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SpanSet®

Technical Information - Slings

NOTE: The information in this technical chapter is intended as a guide only. For specific rigging and chemical guidance please contact the SpanSet **UK Ltd.**

The Advantages of Using Synthetic Slings

Ageing

Polyester has no concealed faults like the steel used in cables or in chain which ages and can suffer a reduction in strength - but can still appear to be new and strong.

Polyester, on the other hand, does not age in a normal working environment.

Withstands Shock - Loading

Steel has poor shock-absorbing properties, whereas polyester has a great power to absorb shock loads without damage.

Internal Corrosion

Wire Rope may appear sound, but can be rusted inside. Deterioration of wire rope often starts at the core and then works out to the surface thus making it very difficult to detect and potentially very dangerous.

Inspection

All lifting equipment must be inspected regularly. Any damage to roundslings and webbing slings is easy to see - it simply cannot be concealed. If the covering of the roundsling is intact, then the lifting capacity is 100%.

The significance of this is that inspection is easier, safer, quicker and does not require special inspection equipment - just good lighting and good eyesight.

Low Weight

We can explain this in the following way:

A green 2-tonne round sling, 4 meters long, weighs only 1.75 kg. The difference between being hit in the face by a free-swinging cable or chain and a soft round sling is very obvious.

The equivalent difference is also appreciated by the person who discovers too late that there are fragile goods in the way.

Slings are often carried from a storage place to the crane or overhead hoist. Regular carrying of slings weighing 15 to 20 kilos will eventually result in back injuries.

The Science of Lifting Materials

Textile slings must be made of high strength multifilament yarns. Whether polyester (PES), polyamide/nylon (PA), polypropylene (PP) or modified high performance polyester (MHPP).

Webbing and slings must only consist of a single material throughout in order to give a consistent chemical degradation indication. In other words, under Australian and international standards, round sling outer casings cannot differ in material to the inner cores.

In selecting the correct lifting sling means you have taken all the important environmental factors into account. Extreme temperatures or aggressive substances - such as acids or bases all affect the durability of the textile assembly used to elevate a load.

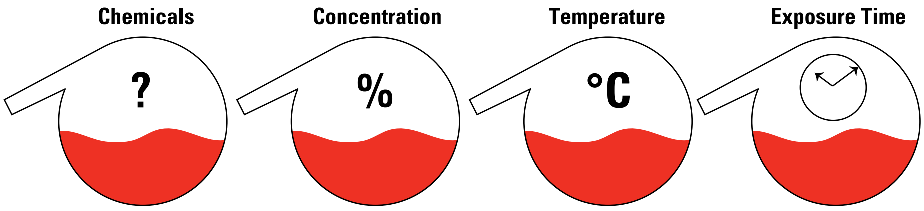
SpanSet specialise in the manufacture of either polyester or modified high performance polyester lifting slings, due to the broad range of chemical resistance and excellent UV performance.

The use of lifting slings in conjunction with chemicals is only permitted following consultation with the manufacturer and indication of the duration of use and operating conditions.

Sling Fabrics and Chemical Suitability

	Acids	Alkalis	Oil/Grease/Fuel	Ultra Violet
PES	Yes	No	Yes	Yes
MHPP	No	No	Yes	Yes
PA	No	Yes	Yes	No
PP	Yes	Yes	Yes	No

The following details will be required:



The Effects of Chemicals and Solvents on Polyester

Chemicals

Danger Classes

0 Solvents, Salts, Artificial Fertilisers

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

The Effects of Chemicals and Solvents on Polyester

Residual Strength After 1-12 Months Exposure (%)

Substance	1 Mth	3 Mths	6 Mths	12 Mths
Acetone	100	100	100	100
Ether	100	100	100	100
Ethanol	100	100	100	100
Ethyl Acetate*	100	100	100	100
Amyl Acetate	100	100	100	100
Aniline	100	100	100	100
Benzaldehyde	100	100	100	100
Benzine	100	100	100	100
Benzoic Acid Amide	100	100	100	100
Benzene	100	100	100	100
Benzyl Alcohol	100	92	78	53
Brandkatechin	100	100	100	100
n-Butanol*	100	100	100	100
Butyl Acetate	100	100	100	100
Chloramine	100	100	100	98
Chloroform	100	100	100	100
Cyclohexanone	100	100	100	100
Cyclohexylamine	86	83	68	57
Diacetone Alcohol	100	100	100	100
Dimethyl Formamide	100	100	100	100
Dimethyl Sulphoxide	100	100	100	100
Epichlorhydrin	100	100	100	100
Formaldehyde 30%	100	100	100	100
Formamide	100	100	100	100
Fuel Oil	100	100	100	100
Glycol	100	100	100	100

