SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Off-Road Tire and Rim Classification - Off-Road Work Machines

RATIONALE

This SAE Recommended Practice is revised to include updates and revisions appropriate for the tires and rims classified for off-road work machines. The updates and revisions are consistent with tire and rim industry standards.

FOREWORD

Technological advances in earthmoving machine designs and applications have necessitated the inception of numerous special size and design tires. The proliferation of old and new terminology requires standard classifications. Specific size, capacity, and other application information should be obtained through tire and rim manufacturers and their organizations.

1. SCOPE

This SAE Recommended Practice describes the classification of off-road tires and rims for use on earthmoving machines (refer to SAE J1116), defines related terminology in common use, and shows representative construction details of component parts.

1.1 Purpose

To establish a standard nomenclature for tire classification and tire and rim components.

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 Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1015 Tonne Kilometer Per Hour Test Procedure

SAE J1098 Tonne Kilometer Per Hour Application

SAE J1116 Categories of Off-Road Self-Propelled Work Machines

2.2 Related Publications

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

For more information on this standard, visit
https://www.sae.org/standards/content/J751_202502/

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1057 Identification Terminology of Earthmoving Machines

SAE J1440 Off-Road Tire and Rim Classification - Forestry Machines

2.2.2 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 3877-1 Tyres, valves and tubes - List of equivalent terms - Part 1: Tyres

ISO 4223-1 Definition of some terms used in the tyre industry - Part 1: Pneumatic tyres

ISO 4250-1 Earthmover tyre and rims - Part 1: Tyre designations and dimensions

ISO 4250-2 Earthmover tyre and rims - Part 2: Loads and inflation pressures

ISO 4250-3 Earthmover tyre and rims - Rims

ISO 6165 Earthmoving machinery - Basic types - Vocabulary

2.2.3 Industry Standards Publications

2.2.3.1 European Tyre and Rim Technical Organisation (ETRTO) Publications

Available from the European Tyre and Rim Technical Organisation, Avenue Brugmann 32/2, B-1060, Brussels, Belgium, Tel: +32-2-344-40-59, www.etrto.org.

ETRTO Standards Manual

2.2.3.2 Japanese Automobile Tyre Manufacturers Association (JATMA) Publications

Available from the Japanese Automobile Tyre Manufacturers Association, No. 33 Mori Bldg. 8th Floor, 3-8-21 Toranomon, Minato-Ku, Tokyo, Japan, 105-0001, Tel: 81-3-3435-9094.

JATMA Year Book

2.2.3.3 Tire and Rim Association Publications

Available from Tire and Rim Association, Inc., 4000 Embassy Parkway, Suite 390, Akron, OH 44333, Tel: 330-666-8121, www.us-tra.org.

TRA Year Book

TRA Engineering Design Information

3. DEFINITIONS

3.1 TIRE DEFINITION

3.1.1 TIRE SIZE DESIGNATIONS

There are three commonly accepted designations: conventional, wide base, and three-part size designation. Note that the nominal section width reference is not a tire dimension.

3.1.1.1 CONVENTIONAL

There are two groups of tires designated as conventional.

3.1.1.1.1 The nominal section width reference ends in zero following the decimal point, for example: 24.00-29, 7.50-15NHS. The aspect ratio for these tires is approximately 0.96.

3.1.1.1.2 There is a limited group of large-diameter tires that fit on single piece drop center rims. The nominal section width reference for these tires is a two-digit number with no decimal point, for example: 27-56.5. These tires have equivalents in 3.1.1.1.1 in external dimensions and load carry capacity.

3.1.1.2 WIDE BASE

The nominal section width reference includes digits other than zero following the decimal point, and the aspect ratio is approximately 0.83, for example: 29.5-25.

3.1.1.3 THREE-PART SIZE DESIGNATION

The tire will be designated by an alphanumeric sequence: nominal section width reference, aspect ratio, nominal rim diameter code designation, tire load capacity, and service code, for example: 41.25/70-39, 40/65-39, or 50/80-57 68 PR L-4.

