FLUXTROL®

Advanced Induction Materials and Technology

Online Induction Heating Course

9 Case Story - Surface Hardening of Truck Axle

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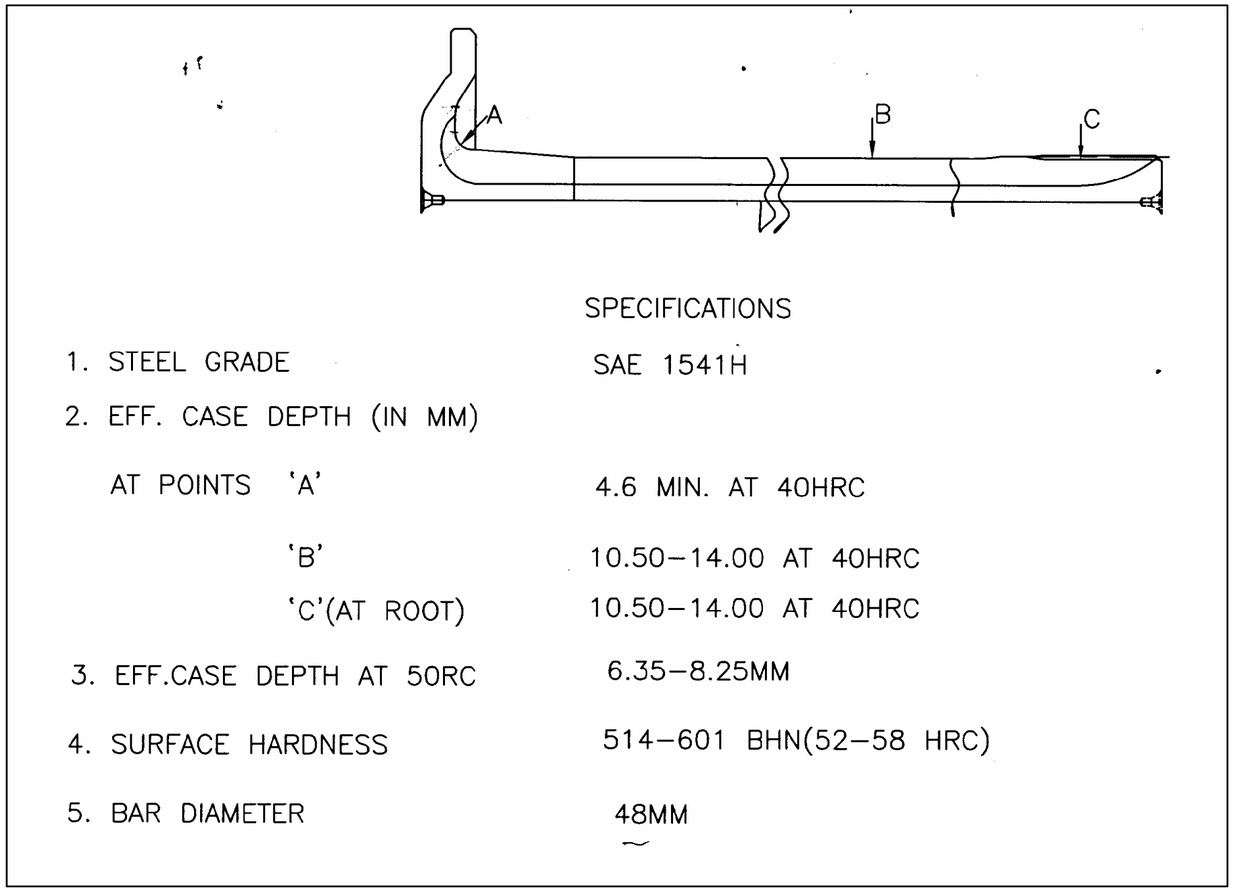
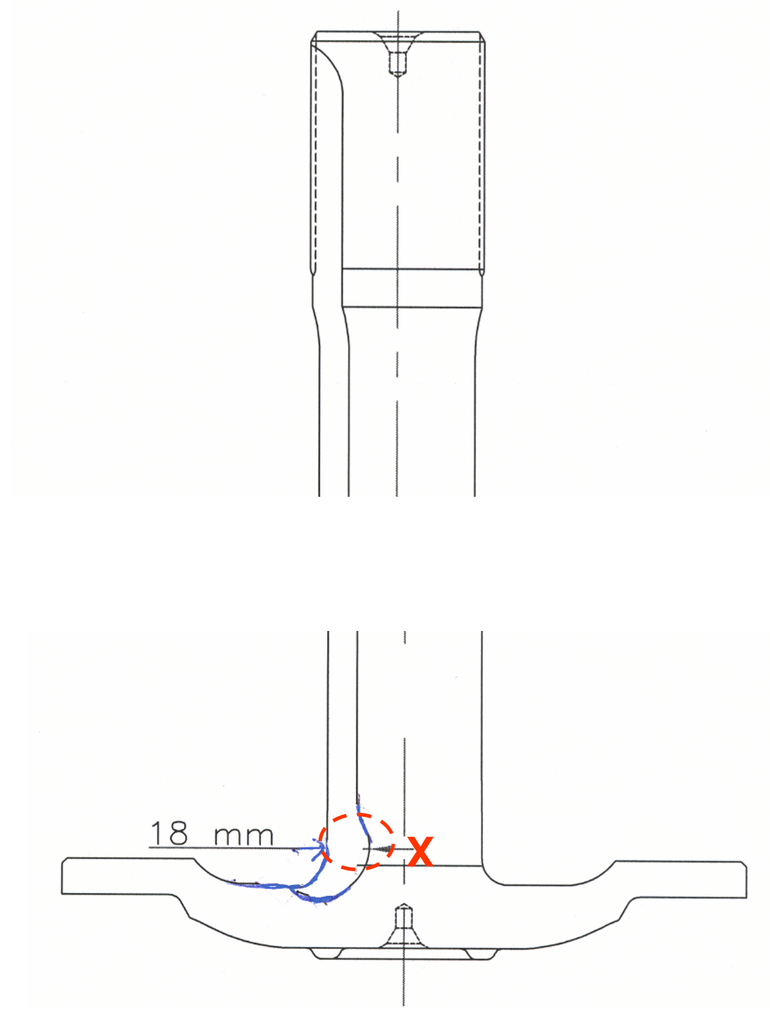
Problem Description and Specifications

