Specialty Materials SiC Fibers

Process, Properties, and Production

OUTLINE OF PRESENTATION

- History of Specialty Materials, InC (SMI) Silicon Carbide Fibers
- Manufacturing Process
- Physical and Mechanical Properties
- Current Production and Sales Price
- Future Plans

HISTORY OF SMI's SiC FIBER

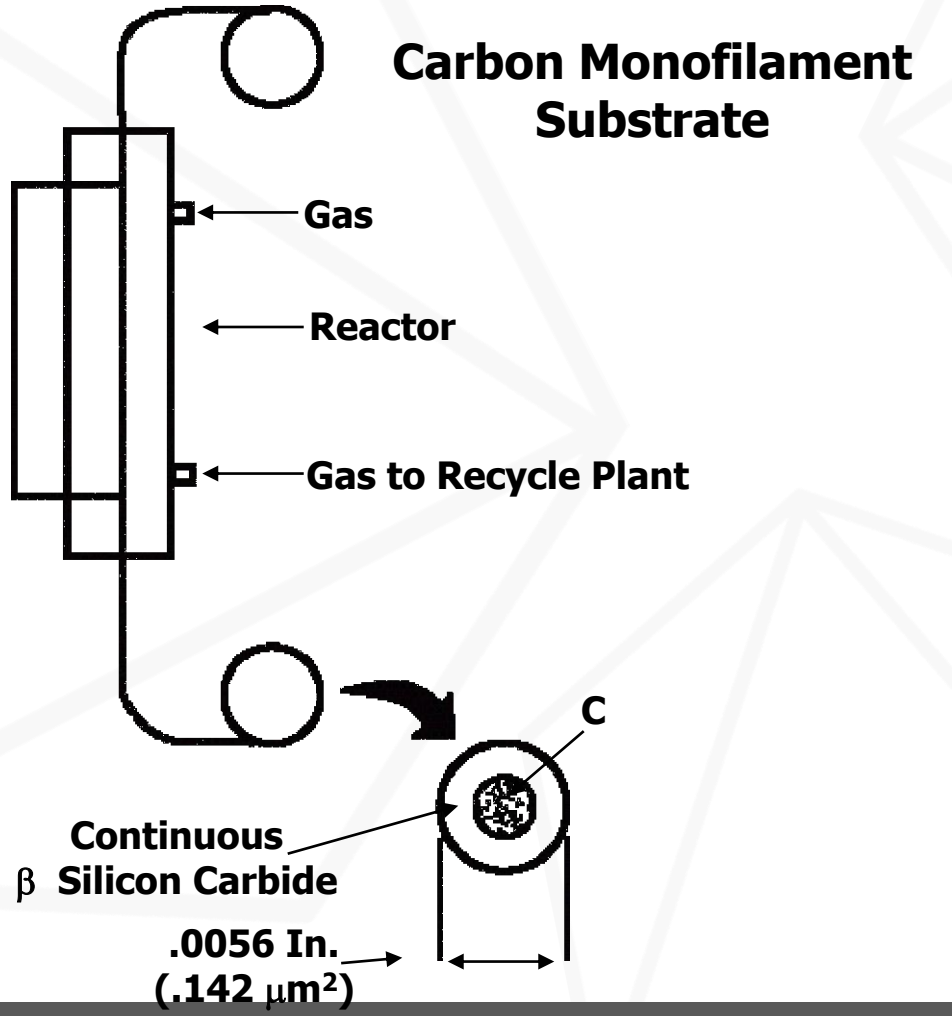
- Boron was ineffective in metal matrices
- The Air Force wanted a fiber for titanium
- AFML funded Avco work in the early 70's
  - Initially, SiC on W substrate
  - Developed SiC on C substrate
  - Improved high temperature strength retention
  - Optimized surface for handling and bonding

