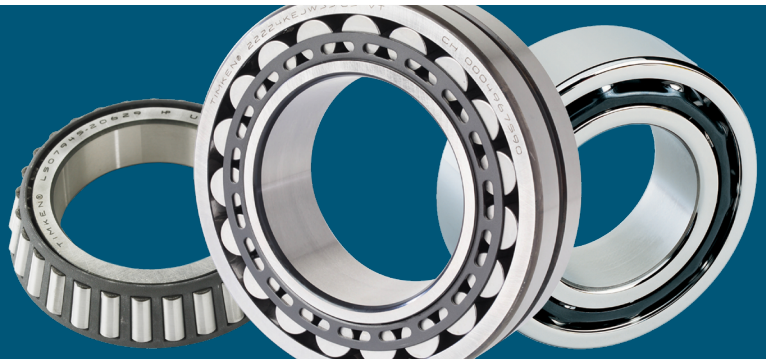
TIMKEN

Bearing Speed Ratings Help Guide



Understanding Bearing Speed Ratings

Roller and Ball bearing operating speeds can fluctuate from very slow to higher speeds exceeding published Thermal Reference or Limiting Speeds. Depending on the type and size of the bearing, internal geometry, applied loads, bearing setting, environmental factors, and lubrication type the following guidelines can be used as a starting point to help determine safe operating speed.

Speed Ratings can be categorized into two main types:

- **Thermal reference speed:** Thermal Reference Speed is the bearing thermal equilibrium speed, under certain referenced conditions. This criteria is based on industry standard reference conditions outlined in **ISO 15312:2003**.
- **Limiting speed:** The speed at which predicted cage life equals the bearing Catalogued fatigue life, under certain reference conditions. The Limiting Speed is based on cage behavior. The Limiting Speed calculation studies cage stability and material wear through a theoretical speed dependent power law correlation.

Note: The Limiting Speed does not consider thermal equilibrium, as does the Thermal Reference Speed.

How to Use the Bearing Speed Rating Tool

Follow these simple steps to get quick and accurate bearing speed ratings as you design Timken® bearings into your project.

1. Go to engineering.timken.com.
2. Select Bearing Speed Rating from the home page.
3. Enter a Timken® Tapered Roller, Spherical Roller, Cylindrical Roller, or Radial or Angular Contact Ball Bearing Part Number. *Don't know the part number? Use our Bearing Search Tool to select one from our online product catalog.*
4. Click the Lookup button.
5. Click the Calculate button.

Output and Interpretations

The results consider the bearing speed ratings for Ball, Cylindrical Roller, Spherical Roller and Tapered Roller Bearings.

- Use to ensure proper selection of the bearing for your application.
- Contact your Timken sales engineer if your application requires higher speeds.

Cylindrical Roller, Spherical Roller, and Radial Ball Bearings results will be displayed in the same format. Tapered Roller Bearing guidelines are displayed in a different manner.

Speed Ratings for 22222EJW33C3 (Radial SRB)

Bearing Type	Part Number	Thermal Reference Speed - Oil (RPM)	Thermal Reference Speed - Grease (RPM)	Limiting Speed
SRB	22222EJW33C3	3500	2900	2940

Fig. 1. Spherical Roller Bearing Thermal Reference Speeds for Oil or Grease Lubrication and Limiting Speed.

Speed Ratings for NU220EMA (Cylindrical 1-Row)

Bearing Type	Part Number	Thermal Reference Speed - Oil (RPM)	Thermal Reference Speed - Grease (RPM)
CRB	NU220EMA	4000	3400

Fig. 2. Cylindrical Roller Bearing Thermal Reference Speeds for Oil or Grease Lubrication.

Speed Ratings for 6210 (Radial Deep-Groove Ball)

Bearing Type	Part Number	Thermal Reference Speed - Oil (RPM)	Thermal Reference Speed - Grease (RPM)
RBB	6210	8300	7100

Fig. 3. Radial Deep-Groove Thermal Reference Speed for Oil or Grease Lubrication.

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Tapered Roller Bearings

The usual measure of the speed of a tapered roller bearing is the circumferential velocity at the midpoint of the inner ring large end rib, also described as the “Rib Speed”, calculated in feet/minute or meters/second.

The mean large rib diameter at the midpoint of the roller end contact can be scaled from a drawing of the bearing, if available, or this diameter can be determined by consulting your Timken engineer. In addition to the Bearing Speed Rating tool on engineering.timken.com, refer to the Timken Engineering Manual (order# 10424) for additional information relating to tapered roller bearing speed ratings and rib speed equations.

The results are provided as a table summary of guidelines relating to speed and temperature based on customer experience, customer tests, and research conducted by The Timken Company. Consult your Timken engineer with questions regarding high-speed capability.

