

12 May 2010

## **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 54: Regulation No. 55**

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

Supplement 1 to the 01 series of amendments: Date of entry into force: 17 March 2010

### **UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MECHANICAL COUPLING COMPONENTS OF COMBINATIONS OF VEHICLES**



**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.

Annex 5, paragraph 1.4., amend to read:

- "1.4. Coupling balls and towing devices shall be able to satisfy the tests given in Annex 6, paragraph 3.1. or paragraph 3.10. according to the choice of the manufacturer. However, the requirements given in paragraphs 3.1.7. and 3.1.8. are always applicable."

Annex 6

Paragraph 1.3., amend to read:

- "1.3. The dynamic test (except the test according to paragraph 3.10. of this annex) shall be performed with approximately sinusoidal load (alternating and/or pulsating) with a number of stress cycles appropriate to the material. No cracks or fractures shall occur."

Paragraph 1.5., amend to read:

- "1.5. The loading assumptions in the dynamic tests are based on the horizontal force component in the longitudinal axis of the vehicle and the vertical force component. Horizontal force components transverse to the longitudinal axis of the vehicle, and moments, are not taken into account provided they are of only minor significance. This simplification is not valid for the test procedure according to paragraph 3.10. of this annex.

If the design ..."

Paragraph 2., amend to read:

- "2. TEST PROCEDURES

In case the test procedure according to paragraph 3.10. of this annex is used, paragraphs 2.1., 2.2., 2.3. and 2.5. are not applicable."

Paragraph 3., amend to read:

- "3. SPECIFIC TESTING REQUIREMENTS

In case the test procedure according to paragraph 3.10. of this annex is used, the requirements of paragraphs 3.1.1. to 3.1.6. are not applicable."

Add new paragraphs 3.10. to 3.10.4., to read:

- "3.10. Alternative endurance test for coupling balls and towing brackets with a D-value  $\leq 14$  kN.

Alternatively to the test procedure described in paragraph 3.1., coupling balls and towing brackets with a D-value  $\leq 14$  kN can be tested under the following conditions.

### 3.10.1. Introduction

The endurance test described below consists of a multi-axial test with 3 load directions, with simultaneously introduced forces, defined maximum amplitudes and fatigue equivalences (load intensity values, according to the definition given below).

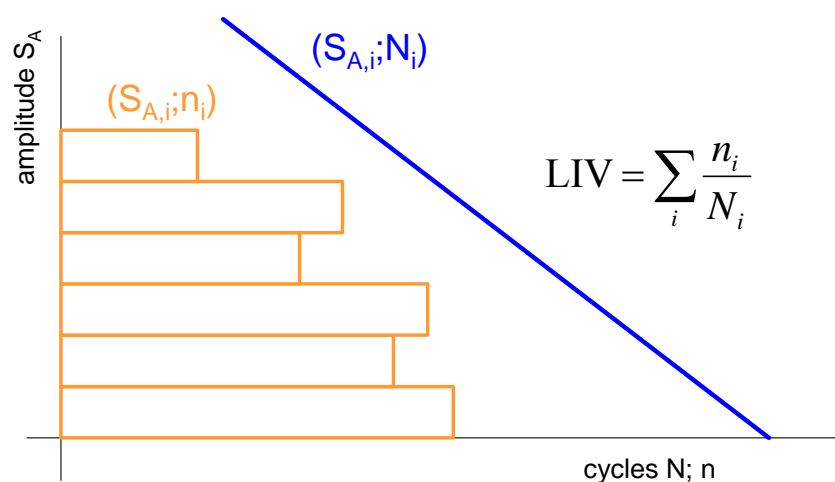
### 3.10.2. Test requirements

#### 3.10.2.1. Definition of the load intensity value (LIV):

The LIV is a scalar value which represents the severity of one load time history considering durability aspects (identical to damage sum). For the damage accumulation the miner elementary rule is used. For its determination, the load amplitudes and the number of repetitions of each amplitude are considered (effects of mean loads are not taken into account).

The S-N curve (Basquin curve) represents the load amplitudes versus the number of repetitions ( $S_{A,i}$  vs.  $N_i$ ). It has a constant slope  $k$  in a double logarithmic diagram (i.e. every amplitude /applied test force  $S_{A,i}$  relates to a limited number of cycles  $N_i$ ). The curve represents the theoretical fatigue limit for the analyzed structure.

The load time history is counted in a range-pair diagram of load amplitude versus number of repetitions ( $S_{A,i}$  vs.  $n_i$ ). The sum of the ratio  $n_i/N_i$  for all available amplitude levels  $S_{A,i}$  is equal to the LIV.



