

# Products and Applications Guide



A guide to selection and performance of polyolefin materials.



QUADRANT

You inspire... we materialize®



## → **Global Leader in Engineering Plastics for Machining.**

**Quadrant Engineering Plastic Products is the world's leading manufacturer of plastic machining stock.** In 1946, we invented and then patented the first process for extruding nylon stock shapes for machining. The industry we created gives designers more flexibility and design possibilities by producing shapes that can easily be machined into parts. Quadrant assists engineers in selecting the optimum material for their application. Quadrant manufactures the broadest array of machinable plastic materials available anywhere in the world.

## → **TECHNICAL SUPPORT FROM CONCEPT THROUGH PRODUCTION.**

**Application and production support when and where you need it.** Quadrant's technical support team works with engineers and machinists from material selection through machining, for optimum performance, productivity and cost.

Quadrant locations around the world offer an experienced technical team and the most comprehensive testing laboratories in the industry. You can count on reliable support at every phase of your project:

- Evaluation of performance needs and application environment
- Material selection – including selection software
- Material certifications
- Regulatory agency compliance
- Set-up and production recommendations from experienced machinists
- A wide range of material selection, design and fabrication guides and tools – all available on the Quadrant Engineering Plastic Products Website, [www.quadrantplastics.com](http://www.quadrantplastics.com)

## → **QUALITY SYSTEMS THAT ENSURE CONSISTENCY.**

**From full lot traceability to ISO certifications, Quadrant meets your requirements for consistent quality, performance and machinability.** As the first to line mark shapes materials, Quadrant set the standard for traceability on our products right back to the resin lot and production shift. We have also kept pace with industry standards and quality systems to comply with the needs of the industries that your company also serves. Count on Quadrant. It is the inspiration behind our drive to provide the best levels of support for our materials in your applications.

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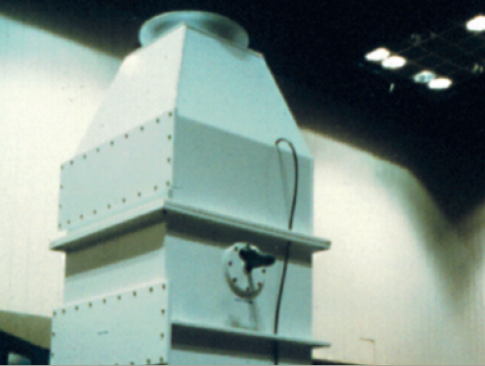
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# [PVC PRODUCTS



## PRODUCT APPLICATION:

### Fume Scrubber

- **Problem:** Harsh chemical fumes are often more damaging to metal scrubbers than the chemical solutions themselves.
- **Solution:** Corzar® CPVC can handle the harsh fumes as the air is scrubbed prior to release into the environment.
- **Benefits:** As reliable as PVC, easy to fabricate and weld, Corzar® CPVC is lighter than steel and absorbs ambient plant noise more effectively.

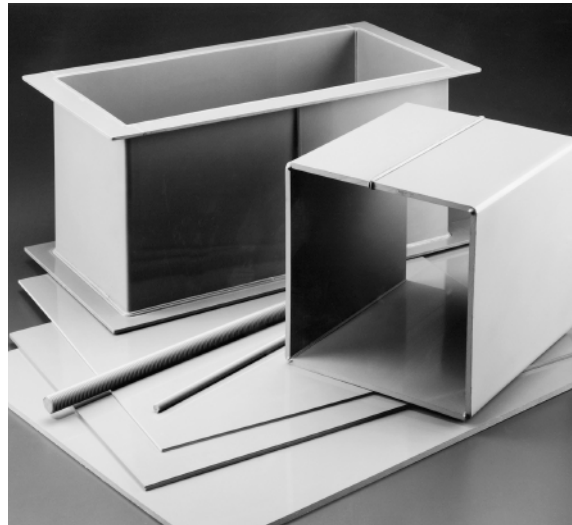
## PRODUCT PROFILE

### ECONOMICAL MATERIALS FOR LOWER TEMPERATURE, WET APPLICATIONS REQUIRING GOOD CHEMICAL RESISTANCE

- Resists many acids, alkalis and solvents
- UL94 V-0 Flammability rating
- Corrosion resistant
- Vacuum formable
- No moisture absorption

### PVC (POLYVINYL CHLORIDE) QUADRANT PVC MEETS ASTM D-1784 TYPE 1, GRADE 1, CELL CLASSIFICATION 12454B

is an economical alternative to more expensive materials for liquid containment. PVC performs in applications up to 160°F and is thermoformable. Quadrant's PVC sheet is compatible with Type I PVC pipe, so the piping system can be welded directly to the liquid container, eliminating flanges and connectors.



PVC is easily welded using standard plastic welding technology.



### Tech Notes:

PVC has a UL94 V-0 Flammability rating. The UL 94 test is a laboratory test where specimens are subjected to a specified flame exposure. The relative ability to continue burning after the flame is removed is the basis for the classification. Materials that extinguish themselves rapidly and do not drip flaming particles are given the more favorable ratings. The UL rating scale, from highest burn rate to most flame retardant, is HB, V-2, V-1, V-0, 5V.

