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Advanced Induction Materials and Technology

Online Induction Heating Course

7 Case Story - Design of Stress Relieving Coil and Process

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$avings Due to Induction Coil and Process Optimization

- Increased production rates
- Lower maintenance costs
- Fewer downstream operations
- Reduced part scrap
- Shorter change-over times
- Energy savings

Everyone must produce “Good Parts”, but there are ways to make them **Better, Faster** and more **Economically**!

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Problem Description

Problem:

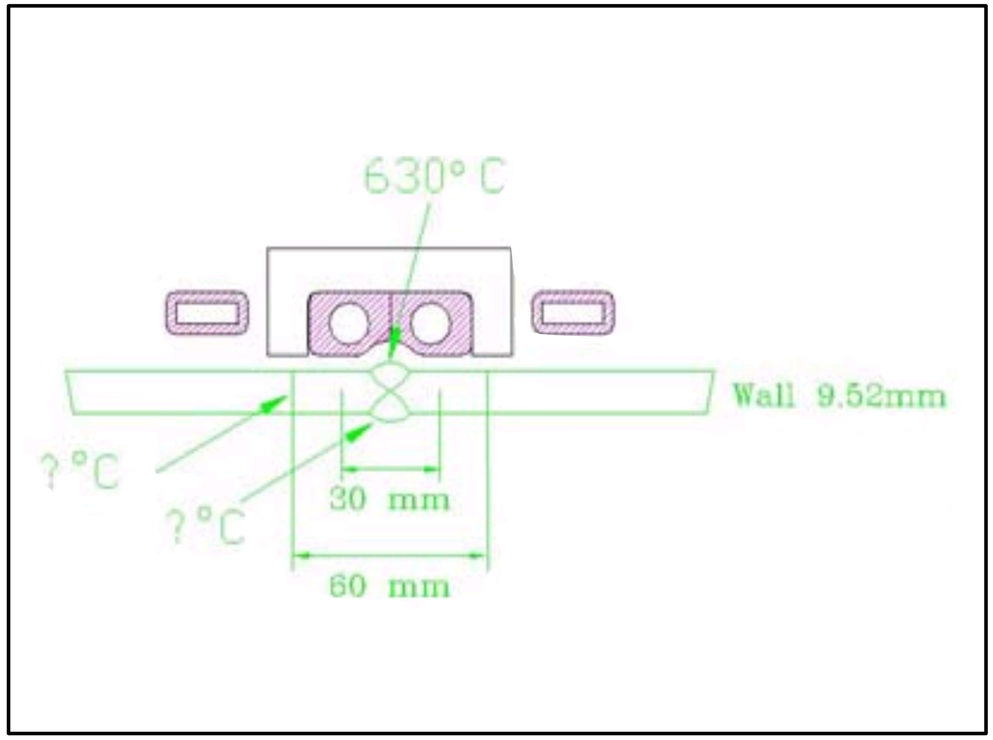
The Customer made contact due to the following:

•System they purchased could not meet required production rate

• To achieve marginal parts, they had to run at half the promised speed

• Even at half speed, they did not meet customer specifications because the heated zone was too narrow and the part was experiencing low temperature on seam bottom

• Difficulties were because the machine was built based upon experience in seam annealing, not stress relieving

