

Date: 02/03/2020

investigation report

Report Name: Together Forged PM steels (sample 1)

Report Number: MUE 20015

Customer Supplier: Zapp Precision Metals

Main application:

Material: unknown Dimension: sample 1

inspection lot: Production order:

Melt:

Summary and Conclusion: For an investigation forged pattern was filed, see Figures 1 and 2. At this pattern should examine each forged documents and hardness measurements are made at the individual layers. For the metallographic investigation of the material was prepared in the micrograph. In the center of the sample is a broad layer (seam), consisting of a PM steel with numerous carbides in a martensitic matrix, see Figure 3 and 7. In Figures 4 to 6, a transition zone, with ferritic appearance of the PM to recognize -Location to the base material. In Figures 5 and 6 partially flaws can be seen at the grain boundaries, which may be an etching effect are (dark areas). A closer examination of these areas is microscopically not feasible. In Figures 8 to 11 this transition zone appears dark. Figure 12 shows the martensitic microstructure of the base material. Next, as shown in Figures 13 and 14, a hardness profile measurement from the center of the PM-zone was seen, starting carried out to the edge. The following diagram shows the variation of hardness which falls off strongly towards the edge. The hardness value of the dark transition zone of 740 HV0.5 (s = +/- 20) is an average of three values.

signatures

Gez. : Dominic Lococciolo

Signed : Dr. Sedat Güler

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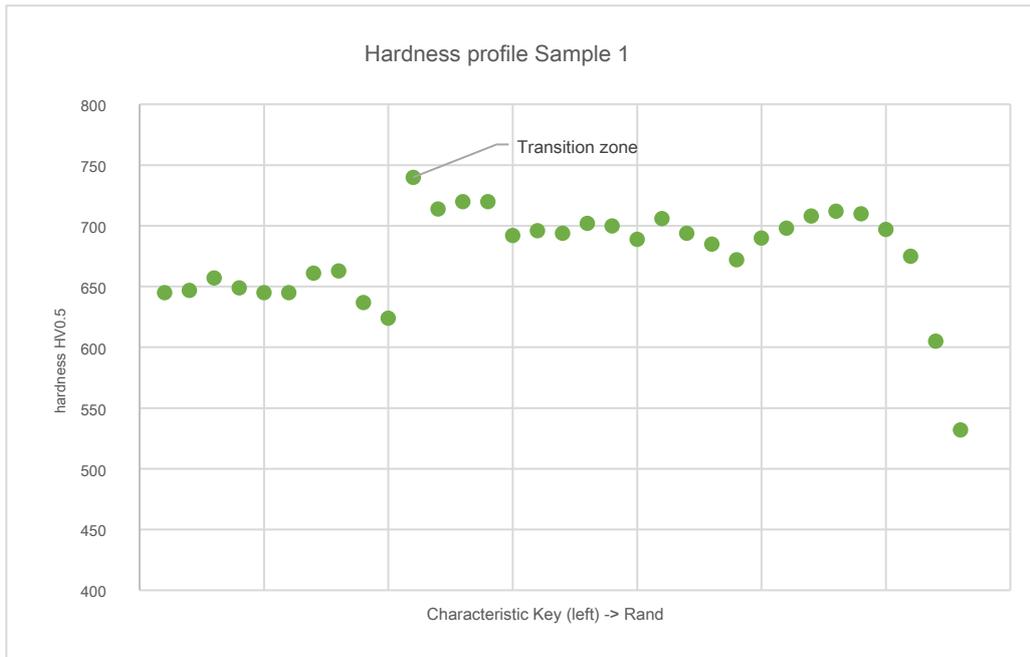


