



PTFE/Rubber Hybrid Bearings for Dry-Start Vertical Pumps

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Outline

- Introduction of Pumps and Bearings
- Bearing Failure Analysis
- Statement of Problems & Countermeasures
- PTFE/Rubber Hybrid Bearings
- Verification & Results
- Results of Field Application
- Recommended Design
- Conclusions

Plants with Vertical Pumps



▪ Desalination Plant



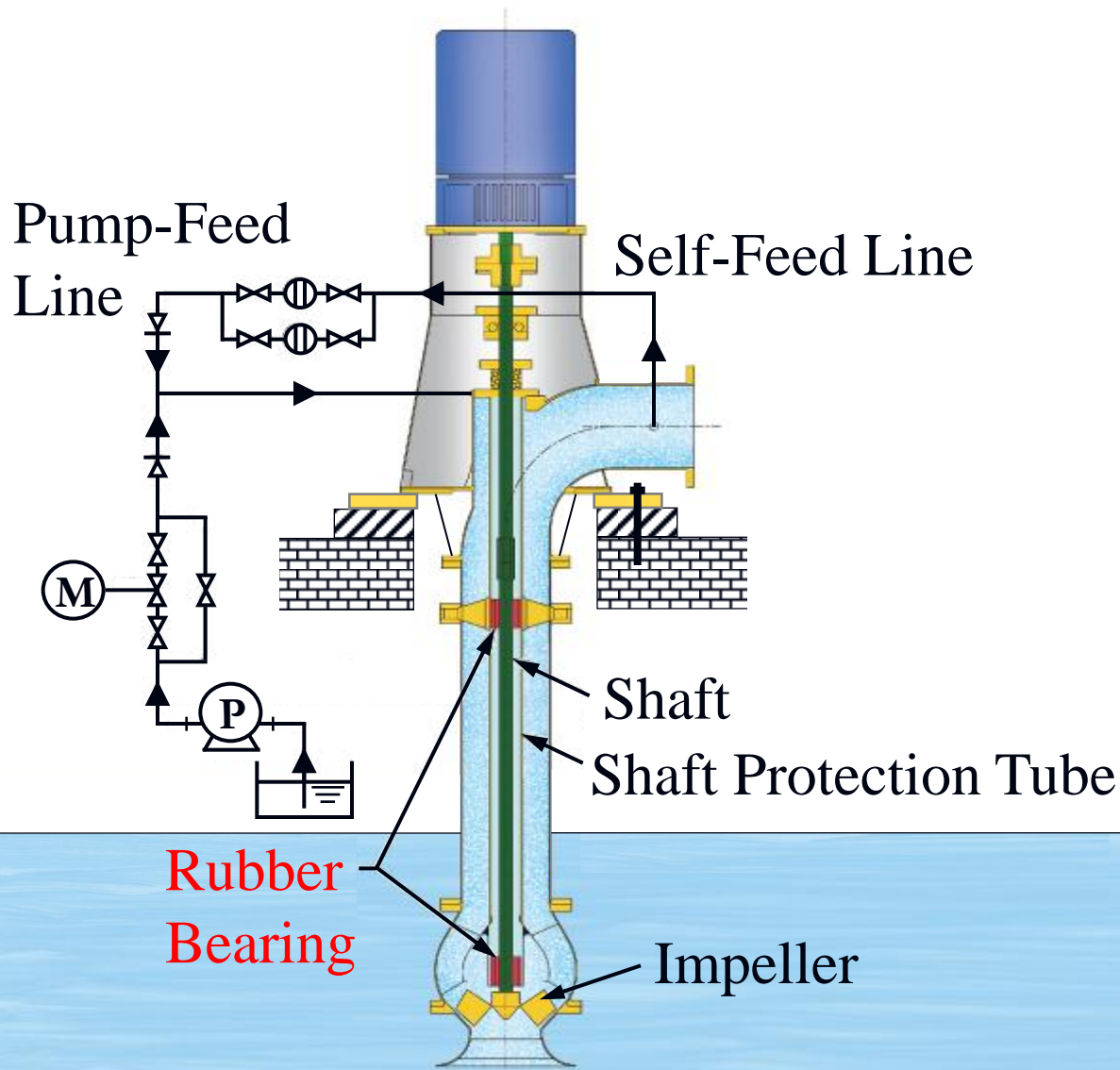
▪ Sewage & Waterworks Plant



▪ Thermal / Nuclear Power Plant

Typical Vertical Pumps

<When Using Rubber Bearings >



Advantages:

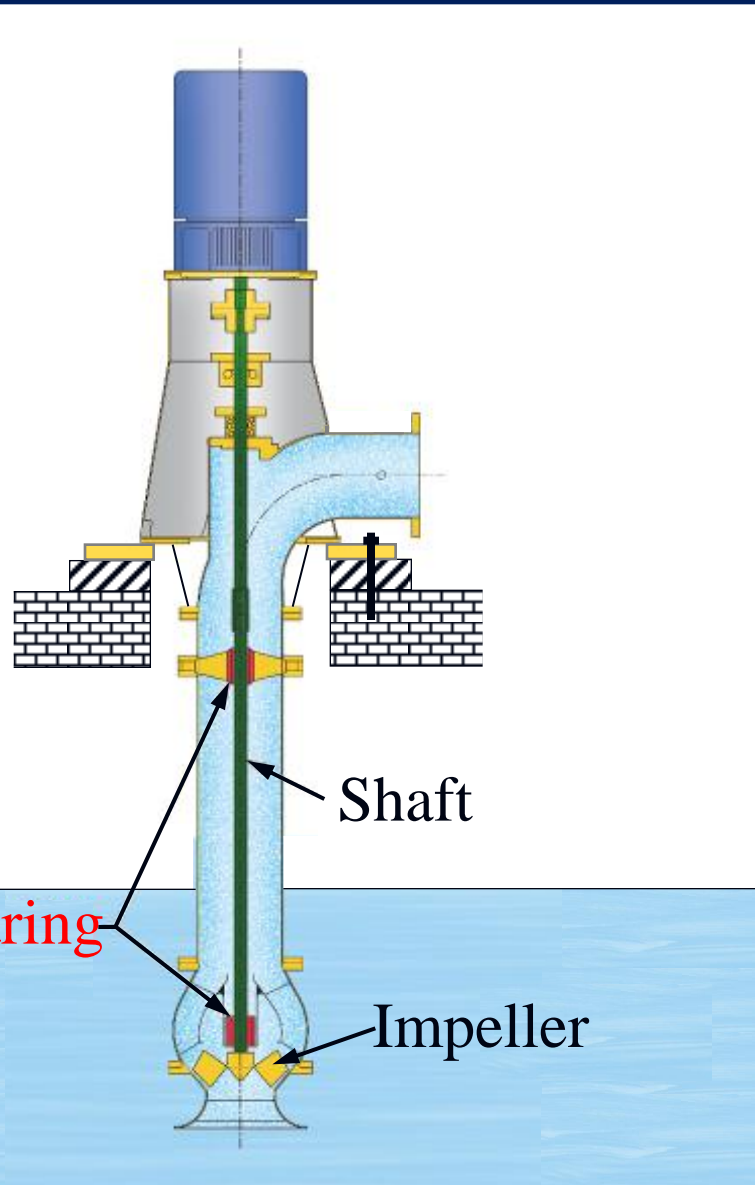
- Stable and durable under normal use
- Free from most forms of shaft vibration

