



PRODUCT CATEGORY RULES (PCR)

For preparing an Environmental Product Declaration (EPD)
for the Product Category:

TIRES

VERSION 3.05 (NOVEMBER 2017)

VALID THROUGH (NOVEMBER, 2023)

Product Category Rules (PCR) for preparing an Environmental Product Declaration (EPD) for the Product Category: Tires, UL 10006

Third Edition, Dated July 1, 2022

Summary of Topics

The Third Version of the Product Category Rules (PCR) for preparing an Environmental Product Declaration (EPD) for the Product Category: Tires, UL 10006 has been issued.

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Versions overview

Version	Description	History
1	TIP_ULE_PCR_for_Tires_v14-3 for Phase 1a Pilot, Version by UL Environment with input from external committee	October 2015
2	TIP_ULE_Quantis_PCR for Tires 2017-01-31, Version updated by Quantis after PCR pilot testing by committee members	January 2017
2.01	TIP_ULE_Quantis_PCR for Tires 2017-02-07, Version updated by Quantis	February 2017
3	TIP_ULE_Quantis_PCR for Tires 2017-03-31, Version updated by Quantis, with the following modifications: implementation of feedbacks received from other program operators (JEMAI and the International EPD® System), implementation of technical improvements, inclusion of bus specifications	March 2017
3.01	TIP_ULE_Quantis_PCR for Tires 2017-04-14, Version updated by Quantis with the implementation of technical improvements by committee members, submitted to open consultation and external review	April 2017
3.02	TIP_ULE_Quantis_PCR for Tires 2017-06-08, Version updated by Quantis with the implementation of comments from open consultation and external review (JEMAI and the International EPD® System), submitted to UL Environment external review	June 2017
3.03	TIP_ULE_Quantis_PCR for Tires 2017-06-28, Version updated by Quantis with the implementation of comments from external review (UL Environment), implementation of technical improvements (product grouping)	July 2017
3.04	TIP_ULE_Quantis_PCR for Tires 2017-11-01, Version updated by Quantis with implementation of updated rules for product grouping	November 2017
3.05	Version updated to align with updated approaches, information, and research, and to add consistency including: - Use stage calculation improvement related to vehicle efficiencies	July 2022

	- Updated and added datasets for fuel combustion emissions related to different energy sources - Updated energy source distribution - Default datasets for raw materials - Updated data points related to tire and road wear particles - Updated impact assessment methods and categories	
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Editor's Notes:

These Product Category Rules are global in scope and serve both B2B and B2C applications, reflecting the global manufacturing, distribution networks, and use of these products. Updates to this PCR are anticipated as advances in scientific research and EPD application advance.

The PCR development committee was comprised of members from the following organizations:

- Bridgestone Corporation
- Continental AG
- Cooper Tire & Rubber Company
- The Goodyear Tire & Rubber Company
- Hankook Tire & Technology Co., Ltd.
- Kumho Tire Company Inc.
- Manufacture Française des Pneumatiques Michelin
- Pirelli & C.
- Quantis
- Sumitomo Rubber Industries, Ltd.
- Toyo Tire & Rubber Co., Ltd.
- UL Environment
- WBCSD
- The Yokohama Rubber Co., Ltd.

The first PCR external review was conducted by:

- Dr. Thomas Gloria, Industrial Ecology Consultants, Chair
- Dr. Amy Landis, Clemson University
- Dr. Stefan Hausberger, Graz University of Technology
- Dr. Michael Hauschild, Technical University of Denmark
- Mr. Mamoru Yanagisawa, Japan Gas Appliances Inspection Association
- Dr. JoongWoo Ahn, Sungshin University

The PCR external review report is available upon request at ul.pcr@ul.com.

The PCR was also submitted to review by other program operators, including:

- Mr. Akira Kataoka, JEMAI
- Mr. Kristian Jelse, The International EPD® System

A second PCR external review was conducted from April 2017 by:

- Dr. Thomas Gloria, Industrial Ecology Consultants
- Dr. Michael Hauschild, Technical University of Denmark
- Mr. Mamoru Yanagisawa, Japan Gas Appliances Inspection Association

In addition, the PCR was reviewed by the Technical Committee of the International EPD® System in accordance with the General Program Instructions. The output of the review is that the current PCR is accepted, and can thus be adopted into the PCR library of the International EPD® System. The review panel members were:

- Maurizio Fieschi (review chair)
- Paola Borla
- Adriana Del Borghi
- Hüdai Kara
- Lars-Gunnar Lindfors
- Barbara Nebel
- Andrew Norton
- Claudia A. Peña

An addendum PCR, to be used with this document, has also been developed by the EcoLeaf program in Japan (Eco-Design Office, ecodesign@jemai.or.jp). This PCR document and the addendum PCR were reviewed by external panel.

Questions on the present document shall be addressed to Anne-Cécile Remont (Remont@wbcsd.org) and Elisa Pesce (Pesce@wbcsd.org), WBCSD Tire Industry Project.

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1 General Information

The intended application of this Product Category Rules (PCR) document is to provide guidance for developing Environmental Product Declarations (EPDs) for tires and to pinpoint the underlying requirements of a Life Cycle Assessment (LCA) pursuant to ISO standards that address appropriate environmental aspects of the tire life cycle. The user of this PCR will be manufacturers of tires and other interested parties and will enable EPDs that support comparable, informed, and objective evaluation of tires.

This document was developed under the UL Environment EPD Program, operating in conformance with ISO 14025:2006 and the following international standards:

- ISO 14040, LCA - Principles and procedures
- ISO 14044, LCA - Requirements and guidelines

The rules and requirements of the UL EPD Program are defined in the UL General Program Instructions, available at: <http://industries.ul.com/environment/transparency/product-category-rules-pcrs>.

This PCR is valid for tires used in passenger vehicle, light truck, medium and heavy truck, pick-up, city and school bus, coaches, aircraft, off-the-road vehicles and motorcycle as further described in Section 2.1. This PCR is global in scope and presents a harmonized calculation procedure for tire-attributed vehicle use stage emissions.

Impacts reported in EPDs created using this PCR are only related to tires and shall not be used to compare to vehicle performance in other reported contexts beyond this PCR scope. This PCR shall not be used to represent the tire industry and/or individual tire company impacts on the whole given certain equations presented in this document could overestimate the environmental impact of tires (e.g. the amount of rubber in wear loss).

