ISO 27956 - A NEW STANDARD DESCRIBING REQUIREMENTS AND TEST METHODS FOR LASHING POINTS AND PARTITIONING SYSTEMS FOR CARGO SECURING IN DELIVERY VANS

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ABSTRACT

According to the German Road Traffic Regulations, the cargo has to be secured in a vehicle so that it will not move, fall down, roll around, be shed or generate avoidable noise. This is required under normal conditions of operation including full braking, emergency braking, braking in a curve, fast lane changing and driving in a curve. The basis for a proper securing of cargo in delivery vans (N_1-vehicles) includes a robust partitioning system which fully or partially separates the occupant compartment from the loading space, as well as lashing points. The partitioning system retains the cargo during braking, for example. Lashing points serve to hold lashing devices to secure the cargo, e.g. lashing straps for tie-down lashing.

In Germany, partitioning systems and lashing points for commercially employed new vehicles covered by the scope of the Accident Prevention Regulation for Vehicles (BDG D29) have been mandatory since 1996. DIN 75410-3 “Securing of Cargo in Truck Station Wagons (Closed Body)”, did apply here as the national technical regulation.

In order to anchor the tried-and-tested requirements regarding partition systems and lashing points in globally applicable regulations, the ISO/TC22/SC12 set up the workgroup WG9. On a voluntary basis non-governmental organisations and OEMs created the standard ISO 27956. As a result the national standard has not only been transferred into English but has also been further developed now. As the drafts ISO/CD 27956 and ISO/DIS 27956 were received favourably after their worldwide ballots, the final standard ISO 27956 has been approved now and will be published in the spring of 2009.

The paper will report on the necessity and the background as well as on the contents of this standard which may be used for self certification, for example. Prospects of further development of the Standard to cover latest additional equipment for load securing in delivery vans will be given as well.

INTRODUCTION

Lashing points and partitions as devices fitted to closed-body vehicles as a means of securing cargo are required in the German national standard DIN 75410-3. It first appeared in April 1996. Since October 1996 this standard stipulated the obligation for lashing points and partitions in all new vehicles covered by the Accident Prevention Regulation “Vehicles” (BGV D 29, Section 22 Sub-section 1, formerly VBG 12) [1] in Germany. This are in principle all commercially used vehicles.

Accidents and daily practice were the cause for the first version of the standard to be subjected to a renewed revision and for some requirements to be formulated more precisely. The calls to correspondingly raise the requirements of the previous standard have been generally supported by the German workgroup responsible for the standardisation committee for motor vehicles at VDA (German Association of the Automotive Industry). This led to the current version of DIN 75410-3, which is valid since October 2004 [2, 3].

In order to embed the now tried-and-tested requirements for partitions and lashing points in the globalised markets, the ISO/TC22/SC12 set up the workgroup WG9 in January 2006. Its remit included converting the standard DIN 75410-3 into the international standard ISO 27956. The original contents of the national standard were subjected to further development again and the first draft ISO/CD 27956 was completed in October 2007. After taking into consideration the received comments the revised second draft ISO/DIS 27956 was published in April 2008. After the approval of the final version of the standard ISO 27956 “Road Vehicles – Securing of Cargo in Delivery Vans – Requirements and Test Methods” it will be published in the spring of 2009 [4].

This paper reports on the necessity and the historic background as well as on the contents of the standard (scope, definitions, requirements and tests). Furthermore, reference will be made to previous experience and to the prospects of further development of the standard.

METHODS OF CARGO SECURING AND LOAD ASSUMPTIONS

In Germany the VDI guideline 2700 ff is one of the basic regulations concerning the securing of loads on road vehicles [5]. An example of international regulations would are those set out in the European Best Practice Guidelines on Cargo Securing for Road Transport [6]. An example of specific regulations for an industrial loader for securing cargo for transport by load carriers on commercial vehicles which covers road transport with vans is the guideline for the interfactory transport by Daimler AG [7]. At the moment, the Guideline VDI 2700 - Sheet 16, which describes in detail the securing of cargo in vans (transporters) up to 7.5 t Gross Vehicle Mass (m_{GVM}), is only available in a draft version [8]. This guideline is intended for forwarders, freight carriers, loaders, vehicle owners, vehicle drivers and all those who the law, ordinances, contracts or other regulations deem responsible for securing the cargo and ensuring safe transport. In other words: Guideline VDI 2700 – Sheet 16 regulates the practical execution of cargo securing measures in vans (transporters). The guideline also defines in its scope that it applies to all vans up to 7.5 t m_{GVM}, irrespective of whether they are fitted with a closed body, box-type body or platform superstructure, and to any hitched trailers. In contrast to this, ISO 27956 (or DIN 75410-3) describes the requirements for the vehicle devices intended to secure the cargo in delivery vans (closed-body vehicles) and the associated test methods.

The VDI 2700 ff states basic load assumptions for cargo securing. For the commercial vehicles referred to here, it has hitherto been the case that, when regard the securing of cargo, a longitudinal deceleration of the vehicle forwards of 0.8 g (emergency braking) as well as an acceleration laterally left or right (cornering, sudden swerve and lane change) as well as in rearward direction of 0.5 g had to be assumed. Sheet 16 was the first to define greater load assumptions for lighter vans corresponding to their driving dynamic properties, Figure 1. For instance, for a vehicle with a permissible total mass of over 2.0 up to 3.5 t, the minimum inertia force of the cargo in the forward direction is 0.9 times and laterally 0.7 times its weight force.

