Economic and Social Council

Distr.: General
19 November 2012

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on Noise

Fifty-seventh session
Geneva, 5–7 February 2013
Item 6 of the provisional agenda
Regulation No. 117 (Tyre rolling noise and wet grip adhesion)

Proposal for Supplement 3 to the 02 series of amendments to Regulation No. 117

Submitted by the expert from the Russian Federation[1]

The text reproduced below was prepared by the experts from the Russian Federation to elaborate on the concept of tyre deceleration (dω/dt) in the test technology. The proposal is based on a document without symbol (GRB-56-02) distributed at the fifty-sixth session of the Working Party on Noise (GRB)(ECE/TRANS/WP.29/GRB/54, para. 21). The modification to the existing text of the UN Regulation are marked in bold for new or strikethrough for deleted characters.

[1] In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Annex 6,

Paragraph 3.5., amend to read:

"3.5. Duration and speed.

When the deceleration method is selected, the following requirements apply:

(a) The deceleration j shall be determined in exact dω/dt or approximate Δω/Δt form, where ω is angular velocity, t – time;

If the exact form dω/dt is used, then the recommendations of Appendix 4 to this Annex to be applied.

(b) …"

Annex 6, insert a new Appendix 5, to read:

"Annex 6 – Appendix 5

Deceleration method: Measurements and data processing for deceleration value obtaining in differential form dω/dt.

1. Record dependency "distance-time" for rotating body in a discrete form:

$$\alpha_i = i\Delta\alpha = \varphi(t_i)$$

where:

α_i is an angle of body rotation during deceleration from speed 80 to 60 km/h or 60 to 40 km/h dependently of PC or CV tyre in radians;

i is the number of constant angle increments;

Δα is constant increment of angle of rotation in radians;

t_i is time in seconds.

<u>Note:</u> The recommended value of Δα is 2π for testing PC tyres and π for CV tyres.

2. Insert measured data into the "deceleration calculator" downloaded from XXX [2]and obtain:

2.1. Constants of approximating dependency:

$$\alpha = f(t) = A \ln \frac{1}{\cos B(T_{\Sigma} - t)},$$

[2] Note by the secretariat: According to the outcome of discussion of the fifty-sixth session of GRB (ECE/TRANS/WP.29/GRB/54, para. 21), the clarification of the reference to the "deceleration calculator" by the expert from the Russian federation is pending.

where:

A is constant in radians;

B is constant in 1/s;

T_Σ is constant in s.

2.2. **The result in accordance of relations for speed 80 (60) kph:**

$$j = \frac{d\omega}{dt} = \frac{d^2\alpha}{dt^2} = \frac{AB^2}{\cos^2 BT_\Sigma}$$

2.3. **The estimation of approximation executed by quadrature R^2 and by standard deviation σ which is also an estimation of parameter j accuracy.**"

II. Justification

1. The proposed principal is based on an absolutely exact perform:

$$j = \frac{d\omega}{dt} = \frac{d^2\alpha}{dt^2}$$

2. There are no real any suppositions, simplification or assumption between formulae in clauses 2.1 and 2.2 of Appendix 7 because the formula in clause 2.2 is derived from formula in clause 2.1 according to the rules of differential calculus:

$$j = \frac{d^2\alpha}{dt^2} = \frac{AB^2}{\cos^2 B(T_\Sigma - t)}$$

3. As soon as the measurements begin at 80 (60) km/h when t = 0, one can obtain formula shown in clause 2.2 of Appendix 7. This means that an accuracy of the result j depends on a quality of approximation of empirical dependency α=f(t) by formulae in clause 2.2.

4. The "deceleration calculator" presents the estimation of the result in the form of a standard deviation σ:

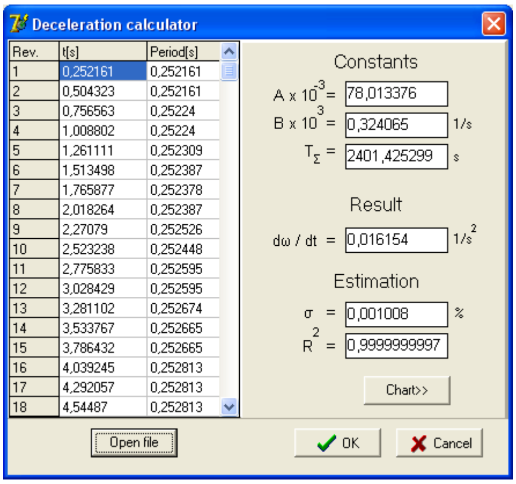
$$\sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}[\alpha_i - f(t_i)]^2}$$

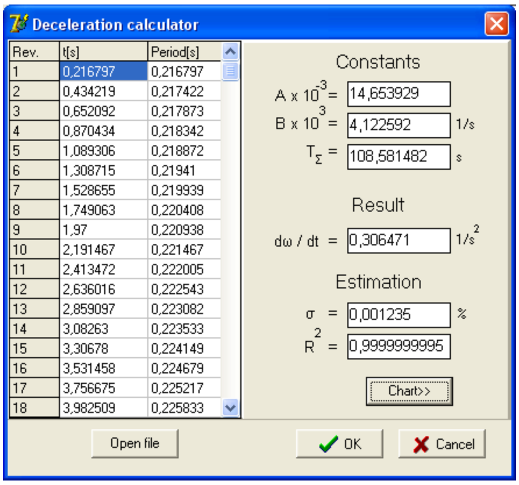
where $f(t_i)$ is approximating dependency from clause 2.1 of Appendix 7 in a discrete form, and in a form of quadrature R^2 of coefficient of correlation for non-linear approximation:

