

Inverkan av stålverk, lastsätt och geometri på formförändringar vid härdning av kronhjul och pinjonger

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Innehåll

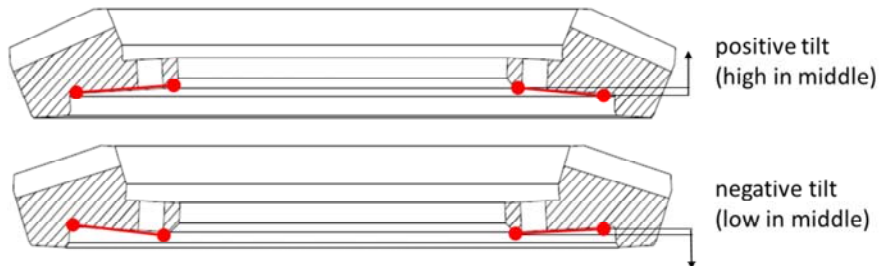
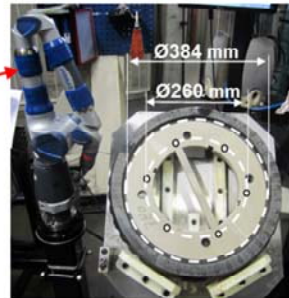
- Inverkan av gjutmetod
- Inverkan av form
- Inverkan av lastsätt
- Inverkan av deformation/tåga

Quench pressing

Definition of back-face tilt

Measured by Faro gage arm

- Height distance between circular section $\varnothing 384$ and $\varnothing 260$ mm.
- Tolerance $\pm 0,05$ mm.

