Transportation Testing Techniques

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RAM V
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Objective

- Importance of testing
- Transportation conditions
- Methods for simulating

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Importance of Testing & Transportation Conditions

- Temperature
- Humidity
- Altitude
- Vibration
- Shock loading

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Environmental Conditions

- Shipped a data logger sensor to Korea, Germany, and within the US
  - 15.5% RH – 59% RH
  - Sea Level – 7000 ft
  - 2.6°C – 38.7°C

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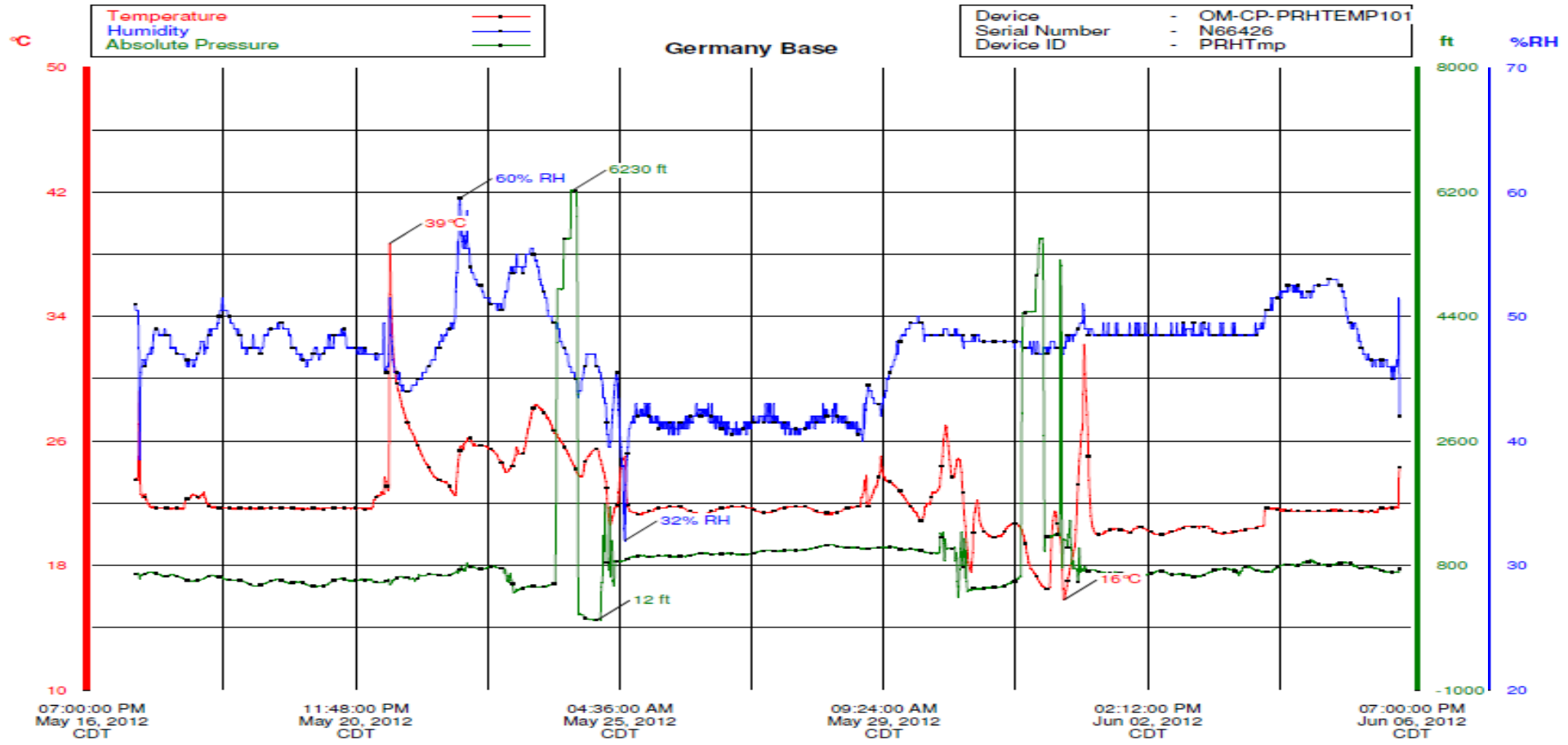
Environmental Conditions



