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| 6-57) A schematic of a clutch-testing machine is shown. The steel shaft rotates at a constant **speed v.** An axial load is applied to the shaft and is cycled from **zero to *P***. The **torque *T***induced by the clutch face onto the shaft is given by    where ***D***and ***d***are defined in the figure and ***f***is the coefficient of friction of the clutch face. The shaft is machined with ***Sy* = 120 kpsi** and ***Sut*  = 145 kpsi**. The theoretical **stress-concentration factors** for the fillet are **3.0** and **1.8** for the axial and torsional loading, respectively.  Assume the **load variation *P***is synchronous with shaft rotation. With **f = 0.3**, find the maximum allowable load ***P***such that the shaft will survive a minimum of **106 cycles** with a **factor of safety** of **3**. Use the modified Goodman criterion. Determine the corresponding factor of safety guarding against yielding. |  |

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| 6-58) For the clutch of Prob. 6–57, the external load *P* is cycled between **4.5 kips** and **18 kips.** Assuming that the shaft is rotating synchronous with the external load cycle, estimate the number of cycles to failure. Use the modified Goodman fatigue failure criteria.  Mid range= 11.25 |  |