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Report and Load Survey of: Free issue Readylock prefabricated transoms

Document number: *TES000188TR-1*
Client: *VR Access Solutions Ltd*

Address: *1 Swan Court Yard*
Charles Edwards Road
Birmingham
B26 1BU

Date of applied testing/survey: *Start date 4th October 2016 to 21st November*

Item description: *VR prefabricated transom system*

Identification mark affixed to item: *No apparent identification marks affixed*

Client submitted drawing numbers: *Non submitted*

Client design review Ref: *S-Mech to analyzes and review all data and findings*

Quantity submitted for test: *50 fabrications submitted,*

Client submitted British standard or procedure number*: Guidance from TG20:13 prefabricated transoms and S Mech structural Engineers*

Test equipment calibration: *load cell 7500kg number 51808, DSCUSB logger 17167352 calibration date 4th May 2014, LVDT transducer 100mm-002-000 serial number 15385 & LVDT transducer 100mm-002-000 serial number 15200 calibration 4th May 2016*

Address of where testing /surveys were conducted: *TESMEC Limited;*
Independent Testing and Engineering services.
Test House
Unit 19, Newey Business Park
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Number of pages contained in this report: 62

The data collated and compiled in this document is solely for client review and if/ where required, is to be used in conjunction with the additional requirements of the stated standard as a whole or accompanying standards where applicable for further calculation, statistical analysis and review prior to compliance.

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Introduction

Vr Access solutions requested a load survey to their submitted samples generally in accordance with TG20:13 prefabricated structural transom units and guidance from S Mech Structural Engineering.
Trail tests were conducted and methods obtained to apply load requirements generally in accordance with TG20:13.
All recorded data will be analysed by S Mech Structural Engineers and cross referenced as detailed to assess compliance with all relevant standards.
All samples subject to final test are documented graphically in this report.
All dimensional additional fabrications to allow for rotational surveys where documented for future reference.
All dimensional displacements were recorded using 100mm LDVT transducers, test type 1 and 2 linear displacements recorded as per the guidance of EN74-1.
All rotational displacements monitored via two number LDVT transducers set 50mm apart and data analysed and converted to give true rotational data.

Section 1:

1.1. Submitted samples

50 units were submitted for random selection by VR access solutions, the samples were all 5 board prefabricated transoms, 4 mm tubular wall thickness galvanised surface finished.
All nuts were torque 5 times to 50Nm in accordance with EN74 and TG20 guidance prior to load applications.
Threads were not subject to light oiling during any test.
All samples were numbered for test reference and laboratory results reference.

1.2. Test Equipment

AML bi-directional load cell capacity 7500kg converted to kN were applicable.
Serial number 51808, linearity 0.029%FS, hysteresis 0.004%FS
Calibration by UKAS traceable test equipment by AML
Calibration date 4/5/16
2 number calibrated AML /SGD -100mm-002-000 LDVT transducers, serial numbers 15200 and 15385
Calibration by UKAS traceable test equipment by AML
Calibration date 4/5/16
Denison T42 500kN universal testing machine class 1, serial number 921-2, calibration number C6592
Calibrated 23/6/16.

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Section 2: Test type

2.1. Test type 1 reference TG20:13 sub section 3.1

Characteristic slip resistance down the standard F_{sy} kN
Test arrangement in accordance with BSEN74 section 7.2.1.2. Load application in accordance with section 7.1.2.4. All bolts were subject to torque of 50Nm 5 times prior to load application and 10 minutes resting time upon installation to test.
The Characteristic slip resistance shall not be less than 10kN
Displacements recorded at $\Delta 1$ 0-7mm measured at the ledger centreline & $\Delta 2$ 1-2mm measured at the rear clasp for slip.
Load applied at 2mm/min through to maximum values required. Load applied to the ledger as described in BSEN74-1.
A minimum of 5 samples were subject to load application.

2.2. Test type 2 reference TG20:13 sub section 3.2

Characteristic slip resistance down the ledger F_{sx} kN
The PST samples were installed as per guidance of sub section 3.2. the standard and stub transom were securely supported and the ledger subject to compressive force through to slippage.
The load was generally in accordance with BSEN74-1 section 7.2.1.4. with the exception of $\Delta 1$ which was not required. All bolts were subject to torque of 50Nm 5 times prior to load application and 10 minutes resting time upon installation to test.
The Characteristic slip resistance shall not be less than 1.85kN, the load was applied beyond the first maximum for a minimum of 5mm.
Displacement recorded at $\Delta 2$.
A minimum of 5 samples were subject to load application.

2.3. Test type 3 reference TG20:13 sub section 3.3

Transom to standard rotation about the ledger axis $M_{serv,sx}$ = 1.06kNm
The transom to standard connection was assembled as per the requirement of TG20:13
The load was applied to the transom at 500mm from the standard centre line, the displacements were recorded via the 2 number LDVT linear transducers set at 50mm distance apart the furthest away being centralised above the end of the transom coupler weld. Load applied in the positive direction only as required.
All bolts were subject to torque of 50Nm 5 times prior to load application and 10 minutes resting time upon installation to test.
The load cycle was applied 3 times to the intended safe moment 1.06kNm and then final load to failure. Load cycles applied with guidance from S Mech and TG20:13.

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2.4. Test type 4 reference TG20:13 sub section 3.4

Transom to standard rotation about the transom axis $M_{serv,sz}$ = 1kNm
The transom to standard connection was assembled generally as per the requirement of TG20:13
The load was applied to the transom at 500mm from the standard centre line via a welded lever arm, the displacements were recorded via the 2 number LDVT linear transducers set at 50mm distance apart the being centralised above the end of the transom coupler weld.
The remaining transom stub was fitted into a journal bearing to remove negative bending without frictional support. All bolts were subject to torque of 50Nm 5 times prior to load application and 10 minutes resting time upon installation to test.
The load cycle was applied 3 times to the intended safe moment 1kNm and then final load to failure. Load cycles applied with guidance from S Mech and TG20:13.
The transoms were subject to load against the clasp and against the bolt due to non symmetry of the end coupler.
10 samples total subject to load application.

2.5. Test type 5 reference TG20:13 sub section 3.5

Transom to ledger rotation about the standard axis $M_{serv,ly}$ = 0.45kNm
The transom to ledger connection was assembled as per the requirement of TG20:13
The load was applied to the transom at 600mm from the standard centre line, the displacements were recorded via the 2 number LDVT linear transducers set at 50mm distance apart the furthest away being centralised above the end of the transom coupler weld. Load applied in one direction only as required by S Mech.
The load cycle was applied 3 times to the intended safe moment 0.45kNm and then final load to failure. Load cycles applied with guidance from S Mech and TG20:13.

Each sample subject to rotational loads were numerically documented and plate from each sample removed and prepared for Vickers Hardness testing to BS EN6507-1:2005

A sample of tube subject to test was spectrographically analysed along with a section of plate.
Results shown in section 4 of this report.

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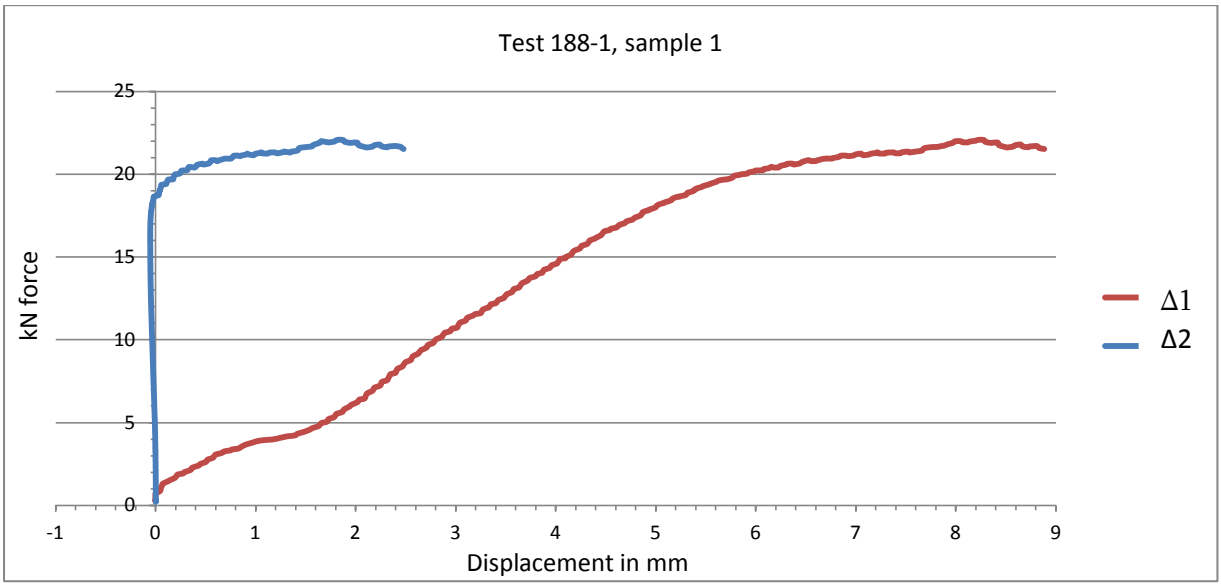
3.0. Recorded graphical data

3.1. Tests 188-1 to 188-5 Characteristic slip resistance down the standard.

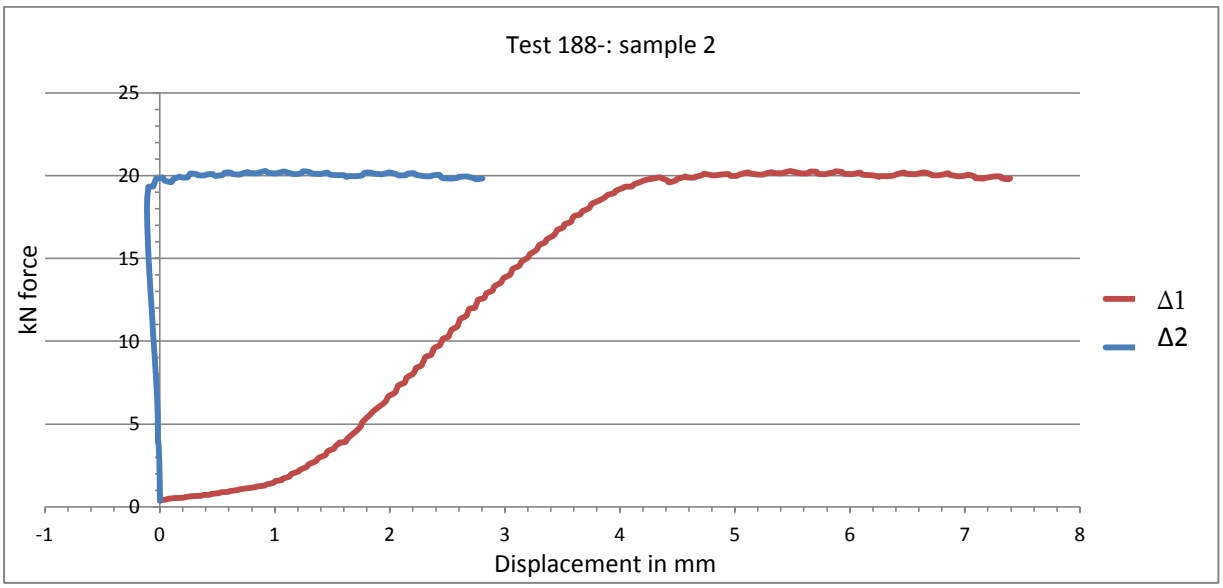
TG20: section 3.1 Test series 1 F_{sy}
Recorded data log reference 188-1 t0o 188-5

Sample 1; test record 188-1



Δ^1 at 7mm = 21.23kN: Δ^2 at 1-2mm lowest recorded force = 21.22kN:

Sample 2; test record 188-2



Δ^1 at 7mm = 19.99kN: Δ^2 at 1-2mm lowest recorded force = 19.90kN:

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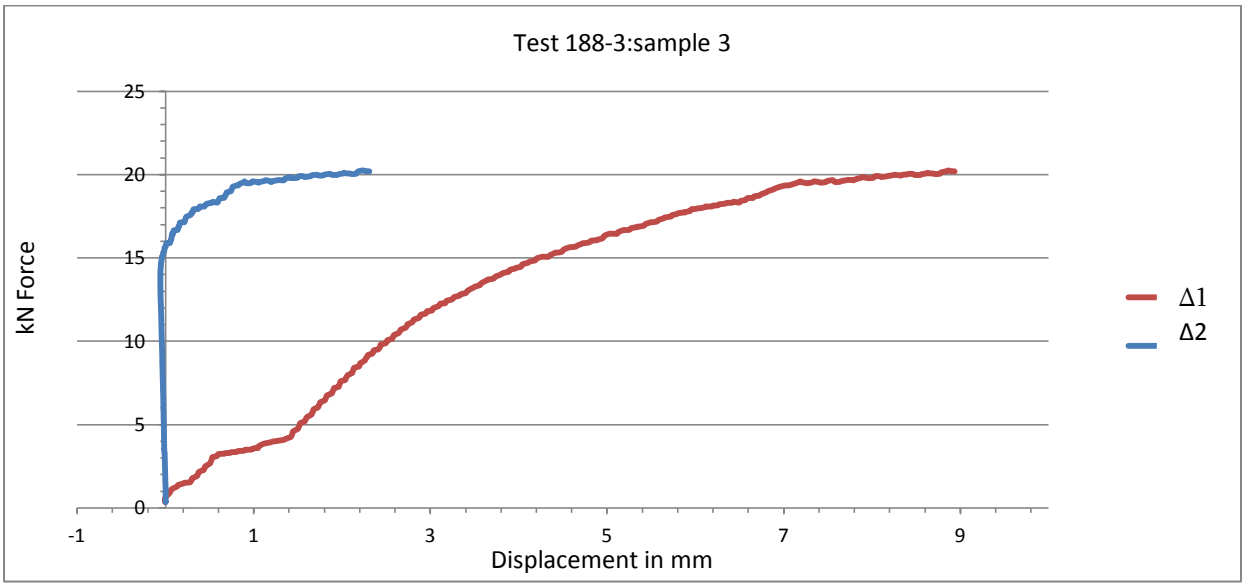
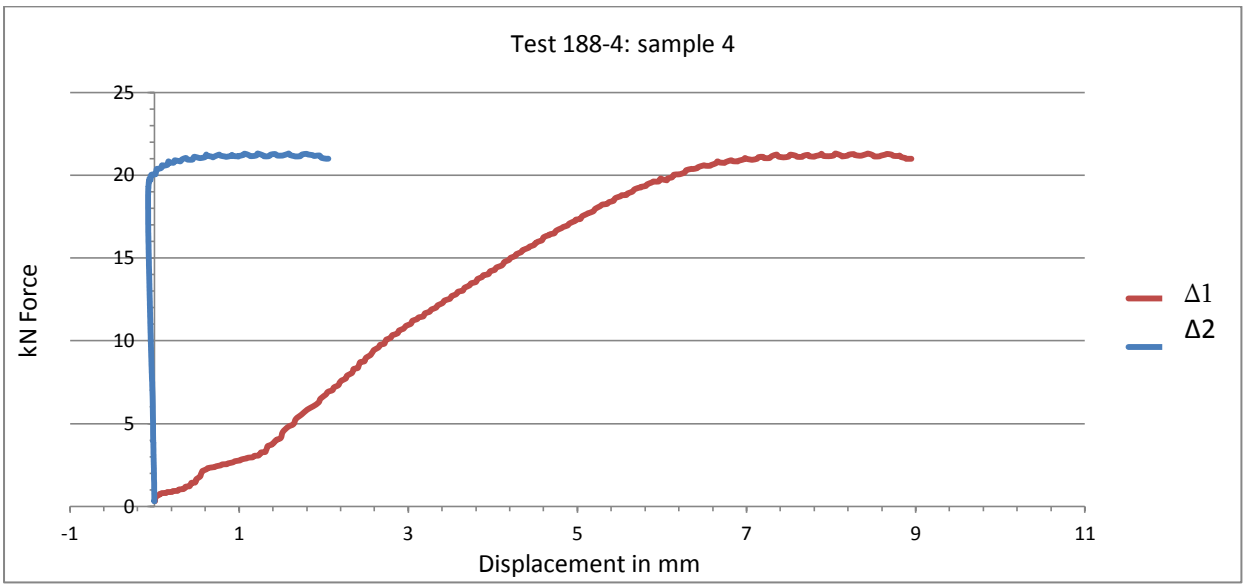
Sample 3; test record 188-3



Δ^1 at 7mm = 19.33kN: Δ^2 at 1-2mm lowest recorded force = 19.50kN:

Sample 4; test record 188-4



Δ^1 at 7mm = 20.97kN: Δ^2 at 1-2mm lowest recorded force = 21.02kN:

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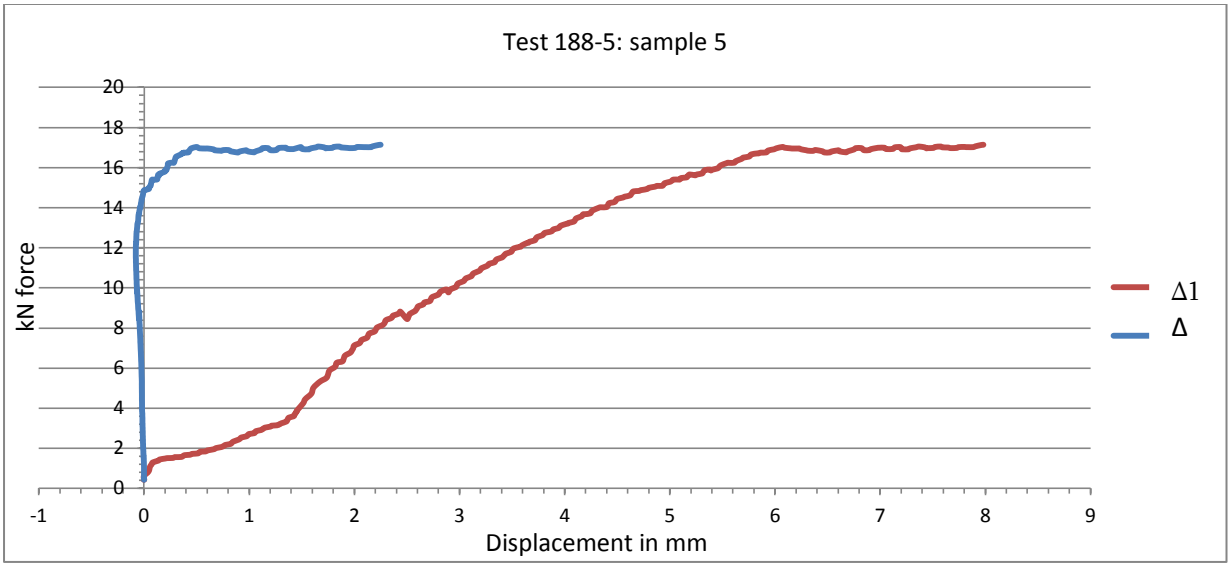
Sample 5; test record 188-5



Δ^1 at 7mm = 17.00kN: Δ^2 at 1-2mm lowest recorded force = 16.77kN:

Typical test arrangement slips along standard

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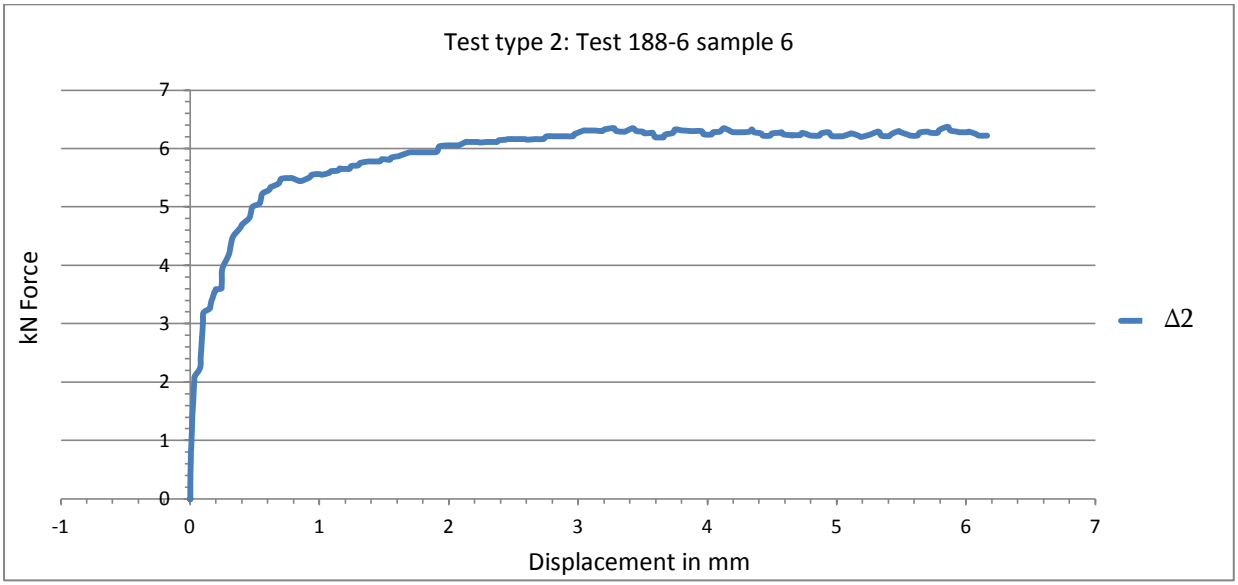
3.2. Tests 188-6 to 188-10 Characteristic slip resistance down the ledger

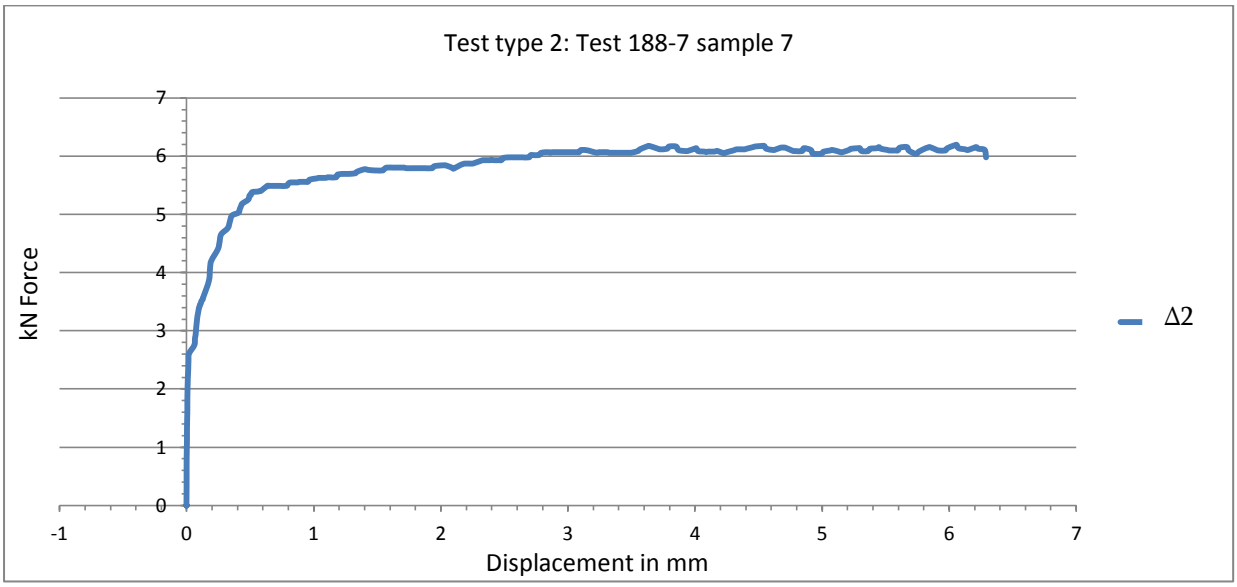
TG20: section 3.2 Test series 2 F_{sx}
Recorded data log reference 188-6 t0o 188-10

