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UHMWPE Braided Assembly with Integrated Component Fixation

Executive Summary

This development programme focused on manufacturing a bespoke UHMWPE braided assembly that integrated customer-supplied components into a 16-carrier braided structure in accordance with a detailed technical drawing.

In addition to achieving the specified geometry, the programme was required to maintain assembly integrity, braid consistency, and the key mechanical properties of UHMWPE while establishing a controlled manufacturing process suitable for production scale-up.

Through optimisation of braid construction, splice design, and assembly control methods, a repeatable production-ready assembly process was successfully developed.

The Challenge

The project required the integration of rigid customer-supplied components into a flexible UHMWPE braid without compromising structural performance or manufacturing repeatability.

Key engineering challenges included:

- Maintaining the mechanical properties of UHMWPE during assembly
- Preventing fibre damage during splice formation
- Ensuring reliable mechanical retention of the component interface
- Maintaining consistent braid geometry and handling characteristics
- Achieving dimensional conformity to the customer drawing
- Establishing a scalable manufacturing process suitable for production volumes

The assembly therefore needed to function not only as a bespoke prototype but as a repeatable production-ready medical textile construct.

Engineering Objectives

The programme was designed to:

- Develop a stable 16-carrier UHMWPE braid architecture
- Integrate customer-supplied components without compromising braid integrity
- Maintain dimensional accuracy to the technical drawing specification
- Preserve UHMWPE strength and low-elongation characteristics
- Develop a repeatable splice formation process
- Establish a controlled manufacturing route suitable for production scale-up

Development Approach

Braid Architecture

A 16-carrier braid construction was selected to provide an appropriate balance of flexibility, dimensional control, and tensile performance.

UHMWPE was chosen for this:

- High strength-to-weight ratio
- Low elongation under load
- Good abrasion resistance

Critical braid parameters, including carrier tension, pick count, and braid angle, were controlled to achieve consistent structure and handling characteristics.

Component Integration & Splice Design

A dedicated splice methodology was

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developed to integrate the customer-supplied metal components into the braid while protecting fibre integrity.

Key design considerations included:

- Minimising fibre damage during splice formation
- Maintaining load distribution through the braid structure
- Achieving secure mechanical retention of the component interface
- Ensuring dimensional consistency across assemblies

The splice configuration was refined to maximise both repeatability and robustness under load.

Validation & Performance Assessment

Assemblies were evaluated against dimensional and structural acceptance criteria to confirm process stability and assembly integrity.

Assessment activities included:

- Dimensional verification to drawing specification
- Visual inspection of splice quality
- Evaluation of component retention
- Structural consistency assessment
- Handling and assembly repeatability review

Validation confirmed that the assembly could be produced consistently while maintaining the required geometry and mechanical integrity.

Process Control & Repeatability

To support the transition from development to production, the manufacturing process was standardised through defined controls covering:

- Braid setup and yarn handling
- Carrier tension management
- Splice formation technique
- Assembly sequencing
- Bespoke assembly templates and fixtures
- Final dimensional inspection

These controls reduced build-to-build variability and ensured consistent compliance with drawing specifications.

Engineering Outcome

The programme successfully demonstrated the manufacture of a bespoke UHMWPE braided assembly with integrated component fixation that met the specified drawing requirements and performance expectations.

Key engineering outcomes included:

- Stable 16-carrier UHMWPE braid construction
- Successful integration of rigid customer-supplied components
- Repeatable splice-based assembly performance
- Preservation of UHMWPE mechanical characteristics
- Consistent dimensional conformity across builds
- A production-ready manufacturing process suitable for scale-up

The project demonstrated the capability to translate a detailed technical drawing into a robust, scalable medical textile assembly through controlled braid engineering and component integration.

Application Relevance

Orthopaedics Surgery

High-strength fixation systems for ligament reconstruction, tendon repair, and soft tissue reconstruction where resistance to elongation under load is critical.

Sports Medicine

Suspensory fixation constructs used in procedures such as ACL reconstruction and rotator cuff repair.

Trauma & Orthopaedic Repair

Soft tissue-to-bone fixation systems requiring durable, high-load braided assemblies with integrated hardware interfaces.

General Surgery

High-strength loop and suture assemblies used for soft tissue approximation and reinforcement applications.

Key Takeaways

- UHMWPE braid performance can be preserved during complex component integration through controlled splice design.
- Multi-carrier braid architectures provide a balance of strength, flexibility, and dimensional control.
- Repeatable assembly performance depends on standardised process control and fixture design.
- Rigid components can be integrated into flexible textile systems without compromising structural integrity.
- Engineering-led process development enables reliable transition from bespoke prototype to production-ready manufacture.

“By combining controlled UHMWPE braid construction with repeatable component integration methods, a bespoke assembly concept was transformed into a scalable production-ready medical textile solution.”



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