

# INFLUENCE OF CONTACT CONDITIONS AND STRAIN PATH ON STRETCHING OF STEEL AND AL-ALLOY SHEET METALS

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## ABSTRACT

Biaxial tension – stretching of sheet metals is one of characteristic stress-strain-schemes, which in the course of sheet metal forming by deep drawing may exist in particular work piece zones or may dominate completely (Erichsen's test). In such forming conditions, tribological conditions of tool and sheet metal contact are extremely important. In addition to fracture depth, which is a main investigation indicator, the paper also presents more complex parameters for estimation of contact conditions influence – fracture force and realized strains distribution, as well as relations in forming limit diagram. Furthermore, it shows that in the multistage forming conditions, i.e. at modification of so called strain paths, contact conditions have a considerable influence on the degree of realized limit strains. Steel and Al-alloys sheet metals were used in the experiment. In addition to the analysis from the formability aspect, the specified methodology can be used with great success for the estimation of technological qualities of lubricants for deep drawing.

KEYWORDS: Deep drawing, Stretching, Formability, Friction, Strain

## 1. INTRODUCTION

In deep drawing of complex geometry parts, such as vehicle body elements, various stress-strain schemes may exist in particular zones of the workpiece being formed, with tribological conditions influence which might often be complex. On work piece flange, next to pure tangential compression zone, parts without completely curved inner contour have uniaxial tension, which moves to bending field on the die edge. If there are draw beads on the flange, stress scheme gets complicated significantly. As a rule, uniaxial tension is dominant in the wall of the work piece which conveys the forming force. In the specified zones, it is necessary to reduce friction, i.e. to control friction on flange, in order to control sheet metal moving into die opening. During the last few years, researchers have given great attention to the control of blank holding force on the flange of the work piece being drawn in the real time /1/. From the aspect of successful forming, i.e. utilization of formability potential of the material being formed, the zone under the punch face, where stress scheme of biaxial tension is dominant, is extremely important.

The influence of tribological factors in deep drawing process is as important as the influence of other main process factors – machine, tools and work piece material /2/. By using appropriate combination of specified factors, it is possible to realize reliable production and obtain high-quality piece.

In physical modelling of deep drawing process, i.e. modelling of contact friction influence, it is necessary to comply with similarities of stress-strain ratios, as well as similarities of main tribological parameters: speed, pressure and temperature on sliding surfaces. [Figure 1](#) shows, in details, the tribo-model of stretching in global survey of other models significant for deep

















