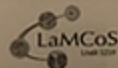


27–29 August 2018  
Lyon Villeurbanne, France

Organized by



**INSA** INSTITUT NATIONAL  
DES SCIENCES  
APPLIQUÉES  
15708

LTDS



IFSTTAR

ECAM

CHARTRIDGE  
BOOKS OXFORD

Reduction of tooth root bending stress by  
employing asymmetry both in tooth profile shape  
and tooth fillet form – dual asymmetry

B. Sahin<sup>1</sup>, N. Yıldırım<sup>1</sup>, A. Akpolat<sup>1</sup>, C. Fevzi<sup>1</sup>, Ö. Yıldırım<sup>1</sup>, B. Karatas<sup>1</sup>,  
F. Endogan<sup>2</sup>  
<sup>1</sup> Gazişehir University, Mechanical Engineering Department, Turkey  
<sup>2</sup> Istanbul University, Mechanical Engineering Department, Turkey  
<sup>3</sup> Mechanical Engineer, BSC, Turkey  
<sup>4</sup> Emakina Gear Industry, Turkey

ABSTRACT

Gear tooth form, on both drive and coast sides, consists of active involute part and inactive fillet part. Conventional designs produce symmetrical involute and symmetrical fillet forms on both driving and coast sides of the tooth. Asymmetry in involute form has been studied by researchers to increase tooth root thickness and hence to reduce the root bending stress. Similarly, asymmetry in fillet form has also been recently studied with resulting 10% reduction in bending stress of conventional 20degree symmetric tooth gears. In this paper, asymmetry both in involute and root fillet forms are employed together to further investigate any likely reduction in bending stress. Results for different levels of asymmetry in both tooth form (pressure angles) of drive and coast sides and also for different levels of cutter tip radii coefficients of drive and coast sides produced bending stress reductions between 9-15%.

NOTATION

Symbol

|              |   |
|--------------|---|
| $\alpha$     | Pressure angle of basic rack, degrees                     |
| $\alpha_d$   | Pressure angle of basic rack for drive side, degrees      |
| $\alpha_c$   | Pressure angle of basic rack for coast side, degrees      |
| $r_f/r_b$    | coefficient of fillet radius of basic rack                |
| $r_{fd}/r_b$ | coefficient of fillet radius of basic rack for drive side |
| $r_{fc}/r_b$ | coefficient of fillet radius of basic rack for coast side |
| $r_f$        | fillet radius of basic rack, mm                           |
| $\sigma$     | bending stress, MPa                                       |
| $M$          | bending moment, Nm  |
| $I$          | moment of inertia, mm <sup>4</sup>                        |
| $c$          | distance to neutral axis, mm                              |
| $s_{cr}$     | tooth root critical section thickness, mm                 |