Sample 6: test record 188-6



Δ^2 1-2mm lowest recorded force = 5.55kN

Sample 7: test record 188-7



Δ^2 1-2mm lowest recorded force = 5.61kN

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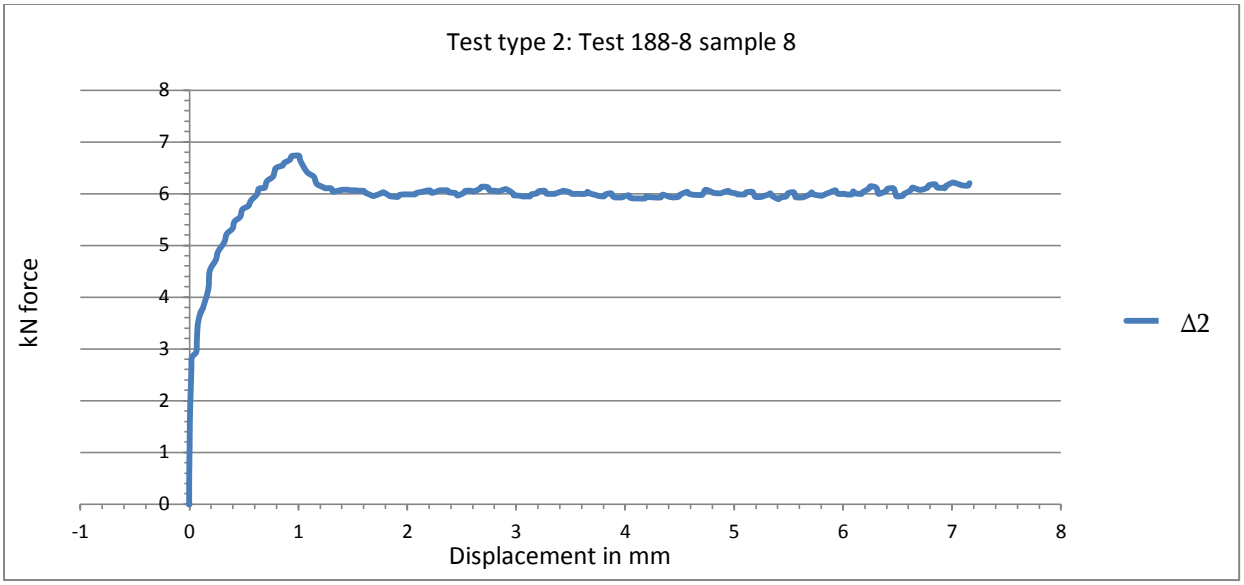
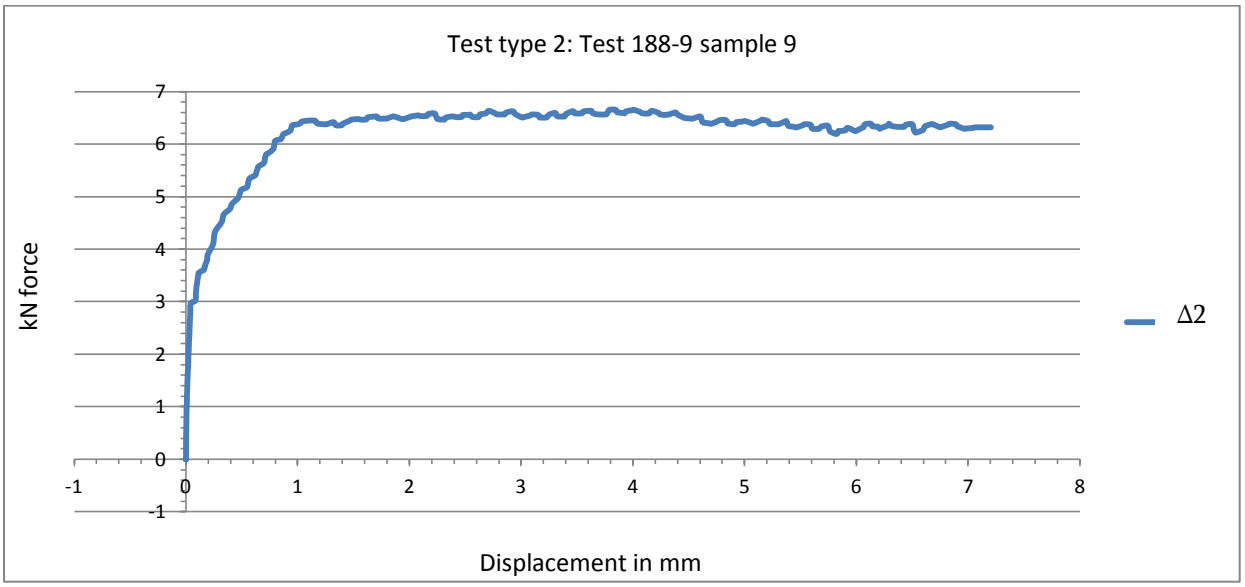
Sample 8: test record 188-8



Δ^2 1-2mm lowest recorded force = 5.93kN

Sample 9: test record 188-9



Δ^2 1-2mm lowest recorded force = 6.35kN

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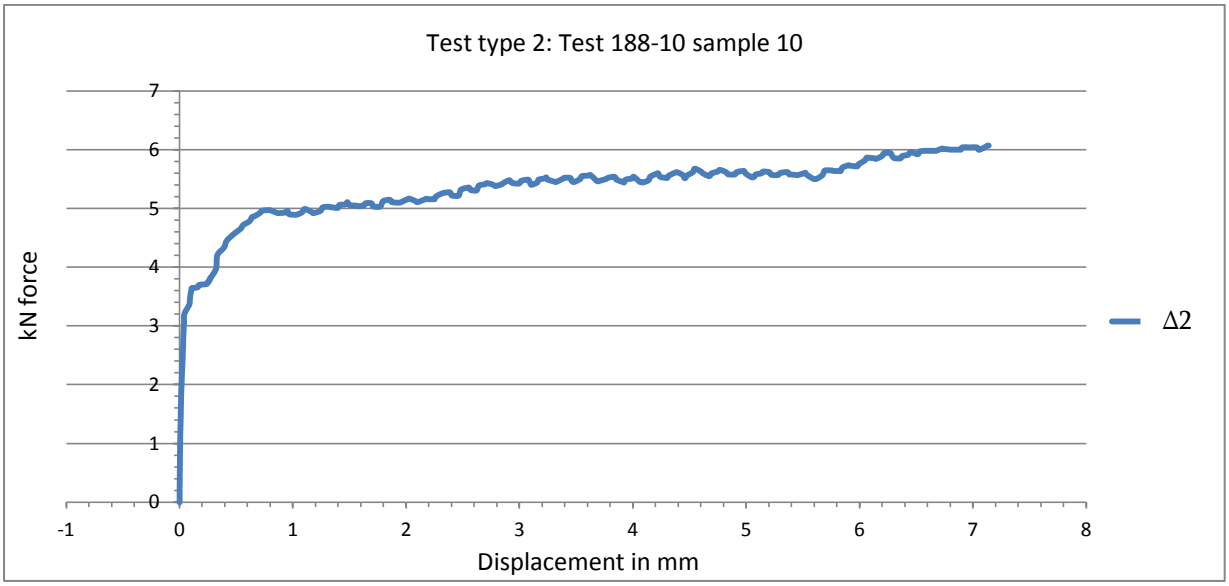
Sample 10: test record 188-10



Δ^2 1-2mm lowest recorded force = 4.89kN

Typical test arrangement slips along ledger

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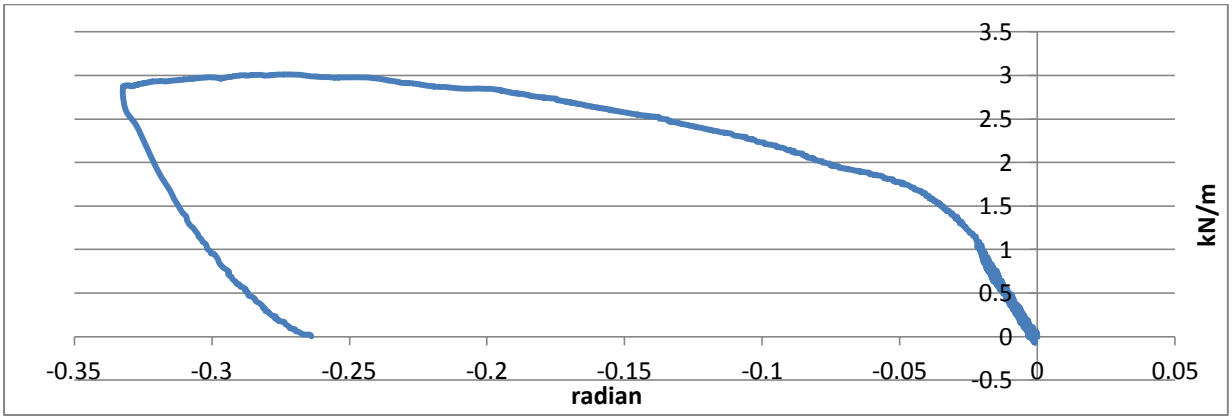
3.3. Tests 188-11 to 188-15 Transom to standard rotation about the ledger axis

TG20: section 3.3 Test series 3 $M_{serv, sx}$

Recorded data log reference 188-11 to 188-15

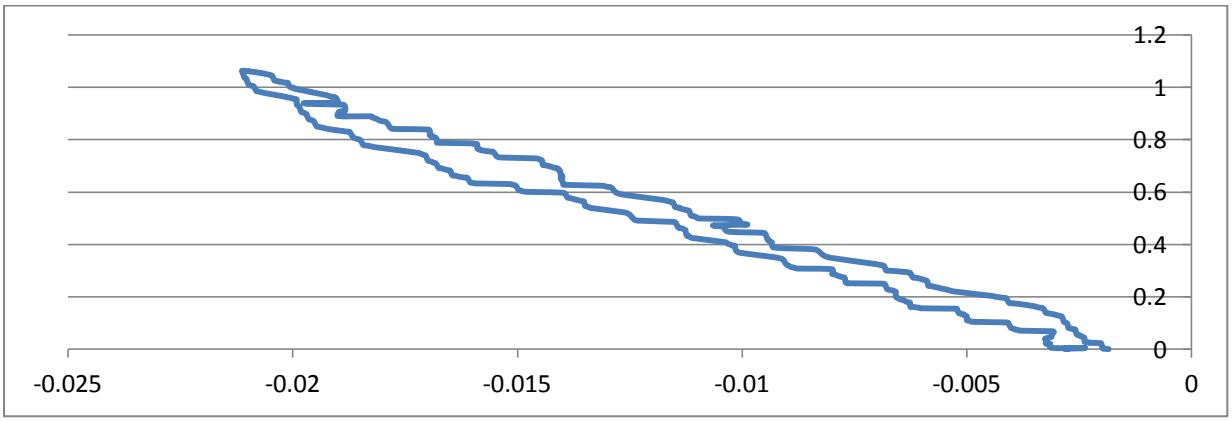
Sample 11: Test record 188-11 test type 3

Test load trace



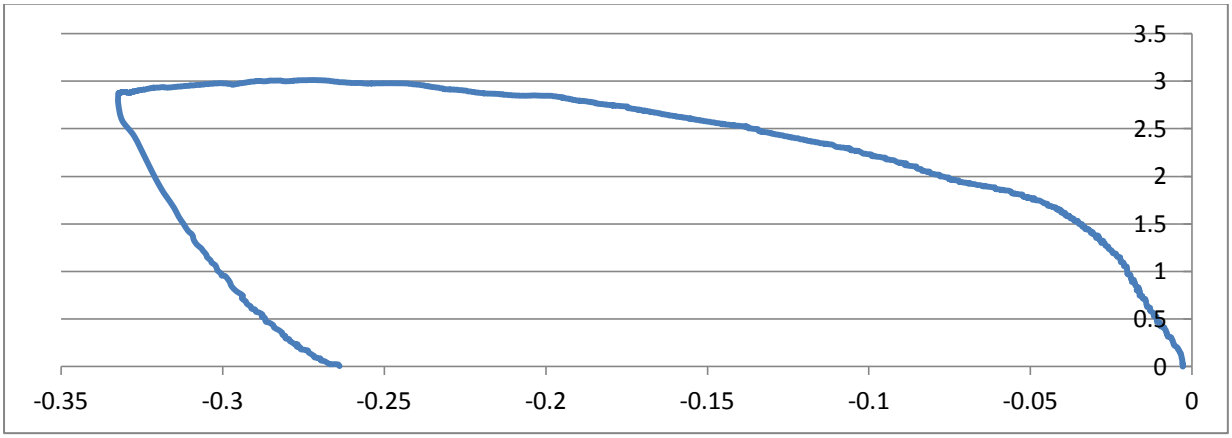
Sample 11: Test record 188-11 test type 3

Test load trace third cycle



Sample 11: Test record 188-11 test type 3

Test load trace to failure



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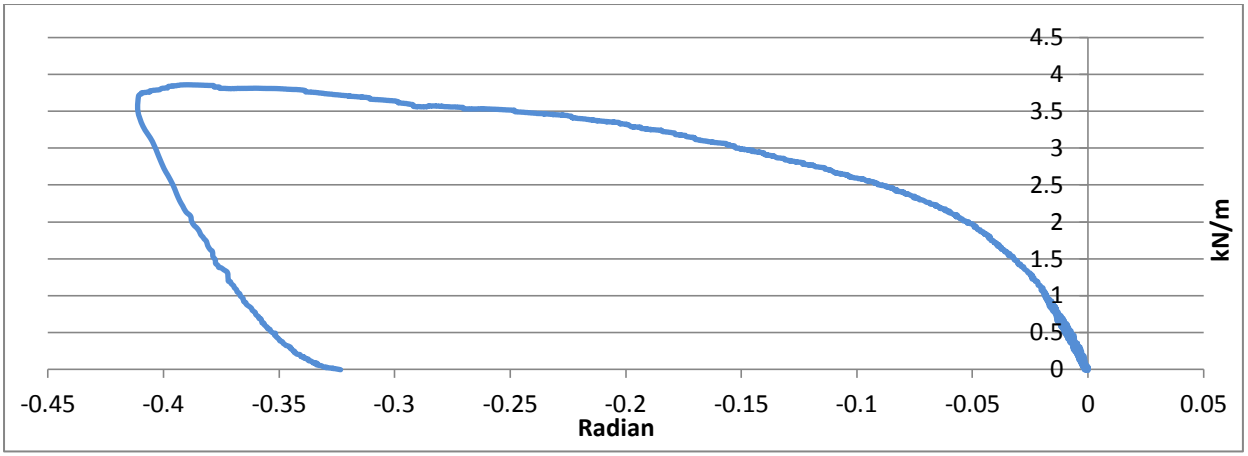
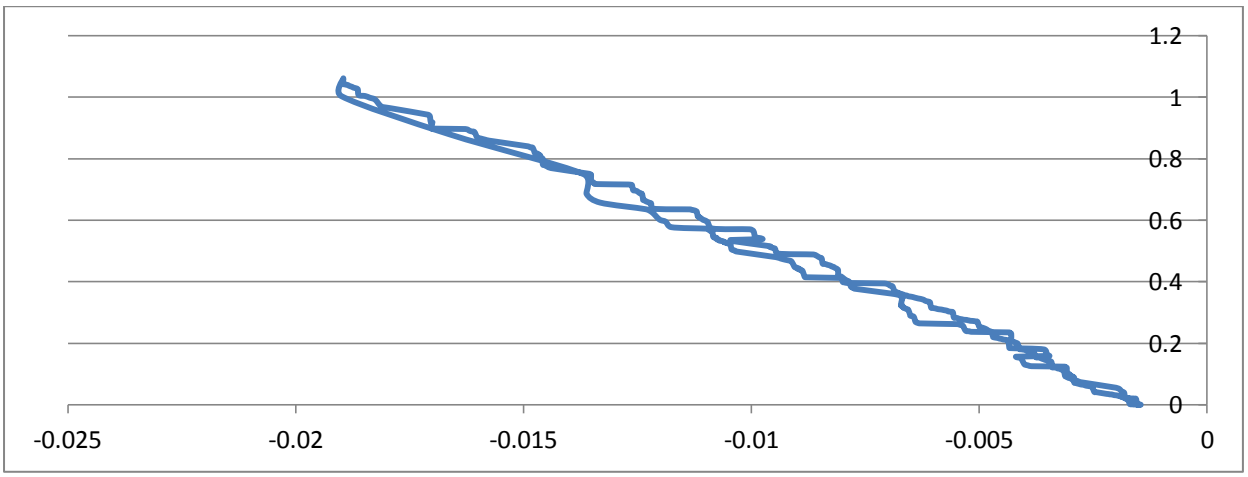
Sample 12: Test record 188-12 test type 3

Test load trace



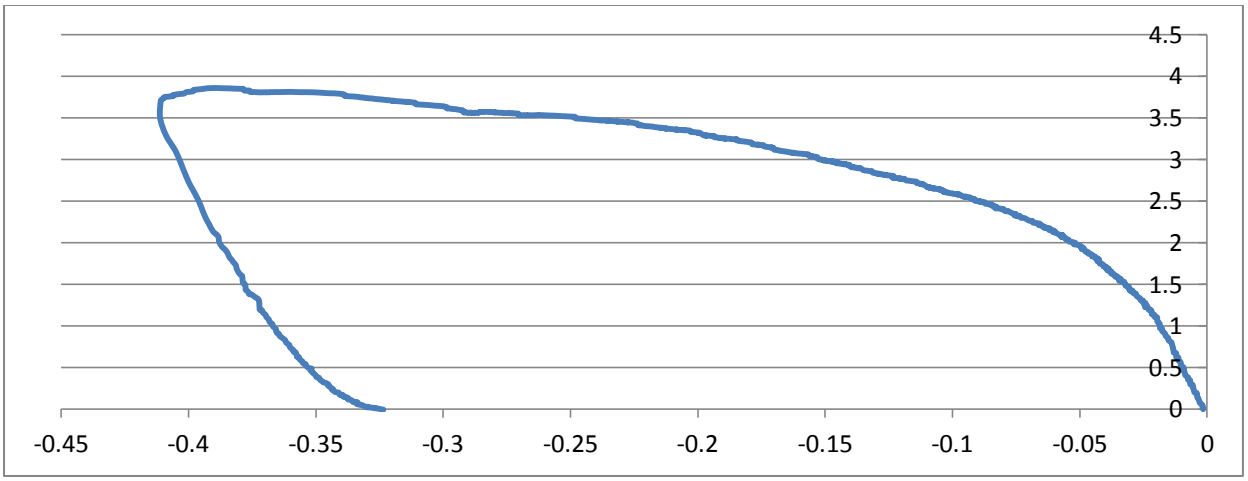
Sample 12: Test record 188-12 test type 3

Test load trace third cycle



Sample 12: Test record 188-12 test type 3

Test load trace to failure



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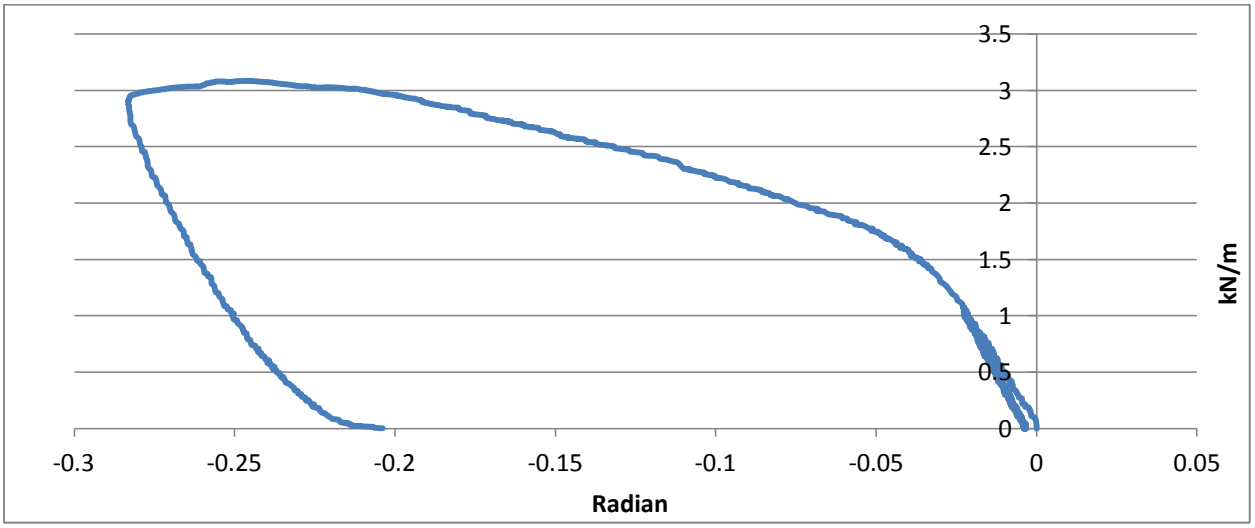
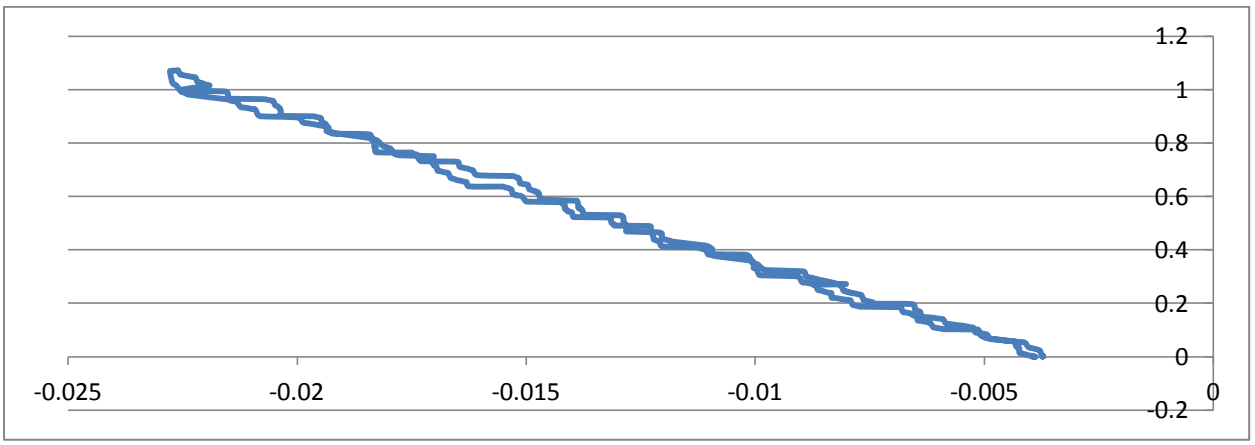
Sample 13: Test record 188-13 test type 3

Test load trace



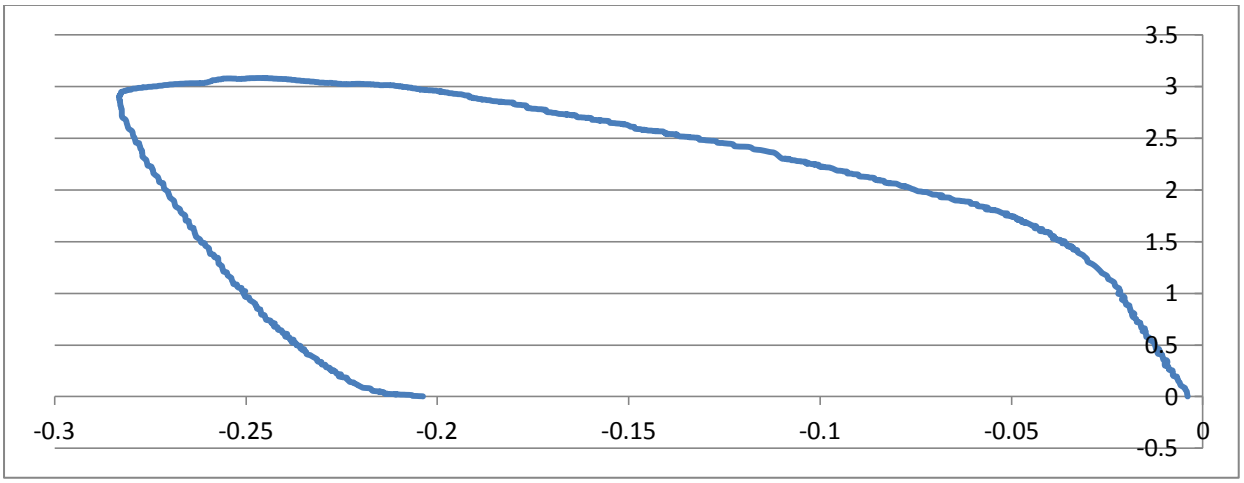
Sample 13: Test record 188-13 test type 3

