APTA STANDARDS PROGRAM

STANDARD

APTA PR-M-S-012-99, Rev. 3

First Published: March 17, 1999

First Revision: January 11, 2003

Second Revision: February 13, 2004

Third Revision: February 10, 2025

PRESS Mechanical Working Group

Manufacture of Wrought Steel Wheels

Abstract: This standard is intended to supplement the AAR's Manual of Standards and Recommended Practices, Section G, Wheels and Axles. This standard relies heavily on the AAR's manufacturing requirements and references its requirements frequently.

This standard specifies those requirements for passenger car wheel designs that are not included in the AAR manual. An attempt has been made to cover all possible requirements related to the large variety of designs utilized in passenger rail vehicles.

Keywords: wheel, wheel stamping, wheel marking, wrought steel, heat treatment, shot peening, cheek disc, damping ring, hydraulic assist port, wheel balance, terminology, tension testing, chemical properties, profiles, reference groove

Summary: This standard covers the minimum manufacturing requirements for multi-wear wrought carbon-steel heat-treated wheels for rail passenger equipment. It does not duplicate the standards established by the AAR, rather, it supplements those requirements with standards applicable to wheels used in passenger car service.

Foreword

The American Public Transportation Association is a standards development organization in North America. The process of developing standards is managed by the APTA Standards Program's Standards Development Oversight Council (SDOC). These activities are carried out through several standards policy and planning committees that have been established to address specific transportation modes, safety and security requirements, interoperability, and other topics.

APTA used a consensus-based process to develop this document and its continued maintenance, which is detailed in the manual for the APTA Standards Program. This document was drafted in accordance with the approval criteria and editorial policy as described. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

This document was prepared by the PRESS Mechanical Working Group as directed by the Passenger Rail Equipment Safety Standards Policy and Planning Committee.

This document represents a common viewpoint of those parties concerned with its provisions, namely transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. APTA standards are mandatory to the extent incorporated by an applicable statute or regulation. In some cases, federal and/or state regulations govern portions of a transit system's operations. In cases where there is a conflict or contradiction between an applicable law or regulation and this document, consult with a legal adviser to determine which document takes precedence.

This document supersedes APTA PR-M-S-012-99, Rev. 2, which has been revised. The approach taken in this revision differs greatly from the original standard. The original standard was modeled after the AAR specification for the manufacture of steel wheels, AAR M-107/M-208. This revision incorporates the AAR's manufacturing requirements by reference, allowing for the periodic updates to the AAR standard to be incorporated into this standard automatically. The contents of this revision to the APTA standard focus on those aspects of wheels that are unique to wheels used in passenger car service.

Below is a summary of changes from the previous document version:

- Standard retitled from "Manufacture of Wrought Steel Wheels for Passenger Cars and Locomotives" to "Manufacture of Wrought Steel Wheels."
- Rewrite of abstract, summary, and Keywords
- Section 1: Added new section "Terminology."
    - Added new section 1.1, "Wheel nomenclature."
        - Added nomenclature for **back**, **curved plate**, **flange**, **front**, **gauge point**, **hub**, **plate**, **rim**, **straight plate**, **tread**, **wear limit reference groove**, and **web**.
        - Added new figure 1 detailing wheel nomenclature.
    - Added new section 1.2, Dimensional codes."
        - Added codes to be used in reference to various dimensional attributes of wheels.
        - Added new figure 2 detailing reference locations of dimensional codes.
    - Relocated Definitions to new section 1.3, "Definitions."
        - Added new definitions for **axle-mounted brake disc**, **block**, **bore**, **casting**, **cheek discs**, **damping ring**, **diesel multiple unit (DMU)**, **electric multiple unit (EMU)**, **end user**, **forging**, **heat**, **heat treatment bench**, **hub depression**, **hub-mounted brake disc**, **hub projection**, **inboard**, **locomotive**, **material class**, **material grade**,

mult, **multiple unit (MU)**, **outboard**, **passenger equipment vehicle**, **plate-mounted brake disc**, **purchaser**, **tape line**, **tape size**, **unbalance**, **unbalance, dynamic**, **unbalance, static**, **wheel manufacturer**, **wheel-mounted brake disc**, **wheel producer**, and **wrought**.

- Section 2: Renamed "Production and manufacturing requirements."
    - Added AAR M-107/M-208 adherence base allowing exceptions only as detailed within this standard.
    - Added end user approved exception for manufacturers without AAR M-1003 certification.
    - Removed temperature control requirements.
- Section 3: added new section "Production and manufacturing cycle for wheels."
    - Added production and manufacturing cycle steps for wrought steel wheels and cast steel wheels.
- Section 4: Added new section "Wheel producers" detailing AAR M-1003 requirements for wheel producers.
- Section 5: Added new section "Wheel manufacturers" detailing AAR M-1003 requirements for wheel manufacturers.
- Section 6: Added new section "Exceptions to AAR M-107/M-208 requirements."
- Section 7: Revised details regarding material class and grade.
- Section 8: Revised details regarding shot peening.
- Section 9: Renamed section from "Quality assurance provisions" to "Testing."
    - Redefined testing requirements to be in accordance with AAR M-107/M-207.
    - Added gas content testing requirements and limits.
    - Added new table 1: Gas content maximums.
- Section 10: Redefined chemical analysis requirements to be in accordance with AAR M-107/M-208.
- Removed former section "Check Analysis."
- Section 11: Added new section "Tension testing."
    - Added new table 2: tension testing minimum results.
- Section 12: Replaced for section "Brinell hardness" with "Hardness testing" replacing Brinell requirements with requirements as detailed in AAR M-107/M-208.
- Section 13: Added new section "Charpy impact testing."
- Removed former section "Number of tests."
- Section 14: Added new section "Fracture toughness testing."
    - Added new table 3: fracture toughness minimums.
- Section 15: Added new section "Tread profiles."
- Removed former sections "Retreatment," "Mating," and "gages."
- Section 16: Renamed section from "Permissible variations in dimensions" to "Dimensional Tolerances."
    - Added new dimensional tolerances.
    - Added new table 4: dimensional tolerances table.
    - Added new figure 3 detailing dimensional tolerances for wheels.
- Removed former section "Finishing."
- Section 17: Added new section "Wear limit reference groove."
    - Added new figure 4 detailing wear limit reference groove and rim thickness.
    - Added new table 5: wear limit reference groove locations.
- Section 18: Added new section "Wheel balance requirements."
    - Added new table 6: wheel maximum unbalance requirements.
- Section 19: Added new section "Hydraulic assist ports and grooves."

- Added new figure 5 containing a wheel hub showing an angled hydraulic assist port.
- Added new figure 6 containing a wheel hub showing a hub face hydraulic assist port.
- Added new figure 7 detailing the annular groove.
- Added new figure 8 detailing the hub fillet assist port dimensions.
- Added new figure 9 detailing the hub face hydraulic assist port dimensions.
- Added new figure 10 detailing the hub face port passageway intersection with annular dimensions.

- Section 20: Added new section "Cheek discs."
  - Added new figure 11 containing a wheel showing thru holes without center pin holes.
  - Added new figure 12 containing a wheel showing thru holes and center pining holes.
  - Added new table 7: thru hole bolt circles (inches).
  - Added new table 8: thru hole bolt circles (metric).
- Renamed former section "Marking" to "Identification marking."
  - Removed figure detailing hub stamping markings.
  - Added new figure 13 containing a wheel hub face showing the marking pattern and spacing.
  - Revised marking requirements.
- Section 22: Added new section "Damping ring grooves."
  - Added new figures detailing damping ring grooves.
  - Added new table 9: groove dimensions and tolerances.
- Removed former section "Inspection."
- Removed former section "Certification."
- Removed former section "Rejection."
- Removed former section "Authorization to deliver wheels."

Table of Contents

List of Figures and Tables

Participants

At the time this recommended practice was revised, the task group included the following members:

Glenn Brandimarte, ORX, *Task Group Lead*

Frank Banko, *WSP*
Michael Barron, *Federal Railroad Administration*
B. A. "Brad" Black, *Virginkar and Associates, Inc.*
Greg Buzby, *SEPTA*
Reginald Cook, *SEPTA*
Joshua Coran, *Talgo, Inc.*
Richard Curtis, *Curtis Engineering, Inc.*
Gary Fairbanks, *Federal Railroad Administration*
Dooheon Ghim, *WMATA*
Joanna Hallisy, *Timken*
Matthew Klinger, *SEPTA*
Frank Maldari, *MTA Long Island Rail Road*
Eloy Martinez, *Hatch*
Katie McCabe, *ORX*
Patrick McCunnery, *Atkins Global NA*
Luke Morscheck, *Steady On Engineering*
Thomas O'Brien, *KLD Labs, Inc.*
Patrick Musselman, *Federal Railroad Administration*
Brian Pitcavage, *Hatch*
Michelle Rodriguez, *SEPTA*
Jeffrey Rogers, *Amtrak*
Ralph Schorr, *Amsted Rail*
Benjamin Spears, *Hatch*
Anthony Ursone, *UTCRAS, LLC*
Frank Ursone, *UTCRAS, LLC*
Gary Wagner, *Amsted Rail*
Michael Wetherell, *McKissak and McKissak*
Todd Williams, *Penn Machine Company*

The American Public Transportation Association greatly appreciates the contributions of the **PRESS Mechanical Working Group**, which provided the primary effort in the drafting of this document.

