
TULMAR

TULMAR SAFETY SYSTEMS INC.

Your official Distributor for CELLBLOCK FCS



Fire and Smoke Suppression Kit

for Lithium-Ion Battery Thermal Fire Runaway Incident

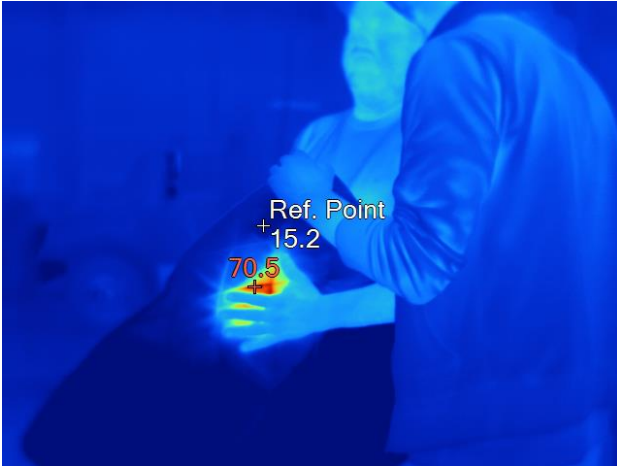
No Halon, No Water, No Spray Agent

The foregoing results were obtained during a LIVE DEMO where we re-created Lithium-Ion Batteries Thermal Runaway Incidents and were successful in showing how quickly, safely and efficiently such an incident can be controlled without the use of water, halon or spray agent.

Report Prepared By:
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Int'l Acc't Mgr, Defence Systems
TULMAR SAFETY SYSTEMS INC.

LIBIK

Fire Blanket Flame/Heat Protection Demo



IR_00042.IS2

12/2/2019 11:03:32 AM

Torch flame applied to opposite side of shown.

NOTE: Blanket material safe to touch.



Visible Light Image – hand directly against inner side (black) of blanket with Torch flame in the same location on the outer side (blue).

Image Info

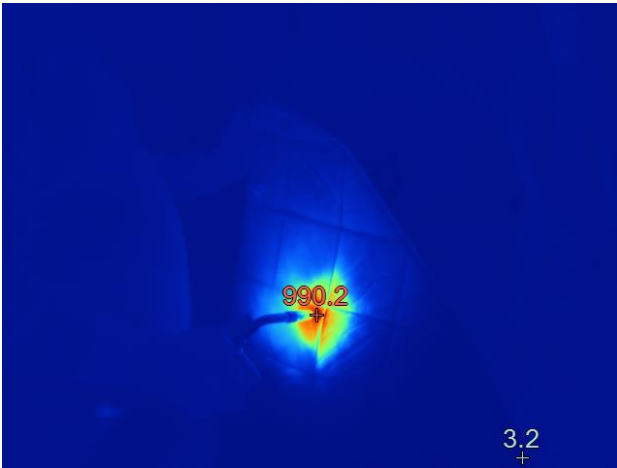
Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

Main Image Markers

Name	Temperature
Hot	70.5°C
Ref. Point	15.2°C

LIBIK

Fire Blanket Flame/Heat Protection Demo



IR_00043.IS2

12/2/2019 11:03:56 AM

Blow torch flame applied to one side (may be applied on either side). Flame directly on the outer side (blue) may cause a slight discoloration .



Visible Light Image – Torch flame applied directly to inner side (black) of blanket.

