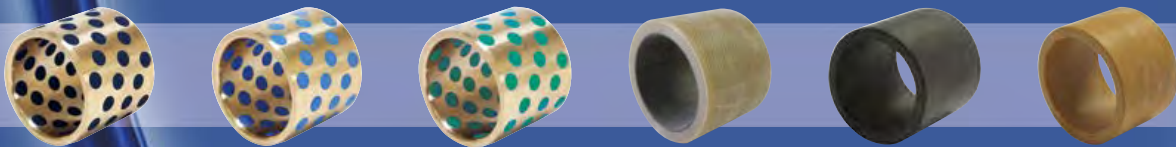


# ***OILES SELF-LUBRICATING BEARINGS***

*for HYDRO POWER & GATES*





# Who is OILES Corporation

In 1932, an encounter of Sozo Kawasaki, the founder of OILES corporation, opened the door to the history of OILES as well as the history of oil-less bearings in Japan.

One day, when Kawasaki, by then the mechanical agent chief of the monopoly bureau, was disassembling a cigarette-rolling machine imported from America, he found a bearing that did not require the use of oil. The wood bearing had no oil hole. It was a self-lubricating bearing that had never been produced in Japan.

Since then, OILES experienced incredible growth with its leading technology in tribology field, and now OILES bearing is used in many of application in many industries.

Specifically for hydro power and water gate, OILES have been supplying self-lubricating bearings to those industries for over 60 years, and now, OILES bearing is used in more than 2,000 facility of Hydropower industry throughout the world.

With this long experience, OILES established a reputation for quality and reliability in these markets.

## The benefits of OILES Bearings

### **Maintenance-free**

Reduce the lubrication quantity and frequency or that can be used without oil or grease.

### **Environment-friendly**

Protects the environment against contamination from oil.

### **Reduction of running costs**

Reduces lubricating oil consumption and equipment maintenance costs and enables a remarkable reduction in operating costs.

### **Corrosion resistance**

Can be used in corrosion environments, such as wet environments.

### **Flexibility**

It's possible to choose from metallic bearings and plastic bearing according to the conditions for use. There are various sizes of Standard products and it's also possible to make custom-made-products.

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# Hydro Power Applications

Since OILES 500 Series Bearings were first adopted as Wicket Gate Bushings in 1967, OILES Corporation has been a Leading Supplier for Self-lubricating Bearings for Hydro Power Generation.



Okutadami Power Station



Kaplan Runner Bushings



Wicket Gate Control Rod Bushings



Upper Wicket Gate Bushings



Lower Wicket Gate Bushings

## Water Turbine

- Linkage Bearings, Servo Motor Bearings
- Operating Ring Bearings, Lower
- Upper Operating Ring Segments
- Shaft Sealing Packings
- Main Shaft Bearing
- Shaft Sealing Packings

Wicket Gate Bushings

- Runner Blade Stem Bushings
- Runner Blade Hub Bushings
- Lower Operating Rod Guide Bushing
- Lower Operating Rod Guide Bushing

## Inlet Valve

Bushing

Bushing

# Dam, Gate and Lock Applications

With years of our self-lube technology OILES Corporation has supported clean river environment without being seen.



Three Gorges Ship Lock



Upper: Cylinder Bearing 480x530xL500



Bottom: Pintle Bearing 1000x1140xL585

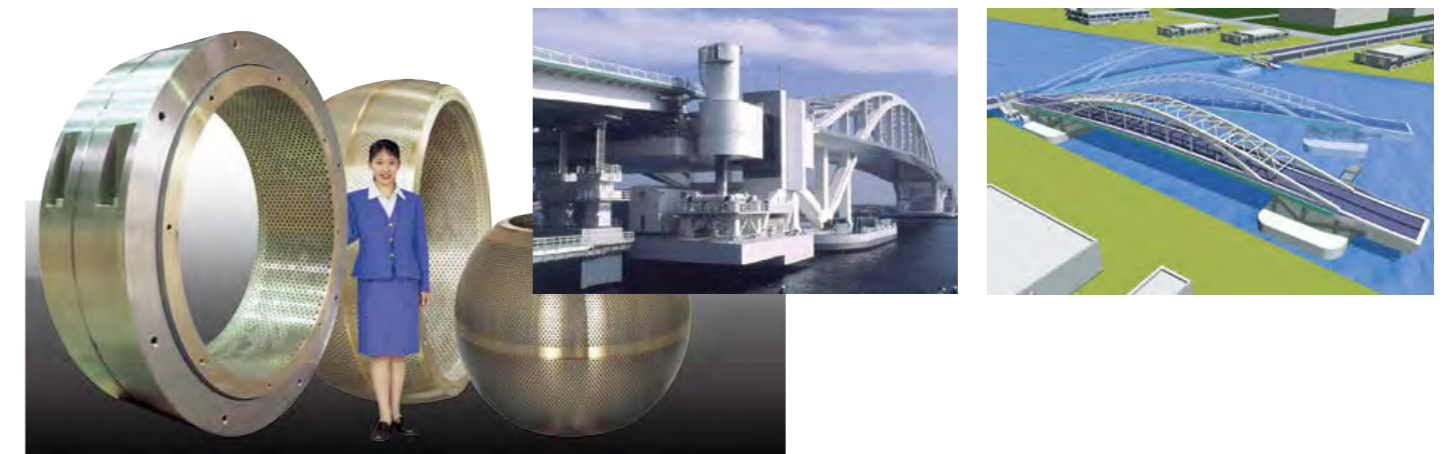


Sakuma Dam [OILES 500]



Maheshwar Dam (India), Radial Gate

## OILES Large-Size Bushings



Yumemai Bridge - The World's First Floating Swing Bridge [OILES 500]

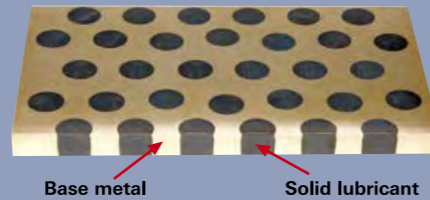


# OILES 500 Series

OILES 500 series are self-lubricating bearings which incorporate high quality alloy based metals with engineered solid lubricant plugs. These bearings are designed to accommodate a wide variety of application requirements demanded by today's equipments. Precise tolerances utilizing strategic plug location and plug compounds ensure performance delivery and lubrication free service. This bearing style is available in a wide range of standard lines and made to order sizes. 500 series bearings provide extreme temperature limits and high load capacity performance.

