

# Gear Precision Manufacturing Key Technology, Machine Tool and Numerical Control System

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**Abstract:** With the rapid development of times economy, the development of gear manufacturing industry based on the high development of science and technology has been effectively improved. With the development of gear construction industry, the economic construction of our country has also got a great push. In this case, the development direction of gear manufacturing industry has received attention from all walks of life, so the technology in various fields of gear manufacturing has been highly developed, relying on the introduction of modern technology, which has a great impact on the quality of gear manufacturing. In the gear manufacturing industry, the use of CNC machine tools can highly realize the needs of gear precision machining, is an important means of industrial development at the present stage, but also the development trend of gear manufacturing industry technology equipment in the future, has played an irreplaceable role in the gear manufacturing industry, CNC system is the core of the efficient application of machine tools.

**Keywords:** Gear; Precision manufacturing; Numerical control system

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As a basic component in process construction industry, the precision of gear can directly affect the performance of process. The key to achieve precision in gear construction lies in the formulation of relevant processes, and the selection of processes should be based on the specific selection of gear types for different purposes <sup>[1]</sup>.

## 1. Gear precision machining technology

There are many kinds of gear manufacturing, among which the pattern forming method is a representative gear profile machining method. This machining method is based on the principle of gear meshing. The typical machining methods are gear hobbing and shaving. In addition, the tool processing mode based on the tooth blank is also a gear processing mode. Normal gear manufacturing can be processed with 8 levels of precision, using precision gear machining equipment and hobs can be processed with 4 to 5 levels of precision. In the manufacturing process of the gear may appear tooth shape or rough surface and other direction deviation, resulting in the precision of the gear does not meet the requirements, which requires the processing personnel to find the problem in the processing process, and to control it, effectively improve the precision of the processing process.

The machining process of the grinding wheel is based on the machining principle of the grinding wheel. The machining method of the grinding wheel has the highest precision in the machining of the gear. It can be used to process the gear with higher hardness after machining and quenching. But at the same time, it will have higher technical requirements, and the production cost is higher.

The gear machining method of strong honing is based on the meshing operation mode between the honing wheel and the corresponding honing wheel. There will be a relative sliding speed between the honing wheel and the corresponding honing wheel tooth surface, and the speed generation is accompanied by the generation of pressure. Using the generated speed and pressure, the gear can be precision machining. Make it more and more widely used in gear manufacturing industry.

## 2. Gear precision forging equipment

### 2.1 Multi-link drive mechanical press

In the process of cold exercise, because the forging material has the characteristics of strong compressive deformation ability, the required forging deformation speed is low. Because of the characteristic of the deformation speed, the production speed of the gear is slow and the efficiency is low. The multi-link press can effectively solve this problem. The driving structure adopted by this structure

effectively reduces the formation speed of the slide block and increases the speed of the blank line process of the slide block, which effectively improves the efficiency of the production process<sup>[2]</sup>. Compared with the general press, under the same stroke condition, the multi-link equipment has a higher running speed than the general press, and the impact speed will not be different.

## **2.2 Precision forging hydraulic press**

Because the forging material has strong compressive properties and the required deformation rate is low in the case of refining, the hydraulic press equipment can meet the refining process requirements.

The new single-action, double-action, three-action, multi-direction and multi-station CNC precision forging hydraulic press developed by Huazhong University of Science and Technology is composed of high stiffness fuselage formed by the knuckle-bar press, precision guide module, hydraulic device with slow deformation, etc., which can realize fast short-range and slow deformation. These properties enable the hydraulic press to accurately control the fast slow conversion. Fully meet the needs of precision forging.

## **2.3 New CNC electric screw press**

The performance of the new CNC electric screw press developed by Huazhong University of Science and Technology can match the international coal industry level, but its price is relatively low. The working principle of this press is based on the rotating motion of the motor in the screw, and the pulley moves back and forth accordingly, so as to complete the forging work. This type of press can have the following excellent performance. First of all, it has a high precision, which can accurately control the striking range, so that the gear manufacturing has a high precision, suitable for precision forging manufacturing; Secondly, when the sliding block is in a static state, the motor stops working, so that the power consumption capacity is low, and the use of the recycling device, strengthen the reduction of power consumption; The application of modern AC system in the pressure system avoids the influence on other equipment in the plant and the power grid; Because of the simple structure of the machine and equipment used, it may cause low impact of the noise, and it is relatively simple in the process of use and maintenance. The introduction of digital system makes the production more automated.

