WHITEPAPER

Loads on transported goods

According to a study by the University of St. Gallen, one out of three deliveries in global goods traffic is complained about by the recipient because of transport damage. Whether it is due to vibrations or the effects of weather, damage is an everyday occurrence in the logistics industry, although the causes often remain unclear. Electronic data loggers allow reliable recording of events during transport and for this purpose, the information about the loads that occur during transport is of central importance. If the settings of the data loggers are selected correctly based on the transport conditions, the sensors reliably and precisely record any excessive stresses during transport. The data obtained is then used in case of transport damage as proof against service providers and insurance companies.

1. Stress-appropriate packaging

The basis for the best possible avoidance of transport damage is always packaging tailored to the transported goods. Optimal packaging should fulfil the following four distinct functions:

- Protection
  The packaging must protect the packaged goods from the stresses of transport. The protection is always directed inwards to ensure the serviceability of the transported goods.
- Manageability
  The packaging must reliably absorb the compressive forces that arise during overstowing – i.e. the stacking of goods in transit.
- Suitability for transport
  The packaging must be designed so that it reduces dynamic loads during transport in such a way that damage to the goods to be transported is prevented.
- Maintaining quality
  The packaging should ensure that the goods are transported from the sender to the consignee in perfect condition.

Source: http://www.tis-gdv.de/tis/verpack/verpackungshandbuch/01verpackungshandbuch_01.htm

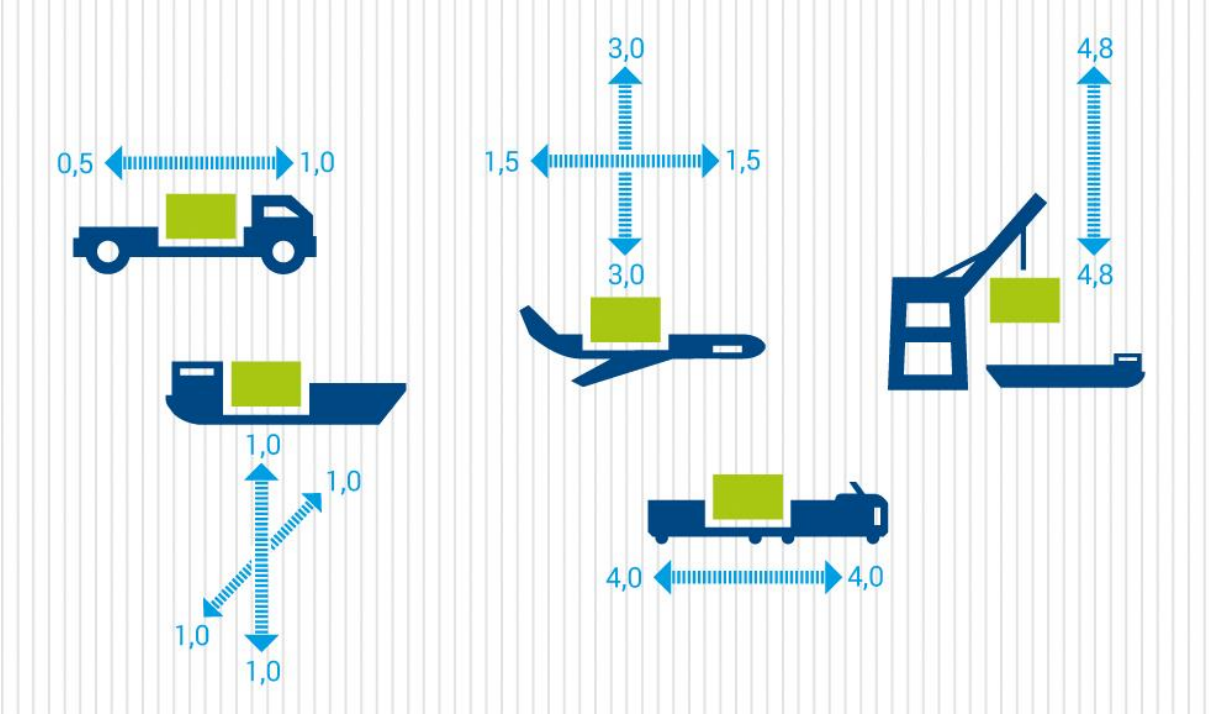
2. Mechanical-dynamic loads during transport

Every item to be transported is continually exposed to a mechanical-dynamic load. These loads result from the movement of the mode of transport (for example, a truck, a ship or a plane) and the packaging. The dynamic loads refer to x times the gravitational acceleration. The gravitational acceleration is a mathematical constant, which results from the formula 9,81 (~10) m / s^2 = 1 g. Depending on the means of transport used, a wide variety of G-forces can act on the cargo and these forces are responsible for the slippage of transport loads, the deformation of packages or the tearing off of entire containers on cargo ships.

