

# E CIGARETTES

Mark Goodson PE  
Goodson Engineering

# The Texas State Fire Marshal's Office

- ▣ February 25, 2014
- ▣ Corpus Christi, Texas
  
- ▣ The BEST state fire investigation group in the US

Us Tareyton smokers would rather fight than switch!"



**Join the Unswitchables.  
Get the filter cigarette with the taste worth fighting for!**

Tareyton has a white outer tip  
...and an inner section of charcoal.  
Together, they actually improve  
the flavor of Tareyton's fine tobaccos.

*Tareyton*

Member of The American Tobacco Company





R. J. REYNOLDS TOBACCO CO., WINSTON-SALEM, N. C.

For bright, clear flavor—  
switch to **WINSTON**

Wherever you go, folks go for Winston! You will, too. You'll like the full, rich flavor of fine tobacco. And you'll like Winston's exclusive filter, too—the pure, snow-white filter in the smart, cork-smooth tip. It's a great cigarette in *every* way!



Now available  
in crush proof box, too!

Smoke **WINSTON** America's best-selling, best-tasting filter cigarette!

# Guard Against Throat-Scratch

*— enjoy smooth smoking —*

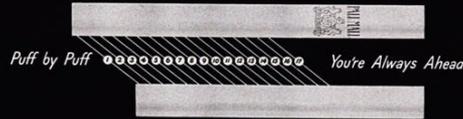


PALL MALL's

greater length of fine tobaccos  
travels the smoke further...

**filters the smoke  
and makes it mild**

**PUFF BY PUFF... YOU'RE ALWAYS AHEAD**  
*Take 5 puffs* or 10... when you smoke **PALL MALL**  
 or 17...



**STUDY THE PUFF CHART!** At the first puff, PALL MALL's smoke is filtered further than that of any other leading cigarette. Moreover, after 5 puffs of each cigarette—or 10, or 15, or 17—PALL MALL still gives you a longer, natural filter of fine tobaccos—guards against throat-scratch.



*Outstanding...and they are mild!*



# Virginia Slims?

- ▣ You've come a long way, baby
- ▣ To get where you go to today
- ▣ You've got your own cigarette now baby
- ▣ Hey hey hey hey

# The E Cigarette

- ▣ Safety in terms of intake of carcinogens
- ▣ They use heat to atomize nicotine
- ▣ Also atomize other substances
  
- ▣ Long term safety is unknown
- ▣ Nicotine dependence still an issue

# The E Cigarette

- ▣ Parts:
- ▣ Battery
- ▣ Heating element
- ▣ Pressure switch
- ▣ USB charging circuit

# USB port

- ▣ Essentially charge the E cigarette off uP
- ▣ Energy storage is via Li ion battery

# Fire investigation basics

- ▣ The issue is the Li ion battery
- ▣ Poor quality control
- ▣ Abuse of cells
- ▣ No uniform charging circuit
- ▣ No 'smart' charging of battery

# Fire investigation basics

- ▣ This is a chicken or egg question
- ▣ Submit ONLY a failed cell – so far, there is no test as far as primary vs secondary Rx

# Fire investigation basics

- ▣ Standard laptop charging
- ▣ Monitor current
- ▣ Monitor voltage
- ▣ Monitor temperature
- ▣ Overcharge and cutout circuits
- ▣ Little or none of this in Li ion for e cigs