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Testing Methods
Environmental Conditions

- Relative Humidity & Temperature
  - 5% – 95% RH
  - -40° – 100°C
- Altitude & Temperature
  - Sea level – 100,000 ft
  - -40° – 100°C

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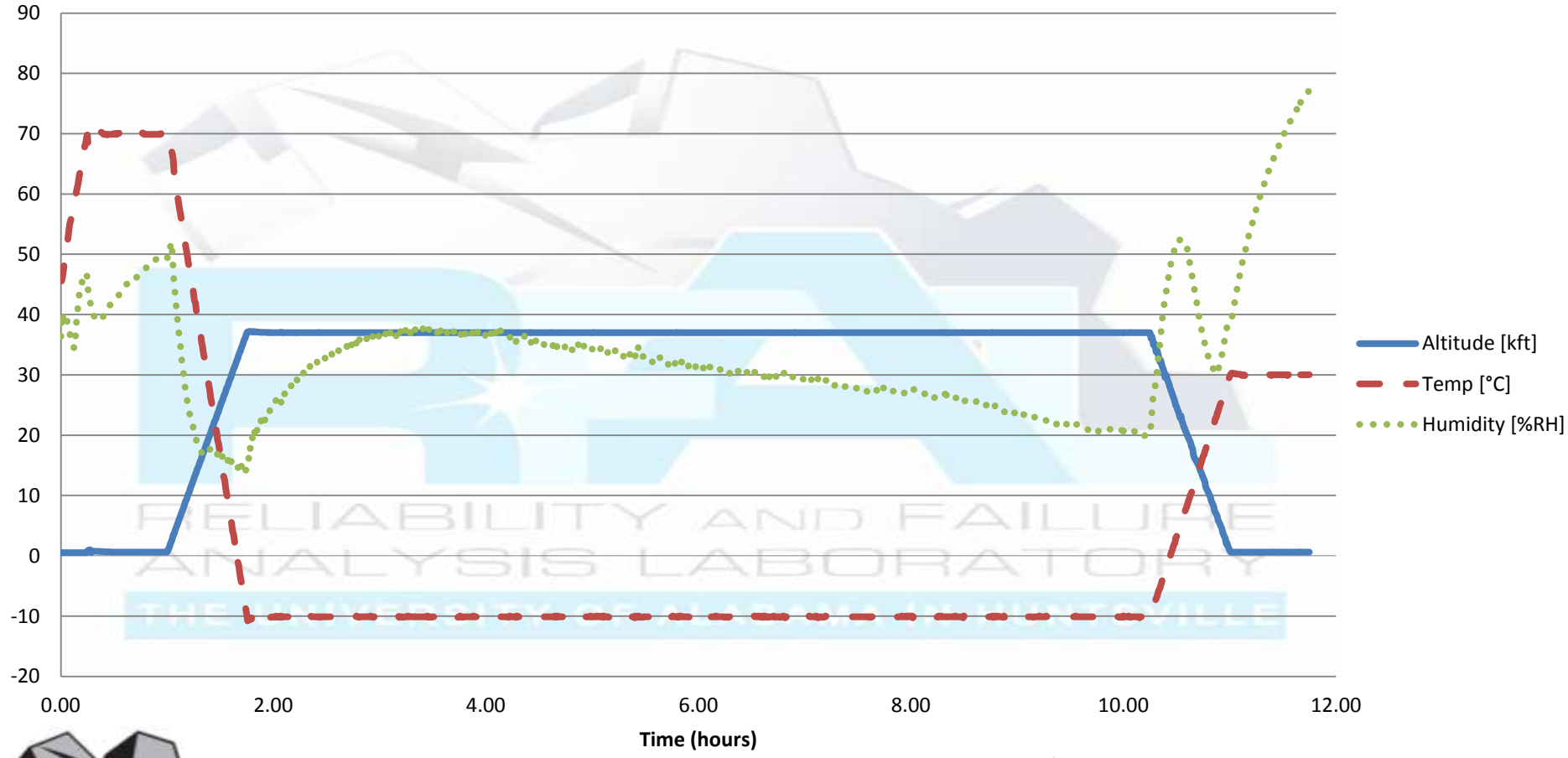

