28th May 2010

Kite Notes

Mainly on dual line stunt kites

Disclaimer: Like anything else in life, kite flying can be dangerous. Please read any instructions that come with your kite, and also observe the safety rules about where and when not to fly that can be found in this document and in many other places. The advice given here is for guidance only, and should be used together with your own judgement as to its applicability. No book can hope to cover all eventualities and the author cannot be held responsible should you cause injury to yourself or others.

Contents

1 Introduction

1.1 Why another kite book?

Dual and quad line stunt kiting is a relatively new popular sport, having only developed in the second half of the 20th century, with many of the developments taking place since 1990. Yet the only book that covers this subject, (as opposed to the much more commercial power kiting) was written in 1992, and last published in 1997.[1]

This book is an attempt to write an up-to-date book that answers questions that someone participating in mostly two and some four line stunt kiting may have. It is not written, as in many other books' cases, by professional authors or by people who became famous in the sport. It is written by an amateur from notes made while becoming competent, and contains the information that he and his friends would have found useful to know. This information is mainly on stunt kites, but as flyers will come into contact with other disciplines at festivals and fly-ins, it also includes some information on single line kites and on power kite flying.

No book can comprehensively cover all aspects of kite flying, or even of just stunt kite flying. It is hoped that this book contains something of interest for everyone from beginners to experts. It is particularly written with intermediate dual line stunt kite flyers in mind, those who have mastered most of the basics of stunt kite flying, and are faced with maintaining their kites and learning tricks without the benefit of access to good instructors.

1.2 How the book is arranged.

The next chapter (2) gives a short history of kites in general and modern stunt kites in particular.

Chapter 3 is a compendium of kite models and types.

Chapters 4 to 9 are on two line stunt kite flying. Chapter 4 is on the basics of choosing and flying a kite and chapter 5 is on the basics of trick flying. Chapter 6 is on flying in high winds. Chapter 7 is on low wind flying and chapter 8 is on flying indoors. Chapter 8 is principally on indoor two line stunt kite flying, but also contains some discussion of indoor single and quad-line flying. Chapter 9 covers figure and ballet flying for competition.

The next chapters are on kite maintenance and repairs. Chapter 10 is on kite lines, and chapter 11 covers repairs.

Chapters 12 to 14 cover literature. Chapter 12 covers books, chapter 13 is on videos, and chapter 14 describes web-sites.

Chapter 15 is a short chapter reviewing conventions for classifying wind speeds.

If you get hooked on kiting and visit festivals and indoor events, chapter 16 gives a check list of things that may be very useful to take along.

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[1] "Stunt Kites to make and fly". See also "Put the Wind in Your Hands – Getting started flying a two line stunt kite". See chapter 12.

It is unlikely that the notes will be publicly updated from June 2010 onwards. Chapter 17 is a postscript on the notes up to May 2010, reviewing the notes intentions and their success, and discussing hopes for others to take the subject further in the future.

Chapter 18 is a glossary of kite terms. Really this is the heart of the book, and everything from chapter 4 to chapter 15 just enlarge on particular sections of entries in the glossary. However it is placed at the back of the book, just before the index, as this is where most people expect to find it.

1.3 Acknowledgements

This book wouldn't have been half as good if it were not for the many flyers whose expertise has contributed to it. Special mention goes to the community at the Prism kites on-line forum, who are especially welcoming to beginners, and prepared to answer questions at a more basic level than elsewhere. The guys on the Fractured Axel forum helped correct several of the more subtle errors. Bryan and Carl Wright of "Team Spectrum" (www.teamspectrum.org.uk) regularly give exhibitions at UK kite festivals, and were agreeable that photos of some of their demonstrations be included here.

1.4 About the author, and how the book was written

Peter Massey and his partner started serious kite flying in 2006, at his partner's behest. The first kites they bought didn't really fly, which is why he started exploring much more on the subject.

Peter was frustrated by the lack of instructors and comprehensive teaching and reference material, which prompted him to start compiling this book.

The book started as a set of personal notes, arranged in alphabetical order of topics, which formed the heart of the glossary. There was also collection of notes on particular kites, which became chapter 3. When he shared this with other flyers, they recommended new sections on beginning flying and stunting, and the book grew.

Since then drafts of the book have been shown to fellow flyers at all levels from newbies to old-hands, the evolution of the book has been strongly influenced by their feedback.

2 A short history of modern kites and stunt kites

It is said that in 1903 the Wright brothers tested early prototype models of their plane by towing them on two lines. In World War II Paul Garber, Lloyd Reicher and Stanley Potter created a manuverable dual-line stunt kite. This "Garber target kite" used a rudder to change direction, and was manufactured for army and navy target practice. An initial order of 1500 was followed by a second order for 125,000. The manual for this kite can be found at http://robroy.dyndns.info/targetkites/Edition-1/five-foot-kite.html and describes how to do loops and figure 8 patterns, dive-bombing, slow descent and hovering.

The Peter Powell stunt kite was constructed with a heavy duty polyethylene sail and originally an aluminium tubing frame, later replaced with fibre glass. The Peter Powell kite became really popular in 1975.

In 1976 the Flexifoil was developed by Ray Merry and Andrew Jones, two English industrial design students who started with a project that involved getting plastic bags flying in the air, and evolved into a two lined wing kite.

The Revolution 4 line kite was introduced in 1988 by brothers: Dave, Jim, and Joe Hadzicki.

The invention of the axel, the first kite trick, can be traced back to California in 1992, where Steve Thomas demonstrated it. Before developing what is now the classical axel, he first discovered an axel that is now called the flatspin.

Old school versus new school. At its simplest, old school kites do axels and other flat spin tricks, and new school kites sacrifice some of their flat spin ability for the ability to do roll-ups. A UK centric view of this can be found at http://www.khite.org/pivot/entryphp?id=5 - body.

3 Kite types

Here you will find short descriptions of a range of kite types. These are mainly two line sport kites, but other types of kites are also included. This does not cover every kite, just the ones that the author and his friends have been interested in so far.[2]

A few of the entries include details such as spar and bridle dimensions that are useful in maintaining the kites.

For some of the kites references to videos are included. There are many many kite videos on the internet, and there are no plans to include them all or even one for each kite. The videos references included were chosen as they inspired the writer. I hope you will enjoy them also.

3.1 0-9

Prism **3D** 2003 version is 80grams. 48inches (121cm) wingspan. 0-10mph. There are two versions. The "classic" version was produced up to 2003, and was the one that claims the indoor kite endurance record. The 2003 version is said to be deeper and slightly wider.[3] Some fliers say that the classic version is more floaty. The sail is ripstop polyester.

The 2003 version comes with 20 foot long lines of 50lb spectra. Its weight to sail ratio is quoted as 0.57oz/square foot. It has adjustable stand-offs. The manufacturers rate it as for beginner to advanced fliers.

Prism **4D** This was introduced in 2010 as an upgrade for the 3D. 2 ½ ounces, and 58 inch wingspan. Wind range indoor to 15mph. Unlike the in 3D, the solid carbon rod leading edge is ferruled.

3.2 A to E

Prism **Adrenaline** A small kite, that was superseded by the Prism Nexus. The Adrenaline could not fold down as far as the Nexus, as its leading edges and lower spreader were each a single piece of carbon.

Soyokaze **Akuji** – Designed and built by Yann Gautier. Soyokaze stopped trading in around 2008. The Akuji was made in SUL, UL, standard, comp and vented versions. The comp was essentially a standard with a slightly different sail pattern and which used tapered spars in the leading edges, and which therefore had a slightly higher upper wind limit.

Prism **Alien** 73.5inch wingspan. 7-30mph wind speed. The manufacturer rates it as for intermediate to expert fliers. It has a polyester and mylar sail. The weight to sail area ratio is quoted as 1.42oz/square foot.

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[2] For example, the entry on the Prism Quantum Pro is particularly long as this is the kite that the author uses flies the most, and has several sets of for pairs flying.

[3] See Figure 36 for a picture taken from a distance of the post 2003 3D in flight.

Figure 1 Amazing by Level 1
78 ¾ inch wingspan. 0.3mph wind speed. 4 ¾ ounces. This is an indoor and very light wind kite.

HQ **Bolero** – Polyester sail, 83cm high x 163cm across. Carbon and carbon/fibreglass frame. Wind range 4 – 24mph

Flexifoil **Buzz** – Soft dual line parafoil available in 145 and 205cm versions.

Buena Vista **Catalyst** is rated at 4 to 20mph. Was originally released by Buena Vista in around 1997. Later was manufactured by Invento. An advertisement for the original kite can be found at: www.bfk.com/kite97/3219.htm .

Prism **Catalyst** – 55 inch wingspan novice kite withdrawn around 2006/2007. 5-25mph windspeed. Carbon and fibreglass frame. Came with 65 feet x 65lb or 65 feet x 85lb lines.

Kitehouse **Cosmic TC** - Designed by Christian Stahl and released in late 2007. Cosmic TC is often abbreviated to "CTC". 250cm width. This is available in UL (3 to 12mph), standard (5 to 20mph) and vented versions, and also as a SUL called the Ghost. The UL uses Structil 6mm leading edges and spine, Icone Red lower spreaders, Skyshark P200 spine. The standard and vented use Structil 6mm carbon leading edges and upper spreader, and G-Force standard spine. The standard's lower spreaders are Icone White or Aerostuff Gold. The vented uses Skyshark Nitro or Aerostuff Gold lower spreaders.

Kitehouse **Cosmic TC XS** – The "XS" is rumoured to stand for "extra small", the XS being a smaller version of the Cosmic TC, and is intended as a trick kite.

The **Dot Matrix** was a ¾ size version of the Matrix.

Benson **Deep Space** (//bensonkites.com/kites/deepspace.html) 84 inch (214cm) (212cm measured) wingspan. 96cm measured height. 3-18mph. Variously quoted as 275grams + 15grams tail weight, or in 2009 on the Benson site, 300grams including tail weight. Measured as 300grams (11 ounces). Uses Skyshark P200 in leading edges and Skyshark 5PT in the lower spreader. The video used to launch this kite can be found at www.bensonkites.com/media/videos.html .

Figure 2 Benson Deep Space in lime green
The upper spreader has been removed for light wind flying. This is an early model, which has the white roll bars. The later kites have black roll bars.

The UL version of the Deep Space was in preparation for some years, with a few customs being produced and being user moded during this period. The UL was officially released as a production kite in summer 2009. It is listed as having P90 leading edges and 3PT lower spreader. 1-15mph. Officially weighs 238 grams including 12gram tail weight.

Specifications for the framing of some of the UL prototypes can be found under "Tweaks" at www.kiteclique.com .

Prism **E2** This kite was discontinued in winter 2008/09. 330grams (10.3oz 292grams officially). 91inch (231cm) wingspan (234cm measured). 97cm high measured. 3-25mph (5-35kph) Uses Skyshark P200 dimensioned rods in leading edges and branded rods in lower spreader. Uses a reverse turbo bridle. It has a polyester and mylar sail. It came with 85feet x 150lb lines. It was rated by the manufacturer as moderate to fast, with medium pull, and for intermediate to advanced flyers. Figure 44 shows a "jungle" coloured E2 in a fade. This kite was discontinued at the end of 2008, and replaced with the E3.

Prism **E3** Introduced in 2009, except for the spine, upper spreader and standoffs, this kite uses the same frameset as its predecessor, the E2. It has straighter leading edges,

giving it a higher aspect ratio, and also has yoyo stoppers and a weight set, which the E2 lacks.

Figure 3 Prism E3 in graphite colour scheme
Left picture shows normal flight, and right picture shows kite in a fade

In 2010 the E3's lower spreaders were changed to Skyshark P2X.

Prism **Eclipse** is an 1990s dual line stunt kite. It was available in standard, SUL and vented forms. The wingspan was always 90inches with 8.9 sq ft wing area, and an aspect ratio of 6.3. The SUL Eclipse weighed 7.0oz, had a wing loading of 0.79 oz/ft2, and a wind range 2 to 12mph. It used G-Force UL spars. The standard weighed 9.3oz, had a wing loading of 1.04oz/ft2, and a wind range of 4 to 25mph. It used .2200 Avia Sport carbon spars for the spreaders, leading edges and spine. The standoffs used 0.098" carbon. The vented Eclipse weight 11.8oz, had a wing loading of 1.33oz/ft2, and a wind range of 10 to 30mph. It used 0.2650 Avia Sport carbon spars.

From 1993 to 1997 the standard used a 3 point bridle. In 1998 a turbo bridle was introducted.

Eido kites are named after the old Japanese name for Tokyo. These use a very long set of bridle lines (e.g. 600metres) to stabilise the kite.

Element – Kite developed by Chris Goff and manufactured by Carl Robertshaw's Kite Studio. It was introduced in the first half of 2009.

Prism **Elixir** 93 inch wingspan. 3 to 20mph. The weight to sail ratio is quoted as 1.14oz/square foot. It has adjustable standoffs. The manufacturers rate this for intermediate to expert fliers.

EO stands for "Expandable Object" and is the starting name for a number of kites developed by Phil McConnachie. Prism mass produce his EO6 and EO10 designs.

3.3 F to H

Prism **Fanatic** Launched as a smaller and simpler version of the Illusion. 76inch wingspan and 5 to 25mph windrange. Used a turbo bridle and variable standoff positions. It was rated by the manufacturer as for beginner to advanced flyers.

Prism **Flashlight** 75inch wingspan. 1 to 12mph (0 to 12mph according to the instructions on its flashcard), carbon frame and polyester sail. Weight to sail ratio is 0.68oz/square foot. It is rated by the manufacturer as for intermediate fliers.

R-Sky **Frenzy Evolution**. 200cm wingspan. 4-23mph.

Fury Carl Robertshaw (www.kitestudio.com). 250cm wingspan. 4-20mph. It is available in Skyshark and Aerostuff framed versions.

Figure 4 A vented Fury

Fury .85. 210cm wingspan. The UL version is 215grams 2-12mph. The standard version is 255 grams 4-25mph.

The **Fury .85 Aerostuff** is available in UL (205grams [240grams 9oz measured] 2-20mph) and standard (255 grams 4-30mph). The UL kite takes the same 70.0cm long Aero Stuff Blue Sport S (tapered) spars in the leading edges and lower spreader (two spars in each leading edge and lower spreader). The stopper on the lower leading edge is situated 24.0cm below the wide (centre located) end of the spar. The nocks have an internal diameter of 7.8mm.

Figure 5 Fury 0.85 UL Aerostuff in custom colours

Robertshaw uses standard PVC tape (e.g. insulating tape) to secure the nocks to the leading edges.

The **Flexifoil Fury** was made of rip stop nylon and 6mm and 8mm carbon frame, and was almost half the cost of the **Carl Robertshaw Fury**.

Benson **Gemini**: 2.16m (85") wingspan. 5 to 30kph (3-19mph).

Benson **Gemini UL** 2 to 15 mph with 3 to 8 mph sweet spot.

Kitehouse **Ghost** – The SUL version of the Cosmic TC. Has a white sail as it is said that this is a particularly lightweight grade of Icarex. 2.5m wide. 5mm structil leading edges and upper spreader, and G-Force Superskinny lower spreader and spine. Rated as 2 to 10mph.

Prism **Hypnotist** – This kite was originally known as the "Mirage", but apparently the original name clashed with that of another manufacturer's kite. It has a 94inch wingspan and is for 3 to 25mph windspeed. Its measured weight is 390grams (13½ ounces). It has a nylon and mylar sail, carbon frame, and comes with 85 feet x 150lb lines, and a Prism "Flight School" DVD. It is manufacturer rates as novice to advanced. Its spine is 6mm diameter carbon, similar to that used in the Prism Quantum.

3.4 I to N

Prism **Illusion** - 86inch wingspan. 2-20mph windspeed. Ripstop polyester and mylar sail. The weight to sail rating is quoted as 1.08oz/square foot. The manufacturer rates for advanced to expert fliers. It has velcro patches to allow spoilers to be fitted for high winds.

SUL (1/2 to 10mph) and vented (12 to 30+mph) versions were available.

The kites was updated and released as the Illusion 2000 (I2K). This was often disliked. The dislike may have been due to incorrect bridle set-up. There should not be any slack on the inhaul, which may be shortened by moving the knot up which clips into the centre tee. The in-hauls should be typically 22 inches long, measured from spine to other lines. (see Prism forum, "classic Illusion" thread, 20th March 2010).

Figure 6 Benson Gemini UL in a fade
It is being flown by Piero Serra.

Prism **Ion** – Introduced in 1993. 72inch wingspan, 7.5oz, 1.13oz/ft^2 wing loading. Rated at 3 to 20mph.

Indian fighting kite – is a single line kite, usually consisting of a small square sail with a flexible bamboo frame. Without tension on the line, the bamboo frame lies flat and the kite is unstable, usually spinning about the line. When tension is applied to the line, the frame bends to form a dihedral about a diagonal of the square sail, and the kite flies in a straight line along the axis of the dihedral. Thus the kite can be steered by releasing tension on the line, waiting for the kite to rotate in the required direction, and then pulling on the line to drive the kite in that direction.