Disadvantages:

- Requires feed-water line
- Maintenance for feed-water line is indispensable

Typical Vertical Pumps

<When Using Bronze Bearings >



Advantages:

- No need for a feed-water line
- Simple structure and low cost

Disadvantages:

- Risk of shaft vibration
- Risk of short life

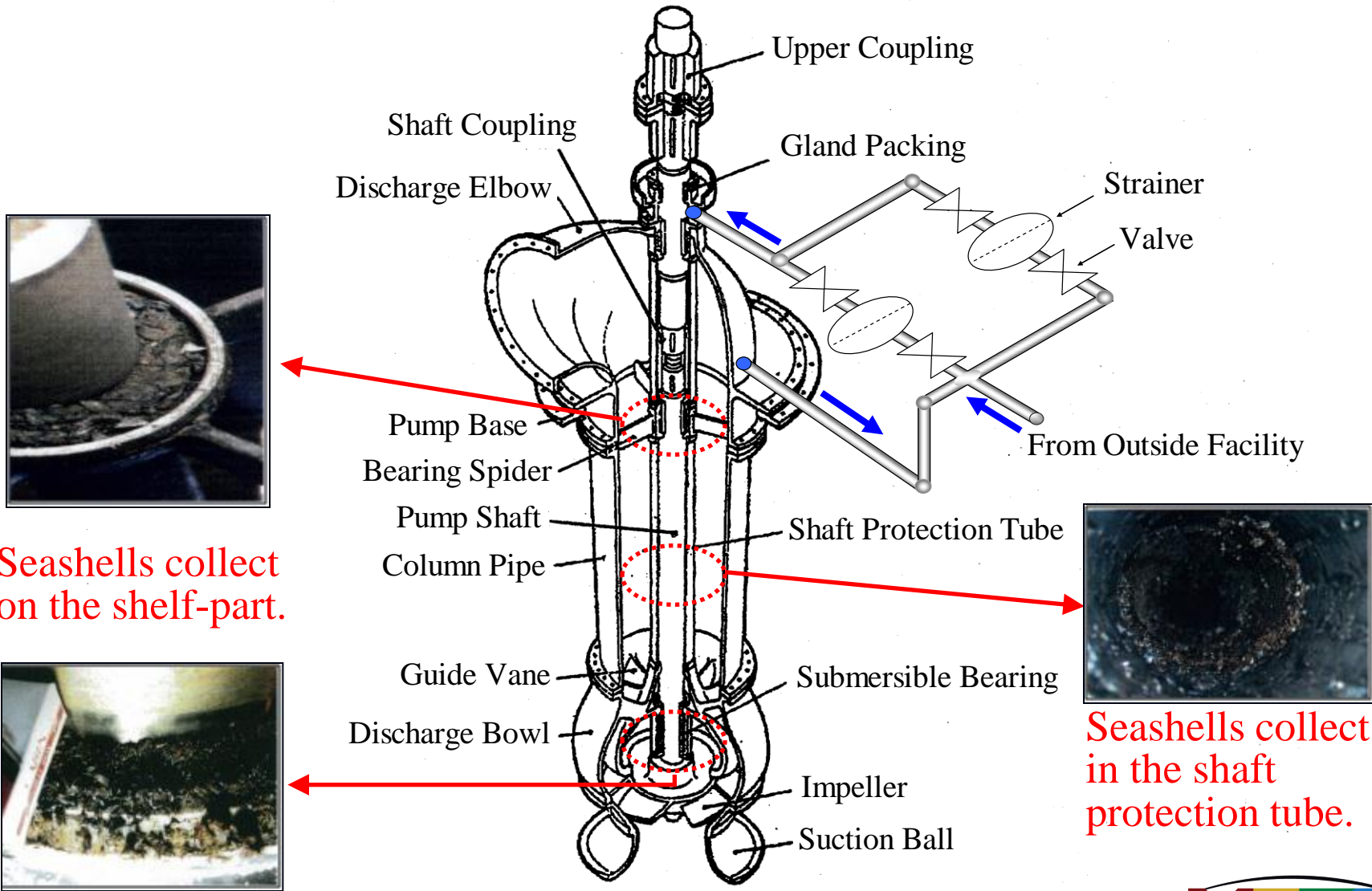
Bearing Failure Analysis

<Fishbone Diagram >

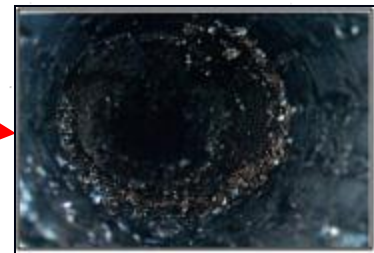


Examples of Feed Water Defects

<When Using Rubber Bearings >



Seashells collect on the shelf-part.



Seashells collect in the shaft protection tube.