# PROTEUS® PRODUCTS

## PRODUCT PROFILE

### FOR GENERAL PURPOSE APPLICATIONS IN WET AND DRY ENVIRONMENTS WHERE EASE OF FABRICATION IS IMPORTANT

- Excellent chemical/corrosion resistance
- High strength
- Resists most acids, alkalis and solvents
- No moisture absorption
- Vacuum formable
- Ideal for applications up to 180°F

### PROTEUS® HOMOPOLYMER POLYPROPYLENE

offers a high strength-to-weight ratio and excellent chemical resistance for use in highly corrosive environments. Proteus® Homopolymer Natural Polypropylene is easily fabricated and welded into tanks and processing equipment used in the metal plating and chemical processing industries. The excellent formability and consistency of the material have also made it a standard in the prosthetics and orthotics industry. **Proteus® Natural Polypropylene meets FDA/USDA, NSF and 3-A Dairy requirements for food processing and handling applications.**

### PROTEUS® CO-POLYMER POLYPROPYLENE

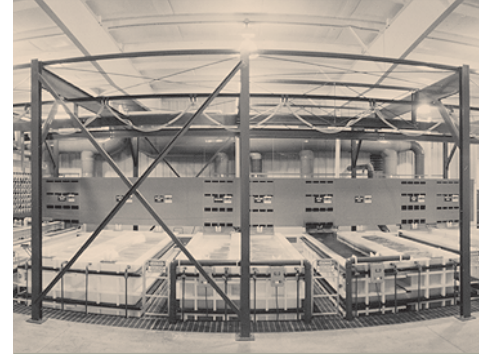
offers the same excellent chemical resistance of Homopolymer Polypropylene, with the added benefit of better resistance to stress cracking at low temperatures while being more pliable. **Proteus® Co-Polymer Polypropylene is FDA and 3-A Dairy Sanitation compliant, for use in food storage or processing equipment. Now available in Eurogrey.**

### PROTEUS® HOMOPOLYMER POLYPROPYLENE PREMIUM GLOSS

is a white plus, standard white or black, stress-relieved sheet, with film masking on one side (two-sided masking available on request). Quadrant's advanced quality control system allows us to achieve and maintain our color and gloss for demanding users like the semiconductor industry. **Proteus® Premium Gloss White grades (white plus and standard) meet FDA criteria for food contact and is easy to fabricate, weld and thermoform.**

### PROTEUS® ORTHOTIC AND PROSTHETIC GRADE

is a natural homopolymer polypropylene that is more rigid, used where a higher degree of stiffness is required. Proteus® O & P Grade offers tighter lot-to-lot consistency demanded by many thermoformers in the orthotic and prosthetic industry. **Proteus® O & P Grade exhibits the same chemical and corrosion resistance as standard Proteus® Polypropylene and does not absorb moisture.**



### PRODUCT APPLICATION: Metal Anodizing

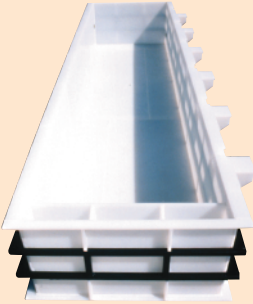
- **Problem:** Steel chemical tanks corrode and leak causing safety issues and loss of expensive chemicals used in process.
- **Solution:** Proteus® Homopolymer Natural Polypropylene is easy to weld into tanks and resists corrosion from a variety of chemicals.
- **Benefits:** Proteus® works with many different chemicals and a high strength-to-weight ratio of the material provides the rigidity needed.



### PRODUCT APPLICATION: Fire Truck Tanks

- **Problem:** Steel water tanks on pumper fire trucks rust and corrode quickly. Constant road vibration causes leaks and failures.
- **Solution:** Proteus® Co-Polymer Polypropylene is easy to fabricate and has better weld strength to resist stress cracking at lower temperature.
- **Benefits:** Lighter, more durable tanks help reduce fuel consumption and reduce maintenance costs.

# PROTEUS®, SANALITE®, BOROTRON® PRODUCTS



## PRODUCT APPLICATION:

### Chemical Processing Storage Tank

- **Problem:** Chemical corrosion caused metal tanks to leak hazardous chemicals.
- **Solution:** Fabricated HDPE tanks resist corrosion from the harsh chemicals that destroyed costly metal reservoirs.
- **Benefits:** Cleaner, more impact resistant tanks are much easier to utilize and require far less repair and maintenance.



## PRODUCT APPLICATION:

### Commercial Cutting Board

- **Problem:** Many commercial kitchens and food processing facilities have struggled with wood cutting boards that absorb liquids, flavors and odors. These substances can grow into bacteria that can contaminate food products.
- **Solution:** Sanalite® HDPE or PP cutting boards eliminate these problems.
- **Benefits:** Easy to clean and disinfect. Will not absorb liquid, flavor or odor. Sanalite® is lighter than wood allowing for easier installation. This highly cut resistant polymer provides a longer service life for knives and cutting tools.

## PRODUCT PROFILE

### COST EFFECTIVE MATERIALS FOR GENERAL PURPOSE APPLICATIONS IN WET AND DRY ENVIRONMENTS

- Excellent chemical/corrosion resistance
- High strength
- No moisture absorption
- Good impact strength
- Vacuum formable
- FDA/USDA compliant (natural color)

### PROTEUS® HDPE (HIGH DENSITY POLYETHYLENE)

is used in a wide variety of applications that require basic engineering plastic performance. High impact and tensile strength make Quadrant HDPE appropriate for vacuum and thermoforming prosthetic devices or industrial parts and containers. Excellent chemical and corrosion resistance combined with ease of fabrication and welding make it the standard for chemical processing tanks and equipment. **Proteus® Natural HDPE meets FDA/USDA requirements for food processing and handling applications.**

### PROTEUS® HDPE (HIGH DENSITY POLYETHYLENE) BLACK

is a non-FDA compliant material that offers the same performance as natural HDPE. Also available with a pebble finish.