Fighting is done using cotton lines coated in a mixture of rice starch and ground glass (traditionally ground from broken coke bottles). These lines can cut other lines. The attacking kite loops its line under or over the line of the victim kite and cuts the line.

Indoor Wren – Made by the Precision Kite Company. Wind range indoors – 5mph. 66inches across x 33inches high. 2.2 ounces. Sail loading 0.59oz/sq.ft.

The Indoor Wren uses thin rods in the sails to maintain the aerodynamics of the curved sail shape even when there is not enough wind to fill the sail. It is probably for this reason that this kite is one that requires very little work indeed to keep up in the lightest of air currents. On the down side, as the sail shape is fixed, it is not so suited for tricks such as the fade where the kite is inverted.

HQ **Infinity** – Available in both standard Dynamic T15 sparred and vented T18 sparred versions.

Inner space – (//bensonkites.com/kites/ispace.html) 2.29m (90 inch) wingspan. 0 to 8kph, 0 to 5mph. Inner Spaces are: 119grams (4.25oz), 150 grams (5.2oz) measured.

Modern Inner Spaces have: 2PT leading edges, spine and lower spreader. The ferrule between the lower spreaders is 113mm long, and has 52.5mm glued into one spreader.

Older Inner Spaces are framed in Avia Skinny UL.

The recommended line for an Inner Space is 20ft x 50lb (6 metres x 22daN) indoors.

Airdynamics **Insider** – A freestyle dual line kite, introduced around 2008. Optimised for 3 to 12mph. Nominally it is 0.91 the linear dimensions of a Airdynamics T4.

ITrix made by Wolfgang Siebert in Germany. 1.52m x 0.69m. Indoor kite. 70grams. Icarex sail and Avia 3-4mm spars: upper spreader .125x32cm. Lower spreader .156x114cm.

The kite's designer flies it on 4.5 to 5.5 metre 25daN lines.

Prism **Jazz** – Novice kite introduced in around 2006. 55inch wingspan 5-25mph. Carbon and fibre glass frame. Ripstop nylon sail. Comes with 65 feed x 85lb lines.

R-Sky **Krystal FX**. 235cm wingspan. 3-15mph.

Martin Lester's **legs**. Single line kite, which inflates in the wind to form the lower half of a body. See Figure 7.

Figure 7 Footballer and female versions of Martin Lester's legs

Prism **Macro Ion** – 1990s kite. 96inch wingspan, 10.5oz, .86oz/ft2 wing loading.

HQ **Maestro**. 220cm wingspan. 4-22mph.

Matrix was designed by Andy Preston in 1996. At the time it was produced by Flexifoil. In 1999 Flexifoil handed over production to Carl Robertshaw. The Matrix was retired from production in 2005.

The Matrix was available in UL, standard, mid-vented and mega-vented versions.

Figure 8 Carl Robertshaw Matrix

MEFM – This stands for "Most Excellent Flying Machine". The MEFM has a number of novel features, including variable aspect ratio through different spacers on the lower spreader, and a bow string that runs across the lower spreaders and tensions the standoffs without the need for the lower spreaders to be bent.

MEFMs were originally designed and built by Ray Bordelon in the USA. Today they are made under license in Australia. See www.mefm.com.au .

Prism **Micron** Manufacturer rated for intermediate to advanced flyers. The classic Micron is 36inches across. The new micron is 39inches across. Both Microns use Avia 0.098" and 0.080" spars, have a 3 point bridle and have a wind range of 5-25mph.

HQ **MyFly** 200grams. No longer made. Bridle dimensions are 49cm to upper leading edge, 51cm to spine, 44.5cm to lower leading edge, and 38cm to middle leading edge.

Prism **Nexus** is 60 inch wingspan, 4-22mph. Supplied with 65 feet 80 lb lines. Manufacturer rated as novice to intermediate. Carbon and fibreglass frame. Nylon and mylar sail.

Figure 9 Prism Nexus

The Nexus is also sold as a 5-stack, with tails and 220lb lines. The kites in the Nexus 5 stack differ from the single Nexus in that they use a single piece lower spreader and a different centre tee that enables the lower spreader to be turned parallel with the spine for storage. This lower spreader and centre tee are identical to the ones used in the earlier Prism Adrenaline.

Nexuses sometimes come with bent standoffs. Mark Reed has explained that this is to make them springy to absorb shocks, and it makes the kite feel lighter and more forgiving. He recommends winding the tails in figure 8 fashion around the tips of the stack before putting the stack in its bag. He also explained that the idea for shortening the lower lines connecting the last kite in the stack was from Ray Bethell, and that the Nexus Stack prefers the tow points moved up to or past the light wind knot.[4]

R-Sky **Nirvana** 235cm wingspan. 3-20mph.

North Shore Radical. Made by Top of the Line kites. is an earlier stunt kite. Available in standard and UL versions. . "North Shore" refers to the north shore of Hawaii.

Figure 10 North Shore Radical UL

3.5 O to P

Benson **Outer Space**. 3-18mph. 90inch (229cm) wingspan. 238grams (8.5oz).

Prism **Ozone** (not to be confused with Ozone kites) 180grams (6 oz 170grams measured). Avia Sport G-Force skinny (UL) lower spreader with 101.5mm long 6mm

[4] "Flying Nexus stack Q's" Prism forum 26-27th February 2008.

diameter internal ferrule. 75inch wingspan. Avia Sport 4mm/.157 upper ferrule. Polyester and mylar sail. The wind range is 0 to 12mph. The manufacturer rates with as a kite for intermediate to expert fliers. The weight to sail area ratio is quoted as 0.75oz/square foot.

Some Prism Ozones have US patent number 4,781,345 printed on them. This corresponds to a patent titled: "Kite Strut" which was invented by a Robert J.Mileti of Connecticut, and filed on 16th June 1987. The patent describes the use of heat shrink possibly polyolefin possibly thermo-plastically glued stoppers on kite struts. The patent mentions that the struts are preferably made from plastic material preferably reinforced with fibreglass. Carbon fibre is not mentioned.

Figure 11 A late series Prism Ozone
The earlier version had mylar along the spine.[5]

Benson **Phantom** – This is a kite with a very long history. While the design has always had something to do with Tim Benson, over the years it has been manufactured in a large number of variations, by a variety of manufacturers.

[5] See Figure 36 for an example of the earlier version in flight.

The Phantom dates back to 1989, and was first marketed by Benson Kites, then by: "Highflyers, "Benson Kites", "Fizz Sports Kites" and finally "Benson Kites" again. [6]

The modern Phantom can be traced back to Tim Benson's work in 1994 and 1995, when he developed a revised Phantom alongside the "Box of Tricks", "Reflex" and "Fusion" trick kites. The result was the Phantom Elite (nowadays again simply called the "Phantom"). The kite was officially launched in May 1995. The "Fizz" brand was no longer used after August 1995, and the kite was manufactured and marketed under "Benson Kites"

Prism **Prophecy** - 85 inch wingspan. 2-20mph. Polyester and mylar sail. The weight to sail area ratio is quoted as 1.0oz/square foot. The manufacturer rates it as for intermediate to expert fliers.

Pro Dancer – Designed by Jon Trennepohl and Wayne Brunjes. Made by Skyburner. This is a SUL/indoor kite, rated at between 0-10mph. It is 96 inches across by 40 inches high, has a polycarbonate sail, weighs 5oz and uses a Skyshark 2PT frame.

Figure 12 Skyburner Pro Dancer

Pro Wren The Indoor Wren's big brother. This kite is 6' 8" x 3' 4" and weights 3.8oz. Rated 0 to 8mph. Sail loading 0.59oz/sq.ft.

3.6 Q to R

Prism **Quantum** is 87inch (2.21metre) (84 inches officially) wingspan. 400grams. 3-25mph. Ripstop nylon and laminate sail. Comes with 85 feet x 150lb lines. Manufacturer rated as novice to intermediate. The spine is 6mm fibreglass rod and is

[6] This information was gleaned from Bill Lancashire's excellent series of threads about the Phantom posted in the Fractured Axel forum during May and June 2009. These threads go into far more detail about the various versions. Unfortunately forum rules prevent the links for these threads being posted here.

roughly 34 3/8th inch long, with an end cap making an overall length of 34 ½ inches. The upper spreader is .230 inch fibreglass innered tube. The other spars are carbon rod.

In 2010 yellow and black striped "caution tape" panels were introduced.

Prism **Quantum Pro** is 2.4m wingspan x 1m height. 2-20mph. SUL, UL and vented versions are produced to special order.[7]

The ***standard*** version uses SkyShark P200 with 5PT lower spreaders and a .2200 x 24.75 inch upper spreader. The upper part of its spine is 667.5mm long P200 and the lower part is 200mm long P300. There is an end cap at the tail end of the spine. Its wind range is 2 to 20mph according to the Prism site. Cutting Edge kites (source given below) give the wind range as 6 to 20mph with a competition range of 6 to 14mph. Its measured weight is 320grams (11½ ounces), excluding its weight kit. The sail to weight ratio is quoted as 1oz/square foot. It has a ripstop polyester and mylar sail. The manufacturer rates it as for intermediate to expert flyers.

The ***Super Ultra Light (SUL)*** version has: a SkyShark spine of P90 with P200 lower end, 2PT leading edges, 3PT lower spreaders, .1600inch carbon tube x 615mm upper spreader. The lower leading edge rods (without nocks) are 795mm long. Its wind range is 1 to 8mph with a 2 to 6 mph competition range. Its measured weight is 230 grams (8 oz). If the "ladybugs" the plastic caps that secure the standoffs to the sail, go missing, they can be replaced with 3mm E clips. These do not have to be stuck on, but are pushed on with small pliers, and surprisingly the lines do not catch on these as much as they catch on the ladybugs.

A video showing what the SUL can do can be found at: http://www.youtube.com/watch?v=b9KaHaAzfgY . This is a very good video, but unfortunately the image resolution is relatively poor.

The ***Ultra Light (UL)*** version has a SkyShark P100 spine, 2PT leading edges, 3PT lower spreaders, .2100 upper spreader.

The ***Variable Vented (VV)*** version has several vents covered by removable patches. It has a SkyShark P300 spine, 5PT leading edges, 7PT lower spreaders, and .2200 upper spreader. The upper spreader is 63.0cm long, which is nominally the same as in the standard. Its measured weight is 410grams (~14 ½ ounces) with its vent covers, and 380grams (~13 ½ ounces) without the vent covers. Prism's website quotes its wind range as 18 to 35mph. Team Cutting Edge member Jerry Cannon quotes its wind range is 12 to 28mph with 14 to 30mph competition [8] Personal experience indicates that, with all its vent covers on and with 90lb 25metre long lines, the kite flies in winds as low as 9mph.

From a discussion on the Gone With The Wind forum with team Cutting Edge member: Jerry Cannon, there is the following advice on how the VV was set up for competition for fast precision and ballet routines. Team Cutting Edge started using the VV at 14mph on 150lb x 130ft of Laser Pro Gold. The kite is set up with the

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[7] Team Cutting edge member: Jerry Cannon wrote reviews of how each kite is flown, which were originally available at www.cuttingedgekites.com/prismreview.html . These pages appear to no longer be available.

[8] . Source www.cuttingedgekites.com/qpro2.html . This web page is no longer available. The information above is corrected to show that the leading edges are 5PT rather than P300.

bridle on the closet knot to the kite, and the big lower vents were only half covered across their upper half. At 16 to 18mph the lower vent covers are removed. At 18 to 20mph in bumpy wind, breaks are added running from the inner standoff to the upper spreader. If the kite is moving too fast 300lb lines can be used. The bridle line is moved one knot away from the kite. This supports the centre tee better in higher winds, and so reduces the stress on the lower spreaders. At 20mph the upper vent covers are removed, as their absence is said to make the kite centre spin in lower winds. Above 20mph a second break is added running from the lower spreader to the upper spreader. For 28mph upwards the bridle knot is moved out past the last knot and a 4 inch brake is added.

Expert flyer Kevin Doublet has modified UL, standard and VV QPros to make them more tricky. His modifications for the standard are given at http://vkites.googlepages.com/kevindoubletqpro . The bridle is a 3 point, where the top leading edge connection has been moved up 3cm with the help of a spacer. The bridle arm lengths are: top leg 45.5cm (17.91 inches), middle leg 62cm (24.41 inches), lower leg 41cm (16.14 inches). The aims of these modifications are: to move the tow points further away from the centre for better backspin type tricks, and to move the upper tow point higher to give easier tipping forward for yoyo type tricks and crazy copters, with better nose away control in lazy susans, and making it easier to kill the kite in any position. The frame uses 5PT for the upper leading edge and 7PT for the lower leading edge, with 62.5cm P200 for the upper spreader, and 75.8cm Black Diamond Nitros in the lower spreaders. The spreaders are 5mm shorter to allow for them not going so far into the elbows as the original spars. The aim of the reframing is to make the kite stiffer and more responsive. For weights, the original metal centre tee has been replaced with a plastic centre tee from a Prism Illusion, with a 15gram weight around the base of the spine. Kevin states that he finds the modified kite better with lines of 38 to 45 metres, rather than lines of 30metres or shorter.

Figure 13 Two Quantum Pros
These ones are photographed from the other end of 40metre long flying lines, and they are resting side by side in the snow, waiting to be flown in pairs ballet and figure practice. These kites are QPro standards, but they are almost exactly identical in appearance to the SUL and UL versions. The optional yoyo stoppers fitted to the left one can just be made out. These are absent from the one on the right.

Prism **Radian** was an early Prism kite, first released in Spring 1992, and discontinued in 1999. It is said to have been the most complicated kite that they ever produced. 96inch wingspan, 11.1oz, 1.27oz/ft2 wing loading, 5-30mph wind speed, .220 and .2300 Avia Sport carbon spars.

To celebrate the 5th anniversary of Radians, in 1997 a limited edition of 75 numbered predominantly black and white Radians were made.

Benson **Reflex** – This was framed in 6mm Structil rods. The spar lengths are: upper spreader = 50.5cm, lower spreader = 70cm, upper leading edge = 57.5cm, lower leading edge = 82.5cm, spine = 75.25cm. The standoffs are 21cm of 3mm carbon rod.

Revolution – A company and a series of quad line kites. The properties of these kites are summarised in Table 1. The Exp is the cheapest introductory kite, and is believed to be constructed from ripstop nylon. The other kites are believed to be constructed from ripstop polyester.

Name	**Wingspan** (inches)	**Weight** (oz)	**Wind speed** (mph)
1	108	SLE 11.5 Standard 10	2-25
1.5 SLE	92	10	4-25
1.5 SUL	93	7	0-8
1.5 Vented	92	11.75	10-25+
2	74		5-20
Exp	93	8.8	4-15
Blast	115	13.75	3-12 recreation 12-25 power
Power Blast 2.4	120	18	0-10 recreational 19-20 power
John Barresi 1.5 Pro	91		2 wrap: 3-10 3 wrap: 4-16 both: 6-20
John Barresi 1.5 Vented	91		3 wrap : 5-20 4 wrap: 6-30 both :10-45
Shockwave	96	11	6-25
Supersonic	90	10	4-20
Sonic vented	90	11	7-30 10-28 performance
Indoor	99	4.5	0-2

Table 1 Types of Revolution kites

Revolution was originally and briefly called “Neos Omega”, but by summer 1989 had changed its name.

A good video showing just what a Rev can do can be found at http://www.youtube.com/watch?v=OKqZU4WwTS0&feature=channel_page .

Rokkaku – Said to be Japanese for “six corners”, reflecting that it is a hexagonal kite. These are Japanese single line fighting kites. There is a story that says they were

developed to let the young men of villages fight each other with kites rather than directly.

Figure 14 Rokkaku kite
This particular one is part of a series first released by HQ in summer 2009. The other two kites in that series had identical materials and dimensions, but different pictures. One showed the head of a pharaoh, and the other showed a stylised drawing of a lizard.

Rotor kite – Also known as a "UFO" kite, this kite consists of a structure that rotates about a horizontal axis while in flight. The rotation is such that the structure is moving from the flyer at the top and towards the flyer that the bottom. This gives a difference in air pressure – being greater at the bottom and less at the top, thus giving lift. This lift mechanism is called the Magnus effect.[9] The mechanism by which the rotation is maintained is a bit of a mystery. In some kites the rotating structure is shaped so that it catches the wind more at the top than the bottom. However one structure uses flat symmetric surfaces for the rotor, and therefore it is not clear what could be the mechanism for catching the wind unevenly.

For more information see: http://www.cit.gu.edu.au/~anthony/kites/rotor/ .

3.7 S to Z

HQ **Salsa** Ripstop nylon and hybrid carbon-fiberglass frame. 182cm x 90cm. 4-24mph wind range.