This Product Category Rules (PCR) document has been developed as part of the Tire Industry Project (TIP) of the World Business Council for Sustainable Development (WBCSD) with the aim to promote the development and the use of Environmental Product Declarations (EPD) for the tire industry around the world.

In order to address certain regional differences, this document provides different rules and options for users in different regions. The International EPD® System in Sweden has validated that this PCR document can be adopted into the PCR library of the International EPD® System. Addendum PCR, to be used with this document, has also been developed by the EcoLeaf program in Japan.

- Ecoleaf program: Eco-Design Office (ecodesign@jemai.or.jp)
- The International EPD® System: Mr. Kristian Jelse (kristian@environdec.com)

1.1 Committee Members

PCR version 3.04, published in November 2017.

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PCR version 3.05, published in June 2022.

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1.2 Acknowledgements

The committee would like to acknowledge the European Tyre and Rubber Manufacturer's Association (ETRMA) for the use of tire research and data to inform the development of this PCR.

1.3 Identification of Tire Product

This PCR covers commercially available, new, pneumatic tires, both tube type and tubeless, for use on conventional passenger cars, light trucks, medium to heavy trucks, pick-up, city and school buses, coaches, and similar vehicles normally operated on public roads and highways. This PCR also covers commercially available, special application light truck tires for operation on non-improved road surfaces, off-the-road tires, motorcycle tires, and aircraft tires. This PCR includes various sub-categories according to the following tire type:

- Passenger car/ light truck
- Medium/heavy truck (Commercial),
- Pick-up bus,
- City bus,
- School bus,
- Coach,
- Motorcycle,
- Off-the-road, and
- Aircraft tires

These tires are subject to the standards or technical approvals shown under Section 2.4.6. Additional rules around tire performance are provided for each tire sub-category.

1.3.1 UNSPSC Code

The following code covers the range of this rule: 25172500 (Tires and tire tubes)

1.4 Geographic Coverage

This PCR is global in scope and was developed in English. Regions of applicability include:

- China
- Europe
- Japan
- South Korea
- Latin America (including Mexico)
- North America
- Rest of World (ROW)
 - Middle East/ Africa
 - Oceania
 - Russia
 - Asia - Others
 - Taiwan

1.5 Period of Validity

This document is effective for five (5) years from the latest date of publication. If relevant changes in LCA methodology or other relevant considerations for the product category occur, the document will be revised.

1.6 Public Comment

In accordance with the UL Environment General Program Instructions, this PCR is made freely available for public comment for at least one calendar month and open to all public comments. Identifiable sources are addressed and responses will be posted.

1.7 PCR Review Panel

The first PCR external review was conducted by:

- Dr. Thomas Gloria, Industrial Ecology Consultants, Chair
- Dr. Amy Landis, Clemson University
- Dr. Stefan Hausberger, Graz University of Technology
- Dr. Michael Hauschild, Technical University of Denmark
- Mr. Mamoru Yanagisawa, Japan Gas Appliances Inspection Association
- Dr. JoongWoo Ahn, Sungshin University

In addition, the PCR was also submitted to review by other program operators, including:

- Mr. Akira Kataoka, JEMAI
- Mr. Kristian Jelse, The International EPD® System

A second PCR external review of the document was conducted from April 2017 by:

- Dr. Thomas Gloria, Industrial Ecology Consultants
- Dr. Michael Hauschild, Technical University of Denmark
- Mr. Mamoru Yanagisawa, Japan Gas Appliances Inspection Association

In addition, the PCR was reviewed by the Technical Committee of the International EPD® System in accordance with the General Program Instructions. The output of the review is that the current PCR is accepted, and can thus be adopted into the PCR library of the International EPD® System. The review panel members were:

- Barbara Nebel (review chair)
- Paola Borla
- Adriana Del Borghi
- Hüdai Kara
- Lars-Gunnar Lindfors
- Barbara Nebel
- Andrew Norton
- Claudia A. Peña
- Nasser Ayoub

An addendum PCR, to be used with this document, has also been developed by the EcoLeaf program in Japan (Eco-Design Office, ecodesign@jemai.or.jp). This PCR document and the addendum PCR were reviewed by external panel.

1.8 Public Commenters

For the first open consultation, comments were received from:

- Japan Automobile Tyre Manufacturers Association (JATMA)

For the second open consultation (on the version 3.01), comments were received from:

- U.S. Tire Manufacturers Association (USTMA)
- European Tyre & Rubber Manufacturers' Association (ETRMA)

1.9 Other Tire Product Category Rules

Two existing PCRs for tires were reviewed and used to inform this PCR development process: The Taiwanese PCR for New Pneumatic Tyres (November 2013, developed by the Taiwan Rubber and Elastomer Industries Association) and the Korean PCR for Tires for passenger

cars. Additionally, the Japan Automobile Tyre Manufacturers Association (JATMA) Tyre Life Cycle CO₂ Calculation Guidelines (April 2012) was used to inform this PCR.

1.10 LCA Study References

In developing this PCR, the committee reviewed several LCA studies of tires, including:

Continental AG 2000. Life Cycle Assessment of a Car Tire.

Corti and Lombardi 2004. End life tyres: Alternative final disposal processes compared by LCA. Energy 29 (2004) 2089–2108.

Feraldi, Cashman et al. 2012. Comparative LCA of treatment options for US scrap tires: material recycling and tire-derived fuel combustion. The International Journal of Life Cycle Assessment. 03/2012; 18(3). DOI: 10.1007/s11367-012-0514-8

Fiksel, Bakshi et al. 2011, Comparative life cycle assessment of beneficial applications for scrap tires. Clean Technologies and Environmental Policy. February 2011, Volume 13, Issue 1, pp 19-35

Li, Xingfu, He Xu et al. Comparison of end-of-life tire treatment technologies: A Chinese case study. Tianjin: Elsevier, 2010, Waste management, Vol. 30, pp. 2235-2246.

Van Beukering, P. J. H. and M. A. Janssen. 2000. A Dynamic Integrated Analysis of Truck Tires in Western Europe. Journal of Industrial Ecology 4(2): 93-115.