Some older tires of 0.65 aspect ratio may have the order reversed, for example: 65/40.

3.2 CONSTRUCTION

There are two basic tire constructions: bias ply and radial. See Figure 1.

3.2.1 BIAS PLY

A bias or diagonal ply constructed tire is designated by a hyphen (“-”) after the nominal section width reference, for example: 24.00- or 50/80-.

3.2.2 RADIAL

A radial constructed tire is designated by an upper case “R” after the nominal section width reference or aspect ratio, for example: 24.00R, 50/80R.

3.3 RIM DIAMETER CODE DESIGNATION

The rim diameter code designation follows the nominal section width reference or aspect ratio and construction indicator and specifies the appropriate diameter code rim, for example: 24.00-49, 24.00R49, 48/95R57.

3.4 TIRE LOAD CAPACITY

Tire load capacity (formerly known as “carcass strength”) is identified by three methods: ply rating (PR) for bias tires, symbol mark type of rating (e.g., star “*”) for radial tires, and Load Index.

Ply rating is an index of tire load capacity, formerly “strength,” and does not necessarily represent the number of cord plies in a tire.

Load Index is a numerical code associated with the maximum load a tire can carry at the speed indicated by its Speed Symbol under specified service conditions. See 3.5.1 and 3.5.2.

For the meaning of symbols on symbol marked tires, refer to the respective tire manufacturer or tire standards organization, e.g., The Tire and Rim Association, Inc. (TRA) Akron, OH; European Tyre and Rim Technical Organisation (ETRTO) Brussels, Belgium; Japan Automobile Tyre Manufacturers Association, Inc. (JATMA) Tokyo, Japan.

3.5 SERVICE CODE

Service code is an alphanumeric identification for off-road tires in terms of type of tire intended service and tire tread. The identification consists of a letter designating service category, followed by a numeral indicating the tread. The recommended code identification is given in Table 1.

Figure 1 - Nomenclature for off-road tires

Table 1 - Recommended code identification for off-road tires (tube or tubeless types)

Category	Tread Type	Code Number[1]
C - Compactor Service	Smooth	C-1
	Grooved	C-2
E - Earthmover Service	Rib Regular	E-1
	Traction Regular	E-2
	Regular	E-3
	Deep	E-4
	Flotation	E-7
G - Grader Service	Rib Regular	G-1
	Traction Regular	G-2
	Regular	G-3
	Deep	G-4
IND - Industrial	Regular	IND-3
	Deep Tread	IND-4
	Extra Deep tread	IND-5
L - Loader and Dozer Service	Traction Regular	L-2
	Regular	L-3
	Deep	L-4
	Extra Deep	L-5
	Smooth Regular	L-3S
	Smooth Deep	L-4S
	Smooth Extra Deep	L-5S
SH - Subterranean Haulage	Regular	SH-3
	Deep	SH-4
LHD - Subterranean Load-Haul-Dump	Regular	LHD-3
	Deep	LHD-4
	Extra Deep	LHD-5
	Smooth Regular	LHD-3S
	Smooth Deep	LHD-4S
	Smooth Extra Deep	LHD-5S

[1] Dual designation tires can also be used. (For example: E-3/L-3.)

3.5.1 COMPACTOR TIRE

Category C can be defined as a tire utilizing a wide, smooth tread surface for smooth road work and a button design for compaction in loose soils. The tires are load capacity rated for operation, basically up to 10 km/h (5 mph).

3.5.2 EARTHMOVER TIRE

Category E can be defined as a tire designed for haulage machines at medium to higher speeds. These tires are load capacity rated for short-haul operation, up to 4 km (2.5 miles) one way at a speed of 50 km/h (30 mph). They are also rated for tonne-kilometer per hour (TKPH) and ton-mile per hour (TMPH) capacity (refer to SAE J1015 and SAE J1098). For applications above 50 km/h (30 mph), follow recommendations of tire and wheel manufacturers.