Sky Sport **Sea Devil** – 36 inches high, 90.5 inch wingspan. SUL: 7oz/199 grams 0-5mph., Ultralight 8.5oz/239grams, Light 10.8oz/310grams 3-15mph, standard 11.3oz/323 grams 5-25mph.

[9] The Magnus effect is named after German physicist Heinrich Magnus, who described the effect in 1852. Sir Isaac Newton had already described the effect for spinning tennis balls in 1672 and Benjamin Robins (1707-1751) had explained the deviation of musket balls by the same mechanism.

Seven – Made in Sweden by Sportkitedesign. The standard was introduced in 2009. See www.sportkitedesign.se .

HQ **Shadow** 207cm wingspan. 1-10mph.

Kitehouse **Sissy** 180cm wide x 75cm high. This was originally designed by Sascha Treder as an indoor kite, but has gained a reputation as an outdoor zero wind kite. The leading edges, spine and upper spreader is mostly 4mm structil, with an Avia Skinny UL lower spreader. There is a single standoff on each side. The sail is Icarex with ripstop nylon leading edge tunnels and Dacron reinforcement. The bridle is 3 point. The original Sissy was done in pink, hence the name "Sissy".

The Sissy was never issued as a production kite. A limited run of single colour kites was made.

Flexifoil **Sting** is a soft parafoil available in 1.2, 1.7, 2.4 and 3.3 square metre versions, with dual line bar or 4 line handles. The Sting 2 was released in 2007, and has a mesh across the leading vents. The 1.2 square metre version is 175 cm across x 75 cm deep (maximum dimensions).

Flexifoil **Stranger** – Released in 1993/94. In 1994 a video was released to accompany it.

Flexifoil **Symphony** is a dual line kite.

Airdynamics **T4** - Dual line ballet competition kite, introduced in around 2007. 244cm wide and 108cm high. Available in "Zero" SUL (220grams), UL (255grams, 1-12mph with 2-10mph optimum), standard (305grams, 3-20mph with 4-15mph optimum), vented "V1" (8-25mph with 10-20mph optimum, up to 30mph with brakes), and megavented "V2" versions. The Zero uses a Skyshark P90 and 3PT frame. The UL uses a Skyshark P90/P100 and 3PT frame. The standard uses a P200/P100 and 5PT frame. The vented versions use Skyshark P400/P200 leading edges and Nitro lower spreaders.

Jest of Eve **Talon** was introduced in 2007.

The standard version is for 3 to 25mph (with a 5-15mph sweet spot) . The Frame is P200 upper leading edge, black diamond nitro lower, 6mm Structil spine with P200 reinforcement at the centre T, 5mm structil upper spreader and 7PT lower spreader. It is 223cm wide by 90cm high and weights approximately 300grams.

The ultra light version is for 1-12 mph winds (with a 2-8mph sweet spot), and weighs about 245grams. It has P90 upper and middle leading edge, 3PT lower leading edge, a 3PT lower spreader, Structil 5mm upper spreader, 5mm Structil spine.

Figure 15 Jest of Eve Talon
The one shown is a UL, but it visually indistinguishable from the standard.

Prism **Total Eclipse** – 108 inch wingspan, 12.4oz, G-Force STD frame, 1.0oz/ft^2 wing loading, 2-25mph wind range.

L'Atelier **Transfer** is a 240cm wingspan kite with 3 – 24 mph wind range.

Jest of Eve **Trident** This is available with eye, alien or skull graphic centre panels.

The standard version has 3-18mph wind range (6-10mph sweet spot). P200 leading edges and 5PT lower spreaders. Structil 6mm spine and 5mm upper spreader. Active bridle. 305 grams with 20grams of ballast installed.

The UL version has 1 to 10 mph wind range (2-6mph sweet spot). 3PT lower and P90 upper leading edges, 3PT lower spreaders, 5.5mm structil spine and 5mm structil upper spreader. 3-point bridle with fade activator. 80cm high x 225cm across. Weighs approximately 250grams with 10grams of ballast installed.

Figure 16 Jest of Eve Trident
Alien graphic shown. The photo is of a UL version, but this is visually indistinguishable from the standard version.

Skyburner **Widow Maker** 93 inches (2.36m) across x 39 inches (99cms) high. Uses a P-31 sail. Designed by Jon Trennepohl and Wayne Brunjes. The standard is rated as 3 to 30mph with a claimed weight of 10oz. The lower spreaders are Skyshark Nitro Clear coat and the spine is P300. It has a 3 point bridle. The ultralite has Skyshark 3PT Black Diamond clear coat lower spreaders, 2PT edges and a P100 spine. Its claimed weight is 8oz, and it has a turbo bridle.

Figure 17 Skyburner Widow Maker
The kite in the background being tended to by the father and son is a Prism Nexus in "spectrum" colour scheme.

Prism **Vapor** 80inch wingspan. 48 inches high. 0-5mph wind speed. 5.4ppz (153grams) weight. 0.53oz/square foot weight to sail area ratio. Avia G-Force Skinny frame and turbo bridle.

The Vapor had at least three different versions. By 1997 it used four adjustable standoffs, a compound turbo bridle and a new sail shape. The third version had a longer 22inch upper spreader.

The Prism **Zephyr** was released in summer 2007. 1-17mph. It uses 3PT for the lower spreader, P100 for the leading edges, P300 for the spine (not P100 for the spine as stated in its manual) and 5mm protruded tube for the upper spreader. It comes in a hard case designed to accommodate 2 kites inside, with the facility for an extra kite to put under bungee ropes on the outside. The measured weight is 300 to 310grams without tail weight.

For 1 – 6mph light winds, the Zephyr's designer Mark Reed recommends 50lb x 75 foot lines, a loose leechline, the spine weight and top spreader removed, and the bridle tow points against the upper limit knot or ½ inch beyond it.

Figure 18 Prism Zephyr (eggplant colour scheme)

4 Beginning two line delta stunt kite flying

This chapter is an introduction to dual line delta stunt kite flying. First the issues in choosing and buying a kite are briefly overviewed. Section 4.2 runs through the terminology of the various parts of the kite. Section 4.3 discusses how to assemble a kite and section 4.4 discusses how to pack the kite away. Section 0 discusses safety. Section 4.7 explains how to start flying.

4.1 Choosing a kite

It is an unfortunate fact that larger stunt kites react slower and are easier to control. So the cheaper smaller kites most often sold as beginner's kites (typically costing £30 to £60) are much more difficult to control than the large 80inch across kites sold for around £200 for advanced or expert flyers. The main advantage of "beginner's kites" is that because they use solid fibreglass or carbon spars, they usually very strong and able to survive many hard crashes. Consequently as soon as the beginner is past the crashing the kite into the ground stage, it can be worthwhile to buy a full size kite. High quality kites are often available second hand, e.g. through the "For Sale and Wanted" section of the Fractured Axel forum.

4.2 Kite anatomy

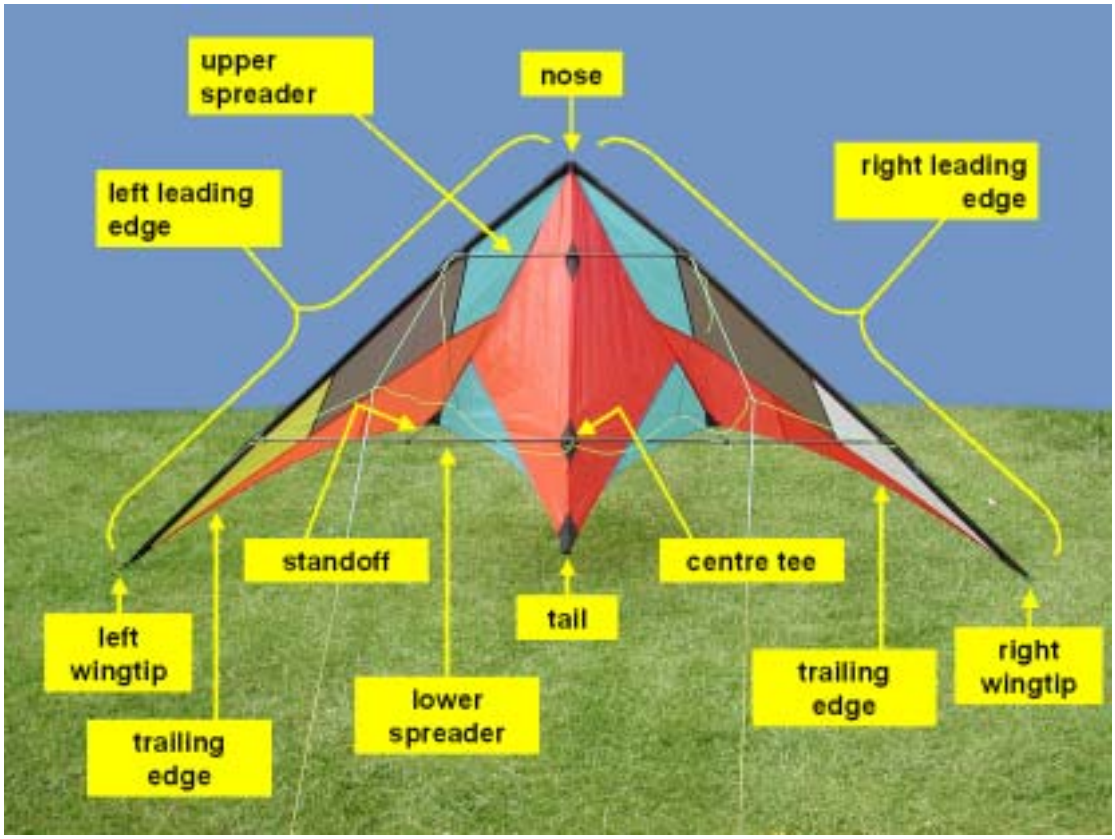

Figure 19 Major parts of a two line delta stunt kite

Figure 19 shows most of the major parts of a relatively simple dual line sports kite. The sail has as edges: the *left leading edge*, the *right leading edge*, and at its base: the *trailing edges*. The lower spar running across the kite is known as the *lower spreader*, or *lower spreaders*, according to whether it is one solid length, or can be disassembled into two pieces when the kite is put away. A *spine* (not shown as it is at

the back side of the kite) runs between the *nose* and *tail*, and is connected to the lower spreader(s) by the *centre tee*. The figure shows a kite with just two *standoffs* (one each side) that run between the lower spreader(s) and the trailing edges. These standoffs push the sail away from the lower spreader(s) and give the sail its shape.

The region of sail between the standoffs (innermost standoffs if the kite has more than one standoff on each side) is known as the *keel*, and is responsible for giving the kite its stability in flight.

Within each of the leading edges of the sail there is a spar, which in many larger kites can be dissembled into two pieces so that the kite can be folded down into a more compact form for storage and transportation. This spar is also often called the leading edge, with the distinction between the leading edge of the sail and the leading edge spar only coming from the context of the discussion. For example "a rip in the leading edge" very probably refers to a leading edge of the sail, but "a leading edge break" normally refers to damage to the spar. When the leading edge spar can be broken into two, the part situated near the nose is called the *upper leading edge*, and the part situated near the wingtip is called the *lower leading edge*.

Often in discussions the names are abbreviated: LE = leading edge, LLE = lower leading edge, LS = lower spreader, ULE = upper leading edge, TS = top spreader.

The spreaders are attached to the leading edge spar by pieces of plastic or rubber that because of their bent shape, are called *elbows*. The upper spreader is attached by the *upper elbows* and the lower spreader(s) is attached by the *lower elbows*.

In many sport kites, there is a *leach line* that is hidden within the trailing edge. The purpose of this line is to tension the trailing edge so that it does not flap in the wind. In some kites it is adjustable so that optionally the trailing edge can be allowed to flap, increasing the kite's drag (slowing it down) and also creating noise.

The kite is attached to the kite lines by a network of lines called *the bridle*. The basic bridle, called a three point bridle, is shown in Figure 20. Three lines: the *uphaul*, *outhaul* and *inhaul*, meet at the *tow point*. The uphaul is attached to the leading edge at an attachment point that is somewhere near or at the upper elbow. The outhaul is attaché to the leading edge at an attachment point that is somewhere near or at the lower elbow. The inhaul is attached to the spine at a point at or near the centre tee.

The figure also shows a *keeper line*. This line stops the inhaul from dropping so low down that it can be caught around the tail at the base of the spin. On many kites the keeper line is not present. A *leader* line runs from the tow point to the kite line. The leader is sometimes called a *pig tail* due to the knot at one end that is used for tying on the kite line.

The names: *inhaul*, *outhaul* and *uphaul* are used throughout most of these notes. However one should be aware that these names are not always used, and are not always used with the meanings given above and in the figure. For example, probably because in some kites, the uphaul and outhaul is a single line, some call this single line the outhaul, and distinguish between the parts above and below the tow point by referring to the upper and lower outhauls. Others don't talk about inhauls and outhauls at all, but refer to inner and outer yokes.

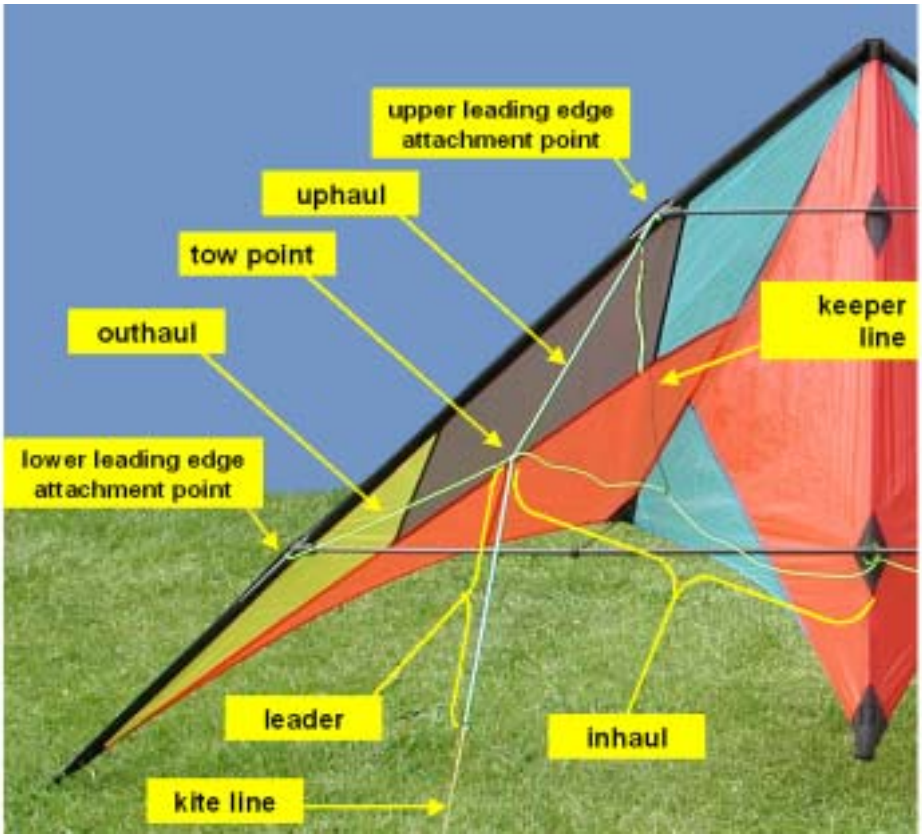

Figure 20 Parts of a 3 point bridle
Left side shown. The right side is similar to the left side, but mirrored about the centre line of the kite.

The three point bridle is the most basic sort of dual line sport kite bridle. *Dynamic* bridles are often used. These differ from the three point bridle in that one of the uphaul, outhaul and inhaul lines does not run to the tow point, but instead is attached to the leader at another point. There are also various sorts of *active* bridles, which use additional lines to affect the bridles' behaviour, and which are discussed later.

4.3 Kite assembly

The upper and lower leading edges are first slotted together. Then the sail is tensioned against the leading edge spars. Next the upper and lower spreaders are inserted. Then the standoffs are positioned.

The leach line is adjusted if necessary once the rest of the kite has been assembled.

On windy days, the order in which the kite is assembled does not change, but after the sail is tensioned against the leading edge spars, it is best to lean the kite upright into the wind, and to half-kneel behind the kite to prevent it tipping over. Then the upper and lower spreaders, and standoffs can be inserted. There is a video of this in the tutorials section of the Close Encounters website:: www.closeencounterskites.co.uk/tutorials.htm .

4.4 Kite disassembly

Kite disassembly is essentially the reverse of kite assembly. In windy situations, it is best to stand the kite into the wind and to half-kneel behind the kite to prevent it tipping over. Then the upper spreader can be removed, and then the standoffs are disconnected from the lower spreaders. Next the lower spreaders are removed from

the leading edge connections. This allows the sail to be blown away from the lower spreaders, which reduces the chances of the lower spreaders making a hole in the sails. Then the female lower spreader is removed, followed by the male lower spreader.

