Impact Switch Investigation

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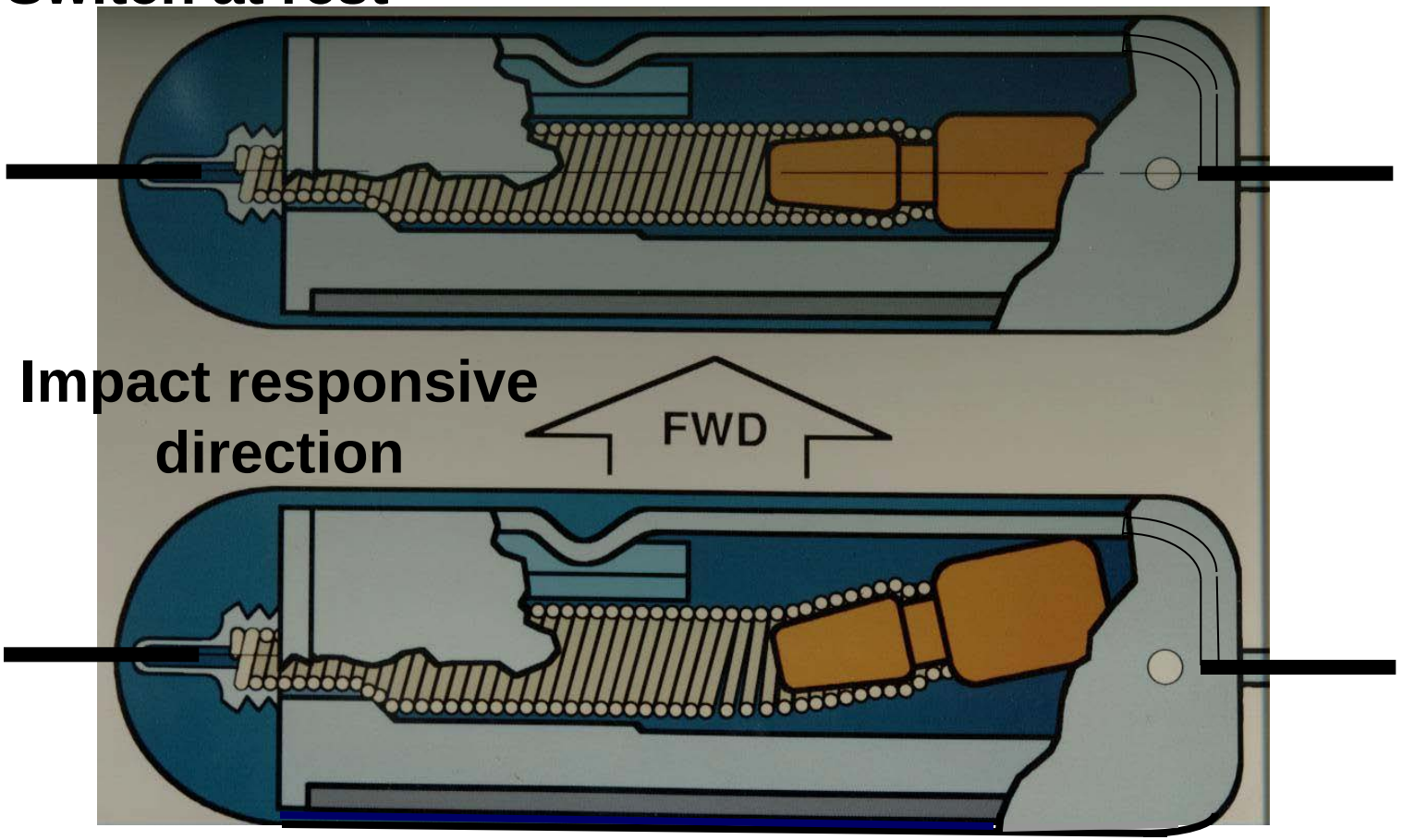
Impact Switch
Investigation

- Investigation objective is to characterize switch vibration response
  - Investigation is 40% complete
  - Vibration test level is based on estimated and actual flight test data
- Reporting on preliminary result
  - This data is not yet applicable to any system in use
  - Switch becoming more sensitive to vibration as exposure is accumulated
- Has plan to complete switch characterization with vibration levels from flight testing

