TUV SUD Canada Inc.
1229 Ringwell Drive
Newmarket, Ontario, Canada
L3Y 8T8
(905) 715-7991

Test Performed By: K.Morrison, C.Gibbs
Test Reviewed By: Ian Wales
Test Previously Performed (Yes/No): No
Previous Quotation Number: N/a

Elite Power Cell Abuse

Quotation/Report Number: TUV-3230.00
Revision Number of Report: 0

TUV SUD America
(Auburn Hills)
1670 Harmon Road
Auburn Hills, MI 48326
USA
248-393-6984

Test Start Date: January 20, 2011
Test Completion Date: March 9, 2011
Report Issue Date: March 15, 2011

Test Technician	15-Mar-11 Date	Program Manager	15-Mar-11 Date

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Test Report

Test Description

Perform cell abuse DV testing on provided Elite Power cell samples as per TUV SUD America quotation QLE-110109C (12-Jan-11). Testing will be performed with reference to specified sections in SAE J2464 (Nov.2009) Surface Vehicle Recommended Practice for RESS Safety and Abuse Testing, with verbally requested modifications. Refer to Table 1: Test Breakdown for a list of tests to be performed.

Table 1: Test Breakdown

Section	Test Description	Number of Tests
4.3.3	Penetration – Single Cell	2
4.3.6	Crush	2
4.4.2	Thermal Stability	2
4.5.1	Short Circuit – Single Cell	2
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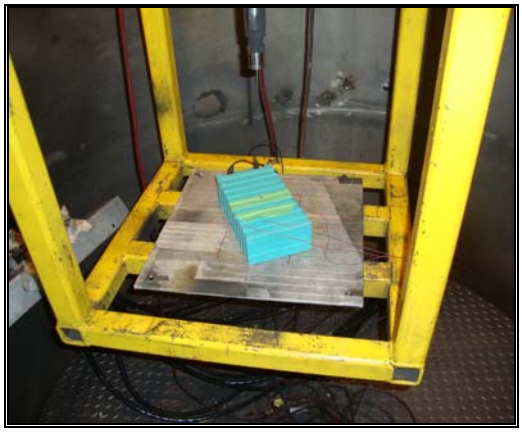
Test and Setup Procedures

Penetration Testing (4.3.3)

Three (3) Elite Power cell samples were used for single cell penetration (1 x 100Ah, ~60%SOC and 2 x 100Ah, 100% SOC). Samples were placed on an insulated test fixture base plate, without any compression or upper fixtures. The lower plate had a 15mm clearance hole to allow the penetration nail to pass all the way through the cell. A cylinder was positioned in the central area of the cell to actuate a 3mm tapered nail (with 28° head angle) through the cell at a rate of 8 cm/s. Foam rubber dampeners were also placed below the base fixture to compensate for any vibration within the chamber. The fixture was placed in a large abuse chamber to contain any smoke or flames that may be emitted during penetration. A video camera was placed inside the chamber to capture any cell reaction, and a ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. A spark source was used during testing. Refer to photographs 1 and 2 (page 2).



Photograph 1: Cell Penetration Test Fixture

Photograph 2: Abuse Chamber housing the Test

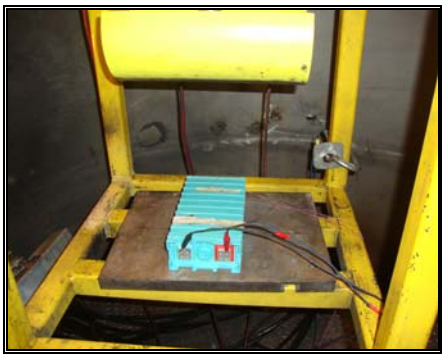
Crush Testing (4.3.6)

Six (6) Elite Power separator cell samples were used for Cell Crush Testing (6 x 100Ah, 100% SOC). Samples were setup on an insulated base, positioned on the lower cell abuse fixture. No upper fixture was used for this test. Foam rubber dampeners were also placed below the base fixture to compensate for any vibration within the chamber. The fixture was placed in a large abuse chamber to contain any smoke or flames that may be emitted during testing. A video camera was placed inside the chamber to capture any cell reaction, and a ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. A spark source was used during testing.

All active protective devices were disabled - in this case, customer specified that none were present. A 75mm radius crush fixture was used to crush the cell as per customer direction, applied in two different planes and 3 axes. The following three crush orientations were used:

1) On the largest area side, perpendicular to the line of the terminals through the cell.
2) On the largest area side, parallel to the line of the terminals
3) On the side of the cell, parallel to the line of the terminals, with the positive terminal above the negative terminal.

First, the cell was crushed 15% of its height, compressed to 85% of the initial dimension of the cell, and held for 5 minutes. Second, the cell was crushed 50% of its height, compressed to 50% of the initial dimension of the cell, and held. Load was limited at 1000x the weight of the cell, so the crush may or may not have reached the targeted positions. Measurements included voltage at the terminals, temperature and a recorded video. Refer to photograph 3 (right).



Photograph 3: Cell Crush Test Setup

Thermal Stability Testing (4.4.2)

Two (2) Elite Power cell samples were used for Cell Thermal Stability Testing (2 x 100Ah, 100% SOC). Samples were setup on an elevated/vented rack within an environmental chamber to allow chamber air flow around the samples. Samples sat freely, without any compression fixture. All active protective devices were disabled - in this case, customer specified that none were present. The environmental chamber was contained in a large abuse chamber to contain any smoke or flames that could be emitted during testing. A ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. Video was taken, and a spark source was used during testing.

The environment of the chamber was started and stabilized at 100°C for 30 minutes. The temperature was then increased in increments of 5°C, and held at each temperature step for 30 minutes, or until there was any self-heating detected. Self-heating was defined as a temperature increase of 10°C per minute or greater. The customer requested that testing stop at an environmental temperature of 200°C if no thermal run-away was detected in the cell. Testing was also to be stopped if any venting, rupture, or catastrophic event occurred. Measurements included voltage at the terminals and temperature.

Short Circuit Testing (4.5.1)

Three (3) Elite Power cell samples were used for single cell Short Circuit testing (3 x 100Ah 100% SOC). Samples were setup on an insulated base, positioned on the lower cell abuse fixture. No upper fixture was used for this test. All active protective devices were disabled - in this case, customer specified that none were present. Foam rubber dampeners were also placed below the base fixture to compensate for any vibration within the chamber. The fixture was placed in a large abuse chamber to contain any smoke or flames that could be emitted during testing. A video camera was placed inside the chamber to capture any cell reaction, and a ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. A spark source was used during testing. Refer to photograph 4 (page 4).

A hard short circuit method was used, with a circuit resistance less than 5 mohm. The cells, semi-resistive wiring and a switch (resistance included) were connected in a series circuit for this test. A short was applied in less than 1 second between the positive and negative terminals of the cells, using a remotely controlled switch. The short was held for 60 minutes or until another condition occurred which would prevent completion of the test (i.e. component melting, etc.). The cells were also monitored for an additional 60 minutes once the short circuit was terminated. Measurements included voltage at the terminals, current, temperature and a recorded video.

Photograph 4: Cell Short Circuit Test Setup

Photograph 5: Cell Overcharge Setup

Overcharge Testing (4.5.2)

Two (2) Elite Power cell samples were used for single cell Overcharge testing (2 x 100Ah, 100% SOC). Samples were setup on an insulated base, positioned on the lower cell abuse fixture. No upper fixture was used for this test. Foam rubber dampeners were also placed below the base fixture to compensate for any vibration within the chamber. The fixture was placed in a large abuse chamber to contain any smoke or flames that could be emitted during testing. A video camera was placed inside the chamber to capture any cell reaction, and a ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. A spark source was used during testing. Refer to photographs 5 (above).

Cells were connected to the power source through the terminals with clamped, low impedance mono-blocs, and charged at a rate of 1C (100Ah). Limiting voltage was manually controlled at 5.7V (1.5 x 3.8V, Max Voltage). Charging was continued until 205% SOC or destruct, whichever took longer, or until the customer requested testing to stop. The cell was also monitored for an additional 60 minutes once the test was terminated. Temperature was monitored to determine when hyper-ambient levels were achieved for safe removal. Measurements included voltage at the terminals, current, temperature and a recorded video.

Over Discharge Testing (4.5.3)

Two (2) Elite Power cell samples were used for single cell Over Discharge testing (2 x 100Ah, 100% SOC). Samples were setup on an insulated base, positioned on the lower cell abuse fixture. No upper fixture was used for this test. Foam rubber dampeners were also placed below the base fixture to compensate for any vibration within the chamber. The fixture was placed in a large abuse chamber to contain any smoke or flames that could be emitted during testing. A video camera was placed inside the chamber to capture any cell reaction, and a ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. A spark source was used during testing.

Cells were connected to the power source through the terminals with clamped, low impedance mono-blocs, and discharged at a rate of 5C. Limiting voltage was manually controlled at -3.8V. Discharging was continued until -100% SOC in Ah and held for 30 minutes, or taken to destruct, whichever occurred first, or until the customer requested testing to stop. The cell was also monitored for an additional 60 minutes once the test was terminated. Temperature was monitored to determine when hyper-ambient levels were achieved for safe removal. Measurements included voltage at the terminals, current, temperature and a recorded video.

Separator Shutdown Integrity Testing (4.5.4)

Two (2) Elite Power cell samples were used for single cell Separator Shutdown Integrity testing (2 x 100Ah, 100% SOC). Samples were setup on an elevated/vented rack within an environmental chamber to allow chamber air flow around the samples. Samples were placed in an environmental chamber that was housed in a large abuse chamber to contain any smoke or flames that could be emitted during testing. A video camera was placed inside the chamber to capture any cell reaction, and a ventilation fan was turned on at the top of the chamber to clear any smoke and fumes. A spark source was used during testing.

Cells were connected to the power source through the terminals with clamped, low impedance mono-blocs. The cell was heated to 145°C, 5°C above the separator shutdown temperature of 140°C that was specified. Once the temperature had stabilized for a minimum of 10 minutes, an over-voltage of 20V was applied with a current limit of 1C. The voltage was to be held for 30 minutes or until the separator failed. Measurements included voltage at the terminals, current, temperature and a recorded video.

Data Acquisition and Measurements

During each of the tests, cells were connected to a data acquisition system to monitor voltage and temperature over time. The system was set to acquire data at a rate of 10Hz for voltage and temperature. The locations and particular measurements taken for each cell are noted on the test setup and test data sheets. The following measurements were taken where specified:

- Voltage at DUT terminals
- Temperature monitoring (sensors placed on top of the cell per setup notes)
- Thickness measured before and after test
- Weight of the cell before and after testing
- Current
- Amp Hours (calculated from current measured)

Deformation measurements were taken by measuring each corner of the cell with digital calipers before and after the test. The calipers were placed on the cell until the side of the cell contacted the base of the caliper opening, and then the calipers were closed until light contact with the cell occurred. Video was also recorded inside the chamber during the tests, to capture any cell reaction. Photographs were also taken of the cells before and after each test.

Sample Description and Quantities

ITS ID/Serial #	Sample Description	Model Number	Test
1010816967	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	None
10090115227	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	None
1010816952	New Generation GBS LifeMinPOP Battery, 100Ah ~60% SOC	GBS-LFMP100AH	Penetration
1010817042	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Penetration
1010817046	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Penetration
1010816961	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Crush
1010816951	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Crush
1010816949	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Crush
1010816985	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Crush
1010816992	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Crush
1010817004	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Crush

ITS ID/Serial #	Sample Description	Model Number	Test
1010817036	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Thermal Stability
1010817041	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Thermal Stability
1010817037	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Short circuit
1010816978	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Short Circuit
1010817048	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Short circuit
1010817044	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Overcharge
1010817045	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Overcharge
1010816991	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Over Discharge
1010816993	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Over Discharge
1010816979	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Separator Shutdown
10090115218	New Generation GBS LifeMinPOP Battery, 100Ah 100% SOC	GBS-LFMP100AH	Separator Shutdown

Deviations

N/A

Subcontractors

N/A

Summary of Test Results

Note: Hazard Severity Levels used to quantify the visible reaction of the cell are based on subjective observation only, and are by no means intended to be an official rating or seal of approval. Customer is responsible for performing all final observations and evaluations on all samples.

Penetration Testing (4.3.3)

Three (3) Elite Power samples were used for single cell penetration testing. The first sample was not provided at 100% SOC, so it was only tested at approximately 60%SOC. Testing was performed on two other samples charged to 100% SOC.

Refer to Appendix A: Penetration Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data, photographs and video taken of each test.

Crush Testing (4.3.6)

Six (6) Elite Power samples were used for single cell Crush Testing.

Refer to Appendix B: Crush Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data, photographs and video taken of each test.

Thermal Stability Testing (4.4.2)

Two (2) Elite power samples were used for Cell Thermal Stability.

Refer to Appendix C: Thermal Stability Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data and photographs of each test.

Short Circuit Testing (4.5.1)

Three (3) Elite power samples were used for single cell Short Circuit testing. The customer fixture blocks used to connect to the sample were unable to handle the in-rush current which damaged the fixture, severing the terminal connection. New fixtures were made to attach to the terminals and two new tests were performed.

Refer to Appendix D: Short Circuit Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data, photographs and video taken of each test.

Overcharge Testing (4.5.2)

Two (2) Elite power samples were used for single cell Overcharge testing.

Refer to Appendix E: Overcharge Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data, photographs and video taken of each test.

Over Discharge Testing (4.5.3)

Two (2) Elite power samples were used for single cell Over Discharge testing.

Refer to Appendix F: Over Discharge Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data, photographs and video taken of each test.

Separator Shutdown Integrity Testing (4.5.4)

Two (2) Elite power samples were used for single cell Separator Shutdown Integrity testing.

Refer to Appendix G: Over Discharge Setup, Data and Graphs for detailed data. Also refer to Appendix H: Digital Test Data for all data, photographs and video taken of each test.

Test Equipment & Uncertainty

Equipment Description	Classification Number	Measurement Uncertainty (K Factor = 2, 95% Confidence Level)
Data Acquisition System	DATA-AQ-01	0.2 VDC, 1.8°C, 1.3 amps
Fluke Precision Multi-meter	DATA-AQ-06	0.00001 VDC
Data Acquisition System	DATA-AQ-08	1.6°C, 1.2 amps
Environmental Chamber	CH-ENV-14	0.8°C
Environmental Chamber	CH-ENV-01	0.2°C
Mitutoyo Digital Calipers	VR-006-01	0.02 mm
Mitutoyo Digital Calipers	VR-006-05	0.02 mm
Hydraulic Cylinder	PT-024-09	0.1 mm
Fluke Digital Multi-meter	MU-600-03	0.04 VDC

Attached Documents

Appendix A: Penetration Setup, Data and Graphs (7 pages)
Appendix B: Crush Setup, Data and Graphs (11 pages)
Appendix C: Thermal Stability Setup, Data and Graphs (6 pages)
Appendix D: Short Circuit Setup, Data and Graphs (10 pages)
Appendix E: Overcharge Setup, Data and Graphs (6 pages)
Appendix F: Overcharge Setup, Data and Graphs (6 pages)
Appendix F: Separator Shutdown Setup, Data and Graphs (6 pages)
Appendix H: Digital Test Data (1 Data Storage Device)

Distribution

TUV SUD Canada (Newmarket), 1 original copy
TUV SUD America (Auburn Hills), 1 copy

Appendix A:
Penetration Setup, Data and Graphs

(7 pages)

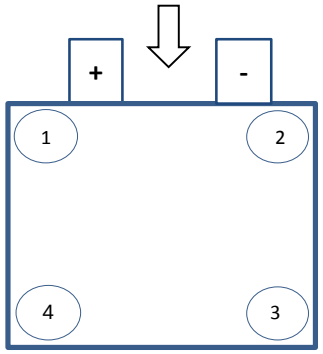
Penetration Test Setup Parameters

Data Acquisition Program:	DasyLab 7.0
Data Acquisition Program Worksheet:	PENNCRSH TRIG(CH2), OCV(CH4), TypeT(ch11,12,13).DSB
Data Acquisition Program:	
Data Acquisition Program Worksheet:	

Technical Form Number
TF-00019B
Revision Number
0.0
Revision Date
14-Jan-10

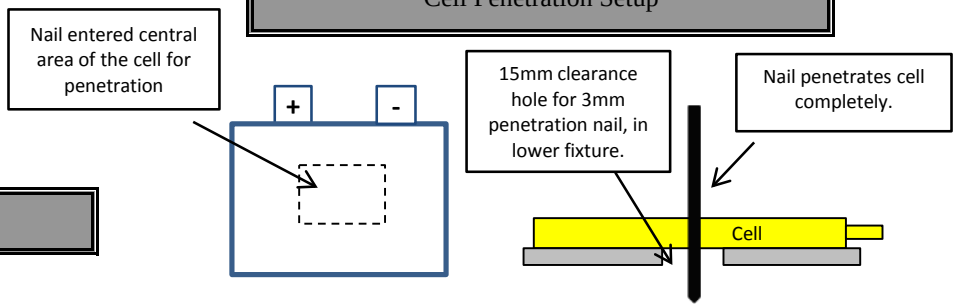
Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	4
Voltage - Anode to Fixture	DATA-AQ-01	10 Hz	4
Voltage - Cathode to Fixture	DATA-AQ-01	10 Hz	5
Temperature 1, T-type thermo-couple	DATA-AQ-01	10 Hz	11
Temperature 2, T-type thermo-couple	DATA-AQ-01	10 Hz	12
Temperature 3, T-type thermo-couple	DATA-AQ-01	10 Hz	13
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a
Acceleration 1, accelerometer #	N/a	N/a	N/a
Acceleration 2, accelerometer #	N/a	N/a	N/a
Acceleration 3, accelerometer #	N/a	N/a	N/a

Deformation/Depth Measurement Locations

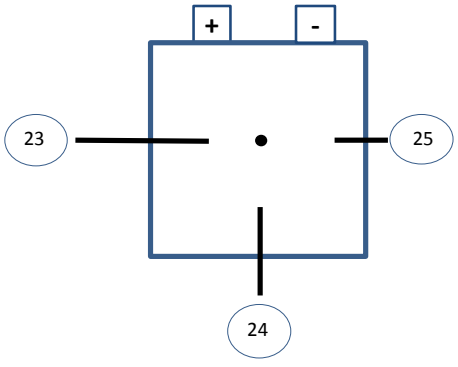


Cell Dimensions measured at Locations 1, 2, 3 and 4.

Cell Penetration Setup



Temperature Probe Setup



All thermocouples placed above the cell.

Thermocouple 23: (Closest to Center) 20mm to left of center (as shown)

Thermocouple24: 55mm below center (as shown).