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Testing Methods
Vibration & Drop Testing

- ISTA-6-FedEx-A Standard
  - ASTM D4728
- Random Vibration Test:
  - Truck Vibration at 0.52 Grms (15 min)
  - Air Vibration at 1.06 Grms (15 min)
  - Repeat Truck Vibration at 0.52 Grms (15 min)
- Series of 10 drops ISTA-6-FedEx-A Standard
  - 6 faces
  - 1 corner
  - 3 edges

FedEx

ASTM INTERNATIONAL
Standards Worldwide

Package Weight	Drop Height	Drops per Sequence
w ≤ 75 lbs.	30"	10
75 lbs. < w ≤ 100 lbs.	24"	10
100 lbs. < w ≤ 150 lbs.	18"	10

RAL
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Testing Methods
Random Vibration

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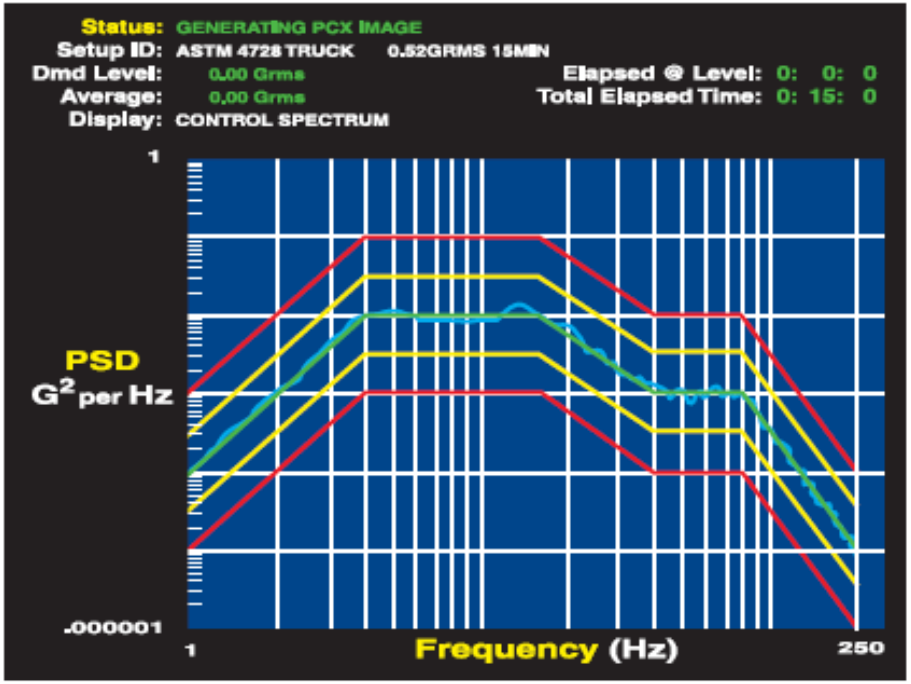
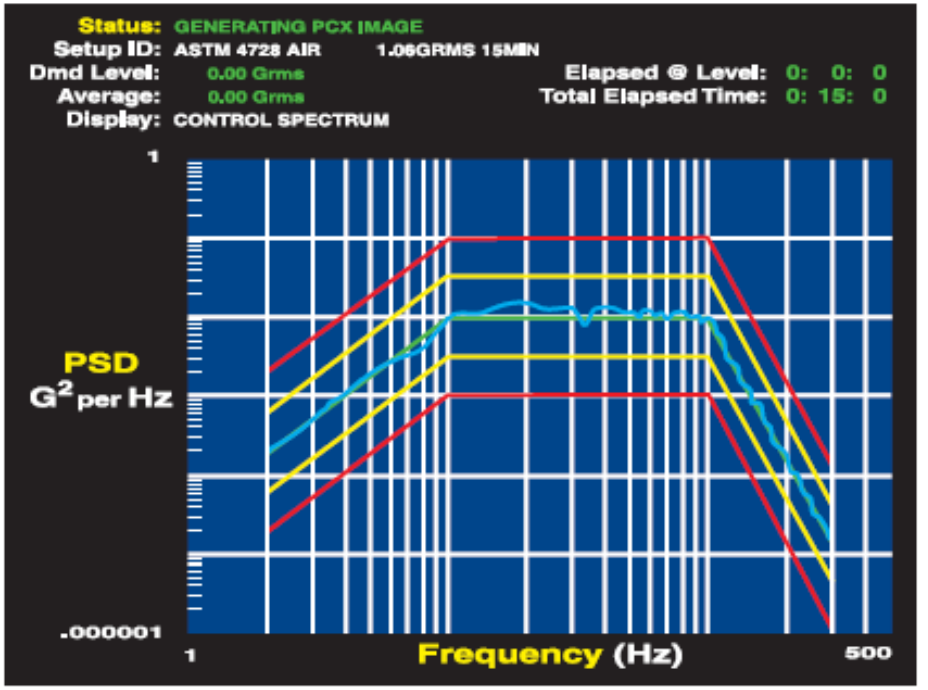
Testing Methods
Random Vibration

