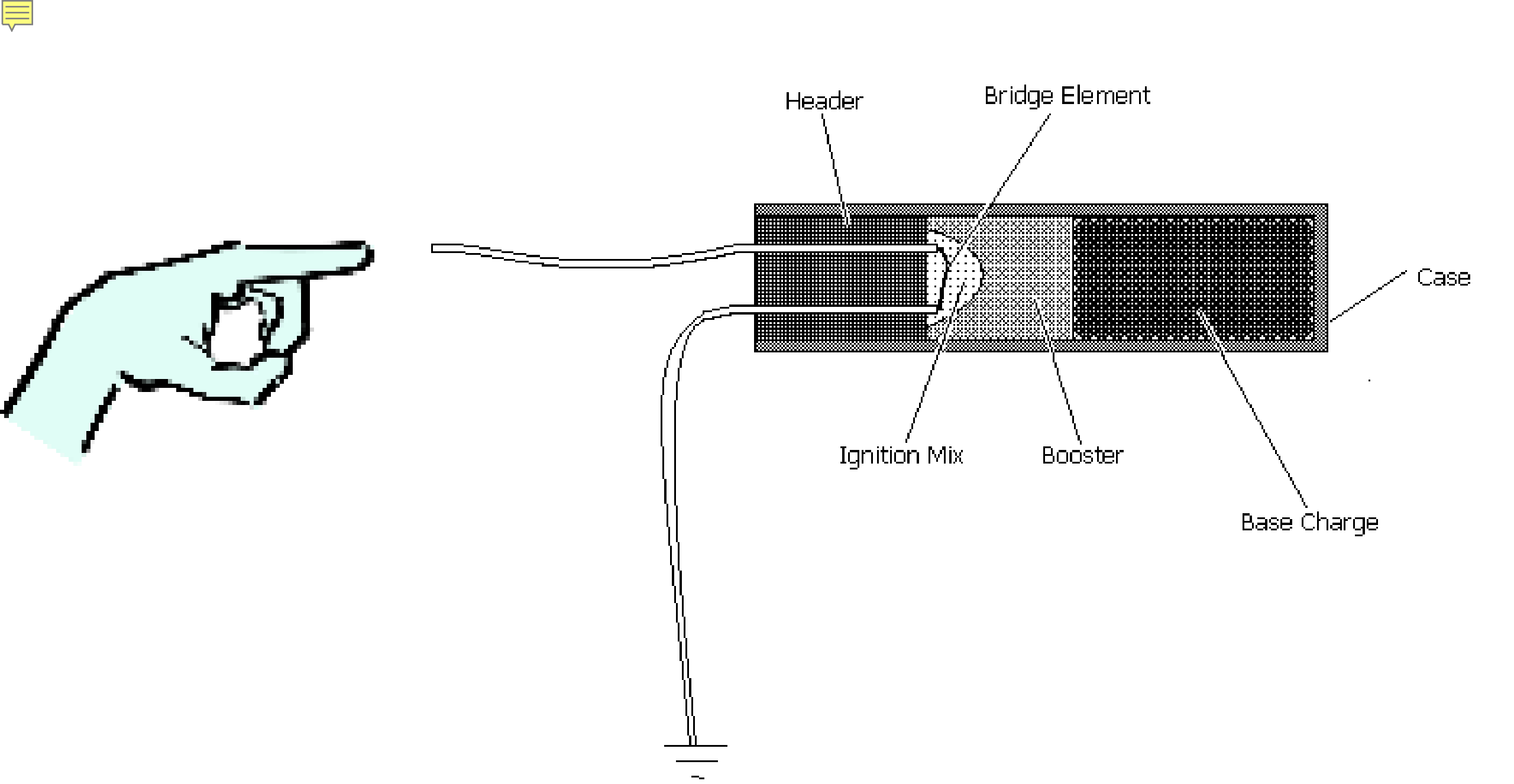
Likelihood of ESD Firing an Electric Initiator

