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Rolling bearings - Test and assessment methods for cleanliness

滚动轴承 清洁度测量及评定方法

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Table of Contents

1 Application Scope	
2 Normative References	
3 Terms and Definitions	
4 Measuring Principle...	
5 Environmental Conditions for Measurement...	
6 Measuring Equipment, Appliances and Materials and Washing of Appliances...	
7 Measuring Procedure...	
7.2 Measuring procedure of weighing method	
7.2.1 Liquid sample preparation	
7.2.2 Preparation and weighing of filtration membrane	
7.3.3 Liquid sample preparation and counting filtration membrane preparation	
7.3.4 Counting procedure	

Foreword

This Standard was drafted in accordance with the rules given in GB/T 1.1-2009. This Standard was proposed by China Machinery Industry Federation. This Standard shall be under the jurisdiction of the National Standardization Technical Committee on Rolling Bearings (SAC/TC 98). The drafting organizations of this Standard. Hangzhou Bearing Test and Research Centre, Jinfa Bearing Co., Ltd., Tianma Bearing Group Co., Ltd., Ningxia Qinchang Rolling-Bearing Manufacturing Co., Ltd., National Bearing Products Testing Centre, Zhejiang XCC Group Co., Ltd., Zhejiang Huanyu Bearing Co., Ltd., Zhejiang Chentong Bearing Co., Ltd. The main drafters of this Standard. Zhang Yajun, Chen Fanghua, Xu Jingxian, Zhao Liya, Li Xianhong, Shi Dafang, Liu Changming, Yang Weichun, Zhang Xunlei, Luo Qing, Zhang Xiaopeng, Zhang Baoming, Chen Lingfang, Li Xinglin.

Rolling Bearings - Test and Assessment Methods for Cleanliness

1 Application Scope

China's national standard for measuring and assessing the cleanliness of rolling bearings. It specifies the measuring principle, the environmental conditions for the measurement, the equipment, appliances and materials and how they are washed, the measuring procedure and the cleanliness assessment, with normative annexes on measuring the dust fall per unit area in the test room, on the equipment and its washing, and on the blank experiment and effective filtration area calibration, plus an informative annex giving cleanliness limits for

radial ball bearings. It applies to open bearings and to closed bearings before greasing, and to bearing parts. Cleanliness here means the mass of particulate contamination inside a bearing as delivered, and it is measured by washing the bearing, filtering the washings and weighing what the filter retained. The reason it matters is that a rolling bearing has no clearance to spare. A rolling element passes through the loaded zone thousands of times a minute, and a hard particle caught between it and the raceway is rolled into the surface, leaving an indentation with raised edges. That dent is a stress raiser, and the fatigue crack that eventually spalls the raceway starts there. So contamination does not wear a bearing out gradually; it plants the defect that ends its life, and a bearing that would have run for twenty thousand hours fails in two thousand. The difficulty is that measuring a few milligrams of particulate requires the measurement itself to be cleaner than the thing being measured, which is why three of the four annexes are about the procedure's own contamination. Issued on 12 May 2017 and in force since 1 December 2017.

This Standard specifies the test and assessment of cleanliness of rolling bearings (hereinafter referred to as bearings) and bearing parts. This Standard applies to the test and assessment of all kinds of open bearings and closed bearings before greasing, as well as the test and assessment of bearing parts.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition dated applies to this document. For undated references, the latest edition of the referenced documents (including all amendments) applies to this Standard. SH 0004-1990 (2007), Solvent Oil for Use in Rubber Industry

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1 impurity Particles which adhere to the surface of bearings/bearing parts and are adverse to the performance of bearings.

3.2 particle size The maximum size of particles (the maximum distance between points on the contour line of the particle image map).

3.3 bearing/bearing part cleanliness The size of impurity on each bearing/each bearing part or the weight of unit surface area; the size and quantity of impurity particle on each bearing/each bearing part or wash the appliances once again as specified in B.3 or carry out blank test once again after using filtration membrane of pore size 0.45 µm to filter the solvent once again.

7.2.1 Liquid sample preparation

7.2.1.1 Unless the cleanliness of the samples is so poor that the filtration speed of the liquid

samples is lowered, multiple sets/pieces may be washed and measured together with the weighing method.