For Tapered Roller Bearings

1. Go to engineering.timken.com.
2. Select Bearing Speed Rating from the home page.
3. Enter a Timken Bearing Part Number. *Don’t know the part number? Use our Bearing Search Tool to select one from our online product catalog.*
4. Select Display Units.
5. Click the Lookup button or press Enter.
6. Select a part from the list.
7. Click the Done button.
8. Clicking Calculate without entering Operating Speed or Lubrication Type will generate a Speed Capability Guideline Table for various types of lubrication systems. (Figure 4)
9. Entering an Operating Speed (without Lubrication Type) will calculate bearing Rib Speed and display results for the various lubrication systems. (Figure 5)
10. Entering Operating Speed and Lubrication Type calculates bearing Rib Speed and displays results indicating whether the method of lubrication is acceptable for the Operating Speed. (Figure 6)

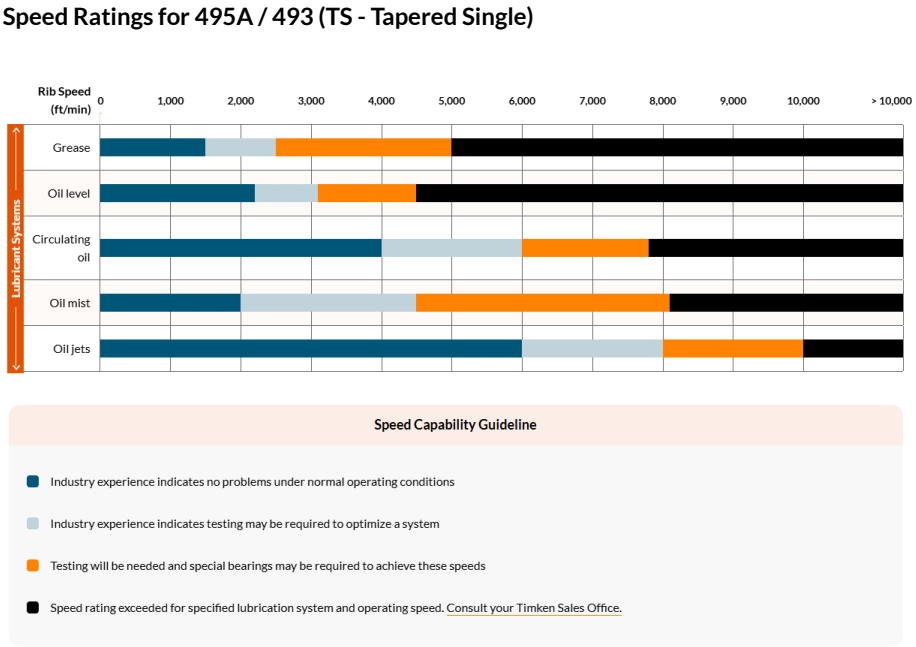

Fig. 4. Speed Guidelines for Various Types of Lubrication Systems.

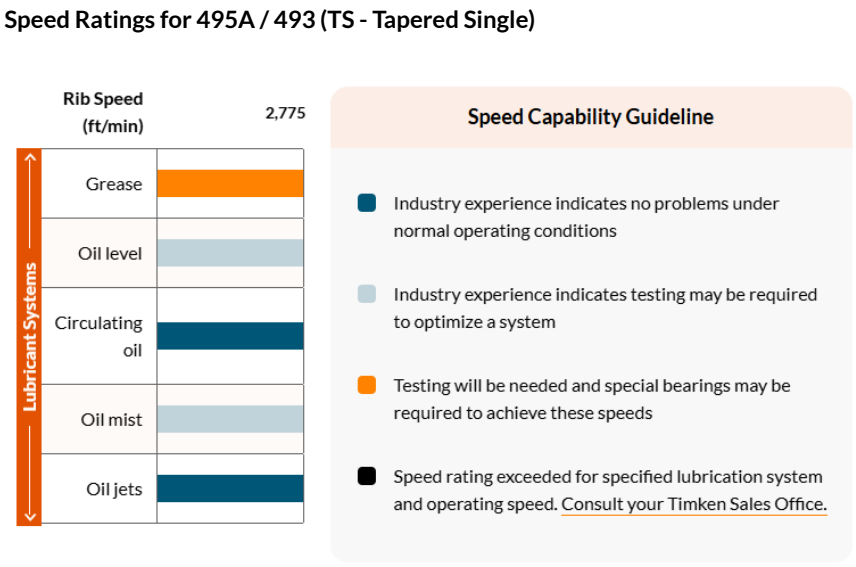

Fig. 5. Results displayed when Operating Speed without Lubrication Type.

