

TEST REPORT

No. IR4442

NANJING GUHUA - SCAFFOLD TESTING

Test Location - **TestConsult Ltd.**
Unit 11
Rufford Court
Woolston
Warrington
Cheshire
WA1 4RF
United Kingdom

Test For - **Nanjing Guhua**

Test Report Date - **13th November 2014**

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1.0 Introduction

TESTCONSULT LIMITED was commissioned by **Nanjing Guhua**, for provision of testing and analysis of their own scaffolding at:

TestConsult Ltd. Ruby House, Warrington, WA1 4RF (UK)

The testing involved was to analyse the material and loading properties on scaffolding provided by the client. All testing was undertaken in controlled conditions and TestConsult's laboratory. The load testing conforms to BS EN 12811-3:2002 throughout and this report explains all testing and analysis.

1.1 Test Descriptions

The table below lists all the tests carried out in this stage of testing.

Test Number	Test	Date Tested	Qty. of Tests
TS1	Cyclic Test Tube Ledger	20/09/2014	10
TS1.1	Cyclic Test Box Ledger	21/10/2014	10
TS2	Brace Test	07/10/2014	5
TS3	Vibration Test Tube Bar	22/10/2014	5
TS3.1	Vibration Test Box Ledger	22/10/2014	5

A full list of items tested, including all components for each test can be found in Appendix B.

1.2 Test Components

The Nanjing Guhua Scaffolding system consists of galvanized high-strength steel modular components that are assembled together using circular wedge connectors. It consists of vertical members with integral wedge connections spaced at 500mm (19 inch) increments. The horizontal ledgers and diagonal braces are secured to the connectors on the vertical tubes by means of end connectors that insert and are locked into the circular wedges.

Horizontal ledgers provided for testing have been supplied in the following lengths:

- 8 foot

For a section of the tests diagonal bay braces were used, just one length was used for each test this was a 10.8 foot brace.

Upright standards provided are in the following length, these were used in majority of the testing:

- 10 foot

The major components of the Scaffolding System comprises of cold formed tubular sections.

The modular vertical members (standards) have circular connection wedges at 500mm spacing's, manufactured from stamped steel plate.

All materials supplied by the client were on the whole ex stock and appeared undamaged and were in full usable condition upon arrival.

2.0 Test Program

2.1 TS1 – Cyclic Test Tube Ledger

Test series 1 is a bidirectional cyclic test which incorporates both upward and downward loading of the ledger when connected to the standard to test the connection between the two components. The standard was fixed both above and below the connection to the Ledger. The angle of the Ledger was measured throughout the test and plotted against the load to give the point at which the yield of the component joint is reached.

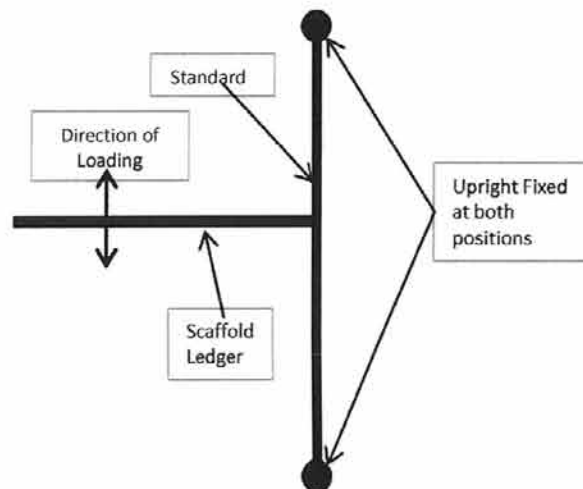


Figure 1.0 – Test Series 1

The test load sequence was calculated by loading the first test in both directions to failure. Following this finding 90% of this value will be used as the upper loading for each of the following 10 tests.

The following table indicates the load sequence followed for test series 1, all load sequences were derived using formulas found in BS EN 12811-3:2002:

	3 Cycles	1 Cycle	1 Cycle
Test Series 1 Up (kN)	+/-0.80	+/-1.75	+/-2.10

Table 1.0 – Test Series 1 Cycles

2.2 TS1.1 – Cyclic Test Box Ledger

Test series 1 is a bidirectional cyclic test which incorporates both upward and downward loading of the Ledger when connected to the Standard to test the connection between the two components. The Standard was fixed both above and below the connection to the Ledger. The angle of the Ledger was measured throughout the test and plotted against the load to give the point at which the yield of the component joint is reached.

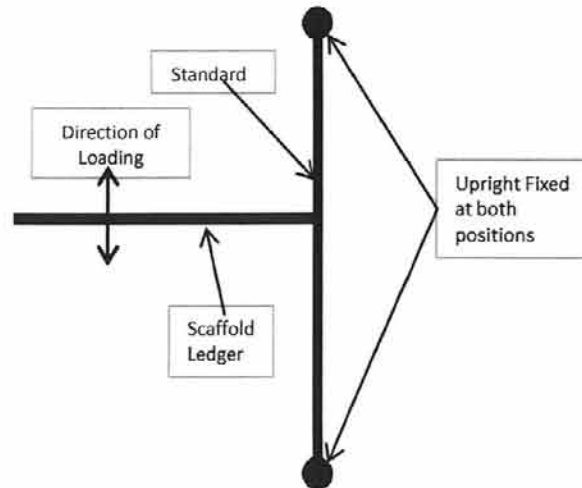


Figure 1.0 – Test Series 1.1

The test load sequence was calculated by loading the first test in both directions to failure. Following this finding 90% of this value will be used as the upper loading for each of the following 10 tests.

The following table indicates the load sequence followed for test series 1.1, all load sequences were derived using formulas found in BS EN 12811-3:2002:

	3 Cycles	1 Cycle	1 Cycle
Test Series 1.1 Up (kN)	+/-0.83	+/-16.50	+/-2.25
Test Series 1.1 Down (kN)	+/-0.43	+/-0.86	+/-1.10

2.3 TS2 – Brace Test

Test series 2 is a singular direct cyclic test on 5 frames containing Braces as shown in Figure 2.0 the tests will terminate with the diagonal Brace failing in compression by bending past the point of yield.

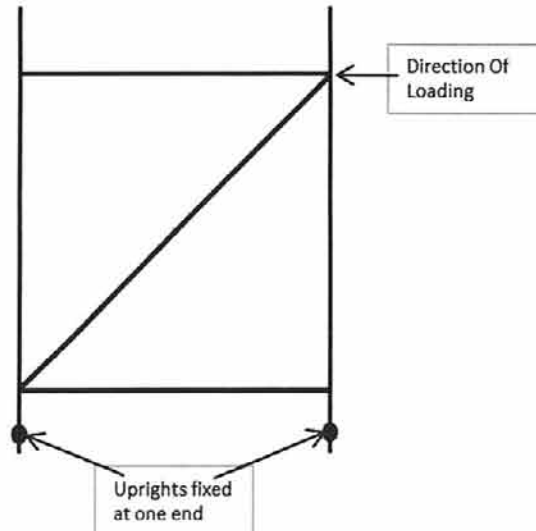


Figure 2.0 – Test Series 2

The test load sequence was calculated by loading the first test until the yield point was reached. Following this finding 90% of this value will be used as the upper loading for each of the following 5 tests. The loading was conducted in cycles the schedule for the loading can be seen below (Table 2). After the components were loaded as per the schedule the component was taken to its yield.

The following table indicates the load sequence followed for test series 2, all load sequences were derived using formulas found in BS EN 12811-3:2002:

	3 Cycles	1 Cycle	1 Cycle
Test Series 2 (kN)	+/- 6.20	+/- 8.0	+/- 10.1

Table 2.0 – Test Series 2 Brace Cycles

2.4 TS4 – Vibration Test

Test series 3 is a bidirectional Vibration test on the Standard / Ledger connection. This test involves vibrating the Ledger in an upwards downward motion to see the effect this has on the joint between the Ledger and Standard and if the joint loosens at all during prolonged exposure to vibration. The vibration was applied to the system for a period of five minutes whilst the angle of the Ledger was continuously measured and recorded.

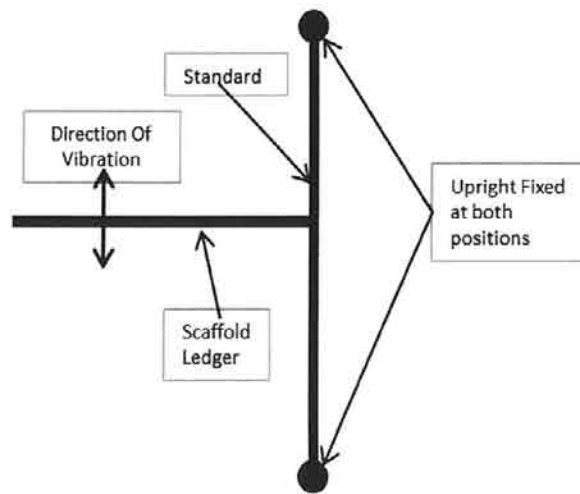


Figure 3.0 – Test Series 3

3.0 Results

All results in this section are taken from the data sets recorded during each test series. These tables have been simplified to show the readings of the instruments at each load sequence.

For all graphed results please see Appendix A. For comprehensive photographic records see Appendix B.

3.1 Test Series 1 Cyclic Tube Ledger Results

TS1-0 UPWARDS (TEST)		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
2.5	-	0.67

TS1-0 DOWNWARDS (TEST)		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
1.1	-	0.5

TS1-1 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.15
0	-	0
-0.75	-	0.07
0	-	0
0.75	-	0.14
0	-	0
-0.75	-	0.08
0	-	0
0.75	-	0.14
0	-	0
-0.75	-	0.09
0	-	0
1.5	-	0.2
0	-	0.08
-1.5	-	0.52
0	-	-0.3
2	-	0.16
0	-	0
-2	-	0.92
0	-	-0.6

TS1-2 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.09
0	-	0
-0.75	-	-0.14
0	-	0
0.75	-	0.08
0	-	0
-0.75	-	-0.14
0	-	0
0.75	-	0.08
0	-	0
-0.75	-	-0.14
0	-	0
1.5	-	0.15
0	-	0.01
-1.5	-	-0.6
0	-	-0.4
2	-	-0.02
0	-	-0.2
-2	-	-0.65
0	-	-0.4

TS1-3 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.12
0	-	0
-0.75	-	-0.18
0	-	0
0.75	-	0.1
0	-	0
-0.75	-	-0.18
0	-	0
0.75	-	0.1
0	-	0
-0.75	-	-0.21
0	-	0
1.5	-	0.17
0	-	0
-1.5	-	-0.8
0	-	-0.6
2	-	0.17
0	-	-0.10
-2	-	*
0	-	*

TS1-4 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.06
0	-	0
-0.75	-	-0.2
0	-	0
0.75	-	0.06
0	-	0
-0.75	-	-0.21
0	-	0
0.75	-	0.05
0	-	0
-0.75	-	-0.22
0	-	0
1.5	-	0.18
0	-	0
-1.5	-	-0.62
0	-	-0.02
2	-	0.18
0	-	-0.02
-2	-	-0.68
0	-	-0.5

* When loading to -2 the Ledger head sheared.

TS1-5 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.18
0	-	0
-0.75	-	-0.24
0	-	0
0.75	-	0.15
0	-	0
-0.75	-	-0.4
0	-	0
0.75	-	0.14
0	-	0
-0.75	-	-0.5
0	-	0
1.5	-	0.18
0	-	0
-1.5	-	-0.64
0	-	0
2	-	*
0	-	*
-2	-	*
0	-	*

TS1-6 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.10
0	-	0.05
-0.75	-	-0.15
0	-	0
0.75	-	0.18
0	-	0.05
-0.75	-	-0.13
0	-	0
0.75	-	0.18
0	-	0.05
-0.75	-	-0.14
0	-	0
1.5	-	0.19
0	-	0.06
-1.5	-	-0.75
0	-	-0.52
2	-	0.12
0	-	-0.1
-2	-	-0.99
0	-	-0.6

* When loading to 2 the Ledger head sheared.

TS1-7 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.22
0	-	0.05
-0.75	-	-0.16
0	-	0
0.75	-	0.18
0	-	0.03
-0.75	-	-0.19
0	-	0
0.75	-	0.18
0	-	0.02
-0.75	-	-0.2
0	-	-0.01
1.5	-	0.25
0	-	0.17
-1.5	-	-0.57
0	-	-0.22
2	-	0.28
0	-	0.18
-2	-	-0.8
0	-	-0.42

TS1-8 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.15
0	-	0.05
-0.75	-	-0.15
0	-	-0.05
0.75	-	0.18
0	-	0
-0.75	-	-0.15
0	-	-0.05
0.75	-	0.18
0	-	-0.01
-0.75	-	-0.15
0	-	-0.06
1.5	-	-0.22
0	-	0
-1.5	-	-0.77
0	-	-0.52
2	-	-0.05
0	-	-0.1
-2	-	-0.78
0	-	-0.50

TS1-9 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.19
0	-	0.05
-0.75	-	-0.2
0	-	-0.05
0.75	-	0.19
0	-	0.05
-0.75	-	-0.2
0	-	-0.04
0.75	-	0.19
0	-	0.05
-0.75	-	-0.18
0	-	-0.04
1.5	-	0.25
0	-	0.2
-1.5	-	-0.75
0	-	-0.7
2	-	0
0	-	-0.02
-2	-	*
0	-	*

TS1-10 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.75	-	0.1
0	-	0.02
-0.75	-	-0.1
0	-	-0.06
0.75	-	0.1
0	-	0
-0.75	-	-0.18
0	-	-0.06
0.75	-	0.1
0	-	0
-0.75	-	-0.18
0	-	-0.02
1.5	-	0.18
0	-	0.3
-1.5	-	-0.75
0	-	-0.15
2	-	0.4
0	-	0.15
-2	-	-0.79
0	-	-0.3

3.2 Test Series 1.1 Cyclic Box Ledger Results

TS1-0 UPWARDS (TEST)		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
2.5	-	0.48

TS1-0 DOWNWARDS (TEST)		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
1.1	-	-0.3

TS1.1-1 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.02
0	-	0
-0.43	-	-0.08
0	-	-0.05
0.83	-	0.02
0	-	0
-0.43	-	-0.08
0	-	-0.05
0.83	-	0.02
0	-	0
-0.43	-	-0.08
0	-	-0.05
1.65	-	0.1
0	-	0.02
-0.86	-	-0.19
0	-	-0.16
2.25	-	0.18
0	-	0.01
-1.1	-	-0.32
0	-	-0.22

TS1.1-2 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.08
0	-	0.02
-0.43	-	-0.06
0	-	-0.02
0.83	-	0.08
0	-	0.02
-0.43	-	-0.06
0	-	-0.02
0.83	-	0.09
0	-	0.02
-0.43	-	-0.06
0	-	-0.02
1.65	-	0.11
0	-	-0.01
-0.86	-	-0.15
0	-	-0.07
2.25	-	0.12
0	-	-0.02
-1.1	-	-0.25
0	-	-0.17

TS1.1-3 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.12
0	-	0
-0.43	-	-0.1
0	-	-0.08
0.83	-	0.12
0	-	0
-0.43	-	-0.1
0	-	-0.08
0.83	-	0.12
0	-	0
-0.43	-	-0.08
0	-	-0.08
1.65	-	0.18
0	-	-0.02
-0.86	-	-0.22
0	-	-0.18
2.25	-	0.21
0	-	-0.1
-1.1	-	-0.36
0	-	-0.28

TS1.1-4 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.1
0	-	0
-0.43	-	-0.05
0	-	-0.03
0.83	-	0.08
0	-	0
-0.43	-	-0.05
0	-	-0.03
0.83	-	0.1
0	-	0
-0.43	-	-0.05
0	-	-0.03
1.65	-	0.14
0	-	0.01
-0.86	-	-0.14
0	-	-0.08
2.25	-	0.16
0	-	-0.02
-1.1	-	-0.36
0	-	-0.3

TS1.1-5 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.05
0	-	0.02
-0.43	-	-0.04
0	-	-0.01
0.83	-	0.05
0	-	0.02
-0.43	-	-0.04
0	-	-0.02
0.83	-	0.05
0	-	0.02
-0.43	-	-0.04
0	-	-0.02
1.65	-	0.1
0	-	0.01
-0.86	-	-0.16
0	-	-0.07
2.25	-	0.15
0	-	-0.02
-1.1	-	-0.4
0	-	-0.35

TS1.1-6 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.09
0	-	0
-0.43	-	-0.09
0	-	-0.05
0.83	-	0.09
0	-	-0.01
-0.43	-	-0.1
0	-	-0.05
0.83	-	0.09
0	-	-0.01
-0.43	-	-0.05
0	-	-0.01
1.65	-	0.15
0	-	0
-0.86	-	-0.2
0	-	-0.15
2.25	-	0.17
0	-	-0.05
-1.1	-	-0.7
0	-	-0.6

TS1.1-7 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.05
0	-	0
-0.43	-	-0.1
0	-	-0.06
0.83	-	0.05
0	-	0
-0.43	-	-0.1
0	-	-0.06
0.83	-	0.05
0	-	0
-0.43	-	-0.1
0	-	-0.06
1.65	-	0.1
0	-	0.01
-0.86	-	-0.21
0	-	-0.17
2.25	-	0.16
0	-	0
-1.1	-	-0.4
0	-	-0.34

TS1.1-8 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.16
0	-	0.1
-0.43	-	-0.08
0	-	-0.2
0.83	-	0.16
0	-	0.1
-0.43	-	-0.08
0	-	-0.2
0.83	-	0.16
0	-	0.1
-0.43	-	-0.08
0	-	-0.2
1.65	-	0.2
0	-	0.14
-0.86	-	-0.2
0	-	-0.1
2.25	-	0.32
0	-	0.15
-1.1	-	-0.4
0	-	-0.3

TS1.1-9 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.14
0	-	0
-0.43	-	-0.13
0	-	-0.05
0.83	-	0.15
0	-	-0.04
-0.43	-	-0.12
0	-	-0.05
0.83	-	0.15
0	-	-0.04
-0.43	-	-0.12
0	-	-0.05
1.65	-	0.22
0	-	0.04
-0.86	-	-0.22
0	-	-0.14
2.25	-	0.31
0	-	0.05
-1.1	-	-0.5
0	-	-0.4

TS1.1-10 PUSH/PULL		
TOTAL LOAD (kN)	-	Angle Radians
0	-	0
0.83	-	0.15
0	-	0.08
-0.43	-	-0.08
0	-	-0.03
0.83	-	0.15
0	-	0.08
-0.43	-	-0.08
0	-	-0.03
0.83	-	0.15
0	-	0.08
-0.43	-	-0.08
0	-	-0.03
1.65	-	0.21
0	-	0.1
-0.86	-	-0.21
0	-	-0.16
2.25	-	0.30
0	-	0.08
-1.1	-	-0.38
0	-	-0.31

3.3 Test Series 2 Brace Test Results

TS2-A PUSH (TEST)		
TOTAL LOAD (kN)	-	DISP (mm)
0	-	0
9.8	-	67.5

TS2-1 PUSH		
TOTAL LOAD (kN)	-	DISP (mm)
0	-	0.00
3.2	-	8.74
0	-	6.39
3.2	-	8.93
0	-	6.88
3.2	-	10.95
0	-	9.55
6.4	-	18.26
0	-	9.79
9.7	-	65.68
0	-	27.30
9.73 (Failure)	-	71.47

TS2-2 PUSH		
TOTAL LOAD (kN)	-	DISP (mm)
0	-	0.00
3.2	-	7.55
0	-	4.48
3.2	-	9.49
0	-	6.03
3.2	-	10.83
0	-	7.42
6.4	-	19.2
0	-	10.61
9.7	-	59.55
0	-	22.67
9.92 (Failure)	-	67.22

TS2-3 PUSH		
TOTAL LOAD (kN)	-	DISP (mm)
0	-	0.00
3.2	-	10.78
0	-	6.72
3.2	-	12.13
0	-	6.99
3.2	-	12.38
0	-	7.26
6.4	-	19.53
0	-	10.78
9.7	-	54.93
0	-	26.00
9.98 (Failure)	-	64.06

TS2-4 PUSH		
TOTAL LOAD (kN)	-	DISP (mm)
0	-	0.00
3.2	-	6.65
0	-	3.81
3.2	-	7.11
0	-	4.69
3.2	-	7.14
0	-	4.81
6.4	-	17.29
0	-	8.59
9.7	-	48.17
0	-	19.69
10.53 (Failure)	-	64.69

TS2-5 PUSH		
TOTAL LOAD (kN)	-	DISP (mm)
0	-	0.00
3.2	-	9.41
0	-	4.56
3.2	-	9.43
0	-	5.74
3.2	-	9.31
0	-	10.61
6.4	-	20.83
0	-	10.27
9.7	-	50.90
0	-	21.77
9.97 (Failure)	-	59.91

3.4 Test Series 3 Vibration

Test Number	Maximum Angle Tube (Radians)	Maximum Angle Box (Radians)
1	0.009	0.0008
2	0.0028	0.0014
3	0.017	0.0015
4	0.0025	0.002
5	0.023	0.0025

4 Conclusion

The cyclic test results were analysed by considering the third of three cycles to the approximate service moment. Curve fitting was carried out using Excel to produce a polynomial to the maximum, the maximum is then held for greater rotations.

