03.9

Technical Information

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NOTE: The information in this technical chapter is intended as a guide only. For specific lashing and chemical guidance please contact the SpanSet Australia Ltd Technical Department.

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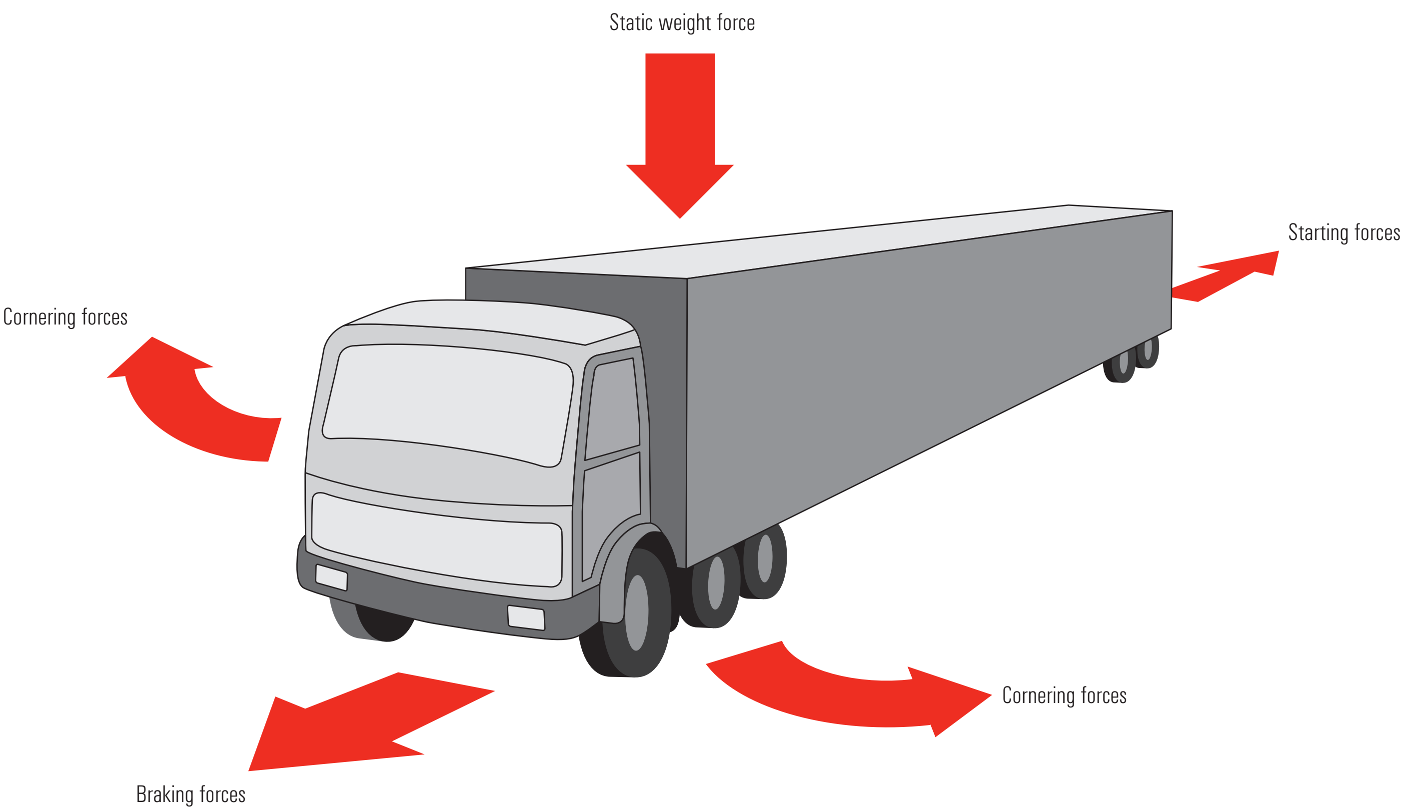
Load Dynamics

These are brought about by changes in speed, direction, braking or road surface conditions. Additionally, cambered and hilly roads as well as airflow can affect the dynamics of the vehicle and its load.

Forces Occurring During Transport Operations



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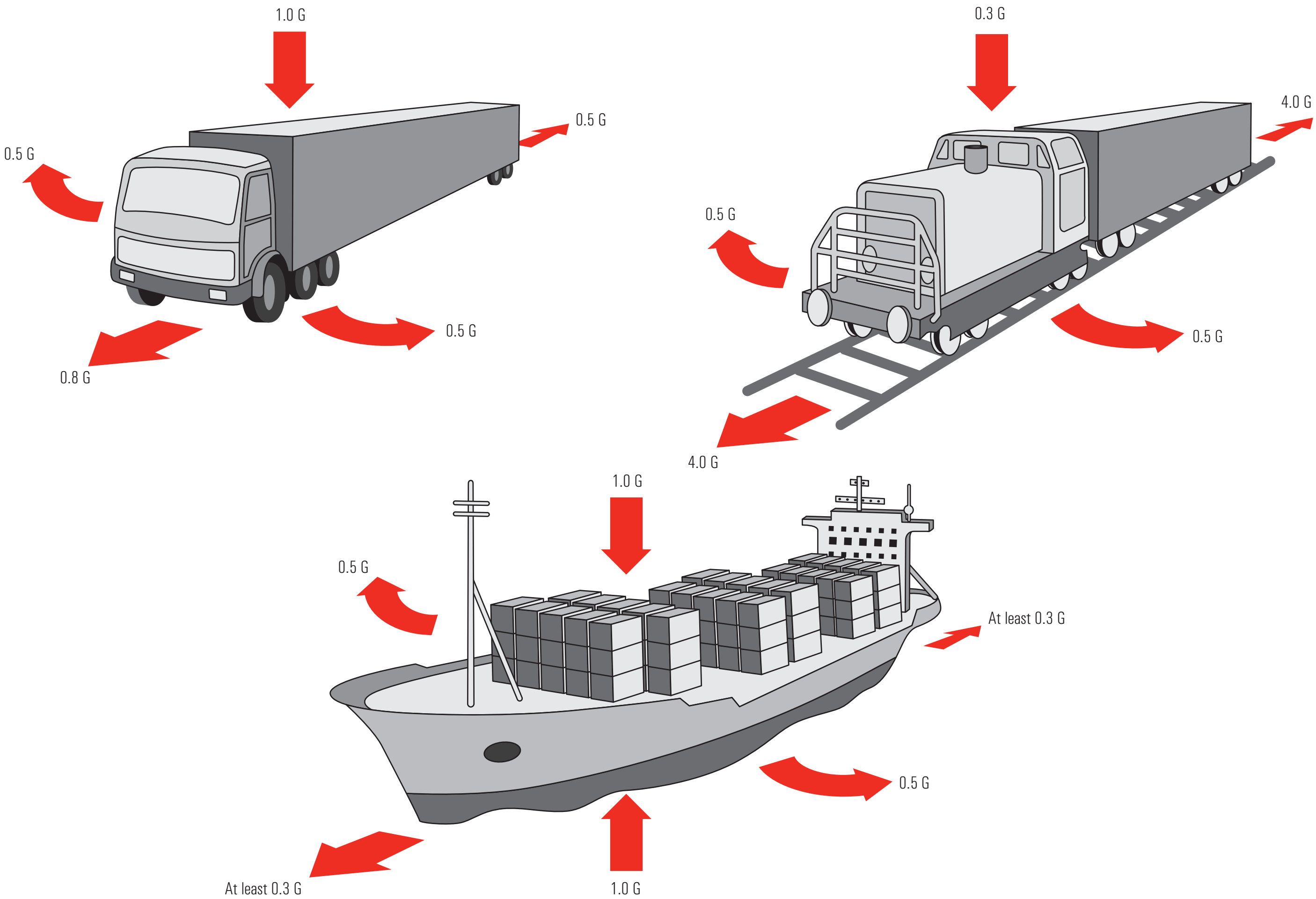
Load Dynamics

Different modes of transport have different effects on the load due to varying dynamics. ie A truck will stop much more abruptly than a ship or a train.

Mass Forces Which Can Have an Effect on the Load in Comparison with the Means of Transport



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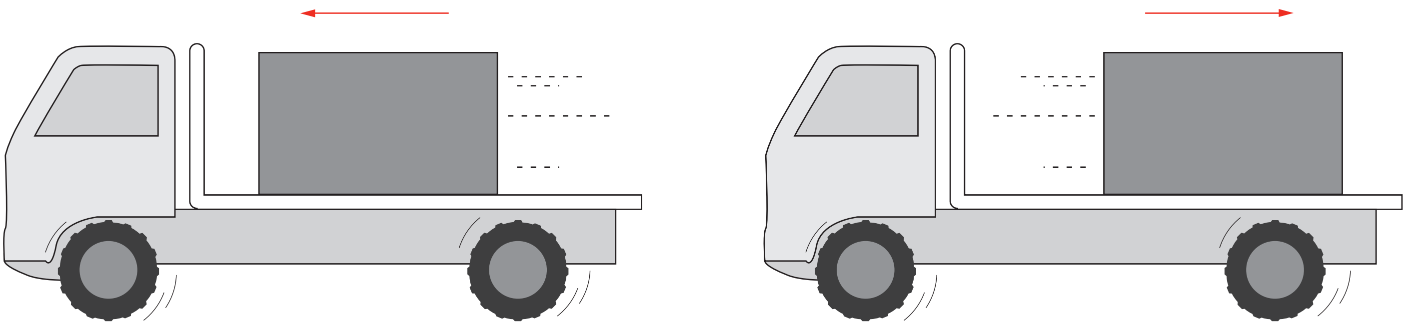
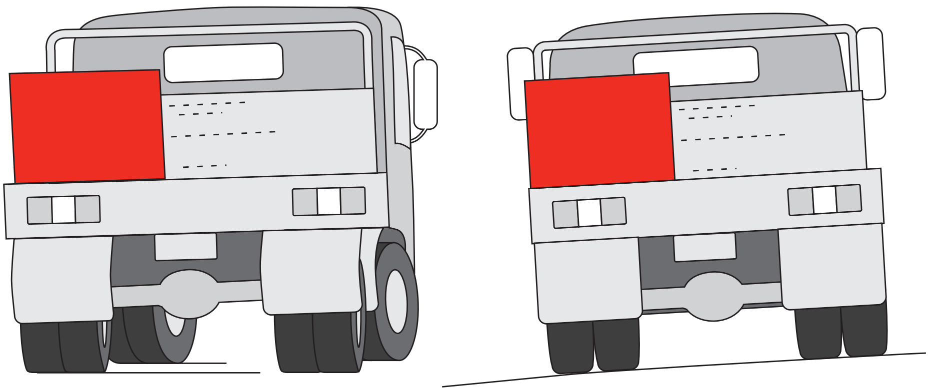
Load Dynamics

When braking or accelerating the load can shift forwards or rearwards.



When cornering, the load can shift sideways with increasing force as the speed increases and the corner gets tighter.

Cambered roads can also have an effect on the load stability.



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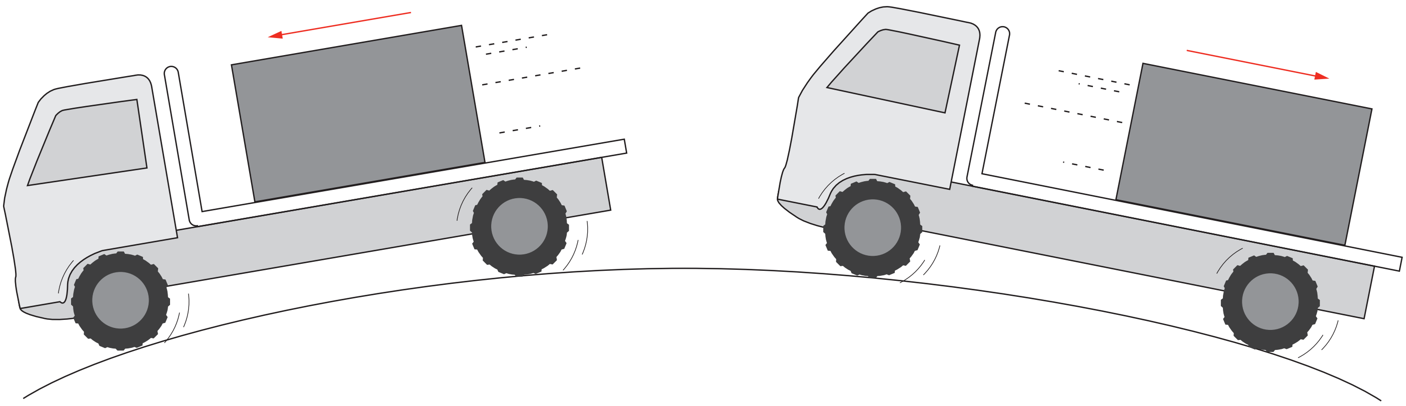
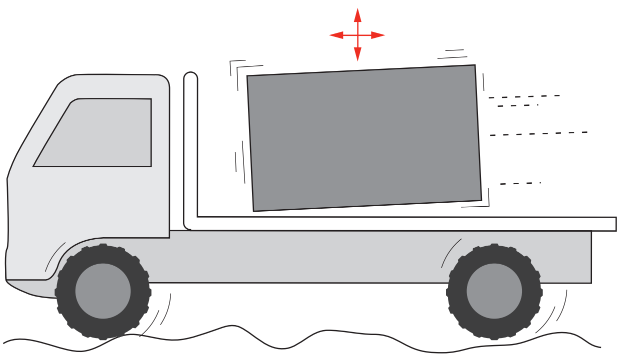
Load Dynamics

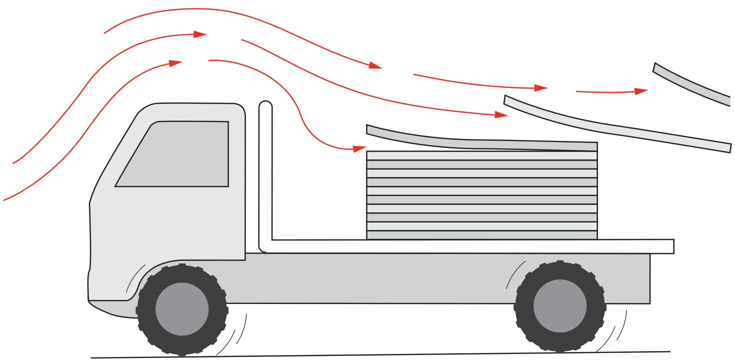
Travelling up and down hilly or undulating terrain can cause the load to move forwards or rearwards.



Rough road surfaces can have a vibratory effect causing loads to settle and bounce.



Wind forces at high speeds can have an adverse effect on loads, especially light components with large surface areas.



