HARMONIZED PROVISIONS CONCERNING PNEUMATIC TYRES FOR PASSENGER AND LIGHT TRUCK (COMMERCIAL) VEHICLES

Transmitted by the Experts from the ETRTO, JATMA, and RMA

Note: The text reproduced below was prepared by the experts from the European Tyre and Rim Technical Organisation (ETRTO), Japan Automobile Tyre Manufacturers Association (JATMA), and the Rubber Manufacturers Association (RMA) on behalf of the informal group on tyres in charge of developing a draft global technical regulation (gtr).
The text includes all the agreed amendments resulting from the discussion during the 10th informal Tyre gtr working group meeting on 1 February 2011.

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Global Technical Regulation

For

Passenger and Light Truck (Commercial) Tyres

HARMONIZED PROVISIONS CONCERNING PNEUMATIC TYRES
FOR PASSENGER AND LIGHT TRUCK (COMMERCIAL) VEHICLES

CONTENTS

I. STATEMENT OF TECHNICAL RATIONALE AND JUSTIFICATION (Note: This is not the latest version of the Justification. Neither version was discussed at the informal meeting on 01 Feb 2011.)

A. TECHNICAL AND ECONOMIC FEASIBILITY

1. The objective of this proposal is to establish a global technical regulation (gtr) for new radial pneumatic tyres equipping passenger cars and light vehicles up to 4536 kg (10,000 pounds) under the 1998 Global Agreement. The bases of this harmonized set of requirements are the UN ECE Regulations 30, and 54 and 117, as well as the FMVSS 139 requirements established in the USA under the direction of the National Highway Traffic Safety Administration (NHTSA).

2. Many countries throughout the world have already introduced regulations concerning pneumatic tyres. Many of the existing regulations are based on the four mentioned above, UN ECE and USA regulations. However, many differences in test conditions and regulatory marking requirements require tyre manufacturers to make specific products for specific regions.

3. Pneumatic tyres for passenger cars and light vehicles are more and more becoming worldwide products, expected to be used anywhere in the world when mounted as original equipment on new vehicles which are themselves commercialised all over the planet. It therefore becomes more and more necessary to harmonize the various requirements from around the world to ensure that tyres will systematically meet the global requirements.

4. In this first version of the gtr for tyres, only the requirements for passenger car tyres have been harmonized. Work is ongoing for the harmonization of tyres with the designations LT or C.

5. Several test requirements for passenger car tyres were unique to one or the other of the existing regulations and needed no harmonization. These tests were simply included “as is” in the gtr for tyres. In particular, no harmonization was required for:

   (a) Endurance test
   (b) Low pressure endurance test
   (c) Bead unseating test
   (d) Strength test
   (e) Rolling sound emission test
   (f) Rolling resistance test
   (g) Wet grip test
   (h) Run flat test

6. Other tests or requirements required extensive harmonization during the course of the ad hoc working group’s mandate. These newly harmonized tests or requirements are:

   (a) High speed test

(b) Physical dimensions test
(c) Required markings

7. The high speed test posed a significant challenge in that the two existing tests were quite different from each other and based on different principles. One was designed to ensure that a tyre would perform adequately at speeds well above a national speed limit, but the test requirements were not related to any speed ~~capacity index~~ symbol ~~[This is just a "speed symbol". should we just say "speed symbol".On page 12 add speed symbol to definitions?]~~ indicated on the tyre itself. The other required that a tyre pass a test at its highest rated speed. The harmonization work was based on a determination of which test was more severe for tyres of different speed indices, and using the most severe test.

~~6.~~8. The physical dimensions test was less difficult to harmonize from a technical point of view, because of the elementary simplicity of determining the outside diameter and width of a tyre in its inflated state to ensure interchangeability between tyres marked with the same size designation. A small but not insignificant gain was obtained for the tyre industry by measuring the tyre's width at four points around the circumference instead of the customary six.

The different tests for passenger car tyres were organized into modules consisting of one mandatory module (tyres must comply with all these tests regardless of the region of the world for which they are destined) and two permissive modules whose application is left to the discretion of Contracting Parties applying the gtr. In this version of the gtr for tyres, which only contains harmonized requirements for passenger car tyres, the module concept does not apply to LT/C tyres. The result is shown in the table below: ~~[How did this item get placed in draft?? Need to discuss.]~~

Type of Tyre					
Passenger Car				LT/C	
	Test Name	Paragraphs		Test Name	Paragraphs
Mandatory Module	Marking and treadwear indicators	3.2. and 3.3. and 3.4.		Marking and treadwear indicators	3.2. and 3.3. and 3.4.
	Physical dimensions	3.5.		Physical dimensions	3.20. and 3.21.
	High speed test	3.11.		High speed test	3.16. and 3.19.
	Endurance test	3.9.		Endurance test	3.16. and 3.17.
	Low pressure test	3.10.		Low pressure test	3.18.
	Wet grip test	3.12.		Wet grip test	3.12.
	Run Flat test	3.13.		Run Flat test	None
				Strength test	3.14.
Module 1	Strength test	3.6.		Bead unseating test	3.15.
	Bead unseating test	3.7.		Rolling sound emissions	3.8.

Module 2	Rolling sound emissions	3.8.	

9. In the case of required markings, it was possible to eliminate some markings that had become unnecessary over the years, such as the word Radial. Also, a significant change was made in the way the Tyre Identification Number (TIN) will be used in combination with other markings such as type approval numbers, but any benefits ~~this~~ will depend on the way individual Contracting Parties implement the gtr. ~~[No current recommendations for this. It should be deleted. Administrative procedures have not addressed this, at least not yet.]~~

10. The Tyre Identification Number (TIN) format is based on NHTSA's plan to change the currently assigned 2 digit plant codes to 3 digits. A symbol, the number "1" for example, will be reserved to precede all current 2-digit codes, and be used exclusively for existing plant codes. The "1" would only be used as the prefix for existing 2-digit codes, and not be used as the leading digit for any new 3-digit codes. It is expected that US NHTSA will continue to assign global plant codes and the necessary information to obtain such a code is contained with the gtr.

B. ANTICIPATED BENEFITS

12. The principal economic benefit of this regulation will be a reduction in the variety of tests for the same or substantially similar requirements.

13. Depending on how different Contracting Parties implement this gtr, there may be benefits due to the way the certification markings are treated. If individual markings for different countries are replaced by a global mark, tyre mould design and fabrication can be rationalized to some extent, with concomitant gains in production costs. ~~[Why is this included? Rationale??]~~

14. There will be no reduction in current safety levels, and depending on existing regional regulations there may be marginal safety benefits in those specific regions with the adoption of this gtr.

C. POTENTIAL COST EFFECTIVENESS

15. The overall cost effectiveness of the gtr for tyres has not been calculated. It seems likely, especially for Contracting Parties to the UN ECE 1958 Agreement, and depending on how it is implemented by different Contracting Parties, that initially the gtr will cost more to apply than the current UN ECE regulations for regional tyres (regional tyres are those ~~[Do we need to give details on implementation? Should the US comment on implementation?? This will affect all CPs. Comments here should be of a universal nature and not just for one region or CP. this will effect more than just Europe.]~~ destined to be commercialised in a single region, such as Europe, rather than worldwide). This is due to the simple fact that there are more tests in the gtr than in the UN ECE regulations alone. However, those costs should diminish over time as the need for more and more truly worldwide tyres manifests itself.

16. Since no significant safety gains are anticipated, it is not possible to calculate a cost effectiveness based on a reduction in number of accidents.

II. TEXT OF THE REGULATION

1. SCOPE

This global technical regulation covers new radial pneumatic tyres designed primarily for vehicles in category 1 and 2, all with a mass limit of 4,536 kg, as defined in the Special Resolution Number 1. 1/

It does not apply to:
- T-Type temporary spare tyres;
- ~~Tyres for vintage cars;~~
- ~~Tyres for competitions;~~
- Tyres having a nominal rim diameter code ≤ 10 [8] (or ≤ 254 [203] mm);
- ~~Tyres intended to be fitted to road vehicles of categories other than M, N and O;~~
- ~~Tyres fitted with additional devices to improve traction properties (e.g. studded tyres);~~
- ~~Tyres with a speed rating less than 80 km/h (speed symbol F)~~
- ~~Special tyres (ST) for trailers in highway service.~~
- ~~LT or C~~ Tyres ~~with tread depth of greater than 14.3 mm (18/32 in)~~. (Data to be provided by RMA to justify)

2. DEFINITIONS

For the purpose of this regulation the following definitions apply:

"Basic tyre functions" means the nominal capability of an inflated tyre in supporting a given load up to a given speed and transmitting the driving, the steering and the braking forces to the ground on which it runs;

"Bead" means the part of the tyre which is of such shape and structure as to fit the wheel rim and hold the tyre on it;

"Bead separation" means a breakdown of the bond between components in the tyre bead area;

"Brand name, Trade name or Trade mark" means an identification applied to the tyre which may be the name or mark of the manufacturer or of a customer for whom the manufacturer is producing tyres for subsequent re-sale (that is, "Own Branding");

"Carcass" means that part of the pneumatic tyre structure other than the tread and sidewall rubber, which, when inflated, bears the load;

"Chunking" means the breaking away of pieces of the tread or sidewall;

"Class C1 tyres" means tyres designed primarily for vehicles of Category 1-1 of Special Resolution N°~~R.~~ 1 ;

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1 Document TRANS/WP29/1045.

"Class C2 tyres" means tyres designed primarily for vehicles of Categories 1-2 and 2 of Special Resolution N°~~R.~~ 1 with a ~~load capacity index~~load index in single formation ≤ 121 and the speed category symbol ≥ "N";

"Class C3 tyres" means tyres designed primarily for vehicles of Category 2 of S~~.R~~pecial Resolution N° 1 with a ~~load capacity index~~load index in single formation ≤ 121 and the speed category symbol ≤ "M", or with a ~~load capacity index~~load index in single formation ≥ 122;

"Cord" means the strands or filaments of material forming the plies of the tyre structure;

"Cord separation" means the parting of cords from adjacent rubber compounds;

"CP tyre" means a commercial vehicle tyre for service on motor caravans.

"Cracking" means any parting within the tread, sidewall or inner liner of the tyre which may or may not extend to cord material;

"Deflected section height" is the difference between the deflected radius, measured from the centre of the rim to the surface of the drum, and one half the nominal rim diameter as defined in ISO 4000-1 (add date);

"Flat tyre running mode" describes the state of the tyre, essentially maintaining its structural integrity, while operating at an inflation pressure between 0 and 70 kPa, for runflat tyres or systems;

"Inner liner" means the layer of rubber forming the inside surface of a tubeless tyre that contains the inflating medium within the tyre;

"Intended outboard sidewall" means the sidewall that contains a whitewall, bears white lettering, or bears manufacturer or model name moulding that is higher or deeper than that on the other sidewall of the tyre;

"Light Load (LL)" means a tyre designed for loads lower than the standard load (SL) version;

"Light Truck (Commercial) tyre" means a tyre of a group prescribed in the Light Truck or "C" Commercial tyre section of the standards manual from European Tyre and Rim Technical Organisation, the Japan Automobile Tyre Manufacturers Association, the Tire and Rim Association, etc;

"Load ~~capacity~~ ~~[discuss deletion of "Load capacity index", per ISO]~~ ~~index or load~~ ~~l~~index" means one or two numbers which indicate the load the tyre can carry in single or in single and dual operation at the speed corresponding to the associated speed category ~~and when operated in conformity with the requirements governing utilization specified by a standards organization~~~~the manufacturer~~ ~~[need to discuss further]~~. A type of pneumatic tyre can have either one or two sets of load ~~capacity~~ indices ~~depending on whether or not the provisions of paragraph XXX are applied~~. The list of these indices and their corresponding loads is given in Appendix 2;

"Load capacity variation with speed" means an authorized variation of the reference mass, as indicated by the ~~load capacity index~~load index, based on the actual in-use speed in comparison with the capabilities indicated by the service description (see Appendix 5) ; (Add paragraphs 6.2.4 and 6.2.5 from R54)

[Add definition for Load Range (may get from FMVSS139)].

"Maximum application load capacity" means the maximum mass a tyre can support in a specific application, and is dependent on the speed symbol of the tyre, the maximum design speed of the vehicle on which the tyre is fitted, the inflation pressure and the camber angle of the wheels of the vehicle;

"Maximum load rating" means the ~~Load Capacity Index~~Load index;

"Maximum permissible inflation pressure" means the maximum cold inflation pressure to which the tyre may be inflated.

"Measuring rim" means an actual rim of specified width as defined by one of the standards organization as specified in paragraph 3.5.8., on which the tyre is fitted for measuring the physical dimensions; ~~[An actual rim of specified width??]~~

"Nominal aspect ratio (profile)" means the ratio of the nominal section height to the nominal section width expressed as a percentage in a multiple of 5 (ending in 0 or 5);

"Nominal section width" shall be indicated in millimetres, and this part of the designation shall end in either the number zero or five, so that in any single series of tyres with the same nominal aspect ratio, the values shall all end in "0" or they shall all end in "5";

"Open splice" means any parting at any junction of tread, sidewall, or inner liner that extends to cord material;

"Outer diameter" means the overall diameter of an inflated new tyre;

"Overall width" means the linear distance between the outsides of the sidewalls of an inflated pneumatic tyre, including elevations due to labelling (marking), decorations, and/or protective bands or ribs;

"Passenger tyre" means a tyre of a group prescribed in the passenger tyre section of the standards manuals from European Tyre and Rim Technical Organisation, the Japan Automobile Tyre Manufacturers Association, the Tire and Rim Association, etc;

"Ply" means a layer of rubber-coated parallel cords;

"Ply separation" means a parting of adjacent plies;

"Pneumatic tyre" means a form of tyre comprising a reinforced flexible envelope which is either provided with, or forms in conjunction with the wheel upon which it is mounted, a continuous, closed, essentially toroidal chamber containing a gas, (usually air), or gas and a liquid, which is intended to be used at a pressure greater than atmospheric pressure. A pneumatic tyre may be classified as a passenger tyre (see "passenger tyre" above), or a light

truck (commercial) tyre, (see "light truck (commercial) tyre" above), depending on the service duty conditions required for any specific application;

"Principal grooves" means the wide grooves positioned in the central zone of the tyre tread, which, in the case of passenger and light truck (commercial) tyres, have the treadwear indicators located in the base;

"PSI index" is a code identifying the inflation pressure which may be used during testing of tyres as shown in Appendix 4;

"Radial ply tyre" means a pneumatic tyre structure in which the ply cords that extend to the beads are laid at substantially 90° to the centreline of the tread, the carcass being restrained by circumferential belts of 2 or more layers of substantially inextensible cord material;

"Reinforced or Extra Load" means a passenger tyre designed to operate at higher loads and at higher inflation pressures than the corresponding standard load tyre;

"Rim" means that part of the wheel forming the support for the tyre and on which the tyre beads are seated;

"Rim protector" means a feature (for example: a protruding circumferential rubber rib) incorporated into the lower sidewall area of the tyre which is intended to protect the rim flange from damage";

"Run flat tyre" or "Self supporting tyre" describes a pneumatic tyre structure provided with any technical solutions (for example, reinforced sidewalls, etc.) allowing the pneumatic tyre, mounted on the appropriate wheel and in the absence of any supplementary component, to supply the vehicle with the basic tyre functions, at least, at a speed of 80km/h (50mph) and a distance of 80km when operating in flat tyre running mode.

"Run flat system" or "Extended mobility system" describes an assembly or specified functionally dependant components, including a tyre, which together provide the specified performance granting conditions for the vehicle with at least basic tyre functions, at a speed of 80 km/h (50 mph) and a distance of 80 km (50 miles) when operating in flat tyre running mode.

"Secondary grooves" means the supplementary grooves of the tread pattern which may disappear in the course of the tyre's life;

"Section height" means a distance equal to half the difference between the outer diameter of the tyre and the nominal rim diameter;

"Section width" means the linear distance between the outside of the sidewalls of an inflated pneumatic tyre, excluding elevations due to labelling (marking), decoration or protective band or ribs;

"Service description" means the association of the load index or indices with a speed symbol (for example, 91H or 121/119S);

"Sidewall" means that portion of a tyre between the tread and the bead;

"Sidewall separation" means the parting of the rubber compound from the cord material in the sidewall;

"Snow tyre" means a tyre whose tread pattern and whose structure are designed to enhance traction in mud and fresh or melting snow and performance better than that of an ordinary (road-type) tyre. The tread pattern of a snow tyre generally consists of groove (rib) and/or solid-block elements more widely spaced than on an ordinary (road-type) tyre. These tyres are labelled on at least one sidewall with the letters "M" and "S" (e.g., MS, M/S, M&S, M+S, etc.);

"Snow tyre for use in severe snow conditions" distinguished by a three-peaked mountain snowflake (alpine) symbol on the sidewall next to the M+S mark. Together, these marks indicate snow traction performance relative to ASTM E1136-1093 ~~(2003)~~ standard reference test tyre (SRTT). An example of the symbol is shown below;

"Special use tyre" means a tyre intended for mixed use, both on and/or off road or for other special service duty;

"Speed symbol" means the letter code which defines the maximum speed which the tyre can sustain, (see appendix 1 to this regulation);

"Structure" means the technical characteristics of the tyre's carcass (for example: radial, bias-belted, bias ply, etc.);

"Temporary use spare tyre" means a [car] tyre different from a tyre fitted to a vehicle for normal driving conditions, and intended only for temporary use under restricted driving conditions.

"Test rim" means the rim on which a tyre is fitted for testing and which may be any rim listed in industry standards as appropriate for use with that tyre;

"Theoretical rim" means a rim width calculated by multiplying the nominal section width by a specific, industry standardized, coefficient depending upon the aspect ratio of the tyre;

"Tread" means that part of a tyre that comes into contact with the road;

"Tread groove" means the space between two adjacent ribs or blocks in the tread pattern;

"Tread pattern" means the geometric arrangement of blocks, ribs and grooves of the tread;

"Tread separation" means the pulling away of the tread from the tyre carcass;

"Tread wear indicators (TWI)" means the projections within the principal grooves designed to give a visual indication of the wear of the tread;

~~Other references to T-type spares need to be deleted as well.~~

"Tubeless tyre" means a tyre specifically designed for fitting to appropriate wheel rims without an inner tube; (Add definition of T-type temp spares)

"Tyre size designation" means a combination of letters, numbers and symbols which uniquely identify the size and structure of the tyre as set out in one of the standards shown in paragraph§ ~~4.4.5.4~~3.5.8. or in Appendix 7 to this gtr.

3. REQUIREMENTS

3.1 Plant Code Registration

3.1.1. Each tyre manufacturer of new pneumatic tyres shall apply in writing to the following address for registration and allocation of a manufacturer plant code identification symbol:

Office of Vehicle Safety Compliance,
National Highway Traffic Safety Administration,
1200 New Jersey Avenue, SE,
Washington, DC 20590
USA

The tyre manufacturer requesting a plant code assignment shall identify itself as the tyre manufacturer and declare the following information in the application and shall inform the NHTSA of any changes to the information:

3.1.2.

3.1.2.1. The name or other designation identifying the applicant, and its main office address;

3.1.2.2. The name, or other identifying designation, of each individual plant operated by the manufacturer and the address of each plant, if applicable;

3.1.2.3. The type of tyres manufactured at each plant, e.g., pneumatic tyres for passenger cars, buses, trucks or motorcycles; pneumatic retreaded tyres; or non-pneumatic retreaded tyres; or non-pneumatic tyre assemblies.

3.2 Marking ~~(Labelling)~~

3.2.1. Tyre Identification Number Format

Tyre Identification Number Format

YYY_MMMMMMMM_DDDD

YYY	Plant Code (*increased from 2 to 3 digits)*
MMMMMMMM	Manufacturer's Code *(Combines current size and type codes)*
DDDD	Four Digit Date Code
_	Space *(6mm – 19mm)*

~~Remove the blue text from here and put in the Justification.~~

~~4.2.1.1~~The **"YYY"** is the universal plant code for place of manufacture of the tyre. ~~*[Plan is to change current NHTSA assigned 2 digit plant codes to 3 digits. One symbol, "1" for example will be reserved to precede all current 2-digit codes, and be used exclusively for existing plant codes. The "1" would only be used as the prefix for existing 2 digit codes, and not be used as the leading digit for any new 3 digit codes. Existing plant code holders will have 5 years to phase in new 3-symbol (may appeal for longer period if justified). It is expected that US NHTSA will continue to assign global plant codes.]*~~

~~3.2.1.2.~~3.2.1.1.

~~3.2.1.3.~~3.2.1.2. The **"MMMMMMMM"** is an 8 digit manufacturer's code. Within the ~~GTR~~ tyre identification number format, this will be an 8 digit required field, but the content is up to the tyre manufacturer. ~~*[This field replaces the size code field and the optional type code field that is part of the US NHTSA Tyre Identification Number (TIN). The US is receptive to this revised format for the manufacturers to use at their discretion.]*~~

~~3.2.1.4.~~3.2.1.3. The **"DDDD"** represents the week and year of manufacture, also know as the date code. The first two symbols must identify the week of the year by using "01" for the first full calendar week in each year, "02" for the second full calendar week, and so on. The calendar week runs from Sunday through the following Saturday. The final week of each year shall include not more than 6 days of the following year. The third and fourth symbols must identify the year. Example: 0110 means the first week of 2010.

~~3.2.1.5.~~3.2.1.4. The "_" is a space ~~is~~of not less than 6 mm nor greater than 19 mm.

