

“A small surface indication exposed by a machining operation was not a material defect as determined by failure analysis service performed by MSi Testing & engineering.’

MSi Investigative Summary

BACKGROUND

One (1) cold drawn and machined part exhibiting a linear defect indication on the machined ID surface was submitted to our laboratory for a metallurgical failure analysis service investigation. Our metallurgy experts were requested to determine the source cause of the ID surface defect indication. The material identification is shown in the table below.

SAMPLE IDENTIFICATION

Part Description	Heat No.	HR Size	CD Size	Grade
Machined Part	██████	██████" RD	██████" RD	C-1215

PERFORMED TESTING

Scanning Electron Microscopy (SEM) Examination
Metallographic (Microstructure) Examination
Chemical Analysis

CONCLUSIONS

1. Based upon the opinion of our failure analysis lab and the performed examinations, it is our opinion the ID surface of the part contained a faint, intermittent, tool mark that was induced during the machining operation.
2. No evidence was observed of a pre-existing internal steel defect or inclusion stringer on the ID surface that could have caused the defect indication.
3. The microstructure as determined by the metal test lab was typical of AISI 1215 steel.
4. The chemical composition was typical of AISI 1215 steel.

SUMMARY of TEST RESULTS

Scanning Electron Microscopy Examination

1. SEM examination of the ID surface revealed a faint, intermittent, linear surface defect indication along the .234" diameter ID surface. (See arrows in Photos 1 - 2).
2. Examination at higher magnification showed evidence of disturbed metal, most likely from the machining tool (see Photos 3 - 4). No evidence was observed of a pre-existing internal steel defect or inclusion stringer on the ID surface.

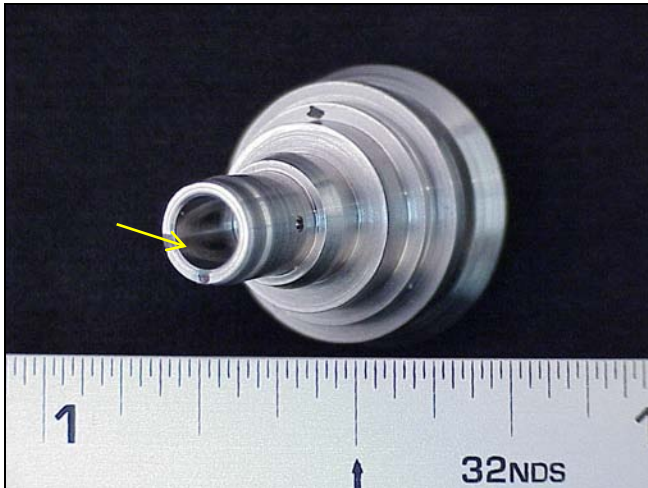


Photo 1: Submitted part with surface defect indication on the ID surface, denoted by the yellow arrow. 1.5X



Photo 2: SEM image showing the faint linear defect indication on the machined ID surface. 10X

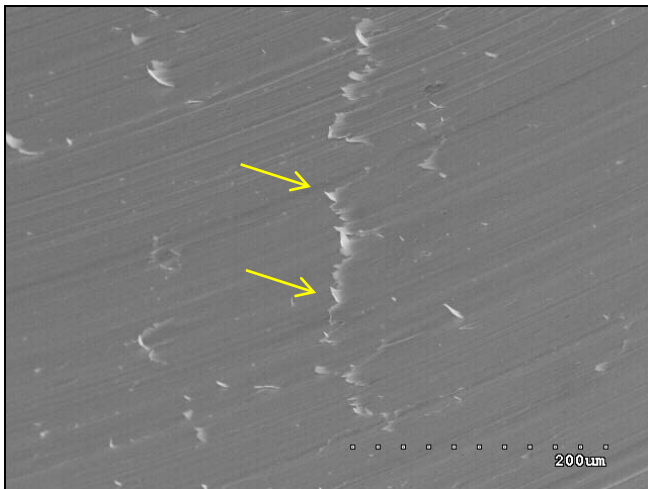


Photo 3: Close-up view of linear defect indication denoted by the yellow arrow in Photo 2. 165X

