TTI EXPERTS PUT ARAMID-BASED MOORING LINES TO THE TEST

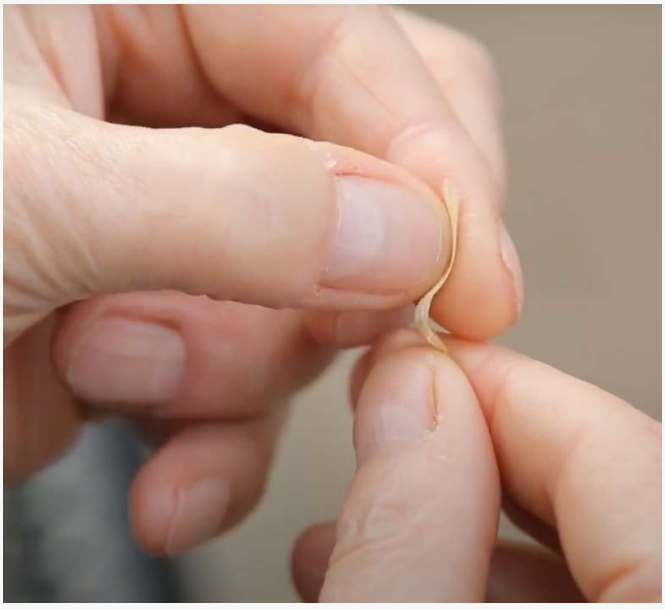
Reliability in ship mooring relies heavily on the materials used in mooring lines. Independent rope testing authority, Tension Technology International (TTI), tested mooring lines extensively for tensile strength and creep resistance. The results show that aramid-based mooring lines perform better than HMPE equivalents overall, particularly in high-temperature environments.

Strength and reliability are two essential requirements of mooring lines and marine ropes and are increasingly top of mind for end users of these applications. To make informed buying decisions, marine customers require clarity from rope manufacturers about the products they buy.

Twaron® Technora®

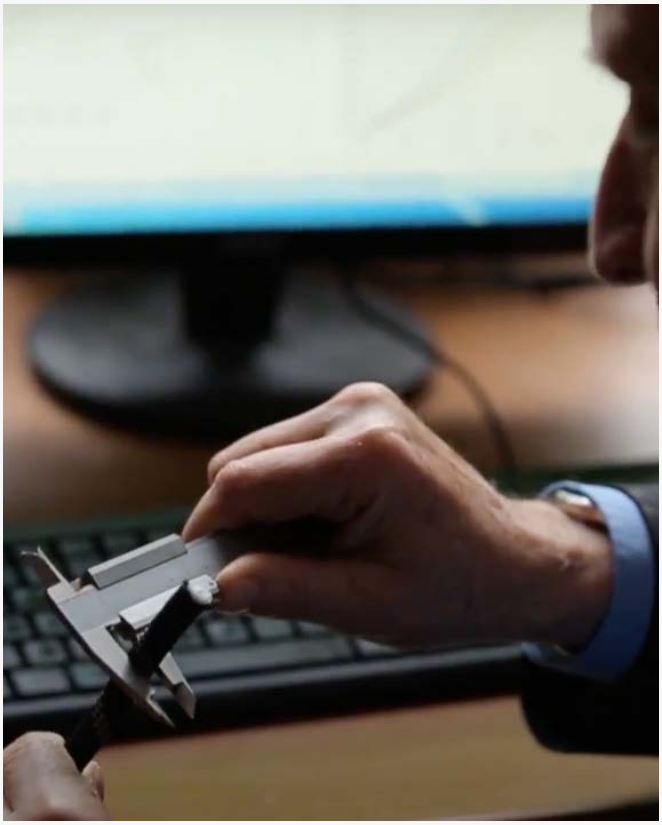
The importance of independently testing mooring lines

Independent testing plays a central role in decision-making. Established in 1986, Tension Technology International (TTI) relies on an experienced consulting team to accurately assess the performance of specialty industrial ropes and cables, including in mooring applications. The data TTI provides helps rope manufacturers make informed choices about their materials – and, in turn, ensure high levels of safety and performance for end users.



TTI's precise calculations provide peace of mind for rope manufacturers serving highly demanding industries, including commercial shipping. "Shipping industry suppliers represent our biggest customer group," explains TTI Chairman Nick O'Hear.

"WITH THE MOVE TOWARD LARGER VESSELS AND THE USE OF LARGER, MORE EXPOSED OFFSHORE TERMINALS, THE DEMANDS ON THE PRODUCTS THEY MAKE ARE CONSTANTLY GROWING. THE LOAD- AND TENSION- BEARING REQUIREMENTS FOR MOORING LINES INCREASE MONTH BY MONTH."



