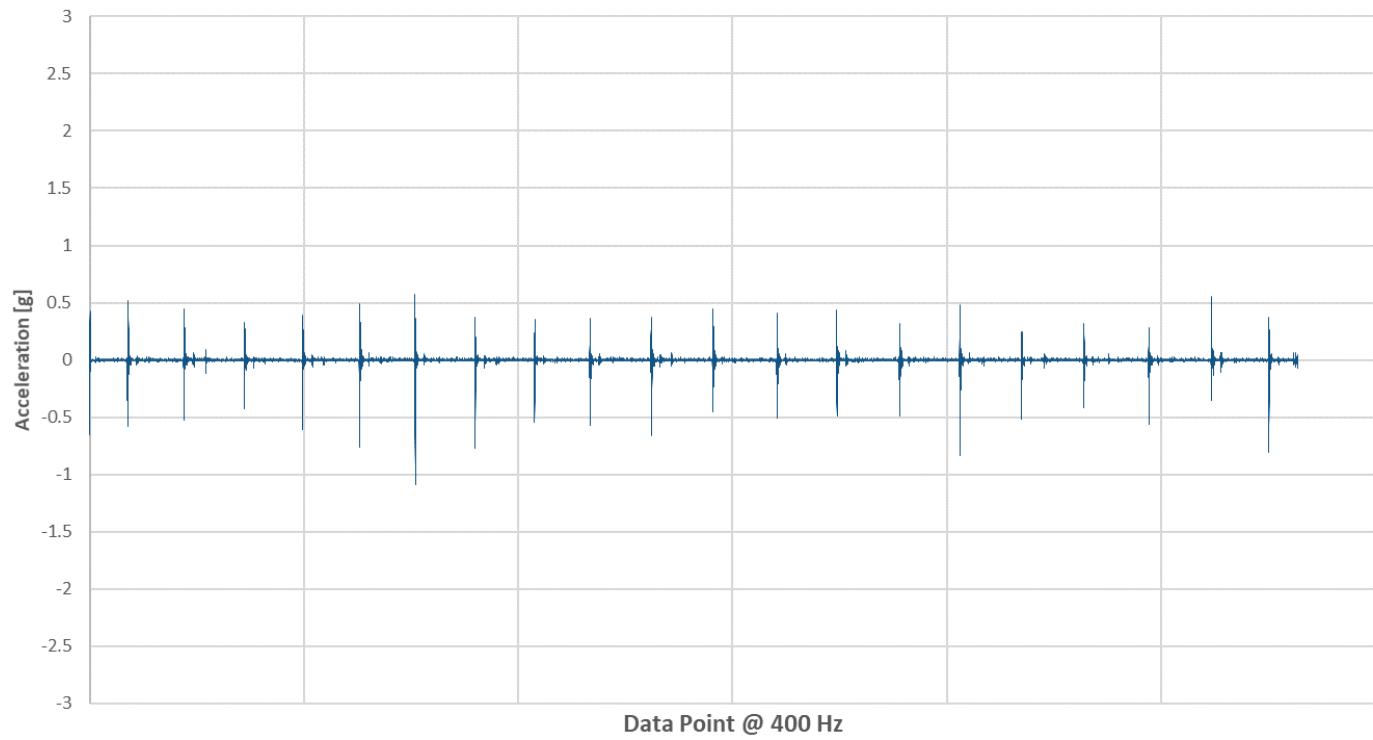




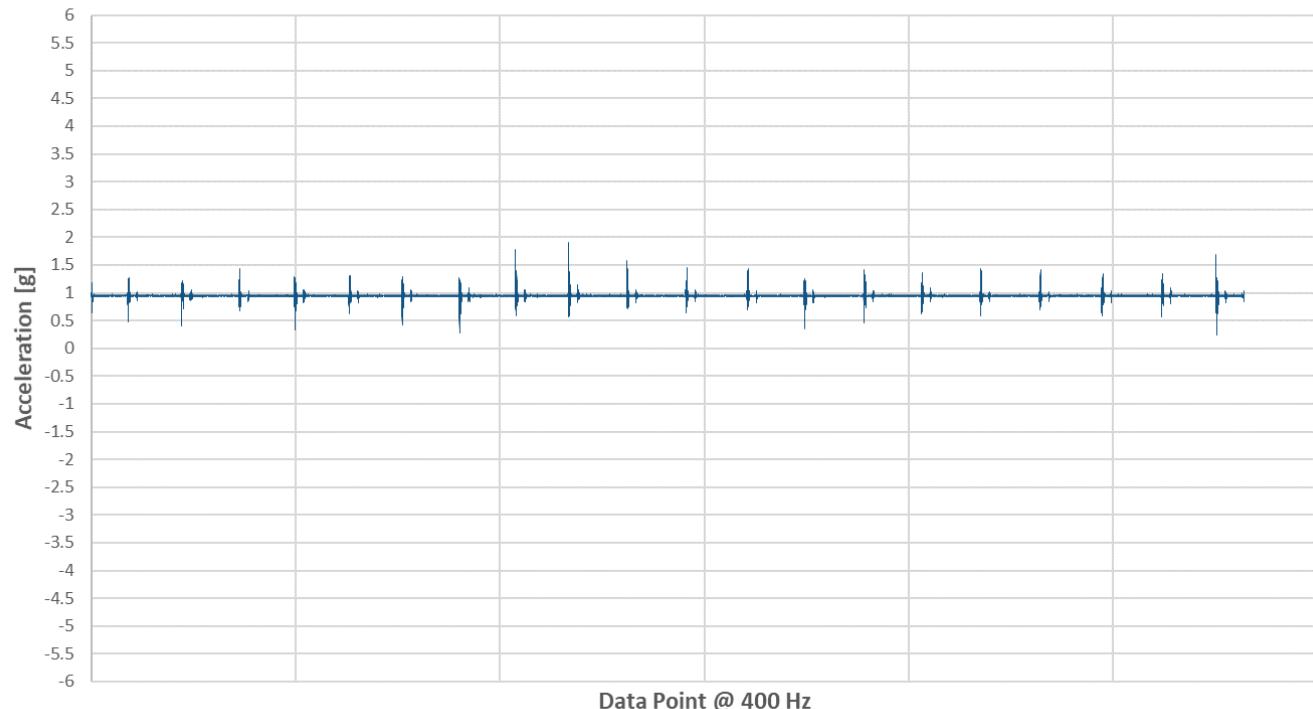
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Y Acceleration (Head to Toe) - Haven