Statement of Problems & Countermeasures

< Problems >

< Countermeasures >

- Corrosion of Shaft Protection Tubes and Feed Water Piping



Eliminate Protection Tubes and Feed Water Piping by adopting Dry-Start Bearings

- Maintenance trouble for feed-water line



Eliminate feed water by adopting Dry-Start Bearings

- High Wear and Seizure



Apply Low Friction Material as the Slide Member

- High Shaft Vibration



Use the Viscoelasticity of Rubber

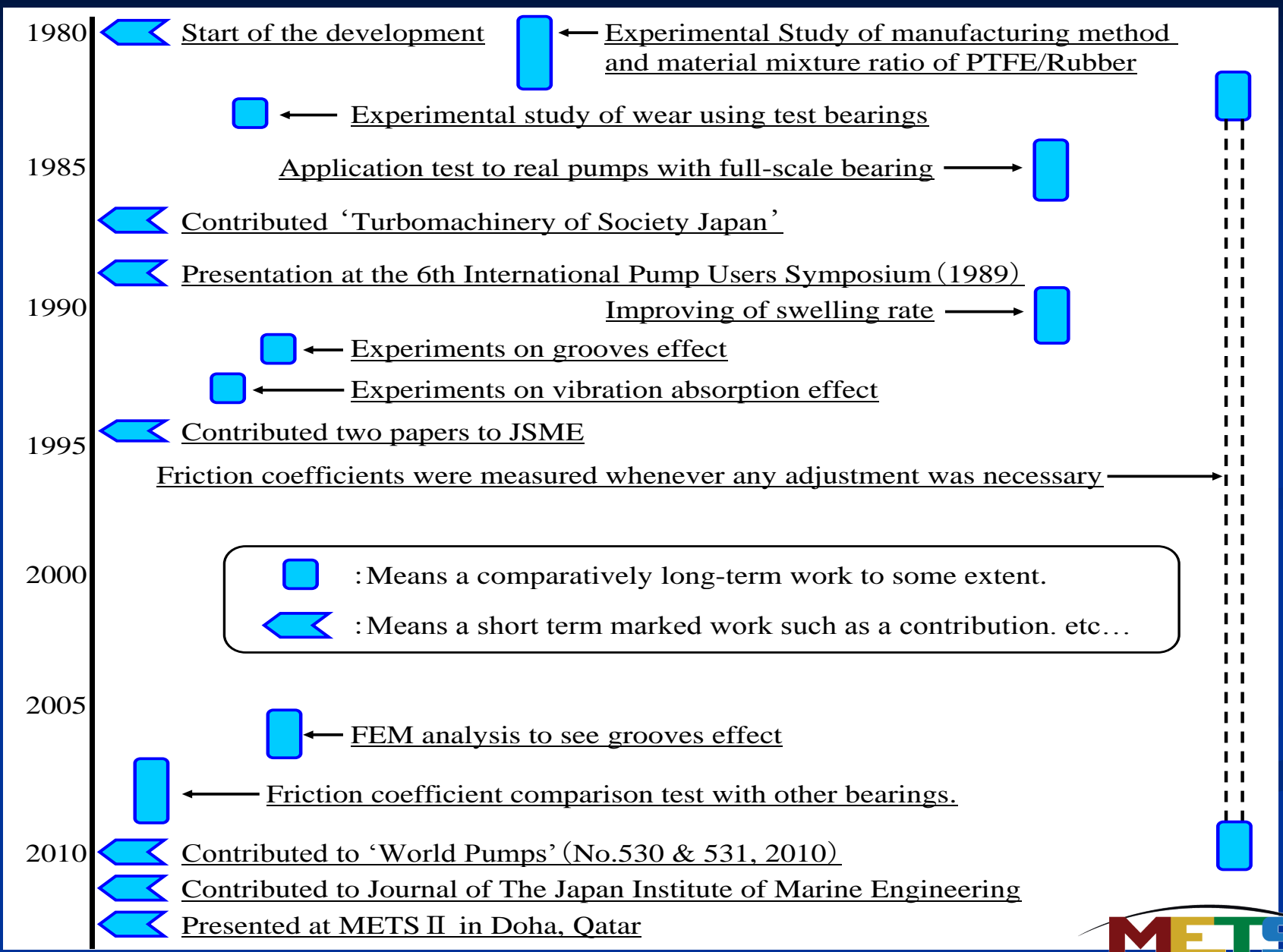
PTFE/Rubber Hybrid Bearings



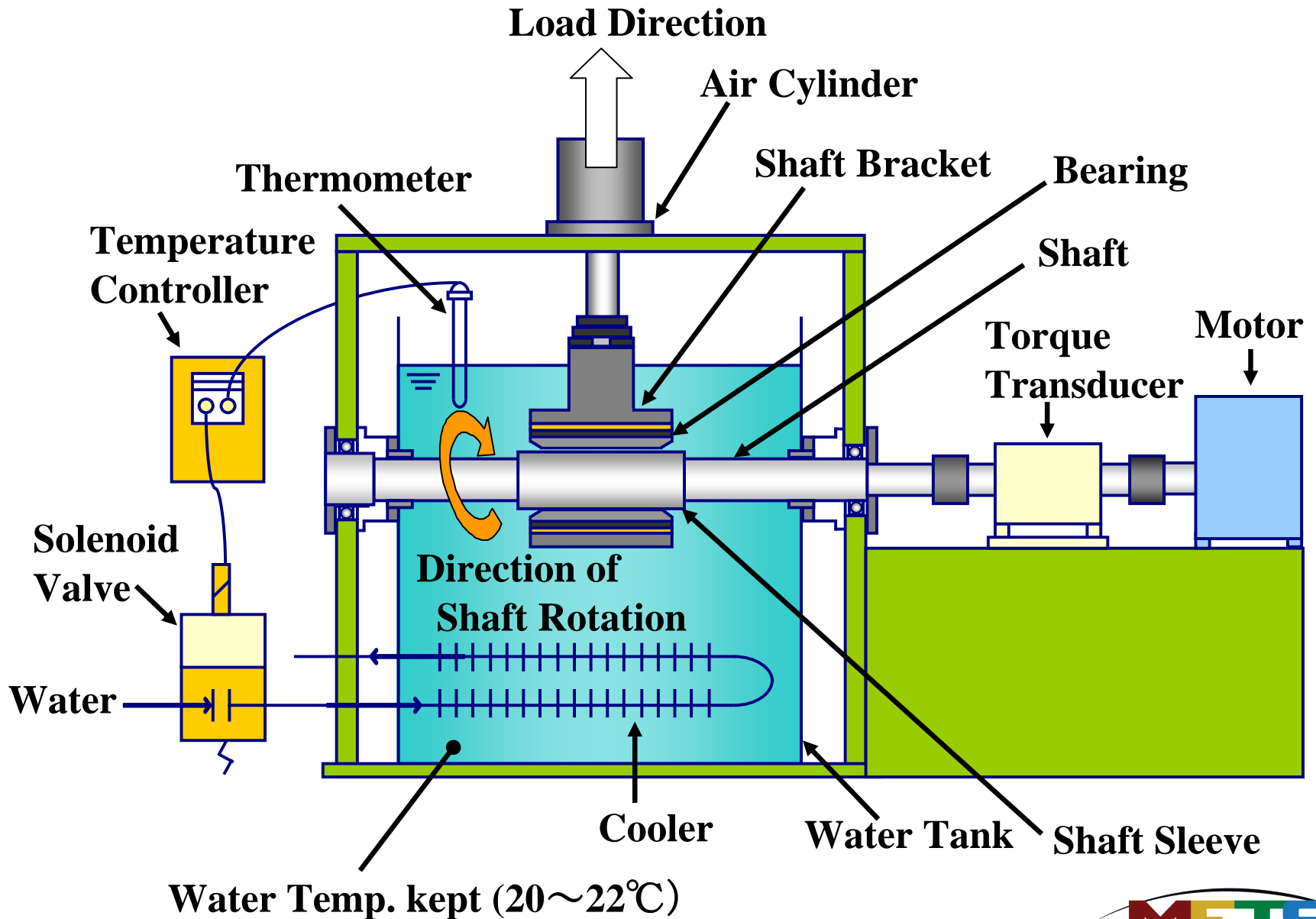
PTFE/Rubber Hybrid Bearings have a three-layer structure: strips of self-lubricating PTFE as a sliding material, elastic rubber, and a metal/resin shell.