Test load trace third cycle



Sample 13: test record 188-13 test type 3

Test load trace to failure



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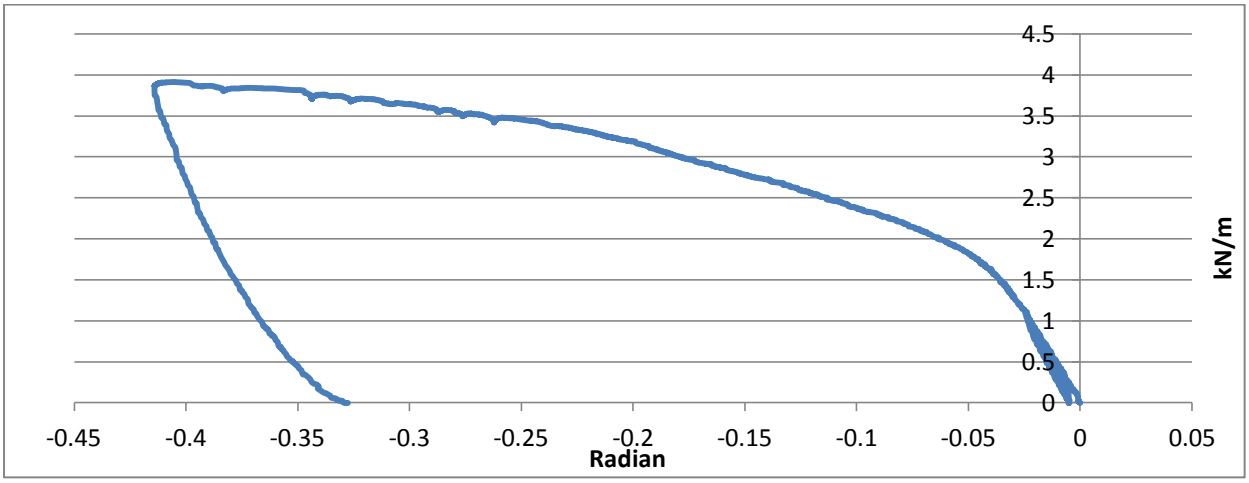
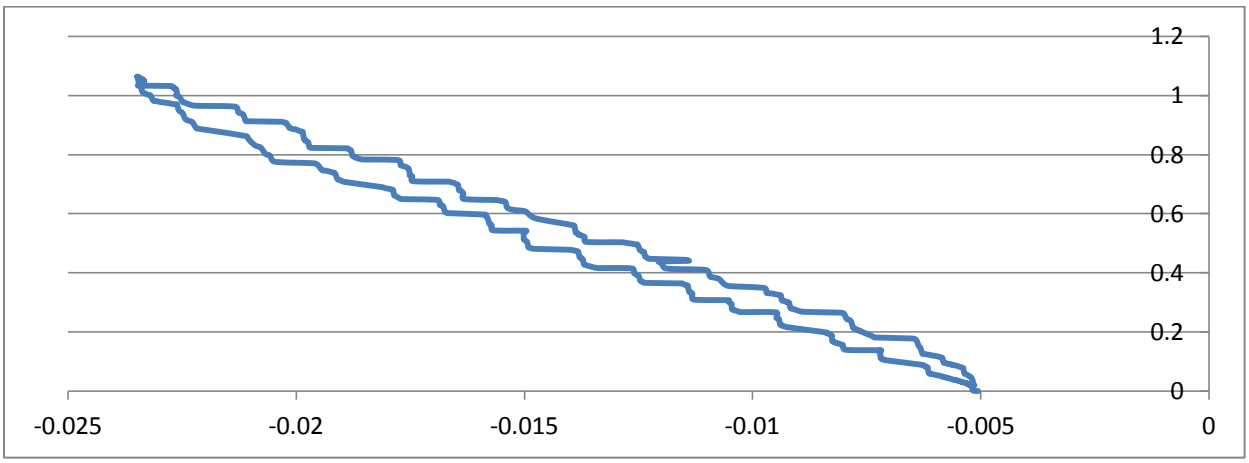
Sample 14: Test record 188-14 test type 3

Test load trace



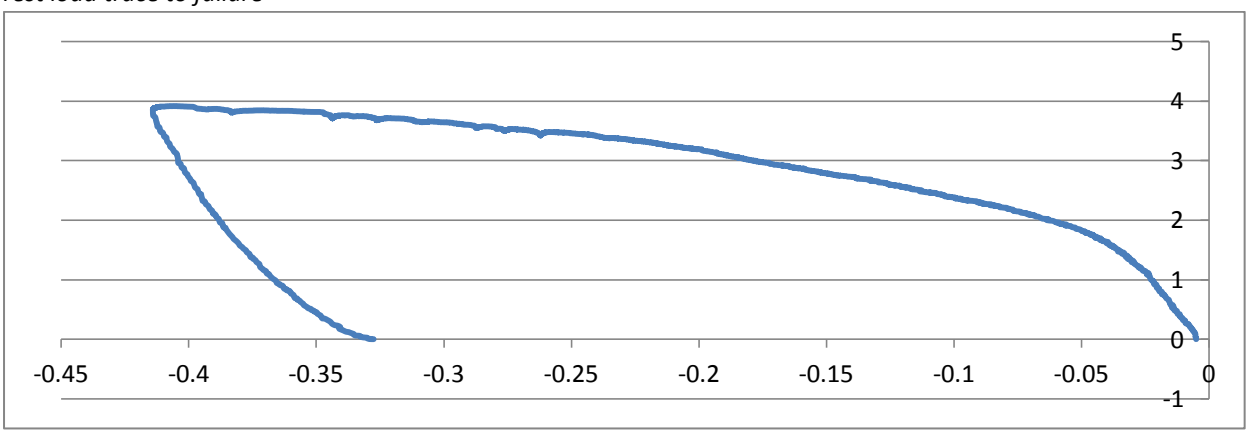
Sample 14: Test record 188-14 test type 3

Test load trace third cycle



Sample 14: Test record 188-14 test type 3

Test load trace to failure



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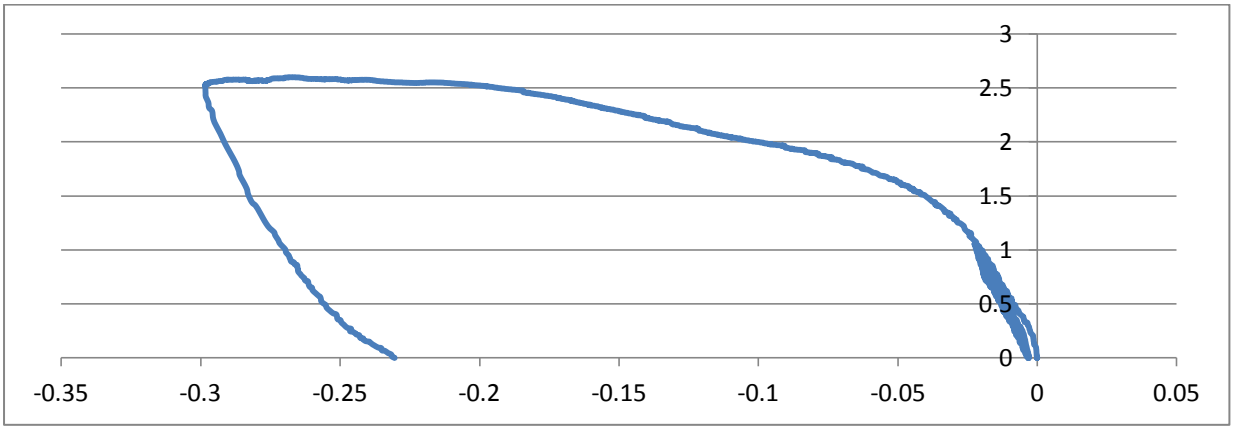
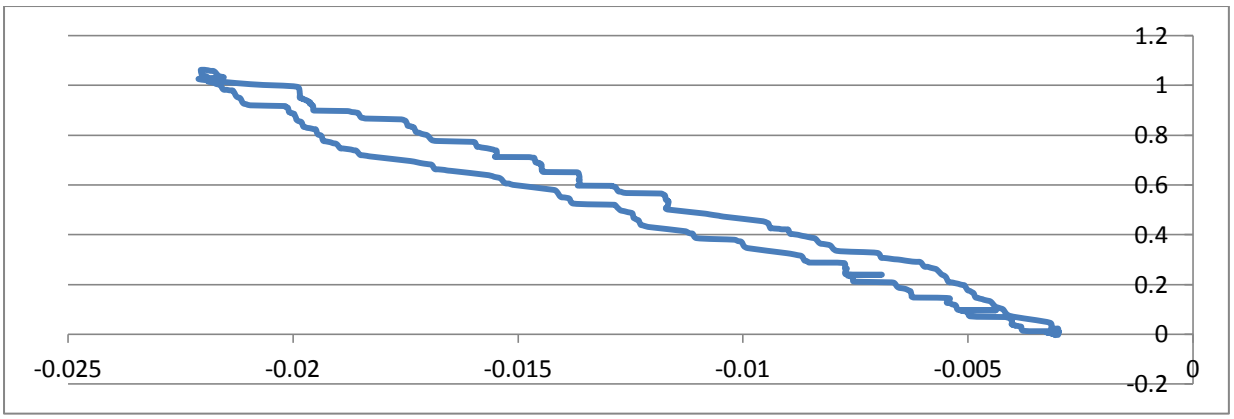
Sample 15: Test record 188-15 test type 3

Test load trace



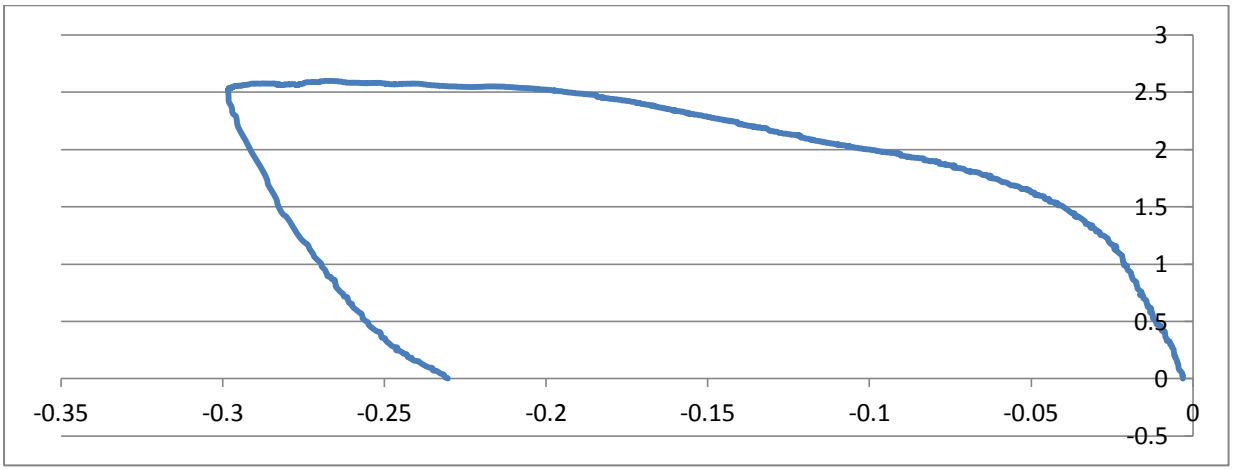
Sample 15: Test record 188-15 test type 3

Test load trace third cycle



Sample 15: Test record 188-15 test type 3

Test load trace to failure



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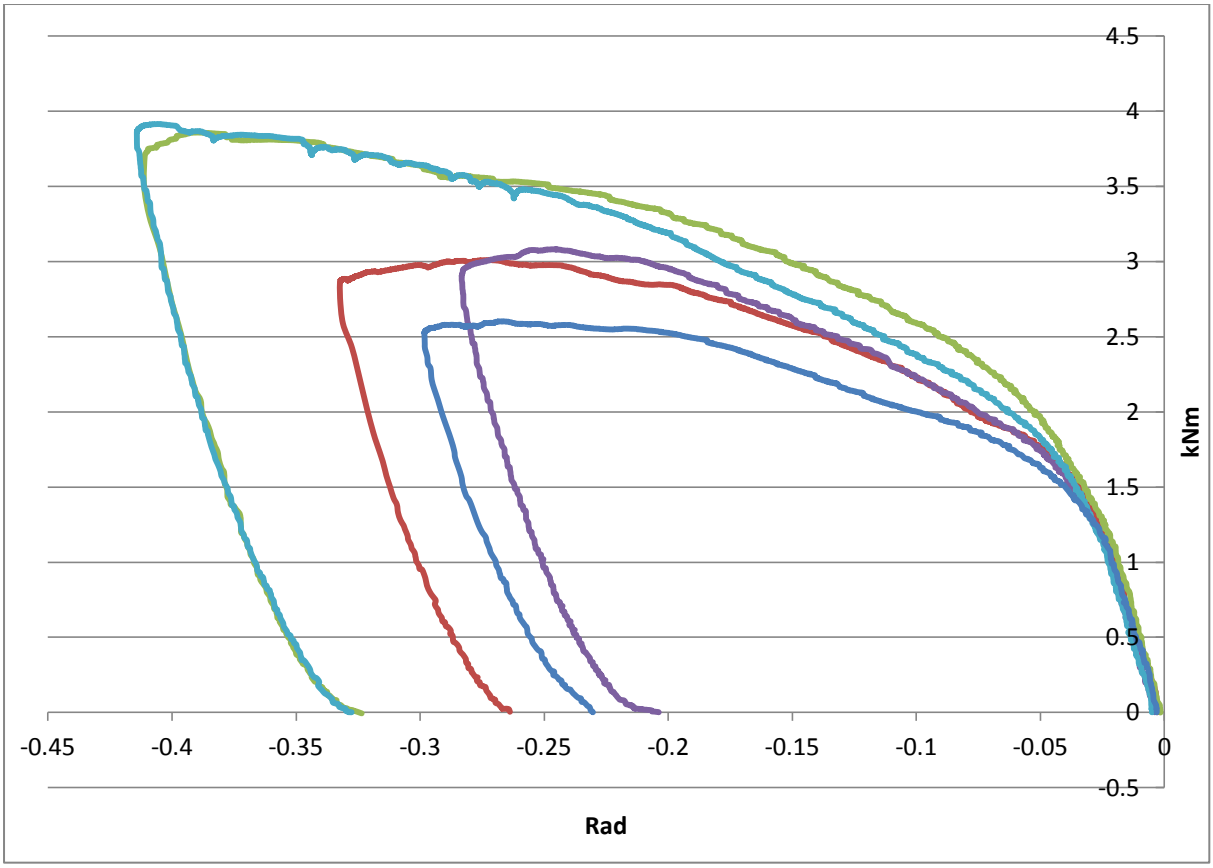
Samples 188-11 to 188-15 load to failure



Typical arrangement

showing parent material fracture

weld failure

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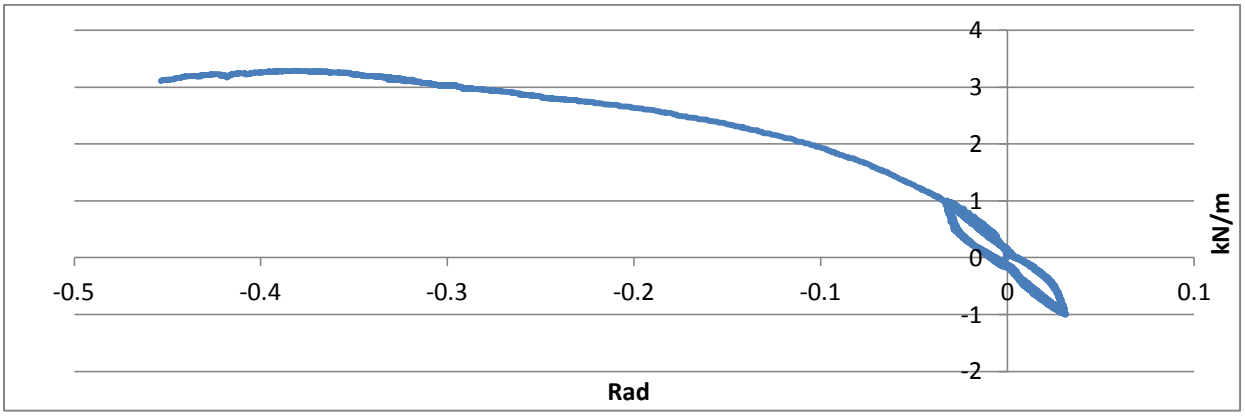
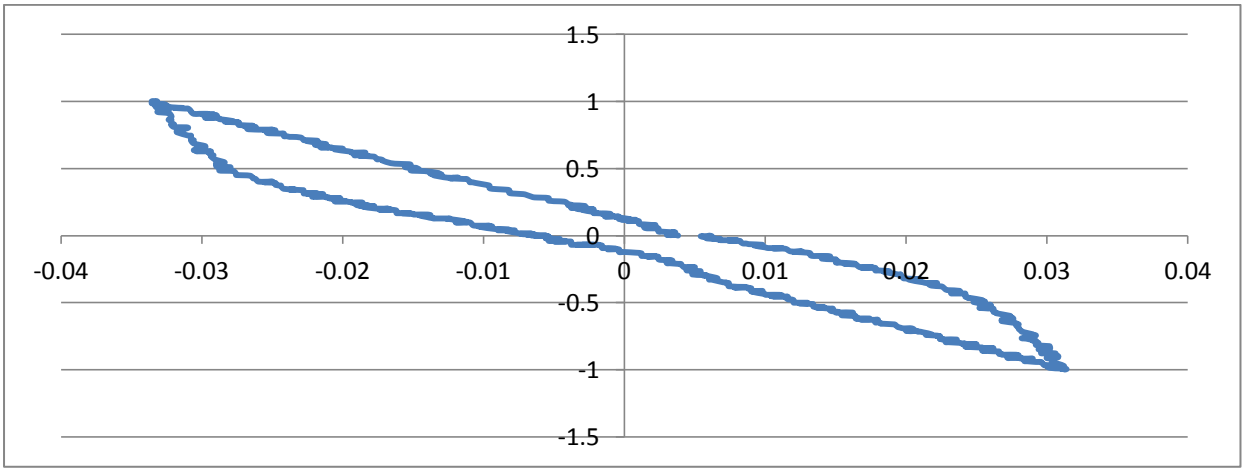
3.4. Tests 188-17 to 21 Transom to standard rotation about the transom axis $M_{serv,sz}$ = 1kNm
TG20: section 3.4 Test series 4 $M_{serv,sz}$ = 1kNm
Recorded data log reference 188-17 to 188-21

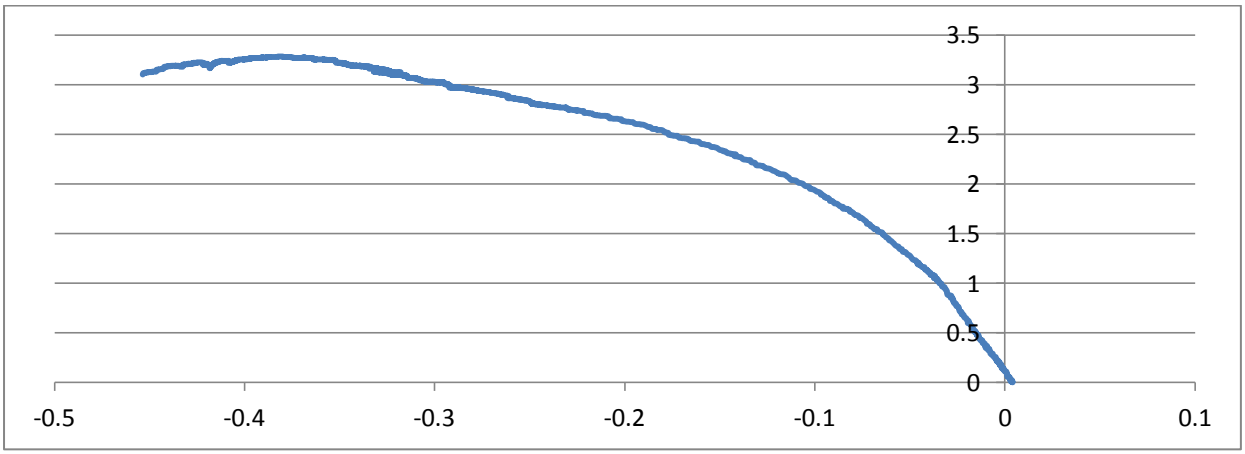
Sample 17: Test record 188-17 test type 4 load against clasp hinge



Sample 17: Test record 188-17 test type 4
Test load trace third cycle



Sample 17: Test record 188-17 test type 4
Test load trace load to failure



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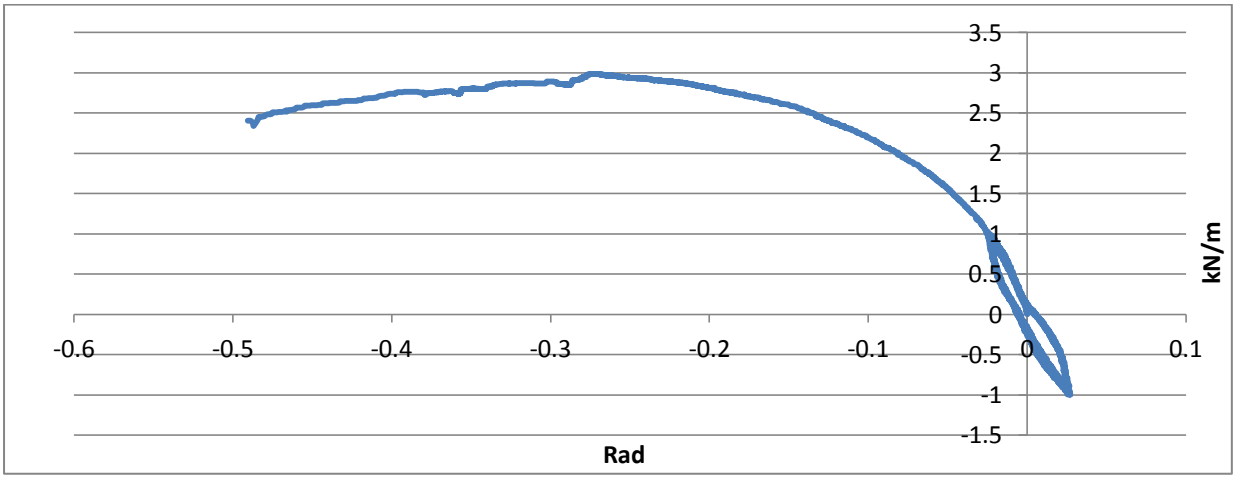
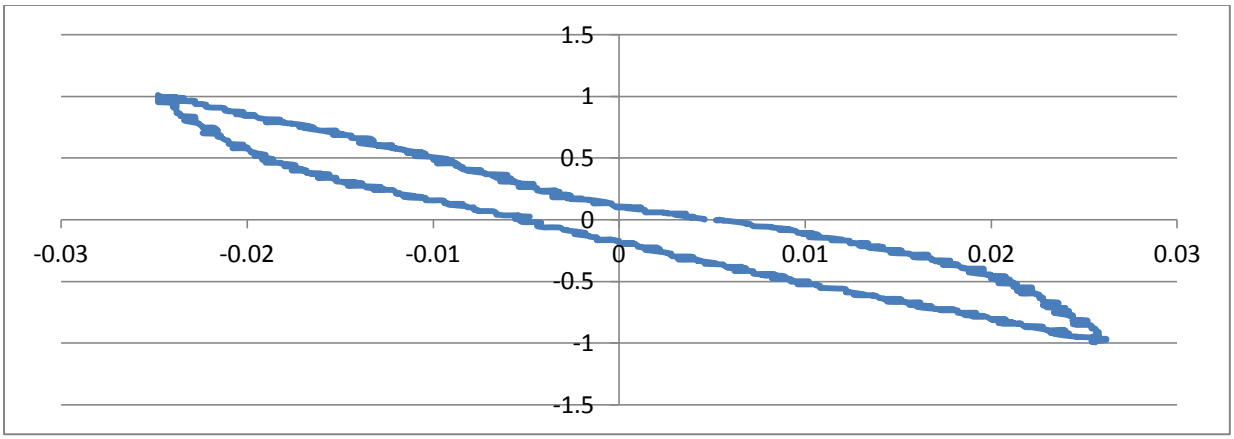
Sample 18: Test record 188-18 test type 4 load against clasp hinge