A very good overview of impact loads of the various modes of transport can be found at the TIS Transport Information Service, published by GDV, Gesamtverband der Deutschen

Versicherungswirtschaft e.V. The various modes of transport are clearly listed with their stresses, for example, accelerations of 10 g in coupling operations in rail transport are mentioned.

Source: http://www.tis-gdv.de/tis/misc/mechanisch.htm



The graph shows an overview of the main dynamic loads of different modes of transport as well as handling in container shipping (values in g).

3. Examples of accelerations

Understanding G-forces when transporting goods is essential for the correct setting of shock sensors. An impressive example of a sixfold gravity acceleration (6 g) can be found in the following video: here, the measurement accuracy of the data logger was tested with a so-called shaker.

https://www.youtube.com/watch?v=40feGscSfuA

As an illustration of stresses occurring during a truck transport accident, here is another example:

A truck is travelling at 50 km / h and bounces against a rigid wall. Due to the impact, the truck comes to a stop in 100 ms, which corresponds to an acceleration of 140 m / s². The acceleration forces occurring here are about 14 g! The forces on corresponding objects act according to the acceleration time, which in our example means 14 times the weight force for 100 ms.

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

4. Loads on containers

Unfortunately, there are no direct load values for the handling of goods that could be taken as a guide. As part of a research conducted by the Federal Institute for Materials Testing, however, interesting benchmarks of acceleration loads were determined, which reflect the recommendations in the VDI Directive 2700 and the CTU Packaging Directive quite well.

As an example, a cargo container is listed in the research, which is first transported on a truck and then loaded onto a ship. When starting and stopping the truck and when cornering, 0.3 g act on the container. So far, so harmless. Less harmless, however, are the vertical loads that occur when picking up and dropping the container onto the loading area. Already 3.7 g - that is 3.7 times the gravitational acceleration - is acting on the container floor. Arriving at the port, the container is once again picked up from the truck bed by crane and deposited on the ship. During this process, up to a 4.8-fold acceleration of gravity can act on the container bottom!

Source:
http://www.tis-gdv.de/tis/verpack/verpackungshandbuch/04verpackungshandbuch_014.htm

5. Choosing the right settings for data loggers

There is no universal formula for choosing the right settings for recording shock events for a data logger because the transported goods and goods are as varied as their manufacturers. A pump weighing several tons can be monitored differently than a sensitive measuring device, which in turn places different demands on the sensors than a complete machine of several metres in length. Therefore, the following considerations should always be considered before installing and configuring data loggers:

- How is it transported? By road only or also by ship? What are the road conditions, for example, in the destination country?
- Threshold values must always be selected in accordance with the means of transport and the basic values at load heights must be observed.
- Where are the sensitive points of the goods to be transported? If this point is defined, the data logger should be attached here.
- The leverage must also be considered when attaching data loggers. When falling over or falling sideways, the acceleration effect in the upper third of the cargo is higher than at the foot of the object.
- The duration of the shock effect is also relevant. Prolonged shocks have a greater impact than short pulses of just a few milliseconds.

6. Optimal attachment of a data logger to the transported goods

The sensors should always be attached directly to the cargo and not to the packaging. This is the only way to ensure that forces acting on the object are recorded directly and reliably. An ideal attachment of the sensor is the screw connection. If this is not possible, industrial adhesive tape can be used as an alternative.

7. Example control cabinet

Switch cabinets are little marvels of technology and are correspondingly sensitive, as far as loads during transport are concerned. In order to avoid mechanical damage to the cabinets and installed components, optimised packaging and careful padding are essential. If, for example, the frame of the packaging is not sufficiently dimensioned, this can lead to high dynamic loads leading in turn to damage to the housing.

To cover any transport damage, such as concealed damage, the control cabinet is provided with a data logger in addition to the optimised packaging. The sensor is mounted in the upper third of the control cabinet near the sensitive electronic components and configured according to the means of transport, the specific weight and all other known parameters.

Incidentally, a data logger can also provide valuable services in connection with packaging. For example, the load on the packaging can be checked and optimised for this purpose.

Source: http://www.tis-gdv.de/tis/ware/maschinen/schaltschr/schaltschraenke.htm#mechanische%20einfluesse

8. Conclusion

The fact is, goods can not be transported from A to B without loads. Packaging tailored to the respective transport route is decisive for a transport without any damage. This can best be constructed with the knowledge of acceleration forces and the knowledge of packaging guidelines. The use of data loggers in the event of damage is a safeguard against recourse claims but the sensor reliably proves when and which loads have impacted on the transported goods - especially helpful in the elucidation of hidden transport damage.

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