3.2.1.5. The Tyre Identification Number ~~Location: Must~~shall be located on the intended outboard sidewall of the tyre, and positioned between the bead and ~~[~~50% of ~~]~~ the distance from the bead to the tread. On the other sidewall of the tyre either a tyre identification number or a partial tyre identification number is required. The partial

tyre identification number is comprised of all characters except the date code.

3.2.1.6. The content of the manufacturer's code is optional, but the data field is not.

3.2.1.7. The symbols to be used in the tyre identification number format are A, B, C, D, E, F, H, J, K, L, M, N P, R, T, U, V, W, X, Y, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.

3.2.1.8. The symbols that shall not be used are G, I, O, Q, S, and Z.

3.3 Other Sidewall Markings

3.3.1. [May need to go under 3.3] Unless otherwise stated, the following information, together with any other markings required by provisions in annexes to this regulation, shall be legibly and permanently moulded into or onto the sidewall(s):

3.3.1.1. in the case of asymmetric tyres on the intended outboard sidewall as viewed when the tyre is fitted to the vehicle;

3.3.1.2. in either case, on at least one sidewall, the required markings shall be in a position on the sidewall where they are least susceptible to being "scrubbed" away during use;

3.3.1.2.1. The brand name or the trade name or trade mark, in characters not less than 4 mm high;

3.3.1.2.2. The country of manufacture in characters not less than 2 mm high;

3.3.1.2.3. The tyre size ~~b~~ designation in characters not less than 6 mm high comprising:

3.3.1.2.3.1. an indication of the tyre structure;

3.3.1.2.3.1.1. R for radial construction;

3.3.1.2.3.1.2. RF for radial run flat tyre;

3.3.1.2.3.2. The service description (load index and speed symbol);

3.3.1.2.3.3. An identification of the tyre to rim fitment configuration when it differs from the standard configuration.

3.3.1.2.3.4. Add load range for LT/C tyres.

3.3.2. Each tyre must be labelled on the other side (from that directed in 43.2.1.5. above) with the same tyre identification number except for the date code and, at the discretion of the manufacturer, any optional code on the other sidewall.

3.3.3. For ~~radial ply take this out~~ tyres suitable for speed in excess of 300 km/h, the letter "R" placed in front of the rim diameter code symbol marking shall be replaced by "ZR" and the tyre shall be marked, in parentheses, with a service description consisting of the speed symbol "Y" and a corresponding load index, for example, 245/45ZR17 (95 Y). Note: the actual maximum tyre load capacity and speed capability shall be stated in the tyre

manufacturer's technical literature and made available to the public.

3.3.4. Each tyre must be labelled with its maximum permissible inflation pressure in kPa (psi). ~~For standard load and light load tyres: 240 kPa (35 psi), 250 kPa (36 psi), 300 kPa (44 psi) or 350 kPa (51 psi). For reinforced or extra load tyres: 280 kPa (41 psi), 290 kPa (42 psi) or 340 kPa (50 psi).~~

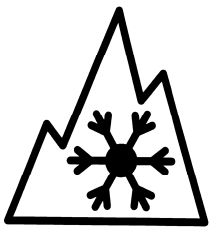
3.3.5. Each tyre must be labelled with its maximum load rating, in kilograms (lbs). ~~, pursuant to the maximum permissible inflation pressure in the preceding paragraph 4.2.7.5~~3.3.4. ~~above~~.

3.3.6. The inscription "REINFORCED" or "EXTRA LOAD" or "~~X~~XE~~L~~" or "REINF" ~~word "REINFORCED", or "EXTRA LOAD"~~for reinforced or extra load tyres, or the inscription "LL" or "LIGHT LOAD"for light load tyres ~~"LIGHT LOAD"~~, if applicable, in characters not less than 4 mm high;

3.3.7. The word "TUBETYPE", if applicable, in characters not less than 4 mm high;

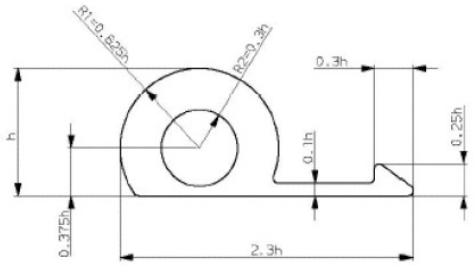
3.3.8. The inscription "M+S", "M.S.", "M&S", "M-S", or "M/S", in characters not less than 4 mm high, if the tyre is a snow tyre.

3.3.9. The t~~T~~hree-peaked mountain snowflake symbol~~: I~~ which identifies a tyre that is an M+S marked snow tyre, and is also intended for use in severe snow conditions, and meets snow performance requirements. The symbol must have a minimum base of 15 mm and a minimum height of 15 mm and must contain three peaks with the middle peak being the tallest. Inside the mountain, there must be a six-sided snowflake having a minimum height of one-half the tallest peak. An example is shown below, and is to be placed adjacent to the M+S type designation.



~~4.2.2.12Run flat marking~~

~~3.3.11.~~3.3.10. The symbol below if the tyre is a "run flat" or "self supporting" tyre, and run flat performance requirements are met ~~(ref. ISO 16992)~~, where "h" is at least 12 mm.



3.3.11. In the case of LT or C type tyres, an indication, by the "PSI" index, of the inflation pressure to be adopted for the load/speed endurance tests. ~~Below is a~~ A table showing the relationship among "PSI" ~~, "bar",~~ and "kPa" units ~~which may be helpful in sidewall~~

~~labelinglabelling and tyre testing~~ can be found in ~~a~~Appendix 4.

3.3.12. In the case of LT or C type tyres, ~~T~~the inscription "ET" or "ML" or "MPT" for "Special use tyres"

3.3.12.1. ET = Extra Tread ~~[Special use tyres whose tread is primarily designed for mixed use (on-and off-road) or at restricted speed.]~~

3.3.12.2. ML = Mining and Logging ~~tire~~tyre used in intermittent highway service. ~~[Special use tyres whose tread is primarily designed for mixed use (on-and off-road) or at restricted speed.]~~

3.3.12.3. MPT = Multi Purpose Truck~~s~~ tyres ~~[Commercial vehicle tyres for service on Multipurpose Trucks]~~

3.3.13. In the case of LT or C type tyres, the prefix “LT” before the tyre size designation, or the ~~The~~ suffix "C" or "LT" after the rim diameter marking referred to in Appendix 3, and, if applicable, after the tyre to rim fitment configuration referred to in paragraph ~~4.2.2.4~~3.3.1.2.3.3.

3.3.13.1. For C type tyres, t~~T~~his marking is optional in the case of tyres fitted on 5° drop centre rims, suitable for single and dual fitment, having a ~~load capacity index~~load index in single lower or equal to 121 and destined for the equipment of motor vehicles.

3.3.13.2. This marking is mandatory in the case of tyres fitted on 5° drop centre rims, suitable for single fitment only, having a ~~load capacity index~~load index higher or equal to 122 and destined for the equipment of motor vehicles.

3.3.14. In the case of LT or C type tyres, ~~T~~the suffix "CP" after the rim diameter marking referred to in paragraph Appendix 3 and, if applicable, after the tyre to rim fitment configuration referred to in paragraph 3.3.1.2.3.3.~~4.2.2.4.~~ This marking is mandatory in the case of tyres fitted on 5° drop centre rims, having a ~~load capacity index~~load index in single lower or equal to 121 and specifically designed for the equipment of motor caravans .

3.4 Treadwear Indicators

3.4.1. Except as noted below, each passenger tyre and each LT/C tyre shall have at least six transverse rows of treadwear indicators, approximately equally spaced around the circumference of the tyre and situated in the principal grooves of the tread.

3.4.2. For passenger tyres designed for mounting on rims of nominal rim diameter code 12 or less, not less than three transverse rows of treadwear indicators is acceptable.

3.4.3. ~~4.3.3~~ The height of each treadwear indicator shall be 1.6 mm, + 0.6, - 0.0 mm.

3.5 Physical Dimensions of ~~Radial~~ ~~Pneumatic~~ Tyres

3.5.1. The following paragraphs describe in detail the requirements for determining the physical dimensions of radial pneumatic tyres for approval according to this regulation. The characteristics to be determined are the overall width, and the outside diameter. If these characteristics are within the specified tolerances, the physical dimensions of the tyre are acceptable.

3.5.2. Definitions (see ~~section 3~~paragraph 3.3 of th~~e main document~~is gtr for detailed definitions of various terms)

3.5.2.1. The overall width of the tyre is defined as the average of four measurements of its width at the widest point, including any markings or protective ribs~~,~~. ~~but excluding rim protectors. [In conflict with FMVSS 139. NHTSA to investigate.??]~~ Decision of inf WG

3.5.2.2. There is no defined theoretical overall width of standard tyres. It is a measured characteristic, not a calculated one.

3.5.2.3. The section width of the tyre is its width at the widest point excluding any markings, protective ribs or rim protectors.

3.5.3. The ~~theoretical~~ section width~~-~~ shall be calculated by the following formula:

$$S = S_1 + K(A-A_1),$$

where:

S is the "~~theoretical~~ section width" expressed in mm;

S_1 is the "nominal section width" (in mm) as shown on the side wall of the tyre in the designation of the tyre as prescribed;

A is the width (expressed in mm) of the measuring rim, as shown by the manufacturer in the descriptive note; 1/

A_1 is the width (expressed in mm) of the theoretical rim.

A_1 shall be taken to equal S_1 multiplied by the factor x, as specified in the international standard ISO 4209-1, and K shall be taken to equal 0.4.

3.5.4. Outer diameter of tyre

The ~~theoretical~~ outer diameter of the tyre shall be calculated by the following formula:

D = d + 2H, where:

1/2/ When the conventional number is given by codes, the value in millimetres is obtained by multiplying the code number by 25.4.

D is the ~~theoretical~~ outer diameter in millimetres,

d is the rim diameter in millimetres; 2/

H is the nominal section height in millimetres, equal to:

$H = 0.01\ S_1 * Ra$

S_1 is the nominal section width in millimetres, and Ra is the nominal aspect ratio,

all as shown on the sidewall of the tyre in the tyre size designation.

3.5.5. Physical Dimensions Measurement Method

3.5.5.1. Mount the tyre on ~~one of~~ the measuring ~~approved~~ rim~~s~~ mentioned in the appropriate Standards Manual.]

3.5.5.2. Adjust the pressure to that specified ~~by the manufacturer. Add table of pressures~~in the table below:

Physical Dimensions Test Tyre Inflation Pressures	Tyre Application	Test Pressure (kPa)
	Standard Load, Light Load	180
	Reinforced or Extra Load	220

ondition the tyre, mounted on its rim, at the ambient room temperature between 18°C and ~~36~~38°C for not less than 24 hours.

3.5.5.4. Re-adjust the pressure to that specified in the table above.

3.5.5.5. Measure the overall width at four equally spaced points around the tyre, taking the thickness of protective ribs or bands into account. The reported value will be the average of the four measurements rounded to the nearest millimetre.

3.5.5.6. Determine the outer diameter by measuring the maximum circumference, dividing the result by 3.1416 and rounding to the nearest millimetre.

3.5.5.7. Determine the height of the treadwear indicators by measuring the difference between the total depth of the tread groove in the vicinity of the treadwear indicator and the depth to the top of the treadwear indicator. Repeat this measurement for at least one treadwear indicator in each row (minimum of 6 or 3, depending on the rim diameter; a row is the

1/2/ When the conventional number is given by codes, the value in millimetres is obtained by multiplying the code number by 25.4.

linear sequence of treadwear indicators positioned radially across the tread from one side to the other). At least one treadwear indicator in each principal groove shall be measured (the principal grooves are the wide grooves positioned circumferentially around the tread). Record all of the individual values rounded to the nearest tenth of a millimetre.

3.5.6. Physical Dimension ~~Tolerances~~Requirements

3.5.6.1. Overall width

3.5.6.1.1. The tyre overall width may exceed the ~~theoretical~~ section width defined in paragraph ~~4.4~~3.5.3~~.3~~ above by the following percentages:

in radial and run flat tyres: 4% (Simplify this)

3.5.6.2. Outer diameter

3.5.6.2.1. The outer diameter of a tyre must not be outside the values Dmin and Dmax obtained from the following formulae:

Dmin = d + (2H . a)
Dmax = d + (2H . b)

where:

the coefficients "a" and "b" are:

coefficient "a" = 0.97

coefficient "b" = 1.04 for normal (road type) radial and 1.06 for Special tyres

for snow tyres the maximum overall diameter (Dmax) may be exceeded by 1%.

3.5.7. Figure 1: Drawing of normal tyre showing rim diameter (d), outside diameter (D), ~~sidewall [s~~Section~~]~~ height (H) and section width (S) and the rim width (A).

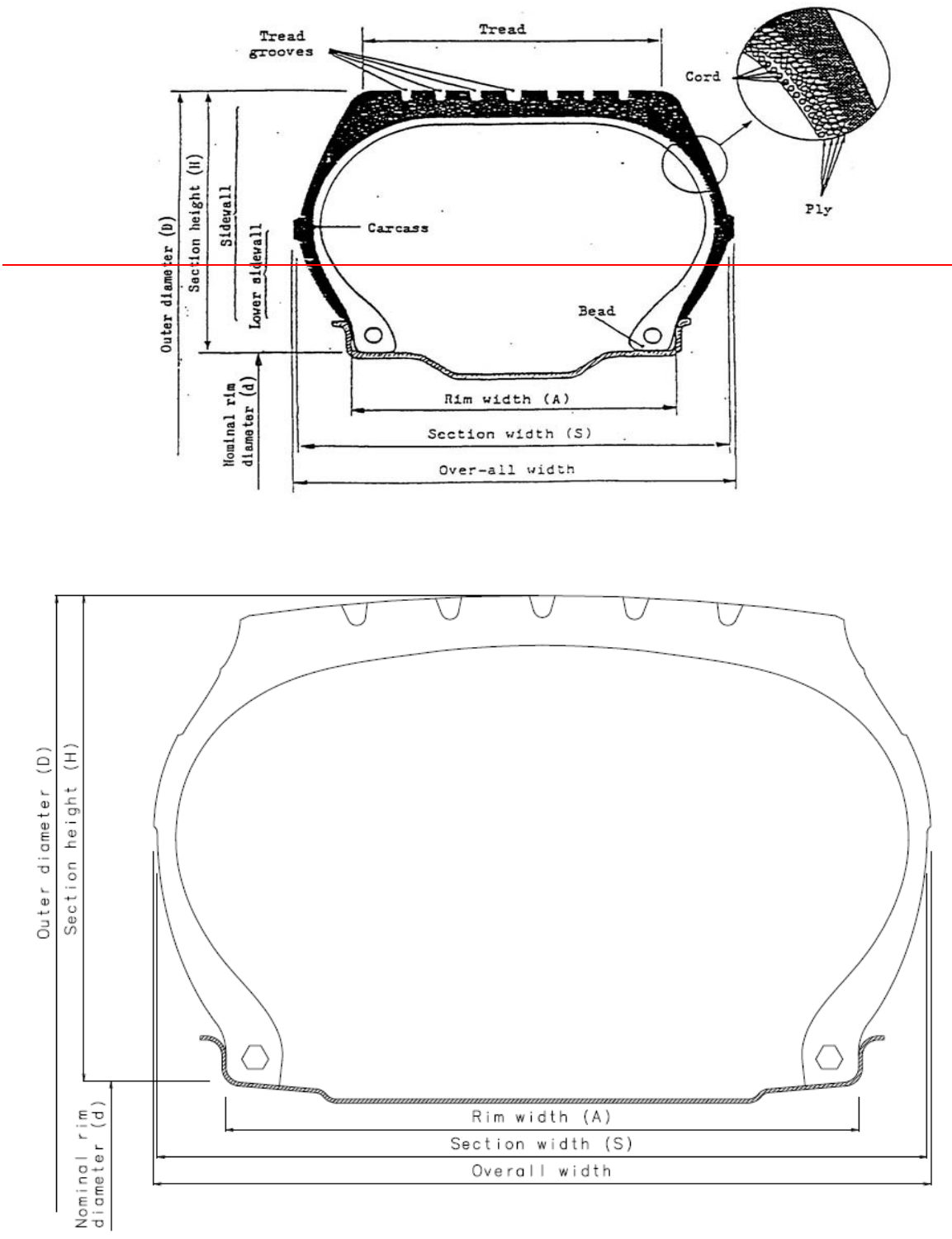


Figure 1: Drawing of a normal tyre showing various dimensions

3.5.8. For other tyre sizes for which dimensions cannot be calculated, the dimensions including allowance for growth in service, shall comply with those given in standards publications of the following organizations and which were current either at the date of manufacture of the tyre or at any later date:

The Tire and Rim Association, Inc. (T&RA)
The European Tyre and Rim Technical Organisation (ETRTO)
The Japan Automobile Tyre Manufacturers' Association (JATMA)
The Tyre and Rim Association of Australia (TRAA)
South Africa Bureau of Standards (SABS)
China Association for Standardization (CAS)
Indian Tyre Technical Advisory Committee (ITTAC)

~~3.5~~3.6 Strength Test for Passenger Car Tyres

3.6.1. Each tyre shall meet the requirements for minimum breaking energy specified in the table below.

Size Designation		~~Maximum Permissible Inflation (kPa)~~				
		Std Ld or Light Load ~~240 or 250, 300, or 350~~	XL ~~280 or 290, or 340~~	~~300~~	~~340~~	~~350~~
Below 160 mm	joules…..…	220	441	~~220~~	~~441~~	~~220~~
	in-lbs.....	1,950	3,900	~~1,950~~	~~3,900~~	~~1,950~~
160 mm or above	Joules…….	294	588	~~294~~	~~588~~	~~294~~
	In-lbs……..	2,600	5,200	~~2,600~~	~~5,200~~	~~2,600~~

~~Add table for LT/C tyres~~

3.6.2. Strength Test Procedure

3.6.2.1. Mount the tyre on a test rim and inflate it to the test inflation pressure specified in the table below:

Strength Test	Passenger Car Tyres				
	kPa				
Inflation Pressure Marked on Sidewall	240	280	300	340	350
Test Inflation Pressure	180	220	180	220	180

~~Note: Inflation pressures for LT/C tyres have to be added (inflation being given according to load range, this test should be harmonized)~~

3.6.2.2. Condition the wheel and tyre assembly for at least three hours at the temperature of the test room;

~~3.6.2.2.~~3.6.2.3. Re-adjust the tyre pressure to that specified in the previous table above (3.6.2.1~~4.5.2.~~);

~~3.6.2.3.~~3.6.2.4. Force a 19 mm (3/4 inch) diameter cylindrical steel plunger with a hemispherical end perpendicularly into the tread rib as near to the centerline as possible, avoiding penetration into the tread groove, at the rate of 50 mm (2 inches) per minute;

~~3.6.2.4.~~3.6.2.5. Record the force and penetration at five test points equally spaced around the circumference of the tyre. ~~If the tyre fails to break before the plunger is stopped by reaching the rim, record the force and penetration as the rim is reached and use these values in the following paragraph (4.5.7) below.~~ If the tyre fails to break before plunger is stopped on reaching the rim ~~and the required minimum breaking energy is not achieved~~, then the required minimum breaking energy is deemed to have been achieved at that point.

~~3.6.2.5.~~3.6.2.6. The breaking energy, W, in Joules, shall be calculated from:

$$W = [(F \times P)/2] \times 10^{-3} \text{ (joules)}$$

Where:

W = Energy in Joules
F = Force in Newtons applied to the plunger
P = Penetration of the plunger in mm

or

$$W = [FxP]/2$$

Where:

W = Energy~~,~~ in inch-pounds;
F = Force~~,~~ in pounds; and
P = Penetration in~~,~~ inches.

~~3.6.2.6.~~3.6.2.7. Determine the breaking energy value for the tyre by computing the average of the five values obtained.

~~3.6.2.7.~~3.6.2.8. In the case of tubeless tyres, an inner tube ~~equipment~~ may be provided to ensure the retention of the inflation pressure throughout the test provided that ~~such~~ such inner tube~~equipment~~ does not adversely affect the test.

~~3.6~~3.7 Tubeless[c5] Tyre Bead Unseating Resistance Test for Passenger Car Tyres

3.7.1. Requirements

The following requirements apply to all radial ply tyres using the blocks referred to in the

test procedure described in this section.

3.7.1.1. Each tubeless tyre shall meet the requirements for minimum force, in Newtons, for bead unseating resistance, specified in one of the tables below.

3.7.1.2. For tubeless radial ply tyres the applied force required to unseat the tyre bead at the point of contact, in relation to the nominal section width of the tyre, shall not be less than:

Nominal Section Width S (mm)	Minimum Force (N)
S < 160	6 670
160 ≤ S < 205	8 890
S ≥ 205	11 120

Nominal Section Width S (code)	Minimum Force (N)
S < 6.00	6 670
6.00 ≤ S < 8.00	8 890
S ≥ 8.00	11 120

3.7.2. Preparation of tyre

3.7.2.1. Wash the tyre and dry it at the beads. Mount it without lubricant or adhesive on a clean, painted test rim. The rim contour shall be one of those specified for the fitment of the test tyre.

3.7.2.2. Inflate the tyre to the pressure specified in the table shown below:

Test Type	Passenger Tyres				
	kPa				
	240	280	300	340	350
Bead Unseating Test Pressure	**180**	**220**	**180**	**220**	**180**

~~Note: add inflation pressure for LT/C tyres (inflation being given according to load range, this test should be harmonized).~~

3.7.3. Test Procedure

3.7.3.1. Mount the assembly on a fixture as shown in Figure~~s 1~~2, below.

3.7.3.2. Position the bead unseating block (shown in the figures below) against the tyre sidewall at a horizontal distance "A" as shown in Figure ~~1~~2 and Table 1, below.