Test load trace



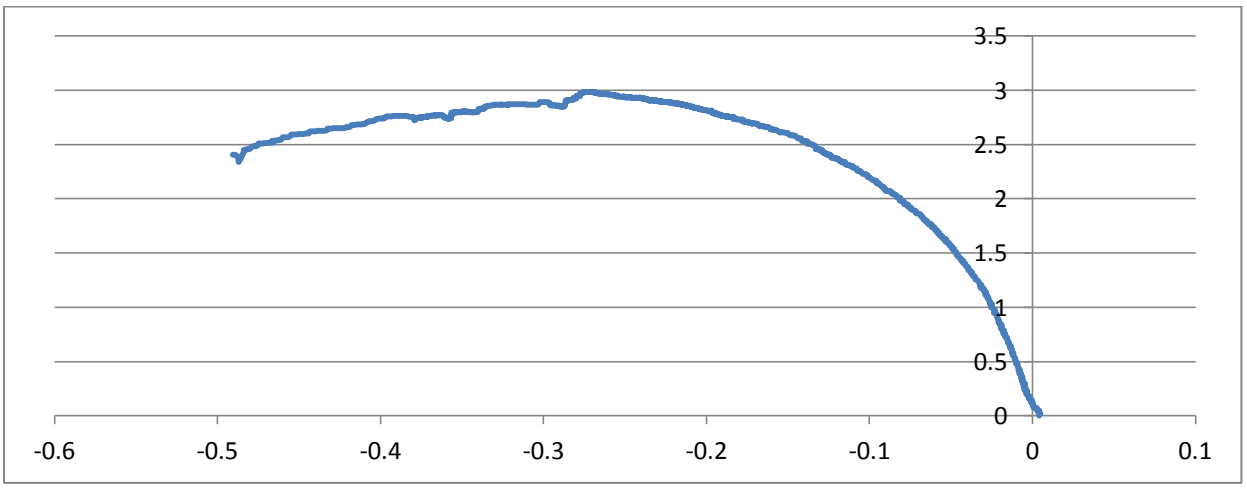
Sample 18: Test record 188-18 test type 4

Test load trace third cycle



Sample 18: Test record 188-18 test type 4

Test load trace load to failure



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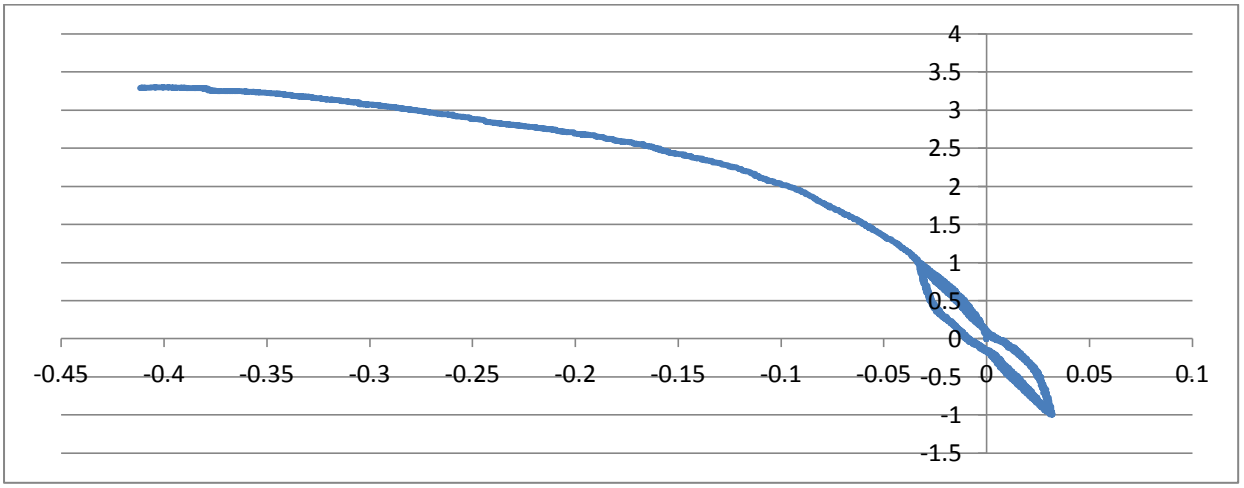
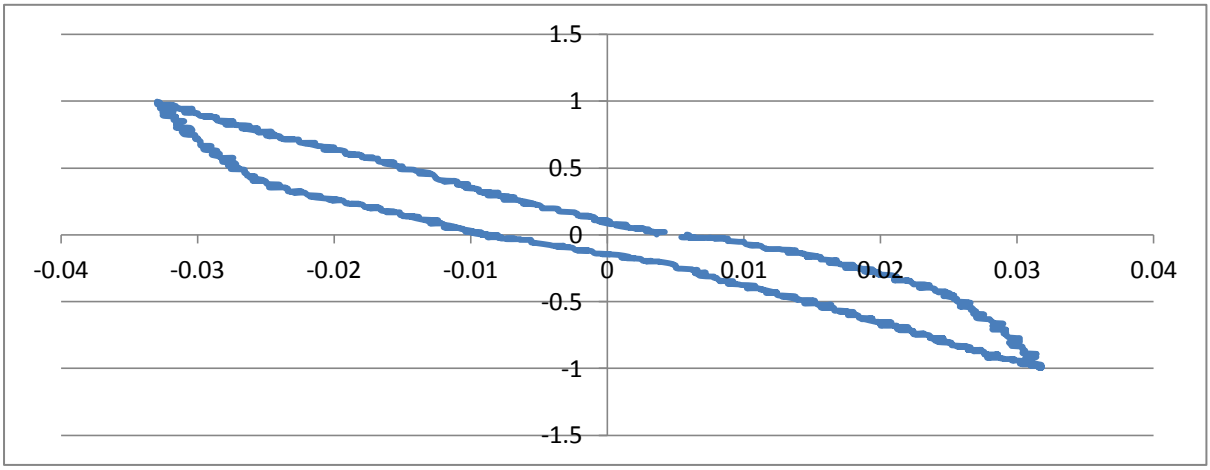
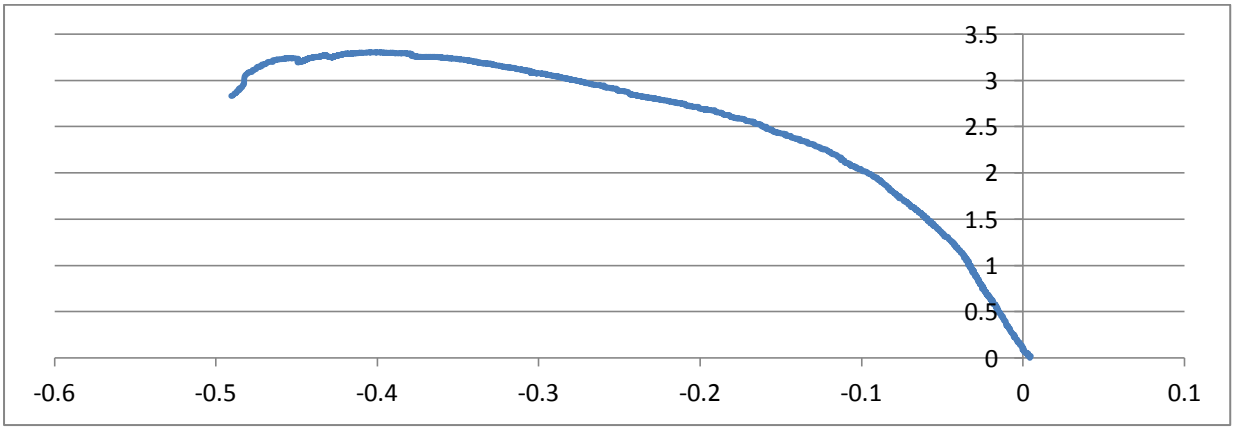
Sample 19: Test record 188-19 test type 4 load against clasp hinge
Test load trace



Sample 19: Test record 188-19 test type 4
Test load trace third cycle



Sample 19: Test record 188-19 test type 4
Test load trace load to failure



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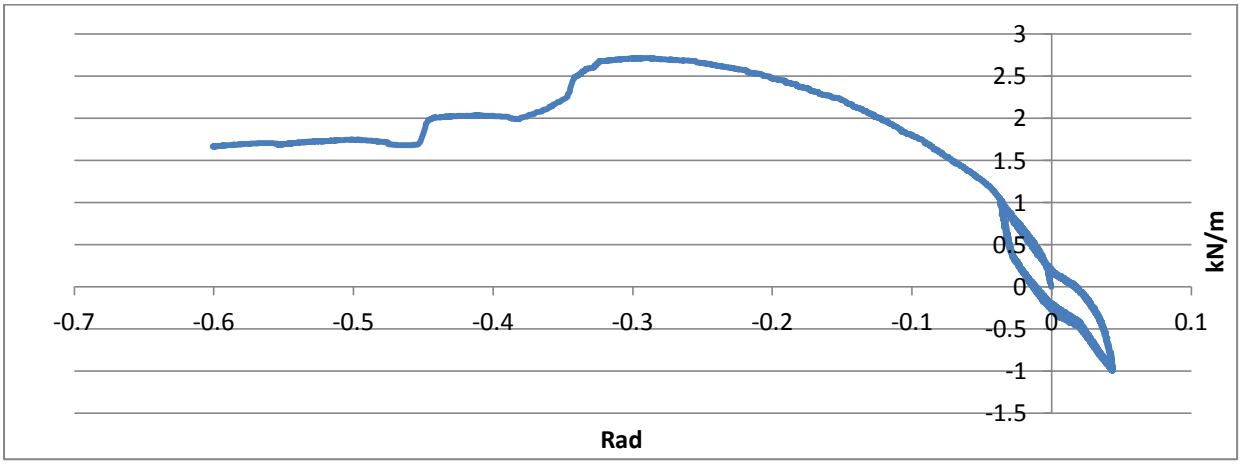
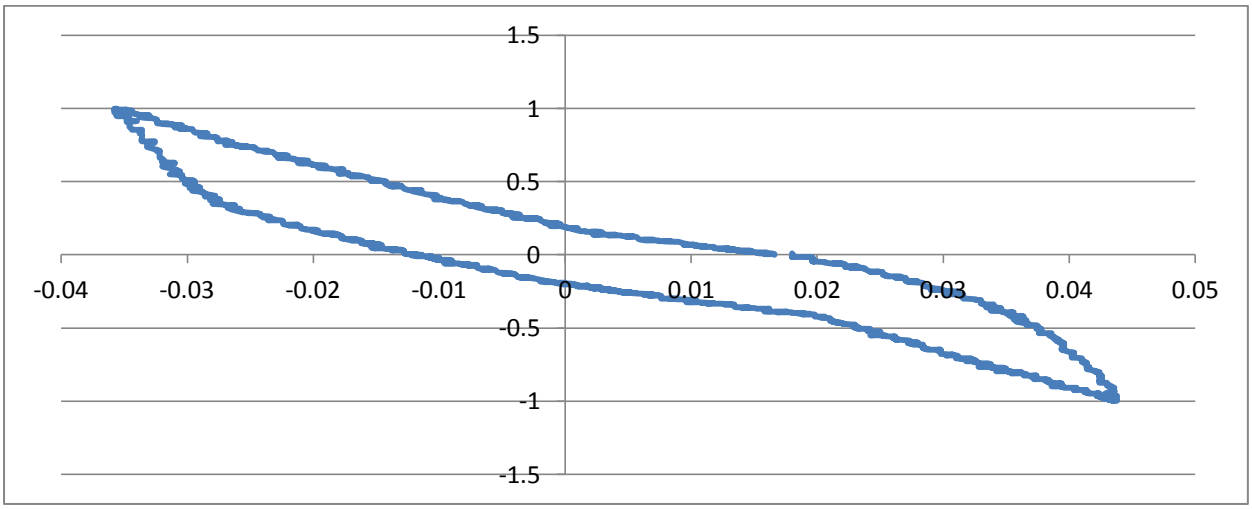
Sample 20: Test record 188-20 test type 4 load against clasp hinge

Test load trace



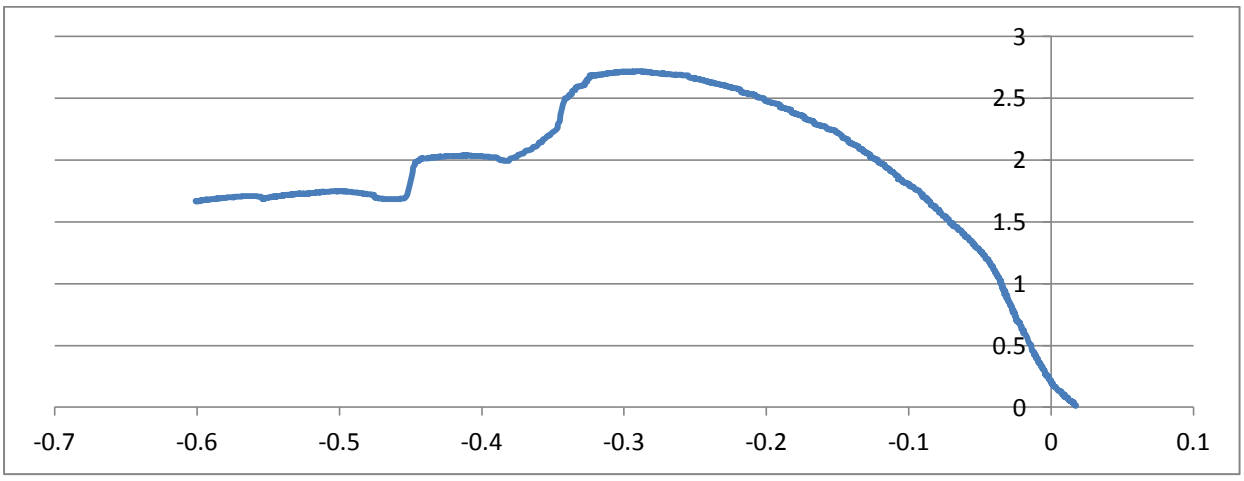
Sample 20: test record 188-20 test type 4

Test load trace third cycle



Sample 20: test record 188-20 test type 4

Test load trace load to failure



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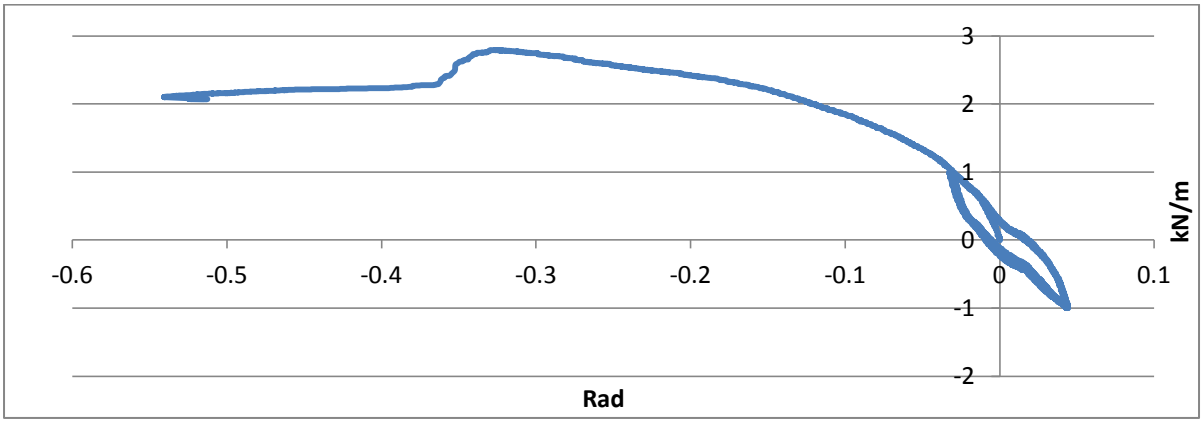
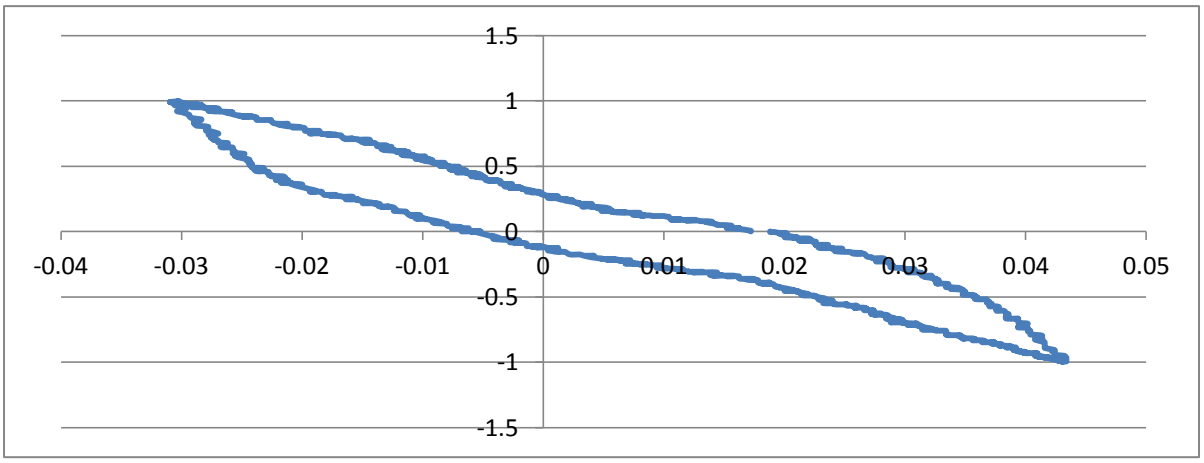
Sample 21: Test record 188-21 test type 4 load against clasp hinge

Test load trace



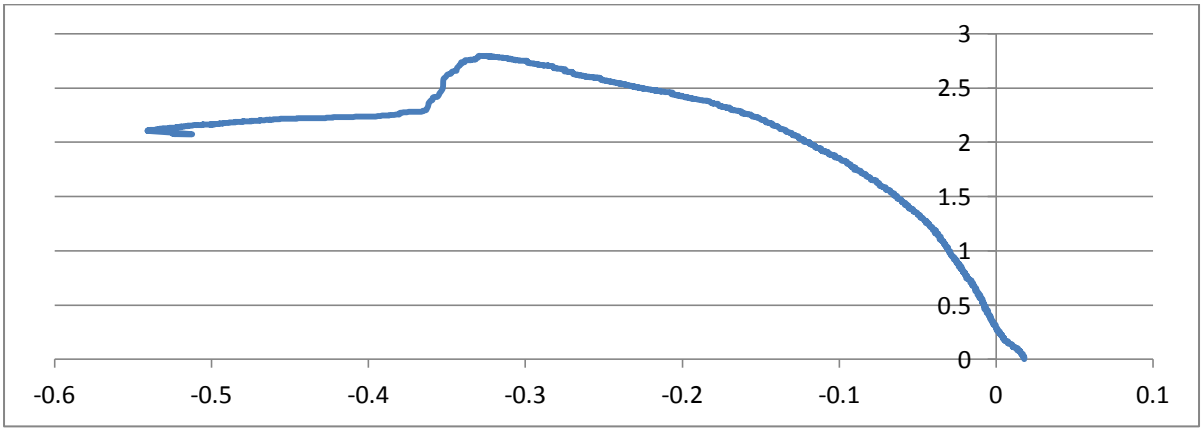
Sample 21: test record 188-21 test type 4

Test load trace third cycle



Sample 21: test record 188-21 test type 4

Test load trace load to failure



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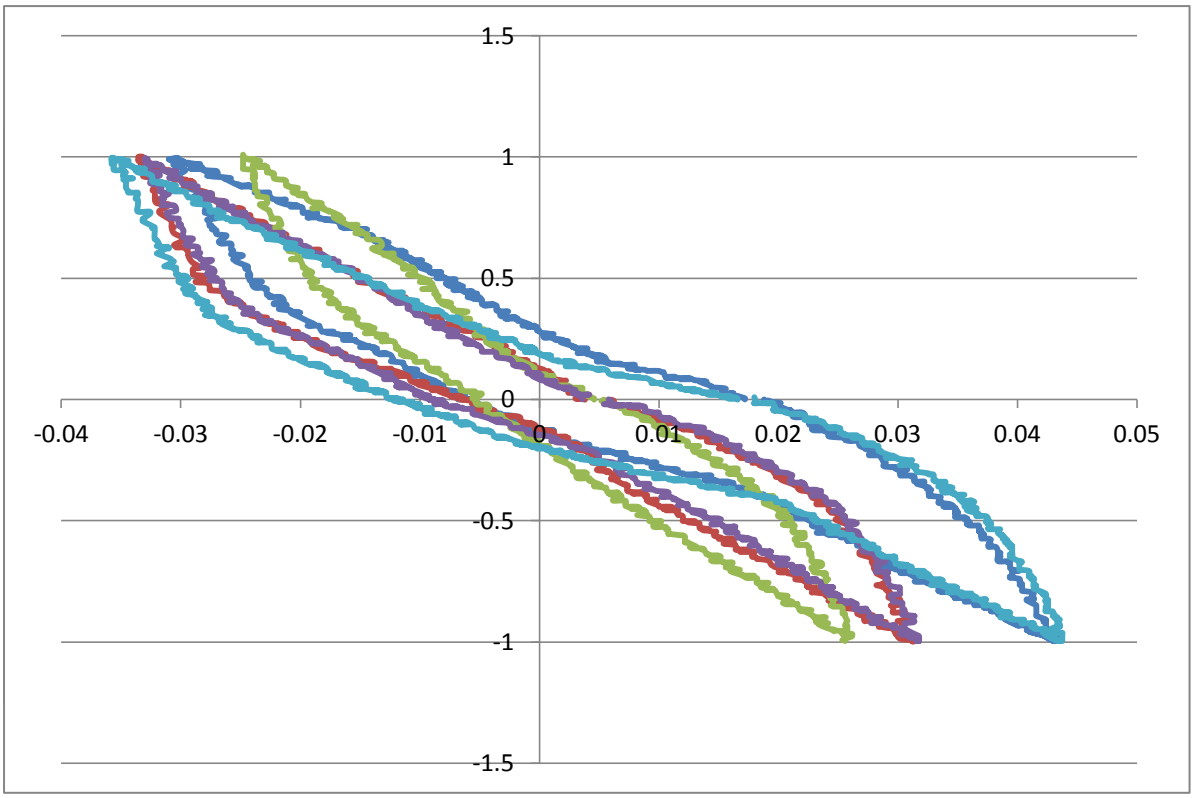
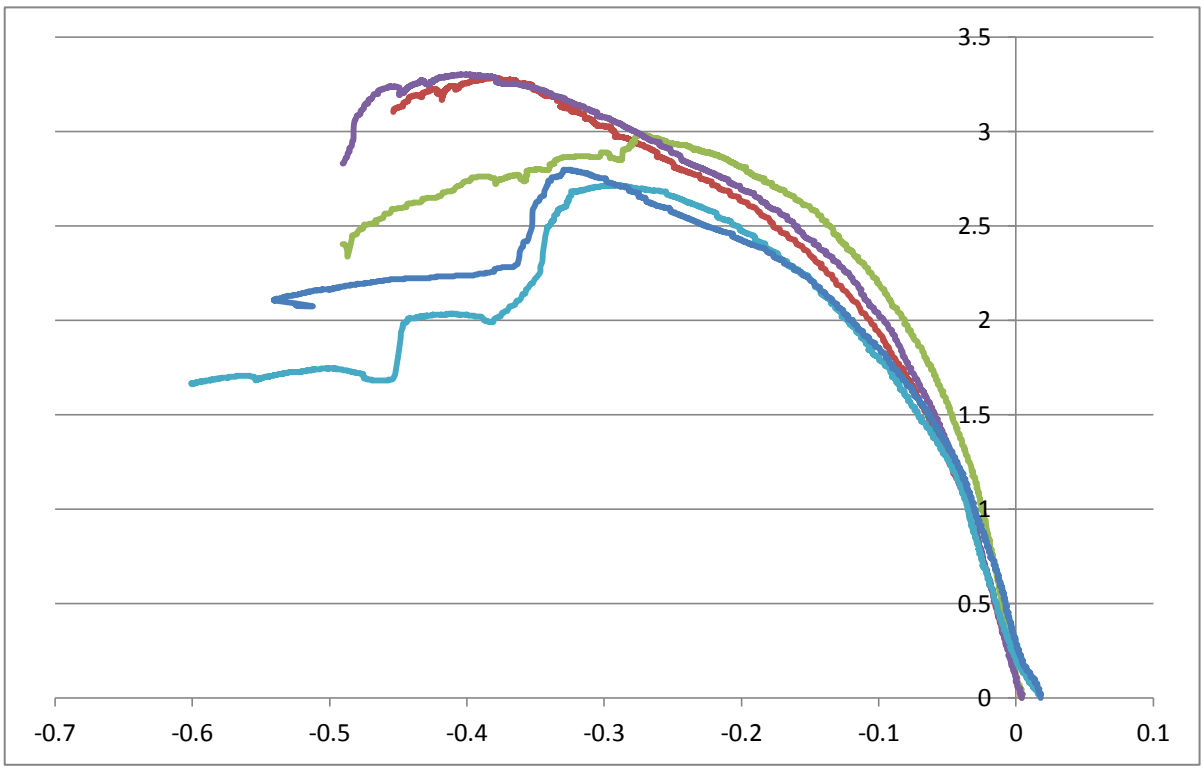
Samples 188-17 to 188-21 3rd cycle