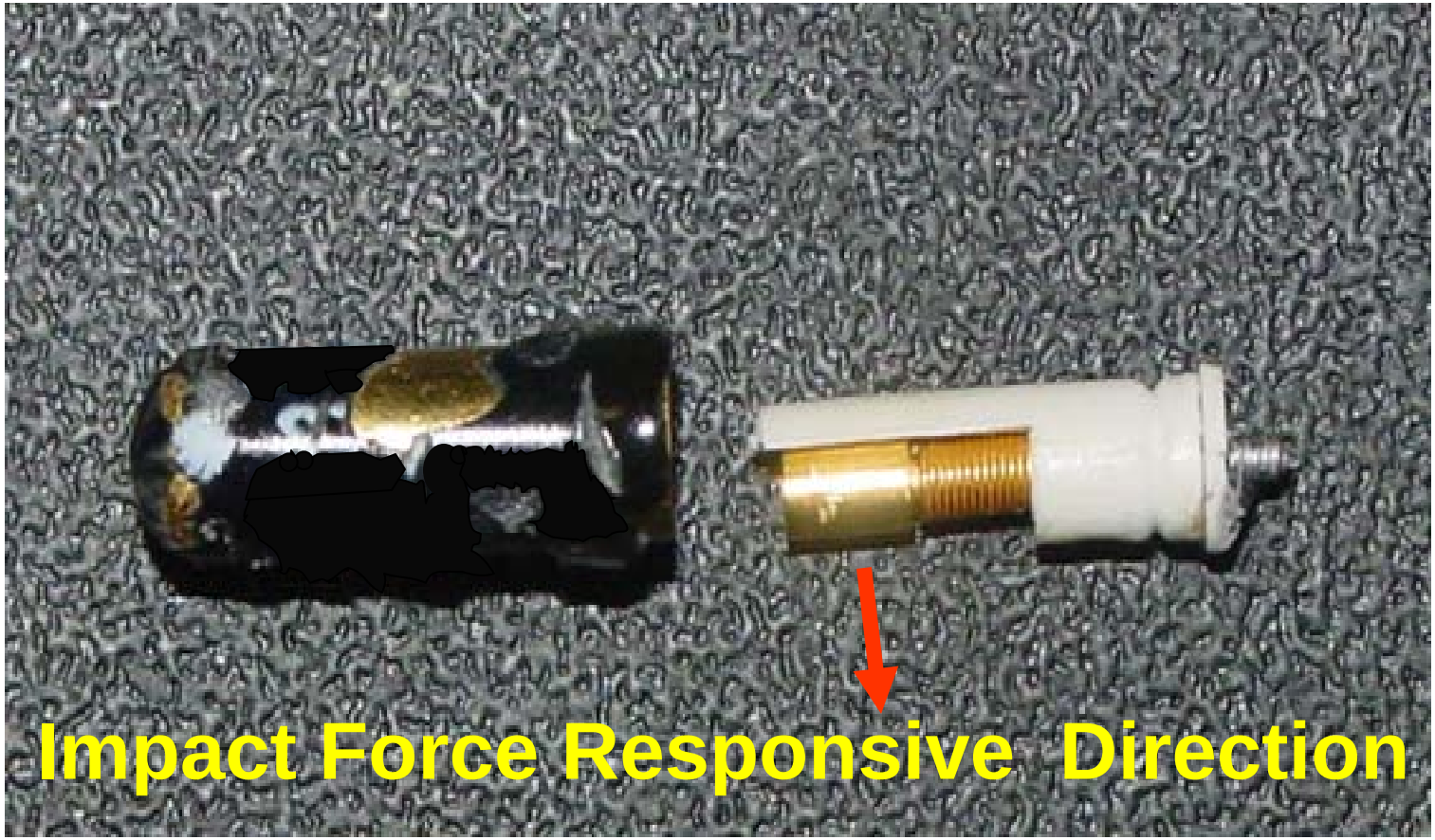
Impact Switch
How It Works

Switch at rest

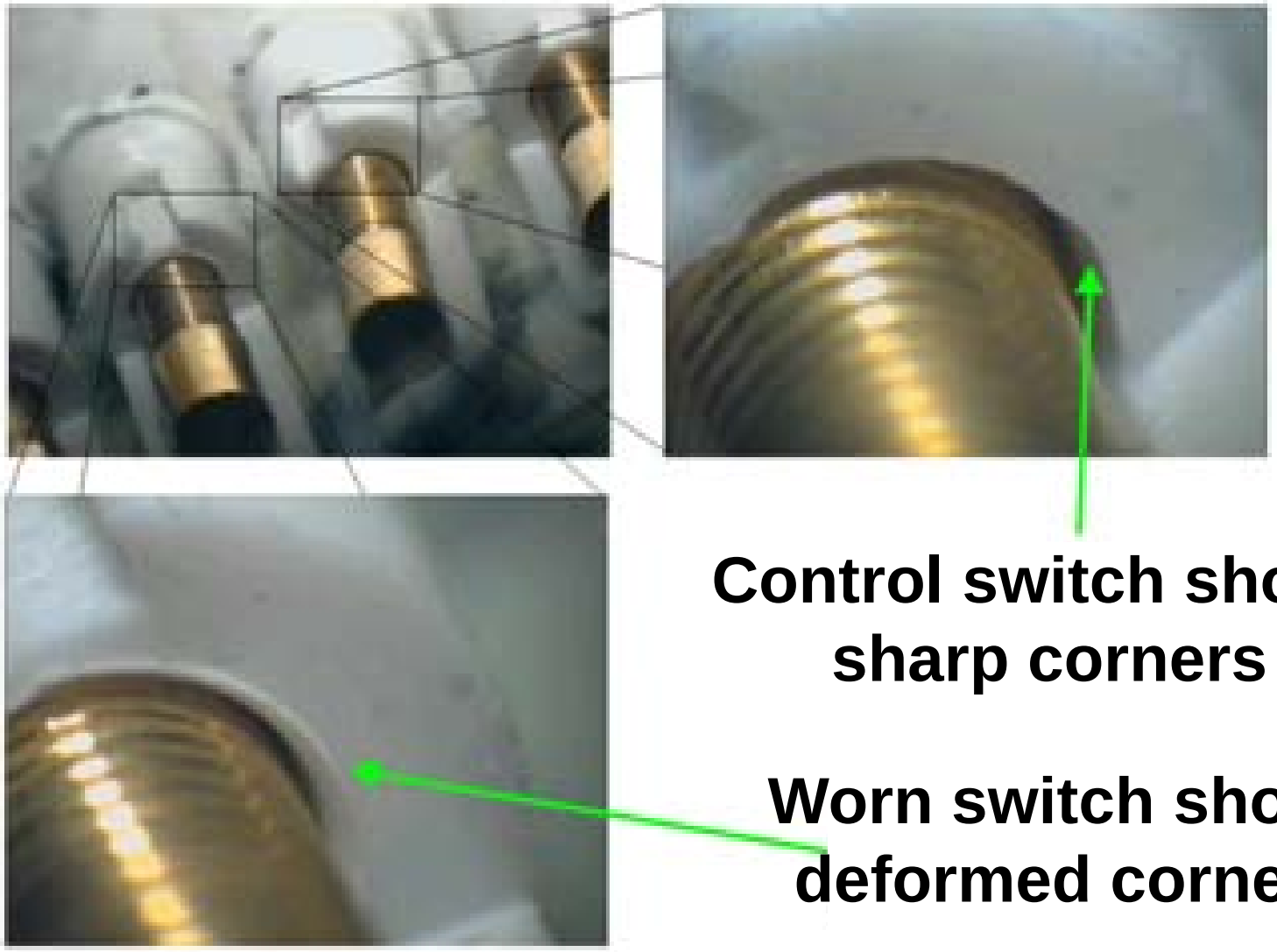


Impact Switch Construction

Partially disassembled switch



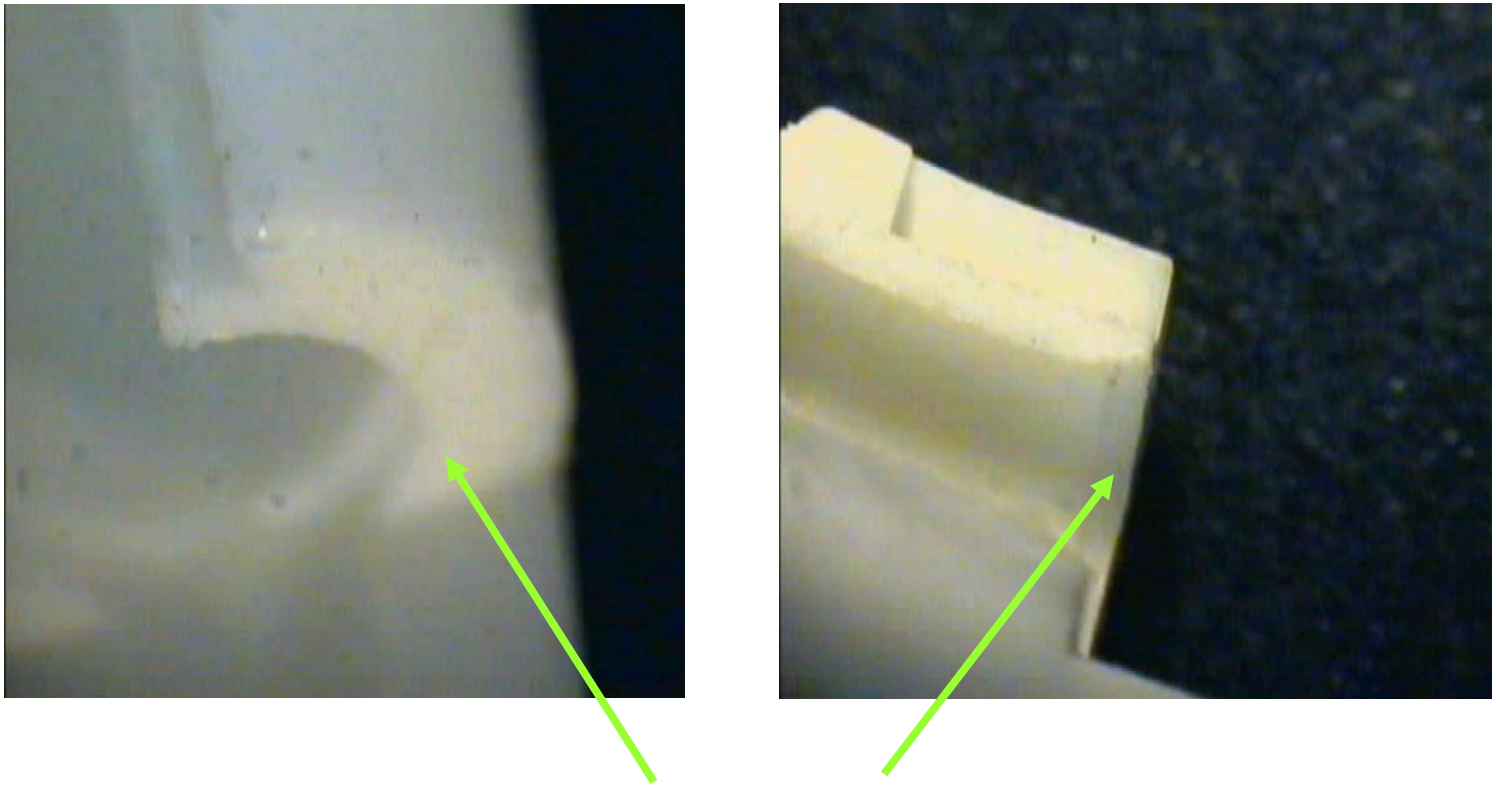
Impact Switch