Comparative testing of aramid and HMPE mooring lines

ARAMID ROPE

HMPE ROPE

Observing failures in synthetic mooring ropes, including those made of high-molecular-weight polyethylene (HMPE), TTI carried out an extensive testing program. The program compared aramid-based applications against HMPE on critical areas: strength, tensile performance, and creep rupture. A key focus of the testing program was to assess how the materials performed under elevated temperatures, to replicate real-life shipping conditions in warmer parts of the world.

Tests compared a three-strand HMPE rope typically used for this application with three alternative aramid fiber ropes made with different grades of Technora® and Twaron® aramid fibers. All rope samples had a braided polyester jacket and a 32 mm diameter.

> THE HIGHER THE PERCENTAGE, THE GREATER THE RESISTANCE

The TCLL test: Measuring tensile strength

First, TTI compared the tensile fatigue performance of Technora® and Twaron®, as well as HMPE, using a thousand-cycle load level (TCLL) test. In the maritime industry, the TCLL value is a standardized gauge of rope performance. TCLL indicates the maximum percentage of the nominal breaking strength at which a rope can be cycle loaded 1,000 times under closely controlled laboratory conditions. In simple terms, the higher the percentage, the greater the resistance.

The aramids were put through two TCLL testing cycles. The first test used Oil Companies International Marine Forum (OCIMF) specifications for mooring lines, exposing the materials to wet conditions and room temperature. The second test applied dry conditions and an elevated temperature of 40 °C, to closely resemble typical shipping conditions in warmer climates.

Aramid delivers strong results

The OCIMF test reported no significant variation between the materials. HMPE recorded the highest overall TCLL value (approximately 74 %), while the three aramid samples recorded values of approximately 69 %, 64 %, and 52 %, respectively.

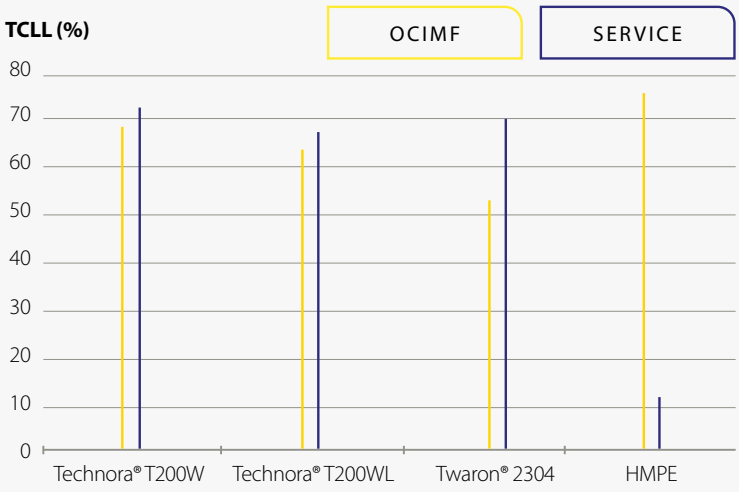
These values all signify a good level of performance. "Ropes are not supposed to be taken beyond 50 % of their breaking strength," explains O'Hear. "50 % is already quite a high load in a fatigue application, so any value above this is indicative of strong performance."

Aramids outperform HMPE at high temperatures

However, the second test, held under service conditions, revealed a much higher level of variation. The three aramid samples each saw an increase in performance from the first test, producing TCLL values of between 68 % and 72 %. In contrast, the TCLL value of the HMPE sample deteriorated significantly, falling to just 12 %.

The results show conclusively that HMPE-based lines lose significant tensile strength under elevated temperatures, while aramid mooring lines maintain a good level of performance.

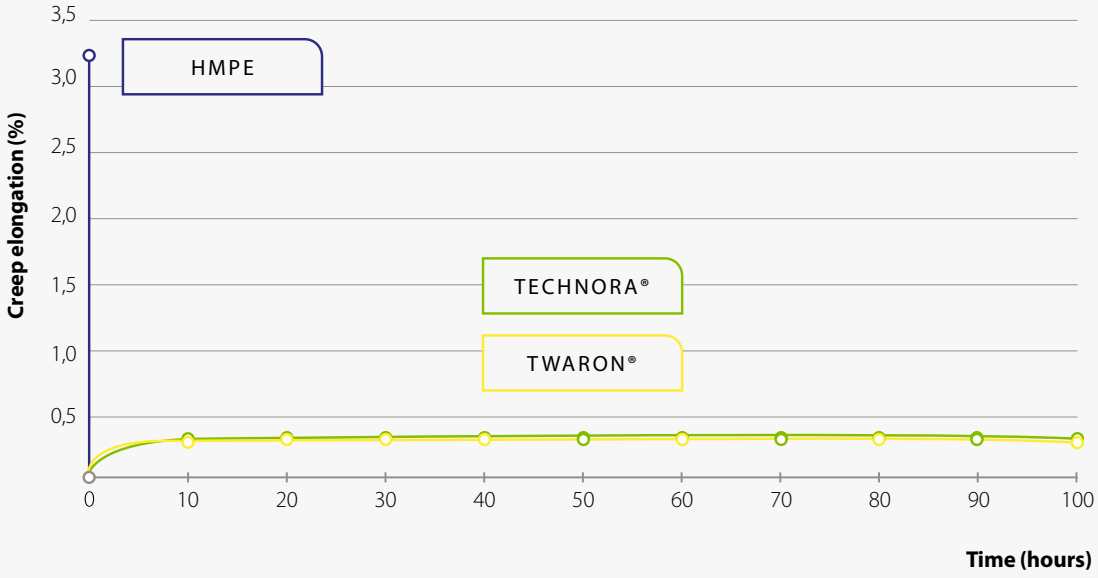
TCLL results: 22 °C & wet Vs 40 °C & dry conditions