# Menthol cartridge





**USB Charger Adapter**

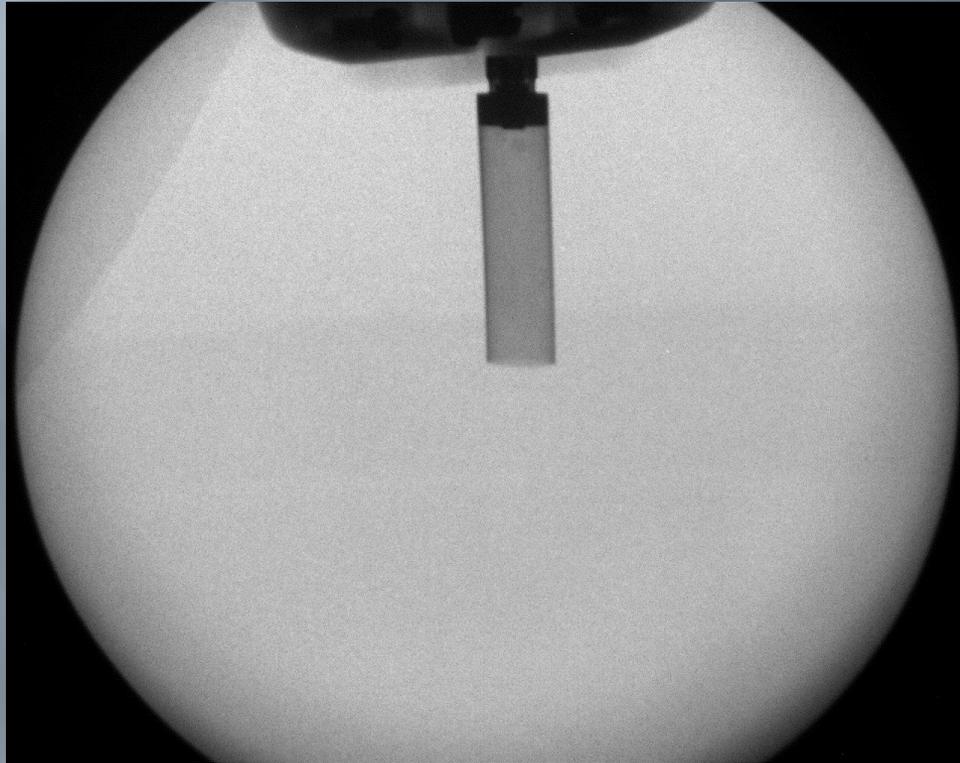


**Heater (atomizer) and  
battery**



**Battery in charger base**

# Xray of menthol cartridge



## Internal E cig parts



# Internal parts



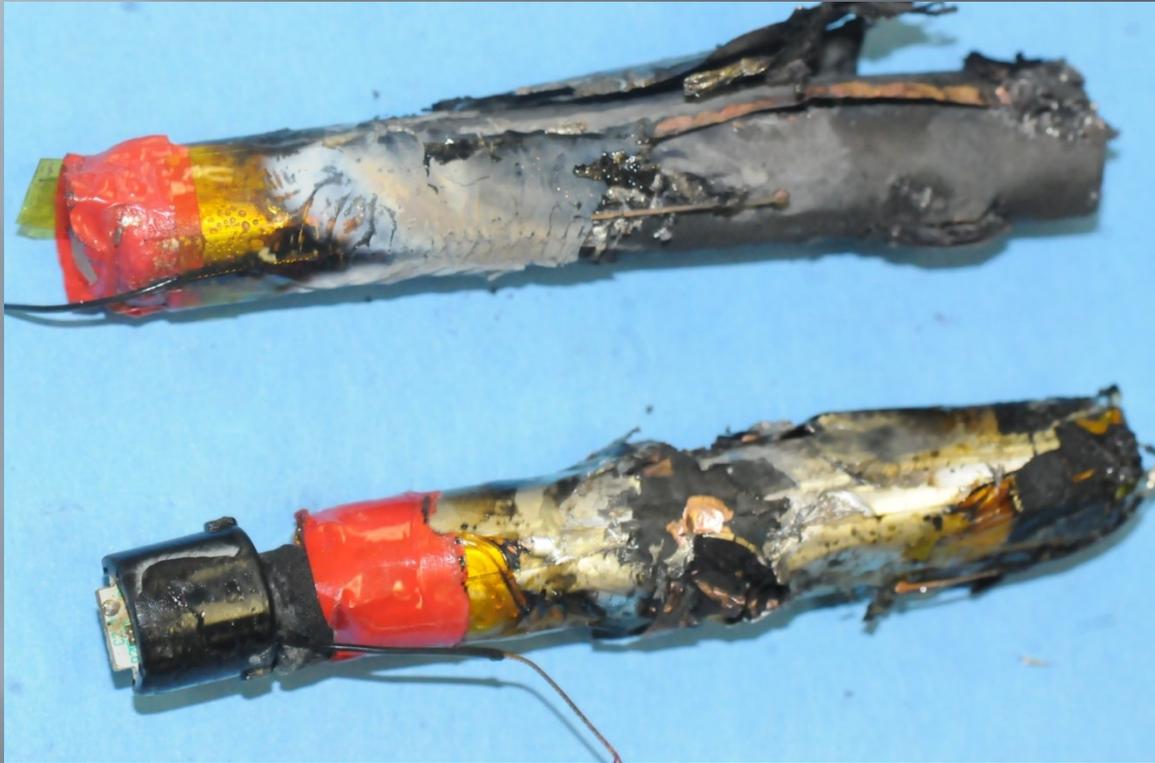
