

Discussion on the Application of Conical Interlocks in Automobile Mold

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Abstract: The correct use of the conical interlocks in the automobile mold can keep the mold stability unchanged, and the mold stability does not change with the parallel accuracy of the bed. In this way, repeated research and development and repeated debug are avoided to obtain stable quality parts.

Keywords: Conical interlocks; Stability; Repeated research and development; Repeated debug

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1 Introduction

In the process of manufacturing and delivering stamping automobile molds, we often find that after the mold is repeatedly punched and replaced with stamping equipment, the coloring of the cone balance block and the coloring between the convex model surface and the presser surface are different and the quality of the produced parts is unstable. So, it has to be re-developed and adjusted, which increases the workload, prolongs the manufacturing cycle, the production cycle, and wastes manpower and resources. When we tracked a project, the mold manufacturer did not understand the role and correct use of the conical interlocks, the stability of the mold and repeated research and development have not been well resolved and the surface quality of the mold parts during production varies from time to time. Therefore, the correct understanding of the role of the conical interlocks and the correct use of the conical interlocks are the problems we must solve.

2 Correct understanding of conical interlocks

The technical requirements for the assembly of conical interlocks: the size of the four conical interlocks is the same, the size of the plate under the four conical interlocks is the same, and the fit rate of the conical interlocks is more than 95%.

The original assembly process plan was arranged as follows:

(1) Develop the presser first to make the fitting rate of the profile meet the requirements, and then measure the size of the upper and lower mounting surfaces of the four conical interlocks;

(2) According to the actual measurement size, determine the size of the backing plate under the conical interlock;

(3) Determine the size of the backing plate with grinding cone

(4) Assemble the conical interlocks and the backing plate with grinding cone, and adjust the fitting rate of the profile again by pressing the upper mold.

This solution has the following disadvantages:

(1) The size of the four or more sets of conical interlocks is not guaranteed to be the same. The size of the backing plate under the conical interlocks is inconsistent and the conical interlocks cannot be interchanged; and it is easy to be confused when it is disassembled and reinstalled during maintenance;

(2) The influence of the equipment's parallel accuracy on the mold during manufacturing cannot be eliminated;

(3) The accuracy after CNC machining is not guaranteed; cannot detect the error of CNC machining; cannot detect the grinding allowance during research and development;

(4) The mold is debugged in different stamping

equipment. When stamping parts, the fit rate of the presser is unstable, and the fit rate of the conical interlocks is also different; it is necessary to repeatedly research and configure the press plate and repeatedly adjusts the fit rate of the conical interlocks and so the surface quality of parts is not stable during mass production.

In the following period, I looked through some materials regarding the use of conical interlocks, but no such information is available. , Each worker master, engineer and each mold manufacturer have different understandings and views on its role and use, but they are very vague as for how to assemble, and when to install a conical interlocks, and the method of assembly is also different.

In practice, I repeatedly studied and analyzed: CNC machine tool mold surface error value is less than 0.1mm, and high-speed five-axis machining is used for finishing. After processing, measure with a measuring machine. The surface error is qualified within 0.1mm

and the cumulative error of the profile of the punch and the blank does not exceed 0.2mm. However, after we completed the research and development of the press, the upper and lower mold surface errors were far beyond 0.2 mm.

The reasons for this result are found to be related to the following two factors after analysis:

(1) It has something to do with the parallel accuracy of the bed.

(2) Whether the conical interlocks are installed after the press plate is researched and developed, or it is installed before the development;

I seem to have realized that there is a way to ensure the interchangeability of the four conical interlocks. When researching the press plate, I must also ensure that the four conical interlocks have the same size; then the size of the mounting surface where the convex-concave conical interlocks are installed should be the size of the convex-concave conical interlocks plus the size of the backing plate (Figure 1).