Gross Vehicle Mass (m_{GVM})	up to 2.0t	more than 2.0t up to 3.5t	more than 3.5t
Inertia force in frontal direction	$0.9 \cdot F_G$	$0.8 \cdot F_G$	$0.8 \cdot F_G$
Inertia force in rearward direction	$0.5 \cdot F_G$	$0.5 \cdot F_G$	$0.5 \cdot F_G$
Inertia force in sideward directions	$0.7 \cdot F_G$	$0.6 \cdot F_G$	$0.5 \cdot F_G$

Examples of inertia forces for a gross vehicle mass of more than 2.0t up to 3.5t

F_G: Force of gravity of the cargo

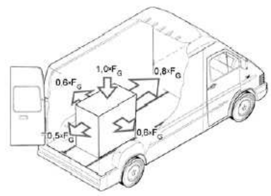


Figure 1. The minimum mass forces to be taken into account for standard operation in accordance with VDI 2700 – Sheet 16 (draft, April 2008)

In order to resist the inertia forces, various methods of cargo securing are applied in practice. These can be basically divided into tie-down lashing, direct lashing and form-fit blocking as well as combined cargo securing, Figure 2.

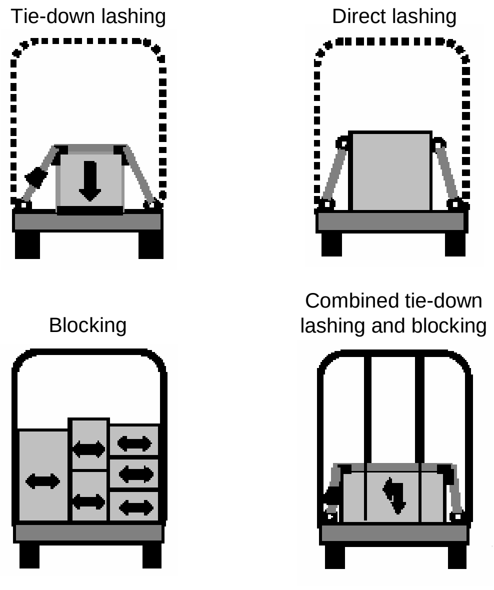


Figure 2. Basic types of securing cargo on road vehicles (Source: VDI 2700-16, draft, April 2008)

Tie-down lashing involves the tensioning of suitable lashing devices (usually straps) that tie down the cargo. The permanently acting tension forces which are necessary to secure the cargo, are conducted via the lashing devices into the so-called lashing points (usually loops/rings) and thus into the vehicle structure. Direct lashing involves only a slight pre-tensioning of the lashing devices (straps or chains). This method generates the temporary forces required to secure the cargo depending on the driving dynamic requirements directly from the inertia forces, reduced by the friction force only and generated as a consequence of the inertia force. Here too, the securing forces are conducted via the lashing points into the vehicle structure.

Securing the cargo by means of form-fit methods is achieved without tie-down lashing or direct lashing. The cargo, under the influence of the driving dynamic inertia forces, is directly supported by the vehicle superstructure or suitable additional devices.

Furthermore, cargo can be secured by using a combination of methods. In general the combined measures are tie-down lashing in conjunction with form-fitting.

CONTENTS OF ISO 27956

<u>Scope</u>

ISO 27956 applies to N_1 vehicles and N_2 vehicles up to 7.5 t in compliance with the ECE classification as per ECE/TRANS/WP.29/78/Rev.1/Amend.2 “Consolidated Resolution on the construction of vehicles (R.E.3)”. For vehicles preliminary designed for goods transport and derived from a passenger car (M_1 vehicle), only the partitioning system requirements of ISO 27956 apply. Figure 2 gives a few examples of vehicles covered by ISO 27956. The characteristic feature of all these vehicles is that the superstructure consisting of occupant compartment and the loading space forms a closed unit (closed body or “one-box vehicle”).

For these vehicles minimum requirements are defined for the devices intended to secure the cargo as well as associated test methods. The intention is to ensure that the cargo is secured in a roadworthy and operationally safe manner to protect the occupants against injuries caused by shifting cargo. This is the same intended objective as set out in DIN 75410-3. ISO 27956 additionally mentions as a clarification that extreme loads, such as those that may occur in frontal collisions, are not taken into account by this standard. For this the term “roadworthy” has been included. It means design concepts aiming at excluding harm (e.g. injuries, fatalities) to the occupants of a vehicle travelling on public roads under normal conditions of operation (including full braking, emergency braking, braking in a curve, fast lane changing and driving in a curve).

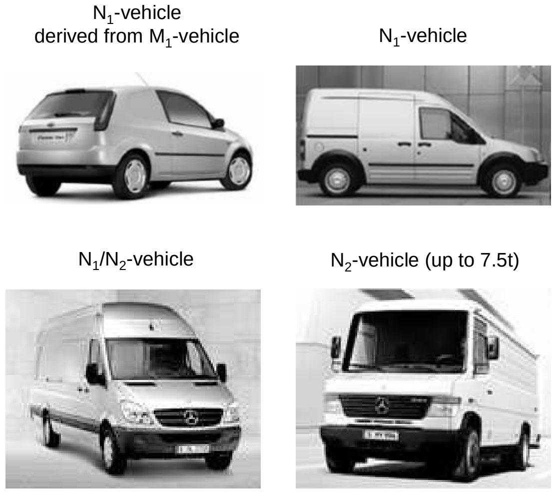


Figure 3. Examples of vehicles covered by ISO 27956

<u>Requirements and Tests</u>

In general N_1 vehicles and N_2 vehicles up to 7.5t must be fitted with suitable equipment to prevent the cargo from penetrating the occupant compartment. Therefore, protection devices consisting of a partitioning system and lashing points must be provided. Partitioning systems are defined as a device (e.g. bulkhead, partition wall, grid) which fully or partially separates the occupant compartment from the loading space. Lashing points are attachment parts on the vehicle or integrated devices (e.g. rings, eyelets, hooks, loops, oval members, hooking-up edges, threat connections, rails) to which lashing devices can be connected in a form-fit manner. They are designed to transfer the lashing forces to the vehicle structure.