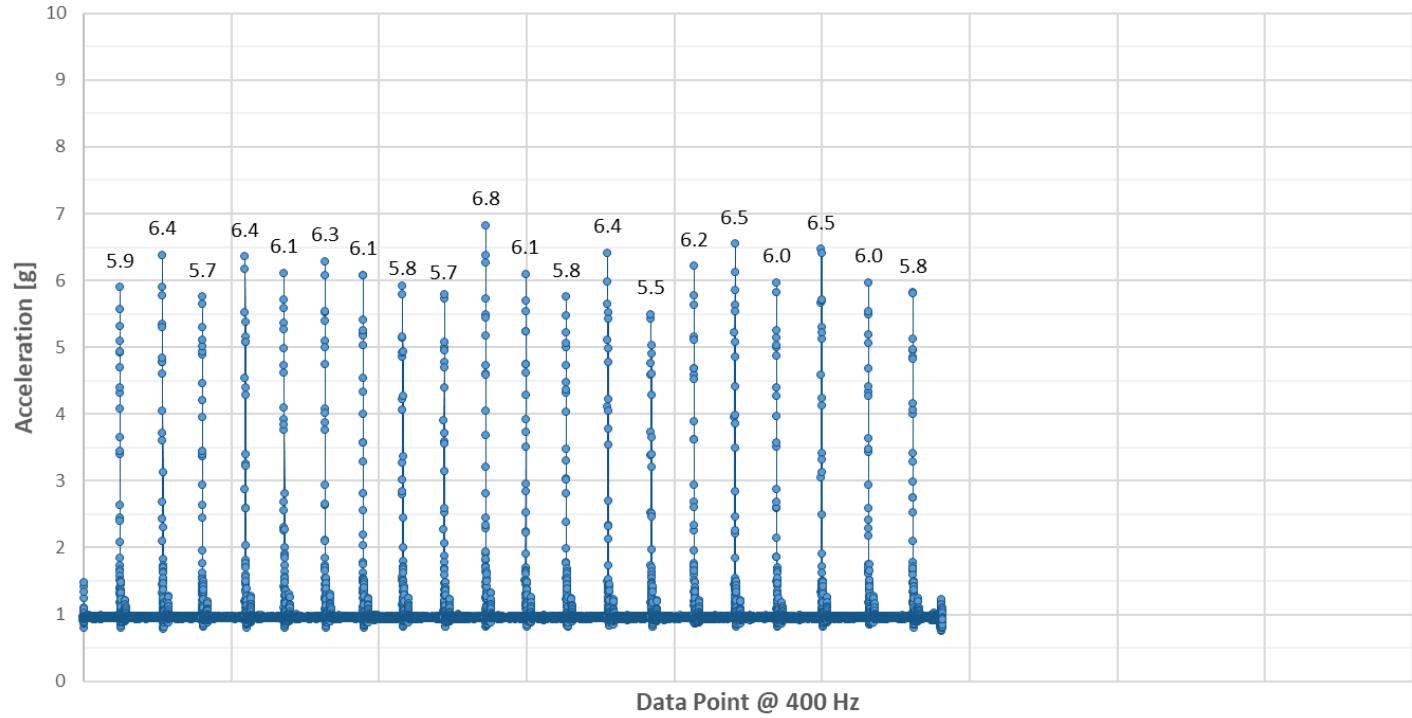
Z Acceleration (Up and Down) - Haven



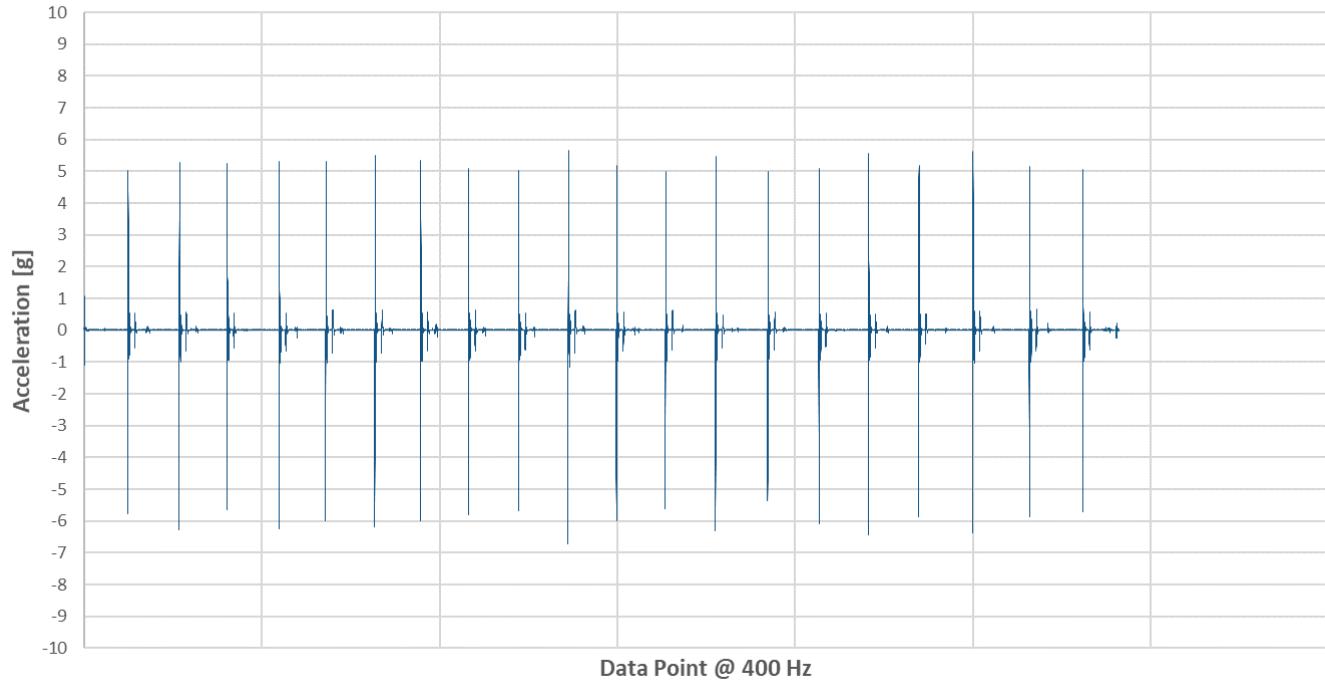


TEST 3 – PUFFY (V2)

Vector Magnitude Acceleration - Puffy (V2)



X Acceleration (Side to Side) - Puffy (V2)

