



ELECTRONICS BENCH TOOL SOLUTIONS

SmartHeat Technology

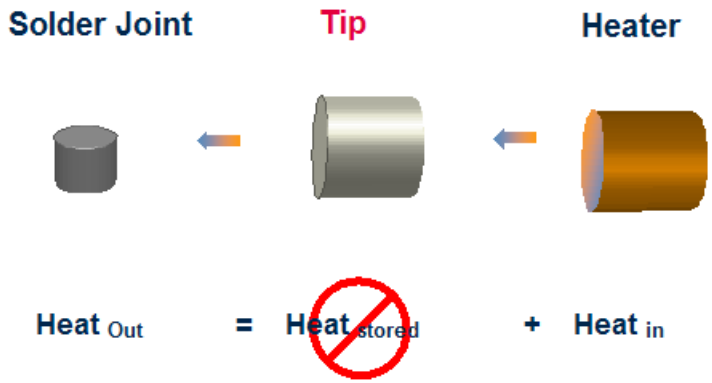
Power on Demand vs Fixed Power

METCAL
A BRAND OF **OKInternational**

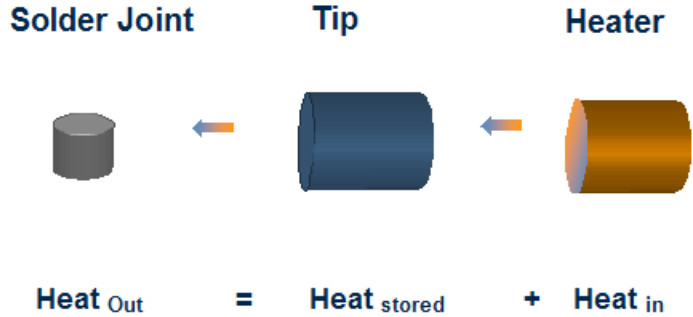
Tip Construction



SmartHeat™
Solder Tip



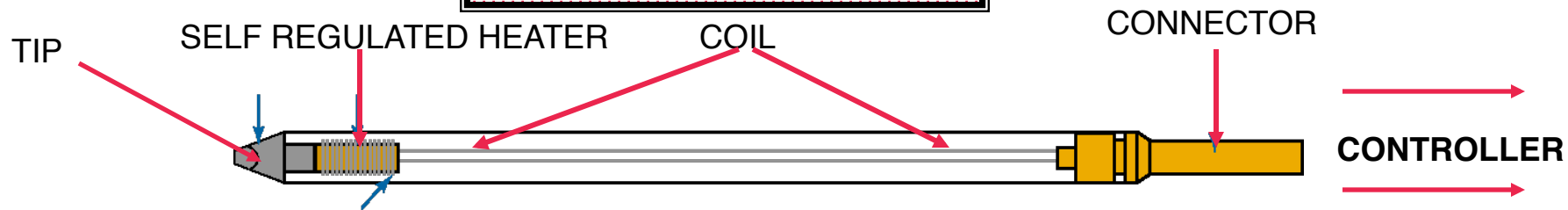
Conventional
Solder Tip



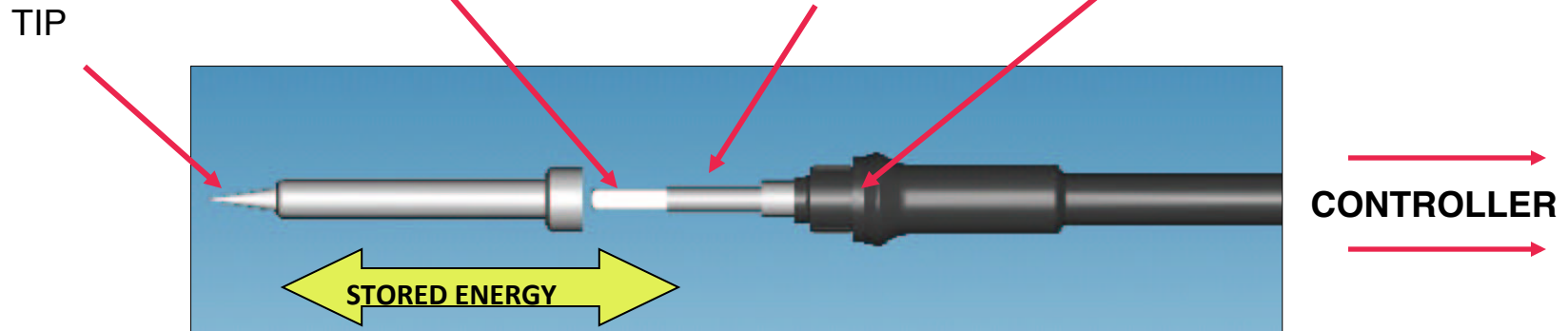
Tip Construction Comparison



SmartHeat™ Solder Tip



TC/SENSOR DRIVEN HEATER TEMPERATURE SENSOR CONNECTOR



Conventional Solder Tip



Q: How does SmartHeat[®] Work? What is Power on Demand?

