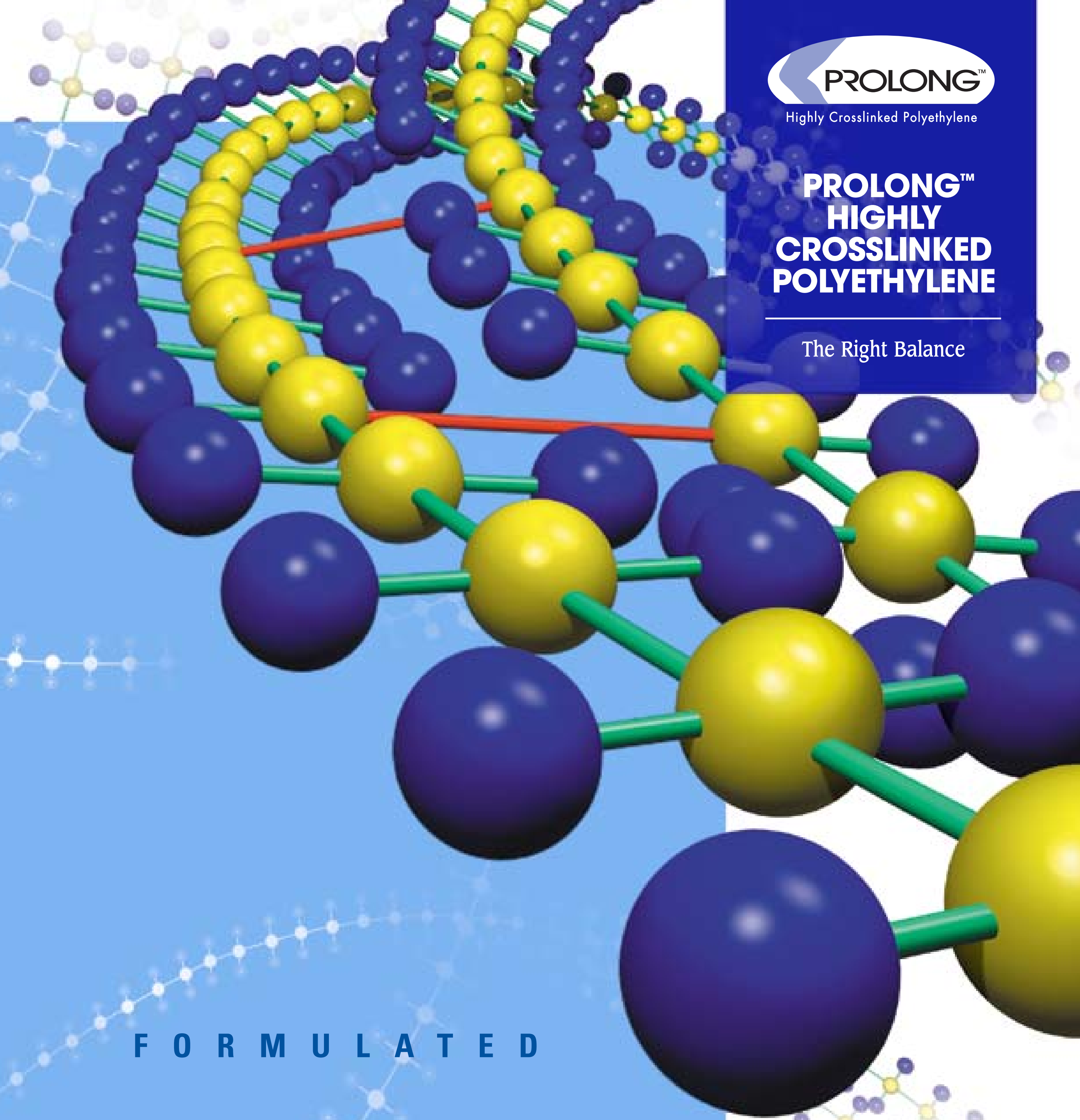


PROLONG™
Highly Crosslinked Polyethylene

PROLONG™ HIGHLY CROSSLINKED POLYETHYLENE

The Right Balance

FORMULATED SPECIFICALLY FOR KNEES

Because Hips & Knees Are Different

PROLONG

PROLONG™

Highly Crosslinked Polyethylene

Unlike surface wear that occurs with hip acetabular liners, knee polyethylene articulating surfaces sustain surface wear and subsurface fatigue, resulting in pitting and delamination. *Prolong* Highly Crosslinked Polyethylene is designed specifically for knee replacement surgery and can help to reduce surface wear by 81%,[1] and helps to resist the compression and tensile stresses that can cause subsurface fatigue.

