

## The Effect of Hybrid SPD Process on Mechanical Properties, Drawability, and Plastic Anisotropy of DC03 Steel

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**Abstract :** The hybrid SPD process called DRECE (Dual Rolls Equal Channel Extrusion) combines the concepts of ECAP method and CONFORM extrusion, and is intended for processing sheet-metal workpieces. The material in the form of a metal strip is subjected to plastic deformation by passing through the shaping tool at a given angle  $\alpha$ . Importantly, in this process the dimensions of the metal strip do not change after the pass is completed. Subsequent DRECE passes allow for increasing the effective strain in the tested material. The method has a significant effect on the microstructure and mechanical properties of the strip. The experimental tests have been conducted on the unconventional DRECE device in VŠB Ostrava, the Czech Republic. The DC03 steel strips have been processed in several passes - up to six. Then, both Erichsen cupping tests as well as static tensile tests have been performed to evaluate the effect of DRECE process on drawability, plastic anisotropy and mechanical properties of the investigated steel. Both yield strength and ultimate tensile strength increase significantly after consecutive passes. Drawability decreases slightly after the first and second pass. Then it stabilizes on a reasonably high level, which means that the steel is characterized by useful drawability for technological processes. It was investigated in the material is characterized by a normal anisotropy. In the microstructure, an intensification of the development of microshear bands and their mutual intersection is observed, which leads to the fragmentation of the grain into smaller volumes and, consequently, to the formation of an ultrafine grained structure. "The project was co-financed by the European Union within the programme "The European Funds for Śląsk (Silesia) 2021-2027".

**Keywords :** SPD process, low carbon steel, mechanical properties, plastic deformation, microstructure evolution

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