SECURING LOADS IN TRUCK, RAIL, SHIPS AND PLANES

LOAD RESTRAINT MATTING

Regupol
(Australia) Pty. Ltd.

Regupol® 7210 LS plus

Regupol® 7210 LS plus is our best-selling anti-slip mat. Offering good value for money, it is suitable for most average transports. **Regupol® 7210 LS plus** has proven its worth for many years and is used as the standard friction-increasing surface by many transport companies and shipping agents today.

Maximum loading
250 t/m² = 2.50 N/mm² when 8 mm thick

Sliding friction coefficient
Sheet 15 of Directive VDI 2700, defines the minimum requirements for anti-slip mats' friction coefficients. The **Regupol® Anti-Slip Mats** easily exceed these minimum requirements by 15-50 % depending on the friction elements. Because the given circumstances are hard to calculate in practice (moisture, soiled load floor), a value of 0.6 μ should be the base for calculations (which is also recommended by sheet 15 of VDI 2700).

In addition, the behaviour of **Regupol®** has been measured under paper coils in a road test and has been certified by DEKRA. Result: **Regupol®** is suitable as a component in the load securing variation described in VDI 2700 page 9.

Regupol does not publish any generalised uncommented sliding friction coefficients. The sliding friction coefficient of a friction increasing surface depends on the combination of materials involved, the temperature, the condition of the material surfaces and the anti-slip mat (soiling, moisture, etc.). The contact surfaces of load and floor must be swept clean, grease-free and dry to achieve optimum anti-slip properties.

Material
anti-slip mat based on SBR/NBR

Colour
black with green, light green and yellow colour particles

Surface weight
approx. 6.88 kg/m² when 8 mm thick

Bulk density
approx. 860 kg/m³

Tensile strength
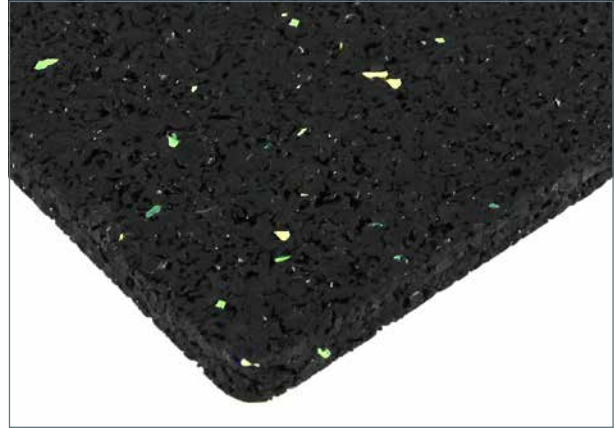at least 0.60 N/mm² in accordance with DIN EN ISO 1798

Elongation at break
at least 60% in accordance with DIN EN ISO 1798

Temperature resistance
-40 °C to +120 °C

Regupol® 7210 LS plus Anti-Slip Mat

Discard status
Cracks, holes, crushing, after contact with oil, fuel, chemicals, etc. **Regupol® 7210 LS plus** Anti-Slip Mats are suitable for repeated use through to discard status pursuant to testing by VDZ Dortmund.

Resistance
UV light, sodium chloride, weak acids and alkaline solutions (swells up when exposed to hydrocarbons such as oil, fuel, etc.)

Cleaning
Shaking out, vacuuming, washing, possibly treating with a high-pressure cleaner

Delivery form
rolls, sheets, cuttings on request

Thicknesses
8 mm (other on request)

Regupol® 9510 RHS plus

Regupol® 9510 RHS plus can take higher loads than **Regupol® 7012 LS plus**. The maximum loading is 3.0 N/mm². It is used in many areas where conventional anti-slip mats based on SBR/NBR are not appropriate because of possible black discolouring.

Maximum loading
300 t/m² = 3.0 N/mm² when 8 mm thick

Sliding friction coefficient
Sheet 15 of Directive VDI 2700, defines the minimum requirements for anti-slip mats' friction coefficients. The **Regupol® Anti-Slip Mats** easily exceed these minimum requirements by 15-50 % depending on the friction elements. Because the given circumstances are hard to calculate in practice (moisture, soiled load floor), a value of 0.6 μ should be the base for calculations (which is also recommended by sheet 15 of VDI 2700).