SMI's SiC FAMILY OF FIBERS

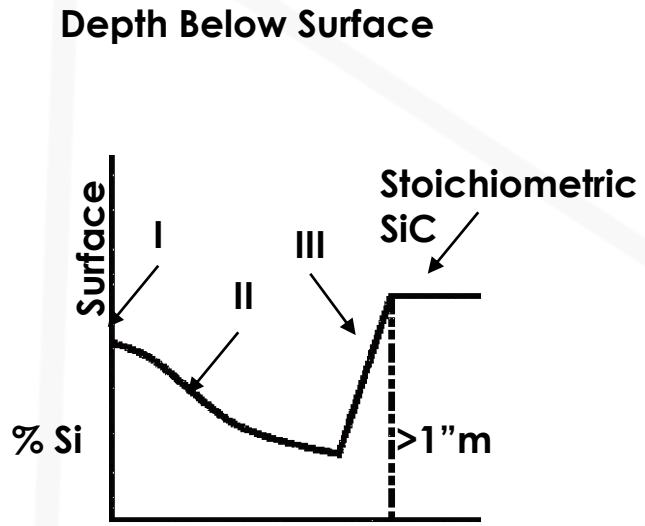
- SCS-6
  - Developed for titanium and ceramic matrices
  - 5.6 mil diameter
- SCS-9A
  - Developed for thin-gauge face sheets for NASP
  - 3.1 mil diameter
- SCS-ULTRA
  - Developed to achieve highest strength
  - 5.6 mil diameter