Partitioning Systems

<u>Dimensions</u>

The partitioning system shall fully separate the occupant compartment from the loading space across its entire width and height. In addition ISO 27956 takes into account permissible exceptions which occur in practice. If the loading space extends above the occupant compartment, it may be limited in height to the horizontal separation between the occupant compartment and the upper part of the loading space. In the case of vehicles that are only equipped with a driver seat and have no passenger seat, the partitioning system does not need to cover the entire width of the vehicle. However, the protective zone behind the driver seat to be described below must be covered and the seating position of the driver must also be sufficiently protected against laterally shifting cargo. Figure 4 shows examples of partitioning systems in various vehicles.

Figure 4. Examples of partitioning systems

If there is a gap between the partitioning system and the vehicle body, it shall not be more than 40mm. It also states that such a distance must be observed without removing any existing covering (or trim). A greater distance is permissible if the vehicle has corrugations in the side walls (see Figure 5, top) and to ensure proper deployment of curtain airbags, if fitted.

If the partitioning system consists of a grid or cargo net, a rigid test device (e.g. an iron rod) with a front surface of 50mm x 10mm shall not be able to pass such nets or grids in any orientation. In order to verify this, the test device is passed in a horizontal direction parallel to the x-axis of the coordinate system of the vehicle and can at the same time be rotated about its x-axis in any orientation, Figure 6.

<u>Testing</u>

The test conditions described below involve loading exerted by two different test plungers (Type 1 and Type 2). The partitioning system shall not deform permanently by more than 300mm (see Figure 5, bottom). No sharp edges or other deformations during the process are permitted to appear which might result directly or indirectly in injuries to the occupants.

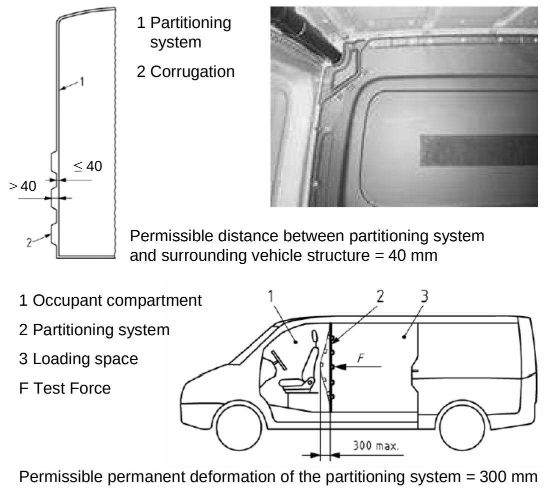


Figure 5. Partitioning system requirements regarding deformation under test loading with plungers (bottom) and the distance of the surrounding vehicle structure (top)

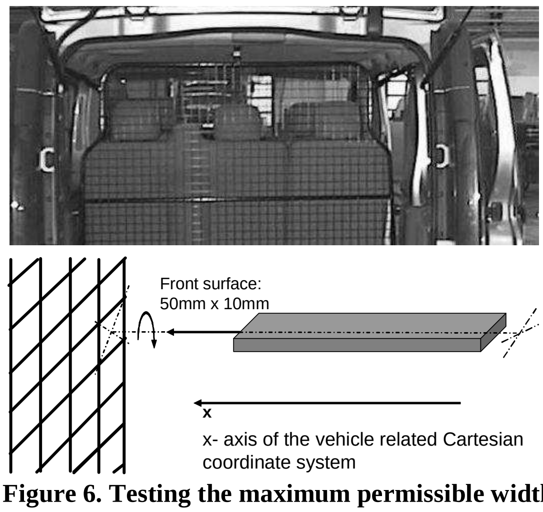
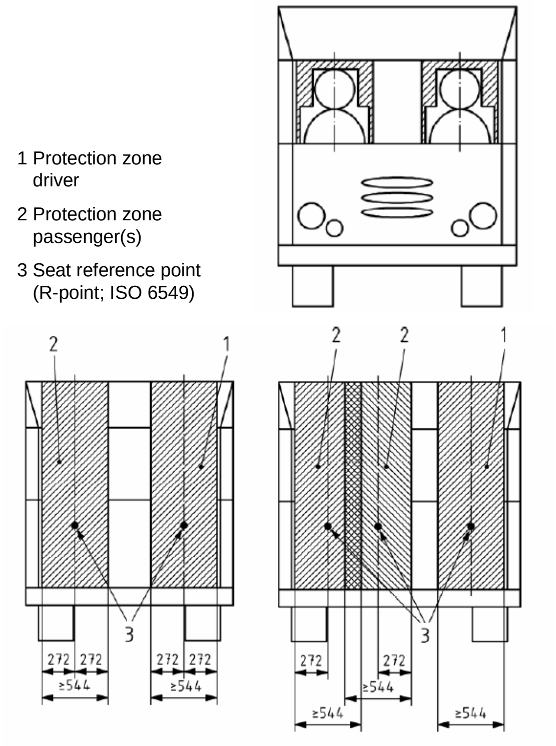


Figure 6. Testing the maximum permissible width of the gap of a partitioning system consisting of a grid or net using a rod test device

The partitioning system displays special protection zones behind the seating positions of driver and front passenger(s) or of the passengers sitting on the rear seats in dual cabins, if fitted. For this area more stringent requirements are stipulated to protect against penetrating cargo. These protection zones span the entire height of the occupant compartment and are 544mm wide each. Their vertical limits run symmetrically to the seat reference point (R-point, see ISO 6549) of the respective seat in a distance of 272mm, Figure 7. Behind a seat bench these protection zones may overlap between the R-points.