The customer contacted Fluxtrol Inc. for the following reasons:

- They were unable to produce good parts for a contract they had won
- The problem was the new part had a sharper fillet than other parts they had worked with before





In order to get the required depth in the fillet, they had to severely overheat the area (**X**) just above it resulting in almost through hardening

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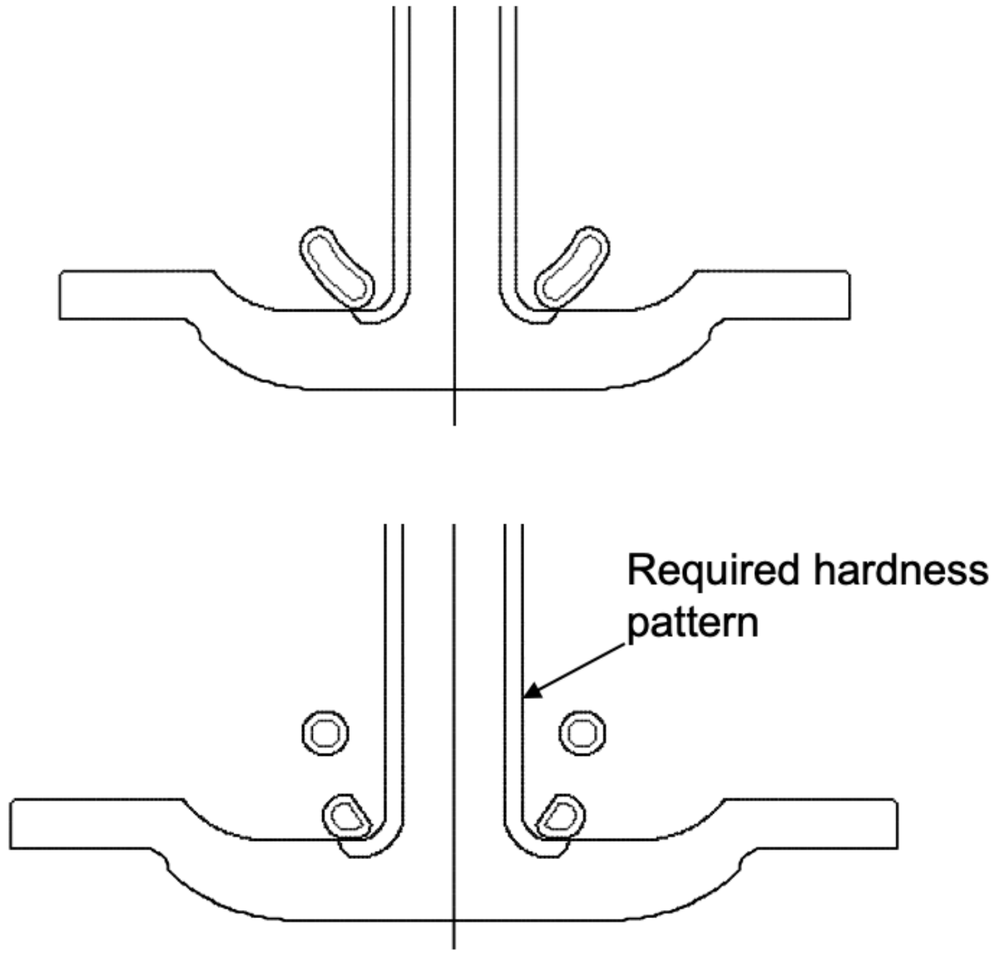
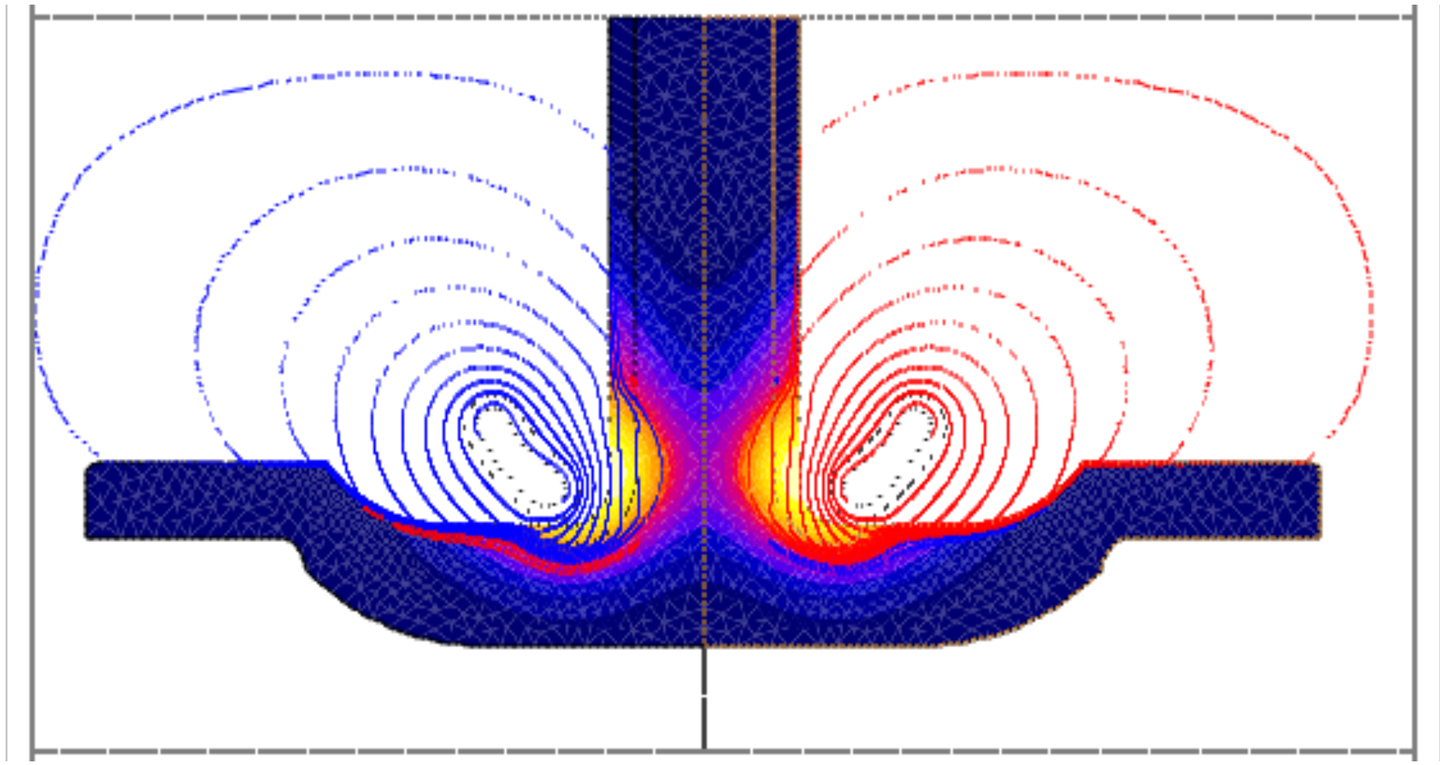
Step 1: Analysis of Results Obtained with Existing Equipment