SCS FIBER PRODUCTION FACILITY

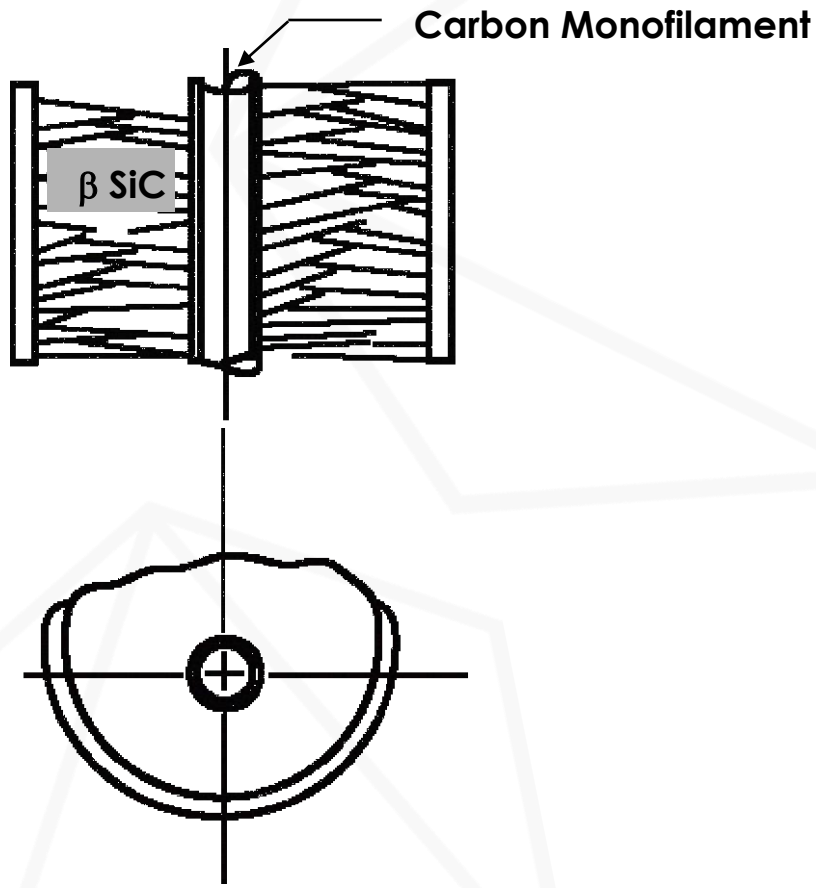
SCS FIBER MANUFACTURING PROCESS



CONSTRUCTION OF FIBER FOR STRENGTH AND MATRIX COMPATIBILITY

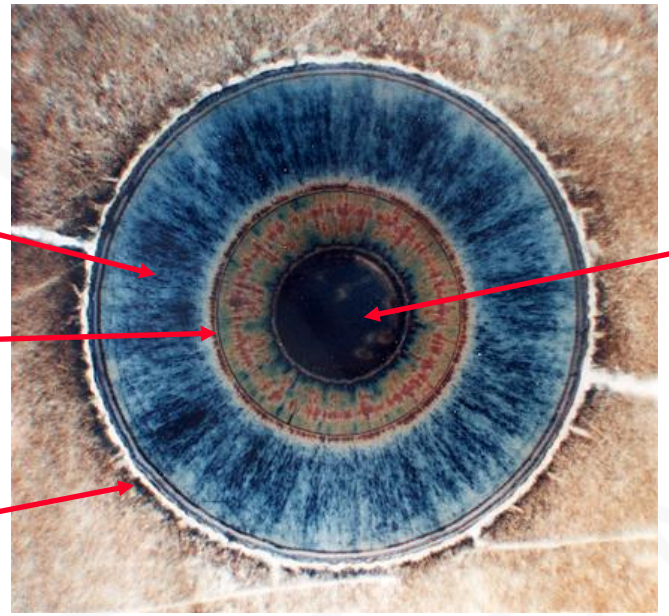


- **Zone I -** Surface Bondable & Wettable By Matrix
- **Zone II -** Broad Forgivability Zone
- **Zone III -** Inner Gradient - Necessary for Maintaining Filament Strength



