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Fiber Optic Cable Preparation to Ensure Stable Operation

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SPIE Optics + Photonics 2008

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Overview

- How to properly precondition a fiber optic cable
- Performance of different types of fiber optic cables that are properly prepared
- What happens when you do not properly precondition the fiber optic cable

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Fiber Optic Cables

- TEQS Powerflex hard-polymer coated
  - 365/400/425 (TEQS)/730 (TEFZEL buffer)
  - Manufactured by InnovaQuartz

- Flexlite
  - 400/440 Step Index Fiber
  - E-PTFE buffer, Kevlar aramid braid, fluoropolymer jacket
  - Manufacture by W. L. Gore

- International Space Station Fiber
  - 100/140 Graded Index Carbon Coated
  - Fiberglass with Teflon coating, polymer jacket
  - Manufactured by Brand-Rex Company

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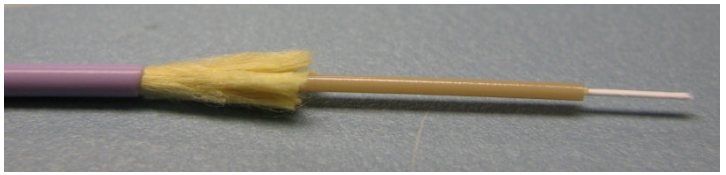
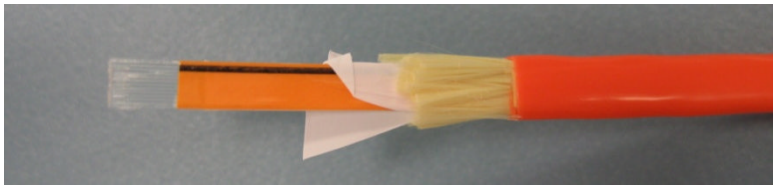
Fiber Optic Cables

- SMF with 1.8 mm PEEK
  - 9/125/250 SM fiber
  - Expanded PTFE, PEEK tube, aramid strength members, outer polymer jacket
  - Manufactured by W. L. Gore



- MTP cable
  - Mylar lamination, E-PTFE wrap, Kevlar strength member, outer polymer jacket
  - Manufactured by W. L. Gore



- Strong Tether Fiber Optic Cable (STFOC)
  - 9/125 SM fiber with acrylate coating
  - Proprietary secondary buffer
  - Manufactured by Linden Photonics

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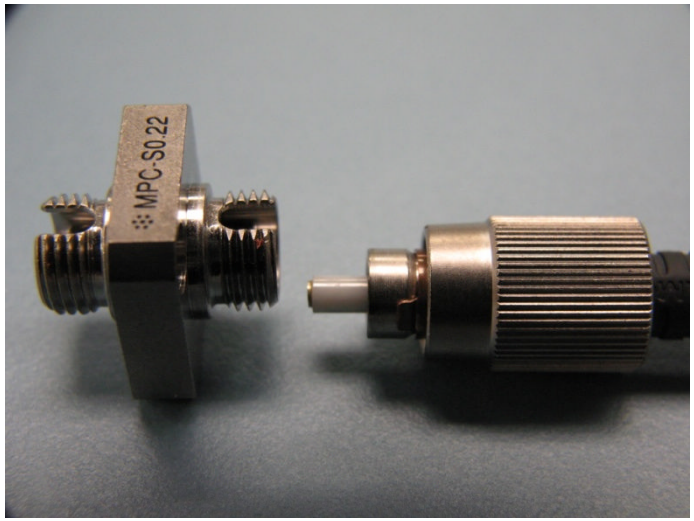
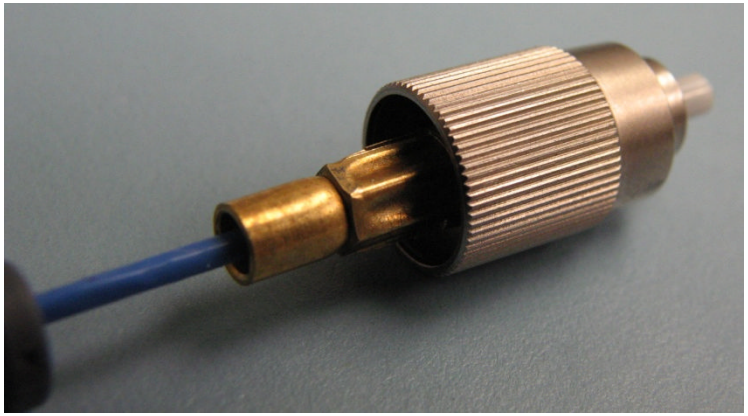
Cable Terminations

- FC connectors
  - 2.5 mm ferrule
    - Ceramic outside
    - Metal insert
  - Keyed to adapter



- Cable connected to back of connector
  - Metal crimp sleeve
  - Cable strength members (Kevlar) crimped