A: The tip cartridge **senses** the thermal load and instantly delivers the right amount of power **directly** to the joint.

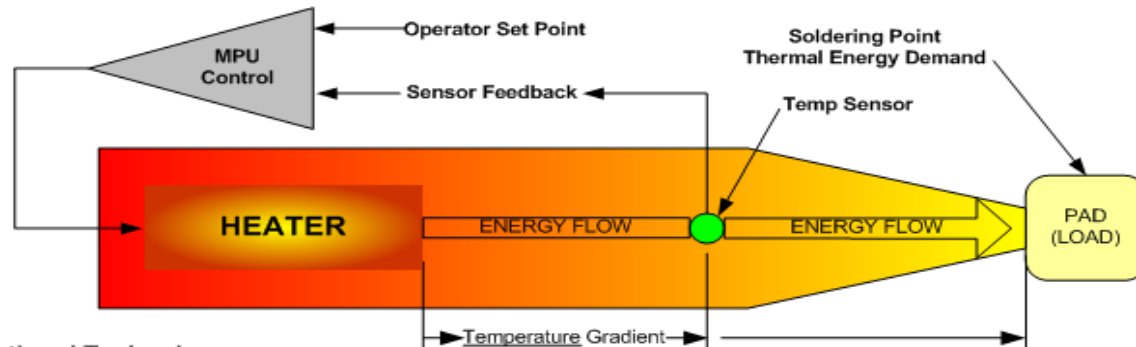
Q: What does Power on Demand do for the user?

A: It allows the user to solder and rework varying loads and only the power needed will be applied to the joint. **SmartHeat[®]** provides a fast, safe and repeatable process with no manual adjustments required.

SmartHeat[®] Technology



Fundamental Defining Equation : $T_2 - T_1$ (temperature difference) = Power X R_t (Thermal Resistance)

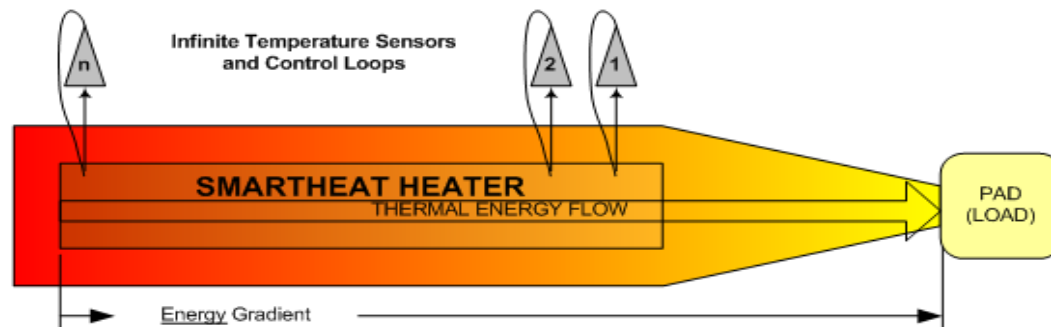


Conventional Technology:

T_2 = Heater temperature

T_1 = Sensor temperature (Note - Pad temperature is predicted & secondary)

Result = System responds to Sensor Temperature (temperature gradient) & Applied Power defined by generalized CPU algorithm



Smartheat Technology:

$T_2 = TH_1 \dots TH_n$ = Infinite layers of Heater temperature control loops (each responding to an incremental temp difference)