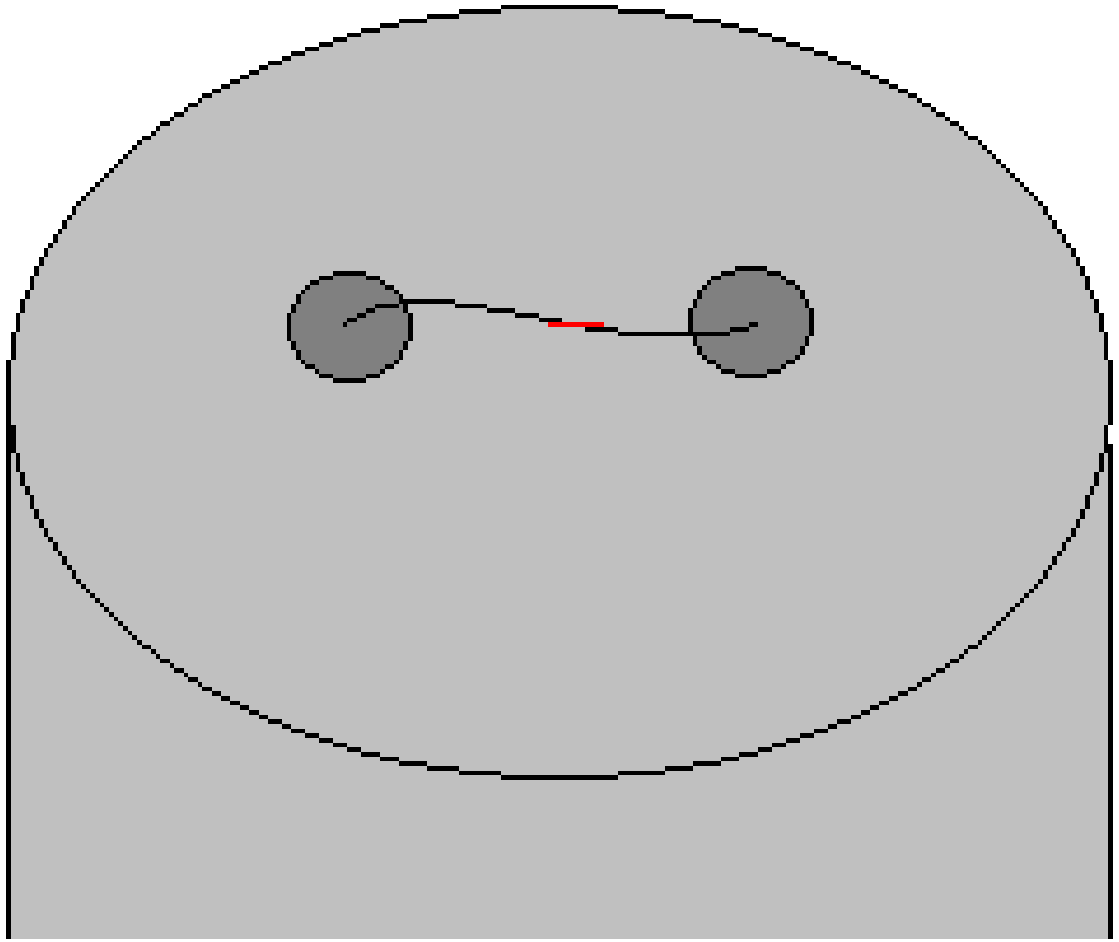
*James G. Stuart, Franklin Applied Physics, Inc.

John P. Norton, NSWC – Indian Head Division

Stephen A. Smith, NSWC – Indian Head Division


Header
Bridge Element
Case
Ignition Mix
Booster
Base Charge

Hot Spot on Bridge Wire – Possible?



Factors that Might Lead to Formation of Hot Spot

- Uneven resistance distribution
- Brief pulse of current
- Thin bridge wire (1A/1W less thin)
- Little heat conductivity along bridge wire