2 Goal and Scope

The intended application of this Product Category Rules (PCR) document is to give guidance for developing Environmental Product Declarations (EPD) for tires and to outline the requirements of a Life Cycle Assessment (LCA) report used to inform the EPD. The users of this PCR will be manufacturers of new tires and other interested parties. This PCR is valid for tires used in passenger vehicle, light truck, medium and heavy truck, pick-up, city and school bus, coaches, aircraft, off-the-road vehicles and motorcycle as further described in Section 2.1.

This PCR addresses the cradle to end of life environmental impacts of tires and conforms with ISO 14025, Environmental labeling and declarations – Type III environmental declarations – Principles and procedures. The reporting of additional information as shown under Section 6.2 is permitted. The environmental impacts are calculated using attributional LCA methodology. The life cycle stages excluded from the scope are the following:

- Installation (corresponding to module A5, as described in Section 3.2);
- Transport of the assembled product to the consumer (corresponding to module A6, as described in Section 3.2), i.e. the transport of the vehicles on which the tire is mounted;

- Maintenance (corresponding to module B2, as described in Section 3.2), i.e. tire cleaning, inspection, inflation, rotation, balancing, and alignment;
- Repair (corresponding to module B3, as described in Section 3.2), i.e. repair of the tire over the reference service life. This includes routine patching and other standard repair processes;
- Removal (corresponding to module C1, as described in Section 3.2), i.e. the removal of the tire from the vehicle, including on-site sorting of materials;
- Capital equipment manufacture;
- Personnel impacts;
- Infrastructures;
- Vehicle & rim production, maintenance and end of life;
- Road production, maintenance and end of life.

Impacts reported in EPDs created using this PCR are only related to tires and shall not be used to compare to vehicle performance in other reported contexts or tire categories not covered in the PCR scope.

An EPD prepared under this PCR will present data that have been aggregated over the information modules.

Table 1. Tire product EPD types

EPD type	Declared Unit or Functional Unit	Life Cycle Stages/Information modules	Reference Service Life (RSL)	Primary audience
Cradle to factory gate + end of life	Declared unit	Modules A1-A3, C1-C3, as described in Section 3.2	Not specified	Business-to-business (B to B)
Cradle to grave	Functional unit	Modules A1-A6, B1-B4, C1-C3, as described in Section 3.2	RSL is required	Business to business (B to B) and/or Business to consumer (B to C)

The comparability of EPD of tire products will be in accordance with the requirements for comparability as described in ISO 14025, Section 5.6,

“Type III environmental declarations are intended to allow a purchaser or user to compare the environmental performance of products on a life cycle basis. Therefore, comparability of Type III environmental declarations is critical. The information provided for this comparison shall be transparent in order to allow the purchaser or user to understand the limitations of comparability inherent in the Type III environmental declarations.

Type III environmental declarations not based on an LCA covering all life cycle stages, or based on different PCR, are examples of declarations that have limited comparability. Type III environmental

declarations based on the same PCR but based on different impact and inventory results are examples of declarations that have limited comparability.”

This PCR allows comparison only for the same size, same load index category (as per Table 28), and same tire-sub categories according to Section 2.1 for passenger car and light truck. This PCR allows comparison only for the same size, same load index, and same tire sub-categories according to Section 2.1 for truck and bus. In particular, dual tires are not comparable with a single wide based tire.

If multiple plants are producing the same product, the average performance of the manufacturing plant locations shall be taken into account.

2.1 Tire Sub-Categories

Tire category definitions are provided to assist the user in identifying the most appropriate and applicable requirements within this global tire PCR. If the intended tire application is not specifically represented by a category and region provided, the user may select the most representative category or region. All tires referenced in Sections 2.1.1 - 2.1.14 shall be in conformance with ISO TC 31 Standards.

If the tire has been developed for a specific vehicle, this information may be reported in Section 6.1 and the results may be additionally reported under Section 6.2 as supplemental information.

2.1.1 Passenger Car Tire

A pneumatic tire for power-driven vehicles having at least four wheels, used for the carriage of passengers, and designed to seat no more than nine persons. Typically, these are vehicles classified in category M₁ of the World Forum for Harmonization of Vehicle Regulations. This category, for example, includes tires for passenger vehicles in North America designed to exceed 20 mph (32 km/h) and licensed for use on public roads (e.g. not golf cart tires).

2.1.2 Light Truck Tire

A pneumatic tire for power driven vehicles having at least four wheels used for the carriage of passengers and cargo (i.e. pick-up truck or light van). Typically, these are vehicles classified in category N₁ or the smaller vehicles in category N₂ of the World Forum for Harmonization of Vehicle Regulations.

Table 2. Gross Weight (metric tonnes) ranges for Vehicles in the Light Truck Category¹

China		Europe	Japan	South Korea		Latin America (LA)	North America (NA)	UN World Forum (N ₁) / Rest of World (ROW)
<u>Small</u>	≤ 1.8	≤ 3.50	≤ 5	<u>Small</u>	≤ 3.50	≤ 3.50	≤ 6.35	≤ 3.50
<u>Light truck</u>	$\begin{matrix} > 1.8 \\ \leq 6 \end{matrix}$			<u>size truck</u>				

2.1.3 Pick-up and Delivery Truck Tire

A pneumatic tire for trucks used for local service or carriage of retail product. Typically, these are the larger vehicles classified in category N₂ of the World Forum for Harmonization of Vehicle Regulations.

Table 3. Gross Weight (metric tonnes) ranges for Vehicles in the Pick-up and Delivery Truck Category¹

China		Europe	Japan	South Korea		LA	NA	UN World Forum (N ₂) / ROW
Medium size truck	$\begin{matrix} > 6 \\ \leq 14 \end{matrix}$	$\begin{matrix} > 3.5 \\ \leq 12 \end{matrix}$	$> 5 \leq 11$	Medium size truck	$\begin{matrix} > 3.50 \\ < 10 \end{matrix}$	$> 3.50 < 12$	$> 6.35 \leq 20$	$> 3.5 \leq 12$

2.1.4 Long Haul Truck Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for carriage of cargo primarily on highways. Typically, these vehicles are classified in category N₃ of the World Forum for Harmonization of Vehicle Regulations.