In case of the brace assembly the buckling failure mode give a graph of displacement against load where the first maximum reduces sharply after failure and then levels of after a displacement of approximately 120mm. The design curve has is represented by a polynomial up to 120mm and then represented by a straight line. It is felt that this demonstrates more closely the performance of the arrangement.

Values of q_e were found for each test and the value used for further calculation in accordance with BS EN 12811-3:2002.

There was significant looseness in all assemblies, this was measured and the average value was produced for using in the design.

The results graphs show separate results graphs for each component assembly. Rotations and loads have been normalised to the so that the predominant direction of load is shown as positive.

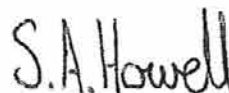
Summary of properties

Property	Units	Ledger Tube		Ledger Box		Brace Assembly	
		Up	Down	Up	Down	Units	Compression
char $R_{k,nom}$	kNm	2.92	1.99	2.1	1.45	kN	12.45
Theta @ $R_{k,nom}$	rad	0.22	0.08	0.11	0.08	mm	74
serv $R_{k,nom}$	kNm	3.65	1.20	3.25	1.11	kN	4.02
Theta @ serv	rad	0.12	0.04	0.10	0.03	mm	55
Initial slope	kNm/rad	62.43	48.51	78.21	58.51	kN/mm	0.32
unloading slope	kNm/rad	88.21	74.82	97.58	91.07	kN/mm	0.41
final slope	kNm/rad	27.62	31.81	32.78	33.30	kN/mm	0.18
total loose	rad	0.17	0.11	0.14	0.09	mm	8
mean loose	rad	0.11	0.07	0.08	0.04	mm	6

This report describes the tests made on the system scaffolding in accordance with the procedures and recommendations found in BS EN 12811-3. The findings are set out in the tables above.



ANDREW GORE
SENIOR ENGINEER



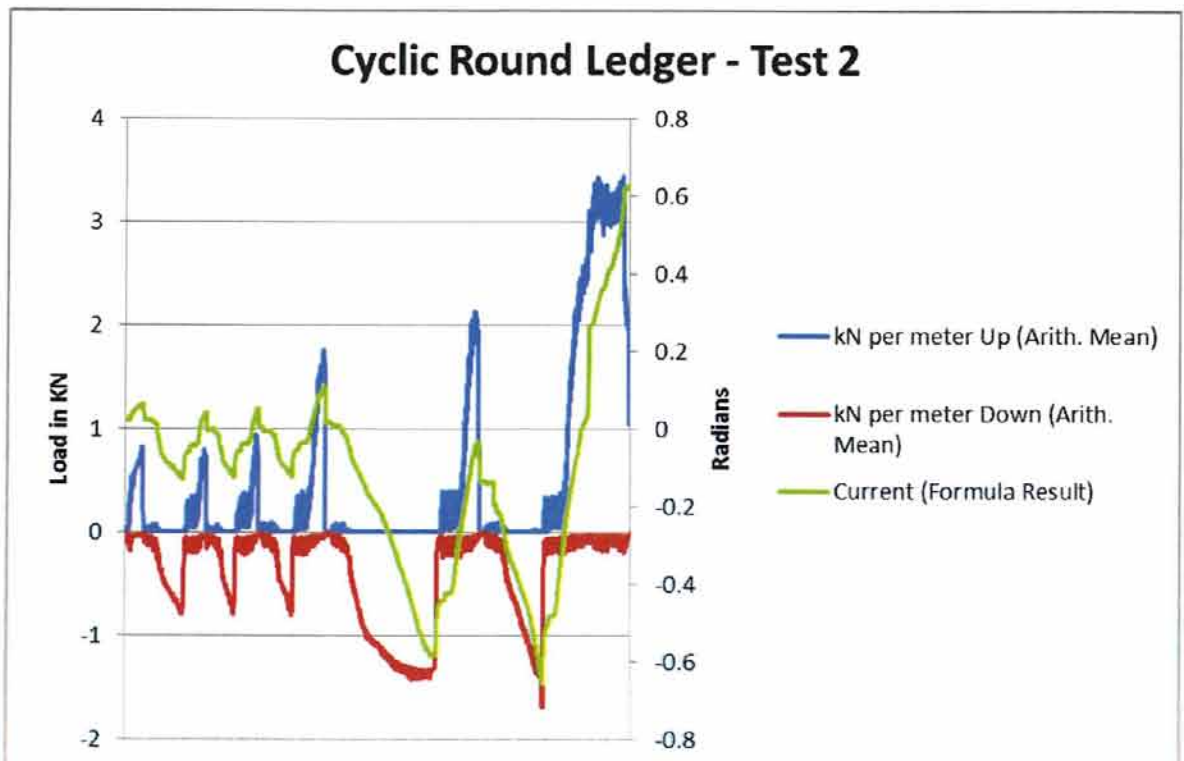
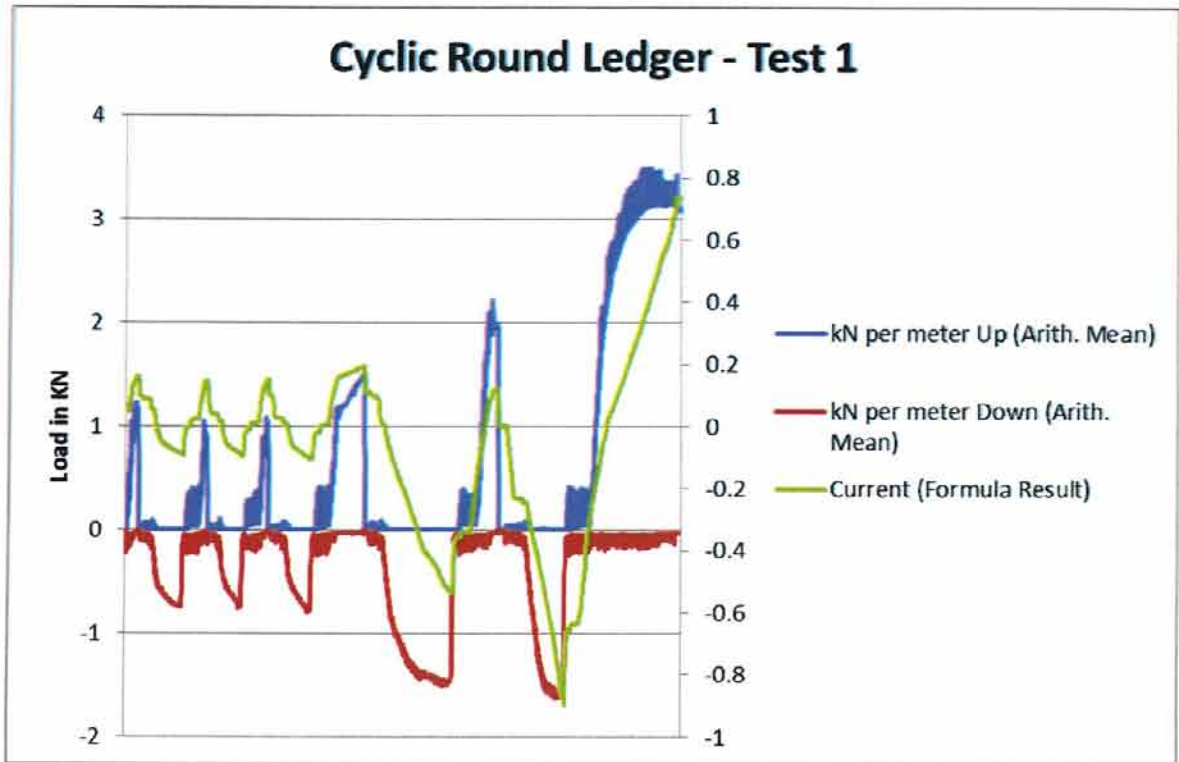
STEVEN HOWELL
ENGINEER

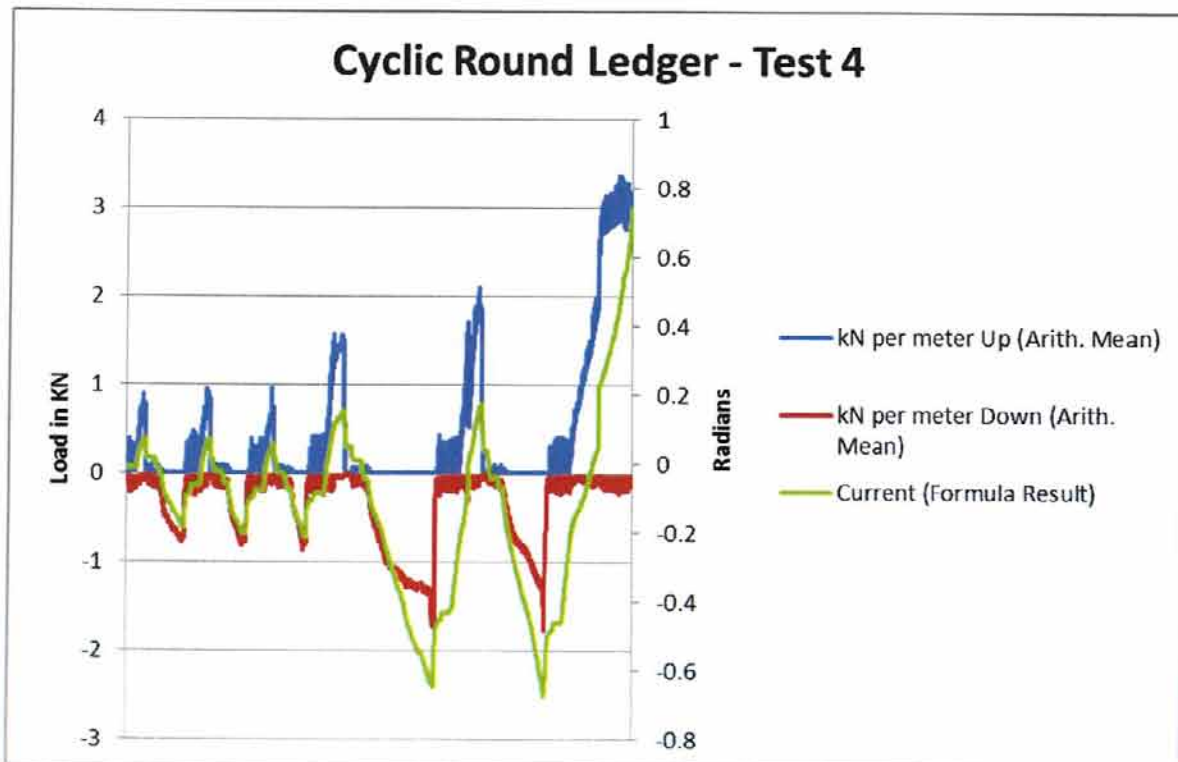
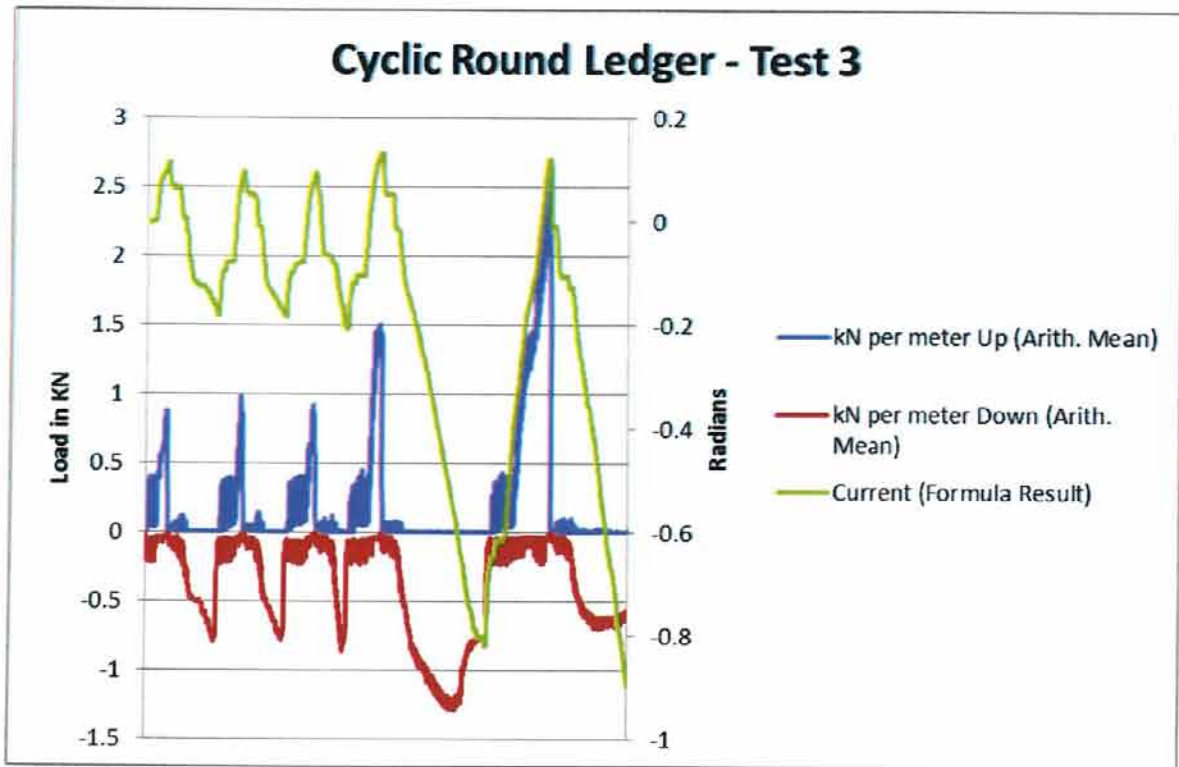
For and on behalf of TESTCONSULT LIMITED

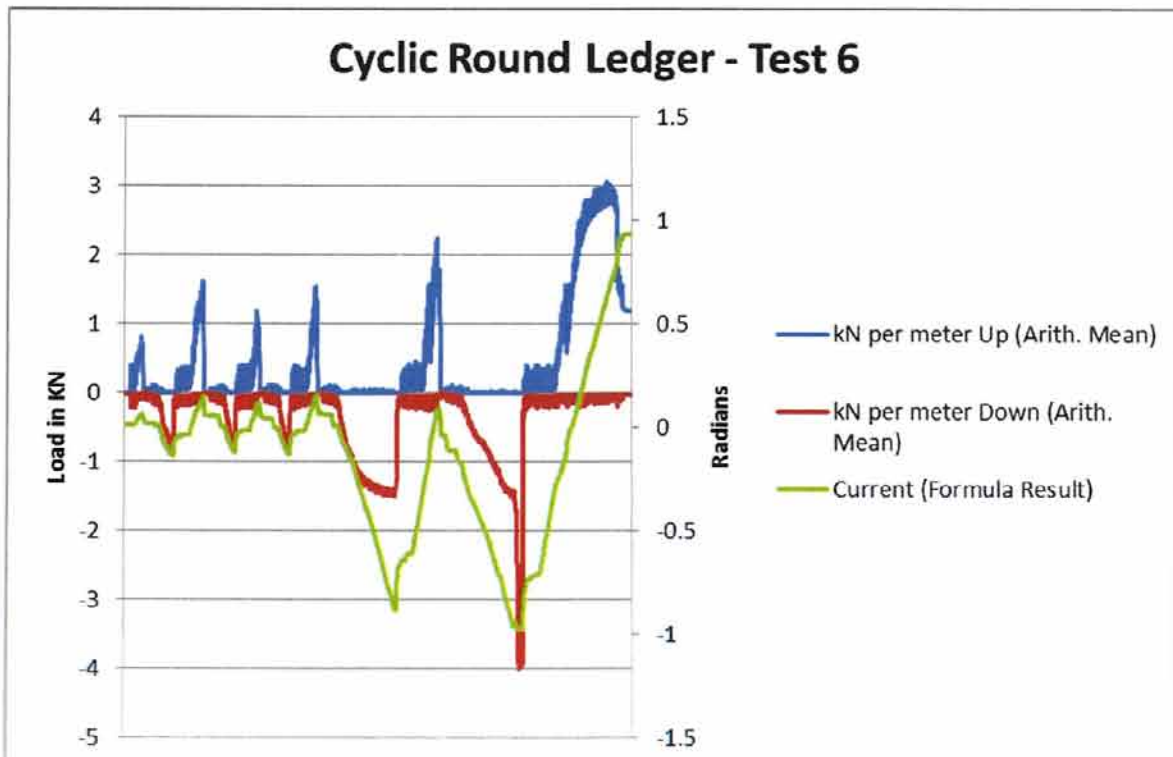
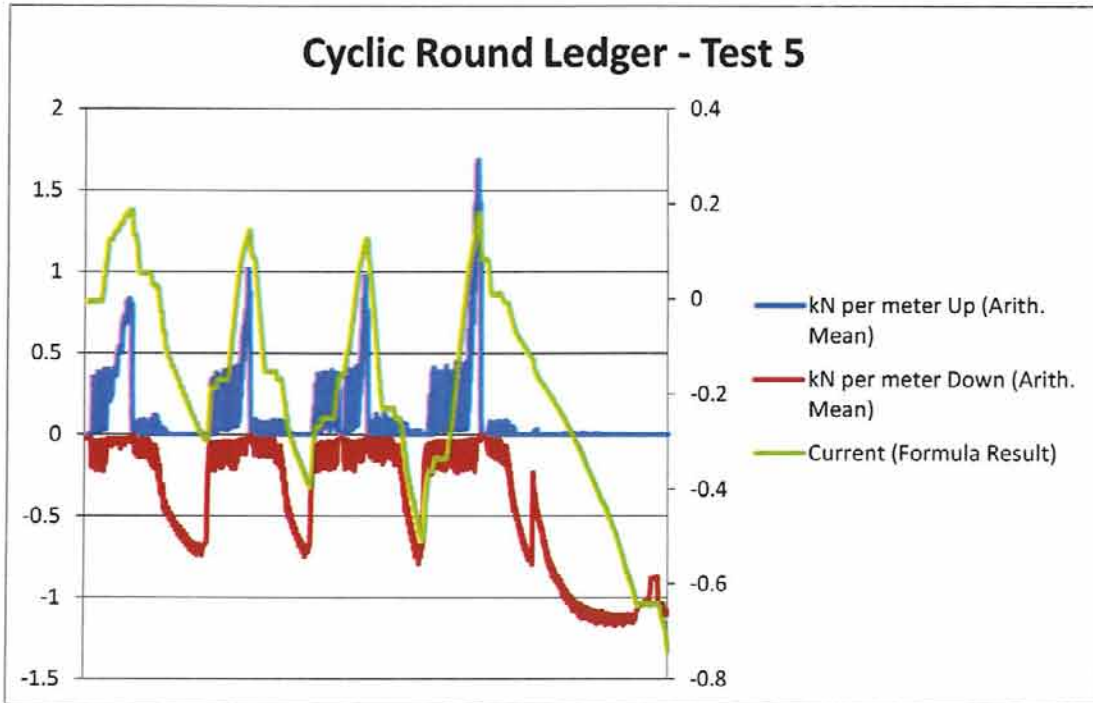
APPENDIX A