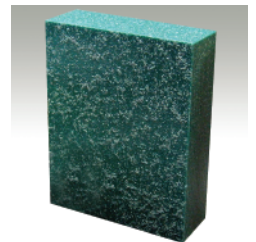
### SANALITE® HDPE (HIGH DENSITY POLYETHYLENE) CUTTING BOARD

is an odorless and taste-free pebbled finished cutting board material recognized as the industry standard of excellence for use in food preparation and meat/poultry processing. Sanalite® is lightweight, easily cleaned and sanitized, and is compliant with FDA, USDA, NSF Standards 2 & 51 and CFIA. Sanalite® Cutting Board is also available in Natural Polypropylene for users who prefer a harder cutting surface and added stain resistance. **Now available in black - meeting the same compliance standards as natural Sanalite®.**

### BOROTRON® BORATED HDPE (HIGH DENSITY POLYETHYLENE)

Borotron® HD050 HDPE is based on Quadrant's high performance HDPE with 5% elemental boron. Borotron® has been used as a medical and industrial shielding material to attenuate and absorb neutron radiation. This easily fabricated polymer material also offers designers greater durability and function over a wider range of temperatures than traditional materials.

- Easy to handle and fabricate
- Durable over a wider temperature range than other solutions
- Consistent density and homogeneity
- Superior dimensional quality and flatness



### PROTEUS® LDPE (LOW DENSITY POLYETHYLENE)

is more flexible than HDPE. LDPE is easily vacuum or draped formed into prosthetic devices that offer more flexibility of motion. LDPE also provides good chemical resistance and impact strength and is easy to fabricate into industrial parts. **Proteus® LDPE meets FDA criteria for use in food processing and packaging.**



#### Tech Notes:

Few cutting board suppliers have both NSF Standards 2 & 51 on their material. Meaning that if a sheet gets cut up into smaller pieces, the NSF rating is lost. Sanalite has NSF on both full sheets and cut pieces.

# TIVAR® UHMW-PE PRODUCTS

## PRODUCT PROFILE

### FOR SUPERIOR WEAR RESISTANCE AND PART LIFE IN WET AND DRY ENVIRONMENTS

- Excellent abrasion resistance
- Low coefficient of friction
- No moisture absorption
- Corrosion resistant
- Excellent noise abatement
- Excellent impact strength
- Maintains key physical properties to -30°C

### NEW TIVAR® COLORS:

- Very low minimums on standard colors
- 48" x 120" sheet size
- Ideal for change parts
- Custom color matching upon request

### TIVAR® 1000 UHMW-PE

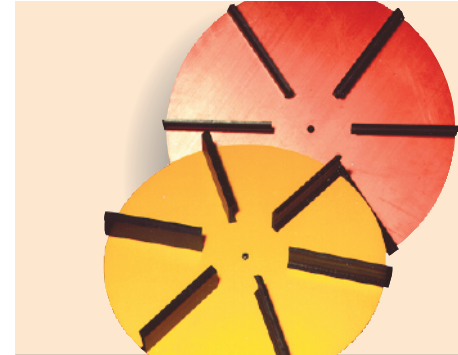
meets FDA, USDA and 3-A Dairy Sanitation guidelines for food processing and handling, making it the material of choice for tough food handling problems. Because TIVAR® 1000UHMW-PE is resistant to chemical attack, it stands up to repeated wash downs with aggressive chlorine solutions, common in the food processing industry, which is damaging to other polymer materials. Available in a broad array of custom colors, including many that meet FDA requirements, on a made to order basis.

### TIVAR® ECO

is a blend of virgin and reclaimed TIVAR® UHMW-PE that maintains an acceptable combination of TIVAR® UHMW-PE properties for less-demanding, non-FDA applications.

### TIVAR® UV RESISTANT UHMW-PE

provides enhanced stability for outdoor applications. TIVAR® UV Resistant UHMW-PE retains all the key properties of TIVAR® 1000 and prevents premature degradation of the material under continuous UV exposure (see Fig. 1). It is ideal for agricultural, recreation and transportation applications. Parts made from TIVAR® UV Resistant UHMW-PE are self-lubricating and will not corrode or freeze, providing extended part life and improved performance.



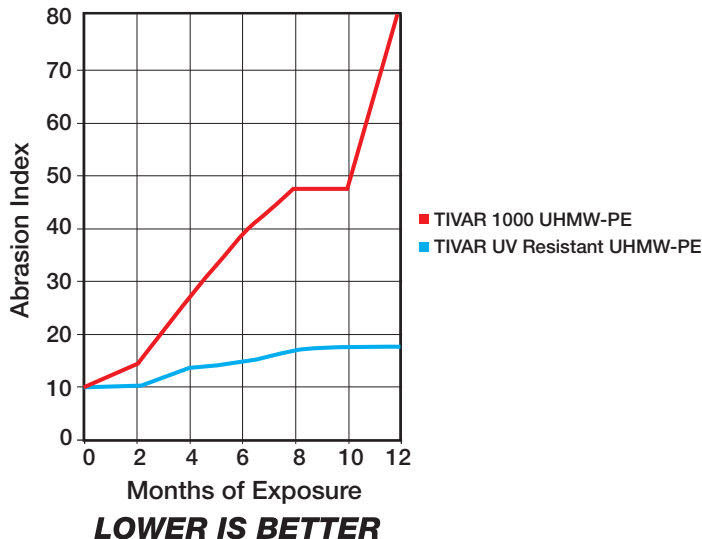
### PRODUCT APPLICATION:

#### Salt Spinners

- **Problem:** Chemical corrosion and harsh environment cause steel spinners to rust and require costly, premature replacement.
- **Solution:** Spinners made from TIVAR® UV Resistant UHMW-PE material eliminate corrosion and rusting problems from salt and water.
- **Benefits:** Smoother operation. Less salt build-up and less sticking to spinner. Replaceable fins allow for quicker more economical maintenance.

