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# Tapered Roller Bearing Test Rig: Axially Loaded Application to Accelerate Bearing Failure

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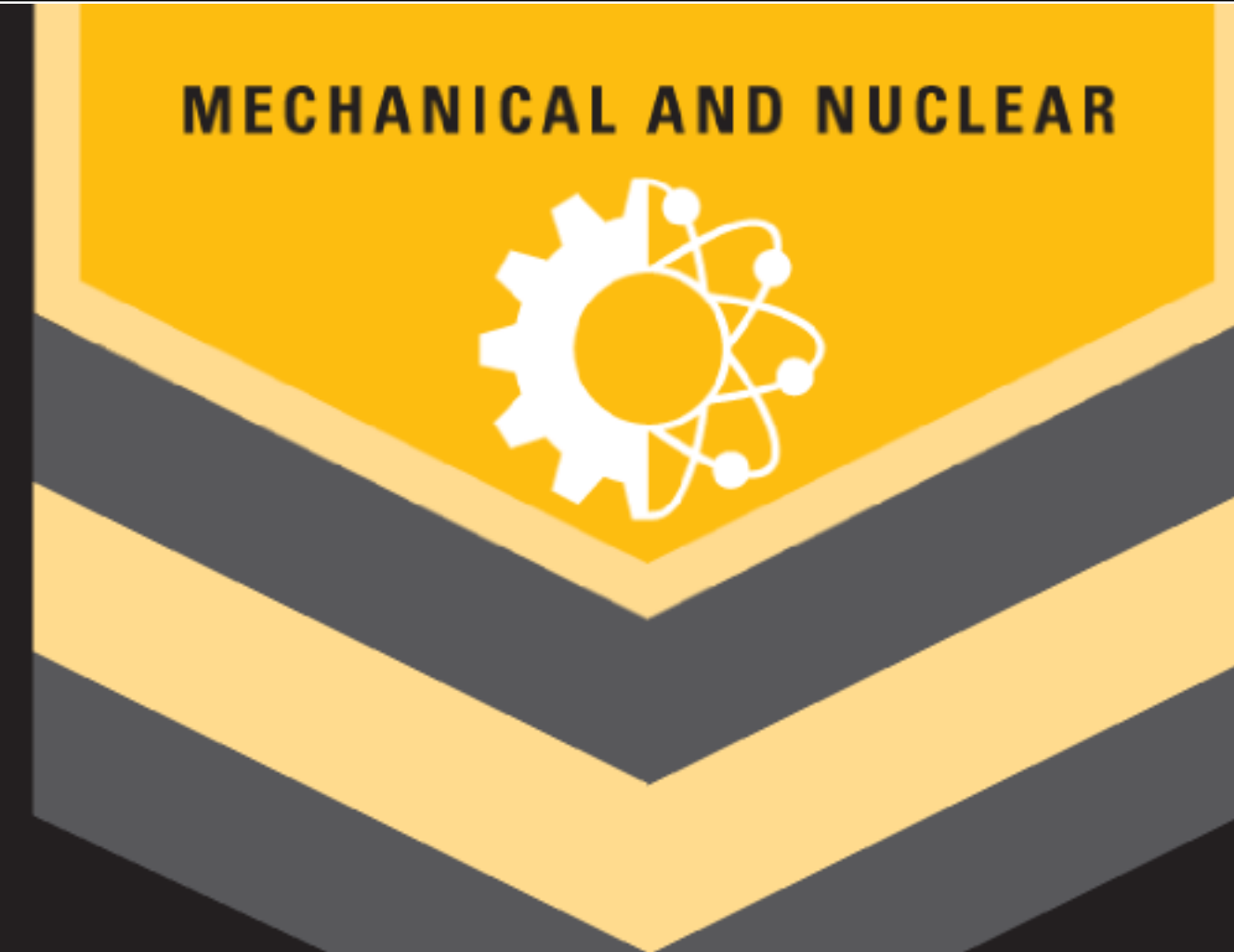
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# Tapered Roller Bearing Test Rig

## Axially Loaded Application to Accelerate Bearing Failure



### Current Testing Method

Railcar Tapered Roller Bearings Manufactured by:

**Amsted Rail**

Fig 1: Railcar bearing

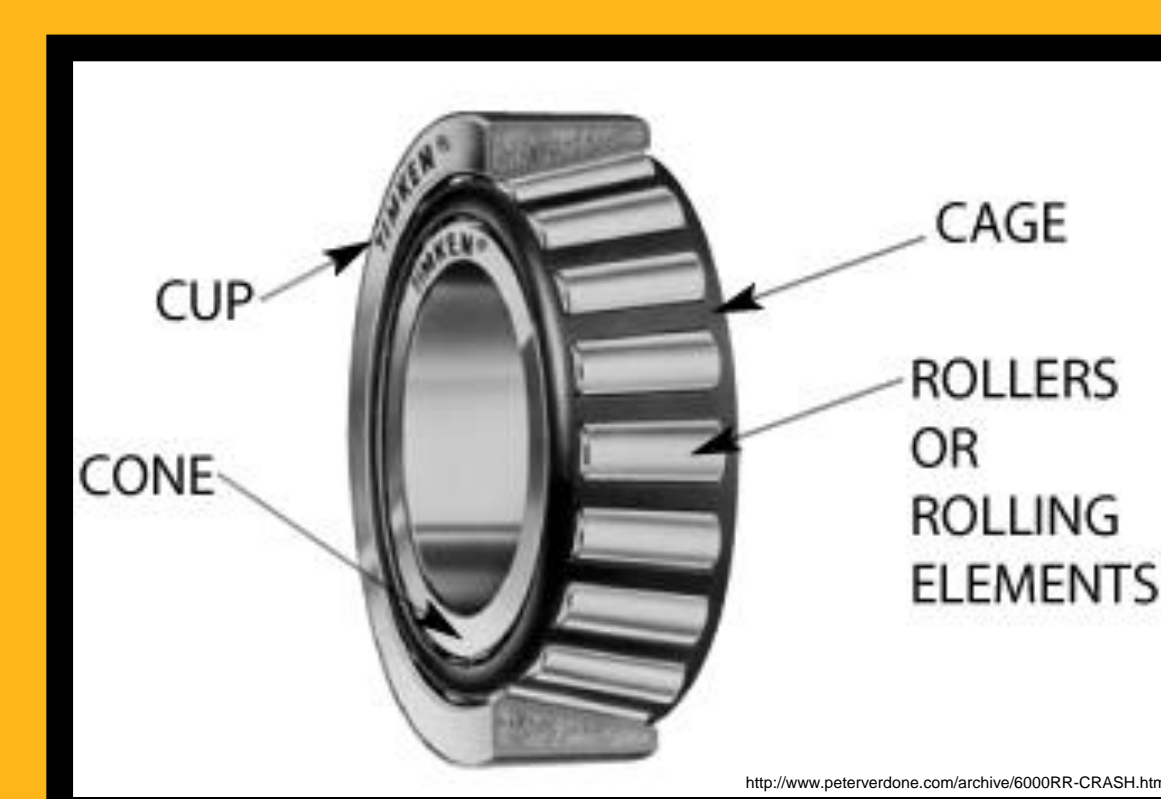


Fig 2: Conventional cup/cone tapered roller bearing diagram

❖ Other companies have the ability to test small scale bearings (with reduced fatigue life) using a multitude of test rigs to obtain failure data. Amsted Rail however, desires to have a new type of testing method to analyze larger bearings and to produce failure in a short amount of time.

### Applied Load:

- ❖ Within current test rigs, forces are applied radially simulating actual railcar loading
- ❖ Currently a time frame of six to twelve months is required to obtain meaningful results

