PURE MOSAIC

PURE MOSAIC TECHNICAL MEMO

TO:	**JACK WOOLLINGS**	DATE:	18/05/2018
	Novosbed	PROJECT #:	18-4320
FROM:	**WES SCHROEDER, P.ENG** wschroeder@oceng.ca	DOC #:	PMTM-4320-01
RE:	**NOVOSBED MATTRESS TESTING**		

INTRODUCTION

In May of 2017, Novosbed commissioned Pure Mosaic to provide independent 3rd party testing of multiple mattresses. Similar testing was done by Pure Mosaic in August 2017 (PMTM-4211-01). Data from both test runs are represented in this document. Pure Mosaic followed testing procedures as directed by Novosbed and attached in Appendix B. Below follows an overview of the testing procedures used as well as the results that they produced.

REFERENCE LOADS & TEST CONDITIONS

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.*

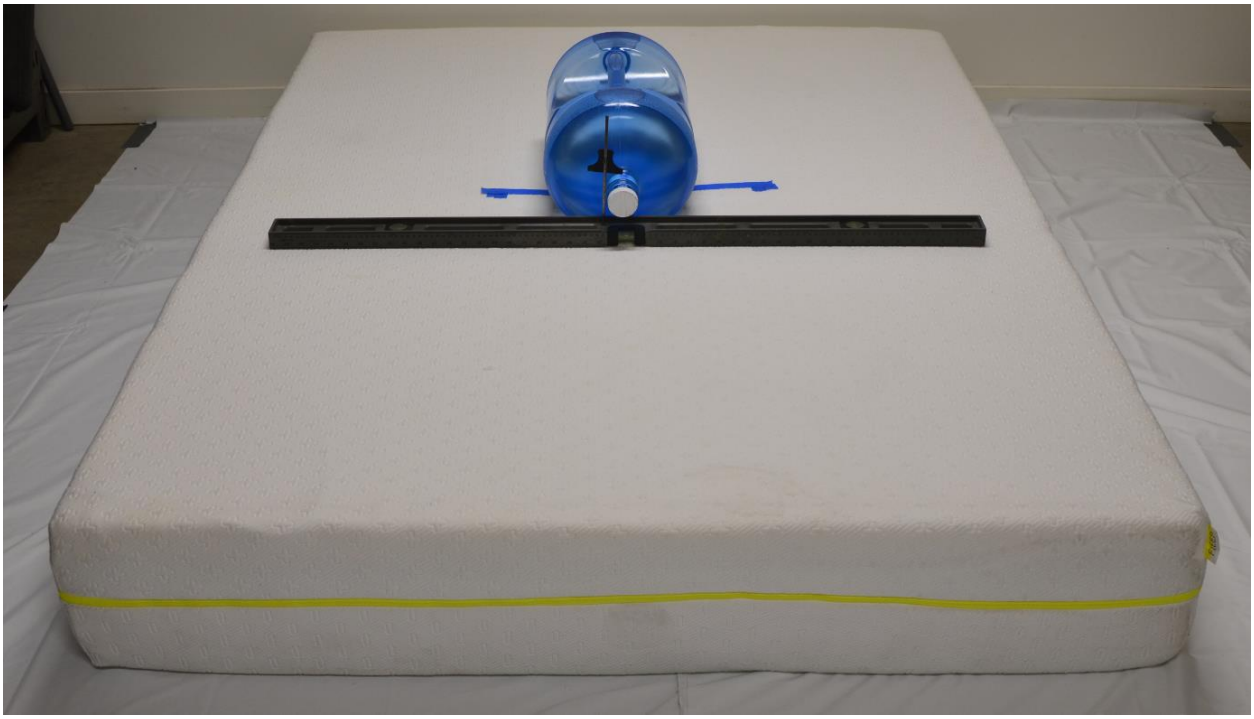


Figure 3: Typical setup for Test 1

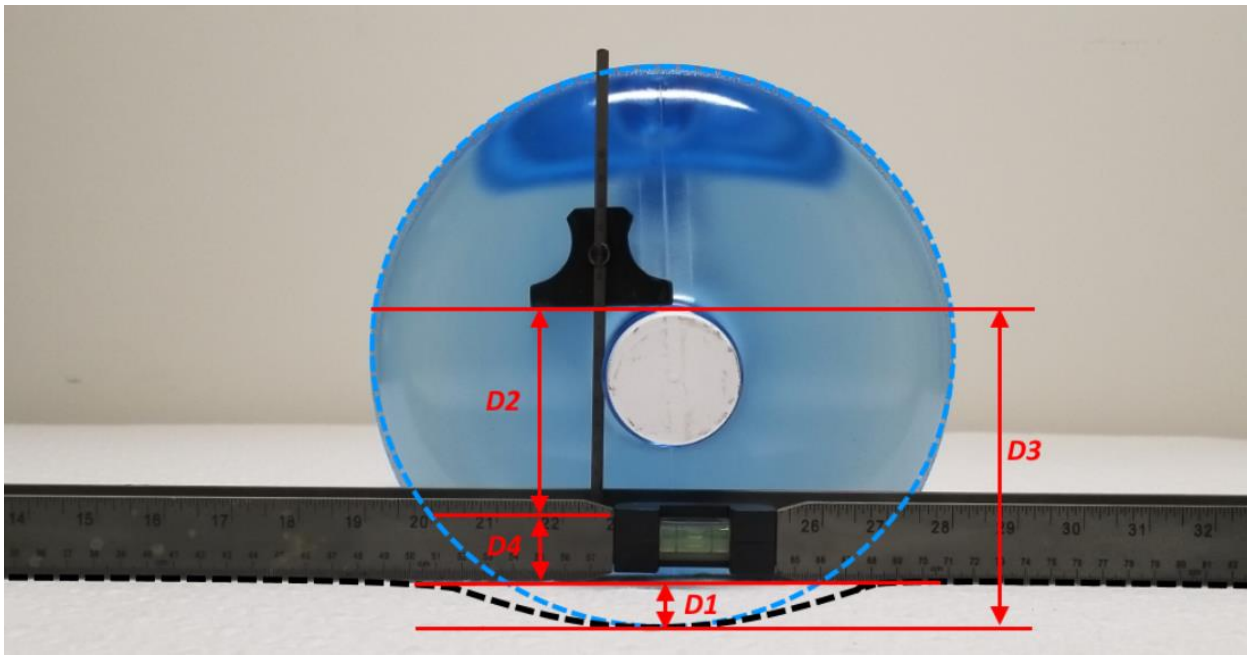


Figure 4: Deflection measurements for Test 1

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:

$$D_1 = D_3 - D_2 - D_4$$

$$D_2 = Measured \text{ (Deflection)}$$

$$D_3 = 160\ mm \text{ (Constant)}$$

$$D_4 = 21.2\ mm \text{ (Constant)}$$

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.*

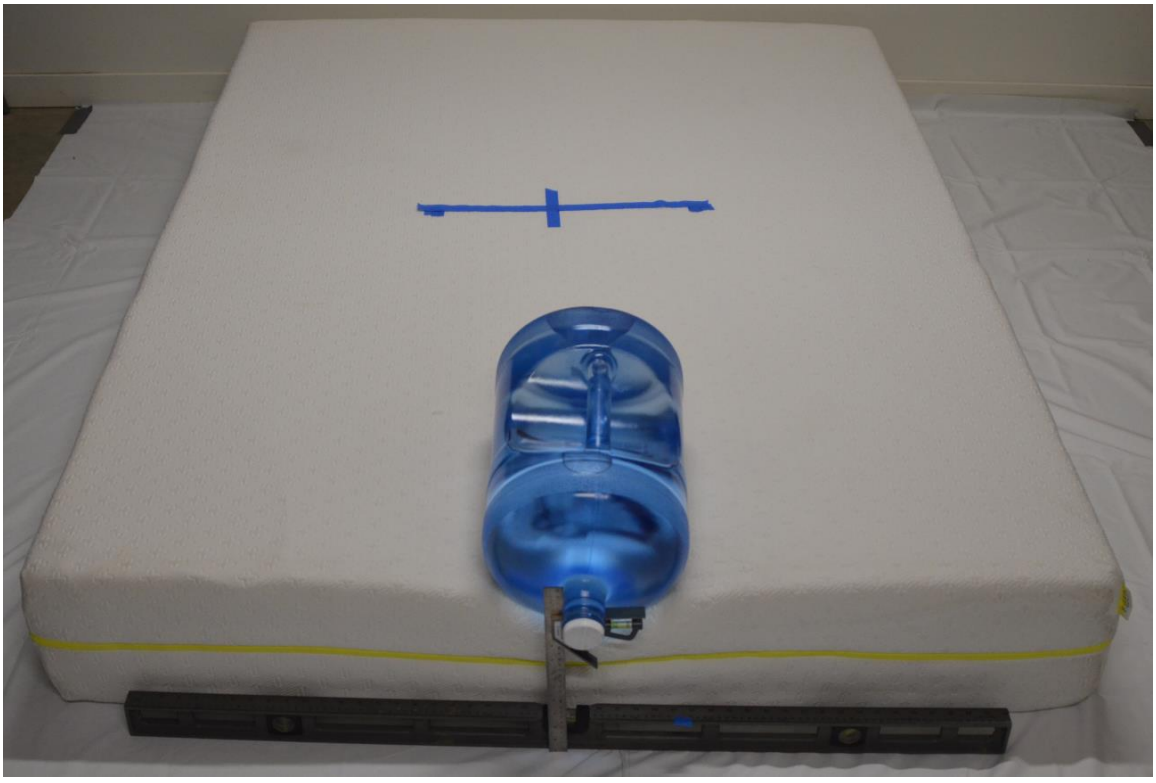


Figure 5: Typical setup for Test 2

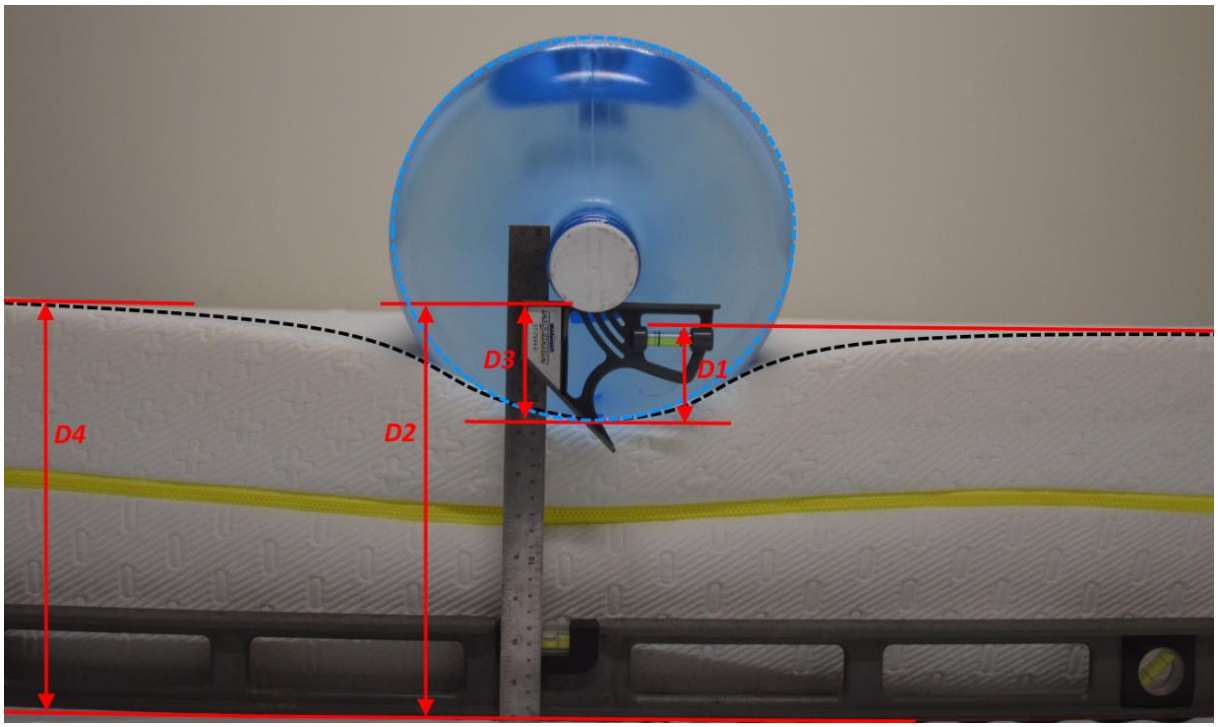


Figure 6: Deflection measurements for Test 2

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.*

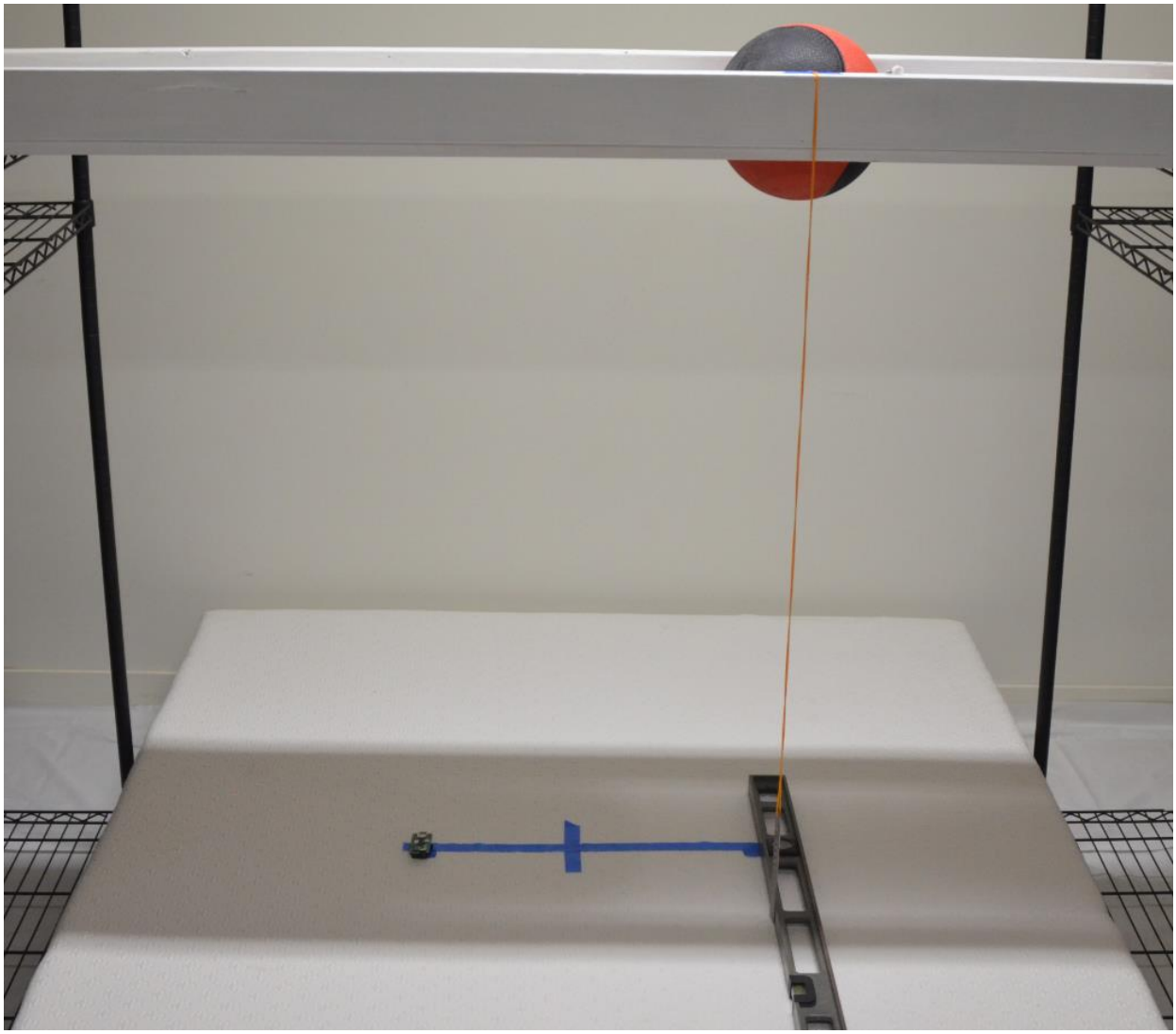


Figure 7: Typical setup for Test 3

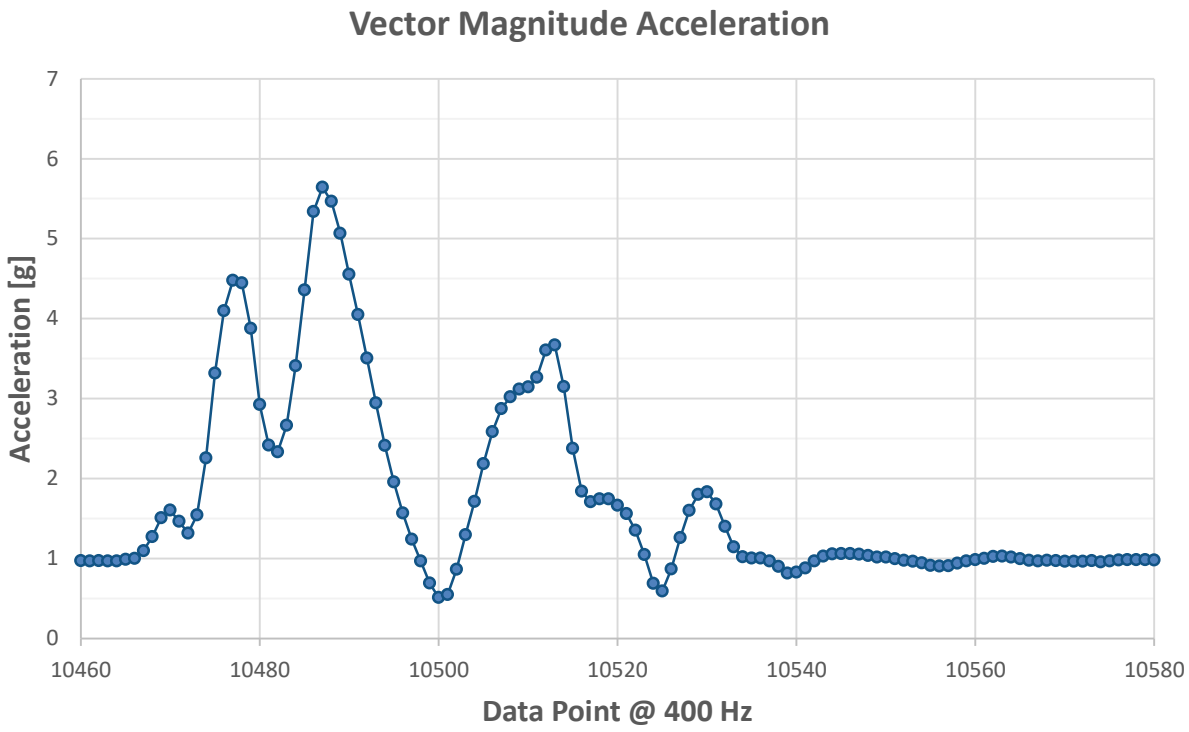


Figure 8: Example Vector Magnitude Acceleration of one ball drop

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.*

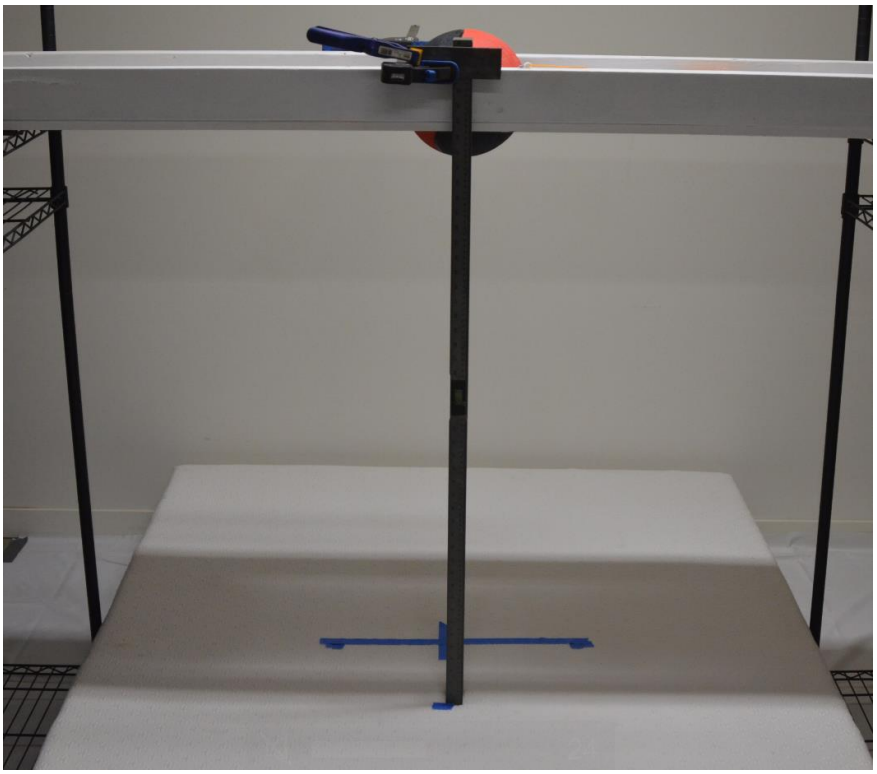


Figure 9: Typical setup for Test 4

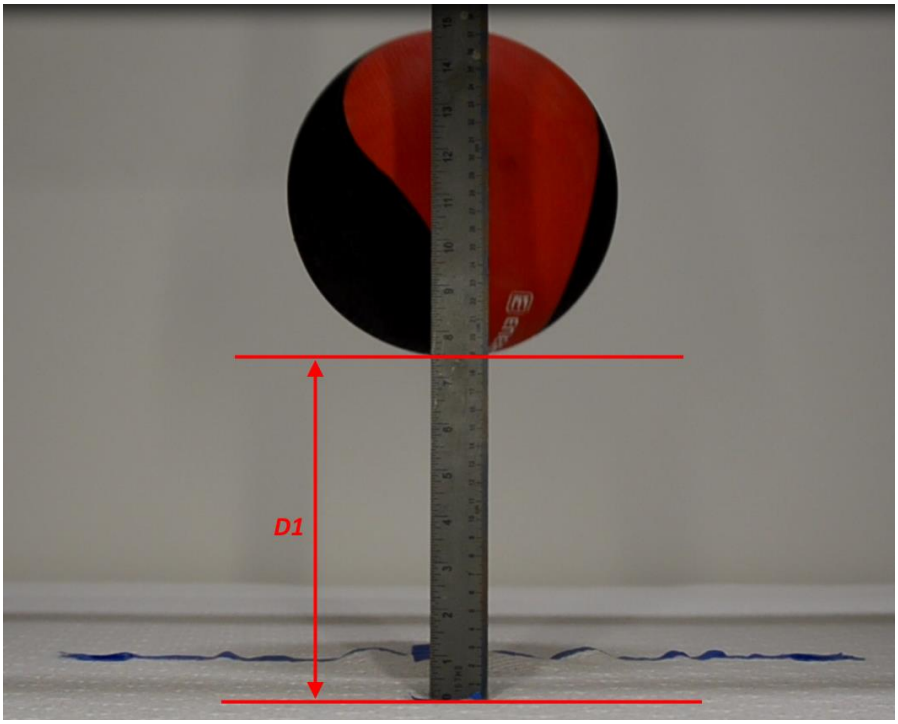


Figure 10: Rebound Measurement for Test 4

TEST 1 RESULTS

Table 1: Test 1 – Mattress Firmness

	Mattress	Deflection [mm]	Deflection [in]	Measured [mm]	Measured Out of 10
1	Fleep (+ Firm)	50.3	1.98	88.5	7.6
	Fleep (- Soft)	69.3	2.73	69.5	5.2
2	Leesa	76.3	3.00	62.5	4.3
3	Luna	66.8	2.63	72.0	5.5
4	Tuft & Needle	66.8	2.63	72.0	5.5
5	Douglas (V1)	68.3	2.69	70.5	5.3
6	Douglas (V2)	57.8	2.28	81.0	6.6
7	Endy	76.3	3.00	62.5	4.3
8	Casper	71.8	2.83	67.0	4.8
9	Bloom	64.3	2.53	74.5	5.8
10	Classic Brands (Thin)	46.8	1.84	92.0	8.1
11	Classic Brands (Thick)	56.8	2.24	82.0	6.8
12	Saatva	80.8	3.18	58.0	3.7
13	Purple	66.8	2.63	72.0	5.5
14	Lucid	53.8	2.12	85.0	7.2
15	Novosbed Firm	59.3	2.33	79.5	6.5
16	Novosbed Medium	68.3	2.69	70.5	5.3
17	Novosbed Soft	79.3	3.12	59.5	3.9
18	Hamuq	63.8	2.51	75.0	5.9
19	Logan & Cove	62.8	2.47	76.0	6.0
20	Nora	58.8	2.31	80.0	6.5
21	PolySleep	65.8	2.59	73.0	5.6
22	iComfort	65.8	2.59	73.0	5.6
23	Tempur-Pedic	68.8	2.71	70.0	5.2

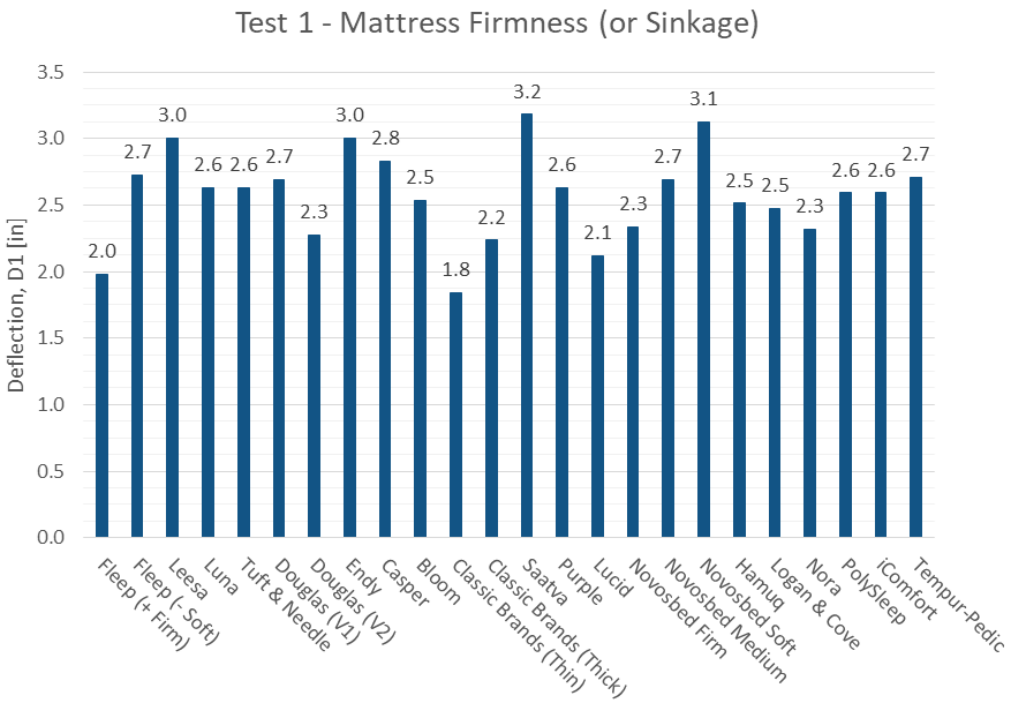


Figure 11: Test 1 – Mattress Firmness measuring how far Reference Load 1 deflects in the center of the mattress. A higher number indicates larger deflection (or a softer mattress).

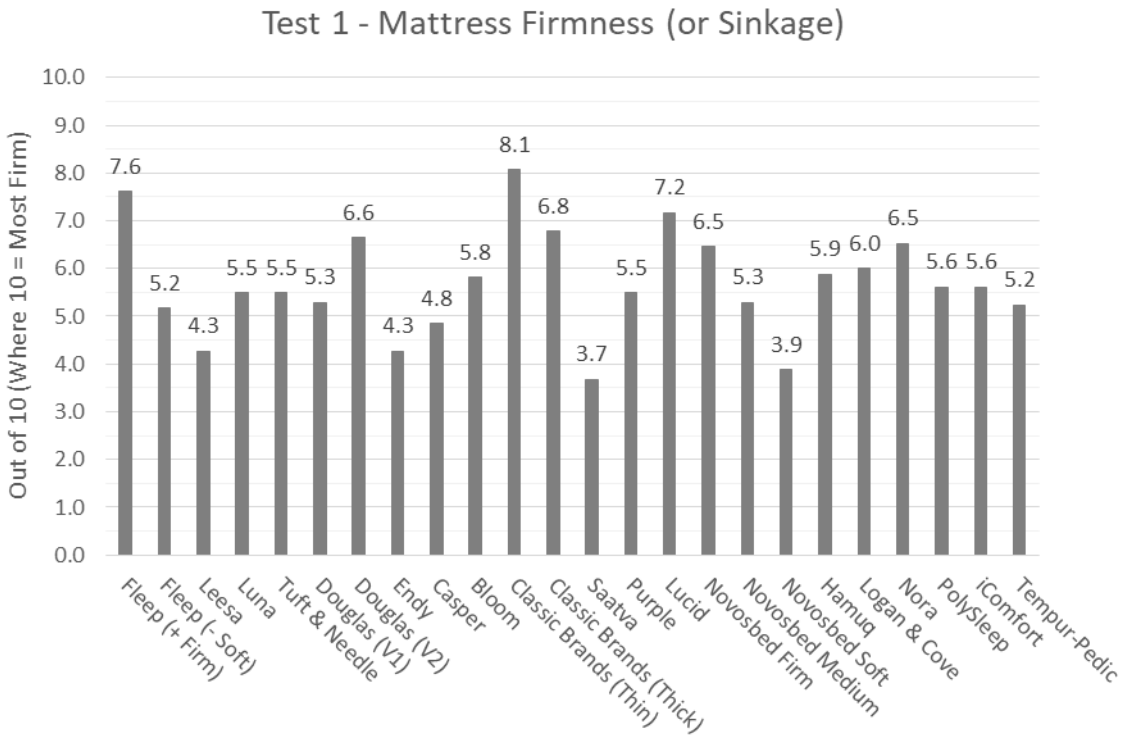


Figure 12: Test 1 – Mattress Firmness on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = most firm)

TEST 2 RESULTS

Table 2: Test 2 – Edge Supportiveness

	Mattress	Mattress Height, D4		Measured Depth, D2		Deflection, D1 [in]		Out of 10
		[mm]	[in]	[mm]	[in]	[mm]	[in]	
1	Fleep (+ Firm)	249	9.8	259	10.2	94.0	3.7	6.2
	Fleep (- Soft)	249	9.8	243	9.6	110.0	4.3	4.8
2	Leesa	250	9.8	273	10.7	81.0	3.2	7.3
3	Luna	256	10.1	275	10.8	85.0	3.3	7.0
4	Tuft & Needle	251	9.9	270	10.6	85.0	3.3	7.0
5	Douglas (V1)	258	10.2	276	10.9	86.0	3.4	6.9
6	Douglas (V2)	253	10.0	283	11.1	74.0	2.9	7.9
7	Endy	261	10.3	250	9.8	115.0	4.5	4.3
8	Casper	249	9.8	268	10.6	85.0	3.3	7.0
9	Bloom	281	11.1	301	11.9	84.0	3.3	7.1
10	Classic Brands (Thin)	154	6.1	194	7.6	64.0	2.5	8.8
11	Classic Brands (Thick)	204	8.0	239	9.4	69.0	2.7	8.4
12	Saatva	400	15.7	384	15.1	120.0	4.7	3.9
13	Purple	242	9.5	236	9.3	110.0	4.3	4.8
14	Lucid	254	10.0	292	11.5	66.0	2.6	8.7
15	Novosbed Firm	293	11.5	316	12.4	81.0	3.2	7.3
16	Novosbed Medium	307	12.1	311	12.2	100.0	3.9	5.6
17	Novosbed Soft	286	11.3	276	10.9	114.0	4.5	4.4
18	Hamuq	300	11.8	328	12.9	76.0	3.0	7.8
19	Logan & Cove	352	13.9	390	15.4	66.0	2.6	8.7
20	Nora	289	11.4	272	10.7	121.0	4.8	3.8
21	PolySleep	248	9.8	297	11.7	55.0	2.2	9.6
22	iComfort	302	11.9	324	12.8	82.0	3.2	7.2
23	Tempur-Pedic	286	11.3	246	9.7	144.0	5.7	1.7

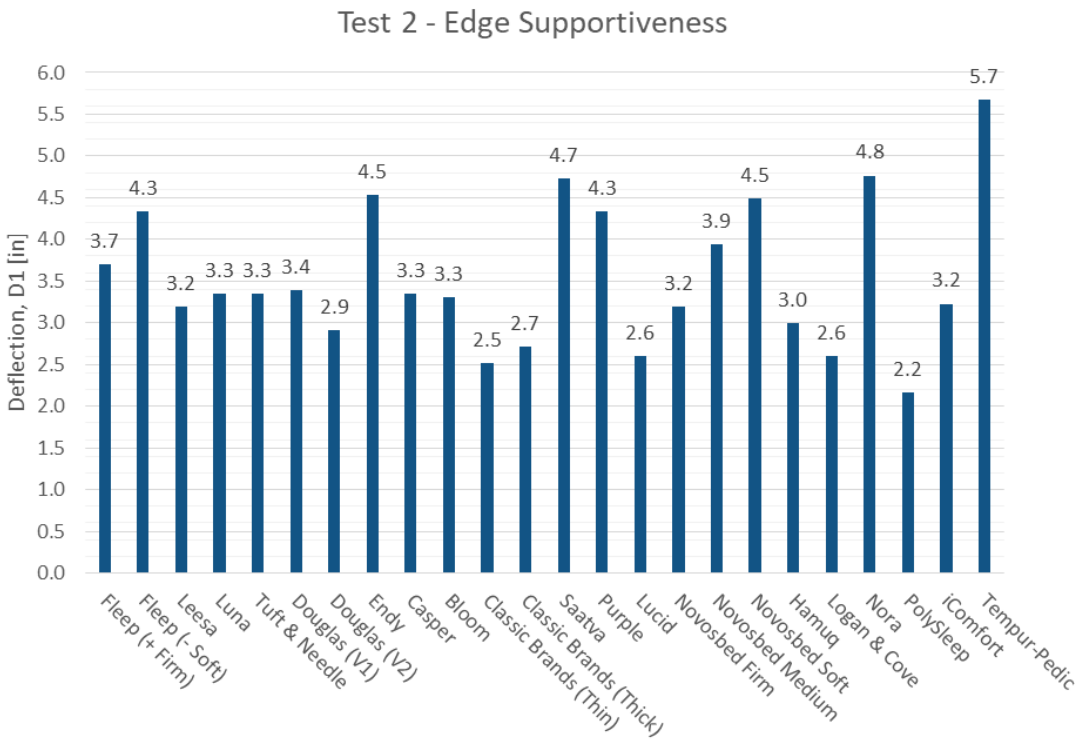


Figure 13: Test 2 – Mattress Firmness measuring how far Reference Load 1 deflects on the edge of the mattress. A higher number indicates larger deflection (or a softer mattress).

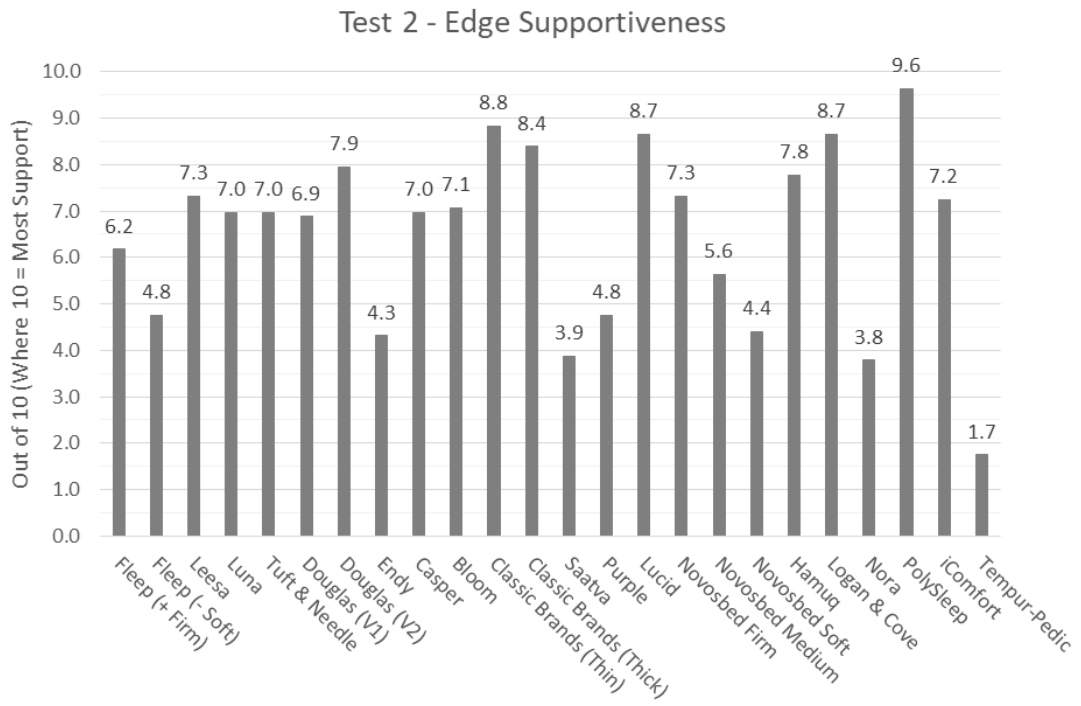


Figure 14: Test 2 – Mattress Edge Support on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = most support)

TEST 3 RESULTS

Table 3: Test 3 – Motion Isolation

	Mattress	Average Peak Acceleration [g]	Out of 10
1	Fleep (+ Firm)	5.2	6.9
	Fleep (- Soft)	5.2	6.9
2	Leesa	6.4	6.1
3	Luna	6.6	6.1
4	Tuft & Needle	4.7	7.2
5	Douglas (V1)	3.3	8.0
6	Douglas (V2)	2.8	8.3
7	Endy	5.1	6.9
8	Casper	8.7	4.8
9	Bloom	5.1	6.9
10	Classic Brands (Thin)	6.4	6.2
11	Classic Brands (Thick)	7.0	5.8
12	Saatva	5.2	6.9
13	Purple	9.9	4.0
14	Lucid	5.4	6.8
15	Novosbed Firm	5.4	6.8
16	Novosbed Medium	5.0	7.0
17	Novosbed Soft	6.7	6.0
18	Hamuq	6.0	6.4
19	Logan & Cove	5.2	6.9
20	Nora	3.1	8.1
21	PolySleep	3.3	8.0
22	iComfort	4.4	7.4
23	Tempur-Pedic	4.3	7.4

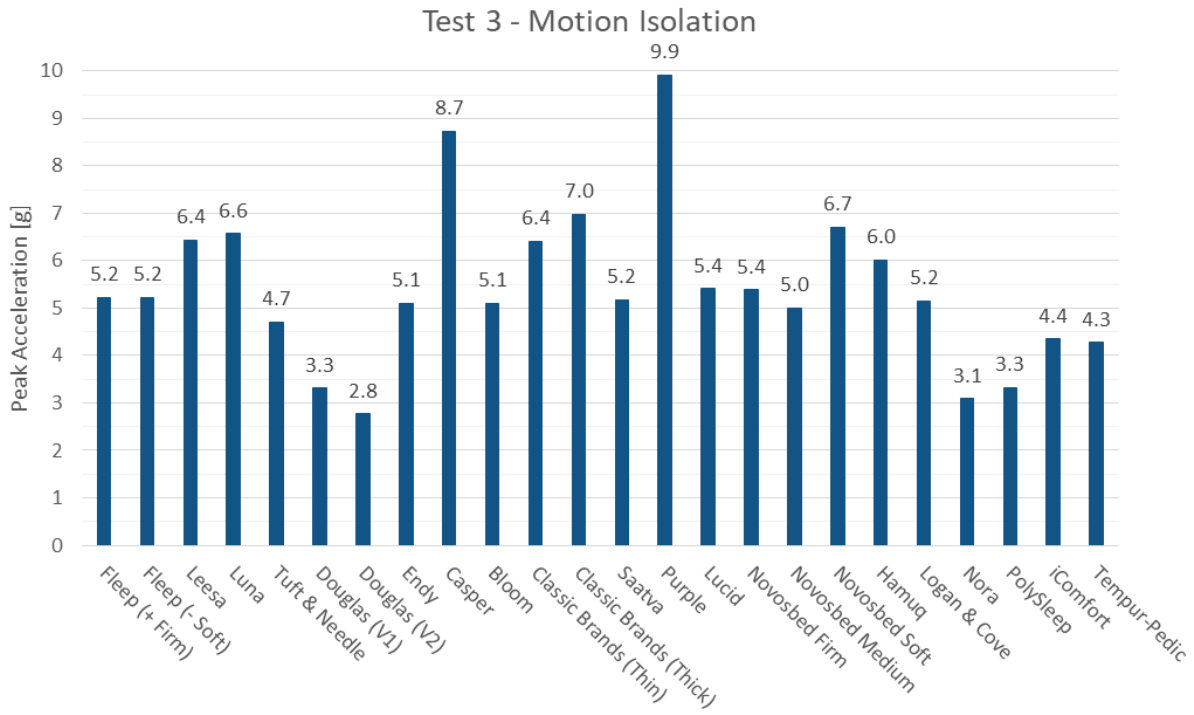


*Figure 15: Peak Acceleration at one sleep point when Reference Load 2 is dropped on the other sleep point. Values shown are an average of 20 runs per mattress.**

**Additional data on motion isolation for each mattress shown in Appendix A*

Figure 16: Test 3 – Motion Isolation on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = max motion isolation)

TEST 4 RESULTS

Table 4: Test 4 – Bounciness

	Mattress	Rebound Height Run 1, [in]	Rebound Height Run 2, [in]	Rebound Height Run 3, [in]	Rebound Height Average, [in]	Out of 10
1	Fleep (+ Firm)	7.5	7.6	7.5	7.5	5.5
	Fleep (- Soft)	3.6	3.7	3.5	3.6	3.2
2	Leesa	4.4	4.4	4.3	4.4	3.6
3	Luna	3.3	3.4	3.4	3.4	3.0
4	Tuft & Needle	6.3	6.5	6.4	6.4	4.8
5	Douglas (V1)	5.5	5.7	5.5	5.6	4.3
6	Douglas (V2)	3.8	3.8	3.5	3.7	3.2
7	Endy	2.5	2.6	2.6	2.6	2.5
8	Casper	4.9	5.0	5.1	5.0	4.0
9	Bloom	3.5	3.7	4.0	3.7	3.2
10	Classic Brands (Thin)	7.1	7.1	7.2	7.1	5.3
11	Classic Brands (Thick)	3.4	3.6	3.5	3.5	3.1
12	Saatva	12.2	12.5	12.3	12.3	8.4
13	Purple	8.6	8.5	8.6	8.6	6.1
14	Lucid	3.4	3.5	3.4	3.4	3.1
15	Novosbed Firm	1.2	1.3	1.3	1.3	1.8
16	Novosbed Medium	1.7	1.7	1.6	1.7	2.0
17	Novosbed Soft	3.4	3.5	3.6	3.5	3.1
18	Hamuq	6.8	6.5	6.8	6.7	5.0
19	Logan & Cove	7.5	7.8	7.6	7.6	5.6
20	Nora	3.4	3.5	3.5	3.5	3.1
21	PolySleep	3.5	3.8	3.6	3.6	3.2
22	iComfort	1.8	2.0	1.8	1.8	2.1
23	Tempur-Pedic	1.1	1.1	1.0	1.1	1.7

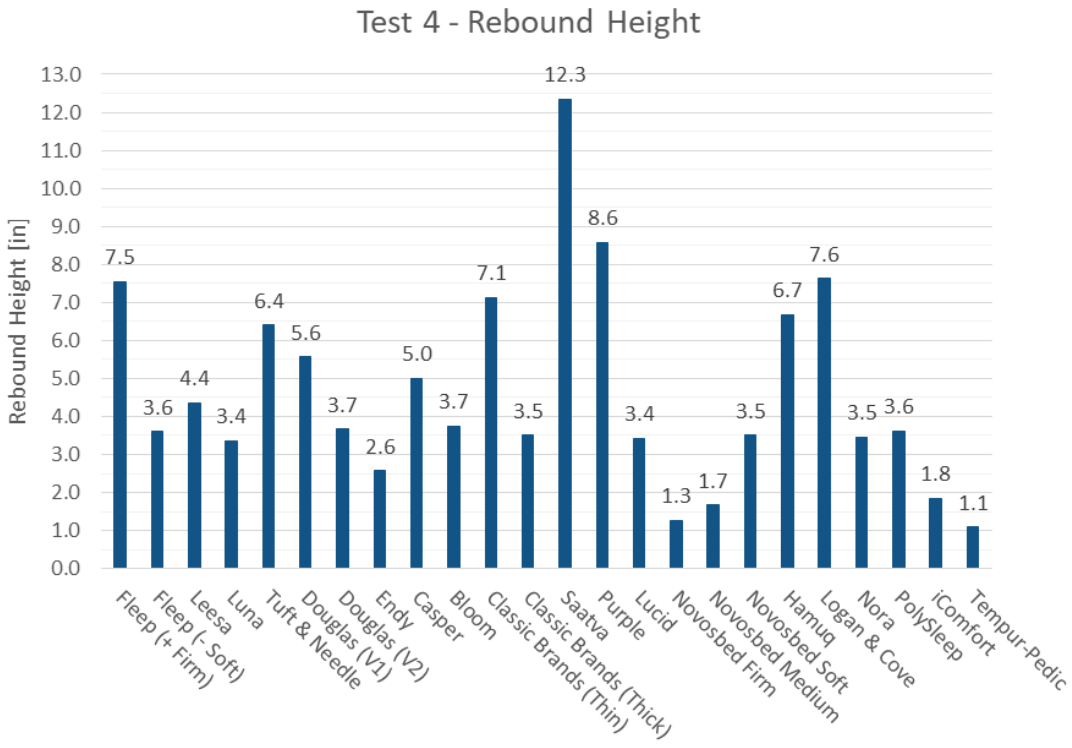


Figure 17: Rebound height of Reference Load 2 when dropped in the center of the mattress. Values shown are an average of 3 runs per mattress.