3.7.3.3. ~~NOTE:~~ Use the lower of the "A" dimensions published in Table 1 List of "A" Dimensions, or the "A" dimension derived from the following formula :

$$A=0.75 \times [0.5(OD - RD)] + 0.5RD$$

Where:

OD = tyre outer diameter or nominal diameter from applicable standard

RD = nominal rim diameter

Note: The tolerance for the "A" dimension (calculated or listed in the table) is +/- 1.5 mm (0.06 in.).

3.7.3.4. Apply a force through the block to the tyre outer sidewall at a rate of 50 mm/min ± 2.5 mm/min.

3.7.3.5. Increase the force until the bead unseats or until the prescribed value is reached.

3.7.3.6. Repeat the test at least four times at places approximately equally spaced around the tyre circumference.

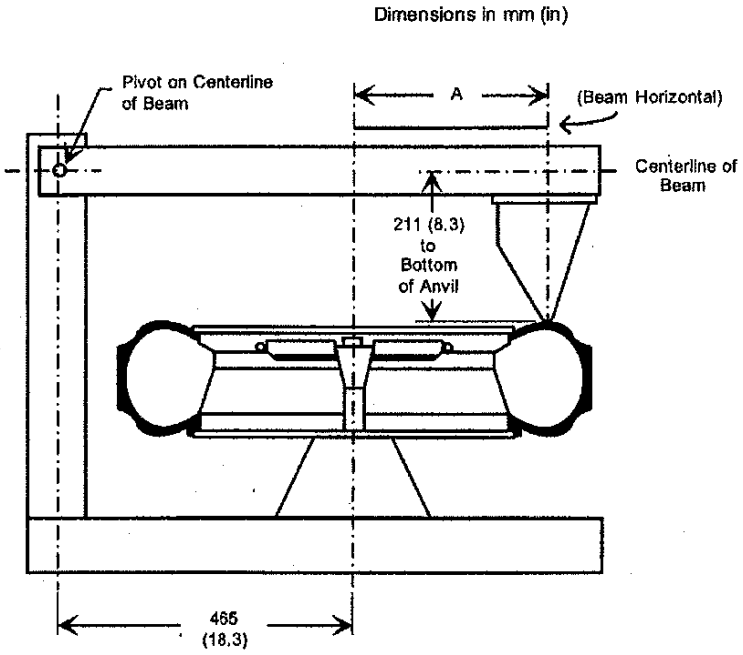


Figure 21 ~~right~~:
Bead unseating fixture

Recommended Block	Rim Size		"A" Dimension	
	Diameter Code	mm	Inch	mm
2C	30		18.5	470
2C	29		18.0	458
2C	28		17.5	445
2C	27		17.0	432
2C	26		16.5	420
2C	25		16.0	406
2B	24		15.5	394
2B	23		15.0	381
2B	22		14.5	368
2B	21		14.0	356
2B	20		13.5	343
2B	19		13.0	330
2A	18		12.5	318
2A	17		12.0	305
2A	16		11.5	292
2A	15		11.0	279
2A	14		10.5	267

2A	13		10.0	254
2A	12		9.5	241
2A	11		9.0	229
2A	10		8.5	216
2A		415	11.5	292
2A		390	11.0	279
2A		370	10.0	254
2A		365	9.8	248
2A		345	9.3	235
2A		340	9.0	229
2A		320	8.5	216
2A		315		
2A		290		

Table 1 ~~above~~: List of "A" Dimensions

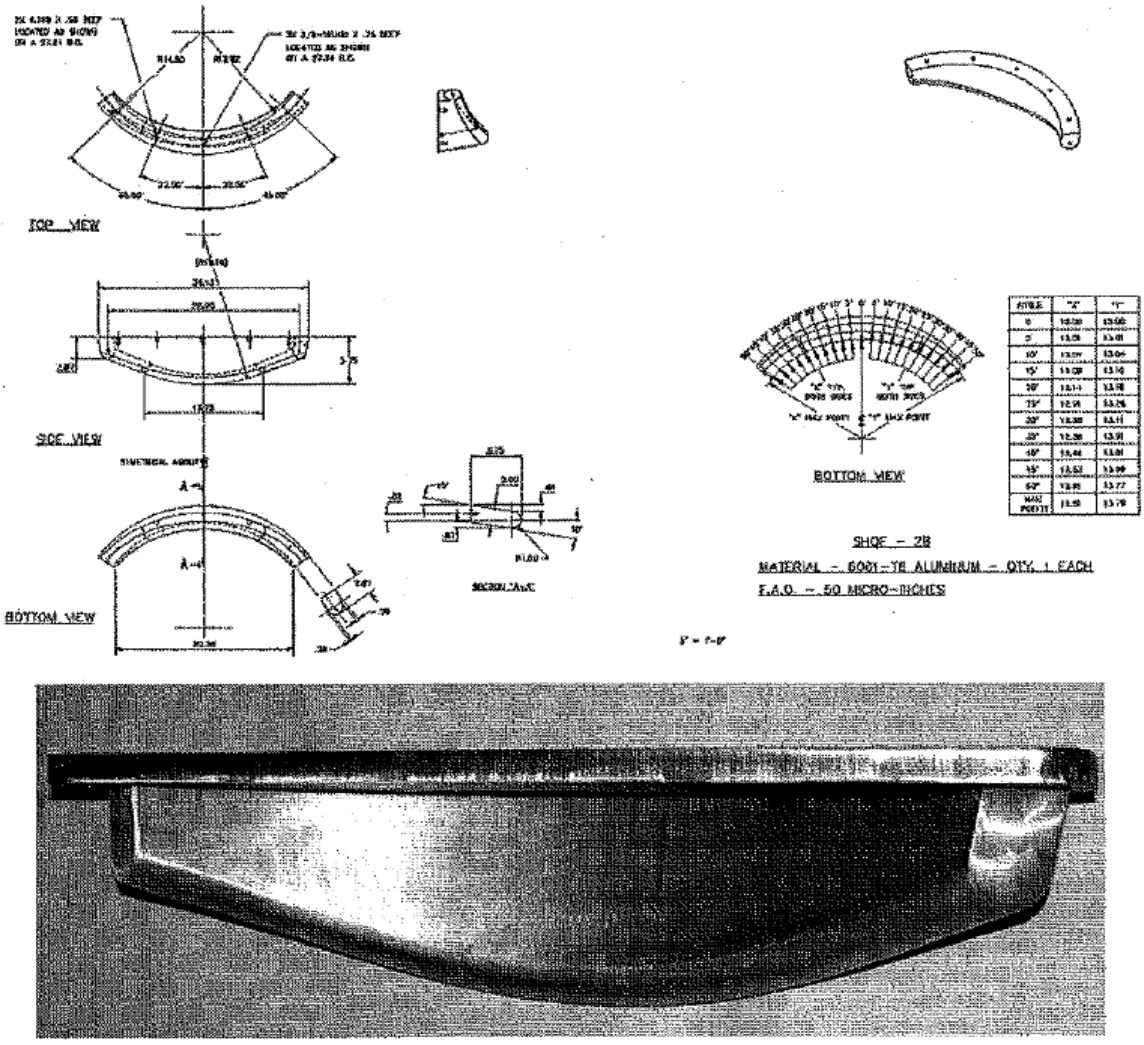
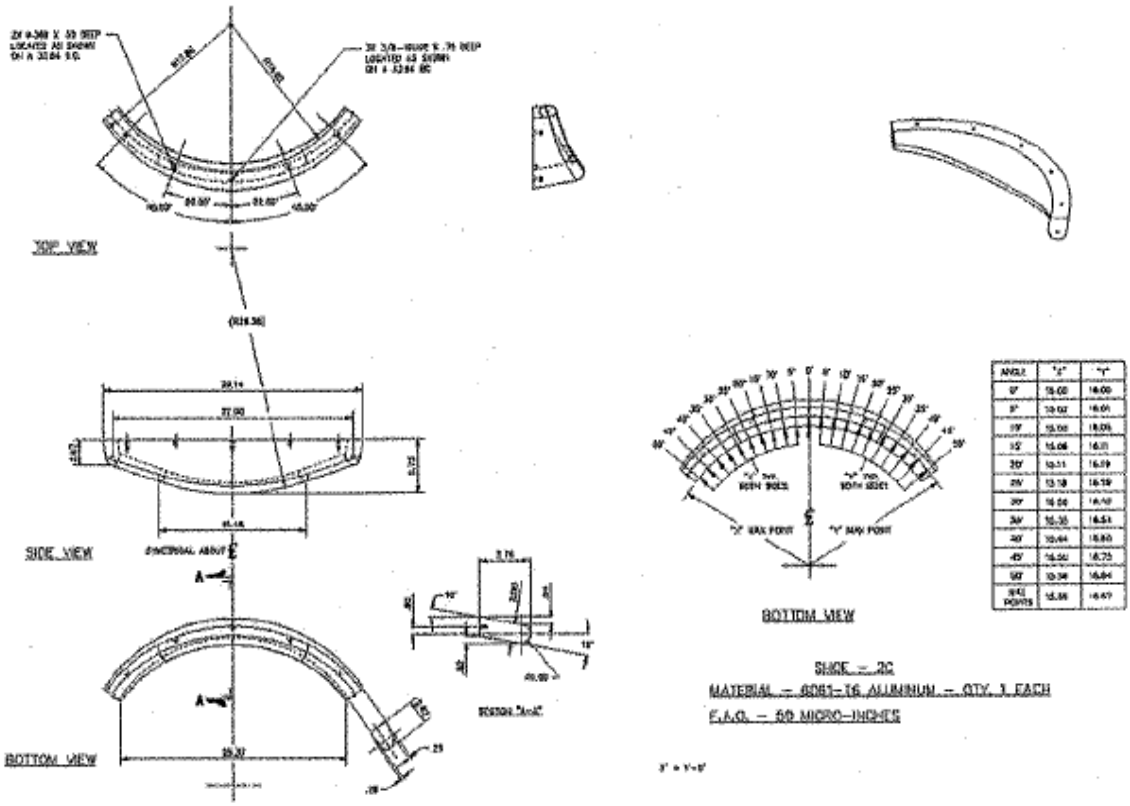


Figure 3: ~~2~~—Type 2A Bead Unseating Block



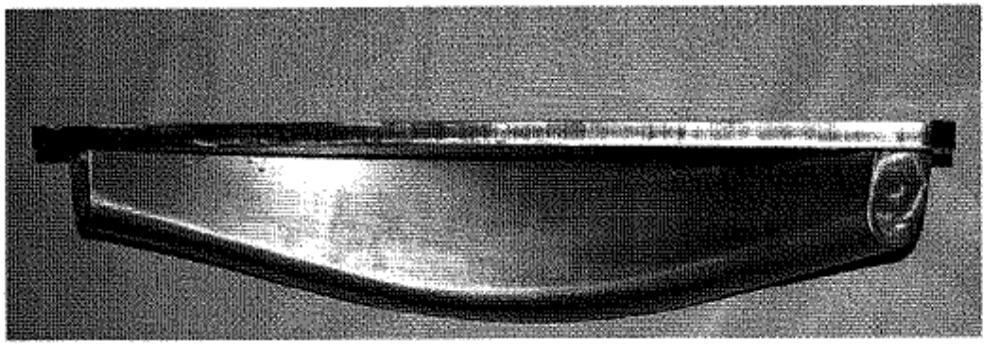


Figure ~~3~~4: Type 2B Bead Unseating Block and Adaptor

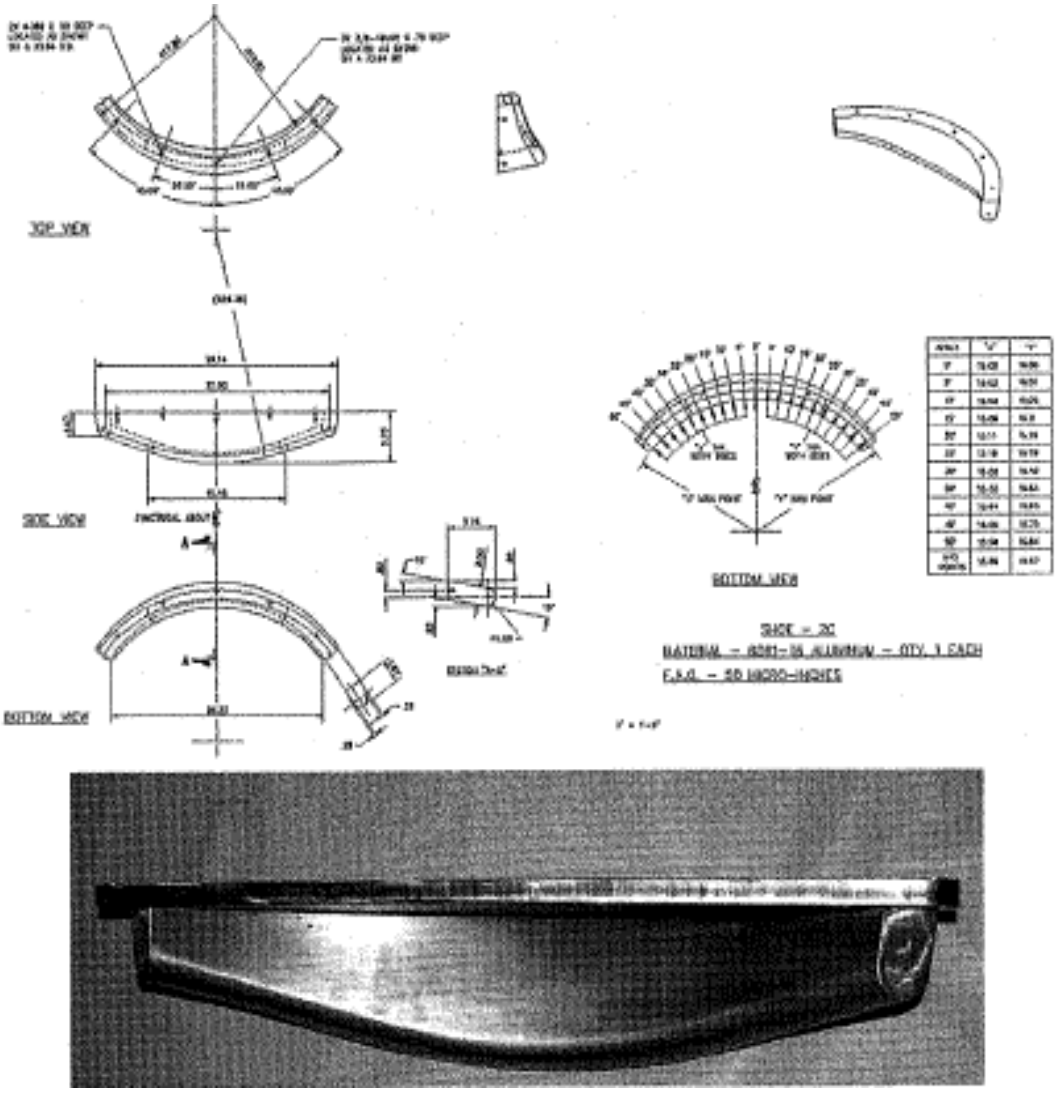


Figure 45: Type 2C Bead Unseating Block and Adaptor

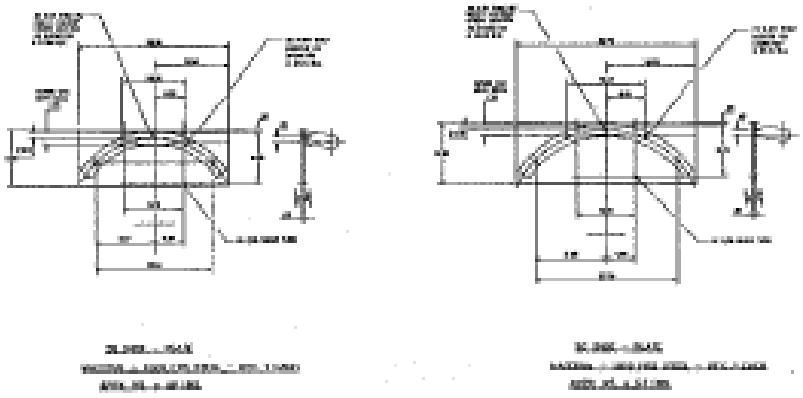


Figure 56: Diagrams of Adaptors for RJS Style Machines

* * *

~~3.7~~3.8 Tyre Rolling Sound Emission Test

3.8.1. Requirements

~~Need to modify this section to reflect new noise limits~~

For tyres which are included within the scope of this gtr, except those with rim diameter code greater than or equal to 25 (635mm), the rolling sound emission value shall not exceed the values given below for tyres of classes C1, C2 and C3, with reference to the categories of use and, where relevant, the nominal section widths, given in the definitions section in paragraph 2 of this gtr.~~For passenger tyres (Class C1), which are included within the scope of this gtr, the rolling sound emission value shall not exceed the values given below. These values apply to both normal and snow tyres and refer to the nominal section width given in paragraph 3 of the definitions section of this gtr standard.~~

~~Note: One dB(A) allowance for extra load or reinforced tyres.~~
~~Two dB(A) allowance for special tyres.~~

Class C1 tyres

Nominal Section Width	Limit dB(A)
185 and lower	70
Over 185 up to 245	71
Over 245 up to 275	72
Over 275	74
The above limits shall be increased by 1 dB(A) for snow tyres for use in severe snow conditions[2], extra load tyres or reinforced tyres, or any combination of these classifications.	

~~Nominal Section Width~~	~~Limit dB(A)~~
~~145 and lower~~	~~72~~
~~Over 145 up to 165~~	~~73~~
~~Over 165 up to 185~~	~~74~~
~~Over 185 up to 215~~	~~75~~
~~Over 215~~	~~76~~

~~For Class C2 tyres, the rolling sound emission value with reference to its category of use shall not exceed:~~

2 (editorial note) 'Snow tyre for use in severe snow conditions' is currently defined in the gtr text. However, this definition could be further refined, if desired, by adopting the new snow tyre definition in UNECE Regulation 117, including the test procedure contained in Annex 7 to that Regulation.

~~Category of use~~	~~Limit dB(A)~~
~~Normal~~	~~75~~
~~Snow~~	~~77~~
~~Special~~	~~78~~

Class C2 tyres

Category of use	Limit dB(A)
Normal	72
Snow*	73
Special	74
* Snow tyres for use in severe snow conditions	

Class C3 tyres

Category of use	Limit dB(A)
Normal	73
Snow*	74
Special	75
*Snow tyres for use in severe snow conditions	

~~For Class C3 tyres, the rolling sound emission value with reference to its category of use shall not exceed:~~

~~Category of use~~	~~Limit dB(A)~~
~~Normal~~	~~76~~
~~Snow~~	~~78~~
~~Special~~	~~79~~

3.8.2. Coast-by Test Method for Measuring Tyre Rolling Sound Emission

The presented method contains specifications on measuring instruments, measurement conditions and the measurement method, in order to obtain the sound level of a set of tyres mounted on a test vehicle rolling on a specified road surface. The maximum sound pressure level is to be recorded, when the test vehicle is coasting, by remote-field microphones; the final result for a reference speed is obtained from a linear regression analysis. Such test results cannot be related to tyre rolling sound measured during acceleration under power or deceleration under braking.

3.8.2.1. Measuring instruments

3.8.2.2. Acoustic measurements

The sound level meter or the equivalent measuring system, including the windscreen recommended by the manufacturer shall meet or exceed the requirements of Type 1 instruments in accordance with IEC 60651:1979/A1:1993, second edition.

The measurements shall be made using the frequency weighting A, and the time weighting F.

When using a system that includes a periodic monitoring of the A-weighted sound level, a reading should be made at a time interval not greater than 30 ms.

3.8.2.3. Calibration

At the beginning and at the end of every measurement session, the entire measurement system shall be checked by means of a sound calibrator that fulfils the requirements for sound calibrators of at least precision Class 1 according to IEC 60942:1988. Without any further adjustment the difference between the readings of two consecutive checks shall be less than or equal to 0.5 dB. If this value is exceeded, the results of the measurements obtained after the previous satisfactory check shall be discarded.

3.8.2.4. Compliance with requirements

The compliance of the sound calibration device with the requirements of IEC 60942:1988 shall be verified once a year and the compliance of the instrumentation system with the requirements of IEC 60651:1979/A1:1993, second edition shall be verified at least every two years, by a laboratory which is authorized to perform calibrations traceable to the appropriate standards.

3.8.2.5. Positioning of the microphone

The microphone (or microphones) must be located at a distance of 7.5 ± 0.05 m from track reference line CC' (Ff~~i~~gure ~~1~~7) and 1.2 ± 0.02 m above the ground. Its axis of maximum sensitivity must be horizontal and perpendicular to the path of the vehicle (line CC').

3.8.3. Speed measurements

The vehicle speed shall be measured with instruments with accuracy of ± 1 km/h or better when the front end of the vehicle has reached line PP' (Ff~~i~~gure ~~1~~7).

3.8.4. Temperature measurements

Measurements of air as well as test surface temperature are mandatory.

The temperature measuring devices shall be accurate within ± 1 °C.

3.8.4.1. Air temperature

The temperature sensor is to be positioned in an unobstructed location close to the microphone in such a way that it is exposed to the airflow and protected from direct solar radiation. The latter may be achieved by any shading screen or similar device. The sensor should be positioned at a height of 1.2 ± 0.1 m above the test surface level,

to minimize the influence of the test surface thermal radiation at low airflows.