In addition, the behaviour of **Regupol®** has been measured under paper coils in a road test and has been certified by DEKRA. Result: **Regupol®** is suitable as a component in the load securing variation described in VDI 2700 page 9.

Regupol does not publish any generalised uncommented sliding friction coefficients. The sliding friction coefficient of a friction increasing surface depends on the combination of materials involved, the temperature, the condition of the material surfaces and the anti-slip mat (soiling, moisture, etc.). The contact surfaces of load and floor must be swept clean, grease-free and dry to achieve optimum anti-slip properties.

Material
anti-slip mat made of butyl rubber

Colour
multi-coloured

Surface weight
approx. 8.4 kg/m² when 8 mm thick

Bulk density
approx. 1,050 kg/m³

Tensile strength
at least 0.60 N/mm² in accordance with DIN EN ISO 1798

Elongation at break
at least 60% in accordance with DIN EN ISO 1798

Temperature resistance
-40 °C to +120 °C

The **Regupol® 9510 RHS plus** Anti-Slip Mat is made from butyl rubber.

Discard status
Cracks, holes, crushing, after contact with oil, fuel, chemicals, etc. **Regupol® 9510 RHS plus** Anti-Slip Mats are suitable for repeated use through to discard status pursuant to testing by VDZ Dortmund.

Resistance
UV light, sodium chloride, weak acids and alkaline solutions (swells up when exposed to hydrocarbons such as oil, fuel, etc.)

Cleaning
Shaking out, vacuuming, washing, possibly treating with a high-pressure cleaner

Delivery form
rolls, sheets, cuttings on request

Thicknesses
8 mm (other on request)

Regupol® 1000 LSE

Regupol® 1000 LSE is a premium product. The anti-slip mat is suitable for loading of up to 6.30 N/mm² and thus for heavy transports. In a widespread trial, the winter suitability of various anti-slip mats was tested by the TUL-LOG Institute Dresden in the BASt Federal Highway Research Institute.

Together with just one other mat, **Regupol® 1000 LSE** achieved sliding friction coefficients under winter conditions of more than 0.6μ, while being exposed to a sodium chloride brine to simulate melted snow and ice contaminated with gritting salt, at a temperature of -15°C. This result means that **Regupol® 1000 LSE** is probably the only anti-slip mat that is suitable for all kinds of transport right through to heavy loads under winter conditions.

Maximum loading
630 t/m² = 6.30 N/mm² when 8 mm thick

Sliding friction coefficient
Sheet 15 of Directive VDI 2700, define the minimum requirements for anti-slip mats' friction coefficients. The **Regupol® Anti-Slip Mats** easily exceed these minimum requirements by 15-50 % depending on the friction elements. Because the given circumstances are hard to calculate in practice (moisture, soiled load floor), a value of 0.6 μ should be the base for calculations (which is also recommended by sheet 15 of VDI 2700).

Regupol does not publish any generalised uncommented sliding friction coefficients. The sliding friction coefficient of a friction increasing surface depends on the combination of materials involved, the temperature, the condition of the material surfaces and the anti-slip mat (soiling, moisture, etc.). The contact surfaces of load and floor must be swept clean, grease-free and dry to achieve optimum anti-slip properties.

Material
anti-slip mat based on SBR/NBR

Colour
black with green, light-green and yellow colour particles

Surface weight
approx. 7.8 kg/m² when 8 mm thick
approx. 11.7 kg/m² when 12 mm thick

Bulk density
approx. 983 kg/m³

Tensile strength
at least 0.60 N/mm² in accordance with DIN EN ISO 1798

Elongation at break
at least 60% in accordance with DIN EN ISO 1798

Regupol® 1000 LSE Anti-Slip Mat

Temperature resistance
-40°C to +120 °C

Discard status
Cracks, holes, crushing, after contact with oil, fuel, chemicals, etc. **Regupol® 1000 LSE** Anti-Slip Mats are suitable for repeated use through to discard status pursuant to testing by VDZ Dortmund.

Resistance
UV light, sodium chloride, weak acids and alkaline solutions (swells up when exposed to hydrocarbons such as oil, fuel, etc.)