Truck Random Vibration Profile



Aircraft Random Vibration Profile



*Images from Fed-Ex Packaging Brochure 0004523PM-Rev. 3/11

Truck		Air	
Frequency Hz	Level g^2/Hz	Frequency Hz	Level g^2/Hz
1	0.00005	2	0.0002
4	0.01	12	0.01
16	0.01	100	0.01
40	0.001	300	0.00001
80	0.001		
200	0.00001		
Overall Level, g rms	0.52		1.05

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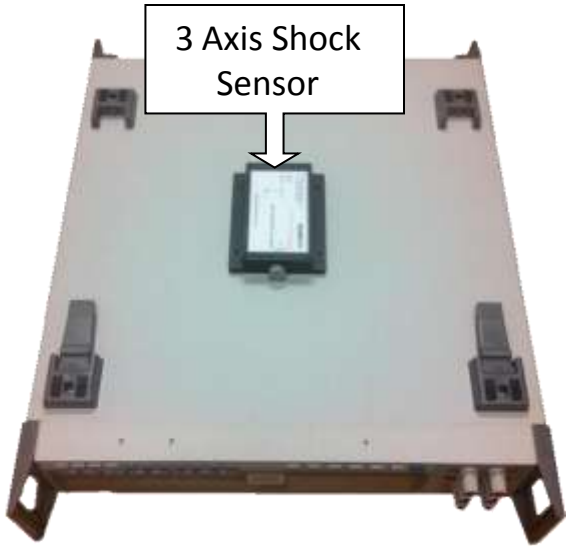
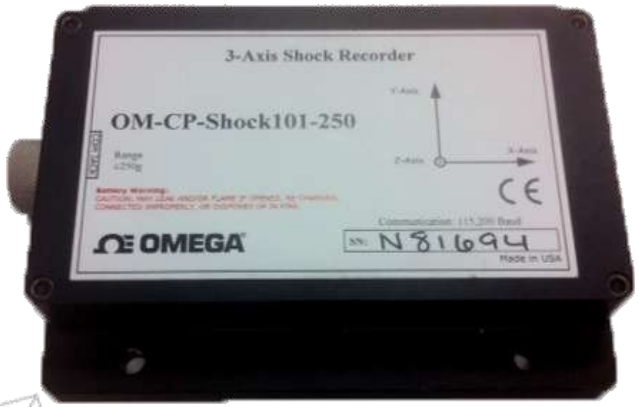
Testing Methods
Free-Fall Drop Test