Example of a 2-seater occupant compartment

Example of a 3-seater occupant compartment

Figure 7. Protection zones of the partitioning systems behind driver and front passenger(s)

To test the strength of the entire partitioning system and its fixation, a large plunger piston (Type 1) has to be applied, see Figure 8, left. The test plunger piston has a flat square surface with a side length of 1,000mm and an edge radius of less than 20mm. It shall be applied with its central axis in the geometric centre of the partitioning system (based on its height and width).

The test force F (compressive force) has to be calculated on the basis of the mass m_P of the maximum payload of the vehicle in accordance with the equation

$$\mathbf{F = 0.5 \cdot m_P \cdot g}$$

(g = acceleration of gravity = 9.81 m/s^2).

This test force acts horizontally in the longitudinal direction (i.e. in x-direction of the vehicle-based coordinate system) on the partitioning system.

In vehicles in which the opening of the rear loading doors and/or the dimensions of the partitioning system, make the application of the Type 1 plunger piston impossible, a corresponding plunger piston of reduced dimensions and of the maximum possible rectangular geometry should be used, see Figure 8, right.

When testing the partitioning system, the test force F has to be applied as fast as possible within a maximum of 2 seconds and shall be maintained for 10 seconds. This is intended to simulate the loading of the entire partitioning system by the cargo during full braking.

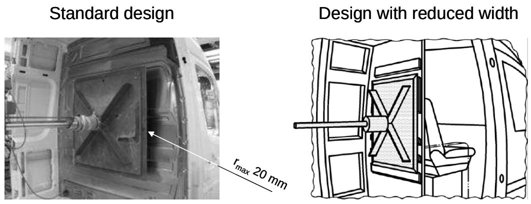


Figure 8. Plunger piston Type 1 (large plunger piston) to test the strength of the entire partitioning system and its fixation

Additionally, a second, smaller plunger piston (Type 2) is employed to test the strength of the partitioning system in the protection zones. This plunger piston has a flat square surface with a side length of 50mm and an edge radius of a maximum of 0.5mm.

This small plunger piston shall be used to apply force to any desired point of the retaining device only within the protection zones. If the partitioning system consists of a grid or net, the plunger piston (Type 2) shall be applied to the points were the bars crisscross. If a door or windows are located in the protection zone, such elements shall also withstand this test, Figure 10. The window material may fracture, as long as the deformation criteria given in the standard are met.

For the test using the smaller plunger piston (Type 2) the test force F shall also be applied horizontally in the longitudinal direction and calculated on the basis of the mass m_P. The equation to be applied here is

$$\mathbf{F = 0.3 \cdot m_P \cdot g}.$$

Nevertheless, this test force should not exceed 10 kN.

Identical to the large plunger piston (Type 1), the small plunger piston (Type 2) must generate the test force as fast as possible within the maximum

2 seconds and then be maintained for 10 seconds. This simulates a situation, for example, in which only a part of the cargo is directly in contact with the partitioning system which is directly loaded within the protection zone.

Figure 9. Plunger piston Type 2 (small plunger piston) to test the strength of the partitioning system within the protection zones

During the tests the partitioning system must either be installed in the specific vehicle or its body-in-white in order to ensure that the fixation corresponds to the original installation conditions. If the tests cannot be conducted this way, the partitioning system with its fixation elements shall be attached to a rigid frame with its attachment hardware.

The set-up of the rigid frame shall incorporate a horizontal surface which replicates the general level of the cargo space floor. The attachment points have to reproduce the geometry of the vehicle in which the partitioning system will be installed.

For both pistons (Type 1 and Type 2), the use of adapters between the partitioning system and the surface of the piston is permissible if necessary. This enables, for example, an even distribution of the contact pressure for offset partitions.

Lashing Points

Number, Alignment and Dimensions

For vehicles addressed in the scope of ISO 27956 lashing points are mandatory. They can be located in the floor and/or in the side walls of the loading space. Lashing points which comply with the requirements of the standard and which are located on the side walls have to be aligned as closely as possible to the loading space floor. Hereby a distance of 150mm to the loading space floor shall not be exceeded.

In practice, these days lashing points are also found in rails on the sidewalls which are located clearly higher up, Figure 11. These are additional lashing points which are not covered by the scope of ISO 27956. If necessary these additional lashing points could later on also be taken into account in a supplemental section of ISO 27956 as elements of an additional system installed in the vehicle for the securing of the cargo.