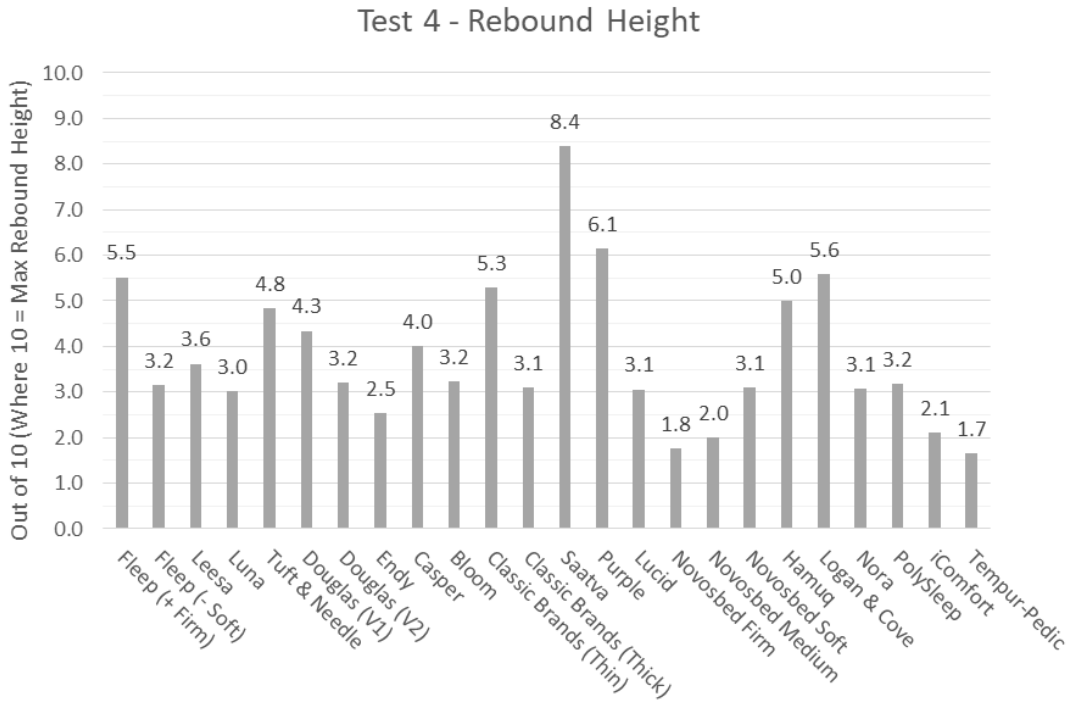


Figure 18: Test 3 – Rebound height on a scale from 1 to 10 based on the given mattresses that were sampled (where 10 = max rebound height)

CONCLUSION

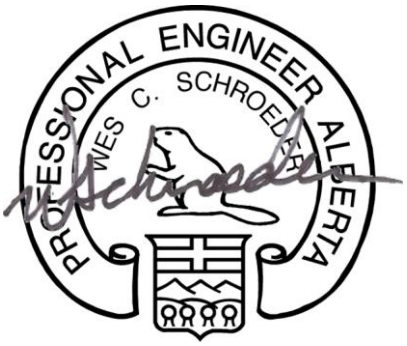
We trust that the above and attached information is satisfactory. Please do not hesitate to contact the undersigned if you have any questions or require further information.

Sincerely,

PURE MOSAIC SERVICES.

P-13431

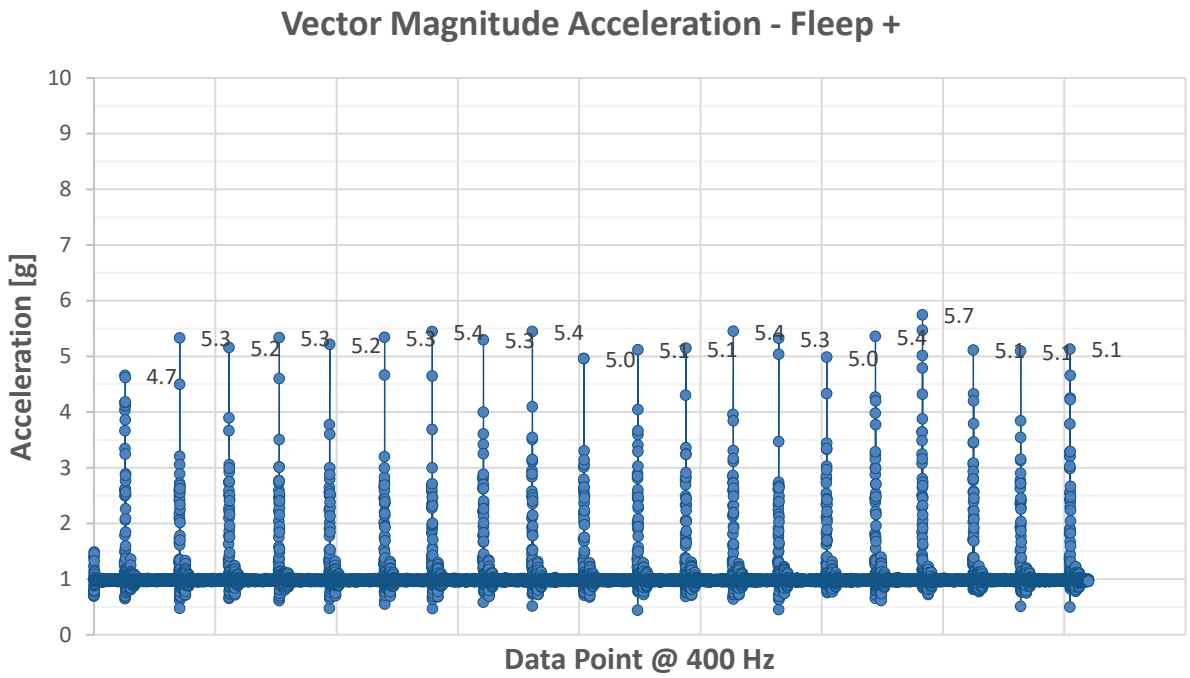
Wes Schroeder, P.Eng



May 18, 2018

APPENDIX A

TEST 3 – FLEEP +


Vector Magnitude Acceleration - Fleep +
Acceleration [g]
Data Point @ 400 Hz
10
9
8
7
6
5
4
3
2
1
0
4.7
5.3
5.2
5.3
5.2
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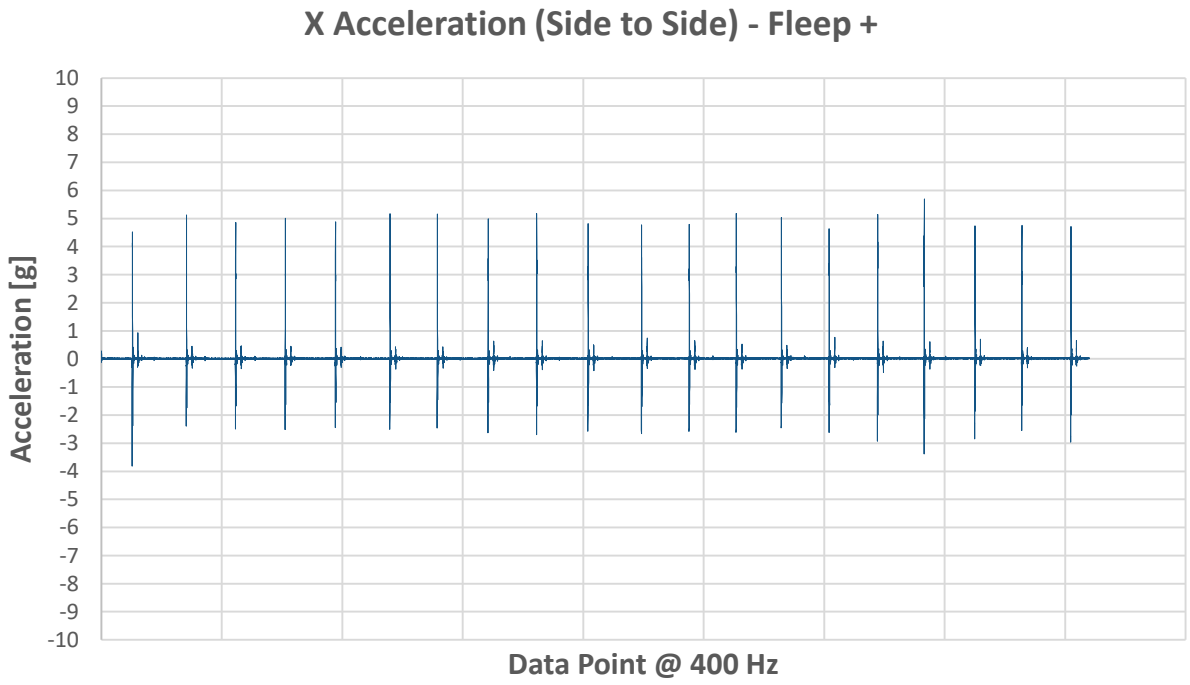
X Acceleration (Side to Side) - Fleep +
Acceleration [g]
Data Point @ 400 Hz
10
9
8
7
6
5
4
3
2
1
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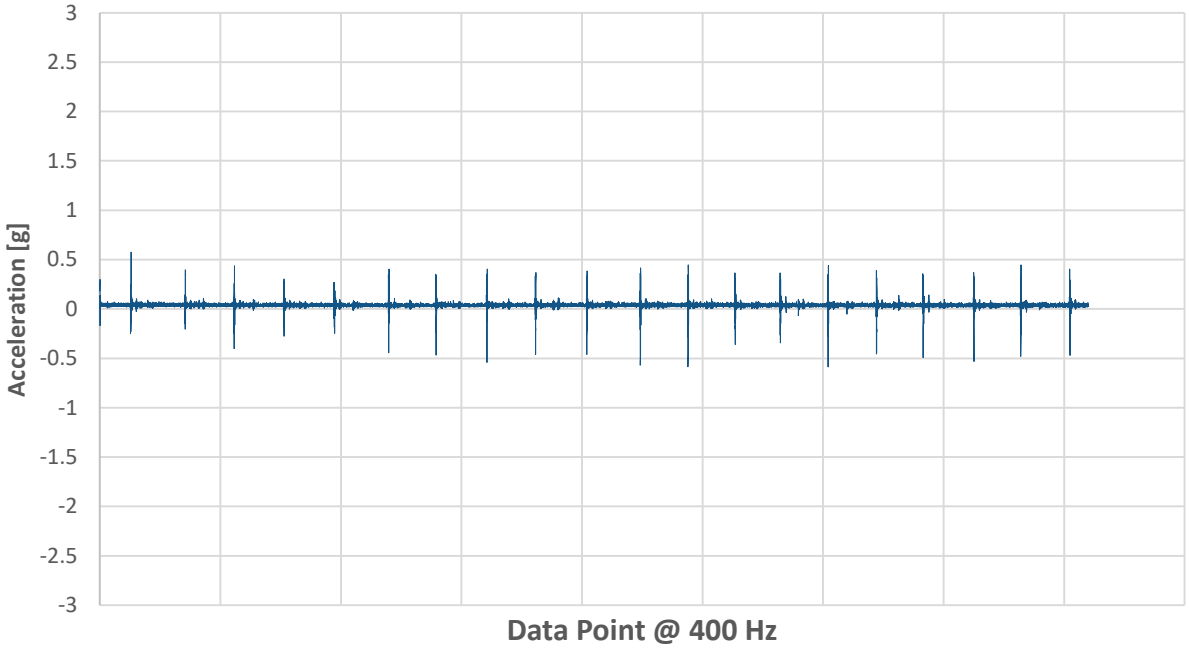
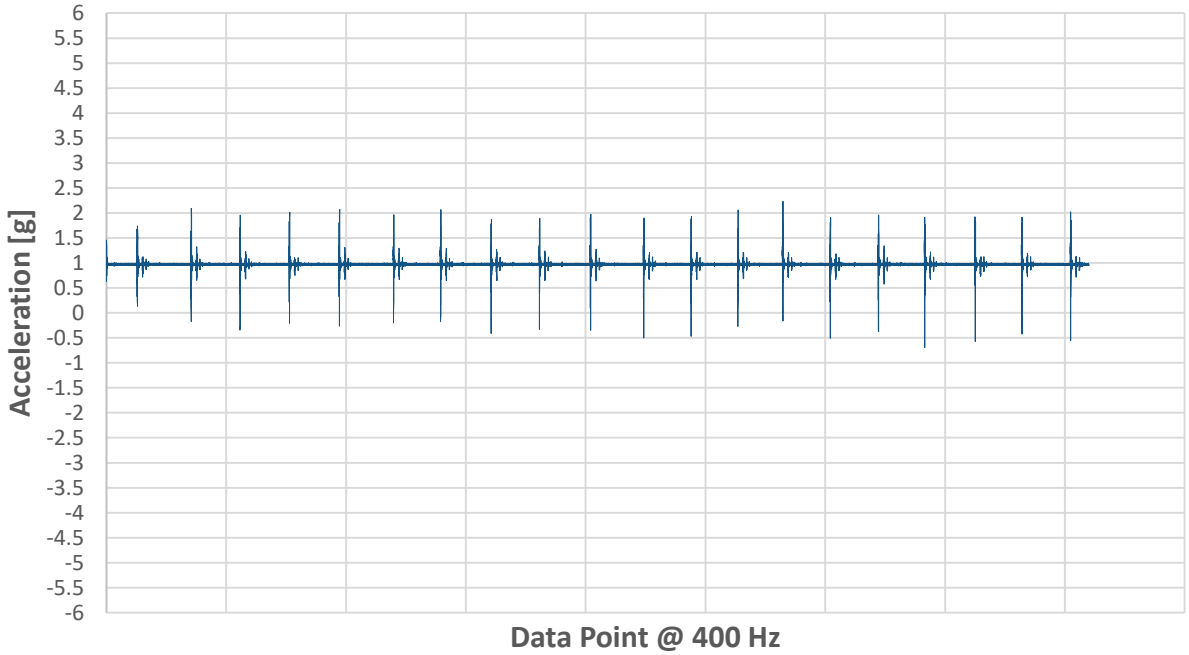
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10

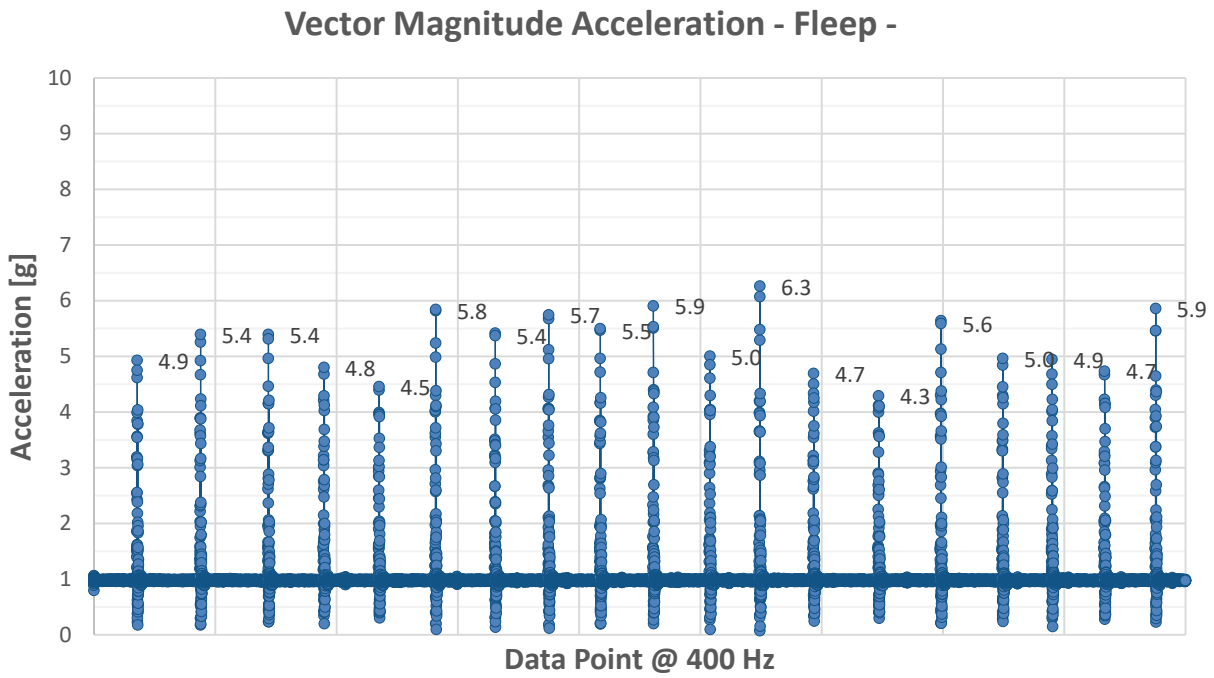
Y Acceleration (Head to Toe) - Fleep +



Z Acceleration (Up and Down) - Fleep +



TEST 3 – FLEEP –


Vector Magnitude Acceleration - Fleep -
Acceleration [g]
Data Point @ 400 Hz
4.9
5.4
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5.9
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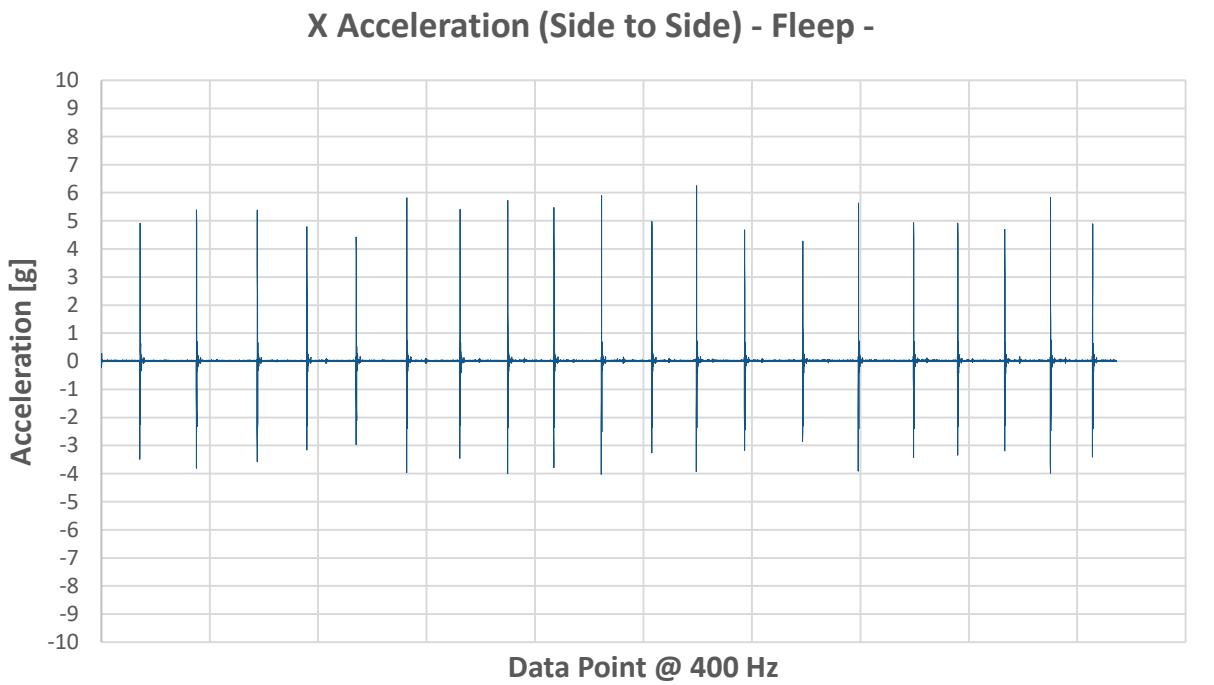
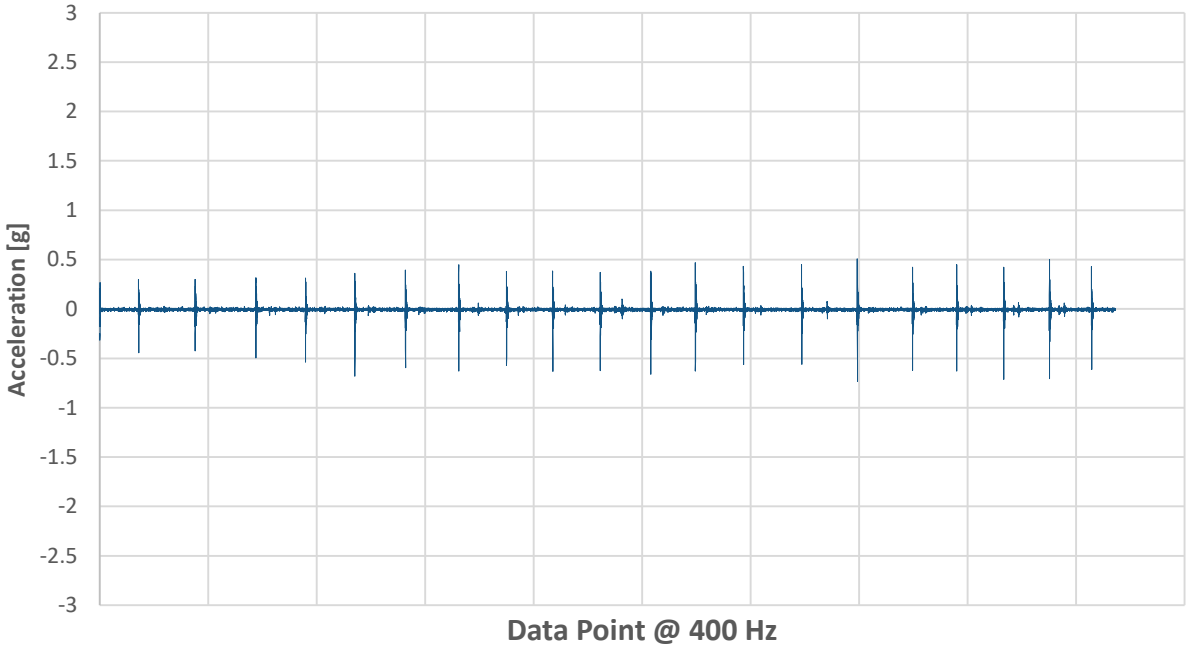
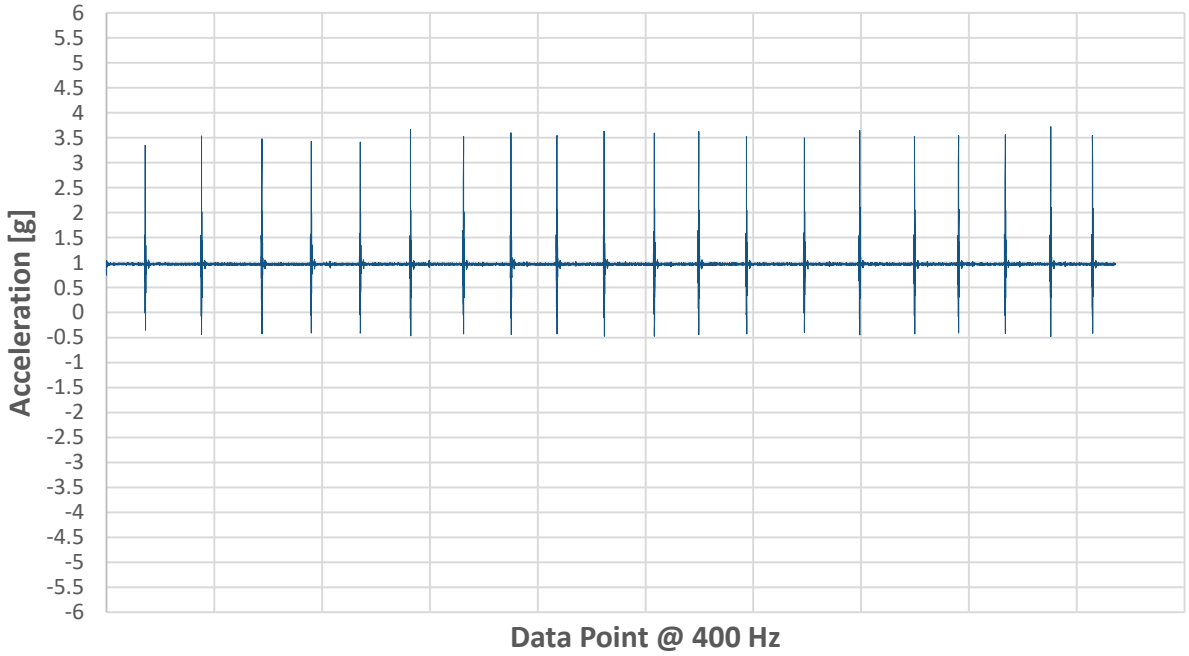
4.9
4.7
5.9


X Acceleration (Side to Side) - Fleep -
Acceleration [g]
Data Point @ 400 Hz

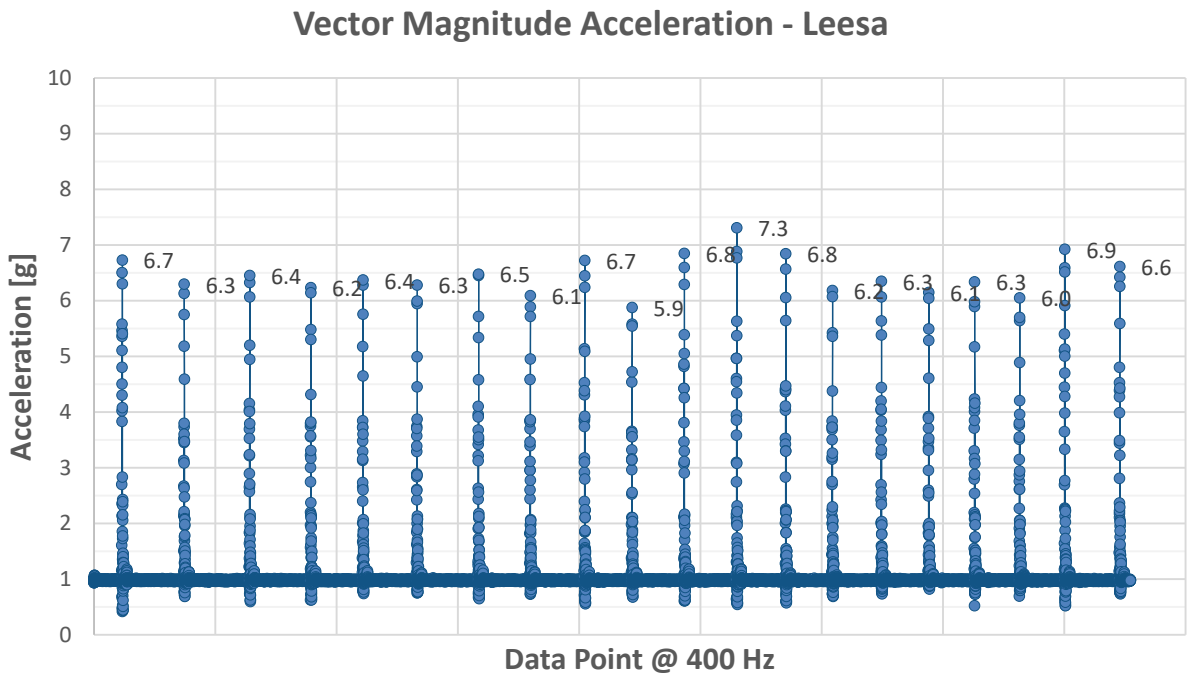
Y Acceleration (Head to Toe) - Fleep -



Z Acceleration (Up and Down) - Fleep -



TEST 3 – LEESA


Vector Magnitude Acceleration - Leesa
Acceleration [g]
Data Point @ 400 Hz
6.7
6.3
6.4
6.2
6.4
6.3
6.5
6.1
6.7
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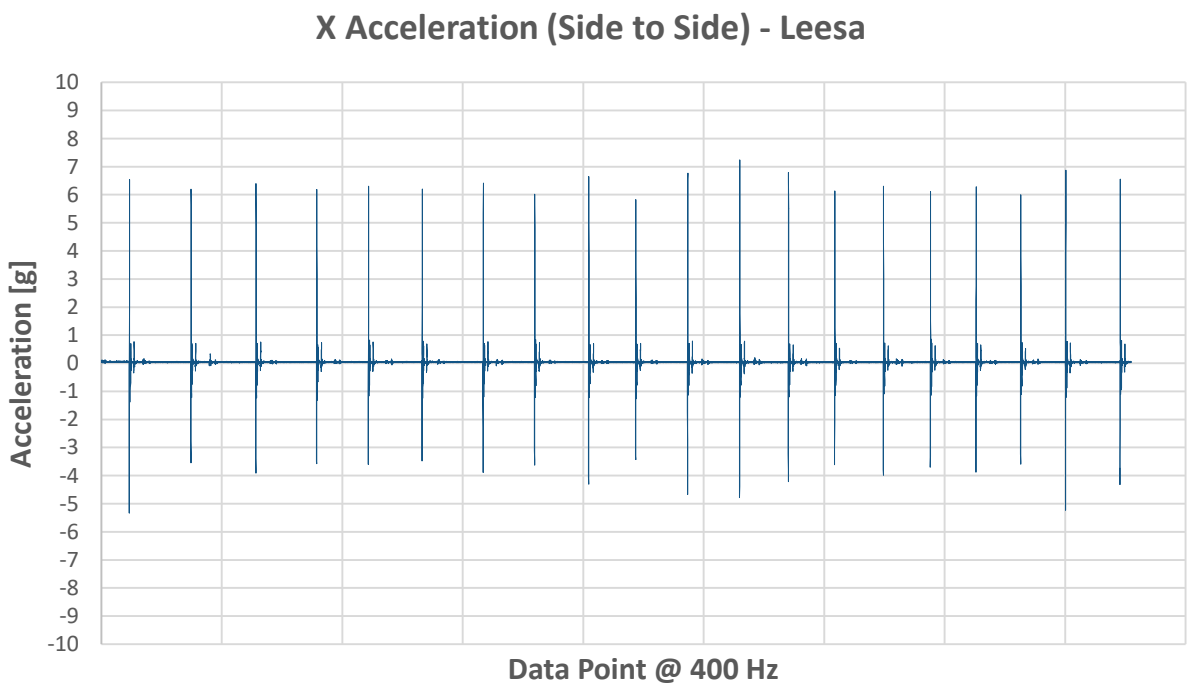
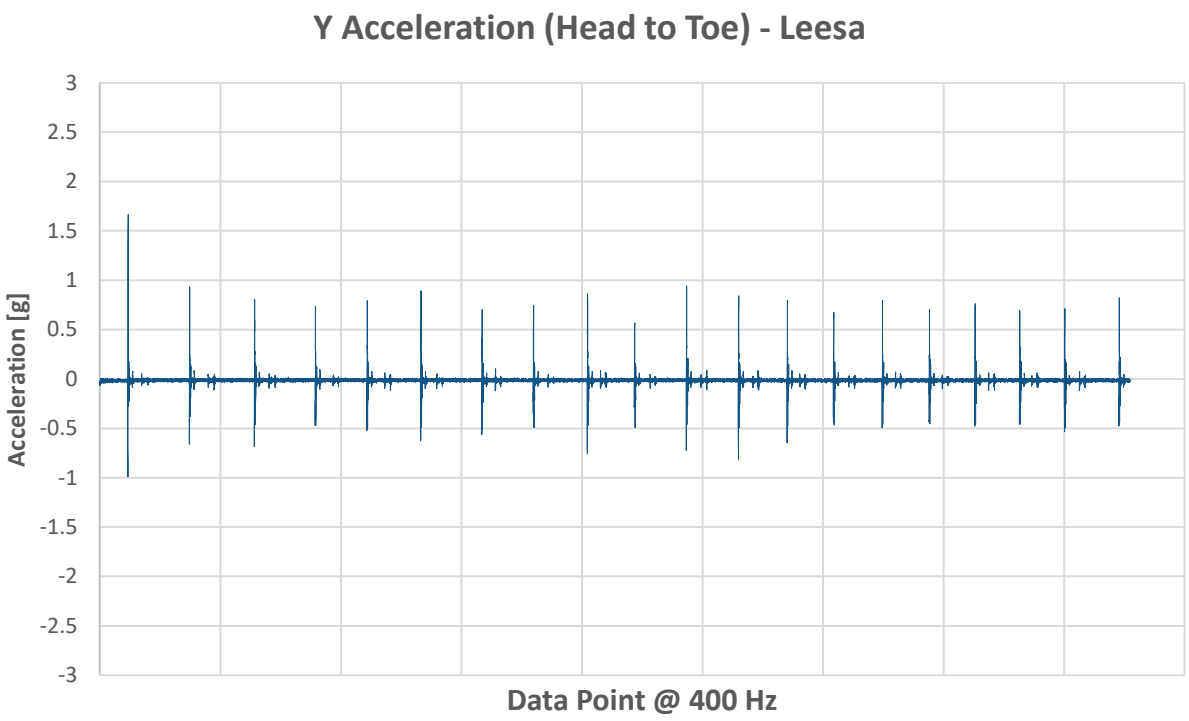
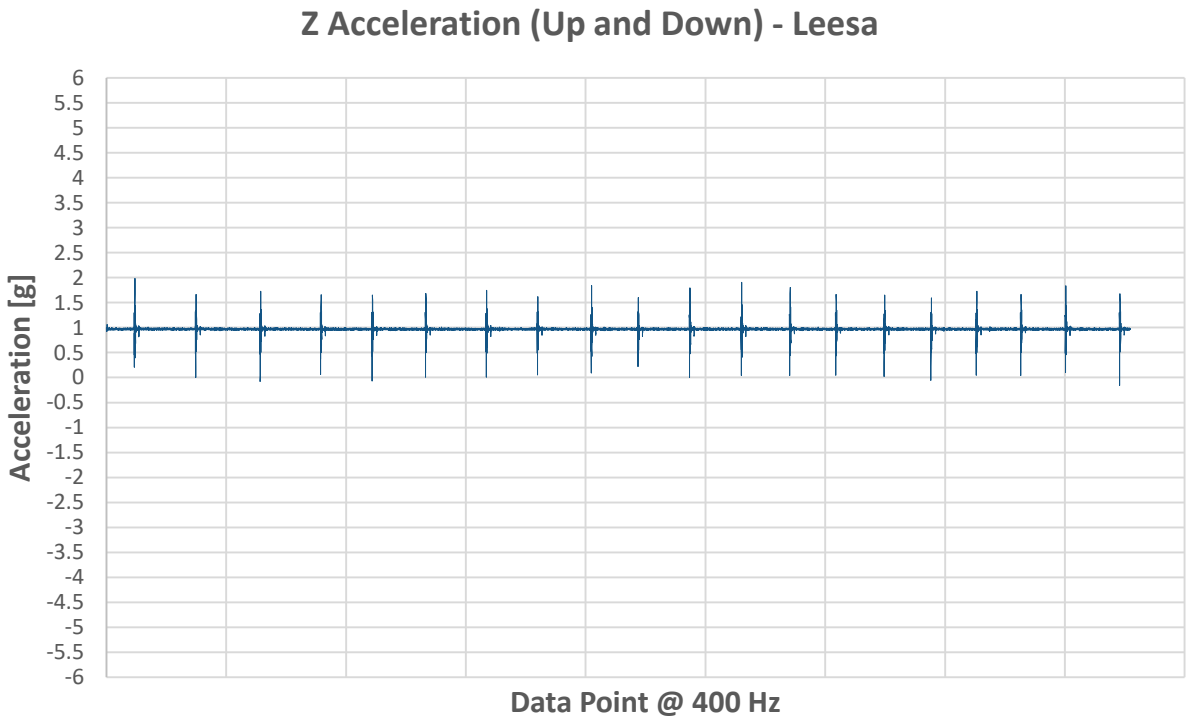
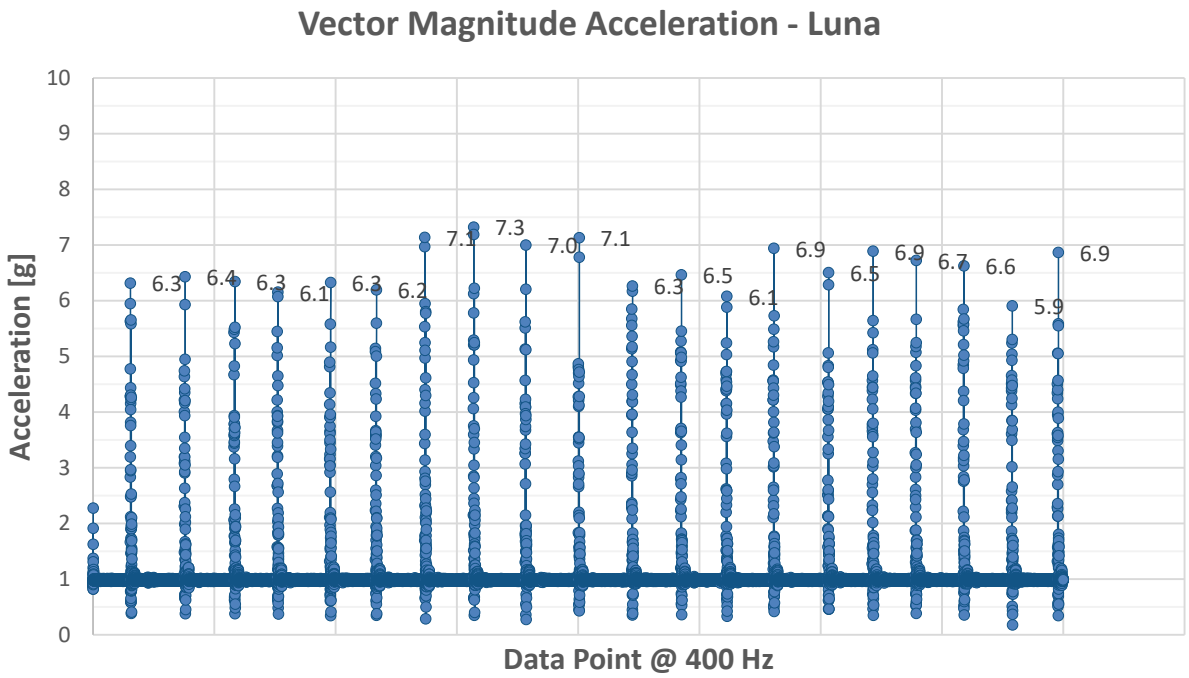
6.3
6.1
6.3
6.0
6.9
6.6