¹ The sources are the following : China : MarkLines Data Center (https://www.marklines.com/en/vehicle_production/search_note), Europe : DIRECTIVE 2007/46/EC - ANNEX II (N1), Japan : Road Traffic Law, South Korea: Expert judgement, LA and NA : Estimated based on UN classifications and using manufacturer information about common vehicles

Table 4. Gross Weight (metric tonnes) ranges for Vehicles in the Long Haul Truck Category¹

China		Europe	Japan	South Korea		LA	NA	UN World Forum (N ₂) / ROW
Large size truck	> 14	> 12	> 11	Large size truck	≥ 10	> 12	> 20	> 12

2.1.5 Regional/City Truck Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for carriage of cargo on both highways and improved intra city roads. Typically, these vehicles are classified in category N₃ of the World Forum for Harmonization of Vehicle Regulations.

Table 5. Gross Weights (metric tonnes) ranges for Vehicles in the Regional / City Truck Category¹

China		Europe	Japan	South Korea		LA	NA	UN World Forum (N ₃) / ROW
Large size truck	> 14	> 12	> 11	Large size truck	≥ 10	> 12	> 20	> 12

2.1.6 Mixed Service Truck Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for carriage of cargo on and off improved roads. Typically, these vehicles are classified in category N₃ of the World Forum for Harmonization of Vehicle Regulations.

Table 6. Gross Weights (metric tonnes) ranges for Vehicles in the Mixed Service Truck Category¹

China		Europe	Japan	South Korea		LA	NA	UN World Forum (N ₃) / ROW
Large size truck	> 14	> 12	> 11	Large size truck	> 10	> 12	> 20	> 12

2.1.7 Pick-up Bus Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for local transport of passengers. Typically, these vehicles are classified in category M2 of the World Forum for Harmonization of Vehicle Regulations. Typical applications would be shuttle buses or community services. The buses are often minivans which are designed primarily for passengers with two or three rows of seating accessed via large (often sliding) doors. They have a greater height than sedan or station wagon counterpart. Their interior is often re-configurable with flexible or removable seating. In international markets, the minivan is classified as multi-purpose vehicle (MPV) or people carrier.

Table 7. Gross Weights (metric tonnes) ranges for Vehicles in the Pick-up Bus Category²

China	Europe	Japan	South Korea ³	LA	NA	UN World Forum (M2) / ROW
< 5	< 5	>3.5 =<6	< 5	>3.5 and <12	<4.5	< 5

2.1.8 City Bus Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for local transport of passengers. Typically, these vehicles are classified in category M3 of the World Forum for Harmonization of Vehicle Regulations. Typical applications are large and medium city buses as well as articulated buses. Their service is generally based on a regular operation along a route calling at agreed bus stops according to a published timetable. City buses can operate within the city as well as between the city and local suburban areas. City buses are designed to provide space for passengers to stand-up during the trip.

² The sources are the following : China : same as Europe, Europe : http://www.hbefa.net/e/documents/HBEFA_31_Docu_hot_emissionfactors_PC_LCV_HDV.pdf and <http://www.transportpolicy.net/index.php?title=EU: Vehicle Definitions>, Japan : http://www.meti.go.jp/committee/sougouenergy/shoene_shinene/sho_ene/jidosha_wg/2016/pdf/001_03_00.pdf, South Korea: same as Europe, LA : OEM literature, Law 9503 Compilado (Brazil), and DNIT: <http://www.dnit.gov.br/download/rodovias/operacoes-rodoviaras/pesagem/qfv-2012-abril.pdf>, and NA : Internal knowledge, manufacturer information, APTA "An Analysis of Transit Bus Axle Weight Issues.

³ For South Korea the classification shall be based on length instead of weight as per national classification rules. As a proxy, the same values as Europe were used for gross weight ranges.

Table 8. Gross Weights (metric tonnes) ranges for Vehicles in the City Bus Category²

China	Europe	Japan	South Korea ³	LA	NA	UN World Forum (M2) / ROW
> 5	> 5	>6	> 5	>3.5	>4.5	> 5

2.1.9 School Bus Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for local transport of passengers and carrying students and school kids to and from school and related events. Typically, these vehicles are classified in category M3 of the World Forum for Harmonization of Vehicle Regulations. Typical applications are pick-up buses for school kids. This service is largely, but not exclusively, limited to the US.

Table 9. Gross Weights (metric tonnes) ranges for Vehicles in the School Bus Category²

China	Europe	Japan	South Korea ³	LA	NA	UN World Forum (M3) / ROW
N/A	N/A	N/A	N/A	N/A	>8.2	> 5

2.1.10 Regional/Inter-city Coach Bus Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for regional transport of passengers on both highways and improved intra city roads. Typically, these vehicles are classified in category M3 of the World Forum for Harmonization of Vehicle Regulations. Regional and inter-city coach buses are used for excursions and for longer-distance services like inter-city. Unlike city busses, designed for shorter journeys, coaches often have a luggage compartment that is separate from the passenger cabin and are normally equipped with facilities required for longer trips, including comfortable seats and sometimes a toilet. In coach buses the passengers are required to have a seat for the journey.

Table 10. Gross Weights (metric tonnes) ranges for Vehicles in the Regional/Inter-city Coach Category²

China	Europe	Japan	South Korea ³	LA	NA	UN World Forum (M3) / ROW
≤ 18	≤ 18	>14	≤ 18	> 10	> 20	> 5

2.1.11 Long Haul Coach Bus Tire

A pneumatic tire for power driven vehicles with four or more wheels, used for transport of passengers, mainly on highways. Typically, these vehicles are classified in category M3 of the World Forum for Harmonization of Vehicle Regulations. Long-haul coach buses are often multi-axle buses that have more than the conventional two axles, usually three axles, or more rarely, four axles. Extra axles are usually added for legal weight restriction reasons, or to accommodate different vehicle designs such as articulation, or rarely, to implement trailer buses.

Long Haul coach buses are used for longer-distance services like international travel. Coaches often have a luggage compartment that is separate from the passenger cabin and are normally equipped with facilities required for longer trips, including comfortable seats and sometimes a toilet. In coach buses the passengers are required to have a seat for the journey.

Table 11. Gross Weights (metric tonnes) ranges for Vehicles in the Long Haul Coach Category²

China	Europe	Japan	South Korea ³	LA	NA	UN World Forum (M3) / ROW
≤ 18	≤ 18	>14	≤ 18	> 10	> 20	> 5

2.1.12 Motorcycle Tire

A pneumatic tire designed for a two or three wheeled vehicle powered by a motor. Typically these vehicles are classified in Category L of the World Forum for Harmonization of Vehicle Regulations.