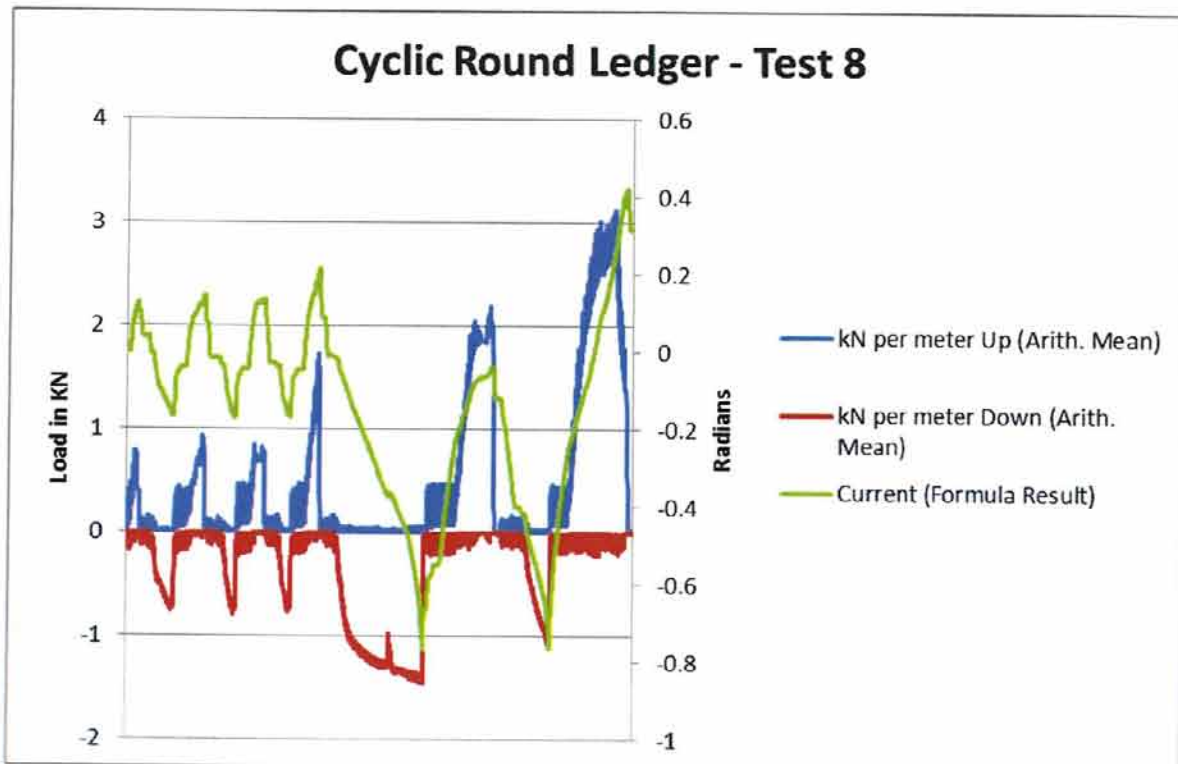
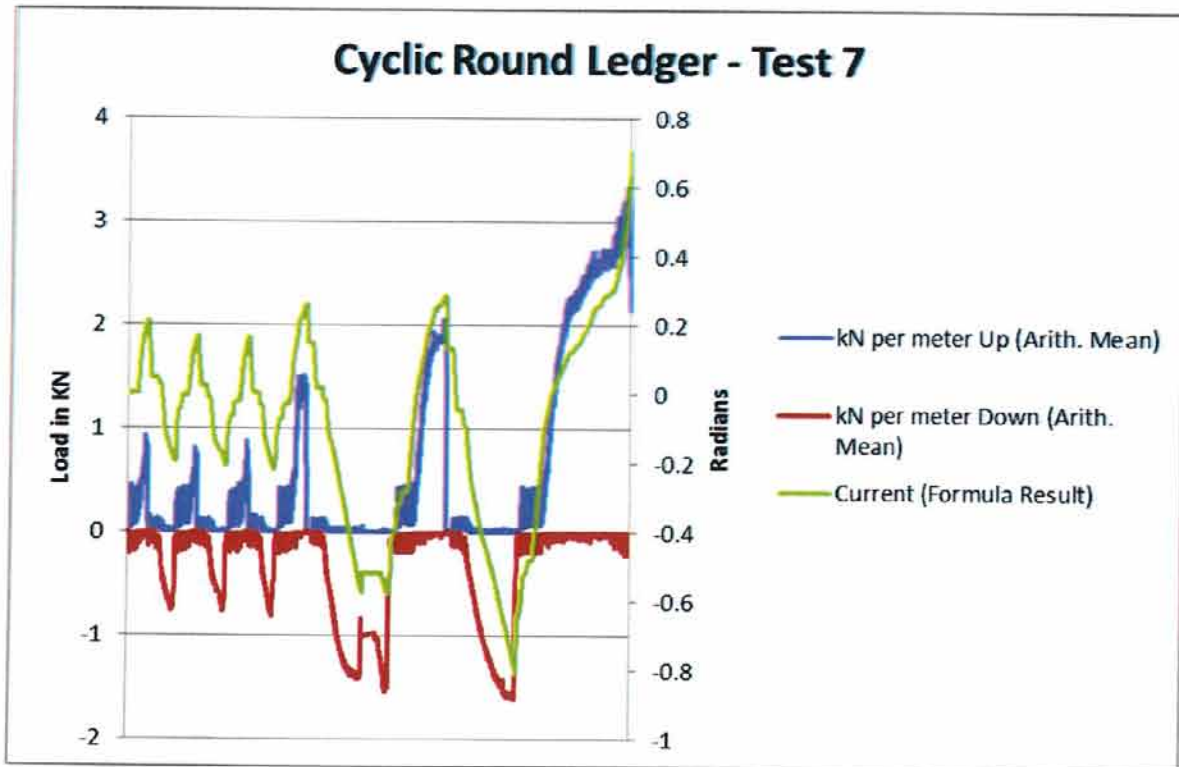
GRAPHICAL RESULTS

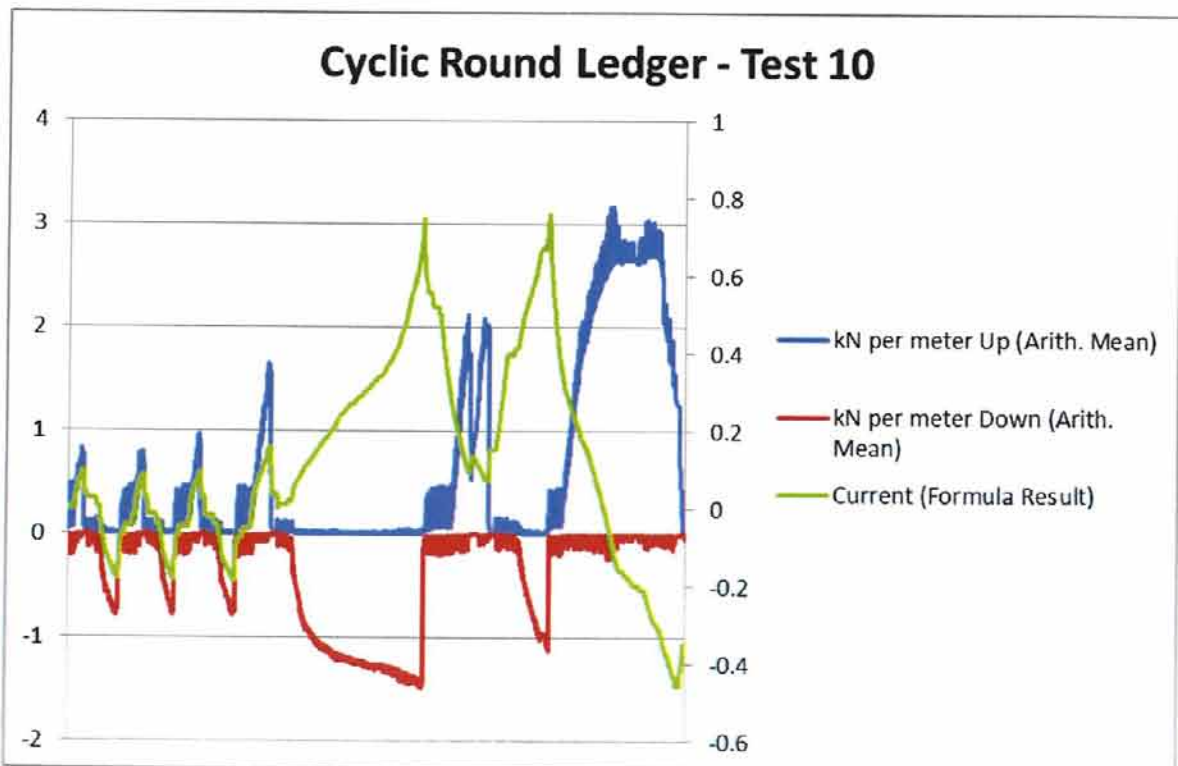
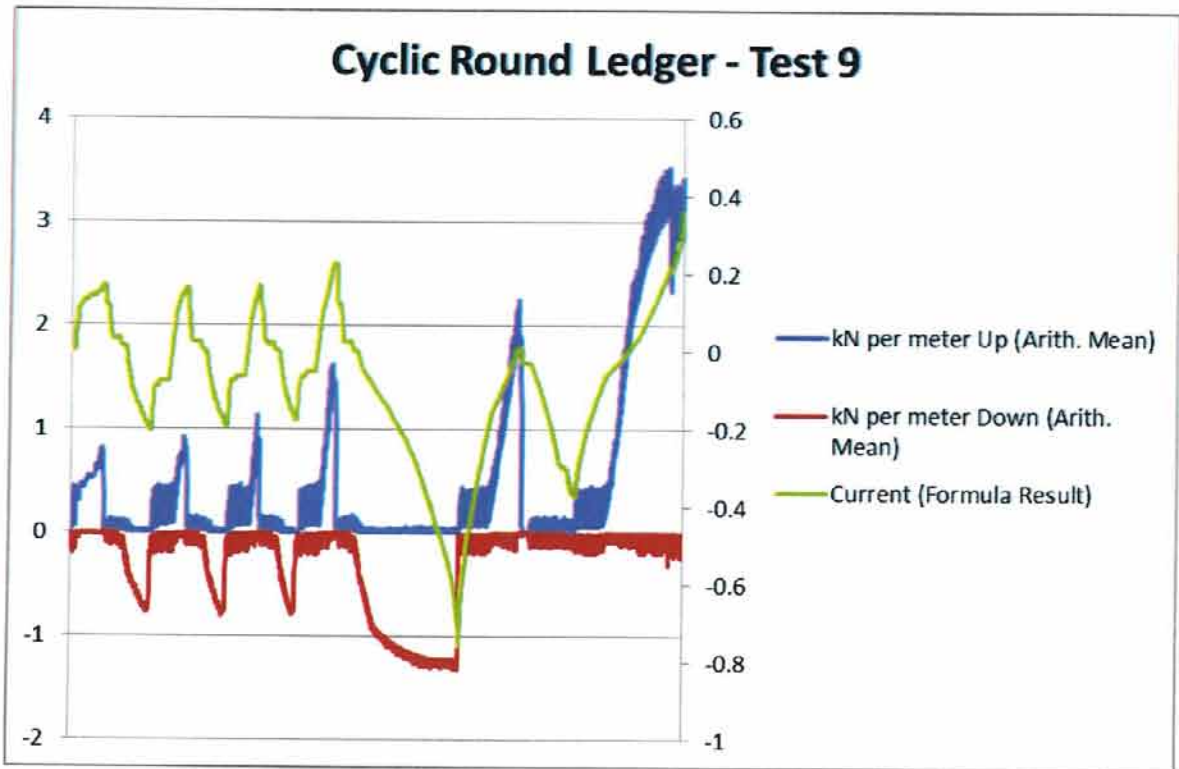
Cyclic Round Ledger – Test Graphs



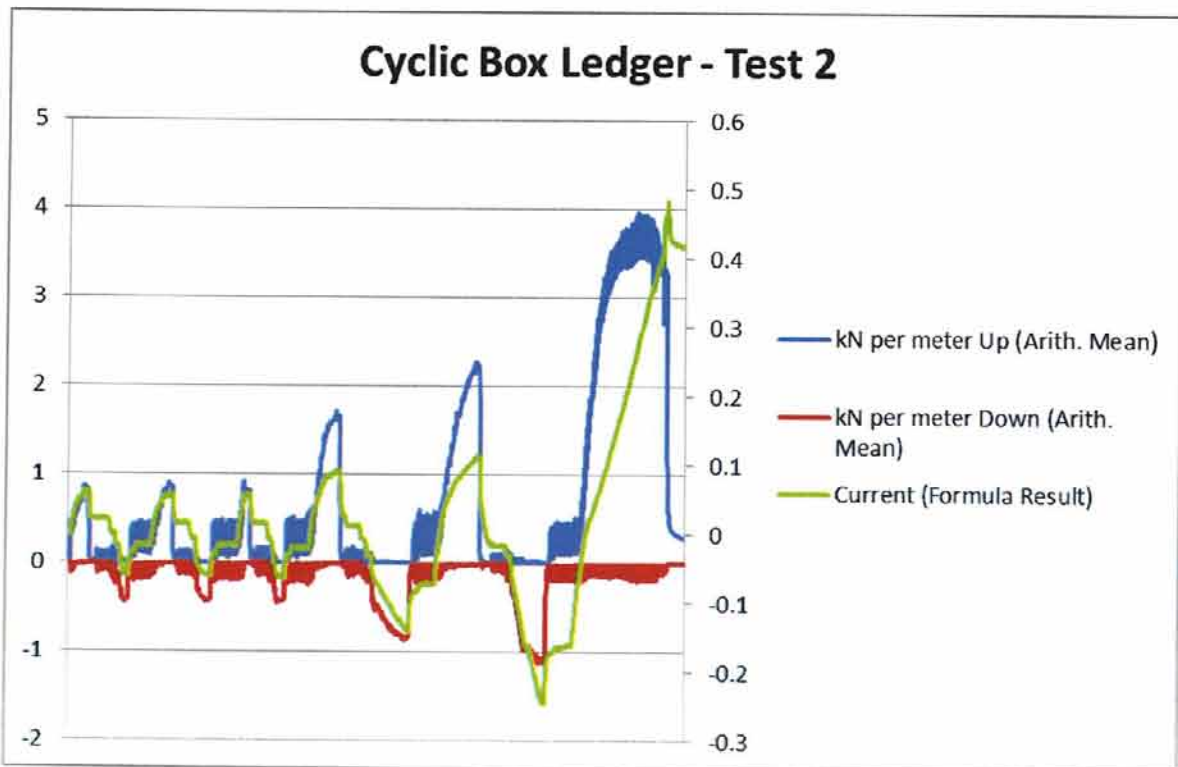
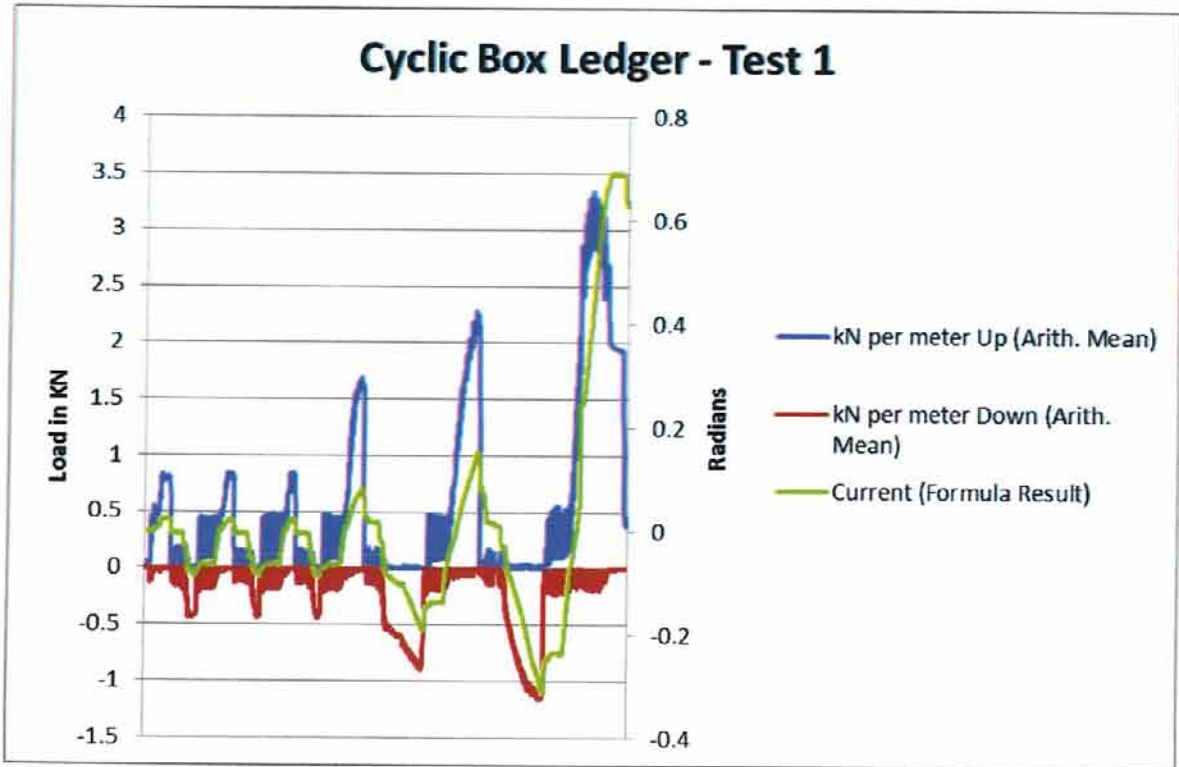


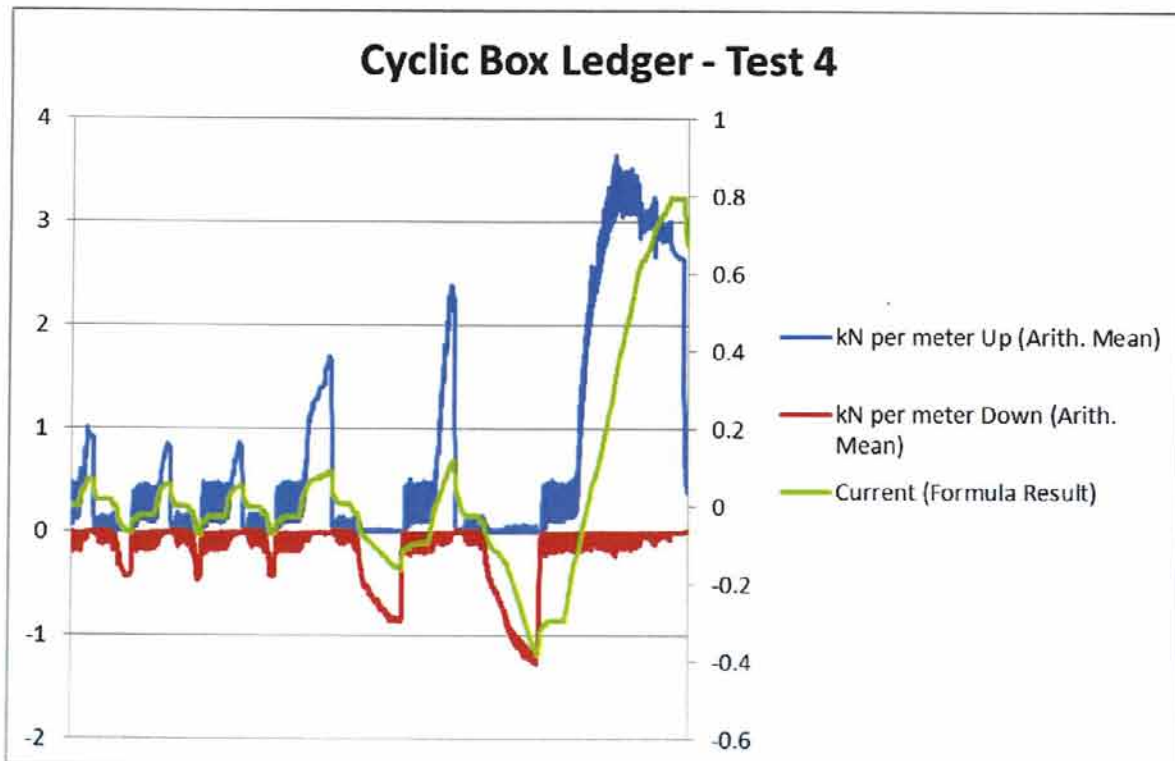
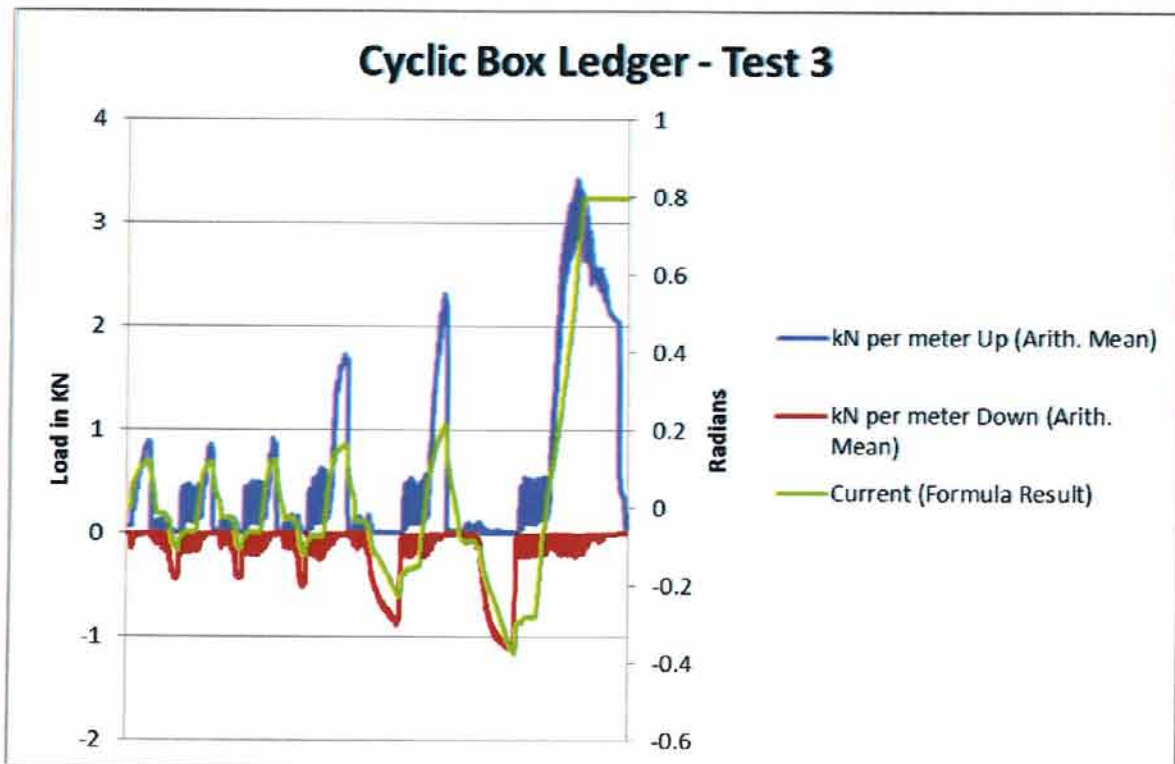