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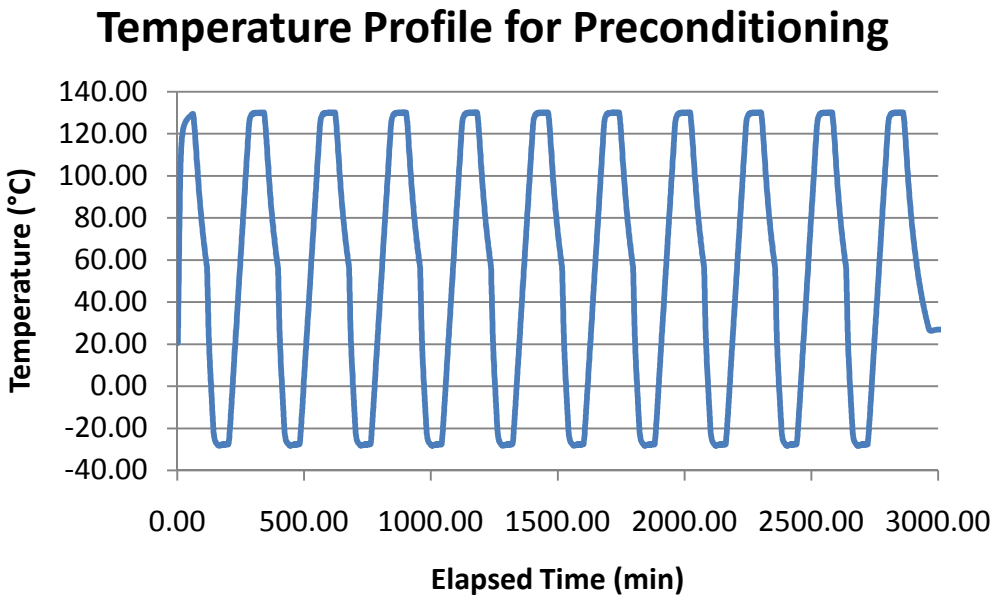
Thermal Preconditioning

- Cable lengths: 1, 3, and 6 meters
- Thermal Profile
  - -30°C to 130°C
  - 2°C/min
  - 1 hour dwell at extremes



- Cables were removed from thermal chamber and measured periodically during preconditioning study

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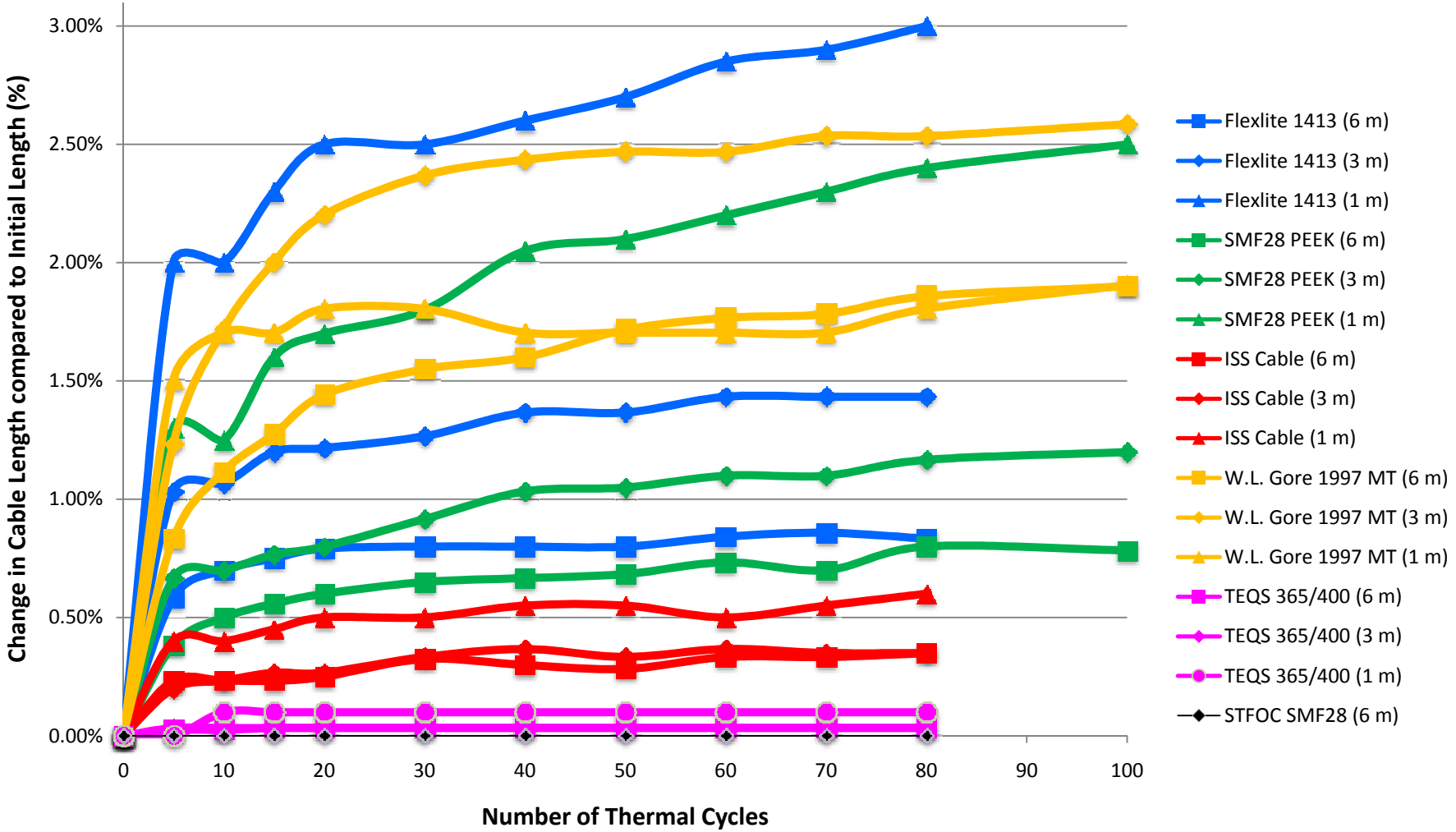
Thermal Preconditioning