A haulage cycle is where equipment self-loads or receives a load from loading equipment, then transports this load to another location and returns unloaded. Transportation usually occurs over unimproved surfaces at speeds up to 65 km/h (40 mph) and short distances, up to 4 km (2.5 miles), one way. Equipment in this category is mainly haulage trucks and scrapers.

3.5.3 GRADER TIRE

Category G can be defined as a tire which is generally provided with both a rib-type tread for resistance to lateral forces caused by blading and by turning, and with a lug-type tread having superior traction and self-cleaning abilities for operation in both soft soils and rugged terrains. These tires are load capacity rated for operations up to 40 km/h (25 mph).

For applications above 40 km/h (25 mph), follow recommendations of tire and wheel manufacturers. This is a working condition where equipment is used in construction and road maintenance. Tire loads are relatively constant during the work cycle. Equipment speeds are slow during working periods with maximum transportation speeds reaching 40 km/h (25 mph). Travel distances vary depending on work situations.

3.5.4 LOADER AND DOZER TIRE

Category L can be defined as a thick, heavy tread and sidewall tire for maximum protection against cutting. These tires are load capacity rated for operation up to 10 km/h (5 mph).

The “Loader” work cycle is where the equipment is used to pick up material and relocate a short distance away. Tire loads fluctuate depending on the conditions involved when the equipment picks up the load. Transportation speeds are low, up to 10 km/h (5 mph), and distances are short, a maximum of 76 m (250 feet), one way.

The “Dozer” work cycle is where the equipment is used to move materials (usually earth) by pushing, dragging, or grading. Tire loads are relatively constant, and speeds are low, up to 10 km/h (5 mph). Travel distances vary depending on work situations.

For applications above 10 km/h (5 mph) or distances greater than 76 m (250 feet) one way, follow recommendations of tire and wheel manufacturers.

3.6 SERVICE DESCRIPTION

The service designation, which is distinct from the size designation, consisting of the Load Index (for single load or single load/dual load, where applicable) and Speed Symbol.

3.6.1 LOAD INDEX

A numerical code associated with the maximum load a tire can carry at the speed indicated by its Speed Symbol under specified service conditions.

E.g., 188E: 188 = 10 000 kg.

3.6.2 SPEED SYMBOL

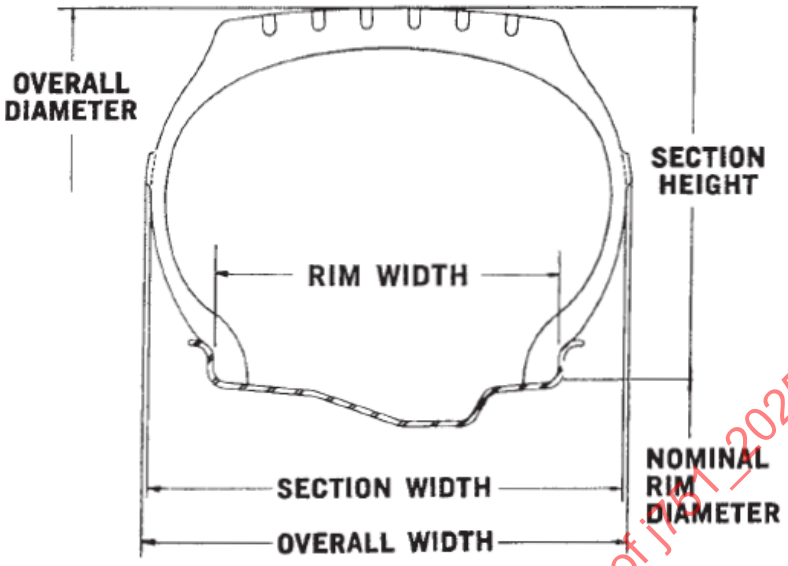
A symbol indicating the speed category at which the tire can carry a load corresponding to its Load Index under specified service conditions.

E.g., 188E: E = 70 km/h.