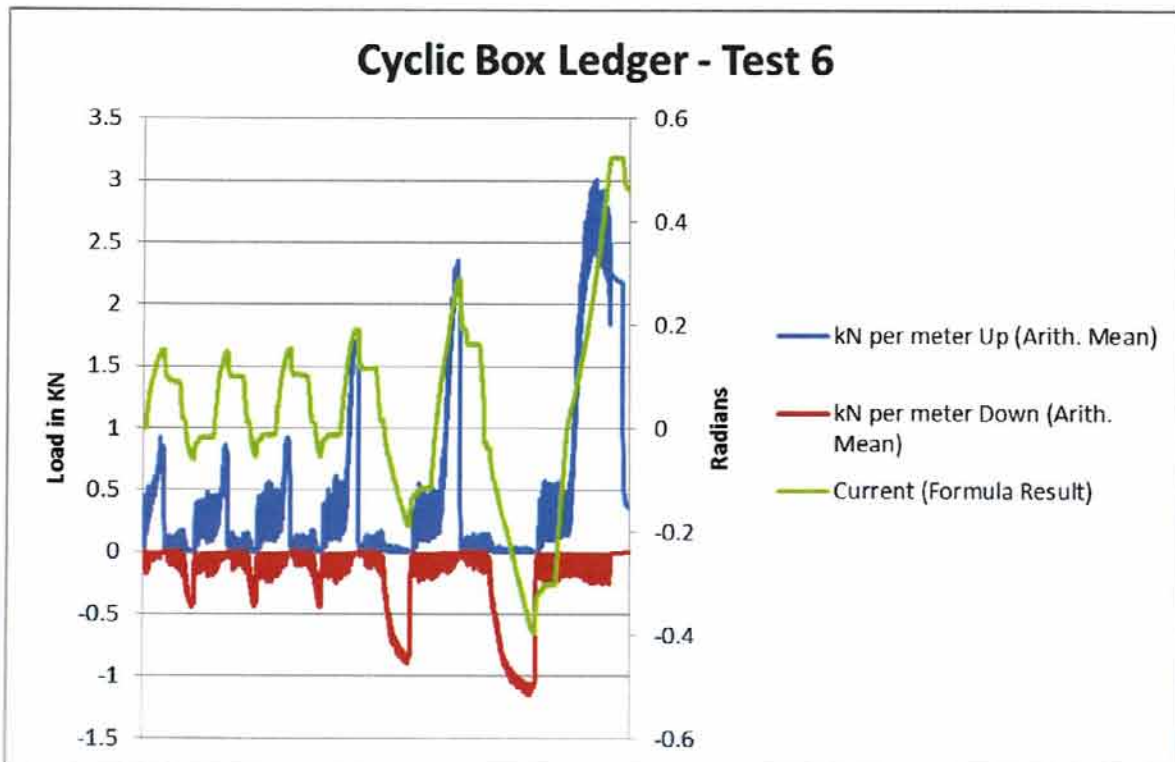
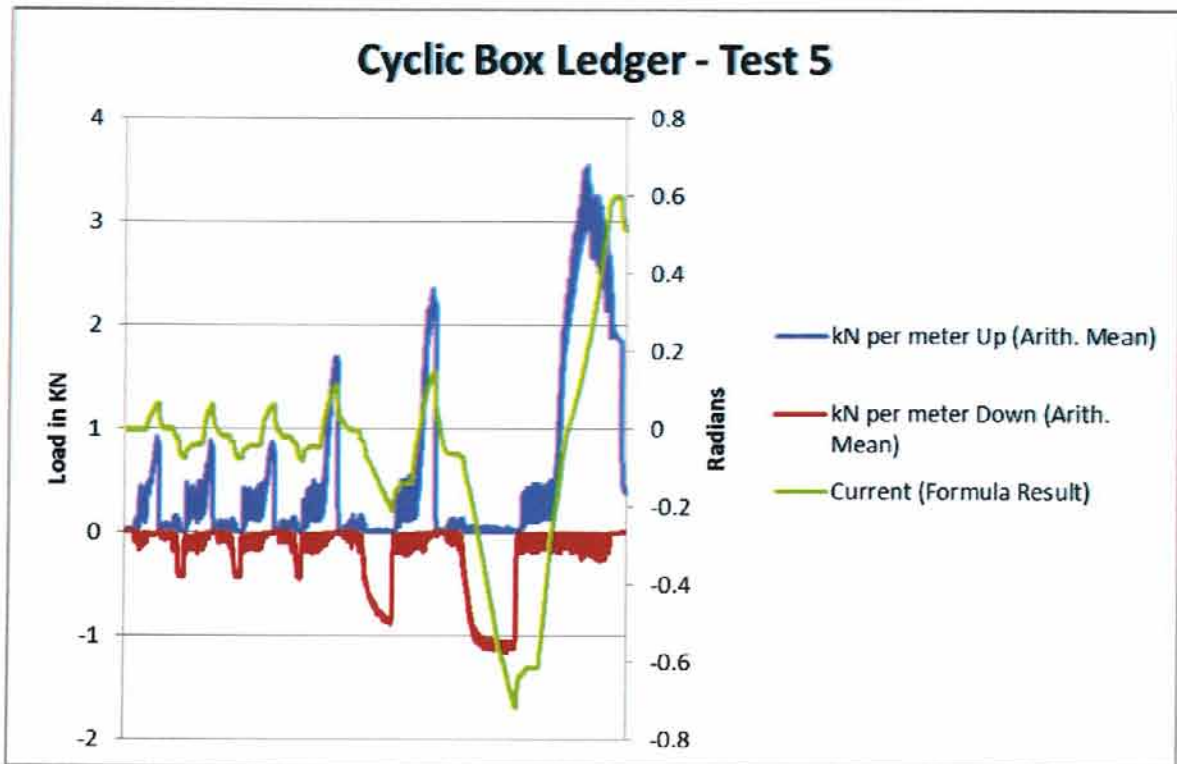


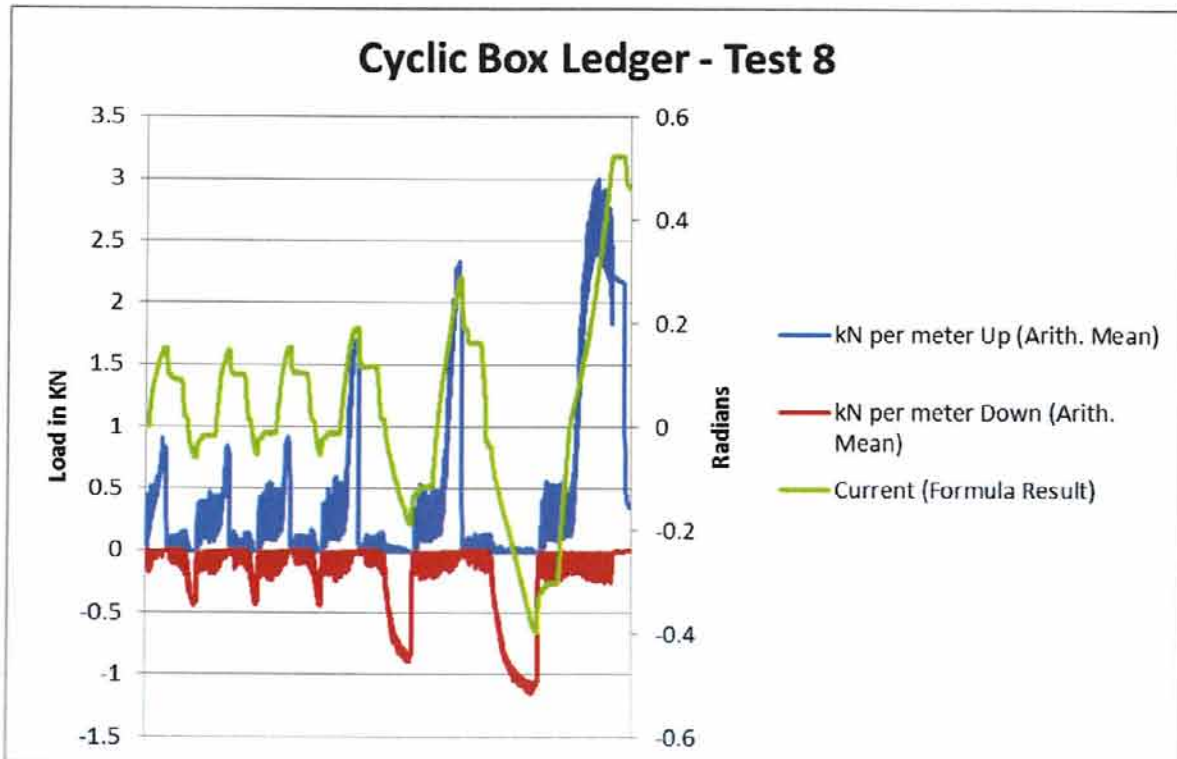
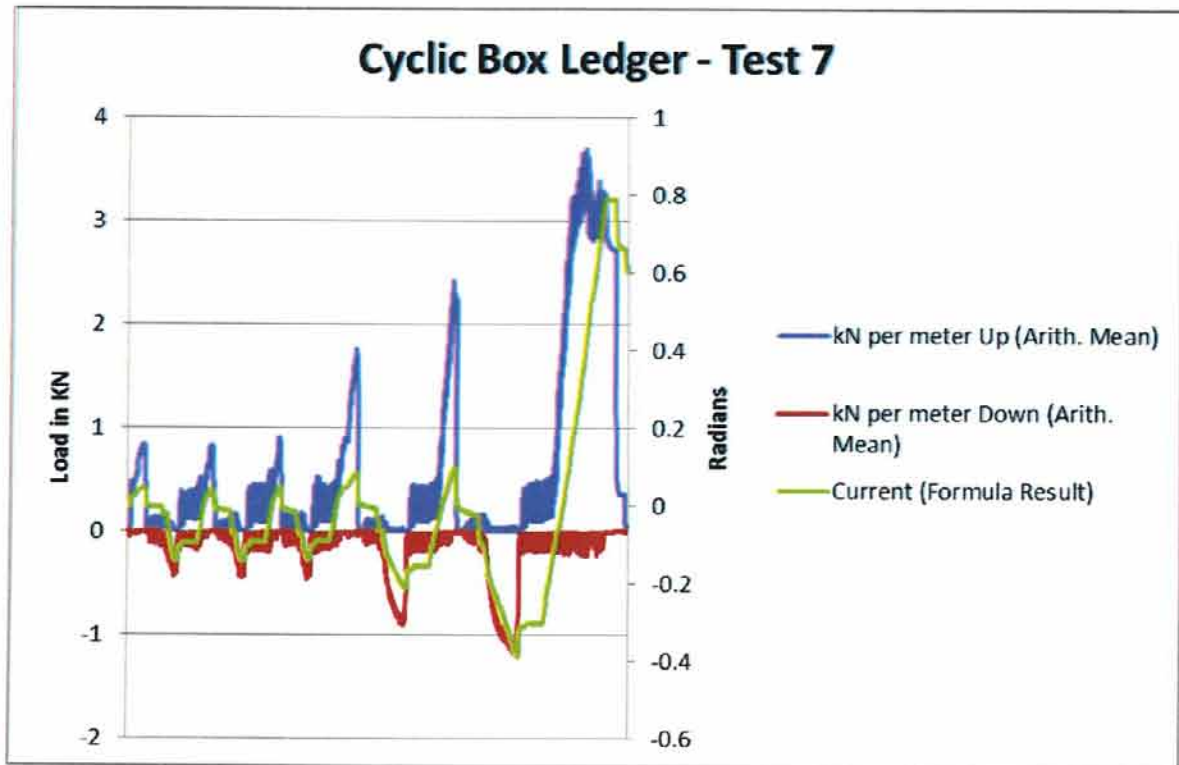


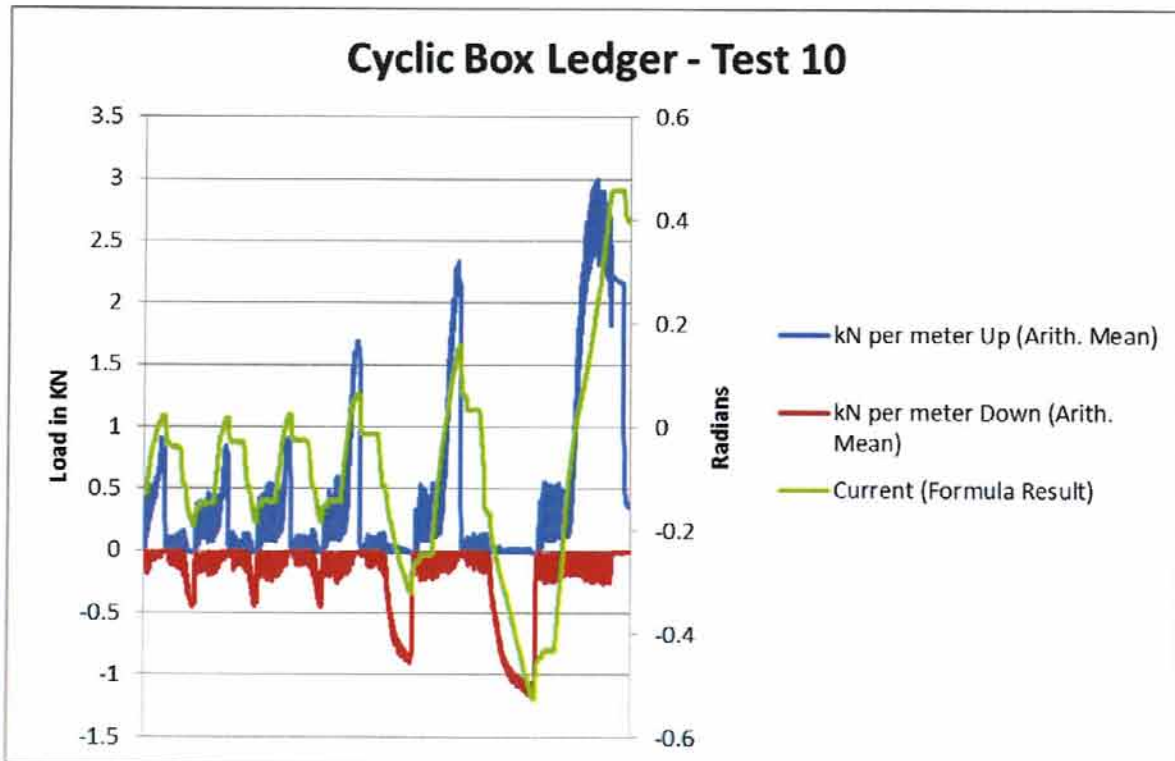
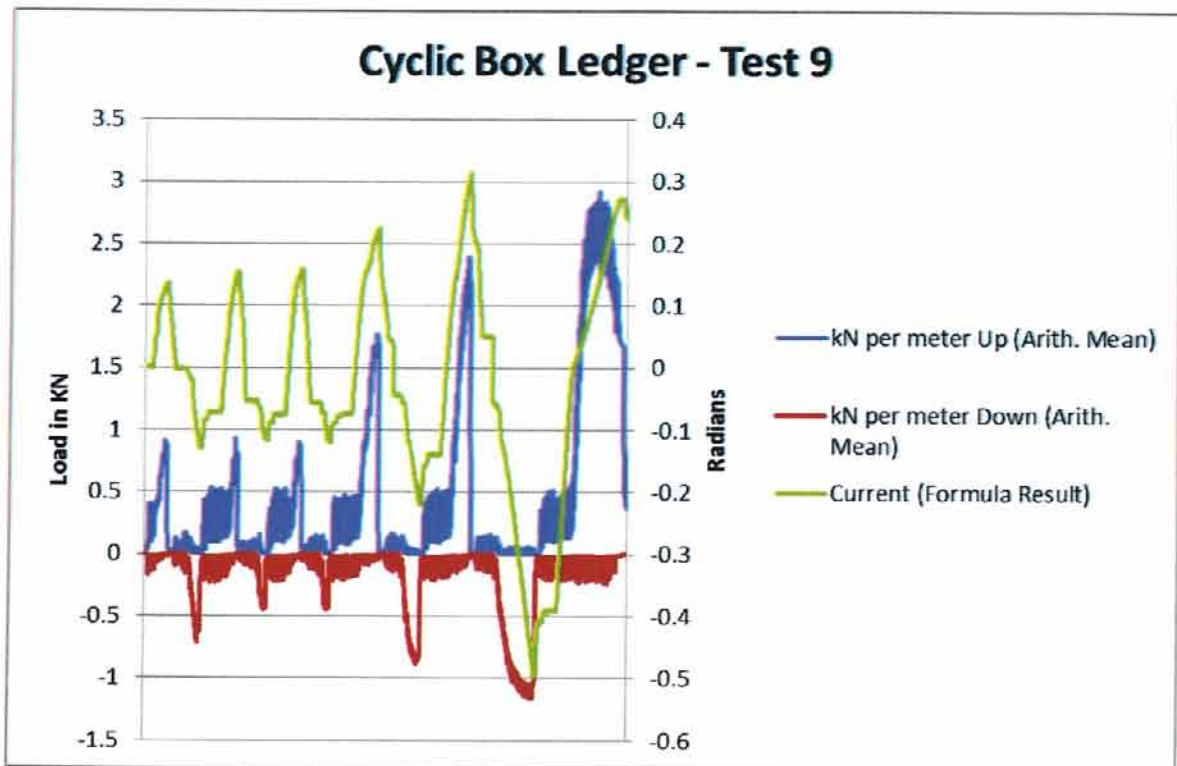
Cyclic Box Ledger Test Graphs