At the time this standard was completed, the working group included the following members:

Chris Madden, Amtrak, *Chair*
Greg Buzby, SEPTA, *Vice Chair*
Benjamin Spears, Hatch, *Secretary*

Mohamed Alimirah, *Metra*
Carl Atencio, *American Rocky Mountaineer*
Gordon Bachinsky, *Advanced Rail Management*
Frank Banko, *WSP USA*
Juan Barahona, *Talgo, Inc.*
Michael Barnes, *Jacobs*
Taft Bearden, *AtkinsRéalis*
David Bennett, *Capital Metro. Transp. Auth.*
Jonathan Bernat, *Knorr Brake Corp.*
Eric Bisaillon, *Wabtec Corp.*
Kristoffer Bittner, *MTA Long Island Rail Road*
B. A. "Brad" Black, *Virginkar and Associates, Inc.*
Casey Blaze, *GCRTA*
Stephen Bonina, *WSP USA*
Glenn Brandimarte, *ORX*
Richard Bruss, *Retired*
Dennis Cabigting, *STV, Inc.*
Elvin Calderon, *Denver Transit Operators*
Rob Caldwell, *NRC*
Paul Callaghan, *Transport Canada*
Julia Camacho, *Talgo, Inc.*
Gordon Campbell, *Crosslinx Transit Solutions*
Kevin Carmody, *STV, Inc.*
David Carter, *New Jersey Transit Corp.*
Steve Cavanaugh, *Metrolinx*
Dion Church, *AtkinsRéalis*
Vlad Ciobanu, *Siemens Mobility, Inc.*
John Condrasky, *Retired*
Joshua Coran, *Talgo, Inc.*
Michael Craft, *MxV Rail*
Brian Creely, *Siemens Mobility, Inc.*
Brendan Crowley, *Knorr Brake Corp.*
Ryan Crowley, *AtkinsRéalis*
K'Moy Daye, *MTA Metro-North Railroad*
Joe Di Liello, *Via Rail Canada, Inc.*
David Diaz, *Hatch*

Adam Eby, *Amtrak*
Terran Engle, *Stadler*
Phillippe Etchessahar, *Alstom*
Gary Fairbanks, *Federal Railroad Administration*
Robert Festa, *MTA Long Island Rail Road*
Steve Finegan, *AtkinsRéalis*
Gavin Fraser, *Jacobs*
Francesco Paolo Fumarola, *Alstom*
Edward Gacsi, *New Jersey Transit Corp.*
Joe Gagliardino, *McConway & Torley LLC*
Sebastian Geraud, *Alstom*
Dooheon Ghim, *WMATA*
Jeffrey Gordon, *Federal Railroad Administration*
Emily Greve, *Amtrak*
Christian Gschnitzer-Baernthaler, *Stadler*
Stan Gurule, *MxV Rail*
Joanna Hallisy, *Timken*
Guillaume Ham-Livet, *Alstom*
Eric Harden, *Knorr Brake Corp.*
Nicholas Harris, *Hatch*
Juan Hernandez, *Mott McDonald*
Lew Hoens, *MTA Metro-North Railroad*
Christopher Holliday, *STV, Inc.*
Gregory Holt, *Penn Machine Company*
George Hud, *Hatch*
Jessica, Iacobucci, *Hatch*
Paul Jamieson, *Retired*
John Janiszewski, *Hatch*
MaryClara Jones, *MxV Rail*
Robert Jones, *Stadler*
Larry Kelterborn, *LDK Advisory*
Joseph Kenas, *Alstom*
Peter Klauser, *Vehicle Dynamics*
Christian Knapp, *Denver Transit Operators*
Karan Kothari, *Amtrak*
Heinz-Peter Kotz, *Siemens Mobility, Inc.*
Scott Kramer, *McConway & Torley LLC*
Tammy Krause, *STV, Inc.*
Pierre Laberge, *Alstom*
Pallavi Lal, *Hatch*
Peter Lapre, *Federal Railroad Administration*
Brand Loney, *WMATA*
Cameron Lonsdale, *Amsted Rail*
Daniel Luskin, *Amtrak*
John MacEwan, *SEPTA*
Eric Magel, *Retired*
Daniel Magnus, *KLD Labs, Inc.*
Frank Maldari, *MTA Long Island Rail Road*
Brian Marquis, *Federal Railroad Administration*
Eloy Martinez, *Hatch*
Francis Mascarenhas, *Metra*
Maria Mauri, *Wabtec Corp.*
Ronald Mayville, *Retired*
Katie McCabe, *ORX*
William McClellan, *ACI*
Patrick McCunney, *AtkinsRéalis*Gerard McIntyre, *Knorr Brake Corp.*
William Minnick, *Omni Strategy, LLC*
Felix Moreau, *MTA Long Island Rail Road*
Luke Morscheck, *Steady-On Engineering*
Karl Mullinix, *Knorr Brake Corp.*
Paul O'Brien, *UTA*
Thomas O'Brien, *KLD Labs, Inc.*
Chase Patterson, *Voith*
Joe Patterson, *Amsted Rail*
Martin Petzoldt, *Wabtec Corp.*
Ian Pirie, *STV, Inc.*
Brian Pitcavage, *Hatch*
Benoit Poulin, *Alstom*
Ian Pradhan, *Stadler*
Brandon Reilly-Evans, *Hatch*
Peter Reumueller, *Siemens Mobility, Inc.*
Daniel Rice, *Wabtec Corp.*
Kurt Rindgen, *Hatch*
Jeffrey Rogers, *Amtrak*
Carol Rose, *STV, Inc.*
Thomas Rusin, *Rusin Consulting*
Mehrdad Samani, *Jacobs*
Jean-Francois Savaria, *Alstom*
Gerhard Schmidt, *Siemens Mobility, Inc.*
Ralph Schorr, *Amsted Rail*
Martin Schroeder, *Jacobs*
George Scoullos, *New Jersey Transit Corp.*
Richard Seaton, *TDG International, Inc.*
Frederic Setan, *Alstom*
Patrick Sheeran, *Hatch*
Xinggao Shu, *MxV Rail*
Melissa Shurland, *Federal Railroad Administration*
Marcel Silva, *Hatch*
David Skillman, *Amtrak*
Rick Spencer, *Knorr Brake Corp.*
Mark Stewart, *Hatch*
Jonathan Sunde, *Strato, Inc.*
Lukasz Szymsiak, *Via Rail Canada, Inc.*

Medhi Taheri, *Raul V. Bravo + Associates, Inc.*
Ali Tajaddini, *Federal Railroad Administration*
Jeff Thompson, *SEPTA*
Ben Titus, *Jacobs*
Matthew Todt, *Amsted Rail*
Michael Trosino, *Amtrak*
Ronald Truitt, *HTSI*
Anthony Ursone, *UTCRAS, LLC*
Frank Ursone, *UTCRAS, LLC*
Rudy Vazquez, *Amtrak*
Gary Wagner, *Amsted Rail*
Michael Walsh, *MBTA*
David Warner, *STV, Inc.*
Michael Wetherell, *McKissack & McKissack*
Brian Whitten, *AtkinsRéalis*
Kristian Williams, *Amtrak*
Todd Williams, *Penn Machine Company*
Nicholas Wilson, *MxV Rail*
Timothy Wineke, *Knorr Brake Corp.*
Reggie Wingate, *Knorr Brake Corp.*
Tamar Yassa, *Transport Canada*
Aleksey Yelesin, *Alstom*
Kevin Young, *Amsted Rail*
Gregory Yovich, *NICTD*
Steven Zuiderveen, *Federal Railroad Administration*

Project team
Nathan Leventon, *American Public Transportation Association*

Introduction

This introduction is not part of APTA PR-M-S-012-99, Rev. 3, "Manufacture of Wrought Steel Wheels."

This standard applies to all:

1. Railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
2. Railroads that provide commuter or other short-haul rail passenger train service in a metropolitan or suburban area, including public authorities operating passenger train service.

This standard may apply to:

1. Rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
2. Tourist, scenic, historic or excursion operations, whether on or off the general railroad system of transportation;
3. Operation of private cars, including business/office cars and circus trains; or
4. Railroads that operate only on track inside an installation that is not part of the general railroad system of transportation.

Scope and purpose

This standard applies to wrought steel wheels intended for use on North American rail passenger vehicles, including MU cars and passenger cars, including coaches, non-passenger-carrying cars, and locomotives that are intended for use in passenger service. This standard applies to U.S. Department of Transportation Federal Railroad Administration speed classifications for Tier I and Tier II vehicles. This standard applies to single-piece (monobloc) wheels. This standard may be applied to cast steel wheels whenever cast steel is specifically approved by the end user.