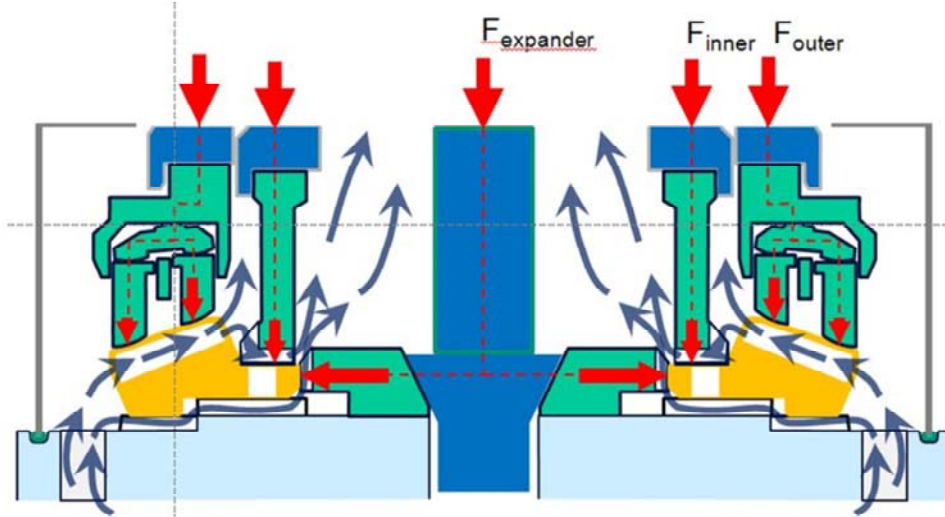


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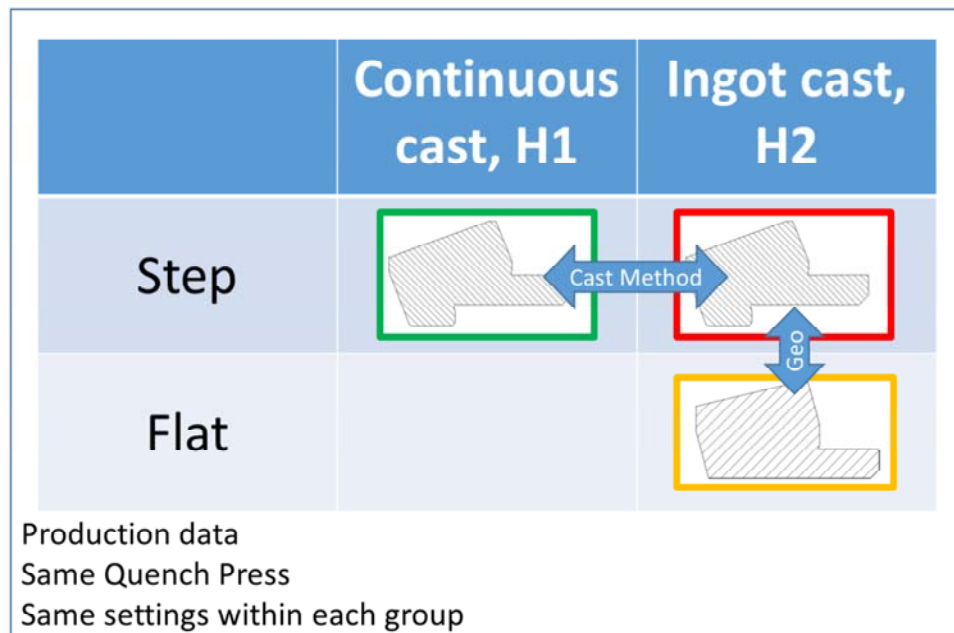
Two circles are measured using a gage arm. The two circles define two planes. The height difference between them defines the tilt.

Quench press design



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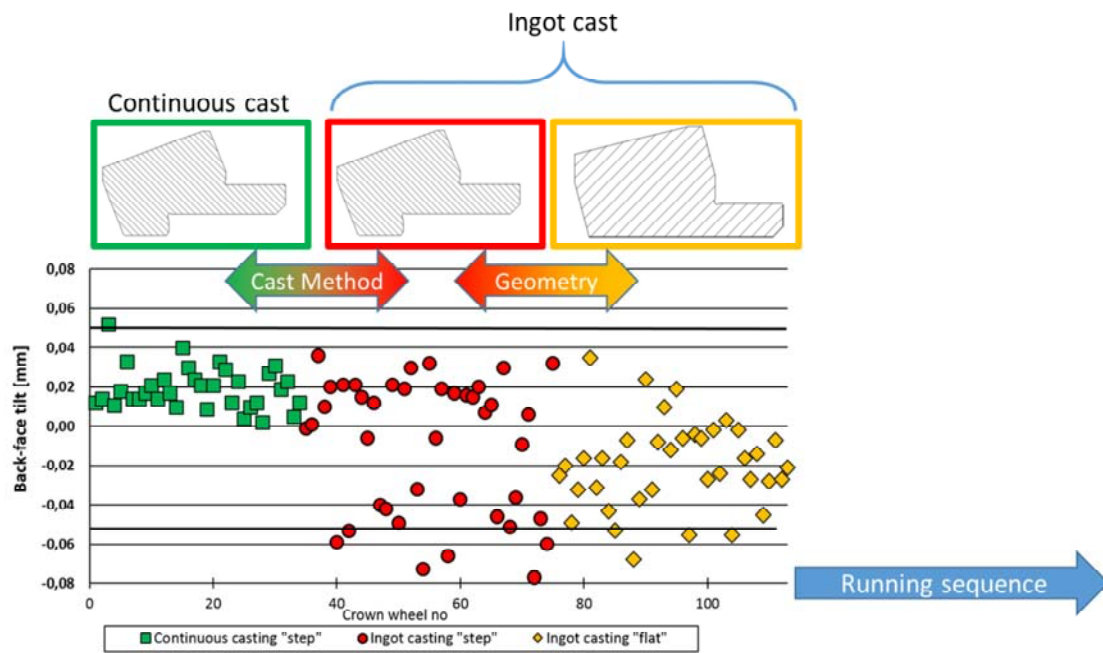
The quench press has a central expander pressing on 6 moving sectors. The crown wheel is pressed on an inner position and on two outer positions on some of the gears. The hardening oil flows between the teeth and in grooves in the lower fixture.



