

# *Polski Rejestr Statków*

## **RULES**

PUBLICATION NO. 111/P

### **PERIODICAL SURVEYS OF PROPELLER SHAFTS**

**2016**

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków complete or extend the Rules and are mandatory where applicable.



GDĄŃSK

*Publication No. 111/P – Periodical Surveys of Propeller Shaft –2016*, based on the IACS Unified Requirements Z21 (Rev. 3), is an extension of the requirements contained in *Part I – Classification Regulations of the Rules for the Classification and Construction of Sea-Going Ships*, as well as in all other PRS Rules, in which reference to the *Publication* has been made.

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# 1 GENERAL

## 1.1 Scope of Application

**1.1.1** The requirements of *Publication No. 111/P – Periodical Surveys of Propeller Shafts*, hereinafter referred to as the *Publication*, are an extension of the requirements specified in *Part I – Classification Regulations of the Rules for the Classification and Construction of Sea-going Ships*, where the *Publication* is referred to, within the scope of PRS survey of Propeller shafts. .

**1.1.2** Unless equivalent measures have been applied, the requirements of this *Publication* apply for ships with mechanical propulsion, which are fitted with conventional propeller shaft system.

## 1.2 Definitions

**Adequate means for protection against corrosion** – a PRS approved means for full protection of the core shaft against sea water intrusion and subsequent corrosion attack. Such means are used for the protection of common steel material against corrosion, particularly in combination with water lubricated bearings. Typical means are for example:

- continuous metallic, corrosion resistant liners,
- continuous cladding,
- multiple layer synthetic coating,
- multiple layer of fiberglass,
- combinations of above mentioned,
- rubber / elastomer coating.

The means for protection against corrosion are installed / applied according to PRS approved procedures.

**Closed loop oil lubricated bearing system** – Closed loop oil lubricating systems use oil to lubricate the bearings and are sealed against the environment (seawater) by adequate sealing / gland devices.

**Closed loop fresh water lubricated bearing system** – Closed loop water lubricating systems use fresh water to lubricate the bearings and are sealed against the environment (such as seawater) by adequate sealing / gland devices.

**Corrosion resistant shaft** – Corrosion resistant shaft is made of approved corrosion resistant steel as core material for the shaft.

**Equivalent solutions** – solutions other than those given in this *Publication* and approved by PRS.

**Flanged connection** – flanged connection is the coupling methodology, between the shaft and the propeller, achieved by a flange, built in at the shaft aft end, bolted to propeller boss.

**Fresh water sample test** – the test should be carried out at regular intervals not exceeding six (6) months. Samples are to be taken under service conditions and are to be representative of the water circulating within the sterntube. Analysis results are to be retained on board and made available to the surveyor. At time of survey the sample for the test has to be taken at the presence of the surveyor.

Fresh water sample test shall include the following parameters:

- chlorides content,
- pH value,
- presence of bearing particles or other particles (only for laboratory analysis, not required for tests carried out in presence of the surveyor).

**Keyed connection** – keyed connection is the forced coupling methodology between the shaft and the propeller with a key and keyway achieved through the interference fit of the propeller boss on the shaft tapered end.

**Keyless connection** – keyless connection is the forced coupling methodology between the shaft and the propeller without a key achieved through interference fit of the propeller boss on the shaft tapered end.

**Lubricating oil analysis** – Lubricating oil analysis is to be carried out at regular intervals not exceeding six (6) months. The documentation on lubricating oil analysis is to be available on board. Oil samples, to be submitted for the analysis, should be taken under service conditions.

**Oil sample examination** – it is a visual examination of the stern tube lubricating oil taken in presence of the surveyor with a focus on water contamination.

**Open systems (water)** – open water lubricating systems use water to lubricate the bearings and are exposed to the environment.

**Propeller shaft** – propeller shaft is the part of the propulsion shaft to which the propeller is fitted. It may also be called screwshaft or tailshaft.

