“The PoE Market is Heating Up: What You Need to Know to Create a Best-In-Class PoE System”

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Why PoE?

Market Drivers

- Internet of Everything (IoE)
- RJ45 universal compatibility
- Simplicity of device deployment
- Fueling copper cabling growth

Benefits

PoE vs. Traditional Power

- Reduced costs
  - One system to be installed
  - Easier to maintain and administer
  - Faster deployment of powered devices
- Centralized control
  - Emergency back-up power
  - Disaster recovery

Benefits Continued
PoE vs. Traditional Power

- Safety
  - Auto sensing for power needed
  - Safer power levels than A/C circuit
- Energy Efficiency and Savings
  - Building Automation Sensors and Control
- Flexibility
  - Standardized power levels and Ethernet ubiquity

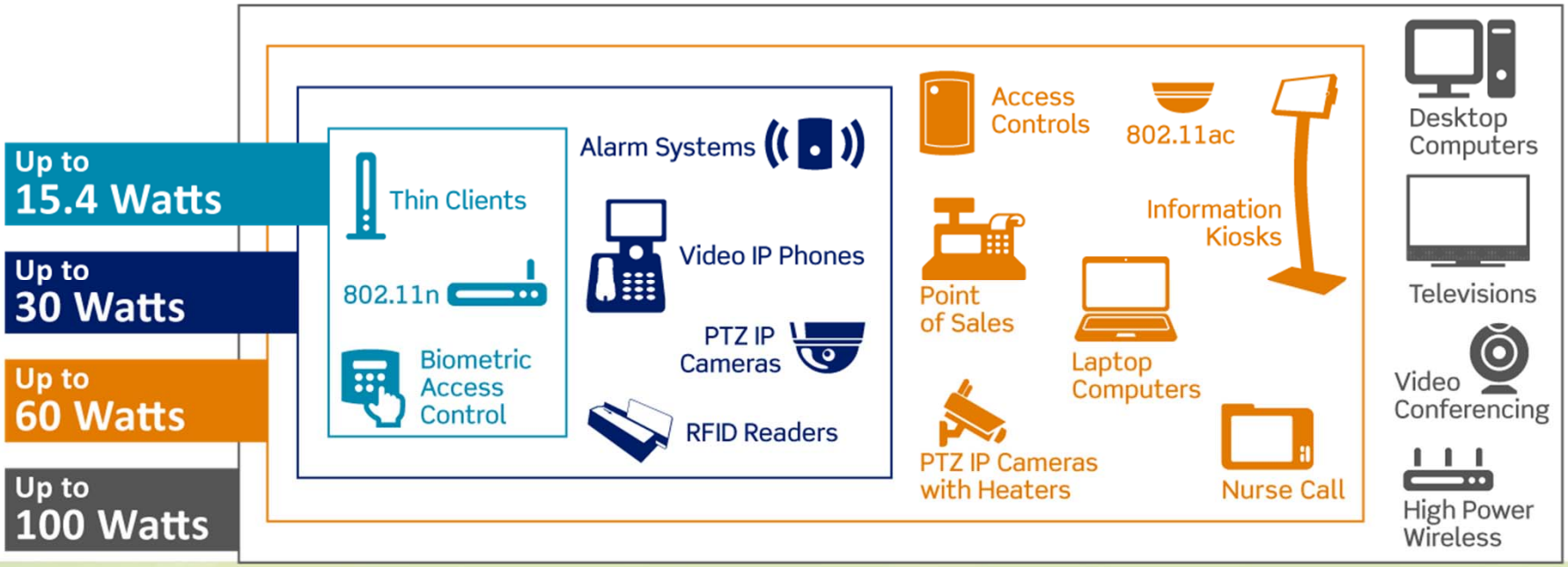
Power over Ethernet

The Evolution

- 802.3af completed in 2003
  - 15W power sent = 12.95W of delivered power (Type 1)
- 802.3at PoE+ completed in 2009
  - 30W power sent = 25.5W of delivered power (Type 2)
- Since 2009 more new devices requiring increased power have hit the market