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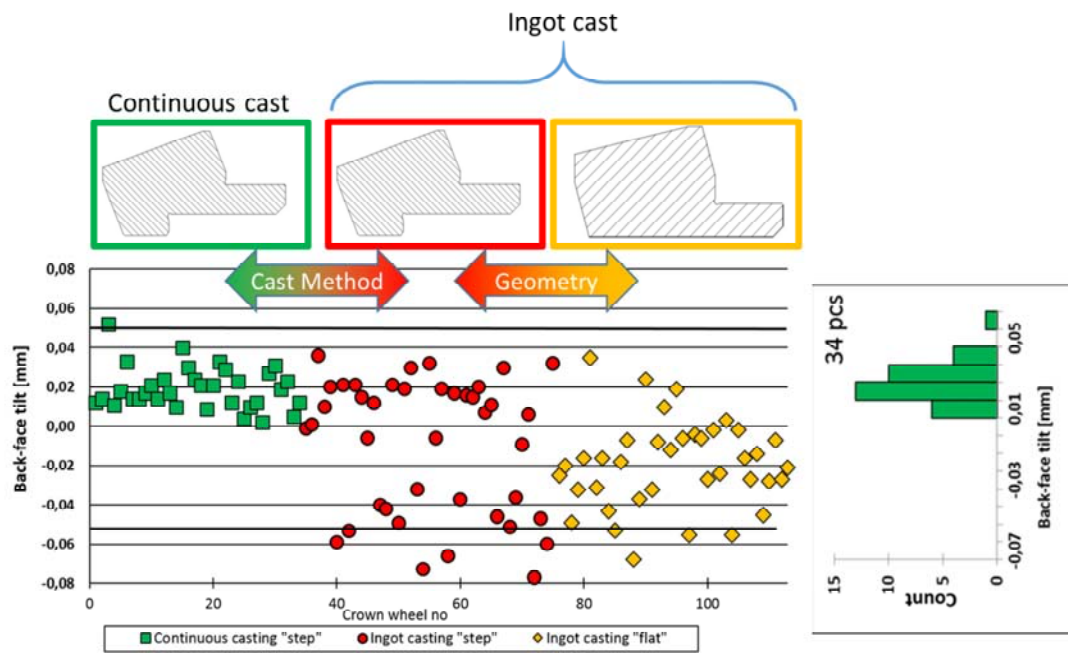
Three groups were tested from two heats, H1 and H2. Two geometries were tested for the ingot cast crown wheels. Within each group, the press parameters were kept constant during production. However, they were slightly different between the groups.



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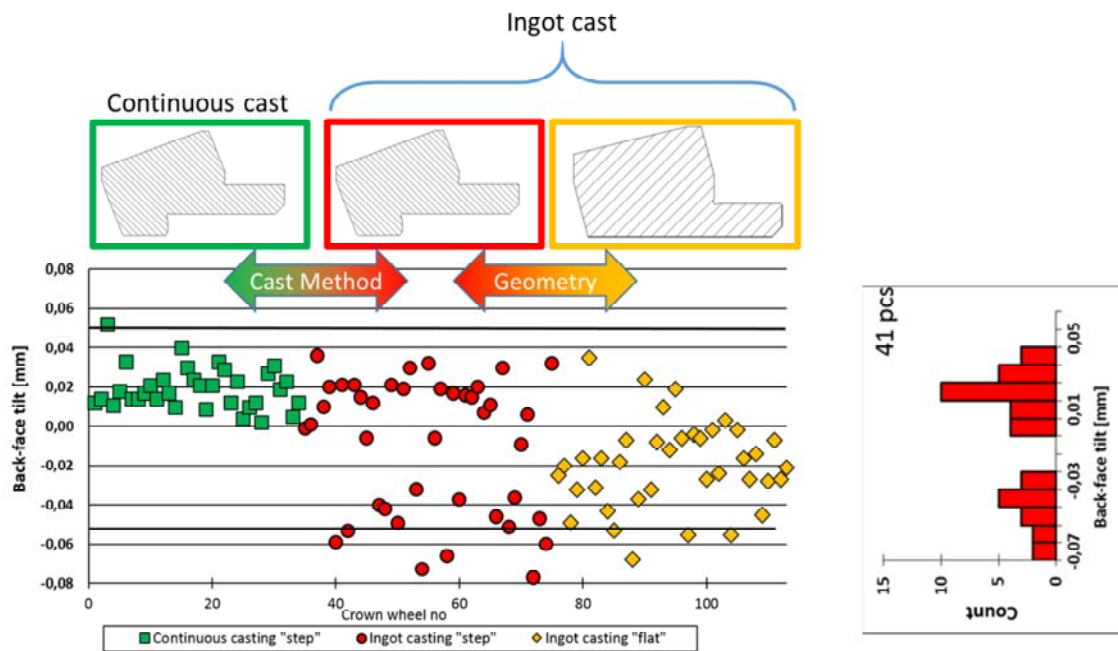
The three groups in the order they were produced. Thick lines indicate allowed spread.



