Pain-Free Melting Point Determination

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Stanford Research Systems

Who is Stanford Research Systems?

- In business since 1980
- Full catalog is over 200 pages
- Famous for first digital lock-in amplifier
- Successful quadrupole mass spectrometer (RGA)
- Now makes 3 kinds of melting point apparatus

Introduction

Student grade melting point apparatus

Integral RTD thermometer

Microprocessor controlled temperature ramps

PID gives fast preheats without overshoot

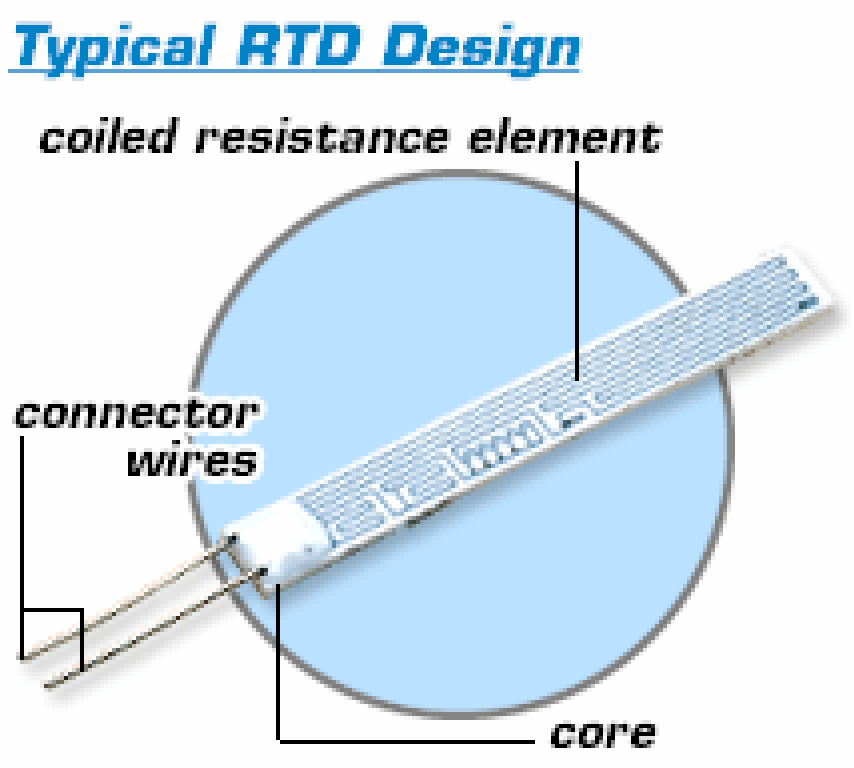
Tube Tapper (integral capillary packing device)

Easy to clean, maintain

Price (single unit) : $990
(Discounts will be given for orders in quantity)

What is an RTD?

Resistance Temperature Detectors (RTDs) are simply materials whose resistivity changes as a function of temperature.



Taken from Omega's website : http://www.omega.com

What is PID?

Proprotional – Make a correction term proportional to the error

Integral – Make a correction term that integrates the error with respect to time

Derivative – Make a correction term that differentiates the error with respect to time

Correction = $Pe(t) + I\int e(t)dt + D\,de/dt$
(where e(t) is the error signal with respect to time,
P, I, and D are constants)

Temperature Measurement

MEL-TEMP

Liquid in-glass (often Mercury)

Accuracy typically +/- 1 degree

Resolution typically 0.2 degree

DigiMelt

RTD accuracy in this version is
± 0.5 degree C <200 C
± 0.8 degree C >200 C

Resolution is 0.1 degree C

Temperature Measurement

MEL-TEMP

500 C is reachable, thermometer often only goes to 400 C

Thermometer is TAKE-able!