These bearings never burn out, even when used for short periods under dry conditions at pump start-up. They also minimize shaft vibration.

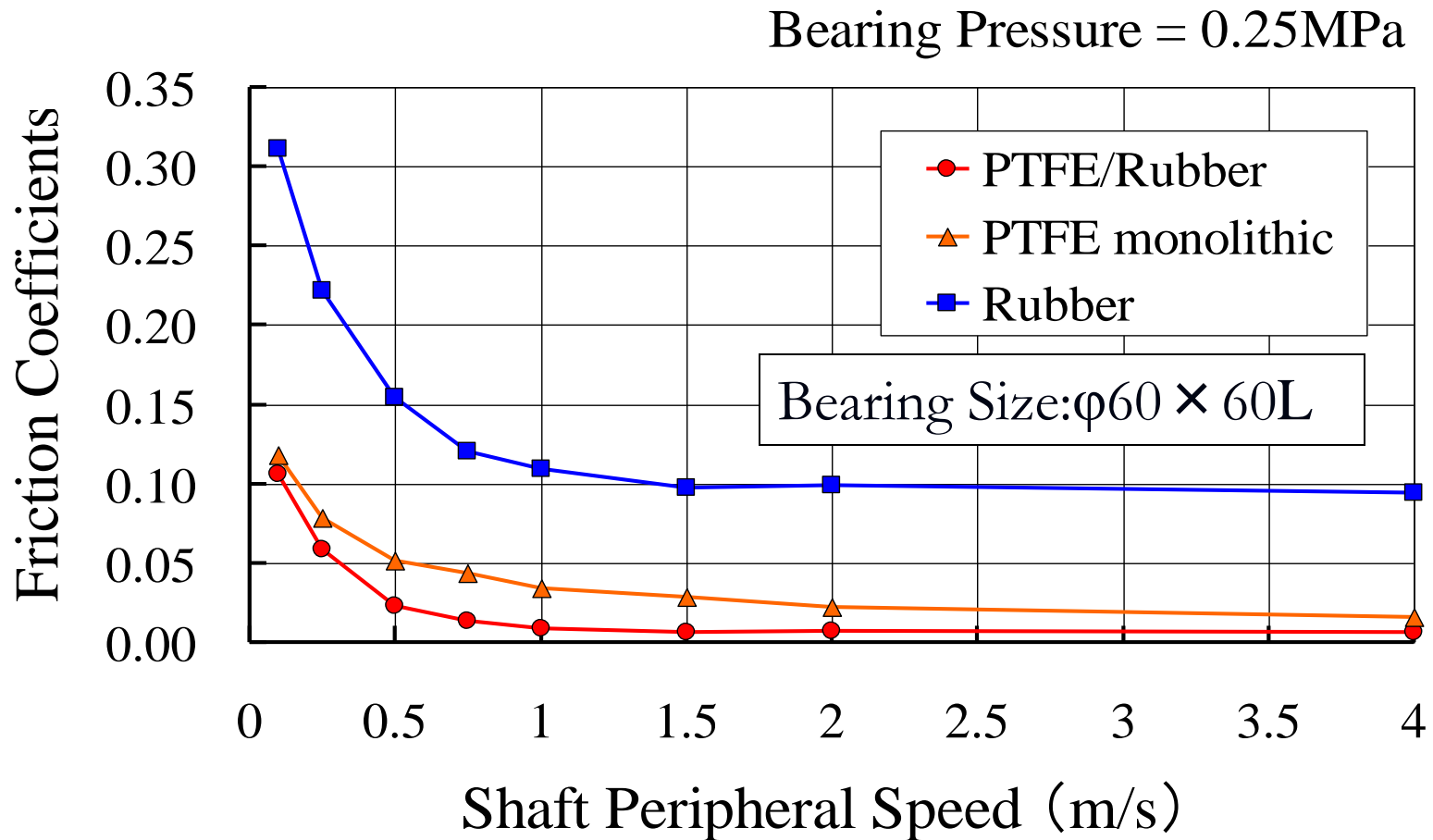
Brief History of Development



Measurement of Friction Coefficients

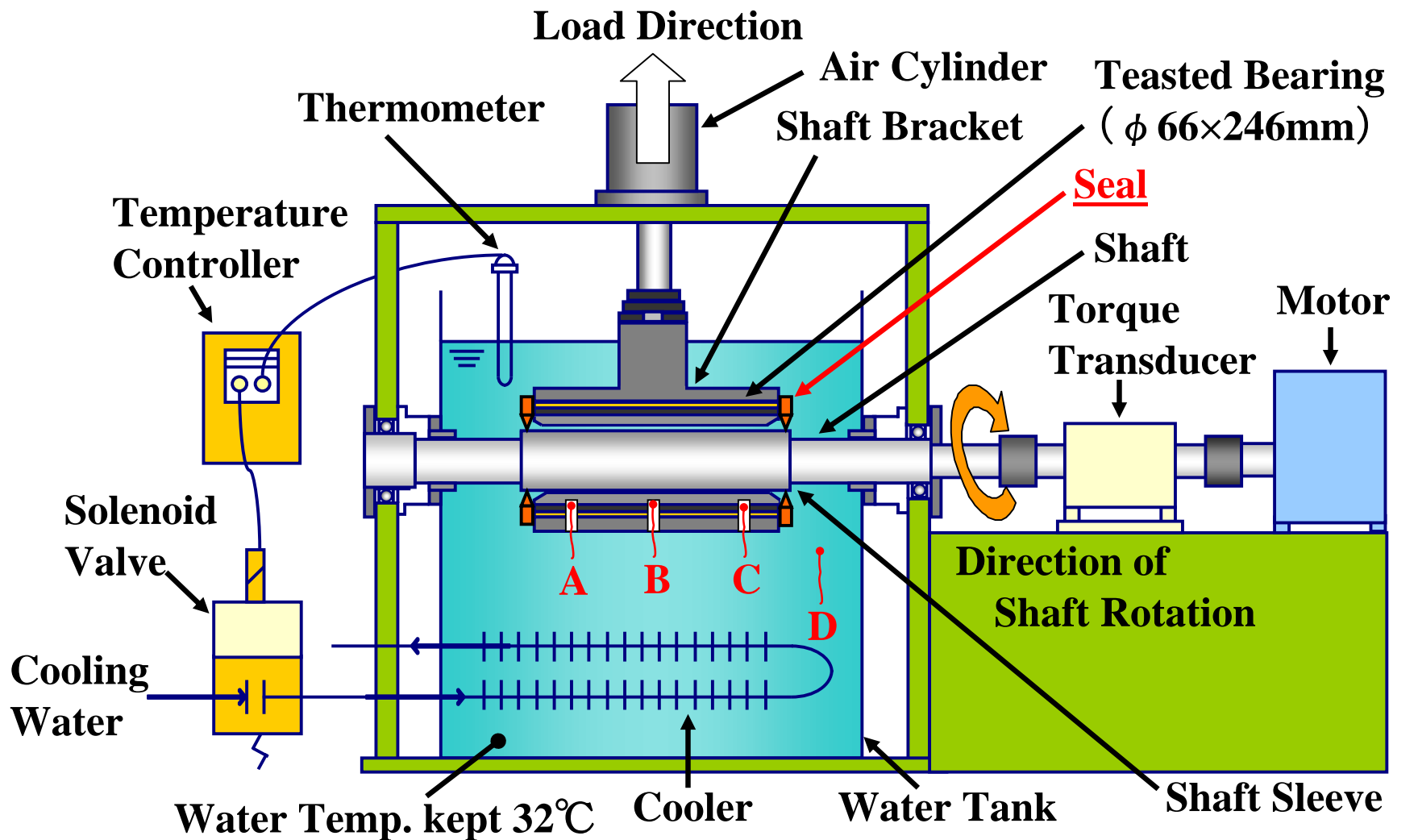


Comparison of Friction Coefficients



The PTFE/Rubber Hybrid bearing is more 'self-alignable' than the monolithic PTFE bearing.