4. MACHINE CLEARANCES

When designing for machine clearances, the maximum dimensions for grown tires in service should be used (see Figure 2A). Where specific tire dimensions are required, the alpha dimensions and definitions in Figure 2B are the recommended nomenclature for communication with the tire manufacturer.

NEW TIRE DIMENSIONS



DEFINITION OF TERMS

Design/Measuring Rim Width - "Design/Measuring Rim Width" is the specific rim width assigned to each tire size designation to determine basic tire dimensions.

Section Width - "Section Width" is the width of a new tire, including 24-hour inflation growth and including normal sidewalls, but not including protective side ribs, bars, or decorations.

Overall Width - "Overall Width" is the width of a new tire, including 24-hour inflation growth, and including protective side ribs, bars and decorations.

Overall Diameter - "Overall Diameter" is twice the section height of a new tire, including 24-hour inflation growth, plus the nominal rim diameter.

Size Factor - "Size Factor" of an inflated tire is the sum of the section width and overall diameter.

Figure 2A - Industry method for depicting maximum dimensions for grown tires in service
Reprinted with permission of The Tire and Rim Association, Inc.

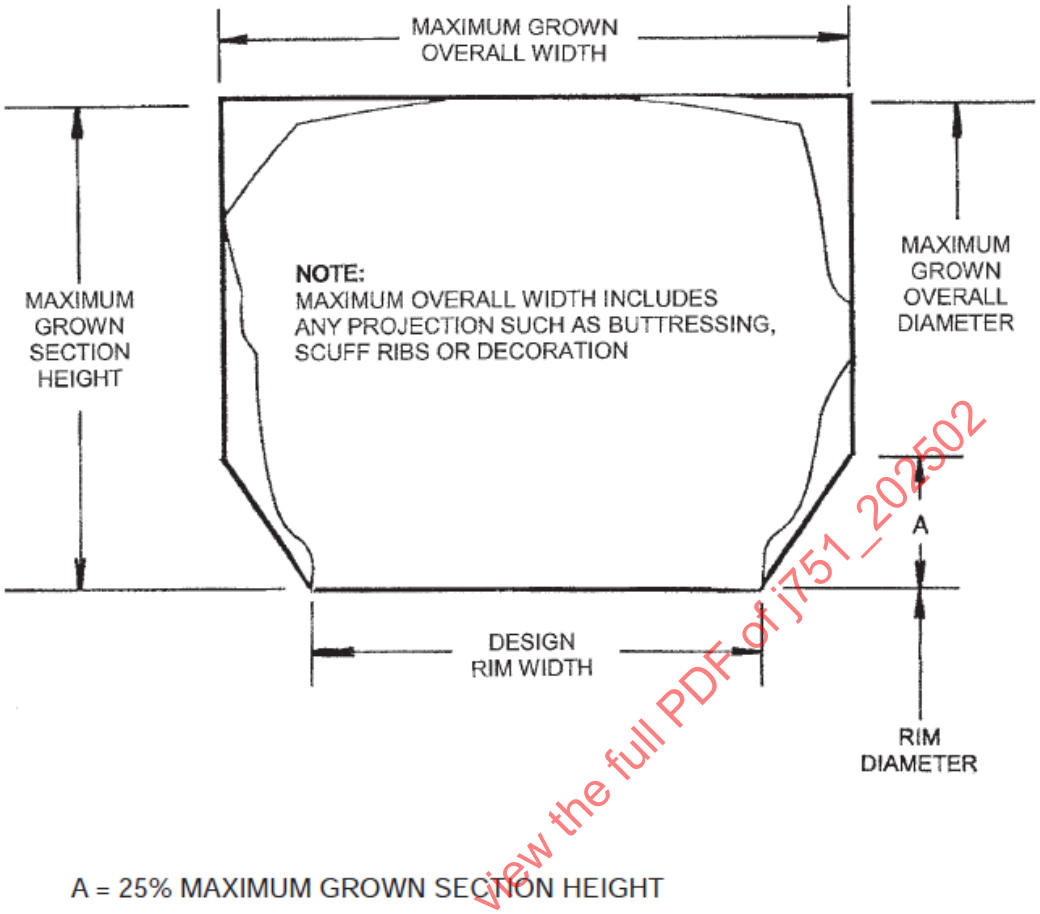


Figure 2B - Maximum envelope for grown tires in service
Reprinted with permission of The Tire and Rim Association, Inc.