Superior creep resistance with aramid

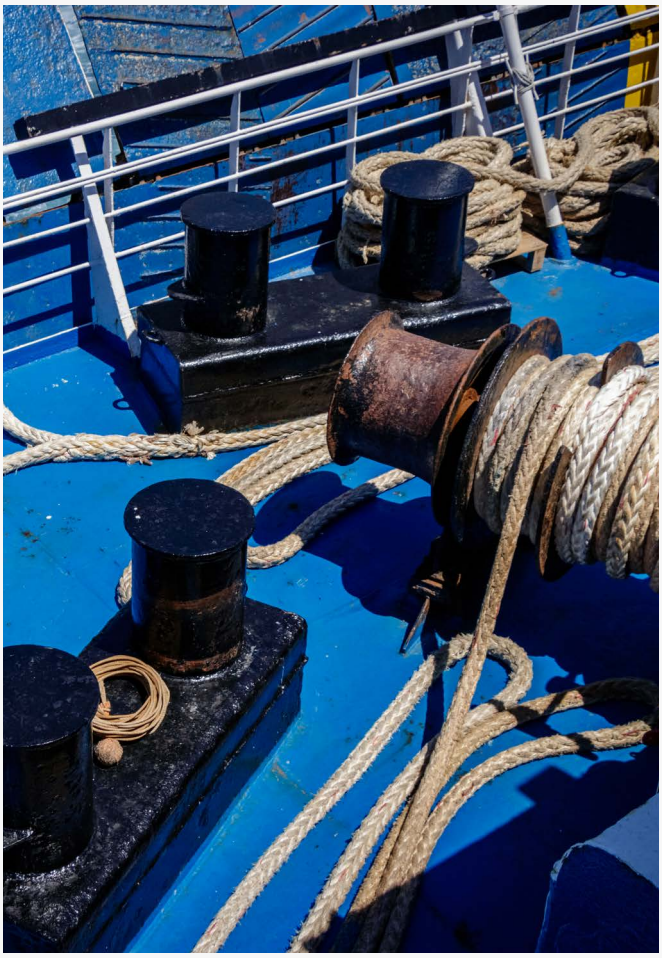
Creep resistance is another important gauge of durability in mooring lines. TTI set up a creep rupture test, again comparing aramid with HMPE. The materials were subjected to 'severe' conditions: a 70 % rope minimum breaking load (MBL) at 50 °C, taking place over 100 hours. The aramid samples completed the 100 hours with only minimal creep. In contrast, the HMPE rope failed about 10 minutes into the test. At a lower temperature (40 °C combined with 50 % MBL), the HMPE rope lasted longer – around 60 hours – but still showed vulnerability to creep rupture.

Creep comparison after 100 hr at 70 % rope MBL and 50 °C



Reliability in every climate

TTI's thorough independent testing program shows how Technora® and Twaron® outperform HMPE-based synthetic fibers for strength and reliability, particularly in warmer climates.



As O'Hear explains, these qualities are especially important in challenging maritime conditions. "The aramids Twaron® and Technora® are excellent options for offshore applications. They enable lighter mooring ropes while still delivering exceptional strength. Their high breaking strength outperforms typical mooring rope breaking loads, making them ideal for shipping applications."

"We've observed that ropes made with Twaron® and Technora® can bear up to 55-60% of their breaking strength. Moreover, unlike conventional synthetics such as HMPE, these aramids maintain a high level of reliability and dimensional stability under demanding conditions, including high temperatures. No other fiber offers that level of performance."

Twaron® or Technora®, for strength in mooring lines

In conclusion, O'Hear has no hesitation about recommending Twaron® and Technora® for mooring lines: "We've seen highly encouraging performances from these products in mooring lines for ships," he explains. "I would go further than to simply advise rope manufacturers to convert to aramid-based ropes; for their systems to perform to the level required, I strongly recommend they use Twaron® or Technora®."

For more information

Please visit our website:
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