

5 February 2016

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## **Agreement**

### **Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions\***

(Revision 2, including the amendments which entered into force on 16 October 1995)

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#### **Addendum 108 – Regulation No. 109**

##### **Revision 1 - Amendment 1**

Supplement 7 to the original version of the Regulation – Date of entry into force:  
20 January 2016

#### **Uniform provisions concerning the approval for the production of retreaded pneumatic tyres for commercial vehicles and their trailers**

This document is meant purely as documentation tool. The authentic and legal binding text is:  
ECE/TRANS/WP.29/2015/67 (as amended by paragraph 69 of the report  
ECE/TRANS/WP.29/1116).



**UNITED NATIONS**

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\* Former title of the Agreement: Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

*Contents,*

*Insert a new Annex 10, to read:*

- "10            Procedures for snow performance testing relative to snow tyre for use in severe snow conditions
- Appendix 1            Pictogram definition of Alpine symbol
- Appendix 2            Test reports and test data for C2 tyres
- Appendix 3            Test reports and test data for C3 tyres"

*Paragraph 2.3.3., amend to read:*

- "2.3.3.        "*Snow tyre*" means a tyre whose tread pattern, tread compound or structure, are primarily designed to achieve in snow-conditions a performance better than that of a normal tyre with regard to its ability to initiate or maintain vehicle motion."

*Insert a new paragraph 2.3.3.1., to read:*

- "2.3.3.1.     "*Snow tyre for use in severe snow conditions*" means a snow tyre whose tread pattern, tread compound or structure is specifically designed to be used in severe snow conditions and that fulfils the requirements of paragraph 7.2. of this Regulation."

*Paragraph 2.26., footnote 3, amend to read:*

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- <sup>3</sup> ETRTO, 78, Rue Defacqz, B-1060 Brussels, Belgium"

*Insert new paragraphs 2.46. to 2.52., to read:*

- "2.46.        "*Representative tyre size*" means the tyre size which is submitted to the test described in Annex 10 to this Regulation to assess the performance of a range of tyres produced by the retreading production facility with regard to their performance for use in severe snow conditions. It can be either a retreaded tyre produced with a pre-cured tread or a retreaded tyre with mould cure process.
- 2.47.        "*Standard reference test tyre (SRTT)*" means a tyre that is produced, controlled and stored in accordance with the American Society for Testing and Materials (ASTM) standards:
- (a)    E1136-93 (2003) for the size P195/75R14;
- (b)    F2872 (2011) for the size 225/75 R 16 C;
- (c)    F2871 (2011) for the size 245/70R19.5;
- (d)    F2870 (2011) for the size 315/70R22.5.
- 2.48.        "*Control tyre*" means a new production tyre that is used to establish the snow grip performance of tyre sizes unable to be fitted to the same vehicle as the standard reference test tyre – see paragraph 3.4.3. of Annex 10 to this Regulation.
- 2.49.        "*Snow grip index (SG)*" means the ratio between the performance of the candidate tyre and the performance of the standard reference test tyre.

- 2.50. "Candidate tyre" means a tyre, that is submitted to one of the procedures for snow performance testing relative to snow tyre for use in severe snow conditions – see Annex 10 to this Regulation.
- 2.51. Class C2 tyres: Tyres conforming to Regulation No. 54 and identified by a load capacity index in single formation lower or equal to 121 and a speed category symbol higher or equal to "N";
- 2.52. Class C3 tyres: Tyres conforming to Regulation No. 54 and identified by:
- (a) A load capacity index in single formation higher or equal to 122 or;
  - (b) A load capacity index in single formation lower or equal to 121 and a speed category symbol lower or equal to "M".

*Insert a new paragraph 3.2.7.1., to read:*

- "3.2.7.1. The "Alpine" symbol (3-peak-mountain with snowflake) shall be added if the snow tyre is classified as "snow tyre for use in severe snow conditions.

In addition, in case a pre-cured tread is used for the retreading process, the inscription M+S or MS or M.S. or M & S and the "Alpine" symbol shall be marked, at least once, on both sides of the tread shoulder.

In both cases, the "Alpine" symbol ("3-peak-mountain with snowflake") shall conform to the symbol described in Annex 10, Appendix 1."

*Paragraph 3.2.12., amend to read:*

- "3.2.12. The inscription "ET" or "ML" or "MPT" for Special use tyres."

*Paragraph 3.2.14., amend to read:*

- "3.2.14. The prefix "LT" or the suffix "C" or "LT" following the rim diameter marking referred to in paragraph 2.21.3. and, if applicable, after the tyre to rim fitment configuration symbol referred to in paragraph 2.21.4. or the suffix "LT" after the service description."

*Paragraph 4.1.4.3., amend to read:*

- "4.1.4.3. The category of use of tyres (normal, snow or special tyres);"

*Insert a new paragraph 4.1.4.3.1., to read:*

- "4.1.4.3.1. For snow tyres the list of tyres having to fulfil the requirements of paragraph 7.2."

