Determining Diametral Pitch, Center Distance

THE QUESTION

I need help determining the diametral pitch needed to achieve the closest center-to-center distance for 2 spur gears. The 1st gear is a 34-tooth and the 2nd gear is a 28-tooth. The center-to-center distance between the gears needs to be as close to 2⅛" as possible.

Expert response provided by Hermann J. Stadtfeld, Gleason Corp. The center distance between two cylindrical gears is calculated by adding the two pitch diameters and dividing the result by two. If the number of teeth is given, the pitch diameter can be calculated by dividing the number of teeth by the diametral pitch. If we plug those relationships into each other and solve the equation for the diametral pitch, then this results in: $DP = (z_1 + z_2) / (2 \cdot a)$, as shown in Figure 1.

In many cases, a profile shift is applied to one or both gear members. The profile shift factors will change the center distance, except in situations in which the pinion and gears use the same profile shift factor, but with opposite signs (V0 System). The most common reason for profile shift is the avoidance of undercut. Given the fine pitch geometry and the tooth numbers of the present gearset, a profile shift factor is most likely not required.

The resulting diametral pitch is valid in the face plane of the pinion and gear. With spur gears, this is also consistent with the normal diametral pitch and therefore can be used in selecting a suited hobbing tool.

In the present case the number of teeth and the given center distance deliver a diametral pitch of 14.588 1/inch. The series of standard hobs shows the availability of 14 DP and 16 DP. If 14 DP is chosen, then a center distance of 2.214 inch is required. If this dimension is too large, then the alternative is to manufacture the two gears with the 16 DP hob, which will result in a center distance of 1.936 inch.

If both results are too far away from the desired center distance, then a metric hob with a module of 1.75 mm could be an acceptable alternative. The m = 1.75 mm hob will deliver a center distance of 54.25 mm, equal to 2.1358 inch, which is $^{11}/_{1000}$ inch larger than the ideal target dimension.

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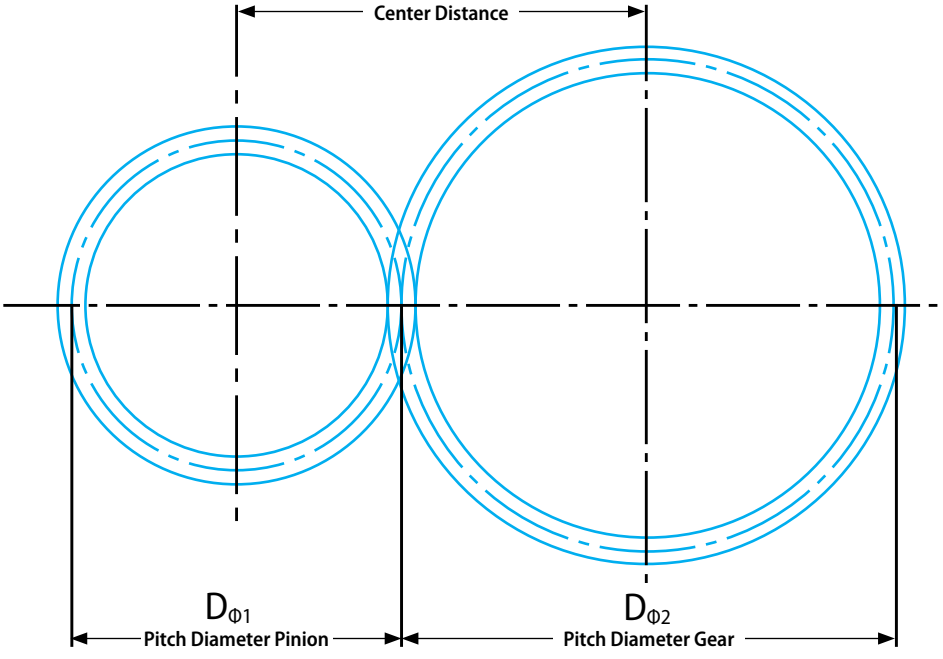

Figure 1 Relationship between number of teeth, DP and center distance.

$$D_{\Phi 1} = \frac{Z_1}{DP} \qquad D_{\Phi 2} = \frac{Z_2}{DP}$$

$$a = \frac{D_{\Phi 1} + D_{\Phi 2}}{2} = \frac{Z_1 + Z_2}{2\,DP}$$

$$DP = \frac{Z_1 + Z_2}{2 \cdot a} \quad \text{or} \quad m_f = \frac{2 \cdot a}{Z_1 + Z_2}$$

where

a = Center Distance
DP = Diametral Pitch
$D_{\Phi 1}$ = Pitch Diameter Pinion
$D_{\Phi 2}$ = Pitch Diameter Gear
m_f = Face Module
Z_1 = Number of Teeth (Pinion)
Z_2 = Number of Teeth (Gear)

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