Image Info

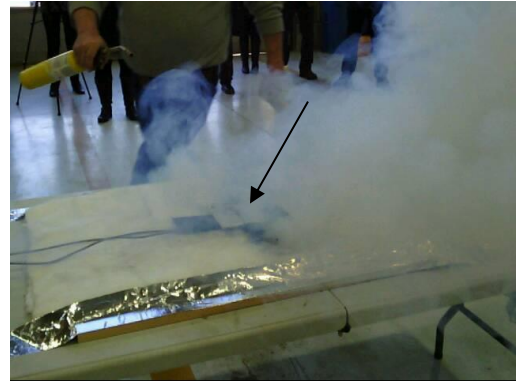
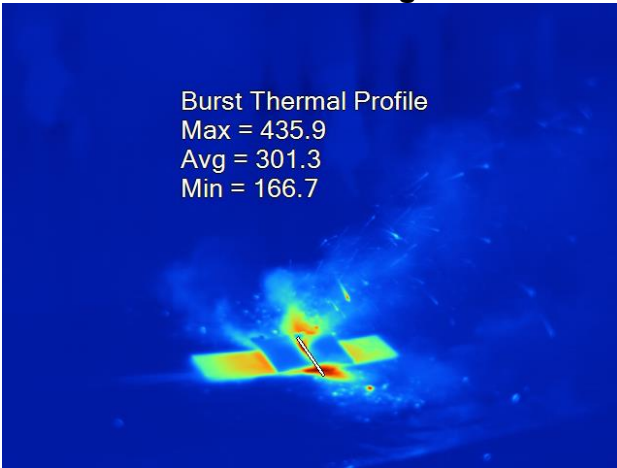
Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

Main Image Markers

Name	Temperature
Hot	990.2°C
Cold	3.2°C

LIBIK Li-Ion Battery Burn Demo

Re-creating Thermal Runaway Incident Cell Phone

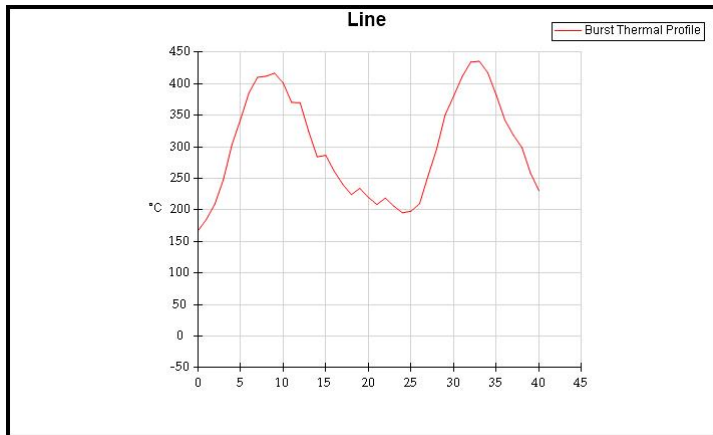


Visible Light Image –

IR_00073.IS2

12/2/2019 11:10:55 AM

Li-Ion Cells thermal runaway event in full progress.



Graph

Image Info

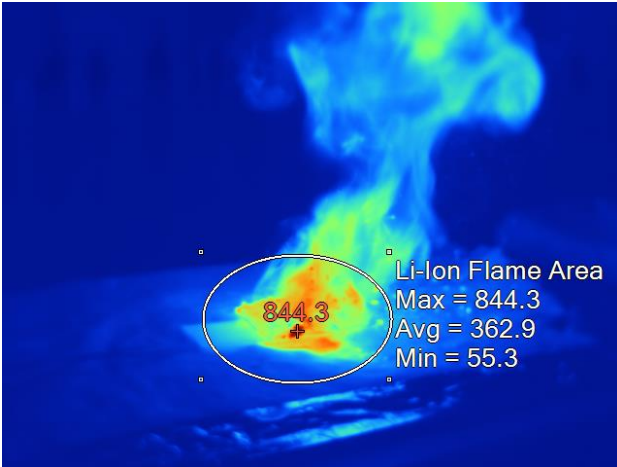
Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

Main Image Markers

Name	Max
Burst Thermal Profile	435.9°C

LIBIK Li-Ion Battery Burn Demo –

Re-creating Thermal Runaway Incident – Cell Phone



Visible Light Image -

IR_00075.IS2

12/2/2019 11:11:01 AM

Li-Ion in full thermal runaway. Open flames with HF Gas (Hydrogen Fluoride) - highly toxic.

