Materials for Wormsets

Only a few materials are suitable for wormsets. The worm is highly stressed and requires a hardened steel. Low-carbon steels such as AISI 1020, 1117, 8620, or 4320 are used and case hardened to HRC 58-62. Medium-carbon steels such as AISI 4140 or 4150 are also used, induction or flame hardened to a case of HRC 58-62. They need to be ground or polished to a finish of 16 µin (0.4 µm) R_a or better. The worm gear needs to be made from a material soft and compliant enough to run-in and conform to the hard worm under the high-sliding conditions. Sand-cast, chill-cast, centrifugal-cast, or forged bronze is typically used for the worm gear. Phosphor or tin bronze is used for high-power applications and manganese bronze for small, slower-speed worms. Cast iron, soft steel, and plastics are sometimes used for lightly loaded, low-speed applications.

Lubrication in Wormsets

The lubrication condition in a wormset can range from boundary lubrication to partial or full EHD depending on loads, velocities, temperatures, and lubricant viscosity as discussed in Chapter 11. The lubrication situation is more like that of sliding bearings than rolling bearings in this instance because of the dominant sliding velocities. Their high percentage of sliding makes wormsets less efficient than conventional gearsets. Lubricants containing extreme-pressure (EP) additives are sometimes used in wormsets.

Forces in Wormsets

A three-dimensional loading condition exists at the mesh of a wormset. Tangential, radial, and axial components act on each member. With a (typical) 90° angle between the axes of worm and worm gear, the magnitude of the tangential component on the worm gear W_{tg} equals the axial component on the worm W_{aw} and vice versa. These components can be defined as

$$W_{tg} = W_{aw} = \frac{2T_g}{d_g} \tag{13.14a}$$

where T_g and d_g are the torque on, and the pitch diameter of, the worm gear. The axial force W_{ag} on the worm gear and the tangential force on the worm W_{tw} are

$$W_{ag} = W_{tw} = \frac{2T_w}{d} \tag{13.14b}$$

where T_w is the torque on, and d is the pitch diameter of, the worm. The radial force W_r separating the two elements is

$$W_r = \frac{W_{tg} \tan\phi}{\cos\lambda} \tag{13.14c}$$

where ϕ is the pressure angle and λ is the lead angle.

Wormset Geometry

The pitch diameters and numbers of teeth of nonworm gearsets have a unique relationship but this is not so in wormsets. Once the decision is made regarding the number of