5. RIM DEFINITION

The rim assembly is that part on which the tire is mounted and supported.

5.1 A multipiece off-highway rim contour is designated by a numeric or alphanumeric sequence: a rim diameter code designation, a rim width designation, can include a flange height designation, and a rim profile designation if needed (for example: 49x17.00/3.5, 24x8.00TG).

5.2 A single-piece rim contour is designated by a numeric sequence which uses rim diameter code designation and rim width designation (for example: 56.5x20.0). See 5.3 and 5.4.

5.3 Rim Width Designation

The rim width designation “A” is the width as measured by inches between flanges of the rim (for example: 17.00). See Figure 3.

5.4 Rim Diameter Code Designation

Nominal (named) rim diameter “B” for tire/rim matching (for example: 49x17.00). See Figure 3.

5.4.1 Specified Rim Diameter

The diameter of the rim as measured at the intersection point of the bead taper and the vertical tangent of the flange. See Figure 3.

For example, the diameter of the “intersection point” of the 24x8.00TG rim is 24.188, not 24.

5.4.2 Flange Height Designation

The flange height designation “C” is the height of the flange, as measured in inches from the intersection point of the bead taper and the vertical tangent of the flange contour to the horizontal tangent of the uppermost portion of the flange (for example: 49x17.00/3.5). See Figure 3.

5.4.3 Rim Profile Designation

The rim profile designation (when applicable) is one or more letters which signify the rim contour at the tire-to-rim interface. This designation is used instead of the nominal flange height designation on certain rim contours and follows the rim width (for example: 24x10.00VA, 24x8.00TG).

6. TYPICAL OFF-HIGHWAY RIM CONSTRUCTION AND COMPONENT IDENTIFICATION

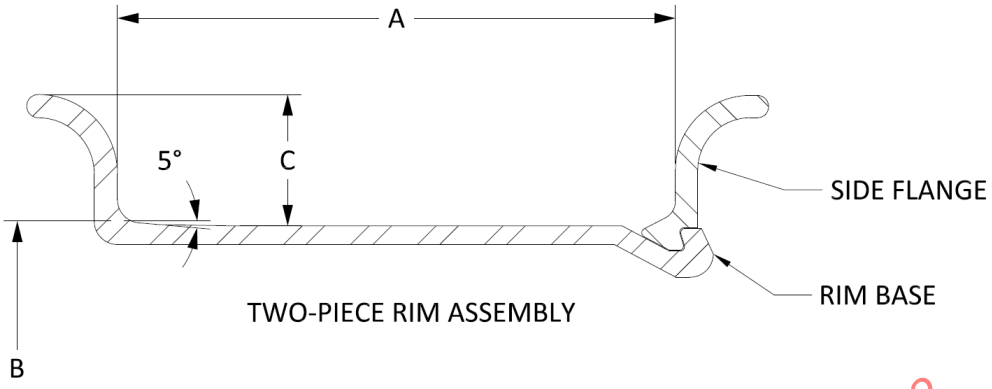
There are four types of off-highway rim constructions (note that other types may exist). See Figure 3.

