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Item 5 (c) of the provisional agenda

Tyres: UN Regulation No. 106 (Tyres for agricultural vehicles and their trailers)**Proposal for amendments to UN Regulation No. 106****Submitted by the experts from the European Tyre and Rim Technical Organization***

The text reproduced below was prepared by the experts from the European Tyre and Rim Technical Organization (ETRTO). The modifications to the existing text of the UN Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2023 as outlined in proposed programme budget for 2023 (A/77/6 (Sect. 20), table 20.6), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.



I. Proposal

Paragraph 1.2.1., amend to read:

"1.2.1. Tyres identified by speed category symbols corresponding to speeds higher than ~~65~~**70** km/h (i.e. speed category symbols higher than "~~DE~~")."

Paragraph 2.1., amend to read:

"2.1. "*Type of agricultural tyre*" means tyres which do not differ in such essential characteristics as:

- (a) The manufacturer's name;
- (b) Tyre-size designation;
- (c) Category of use:
 - (i) ~~Tractor steering~~**Tractor steering** wheel;
 - (ii) ~~Tractor drive~~**Tractor drive** wheel - standard tread;
 - (iii) ~~Tractor drive~~**Tractor drive** wheel - special tread;
 - (iv) Implement - traction;
 - (v) Implement - trailer;
 - (vi) Implement - mixed applications;
 - (vii) Forestry machines – standard tread;
 - (viii) Forestry machines – special tread.
 - (ix) Construction applications (IND).
- (d) Structure (diagonal or (bias-ply), bias-belted, **radial** (radial-ply));
- (e) Speed category symbol;
- (f) Load capacity index;
- (g) Tyre cross-section."

Paragraph 2.6.3., amend to read:

"2.6.3. "*Radial*" or "**radial-ply**" describes a tyre structure in which the ply cords extend to the beads and are laid substantially at 90° to the centreline of the tread, the carcass being stabilised by an essentially inextensible circumferential belt;"

Paragraph 2.18.10., amend to read:

"2.18.10. The letters "CFO" after the nominal rim diameter marking in case of "Improved Flexion" or "Very High Flexion" ~~tractor drive~~**tractor drive** wheel tyres specifically designed for the ~~equipments~~**equipment** of machines to be used in Cyclic Field Operations."

Paragraph 2.18.11., amend to read:

"2.18.11. The letters "CHO" after the nominal rim diameter marking in case of standard ~~tractor drive~~**tractor drive** wheel tyres specifically designed for the ~~equipments~~**equipment** of machines to be used in Cyclic Harvesting Operations."

Paragraph 2.23., amend to read:

"2.23. "~~Tractor drive~~**Tractor drive wheel tyre**" means a tyre designed to be fitted to driven axles of agricultural and forestry tractors (vehicles in categories T) suitable for sustained high torque service. The tread pattern of the tyre consists of lugs or cleats;"

Paragraph 2.30., amend to read:

- "2.30. *"Supplementary service description"* means an additional service description, marked within a circle, to identify a special type of service (load ~~rating~~**capacity index** and speed category) to which the tyre type is also allowed in addition to the applicable ~~load~~**variation of load capacity** with speed (see Annex 7);"

Paragraph 2.31., amend to read:

- "2.31. ~~"Load capacity"~~***"Load capacity index"*** means one number which indicates the load the tyre can carry in single formation at the speed corresponding to the associated speed category and when operated in conformity with the requirements governing utilisation specified by the manufacturer. The list of these indices and their corresponding masses is given in Annex 4;"

Paragraph 2.32., amend to read:

- "2.32. *"Speed category"*, the reference speed expressed by the speed category symbol as shown in the table below:

<i>Speed category symbol</i>	<i>Reference speed (km/h)</i>
A2	10
A4	20
A6	30
A8	40
B	50
D	65
E	70

"

Paragraph 2.34.1., amend to read:

- "2.34.1. It must not exceed the percentage of the value associated with the relevant load capacity index of the tyre as indicated in the table ~~"Load capacity variation with speed"~~**"Variation of load capacity with speed"** (see paragraphs 2.30. and 2.33. above), with reference to the category of use, the speed category symbol of the tyre and the speed capability of the vehicle to which the tyre is fitted;"

