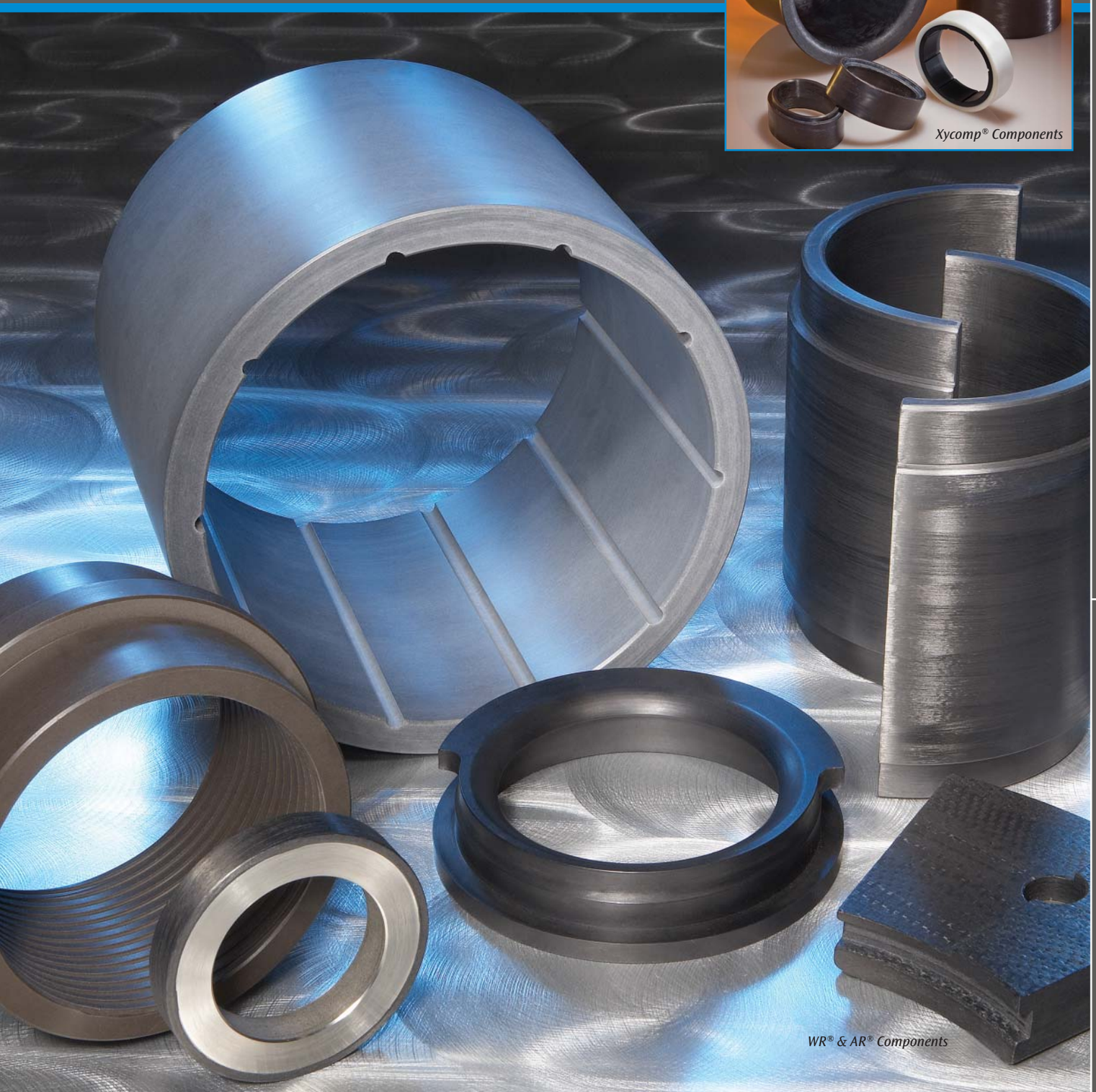
Greene Tweed
The Inside Advantage®

HIGH-PERFORMANCE THERMOPLASTIC COMPOSITES

WR® | AR® | XYCOMP®

Xycomp® Components



WR® & AR® Components

High-Performance Thermoplastic Composites

INDUSTRY LEADING SOLUTIONS

INCREASE EFFICIENCY AND IMPROVE PERFORMANCE WITH INNOVATIVE THERMOPLASTIC COMPOSITES

With over 145 years of proven technological innovation, Greene, Tweed offers trusted solutions for your most critical applications. And Greene, Tweed has been at the forefront of the Petrochemical and Power industry for many years with our industry leading sealing solutions. We continue our tradition of innovation today, maintaining a global presence and offering the most effective solutions for our customers' performance challenges.