Image Info

Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

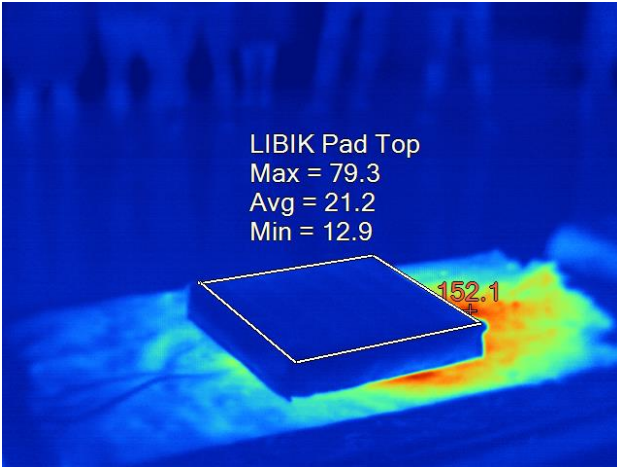
Main Image Markers

Name	Max
Li-Ion Flame Area	844.3°C

Name	Temperature
Hot	844.3°C

LIBIK Li-Ion Battery Burn Demo

PED PAD filled with Cellblock-X Beads applied on top Cell Phone



Visible Light Image

IR_00077.IS2

12/2/2019 11:11:08 AM

PED pad applied ~35 seconds after burst.

NOTE: No toxic fumes.

Image Info

Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

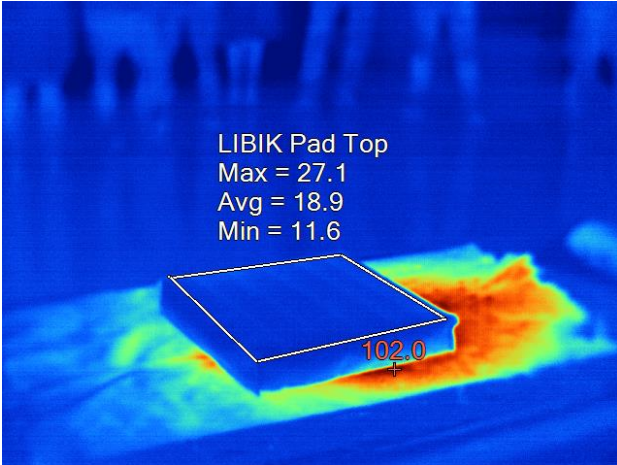
Main Image Markers

Name	Max
LIBIK Pad Top	79.3°C

Name	Temperature
Hottest point	152.1°C

CellBlock LIBIK Li-Ion Battery Burn Demo

PED PAD filled with Cellblock-X Beads applied on top Cell Phone – 15 Sec.



Visible Light Image

IR_00078.IS2

12/2/2019 11:11:11 AM

LIBIK PED pad applied ~15 seconds after burst.

Image Info

Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

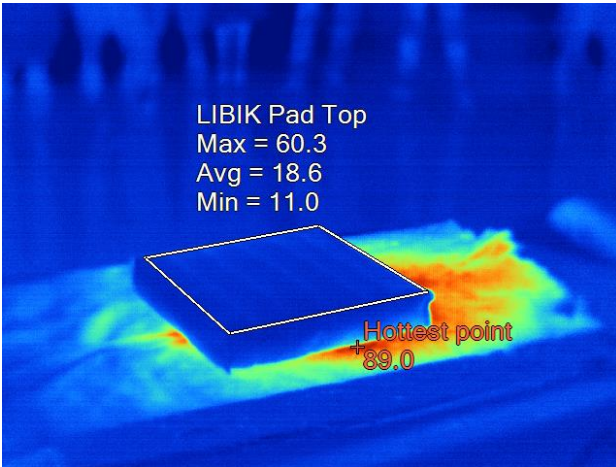
Main Image Markers

Name	Max
LIBIK Pad Top	27.1°C

Name	Temperature
Hottest point	102.0°C

CellBlock LIBIK Li-Ion Battery Burn Demo

PED PAD filled with Cellblock-X Beads applied on top Cell Phone – 25 Sec.



Visible Light Image

IR_00079.IS2

12/2/2019 11:11:15 AM

LIBIK PED pad applied ~25 seconds after burst.