3.8.4.2. Test surface temperature

The temperature sensor is to be positioned in a location where the temperature measured is representative of the temperature in the wheel tracks, without interfering with the sound measurement.
If an instrument with a contact temperature sensor is used, heat-conductive paste shall be applied between the surface and the sensor to ensure adequate thermal contact.

If a radiation thermometer (pyrometer) is used, the height should be chosen to ensure that a measuring spot with a diameter of ≥ 0.1 m is covered.

3.8.5. Wind measurement

The device must be capable of measuring the wind speed with a tolerance of ± 1 m/s. The wind shall be measured at microphone height. The wind direction with reference to the driving direction shall be recorded.

3.8.6. Conditions of measurement

3.8.6.1. Test site

The test site must consist of a central section surrounded by a substantially flat test area. The measuring section must be level; the test surface must be dry and clean for all measurements. The test surface shall not be artificially cooled during or prior the testing.

The test track must be such that the conditions of a free sound field between the sound source and the microphone are attained to within 1 dB(A). These conditions shall be deemed to be met if there are no large sound reflecting objects such as fences, rocks, bridges or building within 50 m of the centre of the measuring section. The surface of the test track and the dimensions of the test site shall be in accordance with Appendix ~~2~~ 5 of this ~~Annex~~gtr.

A central part of at least 10 m radius shall be free of powdery snow, tall grass, loose soil, cinders or the like. There must be no obstacle, which could affect the sound field within the vicinity of the microphone and no persons shall stand between the microphone and the sound source. The operator carrying out the measurements and any observers attending the measurements must position themselves so as not to affect the readings of the measuring instruments.

3.8.6.2. Meteorological conditions

Measurements shall not be made under poor atmospheric conditions. It must be ensured that the results are not affected by gusts of wind. Testing shall not be performed if the wind speed at the microphone height exceeds 5 m/s.

Measurements shall not be made if the air temperature is below 5 °C or above 40 °C

or the test surface temperature is below 5 °C or above 50 °C.

3.8.6.3.Ambient noise

3.8.6.3.1. The background sound level (including any wind noise) shall be at least 10 dB(A) less than the measured tyre rolling sound emission. A suitable windscreen may be fitted to the microphone provided that account is taken of its effect on the sensitivity and directional characteristics of the microphone.

3.8.6.3.2. Any measurement affected by a sound peak which appears to be unrelated to the characteristics of the general sound level of tyres, shall be ignored.

3.8.6.4.Test vehicle requirements

3.8.6.4.1. General

The test vehicle shall be a motor vehicle and be fitted with four single tyres on just two axles.

3.8.6.4.2. Vehicle load

The vehicle must be loaded such as to comply with the test tyre loads as specified in paragraph ~~2.5~~3.8.6.5.2. below.

3.8.6.4.3. Wheelbase

The wheelbase between the two axles fitted with the test tyres shall for Class C1 be less than 3.50 m and for Class C2 and Class C3 tyres be less than 5 m.

3.8.6.4.4. Measures to minimize vehicle influence on sound level measurements

To ensure that tyre rolling sound is not significantly affected by the test vehicle design the following requirements and recommendations are given.

3.8.6.4.5. Requirements:

(a) Spray suppression flaps or other extra device to suppress spray shall not be fitted;

(b) Addition or retention of elements in the immediate vicinity of the rims and tyres, which may screen the emitted sound, is not permitted;

(c) Wheel alignment (toe in, camber and caster) shall be in full accordance with the vehicle manufacturer's recommendations;

(d) Additional sound absorbing material may not be mounted in the wheel housings or under the underbody;

(e) Suspension shall be in such a condition that it does not result in an abnormal reduction in ground clearance when the vehicle is loaded in accordance with the testing requirement. If available, body level regulation

systems shall be adjusted to give a ground clearance during testing which is normal for unladen condition.

3.8.6.4.6. Recommendations to avoid parasitic noise:

(a) Removal or modification on the vehicle that may contribute to the background noise of the vehicle is recommended. Any removals or modifications shall be recorded in the test report;

(b) During testing it should be ascertained that brakes are not poorly released, causing brake noise;

(c) It should be ascertained that electric cooling fans are not operating;

(d) Windows and sliding roof of the vehicle shall be closed during testing.

3.8.6.5. Tyres

3.8.6.5.1. General

Four identical tyres shall be fitted on the test vehicle. In the case of tyres with a ~~load capacity index~~load index in excess of 121 and without any dual fitting indication, two of these tyres of the same type and range must be fitted to the rear axle of the test vehicle; the front axle must be fitted with tyres of size suitable for the axle load and planed down to the minimum depth in order to minimize the influence of tyre/road contact noise while maintaining a sufficient level of safety. Winter tyres that in certain Contracting Parties may be equipped with studs intended to enhance friction shall be tested without this equipment. Tyres with special fitting requirements shall be tested in accordance with these requirements (e.g. rotation direction). The tyres must have full tread depth before being run-in.

Tyres are to be tested on rims permitted by the tyre manufacturer.

3.8.6.5.2. Tyre loads

The test load Q_t for each tyre on the test vehicle shall be 50 to 90 per cent of the reference load Q_r, but the average test load $Q_{t,avr}$ of all tyres shall be 75 ± 5 per cent of the reference load Q_r.

For all tyres the reference load Q_r corresponds to the maximum mass associated with the ~~load capacity index~~load index of the tyre. In the case where the ~~load capacity index~~load index is constituted by two numbers divided by a slash (/), reference shall be made to the first number.

3.8.6.5.3. Tyre inflation pressure

Each tyre fitted on the test vehicle shall have a test pressure P_t not higher than the reference pressure P_r and within the interval:

$$P_r \cdot \left(\frac{Q_t}{Q_r}\right)^{1.25} \leq P_t \leq 1.1\, P_r \cdot \left(\frac{Q_t}{Q_r}\right)^{1.25}$$

For Class C2 and Class C3 the reference pressure P_r is the pressure corresponding

to the pressure index marked on the sidewall.

For Class C1 the reference pressure is P_r = 250 kPa for "standard" tyres and 290 kPa for "reinforced" tyres; the minimum test pressure shall be P_t = 150 kPa.

3.8.6.5.4. Preparations prior to testing

The tyres shall be "run-in" prior to testing to remove compound nodules or other tyre pattern characteristics resulting from the moulding process. This will normally require the equivalent of about 100 km of normal use on the road.

The tyres fitted to the test vehicle shall rotate in the same direction as when they were run-in.

Prior to testing tyres shall be warmed up by running under test conditions.

3.8.6.6. Method of testing

3.8.6.6.1. General conditions

For all measurements the vehicle must be driven in a straight line over the measuring section (AA' to BB') in such a way that the median longitudinal plane of the vehicle is as close as possible to the line CC'.

When the front end of the test vehicle has reached the line AA', the vehicle's driver must have put the gear selector on neutral position and switched off the engine. If abnormal noise (e.g. ventilator, self-ignition) is emitted by the test vehicle during the measurement, the test must be disregarded.

3.8.6.6.2. Nature and number of measurements

The maximum sound level expressed in A-weighted decibels (dB(A)) shall be measured to the first decimal place as the vehicle is coasting between lines AA' and BB' (~~f~~Figure ~~1~~7 - front end of the vehicle on line AA', rear end of the vehicle on line BB'). This value will constitute the result of the measurement.

At least four measurements shall be made on each side of the test vehicle at test speeds lower than the reference speed specified in paragraph ~~4.1~~3.8.6.8. and at least four measurements at test speeds higher than the reference speed. The speeds shall be approximately equally spaced over the speed range specified in paragraph ~~4.7~~3.8.6.6.3.

3.8.6.6.3. Test speed range

The test vehicle speeds shall be within the range:

(a) From 70 to 90 km/h for Class C1 and Class C2 tyres;

(b) From 60 to 80 km/h for Class C3 tyres.

3.8.6.7. Interpretation of results

The measurement shall be invalid if an abnormal discrepancy between the values is recorded (see paragraph 4.73.8.6.3.2 above).

3.8.6.8. Determination of test result

Reference speed V_{ref} used to determine the final result will be:

(a) 80 km/h for Class C1 and Class C2 tyres;

(b) 70 km/h for Class C3 tyres.

3.8.6.9. Regression analysis of rolling sound measurements

The tyre-road rolling sound level L_R in dB(A) is determined by a regression analysis according to:

$$L_R = \overline{L} - a \cdot \overline{v}$$

where:

$\overline{L}$ is the mean value of the rolling sound levels L_i, measured in dBb(A):

$$\overline{L} = \frac{1}{n}\sum_{i=1}^{n} L_i$$

n is the measurement number ($n \geq 16$),

$\overline{v}$ is the mean value of logarithms of speeds v_i:

$$\overline{v} = \frac{1}{n}\sum_{i=1}^{n} v_i \quad \text{with} \quad v_i = \lg\left(v_i / v_{ref}\right)$$

"a" is the slope of the regression line in dB(A):

$$a = \frac{\sum_{i=1}^{n}\left(v_i - \overline{v}\right)\left(L_i - \overline{L}\right)}{\sum_{i=1}^{n}\left(v_i - \overline{v}\right)^2}$$

3.8.6.10. Temperature correction

For Class C1 and Class C2 tyres, the final result shall be normalized to a test surface reference temperature ϑ_{ref} by applying a temperature correction, according to the following:

$$L_R(\vartheta_{ref}) = L_R(\vartheta) + K(\vartheta_{ref} - \vartheta)$$

where ϑ = the measured test surface temperature,
ϑ_{ref} = 20 °C,

For Class C1 tyres, the coefficient K is -0.03 db(A)/°C,
-when $\vartheta > \vartheta_{ref}$ and -0.06 dB(A)/°C when $\vartheta < \vartheta_{ref.}$

For Class C2 tyres, the coefficient K is -0.02 dB(A)/°C.

If the measured test surface temperature does not change more than 5 °C within all measurements necessary for the determination of the sound level of one set of tyres, the temperature correction may be made only on the final reported tyre rolling sound level as indicated above, utilizing the arithmetic mean value of the measured temperatures. Otherwise each measured sound level L_i shall be corrected, utilizing the temperature at the time of the sound recording.

3.8.6.11. In order to take account of any measuring instrument inaccuracies, the results according to paragraph ~~4.3~~3.8.6.10. shall be reduced by 1 dB(A).

3.8.6.12. The final result, the temperature corrected tyre rolling sound level $L_R(\vartheta_{ref})$ in dB(A), shall be rounded down to the nearest lower whole value.

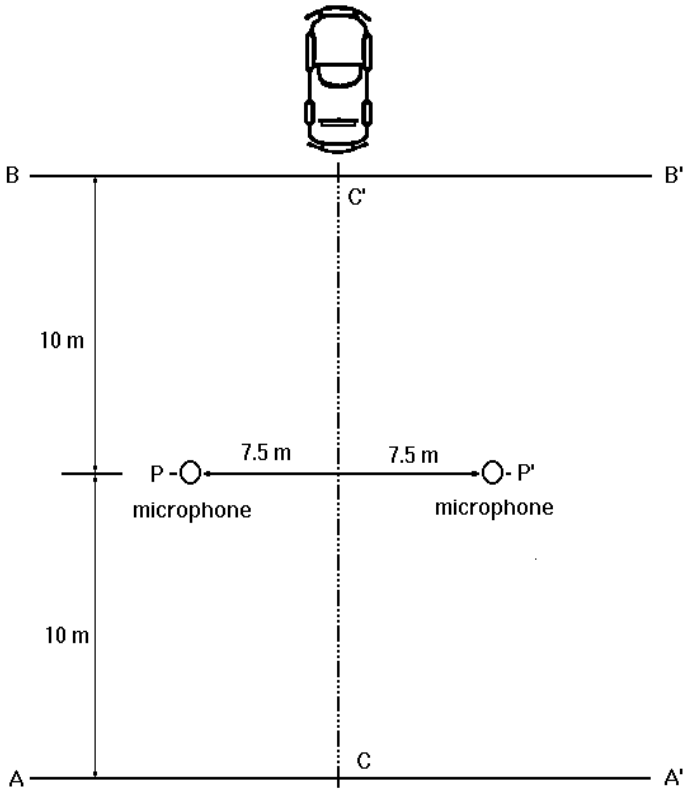


Figure ~~7~~1. Microphone positions for the measurement

~~3.8.7.If a method other than that described in this paragraph is used, it must be demonstrated to be equivalent or more severe.~~

~~3.8.8.~~3.8.7. Test Report – Rolling Sound Emissions for Tyres

Part 1 - Report

~~Type approval authority or Technical Service~~Name of Testing Organization: ……

Name and address of applicant: ……

……..

Test report No.: ……

Manufacturer and Brand Name or Trade description: ……

Tyre Class (C1 or C2 or C3): ……..

Category of use: ……

Sound level according to para~~graphss~~. ~~4.4~~3.8.6.11. and ~~4.5~~3.8.6.12. of ~~Annex 3~~this gtr: ~~……~~……dB(A)
at reference speed of 70/80 km/h 1/

Comments (if any): ……

Date: ……..

Signature: ……

Part 2 - Test data

Date of test: ……..

Test vehicle (Make, model, year, modifications, etc.): ……

……

Test vehicle wheelbase: ……..mm

Location of test track: ……

Date of track certification to ISO 10844:1994: .....

Issued by: .....

Method of certification: ……..

Tyre test details: ……

Tyre size designation: .....

Tyre service description: .....

Reference inflation pressure: .....

Test data

	Front left	Front right	Rear left	Rear right
Test mass (kg)				
Tyre load index (%)				
Inflation pressure (cold) (kPa)				

Test rim width code: .....

Temperature measurement sensor type: .....

Valid Test results:

Run No.	Test Speed km/h	Direction of run	Sound level left 2/ measured dB(A)	Sound level right 2/ measured dB(A)	Air temp. °C	Track temp °C	Sound level left 2/ temp. corrected dB(A)	Sound level right 2/ temp. corrected dB(A)	Comments
1									
2									
3									
4									
5									
6									
7									
8									

Regression line slope: .....

Sound level after temperature correction according to paragraph ~~4.3~~3.8.6.10: ……dB(A)

1/ Strike out what does not apply.
2/ Relative to the vehicle.

* * *

~~3.8 Section II. Regulation for Passenger Car Tyres~~

~~3.9~~

~~3.10~~

~~3.11~~3.9 Endurance Test ~~[f~~For passenger car tyres~~]~~

3.9.1. Requirements

3.9.1.1. The following requirements shall be met by all ~~radial~~ passenger tyres when tested in accordance with the procedures ~~(4.8.2 and 4.8.3) given~~described in paragraphs 3.9.2. and 3.9.3. below.

3.9.1.2. There shall be no visible evidence of tread, sidewall, ply, cord, inner liner, belt or bead separation, chunking, open splices, cracking or broken cords.

3.9.1.3. The tyre pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in paragraph 3.9.2.~~The tyre pressure, measured no less than 60 minutes after the test, shall not be less than the initial pressure specified in paragraph 4.8.2 below.~~

3.9.2. Preparation of Tyre

Mount the tyre on a test rim and inflate it to the pressure specified in the table below.

Endurance Test Tyre Inflation Pressures	Tyre Application	Test Pressure (kPa)
	Standard Load, Light Load	180
	Reinforced or Extra Load	220

3.9.2.1. Condition the assembly at 32 to 38 °C for not less than 3 hours.~~Condition the assembly at an ambient temperature of not less than 38o C for at least three hours.~~

3.9.2.2. Readjust the pressure to the value specified in the table in paragraph 3.9.2 immediately before testing.

3.9.3. Test Procedure

3.9.3.1. Mount the assembly on a test axle and apply a load as given in paragraph 3.9.3.3 below to load it against the outer face of a smooth wheel having a diameter of 1.7 m +/- 1%.

3.9.3.2. During the test the ambient temperature, at a distance of not less than 150 mm and not more than 1 m from the tyre, is maintained at not less than 32 °C or more than 38 °C.~~shall~~

~~be at least 38° C.~~

3.9.3.3. Conduct the test, without interruptions, at not less than 120 km/h (110 km/h for snow tyres marked with the three-peaked mountain-snowflake symbol) test speed with loads and test periods not less than those shown in the table below:

Radial passenger tyres

Test period	Duration	Load as a percentage of tyre maximum load capacity
1	4 h	85%
2	6 h	90%
3	24 h	100%

3.9.3.4. Throughout the test the inflation pressure shall not be corrected and the test loads shall be kept constant at the value corresponding to each test period.

3.9.3.5. Allow the tyre to cool for one hour after running the tyre for the time specified in the table above, measure its inflation pressure. Inspect the tyre externally on the test rim for the conditions specified in section 3.9~~4.8~~.1 above.

~~3.12~~

~~3.13~~3.10 Low Inflation Pressure Performance Test for Passenger Car Tyres

3.10.1. Requirements

The following requirements shall be met by radial tyres when tested in accordance with the procedure given in paragraph ~~4.9~~3.10.3 below.

3.10.1.1. There shall be no visible evidence of tread, sidewall, ply, cord, inner liner, belt or bead separation, chunking, open splices, cracking or broken cords.

3.10.1.2. The tyre pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in paragraph 3.10.2. below.~~The tyre pressure, measured no less than 60 minutes after the test, shall not be less than the initial pressure specified in paragraph 4.9.2 below.~~

3.10.2. Preparation of tyre

This test is conducted following completion of the tyre endurance test using the same

tyre and rim assembly tested in accordance with section ~~4.7~~3.9. above, with the tyre deflated to the following pressures show in the table below:

Low Inflation Pressure Performance test
Inflation Pressure Chart for Passenger Tyres

Low Inflation Pressure Performance Pressures	Tyre Application	Test Pressure kPa
Passenger Tyres	Standard Load, Light Load	140
	Reinforced, Extra Load	160

3.10.2.1. After the tyre is deflated to the appropriate test pressure in paragraph 3.10.2. at the completion of the endurance test, condition the assembly at 32 to 38 °C for not less than 2 hours.~~The assembly is conditioned at not less than 38°C.~~

3.10.2.2. Before or after mounting the assembly on a test axle, readjust the tyre pressure to that specified in the table in paragraph ~~4.9~~3.10.~~.~~2.

3.10.3. Test Procedure

3.10.3.1. The test is conducted for ninety minutes at the end of the test specified in section 4.8, continuous and uninterrupted, at a speed of 120 km/h.

3.10.3.2. Press the assembly against the outer face of a test drum with a diameter of 1.7 m +/- 1%.

3.10.3.3. Apply to the test axle a load equal to 100% of the tyre's maximum load rating.

3.10.3.4. Throughout the test, the inflation pressure is not corrected and the test load is maintained at the initial level.

3.10.3.5. During the test, the ambient temperature, at a distance of not less than 150 mm and not more than 1 m from the tyre, is maintained at not less than 32°C or more than 38°C.

3.10.3.6. Allow the tyre to cool for one hour. Measure its inflation pressure. Then deflate the tyre, remove it from the test rim, and inspect it for the conditions specified in paragraph ~~4.9~~3.10.1~~[~~.1~~]~~ above.

~~3.14~~

~~3.15~~3.11 High Speed Performance Test ~~[f~~For Passenger Car Tyres~~]~~

3.11.1. Requirements; When the tyre is tested in accordance with paragraph 3.11.3 or 3.11.4.;

3.11.1.1. There shall be no visible evidence of tread, sidewall, ply, cord, inner liner, belt or bead separation, chunking, open splices, cracking or broken cords. For tyres tested at a speed of 300 km/h (speed category "Y") or above, superficial blistering in the tyre

tread due to localized heat build-up in the test drum is acceptable.

3.11.1.2. The tyre pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure.

3.11.1.3. The outer diameter of the tyre, measured **[six hours]** after the load/speed performance test, must not differ by more than ± 3.5% from the outer diameter as measured before the test.

~~3.11.1.3.~~3.11.1.4. For tyres identified by means of letter code "ZR" within the size designation and suitable for speeds over 300 km/h, the above high speed test is carried out on one tyre at the load and speed conditions marked on the tyre. Another load/speed test must be carried out on a second sample of the same tyre type at the load and speed conditions specified as maximum by the tyre manufacturer. The second test may be carried out on the same tyre sample if the tyre manufacturer agrees.

3.11.2. ~~———~~Preparation of the Tyres With Speed Symbols "S" and Below, excluding "H"

3.11.2.1. For tyres with a speed symbol "S" and below, excluding "H", mount the tyre on a test rim and inflate it to the appropriate pressure specified in the table below:

Inflation Pressure and test load

	Inflation Pressure, kPa		Test Load in kg
Speed Symbol	Standard Load, Light Load	Reinforced, Extra Load	
L, M, N, P, Q, R, S	220	260	85% of the ~~load capacity index~~load index

3.11.2.2. Condition the assembly at 32°C to 38°C for not less than three hours.

3.11.2.3. Before or after mounting the assembly on a test axle, readjust the tyre pressure to that specified in the table above in ~~4.9.~~3.11.2.1.

3.11.3. Test ~~P~~procedure for t~~T~~yres w~~W~~ith s~~S~~peed ~~S~~symbols "S" and ~~B~~below, excluding "H"

3.11.3.1. Press the assembly against the outer face of a test drum with a diameter of 1.7 m +/- 1%.

3.11.3.2. Apply to the test axle a load equal to 85% of the tyre's maximum load carrying capacity.

3.11.3.3. Break-in the tyre by running it for 2 hours at 80 km/h.

3.11.3.4. Allow the tyre to cool to 38° C and readjust inflation pressure to applicable pressure in table in ~~1.6.1~~3.11.2.1 above immediately before the test.