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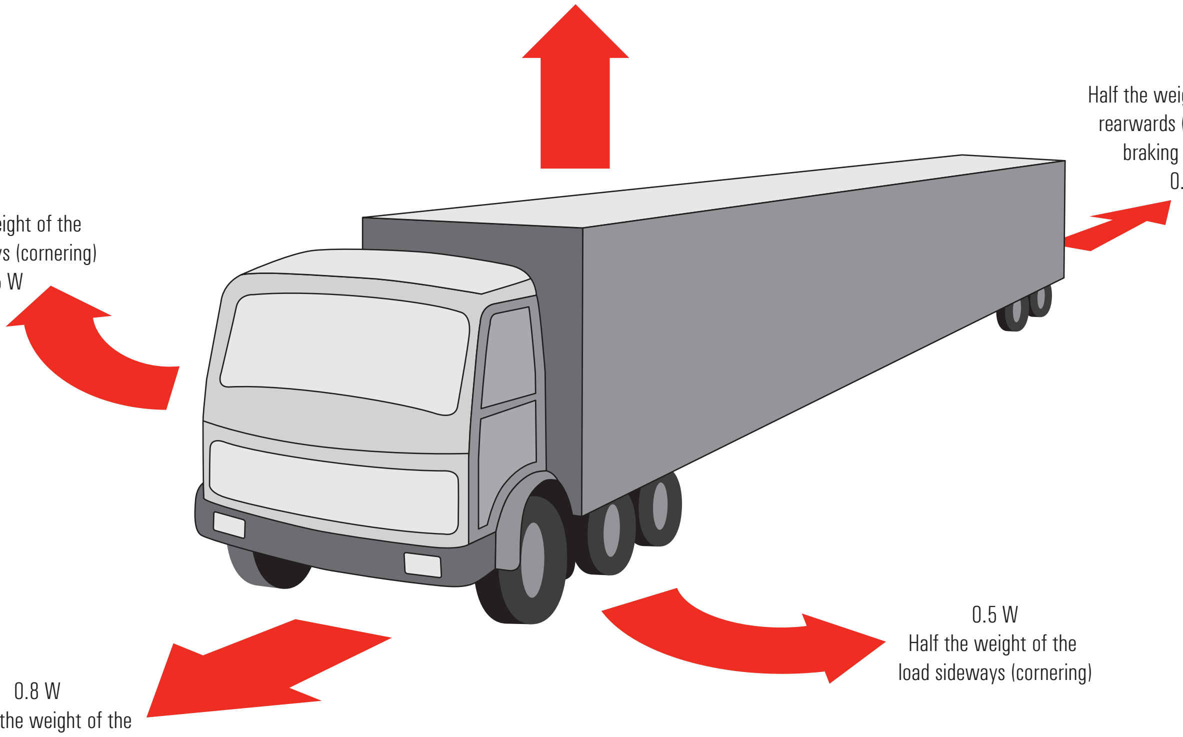
Load Dynamics

The forward restraint will prevent the load shifting on heavy vehicles and the majority of light vehicles in emergency braking situations. Sideways restraint is to avoid the load shifting during cornering or evasive actions and destabilising the heavy vehicle.

Australian Load Restraint Requirements



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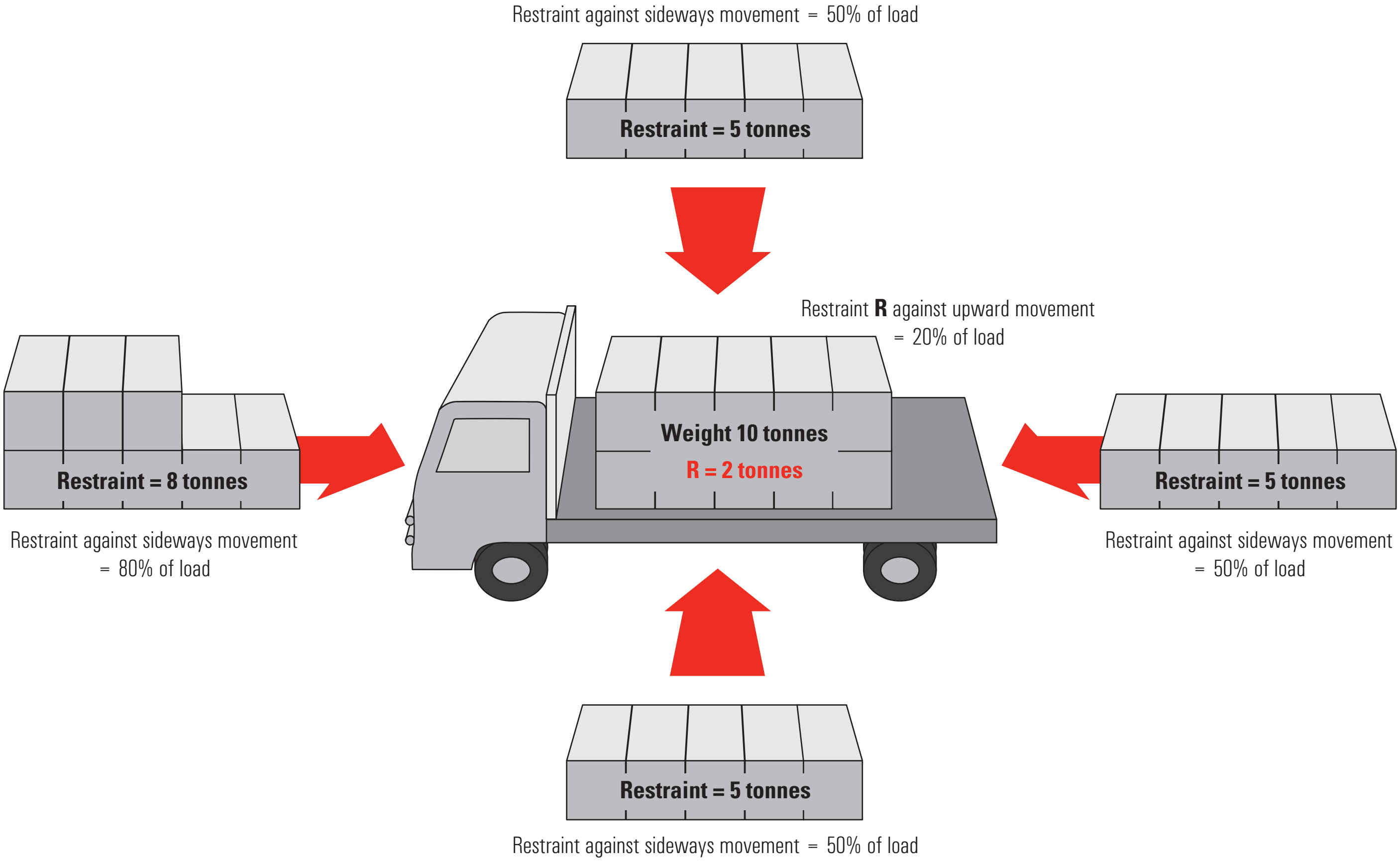
Load Dynamics

To ensure there is always friction between the load and the deck, a force of 20% of the load must be applied downward by the tensioning of the lashings.

Australian Load Restraint Requirements



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Methods of Load Restraint – Tie Down

The most common form of restraint is tie down lashing which prevents the load from moving by increasing the friction between the load and the vehicle.

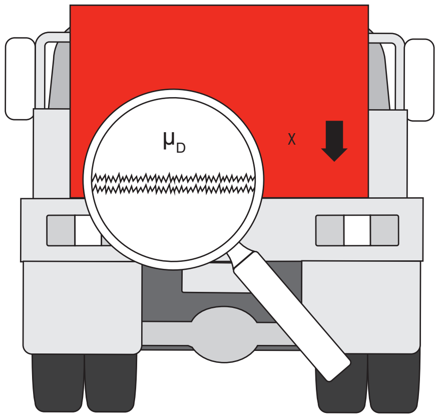
These lashings work like a giant G clamp and also prevent the load from moving upwards. The total friction is achieved by both the weight of the load and the downward force of the tie downs.

Varying surface conditions can give a different friction performance, ie A "grippy" surface gives a high friction coefficient while a slippery surface gives a low friction coefficient.

If the load is standing on the load floor, a "micro-interlocking" between the surface of the load floor and the surface of the load occurs, which will be stronger, the rougher the surface is.

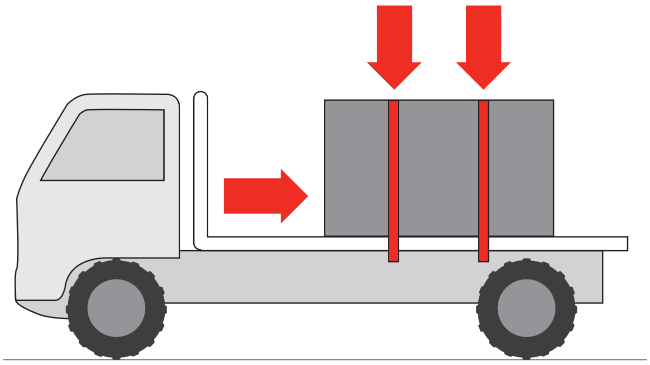
This micro-interlocking characterises the coefficient of kinetic friction

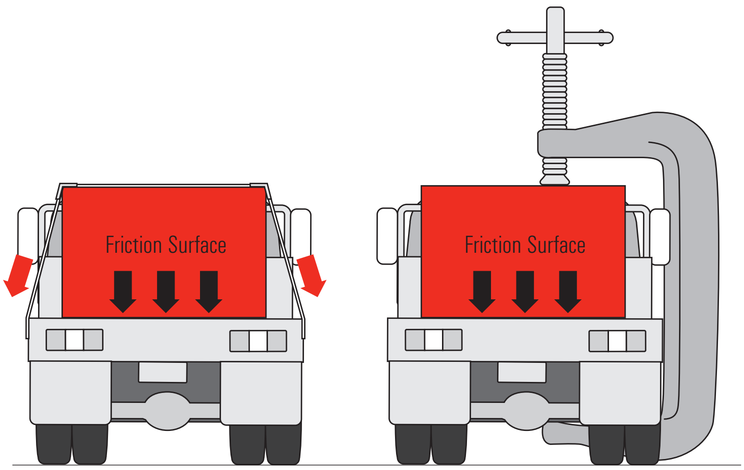
Coefficient of friction x Weight force

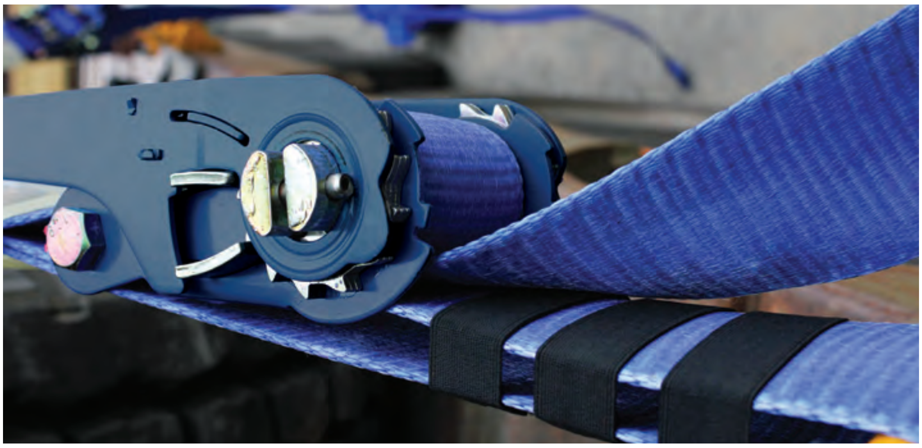


Tie Down Load Restraint

Tie down
Friction
Weight of load + Tie down lashings







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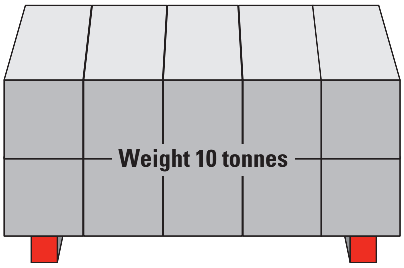
Methods of Load Restraint – Tie Down

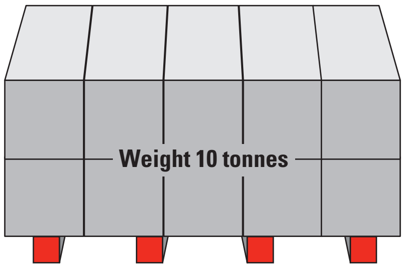
If the load does not shift, it is not the strength of the lashing that determines the holding ability of a tie-down lashing. It is determined by the amount of tension in the lashing from initially operating the ratchet, winch or dog, in conjunction with the amount of friction present. Tie-downs should not be used on slippery loads because too many lashings are needed

Friction cannot be increased by additional surface area. Adding extra timber dunnage as at right achieves exactly the same result.

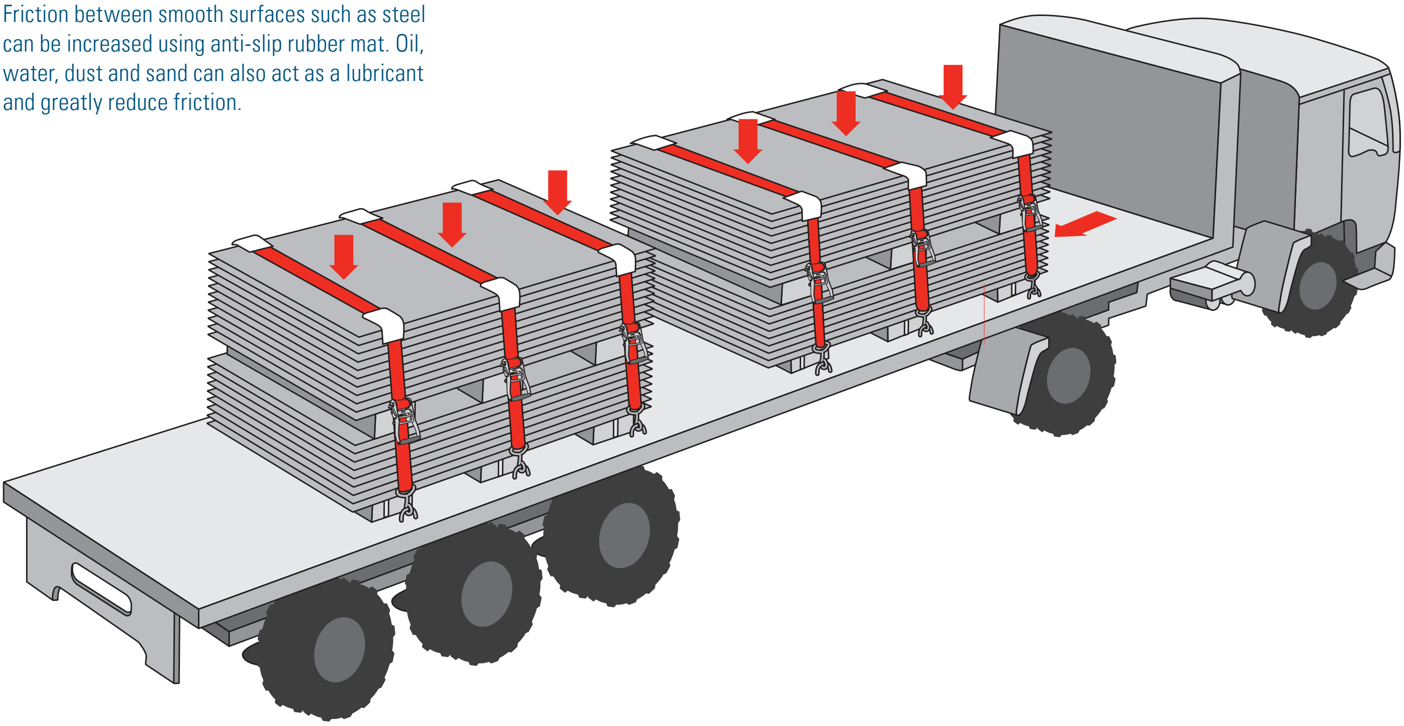
Friction between smooth surfaces such as steel can be increased using anti-slip rubber mat. Oil, water, dust and sand can also act as a lubricant and greatly reduce friction.