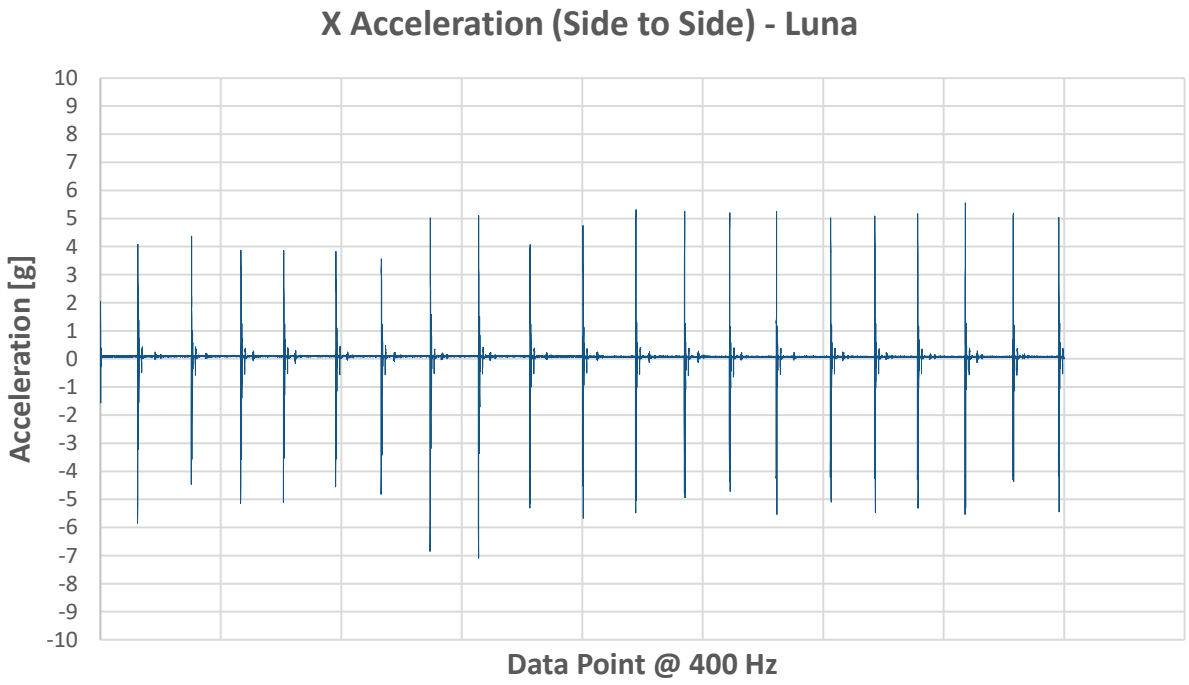

X Acceleration (Side to Side) - Leesa
Acceleration [g]
Data Point @ 400 Hz


Y Acceleration (Head to Toe) - Leesa
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

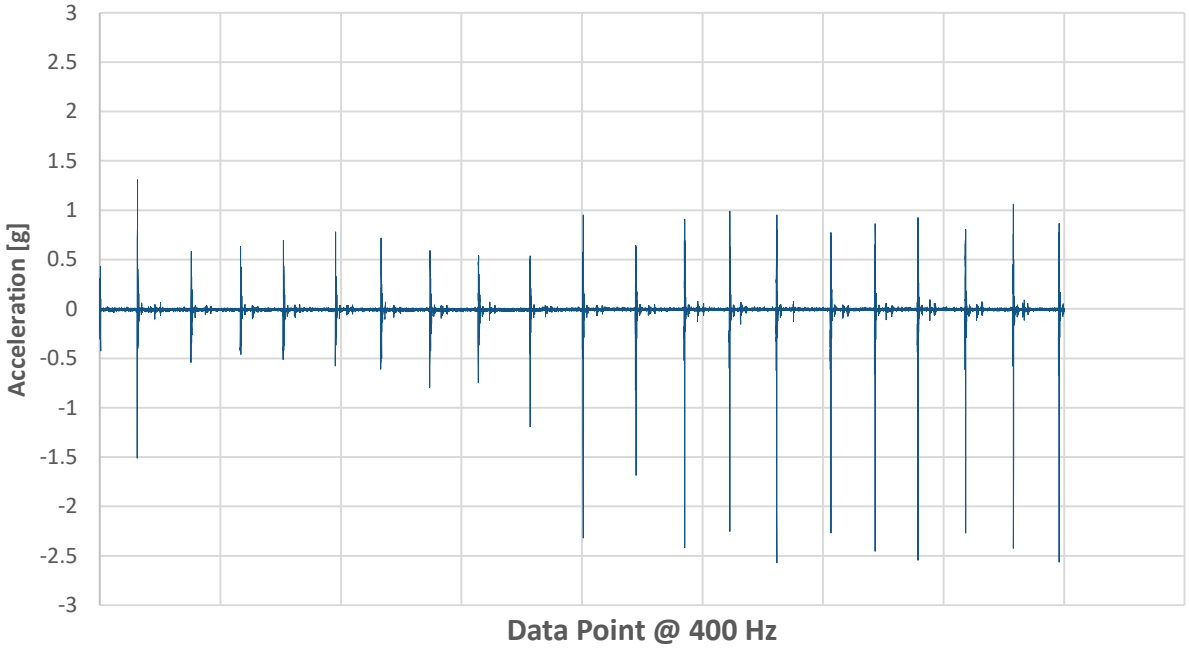

Z Acceleration (Up and Down) - Leesa
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – LUNA

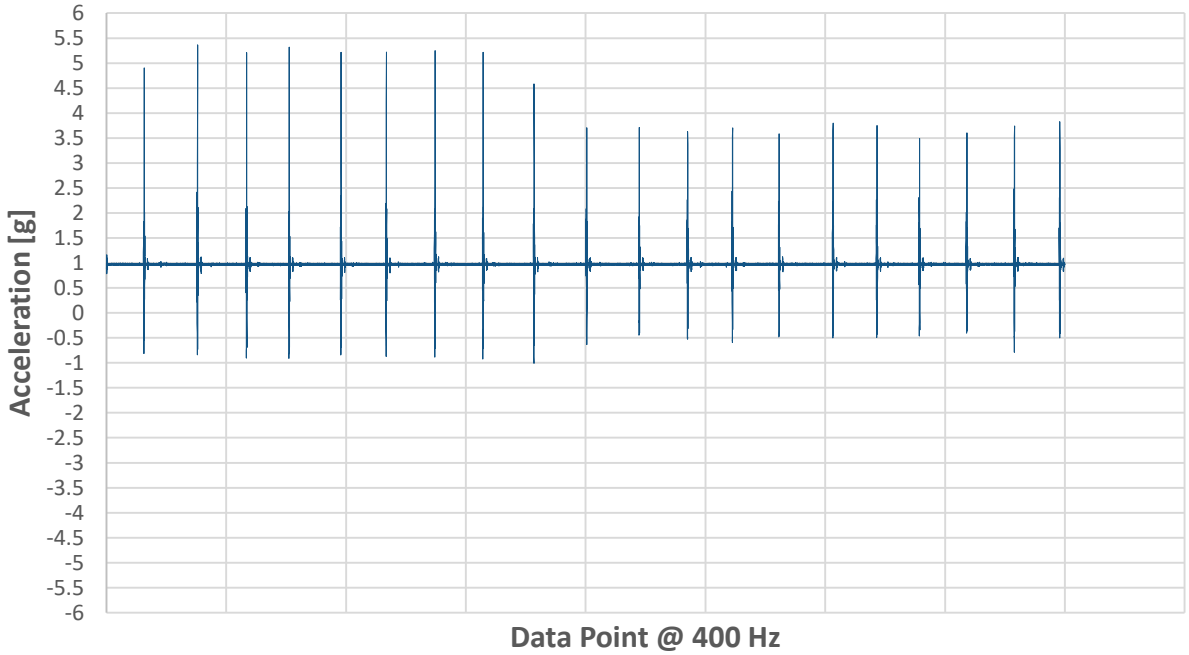

Vector Magnitude Acceleration - Luna
Acceleration [g]
Data Point @ 400 Hz
6.3
6.4
6.3
6.1
6.3
6.2
7.1
7.3
7.0
7.1
6.3
6.5
6.1
6.9
6.5
6.9
6.7
6.6
5.9
6.9


X Acceleration (Side to Side) - Luna
Acceleration [g]
Data Point @ 400 Hz

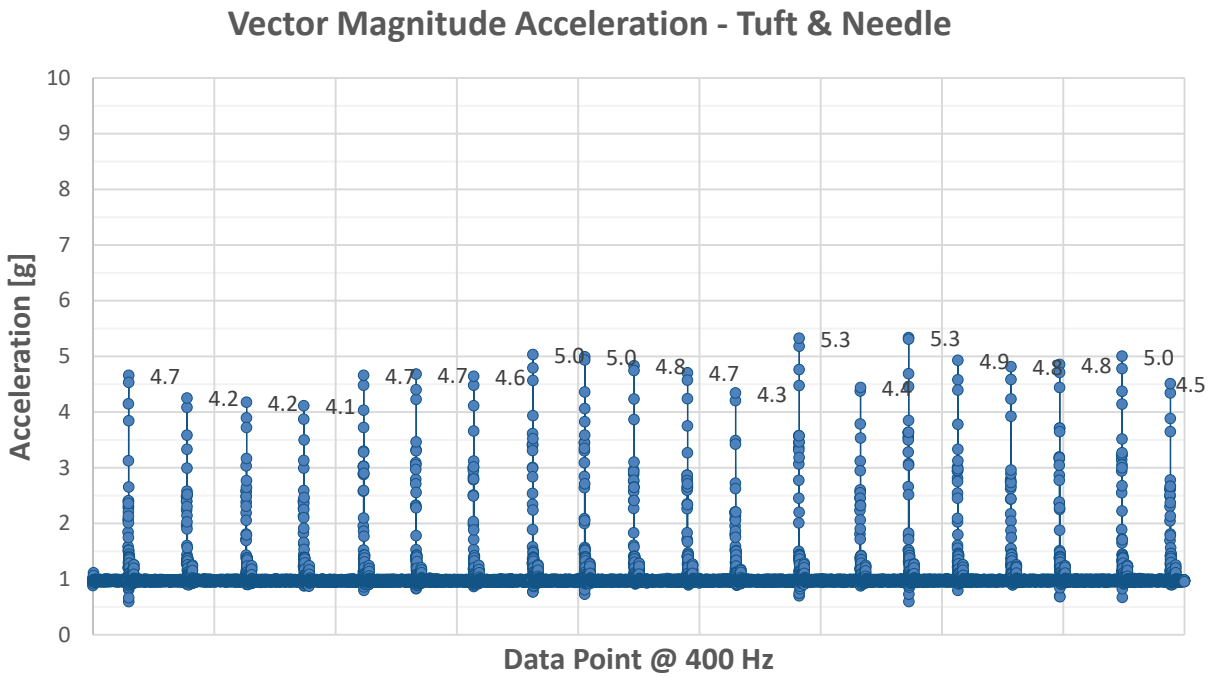
Y Acceleration (Head to Toe) - Luna

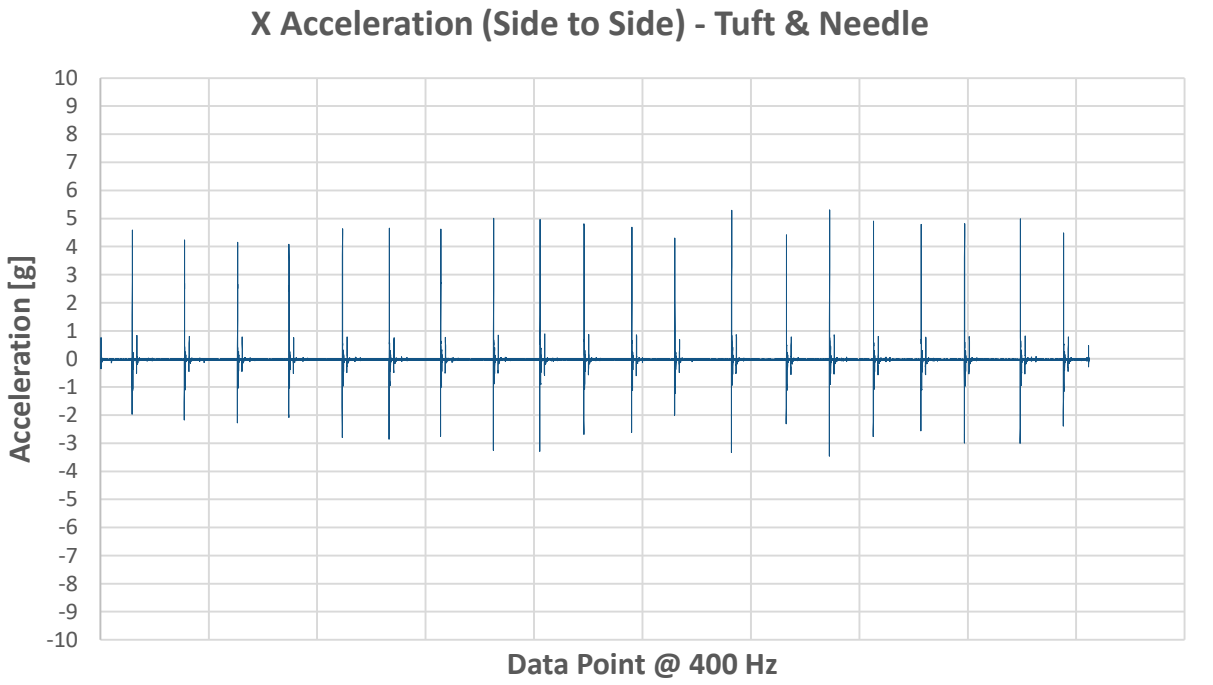


Z Acceleration (Up and Down) - Luna

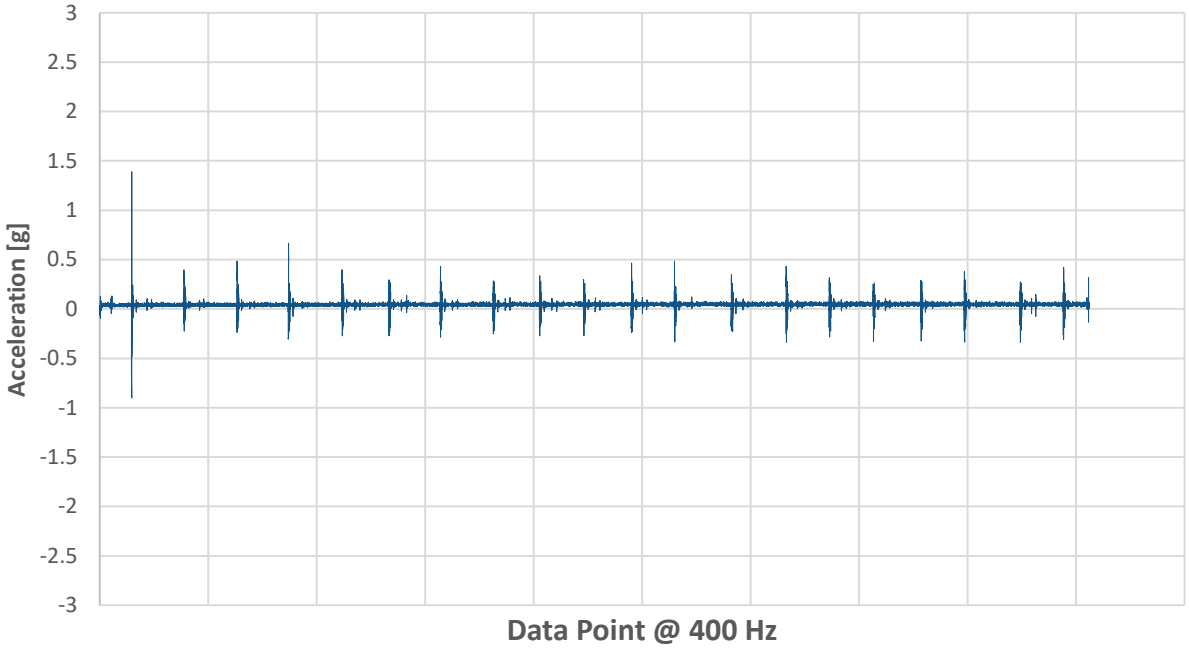


TEST 3 – TUFT & NEEDLE

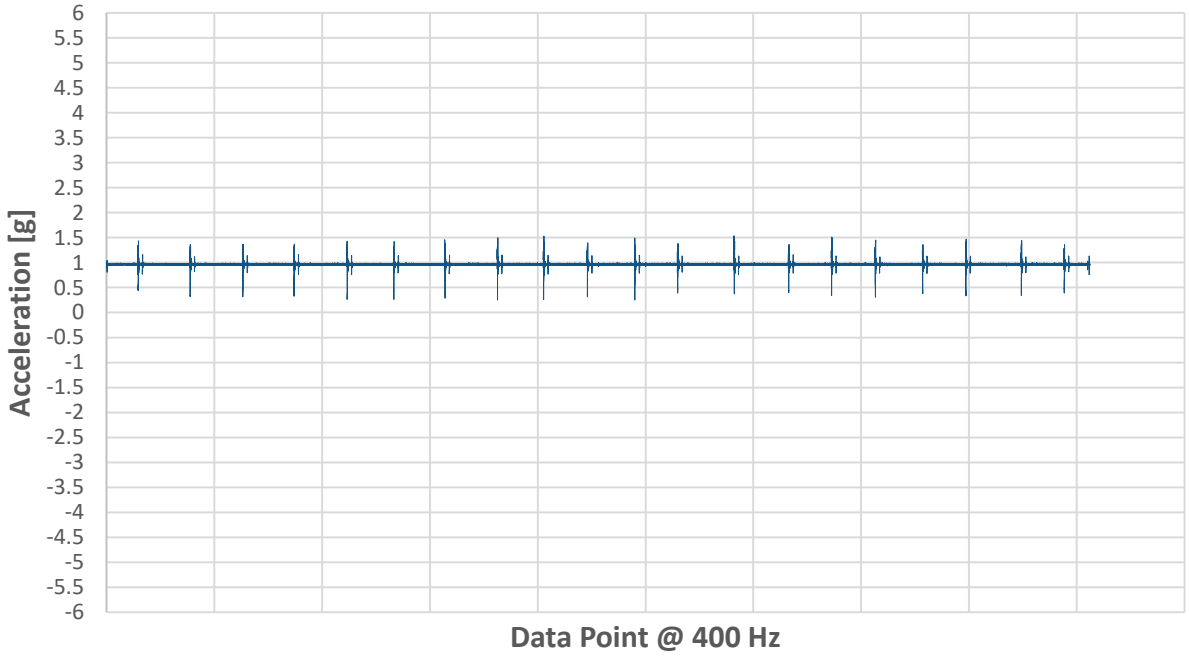




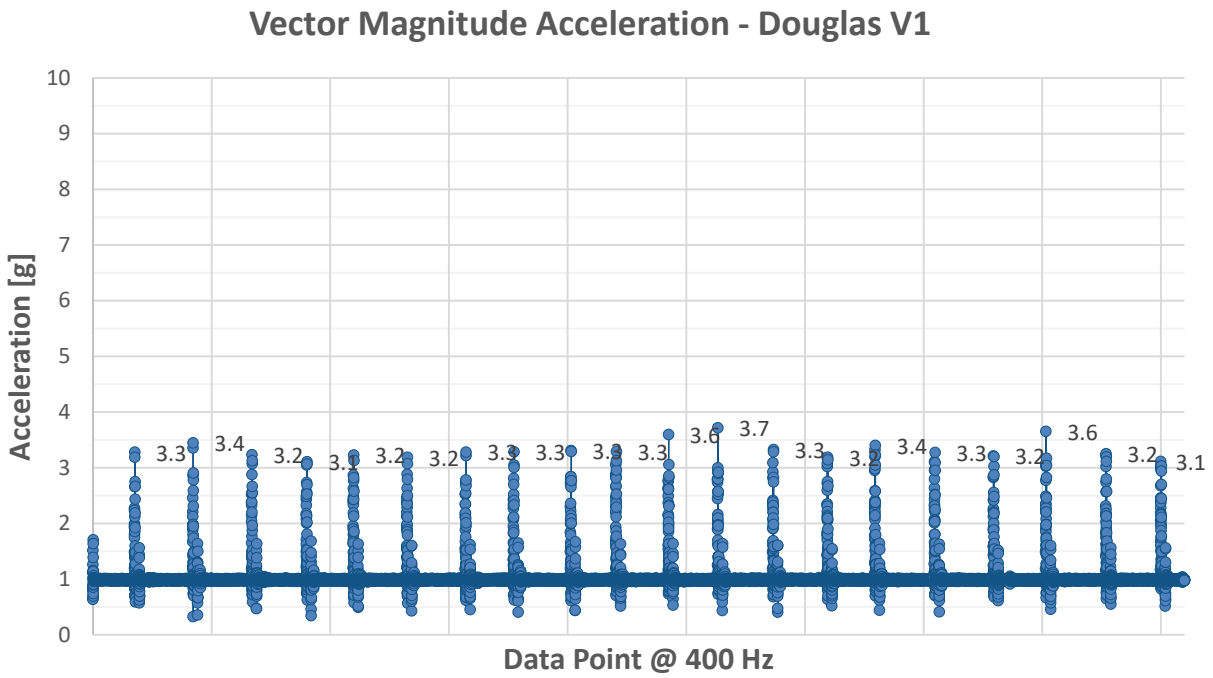
Y Acceleration (Head to Toe) - Tuft & Needle

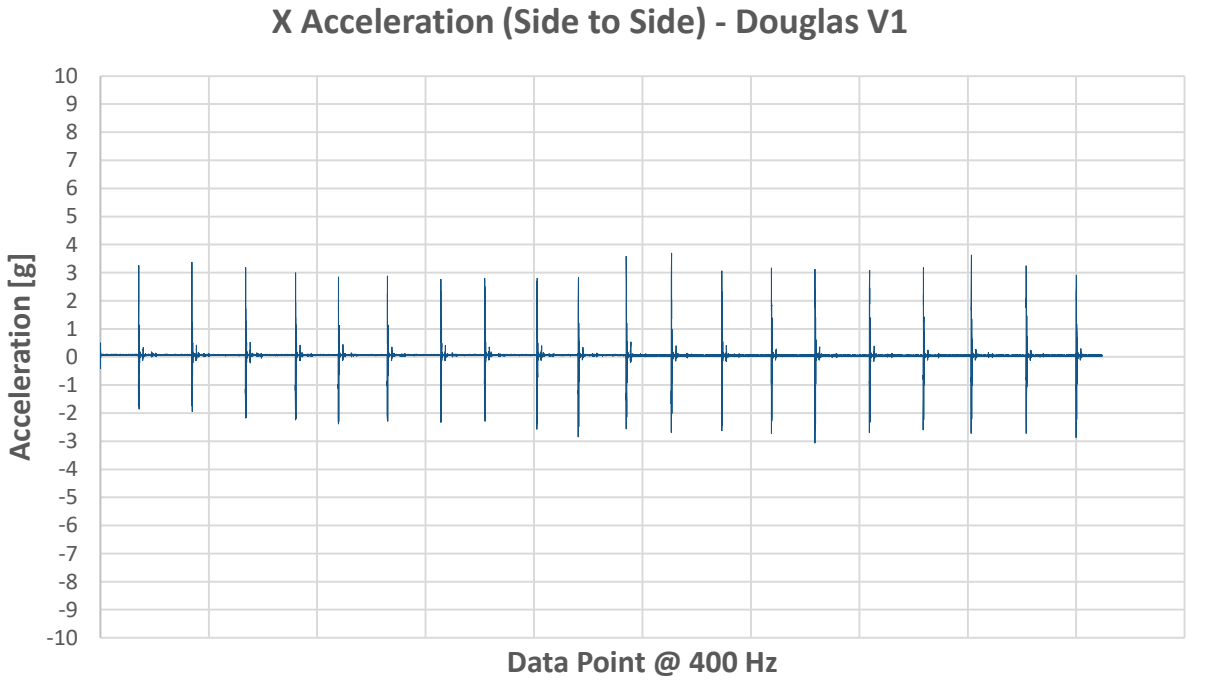


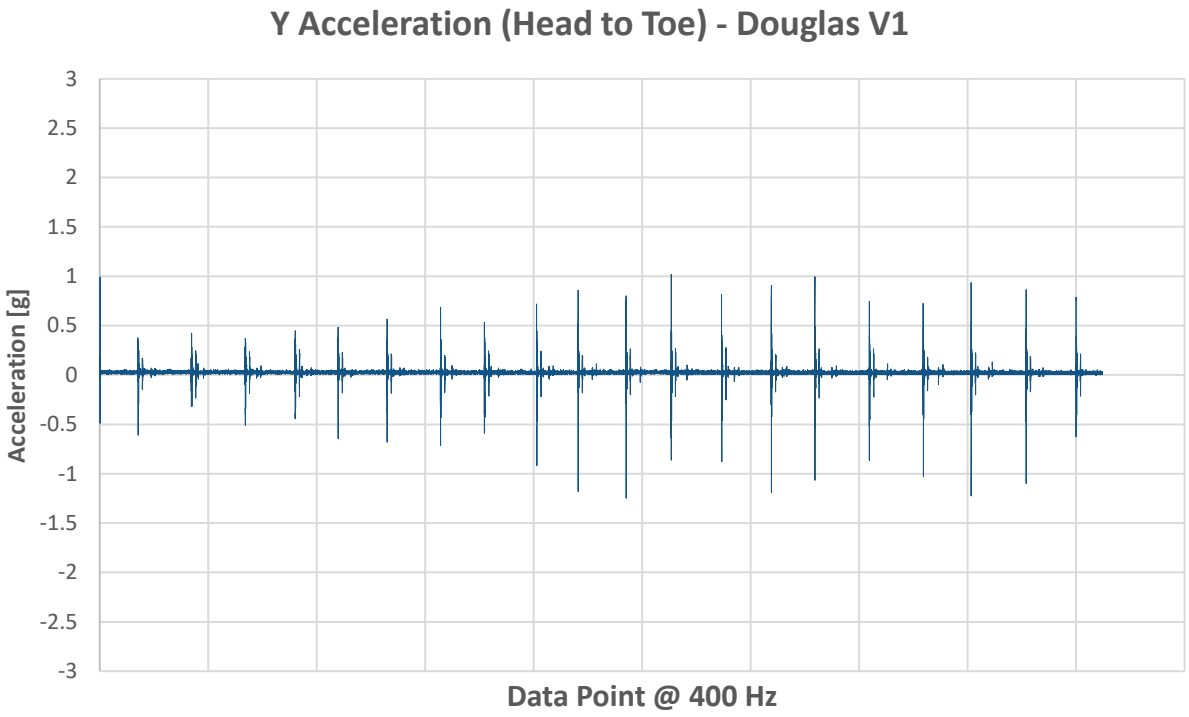
Z Acceleration (Up and Down) - Tuft & Needle

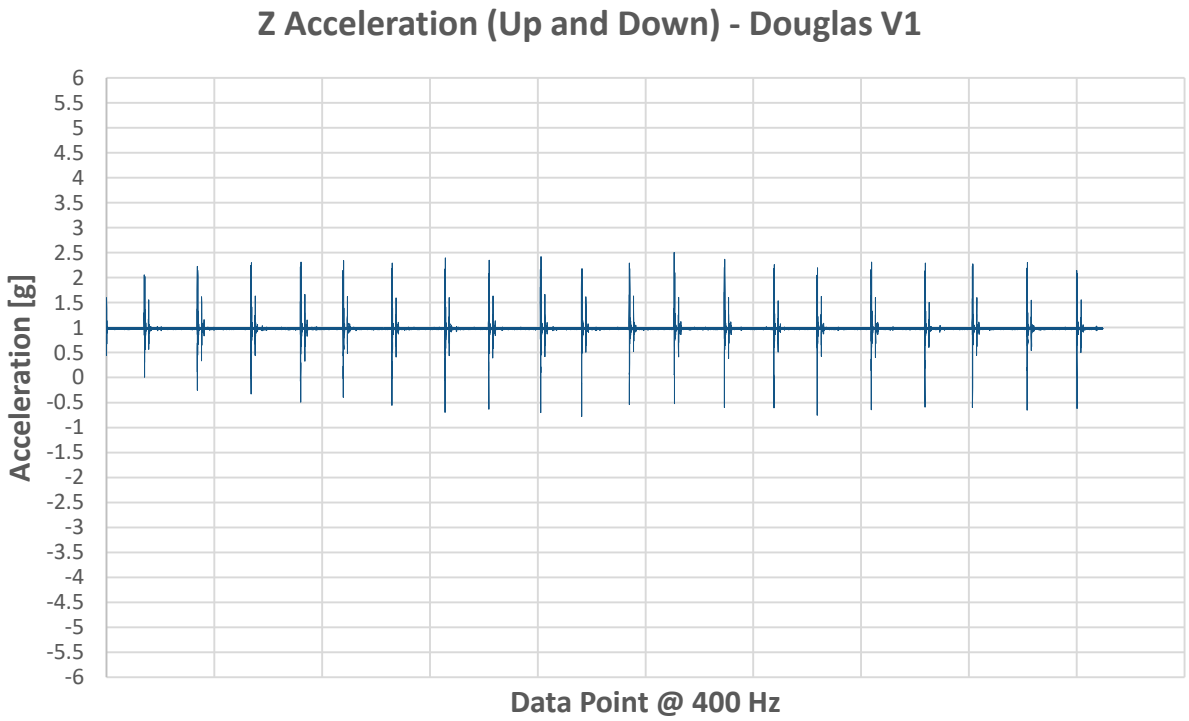


TEST 3 – DOUGLAS V1

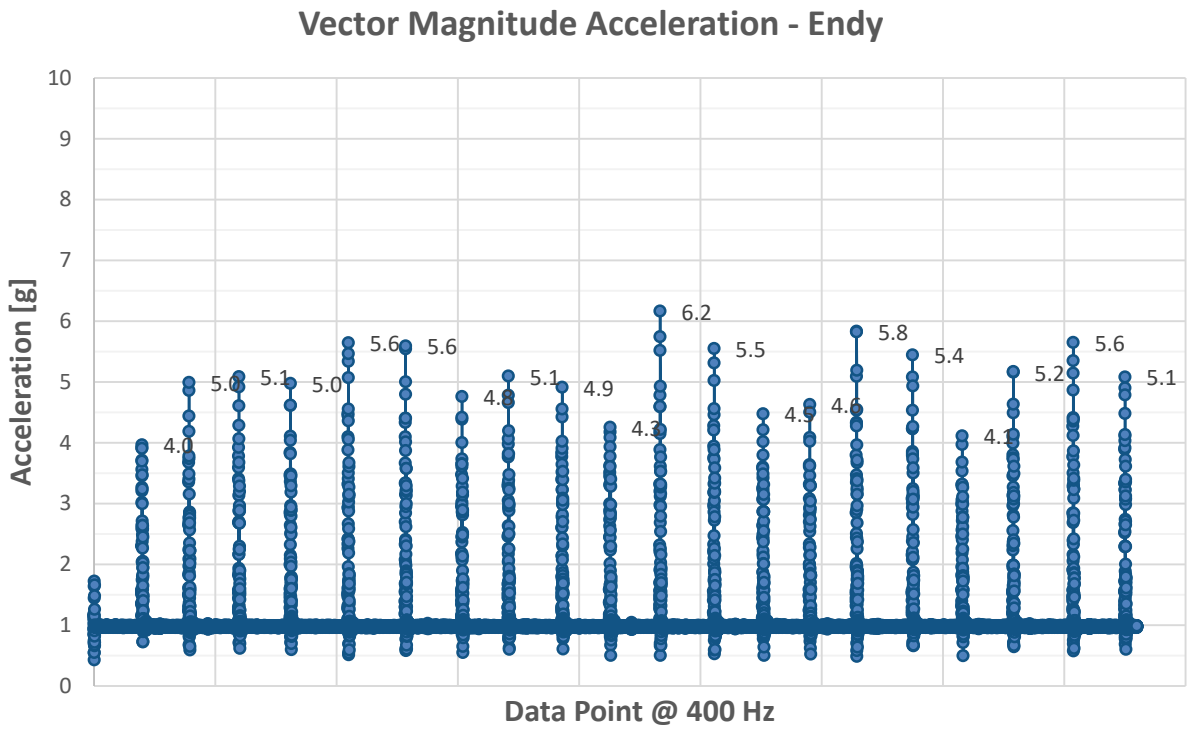


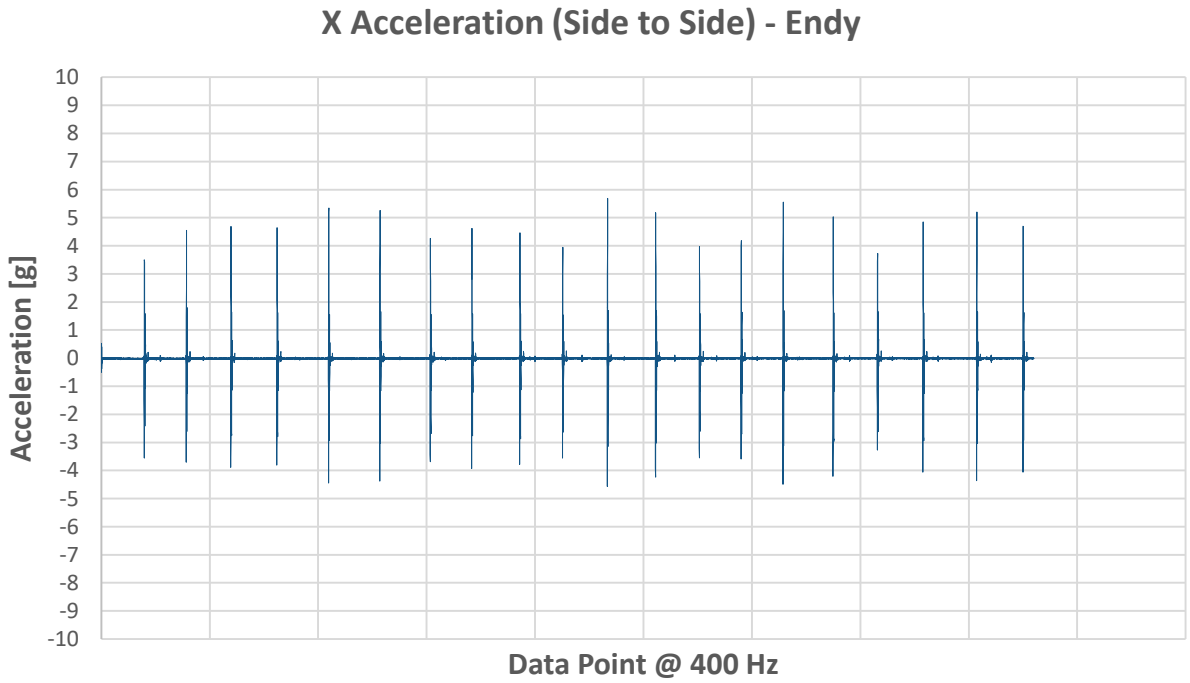



Y Acceleration (Head to Toe) - Douglas V1
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

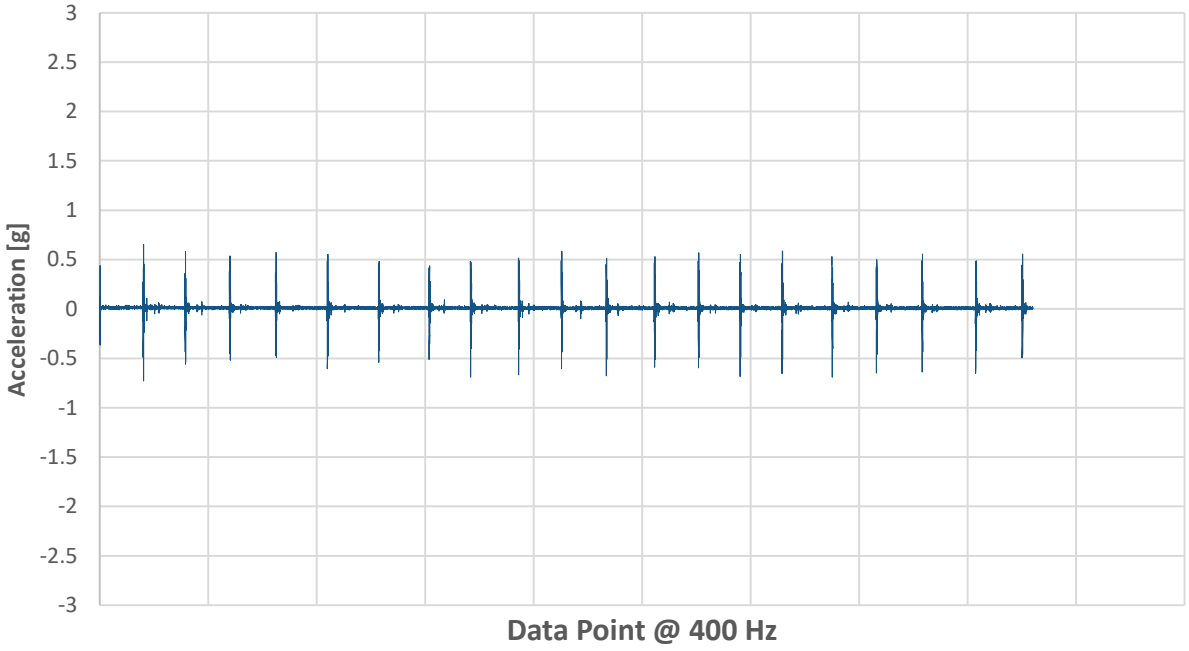

Z Acceleration (Up and Down) - Douglas V1
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – ENDY

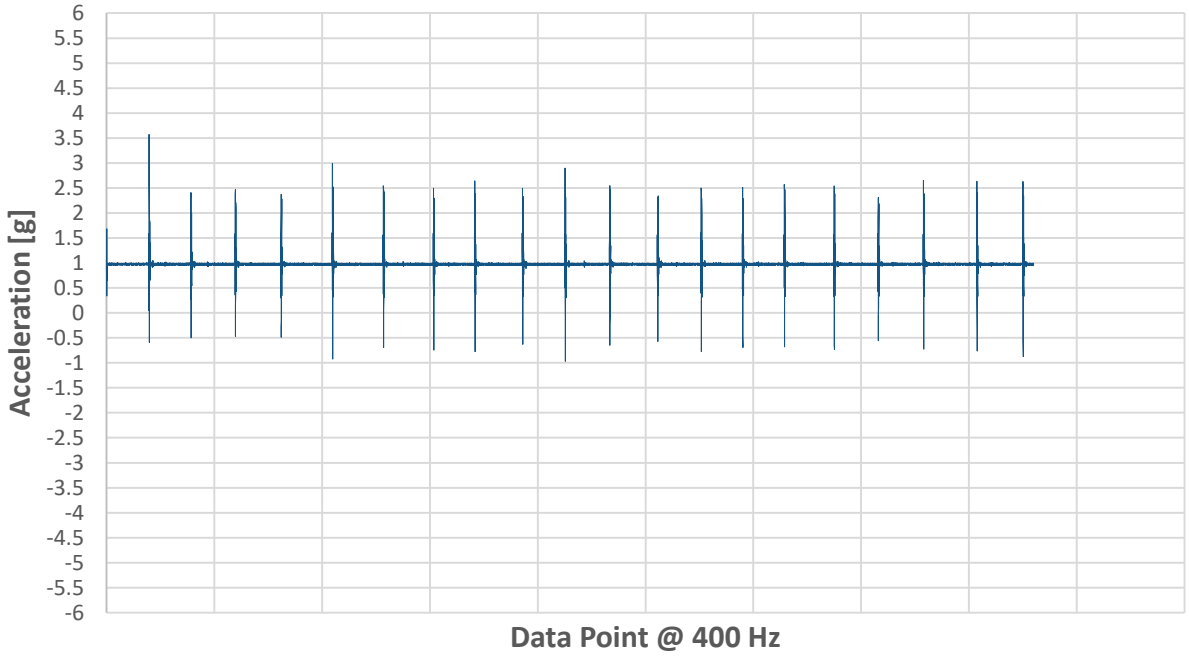

Vector Magnitude Acceleration - Endy
Acceleration [g]
Data Point @ 400 Hz
0
1
2
3
4
5
6
7
8
9
10
4.0
5.0
5.1
5.0
5.6
5.6
4.8
5.1
4.9
4.3
6.2
5.5
4.5
4.6
5.8
5.4
4.1
5.2
5.6
5.1


X Acceleration (Side to Side) - Endy
Acceleration [g]
Data Point @ 400 Hz
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10