3.11.3.5. Throughout the test, the inflation pressure is not corrected and the test load is maintained

at the value applied in paragraph ~~4.9~~3.11.2.1.

3.11.3.6. During the test, the ambient temperature, measured at a distance of not less than 150 mm and not more than 1 m from the tyre, shall be maintained at not less than 32°C or more than 38° C.

3.11.3.7. The test is conducted, continuously and uninterrupted, for ninety minutes through three thirty-minute consecutive test stages at the following speeds: 140, 150, and 160 km/h.

3.11.3.8. Allow the tyre to cool for between 15 minutes and 25 minutes. Measure its inflation pressure. Then, deflate the tyre, remove it from the test rim, and inspect it for the conditions specified in paragraph ~~Allow the tyre to cool for one hour. Measure its inflation pressure. Then, deflate the tyre, remove it from the test rim and inspect it for the conditions specified in Section 4.9~~3.11.1.1. above.

3.11.4. ~~———~~Preparation of ~~Tyres~~ tyres w~~W~~ith ~~S~~speed ~~S~~symbols "T" and ~~A~~above, including "H"

3.11.4.1. Mount a new tyre on the test rim specified by the manufacturer as the "measuring rim and test rim".

3.11.4.2. Inflate it to the appropriate pressure as given (in kPa) in the table below:

Inflation pressure and test load

	Inflation Pressure, kPa		
Speed Symbol	Standard Load, Light Load	Reinforced, Extra Load	Test Load ~~in kg~~
T, U, H	280	320	80% of the ~~load capacity index~~load index
V	300	340	73% of the ~~load capacity index~~load index
W	320	360	68% of the ~~load capacity index~~load index
Y	320	360	68% of the ~~load capacity index~~load index

3.11.4.3. Condition the tyre~~-~~ and ~~-~~wheel assembly at test~~-~~ room temperature for not less than three hours.

3.11.4.4. Re-adjust the tyre pressure to that specified in paragraph ~~4.9~~3.11.4.2 above.

3.11.5. Test ~~P~~procedure for ~~T~~tyres w~~W~~ith s~~S~~peed s~~S~~ymbols "T" and a~~A~~bove, including "H"

3.11.5.1. Press the assembly against the outer face of ~~the~~ 1.7 m ± 1% or 2.0 m ± 1% test drum.

3.11.5.2. Depending upon the speed symbol applicable to the tyre, apply to the test axle, a load

equal to ~~80% of:~~that shown in the table in paragraph 3.11.4.. above.

~~3.11.5.3. The maximum load rating equated to the Load Capacity for tyres with Speed Symbols "T" to "H" inclusive.~~

~~3.11.5.4. The maximum load rating associated with a maximum speed of 240 km/h for tyres Speed Symbol "V"; equal to 91% of the load capacity index.~~

~~3.11.5.5. The maximum load rating associated with a maximum speed of 270 km/h for tyres with speed symbol "W"; equal to 85% of the load capacity index.~~

~~3.11.5.6. The maximum load rating associated with a maximum speed of 300 km/h for tyres with speed symbol "Y"; equal to 85% of the load capacity.~~

~~3.11.5.7.~~3.11.5.3. Throughout the test the tyre pressure shall not be corrected and the test load shall be kept constant.

~~3.11.5.8.~~3.11.5.4. During the test the temperature in the test-room shall be maintained at between 20° and 30° C or at a higher temperature if the manufacturer desires to increase test severity.

~~3.11.5.9.~~3.11.5.5. Carry the test through, without interruptions as follows, in relation to the tyre's speed symbol:

~~3.11.5.10.~~3.11.5.6. The initial test speed (ITS) is equal to the tyre's speed symbol,

- less 40 km/h on a 1.70 m ± 1% drum, or
- less 30 km/h on a 2.0 m ± 1% drum.

3.11.6. For tyres of speed symbol "T" through "W", inclusive, including "H";

3.11.6.1. Accelerate the equipment at a constant rate such that the initial test speed (ITS) is reached at the end of 10 minutes from start-up.

- then, at the ITS for 10 minutes.
- then, at the ITS plus 10 km/h for 10 minutes.
- then, at the ITS plus 20 km/h for 10 minutes.
- then, at the ITS plus 30 km/h for 20 minutes;

3.11.6.2. For tyres of speed symbol "Y": Accelerate the equipment at a constant rate such that the initial test speed (ITS) is reached at the end of 10 minutes from start-up.

- then, at the ITS for 20 minutes.
- then, at the ITS plus 10 km/h for 10 minutes.
- then, at the ITS plus 20 km/h for 10 minutes.
- then, at the ITS plus 30 km/h for 10 minutes.

3.11.7. For tyres with "ZR" in the size designation intended for use at speeds greater than 300 km/h;

3.11.7.1. Test the tyre at the load and inflation for a speed symbol "Y" tyre according to the procedures specified above in paragraphs 3.11.4.2.~~4.9.4~~ and 3.11.6.2.~~4.9.5~~ above.

3.11.7.2. Test a further sample of the same type according to:

Inflate the tyre to 320 kPa for standard load or light load and 360 kPa for reinforced/extra load. Apply a load to the test axle that is equal to 80% of the load capacity specified by the tyre manufacturer. Accelerate the equipment at a constant rate such that the rated speed of the tyre is reached at the end of 10 minutes from the start-up. Then test at the rated speed for 5 minutes.

~~NOTE: paragraphs [4.9.6.1] above may be carried out on the same tyre if the tyre manufacturer agrees.~~

~~3.11.8. If a method other than that described in this section is used, its equivalence or greater severity must be demonstrated.~~

~~3.16~~3.12 Test for Adhesion Performance on Wet Surfaces

3.12.1. Requirements

Passenger tyres (Class C1 tyres) shall meet the following requirements:

Category of use	Wet grip index (G)
snow tyre with a speed symbol ("Q" or below) indicating a maximum permissible speed not greater than 160 km/h	≥ 0.9
snow tyre with a speed symbol ("R" and above) indicating a maximum permissible speed greater than 160 km/h	≥ 1.0
normal (road type) tyre	≥ 1.1

3.12.2. General Test Conditions

3.12.2.1. Track characteristics

3.12.2.1.1. The track shall have a dense asphalt surface with a gradient in any direction not exceeding 2 per cent. It shall be of uniform age, composition, and wear and shall be free of loose material or foreign deposits. The maximum chipping size shall be 10 mm (tolerances permitted from 8 mm to 13 mm) and the sand depth measured as specified in ASTM standard E 965-96 (2006) shall be 0.7 ± 0.3 mm.

The surface friction value for the wetted track shall be established by one or other of the following methods:

3.12.2.1.1.1. Standard reference test tyre (SRTT) method
When tested using the SRTT and the method given in paragraph ~~2.1.~~3.12.3.1.~~2.1.~~. the average peak brake force coefficient (pbfc) shall be between 0.6 and 0.8. The measured values shall be corrected for the effects of temperature as follows:

$$pbfc = pbfc\ (measured) + 0.015(t - 20)$$

where "t" is the wetted track surface temperature in degrees Celsius.
The test shall be conducted using the lanes and length of the track to be used for the wet grip test;

3.12.2.1.1.2. British pendulum number (B~~N~~PN) method
The averaged British pendulum number (BPN) of the wetted track, measured in accordance with the procedure given in the ASTM standard E 303-93 (2008) and using the pad as specified in ASTM standard E 501-08, shall be between 40 and 60 after temperature correction. Unless temperature correction recommendations are indicated by the pendulum manufacturer, the following formula can be used:

$$BPN = BPN\ (measured\ value) + 0.34 * t - 0.0018 * t^2 - 6.1$$

where "t" is the wetted track surface temperature in degrees Celsius.

In the lanes of the track to be used during the wet grip tests, the BPN shall be measured at intervals of 10 m along the length of the lanes. The BPN shall be measured 5 times at each point and the coefficient of variation of the BPN averages shall not exceed by 10 per cent.

3.12.2.1.2. The ~~type approval authority~~testing organization shall satisfy itself of the characteristics of the track on the basis of evidence produced in test reports.

3.12.2.2. Wetting conditions

The surface may be wetted from the track-side or by a wetting system incorporated into the test vehicle or the trailer.
If a track-side system is used, the test surface shall be wetted for at least half an hour prior to testing in order to equalize the surface temperature and water temperature. It is recommended that track-side wetting be continuously applied throughout testing.
The water depth shall be between 0.5 and 1.5 mm.

3.12.2.3. The wind conditions shall not interfere with wetting of the surface (wind-shields are permitted).

The wetted surface temperature shall be between 5 °C and 35 °C and shall not vary during the test by more than 10 °C.

3.12.3. Test Procedures

The comparative wet grip performance shall be established using either:

a) A trailer or special purpose tyre evaluation vehicle; or

b) A standard production passenger carrying vehicle (~~M_1 category as defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.) contained in TRANS/WP.29/78/Rev.1/Amend.2 as last amended by Amend.4~~[KH10])Category 1-1 vehicle as defined in Special Resolution N° 1, Document TRANS/WP29/1045).

3.12.3.1. Trailer or special purpose tyre evaluation vehicle procedure

3.12.3.1.1. The trailer, together with the towing vehicle, or the tyre evaluation vehicle shall comply with the following requirements :

3.12.3.1.1.1. Be capable of exceeding the upper limit for the test speed of 67 km/h and of maintaining the test speed requirement of 65 ± 2 km/h at the maximum level of application of braking forces;

3.12.3.1.1.2. Be equipped with an axle providing one test position having an hydraulic brake and actuation system that can be operated from the towing vehicle if applicable. The braking system shall be capable of providing sufficient braking torque to achieve the peak brake force coefficient over the range of tyre sizes and tyre loads to be tested;

3.12.3.1.1.3. Be capable of maintaining longitudinal alignment (toe) and camber of the test wheel and tyre assembly throughout the test within ± 0.5 ° of the static figures achieved at the test tyre loaded condition;

3.12.3.1.1.4. In the case of a trailer, the mechanical coupling device between the towing vehicle and trailer shall be such that, when the towing vehicle and trailer are coupled together, the drawbar, or part of the drawbar, of a trailer that incorporates the braking force measurement sensing is horizontal or slopes downwards from rear to front at a maximum angle of 5 º. The longitudinal distance from the centre line of the articulation point of the coupling (hitch) to the transverse centre line of the axle of the trailer shall be at least ten times the coupling (hitch) height;

3.12.3.1.1.5. In the case of vehicles that incorporate a track wetting system, the water delivery nozzle(s) shall be such that the resulting water film is of uniform section extending at least 25 mm beyond the width of the tyre contact patch. The nozzle(s) shall be directed downwards at an angle of 20 ° to 30 ° and shall contact the track surface between 250 mm and 450 mm in front of the centre of the tyre contact patch. The height of the nozzle(s) shall be 25 mm or the minimum to avoid any obstacles on the track surface without exceeding a maximum of 100 mm. Water delivery rate shall ensure a water depth of 0.5 mm to 1.5 mm and shall be consistent throughout the test to within ± 10 per cent. Note that a typical rate for testing at 65 km/h will be 18 ls^{-1} per metre of wetted track surface width.

The system shall be able to deliver the water such that the tyre, and track surface in front of the tyre, is wetted before the start of braking and throughout the duration of the test.

3.12.3.1.2. Test Procedure for trailer or special purpose vehicle

3.12.3.1.2.1. The test tyre shall be trimmed to remove any moulding protrusions that are likely to affect the test.

3.12.3.1.2.2. The test tyre shall be mounted on the test rim declared by the tyre manufacturer in the approval application and shall be inflated to 180 kPa in the case of the SRTT and standard load tyre or 220 kPa in the case of a reinforced or extra load tyre.

3.12.3.1.2.3. The tyre shall be conditioned for a minimum of two hours adjacent to the test track such that it is stabilized at the ambient temperature of the test track area. The tyre(s) shall not be exposed to direct sunshine during conditioning.

3.12.3.1.2.4. The tyre shall be loaded to :

a) Between 445 kg and 508 kg in the case of the SRTT; and

b) Between 70 per cent and 80 per cent of the load value corresponding to the load index of the tyre in any other case.

3.12.3.1.2.5. Shortly before testing, the track shall be conditioned by carrying out at least ten braking tests on the part of the track to be used for the performance test programme but using a tyre not involved in that programme.

3.12.3.1.2.6. Immediately prior to testing, the tyre inflation pressure shall be checked and reset, if necessary, to the values given in paragraph 3.12.3.

3.12.3.1.2.7. The test speed shall be between 63 km/h and 67 km/h and shall be maintained between these limits throughout the test run.

3.12.3.1.2.8. The direction of the test shall be the same for each set of tests and shall be the same for the test tyre as that used for the SRTT with which its performance is to be compared.

3.12.3.1.2.9. The brakes of the test wheel assembly shall be applied such that peak braking force is achieved within 0.2 s and 0.5 s of brake application.

3.12.3.1.2.10. In the case of a new tyre, two test runs shall be carried out to condition the tyre. These tests may be used to check the operation of the recording equipment but the results shall not be taken into account in the performance assessment.

3.12.3.1.2.11. For the evaluation of the performance of any tyre compared with that of the SRTT, the braking test shall be carried out from the same point and in the same lane of the test track.

3.12.3.1.2.12. The order of testing shall be :

R1 – T – R2
Where
R1 is the initial test of the SRTT, R2 is the repeat test of the SRTT and T is the test of the candidate tyre to be evaluated

A maximum of three candidate tyres may be tested before repeating the SRTT test, for example:
R1–T1 – T2 – T3 – R2

3.12.3.1.2.13. The average value of peak brake force coefficient (pbfc) shall be calculated over at least six valid results.

For results to be considered to be valid, the coefficient of variation as determined by the standard deviation divided by the average result, expressed as a percentage, shall be within 5 percent. If this cannot be achieved with the repeat testing of the SRTT, the evaluation of the candidate tyre(s) shall be discarded and the en~~tire~~tyre order of testing shall be repeated.

3.12.3.1.2.14. Using the value of the average pbfc for each series of test runs:

In the case of the order of testing R1 – T – R2, the pbfc of the SRTT to be used in the comparison of the performance of the candidate tyre shall be taken to be:

(R1 + R2)/2

where:

R1 is the average pbfc for the first series of test runs of the SRTT and R2 is the average pbfc for the second series of test runs of the SRTT.

In the case of the order of testing R1 – T1 – T2 – R2, the pbfc of the SRTT shall be taken to be:

2/3 R1 + 1/3 R2 for comparison with the candidate tyre T1 and

1/3 R1 + 2/3 R2 for comparison with the candidate tyre T2

In the case of the order of testing R1 – T1 – T2 – T3 – R2, the pbfc of the SRTT shall be taken to be:

3/4 R1 + 1/4 R2 for comparison with the candidate tyre T1

(R1 + R2)/2 for comparison with the candidate tyre T2 and

1/4 R1 + 3/4 R2 for comparison with the candidate tyre T3

3.12.3.1.2.15. The wet grip index (G) shall be calculated as:

$$G = \frac{\text{pbfc of candidate tyre}}{\text{pbfc of SRTT}}$$

3.12.3.2. Standard vehicle procedure

3.12.3.2.1. The vehicle shall be a standard Category 1-1 vehicle as defined in Special Resolution N° 1, Document TRANS/WP29/1045~~M_1 category vehicle~~, capable of a minimum speed of 90 km/h and equipped with an anti-lock braking system (ABS).

3.12.3.2.1.1. The vehicle shall not be modified except:

(a) To allow the fitting of an increased range of wheel and tyre sizes;

(b) To allow mechanical (including hydraulic, electrical or pneumatic) operation of the service brake control. The system may be operated automatically by signals from devices incorporated in, or adjacent to, the track.

3.12.3.2.2. Test procedure using standard vehicle

3.12.3.2.2.1. The test tyres shall be trimmed to remove any moulding protrusions that are likely to affect the test

3.12.3.2.2.2. The test tyre shall be mounted on the test rim declared by the tyre manufacturer in the approval application and shall be inflated to 220 kPa in all cases.

3.12.3.2.2.3. The tyre shall be conditioned for a minimum of two hours adjacent to the test track such that it is stabilized at the ambient temperature of the test track area. The tyre(s) shall not be exposed to direct sunshine during conditioning

3.12.3.2.2.4. The static load on the tyre shall be:

(a) Between 381 kg and 572 kg in the case of the SRTT; and

(b) Between 60 per cent and 90 per cent of the load value corresponding to the load index of the tyre in any other case.

The variation in load on tyres on the same axle shall be such that the load borne by the more lightly loaded tyre shall not be less than 90 per cent of that of the tyre bearing the greater load.

3.12.3.2.2.5. Shortly before testing, the track shall be conditioned by carrying out at least ten braking tests from 90 km/h to 20 km/h on the part of the track to be used for the performance test programme but using tyres not involved in that programme.

3.12.3.2.2.6. Immediately prior to testing, the tyre inflation pressure shall be checked and reset, if necessary, to the values given in paragraph 3.12.3.2.2.2.

3.12.3.2.2.7. Starting from an initial speed of between 87 km/h and 83 km/h, a constant force sufficient to cause operation of the ABS on all wheels of the vehicle and to result in stable deceleration of the vehicle prior to the speed being reduced to 80 km/h, shall be applied to the service brake control and this force shall be maintained until the vehicle has been brought to rest.

The braking test shall be carried out with the clutch of a manual transmission disengaged or with the selector of an automatic transmission in the neutral position.

3.12.3.2.2.8. The direction of the test shall be the same for each set of tests and shall be the same for the candidate test tyre as that used for the SRTT with which its performance is to be compared.

3.12.3.2.2.9. In the case of new tyres, two test runs shall be carried out to condition the tyres. These tests may be used to check the operation of the recording equipment but the results shall not be taken into account in the performance assessment.

3.12.3.2.2.10. For the evaluation of the performance of any tyre compared with that of the SRTT, the braking test shall be carried out from the same point and in the same lane of the test track.

3.12.3.2.2.11. The order of testing shall be:

R1 – T – R2

where:

R1 is the initial test of the SRTT, R2 is the repeat test of the SRTT and T is the test of the candidate tyre to be evaluated.

A maximum of three candidate tyres may be tested before repeating the SRTT test, for example:

R1–T1 – T2 – T3 - R2

3.12.3.2.2.12. The mean fully developed deceleration (mfdd) between 80 km/h and 20 km/h shall be calculated for at least three valid results in the case of the SRTT and 6 valid results in the case of the candidate tyres.

The mean fully developed deceleration (mfdd) is given by:

mfdd = 231.48 / S

where:

S is the measured stopping distance in metres between 80 km/h and 20 km/h.

For results to be considered to be valid, the coefficient of variation as determined by the standard deviation divided by the average result, expressed as a percentage, shall be within 3 per cent. If this is cannot achieved with the repeat testing of the SRTT, the evaluation of the candidate tyre(s) shall be discarded and the en~~tire~~tyre order of testing shall be repeated.

The average of the calculated values of mfdd shall be determined for each series of test runs.

3.12.3.2.2.13. Using the value of the average mfdd for each series of test runs:

In the case of the order of testing R1 – T – R2, the mfdd of the SRTT to be used in the comparison of the performance of the candidate tyre shall be taken to be:

(R1 + R2)/2

where:

R1 is the average mfdd for the first series of test runs of the SRTT and R2 is the average mfdd for the second series of test runs of the SRTT

In the case of the order of testing R1 – T1 – T2 – R2, the mfdd of the SRTT shall be taken to be:

2/3 R1 + 1/3 R2 for comparison with the candidate tyre T1 and

1/3 R1 + 2/3 R2 for comparison with the candidate tyre T2

In the case of the order of testing R1 – T1 – T2 – T3 – R2, the mfdd of the SRTT shall be taken to be:

3/4 R1 + 1/4 R2 for comparison with the candidate tyre T1

(R1 + R2)/2 for comparison with the candidate tyre T2 and

1/4 R1 + 3/4 R2 for comparison with the candidate tyre T3

3.12.3.2.2.14. The wet grip index (G) shall be calculated as:

$$G = \frac{\text{average mfdd of candidate tyre}}{\text{mfdd of SRTT}}$$

3.12.3.2.2.15. In the case where the candidate tyres cannot be fitted to the same vehicle as the SRTT, for example, due to tyre size, inability to achieve required loading and so on, comparison shall be made using intermediate tyres, hereinafter referred to as "control tyres", and two different vehicles. One vehicle shall be capable of being fitted with the SRTT and the control tyre and the other vehicle shall be capable of being fitted with the control tyre and the candidate tyre.

3.12.3.2.2.15.1. The wet grip index of the control tyre relative to the SRTT (G1) and of the candidate tyre relative to the control tyre (G2) shall be established using the procedure in paragraphs 3.12.3.2.2.1 to 3.12.3.2.2.15.

The wet grip index of the candidate tyre relative to the SRTT shall be the product of the two resulting wet grip indices, that is G1 x G2.

3.12.3.2.2.15.2. The track, and the portion of the track, shall be the same for all of the tests and the ambient conditions shall be comparable, for example, the surface temperature of the wetted track shall be within ± 5 °C. All tests shall be completed within the same day.

3.12.3.2.2.15.3. The same set of control tyres shall be used for comparison with the SRTT and with the candidate tyre and shall be fitted in the same wheel positions.

3.12.3.2.2.15.4. Control tyres that have been used for testing shall subsequently be stored under the same conditions as required for the SRTT.

3.12.3.2.2.16. The SRTT and control tyres shall be discarded if there is irregular wear or damage or when the performance appears to have deteriorated.