- Customer had the necessary equipment (dual-spindle scanner and power supply 400 kW, 1 kHz)
- Customer had 2 standard scan coils that they attempted to use for the process
- Single turn coil came closer to achieving the desired results, but production rate was low during scanning
- Two turn coil could produce parts faster, but could not properly heat the fillet area



Step 2a: Simulation of the Process with Existing Single Turn Coil

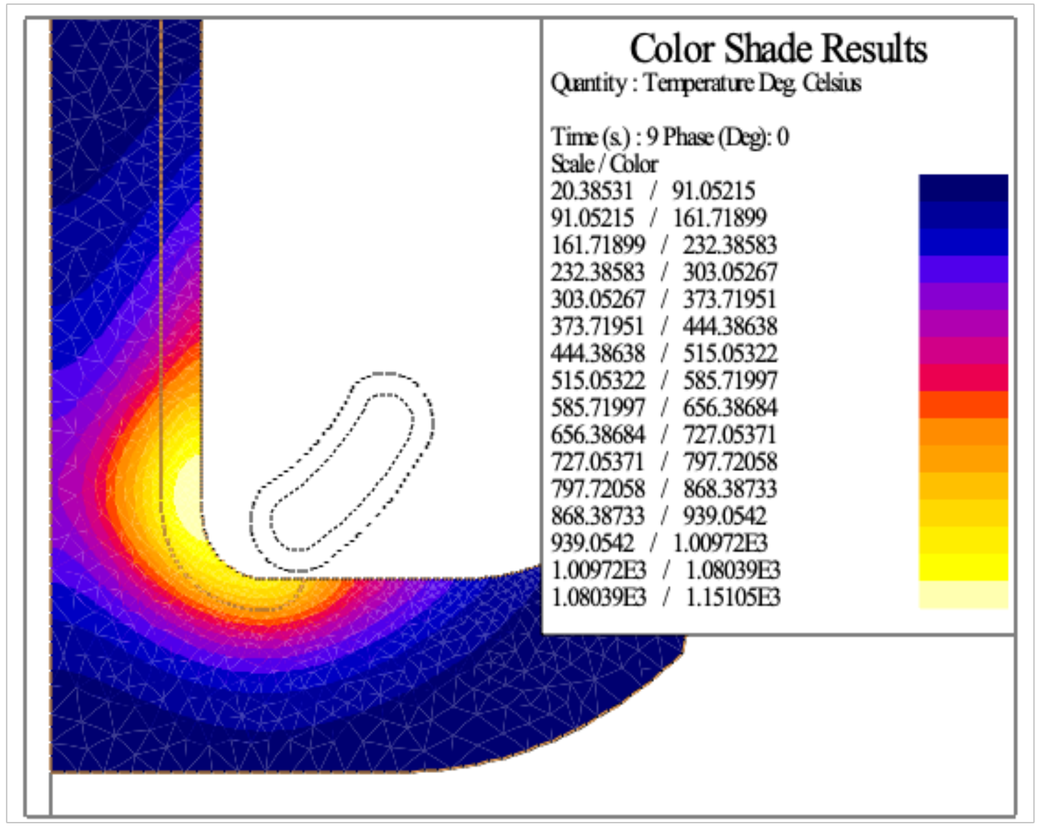
Simulation of the process with a single-turn coil without a magnetic flux controller clearly showed overheating of the stem near fillet area (in good agreement with tests results)



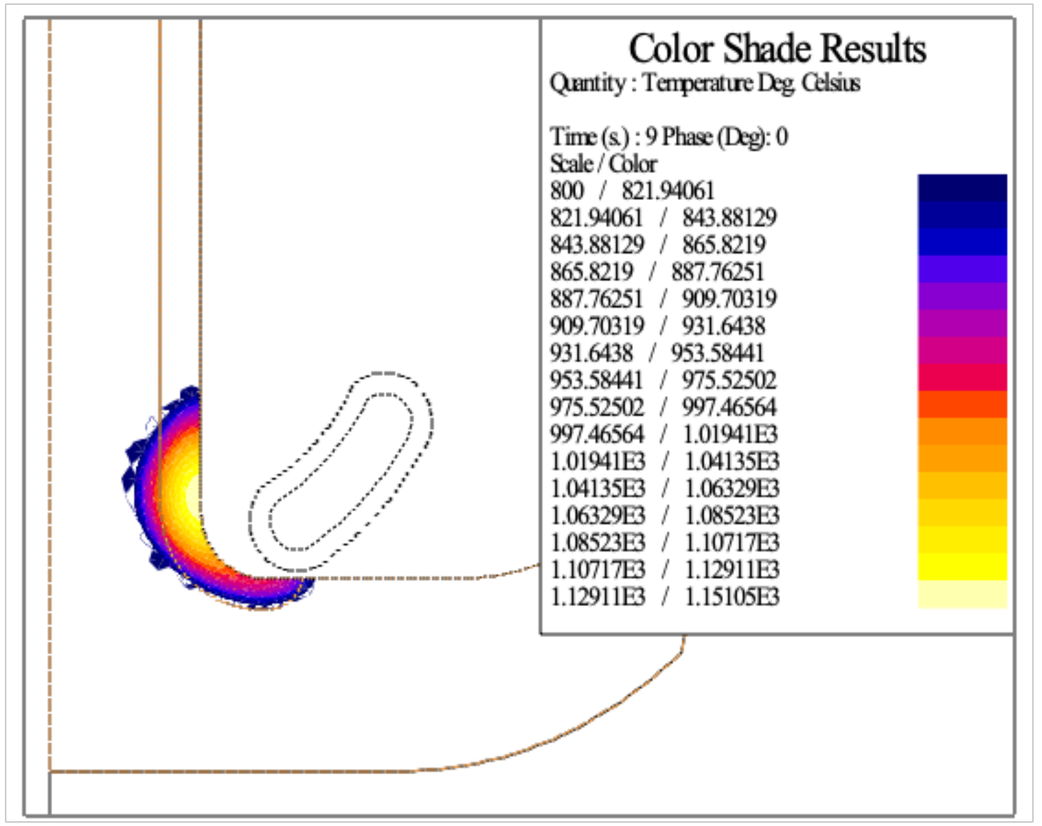
Temperature distribution and magnetic field lines at the end of dwelling period