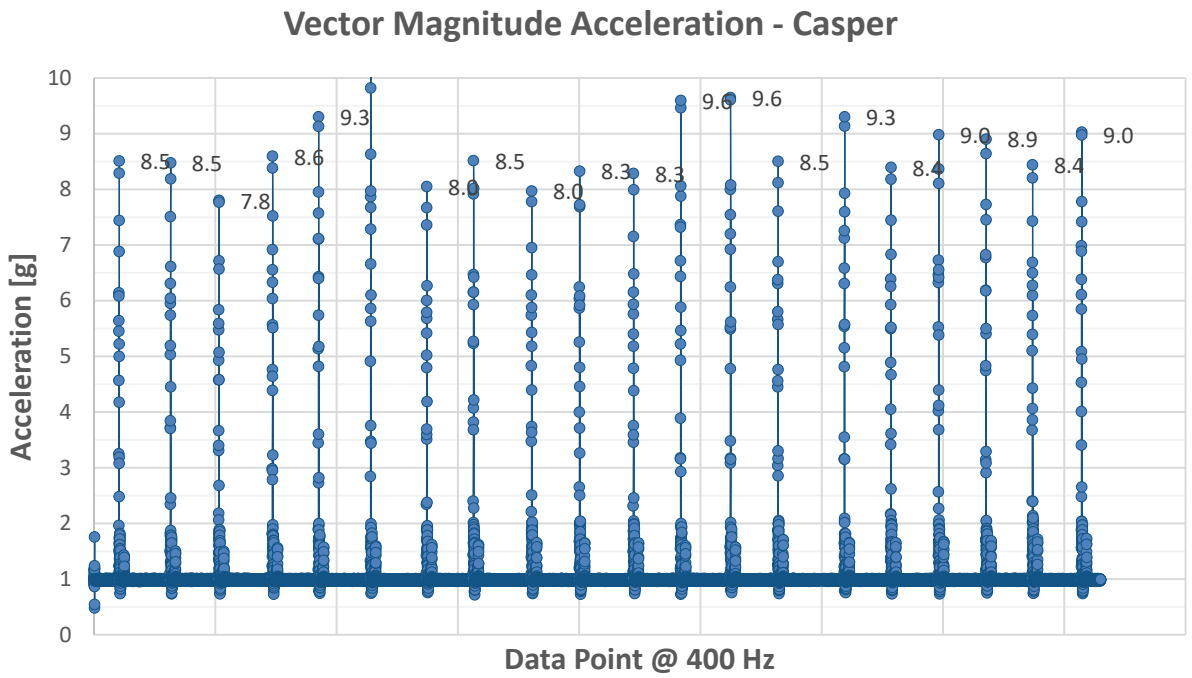
Y Acceleration (Head to Toe) - Endy

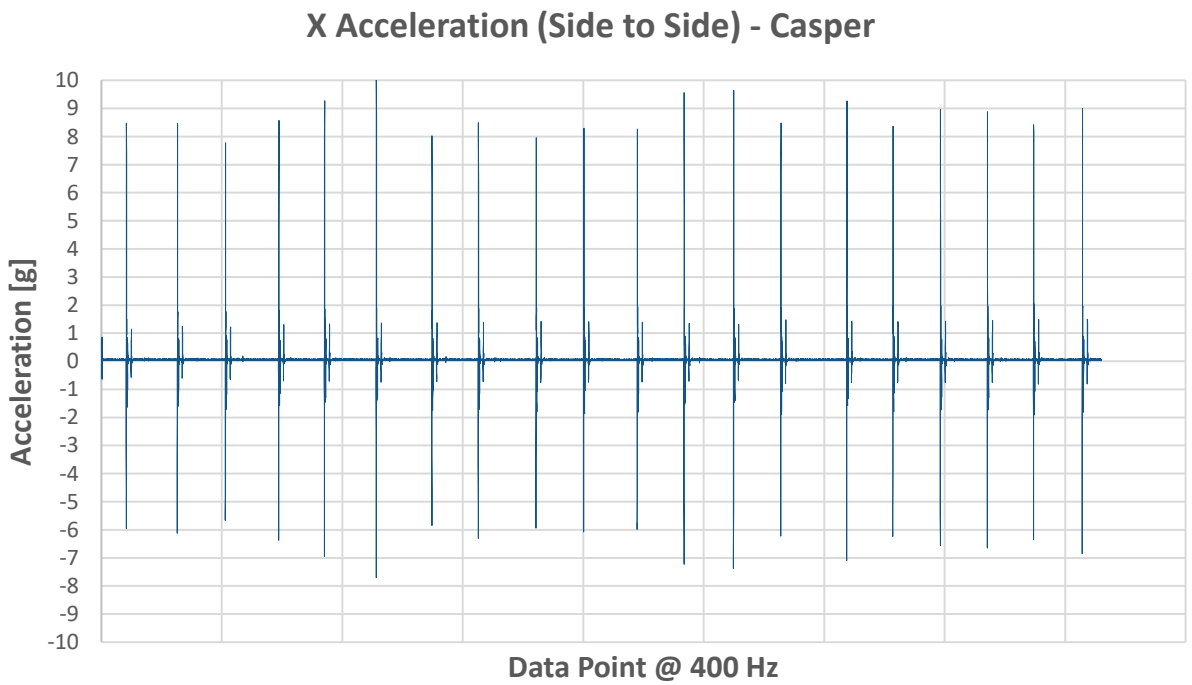


Z Acceleration (Up and Down) - Endy

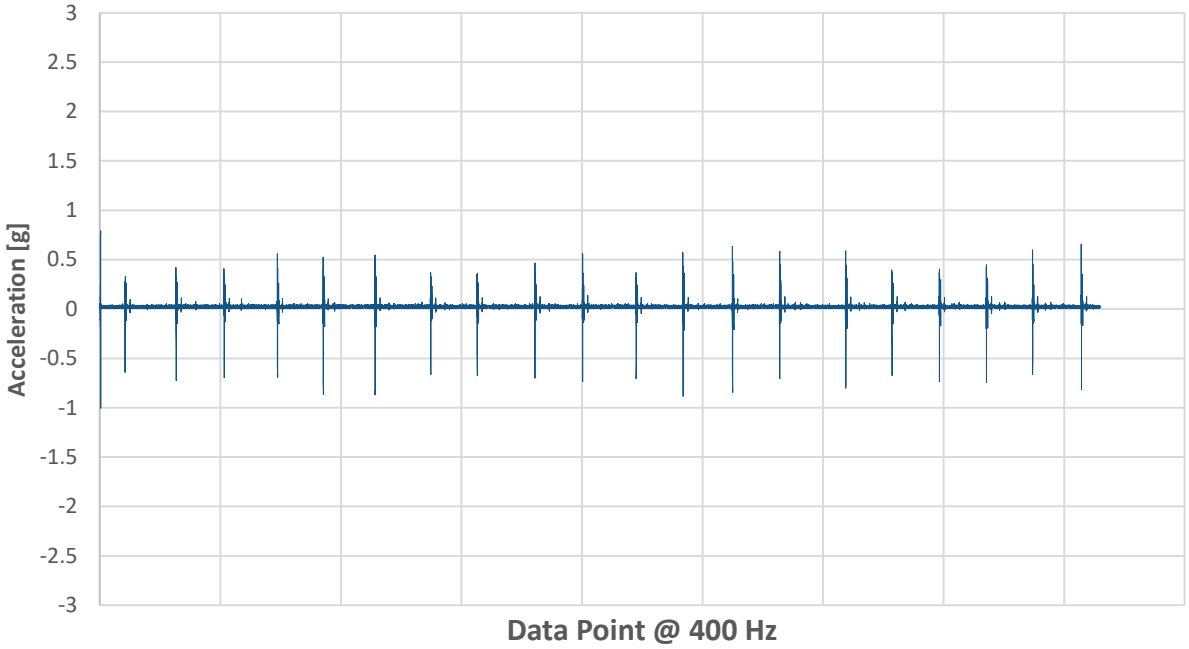


TEST 3 – CASPER

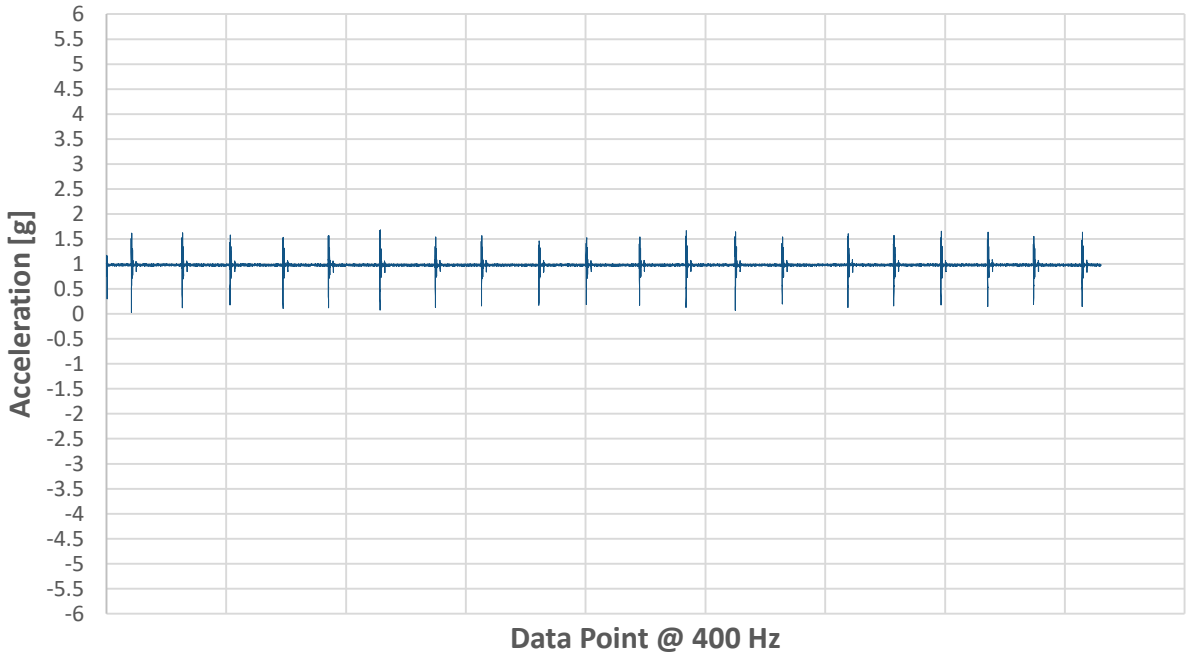




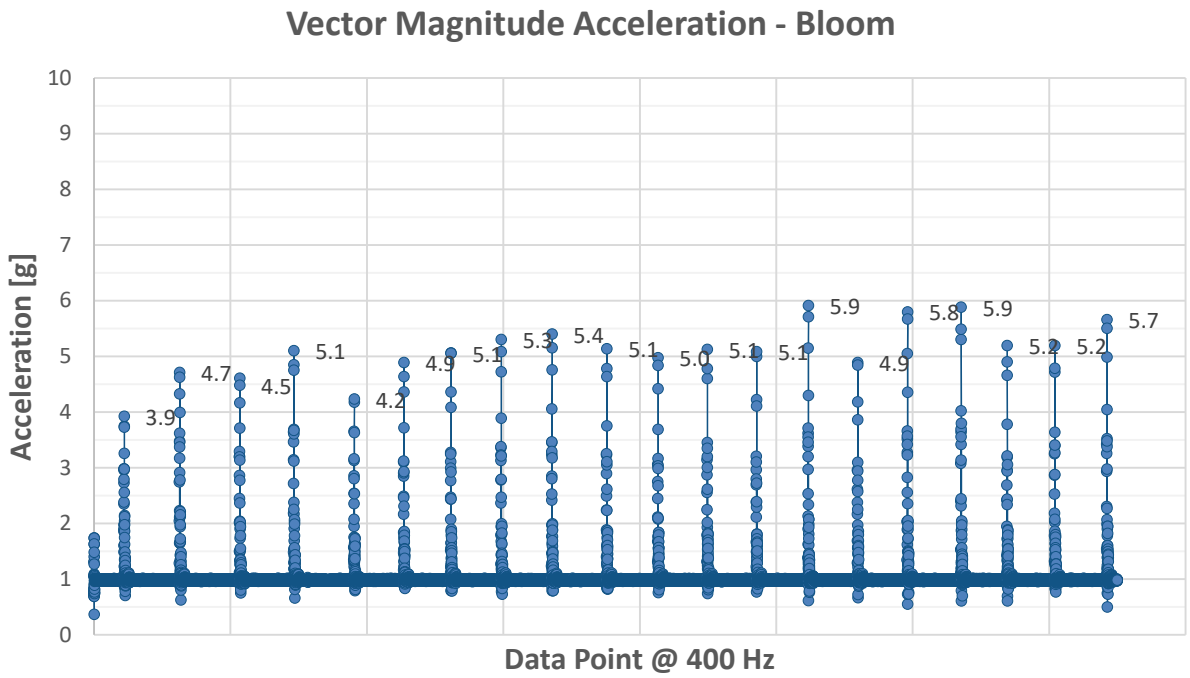
Y Acceleration (Head to Toe) - Casper

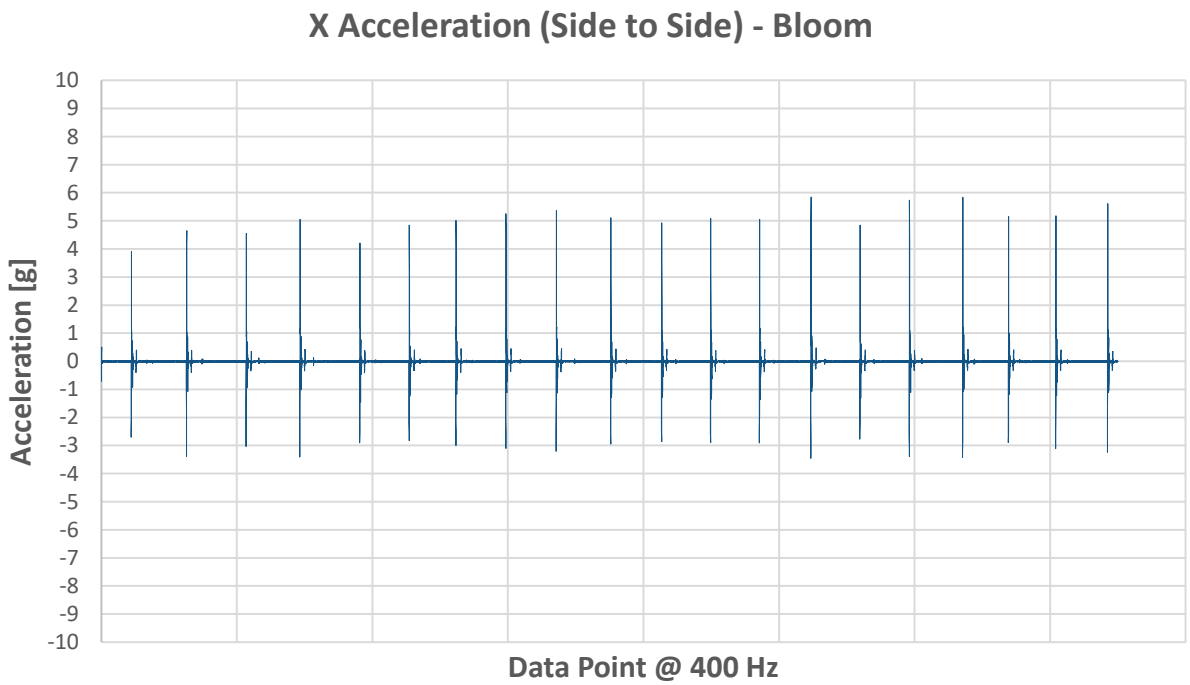


Z Acceleration (Up and Down) - Casper

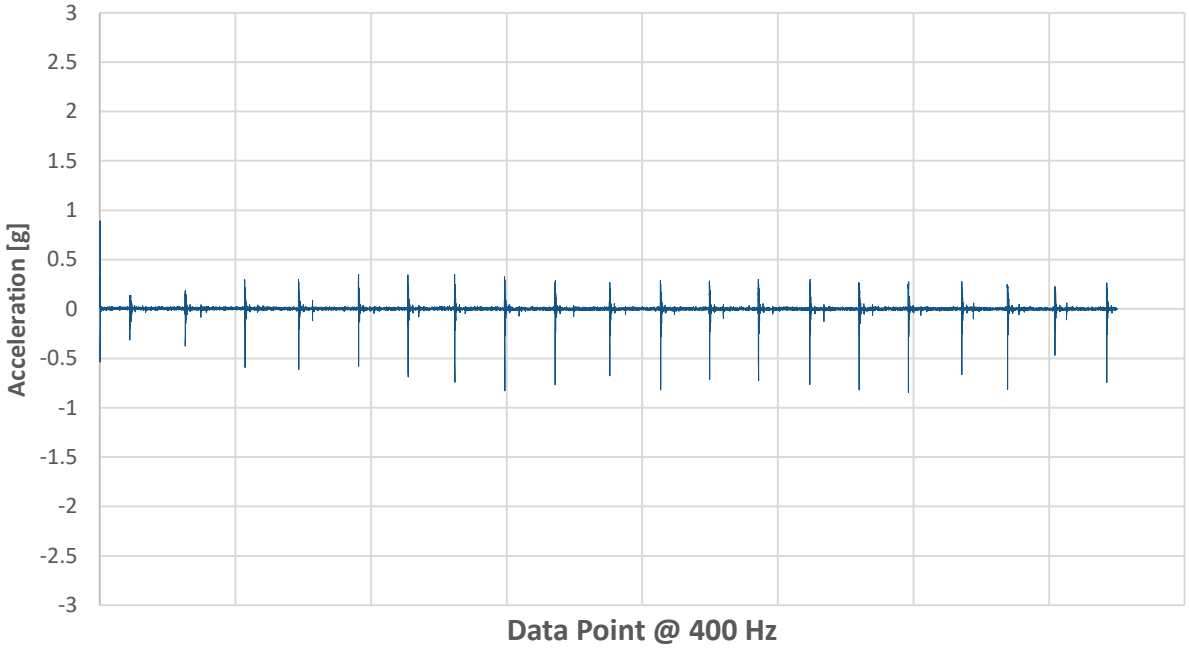


TEST 3 – BLOOM

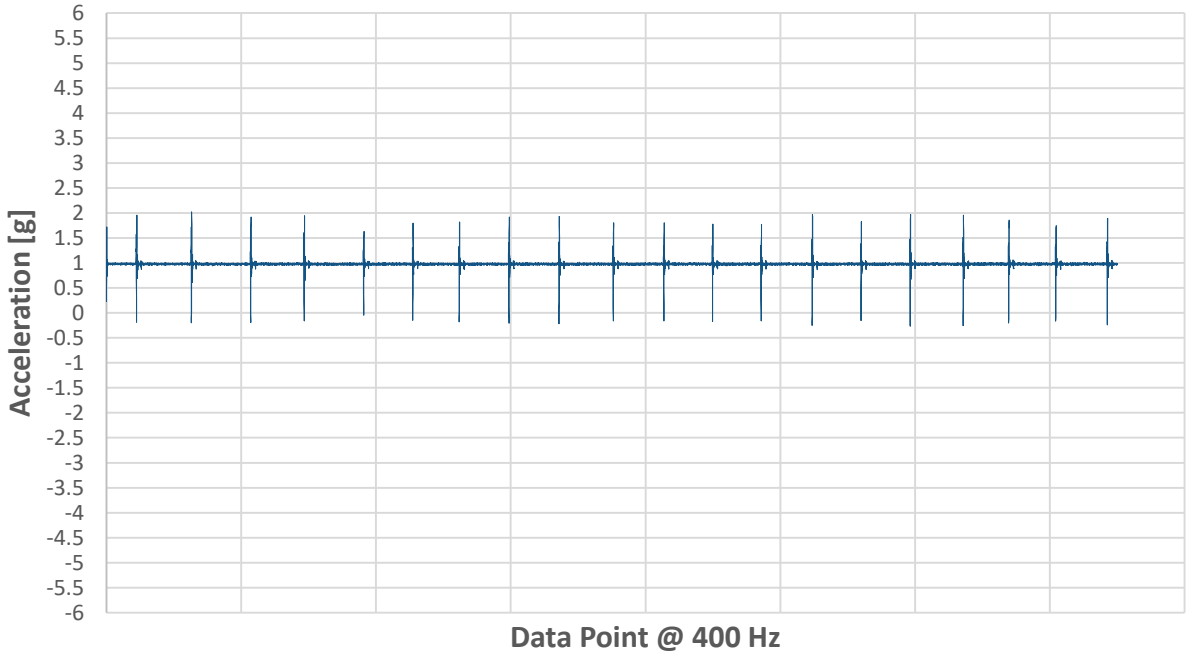

Vector Magnitude Acceleration - Bloom
Acceleration [g]
Data Point @ 400 Hz
3.9
4.7
4.5
5.1
4.2
4.9
5.1
5.3
5.4
5.1
5.0
5.1
5.1
5.9
4.9
5.8
5.9
5.2
5.2
5.7


X Acceleration (Side to Side) - Bloom
Acceleration [g]
Data Point @ 400 Hz

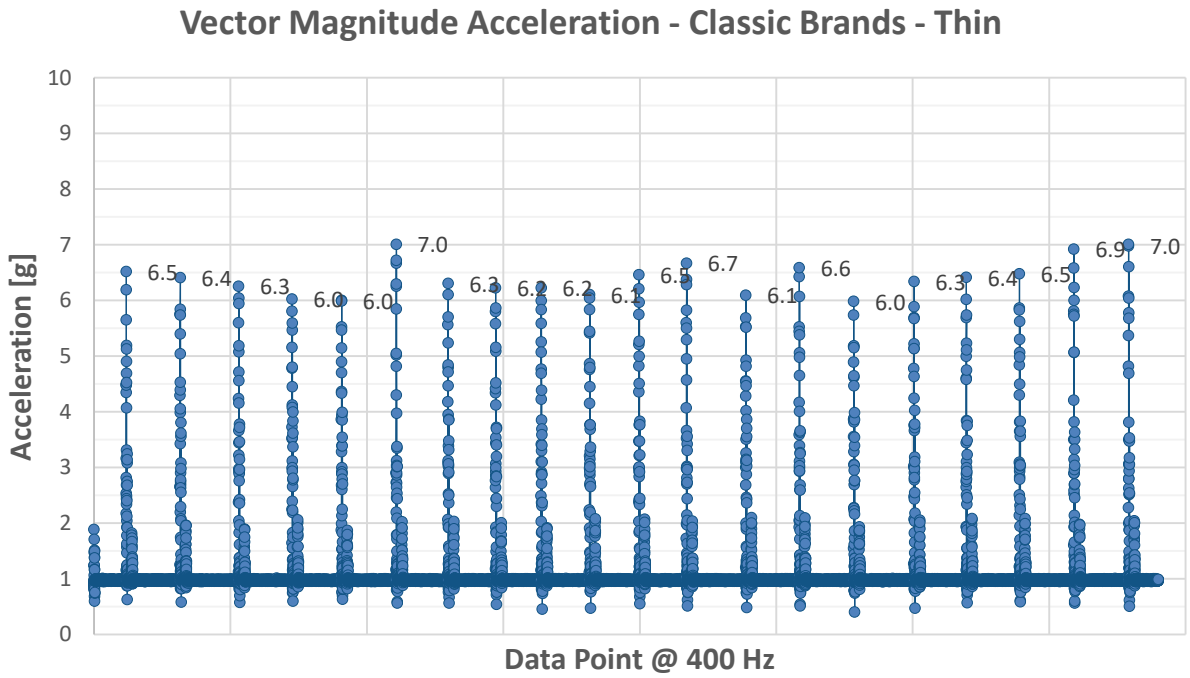
Y Acceleration (Head to Toe) - Bloom

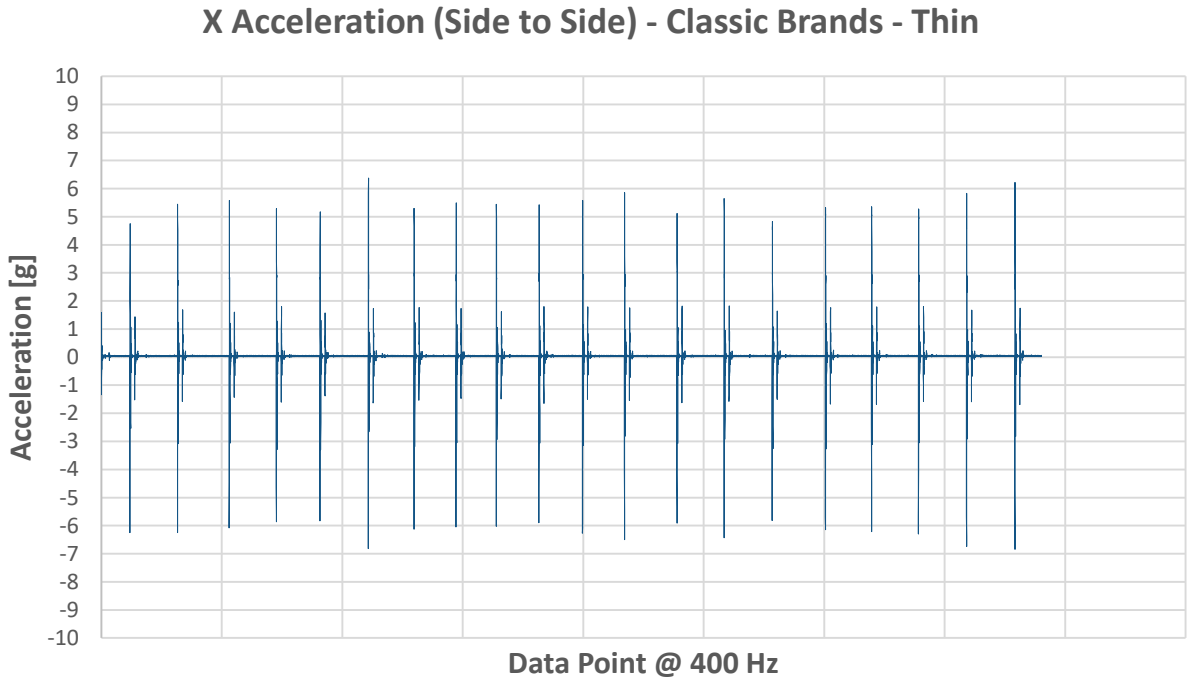


Z Acceleration (Up and Down) - Bloom

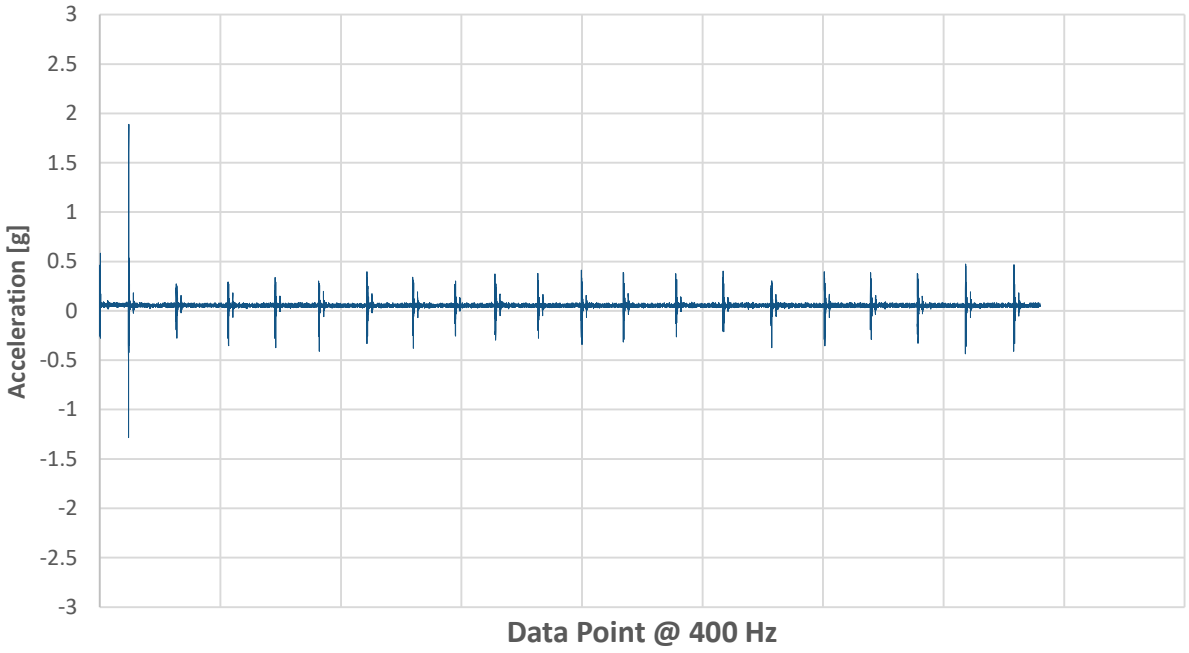


TEST 3 – CLASSIC BRANDS – THIN

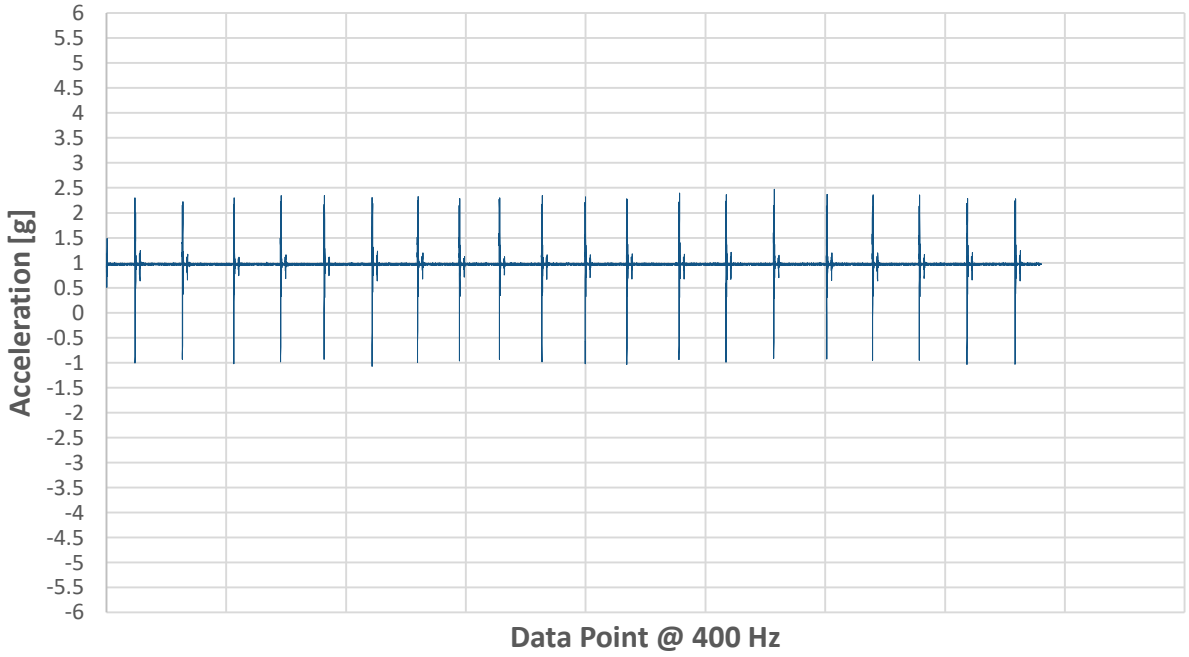




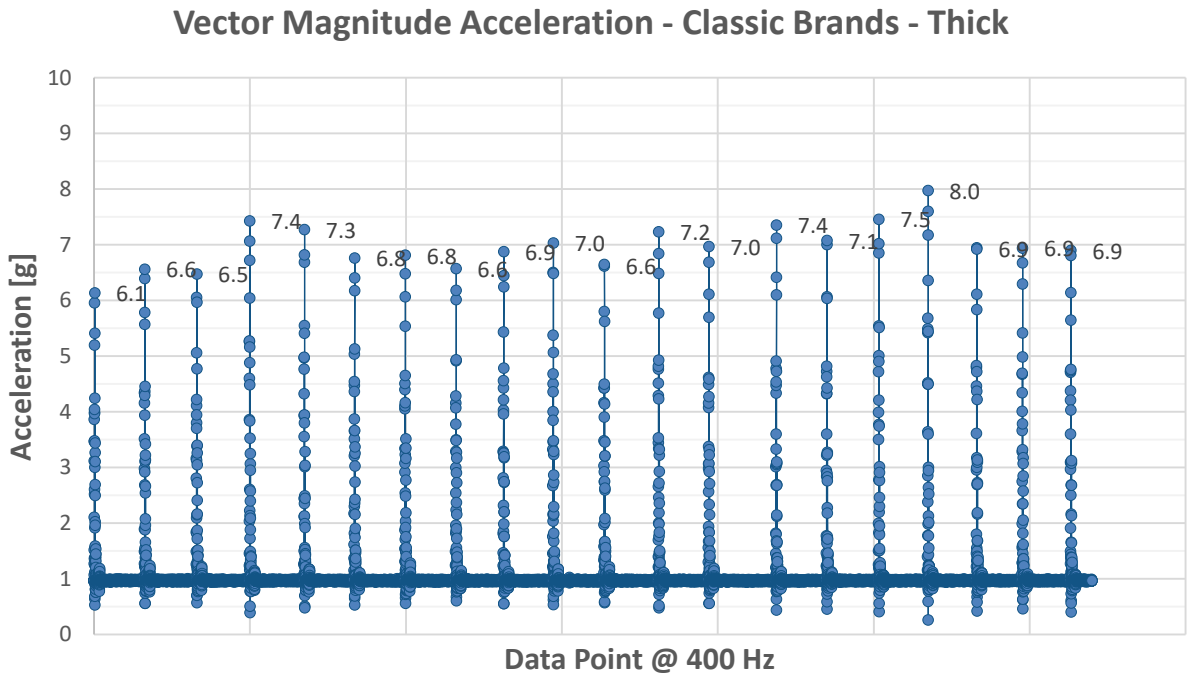
Y Acceleration (Head to Toe) - Classic Brands - Thin

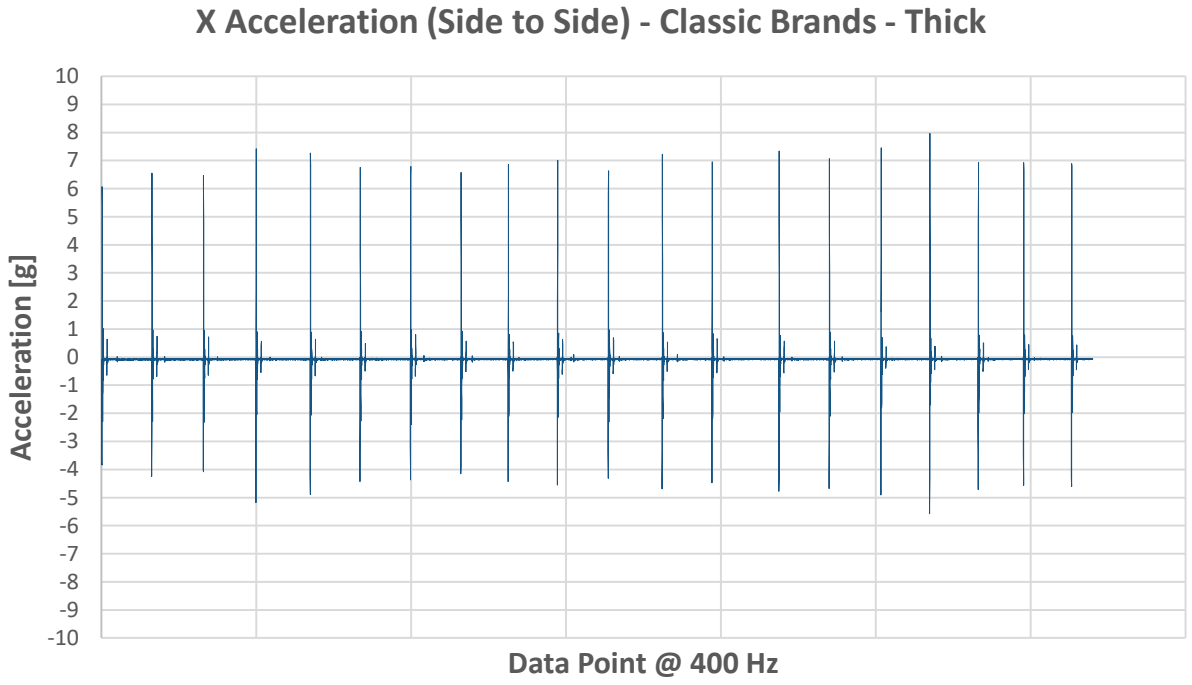


Z Acceleration (Up and Down) - Classic Brands - Thin

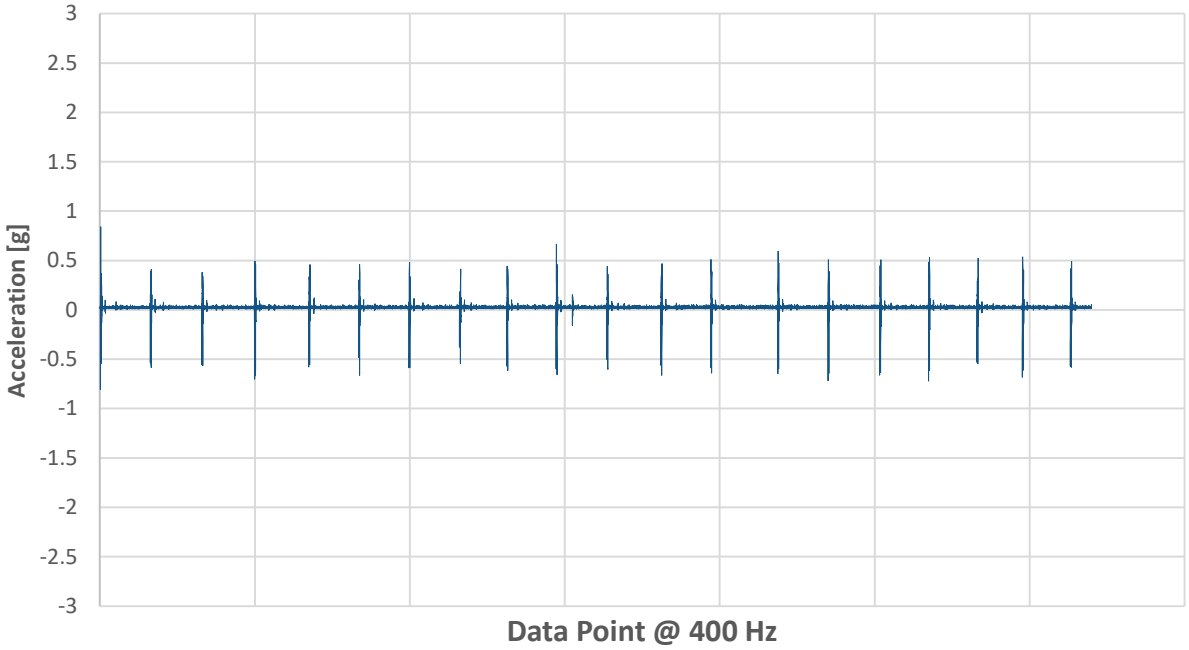


TEST 3 – CLASSIC BRANDS – THICK

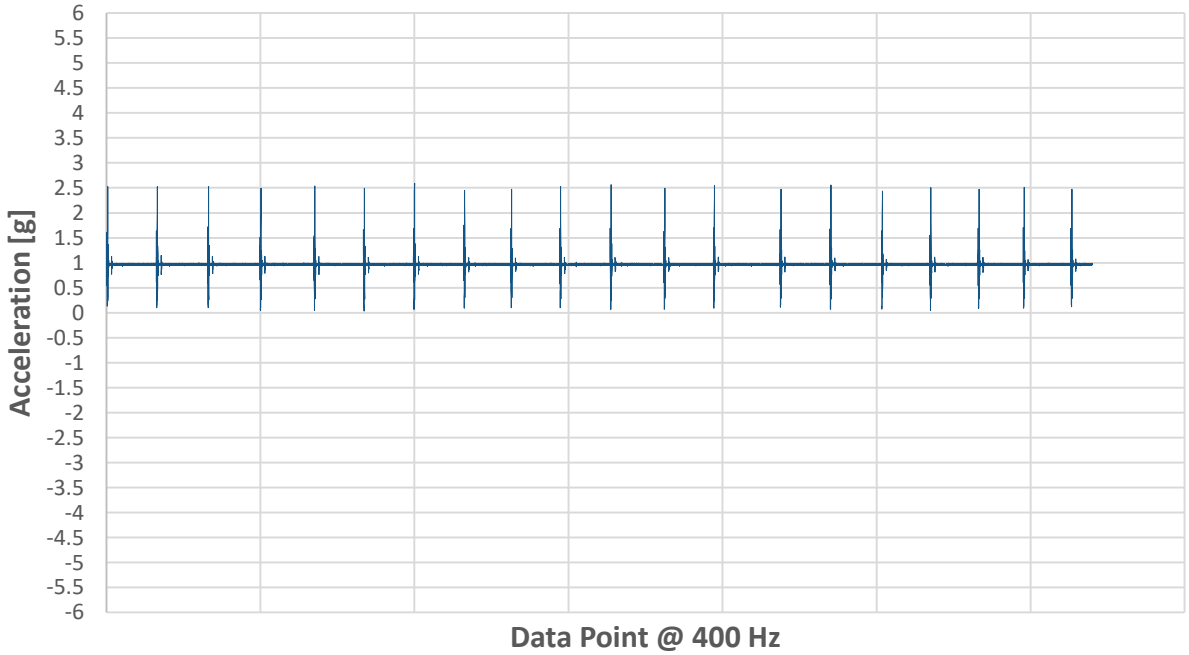




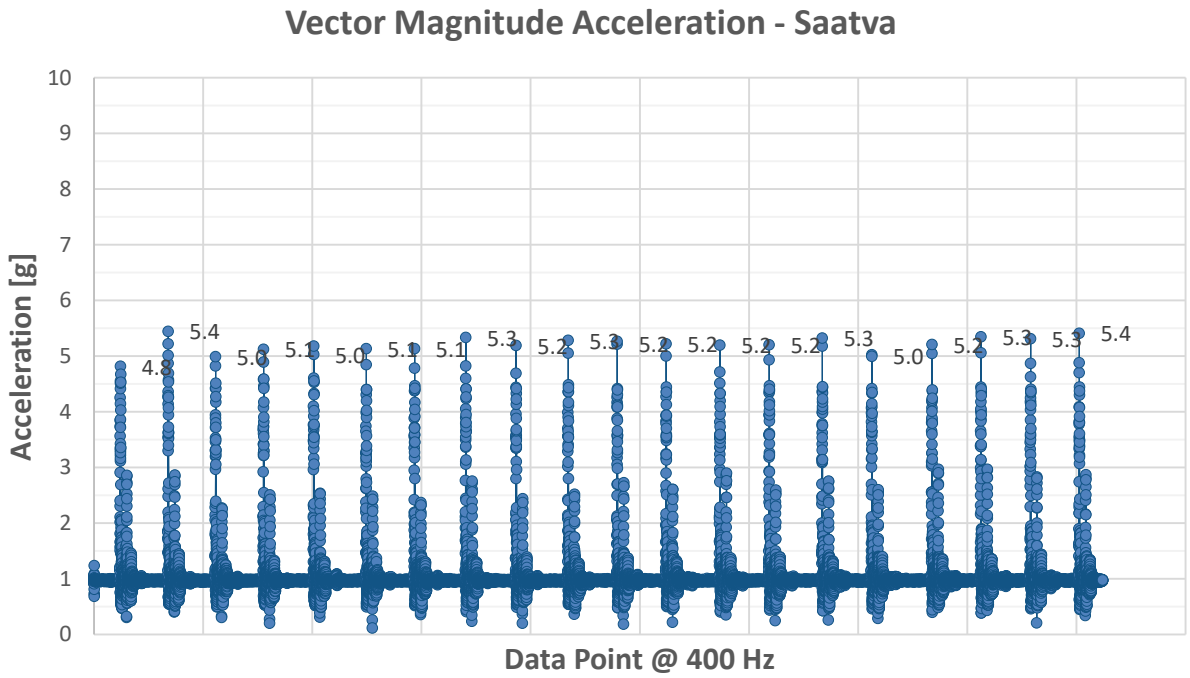
Y Acceleration (Head to Toe) - Classic Brands - Thick