MelTemp is useless with a missing thermometer

DigiMelt

Temperatures > 300 C disallowed

RTD is never missing

RTD is difficult to destroy

Temperature Control

MEL-TEMP

Open Loop Variac: No feedback
Student is the controller
Typical student is a poor controller
Overshoot leads to fanning the block
which leads to Hg spills

DigiMelt

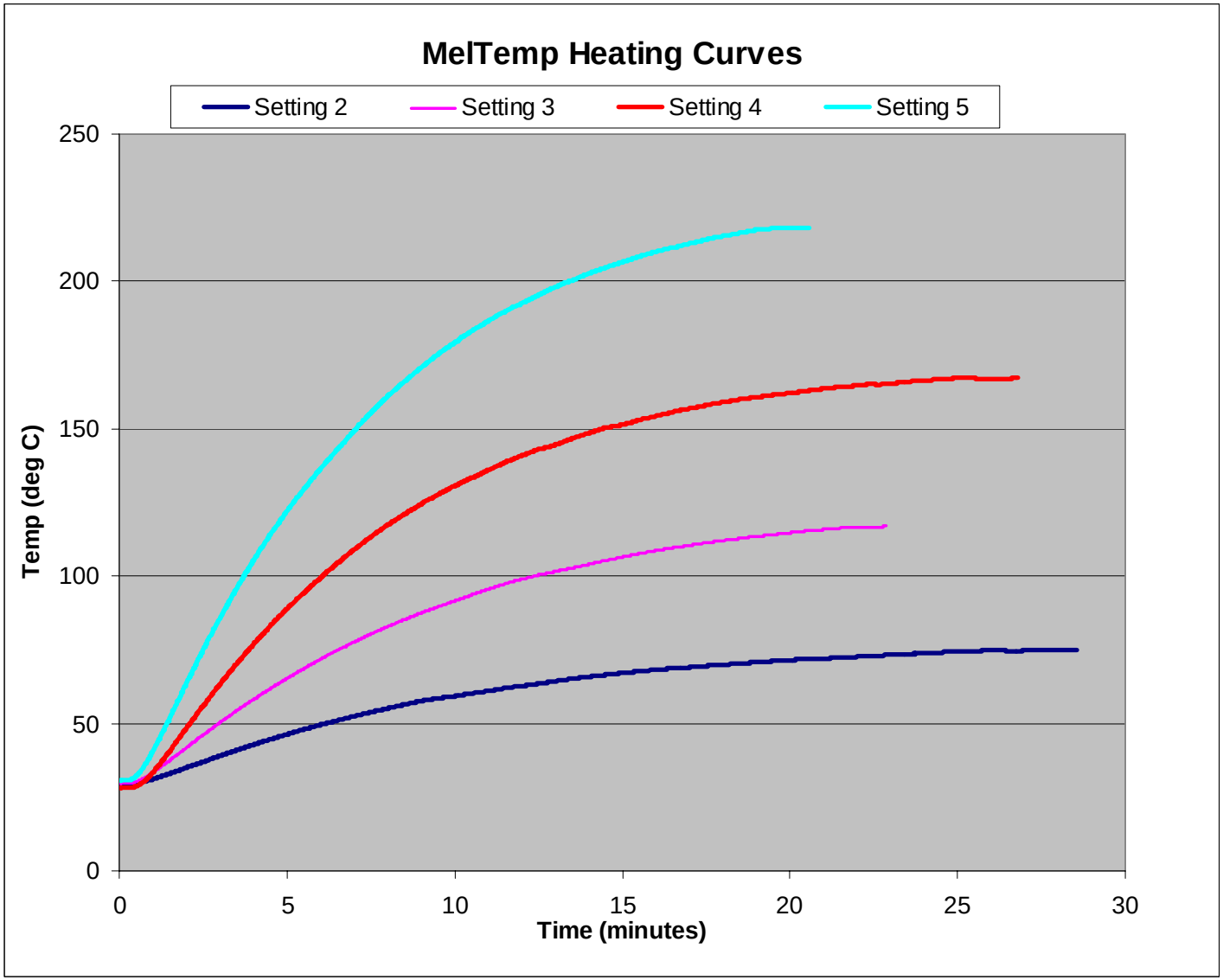
