

2. APTA PR-M-RP-008-98

Recommended Practice for Passenger Car Axle Design

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Abstract: This recommended practice provides guidance for specifying the axles for passenger rail cars, whose operations fall under the jurisdiction of Federal Railroad Administration regulation. The designs shown herein are provided as guidelines based on historical experience.

Keywords: axles, axle design

NOTE: *This document was previously referenced as APTA RP-M-001-98. This number was updated February 2013.*

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Introduction

(This introduction is not part of APTA PR-M-RP-008-98, Recommended Practice for Passenger Car Axle Design)

This recommended practice is essentially a reprint of former AAR Standards referenced in Part II. In order to provide consistency of cross reference between the former AAR standard and this recommended practice, the former AAR Standard designations are referenced in each of the four sections of this document. The applicable data and information from the AAR standards has been carried over intact from the last AAR revision of each of these former AAR standards.

This recommended practice is provided as a guide to those specifying the axles for passenger rail cars, whose operations fall under the jurisdiction of FRA regulation. The designs shown herein are provided as guidelines based on historical experience. The responsible designer must verify that the materials and processes used, including but not limited to the finish of press fit surfaces, are applicable to the intended vehicle and operating environment

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Recommended Practice for Passenger Car Axle Design

1. Overview

This recommended practice is divided into four sections according to bearing type and application. They are identified as sections 3.1 through 3.4 of this recommended practice. Sections 3.5 and 3.6 provide supplementary axle information referenced in drawings and tables.

Section 3 applies to standard passenger cars with standard outboard bearing axles in the load capacity ranges shown in the tabulation. Plain (friction) bearing axles, covered by former AAR Standard S-012, have been deleted from this Recommended Practice since their use is no longer permitted.

Section 4 applies to freight car axles used under Baggage Express "BX" type container or box cars in the load capacity ranges shown in the tabulation.

Section 5 defines axle classifications for journal sizes for roller bearings applied to outboard axles with raised wheel seats.

Section 6 defines an axle for use on AMFLEET intercity cars, as originally built by the Budd Company and operated by the National Railroad Passenger Corporation (AMTRAK).

Section 7 defines the Axle Centers for roller bearing Passenger car axles.

Section 8 defines the New and Limiting Dimensions for Inboard Roller Bearing Axles

1.1 Scope

This is a recommended practice for the application of service proven and industry accepted axles for use in railroad passenger cars used in commuter and intercity service.

The passenger rail industry will phase this recommended practice into practice over the six-month period from July 1 to December 31, 1999. The recommended practice takes effect January 1, 2000.

1.2 Purpose

This recommended practice is intended to be used by persons knowledgeable in the application of axles as an aid in selecting appropriate components for new or replacement applications in which it is desired to utilize industry accepted axles. This recommended practice is provided as a guide to those specifying the axles for passenger rail cars, whose operations fall under the jurisdiction of FRA regulation. The designs shown herein are provided as guidelines based on historical experience. The responsible designer must verify that the materials and processes used,

including but not limited to the finish of press fit surfaces, are applicable to the intended vehicle and operating environment.

2. References

This recommended practice is derived from, and where applicable, shall be used in conjunction with the following publications. If the following publications are superseded by an approved revision, the approved revision shall apply.

AAR Figure 4.12, Section G-II, Axle Centers.

AAR Figure 4.16, Section G-II, Table of New and Limiting Dimensions for Inboard Roller Bearing Axles.

AAR Specification M-101-90, Standard Axles, Carbon Steel, Non-Heat Treated and Heat Treated.

Former AAR Standards S-042, S-012, S-013, S-014 and S-658.

3. Passenger car axles with outboard bearings (former AAR S-042)

Where these axles are used on new cars in passenger service, the load rating of the individual axles should be as follows (See Note 1):

Axle designation	Size of journal (Inches)	Capacity for axles for normal maximum operating speed ranges of: (See notes 2 & 3)	
		Up to and including 85 MPH	86 to 100 MPH
C	5 x 9	28,500 lbs.	27,000 lbs.
D	5 ½ x 10	36,000 lbs.	34,000 lbs.
E	6 x 11	45,000 lbs.	42,500 lbs.
F	6 ½ x 12	54,000 lbs.	51,000 lbs.