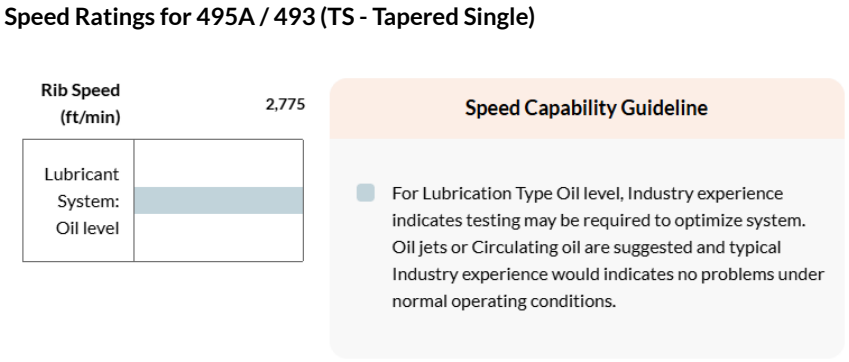

Fig. 6. Results displayed when Operating Speed and Lubrication Type.

Explanation of Lubrication Types

Lubrication Section

Proper lubrication depends on loads, speeds, temperatures, environmental conditions and the type of lubrication-delivery system. Both grease and oil have advantages and disadvantages that you should consider when selecting the right lubricant for your application.

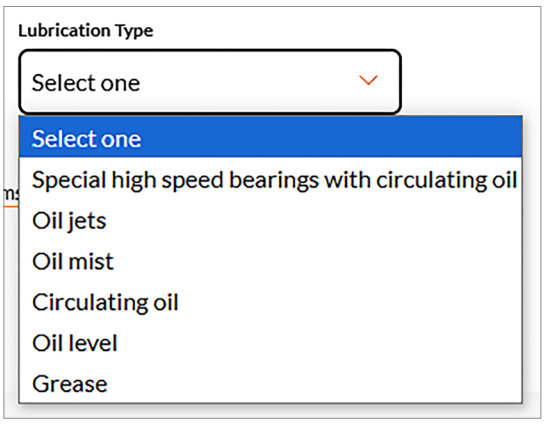

Fig. 7. Descriptions for each type of lubrication method below.

Grease: Grease is the simplest lubrication system for any bearing application. Primary considerations which determine regreasing cycle of any application are operating temperature and sealing efficiency. Overgreasing in certain applications can also be a problem. As operating speed increases, for instance, overgreasing will generate excessive heat which can lead to lubrication degradation and bearing damage.

Oil Level: Oil-level systems where the bearing are partially submerged in a static oil reservoir are the simplest types of oil lubrication systems. The oil-level system is generally only used for low and moderate speed applications because of the limited ability of this type to transfer heat. Effective sealing is important to maintain the required oil level; sight gauges are often used to monitor the oil level.

Heat dissipation can be improved in an oil-level system if the oil is splashed on the entire inner surface of the housing.

Use figures 8 and 9.

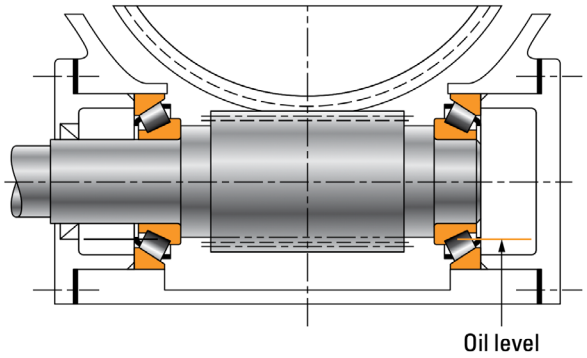

Fig. 8. Proper oil level in an oil-bath lubrication system.

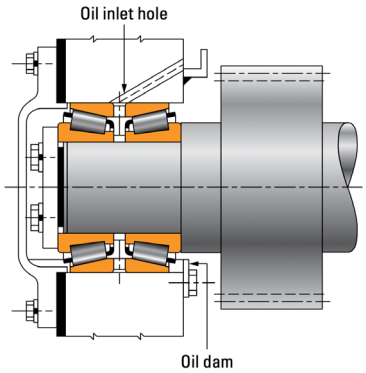

Fig. 9. Examples of catch trough and oil dam.

Circulating Oil (Forced-feed oil lubrication systems): Forced-feed oil systems are more elaborate than static oil systems. In a typical system, oil is pumped from a central reservoir to each bearing. For tapered roller bearings, oil is introduced at the small end of the bearing and drained away at the large end to take advantage of the natural pumping action of tapered roller bearings.