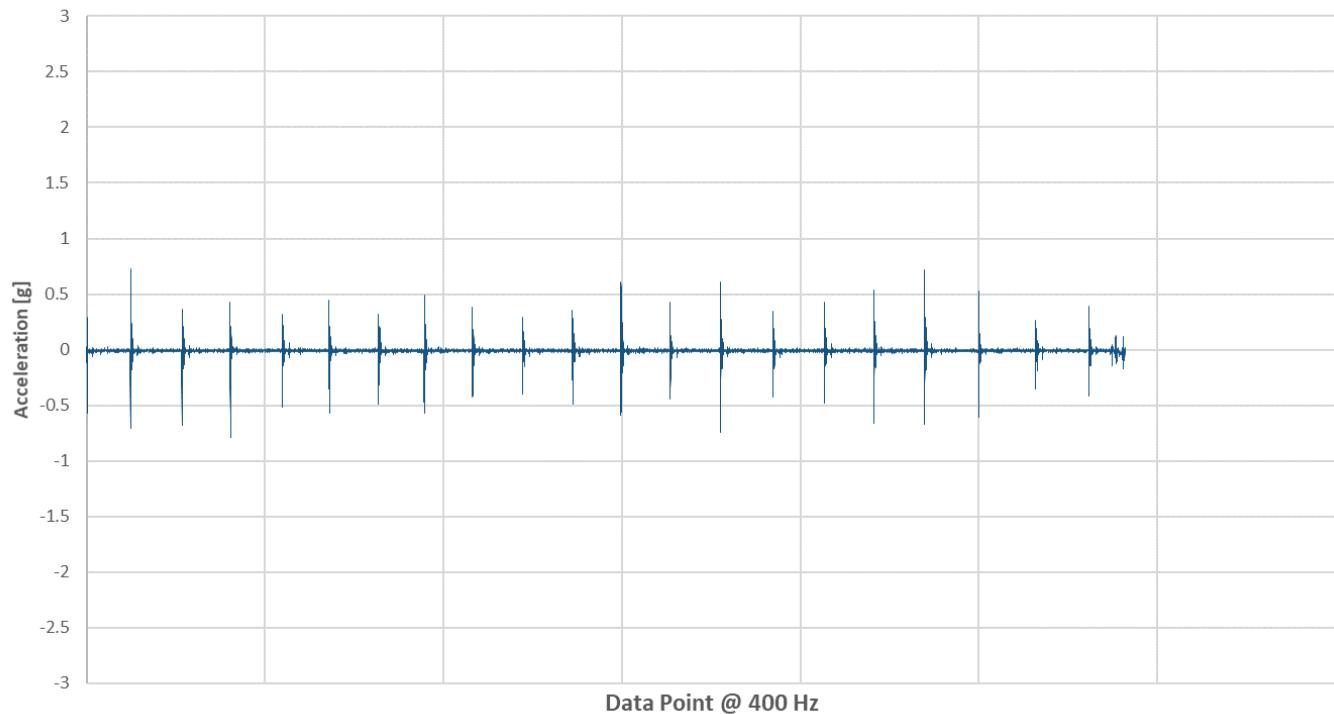




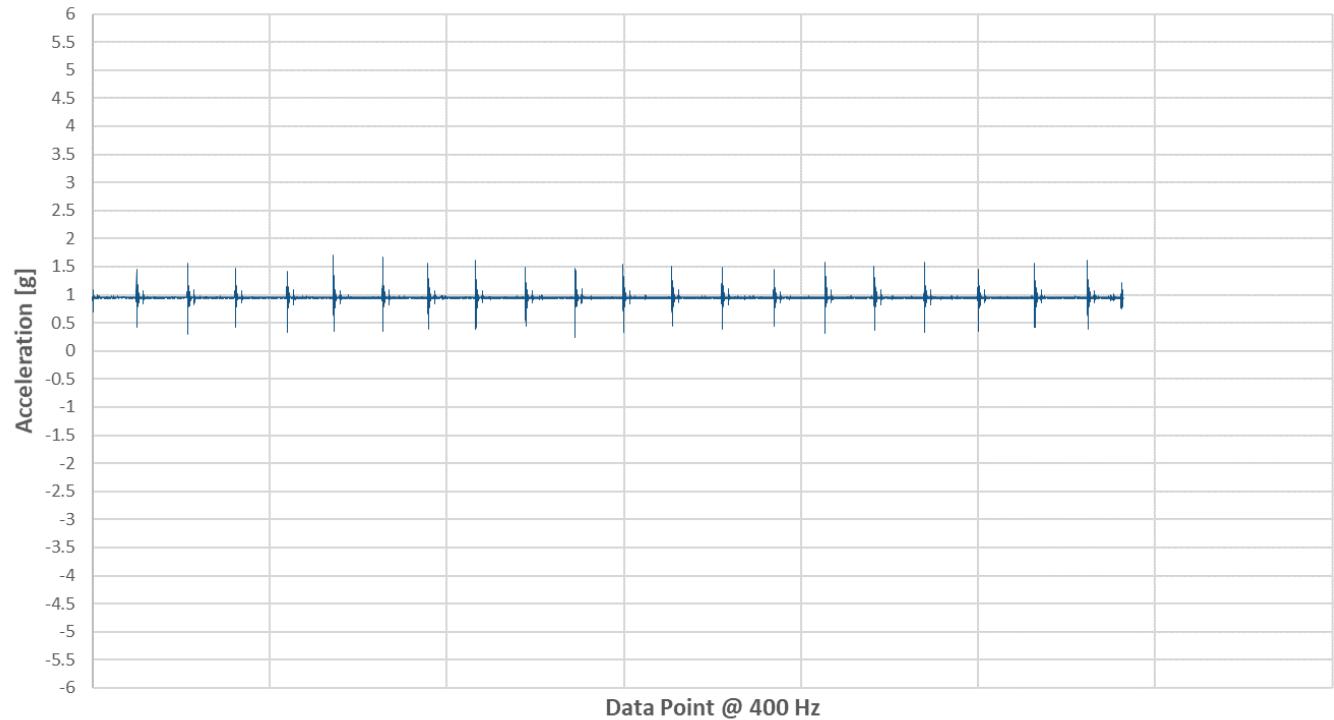
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Y Acceleration (Head to Toe) - Puffy (V2)