Full PID control with RTD feedback

Microprocessor lets students focus on their samples

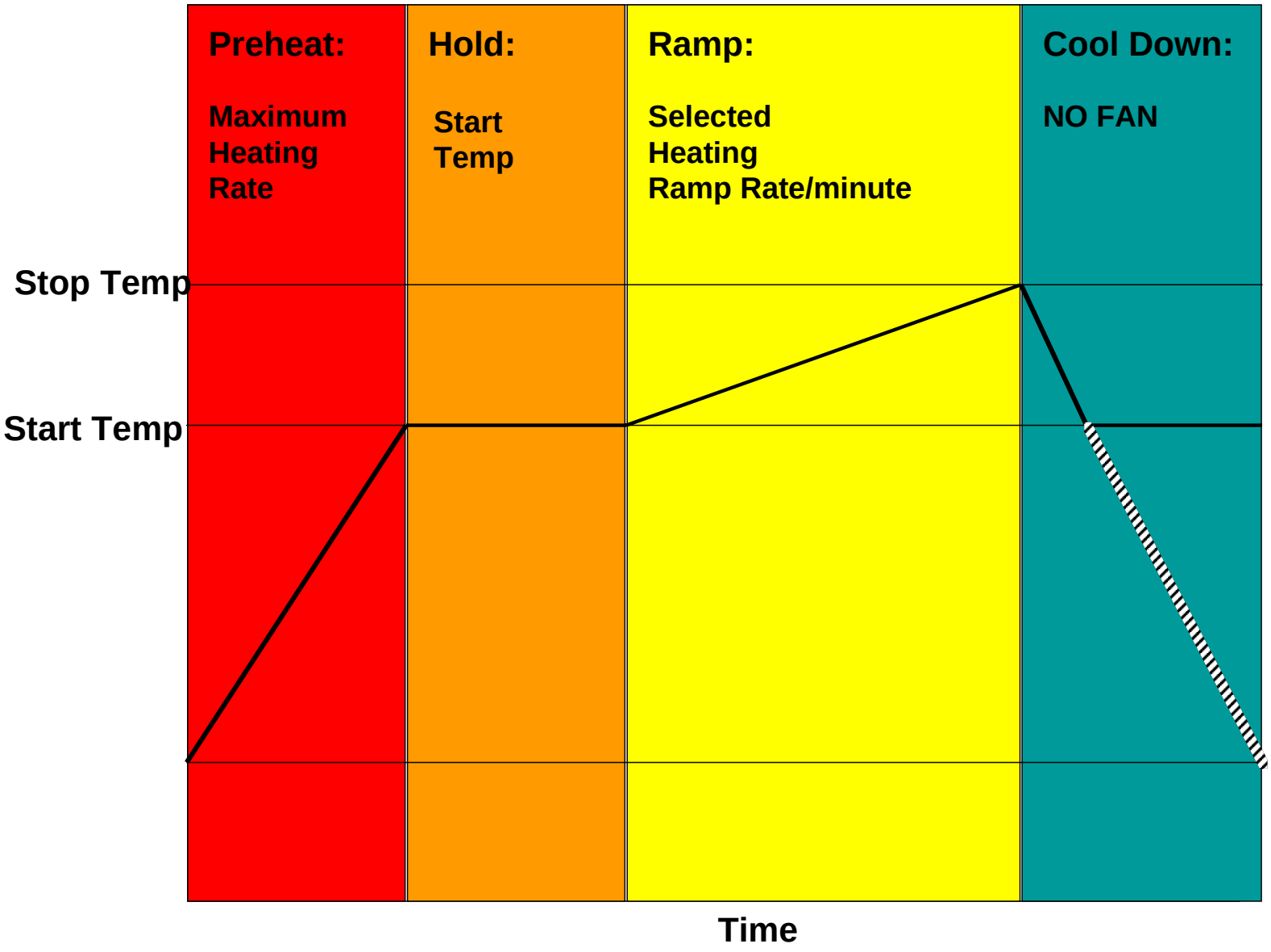
Ramp rates of 0.5, 1, 2, 5 C

Oven turns off after 30 minutes of idle

MelTemp delivers power, not a prescribed temperature



DigiMelt has a preheat, hold, ramp and cool-down



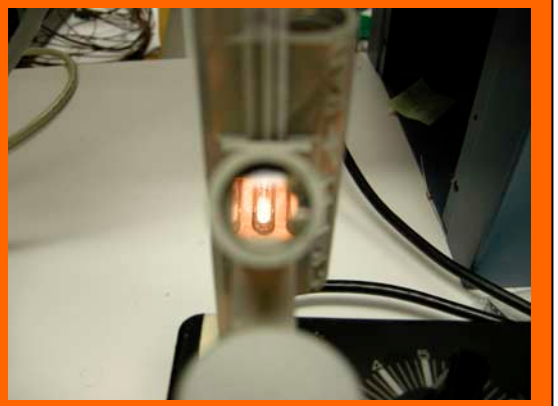
Sample Viewing

MEL-TEMP