6.1 The two-piece type.

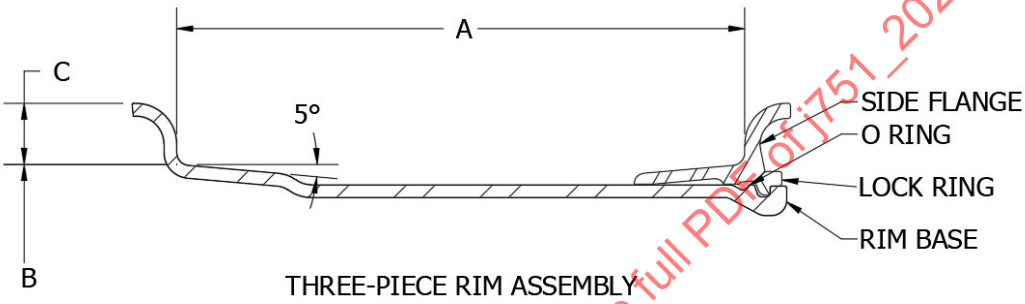
6.2 The three-piece type.

6.3 The five-piece type.

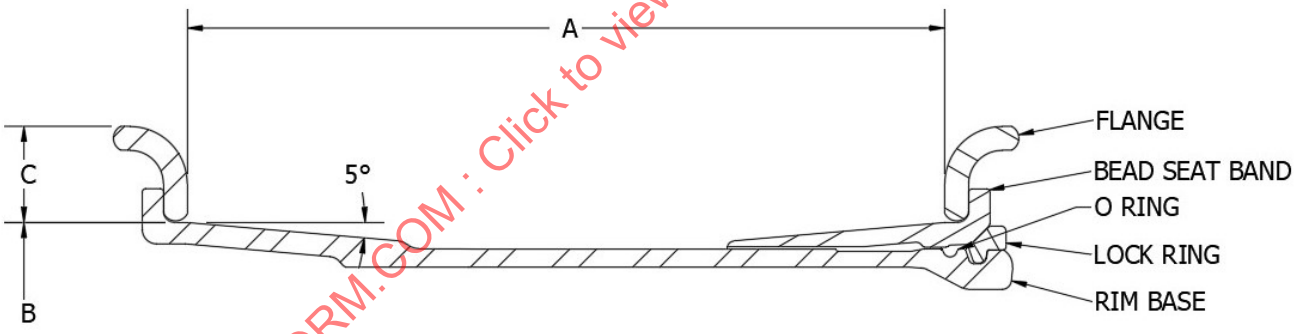
6.4 The single-piece type.