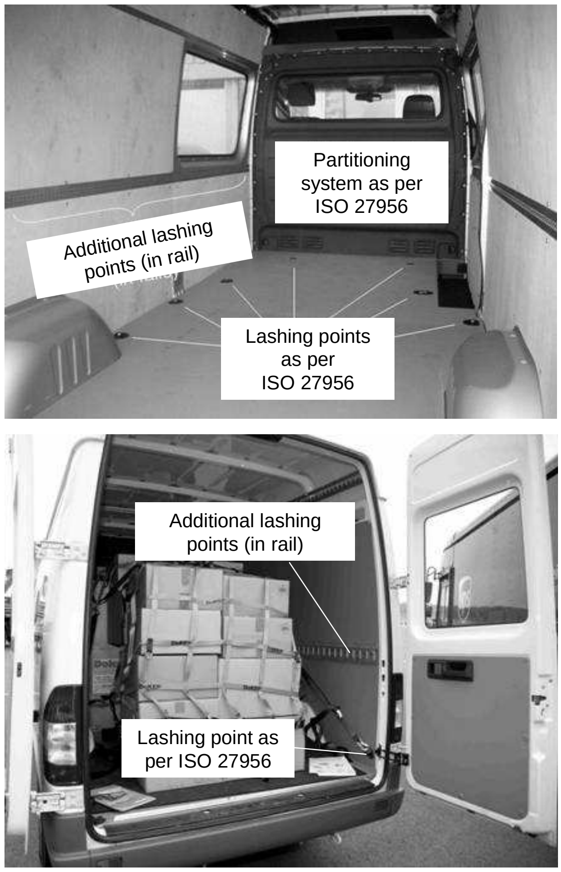


Figure 10. Load securing devices (partitioning system and lashing points) as per ISO 27956 as well as additional lashing points (in rails) in the sidewall of a closed-body N_1 vehicle

The design and the strength of lashing points in closed-body N_1 vehicles have frequently been the subject of intensive discussions both at a national level during the development and revision of DIN 75410-3 (see also [3]), and during the drafting of ISO 27956. This can be traced back, among other things, to the various variants of lashing points that were available on the market for many years (for examples see Figure 12) and to the wide range of experiences in using them in practice.

In contrast to heavy commercial vehicles on a ladder-type frame basis, the design of the relevant structure to attach lashing points on closed-body N_1 and N_2 vehicles with their self-supporting superstructure is usually less rigid and solid. In order to be able to fulfil requirements to transform kinetic energy into the deformation of the vehicle structure in accidents and crash tests, certain zones that can also be located in the loading-space area, have to deform in a predetermined manner under the influence of mechanical stresses and strains. This means that the anchorage of lashing points in closed-body N_1 and N_2 vehicles cannot be designed to have any degree of rigidity.

Figure 11. Examples of lashing point designs seen in practice for securing cargo in closed-body N_1 and N_2 vehicles

On the other hand, as far as the user is concerned, it is important that the lashing points are not overly permanently deformed when required load securing forces are applied using the available lashing devices. Otherwise, the consumer may thing twice about applying the forces required to properly secure the cargo so as to avoid damaging the lashing point anchorages in his vehicle.

This conflict of interests and the coordination of the interplay of lashing devices and lashing points were treated again in detail in the development of ISO 27956. It determined that still potential exists to harmonise the technical requirements and the design of the lashing devices, on the one hand, and the lashing points on the other hand. According to the ISO working group WG9, the various vehicles and easily comprehensible related information for the consumers should be considered more than before.

The geometric design of the lashing points is the responsibility of the vehicle manufacturer and is not stipulated in concrete terms in ISO 27956. The international standard contains drawings of some typical examples of designs of lashing points. Irrespective of the design of the lashing points chosen, a cylindrical probe shall be passed through the opening of the lashing point. New here is that according to ISO 27956 the diameter of this probe depends on the Gross Vehicle Mass of the vehicle, which has been divided into three classes for this purpose, Figure 13, top. The basic idea behind this was, firstly the function of the lashing point, for example to fit to a lashing device hook. Secondly, a standardised design of geometry and strength of such hooks could simplify the use of lashing devices that match the vehicle. Another requirement was that the inner diameter of a lashing point should not to be too small as in practice lashing straps are also passed through the lashing points without hooks (see Figure 12, bottom right). If the diameter of the lashing point was too small, this could lead to unfavourable folds in a strap.

d_1 [mm]	Gross Vehicle Mass [t]
35	$5.0 < m_{GVM} \leq 7,5$
25	$2.5 < m_{GVM} \leq 5.0$
20	$m_{GVM} \leq 2.5$

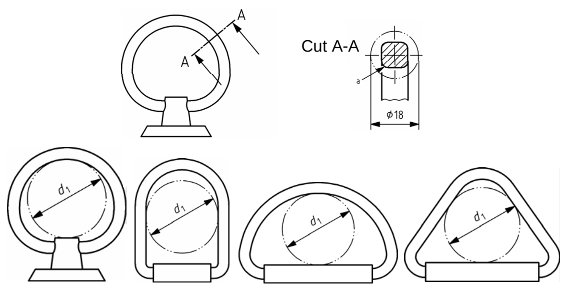


Figure 12. Examples of typical shapes of lashing points and dimensions stipulated by ISO 27956

Likewise considering the function of the lashing points in practice and, for example, the provision of suitable hooks, ISO 27956 stipulates that the maximum cross-section surface of the material of an eyelet or a ring shall not be larger than 18mm (see Figure 12). If the vehicle manufacturer designs the lashing point in a different shape or using different dimensions, he should provide adequate fastening elements to match the lashing devices. This also applies if the lashing points only consist of a thread connection.

Conforming to their use as a means to secure cargo (predominantly by tie-down lashing) it is also stipulated that lashing points should be arranged in pairs located opposite each other. The lashing points should be distributed as evenly as possible along the length of the vehicle and as close as possible to the sidewall.

The number of lashing point pairs and their alignment in the loading space depends on the maximum distance between the lashing points in the longitudinal direction of the vehicle and the length of the loading area. The distance l_S between two lashing points shall not be smaller than or equal to 700mm. This distance may be exceeded, but it must never exceed 1,200mm. In longitudinal direction the distance between the boundary of the usable loading space length and the lashing points on the front side or the rear side shall not be more than 250mm. The lateral distance to the usable loading space width and the lashing points shall be not more than 150mm. For vehicles with a loading-space length up to 1,300mm, at least two lashing point pairs shall be provided (two lashing points on each side).