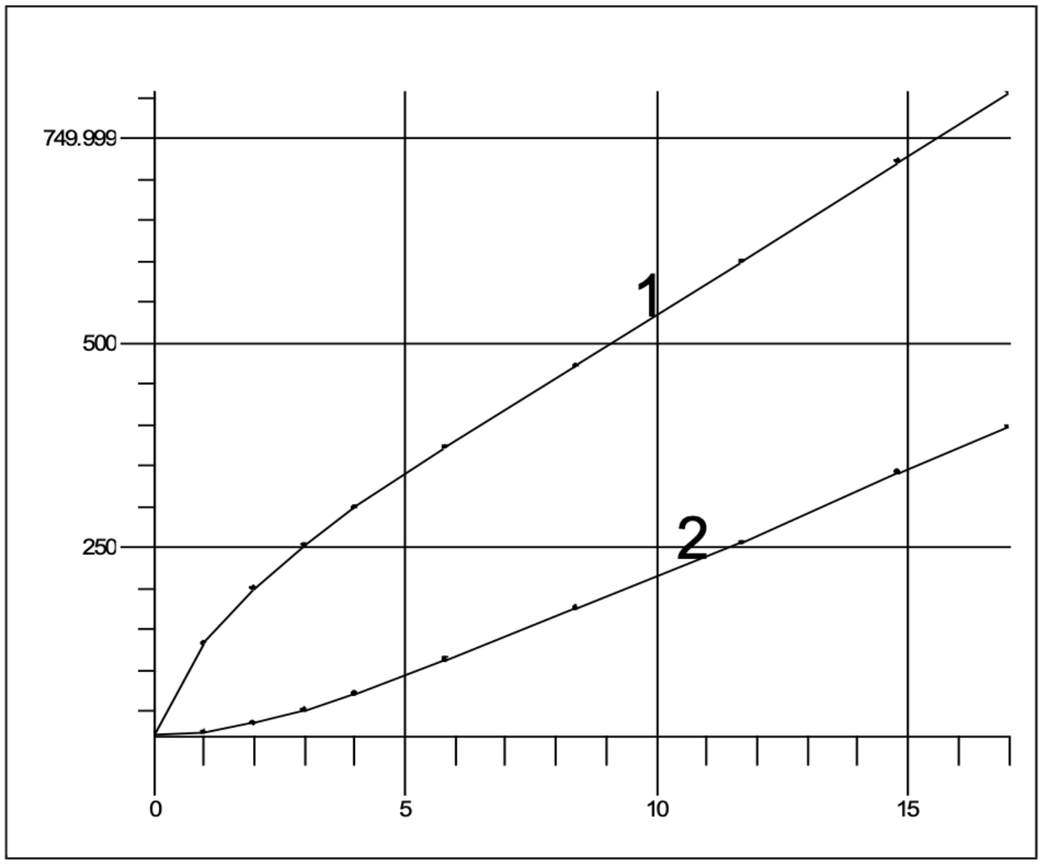


Inductor for seam annealing on spiral welded big diameter pipe

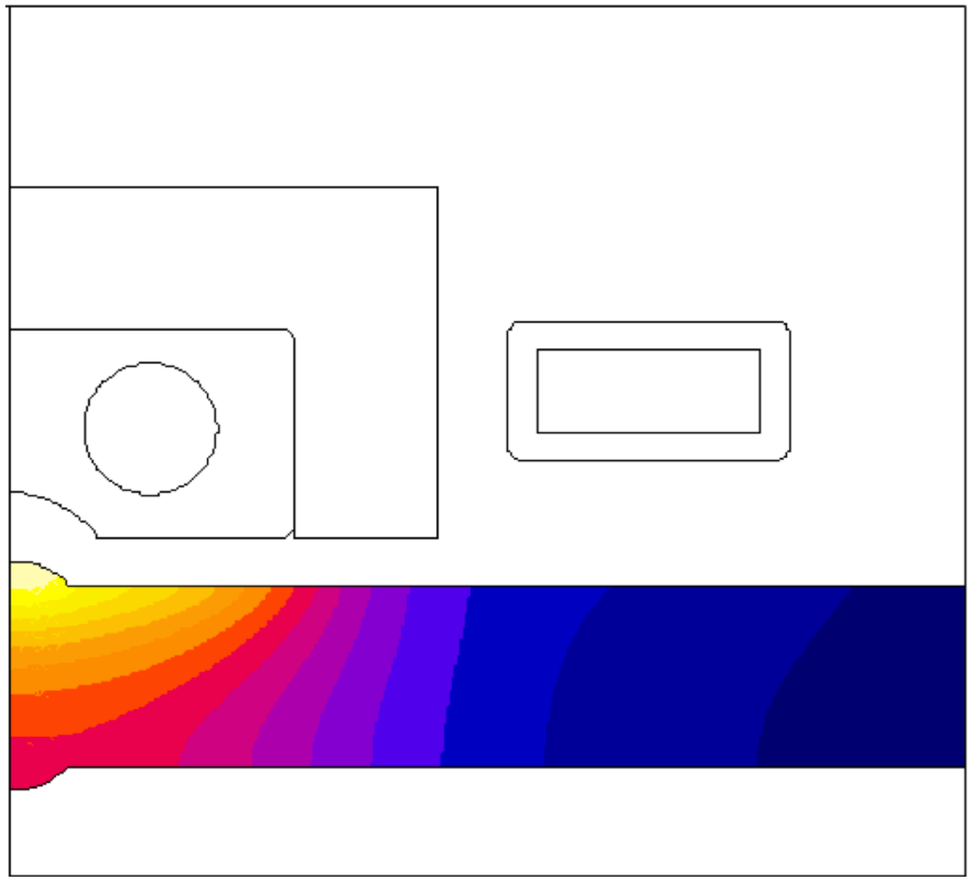
Step 1: Analysis of Process Conditions

- Limited space on spiral welding mill
- Power supply and other equipment with frequency 3 kHz and power 500 kW already exists
- Heat tube material: Steel 1040
- Wall thickness 12.7 mm
- Relatively small temperature window
  - Tmax = 650 C
  - Tmin = 550 C
- Heat Affected Zone (HAZ) 60 mm
- Required heating time 16 seconds
- Flux concentrator: **Laminations on original coil later replaced with Fluxtrol "A"**