T_1 = PAD temperature directly

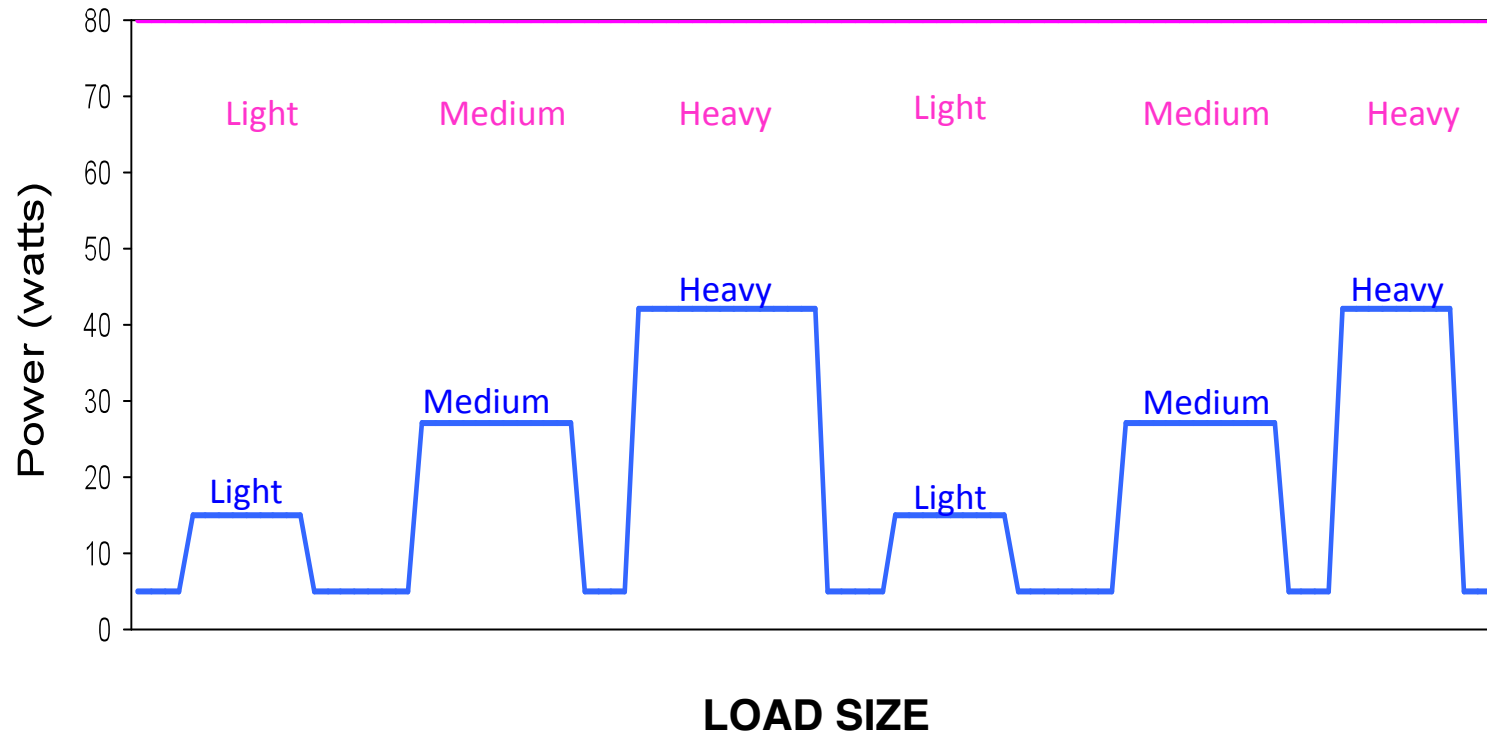
Result: System responds to Pad Thermal Energy Demand & Applied Power is directly related to Pad temperature requirement