Samples 188-17 to 188-21 load to failure



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Tests 188-17 to 21 type 3.4 rotation images and typical modes of failure

Typical arrangement

longitudinal weld fracture

initial weld failure

Typical side wall buckling

initial toe of weld failure

tube wall buckling

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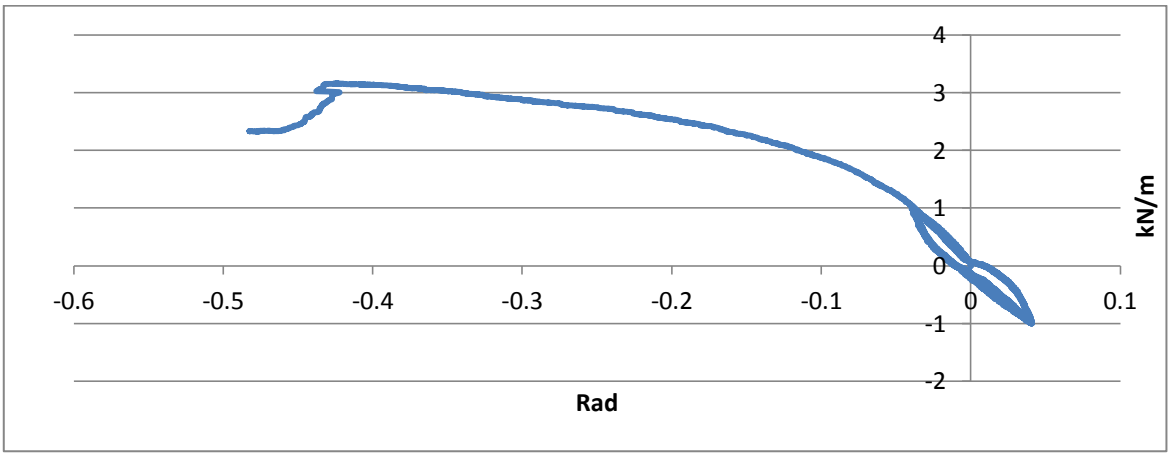
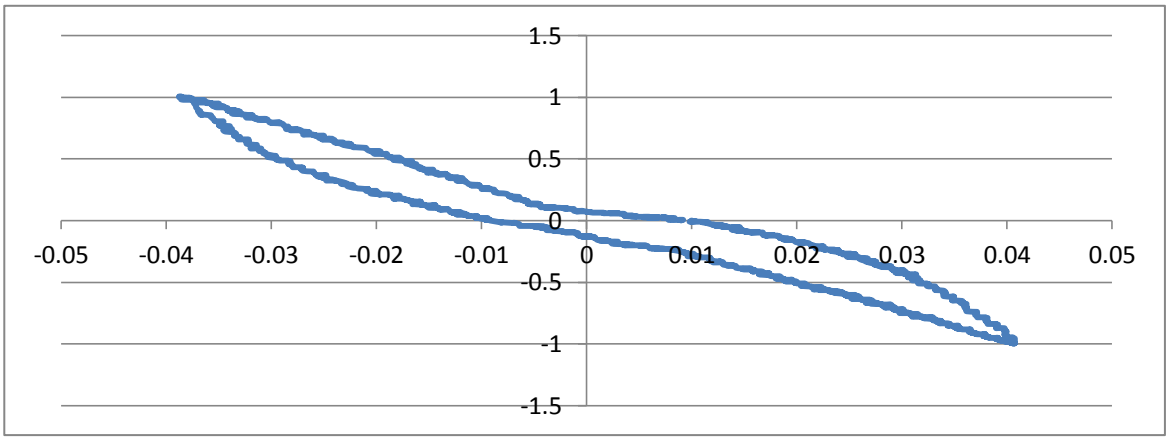
Test type 3.4 inverted direction rotations against bolt and clasp

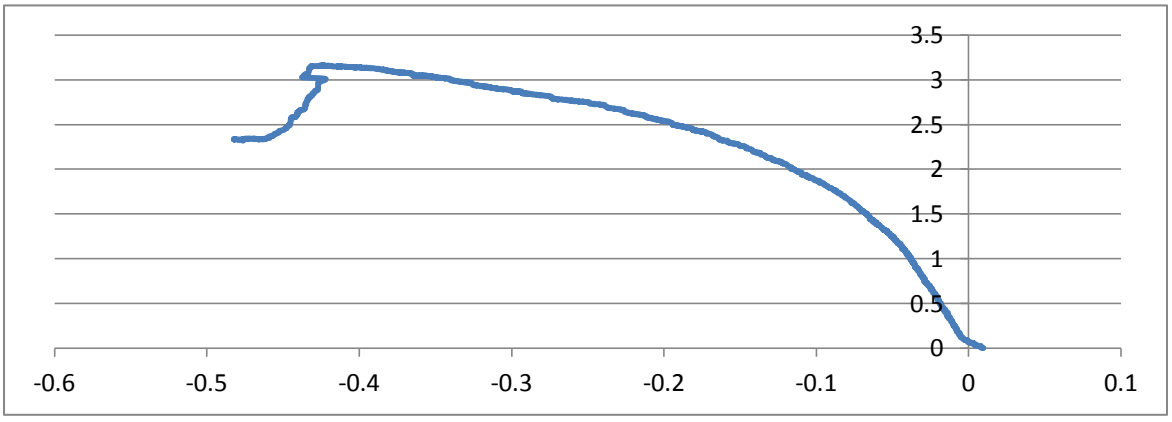
Sample 22: Test record 188-22 test type 4 inverted



Test load trace third cycle



Test load trace load to failure



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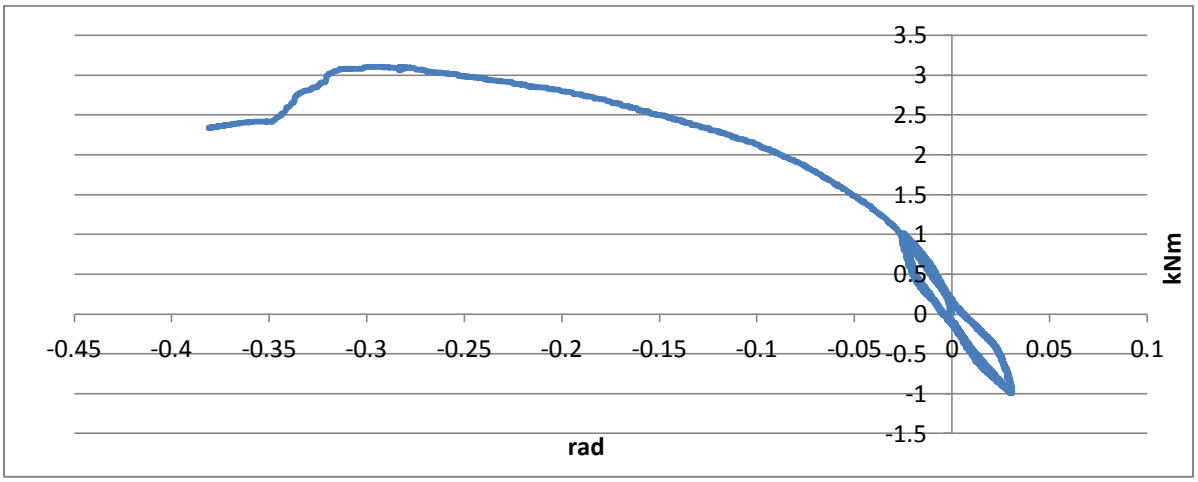
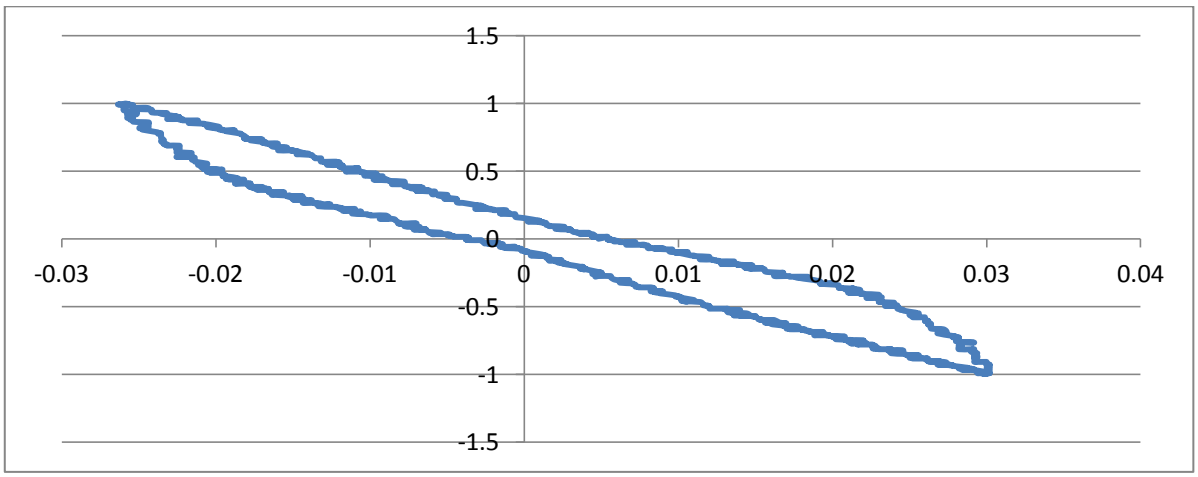
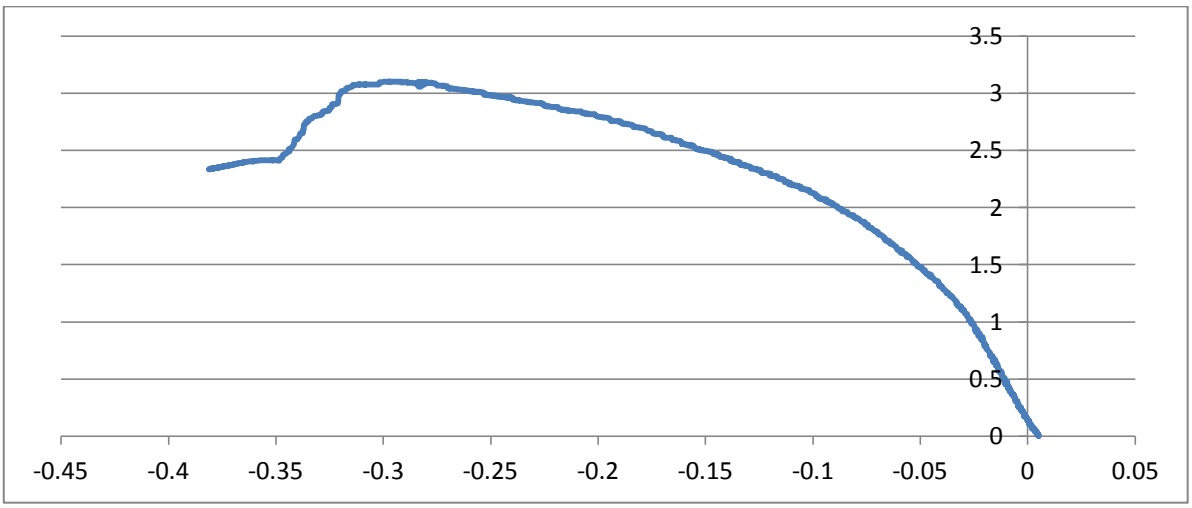
Sample 23: Test record 188-23 test type 4 inverted



Test load trace third cycle



Test load trace load to failure



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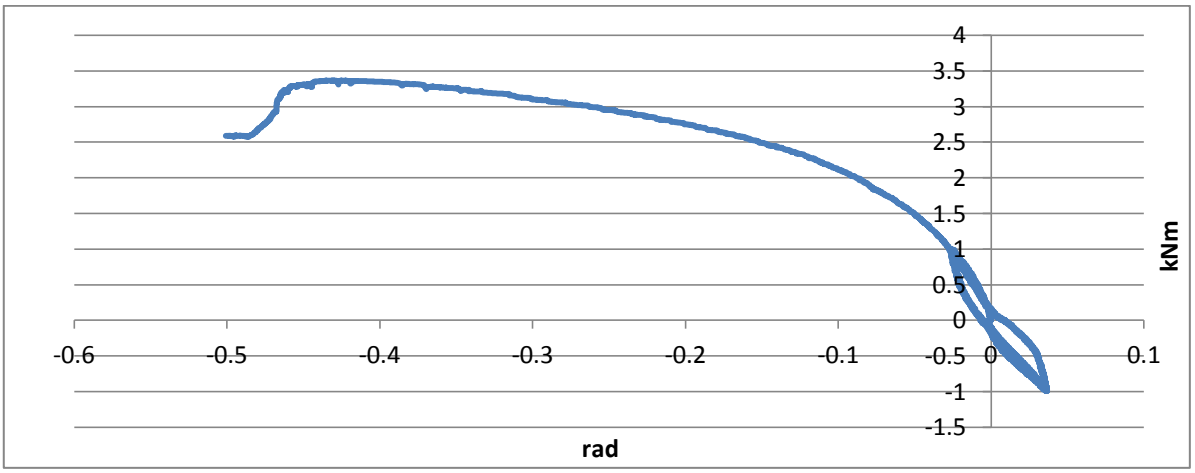
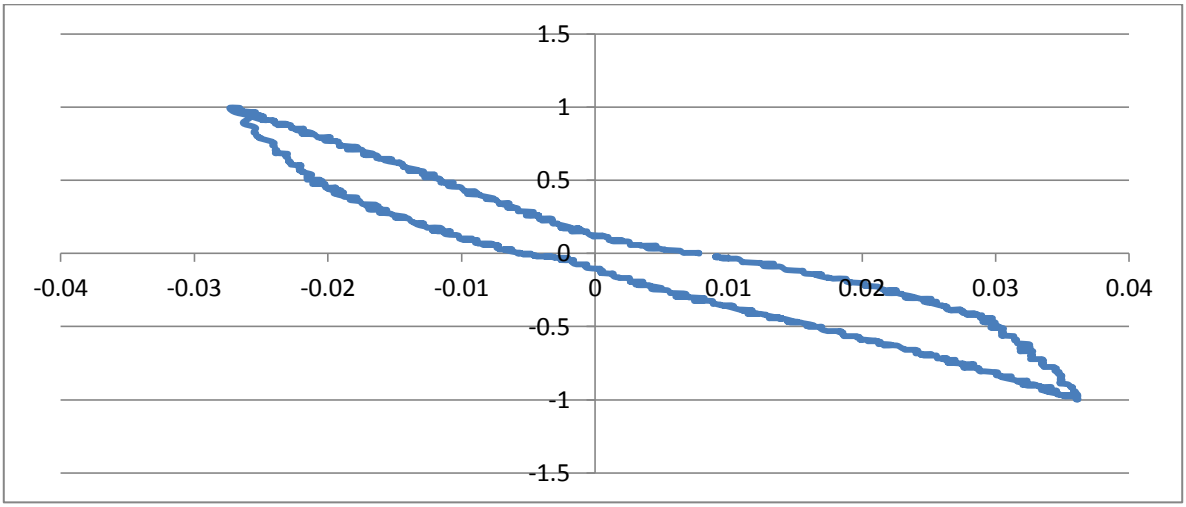
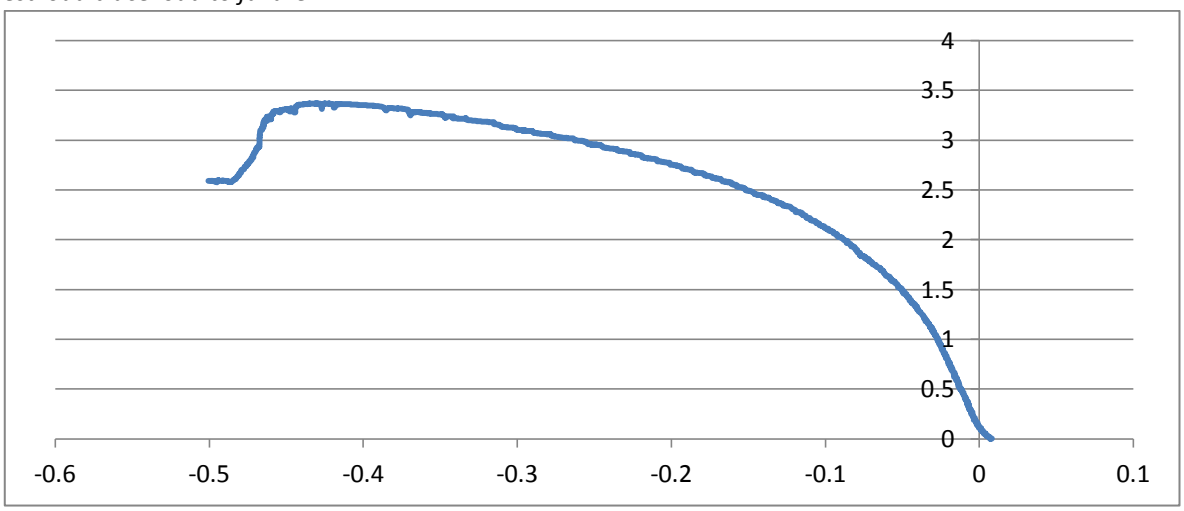
Sample 24: Test record 188-24 test type 4 inverted



Test load trace third cycle



Test load trace load to failure



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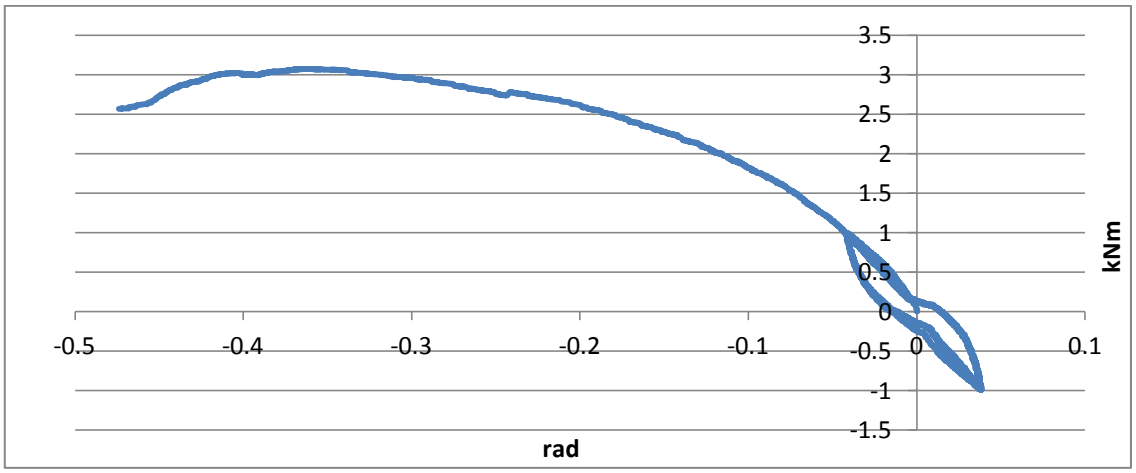
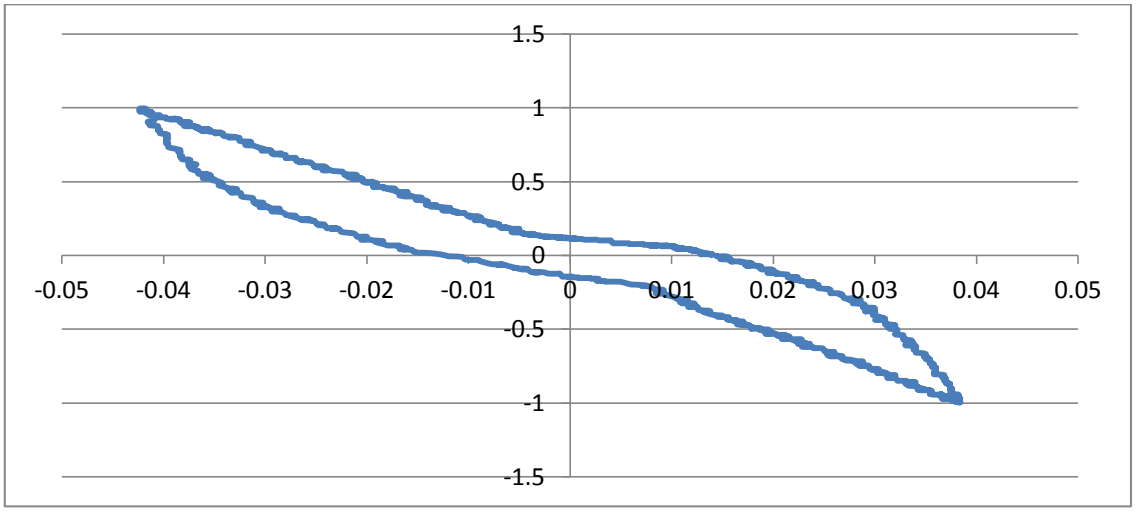
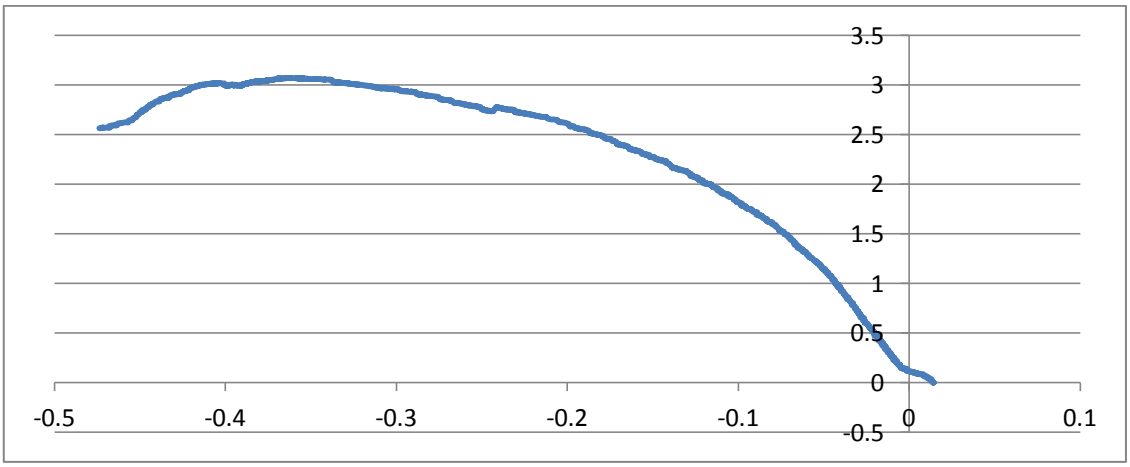
Sample 25: Test record 188-25 test type 4 inverted