Note 1 -The designs shown herein are provided as guidelines based on historical experience. The responsible designer must verify that the materials and processes used, including but not limited to the finish of press fit surfaces, are applicable to the intended vehicle and operating environment.

Note 2 -Maximum wheel size=36" (91 cm).

Note 3 -Capacities indicated are rail loads.

4. Axles for cars in BX service (former AAR S-013)

Capacity in pounds of freight car roller bearing raised wheel seat axles when used in Baggage Express “BX” Passenger Train Service (See Note 4)

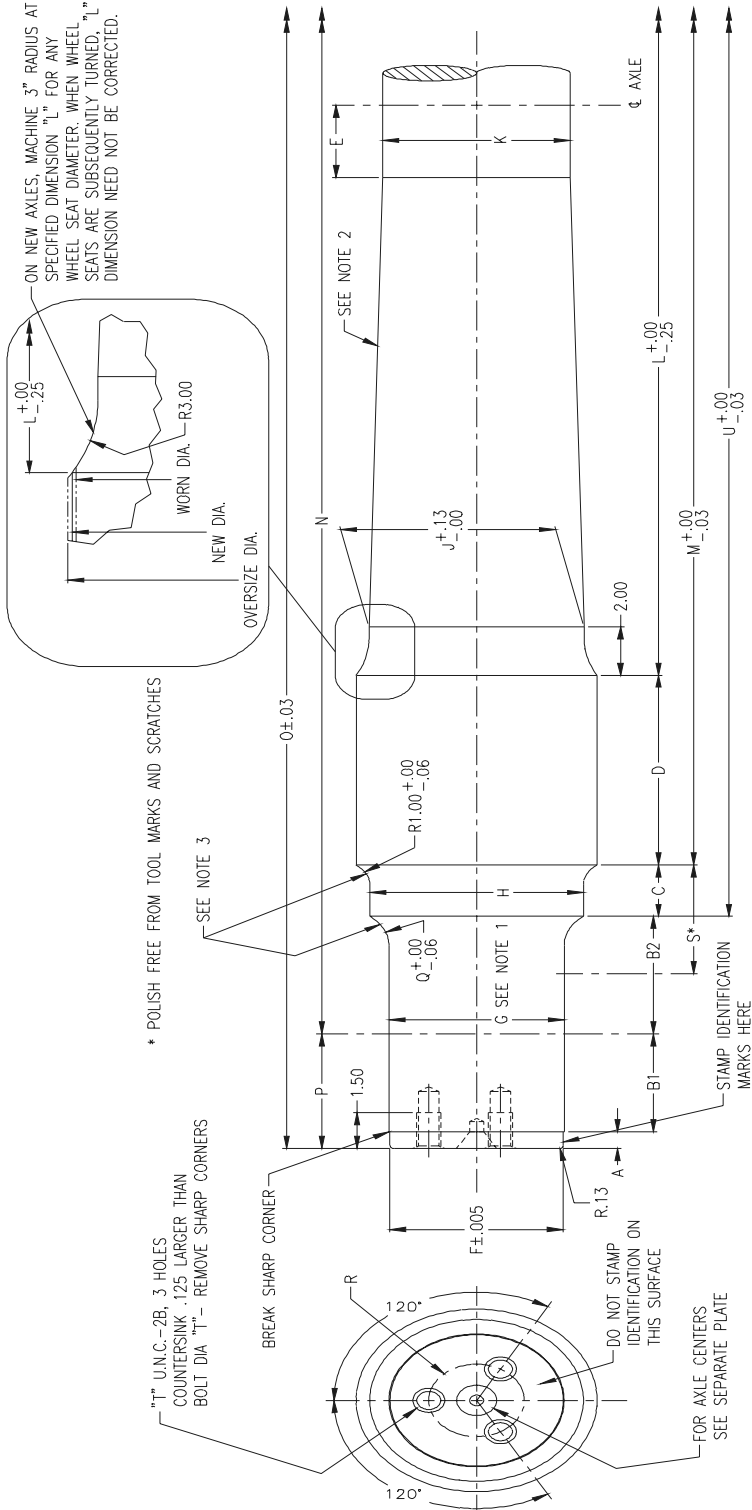
AAR Axle Designation	Size of Journal (Inches)	Capacity for Axles for Normal Maximum Operating Speed Ranges of:	
		(See Notes 2 & 3)	
		Up to and including 85 MPH	86 to 100 MPH
C	5 x 9	33,500 lbs.	32,000 lbs.
D	5 ½ x 10	42,000 lbs.	40,000 lbs.
E	6 x 11	52,500 lbs.	50,000 lbs.
F	6 ½ x 12	63,000 lbs.	60,000 lbs.
G	7 x 12	76,000 lbs.	72,000 lbs.