### 3.10.2.2. Required LIVs and maximum amplitudes

The following coordinate system has to be considered:

x direction: longitudinal direction / opposite of driving direction  
y direction: to the right considering the driving direction  
z direction: vertical upwards

The load time history can then be expressed following the intermediate directions based on the main directions (x, y, z) considering the following equations ( $\alpha = 45$ ;  $\alpha' = 35.2$ ):

$$F_{xy}(t) = F_x(t) \cdot \cos(\alpha) + F_y(t) \cdot \sin(\alpha)$$

$$F_{xz}(t) = F_x(t) \cdot \cos(\alpha) + F_z(t) \cdot \sin(\alpha)$$

$$F_{yz}(t) = F_y(t) \cdot \cos(\alpha) + F_z(t) \cdot \sin(\alpha)$$

$$F_{xyz}(t) = F_{xy}(t) \cdot \cos(\alpha') + F_z(t) \cdot \sin(\alpha')$$

$$F_{xzy}(t) = F_{xz}(t) \cdot \cos(\alpha') - F_y(t) \cdot \sin(\alpha')$$

$$F_{yzx}(t) = F_{yz}(t) \cdot \cos(\alpha') - F_x(t) \cdot \sin(\alpha')$$

The LIVs expressed in each direction (also combined directions) are calculated respectively as the sum of the ratio  $n_i/N_i$  for all available amplitude levels defined in the adequate direction.

In order to demonstrate the minimum fatigue life of the device to be type-approved, the endurance test has to achieve at least the following LIVs:

	LIV ( $1 \text{ kN} \leq D \leq 7 \text{ kN}$ )	LIV ( $7 \text{ kN} < D \leq 14 \text{ kN}$ )
LIV <sub>x</sub>	0.0212	0.0212
LIV <sub>y</sub>	linear regression between: D=1 kN: 7.026 e-4; D=7 kN: 1.4052 e-4	1.4052 e-4
LIV <sub>z</sub>	1.1519 e-3	1.1519 e-3
LIV <sub>xy</sub>	linear regression between: D=1 kN: 6.2617 e-3; D=7 kN: 4.9884 e-3	4.9884 e-3
LIV <sub>xz</sub>	9.1802 e-3	9.1802 e-3
LIV <sub>yz</sub>	linear regression between: D=1 kN: 7.4988 e-4; D=7 kN: 4.2919 e-4	4.2919 e-4
LIV <sub>xyz</sub>	linear regression between: D=1 kN: 4.5456 e-3; D=7 kN: 3.9478 e-3	3.9478 e-3
LIV <sub>xzy</sub>	linear regression between: D=1 kN: 5.1977 e-3; D=7 kN: 4.3325 e-3	4.3325 e-3
LIV <sub>yzx</sub>	linear regression between: D=1 kN: 4.5204 e-3; D=7 kN: 2.9687 e-3	2.9687 e-3

To derive a load time history based on above-mentioned LIVs, the slope shall be  $k = 5$  (see definition in paragraph 3.10.2.1.). The Basquin curve shall pass through the point of an amplitude  $S_A = 0,6 \cdot D$  with the number of cycles  $N = 2 \cdot 10^6$ .

The static vertical load  $S$  (as defined in paragraph 2.11.3. of this Regulation) on the coupling device as declared by the manufacturer shall be added to the vertical loads.

During the test, the maximum amplitudes should not exceed the following values:

	longitudinal $F_x$ [-]	lateral $F_y$ [-]	vertical $F_z$ [-]
Maximum	$+1,3 \cdot D$	$+0,45 \cdot D$	$+0,6 \cdot D + S$
Minimum	$-1,75 \cdot D$	$-0,45 \cdot D$	$-0,6 \cdot D + S$

An example of a load time history which fulfils these requirements is given at:  
<<http://www.unece.org/trans/main/wp29/wp29wgs/wp29grrf/grrf-reg55.html>> "

### 3.10.3. Test conditions

The coupling device shall be mounted on a rigid test bench or on a vehicle. In the case of a 3 dimensional time history signal, it shall be applied by three actuators for simultaneous introduction and control of the force components  $F_x$  (longitudinal),  $F_y$  (lateral) and  $F_z$  (vertical). In other cases, the number and the position of the actuators may be chosen in agreement between the manufacturer and the technical services. In any case, the test installation shall be able to introduce simultaneously the necessary forces in order to fulfil the LIVs required in paragraph 3.10.2.2.

All bolts have to be tightened with the torque as specified by the manufacturer.

#### 3.10.3.1. Coupling device mounted on stiff support:

The compliance of the fixing points of the coupling device shall not exceed 1.5 mm from the reference point of "0-Load" during the application of the maximum and minimum forces  $F_x$ ,  $F_y$ ,  $F_z$  and each separately applied to the coupling point.

#### 3.10.3.2. Coupling device mounted on vehicle body or body part:

In this case the coupling device shall be mounted on the vehicle body or a body part of the vehicle type, for which the coupling device is designed. The vehicle or body part shall be fitted on a suitable rig or test bench in such a manner, that any effect of the vehicles suspension is eliminated.

The exact conditions during the test shall be declared in the relating test report. Possible resonance effects have to be compensated by a suitable test facility control system and may be reduced by additional fixing between vehicle body and test rig or modified frequency.

3.10.4. Failure criteria

In addition to the criteria given in paragraph 4.1. verified by liquid penetration verification of this Regulation, the coupling device shall be deemed to have failed the test, if:

- (a) Any visible plastic deformation is detected;
- (b) Any functionality and safety of the coupling is effected (e.g. safe connection of the trailer, maximum play);
- (c) Any torque loss of the bolts exceeding 30 per cent of the nominal torque measured in the closing direction;
- (d) A coupling device with detachable part cannot be detached and attached for at least 3 times. For the first detachment, one impact is permitted."

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