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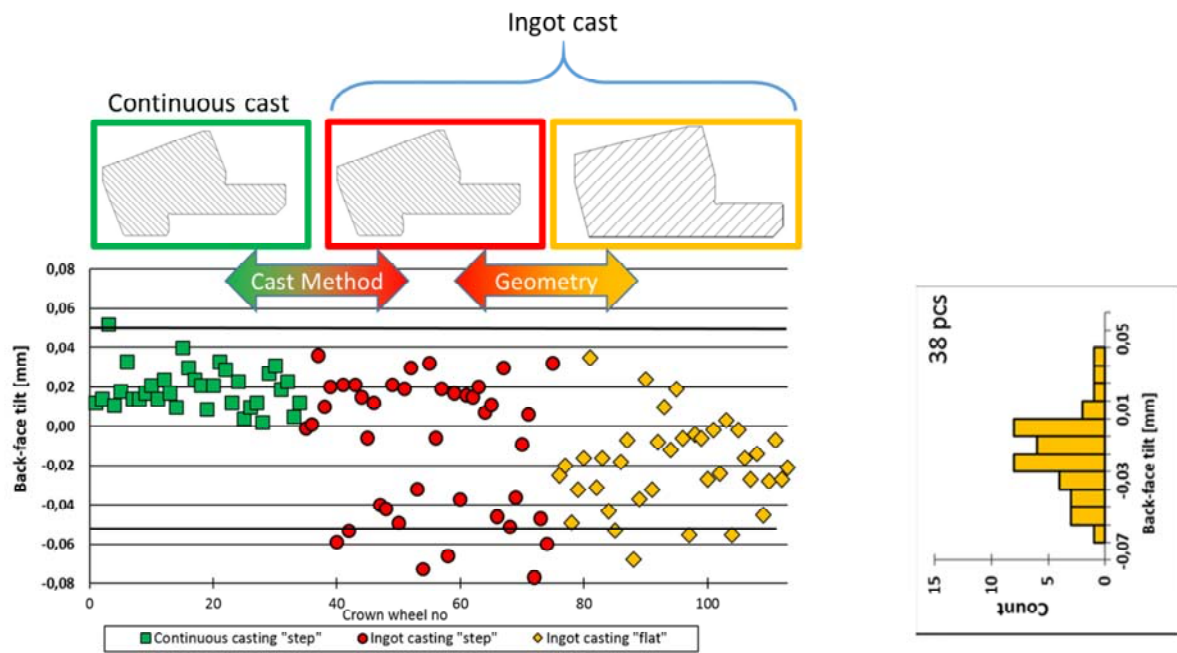
Small spread, approximately normal distributed



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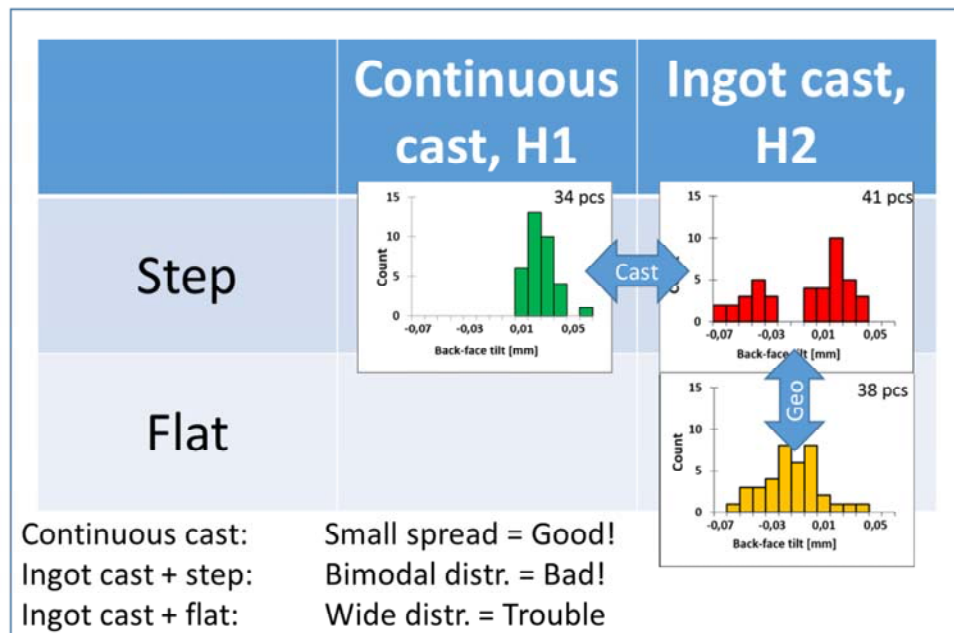
Bimodal distribution. Later experiments have shown that the peaks correspond to top and bottom positions of the ingot. Impossible to make correct adjustments of press-quench parameters.