Thermal precondition until cable length stabilizes

Shorter cables show a greater percentage change in cable length

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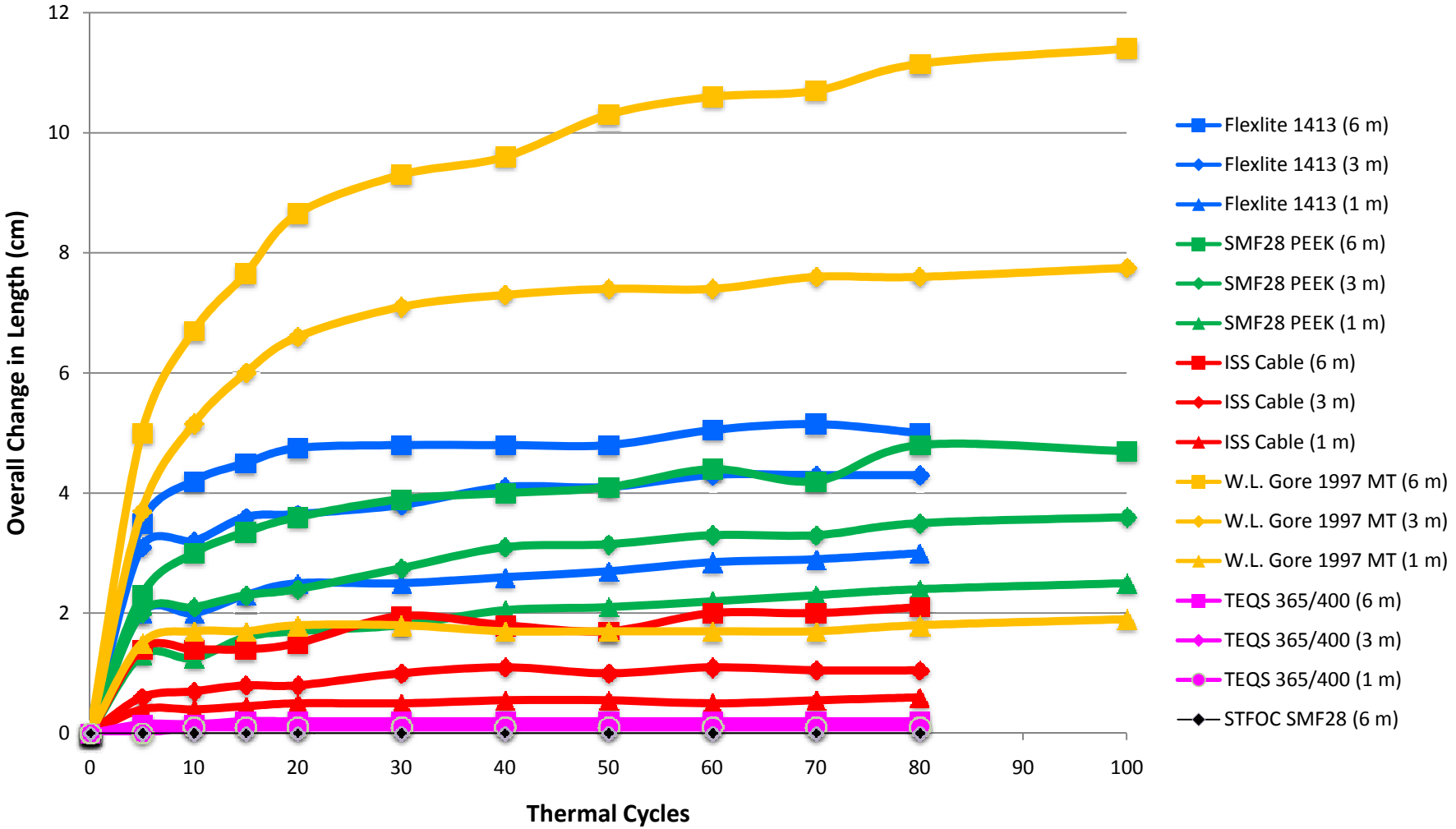
Thermal Preconditioning