Note 4 -The designs shown herein are provided as guidelines based on historical experience. The responsible designer must verify that the materials and processes used, including but not limited to the finish of press fit surfaces, are applicable to the intended vehicle and operating environment.

Note 5 -Based on 72” (1.83 m) Center of Gravity and 33” (84 cm) wheels.

Note 6 -Capacities indicated are rail loads.

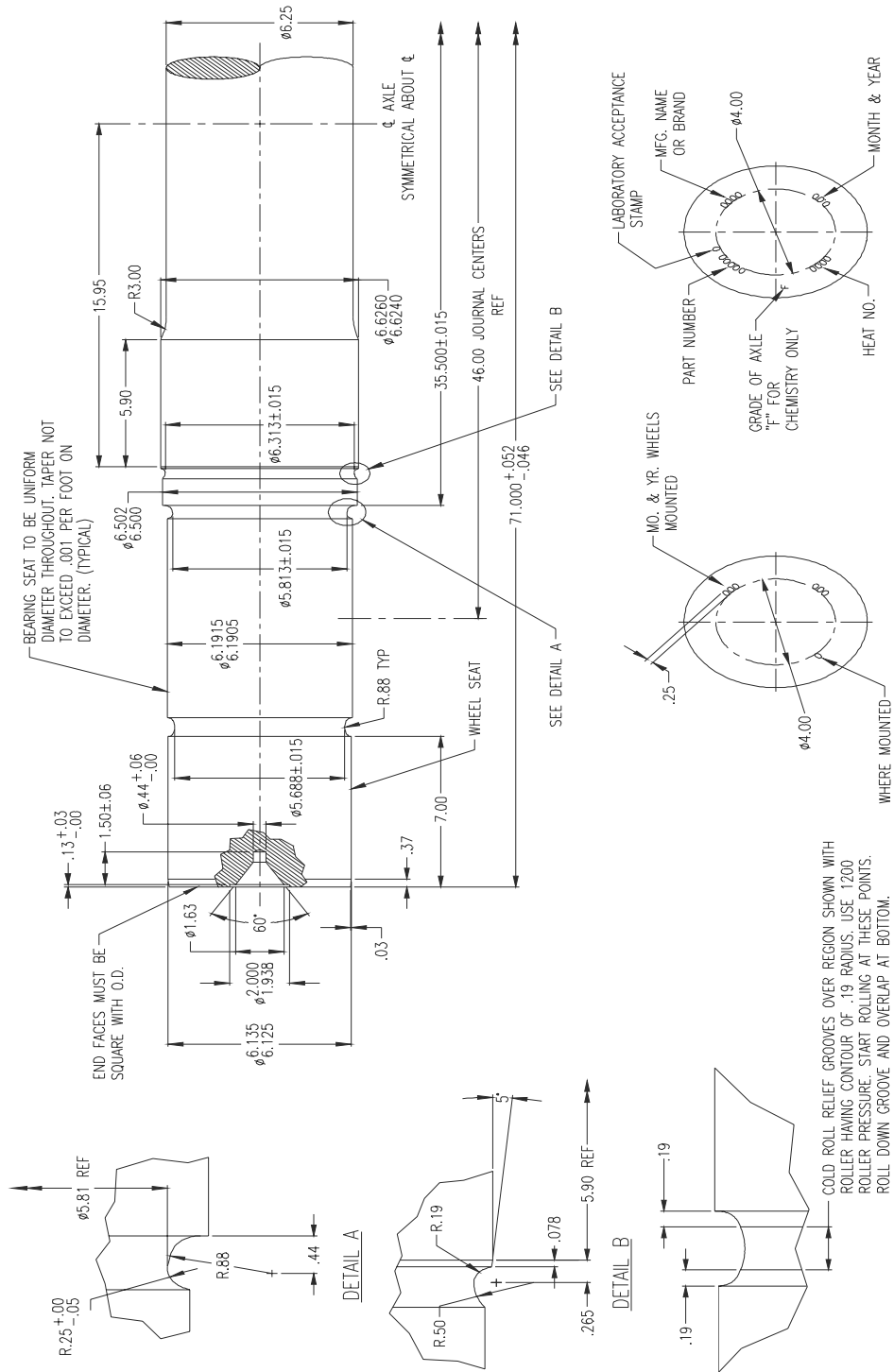
5. Passenger car axles with outboard roller bearings with raised wheel seats (former AAR S-014)