Manufacture of Wrought Steel Wheels

1. Terminology

1.1 Wheel nomenclature

back: The surface of the wheel on its inboard side.

curved plate. A wheel plate that is curved in a manner to allow flexing of the plate whenever the wheel rim is heated under braking thermal input.

flange: The section of the wheel rim that protrudes from the wheel tread. The purpose of the flange is to keep the vehicle confined within the rails.

front: The surface of the wheel on its outboard side.

gauge point: The point on the wheel profile at which the wheel is designed to contact the rail.

hub: The cylinder-shaped central section of the wheel.

plate: The relatively thin section of the wheel between the rim and the hub.

rim: The circular ring-shaped section of the wheel at its outside diameter. The outside of the rim is the surface on which the wheel contacts the rail.

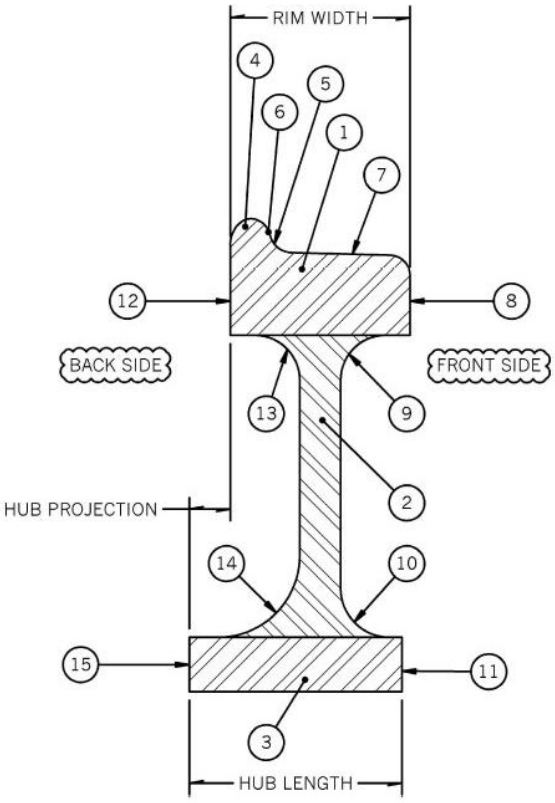
straight plate: A wheel plate that is flat between its intersection with the wheel hub and the wheel rim. The plate may be disc shaped or an angled conical shape.

tread: A two-dimensional rail interface surface at the outermost diameter of the rim.

wear limit reference groove: A thin circular groove machined into the front or back rim face of the wheel to facilitate accurate measurement of rim thickness, not to be confused with witness groove.

web: Synonymous with *plate*.

FIGURE 1
Nomenclature for Wheels



WHEEL NOMENCLATURE	
1	Rim
2	Plate
3	Hub
4	Flange
5	Flange Throat
6	Gauge Point
7	Tread
8	Front Rim Face
9	Front Rim Fillet
10	Front Hub Fillet
11	Front Hub Face
12	Back Rim Face
13	Back Rim Fillet
14	Back Hub Fillet
15	Back Hub Face

The wheel shown is a straight plate design.

1.2 Dimension codes

The following codes should be used for reference to the various dimensional attributes of wheels. Lowercase letters are used for diameters and radii. Uppercase letters are used for lengths.

O_F: The outside diameter of the front hub face
O_B: The outside diameter of the back hub face

R_F: The projection or depression of the plane of the front hub face relative to the front rim face
R_B: The projection or depression of the plane of the back hub face relative to the back rim face

d_0: The diameter of the wheel measured at the tape line
d_T: The circumference tape size of the wheel

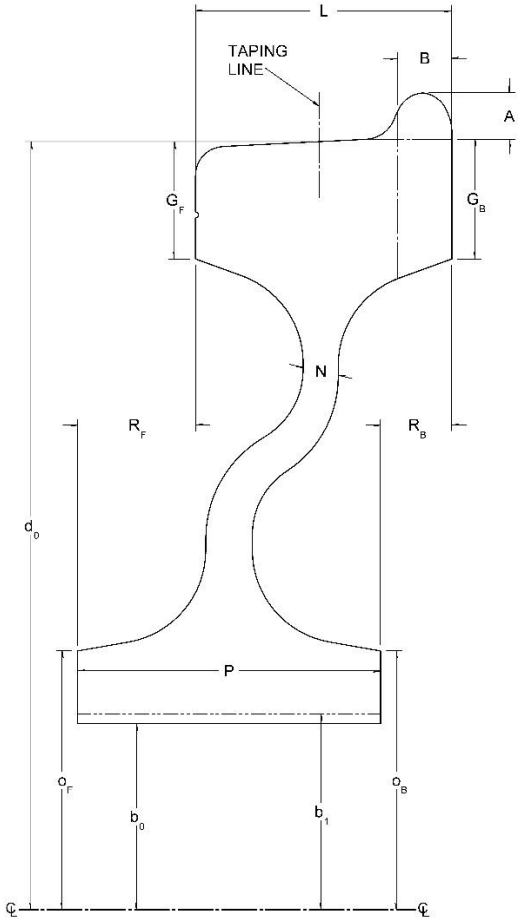
L: The width of the rim
P: The length of the bore

A: The flange height measured as the radial distance between the tape line and the apex of the flange
B: The width of the flange measured from the back rim face to the wheel flange gauge point

G_F: The rim thickness measured as the radial distance between the tape line and the inside diameter of the front rim face
G_B: The rim thickness measured as the radial distance between the tape line and the inside diameter of the back rim face

b_0: The diameter of the rough bore
b_1: The diameter of the finished (ready for mounting) bore

FIGURE 2
Dimension Codes for Wheels



1.3 Definitions

axle-mounted brake disc: A brake disc attached to an axle by means of an interference fit (press fit or shrink fit) between the brake disc hub and the axle seat onto which it is fitted.

block: A piece of steel appropriately sized for processing; also known as a *mult*.

bore: A cylindrical through hole centrally located relative to the outside diameter of a component.

casting: A manufacturing process in which a liquid material is poured into a mold and then allowed to solidify by cooling.

cheek discs: Flat, wheel-mounted brake discs, assembled in pairs, with one disc attached to each side (front and back) of the wheel plate and bolted together using thru holes in the wheel plate.

damping ring: A circular cross-section hoop installed in a groove in the rim fillet of a wheel, the purpose of which is to reduce the noise emitted by the wheel in service.

diesel multiple unit (DMU): a diesel fuel powered multiple unit with passenger carrying provisions, capable of providing tractive effort and of operating alone or coupled to other MUs to provide additional capacity.

electric multiple unit (EMU): An electric powered multiple unit with passenger carrying provisions, capable of providing tractive effort and of operating alone or coupled to other MUs to provide additional capacity.

end user: The authority ultimately responsible for the operation of the products defined in this standard.

forging: A steel product whose shape is produced by hammering, pressing or rolling.

heat: In the manufacture of steel from raw or recycled materials, all the material processed (melted) in one individual ladle; also referred to as a *melt*.

heat treatment batch: For batch-processed heat treatment, all the material subjected to the same heat treatment conditions—i.e., processed in the same furnace or oven simultaneously. For continuous heat treatment lines, all the material from a single heat subjected continuously to the same heat-treating conditions.

hub depression: The distance between the planes of the back rim face and back hub face of a wheel when the plane of the hub face is outboard of the plane of the back rim face. Hub depressions are most often used on inboard bearing design wheel sets.

hub-mounted brake disc: A brake disc attached to the front or back hub of a wheel, secured to the hub with screws.

hub projection: The distance between the planes of the back rim face and back hub face of a wheel when the plane of the hub face is inboard of the plane of the back rim face. Hub projections are most often used on outboard bearing design wheel sets. A negative hub projection is a hub depression.

inboard: The direction toward the centerline of the track or toward the centerline of a wheel set assembly.

locomotive: A vehicle, with no passenger carrying provisions, capable of providing tractive effort for a consist of varying length.

material class: The chemical composition of the steel used to manufacture wheels, often referred to as *chemical composition*, or simply *chemistry*. Note that the AAR defines both the chemical and mechanical properties using a single letter designation, which it refers to as “class”—e.g., Class B, Class C.

material grade: The mechanical properties of the steel used to manufacture wheels. Note that the AAR defines both the chemical and mechanical properties using a single letter designation, which it refers to as “class”—e.g., Class B, Class C.

mult: A piece of steel appropriately sized for processing, also known as a *block*.

multiple unit (MU): A vehicle capable of operating in a consist with other same or similar vehicles all of which are controlled simultaneously from a single source.

outboard: The direction away from the centerline of the track or from the centerline of a wheel set assembly.

passenger equipment vehicle: Rail rolling equipment, including locomotives, intended to provide transportation for members of the general public, along with vehicles that carry baggage, mail and other ancillary vehicles.