Flux 2D program

Step 2 a: Temperature Distribution at the End of the Dwell



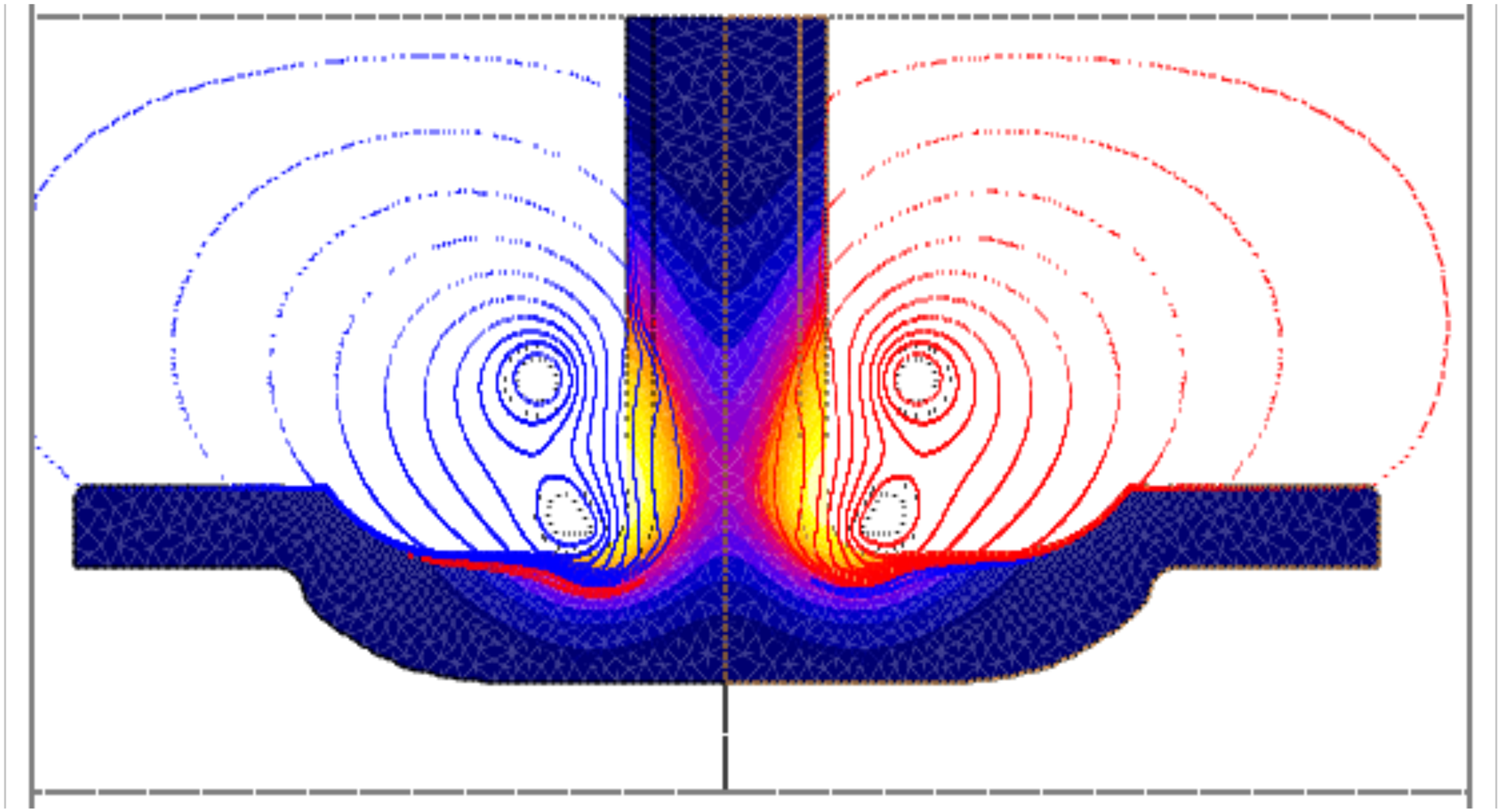
Temperature range 20 – 1150 C



Temperature range 800 – 1150 C

Results: Marginal depth in the radius, severe overheating in the area above the radius (temperature over 1150 C, which would continue to grow in the beginning of the scanning process)

