



# NON-METALLIC BEARINGS FOR PUMPS - XYTREX® -





Xytrex® materials

Xytrex® Benefits

Technical support

## **3P – Performance Plastics Products**

- 55 years old company
- Key markets FHS Oil & Gas, Energy, Aerospace, Automotive
- Production sites in Europe and USA
- Quality : ISO 9001, ISO 14001



 Core Business : processing of high performance polymers (PTFE, PEEK) to provide solutions for critical industrial applications





29/02/2024 - spujol@3pcorporate.com



## Overview of Xytrex® components in centrifugal pump





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## **PEEK among Thermoplastics**

#### Key features :

- Very High strength polymer at elevated temperature
- Low level of creep
- Excellent tribological properties
- Good abrasion resistance
- Very good chemical resistance
- Inherently flame retardant
- Resistance to radiation
- Very low absorption
- >> Unique combination of properties !!
- >> Approved polymer in API 610

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## **XYTREX®** 451 **API 610 choice for Non-Metallic Stationary parts**

### **Xytrex**<sup>®</sup> **451** : PEEK reinforced with chopped carbon fiber

- Processed by melt molding
- Extensive tooling capabilities and sizes (max size up to Ø1000mm)
- <u>Recommended for stationary</u> wear components (-60°C to +150°C)
- Moderate to high radial load capability



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## **Mechanical & Tribological Properties**



## **API Standard 610**

X451 **Temperature limits** Limiting pressure differential °C (°F) per wear part linear measure Material Application of 25 mm (1,0 in) min. max. kPa (bar; psi) Polyether ether ketone 135 (275) Stationary parts -30 (-20) 2 000 (20; 300) (PEEK) Chopped-carbon-fibre filled Polyether ether ketone -30(-20)230 (450) 3 500 (35; 500), or Stationary or (PEEK) rotating 14 000 (140; 2 000) if suitably Continuous-carbonsupported fibre wound PFA/CF reinforced -46 (-50) 230 (450) 2 000 (20; 300) Stationary parts composite 20 % mass fraction random X-Y oriented carbon-fibre Carbon prophit arts XYTREX<sup>®</sup>451 & XC<sup>®</sup>2 enable the pump to Resin XC<sup>®</sup>2 Babb operate safety at clearances that are Nicke Copp approximately half the API recommendation mits. Non-meta See 6.7.4 for metal wear ring => better efficiency !! 12 % Such mat Cr steel o n be provided, and ir approved by the purchaser.

#### Table H.3 — Non-metallic wear part materials

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## **Installation into metallic inserts**



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## **Maintenance operation**









Previous damaged wear component is removed





Beyond Performance Plastics<sup>®</sup> A new Xytrex<sup>®</sup> wear component is inserted



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## XYTREX® 115 Vibration Absorption

### Xytrex<sup>®</sup> 115 : Proprietary PTFE compound

- Highest ductility of PTFE vs PEEK : better absorption of vibration
- Processed by sintering molding
- Extensive tooling capabilities and sizes (max size up to Ø1000mm)
- <u>Recommended for stationary</u> wear components (-60°C to +50°C)
- Low radial load capability
- Substitution of radial bearings in vertical pumps with low pressure





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## XYTREX® 116 Abrasive Resistance

### Xytrex<sup>®</sup> 116 : Proprietary PEEK/PTFE compound

- Ability to work in abrasive media
- Processed by melt molding
- Extensive tooling capabilities and sizes (max size up to Ø1000mm)
- <u>Recommended for stationary</u> wear components (-60°C to +120°C)
- Moderate radial load capability



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## XYTREX® 751 Chemical Resistance

Xytrex<sup>®</sup> 751 : PFA reinforced with chopped carbon fiber

- Outstanding chemical resistance (including sulfuric acid, nitric acid, bromine, chlorine, fluorine, sodium).
- Processed by melt molding
- Extensive tooling capabilities and sizes (max size up to Ø1000mm)
- <u>Recommended for stationary</u> wear components (-60°C to +150°C)
- Low to moderate radial load capability



## XYTREX® 120 ASTM D4745 grade 8 compliant

### Xytrex<sup>®</sup> 120 : PTFE compound + Carbone / Graphite

#### ASTM D4745 grade 8 compliant



Standard Classification System and Basis for Specification for Filled Polytetrafluoroethlyene (PTFE) Molding and Extrusion Materials Using ASTM Methods<sup>1</sup>