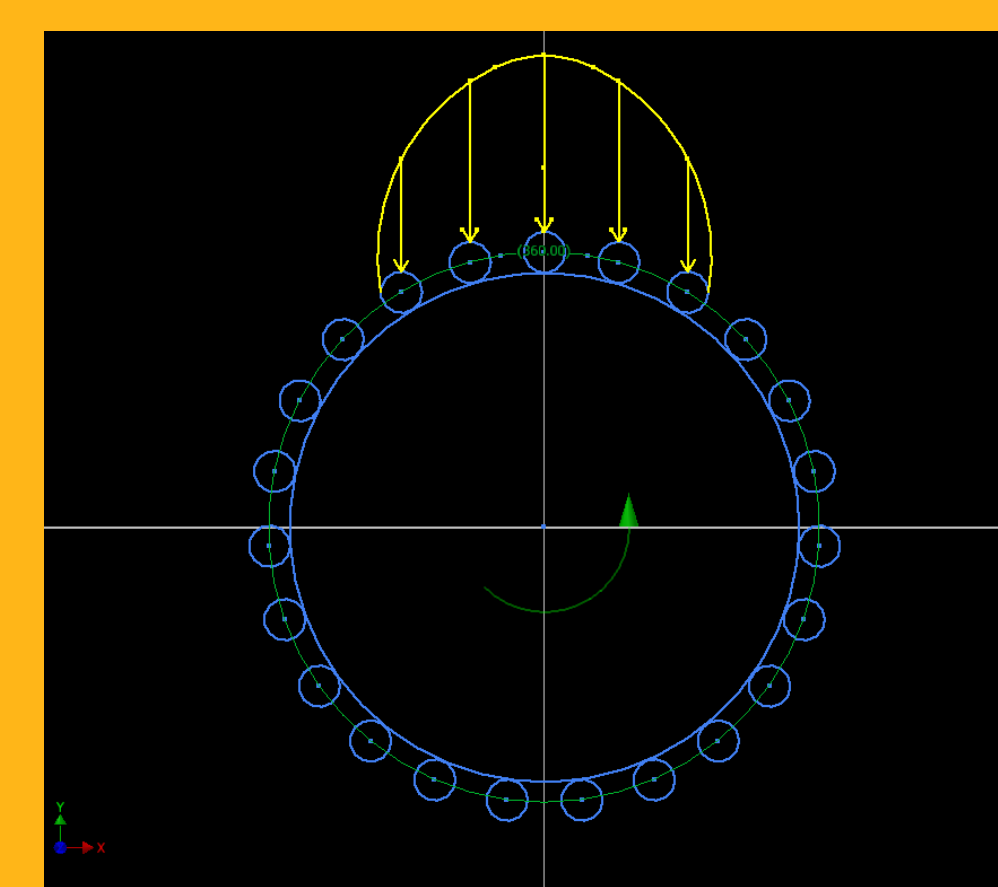


Fig 3: Load distribution using conventional testing method

### Proposed Testing Method

#### Project Goal:

- ❖ To design an accelerated fatigue life test rig that will study Association of American Railroad Class K, 6 ½ x 9 inch double row tapered roller bearings by applying an axial load instead of the conventional radial load

#### Applied Load:

- ❖ Axially applied loads cause failure to occur at a more rapid pace in Class K bearings due to characteristic simultaneous loading on each roller while in motion (depicted in Fig. 4)