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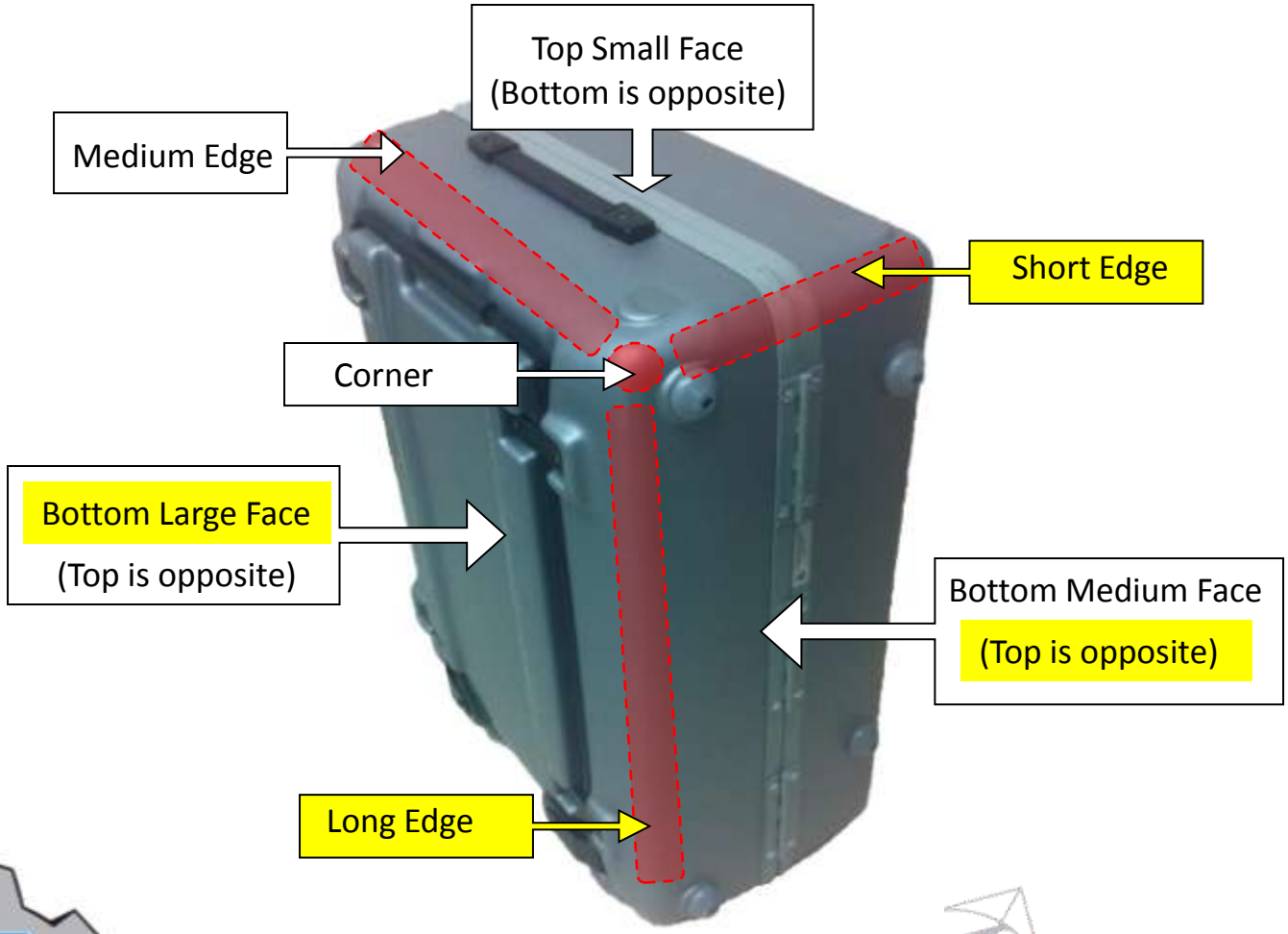