Friction = 4 tonnes



Friction = 4 tonnes



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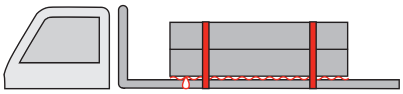
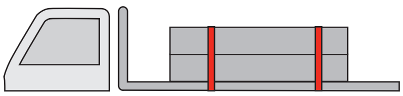
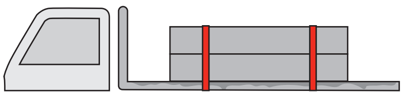
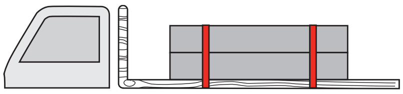
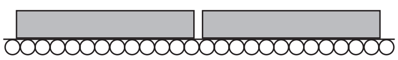
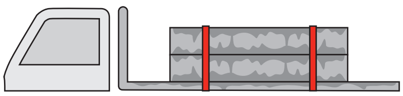
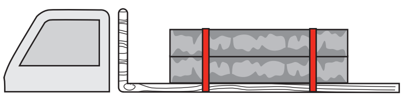
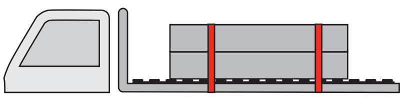
Basic Material Guidelines

	Load	Friction	Typical Friction Coefficient
	Wet or greasy steel on steel	VERY LOW	0.01-0.1
	Smooth steel on smooth steel	LOW	0.1-0.2
	Smooth steel on rusty steel	LOW TO MEDIUM	0.2-0.4
	Smooth steel on timber	MEDIUM	0.3-0.4
	Smooth steel on conveyor belt	MEDIUM	0.3-0.4
	Rusty steel on rusty steel	MEDIUM TO HIGH	0.4-0.7
	Rusty steel on timber	HIGH	0.6-0.7
	Smooth steel on rubber load mat	HIGH	0.6-0.7

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Maintaining Friction

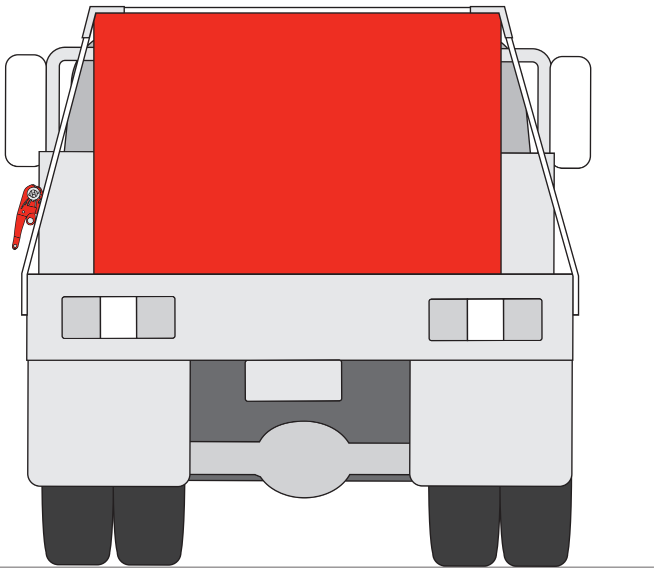
In order to maintain friction force during normal driving, the load must always be in contact with the vehicle with the correct downward lashing force, therefore the tie down lashings must always be tensioned correctly.

The maximum lashing tension is applied to the side of the load where the tensioner is located. The tension on the opposite side can be 50% less due to the snagging and friction of the strap passing over the load.

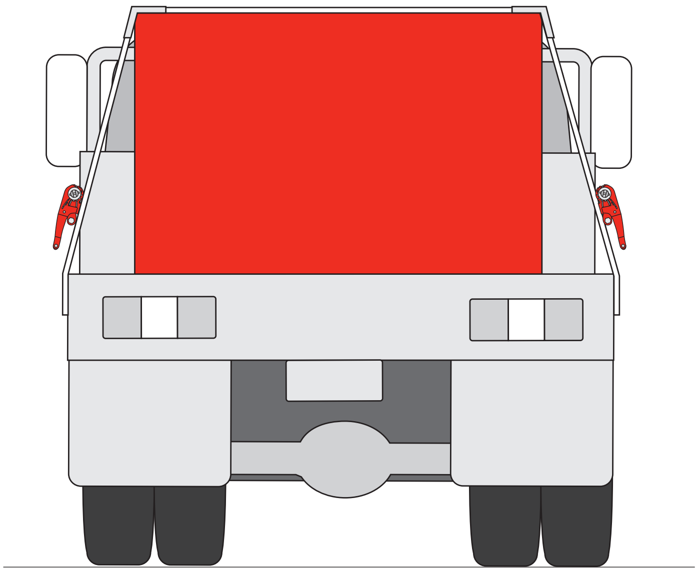
Smooth, rounded corner protectors can minimize this reduction as can specialized sleeves with low internal friction such as Spanset sliP. Alternatively, two tensioners can be used on each lashing.

Note: For calculation purposes the pretension is multiplied 1.5 times on single lashings and 2 times on double sided lashings.

1.5 x Pretension



2 x Pretension



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Pretension

Lashing Type	Size	Tensioner	Pretension
Rope	10mm	Single hitch	50kg
	12mm	Double hitch	100kg
Webbing Strap	25mm	Hand ratchet	100kg
	35mm	Hand ratchet	250kg
	50mm	Truck winch	300kg
	50mm	Hand ratchet (push up)	300kg
	50mm 20020	Hand Ratchet (push up)	600kg
	50mm 20035 ERGO	Ratchet (pull down)	750kg
Chain	7mm and over	Dog	750kg
		Turnbuckle	1000kg
Web Dog	8mm	Hand ratchet (pull down)	1500kg

Note: Values are multiplied by 1.5 for LC calculations as pretension is applied to 2 sides of the load, minus the friction derating caused by the edges of the load. If using tensioners on both sides or SpanSet SliP sleeves multiply by 2.0.

Example

10,000kg load, smooth steel on timber, friction coefficient (μ) 0.4 = 10,000 kg x 0.4 = 4,000 kg of friction force

Forward restraint requirement (0.8) 8,000kg minus 4,000kg friction force from weight of load leaves 4,000kg clamping force required

Standard 50mm ratchet pretension
300kg x 1.5 = 450kg (9 required)

20020 ratchet pretension
500 x 1.5 = 750kg (6 required)

20035 ratchet pretension
750 x 1.5 = 1120kg (4 required)

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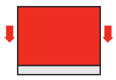
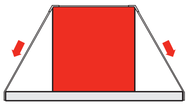
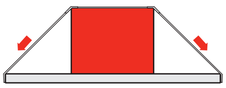
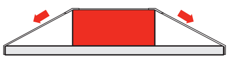
Tie Down Angle Effect

	Approximate angle degree	Tie down angle effect	Tie down effectiveness
	60	0.85	85%
	45	0.70	70%
	90	1.00	100%
	30	0.50	50%
	15	0.25	25%

A tie down is not 100% effective unless it is vertical or at 90˚ to the deck. If the angle is less than 90° (most loads!) its effectiveness is reduced and this must be reflected in the load restraint calculations.

Tie downs are most efficient if they are vertical and tensioned correctly.

The less the angle, or closer to horizontal, the less clamping force is applied to the load which means more lashings are required to achieve the required force.

Example

If a ratchet/strap combination is tensioned to 750kg but only at an angle of 15° then it is only applying a clamping force of 187.5kg or 25% on one side of the load. Therefore it would take 4 straps to apply the full 750kg of force. Hence the term “angle effect”.

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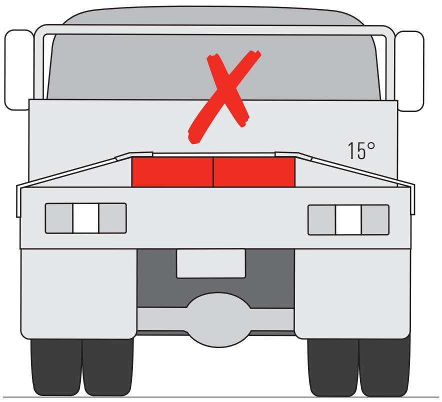
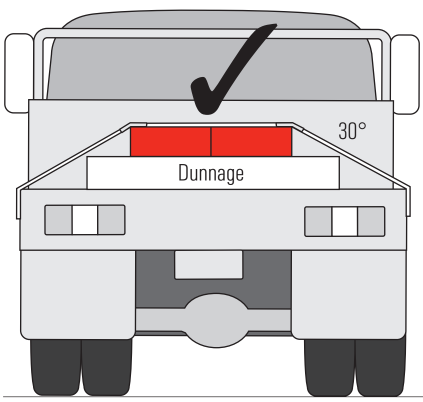
Dunnage (Packing)

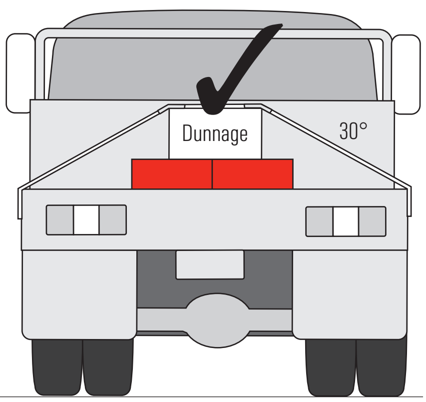
Many loads are too low for tie-down lashings to be fully effective.



Low tie down angle (not recommended)

Dunnage (packing) can be used to lift the load height and increase the effective angle.





For easy tie down calculations refer to our Lashing Controller App for Apple and Android.

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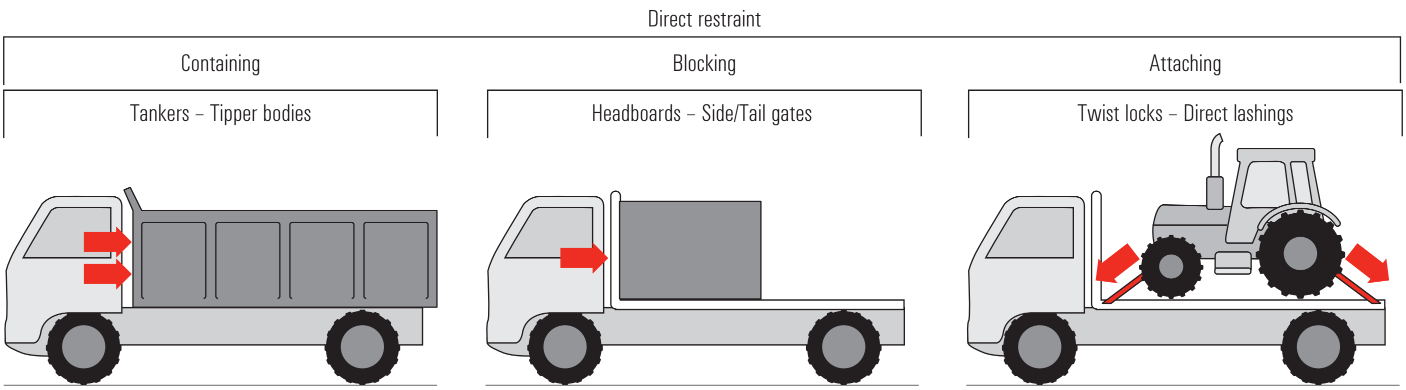
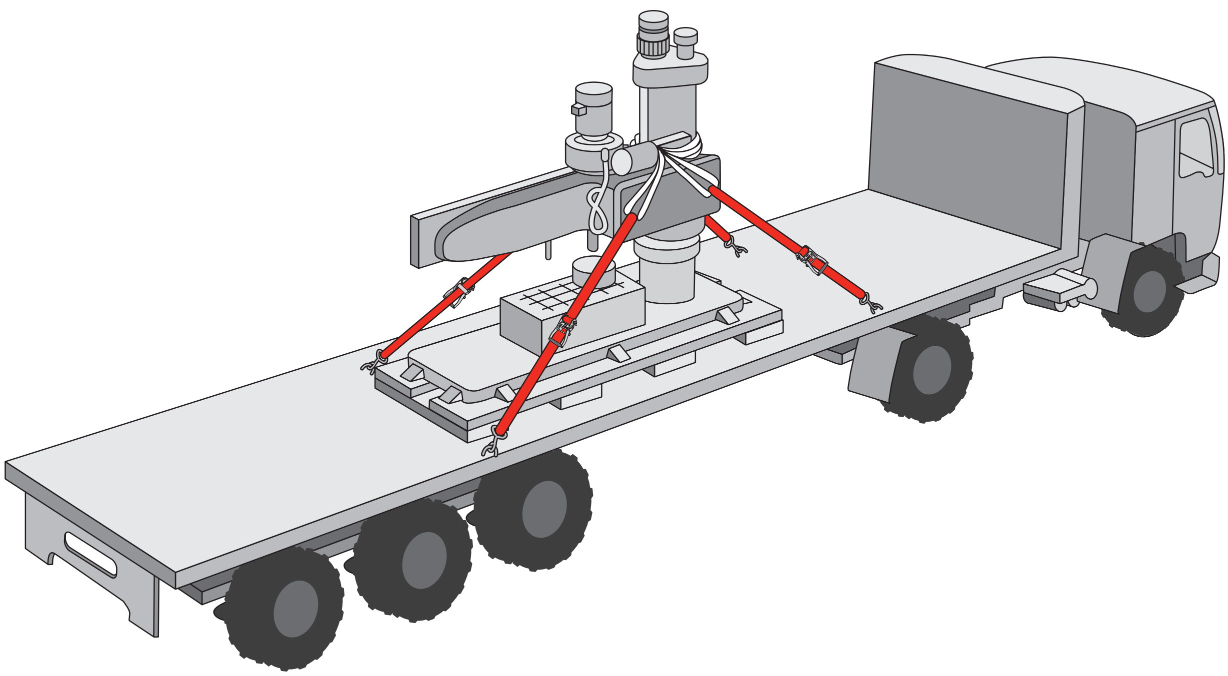
Direct Load Restraint





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Direct Lashing Angles

Direct lashing relies on the strength of the assembly to restrain the load, as opposed to friction to clamp the load.