2.1.13 Off-the-Road Tire

A pneumatic tire designed for heavy equipment intended primarily for use off improved roads, such as for construction and mining applications. Typically, these vehicles are classified in Category G of the World Forum for Harmonization of Vehicle Regulations.

2.1.14 Aircraft Tire

A pneumatic tire designed for use on aircraft for landing, takeoff and taxiing.

2.2 System Function

The function of a tire is to provide friction between the ground and a vehicle to support a vehicle's safe movement. A tire is a ring-shaped covering that fits around the rim of a wheel and also serves to protect the wheel, improve a vehicle's acceleration, braking performance, driving performance and reduce the shock caused by surface irregularities. In this PCR, the term "new pneumatic tires" does not include retreaded tires.

This PCR uses functional and declared units, depending on the scope of the EPD. Section 3.1 discusses these units and defines them for the tire product category.

2.3 Definitions and Acronyms

For the purposes of this document, the following definitions and acronyms apply:

Background Process

A process other than a foreground process; a process not under direct operational control of a manufacturer with contributing data which may not be directly measured by the manufacturer.

CNG Compressed Natural Gas

Driving Cycle

Driving cycles are standardized driving conditions that duplicate the driving behavior and conditions experienced by a person operating a vehicle. Driving cycles are produced by different countries and organizations to assess vehicle performance attributes, such as fuel consumption and polluting emissions.

DU Declared Unit

Quantity of a tire for use as a reference unit description in an EPD not covering the full life cycle.

DQR Data Quality Rating

Methodology, criteria and matrix used to calculate the score estimating the quality of a data or of a dataset.

Drive tire

Drive-axle tires are the tires mounted and installed on the powered axle(s) of a commercial vehicle. May be used in conjunction with steer and trailer tires on commercial trucks.

Ecosphere flow

A flow directly to and from nature.

ELT End of Life Tire

A tire that can no longer be used for its original purpose; all tires including passenger car, truck, aircraft, motorcycle and off-road tires result in ELTs.

ETRMA

European Tyre & Rubber Manufacturers' Association

ETRTO

European Tyre and Rim Technical Organisation

Feedstock Energy

Heat of combustion of a raw material input that is not used as an energy source to a product system, expressed in terms of higher heating value or lower heating value [ISO 14044].

Foreground Process

A process under operational control of the EPD owner. Foreground processes includes data collected by the owner of the EPD, e.g., raw materials amount and processing, energy consumed and waste generated during the manufacturing stage, direct emissions of the facility under operational control of the EPD owner.

FU Functional Unit

Quantified performance of a tire for use as a reference unit description in an EPD based on LCA [ISO 14025].

Information Module

Compilation of data to be used as a basis for a Type III Environmental Declaration, covering a unit process or a combination of unit processes that are part of the life cycle of a product [ISO 14025].

ISO

International Organization for Standardization

JATMA

Japan Automobile Tyre Manufacturers Association

KOTMA

Korea Tire Manufacturers Association

LA

Latin America

LCA Life Cycle Assessment

Calculation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle [ISO 14040].

LCI Life Cycle Inventory

Phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle [ISO 14040].

LCIA Life Cycle Impact Assessment

Phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product [ISO 14040].

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. The load index is unitless.

LPG Liquid Petroleum Gas

LHV Lower Heating Value

The amount of heat released by combusting a specified quantity of material (initially at 25°C or another reference state) and returning the temperature of the combustion products to 150°C. The lower heating value (LHV) (net calorific value (NCV) or lower calorific value (LCV)) is determined by subtracting the heat of vaporization of the water vapor from the higher heating value. This treats any H₂O formed as a vapor. The energy required to vaporize the water therefore is not released as heat.

LHV calculations assume that the water component of a combustion process is in vapor state at the end of combustion, as opposed to the higher heating value (HHV) which assumes that all of the water in a combustion process is in a liquid state after a combustion process.

NA

North America

PM Particulate matter

The term "particulate matter" (PM) includes both solid particles and liquid droplets found in air. Many manmade and natural sources emit PM directly or emit other pollutants that react in the atmosphere to form PM.

Particles less than 10 micrometers in diameter are called (PM₁₀).

Particles less than 2.5 micrometers in diameter are termed (PM_{2.5}) and are sometimes referred to as "fine" particles.

Process Energy

Energy input required for operating the process or equipment within a unit process, excluding energy inputs for production and delivery of the energy itself [ISO 14044].

Product Category

Group of products that can fulfill equivalent functions [ISO 14025].

TRAC

Rubber Association of Canada

RECICLANIP

Brazilian tire collection and recycling association

Regrooving

Process that extends the life of a tire by carving out the rubber in the grooves of a tire to create additional tread. Often performed before retreading and lowers a tire's profile thickness and reduces rolling resistance.

Retreading

Retreading also known as "recapping," or "remolding" is a re-manufacturing process for tires that replaces the tread on worn tires. Retreading is the process whereby partly-worn tires, receive an additional tread in order to extend their useful service life. It also includes modifying other parts of the tire, such as the outermost sidewall surface or the protective ply. In this PCR, retreading impacts shall only be considered for commercial truck tires and are optionally reported in supplemental information.

ROW

Rest of the World

RSL Reference Service Life

Service life of a product which is known to be expected under a particular set, i.e. a reference set, of in-use conditions and which may form the basis of estimating the service life under other in-use conditions. The reference service life (RSL) of a tire is based on several types of tests to ensure the safety, durability, and mileage of the product.

RR Rolling resistance

Sometimes called rolling friction or rolling drag, rolling resistance is the force resisting motion when a tire rolls on a surface. It is mainly caused by non-elastic effects in that not all energy needed for deformation or movement of the tire is recovered when the pressure is removed.

RR_c Rolling resistance coefficient

The ratio of the rolling resistance of the tire (expressed in Newtons) to the load of the tire (expressed in Kilonewtons). The coefficient is dimensionless.

Steer tire

Steer tires are the front two tires on a commercial truck and used to steer the vehicle.

Specific data

Data representative of a product, product group or construction service, provided by one supplier.

Technosphere flow

A flow related to economic activity; any flow not taken directly from the earth (ecosphere).

Tire Wear Loss

Tire wear loss is the weight of tire tread expected to be lost due to the friction between the tire and road surface.

Trailer tire

Trailer axle tires are mounted and installed on non-powered axles of the trailer of a commercial vehicle.