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A flat geometry gives a wide spread but with a central peak.



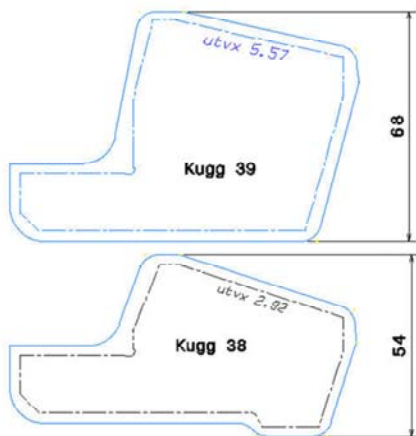
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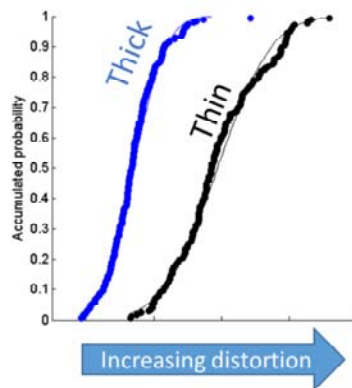
Comparison between the groups.

Influence of blank thickness

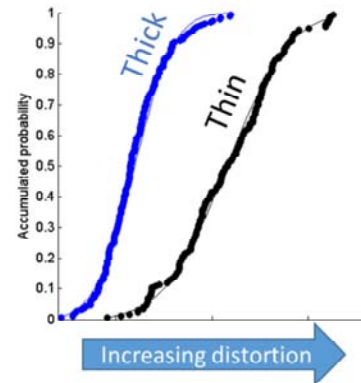
Same steel plant and forging plant
Same processing by Scania