Cable termination stability is determined by length change at connector

Longer cable show an overall greater change in length

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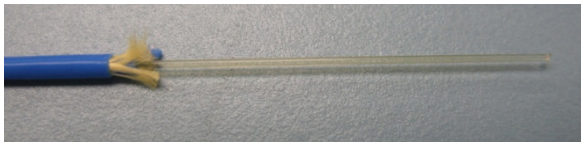
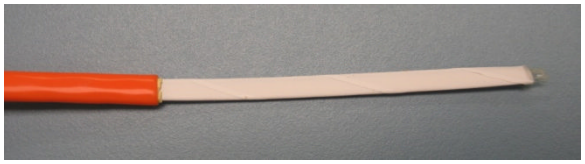
Thermal Preconditioning

- Fibers must be cut to length before they are preconditioned
- Cables must be subjected to thermal cycling until shrinkage has stabilized

Cable Shrinkage during Preconditioning



Flexlite cable



MTP cable

ISS cable

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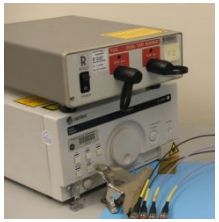
Fiber Cable Performance



Optical Sources

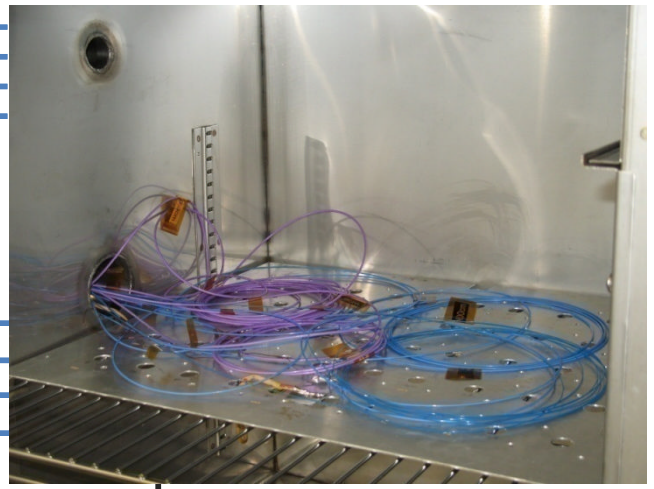
850 nm
1310 nm
1550 nm

Fiber Splitter

Source Monitor

Multi-channel Detector

Thermal Chamber



Thermal Monitor

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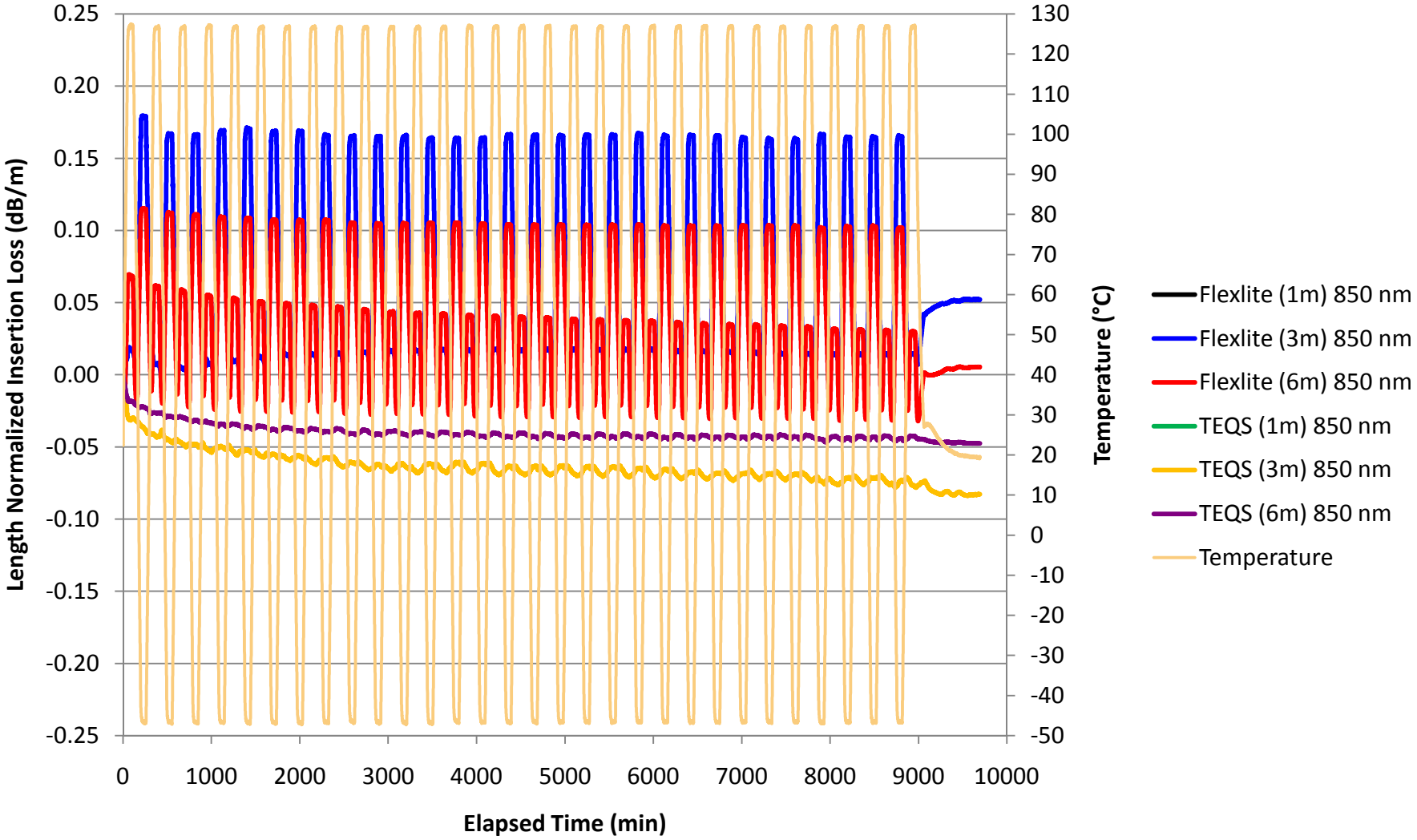
Fiber Cable Performance



