Forming Analysis of Tailored Tubes with an Internal Contoured Wall Thickness and External Axial Ribs Manufactured by Internal Flow-Turning

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Abstract. Internal Flow-Turning is an innovative rolling process for the manufacture of tailored tubes with a variable wall thickness contour over the longitudinal axis. The wall thickness distribution is determined solely by the internal diameter created by a special roller tool. The wall thickness is defined by the gap between the roller element on the inside and a die ring on the outside of the tube. The outer diameter of the manufactured tube can remain constant, thus greatly simplifying further processing by hydroforming, for example, or can be structured by ribs in the longitudinal direction. For this reason, internal flow-turned parts offer beneficial characteristics when used as semi-finished parts and are favourable for downstream processing. Depending on the tool design, a wall thickness reduction of > 90 % of the initial wall thickness is possible. In addition, the roughness of the rolled surface can be significantly improved. Through the incorporation of cold hardening in the process, the strength and hardness of the processed work piece can be improved by up to 70 % of the initial state. Internal Flow-Turning is also well-suited to the calibration of a tubular part, since it provides tighter dimensional and geometrical accuracy. By using a die with longitudinal grooves, it is possible to form axial rib elements on the outer surface of the tube. The main subject of this paper is a material flow and forming analysis of the Internal Flow-Turning process. The focus is on a forming analysis in respect of the wall thickness reduction and the shape of various formed axial ribs.