# Typical Jelly Roll / Li ion





**Damaged E Cig**

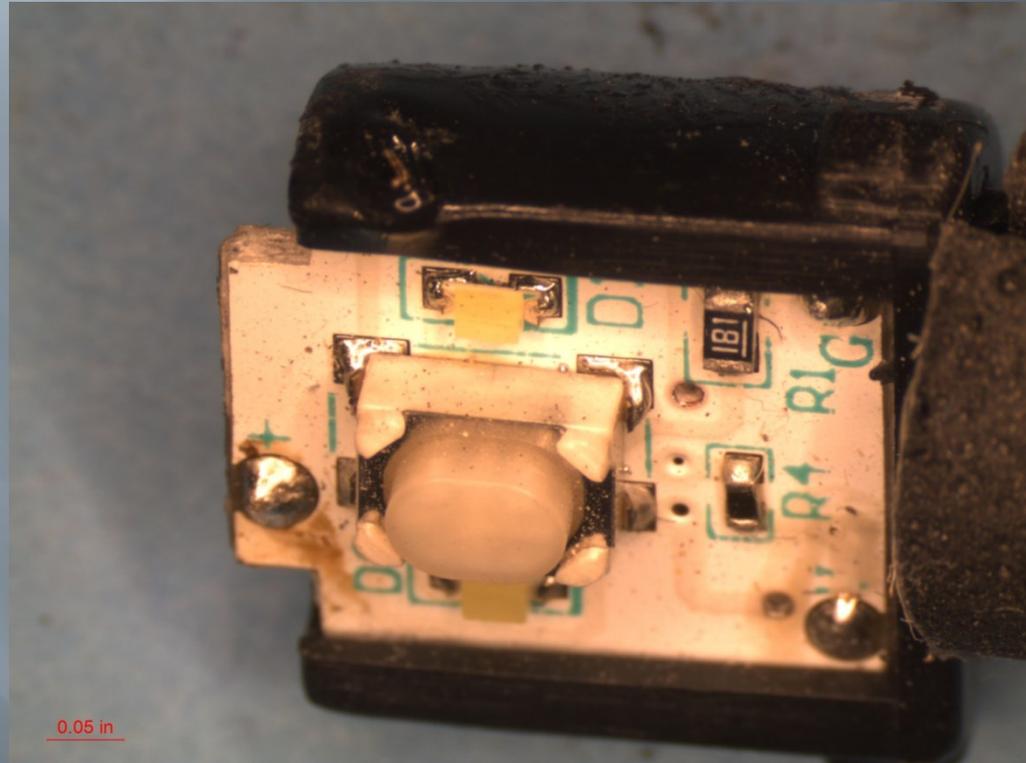
# Damaged E cigs



# Damaged E cig



# Microscopic - charge circuit



# Failed Li ion cell - Jelly Roll



# Melted Cu stranded wire



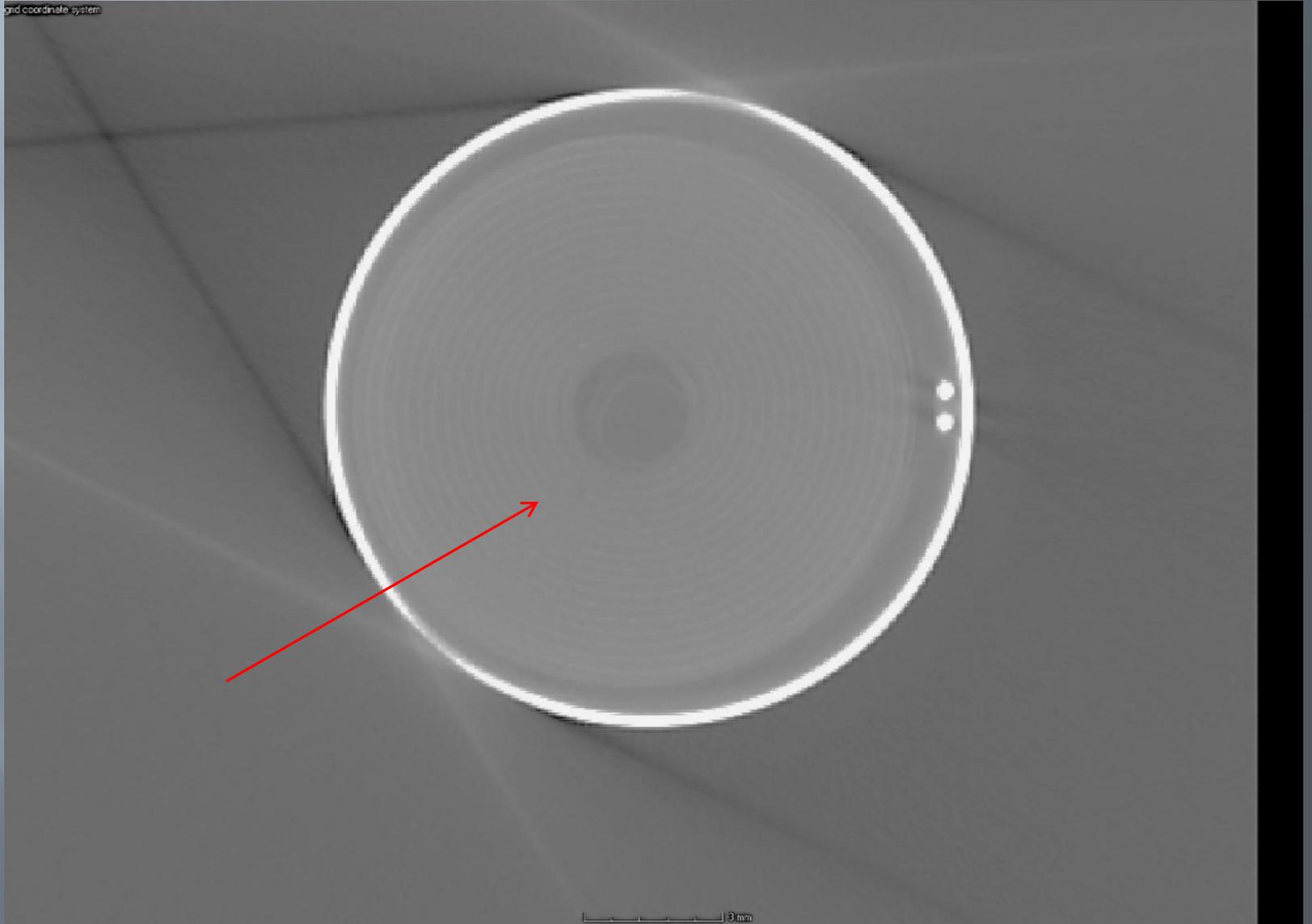
# Melted Cu stranded wire



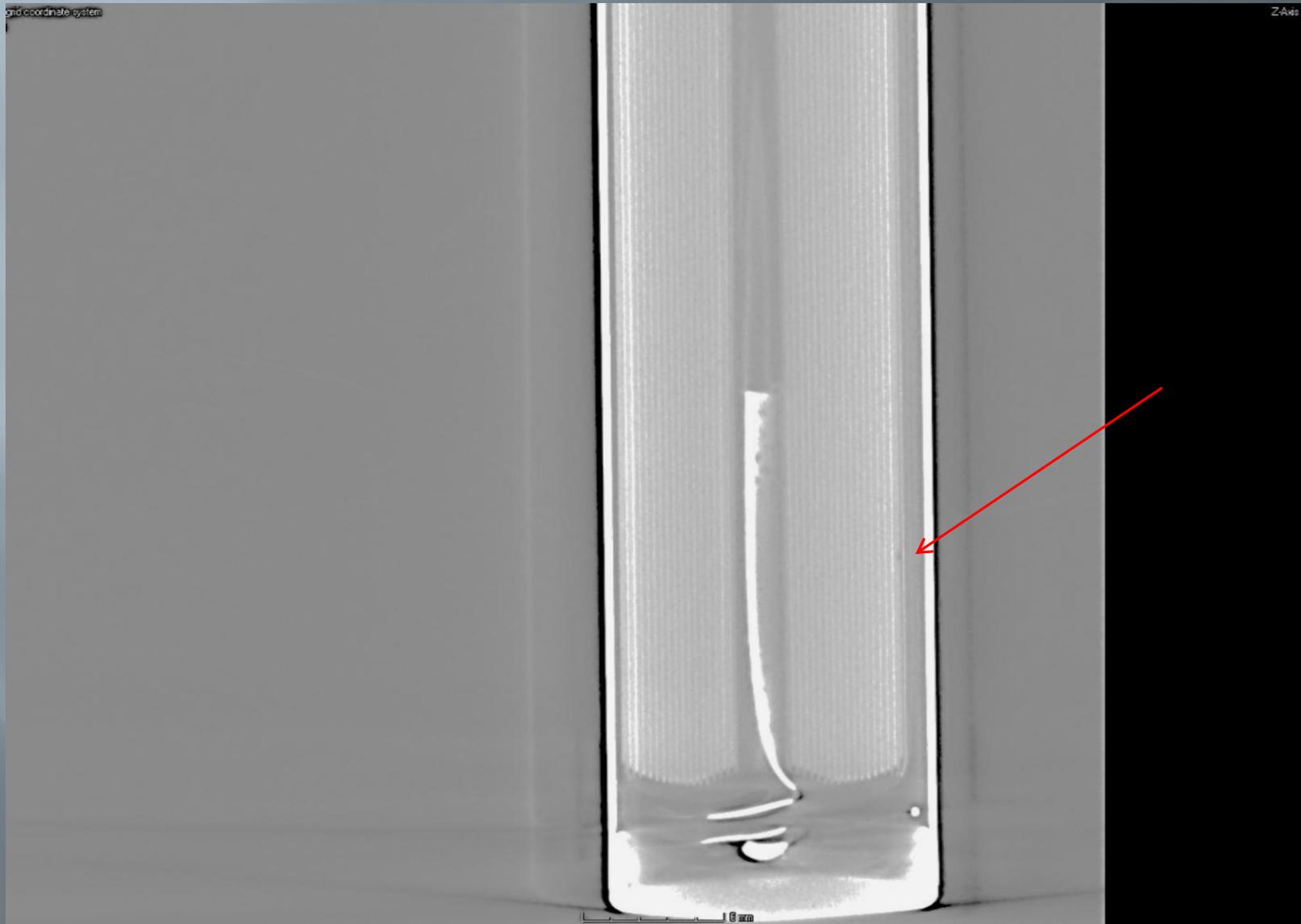
# Summation

- ▣ What we Know
- ▣ Li ion batteries are hi energy density sources
- ▣ As such, they can release substantive heat

# Jellyroll w Debris



# Jellyroll w Debris



# What We Know

- ▣ Numerous manufacturers
- ▣ No standard
- ▣ Mixing of batteries, voltages
- ▣ No control of charge
- ▣ No safeties

# What we know

- ▣ Li ion quality control
- ▣ Poor handling
- ▣ Myriad of manufacturers

# What we Know

- ▣ Chicken or Egg
- ▣ Cannot look at a cell in isolation and determine if it is primary or secondary
- ▣ Li ion cells DO fail from external heat
- ▣ Scene exam is important (What's new?)