CLASSIFICATION OF AXLE	SIZE OF JOURNAL	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
C	5.00 X 9.00	.75	3.75	4.50	2.00	7.88	1.50	4.94	MAX. 5.004 MIN. 5.003	6.213 6.211	7.000	6.188	5.38	47.25	63.00	76.00	85.00	4.50	1.25	1.50	4.50	$\frac{5}{16}$ -11	67.00
D	5.50 X 10.00	1.06	3.69	4.88	2.13	7.88	3.00	5.438	MAX. 5.504 MIN. 5.503	6.703 6.701	7.563	6.75	5.88	47.25	63.00	77.00	86.50	4.75	1.50	1.50	4.50	$\frac{3}{8}$ -10	67.25
E	6.00 X 11.00	.94	4.19	5.38	2.38	7.63	3.00	5.938	MAX. 6.004 MIN. 6.003	7.250 7.249	8.250	7.31	6.44	47.25	62.50	78.00	88.25	5.13	1.50	1.75	4.50	$\frac{7}{8}$ -9	67.25
F	6.50 X 12.00	1.13	4.75	5.94	2.44	7.50	3.00	6.438	MAX. 6.504 MIN. 6.503	7.906 7.905	8.750	7.88	6.88	47.25	62.25	79.00	90.75	5.88	1.50	1.94	4.50	$\frac{7}{8}$ -9	67.13

NOTES:
 1. MAXIMUM PERMISSIBLE VARIATION IN JOURNAL DIAMETER AT ANY PLACE MUST NOT EXCEED .001 INCH AND THERE SHALL BE NO ABRUPT CHANGES OR STEPS OVER THE LENGTH OF THE JOURNAL.
 2. AXLES SHALL BE MACHINED TO 250 MICRO INCHES MAX. BETWEEN WHEEL SEATS.
 3. RADIUS "Q" AND 1" RADIUS BACK OF DUST GUARD SEAT ARE REQUIRED AS SHOWN TO ACCOMMODATE ALL TYPES OF ROLLER BEARINGS THAT MAY BE APPLIED TO THESE AXLES.
 4. ROLLER BEARING AXLES, WHEN FINISHED ON LATHE CENTERS, SHALL HAVE ENDS RE-CENTERED PRIOR TO GRINDING OR ROLLING OF JOURNALS.
 5. THE DESIGNS SHOWN HEREIN ARE PROVIDED AS GUIDELINES BASED ON HISTORICAL EXPERIENCE. THE RESPONSIBLE DESIGNER MUST VERIFY THAT THE MATERIALS AND PROCESSES USED, INCLUDING BUT NOT LIMITED TO THE FINISH OF PRESS FIT SURFACES, ARE APPLICABLE TO THE INTENDED VEHICLE AND OPERATING ENVIRONMENT.

