

## Confirmation of the heat check deterrent effect by the shot peening

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Die cast method is often used for automotive parts that can make high strength and high precision parts. Parts are molded in high temperature and high pressure. Then, high strength is required on die casting die. Most common destruction forms of die cast die are called heat checking which generate casting defects. In this study was used specimens of the same material, but submitted to different treatments. The cyclic heat stress was simulated on the specimens and were compared the results among the different treatments.

**Keywords:** shot peening, die cast, heat checking.

### 1. Introduction

Die cast method is often used for automotive parts that can make high strength and high precision parts.

Parts are molded in high temperature and high pressure. Then, high strength is required on die casting die.

Most common destruction forms of die cast die are called heat checking which generate casting defects. Heat checking is occurred on the grain boundary by cyclic heat stress due to molten and release agent. Therefore, it will occur flat surface easily.

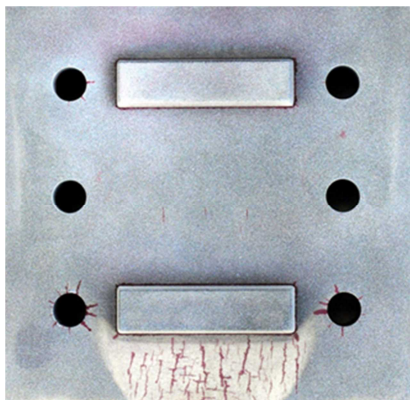


Fig.1 Heat checking

Fig.1 shows the typical heat checking that occurred at the die surface [1] [2]. Shot peening is a method of cold working. Residual stress is generated by shot peening near the metal surface by hitting small spherical metal on the surface in order to improve

fatigue strength. Mainly, it is used for transmission gear or valve spring.

In this study, authors will report the shot peening deterrent effect to heat checking on die casting die.

### 2. Experiment method

Hot tool steel that is called SKD61 is prepared for specimens. Table1 shows chemical composition of SKD61. After machining, we carried out various kind of surface treatment. Table 2 shows condition of heat treatment.

Table1 Chemical composition of SKD61 (%)

C	Si	Mn	Cr	Mo	V
0.4	1.0	0.4	5.2	1.2	0.8

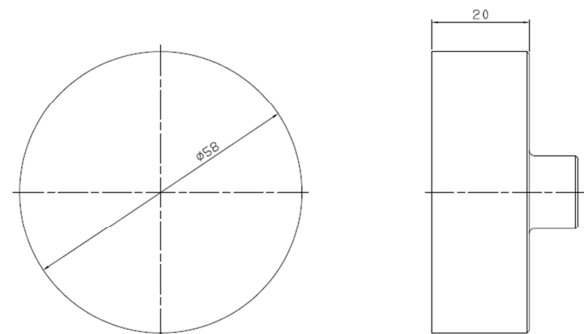


Fig.2 Shape of specimen

Table2 Condition of heat treatment

Heat treatment	Number of cycle
Quenching +Tempering	15000, 100
Salt bath nitriding	10000
Repeening	25000 (5000/Repeening)
Laser peening	100

Fig. 2 shows the shape of specimens. Fig.3 shows the method of experiment. Surface of specimen was put on the heater that was heated in approximately 853K. After this, the specimen was dropped into cold water. Then, the specimens were submitted to cyclic

heat stress. In this cycle was simulated the cyclic heat stress that occurs on die casting die.

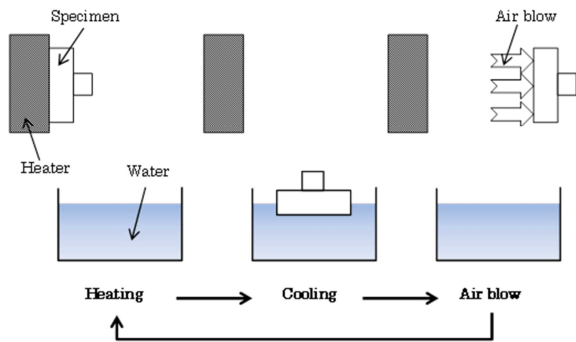


Fig.3 Method of experiment

Basically, heat checking was beginning to occur after 100cycle. But, authors observed heat checking after 1000 ~ 25000 shots. In one specimen, the shot peening was applied again every 5000cycles in order to expand the life of die. Residual stress, FWHM and 3D shape were investigated.

### 3. Result

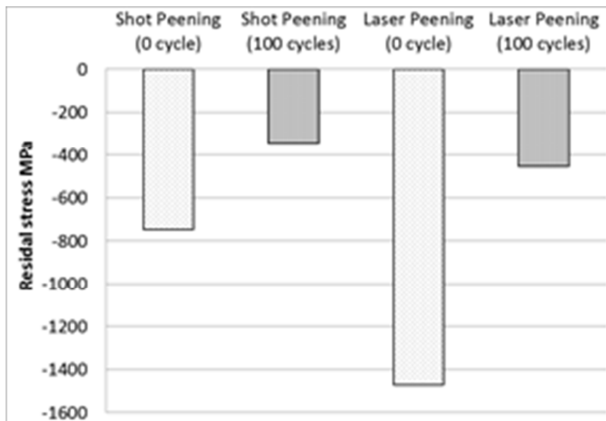


Fig.4 Surface residual stress

The Fig.4 shows the residual stress in the shot peened and laser peened specimens before the cyclic heat stress (0 cycle) and after the cyclic heat stress (100 cycles). The residual stress in the laser peened specimen is 97% higher than the residual stress in the shot peened specimen, but after 100 cycles the residual stress decreases considerably in both cases and now the residual stress in the laser peened specimen is only 31% higher than the residual stress in the shot peened specimen.

In the Fig.5 is shown the photograph of heat checking in a shot peened specimen before the cyclic heat stress, after 100 cycles and a laser peened specimen after 100 cycles. In the first picture, regarding to shot peened specimen before the cyclic

heat stress, was not found any heat checking. In the second picture, regarding to shot peened specimen after 100 cycles, almost there are no cracks due the

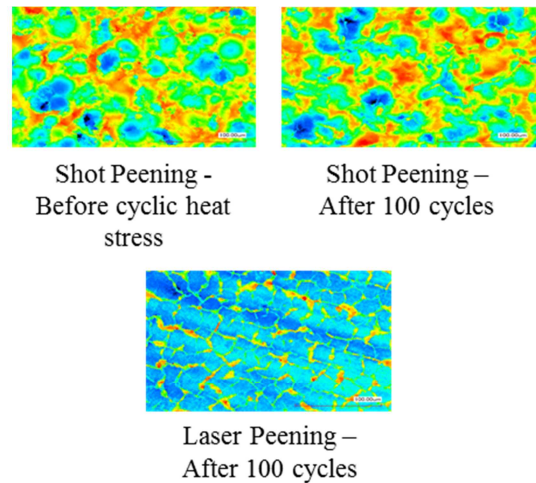


Fig.5 Comparison of heat checking between Shot Peening and Laser Peening

heat checking effect. And, in the third picture, regarding to laser peened specimen after 100 cycles, there are a representative quantity of cracks due the heat checking effect. Although the laser peening process have better remaining residual stress, the shot peening process presents better results for heat checking deterrent effect, because the plastic deformation is much higher in the shot peening process.

Shot peening process is more effective than the laser peening process, beyond being cheaper.

### 4. Summary

Heat checking deterrent effect by shot peening is confirmed. The laser peening process have better remaining residual stress, but the shot peening process is more effective for heat checking deterrent effect than the laser peening process, beyond being cheaper.

The results provide valuable information to reduce casting defects.

### References

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