The lashing is at its most efficient in a straight line but needs to be de-rated when angles are introduced (most loads).

To determine the effectiveness of a lashing in relation to its applied angles, use the following calculations.

For Lashing L1

Angle effect (E1) Forwards = Distance (F1) ÷ Length of lashing (L1)
= % of lashing assembly capacity.

Angle effect (E1) Sideways = Distance (S1) ÷ Length of Lashing (L1).

Example of 2500kg Assembly

Angle effect (E1) Forwards
= Distance (1.0) ÷ Length of Lashing (1.5)
= .666% of lashing assembly capacity
ie Each 2500kg assembly is reduced to 1665kg LC

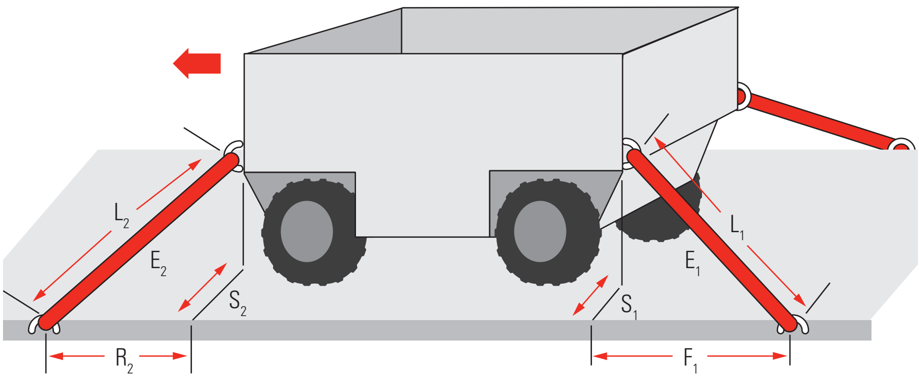
Angle effect (E1) Sideways
= Distance (0.5) ÷ Length of lashing (1.5)
= .333% of lashing assembly capacity
ie Each 2500kg assembly is reduced to 825kg LC

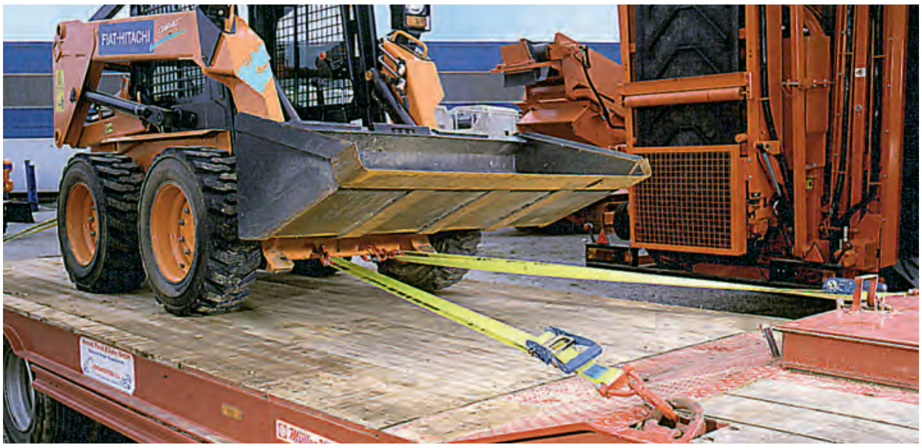
For Lashing L2

Angle effect (E2) Rearwards = Distance (R2) ÷ Length of Lashing (L2)

Angle effect (E2) Forwards = Distance (S2) ÷ Length of Lashing (L2)

For easy direct lashing calculations refer to our Lashing Controller App for Apple and Android





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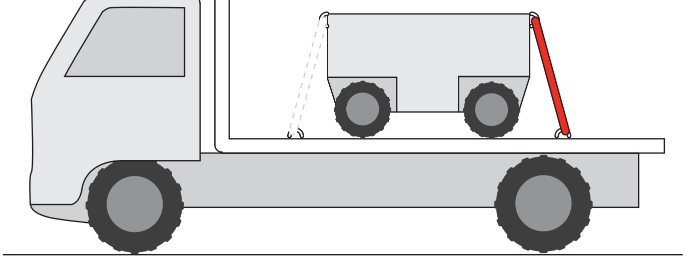
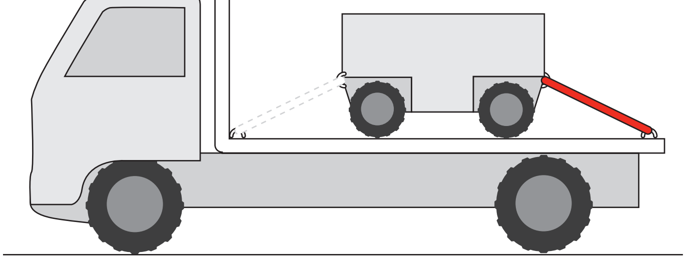
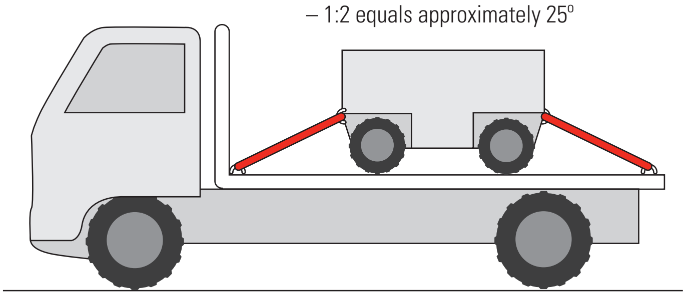
Direct Lashing Angles







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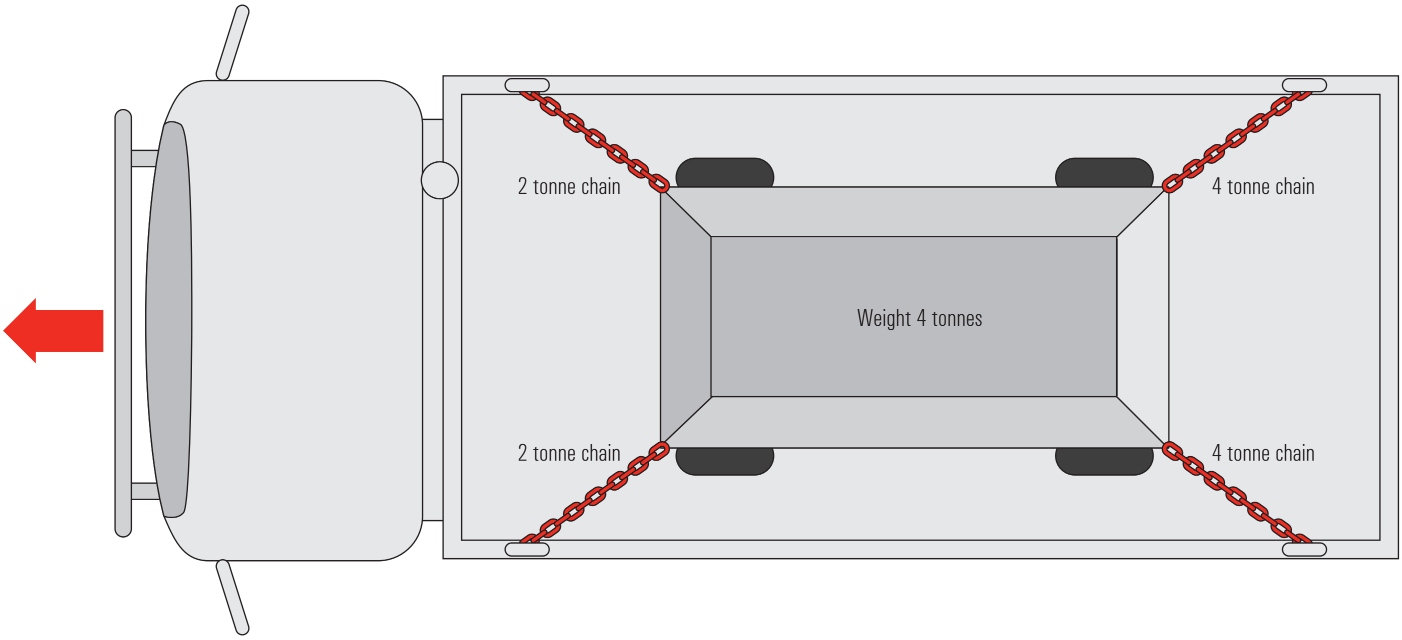
Selecting Lashing Combinations

A simple rule is to select lashings whose combined lashing capacity is:

- In the forwards direction - twice the weight of the load
- In the sideways direction - the weights of the load
- In the rearward direction - the weight of the load.



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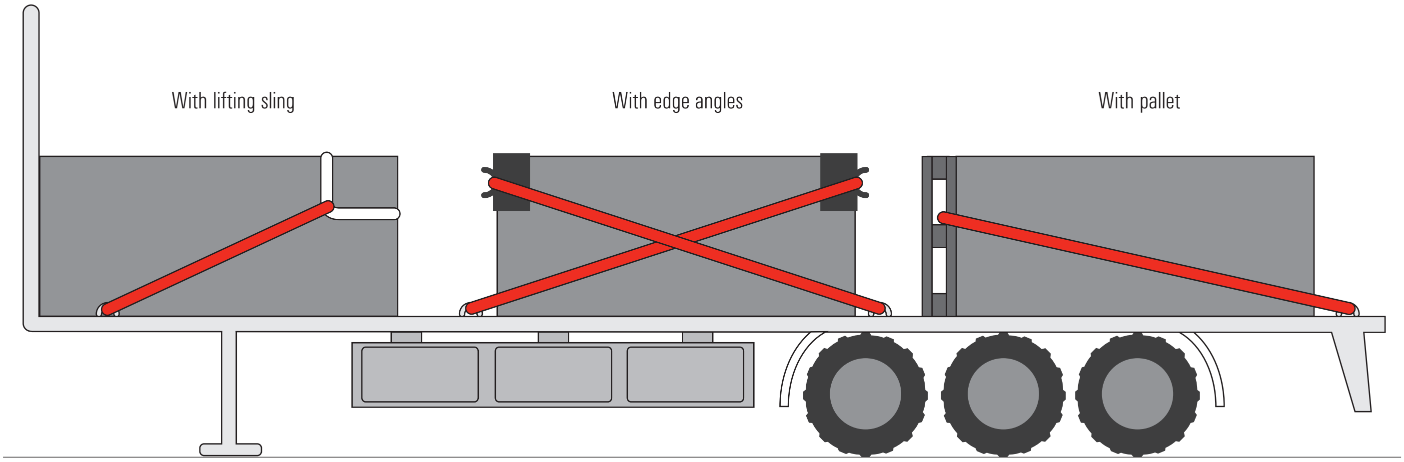
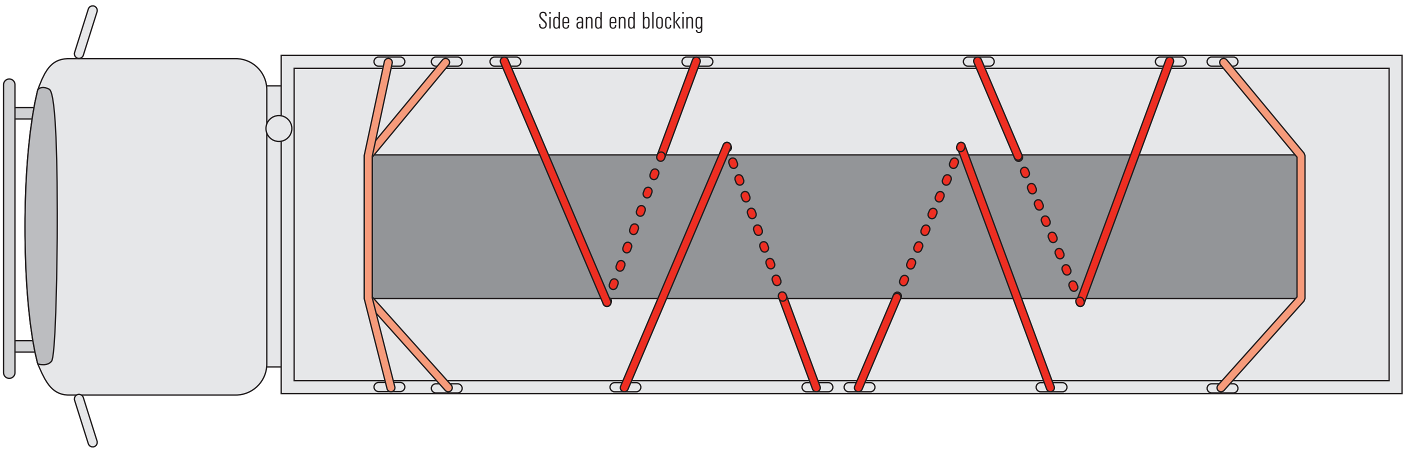
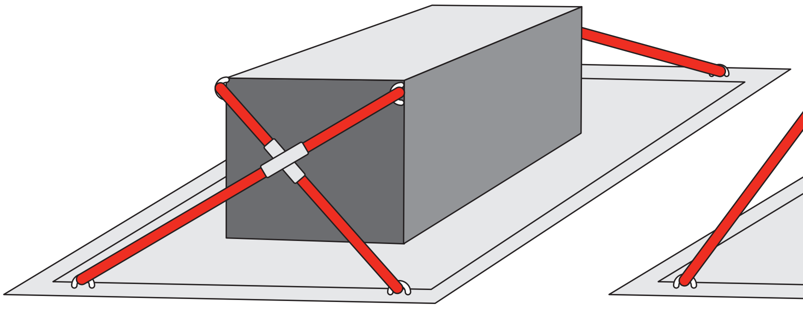
Direct Lashing Examples



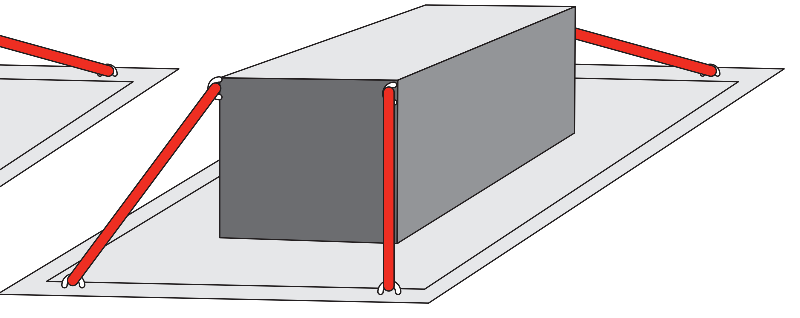


Direct Lashing Examples

Possibility 1



Possibility 2



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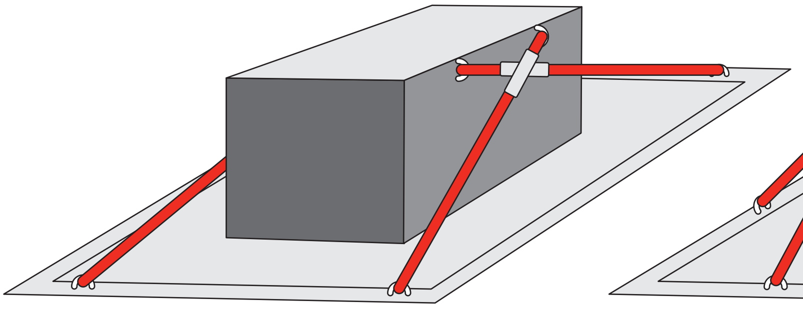
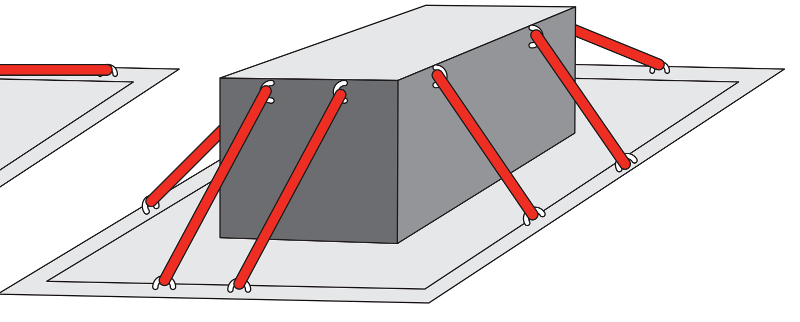


Possibility 4



Note: Where straps cross each other, ensure abrasion protection is in place.

