SAE International

# SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2535 FEB2013

Issued 2001-03
Revised 2013-02

Superseding J2535 DEC2006

## Setting Preload in Heavy-Duty Wheel Bearings

RATIONALE

The changes are to correct the cornering values in Table 4 which were transposed for city delivery, to define Target Preload Setting and clarify the Preload setting procedure.

1. SCOPE

This SAE Recommended Practice applies to the four primary, large volume applications in the class 7-8 heavy-duty market place, as specified in SAE J1842:

a. "N" trailer axle

b. "R" powered rear axle

c. "FF / FG" nonpowered front axle

d. "P" trailer axle

This document applies to on-highway applications. It is not applicable to those applications that exceed the GAWR ratings or the load line restrictions listed in columns "A," "B," and "C" of Table 1. Load lines are measured from the inboard bearing cup backface as shown in 3.4.

This document establishes preload force values only. The methodology to obtain these force values must be determined by the fastener supplier and/or axle assembler.

This document reviews the bearing system. It is NOT intended to prescribe (new or existing) axle and/or hub manufacturers' ratings and/or specifications.

1.1 Purpose

The purpose of this document is to list acceptable axial bearing preload force values for conventional wheel-end components used in heavy-duty tractors and trailers.





**TO PLACE A DOCUMENT ORDER:** **Tel: 877-606-7323 (inside USA and Canada)**
**Tel: +1 724-776-4970 (outside USA)**
**Fax: 724-776-0790**
**Email: CustomerService@sae.org**
SAE WEB ADDRESS: http://www.sae.org

The audience of this document is intended to be the axle and/or component engineers. The user should be aware of both the benefits and the risks of this practice.

a. Benefits - Bearing and seal life can be maximized when the bearings are adjusted to a light, controlled preload setting.

b. Risks - The benefits of a light and controlled preload bearing setting are negated if bearing preload force is excessive. Care must be taken to ensure that preload force does not exceed the recommended amounts. Excessive preload can cause high operating temperatures, reduced lubricant life, reduced seal life, and premature bearing damage. Bearing lock-up and/or wheel-end assembly separation may occur if the preload force is excessive. A light preload bearing setting should only be attempted if the entire bearing setting process is accurate and repeatable.

For adjustment recommendations where bearing end-play is desired, refer to The Technology and Maintenance Council (TMC) Recommended Practice #RP-618.

## 2. REFERENCES

### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1842 Disc Wheel Hub/Spoke Wheel and Axle Interface Dimensions - Commercial Vehicles

SAE J393 Nomenclature-Wheels, Hubs, and Rims for Commercial Vehicles

#### 2.1.2 TMC Publication

Available from the Technology and Maintenance Council, American Trucking Associations, 2200 Mill Road, Alexandria, VA 22314-5388, Tel: 703-838-1700, www.truckline.com.

TMC RP-618 Adjustment of Wheel Bearings

## 3. DEFINITIONS

### 3.1 END-PLAY

An axial clearance between the bearing's rolling elements and the races producing a measurable axial wheel-end movement when a force is applied, first in one axial direction and then in the opposite direction, after oscillating the wheel-end.

### 3.2 PRELOAD

A load resulting from an axial interference between the bearing's rolling elements and races resulting in no discernible axial wheel-end movement when a force is applied, first in one axial direction and then in the opposite direction, after oscillating the wheel-end.

### 3.3 CONVENTIONAL WHEEL-END

A wheel-end assembly that consists of a hub, an inboard seal, two single row tapered roller bearings, and fastening hardware (Figure 1). Conventional wheel-ends use the spindle fastening hardware to establish bearing setting and can not be categorized as unitized, pre-adjusted, or other system that attempts to automatically control bearing adjustment.

### 3.4 LOAD LINE

The distance from the inboard bearing cup backface to the center of the tire(s) contact (Figures 2 and 3) which directly influences the relative wheel bearing load distribution.

### 3.5 TARGET PRELOAD SETTING

The preload force value that is the optimium level of adjustment from which the final wheel bearing adjustment can be achieved.



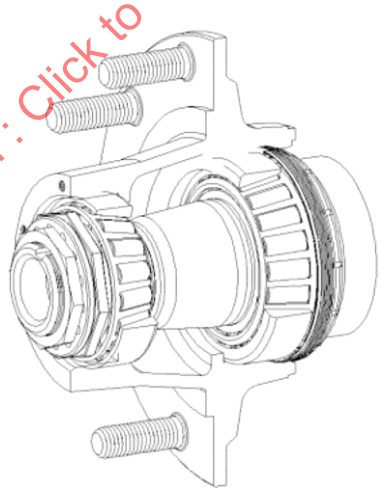

FIGURE 1 - CONVENTIONAL WHEEL END

## 4. PRELOAD SETTINGS

Target and maximum preload force values can be found in columns “D” and “E” in Table 1. Suppliers and/or axle assemblers developing a preload methodology should take care to ensure that their fastener adjustment methodology never results in a final setting that exceeds the maximum value listed in column “E” and to ensure their prescribed adjustment procedure will result in achieving a light, controlled preload setting Maximum GAWR shown is for calculation purposes and actual GAWR rating for each type of axle should be obtained from the axle manufacturer.

