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BASIC METHODS USED IN ANGLE MEASUREMENT AND THEIR ADVANTAGES

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Abstract: Angular measurements play an important role in the production and assembly of parts in the mechanical engineering industry. Especially in gearing, conical surfaces, cutting tools and complex mechanical mechanisms, angular accuracy is one of the main factors determining product quality. This article analyzes the angular measurement methods widely used in mechanical engineering – mechanical, optical, electronic and coordinate measurement methods – and highlights their advantages.

Keywords: Mechanical engineering, angular measurement, goniometer, cone angle, CNC, electronic encoder, accuracy.

Introduction

In mechanical engineering, parts manufactured are required to have high geometric accuracy. Even small deviations in angular parameters lead to malfunctions of mechanisms, the appearance of vibrations, rapid wear and a reduction in service life. Therefore, angular measurements are an integral part of the technological processes of mechanical engineering.

1. Mechanical angular measurement methods

Mechanical angular measurement methods are one of the most common methods in mechanical engineering. These methods use protractors, mechanical goniometers, sine lines, and angle templates.

These methods are mainly used to check the angles of conical parts, cutting tools (reamers, milling cutters, drills), as well as for initial control during the assembly process.

Advantages:
-Simple and reliable design;
-Convenient in production conditions;
-Does not depend on electricity.

Disadvantages:
-Limited measurement accuracy;
-Dependent on operator experience.

2. Optical angle measurement methods

Optical methods are used in mechanical engineering in processes requiring high accuracy. Optical goniometers, universal measuring microscopes and optical projectors belong to this group.

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They are used to control the tooth angles of gears, parts with complex profiles and precision cutting tools.

Advantages:
-Provides high accuracy;
-Contactless measurement is possible;
-Analysis of complex geometric shapes is possible.

Disadvantages:
-Instruments are expensive;

Limited use in production workshops.
3. Electronic and digital angular measurement methods
Electronic and digital measurement methods are widely used in modern mechanical engineering. Electronic goniometers, incremental and absolute encoders are used to control the angular position of the axes of rotation on CNC machines.
These methods provide high accuracy and speed in automated production systems.

Advantages:
-Very high accuracy;
-Possibility of automatic processing of results;
-Minimal impact of the human factor.

Disadvantages:
-Dependent on power supply;
-Requires maintenance.

4. Coordinate Measuring Machines (CMM)
Coordinate measuring machines are one of the most modern measuring tools in mechanical engineering. With the help of CMM, angles and complex surfaces in three-dimensional space are determined with high accuracy.
This method is especially effective in inspecting complex and high-precision parts.

Conclusion
The correct choice of angular measurement methods in mechanical engineering is an important factor in improving product quality. While mechanical methods are simple and reliable, optical and electronic methods provide high accuracy. Modern CNC and CMM technologies automate angular measurement processes in mechanical engineering, allowing for the production of competitive products.

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