*Insert new paragraphs 4.2., 4.2.1. and 4.3., to read:*

- "4.2. The application for approval shall be accompanied by:
- 4.2.1. Details of the major features, including the tread pattern, with respect to the effects on the snow grip performance of the range of tyre sizes listed as required by paragraph 4.1.4.3.1. This may be by means of descriptions supplemented by drawings and/or photographs which must be sufficient to allow the type approval authority or technical service to determine whether any subsequent changes to the major features will adversely affect the tyre performance. The effects of changes to minor details of tyre construction on tyre performances will be evident and determined during checks on conformity of production;

- 4.3. At the request of the Type Approval Authority, the applicant shall submit samples of tyres for test or copies of test reports from the technical services, communicated as given in paragraph 12. of this Regulation."

*Paragraph 5.4., amend to read:*

- "5.4. Before granting approval the authority must be satisfied that retreaded tyres conform to this Regulation and that the tests have been successfully carried out:
- (a) On at least five and not necessarily more than 20 samples of retreaded tyres representative of the range of tyres produced by the retreading production unit when prescribed according to paragraphs 6.5. and 6.6.1. and;
  - (b) On at least one sample of retreaded tyres, of each pattern not covered by paragraphs 6.4.4.1. and 6.4.4.2., representative of the range of tyres produced by the retreading production unit when prescribed according to paragraph 6.6.2.\* In case of paragraph 6.4.4.2., the Type Approval Authority might request a test of compliance for the retreaded tyre. Testing of sampled sizes may be confined to a worst case selection\*, at the discretion of the Type Approval Authority or designated Technical Service."

*Insert new paragraphs 6.4.4.1. and 6.4.4.2. and a footnote \*, to read:*

- "6.4.4.1. For tyres retreaded by using pre-cured tread material with a tread pattern not covered by paragraph 6.4.4.2. having to fulfil the requirements of paragraph 7.2. \* the retreader shall ensure that either the manufacturer or the supplier of the pre-cured tread material provides:
- (a) A copy of the test report(s) as in Annex 10, Appendix 3 of the representative tyre size(s) (2.46) demonstrating compliance of the pre-cured tread to the requirements of paragraph 7.2.;
  - (b) The list of tyre sizes to which it can be applied for the retreading process and validated by the same designated Technical Service and/or TAA which issued the test report in paragraph 6.4.4.1.(a)
  - (c) A copy of the measures taken to ensure the conformity of production. These measures shall include test results demonstrating that the minimum levels of the snow performances required in paragraph 7.2.1 will be maintained.
- 6.4.4.2. For tyres retreaded by using either mould cure or pre-cured tread material with the same major features including tread pattern(s) as a new tyre type approved according to Regulation No. 117 having fulfilled the requirements about minimum snow performance in severe snow conditions, the retreader shall ensure that the manufacturer of the new tyre type provides either directly to the Type Approval Authority (or Technical Service) or to the

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\* If a tread pattern can be applied to both moulds for mould cure process and pre-cured tread band, the snow test may be performed with a representative tyre size retreaded with only one of the two possible processes and the snow test report can be used for both cases as long as the major features of the tread are comparable.

retreader: a copy of the UN Regulation No. 117 certificate(s) and a copy of the appropriate test report(s) issued by a designated Technical Service\*\* demonstrating compliance of the new tyre to the minimum snow performance in severe snow conditions.

- (a) The list of tyre sizes to which it can be applied for the retreading process and validated by the same designated Technical Service\*\* and/or Type Approval Authority that issued the Regulation No. 117 certificate(s);
- (b) The drawing(s) of the tread pattern(s) covered by the certificate(s);
- (c) A copy of the last report of the conformity of production as required in UN Regulation No. 117.

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\*\* Refer to the designated Technical Services listed in the document ECE/TRANS/WP.29/343 in its latest revision."

*Paragraph 6.6., amend to read:*

"6.6. Performance tests"

*Insert a new paragraph 6.6.1., to read:*

"6.6.1. Load/speed endurance test:"

*Renumber former paragraph 6.6.1. as 6.1.1.1.*

*Renumber paragraphs 6.6.2. and 6.6.3. as 6.6.1.2. and 6.6.1.3.*

*Insert new paragraphs 6.6.2. and 6.6.2.1., to read:*

"6.6.2. Snow test

6.6.2.1. Retreated Snow Tyres for use in severe snow conditions to comply with this regulation shall be capable of meeting snow performance test as specified in Annex 10 to this Regulation."

*Insert new paragraphs 7.2. and 7.2.1., to read:*

"7.2. In order to be classified as a "snow tyre for use in severe snow conditions", the retreaded tyre to comply with this Regulation shall meet the performance requirements of paragraph 7.2.1. The retreaded tyre size shall meet these requirements based on a test method of Annex 10 by which:

- (a) The mean fully developed deceleration ("mfdd") in a braking test;
- (b) Or alternatively an average traction force in a traction test;
- (c) Or alternatively the average acceleration in an acceleration test of a candidate tyre is compared to that of a standard reference tyre.

The relative performance shall be indicated by a snow grip index.