## Benefits

- Exhibits incomparable performance under a high load, low speed operation. Usable without lubrication.
- Excellent wear resistance in such places where an oil film is difficult to be formed due to reciprocating, oscillating motions and frequently intermittent operations.
- Remarkable resistance to corrosion and resistance to chemical attack.
- Available in various dimension standard products.



## OILES 500SP1

### Features

- The OILES 500SP1 series are self-lubricating bearings composed of high-strength brass alloy bases made with advanced casting technology and embedded solid lubricants.
- They may be combined with various types of solid lubricants.



## OILES 500SP4

### Features

- The OILES 500SP4 series are self-lubricating bearings embedded with solid lubricant and metal base that conforms to the universally-acknowledged ASTM Standards (C86300).



## OILES 500SP5

### Features

- The OILES 500SP5 series are bearings composed of special high-strength cast brass bases featuring higher strength and hardness than the 500SP1 and embedded solid lubricant.
- They demonstrate superior wear resistance under high load conditions.



## OILES 500AB

### Features

- The OILES 500AB series are highly corrosion-resistant and heat-resistant bearings composed of aluminum bronze alloy bases and embedded solid lubricant.
- Usable in seawater.

## Types of Solid Lubricants

SL types	SL Color	Major Material	Application	Temperature Range °C	Exclusive Lubricant Grease	Feature
SL401		PTFE with lead	General Use, Underwater	-40 to +60	SL-4g	Low friction at low water temperature Low friction during minute movement
SL464		PTFE, lead-free	General Use, Underwater	-40 to +80	SL-464g	
SL464LT		PTFE, lead-free	General Use, Underwater	-40 to +60	SL-464LTg	Low friction at low water temperature Low friction during minute movement

The exclusive lubricant is grease or coating agent that has the same contents as the solid lubricant embedded in the OILES 500. It is used to improve the initial stage of operation. Use grease with lithium soap thickening agent obtainable in the market in the temperature range from -40°C to +120°C (-104°F to +248°F) for the bearings with SL101. OILES 500SP1-SL464LT were tested at Powertech Labs Inc. to the USACE CERL TR 99/104 test specification and survived the performed tests.

## Service Range for 500 Series Hydro Power Plants, Dam Gates

Variation of Base Metal with Solid Lubricant	OILES 500SP1, OILES 500SP4 -SL401-SL464LT / SL464	OILES 500SP5 -SL401-SL464LT / SL464	OILES 500AB -SL401-SL464LT / SL464
Applications	General Use, Underwater	High Load, Underwater	Corrosive Condition, High Temp. Underwater
Lubrication	Dry	Dry	Dry
Service Temperature Range(°C)	-40~+60(SL401-SL464LT) -40~+80(SL403-SL464)	-40~+60(SL401-SL464LT) -40~+80(SL403-SL464)	-40~+60(SL401-SL464LT) -40~+80(SL403-SL464)
P max. N/mm <sup>2</sup> {kgf/cm <sup>2</sup> }	49(150) {500(1,530)}	73(170) {745(1,735)}	34(100) {347(1,020)}
V max. m/s{m/min}	0.25{15}	0.25{15}	0.25{15}
PV max. N/mm <sup>2</sup> ·m/s{kgf/cm <sup>2</sup> ·m/min}	1.65{1,010}	1.65{1,010}	1.65{1,010}
Coefficient of Friction(No ext. lube)	0.12~0.15	0.12~0.15	0.14~0.17
Coefficient of Friction(Underwater)	0.08~0.12	0.08~0.12	0.10~0.14
Minimum Shaft Hardness	HB180	HB180	HB180
Shaft Surface Roughness	Ra 1.6μm	Ra 1.6μm	Ra 1.6μm

Note: Static allowable pressure: pressure in ( ) is allowable pressure in the condition with no sliding or with sliding at quite low speed, which is 0.0017 m/s(0.1m/min) or less.

## Mechanical Properties for 500 Series

Type of Base Metal		OILES 500SP1	OILES 500SP4	OILES 500SP5	OILES 500AB	
Density	-	g/cm <sup>3</sup>	7.8	7.8	7.8	7.6
Tensile Strength	JIS Z 2241	N/mm <sup>2</sup> {kgf/mm <sup>2</sup> }	755{77}	755{77}	785{80}	590{60}
Tensile Elongation at Break	JIS Z 2241	%	12	12	10	15
Compressive Strength	-	N/mm <sup>2</sup> {kgf/mm <sup>2</sup> }	345{35} (note)	345{35} (note)	390{40} (note)	240{24} (note2)
Hardness	JIS Z 2243	-	HB210	HB223	HB235	HB160
Modulus of Longitudinal Elasticity	JIS Z 2241	N/mm <sup>2</sup> {kgf/mm <sup>2</sup> }	105,000{10,700}	105,000{10,700}	98,000{10,000}	108,000{11,000}
Coefficient of Linear Expansion	-	×10 <sup>-6</sup> °C <sup>-1</sup>	2.12	2.2	2.13	1.6
Applicable Material Standard	-	-	High-strength brass	ASTM B22 C86300	Special high-strength brass	Aluminum bronze

Note : Compressive strength is 0.1%.  
Note2: Compressive strength is 0.2%.