-50°C to 125°C, 2°C/min, 60 min dwell at extremes

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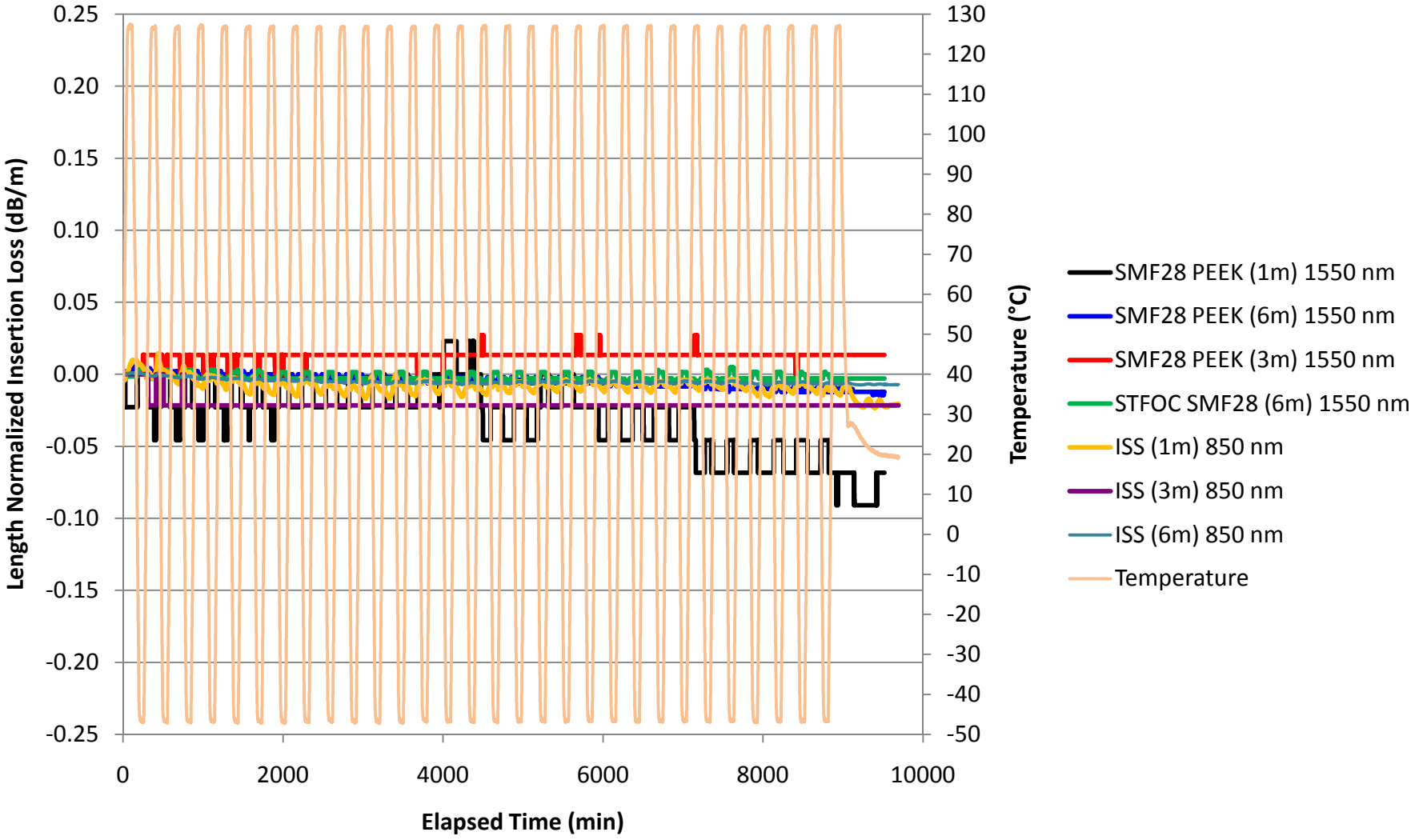
Fiber Cable Performance