7.2.1. For Class C2 and C3 tyres, the minimum snow index value, as calculated in the procedure described in Annex 10 and compared with the SRTT shall be as follows:

<i>Class of tyre</i>	<i>Snow grip index (spin traction method) <sup>(b)</sup></i>	<i>Snow grip index (brake on snow method) <sup>(a)</sup></i>	<i>Snow grip index (acceleration method) <sup>(c)</sup></i>
	<i>Ref. = SRTT 14</i>	<i>Ref. = SRTT 16C</i>	<i>Ref. = SRTT 19.5 Ref. = SRTT 22.5</i>
C2	1.10	1.02	No
C3	No	No	1.25

<sup>(a)</sup> See paragraph 3 of Annex 10 to this Regulation

<sup>(b)</sup> See paragraph 2 of Annex 10 to this Regulation

<sup>(c)</sup> See paragraph 4 of Annex 10 to this Regulation"

*Paragraph 9.2.*, amend to read:

"9.2. The holder of the approval shall ensure that, at least the following number of tyres, representative of the range being produced, is checked and tested as prescribed in this Regulation:"

*Paragraph 9.2.1.*, amend to read:

"9.2.1. 0.01 per cent of the total annual production but in any case not less than 2 and not necessarily more than 10 during each year of production, and spread throughout that year;"

*Insert a new paragraph 9.2.2.*, to read:

"9.2.2. At least 1 tyre once every two years in order to verify conformity of the performance of the snow tyres for use in severe snow conditions fulfilling paragraph 6.6.2. and not covered by paragraphs 6.4.4.1. or 6.4.4.2."

*Insert a new paragraph 9.2.3.*, to read:

"9.2.3. At least 1 tyre once every four years in order to verify conformity of the performance of the snow tyres for use in severe snow conditions fulfilling paragraph 6.6.2. and covered by paragraphs 6.4.4.1. or 6.4.4.2. This requirement can be fulfilled through the analysis either of the test results requested in paragraph 6.4.4.1.c or the report(s) requested in paragraph 6.4.4.2.(c)."

*Paragraph 9.4.*, amend to read:

"9.4. The authority which has approved the retreading production unit may at any time verify the conformity control methods applied in each production facility including among others the prescriptions defined in the paragraph 6.4.4.1.(c) and 6.4.4.2.(c). For each production facility, the type Approval Authority shall take samples at random and at least the following number of tyres, representative of the range being produced, shall be checked and tested as prescribed in this Regulation:"

*Paragraph 9.4.1.*, amend to read:

"9.4.1. 0.01 per cent of the total annual production but in any case not less than 2 and not necessarily more than 10 during each and every production year;"

*Insert a new paragraph 9.4.2., to read:*

- "9.4.2. At least 1 tyre once every two years in order to verify conformity of the performance of the snow tyres for use in severe snow conditions fulfilling paragraph 6.6.2. and not covered by paragraphs 6.4.4.1. or 6.4.4.2."

*Insert a new paragraph 9.4.3., to read:*

- "9.4.3. A least 1 tyre once every four years in order to verify conformity of the performance of the snow tyres for use in severe snow conditions fulfilling paragraph 6.6.2. and covered by paragraphs 6.4.4.1. or 6.4.4.2. This requirement can be fulfilled through the analysis either of the test results requested in paragraph 6.4.4.1.(c) or the report(s) requested in paragraph 6.4.4.2.(c)."

*Insert a new Annex 10, to read:*

## "Annex 10

### **Procedures for snow performance testing relative to snow tyre for use in severe snow conditions**

1. Specific definitions for snow test when different from existing ones
  - 1.1. "Test run" means a single pass of a loaded tyre over a given test surface.
  - 1.2. "Braking test" means a series of a specified number of ABS-braking test runs of the same tyre repeated within a short time frame.
  - 1.3. "Traction test" means a series of a specified number of spin-traction test runs according to ASTM (American Standard Test Method) standard F1805-06 of the same tyre repeated within a short time frame.
  - 1.4. "Acceleration test" means a series of specified number of traction controlled acceleration test runs of the same tyre repeated within a short timeframe.
2. Spin traction method for Classes C2 tyres (traction force test per paragraph 7.2.(b) of this Regulation).

The test procedure of ASTM standard F1805-06 shall be used to assess snow performance through spin traction values on medium packed snow (The snow compaction index measured with a CTI penetrometer<sup>1</sup> shall be between 70 and 80).

  - 2.1. The test course surface shall be composed of a medium packed snow surface, as characterized in table A2.1 of ASTM standard F1805-06.
  - 2.2. The tyre load for testing shall be as per option 2 in paragraph 11.9.2. of ASTM standard F1805-06.

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<sup>1</sup> See appendix of ASTM standard F1805-06 for details.

3. Braking on snow method for Class C2 tyres
  - 3.1. General conditions
    - 3.1.1. Test course

The braking tests shall be done on a flat test surface of sufficient length and width, with a maximum 2 per cent gradient, covered with packed snow.

The snow surface shall be composed of a hard packed snow base at least 3 cm thick and a surface layer of medium packed and prepared snow about 2 cm thick.