Power on Demand; Fixed vs. Variable Power

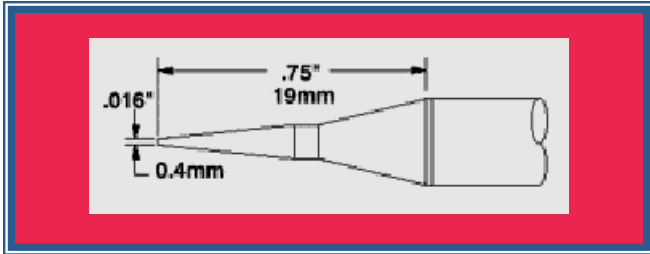


SmartHeat™ Soldering Iron = Varying Load Size, Varying Power

Conventional Soldering Iron = Varying Load Size, Fixed Power

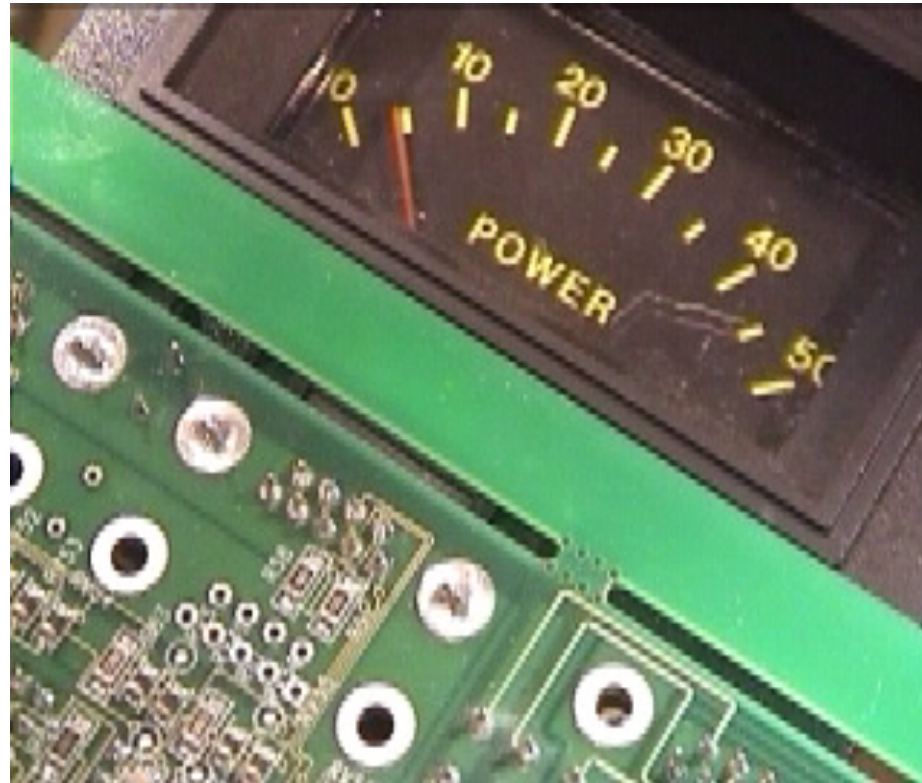


Heat Transfer

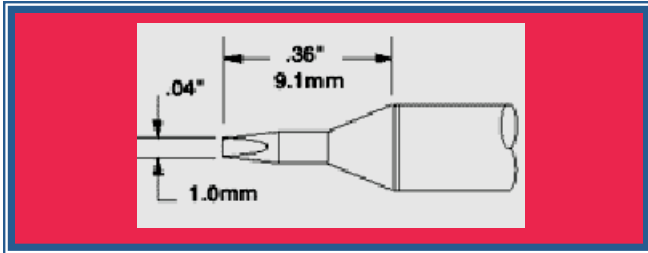


Fine Tip Geometry

- Small Load
- Medium Load
- Heavy Load

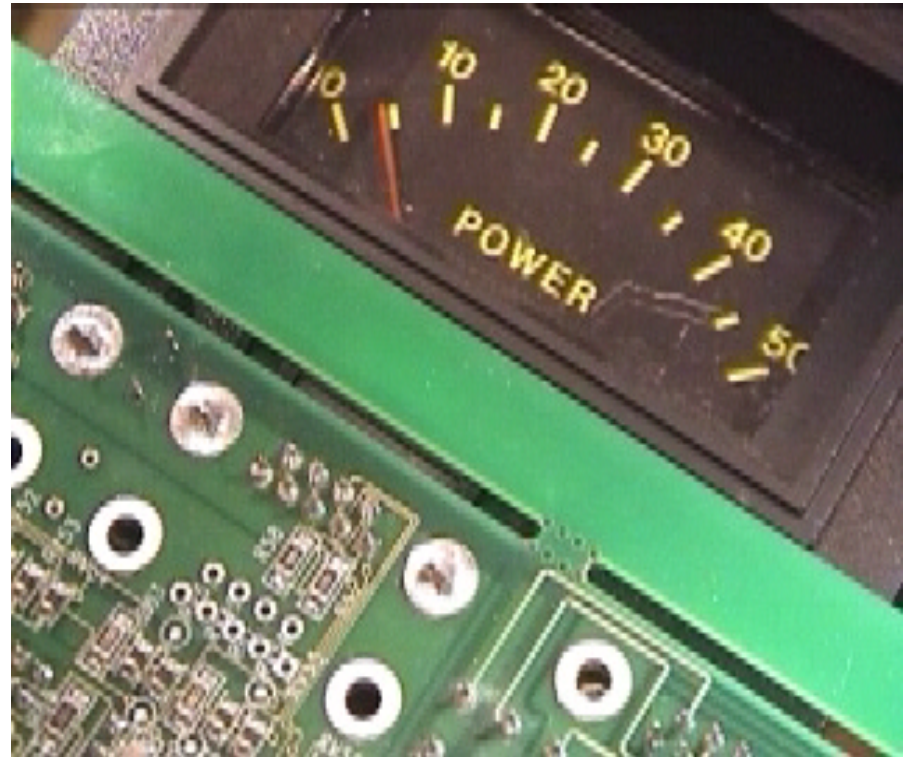


Heat Transfer

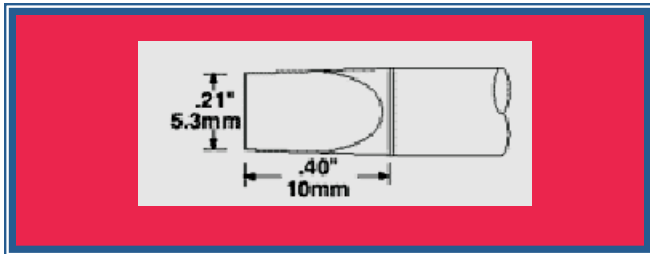


Medium Tip Geometry

- Medium Load

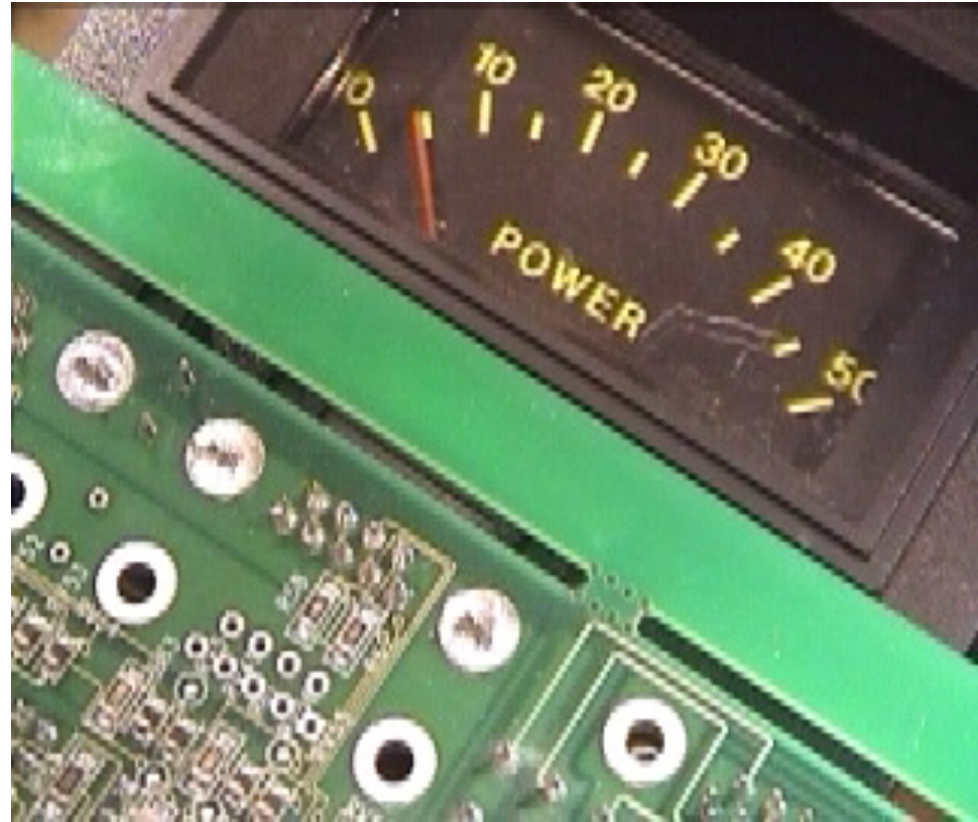


Heat Transfer



Large Tip Geometry

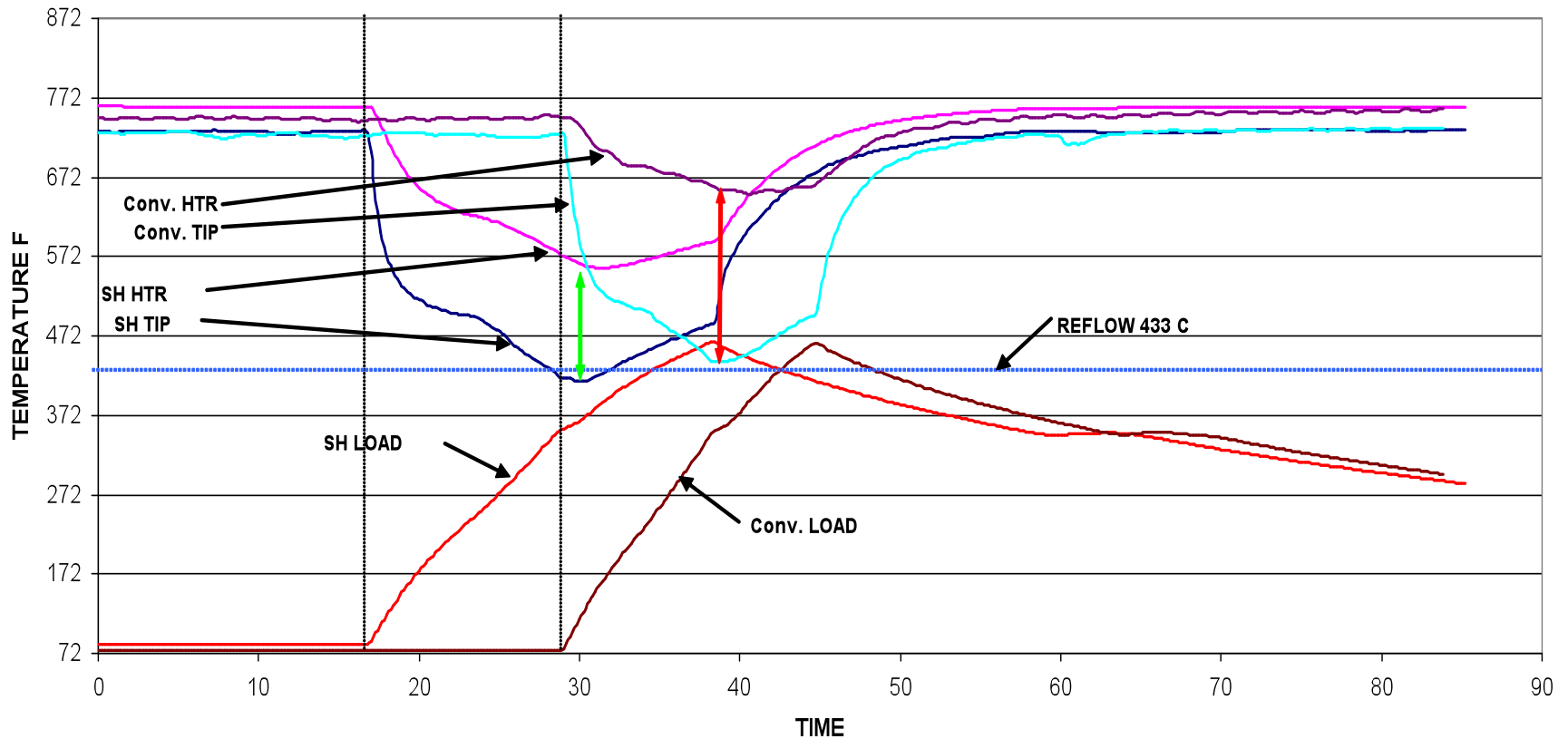
- Heavy Load



SH Thermal Energy Advantage



CONTROL TECHNOLOGY PERFORMANCE COMPARISONS SMARTHEAT vs. CONVENTIONAL TIP IDLE CONTROL (IDLE TIP TEMP = 750F)



Attributes of Conventional & SmartHeat™



	CONVENTIONAL IRONS	SMARTHEAT™ IRONS
HEAT	Uses TC/Sensors to Monitor Heat <ul style="list-style-type: none">■ Stored Heat	Self Regulated Heaters <ul style="list-style-type: none">■ Rapid Heating