Step 2b: Simulation of the Process with Existing Two-Turn Coil



Temperature distribution and magnetic field lines at the end of dwell

Flux 2D program

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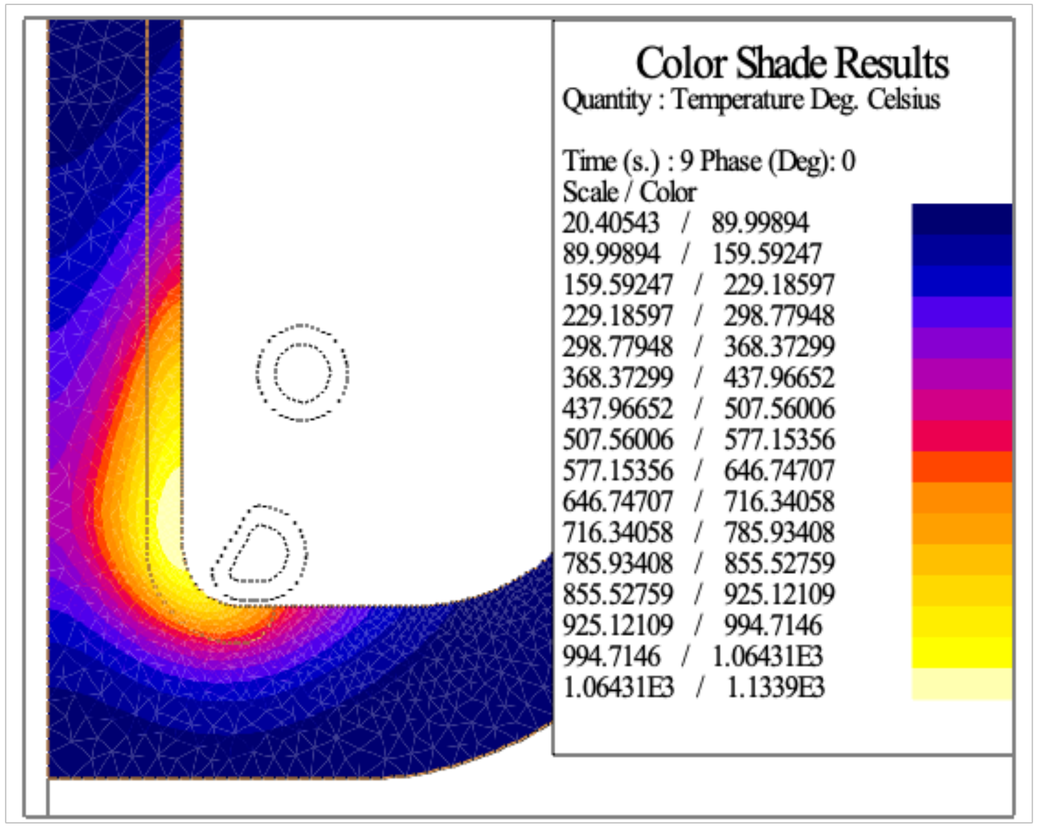
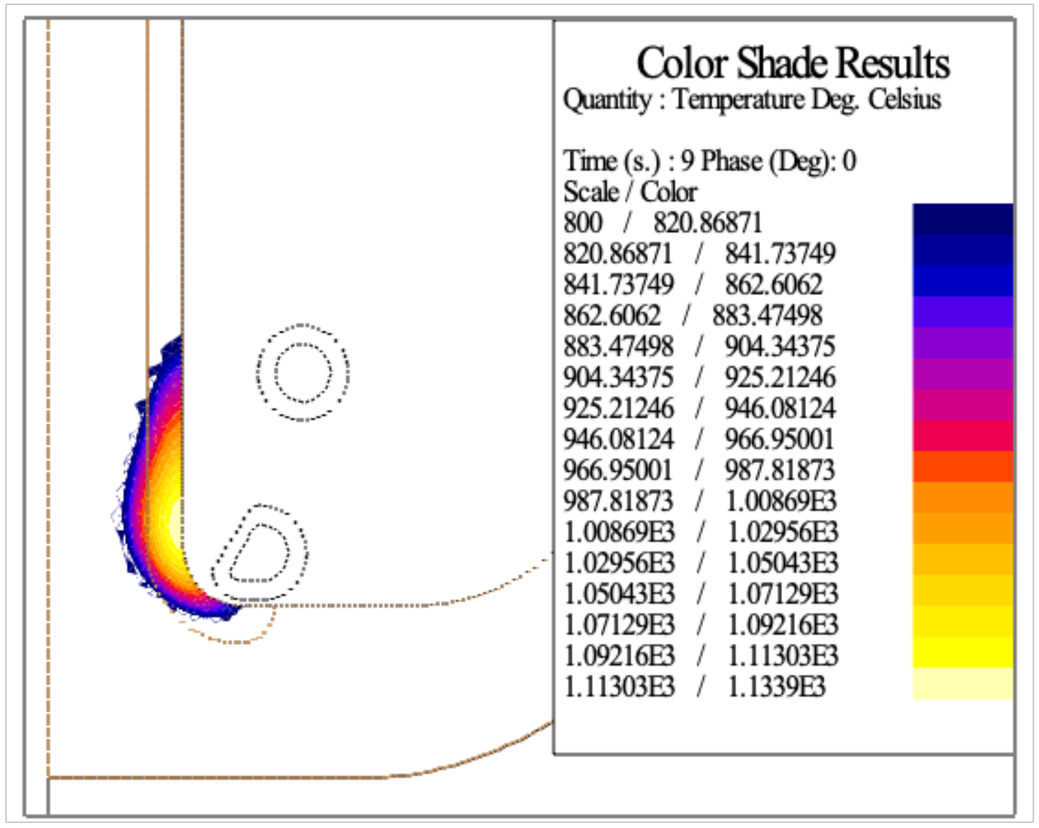
Temperature Distribution at the End of the Dwell with Two-Turn Coil





Results: Insufficient depth in the radius and short pattern on fillet, severe overheating in the area above the radius (temperature over 1130 C, which would continue to grow in the beginning of the scanning process).

