corzamedical

April 2012

Development of a 12-Carrier UHMWPE Braid Using Single-End Per Carrier Architecture

Executive Summary

In 2012, a development programme was undertaken to evaluate the feasibility of producing a controlled 12-carrier braid using a single end of UHMWPE 144/1 dtex per carrier.

The objective was to determine whether a fine UHMWPE yarn could be scaled into a stable, repeatable multi-carrier braid architecture while preserving the material's intrinsic performance characteristics, including high tensile strength, low elongation, and controlled handling behaviour.

The programme formed part of a broader capability development initiative focused on advancing high-performance braided textile platforms for implantable and surgically demanding applications.

Through iterative optimisation of braid geometry and process conditions, the study successfully established a stable 12-carrier braid configuration and defined the process window required for repeatable production.

The Challenge

Scaling fine UHMWPE fibres into a controlled multi-carrier braid presented a series of structural and manufacturing challenges.

UHMWPE offers exceptional tensile performance but can become increasingly sensitive to process variation as braid complexity increases. Structural stability required balancing braid compactness with flexibility while maintaining uniform carrier interaction throughout production.

Key engineering challenges included:

- Maintaining yarn stability under multi-carrier loading
- Controlling braid geometry without compromising fibre integrity
- Managing sensitivity to picks per inch (PPI)
- Preventing braid variability and uneven compaction
- Maintaining flexibility alongside structural stability
- Reducing instability at elevated braiding speeds

Initial development trials demonstrated that process refinement was necessary to stabilise braid formation and improve repeatability.

Engineering Objectives

The programme focused on:

- Demonstrating feasibility of single-end per carrier UHMWPE braiding
- Scaling fine UHMWPE yarn into a controlled 12 carrier architecture
- Maintaining structural consistency throughout production
- Balancing flexibility with load-bearing performance
- Establishing repeatable process conditions
- Defining a scalable manufacturing framework

Development Approach

Architecture & Process Development

The engineering approach centred on understanding how braid structure and process variables influenced stability and mechanical behaviour.

Development activities included optimisation of:

- Carrier loading behaviour
- Picks per inch (PPI)
- Machine speed
- Yarn tension distribution
- Braid symmetry and formation

Multiple braid configurations were produced and comparatively assessed to determine the most stable operating conditions.

Structural Optimization

Development work demonstrated that braid architecture became increasingly sensitive as fibre size reduced and carrier complexity increased.

Controlled adjustment of process variables enables optimisation of:

- Structural uniformity
- Load sharing across carriers
- Flexural behaviour
- Braid consistency
- Handling performance

This established a defined process window capable of supporting repeatable braid formation.

Validation & Performance Assessment

Validation focused on confirming structural repeatability and preserving expected UHMWPE performance characteristics.

Assessment activities included:

- Runnage consistency evaluation
- Break load testing
- Dimensional stability verification
- Visual inspection of braid uniformity
- Structural integrity assessment

Multiple braid configurations were evaluated to identify the optimal balance between mechanical performance and handling behaviour.

The resulting architecture demonstrated stable formation with repeatable dimensional and mechanical characteristics.

Process Control & Repeatability

Process consistency was achieved through controlled refinement of critical braiding parameters.

Key process controls included:

- Picks per inch (PPI) optimisation
- Carrier tension balancing
- Machine speed control
- Defined operating windows
- Monitoring of braid uniformity

Once process conditions were standardised, repeatability improved significantly and supported reliable production within defined tolerances.

The project demonstrated that tightly controlled process windows are essential when scaling fine UHMWPE into multi-carrier structures.

Engineering Outcome

The development successfully demonstrated that fine UHMWPE yarn can be translated into a stable 12-carrier braid architecture using a single-end per carrier approach.

Key engineering outcomes included:

- Validation of single-end per carrier feasibility
- Establishment of process conditions for stable braid formation
- Improved understanding of PPI sensitivity in UHMWPE systems
- Enhanced capability in fine-fibre braid engineering
- Creation of a transferable framework for future braid development

The project expanded internal capability in precision braid engineering and established a technical foundation for future high-performance medical textile platforms.

Application Relevance

Cardiovascular Applications

Fine UHMWPE braid architectures support applications requiring low profile, high tensile performance, and predictable handling characteristics, including reinforcement structures and fixation components.

Orthopaedics & Sports Medicine

Suitable for ligament reconstruction, tendon repair, and fixation systems where long-term tensile stability and abrasion resistance are critical.

Soft Tissue Repair & General Surgery

Applicable to braided constructs requiring controlled mechanical behaviour and reliable handling performance.

Surgical Sutures & Closure Systems

Relevant to high-performance braided suture systems requiring low elongation, fatigue resistance, and retained tensile performance.

Minimally Invasive & Robotic Surgery

Fine braid architectures support delivery through constrained pathways while maintaining structural integrity and procedural control.

Advanced Implants & Tissue Technologies

Suitable for implantable textile structures requiring repeatable geometry and long-term mechanical reliability.

Key Takeaways

- Fine UHMWPE fibres can be successfully scaled into controlled multi-carrier braid architectures.
- Structural stability depends on careful management of PPI, tension, and carrier interaction.
- Defined process windows significantly improve repeatability and manufacturing consistency.
- Braid architecture remains a critical lever for balancing handling and mechanical performance.
- The engineering principles demonstrated are transferable across advanced medical textile applications.

"Scaling fine UHMWPE into a stable multi-carrier architecture required precise control of braid geometry, process conditions, and structural balance."

Contact Corza Medical today

corzamedical

2755 Canyon Boulevard, 1st Floor
Boulder, CO 80302