lar procedure for the 8.5 in. (21.6 cm) pulley produces σ_m = 16,460 lb/in.^{2} (113.5 MPa), σ_0 = 11,490 lb/in.^{2} (79.2 MPa), and $N = 5.78 \times 10^7$ cycles. Following the procedure of reference [3], life for each pulley is substituted into Miner's theory of cumulative damage

$$\frac{1}{N_{\text{drive}}} = \frac{1}{1.20 \times 10^7} + \frac{1}{5.78 \times 10^7} \qquad \text{(A1)}$$

to obtain a resultant drive life of $N_{\text{drive}} = 9.94 \times 10^6$ cycles.

Equation (1) is used to establish horsepower ratings for V-belt drives by specifying a base life and then iteratively solving for strand tensions which yield that life. The order of this procedure is the reverse of that illustrated in the example.

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DISCUSSION

G. Gerbert[1]

At last the V-belt fatigue has been based on the mean stress and the alternating stress, i.e., the same kinds of stresses the mechanical engineers have used for a long time in other applications. The authors and the V-belt industry are to be congratulated for this new approach. In the past, the major objection to including the slack side tension in the analysis has been that the influence is of minor importance, but in Fig. 7 in the paper we find the surprising result that belt life increases with increasing slack side tension. The result is contradictory to common sense, but can probably be explained from the nonlinear relation between σ_O and σ_m. With this new approach, it is obviously possible to correlate the disturbing discrepancies between fatigue measurements in dead weight tests ($T_1 = T_2$) and dynamometer tests ($T_1 > T_2$) reported in reference [1]. This discusser is pleased to see that his investigations on stress distribution due to shearing and bending (now available as a journal paper [2]) have been applied in the way he wanted them to be used—namely, in V-belt fatigue analysis.

This discusser wants to comment on the stress analysis due to the bending of the cord. The authors use the following relation (see Table 1, equation (2), and Fig. 9):

$$\sigma_{be} = T_{be}/A = (C_1 + C_2/D)/A$$

Only one of the investigated belts (.470 − lam) has $C_1 = 0$. All the others have $C_1 > 0$. What is the physical meaning of $C_1 > 0$? The results in Fig. 9 are obtained from strain gage measurements. Is the bridge not balanced when the belt is straight, i.e., $1/D = 0$? During a year-long visit at the Gates Rubber Company with Mr. William Spencer Worley, the discusser had the opportunity to investigate stresses in a cord subjected to stretching and bending, both theoretically and experimentally. He found that the stress in the multiple-ply yarn is a more adequate measure of the stress situation than the stress in the complete cord. The bending stress in the multiple-ply yarn can vary between a lower limit when it is bent around its own center line and an upper limit when it is bent around the center of the cord. The actual bending stress in the multiple-ply yarn depends upon the degree of bonding between the individual yarns in the cord and upon the elasticity of the rubber in the cord-adhesion region. The stress in the multiple-ply yarn is lower than the one the authors have measured by gluing strain gages on the top and bottom of two adjacent cords. It is the discusser's hope that, when his analysis on cord stresses due to stretching and bending is published, even those results can be included in the V-belt fatigue analysis. Then, maybe, it will also be time to introduce different correction factors C_4 on driver and driven pulleys.

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[1] Assist. Prof., Lund Technical University, Machine Elements Division, Lund, Sweden.

Author's Closure

The authors generally concur with Professor Gerbert's pertinent remarks concerning effects of mean and alternating stresses on V-belt fatigue. However, two items should be clarified. Firstly, the reported life dependence on T_2 is not considered surprising since the modified Goodman equation predicts a similar trend and the stress correction factor C_4 diminishes with increasing T_2. Secondly, the bending intercept C_1 is not intended to have a physical meaning. It merely results from extrapolation of experimental data for the purpose of obtaining a linear equation in the application range of diameters.