Största delningshopp mellan
två kuggar

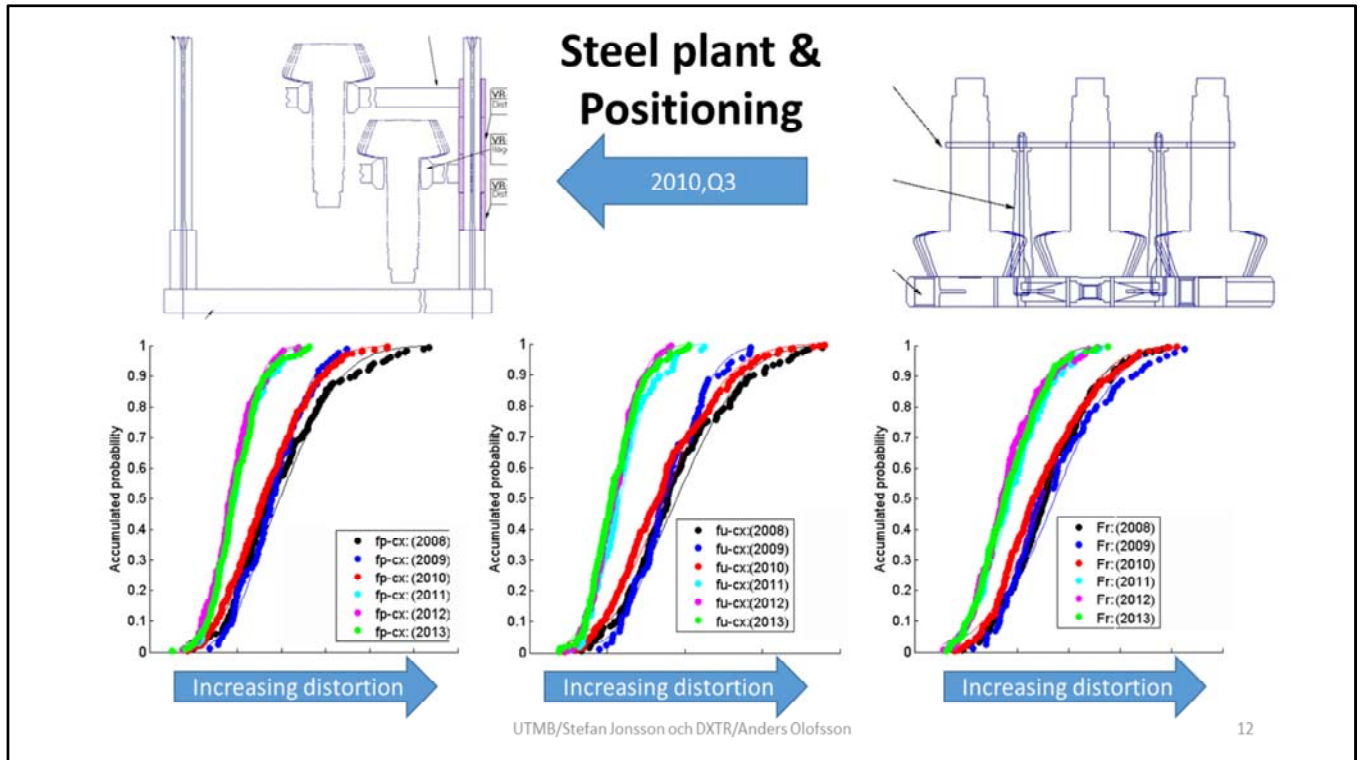


Rundgång, kast på kugg 90
grader mot kuggyta



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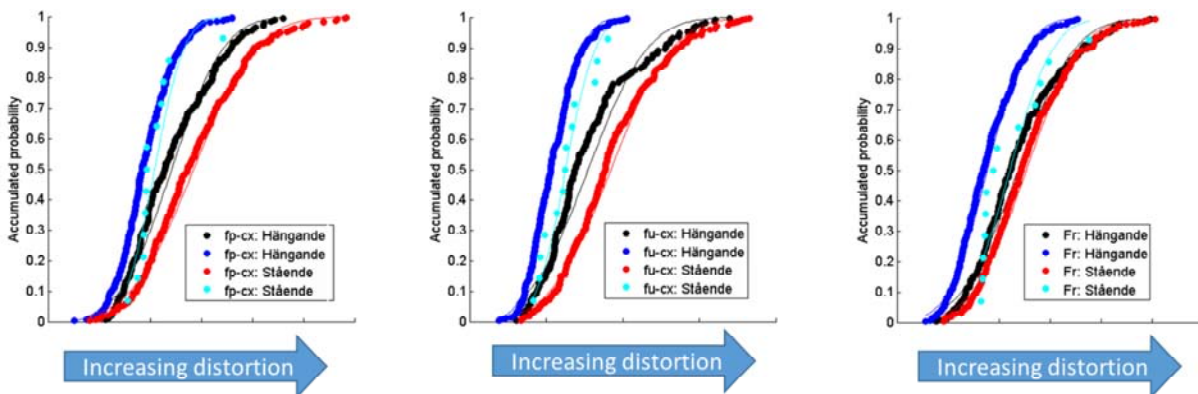


In Q3 of 2010, steel plant and positioning of pinions were changed.

