ESi

CASE STUDY

DIE CAST ALUMINUM BACKING PLATE CRACK EVALUATION

The customer was delighted in the confirmation of their initial response to their European customer – that the parts met the drawing requirements for roughness and surface flaws and were structurally sound for their intended, albeit very rough, use in grinding railroad rail profiles.

SITUATION

A client provides equipment used for maintaining railroad rails. Grinding wheels (called stones) are used to grind the rails and remove deformed and worn areas. They are composed of an aluminum backing plate bonded to an abrasive media, with the whole assembly wrapped in fiberglass stranding followed by phenolic impregnation. The aluminum backing plates are die cast alloy 380 aluminum.

Crack-like indications were noted on a shipment of grinding stones. They were observed on the aluminum backing plate near the mounting bosses. This raised safety concerns with a European customer, given the more densely populated railroad operations in Europe in contrast to domestic US operations.

The drawing requirements for the backing plates stated a maximum surface roughness of 125 micro inch Ra and a maximum surface flaw of 0.006” in the vicinity of the mounting bosses.

The objective of this project was to determine if the three parts submitted met the drawing requirements.

Practice: Materials Science

ESi Consultant

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Services Utilized

- Destructive Testing
- Metallography
- Surface Roughness

About ESi

For over 30 years, ESi has leveraged its multidisciplinary team of engineers, scientists, and professional technical staff to investigate many major accidents and disasters. Our technical expertise, hands-on experience and state-of-the-art facilities, combined with diagnostic, analytical and physical testing capabilities create an ideal environment for quickly identifying and interpreting the facts of a case.

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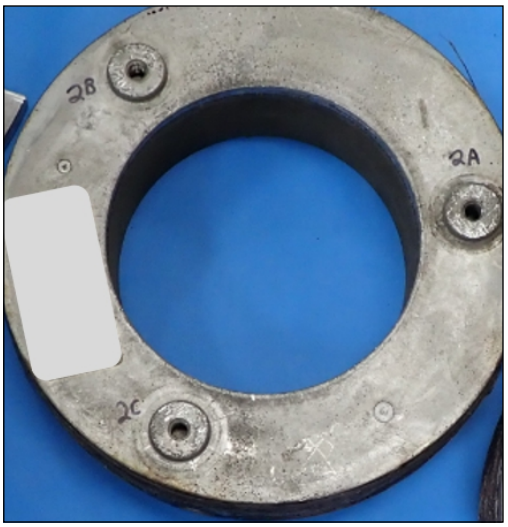
SOLUTION

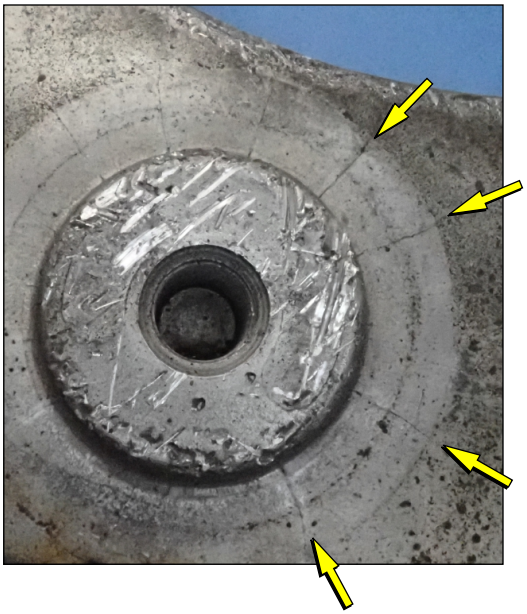
The initial request from the customer was to x-ray these stones and confirm or deny cracking was present in the aluminum backing plate. The stones are approximately five inches thick and x-ray examination was not feasible.

Photos of the apparent cracking condition were taken to document the as-received condition. A destructive disassembly procedure was then formulated. This consisted of striking the gap between the bonded abrasive and the die cast aluminum backing plate repeatedly with a hammer and a cold chisel to break off the bonded abrasive media. Some cracking of the backing plates was created during this aggressive destructive disassembly process. However, no cracking occurred near the mounting bosses where the suspect cracks were located.

Further sectioning of the backing plate and removal of the cast abrasive was required to facilitate a sample of appropriate size for surface roughness testing and metallographic evaluation.

Samples were then evaluated for surface roughness using contact measuring techniques and subsequently mounted for metallographic examination.





RESULTS

The surface roughness measurements indicated all samples met the < 125 microinch Ra surface roughness requirement, with a range of roughness from 37 – 99 microinches.

The metallographic mounts showed that the maximum depth (or protrusion in some cases) was < 0.003" on all samples examined. This indicated the die cast aluminum backing plates met the requirements of a maximum surface flaw of 0.006".

It is well understood that steel tooling used in the die casting process will develop heat checking after a high volume of parts have been run. The client indicated that after > 100,000 parts, this heat checking phenomenon had been previously observed. This was an indication that the tooling would require maintenance in the near future.

The results of this study were:

a) A process to examine the crack-like indications of the die cast aluminum backing plates was developed.

b) This process, although destructive, did not exacerbate the crack-like indications that were present.

c) The parts met the surface roughness requirements of the drawing.

d) The parts met the maximum allowable surface defect criteria on the drawing.

e) The crack-like indications noted were actually surface impressions attributed to heat checking of the die casting tooling.

Why ESi. The Materials Science and Engineering practice group is comprised of consultants with backgrounds in:

- Metallurgical Failure Analysis
- Destructive and Non-Destructive Testing
- Optical Microscopy
- Metallography Evaluations
- Microstructure Evaluations
- Materials Analysis
- Scanning Electron Microscopy
- Computed Tomography
- Chemical Analysis
- Process Evaluations
- Borescope Examination
- 3D Laser Scanning
- Corrosion Evaluation
- Fatigue and Fracture Mechanics
- Mechanical Testing

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