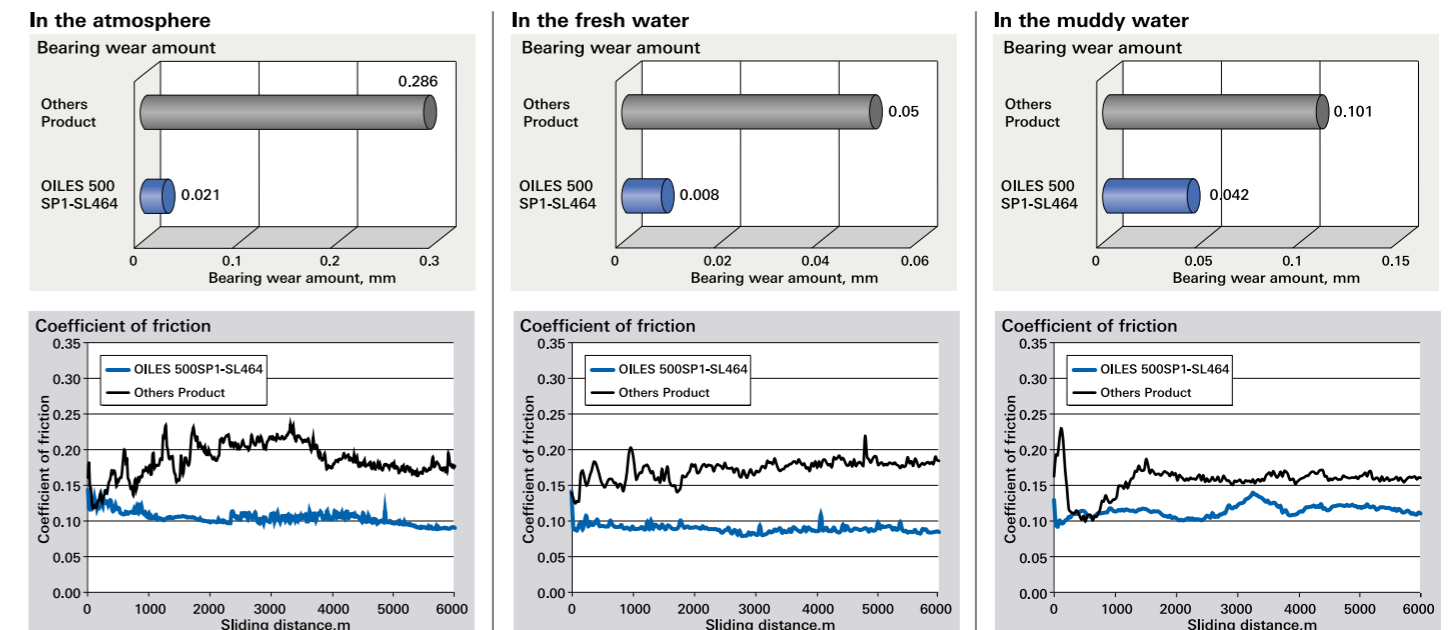
## OILES 500 Series Test Data

There are many companies who are manufacturing and selling bronze cast bearings embedded with solid lubricant in the market. You can not easily distinguish each bearing by appearance. When you select bearings, considering how you could lower coefficient of friction to suppress drive force and how you could minimize the wear amount for using long life is the important factor. This test was performed to indicate the difference in performance between OILES and other products.

Test Condition	Test environment		
	In the atmosphere	In the fresh water	In the muddy water *
Mode of motion	Mating shaft rotation		
Mating shaft material	X5CrNi18-10 (ISO/DIN), 304 (AISI), SUS304 (JIS)		
Bearing dimensions	ID 60 x OD 75 x L 50 mm		
Contact pressure	23 MPa		
Sliding velocity	8.34 x 10 <sup>-3</sup> m/s		
Rotational velocity	2.65 rpm		
Lubricant	Initial greasing		

\*JIS test powders 1, Class 7 (JIS Z 8901), 0.1wt%

## Journal Oscillation Test

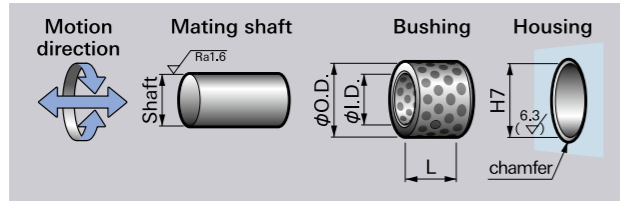


Other product :Copper alloy bearing with embedded solid lubricants from other supplier. Similar design to OILES 500.



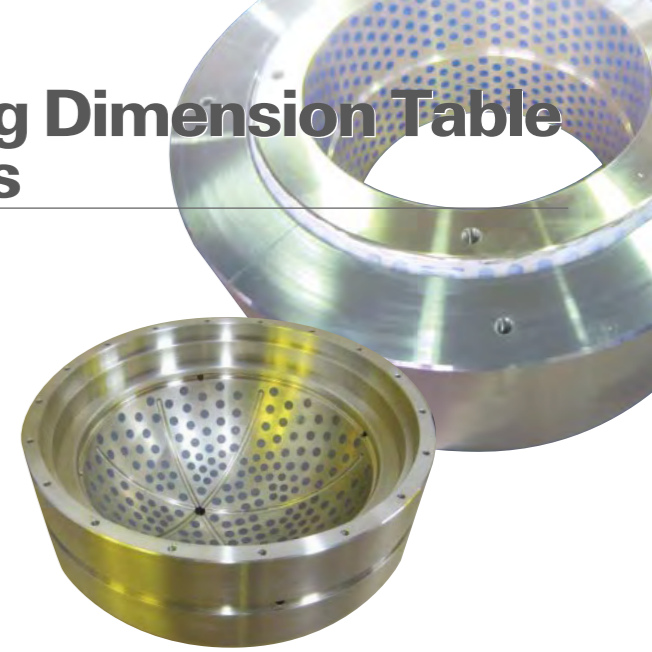
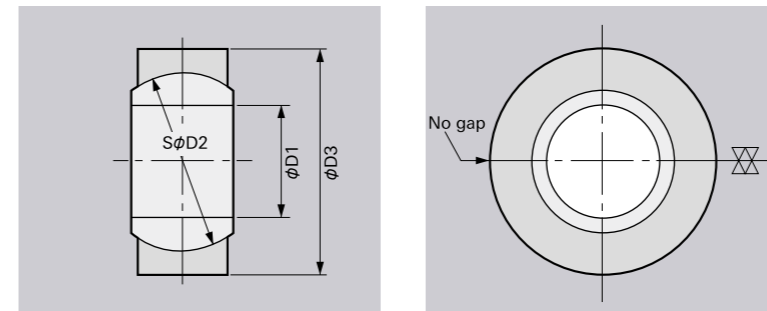
# OILES 500 Dimension Table for Dams, Gates and Locks

How to install	Interference fit
Tolerance of housing bore	H7
Tolerance of bushing inner diameter	See below chart
Tolerance of bushing outer diameter	See below chart
Tolerance of shaft diameter	h7
Surface roughness of bushing	Ra 1.6 - 6.3 $\mu\text{m}$
Surface roughness of shaft	Ra 1.6 $\mu\text{m}$ or less



# OILES 500 Spherical Bearing Dimension Table for Dams, Gates and Locks

(Split outer race type with I.D. of up to  $\phi 1,250\text{mm}$ )



Fitting standard table for water gate application (OILES 500SP1-SL464 / OILES 500SP1-SL464LT) (unit : mm)