## EFFECTS OF UV ON WEAR PERFORMANCE

Fig. 1 — SAND SLURRY LOSS AS FUNCTION OF UV EXPOSURE



# TIVAR® UHMW-PE PRODUCTS



## PRODUCT APPLICATION:

### Outbound Chutes

- **Problem:** An electronic catalog mail order house had jamming problems with outbound chutes. The light packages needed to travel 18 feet down the chute and across 100 feet of rollers to trucks.
- **Solution:** One-piece welded TIVAR® DrySlide UHMW-PE chute liners helped the packages move faster and more consistently across the rollers to the loading doors.
- **Benefits:** ESD properties kept packages moving with no static build-up even during winter months. DrySlide's dry lubricant does not transfer to the packages or smear bar codes.



## PRODUCT APPLICATION:

### Chain Guides

- **Problem:** A roller chain system required an expensive, high maintenance oil delivery system.
- **Solution:** Chain guide components from TIVAR® Oil Filled UHMW-PE allow lubricant to be transferred from the chain guide to the chain, lubricating the entire system.
- **Benefits:** No costly external lubrication systems need to be installed and the TIVAR® Oil Filled UHMW-PE keeps the chains from rusting and seizing. Also, used to eliminate squealing from increase speeds.

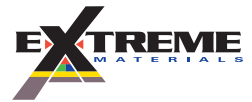
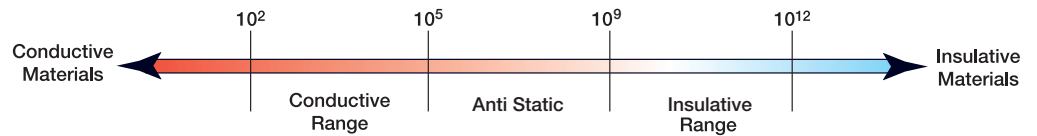
## TIVAR® ESd UHMW-PE (ELECTRO STATIC DISSIPATIVE)

protects against electrical charge build-up on wear surfaces. TIVAR® ESd UHMW-PE is the ideal material to use when potentially volatile conditions exist in munitions plants. It also protects expensive robotic and conveyor equipment that is sensitive to electrical charge build-up. ( $10^5$  to  $10^9$ )

## TIVAR® EC UHMW-PE (ELECTRICALLY CONDUCTIVE)

provides more protection from electrical charge build-up by offering greater conductivity, quickly moving the charge away from the application environment. ( $< 10^5$ )

Fig. 2— SURFACE RESISTIVITY ( $\Omega$ /sq.)



## TIVAR® DRYSLIDE UHMW-PE

is modified with a dry lubricant to have the lowest coefficient of friction of all TIVAR® UHMW-PE products. The enhanced wear resistance and electro static dissipative properties make TIVAR® DrySlide UHMW-PE a proven performer in dusty, dirty environments. It moves parcels and packages quickly even in high humidity. TIVAR® DrySlide UHMW-PE is inherently UV stabilized and performs well in any outdoor application. ( $10^5$  to  $10^9$ )

## TIVAR® CLEANSTAT® UHMW-PE

is a unique ESD (Electro Static Dissipative) material that still meets FDA/USDA guidelines and is 3-A Dairy Sanitation compliant for food processing and handling applications where static charge build-up is a problem. TIVAR® CleanStat® UHMW-PE reduces fine build-up in pan conveyors and feeders, reducing clean outs and downtime. ( $10^7$  to  $10^{10}$ )

## TIVAR® OIL FILLED UHMW-PE

provides lower coefficient of friction by introducing a wet lubricant that exudes from the material, adds lubrication to mating parts and still meets FDA/USDA guidelines for food processing and handling applications. With TIVAR® Oil Filled UHMW-PE, conveyors operate more effectively without the added expense of unnecessary lubricant delivery systems.

## TIVAR® CERAM P UHMW-PE

is a unique combination of virgin material and premium additives which makes it the material of choice for severe sliding abrasion applications. Its higher tensile strength and wear resistance over standard UHMW products increased part life, and reduced maintenance downtime.

## TIVAR® MD UHMW-PE

is a special UHMW formulation designed to be detected by existing metal detection food processing line equipment. By incorporating UHMW components, which provide all of the expected benefits of good impact strength, machinability and FDS/3A Dairy compliance, along with the unique feature of "metal detection", food processors in the meat, cheese, dairy and bakery industries can move to another level of contamination control...and the product is blue!



### Tech Notes:

TIVAR® UHMW-PE products maintain many of their impact and tensile properties at cryogenic temperatures, making them ideal for flash or quick freeze applications.



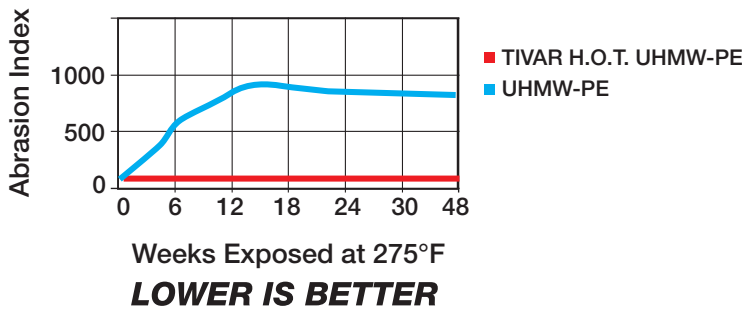
# TIVAR® UHMW-PE PRODUCTS

## TIVAR® H.O.T. UHMW-PE (HIGHER OPERATING TEMPERATURE)

excels in a variety of industrial manufacturing environments where temperatures reach up to 275°F. TIVAR® H.O.T. UHMW-PE reduces oxidation rate at higher temperatures, slows degradation and extends wear-life in chemical, elevated temperature and thermo-cycling environments. TIVAR® H.O.T. UHMW-PE meets FDA/USDA guidelines and is 3-A Dairy Sanitation compliant, making it the ideal, longer life material for wear parts in dairy, bakery, poultry/meat and other food processing industries where higher temperatures or frequent chemical wash downs shorten part life.