Thermocouple 25: 40mm to the right of center (as shown)

TUV SUD Canada				Technical Form Number:	TF-00019	Page: PS-2
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Job Description:	Elite Power Cell Abuse			Revision Date:	14-Jan-10	

Setup Checklist - Penetration Testing

Abuse Chamber	CH-ABUSE-2	Load Fixture	Yes	Data Acquisition Cart (1)	DATA-AQ-01
Base Fixture	BATT-PEN-02	Penetration Nail (s)	PEN-002	Data Acquisition Cart (2)	N/a

Feature to be checked	Sample Numbers					
	1010816952	**1010817042**	**1010817046**			
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah	New Generation GBS LifeMinPOP Battery - 100Ah	New Generation GBS LifeMinPOP Battery - 100Ah			
Voltage monitoring at terminals setup (Yes)	Yes	Yes	Yes			
Temperature sensors setup on the cell (3 sensors - Yes)	167, 170, 175	113, 175, 177	113, 175, 177			
Lower Fixture covered with masking-tape for insulation (Yes)	Yes	Yes	Yes			
Acceleration equipment setup to monitor case exertion (No)	No	No	No			
Data Logging Rate (10Hz)	Yes	Yes	Yes			
Penetration Nail Diameter (3mm, tapered to sharp point)	Yes	Yes	Yes			
Penetration Nail Angle (28° head angle)	Yes	Yes	Yes			
Nail Penetration Rate (Minimum 8 cm/s)	Yes	Yes	Yes			
Cell penetration Apply Device (Hydraulic)	Yes	Yes	Yes			
Video camera mounted in safety tube for recording test	Yes	Yes	Yes			
Initial cell dimension measured	Yes	Yes	Yes			
"Fresh eyes" review of test setup	Yes	Yes	Yes			
General Set up Photos taken	Yes	Yes	Yes			
Video of Test Recorded	Yes	Yes	Yes			
Pre Test Photos taken of sample from each side	Yes	Yes	Yes			
Post Test Photos taken of sample from each side	Yes	Yes	Yes			
Digital Callipers and Multi-meter used for Set up Recorded	Yes	Yes	Yes			
Date	16-Feb-11	16-Feb-11	17-Feb-11			
Gauges	MU-600-03, VR-006-01	MU-600-03, VR-006-01	MU-600-03, VR-006-01			
Initials	C.G	C.G	C.G			

TUV SUD Canada

Technical Form Number: TF-00020A

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 14-Jan-10

Penetration Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.3.3

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Nail Penetration)	Comments	Date	Initials	Gauge
1010816952	2.82	2.47		27-Jan-11	P.F	SCALE-01
1010817042	2.81	2.45		27-Jan-11	P.F	SCALE-01
1010817046	2.81	2.45		27-Jan-11	P.F	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

Job Number: TUV-3230
Job Description: Elite Power Cell Abuse

Revision Number: 0.0
Revision Date: 14-Jan-10

Penetration Testing (Single Cell Penetration)

DVP&R Item: N/a | **SAE J2464, 4.3.3**

Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV (VDC)	Open Circuit Voltage installed in Fixture (OCV-F) (VDC)	Gap Above Cell (mm)	Nail Penetration Rate (cm/s)	Nail Diameter (mm)	Nail Head Angle (°)	Peak Temp. Observed (°C)	Was there a visible reaction after penetration? (Yes or No)	Hazard Severity Level	Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4													
1010816952	61.73	61.96	62.02	61.81	64.57	64.62	65.13	64.13	3.320	3.320	N/A	8	3	28	221.2	No	3-5	At approx. 1min 15 secs smoke started coming from the penetration hole and the temperature increased. Vent cap remained intact. The cell completed the remaining 1hr without further reaction. The nail was unable to completely penetrate cell, it bent upon contact. Cell was estimated to be at 60%SOC only, so test was re-performed.	27-Jan-11	C.G.	DATA-AQ-01, DATA-AQ-06, VR-006-01
1010817042	62.12	61.87	62.10	62.23	64.67	64.53	65.14	65.30	3.318	3.318	N/A	8	3	28	102.9	No	3-4	At approx. 1min 30 secs vent cap was released from cell followed by venting smoke. The cell completed the remaining 1hr without further reaction. The nail was unable to completely penetrate cell, it bent upon contact.	27-Jan-11	C.G.	DATA-AQ-01, DATA-AQ-06, VR-006-01
1010817046	61.87	62.14	62.21	61.88	64.42	64.83	65.06	65.18	3.316	3.316	N/A	8	3	28	77.94	No	3-4	At approx 30 secs vent cap was released from cell followed by venting of light smoke. The cell completed the remaining 1hr without further reaction.	27-Jan-11	C.G.	DATA-AQ-01, DATA-AQ-06, VR-006-01

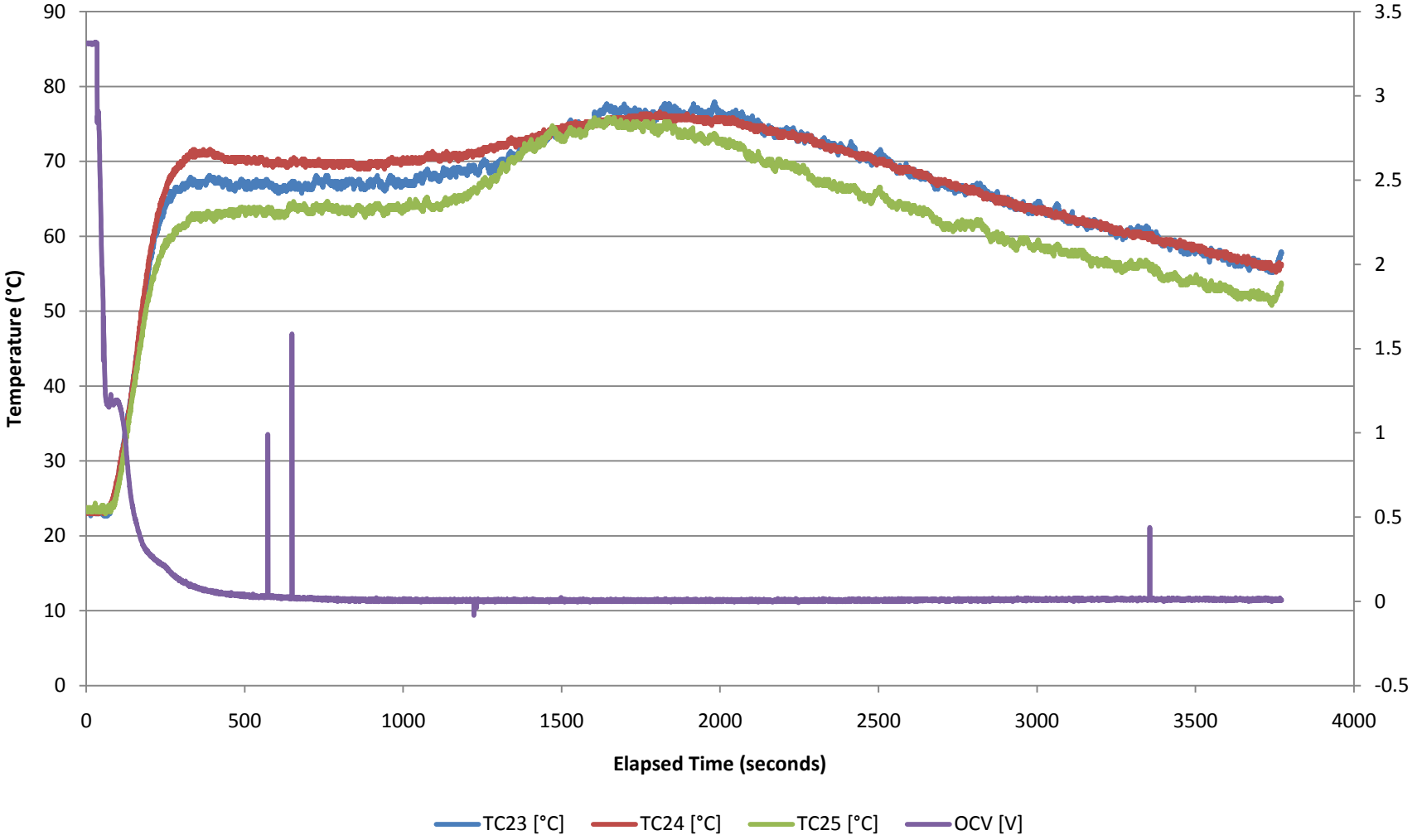
Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

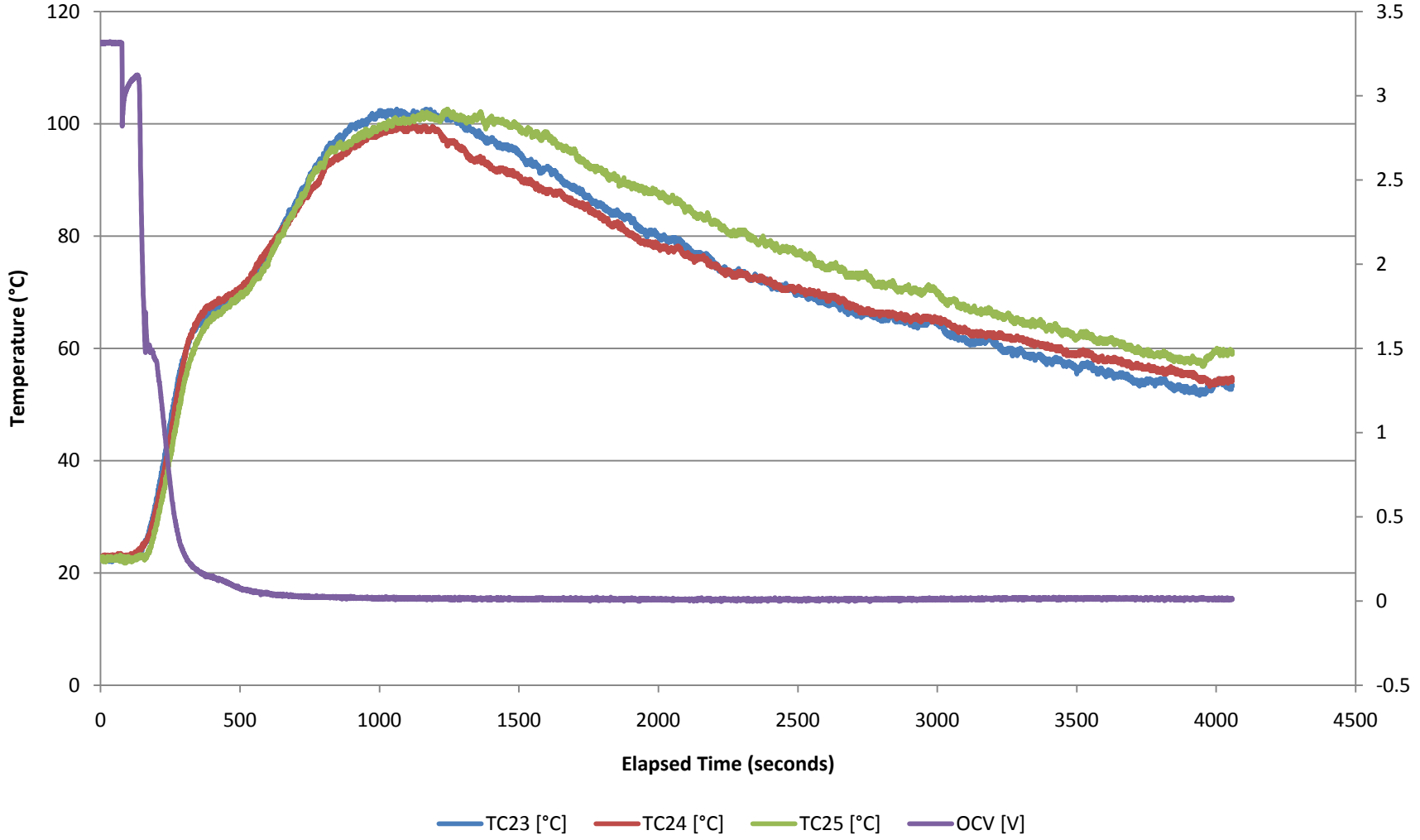
3) PSI calculated from load measured, based on surface area of 247mm x 227mm (9.72" x 8,94" = 86.9 sq.inch) specified by customer.

4) If post testing cell dimensions are listed as N/a, the measurements could not be performed accurately because the cell had fused with the pouch, insulator and casing.

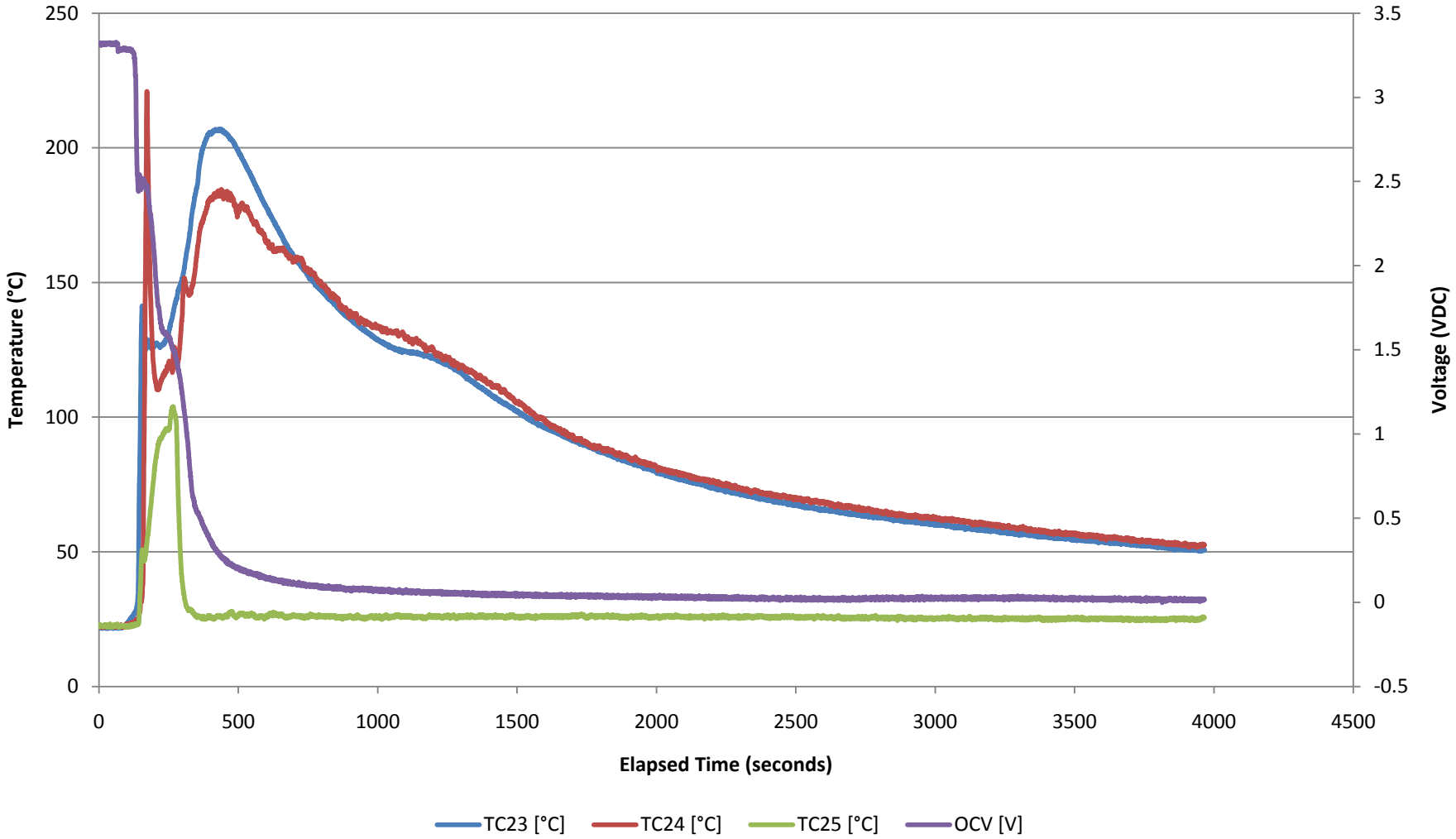
Job: MEC-3230
Project: Cell Penetration Testing
Description: Elite Power 100Ah 100%SOC
Temperature: Ambient
Sample ID: 1010817046



Job: MEC-3230
Project: Cell Penetration Testing
Description: Elite Power 100Ah 100%SOC
Temperature: Ambient
Sample ID: 1010817042



Job: MEC-3230
Project: Cell Penetration Testing
Description: Elite Power 100Ah (As received SOC - approx. 60%SOC)
Temperature: Ambient
Sample ID: 1010816952



Appendix B:
Crush Setup, Data and Graphs

(11 pages)

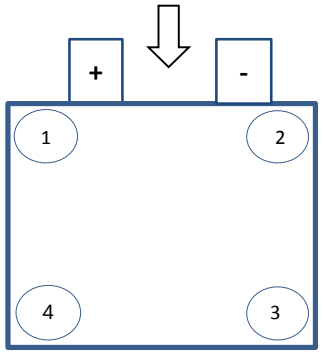
Crush Test Setup Parameters

Data Acquisition Program:	DasyLab 7.0
Data Acquisition Program Worksheet:	PENNCRSH TRIG(CH2), OCV(CH4), TypeT(ch11,12,13).DSB
Data Acquisition Program:	
Data Acquisition Program Worksheet:	

Technical Form Number
TF-00030A
Revision Number
0.0
Revision Date
18-Aug-10

Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	4
Voltage - Anode to Fixture	DATA-AQ-01	10 Hz	
Voltage - Cathode to Fixture	DATA-AQ-01	10 Hz	
Temperature 1, T-type thermo-couple	DATA-AQ-08	10 Hz	11
Temperature 2, T-type thermo-couple	DATA-AQ-08	10 Hz	12
Temperature 3, T-type thermo-couple	DATA-AQ-08	10 Hz	13
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a
Acceleration 1, accelerometer #	N/a	N/a	N/a
Acceleration 2, accelerometer #	N/a	N/a	N/a
Acceleration 3, accelerometer #	N/a	N/a	N/a

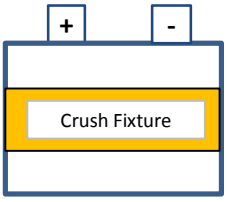
Deformation/Depth Measurement Locations

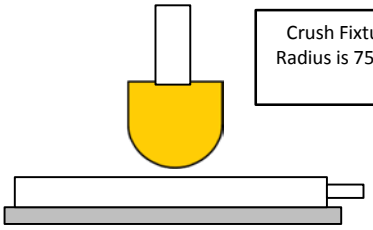


Cell Dimensions measured at Locations 1, 2, 3 and 4.

Crush Application

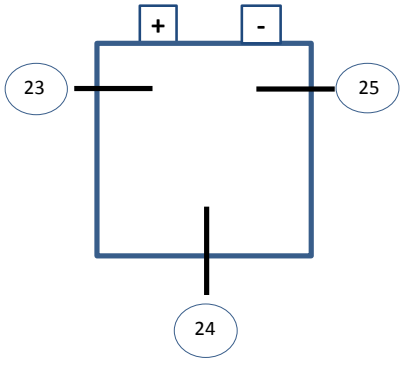
3 orientations used. Refer to page CRS-3.





Crush Fixture Radius is 75mm

Temperature Probe Setup



All thermocouples placed above the cell.

Thermocouple 23: 40mm to left, and 170mm above center (as shown)

Thermocouple24: 55mm below center (as shown).

Thermocouple 25: 40mm to right, and 170mm above center (as shown)

Two crush applications applied to the cell.

First, the cell is crushed 15% of its height - compressed to 85% of the initial dimension of the cell, and held for 5 minutes.

Second, the cell is crushed 50% of its height - compressed to 50% of the initial dimension of the cell, and held for 1 hour.

Note that load limited at 1000x weight of cell, so crush fixture may stop before desired crush %.