**Service records** – service records are regularly recorded data showing in-service conditions of the shaft(s) and may include, as applicable: lubricating oil temperature, bearing temperature and oil consumption records (for closed loop oil lubricated bearing systems) or water flow, water temperature, salinity, pH, water make-up and water pressure (for closed loop fresh water lubricated bearing systems) depending on design.

**Stern tube** – tube or pipe fitted in the shell of a ship at the stern (or rear part of the ship), below the water-line, through which passes the propeller shaft or tube shaft. Sterntube is the housing of the shaft bearings, generally two (one aft and one fore), that sustain the shaft and allow its rotation with less frictional resistance. The stern tube also accommodates the shaft sealing arrangement.

**Stern tube sealing system** – stern tube sealing system is the equipment installed on the inboard extremity and, for closed systems, at outboard extremity of the stern tube. Inboard Seal is the device fitted on the fore part of the stern tube that achieve the sealing against the possible leakage of the lubricant media in to the ship internal. Outboard seal is the device fitted on the aft part of the stern tube that achieve the sealing against the possible sea water ingress and the leakage of the lubricant media.

**Tube shaft** – tube shaft is a shaft placed between the intermediate shaft and propeller shaft, normally arranged within a stern tube or running in open water. It may also be called **Stern Tube Shaft**.

**Water lubricated bearing** – water lubricated bearings are bearings cooled / lubricated by water (fresh or salt).

## **2 OIL LUBRICATED SHAFTS OR CLOSED LOOP SYSTEM FRESH WATER LUBRICATED SHAFTS (CLOSED SYSTEMS)**

### **2.1 Shaft Survey Methods**

#### **2.1.1 METHOD 1**

The survey is to consist of:

- Drawing the shaft and examining the entire shaft, seals system and bearings
- For keyed and keyless connections:
  - Removing the propeller to expose the forward end of the taper,
  - Performing a non-destructive examination (NDE) by an approved surface crack-detection method all around the shaft in way of the forward portion of the taper section, including the keyway (if fitted). For shaft provided with liners the NDE shall extended to the after edge of the liner.
- For flanged connections:
  - Whenever the coupling bolts of any type of flange-connected shaft are removed or the flange radius is made accessible in connection with overhaul, repairs or when deemed necessary by the surveyor, the coupling bolts and flange radius are to be examined by means of an approved surface crack detection method.
- Checking and recording the bearing clearances.
- Verification that the propeller is free of damages which may cause the propeller to be out of balance.
- Verification of the satisfactory conditions of inboard and outboard seals during the re- installation of the shaft and propeller.
- Recording the bearing wear-down measurements (after re-installation)

### **2.1.2 METHOD 2**

The survey is to consist of:

- For keyed and keyless connections:
    - Removing the propeller to expose the forward end of the taper,
    - Performing a non-destructive examination (NDE) by an approved surface crack-detection method all around the shaft in way of the forward portion of the taper section, including the keyway (if fitted).
  - For flanged connections:
    - Whenever the coupling bolts of any type of flange-connected shaft are removed or the flange radius is made accessible in connection with overhaul, repairs or when deemed necessary by the surveyor, the coupling bolts and flange radius are to be examined by means of an approved surface crack detection method.
  - Verification that the propeller is free of damages which may cause the propeller to be out of balance.
  - Visual Inspection of all accessible parts of the shafting system.
  - Checking if seal liner is found or placed in a satisfactory condition.
  - Verification of the satisfactory re-installation of the propeller including verification of satisfactory conditions of inboard and outboard seals.
  - Checking and recording the bearing wear-down measurements.
- Pre-requisites to satisfactorily verify in order to apply METHOD 2:
- Review of service records.
  - Review of test records of:
    - Lubricating oil analysis (for oil lubricated shafts), or
    - Fresh water sample test (for closed loop system fresh water lubricated shaft).
  - Lubricating oil sample examination (for oil lubricated shafts), or fresh water sample test (for closed loop system fresh water lubricated shafts).
  - Verification of not reported repairs by grinding or welding of shaft and/or propeller.