* May be included in pigments for industrial use

Residual Strength After 1-12 Months Exposure (%)

Substance	1 Mth	3 Mths	6 Mths	12 Mths
n-Hexylamine	21	0	0	0
Hydroquinone	100	100	100	100
m-Cresole	100	100	100	100
Methyl Acetate	100	100	100	100
Methyl Ethyl Ketone	100	100	100	100
Methyl Alcohol	100	100	100	100
Methylene Chloride	100	100	100	100
Mineral Oil	100	100	100	100
Nitrobenzene	100	100	100	100
Petroleum	100	100	100	100
Phenol	100	100	100	100
2-Phenylethyl Alcohol	100	100	100	100
Floroglucine	100	100	100	100
Isopropyl Alcohol	100	100	100	100
Pyrogallol	100	100	100	100
Pyridine	100	100	100	100
Resorcin	100	100	100	100
Styrene	100	100	100	100
Turpentine*	100	100	100	100
Tetrachloretane	100	95	93	92
Powdered Carbon Tetrachloride	100	100	100	100
Toluene	100	100	100	100
Trichlorethylene	100	100	100	100
Trimethylamine	80	24	0	0
Xylene	100	100	100	100

* May be included in pigments for industrial use

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

The Effects of Acids on Polyester

From a chemical point of view, polyester fibre is liable to hydrolysis. If one discounts extreme conditions, the rate of acidic hydrolysis is unexpectedly low, due to polyester having a characteristically good resistance to the majority of organic and inorganic acids.

Residual Strength After 1-12 Months Exposure (%)

Substance	pH	1 Mth	3 Mths	6 Mths	12 Mths
Concentrated Formic Acid	0.1	100	100	100	100
Malic Acid 25%	0.1	100	100	100	100
Benzoic Acid	-	100	100	100	100
Boric Acid	3.5	100	100	100	100
Chlorosulphate Acid	-	0	0	0	0
Acetic Acid	0.1	100	100	100	100
Acetic Acid 15%	2.0	100	100	100	100
Acetic Anhydride	-	100	100	100	100
Hydrofluoric Acid 38-40%	-	97	86	70	48
Concentrated Lactic Acid	0.7	100	100	100	100
Oxalic Acid	-	100	100	100	100
Phosphoric Acid 85%	0.1	100	100	100	100
Nitric Acid 15%	0.1	100	100	100	100
Nitric Acid 65%	0.1	7	0	0	0
Hydrochloric Acid 15%	0.1	100	100	100	100
Hydrochloric Acid 37%	0.1	43.5	20	0	0
Sulphuric Acid 15%	0.1	100	100	100	100
Sulphuric Acid 38%	0.1	100	100	100	100
Concentrated Sulphuric Acid	0.1	0	0	0	0
Stearic Acid	-	100	100	100	100
Citric Acid 15%	1.5	100	100	100	100
Citric Acid 25%	1.2	100	100	100	100

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%.

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

The Effects of Inorganic Salts on Polyester

Residual Strength of After 1-12 Months Exposure (%)

Saturated Aqueous Solution at Room Temperature

Substance	pH	1 Mth	3 Mths	6 Mths	12 Mths
Aliminium Sulphate	2.9	100	100	100	100
Ammonium Chloride	5.1	100	100	100	100
Ammonium Nitrate	4.8	100	100	100	100
Ammonium Sulphate	4.6	100	100	100	100
Ammonium Sulphide 40%	9.6	50	0	0	0
Lead Acetate	5.7	100	100	100	100
Calcium Chloride	7.2	100	100	100	100
Colcium Nitrate	3.9	100	100	100	100
Ferrous Chloride	0.8	100	100	100	100
Ferrous Sulphate	3.0	100	100	100	100
Potassium Dichromate	3.7	100	100	100	100
Potassium Bromide	6.5	100	100	100	100
Potassium Carbonate	13.1	100	100	100	100
Potassium Chlorate	6.9	100	100	100	100
potassium Chloride	8.0	100	100	100	100
Potassium Chromate	9.4	100	100	100	100
Potassium Nitrate	8.8	100	100	100	100
Potassium Hyperchlorate	9.9	100	100	100	100
Potassium Permanganate	9.7	100	100	98	94
Potassium Sulphate	7.5	100	100	100	100
Copper Sulphate	3.5	100	100	100	100
Magnesium Chloride	4.0	100	100	100	100
Magnesium Sulphate	6.6	100	100	100	100
Sodium Ammonium Sulphate	8.2	100	100	100	100
Sodium Bicarbonate	7.8	100	100	100	100
Sodium Bisulphide	4.1	100	100	94	94