TUV SUD Canada			Technical Form Number:	TF-00030B	Page: CRS-2
Job Number:	TUV-3230		Revision Number:	0.0	
Job Description:	Elite Power Cell Abuse		Revision Date:	18-Aug-10	

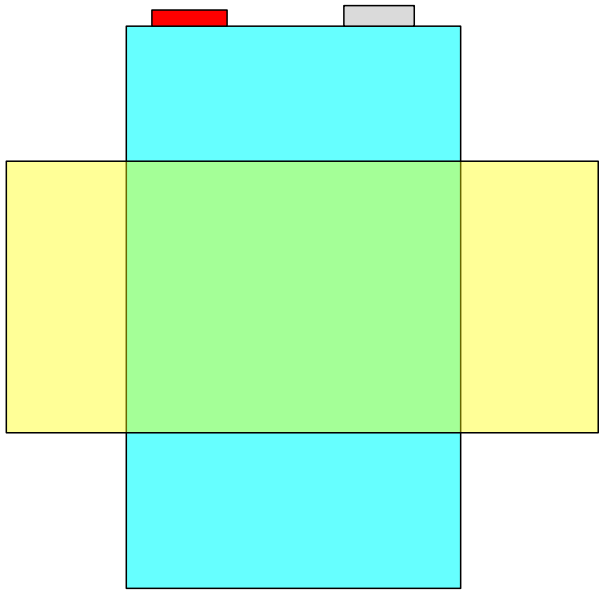
Setup Checklist - Crush Testing

Abuse Chamber	CH-ABUSE-2	Load Fixture	N/a	Data Acquisition Cart (1)	DATA-AQ-01
Base Fixture		Crush Apply Fixture	CRUSH-01	Data Acquisition Cart (2)	DATA-AQ-08

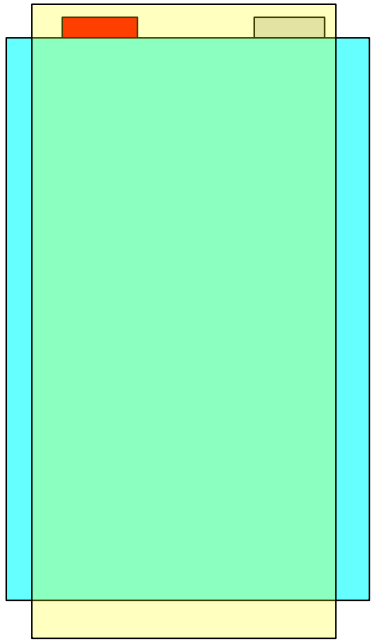
Feature to be checked	Sample Numbers					
	1010816961	**1010816951**	**1010816949**	**1010816985**	**1010816992**	**1010817004**
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah 100%SOC
Axis Used (refer to Sketches of axis)	Axis 1- Below both terminals on largest face	Axis 1- Below both terminals on largest face	Axis 2- Between terminals on largest face	Axis 2- Between terminals on largest face	Axis 3- on side with positive teminal up	Axis 3- on side with positive teminal up
Crush fixture Impact point aligned with Top of Cell	Yes	Yes	Yes	Yes	Yes	Yes
Height of Cell (mm)	66	66	66	66	125	125
Checked Position of 15 % Crush - 85% of initial dimension of the cell (0.9 mm down/inches down)	9.9	9.9	9.9	9.9	18.75	18.75
Checked Position of 50 % Crush - 50% of initial dimension of the cell (3 mm down/inches down)	33	33	33	33	62.5	62.5
Check Program Crush Rate (0.5 to 1.0 mm/min)	1	1	1	1	1	1
Crush Force limited to 1000 x the weight of the cell (N/a)	Yes (6261 lbs)	Yes (6261 lbs)	Yes (6261 lbs)	Yes (6261 lbs)	Yes (6261 lbs)	Yes (6261 lbs)
Voltage monitoring at terminals setup (Yes)	Yes	Yes	Yes	Yes	Yes	Yes
Temperature sensors setup on the cell (3 sensors - Yes)	Yes	Yes	Yes	Yes	Yes	Yes
Lower Fixture covered with masking-tape for insulation (Yes)	Yes	Yes	Yes	Yes	Yes	Yes
Data Logging Rate (10Hz)	Yes	Yes	Yes	Yes	Yes	Yes
Cell secured in the Abuse Chamber with tape	Yes	Yes	Yes	Yes	Yes	Yes
Video camera mounted in safety tube for recording test	Yes	Yes	Yes	Yes	Yes	Yes
Initial cell weight measured	Yes	Yes	Yes	Yes	Yes	Yes
Initial cell voltages measured on and off fixture	Yes	Yes	Yes	Yes	Yes	Yes
Initial cell dimension measured	Yes	Yes	Yes	Yes	Yes	Yes
"Fresh eyes" review of test setup	Yes	Yes	Yes	Yes	Yes	Yes
General Set up Photos taken	Yes	Yes	Yes	Yes	Yes	Yes
Video of Test Recorded	Yes	Yes	Yes	Yes	Yes	Yes
Pre Test Photos taken of sample from each side	Yes	Yes	Yes	Yes	Yes	Yes
Post Test Photos taken of sample from each side	Yes	Yes	Yes	Yes	Yes	
Digital Calipers and Multi-meter used for Set up Recorded	Yes	Yes	Yes	Yes	Yes	Yes
Date	23-Feb-11	23-Feb-11	7-Mar-11	7-Mar-11	7-Mar-11	8-Mar-11
Gauges	VR-006-01, DATA-AQ-06	VR-006-01, DATA-AQ-06	VR-006-01, DATA-AQ-06	VR-006-01, DATA-AQ-06	VR-006-01, DATA-AQ-06	VR-006-01, DATA-AQ-06
Initials	C.G	C.G	C.G	C.G	C.G	C.G

Top View

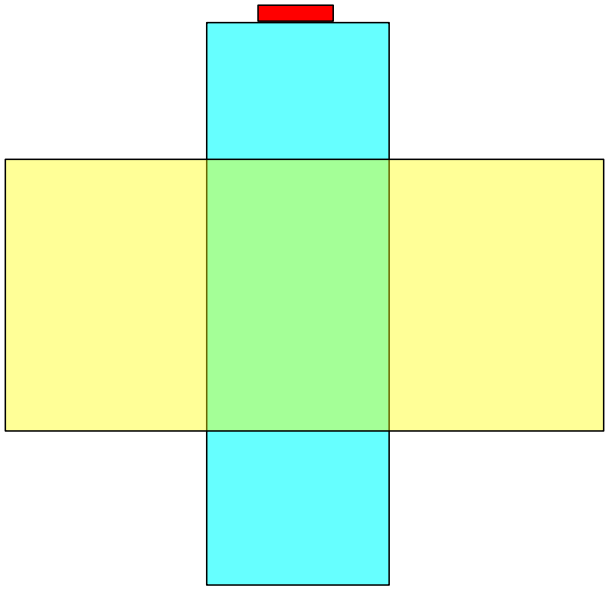
Axis 1
Samples: 1010816961, 1010816951



Axis 2
Samples 1010816949, 1010816985



Axis 3 (positive terminal is above the negitive)
Samples 1010816992, 1010817004



TUV SUD Canada

Technical Form Number: TF-00029A

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Crush Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.3.6

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Testing)	Comments	Date	Initials	Gauge
1010816961	2.84	2.84		27-Jan-11	P.F	SCALE-01
1010816951	2.84	2.84		27-Jan-11	P.F	SCALE-01
1010816949	2.85	2.84		27-Jan-11	P.F	SCALE-01
1010816985	2.84	2.82		27-Jan-11	P.F	SCALE-01
1010816992	2.86	2.83		27-Jan-11	P.F	SCALE-01
1010817004	2.84	2.82		27-Jan-11	P.F	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

Crush Testing - Elite 100Ah Cell Samples

DVP&R Item: N/a | **SAE J2464, 4.3.6**

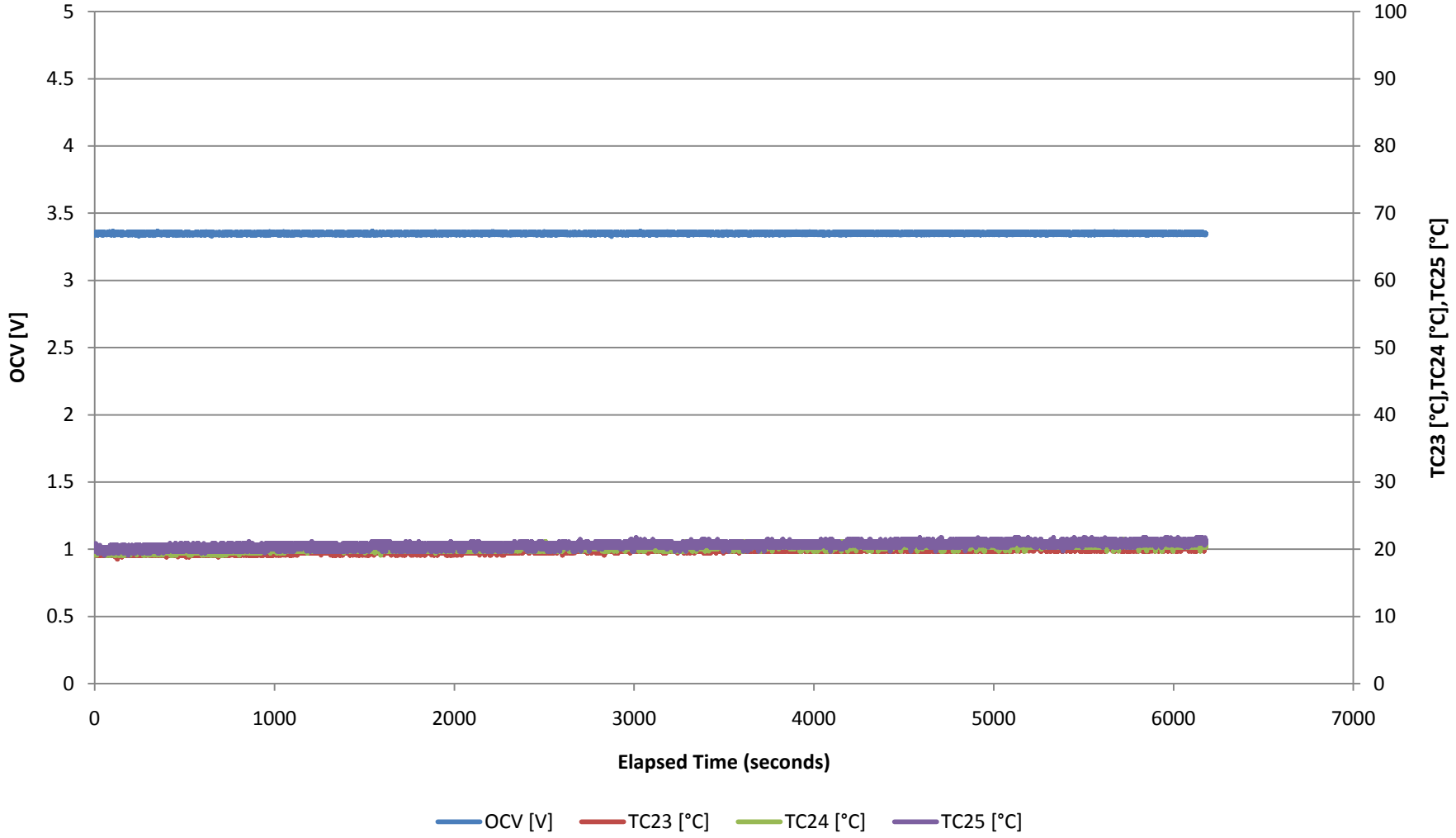
Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV (VDC)	Open Circuit Voltage installed in Fixture (OCV-F) (VDC)	Number of Semi-cylindrical Crush Surfaces	Radius of Crush Surfaces	Gap Between Crush Surfaces	Spark Source Present (Yes or No)	15 % Crush			50% Crush			Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4							Peak Temperature Observed (°C)	Was there a visible reaction after Crush? (Yes or No)	Hazard Severity Level	Peak Temperature Observed (°C)	Was there a visible reaction after Crush? (Yes or No)	Hazard Severity Level				
1010816961 (Large Face - Crush fixture perpendicular to axis of terminals)	62.05	62.22	62.40	62.31	64.46	64.99	66.18	65.57	3.349	3.349	1.0	75.0	N/A	Yes	24.68	No	0-2	24.68	No	0	Hydraulic pressure was limited to control the force applied to 1000X DUT weight. Very little compression was observed and minimal visual damage to cell post test.	23-Feb-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010816951 (Large Face - Crush fixture perpendicular to axis of terminals)	62.26	61.88	62.20	62.38	65.07	64.81	65.80	65.82	3.351	3.351	1.0	75.0	N/A	Yes	24.39	No	0-2	24.39	No	0	Hydraulic pressure was limited to control the force applied to 1000X DUT weight. Very little compression was observed and minimal visual damage to cell post test.	23-Feb-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010816949 (Large Face - Crush fixture parallel to axis of terminals)	62.11	62.05	62.19	62.44	64.65	64.76	66.00	65.70	3.348	3.348	1.0	75.0	N/A	Yes	21.46	No	0-2	21.5	No	0	Hydraulic pressure was limited to control the force applied to 1000X DUT weight. Very little compression was observed and minimal visual damage to cell post test.	7-Mar-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010816985 (Large Face - Crush fixture parallel to axis of terminals)	62.16	61.89	62.20	62.20	64.51	65.01	65.23	64.81	3.350	3.350	1.0	75.0	N/A	Yes	22.34	No	0-2	22.34	No	0	Hydraulic pressure was limited to control the force applied to 1000X DUT weight. Very little compression was observed and minimal visual damage to cell post test.	7-Mar-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010816992 (Side - Crush fixture perpendicular to axis of terminals)	62.19	62.24	61.94	62.07	#####	85.47	75.36	88.38	3.349	3.349	1.0	75.0	N/A	Yes	21.76	No	0-2	21.76	No	0	DUT was compressed to 85% with no change in voltage or temp. This was held for 5 minutes. DUT was then compressed to 50%, Limiting load was reached before getting to 50%. No change in voltage or temp. was observed.	7-Mar-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010817004 (Side - Crush fixture perpendicular to axis of terminals)	62.15	62.18	62.08	62.11	#####	89.38	77.60	85.74	3.350	3.350	1.0	75.0	N/A	Yes	21.76	No	0-2	21.76	No	0	DUT was compressed to 85% with no change in voltage or temp. This was held for 5 minutes. DUT was then compressed to 50%, Limiting load was reached before getting to 50%. No change in voltage or temp. was observed.	8-Mar-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05

Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

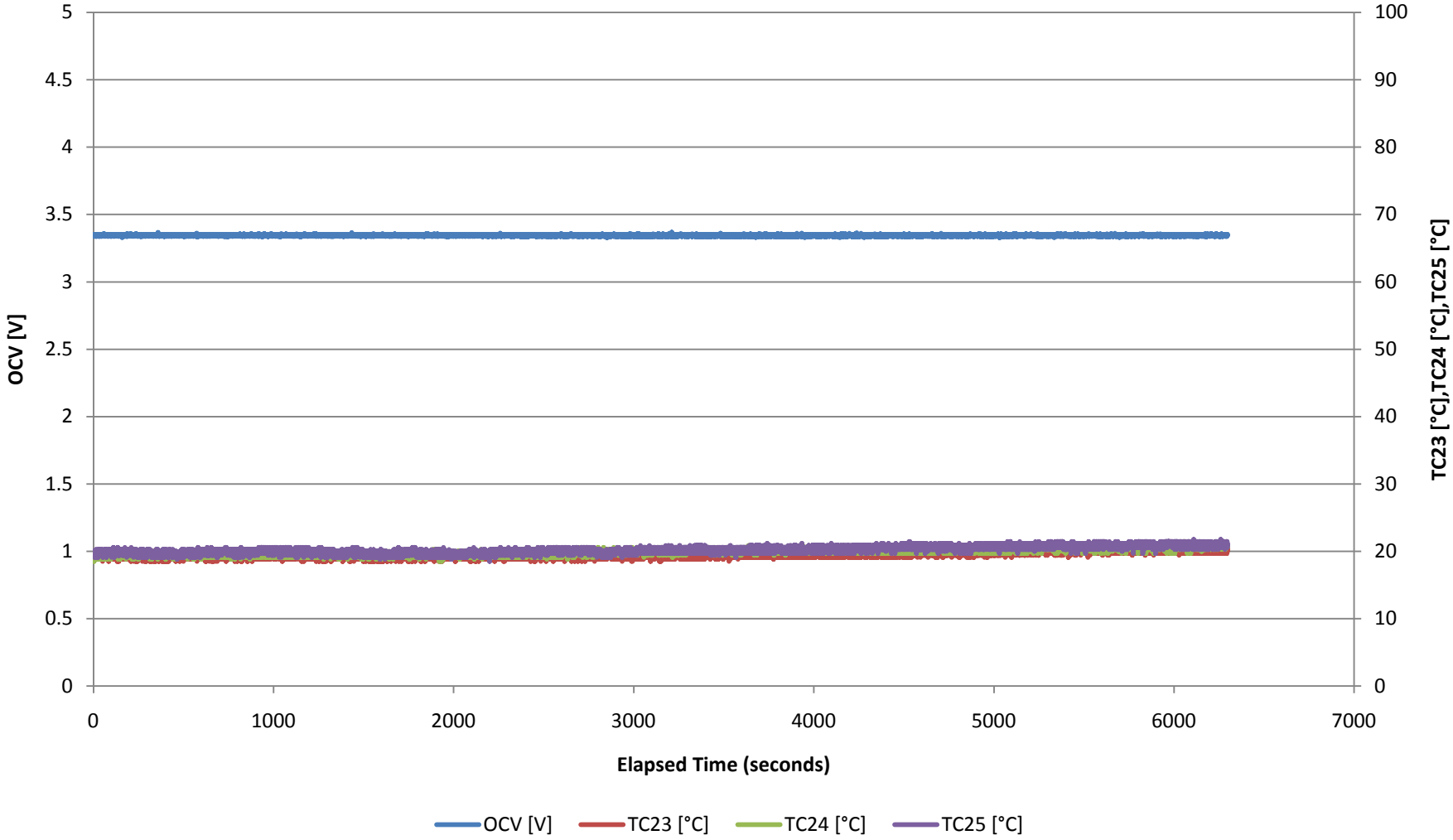
2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

3) Hazard level ratings listed as 0-2 were given because samples did not react, but function of battery was not evaluated post testing - customer to make functional determination.

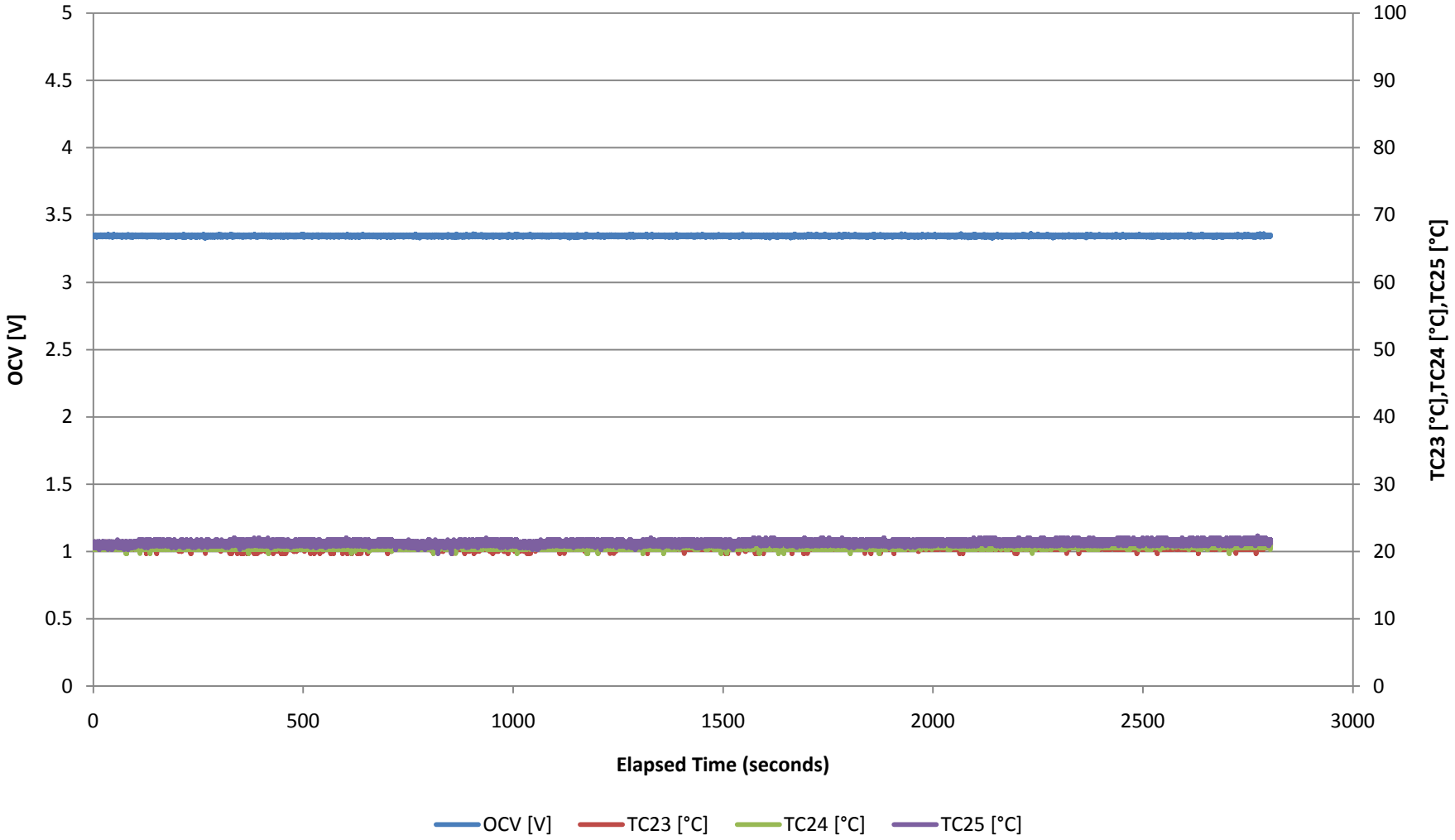
Job: MEC-3230
Project: Cell Crush Testing
Description: Elite 100Ah Cell 100%SOC
Temperature: Ambient
Sample ID: 1010817004



