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*Changes to legislation:* There are outstanding changes not yet made to Commission Regulation (EU) No 1230/2012. Any changes that have already been made to the legislation appear in the content and are referenced with annotations. (See end of Document for details) [View outstanding changes](#)

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Commission Regulation (EU) No 1230/2012 of 12 December 2012 implementing Regulation (EC) No 661/2009 of the European Parliament and of the Council with regard to type-approval requirements for masses and dimensions of motor vehicles and their trailers and amending Directive 2007/46/EC of the European Parliament and of the Council (Text with EEA relevance)

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## ANNEX III

### CONDITIONS OF EQUIVALENCE OF A SUSPENSION TO AIR-SUSPENSION

1. This Annex lays down the technical conditions relating to the equivalence of a suspension to air-suspension for vehicle driving axle(s).
2. In order to be recognised as equivalent to air suspension, a suspension shall comply with the following requirements:
  - 2.1. During free transient low-frequency vertical oscillation of the sprung mass above a driving axle or group of axles, the measured frequency and damping with the suspension carrying its maximum load shall fall within the limits defined in points 2.3 to 2.6
  - 2.2. Each axle shall be fitted with hydraulic dampers. On groups of axles, the dampers shall be positioned to minimise the oscillation of the groups of axles.
  - 2.3. The mean damping ratio  $D_m$  shall be more than 20 % of critical damping for the suspension in its normal condition with hydraulic dampers in place and operating.
  - 2.4. The damping ratio  $D_r$  of the suspension with all hydraulic dampers removed or incapacitated shall be not more than 50 % of  $D_m$ .
  - 2.5. The frequency of the sprung mass above the driving axle or group of axles in a free transient vertical oscillation shall not be higher than 2,0 Hz.
  - 2.6. The test procedures for measuring the frequency and damping shall be laid down in point 3.

### 3. Test procedure

#### 3.1. Frequency and damping

- 3.1.1. The free oscillation of the sprung mass shall be given by the following equation:

$$M \frac{d^2 Z}{dt^2} + C \frac{dZ}{dt} + KZ = 0$$

Where

‘M’ is the sprung mass (kg),

‘Z’ is the vertical displacement of the sprung mass (m),

‘C’ is the total damping coefficient (N.s/m) and

‘K’ is the total vertical stiffness between the road surface and the sprung mass (N/m).

- 3.1.2. The frequency of oscillation (‘F’ in Hz) of the sprung mass shall be given by the following equation:

$$F = \frac{1}{2\pi} \sqrt{\frac{K}{M} - \frac{C^2}{4M^2}}$$

- 3.1.3. The damping is critical when  $C = C_0$

where:

$$C_0 = 2\sqrt{KM}$$

The damping ratio as a fraction of critical is  $C/C_0$ .

- 3.1.4. During free transient oscillation of the sprung mass the vertical motion of the mass will follow a damped sinusoidal path (Figure 2). The frequency can be estimated by

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measuring the time for as many cycles of oscillation as can be observed. The damping can be estimated by measuring the heights of successive peaks of the oscillation in the same direction.

- 3.1.5. If the peak amplitudes of the first and second cycles of the oscillation are  $A_1$  and  $A_2$ , then the damping ratio  $D$  is given by the following equation:

$$D = \frac{c}{c_0} = \frac{1}{2\pi} \ln \frac{A_1}{A_2}$$

'ln' being the natural logarithm of the amplitude ratio.

### 3.2. Test procedure

To establish by test the damping ratio  $D_m$ , the damping ratio  $D_r$ , with hydraulic dampers removed, and the frequency  $F$  of the suspension, the loaded vehicle shall be either:

- driven at low speed ( $5 \text{ km/h} \pm 1 \text{ km/h}$ ) over an 80 mm step with the profile shown in Figure 1. The transient oscillation to be analysed for frequency and damping occurs after the wheels of the driving axle have left the step;
- pulled down by its chassis so that the driving axle load is 1,5 times its maximum static value. The vehicle held down is suddenly released and the subsequent oscillation analysed;
- pulled up by its chassis so that the sprung mass is lifted by 80 mm above the driving axle. The vehicle held up is suddenly dropped and the subsequent oscillation analysed;
- subjected to other procedures insofar as it has been proved by the manufacturer, to the satisfaction of the technical service, that they are equivalent.

### 3.3. Test equipment of the vehicle and loading conditions

- 3.3.1 The vehicle shall be fitted with a vertical displacement transducer between driving axle and chassis, directly above the driving axle. From the trace, the time interval between the first and second compression peaks shall be measured to obtain the damping.

