

# Study on the Failure Ratio of the High Carbon Cast Steel Shot

This paper was submitted by Xinhua Zhao, a graduate student at the Material Science & Engineering College of Shandong University in China. The Shandong Material Science & Engineering College extensively studies shot peening and blast cleaning and provides technology support to Shandong Kaitai Metal Abrasive Company, one of China's largest metal abrasive producers. According to Mr. Zhao, his study on the wear failure of high carbon cast steel shot brings new concepts to the abrasive field. The complete article is available in the online library at [www.shotpeener.com](http://www.shotpeener.com).

Xinhua Zhao<sup>1</sup>, Ruwei Liu<sup>1</sup>, Hongwei Wang<sup>2</sup>,  
Hongju Gao<sup>1</sup>, Laibin Zhang<sup>3</sup>, Ruiguo Wang<sup>3</sup>

1. College of Materials Science and Engineering, Shandong University  
Jinan 250061, P.R. China

2. Chemical Products Recovery Shop  
Laiwu Steel Corporation  
Laiwu 271104, P.R. China

3. Shandong Kaitai Metal Abrasive Co., Ltd.  
Zouping 256217, P.R. China

## Abstract

The ERVIN test machine was used in this study to mimic the actual blast cleaning process. The high carbon cast steel shot sample, heat-treated at five different temperatures, are put into a ERVIN tester and ran for predefined cycles. The wearing of the samples were examined under a magnifier. The failure ratio was defined and its influencing factors were studied. The results show that the failure modes, including brittle fracture, surface peeling and core spall, can be analyzed by means of failure ratio represented by the defined weight ratio  $G_f/G_t$ , the failure ratio are affected by the heat treatment, ERVIN cycle, microstructure and flaws, particle size, target hardness. Impact velocity and impact angle play an important role in the wearing failure process.

Keywords: high carbon cast steel shot, failure ratio, surface peeling; core spall, weight ratio, influencing factors

## 1. Introduction

From the appearance, it is difficult to distinguish the high carbon cast steel shot samples after different heat treatments, and at present the abrasive manufacturers only provide the

technical data and physical characteristics in the data sheet based on related standards[1,2], but the ERVIN life and the wearing failure modes are not given enough importance, hence the author suggests that ERVIN life, the main failure mode and its wearing ratio should be added to the data sheet, which can complete the abrasive standard, provide convenience for the end users to choose the suitable abrasive, encourage the manufacturers to improve their manufacturing process and improve the abrasive quality. But the failure ratio is affected by many factors so that it is necessary to evaluate the failure ratio under the same condition.

## 2. Samples and the Processing Procedure

The as-cast high carbon cast steel shot sample used in this experiment, manufactured by Shandong Kaitai Metal Abrasive Co., as shown in Table 1, was melted by medium frequency induction furnace and formed by centrifugal atomizing method. The samples were in good spherical shape without irregular forms and cracks. The box resistor stove was used as the heating device and water was used as the cooling medium. The samples were etched by the alcohol solution with 4% of nitric acid and then studied for the microstructures using a metalloscope. The micro hardness of the samples were tested by the vickers hardness tester with a 500g load. As shown in Table 1 and Table 2, five high carbon cast steel shot samples, undergone five various heat treatments, were prepared for this study; the samples, tempered at 150°C and 550°C and double quenched at 840°C, were run in ERVIN test machine for 500 cycles, 1000 cycles and 1500 cycles respectively. 20g samples were used in each run for clear observation of the wear failure morphology and hence easy assessment of the failure ratio,

DOWNLOAD COMPLETE ARTICLE FROM ONLINE LIBRARY AT [WWW.SHOTPEENER.COM](http://WWW.SHOTPEENER.COM)