STRENGTH CALCULATION FOR A SEALING RING OF A CLOSURE WITH A DOUBLE-CONE SEAL

É. B. Fel'dman, D. G. Malova, and O. V. Rumyantsev

UDC 66.025.001.24

In [1] an approximate method of calculating a sealing ring for a double-conical closure is described, based on the theory of beam bending on an elastic base [2].

The known methods of calculating beams on an elastic base of variable stiffness with a discontinuous loading character [3, 4] necessitate a large number of calculations, as a result of which one determines the reactive load q, the shearing force Q, and the bending moment M. Analysis of the deformation conditions of a sealing ring of a closure with a double-cone seal, and also the results of analytical design by the section method, which are confirmed by an experimental check [1], make it possible to suggest a simplified engineering method of calculating the magnitudes of q, Q, and M in danger points [1].

Let us consider the action of axial and radial loads (Fig. 1).

The axial loads p and Pm cause an off-center compression. Because of the comparatively low flexibility of the beam being considered, one can neglect the shearing forces and displacements which arise thereupon, and can carry out a calculation of the bending moment in the dangerous middle section 1-1 by the formula

\[ M = \frac{ab}{2}(p + Pm). \]

The radial loads p and P_R cause the appearance of considerable bending moments and shearing forces, and also cause a considerable displacement of the part. Deformation of the sealing ring from radial loading is accompanied by a deflection; however, the magnitude of the latter is small as compared with

![Fig. 1. Calculation scheme for a closure sealing ring.](chart1)

![Fig. 2. Dependence of values of q, Q, and M as calculated by various methods: ----) simplified method; ---) section method.](chart2)
the total displacement of the part (which is connected with the appreciable pliability of the parts which contain the seal — the body and the stud bolts). The circumstance permits one to use a simplified method of calculation based on the assumption of constancy of displacements along the height of the part, that is, \( \frac{q}{B} = \text{const.} \), in an approximate practical determination of the magnitudes of \( q, Q, \) and \( M \), depending on the radial loading.

Considering the comparatively small change in magnitude of the radius of the sealing ring, \( R \), one can consider the character of the change in the bed coefficient, \( B \), to be linear, and can determine it from the calculated values for the extreme trapezoidal sections.

Taking account of the assumptions stated, from the equilibrium equation for a beam on an elastic base formulas were obtained for determining the basic calculational quantities as a function of the radial load in the dangerous sections: from preliminary tightening

\[
q_{pr} = \frac{2m}{c + (1 + K_r)m} p_{m}^{R}; \quad Q_{max} = \frac{cm}{c + (1 + K_r)m} p_{m}^{R},
\]

\[
M_{max}^{R} = \left( m + \frac{c}{4} - m_{c,g} \right) cm \quad \frac{p_{m}^{R}}{p_{m}},
\]

from pressure

\[
q_{pr} = \frac{A}{c + (K_2 + K_3)m} p; \quad Q_{max} = \frac{\left( K_2 + K_1 \right) cm}{c + (K_2 + K_3)m} p,
\]

\[
M_{max}^{R} = \frac{\left( K_2 + K_1 \right) \left( m + \frac{c}{4} - m_{c,g} \right) cm}{c + (K_2 + K_3)m} p,
\]

where \( q_{pr} \) is the reactive load of a rectangular section of the beam being examined; \( K_1 = B_1 / B_{pr} \); \( K_2 = B_2 / B_{pr} \); \( B_1, B_2, \) and \( B_{pr} \) are coefficients of the elastic base at the end, in section 2–2 (see Fig. 1), and in a rectangular section of the beam under examination, respectively; \( Q_{max} \) and \( M_{max}^{R} \) are the shearing force in the section 2–2 and the bending moment in section 1–1 from the action of radial loading; \( m_{c,g} \) is the