6. Axle for AMFLEET inboard roller bearing (former AAR S-658)



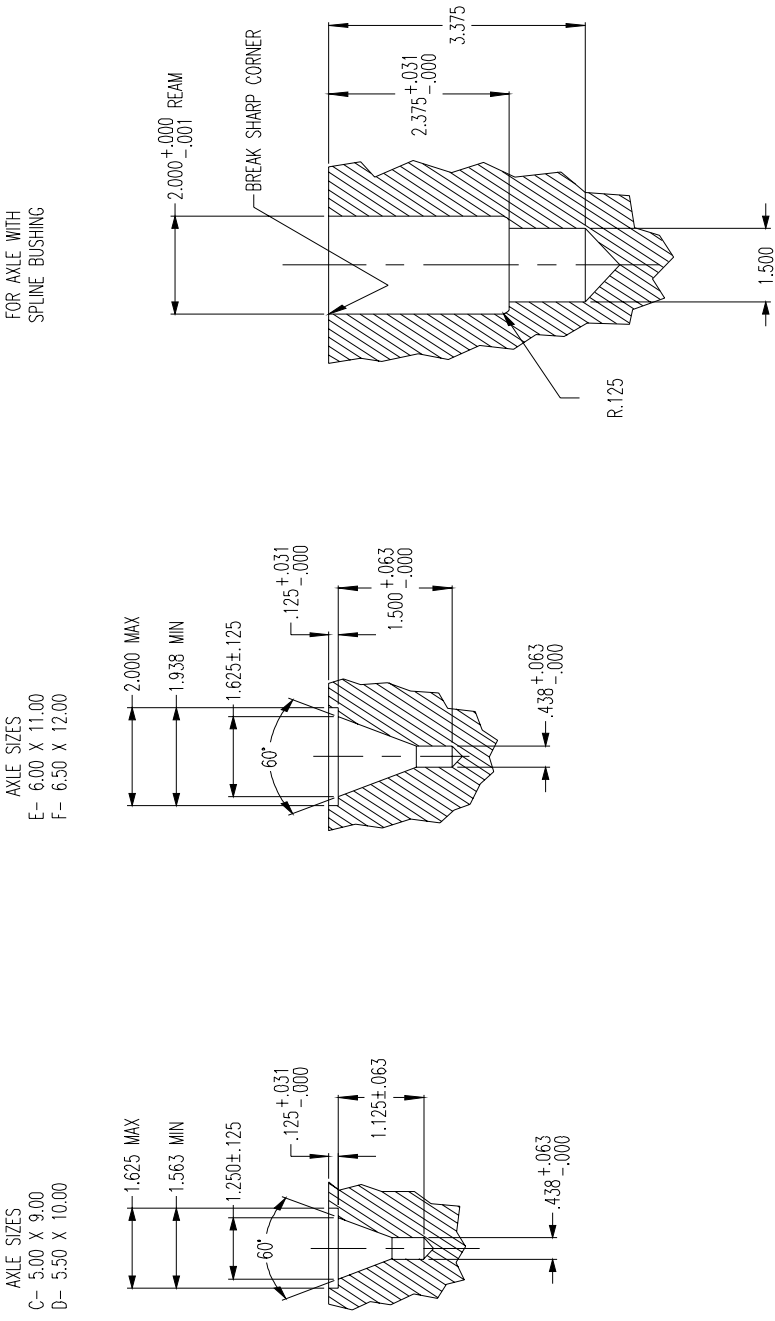
STAMPING OTHER END OF AXLE

STAMPING ONE END OF AXLE

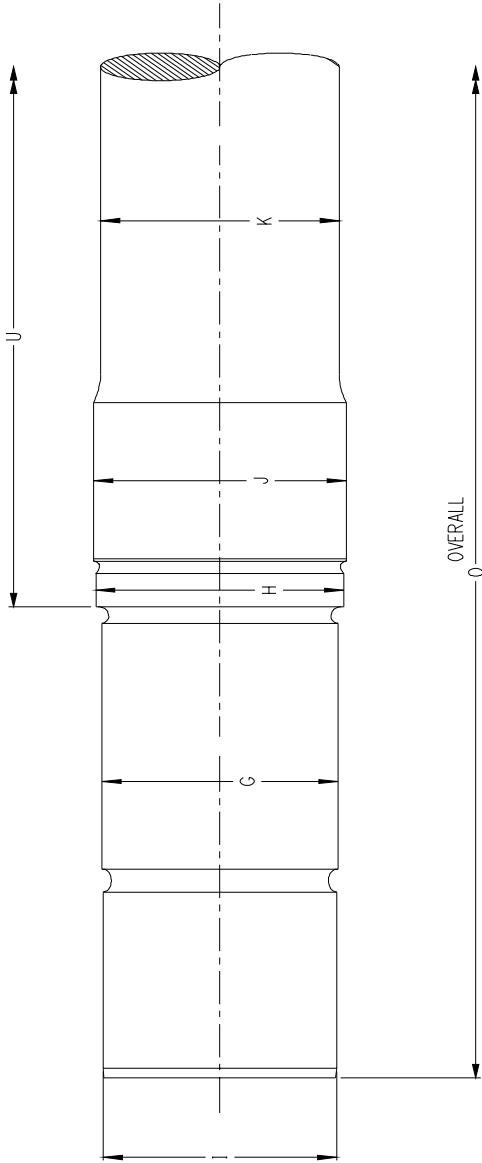
- NOTES:
1. MATERIAL AAR, M-101 GRADE F. THE AXLE OTHERWISE MUST BE IN COMPLIANCE WITH AAR SPECIFICATION M-101, LATEST REVISION.
 2. ROUGH MACHINED AXLE TO BE SUB CRITICALLY QUENCHED FROM 1000 TO 1050°F IN WATER. ALLOW .187" OVER FINISHED DIAMETERS. RELIEF GROOVES TO BE MACHINED AND COLD ROLLED AFTER SUB CRITICAL QUENCHING.
 3. FINISH MARKS REMOVED IN 1982 REVISION.
 4. DESIGN CRITERIA: SPEED- 125 MPH, WHEELS- 36 IN. DIA. FULL SEATED RAIL LOAD 29190 LBS PER AXLE
 5. THE DESIGN SHOWN HEREIN ARE PROVIDED AS GUIDELINES BASED ON HISTORICAL EXPERIENCE. THE RESPONSIBLE DESIGNER MUST VERIFY THAT THE MATERIALS AND PROCESSES USED, INCLUDING BUT NOT LIMITED TO THE FINISH OF PRESS FIT SURFACES, ARE APPLICABLE TO THE INTENDED VEHICLE AND OPERATING ENVIRONMENT.

7. Axle centers, (former AAR G-II, figure 4.12)

FINISHED DIMENSIONS
PASSENGER ROLLER BEARING AXLES



8. Table of new and limiting dimensions for inboard roller bearing axles (former AAR G-II, figure 4.16)



JOURNAL SIZE	ROAD LIMITS		SHOP LIMITS					DIMENSIONS NEW					
	Requiring the removal of axle from service		Axles must not be applied in passenger service or under foreign equipment if not within the following limits					Note 1 - Oversize axles may be .030 larger than shown under Dimension "I" Note 2 - Dimension "O" may be +1/32" or -3/64"					
	WHEN LESS THAN		WHEN LESS THAN										
	I	K	I	U	O	K	I	J	K	G	H	O	U
6.50 X 12.00	5.88	6.13	5.88	35.44	70.95	6.13	6.13	6.63	6.25	6.1915 6.1905	6.502 6.500	71.00	35.50

NOTES:
 1. OTHER AXLE DIMENSIONS TO BE SAME AS FOR AMTRAK INBOARD ROLLER BEARING PASSENGER CAR AXLE.
 2. ALL DIMENSIONS ARE IN INCHES.