New vs. Worn Out



Control switch shows sharp corners

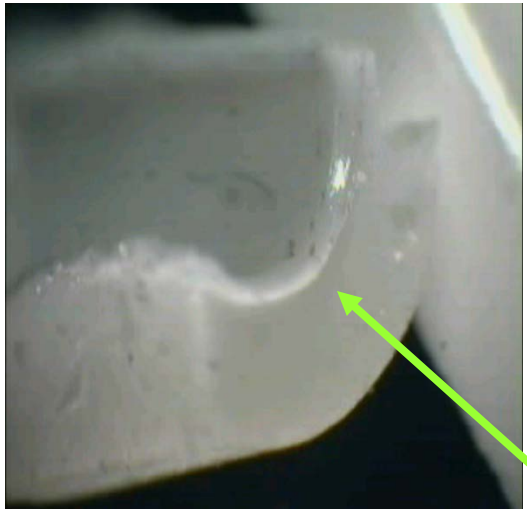
Worn switch shows deformed corners

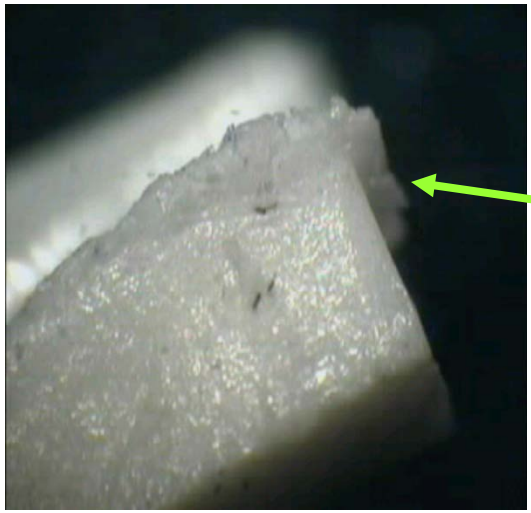
New Impact Switch



New Switch Plastic Body

Worn Impact Switch