> **NOTE:** The definition provided here is based on the various definitions of vehicles given in 49 CFR §238.5.

plate-mounted brake disc: Same as *cheek disc*.

power car: A locomotive designed specifically for powering a trainset to which it is permanently coupled.

purchaser: The entity that specifies and places an order for purchase.

tape line: A circle on the tread of the wheel at a prescribed distance from the back rim face.

tape size: The number of eighths of an inch by which the circumference of a wheel, measured at its tape line, exceeds 84 in.

unbalance: The uneven distribution of mass around an axis of rotation.

unbalance, dynamic: Unbalance measured in more than one plane, each of which is perpendicular to the axis of rotation.

unbalance, static: Unbalance measured in a single plane perpendicular to the axis of rotation.

wheel manufacturer: The entity that machines the wheel to its finished condition ready for use.

wheel-mounted brake disc: Brake discs mounted to wheels as opposed to those mounted to axles. Cheek discs and hub-mounted brake discs are wheel-mounted.

wheel producer: The entity that forges a block from an ingot or bloom into a wheel shape ready for heat treatment and machining. The wheel producer is also referred to as the *forge*.

wrought: A forging operation in which metal is formed by rolling to produce a disc-shaped part.

2. Unit explanation

Dimensions specified in this standard are given in native units, i.e., in the original design's units. U.S. and metric equivalents are not given. Only the original design units are shown. For example, U.S. wheel designs are specified in inches without their metric equivalents. The one metric design wheel in this standard, along with metric design cheek disc thru hole locations, are specified in mm without the inch equivalent.

3. Production and manufacturing requirements

1. Wheels must be produced and manufactured in accordance with the specifications of AAR M-107/M-208 for carbon steel wheels except as required by this APTA manufacturing standard.
2. Wheels must be produced and manufactured by entities having AAR M-1003 certification.

3. Wheel producers and manufacturers other than those with AAR M-1003 certification are acceptable when specifically approved by the end user of the wheel.

4. Production and manufacturing cycle for wheels

The production and manufacturing cycle for wrought steel wheels consists of the following steps:

1. Manufacturing of raw steel as ingots or blooms
2. Division of ingot or bloom into an appropriately sized block (mult) for forging into a single wheel
3. Forging and rolling to shape the wheel
4. Heat treating
5. Machining to achieve the final wheel dimensions
6. Magnetic particle testing of wheel plate
7. Ultrasonic inspection of rim
8. Shot peening of specified wheel plate areas

The production and manufacturing cycle for cast steel wheels consists of the following steps:

1. Production of steel
2. Pouring of molten steel into molds
3. Heat treating
4. Machining to achieve the final wheel dimensions
5. Magnetic particle testing of wheel plate
6. Ultrasonic inspection of rim
7. Shot peening of specified wheel plate areas

5. Wheel producers

1. Wheel producers must have an AAR-approved M-1003 quality assurance certification for activity code A-13.
2. Wheel producers must be approved by the AAR for production of wheels.
3. Wheel producers other than those approved by the AAR are acceptable if specifically approved by the end user.

6. Wheel manufacturers

1. The wheel manufacturer is responsible for manufacturing wheels in accordance with the specifications provided by the purchaser of those wheels.
2. Wheel manufacturers must have AAR-approved M-1003 quality assurance certifications B33-8 and B33-8a.
3. Wheel manufacturers other than those with AAR M-1003 certification are acceptable when specifically approved by the end user of the wheel.

7. Exceptions to AAR M-107/M-208 requirements

1. Section 2.0 (Design) of AAR M-107/M-208 is not applicable to this standard but may be used at the discretion of the end user. Wheel designs and dimensional tolerances should meet the requirements of this standard.
2. Wheels must be produced from vacuum-degassed steel.
3. Hub stamping is preferable to rim stamping.
4. Wheels may be rim stamped whenever it is necessary that wheel serial numbers be visible in service and the design of the wheel set assembly precludes the visibility of hub stamping.

5. Locomotive wheels may be rim stamped.
6. Rim stamping of wheels must be made with low-stress stamps or by etching.
7. Wheels may be stamped on either the front or back face of the hub or rim.
8. Wheels for inboard bearing wheel set applications should not be stamped on the back hub face.

   NOTE: This recommendation is to avoid the loss of manufacturing information since inboard bearing wheels normally have their back hub faces machined prior to mounting. Additionally, hub stamping in this location will be difficult to see after the wheel is mounted.

9. Straight plate wheel designs are permitted when used in conjunction with plate-mounted brake discs.
10. The provisions of 49 CFR §238.119 are applicable to the rim stamping of straight plate wheels.

    NOTE: This is the text of 49 CFR §238.119 as of March 31, 2024, the date on which this standard was written. Be sure to check for revisions to the regulation, which should be available at https://www.ecfr.gov/current/title-49/subtitle-B/chapter-II/part-238/subpart-B/section-238.119.

11. Thru holes in the plates of wheels are permitted when used in conjunction with plate-mounted brake discs.
12. Wheels that do not incorporate cheek discs must be of curved plate design, except as provided in this section.
13. Straight plate wheel designs may be used for legacy vehicles whenever such designs are necessary to maintain compatibility with existing equipment.
    a. Straight plate wheels used in legacy vehicles that utilize tread braking must be hub stamped and must not be rim stamped.
    b. Straight plate wheels used in legacy vehicles that utilize tread braking must be wrought steel.
14. Front wheel hubs may be designed to include provisions for removal tooling engagement.
15. Front and back wheel hubs may be designed to allow for the attachment of brake discs directly to the hub.

8. Material class and grade

1. Wheels must be of a material class and grade specified in AAR M-107/M-208.
2. AAR M-107/M-208 do not separate the material class (i.e., the chemical composition of the steel) from the material grade (i.e., the mechanical properties of the steel). The steel class and grade are specified by a single designation, referred to by the AAR as “class.”

9. Shot peening

1. Wheel plates must be shot peened in accordance with AAR M-107/M-208.
2. For wheels that utilize plate-mounted cheek discs, the wheel’s finished-to-size disc interface surface must not be shot peened. This interface may be finish-machined after peening or masked during peening.
3. The surface finish of wheel plates prior to shot peening must not exceed 250 µ-in. (6.4 µm).
4. The surface finish of the disc interface surface must not exceed 125 µ-in. (3.2 µm).

10. Testing

1. The results of all testing required by this standard must be supplied to the purchaser.

2. Testing must be conducted as required by AAR M-107/M-208. This testing must include the following items:
    a. chemistry
    b. cleanliness
    c. hardness
    d. ultrasonic inspection
    e. magnetic particle inspection
3. In addition to the testing requirements prescribed in AAR M-107/M-208, gas content must be tested and must meet the requirements shown in **Table 1**. Gas content must be checked in accordance with ASTM E1019 for nitrogen and oxygen, and in accordance with ASTM F1113 for hydrogen.

TABLE 1
Gas Content Maximums

Ref.	Gas	Max. (ppm)
1	Hydrogen	2.5
2	Oxygen	24
3	Nitrogen	90

4. Additional testing may be required by the purchaser or end user.
5. Whenever additional testing is required, the results of those tests must be reported to the purchaser.

11. Chemical analysis

1. The chemical composition of each heat of steel used to produce wheels must be tested as specified in AAR M-107/M-108.
2. The chemical composition of each heat must meet the requirements specified in AAR M-107/M-208.

12. Tension testing

1. Tension testing must be performed when required by the purchaser. When such testing is specified, the testing must meet the requirements of this section.
2. Tension tests must be performed after final heat treatment.
3. Tension tests must be taken from at least one wheel in each heat treatment batch.
4. Tension test specimens must be taken from the locations specified in AAR M-107/M-208, Appendix C, or from the locations specified in EN 13262, as required by the purchaser.
5. Tension tests for ultimate tensile strength, yield strength, elongation and reduction of area must be in accordance with ASTM A370.
6. Tension test results should meet the requirements shown in **Table 2**. The values are minimums.

TABLE 2
Tension Test Minimum Results

Class	Tensile (psi)	Yield (psi)	Elongation	ROA
L	TBD	TBD	TBD	TBD
A	130,000	85,000	16%	35%
B	134,000	99,000	14%	35%
C	160,000	115,000	14%	30%
D	160,000	115,000	14%	30%

NOTE: TBD stands for "to be determined." For steel grades other than D, the AAR does not require tension testing. For mechanical properties, only hardness testing is required. The AAR's testing requirements for the approval of Grade D (referred to as Class D by the AAR) requires tension testing of AAR Class (Grade) C wheels. There it specifies tension test acceptance values for Class (Grade) C wheels. It specifies that Class (Grade) D wheel tension test results "must be no worse than Class C." The values in **Table 2** are taken from those tension test requirements.

The tension test values for wheel classes (grades) A and B were derived from a very limited amount of available data. No data was available for Class (Grade) L. Class L wheels have not been specified or produced in more than 50 years, though that class is still included in AAR M-107/M-208.

7. Tension tests must be performed at room temperature (nominally, 20 °C) on specimens that are stabilized to that temperature.

13. Hardness testing

1. Hardness testing of the rim must be as required by AAR M-107/M-208.
2. Acceptable hardness values must meet the requirements specified in AAR M-107/M-208.

14. Charpy impact testing

1. When required by the purchaser, Charpy impact testing must be performed.
2. Minimum acceptable values and test conditions must be defined by the purchaser.
3. Charpy testing must be performed as specified in ASTM E23.

NOTE: Additional *reference* information regarding Charpy impact testing can be found in ASTM A370.

