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GB/T 3478.5-2008

Replacing GB/T 3478.5-1995

**Straight cylindrical involute splines -
Metric module, side fit - Part 5: Inspection**

圆柱直齿渐开线花键（米制模数 齿侧配合）- 第5部分：检验

(ISO 4156-3:2005, Straight cylindrical involute splines -
Metric module, side fit - Part 3: Inspection, MOD)

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Foreword

GB/T 3478 “Straight cylindrical involute splines - Metric module, side fit” is divided into 9 parts:

- Part 1: Generalities;
- Part 2: 30° pressure angle dimensions tables;
- Part 3: 37.5° pressure angle dimensions tables;
- Part 4: 45° pressure angle dimensions tables;
- Part 5: Inspection;
- Part 6: 30° pressure angle M and W values;
- Part 7: 37.5° pressure angle M and W values;
- Part 8: 45° pressure angle M and W values;
- Part 9: Measuring pin.

This part is the part 5 of GB/T 3478.

This part modifies and adopts ISO 4156-3:2005 “Straight cylindrical involute splines - Metric module, side fit - Part 3: Inspection”. The main differences are as follows:

- Respectively INCLUDE the calculation of the diameter of the measuring bar D_{Ri} and D_{Re} in clause 8.5, the calculation of pin spacing M_{Ri} and cross-pin distance M_{Re} in clause 8.6, the calculation of the average length W of the common nominal line of the external spline in clause 9 of ISO 4156-3:2005 into part 6, part 7, part 8 of GB/T 3478;
- MOVE the gauge design part of clause 10 of ISO 4156-3:2005 into Appendix A;
- ADD the one-way test method;
- ADD the analytical inspection; INCLUDE the appendix (indexing error analysis) of ISO 4156-3:2005 into clause 5.4.

This part is a revision of GB/T 3478.5-1995 “Straight cylindrical involute splines - Inspection methods”.

The main differences between this part and GB/T 3478.5-1995 are as follows:

Straight cylindrical involute splines - Metric module, side fit - Part 5: Inspection

1 Scope

This part of GB/T 3478 specifies the test method for the straight cylindrical involute splines.

This part is applicable to the inspection of splines manufactured according to GB/T 3478.1. It may also be used as a reference when using the gauge to inspect the straight cylindrical involute splines.

2 Normative references

The provisions in following documents become the provisions of this part through reference in this part of GB/T 3478. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this part; however, parties who reach an agreement based on this standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 1957 Tolerances and general features for plain limit gauges

GB/T 3478.1 Straight cylindrical involute splines - Metric module side fit - Part 1: Generalities (GB/T 3478.1-2008, ISO 4156-1:2005, MOD)

GB/T 3478.6 Straight cylindrical involute splines - Metric module side fit - Part 6: 30° pressure angle M and W values

GB/T 3478.7 Straight cylindrical involute splines - Metric module side fit - Part 7: 37.5° pressure angle M and W values

GB/T 3478.8 Straight cylindrical involute splines - Metric module side fit - Part 8: 45° pressure angle M and W values

GB/T 3478.9 Straight cylindrical involute splines - Metric module side fit - Part 9: Measuring pin

GB/T 13924 Inspection code for accuracy of involute cylindrical gears

3 Standard temperature

The standard temperature for measurement is 20 °C.

4 Inspection of major diameter and minor diameter of spline

4.1 The limit size of the minor diameter of the internal spline D_{ii} may be checked by the general smooth GO plug gauge and the NO GO plug gauge, it may also be measured by other methods.

4.2 The limit size of the minor diameter of the external spline D_{ee} may be checked by the general smooth GO plug gauge and the NO GO plug gauge, it may also be measured by other methods.

4.3 The use of general smooth plug gauge and ring gauge shall comply with the provisions of GB/T 1957.

4.4 The major diameter of internal spline D_{ei} , the minor diameter of external spline D_{ie} , the minimum radius of curvature of the root arc may be guaranteed by the process. If necessary, it shall be tested.

5 Inspection of the space width of internal spline, tooth thickness of external spline, diameter of involute end circle, diameter of involute starting circle

In GB/T 3478.1, it specifies three composite inspection methods and one single-item inspection method, totally four inspection methods, which are used to inspect four limit sizes of the space width and the tooth thickness (see Figure 1), as well as the minimum value of diameter of the involute's end circle $D_{Fi \min}$ and the maximum value of the diameter of the starting circle $D_{Fe \max}$.