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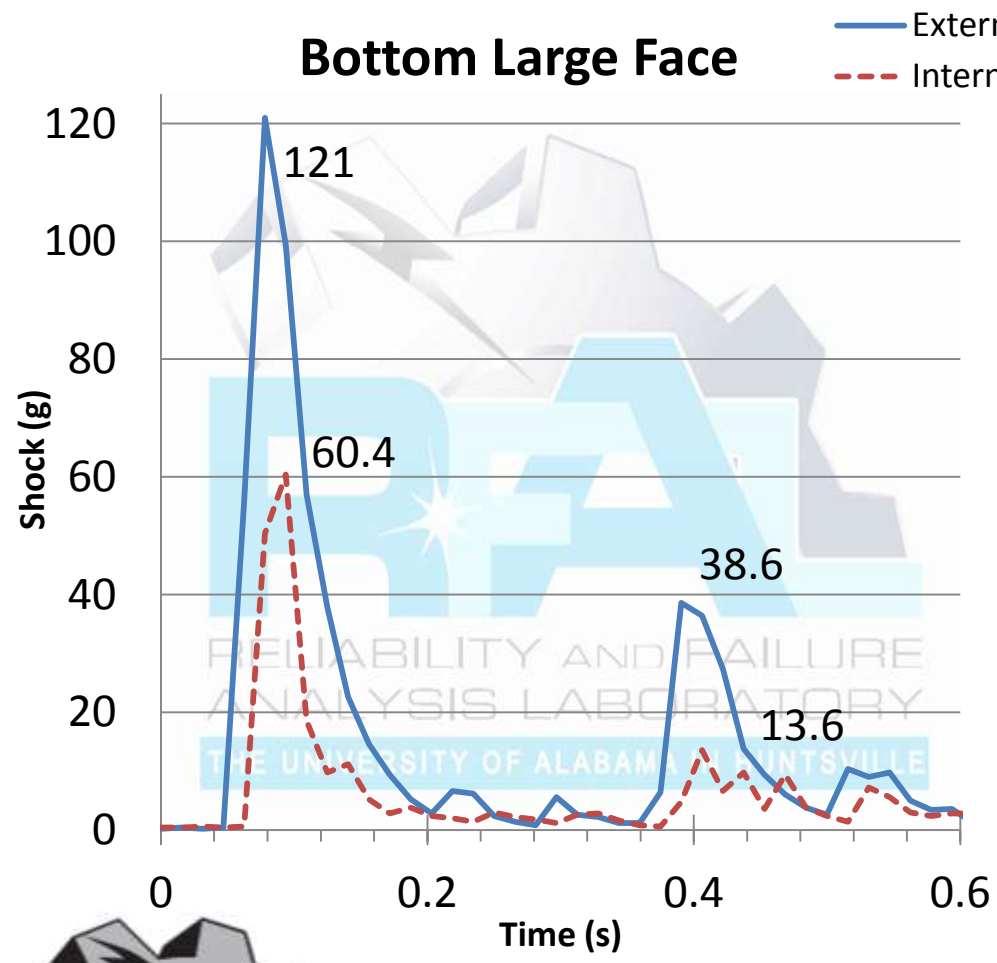