### **2.1.3 METHOD 3**

The survey is to consist of:

- Checking and recording the bearing wear-down measurements.
  - Visual Inspection of all accessible parts of the shafting system.
  - Verification that the propeller is free of damages which may cause the propeller to be out of balance.
  - Verification that seal liner is found or placed in a satisfactory condition.
  - Verification of the satisfactory conditions of inboard and outboard seals.
- Pre-requisites to satisfactorily verify in order to apply METHOD 3:
- Review of service records.
  - Review of test records of
    - lubricating oil analysis (for oil lubricated shafts), or
    - fresh water sample test (for closed loop system fresh water lubricated shaft).
  - Oil sample examination (for oil lubricated shafts), or fresh water sample test (for closed loop system fresh water lubricated shafts).
  - Verification of not reported repairs by grinding or welding of shaft and/or propeller.

## **2.2 Extension of Shaft Survey Interval – Extension Types**

### **2.2.1 Extension up to 2.5 Years**

The survey is to consist of:

- Checking and recording the bearing wear-down measurements, as far as practicable.
  - Visual Inspection of all accessible parts of the shafting system.
  - Verification that the propeller is free of damages which may cause the propeller to be out of balance.
  - Verification of the effectiveness of the inboard seal and outboard seals.
- Pre-requisites to satisfactorily verify in order to apply the extension up to 2,5 years:
- Review of previous records of shaft wear-down/clearance.

- Review of service records.
- Review of test records of
  - lubricating oil analysis (for oil lubricated shafts), or
  - fresh water sample test (for closed loop fresh system water lubricated shaft).
- Oil sample examination (for oil lubricated shafts), or fresh water sample test (for closed loop systems fresh water lubricated shafts).
- Verification of not reported repairs by grinding or welding of shaft and/or propeller.
- Confirmation from the Chief Engineer that the shafting arrangement is in good working condition.

### **2.2.2 Extension up to 1 Year**

The survey is to consist of:

- Visual Inspection of all accessible parts of the shafting system.
- Verification that the propeller is free of damages which may cause the propeller to be out of balance.
- Verification of the effectiveness of the inboard seal and outboard seals.

Pre-requisites to satisfactorily verify in order to apply the extension up to 1 year:

- Review of the previous shaft wear and/or clearance recordings.
- Review of service records.
- Review of test records of:
  - lubricating oil analysis (for oil lubricated shafts), or
  - fresh water sample test (for closed loop system fresh water lubricated shafts).
- Lubricating oil sample examination (for oil lubricated shafts), fresh water sample test (for closed loop system fresh water lubricated shafts).
- Verification of not reported repairs by grinding or welding of shaft and/or propeller.
- Confirmation from the Chief Engineer that the shafting arrangement is in good working condition.

### **2.2.3 Extension up to 3 Months**

The survey is to consist of:

- Visual Inspection of all accessible parts of the shafting system.
- Verification of the effectiveness of the inboard/outboard seal.

Pre-requisites to satisfactorily verify in order to apply the extension up to 3 months:

- Review of the previous shaft wear and/or clearance recordings.
- Review of service records.
- Review of test records of:
  - lubricating oil analysis (for oil lubricated shafts), or
  - fresh water sample test (for closed loop fresh system water lubricated shafts).
- Lubricating oil sample examination (for oil lubricated shafts), or fresh water sample test (for closed loop system fresh water lubricated shafts).
- Verification of not reported repairs by grinding or welding of shaft and/or propeller.
- Confirmation from the Chief Engineer that the shafting arrangement is in good working condition.

## **2.3 Oil Lubricated Shafts**

### **2.3.1 Survey Intervals**

For surveys completed within 3 months before the shaft survey due date, the next period will start from the shaft survey due date.

#### **2.3.1.1 Flanged Propeller Connection**

The following methods are applicable:

- A) Method 1 every 5 years, or
- B) Method 2 every 5 years (pre-requisites have to be fulfilled), or
- C) Method 3 every 5 years (pre-requisites have to be fulfilled).



