

# Research on the Application of Precision Detection Technology in Machining and Manufacturing

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**Abstract:** In recent years, the speed of China's social and economic development continues to accelerate, and the quality requirements of machining and manufacturing have been improved. At present, there are problems in machining and manufacturing in China, which cannot guarantee the effect of quality control, which is not conducive to the improvement of the precision of machining products, and the application of precision detection technology in machining and manufacturing can comprehensively detect the precision of products. This paper accurately analyzes quality problems and provide support for improving the quality of machining and manufacturing. Based on this, this paper analyzes the significance of the application of precision detection technology in machining and manufacturing, and puts forward the application measures to provide help for improving the quality of machining and manufacturing.

**Keywords:** Precision Detection Technology; Mechanical Processing and Manufacturing; Apply

## 1. Introduction

In the process of machining and manufacturing, precision testing technology can accurately analyze the quality of products, and provide support for improving the precision and quality of product production. Therefore, it is necessary to pay attention to the use of precision testing technology during machining and manufacturing, improve the mode of technology application, conduct in-depth and accurate precision testing and analysis of machining and manufacturing products, quickly and accurately study processing quality problems, comprehensively and effectively solve problems, and contribute to the improvement of the quality and level of machining and manufacturing.

## 2. The Application Value of Precision Detection Technology in Machining and Manufacturing

The application value of precision testing technology in machining and manufacturing, like a precision gear, plays an indispensable role in improving product quality, optimizing the production process, and enhancing the market competitiveness of enterprises. With its high accuracy and efficiency, such technologies have brought revolutionary changes to the machining manufacturing industry. First of all, in machining manufacturing, even the smallest error can lead to a significant decline in product performance and even threaten the service life of the product. With advanced instruments and algorithms, precision detection technology can detect such errors and defects at the micron level or even nanoscale to ensure that every link of the product from design to production meets strict quality standards. The improvement of such capabilities undoubtedly provides a solid guarantee for product quality and makes enterprises invincible in the fierce market competition. Secondly, with the advent of the era of Industry 4.0, intelligent and automated production has become an inevitable trend in the machining and manufacturing industry. As an important part of intelligent production, precision detection technology can seamlessly dock with automated equipment and intelligent control systems to achieve dynamic monitoring and accurate control of the production process. The dynamic analysis and processing of detection data can adjust production parameters and processes in time to ensure that the production process is always in the best state. While improving production efficiency, it can reduce production fluctuations caused by human factors and make the production process more stable and reliable. Thirdly, in the process of machining and manufacturing, the connection

and cooperation between various production links is very important. Precision detection technology can provide accurate detection data to help enterprises more accurately grasp the actual situation in the production process, identify bottlenecks and shortcomings in the production process, and then optimize and improve them. . Finally, in today's society, consumers have higher and higher requirements for product quality and performance. Precision testing technology can help enterprises continuously improve product quality and reliability and meet the needs of consumers. At the same time, enterprises need to optimize the production process and reduce production costs, which can provide more products under the premise of ensuring product quality. Competitive prices further win the favor of consumers. The improvement of such value enhances the market competitiveness of enterprises and brings more business opportunities and development space to enterprises.

### **3. The Application Strategy of Precision Detection Technology in Machining and Manufacturing**

#### **3.1 Select the Appropriate Detection Equipment and Technology**

Choosing the right testing equipment and technology is a crucial link in machining and manufacturing, in order to ensure the accuracy and reliability of the test results, enterprises need to carefully analyze the characteristics and requirements of the product, select the appropriate testing equipment and testing technology. First of all, different products have different size, shape, material and performance requirements, so it is necessary to choose the matching detection equipment and detection technology. For example, for metal parts, it may be necessary to use optical microscopes, coordinate measuring machines and other equipment for dimensional measurement; For high-precision parts, it may be necessary to use laser interferometers, profilometers and other equipment to detect surface topography and roughness. Secondly, according to the product requirements to choose the appropriate testing method and accuracy level, for products with high precision requirements, high-precision testing equipment and testing methods should be selected to ensure that product quality meets

the requirements; At the same time, enterprises also need to pay attention to the development trend of technology, in order to introduce new testing technology and equipment in a timely manner, with the continuous development of science and technology, non-destructive testing, artificial intelligence and other new testing technology and equipment continue to emerge, such technology can improve testing efficiency, reduce costs and improve accuracy. Thirdly, when selecting the appropriate testing equipment and testing technology, the enterprise also needs to consider the compatibility and ease of use of the equipment, the equipment may only be suitable for a specific production process or a specific product type, so it is necessary to choose the equipment that can match the production process and product type of the enterprise. At the same time, enterprises also need to consider the maintenance and maintenance costs of equipment to ensure the long-term stable operation of equipment. Finally, after selecting the appropriate testing equipment and testing technology, it is also necessary to have the appropriate skills and knowledge of personnel to operate and maintain such equipment, so the enterprise needs to carry out technical training and talent team construction in stages to ensure the normal operation and use of testing equipment.