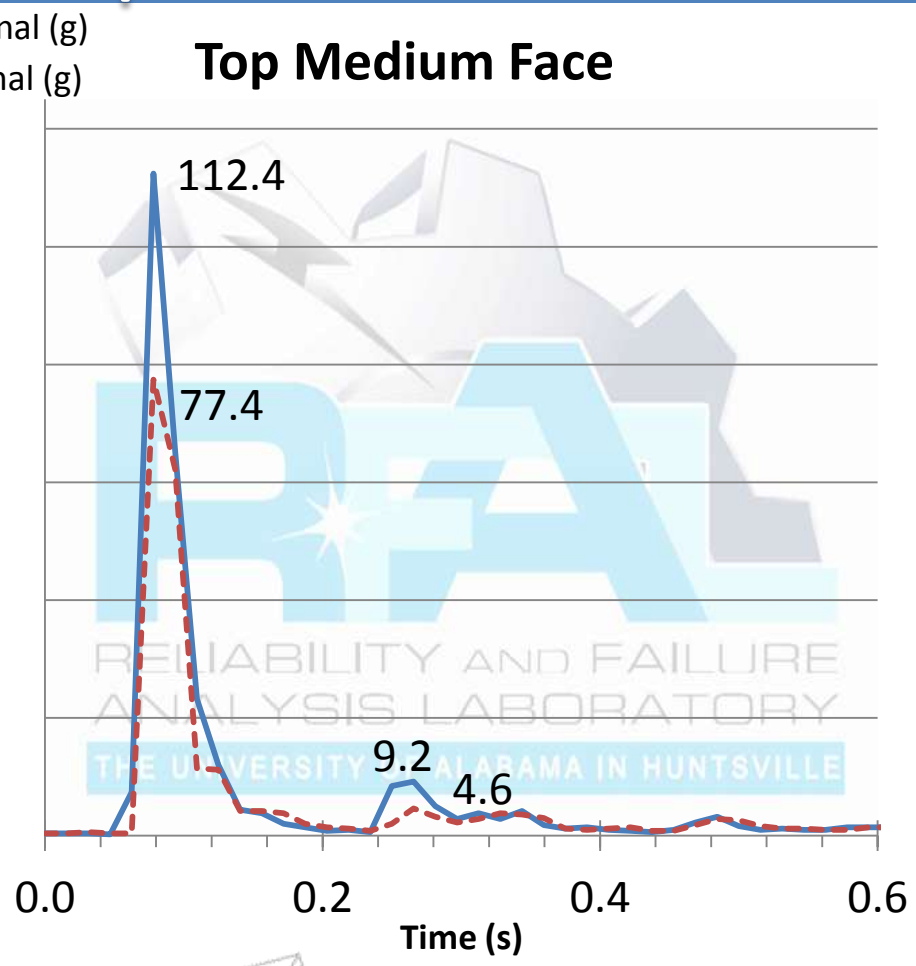

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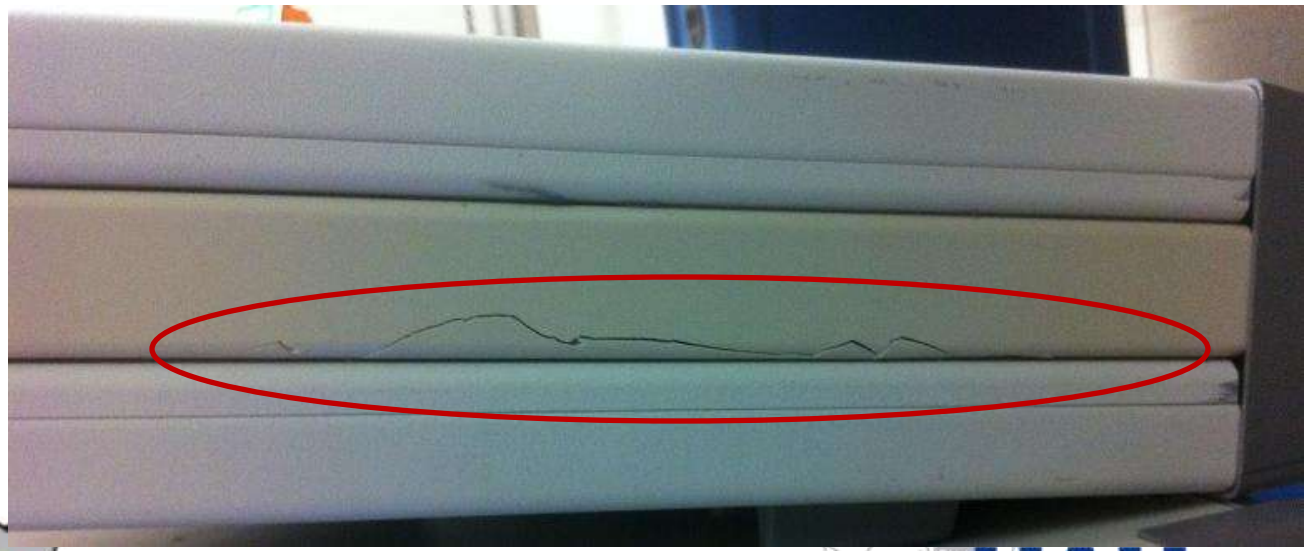