1 Wear reduction of 81% when compared to standard Zimmer knee polyethylene. The results of *in vitro* wear tests have not been shown to correlate with clinical wear mechanisms. These highly crosslinked components are designed for posterior cruciate ligament retention and are intended to be used as part of a cemented knee system.

Formulated Specifically For Knees

Prolong Highly Crosslinked Polyethylene represents a significant advance in wear reduction specifically for knee components. Like all Zimmer polyethylene formulations, *Prolong* Highly Crosslinked Polyethylene was developed with consideration for five key performance factors: material, processing, design, sterilization, and packaging. So *Prolong* Highly Crosslinked Polyethylene meets our exacting standards, as well as ASTM and FDA guidelines governing polyethylene for orthopaedic applications.

81%[1]

Wear Reduction

Resistance To Delamination

In laboratory testing, accelerated aged *Prolong* polyethylene CR articular surfaces showed no evidence of delamination at 8 million cycles. Delamination is a separation into layers that can be characterized by pitting.*

* Data on file. The results of in *vitro* delamination tests have not been shown to correlate with clinical delamination mechanisms.

Simulator Test at 5 Million Cycles

Standard Polyethylene	14.4mg Wear/Million Cycles
Prolong Highly Crosslinked Polyethylene	2.7mg Wear/Million Cycles

Prolong Highly Crosslinked Polyethylene was specifically formulated to account for the stress patterns found in knees. The differences in hip and knee patterns result from different kinematics, loading, and geometry. In an acetabular component, stresses concentrate on the surface. In a tibial articulating surface, stresses concentrate 1-2mm below the surface.

Highlighted area indicates subsurface fatigue

Highlighted area indicates surface wear

Subsurface Fatigue vs. Surface Wear

Subsurface fatigue is consistent with damage modes found in knees, such as delamination, pitting and cracking rather than the surface burnishing, abrasion and creep evident in hips.

Polyethylene articulating surfaces in the knee, in every day use, experience alternating compressive and tensile loads.

Compression

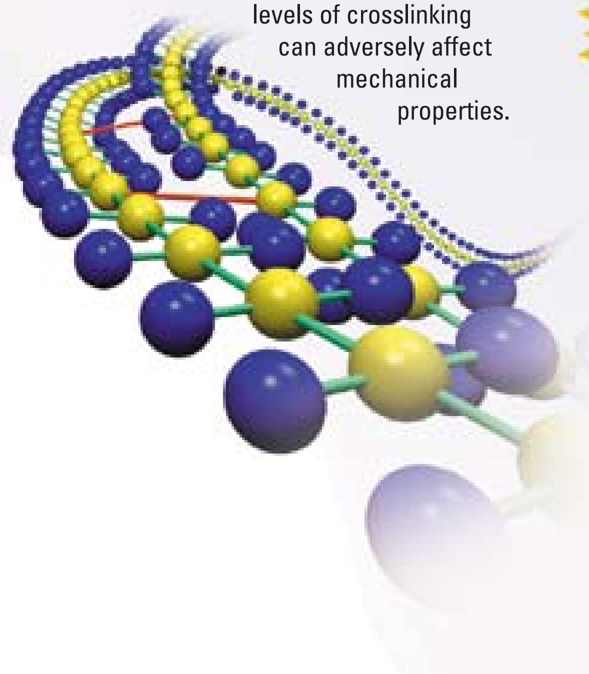
Tension

Combined stresses create subsurface fatigue

Full surface contact. No subsurface wear.

Resisting Wear With Crosslinking

The three-dimensional structure created by crosslinking makes polyethylene more resistant to wear. The higher the level of crosslinking, the greater the resistance to wear. Yet high levels of crosslinking can adversely affect mechanical properties.