The air temperature, measured about one meter above the ground, shall be between -2 °C and -15 °C; the snow temperature, measured at a depth of about one centimetre, shall be between -4 °C and -15 °C.

It is recommended to avoid direct sunlight, large variations of sunlight or humidity, as well as wind.

The snow compaction index measured with a CTI penetrometer<sup>1</sup> shall be between 75 and 85.
    - 3.1.2. Vehicle

The test shall be conducted with a standard production vehicle in good running order and equipped with an ABS system.

The vehicle used shall be such that the loads on each wheel are appropriate to the tyres being tested. Several different tyre sizes can be tested on the same vehicle.
    - 3.1.3. Tyres

The tyres should be "broken-in" prior to testing to remove spew, compound nodules or flashes resulting from the moulding process. The tyre surface in contact with snow shall be cleaned before performing a test.

Tyres shall be conditioned at the outdoor ambient temperature at least two hours before their mounting for tests. Tyre pressures shall then be adjusted to the values specified for the test.

In case a vehicle cannot accommodate both the reference and candidate tyres, a third tyre ("control" tyre) may be used as an intermediate. First test control vs. reference on another vehicle, then test candidate vs. control on the vehicle.
    - 3.1.4. Load and pressure
      - 3.1.4.1. For C2 tyres, the vehicle load shall be such that the resulting loads on the tyres are between 60 per cent and 100 per cent of the load corresponding to the tyre load index.

The static tyre load on the same axle should not differ by more than 10 per cent.

The inflation pressure is calculated to run at constant deflection:

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<sup>1</sup> See appendix of ASTM standard F1805-06 for details.



For a vertical load higher or equal to 75 per cent of the load capacity of the tyre, a constant deflection is applied, hence the test inflation pressure "P<sub>t</sub>" shall be calculated as follows:

$$P_t = P_r \left( \frac{Q_t}{Q_r} \right)^{1.25}$$

Q<sub>r</sub>: is the maximum load associated to the load capacity index of the tyre written on the sidewall.

P<sub>r</sub>: is the reference pressure corresponding to the maximum load capacity Q<sub>r</sub>.

Q<sub>t</sub>: is the static test load of the tyre.

For a vertical load lower than 75 per cent of the load capacity of the tyre, a constant inflation pressure is applied, hence the test inflation pressure P<sub>t</sub> shall be calculated as follows:

$$P_t = P_r (0.75)^{1.25} = (0.7)P_r$$

P<sub>r</sub>: is the reference pressure corresponding to the maximum load capacity Q<sub>r</sub>.

Check the tyre pressure just prior to testing at ambient temperature.

#### 3.1.4.2. Instrumentation

The vehicle shall be fitted with calibrated sensors suitable for measurements in winter. There shall be a data acquisition system to store measurements.

The accuracy of measurement sensors and systems shall be such that the relative uncertainty of the measured or computed mean fully developed decelerations is less than 1 per cent.

#### 3.2. Testing sequences

##### 3.2.1. For every candidate tyre and the standard reference tyre, ABS-braking test runs shall be repeated a minimum of six times.

The zones where ABS-braking is fully applied shall not overlap.

When a new set of tyres is tested, the runs are performed after shifting aside the vehicle trajectory in order not to brake on the tracks of the previous tyre.

When it is no longer possible not to overlap full ABS-braking zones, the test course shall be re-groomed.

Required sequence:

6 repeats SRTT, then shift aside to test next tyre on fresh surface;

6 repeats Candidate 1, then shift aside;

6 repeats Candidate 2, then shift aside;

6 repeats SRTT, then shift aside.

##### 3.2.2. Order of testing:

If only one candidate tyre is to be evaluated, 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 two candidate tyres may be tested before repeating the SRTT test, for example:

$$R1 - T1 - T2 - R2.$$

The comparative tests of SRTT and candidate tyres shall be repeated on two different days.

3.3. Test procedure

3.3.1. Drive the vehicle at a speed not lower than 28 km/h.

3.3.2. When the measuring zone has been reached, the vehicle gear is set into neutral, the brake pedal is depressed sharply by 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 and held down until the speed is lower than 8 km/h.

3.3.3. The mean fully developed deceleration between 25 km/h and 10 km/h shall be computed from time, distance, speed, or acceleration measurements.

3.4. Data evaluation and presentation of results

3.4.1. Parameters to be reported

3.4.1.1. For each tyre and each braking test, the mean and standard deviation of the mfdd shall be computed and reported. The coefficient of variation CV of a tyre braking test shall be computed as:

$$CV(\text{tyre}) = \frac{\text{Std.dev}(\text{tyre})}{\text{Mean}(\text{tyre})}$$

3.4.1.2. Weighted averages (wa) of two successive tests of the SRTT shall be computed taking into account the number of candidate tyres in between:

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

$$wa(\text{SRTT}) = (R1 + R2)/2$$

Where:

R1: is the mean mfdd for the first test of the SRTT and R2 is the mean mfdd for the second test of the SRTT.