PROCESS CONTROL	In Operator's Control <ul style="list-style-type: none">■ Possible Operator Error	No Operator Controls <ul style="list-style-type: none">■ No Operator Errors
CALIBRATION	Required	Not Required
TEMPERATURE	Manually Set	Self Regulated Heater
POWER SYSTEMS	Fixed Power <ul style="list-style-type: none">■ Stored Energy in Tip	Power on Demand <ul style="list-style-type: none">■ Instantly Delivers Right Amount of Power Directly to the Joint



Why do Conventional Irons Need Calibration?

- Thermocouples degrade over time.
- Repackaged conventional soldering irons still require calibration.
- Different heating requirements for different tip sizes.

Calibration



	CONVENTIONAL IRONS	SmartHeat™ IRONS
Calibration Required	YES	NO
Thermocouples	YES ■ Thermocouples / Sensors Degrade Over Time	NO ■ No Thermocouples/Sensors To Degrade
Tip Temperature	VARIABLE ■ Different Heating Requirements for Different Tip Sizes ■ Tip Temperature Can Vary from Set Point	FIXED ■ Tips Drive Heating Not Power Supply ■ Cannot Over Shoot
Over Shooting	■ Operator Controlled	■ Self Regulated Heater Controlled

Calibration

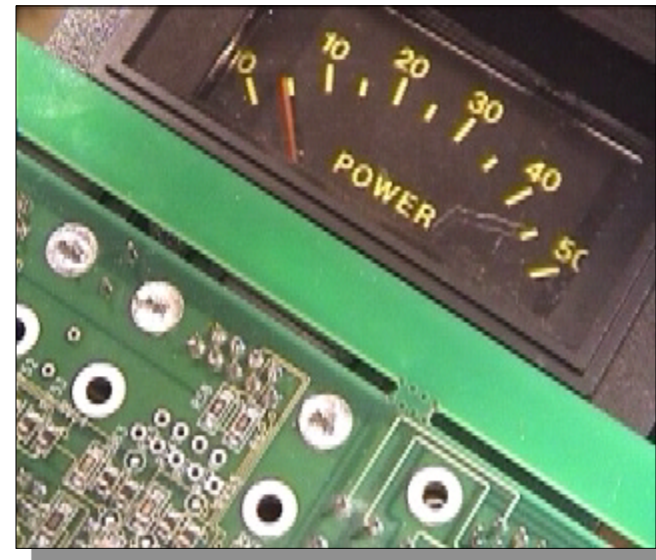


Conventional Tip Testing



Measures Idle Tip Temperature

SmartHeat™ Power Meter



**Measures (Power) Wattage
at the Solder Joint**

Conventional vs. SmartHeat™ Technology

Heat Transfer Characteristics



	Conventional Soldering	SmartHeat™ Soldering
HEAT TRANSFER PROCESS	Increase Tip Temperature	Increase (Vary) Power to Improve Heat Transfer
INTER-METALLICS	Can Increase Operator Control	Very Limited Equipment Controlled
FLUX PERFORMANCE	Good	Good Reduced Oxidation Controlled Solder Flow
SOLDERING TEMPERATURE	Increased Decrease Tip Life	Constant
CHANCE OF DAMAGE TO PCB AND/OR COMPONENTS	Increased Hard to Control Over Shooting	No Over Shooting