If the kite's leading edges cannot be, or to save assembly time: are not to be split, the leading edges are placed next to the spine, and the sail is straightened, and then rolled up from the outside towards the spin and leading edges. Finally the spreaders are placed next to the spine, and disassembled kite bundle is secured with a rubber band or velcro and placed in the bag.[10]

If the kite's leading edges are to be split and folded, then this is done, leading to the spine and split leading edges folded next to each other. The sail is flattened, with the standoffs laid flat within the sail. Then the sail is rolled from the outside to the spin and leading edges, the spreaders are placed next to the spine, and the disassembled kite bundle is secured with a rubber band or velcro strap and placed in the bag.

4.5 Storage and transport

Most mid and high end kites come with long fabric bags, and are stored in these. For transporting collections of kites, there are a variety of kite bags. Some are essentially just bags that are large enough to hold a number of kites. – Ski bags can be a cheap substitute for this type (Figure 21). Others have compartments for individual kites, and roll up for transportation, and roll out flat to provide access to the kites and act as a clean working surface. – This "burrito bag" type is a kiting version of a tool roll (Figure 22 and Figure 23).

Figure 21 A ski bag used to carry sport kites
Ski bags are relatively cheap, and can be used to carry kites with their leading edges assembled. This ski bag is being used to carry 6 kites with folded down leading edges in one

[10] There is a video of this in the tutorials section of the Close Encounters website:: www.closeencounterskites.co.uk/tutorials.htm .

half (the fuller part at the top). The bottom half contains bags of linesets, stakes and airbrakes, and other accessories.

Figure 22 Prism's burrito bag used to hold kites with unfolded leading edges
Top view is the rolled up bag, which is 182cm (71 ½ inches) long. The bottom view is the unrolled bag. There are pockets for 10 kites (only 6 kites are shown), and others can be secured by rolling up the burrito bag around them. The mesh pockets to either side can be used for linesets. There are also some slim pockets for spare spars.

Figure 23 Prism's burrito bag used to hold kites with folded leading edges
With leading edges folded down, most sport kites are slightly longer than half the length of Prism's burrito bag. Therefore in order to get the burrito bag to fold and roll up into a shorter length, it is necessary to put kites only in pockets on one side of the bag. It is also helpful if the mesh pockets on that side only are used. Then the side of the bag that is unfilled can be folded over the used side, and the bag folded up to give the compact bundle shown in the lower illustration.

The spars in the frames of lighter kites: UL, SUL and indoor kites, can easily be damaged during storage and transportation. It is best to store these kites in rigid cases, such as the long cardboard tubes used for posting. Or for convenience in transportation, "drawing tubes" can be used. These are (normally plastic) tubes that are meant for carrying rolled up drawings and plans, and which often come with handles or shoulder straps, and often have a method of adjusting their length. With the larger diameters, several kites can be stored in one tube. There are also a few purpose built cases, such as Prism's shell case, which is suitable for protecting two kites.[11]

[11] The Prism shell case was originally only available with Prism's Zephyr. However it was released for sale on its own in early 2010. It can hold many full-sized kites folded down, such as Prism's QPro

Figure 24 Plastic storage tubes for transporting lighter kites
The upper tube is sold to protect fishing rods, and comes with two red end caps. It can hold one kite and has been cut down to length. The lower tube is a drawing tube, as described in the text.

SUL. However many indoor kites, (e.g. ITrix, Prism 3D) do not have folding down spreaders and cannot be accommodated. Neither can larger indoor kites such as Benson's Inner Space.

Figure 25 Prism's shell case
The upper view shows the closed case. The lower view shows the open case, with two kites folded up in their sleeves. A lineset is stored beneath bungee straps in the lid, and there are spaces for two further linesets. The yellow gadget visible in the storage pocket is a kitemate spar remover, similar to those shown in Figure 46 and Figure 47.

As a guide, if a kite has any Skyshark: 2PT, P90 or P100, or Avia .157inch or G-Force Skinny UL spars, it should definitely be transported and stored in a rigid case.

4.6 Kite safety

Before discussing actual flying, it is necessary think of safety, both of yourself and others. While sports kites are generally quite light, typically weighing less than half a kilogram (less than a pound), they travel at speed, and are connected to the flyer by long strong lines. Consequently there are many ways in which humans, pets, livestock and property can be damaged. Below is a non-exhaustive list of things to avoid.

At the risk of stating the obvious, please don't:

- Fly where people or property can be hit by the kite.
- Fly in winds that are too high for you to control the kite. – You may loose control of the kite and cause damage to life or property, or in the case of larger kites, you may yourself be injured by being pulled along by the kite.
- Fly near electricity power lines. – Even on farm land, these often carry many thousands of volts. There is always a danger that electricity may be transferred to you or others via the kite lines. And the large distribution lines (e.g national grid in the UK) carry much higher voltages.
- Fly in thunderstorms. The rain wets the lines and makes them better conductors, allowing the kite and lines to be a tall lightening conductor with the flyer making the connection to ground.
- Fly near traffic. The kite may distract drivers, causing an accident, or if the lines break, the kite may go across the path of a road vehicle, again causing damage or an accident.
- Fly near livestock. The livestock many be upset, and also may panic and hurt themselves or others.
- Fly near horseriders. Some horses panic in the presence of fast moving unfamiliar objects.
- Fly near bushes, trees or fences. These may damage the kite. More rarely the kite may damage them.
- Fly using Kevlar or other sharp lines, unless special precautions are being taken to avoid them causing injury to yourself (e.g. your hands) and others.
- Fly near unfamiliar dogs, or dogs known to react badly to kites.

If you find yourself with a dog attempting to catch your kite, or otherwise reacting to it, perhaps the best bet is to if possible, fly the kite as high as it will go, and keep it there until either the dog goes away or its owner has had a chance to retrieve it. If you cannot keep the kite in the air, or the kite is already on the ground and cannot take off before the dog reaches it, then the best thing to do is to keep the kite still, preferably putting the lines on the ground so that he dog is less likely to get caught in them. If the kite isn't moving, many dogs will just sniff it or run around it.

Please clear up any debris, including broken lines, tails and bits of kite, that could injure wildlife or domestic animals.

Please also observe the laws in your neighbourhood. These laws may cover: the maximum weight and/or size of kite you are allowed to fly, the use of buggies and skateboards, etc., the maximum height you can fly to, and whether you are allowed to fly at all (e.g. it is often forbidden to fly near airfields).

And for if the safety measures fail, consider insurance. For many people, the third party cover of their home insurance policy may already cover themselves and their families, even when they are sport kite flying (but not some forms of power kite flying) on trips away from home.[12] It is worth checking this with your insurer. Flyers

[12] As a rule of thumb, if your home insurance covers residents for third party claims if they hit someone with a golf ball, then it is likely to also cover sport kites. But still please check with the insurer.

who belong to kite clubs and associations may also be covered through their association, but that cover may only extend to official club events or competitions. One significant difference between home insurance cover and kite club cover may be the amount of cover. For instance in 2009 in the UK, home insurance typically provided £2,000,000 of cover, but club insurance typically provided £5,000,000 of cover. While any claim is unlikely to reach the £2,000,000 limit, the cover may be insufficient for participating in some kite festivals, where £5,000,000 cover is often a prerequisite for participating in the flying events.

4.7 The first few flights

A really good in depth review of beginning two line stunt kite flying can be found in Bill Taylor and Kim Taylor "**Put the Wind In Your Hands – Getting started flying a two line stunt kite**" Taylor's, 1997 – This spends almost all of its 48 pages on the subject, and is downloadable at http://www.gwtwforum.com/pdf/dualbook.pdf. The text below just summarises the main points.

Before flying, make sure that the lines are the same length. Ideally, they should be the same length to within about ¼ inch or 1cm. Also check that the lines are being held in the correct hands. The common convention is that the right hand line is coloured coded with red or a very similar colour.[13] This colour coding may only be in the line sleeving, or may include the handles or straps.

When flying at the beginning, keep your hands next to each other and in front of you.[14] You will turn by moving one hand forward or backward relative to the other, and when the hand is returned next to the other hand the kite should go straight.

To launch the kite, start with it leaning backwards on its tips facing you near the middle of the wind window. As the kite is leaning backwards, the wind is forcing it into the ground. Pulling the kite towards you will enable the wind to drive it upwards, and the kite will rise into the air.

Having got the kite off the ground, the next task is turning it. Normally pull turns are taught and attempted first. However in higher winds, say above 8mph, push turns may be preferable, as the turn happens slower.

Push turns are also very useful for sharp angled turns. This is because the kite slows down in the push turn when tension to the wing to the outside of the turn is released. This gives time for the flyer to get the angle of the turn just right. And at the end of the turn, when tension is picked up again, the kite accelerates away.

To land the kite, at the start the easiest way is to fly the kite to the edge of the wind window, and as the kite's speed dies away, let it float down onto a leading edge.

Avoiding damaging crashes. The most damaging crashes occur when the beginning pilot sees that the kite is heading to the ground and panics and tenses up, pulling the lines towards him, causing the kite to go even faster downwards and into the ground. Ideally the flyer should just turn the kite away from its downwards path before it hits

[13] The common convention is different for 4-line Revolution kites, where the right hand line is colour coded blue.

[14] Precision flyers often fly this way. Trick flyers often fly with their arms by their sides. They do this so that they can throw their hands a long way forward or backward the tricks. However flying in a straight line with the hands not next to each other is a fairly advanced skill, and is best left to later.

the ground. However there are occasions where the kite has become tangled in the lines or lost a part in mid-air, or simply that the pilot does not feel confident in executing the turn. Then the technique to avoiding or minimising damage is simply to run towards the kite. This reduces the tension on the lines, which reduces the kite's speed and consequently the damage caused.

5 Beginning 2-line trick flying

In trick flying the kite does various crazy things in the sky, rotating and tumbling in a variety of ways. Trick flying is rather like magic tricks, as in order to achieve many tricks certain manoeuvres are done which may be invisible to the observer, and hard to see even when the trick is replayed in slow motion. Here we attempt to explain what those manoeuvres are.

The next three sections are on the basics of trick flying: how the kite is pulled (sections 5.1 and 5.2), and in section 5.3 how to let the lines go slack.

Sections 5.4 onwards cover specific tricks. This builds up from stalls and the front flip, through axels (spins starting with the nose facing the flyer) and then flat spins (spins starting with the nose facing away from the flyer), into back flips and Lazy Susans (spins while the kite is on its back). Next Insanes (which are related to Lazy Susans) and half axels and cascades (which are related to axels) are covered. Then the fade (kite on its back with nose facing the flyer) is introduced. This leads to lateral rolls and back spins.

Section 5.14 is on basic recoveries from landings and launches.

Section 5.15 is on stalls. This leads onto discussing two point landings (section 5.16).

Advanced recovery techniques are left to last (section 5.17).

Hopefully you will pass on your trick skills to others. Section 5.18 gives some tips that the author has found useful.

5.1 Normal flying versus tricks

In normal flying with normal push and pull turns, all the bridle lines of the kite are to a greater or lesser extent under tension. With trick flying, the kite is being oriented in such a way that when the flyer pulls on the lines, only some of the bridle lines pick up the tension. For example, if the kite faces the flyer as in normal upwards flight, but the nose is dropped lower than usual, when the lines are pulled, the force is transferred via the lower bridle lines to the lower part of the kite. Similarly if the nose is further back than usual, the force from the lines is transferred via the upper outhauls on the bridle to the upper part of the kite. It is this transfer of force to just one or two of the bridle lines that allows the kite to be tricked.

5.2 Pulls and pops to the line

Many trick flyers use the term “pop” to describe some of the pulls on the line. In essence a pop is a short tug on the line, applied at just the right time to apply force to the intended bridle lines, and to apply that force to apply momentum to the kite in the intended direction. If the pop/pull is applied for too long, then some of the force will not be applied to the intended bridle lines, or in the intended direction. In the sections below there are descriptions of which bridle lines are being tensioned, and the direction the force is being applied.

Physics teaches that the work done (energy given to the kite) is given by the force times by the distance it is applied. Therefore to apply the same energy in a short pop as in a long pull, the pop has to use more force. Unfortunately not all kites can cope with a strong force being applied. In low wind kites and those made from cheaper frame materials the frame distorts in response to a strong pull, and this distortion both absorbs the energy and results in the kite not flying correctly. Consequently these

kites have to be flown in a gentler manner than carbon tube framed UL and standard sports kites.[15]

To apply a sharp pop to the flying line, start by holding the lines under tension, with the arms fairly close to your side, rather than with your arms far in front or far back. Momentarily release the tension on the line you are going to pop by moving your arm forward. Then pull back quickly. By the time the tension gets applied to the line, the arm has built up speed, and the tension is applied very quickly with a strong force.

5.3 Slack line work and the wind window

Many of the tricks described below require one or more of the lines connecting the flyer to the kite to be slack at some point. Consequently it is useful to allow the kite to float free with the wind, with the lines loose. With the kite directly downwind this could be achieved by the flyer moving as fast as the wind speed in the direction of the kite. Of course in higher winds the flyer will not be able to run as fast as the wind, and some other method of ensuring that the kite can float freely must be used. This is made possible by flying the kite off to the side of the wind window, and then moving towards the kite to allow it to drift downwind. The closer the kite is to the edge of the wind window, the slower the kite flyer has to move to ensure that the lines are slack. Figure 26 gives the geometry involved in explaining this effect.

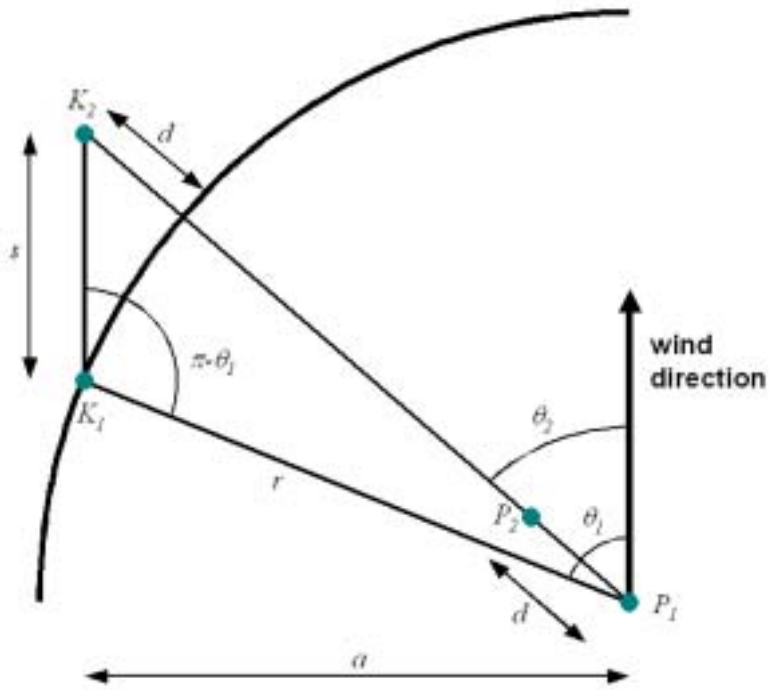

Figure 26 The geometry of floating the kite downwind

[15] As a rule of thumb, the best sports kites are those that can withstand the greatest forces without distorting the frame. Some achieve this by using a pre-stressed construction. E.g. the Benson Deep Space has its leading edge tubes stressed by being curved within the sail. Others such use very stiff spars. E.g. the Skyburner Widow Maker standard uses Skyshark P300 and Nitro spars.

The kite flyer (aka pilot) is initially at point P_1, with the kite a little above the ground at point K_1. The kite lines subtend an angle θ_1 to the direction of the wind. The kite lines are *r* long, and so if the pilot stands still, the kite can move along a curved surface of radius r centred on P_1 where the pilot is standing.

Now suppose that the kite is allowed to float in the wind a distance *s*, from K_1 to K_2. In order to allow this, the kite flyer must move to point P_2, which is a distance *d* from P_1. One can show that the distance *d* is given by:[16]

$$d = -r + \sqrt{r^2 + s^2 + 2\,s\,r\cos\theta_1}$$

One can also find a formula for the angle θ_2 , which is the angle subtended by the kite line to the direction of the wind at the end of the float.[17]

$$\theta_2 = \tan^{-1}\left(\frac{r\sin\theta_1}{s + r\cos\theta_1}\right)$$

Here is an example of the consequences of these formulae. Suppose that the pilot is using 25metre lines (a common length for outdoor two line stunt flyers), and the kite is to be allowed to float for 1 metre. If the kite it first flown out to an angle $\theta_1 = 85°$, then d = 0.107 metres. I.e. the flyer has to move about a 1/10th of the distance he would have to move if the kite were flying downwind. In a 25mph gale, this means the difference between moving at 25mph (about the speed of a typical professional road racing cyclist) and moving at 2.5mph (a gentle walking pace). The kite is now at an angle θ_2. = 82.73°, and if the kite were allowed to float with the wind a further 1 metre, then (using θ_2. as the new θ_1) the pilot would have to move 0.146metres, which in a 25mph gale would mean walking at 3.65mph.