## **3. Strengthen the application level of numerical control technology**

Numerical control technology includes computer technology, automation technology, mechanical construction technology, is an integrated platform, can realize the application of high-tech technology, the introduction and application of numerical control technology can make gear manufacturing integration, and improve the efficiency and quality of manufacturing, and can effectively ensure the reliability of gear production, The manufacturing capacity of gears has reached a new level<sup>[3]</sup>. Numerical control system can effectively realize the production process of equipment control, the effective application of numerical control system depends on the correct working process of machine tool equipment. In industrial construction and products, gear is an important component in the production of mechanical products. The precision level of gear is closely related to the size and shape in the manufacturing process. Due to the high level of industrial production technology at the present stage, the requirements of gear production specifications are also high, so we should pay attention to the precision of gear products in the manufacturing process. Gear manufacturing enterprises need to improve the level of specialization of manufacturing equipment and testing. Gear detection equipment also needs to be more advanced, such as the evaluation of gear tooth surface features such as numerical control system. Facilities and systems are only in the initial stage. If enterprises want to realize the precision production of gear, they need to build a mature production environment. Therefore, the enterprise needs to adjust the gear cutting parameters according to the practice of gear production, so that the cutting feed can be reduced, improve the cutting times, the non-compliant gear design again, in the production work, pay attention to the maintenance and update of CNC system related equipment.

## **4. Development direction of new gear manufacturing technology**

### **4.1 Process centralization**

For the process centralization, the biggest advantage is that the process centralization program has a strong machining precision. For some processing components with complex processes, the process centralization program can be adopted to realize the integrated clamping processing, which avoids the positioning errors generated in multiple processes to a great extent and effectively improves the precision of gear processing<sup>[4]</sup>. The introduction of all kinds of modern machine tool technology, so that the processing of components can realize integrated manufacturing, and milling groove, drilling series processing program from the original must be completed separately into the integration of the process can be realized in situ, so that the manufacturing precision of gear can be greatly improved, avoid the positioning error caused by repeated procedures, positioning error of the machine tool itself can be controlled by numerical control system, Improve the precision of gear manufacturing.

## 4.2 Application of tooth grinding

The precision level of the gear grinding process is of great significance in maintaining a country's capability in precision gear manufacturing. At present, the precision of grinding tooth manufacturing in China is up to 3 levels, which is 1 to 2 levels behind that in the international industry. Gear grinding manufacturing scheme is one of the effective technologies to realize gear precision machining. The range of application of gear grinding technology in the current industry mainly covers the processing of transmission cylindrical gear and spiral bevel gear manufacturing. The grinding gear machining method can realize the precision production of the hardened gear based on the heat treatment deformation method. But at the same time, it is urgent to solve the problems caused by the tooth grinding process in the hot deformation process.

## 4.3 Gear automatic sorting and testing machine

At present, with the introduction of modern technology and the rapid development of gear manufacturing technology, the gear burr elimination technology in the production process and production to prevent gear bump technology has also been a higher development, but still can not meet the production of gear, collision and burr is still an important factor for repair. In the form of gear manufacturing industry at this stage, how to avoid these problems has the following two ideas. The first is how to avoid the occurrence of burr and collision between gears in the process of production; Secondly, before assembly, it is necessary to use the sorting inspection machine to check the burr and the knock generated, so that the assembled device meets the production needs and avoids the production of repair problems.

## Conclusion:

As an important component in industrial construction industry, gear is indispensable in industrial manufacturing industry. With the introduction of modern technology, gear manufacturing industry has been a certain development, the realization of intelligent, efficient, precise gear manufacturing is the development trend of the current and future gear manufacturing industry. Gear processing gradually becomes more fine, all kinds of machine tools suitable for gear processing have become more practical, the introduction of numerical control system makes machining machine tools more precise, more efficient, more automation level. Chinese gear manufacturing industry should seize the development opportunity to realize the development of modern technology reference and practicality, and realize the development of gear manufacturing better and higher.

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