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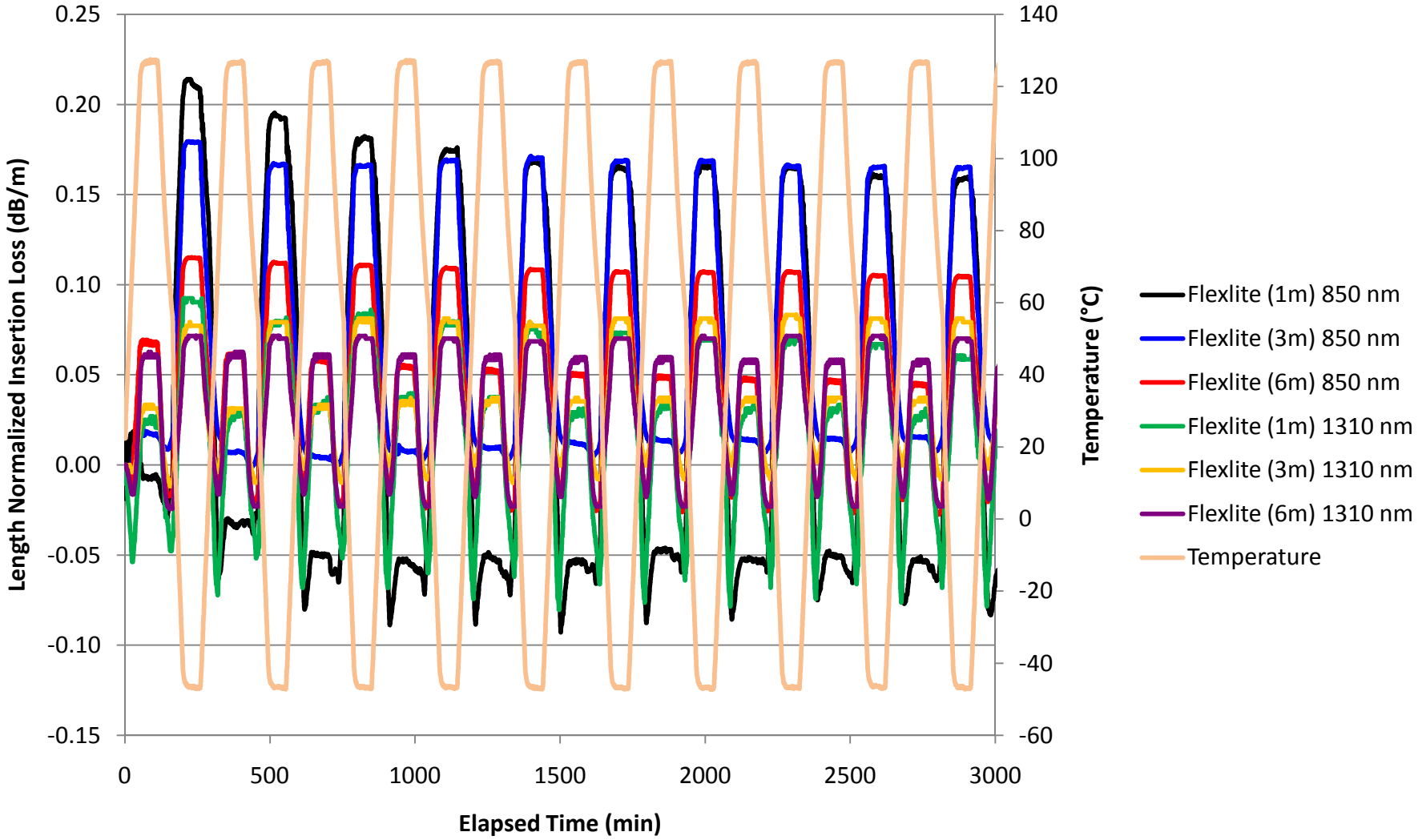
Fiber Cable Performance