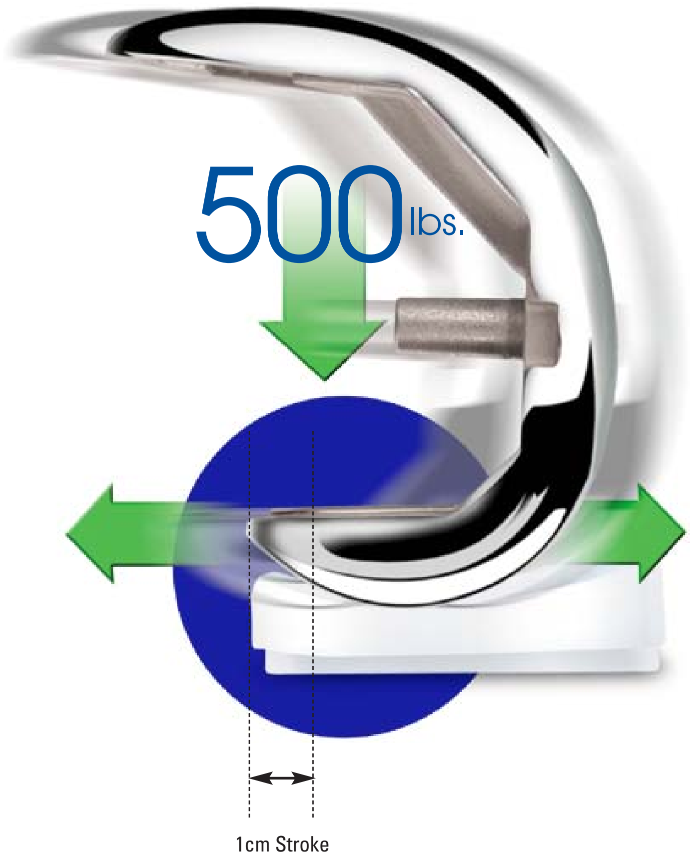
Primary Wear Mechanisms

The primary wear mechanisms in polyethylene knee components are subsurface cracking, pitting, and delamination[2], which result in the larger wear particles. As weight is transferred from the femoral component condyles to the tibial component, there are compressive stresses below the points of contact and tensile stresses in the surrounding polyethylene. This creates subsurface fatigue which may eventually lead to cracking, pitting delamination observed in the small percentage of articular surfaces that fail.

2 Wright TM, Rimnac CM, Faris PM, et al. Analysis of surface damage in retrieved carbon fiber-reinforced and plain polyethylene tibial components from posterior stabilized total knee replacements. *J Bone Joint Surg.* 1988; 70A(9):1312-1319.

Resisting Posterior Plateau Damage

Posterior Crush Test at 1 Million Cycles (at 1Hz)



Prolong Highly Crosslinked Polyethylene retained its mechanical integrity and performed as well as the polyethylene used in current knee implants.

The posterior crush test assesses polyethylene wear in areas of retrieved tibial implants often damaged by pitting and delamination. In this test, *Prolong* Highly Crosslinked Polyethylene retained its mechanical integrity and proved equivalent to the polyethylene components used in current knee implants[1].

Optimizing Polyethylene Performance In Knees

At various energy doses, the level of crosslinking can be maximized and the wear reduction optimized for specific implant applications. *Prolong* Highly Crosslinked Polyethylene is specifically formulated to resist wear under the conditions found in knees. The electron-beam dose selected for knees minimizes wear while retaining the mechanical properties necessary to help resist the subsurface fatigue encountered in knees.

Electron Beam Dose Required To Maintain Mechanical Properties

At various energy doses, wear reduction can be optimized for specific implant applications. The electron-beam dose selected for crosslinking in knees helps to optimize wear reduction while retaining necessary mechanical properties.

Suggested Reading

Muratoglu OK, Bragdon CR, O'Connor DO, Skehan H, Delaney J, Jasty M, Harris WH. The Comparison of the Wear Behavior of Four Different Types of Crosslinked Acetabular Components. 46th Annual Meeting, Orthopaedic Research Society, March 12-15, 2000, Orlando, FL.