### 2.3.1.2 Keyless Propeller Connection

The following methods are applicable:

- A) Method 1 every 5 years, or
- B) Method 2 every 5 years (pre-requisites have to be fulfilled), or
- C) Method 3 every 5 years with the maximum of two consecutive Method 3 surveys (pre-requisites have to be fulfilled). The maximum interval between two surveys carried out according to Method 1 or Method 2 shall not exceed 15 years, except in the case when one extension not more than three months is granted.

### 2.3.1.3 Keyed Propeller Connection

The following methods are applicable:

- A) Method 1 every 5 years, or
- B) Method 2 every 5 years (pre-requisites have to be fulfilled).

### 2.3.2 Survey Extension

For all types of propeller connections, the interval between two consecutive surveys may be extended after the execution of extension survey as follows:

- A) **Extension up to a maximum of 2.5 years:** no more than one extension can be granted. No further extension, of other type, can be granted.
- B) **Extension by up to a maximum of 1 year:** no more than two consecutive “one year extensions” can be granted. No further extension, of other type, can be granted.
- C) **Extension by up to a maximum of 3 months:** no more than one “three months extension” can be granted. In the event an additional extension is requested, the requirements of the “one year extension” are to be applied and the shaft survey due date is postponed by a maximum of one year.

The extension survey should normally be carried out within 1 month before the shaft survey due date and the extension counts from the shaft survey due date.

If the extension survey is carried out more than 1 month prior to the shaft survey due date, then the period of extension counts from the date of completion of the extension survey.

## 2.4 Closed Loop System Fresh Water Lubricated Shaft

The maximum interval between two surveys carried out according to Method 1 shall not exceed 15 years. An extension for no more than three months can be granted.

### 2.4.1 Survey Intervals

For surveys completed within 3 months before the shaft survey due date, the next period will start from the shaft survey due date.

#### 2.4.1.1 Flanged Propeller Connection

The following methods are applicable:

- A) Method 1 every 5 years, or
- B) Method 2 every 5 years (pre-requisites have to be fulfilled), or
- C) Method 3 every 5 years (pre-requisites have to be fulfilled).

#### 2.4.1.2 Keyless Propeller Connection

The following methods are applicable:

- A) Method 1 every 5 years, or
- B) Method 2 every 5 years (pre-requisites have to be fulfilled), or
- C) Method 3 every 5 years (pre-requisites have to be fulfilled).

#### 2.4.1.3 Keyed Propeller Connection

The following Methods are applicable:

- A) Method 1 every 5 years, or
- B) Method 2 every 5 years (pre-requisites have to be fulfilled).

## 2.4.2 Survey Extensions

For all types of propeller connections, the interval between two consecutive surveys may be extended after the execution of extension survey as follows:

- A) Extension up to a maximum of 2.5 years, no more than one extension can be granted. No further extension, of other type, can be granted.
- B) Extension up to a maximum of 1 year, no more than two consecutive extensions can be granted. No further extension, of other type, can be granted.
- C) Extension up to a maximum of 3 months, no more than one “three months extension” can be granted. In the event an additional extension is requested, the requirements of the “one year extension” are to be applied and the shaft survey due date is postponed by a maximum of one year.

The extension survey should normally be carried out within 1 month of the shaft survey due date and the extension counts from the shaft survey due date.

If the extension survey is carried out more than 1 month prior to the shaft survey due date, then the period of extension counts from the date of completion of the extension survey.

The maximum interval between two surveys carried out according to Method 1 shall not exceed 15 years, except in the case when one extension by no more than three months is granted.