Add a new paragraph 3.1.5.3., to read:

- "3.1.5.3. In the case of implement tyre for mixed applications where the service descriptions for "trailer" applications and that for "traction" applications are equal, the relevant application symbols (see paragraphs 2.26. and 2.27. above) may be omitted and only one service description may be marked on the tyre sidewalls."**

Paragraph 3.1.8., amend to read:

- "3.1.8. The inscriptions "F-1" or "F-2" **or "F-2M"** or "F-3" in the case of a tractor steering wheel tyre that is not already marked as per paragraph 2.18.6. above;"

Paragraph 3.4.1., renumber as 3.3.1.

Paragraph 4.1.6., amend to read:

- "4.1.6. The ~~load capacity~~**load capacity** index of the tyre, specifying in case of implement tyres that for traction (only) and that for trailer application, if applicable;"

Paragraph 6.5.3., amend to read:

- "6.5.3. The test procedures to assess, **in case of tyres with speed category symbol D or E**, the suitability of the tyre for the claimed performances are described in Annex 9."

Add new paragraphs 6.5.3.3. and 6.5.3.3.1., to read:

"6.5.3.3. Where application is made for the approval of a type of 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 tables in Annex 7 (supplementary service description), an additional load/speed test as prescribed in paragraph 6.5.3. above shall also be carried out on a second tyre of the same type at the additional load/speed combination.

6.5.3.3.1. Tyres marked with a nominal speed category symbol D and supplementary service description with speed category symbol E and a load capacity index reduced by 3 points^(*) or more with respect to the nominal load capacity index can be exempted from performing an additional load/speed test.

(*) This corresponds to a reduction of the load capacity at 70 km/h applicable to speed category symbol D which approximates the reduction of 9% given in Annex 7 part A and C."

Annex 1,

Paragraph 4.5., amend to read:

"4.5. ~~Load capacity~~Load capacity index:....."

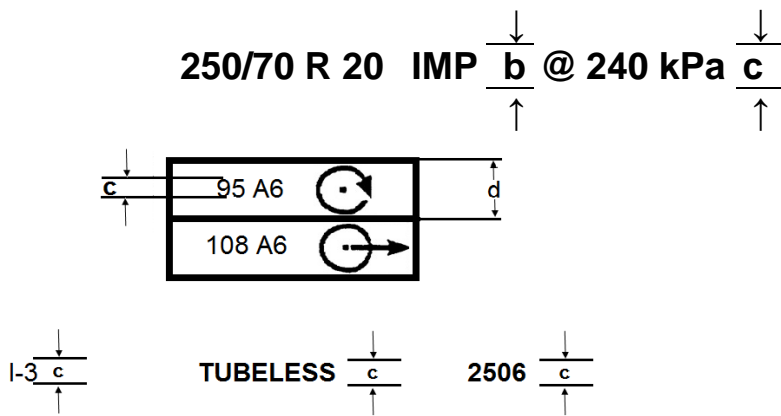
Paragraph 4.8., amend to read:

"4.8. Inflation pressure (kPa/bar ²)"

Annex 3, Part C, amend to read:

"Part C: Implement tyres

Example of the markings to be borne by types of tyres complying with this Regulation



Minimum heights of markings (mm)

Tyres of nominal section width	Tyres of rim diameter code		
	Up to 12	13 to 19.5	20 and above
up to 130	b = 4 c = 4 d = 7	b = 6 c = 4 d = 12	b = 9 c = 4 d = 12
135 to 235	b = 6 c = 4 d = 12	b = 6 c = 4 d = 12	b = 9 c = 4 d = 12
240 and above	b = 9 c = 4 d = 12	b = 9 c = 4 d = 12	b = 9 c = 4 d = 12

These markings define an implement tyre:

- (a) Having a nominal section width of 250;
- (b) Having a nominal aspect ratio of 70;
- (c) Of radial-ply structure (R);
- (d) Having a nominal rim diameter of 508 mm, for which the code is 20;
- (e) Designed primarily for the equipment of implements, agricultural machinery or agricultural trailers (IMP);
- (f) Having load capacities of 690 kg corresponding to the load capacity index 95 shown in Annex 4 when used on driven axles (traction application), as identified by the appropriate symbol;
- (g) Having load capacities of 1,000 kg when used on non-driven axles (trailer application) corresponding to the load capacity index 108 shown in Annex 4, as identified by the appropriate symbol;
- (h) Both applications being classified in the nominal speed category **symbol A6** (reference speed 30 km/h);
- (i) For fitting without an inner tube "tubeless";
- (j) Manufactured during the twenty-fifth week of the year 2006 (see paragraph 3.2. of the Regulation);
- (k) Requiring to be inflated to 240 kPa for measurements and tyre resistance to burst and, if applicable, load/speed test.

The positioning and order of the markings constituting the tyre designation are as follows:

- (a) The **tyre** size designation, comprising **the prefix (if any)**, the nominal section width, the nominal aspect ratio, the type-of-structure symbol (where applicable), the nominal rim diameter and optionally the letters 'IMP' must be grouped as shown in the ~~above example~~**examples**:
250/70 R 20 IMP, **VF 650/55 R 26.5 IMP**;
- (b) The service description (the load **capacity** index and the speed category symbol) and the relevant type of application symbol are placed together near the size designation. They may either precede or follow it or be placed above or below it;
- (c) The symbol "TUBELESS", I-3 if any, the optional word "RADIAL", the optional word "IMPLEMENT" and the date of manufacture may be at a distance from the size designation;
- (d) The inflation pressure to be used for measurement and tests is placed near the service description. It may either follow or be placed below it."

Annex 5, table 1, note 1, amend to read:

"1. Agricultural steering wheels tyres are identified either by suffix "Front" placed after the Tyre size designation (e.g. 4.00 - 9 Front) or by one of the following additional markings added to the Tyre sidewalls: "F-1", "F-2", "**F-2M**" or "F-3"."

Annex 6, paragraph 4., amend to read:

"4. The overall width is measured ~~by calliper~~ at six ~~equally paced~~**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."

Annex 7, Part A, amend to read:

"Part A: Drive wheel tyres for agricultural tractors

Applicable to tyres classified with categories of use: "Tractor drive wheel" (see paragraph 2.23. of this Regulation)

(see paragraph 2.23. of this Regulation)

Variation of load carrying capacity (per cent)

Speed (km/h)	Speed category symbol														(2)	(3)
	Standard tyres						IF tyres				VF tyres					
	A2	A6 (1)	A8 (1)	B (1)	D (1)	E (1)	A8 (1)	B (1)	D (1)	E (1)	A8 (1)	B (1)	D (1)	E (1)		
10	0	+40	+50	+50	+50	+50	+27	+27	+27	+27	+10	+10	+10	+10	+ 58	+ 56
15	-6	+30	+34	+34	+34	+34	+15	+15	+15	+15	+5	+5	+5	+5	+ 32	+ 44
20	-11	+20	+23	+23	+23	+23	+8	+8	+8	+8	+4	+4	+4	+4	+ 26	+ 33
25	-16	+7	+11	+11	+18,5	+18,5	+6	+6	+6	+6	+3	+3	+3	+3	+ 19	+ 22
30	-20	0	+7	+7	+15	+15	+4	+4	+4	+4	+2	+2	+2	+2	+ 12	+ 11
35	-24	-5	+3	+3	+12	+12	+2	+2	+2	+2	+1	+1	+1	+1	+ 10	+ 6
40	-27	-10	0	0	+9,5	+9,5	0	0	0	0	0	0	0	0	+ 6	0
45	-	-	-4	0	+7	+7	-4	0	0	0	-4	0	0	0	+ 2	-
50	-	-	-9	0	+5	+5	-9	0	0	0	-9	0	0	0	0	-
55	-	-	-	-	+3	+3	-	-	0	0	-	-	0	0	-	-
60	-	-	-	-	+1,5	+1,5	-	-	0	0	-	-	0	0	-	-
65	-	-	-	-	0	0	-	-	0	0	-	-	0	0	-	-
70	-	-	-	-	-9	0	-	-	-9	0	-	-	-9	0	-	-

The above load/speed variations apply when the tyre is not subjected to sustained high torque service.