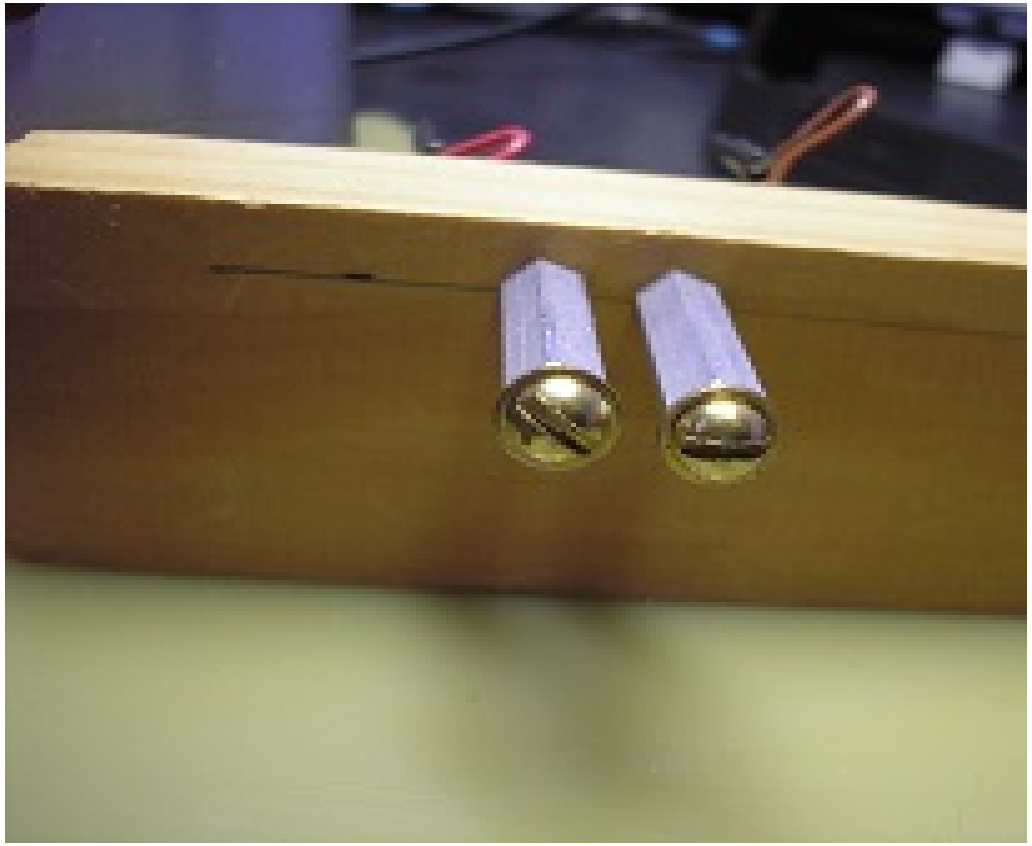
Our Investigation

- Photograph Bridge Wires Activated by Short Pulses of Current
- Compare EED Firing Sensitivity, Short & Long Pulses