### EFFECTS OF TEMPERATURE ON WEAR PERFORMANCE

Fig. 3— SAND WHEEL WEAR



## TIVAR® 88 UHMW-PE

has achieved worldwide recognition as the premier lining material for all bulk material handling problems. Excellent abrasion and chemical resistance help make TIVAR® 88 UHMW-PE the longest wearing liner available. The low coefficient of friction promotes continuous, reliable flow of the stickiest bulk material eliminating arching, ratholing and erratic material flow. TIVAR® 88 ESD/UV UHMW-PE is available if static build-up is a problem or the liner is subjected to continuous sunlight.

## TIVAR® 88-2 UHMW-PE

can be fabricated and welded to solve complicated chute or hopper lining problems. System TIVAR® UHMW-PE Engineering can design the right solution for your individual situation. TIVAR® 88-2 UHMW-PE is also available in a ESD/UV Resistant formulation.

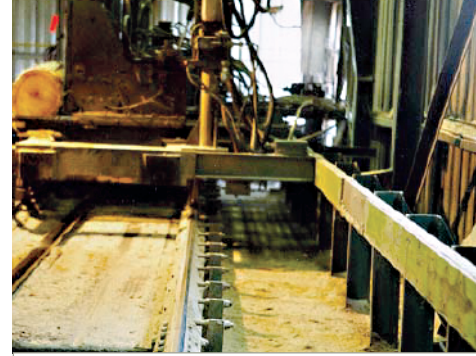
## TIVAR® 88 UHMW-PE W/BURNGUARD

was designed for applications where TIVAR® 88 UHMW-PE liners might be exposed to combustion. TIVAR® 88 UHMW-PE w/BurnGuard is designed to self-extinguish when the source of combustion is removed and the material experiences no further impact. TIVAR® 88 UHMW-PE w/BurnGuard meets MSHA 1C-112/1 for underground mining and has a UL94 V-0 Flammability Rating.



### Tech Notes:

Quadrant's SystemTIVAR UHMW-PE Engineering group has decades of experience in liner design and installation technology. They can assist with material selection, custom application design and complete project engineering - including installation. Plug into the SystemTIVAR UHMW-PE team at 877-476-5944 or online at [www.quadrantplastics.com](http://www.quadrantplastics.com)



### PRODUCT APPLICATION:

#### Saw Wear Pads

- **Problem:** Steel wear pads on a transverse saw in a lumber mill wear quickly and fill with sawdust causing jams.
- **Solution:** Strips of TIVAR® Ceram P UHMW-PE replaced metal wear strips and guide rails
- **to improve uptime.**
- **Benefits:** Smoother operation with less build-up and sticking causing fewer jams and less downtime.



### PRODUCT APPLICATION:

#### Concrete Receiving Hopper

- **Problem:** Flow of PRB coal was not possible in concrete receiving hoppers.
- **Solution:** TIVAR® 88-2 UHMW-PE anti-static was used to line the hoppers and completely eliminate flow problems.
- **Benefits:** Mass flow of coal now possible, eliminating sticking and "ratholing."

# PRODUCT AVAILABILITY

	Product	Plate	Rod	Tube
1	Proteus® HDPE- Natural	.062"-4" A, .062"-2.5"B, .125" - 5" D	-	-
2	Sanalite® HDPE- Natural	.250"-1.5" A, B, .375"-1" D	-	-
3	Proteus® HDPE- Black	.125"-1.5" A, B, .125"-5" D	-	-
4	Sanalite® HDPE- Black	.375"-1" A, B, .375"-1 D minimums apply	-	-
5	Borated HDPE-Borotron®	1" A	-	-
6	Proteus® Natural Homopolymer Polypropylene	.062"-4"A, .062"-3" B, .125"-5" D	-	-
7	Proteus® Black and White plus Homo Polypropylene	.125"-1"A, B, .125" -1" D minimums apply	-	-
8	Proteus® White Homopolymer Polypropylene	.125"-1" A, B, .125" - .750" D	-	-
9	Proteus® Natural O&P Homopolymer Polypropylene	.062"-.625" A, B, .125" - .625" D	-	-
10	Proteus® Natural Copolymer Polypropylene	.125"-4" A, B, .125"-1" D	-	-
11	Proteus® Eurogrey and Black Copolymer Polypropylene	.250"-1" A, B, .250"-.750" D minimums apply	-	-
12	Proteus® LDPE	.062"-1" A, B, .250"-.5" D minimums apply	-	-
13	TIVAR® 1000 Natural UHMW-PE	.062"-2" A, .062"-6" B,E, .750"-4" C, .250"-1" D	.250"-10" dia	
14	TIVAR® 1000 Black UHMW-PE	.500"-.625" A, .062"-6" B, .750"-4" C, .062"-6" E	.250"- 6" dia	
15	TIVAR® UV UHMW-PE	.062"-2" A, .062"-6" B, E .750"-4" C, .250"-.375" D	MTO	MTO
16	TIVAR® ESd UHMW-PE	.500"-.625" A, .062"-6" B,E, .750"-4" C, .250"-.500" D	MTO	MTO
17	TIVAR® EC UHMW-PE	.062"-6" B, E, .750"-4" C, .250"-.750" D	-	-
18	TIVAR® Oil Filled UHMW-PE	.125"-6" B, E, .750"-4" C,	MTO	
19	TIVAR® ECO UHMW-PE	.062"-6" B, E, .750"-4" C, .250"-1" D	-	-
20	TIVAR® Dryslide UHMW-PE	.062"-6" B, E, .750"-4" C, .250"-.750" D	MTO	-
21	TIVAR® Ceram P UHMW-PE	.062"-6" B, E, .750"-4" C,	MTO	-
22	TIVAR® H.O.T. UHMW-PE	.062"-6" B, E, .750"-4" C,	MTO	MTO
23	TIVAR® Cleanstat UHMW-PE	.062"-6" B, E, .750"-4" C, .250"-.750" D	-	MTO
24	TIVAR® 88 UHMW	.062"-6" B, E, .750"-4" C, .375"-.500" D	MTO	-
25	TIVAR® 88 ESD UHMW	.062"-6" B, E, .750"-4" C, .375"-.500" D	MTO	-
26	TIVAR® 88-2 UHMW	.250"-6" B, E, .750"-4" C, .250"-.750" D, .625"-6" E	MTO	-
27	TIVAR® 88-2 ESD UHMW	.062"-6" B, E, .750"-4" C, .250"-.750" D	MTO	-
28	TIVAR® 88 UHMW with Burnguard	.250"-4" B, .750"-1.5" C	MTO	-
29	TIVAR® MD UHMW-PE	.250"-3.5" B	1"-3" dia	-

