# IMPACT RESISTANCE OF VP159 HIGH NITROGEN STEEL

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## ABSTRACT

This work presents the impact resistance results of investigation on the VP159 high nitrogen steel. The tests were carried out using the Instron impact system at the projectile velocity equal to 12,5 m/s. The experimental results were compared to the FE predictions. The Rusinek-Klepaczko constitutive model was applied to describe mechanical response of tested material. It was concluded that the FE results were in a good agreement with the experiment.

## INTRODUCTION

A high nitrogen austenitic steels are very often used in many branches of industries: transport, military, nuclear as well as civil engineering due to excellent properties concerning: ductility, strength and corrosion resistance. A broad applicability of wide area of austenitic steels requires the efficient constitutive models to be elaborated in order to ensure a rational predictions of their mechanical behaviour. This work presents the impact resistance results of tests carried out on the VP159 high nitrogen austenitic steel. The experimental data were compared with the FE simulations in order to validate the Rusinek-Klepaczko (RK) constitutive model applied for description of the phenomena taking place under dynamic loading of the VP159 steel. It was calibrated using data obtained during tests carried out at a wide range of strain rates.

## RESULTS AND CONCLUSIONS

The impact resistance tests were carried out using Dynatup 9259HV system. The test parameters were as follows: energy equal to 500J and projectile velocity equal to 12,5 m/s. The conical projectile of 10 mm diameter was made using the NC3 steel. The plane specimen of 3 mm thickness was fabricated. A view of perforated specimen is shown in Fig. 2(a).

Subsequently, the mechanical response of the VP159 steel at static and dynamic loading conditions was analysed. Two experimental techniques were applied in order to elaborate stress-strain characteristics at wide range of strain rates: monotonic loading on the servohydraulic testing machine and dynamic loading using the Hopkinson bar. The RK constitutive model (Rusinek, 2009) was calibrated on the basis of the experimental data. On the basis of the results presented in Fig. 1 one can conclude, that there is a good agreement of a stress-strain curves between experiment and RK prediction.

The FE simulations were carried out using ABAQUS Explicit code. The RK model data were applied in order to predict flow stress of the VP159 steel whereas a fracture behaviour of austenitic steel, in a the form of Johnson-Cook equation was taken from earlier work (Trattning, 2008). The results of simulation are presented in Fig. 2(b).

The FE calculations show a good agreement with the experimental data of impact resistance test. It may be concluded that the RK model developed for the VP159 steel enables a good predictions in the case of high level of strain rate what corresponds to the conditions typically met at crashworthiness and ballistic impact for example.

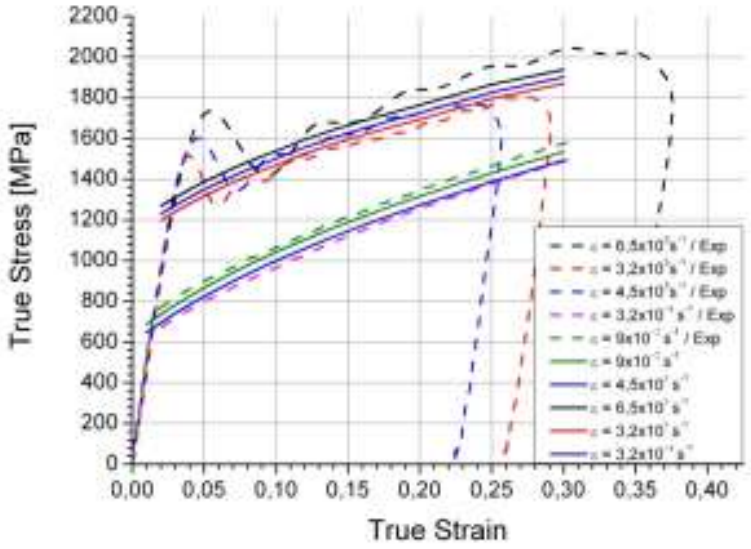


Fig.1 The comparison of experimental results with model based data.

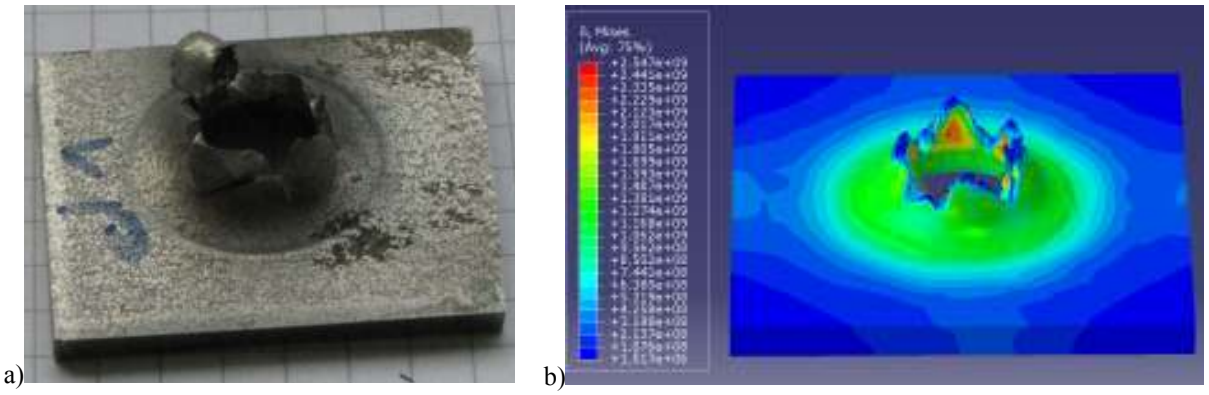


Fig.2 Specimen view after impact tests; a) – experimental results; b) – FE results

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