Applications

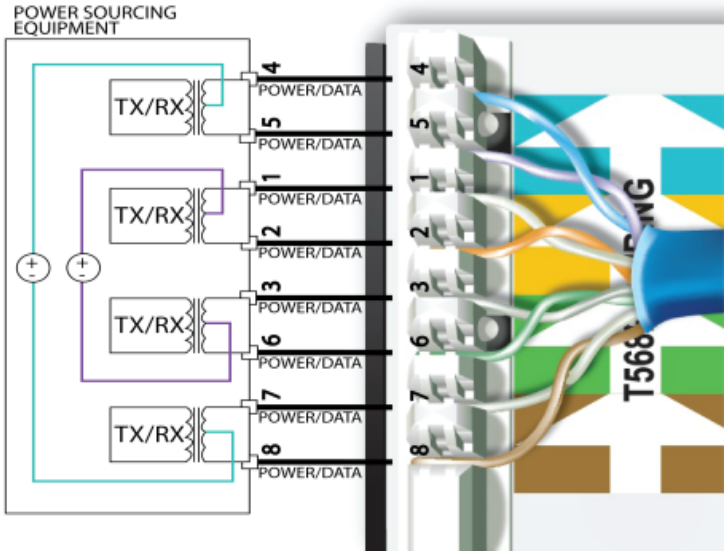
Why We Need More Power



IEEE 802.3bt

Newest PoE Standard in Development

- 4-pair power delivery
  - Increases system efficiencies
  - Higher complexity
- Two power variants
  - Type 3 = 60W power sent
  - Type 4 = 100W power sent
- Support for 10GBASE-T
  - 802.11ac Wireless Access Point bandwidth



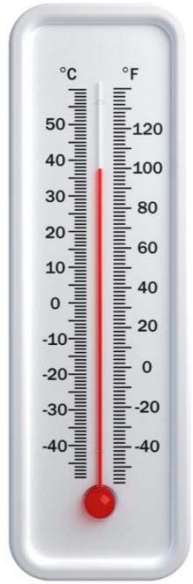
Next Generation PoE Challenges

Managing Heat Rise

- Telecommunications Industry Association (TIA) evaluating from a performance/installation practice standpoint
- National Fire Protection Agency (NFPA) evaluating heat rise from a safety/code standpoint

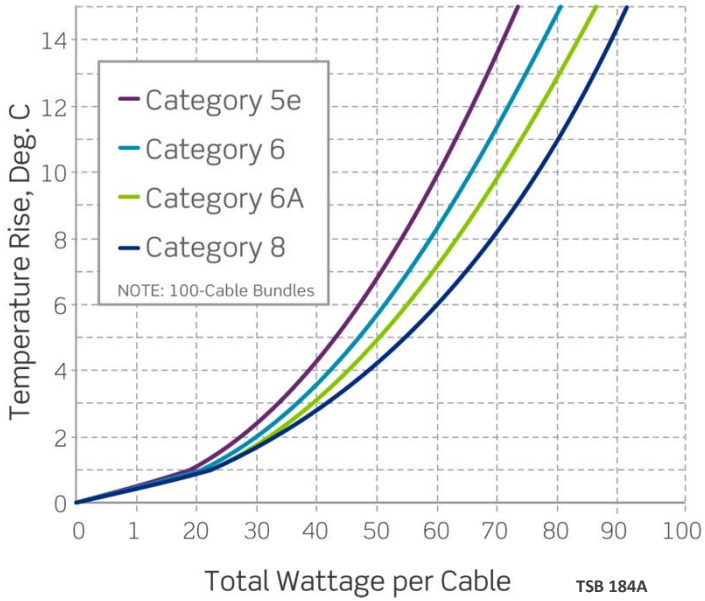
Managing Heat Rise

- TIA examining installed cabling issues
  - TSB 184-A under development
  - Bundle sizes to limit temperature rise to 15° C with a 60° C listed cable
  - Assumes 45° C ambient and power on all 4 pairs
  - *Note: there is no definition of what a "bundle" is*



High Power PoE and
Cable Temperatures Increase

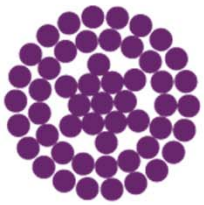
- The higher the category cable, the lower the temperature rise (in general)
- At levels above 60W, the heat rise for 100-cable bundles running PoE can cause:
  - Cables to operate at temperatures above their listed rating
  - Reduced performance