**Key:**  
 A = 48" x 96"  
 B = 48" x 120"  
 C = 48" x 240"  
 D = 60" x 120"  
 E = 40" x 80"  
 MTO = Make to Order

UV additive available in HDPE and PP. Selected colors available in HDPE and PP. Armor-X, Armor-X w/knobs, DS, EXTW, Premium, Super +, Rubberback, Polysteel, Tech, Glass, and Proteus LSG HS PP available in selected thickness and sheet sizes. Special lengths and CTS pieces available upon request.

Our capabilities are always growing, so give us a call to see if your configuration is possible.

# NOTES:



# PRODUCT COMPARISON DATA

		Units	Test Method ASTM	Quadrant PVC	Proteus® Natural Homopolymer Polypropylene	Proteus® Natural Co-Polymer Polypropylene	Proteus® White Homopolymer Polypropylene	Proteus® Natural O & P Homopolymer Polypropylene	Proteus® HDPE - Natural Polyethylene
	Product Description			Extruded & Compression Molded	Extruded & Compression Molded	Extruded & Compression Molded	Extruded & Compression Molded	Extruded & Compression Molded	Extruded & Compression Molded
MECHANICAL	1 Specific Gravity, 73°F	-	ASTM D792	1.4	0.91	0.90	0.91	0.91	0.96
	2 Yield Point, 73°F	psi	ASTM D638	8,350	4,800	3,400	4,000	4,800	4,600
	3 Tensile Elongation (at yield), 73°F	%	ASTM D638	5	14	11	12	14	12
	4 Tensile Break, 73°F	psi	ASTM D638	8,350	4,800	4,800	4,800	4,800	4,600
	5 Tensile Elongation (at break), 73°F	%	ASTM D638	20	400	300	300	400	400
	6 Tensile Modulus of Elasticity, 73°F	psi	ASTM D638	465,000	190,000	152,000	173,000	190,000	200,000
	7 Flexural Modulus of Elasticity, 73°F	psi	ASTM D790	398,000	195,000	180,000	180,000	195,000	174,000
	8 Hardness, Durometer D	-	ASTM D2240	89	78	72	78	78	70
	9 Izod Impact (notched) 73°F	ft. lb./in.	ASTM D256 Type "A"	0.4	1.2	8	1.9	1.2	1.3
THERMAL	10 Heat Deflection Temperature (HDT)	°F	ASTM D648	-	205	212	210	210	-
	11 Melt Point	°F	ASTM D3418	-	324	305	327	327	260
	12 Continuous Service Temp in Air (max) (1)	°F	-	140	180	180	180	180	180
	13 Surface Resistivity	Ohm-cm	ASTM D257	> 10 <sup>12</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>
	14 Volume Resistivity	Ohm	ASTM D257	> 10 <sup>12</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>	> 10 <sup>15</sup>
	15 Flammability (5)	-	UL94	V0	HB	HB	HB	HB	HB
CHEMICAL (3)	16 Water Absorption	% by wt.	ASTM D570 (2)	-	-	-	-	-	< .01
	17 Acid, Weak	@73°F	-	A	A	A	A	A	A
	18 Acid, Strong	@73°F	-	L	A	A	A	A	A
	19 Alkalies, Weak	@73°F	-	A	A	A	A	A	A
	20 Alkalies, Strong	@73°F	-	A	A	A	A	A	A
	21 Hydrocarbons, Aromatic	@73°F	-	U	U	U	U	U	U
	22 Hydrocarbons, Aliphatic	@73°F	-	L	U	U	U	U	U
	23 Ketones, Esters	@73°F	-	U	U	U	U	U	U
	24 Ethers	@73°F	-	U	U	U	U	U	U
	25 Chlorinated Solvents	@73°F	-	U	U	U	U	U	U
	26 Alcohols	@73°F	-	A	A	A	A	A	A
	27 Inorganic Salt Solutions	@73°F	-	A	A	A	A	A	A
	28 Sunlight	@73°F	-	U	U	U	U	U	U

- (1) Data represents Quadrant's estimated maximum long term service temperature based on practical field experience.
- (2) Specimens 1/8" thick x 2" dia. or square.
- (3) Chemical resistance data are for little or no applied stress. Increased stress, especially localized may result in more severe attack. Examples of common chemicals also included.
- (5) **Estimated rating based on available data.** The UL 94 Test is a laboratory test and does not relate to actual fire hazard. Contact Quadrant for specific UL "Yellow Card" recognition number.

**Key:**

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 L = Limited Service  
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**NOTE:** Property data shown are typical average values. A dash (-) indicates insufficient data available for publishing.