PHYSICAL AND MECHANICAL PROPERTIES

Schematic of SMI's "SCS" CVD SiC Monofilament

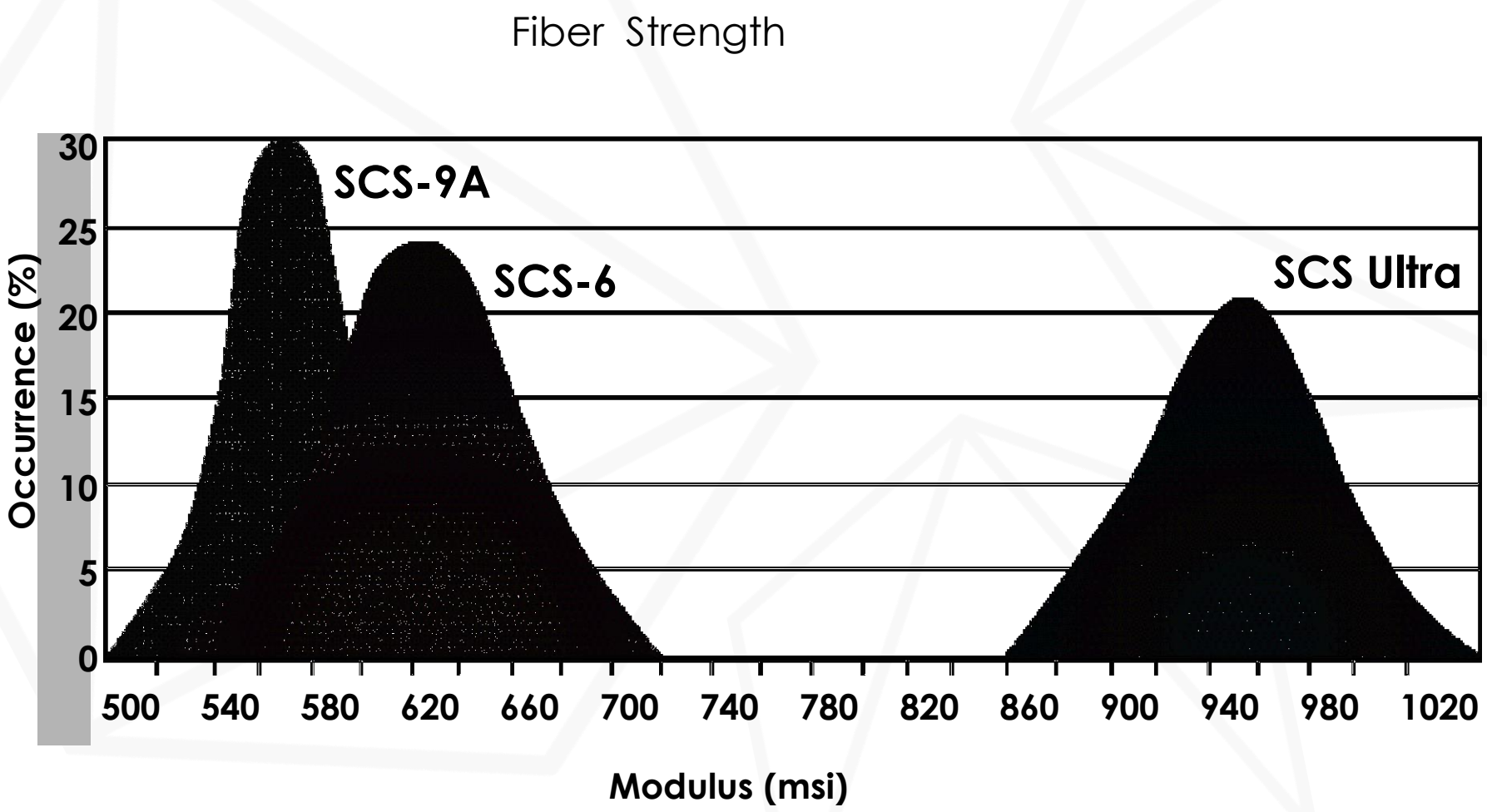


CVD Silicon Carbide

Filament Properties *(SCS-6)*