TRWP Tire and road wear particles

Tire and road wear particles (TRWP) are tiny particles that are produced by the friction between tires and the road surface, often referred to as abrasion. These particles are a mixture of tire tread and road pavement material.**Type III Environmental Declaration, Environmental Product Declaration (EPD)**

Providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information [ISO 14025].

Unit Process

Smallest portion of a product system for which data are collected when performing a life cycle assessment.

USTMA

U.S. Tire Manufacturers Association

UTQG

Uniform Tire Quality Grading. Established in the US by the National Traffic Safety Administration (NHTSA) in 49 CFR 575.14. A UTQG rating consists of a treadwear grade, traction grade, and temperature grade.

2.4 Description of company/organization and product

2.4.1 Description of company/organization

The EPD will set forth the name of the manufacturing company/organization as well as the place(s) of production. The EPD may include general information about the company/organization, such as the existence of quality systems, according to ISO 9001, or environmental management systems, according to ISO 14001 or any equivalent recognized standard, or any other management system in place.

2.4.2 Description of product and technical description

The EPD will provide a brief narrative description of the product or product line in a manner that enables the user to clearly identify the product.

2.4.3 Product identification

The EPD shall include product identification by brand name, by model name, and by simple visual representation, which may be by photograph or graphic illustration. Commercial tires shall be identified by steer, drive, or trailer position.

2.4.4 Specifications

Tire specifications shall be provided according to the following designation using appropriate references from the Tire and Rim Association (TRA), the European Tyre and Rim Technical Organization (ETRTO), the Tire and Rim Association of Australia (TRAA), the Japan Automobile Tyre Manufacturer's Association (JATMA), the Korea Tire Manufacturers Association (KOTMA), the Associacao Latino Americana de Pneus e Aros (ALAPA), the South African Bureau of Standards (SABS), or the ISO product specification (ISO TC 31), including pertinent physical properties and technical information.

Tire designation (some of the tire designation may be from the sidewall, brochure, or other technical specifications):

- Tire size
- Tire mass
- Intended use as identified in Tire Sub-Categories, Section 2.1
- Nominal section width
- Aspect ratio
- Casing construction (e.g. 1 ply, 2 ply, polyester, nylon, etc..., including steel ply/bels for commercial tires)
- Rim diameter

- Load index
- Speed rating
- Applicable mandatory regional labeling

2.4.5 Flow diagram

A graphical depiction (i.e. flow diagram) illustrating main production processes according to the scope of the declaration shall be provided.

2.4.6 Performance standards, labelling and regulation

The product assessed using this PCR shall be compliant with performance standards, labelling requirements and regulations specific to each region. The rolling resistance coefficient (RR_c) shall be based upon requirements of the test methods listed in Table 12. As this list is non-exhaustive, if a region is not identified please indicate the additional relevant testing method not already included in this list.

Table 12. Rolling resistance test method – non-exhaustive list

Region	RR_c test method
North America	ISO 28580 as regionally modified to account for local calibrations
Europe	ISO 28580 UN Regulation 117 Annex 6 respectively EU Regulation 1222/2009 + amendments
Japan	ISO 28580 as regionally modified to account for local calibrations
South Korea	ISO 28580 as regionally modified to account for local calibrations
China	ISO 28580 as regionally modified to account for local calibrations
Latin America (including Mexico)	ISO 28580 as regionally modified to account for local calibrations
ROW	ISO 28580 as regionally modified to account for local calibrations

2.4.7 Reference Service Life

The reference service life (RSL) will be set using an individual manufacturer's confidential/proprietary regimented testing system. The reference service life is discussed in more detail in Section 3.2.3.

3 Requirements for the Underlying LCA

3.1 Functional and declared units

The functional unit of a product provides the quantitative normalization for comparing products of equivalent function (functional unit) or equivalent specification (declared unit). A functional unit serves as the reference unit upon which the LCA study is performed and the results are presented in accordance with the ISO 14040 standard. For declarations covering the complete life cycle, a functional unit is defined. Where there is an applicable standard, that standard will be referenced per Section 2.4.6.

For declaration and reporting purposes only, it is required to report the functional and declared units and LCA results in SI units.

The declared and functional units for the various applications are provided in Table 13. Table 13. Functional and declared units*

Tire type	Declared Unit (cradle-to-gate + end of life)	Functional Unit** (cradle-to-grave)
Passenger car	n/a	1 tire driven 1,000 km (modules A1 – C3)
Light truck	n/a	1 tire driven 1,000 km (modules A1 – C3)
Medium/heavy truck Pick-up and Delivery Regional and City Long Haul Mixed Service	n/a	1 tire driven 1,000 km*** (modules A1 – C3)
Pick-up service bus City bus School bus Coach	n/a	1 tire driven 1,000 km**** (modules A1 – C3)
Off-road	1 tire (modules A1 – A3, C1 – C3)	n/a
Motorcycle	1 tire (modules A1 – A3, C1 – C3)	n/a
Aircraft	1 tire (modules A1 – A3, C1 – C3)	n/a

*See Section 3.2 for information module definitions



** Assuming intended use and maintenance for safe distance traveled

*** For medium/heavy trucks, the functional unit includes steer, drive, and trailer tires. When including retreading and regrooving for optional reporting as indicated in Section 6.2, the functional unit includes also number of retreads indicated and retreading impacts according to Section 9.4

**** For buses, when including retreading and regrooving for optional reporting as indicated in Section 6.2, the functional unit includes also number of retreads indicated and retreading impacts according to Section 9.4.

For declarations covering the complete life cycle, the references flows needed to fulfill the functional unit are calculated based on the tire reference service life (RSL)⁴. More details on tire RSL are provided in Section 3.2.3.

⁴ The guidance to calculate the references flows when including retreading and regrooving for optional reporting is provided in Section 9.4.

Guidance - Reference flows

The performance of the studied tire is fulfilled by the production and use of a certain tire fraction, i.e., the reference flow.

The fraction of tire per functional unit (No per FU) is calculated based on the following equation (1):

$$(1) \text{ No per FU } \left[\frac{\text{unit}}{\text{FU}} \right] = \frac{\text{Dist_FU} [\text{km/FU}]}{\text{Tire_RSL} [\text{km}]}$$

The parameters are the distance considered for the functional unit (Dist_FU) and the reference service life of the tire (Tire_RSL).