Diagram 1: hardness profile

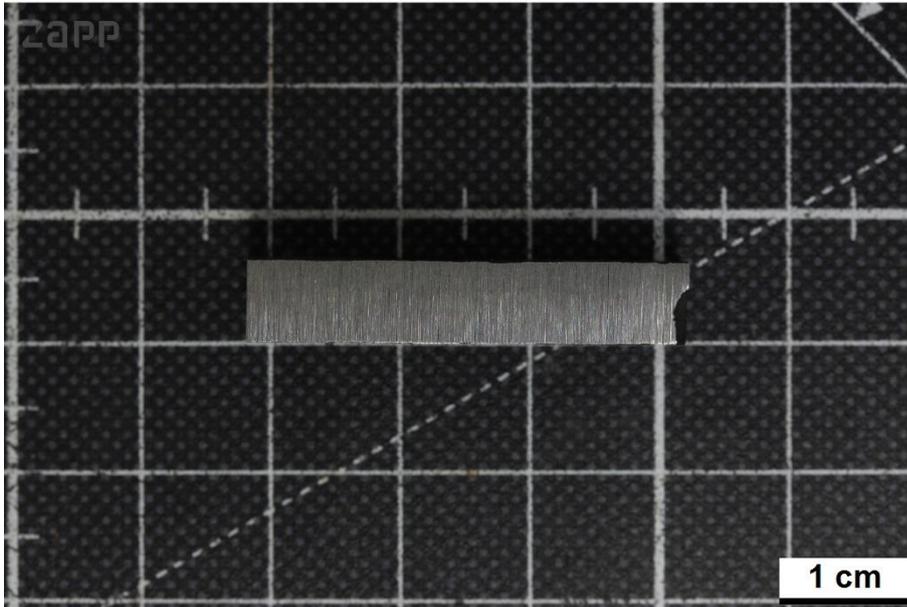


Illustration: 1

Etching:

Cut-No.:

Sample Location:

Remarks:

Pattern overview Sample 1

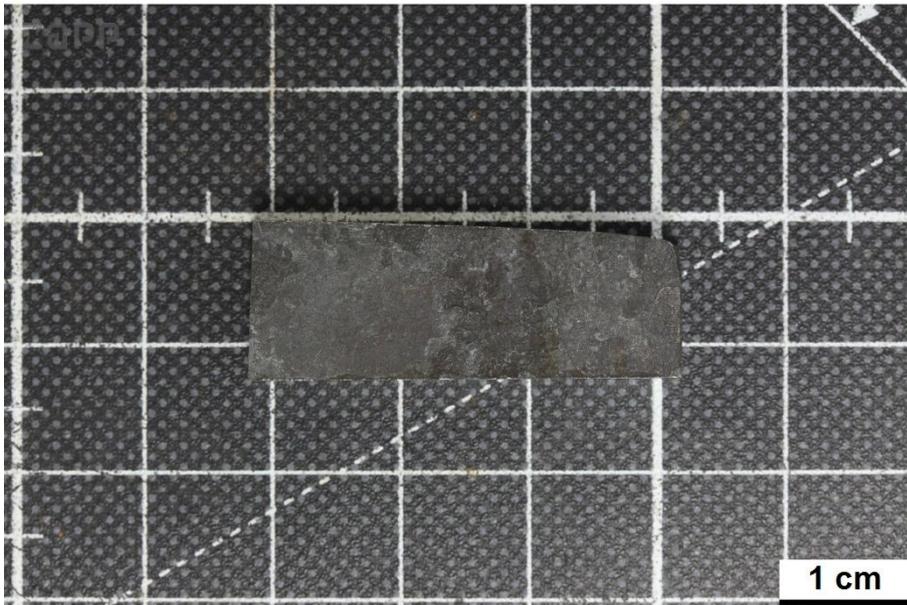


Illustration: 2

Etching:

Cut-No.:

Sample Location:

Remarks:

Pattern overview Sample 1



Illustration: 3
Etching: nital
Cut-No.: 6302
Sample Location: cross section

Remarks:

Overview

_PM zone in the middle

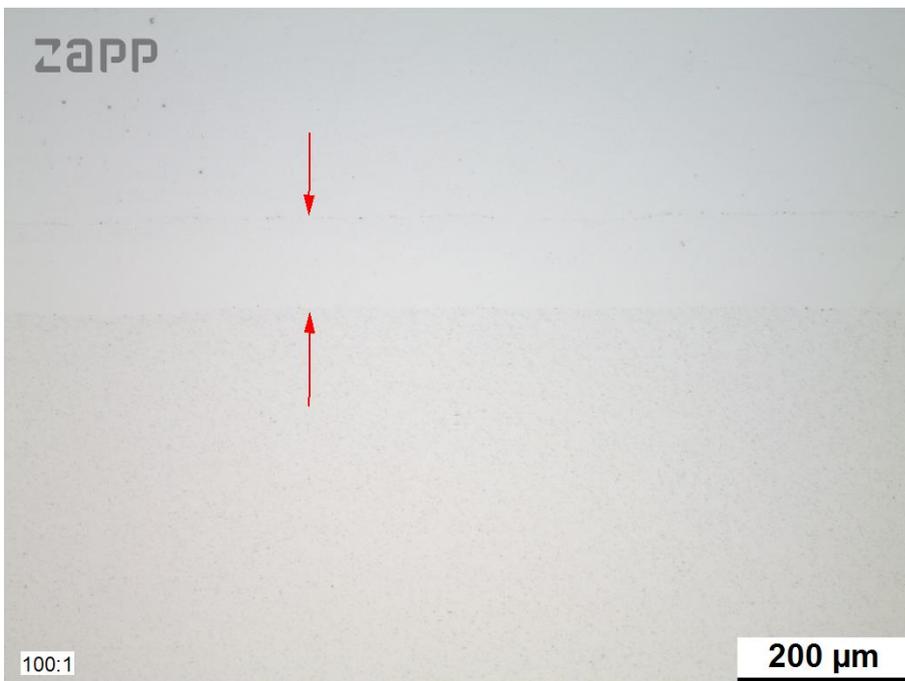


Illustration: 4
Etching: unetched
Cut-No.: 6302
Sample Location: cross section

Remarks:

Sample 1 - transition zone

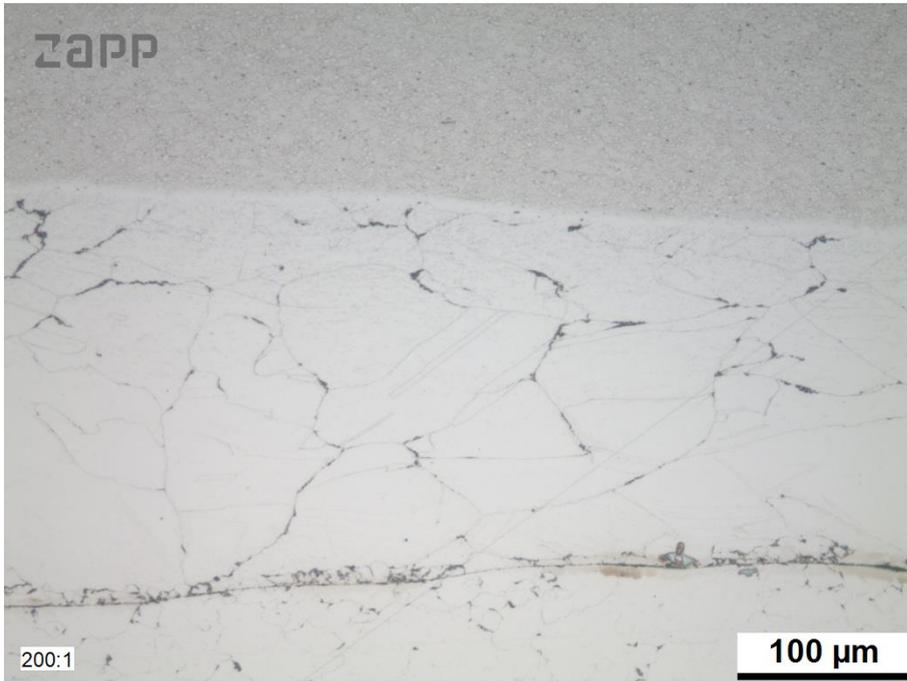


Illustration: 5
Etching: nital
Cut-No.: 6302
Sample Location: cross section

Remarks:

Transition zone



Illustration: 6
Etching: nital
Cut-No.: 6302
Sample Location: cross section

Remarks:

Transition zone

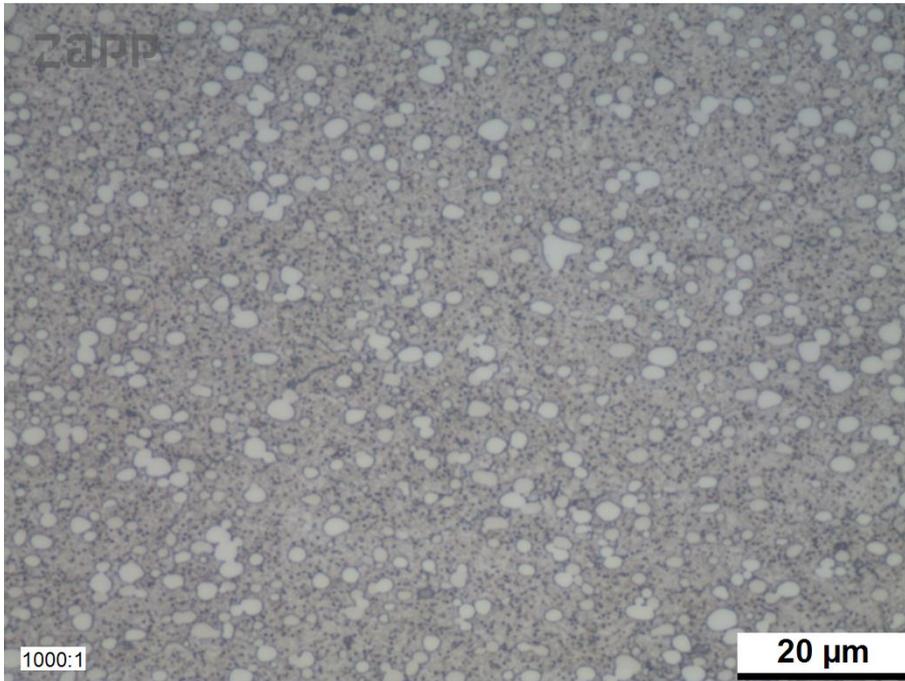


Illustration: 7
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

PM-zone



Illustration: 8h
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

Transition area:

_from top to bottom: PM-zone -> Dark Zone -> basic matrix

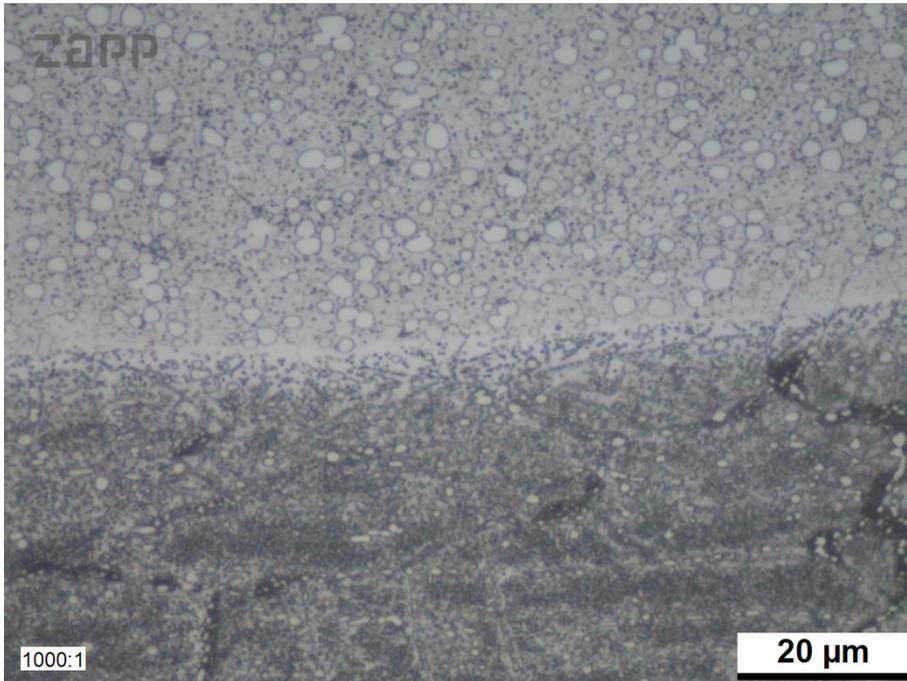


Illustration: 9
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

PM transition zone to the dark zone

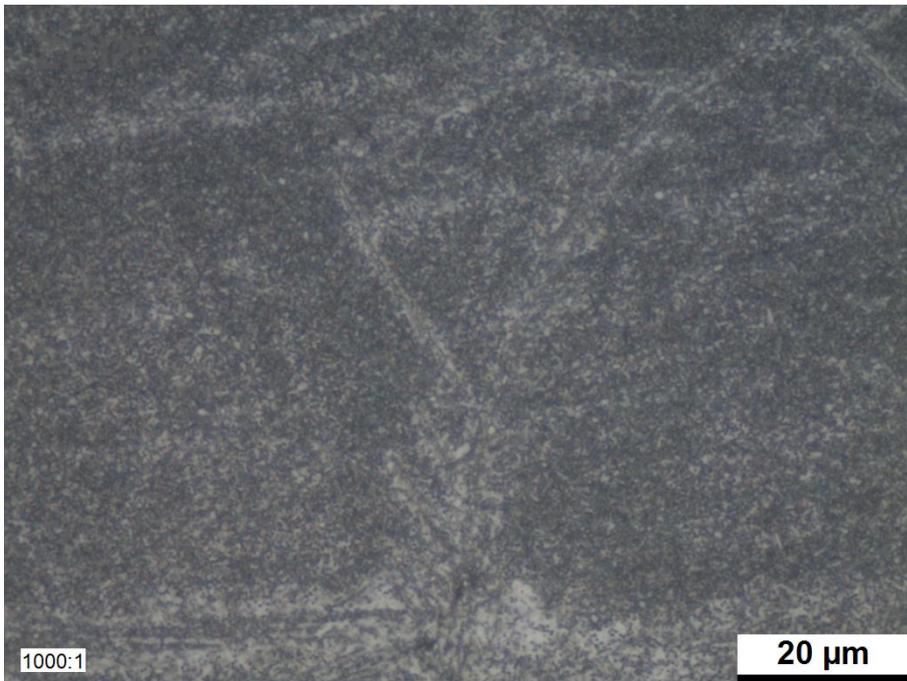


Illustration: 10
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