Kurtz SM, Rimnac CM, Li S, Bartel DL. A bilinear material model for UHMWPE in total joint replacements. *Trans. Ortho. Res. Society.* 1994.

Collier JP, Sperling DK, Carrier JH, et al. Impact of gamma sterilization on clinical performance of polyethylene in the knee. *J Arthroplasty.* 1996;11(4):377.

Bartel DL, Bicknell VL, Wright TM. The effect of conformity, thickness, and material on stresses in ultra-high molecular weight components for total joint replacement. *J Bone Joint Surg.* 1986;68A(7):1041-1051.

Jahan MS, Wang C, Schwartz G, Davidson JA. Combined chemical and mechanical effects of free radicals in UHMWPE joints during implantation. *J. Biomed. Mater. Res.* 1991;25: 1005-1017.

Zimmer employs a proprietary process based in part on patents licensed from Massachusetts General Hospital and Massachusetts Institute of Technology.

For more information regarding the *Prolong* Highly Crosslinked Polyethylene, contact your Zimmer representative or visit us at www.zimmer.com.

Prolong Highly Crosslinked Polyethylene

Cat. Number	Description
5952-20-10	*Prolong* CR Art Surf 1,2/purple 10mm
5952-20-12	*Prolong* CR Art Surf 1,2/purple 12mm
5952-20-14	*Prolong* CR Art Surf 1,2/purple 14mm
5952-20-17	*Prolong* CR Art Surf 1,2/purple 17mm
5952-20-20	*Prolong* CR Art Surf 1,2/purple 20mm
5952-21-10	*Prolong* CR Art Surf 1,2/stripe-purple 10mm
5952-21-12	*Prolong* CR Art Surf 1,2/stripe-purple 12mm
5952-21-14	*Prolong* CR Art Surf 1,2/stripe-purple 14mm
5952-21-17	*Prolong* CR Art Surf 1/2/stripe-purple 17mm
5952-21-20	*Prolong* CR Art Surf 1,2/stripe-purple 20mm
5952-30-10	*Prolong* CR Art Surf 3,4/yellow 10mm
5952-30-12	*Prolong* CR Art Surf 3,4/yellow 12mm
5952-30-14	*Prolong* CR Art Surf 3,4/yellow 14mm
5952-30-17	*Prolong* CR Art Surf 3,4/yellow 17mm
5952-30-20	*Prolong* CR Art Surf 3,4/yellow 20mm
5952-31-10	*Prolong* CR Art Surf 3,4/stripe-yellow 10mm
5952-31-12	*Prolong* CR Art Surf 3,4/stripe-yellow 12mm
5952-31-14	*Prolong* CR Art Surf 3,4/stripe-yellow 14mm
5952-31-17	*Prolong* CR Art Surf 3,4/stripe-yellow 17mm
5952-31-20	*Prolong* CR Art Surf 3,4/stripe-yellow 20mm
5952-40-10	*Prolong* CR Art Surf 5,6/green 10mm
5952-40-12	*Prolong* CR Art Surf 5,6/green 12mm
5952-40-14	*Prolong* CR Art Surf 5,6/green 14mm
5952-40-17	*Prolong* CR Art Surf 5,6/green 17mm
5952-40-20	*Prolong* CR Art Surf 5,6/green 20mm
5952-41-10	*Prolong* CR Art Surf 5,6/stripe-green 10mm (Japan only)
5952-41-12	*Prolong* CR Art Surf 5,6/stripe-green 12mm (Japan only)
5952-41-14	*Prolong* CR Art Surf 5,6/stripe-green 14mm (Japan only)
5952-41-17	*Prolong* CR Art Surf 5,6/stripe-green 17mm (Japan only)
5952-41-20	*Prolong* CR Art Surf 5,6/stripe-green 20mm (Japan only)
5952-50-10	*Prolong* CR Art Surf 7-10/blue 10mm
5952-50-12	*Prolong* CR Art Surf 7-10/blue 12mm
5952-50-14	*Prolong* CR Art Surf 7-10/blue 14mm
5952-50-17	*Prolong* CR Art Surf 7-10/blue 17mm
5952-50-20	*Prolong* CR Art Surf 7-10/blue 20mm

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