Circulating oil provides a continuous, regulated oil flow providing the advantages of maximum heat removal and washing action which helps remove contamination or debris which could cause bearing damage or wear. Heat exchangers can be included in a circulating oil system to reduce oil temperature and extend lubricant life, and filters can be used to remove debris which will cause bearing damage or wear.

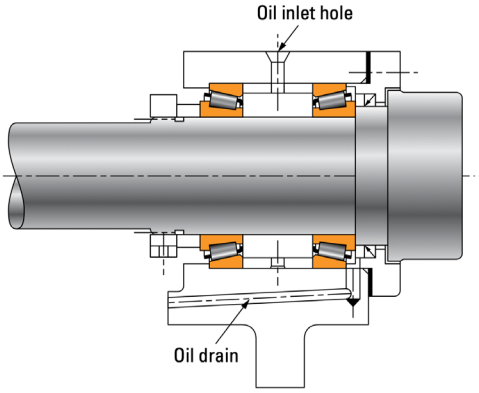

Fig. 10. Oil circulation system.

Forced-feed lubrication systems are used in applications in which a high amount of heat needs to be dissipated due to the operating parameters, like in medium- to high-speed gear drives. Oil flow also can be gradually adapted to the required level of heat dissipation. If necessary, you can add an oil-cooling unit. In certain applications or environments, you might need to preheat the oil to avoid start-up of machinery with too thick oil. In a typical oil-circulation system (fig. 10), oil is pumped from a central reservoir to each bearing. In tapered roller bearing applications, to take advantage of the natural pumping action, the oil is introduced at the small end of the bearing and drained away at the large end.

Oil Jets: Oil jets are used in forced-feed oil systems at higher operating speeds than standard circulating oil systems. The jets are positioned to direct oil to the space between the cage and the cone at the small end of the roller. In addition, oil-jet orifices can be arranged around the circumference of the bearing to distribute oil at the small end and sometimes at the large end of the rollers for maximum cooling and lubricating efficiency.

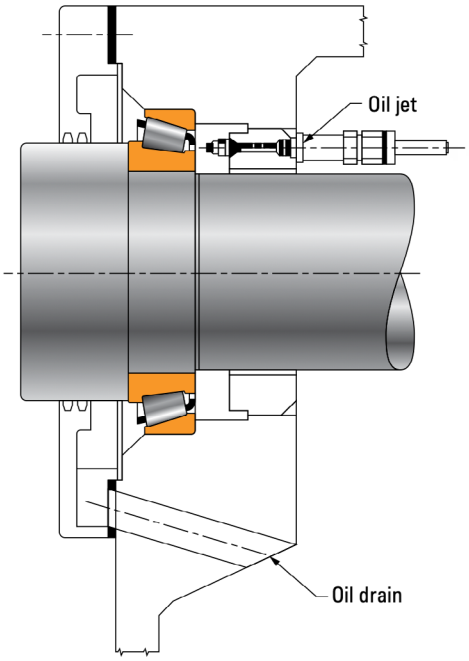

Fig. 11. Forced-feed oil system with oil jet.

Oil Mist: Oil-mist systems deliver very fine particles of oil suspended in a low-velocity, low-pressure air stream. Although oil mist is commonly used to lubricate roller bearings on rolling mills, its use has been limited on other types of equipment. The heat dissipation rate of oil-mist systems is much lower than with circulating oil due to the very small amount of oil in the bearing. A Timken Company sales engineer should be contacted for more information.

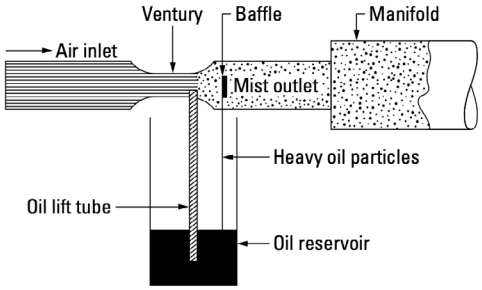

Fig. 12. Principle of the oil-mist generation.

Special high-speed bearings with circulating oil: Contact your Timken engineer.

Heat Generation and Dissipation

Heat generation: Churning of excess lubricant can be the major source of heat if filling instructions are not properly followed or if lubrication intervals are not properly maintained. In a properly lubricated bearing, the majority of heat is developed between the rolling elements and the raceways.

Heat dissipation by the circulating oil: In a circulating-oil system, the oil removes the majority of the heat. If the lubricant flow is unrestricted, the flow rate can freely pass through the bearing. The quantity of lubricant effectively cooling the bearing depends on bearing size and internal geometry, direction of oil flow, bearing speed and lubricant properties.

In a splash or oil-bath lubrication system, heat is transferred within the bearing through convection. The heat-dissipation rate with this lubrication method can be enhanced through the use of housing-cooling coils, a housing sump or a housing splash system.