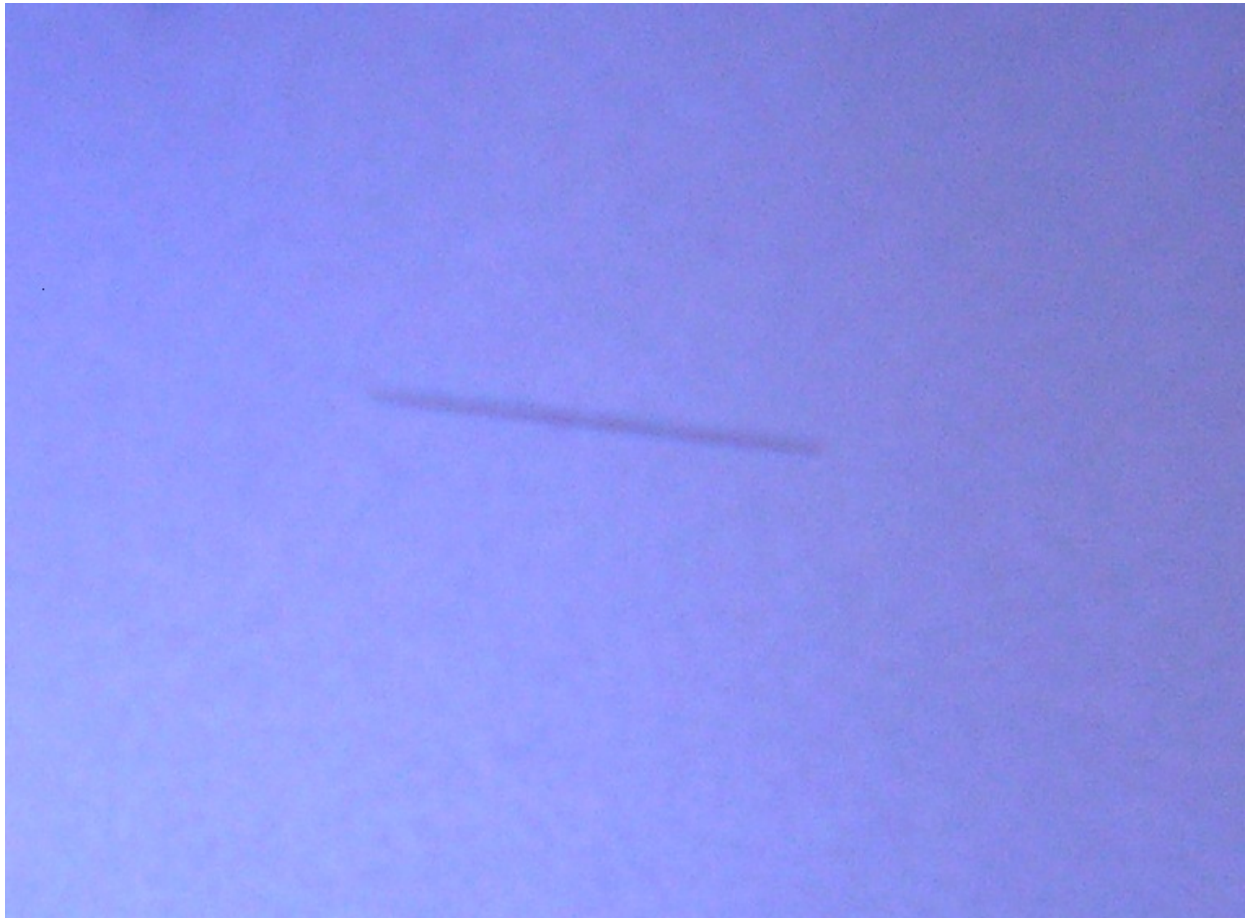
Compare Results, Keeping E/R Constant
Short Pulse of Current vs. Long Pulse

- $P = I^2 R$
- $\frac{E}{R} = I^2 t$
- Shorter time, set current higher
- Longer time, set current lower