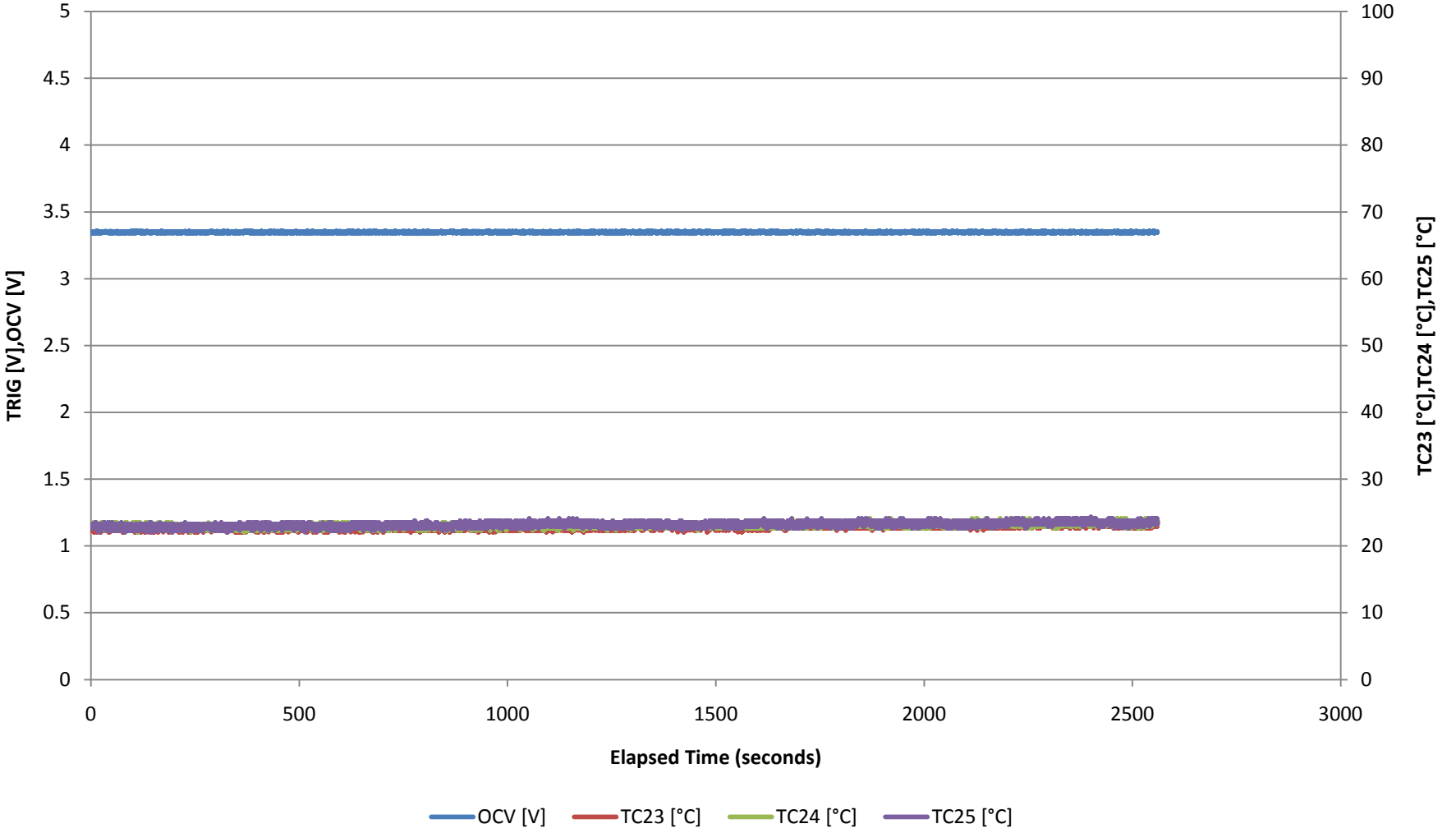
Job: MEC-3230
Project: Cell Crush Testing
Description: Elite 100Ah Cell 100%SOC
Temperature: Ambient
Sample ID: 1010816992



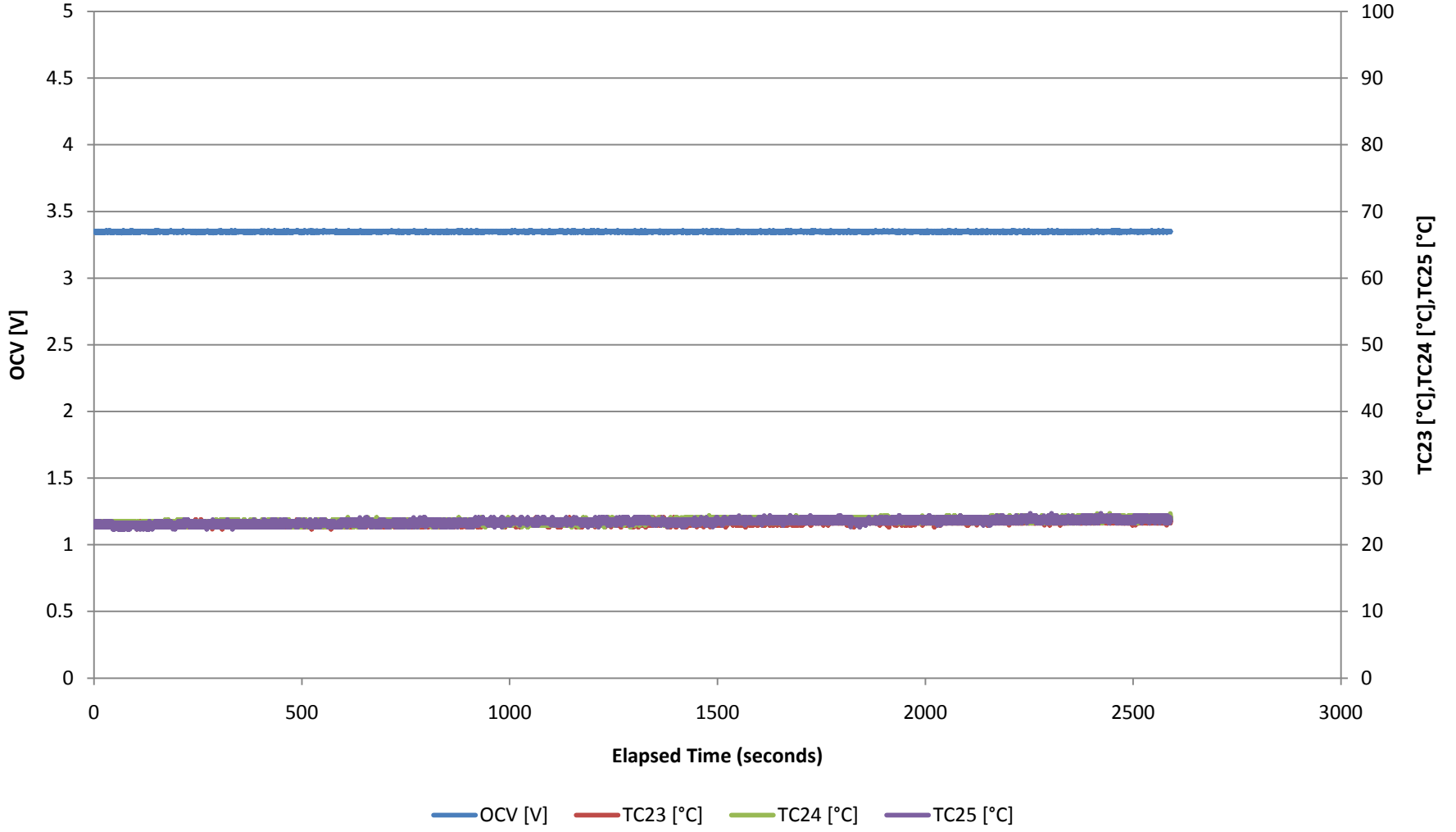
Job: MEC-3230
Project: Cell Crush Testing
Description: Elite 100Ah Cell 100%SOC
Temperature: Ambient
Sample ID: 1010816985



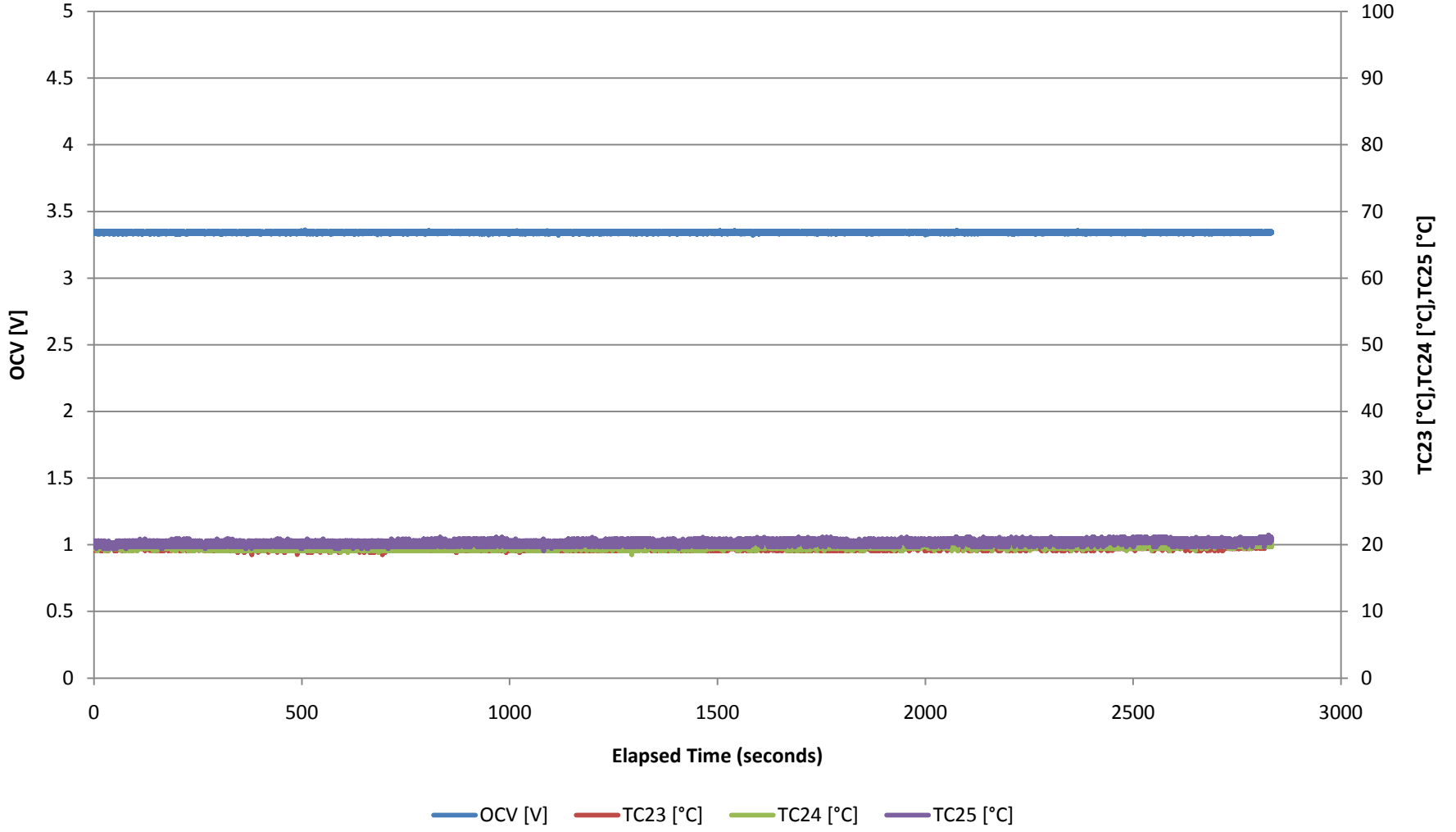
Job: TUV-3230
Project: Cell Crush Testing
Description: Elite 100Ah Cell 100%SOC
Temperature: Ambient
Sample ID: 1010816961



Job: TUV-3230
Project: Cell Crush Testing
Description: Elite 100Ah Cell 100%SOC
Temperature: Ambient
Sample ID: 1010816951



Job: MEC-3230
Project: Cell Crush Testing
Description: Elite 100Ah Cell 100%SOC
Temperature: Ambient
Sample ID: 1010816949



Appendix C:
Thermal Stability
Setup, Data and Graphs

(6 pages)

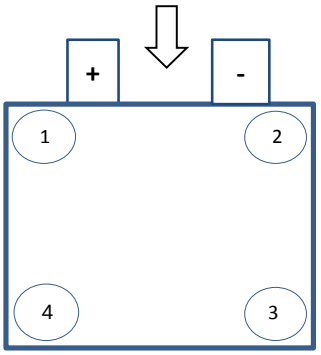
Thermal Stability Test Setup Parameters/Diagrams

Data Acquisition Program:	DaisyLab 7
Data Acquisition Program Worksheet:	Thermal OCV(Ch4)TypeT (Ch11, 12, 13).DSB

Technical Form Number
TF-00034A
Revision Number
0.0
Revision Date
18-Aug-10

Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	2
Voltage - Anode to Fixture	DATA-AQ-01	10 Hz	4
Voltage - Cathode to Fixture	DATA-AQ-01	10 Hz	5
Temperature 1, T-type thermo-couple	DATA-AQ-08	10 Hz	1
Temperature 2, T-type thermo-couple	DATA-AQ-08	10 Hz	2
Temperature 3, T-type thermo-couple	DATA-AQ-08	10 Hz	3
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a

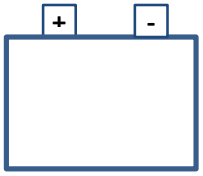
Deformation/Depth Measurement Locations



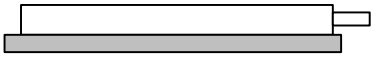
Cell Dimensions measured at Locations 1, 2, 3 and 4.

Thermal Stability Setup

Top View

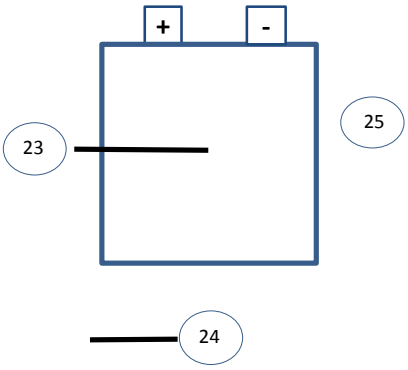


Side View



Cell placed in environmental chamber for high temperature profile. Sample is sitting on vented surface - no holding fixtures used.

Temperature Probe Setup



All Thermocouples placed above the cell.

Thermocouple 1 (23): Center of cell

Thermocouple 2 (24): Suspended in chamber

Thermocouple 3 (25): Not used

TUV SUD Canada			Technical Form Number:	TF-00034B	Page: THSTB-2
Job Number:	TUV-3230		Revision Number:	0.0	
Job Description:	Elite Power Cell Abuse		Revision Date:	18-Aug-10	

Setup Checklist - Thermal Stability Testing

Abuse Chamber	CH-ABUSE-2	Environmental Chamber (1)	CH-ENV-14	Data Acquisition Cart (1)	DATA-AQ-01
Holding Fixture	None	Environmental Chamber (2)	N/a	Data Acquisition Cart (2)	DATA-AQ-08

Feature to be checked	Sample Numbers					
	1010817036	**1010817041**				
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah, 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah, 100%SOC				
Specified Starting Temperature (100°C)	100	100				
Thermal Ramp Rate (Minimum 5°C/min)	5	5				
Data Logging Rate (10Hz)	Yes	Yes				
Test Temperature Test Limit (200°C)	Yes	Yes				
Voltage monitoring at terminals setup (Yes)	Yes	Yes				
Temperature sensors 23 setup on the cell	Yes	Yes				
Temperature sensors 24 setup for Chamber	Yes	Yes				
Lower Fixture vented to allow air flow around cell	Oven Rack	Oven Rack				
Video camera mounted in safety tube for recording test	Yes (LifeCam)	Yes (LifeCam)				
Initial cell dimension measured	Yes	Yes				
"Fresh eyes" review of test setup	Yes	Yes				
General Set up Photos taken	Yes	Yes				
Video of Test Recorded and Start Time	Yes	Yes				
Pre Test Photos taken of sample from each side	Yes	Yes				
Post Test Photos taken of sample from each side	Yes	Yes				
Digital Calipers and Multi-meter used for Set up Recorded	Yes	Yes				
Date	23-Feb-11	24-Feb-11				
Gauges	MU-600-03, VR-006-01	MU-600-03, VR-006-01				
Initials	C.G	C.G				

TUV SUD Canada

Technical Form Number: TF-00033A | Page: 4.4.2-1

Job Number: TUV-3230

Job Description: Elite Power Cell Abuse

Revision Number: 0.0

Revision Date: 18-Aug-10

Thermal Stability Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.4.2-1

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Test)	Comments	Date	Initials	Gauge
1010817036	2.83	1.96		27-Jan-11	P.F	SCALE-01
1010817041	2.83	1.91		27-Jan-11	P.F	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

TUV SUD Canada

Technical Form Number: TF-00033B

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Thermal Stability Testing - Separator Comparison

DVP&R Item: N/a | **SAE J2464, 4.4.2**

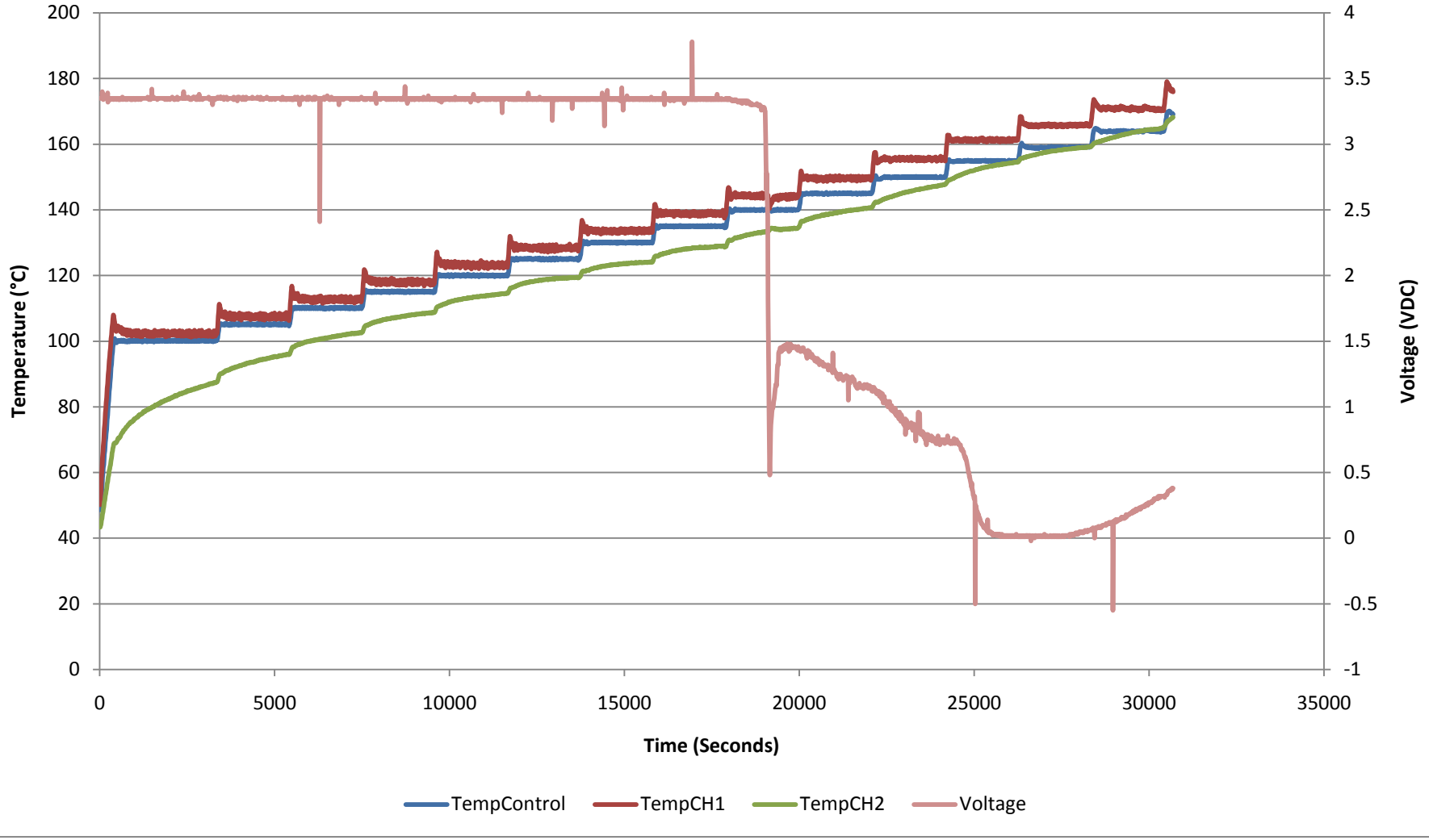
Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV	OCV installed in fixture	Spark Source present for Igniting gases? (Yes or No)	Environment Temperature Ramp Rate Minimum (°C)	Starting Environment Temperature (°C)	End Environment Temperature (°C)	Environment Temperature at Thermal Runaway (°C)	Peak Cell Temperature (°C)	Was there a visible reaction during test? (Yes or No)	Hazard Severity Level	Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4													
1010817036	62.28	61.99	62.25	62.46	58.16	60.36	72.28	63.99	3.348	3.348	Yes	5°C/Min	100°C	270°C	175°C	167°C	Yes	3-5	Voltage dropped to 0.5V and bounced back to 1.5V at 145°C, but slowly tapered off after that. On ramp to 175°C plastic casing began to melt. Testing stopped.	27-Jan-11	P.F	DATA-AQ-01, CH-ENV-14, MU-600-03, VR-006-01
1010817041	62.28	61.88	62.16	61.50	58.23	65.90	63.29	57.55	3.350	3.350	Yes	5°C/Min	100°C	270°C	185°C	186°C	Yes	3-5	Voltage dropped off at 115°C. On ramp to 185°C plastic casing began to melt, and it appreared that thermal runaway started in the cell. Testing stopped.	27-Jan-11	P.F	DATA-AQ-01, CH-ENV-14, MU-600-03, VR-006-01