Residual Strength of After 1-12 Months Exposure (%)

Saturated Aqueous Solution at Room Temperature

Substance	pH	1 Mth	3 Mths	6 Mths	12 Mths
Sodium Carbonate	11.2	100	100	100	94
Sodium Chlorate	7.4	100	100	100	100
Sodium Chloride	7.4	100	100	100	100
Sodium Perchlorate	5.8	100	100	100	100
Sodium Sulphate	5.4	100	100	100	100
Sodium Tetraborate	9.3	100	100	100	100
Sodium Thiosulphate	7.4	100	100	100	100
Sodium Nitrate	8.3	100	100	100	100
Nickel Sulphate	4.5	100	100	100	100
Silver Nitrate	4.6	100	100	100	100
Zinc Chloride	2.4	100	100	100	100
Zinc Sulphate	4.0	100	100	100	100

Saturated Solutions of Inorganic Salts at 60°C

Substance	pH	Residual strength in % after 7 days
Aluminium Chloride 5%	3.9	100
Potassium Carbonate (cold saturated solution)	13.1	100
Magnesium Chloride	5.1	100
Sodium Bicarbonate	7.8	100
Sodium Carbonate	11.2	100

The Effects of Various Other 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, silverfish, 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

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 opposite 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 saturated 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 $10 \times 0.12 \times 2.2^5$ 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 $5 \times 0.1211.082^5$, 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.

Cyclohexylamine

In certain boiler systems cyclohexylamine compounds may be present in concentrations of a few parts per million. If these are picked up by the steam which has circulated in the boilers and comes into contact with the polyester, the effect is small. If, however, a polyester fabric is exposed to unlimited amounts of steam containing cyclohexylamine, eg in laundry steam pressing, there will be a very rapid breakdown of the polyester fibres.

Atmospheric Effects

Weekly (168 hrs) % Reduction in Tensile Strength

Polyester in water, saturated steam or moist air

Temperature °C	Strength Reduction (%)					
	10 RL	20 RL	40 RL	Moist Air 60 RL	80 RL	Water or Saturated Steam 100 RL
0	0.0002	0.0004	0.0011	0.0026	0.0064	0.0075
20	0.0009	0.0018	0.0055	0.013	0.031	0.036
40	0.0045	0.009	0.027	0.063	0.15	0.18
60	0.022	0.045	0.13	0.3	0.72	0.85
80	0.1	0.1	0.62	1.4	3.5	4.1
100	0.5	1	3	7	17	20

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.