Short Wire Sample, 0.0015” Diameter



I^2t = 0.023 ampere^2-second



I^2t = 0.035 ampere^2-second

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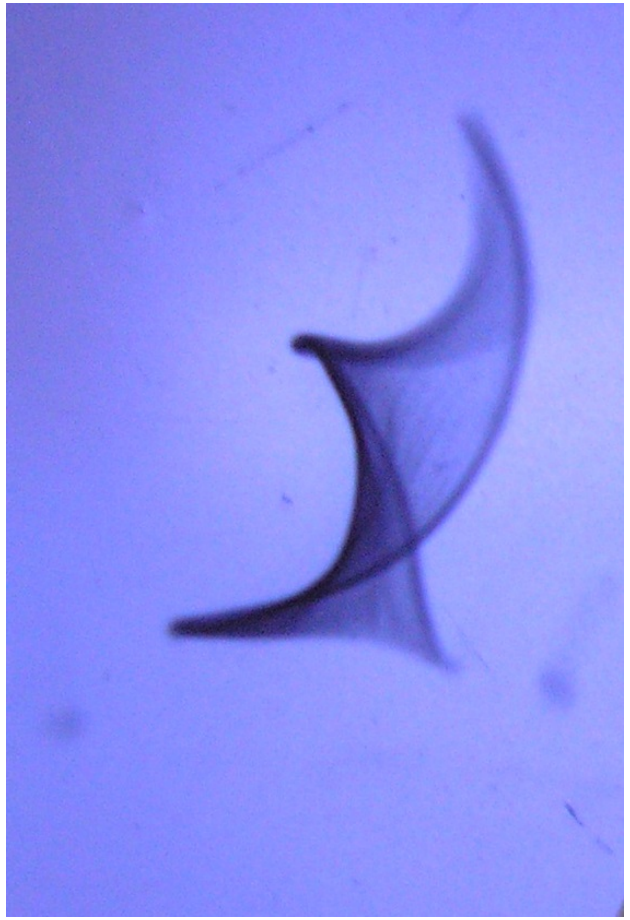
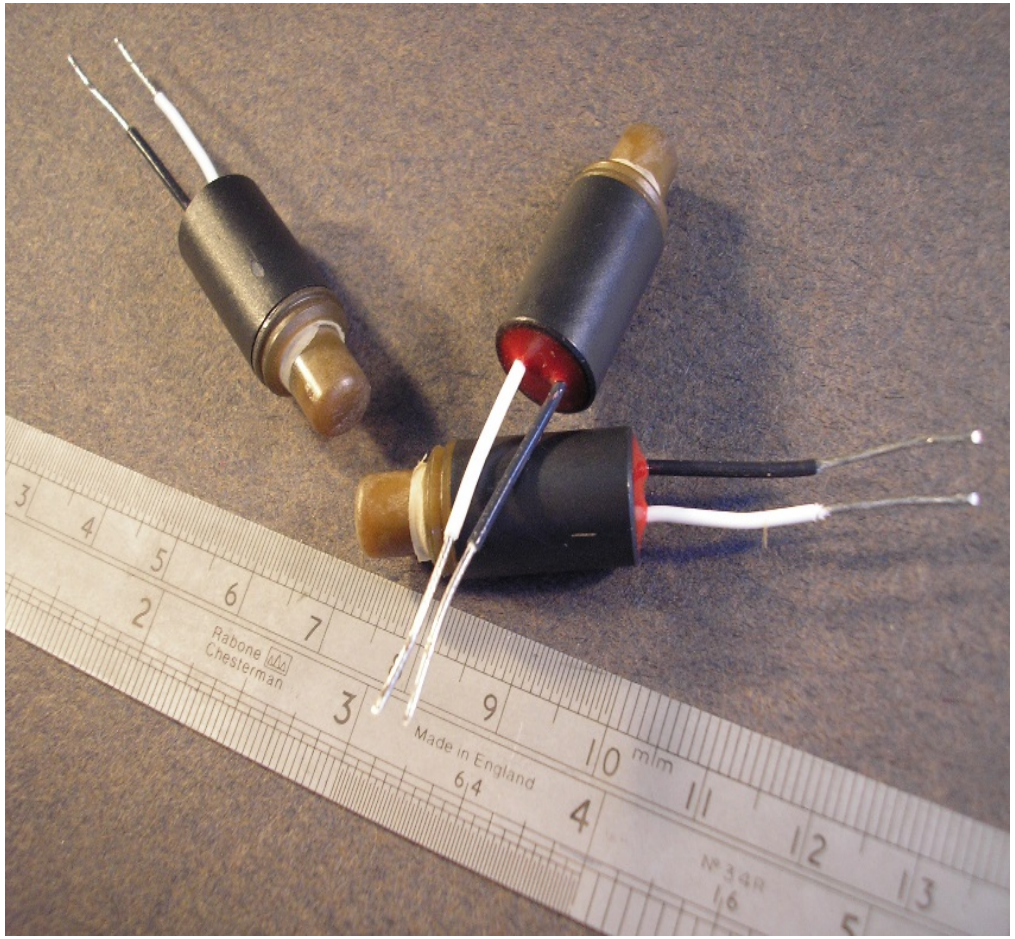
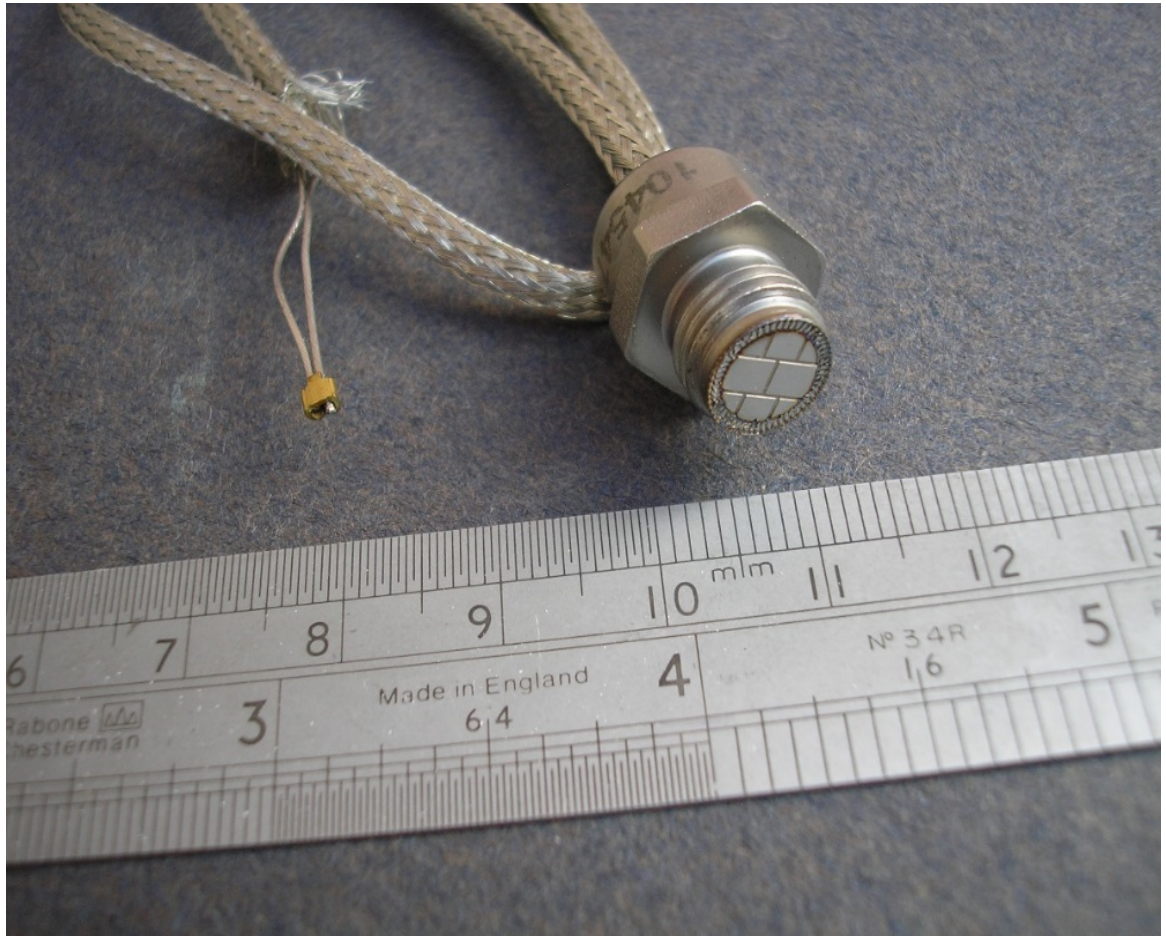


