QC

AUTOMOBILE INDUSTRY STANDARD OF

THE PEOPLE'S REPUBLIC OF CHINA

QC/T 480-1999

Replacing GB/T 13047-91

Criterion thresholds and evaluation of controllability and stability for automobiles

汽车操纵稳定性指标限值与评价方法

Approved on: March 15, 1999 **Implemented on: March 15, 1999**

Issued by: State Machinery Industry Bureau

Table of Contents

Criterion thresholds and evaluation of controllability and stability for automobiles

1 Subject content and applicable scope

This Standard specifies the criterion thresholds and evaluation methods of controllability and stability for automobiles.

This Standard is applicable to the automobiles that are driving on highways, city roads. For the automobiles that are not driving on highways may refer to this Standard for implementation.

2 Steady-state rotation test

2.1 This test evaluates and scores according to three indicators: lateral acceleration a_n at the neutral turning point, understeer degree U and roll degree of trunk K_Φ.

2.2 See Table 1 for the lower limits of a_n, U and K_Φ: a_{n60}, U_{60} and $K_{\Phi 60}$ as well as the upper limits: a_{n100}, U_{100} and $K_{\Phi 100}$.

NOTE:

1) It is used for the automobiles of which the maximum speed is greater than 160km/h.

2) It is used for the passenger cars of which the maximum total mass is greater than 9t.

$\lambda=\frac{2 \cdot U_{60}/U_{100}}{U_{60}/U_{100}-2} \cdot U_{100}$ - The coefficient that is calculated according to the ratio of U_{60} to U_{100};

U_{60} - The lower limit of the understeer degree, (°)/(m/s^2);

U_{100} - The upper limit of the understeer degree, (°)/(m/s^2).

2.5 The roll degree of trunk K_Φ is calculated according to the average slope (divide the ordinate value by the abscissa value) at the position where the lateral acceleration is 2ms/^{2} on the curve of relationship between the roll angle of trunk and the lateral acceleration. The evaluation score is calculated according to formula (3):

$$N_\Phi=60+\frac{40}{K_{\Phi 60}-K_{\Phi 100}} \cdot (K_{\Phi 60}-K_\Phi) \quad \cdots\cdots (3)$$

Where,

N_Φ - The evaluation score of the trunk roll degree;

$K_{\Phi 60}$ - The lower limit of the trunk roll degree, (°)/(m/s^2);

$K_{\Phi 100}$ - The upper limit of the trunk roll degree, (°)/(m/s^2);

K_Φ - The test value of the trunk roll degree, (°)/(m/s^2).

2.5.1 When N_Φ is greater than 100, score as 100.

2.6 The comprehensive evaluation score of steady-state rotation test is calculated according to formula (4):

$$N_w=\frac{N_{a_y}+N_U+N_\Phi}{3} \quad \cdots\cdots (4)$$

Where,

N_w - The comprehensive evaluation score of steady-state rotation test.

3 Cornering with steer release performance test

3.1 This test is evaluated and scored according to two indicators: the absolute value of residual yaw rate Δr when turning wheel (steering wheel) is released for 3s and the total variance of yaw rate E_r.

$$N_E = 60 + \frac{40}{\Delta r_{60} - \Delta r_{100}} \cdot (E_{r60} - E_r) \quad \cdots\cdots (6)$$

Where,

N_E - The evaluation score of the total variance of yaw rate in cornering with steer release performance test;

E_{r60} - The lower limit of the total variance of yaw rate in cornering with steer release performance test, s;

E_{r100} - The upper limit of the total variance of yaw rate in cornering with steer release performance test, s;

E_r - The test value of the total variance of yaw rate in cornering with steer release performance test, s.

3.4.1 When N_E is greater than 100, score as 100.

3.5 Comprehensive evaluation score of cornering with steer release performance test

3.5.1 For the automobiles that can only conduct the low-speed cornering test, it shall be evaluated and scored according to $N_{\Delta r}$ and N_E, according to formula (7):

$$N_H = \frac{N_{\Delta r} + N_E}{2} \quad \cdots\cdots (7)$$

Where,

N_H - The comprehensive evaluation score of cornering with steer release performance test.