Bushing dimension (Note)			Shaft diameter (h7)		Bushing I.D. before fitting		Bushing I.D. after fitting (Reference)		Bushing O.D. before fitting		Housing bore (H7)		Interference between bushing O.D. and housing (Reference)		Clearance between bushing I.D. and shaft (Reference)	
Inner diameter	Wall thickness	Outer diameter	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
			up to 10	1.5 - 6.0	up to 10 above 10, up to 18	0	-0.015	+0.097	+0.075	+0.082	+0.060	+0.034	+0.019	+0.015	0	+0.034
above 10, up to 18	2.0 - 6.5	above 10, up to 18 above 18, up to 30	0	-0.018	+0.142	+0.115	+0.124	+0.097	+0.041	+0.023	+0.018	0	+0.041	+0.005	+0.142	+0.097
above 18, up to 30	3.0 - 7.0	above 18, up to 30 above 30, up to 50	0	-0.021	+0.195	+0.162	+0.173	+0.140	+0.049	+0.028	+0.021	0	+0.049	+0.007	+0.194	+0.140
above 30, up to 50	4.5 - 8.0	above 30, up to 50 above 50, up to 80	0	-0.025	+0.266	+0.227	+0.239	+0.200	+0.059	+0.034	+0.025	0	+0.059	+0.009	+0.264	+0.200
above 50, up to 80	7.0 - 10.0	above 50, up to 80 above 80, up to 120	0	-0.030	+0.360	+0.314	+0.326	+0.280	+0.073	+0.041	+0.030	0	+0.073	+0.011	+0.356	+0.280
above 80, up to 120	8.0 - 12.5	above 80, up to 120 above 120, up to 180	0	-0.035	+0.468	+0.414	+0.426	+0.372	+0.089	+0.051	+0.035	0	+0.089	+0.016	+0.461	+0.372
above 120, up to 180	12.0 - 16.0	above 120, up to 180 above 180, up to 250	0	-0.040	+0.595	+0.532	+0.543	+0.480	+0.108	+0.063	+0.040	0	+0.108	+0.023	+0.583	+0.480
above 180, up to 250	14.0 - 20.0	above 180, up to 250 above 250, up to 315	0	-0.046	+0.736	+0.664	+0.672	+0.600	+0.130	+0.077	+0.046	0	+0.130	+0.031	+0.718	+0.600
above 250, up to 315	16.0 - 24.0	above 250, up to 315 above 315, up to 400	0	-0.052	+0.838	+0.757	+0.761	+0.680	+0.150	+0.094	+0.052	0	+0.150	+0.042	+0.813	+0.680
above 315, up to 400	17.0 - 29.0	above 315, up to 400 above 400, up to 500	0	-0.057	+0.943	+0.854	+0.854	+0.765	+0.171	+0.108	+0.057	0	+0.171	+0.051	+0.911	+0.765
above 400, up to 500	21.0 - 35.0	above 400, up to 500 above 500, up to 630	0	-0.063	+1.085	+0.988	+0.982	+0.885	+0.195	+0.126	+0.063	0	+0.195	+0.063	+1.045	+0.885
above 500, up to 630	23.0 - 38.0	above 500, up to 630 above 630, up to 800	0	-0.070	+1.212	+1.102	+1.050	+0.940	+0.235	+0.158	+0.070	0	+0.235	+0.088	+1.120	+0.940
above 630, up to 800	25.5 - 41.0	above 630, up to 800 above 800, up to 1000	0	-0.080	+1.291	+1.166	+1.095	+0.970	+0.280	+0.192	+0.080	0	+0.280	+0.112	+1.175	+0.970
above 800, up to 1000	28.0 - 45.0	above 800, up to 1000 above 1000, up to 1250	0	-0.090	+1.385	+1.245	+1.150	+1.010	+0.329	+0.230	+0.090	0	+0.329	+0.140	+1.240	+1.010
above 1000, up to 1250	31.5 - 50.0	above 1000, up to 1250 above 1250, up to 1600	0	-0.105	+1.490	+1.325	+1.205	+1.040	+0.395	+0.280	+0.105	0	+0.395	+0.175	+1.310	+1.040

Note : As for the products with other dimension or thickness, please contact us for inquiry.

(unit:mm)