Observed no hot-spot in bare wire study…

- Now fire some all-up EEDs
- Different kinds of bridge wires
- Keep energy constant
- Long pulse?
- Short pulse?
- Same sensitivity?

Mk 26 Mod 0 Initiator, Javelin Initiator





Some Javelin Firing Data

Sequence	s/n	Ohms	Amp	Result	ms	I*I*t
8	104513	1.034	5.66	O	0.50	0.016
9	104546	1.035	7.55	O	0.50	0.028
10	104624	1.039	10.57	X	0.50	0.056
11	104539	1.063	7.55	X	0.50	0.028
12	104532	1.062	5.66	O	0.50	0.016
13	104514	1.022	7.55	X	0.50	0.028

Javelin Results Summary

$I^2 t$, $A^2 s$	Fired with long pulse	Fired with short pulse
0.016	0 out of 4	0 out of 3
0.022	0 out of 3	0 out of 3
0.028	3 out of 4	3 out of 4
0.056	1 out of 1	1 out of 1

Mk 26 Mod 0 Results Summary

$I^2 t$, $A^2 s$	Fired with long pulse	Fired with short pulse
0.0011	0 out of 1	
0.0018	0 out of 2	0 out of 2
0.0028	2 out of 2	3 out of 3

Conclusions

- Fine wire heating, 100 shots, entire length always heated
- 1A/1W initiators, identical sensitivity to long & short pulses
- Sensitive initiators, identical sensitivity to long & short pulses
- No reason to think brief current pulse can fire EED
- Cannot fire due to personnel-borne ESD heating bridge wire
- Cannot fire due to standard ESD test

Acknowledgements

- John Nial, NSWC – Indian Head Division
- Beth Shimer, Franklin Applied Physics