Cleaning
Shaking out, vacuuming, washing, possibly treating with a high-pressure cleaner

Delivery form
rolls, sheets, cuttings on request

Thicknesses
8 mm, 12 mm (other on request)

Regupol® Webbing Protectors

Regupol® Webbing Protectors safeguard lashing straps from premature wear and tear caused by sharp edges, and protect breakable loads from damage. **Regupol® Webbing Protectors** ensure that the lashing strap slides across the load on both edges when being lashed and that the lashing capacity of the belt is evenly distributed. Their underside consists of robust, anti-slip **Regupol®** material, and their upper side of a special fabric layer.

Material
Robust, friction-enhancing and pressure-resistant **Regupol®** anti-slip material with a special fabric on the upper side.

Advantages
– Fast, simple fixing
– No threading of the lash required
– Rear side original **Regupol® Anti-Slip Mats**
– Improvement of the transfer coefficient K
– Flexible and optimally adaptable for all lashes
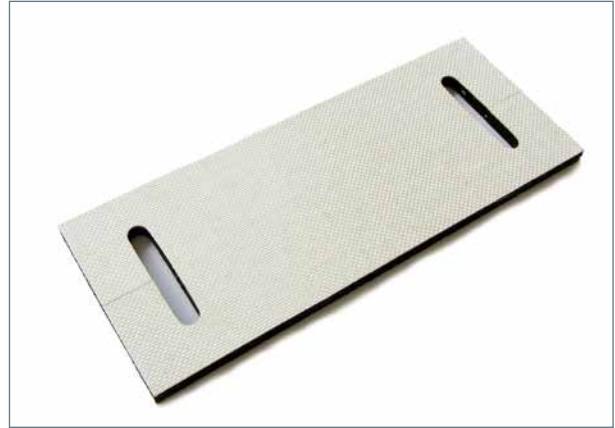
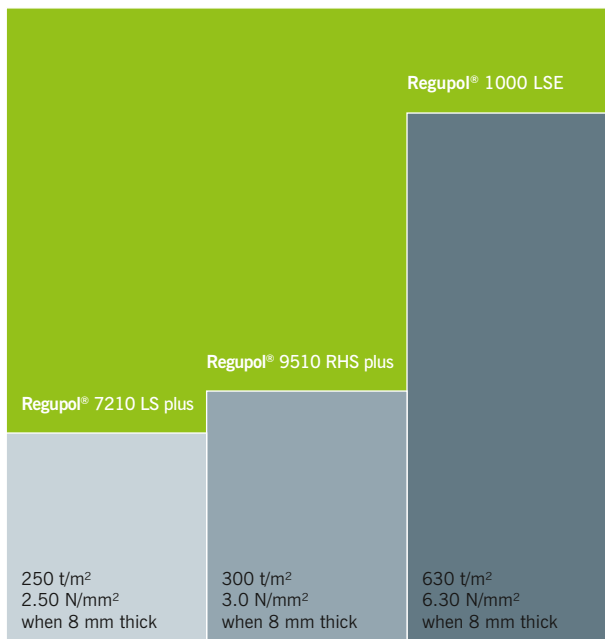The underside of the **Regupol® Webbing Protector**s consists of robust, anti-slip **Regupol®** material.

Regupol® Webbing Protectors can be fitted in just a few moves.

Regupol
(Australia) Pty. Ltd.

Maximum loading

The choice of suitable anti-slip mat depends on the expected maximum loading. This diagram gives an overview of the maximum loading for the three **Regupol®** Anti-Slip Mats.

Regupol® 1000 LSE

Regupol® 9510 RHS plus

Regupol® 7210 LS plus

250 t/m²
2.50 N/mm²
when 8 mm thick

300 t/m²
3.0 N/mm²
when 8 mm thick

630 t/m²
6.30 N/mm²
when 8 mm thick

According to VDI 2700, sheet 15, the maximum loading of anti-slip mats is selected so as not to exceed a deformation of 30% of the material thickness.