## NOTES:

	Sanalite® HDPE Polyethylene	Borotron® Borated PE (HDPE)	Proteus® LDPE
	Extruded & Compression Molded	Extruded	Extruded & Compression Molded
1	0.96	1.01	0.92
2	4,900	-	1,500
3	12	-	100
4	4,900	-	1,700
5	350	3.9	400
6	176,000	111,200	57,000
7	170,000	126,500	29,000
8	70	71	54
9	1.3	0.9	No Break
10	-	-	-
11	260	260	230
12	180	180	160
13	> 10 <sup>15</sup>	> 10 <sup>12</sup>	> 10 <sup>15</sup>
14	> 10 <sup>15</sup>	> 10 <sup>12</sup>	> 10 <sup>15</sup>
15	HB	HB	HB
16	< .01	< .01	< .01
17	A	A	A
18	A	A	A
19	A	A	A
20	A	A	A
21	U	U	U
22	U	U	U
23	U	U	U
24	U	U	U
25	U	U	U
26	A	A	A
27	A	A	A
28	U	U	U

# TIVAR® PRODUCT COMPARISON DATA

	Product Description	Units	Test Method ASTM	TIVAR® 1000 UHMW-PE	TIVAR® ECO UHMW-PE	TIVAR® UV UHMW-PE	ARMOR-X UHMW-PE	TIVAR® ESD UHMW-PE	TIVAR® EC UHMW-PE	
				Compression Molded/Ram Extrusion	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded	
MECHANICAL	1	Specific Gravity, 73°F	-	D792	0.93	0.93	0.94	1.0	0.94	0.94
	2	Tensile Strength, 73°F	psi	D638	5,800	4,000	5,800	3,200	5,800	5,800
	3	Tensile Modulus of Elasticity, 73°F	psi	D638	80,000	98,000	116,000	51,500	87,000	101,000
	4	Tensile Elongation (at break), 73°F	%	D638	300	200	300	100	300	300
	5	Flexural Strength, 73°F	psi	D790	3,500	2,000	3,800	2,200	3,700	3,200
	6	Flexural Modulus of Elasticity, 73°F	psi	D790	87,000	81,000	116,000	44,000	87,000	101,000
	7	Shear Strength, 73°F	psi	D732	4,800	-	-	-	-	-
	8	Compressive Strength, 10% Deformation, 73°F	psi	D695	3,000	2,800	3,300	3,900	3,300	3,300
	9	Compressive Modulus of Elasticity, 73°F	psi	D695	80,000	60,000	100,000	34,000	100,000	100,000
	10	Hardness, Rockwell, Scale as Noted, 73°F	-	D785	R56	N/A	N/A	N/A	N/A	N/A
	11	Hardness, Durometer, Shore "D" Scale, 73°F	-	D2240	66	67	66	50	66	66
	12	Izod Impact (notched), 73°F	ft. lb./in. of notch	D256 Type "A"	No Break	No Break	No Break	No Break	No Break	No Break
	13	Izod Impact (double notch), 73°F	ft. lb. / in. <sup>2</sup> of notch	D4020	47.6	38.1	47.6	-	46.2	28.6
	14	Coefficient of Friction (Dry vs. Steel) Dynamic	-	QTM 55007	0.12	0.14	0.12	0.20	0.12	0.12
	15	Limiting PV (with 4:1 safety factor applied)	ft. lbs./in. <sup>2</sup> min	QTM 55007	3,000	3,000	3,000	-	3,000	3,000
	16	Sand Slurry	1018 Steel=100	ASTM D4020	10	18	10	-	10	10
THERMAL	17	Coefficient of Linear Thermal Expansion (-40°F to 300°F)	in./in./°F	E-831 (TMA)	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	-	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>
	18	Heat Deflection Temperature 264 psi	°F	D648	116	116	116	116	116	116
	19	Tg-Glass Transition (amorphous)	°F	D3418	N/A	N/A	N/A	N/A	N/A	N/A
	20	Melting Point (crystalline) Peak	°F	D3418	275	260	275	275	275	275
	21	Continuous Service Temperature in Air (Max.) (1)	°F	-	180	180	180	180	180	180
	22	Thermal Conductivity	BTU in./hr. ft. <sup>2</sup> °F	F433	2.84	N/A	N/A	N/A	N/A	N/A
ELECTRICAL	23	Dielectric Strength, Short Term	Volts/mil	D149	1,150	N/A	N/A	N/A	N/A	N/A
	24	Surface Resistivity	ohm/square	D257	>10 <sup>15</sup>	<10 <sup>15</sup>	>10 <sup>15</sup> (UV Colors) <10 <sup>15</sup> (UV Black)	>10 <sup>15</sup>	10 <sup>5</sup> - 10 <sup>9</sup>	<10 <sup>5</sup>
	25	Dielectric Constant, 10 <sup>6</sup> Hz	-	D150	2.3	N/A	N/A	N/A	N/A	N/A
	26	Dissipation Factor, 10 <sup>6</sup> Hz	-	D150	<0.5 x 10 <sup>-3</sup>	N/A	N/A	N/A	N/A	N/A
	27	Flammability @ 3.1 mm (1/8 in.) (5)		UL 94	HB	HB	HB	HB	HB	HB
CHEMICAL (3)	28	Water Absorption Immersion, 24 Hours	% by wt.	D570 (2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	29	Water Absorption Immersion, Saturation	% by wt.	D570 (2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	30	Acids, Weak, acetic, dilute hydrochloric or sulfuric acid	@73°F		A	A	A	A	A	A
	31	Acids, Strong, conc. hydrochloric or sulfuric acid	@73°F		A	A	A	A	A	A
	32	Alkalies, Weak, dilute ammonia or sodium hydroxide	@73°F		A	A	A	A	A	A
	33	Alkalies, Strong, strong ammonia or sodium hydroxide	@73°F		A	A	A	A	A	A
	34	Hydrocarbons-Aromatic, benzene, toluene	@73°F		L	L	L	L	L	L
	35	Hydrocarbons-Aliphatic, gasoline, hexane, grease	@73°F		A	A	A	A	A	A
	36	Ketones, Esters, acetone, methyl ethyl ketone	@73°F		A	A	A	A	A	A
	37	Ethers, diethyl ether, tetrahydrofuran	@73°F		L	L	L	L	L	L
	38	Chlorinated Solvents, methylene chloride, chloroform	@73°F		L	L	L	L	L	L
	39	Alcohols, methanol, ethanol, anti-freeze	@73°F		A	A	A	A	A	A
	40	Continuous Sunlight	@73°F		L	L	A	A	A	A
OTHER	41	FDA Compliance			Y	N	N	N	N	N
	42	Relative Cost (4)			\$	\$	\$\$	\$\$	\$\$	\$\$
	43	Relative Machinability (1-10, 1=Easier to Machine)			2	3	3	3	3	3