Body Deformed

Impact Switch Production Test Spec

- Pendulum Test
  - Switch remains open at velocity change = x ft/s
  - Switch closes at velocity change = y ft/s

- Centrifuge test
  - Switch closes at xx g
  - Switch remains open at yy g

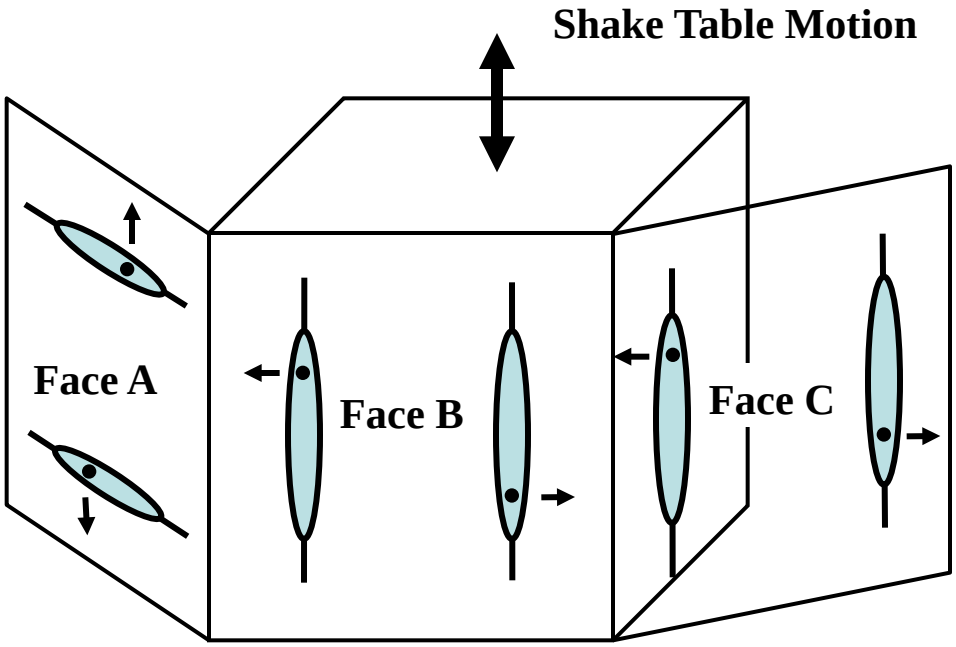
- Sine vibration environmental conditioning
  - 5 g for 30 minutes
  - Frequency sweep = 10 to 2k Hz

Impact Switch

Vibration Characteristic Test Set Up

Vibration test fixture

(With up to 12 switches per side)