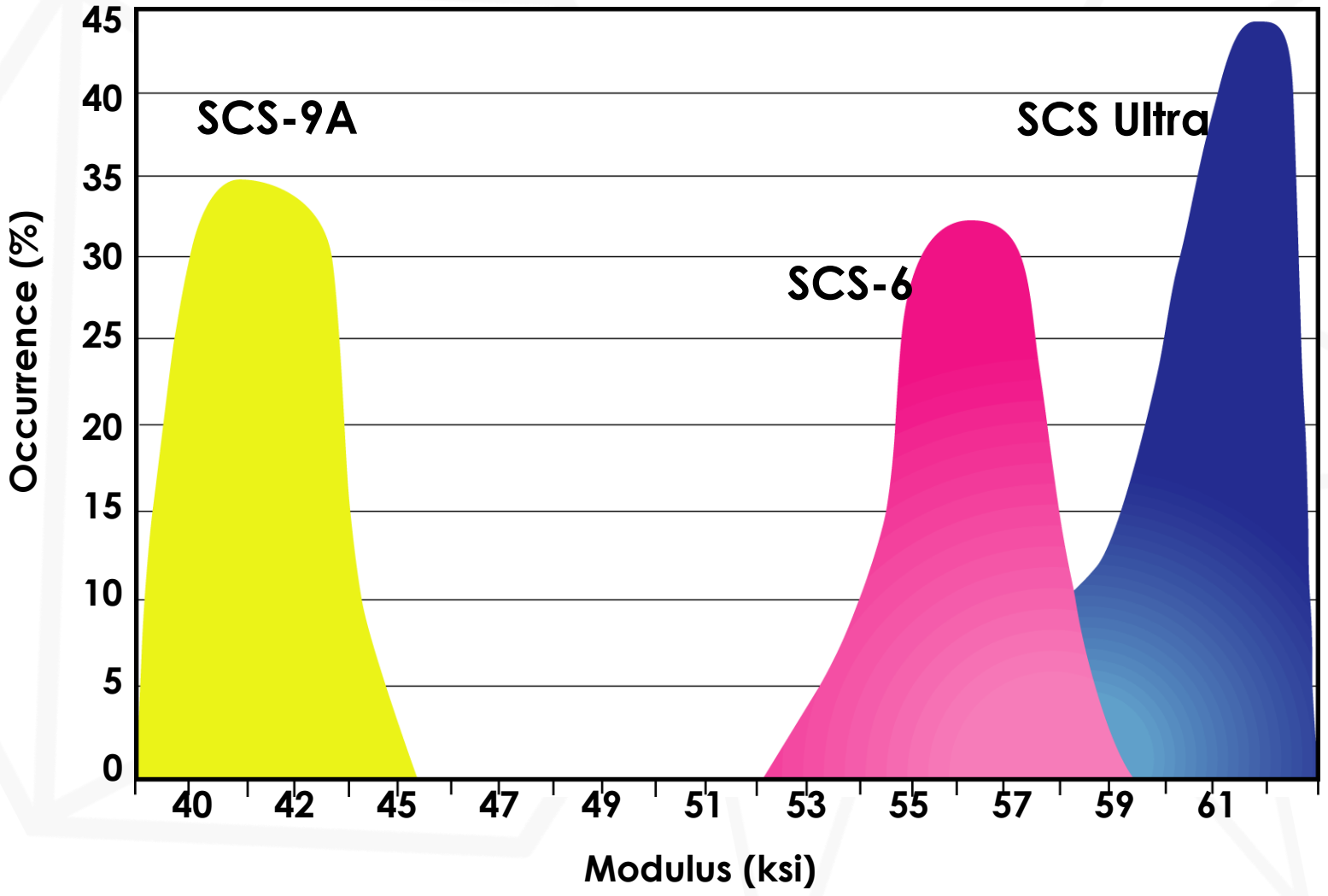
• Diameter	5.6 mils	140 μm
• Tensile Strength	500 + ksi	3450 MPa
• Modulus	56 msi	400 GPa
• Density	0.11 lb/in^3	3.0 gm/cc