Step 2: Simulation of Existing Process



Temperature evolution in Outside (1) and Inside (2) seam points

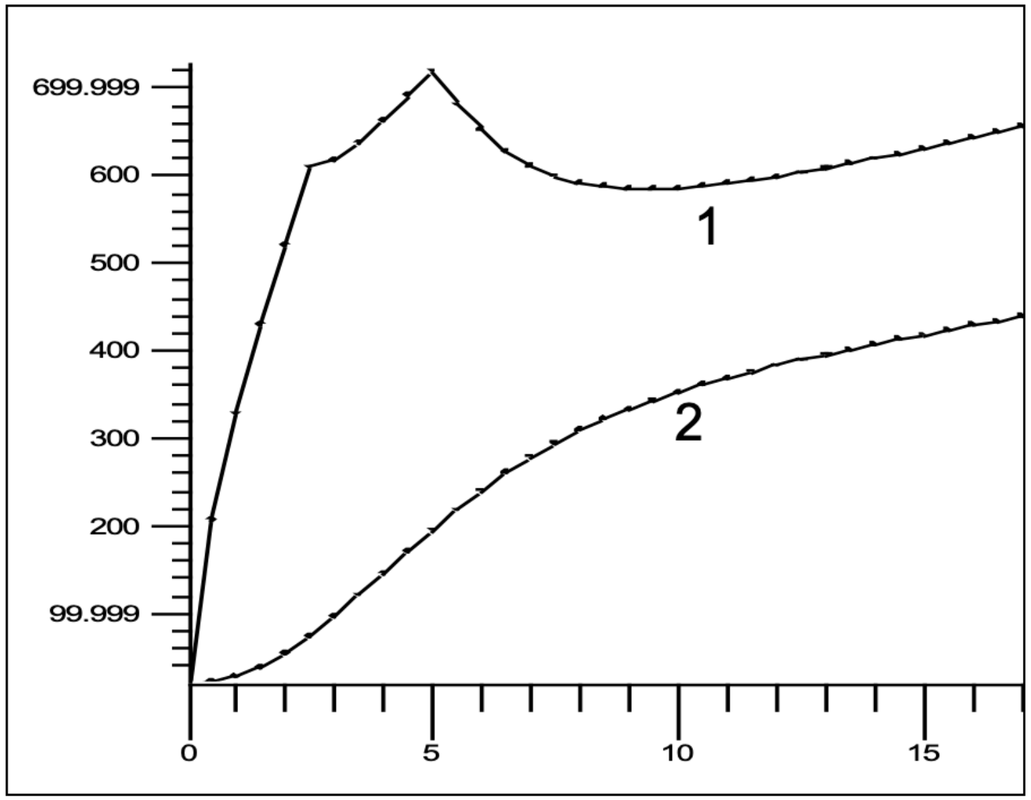


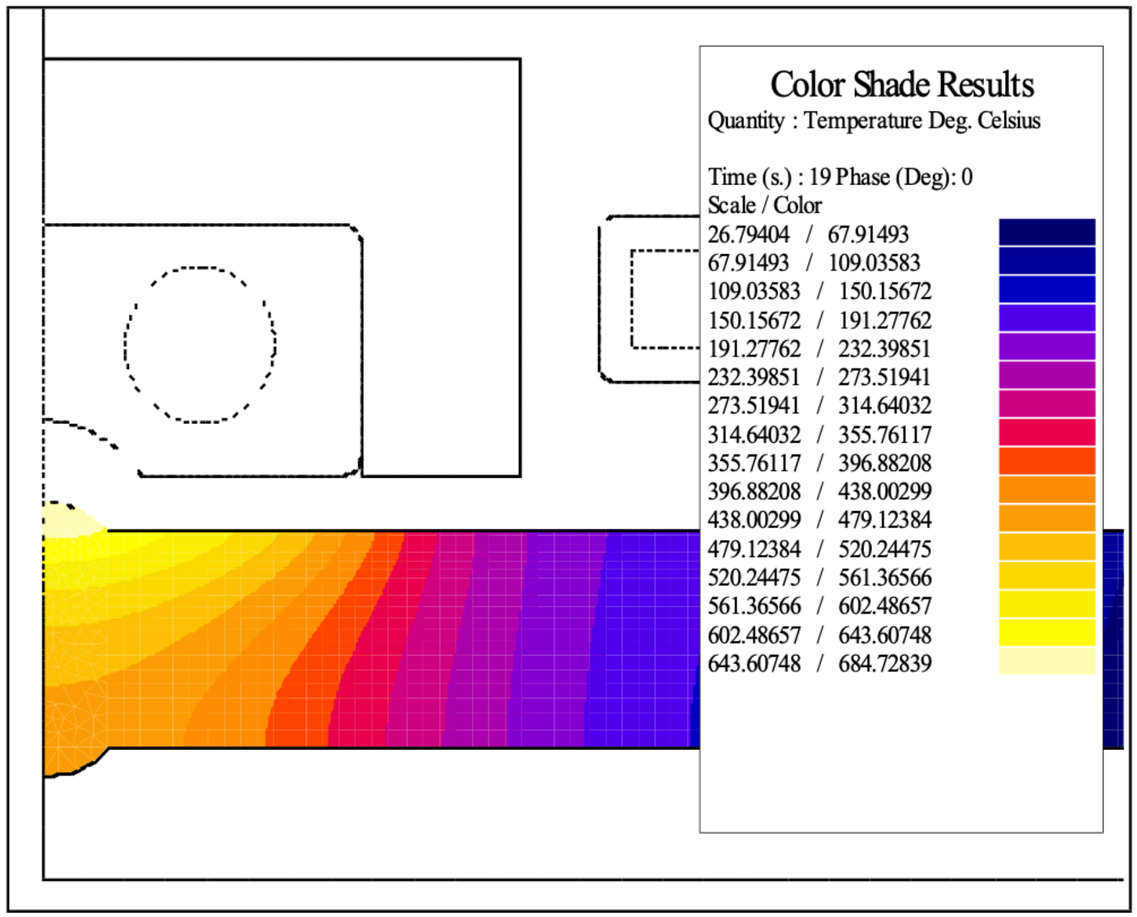
Temperature color map at the end of heating