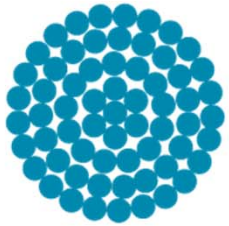
TIA TSB-184A

Maximum Bundle Size Recommendations

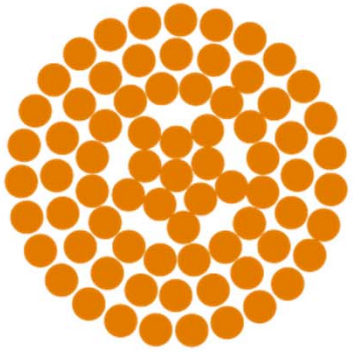
For Maximum 15°C Temperature Rise in Bundle @ 100W



Cat 5e
58 Cables



Cat 6
82 Cables



Cat 6A UTP
101 Cables

Cat 8 (draft)
280 Cables

Assumes cable listed to 60°C and ambient temp of 45°C and all cables are carrying power on all pairs

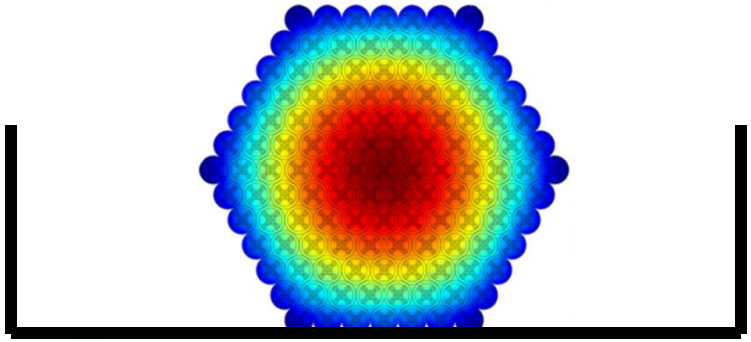
High Quality Cables Can Perform Better Than TSB-184A*

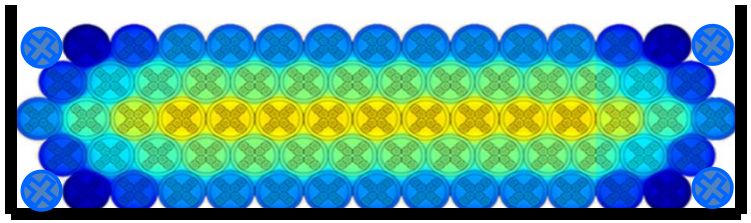
Example Cable Type	Max Number of Bundled Cables in Open Pathway Within Listed Temperature Rating	TSB-184A Bundle Size for 15°C Rise
LANmark-6 (75°C) Cat 6	264	82
LANmark-1000 (75°C) Cat 6	312	82
LANmark-2000 (90°C) Cat 6	480	82
LANmark-XTP (90°C) Cat 6A	720	101

For Type 4 power @ 100W (1000mA/pair) in open tray with cable remaining within listed temperature *TSB-184A (Draft 7.1)

To “Bundle” or Not To “Bundle”

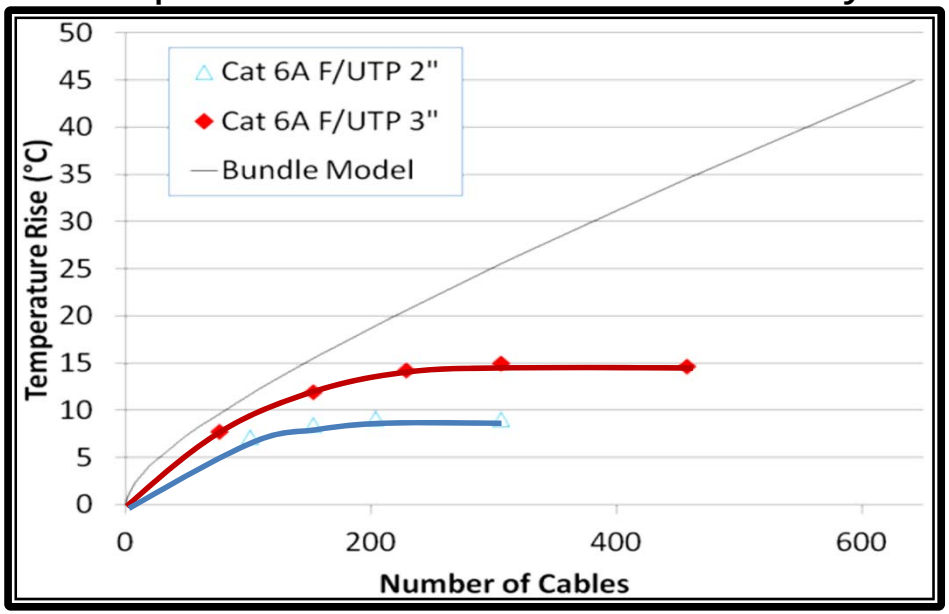
- Bundled cables and unbundled cables in open cable tray behave very differently
- “Bundle” tests are conducted on group of cables held tightly together continuously for 6 to 8 feet – no space between cables allowed