Image Info

Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

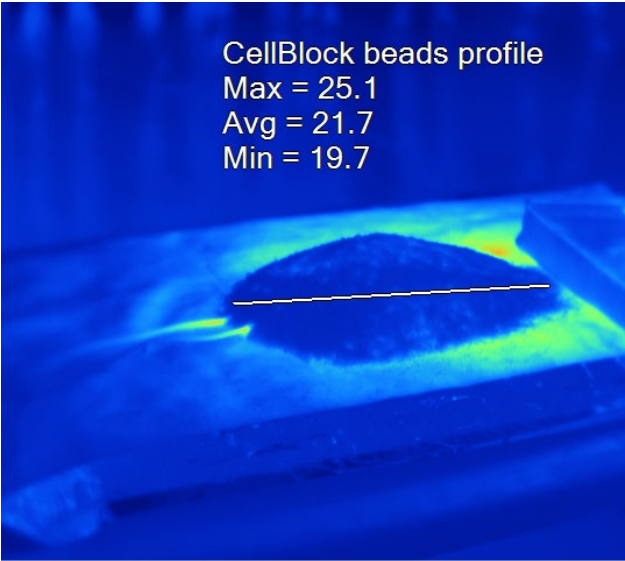
Main Image Markers

Name	Max
LIBIK Pad Top	60.3°C

Name	Temperature
Hottest point	89.0°C

CellBlock LIBIK Li-Ion Battery Burn Demo

PED PAD filled with Cellblock-X Beads applied on top Cell Phone – 60 Sec.



Visible Light Image

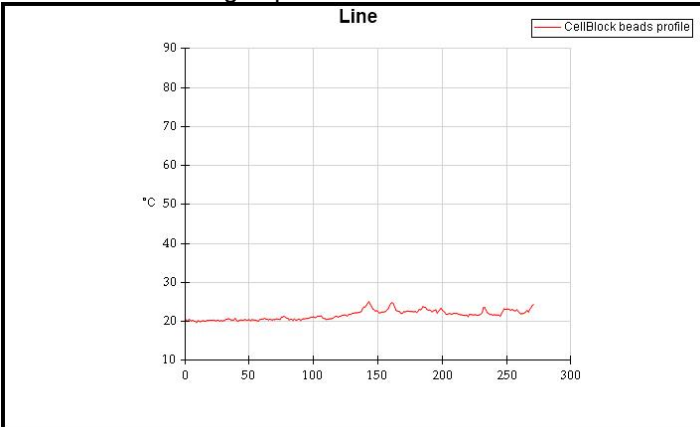
IR_00083.IS2

12/2/2019 11:11:28 AM

LIBIK PED pad removed ~60 seconds after Li-Ion fire extinguished.

NOTE 1: Temp. w/in safe range.

NOTE 2: No toxic gas present.



Graph

Image Info

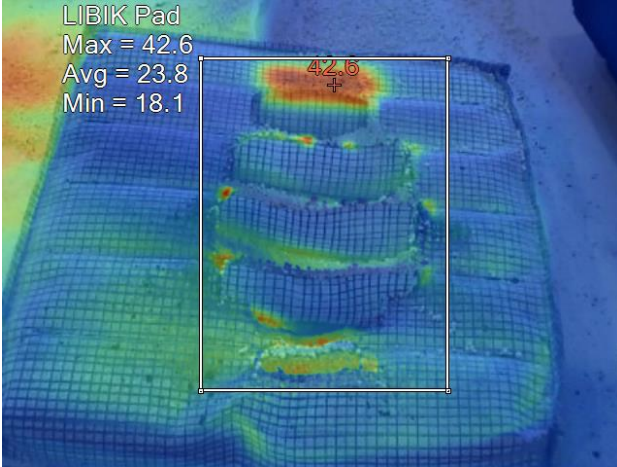
Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

Main Image Markers

Name	Max
CellBlock beads profile	25.1°C

LIBIK –

Cellblock-X Beads - Lithium-Ion Battery Burn Demo – Aftermath



Visible Light Image – Beads were successfully released from the PED Pad

IR_00084.IS2

12/2/2019 11:12:04 AM

Under side of LIBIK PED-Pad ~90 seconds after Li-Ion fire has been extinguished.