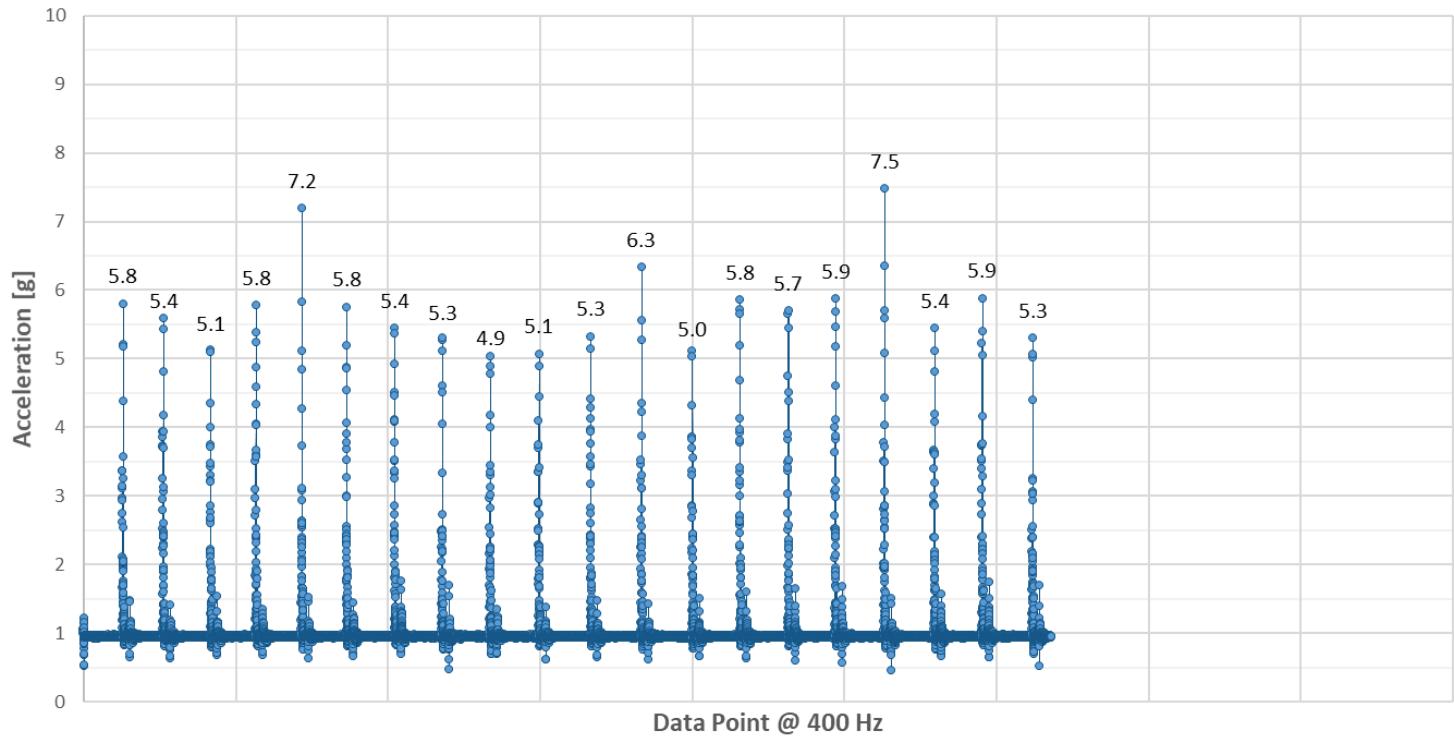
Z Acceleration (Up and Down) - Puffy (V2)