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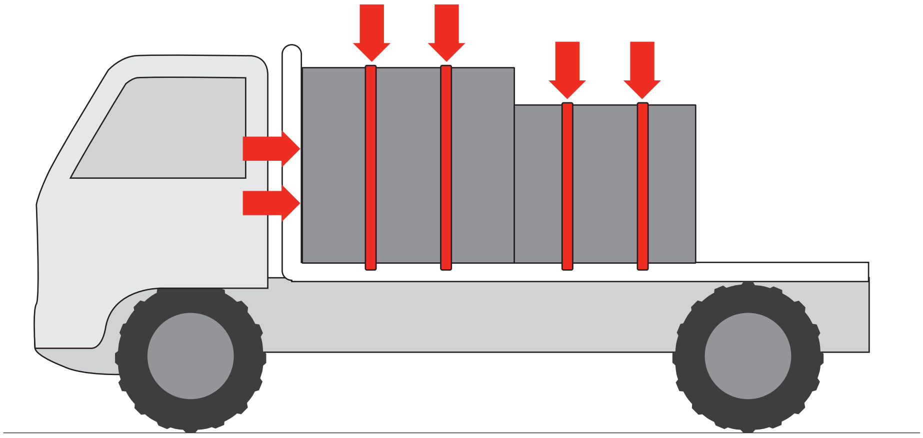

Combined Tie Down and Direct Restraint

Combined tie-down and direct restraint uses both friction and direct restraint. Figure illustrates load restraint provided by:

- Friction force from the weight of the load; and
- Friction force from tie-down lashings; and
- Blocking (the front part of the load is blocked by the headboard and the rear part of the load is then blocked by the front part).

The load is prevented from moving forwards by a combination of friction force from the weight of the load and the lashing tension, and also blocking against the headboard.

The load is prevented from moving rearwards and sideways only by friction. The load is prevented from moving upwards by the lashings.

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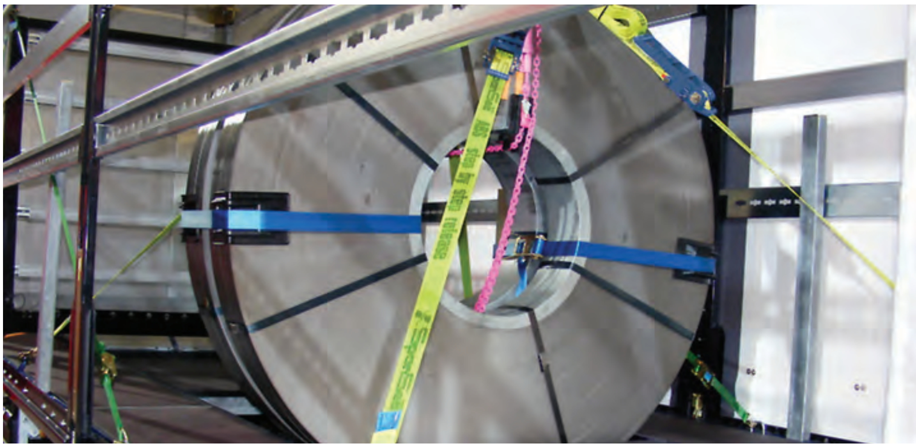
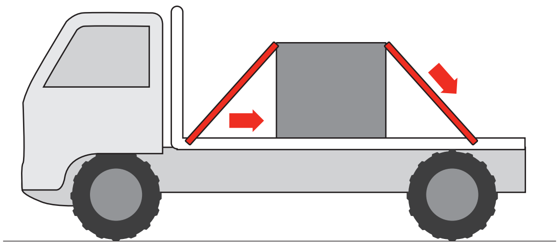
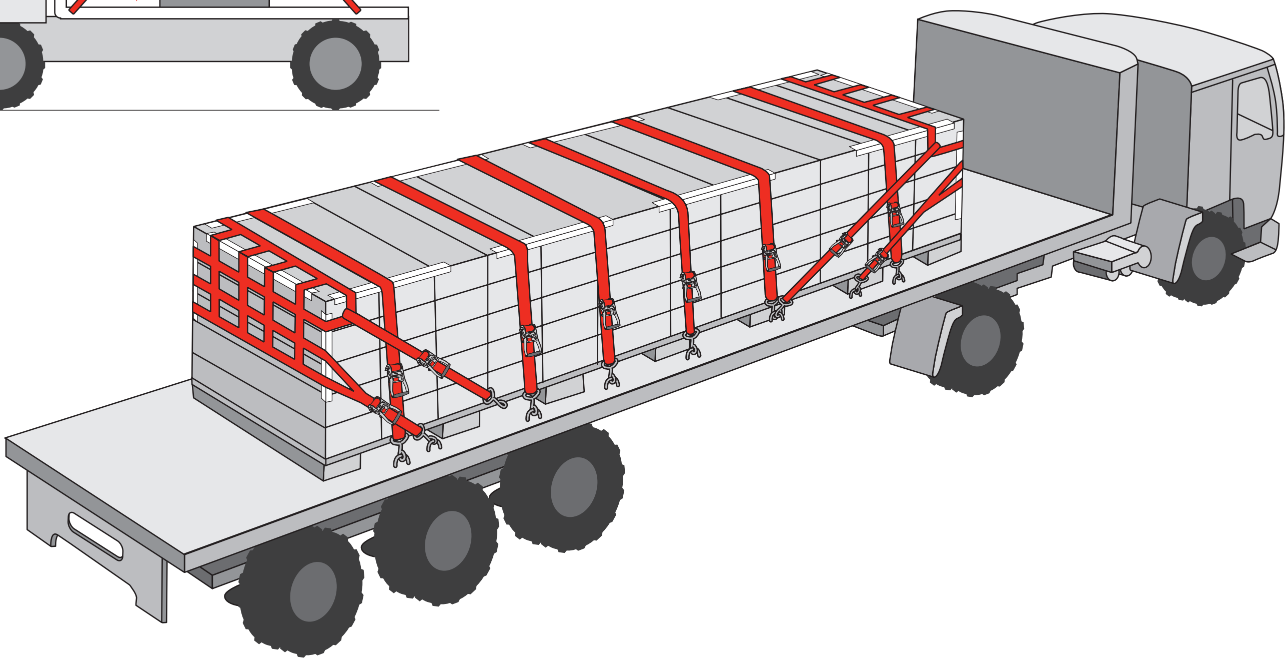


Friction and Direct Restraint

Figure illustrates load restraint provided by:

- Friction force from the weight of the load, plus
- Friction force from the downward force from the lashings, plus
- Direct restraint from lashings that are attached to the load.





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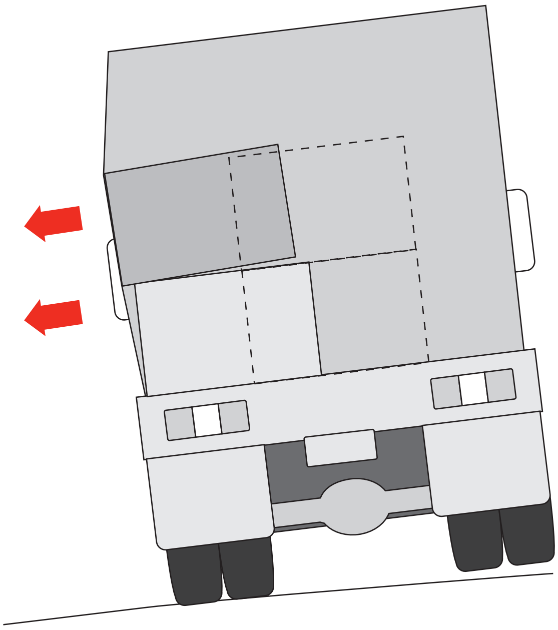
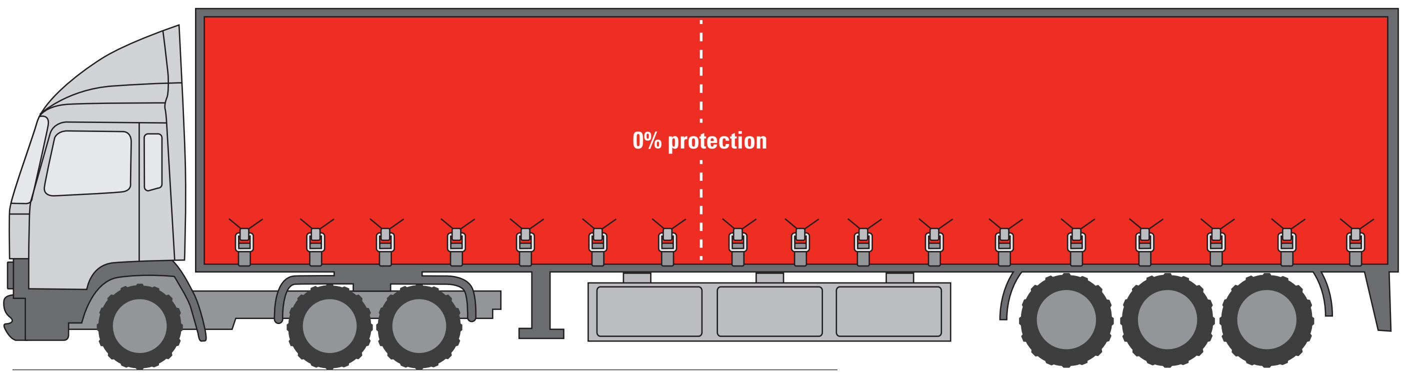
Curtain Sided Vehicles



Curtain sides are used primarily for protection from the elements and are a safer alternative to tarpaulins.

These curtains are not considered primary load restraints. Despite many of the fastening straps being rated, they do not prevent the internal load from shifting and destabilising the vehicle and potentially leading to an accident.



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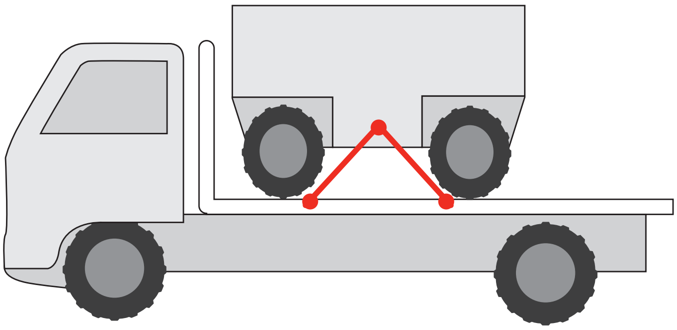
Rubber Tyre Bounce

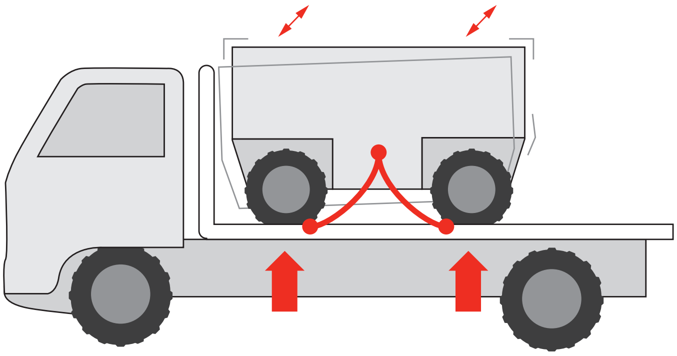
During braking, pneumatic rubber tyred equipment can pull down and compress the tyres causing the load to bounce repeatedly, leading to wear in chains and lashing points.

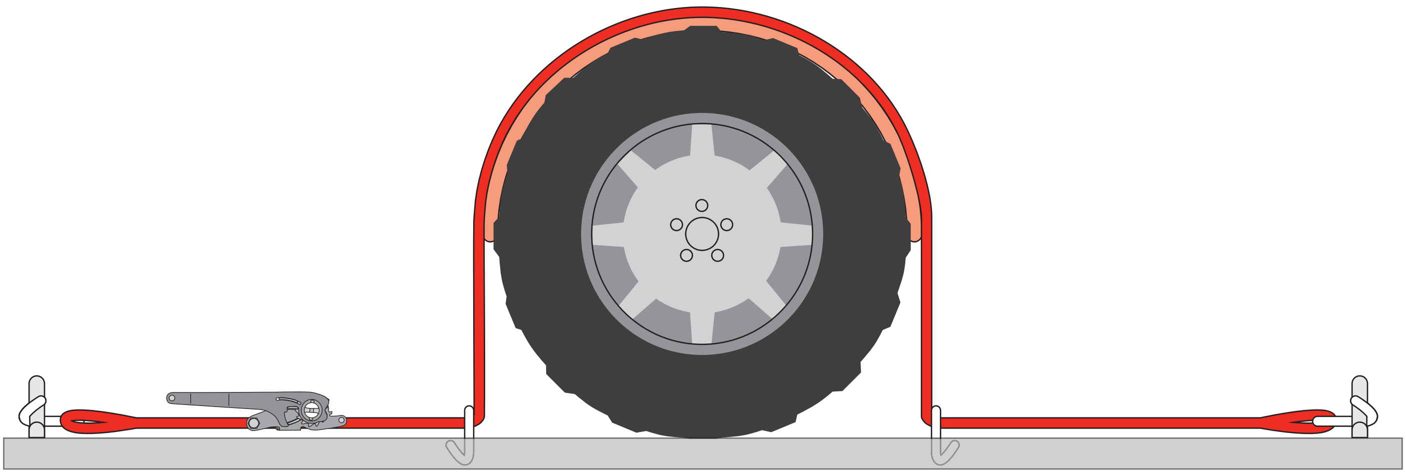
In extreme circumstances the chains can become slack in the compression process and the grab hook can release from the chain especially on rough roads.