In the case of the order of testing R1 - T1 - T2 - R2, the weighted average (wa) of the SRTT to be used in the comparison of the performance of the candidate tyre shall be taken to be:

wa (SRTT) = 2/3 R1 + 1/3 R2 for comparison with the candidate tyre T1;  
and:

wa (SRTT) = 1/3 R1 + 2/3 R2 for comparison with the candidate tyre T2.

- 3.4.1.3. The snow grip index (SG) in per cent of a candidate tyre shall be computed as:

$$\text{Snow Grip Index (candidate)} = \frac{\text{Mean (candidate)}}{wa (SRTT)}$$

- 3.4.2. Statistical validations

The sets of repeats of measured or computed mfdd for each tyre should be examined for normality, drift, eventual outliers.

The consistency of the means and standard-deviations of successive braking tests of SRTT should be examined.

The means of two successive SRTT braking tests shall not differ by more than five per cent.

The coefficient of variation of any braking test shall be less than six per cent.

If those conditions are not met, tests shall be performed again after re-grooming the test course.

- 3.4.3. 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.

- 3.4.3.1. The snow grip index of the control tyre relative to the SRTT (SG1) and of the candidate tyre relative to the control tyre (SG2) shall be established using the procedure in paragraphs 3.1. to 3.4.2. above.

The snow grip index of the candidate tyre relative to the SRTT shall be the product of the two resulting snow grip indices that is SG1 x SG2.

- 3.4.3.2. The ambient conditions shall be comparable. All tests shall be completed within the same day.

- 3.4.3.3. 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.

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

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

4. Acceleration method for Class C3 tyres

- 4.1. According to the definition of C3 tyres reported into paragraph 2.52. of this Regulation, the additional classification for the purpose of this test method only applies:

- (a) C3 Narrow (C3N), when the C3 tyre nominal section width is lower than 285 mm;
- (b) C3 Wide (C3W), when the C3 tyre nominal section width is greater or equal to 285 mm.

- 4.2. Methods for measuring Snow Grip index (SG)
- Snow performance is based on a test method by which the average acceleration in an acceleration test, of a candidate tyre is compared to that of a standard reference tyre.
- The relative performance shall be indicated by a snow grip index.
- When tested in accordance with the acceleration test in paragraph 4.7. below, the average acceleration of a candidate snow tyre shall be at least 1.25 compared to one of the two equivalent SRTTs – ASTM F 2870 and ASTM F 2871.
- 4.3. Measuring equipment
- 4.3.1. A sensor suitable for measuring speed and distance covered on snow/ice surface between two speeds must be used.
- To measure vehicle speed, a fifth wheel or non-contact speed-measuring system (including radar, GPS ...) shall be used.
- 4.3.2. The following tolerances shall be respected:
- (a) For speed measurements:  $\pm 1$  per cent (km/h) or 0.5 km/h whichever is greater.
  - (b) For distance measurements:  $\pm 1 \times 10^{-1}$  m
- 4.3.3. A display of the measured speed or the difference between the measured speed and the reference speed for the test is recommended inside the vehicle so that the driver can adjust the speed of the vehicle.
- 4.3.4. For Acceleration test covered in paragraph 4.7. below, a display of the slip ratio of the driven tyres is recommended inside the vehicle and shall be used in the particular case of paragraph 4.7.2.1.1. below.
- The slip ratio is calculated by:
- $$\text{Slip Ratio \%} = \left[ \frac{\text{Wheel Speed} - \text{Vehicle Speed}}{\text{Vehicle Speed}} \right] \times 100$$
- (a) Vehicle speed is measured as defined in 4.3.1. above (m/s);
  - (b) Wheel speed is calculated on a tyre of the driven axle by measuring its angular velocity and its loaded diameter
- $$\text{Wheel Speed} = \pi \times \text{loaded diameter} \times \text{angular speed}$$
- Where,  $\pi = 3.1416$  (m/360deg), the loaded diameter (m) and the angular speed (revolution per second = 360 deg/sec).
- 4.3.5. A data acquisition system can be used for storing the measurements.
- 4.4. General conditions
- 4.4.1. Test course
- The test shall be done on a flat test surface of sufficient length and width, with a maximum two per cent gradient, covered with packed snow.

- 4.4.1.1. The snow surface shall be composed of a hard packed snow base at least 3 cm thick and a surface layer of medium packed and prepared snow about 2 cm thick.
- 4.4.1.2. The snow compaction index measured with a CTI penetrometer shall be between 80 and 90. Refer to the appendix of ASTM F1805 for additional details on measuring method.
- 4.4.1.3. The air temperature, measured about one meter above the ground, shall be between -2 °C and -15 °C; the snow temperature, measured at a depth of about one centimetre, shall be between -4 °C and -15 °C.

Air temperature shall not vary more than 10 deg C during the test.

- 4.5. Tyres preparation and break-in
  - 4.5.1. Fit the test tyres on rims as per ISO 4209-1 using conventional mounting methods. Ensure proper bead seating by the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.
  - 4.5.2. The tyres should be "broken-in" prior to testing to remove spew, compound nodules or flashes resulting from moulding process.
  - 4.5.3. Tyres shall be conditioned at the outdoor ambient temperature at least two hours before their mounting for tests.