As a rule the loading surface of a closed-body vehicle is not perfectly rectangular. Entry steps by the lateral sliding doors and the wheel arch protrudes generally more than 150mm into the side of the loading space. Figure 13 shows an example. Here, two lashing points have been offset inwards near the side door. They can be considered as an additional lashing point pair if the stipulated distance $l_S \leq 700$mm (or $l_S <$ 1,200mm) for the remaining lashing point pairs has been considered.

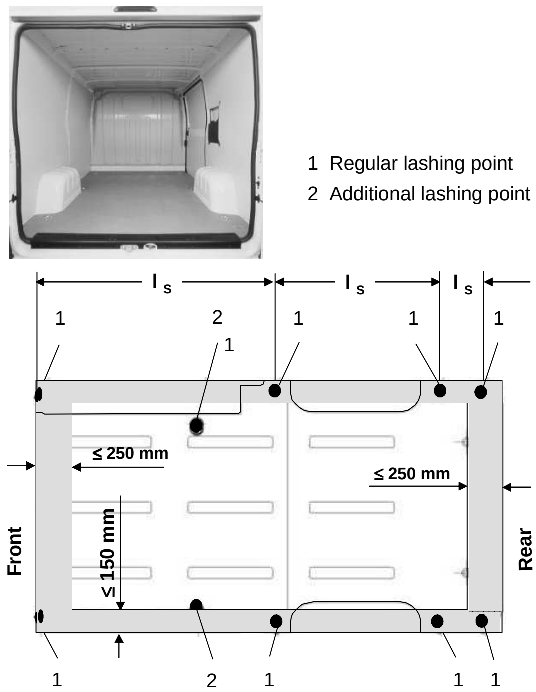


Figure 13. Example of the alignment of lashing points in a closed-body N_1 vehicle

The minimum number N of lashing point pairs to be installed is derived from the length L of the loading space (measured along the centre of the loading space floor where y = 0), taking into consideration the distances of 250mm at the front and rear side as well as a regular distance of the lashing point pairs of 800mm in accordance with the equation

$$\mathbf{N = 1 + (L\,[mm] - 2 \cdot 250\,mm) / 800\,mm.}$$

Applying the conventional mathematical rounding rules the result of the calculation for decimal places in the range .50 - .99 are rounded up and decimal places in the range .01 - .49 are rounded down. If, for example the length of the loading space L = 2,550mm, the minimum number N of required lashing point pairs is:
N = 1 + (2,550 mm – 2 · 250 mm) / 800 mm =
1 + 2.56 = 3.56 rounded up to N = 4 lashing point pairs.

Testing

In principle, the mechanical loading of the lashing points depends on the mass of the maximum permissible vehicle payload. This loading can, as extensive sample calculations have shown, vary considerably for different vehicles with the same permissible total mass. This is why equations were developed for ISO 27956 which can be employed to calculate the nominal tensile force of a lashing point based on the maximum vehicle payload. Larger vehicles generally have more lashing point pairs located in the loading space than small vehicles. This also applies with reference to the existing lashing point pairs facing the mass of the maximum vehicle payload. Accordingly, various factors were integrated into the formulae for the vehicles in question depending on their Gross Vehicle Mass m_{GVM}. To do this, the vehicles were classified into three groups (2.5t $\leq m_{GVM}$; 2.5t $< m_{GVM} \leq$ 5.0t; $m_{GVM} >$ 5.0t). In addition, in order to avoid outliers in the calculation results, the resulting nominal tensile forces generated by the formulae were restricted to an upper and a lower limit.

Table 1. shows an overview of the equation for calculating the nominal tensile forces of lashing points in accordance with ISO 27956. The vehicle classes selected here based on the permissible total mass are the same as those stipulated for the test probe for the inner diameter of the lashing points (see Figure 12). It has to be expected that the vehicle manufacturers will in practice base their lashing point configuration of their various model ranges lashing points on the upper limits (F_N = 8.0 kN, F_N = 5.0 kN, F_N = 4.0 kN). If this proves to be the case, the manufacturers of lashing devices could provide

products correspondingly divided into three classes with matching hooks and nominal tensile forces to secure cargo in vehicles with a Gross Vehicle Mass up to 2.5t, over 2.5t to 5.0t and over 5.0t to 7.5t.

According to ISO 27956 every lashing point in a specific vehicle is to be capable of resisting loading in accordance with the formula and details set out above under any angle spanning 0 to 60° in the vertical, Figure 14.

Table 1. Calculation of the nominal tensile forces per lashing point as per ISO 27956

Nominal tension force **F_N [kN]**	**Gross Vehicle Mass** **m_{GVM} [t]**
$F_N = ¼\, m_P \cdot g$ but $3{,}5 < F_N \leq 8{,}0$	$5 < m_{GVM} \leq 7{,}5$
$F_N = ⅓\, m_P \cdot g$ but $3{,}5 < F_N \leq 5{,}0$	$2{,}5 < m_{GVM} \leq 5{,}0$
$F_N = ½\, m_P \cdot g$ but $3{,}0 < F_N \leq 4{,}0$	$m_{GVM} \leq 2{,}5$
m_P is the maximum payload in kg; g is the acceleration of gravity (9.81 m/s^2)	

1 Floor of the loading space
2 Lashing point under test
3 Reference point and direction of measuring of the maximal lasting deformation
F_N Nominal tension force

