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GB/T 14230-2021

Replacing GB/T 14230-1993

Test method of tooth bending strength for gear load capacity

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1 Scope

GB/T 14230-2021 is the Chinese national standard on test method of tooth bending strength for gear load capacity, in the field of mechanical systems and components. The /T

suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 21 May 2021 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 December 2021. Classification: ICS 21.200, CCS J17. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the principle, purpose, type, method, equipment, failure criteria, procedure, data processing, test report of the bending fatigue strength test of the tooth root of involute cylindrical gears. This document is applicable to the basic data required for the design of the bending fatigue bearing capacity of the tooth root of involute cylindrical gears, which are made of steel or cast iron; it is also applicable to the comparative analysis of the bending fatigue performance of gears under conditions of different materials, different processes, different shaping methods, etc. Similar tests of gears made of other materials or non- involute gears can make reference to this standard.

2 Normative references

The contents of the following documents constitute the essential terms of this document through normative references in the text. Among them, for the referenced documents with dates, only the versions corresponding to the dates are applicable to this document; for the referenced documents without dates, the latest versions (including all amendments) are applicable to this document.

GB/T 1356 Cylindrical gears for general and heavy engineering - Standard basic rack tooth profile

GB/T 3358.1 Statistics - Vocabulary and symbols - Part

3 Terms, definitions, codes

The terms and definitions as defined in GB/T 3358.1, GB/T 3480.1, GB/T 3480.3, as well as the codes in Table 1, apply to this document.

4 Test principle

4.1 Through meshing operation (see Figure 1) or pulsating loading (see Figure 2), a controlled load is applied to the test gear teeth, to reproduce or simulate the stress state and value of the tooth root, to determine the number of cycles when the gear teeth fail due to bending fatigue (or fail after exceeding the root stress cycle base N0), OR to determine the stress (load) level when the gear teeth fail due to bending fatigue under a given number

of cycles (such as N0).

4.2 Since the discreteness of fatigue test data is inevitable, its distribution will have certain statistical significance, only when enough test data is obtained. Therefore, in practical applications, if only limited test data points can be used for analysis or comparison, the test process shall be strictly controlled and the limitations of the conclusions shall be noted.

5 Test purpose

5.1 Basic data determination When a specific material and a specific process are used to process the test gear, the bending fatigue limit stress or S-N curve of the gear can be obtained by processing the test data, which can be used as the basic value of the strength design of the material and process. The specific requirements are as follows:

5.2 Performance comparison

5.2.1 When different materials or different processes are used to process the test gear, the influence of different factors on the bending fatigue strength of the gear can be evaluated by processing the test data. These factors include but are not limited to.

5.2.2 Based on the comparison in 5.2.1, the material, process, tooth root design, etc. of the gear can be optimized.

5.2.3 If it is necessary to compare the durability fatigue limit stress, the test shall be conducted in accordance with the requirements of

5.3 Others Except for

5.1 and 5.2, other test purposes can be set by the researchers themselves. For example, explore the mechanism and main causes of gear bending fatigue failure, analyze the initiation and stable expansion process of gear bending fatigue cracks, formulate a method to suppress gear tooth bending fatigue damage.

6 Test type

6.1 General In order to determine the gear bending load capacity and fatigue strength, the method of installing the test gear pair on the test bench for running loading is called the running type test (see Figure 1), whilst the method of fixing the test gear on the test machine with a special fixture to load the gear teeth in a pulsating manner is called the pulsating type test (see Figure 2).

6.3 Pulsating type test

6.3.1 In the test, a set pulsating load is applied to the effective involute position of the test gear tooth close to the tooth top.

6.3.3 The tooth root bending stress generated when the test gear is loaded at point E is calculated according to formula (2) and formula (3).

7.3 Few-point combination method

7.3.1 This method is to conduct fatigue life tests with a small number of points under multiple stress levels, to obtain the S-N curve through data fitting. This method can be used to determine the S-N curve at 50% reliability within the limited life range of the test gear; it can also be used to estimate the root bending fatigue limit stress sigmaF lim, or can be used for comparative testing of the bending fatigue performance of test gears under different materials, different processes, different root morphologies.

7.4 Up-down load change method

7.4.1 This method is to set multiple stress levels near the estimated fatigue limit stress sigma'lim after a given number of cycles, to obtain the fatigue limit stress based on the rising and falling distribution of failure or overshoot of the test point. This method can be used to determine the tooth root bending fatigue limit stress sigmaF lim more accurately.

7.5 Step loading method

7.5.1 This method is based on the Palmgren-Miner rule. It uses only one failure test point and quickly obtains the fatigue limit stress by step-up loading. This method is particularly suitable for rapid comparison tests of bending fatigue properties of test gears under different materials, different processes, different tooth root morphologies. Where there are a lot of test data, this method can also be used to roughly determine the root bending fatigue limit stress sigmaF lim.

7.6 Other methods This document does not exclude other test methods, but the method shall meet the requirements of sampling and mathematical statistics and reach an agreement with the test entrusting party or data user. For example, when using the orthogonal method for comparative testing, each comparative factor shall have at least 3 test points.

7.7 Comparison of various test methods The processing results and test cycles occupied by different test methods in 7.2 ~

7.5 are compared, see Table 2.

8.2.1 Main parameters

8.2.1.1 For basic data test of gear (or gear material), it should select cylindrical gear with module number mn = 2 mm ~ 6 mm. The accuracy shall meet the requirements of level 5 ~ 7 in GB/T 10095 (all parts); the basic tooth profile shall meet the requirements of GB/T 1356.The parameter range in Table 3 can be selected first; the parameter matching shall