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Tapered Roller Bearing Accelerated Fatigue Life Test Rig Design

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MECHANICAL AND NUCLEAR

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L10 Life

Bearing types differ greatly and so do the variables they are subject to, such as temperature, load, and speed, which results in different bearing lifespans. The L10 life represents the life at which 10% of bearings are predicted to fail.

L10 Calculations - 6 1/2 x 9 inch Class K				
Loading type	Radial		Axial	
Load (lb per roller)	5000		165	
Speed (mph)	65	80	65	80
L10 (miles)	1692260		1339380	
L10 (months)	36	29	29	23
Expected Spalling (months)	9	6	6	4

Statics Analysis

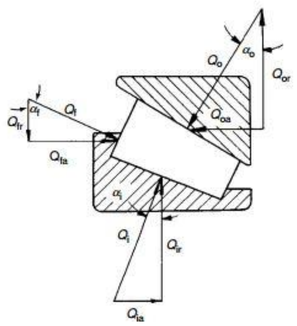
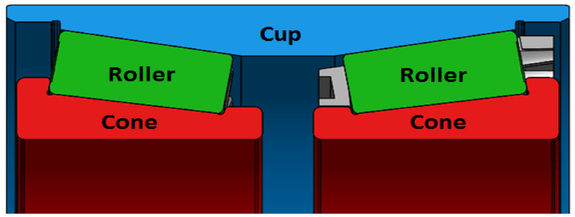


Image courtesy of Tedric A. Harris and Michael N. Kotzals, *Essential Concepts of Bearing Technology, Fifth Edition*

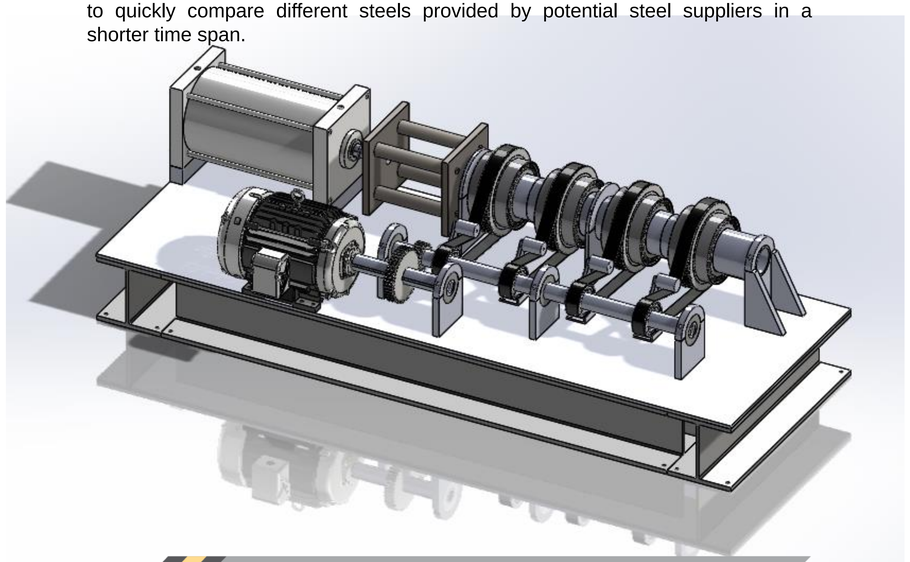
Brenco's current method for fatigue testing uses a radially applied load of 5,000 pounds per roller, which represents the weight of a standard railcar. This weight application parabolically loads the upper-half of the rollers inside the bearing. The newly purposed test rig will apply an axial load, at 165 pounds per roller, as an equivalent radial load. This will load all of the rollers simultaneously and evenly reducing the testing time from 6 months to approximately 4 months.



Overview

The purpose of this project is the development of a tapered roller bearing test rig to test bearings to their fatigue life as quickly as possible. The rig design may accommodate bearing sizes in the range of one half to a maximum of four Class K, 6 ½ x 9 inch double row tapered roller bearings in-line with an axially applied load.

Brenco's current fatigue testing of large tapered roller bearings for railroad car applications may take up to six months to complete. The accelerated testing process is not meant to replace the current testing method, but will serve as a way to quickly compare different steels provided by potential steel suppliers in a shorter time span.



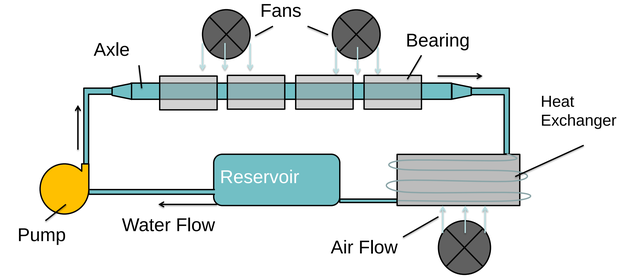
Monitoring Systems

This design will incorporate two main monitoring systems. A piezoelectric accelerometer will monitor the vibrations of each bearing. If a bearing spalls, seizes up, or fails in any way that produces larger than normal vibrations, an emergency stop on rig operations will be engaged. An infrared temperature sensor, or a non-contact temperature sensor, will be used to measure the temperature of each of the rotating cups. If the temperature gets too high, an emergency stop will occur automatically.

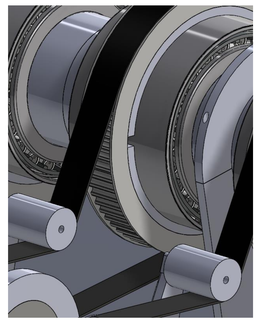
Cooling System

The cooling method previously utilized by Brenco for radially loaded bearings while undergoing testing was a series of fans which circulated the air around the bearings. Unlike the radial load, which parabolically loads the rollers, the axially loaded system loads all rollers simultaneously and evenly, causing the bearing to produce more heat.

To remove this extra heat from the bearings, water will be pumped through a hollow axle. This water will pass through a heat exchanger to transfer the heat to the surrounding air; additionally, fans will be used to disperse the heat.



Drive Mechanism



Brenco's current method for testing bearings utilizes a radial load and a rotating cone and axle. The newly purposed drive design is different from Brenco's current method in that it utilizes a stationary axle and cone with an axially applied load, while the cup is rotated.

Support provided by Amstead Rail – Brenco Bearings

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