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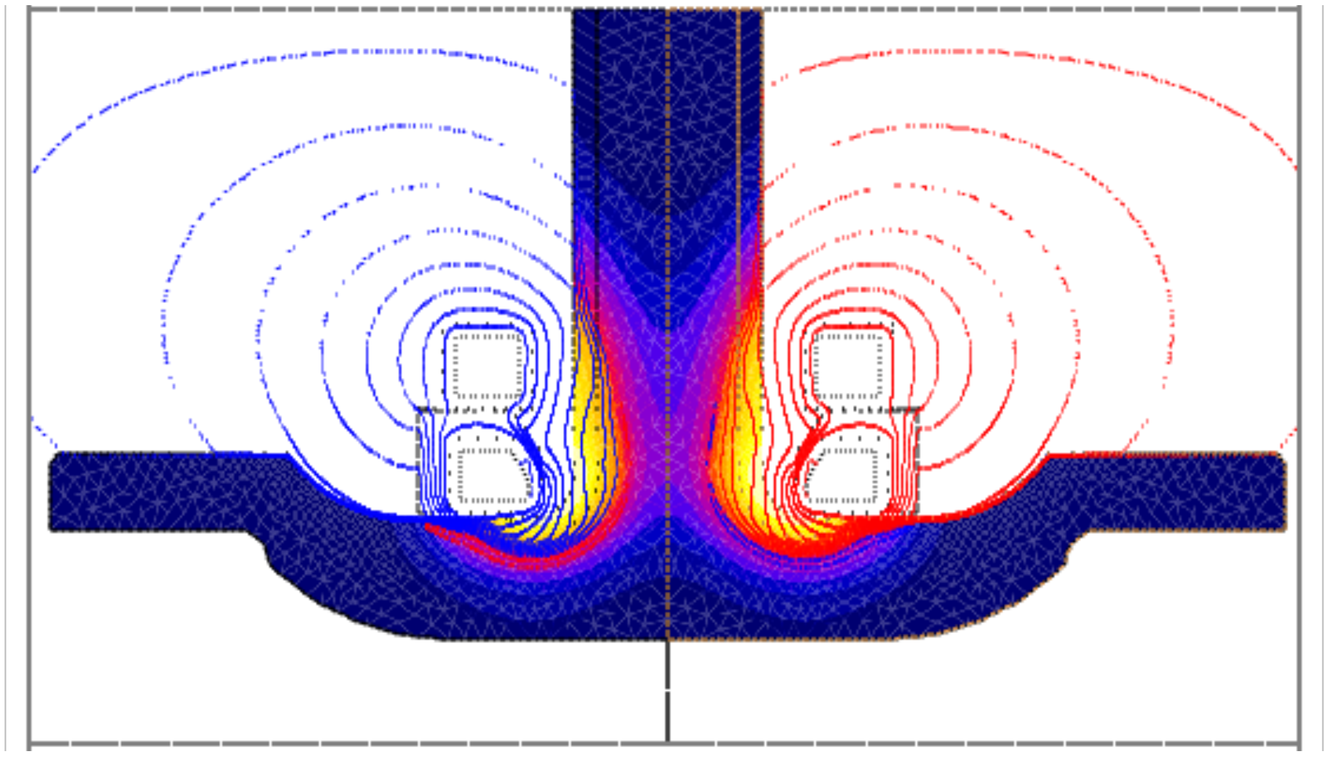
Step 3: Development of Optimized Coil

Based on results of computer simulation and previous experience it was decided to design a two-turn coil with Fluxtrol concentrator on the lower turn.

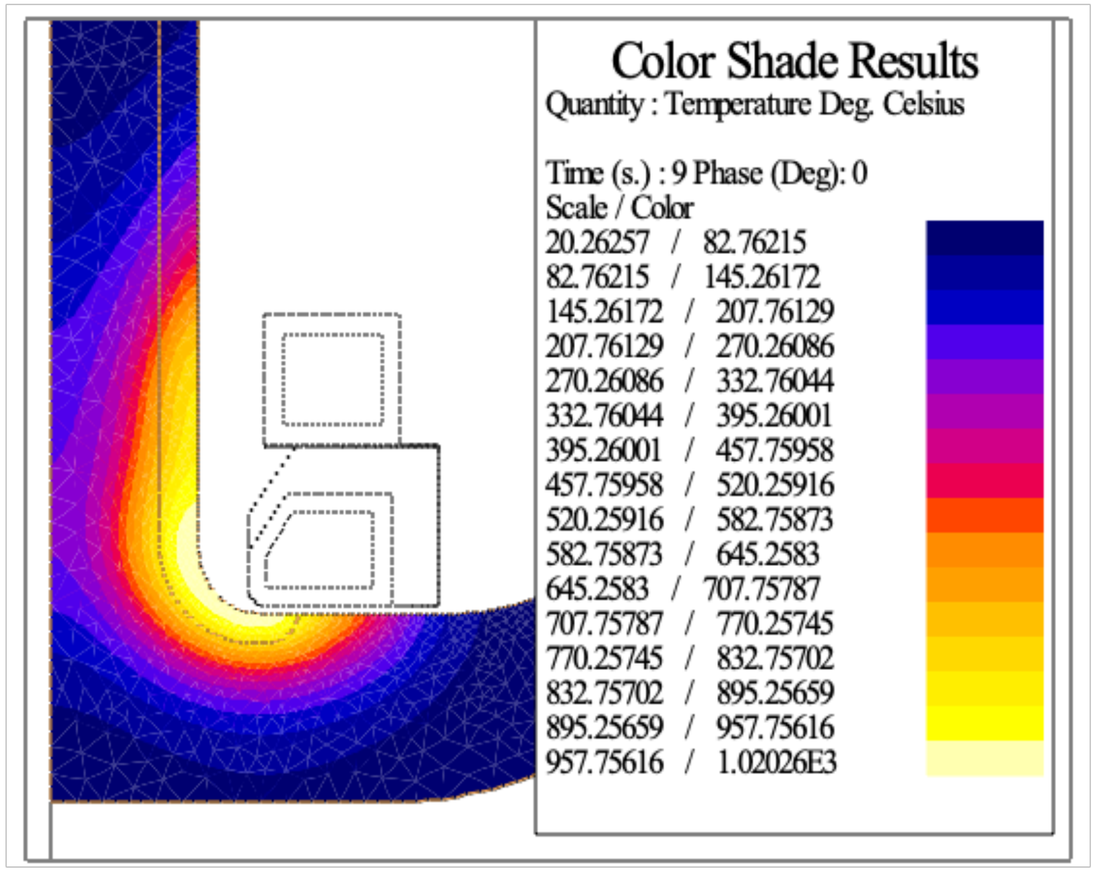
This design provides a favorable temperature distribution with required hardness depth on fillet and well controlled preheating of the stem area by the upper turn.