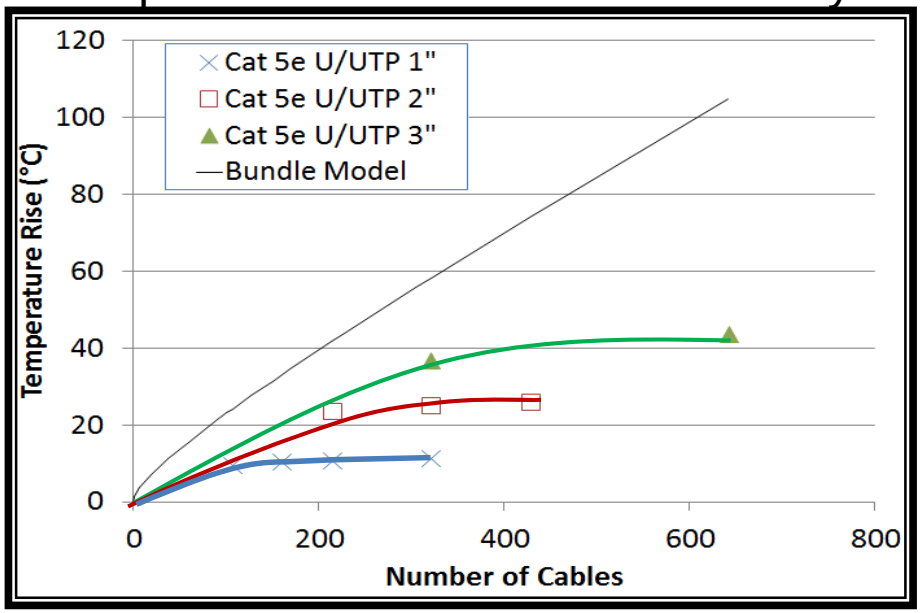
Open Cable Tray vs. Bundles

Temperature Rise in Wire Basket Tray



Tray depth noted in legend

Temperature Rise in Wire Basket Tray



Tray depth noted in legend

Managing Heat Rise
Safety

- National Fire Protection Agency (NFPA 70/NEC) - 2017
  - Addressed heat-related safety concerns
  - New requirements for communications cable carrying power over 60W
  - Bundle size for power over 60W limited by maximum cable temperature rating and ampacity
  - Assumes 30 °C ambient temperature

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Premises Powering of Communications Equipment over Communications Cables

- Article 840.160 “Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communication cables and the power circuit shall comply with 725.144 where communications cables are used in place of Class 2 and Class 3 cables.”

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Cable Bundle Size Restrictions

Ampacity Based

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86°F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2–7			8–19			20–37			38–61			62–91			92–192		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.8	0.9	0.5	0.6	0.7

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.

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Ampacity of 0.5 Amperes per conductor in a 4-pair cable ≈ 100 Watts

Underwriters Laboratories
Limited Power (LP) Cable Certification Program

- New optional UL Limited Power (LP) cable marking
  - ***NOT*** a listing or listing requirement
  - Alternative to table 725.144, bundle size agnostic
  - 30 °C ambient temperature assumed
  - Above 30 °C, refer to 310.15 for ampacity de-rating

Optional Cable Certification for PoE Power

- Goal of LP rating is to indicate power capability without bundling restrictions in any “reasonable worst case”
- Cables are tested to assure temperature rating is not exceeded when used at the LP-rated current in an 8 foot 192 cable bundle enclosed in conduit

LP Certified Cable Markings

- Cable Legend to include "…CMP-LP(0.xA)"
- x = Ampacity of the cable (A = Amps)
  - 0.5A = 100W using 50 Volts over 4 pairs
  - 0.6A = 120W using 50 Volts over 4 pairs
  - 0.7A = 140W using 50 Volts over 4 pairs
  - LP cables are not mandated by the new 2017 NEC but included as an option

2017 NEC

What happens next, what do you need to know?