Regupol® Anti-Slip Mats are tested by:

TÜV NORD

TÜV NORD Group (TÜV - technical inspection agency)

BIA
Berufsgenossenschaftliches Institut für Arbeitsschutz

Institute for Occupational Safety and Health of the German Social Accident Insurance

vdz GmbH
Verpackungstechnisches Dienstleistungszentrum

DB Deutsche Bahn AG

German national railway company

Fraunhofer Institut Materialfluss und Logistik
IML

Fraunhofer Institute for Material Flow and Logistics (IML)

DEKRA

TUL LOG

IfV
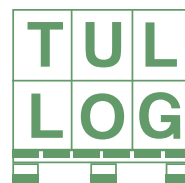
Technical advice is free

Please do not hesitate to contact our customer consultant to find out which mat is best suited for specific modes of transport and specific cargos and loads.

Phone: +61 2 4624 0050

Regupol® easy LaSi Software

Regupol® easy LaSi Software is freely accessible software for calculating loading safety. The new software includes four loading safety methods, for calculating and documenting the result quickly and straightforwardly.

The software is free to use and can be accessed via the website: **www.regupol-easycargosec.eu**

It is not necessary to download the software, the user can enter the data required directly on the interactive website and the result will appear immediately. **Regupol® easy LaSi Software** is currently available in German, English, French, Polish, Czech, Danish, Hungarian and Italian. Further language versions will follow in the future.
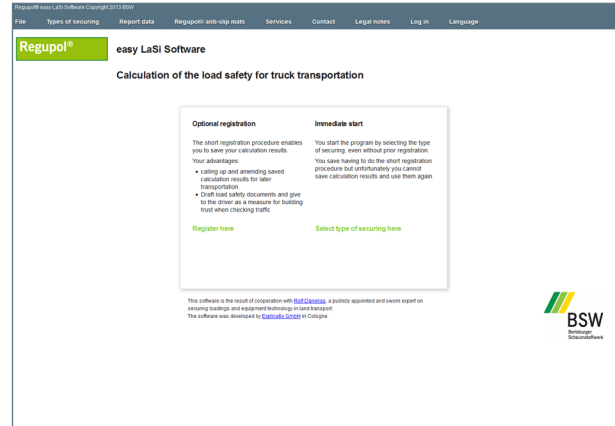
The homepage for **Regupol® easy LaSi Software** is www.regupol-easycargosec.eu There is no need to download the software.

The four loading safety measures

Regupol® easy LaSi Software calculates the following safety measures:

– Lashing down with or without form locking
– Restraint lashings combined with side lashing
– Diagonal lashing
– Transversal lashing
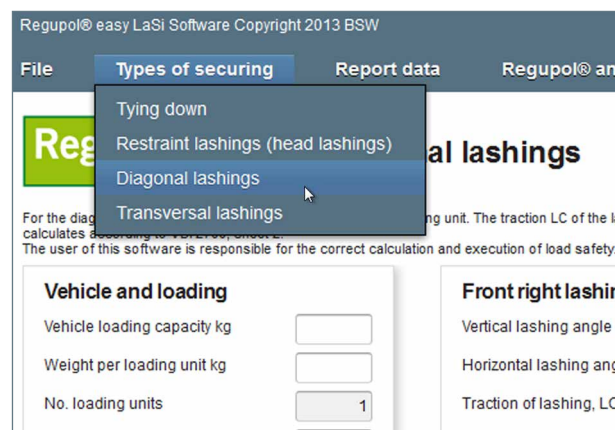
The four loading safety measures in the software.

Calculation results

The software either confirms the correctness of the load safety or formulates warning notes and correctional recommendations for inadequate safety measures. The calculation results can be saved and printed out in the form of a report, which serves as working instructions for those responsible for loading safety, and as a back-up document for traffic checks for the driver.

The individual calculation results can be saved, along with the associated report, and can be called up again and quickly updated or modified for the same or similar transports.

The correctness of the calculated results has been monitored and confirmed by an independent appraiser.
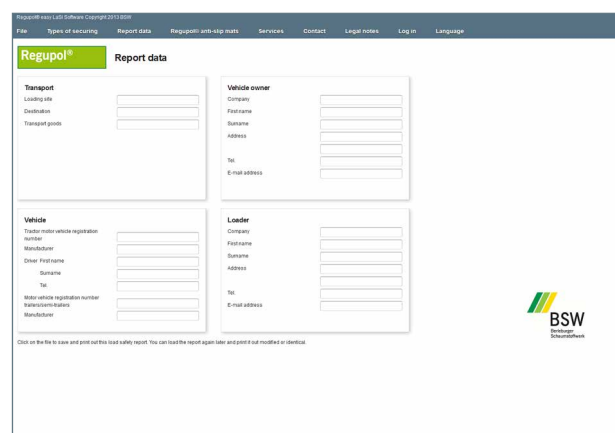

The software report data.