Bearing Nominal Dimension (D1)	Recommended Shaft (h7)	I.D. Tolerance (D1)		Clearance		Inner Race O.D. Tolerance (D2)						Recommended O.D. Tolerance		Interference				
		Max.	Min.	Max.	Min.	Outer Race I.D.	Inner Race O.D.(e8)	Clearance	Hole (H7)	(D3)p7	Max.	Min.	Max.	Min.				
above 10, up to 14	0	-0.018	0.124	0.097	0.142	0.097	0.049	0.022	-0.032	-0.059	0.086	0.032	0.021	0	0.043	0.022	0.043	0.001
above 14, up to 18	0	-0.018	0.124	0.097	0.142	0.097	0.055	0.022	-0.040	-0.073	0.106	0.040	0.021	0	0.043	0.022	0.043	0.001
above 18, up to 24	0	-0.018	0.124	0.097	0.142	0.097	0.051	0.026	-0.050	-0.089	0.114	0.050	0.025	0	0.051	0.026	0.051	0.001
above 24, up to 30	0	-0.021	0.173	0.140	0.194	0.140	0.059	0.026	-0.040	-0.073	0.106	0.040	0.025	0	0.051	0.026	0.051	0.001
above 30, up to 40	0	-0.021	0.173	0.140	0.194	0.140	0.065	0.026	-0.050	-0.089	0.128	0.050	0.030	0	0.062	0.032	0.062	0.002
above 40, up to 50	0	-0.025	0.239	0.200	0.264	0.200	0.065	0.026	-0.050	-0.089	0.128	0.050	0.025	0	0.051	0.026	0.051	0.001
above 50, up to 65	0	-0.025	0.239	0.200	0.264	0.200	0.078	0.032	-0.060	-0.106	0.152	0.060	0.030	0	0.062	0.032	0.062	0.002
above 65, up to 80	0	-0.025	0.239	0.200	0.264	0.200	0.078	0.032	-0.060	-0.106	0.152	0.060	0.030	0	0.062	0.032	0.062	0.002
above 80, up to 100	0	-0.025	0.239	0.200	0.264	0.200	0.091	0.037	-0.072	-0.126	0.180	0.072	0.035	0	0.072	0.037	0.072	0.002
above 100, up to 120	0	-0.030	0.326	0.280	0.356	0.280	0.078	0.032	-0.060	-0.106	0.152	0.060	0.030	0	0.062	0.032	0.062	0.002
above 120, up to 150	0	-0.030	0.326	0.280	0.356	0.280	0.091	0.037	-0.072	-0.126	0.180	0.072	0.035	0	0.072	0.037	0.072	0.002
above 150, up to 200	0	-0.030	0.326	0.280	0.356	0.280	0.106	0.043	-0.085	-0.148	0.211	0.085	0.040	0	0.083	0.043	0.083	0.003
above 200, up to 250	0	-0.035	0.426	0.372	0.461	0.372	0.097	0.043	-0.072	-0.126	0.180	0.072	0.040	0	0.083	0.043	0.083	0.003
above 250, up to 315	0	-0.035	0.426	0.372	0.461	0.372	0.106	0.043	-0.085	-0.148	0.211	0.085	0.040	0	0.083	0.043	0.083	0.003
above 315, up to 400	0	-0.035	0.426	0.372	0.461	0.372	0.122	0.050	-0.100	-0.172	0.244	0.100	0.046	0	0.096	0.050	0.096	0.004
above 400, up to 500	0	-0.040	0.543	0.480	0.583	0.480	0.113	0.050	-0.085	-0.148	0.211	0.085	0.046	0	0.096	0.050	0.096	0.004
above 500, up to 630	0	-0.040	0.543	0.480	0.583	0.480	0.128	0.056	-0.100	-0.172	0.244	0.100	0.052	0	0.108	0.056	0.108	0.004
above 630, up to 800	0	-0.046	0.672	0.600	0.718	0.600	0.137	0.056	-0.110	-0.191	0.272	0.110	0.052	0	0.108	0.056	0.108	0.004
above 800, up to 1000	0	-0.046	0.672	0.600	0.718	0.600	0.151	0.062	-0.125	-0.214	0.303	0.125	0.057	0	0.119	0.062	0.119	0.005
above 1000, up to 1250	0	-0.052	0.761	0.680	0.813	0.680	0.151	0.062	-0.125	-0.214	0.303	0.125	0.057	0	0.119	0.062	0.119	0.005
above 1250, up to 1600	0	-0.052	0.761	0.680	0.813	0.680	0.165	0.068	-0.135	-0.232	0.329	0.135	0.063	0	0.131	0.068	0.131	0.005
above 1600, up to 2000	0	-0.057	0.854	0.765	0.911	0.765	0.165	0.068	-0.135	-0.232	0.329	0.135	0.063	0	0.131	0.068	0.131	0.005
above 2000, up to 2500	0	-0.063	0.982	0.885	1.045	0.885	0.188	0.078	-0.145	-0.255	0.365	0.145	0.070	0	0.148	0.078	0.148	0.008
above 2500, up to 3150	0	-0.063	0.982	0.885	1.045	0.885	0.213	0.088	-0.160	-0.285	0.410	0.160	0.080	0	0.168	0.088	0.168	0.008
above 3150, up to 4000	0	-0.070	1.050	0.940	1.120	0.940	0.198	0.088	-0.145	-0.255	0.365	0.145	0.080	0	0.168	0.088	0.168	0.008
above 4000, up to 5000	0	-0.070	1.050	0.940	1.120	0.940	0.225	0.100	-0.160	-0.285	0.410	0.160	0.090	0	0.190	0.100	0.190	0.010
above 5000, up to 6300	0	-0.080	1.095	0.970	1.175	0.970	0.225	0.100	-0.160	-0.285	0.410	0.160	0.090	0	0.190	0.100	0.190	0.010
above 6300, up to 8000	0	-0.080	1.095	0.970	1.175	0.970	0.260	0.120	-0.170	-0.310	0.450	0.170	0.105	0	0.225	0.120	0.225	0.015
above 8000, up to 10000	0	-0.090	1.150	1.010	1.240	1.010	0.305	0.140	-0.195	-0.360	0.525	0.195	0.125	0	0.265	0.140	0.265	0.015
above 10000, up to 12500	0	-0.090	1.150	1.010	1.240	1.010	0.365	0.170	-0.220	-0.415	0.610	0.220	0.150	0	0.320	0.170	0.320	0.020
above 12500, up to 16000	0	-0.105	1.205	1.040	1.310	1.040	0.305	0.140	-0.195	-0.360	0.525	0.195	0.125	0	0.265	0.140	0.265	0.015
above 16000, up to 20000	0	-0.105	1.205	1.040	1.310	1.040	0.365	0.170	-0.220	-0.415	0.610	0.220	0.150	0	0.320	0.170	0.320	0.020

Note : I.D. dimension of outer race is H8 after the bearing installed into a housing.

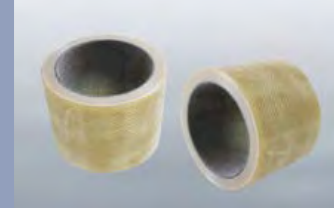


# OILES Plastic Composite Bearings

OILES has developed and selected the optimum plastic material for Hydro Power applications. Our material consists of hydrophilic resin and special lubricants to improve bearing performance.

## Material Introduction

### For Wicket Gate



### Fiberflon OH

#### Features

- Fiberflon OH is a special fiber and phenol resin based bearing for both dry and underwater applications.
- Fiberflon OH consists of two layers; phenol resin based layer and fiber glass layer.
- Creep deformation is minimal. This material is suited for wicket gate bushings and deliver superior sliding characteristics in microscopic oscillation.
- The bush can be inserted into housing by press fit.
- It's possible to manufacture bearings up to 800mm in inside diameter.

### For Main Shaft



### Fiberflon OS

#### Features

- Fiberflon OS is a special fiber and phenol resin based water-lubricated bearing for high speed underwater application.
- Dimensional stability is greatly improved compared to longstanding conventional product as a main shaft bearing for water turbines, realizing a smaller swelling rate, superior water lubrication characteristics and low friction.
- Under abrasive wear condition, Fiberflon OS demonstrates stable friction characteristics without major cracks on the sliding surface and is suited for main shaft bearing of water turbines.
- It's also possible to manufacture segment bearing.

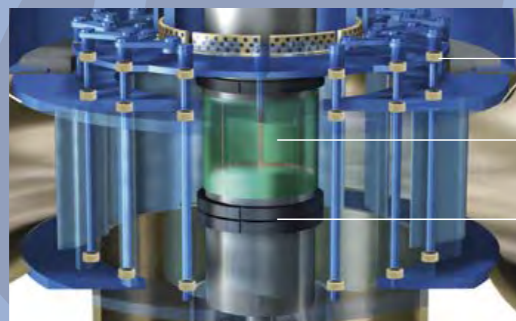
### For Sealing Packing



### OILES 470-02

#### Features

- OILES 470 is a fiber-reinforced phenol resin water-lubricated bearing.
- Hydrophilic phenol resin helps form a water film to perform superior water lubrication characteristics.
- Under abrasive wear condition, OILES 470 demonstrates stable friction characteristics using a special fiber.
- Many of the applications suited for OILES 470 require high wear resistance such as a sealing packing.
- It's also possible to manufacture segment bearing.