Operating Temperatures

The Long Term Effect of Heat

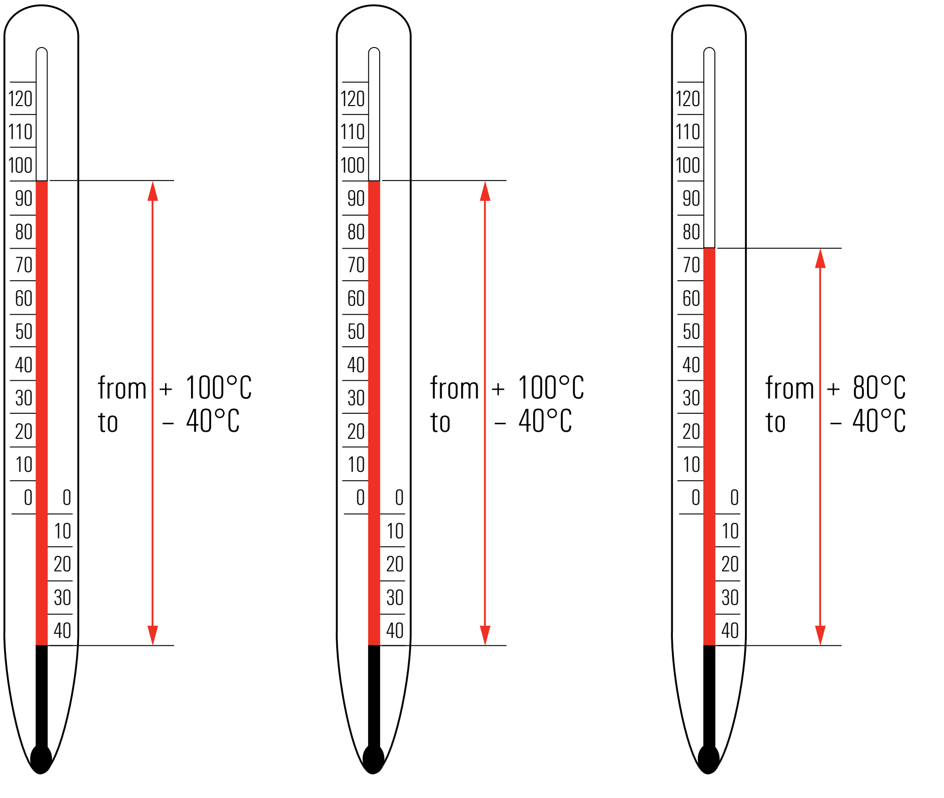
The expression 'resistance to heat' means the ability to withstand increases in heat in a normal atmosphere, ie air which contains small quantities of moisture.

Nylon has a poor resistance to dry heat at temperatures above 100°C and rapidly loses its strength as a result of oxidation. Thus, exposure for five days at 150°C will, for example, result in a loss of strength of about 75%.

On the other hand polyester fibre exhibits a very high level of resistance to heat. The effect of heat on polyester over a long period gradually reduces its tensile strength and its extension point.

If exposed to temperatures of about 150 degrees for a period of six weeks polyester will lose only about 20-25% of its original strength, and after 28 weeks only about 50%.

Many textile fibres suffer considerable discolouration if they are exposed to temperatures in excess of 100°C for long periods, but in this respect polyester has the advantage of exhibiting relatively little deterioration in colour even at temperatures approaching 180°C, where colour is important.



Electrical Conductivity

Electrical Properties

In common with other synthetic fibres with low moisture content, polyester is a very good insulator. It has a dielectric constant of 3.17 at 20°C frequency of 1KHz, falling to 2.98 at 1 Mc/sec, whilst the power loss resulting from the resistance in the material is insignificant.

Its specific resistance, measured on a film with a thickness of 0.001 inches or 0.0254 mm is about 1.2 x 10^{19} ohm/cm at 25°C and 65% RH which is 10^{9}-10^{12} times the equivalent for natural silk, nylon, cotton or rayon. As a result of the low moisture content of polyester, it retains an exceptionally good resistance even at high relative humidity.

The value remains high even at elevated temperatures and thus the specific resistance of polyester is about 3 x 1012 ohm/cm at 180°C. This is a useful property, since polyester also has good resistance to heat and can, in addition, be made dimensionally stable at given temperatures by means of thermo-fixation.

In addition to the high level of resistance, the limit of degradation of the fibre is as high as 2.5kv per thousandth of an inch. Polyester is non-conductive, which is why occasional flash-over will not produce conductive contact.

Sharp Edges

There are two different criteria for assessing the sharp edges when attaching a synthetic sling, those being:

- Attachment hardware such as a shackle or hook, which generally remain static and do not allow the sling to slide
- Direct attachment to loads eg when choking. Load may move slightly during suspension to adjust to centre of gravity.