They should be placed such that they all have the same ambient temperature prior to testing and be shielded from the sun to avoid excessive heating by solar radiation.

The tyre surface in contact with snow shall be cleaned before performing a test.

Tyre pressures shall then be adjusted to the values specified for the test.

- 4.6. Testing sequence

If only one candidate tyre is to be evaluated, 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 3 candidate tyres may be tested before repeating the SRTT test, for example: R1 - T1 - T2 - T3 - R2.

Recommendations are that the zones where acceleration is fully applied shall not overlap without reworking and when a new set of tyres is tested;

The runs are performed after shifting the vehicle trajectory in order not to accelerate on the tracks of the previous tyre; when it is no longer possible not to overlap full acceleration zones, the test course should be re-groomed.

- 4.7. Acceleration on snow test procedure for snow grip index of Classes C3N and C3W
- 4.7.1. Principle
- The test method covers a procedure for measuring the snow grip performance of commercial vehicle tyres during acceleration, using a commercial vehicle having a Traction Control System (TCS, ASR, etc.).
- Starting with a defined initial speed, the full throttle is applied to activate the Traction Control System, the Average acceleration is calculated between two defined speeds.
- 4.7.2. Vehicle
- 4.7.2.1. The test shall be conducted with a two axles standard model commercial vehicle in good running conditions equipped with:
- (a) Low rear axle weight and enough powerful engine to ensure the average percentage of slip during the test as required in paragraphs 4.7.5.1. and 4.7.5.2.1. below;
  - (b) A manual gearbox (automatic gearbox with manual shift allowed) having a gear ratio covering a 19 km/h range between 4 and 30 km/h;
  - (c) Blocking differential on driven axle is recommended as increasing repeatability;
  - (d) A standard commercial system controlling/limiting the slip of the driving axle when accelerating (called Traction Control, ASR, TCS, etc.).
- 4.7.2.1.1. In the particular case where it is not possible to find a standard commercial vehicle equipped with a traction control system, a vehicle without Traction Control/ASR/TCS is allowed with a mandatory display of the percentage slip as stated in 4.3.4. and a mandatory blocking differential on the driven axle to put in practice the operating procedure of paragraph 4.7.5.2.1. below.
- 4.7.2.2. The permitted modifications are:
- (a) Those allowing to increase the number of tyre sizes capable to be mounted on the vehicle;
  - (b) Those permitting to install an automatic activation of the acceleration and the measurements.
- Any other modification of the acceleration system is prohibited.
- 4.7.3. Vehicle fitting
- The rear driven axle may be indifferently fitted with 2 or 4 test tyres if respecting the loading by tyre.
- The front steer non driven axle is equipped with 2 tyres having a size suitable for the axle load. These 2 front tyres could be maintained along the test.
- 4.7.4. Load and inflation pressure
- 4.7.4.1. The static load on each rear driven test tyres must be between 20 per cent and 55 per cent of the tested tyre load capacity written on the sidewall.

The vehicle front steer total static axle load should be between 60 per cent and 160 per cent of the driven rear total axle load.

The static tyre load on the same driven axle should not differ by more than 10 per cent.

- 4.7.4.2. The driven tyres inflation pressure shall be 70 per cent of the one written on the sidewall.

The steer tyres are inflated at nominal sidewall pressure

- 4.7.5. Testing runs

- 4.7.5.1. Mount first the set of reference tyres on the vehicle and when on the testing area.

Drive the vehicle at an initial constant speed between 4 km/h and 11 km/h and the gear ratio capable of covering the speed range of 19 km/h.

Recommended gear ratio selected is third or fourth and shall give minimum 13 per cent average slip ratio in the measured range of speed.

- 4.7.5.2. In case of Traction Control System equipped vehicles (already switched "on" before the run) apply full throttle until the vehicle has reached the final speed.

Final speed = Initial speed + 15 km/h

No rearward restraining force shall be applied to the test vehicle.

- 4.7.5.2.1. In the particular case of paragraph 4.7.2.1.1. above where it is not possible to find a standard commercial vehicle having the Traction Control system, the driver maintains manually the averaged slip ratio range of 20 per cent  $\pm$  10 per cent (Controlled Slip procedure in place of the Full Slip) in the same range of speeds. All the tyres and runs in the test session are performed with Controlled Slip procedure.

- 4.7.5.3. Measure the distance and the time between the initial speed and the final speed.

- 4.7.5.4. For every candidate tyre and the standard reference tyre, the acceleration test runs shall be repeated a minimum of 6 times and the coefficients of variation (standard deviation/average\*100) calculated for minimum 6 valid runs on the distance and the time should be lower than or equal to 6 per cent.

- 4.7.5.5. In case of Traction Control System equipped vehicle, the average slip ratio shall be in the range from 13 per cent to 40 per cent (calculated as per in paragraph 4.3.4. above).

- 4.7.5.6. Apply testing sequence as defined in paragraph 4.6. above.