3.12.4. T~~EST REPORT~~est Report (Adhesion on wet surface)

Part 1 – Report

Name of Testing Organization: .....

Name and address of applicant: .....

Test report No.: .....

Manufacturer and brand name or trade description: .....

Tyre Class (C1): .....

Category of use: .....

Adhesion coefficient on wet surfaces relative to SRTT according to paragraphs ~~2.1.2.15~~3.12.3.1.2.15. or ~~2.2.2.15~~3.12.3.2.2.14.:

Comments (if any): .....

Date: .....

Signature: .....

Part 2 - Test data

Date of test: .....

Test vehicle (make, model, year, modifications, etc. or trailer identification): .....

Location of test track: .....

Test track characteristics: .....

Issued by: .....

Method of certification: .....

Test tyre details: .....

Tyre size designation and service description: .....

Tyre brand and trade description: .....

Reference inflation pressure: kPa .....

Test data: .....

Tyre	SRTT	Candidate	Control
Test tyre load (kg)			
Water depth (mm) (from 0.5 to 1.5 mm)			
Wetted track temperature average (^{o}C) (from 5 to 35 °C)			

Test rim width code: .....

Temperature measurement sensor type: .....

Identification of the SRTT: .....

Valid test results: .....

Run No	Test Speed (Km/h)	Direction of run	SRTT	Candidate tyre	Control tyre	Peak brake force coefficient (pbfc)	Mean fully developed deceleration (mfdd)	Wet Grip index (G)	Comments
1									
2									
3									
4									
5									
6									
7									
8									

~~3.17~~3.13 Procedure to assess the flat tyre running mode of run flat tyres

For run flat tyres identified by means of letter code "RF" within the size designation a load/speed test must be carried out as specified in paragraph 3.13.1 below.

If a run flat tyre which, after undergoing the test as specified below in paragraph 3.13.1, does not exhibit a change in the deflected section height, compared to the deflected section height at the start of the test, higher than 20 per cent and retains the tread connected to the two sidewalls, it is deemed to have passed the test.

3.13.2. Test Procedure

3.13.2.1. Mount a new tyre on the test rim specified by the manufacturer.

3.13.2.2. Condition the tyre at 38ºC +/- 3ºC and 250 kPa for three hours.

3.13.2.3. Remove the valve core and wait until the tyre deflates completely.

3.13.2.4. Mount the tyre-and-wheel assembly to a test axle and press it against the outer surface of a smooth wheel 1.70 m ± 1 per cent or 2.0 m ± 1 per cent in diameter.

3.13.2.5. Apply to the test axle a load equal to 65 percent of the maximum load rating corresponding to the load index of the tyre.

3.13.2.6. At the start of the test, measure the deflected section height (Z1).

3.13.2.7. During the test the temperature of the test room must be maintained at 38°C ± 3°C.

3.13.2.8. Carry the test through, without interruption in conformity with the following particulars:

3.13.2.9.

Time taken to pass from zero speed to constant test speed: 5 minutes;

Test speed: 80 km/h; Duration of test at the test speed: 60 minutes.

3.13.2.10. At the end of the test, measure the deflected section height (Z2).

3.13.2.11. Calculate the change in percent of the deflected section height compared to the deflected section height at the start of the test as ((Z1 – Z2) / Z1) x 100.

~~3.18~~3.14 Strength Test for LT/C Tyres (from FMVSS 119)

3.14.1. Requirements

When tested according to the procedure described in this section, LT/C tyres must have an average strength of not less than the values shown in the table below:

	Tyres other than CT tyres							
	psi			kPa				
Size designation	32	36	40	240	280	300	340	350
Below 160 mm:								
(in-lbs)	1,950	2,925	3,900	1,950	3,900	1,950	3,900	1,950
(joules)	220	330	441	220	441	220	441	220
160 mm or above:								
(in-lbs)	2,600	3,900	5,200	2,600	5,200	2,600	5,200	2,600
(joules)	294	441	588	294	588	294	588	294

3.14.2. Preparation of tyre

Mount the tyre on a test rim and inflate it to the applicable pressure specified in the table below;

Maximum Tyre Inflation Pressure	psi				kPa				
	32	36	40	60	240	280	300	340	350
Test Pressure	24	28	32	52	180	220	180	220	180

Condition it at room temperature for at least 3 hours and readjust the inflation pressure to that specified above.

FMVSS 571.119 Plunger Table

		All Motorcycle		Rim diameter <= 12		Light Truck and tubeless <=17.5 rim diameter		All other						
								Tube type		Tubeless		Tube type		
Plunger Rod Diameter		7.94 mm	5/16"	19.05 mm	¾"	19.05 mm	¾"	31.75 mm	1 ¼"	31.75 mm	1 ¼"	38.10 mm	1 ½"	
Breaking Energy		J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs	
Load Range:	A	16	150	67	600	225	2000							
	B	33	300	135	1200	293	2600							
	C	45	400	203	1800	361	3200	768	6800	576	5100			
	D			271	2400	514	4550	892	7900	734	6500			
	E			338	3000	576	5100	1412	12,500	971	8600			

3.14.3. Test Procedure

~~Test procedure~~

3.14.3.1. Force a 19 mm (3/4inch) diameter cylindrical steel plunger with a hemispherical end perpendicularly into the tread rib as near to the centerline as possible,

avoiding penetration into the tread groove, at the rate of 50 mm (2 inches) per minute.

3.14.3.2. Record the force and penetration at five test points equally spaced around the circumference of the tyre. If the tyre fails to break before the plunger is stopped by reaching the rim, record the force and penetration as the rim is reached and use these values in 3.14.3.3.

3.14.3.3. Compute the breaking energy for each test point by means of one of the two following formulas:

$W=[(F\times P)/2]\times 10^{-3}$ (joules)

Where

W=Energy, in joules;

F=Force, in Newtons; and

P=Penetration, in mm; or

$W=[(F\times P)/2]$

Where

W=Energy, in inch-pounds;

F=Force, in pounds; and

P=Penetration, in inches

3.14.3.4. Determine the breaking energy value for the tyre by computing the average of the five values obtained in accordance with 3.14.3.3.

~~3.19~~3.15 Tubeless Tyre Bead Unseating Resistance Test for LT/C Tyres (from FMVSS ~~109~~)

3.15.1. Requirements

When a tubeless LT/C tyre ~~that has a maximum inflation pressure other than 420 kPa (60 psi)~~ is tested in accordance with the procedure described in this section, the applied force required to unseat the tyre bead at the point of contact shall be not less than:

(a) 6,670 N (1,500 pounds) for tyres with a nominal section width of less than 160 mm (6 inches);

(b) 8,890 N (2,000 pounds) for tyres with a nominal section width of 160 mm (6 inches) or more but less than 205 mm (8 inches);

(c) 11,120 N (2,500 pounds) for tyres with a nominal section width of 205 mm (8 inches) or more.

~~3.15.1.~~3.15.2. Preparation of tyre-wheel assembly

3.15.2.1. Wash the tyre, dry it at the beads, and mount it without lubrication or adhesives on a clean, painted test rim.

3.15.2.2. Inflate it to the applicable pressure specified in the following table at ambient room temperature:

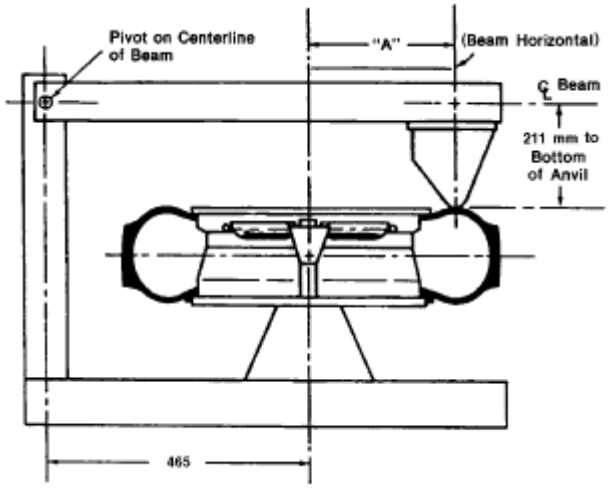
For LT/C tyres, the maximum permissible inflation pressure to be used for the bead unseating test is as follows:

Load Range C	260 kPa.
Load Range D	340 kPa.
Load Range E	410 kPa.

For LT/C tyres with a nominal cross section greater than 295 mm (11.5 inches), the maximum permissible inflation pressure to be used for the bead unseating test is as follows:

Load Range C	190 kPa.
Load Range D	260 kPa.
Load Range E	340 kPa.

3.15.2.3. Mount the wheel and tyre in a fixture shown in Figure 8, and force the bead unseating block shown in Figure 9 or Figure 10 against the tyre sidewall as required by the geometry of the fixture.



Wheel size	Dimension "A" for tyres with maximum inflation pressure	
	Other than 60 psi (in)	Other than 420 kPa (mm)
20	13.50	345
19	13.00	330
18	12.50	318
17	12.00	305

16	11.50	292
15	11.00	279
14	10.50	267
13	10.00	254
12	9.50	241
11	9.00	229
10	8.50	216

Figure 8: Bead Unseating Fixture (all dimension in mm) and table of "A" dimensions

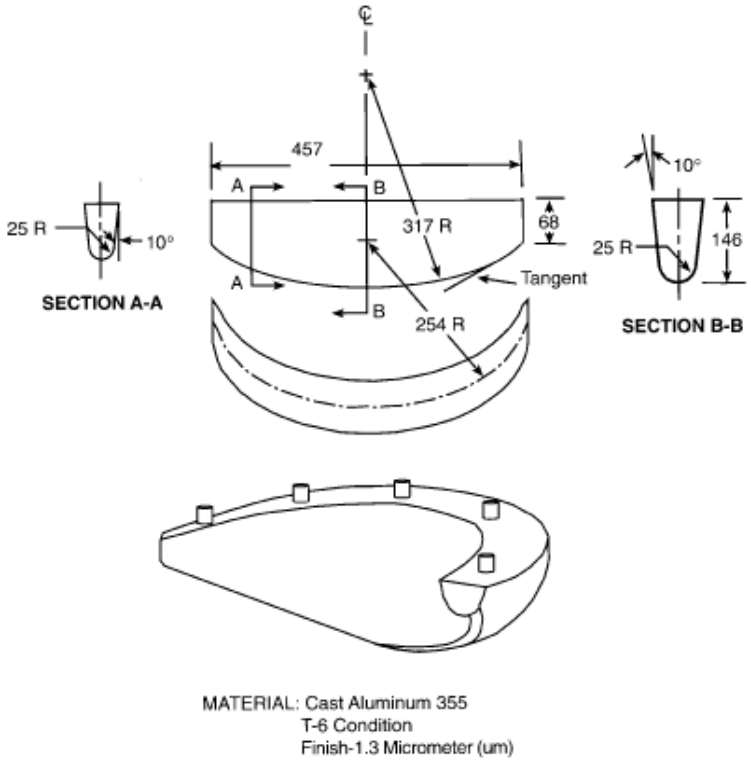


Figure 9: Diagram of Bead Unseating Block (all dimensions in mm)

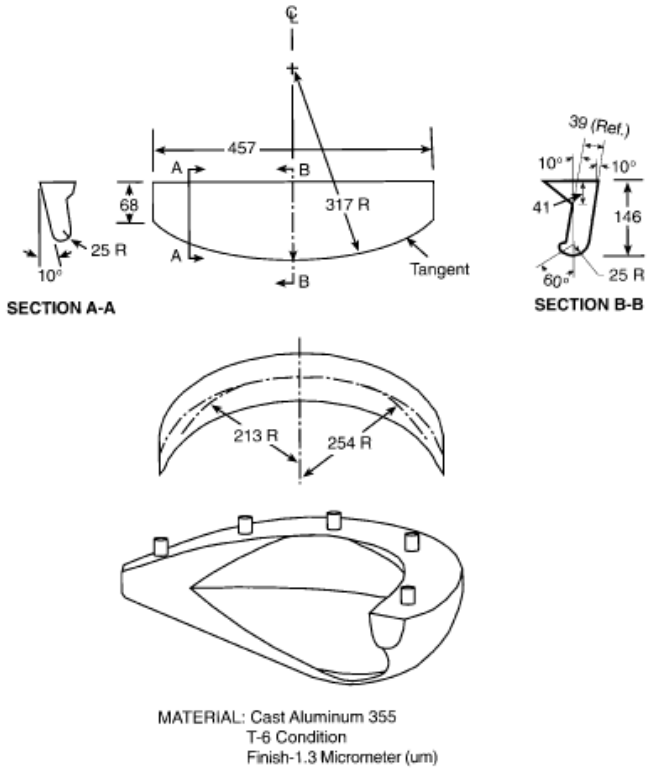


Figure 10: Diagram of Bead Unseating Block (all dimensions in mm)

3.15.3. Test Procedure

3.15.3.1. Apply a load through the block to the tyre's outer sidewall at the distance specified in Figure 8 for the applicable wheel size at a rate of 50 mm (2 inches) per minute, with the load arm substantially parallel to the tyre and rim assembly at the time of engagement.

3.15.3.2. Increase the load until the bead unseats or the applicable value specified in 3.15.1 is reached.

3.15.3.3. Repeat the test at least four places equally spaced around the tyre circumference.

~~3.20~~3.16 Load/Speed Endurance Test for LT/C Tyres (from UN ECE Regulation 54)

3.16.1. Preparing the tyre

3.16.1.1. Mount a new tyre on the test rim specified by the manufacturer. ~~pursuant to paragraph 4.1.11. of this Regulation.~~

3.16.1.2. Use a new inner tube or combination of inner tube, valve and flap (as required) when testing tyres with inner tubes.

3.16.1.3. Inflate the tyre to the pressure corresponding to the pressure index specified by the manufacturer. ~~pursuant to paragraph 4.1.12. of this Regulation.~~

3.16.1.4. Condition the tyre-and-wheel assembly at test-room temperature for not less than three hours.

3.16.1.5. Readjust the tyre pressure to that specified in paragraph 3.16.1.3. above.

3.16.2. Test procedure

3.16.2.1. Mount the tyre-and-wheel assembly on the test axle and press it against the outer face of a smooth power-driven test drum 1.70 m ± 1 per cent in diameter having a surface at least as wide as the tyre tread.

3.16.2.2. Apply to the test axle a series of test loads expressed in per cent of the load carrying capacity of the tyre, in accordance with the test programme shown in 3.16.3.7. below. Where the tyre has load indices for both single and twinned utilization, the reference load for single utilization shall be taken as the basis for the test loads.

3.16.2.2.1. In the case of tyres with a speed category symbol above P, test procedures are as specified in paragraph 3.16.3.

3.16.2.2.2. For all other tyre types, the endurance test programme is shown in paragraph 3.16.3.7.

3.16.2.3. The tyre pressure must not be corrected throughout the test and the test load must be kept constant throughout each of the three test stages.

3.16.2.4. During the test the temperature in the test-room must be maintained at between 20°C and 30°C or at a higher temperature if the manufacturer so agrees.

3.16.2.5. The endurance-test programme shall be carried out without interruption.

3.16.3. Load/speed test programme for tyre with speed category symbol Q and above

3.16.3.1. This programme applies to:

3.16.3.1.1. all tyres marked with ~~load capacity index~~load index in single 121 or less.

3.16.3.1.2. tyres marked with ~~load capacity index~~load index in single 122 and above and with the additional marking "C", or "LT", referred to in paragraph 3.3.13. of this gtr.

3.16.3.2. Load placed on the wheel as a percentage of the load corresponding to the load index:

3.16.3.2.1. 90% when tested on a test drum 1.70 m ± 1 per cent in diameter;

3.16.3.2.2. 92% when tested on a test drum 2.0 m ± 1 per cent in diameter.

3.16.3.3. Initial test speed: speed corresponding to the speed category symbol less 20 km/h;

3.16.3.3.1. Time to reach the initial test speed 10 min.

3.16.3.3.2. Duration of the first step = 10 min.

3.16.3.4. Second test speed: speed corresponding to the speed category symbol less 10 km/h;

3.16.3.4.1. Duration of the second step = 10 min.

3.16.3.5. Final test speed: speed corresponding to the speed category symbol:

3.16.3.5.1. Duration of the final step = 30 min.

3.16.3.6. Total test duration: 1 h.

3.16.3.7. Endurance test programme

Load index	Tyre speed category	Test-drum speed		Load placed on the wheel as a percentage of the load corresponding to the load index		
		Radial-ply min^{-1}	Diagonal (bias-ply) min^{-1}	7 h.	16 h.	24 h.
122 or more	F	100	100			
	G	125	100			
	J	150	125			
	K	175	150			
	L	200	-			
	M	225	-	66%	84%	101%
121 or less	F	100	100			
	G	125	125			
	J	150	150			
	K	175	175			
	L	200	175	70% 4 h.	88% 6 h.	106%
	M	250	200		97%	114%
	N	275	-	75%	97%	114%
	P	300	-	75% 75%	97%	114%

~~3.21~~3.17 Endurance Test for LT/C Tyres (from FMVSS 139)

3.17.1. Requirements

3.17.1.1. When the tyre is tested in accordance with 3.17.3.:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, belt or bead separation, chunking, open splices, cracking or broken cords.

(b) The tyre pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in 3.17.2.1.

3.17.2. Preparation of tyre

3.17.2.1. Mount the tyre on a test rim and inflate it to the pressure specified for the tyre in the following table:

Light truck tyres with a nominal cross section ≤ 295 mm (11.5 inches)	
Tyre application	**Test pressure (kPa)**
Load Range C	260
Load Range D	340
Load Range E	410
Light truck tyres with a nominal cross section > 295 mm (11.5 inches)	
Load Range C	190
Load Range D	260
Load Range E	340

3.17.2.2. Condition the assembly at 32 to 38 °C for not less than 3 hours.

3.17.2.3. Readjust the pressure to the value specified in 3.17.2.1 immediately before testing.

3.17.3. Test Procedure

3.17.3.1. Mount the assembly on a test axle and press it against the outer face of a smooth wheel having a diameter of 1.70 m ± 1%.

3.17.3.2. During the test, the ambient temperature, at a distance of not less than 150 mm and not more than 1 m from the tyre, is maintained at not less than 32 °C or more than 38 °C.

3.17.3.3. Conduct the test, without interruptions, at the test speed of not less than 120 km/h with loads and test periods not less than those shown in the following table. For snow tyres, conduct the test at not less than 110 km/h.

Test period	**Duration (hours)**	**Load as a percentage of tyre maximum load rating**
1	4	85
2	6	90
3	24	100

3.17.3.4. Throughout the test, the inflation pressure is not corrected and the test loads are maintained at the value corresponding to each test period, as shown in the table in 3.17.3.3.

3.17.3.5. Allow the tyre to cool for between 15 minutes and 25 minutes after running the tyre for the time specified in the table in 3.17.3.3., measure its inflation pressure. Inspect the tyre externally on the test rim for the conditions specified in 3.17.1.1.

3.18 Low Inflation Pressure Performance Test for LT/C Tyres (from FMVSS 139)

3.18.1. Requirements

3.18.1.1. When the tyre is tested in accordance with 3.18.3.:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner, belt or bead separation, chunking, open splices, cracking, or broken cords, and

(b) The tyre pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in 3.18.2.1.

3.18.2. Preparation of Tyre

3.18.2.1. This test is conducted following completion of the tyre endurance test using the same tyre and rim assembly tested in accordance with 3.17. with the tyre deflated to the following appropriate pressure:

Light truck tyres with a nominal cross section ≤ 295 mm (11.5 inches)	
Tyre application	**Test pressure (kPa)**
Load Range C	200
Load Range D	260
Load Range E	300
Light truck tyres with a nominal cross section > 295 mm (11.5 inches)	
Load Range C	150
Load Range D	200
Load Range E	260

3.18.2.2. After the tyre is deflated to the appropriate test pressure in 3.18.2.1. at the completion of the endurance test, condition the assembly at 32 to 38 °C for not less than 2 hours.

3.18.2.3. Before or after mounting the assembly on a test axle, readjust the tyre pressure to that specified in 3.18.2.1.

3.18.3. Test Procedure

3.18.3.1. The test is conducted for ninety minutes at the end of the test specified in 3.17., continuous and uninterrupted, at a speed of 120 km/h. For snow tyres, conduct the test at not less than 110 km/h.

3.18.3.2. Press the assembly against the outer face of a test drum with a diameter of 1.70 m + 1%.

3.18.3.3. Apply to the test axle a load equal to 100% of the tyre's maximum load carrying capacity.

3.18.3.4. Throughout the test, the inflation pressure is not corrected and the test load is maintained at the initial level.

3.18.3.5. During the test, the ambient temperature, at a distance of not less than 150 mm and not more than 1 m from the tyre, is maintained at not less than 32 °C or more than 38 °C.

3.18.3.6. Allow the tyre to cool for between 15 minutes and 25 minutes. Measure its inflation pressure. Then, deflate the tyre, remove it from the test rim, and inspect it for the conditions specified in 3.18.1.(a).

~~3.22~~3.19 High Speed Performance Test for LT/C Tyres (from FMVSS 139)

3.19.1. Requirements.

3.19.1.1. When the tyre is tested in accordance with 3.19.3.:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner, belt or bead separation, chunking, open splices, cracking, or broken cords.