- Adopted changes have little effect on PoE applications at 60W or lower, per Article 840
- Impact of PoE greater than 60W has new requirements
  - 2017 NEC was published in August 2016
  - Every state has different process/timeline for adopting codes
  - Check with local authority on PoE installation codes/requirements
  - Using LP cabling is optional, check with cable manufacturer for specific information on product capability

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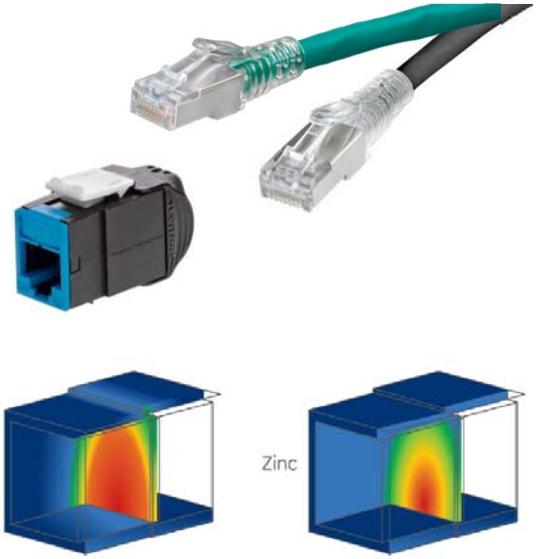
What 100 Watt PoE Means to You

- Installers need to consider bundle size, environmental temperatures and power level
- Elimination of bundling will improve heat dissipation
  - Use of cables in open cable tray reduces thermal effect
- Code and standards work associated with PoE has addressed cables only

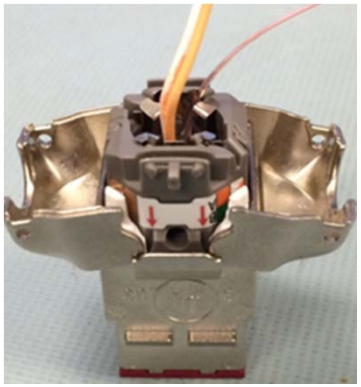
Connectivity Should Be Engineered to Maximize Heat Dissipation

- Patch cords that utilize an F/UTP construction dissipate heat more efficiently than solutions using standard UTP cords
- Connectors that feature a solid metal body, dissipate heat 53% more efficiently than plastic alternatives



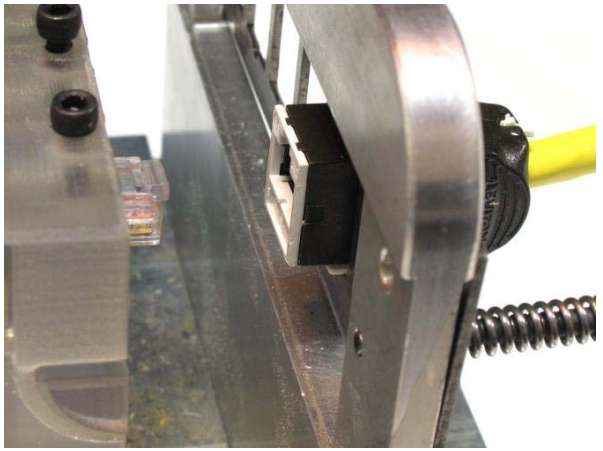
Additional Connectivity Standards to Ensure Best PoE Performance

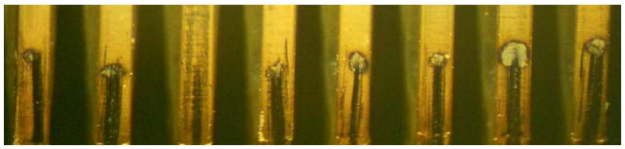
- IEC 60512-5-2 connectors for electronic equipment standard
  - Proposed Standard: Temp rise should be less than 45°C
  - Good Results = Temp rise of <25°C