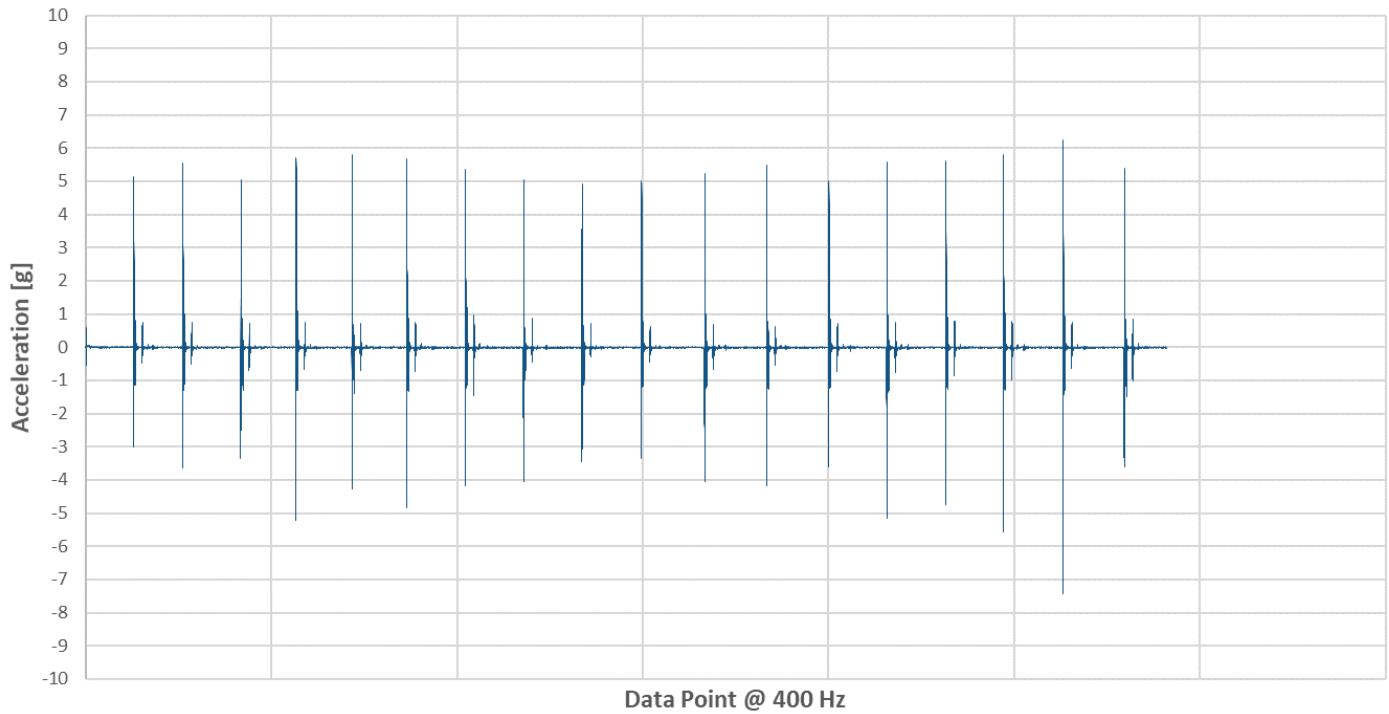


TEST 3 – SIMBA (V2)

Vector Magnitude Acceleration - Simba (V2)



X Acceleration (Side to Side) - Simba (V2)