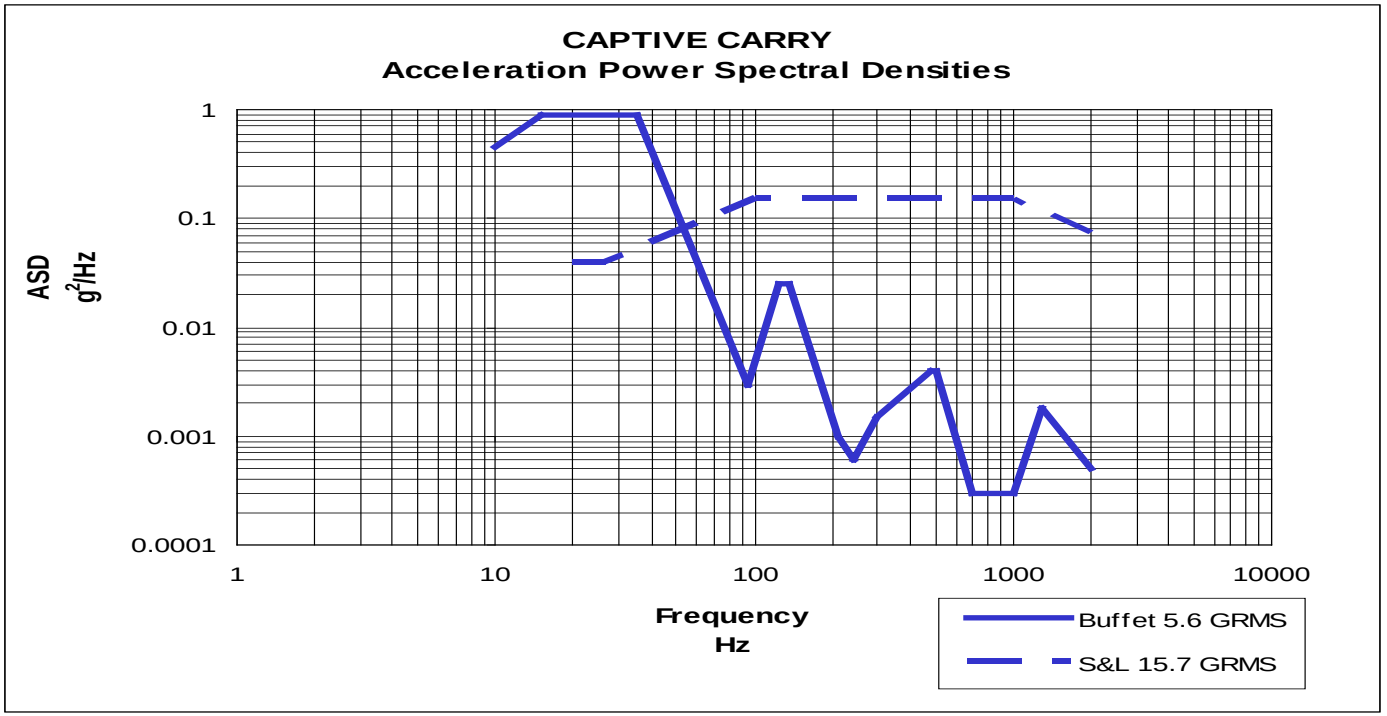


Impact Switch Placement on cube

Impact Force Responsive Direction

Impact Switch
Vibration Test Levels

- **Estimated captive carry vibration test level**



- **Free flight vibration test level was from flight test data**

Group1 Impact Switches Vibration Test Data

Looking for trigger threshold (12 Switches on Face A had response)

	Test 1	Test 2	Test 3	Test 4
Sine Sweep	Start from 5g, 50 - 2kHz 5g = trigger, 50-120Hz	From 5 g going down, 5-150 Hz 0.7g = trigger, 35-50 and 80-90 Hz		
Estimated Captive Carry			Start from 1x 1 x = trigger	
Free Flight				Start from 1x 1x = no trigger 1.26 x = trigger

Group1 Impact Switches Vibration Test Data

Face B and C Switches Moved to Face A (10 Switches)

	Test 1	Test 2	Test 3	Test 4
Sine Sweep		Start from 5g going down 3g = trigger		
Captive Carry				
Free Flight	Start from 1x 5x = trigger		Start from 1x 3.16x = trigger	Start from 1x 1.26x = trigger

Note the quick drop in free flight trigger threshold
Switches would still pass G trigger threshold test

Fresh Impact Switches Vibration Test Data

12 New Switches on Face A

	Test 1	Test 2
Sine Sweep		Start from 1g, 50–1kHz 4g = trigger, 50-120Hz
Captive Carry		
Free Flight	Start from 1x 1 to 10 x = no trigger	

Impact Switch

Preliminary Characteristic/Conclusion

- Based on limited test data
- Transition from fresh to worn switch is TBD
  - Transition is rapid at a TBD level
  - No change in impact g trigger level
- New switch vibration trigger threshold
  - Sine: 4g, 80-90 Hz
  - Captive carry: TBD
  - Free flight: ≥ 10x
- Worn switch vibration trigger threshold
  - Sine: 0.7 g, 40-50 Hz and 80-90 Hz
  - Captive carry: ≤ 1x
  - Free flight: 1.26x
  - No change in impact g trigger level

Impact Switch To Complete Characterization

Plan is to get 3 D plot on switch:

Trigger Threshold = F(Vibration Level, Exposure Time)