SUPERIOR THERMOPLASTIC COMPOSITE SOLUTIONS

To ensure we continue meeting your industry's evolving needs, Greene, Tweed offers a comprehensive portfolio of high-performance thermoplastic composite solutions for a wide range of applications – from wear and abrasion requirements to various structural components. These innovative composite solutions offer efficient and effective alternatives to other metallic and composite solutions.

WHY THERMOPLASTIC COMPOSITES?

The API 610 10th (American Petrochemical Institute) edition includes PEEK™-based composites as a viable alternative to metallic wear materials and acknowledges the significant benefits of these advanced materials.

WR® WEAR RESISTANT COMPONENTS

Greene, Tweed's WR® material portfolio won't gall or seize, enabling extended MTBR (Mean Time Between Repair) and improved reliability. Offering outstanding wear and friction properties, extended dry-run performance, broad chemical resistance, our WR materials can reduce running clearances by more than 50%, in many cases without the risk of damaging expensive metal components. These reduced clearances minimize recirculation to maximize rotor stability and overall efficiency. WR materials also minimize shaft run out, deflection and vibration for dramatically reduced energy consumption and repair costs.

AR® ABRASION RESISTANT COMPONENTS

Media containing abrasives such as sand, coal ash and other solids can wreak havoc in pumps, warping flow paths and increasing the risk of failures. Greene, Tweed's AR® components deliver exceptional abrasion resistance, handling entrenched particles to extend the service life of pumps.

AR materials have been specified on hundreds of power industry pumps including circulating water, open and closed cooling water, river water, screen wash and sump applications. These innovative materials commonly replace metallic line shaft bearings, bowl bearings and bowl wear rings on vertical pumps.

With **50% reduction** in **running clearances, WR** and **AR** components **maximize pump performance.**

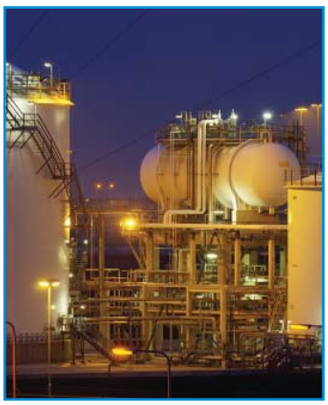
XYCOMP® STRUCTURAL COMPONENTS

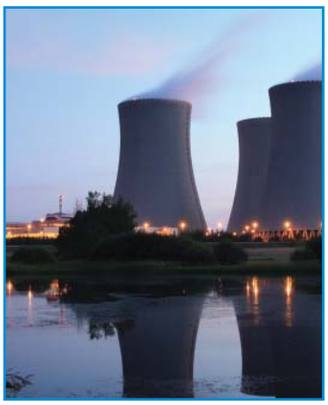
Greene, Tweed's Xycomp® high-performance thermoplastic composites provide an efficient and effective alternative to metal and other composite solutions. Xycomp offers significantly reduced energy and maintenance costs to keep your pumps running longer and more efficiently. From improved chemical and impact resistance to excellent post-molding machinability and recyclability, this innovative material offers a wide range of benefits for challenging Petrochemical and Power applications. And with our material expertise and global engineering resources, we have the capabilities to custom design a solution to suit your unique application requirements.

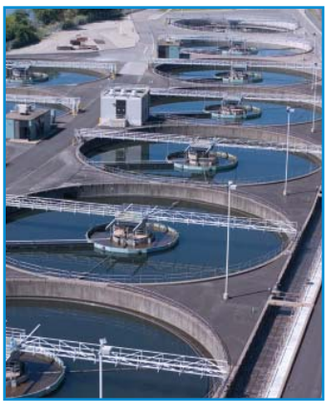
Xycomp eliminates eddy-current loss for dramatic **energy savings** and improved **efficiencies.**

MARKETS WE SERVE

With expertise across a variety of markets, Greene, Tweed collaborates with industry leaders to understand the technical challenges of the Petrochemical and Power markets, developing the most advanced solutions on the market for a wide range of application-specific requirements.