Fiberflon OH

Fiberflon OS

OILES 470-02  
(Segment bearing)

### Service Range

	Fiberflon OH	Fiberflon OS	470-02
Atmosphere	Underwater/dry	Underwater	Underwater
Service Temperature Range (°C)	-40~+120	-40~+90	-40~+90
Allowable Max. Pressure (N/mm <sup>2</sup> {kgf/cm <sup>2</sup> })	49{500} (100)	10{102}	15{153}
Allowable Max. Velocity (m/s{m/min})	0.15{9}	20{1,200}	16.5{990}
Allowable Max. PV Value (N/mm <sup>2</sup> ·m/s{kgf/cm <sup>2</sup> ·m/min})	1.2{735}	10{6,120}*	8.15{4,990}

Note : Static allowable pressure: pressure in ( ) is allowable pressure in the condition with no sliding or with sliding at quite low speed, which is 0.0017 m/s{0.1m/min} or less.

\* reference valve

# OILES Plastic Composite Bearings

## Mechanical Properties

			Fiberflon OH*	Fiberflon OS	470-02
Specific Gravity	JIS K 6911	—	1.7	1.4	1.4
Tensile Strength	JIS K 6911	N/mm <sup>2</sup>	165	76	45{4.6}
Flexural Property	JIS K 6911	N/mm <sup>2</sup>	127	101	75{7.7}
Compressive Strength	JIS K 6911	N/mm <sup>2</sup>	238	252	124{12.7}
Hardness	JIS K 6911	—	HRM60	HRM104	HRM103
Modulus of Longitudinal Elasticity	—	kgf/mm <sup>2</sup>	240 (sliding layer) 1000 (back layer)	—	—
Coefficient of Linear Expansion	ASTM D 696	×10 <sup>-5</sup> °C <sup>-1</sup>	5~8	6~7	2~2.5
Swelling Rate of thickness(25°C) (reference value)	—	%	0.35	0.15	1.0

\*Value for Fiberflon OH includes fiberglass layer.

## OILES Fiberflon Test Data

Plastic composite bearings are being manufactured and sold by many companies and you can not judge the performance by appearance.

It is important to select bearings with low wear amount and maintaining stable coefficient of friction under variable using conditions, such as oscillation angle, atmosphere, water, velocity and operating time.

This test indicates the difference in performance between OILES and similar plastic composite bearing.

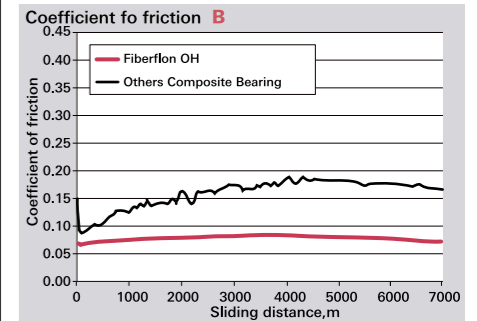
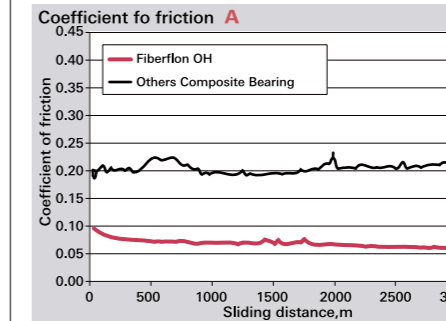
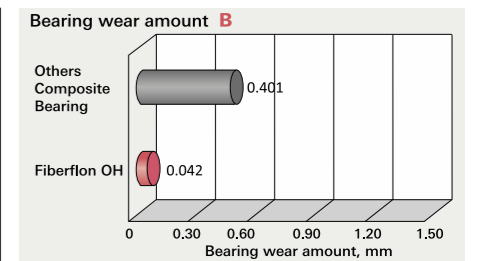
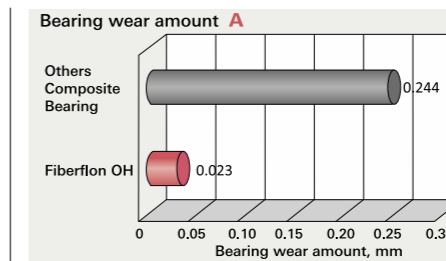
#### Test Condition

Test environment	In the atmosphere	In the fresh water
Mode of motion	Mating shaft oscillation	
Mating shaft material	403(AISI), SUS403(JIS)	
Bearing dimensions	ID 60 x OD 75 x L 50 mm	
Contact pressure	24.5 N/mm <sup>2</sup>	
Lubrication	Non-lubricating	

## Table 1 Test Condition & Result

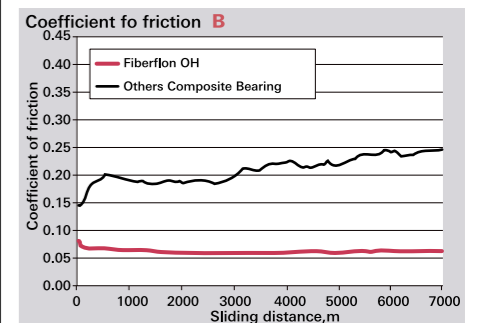
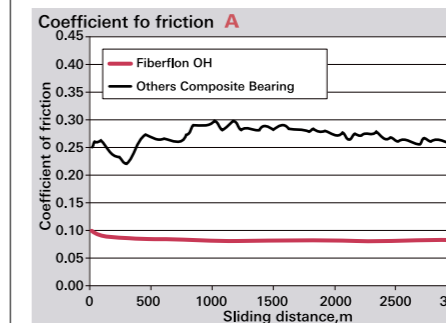
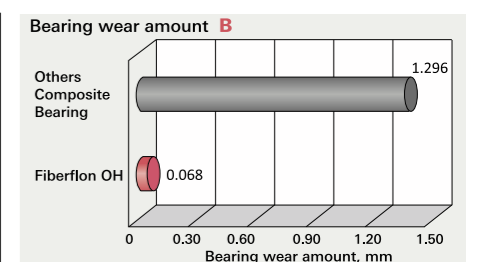
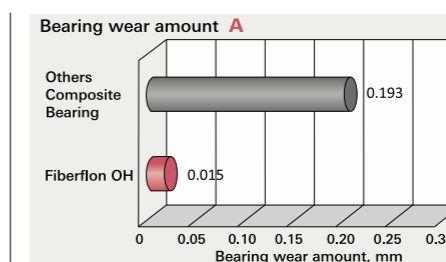
### In the atmosphere