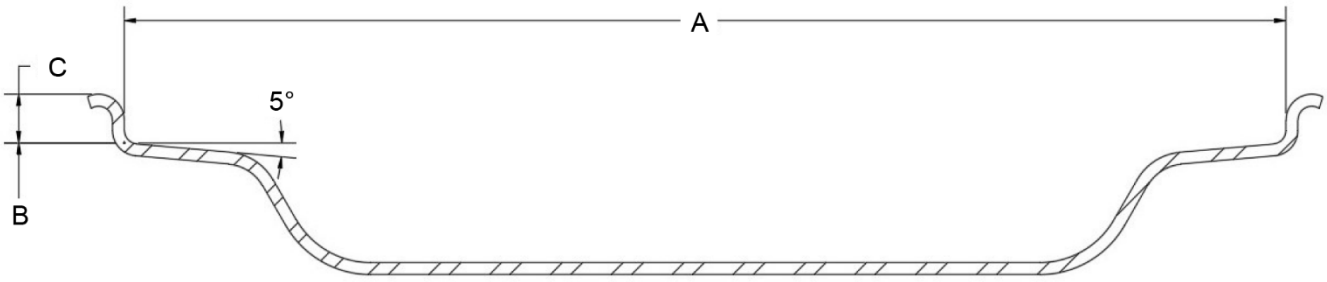
TWO-PIECE RIM ASSEMBLY



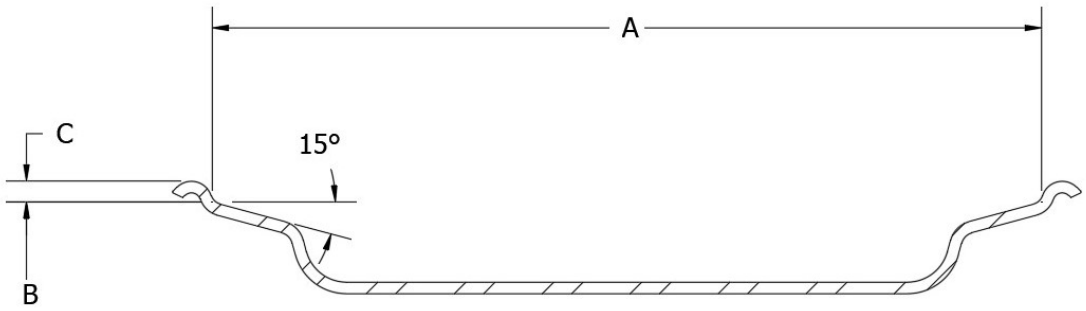
THREE-PIECE RIM ASSEMBLY



FIVE-PIECE RIM ASSEMBLY



SINGLE PIECE RIM - TYPE DH



SINGLE PIECE RIM - TYPE 15°

Figure 3 - Rim contour

7. RIM MARKING

Single-piece rims and each component of multipiece rim assemblies are identified by legible alphanumeric marking. The origin of the numeric marking is in inch units. The marking is to be visible after the tire is mounted and inflated.

7.1 Single-Piece

The single-piece rim marking consists of three digits denoting rim diameter and three digits denoting rim width (for example: 56.5-20.0).

There are also single-piece rims available for conventional and wide base tires used in Grader applications. These rims feature 5-degree bead seat tapers drop center rim contours and are designated by the rim width, followed by the letters “DC” (for example: 9.00DC, 12.00DC, 13.00DC, 14.00DC).

7.2 Multipiece

The five-piece assembly is the only multipiece construction for which a standard method of component marking is established, as detailed in 7.2.1 through 7.2.5. Consult rim manufacturers’ catalogs for the marking of other rim constructions.

CAUTION: Rim components are not necessarily interchangeable; therefore, consult rim manufacturers for proper matching and assembly instructions.

7.2.1 Rim Base Marking

The rim base marking consists of a prefix letter “B,” denoting a rim base, followed by two digits denoting rim width, two digits denoting rim diameter code, and one or more numbers or letters denoting rim type or style designation. In cases where the rim design width contains decimal fractions, the decimal portion is deleted from the rim marking. The rim type or style designation indicates certain design details or features of the rim assembly and does not relate to the tire-to-rim contour. The use and meaning of the suffix letters and numbers is at the discretion of the rim manufacturer.

EXAMPLE: B1751 HDTD
B1533 EM

7.2.2 Bead Seat Band Marking

The bead seat band marking consists of prefix letters “BB” and two or three digits, followed by one or more letters. The “BB” denotes bead seat band. The latter two digits denote nominal rim diameter. Where a third digit is present, it denotes the bead seat taper width to the smallest whole inch. The suffix letters denote type or style designations.

EXAMPLE: BB35 HTG
BB25 STN
BB425 EMO
BB539 EH

7.2.3 Flange Marking

The flange marking consists of a prefix letter, usually “S,” “H,” or “R,” followed by four digits. The prefix letter denotes flange. The first two digits denote flange height to the nearest tenth of an inch, and the last two digits denote nominal rim diameter code. Suffix letters, when shown, denote type or style.

EXAMPLE: H5051
H5063HMS
S3535 E
S4049 HS

7.2.4 Lock Ring Marking

The lock ring marking consists of letters “LR,” denoting lock ring, followed by two digits denoting the nominal rim diameter code, and one or more letters denoting type or style.

EXAMPLE: LR29 HTM
LR49 EML

7.2.5 O-Ring Marking

The O-ring marking consists of the prefix letters “OR,” followed by three digits and one or more letters. The prefix letters denote O-ring. The first digit indicates cross section diameter in eighths of an inch. The latter two digits denote nominal rim diameter code. The suffix letters denote type or style.

EXAMPLE: OR329EM