Definition of Sharp Edges Relating to Attachment Fittings (Hooks, Shackles, Masterlinks etc)

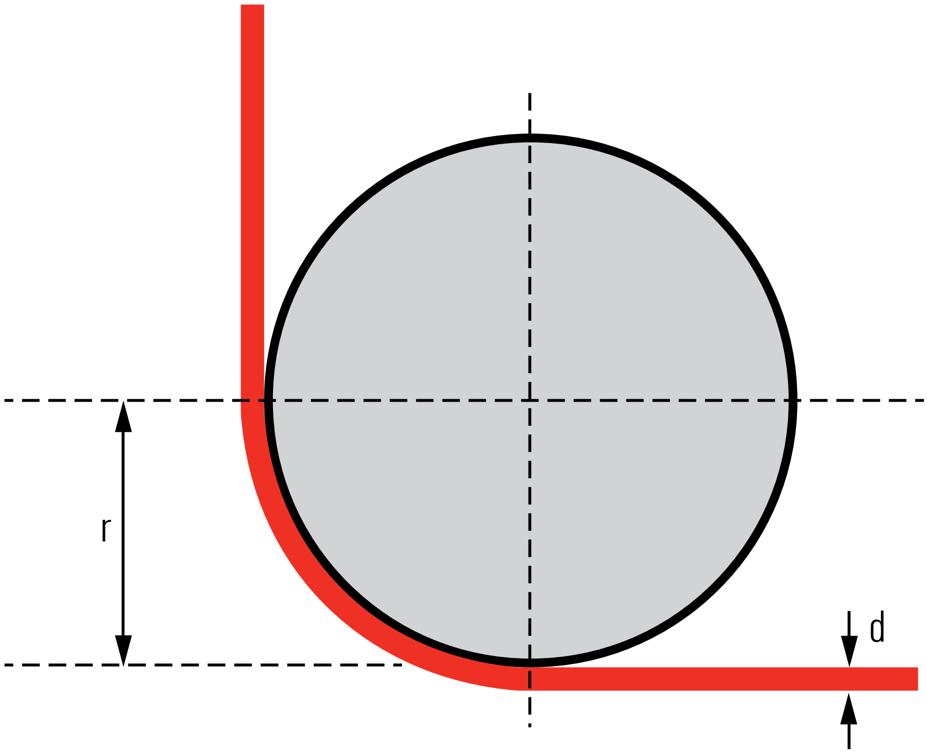
What is a sharp edge?

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

Definition of Sharp Edges Relating to Attachment Directly to Loads (Choke, Basket etc)

What is a sharp edge?

If the radius (r) of the edge of the load is less than 3 times the compressed thickness (d) of the sling (AS4497).



Sharp Edges

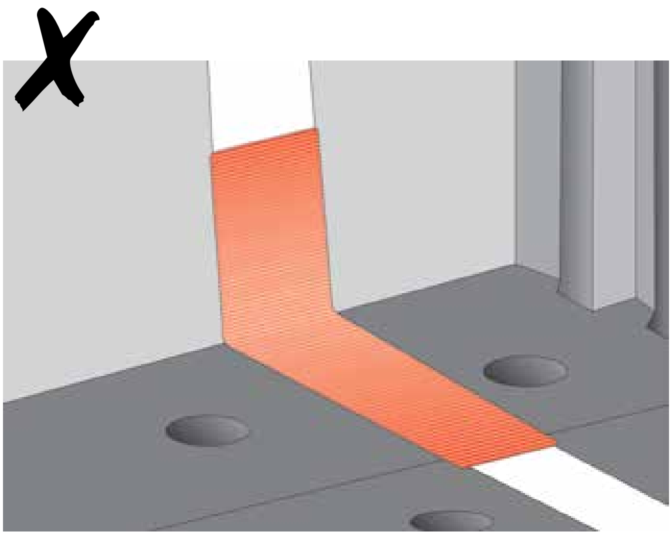
Protection of synthetic slings from sharp edges is critical. A sharp edge does not have to be a razor like contact point, but may also be a rolled edge of insufficient diameter to suit the thickness of the sling.

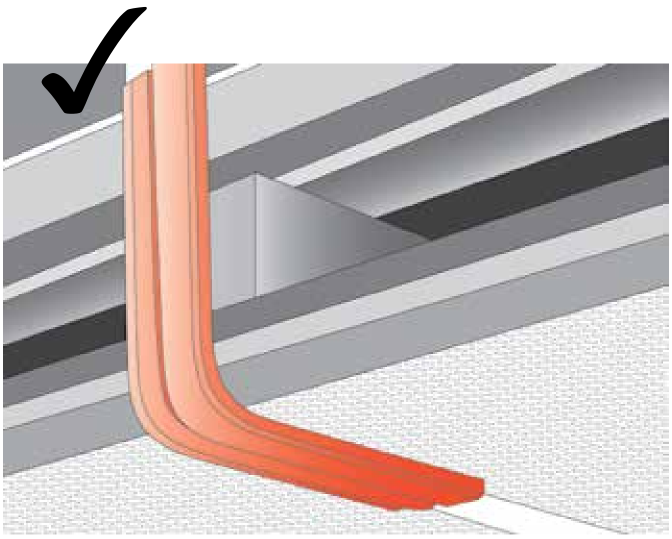
The use of protective sleeves can safeguard against cutting and prolong the life of the sling.