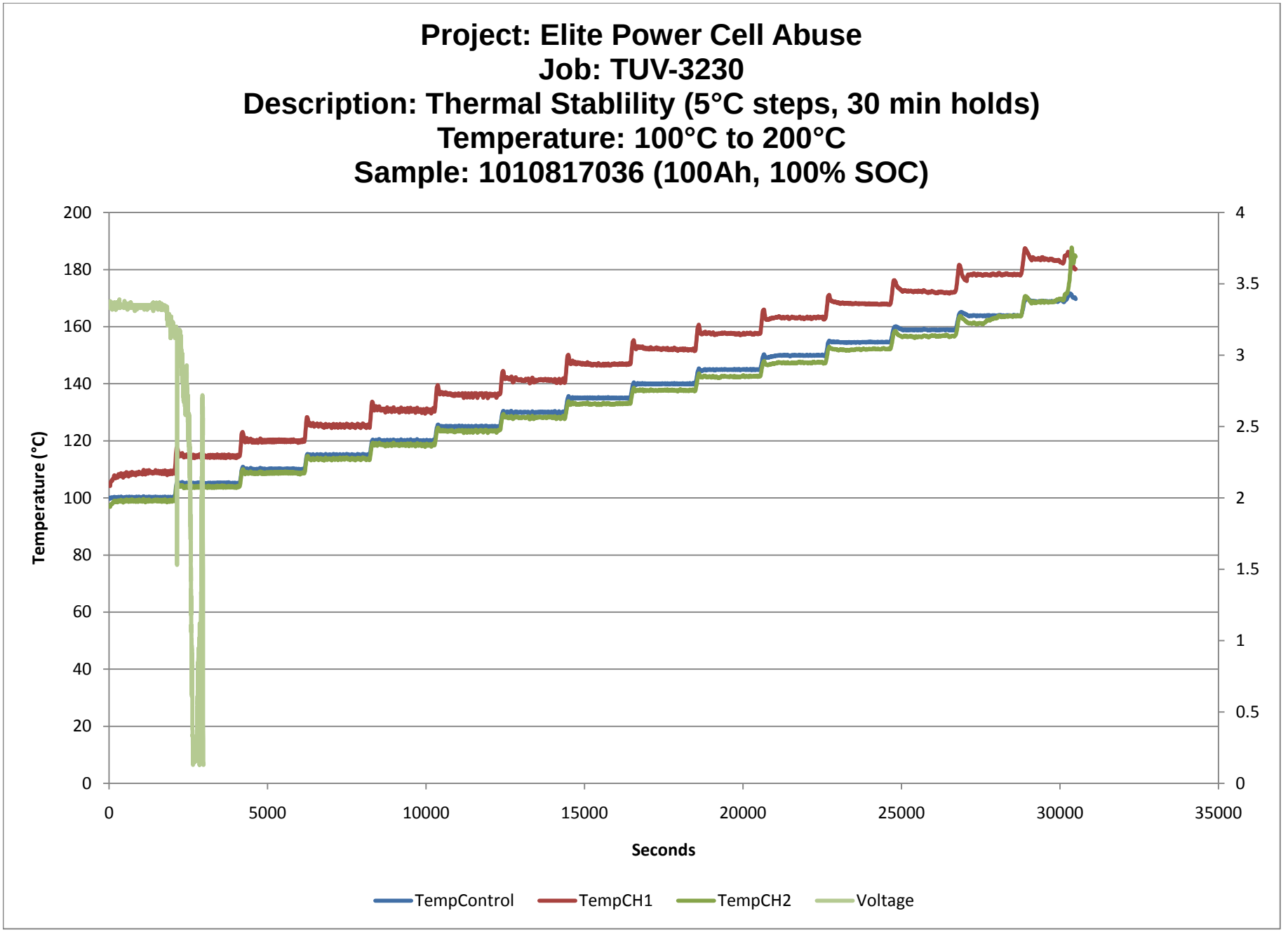
Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

3) Hazard level ratings listed as 0-2 were given because samples did not react, but function of battery was not evaluated post testing - customer to make functional determination. Ratings of 3-5 given if cell reacted, because determination of venting versus rupture requires vent locations (not provided), and distinguighing amount of electrolyte lost not evaluated.

Project: Elite Power Cell Abuse
Job: TUV-3230
Description: Thermal Stablility (5°C steps, 30 min holds)
Temperature: 100°C to 200°C
Sample: 1010817041 (100Ah, 100% SOC)




Project: Elite Power Cell Abuse
Job: TUV-3230
Description: Thermal Stablility (5°C steps, 30 min holds)
Temperature: 100°C to 200°C
Sample: 1010817036 (100Ah, 100% SOC)
Temperature (°C)
200
180
160
140
120
100
80
60
40
20
0
4
3.5
3
2.5
2
1.5
1
0.5
0
0
5000
10000
15000
20000
25000
30000
35000
Seconds
TempControl
TempCH1
TempCH2
Voltage

Appendix D:
Short Circuit Setup, Data and Graphs

(10 pages)

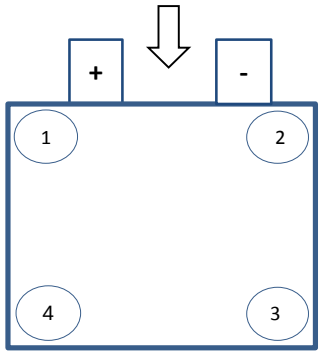
Short Circuit Test Setup Parameters

Data Acquisition Program:	DasyLab 7.0
Data Acquisition Program Worksheet:	SHORTCIR SH500-01(CH1), TRIG(CH2), OCV(4),TYPET(CH11,12,13).DSB
Data Acquisition Program:	
Data Acquisition Program Worksheet:	

Technical Form Number
TF-00028A
Revision Number
0.0
Revision Date
18-Aug-10

Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Current Monitoring	DATA-AQ-01	10 Hz	1
Trigger for marking test start	DATA-AQ-01	10 Hz	2
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	4
Temperature 1, T-type thermo-couple	DATA-AQ-01	10 Hz	11
Temperature 2, T-type thermo-couple	DATA-AQ-01	10 Hz	12
Temperature 3, T-type thermo-couple	DATA-AQ-01	10 Hz	13
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a
Acceleration 1, accelerometer #	N/a	N/a	N/a
Acceleration 2, accelerometer #	N/a	N/a	N/a
Acceleration 3, accelerometer #	N/a	N/a	N/a

Deformation/Depth Measurement Locations

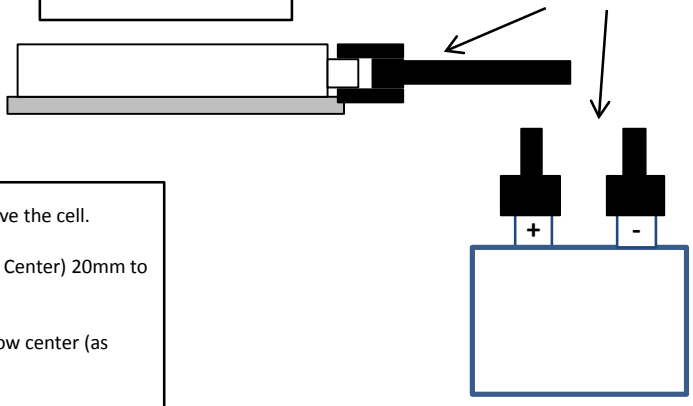


Cell Dimensions measured at Locations 1, 2, 3 and 4.

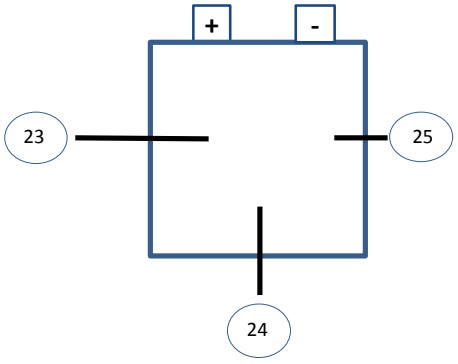
Short Circuit Setup

Cell not containined in a fixture. Sitting on insultated surface

Terminal Clamps attached to cell for



Temperature Probe Setup



All thermocouples placed above the cell.

Thermocouple 23: (Closest to Center) 20mm to left of center (as shown)

Thermocouple24: 55mm below center (as shown).

Thermocouple 25: 40mm to the right of center (as shown)

TUV SUD Canada

Technical Form Number: TF-00028B

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Setup Checklist - Short Circuit Testing

Abuse Chamber	CH-ABUSE-2	Load Fixture	N/a	Data Acquisition Cart (1)	DATA-AQ-01
Base Fixture	BASE-01			Data Acquisition Cart (2)	N/a

Feature to be checked						
	1010817037	**1010817048**	**1010816978**			
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah	New Generation GBS LifeMinPOP Battery - 100Ah	New Generation GBS LifeMinPOP Battery - 100Ah			
Circuit Resistance without Cell (mohm) (3 mohm max., including resistance of line and switch)	1.3 mohm	1.3 mohm	1.3 mohm			
Approximate Cell Resistance provided by Customer (N/a)	Not Provided	Not Provided	Not Provided			
Circuit Resistance (mohm) (<5 mohm, including resistance of line, switch and cell)	N/a	N/a	N/a			
Voltage monitoring at terminals setup (Yes)	Yes	Yes	Yes			
Temperature sensors setup on the cell (3 sensors - Yes)	113, 175, 177	113, 175, 177	113, 175, 177			
Lower Fixture covered with masking-tape for insulation (Yes)	Yes	Yes	Yes			
Data Logging Rate (1 KHz and 10Hz)	Yes	Yes	Yes			
Video camera mounted in safety tube for recording test	Yes	Yes	Yes			
Initial cell weight measured	Yes	Yes	Yes			
Initial cell voltages measured on and off fixture	Yes	Yes	Yes			
Initial cell dimension measured	Yes	Yes	Yes			
"Fresh eyes" review of test setup	Yes	Yes	Yes			
General Set up Photos taken	Yes	Yes	Yes			
Video of Test Recorded	Yes	Yes	Yes			
Pre Test Photos taken of sample from each side	Yes	Yes	Yes			
Post Test Photos taken of sample from each side	Yes	Yes	Yes			
Digital Calipers and Multi-meter used for Set up Recorded	Yes	Yes	Yes			
Date	18-Feb-11	18-Feb-11	22-Feb-11			
Gauges	DATA-AQ-06, VR-006-01	DATA-AQ-06, VR-006-01	DATA-AQ-06, VR-006-01			
Initials	C.G	C.G	C.G			

TUV SUD Canada

Technical Form Number: TF-00027A

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Short Circuit Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.5.1

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Testing)	Comments	Date	Initials	Gauge
1010817037	2.84	2.82		27-Jan-11	P.F	SCALE-01
1010817048	2.80	2.50		27-Jan-11	P.F	SCALE-01
1010816978	2.83	2.58		27-Jan-11	P.F	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

TUV SUD Canada

Technical Form Number: TF-00027B

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Short Circuit Testing - Elite Power Cell Samples

DVP&R Item: N/a

SAE J2464, 4.5.1

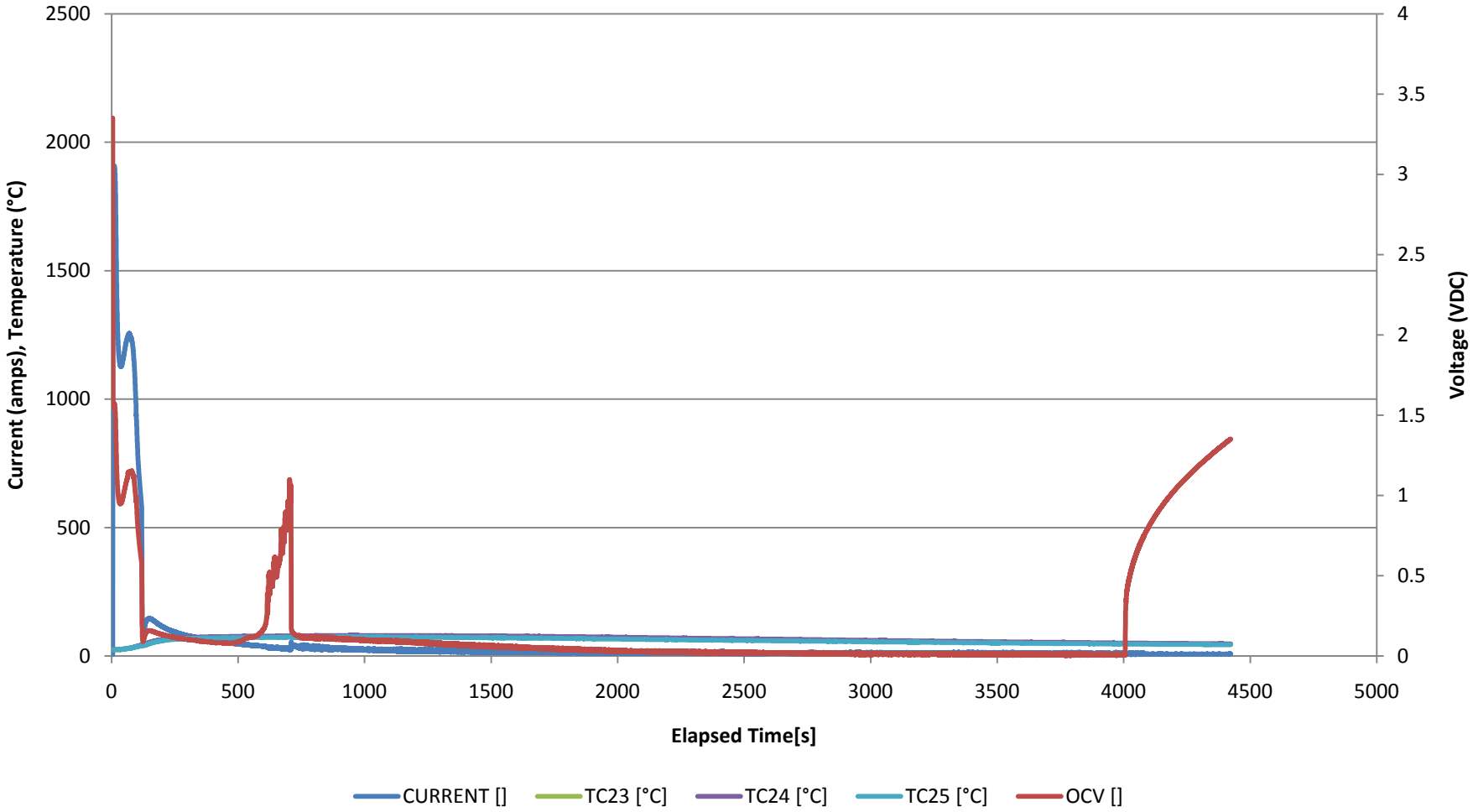
Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV (VDC)	Open Circuit Voltage installed in Fixture (OCV-F) (VDC)	Circuit Resistance without Cell (mohm)	Approximate Cell Resistance (mohm)	Spark Source Present (Yes or No)	Peak Current Observed (A)	Peak Temperature Observed (°C)	Was there a visible reaction during testing? (Yes or No)	Hazard Severity Level	Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4													
1010817037	61.87	62.28	62.29	62.19	64.59	65.06	65.27	65.20	3.33100	3.33100	1.30	Not given	Yes	1641	27.43	N/a	N/a	Terminal clamp got red hot then small flame appeared and broke the electrical connection. Appeared to be caused by using the small terminal clips provided which were not sufficient for the current. Test Void - will perform again with suitable terminal clamp	17-Feb-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010817048	62.11	61.82	62.14	62.24	64.67	64.70	66.02	65.76	3.33500	3.33500	1.30	Not given	Yes	1909	80.52	Yes	3-4	Vent cap released and vented pressure from cell.	18-Feb-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05
1010816978	61.95	62.26	62.25	61.95	64.91	64.21	66.19	66.13	3.34000	3.34000	1.30	Not given	Yes	1642	75.26	Yes	3-4	Vent cap did not release, Plastic melted around negitive terminal.	22-Feb-11	C.G	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, PT-024-09, VR-006-05

Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

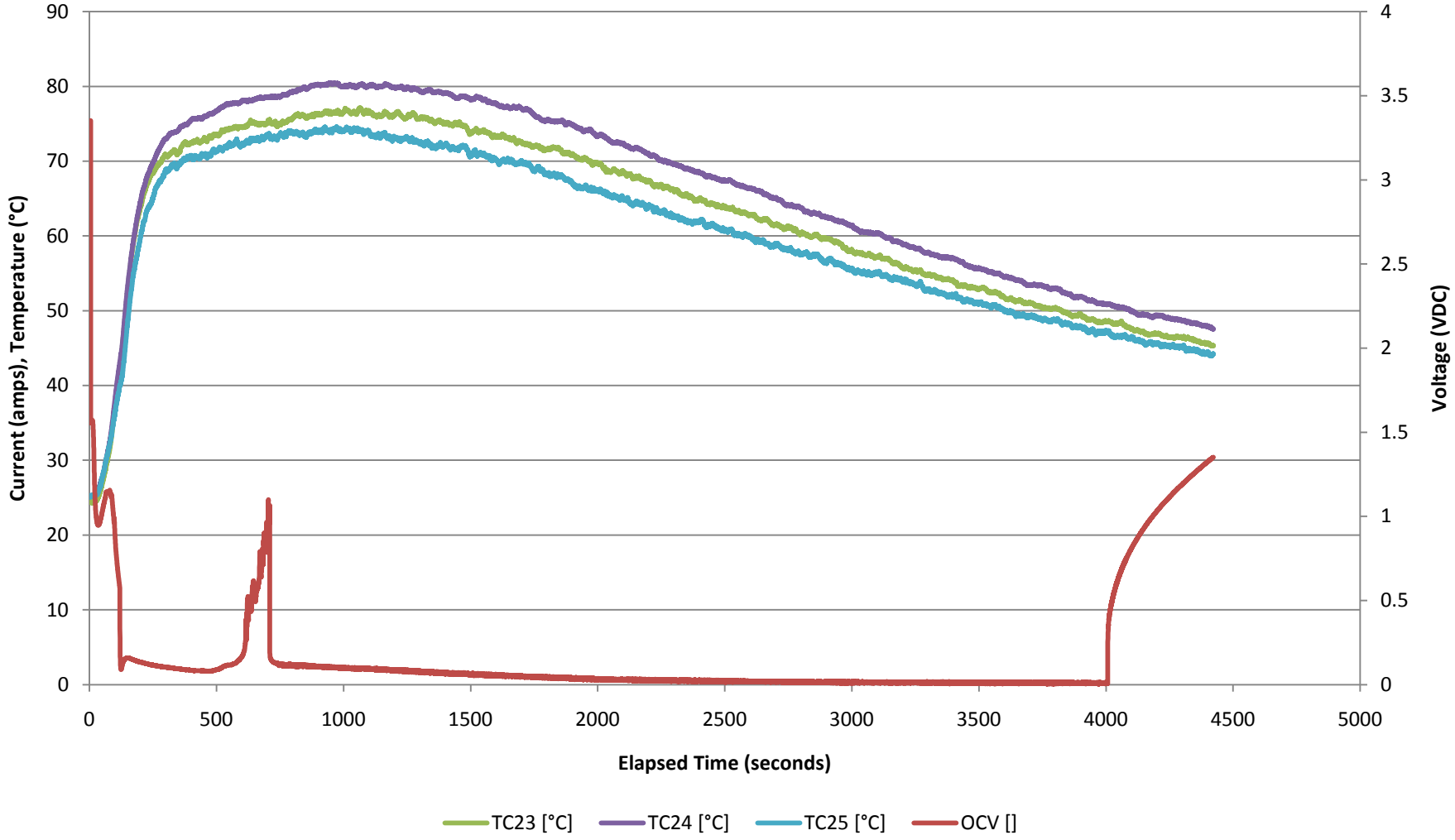
2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

3) Hazard level ratings listed as 0-2 were given because samples did not react, but function of battery was not evaluated post testing - customer to make functional determination. Ratings of 3-5 given if cell reacted, because determination of venting versus rupture requires vent locations (not provided), and distinguighing amount of electrolyte lost not evaluated.