As the arms can be thrown forward must faster than a man can walk, good stunt flyers give much of line slack with their arms. Nevertheless you will still find that they often walk forwards to give slack. Also you can walk away from the kite to help it fly to the very edge of the wind window (large as possible θ_1), and then recover your position while giving slack.

5.4 Simple stalls and the front flip

If the tension on the lines of a 2 line sport kite is released gently, it will eventually stop flying and start to fall. When the kite is no longer flying but rather falling this is called a stall. The way it falls is shown in Figure 27. This can be shown by holding a kite in the normal flight position, and then letting it go. It can also be demonstrated by flying when the wind is just enough to fly the kite. When the kite is near the ground and flying upwards move the arms towards the kite and walk forward to release the tension on the lines. The kite should fall back as shown in the figure. [18]

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[16] For those readers who are mathematically inclined, the proof involves using the cosine rule for the relation between the angle π-θ_1 and the triangle with sides of length: *r*, *s* and *d*+*r*.

[17] This formula is calculated using a right angled triangle, whose non-right angles are at points P_1 and K_2. It has one side of length $a = r \sin \theta_1$ opposite θ_2 and another side of length $s + r \cos \theta_1$ adjacent to θ_2. The tangent of θ_2 is the ratio of these two sides.

[18] The kite used in the illustrations in this chapter is loosely based on the geometry and 3-point bridle of the Carl Robertshaw Fury 0.85. However the sail panels are radically different. In order to help give a sense of orientation, the right wing is coloured red and the left wing is coloured blue.

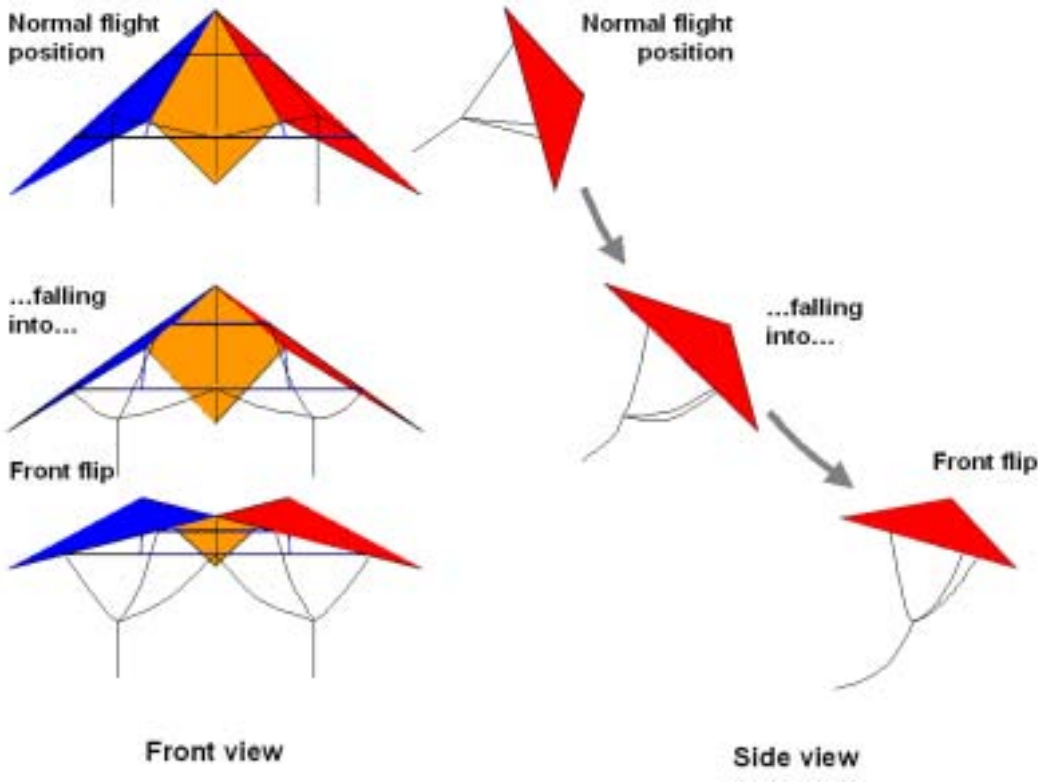

Figure 27 Front flip from a simple stall

Diagram shows how kite falls after lines have been released from normal flying position. The distances between the normal flight and front flip positions vary with the kite. Here the distances have been exaggerated slightly in order to space out the kite drawings and labels.

The position with the nose towards the flyer and the front of the kite facing downwards is known as the "front flip". The front flip is useful as a starting position for doing many manoeuvres, such as the axel and the roll-up, as explained elsewhere in these notes. In the next section some of the methods of starting an axel first require a front flip. The method shown above is one of the simplest ways to get into a front flip, but there are others. Two of the most commonly used ones are: 1) to lateral roll out of a fade, and 2) to pull out of a backflip.

The method describe above for achieving a front flip can be contrasted with the method described in section 5.7 for getting the nose to fall backwards into a back flip. The key difference is that: for the front flip the kite speed is reduced to zero (into a stall) by releasing the line tension relatively gradually, but for the back flip the line tension is removed suddenly from a quickly flying kite.

5.5 Axels

An axel is when the kite rotates roughly in the plane of its wing. It starts with nose of the kite being the closest part to the flyer. The rotation is started by a pull on one line that is transferred to the lower leading edge attachment point. The rotation works better if the wing being pulled is set back. So to achieve an axel, it is necessary to first put the kite in a position where the nose is towards the flyer, and one wing (the wing that is to be pulled) is further back than the other wing. The main trick to doing

an axel is achieving this position. The following subsections describe a few of the ways of doing this.[19]

5.5.1 The "Easy Peasy" way

The following method for first doing axels is adapted from Andy Wardley's recommendations for doing it the "Eezy Peezy" way. See. http://wardley.org/kites/reckites/freestyle/axel1.html .

From the centre of the wind window, fly sideways towards one edge. As you approach the edge and the kite slows down to a halt, pull turn with the inside hand, so that the kite turns upwards. Then push with the same inside hand so that the kite stalls. Now give a quick pull with the same inside hand, followed by pushing with both hands to give slack to the lines.[20] The kite should rotate in an axel.

The above method has the advantage that from the start of the pull turn, through the push for the stall, up it the fast pull (or pop) for the axel, the same hand is being used.

5.5.2 An alternative for opposite direction axel rotations

An alternative method which uses the outside hand for the pop to give an axel with the opposite sense of rotation is as follows.

From the centre of the wind window, fly sideways towards one edge. As the kite approaches the edge and it slows down to a half, pull turn with the inside hand, so that the kite turns upwards. Now push with both hands so that the kite stalls. You should find that the outside wing of the kite is further away from you than the inside wing. Now give a fast pull (or "pop") to the outside wing, and the kite should rotate in an axel. As the kite rotates in the opposite sense to the earlier description, this trick is called the "reverse axel".

5.5.3 Axels in any direction

Once the flyer has mastered basic axels, as described in the above paragraphs, the next challenge is to axel with the kite initially pointing in any direction. As always, the trick is to have the tip of the wing on which the axel pop is to be performed, furthest away from the flyer. When this is done, the kite does not have to be stalled at the start of the axel.

For example, when the kite is being turned in normal manner, then the pull on one line being transferred to all three of the bridle attachment points naturally puts that wing closer to the flyer than the other, with the nose being the part of the kite that is closest to the flyer. So an axel can be started by a pull on the other line. This is a spin axel.

5.5.4 Multiple axels

The problem with doing multiple axels on the more modern pitchy kites is that the nose comes up near the end of the rotation. The following tip to correct this issue comes from http://wardley.org/kites/reckites/freestyle/multi2.html . As the nose is

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[19] If none of these descriptions help you, you can also find a useful check list of axeling tips at: http://www.kites.tug.com/Axel/ilh.txt .

[20] If it helps, the push with the outside hand can be done at the same time as the pop with the inside hand.

coming around from the far side, when it is facing roughly to the side, give a short gentle pull with the other hand to the one that did the axel pop. This pulls the nose down.

5.6 540 flat spins

In a 540 flat spin, the kite first flies downwards. Then it is put into an uneven flare where one wing is further away than the other. Next the wing nearer the flier is pulled to put the kite into a spin. The spin is allowed to continue for at least a full rotation. Then the lines are tensioned to complete the final half-rotation and to pull the kite into normal flying position.

It is all very well giving the above description, but it is often the case that the 540 is easier to describe and demonstrate than to learn. Below first in section 5.6.1 an easy way of doing a 540 where the spin occurs near the edge of the wind window is reviewed. This technique might help the flier to get started with the 540 and have some success with it. But if the flier does not succeed with this, section 5.6.2 may still be of use. In section 5.6.2 the conventional 540 is described in more detail, common problems with its execution are identified and remedies are suggested.

5.6.1 The "Easy Peasy" way

The following method for first doing 540s is adapted from Andy Wardley's recommendations for doing it the "Eezy Peezy" way. See http://wardley.org/kites/reckites/freestyle/ezpz540.html .

From the top of the wind window, fly down towards a lower corner of the wind window. The kite should turn to one side, as it flies down the window's edge. (i.e 4 or 5 o'clock on the right side of the window, or 7 or 8 o'clock on the left side of the window). As the kite starts to slow down, push with the outside hand, to release the lower wing, which should move away from the pilot. Now pop with the inside hand, which starts the flat spin.

If the kite slides back in towards the centre of the window while it's spinning, then that is a variation of the 540 flatspin, called the Flashback.

5.6.2 The conventional 540

The following steps describe a conventional 540.

1) The trick starts with the kite flying downwards.

2) The flyer throws both arms forward and if necessary (i.e. for stronger winds) steps or lunges forward to give slack to the lines, which allows the kite to flare. When the arms are thrown forward, one is thrown forward more than the other. This gives an uneven flare with one wing further away. For example if the left arm is thrown forward further than the right, then the wing to the right side of the kite goes further away, and as seen from the flyer, the kite not only flares but starts spinning clockwise, in that the further wing (on the right) is starting to go to the left and below the line of sight to the nearer wing.

3) When the rotation has got to where the leading edge of the wing on the left is starting to point in the direction of the flyer, the line for that wing is pulled to spin the kite. For example, if it were the left arm that was thrown further forward in step 2), then the right hand pulls the line to develop the clockwise spin.

4) Slack is given to the lines (if necessary by stepping forwards) until the kite has completed over a complete turn. At the end of this time, the nose is pointing away from the flyer, but is coming around.

5) The recovery into normal flying is started by tensioning the line for the wing that is coming around, which continues the spin until the nose is facing towards the flyer. In the example given in steps 2) and 3), the pull would be with the left hand.

6) The recovery into normal flying is completed by picking up the tension on the other line (in the example: with the right hand).

There are several problems that can occur with the trick. These include:

a) The kite never gets into a good flare, or doesn't stay there for long enough for the trick to be executed.

b) The kite does not rotate enough in the initial flare for it to be in position for the tug that builds up the spin.

c) During the tug of step 3), kite pulls out of its flared aspect, so that the wingtips are upwards and the nose is downwards.

d) The lines wrap around the wingtip during the rotation.

e) The kite pulls out of the trick during the rotation.

Problem a) can be a symptom of the trick being done in too high a winds, so that the flier cannot release line tension fast enough or for long enough before the wind pulls the kite away and picks up the line tension again. If this is the case, performing the trick away from the centre of the wind window can help. Alternatively problem a) may be due to the kite being flown downwards for so long that it has picked up a lot of speed. – To alleviate this, start the flare just after a downwards turn.

The issue with problem b) is in how the arms are thrown forward. In order to get a good rotation, the arm that is being thrown forward the furthest has to start moving forward before the other arm.

When c) happens it is an indication that the pull is happening early. The main force of the pull in step 3) should happen when the wingtip of the wing being pulled is pointing back towards the flyer.

Problem d) can be an indication that insufficient slack is being given during the rotation.

But problem d) is more likely to be due to the angle of the kite during the rotation. Often the flare should not be completely flat (i.e. kite should not lie in a completely horizontal plane) as then during the spinning wing tip may meet with one of the flying lines. Even if the flying lines are given slack before the wing tip reaches them, it is possible that gravity has not had time to pull them out of the way.

The solution is to make sure that the initial flare is not completely flat. The nearer wingtip should be the highest point of the kite. Then the wings will float above the flying lines during the rotation.

Problem e) is due to not being able to give sufficient slack, or to maintain sufficient slack, during the rotation. Try stepping forwards during the rotation, doing the trick at the edge of the wind window and/or doing the trick in lighter winds.

5.7 Back flips

A back flip is where the kite flips out of its normal flying position into a position where the back of the kite is facing you, with the nose facing downwards.

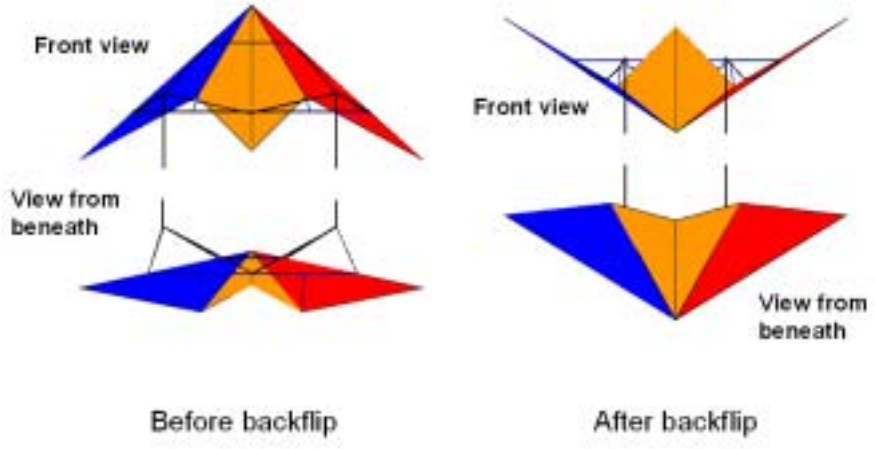

Figure 28 Kite orientation before and after a backflip

To understand how a backflip works, try the following experiment. Take a ruler (or similarly shaped rigid structure such as a strip of card), angle it so that one of the long edges is slightly raised (rather like an aircraft wing has its leading edge raised) hold it by one or both ends, and wave it through the air, raised edge first. If you are very sensitive, you may be able to feel the ruler being lifted by the current of air over its surfaces, just like a wing is. But don't worry if you can't feel this effect. Now again wave the ruler through the air raised edge first, but this time, in the middle of the wave, let go of the ruler. You should find that it spins about the long axis of the ruler, with the spin starting with raised edge first moving back over the rest of the ruler.

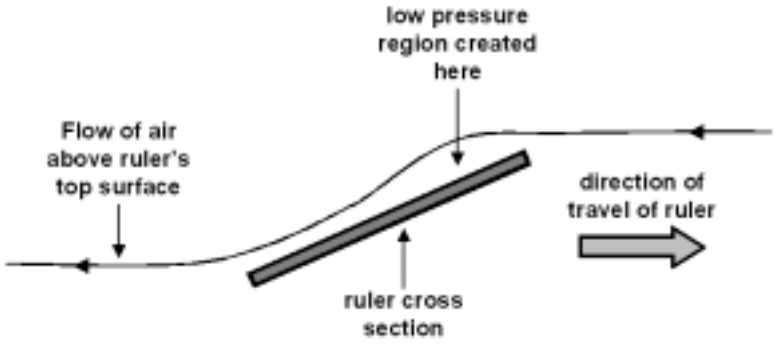

Figure 29 Air flow over the top of an angled ruler

What is happening is that when the ruler or any similar flat structure with a raised leading edge moves through the air, the air flows over the raised edge, but can't change direction fast enough to get to the top surface just behind the raised edge. So there is a low pressure area just behind the raised edge. Further down the upper surface the air flow has had time to change its direction to get to the surface, and the pressure reduction is not so great. The result of this disparity in air pressures is that the ruler wants to flip over, which is what happens when you let go of it.

The same thing happens with a sport kite. When flying normally, the reduced pressure behind the top of the sail means that if the lines are suddenly released, then the kite flips over backwards. Just how fast and far it flips depends on the kite's shape and weight distribution, and on how fast the kite is flying before the lines are released.

So, to do a backflip, start with the kite facing nose upwards, then pull down with the arms ending with a flick with the hands in one smooth movement to make the kite fly fast. Then push the arms forward to release the lines. If the pull or flick gives jerky movement, it causes turbulence and the kite doesn't fly normally and then the back flip doesn't always work.