### SURVEY INTERVALS (closed loop systems)

Oil lubricated			
	Flanged propeller connection	Keyless propeller connection	Keyed propeller connection <sup>c</sup>
Every five years <sup>a</sup>	Method 1 or Method 2 or Method 3	Method 1 or Method 2 or Method 3 <sup>d</sup>	Method 1 or Method 2
Extension 2.5 Y <sup>b</sup>	Yes <sup>e</sup>	Yes <sup>e</sup>	Yes <sup>e</sup>
Extension 1 Y <sup>b</sup>	Yes <sup>f</sup>	Yes <sup>f</sup>	Yes <sup>f</sup>
Extension 3 M <sup>d</sup>	Yes <sup>g</sup>	Yes <sup>g</sup>	Yes <sup>g</sup>
Closed loop fresh water lubricated system			
	Flanged propeller connection	Keyless propeller connection	Keyed propeller connection <sup>c</sup>
Every five years <sup>a</sup>	Method 1 <sup>h</sup> or Method 2 or Method 3	Method 1 <sup>h</sup> or Method 2 or Method 3 <sup>d</sup>	Method 1 <sup>h</sup> or Method 2
Extension 2.5 Y <sup>b</sup>	Yes <sup>e</sup>	Yes <sup>e</sup>	Yes <sup>e</sup>
Extension 1 Y <sup>d</sup>	Yes <sup>f</sup>	Yes <sup>f</sup>	Yes <sup>f</sup>
Extension 3 M <sup>d</sup>	Yes <sup>g</sup>	Yes <sup>g</sup>	Yes <sup>g</sup>
<p>General notes:</p> <p>For surveys (Method 1, Method 2, or Method 3) completed within 3 months before the shaft survey due date, the next survey period will start from the shaft survey due date. The extension survey should normally be carried out within 1 month before the shaft survey due date and the extension period counts from the shaft survey due date. If the extension survey is carried out more than one month prior to the shaft survey due date, then the period of extension counts from the date of completion of the extension survey.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>a: unless a extension type (extension 2.5 Y, extension 1 Y, extension 3 M) is applied in between.</li> <li>b: only one extension type can be applied in between of two methods (extension 2.5 Y, or extension 1Y) except for what concerns the extension 3 M (see further note g).</li> <li>c: Method 3 is not allowed.</li> <li>d: a maximum of two consecutive Method 3 surveys. The maximum interval between two surveys carried out according to Method 1 or Method 2 shall not exceed 15 years, except in the case when one extension by no more than three months is granted.</li> <li>e: no more than one extension can be granted. No further extension of other type can be granted.</li> <li>f: no more than two consecutive extensions can be granted. No further extension of other type can be granted.</li> <li>g: no more than one three months extension can be granted. In the event an additional extension is requested the requirements of the “one year extension” are to be applied and the shaft survey due date is postponed by a maximum of one year.</li> <li>h: the maximum interval between two surveys carried out according to Method 1 shall not be more than 15 years.</li> </ul>			

### **3 WATER LUBRICATED SHAFTS (OPEN SYSTEMS)**

#### **3.1 Shaft Survey Methods**

##### **3.1.1 METHOD 4**

The survey is to consist of:

- drawing the shaft and examining the entire shaft (including liners, corrosion protection system and stress reducing features, where provided), inboard seal system and bearings.
- for keyed and keyless connections:
  - removing the propeller to expose the forward end of the taper,
  - performing a non-destructive examination (NDE) by an approved surface crack- detection method all around the shaft in way of the forward portion of the taper section, including the keyway (if fitted). For shaft provided with liners the NDE shall be extended to the after edge of the liner
- For flanged connection:
  - Whenever the coupling bolts of any type of flange-connected shaft are removed or the flange radius is made accessible in connection with overhaul, repairs or when deemed necessary by the surveyor, the coupling bolts and flange radius are to be examined by means of an approved surface crack detection method.
- Checking and recording the bearing clearances.
- Verification that the propeller is free of damages which may cause the propeller to be out of balance.
- Verification of the satisfactory conditions of inboard seal during re-installation of the shaft and propeller.