Hard to see all three tubes

Light reflects from sample to eye via window, lens

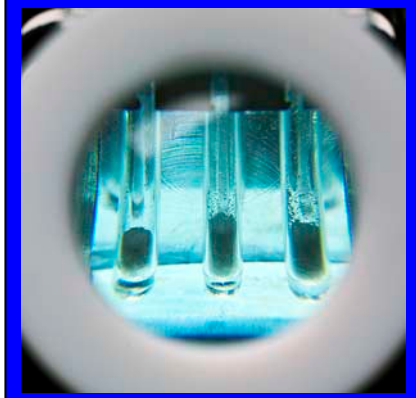
Student must switch between viewing sample and viewing thermometer



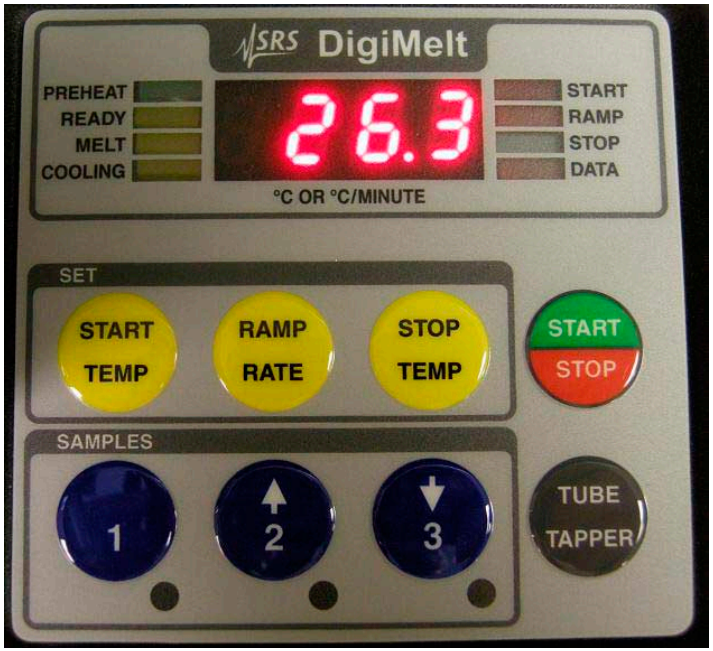
DigiMelt

Large lens allows view of three samples simultaneously

Student records critical temperatures (onset, meniscus, clear point) by touching keypad