Direct lashings should be angled at no more than 25° to the horizontal or use and over the tyre, in line lashing.

Over tyre lashings eliminate these issues.







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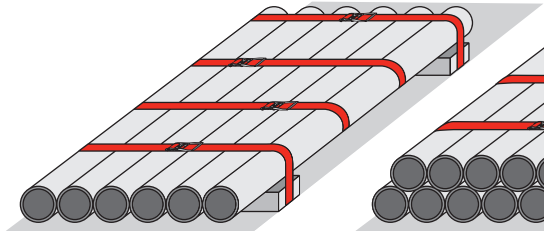
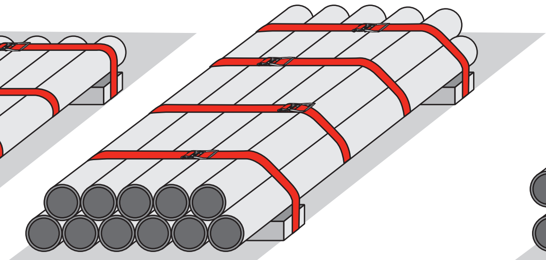
Pipe Transport

Bundling or unitising is an effective way of preventing pipes, bars and billets from rolling. This can be done by belly strapping or belly wrapping the lashings around the products.

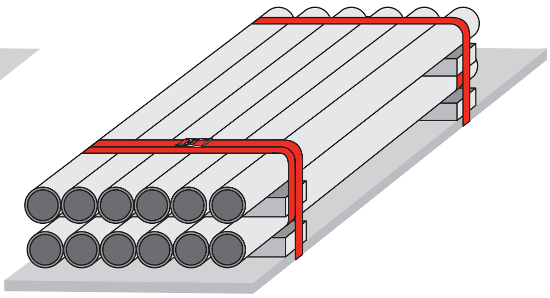
This is not suitable for slippery, soft or crushable products.



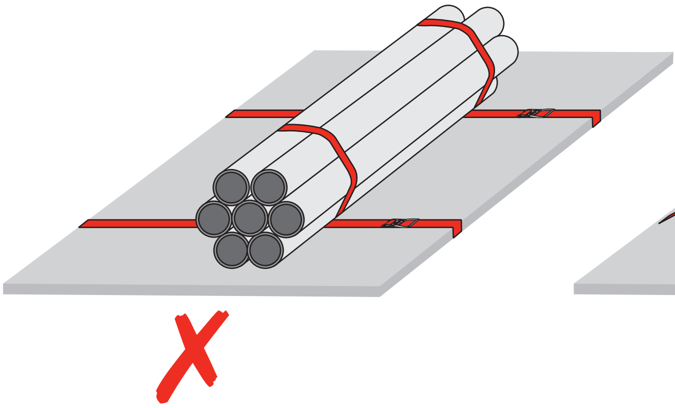
Belly strap

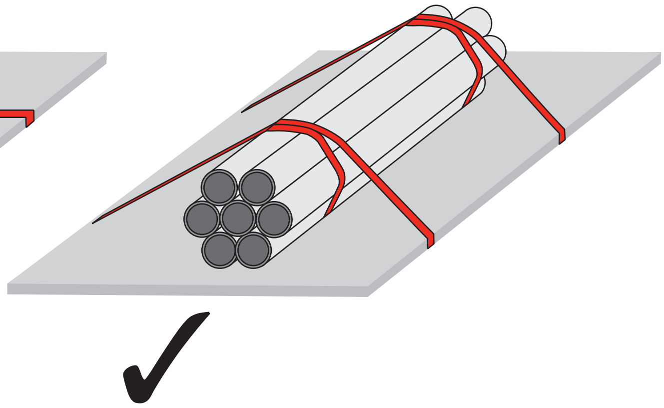


Belly strap



Belly wrap





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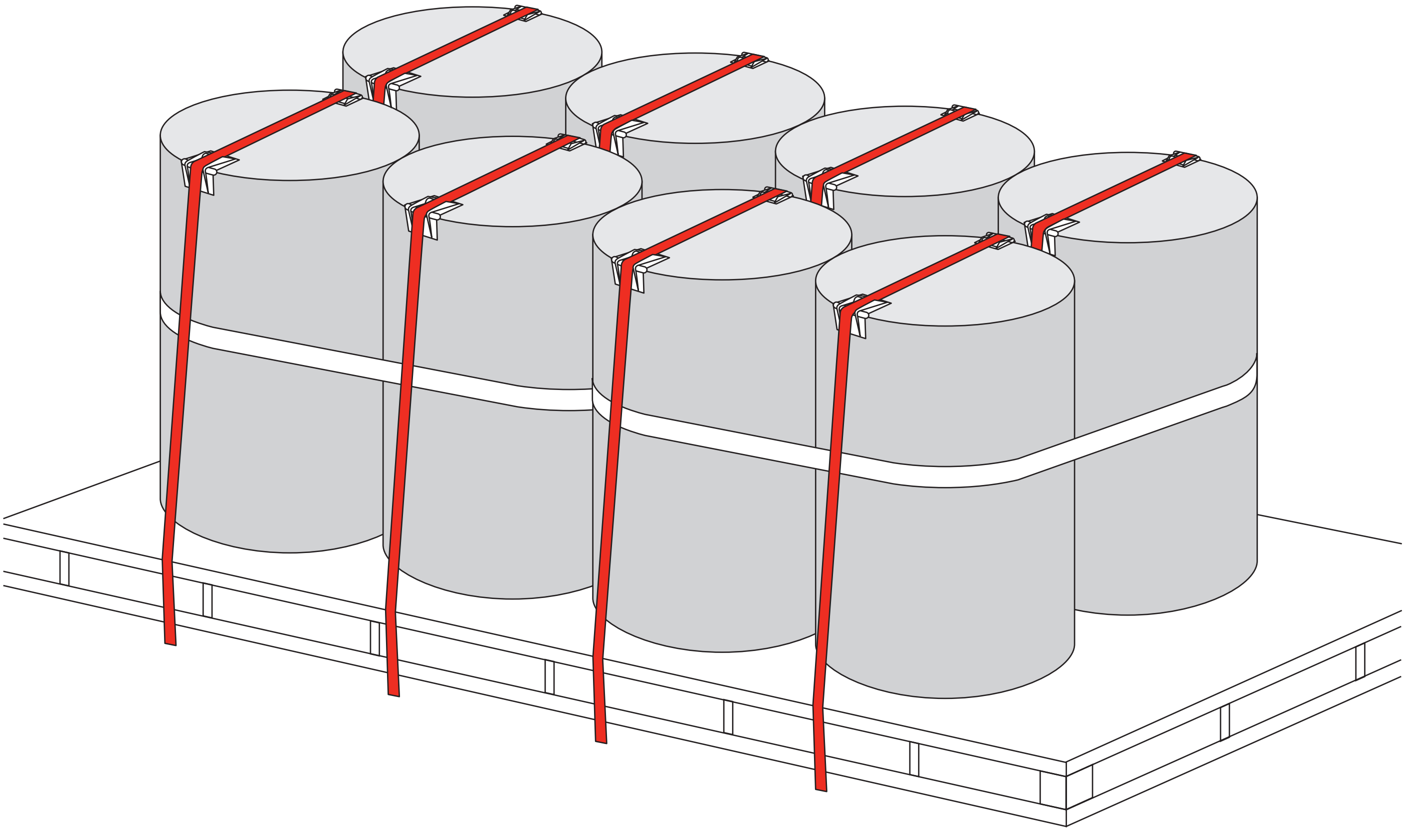
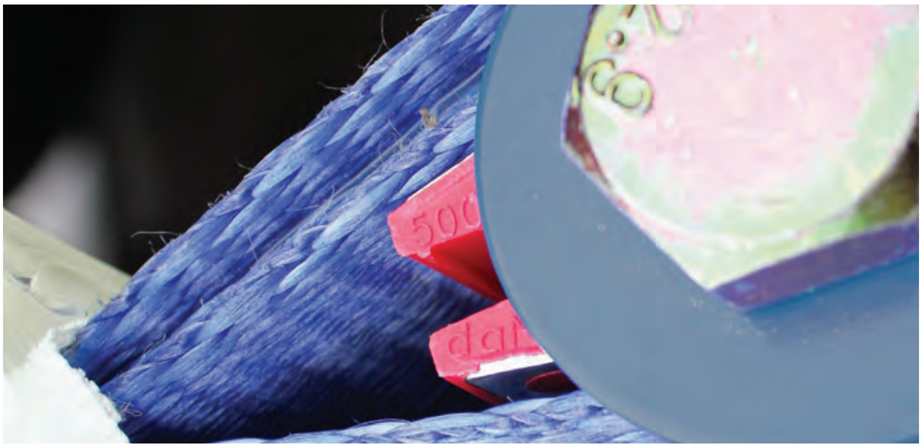
Vertical Rolls, Reels, Coils and Drums

Rolls reels, coils and drums must be lashed to the deck and blocked to prevent forward movement or otherwise completely contained. If they are not bundled or unitised on a pallet or stored in a suitable container, each item should be individually lashed.





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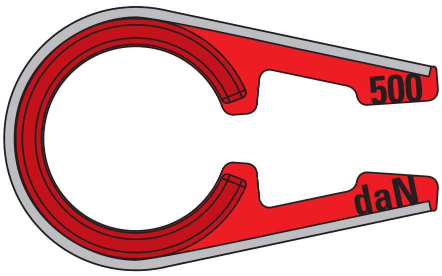
Checking the Load

Some loads can settle and shift during the journey causing the lashings to lose tension, causing objects to fall off. The driver must regularly check their loads and restraints to ensure the load is secure and cannot fall off. The type of load and the road conditions will determine the frequency of these checks.

A critical aspect of these precautions is the actual ability to check the amount of tension in each strap. All SpanSet 50mm and 75mm premium ratchets come fitted with tension force indicators (TFI) allowing the tension to be checked at a glance.

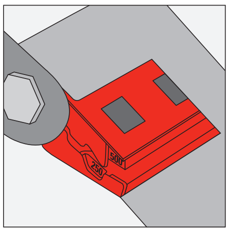


TFI - Tension Force Indicator

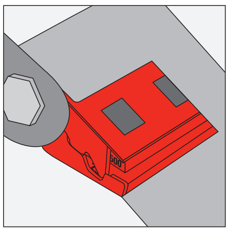
ERGO ABS lashing straps are fitted with the TFI, Tension Force Indicator, as standard. The TFI indicates the attained pretension force which you can read off either on the left side (250daN and 500 daN), or on the right side (750 daN).

Knowledge of the actual tension force allows precise securing of the cargo. The required number of lashing straps can then be determined and the labour time calculated.

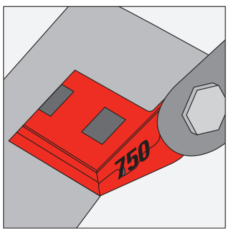
Reading off the Initial Tension Force with the TFI



250 daN tension force: The first tooth starts to overlap the recessed indicator range of 250 daN.



500 daN tension force: The second tooth starts to overlap the outside indicator range.



750 daN tension force: The two halves are pressed together (positive engagement).

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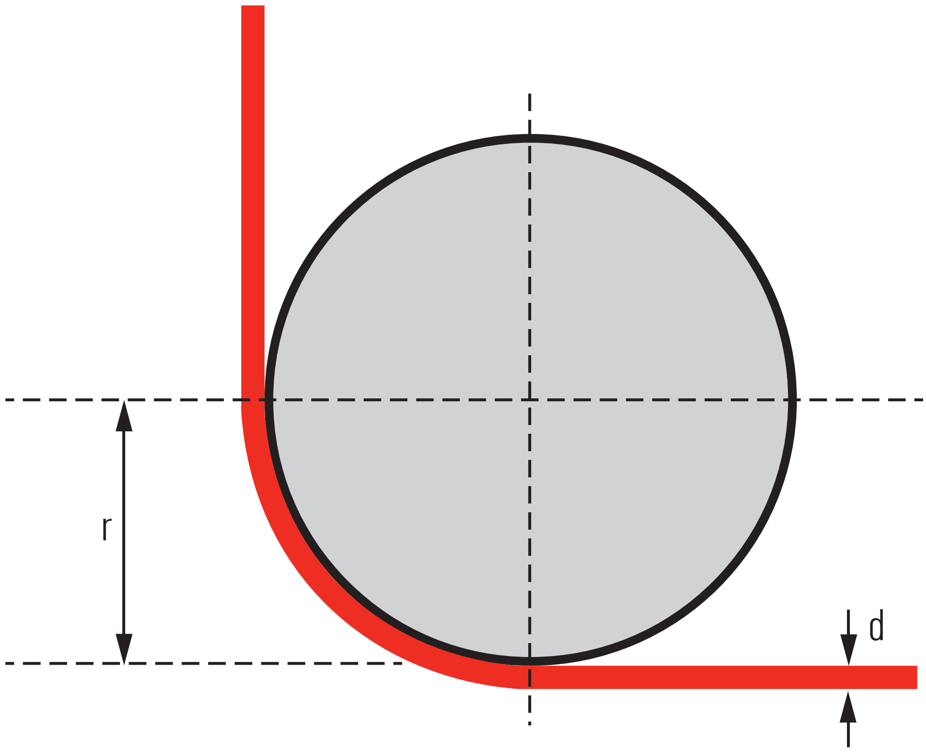
Sharp Edges

Definition of Sharp Edges Relating to Synthetic Lashings Around Loads

If the radius (r) of the edge of the fitting is the same or less than the compressed thickness (d) of the lashing strap. A fitting with insufficient diameter such as a shackle pin is still considered a sharp edge.