#### **3.2 Establish a Sound Detection System**

Establishing a perfect testing system is a key link to ensure stable and reliable product quality and performance. In addition to selecting suitable testing equipment and technologies, it is also necessary to build a relevant system from multiple dimensions such as process, standard, task assignment and result evaluation. First of all, the formulation of a reasonable testing process is the basis for the establishment of a testing system. The testing process should be clear. From sample reception, pre-processing, detection operation, data processing to result output, every step needs to clarify the operation methods and precautions to ensure the standardization and standardization of the testing process. Secondly, setting clear testing standards and requirements is the key to ensuring the accuracy of testing results. Such standards and requirements should be formulated according to the characteristics and uses of the product.

Size, shape, performance and other standards should keep pace with the times and reflect the changes in the market and customer needs in a timely manner. Thirdly, in terms of task assignment, it is necessary to reasonably allocate testing tasks according to the skills and experience of employees to ensure that each employee is qualified for their own work tasks and improve the efficiency and quality of testing. At the same time, it is necessary to clarify the responsibilities and obligations of each employee to ensure the smooth progress of the testing work. Finally, the phased evaluation and feedback of the test results is an important part of the testing system. The statistics and analysis of the test results can grasp the overall situation of product quality, find and solve potential problems in time; feedback the test results to relevant departments and personnel can promote the continuous improvement and improvement of product quality. In addition, to establish a perfect testing system, we also need to pay attention to the following aspects: strengthen the maintenance and maintenance of testing equipment to ensure the normal operation and stable accuracy of the equipment; strengthen the technical training and ability improvement of employees, and improve the testing level and efficiency; strengthen communication and cooperation with suppliers and customers to jointly promote production. Quality improvement.

### **3.3 Establish a Quality Traceability System**

Establishing a quality traceability system is an indispensable part of the modern manufacturing industry. On the basis of improving the level of refinement of product quality management, it can effectively deal with potential quality risks. With the quality traceability system, the enterprise can grasp the quality situation of the product more comprehensively and deeply, and then quickly locate the cause and take corresponding measures when the problem occurs. First of all, the construction of a quality traceability system can prompt enterprises to track the whole life cycle of products. From the procurement of raw materials, the monitoring of the production process, to the inspection and leaving of finished products, the data of each link can be recorded and included in the traceability system. In this way, once there is a

quality problem in the product, the enterprise can quickly trace it to the source of the problem. It is clear that it is a problem of raw materials, a defect in the production process, or a defect in other links. The ability to quickly locate the problem is of great significance for correcting errors in a timely manner and avoiding the expansion of the problem. Secondly, the quality traceability system can provide enterprises with rich data analysis support, grasp the overall distribution, change trend and potential risk points of product quality, prompt enterprises to find weak links in the production process, and provide a strong basis for optimizing the production process. For example, enterprises can adjust production parameters, improve process flow, improve product quality and reduce production costs according to the results of data analysis. Thirdly, the quality traceability system can also improve the customer service level of the enterprise. Once the relevant personnel have questions or complaints about the product quality, the enterprise can use the traceability system to quickly find relevant information, provide customers with accurate and timely answers and solutions, enhance the customer's trust and satisfaction with the enterprise, and establish the enterprise. Good brand image and reputation. It should be noted that in the process of implementing the quality traceability system, enterprises need to pay attention to the following points: ensure the accuracy and completeness of the traceability data and avoid data fraud or omission; phased maintenance and update of the traceability system to adapt to product upgrades and changes in market demand; strengthen the training of employees to the traceability system. Training and education to improve the operation level and quality awareness of employees.

### **3.4 Define the Technical Application Content**

#### **3.4.1 Laser precision detection technology**

The application of laser precision detection technology in machining and manufacturing needs to accurately measure the size and shape of parts, accurately detect the aperture, hole distance, parallelism, perpendicularity, etc., while detecting the surface quality of the workpiece, analyzing the roughness, scratches, pits, etc., the laser beam is irradiated to the

surface of the workpiece during the operation, and the surface quality is judged according to the change of reflected light. Fast and accurate inspection of the workpiece. Or detect the trajectory of the machine tool to ensure the accuracy and stability of the processing process, such as: the laser beam is illuminated to the moving parts of the machine tool, according to the change of the reflected light to determine whether the trajectory is correct, based on the real-time monitoring and adjustment of the machine tool. In addition, laser precision testing technology can be used to detect the density, hardness, elastic modulus of materials, build an automated testing system, quickly and accurately detect the size, shape, surface quality and material characteristics of the workpiece, improve production efficiency and product quality.

#### 3.4.2 Quartz sensor precision detection technology

In the field of machining and manufacturing, quartz sensor precision detection technology is used, which has the characteristics of high precision, high stability and high sensitivity, and can detect various parameters in machining and manufacturing, and clarify pressure, temperature, flow rate, liquid level and so on. During this period, the quartz sensor can be combined with the automated detection system, the automatic detection process, the quartz sensor and the control system and data acquisition system are connected, real-time monitoring of the mechanical processing and production, or the quartz sensor is connected to the Internet for remote monitoring and remote maintenance, to improve the effect of precision detection.