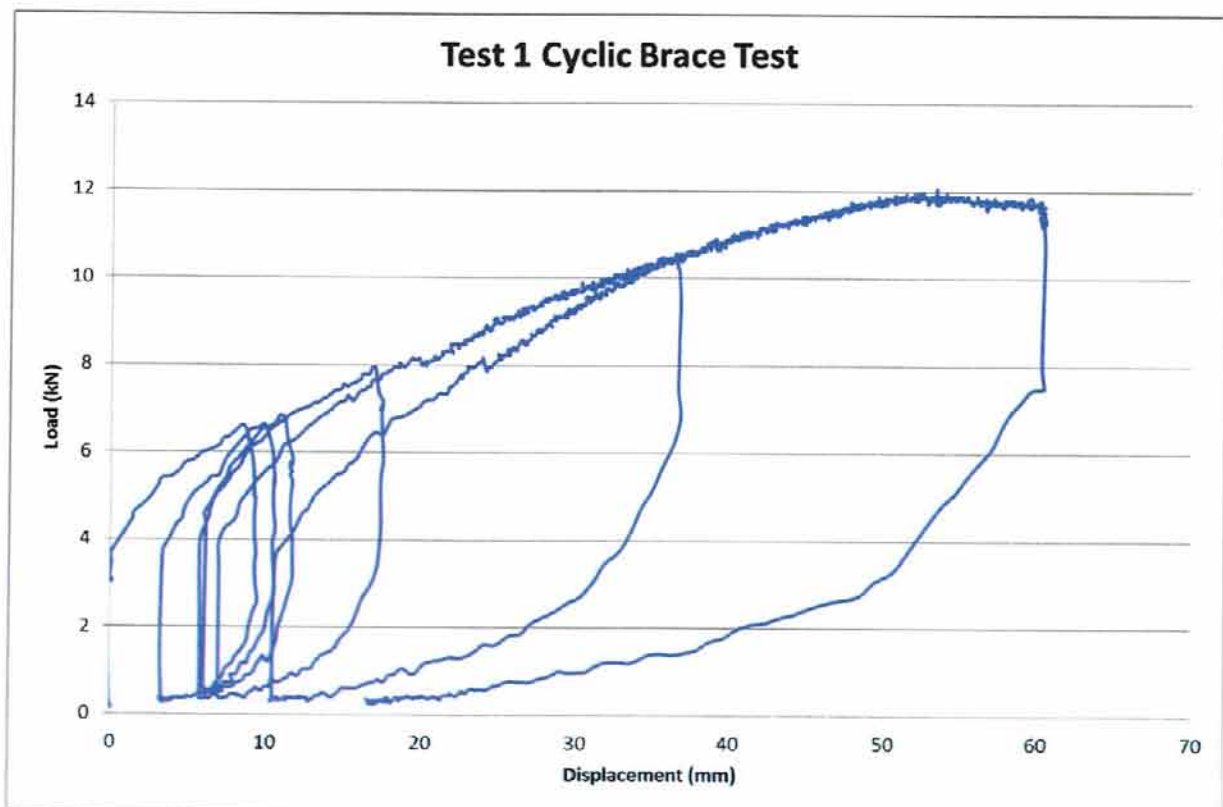
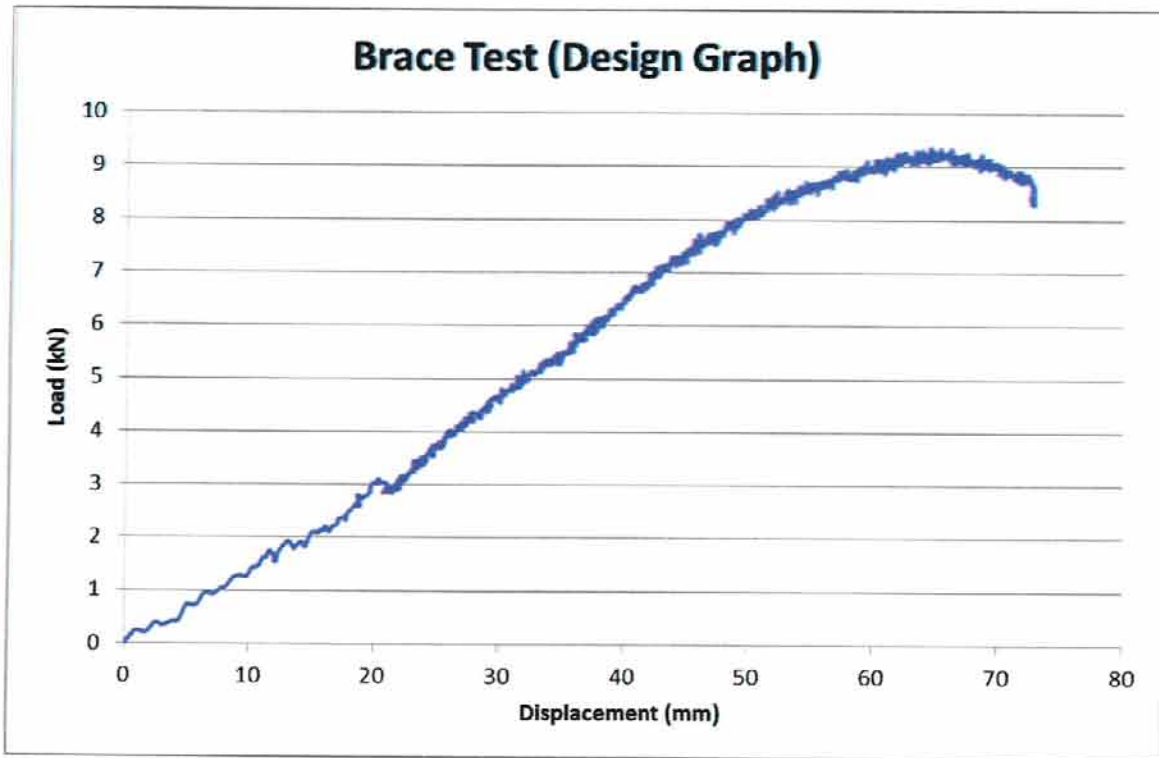


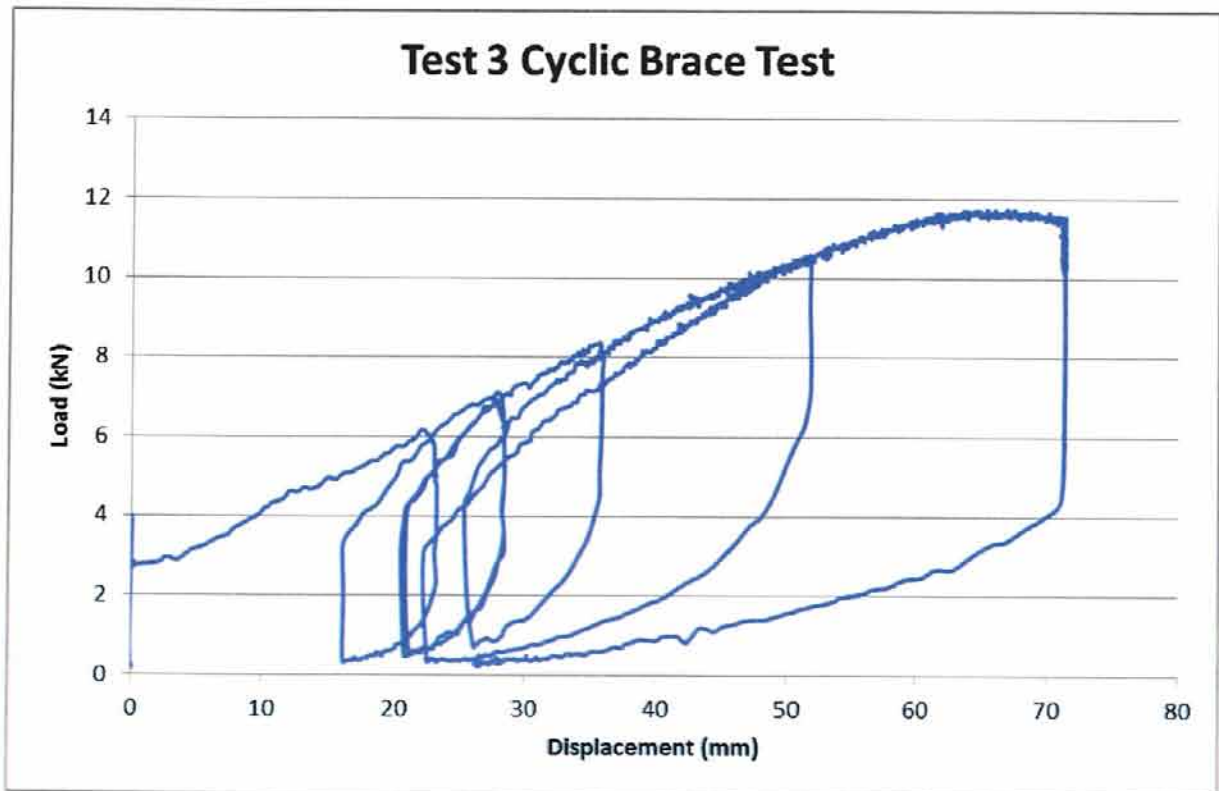
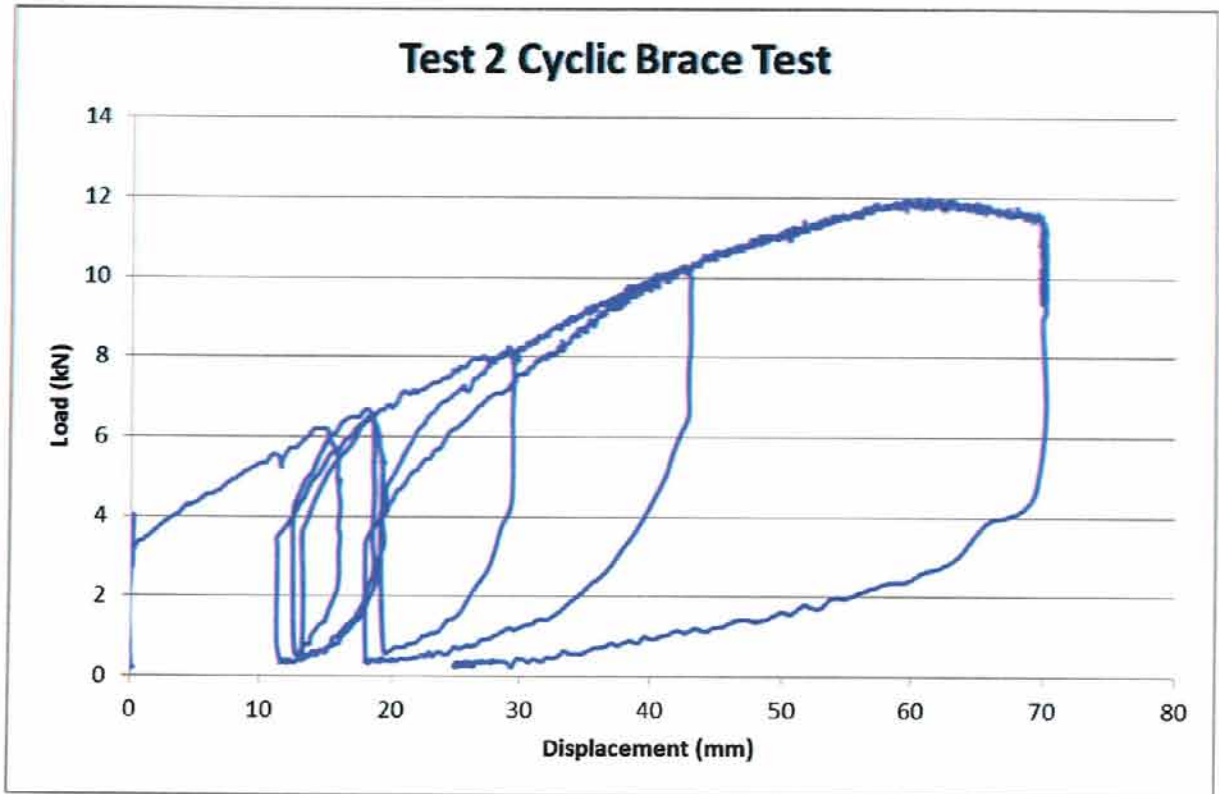


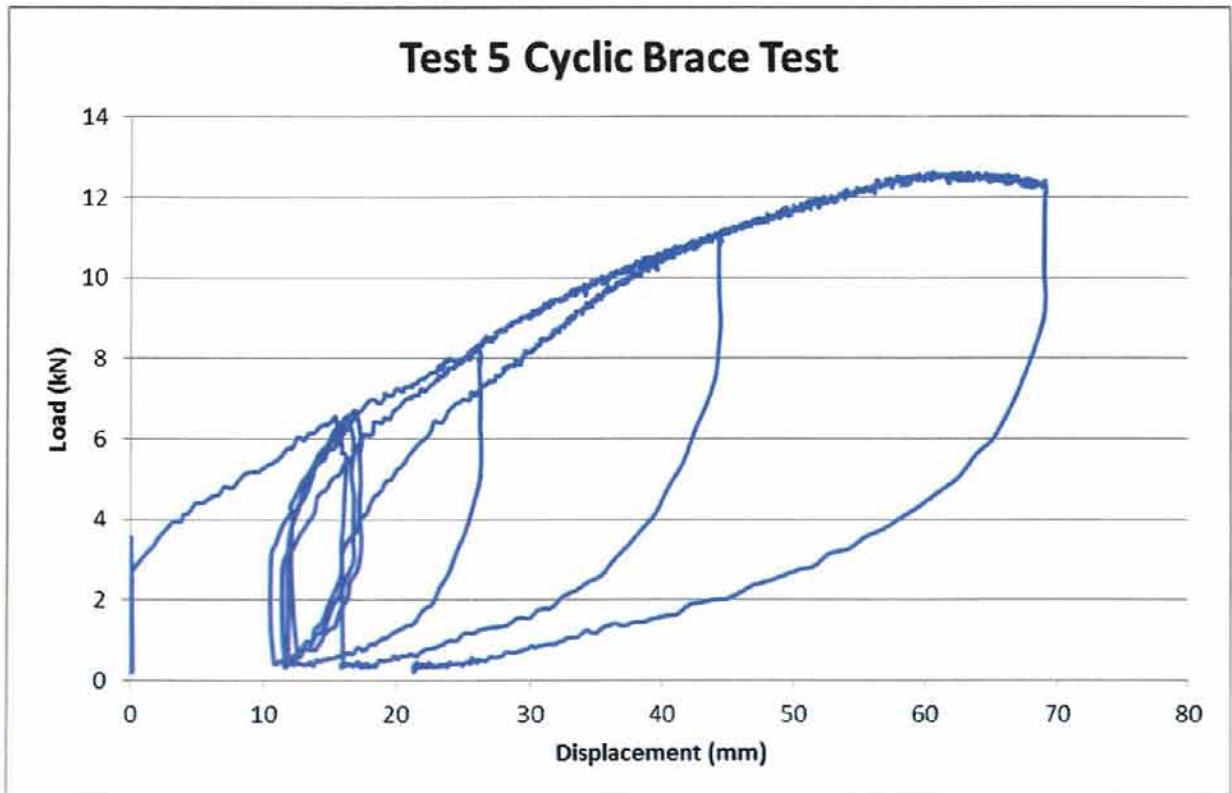
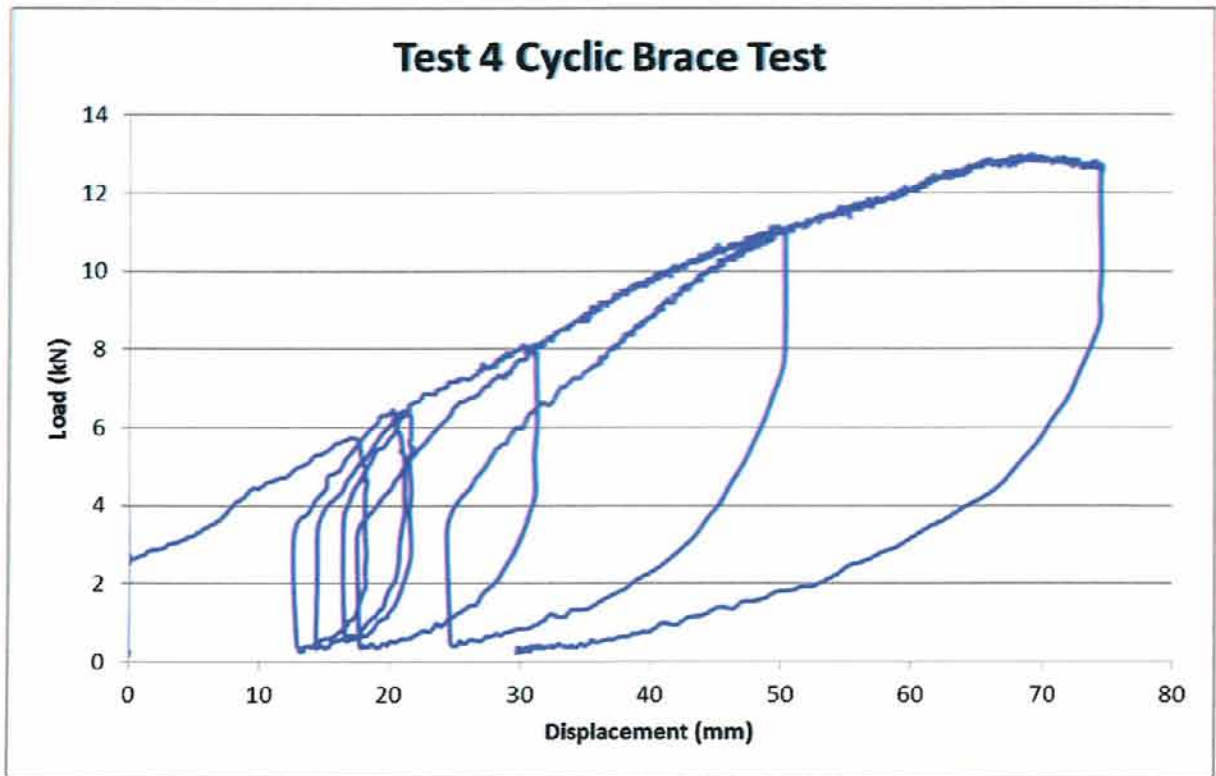




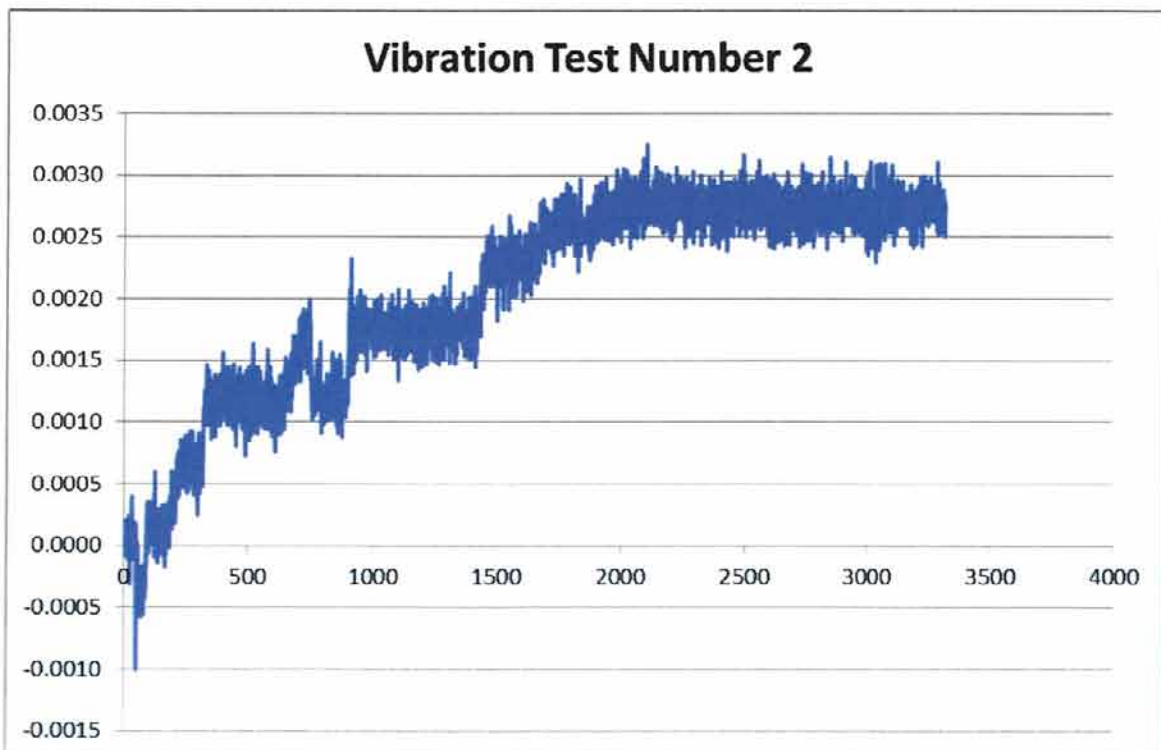
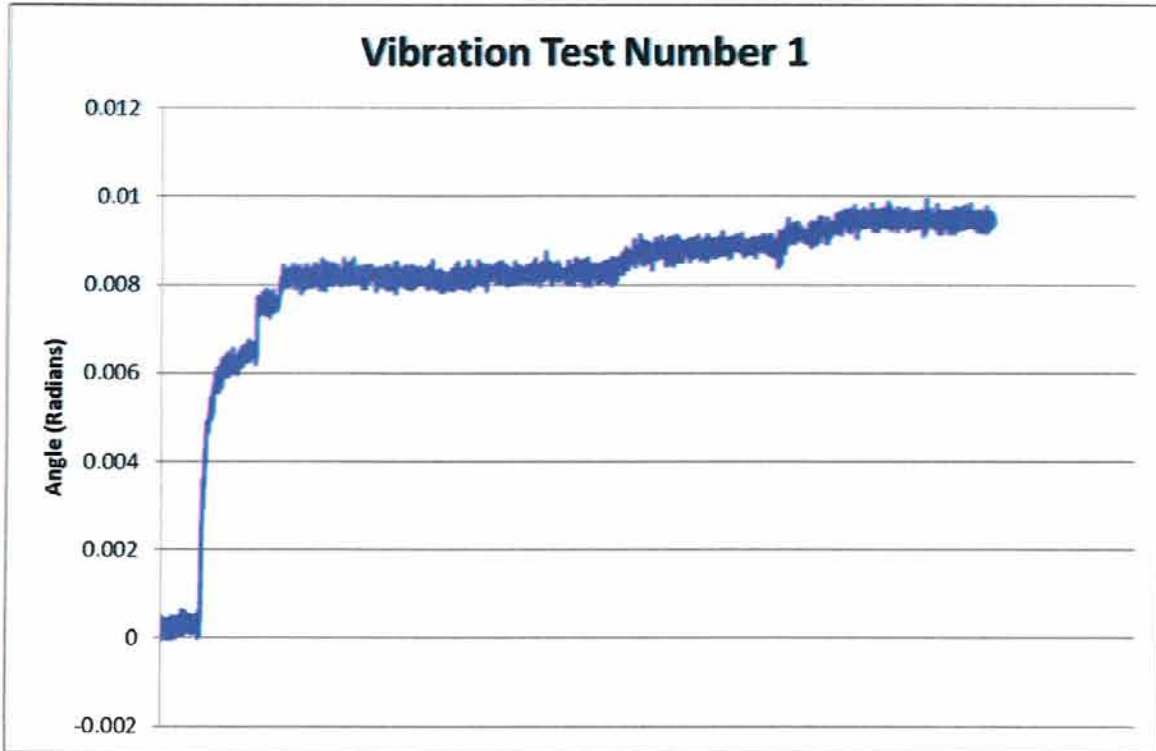
Brace Test Graphs