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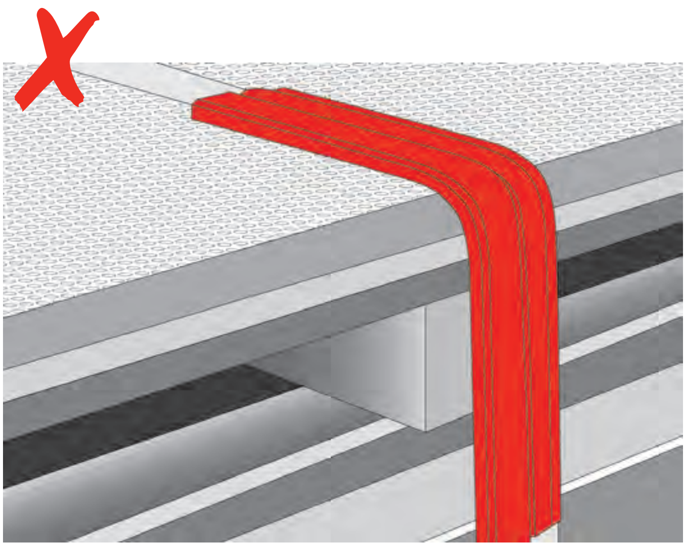
Cut and Abrasion Protection

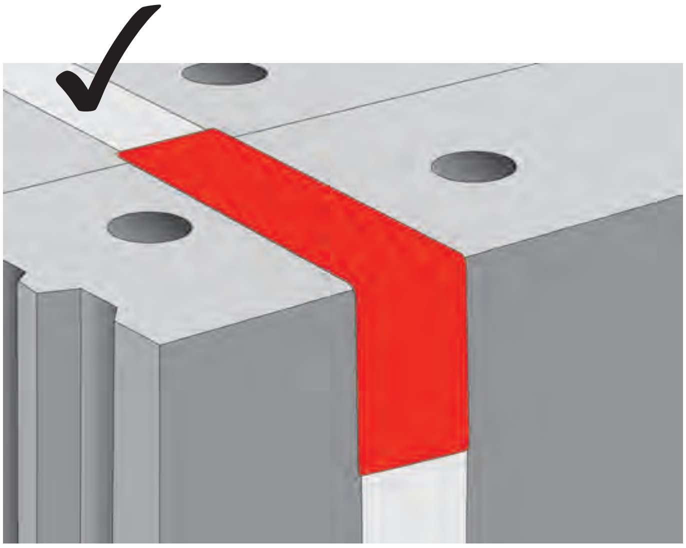
Protection of lashing from sharp edges is critical and a sharp edge does not have to be a razor-like contact point. The use of protective sleeves can safeguard against cutting and prolong the life of lashing.

It is important to note that protective sleeves fall into two categories – cut protection and abrasion protection.

Sleeve Cut/Abrasion Protection

	Cut Protection	Abrasion	Oil/Grease/Fuel
Webbing	No	Yes	Yes
PVC Hose	No	Yes	Yes
Leather	No	Yes	Yes
secutex® Polyurethane	Yes	Yes	Yes





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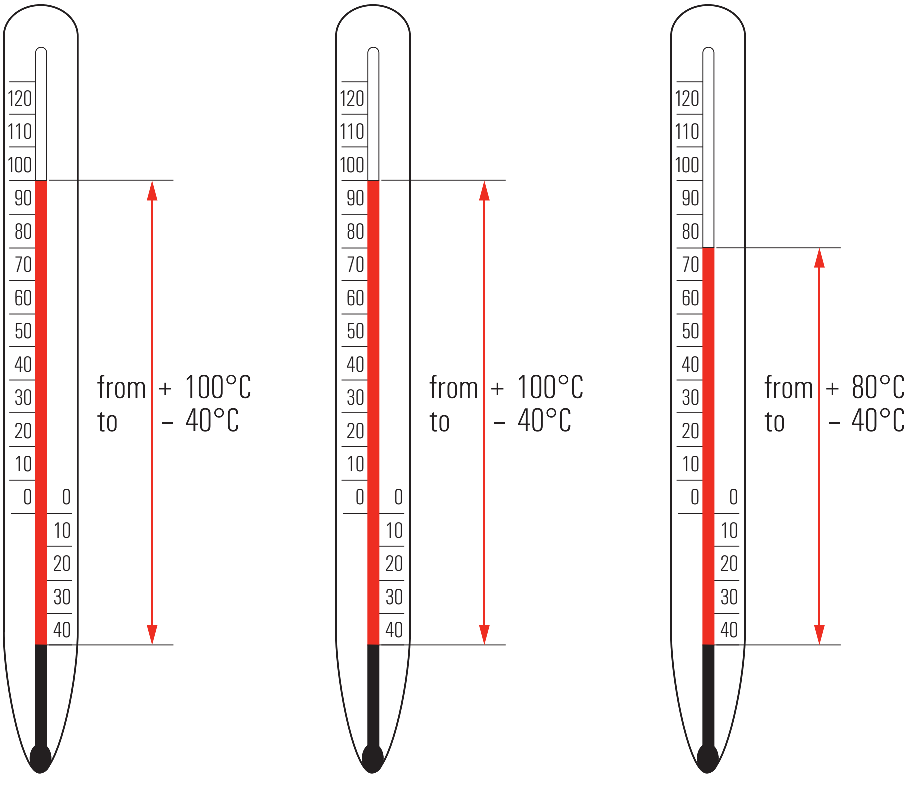
Operating Temperatures and Atmospheric Effects

PES (Polyester)   PA (Polyamid)   PP (Polypropylene)



Resistance to Ultra-Violet

In its level of resistance to sunlight (measured as a percentage of the original tensile strength), polyester may be regarded as a highly-resistant fibre.

Calculated on the basis of units of weight it has a considerably higher original strength than natural fibres, and since it is, generally speaking, more resistant to degradation by the action of steam, chemicals and micro-organisms, one finds in practice that polyester will give greater service life than many other fibres.

When exposed to ultra-violet behind glass, polyester exhibits a considerably higher resistance and is better than the majority of other fibres.

SpanSet ultra-violet stabilised polyester retained more than 95% of its strength after six months continuous exposure in the sunshine of Florida.

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Atmospheric Effects

The Effect of Humidity

The normal moisture content of polyester is very low, whilst for nylon it is considerably higher.

As a result of the extremely low absorption of moisture by polyester its physical properties such as strength, elasticity and modulus vary only slightly in moist or dry conditions below 70°C.

On the other hand, nylon loses about 10-20% of its strength when wet accompanied by a change in the load/extension curve. After drying, the strength is, of course, regained.

The Effect of Water and Steam

The effect of steam on polyester is to cause hydrolytic breakdown with a consequent reduction in the mechanical properties of the fibres. The extent is dependent upon temperature and the duration of exposure.

In spite of polyester being a hydrophobic fibre, its attack by the moisture is a process which does not simply occur on the surface and this breakdown is believed to be the result of the shortening of the molecular chains throughout the fibre.

Unsaturated water vapour at temperatures in excess of 100°C occurs in some important areas of application, eg In the filtration of dust from gases, and it is necessary to be familiar with the effect of various levels of saturation and the incidence of related loss.

The table on page 108 shows the weekly (168 hours) percentage reduction in strength when polyester is exposed to a moist atmosphere at different levels of saturation ranging from 10 to 100% relative humidity.

Reduction in the strength of more than 100% is unrealistic, but these values have been included since they illustrate the deterioration at different levels of temperature and humidity and, therefore, may be used for estimating the damage which may occur in periods of less than one week.

The loss of strength in water is extraordinarily slow at normal temperatures. At 70°C it is barely noticeable after four weeks. The speed of deterioration increases with the temperature, and at 100°C the reduction of mechanical properties is significant in the long term, eg About 60% of the tensile strength is lost after three weeks' continuous immersion in boiling water.

Water saturated steam at 100°C causes the same strength loss and there is nothing to suggest that water in liquid form would have a different effect.

Sometimes tensile strength is not the only significant property, it is nevertheless the very factor which determines the length of service, and is a useful measurement of the changes occurring which provide a convenient yardstick for checking the durability of the fibre. The effect of water or saturate steam on polyester may be summarised as follows:

- The loss of strength is proportional to the duration of treatment
- Strength is lost at a rate of 0.12% per hour at 100°C or approximately 20% per week
- The level of reduction in strength increases or decreases by a factor of 1.082 per °C of temperature. This is equivalent to 1.08210 or 2.2 times per 10°C.

By applying these general principles it will enable an estimate to be made in the reduction of strength resulting from exposure to water or saturated steam for a measured period of time. For example, there is a reduction in the strength of 10 x 0.12 x 2.2 or approximately 62% on exposure to saturated steam at a temperature of 150°C for 10 hours. In a similar way, a period of 5 hours spent in water at 94°C causes a reduction in strength of 5 x 0.1211.08255, or about 0.4%.

These examples should only be regarded as a general indication, since pre-treatment of a fibre may further alter the physical properties.

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The Effects of Various Substances

Perspiration

Neither acidic nor alkaline synthetic perspiration formulations have any effect on the strength of polyester or nylon.

Cooling Agents

Dichloro-difluor-methane (Arcton 6 or Freon 12) and monochloro-trifluor-methane (Arcton 4 or Freon 22) are commonly used in refrigeration plant. Immersion for six months in these substances has a scarcely noticeable effect on the strength of polyester within the temperature range - 20°C to + 20°C, although some swelling does occur in the latter substance.

Attack by Micro-organisms and insects

Since neither polyester nor nylon are digestible as an animal feedstuff, their resistance to bacteria, fungi, termites, silver fish, moth larvae, etc, is excellent. It should be remembered, however, that certain fungi and bacteria are capable of growth even on the very small amounts of impurities which may be found on the surface of the fibres which make up the yarns and fabrics.

Although this has no effect whatsoever on the tensile strength of the material, it is nevertheless possible for the substances produced by these organisms to give rise to discolouration of the polyester sling.

Dimethyl Phthalate

Although dimethyl phthalate quickly dissolves polyester at boiling point, this substance has little effect at ambient temperatures. Total immersion for one month at 30°C does not bring about any reduction in strength.

Phenols

The number of substances capable of dissolving polyester at ambient or moderate temperatures are limited, the only class of chemicals capable or this are the phenols. The majority of phenols either cause polyester to swell or cause dissolution, depending on the level of concentration and the temperature.

At normal temperatures, there is good resistance to the dilute forms of phenols, such as wood tar-derived creosote which may contain up to 20% of phenol substances. Polyester fibre which was stored in creosote at 30°C for six months exhibited an insignificant reduction in strength. At 50°C the loss is still less than 10%, but increases to 25-50% at 70°C.

Thus at normal temperatures, creosote impregnation should not cause serious damage to polyester. The phenols, in particular carbolic acid, metacreosole and creosolic acid, are solvents of nylon. In low concentrations in water, their effect is usually slight, although a certain amount of shrinkage of the nylon yarn does occur.

Hydrocarbons

Fuel at Room Temperature

Substance	Residual strength in % after exposure for 28 weeks	
Petroleum	100	100
Regular Petrol	100	100
Premium Petrol	100	100
Diesel Oil	100	100
Benzene	100	100
Jet Fuel JP1	100	100
Jet Fuel JP4	100	100
Iso-Octane	100	100

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The Effects of Acids on Polyester

The Effects of Acids on Polyester

Inorganic and Organic Acids

Certain chlorine-containing organic acids have the effect of dissolving Polyester. Mono-, di- and trichloracetic acid dissolve all polyesters at temperatures in excess of their fusion points, respectively 63°, 10° and 55°. The solution occurs rapidly at 100°C and in the case of dichloracetic acid, this occurs even at normal room temperature.

The acidic hydrolysis of polyester is not a surface reaction, but continues to act upon the molecules throughout the entire fibre. It is followed by a reduction in the strength of the fibre and of the strain as well as in the Index of Viscosity (IV).

The reduction in the strength of the fibre varies widely depending upon the nature, the concentration and the temperature of the acid.

The Effects of Inorganic and Organic Acids

Substance	Temp C°	Breaking Strength 10%	20%	30%	40%	50%	60%	70%
Nitric Acid pH 0.5	20	100	100	100	99	97	96	
	60	96	89	66	30	0		
	75	70	50	0				
	100	60	0					
Sulphuric Acid pH 0.5	20	100	100	100	100	100	100	100
	50	100	100	100	100	100	97	92
	75	100	100	98	90	72	0	
	100	99	96	81	42			

Substance	Temp C°	Concentration (%) of 2.5	5	10	20	30
Hydrochloric Acid pH 0.5	20	100	100	100	100	100
	50	100	100	100	98	78
	75	100	100	98	66	40
	100	100	91	54	5	0

Substance	Temp C°	Concentration (%) of 10	20	30	50	70
Formic Acid pH 1.6	20	100	100	100	100	100
	50	100	100	100	100	100
	70	100	100	100	100	100

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The Effects of Alkalis and Oxidising Agents on Polyester

The Effect of Oxidising and Reducing Agents

Polyester fibre has a very high resistance to oxidising and reducing agents and the fibre will withstand stronger bleaching processes than those normally used for textile fibres. Polyester products may be exposed without harm to any of the common bleaching agents, including those based upon hypochlorite, chlorite, hydrogen peroxide, the per-salts and reducing sulphur compounds.

The Effect of Alkalis

Alkalis, acids or simply water can all cause the hydrolysis of a polyester such as, for example, polyethyleneterephthalate, but the cause of the reaction and its effect on the fibre is not the same in each case.

The effect of alkalis in an aqueous solution, with the exception of ammonia and its derivatives, is quite different, producing the progressive dissolution of the fibre, whilst water, acids, ammonia and its derivatives, eg Quaternary ammonium bases and amines break down the fibre without dissolving it.

Calcium Hydroxide (Lime)

In spite of the fact that it is possible to obtain only weak solutions of lime, its effect still seems to be 13 times more rapid than that of caustic soda under similar conditions, its effect on polyester is considerable and the loss of strength is significant.

Sodium Hyperchlorite

The resistance of polyester to sodium hyperchlorite under the conditions to which textiles are normally exposed to it, is excellent.

Sodium Chlorite

Boiling for one hour in a 0.2% solution of sodium chlorite at pH 2-3 has no effect on the tensile strength of polyester.

Sodium Hydrosulphite

Those reducing agents which are normally used in textile processes have no noticeable effect on polyester. Treatment for 72 hours at 80°C in a saturated solution of sodium hydrosulphite causes no reduction in the strength of the fibre.

Potassium Dichromate

Polyester which has been treated for 3 days at 80°C in a saturated solution of potassium dichromate to which has been added 1% (weight/volume) of sulphuric acid exhibits a very insignificant change in its properties, the loss of strength being, for example, less than 5%.

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Handling the Load Securing Equipment

The Effects of Alkalis and Oxidising Agents on Polyester

The Effects of Alkalis

Substance	Time in Hours	Temp C°	Residual strength in % at a concentration of 1%	3%	5%
			pH 12.7	pH 12.6	pH12.5
Caustic Soda NaOH	50	20	98	94	80
	50	50	93	91	71
	50	75	85	52	12
	50	100	62	-	-

Substance	Time in Hours	Temp C°	Concentration (%) of 1	2.5	5	10	20	25
Ammonia HNO3	50	20	100	100	100	100	100	100
	50	50	100	100	98	95	60	55
	50	75	100	70	0	50	0	0

Substance	pH	Residual strength in % after 1-12 months at room temperature: 1	3	6	12
Concentrated Ammonia 20%	13.4	0	3	0	0
Calcium Hydroxide 50%	12.4	92	64	29	0
Potash-Lye Concentrated 40%	14.0	0	0	0	0
Soda Lye 0.1%	12.1	100	100	100	94
Soda Lye 15%	12.1	0	0	0	0
Soda Lye Concentrated 30%	11.2	0	0	0	0

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The Effects of Chemicals and Solvents on Polyester

Chemicals

Danger Classes

0 Solvents, Salts, Artificial Fertilizers

1 Inorganic Acids

2 Alkalis

The danger classes have the following significance:

0 Has no effect on polyester at temperatures below 50°C.

1 May be used in combination with polyester in regulated forms at temperatures below 30°C, during a maximum continuous period of use of 2 days. Where this continuous period of use is less than two days, higher concentrations of the acids and/or higher temperatures can be tolerated, since the degradation formula for the polyester may be written as:

Concentration x time x temperature = resistance to degradation.