15. Fracture toughness testing

1. When required by the purchaser, fracture toughness testing must be performed.
2. Fracture toughness testing must be performed as specified in ASTM E399.
3. The frequency for fracture toughness testing must be specified by the end user.

NOTE: Fracture toughness testing is relatively expensive in that it requires the destruction of an entire wheel. For this reason, the frequency for testing is left to the discretion of the end user.

4. At least three specimens, removed from a single wheel at approximately 120 deg. Spacing, must be tested.

5. For all steel classes, the test specimen location and orientation, as well as the test temperature, must be as specified in either AAR M-107/M-208, Appendix C, "Authorization for Class D Wheel Test Allotment," or EN 13262, "Railway applications — Wheelsets and bogies — Wheels —Product requirements."
6. The acceptable minimum values for KQ fracture toughness must meet the requirements shown in **Table 3**. All values are in units of ksi-in^{½}.
    a. The Class column is the heat treatment grade and chemistry class.
    b. The Average column is the average of the three specimens.
    c. The Minimum column is the minimum for each of the three specimens.

NOTE: Fracture toughness testing includes a validity test to determine whether the result is a pure plain-strain fracture toughness (K_{Ic}). The geometry of a wheel's rim limits the test sample size such that it will fail some of the validity tests. Consequently, a pure plain-strain result cannot be achieved. Because of this limitation, KQ values are used as the fracture toughness value.

TABLE 3
Fracture Toughness Minimums

Class	Average (ksi-in½)	Minimum (ksi-in½)
A	TBD	TBD
B	55	50
C	55	50
D	45	TBD
L	TBD	TBD

NOTE: See the note in section 11 for an explanation of "TBD."

16. Tread profiles

1. Wheel tread profiles must meet the requirements of APTA PR-M-S-015-06.
2. Wheel tread profiles other than those defined in APTA PR-M-S-015-06 may be used when specified by the end user.

17. Dimensional tolerances

1. Dimensional tolerances must meet the requirements of **Table 4**. These tolerances apply to vehicle design speed up to 160 mph or (250 kph).
    a. Tier I values apply to vehicle design speeds up to and including 125 mph (200 kph).
    b. Tier II values apply to vehicle design speeds greater than 125 mph (200 kph) and up to 160 mph (250 kph).

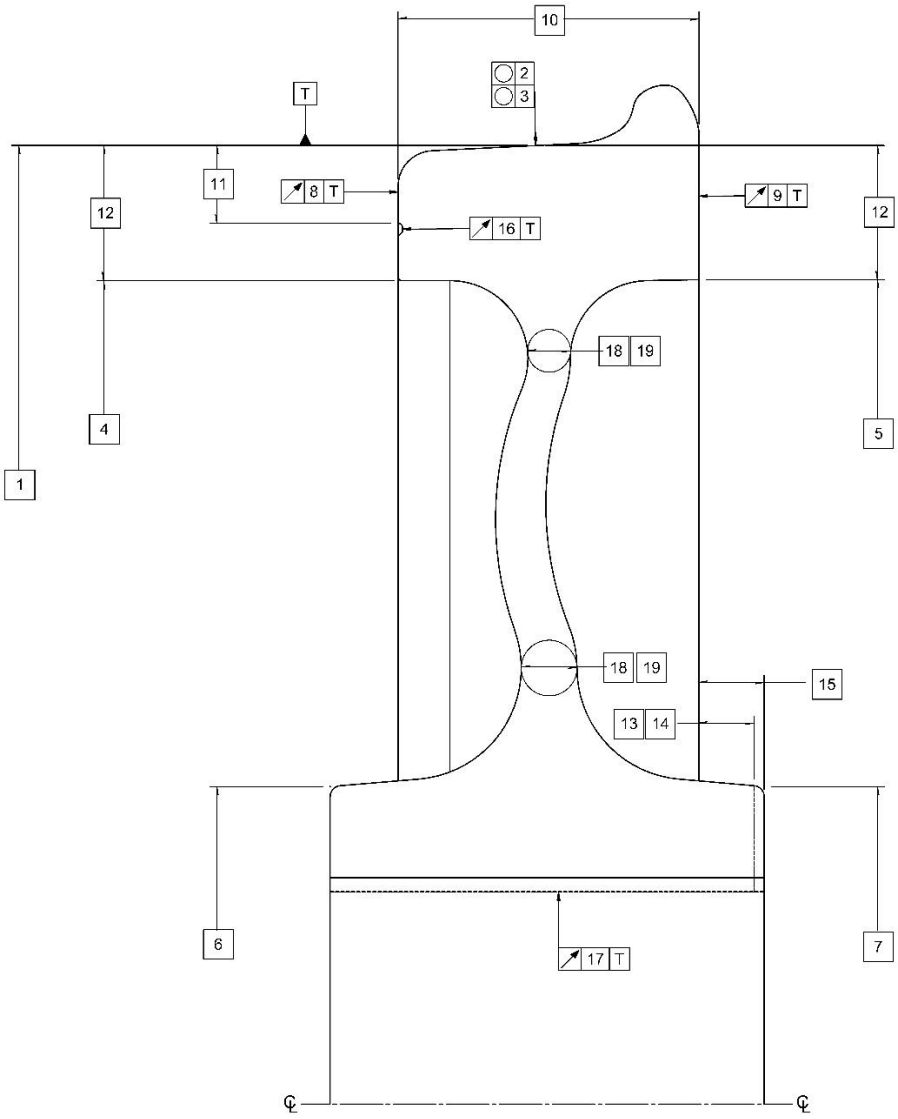
TABLE 4
Dimensional Tolerances Table

Ref.	Dimension	+ U.S. (in.)	− U.S. (in.)	+ Metric (mm)	− Metric (mm)
1	Diameter	0.020	0.000	0.500	0.000
2	Tread circularity, Tier I (<125 mph)	0.008	0.000	0.200	0.000
3	Tread circularity, Tier II (>125 mph)	0.004	0.000	0.100	0.000
4	Inside diameter, front rim	0.000	0.125	0.000	3.000
5	Inside diameter, back rim	0.000	0.125	0.000	3.000
6	Outside diameter, front hub	0.200	0.000	5.000	0.000
7	Outside diameter, back hub	0.200	0.000	5.000	0.000
8	Axial runout, front rim face	0.008	0.000	0.200	0.000
9	Axial runout, back rim face	0.008	0.000	0.200	0.000
10	Rim width	0.010	0.000	0.250	0.000
11	Rim thickness when measured to wear limit groove	0.020	0.020	0.500	0.500
12	Rim thickness when measured at front or back rim face	0.315	0.000	8.000	0.000
13	Back hub projection, outboard bearing WSA, finished	0.040	0.000	1.000	0.000
14	Back hub projection, inboard bearing WSA, finished	0.008	0.000	0.200	0.000
15	Back hub projection, rough, relative to finished projection	0.125	0.080	3.000	2.000
16	Radial runout, wear limit reference groove to tape line	0.020	0.000	0.500	0.000
17	Radial runout, rough bore relative to tape line	0.008	0.000	0.200	0.000
18	Plate thickness minimum, forged condition	0.315	0.000	8.000	0.000
19	Plate thickness minimum, machined condition	0.200	0.000	5.000	0.000

NOTE: See ASME Y14.5 for tolerance and dimension terminology and standards.

2. Rim thickness (G_F and G_B) may be specified relative to either the front or back rim face. The rim thickness is the radial distance along the rim face relative to the tape line. Specification of the rim thickness at the back rim is preferred.
3. The inside diameters of both the front and back rims should be specified the same—i.e., the same diameter and the same tolerance.
4. **Figure 3** provides a reference for dimensional tolerances.

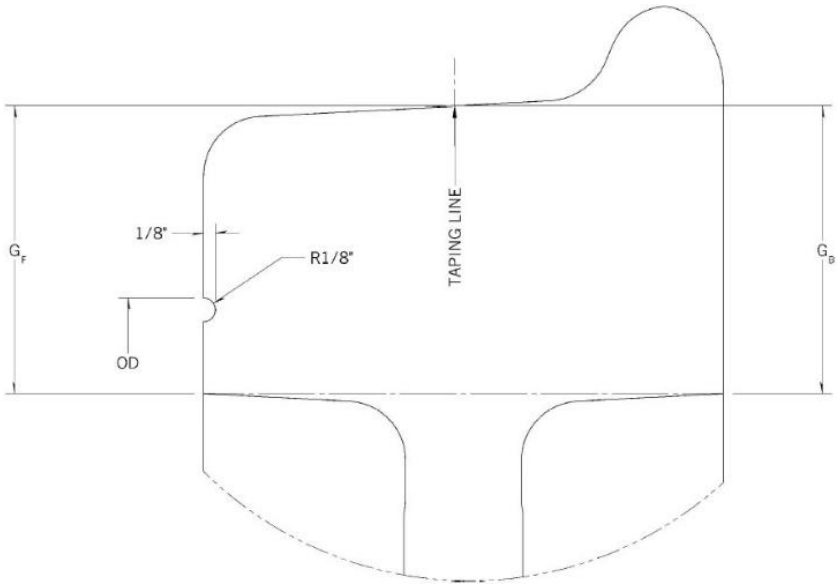
FIGURE 3
Dimensional Tolerances for Wheels



18. Wear limit reference grooves

1. The wear limit reference groove diameter is the outside diameter (OD) of the groove, not its inside diameter (ID).
2. Wear limit reference grooves must be as shown in **Figure 4**.

