WHITEPAPER

Effect of accelerations

The question of the effect of accelerations on a transported material is frequently asked and can only be answered individually. Depending on the goods transported and their sensitivity to shocks and vibrations, they react very differently. The following examples are intended to provide some clues for obtaining a better estimate of the effect of accelerations. Reference is made to the sources used.

1. Examples of settings for shock data loggers from DIN EN 15433-6:2008-02

(Transportation loads - Measurement and evaluation of dynamic mechanical loads - Part 6: Automatic recording systems for measuring randomly occurring shock during monitoring of transports)

The following two settings for shock data loggers are listed in Appendix A for transport monitoring with automatic recording devices as an example in the DIN list.

Transport type Measuring range Shock duration

Transport type	Measuring	range shock duration
Street (e. g. Potholes)	10 g	5 ms
Rail (e. g. Shunting impulse)	10 g	20 ms

Extract from DIN:

DIN EN 15433-6:2008-02
EN 15433-6:2007 (D)

Anhang A
(informativ)

Beispiel für die Einstellung von Stoßaufzeichnungsgeräten

Tabelle A.1 enthält Beispieleinstellungen für das Stoßaufzeichnungsgerät. Bei spezifischen Anwendungen ist die Einhaltung dieser Einstellungen entscheidend.

Tabelle A.1 — Beispiel für die Einstellung eines Stoßaufzeichnungsgerätes

Transportart	Betriebsart	Messbereich m/s²	Stoßdauer ms
Straße z. B. Schlaglöcher	Ereignisaufzeichnung	100	5
Schiene z. B. Rangierstöße	Ereignisaufzeichnung	100	20

Note on calculating the g-value: 9.81 m/s² = 1g

Further examples are given in the revised version of DIN. The complete DIN can be obtained from Beuth Verlag (https://www.beuth.de/de/norm/din-en-15433-6/257219165); English version available.

2. Product Sensitivities – UPS Guide

An example table of product sensitivities is provided in a UPS packaging guide. Abstract:
(abstract in english see next page)

1. Kriterium: Produktempfindlichkeit

Die moderne Gesellschaft besteht auf vielfache Auswahlmöglichkeit bei den einzelnen Produktgruppen. Dadurch bedingt vergrössert sich auch ständig das Angebot.

Durch die Kurzlebigkeit dieser Dinge sowie durch Druck des Wettbewerbs und die dadurch verbundene Weiterentwicklung der Produkte können genauere Angaben über die Produkempfindlichkeit nicht zur Verfügung gestellt werden.

So versucht man, Produkte in bestimmten Gruppen zusammenzufassen, um hier wenigstens Anhaltspunkte über die ertragbare Beanspruchung zu geben.

In der folgenden Beispieltabelle wird die Produktempfindlichkeit in 6 Segmente eingeteilt.

Als Maß dafür wird der „G-Wert" benutzt, das Vielfache der einfachen Erdbeschleunigung (g).

So „erträgt" beispielsweise ein Hühnerei die Stoßkraft von 65G, was dem 65-fachen der einfachen Erdbeschleunigung (g) entspricht.

Beispiele für Produktempfindlichkeiten

	Produkt:	G - Wert:
Extrem empfindlich	**Plasmabildschirme, Präzisionsmessinstrumente mit empfindlicher mechanischer Lagerung, z. B. Kreiselkompass**	**0 - 20**
Sehr empfindlich	**LCD- TV, Raumfahrt/Luftfahrt Navigationsgeräte Lampen, Optisches Gerät**	**20 - 40**
Empfindlich	**Computer / EDV, Elektro-feinmechanische Geräte, Kassensysteme, Schaltanlagen, Kühlanlagen**	**40 - 60**
Mäßig empfindlich	**Rundfunk- und Fernsehgeräte, optische Geräte, Eier (Hart gekocht, seitlich) elektrische Ausrüstungen und Messgeräte, elektrische Haushaltgeräte**	**60 - 80**
Mäßig robust	**Waschmaschine Kühlschrank Akkumulatoren, Telefonapparate**	**80 - 110**
Robust	**Glasflaschen Maschinen, Werkzeuge, Motoren**	**über 110**

1. Criterion: product sensitivity

The modern society insists on a wide range of choices for the individual product groups. As a result, the supply is constantly increasing.

Due to the short lifespan of these items, as well as the pressure of competition and the resulting further development of the products, it is not possible to provide more precise information on product sensitivity.

In this way, the attempt is made to group products together in certain groups in order to give at least some indication of the load bearing capacity.

In the following example table the product sensitivity is divided into 6 segments.

The "G-value", the multiple of the simple gravity (g), is used as a measure of this.