- 4.8. Processing of measurement results

- 4.8.1. Calculation of the average acceleration AA

Each time the measurement is repeated, the average acceleration AA ( $m \cdot s^{-2}$ ) is calculated by:

$$AA = \frac{S_f^2 - S_i^2}{2D}$$

Where D (m) is the distance covered between the initial speed  $S_i$  ( $m \cdot s^{-1}$ ) and the final speed  $S_f$  ( $m \cdot s^{-1}$ ).

4.8.2. Validation of results

For the candidate tyres:

The coefficient of variation of the average acceleration is calculated for all the candidate tyres. If one coefficient of variation is greater than six per cent, discard the data for this candidate tyre and repeat the test.

$$\text{coefficient of variation} = \frac{\text{stdev}}{\text{average}} \times 100$$

For the reference tyre:

If the coefficient of variation of the average acceleration "AA" for each group of min 6 runs of the reference tyre is higher than 6 per cent, discard all data and repeat the test for all tyres (the candidate tyres and the reference tyre).

In addition and in order to take in account possible test evolution, the coefficient of validation is calculated on the basis of the average values of any two consecutive groups of min 6 runs of the reference tyre. If the coefficient of validation is greater than 6 per cent, discard the data for all the candidate tyres and repeat the test.

$$\text{coefficient of validation} = \left| \frac{\text{Average 2} - \text{Average 1}}{\text{Average 1}} \right| \times 100$$

4.8.3. Calculation of the "average AA"

If R1 is the average of the "AA" values in the first test of the reference tyre, R2 is the average of the "AA" values in the second test of the reference tyre, the following operations are performed, according to Table 1 below.

Table 1

<i>If the number of sets of candidate tyres between two successive runs of the reference tyre is:</i>	<i>and the set of candidate tyres to be qualified is:</i>	<i>then "Ra" is calculated by applying the following:</i>
1   R – T1 – R	T1	Ra = 1/2 (R1 + R2)
2   R – T1 – T2 – R	T1 T2	Ra = 2/3 R1 + 1/3 R2 Ra = 1/3 R1 + 2/3 R2
3   R – T1 – T2 – T3 – R	T1 T2 T3	Ra = 3/4 R1 + 1/4 R2 Ra = 1/2 (R1 + R2) Ra = 1/4 R1 + 3/4 R2

"Ta" (a = 1, 2, ...) is the average of the AA values for a test of a candidate tyre.

4.8.4. "AFC" Calculation (Acceleration Force Coefficient)

Also called AFC Acceleration Force Coefficient

Calculation on of AFC(Ta) and AFC(Ra) as defined in Table 2 :



Table 2

	<i>The acceleration force coefficient "AFC" is:</i>
Reference tyre	$AFC(R) = \frac{Ra}{g}$
Candidate tyre	$AFC(T) = \frac{Ta}{g}$

Ra and Ta are in m/s<sup>2</sup>

"g"= gravity acceleration (rounded to 9.81 m/s<sup>2</sup>)

4.8.5. Calculation of the relative snow grip index of the tyre

The Snow grip index represents the relative performance of the candidate tyre compared to the reference tyre.

$$\text{Snow Grip Index} = \frac{AFC(T)}{AFC(R)}$$

4.8.6. Calculation of the slip ratio

The slip ratio can be calculated as the average of Slip ratio as mentioned in paragraph 4.3.4. above or by comparing the average distance referred to in paragraph 4.7.5.3. above of the min 6 runs to the distance of a run done without slip (very low acceleration)

$$\text{Slip Ratio \%} = \left[ \frac{\text{Average distance} - \text{No slip distance}}{\text{No slip distance}} \right] \times 100$$

4.9. Snow grip performance comparison between a candidate tyre and a reference tyre using a control tyre

4.9.1. Scope

When the candidate tyre size is significantly different from the reference tyre a direct comparison on the same vehicle may be not possible. This is an approach using an intermediate tyre, hereinafter called the control tyre.

4.9.2. Principle of the approach

The principle lies upon the use of a control tyre and 2 different vehicles for the assessment of a candidate tyre in comparison with a reference tyre.

One vehicle can fit the reference tyre and the control tyre, the other the control tyre and the candidate tyre. All conditions are in conformity with paragraph 4.7. above.

The first assessment is a comparison between the control tyre and the reference tyre. The result (Snow Grip Index 1) is the relative efficiency of the control tyre compared to the reference tyre.

The second assessment is a comparison between the candidate tyre and the control tyre. The result (Snow Grip Index 2) is the relative efficiency of the candidate tyre compared to the control tyre.

The second assessment is done on the same track as the first one. The air temperature must be in the range of +/- 5 °C of the temperature of the first assessment. The control tyre set is the same set as the set used for the first assessment.

The snow grip performance index of the candidate tyre compared to the reference tyre is deduced by multiplying the relative efficiencies calculated above:

$$\text{Snow Grip Index} = \text{SG1} \times \text{SG2}$$

4.9.3. Selection of a set of tyres as a control tyre set

A control tyre set is a group of identical tyres made in the same factory during one week period.

4.10. Storage and preservation

Before the first assessment (control tyre / reference tyre), normal storage conditions can be used. It is necessary that all the tyres of a control tyre set have been stored in the same conditions.