- (1) For field applications with sustained high torque service the values shown in the line 30 km/h apply.
- (2) These percentages apply only in case of tyres listed in Annex 5, Table 7, with nominal rim diameter (d) 381 mm and above, marked with speed **category** symbol "B"
- (3) These percentages apply only in case of diagonal tyres listed in Annex 5, Table 2 'Drive wheel tyres for agricultural tractors - Normal section sizes' with nominal section width (S1) 211 mm and above (i.e. section width code 8.3 and above) marked with speed **category** symbol "A8". "

Annex 7, Part B, amend to read:

"Part B: Steering wheel tyres for agricultural and forestry tractors

Applicable to tyres classified with category of use "Tractor steering wheels" and marked "Front" or "F-1" or "F-2" or "**F-2M**" or "F-3" (see paragraph 2.24. of this Regulation)

Variation of load carrying capacity (per cent) (See paragraph 2.33. of this Regulation)

Speed (km/h)	Speed category symbol	
	A6	A8
10	+50	+67
15	+43	+50
20	+35	+39
25	+15	+28
30	0	+11
35	-10	+4
40	-20	0
45	-	-7

"

Annex 7, Part C, amend to read:

"Part C: Implement tyres

Applicable to tyres classified with categories of use: "Implement" and marked "IMP" or "IMPLEMENT" (see paragraph 2.25. of this Regulation)

Variation of load carrying capacity (per cent) (see paragraphs 2.33. and 2.34. of this Regulation)

Speed (km/h)	Speed category symbol							(1)
	Standard tyres				IF and VF tyres			
	A4	A6(*)	A8(*)	D	E	D	E	
10	+ 20	+ 29	+ 40	+ 80	+ 80	+ 64	+ 64	+ 58
15	+ 12	+ 21	+ 33	+ 73	+ 73	+ 58	+ 58	+ 32
20	0	+ 14	+ 26	+ 65	+ 65	+ 52	+ 52	+ 26
25	- 2	+ 7	+ 19	+ 58	+ 58	+ 46	+ 46	+ 19
30	- 5	0	+ 12	+ 51	+ 51	+ 41	+ 41	+ 12
35		- 5	+ 5	+ 44	+ 44	+ 35	+ 35	+ 10
40		- 10	0	+ 36	+ 36	+ 29	+ 29	+ 6
45			- 5	+ 29	+ 29	+ 23	+ 23	+ 2
50			- 10	+ 21	+ 21	+ 17	+ 17	0
55				+ 14	+ 14	+ 11	+ 11	-
60				+ 7	+ 7	+ 6	+ 6	-
65				0	0	0	0	-
70				- 9	0	-9	0	-

The above load/speed variations apply when the tyre is not subjected to sustained high torque service.

- (*) For tyres with nominal rim diameter code 24 and above, excluding codes 24.5, 26.5, 28.5 and 30.5, Annex 7, Part A applies.
- (1) These percentages apply only in case of tyres listed in Annex 5, Table 7, with nominal rim diameter (d) 381 mm and above, marked with speed category symbol "B".

Annex 7, Part D, amend to read:

"Part D: Tyres for forestry machines

Applicable to tyres classified with categories of use: "Forestry machines" (see paragraph 2.44. of this Regulation)

Variation of load carrying capacity (per cent) for tyres marked with speed category symbols A6 and A8 (see paragraphs 2.33. and 2.34. of this Regulation)

Service condition	Speed (Km/h)	A6	A8
Road service	20	+15 %	+23 %
	30	0	+7 %
	40	-10 %	0

"

Annex 7, Part E, amend to read:

" Part E: Tyres for construction applications (industrial tractors or skid-steers / mini-loaders)

Applicable to tyres classified with categories of use: "Construction Applications" (see paragraph 2.45.) and marked "IND" or "R-4" or "SS" or "NHS" (see paragraph 2.25.3.1.14. and 2.18.12.1. of this Regulation)

Variation of load carrying capacity (per cent) (see paragraph 2.33. of this Regulation)