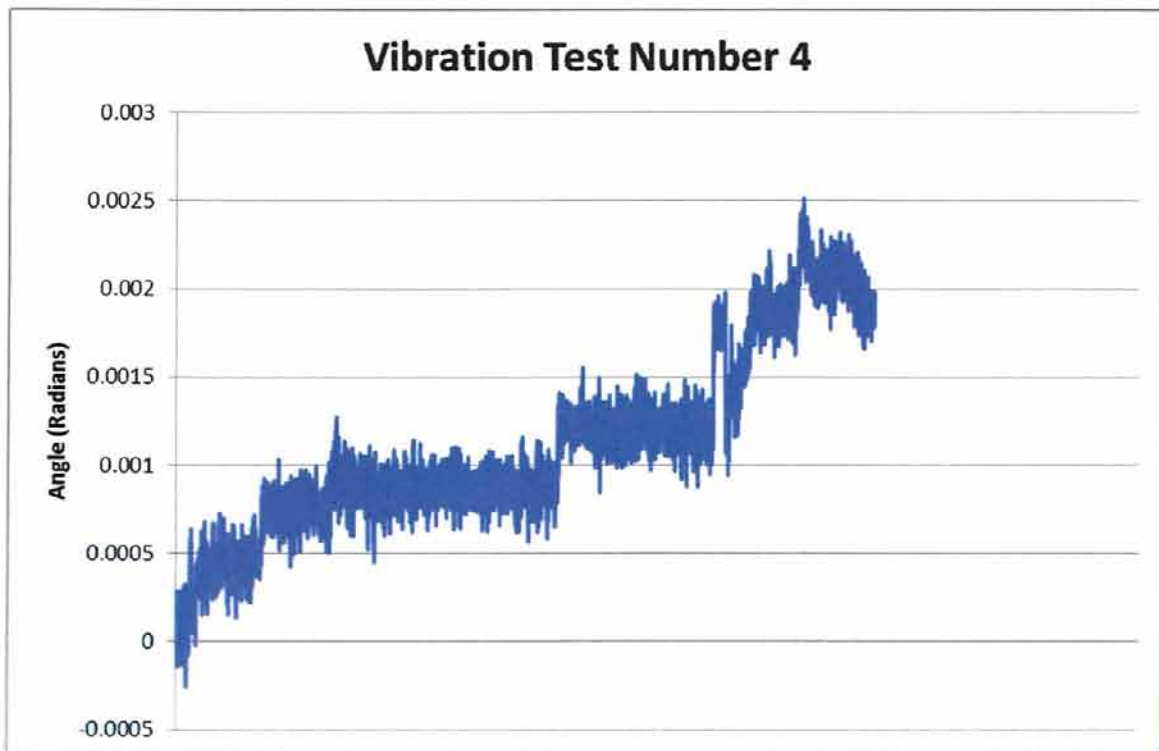
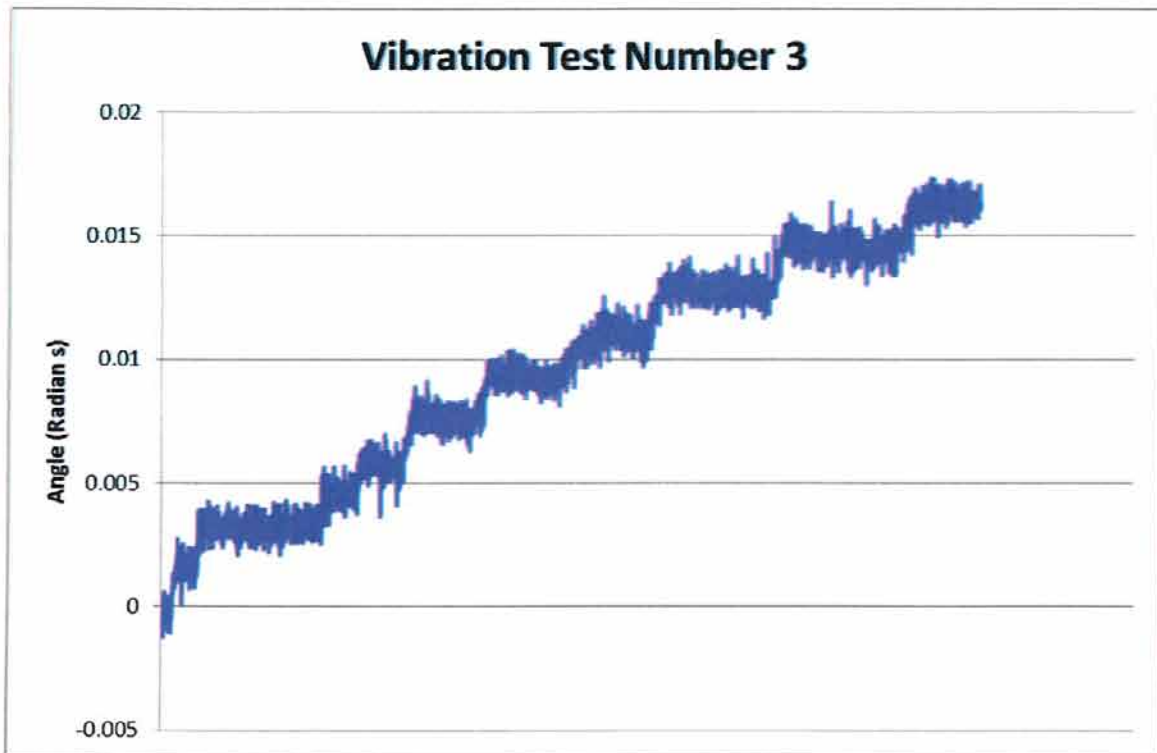


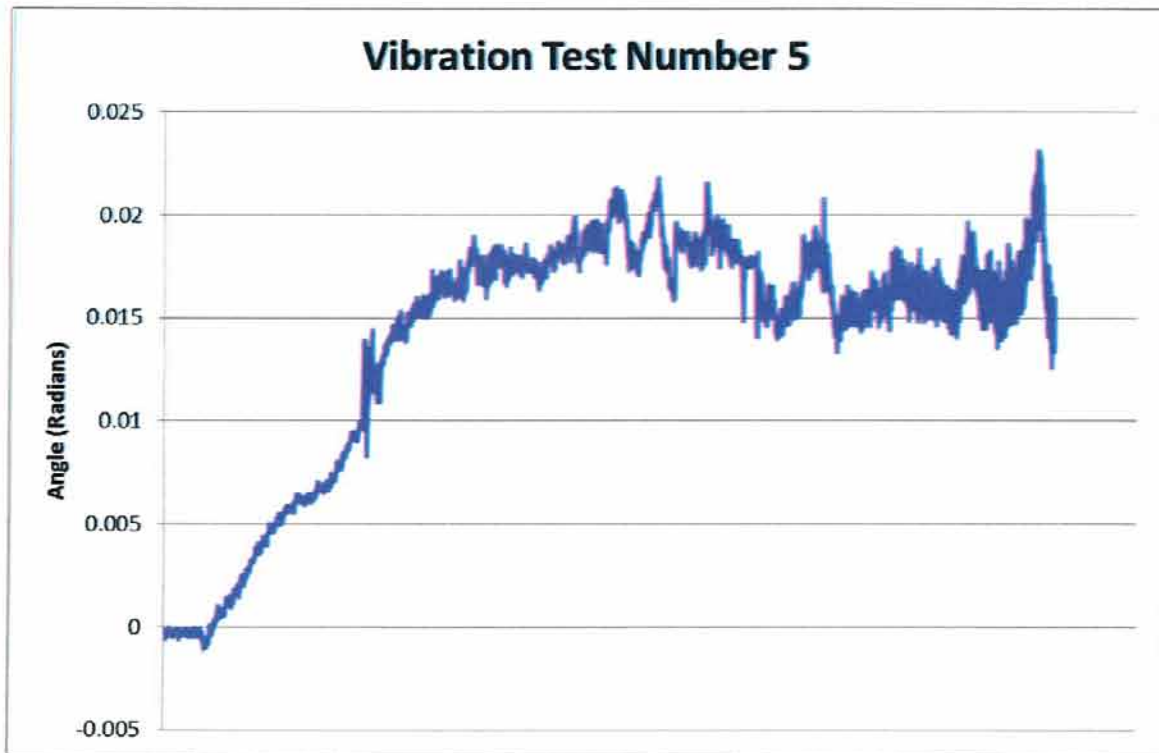




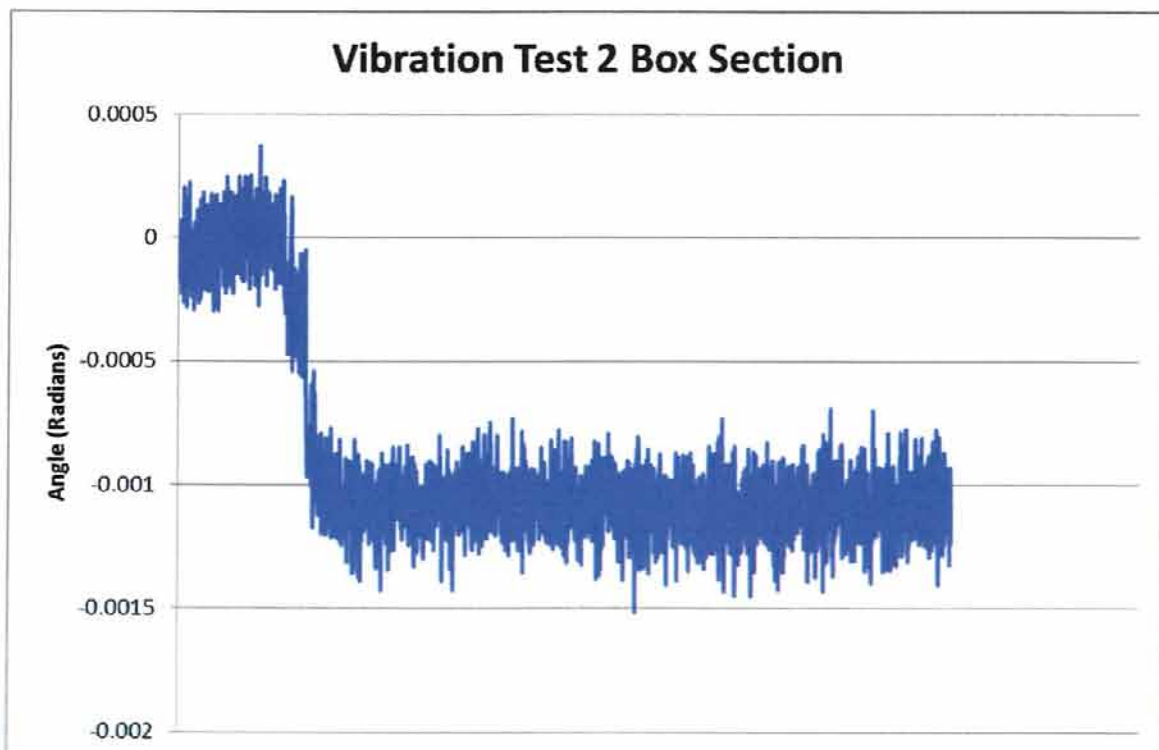
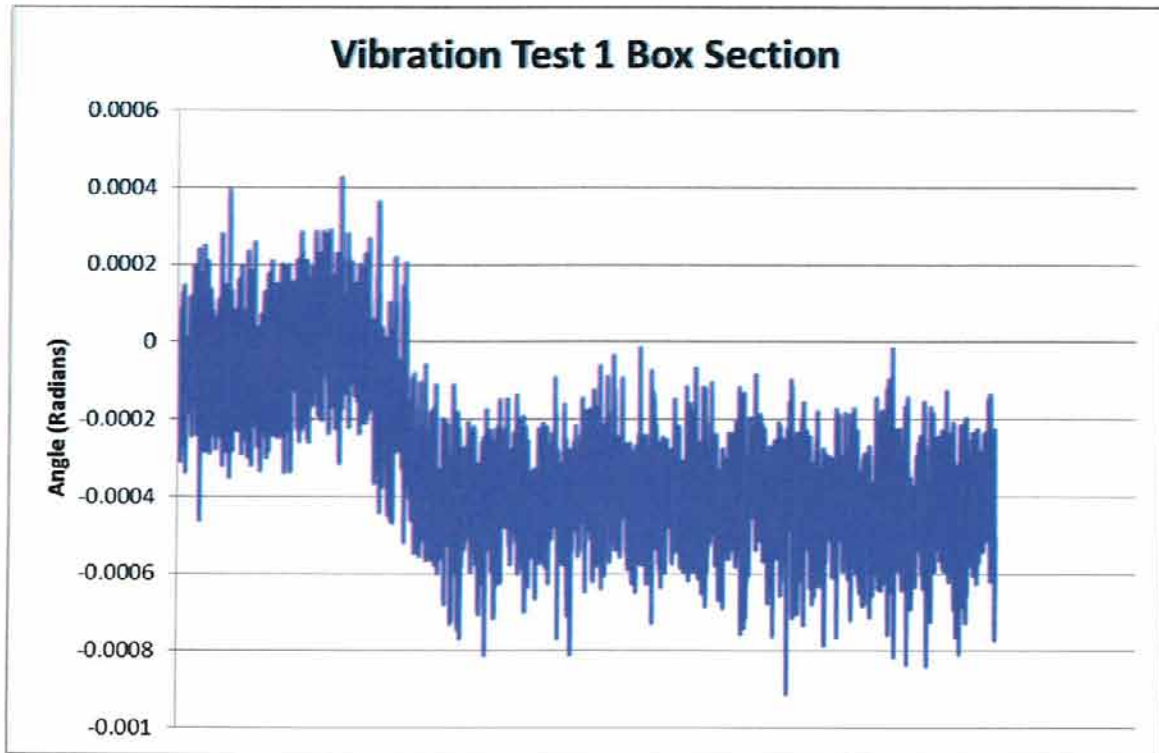
Vibration Tube Ledger Test Graphs

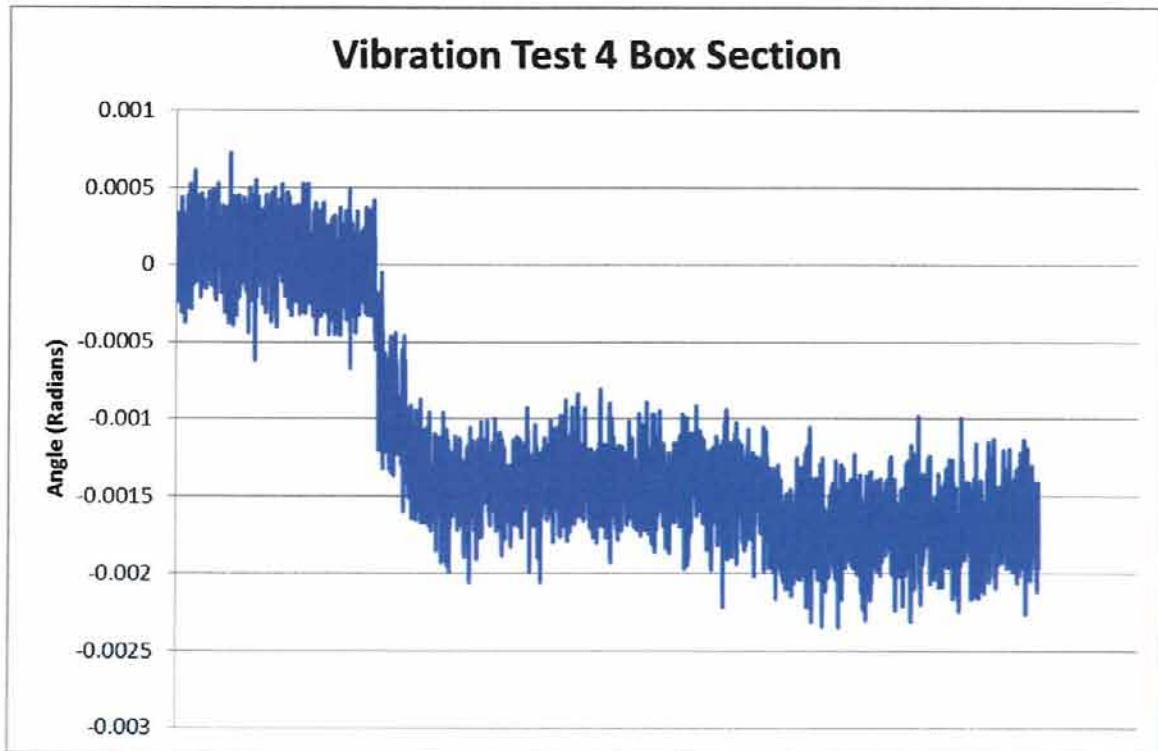
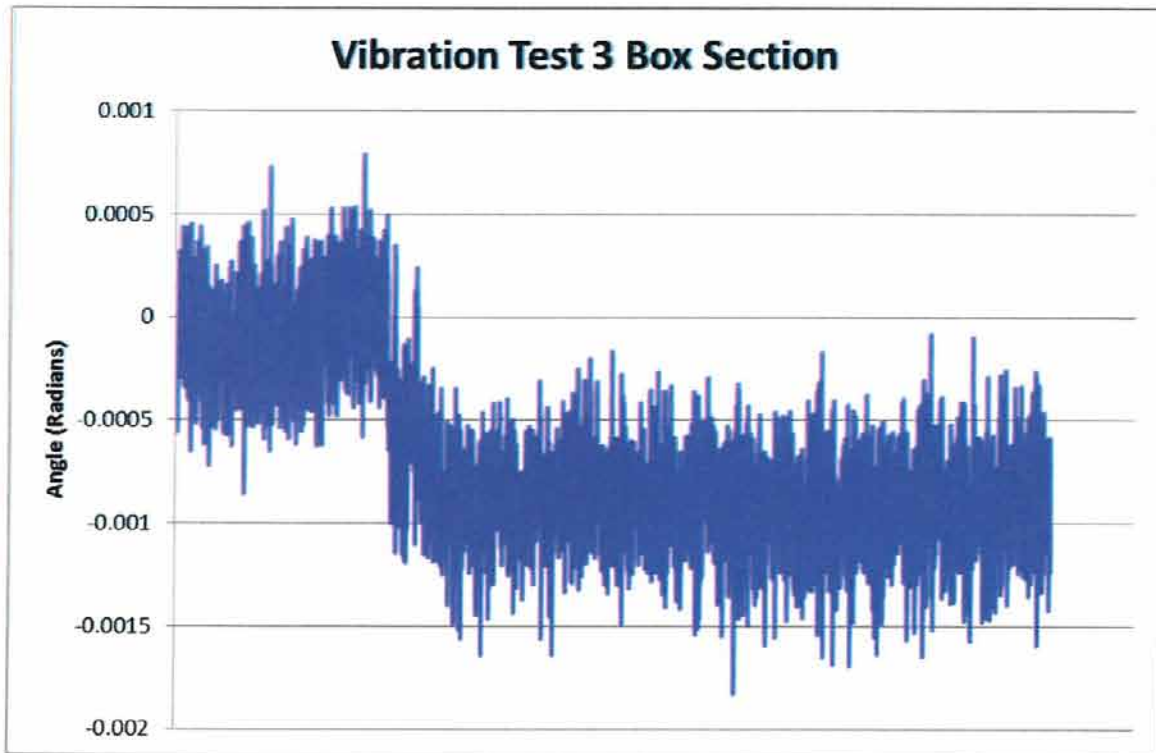