7.2.1.2 No scrubbing shall be carried out for the samples after opening package.

7.2.1.3 Soak cleaning. Use solvent to soak the samples in a container for more than 2 h; shake or rotate them one by one to make the impurity on the surface of the samples fall off to come into solvent. The use level of solvent shall ensure the samples are fully soaked in the container more than 10 mm.

7.2.1.4 Ultrasonic cleaning. Wash the samples twice by ultrasonic cleaning, 2 min for each time of cleaning. The use level of solvent for each time shall not be less than 200 mL and the height of solvent in the container shall not be lower than two times of the height of the samples. Multiple sets/pieces are allowed to be washed, but the samples are not allowed to be overlapped or staggered.

7.2.1.5 Washing of the samples with grooves or curls. Use solvent in the washing bottle to wash the surface of the samples to fully wash away impurity; collect the washings into the container.

7.2.1.6 All washings are liquid samples.

7.2.2 Preparation and weighing of filtration membrane

7.2.2.1 Use tweezers to take 2 pieces of filtration membrane of pore size $1.2\ \mu\text{m}$ to place into two weighing bottles marked "Test (s)" and "Control (k)"; place them semi-openly into the thermostatic chamber for drying for 60 min at $60^\circ\text{C} \pm 5^\circ\text{C}$; put on the cap for them before placing them into the desiccator for cooling for 30 min; then use the analytical balance to weigh the two filtration membranes respectively; record them as m_{s1} and m_{s2} . The filtration membranes shall be dried and weighed twice; the difference between the two weighing results shall not be greater than

0.2 mg; if the difference is greater than

0.2 mg, carry out drying and weighing once again and the final weighing results shall prevail.

7.2.2.2 Use tweezers to take out the filtration membranes from the weighing bottles; place in solvent to soak them before placing them flatwise on the microporous filter, with the control membrane (k) as the lower membrane and the test filtration membrane (s) as the upper membrane.

7.2.2.3 Press the upper funnel on the filtration membrane; use the clamping device to clamp the upper funnel, filtration membranes, microporous filter, lower funnel and up to $50\ \mu\text{m}$; greater than $50\ \mu\text{m}$ up to $100\ \mu\text{m}$; greater than $100\ \mu\text{m}$.

7.3.3 Liquid sample preparation and counting filtration membrane preparation

7.3.3.1 Prepare liquid samples as specified in 7.2.1.2 ~ 7.2.1.6.

7.3.3.2 Select one filtration membrane of appropriate pore size in accordance with the minimum counting particle size; use tweezers to clamp the filtration membranes for soaking before place flatwise on the microporous filter.

7.3.3.3 Carry out liquid samples filtration and impurity collection as specified in 7.2.2.3 ~ 7.2.2.5.

7.3.3.4 Use tweezers to take down the filtration membranes from the microporous filter and place flatwise in the weighing bottle.

7.3.3.5 Place the weighing bottles semi-openly in the thermostatic chamber for drying for 60 min at $60^{\circ}\text{C} \pm 5^{\circ}\text{C}$; then put on the cap for them before placing them into the desiccator for cooling for 30 min

7.3.4 Counting procedure

7.3.4.1 If the samples need to be assessed using the weighing method and the particle counting method in combination, the use the test filtration membrane as the counting filtration membrane and the control filtration membrane without counting.

7.3.4.2 Use tweezers to take out the counting membrane from the weighing bottle; place flatwise carefully on the filtration membrane fixer tray; put on the cover before mounting to the clamping device on the stage of the microscope.

7.3.4.3 In accordance with the minimum counting particle size, select the objective lens of appropriate power; carry out lightness adjustment and shade correction for the microscope; set the diameter of effective filtration area, diameter of counting area, size of minimum counting particle, size segment of counting particles and other parameters; carry out scanning, particle size measurement and quantity statistics for the counting filtration membranes.

7.3.4.4 Output measuring results in accordance with the assessment items. The assessment items may include but not limited to the total count of particles larger than the minimum counting size, the count of particles of all size segments, the count of reflective particles of all size segments and the count of non-reflective particles, the maximum particle size and so on.