Let's assume two illustrative examples with the following specificities:

Illustrative examples	Dist_FU	Tire_RSL
Passenger car tire A	1,000 km	40,000 km
Truck tire B	1,000 km	230,000 km

Applying the parameters reported in the equation (1), the results are the following:

Illustrative example - Passenger car tire A

$$\text{No per FU } \left[\frac{\text{unit}}{\text{FU}} \right] = \frac{1,000 [\text{km/FU}]}{40,000 [\text{km}]} = 0.025 [\text{unit/FU}]$$

Illustrative example - Truck tire B

$$\text{No per FU } \left[\frac{\text{unit}}{\text{FU}} \right] = \frac{1,000 [\text{km/FU}]}{230,000 [\text{km}]} = 0.0043 [\text{unit/FU}]$$

3.2 System boundaries

The tire life cycle is broken into the various “information modules” shown in Figure 1:

Each information module is described in more detail in the following sub-sections.

Retreading and regrooving processes shall not be included in the core section of the EPD, but may be included for commercial and bus tires as optional reporting as presented in Section 9.4 per the requirements in Section 6.2, only if primary data are available (except for regrooved tire RR_c and RR_c loss that shall be calculated using the default values provided).

Due to their small contribution (cut off criteria defined in Section 3.4), the system boundaries do not include the following modules:

- Installation (A5);
- Transport of the assembled product to the consumer (A6), i.e. the transport of the vehicles on which the tire is mounted;
- Maintenance (B2), i.e. tire cleaning, inspection, inflation, rotation, balancing, and alignment;
- Repair (B3), i.e. repair of the tire over the reference service life. This includes routine patching and other standard repair processes;
- Removal (C1), i.e. the removal of the tire from the vehicle, including on-site sorting of materials;
- Capital equipment manufacture;
- Personnel impacts.

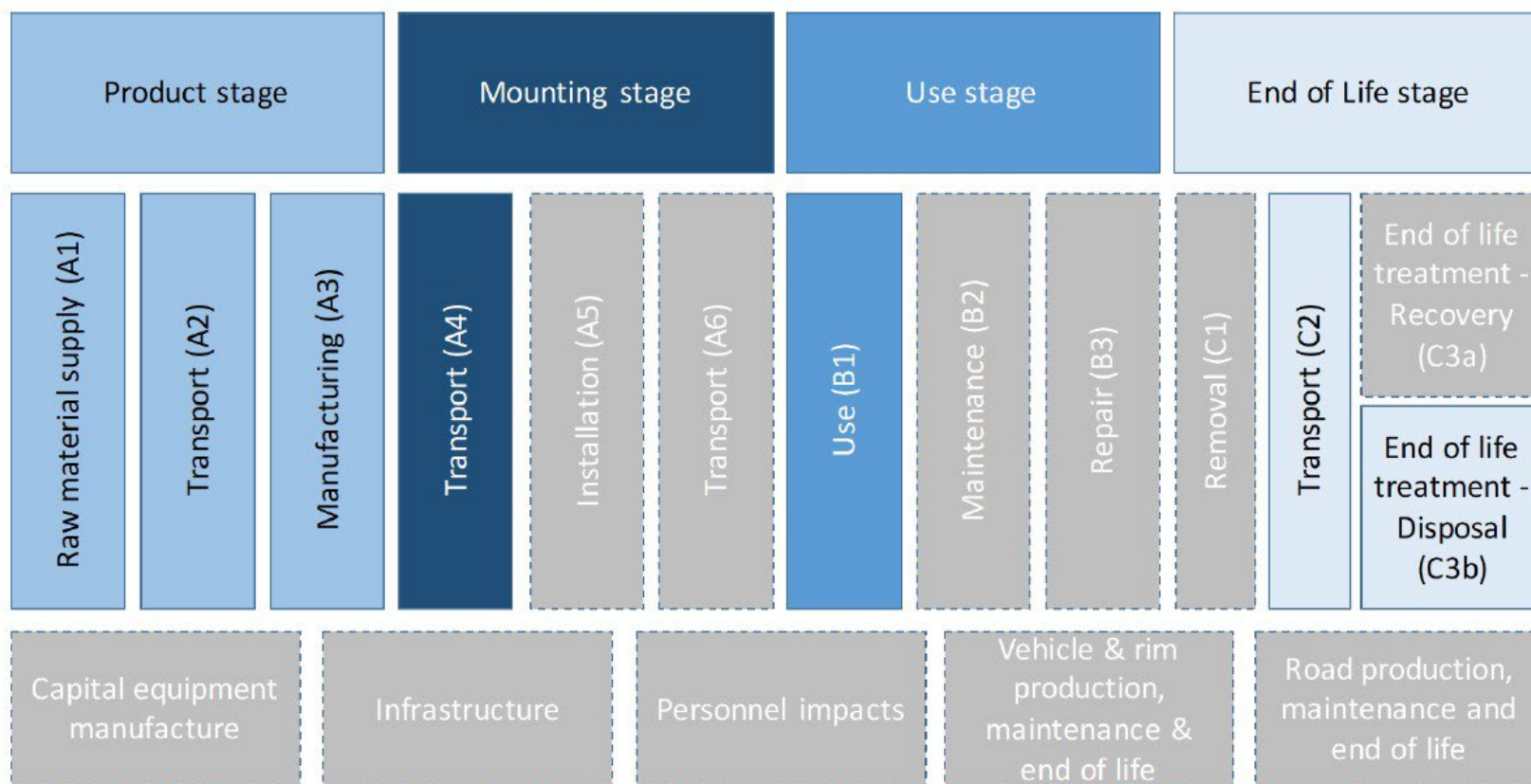
The exclusion of processes or activities due to cut-off criteria should be adapted depending on the vehicle technology considered, the geographical context and the time representativeness of the technologies (e.g., the maintenance module (B2) may become a significant contributor and should be included if the tire is mounted on an electric vehicle using a low-impact electricity mix).

The module “Infrastructure” is not included for foreground processes due to its small contribution to the overall impact and for simplification reasons. Production of infrastructure shall be excluded also for background generic processes, in order to ensure consistency between the foreground and background datasets and to ensure consistency databases.

The modules “Vehicle & rim production, maintenance and end of life” and “Road production, maintenance and end of life” are excluded from the system boundaries, since their impacts are allocated to another system (i.e. vehicle life cycle).