TABLE 1 TFE Compounds, Type I, Standard Flow (Nonpelletized)

		Daw Davia	Molded Parts (Molded and Sintered)					
Grade		Bulk Density,	Specific Gravity, min	Specific Gravity, max	Tensile Strength		Elongation, min,	
		min, gre		-	min, MPa	min, psi	70	
1	15 % glass fiber	400	2.150	2.250	19.6	2840	220	
2	25 % glass fiber	425	2.150	2.250	15.7	2270	180	
3	35 % glass fiber	350	2.200	2.300	10.3	1500	150	
4	5 % glass fiber and 5 % MoS <sub>2</sub>	300	2.150	2.300	13.8	2000	200	
5	15 % glass fiber and 5 % MoS <sub>2</sub>	375	2.150	2.300	13.8	2000	150	
6	10 % graphite	350	2.100	2.220	17.9	2600	120	
7	15 % graphite	300	2 100	2 200	13.8	2000	100	
8	25 % carbon and graphite	350	1.950	2.150	9.6	1400	20	
9	32 % carbon and graphile	250	1.900	2.100	0.9	1000	20	
10	40 % bronze	500	2.950	3.350	16.5	2400	100	
11	60 % bronze	650	3.850	4.154	12.4	1800	50	
12	55 % bronze and 5 % MoS <sub>2</sub>	700	3.500	4.000	10.3	1500	80	
13	50 % stainless steel	500	3.200	3.600	15.2	2200	120	
0	As specified by customer and supplier		Α	as specified by custo	mer and supplier			

- Recommended for stationary wear components (-60°C to +50°C)
- Ideal for oily / sea water with particles
- Qualified and many used by one of the biggest refinery in the world

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## **XC®2-P : Axial Load Application**

**XC<sup>®</sup>2-P**: Thermoplastic matrix reinforced with continuous carbon fibers

Ideal material for axial thrust and face loading applications.

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	XC2-P
Tensile Strength (MPa)	690
Tensile Modulus (GPa)	60
Compressive Strength (MPa)	640
Coefficient of friction	0,27
Coefficient of thermal expansion (ppm 1/ºC)	0,5
Temperature Limit (ºC)	315

- ENHANCED STABITLIY
- Excellent shock & impact resistance
- High strength and high load capability
- SIMPLIFIED MACHINERY DESIGN
- Oil lubrication system unnecessary
- One material product solution



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## **Summary of Xytrex® materials & application**

XYTREX®	BASE	MAX		STATIC SIDE	DYNAMIC SIDE	SPIDER GUID	SPIDER GUIDE BUSHING		THRUST PAD /	/ THROTTLE /
GRADE	MATERIAL	T° (°C)	GAFADILITIES	WEAR RING	WEAR RING	NO ABRASIVES	ABRASIVES PRESENT	BOWL SHAFT	DISK	BUSHING
XIIS	PTFE	50	Low radial load capability Pump overall vibration reduction at commissioning Recommended for stationary components							
x12o	PTFE	50	ASTM D4745 grade B compliant							
XII6	PEEK	120	Moderate load capability Pump overall vibration reduction at commissioning Recommended for stationary components							
X451	PEEK	150	Moderate to high radial load capability Recommended for stationary components WRAS approval							
X459	PEEK	150	X459 with improved coefficient of friction Extended dry running applications							
X751	PFA	150	Outstanding chemical resistance including sulfuric acids Low to moderate radial load capability Dry running applications Recommended for stationary components							
xC*2	PEEK	315	High strength and high radial load capability for high pressures/velocities environments Compatible with fine particles Recommended for both stationary and dynamic components							
XC=2-L	PEEK	315	XC*2 with improved coefficient of friction Extended dry running applications							
хС•2-р	PEEK	315	High strength and high axial load capability							
Beyo Perforn Plast	ond nance ics®			NOT RECOMMEND		ISE WITH CARE	sui	TABLE	IDEAL	
	, in the second s	spujoi@3	ocorporate.com					12/1		17



# **5** Locations where Xytrex<sup>®</sup> components are used



**Project Locations** 

- Non-Exhaustive Customers List : FLOWSERVE, SULZER / ENSIVAL MORET, TORISHIMA, KSB, CELEROS (SPX), DUCHTING, ANDRITZ, APOLLO, FAPMO
- Refineries: SHELL, TOTAL, EXXON, CHEVRON

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## **Improved Reliability & Efficiency**

## SMALLER RUNNING CLEARANCES :

#### INCREASE PUMP EFFICIENCY

Pump efficiency & operation can be improved by reducing recirculation. This efficiency gain is available on the most common API pump applied in Chemical plants & Refineries.