CHEMICAL & HYDROCARBON

In these challenging environments, components must withstand aggressive media across a wide range of application parameters. With abrasive and/or corrosive liquids, sludges and slurries often leading to machinery failure and costly downtime, pump users require components that can help maintain consistent production capabilities. Our composite materials have performed successfully in these demanding environments for over a decade and have been applied in most API and heavy industry pump configurations.

POWER GENERATION

Fluids containing sand and other abrasives continue to be an issue for the power industry, creating expanded running clearances and reduced pump efficiency. Ultimately, equipment failure and unit shutdowns occur, causing a drop in production for the plant. Greene, Tweed's AR® composites last up to 5 times longer than traditional materials for dramatically longer lifetimes, as well as reduced down time and maintenance requirements.

WATER & WASTE WATER

Enabling the collection, purification and distribution of safe drinking water is a critical function of this industry's operations. Pump components must be thoroughly vetted to ensure they do not contaminate the water supply prior to being used in any drinking water application. Our composite materials have received WRAS (Water Regulations Advisory Scheme) approval and have been proven safe and effective for drinking water pumps.

PHARMA & FOOD

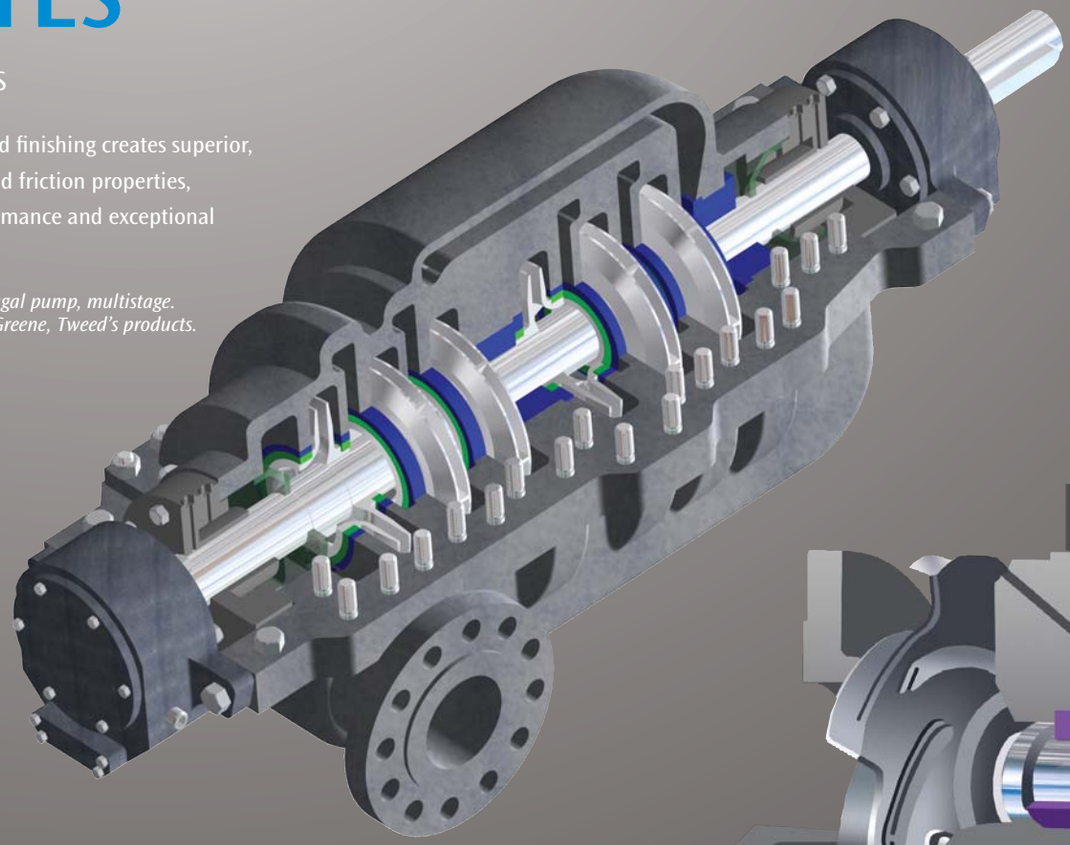
Equipment used in the production of items regulated under strict federal guidelines, such as the FDA (U.S. Food and Drug Administration), must undergo stringent testing to ensure no negative impact on food or pharmaceutical products. With FDA compliant components, our composite material can safely be used for applications involving drinking water, food processing or pharmaceutical equipment.