Danger of Seizure



Seals were installed after the test bearing was merged into the tank to interrupt the inflow/outflow of water.

Results

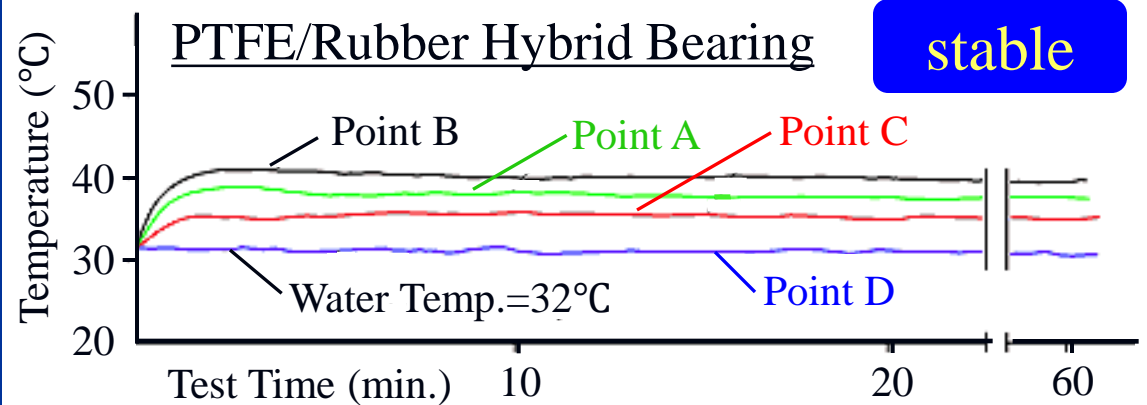
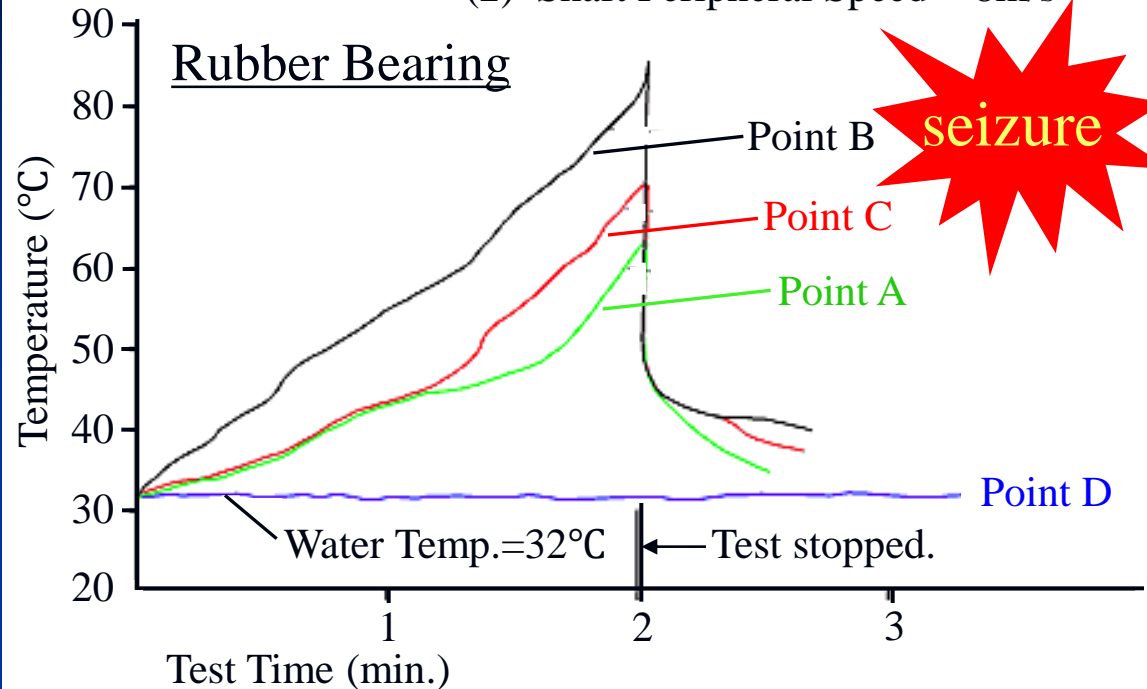
Temp. points A, B, and C were measured near the slide surface. The real temp. of the rubber surface was higher. Seizure occurred.