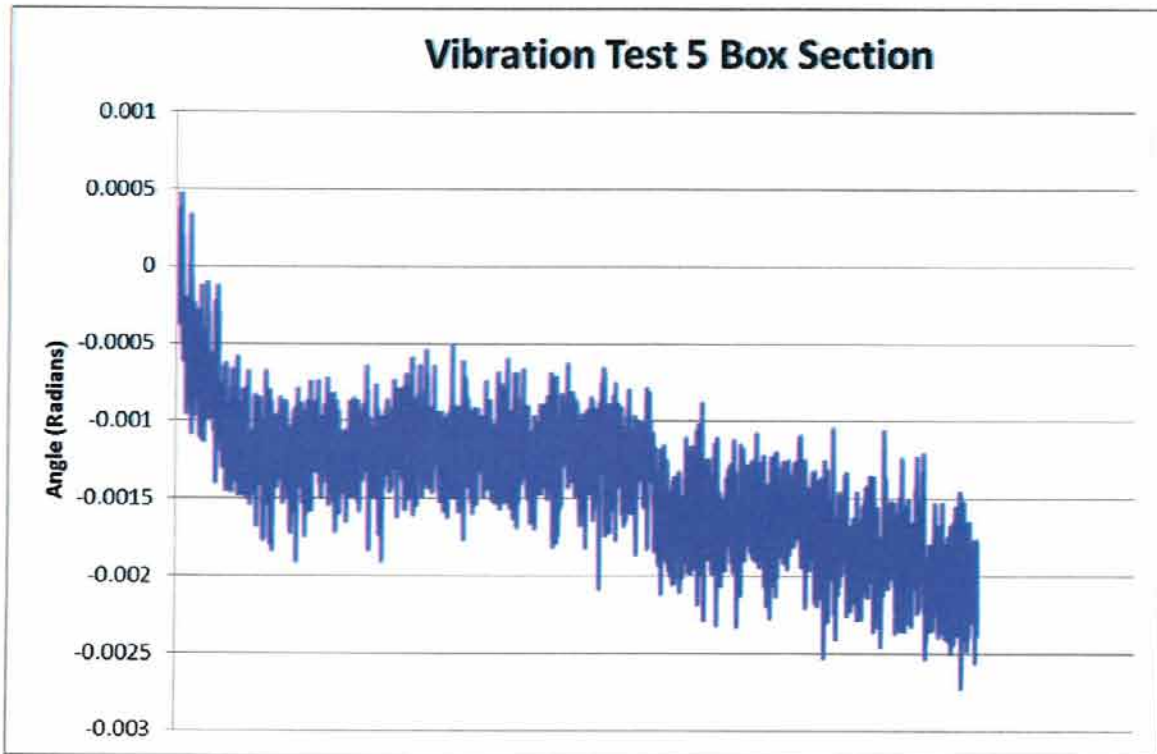




Vibration Box Ledger Test Graphs

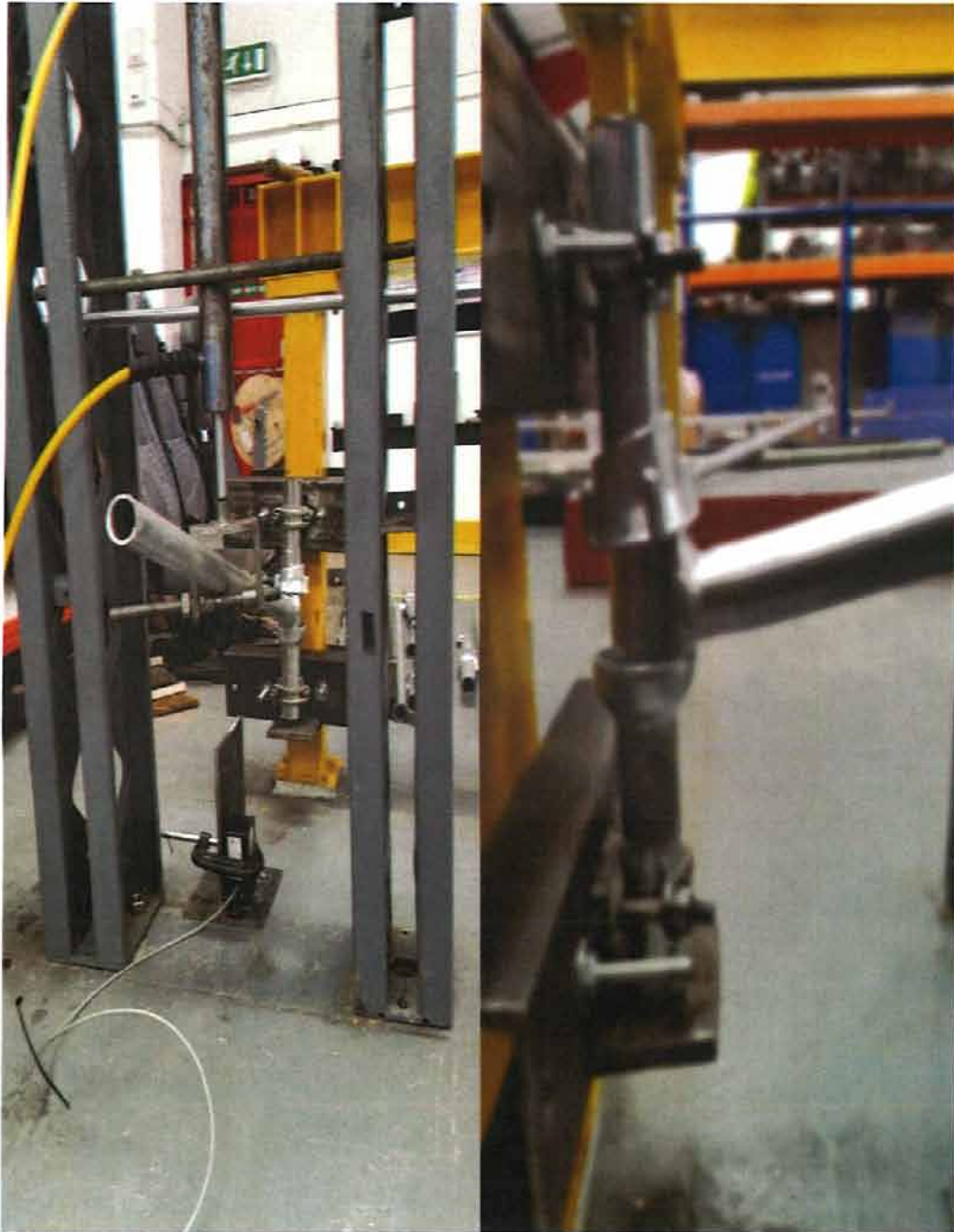






APPENDIX B

PHOTOGRAPHIC RECORDS



Cyclic Ledger Tube Test 1 – Before & After



Cyclic Ledger Tube Test 2 - Before & After



Cyclic Ledger Tube Test 3 - Before & After



Cyclic Ledger Tube Test 4 - Before & After



Cyclic Ledger Tube Test 5 - Before & After



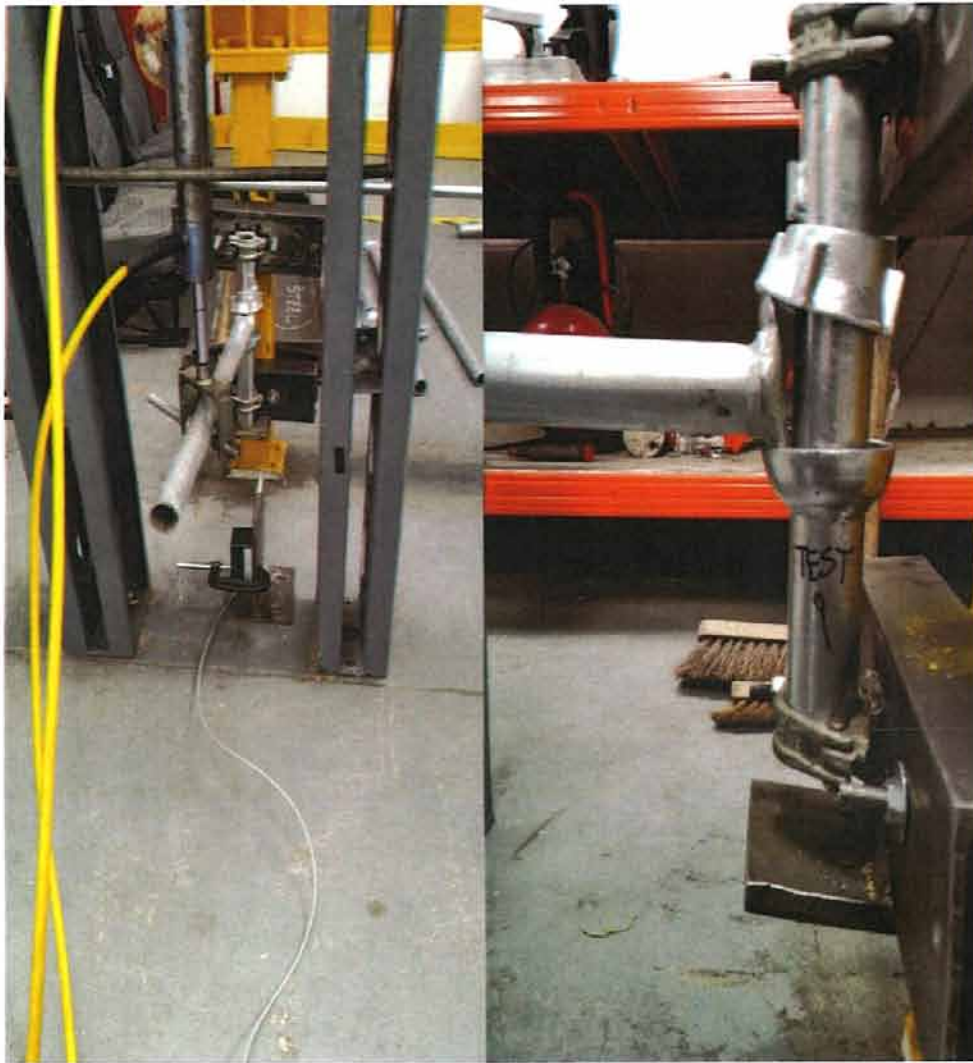
Cyclic Ledger Tube Test 6 - Before & After



Cyclic Ledger Tube Test 7 - Before & After



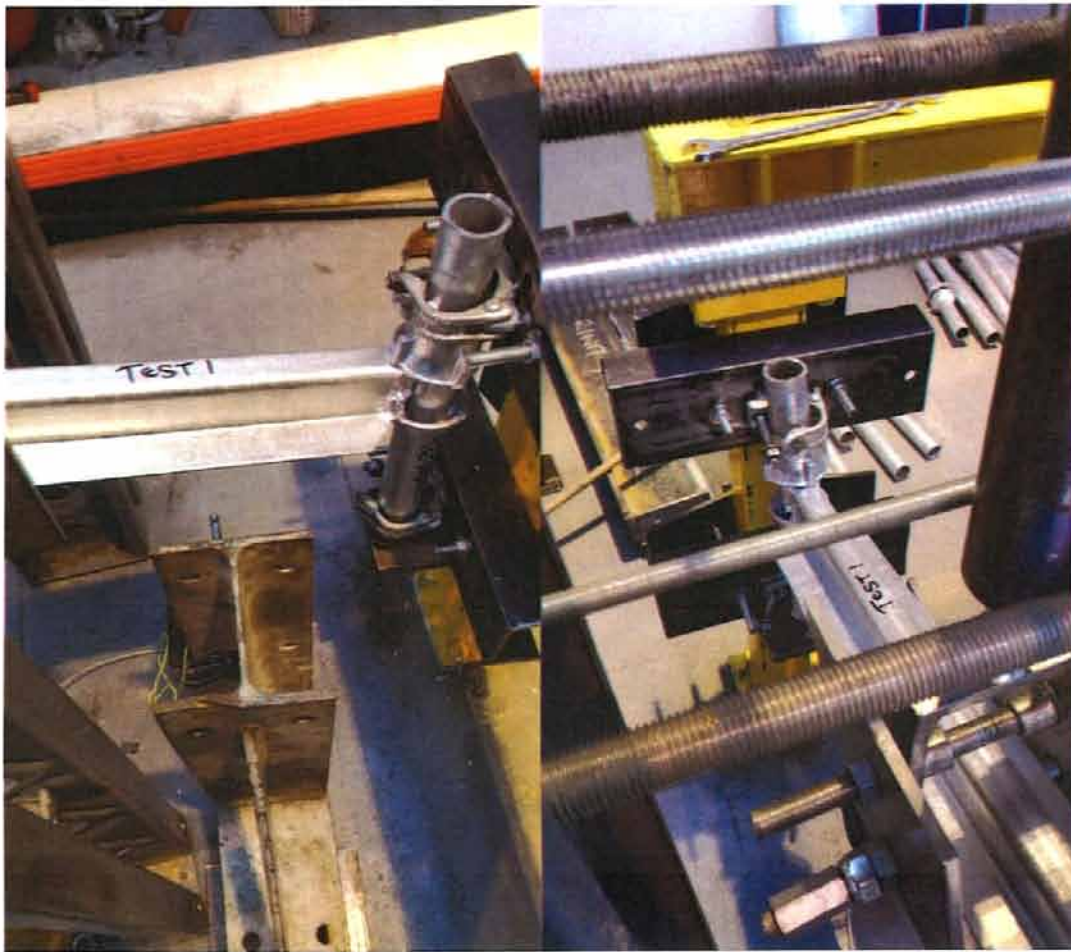
Cyclic Ledger Tube Test 8 - Before & After



Cyclic Ledger Tube Test 9 - Before & After



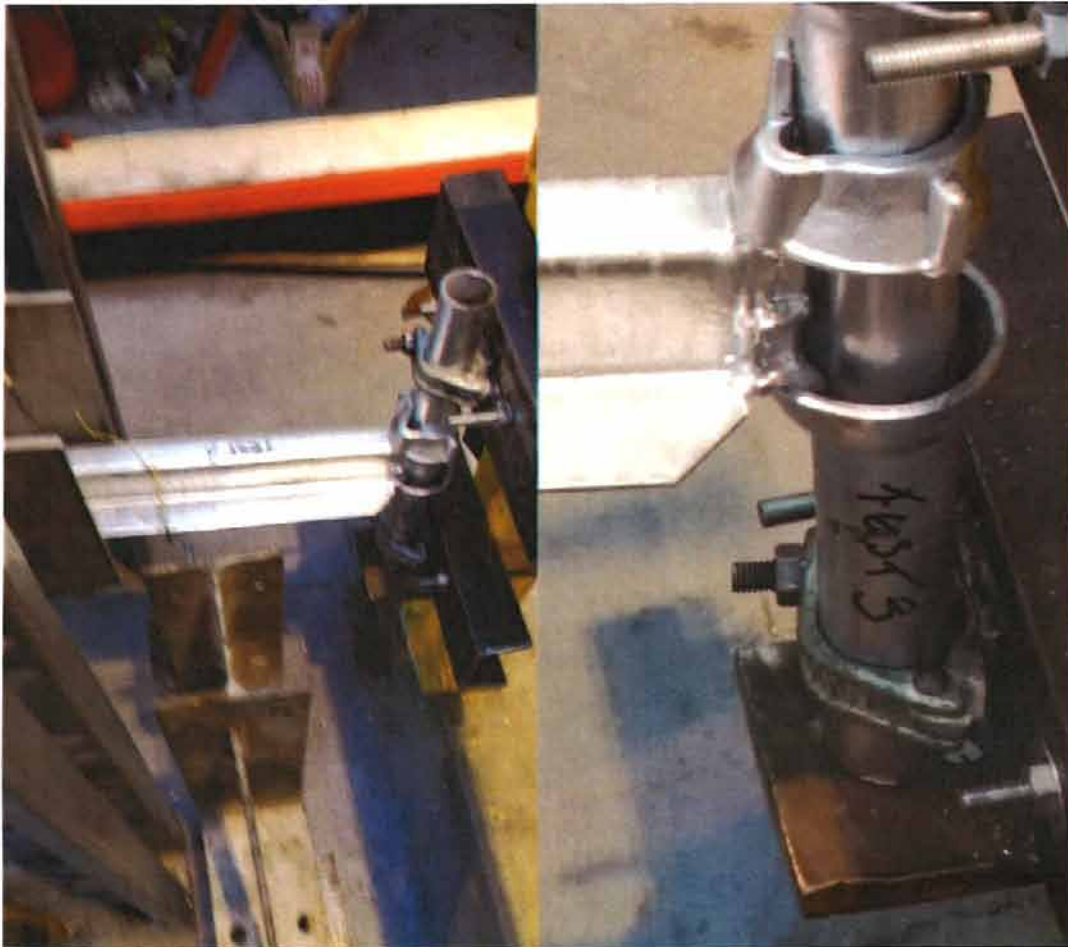
Cyclic Ledger Tube Test 1 - Before & After