2 May not be used in combination with polyester.

Phenols in concentrations above 20% and above ambient temperature will dissolve polyester. This also applies to Hexylamine. However, the salt, Ammonium Sulphide, is an exception, since it is highly destructive to polyester.

Organic acids such as common acetic acid, for example, do have an effect on polyester, although it is negligible. The exception is mono-di and trichloracetic acid.

Polyester tolerates Sodium Carbonate.

Organic Solvents

Both nylon and polyester fibres exhibit a high level of resistance to the majority of common organic solvents. Examples of these, including those which are normally used for dry-cleaning, are as follows: acetone, dioxane, ether, methanol, ethanol, benzene, toluene, xylene, petroleum ether, methylene chloride, chloroform, carbon tetrachloride, perchloroethylene and trichloroethylene.

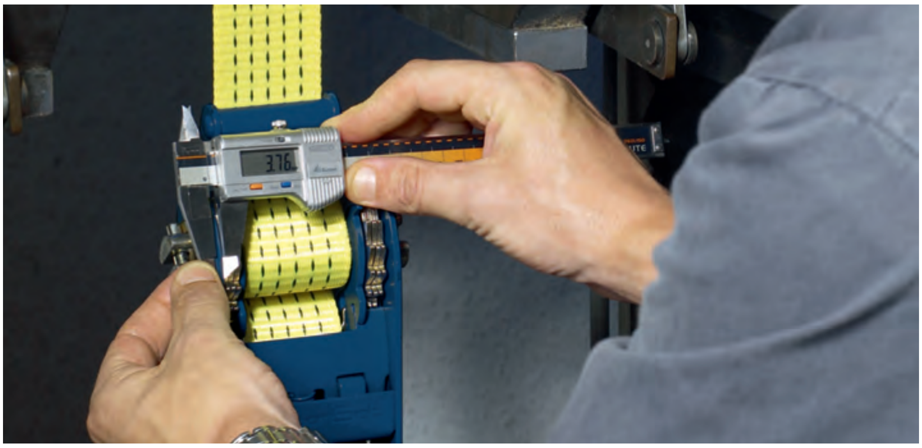
At room temperature, these have an insignificant effect on the strength of either polyester or nylon. Immersion for six months in methanol at 30°C results in very little reduction in strength, whilst the reduction at 50°C is 15%.

Nylon is capable of reacting with methanol under acidic conditions to give a weaker, more elastic yarn with a considerable increase in the diameter of the filament.

Neither nylon nor polyester should be heated for long periods in alcohol or in other compounds of esters, since this will cause an exchange of esters which will break down the polymer.

Residual Strength of Polyester with Organic Solvents

Substance	Temp °C	Residual strength in % after 7 days
Amyl Acetate	60	100
Benzaldehyde	60	100
Butyl Alcohol	60	100
Chloramine	60	100
Chloroform	60	100
Dimethyl Sulphoxide	60	100
Epichlorhydrin	60	100
Formaldehyde	60	97
Formamide	60	100
Freon 11	20/40	100
Freon 12	20/40	100
Freon 22	20/40	100
Fuel Oil	100	100
Hexylamine	60	0
Motor Oil	60	100
Styrene	60	100
Powdered Carbon Tetrachloride	60	100
Trichloroethylene	60	100
Xylene	60	100



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Lashing Deficiencies

Lashing straps should no longer be used if the following deficiencies are present:

Webbing

- Incisions greater than 10 % at the web edge or excessive wear, since repair is then no longer possible
- Damage to the seams
- Deformation from heat
- Contact with aggressive substances, if not expressly approved by the manufacturer
- Illegible data on the label.
- Missing label. Use only load-securing equipment bearing a label
- Unidentified lashing equipment with illegible or missing labels must be withdrawn from use.

More than 10% cut in webbing

Worn and illegible label

Chemical burns from acid

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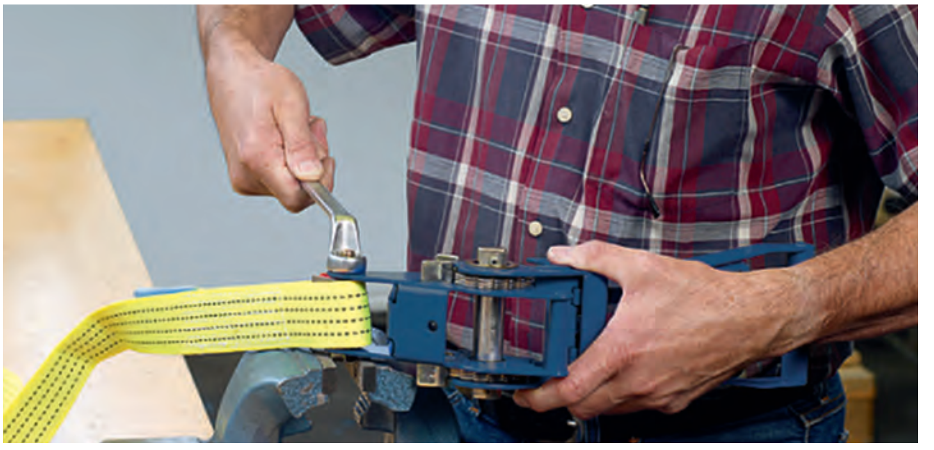
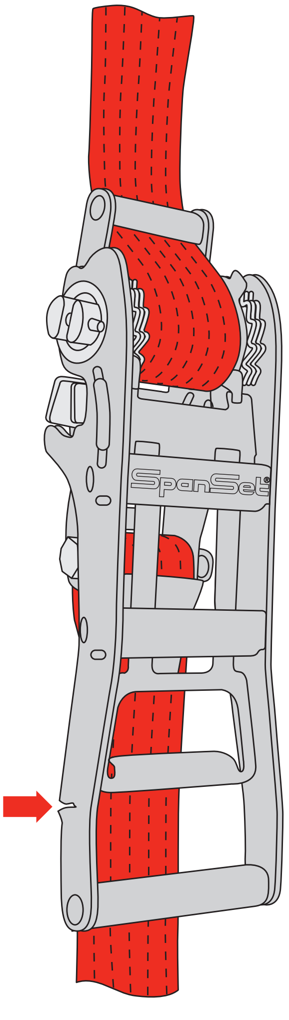


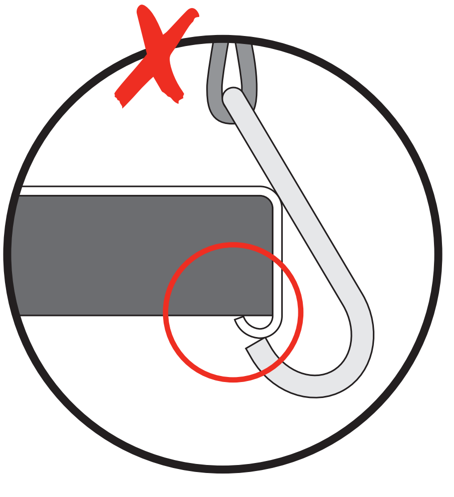
Tensioning Devices

Deformation of the tensioning element at the slotted shaft or of the locking slider, wear of the sprockets or broken ratchet handle.

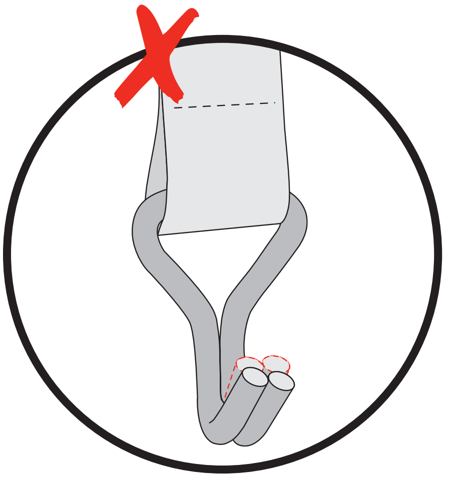


Connection elements

- Widening of the hook by more than 5%
- Cracks
- Fractures
- Considerable corrosion
- Permanent deformation. Lashing hooks must not be loaded at their tips unless the hooks are specially designed for this purpose, otherwise the lashing equipment will no longer be functional.



Don't mount loads on the hook point



Don't use bent end fittings - remove from service

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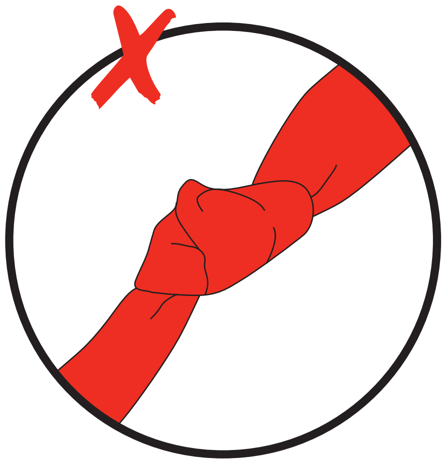
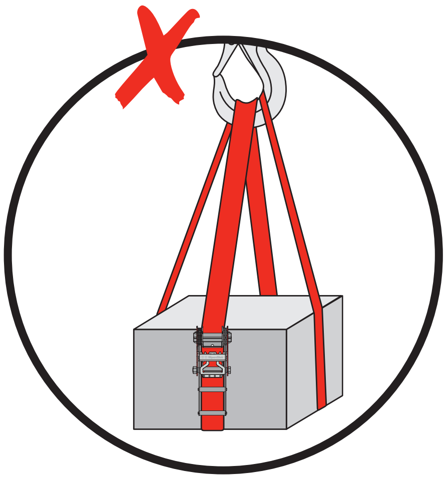
Handling the Load Securing Equipment

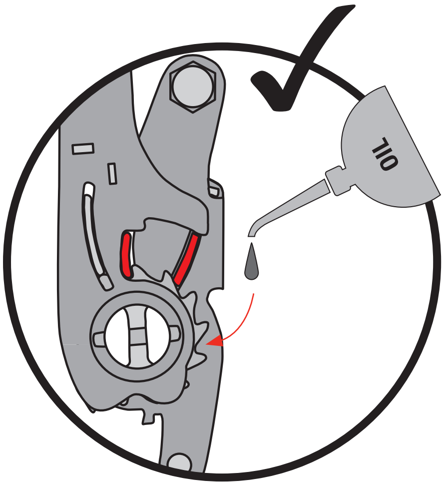
- The lashing strap should only be used by suitably trained personnel.
- Wash in a mild detergent and allow to dry naturally.
- Tensioning devices should be regularly cleaned and lightly lubricated in the vicinity of the sprockets (be sure not to lubricate the places to which the belt is applied; the belt can otherwise slip through and release the load).
- Lashing equipment must not be overloaded, since overloading will lead to breakage of or damage to the lashing equipment.
- Do not use lashing equipment for lifting purposes, as it is not designed for this use.
- Never knot lashing equipment,since considerable loss in strength can result.



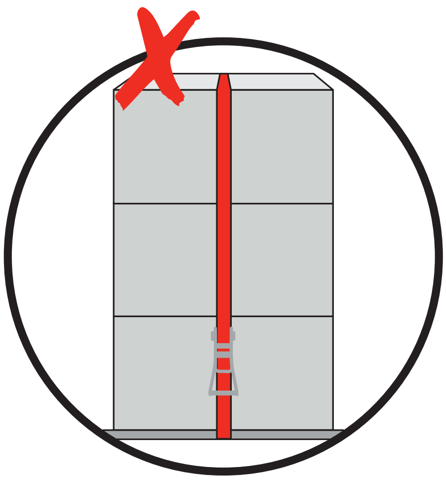
Don't tie knots in lashing webbing



Don't use lashing for lifting purposes. Use a sling.



Clean and lubricate the tensioner sprockets



Don't overload lashing

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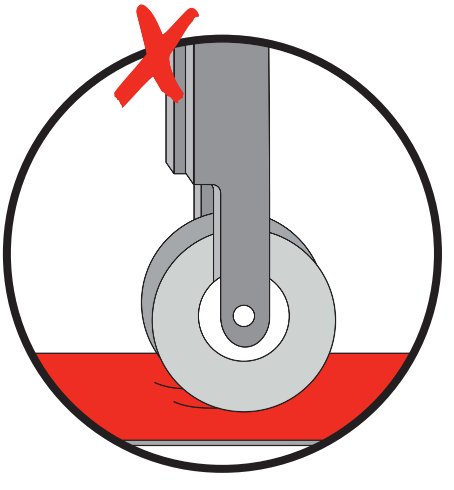
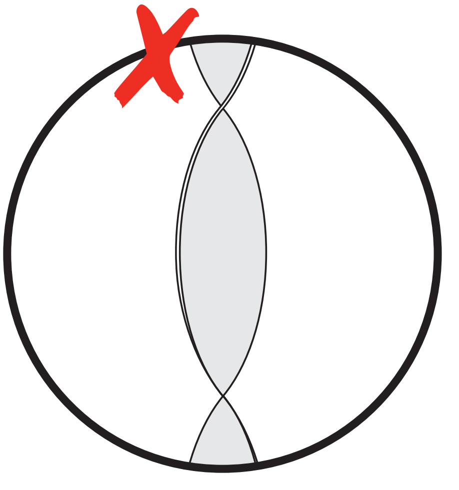
Handling the Load Securing Equipment

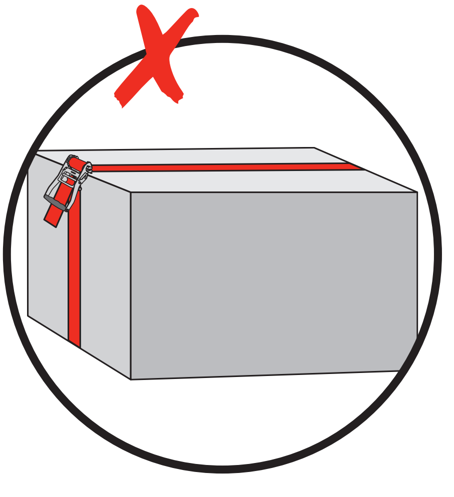
- Do not crush or run over lashing equipment. This can result in considerable loss of strength
- Use only lashing equipment that is not twisted when tensioning
- To avoid stress on tensioning devices and fasteners, do not lay them across edges, otherwise they may fracture. Tensioning devices operating according to the winding principle must not be subjected to less than 1.5 or more than 3 turns of the clamping device (webbing) since with less than 1.5 turns the belt can slip through and with more than 3 turns crushing of the belt begins. In both cases, it is no longer guaranteed that it works.



Don't run over lashing



Don't twist the lashing



Don't lash over edges