Test load trace third cycle



Test load trace load to failure



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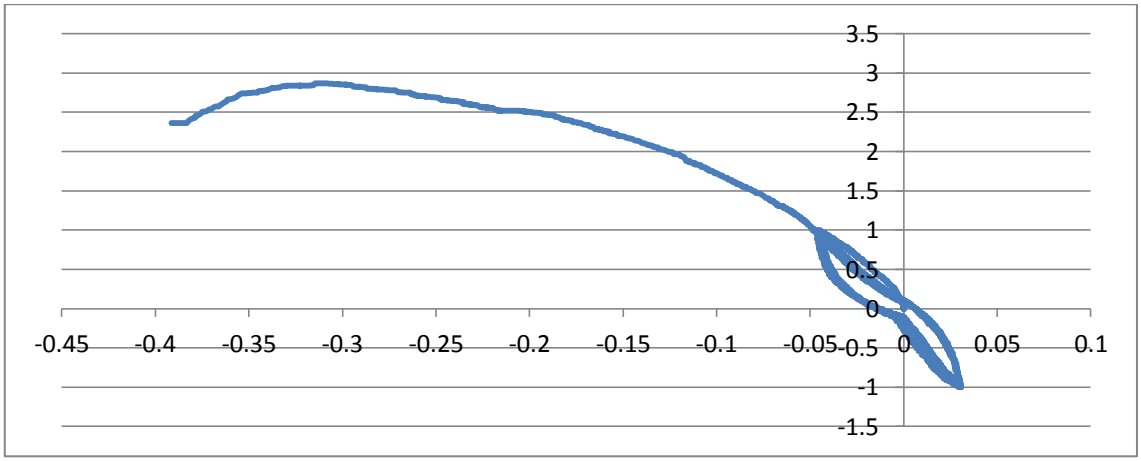
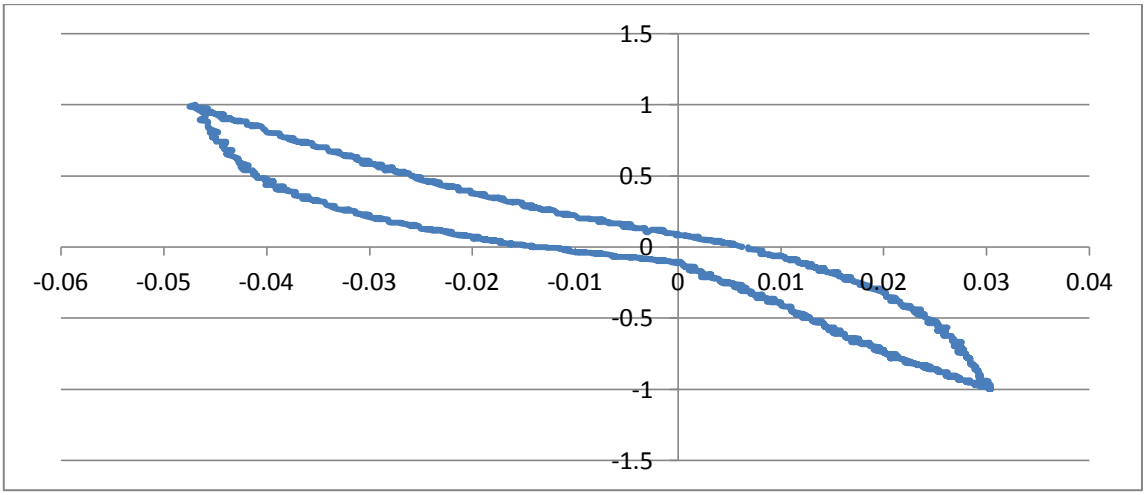
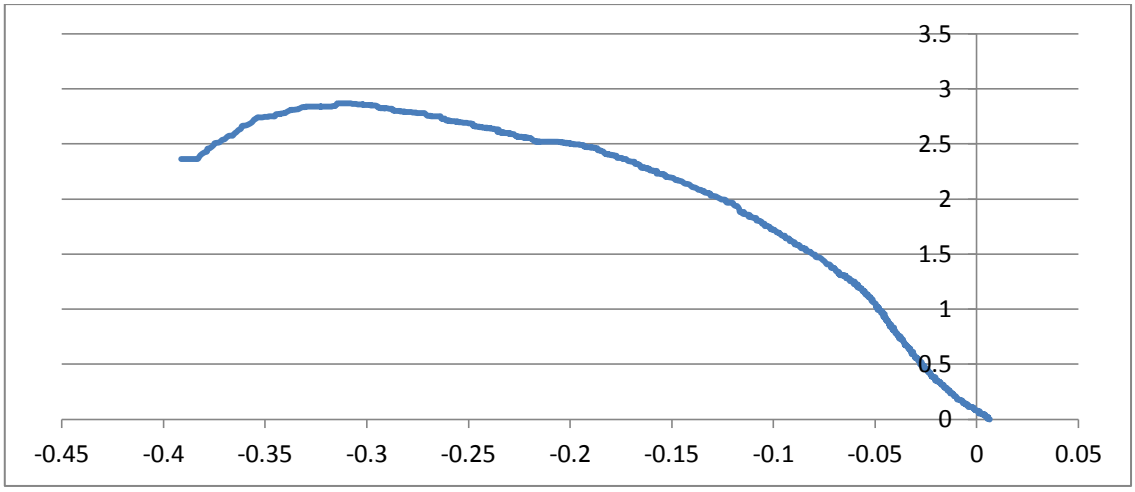
Sample 26: Test record 188-26 test type 4 inverted



Test load trace third cycle



Test load trace to failure



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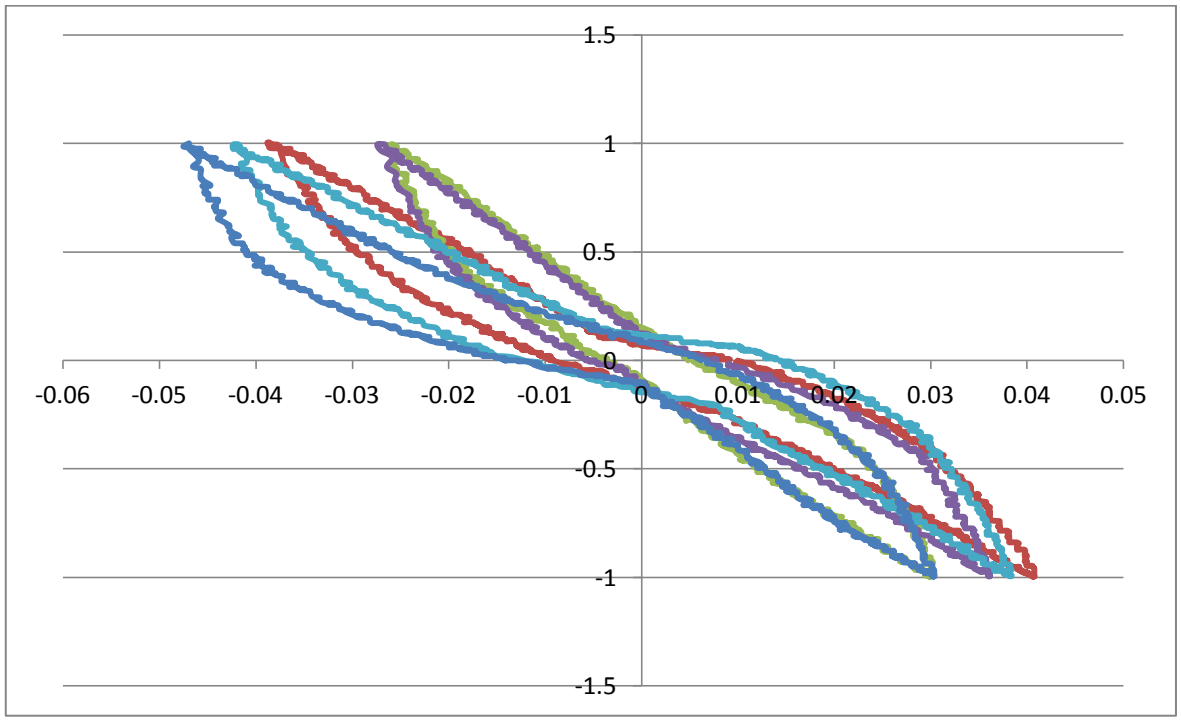
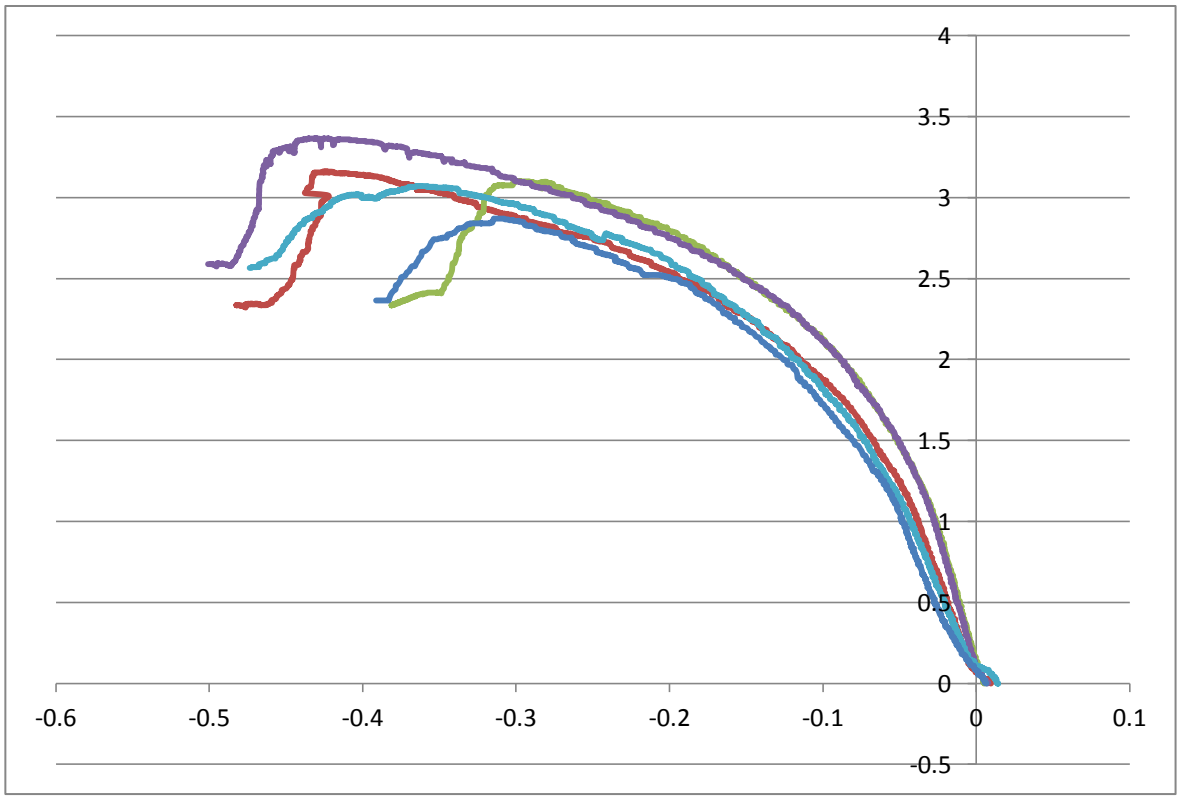
Samples 188-22 to 188-26 3rd Cycle



Samples 188-22 to 188-26 load to failure



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Tests 188-21 to 26 type 3.4 inverted bolt and clasp rotation images and typical modes of failure

Typical arrangement inverted

tube wall tear at weld

toe weld fracture

Hinge plate deformation

weld fracture

initial weld tear

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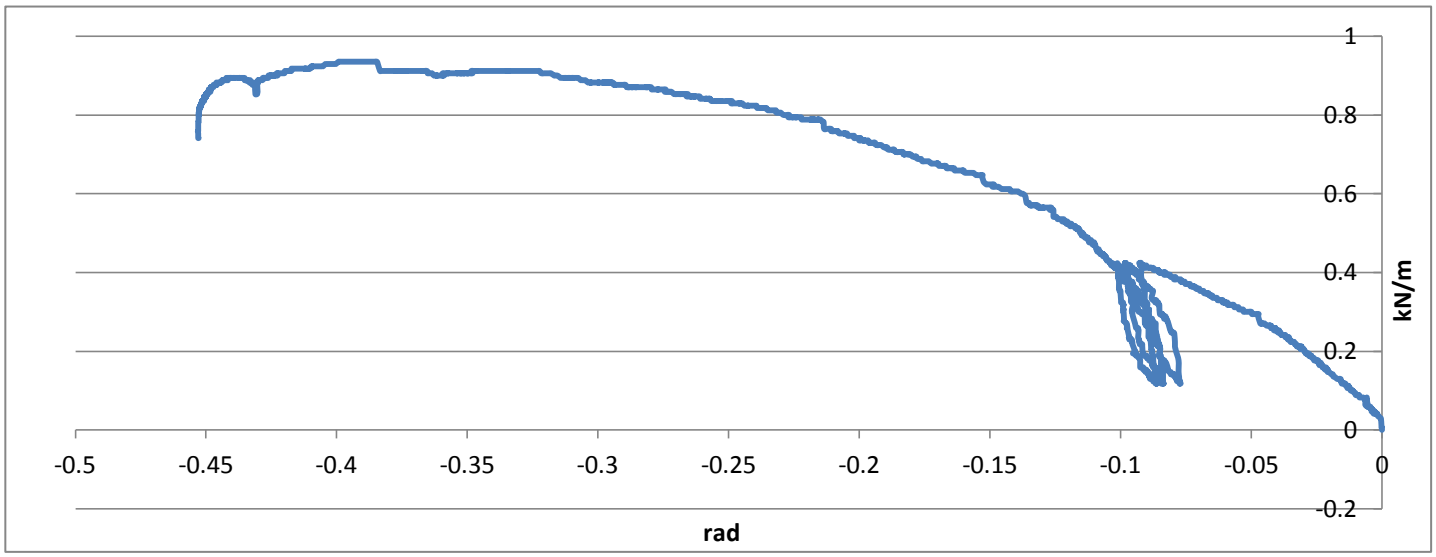
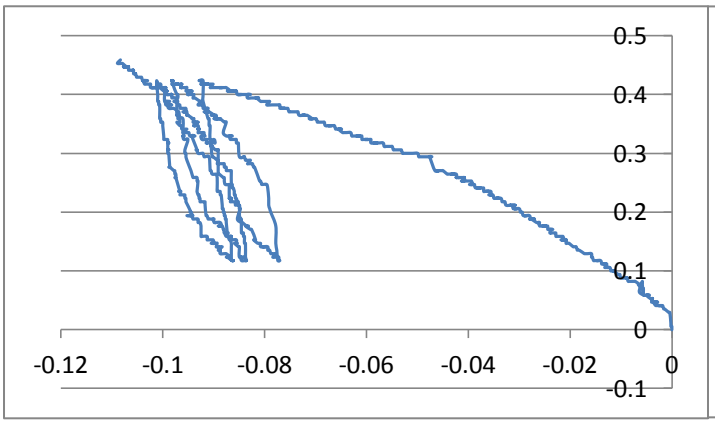
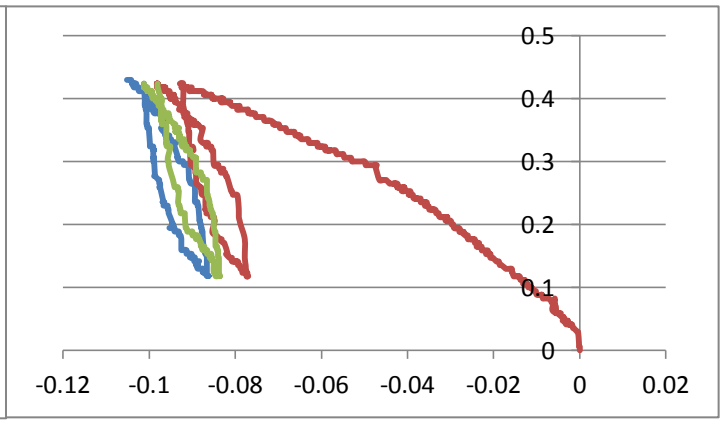
3.5. Tests 188-27 to 31 Transom to ledger rotation about the standard axis $M_{serv,ly}$ = 0.45kNm
TG20: section 3.5 Test series 5 $M_{serv,ly}$ = 0.45kNm
Recorded data log reference 188-17 to 188-21

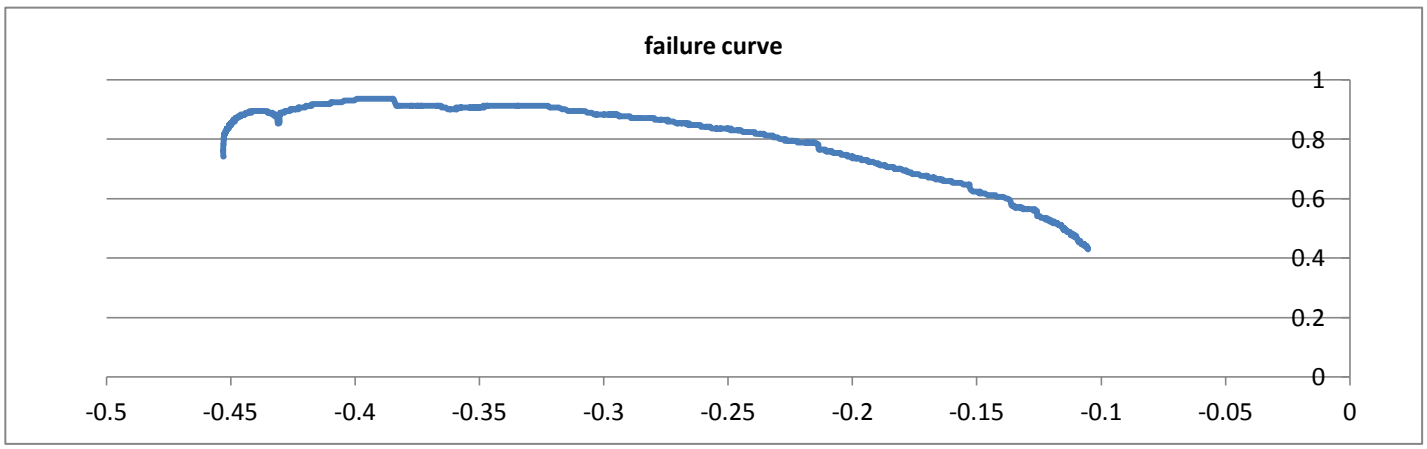
Sample 27 test 188-27: type 3.5



Test 188-27 showing unloading curves







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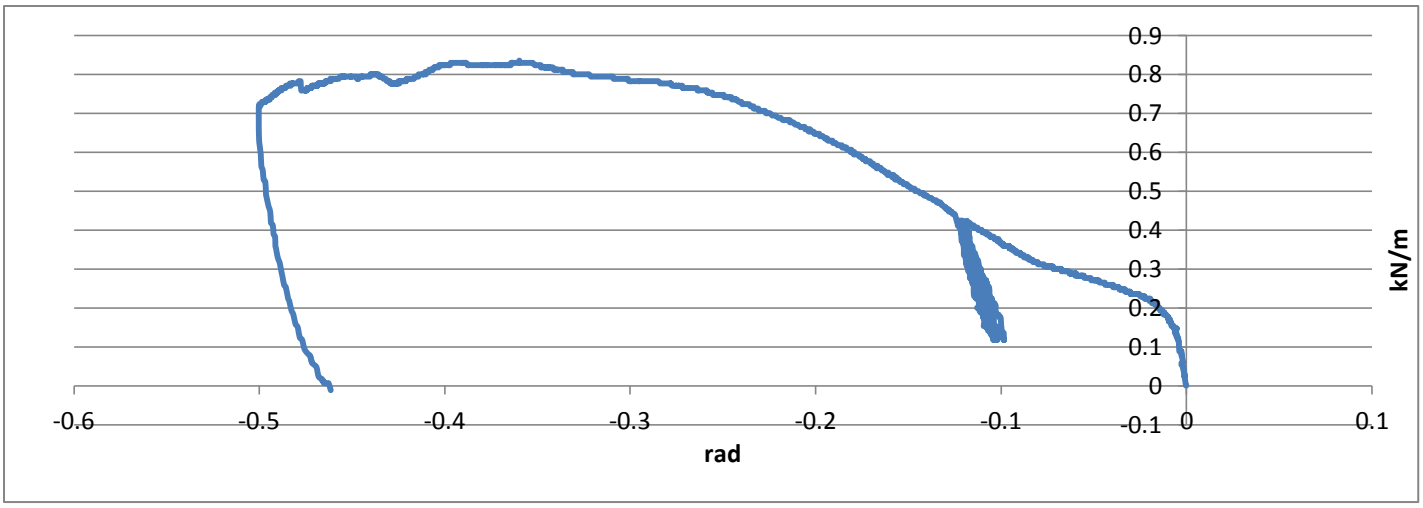
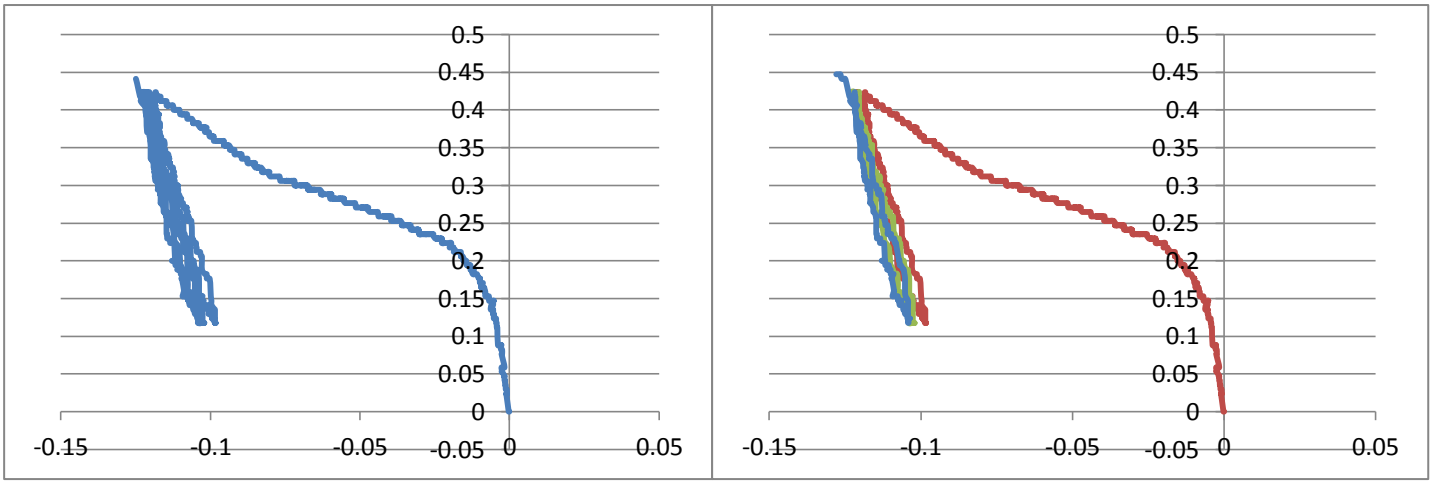
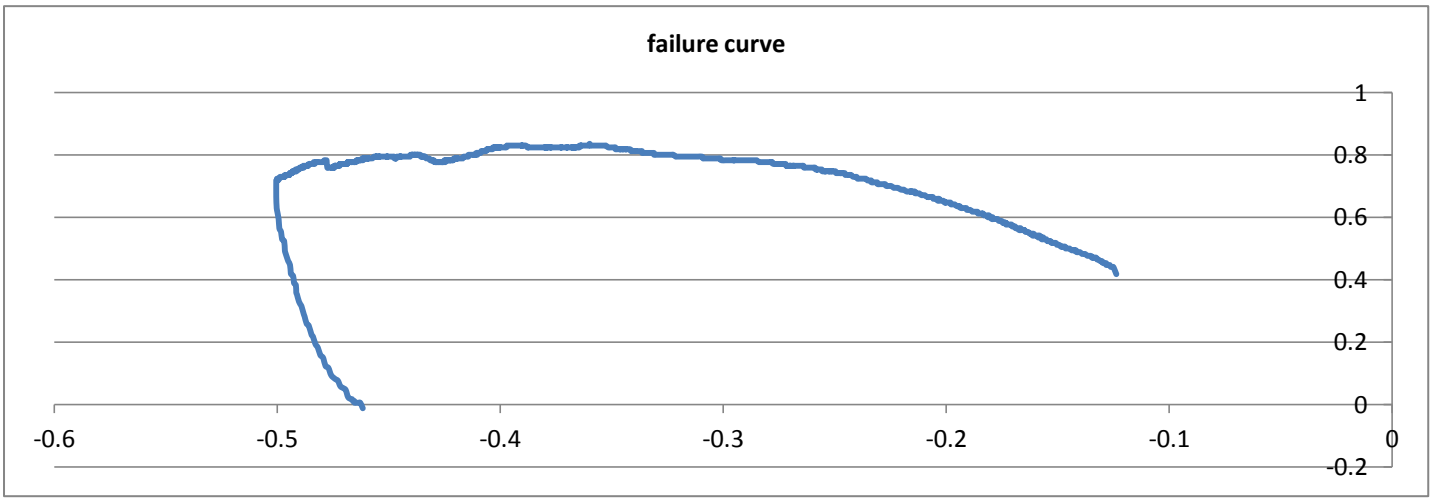
Sample 28 test 188-28: type 3.5