If you cannot get a backflip, then the following exercise may work for you. Without a kite or lines, start with your arms stretched out in front of you, and swing them down and back. You should find that the arms reach a limit when the hands are a little behind the body. And if you have let your arms swing loosely, they will bounce away from that limiting position, perhaps with the elbows bending as the arms swing forward. This arm swing replicates what is needed for a good backflip. The down and back swing of the arms pulls the kite faster and faster, and then the sudden stop followed by the bending of the elbow as the arms swing forward quickly releases tension on the lines and gives the kite enough slack for it to go on its back. The bending of the elbow on the forward swing allows the forearms to quickly become horizontal is of great help in the sudden release of line tension and the throwing of slack.

If the backflip is shallow, as shown below or with the nose higher up relative to the rest of the kite, it is possible to deepen the backflip by pulling evenly on both lines, and then letting go. The kite will rotate for the reasons explained above, giving a deeper backflip, shown in Figure 31.

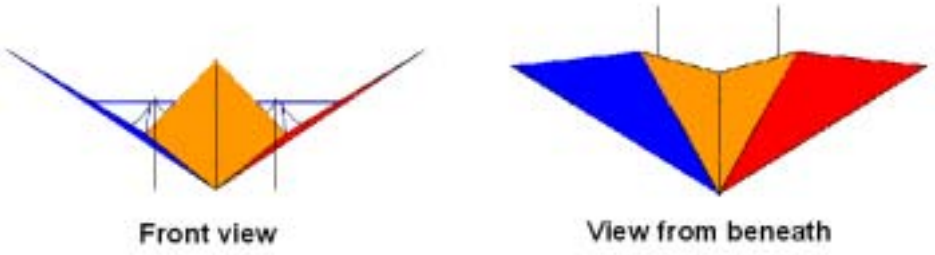

Figure 30 Shallow backflip

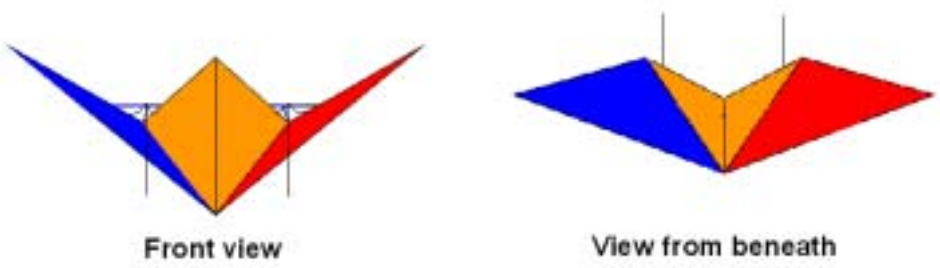

Figure 31 Deep backflip

If a larger even pull is applied with plenty of slack to the lines afterwards, the kite may rotate from the backflip all the way around to normal flying position, but with the lines wrapped around the kite (Figure 32).

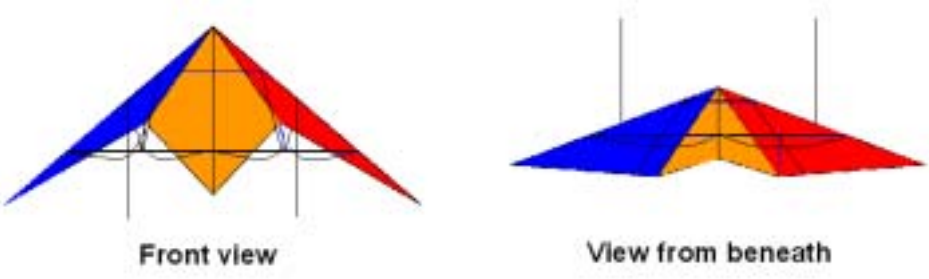

Figure 32 Wrapped kite

The method of achieving a wrapped kite by going from normal flying position into a backflip, and then from the backflip to normal flying position but with the lines wrapped around is called the "two-pop wrap". The first "pop" is the pull to set up the kite for rotating into a backflip, and the second "pop" is the pull to set up the kite for rotating further until the nose is uppermost again in normal flying position.

5.8 Lazy Susans

The Lazy Susan starts from a backflip, and while staying in the backflip, the kite is made to rotate in a full circle about a vertical axis. To do this one of the lines is pulled to start the rotation.

There are many things that can go wrong with a Lazy Susan. These include:

1) The pull on the line that starts the rotation may pull the kite out of the backflip so that the nose faces upwards and the kite is in normal flying position.

2) The kite may not rotate all the way round.

3) The kite looses so much altitude during the rotation that it hits the ground before the rotation is complete.

4) When the pulled line is released the kite rotates about a horizontal axis (with the nose moving further down and then back up). This often results in the lines being tangled around the kite.

5) The Lazy Susan rotation is stopped because the line being pulled is kept under tension for too long.

The following explanation attempts to cover how to a Lazy Susan while avoiding these problems.

The first point to make sure that the kite has gone far enough in the back flip. Just how far is necessary varies with the kite and flyer. If the kite is not sufficiently far back, it is more likely to be pulled all the way out of the back flip. Also, the further the kite nose is downwards in the backflip, then the more the kite will resist loosing altitude during the backflip. It is also very useful to have the wing on the side that is to be pulled for the rotation closer to the flyer than the other wing. For example, if the kite is as shown in Figure 33a), then the kite is ready for a Lazy Susan pulled on the left side. But it is in an awful position for a Lazy Susan pulling on the right hand line. The reason is that if the pull is on the right line, then the force of the pull passes close to the centre of the kite, and much of the pull just causes the kite to float towards the

flyer. However, a pull on the left line passes further away from the kite's centre, and more of this pull is converted into a rotation.

Figure 33 Balanced and unbalanced backflips
Views are from flyer's side.

To obtain an uneven backflip, the fast release in the backflip must be uneven, with the hand of the wing to be popped starting to push later than the other hand, and with it travelling not as far as the other hand. Many teachers suggest that the hand to be popped stops near the waist, and the other hand is extended far in front of the flyer.

Once the uneven backflip is attained, then for the reasons explained above, the Lazy Susan is started by pulling with the arm on the near wing side. With some kites the pull is gentle. For example the Prism QPro SUL prefers a gentler pull. The pull's force/speed should be maximum around the position shown in Figure 34d). A guide to this position is that the leading edge on the side being pulled should appear as a vertical line to the flyer. The reason why the pull's force should be maximum here is that at this angle the line of the force passes furthest away from the kites's centre, and therefore this angle is the most effective for creating rotation. Having the maximum pull at this point increases the chances of the kite rotating all the way around.

Figure 34 Stages of pull for a right handed Lazy Susan

The pull should end at around the position shown in Figure 34e). If the pull ends sooner, then there is danger that the sudden stopping of the pull, will throw the kite into a rotation about an axis that is close to that of the lower spreader. The nose would move first down and come up again, and often this wraps one or both lines around a wing tip. The reason for this unwanted rotation happening is as described in section 5.7. However if the pull ends at Figure 34e), then any rotation due to the effect described in section 5.7 would rotate the near wing upwards and the far wing downwards – because this is across the full wingtip to wingtip width of the kite, such a rotation would happen slowly and not get very far. Moreover, the raising up of the near wing helps in the second reason for ending the pull at Figure 34e), which is that by this point, much of the pull is pulling the kite towards the flyer, creating lift at the near wing and so helping the kite to retain altitude.

So to recap on the common problems encountered in a Lazy Susan:

1) *The pull on the line that starts the rotation may pull the kite out of the backflip so that the nose faces upwards and the kite is in normal flying position.* – Make sure that the kite is deep enough in the backflip at the start of the pull, and that the wing being pulled is the closest to the flyer.

2) *The kite does not rotate all the way round.* – The maximum effort of the pull should be at position d) in Figure 34.

3) *The kite looses so much altitude during the rotation that it hits the ground before the rotation is complete.* – Continue the pull until position e) in Figure 34.

4) *When the pulled line is released the kite rotates about a horizontal axis (with the nose moving further down and then back up), and the lines tangle around the kite.* – Do not end the pull until position e) in Figure 34.

5) *The Lazy Susan rotation is stopped because the line being pulled is kept under tension for too long.* – End the pull at position e) in Figure 34.

5.9 Insanes

The insane is a move where the kite starts rotating due to a deliberate snag of the line around the wingtip. The line is caught behind the wingtip. The rough axis of rotation is approximately in-line with the run of the caught line back to the flyer. The direction of rotation is with the nose falling forwards.

The easiest way to go into an insane is to backflip and pull a line for a lazy susan rotation, but after the pull keep tension on that line. This stops the lazy susan rotation and starts the kite rotating around an axis close to that of the lower spreader. The unpulled line should be kept completely free of tension.

To get out of the insane, when the nose is moving downwards apply tension to the loose line. This moves the kite into a backflip, with the trapped line moving away from the wingtip and along the lower spreader. The kite will probably continue rotating about a horizontal axis and into normal flying position.

The insane can also be entered from an axel. One way of doing this is to retain tension on the popping line after the pop for an axel. This will stop the axel and trap the line behind the popped wing.

5.10 Half axels and cascades

The half axel is generally done from an initial situation of the kite flying sideways. To start with it is easier if the half axel is done with the kite flying towards the edge of the window. The lower wing is given an initial pull. This sets up the kite for the next step, which is a sharp pull to the upper line, that because of the orientation of the kite, is transferred to the lower outhaul of the upper wing. At the same time as this pop, the tension to the lower wing is completely released. The pop to lower outhaul of the upper wing is done immediately after the pull to the upper wing. The kite's upper wing is pulled to the outside of the wind window, and because neither of the upper outhauls are now under tension, the nose drops backwards to face away from the flyer. The result is that the kite has rotated to a belly down nose away position.

If the kite was left to its own devices (with no tension to the lines), then it would continue to rotate relatively slowly with the nose turning to face sideways in the opposite direction to its initial direction, and the initially low wing becoming the high wing. However to do a sharp half-axel, when the nose is facing away, a pull is

applied to the line connecting the initially low wing. This applies tension to the upper outhaul on that side, and causes the wing to rise up quicker than it would otherwise.

For a half-axel, tension is then applied to both lines and the kite flys away in the opposite direction to that at the start of the trick.

To understand how the initial setup for the half axel works, take an assembled kite (without flying lines) and rest it on a wingtip, with the other wingtip pointing up in the air. I.e. the spreaders are vertical. Hold with one hand on the kite frame, say at the upper wingtip, to keep the kite balanced on the lower wingtip. Stand in front of the kite. Now let the kite fall backwards a little. Then with the other hand gently pull the tow point of the bridle of the wing that is touching the ground, and adjust the direction of the pull so that the upper and lower outhauls and the inhaul are all under equal tension. You might find that you can hold the kite on its wingtip just by pulling on the lower tow point, or you may find that you still need to lightly hold the kite frame. But what you will find is that when you are applying tension to the bridle of the lower wing, the wingtip of the upper wing is pointing somewhat away from you. This is what happens in the setup for the half axel. The act of pulling more on the lower wing than the upper wing lets the upper wingtip fall backwards. Then a pull on the upper wing will be transferred mainly to the rear most bridle attachment point, which is along the lower outhaul to where it connects to the lower leading edge. Therefore this pull will pull the upper wing towards you while allowing the nose to start to fall away.

A cascade is a series of half-axels done to alternate sides, with each half axel being done immediately after the one before. If you can do a half-axel, then the challenge is to arrange for the kite at the end of that half axel to be set up ready for the next half axel. Specifically, at the end of the half-axel, the tip on the top wing has to be set back.

For some kites, such as Benson's Inner Space, the kite naturally half-axels to a position where the top wing tip is set back. However with many other kites, the half axel has to be modified slightly. To understand why, consider what happens with a straightforward axel or half axel that is started from the nose pointing sideways. A quarter turn later, the nose has moved away from the flyer, the top wing has gone to the side. After a half turn, the nose has moved to the other side, and formerly bottom wing is facing upwards and slightly forwards. This wing's tip only moves sufficiently away from the flyer for an axel input when the kite has gone through a three-quarter turn. This is too late for doing a cascade of half-axels. Some way must be found to force the wing to move back earlier in the half-axel.

So start again with the conventional half axel input to the upper wing. The nose moves backwards and the upper wing comes around to the side that nose was facing. Just after the quarter turn point, the nose is facing just past away from the flyer, and the upper leading edge attachment point is behind the centre of mass of the kite (which is along the spine, just above the centre tee). Then a gentle pull on the line that is connected to the wing that was lowest at the start of the axel will to pull the wing towards the flyer and upwards. It also starts the nose moving towards the flyer. Consequently when the formerly low wing is uppermost, the nose has moved to be the nearest part of the kite to the flyer. This gives the set-up for the next half-axel. For a

cascade this half-axel is done with the other hand to that of the last half axel. For a comet it would be done with the same hand each time.

5.11 Fades

In going into a fade in moderate to strong winds, it is very important not to give too much slack after the initial tug for the fade. The reason is that if too much slack is given, the kite will rotate over into the fade position, until it achieves tension on the lines through the lines being wrapped over the leading edges. When the leading edges strike the lines, it is like a bow striking the strings of a violin. – The leading edges will bounce off the suddenly taut lines, and the kite will quickly rotate out of the fade.

Rather than this happening, it is better to reduce the slack after to tug for the fade. Then the rotation will slow down as the kite pulls against the lines as the wing tips go back. This is a far gentler way of stopping the rotation than letting the kite's leading edge bounce against the lines, and as the pull is close to along the plane of the kite sail, does not impart much counter rotation.

5.12 Lateral rolls

This is the classic way of getting out of a fade. By pulling on just one line, the wing on that side is pulled forward. And because of the angle of the wing, as the wing is pulled forward, it floats upwards and around the spine until the kite is on its belly. Then pulling on both lines puts the kite into normal nose up flying position.

5.13 Back spins

[21]A back spin has the kite rotating on its back in the plane of the wing. The problem is how to start the rotation, given that a simple pull on one line will put the kite into a lateral role. One key is to give an accelerating pull to one line, only stopping the pull when the wing tip is coming around to face the pilot. If the pull is stopped early, then this causes the nose to fall backwards, which by the time the kite is halfway through the back spin, puts the kite in normal flying position. Hence the backspin has become a lateral roll. The extra pull can also give lift if the wing being pulled starts lower than the other wing, so that the leading edge of the wing being pulled is roughly horizontal when the its wing tip is pointing towards the flyer.

If a back spin proves to be impossible, the kite only performing a lateral roll, try starting the back spin with the nose lower down in the fade.

5.14 Recoveries

Here some of the easier recoveries are listed, which should get the kite off the ground and flying again. More advanced recoveries are described in section 5.17.

5.14.1 Cartwheel

This recovery is for when the kite is resting on a leading edge, belly facing the flyer, and involves a pop to the wing that is away from the ground. The recovery generally works best with some wind to help its rotation, which pushes strongest if it is striking the wing to the outside of the window. So, if the kite is not already resting on the

[21] In contrast to all the other tricks described here, the writer regularly has extreme difficulty in performing a backspin. Therefore this section contains pointers, rather than anything that the writer considers definitive.

leading edge that is to the outside of the window, gently pull one line and then the other until the kite has rocked onto the leading edge to the window's outside.

Once the kite is resting on the leading edge that is to the outside of the window, then a firm pull on the outside line will pull the wing on the inside of the window towards the pilot. At the same time as this firm pull, the other line should be slacked. The outside wing comes face on to the wind and is blown further around. The rest should be that the kite more or less rotates about its nose until the wingtips are closer to the flyer than any other part of the kite. Then the lines can be pulled together to bring the kite into normal launch position, resting on its wingtips.

5.14.2 Leading edge launch

This recovery is for when the kite is near the edge of the wind window, and resting on a leading edge with its nose pointing to the outside of the wind window. It works by the wind driving against the kite and propelling it sideways. To launch pull the upper wing towards you. As the wing starts to fall pull on both lines (if necessary walking or running backwards) to launch the kite. The kite should start flying sideways, at first dragging a leading edge along the ground, but as it picks up speed, this leading edge will move away from the ground. As soon as the leading edge is clear of the ground and the kite is flying normally, it is important to turn away so as to avoid the kite stalling at the edge of the wind window.

5.14.3 Side pop-up

This recovery is for when the kite is resting on the ground, belly down with its nose away from the flyer. The recovery is easiest done by popping the wing that is to the outside of the window,[22] but can with more difficulty be done by popping the inside wing.

For a recovery popping the outside wing, first the nose should be adjusted so that it is facing slightly towards the inside of the window. This is done by pulling on the outside hand, which because the kite is facing away, pulls on the inside wing. Once this is done, then the kite can be lifted off the ground with a sharp pull with the inside hand to the outside wing. Because of the way the wind strikes the wing's face as it is pulled around, the kite should rise off the ground[23], and it should also start facing to the outside of the window. Then tension is applied to the inside line, with less tension to the outside line, to turn the kite upwards and into normal flight.

5.14.4 Sleeping beauty

This recovery is for when the kite is on its back with the nose facing towards the flyer. It is also called the "reverse back-flip take-off"[24] or "reverse turtle" launch.

