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## Harmonic drive gear reducers for robots

机器人用谐波齿轮减速器

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# Harmonic drive gear reducers for robots

## 1 Scope

This standard specifies the terms and definitions, product classification, model and basic parameters, requirements, test methods, inspection rules, markings, packaging, transportation and storage of harmonic drive gear reducers for robots.

This standard applies to harmonic drive gear reducers for robots (hereinafter referred to as reducers).

## 2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB/T 699-1999 Quality carbon structural steels

GB/T 1348-2009 Spheroidal graphite iron castings

GB/T 2828.11 Sampling procedures for inspection by attributes - Part 11: Procedures for assessment of declared quality levels for small population

GB/T 3077-1999 Alloy structure steels

GB/T 6404.1 Acceptance code for gear units - Part 1: Test code for airborne sound

GB/T 13306 Plates

GB/T 13384 General specifications for packing of mechanical and electrical product

GB/T 14118-1993 Harmonic drive reducer

JB/T 9050.3-1999 Load test method of reduction cylindrical gear units

Under the action of torsional moment, the ability of the component to resist torsional deformation, or the ratio of the rated load torque to the tangential elastic deformation angle.

**3.7**

**Starting torque**

The torque to be applied when starting at no load.

**3.8**

**Transmission accuracy**

In the working state, when the input shaft rotates in one direction, the degree of closeness of the actual rotation angle of the output shaft to the relative theoretical rotation angle.

Note: The level of transmission accuracy is measured by the size of the transmission error. The smaller the transmission error, the larger the accuracy; the larger the transmission error, the smaller the accuracy.

**3.9**

**Lost motion**

In the working state, when the input shaft changes from forward to reverse rotation, the lag of the output shaft on the angle of rotation.

**3.10**

**Backlash**

When the output end and the reducer housing are both fixed, a ±2% rated torque is applied to the input end to rotate clockwise and counterclockwise, a slight angular displacement as generated at the input end of the reducer.

**3.11**

**Transmission error**

In the working state, when the input shaft rotates in one direction, the difference between the actual rotation angle and the theoretical rotation angle of the output shaft.

**3.12**

**Length of flexspline**

the load is evenly increased to 4 times the rated load within 30 s and then run for 2 minutes.

### 6.4 Maximum allowable temperature of housing

Use a verified/calibrated thermocouple or other temperature sensor and other primary instruments and their matching secondary instruments for testing. Fix the primary instrument close to the surface of the prototype. After starting up and running, collect and record the temperature value at the time interval required by the test.

### 6.5 Transmission efficiency

The test of transmission efficiency is carried out according to JB/T 9050.3-1999.

### 6.6 Starting torque

The starting torque test shall be carried out after the no-load test.

The load measuring device with constant torque loading function is connected to the output end of the reducer. The torque is applied slowly and evenly until the input shaft of the reducer has an angular displacement. Collect and record the instantaneous torque value. Carry out 5 tests with different phase intervals in the forward and reverse directions. Take the maximum value of 10 tests as the starting torque.

### 6.7 Torsional stiffness

The torsional stiffness test is carried out according to 6.2.5 of GB/T 14118-1993.

### 6.8 Lost motion and backlash

#### 6.8.1 Lost motion

The lost motion test is carried out according to the dynamic measurement method in 6.2.6.1 of GB/T 14118-1993.

#### 6.8.2 Backlash

The backlash test shall be performed after the lost motion test. The measurement adopts optical indexing head, collimating light tube, optical polygonal prism, etc. When measuring, the optical indexing head is installed on the input shaft of the reducer. The polyhedral prism is fixed on the output shaft. One surface of the collimating light tube is adjusted to be perpendicular to the polyhedral prism. Fix the output end. Rotate the input end clockwise and counterclockwise, to make the input end produce a torque of ±4% of the rated torque. Measure the angular displacement value of the reducer input end, which is the backlash. The measurement sampling points are not less than 72 points.

c) The maximum allowable temperature of housing;

d) Noise.

### 7.2 Type inspection

#### 7.2.1 Inspection scope

Type inspection shall be carried out in any of the following situations:

a) In case of type finalization of new product's trial production and the trial production of old product after trans-plant;

b) When the product has major changes in design, technology, materials, etc., which are sufficient to affect product performance;

c) When production is resumed after 2 years of suspension;

d) For mass-produced products, it is carried out every 3 years; the sampling method shall be carried out according to GB/T 2828.11;

e) When relevant departments request type inspection.

#### 7.2.2 Inspection items

The inspection items are:

a) No-load, load and overload capacity;

b) Transmission efficiency;

c) Life test;

d) Starting torque;

e) Torsional stiffness;

f) Transmission accuracy;

g) Noise;

h) The maximum allowable temperature of housing.

## 8 Marking, packaging, transportation and storage

### 8.1 Marking

The reducer shall have a product label in an easily identifiable position. Its requirements shall comply with the provisions of GB/T 13306. The label content

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