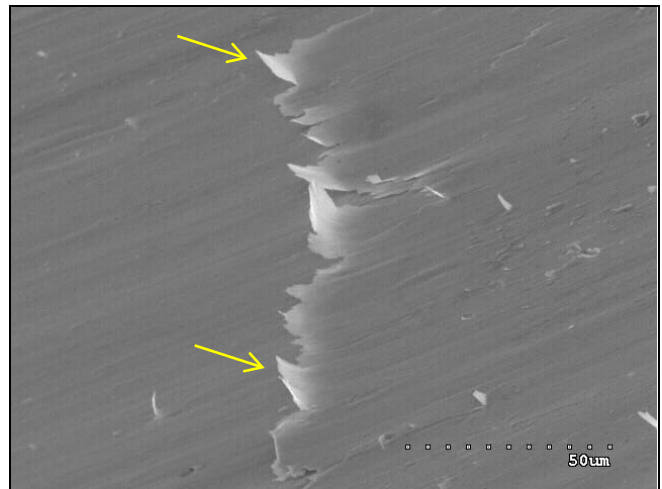
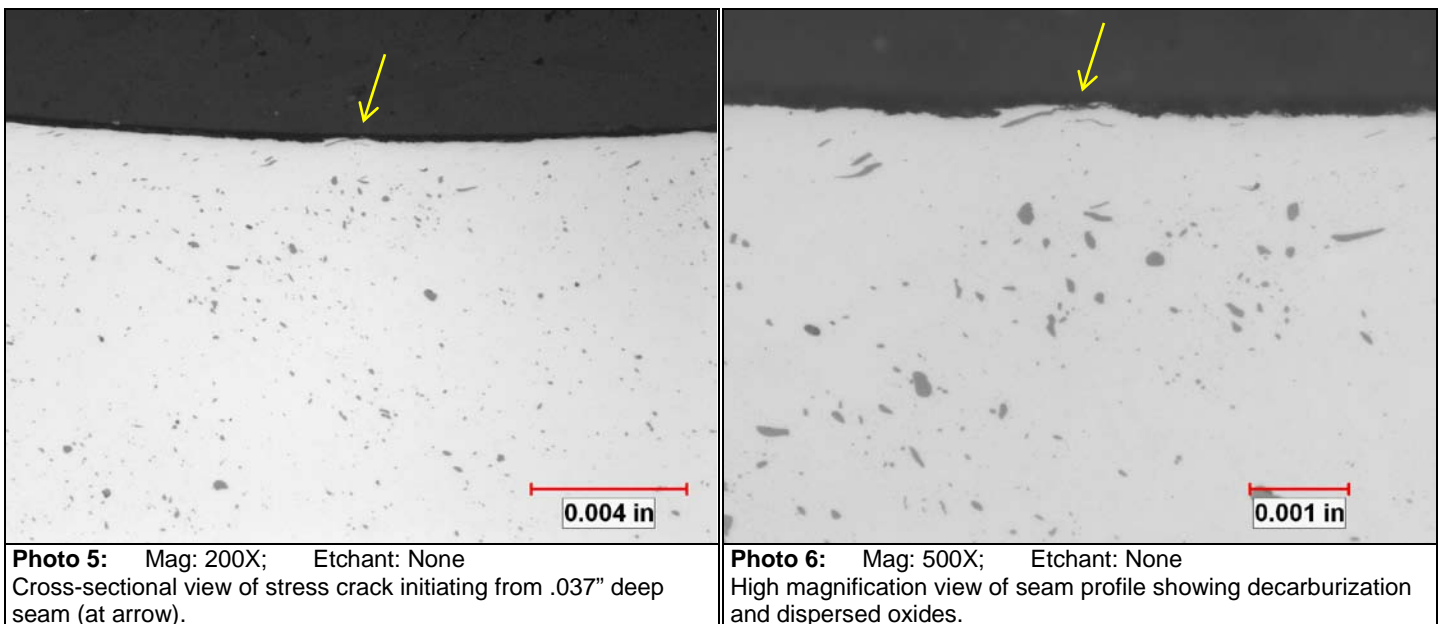


Photo 4: Higher magnification view of Photo 3 showing a tool mark from the machining operation. 1350X

Metallographic Examination

1. A transverse section removed from the region containing the ID surface defect indication confirmed the presence of a tool mark that was induced during the machining operation. (See arrow in Photos 5 - 6)
2. No evidence was observed of an abnormal inclusion content or any other detrimental internal conditions that could have caused the defect indication.
3. The microstructure consisted of pearlite and grain boundary cementite in a matrix of ferrite, typical of AISI 1215 steel.



Chemical Testing

1. Chemical testing revealed the sample classified as AISI 1215 steel.
2. The results are shown in Table 1 attached.

Table 1 – Chemical Testing*

Element	Results
Carbon	.06 %
Manganese	.96
Phosphorus	.05
Sulfur	.31
Silicon	.02
Nickel	.03
Chromium	.03
Molybdenum	.01
Copper	.06

* Testing performed in accordance with ASTM E415.