

# Effect of Various Parameters on the Wrinkling In Deep Drawing Cylindrical Cups

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**Abstract:** The appearance of dimensional deviations of shape and position, of the defects in the metal sheets that have been subjected to a cold plastic deformation process (deep-drawing), represents a critical problem for the specific industry, especially for the mass production, like the machine manufacturing industry. The aim of this publication is to present the principal aspects that effect of various factors like BHF, punch radius, die edge radius, and coefficient of friction on the wrinkling of cylindrical parts in deep drawing process. The initiation and growth of wrinkles are influenced by many factors such as stress ratios, the mechanical properties of the sheet material, the geometry of the work piece, and contact condition. It is difficult to analyze wrinkling initiation and growth while considering all the factors because the effects of the factors are very complex and studies of wrinkling behavior may show a wide scattering of data even for small deviations in factors. In the present study, the mechanism of wrinkling initiation and growth in the cylindrical cup deep drawing process is investigated in detail.

**Keywords:** Deep-Drawing, Wrinkling, Plastic deformation, Blank Holding Force.

## 1. Introduction

Effect of various factors that lead to the wrinkling apparition are: the blank holding force of the blank, the geometrical parameters of the die, the frictions that appear during deep-drawing between the blank and the work elements of the die, the material characteristics and anisotropy, the contact conditions, the part

geometry, the mechanical properties of the material, the imperfections in the structure and the initial state of internal tensions of the material, etc. Usually, the blank holding force has to increase along with the increase of the deep drawing depth, but we must take into consideration the fact that if its value is too big it can lead to cracks and even a break of the material. The main geometric parameters of the die which influence the wrinkling [1] are: the diameter of the punch and punch edge radiuses. In the case of friction between the piece and the tool, the increase of the coefficient of friction determines the wrinkling to reduce, but high values of the coefficient can cause cracks and material breakage [12].

The main phenomena of instability appearing at the cold forming of metal sheets, which lead to a decrease of the processing accuracy through the modification of the geometrical shape and the faulting of the machined surfaces, can be thus grouped: Phenomena of instability which appear after the process of plastic deformation and which lead the modification of the shape of the deformed parts after the deformation forces have stopped. The most important phenomenon of this kind is the phenomenon of elastic recovery.

The force exerted by the blank holder on the sheet supplies a blank holding force which controls the metal flow. This restraining action is largely applied through friction. Excessive flow may lead to wrinkles [2] within the part.

Phenomena of instability which appear during the process of deformation, compression instability being one of them. Wrinkling defect generally occurs at the flange and is generated by excessive compressive stress that causes the sheet to buckle.

Wrinkling and tearing or rupture thus define the deep drawing process limits [8-









