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Determination of machining parameters for a specific adjustment of the residual stress profile by induction hardening

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Within the research work of the transregional collaborative research centre TRR136, the so-called Process Signatures were determined for some processes that result due to an exclusively thermal load for the component surface layer. These Process Signatures represent correlations between material modifications (e.g. residual stress and hardness profile) and characteristic values of the material loading (here e.g. maximum temperature, maximum temperature gradient). The underlying idea is that the material does not know any processes but only loads caused by processes. In particular, the same loads lead to the same material modifications regardless of the process. A decisive advantage of this concept over conventional approaches is the possibility of calculating the necessary internal material loads backwards on the basis of concrete specifications for the material modifications. If there are additionally correlations between internal material loads and process quantities as well as between process quantities and machining parameters, the process quantities and ultimately the necessary machining parameters can be determined, too.
In this paper, this procedure is introduced using the example of one-sided induction hardening of cuboidal components made of quenched and tempered 42CrMo4. The necessary Process Signature and the two correlations just mentioned were determined by experimental and numerical investigations. The specifications for the material modifications consist of the surface residual stresses and the depth for the sign change of the residual stresses from compression to tension. This quantity characterizes the position of the hardness drop, too.

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