Forces under Various Movements

1.0 G indicates the weight of loads. According to this, forces achieve up to 80% of the stated value due to various movements by means of transportation.

Inasmuch as friction force and securing force are acting together against cargo slippage, **Regupol® Anti-Slip Mats** are furthermore able to increase the friction force. Excellent anti-slip mats ensure at least 60% of load securing. However, tie-downs and similar fixing equipment must not be forgotten.
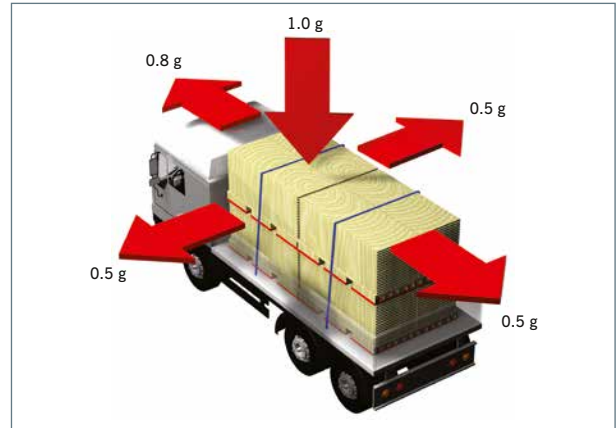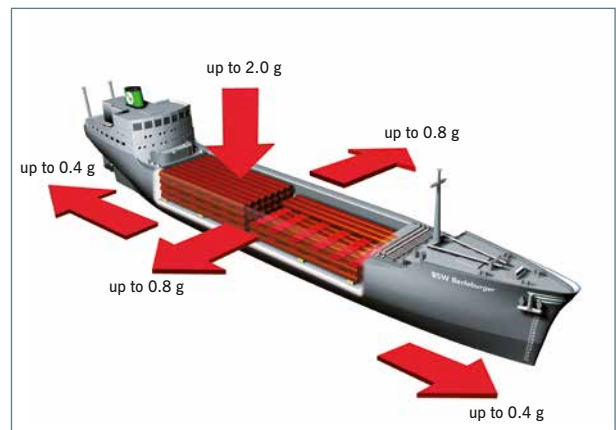

80% of load weight has to be compensated for load securing during driving manoeuvres of trucks.
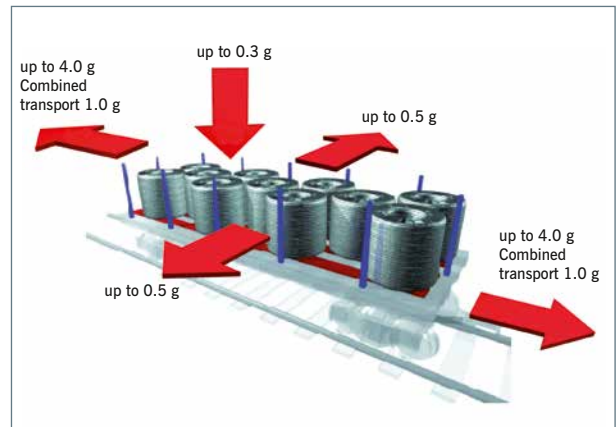
Extreme forces are generated during rail transport: load securing must withstand four times the load weight (Combined transport).

Correct load securing: anti-slip mats are coloured red.

Load securing for cargo ships must withstand 2.2 times the load weight.

Acceleration forces during transport

The dangers resulting from incorrectly secured loads are frequently underestimated. The acceleration forces under normal traffic conditions reach levels approaching the actual weight of the load. The friction force F_F of an anti-slip mat therefore counteracts any displacement of the load and is described in physical terms as follows:

F_F = μ x F_G (friction force)

F_G = weight

μ = sliding friction coefficient

m = mass

g = gravitational acceleration

F_G = m x g

The difference between inertia force F_M and friction force F_F is known as securing force F_R:

F_R = $F_{x,y} - F_F$

The securing force F_R is the force that the securing equipment has to absorb in a forwards direction.