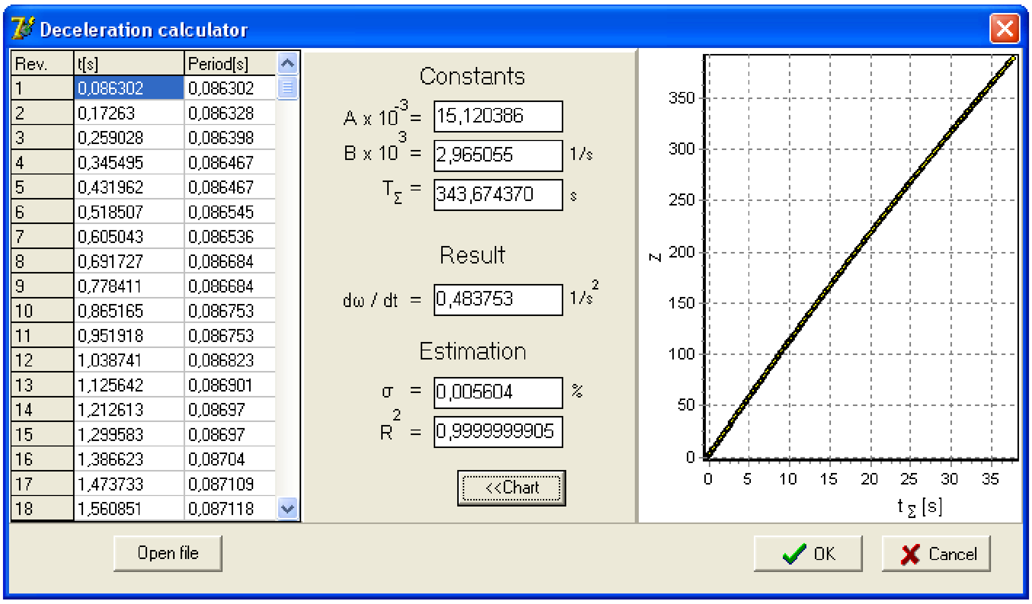
$$R = \sqrt{1 - \frac{\sum_{i=1}^{n}[\alpha_i - f(t_i)]^2}{\sum_{i=1}^{n}(\alpha_i - \overline{\alpha})^2}}$$

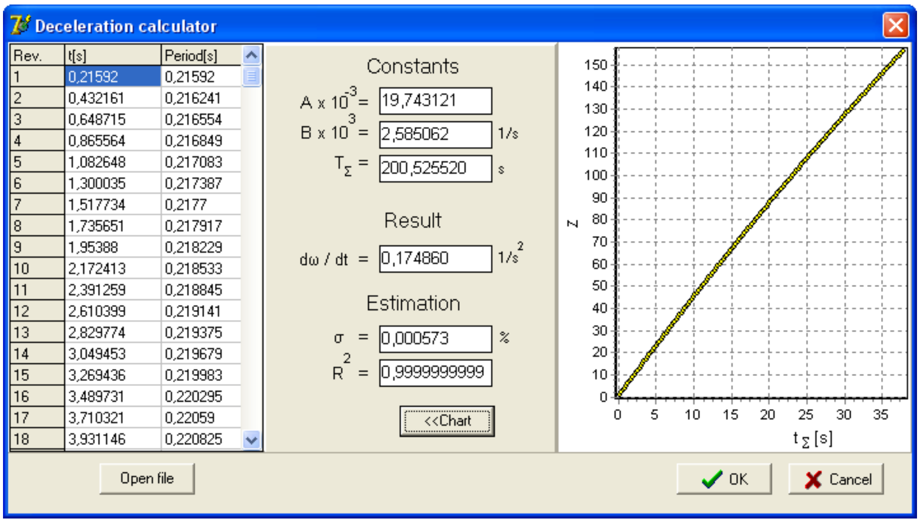
where $\overline{\alpha} = \frac{1}{n}\sum \alpha_i$

5. A user may also check on the button "chart" and have the graph with lens $\alpha = f(t)$ among empirical points. The examples given hereinafter show described opportunities and an exclusively high quality of approximation:








Deceleration calculator
Rev. t[s] Period[s]
1 0,21592 0,21592
2 0,432161 0,216241
3 0,648715 0,216554
4 0,865564 0,216849
5 1,082648 0,217083
6 1,300035 0,217387
7 1,517734 0,2177
8 1,735651 0,217917
9 1,95388 0,218229
10 2,172413 0,218533
11 2,391259 0,218845
12 2,610399 0,219141
13 2,829774 0,219375
14 3,049453 0,219679
15 3,269436 0,219983
16 3,489731 0,220295
17 3,710321 0,22059
18 3,931146 0,220825
Constants
A x 10-3 = 19,743121
B x 10-3 = 2,585062 1/s
TΣ = 200,525520 s
Result
dω / dt = 0,174860 1/s2
Estimation
σ = 0,000573 %
R2 = 0,9999999999
<<Chart
Open file
OK
Cancel
Z
tΣ [s]