Test Condition	A	B
Oscillation Angle	±2°	±45°
Sliding Velocity	8.38 x 10 <sup>-3</sup> m/s	1.88 x 10 <sup>-2</sup> m/s
Sliding Distance	3,000m	7,000m



### In the fresh water

Test Condition	A	B
Oscillation Angle	±2°	±45°
Sliding Velocity	8.38 x 10 <sup>-3</sup> m/s	1.88 x 10 <sup>-2</sup> m/s
Sliding Distance	3,000m	7,000m



# Corrosion Resistance

Corrosion resistance of base resin and base metal used for OILES Bearings.

A : Excellent B : Good C : Fair D : No Resistance - : No Data

Classification	Metallic Bearings		Plastic Composite Bearings		
	High Strength Brass Casting	Aluminum Bronze	FF-OH	FF-OS	470-02
Base Metal					
Product	500SP1/500SP4/500SP5	500AB			
Acid	40% to 80% Sulfuric Acid	D	B	B	B
	80% to 95% Sulfuric Acid	D	C	C	C
	Hydrochloric Acid	D	C	B	B
	Nitric Acid	D	D	-	A
	Phosphoric Acid	D	B	A	A
	Chromic Acid	D	D	B	B
	Lactic Acid	D	B	A	A
	Hydrogen Peroxide	C	B	C	C
	Chlorine (moist)	D	C	C	C
	Chlorine (dry)	A	A	-	-
Alkaline	Ammonia (moist)	D	D	A	A
	Ammonia (dry)	A	A	A	A
	Ferrous Chloride	D	B	A	A
	Calcium Chloride	D	B	A	A
	Sulfur (moist)	D	D	A	A
	Sulfur (dry)	A	B	A	A
Solvent	Calcium Hydroxide	B	A	C	C
	Methanol	A	A	C	C
	Acetone	A	A	A	A
	Toluene	A	A	-	-
Oil, Water, Others	Ethylene Glycol	B	A	A	A
	Lubricating Oil	A	A	A	A
	Water	B	A	A	A
	Sea Water	C	B	A	A

# Mating Materials

## Mating Materials for Normal Applications

Japan JIS	International ISO	Europe EN	Germany DIN	USA AISI	UNS	France NF	UK BS	China GB
S45C	C45	1.0503	C45	1045	G10450	C45	C45	45
SNC415	-	1.5732	14NiCr10	3415	-	14NC11	-	-
SCM430	-	1.7218	-	4131	G41310	-	-	30CrMo
SCM435	34CrMo4	1.722	34CrMo4	4137	G41370	34CrMo4	34CrMo4	35CrMo
SCM440	42CrMo4	1.7225	42CrMo4	4140	G41400	42CrMo4	42CrMo4	42CrMo

## Mating Materials for Corrosive Applications

Japan JIS	International ISO	Europe EN	Germany DIN	USA AISI	UNS	France NF	UK BS	China GB
SUS304	X5CrNi18-10	1.4301	X5CrNi18-10	304	S30400	Z7CN18-09	304S31	0Cr18Ni9
SUS403	-	-	-	403	S40300	-	-	-
SUS 420J1	X20Cr13	1.4021	X20Cr13	420	S42000	Z20C13	420S29	2Cr13
SUS420J2	X30Cr13	1.4028	X30Cr13	420	S42000	Z33C13	420S37	3Cr13
SUS 431	X17CrNi16-2	1.4057	X20CrNi17-2	431	S43100	Z15CN16-02	431S29	-
-	X35CrMo17	1.4122	X35CrMo17	-	-	-	-	-
SUS630	X5CrNiCuNb16-4	1.4542	X5CrNiCuNb16-4	630	S17400	Z6CNU17-04	-	-

## Mating Materials for Use in Seawater

Japan JIS	International ISO	Europe EN	Germany DIN	USA AISI	UNS	France NF	UK BS	China GB
SUS316	X5CrNiMo17-12-2	1.4401	X5CrNiMo17-12-2	316	S31600	Z7CND17.11-02	316S31	0Cr17Ni12Mo2
SUS316L	X2CrNiMo17-13-2	1.4404	X2CrNiMo17-13-2	316L	S31603	Z3CND17.11-02	316S11	00Cr17Ni14Mo2
SUS 329J3L	X2CrNiMoN22-5-3	1.4462	-	S31803	S32205	Z3CNDU22-05Az	-	-
-	X8CrNiMoN27-5	1.4460	-	-	-	-	-	-

# Selection of Mating Materials

Bearing performance is influenced by the material, hardness, surface roughness, surface treatment of the mating shaft, rust and foreign matter. In order to select appropriate mating material, please refer to the below.

Bearing	Contact pressure N/mm2 (kgf/cm2)	Material	Hardness	Surface roughness Ra(Ry)
Metallic Bearings	Up to 24.5(250)	Carbon steel. (S45C, SNC415, SCM435 / C45, 34CrMo4) Corrosion resistant steel. (SUS304, SUS316 / X5CrNi18-10, X5CrNiMo17-12-2)	HB150 or over	Less than 1.6a(6,3s)
	24.5(250) to 49.0(500)	Surface hardening treatment such as induction hardening and carburizing should be implemented for the materials described above.	HB250 or over	
	49.0(500) to 98.0(1,000)	In addition to surface hardening treatment as above, additional surface treatment such as nitriding treatment and hard chrome plating should be implemented.	HRC50 or over	
Plastic Bearings	Up to 49.0(500)	Carbon steel. (S45C, SNC415, SCM435/ C45, 34CrMo4) Corrosion resistant steel. (SUS304, SUS316 / X5CrNi18-10, X5CrNiMo17-12-2)	HB120 or over	Less than 0.8a(3.2s)
	49.0(500) to 98.0(1,000)	Surface treatment such as induction hardening, quenching by carburizing and hard chrome plating should be implemented for the materials described above.	HRC45 or over	

# Cooling Fit and Press Fit

## Cooling Fit

There are two methods to set OILES bearings into a housing. One is called press fit. For press fit, a mandrel and a press machine are used. The other is called cooling fit. The cooling fit uses liquid nitrogen or dry ice. Compared to press fit, cooling fit is efficient and achieves more accurate installation. Avoid shrink fitting as it may deteriorate bearing function.