Image Info

Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

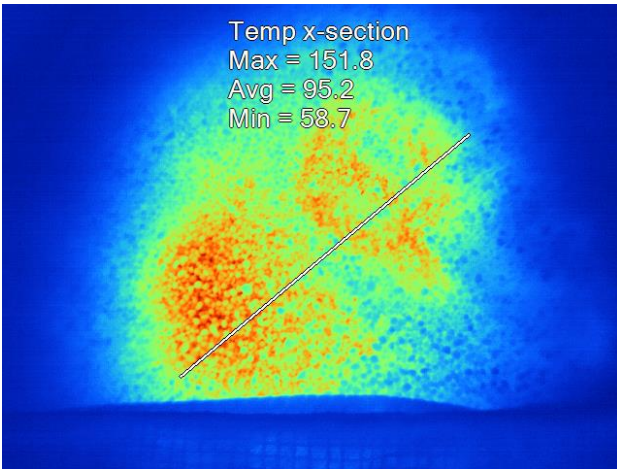
Main Image Markers

Name	Max
LIBIK Pad	42.6°C

Name	Temperature
Hot	42.6°C

LIBIK

Cellblock-X Beads - Post Fire-Suppression

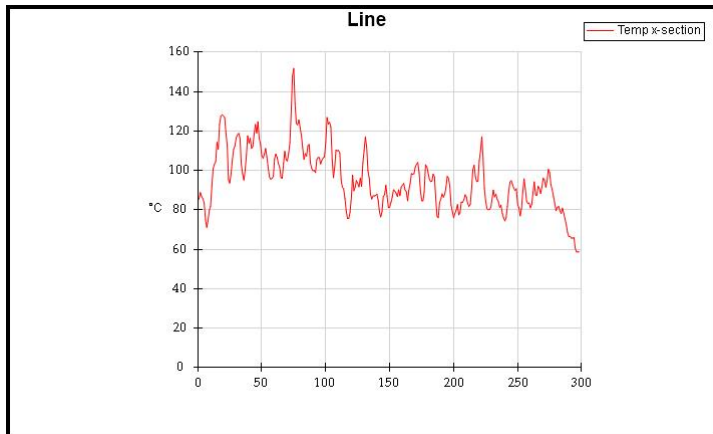


Visible Light Image – Released Beads covering the Cell Phone – suppressing fire, toxic gases and smoke.

IR_00113.IS2

12/2/2019 11:34:02 AM

Thermal profile of extinguished Li-Ion fire approx. 12 minutes after event.



Graph

Image Info

Emissivity	0.95
Camera Model	Ti480P
IR Sensor Size	640 x 480
Camera Manufacturer	Fluke Thermography
Distance to Target	10.39m

Main Image Markers

Name	Max
Temp x-section	151.8°C

Summary

The CellBlock LIBIK Kit demonstration was conducted inside the Hawkesbury Fire Hal main garage on December 2nd, 2019.

Ambient temperature was ~16 deg. C with adequate ventilation.

Present at the test were representatives from CellBlock, Canadian North/First Air, Transport Canada, Hawkesbury Fire Service and Tulmar Safety Systems Inc.

The demonstration was comprised of two controlled tests:

- 1) Li-Ion battery thermal runaway in open air;
- 2) Li-Ion battery thermal runaway inside a CellBlock case.

In both cases, any danger caused by Li-Ion battery/cell fire was mitigated as demonstrated by the reports thermal images.

Further, HF (Hydrogen Fluoride) gas emissions were effectively controlled by the LIBIK Kit PED-Pad and blankets during the open air test.

NOTE: Additional control and mitigation of HF gas dispersion may be obtained by use of optional LIBIK Kit gas filters.

Disclaimer

The information contained in this report is intended for demonstration purposes only.

Tulmar Safety Systems Inc. makes no guarantees as to the validity or accuracy of the report data or its findings.