Finally, the module “End of life treatment - Recovery module” (C3a) is excluded from the system boundaries due to recycled waste stream methodology applied in this PCR (cut-off rules defined in Section 4.3). This module includes the material flows intended for reuse, recycling, and energy recovery, and includes waste processing for recycling and energy recovery (e.g. shredding) and credits related to energy recovery and avoided primary material.

Figure 1. Tire life cycle system boundaries and information modules



Out of scope activities are indicated in the grey boxes

3.2.1 Product Stage (A1, A2, and A3)

The product stage is a set of information modules required to be included in all EPDs. Together, these represent the cradle-to-gate impacts of a tire. As illustrated in Figure 1, it includes the information modules A1 to A3. The system boundary with the ecosphere is set to include those processes that provide the material and energy inputs into the product system, processing, and transport processes up to the factory gate as well as the processing of any waste arising from those processes.

In the case of secondary materials input or energy recovered from incineration input (e.g. incineration of End of Life Tire (ELT)), the cut-off rule is applied according to Section 4.3. In other words:

- The impacts related to the collection of recyclable material (waste from a previous product system) and to its recycling process are allocated to the product using the recycled material;
- The impacts related to the collection of waste from a previous product system and to the energy production process are allocated to the product using the energy.

Processes in the product stage with more than one type of valuable output flow shall be treated by allocation, i.e. input to and emissions from such processes shall be divided between the output flows according to the chosen allocation criterion as described in Section 3.5.

3.2.1.1 Raw material supply (A1)

The raw material supply module (A1) includes all materials⁵⁶ and energy inputs, transportation stages, needed for the raw material supply stage, as well as end of life treatment of final residues produced during the raw material supply stage. However, production of capital goods, infrastructure, production of manufacturing equipment and personnel-related activities are not included.

As a first priority, companies should seek primary data (if available) from their supplier to model the raw material supply module (see section 4.1.1). If no primary data are available, the raw material supply module should be modelled using the default datasets presented in Appendix III (see section 10) for nine of the raw materials (synthetic rubber, natural rubber, carbon black, steel, textile polyester, textile nylon, silica, cobalt salt and plasticizers), unless better-quality data

⁵ The raw materials included in the raw material supply module include materials that are part of the tire (e.g., tube is considered as tire raw material, but tire pressure monitoring system (TPMS) is not considered as tire raw material)

⁶ When semi-finished product are purchased from an external supplier, detailed data on the composition (i.e. raw materials that compose semi-finished product) have to be collected by the EPD owner and listed as « raw materials ».

are available. In fact, those datasets were developed with the objective of being representative of a global technology for each specific raw material, and for a global geographical coverage (i.e., world coverage), except for the natural rubber which is representative of a specific geographical context for fresh latex cultivation (Thailand). If primary data or better-quality data (i.e., with a better geographical, technological or time representativeness) are available for one or several of those nine raw materials, specific datasets shall be developed. A justification of the replacement of the default dataset shall be provided in the background report. In addition, the data quality rating (DQR) of the specific dataset shall be calculated as per information provided in section 4.1.2 and reported in the background report, and shall be better (i.e., with a lower score) than the DQR of the corresponding default dataset to justify a replacement.

The raw material supply module accounts for:

- Extraction and treatment of non-renewable primary materials (e.g., mining and refining processes)
- Production and treatment of renewable primary material (e.g., agricultural or forestry operations);
- Processing of primary and secondary materials; Processing of secondary material from a previous product system (e.g., recycled tire) will be modelled using the cut-off rule, i.e. not including processes that are counted as waste processing in the previous product system (Section 4.3);
- Consumption of electricity, steam and heat from primary energy resources, also including their extraction, refining and transport;
- Consumption of energy recovered from a previous product system or produced from secondary fuels, but not including processes that are counted as waste processing in a previous product system (Section 4.3);
- Transportation up to the factory gate and internal, on-site transport;
- Consumption of ancillary materials or pre-products (e.g., lubricants);
- Waste processing or disposal, including any packaging waste.

3.2.1.2 Transport (A2)

The transport module (A2) includes the transportation of raw materials to the manufacturing site.

3.2.1.3 Manufacturing (A3)

The manufacturing module (A3) concerns the manufacturing of raw materials into the finished tire, and includes all materials and energy inputs, transportation stages needed for the manufacturing stage, as well as end of life treatment of final residues produced during the manufacturing stage. However, production of capital goods, infrastructure, production of manufacturing equipment and personnel-related activities are not included.

The manufacturing module will account for:

- Consumption of electricity, steam and heat from primary energy resources, also including their extraction, refining and transport;
- Consumption of energy recovered from a previous product system or produced from secondary fuels, but not including processes that are counted as waste processing in a previous product system (Section 4.3);
- Internal transport;
- Consumption of ancillary materials or pre-products (e.g., lubricants);
- Production of co-products during the manufacturing process;
- Tire packaging production (material and manufacturing);
- Waste processing or disposal, including any packaging waste.

3.2.2 Mounting Stage (A4, A5, and A6)

The mounting stage (A4, A5 and A6) includes the information modules covering the activities from the tire factory to the final user, i.e. successive transport stages and installation onto the vehicle.

3.2.2.1 Transport (A4)

This module includes the transport of the tire from the factory to the place where the tire is mounted onto the vehicle. This includes the successive transport stages by the different modes of transport (truck, boat, train) to reach: car or truck makers, retailers, tire dealers and assembly centers. Module A4 may be optionally reported only when primary data are available to model impacts.

3.2.2.2 Installation (A5)

Impacts from installation of the tire onto the vehicle are considered outside the scope of this PCR.

3.2.2.3 Transport (A6)

Impacts from transport of the vehicle on which the tire is mounted to final customer are considered outside the scope of this PCR.

3.2.3 Use Stage (B1, B2, and B3)

The use stage (B1, B2 and B3) includes the information modules covering the period from the handover of the tire until it reaches its end of life. The use stage includes the use of tire products, and services in their proper function. Maintenance and repair are part of the use stage but are excluded from system boundaries (discussed in Section 3.2). The duration of the use stage is dependent on the reference service life.

The reference service life (RSL) of a tire is based on several types of tests related to the performance of the product. Each company should use its own confidential/ proprietary regimented testing scheme to set the RSL for a specific tire, plus any regulatory required tests