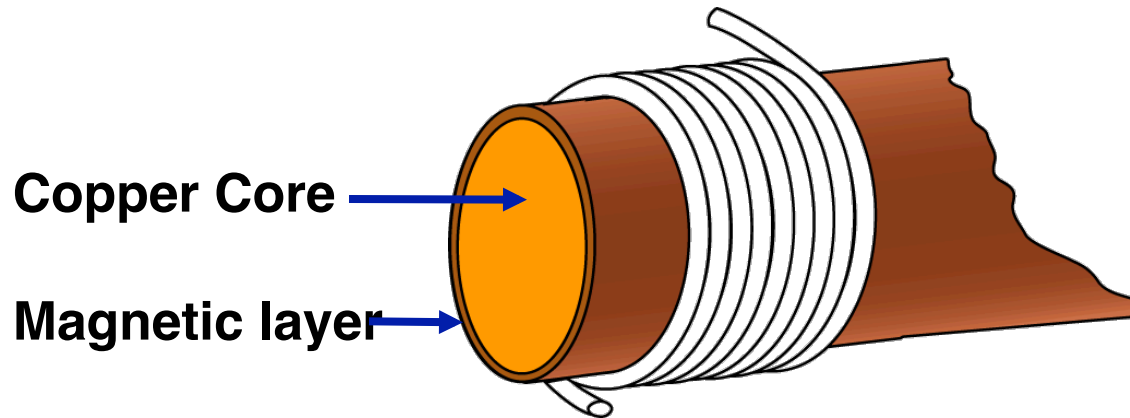
Q: What makes up the SmartHeat[®] Soldering & Rework System?

A: The system consists of two basic elements: a constant-current RF power supply, and a self-regulating heating element: the tip cartridge.

Skin Effect and Curie Point: 1



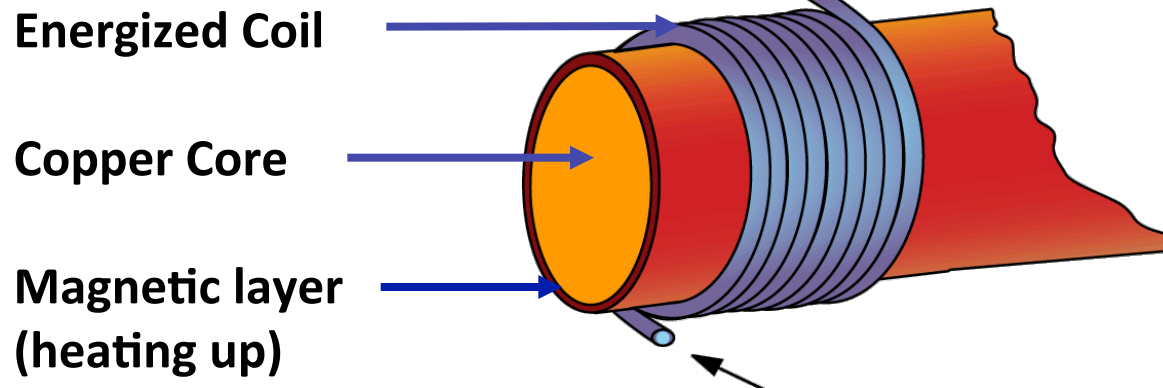
The Metcal[®] tip cartridge is made of a heater of proprietary design, consisting of a **non-heating** copper core and an outer **heating** layer of magnetic alloy.



Skin Effect and Curie Point: 2



As a high-frequency current is passed over the heater, the magnetic alloy causes the current flow to become confined to the “skin.” This is the **Skin Effect**. The resulting high current density causes rapid heating.



Skin Effect and Curie Point: 3

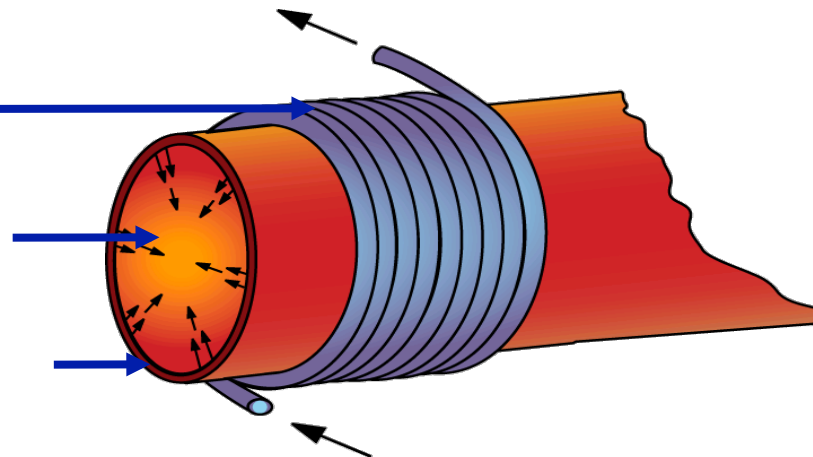


As it heats up, the magnetic alloy passes through its **Curie Point** temperature (T_C), and it loses its magnetic properties. This eliminates the **Skin Effect**, causing the migration of current to the low-resistance non-heating copper core of the heater.