These results are close to experimental data and very far from specifications

Flux 2D program

Step 3: Initial Inductor Design Using Power Ramping





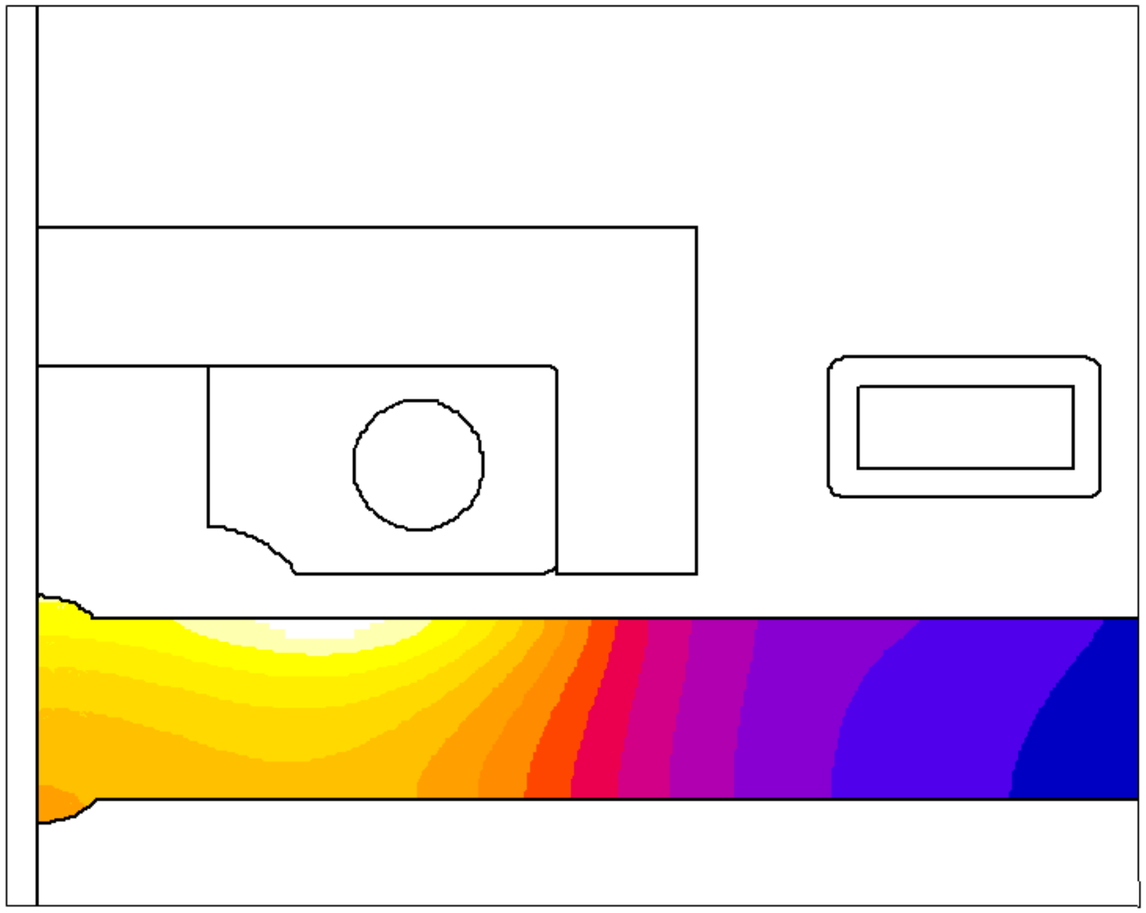
The easiest way to improve temperature distribution is to use power profiling along the coil length. It may be achieved by variation of concentrator geometry.