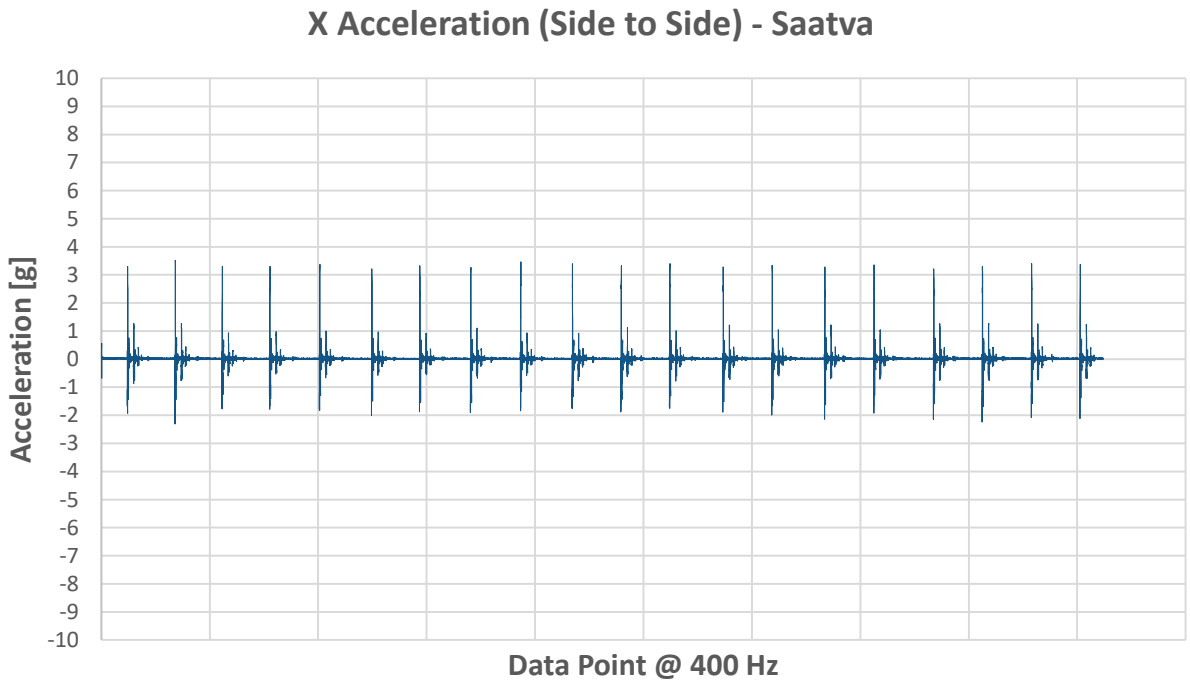


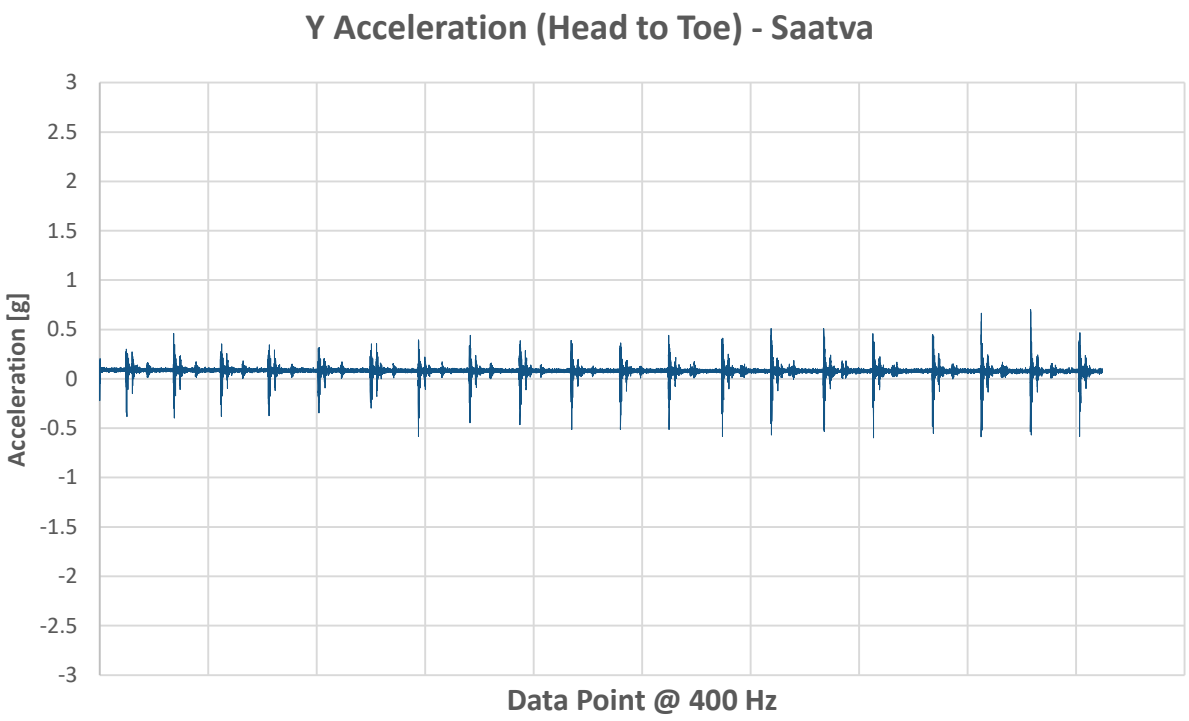
Z Acceleration (Up and Down) - Classic Brands - Thick

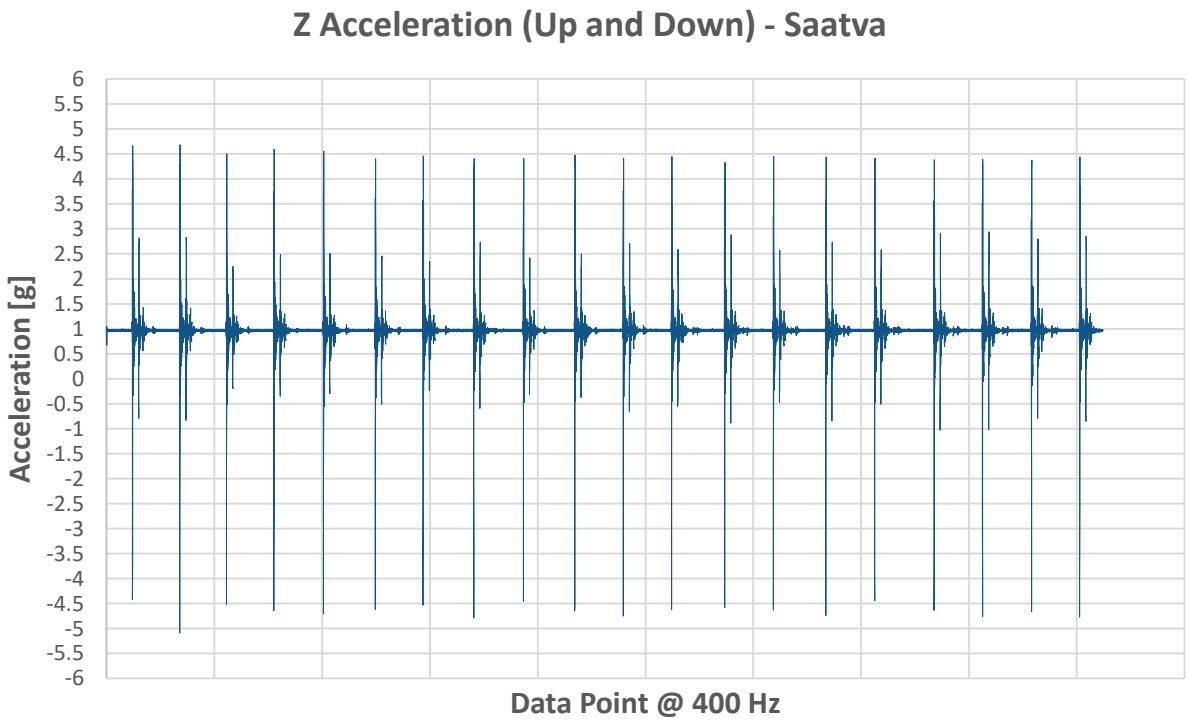


TEST 3 – SAATVA

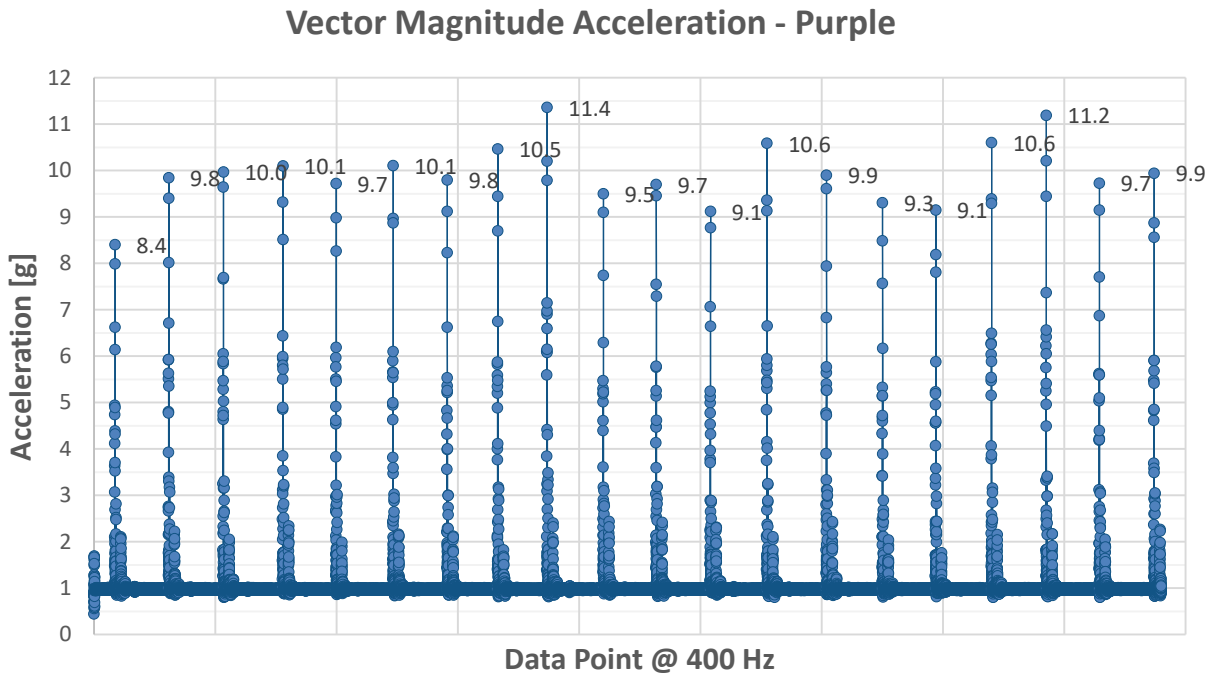


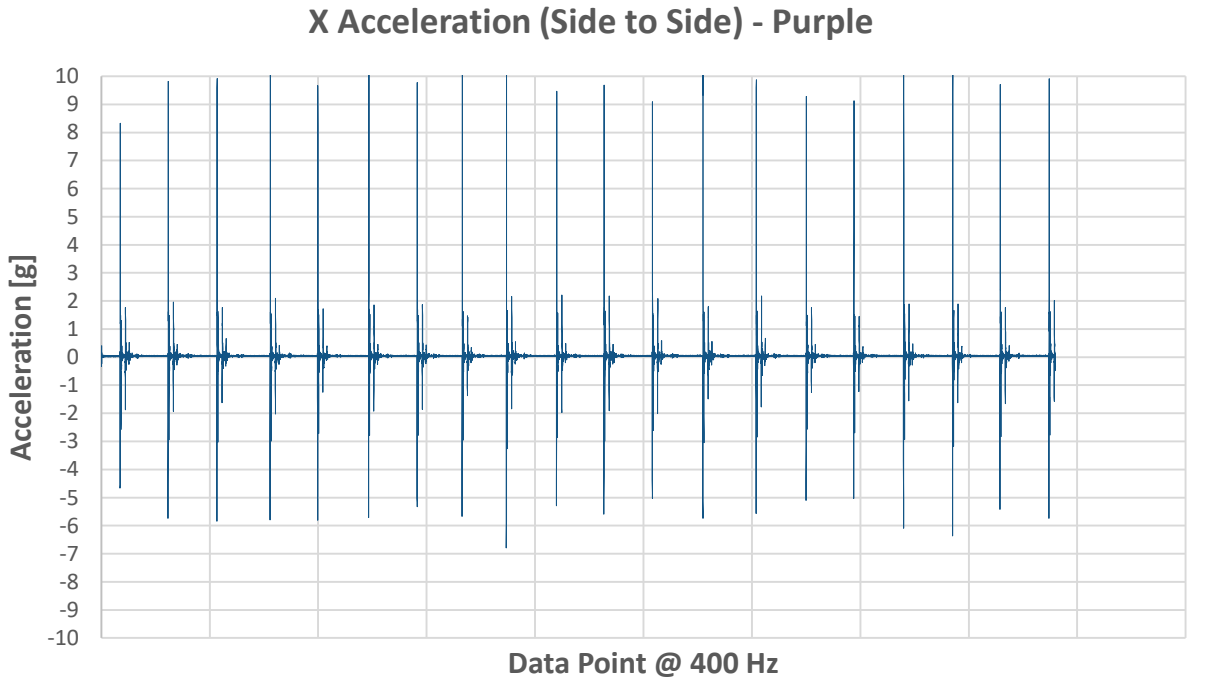


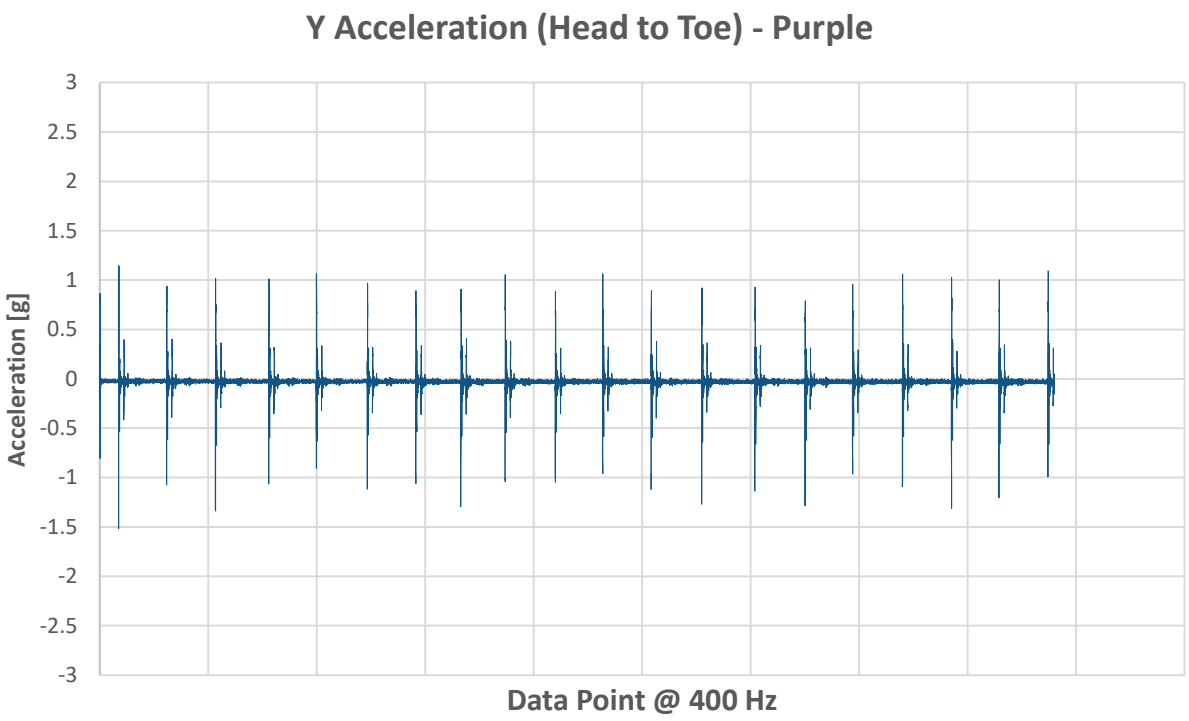

Y Acceleration (Head to Toe) - Saatva
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

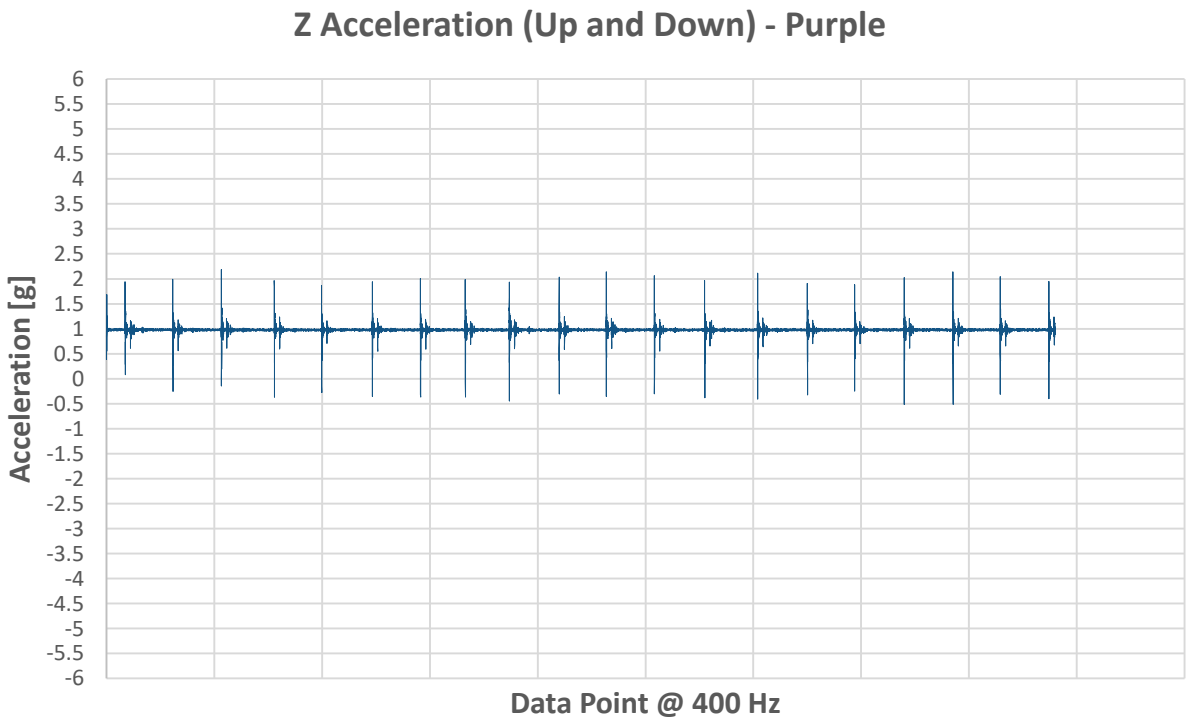

Z Acceleration (Up and Down) - Saatva
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – PURPLE

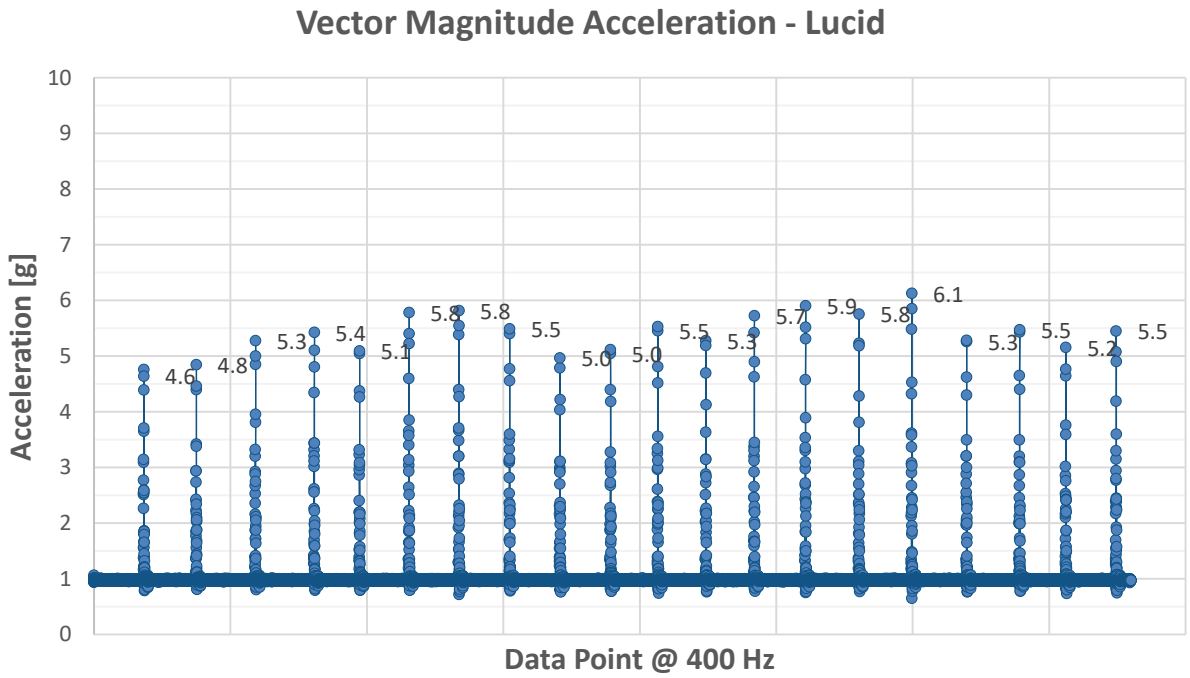


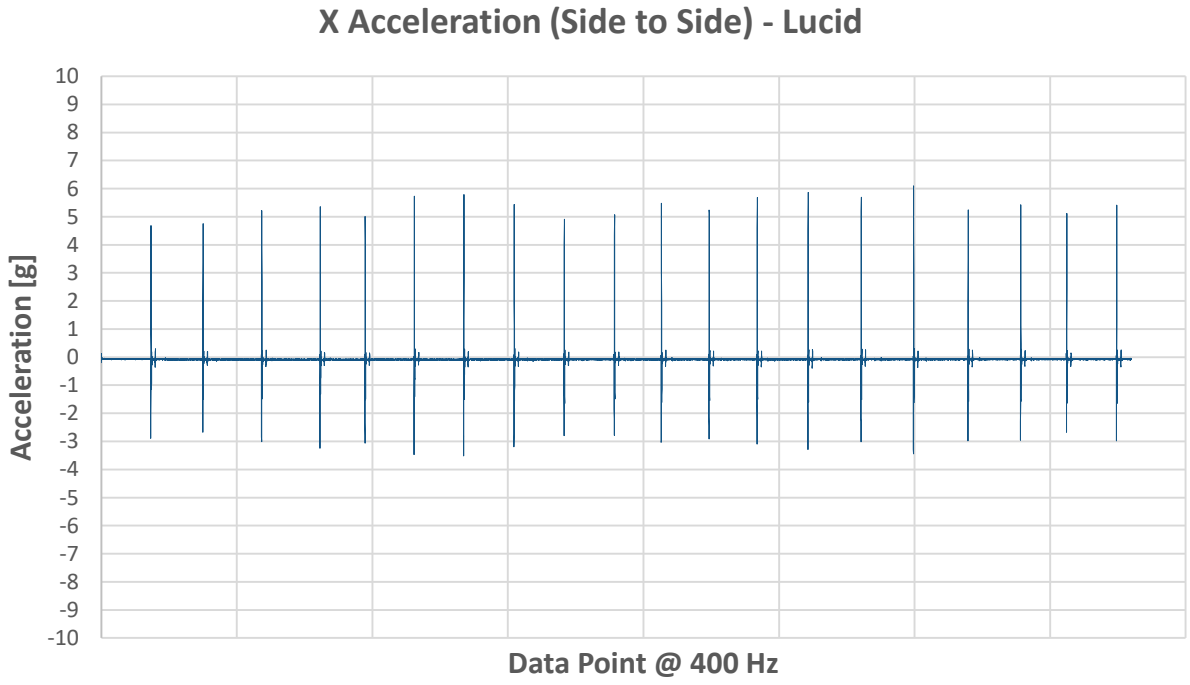


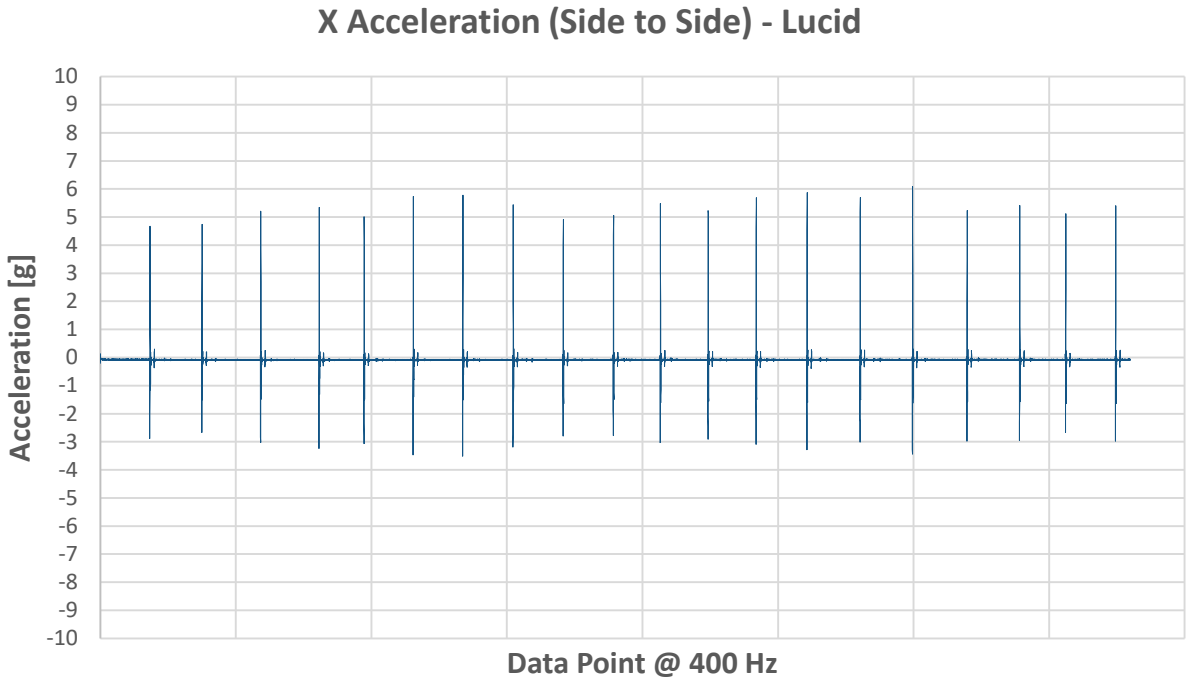

Y Acceleration (Head to Toe) - Purple
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

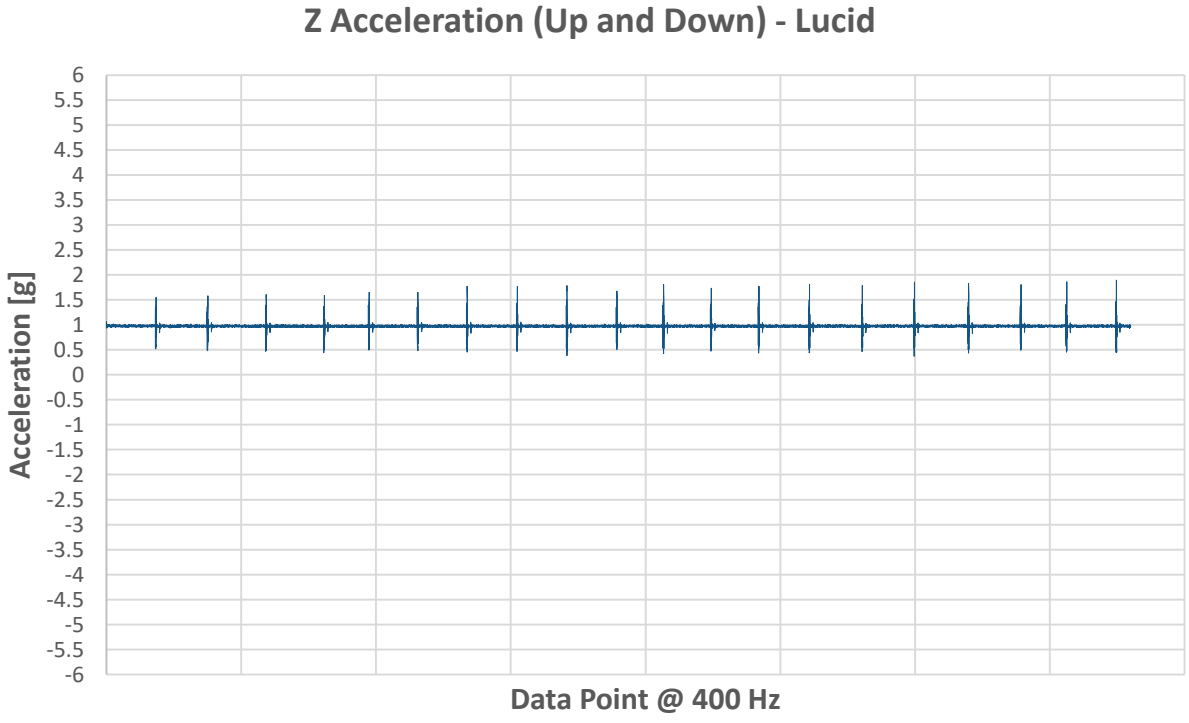

Z Acceleration (Up and Down) - Purple
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – LUCID

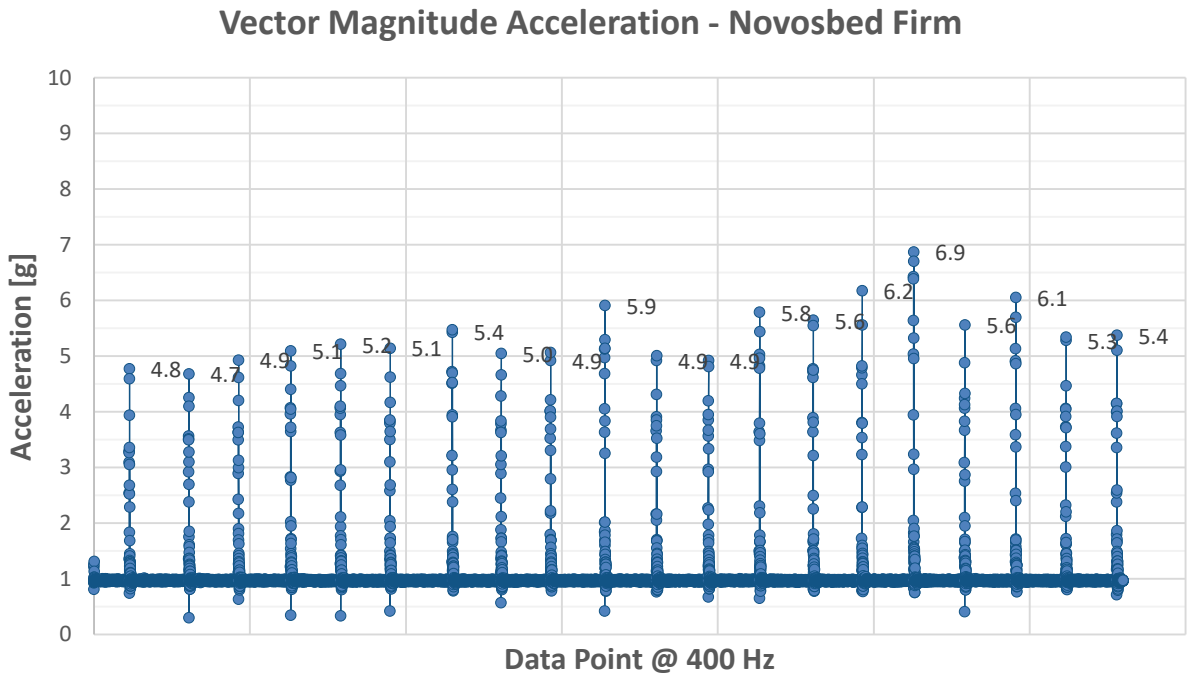

Vector Magnitude Acceleration - Lucid
Acceleration [g]
Data Point @ 400 Hz
4.6
4.8
5.3
5.4
5.1
5.8
5.8
5.5
5.0
5.0
5.5
5.3
5.7
5.9
5.8
6.1
5.3
5.5
5.2
5.5

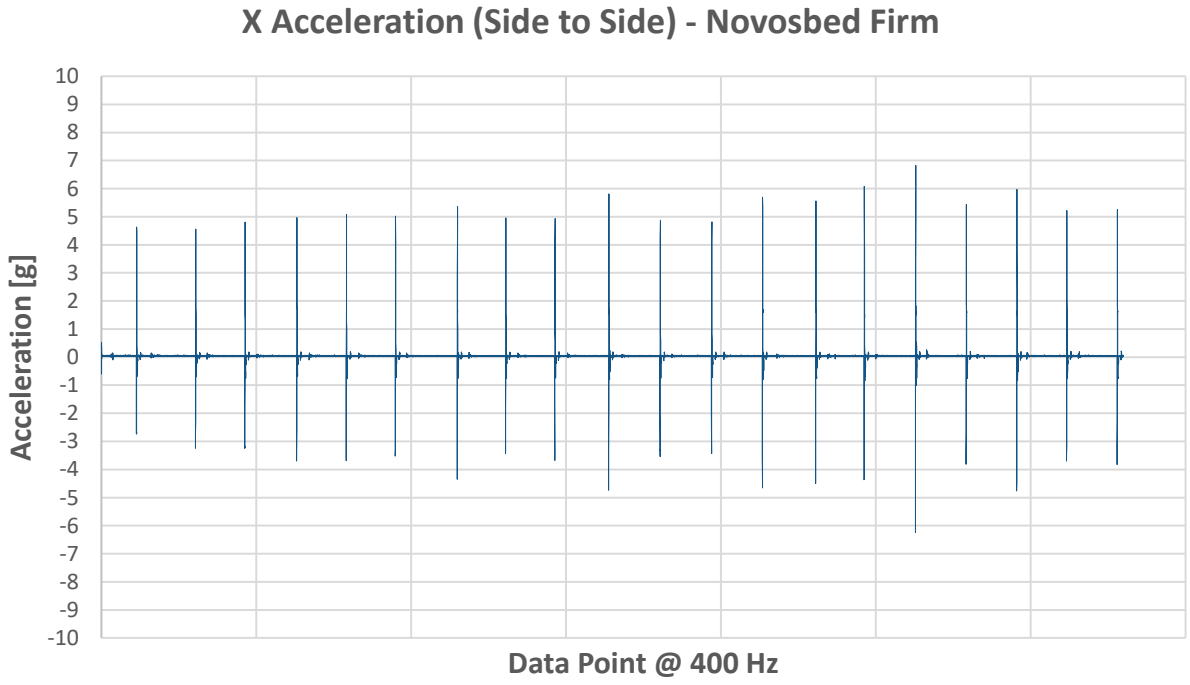

X Acceleration (Side to Side) - Lucid
Acceleration [g]
Data Point @ 400 Hz

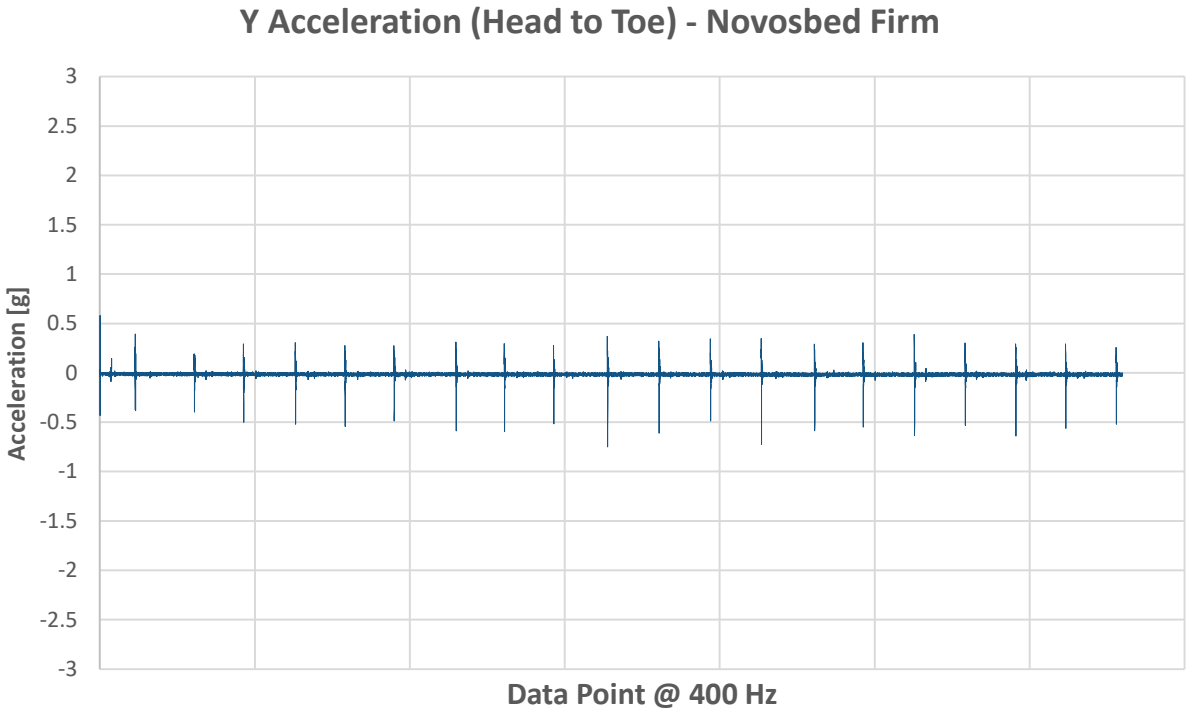

X Acceleration (Side to Side) - Lucid
Acceleration [g]
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
Data Point @ 400 Hz

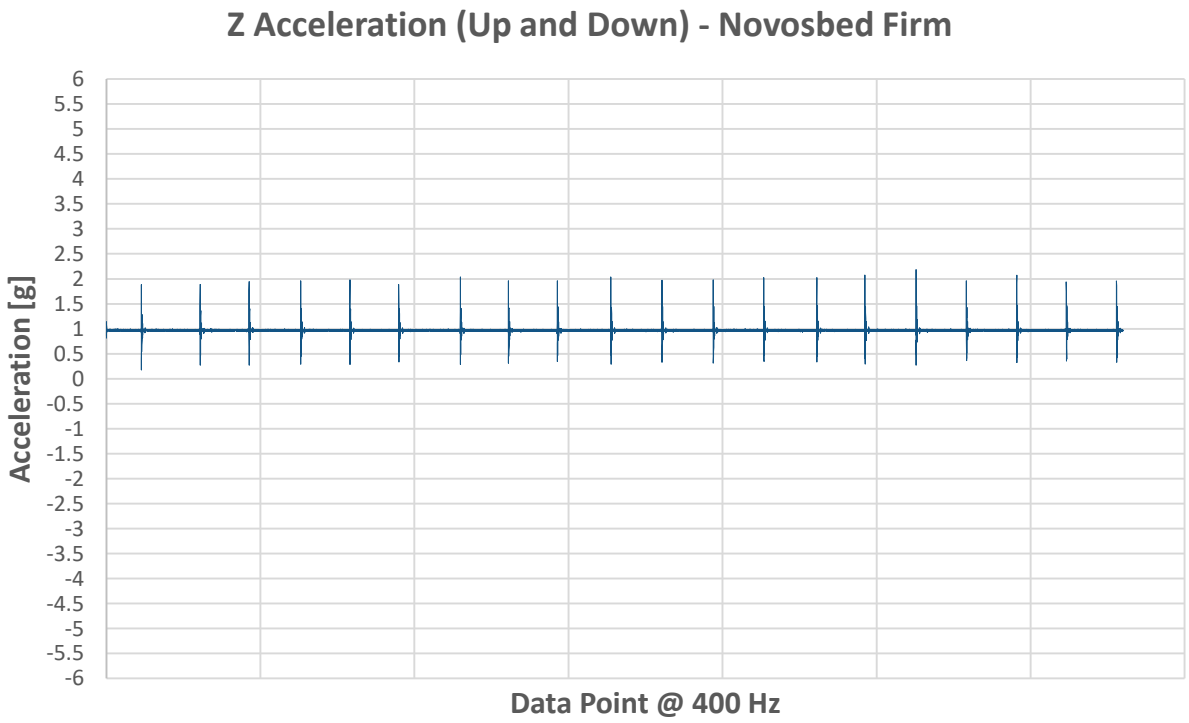

Z Acceleration (Up and Down) - Lucid
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – NOVOSBED FIRM