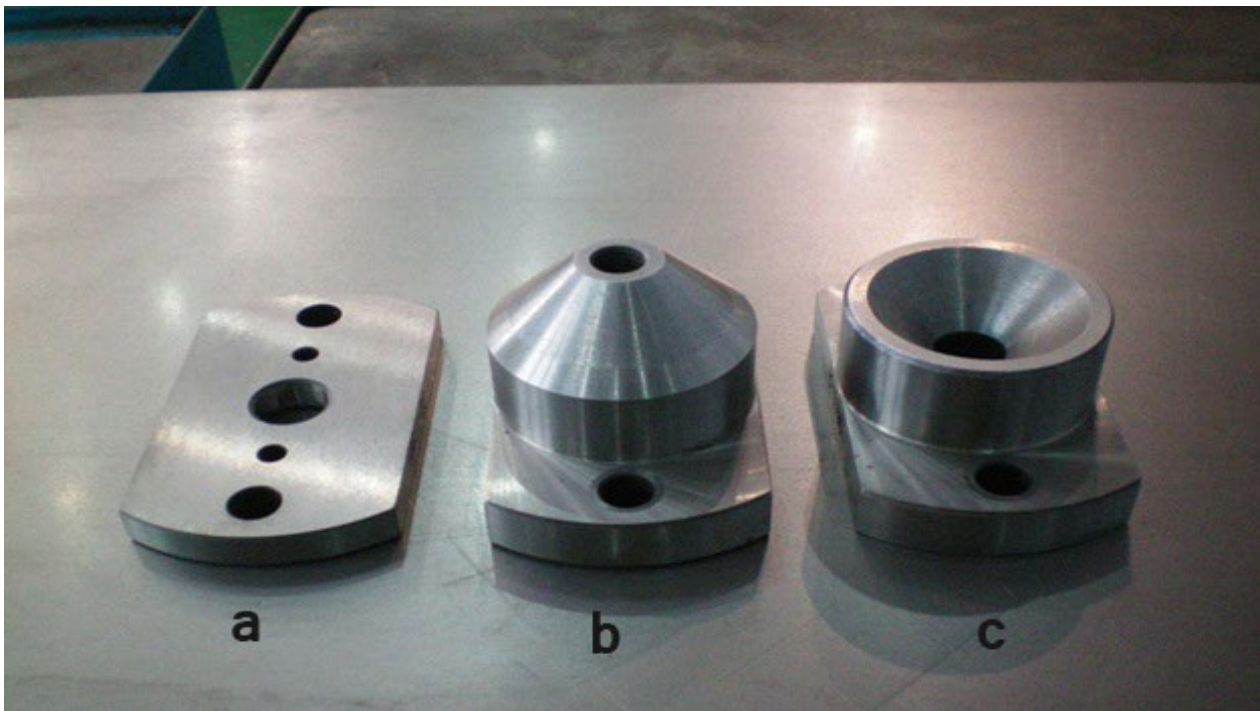


Figure 1. Disassembly of conical interlocks A: Plate; B: Convex conical interlock; C: Concave conical interlock

Therefore, the size of the upper and lower mounting surfaces of the conical interlocks should be the same when CNC machining (Figure 2). In order to avoid the cumulative error of CNC machining, when roughing

the profile, a certain machining allowance is left on the upper and lower mounting surfaces of the conical interlocks. After finishing the profile, the conical interlocks mounting surface is machined.



Figure 2. The size of the upper and lower mounting surfaces of the conical interlocks

Therefore, the installation of the conical interlocks should be done before the research and development; it is necessary to take the conical interlock as the reference to ensure that the size of the four conical interlocks are consistent; and to ensure that the accuracy does not change after CNC machining. To summarize, I finally understood the role of conical interlocks

and the advantages of using them. The rear window frame mold of a certain model of FAW-Volkswagen was experimentally verified and achieved very good results. The same parts made by the previous mold manufacturer were used for benchmarking. There are 47 shifts and 376 hours for post research and development (Table 1).

Table 1. 47 shifts and 376 hours for post research and development

| Statistics of R & D and commissioning shifts of presses by mold manufacturers | | | | | | |
|---|----------------------|----------------------|----------------------|----------------------|---------------|------------------------|
| Mold Name/ Process | OP30 | OP40 | OP50 | OP60 | Empty Station | Total |
| BC316/1 Rear window frame | 4 Shifts 32 Hours | 5 Shifts 40 Hours | 6 Shifts 48 Hours | 8 Shifts 64 Hours | | 23 Shifts 184Hours |
| Statistics of R & D and commissioning shifts of presses after mold transfer | | | | | | |
| Mold Name/ Process | OP30 | OP40 | OP50 | OP60 | Empty Station | Total |
| BC316/1Rear Window Frame | 4 Shifts 32 Hours | 5 Shifts 40Hours | 7 Shifts 56Hours | 8 Shifts 64 Hours | | 24 Shifts 192 Hours |

The improved assembly process plan is used for research and development. The mold manufacturers OP30-60 commission the shifts. After the mold is transferred, the fit ratio of the OP30-60 conical interlocks is same and there is no change in the fit

rate between the convex model surface and the mold profile surface. The surface quality and measurement dimensions of the part have not changed. After the mold is transferred, the OP30-60 mold has zero research and development(Table 2).