Speed (km/h)	Speed Category Symbol						
	A2	A8		B		D	
		Constant load	Cyclic applications (+)	Constant load	Cyclic applications (+)	Constant load	Cyclic applications (+)
5	+ 11	+ 45	+ 67 (1)	+ 45	+ 67 (1)	+67	+92 (1)
10	0	+ 25	+ 50 (2)	+ 25	+ 50 (2)	+44	+73 (2)
15	- 21	+ 13	+ 34	+ 13	+ 34	+30	+54
20	- 24	+ 9	+ 23	+ 9	+ 23	+26	+42
25	- 28	+ 6	+ 11	+ 6	+ 11	+22	+28
30	- 32	+ 4	+ 7	+ 4	+ 7	+20	+23
35	- 33	+ 2	+ 3	+ 2	+ 3	+18	+19
40	- 34	0	0	0	0	+15	+15
45	- 35	- 4	- 4	0	0	+12	+12
50	- 37	- 9	- 9	0	0	+8	+8
55	-	-	-	-	-	+5	+5
60	-	-	-	-	-	+3	+3
65	-	-	-	-	-	0	0
70	-	-	-	-	-	-9	-9

(+) Cyclic means applications where tyres are used one way laden and return unladen (e.g. loaders).

(1) One way distance 150 m, fully loaded.

(2) One way distance 600 m, fully loaded.

Note: speed category symbol A2 applies to tyres marked with suffix "SS" or "NHS"

Annex 9,

Paragraph 1.1., amend to read:

"1.1. This test procedure is applicable for new tyres marked with speed category ~~symbol~~ **symbols "D" or "E".**"

Paragraph 3.2., amend to read:

"3.2. Test drum speed: ~~20 km/h.~~

- **20 km/h for tyres with speed category symbol D or**
- **25 km/h for tyres with speed category symbol E."**

Paragraph 3.3.1., amend to read:

"3.3.1. The mass corresponding to load **capacity** index marked on the tyre in case of tyres marked with speed **category** symbol **D or E.** "

Paragraph 3.4., amend to read:

"3.4. Load/speed test programme:

Tyre speed category symbol	Test step	Percentage of the test load	Duration (hours)
D and E	1	66 per cent	7
	2	84 per cent	16
	3	101 per cent	24

"

Paragraph 3.4.1., amend to read:

"3.4.1. In case of a test drum diameter larger than 1,700 mm \pm 1 per cent, the above "percentage of test load" shall be increased as follows:

$$F_1 = K \cdot F_2$$

Where:

$$K = \sqrt{\frac{(R_1 / R_2) \cdot (R_2 + r_T)}{(R_1 + r_T)}}$$

R_1 is the diameter of test drum, in ~~millimeter~~**millimetres**

R_2 is the diameter of the reference test drum of 1,700 mm

r_T is the tyre outer diameter (see paragraph 6.2. of this Regulation), in ~~millimeter~~**millimetres**

F_1 is the percentage of load to be applied for the test drum

F_2 is the percentage of load, as per above table, to be applied for reference test drum of 1,700 mm

Example:

$K = 1$ for a test drum diameter of 1,700 mm;

In case of a test drum diameter of 3,000 mm and a tyre diameter of 1500 mm:

$$K = \sqrt{\frac{(3000/1700) \cdot (1700+1500)}{(3000+1500)}} = 1.12 "$$

Paragraph 4.2., amend to read:

"4.2. Apply on the trailer a mass in order that each tyre be equally loaded with a test load corresponding to the load ~~carrying~~ capacity allowed for that tyre type at:

- **15 km/h for speed category symbol D or**
- **20 km/h for speed category symbol E**

(see load variations in Annex 7)."