Move the nose so that it is pointing slightly to the inside window side. Then pull on the inside hand to pull the outside wing around. When the kite nose is towards the flyer pull on both lines to pull the kite upwards into normal flight. If required, the kite can be set down on its wingtips by releasing the line tension as soon as the kite is establishing normal flight.

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[22] The recovery is covered in Dodd Gross's Flight School DVD.

[23] A pull to the inside wing is not as effective, as the wind would be striking the wing less head on.

[24] Dodd Gross demonstrates the launch under this name in his Flight School DVD.

5.15 Stalls

5.15.1 Maintaining a stall

If a wingtip starts to drop during a stall, then pull the line on that side to recover. N.B. This is the opposite action to what you would do in normal flight. In normal flight to move a wing upwards, one would push the line on that side, or pull on the line at the other side to turn the kite so that the wing rose. In contrast, during a stall, the wing that is dropping is not getting enough air flow over its surface to maintain its float. Reducing the tension on that side would reduce the air flow even more, and cause the wing to drop faster.

5.15.2 Side slides

While doing a side slide, the kite is being moved into or out of the window by the wind pushing a sail that is angled about a vertical axis. So to move the kite sideways, it is necessary to very gently create that angle.

5.16 Two point landings

These can look very impressive. One moment the kite is flying fast either just above the ground or down towards it, and the next moment the kite is on the ground, settled on its wingtips.

The two point landing can be separated into two issues. The first is to change the orientation of the kite so that it is nose uppermost after the manoeuvre. The second is then to get the kite to settle on the ground. The first issue can be dealt with using a conventional pull/push snap stall to combination turn the kite around, killing its momentum at the same time. Then if the wind is light enough the kite can be settled on the ground by running forward.

However it is more impressive if the kite flies downwards from its nose uppermost position, thus landing firmly on the ground. This is accomplished by the kite being in a partial backflip, with the nose away from the pilot, and the sail sloping so that the wind striking it pushes the kite downwards. To achieve this position, the conventional snap stall is modified so that the pull of the second line starts as the pull of the first line is being completed. Consequently the pushes of the two lines have an overlap, and it is this overlap in pushing after a combined pull that puts the kite into a partial backflip.

5.17 Advanced recoveries

The recoveries listed here are not the simplest way of recovering from a landing or crash. Instead they are interesting and more advanced ways of relaunching a kite.

5.17.1 Nose pop-up

This recovery is described on Dodd Gross's Flight School DVD. It can be used when the kite is initially lying on its back with the nose facing the pilot. Pull evenly on the lines to pull the bottom of the kite upwards, so that the kite is balancing on its nose. When the kite spine is approaching vertical, but the bottom of the spine is still pointing away from the flyer, pop both lines. This will pull the lower leading edge attachment points, pulling bottom of the kite rapidly to the flyer, which will pull the kite into a flare position. As the kite moves past the vertically upside down position,

it will also raise the kite into the air, as the movement of the lower kite towards the flyer displaces air and is converted into upwards motion.

When the kite is slightly flared, that is with the lower spine pointing over the flyer's head, the kite lines can be popped again. This time this applies a pull to the upper leading edge attachment points, and the kite should flip from a flare into a fade.

The nose pop-up can also be used if the kite has just nose-dived into the ground, that is provided of course that the crash was not so hard that it caused damage to the kite or dislocated spars. Just ensure that the kite stays balanced on its nose and give enough slack to allow the bottom of the kite to move back from the flyer beyond where the kite is vertical. Then pop the lines to create the flare with the kite lifting off the ground as before.

5.18 Teaching others

These notes are intended for people when they don't have the benefit of an expert on hand. But they can never do as good or as quick a job as tutorage from a flyer that knows what to do and how to explain it. If you master tricks, then hopefully sooner or later, you will be willing to pass on those skills to others. This section gives some advice on how to tutor.

One of the big problems the author has encountered, both in learning and in teaching others, is that it simply is not enough to demonstrate a trick, no matter how slowly, for the student to pick up the actions. As a student I have spent many frustrating hours trying to duplicate what I think I had repeatedly seen, only to find out much later that there was some important difference between what I thought I saw and the actions necessary. And the most common reaction I have encountered in demonstrating a trick, even when doing it very slowly in low winds, is mystification on what has just happened. This mystification can last through an entire afternoon of repeating the same trick in the same way.

The best cure for this is to have a small kite at hand. If this kite is small enough,[25] it can be used both on and off the field (e.g. in your home or even with your flying buddies in the pub). The small kite can be held in the hands and manipulated to show what a kite is doing when it is being tricked in flight. By holding the kite in one hand and pulling on the bridle line with the other, the timing and duration of the pulls on the lines with respect to the kite's orientation can be shown.

[25] In his book "Indoor = No Wind = More Fun", Harold Slit recommends making up a "practice kite" model to help understand and visualize tricks. The model is essentially drawings of the front and back of a kite that is stuck onto either side of a cardboard sheet, which is then trimmed around the drawings to make a kite shape. Lines can be added, and pins can be stuck into the "leading edges" of the cardboard model to represent yoyo stoppers.
In teaching such a model could be an alternative to using an actual small kite.

6 High wind flying

6.1 Introduction

Perhaps you took up flying because of what you saw at a kite festival on a beautiful day, or perhaps you took it up with thoughts of flying in fresh breezes on nice summer days. However if you are serious about flying, then sooner or later you will have to fly in high winds. This may be in a competition or as a demonstration at a festival. With us it was as students at coaching sessions in the middle of winter.

So how high does the wind speed have to be for it to be "high winds"? - Some people may give a figure of say greater than 15 or 25mph, but really it depends on you, the kite and what you want to do. If the winds are so strong that they are near the top or exceed the wind rating of the kite, or the kite flies too fast to be well controlled, or pulls too hard, then there is something in this chapter for it.

The problems with high wind flying can be divided into:

- ***Damage to the equipment*** – Line breakages, breakages to the kite frame or tears to the sail. These may occur even though the kite is being flown within its official wind range, as the forces imposed by strong winds can expose subtle manufacturing faults and structural weaknesses.[26]
- ***Damage to the flyer*** – The more obvious causes can be due to being dragged along by the kite or as a bystander being hit by a kite travelling at ballistic speeds. Less obvious issues, but equally damaging from a flying point of view, are strains and sprains, particularly to the hands, wrists and arms, due to the lines pulling. These minor injuries can put a flyer out of action for weeks or months.[27]
- ***Controlling the kite*** – the pull on the lines can be very high, making it very hard work to control the kite. Also the kite may be moving too fast for the flyer to react quickly enough to for good control.

All these issues can be tackled by choosing the right kite equipment and the correct set-up for the kite. The choice of kite, lines, bridle settings and the use of additional wind brakes and kite weights is covered below.

It should be emphasised that trick flying can be especially difficult in high winds. This is because most tricks require slack lines at times, which are difficult to maintain when the wind is trying to take the kite far away from you. In addition many of the brake arrangements described in section 6.5 introduce so much drag that they make tricks much more difficult, if not impossible. Perhaps the two best tips for tricking in high winds are 1) to trick at the edge of the wind window, so that one only has to move forward at a small fraction of the wind speed in order to maintain slack (see

[26] The writer has had the lower spreaders of two kites explode in mid-air while the kites were flown towards the upper ends of their recommended wind ranges. In one case there was a flaw in the ferrule, and in the other, a loose fitting ferrule had worn away the interior of the female spar.

[27] The writer injuried his wrist in 15mph average winds by trying to snap stall a large ballet kite. At the moment the wrist was being flicked back to shake the air out of the sail there was a gust and the pull on the lines gave an injury that took months to recover from.

section 5.3), and 2) if one does add brakes, to try using just the wah pad arrangement 1) in the list in section 6.5.[28]

6.2 Choice of kite

Kites for higher winds generally have stronger frames, and have vents, which are holes or mesh panels in the sail. Generally treat their stated wind ranges as a very rough guide. The true useable wind ranges can change dramatically with the choice of air brakes.

Some words on the choice of kite: Some kites designed for high winds pull much more than others. For example the Carl Robertshaw Fury, even in its vented version, is famous for having a strong pull. – The kite was deliberately designed to function this way, as that is what its designer wanted. Other similar sized kites such as the Prism Quantum Pro Variable Vented and Eolo Over have much less pull in high winds. Just how much pull the flyer prefers is up to the individual. However if you have weak wrists or are relatively light, then a high pulling stunt kite might be not what you would enjoy.

Perhaps the best initial practical way of assessing whether a particular kite would be suitable for you in high winds is to see them being flown in high winds. If the flyers are only just stopping themselves from going forwards by having to lean far back and dig their heals into the ground, then that is indicative that the kite pulls hard.

6.3 Lines

In higher winds longer stronger lines are used. The increased length gives more flying space and therefore more time in which to complete manoeuvres with fast moving kites. Stronger line is less likely to break under high loads. Longer stronger lines are also heavier and have more drag through the air, which slows down the kite.

For dual line sport kites, line lengths of up to 50 metres and strengths of up to 300lb or more are used in stronger winds.

6.4 Bridle settings

As the winds build up, in order to reduce the forces on the kite, the tow points are moved up in order to bring the nose towards the flyer. This is the same position as for light wind flying.

In the highest winds there is a tendency for the centre of a dual line sport kite to be pushed back, so that the kite bows between the leading edges, which are held in place by the outhauls of the bridle lines. This bowing not only puts extra strain upon the kite frame, but also tends to trap the wind in the kite (i.e. little spills out to either side) and so increases the effect of the wind pushing the kite. To add support to the leading edges, the tow points can be moved towards each other, so that the inhauls are pulling the more towards the flyer. Alternatively with turbo bridles, the inhaul is moved to the furthest knot from the kite, which again gives more support to the spine.

[28] The writer has successfully done Lazy Susans in 25mph+ winds with an Eolo Over fitted with a nappy. However because nappies run between the flying lines, they may get in the way of many tricks.

6.5 Brakes and weights

Air (wind) brakes are the most common way of slowing down kites in high winds, with weights being a less common method. Both methods can be used simultaneously.

Some kites have purpose built proprietary air brake systems that can only be used with that kite. Prism's Illusion 2000 Spoilerz™ system is an example of this. However most kites use general-purpose wind brakes. The two main varieties of these are wah pads and nappies.

Wah pads are the most versatile. These are triangles of mesh, with a sleeve at one end, and ties at the opposite corner. They come in pairs, which can be fitted in several locations.

1) Firstly, the sleeve of each wah pad can be put around a standoff and the ties tied onto the upper spreader. This puts the plane of the wah pad aligned with the wind direction, and so the wah pads don't add much drag. But they do deform and act as shock absorbers as the kite experiences gusts, and so this is a excellent method for gusty weather.

2) Secondly the sleeve of each wah pad can be put around a lower spreader and the ties again tied around the upper spreader. This places the plane of the wah pads close to the plane of the sail, and the wah pads catch the wind and add drag to the kite.

3) Thirdly the sleeve of each wah pad can be put around a lower spreader and the ties tied onto the tail. The wah pads then catch the wind as it spills off the tail of the kite and so adds drag.

As the winds build up extra pairs of wah pads can be added so that more than one of the above methods is being used. The order of applying methods varies with each kite. For an example, see the description of using brakes on the Quantum Pro in chapter 3.

Nappies are rectangular meshes that fit between the flying lines a metre or so away from the tow points. These catch the wind and push the line more below the kite. This effectively tilts the kite nose forwards, as if the kite were flying further up the wind window. So as well as the drag of the nappies slowing down the kite, the kite catches less wind.

Nappies are also strung between the standoffs, and there are purely as air brakes.

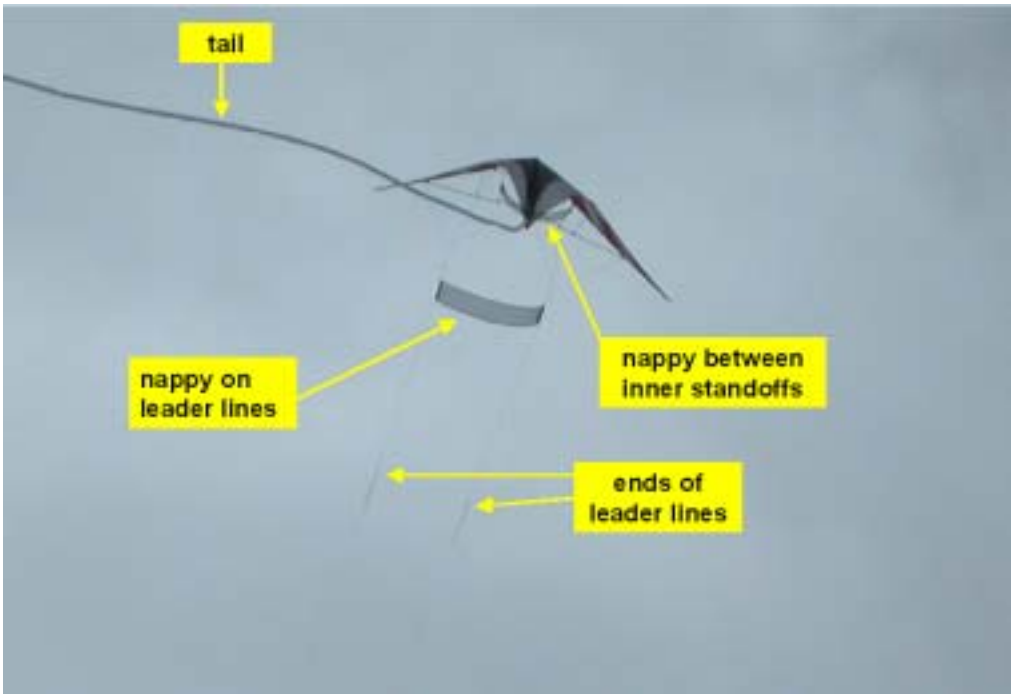

Figure 35 Nappies in use
The kite (a HQ falcon) is being flown as part of a pairs ballet (other kite out of view). Leader lines are being used to extend the flying lines, and the larger nappy is strung between the leader lines. There is a second nappy strung between the kite's inner standoffs.

Many kites have the facility for adding weights, which are usually on or near the spine. Adding weight at the centre of mass of the kite, which is usually at or just above the centre tee, reduces the speed of the kite with minimal effect on the kite's control. The amount of weight to add varies with kite and wind speed. While 20 grams is usually a lot of weight for trick flying, Prism's Quantum Pro has the facility for adding 100grams, which in >20mph winds really slows down the flight of the standard and vented versions.

7 Low wind flying

By “low wind” here we mean winds that are so low that they are near or below the bottom end of a kite’s wind range, and it is difficult to keep the kite in the air without walking/running quickly backwards.

This chapter discusses what can be done to fly dual line sport kites in low winds. Section 7.1 discusses the set up of the kite. Sections 7.2 and 7.3 discuss how to keep the kite in the air without walking or running off the field.

Figure 36 Flying in light winds
The photograph was taken on a calm day. Several things are happening to keep the kites in the air. First they are being flown near and upwind of the crest of a hill, which captures as much of the available air flow, so the kites were experiencing from below 2 to 4mph winds. Secondly the kites are light wind designs with relatively low aspect ratio (large sail area to width). The one on the left is an original series Prism Ozone, and the one on the right is a post 2003 Prism 3D. Secondly both kites are being flown relatively gently, without jerks to the lines. This is because they have relatively flexible thin solid carbon leading edge spars, and which would distort if pulled hard. The kite on the right is pictured being kept still in the sky with its nose upwards, which is the most efficient position for maximum lift.

7.1 Setting up the kite

The following factors can help in getting the 2 line stunt kite to fly in light winds

Bridle knot. – On most 2 line stunt kites, there is a knot whose location determines the location of the tow point relative to the outhaul. Moving this knot upwards tilts the nose of the kite towards the pilot, and thus reduces the kite’s angle of attack into the wind. This gives the kite more lift and thus makes flying in light winds easier. Against this, if the knots are moved too far up the outhaul, control of the kite is lost. Therefore the uppermost location of the knot on the outhaul has to be determined, which gives the maximum lift before control of the kite becomes impractical.

Outer standoffs – If the kite has more than one standoff on each side, then the outer standoffs can either be: a) close to the inner standoff (e.g. Benson Deep Space, Prism QPro, and many other French kites) or b) close to the wing tip (e.g. Prism 3D and Prism Ozone, and generally older style kites). Positions a) and b) have different effects on the kite performance, particularly regarding light wind flying.