FIGURE 4
Wear Limit Reference Groove and Rim Thickness



3. Wear limit reference grooves must be located on the front rim face.
4. Wear limit reference groove runout must be measured relative to the tape line.
5. The tolerance for the outside diameter of each groove is ±0.008 in. (0.200 mm).
6. The location of the outside diameter edge of wear limit reference grooves must be as specified in **Table 5** for the nominal inch-sized wheel diameters shown unless otherwise specified by the end user.

TABLE 5
Wear Limit Reference Groove Locations

Ref.	Wheel ∅	Rim	Groove OD (in.)
1	28	2½	24.000
2	29	2½	25.000
3	30	2½	26.000
4	32	2½	28.000
5	33	2½	29.000
6	34	2½	30.000
7	34½	2½	30.500
8	36	2½	32.000
9	40	2½	36.000
10	41	3	36.000
11	42	2½	38.000
12	42	3½	36.000
13	43	3	38.000
14	44	2½	40.000
15	45	3	40.000

NOTE: Generally, wear limit reference grooves OD should be located such that the nominal rim thickness less half of the difference between the wheel nominal diameter and the reference groove is equal to ½".

19. Wheel balance requirements

NOTE: Note that the unbalance of the two wheels of any particular wheel set assembly will not have an offsetting effect when mounting those unbalances 180 deg. Apart radially. The wheel separation is too great for an offset in balance to take place. Mounting the heavy locations 180 deg. Apart radially will result in an oscillating dynamic unbalance—i.e., two separate planes of unbalance.

Mounting two wheels with their heavy positions aligned will produce an in-phase dynamic unbalance—i.e., an in-phase "thumping" at the axial alignment of the two planes of unbalance—while the mounting of two wheels with their unbalance heavy positions at 180 deg. Opposite will produce a cyclic side-to-side oscillation of the wheel set assembly.

Mounting a cheek disc (heavy) unbalance 180 deg. Opposite the wheel's (heavy) unbalance will have an offsetting effect since both are acting in the same plane.

1. Wheel unbalance must be measured statically.

   NOTE: The terms "static unbalance" and "dynamic unbalance" are often misused. The terms "static" and "dynamic" are not related to whether or not the wheel is spun during testing, but rather the number of planes analyzed during testing. Static balance refers to balance in a single plane while dynamic balance applies to balance in more than one plane.

2. Wheel unbalance must be specified in units of gram-meters (g-m) unless otherwise specified by the purchaser.

NOTE: Since brake discs, particularly cheek discs, are commonly supplied with their unbalances in gram-meter units, using that same unit for wheel unbalance is helpful in estimating the net unbalance of the wheel-cheek disc combination.

3. Wheel unbalance may be measured relative to the finish-machined tread outside diameter or to the finish-machined bore.
4. Wheel unbalance may be measured relative to the finish-machined bore using an arbor placed in the bore so that the wheel is rotated by the arbor. The runout at the wheel tread shall not exceed 0.012 in. (0.30 mm) when rotated using a bore arbor.
5. Wheels must have a maximum residual unbalance (g-m) as shown in **Table 6**.

TABLE 6
Wheel Maximum Unbalance Requirements

Max. mph	Unbalance max. (g-m)
125	125
160	75

NOTE: The unbalance requirements specified here are taken from EN 13262.

6. Corrections required to the finished wheel machining necessary to achieve the unbalance requirements must be carried out in accordance with EN 13262, Annex E.
7. The wheel unbalance in units of gram-meters must be marked on the front or back rim face at the heavy location. Impact stamping is not acceptable for marking the unbalance. The marking must be of sufficient durability to last until the wheels are mounted.

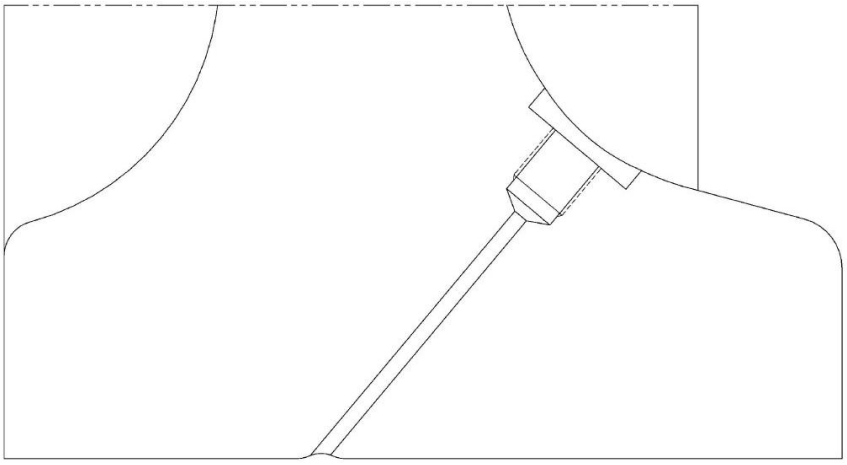
20. Hydraulic assist ports and grooves

NOTE: Hydraulic assists can be used to minimize damage to axle seats during removal of components. Extremely high pressure, approximately 250 MPa, is applied to one or more annular grooves in the bore of the component. This high pressure expands the hub of the component, breaking its fit with the seat and greatly reducing the force required for dismounting.

The pressurized expansion of the component's bore will fall to zero when the annular groove clears the edge of the seat from which the component is being dismounted. However, an advantage to the use of the assist will still exist since the seat will receive a coating of lubricant, i.e., the hydraulic fluid, which aids in minimizing the force required for removal and minimizing potential scoring of the seat. The annular groove in the bore of the component is usually located near the axial centerline of the component's bore when a single groove is utilized.

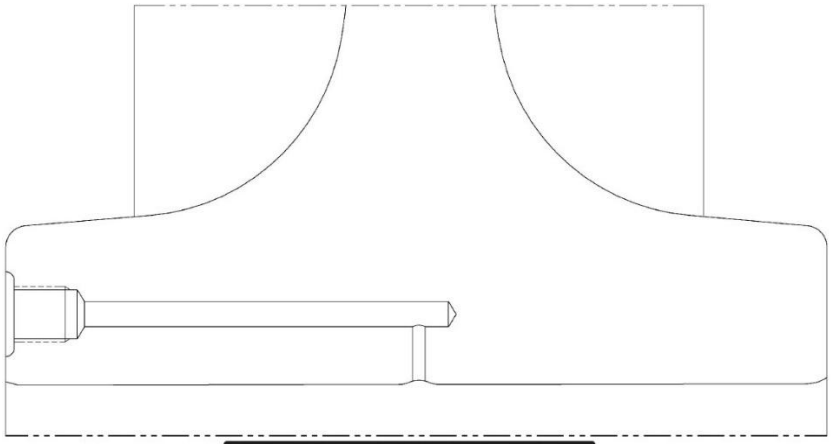
1. Wheels may have a hydraulic assist port with an annular bore groove to assist in the dismounting of wheels from axles.
2. The hydraulic assist port must intersect an annular groove machined into the finished bore.
3. Hydraulic assist ports may be machined into the wheel hub at the approximate mid-radius of either the front or back hub fillet, as shown in **Figure 5**.

FIGURE 5
Wheel Hub Showing Angled Hydraulic Assist Port



4. Hydraulic assist ports may be machined into the hub parallel to the axis of the bore at the front or back hub at the approximate midline of the hub wall as shown in **Figure 6**.

FIGURE 6
Wheel Hub Showing Hub Face Hydraulic Assist Port



5. Dimensions for the annular groove and the threaded assist ports should be as shown in **Figure 7**, **Figure 8**, **Figure 9** and **Figure 10**. The dimensions are millimeters.
6. The depth of the annular groove may be either 1 or 2 mm.