#### **REDUCES VIBRATION**

- Reduced clearances create a higher pressure liquid film than would be possible with API clearances, across the surface of the wear components. The rotating element rides on/inside of this higher pressure liquid film, that yields a hydrostatic bearing effect, which stabilizes the rotor. This concept is referred to as the Lomakin Effect.
- The ductile nature of poly-ether-ether-ketone thermoplastics enable the composite wear materials to absorb shock and/or vibration.



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#### Less energy consumption

Reduction in electricity consumed when fitting the pump with 3P components can also have an impact on environmental pollution.

### GLOBAL 2% to 7% Savings

The energy savings should help End Users to identify favorable returns on investment.

Pump parameters : - Fluid : water at 60°C - Speed: 3000 tr/mn



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## **Bearing Specification Form**

	32	BEARING SPECIFICATION FORM
		a veči
		EQUIPMENT INFORMATION Description Make/Made
1		lf equipment ir pump, plearespecify number of staqes, horizontal or vertical, suction/dircharge pressure etc.
		BEARING CLASSIFICATION Caro Wear Ring Impeller Hub/Eyo Wear Ring Load Carrying Burhing Linear Bearing Thrattle/Throat/Stuffing Box Buc]: Other
		OPERATING CONDITIONS Type of Fluid: water or liquid hydrocarbe Concentration:
		Lubrication: 🗌 No 🔤 Yer Ifyer: 🔲 Continuour 🗋 Intermittent
		Abrarivo Particles 🗌 No 🔄 Yes Ifyes: Average Particle Siz X By volume
		Temperature Range (°C) Time Duration at max. Temp continour Bearing Load (Lb
		Additional Information
		MOTION INFORMATION
		RPM: Angular Travol (Dog) Surfaco Spood (FPM
		Linear Travel (m <del>r</del> Frequency (Cycler/Min)
		Type of Operation: Continuour 🔲 Intermitten (Specify Duration
		Other
		HARDVARE INFORMATION Please gravite barbare draving (it Impeller Hub/Eyo Diameter (mm) Material Finich (um)
		Rad/ShaftDiam.arIWR OD (mm) Material Finish (um) MR : Iaulles Wee Rina
		CWR ID or Houring Bore Dia.(mm) Material Finish (um) CWR : CarWase Ring
		Groove Diameter (mi Axial Length (mm
		Flanqo Roquirod: 🛛 No 🔤 Yos 🛛 Flanqo Diamotor Flanqo Thicknosz(mm)
		CURRENT BEARING INFORMATION: New Derign: No Yer (Ifon, pleare provide existing bearing drawing if quality)
		Material Rearan far Chana
		Haaitionai informatii

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#### Minimum information required :

- Type of bearing
- Housing / shaft diameter + tolerances
- Temperature range
- Fluid (particles ?)
- Load
- Speed

 $\rightarrow$  If possible, current drawing  $\rightarrow$  Desired clearance

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## **Design recommendation**

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SHAFT DIAMETER ** (mm)	MINIMUM RUNNING CLEARANCE * (mm)	HOUSING BORE DIAMETER ** (mm)	MINIMUM PRESS FIT (mm)	MINIMUM WALL THICKNESS ** (mm)
0 - 25	0,1	0 - 25	0,05	1,5 to 2,3
25,1 - 50	0,13	25,1 - 50	0,05	2,3 to 3,2
50,1 - 76	0,15	50,1 - 76	0,08	3,2 to 6,35
76,1 - 101	0,18	76,1 - 101	0,08	3,2 to 9,5
101,1 - 127	0,2	101,1 - 127	0,1	3,2 to 9,5
127,1 - 152	0,23	127,1 - 152	0,1	4,75 to 9,5
152,1 - 178	0,25	152,1 - 178	0,13	4,75 to 9,5
178,1 - 203	0,28	178,1 - 203	0,13	6,35 to 12,7
203,1 - 228	0,31	203,1 - 228	0,15	6,35 to 12,7
228,1 - 254	0,33	228,1 - 254	0,15	6,35 to 12,7

\* At operating temperature

\*\* Contact us if outside this range

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## **Chemical Resistance Guide**