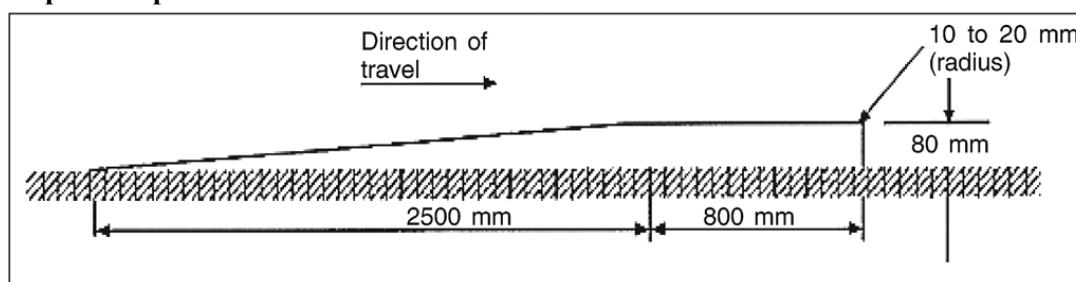
For twin driving groups of axles, vertical displacement transducers shall be fitted between each driving axle and the chassis directly above it.

- 3.3.2. The tyres shall be inflated to the appropriate pressure recommended by the manufacturer.

- 3.3.3 The test for verifying the equivalence of the suspensions shall be made at the technically permissible maximum mass on the axle or group of axles, and the equivalence assumed to cover all the lower masses.

Figure 1

#### Step for suspension tests



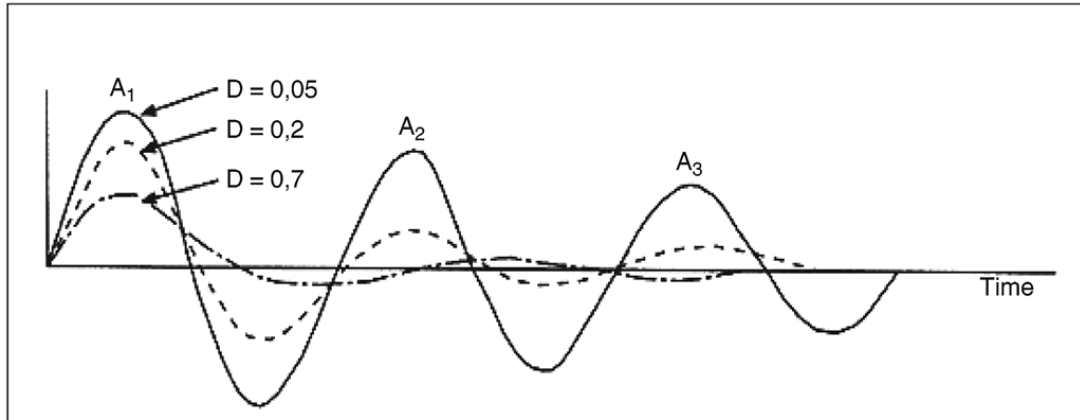
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Figure 2

**A damped transient response**



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**Changes and effects yet to be applied to the whole legislation item and associated provisions**

- Signature words omitted by [S.I. 2022/1273 reg. 71\(10\)](#)
- Annex 5 Pt. B s. 1 words substituted by [S.I. 2022/1273 reg. 72\(4\)\(c\)\(iii\)](#)
- Annex 5 Pt. B s. 2 words substituted by [S.I. 2022/1273 reg. 72\(4\)\(c\)\(iv\)](#)
- Annex 5 Pt. D s. 1 words substituted by [S.I. 2022/1273 reg. 72\(4\)\(e\)\(iii\)](#)
- Annex 1 Appendix 2 point 2.1 words substituted by [S.I. 2022/1273 reg. 72\(2\)\(e\)\(i\)](#)
- Annex 1 Appendix 2 point 2.2 words substituted by [S.I. 2022/1273 reg. 72\(2\)\(e\)\(ii\)\(aa\)](#)
- Annex 1 Appendix 2 point 2.2(c) words substituted by [S.I. 2022/1273 reg. 72\(2\)\(e\)\(ii\)\(bb\)](#)
- Annex 1 Appendix 4 point 1.3 words substituted by [S.I. 2022/1273 reg. 72\(2\)\(f\)](#)
- Art. 2(1) words substituted by [S.I. 2022/1273 reg. 71\(3\)\(b\)](#)
- Art. 2(2) words substituted by [S.I. 2022/1273 reg. 71\(3\)\(c\)](#)
- Art. 2(11) words substituted by [S.I. 2022/1273 reg. 71\(3\)\(d\)](#)
- Art. 2(40) words substituted by [S.I. 2022/1273 reg. 71\(3\)\(e\)](#)
- Art. 6(1)(1a) substituted for Art. 6(1) by [S.I. 2022/1273 reg. 71\(8\)\(a\)](#)