3.5.2 For the automobiles that conduct low-speed and high-speed cornering tests, it shall be evaluated and scored according to four indicators: $N_{\Delta r}$ and N_E of the low-speed cornering as well as $N'_{\Delta r}$ and N'_E of the high-speed cornering, according to formula (8):

$$N_H = \frac{N_{\Delta r} + N_E + N'_{\Delta r} + N'_E}{4} \quad \cdots\cdots (8)$$

Where,

$N'_{\Delta r}$ - The evaluation score of the absolute value of residual yaw rate in high-

4.3.1 When N_{F_s} is greater than 100, score as 100.

4.4 The evaluation score of the maximum steering force of steering wheel F_m is calculated according to formula (10):

$$N_{F_m} = 60 + \frac{40}{F_{m60} - F_{m100}} \cdot (F_{m60} - F_m) \quad \cdots\cdots (10)$$

Where,

N_{F_m} - The evaluation score of the maximum steering force of steering wheel;

F_{m60} - The lower limit of the maximum steering force of steering wheel, N;

F_{m100} - The upper limit of the maximum steering force of steering wheel, N;

F_m - The test value of the maximum steering force of steering wheel, N.

4.4.1 When N_{F_m} is greater than 100, score as 100.

4.5 The comprehensive evaluation score of steering portability test is calculated according to formula (11):

$$N_Q = \frac{N_{F_s} + \eta_F \cdot N_{F_m}}{1 + \eta_F} \quad \cdots\cdots (11)$$

Where,

N_Q - The comprehensive evaluation score of steering portability;

$\eta_F = 0.6 + 0.08G_a$ - The weighting factor related to the maximum total mass of the vehicle, G_a, (in t).

5 Steering transient response test (steering wheel angle step input)

5.1 This test is evaluated and scored according to the vehicle yaw rate response time T, when the lateral acceleration is $2m/s^2$.

Where,

D - Resonant peak level, dB;

A_p - Yaw angle speed gain at $f=f_p$, 1/s;

A_0 - Yaw angle speed gain at f=0, 1/s/

6.4.2 The evaluation score of resonant peak level D is calculated according to formula (15):

$$N_D = 60 + \frac{10}{D_{60} - D_{100}} \cdot (D_{60} - D) \quad \cdots\cdots (15)$$

Where,

N_D - The evaluation score of resonant peak level;

D_{60} - The evaluation score of resonant peak level, dB; (Translator Note: “the lower limit”?)

D_{100} - The upper limit of resonant peak level, dB;

D - The test value of resonant peak level, dB.

6.4.3 When N_D is greater than 100, score as 100.

6.5 The evaluation score of phase lag angle α is calculated according to formula (16):

$$N_\alpha = 60 + \frac{10}{\alpha_{60} - \alpha_{100}} \cdot (\alpha_{60} - \alpha) \quad \cdots\cdots (16)$$

Where,

N_α - The evaluation score of phase lag angle;

α_{60} - The lower limit of phase lag angle, (°);

α_{100} - The upper limit of phase lag angle, (°);

α - The test value of phase lag angle at the corresponding frequency (see the remark of Table 5), (°).

6.5.1 When N_α is greater than 100, score as 100.

N_r - The evaluation score of average yaw rate peak;

r_{60} - The lower limit of average yaw rate peak, (°)/s;

r_{100} - The upper limit of average yaw rate peak, (°)/s;

r - The test value of average yaw rate peak at the base speed, (°)/s.

7.3.1 When N_r is greater than 100, score as 100.

7.4 The evaluation score of average steering wheel angle peak θ is calculated according to formula (19):

$$N_\theta = 60 + \frac{40}{\theta_{60} - \theta_{100}} \cdot (\theta_{60} - \theta) \quad \cdots\cdots (19)$$

Where,

N_θ - The evaluation score of average steering wheel angle peak;

θ_{60} - The lower limit of average steering wheel angle peak, (°);

θ_{100} - The upper limit of average steering wheel angle peak, (°);

θ - The test value of average steering wheel angle peak at the base speed, (°).

7.4.1 When N_θ is greater than 100, score as 100.

7.5 For the automobiles that fail to achieve the base speed, the evaluation scores of N_r and N_θ shall be calculated according to formula (20):

$$N_r = N_\theta = 60 \cdot \frac{V_a}{V_n} \quad \cdots\cdots (20)$$

Where,

V_a - Pylon course slalom speed that is actually achieved, km/h;

V_n - Base speed specified in Table 6, km/h.

7.6 The comprehensive evaluation score of pylon course slalom test is calculated according to formula (21):

$$N_z = \frac{2N_r + N_\theta}{3} \quad \cdots\cdots (21)$$

This is an excerpt of the PDF (Some pages are marked off intentionally)

------ The End ------