FIGURE 7
Annular Groove

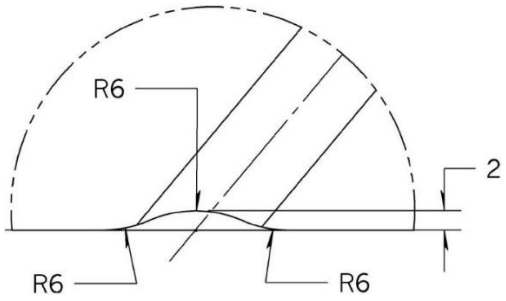


FIGURE 8
Hub Fillet Assist Port Dimensions

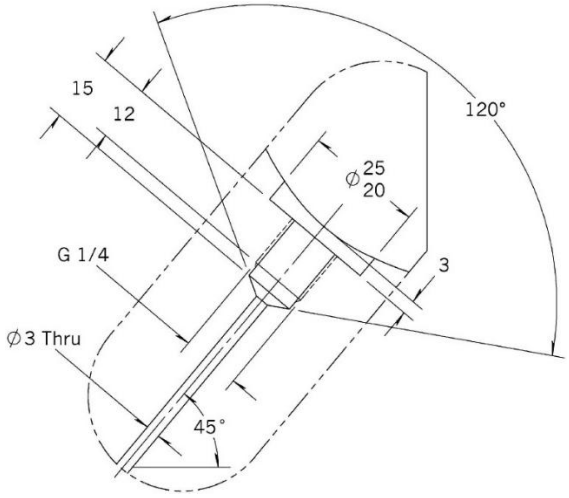


FIGURE 9
Hub Face Hydraulic Assist Port Dimensions

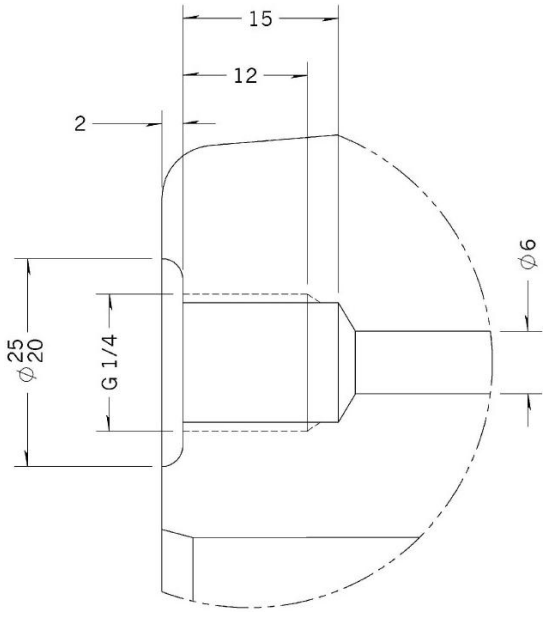
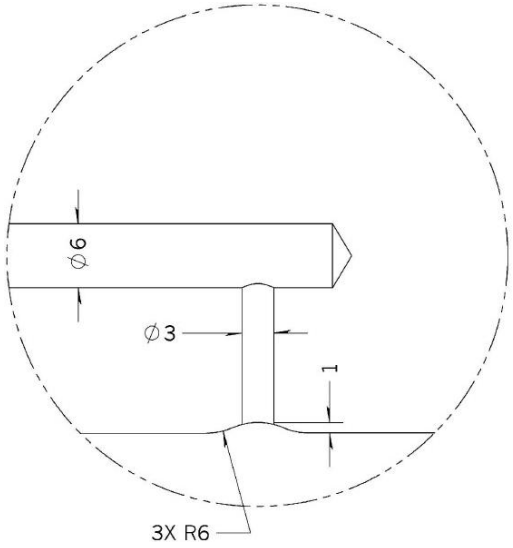


FIGURE 10
Hub Face Port Passageway Intersection with Annular Groove



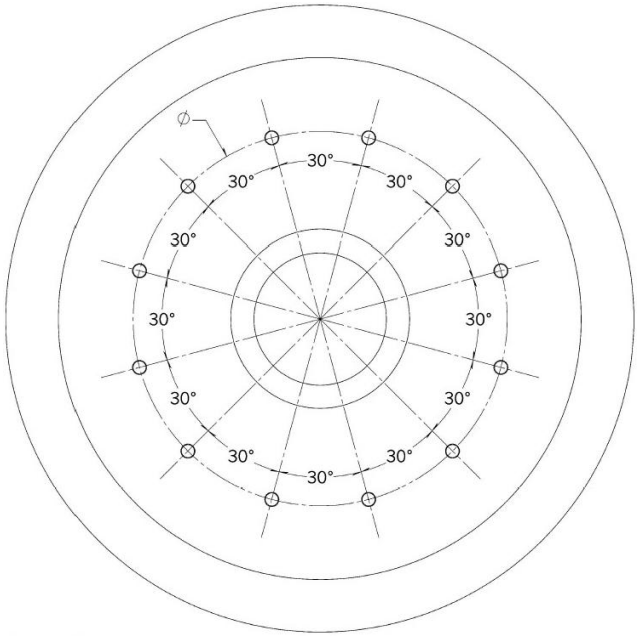
NOTE: The specified thread is British Standard Pipe Parallel (BSPP). Do not confuse this thread with ¼-18 NPT. Hydraulically assisted removal of wheels is accomplished using extremely high pressures, in the approximate range of 30,000 to 35,000 psi (200 to 250 MPa). The oil injection equipment commonly available to generate such pressures utilizes BSPP fittings.

7. Hydraulic assist ports must utilize BSPP G¼-19 threads.
8. The location of the threaded portion of the port should be chosen for easy access during wheel maintenance operations.

21. Cheek discs

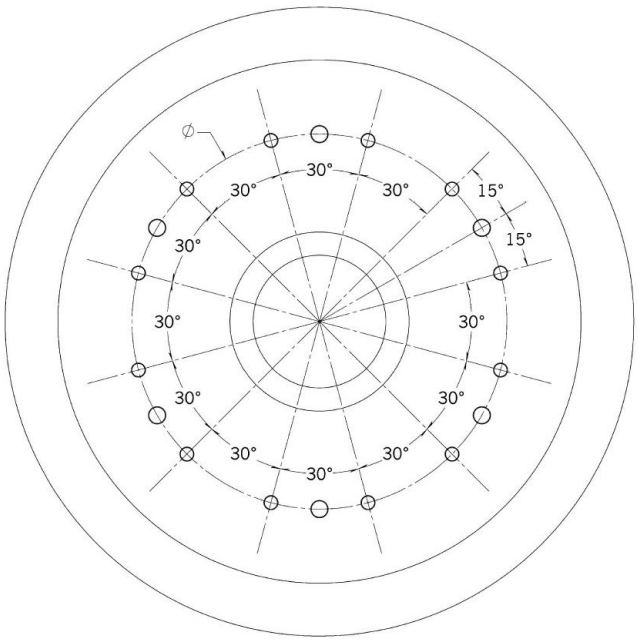
1. The plates of wheels may have thru holes for the attachment of cheek discs.
2. Wheel plates must be machined flat and parallel on the front and back plates over the flat disc-shaped surface that serves as the interface with the cheek discs.
3. Wheel plates should utilize 12 equally spaced thru holes for the attachment of discs to the wheel as shown in **Figure 11**.

FIGURE 11
Wheel Showing Thru Holes Without Centering Pin Holes



4. When wheel plates require thru holes for cheek disc centering alignment pins, these holes must be placed on the same hole diameter as that used for attachment of the discs to the wheel.
5. When holes for centering alignment pins are required, these holes, six of them, should be located midway between alternate pairs of brake disc attachment holes (on the same diameter), as shown in **Figure 12**.

FIGURE 12
Wheel Showing Thru Holes and Centering Pin Holes



6. The attachment bolt thru hole circle should be as shown in **Table 7** and **Table 8**. Nominal wheel diameters are shown in inches for AAR class wheels and millimeters for metric wheels. All bolt hole circle diameters are millimeters.

TABLE 7
Thru Hole Bolt Circles (Inch Wheel Designs)

AAR	Nominal Wheel ∅ (in)	Hole Circle ∅ (mm)
1	36	578
2	40	714
3	44	790

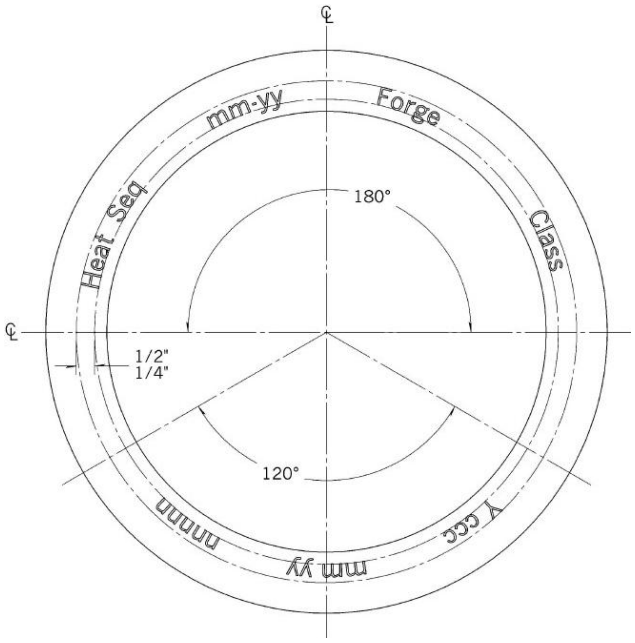
TABLE 8
Thru Hole Bolt Circles (Metric Wheel Designs)

Metric	Nominal Wheel ∅ (mm)	Hole Circle ∅ (mm)
A	900	580

22. Identification marking

1. All wheels must be marked for identification.
2. Wheel identification markings must be made on either the front or back hub face whenever practical.
3. Wheel identification markings may be made on the back rim face. When stamping is used for identification markings on the back rim face, low-stress stamps must be used.
4. The height of wheel marking characters for hub labeled wheels must be between ¼ and ½ in. (inclusive), or between 6 and 12 mm (inclusive).
5. The height of wheel marking characters for rim labeled wheels must be between ½ and 1 in. (inclusive), or between 12 and 25 mm (inclusive).
6. The marking arrangement for wheels that are produced and manufactured by the same entity may be as specified in AAR M-107/M-208.
7. Wheels that are manufactured by an entity other than the wheel producer must have identification marking as shown in **Figure 13**. This marking arrangement applies to both hub-marked and rim-marked wheels.