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R	Resistant - No interaction, possibly slight absorption - Mechanical properties >90% compared to initial status before immersion - Material can be used normally
LR	Limited Resistance - Slight to moderate interaction by absorption - Mechanical properties >75% compared to initial status before immersion - Material will have limited life and will limit load bearing capabilities
NR	Not Recommended - Severe interaction - Material will dissolve or suffer chemical attack in a short time - Mechanical properties <75% compared to initial status before immension
ND	No Data - Test has not been performed - No available data - Prior to actual use it is recommended a compatibility test be run
NR ND	<ul> <li>Severe interaction</li> <li>Material will dissolve or suffer chemical attack in a short time</li> <li>Mechanical properties</li> <li>75% compared to initial status before immersion</li> <li>No Data</li> <li>Test has not been performed</li> <li>No available data</li> <li>Prior to actual use it is recommended a compatibility test be run</li> </ul>

	PTFE and PFA based m		haterials PEEK		(based mat	erials
	(X115, X751)		)	(X451, X459, XC2, XC2-L, X		
	23°C	60°C	100°C	23°C	100°C	200°C
Hydrobromic acid (50%)	R	R	R	NR	NR	NR
Hydrochloric acid (10%)	R	R	R	R	R	ND
Hydrochloric acid (conc.)	R	R	R	R	LR	ND
Hydrocyanic acid	R	R	R	R	R	ND
Hydrofluoric acid (40%)	R	R	R	NR	NR	NR
Hydrofluoric acid (75%)	R	R	R	NR	NR	NR
Hydrolluoric acid, 4%	R	R	ND	ND	ND	ND
Hydrolluoric acid, 48%	R	R	ND	ND	ND	ND
Hydrogen peroxide (30%)	R	R	R	R	R	ND
Hydrogen peroxide (30-90%)	R	R	R	R	R	ND
Hydrogen sulfide	R	R	R	R	R	R
Hydroxide	ND	ND	ND	R	ND	ND
Hypochlorites	R	R	R	ND	ND	ND
Hypochlorites (Na 12-14%)	R	R	R	ND	ND	ND
Iodine Crystals	R	R	ND	LR	LR	ND
Iso-butyl-acetate	R	R	R	ND	ND	ND
Isobutyl Alcohol	R	R	ND	ND	ND	ND
Isocotane	R	R	R	R	R	ND
Isopropanol	R	R	ND	R	ND	ND
Isopropyl Acetate	R	R	ND	R	LR	ND
Isopropyl Alcohol	R	R	ND	ND	ND	ND
Isopropyl Benzene	R	R	ND	ND	ND	ND



## **Machining and assembly procedures**



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 DRILLING PROCEDURE – [XYTREX parts assembly]

If needed, glue can be added to reinforce the cohesion. This design should be approved by the customer.

Pictures to illustrate the procedure :



First hole made with the 3.2mm diameter bit



Drilling with the male (same thread than the screw)



Fix the screw with the spanner



Final result : screw fixed between both components



#### - PRESS FITTING AND MACHINING INSTRUCTIONS -[XYTREX Materials]

 Poly Crystalline diamond tooling is recommended for long cuts or close tolerances on thin wall parts which are prone to "push off"; Parts which require true round conditions may need finish machining after installation or may be machined to wall tolerance only.

- Use water based coolant for turning operations

#### 2. Milling recommendations :

Type of cutter	Carbide Tipped		
Cutter Speed (m/min)	75 - 110		
Coolant	Water based		

#### 3. Drilling recommendations :

Type of Drill	Carbide
Cutting Speed (m/min)	75-120
Feed rate, (mm/rev)	0,05 - 0,2
Lip angle	118°
Clearance Angle	12°
Coolant	Water based

#### 4. Reaming recommendations :

Type of reamer	Spiral Flute
Speed (rev/min)	100 - 200
Coolant	Water based

#### III°) INSTALLATION PROCEDURE OF XYTREX® BEARINGS.

Xytrex<sup>®</sup> bearings can be fitted using following methods :

- Press fitting

- Bonding

#### 1. Press fitting

If a bearing is to be press fitted, installers should ensure that they have equipment available to deliver adequate force to press the bearing fully into the housing. The ease of fitting will vary dependent on the finish of the housing, leading chamfers and the length/diameter ratio.

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## **Drawings**



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# Thank you for your attention.