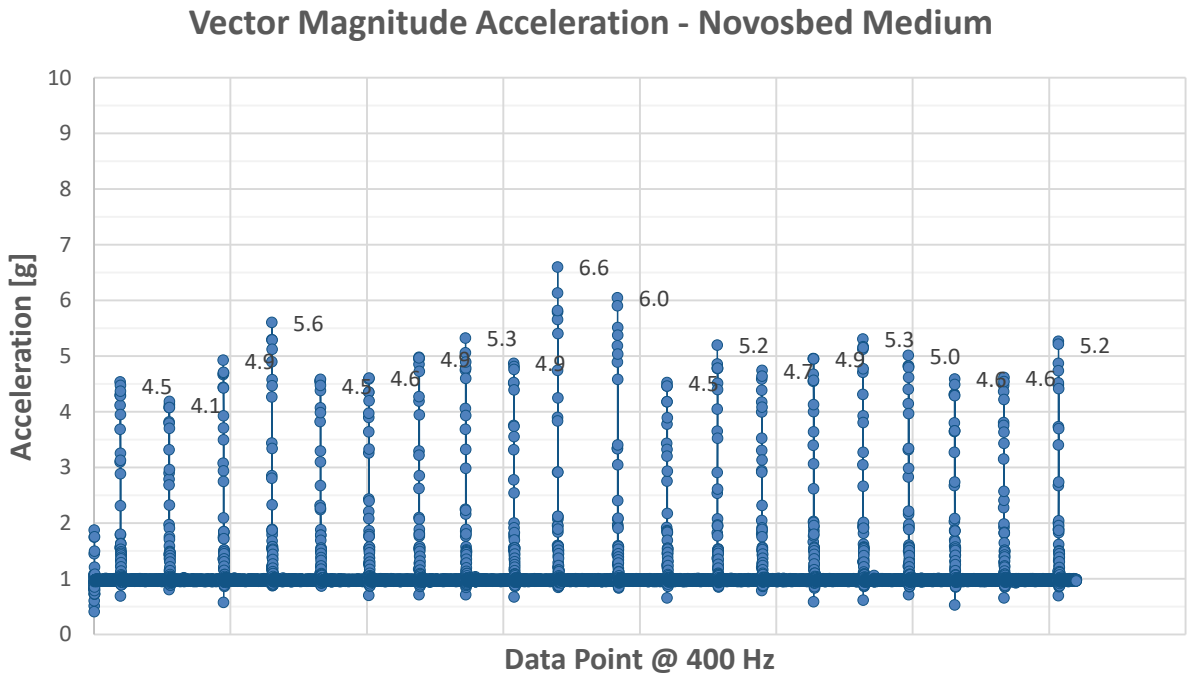


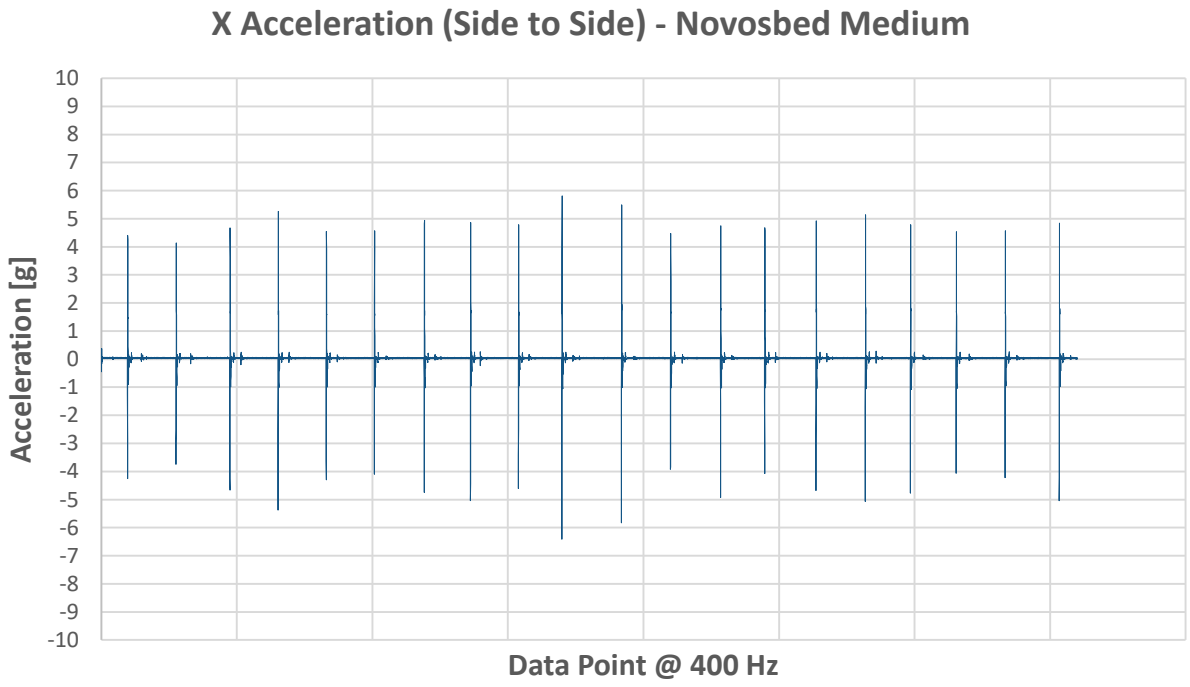



Y Acceleration (Head to Toe) - Novosbed Firm
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

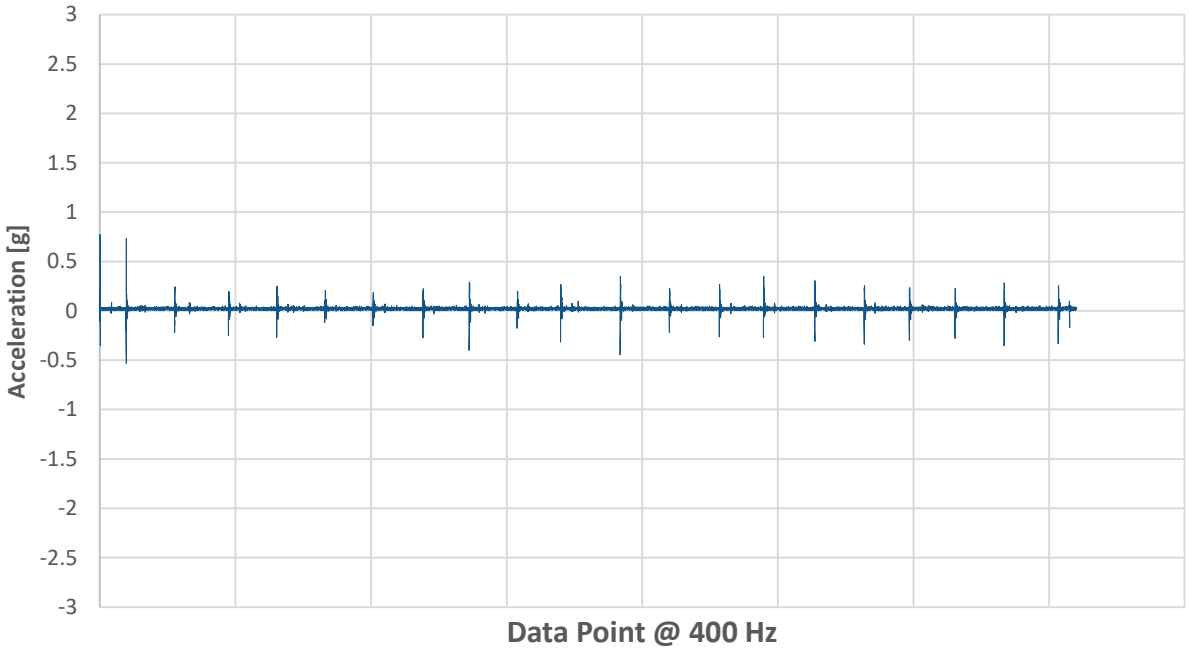

Z Acceleration (Up and Down) - Novosbed Firm
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – NOVOSBED MEDIUM

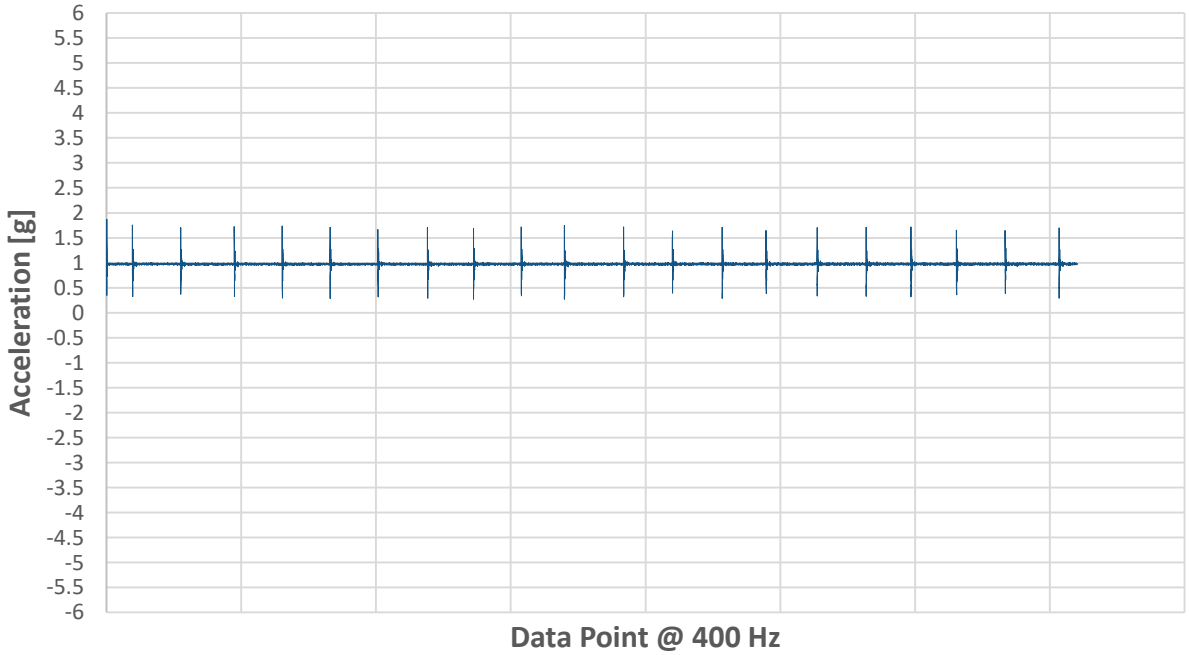




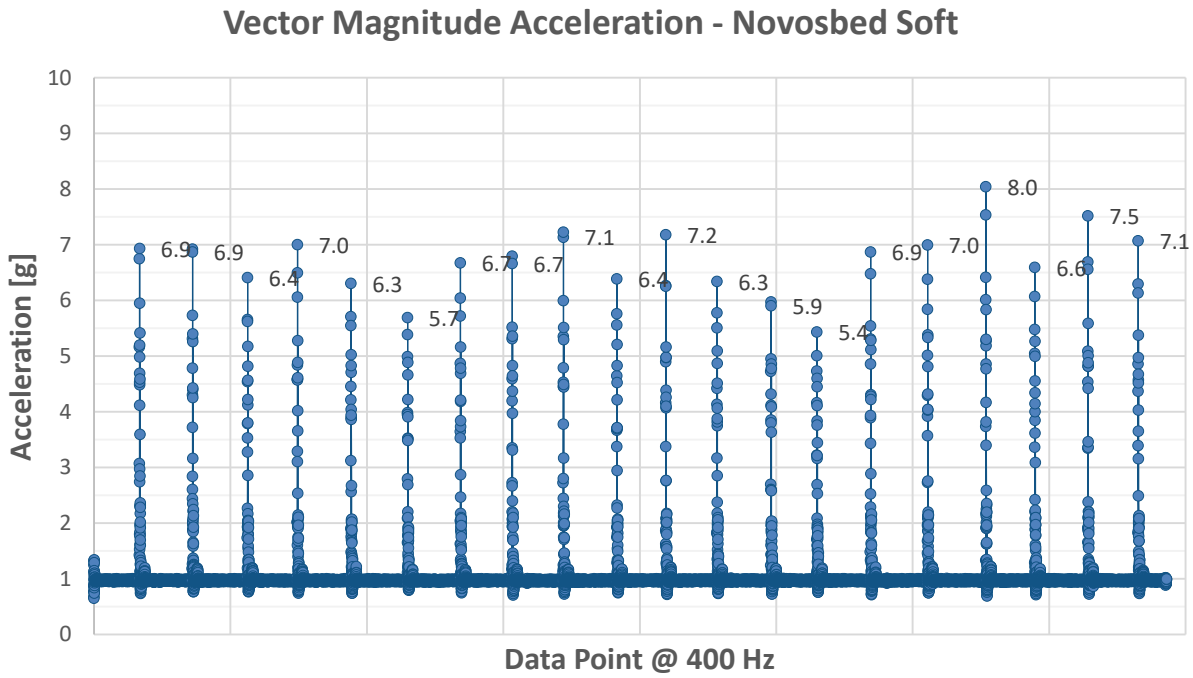
Y Acceleration (Head to Toe) - Novosbed Medium

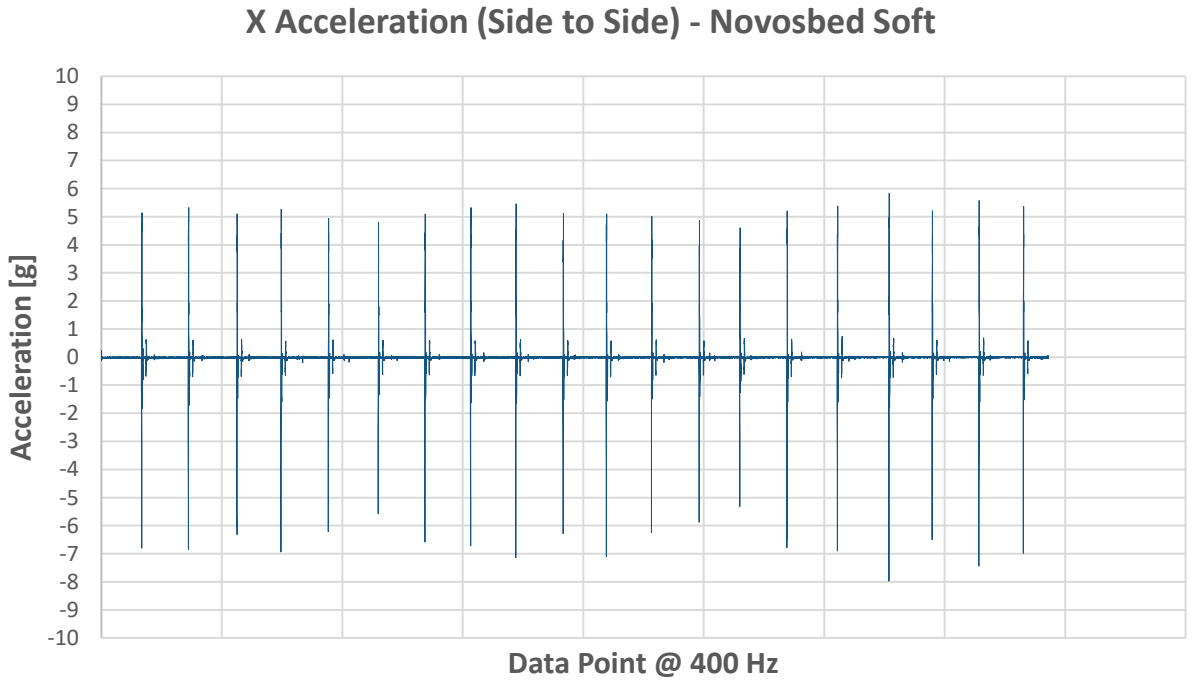


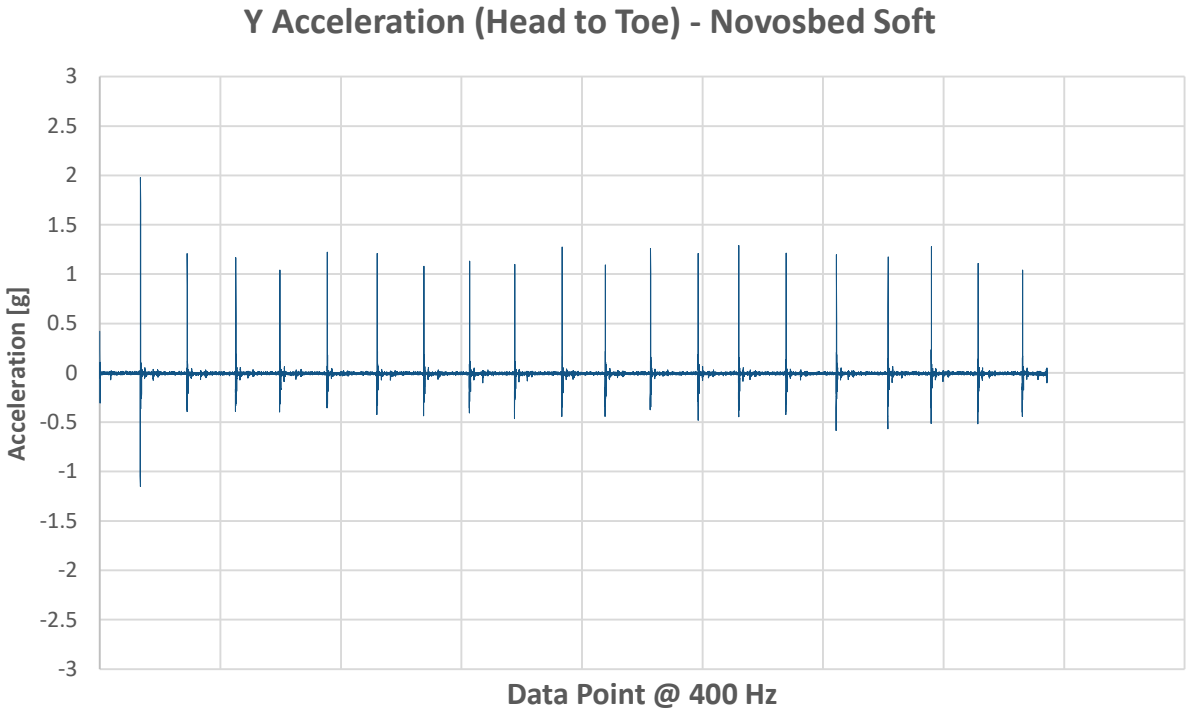
Z Acceleration (Up and Down) - Novosbed Medium

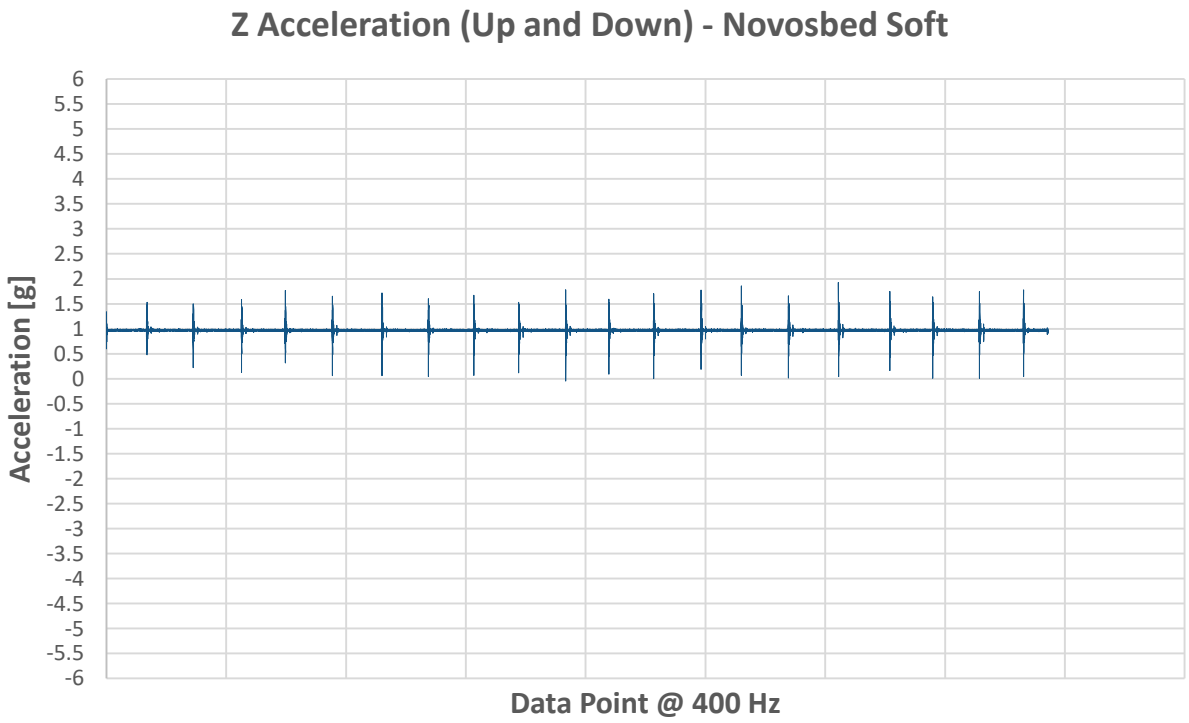


TEST 3 – NOVOSBED SOFT

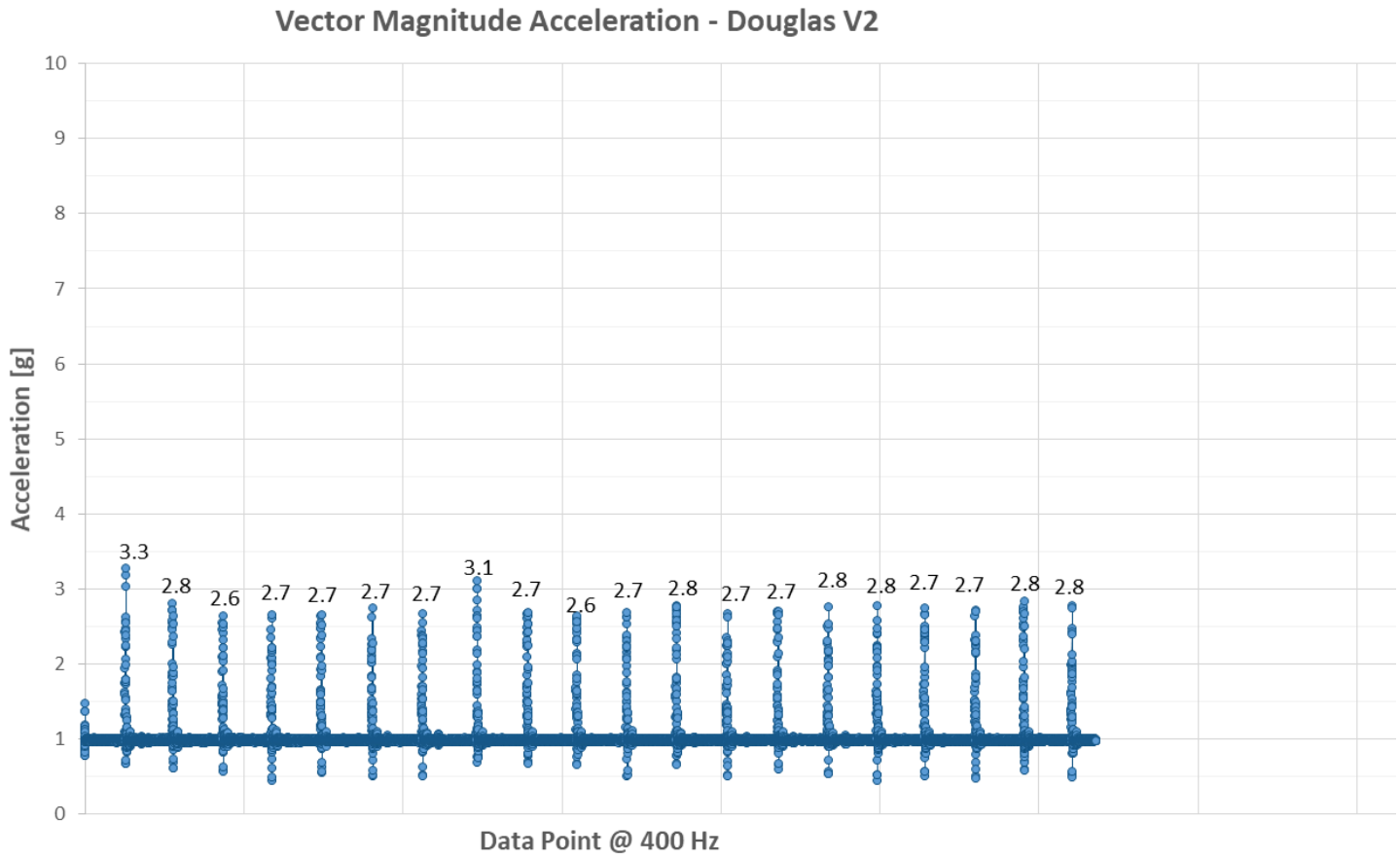


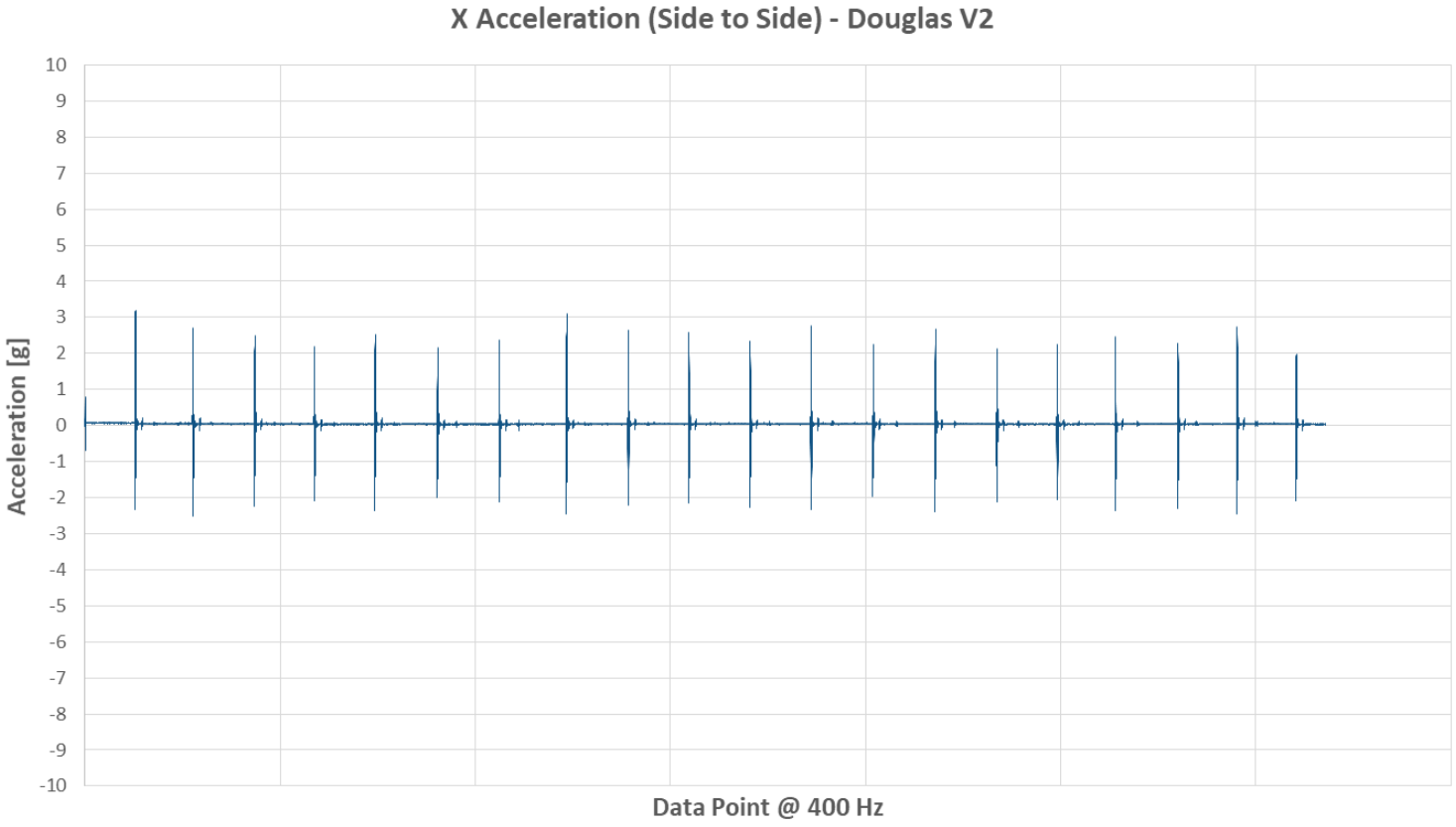


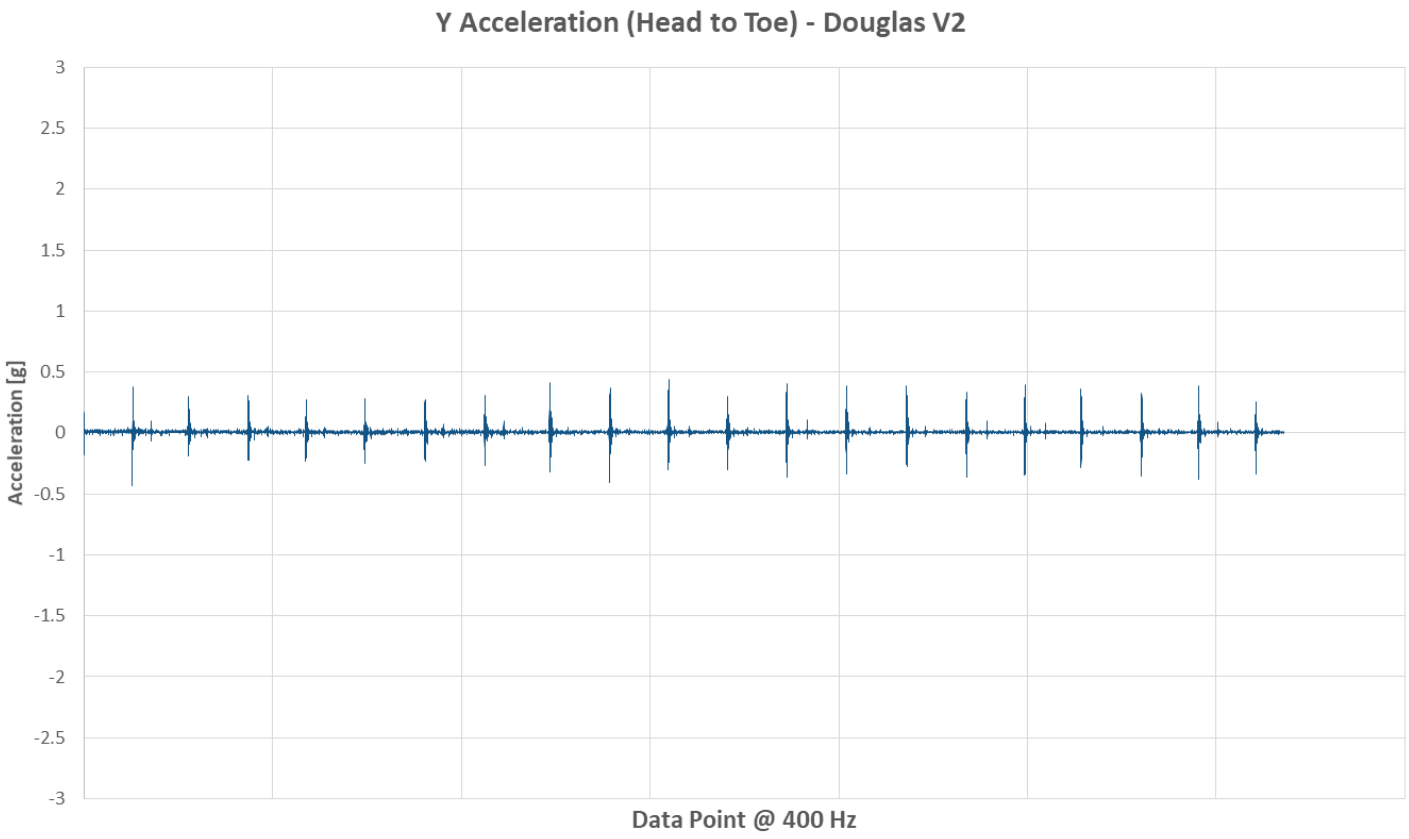

Y Acceleration (Head to Toe) - Novosbed Soft
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

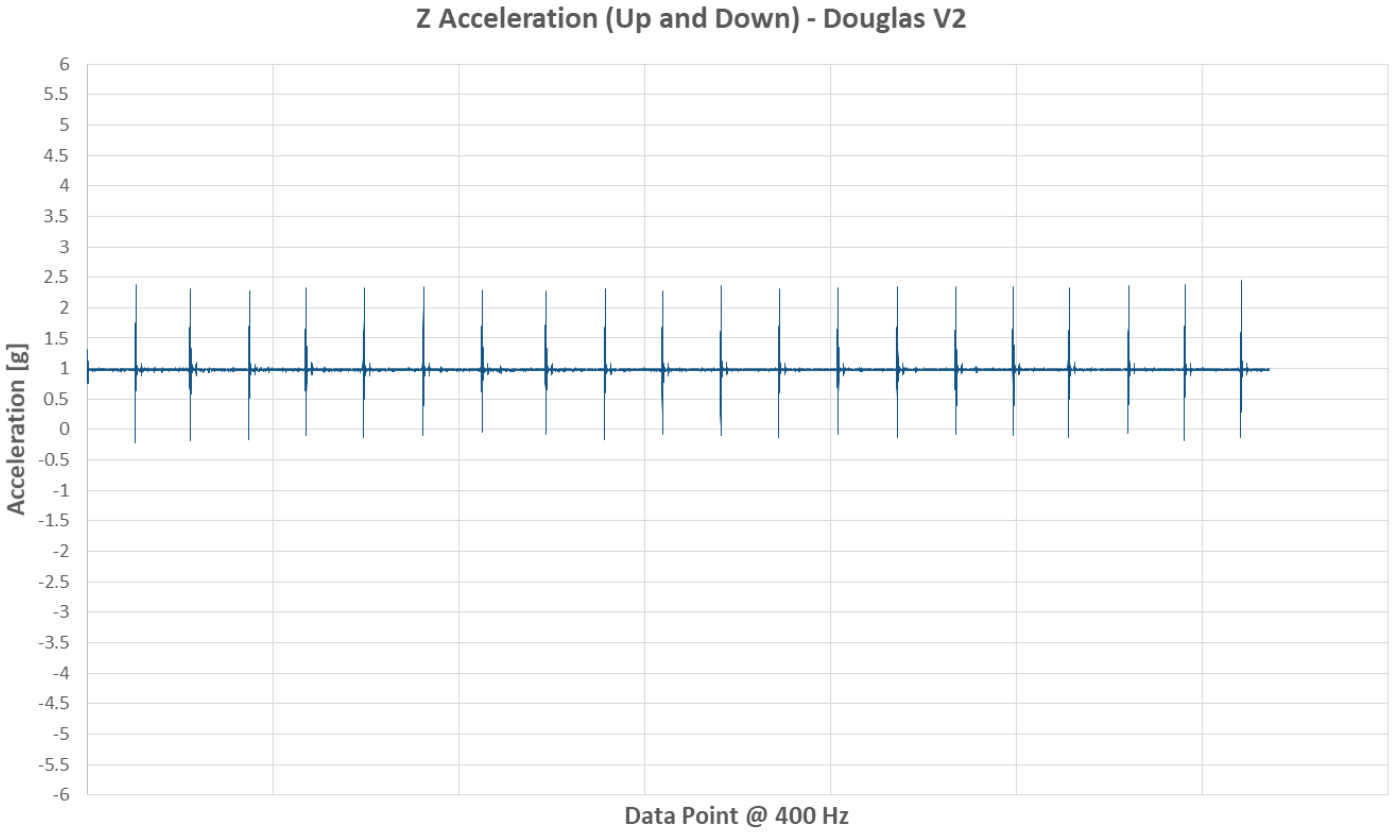

Z Acceleration (Up and Down) - Novosbed Soft
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – DOUGLAS V2