The PTFE/Rubber Hybrid Bearing temperature rose by only about 10 deg. C and stayed almost constant throughout the test.

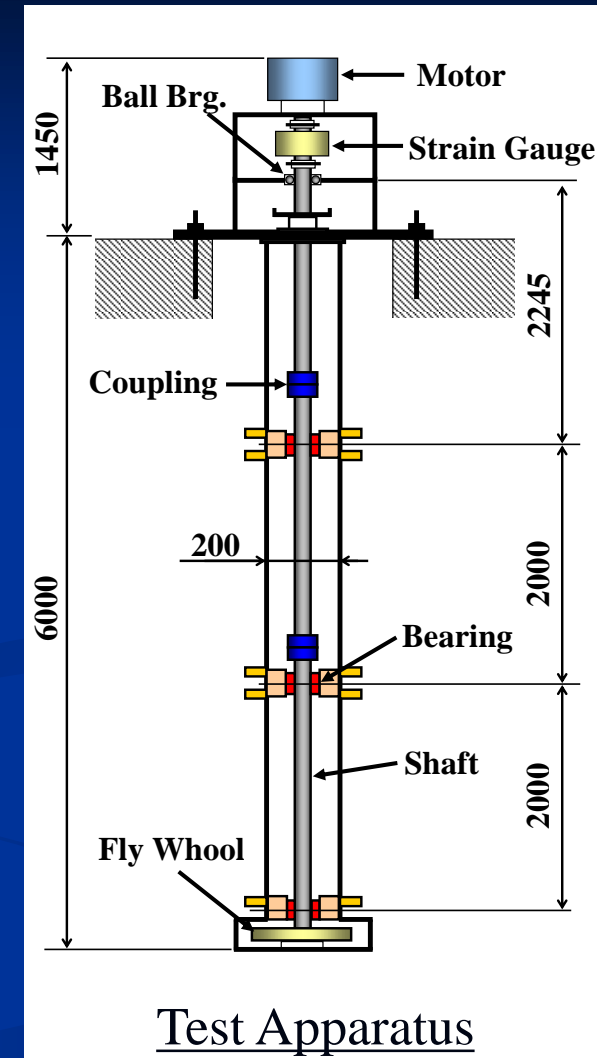
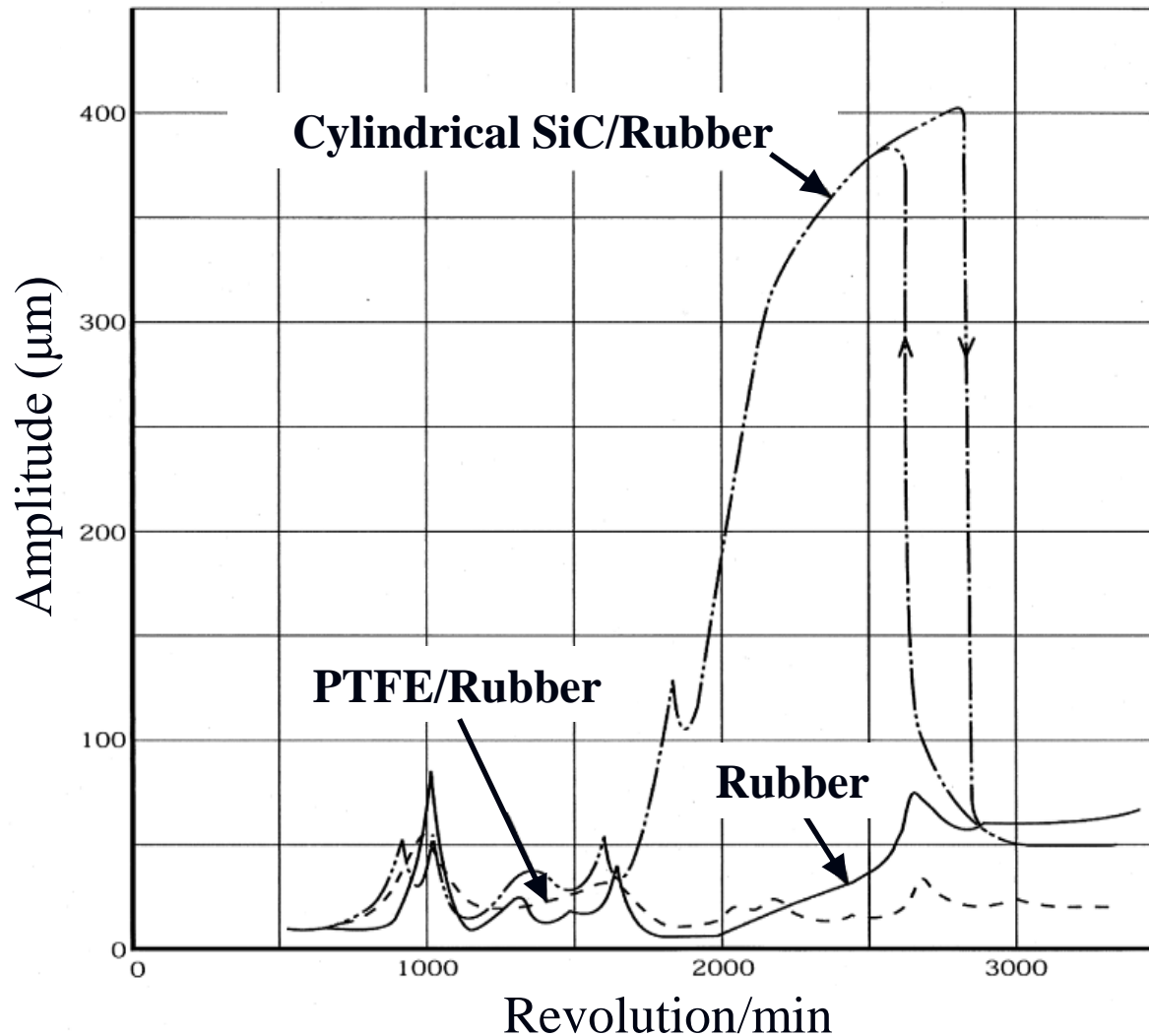
Test Condition