Optimal temperature distribution was achieved by variation of cross-sections of copper and magnetic concentrator made from **Fluxtrol "A"**.

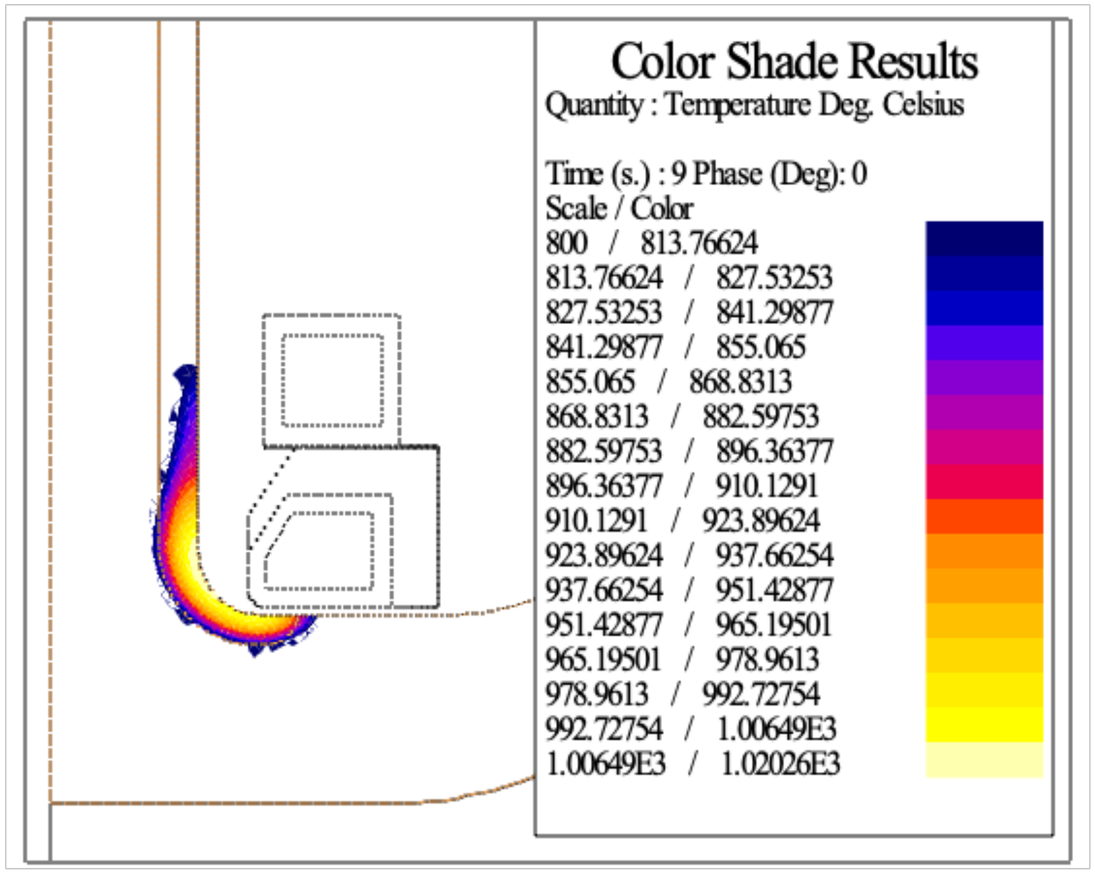


Temperature distribution and magnetic field lines at the end of dwell

Temperature Distribution at the End of the Dwell with Optimized Coil



Temperature range 20 – 1020 C



Temperature range above 800 C corresponding to a total hardness depth

Results: Good depth in the radius, no significant overheating in the area above the radius (temperature less than 1020 C); high scan speed/ production rate

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