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





Safe Sling Use

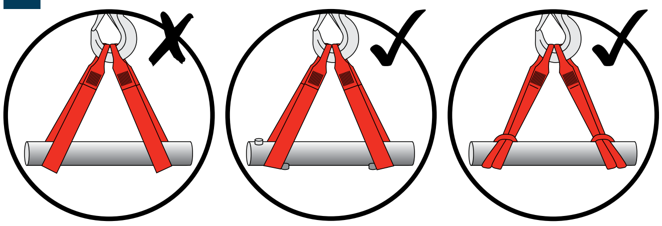
1. Do not use unrestrained slings at an angle. The slings can slide together therefore destabilising the load. The two slings must be blocked or choked to prevent sliding.

2. Never allow a sling to hang freely in the hook as the load can twist and slide uncontrollably. Always use two slings with the necessary blocking.

3. Do not tie knots in lifting slings as this will derate them dramatically. To join two slings together, use a joker hook or appropriate shackle.

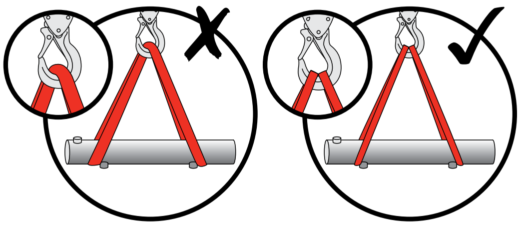
Sling Use Dos and Don'ts

1



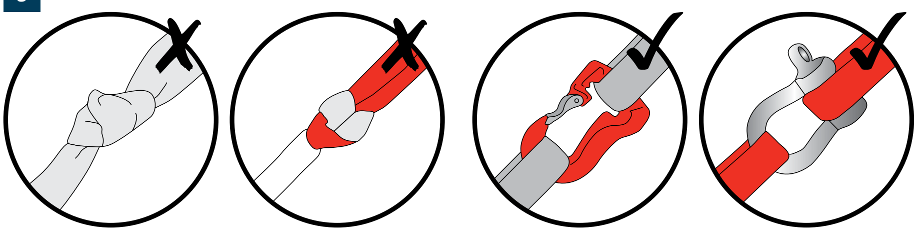
Use object extrusions or choke hitch to stop the sling slipping

2



Do not double layer a single sling - use two

3



Do not knot or join two slings together - use a joker hook or a bow shackle

Safe Sling Use

4 Make sure the hook is not overcrowded.

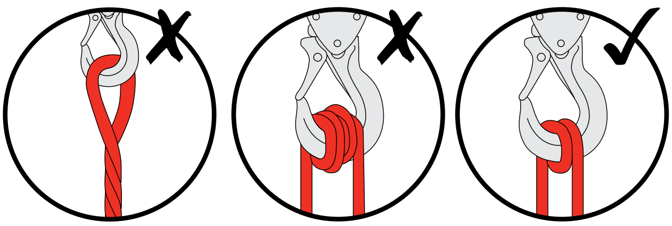
5 Do not twist slings or wrap them over themselves in order to shorten. Round slings may be shortened slightly by wrapping side by side providing they do not overlap or crowd the hook.

6 Unused legs of a multi-leg sling must be attached to the upper fitting and not left dangling.

4

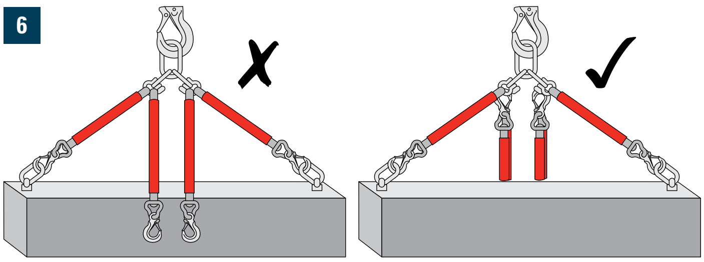
Don't crowd the hook

5



Do not twist the sling to shorten - loop the sling once instead and not multiple times