- (1) Data represents Quadrant's estimated maximum long term service temperature based on practical field experience.
- (2) Specimens 1/8" thick x 2" dia. or square.
- (3) Chemical resistance data are for little or no applied stress. Increased stress, especially localized, may result in more severe attack. Examples of common chemicals also included.
- (4) Relative cost of material profiled in this brochure (\$ = Least Expensive and \$\$\$\$\$\$ = Most Expensive)
- (5) **Estimated rating based on available data.** The UL 94 Test is a laboratory test and does not relate to actual fire hazard. Contact Quadrant for specific UL "Yellow Card" recognition number.

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z	TIVAR® DrySlide UHMW-PE	TIVAR® CleanStat UHMW-PE	TIVAR® Oil Filled UHMW-PE	TIVAR® Ceram P UHMW-PE	TIVAR® H.O.T. UHMW-PE	TIVAR® 88 UHMW-PE	TIVAR® 88 UHMW-PE w/BurnGuard	TIVAR® 88-2 UHMW-PE	TIVAR® 88 Esd UHMW-PE	TIVAR® 88-2 Esd UHMW-PE
	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded	Compression Molded
1	0.94	0.94	0.94	0.96	0.94	0.93	1	0.933	0.945	0.94
2	5,100	5,200	6,500	5,500	6,800	5,800	3,600	5,500	4,800	4,800
3	87,000	94,000	43,500	83,000	72,500	61,000	87,000	97,000	124,000	116,000
4	200	200	280	300	300	300	120	200	250	200
5	2,600	2,700	2,500	3,700	3,800	3,200	2,900	3,000	3,300	3,100
6	72,000	87,000	58,000	94,000	80,000	72,500	94,000	105,000	112,000	106,000
7	-	-	-	-	4,800	-	-	4,800	4,800	4,800
8	2,900	3,100	2,700	3,000	3,000	3,000	2,800	2,900	3,000	2,900
9	80,000	77,750	42,000	94,000	80,000	70,000	65,000	80,000	87,000	80,000
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	64	66	64	68	68	69	64	64	67	64
12	No Break	No Break	No Break	No Break	No Break	No Break	No Break	No Break	No Break	No Break
13	33.3	28.6	36.2	50.0	28.6	34.3	41.9	45.2		
14	0.08	0.12	0.14	0.12	0.12	0.12	0.09	0.08	0.14	0.08
15	4,000	3,000	4,000	3,000	3,000	4,000	-	4,000	4,000	4,000
16	10	13	13	8.5	10	8	15	11	8	10
17	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	9.0 x 10 <sup>-5</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>	1.1 x 10 <sup>-4</sup>
18	116	116	116	116	116	116	116	116	116	116
19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	275	275	275	275	275	275	275	275	275	275
21	180	180	180	180	275	180	180	180	180	180
22	N/A	N/A	2.84	2.84	2.84	2.84	-	2.84	N/A	N/A
23	N/A	N/A	-	-	-	-	-	-	N/A	N/A
24	10 <sup>5</sup> - 10 <sup>9</sup>	10 <sup>7</sup> - 10 <sup>10</sup>	>10 <sup>15</sup>	>10 <sup>15</sup>	>10 <sup>15</sup>	>10 <sup>15</sup>	>10 <sup>12</sup>	>10 <sup>15</sup>	10 <sup>5</sup> - 10 <sup>9</sup>	10 <sup>5</sup> - 10 <sup>9</sup>
25	N/A	N/A	2.3	2.3	2.3	2.3	-	2.3	N/A	N/A
26	N/A	N/A	<0.5 x 10 <sup>3</sup>	<0.5 x 10 <sup>3</sup>	<0.5 x 10 <sup>3</sup>	<0.5 x 10 <sup>3</sup>	-	<0.5 x 10 <sup>3</sup>	N/A	N/A
27	HB	HB	HB	HB	HB	HB	V0	HB	HB	HB
28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
30	A	A	A	A	A	A	A	A	A	A
31	A	A	A	A	A	A	A	A	A	A
32	A	A	A	A	A	A	A	A	A	A
33	A	A	A	A	A	A	A	A	A	A
34	L	L	L	L	L	L	L	L	L	L
35	A	A	A	A	A	A	A	A	A	A
36	A	A	A	A	A	A	A	A	A	A
37	L	L	L	L	L	L	L	L	L	L
38	L	L	L	L	L	L	L	L	L	L
39	A	A	A	A	A	A	A	A	A	A
40	A	L	L	L	L	A	L	A	A	A
41	N	Y	Y	N	Y	N	N	N	N	N
42	\$\$\$	\$\$\$\$	\$\$	\$\$\$	\$\$\$	\$\$\$\$	\$\$\$\$	\$\$\$\$	\$\$\$\$	\$\$\$\$
43	3	3	2	3	2	3	4	2	3	3

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