Effect of positioning

Primary effect: Steel plant
Secondary eff.: Positioning

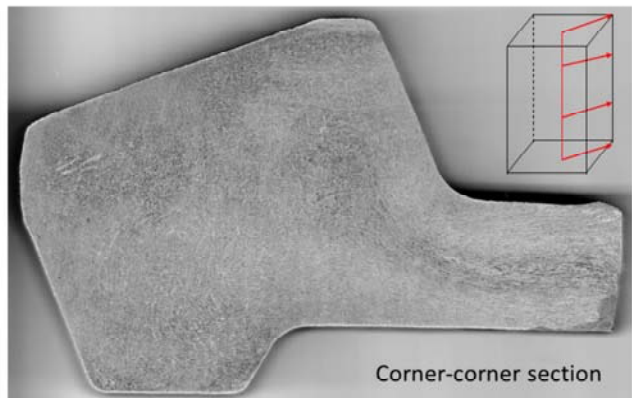
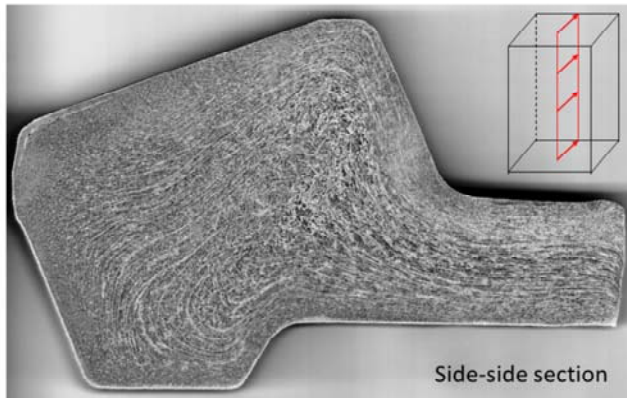
	Hanging	Standing
Steel plant A		
Steel plant B		



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Steel plants have primary influence on distortions and positioning of pinions has secondary .

Flow pattern from upset forging



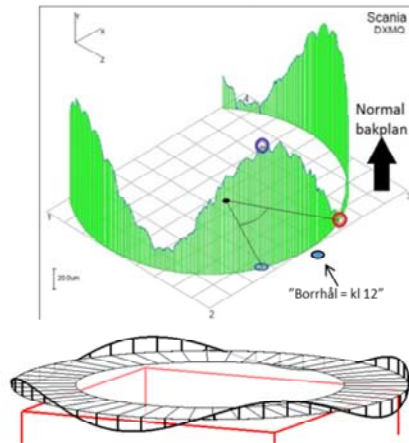
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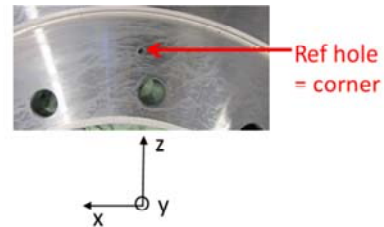
Side-to-side and corner-to-corner sections of a crown wheel blank.

Chip-like distortion of back-face plane

- Back-plane profile (chip shape)



18 crown wheels



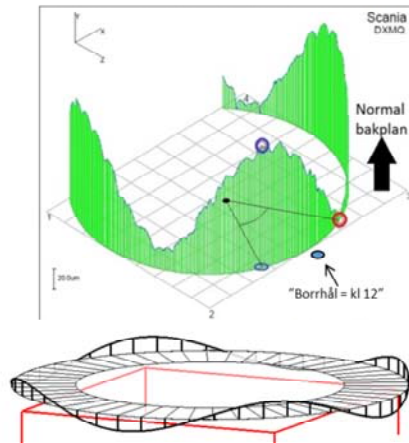
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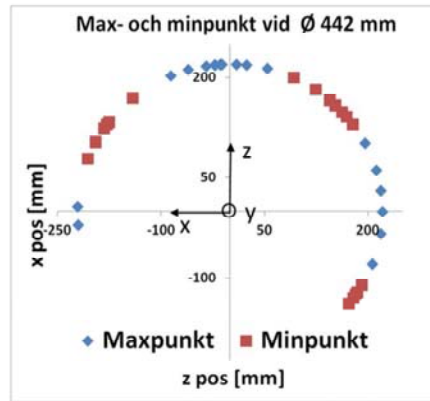
Corner of rectangular block marked after forging by drilling a small hole.

Chip-like distortion of back-face plane

- Back-plane profile (chip shape)



18 crown wheels



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Back plane measured. Heights correspond to corners and walleyes to sides of the forged block.

Conclusions

Casting method	Continuous		Ingot	
Back-plane		Flat back-plane	Back-plane with step	Top Middle Bottom
Thickness	Thick		Thin	
Steel plant	Plant A		Plant B	
Positioning	hanging	standing	hanging	standing
Forging	Round		Rectangular	

Increasing distortion