(1) Bearing Pressure = 0.25MPa

(2) Shaft Peripheral Speed = 8m/s

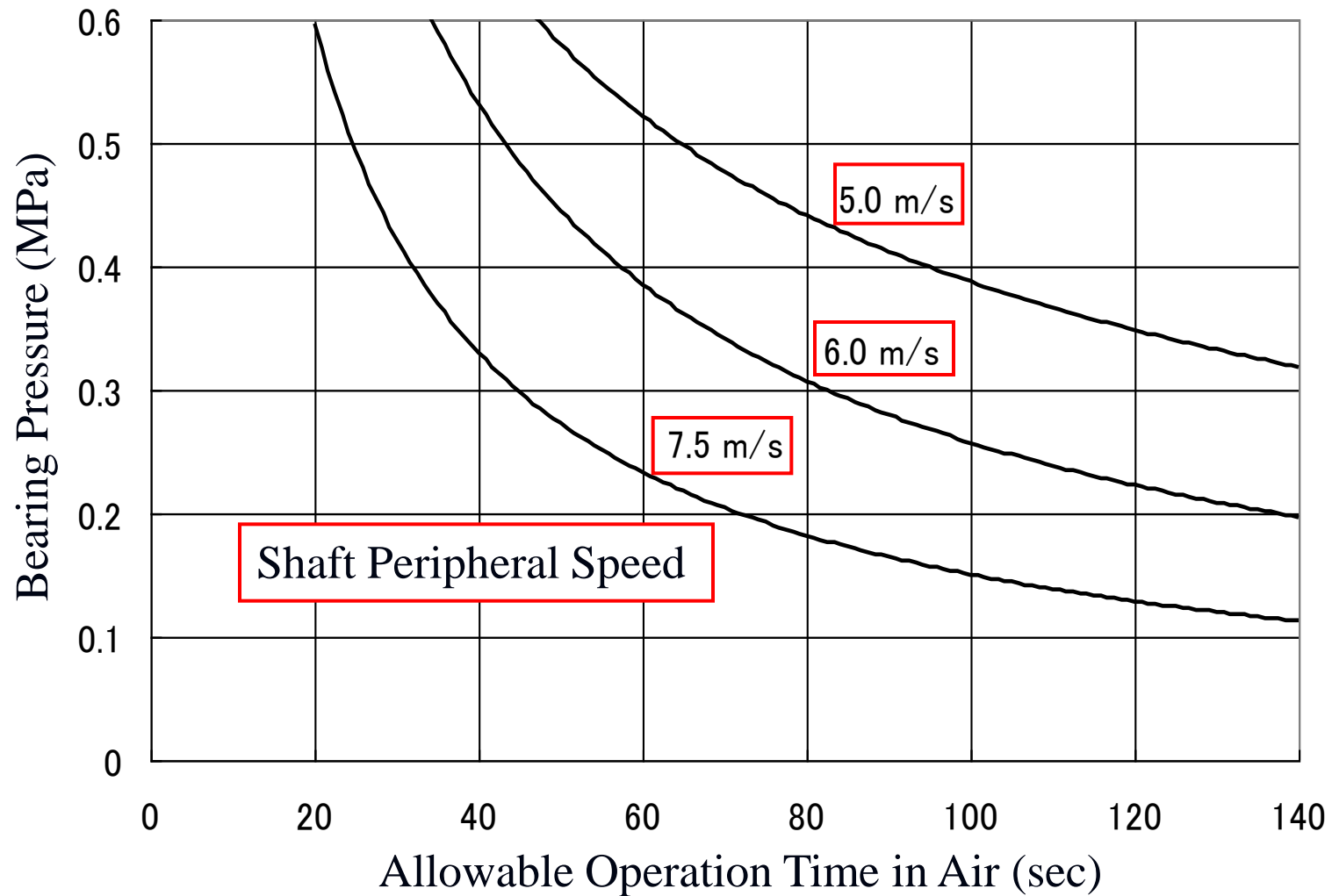


Vibration Characteristics of Bearings



The bearings apparently vibrate as long as a cylindrical bearing material like bronze is used. Distributed rubber doesn't stop the vibration.

Allowable Operation Time in Air



Under a normal bearing load, this PTFE/rubber hybrid bearing can be applied to all vertical pumps.