Using DigiMelt : Enter Settings



Boot up

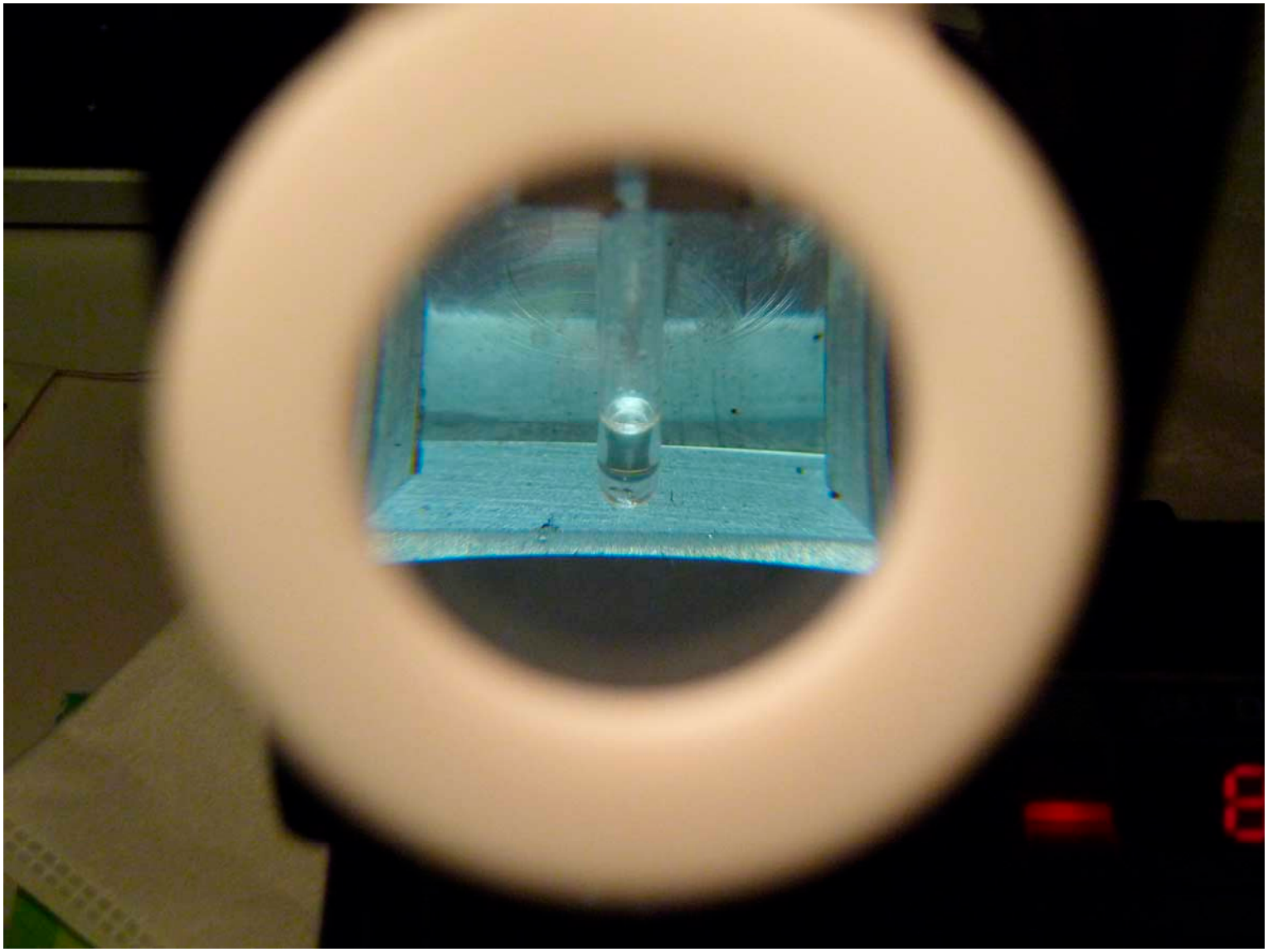
Set Start Temp (40 to 250 C)

Set Rate (0.5 to 10 deg C / min)

Use the yellow keys to select settings
Use the blue arrow keys to adjust settings

Set Stop Temp (up to 300 C)

