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Working Party on Brakes and Running Gear (GRRF)
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agenda item 1.2.)

PROPOSAL FOR A DRAFT AMENDMENT TO REGULATION No. 13 (Braking)

AND REGULATION No. 90 (Replacement brake linings)

Transmitted by the Expert from the International Organization for Standardization (ISO)

Note: The text reproduced below was prepared by the expert from the ISO in order to complete his proposal contained in document TRANS/WP.29/GRRF/1999/12.

Note: This document is distributed to the Experts on Brakes and Running Gear only.

A. PROPOSAL

In the following Regulations and their relevant annexes:

Regulation 13, Annex 11, appendix 2, paragraph 3.2.3
Regulation 13, Annex 11, appendix 2, paragraph 3.3.2
Regulation 13, Annex 15, paragraph 3.4
Regulation 90, Annex 3, paragraph 2.2.2.4
Regulation 90, Annex 4, paragraph 2.1.1.4
Regulation 90, Annex 5, paragraph 2.1.4

amend the text to read:

"..... Cooling air may be used, flowing over the brake in a direction perpendicular to its axis of rotation. The velocity of the cooling air, V_{air}, flowing over the brake shall be according to the following formula:

$$V_{air} = 0.33\ v$$

where:

v = vehicle test speed at initiation of braking

The temperature of the cooling air shall be the ambient temperature."

* * *

B. JUSTIFICATION

The intention to adjust the velocity of the cooling air on a dynamometer has the fundamental target to simulate the real test conditions of a vehicle on the road. Historically, the existing value of 10 km/h is based on a special situation of trailers of category O4 and their fixed test speed of 30 km/h. It is the aim of the proposal to cover not only this situation but also the range of all the test conditions of different vehicle categories more realistically.

To this purpose, a series of practical, comparative tests (i. e. Vehicle vs Dynamometer) have been carried out; the corresponding results are shown in the attached table and typical curves.

The key parameter, for both vehicles and dynamometer tests is the maximum brake temperature, T_{max}. The tests results show that in comparative tests, T_{max} is **always greater** on the dynamometer than on the vehicle, even in the cases where cooling air speed is equal to the (constant) vehicle test speed. This means that the brake temperature results which are recorded during dynamometer testing can generally be expected to be higher than would be achieved under equivalent vehicle testing. Clearly due to the fact that at higher speeds during the early part of the test where energy absorption rate is high, the vehicle test with its proportional speed of

air flow is better able to dissipate the absorbed energy than the brake tested on the dynamometer with a constant airflow rate.

The results have been recorded from data collected from heavier vehicles which, in the fully laden conditions of the tests, make heavy demands on braking and it is reasonable to expect that with lighter vehicles, similar results will apply.

Because the test results do not indicate a clear v_{air} / v_{test} ratio which would give comparable results, the choice of an amended ratio must be, to an extent, subjective.

On the basis of the historical derivation of the 10 km/h, but bringing road and dynamometer conditions closer together yet still maintaining the dynamometer test at some disadvantage, it is proposed that the relationship

$$v_{air} = 0.33\ v_{test}\ \text{(start speed)}$$

should be specified in the above Regulations.

Such a relationship would then be consistent with the testing conditions currently specified for vehicle of category O4.

Attachments : test results (Vehicle test Vs. Dynamometer tests). Table of results

Typical example of measured curves
(Test n°7 : M1, 2.8 t, ventilated disc , Type-I test)

DYNAMOMETER COOLING AIR VELOCITY – TEST RESULTS

TEST	VEHICLE DATA			BRAKE TYPE	KIND OF	v_{test} Test speed	v_{air} Cooling speed	v_{air} / v_{test}	T_{max} Max. Brake Temperature	
N°	Manufact.	**GVW [t]**	**Veh. Category**		**TEST**	**(Vehicle & Dyno) [km/h]**	**(Dyno) [km/h]**		**On vehicle [°C]**	**On Dyno [°C]**
1	**A**	**18.0**	**N3**	**Disc**	**Downhill**	30 const.	30 const.	1	820	900
2	A	10.5	N2	Disc	**Downhill**	**30 const.**	**30 const.**	**1**	**750**	**820**
3	**A**	**3.5**	**N1**	Disc	Downhill	40 const.	40 const.	1	650	700
			N1		Downhill	40 const.	10 const.	0.25	650	780
4	A	2.5	M1	Disc	Downhill	30 const.	10 const.	0.33	630	690
5	A	2.5	M1	Drum	Downhill	30 const.	10 const.	0.33	340	450
6	B	2.8	M1	Disc	Type I	120 – 60	36 const.	0.3	620	705
			M1	(solid)	Type I	120 – 60	10 const.	0.0833	620	750
			M1		Type I	120 – 60	0	0	620	780
7	B	2.8	M1	Disc	Type I	120 – 60	36 const.	0.3	520	610
			M1	ventilated	Type I	120 – 60	10 const.	0.0833	520	660
			M1		Type I	120 – 60	0	0	520	700
8	C	10.5	N2	Disc	Type I	60 – 30	30 const.	0.5	400	450
9	C	18.0	O4	Drum	Type II	30 const.	30 const.	1	420	450
			O4		Type II	30 const.	10 const.	0.33	420	560
10	A	3.5	N1	Disc	AMS-test	105 – 0	30 const.	0.3	720	750

v_{test} - a single value refers to a **constant test speed of the vehicle or dyno** (endurance braking)

- two values refer to the vehicle / dyno speed **at the beginning and at the end of the test cycle** (interval reducing speed braking tests)

v_{air} speed of the cooling air on the dynamometer, constant throughout the test

v_{air}/v_{test} relationship between v_{air} and vtest

(v_{test} = start speed of the test)

T_{max} maximum brake temperature reached during the test

TYPICAL EXAMPLE

Test-No. 7

Type I test (2.8 t / ventilated disc)

heating procedure with repeated braking (ventilated disc)