Thermal threads perform tough assignments

Threads used in manufacturing flame-resistant protective clothing, much like the "commodity" threads (e.g. cotton, polyester and nylon) for making everyday garments, need to demonstrate many of the same properties that contribute to comfort, durability and performance. In addition, these threads need to demonstrate good thermal stability along with flame resistance.

To distinguish the impact of temperature as a property, we need to remember that thermal performance ranges from keeping us "warm" when the temperature is -40° C (-40° F) to keeping us "safe" when the temperature reaches 300° C (575° F). This article discusses performance concerns at high temperatures—that is, those ranging from 260° C to 1100° C.

The clothing manufacturer is responsible for developing appropriately designed garments that have good fit, good appearance and durability. The range of fabrics that will perform at elevated temperatures include a number of pure and hybrid fabrics made from a variety of fibers.

The chart at right shows those fibers and the maximum temperatures at which these products can be used.

Because high temperature applications require a concern about safety for personnel and equipment, the manufacturer needs to ask the industrial end-user several key questions:

- Is this a specialized product that requires small-quantity manufacturing, or is mass production required? Small-quantity specialized manufacturing enables the user to "customize" the product. Mass production may require a "redesign" so a consistently good product can be made while still maintaining a level of manufacturing efficiency.

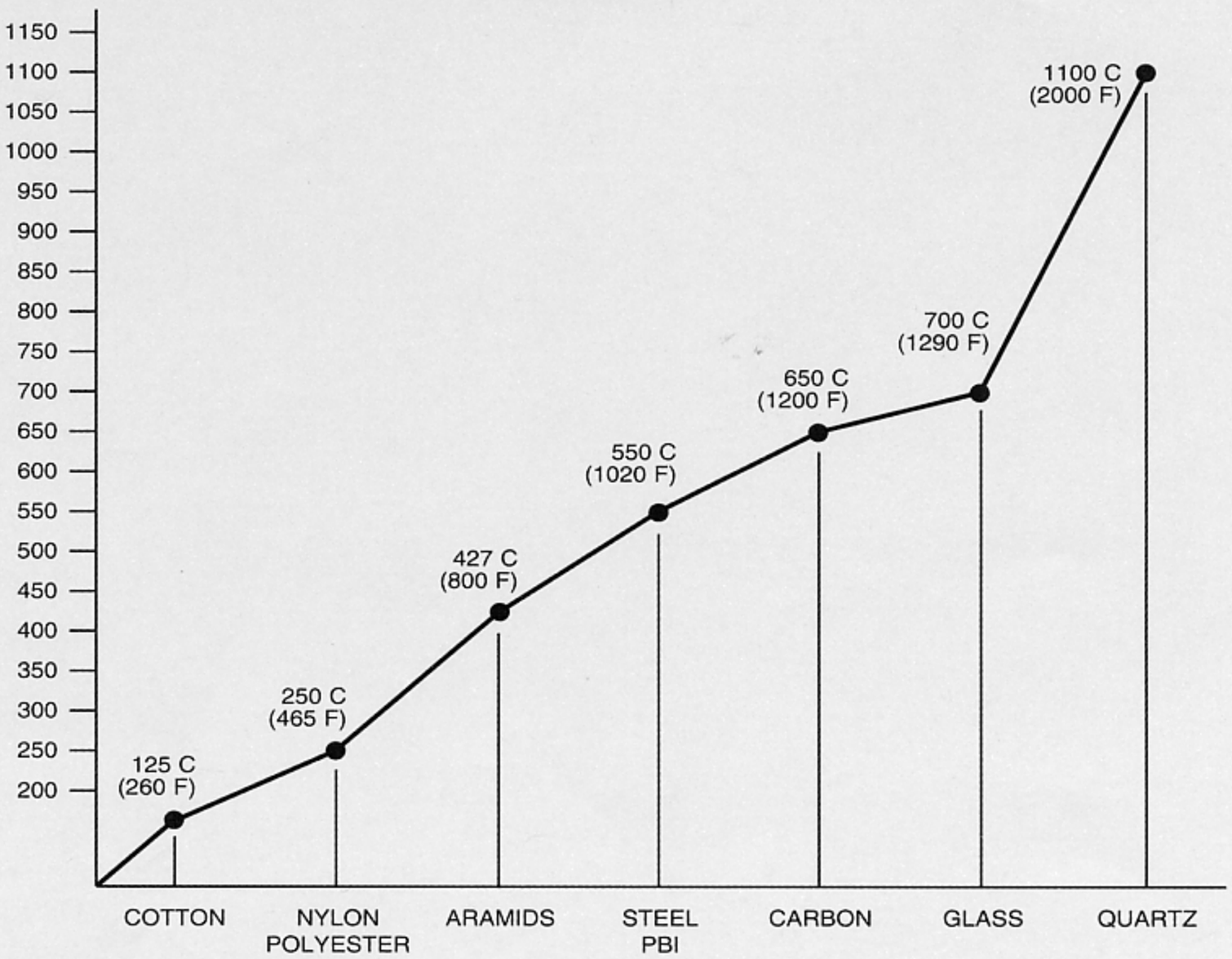
- What is the maximum temperature to which the thread will be directly exposed?