THE BENEFITS OF HIGH-PERFORMANCE THERMOPLASTIC COMPOSITES

WR® WEAR RESISTANT COMPONENTS

In-house design, manufacturing, tooling and finishing creates superior, reliable components with excellent wear and friction properties, superior non-galling and non-seizing performance and exceptional chemical resistance.

The illustration to the right is a horizontal centrifugal pump, multistage. All sections in blue and green show placement of Greene, Tweed's products.



Wear Resistance
With extremely low coefficient of friction for excellent wear resistance, these components offer improved performance for a variety of critical applications.

Increased Efficiency
Tighter clearances (up to 50% tighter than metallic wear parts) offer significantly increased efficiency and excellent vibration damping.

Improved Performance
Combining the strength of metal with superior non-galling and non-seizing properties offer longer product life and reduced pump failure.

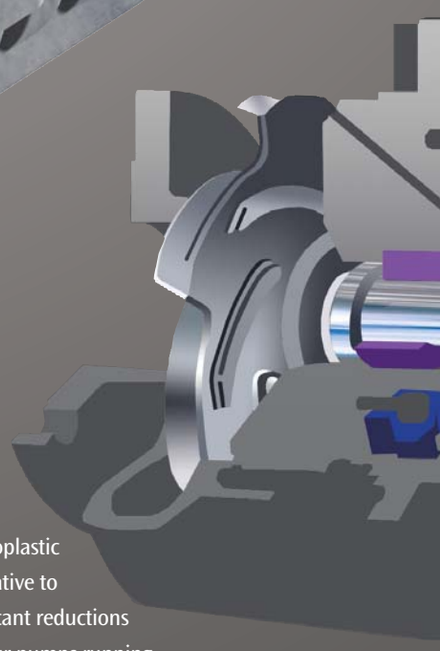
Chemical Resistance
Decrease your maintenance and component replacement costs with superior chemical resistance over traditional metallic materials.

WR Benefits

XYCOMP® STRUCTURAL COMPONENTS

Greene, Tweed's Xycomp® high-performance thermoplastic composites provide an efficient and effective alternative to other metallic and composite solutions. With significant reductions in energy and maintenance costs, Xycomp keeps your pumps running longer and more efficiently.

The illustration to the right is a magnetic drive pump. All sections in blue and purple show placement of Greene, Tweed's products.



Improved Performance
Resistance to the harmful effects of friction offer improved performance and extended life for pump components.

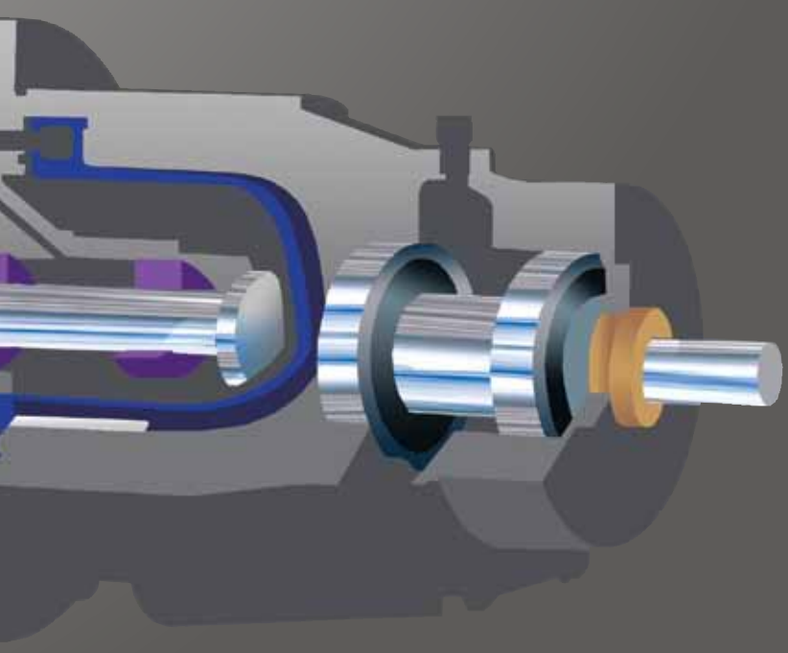
Corrosion Resistance
Exceptional resistance to many common chemicals and fluids found in pumps reduces leakage and increases MTBF to keep your equipment running smoothly.