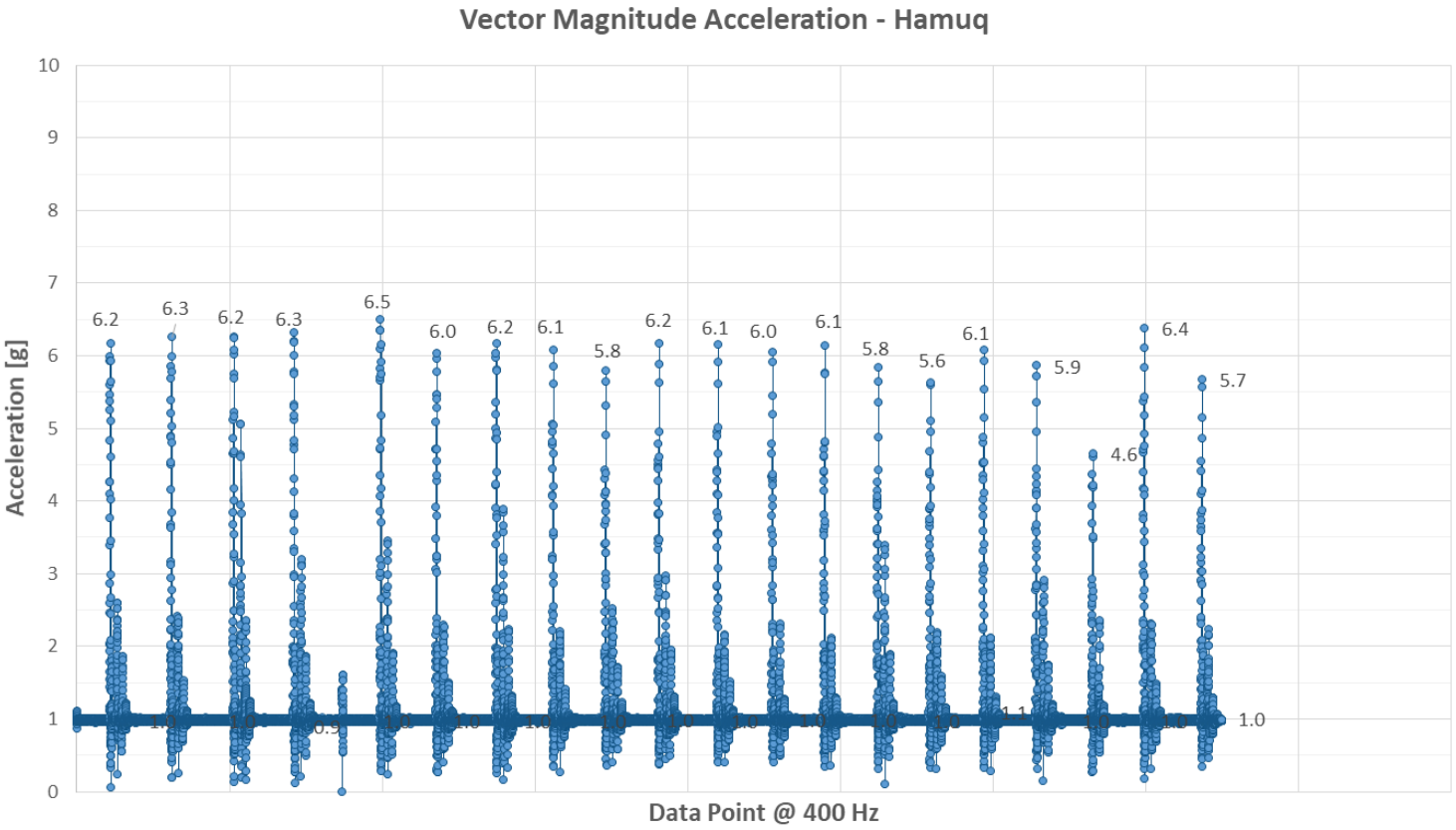


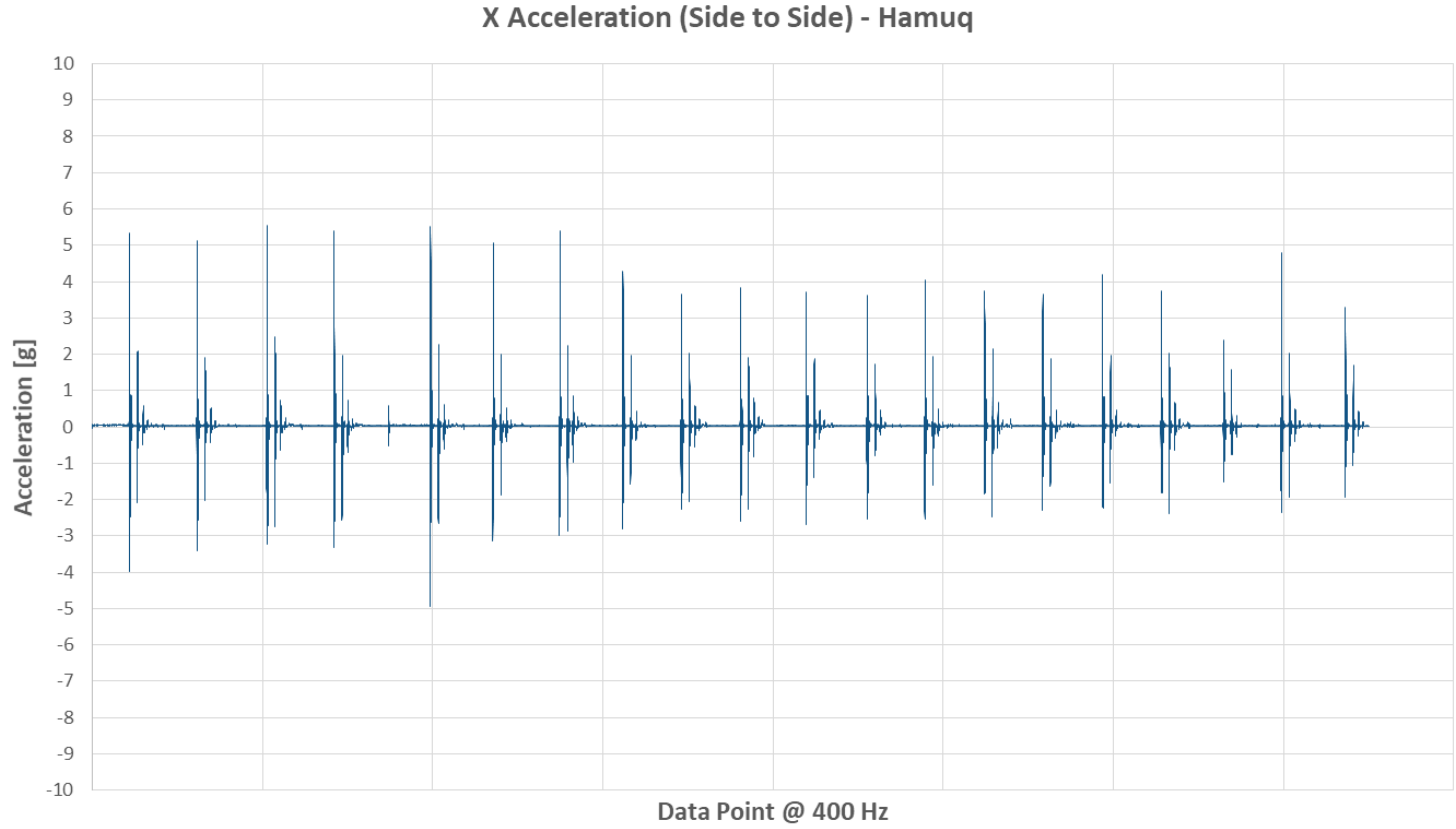


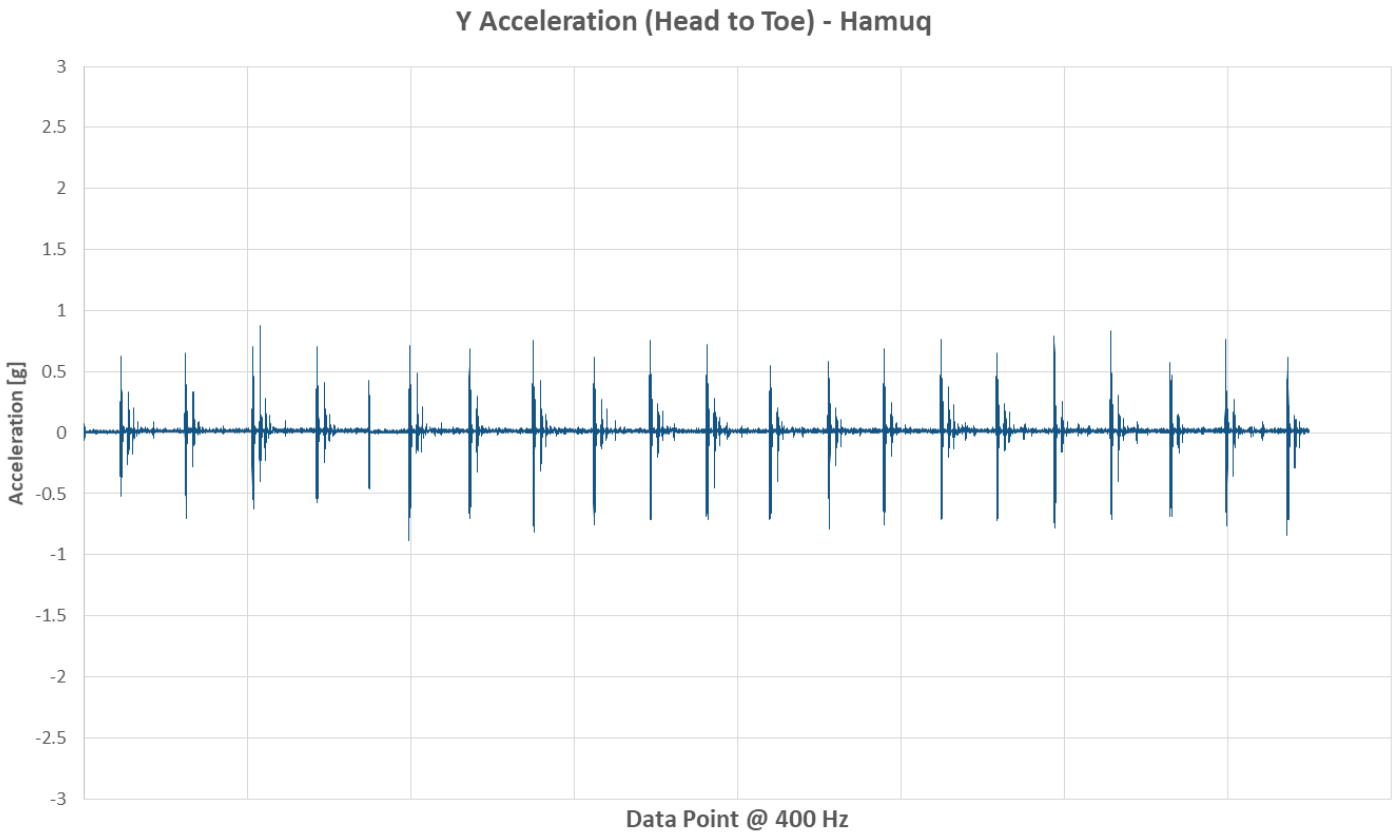

Y Acceleration (Head to Toe) - Douglas V2
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

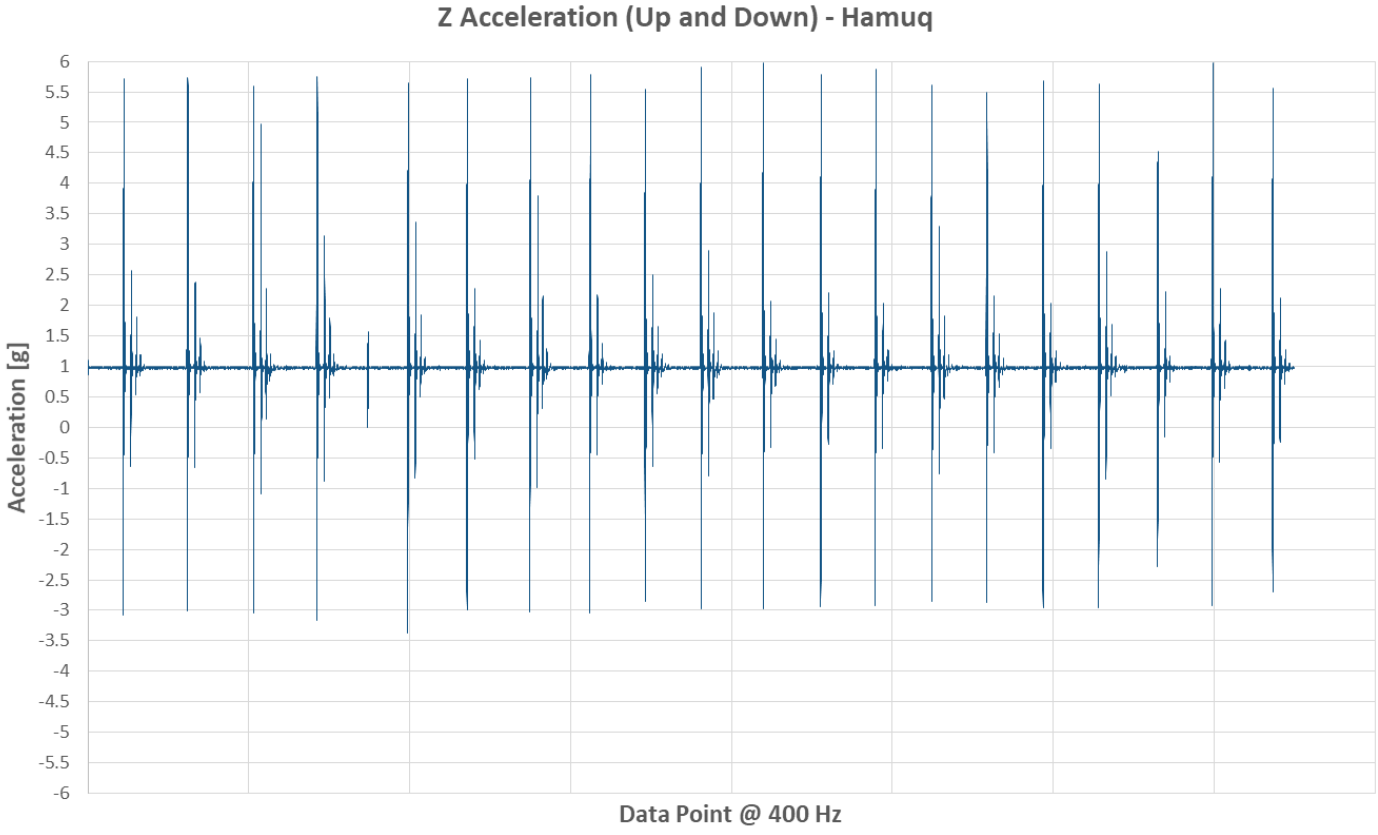

Z Acceleration (Up and Down) - Douglas V2
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – HAMUQ

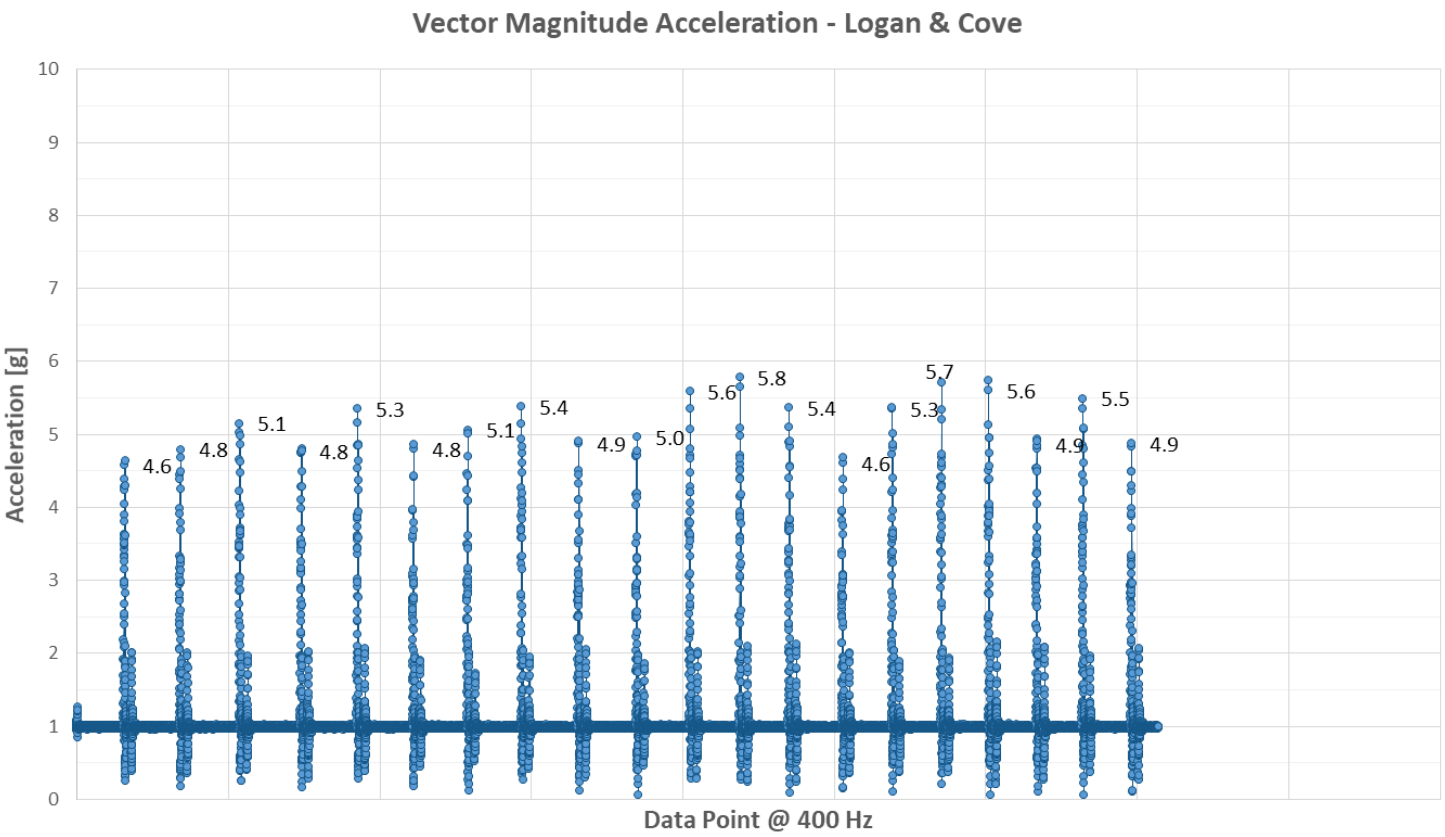

Vector Magnitude Acceleration - Hamuq
Acceleration [g]
Data Point @ 400 Hz
6.2
6.3
6.2
6.3
6.5
6.0
6.2
6.1
5.8
6.2
6.1
6.0
6.1
5.8
5.6
6.1
5.9
4.6
6.4
5.7
1.0

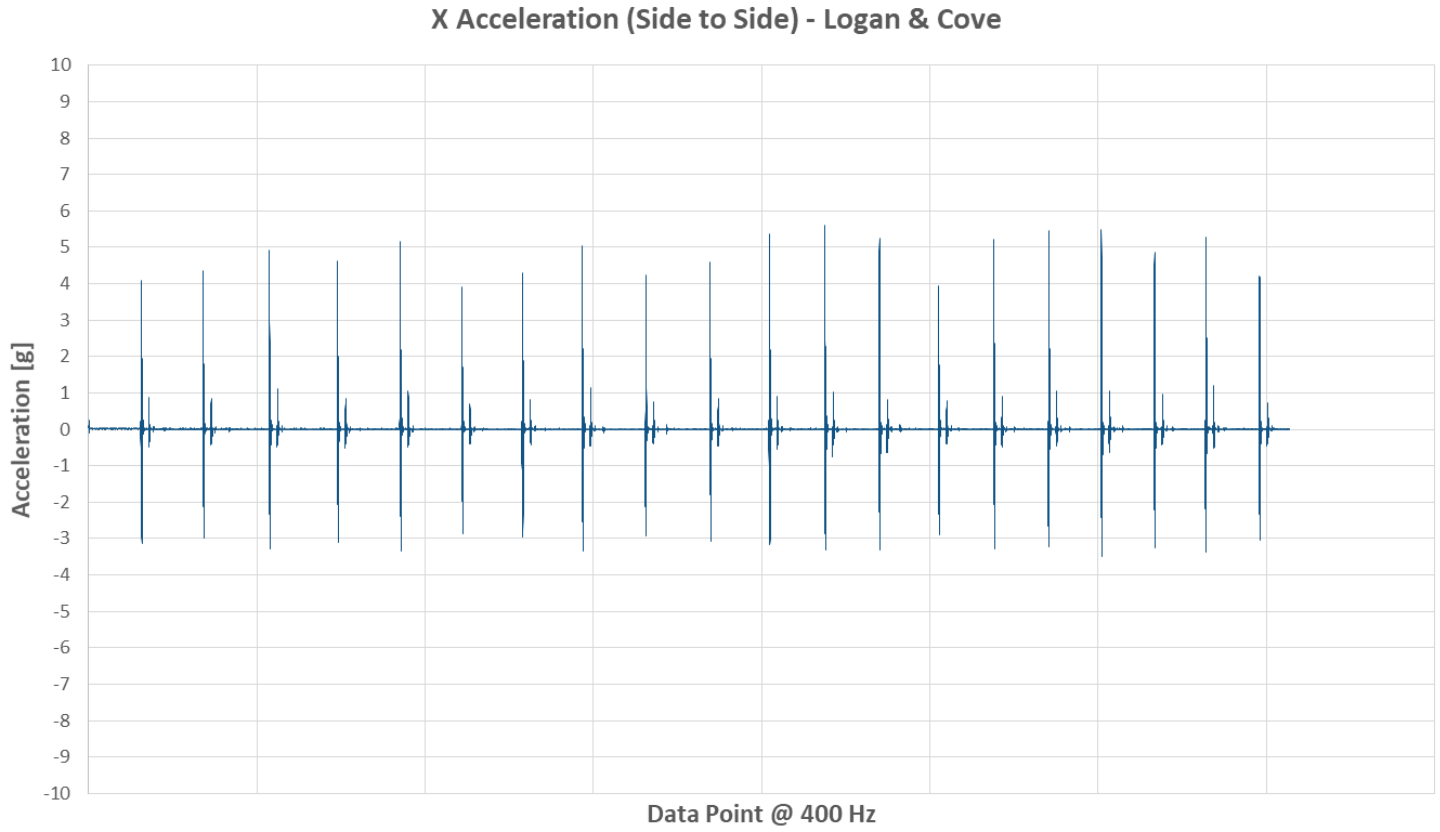

X Acceleration (Side to Side) - Hamuq
Acceleration [g]
Data Point @ 400 Hz

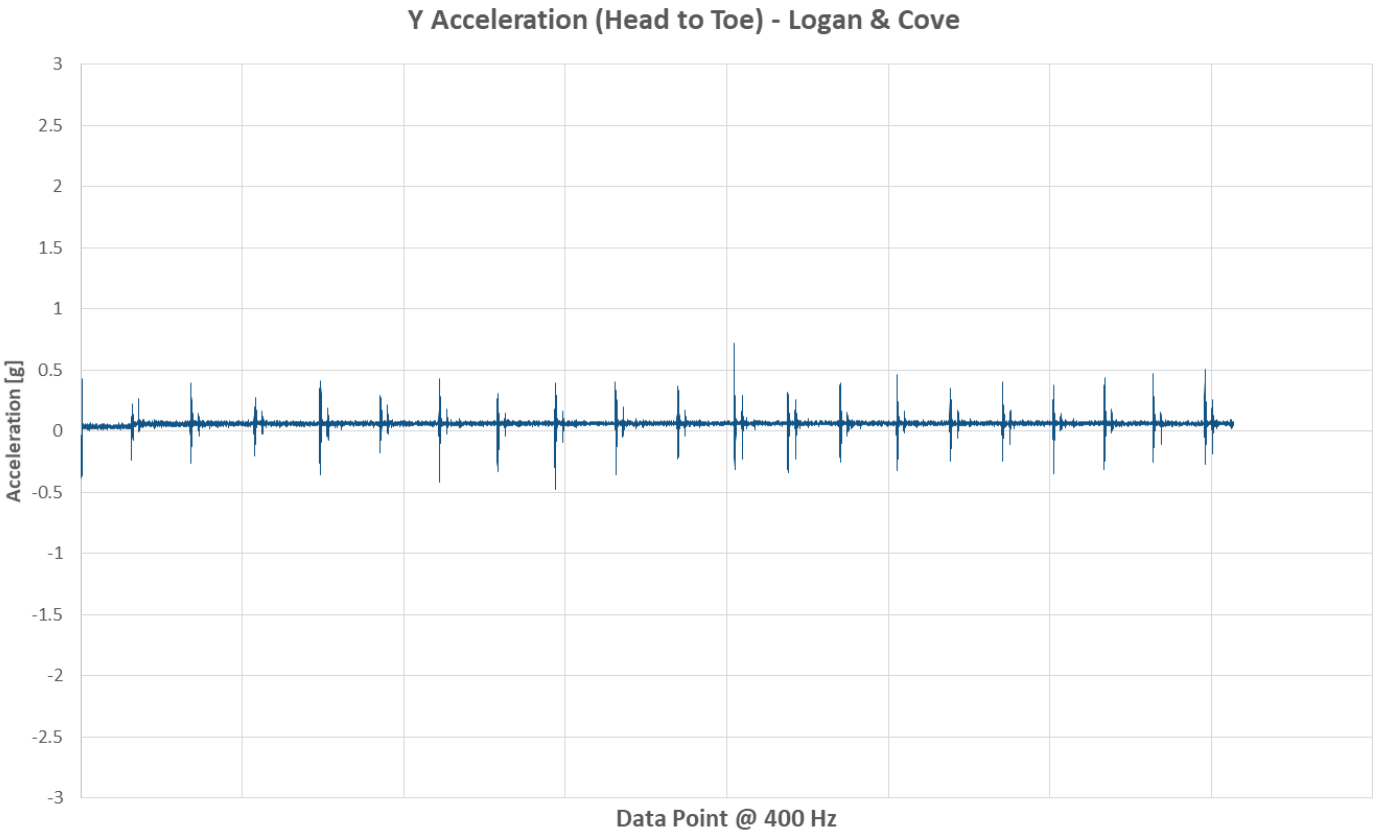

Y Acceleration (Head to Toe) - Hamuq
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

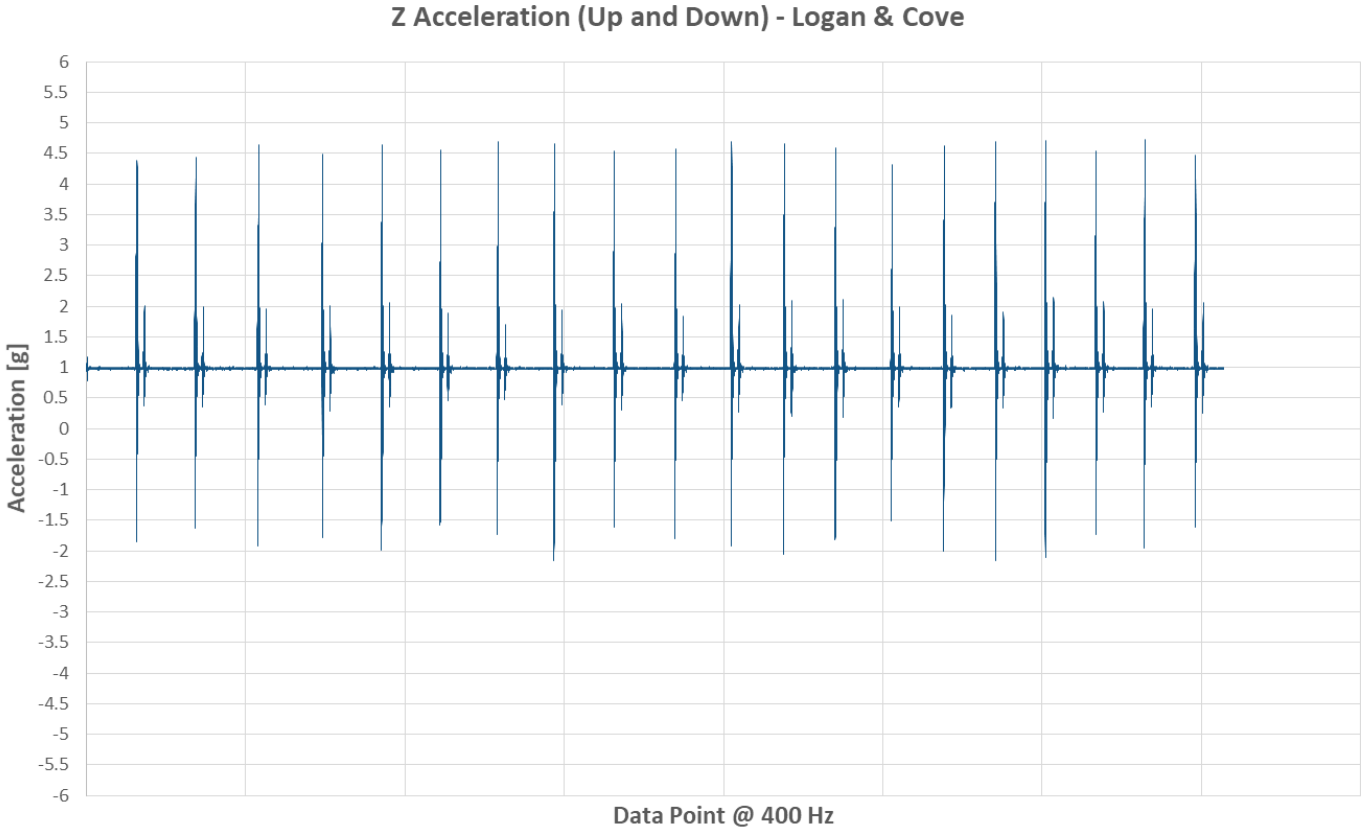

Z Acceleration (Up and Down) - Hamuq
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – LOGAN & COVE

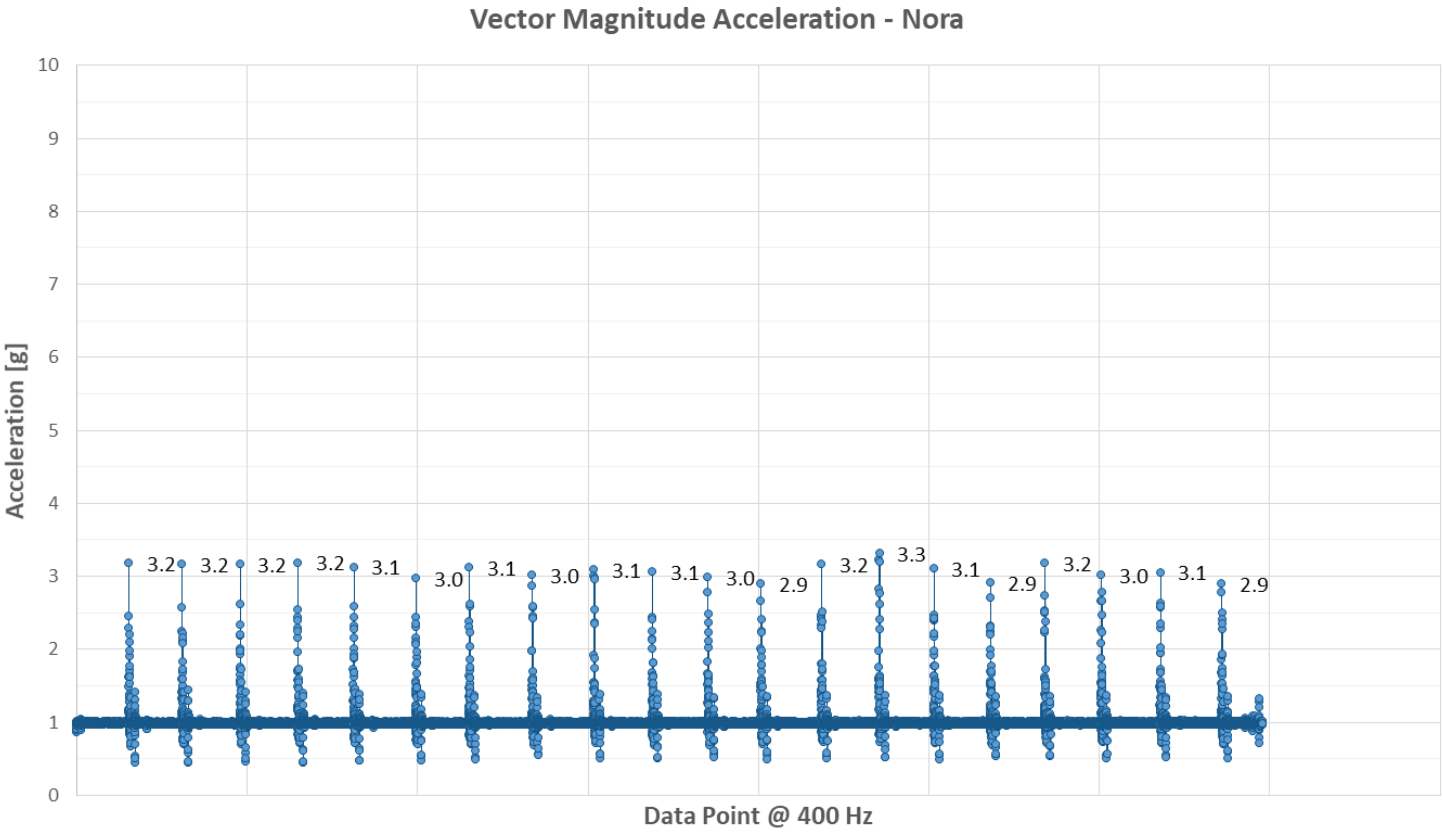


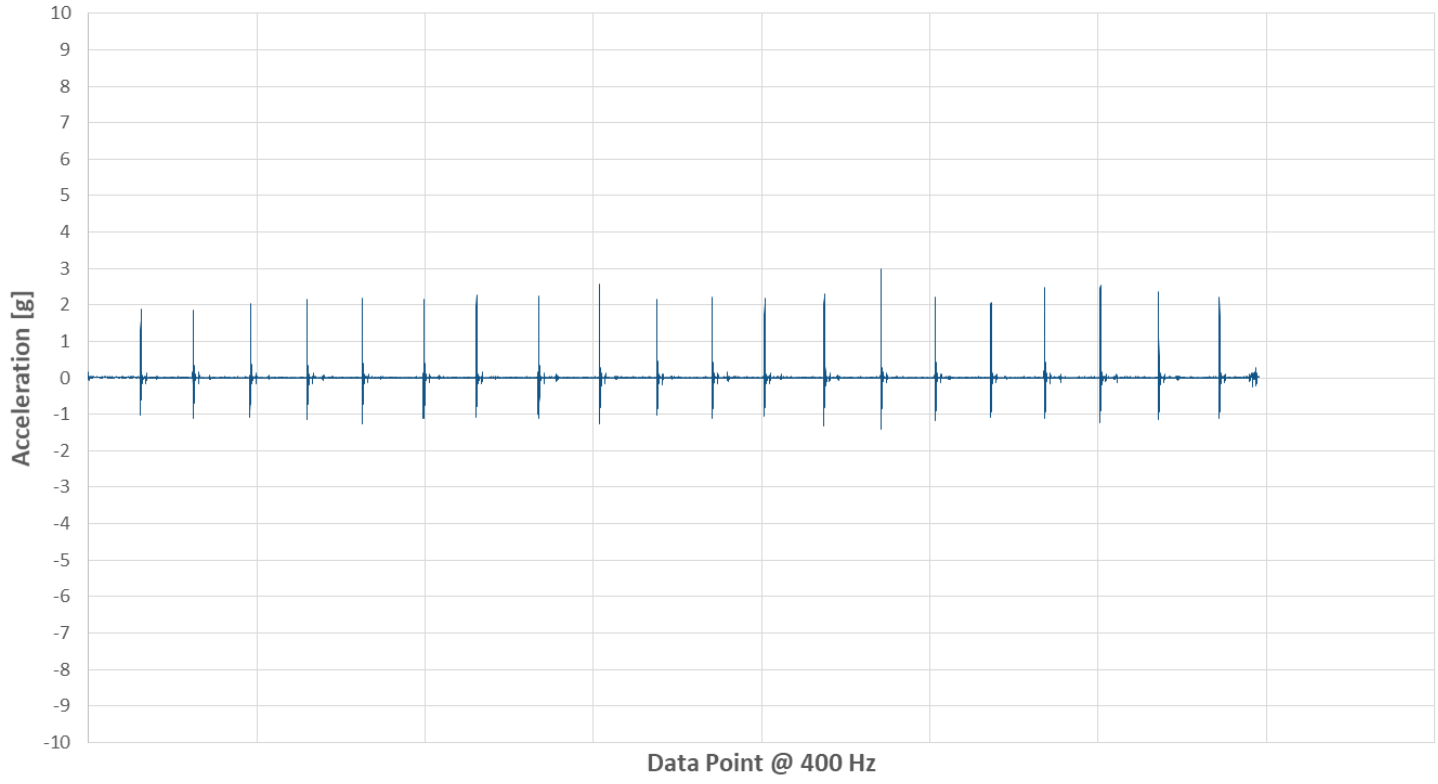


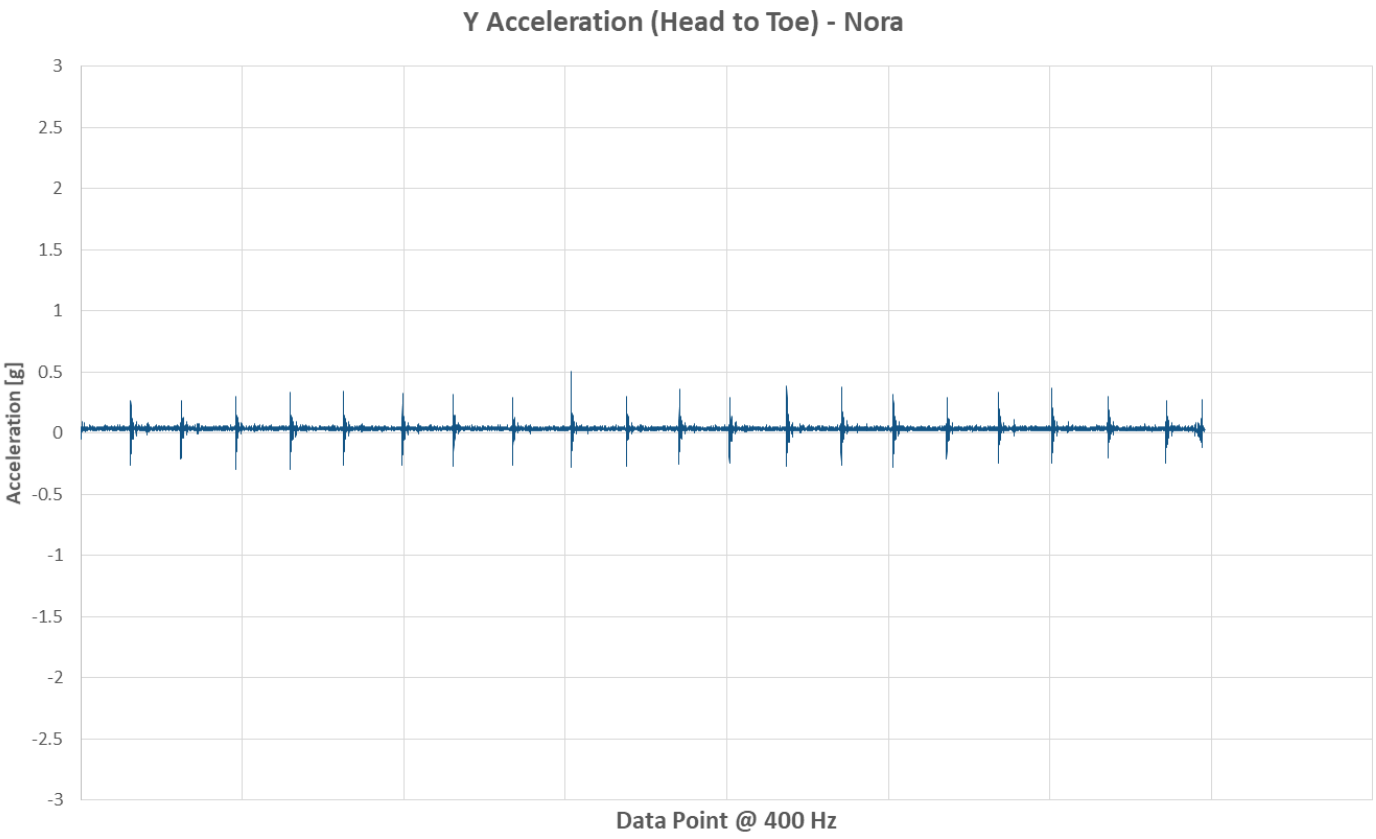

Y Acceleration (Head to Toe) - Logan & Cove
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

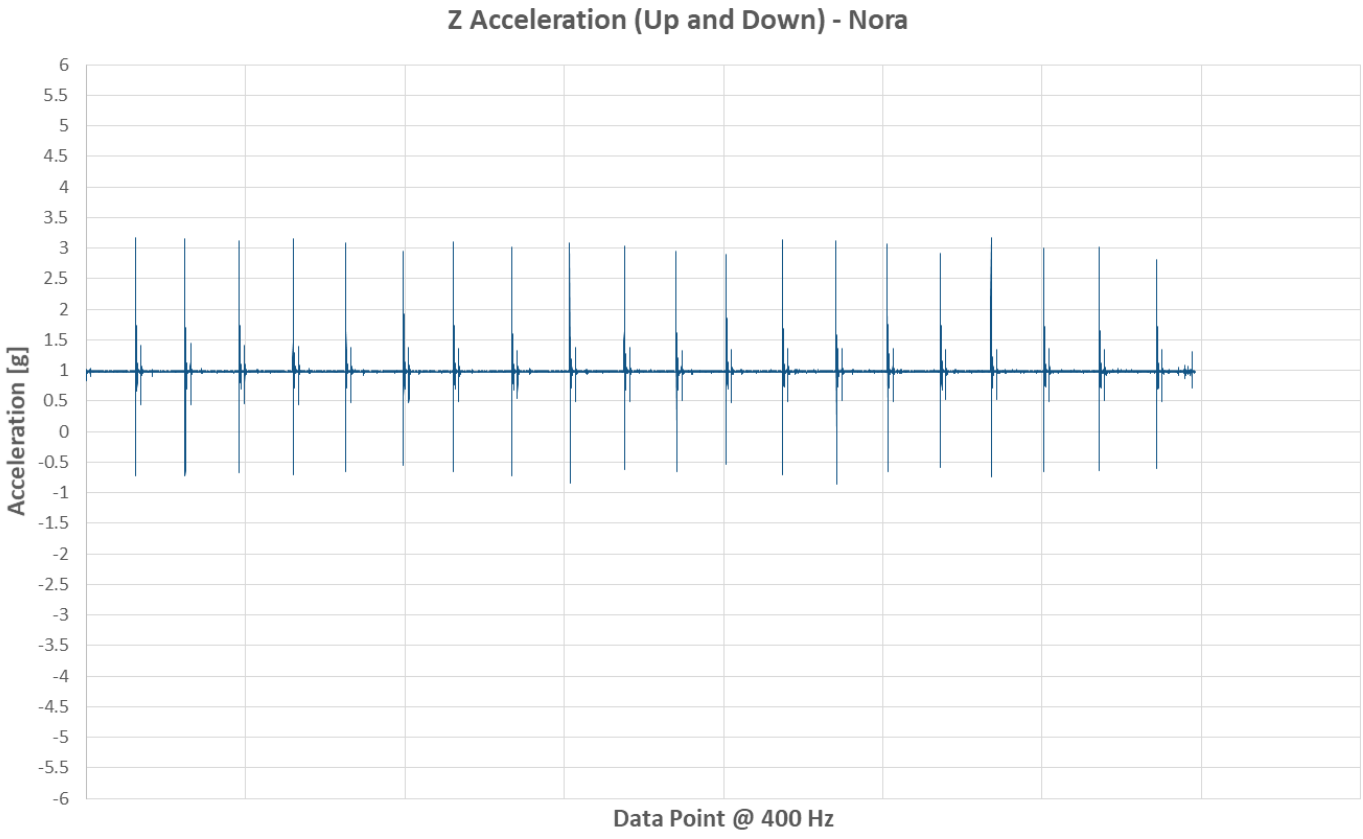

Z Acceleration (Up and Down) - Logan & Cove
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – NORA

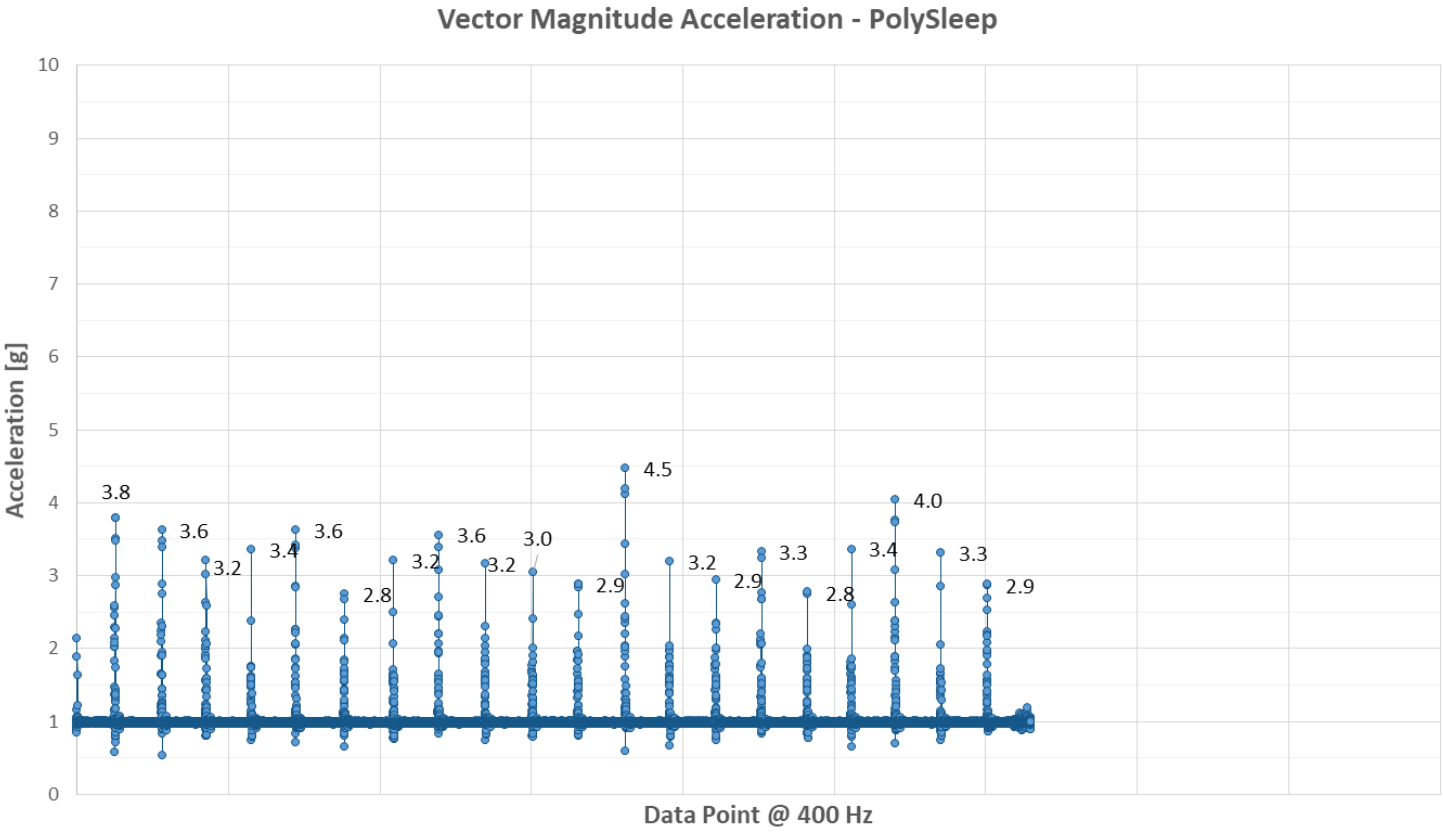

Vector Magnitude Acceleration - Nora
Acceleration [g]
Data Point @ 400 Hz
3.2 3.2 3.2 3.2 3.1 3.0 3.1 3.0 3.1 3.1 3.0 2.9 3.2 3.3 3.1 2.9 3.2 3.0 3.1 2.9