See Appendix A for the involute spline gauges used to inspect the space width and tooth thickness.

thereby controlling the minimum value $C_{v\ min}$ of the active side gap.

At the same time, use the non-whole-depth NO GO spline gauge (plug gauge or ring gauge) or use the measured M value (pin spacing M_{Ri} or cross-pin distance M_{Re}) (for the external spline, it may use the average length W value of the measured common normal line), to control the maximum value of actual space width of the internal spline E_{max} or the minimum value of the actual tooth thickness of the external spline S_{min} , thereby controlling the minimum physical size of the internal and external.

5.2 Method-A

On the basis of the basic method, add the use of NO GO composite spline gauge (plug gauge or ring gauge), to control the maximum value of the active space width of the internal spline $E_{v\ max}$ or the minimum value of the active tooth thickness of the external spline $S_{v\ min}$, thereby controlling the maximum value $C_{v\ max}$ of the active side gap.

This method is suitable for two-way-rotation transmissions that have return requirements.

5.3 Method-B

Use the GO composite spline gauge and the NO GO composite spline gauge (plug gauge or ring gauge) to respectively control the minimum value $E_{v\ min}$ and the maximum value $E_{v\ max}$ of the active space width of the internal spline or the maximum value $S_{v\ max}$ and the minimum value $S_{v\ min}$ of the active tooth thickness of the external spline, thereby controlling the minimum value $C_{v\ min}$ and the maximum value $C_{v\ max}$ of the active side gap.

This method may only be used when the method-A is adopted, and it is proved by mass production that the process quality is stable. If the process quality fluctuates and may affect the product quality, it shall also use the method-A.

5.4 Single-item inspection method

Use the NO GO sector gauge and the NO GO sector gauge, or the pin spacing M_{Ri} , to control the maximum value E_{max} and the minimum value E_{min} of the actual space width of the internal spline. Use the NO GO sector gauge and the NO GO sector gauge, or the measured cross-pin distance M_{Re} or the average length W value of common nominal line, to control the maximum value S_{max} and the minimum value S_{min} of the actual tooth thickness of the external spline.

At the same time, use the measured total pitch error, the tooth profile error, the tooth helix error to control the integrated error.

This method is suitable for splines which are single-item or small-batch

5.4.4 Inspection of measured size M value by measuring pin

5.4.4.1 The diameter of the measuring pin (D_{Ri} , D_{Re}) as well as the measured size M value of the measuring pin ($M_{Ri\ min}$, $M_{Ri\ max}$, $M_{Re\ min}$, $M_{Re\ max}$) are as shown in GB/T 3478.6 ~ 3478.8.

5.4.4.2 Measuring pin for measurement shall comply with the provisions of GB/T 3478.9.

5.4.4.3 When the diameter of the actually-selected measuring pin is different from those as listed in GB/T 3478.9, the M value shall be calculated according to the diameter of the actually-selected measuring pin.

5.4.4.4 The M values (maximum and minimum values) as actually-measured on the same external spline shall be within the range of specified limits.

5.4.5 Inspection of average length W of common normal line

5.4.5.1 The average length W value of the common nominal line and the number of crossed-teeth which is used for the external spline are as shown in GB/T 3478.6 ~ 3478.8.

5.4.5.2 The length of the common nominal line as actually-measured on the same external spline takes the average value, which shall be within the range of specified limits.

6 Selection and labeling of inspection methods

6.1 The selection of the inspection method for the space width and tooth thickness of spline shall be determined by the product designer according to the structural characteristics and functional requirements of the product, or determined by the supplier's process conditions or the means of inspection by both parties.

6.2 The requirements for piece-by-piece inspection, first-piece inspection, spot inspection or regular inspection of spline parts shall be determined and incorporated into the process documents according to the importance of the spline parts and the stability of the process quality.

6.3 After the inspection method is selected, it shall indicate the following items on the spline part drawing or the agreement between the supplier and the purchaser. It may either be indicated together with other parameters of spline by forms, or be directly written into the technical requirements.

6.3.1 When using the basic method for inspection, it shall be indicated of the following items:

Internal spline:

- a) The minimum value of the active space width $E_{v \min}$;
- b) The maximum value of the actual space width E_{\max} .

External spline:

- a) The maximum tooth thickness of the active tooth thickness $S_{v \max}$;
- b) The minimum tooth thickness of the actual tooth thickness S_{\min} .