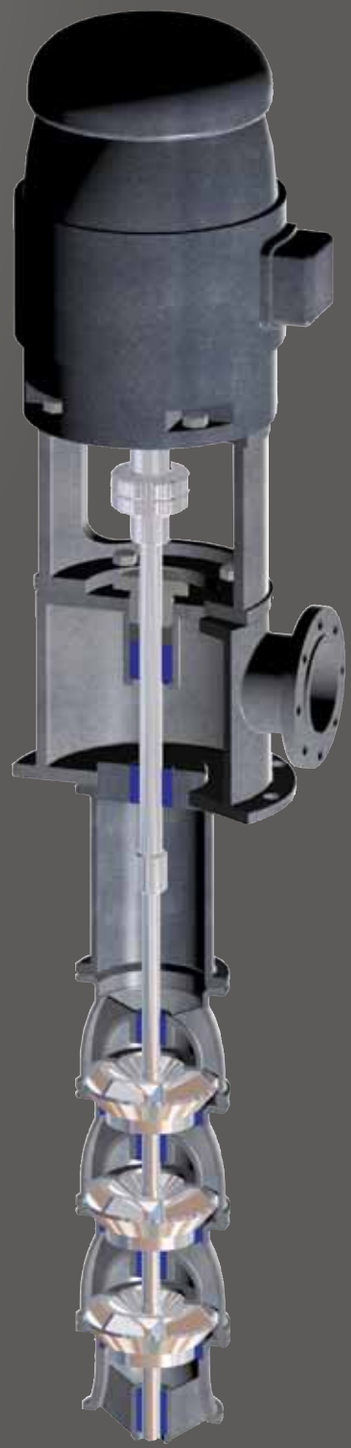
Increased Efficiency
Eliminated eddy current loss in magnetic driven pumps reduces energy costs, eliminates media heating and dramatically improves efficiency.

AR® ABRASION RESISTANT COMPONENTS

Maintaining the performance of wear materials in pumps handling media containing solids has proved to be a challenge for power companies. Our AR®1 and ARHT materials offer superior abrasion resistance over competing materials, enabling longer product life and reduced downtime for your critical pump applications.

The illustration to the right is a vertical centrifugal pump, multistage. All sections in blue show placement of Greene, Tweed's products.





Abrasion Resistance
Achieve improved resistance to damage from abrasive media for dramatically improved performance and extended product life.

Impact Resistance
Exceptional resistance to fracture and impact dramatically improves performance in out-of-balance, long shaft and slurry applications.

Machining & Install
Simplified machining capabilities allow exacting finished dimensions on standard machining equipment and offer reduced turn around times.

High Temperature
Experience superior performance with components specifically designed to handle abrasive media in high temperatures up to 250°F (120°C).

Vibration Damping
With superior vibration damping properties, maintenance requirements are reduced and reliability is improved across your facilities.

AR Benefits

Weight Reduction
Up to 6 times lighter than steel, your shipping costs are reduced while the need for costly installation equipment is eliminated.

Complex Shapes
Our proprietary compression molding and Techna3™ processes offer the unique capability for complex shapes and tubular parts.

Vibration Damping
Vibrations can cause dangerous leakage and costly pump failures. Xycomp minimizes these hazards, effectively damping vibrations and eliminating damage.

Xycomp Benefits

Illustration Color Key

Thermoplastic composites *Ceramic composites* *Elastomeric seals*

WR®300*

Standard wear material

- Increased pump reliability and efficiency for standard applications
- Non-galling/non-seizing properties
- Low coefficient of friction

Color	Black
Maximum Service Temperature, °F (°C)	275°F (135°C)
Compressive Strength, psi (MPa)	29,300 (200)
Coefficient of Thermal Expansion, in/in/°F (mm/mm/°C) (73°F to 290°F/23°C to143°C)	15.3 x 10^{-6} (27.5 x 10^{-6})

WR300

WR525*

High-temperature material

- Increased pump reliability and efficiency for high-temperature applications
- Low coefficient of thermal expansion
- High compressive strength

Color	Black
Maximum Service Temperature, °F (°C)	525°F (273°C)
Compressive Strength, psi (MPa)	Parallel to fiber: 197,000 (1,360)
Tensile Strength at Break, psi (MPa)	Parallel to fiber: 300,000 (2,070)
	Perpendicular to fiber: 12,500 (86)

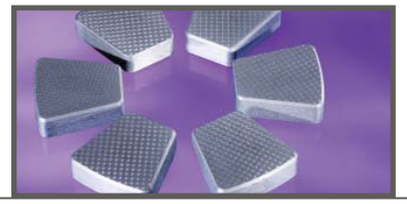
WR525

WR575

High-strength material

- Outstanding stability for thrust bearings
- High strength and high load capability
- Excellent shock and impact resistance
- High corrosion and chemical resistance