(b) The tyre pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in 3.19.2.1

3.19.2. Preparation of tyre

3.19.2.1. Mount the tyre on a test rim and inflate it to the pressure specified for the tyre in the following table:

Light truck tyres with a nominal cross section ≤ 295 mm (11.5 inches)	
Tyre application	**Test pressure (kPa)**
Load Range C	320
Load Range D	410

Load Range E	500
Light truck tyres with a nominal cross section > 295 mm (11.5 inches)	
Load Range C	230
Load Range D	320
Load Range E	410

3.19.2.2. Condition the assembly at 32 to 38 °C for not less than 3 hours.

3.19.2.3. Before or after mounting the assembly on a test axle, readjust the tyre pressure to that specified in 3.19.1.1.

3.19.3. Test Procedure

3.19.3.1. Press the assembly against the outer face of a test drum with a diameter of 1.70 m ± 1%.

3.19.3.2. Apply to the test axle a load equal to 85% of the tyre's maximum load carrying capacity.

3.19.3.3. Break-in the tyre by running it for 2 hours at 80 km/h.

3.19.3.4. Allow tyre to cool to 38 °C and readjust inflation pressure to applicable pressure in 3.19.2.1. immediately before the test.

3.19.3.5. Throughout the test, the inflation pressure is not corrected and the test load is maintained at the value applied in 3.19.2.1.

3.19.3.6. During the test, the ambient temperature, measured at a distance of not less than 150 mm and not more than 1 m from the tyre, is maintained at not less than 32 °C or more than 38 °C.

3.19.3.7. The test is conducted, continuously and uninterrupted, for ninety minutes through three thirty-minute consecutive test stages at the following speeds: 140, 150, and 160 km/h.

3.19.3.8. Allow the tyre to cool for between 15 minutes and 25 minutes. Measure its inflation pressure. Then, deflate the tyre, remove it from the test rim, and inspect it for the conditions specified in 3.19.1.1.(a).

3.20 Physical dimensions of LT/C tyres (from FMVSS 139)

3.20.1. Requirements

~~3.20.1.1.~~3.20.1.1. The actual section width and overall width for each tyre measured in accordance with 3.20.3. shall not exceed the -section width specified one of the publications described in 3.5.8. for its size designation and type by more than:

(a) For tyres with a maximum permissible inflation pressure of 32, 36, or 40 psi, 7 percent, or

(b) For tyres with a maximum permissible inflation pressure of 240, 280, 300, 340 or 350 kPa, 7 percent or 10 mm, whichever is larger.

3.20.2. Preparation of tyre

3.20.2.1. Mount the tyre on the measuring rim specified by the tyre manufacturer or in one of the publications listed in paragraph 3.5.8.

3.20.2.2. Inflate the tyre to the pressure at maximum load as labeled on sidewall.

3.20.2.3. Condition the assembly at an ambient room temperature of 20 °C to 30 °C for not less than 24 hours.

3.20.2.4. Readjust the tyre pressure to that specified in 3.20.1.2.

3.20.3. Test Procedure

3.20.3.1. Measure the section width and overall width by caliper at six points approximately equally spaced around the circumference of the tyre, avoiding measurement of the additional thickness of the special protective ribs or bands. The average of the measurements so obtained are taken as the section width and overall width, respectively.

3.20.3.2. Determine the outer diameter by measuring the maximum circumference of the tyre and dividing the figure so obtained by Pi (3.14).

3.21 Physical dimensions of LT/C tyres (from UN ECE Regulation 54)

3.21.1. Requirements

3.21.1.1. Section width of a tyre

3.21.1.1.1. The section width shall be obtained by means of the following formula:

$S = S_1 + K (A - A_1)$,

where:

S is the "section width" expressed in millimetres and measured on the measuring rim;

S_1 is "the nominal section width" in millimetres, as shown on the sidewall of the tyre in the tyre designation as prescribed;

A is the width of the measuring rim in millimetres, as shown by the manufacturer in the descriptive note; and

A_1 is the width of the theoretical rim in millimetres.

A_1 shall be taken to equal S_1 multiplied by the factor x as specified by the manufacturer, and K shall be taken to equal 0.4.

3.21.1.1.2. However, for the existing types of tyres whose designation is given in the first column of the tables in Appendix 7 to this Regulation, the section width shall be deemed to be that given opposite the tyre designation in those tables.

3.21.1.2. Outer diameter of a tyre

3.21.1.2.1. The outer diameter of a tyre shall be obtained by means of the following formula:

$D = d + 2H$

where:

D is the outer diameter expressed in millimetres;

d is the rinm diameter, expressed in millimetres[3];

S_1 is the nominal section width in millimetres;

Ra is the nominal aspect ratio;

H is the nominal section height in millimetres and is equal to S_1 x 0.01Ra.

All as in the tyre designation shown on the sidewall of the tyre. ~~in conformity with the requirements of paragraph 3.4. above.~~

3.21.1.2.2. However, for the existing types of tyres whose designation is given in the first column of the tables in Appendix 7 to this Regulation, the outer diameter shall be deemed to be that given opposite the tyre designation in those tables.

3.21.1.3. Tyre section width specifications

3.21.1.3.1. The overall width of a tyre may be less than the section width or widths determined pursuant to paragraph 3.21.1.1. above.

3.21.1.3.2. It may exceed that value by 4 per cent in case of radial-ply tyres and by 8 per cent in the case of diagonal (bias-ply) tyres. However, for tyres with nominal section width exceeding 305 mm intended for dual mounting (twinning), the value determined pursuant to paragraph 3.21.1.1. above shall not be exceeded by more than 2 per cent for radial-ply tyres with nominal aspect ratio higher than 60, or 4 per cent for diagonal (bias-ply) tyres.

3.21.1.4. Tyre outer diameter specifications

3.21.1.4.1. The outer diameter of a tyre must not be outside the values Dmin and Dmax obtained from the following formulae:

---

3 When the conventional number is given by codes, the value in millimetres is obtained by multiplying the code number by 25.4.

Dmin = d + (2H x a)

Dmax = d + (2H x b)

where:

3.21.1.4.2. For sizes listed in Appendix 7 the nominal section height H is equal to:

H = 0.5 (D-d) - for references see paragraph 3.21.1.5.

3.21.1.4.2.1. For other sizes, not listed in annex 5

"H" and "d" are as defined in paragraph 3.21.1.2.1.

3.21.1.4.2.2. Coefficients "a" and "b" are respectively:

3.21.1.4.2.2.1. Coefficient "a" = .97

3.21.1.4.2.2.2. Coefficient "b"

	Radial	Diagonal
for normal use tyres	1.04	1.07
for special use tyres	1.06	1.09

3.21.1.4.2.2.3. For snow tyres the outer diameter (Dmax) established in conformity with the above may be exceeded by 1 per cent.

3.21.2. Test procedure

3.21.2.1. The tyre is mounted on the measuring rim specified by the manufacturer and inflated to the pressure corresponding to the pressure index specified by the manufacturer. ~~pursuant to paragraph 4.1.11. of this Regulation and is inflated to a pressure specified by the manufacturer pursuant to paragraph 4.1.12. of this Regulation.~~

3.21.2.2. The tyre fitted on its rim is conditioned to the ambient temperature of the laboratory for at least 24 hours.

3.21.2.3. The pressure is readjusted to the value specified in paragraph 3.21.2.1. above.

3.21.2.4. The overall width is measured by caliper at six equally-spaced points, account being taken of the thickness of the protective ribs or bands. The highest measurement so obtained is taken as the overall width.

3.21.2.5. The outer diameter is calculated from the maximum circumference.

4. ~~If a method other than that described in this paragraph is used, it must be demonstrated to be equivalent or more severe.~~Equivalent Test Methods

4.1 If test methods other than those described in paragraphs 3.5. to 3.21. above are used, they must be demonstrated to be equivalent or more severe.

Appendix 1

SPEED SYMBOL TABLE

Speed symbol	Corresponding speed km/h
F	80
G	90
J	100
K	110
L	120
M	130
N	140
P	150
Q	160
R	170
S	180
T	190
U	200
H	210
V	240
W	270
Y	300

Appendix 2

LOAD INDEX (LI) AND EQUIVALENT LOAD CAPACITY TABLE

LI	kg	LI	kg	LI	kg	LI	kg	LI	kg
0	45	27	97.5	54	212	81	462	108	1 000
1	46.2	28	100	55	218	82	475	109	1 030
2	47.5	29	103	56	224	83	487	110	1 060
3	48.7	30	106	57	230	84	500	111	1 090
4	50.0	31	109	58	236	85	515	112	1 120
5	51.5	32	112	59	243	86	530	113	1 150
6	53.0	33	115	60	250	87	545	114	1 180
7	54.5	34	118	61	257	88	560	115	1 215
8	56.0	35	121	62	265	89	580	116	1 250
9	58.0	36	125	63	272	90	600	117	1 285
10	60.0	37	128	64	280	91	615	118	1 320
11	61.5	38	132	65	290	92	630	119	1 360
12	63.0	39	136	66	300	93	650	120	1 400
13	65.0	40	140	67	307	94	670	121	1 450
14	67.0	41	145	68	315	95	690	122	1 500
15	69.0	42	150	69	325	96	710	123	1 550
16	71.0	43	155	70	335	97	730	124	1 600
17	73.0	44	160	71	345	98	750	125	1 650
18	75.0	45	165	72	355	99	775	126	1 700
19	77.5	46	170	73	365	100	800	127	1 750
20	80.0	47	175	74	375	101	825	128	1 800
21	82.5	48	180	75	387	102	850	129	1 850
22	85.0	49	185	76	400	103	875	130	1 900
23	87.5	50	190	77	412	104	900		
24	90.0	51	195	78	425	105	925		
25	92.5	52	200	79	437	106	950		
26	95.0	53	206	80	450	107	975		

Appendix 3

NOMINAL RIM DIAMETER CODE TABLE

Nominal rim diameter code ("d" symbol)	Value of the "d" symbol expressed in mm
8	203
9	229
10	254
11	279
12	305
13	330
14	356
15	381
16	406
17	432
18	457
19	482
20	508
21	533
22	559
23	584
24	610
25	635
14.5	368
16.5	419
17.5	445
19.5	495
20.5	521
22.5	572
24.5	622
26	660
28	711
30	762

Appendix 4

RELATION BETWEEN THE PRESSURE INDEX ('PSI') AND THE UNITS OF PRESSURE (kPa)

kPa	psi	kPa	psi	kPa	psi	kPa	psi
10	1	270	39	530	77	790	115
15	2	275	40	540	78	800	116
20	3	280	41	545	79	810	117
25	4	290	42	550	80	815	118
35	5	295	43	560	81	820	119
40	6	300	44	565	82	825	120
45	7	310	45	575	83	835	121
55	8	320	46	580	84	840	122
60	9	325	47	585	85	850	123
70	10	330	48	590	86	855	124
75	11	340	49	600	87	860	125
80	12	345	50	610	88	870	126
90	13	350	51	615	89	875	127
95	14	360	52	620	90	880	128
100	15	365	53	625	91	890	129
110	16	375	54	635	92	900	130
120	17	380	55	640	93	905	131
125	18	385	56	650	94	910	132
130	19	390	57	655	95	920	133
140	20	400	58	660	96	925	134
145	21	410	59	670	97	930	135
150	22	415	60	675	98	940	136
160	23	420	61	680	99	945	137
165	24	425	62	690	100	950	138
170	25	435	63	695	101	960	139
180	26	440	64	700	102	965	140
185	27	450	65	710	103	975	141
190	28	455	66	720	104	980	142
200	29	460	67	725	105	985	143
210	30	470	68	730	106	990	144
215	31	475	69	740	107	1 000	145
220	32	480	70	745	108	1 010	146
230	33	490	71	750	109	1 015	147
235	34	495	72	760	110	1 020	148
240	35	500	73	765	111	1 030	149
250	36	510	74	775	112	1 035	150
255	37	520	75	780	113	1 040	151
260	38	525	76	785	114	1 050	152

~~ISO TR 29846 (see EDI TRA page 8-19)~~

~~To be completed~~

Appendix 5

VARIATION OF LOAD CAPACITY WITH SPEED COMMERCIAL VEHICLES TYRES

Variation of load capacity (per cent)										
Speed (km/h)	All load indices				Load indices > 122 1/		Load indices ≤ 121 1/			
	Speed category symbol				Speed category symbol		Speed category symbol			
	F	G	J	K	L	M	L	M	N	P 2/
0	+150	+150	+150	+150	+150	+150	+110	+110	+110	+110
5	+110	+110	+110	+110	+110	+110	+90	+90	+90	+90
10	+80	+80	+80	+80	+80	+80	+75	+75	+75	+75
15	+65	+65	+65	+65	+65	+65	+60	+60	+60	+60
20	+50	+50	+50	+50	+50	+50	+50	+50	+50	+50
25	+35	+35	+35	+35	+35	+35	+42	+42	+42	+42
30	+25	+25	+25	+25	+25	+25	+35	+35	+35	+35
35	+19	+19	+19	+19	+19	+19	+29	+29	+29	+29
40	+15	+15	+15	+15	+15	+15	+25	+25	+25	+25
45	+13	+13	+13	+13	+13	+13	+22	+22	+22	+22
50	+12	+12	+12	+12	+12	+12	+20	+20	+20	+20
55	+11	+11	+11	+11	+11	+11	+17.5	+17.5	+17.5	+17.5
60	+10	+10	+10	+10	+10	+10	+15.0	+15.0	+15.0	+15.0
65	+7.5	+8.5	+8.5	+8.5	+8.5	+8.5	+13.5	+13.5	+13.5	+13.5
70	+5.0	+7.0	+7.0	+7.0	+7.0	+7.0	+12.5	+12.5	+12.5	+12.5
75	+2.5	+5.5	+5.5	+5.5	+5.5	+5.5	+11.0	+11.0	+11.0	+11.0
80	0	+4.0	+4.0	+4.0	+4.0	+4.0	+10.0	+10.0	+10.0	+10.0
85	-3	+2.0	+3.0	+3.0	+3.0	+3.0	+8.5	+8.5	+8.5	+8.5
90	-6	0	+2.0	+2.0	+2.0	+2.0	+7.5	+7.5	+7.5	+7.5
95	-10	-2.5	+1.0	+1.0	+1.0	+1.0	+6.5	+6.5	+6.5	+6.5
100	-15	-5	0	0	0	0	+5.0	+5.0	+5.0	+5.0
105		-8	-2	0	0	0	+3.75	+3.75	+3.75	+3.75
110		-13	-4	0	0	0	+2.5	+2.5	+2.5	+2.5
115			-7	-3	0	0	+1.25	+1.25	+1.25	+1.25
120			-12	-7	0	0	0	0	0	0
125						0	-2.5	0	0	0
130						0	-5.0	0	0	0
135							-7.5	-2.5	0	0
140							-10	-5	0	0
145								-7.5	-2.5	0
150								-10.0	-5.0	0
155									-7.5	-2.5
160									-10.0	-5.0

1/ The load capacity indices refer to a single operation.

2/ Load variations are not allowed for speeds above 160 km/h. For speed category symbols "Q" and above the speed category corresponding to the speed category symbol (see paragraph 2.28.2.) specifies the maximum speed permitted for the tyre.

Appendix 6

SPECIFICATIONS FOR THE ROLLING SOUND EMISSIONS TEST SITE

1. Introduction

This appendix describes the specifications relating to the physical characteristics and the laying of the test track. These specifications based on a special standard 1/ describe the required physical characteristics as well as the test methods for these characteristics.

2. Required characteristics of the surface

A surface is considered to conform to this standard provided that the texture and voids content or sound absorption coefficient have been measured and found to fulfil all the requirements of paragraphs 2.1. to 2.4. below and provided that the design requirements (para.3.2.) have been met.

2.1. Residual voids content

The residual voids content (VC) of the test track paving mixture shall not exceed 8 per cent. For the measurement procedure, see paragraph 4.1.

2.2. Sound absorption coefficient

If the surface fails to comply with the residual voids content requirement, the surface is acceptable only if its sound absorption coefficient $\alpha \leq 0.10$. For the measurement procedure, see paragraph 4.2. The requirement of paragraphs 2.1. and 2.2. is met also if only sound absorption has been measured and found to be $\alpha \leq 0.10$.

Note: The most relevant characteristic is the sound absorption, although the residual voids content is more familiar among road constructors. However, sound absorption needs to be measured only if the surface fails to comply with the voids requirement. This is motivated because the latter is connected with relatively large uncertainties in terms of both measurements and relevance and some surfaces therefore erroneously may be rejected when based only on the voids measurement.

1/ ISO 10844:1994. If a different test surface is defined, in the future, the reference standard will be amended accordingly.

2.3. Texture depth

The texture depth (TD) measured according to the volumetric method (see paragraph 4.3. below) shall be:

$TD \geq 0.4$ mm

2.4. Homogeneity of the surface

Every practical effort shall be taken to ensure that the surface is made to be as homogeneous as possible within the test area. This includes the texture and voids content, but it should also be observed that if the rolling process results in more effective rolling at some places than others, the texture may be different and unevenness causing bumps may also occur.

2.5. Period of testing

In order to check whether the surface continues to conform to the texture and voids content or sound absorption requirements stipulated in this standard, periodic testing of the surface shall be done at the following intervals:

(a) For residual voids content (VC) or sound absorption (α):

when the surface is new;

if the surface meets the requirements when new, no further periodical testing is required. If it does not meet the requirement when it is new, it may do later because surfaces tend to become clogged and compacted with time.

(b) For texture depth (TD):

when the surface is new;

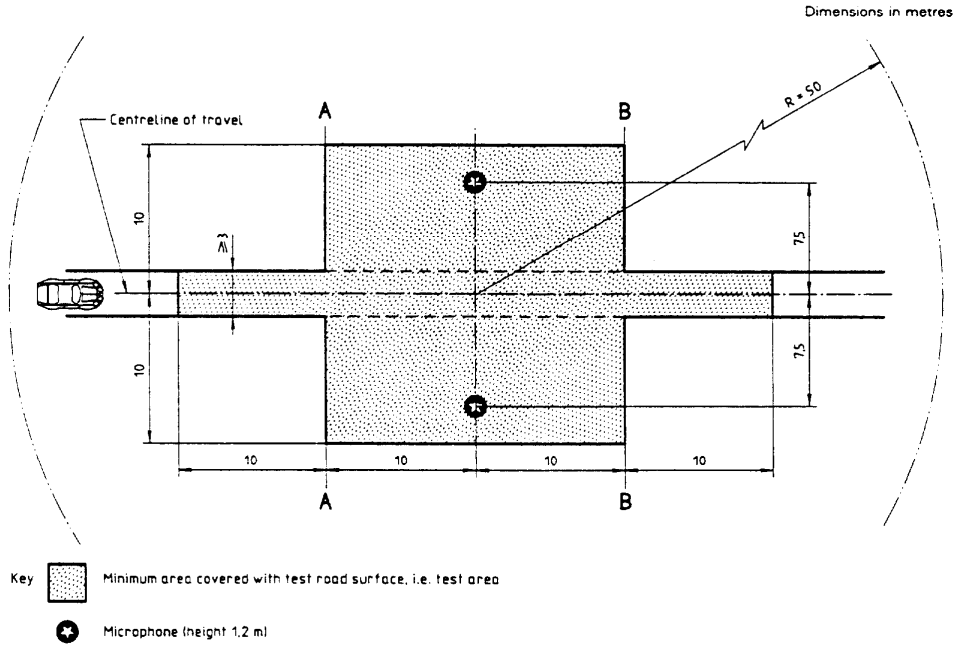
when the noise testing starts (NB: not before four weeks after laying);

then every twelve months.

3. Test surface design

3.1. Area

When designing the test track layout it is important to ensure that, as a minimum requirement, the area traversed by the vehicles running through the test strip is covered with the specified test material with suitable margins for safe and practical driving. This will require that the width of the track is at least 3 m and the length of the track extends beyond lines AA and BB by at least 10 m at either end. Figure 1 shows a plan of a suitable test site and indicates the minimum area which shall be machine laid and machine compacted with the specified test surface material. According to Annex 3, paragraph 3.2., measurements have to be made on each side of the vehicle. This can be made either by measuring with two microphone locations (one on each side of the track) and driving in one direction, or measuring with a microphone only on one side of the track but driving the vehicle in two directions. If the latter method is used, then there are no surface requirements on that side of the track where there is no microphone.



NOTE — There shall be no large acoustically reflective objects within this radius.

Figure 1: Minimum requirements for test surface area
The shaded part is called "Test Area".