6.3.2 When using the method-A for inspection, it shall be indicated of the following items:

Internal spline:

- a) The minimum value of the active space width $E_{v \min}$;
- b) The maximum value of the active space width $E_{v \max}$;
- c) The maximum value of the actual space width E_{\max} .

External spline:

- a) The maximum tooth thickness of active tooth thickness $S_{v \max}$;
- b) The minimum tooth thickness of active tooth thickness $S_{v \min}$;
- c) The minimum tooth thickness of actual tooth thickness S_{\min} .

6.3.3 When using the method-B for inspection, it shall be indicated of the following items:

Internal spline:

- a) The minimum value of the active space width $E_{v \min}$;
- b) The maximum value of the active space width $E_{v \max}$;
- c) The maximum value of the actual space width E_{\max} (process guarantee).

External spline:

- a) The maximum tooth thickness of active tooth thickness $S_{v \max}$;
- b) The minimum tooth thickness of active tooth thickness $S_{v \min}$;
- c) The minimum tooth thickness of actual tooth thickness S_{\min} (process

Appendix A

(Normative)

Gauges

A.1 General

A.1.1 Conditions of use of gauges

A.1.1.1 GO gauges

The GO composite plug and ring gauges shall enter or pass over the complete spline length. Composite spline gauges shall be used without excessive force to prevent damage or distortion to the component or gauge. In case of disagreement, the composite gauge shall be accorded precedence in the acceptance or rejection of a part. If there are two gauges available and both are within the gauge tolerances, the gauge which fits the part shall be accorded precedence.

If a part is rejected by the GO composite gauge, the gauge itself cannot provide the reason. The reason can only be identified by the measurement of the actual tooth thickness or space width using measuring pins or balls, as well as the analytical inspection of total pitch error, tooth profile error, tooth helix error.

A.1.1.2 NO GO sector gauge

The NO GO sector gauge shall enter and pass completely through any specified position of the entire spline length. The inspection shall be carried out in at least three positions as equally-distributed as possible.

A.1.1.3 NO GO composite gauge

The NO GO composite gauge shall not enter the spline being inspected.

A.1.2 Limiting dimensions of use for gauges

The convenience of use of gauge is limited by the mass and size of the gauge.

When the diameter of indexing circle $D \leq 180$ mm, it may be tested by the gauge.

The diameter of indexing circle of gauge $D > 180$ mm. If the agreed between the supplier and the purchaser, the both parties may use the gauge.

A.1.3 Structure of spline plug gauge

A plug gauge which has a diameter of indexing circle $D < 50$ mm may be integral.

$$D_{ee} = 2 \left\{ A - \left[\frac{0.5(M_{Re} - D_{Re})}{\cos \frac{90^\circ}{z}} + \frac{D_{Re}}{2} \right] \right\}$$

Minor diameter:

$$D_{ii} = 2 \left\{ A + D_{Ri} - \left[\frac{0.5(M_{Ri} + D_{Ri})}{\cos \frac{90^\circ}{z}} - \frac{D_{Ri}}{2} \right] \right\}$$

A.5.4 Form diameter

Inspection method: Involute inspection instrument.

A.5.5 Tooth thickness of plug gauge

Inspection method: measurement by more than 2 measuring pins. Measurements shall be made within the range of $0^\circ \sim 90^\circ$ at each end and in the middle of the pin length. To avoid wear and small dirt, the measuring pin shall be wiped clean. Measuring pins may have a tolerance that affects the measurement. In order to meet the requirements, it shall use a calibrated measuring pin which has an exact diameter.

A.5.6 Space width of ring gauge

The inspection method is same as in A.5.5. The ring gauge is inspected by the use of measuring pin and gauge block. If the gauge block can be axially moved without obstruction meanwhile there is no radial movement, the ring gauge is qualified.

A taper master plug gauge may also be used to inspect the size of the ring gauge.

A.5.7 Shape tolerance

Inspection method: gear measuring machine. The tooth profile error and the tooth helix error shall be measured in at least three equally-spaced angular positions on the left or right flanks. For composite gauges, the total pitch error and the indexing error may also be inspected.

A.5.8 Gauge wear inspection

During a test cycle, it shall be ensured that the gauge is still within the wear limit. When the spline's space width and tooth thickness exceed a specified wear limit or when the shape error exceeds 1.5 times the allowable error, it shall consider disposal of the spline gauge.

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