#### **3.2 Extension of Shaft Survey Interval – Extension Types**

##### **3.2.1 Extension up to 1 Year**

The survey is to consist of:

- Visual inspection of all accessible parts of the shafting system.
  - Verification that the propeller is free of damages which may cause the propeller to be out of balance.
  - Checking and recording the clearances of bearing.
  - Verification of the effectiveness of the inboard seal.
- Pre-requisites to satisfactorily verify in order to apply
- Review of the previous clearance recordings.
  - Service records.
  - Verification of not reported repairs by grinding or welding of shaft and/or propeller.
  - Confirmation from the Chief Engineer that the shafting arrangement is in good working condition.

##### **3.2.2 Extension up to 3 Months**

The survey is to consist of:

- Visual Inspection of all accessible parts of the shafting system.
  - Verification that the propeller is free of damages which may cause the propeller to be out of balance.
  - Verification of the effectiveness of the inboard seal.
- Pre-requisites to satisfactorily verify in order to apply extension by up to 3 months:
- Review of the previous clearance recordings.
  - Service records.
  - Verification of not reported repairs by grinding or welding of shaft and/or propeller.
  - Confirmation from the Chief Engineer that the shafting arrangement is in good working condition.

#### **3.3 Shaft Survey Intervals**

**3.3.1** For surveys completed within 3 months before the shaft survey due date, the next period will start from the shaft survey due date.

##### **3.3.1.1 Configurations allowing 5 year intervals**

- Single shaft operating exclusively in fresh water.
- Single shaft provided with adequate means of corrosion protection, single corrosion resistant shaft.
- All kinds of multiple shafts arrangements.

### 3.3.2 Other Systems

Shaft not belonging in one of the configurations listed in 3.3.1.1 has to be surveyed according to Method 4 every 3 years.

### 3.3.3 Survey Extension

For all types of propeller connections, the interval between two consecutive surveys may be extended after the execution of extension survey as follows:

- A) **Extension up to a maximum of 1 year:** no more than one extension can be granted. No further extension, of other type, can be granted.
- B) **Extension up to a maximum of 3 months:** no more than one “three months extension” can be granted. In the event an additional extension is requested the requirements of the “one year extension” are to be carried out and the shaft survey due date is postponed by a maximum of one year.

The extension survey should normally be carried out within 1 month before the shaft survey due date and the extension counts from the shaft survey due date.

If the extension survey is carried out more than 1 month prior to the shaft survey due date, then the period of extension counts from the date of completion of the extension survey.

#### SURVEY INTERVALS (open systems)

<ul style="list-style-type: none"> <li>– Single shaft operating exclusively in fresh water.</li> <li>– Single Shaft provided with adequate means of corrosion protection, single corrosion resistant shaft.</li> <li>– All kinds of multiple shafts arrangements.</li> </ul>		Other shaft configuration.	
All kinds of propeller connections <sup>d</sup>		All kinds of propeller connections <sup>d</sup>	
Every five years <sup>a</sup>	Method 4	Every three years <sup>a</sup>	Method 4
Extension 1 Y	Yes <sup>b</sup>	Extension 1 Y	Yes <sup>b</sup>
Extension 3 M	Yes <sup>c</sup>	Extension 3 M	Yes <sup>c</sup>
<p>General notes:</p> <p>For surveys (Method 4) completed within 3 months before the shaft survey due date, the next period will start from the shaft survey due date.</p> <p>The extension survey should normally be carried out within 1 month before the shaft survey due date and the extension counts from the shaft survey due date. If the extension survey is carried out more than 1 month prior to the shaft survey due date. If the extension survey is carried out more than 1 month prior to the shaft survey date, then the period of extension counts from the date of completion of the extension survey.</p> <p>Notes:</p> <p>a: unless an extension type (1 Y, 3 M) is applied in between.</p> <p>b: no more than extension can be granted. No further extension, of other type, can be granted.</p> <p>c: no more than one extension can be granted. In the event an additional extension is requested, the requirements of the “one year extension” are to be applied and the shaft survey due date is postponed by a maximum of one year.</p> <p>d: For keyless propeller connections the maximum interval between two consecutive dismantling and verifications of the shaft cone by means of non-destructive examination (NDE) shall not exceed 15 years.</p>			