For example, a hoisting operation "tolerates" the impact force of 65G, which corresponds to 65 times the simple acceleration due to gravity (g).

Examples of product sensitivities

	Product	G-value
Extremely sensitive	Plasma screen Precision measuring instruments with sensitive mechanical bearing, e. g. gyro compass	0 – 20
Very sensitive	LCD TV, Space / Aviation Navigation devices lamps, optical equipment	20 – 40
Sensitiv	computers, electro-fine mechanical devices, cash register systems, switchgear, cooling systems	40 – 60
Moderately sensitive	Radio and television sets, optical equipment, eggs (hard boiled, side-by-side) electrical equipment and measuring instruments, household electrical appliances	60 – 80
Moderately robust	washing machine refrigerator accumulators, telephone sets	80 – 110
robust	glass bottles machines, tools, motors	over 110

The complete guide is available at the following link: (german)
https://www.mbe.de/Files/Downloads/DEMBE0124/404f023de615c4475b2de0ce95554432.pdf

3. Manual indicators

ShockWatch 2 with its selection aids provides an approach for estimating sensitivities. The manual indicators (one-time discolouration when the shock value is exceeded) are selected according to the manufacturer according to the size of the shipment and the weight of the cargo. Here is the manufacturer's table (shock duration between 5 ms and 50 ms):

ShockWatch2	5 - 15 ft³ .14 - .42 m³	15 - 50 ft³ .42 - 1.42 m³	50 - 100 ft³ 1.42 - 2.83 m³	100 - 250 ft³ 2.83 - 7.08 m³	250 - 500 ft³ 7.08 - 14.16 m³	500 - 1,000 ft³ 14.16 - 304.8 m³	1,000+ ft³ 304.8+ m³
0 - 10 lbs 0 - 5 kg	75G	75G	50G	37G	N/A	N/A	N/A
10 - 25 lbs 5 - 11 kg	75G	50G	50G	37G	25G	N/A	N/A
25 - 50 lbs 11 - 23 kg	50G	50G	37G	25G	25G	15G	N/A
50 - 100 lbs 23 - 45 kg	50G	37G	37G	25G	15G	15G	10G
100 - 250 lbs 45 - 113 kg	37G	37G	25G	25G	15G	15G	10G
250 - 1,000 lbs 113 - 454 kg	37G	25G	25G	15G	15G	10G	10G
1,000 - 2,000 lbs 454 - 907 kg	25G	25G	25G	15G	15G	10G	5G
2,000 - 5,000 lbs 907 - 2,268 kg	25G	25G	15G	15G	10G	10G	5G
5,000 - 10,000 lbs 2,268 - 4,536 kg	25G	15G	15G	15G	10G	10G	5G
10,000 - 15,000 lbs 4,536 - 6,804 kg	N/A	15G	15G	10G	10G	5G	5G
15,000 - 20,000 lbs 6,804 - 9,072 kg	N/A	N/A	10G	10G	5G	5G	5G
20,000 - 30,000 lbs 9,702 - 13,608 kg	N/A	N/A	N/A	5G	5G	5G	5G
30,000+ lbs 13,608+ kg	N/A	N/A	N/A	N/A	5G	5G	5G

This shows: The larger and heavier the transported material, the lower the threshold value should be selected.

More details available at:

https://cdn2.hubspot.net/hubfs/2072862/SpotSee%202017/Products/ShockWatch%202/ShockWatch2-Sales-Sheet.pdf?t=1504195170990

4. Braking processes, collision damage or falls

If a truck carrying a normal load carries out emergency braking under normal road traffic conditions at a speed of 50 km/h - without damage to the rear end of the vehicle, it will reach the speed limit within approx. three seconds to stand.

In case of collision damage or fall the braking processes (= negative acceleration) are considerably shorter and lie in the range of fractions of a second. Lighter objects (less than 100 kg) are braked very quickly (estimated within 5 to 20 ms) and heavier objects are braked more slowly (50 to 100 ms).

Example:

A truck with a speed of 50 km/h (14 m/s) that comes to a standstill in 100 ms upon impact against a rigid wall experiences an acceleration of 140 m/s², which corresponds to about 14 g. Forces on corresponding objects act according to the acceleration duration. In this case, the 14-fold weight force is applied for 100 ms.

Source, calculation and calculation formulas: (german)
http://www.internetratgeber-recht.de/Verkehrsrecht/Rechner/rechner-bremsweg.htm

Contact

ASPION GmbH
76149 Karlsruhe, Germany
www.aspion.de

Support: +49 (0)721 / 8 51 49-128
E-Mail Support: support@aspion.de

Further FAQs and useful information can be found online in the ASPION customer portal at
www.aspion.de/en