Test 188-28 showing unloading curves





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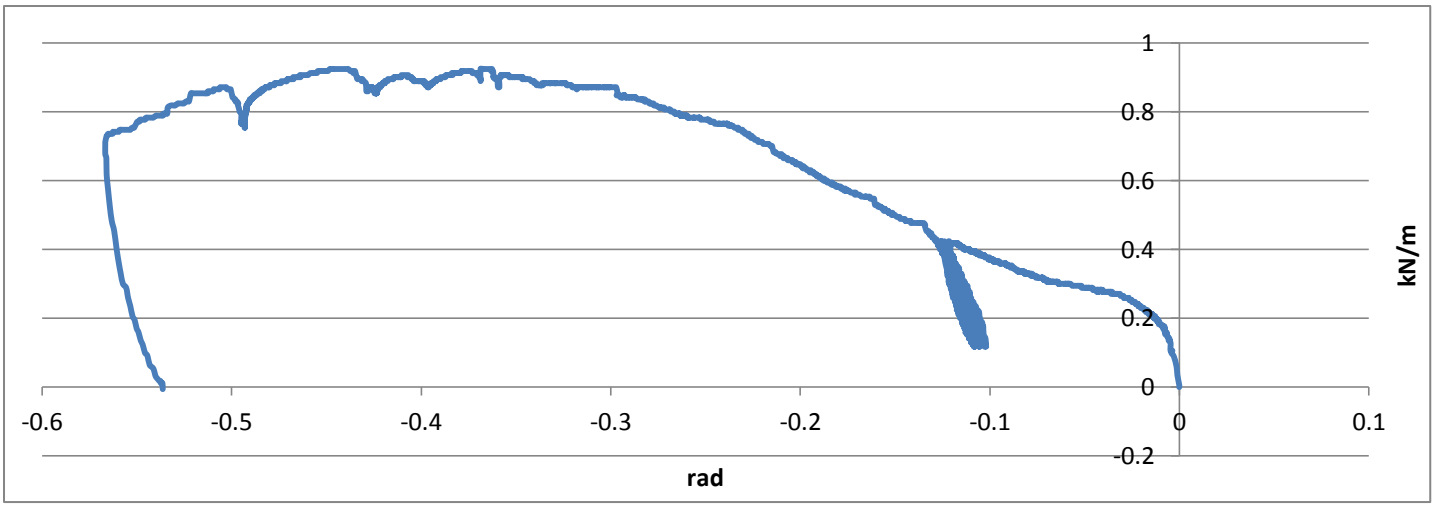
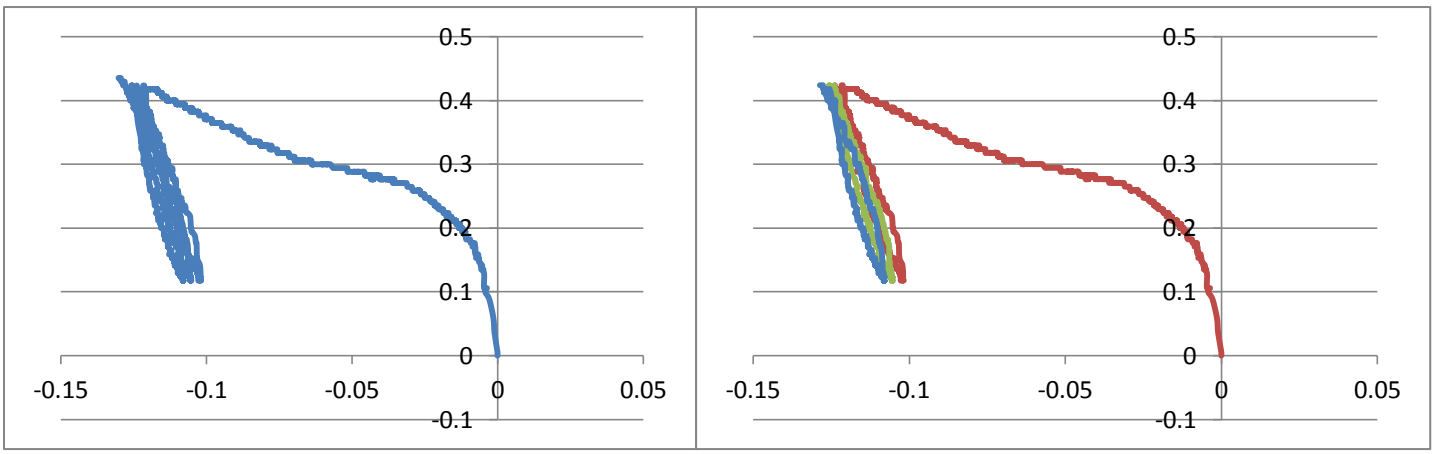
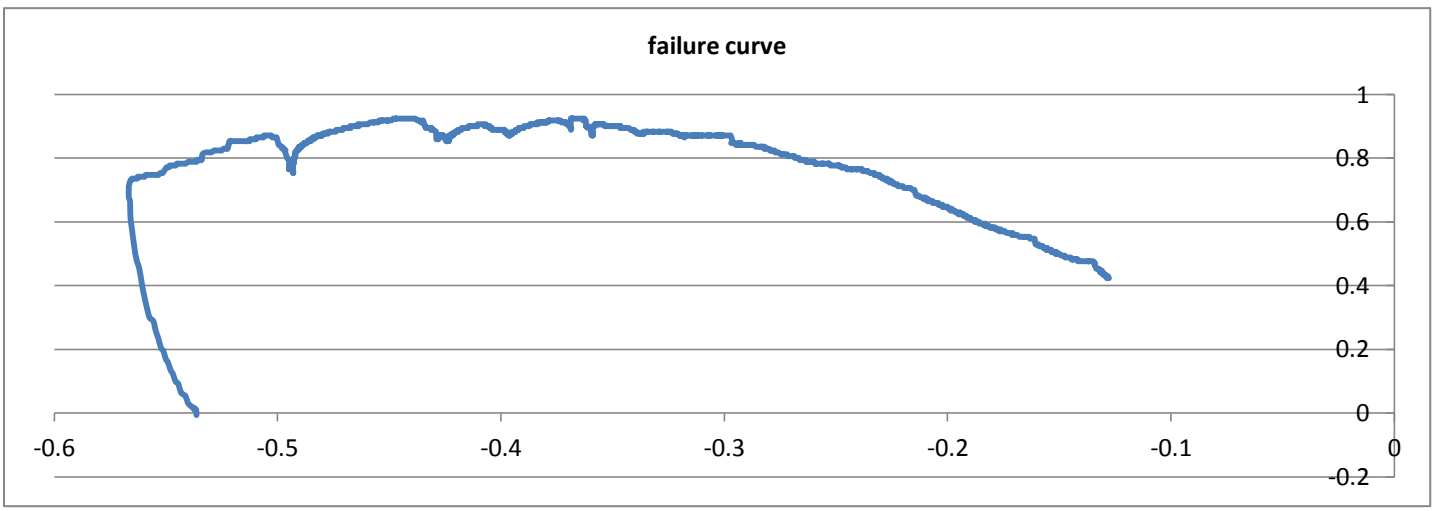
Sample 29 test 188-29: type 3.5



Test 188-29 showing unloading curves





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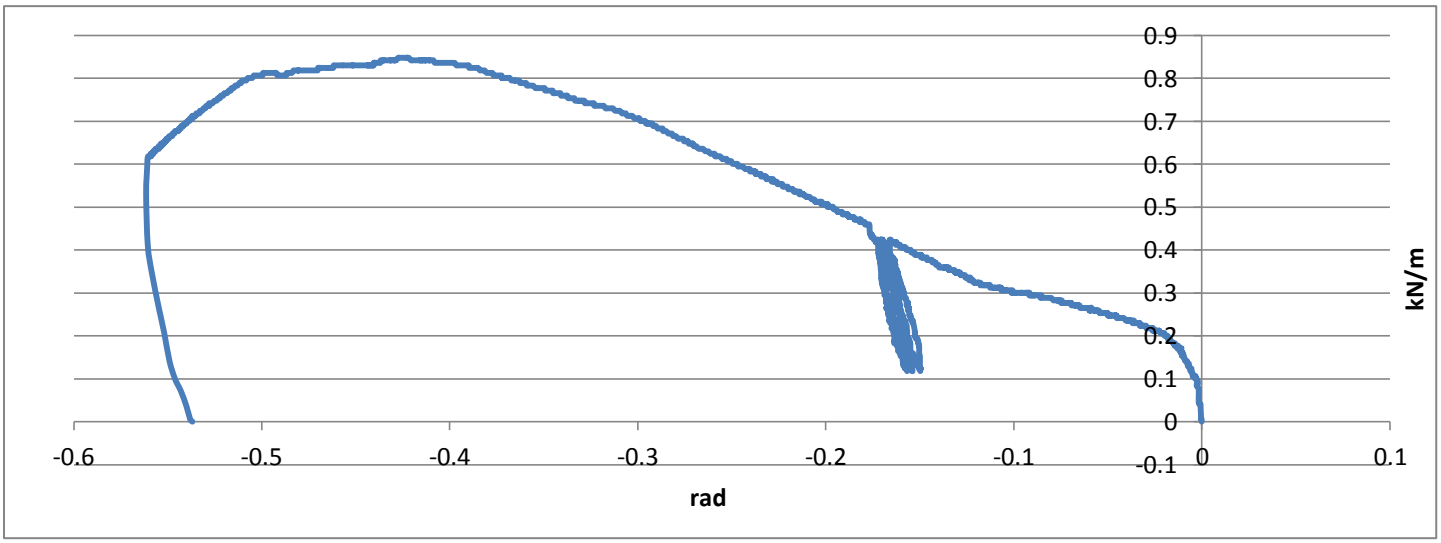
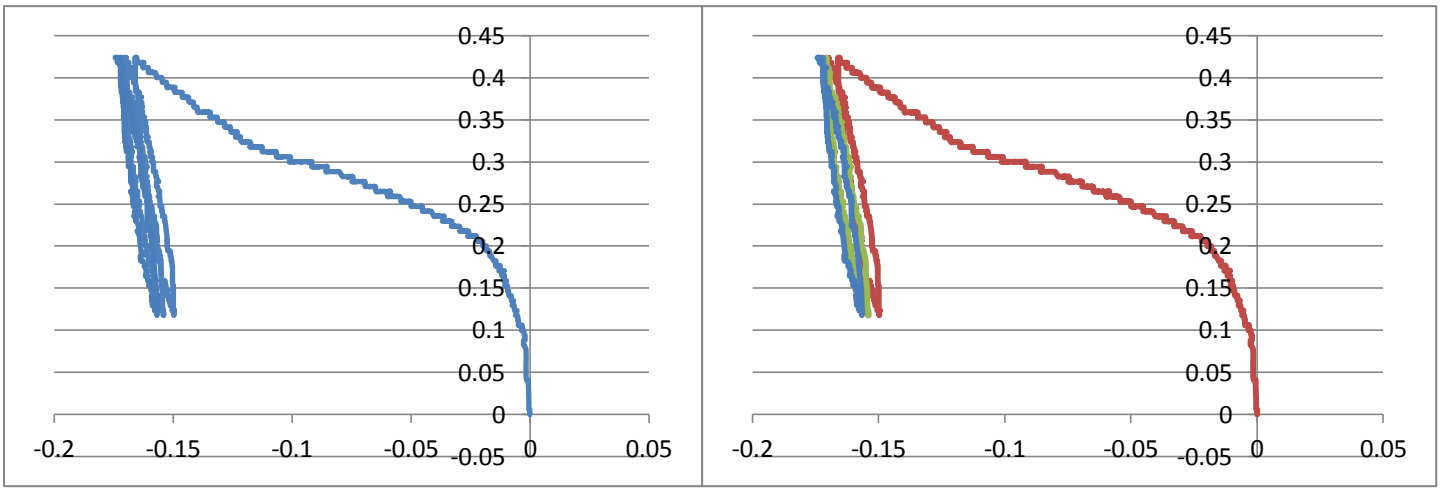
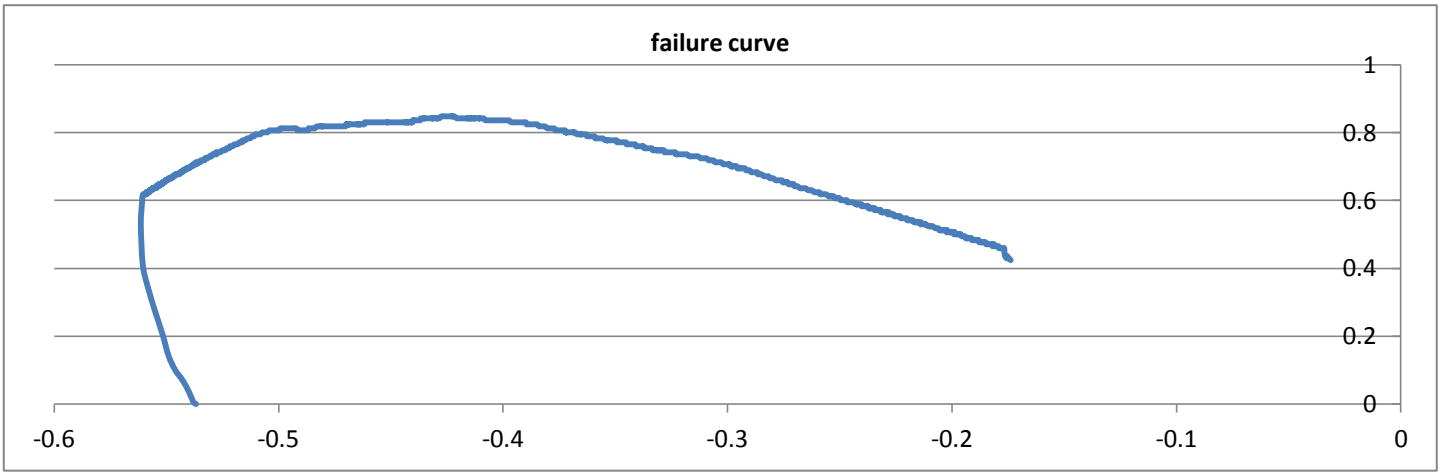
Sample 30 test 188-30: type 3.5



Test 188-30 showing unloading curves





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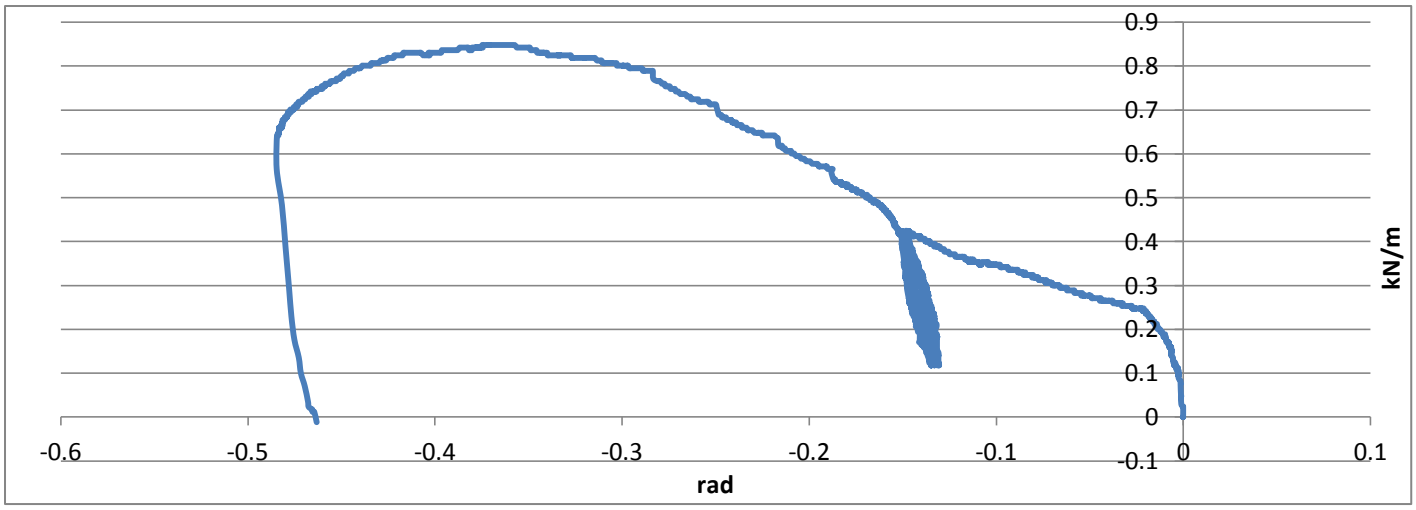
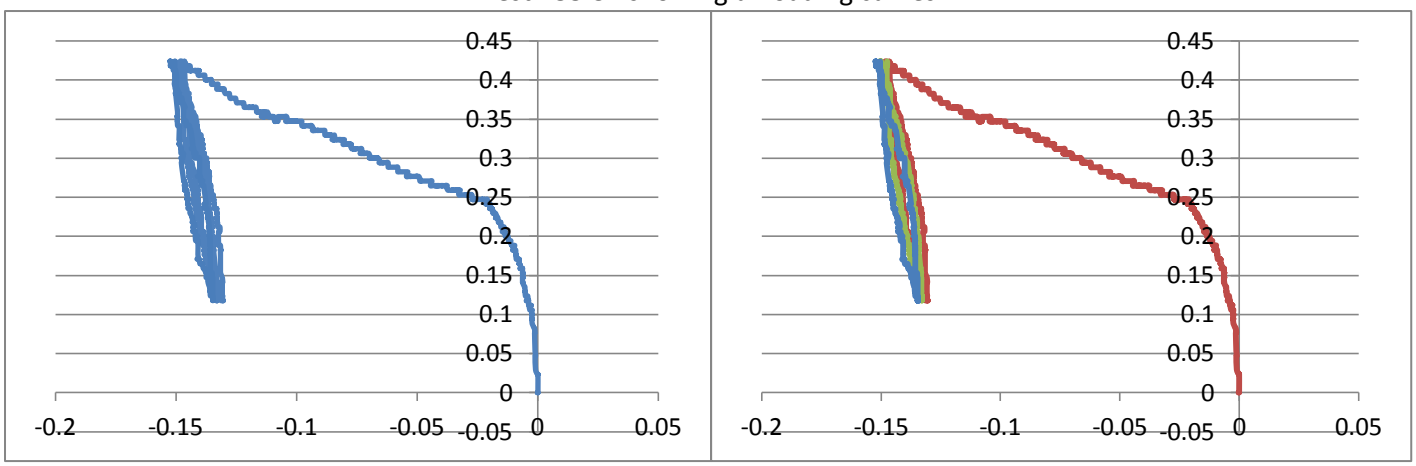
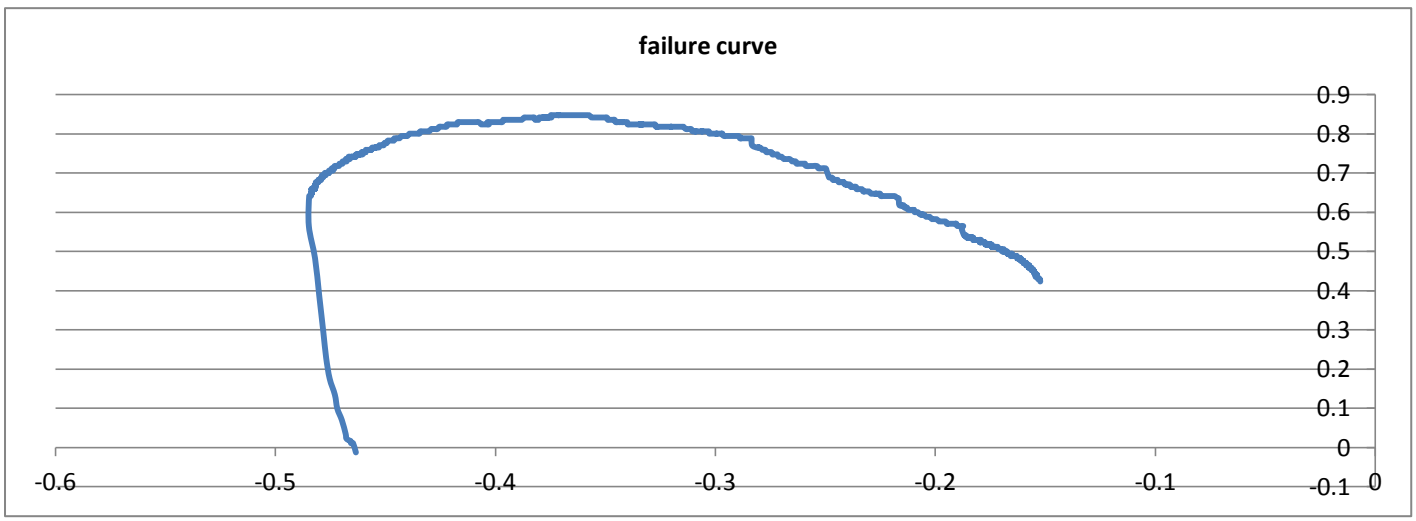
Sample 31 test 188-31: type 3.5



Test 188-31 showing unloading curves





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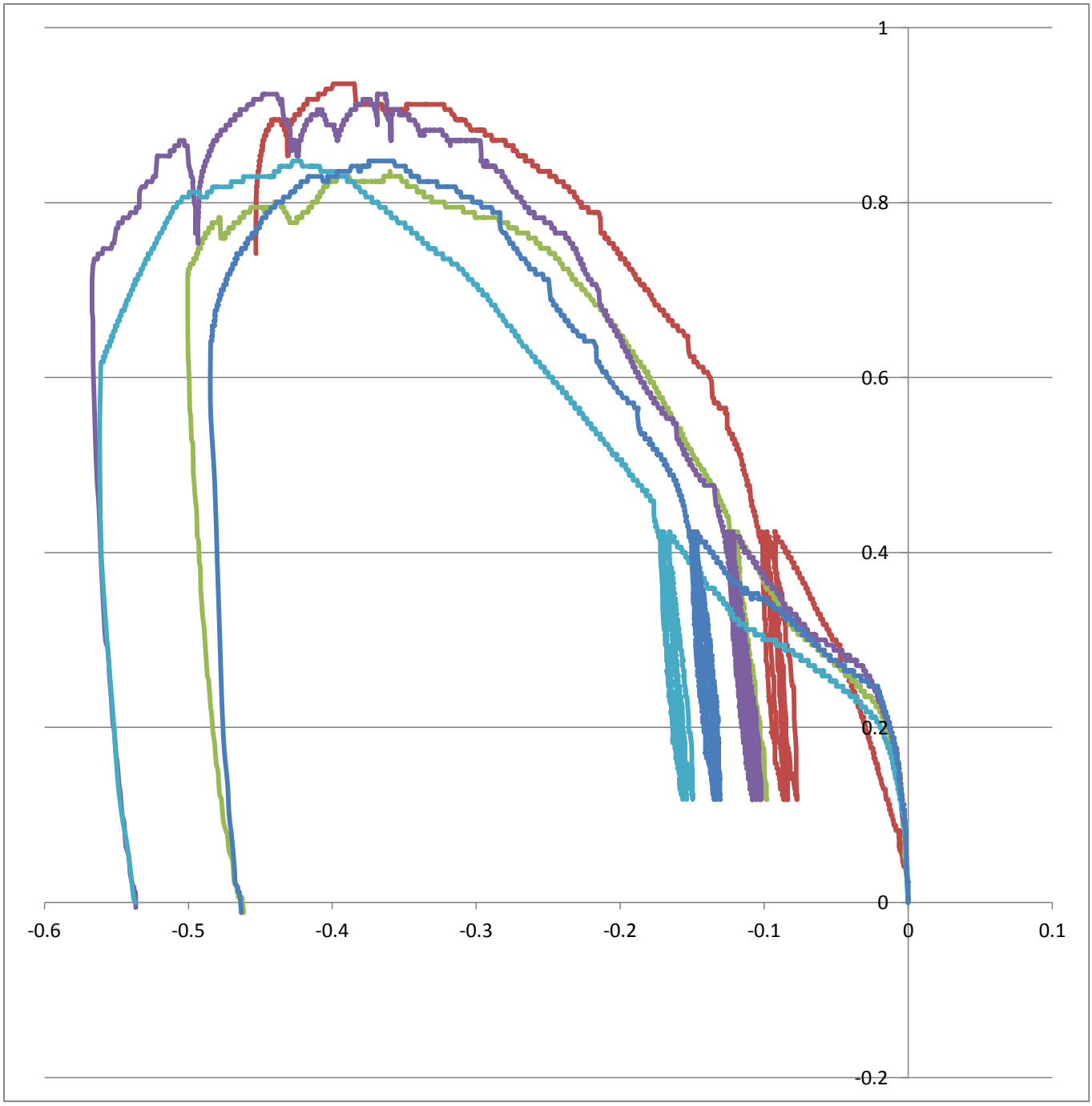
Tests 188-27 to 31 load traces



Upon initial pilot test runs the ledger plate and bolt connection showed looseness when load cycled.

With the guidance of S Mech the load cycles were reduced to give unloading curves to approximately 0.1kNm to eliminate transom to ledger slippage.