3.2. Design and preparation of the surface

3.2.1. Basic design requirements

The test surface shall meet four design requirements:

3.2.1.1. It shall be a dense asphaltic concrete.

3.2.1.2. The maximum chipping size shall be 8 mm (tolerances allow from 6.3 mm to 10 mm).

3.2.1.3. The thickness of the wearing course shall be ≥ 30 mm.

3.2.1.4. The binder shall be a straight penetration grade bitumen without modification.

3.2.2. Design guidelines

As a guide to the surface constructor, an aggregate grading curve which will give desired characteristics is shown in Figure 2. In addition, Table 1 gives some guidelines in order to obtain the desired texture and durability. The grading curve fits the following formula:

$$P\ (\%\ passing) = 100 \times (d/d_{max})^{1/2}$$

where:

d = square mesh sieve size, in mm
d_{max} = 8 mm for the mean curve
= 10 mm for the lower tolerance curve
= 6.3 mm for the upper tolerance curve

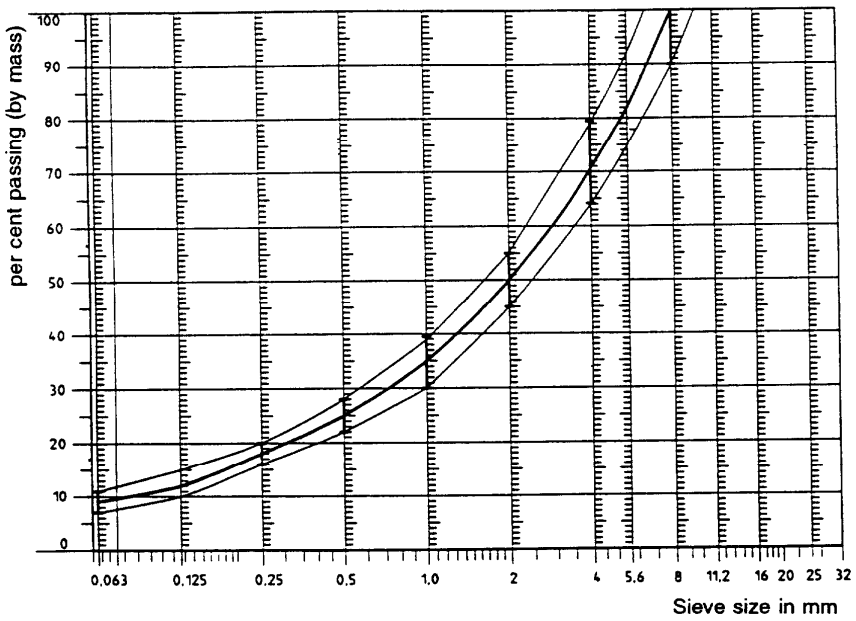


Figure 2: Grading curve of the aggregate in the asphaltic mix with tolerances.

In addition to the above, the following recommendations are given:

(a) The sand fraction (0.063 mm < square mesh sieve size < 2 mm) shall include no more than 55 % natural sand and at least 45 % crushed sand.

(b) The base and sub-base shall ensure a good stability and evenness, according to best road construction practice.

(c) The chippings shall be crushed (100 % crushed faces) and of a material with a

high resistance to crushing.

(d) The chippings used in the mix shall be washed.

(e) No extra chippings shall be added onto the surface.

(f) The binder hardness expressed as PEN value shall be 40-60, 60-80 or even 80-100 depending on the climatic conditions of the country. The rule is that as hard a binder as possible shall be used, provided this is consistent with common practice.

(g) The temperature of the mix before rolling shall be chosen so as to achieve by subsequent rolling the required voids content. In order to increase the probability of satisfying the specifications of paragraphs 2.1. to 2.4. above, the compactness shall be studied not only by an appropriate choice of mixing temperature, but also by an appropriate number of passings and by the choice of compacting vehicle.

Table 1: Design guidelines

	Target values		Tolerances
	By total mass of mix	By mass of the aggregate	
Mass of stones, square mesh sieve (SM) > 2 mm	47.6 %	50.5 %	± 5
Mass of sand 0.063 < SM < 2 mm	38.0 %	40.2 %	± 5
Mass of filler SM < 0.063 mm	8.8 %	9.3 %	± 5
Mass of binder (bitumen)	5.8 %	N.A.	± 0.5
Max. chipping size	8 mm		6.3 - 10
Binder hardness	(see para. 3.2.2. (f))		
Polished stone value (PSV)	> 50		
Compactness, relative to Marshall compactness	98 %		

4. Test method

4.1. Measurement of the residual voids content

For the purpose of this measurement, cores have to be taken from the track in at least four different positions, which are equally distributed in the test area between lines AA and BB (see figure 1). In order to avoid inhomogeneity and unevenness in the wheel tracks, cores should not be taken in wheel tracks themselves, but close to them. Two cores (minimum) should be taken close to the wheel tracks and one core (minimum) should be taken approximately midway between the wheel tracks and each microphone location.

If there is a suspicion that the condition of homogeneity is not met (see paragraph 2.4.), cores shall be taken from more locations within the test area.

The residual voids content has to be determined for each core, then the average value from all cores shall be calculated and compared with the requirement of paragraph 2.1. In addition, no single core shall have a voids value, which is higher than 10 per cent.

The test surface constructor is reminded of the problem, which may arise when the test area is heated by pipes or electrical wires and cores must be taken from this area. Such installations must be carefully planned with respect to future core drilling locations. It is recommended to leave a few locations of size approximately 200 mm x 300 mm where there are no wires/pipes or where the latter are located deep enough in order not to be damaged by cores taken from the surface layer.

4.2. Sound absorption coefficient

The sound absorption coefficient (normal incidence) shall be measured by the impedance tube method using the procedure specified in ISO 10534-1:1996 or ISO 10534-2:1998.

Regarding test specimens, the same requirements shall be followed as regarding the residual voids content (see paragraph 4.1.). The sound absorption shall be measured in the range between 400 Hz and 800 Hz and in the range between 800 Hz and 1,600 Hz (at least at the centre frequencies of third octave bands) and the maximum values shall be identified for both of these frequency ranges. Then these values, for all test cores, shall be averaged to constitute the final result.

4.3. Volumetric macrotexture measurement

For the purpose of this standard, texture depth measurements shall be made on at least 10 positions evenly spaced along the wheel tracks of the test strip and the average value taken to compare with the specified minimum texture depth. See Standard ISO 10844:1994 for description of the procedure.

5. Stability in time and maintenance

5.1. Age influence

In common with any other surfaces, it is expected that the tyre rolling sound level measured on the test surface may increase slightly during the first 6 - 12 months after construction.

The surface will achieve its required characteristics not earlier than four weeks after construction. The influence of age on the noise from trucks is generally less than that from cars.

The stability over time is determined mainly by the polishing and compaction by vehicles driving on the surface. It shall be periodically checked as stated in paragraph 2.5.

5.2. Maintenance of the surface

Loose debris or dust, which could significantly reduce the effective texture depth must be removed from the surface. In countries with winter climates, salt is sometimes used for de-icing. Salt may alter the surface temporarily or even permanently in such a way as to increase noise and is therefore not recommended.

5.3. Repaving the test area

If it is necessary to repave the test track, it is usually unnecessary to repave more than the test strip (of 3 m width in figure 1) where vehicles are driving, provided the test area outside the strip met the requirement of residual voids content or sound absorption when it was measured.

6. Documentation of the test surface and of tests performed on it

6.1. Documentation of the test surface

The following data shall be given in a document describing the test surface:

6.1.1. The location of the test track.

6.1.2. Type of binder, binder hardness, type of aggregate, maximum theoretical density of the concrete (DR), thickness of the wearing course and grading curve determined from cores from the test track.

6.1.3. Method of compaction (e.g. type of roller, roller mass, number of passes).

6.1.4. Temperature of the mix, temperature of the ambient air and wind speed during laying of the surface.

6.1.5. Date when the surface was laid and contractor.

6.1.6. All or at least the latest test result, including:

6.1.6.1. the residual voids content of each core;

6.1.6.2. the locations in the test area from where the cores for voids measurements have been taken;

6.1.6.3. the sound absorption coefficient of each core (if measured). Specify the results both for each core and each frequency range as well as the overall average;

6.1.6.4. the locations in the test area from where the cores for absorption measurement have been taken;

6.1.6.5. texture depth, including the number of tests and standard deviation;

6.1.6.6. the institution responsible for tests according to paragraphs 6.1.6.1. and 6.1.6.2. and the type of equipment used;

6.1.6.7. date of the test(s) and date when the cores were taken from the test track.

6.2. Documentation of vehicle noise tests conducted on the surface

In the document describing the vehicle noise test(s) it shall be stated whether all the requirements of this standard were fulfilled or not. Reference shall be given to a document according to paragraph 6.1. describing the results which verify this.

~~**Section III. Regulation for Light Commercial and LT C, D, and E Tyres**~~

~~**[Note: Work is ongoing to harmonize the ECE R 54 and FMVSS 139 (light truck and C-type tyres) standards into a single document. Upon harmonization, appropriate content from both documents will be incorporated below. For details of each test, please see the specific standards R-54 and FMVSS 139.]**~~

~~**[Note: this text is part of the endurance test for LT/C tyres**~~

~~**Where application is made for the approval of a type of pneumatic tyre which has a load/speed combination in addition to the one that is subject to the variation of load with speed given in the table in annex XX, the endurance test prescribed in paragraph XX above shall also be carried out on a second tyre of the same type at the additional load/speed .]]**~~

~~**To be completed.**~~

Appendix 7

TYRE-SIZE DESIGNATION AND DIMENSIONS

PART I

EUROPEAN TYRES

Table A

CODE DESIGNATED SIZES MOUNTED ON 5° TAPERED RIMS OR FLAT BASE RIMS. RADIAL AND DIAGONAL CONSTRUCTIONS

Tyre Size Designation (+)	Measuring Rim Width Code	Nominal Rim Diameter d (mm)	Outer Diameter D (mm)		Section Width S (mm)	
			Radial	Diagonal	Radial	Diagonal
Std. series						
4.00R8 (*)	2.50	203	414	414	107	107

4.00R10(*)	3.00	254	466	466	108	108
4.00R12(*)	3.00	305	517	517	108	108
4.50R8 (*)	3.50	203	439	439	125	125
4.50R10(*)	3.50	254	490	490	125	125
4.50R12(*)	3.50	305	545	545	125	128
5.00R8 (*)	3.00	203	467	467	132	132
5.00R10(*)	3.50	254	516	516	134	134
5.00R12(*)	3.50	305	568	568	134	137
6.00R9	4.00	229	540	540	160	160
6.00R14C	4.50	356	626	625	158	158
6.00R16(*)	4.50	406	728	730	170	170
6.50R10	5.00	254	588	588	177	177
6.50R14C	5.00	356	640	650	170	172
6.50R16(*)	4.50	406	742	748	176	176
6.50R20(*)	5.00	508	860	-	181	-
7.00R12	5.00	305	672	672	192	192
7.00R14C	5.00	356	650	668	180	182
7.00R15(*)	5.00	381	746	752	197	198
7.00R16C	5.50	406	778	778	198	198
7.00R16	5.50	406	784	774	198	198
7.00R20	5.50	508	892	898	198	198
7.50R10	5.50	254	645	645	207	207
7.50R14C	5.50	356	686	692	195	192
7.50R15(*)	6.00	381	772	772	212	212
7.50R16(*)	6.00	406	802	806	210	210
7.50R17(*)	6.00	432	852	852	210	210
7.50R20	6.00	508	928	928	210	213
8.25R15	6.50	381	836	836	230	234
8.25R16	6.50	406	860	860	230	234
8.25R17	6.50	432	886	895	230	234
8.25R20	6.50	508	962	970	230	234

Table A - (cont'd)

Tyre size designation (+)	Measuring rim width code	Nominal rim diameter d (mm)	Outer diameter D (mm)		Section Width S (mm)	
			Radial	Diagonal	Radial	Diagonal
9.00R15	6.00	381	840	840	249	249
9.00R16(*)	6.50	406	912	900	246	252
9.00R20	7.00	508	1018	1012	258	256
10.00R15	7.50	381	918	918	275	275
10.00R20	7.50	508	1052	1050	275	275
10.00R22	7.50	559	1102	1102	275	275
11.00R16	6.50	406	980	952	279	272
11.00R20	8.00	508	1082	1080	286	291
11.00R22	8.00	559	1132	1130	286	291
11.00R24	8.00	610	1182	1180	286	291
12.00R20	8.50	508	1122	1120	313	312
12.00R22	8.50	559	1174	1174	313	312
12.00R24	8.50	610	1226	1220	313	312
13.00R20	9.00	508	1176	1170	336	342
14.00R20	10.00	508	1238	1238	370	375
14.00R24	10.00	610	1340	1340	370	375
16.00R20	13.00	508	1370	1370	446	446
80 Series						
12/80 R 20	8.50	508	1008	-	305	-
13/80 R 20	9.00	508	1048	-	326	-
14/80 R 20	10.00	508	1090	-	350	-
14/80 R 24	10.00	610	1192	-	350	-
14.75/80 R 20	10.00	508	1124	-	370	-
15.5/80 R 20	10.00	508	1158	-	384	-
Wide Base Tyres for Multipurpose Trucks						
7.50 R 18 MPT	5.50	457	885			208
10.5 R 18 MPT	9	457	905		276	270
10.5 R 20 MPT	9	508	955		276	270
12.5 R 18 MPT	11	457	990		330	325
12.5 R 20 MPT	11	508	1040		330	325
14.5 R 20 MPT	11	508	1095		362	355
14.5 R 24 MPT	11	610	1195		362	355

(+) Tyres in diagonal construction are identified by an hyphen in place of the letter 'R' (e.g. 5.00-8).

(*) The tyre size designation may be supplemented with the letter 'C' (e.g. 6.00-16C).

Table B

CODE DESIGNATED SIZES MOUNTED ON 15° TAPERED RIMS - RADIAL

Tyre size designation	Measuring rim width code	Nominal rim diameter d (mm)	Outer diameter D (mm)	Section Width S (mm)
7 R 17.5 (*)	5.25	445	752	185
7 R 19.5	5.25	495	800	185
8 R 17.5 (*)	6.00	445	784	208
8 R 19.5	6.00	495	856	208
8 R 22.5	6.00	572	936	208
8.5 R 17.5	6.00	445	802	215
9 R 17.5	6.75	445	820	230
9 R 19.5	6.75	495	894	230
9 R 22.5	6.75	572	970	230
9.5 R 17.5	6.75	445	842	240
9.5 R 19.5	6.75	495	916	240
10 R 17.5	7.50	445	858	254
10 R 19.5	7.50	495	936	254
10 R 22.5	7.50	572	1020	254
11 R 22.5	8.25	572	1050	279
11 R 24.5	8.25	622	1100	279
12 R 22.5	9.00	572	1084	300
13 R 22.5	9.75	572	1124	320
15 R 19.5	11.75	495	998	387
15 R 22.5	11.75	572	1074	387
16.5 R 19.5	13.00	495	1046	425
16.5 R 22.5	13.00	572	1122	425
18 R 19.5	14.00	495	1082	457
18 R 22.5	14.00	572	1158	457
70 Series				
10/70 R 22.5	7.50	572	928	254
11/70 R 22.5	8.25	572	962	279
12/70 R 22.5	9.00	572	1000	305
13/70 R 22.5	9.75	572	1033	330

(*) The tyre size designation may be supplemented with the letter 'C' (e.g. 7 R 17.5C).

Table C

- TYRES FOR LIGHT COMMERCIAL VEHICLES - RADIAL AND DIAGONAL CONSTRUCTIONS

Tyre size designation (+)	Measuring rim width code	Nominal rim diameter d (mm)	Outer diameter D (mm)		Section Width S (mm)	
			Radial	Diagonal	Radial	Diagonal
Metric Designated						
145 R 10 C	4.00	254	492	-	147	-
145 R 12 C	4.00	305	542	-	147	-
145 R 13 C	4.00	330	566	-	147	-
145 R 14 C	4.00	356	590	-	147	-
145 R 15 C	4.00	381	616	-	147	-
155 R 12 C	4.50	305	550	-	157	-
155 R 13 C	4.50	330	578	-	157	-
155 R 14 C	4.50	356	604	-	157	-
165 R 13 C	4.50	330	596	-	167	-
165 R 14 C	4.50	356	622	-	167	-
165 R 15 C	4.50	381	646	-	167	-
175 R 13 C	5.00	330	608	-	178	-
175 R 14 C	5.00	356	634	-	178	-
175 R 16 C	5.00	406	684	-	178	-
185 R 13 C	5.50	330	624	-	188	-
185 R 14 C	5.50	356	650	-	188	-
185 R 15 C	5.50	381	674	-	188	-
185 R 16 C	5.50	406	700	-	188	-
195 R 14 C	5.50	356	666	-	198	-
195 R 15 C	5.50	381	690	-	198	-
195 R 16 C	5.50	406	716	-	198	-
205 R 14 C	6.00	356	686	-	208	-
205 R 15 C	6.00	381	710	-	208	-
205 R 16 C	6.00	406	736	-	208	-
215 R 14 C	6.00	356	700	-	218	-
215 R 15 C	6.00	381	724	-	218	-
215 R 16 C	6.00	406	750	-	218	-
245 R 16 C	7.00	406	798	798	248	248
17 R 15 C	5.00	381	678	-	178	-
17 R 380 C	5.00	381	678	-	178	-
17 R 400 C	150 mm	400	698	-	186	-
19 R 400 C	150 mm	400	728	-	200	-
Code Designated						
5.60 R 12 C	4.00	305	570	572	150	148
6.40 R 13 C	5.00	330	648	640	172	172
6.70 R 13 C	5.00	330	660	662	180	180
6.70 R 14 C	5.00	356	688	688	180	180
6.70 R 15 C	5.00	381	712	714	180	180

(+) Tyres in diagonal construction are identified by an hyphen in place of the letter 'R' (e.g. 145-10 C).

Table D

TYRES FOR SPECIAL APPLICATIONS - RADIAL AND DIAGONAL CONSTRUCTION

Tyre size designation (+)	Measuring rim width code	Nominal rim diameter d (mm)	Outer diameter D (mm)	Section Width S (mm)
Code Designated				
15x4 1/2-8	3.25	203	385	122
16x6-8	4.33	203	425	152
18x7	4.33	203	462	173
18x7-8	4.33	203	462	173
21x8-9	6.00	229	535	200
21x4	2.32	330	565	113
22x4 1/2	3.11	330	595	132
23x5	3.75	330	635	155
23x9-10	6.50	254	595	225
25x6	3.75	330	680	170
27x10-12	8.00	305	690	255
28x9-15	7.00	381	707	216
Metric designated				
200-15	6.50	381	730	205
250-15	7.50	381	735	250
300-15	8.00	381	840	300

(+) Tyres in radial construction are identified by the letter 'R' in place of the hyphen '-' (e.g. 15x4 1/2 R 8).

PART II

UNITED STATES TYRES

- Tolerances shown at the bottom of the tables apply in place of those shown in paragraph 3.21.1

- Outer diameters are listed for the various categories of use: Normal, Snow, Special.

Table A

TYRES FOR LIGHT COMMERCIAL VEHICLES (LT TYRES)

DIAGONAL AND RADIAL

Tyre size designation 1/	Measuring rim width code	Nominal rim diameter d(mm)	Outer diameter D (mm) 2/		Section width S (mm) 3/
			Normal	Snow	
6.00-16LT	4.50	406	732	743	173
6.50-16LT	4.50	406	755	767	182
6.70-16LT	5.00	406	722	733	191
7.00-13LT	5.00	330	647	658	187
7.00-14LT	5.00	356	670	681	187
7.00-15LT	5.50	381	752	763	202
7.00-16LT	5.50	406	778	788	202
7.10-15LT	5.00	381	738	749	199
7.50-15LT	6.00	381	782	794	220
7.50-16LT	6.00	406	808	819	220
8.25-16LT	6.50	406	859	869	241
9.00-16LT	6.50	406	890	903	257
G78-15LT	6.00	381	711	722	212
H78-15LT	6.00	381	727	739	222
L78-15LT	6.50	381	749	760	236
L78-16LT	6.50	406	775	786	236
7-14.5LT 4/	6.00	368	677		185
8-14.5LT 4/	6.00	368	707		203
9-14.5LT 4/	7.00	368	711		241
7-17.5LT	5.25	445	758	769	189
8-17.5LT	5.25	445	788	799	199

1/ Tyres in Radial construction are identified by the letter "R" in place of "-" (e.g. 6.00 R 16LT).

2/ Coefficient "b" for the calculation of Dmax: 1.08.

3/ Overall width may exceed this value up to +8 per cent.

4/ The suffix "MH"' may replace "LT" in the tyre size designation (e.g. 7-14.5 MH).

Table B

TYRES FOR LIGHT COMMERCIAL VEHICLES (HIGH FLOTATION TYRES) DIAGONAL AND RADIAL

Tyre size designation 1/	Measuring rim width code	Nominal rim diameter d (mm)	Outer diameter D (mm) 2/		Section width S (mm) 3/
			Normal	Snow	
9-15LT	8.00	381	744	755	254
10-15LT	8.00	381	773	783	264
11-15LT	8.00	381	777	788	279
24x7.50-13LT	6	330	597	604	191
27x8.50-14LT	7	356	674	680	218
28x8.50-15LT	7	381	699	705	218
29x9.50-15LT	7.5	381	724	731	240
30x9.50-15LT	7.5	381	750	756	240
31x10.50-15LT	8.5	381	775	781	268
31x11.50-15LT	9	381	775	781	290
31x13.50-15LT	11	381	775	781	345
31x15.50-15LT	12	381	775	781	390
32x11.50-15LT	9	381	801	807	290
33x12.50-15LT	10	381	826	832	318
35x12.50-15LT	10	381	877	883	318
37x12.50-15LT	10	381	928	934	318
37x14.50-15LT	12	381	928	934	372
8.00-16.5LT	6.00	419	720	730	203
8.75-16.5LT	6.75	419	748	759	222
9.50-16.5LT	6.75	419	776	787	241
10-16.5LT	8.25	419	762	773	264
12-16.5LT	9.75	419	818	831	307
30x9.50-16.5LT	7.50	419	750	761	240
31x10.50-16.5LT	8.25	419	775	787	266
33x12.50-16.5LT	9.75	419	826	838	315
37x12.50-16.5LT	9.75	419	928	939	315
37x14.50-16.5LT	11.25	419	928	939	365
33x9.50 R15LT	7.50	381	826	832	240
35x12.50 R16.5LT	10.00	419	877	883	318
37x12.50 R17LT	10.00	432	928	934	318

1/ Tyres in Radial construction are identified by the letter "R" in place of "-" (e.g. 24x7.50 R 13LT).

2/ Coefficient 'b' for the calculation of Dmax: 1.07.

3/ Overall width may exceed this value up to +7 per cent.