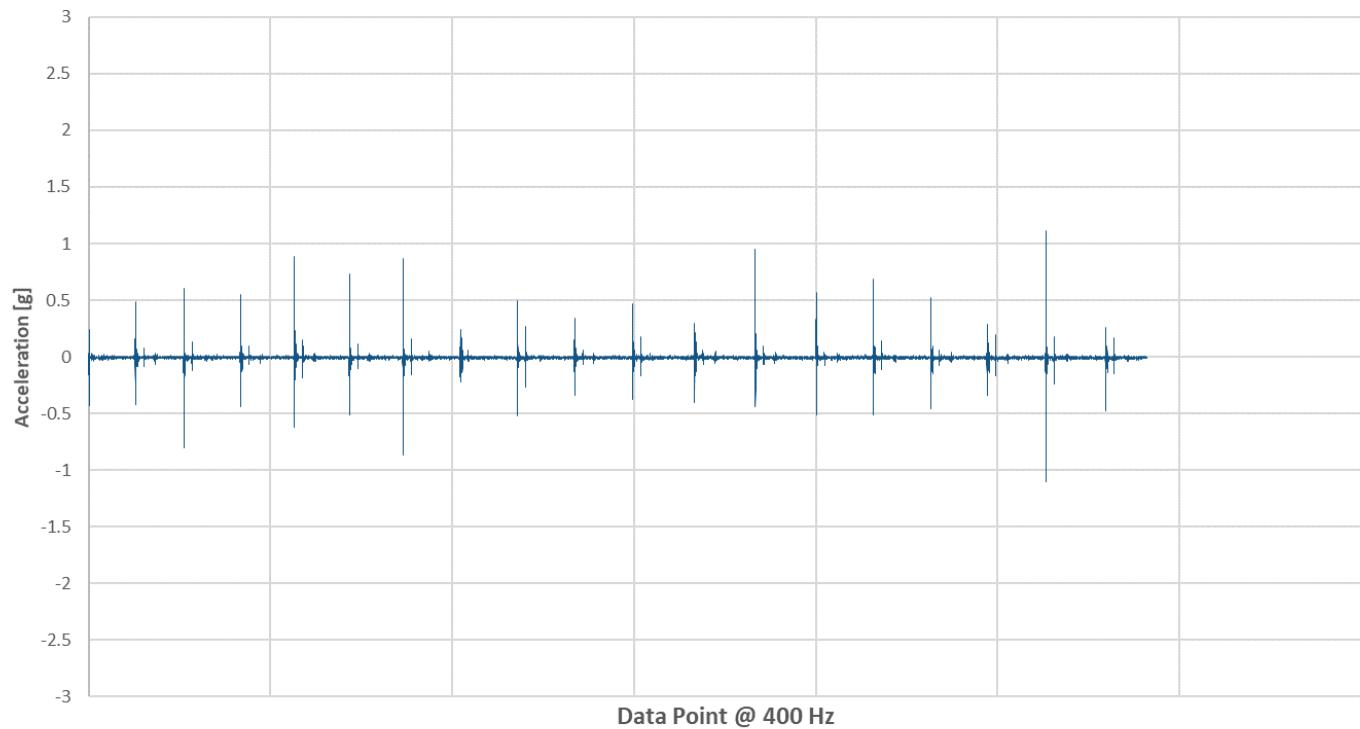




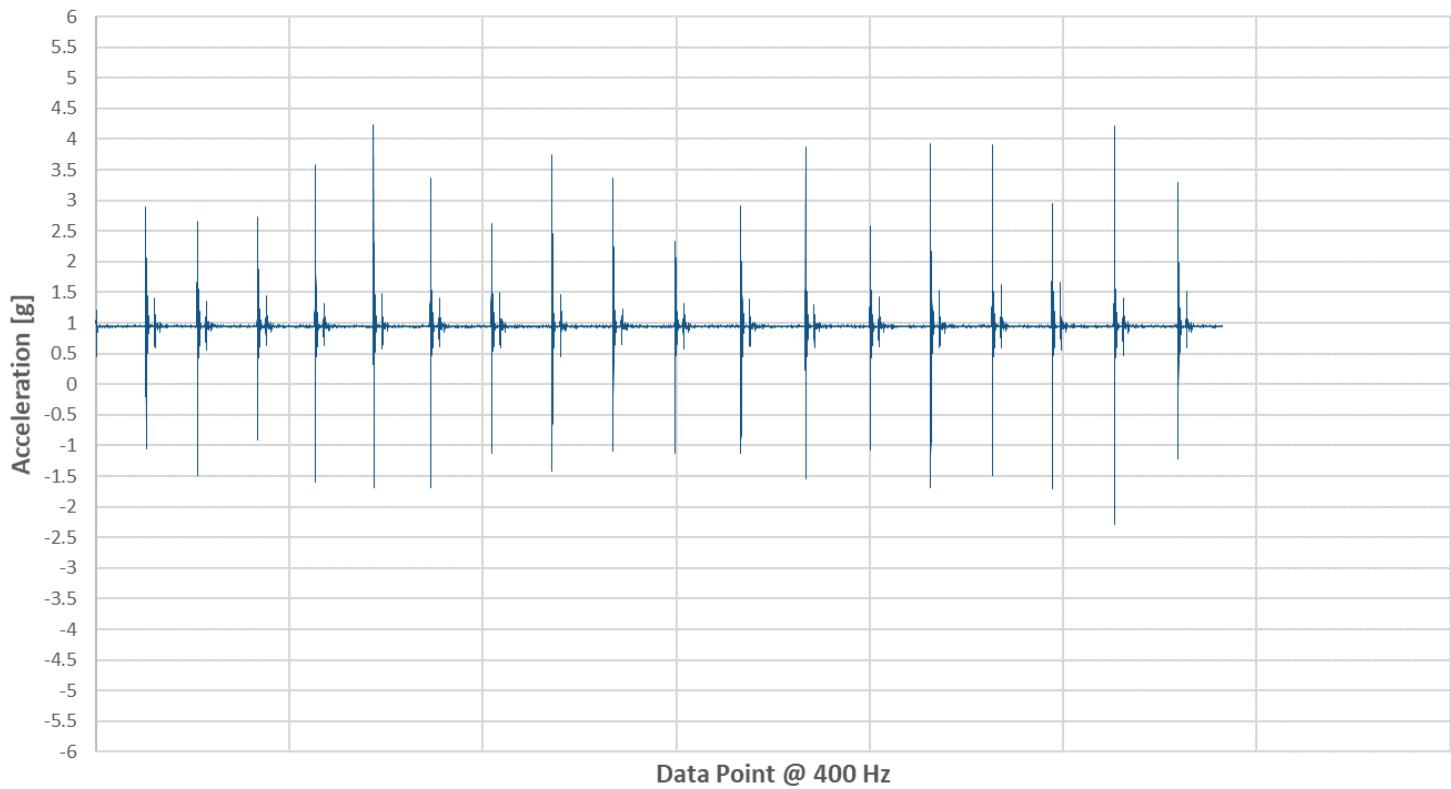
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Y Acceleration (Head to Toe) - Simba (V2)



Z Acceleration (Up and Down) - Simba (V2)





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Engineering Report

Appendix B

**Mattress-Reviews.com Testing Methodology****Goal:**

To gather relative performance data from two or more different queen-sized mattresses to provide basis for comparison, grading, and discussion.

Equipment:

- Reference Load 1: plastic 5 gallon water cooler bottle – size: ~ 10.75" diameter X ~ 19.5" height; weight 42.3 lbs.
- Reference Load 2: spherical medicine ball - size: ~ 9" diameter; weight 10 lbs.
- Tape measure.
- Masking tape.
- Metal ruler.
- 4-foot piece of aluminium, $\frac{1}{4}$ inch thick.
- Calibrated accelerometer.
- A DSLR video camera.

General Test Conditions:

- Measure temperature and humidity in a room and verify it falls within the range of a normal house (18°C - 24°C / 25% - 50%). Measure and record temperature and humidity before each test.
- Lay the test mattress on a flat concrete floor such that the top and sides are unobstructed.

Test #1: Mattress Firmness (or “sinkage”):

Overview and Objective: Apply Reference Load 1 to the center of each subject mattress and measure the vertical displacement of each to establish their respective positions on a firmness (or “sinkage”) scale. A low relative vertical displacement shall indicate a firmer mattress, while a high relative vertical displacement shall indicate a softer mattress.