COMPARISON OF SILICON CARBIDE FIBERS

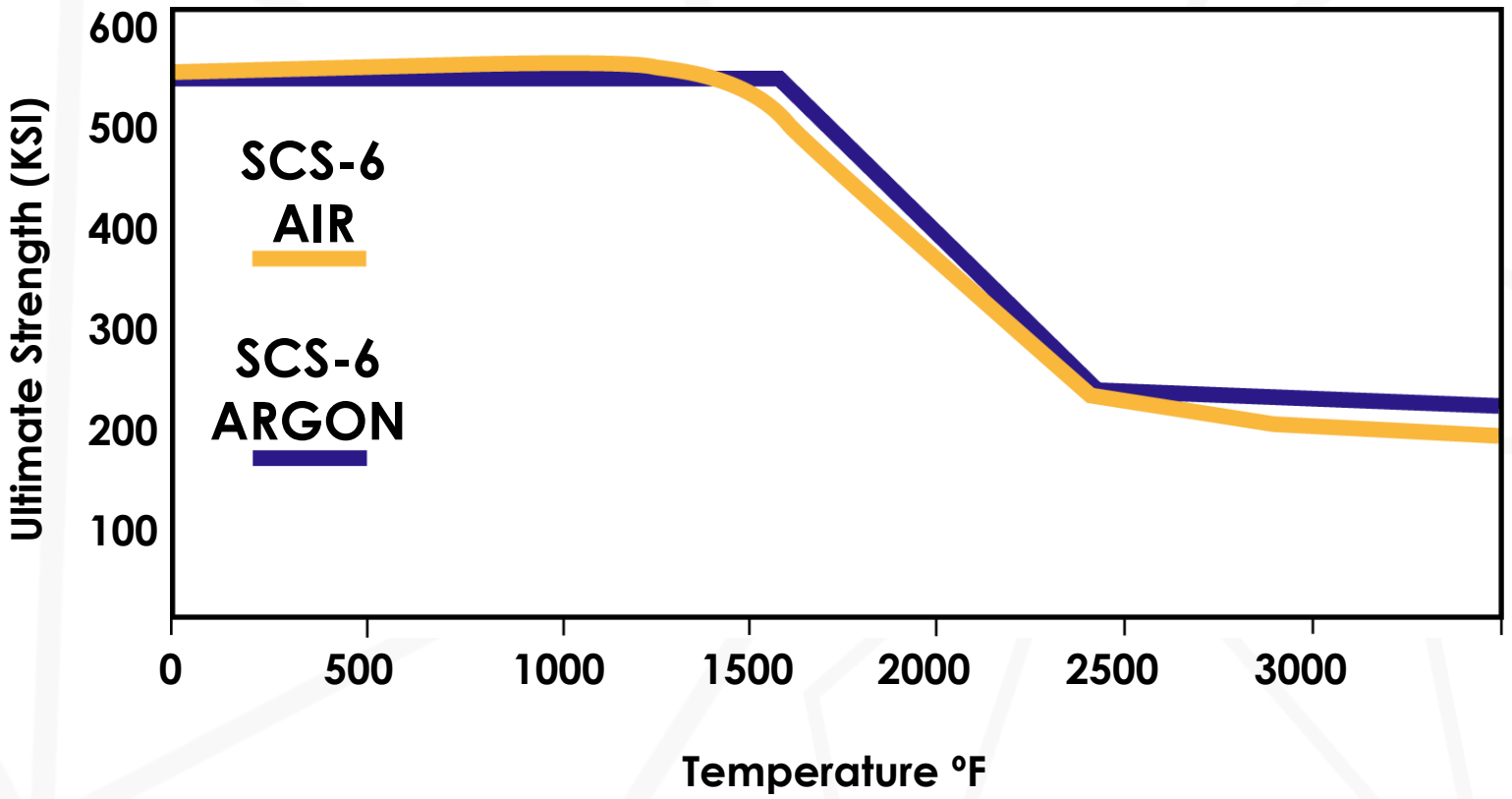


COMPARISON OF SILICON CARBIDE FIBERS

Fiber Modulus

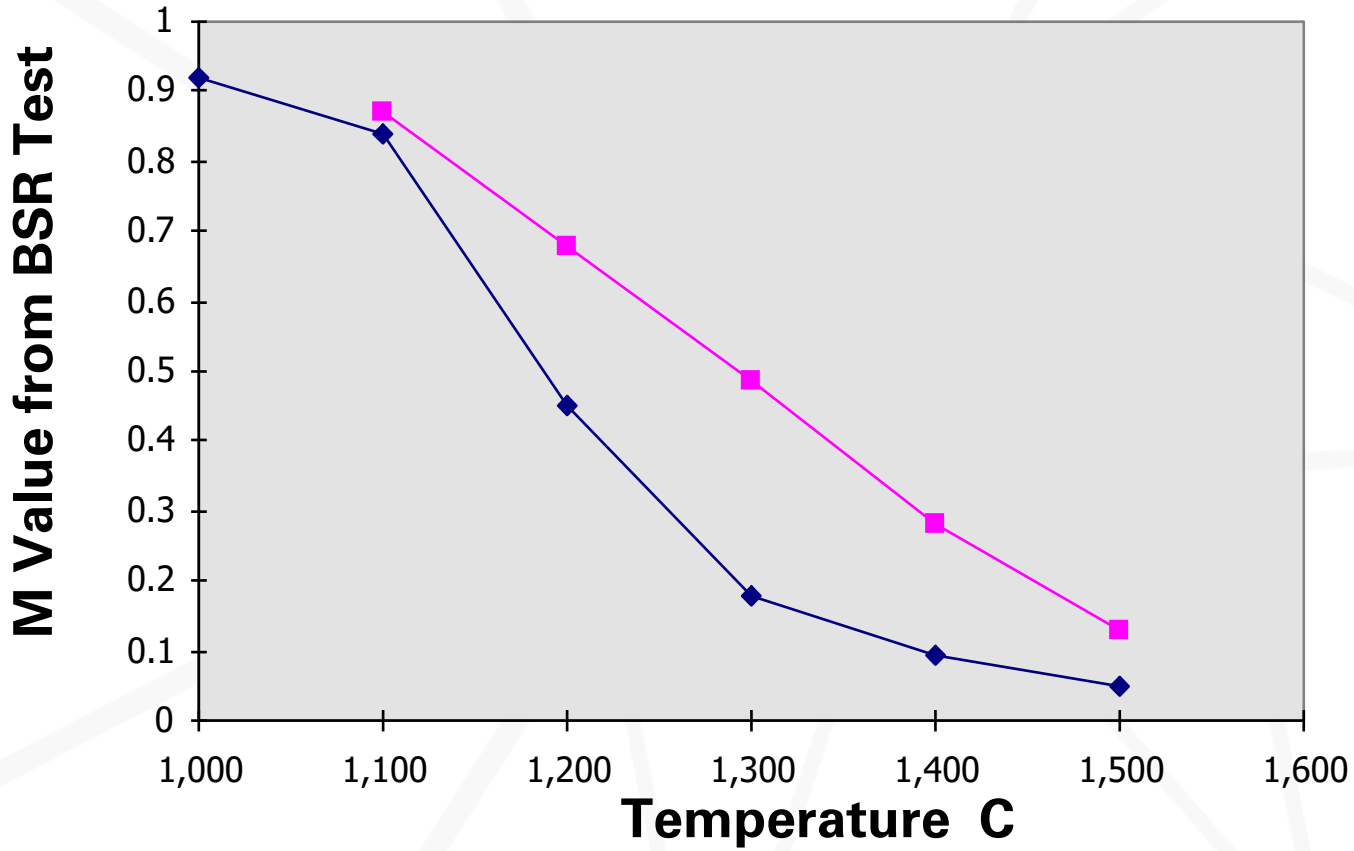


SCS-6 STRENGTH VS. TEMPERATURE

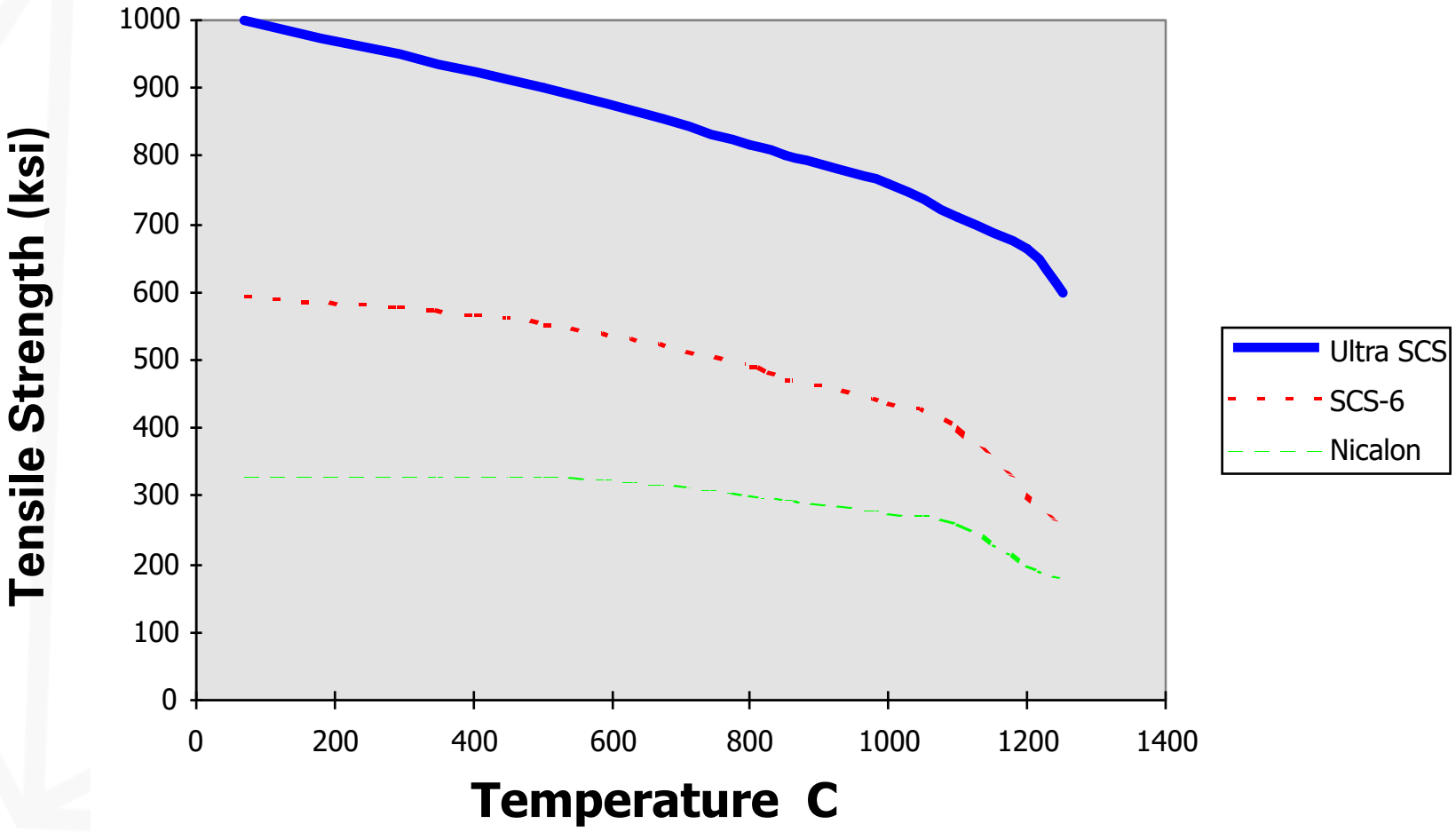