Insertion Loss change is slightly wavelength dependent

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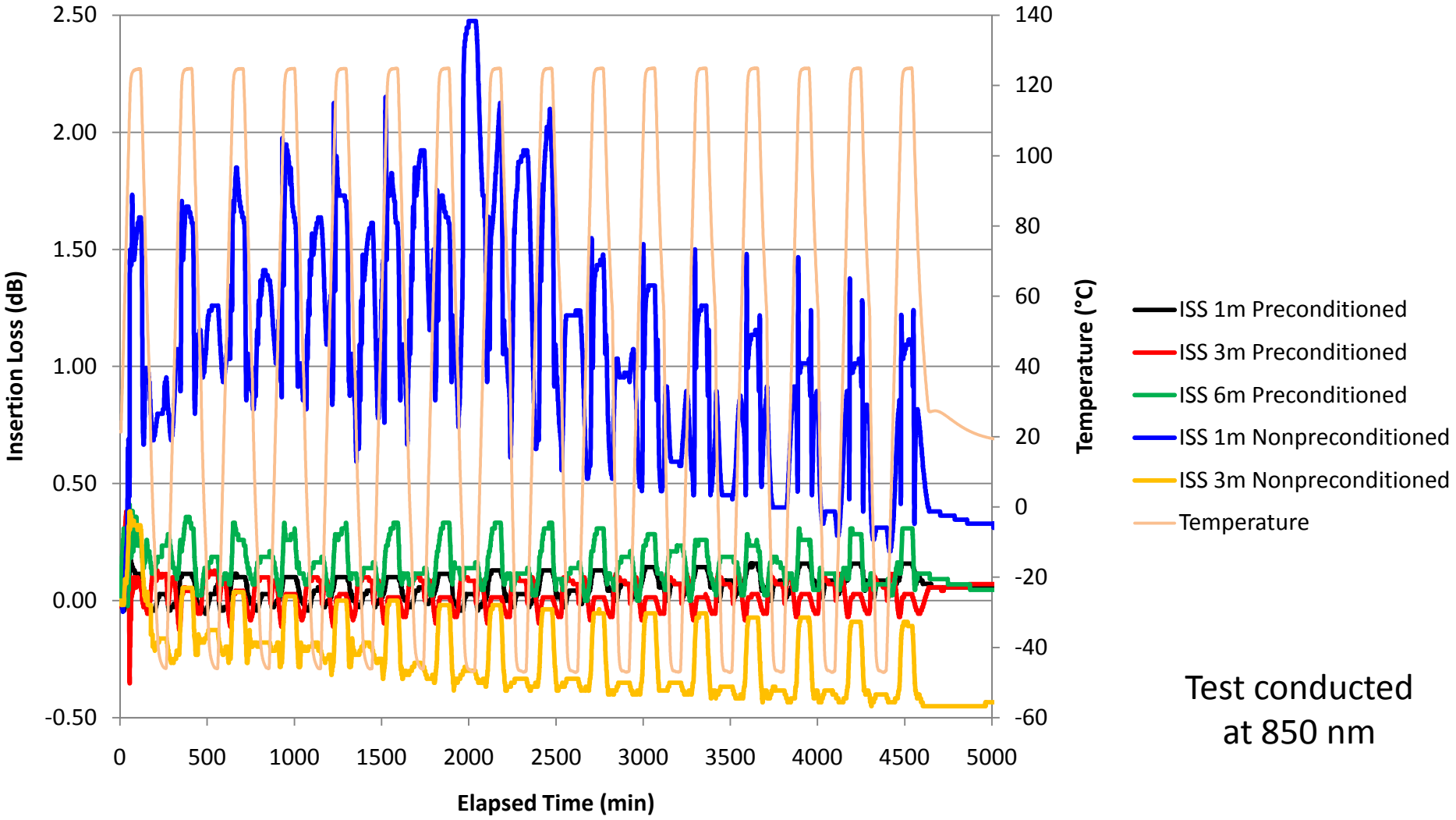
Preconditioned versus Non-Preconditioned