6



Don't let spare multi hook arms dangle - hook them back up to the top connectors

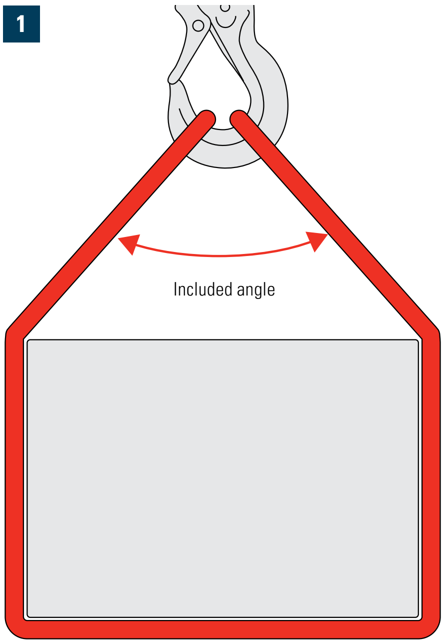
The Effects of Angles

1 When measured between the legs of the slings (Included Angle) the angle must not exceed 120°. Angles over this amount will multiply the forces and result in a decrease in safety factor and ultimate strength.

2 This angle limit also applies to multi-leg slings. Note: standards stipulate that the capacity multiplication of legs can only be a maximum of 1.73 irrespective of how many legs are added. This will also reduced further, the wider the angle between the legs.

3 For slings with formed eyes, the angle inside the eye must not exceed 20°.
4 This is to prevent the sling from splitting due to the use of too large an end fitting or attachment

1



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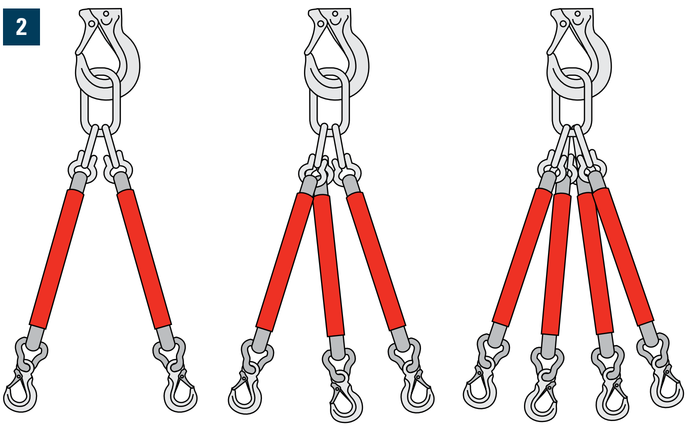

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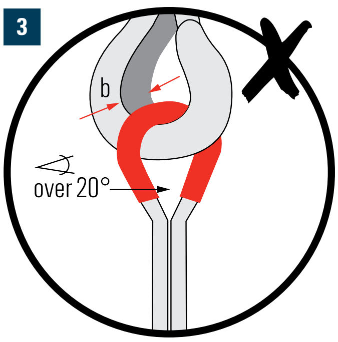

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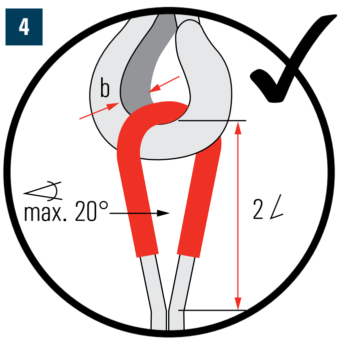
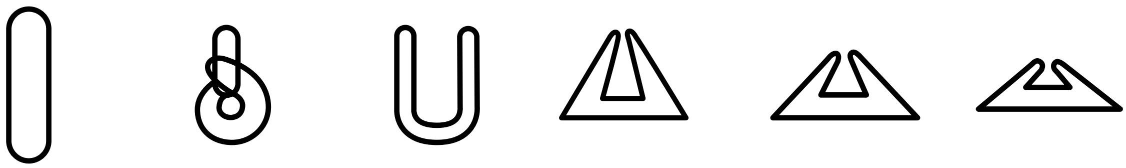


