

Table 20-9 Recommended Lubricants for Worm Gears by AGMA

| Types of Worm | Center Distance mm | Rotating Speed of Worm rpm | Ambient Temperature, °C | | Rotating Speed of Worm rpm | Ambient Temperature, °C | |
|------------------|--------------------|----------------------------|-------------------------|-----------|----------------------------|-------------------------|-----------|
| | | | -10 ... 6 | 10 ... 52 | | -10 ... 16 | 10 ... 52 |
| Cylindrical Type | ≤150 | ≤700 | 7 Comp | 8 Comp | 700< | 8 Comp | 7 Comp |
| | 150 ... 300 | ≤450 | | | 450< | | |
| | 300 ... 460 | ≤300 | | | 300< | | |
| | 460 ... 600 | ≤250 | | | 250< | | |
| | 600< | ≤200 | | | 200< | | |
| Throated Type | ≤150 | ≤700 | 8 Comp | 8A Comp | 700< | 8 Comp | 8 Comp |
| | 150 ... 300 | ≤450 | | | 450< | | |
| | 300 ... 460 | ≤300 | | | 300< | | |
| | 460 ... 600 | ≤250 | | | 250< | | |
| | 600< | ≤200 | | | 200< | | |

Table 20-10 Reference Values of Viscosity Unit: cSt/37.8°C

| Operating Temperature | | Sliding Speed m/s | | |
|-----------------------|----------------------|-------------------|-------------|-------------|
| Maximum Running | Starting Temperature | Less than 2.5 | 2.5 ... 5 | More than 5 |
| 0°C ... 10°C | -10°C ... 0°C | 110 ... 130 | 110 ... 130 | 110 ... 130 |
| 0°C ... 10°C | More than 0°C | 110 ... 150 | 110 ... 150 | 110 ... 150 |
| 10°C ... 30°C | More than 0°C | 200 ... 245 | 150 ... 200 | 150 ... 200 |
| 30°C ... 55°C | More than 0°C | 350 ... 510 | 245 ... 350 | 200 ... 245 |
| 55°C ... 80°C | More than 0°C | 510 ... 780 | 350 ... 510 | 245 ... 350 |
| 80°C ... 100°C | More than 0°C | 900 ... 1100 | 510 ... 780 | 350 ... 510 |

SECTION 21 GEAR NOISE

There are several causes of noise. The noise and vibration in rotating gears, especially at high loads and high speeds, need to be addressed. Following are ways to reduce the noise. These points should be considered in the design stage of gear systems.

1. Use High-Precision Gears
 - Reduce the pitch error, tooth profile error, runout error and lead error.
 - Grind teeth to improve the accuracy as well as the surface finish.
2. Use Better Surface Finish on Gears
 - Grinding, lapping and honing the tooth surface, or running in gears in oil for a period of time can also improve the smoothness of tooth surface and reduce the noise.
3. Ensure a Correct Tooth Contact
 - Crowning and relieving can prevent end contact.
 - Proper tooth profile modification is also effective.
 - Eliminate impact on tooth surface.
4. Have A Proper Amount of Backlash
 - A smaller backlash will help reduce pulsating transmission.
 - A bigger backlash, in general, causes less problems.

5. Increase the Contact Ratio
 - Bigger contact ratio lowers the noise. Decreasing pressure angle and/or increasing tooth depth can produce a larger contact ratio.
 - Enlarging overlap ratio will reduce the noise. Because of this relationship, a helical gear is quieter than the spur gear and a spiral bevel gear is quieter than the straight bevel gear.
6. Use Small Gears
 - Adopt smaller module gears and smaller outside diameter gears.
7. Use High-Rigidity Gears
 - Increasing face width can give a higher rigidity that will help in reducing noise.
 - Reinforce housing and shafts to increase rigidity.
8. Use High-Vibration-Damping Material
 - Plastic gears will be quiet in light load, low speed operation.
 - Cast iron gears have lower noise than steel gears.
9. Apply Suitable Lubrication
 - Lubricate gears sufficiently.
 - High-viscosity lubricant will have the tendency to reduce the noise.
10. Lower Load and Speed
 - Lowering rpm and load as far as possible will reduce gear noise.