corzamedical

November 2007

Material Substitution in UHMWPE Braids for US 3/0 Equivalence

Executive Summary

This development programme addressed the challenge of replacing a discontinued UHMWPE fibre within an established braided medical textile while maintaining the dimensional and mechanical characteristics of a US 3/0 construction.

The objective was to engineer an equivalent braid using an alternative source of 55 dtex UHMWPE combined with dyed polyester, preserving diameter, mechanical performance, and manufacturability without requiring changes to downstream device design or assembly.

Through controlled material integration, braid architecture optimisation, and process refinement, a repeatable replacement construction was successfully developed, demonstrating how supply chain challenges can be addressed through engineering rather than product redesign.

The Challenge

The discontinuation of a legacy 55 dtex UHMWPE fibre created a significant supply chain challenge for an established braided construction. Although the replacement material shared the same nominal specification, differences in fibre characteristics mean it could not simply be substituted on like-for-like basis.

Variations in filament structure, surface characteristics, and frictional behaviour influenced braid compaction, stability, and handling, requiring the entire braid architecture to be re-engineered to achieve equivalent performance.

Key engineering challenges included:

- Replacing the discontinued UHMWPE fibre without altering device geometry
- Maintaining US 3/0 diameter equivalence
- Managing differences in frictional behaviour and filament characteristics
- Balancing mechanical interaction between UHMWPE and dyed polyester fibres
- Preserving braid stability, roundness, and surface uniformity
- Establishing a repeatable manufacturing process suitable for production

Engineering Objectives

The programme was designed to:

- Replace the discontinued UHMWPE fibre with an alternative 55 dtex source
- Maintain US 3/0 dimensional equivalence
- Preserve tensile performance and handling characteristics
- Integrated dyed polyester for visual identification while maintaining structural integrity
- Optimise braid architecture to compensate for material differences
- Establish a repeatable manufacturing process without requiring downstream device redesign

Development Approach

Hybrid Material Architecture

The replacement construction combined a new-source UHMWPE fibre with dyed polyester to achieve the required balance of mechanical performance, dimensional stability, and visual identification.

The braid incorporated:

- Alternative-source 55 dtex UHMWPE as the primary load-bearing component
- D&C Blue dyed polyester to provide visual identification and structural balance
- A single UHMWPE core element to support tensile performance

Rather than relying on direct material substitution, the braid architecture was redesigned to compensate for differences in fibre behaviour while maintaining equivalent device performance.

Structural Optimization

Braid architecture was refined through controlled adjustment of:

- Carrier distribution
- Fibre balance between sheath and core
- Picks per inch (PPI)
- Braid compaction
- Haul-off ratio

These parameters were optimised to preserve diameter, braid stability, and mechanical behaviour despite changes in raw material characteristics.

Validation & Performance Assessment

The redesigned braid was evaluated against dimensional and mechanical performance criteria to confirm equivalence with the legacy construction.

Assessment included:

- Diameter verification against US 3/0 specification
- Break load comparison with the original braid
- Extension assessment under load
- Picks per inch (PPI) verification
- Runnage and manufacturing consistency evaluation

Validation confirmed that the redesigned construction achieved dimensional equivalence while maintaining acceptable mechanical performance and manufacturing stability.

Process Control & Repeatability

Consistent manufacturing performance was achieved through close control of critical processing variables.

Key process controls included:

- Controlled tension management, particularly for low-friction UHMWPE fibres
- Standardised haul-off ratio (1.5:1) to maintain braid density
- Continuous monitoring of PPI and diameter
- Stable carrier loading and fibre distribution
- Controlled machine setup across development trials

These controls established a repeatable manufacturing process capable of consistently producing the redesign braid within specification.

Engineering Outcome

The programme successfully demonstrated that a discontinued UHMWPE fibre could be replaced through engineering of the braid architecture rather than redesign of the finished medical device.

Key engineering outcomes included:

- Successful substitution of a discontinued UHMWPE fibre
- Maintenance of US 3/0 dimensional equivalence
- Preservation of mechanical performance and handling characteristics
- Integration of dyed polyester without compromising structural integrity
- Establishment of a repeatable manufacturing process suitable for production

The project demonstrated that careful control of material selection, braid architecture, and manufacturing parameters can overcome supply chain disruption while maintaining product performance and avoiding downstream redesign.

Application Relevance

The engineering principles demonstrated in this programme are applicable to medical textile developments requiring material substitution, and dimensional precision.

Surgical Sutures & Closure Systems

Braided UHMWPE sutures requiring consistent diameter, knot security, and reliable handling performance.

Orthopaedics & Sports Medicine

High-strength fixation systems for ligament and tendon repair where dimensional consistency and tesile performance are critical.

Soft Tissue Repair & General Surgery

Braided sutures requiring visual identification, predictable handling, and repeatable mechanical performance.

Minimally Invasive & Robotic Surgery

Fine braided constructions requiring controlled diameter, smooth delivery, and consistent behaviour in constrained surgical environments.

Key Takeaways

- Material discontinuation can be addressed through braid engineering rather than device redesign.
- Equivalent product performance depends on optimised braid architecture, not simply replacing fibres.
- Careful management of fibre interaction maintains dimensional stability and mechanical integrity.
- Controlled manufacturing processes enable repeatable production despite changes in raw materials.
- Engineering-led material substitution supports supply chain resilience while preserving established device performance.

"By redesigning the braid architecture rather than the device, a discontinued UHMWPE fibre was successful replaced while maintaining US 3/0 performance and manufacturing repeatability."

Contact Corza Medical today

corzamedical

2755 Canyon Boulevard, 1st Floor
Boulder, CO 80302