

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...16	10...52		-10...16	10...52
Cylindrical Type	≤150	≤ 700			700 <		8 Comp
	150...300	≤ 450			450 <		
	300...460	≤ 300	7 Comp	8 Comp	300 <		7 Comp
	460...600	≤ 250			250 <		
	600 <	≤ 200			200 <		
Throated Type	≤ 150	≤ 700			700 <		
	150...300	≤ 450			450 <		
	300...460	≤ 300	8 Comp	8A Comp	300 <		8 Comp
	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.