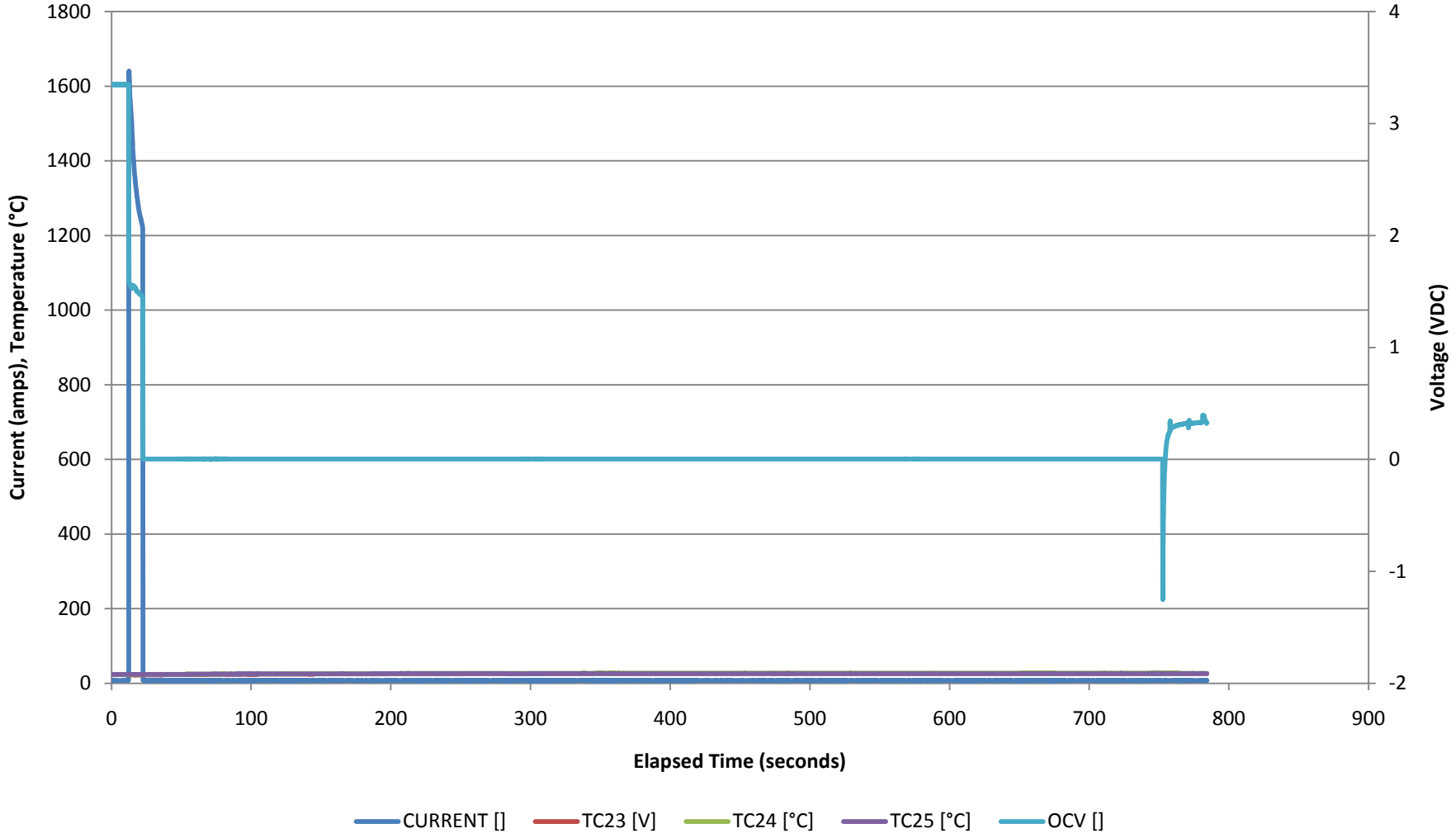
Job: MEC-3230
Project: Short Circuit
Description: Elite Power 100Ah 100% SOC
Temperature: Ambient
Sample ID: 1010817048 (Graph focus on Current)



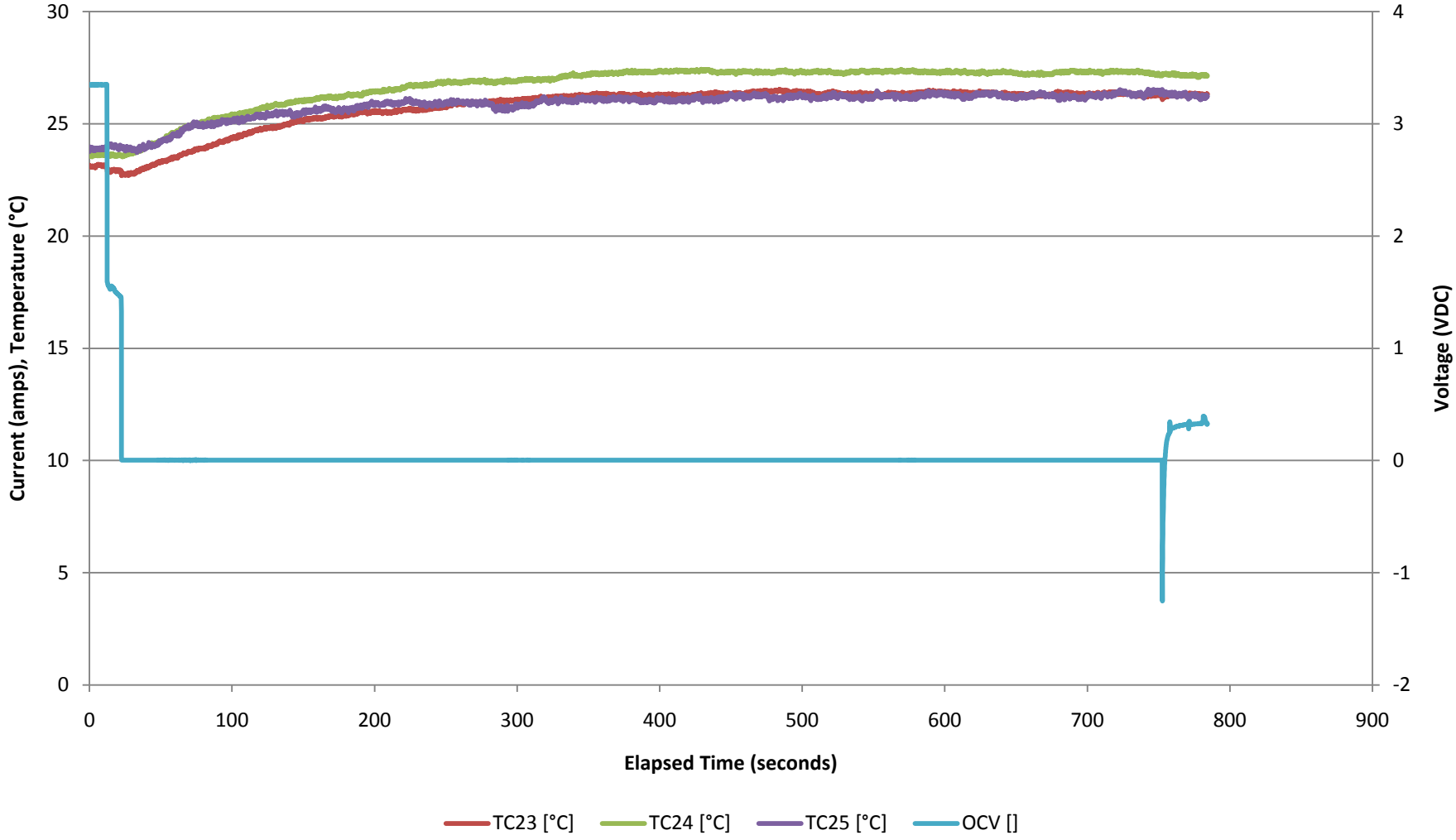
Job: MEC-3230
Project: Short Circuit
Description: Elite Power 100Ah 100% SOC
Temperature: Ambient
Sample ID: 1010817048 (Graph focus on Temperature)



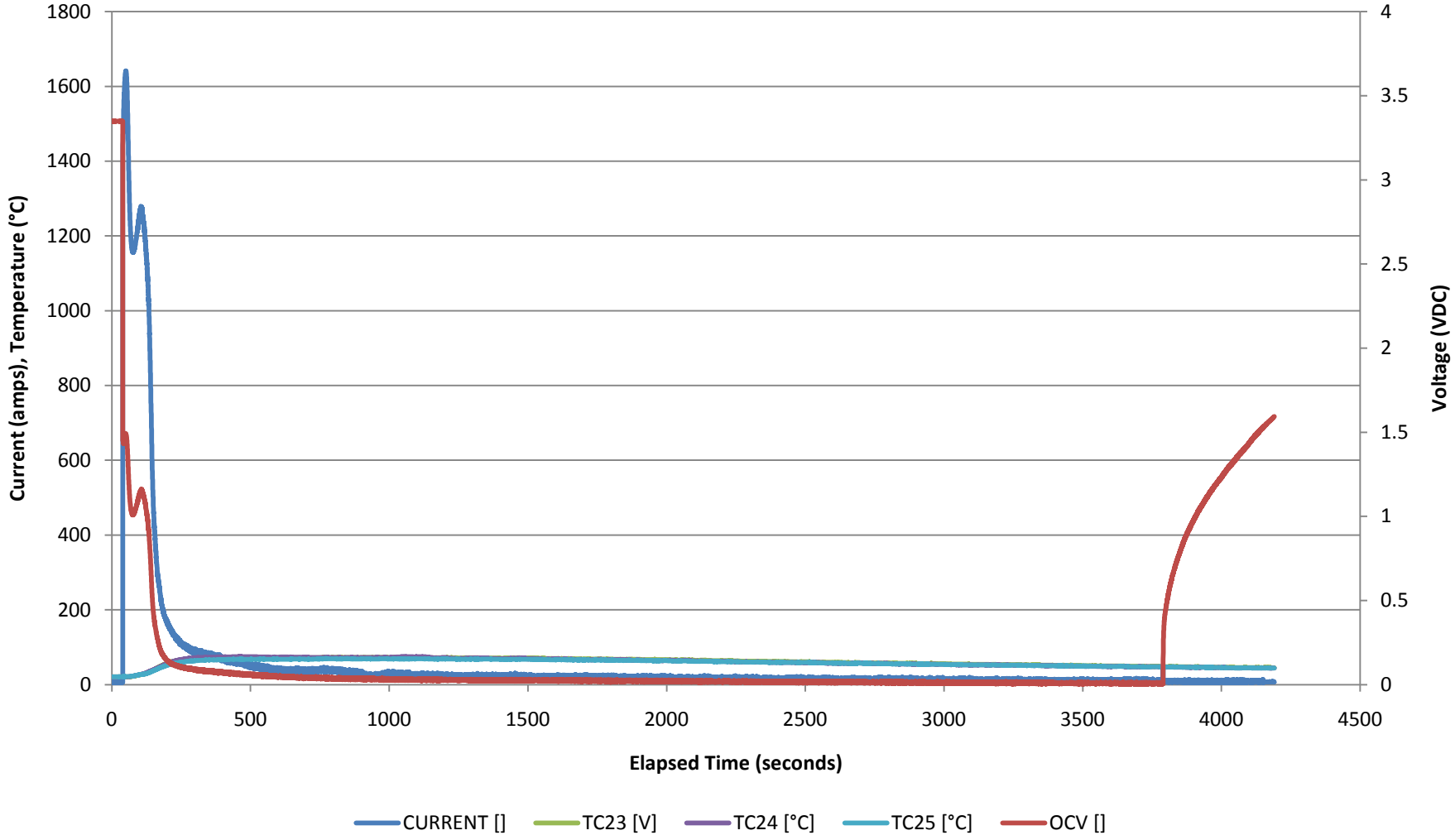
Job: MEC-3230
Project: Short Circuit
Description: Elite Power 100Ah 100% SOC
Temperature: Ambient
Sample ID: 1010817037 (Graph focus on current)



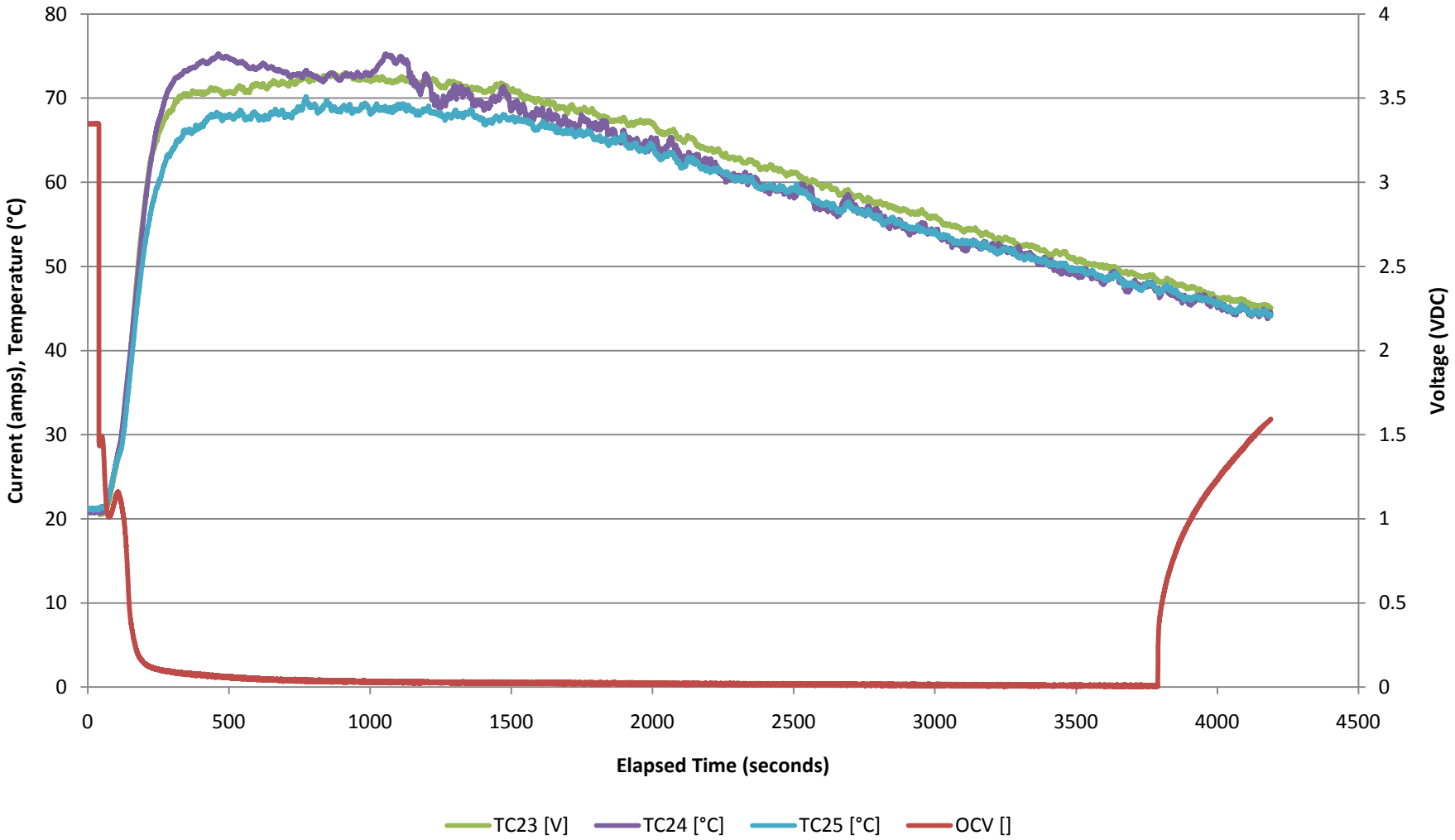
Job: MEC-3230
Project: Short Circuit
Description: Elite Power 100Ah 100% SOC
Temperature: Ambient
Sample ID: 1010817037 (Graph focus on temperature)



Job: MEC-3230
Project: Short Circuit
Description: Elite Power 100Ah 100% SOC
Temperature: Ambient
Sample ID: 1010816978 (Graph focus on Current)



Job: MEC-3230
Project: Short Circuit
Description: Elite Power 100Ah 100% SOC
Temperature: Ambient
Sample ID: 1010816978 (Graph focus on Temperature)



Appendix E:
Overcharge Setup, Data and Graphs

(6 pages)

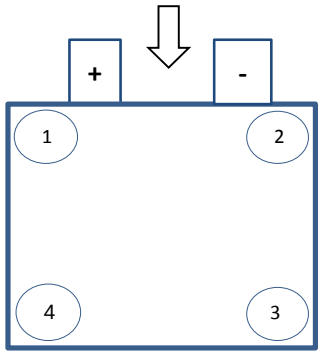
Overcharge Test Setup Parameters/Diagrams

Data Acquisition Program:	DasyLab 7.0
Data Acquisition Program Worksheet:	OVRCHG PS-150-06 A(CH2), OCV(CH8), AHR, TypeT(CH12,13,14).DSB

Technical Form Number
TF-00025A
Revision Number
0.0
Revision Date
14-Jul-10

Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	8
Amperage	DATA-AQ-01	10 Hz	2
Amp Hours	DATA-AQ-01	10 Hz	N/a
Temperature 1, T-type thermo-couple	DATA-AQ-01	10 Hz	12
Temperature 2, T-type thermo-couple	DATA-AQ-01	10 Hz	13
Temperature 3, T-type thermo-couple	DATA-AQ-01	10 Hz	14
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a

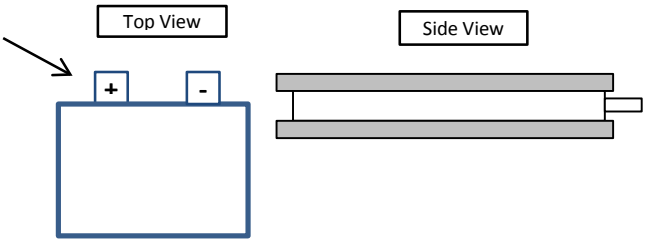
Deformation/Depth Measurement Locations



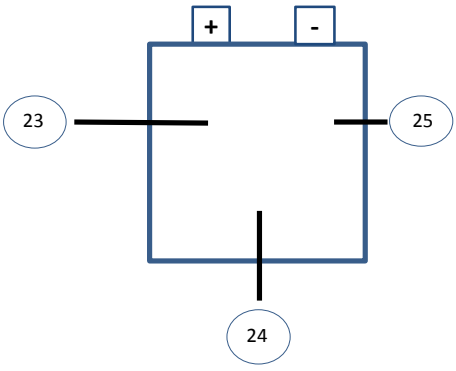
Cell Dimensions measured at Locations 1, 2, 3 and 4.

Cell Overcharge Setup

Overcharge power supply connected to terminals



Temperature Probe Setup



All thermocouples placed above the cell.

Thermocouple 23: (Closest to Center) 20mm to left of center (as shown)

Thermocouple24: 55mm below center (as shown).