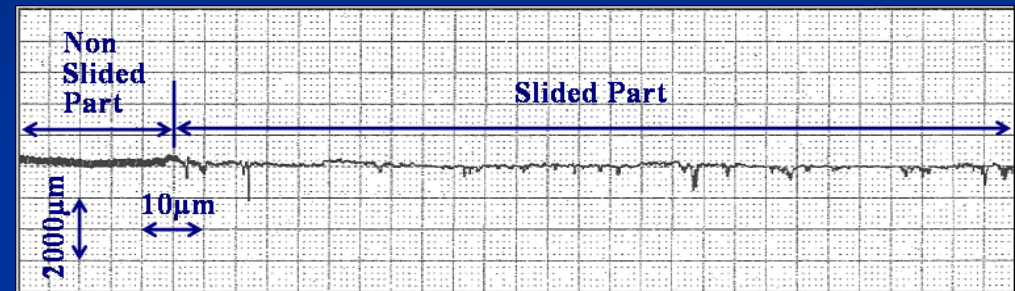
Result of Slide Materials Examination

Ratio of
Bearing Wear

Aggression on Shaft Sleeves

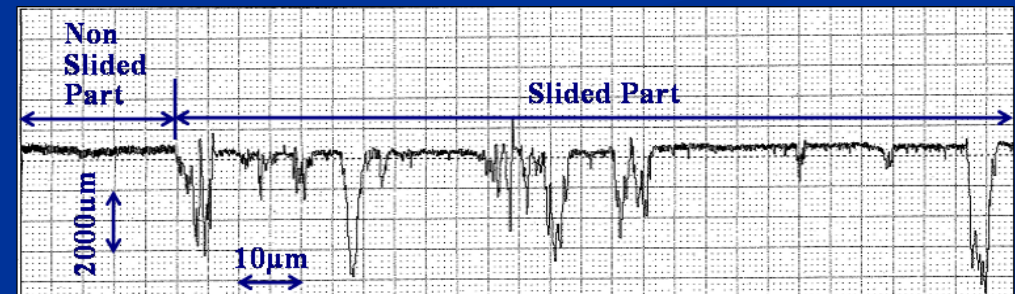
PTFE/Rubber

1.0



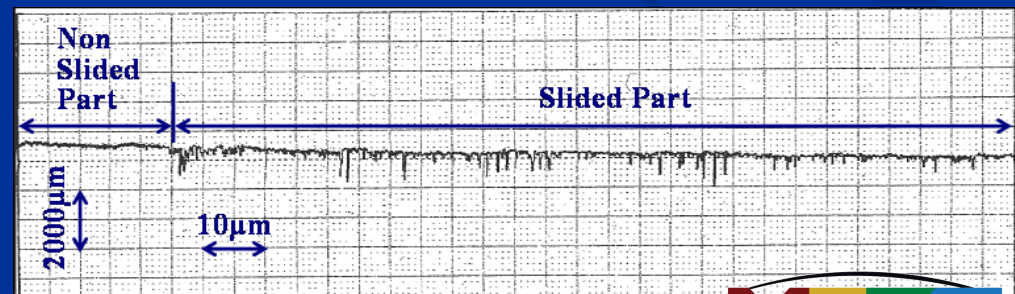
PEEK/Rubber

1.1



Polyurethane
/Rubber

3.5



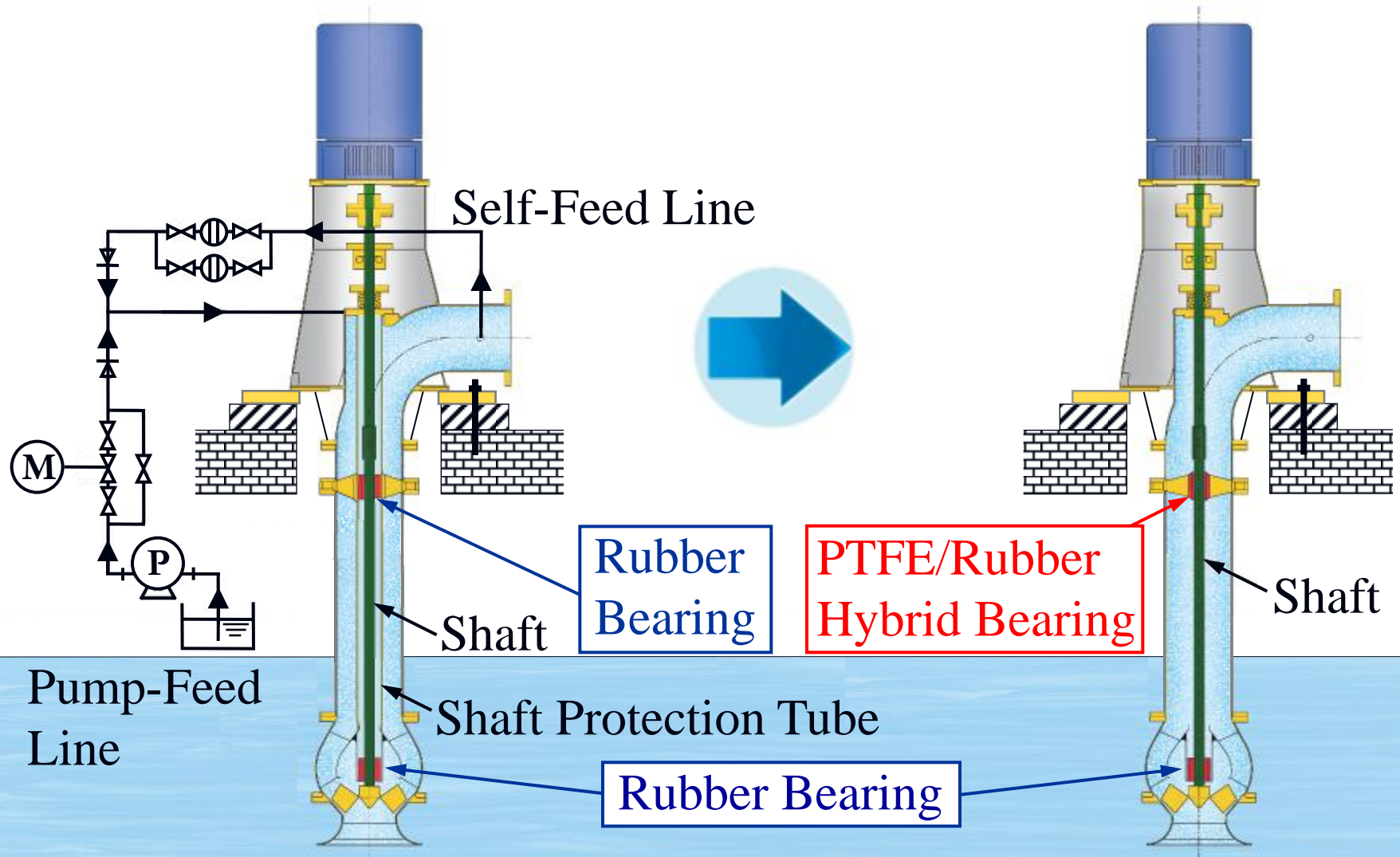
Results of Field Application

▪ Bearing exchange interval

		Bearing Type	
		Rubber	PTFE/Rubber
Bearing I.D.	ϕ 110 ~ ϕ 240	4 ~ 6 years	~10 years
	ϕ 250 and over	4 ~ 6 years	~9 years

▪ The lifetime of PTFE/Rubber Hybrid Bearings was confirmed to be 1.5 to 2 times higher than the lifetime of conventional Rubber Bearings.

Recommended Design



Conclusions

Merits of using the PTFE/Rubber Hybrid Bearing, a component usable with almost all vertical pumps when aiming at 'dry-start':

- No need for a lubrication water system or shaft protection tubes
- No need for corrosion-prone piping
- Simple maintenance: no bearing lubrication control required
- Hardly any vibration



Lower cost and lower risk at operation



This bearing became the De Facto Standard in Japan.
(1200 pieces/year are produced).