Using DigiMelt : Record Data

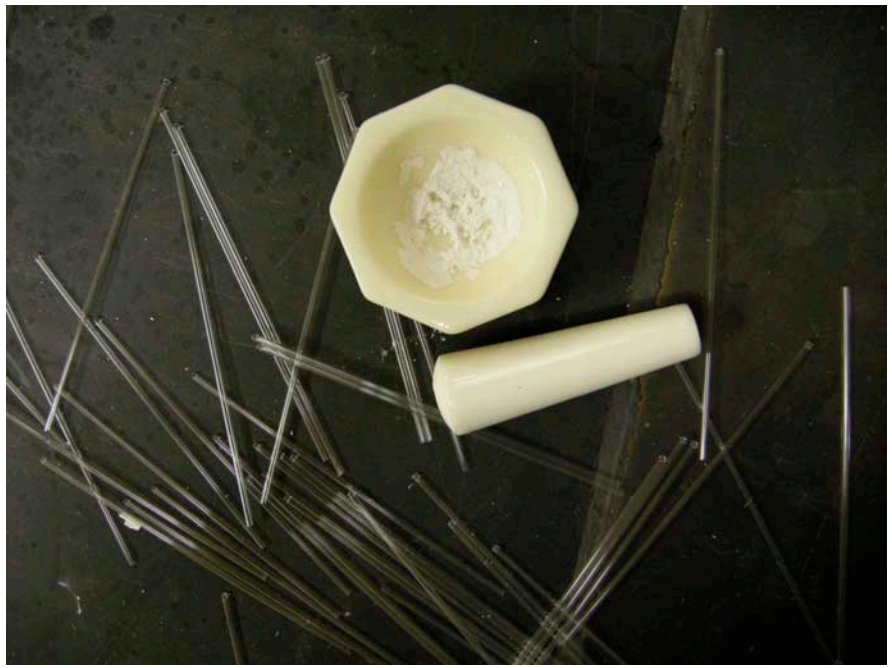


Clear Point

Touch button “3” to Record Clear Point

Using DigiMelt : Retrieve Data

Packing Capillaries



When students tap sample into capillaries, lots of capillaries end up on the floor, lots of capillaries are broken, wasted

DigiMelt

Integral cell phone vibrator motor "Tube Tapper"
Capillaries can be packed 3 at a time
Students can get 3 samples with the same sample height

Maintenance

MEL-TEMP

Incandescent bulb will burn out

Mean time between failures
is about 1000 hrs

Broken thermometer = $200
(Roughly 25% of instrument cost)

DigiMelt

White LED has >100,000 hours
mean time between failures

RTD is well-protected

Maintenance

MEL-TEMP

Capillary holder uses socket head cap screws or other screws

DigiMelt

No tools required

Maintenance

MEL-TEMP

Capillary holder uses socket head cap screws or other screws

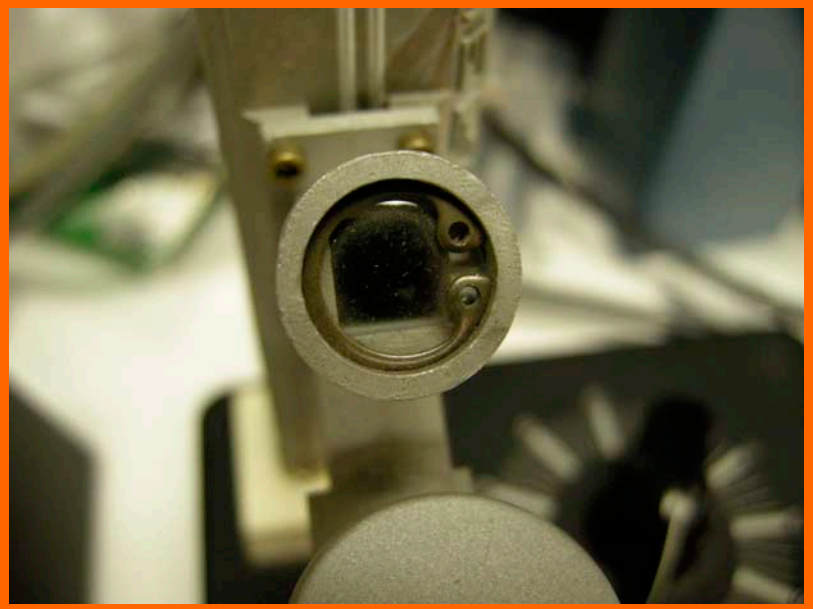
DigiMelt

Easy to remove broken capillaries

Maintenance

MEL-TEMP

Lens, window held with snap rings



DigiMelt

No tools required

Easy to clean or replace lens

Summary

MEL-TEMP

Students know there's a better way; MelTemp is like an oven at home with a 0-10 knob instead of a temperature setting

Wasted time
Hard to use equipment
Broken thermometers

STUDENT FRUSTRATION

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DigiMelt

Students focus on the sample:
THE REAL EXPERIMENT

Faster labs
Safer labs
Less waste
Lower cost of ownership