Paragraph 4.3., amend to read:

"4.3. Run the trailer **for 48 hours** at a constant speed of:

- **15 km/h \pm 1 km/h for speed category symbol D or**
- **20 km/h \pm 1 km/h for speed category symbol E.**~~for 48 hours.~~"

Annex 10, amend to read:

"Annex 10

Tyre classification code

(Optional marking)

Classification code	Nomenclature
F-1	Agricultural tractor steering wheel tyres: single rib tread
F-2 or F-2M	Agricultural tractor steering wheel tyres: multiple rib tread
F-3	Steering wheel tyres: industrial service (construction application)

G-1	Garden tractor tyres (implement tyres): traction service
G-2	Garden tractor tyres (implement tyres): flotation traction service
G-3	Garden tractor tyres (implement tyres): maximum flotation service
HF-1	High-flotation tyres: shallow tread
HF-2	High-flotation tyres: regular tread
HF-3	High-flotation tyres: deep tread
HF-4	High-flotation tyres: extra deep tread
I-1	Agricultural implement tyres: multi-rib tread
I-2	Agricultural implement tyres: moderate traction service
I-3	Agricultural implement tyres: traction tread
I-4	Agricultural implement tyres: plough tail wheel service
I-5	Agricultural implement tyres: steering service
I-6	Agricultural implement tyres: Smooth tread
LS-1	Logging and forestry service tyres: regular tread
LS-2	Logging and forestry service tyres: intermediate tread
LS-3	Logging and forestry service tyres: deep tread
LS-4	Logging and forestry service tyres: shallow tread
R-1	Agricultural tractor drive wheel tyres: regular tread
R-2	Agricultural tractor drive wheel tyres: cane and rice service (deep tread)
R-3	Agricultural tractor drive wheel tyres: flotation service (shallow tread)
R-4	Drive wheel tyres: industrial service (construction application)

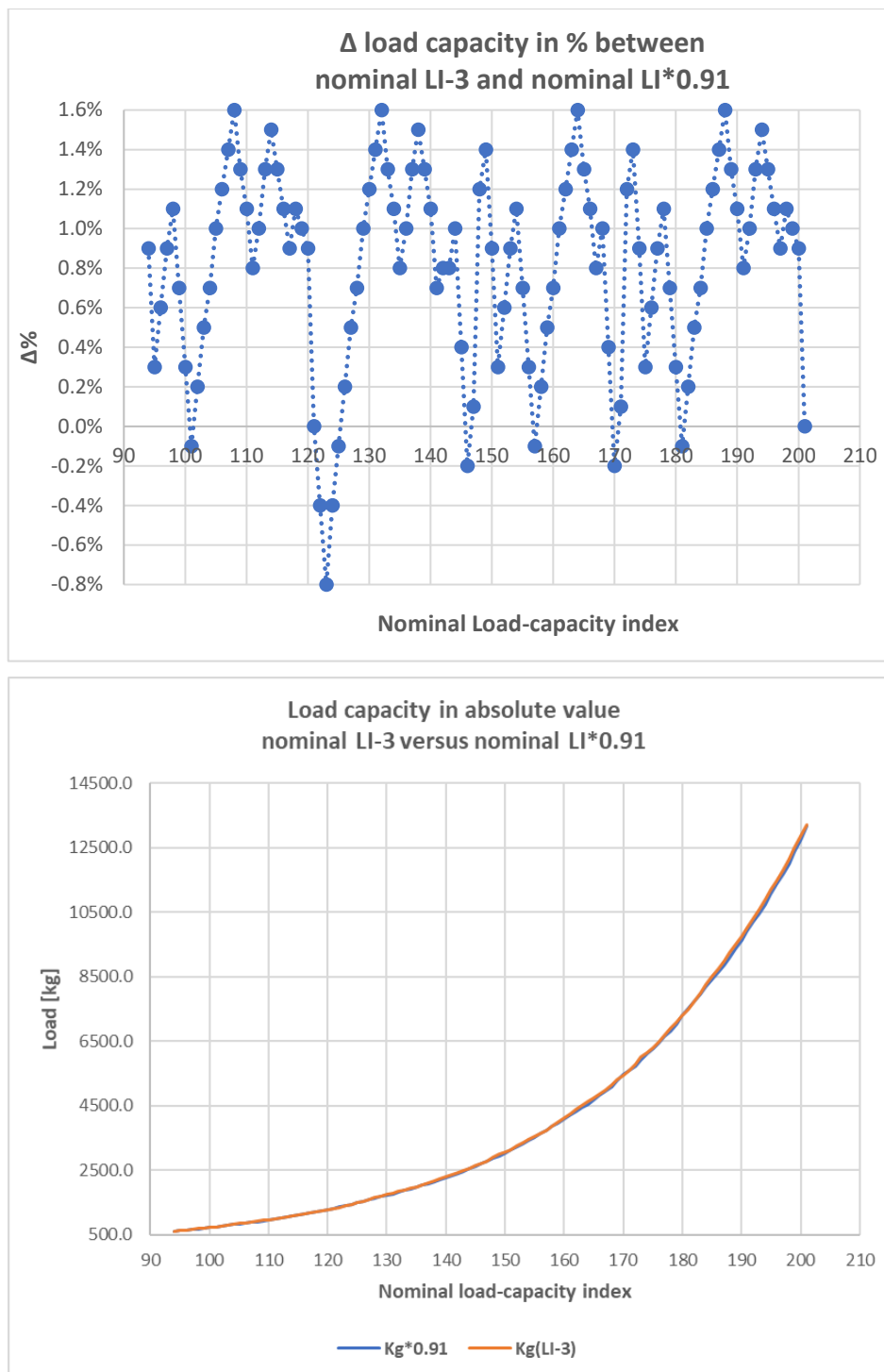
"