Additional Connectivity Standards to Ensure Best PoE Performance

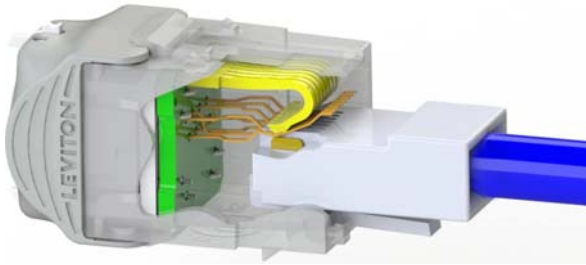
- IEC 60512-99-001 connectors for electronic equipment standard
  - Proposed Standard: Minimum of 25 insertions under load with <20 mΩ contact resistance increase
  - Good Results: >100 cycles with very little degradation in performance





PoE Arcing Damage Protection

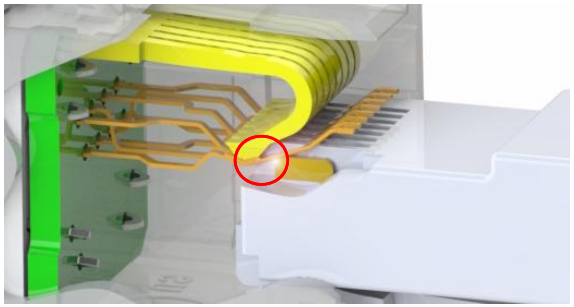
- Contacts Designed to Retain Constant Force
  - Constant contact force at the connector/plug interface
  - Prevents inadvertent intermittent disconnects
  - Extends the life of the connectors
  - Prevents tine damage
  - Saves on costly repairs



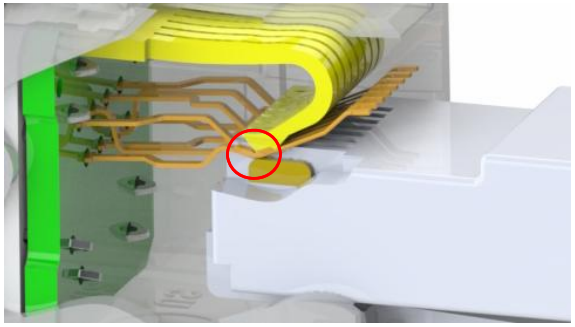
Additional Layer of Protection Against PoE Arcing Damage

- PoE Optimized Tine Geometry
  - Prevents arcing damage in critical contact-mating zone between the plug and connector

Plug at point of disconnect

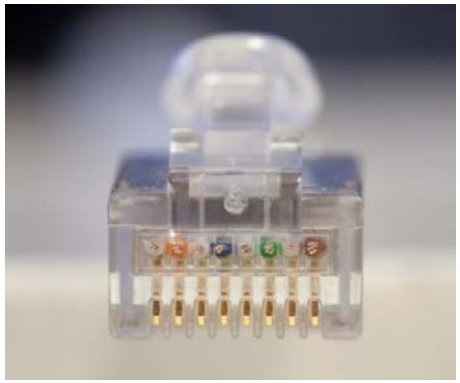


Plug fully engaged in connector



TIA-568-C.2 Compliant Patch Cords

- TIA-568-C.2 requires 50 micro-inches of gold
  - Pitting from disconnect under load wears away gold plating
- Gold plating on tines is a big part of patch cord cost
  - Skimping on gold is easy way to lower costs
- Non-compliant patch cords will fail over time when used in PoE applications



Recommendations for PoE

Category 6A systems for all new installations

- Solutions that meet and exceed current standards
  - 802.3at (Type 1) = 15.5 Watts
  - 802.3at (Type 2) = 30 Watts
  - UPOE = 60 Watts 802.3bt (Type 3)
- Capable of meeting emerging standards, up to 100 watts
  - 802.3bt (Type 4) / PoH = 100 Watts

Category 6A XTP/FTP Systems
Operational Advantages

- 23 AWG conductors and metallic tape/shield provide better heat dissipation
  - Reduces ampacity de-rating – running cooler without compromising insertion loss, enabling longer areas of bundling
  - Cooler temp maintains cable integrity & lifespan
  - Reduced OPEX, less facility cooling required

Thank You

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