Colour Codes and Lifting Modes



Mode WLL Capacity (kg)	Vert 1.0	Choke 0.8	Basket 2.0	60° 1.7	90° 1.4	120°1.0
1000	1000	800	2000	1700	1400	1000
2000	2000	1600	4000	3400	2800	2000
3000	3000	2400	6000	5100	4200	3000
4000	4000	3200	8000	6800	5600	4000
5000	5000	4000	10,000	8500	7000	5000
6000	6000	4800	12,000	10200	8400	6000
8000	8000	6400	16,000	13,600	11,200	8000
10,000	10,000	8000	20,000	17,000	14,000	10,000
15,000	15,000	12,000	30,000	25,500	21,000	15,000
20,000	20,000	16,000	40,000	34,000	28,000	20,000
25,000	25,000	20,000	50,000	42,500	35,000	25,000
30,000	30,000	24,000	60,000	51,000	42,000	30,000

Using Shackles With Round Slings

Type of Round Sling	Fabric	WLL Round Sling [kg]	Material Width Round Sling [mm]	Material Thickness Round Sling [mm]	Proof Loading [kN]	Van Beest Shackle Number	WLL Shackle [kg]	ø Material Thickness Shackle [mm]	Width of Shackle [mm]
SupraPlus	Polyester fibre	500	36	5	25	4161	500	7	20
SupraPlus	Polyester fibre	1,000	36	6	49	4161	1,000	10	26
SupraPlus	Polyester fibre	2,000	37	8	99	4161	2,000	13.5	32
SupraPlus	Polyester fibre	3,000	44	10	148	4161	3,250	16	43
SupraPlus	Polyester fibre	4,000	52	12	197	4161	4,750	19	51
SupraPlus	Polyester fibre	5,000	59	13	246	4161	6,500	22	58
SupraPlus	Polyester fibre	6,000	65	14	295	4161	6,500	22	58
SupraPlus	Polyester fibre	8,000	68	17	314	4161	8,500	25	68
MagnumPlus	Polyester fibre	10,000	90	19	393	4163	12,000	32	83
MagnumPlus	Polyester fibre	15,000	115	21	589	4163	17,000	38	99
MagnumPlus	Polyester fibre	20,000	135	23	785	4163	25,000	45	126
MagnumPlus	Polyester fibre	30,000	170	27	1,178	4163	35,000	50	138
MagnumPlus	Polyester fibre	40,000	190	37	1,570	4163	42,500	57	160
MagnumPlus	Polyester fibre	60,000	190	75	2,355	4163	85,000	75,0	190
MagnumPlus	Polyester fibre	80,000	230	86	3,140	4163	85,000	75	190
MagnumPlus	Polyester fibre	100,000	260	96	3,924	6036	120,000	95	238
Magnum Force	High performance fibre	10,000	55	12	393	4163	12,000	32	83
Magnum Force	High performance fibre	20,000	80	15	785	4163	25,000	45	126
Magnum Force	High performance fibre	30,000	90	20	1,178	4163	35,000	50	138
Magnum Force	High performance fibre	40,000	110	24	1,570	4163	42,500	57	160
Magnum Force	High performance fibre	50,000	117	23	1,962	4163	55,000	65	180
Magnum Force	High performance fibre	60,000	150	30	2,355	4163	85,000	75	190
Magnum Force	High performance fibre	80,000	200	40	3,140	4163	85,000	75	190
Magnum Force	High performance fibre	100,000	233	47	3,924	6036	120,000	95	238
Magnum Force	High performance fibre	125,000	267	53	4,905	6036	150,000	105	275
Magnum Force	High performance fibre	150,000	308	62	5,886	6036	150,000	105	275

Note: The smaller slings were proof loaded to 5 (FIVE) times WLL up to 8T and the larger slings 4 (FOUR) times WLL over 8T in line with the shackle strength safety factors. You will notice at some points the thickness to diameter 1 to 1 criteria does not match. This is because past 4:1 or 5:1 proof load the shackles become the weak link in the lifting assembly and any assembly is only as good as its weakest link. The slings are still 7.1 safety factor. These are based on real tests on Spanset/Axzions proof loader with Van Beest shackles. They do not apply to any other brand shackle despite similar dimensions. These values only apply to the Spanset specification slings listed above. For other brand slings, contact the manufacturer for their recommendations.