II. Justification

1. It is proposed to extend the scope of this UN Regulation to the tyre of speed category symbol E in order to address the technical evolution of agricultural and forestry vehicles.
2. As the test speed to be applied to the tyres of speed category symbol E tyres, it is proposed to set a step of +5 km/h with respect to the test speed applied to the tyres of speed category symbol D.
3. In case of test procedure on a drum, this is an approximation by excess of the intermediate speed obtained by considering the test drum speed specified in UN Regulation No. 106 for the tyres of speed category symbol D and that specified in UN Regulation No. 54 for the special use tyres of speed category symbol F, which are tested at a speed equal to 85 per cent of the speed prescribed for equivalent normal tyres:

$$\text{Test speed on a drum (E)} = [20 + (32 \times 0.85 - 20)/2] \text{ km/h} = 23.6 \text{ km/h} \rightarrow 25 \text{ km/h}$$
4. In case of test procedure on a trailer, this is an approximation by excess of the same ratio that is currently adopted for tyres of speed category symbol D:

$$\text{Test speed on a trailer (E)} = (15/20 \times 25) \text{ km/h} = 18.75 \text{ km/h} \rightarrow 20 \text{ km/h}$$
5. It is proposed not to require performing the additional load/speed test in case of tyres marked with a nominal speed category symbol D and supplementary service description with speed category symbol E and a load capacity index reduced by 3 points (or more) with respect to the nominal load capacity index.
6. Rationale: The load index reduced by 3 points corresponds to a reduction of the load capacity at 70 km/h applicable to speed category symbol D which approximates with negligible difference the reduction of 9% given in Annex 7. The actual differences (in percentage and in absolute value) are shown in the below diagrams.



Diagram

Load capacity differences in per cent and in absolute value

7. It is proposed to complete the information with respect to the new group of IF and VF implement tyres and to revise the possibility of marking of the service description in case of implement tyres for mixed applications.

8. It is proposed to complete the tables regulating the variation of load capacity with speed, defined at Annex 7, part A (drive wheel tyres for agricultural tractors) and part E (tyres for construction applications) with the values to be used in case of tyres type approved with the speed category symbol B as part of the main service description.

9. It is proposed to introduce the classification code “F-2M” currently standardized by tyre industry and used as an alternative to the marking F-2 in case of agricultural tyre with multiple rib tread.

10. It is proposed to explicitly allow other technical measurement solutions of the tyre overall width by removing the words “*by calliper*” which fix a technical limitation. The removal of this technical limitation would be advisable following the principle of not stopping the technical innovations.

11. Editorial corrections are introduced to ensure that the terms "tractor steering wheel", "tractor drive wheel", "load capacity", "load capacity index", "variation of load capacity with speed", "speed category symbol" and "millimetre" are used consistently throughout the text, and to remove some typing mistakes present in the current text.