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Section 4:

4.1. Description of failure modes

Test type ref	Sample number	orientation	Average result HV10	Approximation Conversion only for reference HV*	MPa*	Mode of failure
3.3.	11	normal	181	180	575	1,2,3
	12	normal	174	175	560	1,3
	13	normal	177	175	560	1,2,3
	14	normal	181	180	575	1,3
	15	normal	178	180	575	1,3
3.4. Hinge side	17	Hinge side	181	180	575	1,3,4
	18	Hinge side	181	180	575	1,3,4
	19	Hinge side	173	170	545	1,3,4
	20	Hinge side	174	175	560	2,3,4,5
	21	Hinge side	174	175	560	3,4,5
3.4. Bolt and clamp	22	Bolt side	173	175	560	3,4,5
	23	Bolt side	176	175	560	3,4,5
	24	Bolt side	181	180	575	1,3,4
	25	Bolt side	181	180	575	1,3,4
	26	Bolt side	176	175	560	3,4,5
3.5.	27	ledger	176	175	560	3
	28	ledger	170	170	545	3
	29	ledger	173	170	545	3
	30	ledger	173	170	545	3
	31	ledger	176	175	560	3

*Approximations only for reference not actual tensile strength values: for true tensile strength a tensile test must be conducted.

Modes of failure:
1= Weld failure/fracture:
2= Parent material failure at weld area:
3= Clamp distortion/clamping components distortion:
4= Tube wall rotational distortion at end of welded clamp
5= Rupture of tube at weld area

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4.2. Post load digital images of samples

Sample 11 type 3.3 applications

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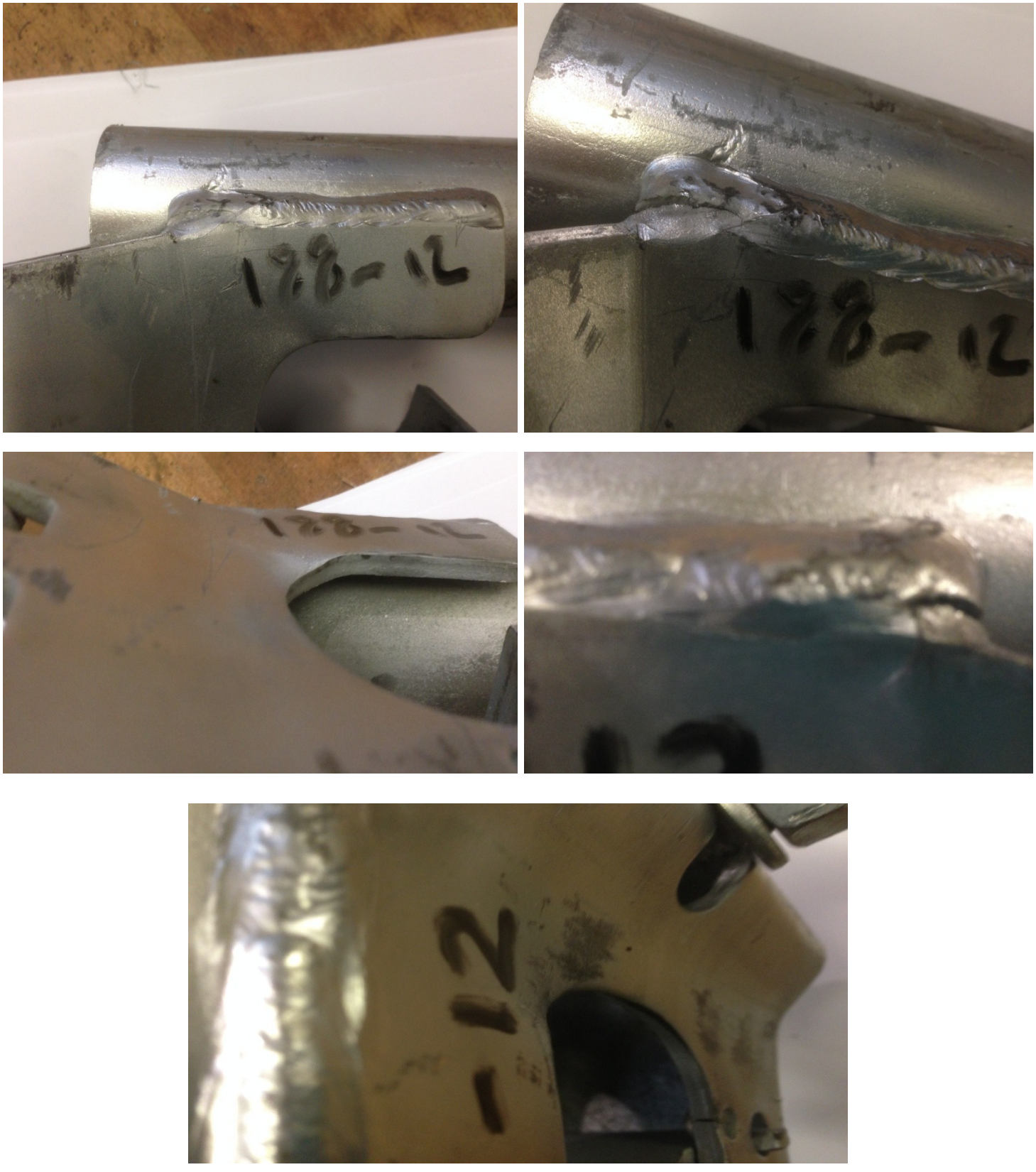
Sample 12 type 3.3 applications



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Sample 13 type 3.3 applications

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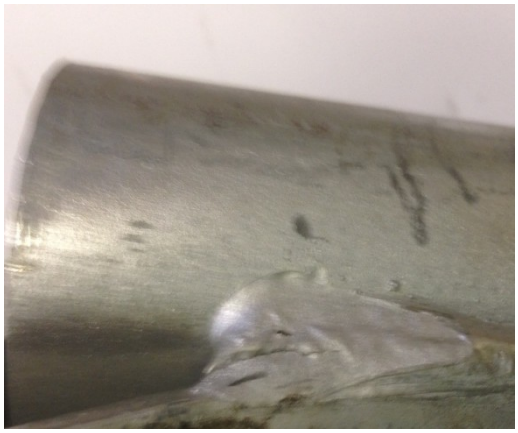
Sample 14 type 3.3 applications



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Sample 15 type 3.3 applications

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Sample 17 types 3.4. application positive load against clasp

Rotational distortion/ torsion yield of transom tube shown above: typical of all samples

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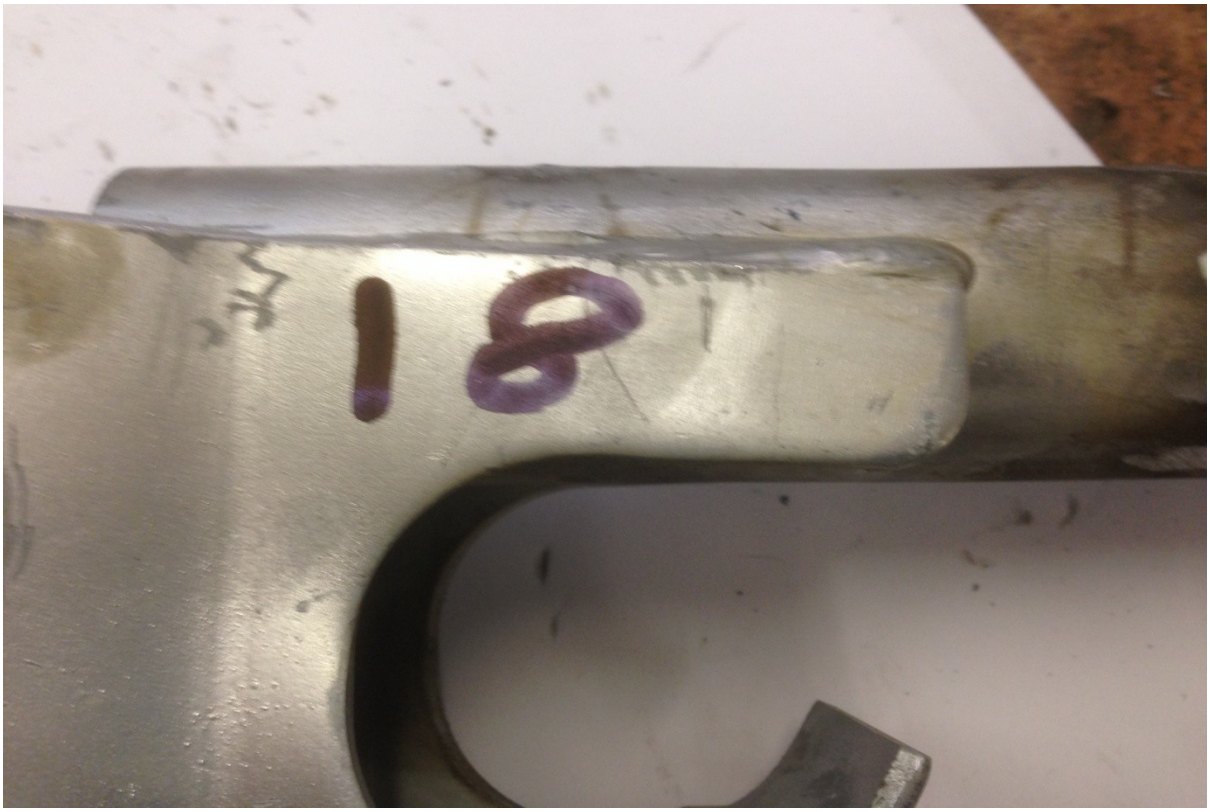
Sample 18 types 3.4. application positive load against clasp



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Sample 19 types 3.4. application positive load against clasp

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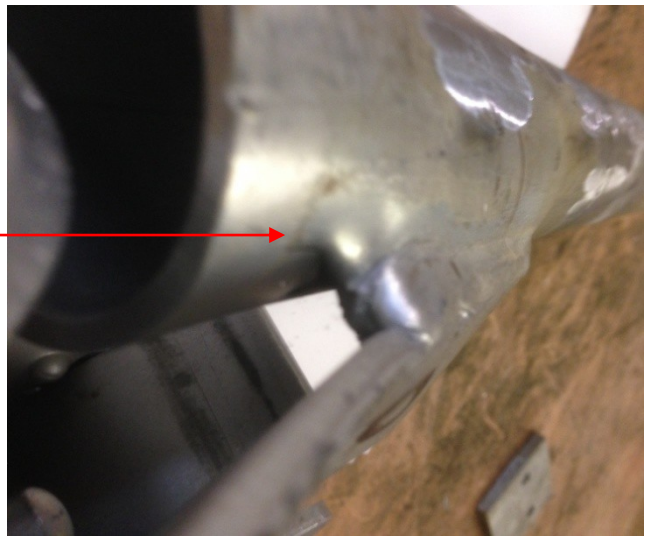
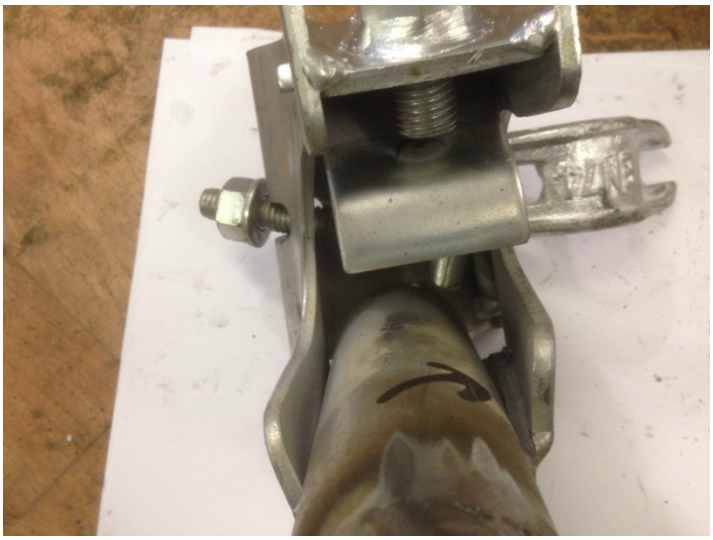
Sample 20 types 3.4. application positive load against clasp



Fracture/tare along tube at weld, parent material rupture



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Sample 21 types 3.4. application positive load against clasp

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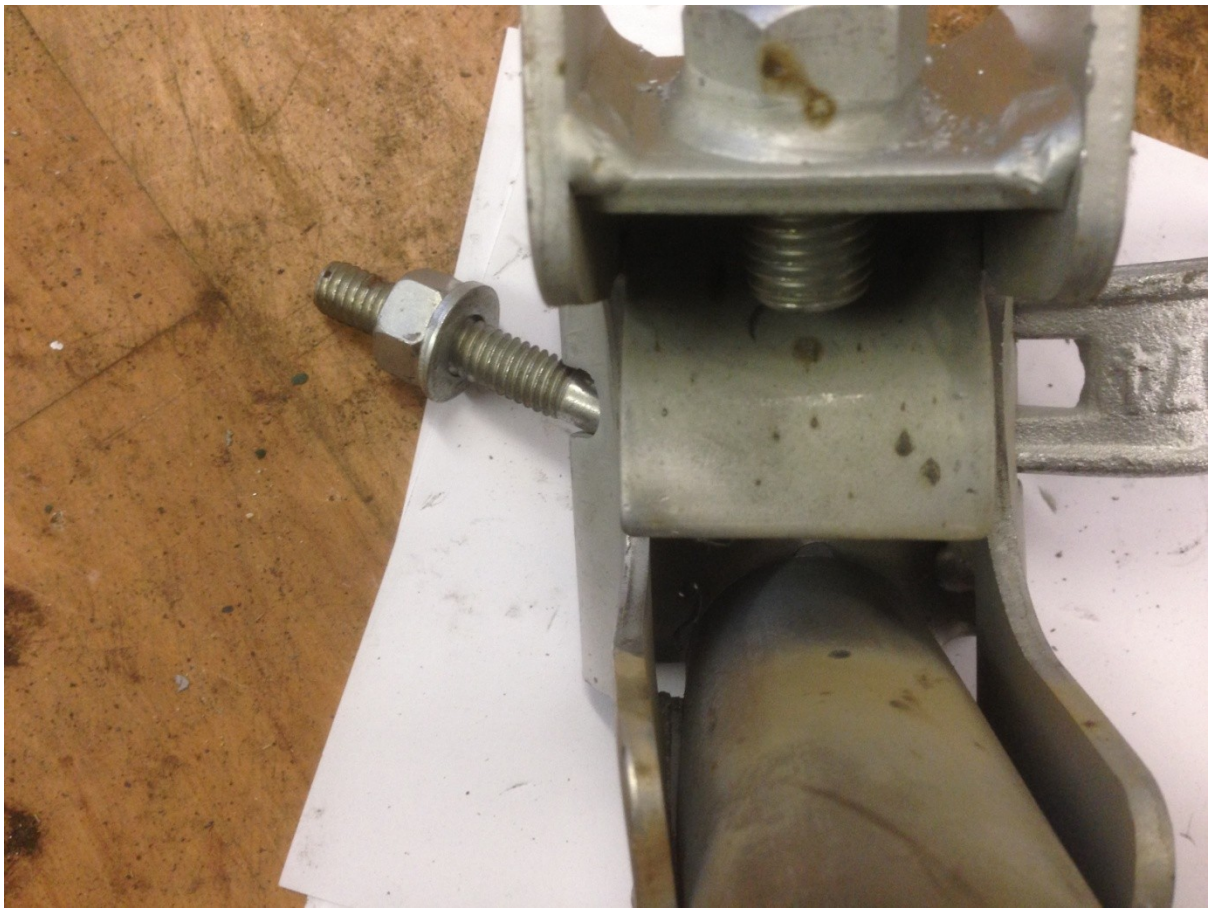
Sample 22 types 3.4. application negative load against bolt



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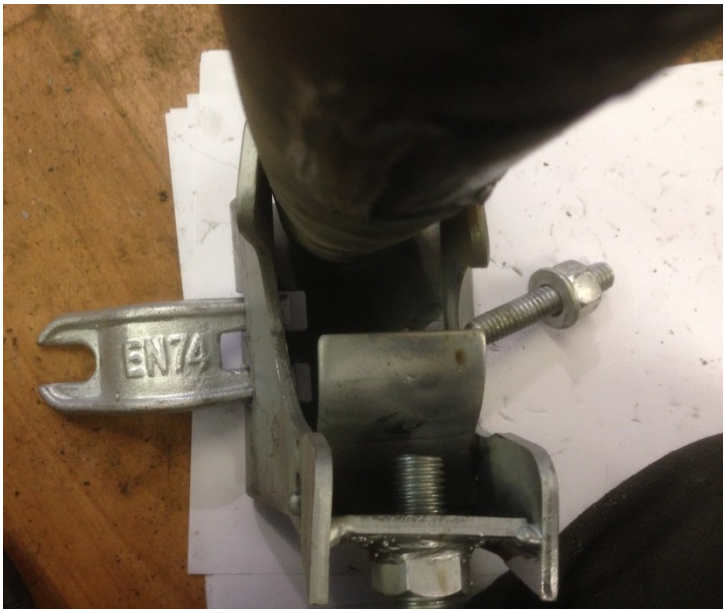
Sample 23 types 3.4. application negative load against bolt



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Sample 24 types 3.4. application negative load against bolt

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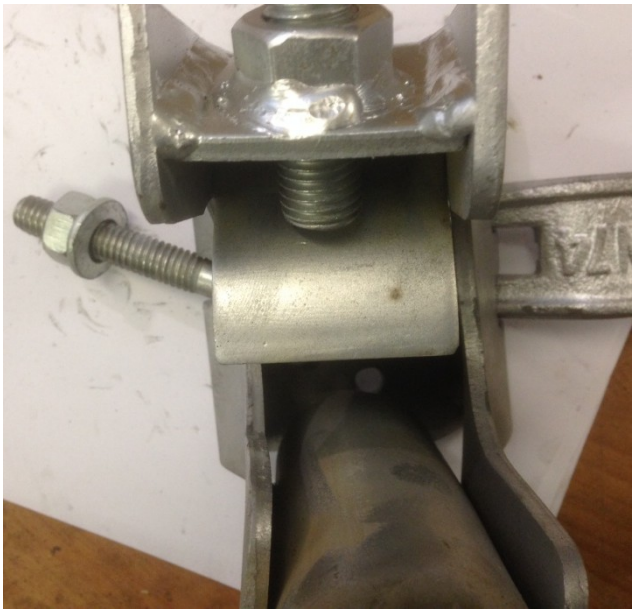
Sample 25 types 3.4. application negative load against bolt



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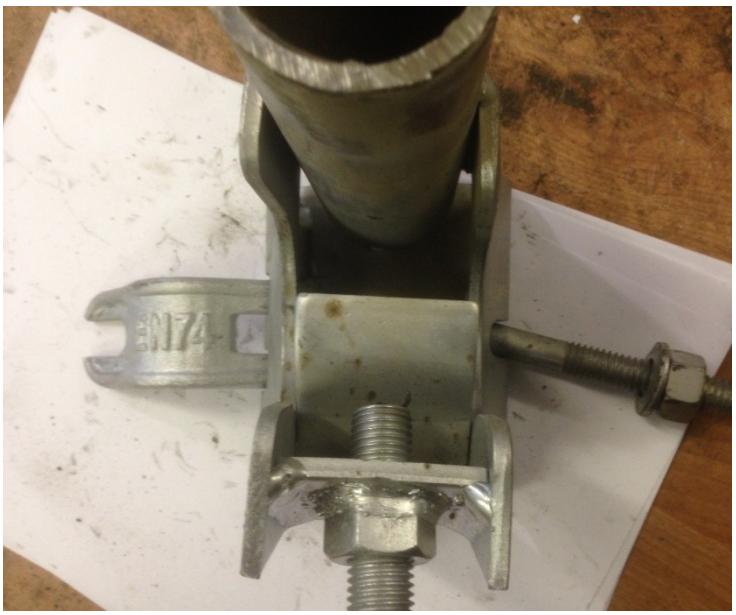
Sample 26 types 3.4. application negative load against bolt



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Sample 27 type 3.5 application

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Sample 28 type 3.5 application

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Sample 29 type 3.5 application

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Sample 30 type 3.5 application

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Sample 31 type 3.5 application

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4.3. Material testing results samples 11 to 31 type test 3.3, 3.4 and 3.5

SOUTHDOWN MATERIALS TESTING LIMITED

DESTRUCTIVE TESTING SERVICES

UNIT 5 TANSEY GREEN TRADING ESTATE, TANSEY GREEN ROAD, PENSNETT, BRIERLEY HILL, WEST MIDLANDS, DY5 4TL
Telephone No: 01384 482880 Fax No: 01384 482877 Email: southdown.smt@btconnect.com

TEST REPORT
No: A26903

Testmec Ltd
Test House
Unit 19
Newey Business Park
Sedgley Road West
Tipton
West Midlands
DY4 8AH

SMT No: A4372-2
Customer O/No: TESPO000120
Date Received: 24/11/16
Description: PLATE
Specification: -
Grade: -

Report Date: 25/11/16

SPECTROGRAPHIC ANALYSIS
(DOCUMENTED IN-HOUSE PROCEDURE TH63)

Tester & Test Date M L WILKINS 25/11/16

Element %		Results	Requirements
Carbon	C	0.17	
Silicon	Si	0.22	
Manganese	Mn	1.30	
Phosphorus	P	0.012	
Sulphur	S	0.003	
Chromium	Cr	0.01	
Nickel	Ni	<0.01	
Molybdenum	Mo	<0.01	
Niobium	Nb	<0.010	
Copper	Cu	<0.01	
Titanium	Ti	<0.015	
Aluminium	Al	0.015	
Vanadium	V	<0.015	
Cobalt	Co	<0.01	
Tungsten	W	<0.05	
Lead	Pb	<0.01	
Tin	Sn	<0.005	
Boron	B	<0.0010	

- End of Report -

Authorised by: ..... K M Worrall Test Technician
FOR SOUTHDOWN MATERIALS TESTING LIMITED

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Independent Testing & Engineering Services

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DESTRUCTIVE TESTING SERVICES

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Telephone No: 01384 482880 Fax No: 01384 482877 Email: southdown.smt@btconnect.com

TEST REPORT
No: A26904

Testmec Ltd
Test House
Unit 19
Newey Business Park
Sedgley Road West
Tipton
West Midlands
DY4 8AH

SMT No: A4372-3
Customer O/No: TESPO000120
Date Received: 24/11/16
Description: TUBE
Specification: -
Grade: -

Report Date: 25/11/16

SPECTROGRAPHIC ANALYSIS
(DOCUMENTED IN-HOUSE PROCEDURE TH63)

Tester & Test Date M L WILKINS 25/11/16

Element %		Results	Requirements
Carbon	C	0.20	
Silicon	Si	0.34	
Manganese	Mn	1.35	
Phosphorus	P	0.021	
Sulphur	S	0.021	
Chromium	Cr	0.01	
Nickel	Ni	<0.01	
Molybdenum	Mo	<0.01	
Niobium	Nb	<0.010	
Copper	Cu	0.02	
Titanium	Ti	<0.015	
Aluminium	Al	<0.005	
Vanadium	V	<0.015	
Cobalt	Co	<0.01	
Tungsten	W	<0.05	
Lead	Pb	<0.01	
Tin	Sn	<0.005	
Boron	B	<0.0010	

- End of Report -

Authorised by: K M Worrall Test Technician
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DESTRUCTIVE TESTING SERVICES

UNIT 5 TANSEY GREEN TRADING ESTATE, TANSEY GREEN ROAD, PENSNETT, BRIERLEY HILL, WEST MIDLANDS, DY5 4TL
Telephone No: 01384 482880 Fax No: 01384 482877 Email: southdown.smt@btconnect.com

TEST REPORT
No: A26902

Testmec Ltd
Test House
Unit 19
Newey Business Park
Sedgley Road West
Tipton
West Midlands
DY4 8AH

SMT No: A4372-1
Customer O/No: TESPO000120
Date Received: 24/11/16
Description: FORMED PLATE SECTIONS
Specification: -
Grade: -

Report Date: 25/11/16

VICKERS HARDNESS TEST
(BS EN ISO 6507-1:2005 – HV10)

Tester & Test Date	K M WINNALL	25/11/16
Reading	Results	Requirements
11	181	
12	174	
13	177	
14	181	
15	178	
17	181	
18	181	
19	173	
20	174	
21	174	
22	173	
23	176	
24	181	
25	181	
26	176	
27	176	
28	170	
29	173	
30	173	
31	176	

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DY4 8AH
Telephone: 07947 103 644

END OF REPORT TES000188TR-1

Testing conducted by TESMEC Limited; Independent Testing and Engineering Services
Test House, unit 19 Newey Business Park
Sedgley Road West
Tipton
West Midlands
DY4 8AH
Date of report issue: 26th November 2016

Signed: 

Mr S.J.Rogers Testing services Manager
Mr A Farmer Test technician.
On behalf of TESMEC Limited.

Report and testing conducted for:

VR Access Solutions Ltd
1 Swan Court Yard
Charles Edwards Road
Birmingham
B26 1BU

Document issued for technical review and analysis by S Mech

Number of pages in this report 62