Thermocouple 25: 40mm to the right of center (as shown)

TUV SUD Canada			Technical Form Number:	TF-00025B	Page: OVCS-2
Job Number:	TUV-3230		Revision Number:	0.0	
Job Description:	Elite Power Cell Abuse		Revision Date:	14-Jul-10	

Setup Checklist - Overcharge Testing

Abuse Chamber	CH-ABUSE-2	Data Acquisition Cart (1)	DATA-AQ-01
Fixture	N/A	Data Acquisition Cart (2)	DATA-AQ-08

Feature to be checked	Sample Numbers					
	1010817044	**1010817045**				
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah, 100% SOC	New Generation GBS LifeMinPOP Battery - 100Ah, 100% SOC				
Voltage monitoring at terminals setup (Yes)	Yes	Yes				
Temp. sensors setup on the cell (3 sensors - Yes)	113, 175, 177	113, 175, 177				
Lower Fixture covered with masking-tape for insulation	Yes	Yes				
Charge Rate (1 C)	Yes	Yes				
Current Charge (100 amps)	Yes	Yes				
Limiting Charge Voltage (5.7V = 1.5 x 3.8(Max Volt))	Yes	Yes				
Overcharge Test Target (205%, Minimum 200% SOC)	Yes	Yes				
Data Logging Rate (10Hz)	Yes	Yes				
Video camera mounted in safety tube for recording test	Yes	Yes				
Initial cell dimension measured	Yes	Yes				
"Fresh eyes" review of test setup	Yes	Yes				
General Set up Photos taken	Yes	Yes				
Video of Test Recorded and Start Time	Yes	Yes				
Pre Test Photos taken of sample from each side	Yes	Yes				
Post Test Photos taken of sample from each side	Yes	Yes				
Digital Calipers and Multi-meter used for Set up Recorded	Yes	Yes				
Date	17-Feb-11	18-Feb-11				
Gauges	VR-006-01, MU-600-03	VR-006-01, MU-600-03				
Initials	C.G	C.G				

TUV SUD Canada

Technical Form Number: TF-00024A | Page: 4.5.2-1

Job Number: TUV-3230

Job Description: Elite Power Cell Abuse

Revision Number: 0.0

Revision Date: 14-Jul-10

Overcharge Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.5.2-1

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Test)	Comments	Date	Initials	Gauge
1010817044	2.85	2.71		27-Jan-11	P.F	Scale-01
1010817045	2.86	2.59		27-Jan-11	P.F	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

Overcharge Testing

DVP&R Item: N/a | **SAE J2464, 4.5.2**

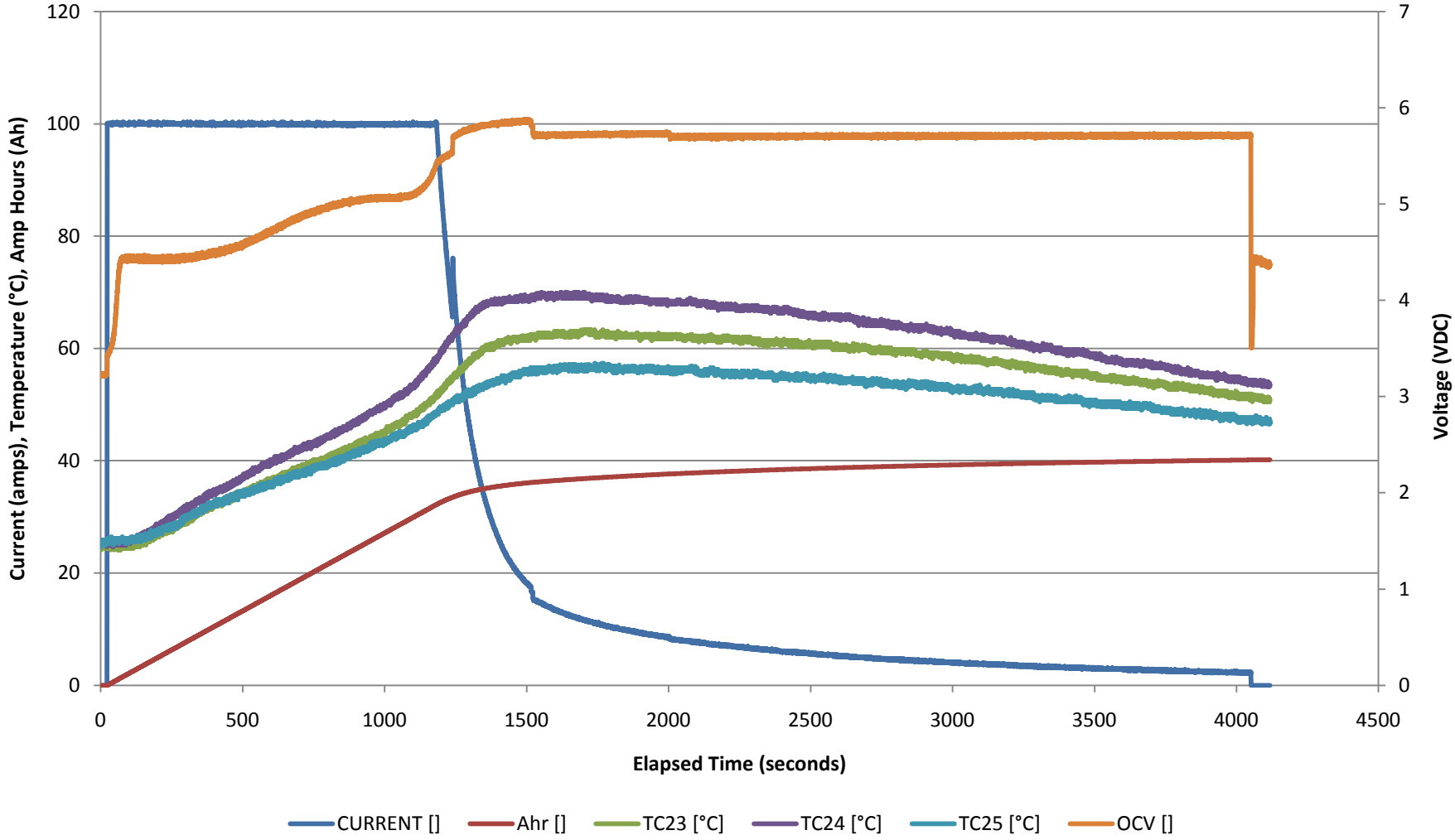
Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV	OCV installed in fixture	Charge Rate (C-Rate)	Target SOC Minimum	Spark Source present for Igniting gases? (Yes or No)	Charge Current (Amps)	Ah Total during Test	Estimated SOC Achieved Total	Ah until Current Change	Estimated SOC at Current Change	Peak Temperature (°C)	Was there a reaction during overcharge? (Yes or No)	Hazard Severity Level	Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4																
1010817044	62.06	62.03	62.13	62.11	64.90	67.34	70.76	71.00	3.330	3.330	1	205%	Yes	100	37.23	137%	24.85	125%	60.61	Yes	3-4	Cell leaked electrolyte it is not clear in the video exactly when this occurred. Did not reach the target of 205%.	27-Jan-11	P.F	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, VR-006-01
1010817045	62.04	62.26	62.20	62.16	64.95	65.12	66.74	68.04	3.335	3.335	1	205%	Yes	100	40.14	140%	32.18	132%	70.01	Yes	3-4	Cell begins to leak electrolyte at approximately 20 minutes. Did not reach the target of 205%.	27-Jan-11	P.F	DATA-AQ-01, DATA-AQ-06, DATA-AQ-08, VR-006-01

Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

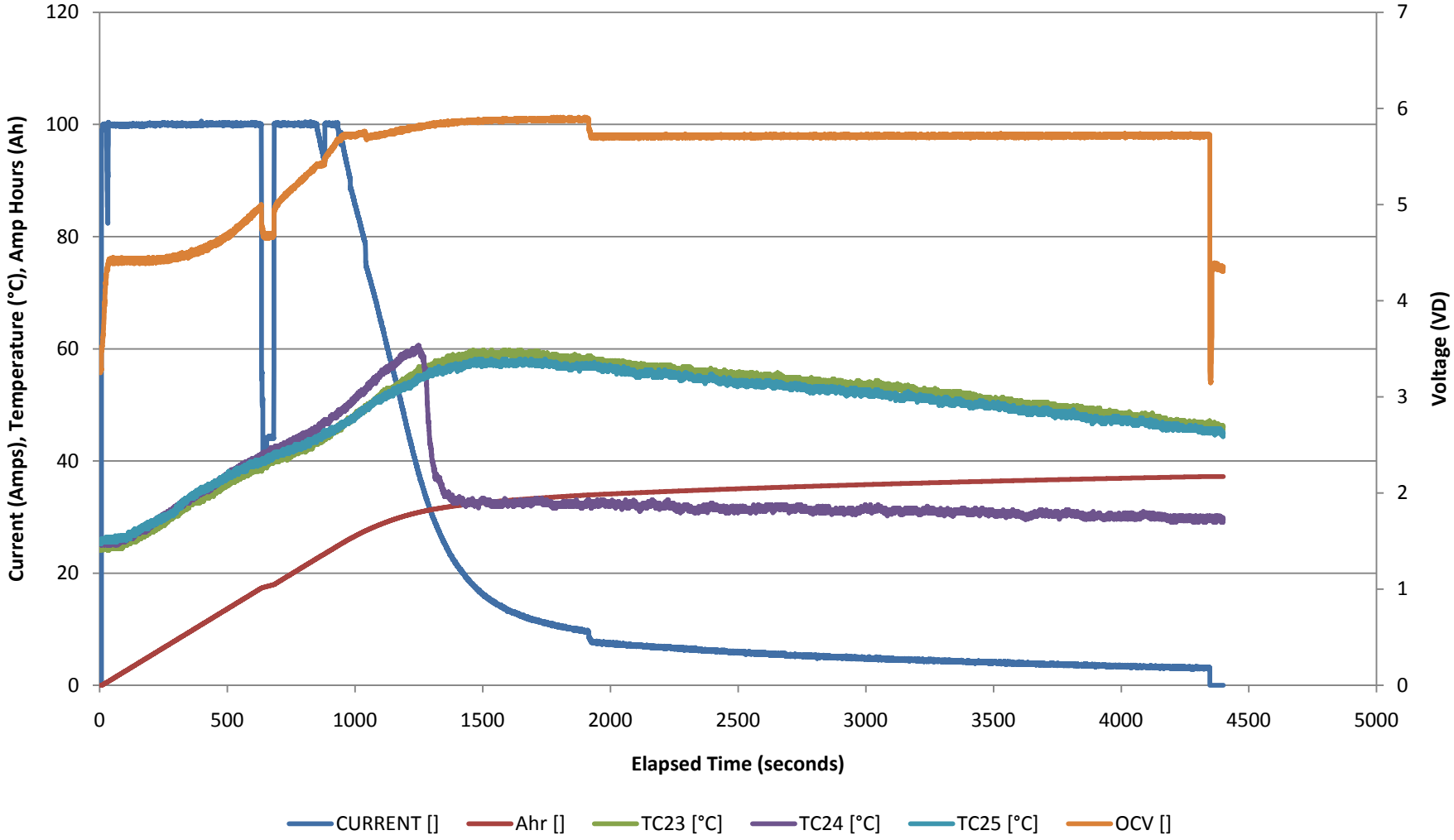
2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

3) Hazard level ratings listed as 0-2 were given because samples did not react, but function of battery was not evaluated post testing - customer to make functional determination. Ratings of 3-5 given if cell reacted, because determination of venting versus rupture requires vent locations (not provided), and distinguishing amount of electrolyte lost not evaluated.

Job: TUV-3230, Elite Cell Abuse
Project: Cell Overcharge
Description: 100Ah Elite 100% SOC
Temperature: Ambient
Sample ID: 1010817045



Job: TUV-3230, Elite Cell Abuse
Project: Cell Overcharge
Description: 100Ah Elite 100% SOC
Temperature: Ambient
Sample ID: 1010817046



Appendix F:
Over Discharge Setup, Data and Graphs

(6 pages)

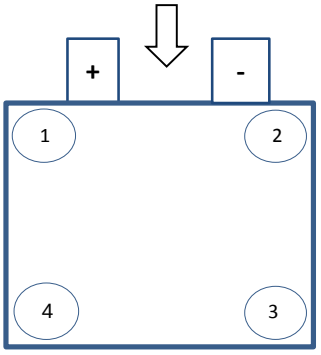
Over-Discharge (Forced Discharge) Test Setup Parameters/Diagrams

Data Acquisition Program:	DaisyLab 7
Data Acquisition Program Worksheet:	OVRDCH-HP-580-01A(ch2), OCV(ch8), Ahr, Type T (Ch 12, 13 ,14).DSB

Technical Form Number
TF-00032A
Revision Number
0.0
Revision Date
18-Aug-10

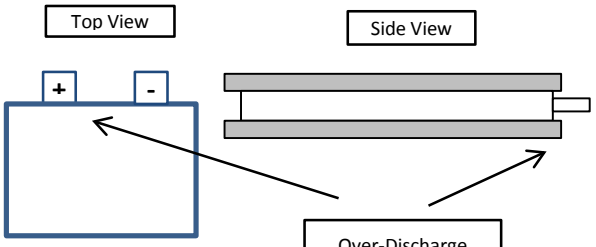
Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	8
Voltage - Anode to Fixture	DATA-AQ-01	10 Hz	4
Voltage - Cathode to Fixture	DATA-AQ-01	10 Hz	5
Temperature 1, T-type thermo-couple	DATA-AQ-08	10 Hz	12
Temperature 2, T-type thermo-couple	DATA-AQ-08	10 Hz	13
Temperature 3, T-type thermo-couple	DATA-AQ-08	10 Hz	14
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a

Deformation/Depth Measurement Locations



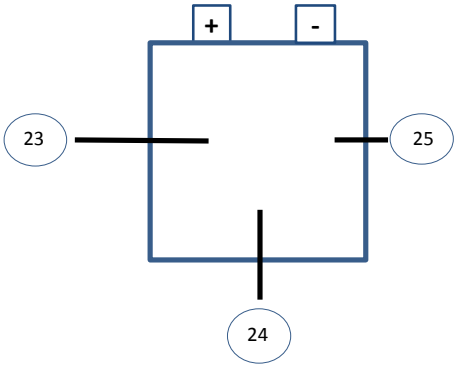
Cell Dimensions measured at Locations 1, 2, 3 and 4.

Cell Overdischarge Setup



Over-Discharge power supply connected to terminals

Temperature Probe Setup



All thermocouples placed above the cell.

Thermocouple 23: (Closest to Center) 20mm to left of center (as shown)

Thermocouple24: 55mm below center (as shown).

Thermocouple 25: 40mm to the right of center (as shown)

TUV SUD Canada			Technical Form Number:	TF-00032B	Page: OVCS-2
Job Number:	TUV-3230		Revision Number:	0.0	
Job Description:	Elite Power Cell Abuse		Revision Date:	18-Aug-10	

Setup Checklist - Over-Discharge (Forced Discharge) Testing

Abuse Chamber	CH-ABUSE-2	Data Acquisition Cart (1)	DATA-AQ-01
Fixture	N/A	Data Acquisition Cart (2)	DATA-AQ-08

Feature to be checked	Sample Numbers					
	1010816991	**1010816993**				
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah	New Generation GBS LifeMinPOP Battery - 100Ah				
Voltage drop across load 3.5V-3.7V	3.57	3.57				
Continuous Disharge Rate (5 C)	Yes	Yes				
Overdischarge Test Target (-100% SOC, that is negative 100%	Yes	Yes				
Limiting Charge Voltage (Max Voltage = 3.8V)	Yes	Yes				
Data Logging Rate (10Hz)	Yes	Yes				
Voltage monitoring at terminals setup (Yes)	Yes	Yes				
Temperature sensors setup on the cell (3 sensors - Yes)	Yes	Yes				
Lower Fixture covered with masking-tape for insulation	Yes	Yes				
Video camera mounted in safety tube for recording test	Yes	Yes				
Initial cell dimension measured	Yes	Yes				
"Fresh eyes" review of test setup	Yes	Yes				
General Set up Photos taken	Yes	Yes				
Video of Test Recorded and Start Time	Yes	Yes				
Pre Test Photos taken of sample from each side	Yes	Yes				
Post Test Photos taken of sample from each side	Yes	Yes				
Digital Calipers and Multi-meter used for Set up Recorded	Yes	Yes				
Date	21-Feb-11	21-Feb-11				
Gauges	VR-006-01, MU-600-03	VR-006-01, MU-600-03				
Initials	C.G	C.G				

TUV SUD Canada

Technical Form Number: TF-00031A

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Over-Discharge Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.5.3

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Test)	Comments	Date	Initials	Gauge
1010816991	2.86	2.54		27-Jan-11	C.G	SCALE-01
1010816993	2.83	2.54		27-Jan-11	C.G	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

Over-Discharge Testing

DVP&R Item: N/a **SAE J2464, 4.5.3**

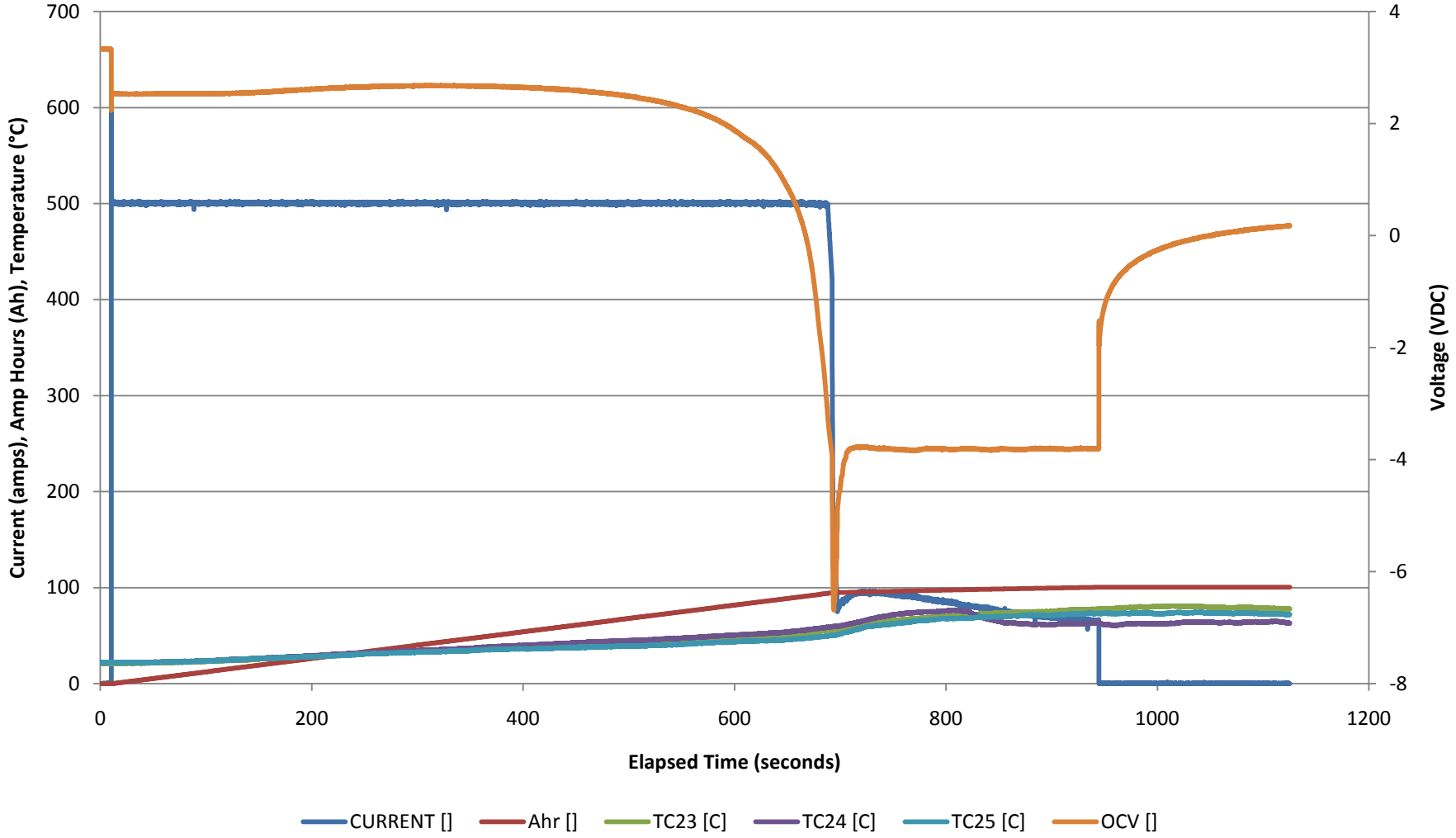
Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV	OCV installed in fixture	Continuous Discharge Rate (C-Rate)	Target SOC	Spark Source present for Igniting gases? (Yes or No)	Charge Current (Amps)	Ah Total during Test	Estimated SOC Achieved Total	Ah until Event	Estimated SOC at Event	Peak Temperature (°C)	Was there a visible reaction during over-discharge? (Yes or No)	Hazard Severity Level	Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4																
1010816991	62.24	62.01	62.25	62.51	64.42	64.97	66.98	66.13	3.34800	3.34800	5	-100%	Yes	500	107.25	-7.3%	95.65	4.35%	93.48	Yes	4-6	At 11:50 the Vent Cap was released from the cell. Light smoke followed.	22-Feb-11	C.G	DATA-AQ-01, DATA-AQ-08, VR-006-01
1010816993	62.18	61.84	61.90	62.29	64.22	64.93	67.24	64.48	3.35000	3.35000	5	-100%	Yes	500	100.44	-0.4%	92.37	7.63%	81.08	Yes	4-6	At 12:45 Vent Cap was released from the cell. Light smpke followed.	22-Feb-11	C.G	DATA-AQ-01, DATA-AQ-08, VR-006-01

Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

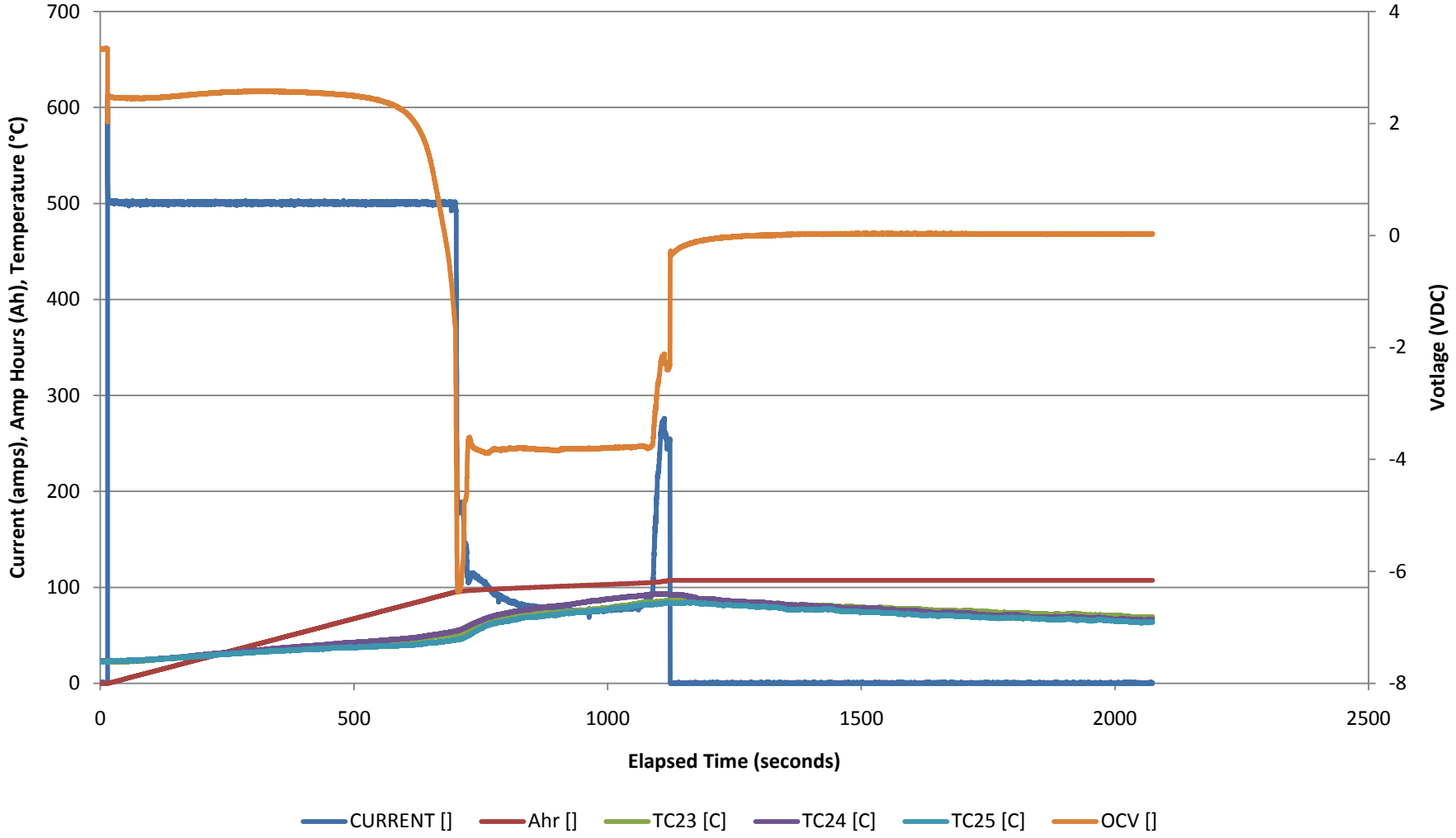
2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

3) Hazard level ratings listed as 0-2 were given because samples did not react, but function of battery was not evaluated post testing - customer to make functional determination. Ratings of 3-5 given if cell reacted, because determination of venting versus rupture requires vent locations (not provided), and distinguighing amount of electrolyte lost not evaluated.

Job: TUV-3230, Elite Power cell Abuse
Project: Cell Over Discharge Testing
Description: Elite 100Ah Cell 100% SOC
Temperature: Ambient
Sample ID: 1010816993



Job: TUV-3230, Elite Power Cell Abuse
Project: Cell Over Discharge Testing
Description: Elite 100Ah Cell (100% SOC)
Temperature: Ambient
Sample ID: 1010816991



Appendix G:
Separator Shutdown Setup, Data and Graphs

(6 pages)

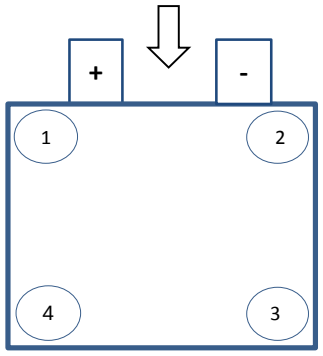
Separator Shutdown Test Setup Parameters

Data Acquisition Program:	DasyLab 7.0
Data Acquisition Program Worksheet:	OVRCHG PS-150-06 A(CH2), OCV(CH8), AHR, TypeT(CH12,13,14).DSB
Data Acquisition Program:	
Data Acquisition Program Worksheet:	

Technical Form Number
TF-00034A
Revision Number
0.0
Revision Date
1-Mar-11

Measurement Description	Data Acquisition System	Data Acquisition Frequency	Channel
Voltage Differential (Monitoring between terminals)	DATA-AQ-01	10 Hz	8
Current (amps)	DATA-AQ-01	10 Hz	2
Amp Hours	DATA-AQ-01	10 Hz	N/a
Temperature 1, T-type thermo-couple	DATA-AQ-01	10 Hz	12
Temperature 2, T-type thermo-couple	DATA-AQ-01	10 Hz	13
Temperature 3, T-type thermo-couple	DATA-AQ-01	10 Hz	14
Temperature 4, K-type thermo-couple	N/a	N/a	N/a
Temperature 5, K-type thermo-couple	N/a	N/a	N/a
Temperature 6, K-type thermo-couple	N/a	N/a	N/a
Acceleration 1, accelerometer #	N/a	N/a	N/a
Acceleration 2, accelerometer #	N/a	N/a	N/a
Acceleration 3, accelerometer #	N/a	N/a	N/a

Deformation/Depth Measurement Locations

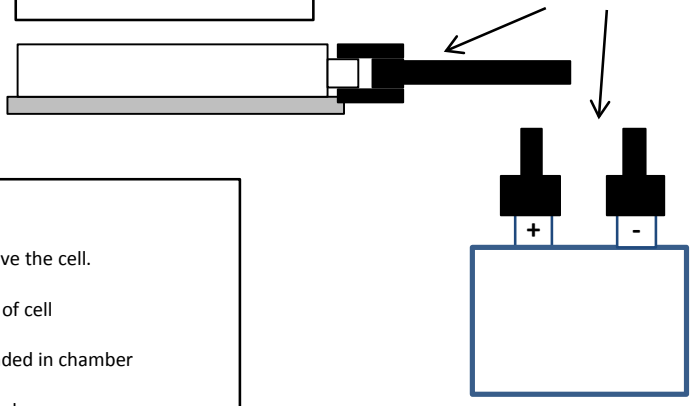


Cell Dimensions measured at Locations 1, 2, 3 and 4.

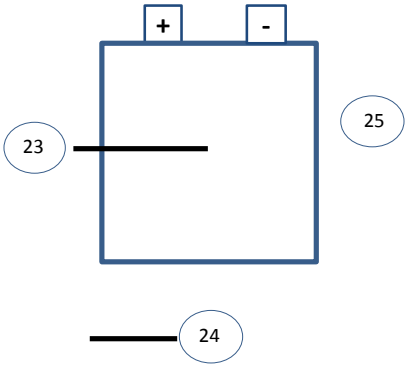
Separator Shutdown Setup

Cell not containined in a fixture. Sitting on vented surface inside an

Terminal Clamps attached to cell for



Temperature Probe Setup



All Thermocouples placed above the cell.

Thermocouple 1 (23): Center of cell

Thermocouple 2 (24): Suspended in chamber

Thermocouple 3 (25): Not used

TUV SUD Canada			Technical Form Number:	TF-00034B	Page: SSDS-2
Job Number:	TUV-3230		Revision Number:	0.0	
Job Description:	Elite Power Cell Abuse		Revision Date:	1-Mar-11	

Setup Checklist - Separator Shutdown Testing

Abuse Chamber	CH-ABUSE-2	Load Fixture	N/a	Data Acquisition Cart (1)	DATA-AQ-01
Base Fixture	BASE-02	Environmental Chamber	CH-ENV-14	Data Acquisition Cart (2)	N/a

Feature to be checked						
	1010816979	**10090115218**				
Cell Description - Make sure Sample Matrix updated	New Generation GBS LifeMinPOP Battery - 100Ah, 100%SOC	New Generation GBS LifeMinPOP Battery - 100Ah, 100%SOC				
Specified Temp. (145°C, 5°C above shutdown temp.)	145	145				
Data Logging Rate (10Hz)	Yes	Yes				
Voltage monitoring at terminals setup (Yes)	Yes	Yes				
Temperature sensors 23 setup on the cell	Yes	Yes				
Temperature sensors 24 setup for Chamber	Yes	Yes				
Lower Fixture vented to allow air flow around cell	Oven Rack	Oven Rack				
Video camera mounted in safety tube for recording test	Yes (LifeCam)	Yes (LifeCam)				
Initial cell voltage, dimension and weight measured	Yes	Yes				
"Fresh eyes" review of test setup	Yes	Yes				
General Set up Photos taken	Yes	Yes				
Video of Test Recorded and Start Time	Yes	Yes				
Pre Test Photos taken of sample from each side	Yes	Yes				
Post Test Photos taken of sample from each side	Yes	Yes				
Digital Calipers and Multi-meter used for Set up Recorded	Yes	Yes				
Date	28-Feb-11	1-Mar-11				
Gauges	DATA-AQ-06, VR-006-01	DATA-AQ-06, VR-006-01				
Initials	C.G	C.G				

TUV SUD Canada

Technical Form Number: TF-00033A

Job Number: TUV-3230

Revision Number: 0.0

Job Description: Elite Power Cell Abuse

Revision Date: 18-Aug-10

Separator Shutdown Testing - Weight Data

DVP&R Item: N/a

SAE J2464, 4.5.4-1

Sample Number	Initial Weight (kg)	Final Weight (kg) (Following Test)	Comments	Date	Initials	Gauge
1010816979	2.84	1.96		27-Jan-11	P.F	SCALE-01
10090115218	2.83	1.91		27-Jan-11	P.F	SCALE-01

Note: 1) Weight measurements taken with scale that was not calibrated. The scale was verified with known weights and a calibrated force gauge.

Separator Shutdown Testing

DVP&R Item: N/a **SAE J2464, 4.5.4**

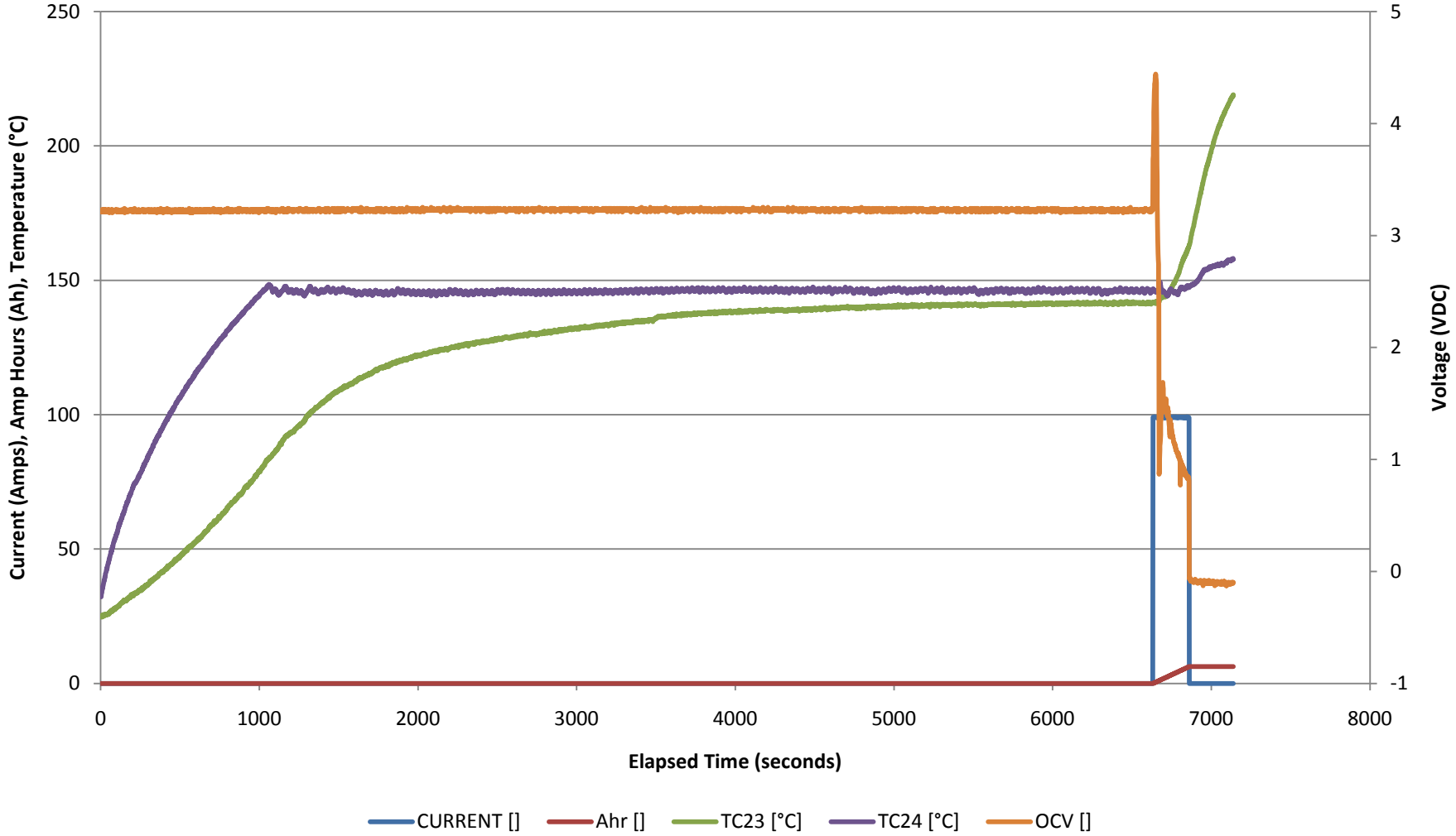
Sample Number	Initial Depth Measured at Sides (mm)				Deformation - Final Depth Measured at Sides (mm)				OCV	OCV installed in fixture	Spark Source present for Igniting gases? (Yes or No)	Cell Shutdown Temperature (°C)	Starting Environment Temperature (°C)	End Environment Temperature (°C)	Environment Temperature at Thermal Runaway (°C)	Peak Cell Temperature (°C)	Was there a visible reaction during test? (Yes or No)	Hazard Severity Level	Comments	Date	Initials	Gauge
	1	2	3	4	1	2	3	4													
1010816979	62.20	61.91	61.91	62.25	72.99	68.73	80.56	84.27	3.3480	3.3480	No	140°C	145°C	145°C	N/A	>250	Yes	4-6	Cell expanded as it soaked to 145°C. When current was applied cell temp. rose quickly. Current held for 2 minutes 40 seconds. Then thermal runaway occurred. Dark smoke was vented/ruptured into the chamber from the cell. No flames were seen on the video, but the casing of the cell was melted and darkened after removal.	28-Feb-11	C.G	MU-600-03, VR-006-01
10090115218	61.96	62.21	62.45	62.17	71.89	68.81	87.71	84.27	3.35	3.35	No	140°C	145°C	145°C	N/A	219	Yes	4-6	Cell expanded as it soaked to 145°C. When current was applied cell temp. rose after approx 40 seconds. Current held for 3 minutes 50 seconds. Then thermal runaway occurred. Dark smoke was vented/ruptured into the chamber from the cell. No flames were seen on the video, but the casing of the cell was melted and darkened after removal.	1-Mar-11	C.G	MU-600-03, VR-006-01

Note: 1) Depth measured in each corner starting with the top left (looking down on the sample with the positive terminal up/at top), working around the sample clockwise.

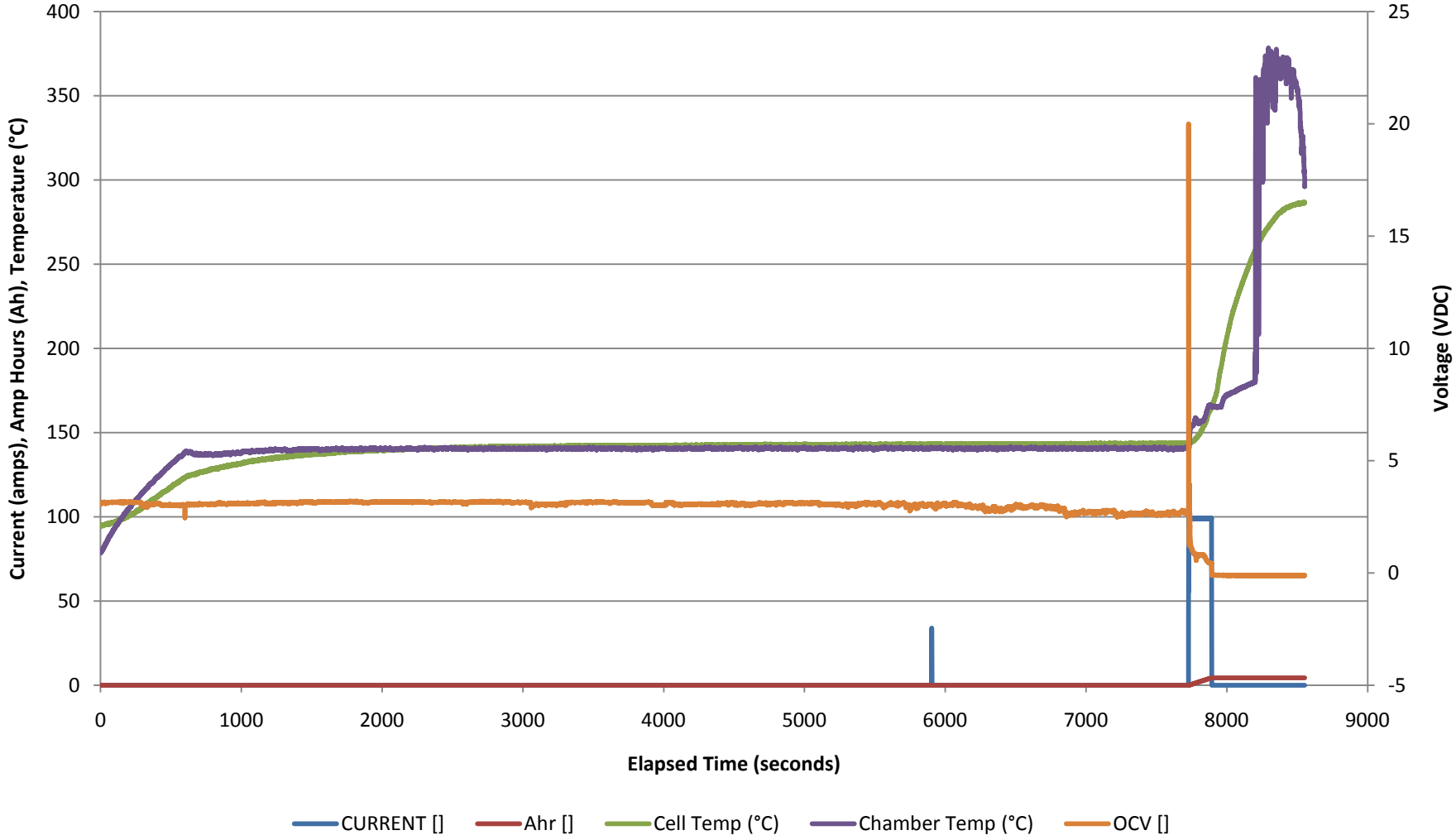
2) Hazard Severity Level rating given without performing spark test during testing, and evaluated as an observation during test only - Not intended as an approval or stamped rating. Level based on EUCAR - SAND2005-3123, Table 2.

3) Hazard level ratings listed as 0-2 were given because samples did not react, but function of battery was not evaluated post testing - customer to make functional determination. Ratings of 3-5 given if cell reacted, because determination of venting versus rupture requires vent locations (not provided), and distinguighing amount of electrolyte lost not evaluated.

Job: TUV-3230, Cell Abuse Testing
Project: Separator Shutdown
Description: Elite Cell, 100Ah 100%soc
Temperature: Ambient
Sample ID: 10090115218



Job: TUV-3230, Elite Cell Abuse Testing
Project: Separator Shutdown
Description: Elite Cell, 100Ah 100%SOC
Temperature: Ambient
Sample ID: 1010816979



Appendix H:
Digital Test Data

(1 Data Storage Device)