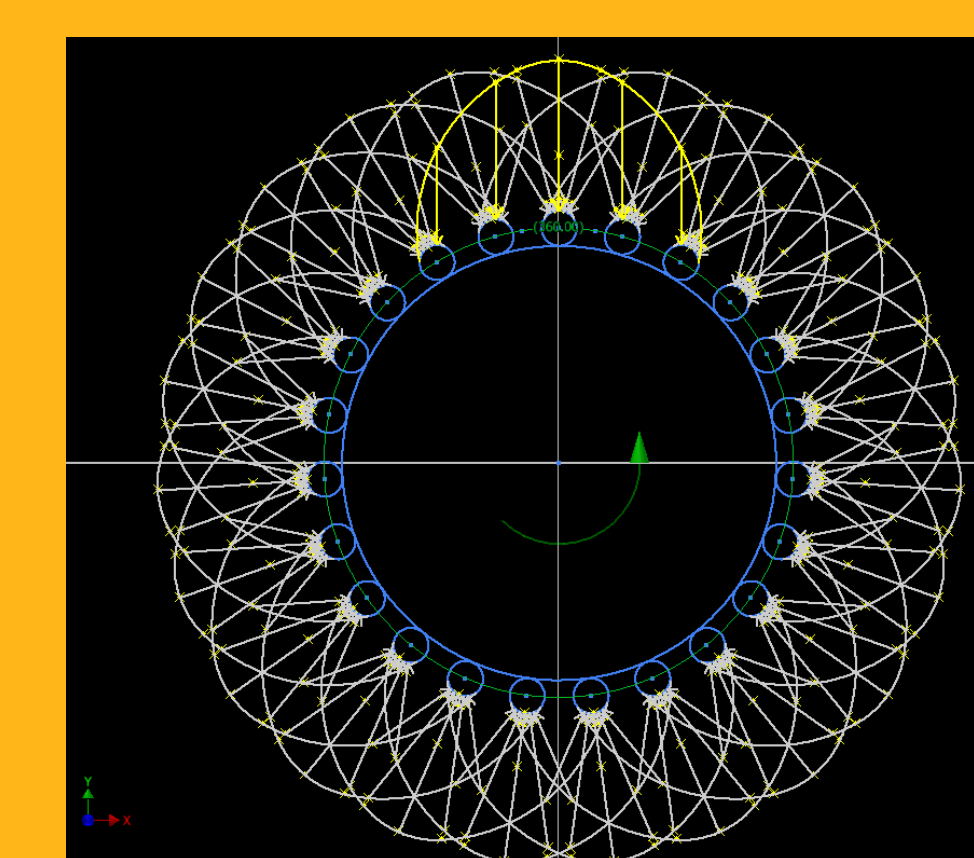


Fig 4: New loading distribution- axially loaded

#### Components:

1. **Electric Motor** – rotates the main driven cone shaft via a gear box
2. **Main Driven Cone Shaft** – rotates press-fitted cone assembly and secondary cone spline shaft
3. **Cone Assembly** – rotates inside of the static cup
4. **Cup** – supported, cooled, and held statically by the split pillow block
5. **Secondary Cone Spline Shaft** – rotates secondary cone assembly inside of cup
6. **Hydraulic Piston** – supports secondary cone spline shaft and applies load (19,942 lb<sub>f</sub>) from hydraulic cylinder via slip-fitted thrust bearings