Results are much better but specifications are still not met

Step 4: Optimal Process and Coil

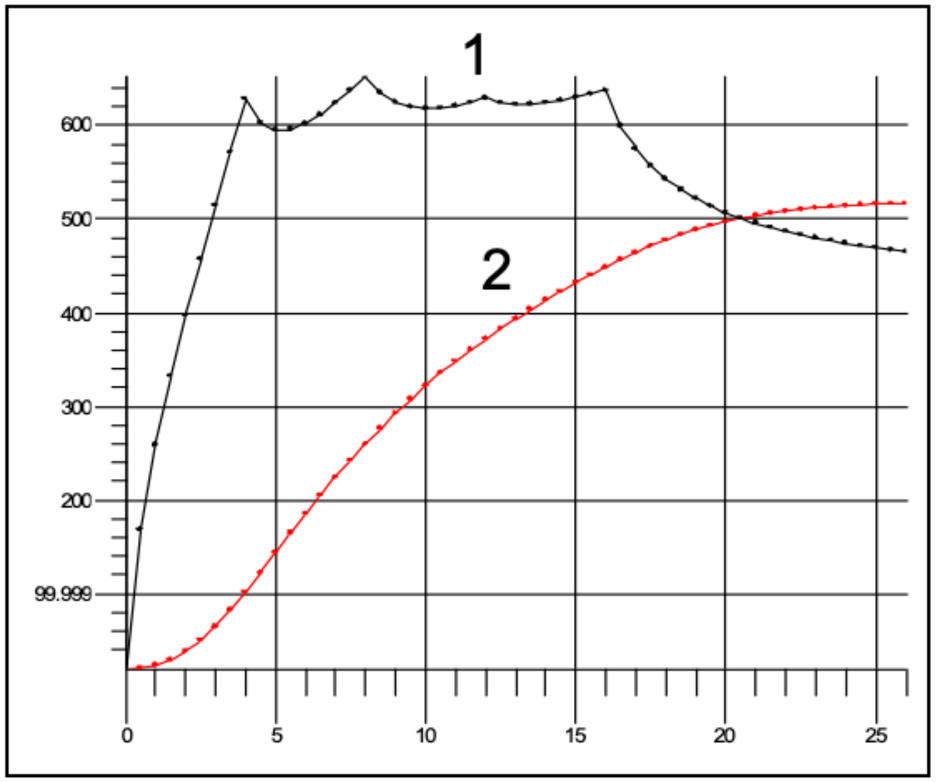
Proposed solution:

1. Make central coil leg of two parallel conductors to increase Heat Affected Zone
2. Power ramping and precise holding of maximum temperature
3. Use Fluxtrol concentrator with profile variation

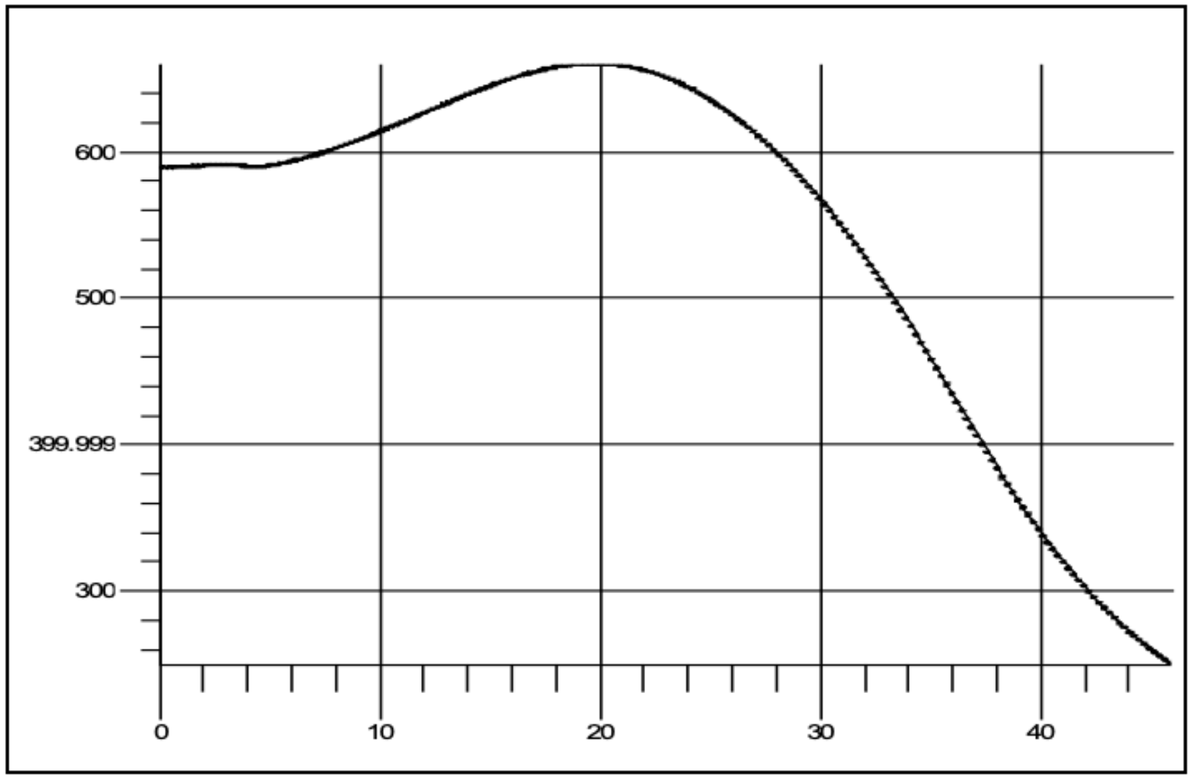


Temperature color map for new coil and process at the end of heating

Temperature Evolution with New Coil



Temperature evolution in Outside (1) and Inside (2) seam points for optimized process