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Long Edge

Short Edge

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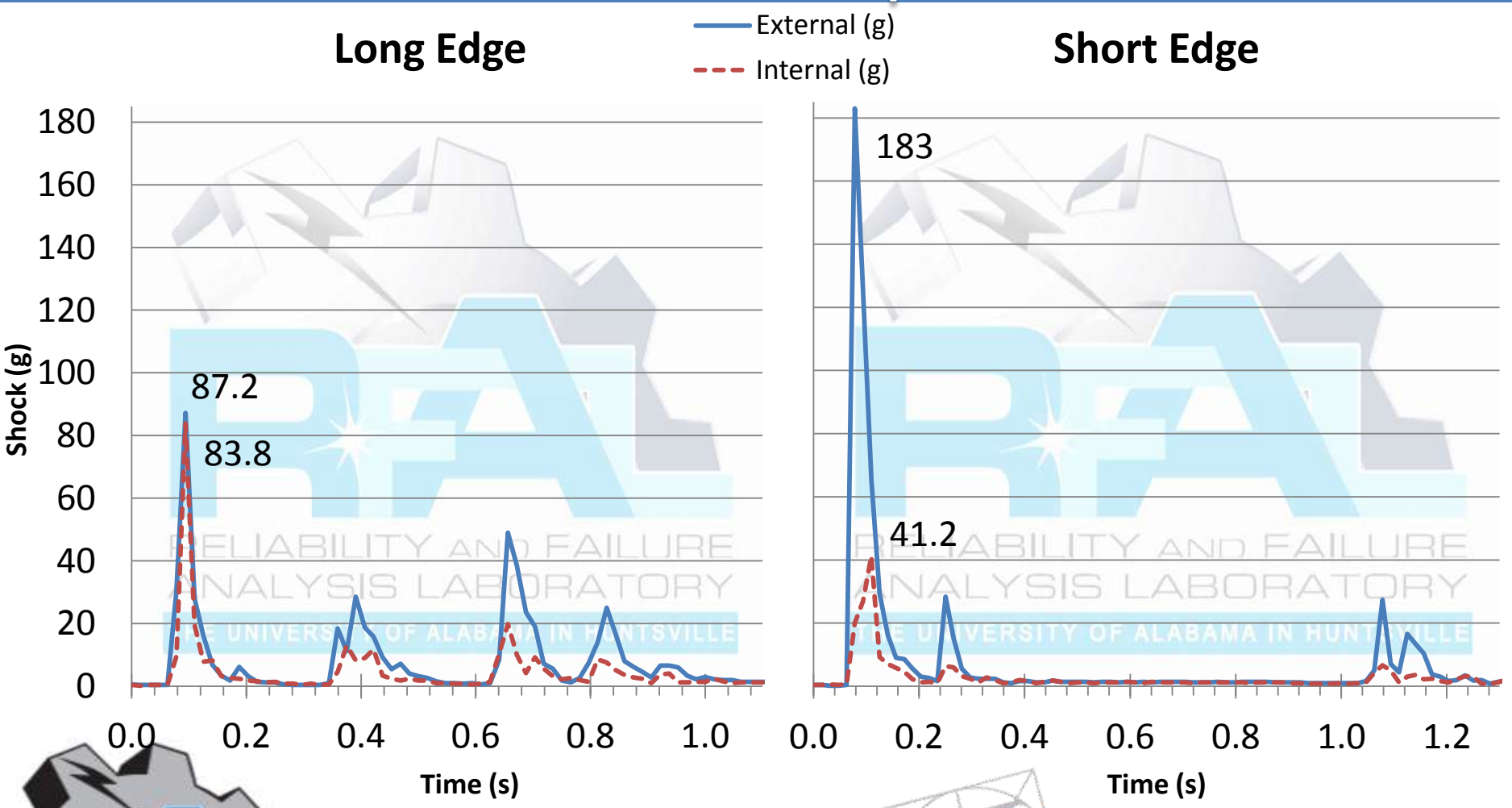

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Conclusion

- Can’t forget about shipping!
  - Ensure equipment can survive under normal shipping conditions
  - Data to prove the equipment can survive shipping
  - In the test presented, the case failed

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Questions?

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