

# Research Programs

## Control of Distortion and Residual Stress in Heat Treated Components

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### Objectives

- Identify and prioritize factors influencing distortion and identify those, which are controllable in the heat treat process.
- Identify and quantify the necessary inputs for a computer model.
- Demonstrate current modeling capabilities with FEM simulations and with experiments.
- Identify the sensitivity of distortion and residual stresses to variations in the input parameters.
- Correlate quenchant performance with the characterization results.
- Provide industry members with tools for prediction/control of distortion and residual stresses.

### Strategy

- Perform literature search and poll members on factors considered to affect distortion. Prioritize and weigh factors controllable through the heat treatment process.
- Determine the factors needed for input to computer prediction models and whether or not adequate data are available.
- Determine experimentally the necessary data for computer models for the two materials to be studied in this project, IN718 and 4142 steel.
- Perform sensitivity analysis using computer model to determine the distortion and residual stress variations caused by various factors.
- Validate model through measurements of distortion and residual stress for the two materials in their specific geometry.
- Collaborate with the quenchant project at WPI to correlate quenchant performance with our characterization results.
- Synthesize the experimental and modeling results into useable tools for control of distortion and residual stress.

### Accomplishments

- Residual strains measurement by Neutron Diffraction method
- Influence of mechanical properties on the FEM calculation
- Development of web-based distortion prediction tool
- FEM calculations for oil quenched 4142 steel tube

APPENDIX A - Neutron Diffraction Measurement of Oil Quenched 4142 Tube

APPENDIX B - High Temperature Mechanical Property Sensitivity

APPENDIX C - Web-based Database (Hotpoint and SysWeld)

APPENDIX D -FEM Calculation for AISI 4142 Tube

Full Report is available to CHTE members; Contact [dapelian@wpi.edu](mailto:dapelian@wpi.edu), or [mpi@wpi.edu](mailto:mpi@wpi.edu).