Loads are secured correctly by achieving a balance between the opposing forces occurring during transport.

The loads are adequately secured when the sum of the friction force F_F and the securing force F_R is at least as large as the inertia force F_M.

The friction force is increased by anti-slip mats, the securing force by lashing straps and other equipment.

As the weight acting in a forwards direction when the truck brakes can reach up to 80% of the load weight (0.8 g), the load must be secured accordingly.

Load securing
= friction force + securing force

The load only has to be secured for normal driving, not for a traffic accident. Normal driving also includes emergency braking, drastic avoidance manoeuvres and poor road surfaces.

The following forces can occur in normal driving:

- maximum 0.8 g in the direction of travel, corresponding to 80% of the load weight

- maximum 0.5 g to the sides, corresponding to 50% of the load weight

- maximum 0.5 g to the rear, corresponding to 50% of the load weight

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Example
ascertaining the preload force with and without anti-slip mats

Preload force: $F_T = \dfrac{(c_x - \mu_D)}{\mu_D \cdot \sin_\alpha} \cdot \dfrac{F_G}{K}$

c_x = 0,8

μ_D = 0,2 (without anti-slip mat)

$\sin_\alpha$ = 1

F_G = 10.000 daN

K = 1,5

Preload force: $F_T = \dfrac{(0,8 - 0,2)}{0,2 \cdot 1} \cdot \dfrac{10.000}{1,5}$

F_T = 19.999,98 daN

For a preload force of 500 daN per lashing strap, altogether **40 lashing straps** are needed here without anti-slip mats.

When anti-slip mats are used to increase the sliding friction coefficient to μ 0.6, this **reduces the number of lashing straps to 5**.

Consequences of Securing Cargo Incorrectly

When goods are being transported, acceleration and braking together with lateral centrifugal force or vibration generate forces approaching the actual weight of the load. As a result, the load can slip and cause severe damage to property as well as accidents with casualties.

For example, the load can break through the front wall of a truck and cause severe injury to the driver. Dangers are also involved in unloading loads which have slipped. Frequently the load also falls from the vehicle and causes a hazard to other road users. Incorrectly secured loads are often also damaged themselves. In Germany alone, this results in load damages amounting to several hundred million euros a year. Incorrectly secured loads are estimated to cause approx. 20% of all accidents in heavy goods traffic.
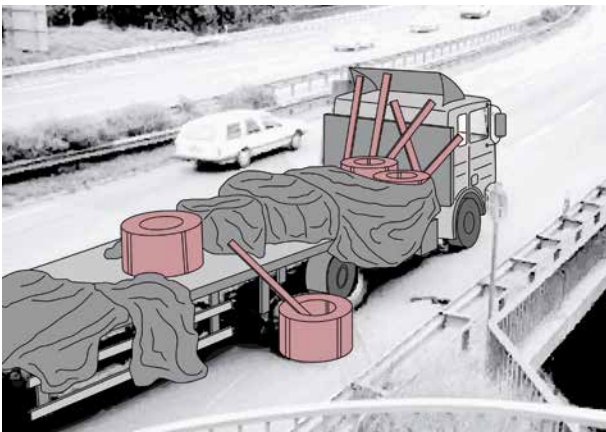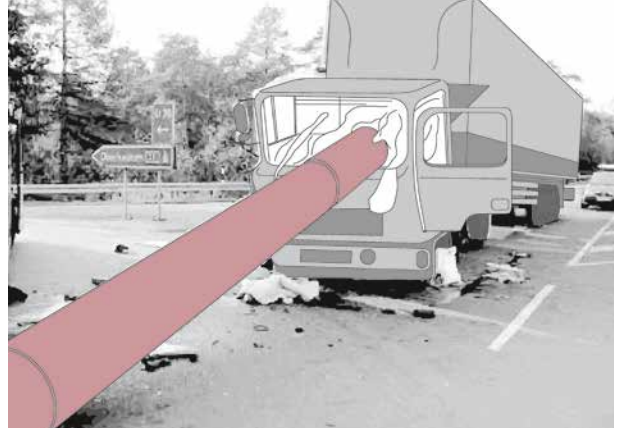
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