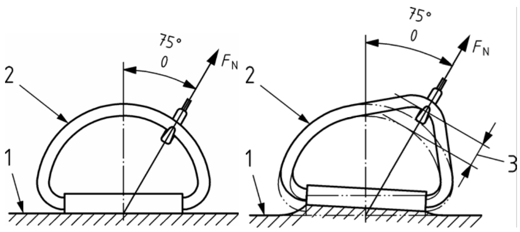


Figure 14. Testing the strength of a lashing point

<u>New Test Procedure</u>

The only decisive criteria for the testing of the strength of a lashing point are safety and functionality for cargo securing. These criteria have to be ensured under normal operating conditions and under a specific loading. The normal operational loadings are derived from the cargo securing requirements.
For example, if the cargo is secured by tie-down lashing, the (known) nominal tensile force F_N of the lashing points limits the maximum pre-tension force to be applied. If this possible pre-tension force does not suffice to completely secure the cargo in a present case, the cargo must be secured by a combination of methods. As a rule this involves the additional supporting or blocking of the cargo by form-fit methods.

It can be assumed that according to what has now been many years of practical experience, the nominal tensile forces of the lashing points for securing the cargo defined in DIN 75410-3 or the equivalent in ISO 27956 are sufficient. For newer vehicles, problems with lashing points being completely torn away are hardly heard of. Nevertheless, there have been repeated reports of “visible” deformations of lashing points. If such deformations are purely elastic, they return to their original shape once the loading on the lashing point has been removed and therefore are completely harmless. Plastic deformations that persist after the loading on the lashing point has been removed are a problem, however.

During the initial loading of a lashing point up to the nominal tensile force F_N and beyond up to a defined excess loading, such plastic deformations must be tolerated for design reasons of some lashing points in vans. The decisive criterion is thus the extent of the plastic deformation of the lashing point under this loading. Also, in the case of further loading the lashing point shall not indicate additional excessive plastic deformation.

In light of this the ISO workgroup WG9 has developed a new procedure to test lashing points which is intended both to provide reproducible as well as unambiguous measuring results of the relevant deformations. Regarding the reproducibility of the results, it is favourable that the relevant deformation and force measurements begin under a specific pre-load followed by a permanent loading.

The test is divided up into four steps:

Step 1

- Apply a pre-load of 5% of the nominal tension force F_N;
- Set the deformation measurement system to zero.

Step 2

- Increase the load within 20s up to F_N;
- Hold the load for at least 30s;
- Release the load to zero;
- Reload the system up to the pre-load;
- Measure the permanent deformation of the lashing point (including the vehicle structure) at the point of force application in direction of the force application – test passed if permanent deformation is ≤ 12mm.

Step 3

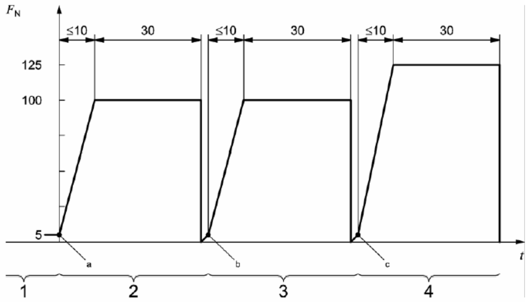
- Apply again within 20s a load equivalent to F_N;
- Hold the load for at least 30s;
- Release the load to zero;
- Reload the system up to the pre-load;
- Measure the permanent deformation – test passed if the limit specified in the 2nd step is not exceeded.

Step 4

- Increase the load within 25s up to a force of 1,25 × F_N;
- Hold the load for at least 30s;
- Release the load to zero;
- Test passed if the function of the lashing point remains intact; additional permanent deformation permissible.

The relevant parameters of this test procedure are shown in Figure 15. A body structure representing the vehicle shall be used for the test. Any reaction forces, if induced into the vehicle structure by the test equipment, should be applied within a distance of at least 300mm to the lashing point under test. However, this distance shall not be less than 100 mm.

Any lashing point on the vehicle may be selected for testing. The lashing point has to be loaded with a suitable lashing device. Adapters may be used if this requires the even distribution of test force into the lashing point. ISO 27956 does not prescribe the hardware for the testing of the lashing points. The strength of the lashing points can also be evidenced by a calculation. In this case, the vehicle manufacturer must demonstrate in a comprehensible manner the equivalence of the calculation to an actual test as per ISO 27956.



1 **Step 1:** **a** **set deformation to zero**
2 **Step 2:** **b** **1st deformation measurement**
3 **Step3:** **c** **2nd deformation measurement**
4 **Step 4**
F_N **Nominal tension force [%]**
t **Time [s]**

Figure 15. Parameters of the four-step procedure to test the strength of the lashing point

<u>Consumer Information</u>

In order to ensure a correct and proper use of the lashing points installed in the vehicle when carrying out cargo securing measures, ISO 27956 stipulates that the maximum lashing point strength shall be provided in the vehicle owner's manual. In addition, a corresponding label has to be attached inside the cargo compartment of the vehicle, Figure 16. This label shall be inscribed with white letters on a blue background with a white border. The label should be fixed in the loading space in a clearly visible position, which normally is not covered by the cargo, e.g. in the upper area of the partitioning system near the door. The minimum size of the label is 100mm x 130mm.