Approximate soak time at temperature - 3 minutes

BEND STRESS RELAXATION CREEP OF SCS-6 AND ULTRA SCS

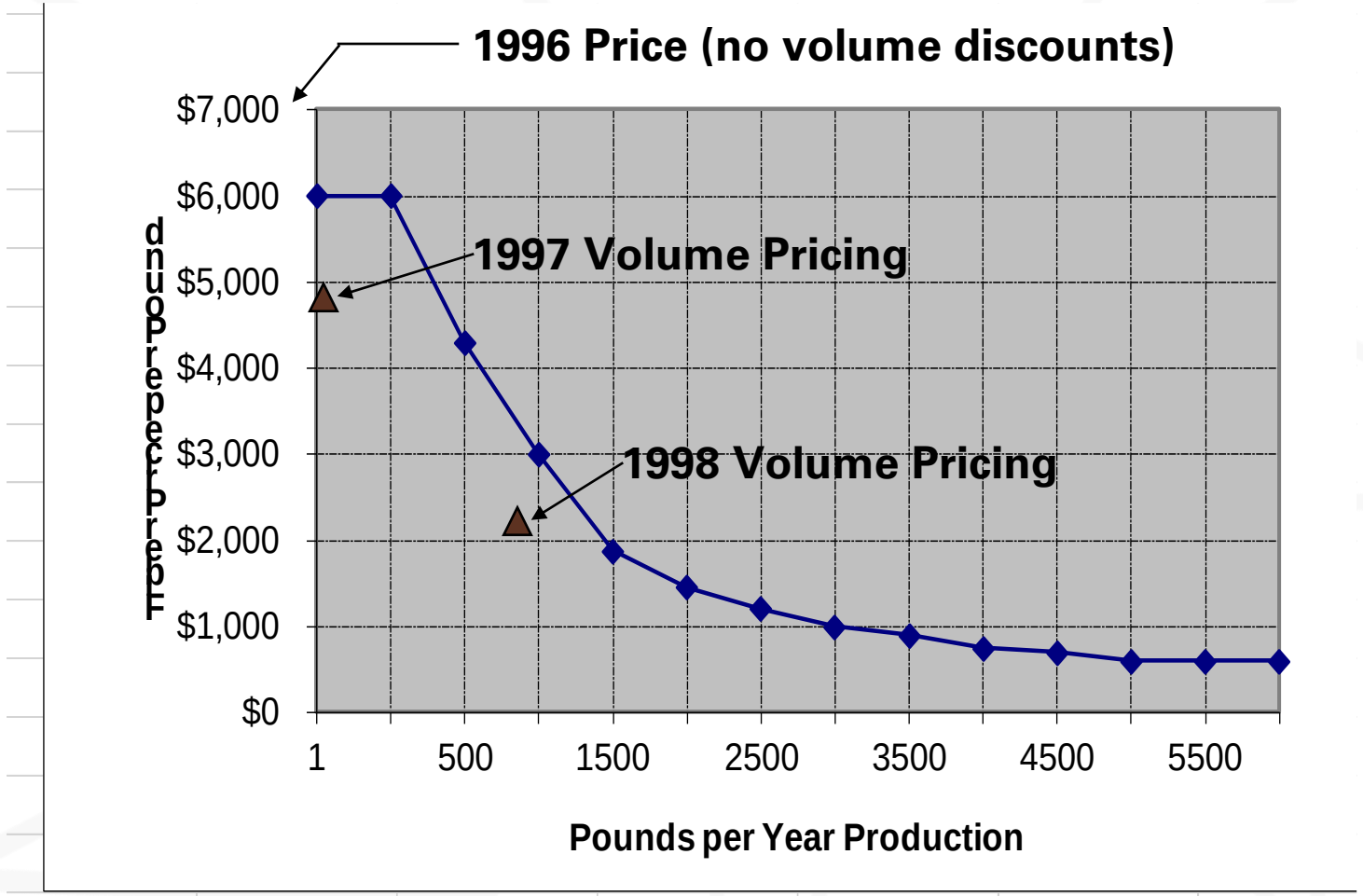


COMPARISON OF TENSILE STRENGTH VS. TEMPERATURE



Approx. soak time at temperature - 3 minutes

SCS-6 Fiber Price Estimate



CURRENT PLANT AND FUTURE PLANS

- Current capacity is ~ 2,000 pounds per year
- Gas recovery system can handle 10,000 pound per year
- Minimal investment needed to scale-up production capacity
- Capacity will be added as fiber demand increases