Energized Coil

Non-heating Copper Core

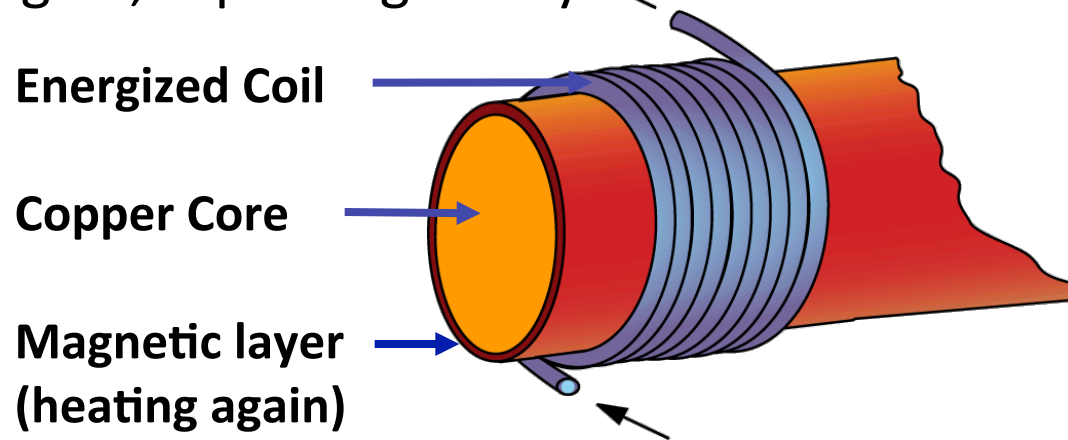
Magnetic layer (cooling off)



Skin Effect and Curie Point: 4



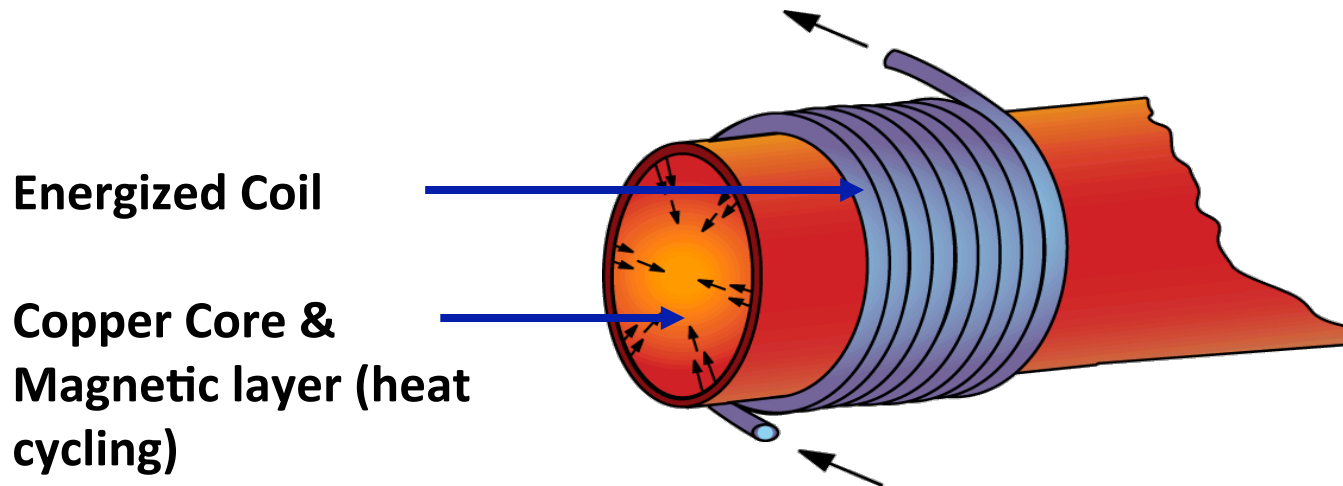
As the tip cools slightly, the alloy passes back through the **Curie Point** temperature and its magnetic properties are restored. The **Skin Effect** immediately returns, and heating begins again, repeating the cycle.



Skin Effect and Curie Point: 5



Thus, the tip self-regulates very close to the **Curie Point**, maintaining constant temperature ($\pm 1.1^{\circ}\text{C}$). As the tip temperature is constant, and heat is not stored in the tip like a conventional soldering iron, the **SmartHeat[®]** system applies **Direct Power** to the joint.



Metcal Soldering Systems



- Rapid heating with Power on Demand
- Self-regulating heaters that require no calibration
- No operator controls
- Closer relationship between heater, tip, & pad.
- Soldering and rework in one station.
- Increased Productivity
- Reduced scrap with built in product process control.