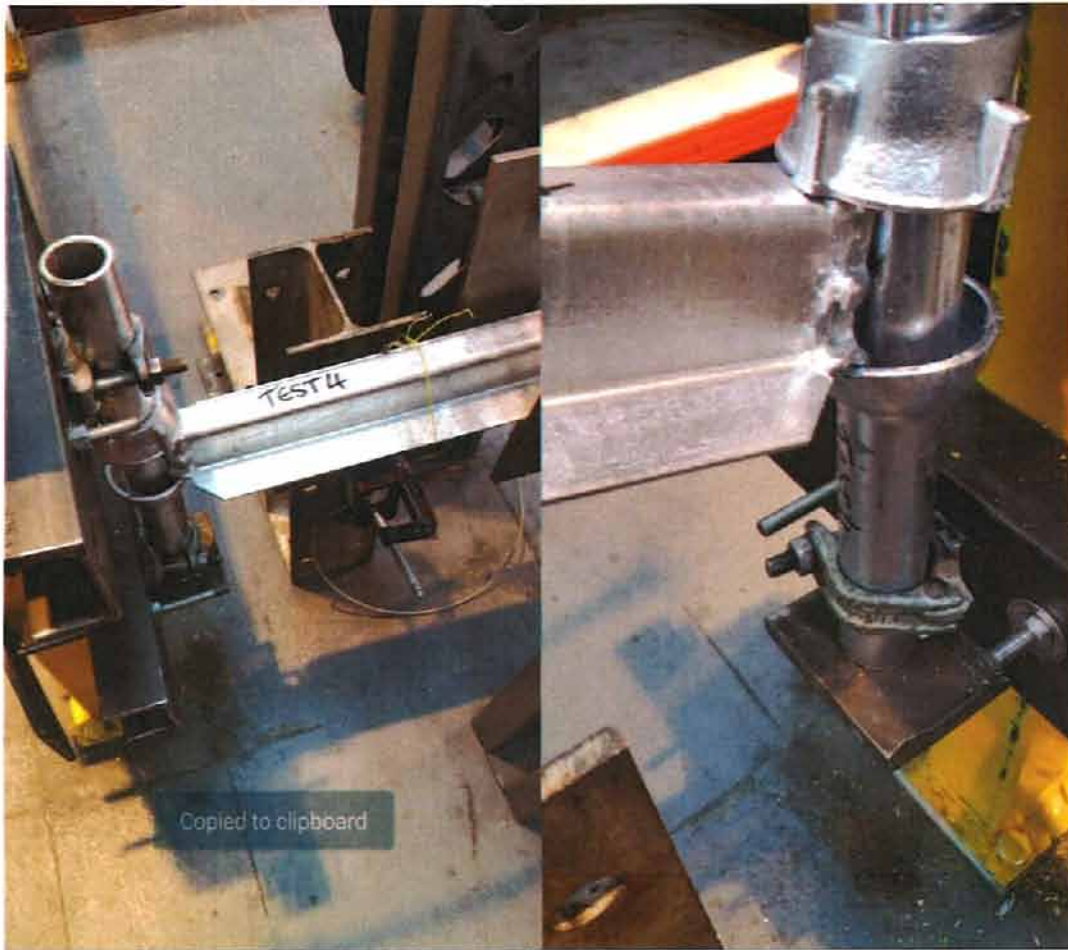
Cyclic Box Ledger – Test 1



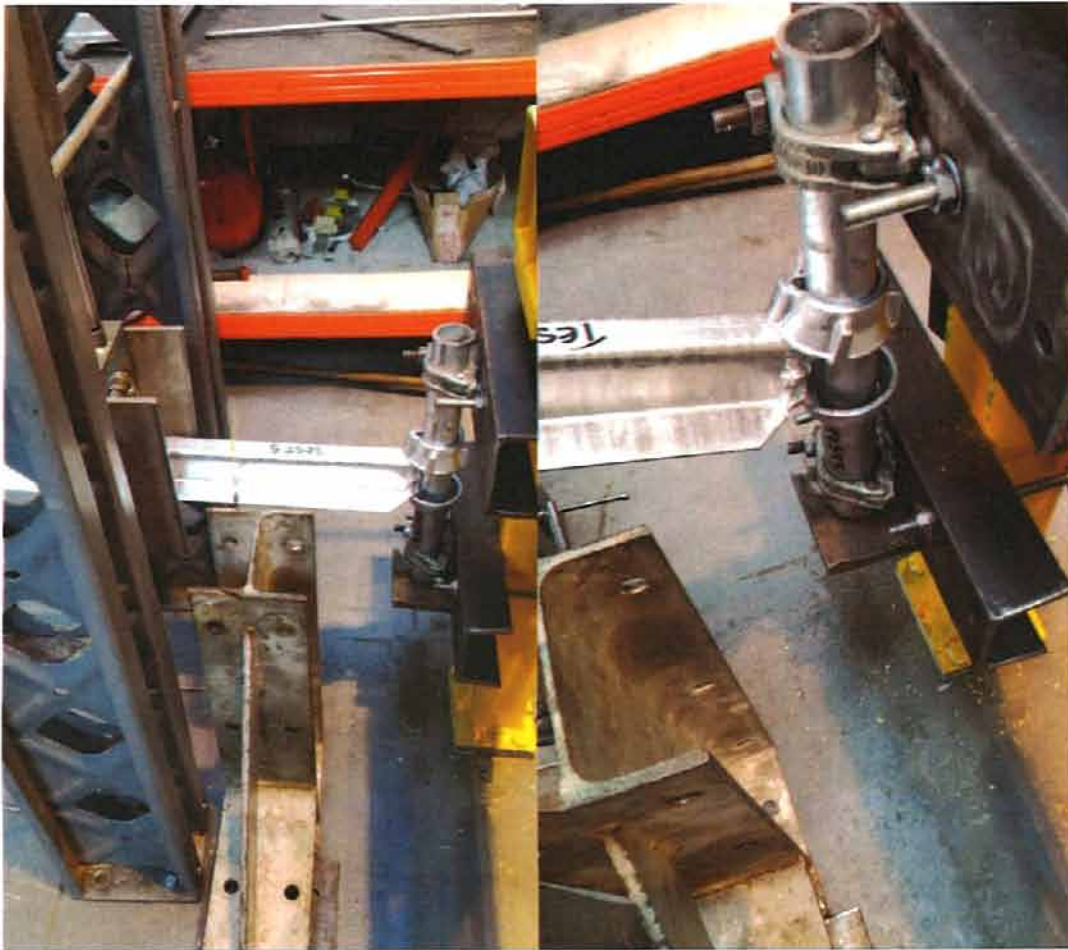
Cyclic Box Ledger – Test 2



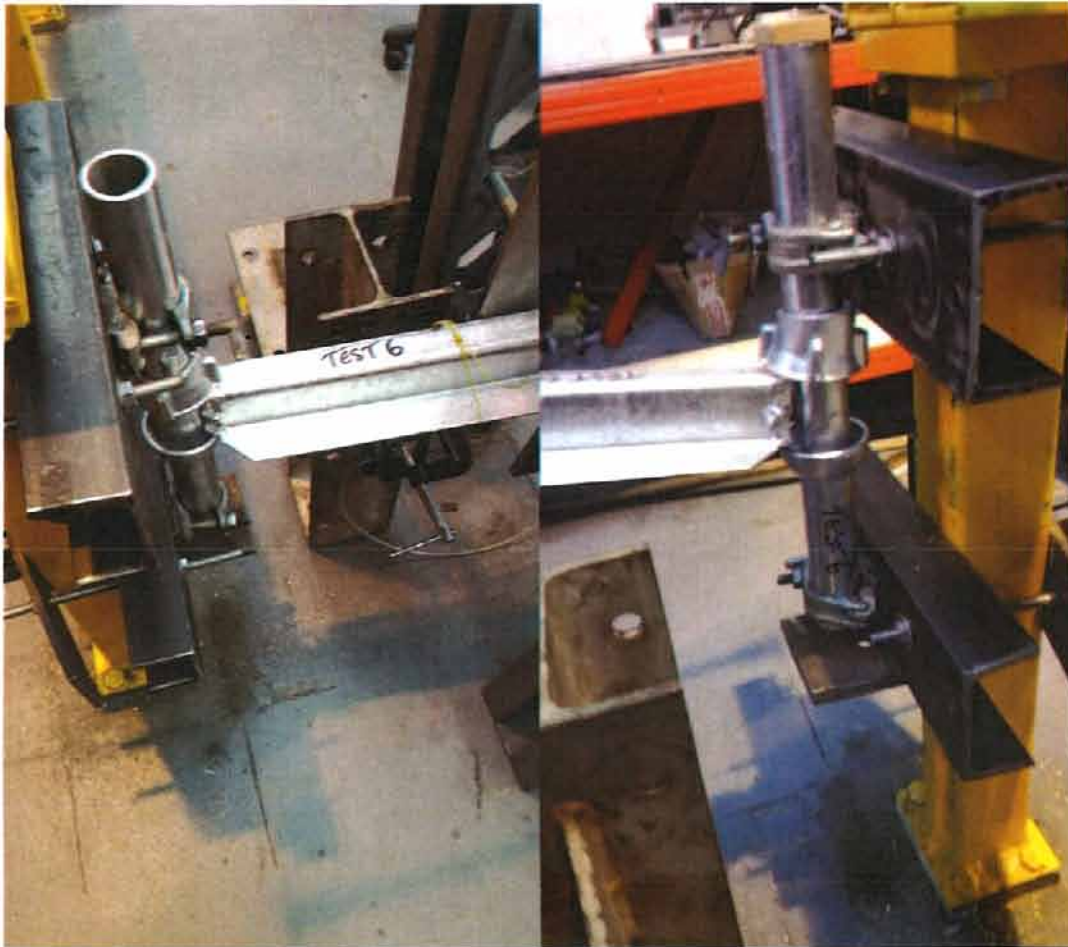
Cyclic Box Ledger – Test 3



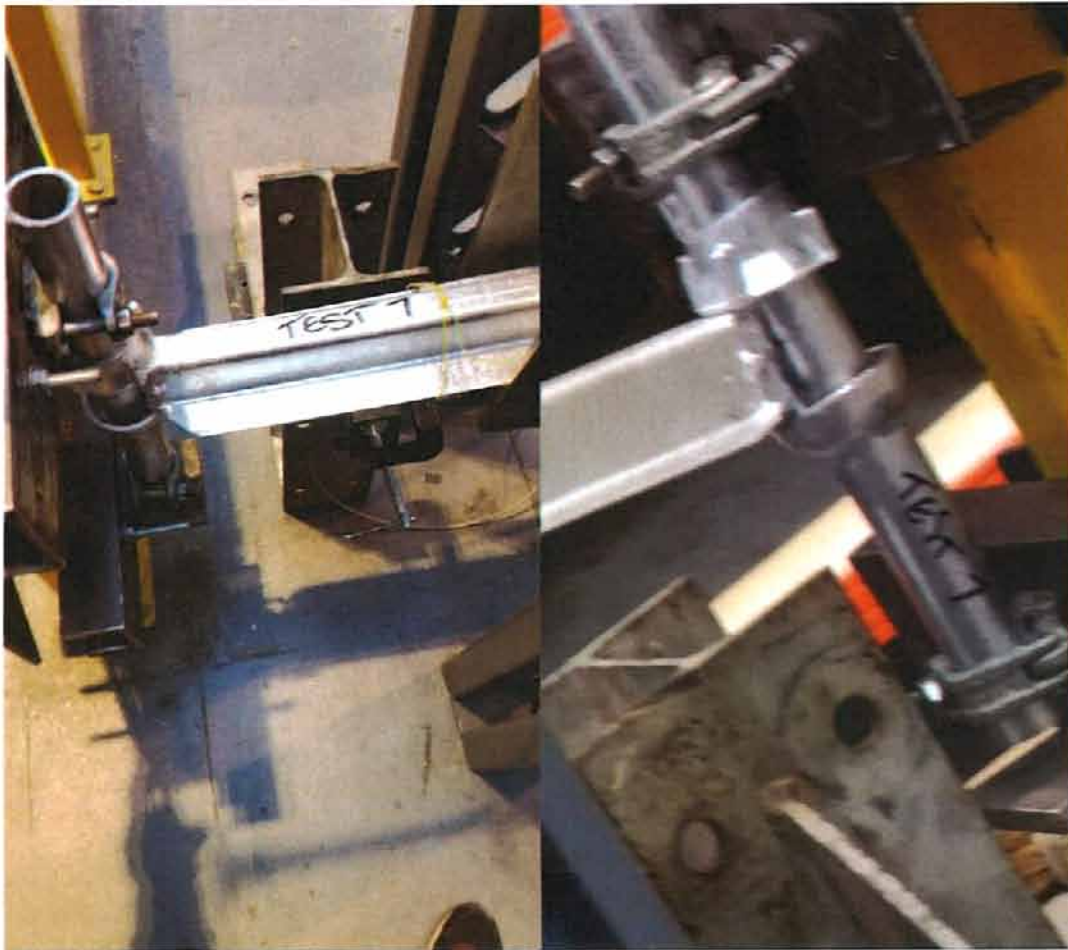
Cyclic Box Ledger – Test 4



Cyclic Box Ledger – Test 5



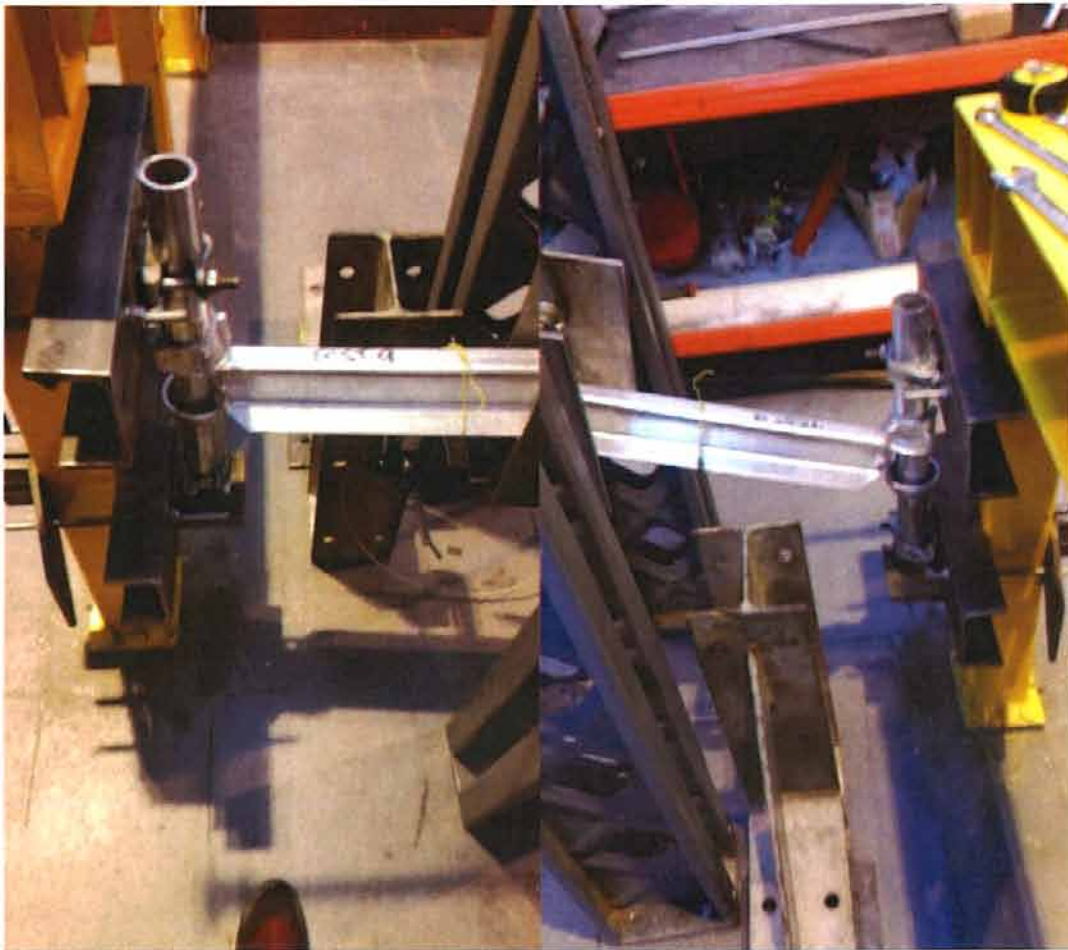
Cyclic Box Ledger – Test 6



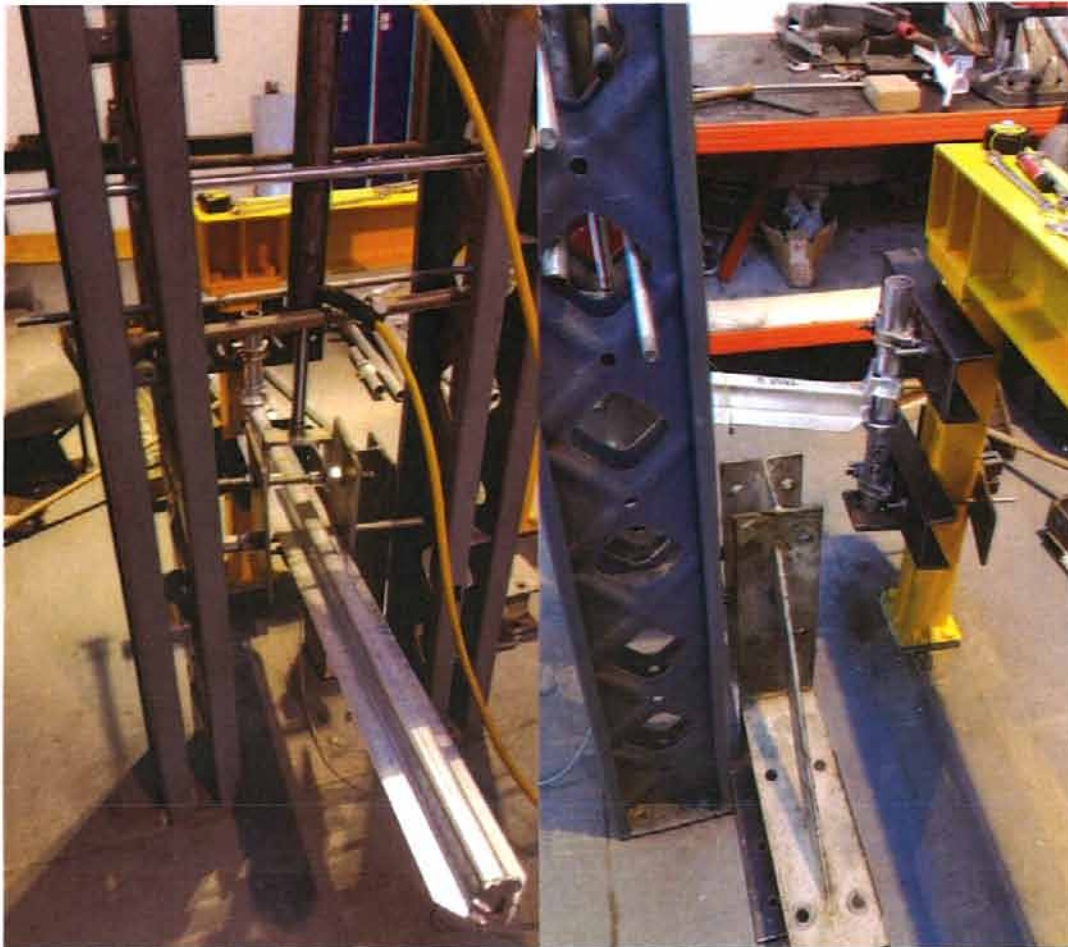
Cyclic Box Ledger – Test 7



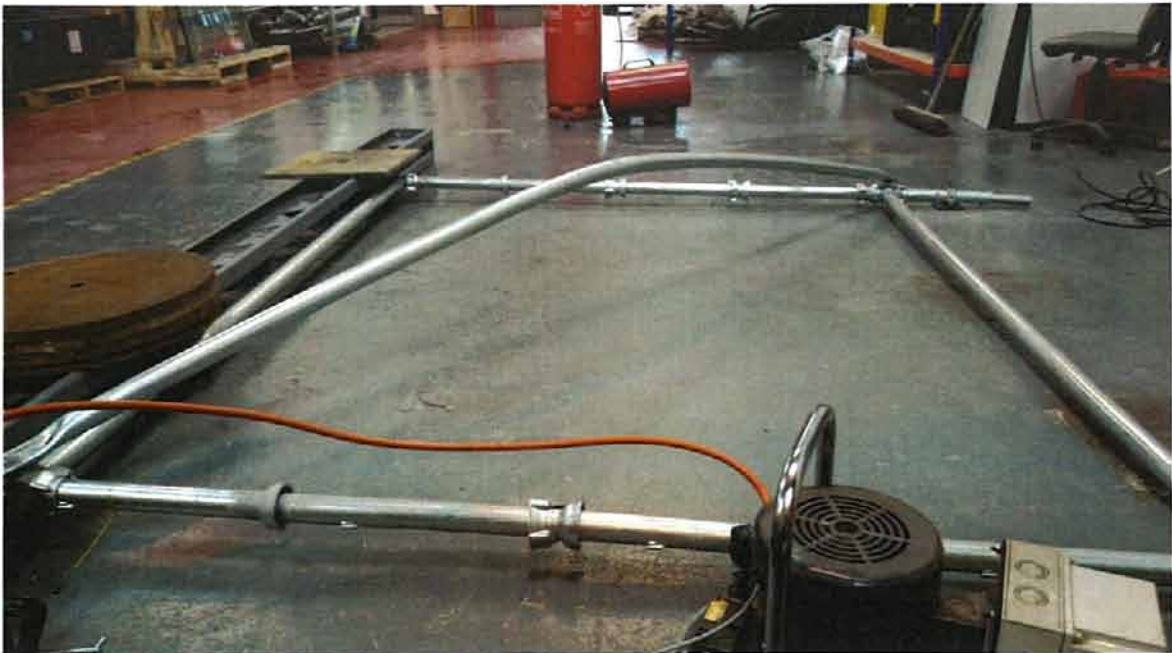
Cyclic Box Ledger – Test 8



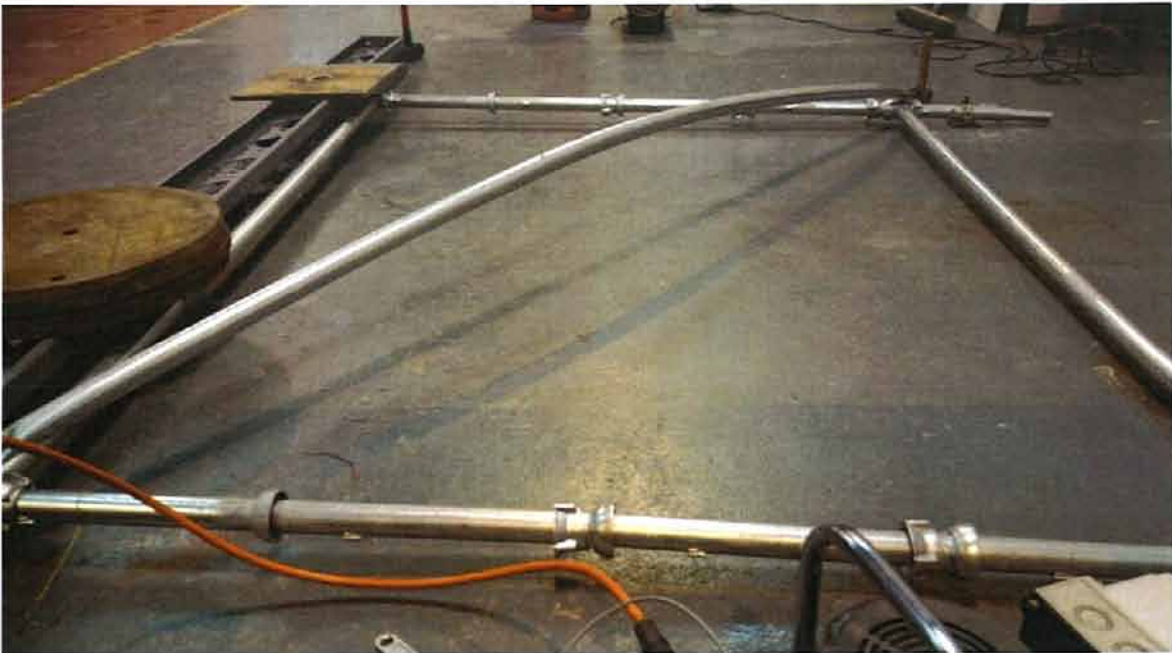
Cyclic Box Ledger – Test 9



Cyclic Box Ledger – Test 10



Brace Test 1 – Before & After



Brace Test 2 – Before & After



Brace Test 3 – Before & After



Brace Test 4 – Before & After



Brace Test 5 – Before & After



General Test Setup For Vibration Series