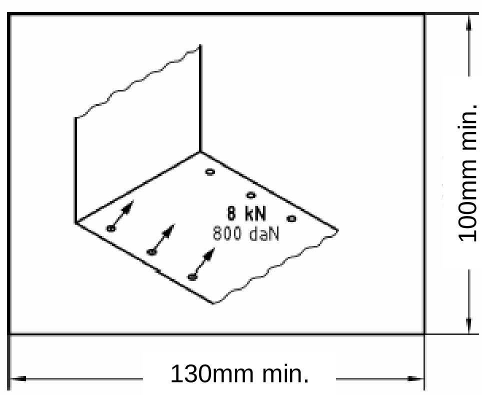


Figure 16. Example of labelling of lashing points

EXPERIENCE GATHERED SO FAR AND PROSPECTS OF FURTHER DEVELOPMENT

The first draft (Committee Draft) ISO/CD 27956 was published in November 2007 and with an international committee balloting it was successfully completed in January 2008. After some fine-tuning considering the comments received, the second draft (Draft International Standard) ISO/DIS 27956 was published in April 2008 for the second international ballot which was passed again without any negative votes until September 2008. Having apprised and incorporated the comments received, the working group ISO/TC22/SC12/WG9 finalised the Standard ISO 27956 for publication in spring 2009.

One focus of the informal discussions and the exchange of experience is the execution of lashing point tests according to the new multistage test procedure (step 1 to step 4). The first results show that as far as the deformation of the lashing points is concerned, the force directly upwards (angle between vertical and the tensile force 0°) can often be seen as a "worst case" scenario. In individual cases, however, this can depend on the design of the lashing point and the vehicle structure underneath.

First individual tests of lashing points involving a vehicle from a current model range have been conducted. The permanent deformations recorded in step 3 of the test (under 5% nominal tensile force) was in one case around a maximum value of 8mm. With a view to ensuring a general buffer for the statistical spread of the production the final decision of the Working Group was to set the corresponding maximum value in the standard to 12mm.

How the vehicle manufacturer, the supplier and the testing institutes estimate the potential for optimisation of individual, possibly "critical" lashing points, could play a decisive role for a discussion in the near future. This possible further discussion of the maximum value of 12mm will depend on more findings of manifold practical tests following the new 4-step-procedure stipulated now in ISO 27956. There is a broad consensus, that this new test procedure is able to deliver reproducible and precise results.

The original remit of ISO/TC22/SC12/WG9 included the conversion of the national standard DIN 75410-3 into the international standard ISO 27956. In the future, there could be a requirement for the standardisation of further assemblies for securing cargo in closed-body delivery vans. This would be equipment required for form-fitting securing of cargo and for locking (blocking) of cargo via appropriate ratchets and bars, Figure 17. Complete shelf and fitted cupboard systems are also available.

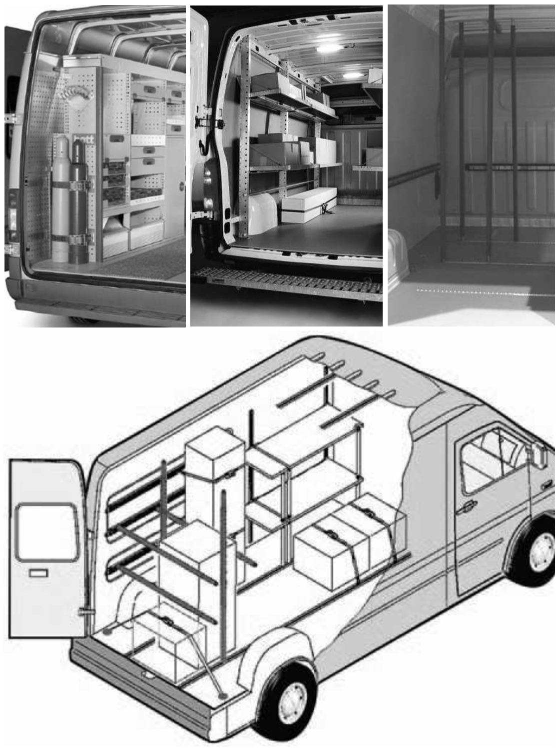


Figure 17. Additional vehicle installations for the securing of cargo in vans

These systems have already been tested in accordance with so called "in-house defined" test procedures taking into account the known relevant load cases. However, a complete harmonised transferability in all cases is not possible or sensible. Freely defined test requirements and associated standard test procedures can demonstrate and ensure the performance of the systems. But in the light of the globalised market place there is an increasing need for a suitable international standard, for example in an extended standard ISO 27956.

Please note: *This paper describes the contents of cited standards, in particular ISO 27956. This article does not hereby replace these standards. Only the cited standards in their original and respective current version have valid and binding force.*

REFERENCES

[1] **BGV D29** (formerly VBG 12) Accident Prevention Regulations "Vehicles". Publishers: Carl Heymanns Verlag, Cologne

[2] DIN 75410-3 Securing of cargo on road vehicles. Part 3: Securing of cargo in truck station wagons (closed body). The German Institute for Standardisation (DIN) Beuth Verlag GmbH, Berlin, October 2004.

[3] Garz, M., Börner, C. J., Berg, A.: Ladungssicherung im Kastenwagen. Verkehrsunfall und Fahrzeugtechnik 43 (2005) February, Edition 2, page 43-46

[4] ISO 27956: Road Vehicles – Securing of Cargo in delivery vans – Requirements and test methods. First edition, spring 2009

[5] VDI 2700: Securing of loads on road vehicles. Berlin, Beuth Verlag, October 2004

[6] European Commission, 2006: European Best Practice Guidelines on Cargo Securing for Road Transport. http://ec.europa.eu/transport/roadsafety/vehicles/best_practice_guidelines_en.htm

[7] DCE-Richtlinie 9.5 Ladungssicherung beim Transport von Ladungsträgern auf Nutzfahrzeugen – Anlage Transporter, Daimler AG, August 2004

[8] VDI 2700-16 (green print): Securing of loads on road vehicles: Securing of loads on transporters up to a mass of 7.5t. Berlin, Beuth Verlag, April 2008