- Is the sewing thread readily available and in quantities for immediate purchase?

Quartz

Only a limited number of fibers can achieve the upper temperature ranges. The most commonly used for high temperatures near 1100° C (2000° F) is quartz. But while it possesses excellent temperature and dielectric properties, quartz sewing thread is very brittle. Consequently, it cannot be used to manufacture ensembles that will be subjected to high rates of dynamic stress.

High-performance fibers and their maximum temperatures



By Vincent Diaz

Glass and carbon

In the temperature range between 650° C - 700° C (1200° F -1300° F), "E" glass and carbon fibers are achieving a level of popularity. Ultra-high temperature proximity and reflective clothing are made of these fibers, which can withstand high temperatures and also tolerate some dynamic mechanical stresses.

Both glass and carbon fibers offer good thermal resistance properties. Both also can be made into sewing threads for protective clothing. Their major drawback is that they require much slower sewing machine speeds, thus reducing production rates. Neither should be used if the manufacturer needs to produce high volume.

All glass sewing threads have coatings such as polytetrafluoroethylene (PTFE) to enhance their sewability and reduce their potential for thread breakage. Carbon threads also have special finishes that help prevent excessive thread breakage.

Steel

Although more often chosen for its anti-static properties, steel sewing thread can be used for joining fabric sections that also require high heat resistance. Steel yarn performs better as a sewing thread when it is blended with another fiber with good sewing characteristics.

This blending permits seam joining while maintaining an acceptable level of sewing efficiency. It also prevents a steel yarn's mechanical action from contacting the metal components of a sewing machine.

Aramids

The widest variety of sewing threads in terms of sizes, colors and break strengths is available in the temperature range of 260° C to 427° C (500° F to 880° F). Sewing threads made of aramid fibers are used to manufacture a broad range of single-layer and multi-layer protective garments. This is because of three primary characteristics:

Sewability. Because of their high sewability, aramids don't require drastic changes in the manufacturing process, as do other high-heat fibers discussed earlier.

Toughness. Sewing thread toughness, also called work-to-break, determines how the thread performs when the seam construction is repeatedly stressed and strained. This helps determine the long-term survivability of the protective ensemble, which in turn helps establish the cost/value of the garment by increasing the number of times it can be used before it needs to be replaced.

Care and maintenance. Fabric and thread that demonstrate adaptability to conventional care and maintenance contribute to establishing the cost/value of the product by extending its useful life.

All the components used to manufacture high-temperature protective clothing need to be carefully selected. This is especially critical when performance and safety "hang by a thread." ❑

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