dark transition zone

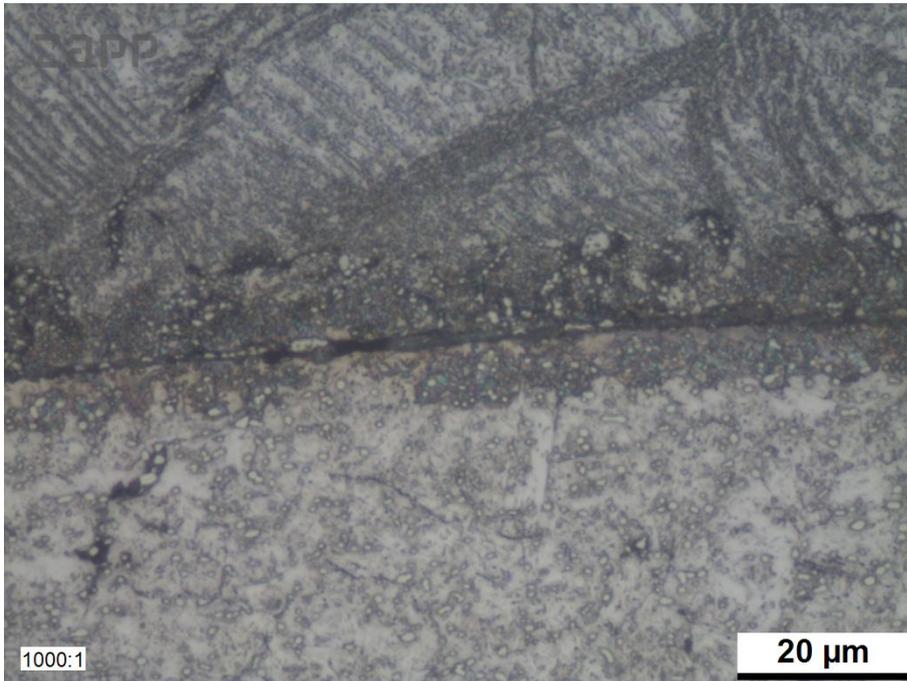


Illustration: 11
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

Transition dark zone -> Basic Materials

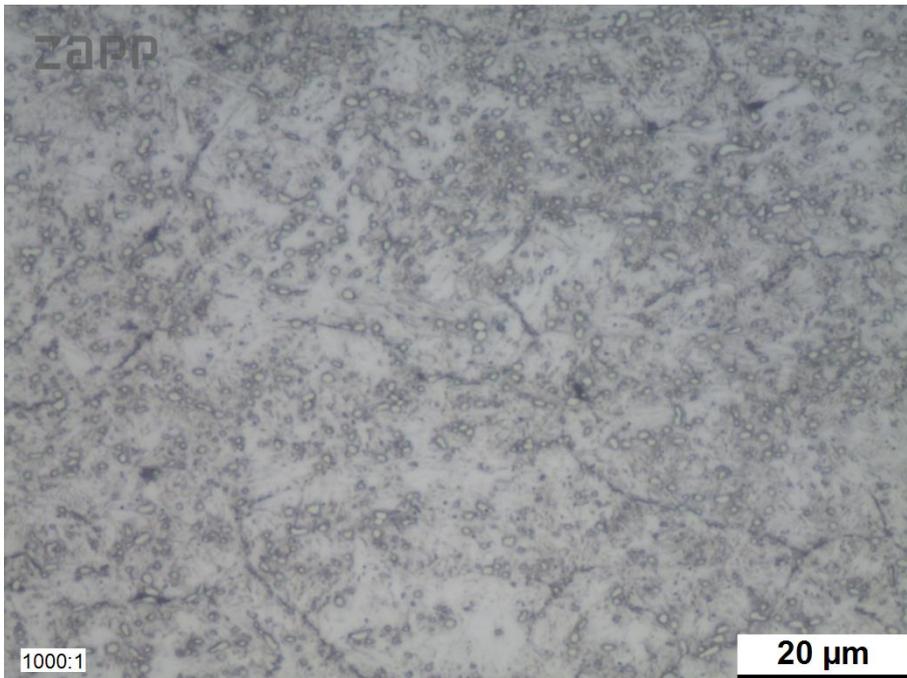


Illustration: 12
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

Parent material

_martensitisches structure