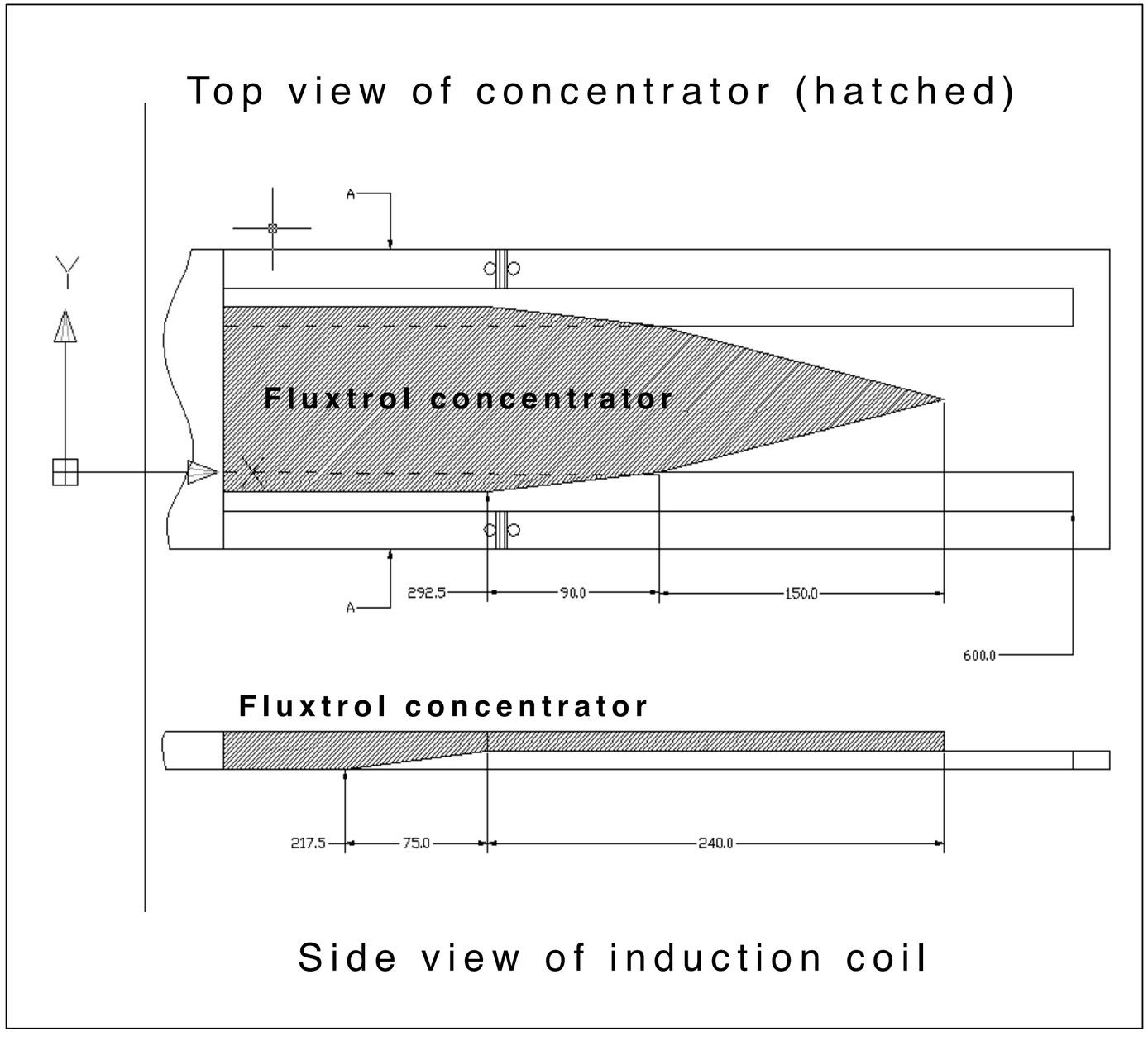


Temperature profile along the pipe OD surface at the end of heating

Minimum temperature in HAZ (point 2) reached required value without material exceeding maximum acceptable temperature

New Inductor Sketch (Top and Side Views)

Concentrator has full C-shaped profile at ramping stage. When maximum permissible temperature was reached, concentrator shape started to change by cutting pole length and then complete removal of concentrator.