Table 2. After the mold is transferred, the OP30-60 mold has zero research and development

| Statistics on the R&D and commissioning shifts of presses after mold transfer | | | | | | |
|---|---------------------|-----------------------|------------------|------------------------|---------------|---------------------|
| Mold Name/Process | OP30 | OP40 | OP50 | OP60 | Empty Station | Total |
| BC316/1Rear Window Frame | 2 Shifts 16Hours | 1.5 Shifts 12Hours | 1Shift 8Hours | 1.5 Shifts 12 Hours | | 6 Shifts 48Hours |

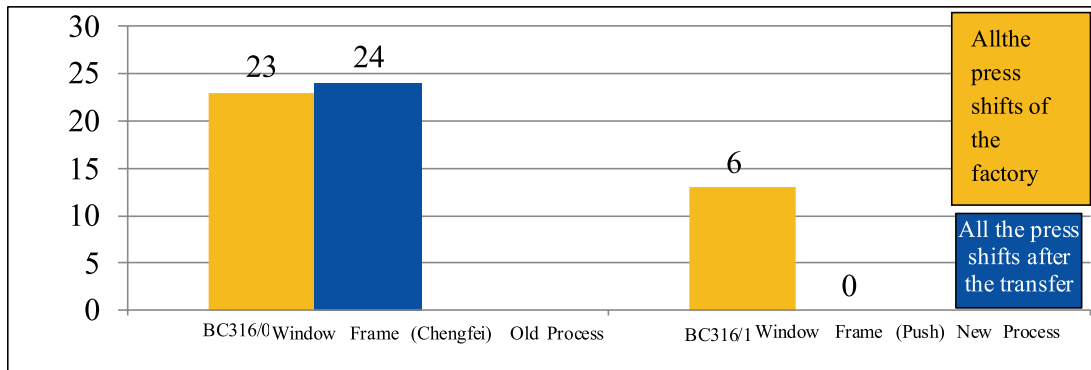


Figure 3. Comparison of old and new assembly research and development

The repeated research and development that was previously impossible to avoid was finally solved, and the mold instability was also solved at the same time. And shorten the mold manufacturing cycle and delivery cycle.

3 The role of conical interlocks

The following are the roles of conical interlocks:

(1) It can avoid damage to the accuracy after CNC machining, and also to check the CNC machining errors; (can check the CNC machining errors, not sure whether there is an error in the upper or lower mold processing)

(2) It can reduce the accumulation error of CNC machining during research and development:

(3) It plays the role of positioning; ensure the material thickness relationship between the punch and the press;

(4) It can correct of parallel accuracy deviation of the bed during punching;

(5) It can ensure that the mold state remains the same when the stamping equipment is replaced, thereby avoiding repeated research and development.

4 Improved assembly process plan

The improved process plan is used to assemble the conical interlocks, which can give full play to the role of the conical interlocks. It has the following advantages:

(1) It can ensure that the size of the four or more sets of conical interlocks and the plates under the conical interlocks are consistent and have good interchangeability;

(2) It can guarantee the accuracy after CNC

machining, and also check CNC machining errors; (Can inspect CNC machining errors, not sure whether there is an error in the upper or lower mold processing)

(3) It can detect the grinding allowance during research and development, and appropriate tools are used for development;

(4) It can correct the parallel accuracy of the bed when the mold is debugged in different stamping equipment.

(5) It can ensure that the stability of the mold does not change with the change of equipment and avoid repeated research and development.

The disadvantage of the conical interlock is that the manufacturing process is complicated and the manufacturing cost is high.

5 Conclusion

In the manufacturing process of the mold, the research and development is the most important step. It takes the most time and is also the most critical step to ensure the quality of the surface of the part. Often, changes are made to the stamping equipment and the replacement of the stamping equipment is done repeatedly, so that repeated research and development cannot ensure the stability of the mold. By adopting the improved assembly process flow plan, practice has proved that the stability of the mold can be guaranteed not to change with the parallel accuracy of the bed, and repeated research and development is avoided to obtain consistent quality parts, shorten the manufacturing cycle, get better economic benefits, and be more competitive.