Procedure:

1. Find the “approximate centre” of a given mattress sample:
 - a. Place 2 straight lines (tensioned string-lines or straight measuring tape), each from one corner of the mattress to the diametrically opposite corner (e.g. top right to bottom left and top left to bottom right).
 - b. Mark the intersection point of each straight line reference with masking tape - this is the “approximate center” of the mattress.
2. Place Reference Load 1 on the mattress, such that a point halfway between the top and bottom extremes of the water bottle lies on the marked approximate center of the mattress; and that the spout of the water bottom faces the foot of the bed, such that the sides of the water bottle are parallel to the sides of the mattress.
3. Wait 30 seconds for the water cooler bottle to entirely stop moving to allow the system to settle to a static state.
4. Place a 4-foot piece of $\frac{1}{4}$ inch thick aluminium across the surface of the mattress. The long side of the aluminium piece shall run parallel to the foot of the mattress. The metal shall rest beneath the spout of the bottle without touching the bottle.
5. Using a tape measure or metal ruler, measure and record the distance between the bottom of the spout and the metal level immediately below it, without noticeably distorting the shape of the mattress at the measurement point.

Test #2 Edge Supportiveness:

Overview and Objective: Apply Reference Load 1 to the edge each subject mattress and to measure the resultant vertical displacement of each to establish their respective positions on an “edge supportiveness” scale. A low relative vertical displacement shall indicate a mattress with more edge support, while a high relative vertical displacement shall indicate a mattress with less edge support.

Procedure:

1. Find the “approximate middle” of the foot of a given mattress sample:
 - a. Measure the length of the top-facing edge of the foot of the subject mattress.
 - b. Divide the measurement by 2 and mark this point with masking tape - this is the “approximate middle” of the foot of the mattress.
 - c. Measure the height of the mattress at this point.
2. Place Reference Load 1 on the mattress such that a predetermined point of the water bottle lies on the marked “approximate middle” of the mattress edge, and that the sides of the water bottle are parallel to the sides of the mattress. The long edge of the water bottle shall be parallel to the long side of the mattress.
 - a. This predetermined point of the water bottle is where the spout of the water bottle begins. That is, there shall be 16 inches of the 19-inch water bottle lying ‘behind’ the edge of the mattress (i.e. on the mattress). The 3-inch spout shall extend off the edge of the mattress.
3. Wait 30 seconds for the water cooler bottle to entirely stop moving to allow the system to settle to a static state.
4. Measure the distance between the bottom of the spout and the floor (**variable X**).
5. Add the height of the mattress (see step 1c) to 4.25 inches (**variable Y**).
6. **Y minus X = vertical displacement.**

Test #3 Motion Isolation:

Overview and Objective: Apply a reference impulse to the top side of each subject mattress, representative of human movement on the mattress, and measure the resultant peak acceleration of a calibrated accelerometer placed on the mattress a fixed distance away from the epicenter of the impulse to establish their respective positions on a “motion isolation” scale. A high resultant peak acceleration shall indicate less motion isolation, while a low resultant peak acceleration shall indicate more motion isolation.

Procedure:

1. Find two “Sleep Points” on a given mattress sample:
 - a. Measure the width of the mattress and divide by 3 (the “Edge Distance”).
 - b. Measure the length of the mattress and divide by 2 (the “Center Distance”).
 - c. Find the first point lying Center Distance from the foot of the bed and Edge Distance from one the side of the bed and mark this point with masking tape - this is the first Sleep Point.
 - d. Repeat the above step for the other side of the bed - this is the second Sleep Point.
2. Center a calibrated accelerometer on the mattress.
3. Drop a 10 lbs sphere (9” diameter) on the second Sleep Point on the mattress from a height of 39” above the mattress surface.
4. Wait 5 seconds and record the peak acceleration experienced by the accelerometer.
5. Repeat 20 times and take an average.

Test #4 Bounciness:

Overview and Objective: Drop a 10lb sphere (9" diameter) from a fixed distance on to the top side of each subject mattress and measure the resultant peak rebound height on its first bounce. A high resultant peak rebound height shall indicate more bounciness, while a low resultant peak height shall indicate less bounciness.

Procedure:

1. Find the "Approximate Centre" of a given mattress sample:
 - a. Place 2 straight lines (tensioned string-lines or straight measuring tape), each from one corner of the mattress to the diametrically opposite corner (e.g. top right to bottom left and top left to bottom right).
 - b. Mark the intersection point of each straight line reference with masking tape - this is the "approximate center" of the mattress.
2. Suspend a 10lb sphere (9" diameter) such that it is centered 39" directly above the Approximate Center.
3. Suspend a measurement scale, such as a measuring tape, vertically above the mattress such that it touches the mattress at a point 9" away from the Approximate Center towards the foot of the bed.
4. Wait 1 minute for the system to reach relative static equilibrium.
5. Release the sphere such that it lands on the Approximate center of the mattress.
6. Place the DSLR video camera, mounted on a static tripod located 6" from the mid-point of the foot of the bed such that its line of sight is parallel to the top surface of the mattress, and that it is focussed on the vertically suspended measurement scale.
7. Wait 1 minute for the system to reach static equilibrium.
8. Begin recording on the video camera.
9. Release the sphere and wait 5 seconds.
10. Review the video and determine the maximum rebound point - that is, the point on the scale reached by the bottom of the weight on its first rebound (if it rebounds).
11. Repeat 3 times and take an average.