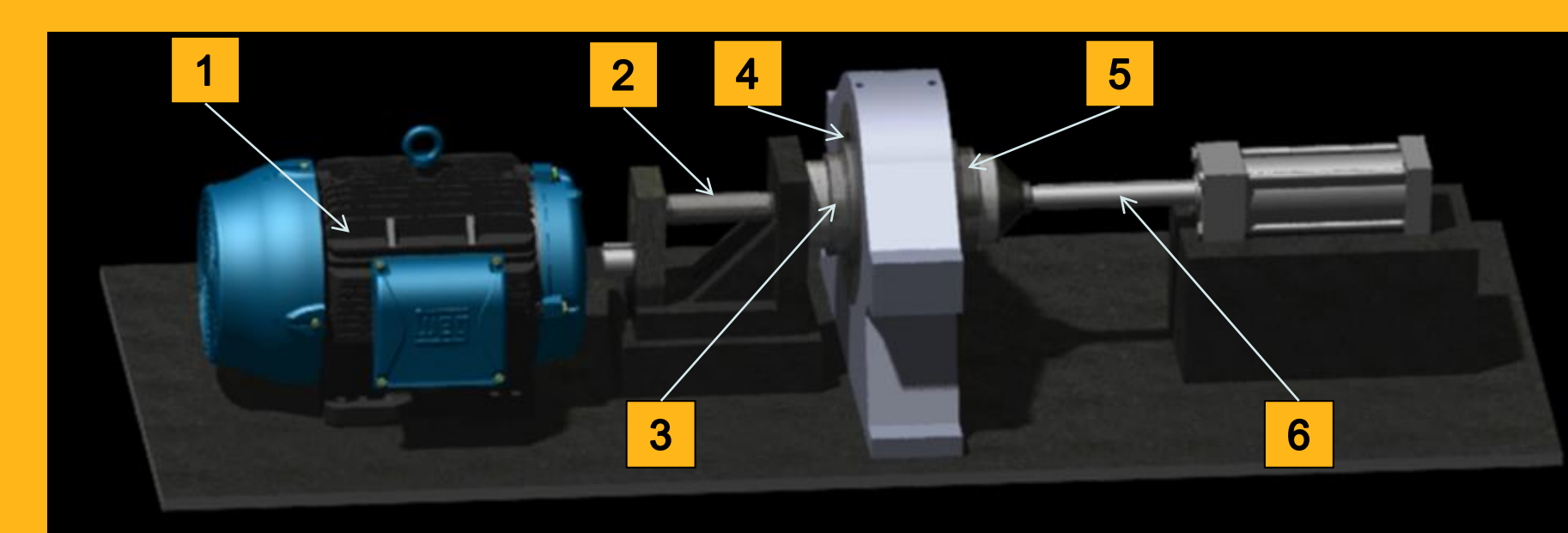
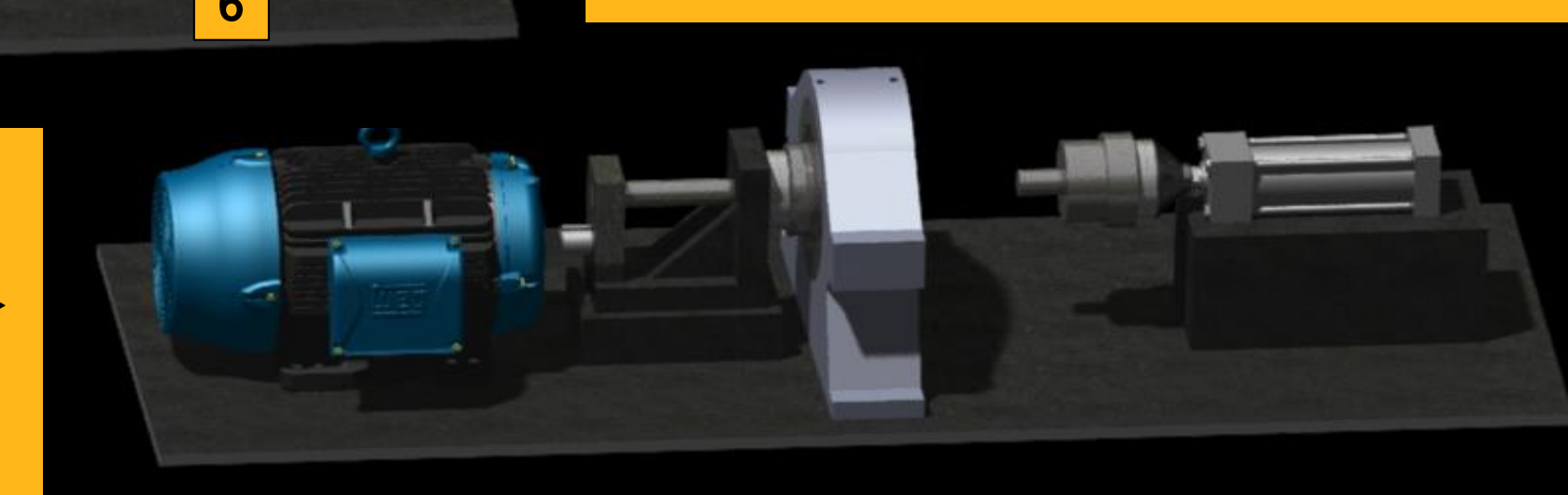


Fig 6: Retracted (Disassembly) Position

Fig 5: Extended (Running) Position



### Specifications and Results

#### Testing Method Specifications

##### ❖ Bearing Specifications:

- 23 rollers per row → 46 total rollers
- Class K
- 6 ½ x 9 inch
- Double row
- Tapered

##### ❖ Axial Load Required:

- Total Load required by Piston: 19,941.9 lb<sub>f</sub>
- Ram Selection: 30,000 lb<sub>f</sub> to allow for increased loading in future applications

##### ❖ Heat Generated:

- Per roller = 22.12 BTU/min
- Total = 1017.4 BTU/min

##### ❖ Torque Required:

- 43.99 lb<sub>f</sub>-in. per roller
- 2023.76 lb<sub>f</sub>-in total = 168.65 lb<sub>f</sub>-ft

##### ❖ Motor HP:

- Total Required: 23.99 HP
- Motor Selection: 40 HP to allow for increased loading in future applications

##### ❖ Cooling Method:

- Custom designed oil cooled jacket to allow operating temperature to remain at or below 100 °F

#### Results:

##### ❖ L<sub>10</sub> Rating:

- 14.75 million cycles
- 1.1 months or 34.3 days