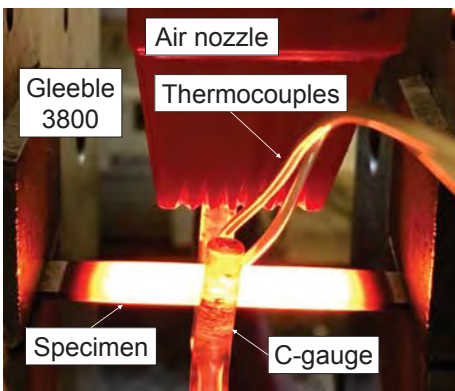


Introduction

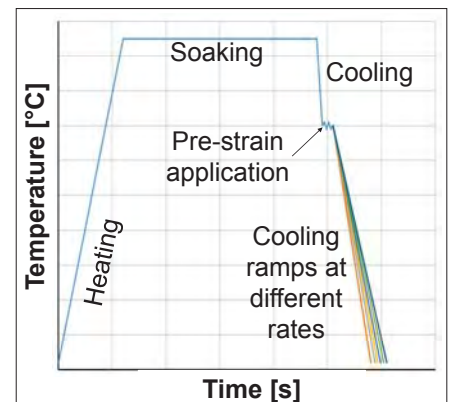
The hot stamping process of boron enriched steels is based on the transformation from the initial ferrite + pearlite microstructure to the final martensite or martensite + bainite microstructure, with an important increase of the mechanical properties. The cooling stage of the process, where the phase transformation occurs, follows the forming stage where a certain strain/stress is applied on the piece. This strain/stress influences the start of the phase transformation, requiring faster cooling or longer soaking times. The aim of the research is to highlight the differences between the base CCT diagram of 22MnB5 steel, and the CCT with strain/stress applied. The experimental results are also validated using LS-Dyna simulations with material model 244_UHS_STEEL.

Experimental Equipment and Procedures



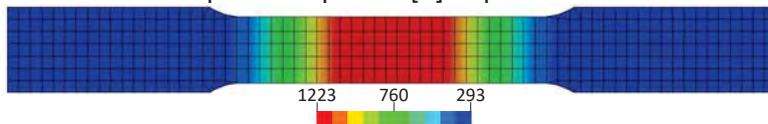
Test conditions:

- Austenitization: heating rate 5°C/s, soaking of 360s at 950°C;
- Temperatures at which the pre-strain is applied: 800°C;
- Pre-strain applied: 0%-5%-10%-15%;
- Strain rate of the pre-strain: 0.1s⁻¹;
- Cooling rate before pre-strain: 50°C/s;
- Cooling rates after pre-strain: 60-45-40-35-30-27°C/s;
- Repeatability: 2.



Numerical Simulation

Temperature profile [K] implemented.



The flag REACT=1 allows the activation of the flags LCEPS23, LCEPS4 and LCEPS5 which describe the dependance of the phase transformation start with the amount of strain applied.

MAT_244_UHS_STEEL:

- Flow curves of Austenite, Bainite and Martensite at different temperatures and strain rates;
- Chemical composition of 22MnB5;
- Thermal parameters for the phase transformation.

Results

From the C-gauge deformation is possible to determine the starting temperatures of martensite (Ms) and bainite (Bs). With increasing pre-strain, the martensitic starting temperatures is lowered of about 20°C and the bainitic transformation is anticipated from a cooling rate of about 27°C/s to 40°C/s. The numerical simulation can foreseen the behaviour described by the experimental data.