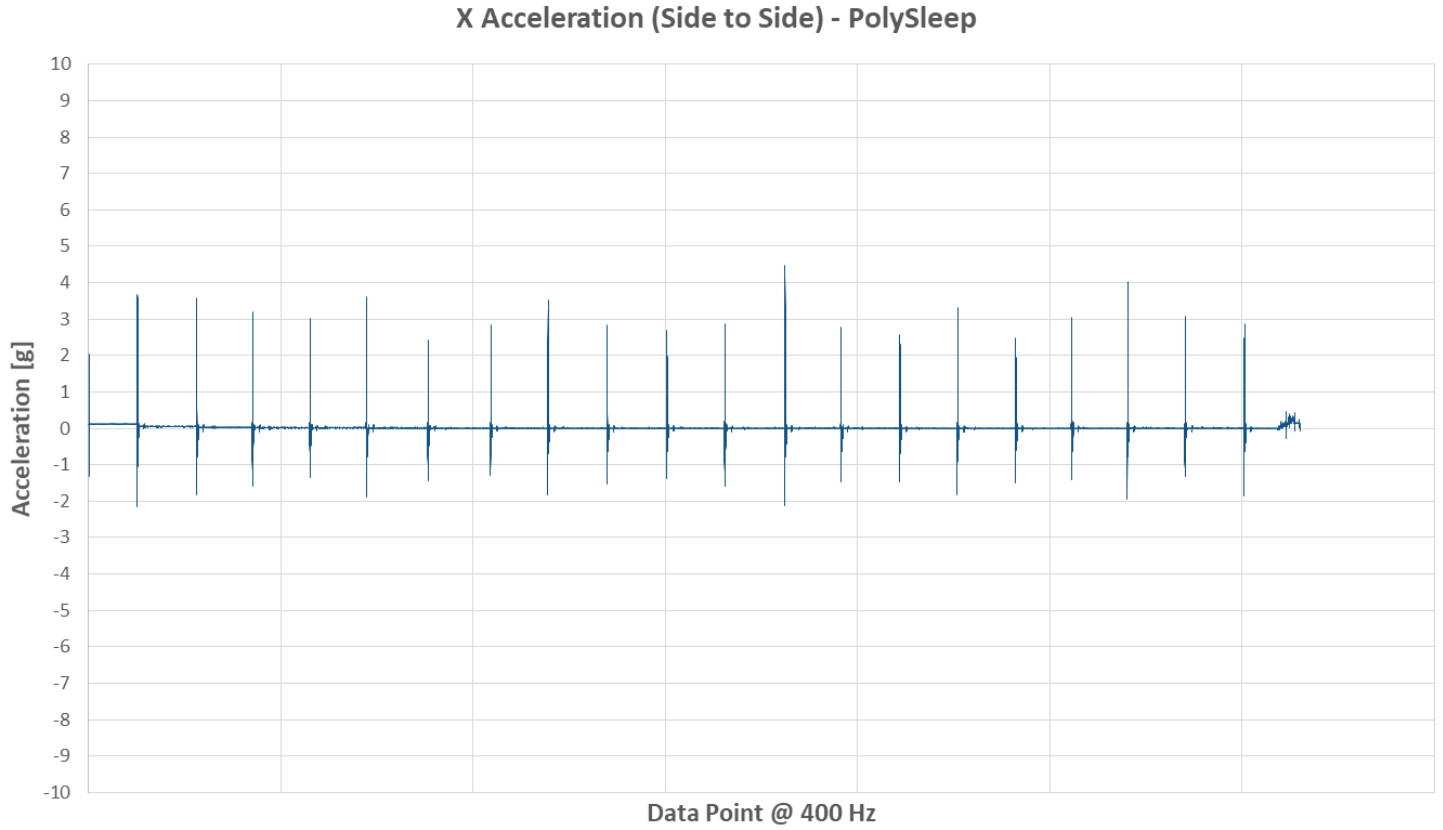

X Acceleration (Side to Side) - Nora
Acceleration [g]
Data Point @ 400 Hz

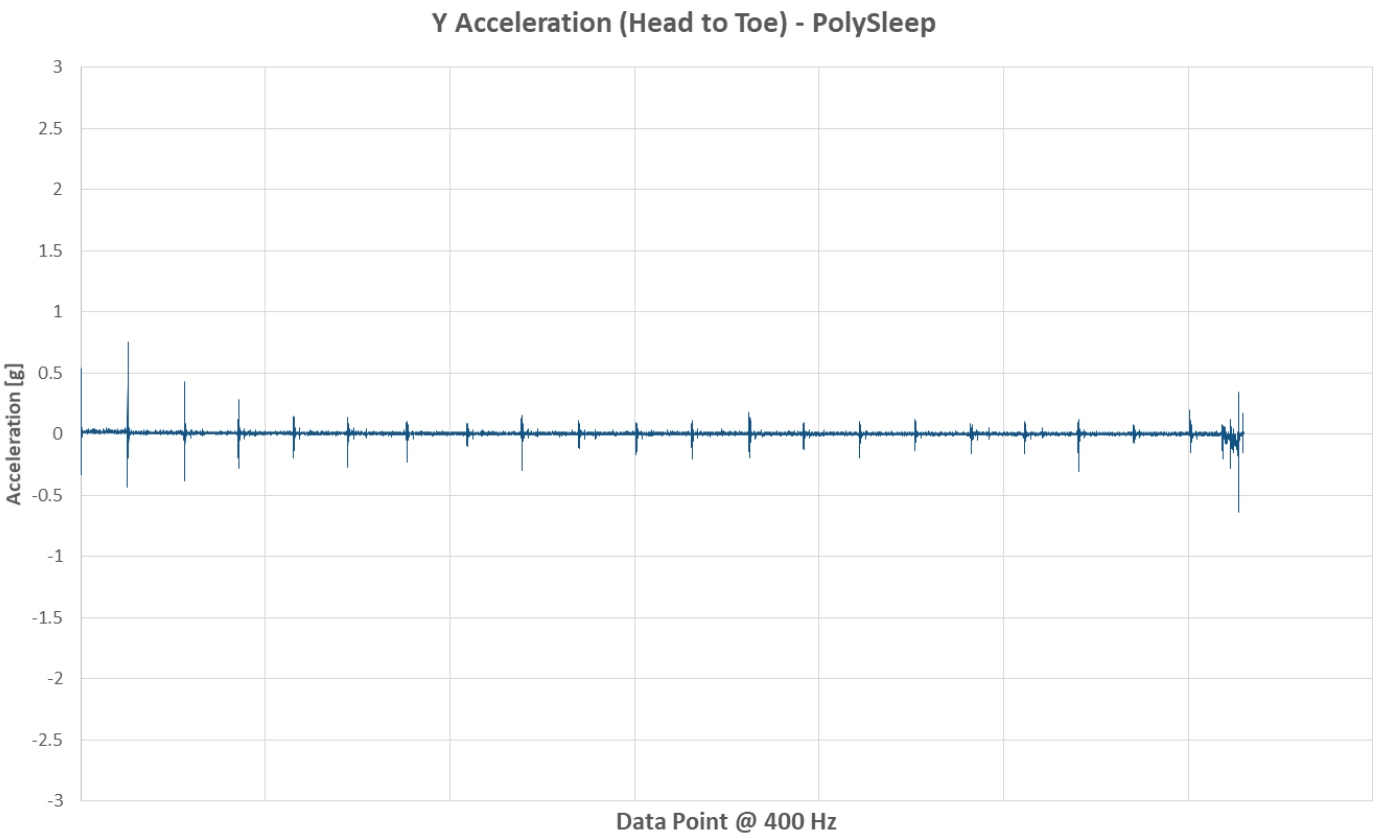

Y Acceleration (Head to Toe) - Nora
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

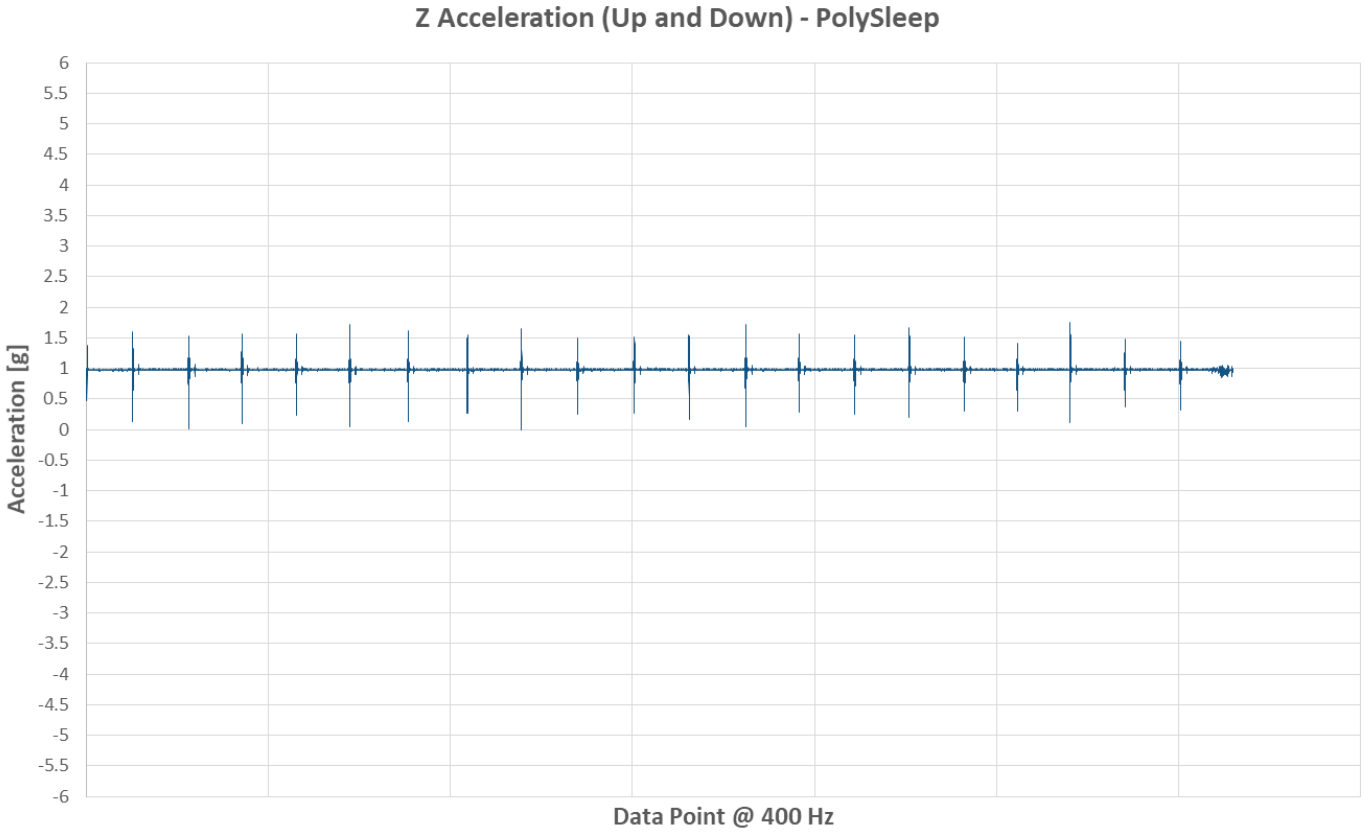

Z Acceleration (Up and Down) - Nora
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – POLYSLEEP

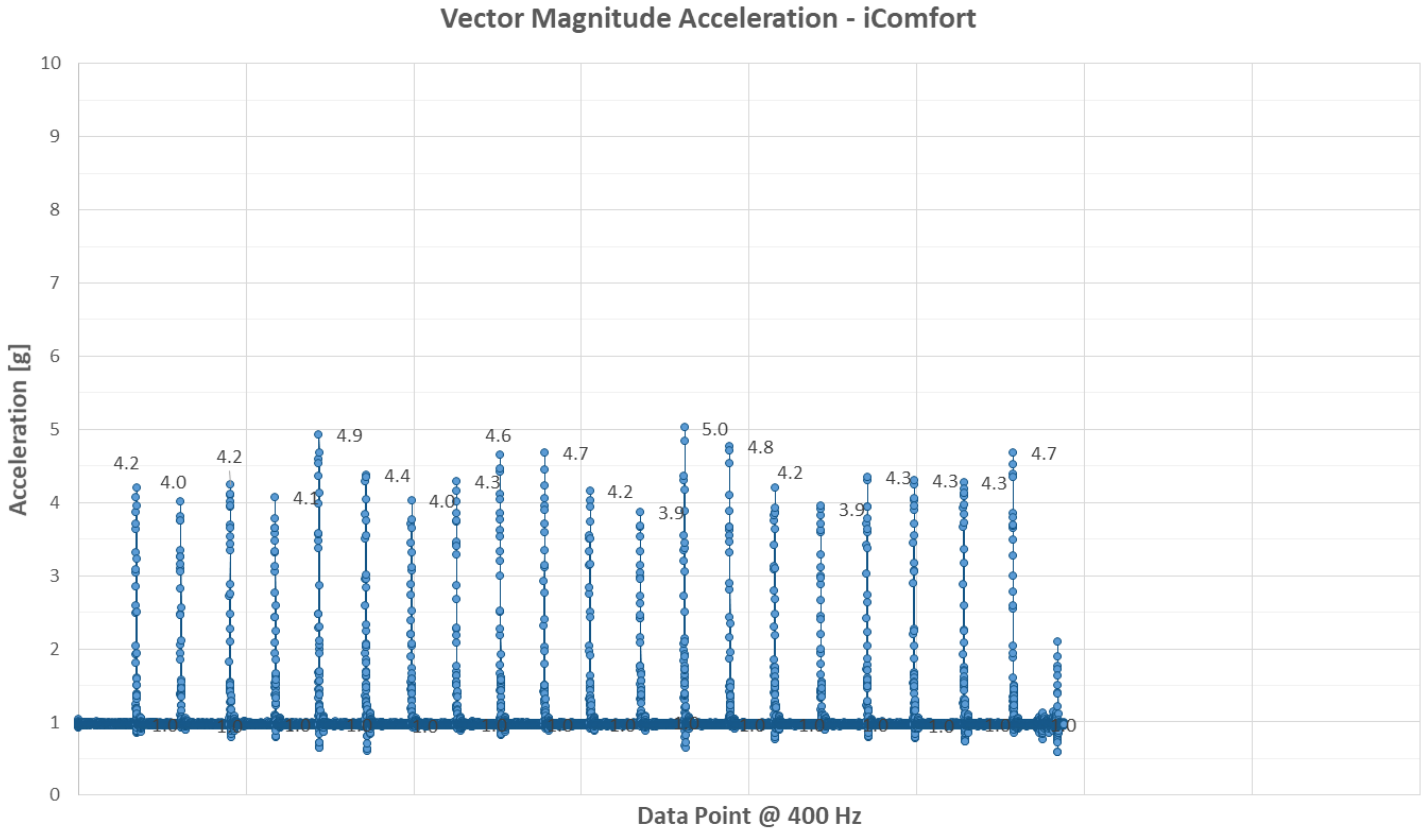


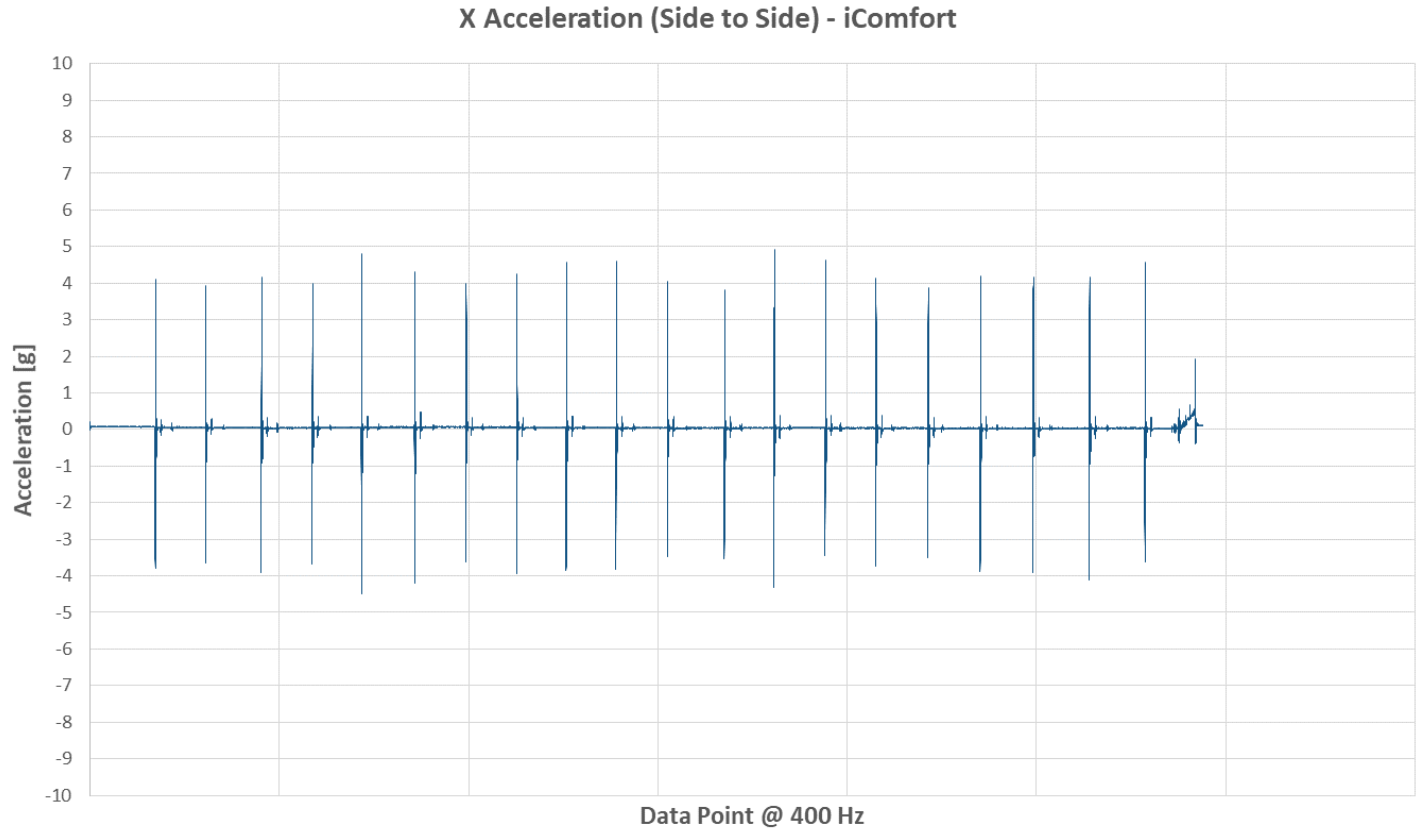


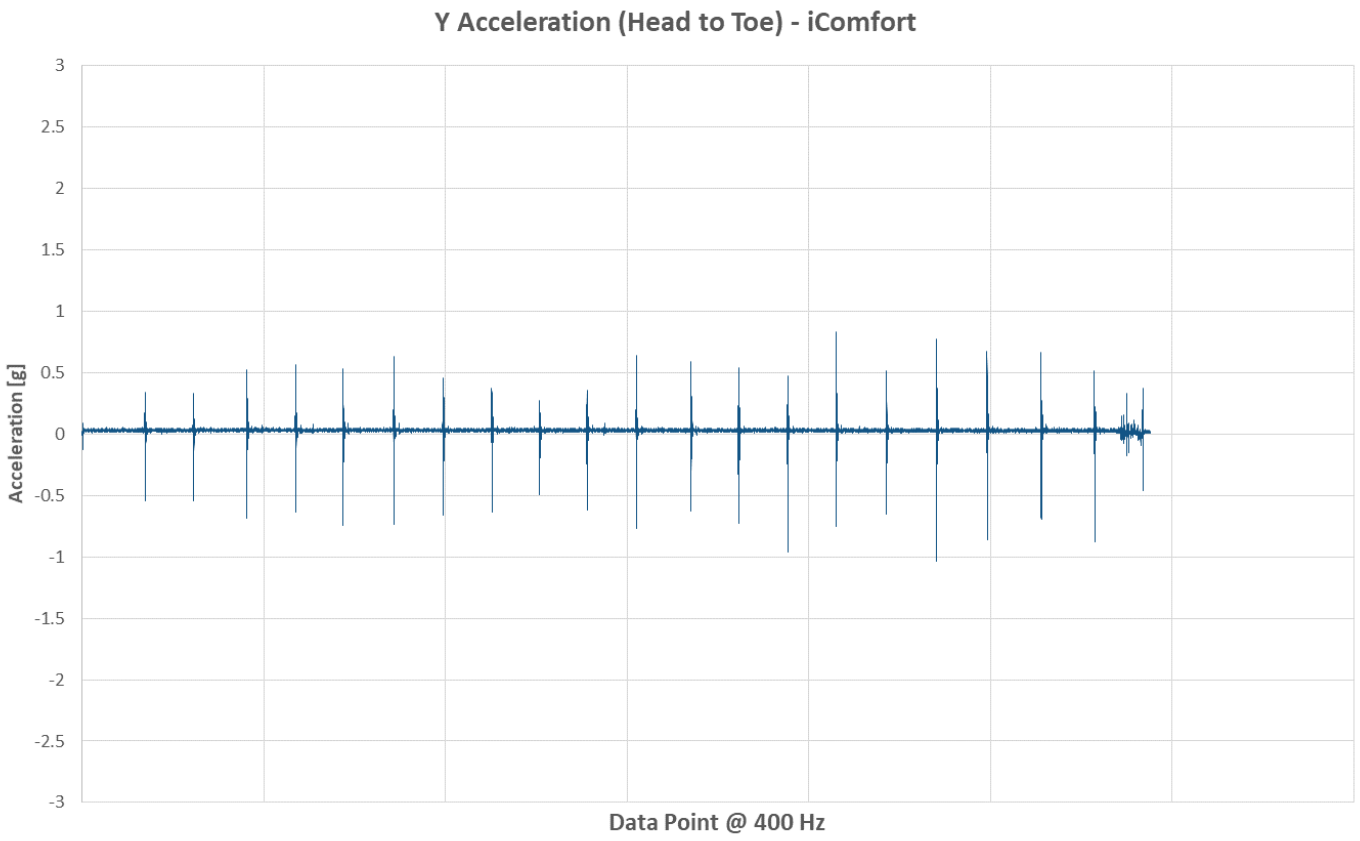

Y Acceleration (Head to Toe) - PolySleep
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

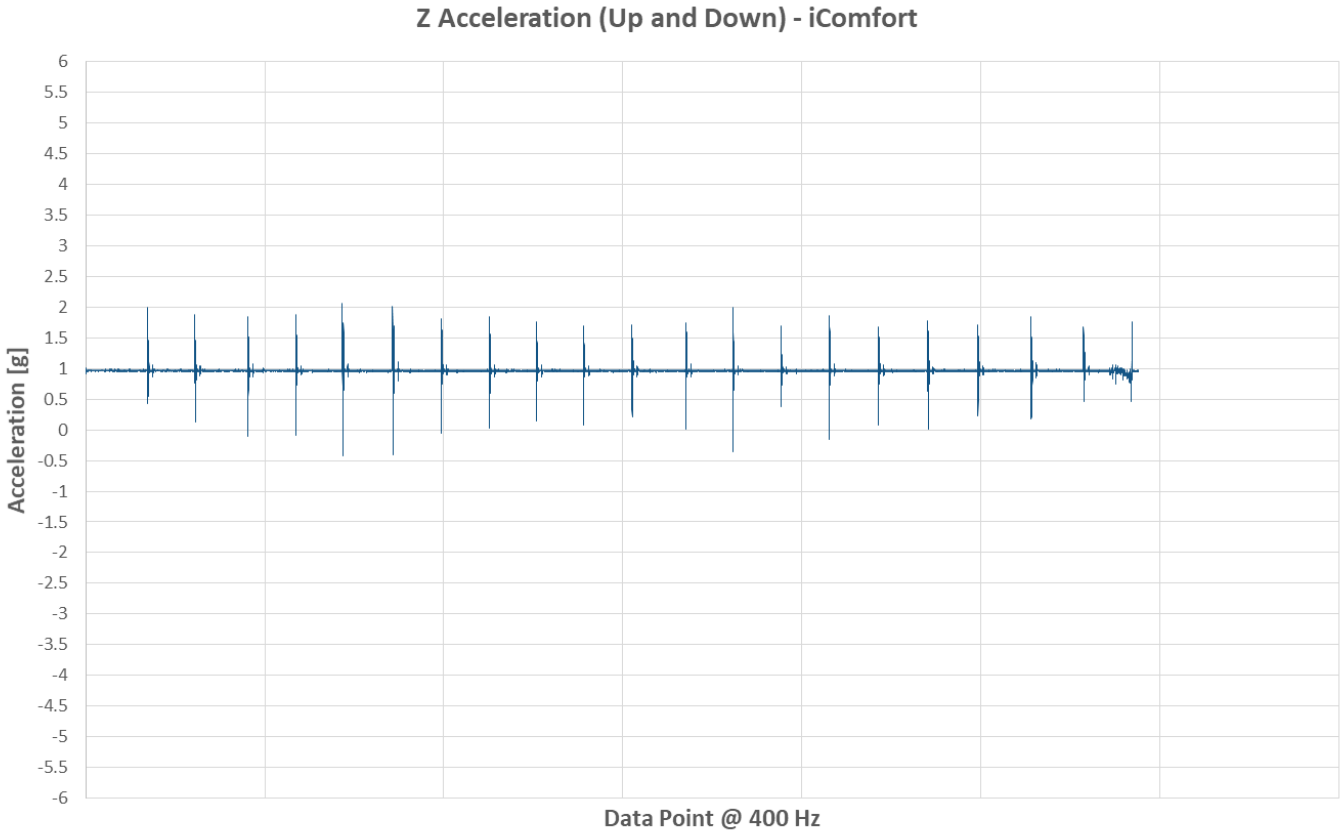

Z Acceleration (Up and Down) - PolySleep
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – iCOMFORT

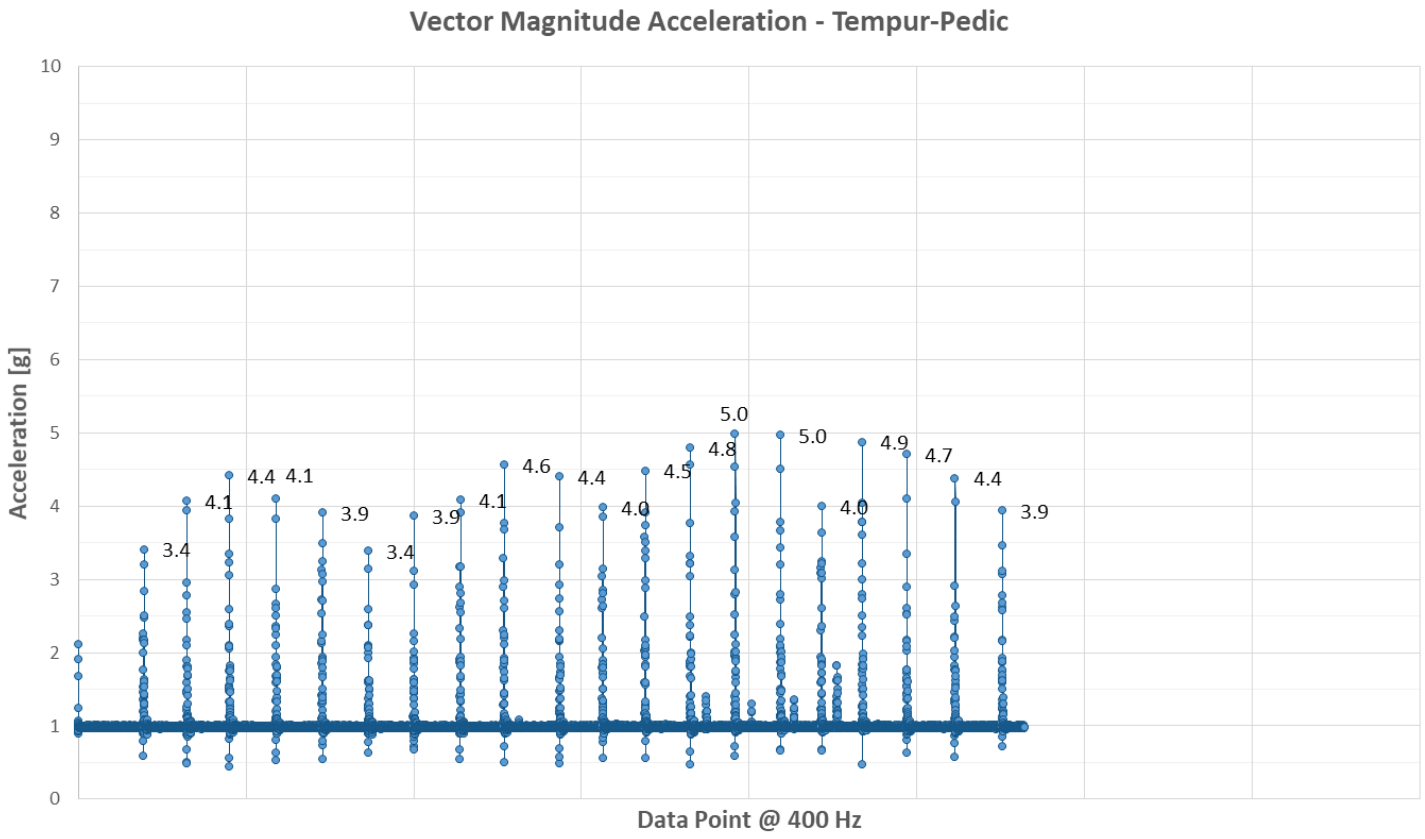


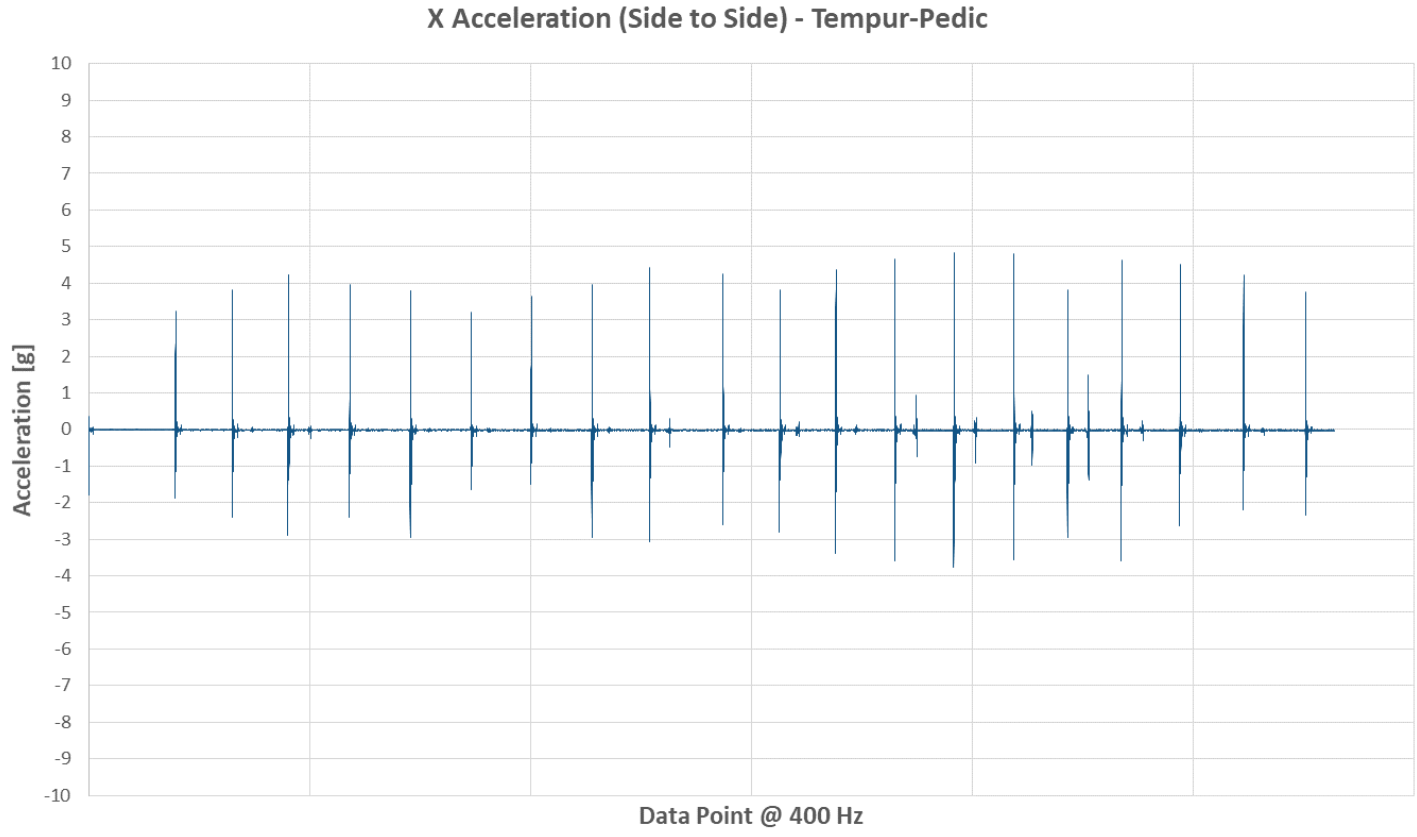


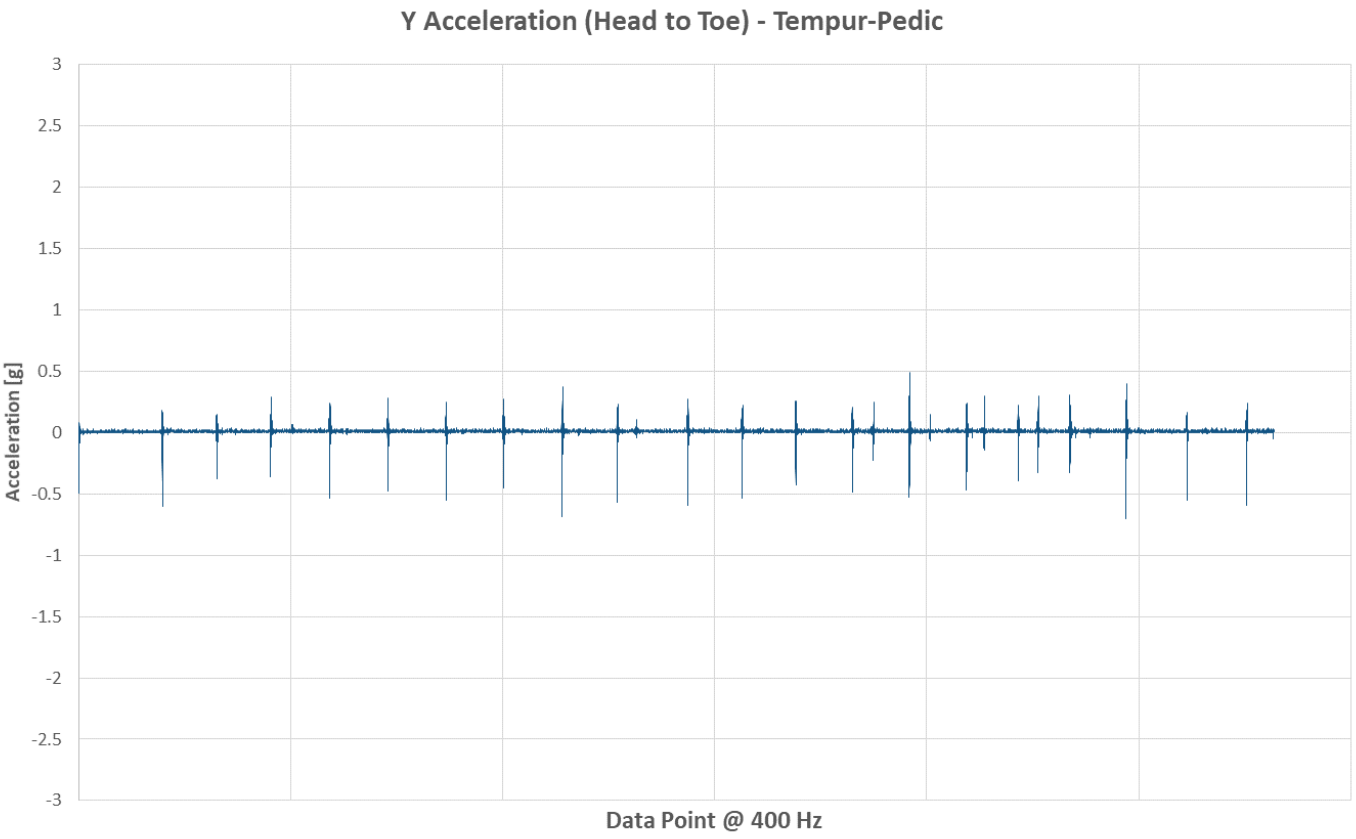

Y Acceleration (Head to Toe) - iComfort
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz

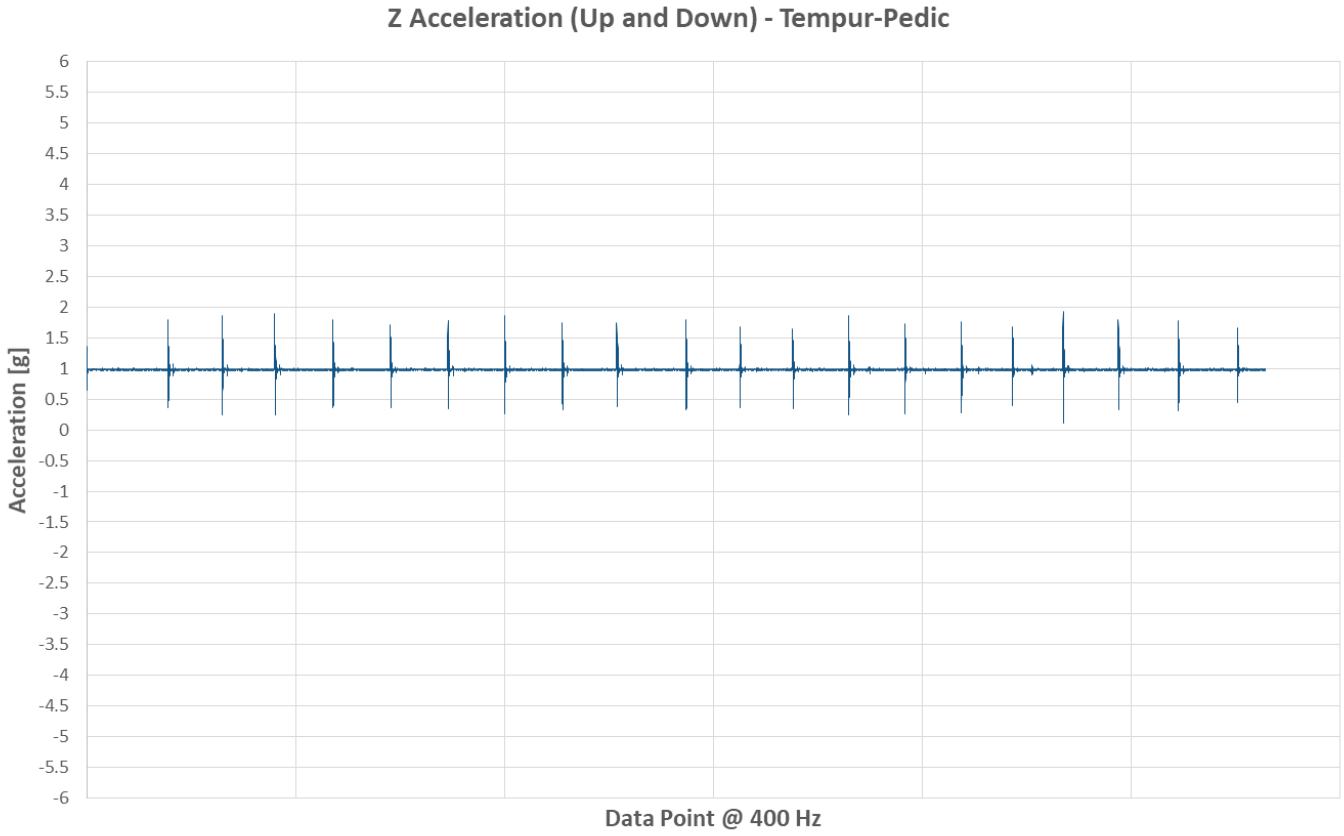

Z Acceleration (Up and Down) - iComfort
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

TEST 3 – TEMPUR-PEDIC






Y Acceleration (Head to Toe) - Tempur-Pedic
Acceleration [g]
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
Data Point @ 400 Hz


Z Acceleration (Up and Down) - Tempur-Pedic
Acceleration [g]
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
Data Point @ 400 Hz

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, ¼ 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 ¼ 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.