As soon as the control tyre set has been assessed in comparison with the reference tyre, specific storage conditions shall be applied for control tyres replacement.

When irregular wear or damage results from tests, or when wear influences the test results, the use of the tyre shall be discontinued."

*Add a new Appendix 1 to Annex 10, to read:*

## "Annex 10 - Appendix 1

### Pictogram definition of "Alpine Symbol"



Minimum 15 mm base and 15 mm height when the marking is on the sidewall.

Minimum 10 mm base and 10 mm height in case of marking on the shoulder of a pre-cured tread.

Above drawing not to scale."

Add a new Appendix 2 to Annex 10, to read:

## "Annex 10 - Appendix 2

### Test reports and test data for C2 tyres

#### Part 1 - Report

1. Type Approval Authority or Technical Service: .....
2. Name and address of applicant: .....
3. Test report No.: .....
4. Manufacturer and brand name or trade description:
5. Tyre class: .....
6. Category of use: .....
7. Snow index relative to SRTT according to paragraph 7.2.1.
- 7.1. Test procedure and SRTT used .....
8. Comments (if any): .....
9. Date: .....
10. Signature: .....
11. Signature of the technical service:
12. Signature of the Type Approval Authority:

#### Part 2 - Test data

1. Date of test: .....
2. Location of test track: .....
- 2.1. Test track characteristics:

	<i>At start of tests</i>	<i>At end of tests</i>	<i>Specification</i>
Weather			
Ambient temperature			-2 °C to -15 °C
Snow temperature			-4 °C to -15 °C
CTI index			75 to 85
Other			

3. Test vehicle (make, model and type, year): .....
4. Test tyre details .....
- 4.1. Tyre size designation and service description:.....
- 4.2. Tyre brand and trade description: .....

4.3. Test tyre data:

	<i>SRTT (1st test)</i>	<i>Candidate</i>	<i>Candidate</i>	<i>SRTT (2nd test)</i>
Tyre dimensions				
Test rim width code				
Tyre loads F/R (kg)				
Load index F/R ( per cent)				
Tyre pressure F/R(kPa)				

5. Test results: mean fully developed decelerations (m/s<sup>2</sup>) / traction coefficient.<sup>1</sup>

<i>Run number</i>	<i>Specification</i>	<i>SRTT (1st test)</i>	<i>Candidate</i>	<i>Candidate</i>	<i>SRTT (2nd test)</i>
1					
2					
3					
4					
5					
6					
Mean					
Std-deviation					
CV (%)	< 6 %				
Validation SRTT	(SRTT) < 5 %	<del></del>	<del></del>	<del></del>	<del></del>
SRTT average		<del></del>	<del></del>	<del></del>	<del></del>
Snow index		1.00			<del></del>

<sup>1</sup> Strike out what does not apply.

..

Add a new Appendix 3 to Annex 10, to read:

## "Annex 10 - Appendix 3

### Test reports and test data for C3 tyres

#### Part 1 - Report

1. Type Approval Authority or Technical Service: .....
2. Name and address of applicant: .....
3. Test report No.: .....
4. Manufacturer and brand name or trade description: .....
5. Tyre class: .....
6. Category of use: .....
7. Snow index relative to SRTT according to paragraph 7.2.1.
- 7.1. Test procedure and SRTT used .....
8. Comments (if any): .....
9. Date: .....
10. Signature: .....
11. Signature of the technical service: .....
12. Signature of the Type Approval Authority: .....

#### Part 2 - Test data

1. Date of test: .....
2. Location of test track: .....
- 2.1. Test track characteristics:

	<i>At start of tests</i>	<i>At end of tests</i>	<i>Specification</i>
Weather			
Ambient temperature			-2 °C to -15 °C
Snow temperature			-4 °C to -15 °C
CTI index			80 to 90
Other			

3. Test vehicle (make, model and type, year): .....
4. Test tyre details .....
- 4.1. Tyre size designation and service description: .....
- 4.2. Tyre brand and trade description: .....

4.3. Test tyre data: .....

	<i>SRTT (1st test)</i>	<i>Candidate 1</i>	<i>Candidate 2</i>	<i>Candidate 3</i>	<i>SRTT (2nd test)</i>
Tyre dimensions					
Test rim width code					
Tyre loads F/R (kg)					
Load index F/R (per cent)					
Tyre pressure F/R (kPa)					

5. Test results: average accelerations (m/s<sup>2</sup>)

<i>Run number</i>	<i>Specification</i>	<i>SRTT (1st test)</i>	<i>Candidate 1</i>	<i>Candidate 2</i>	<i>Candidate 3</i>	<i>SRTT (2nd test)</i>
1						
2						
3						
4						
5						
6						
Mean						
Std-deviation						
Slip ratio (per cent)						
CV (per cent)	< 6 per cent					
Validation SRTT	(SRTT) < 5 per cent	<del></del>	<del></del>	<del></del>	<del></del>	
SRTT average			<del></del>	<del></del>	<del></del>	<del></del>
Snow index		1.00				<del></del>

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