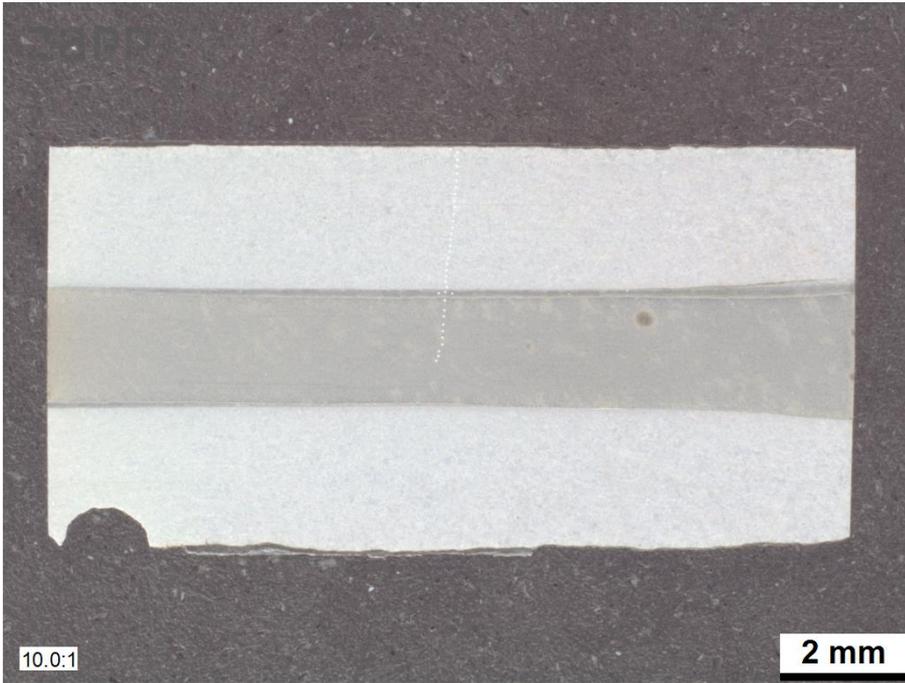


Illustration: 13
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

Overview hardness profile

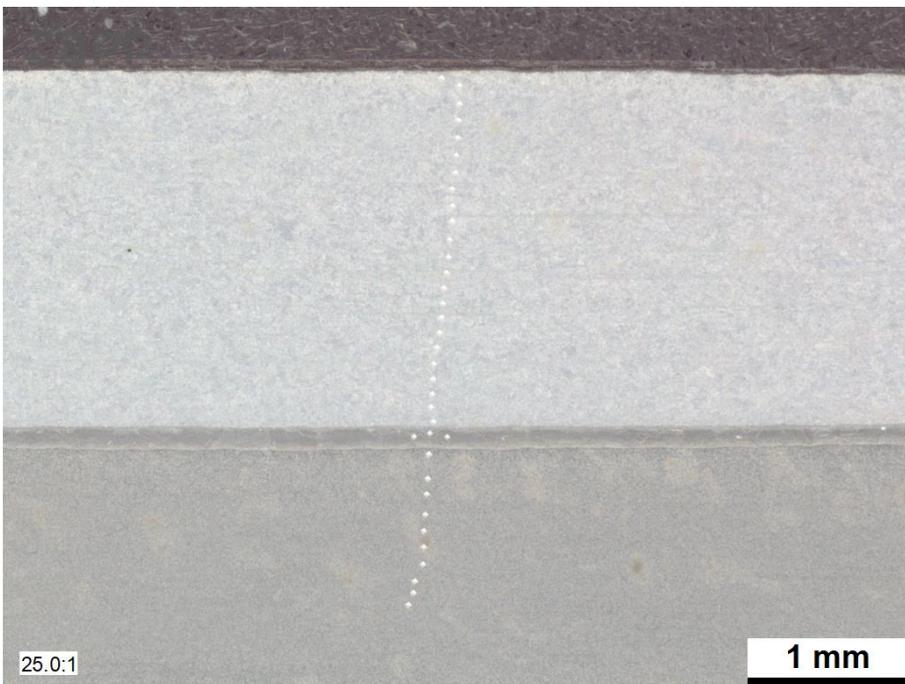


Illustration: 14
Etching: Recipe 104 (ASTM E407)
Cut-No.: 6302
Sample Location: cross section

Remarks:

Overview hardness profile