Color	Black
Maximum Service Temperature, °F (°C)	482°F (250°C)
Compressive Strength, ksi (MPa)	In-plane: 83 (572)
Tensile Strength, ksi (MPa)	In-plane: 91 (627)



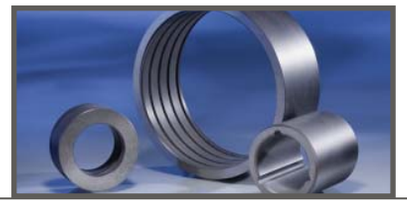
WR575

WR600

Universal chemical resistance

- Almost universal chemical compatibility and corrosion resistance
- Extended dry-run properties
- Superior impact resistance
- Excellent thermal shock resistance

Color	Black
Compressive Strength at Break, ksi (MPa)	In-plane: 11.6 (80)
Tensile Strength at Break, ksi (MPa)	In-plane: 11.8 (81)



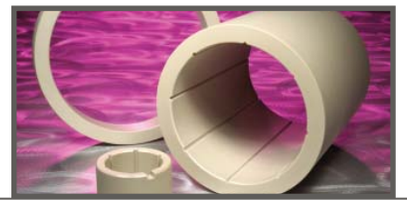
WR600

WR FP100

FDA compliant

- Excellent wear resistance with FDA compliance
- Ideal for drinking water, food processing and pharmaceutical manufacturing

Color	Tan
Service Temperature Range, °F (°C)	-100°F to 275°F (-73°C to 135°C)
Compressive Strength, psi (MPa)	32,300 (223)



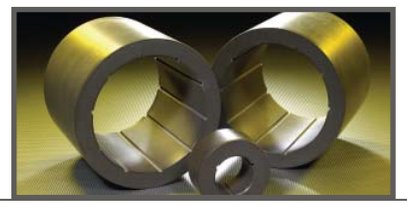
WR FP100

AR®1

Low wear in abrasive media

- Enhanced dry-run protection
- Excellent vibration damping
- Impact resistance
- Easy to machine and install

Color	Brown
Service Temperature Range, °F (°C)	60°F to 120°F (16°C to 49°C)
Compressive Strength, psi (MPa)	2,700 (19)
Coefficient of Thermal Expansion, in/in/°F (mm/mm/°C) (0°F to 105°F/-18°C to 41°C)	60 x 10^{-6} (108 x 10^{-6})



AR1

ARHT

Enhanced high-temperature capabilities

- Low wear in abrasive media
- Excellent vibration damping
- High impact resistance
- Easy to machine and install

Color	Gray
Service Temperature Range, °F (°C)	-100°F to 250°F (-73°C to 121°C)
Compressive Strength, psi (MPa)	9,800 (70)
Coefficient of Thermal Expansion, in/in/°F (mm/mm/°C) (-100°F to 250°F/-73°C to 121°C)	16 x 10^{-6} (28.8 x 10^{-6})

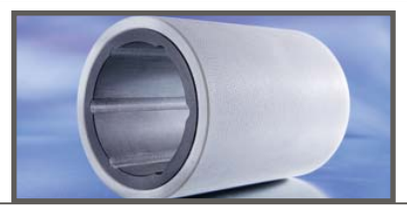
ARHT

Xycomp®

Xycomp® 9625 holder

- Reduced weight for simplified installation and maintenance
- Reduced lead times
- Improved corrosion resistance

Color	White
Service Temperature Range, °F (°C)	-40°F to 390°F (-40°C to 200°C)
Compressive Strength, psi (MPa)	Parallel to laminate: 5,000 (34.5) Perpendicular to laminate: 9,500 (65.5)
Tensile Strength, psi (MPa)	Parallel to laminate: 7,770 (53.5)



XYCOMP & AR1

Xycomp

Xycomp high-performance composite containment shell

- Eliminates eddy current loss
- Increased resistance to high temperature and pressure
- High chemical and corrosion resistance

Color	Black/Gray
Density Volumic Mass, g/cm^3	1.54
Electrical Resistivity, Ohm x m	1.57 x 10^{-4}
Tensile Modulus, ksi (MPa)	In-plane: 6,820 (47,000)

XYCOMP

**Note: WR300 was utilized to validate chopped carbon fiber filled composites in API 610. WR525 was utilized to validate continuous carbon fiber wound composites in API 610.*

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