FIGURE 13
Wheel Hub Face Showing Marking Pattern and Spacing



Forge Information Markings	
Heat Seq	Forge heat and sequence number or serial number
mm-yy	Forge month and year
Forge	Forge AAR code
Class	Wheel AAR class

Manufacturer Information Markings	
Y-ccc	Manufacturer AAR shop code preceded by Y-
mm-yy	Manufacture month and year
nnnnn	Manufacturer's serial number

8. Markings must be separated from one another so that each identification marking is clearly defined.
9. The 180 deg. Marking section is reserved for identification information for the producer of the wheel.
10. The 120 deg. Marking section is reserved for identification information for the wheel manufacturer.
11. The two 30 deg. Sections should be left blank to allow a clear separation of producer versus manufacturer information.
12. When the producer and manufacturer are the same entity, wheel markings maybe as specified above, or as specified in AAR Manual of Standards and Recommended Practices, Section G.

23. Damping ring grooves

1. Damping rings may be installed on wheels to aid in noise reduction.

   NOTE: A damping ring, when properly installed and maintained, can typically reduce the noise produced by the wheel in operation by up to 3.0 dB. To be effective, damping rings must be able to vibrate freely in their grooves—i.e., independently of the wheel.

2. Damping ring nominal cross-sectional diameters must be either ½ in., 14 mm or 16 mm.
3. Prior to roll forming, damping rings' cross-sectional diametrical tolerance must be ±0.006 in. for ½ in. nominally sized rings, and ±0.15 mm for 14 mm and 16 mm nominally sized rings.

NOTE: To meet the requirements of this paragraph, the specified standard metric tolerance for the 14 mm groove radius, g_R, is JS13.

To meet the requirements of this paragraph, the specified standard metric tolerance for the 16 mm groove radius, g_R, is JS13, as specified in ASME B4.2, *Preferred Metric Limits and Fits*.

4. Damping rings may be welded end to end after installation in accordance with EN 15085. Other similar welding specifications which isolate the weld to the ring and prohibit welding on the wheel may be employed.
5. Damping ring grooves may be machined in either, or both, the front and back rim fillets of a wheel, close to the rim faces.
6. Damping ring grooves should be as shown in **Figure 14**, **Figure 15** and **Figure 16** below.

FIGURE 14
Damping Ring Grooves

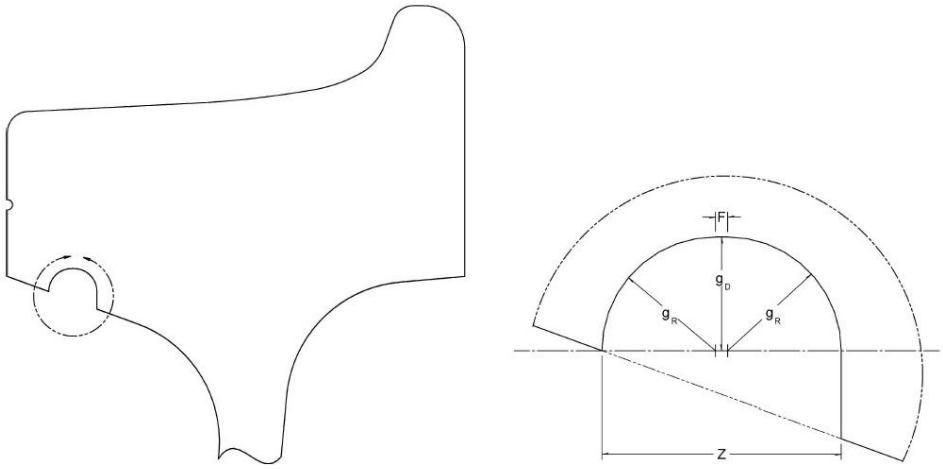


FIGURE 15
Damping Ring Grooves

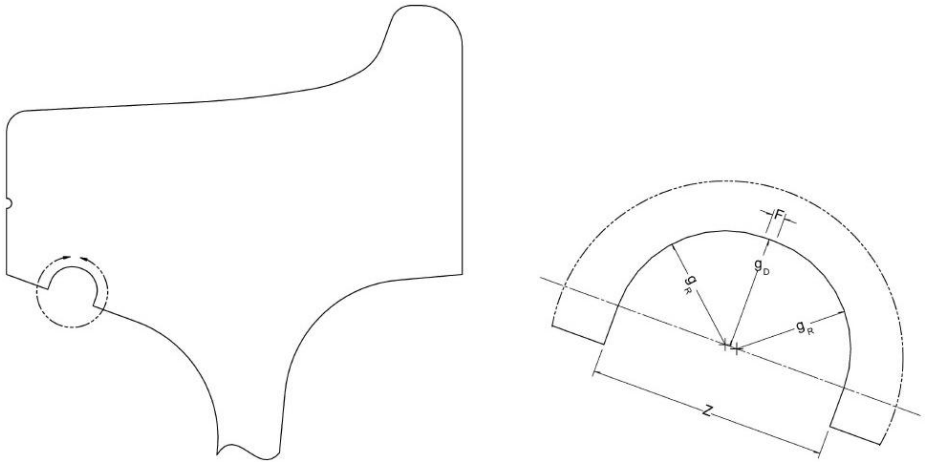
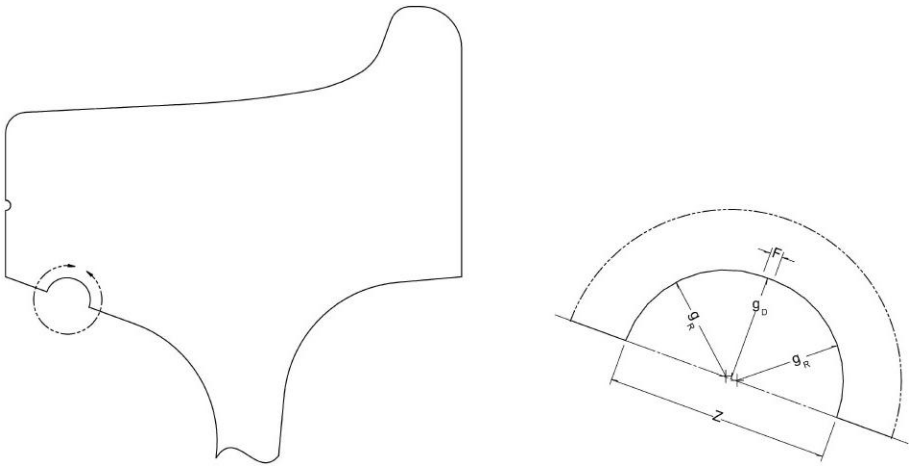


FIGURE 16
Damping Ring Grooves



Groove dimensions and tolerances are shown in **Table 9**. The units shown are inches for the ½ in. nominal-sized ring and millimeters for the 14 mm and 16 mm nominal-sized rings.

TABLE 9
Groove Dimensions and Tolerances

½ in.	Min.	Max.
gR	0.250	0.260
gD	0.250	0.260
F	0.008	0.016
Z	0.508	0.536

14 mm	Min.	Max.
gR	7.000	7.250
gD	7.000	7.250
F	0.200	0.400
Z	14.200	14.900

16 mm	Min.	Max.
gR	8.000	8.250
gD	8.000	8.250
F	0.250	0.450
Z	16.250	16.950

Related APTA standards

APTA PR-M-S-015-06, "Wheel Flange Angle for Passenger Equipment"

References

American Society of Mechanical Engineers standard:

ASME B4.2	Preferred Metric Limits and Fits
ASME Y14.5	Dimensioning and Tolerancing

Association of American Railroads standard:

AAR M-107/M-208 Wheels, Carbon Steel

ASTM International standards:

A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
E23	Notched bar impact test, Charpy & Izod
E399	Standard Test Method for Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials
E1019	Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques
F1113	Standard Test Method for Electrochemical Measurement of Diffusible Hydrogen in Steels (Barnacle Electrode)

European Standard

EN 13262, Railway applications – Wheelsets and bogies – Wheels – Product requirements
EN 15085, Railway applications – Welding of railway vehicles and components

Abbreviations and acronyms

BSPP	British Standard Pipe Parallel
dB	decibels
g-m	gram-meters
ID	inside diameter
MPa	megapascal
OD	outside diameter
ppm	parts per million
psi	pounds per square inch
ROA	reduction of area
TBD	to be determined

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	Rail CEO Approval	Policy & Planning Approval	Publish Date
First published	—	—	—	March 4, 1999	March 17, 1999
First revision	—	—	—	October 30, 2002	Jan. 11, 2003
Second revision	—	—	—	—	Feb. 13, 2004
Third revision	July 2, 2024	August 30, 2024	October 20, 2024	Feb. 9, 2025	Feb. 10, 2025