Test conducted at 850 nm

-50°C to 125°C, 2°C/min, 60 min dwell at extremes

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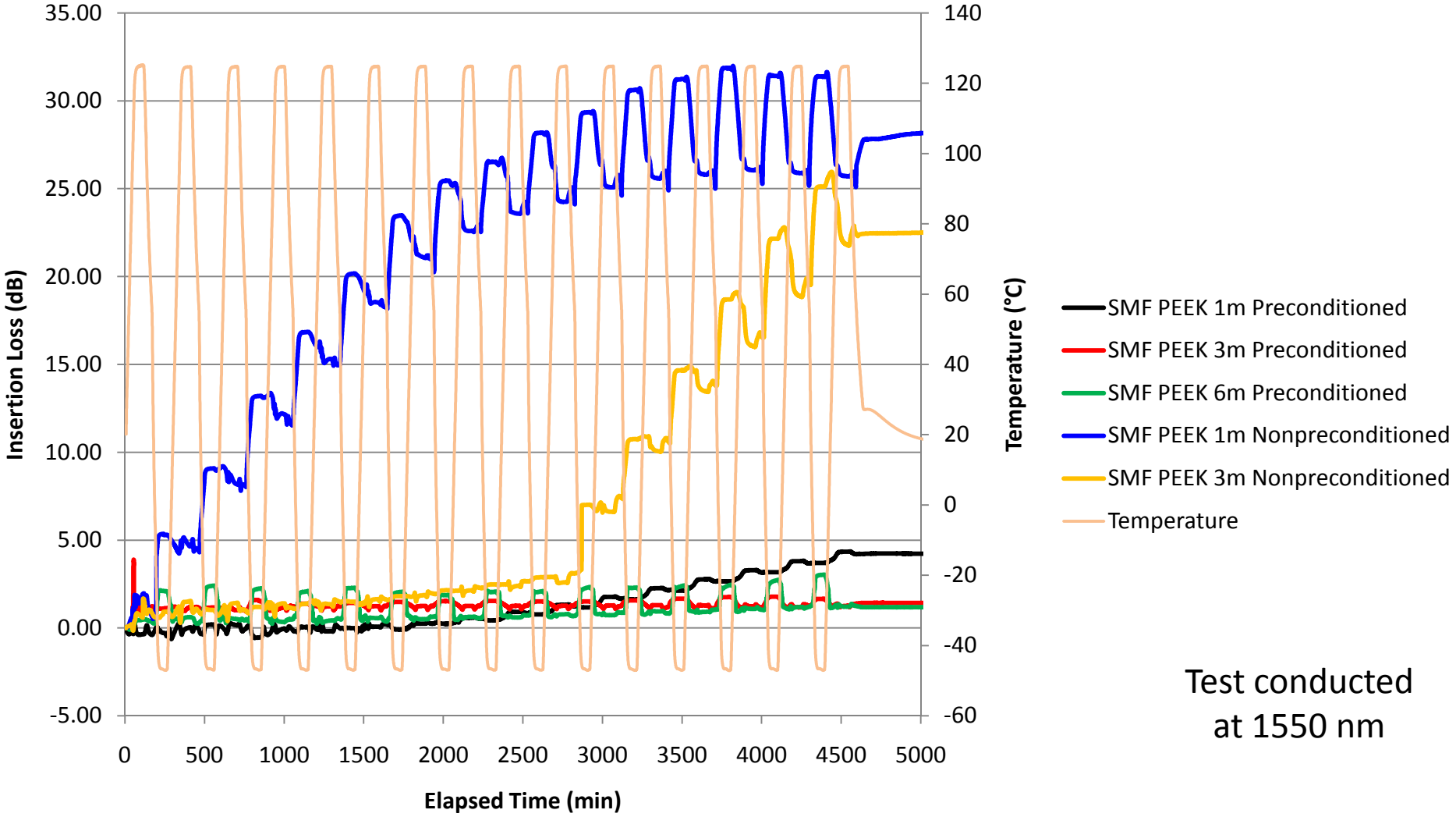
Preconditioned versus Non-Preconditioned



Test conducted at 1550 nm

-50°C to 125°C, 2°C/min, 60 min dwell at extremes

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Summary

- Most fiber optic cables will shrink
- Fiber cables must be cut to length before preconditioning
- Thermal cycling is required to properly precondition the fiber cable
- Temperatures will depend upon mission
- Number of cycles will depend upon cable
- This step early in the manufacturing process can mean the difference between mission success and failure

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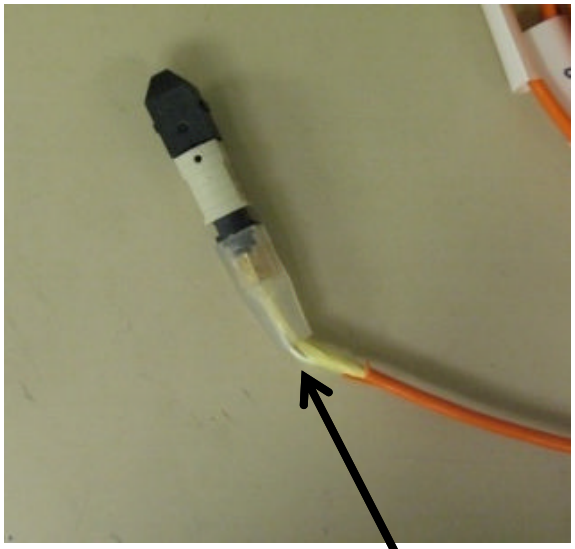
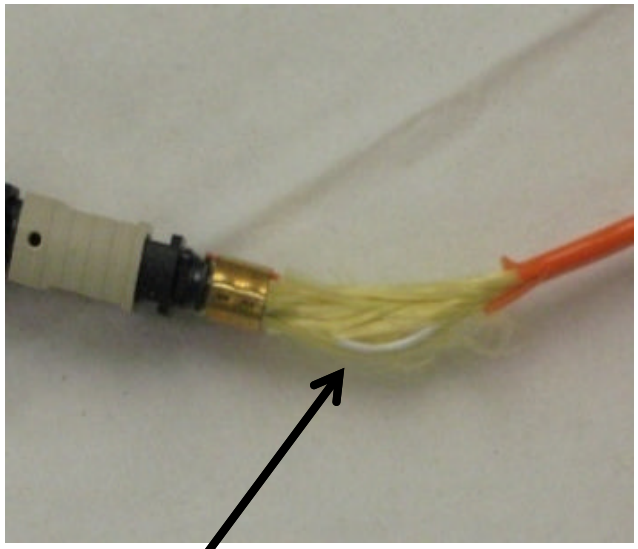
Problems to Avoid



YOU DON'T WANT THIS TO HAPPEN TO YOU



Fiber optic cable

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http://nepp.nasa.gov

For additional information please see our website
http://misspiggy.gsfc.nasa.gov/photonics