TABLE 1 - PRELOAD SETTINGS

| SAE Configuration | “A” Maximum GAWR (Gross Axle Weight Rating) N (lbs) | “B” Minimum Load Line[1] mm (in) | “C” Maximum Load Line[1] mm (in) | “D” Target Preload Force N (lbf) | “E” Maximum Preload Force N (lbf) |
|---|---|---|---|---|---|
| “N” trailer axle | 111 220 (25 000) | 23.1 (0.91) | 52.3 (2.06) | 2 220 (500) | 4 450 (1 000) |
| “R” powered rear axle | 133 470 (30 000) | 46.2 (1.82) | 75.2 (2.96) | 2 220 (500) | 4 450 (1 000) |
| “FF / FG” nonpowered front axle | 65 390 (14 700) | –24.9 (–0.98) | 42.9 (1.69) | 1 110 (250) | 2 220 (500) |
| “P” trailer axle | 113 450 (25 500) | 48.8 (1.92) | 78.0 (3.07) | 2 220 (500) | 4 450 (1 000) |

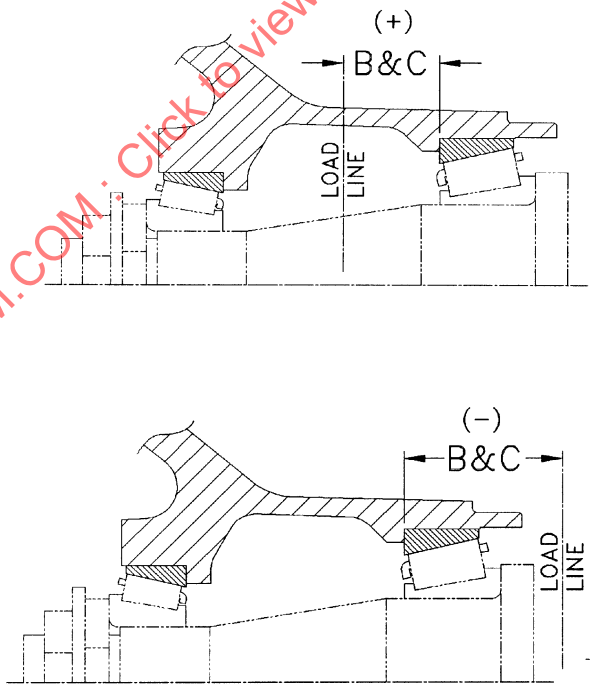


FIGURE 2 - NONPOWERED FRONT



[1]Load line position is measured from the inboard bearing cup backface, the sign convention is explained in Figures 2 and 3.

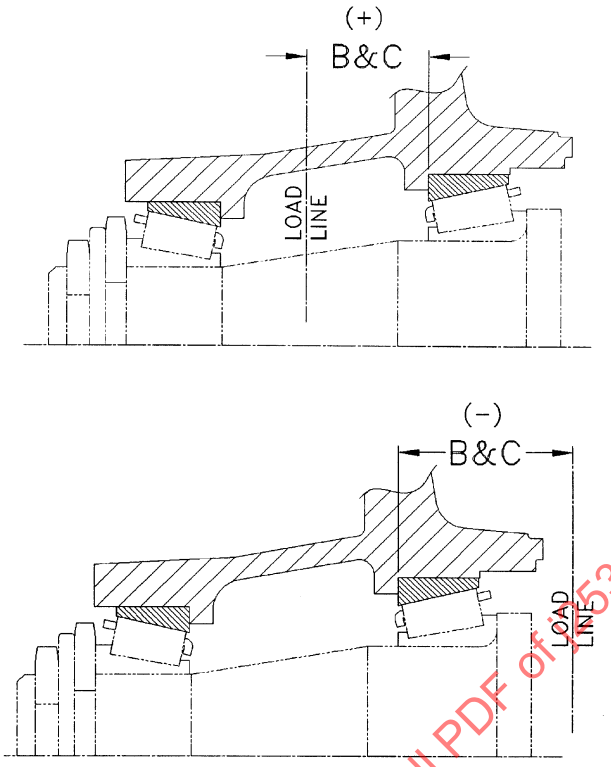


FIGURE 3 - TRAILER OR POWERED REAR



5. METHOD USED TO DETERMINE OPTIMUM PRELOAD (FOR REFERENCE ONLY)

To determine an optimum preload range for heavy-duty wheel bearings, it is necessary to calculate the life of the bearings across a specified range of preload values. The bearing life calculations require a set of constants, a duty cycle, and wheel-end design data. Table 2 shows the assumptions that were held constant for each of the wheel-end preload calculations.

TABLE 2 - CONSTANTS

| Application Definition | Value used for Condition |
|---|---|
| Vehicle Center of Gravity[2] | 1 969 mm (77.5 in) |
| Track Width | 1 816 mm (71.5 in) |
| Tire Radius | 508 mm (20.0 in) |
| Bearing Spread | See SAE J1842 |
| Lubrication Type[3] | Oil |
| Wheel Hub Stiffness[3] | Infinite |

Two duty cycles were used to determine the target and maximum preload for each of the axle configurations. The line-haul duty cycle simulates a vehicle operating under conditions where little turning is involved. The city-delivery duty cycle simulates a vehicle operating under more frequent turning conditions. Tables 3 and 4 show the corresponding duty cycles.

[2]Vehicle Center of Gravity refers to the theoretical point of mass for the vehicle where forces act. It is measured vertically from the ground and is needed for vehicle dynamics calculations that affect bearing life.

[3]Lubrication type and wheel hub stiffness have minimal effect on the calculated preload values.