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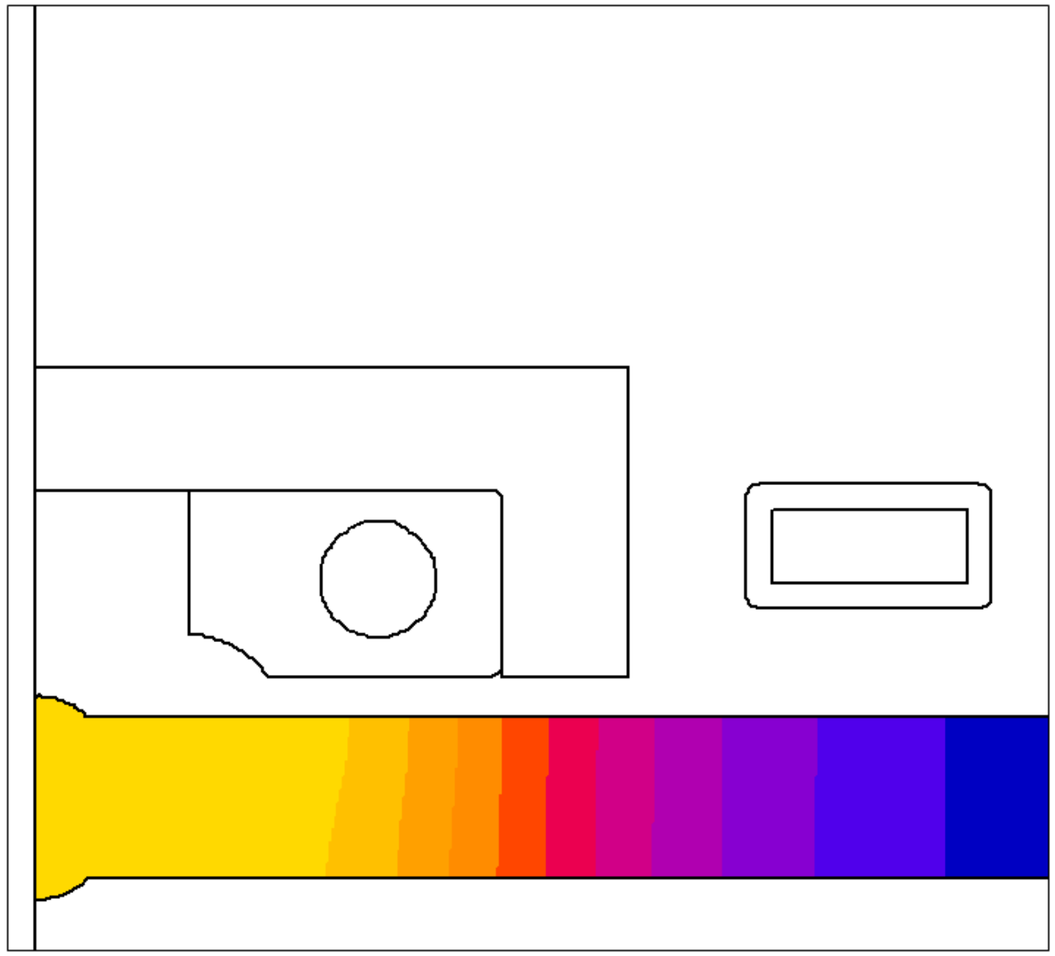
Final Results

- Customer manufactured induction coil according to Fluxtrol suggestions
- Induction user was able to produce parts in specs with desired production rate
- Final customer was completely satisfied



See Seam Anneal Video

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