#### 3.4.3 Visual precision detection technology

The application of visual precision inspection technology in machining and manufacturing requires the use of image processing and analysis technology to accurately detect the size and shape of parts, detect the shaft, gear, mold, etc., detect the surface quality of parts, such as roughness, scratches, pits, etc., point the camera at the surface of the workpiece and shoot images, and use image processing algorithms for analysis. Detect surface quality quickly and accurately. Or the camera is installed in the corresponding position of the machining production line, real-time monitoring of the size, shape, surface quality and other parameters of the workpiece, the

detection results are transmitted to the control system for further processing, to improve the level of precision detection.

### 3.5 Make Full Use of Information Technology

Fully realizing the application of information technology in the field of precision detection is undoubtedly a key way to improve the efficiency, accuracy, automation and intelligence level of enterprise detection. First of all, digital measurement technology has brought unprecedented convenience to enterprises. Traditional measurement methods may be affected by human factors, environmental interference and other factors, resulting in errors in the measurement results. Digital measurement technology mainly uses high-precision sensors and advanced algorithms to accurately collect and process measurement data, reduce human error, and improve the accuracy and reliability of measurement. Secondly, the application of automatic control technology can greatly improve the automation of the detection process. Enterprises adopt an automated control system to accurately control and monitor the detection equipment to ensure that the equipment runs in the best condition. At the same time, automatic control can also reduce the tediousness and complexity of manual operation and reduce the labor strength of operators. Improve work efficiency. Thirdly, using advanced technologies such as image recognition and machine learning, the intelligent identification system can realize the automatic identification, classification and positioning of detection objects, improve the accuracy and efficiency of detection, be used for product quality detection, monitoring and management of production process, and improve the overall operational efficiency of the enterprise. Finally, in order to fully realize the application of information technology in precision detection, enterprises also need to strengthen the construction and integration of information systems, realize information sharing and collaborative work among departments, and improve the overall efficiency and quality of detection work. At the same time, enterprises should also pay attention to the development of information technology, introduce new technologies and equipment in a timely manner, and constantly

improve their detection ability and level.

### 3.6 Introduction of Artificial Intelligence Technology

The introduction of artificial intelligence technology is an important measure in the field of precision detection, which has broad application prospects. First of all, machine learning and deep learning technology are the core applications of artificial intelligence technology in precision detection. Machine learning and deep learning technology in training algorithms are used to identify defect patterns in products and improve the accuracy and efficiency of detection. During this period, a large amount of data is needed as training materials, and algorithms are used for data. Analysis, learning and induction, accurate identification and classification of defects. Secondly, enterprises can build an intelligent detection system to detect products efficiently and automatically, reduce manual intervention, and improve detection efficiency and accuracy. At the same time, artificial intelligence technology can also dynamically monitor and evaluate detection results, provide early warning and feedback on abnormal data and defects, and help enterprises find problems in time and take corresponding measures. Thirdly, artificial intelligence technology can also be applied to the monitoring and management of the production process, analyze and mine the data in the production process, help enterprises achieve refined management of the production process, improve production efficiency and product quality. Finally, in order to give full play to the application of artificial intelligence technology in precision detection, enterprises can cooperate and exchange with other machining manufacturing enterprises or research institutions, jointly research and apply precision detection technology, share resources and experience, accelerate the development of technology, and improve the competitiveness of enterprises.

### 4. Conclusion

All in all, precision testing technology has a very important application value in machining

and manufacturing, enterprises need to choose the right testing equipment and technology, establish a perfect testing system, improve the content of technology, introduce artificial intelligence technology, carry out cooperation and communication, improve the efficiency and accuracy of precision testing, and promote the sustainable development of enterprises. On this basis, in order to adapt to the development trend of technology, enterprises need to have the innovative spirit of keeping pace with The Times, combined with the development needs and development trends of the machining and manufacturing industry, and constantly optimize the precision detection technology and processing technology, so as to stand out in the fierce market competition environment, and win good development prospects and broad space for development.

### References:

- [1] He Jiang. Application Analysis of Precision Inspection Technology in Machining and Manufacturing Field [J]. China Metal Bulletin, 2022(1):58-60.
- [2] Yue Jianshe, Fan Jiangkun. Application Analysis of Precision Inspection Technology in Machining Manufacturing [J]. Mold Manufacturing, 2023, 23(11):133-135.
- [3] Dai Xing. Research on the application of Precision Detection Technology in Machining and Manufacturing [J]. Digital Users, 2024(16):31-32.
- [4] Ni Jing. Analysis of the application of Precision Detection Technology in the field of Machining and Manufacturing [J]. China Equipment Engineering, 2021(24):185-186.
- [5] Chen Zan, Zhang Gongxiao, He Zhiying, et al. Optical Precision Engineering, 2023, 31(19):2836-2849. Magnetic field Time-gate Displacement Sensor Based on Discrete winding [J].
- [6] Yan Qing, Peng Bo, Wang Li, et al. Research on penetration spectrum detection technology of laser cold working hole [J]. Acta Photonica Sinica, 2023, 52(3):241-249