## Cooling Fit Procedure

### 1. Equipment and Materials

- Refrigerant : liquid nitrogen, dry ice
- Container : Heat insulation chamber (A chamber covered with heat insulator which is large enough to accommodate bushings)

### 2. Calculation of amount of shrinkage of outer diameter of bearing caused by cooling (LD)

- Where outer diameter of bearing: D
- Where coefficient of thermal expansion of bearing : α
- Where atmospheric temperature: To
- Where cooling temperature: T1

$$\Delta D = D \times \alpha \times (T_o - T_1)$$

Thermal expansion of OILES 500SP1(SP4):  $\alpha = 2.2 \times 10^{-5}/^{\circ}\text{C}$   
 Thermal expansion of OILES 500SP5:  $\alpha = 1.8 \times 10^{-5}/^{\circ}\text{C}$   
 Thermal expansion of OILES 500AB:  $\alpha = 1.6 \times 10^{-5}/^{\circ}\text{C}$

\* For other materials, please refer to the mechanical properties of each product.

Example: Material OILES 500SP1 100 I.D. × 130 O.D. × 100 L

By cooling, temperature goes down to -70°C from 20°C

$$\Delta D = 130 \times 2.2 \times 10^{-5} \times (20 - (-70)) = 0.211 \text{ mm}$$

\*For the bearing whose diameter exceeds 500 mm, consult an OILES representative.

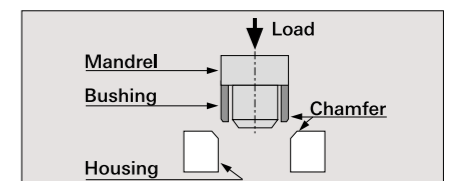
### 3. Operation Procedure

- As a cooling agent, use liquid nitrogen or dry ice. The standard cooling temperature is -40°C to -70°C.
- Cooling time should be more than one hour. Cooling time needs to be longer if the interference is larger, depending on applicable fitting tolerance. In addition to the cooling fit, press fitting should be used if cooling time needs to be shortened.
- Measure and confirm outer diameter of the bushing and inner diameter of the housing before cooling. If any defect is found during fitting, it may develop into a major trouble.
- Bushing should be inserted into the housing soon after taking it out from the cooling agent in chamber. If stopped during fitting, dimension of the bushing goes back to its original size and it is extremely difficult to withdraw the bushing from the housing and do the fitting again.
- Apply lubricant onto the sliding surface.

Note : Warm housing up to 20°C to 30°C if sufficient temperature gap could not be maintained as in winter.

## Press Fit

Usually, OILES bearings are press-fitted into the housing. For this procedure, a mandrel and a press machine are used. In case of a metallic bearing with large press fit interference, chamfer outer diameter of the bearing and inner diameter of the housing. Then use a mandrel to facilitate easier press fit.



## CAUTIONS

- The typical values of the mechanical and physical characteristics shown in this catalog conform to the corresponding JIS Standards, in principle.
- The allowable maximum bearing pressures, allowable maximum speeds, allowable maximum PV values, etc. are obtained by testing in OILES Corporation's standard bearing test methods. Contact our branch or sales offices for details.
- The contents of this catalog are as of March, 2017.
- The specifications or information in this catalog are subject to change without prior notice.

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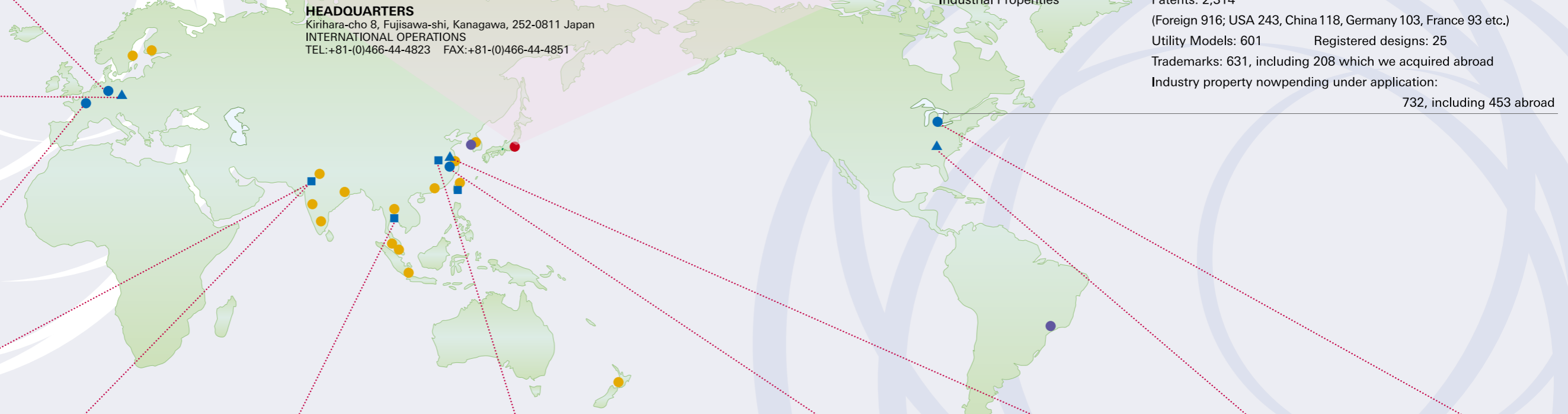


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<b>Name of Company</b>	OILES CORPORATION
<b>Incorporation</b>	March 11, 1952
<b>Capital</b>	JPY 8,585,000,000
<b>Sales Amount</b>	60.1 Billion JPY (Consolidated account, as of March 2016)
<b>Consolidated Number of Employee</b>	2,526 (as of March 2016)
<b>Industrial Properties</b>	Patents: 2,314 (Foreign 916; USA 243, China 118, Germany 103, France 93 etc.) Utility Models: 601 Registered designs: 25 Trademarks: 631, including 208 which we acquired abroad Industry property now pending under application: 732, including 453 abroad



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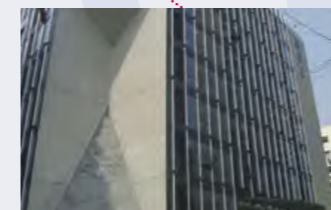
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