For outer standoffs in position a), these standoffs keep some of the sail taut, and so prevent the sail in wind from adopting the curved profile that approximates to a good wing shape for best lift and minimum drag. This is good for moderate and higher winds, as a stunt kite has to be capable of stalling, and it gives some restraint to the kite speed. Also at moderate and high winds, a loose sail can flap creating uncontrolled irregular drag. However for light wind flying the curved profile is advantageous, and reducing the tension on the outer standoff, or even removing it all together can make a big difference to the low wind performance. For example, disconnecting the outer standoff from the lower spreader on the QPro Standard and QPro SUL kites can reduce the stall speed by around 1mph. For these kites standoff removal has been found to be generally unnecessary as one end of the standoff remains secured to the sail, and the standoff does not catch on the ground. Where disconnection or removal is impractical, moving the standoff grabber along the lower spreader towards the centre tee can reduce the tension on the standoff. If necessary the standoff grabber of the inner standoff can also be moved inwards slightly to make room for the outer standoff. Moving the standoff grabber inwards, rather than towards the leading edge, allows the sail between the standoff's sail grabber and the leading edge to be detensioned.

The outer standoffs in position b) are to twist the angle of the sail at its tip. This twist to the sail tips makes the kite easier to steer. However the twist also introduces extra turbulence and drag, and if the twist is reduced by moving the standoffs in, then the kite flies better in light winds. To reduce the twist, their spar grabbers are moved outwards towards the tips of the lower spreaders. To have no twist, the standoffs can be removed. However for some kites too little or no twist can mean that the kite becomes very difficult or impossible to steer. So for light wind flying a compromise in the amount of twist reduction must be reached.

Weights – Naturally removing weights lightens the kite and usually makes it easier to fly in light winds. This is generally true for weights that have been added to the centre of the kite, for which removing the weights does not change the kite's centre of gravity. The weight that put in the tail of many kites may also be removed. For some kites such as the Prism Zephyr the kite is very flyable without its tail weight. However for other kites such as the Benson Deep Space, the tail weight helps in the overall balance of the kite, and it may become very difficult to fly without its tail weight, and without other adjustments to restore the balance of the kite. In the case of the Deep Space, removing the upper spreader removes weight from the top of the kite, which counter-balances the weight reduction at its tail.

Upper spreader – Removing the upper spreader is sometimes a good way of removing weight for light winds, as the kite frame is not subject to as much stresses in light winds as it is in heavy winds, and therefore the additional structural integrity given by an upper spreader is unnecessary. However there are exceptions to this. In particular removing the upper spreader from kites with relatively flexible leading edges can be counter-productive. This is because, without the upper spreader, it becomes impossible to do the height gaining pumping action that is described in

section 7.2. Without the upper spreader, when the kite is pulled, much of the force that would have been transformed into a height gain instead distorts the frame and brings the upper outhaul attachment points towards each other. Thus while the kite gains gliding range from its weight reduction, it looses the ability to be efficiently pulled into the air.

7.2 Pumping or ratcheting the kite into the air

Every flyer knows that if one walks backwards to pull the lines, the kite will rise into the air. However it is often possible to move the kite up into the air in very light winds without moving backwards. This involves a succession of pulls on the lines with the arms interspersed with reducing the tension on the lines by moving the arms forwards again. When the kite is being pulled it rises upwards. When the line tension is reduced, the nose drops (as in a conventional pre-axel stall: section 5.4) and the kite falls downwards and backwards.

Getting the right amount and duration of pulling and decreasing of line tension takes some time to find. Reducing line tension too fast results in loss of control of the kite, with it possibly dropping out of the air. Reducing the line tension too slowly results in the kite not gaining height.

7.3 The downwind glide

This is a method for recovering ground. After flying up to the top of the window, perhaps by pumping the kite up as described in section 7.2, the kite is turned to face downwards, and the flyer moves forwards as the kite flies downwards.

This may sound easy to do, but there is a little more too it if the ground lost in flying upwards is to be regained while flying downwards. For example, if the flyer looses tension while turning the kite around, perhaps by starting to walk forwards prematurely, then contact with the kite will be lost, and the kite can stall and fall out of control. If the flyer waits while the kite turns downwards, maintaining tension on the line perhaps by walking backwards, and then walks forwards while the kite heads to the earth, the chances are that the ground recovered is practically the same as the ground lost while getting the kite in the air. Flying from the top to a lower corner of the wind window gives more time, but still doesn't gain much ground.

A solution is to wait while the kite is being turned, and let it pick up some speed in the dive, then jog forwards while the kite is still diving. With luck the kite will convert some of its downwards velocity into a fast glide away from the flyer, and the distance regained will be much larger than the distance lost while pumping the kite into the air.

Sometimes there is sufficient wind that the kite naturally dives downwards at a fast speed, and the challenge the flyer faces is to run forwards just fast enough to convert the dive into a downwards glide, but not so fast that the kite stalls and control is lost. Here flying diagonally downwards is of help as it allows the flyer to move forward at a slower more comfortable pace.

8 Indoor flying

8.1 Introduction

Indoor flying involves flying without wind. Although this may sound at first very difficult, with the right facilities and equipment it can be surprisingly easy, and there are many kites that can be fairly easily flown indoors. These range from a number of single line kites, through indoor dual line kites, to quad-line kites such as the Revolution "Indoor".

This chapter gives a brief introduction to indoor flying. Currently about the best guide to indoor two-line kite flying is Harold Slit's book: "Indoor = No Wind = More Fun", which is available from http://www.flyingkites.nl/indoor.htm , and readers are strongly recommended to study this.

Indoor flying requires a large open high roofed draught free space, such as a sports hall[29] or deserted factory.

The line lengths required by dual and multi-line kites are determined partly by the kite size, but usually are limited by the size of the hall. Typically used line lengths start at about 3 metres and go up to around 6 metres or 20 feet for the larger kites if the hall width and height permits their use without bumping into things.

8.2 Single line kites

These get a special mention here as they can be so very easy fly indoors. Suitable kites include HQ's "Horvath" series and Focus Kite Design's "Skate". These kites can be launched from the ground with a tug on the line. To fly them indoors, the kite is placed on the ground, the flyer walks some metres away, letting out line, and then launches the kite by pulling in the line. The kite can then glide through the air, over and past the flier, who lets out line to allow it to glide past. At the end of the glide the flier pulls on the line again to gain altitude and turn the kite.

With practice the kite can be steered, and with some kites, it is possible to put them into spins. Some good demo and tutorial videos can be found at www.focuskites.com.

8.3 Dual line kites

Indoor dual line kites of course have to be light so that they can fly in only the wind generated by the flyer pulling them through the air. And because they are often flown in confined spaces, they are often smaller (and because of their size: cheaper) than their outdoor cousins. The lightest and floaty-est include the Indoor Wren and Inner Space. This floaty-ness comes at a price: the sails tend to be flatter than other modern kites and they tend to be more limited in the tricks that they can do.

There is another trend in dual line indoor kites, which is towards providing a full range of tricking capability, which requires a certain depth and cut to the sail, sacrificing some of the floaty-ness to achieve this. The ITrix is an example of this, as it requires more speed to stay in the air, but in the right hands can do every trick that a modern outdoor trick kite can do.

[29] Fliers may find that they have to ask for the heating/air conditioning to be switched off to remove draughts.

8.4 Dual line kite indoor basic manoeuvres

8.4.1 Launches

One of the big differences between indoor and outdoor flying is the surface that is being flown over. Outdoors one is usually on grass, sand or exceptionally: a rough hard court surface. All these surfaces have a lot of friction. Indoors one is often on a plastic or polished wood surface that has relatively little friction. This can make the conventional outdoor method of pulling on the lines to get a kite into the on-its-wingtips launch position impossible. The kite just slides forwards. Instead, at the beginning it is easier to lean the kite against a wall, with its wingtips on the floor, and launch the kite from there.

8.4.2 360

Outdoor 360s usually involve a fair amount of running – partly to overcome the wind, but also because the flier has to create the movement of the kite through the air by walking/running away from it. – Moving the arms creates just a temporary difference to the kite's air speed.

In contrast indoor 360s do not have to compensate for wind. And more usefully, because indoor lines are so short, simply rotating on the spot with arms outstretched can create enough movement to keep the lightest kites aloft. These kites require so little wind that, by the time the flier with arms extended has rotated through 90°, the kite has travelled 90° as well. For the slightly heavier kites, the flier has to walk away from the kite as it does the 360, but extending the arms to the side the kite that the kite is heading towards can significantly reduce the speed at which the flier has to walk backwards.

8.4.3 Up and over

In an outdoor up-and-over using long lines, it is necessary to pump the kite over the flier's head, eventually ending up with one's arms near the ground as the kite passes overhead. In indoor up and overs, it is usually only necessary to build up some momentum by walking away from the kite and waving one's arms outstretched from the direction of the kite over one's head and down in the direction the kite is travelling in. In the writer's experience this is much easier than outdoor up and overs.

8.4.4 Infinities

After a while 360s can make one quite dizzy. Consequently overhead infinities (or figures of eight) is a good way to fly the kite. These consist of up and overs joined by simple half loop turns at either end. Just fly an up and over, and when the kite line is at about 45° on its downward leg, start a half turn, which takes the kite into the start of the next up and over.

9 Precision and ballet

Generally speaking: precision flying is the flying of specific patterns in the sky as cleanly and accurately as possible. Ballet flying is the flying of a routine, usually to music. Both precision and ballet are disciplines in kite competitions.

This chapter gives a brief introduction to precision and ballet flying. Section 9.1 discusses the timing issues that are unique to pairs and team flying. Section 9.2 introduces some of the conditions and rules that are common in dual and multi-line kite competitions.

9.1 Pairs and team flying

Figure 37 Pairs flying
Bryan and Carl of Team Spectrum in the middle of a routine. Carl is having to rush forward to keep his kite in synchronism with the other, as the kites have been subjected to uneven winds.

The major problem in pairs and team flying is of coordination. The flyers have to be doing the correct thing at the correct time. Even if the individual flyers are experts and can do every manoeuvre perfectly, there is still the matter of synchronising the timing. How this is resolved depends on the activity. In precision flying, where any music may be just background and not necessarily helpful to timing, the flyers normally rely on the team leader shouting out calls for the manoeuvres. Sometimes the flyers take their lead for the manoeuvres to be done from the leader's calls. The manoeuvres can have names that are known only to a relatively small circle of flyers, and this can cause problems when having an informal "mega-fly" at a get-together or festival.

Assuming that everyone knows what manoeuvres they are supposed to be doing, there is still the issue of synchronising them. This is often achieved by the leader calling out "Break!" just before the start of a manoeuvre. The leader has to call out "Break!"

early enough that everyone has time to register the call and then act upon it. To get the timing right, a common exercise is for the team to gather round and for the leader to call out "Break!" after which all the team members have to clap. The idea is for the team members to clap together, and for this they may choose to clap just after end of the word: "Break!".

For ballets done to music, it is usual to choreograph the music and moves. The individual team members have to learn their parts by heart and can use the music score as the guide for the timing of their manoeuvres.

For both precision and ballet, fliers can learn their roles off the field by using "practice sticks". A practice stick is a rod about a metre long, on one end of which there is a cutout drawing of a kite. The idea is to move the kite drawings around in the air in a miniature rendition of the actual performance. It can look pretty silly to watch several adults moving sticks around in the air, but is an effective way of ensuring that all fliers know their parts prior to going onto the field with real kites.

As pairs and team flying involves doing manoeuvres synchronously, it is important that the kites are matched in speed. In twin line flying, identical models of kites should be used, and the bridles should be set up identically. Also the kites should have had a similar number of flying hours. This is because a sail's qualities tend to change with flying time,[30] and this affects a kite's speed and performance with wind speed. If a spare (reserve) kite is kept, it is important that this is flown as much as the other kites.

9.2 Competition and the Arena

[31] Links to information on the figures and competition rules can be found at www.stackuk.org .

The standard size of an arena is 110m square. 100m square of this is the flying area. This 100m square area should be bounded by a rope or other markings, and this boundary is called the yellow boundary. The outer boundary of the arena is called the red boundary. The boundaries are guarded by the line judges, who often sit at diagonally opposite corners. As a courtesy the line judges can flag a warning when a flier or his kite crosses the yellow boundary, but this is not mandated. The line judges are obliged to flag when a flier or his kite crosses the red boundary, which leads to instant disqualification.

If fliers are waiting to go into the arena, there may be a pit area in which to set up the kites. A spare kite can be kept in the pit. Regardless of whether the kites are set up in the arena or otherwise outside the arena, the kites must be carried, not flown, into and out of the arena. Flying over the red boundary, whether into or out of the arena, leads to disqualification.

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[30] Nylon sails stretch with flying. Polyester sails tend to stretch less if at all. But if the sail material is crisp when new, it can get softer and more readily adopt shapes under the influence of the wind. This can result in a kite flying in lower winds better with age.

[31] The information in much of this section is taken from notes made during STACK UK's January 2009 bootcamp. The bootcamp contributions particularly of Keith Griffiths (then STACK UK's national director, and MaryAnne Parker (competition field director) are gratefully acknowledged.

Field director. This is an official who stands near the competitors during the contest, and acts as communication between the competitors and the judges who are standing some distance behind the competitors.

Ground crew. The fliers are helped by a ground crew in both transporting the equipment and setting them up, and in resetting the kites on request. Because of the shortage of helpers at most competitions, it is expected that competitors become ground crew for other competitors.

Individual competitors can have up to 2 ground crew. Pairs and team flyers can have as many ground crew as there are fliers.

During the actual flying, the ground crew and fliers are so far away from each other that they communicate by hand signals. In order to avoid misunderstandings about when the kite is to be reset by the ground crew while on the ground, there should be an understanding that it is only to be touched by the ground crew when the pilot signals by raising his arm vertically. Two thumbs up from ground crew or pilot signals all clear. Arm held to the left or right from the pilot indicates that he wishes the ground crew to move the kite in that direction.

Preparation times. An individual competitor is allowed 3 minutes preparation time in the arena. Pair and team flyers are allowed 4 minutes preparation time in the arena. Then from when the judges are ready, the flyer(s) has 45 seconds to commence their performance. When figures and ballet are being done together, there are 90 seconds allowed between the end of the figures and the beginning of the ballet. The commencement of the ballet can be announced by shouting in, as for the figures. Otherwise they can be an assumption that the ballet commences on take-off and ends on landing, but this is not mandated.

Wind speeds. The official ranges for competition flying for novices is from 4 ½ mph to 18.6mph (7 – 30 kph). For experienced and master class flyers the wind range is from 2 ½ to 28mph. Flying can take place outside these wind ranges if the competitors wish. Otherwise, a competitor can request a wind speed check ("wind check") from the field director at any time during the flight. For the wind check, the wind speed has to be measured over 10 sections, and for the check to be passed, the wind speed has to remain in range for the whole 10 seconds. If the wind check is failed then the flyers can elect to have a refly.

10 Lines

10.1 Line types

Dyneema was created by Dutch company: DSM. It is polyethylene fibre, which is ten times as strong as steel of equal weight, and 40% stronger than aramide (Kevlar).

Spectra was developed in the United States and is also polyethylene fibre. Dyneema/Spectra melts at around 150 C, and looses its strength at temperatures approaching this. Therefore frictional heat contributes to line breakages.

Kevlar is a trademark of Du Pont, and Twaron comes for Dutch chemical company AKAO. Kevlar lines are generally deprecated as they are rougher than Dyneema/Spectra, and so cut through themselves, other lines, and anything else they run over.

Dacron is a brand name for polyester, and is suitable for single line flying, but is liable to break when used in multi-line flying.

Nylon is suitable for single line kites, but it can stretch more than 50%, and therefore is unsuitable for multi-line control.

10.2 Line lengths

Feet	metres
16.4	5
20	6.10
30	9.14
32.8	10
49.2	15
50	15.24
65	19.8
65.6	20
75	22.9
82.0	25
85	25.9
98.4	30
100	30.5
114.8	35
131.2	40

Table 2 Imperial to metric line length conversions

There are 3.280843 feet in a metre, or 0.30480 metres per foot.

The figures for recommended strings for the Prism 3D and Prism Ozone kites were taken from the Prism website.

Kite	Wind speed (mph)	String length		Strength
		(feet)	(metres)	(lb)
3D	Indoors	12	4	50
	1-5	20	6	50
	6+	30	9	50
Ozone	Indoors	15	5	50
	0-5	30	10	50
	4-7	50	15	50
	8-12	65	20	80

Table 3 Recommended strings

10.3 Line strengths

pounds	Kilograms (≈ daN)
50	22.7
55.1	25
80	36.3
83.8	38
90	40.8
110.2	50
150	68.0
165.3	75
200	90.7
242.5	110
374.8	170

Table 4 Imperial to metric breaking load conversions

There are 2.2046233 pounds in a kilogram (and 2.247 pounds in a deka Newton).

Kilogram force is denoted kg, and is sometimes also denoted kp, meaning kiloponds. Strictly speaking kilograms and daN (Deka Newtons = 10 Newtons) are slightly different. Kilogram force is the force that Earth's gravity exerts on a kilogram weight. A Newton is the force required to accelerate a kilogram by 1metre per second per second. The Earth's gravity exerts a force of 9.81 Newtons on a kilogram, which is normally taken to be practically the same as 10 Newtons.

10.4 Line sleeving

In the absence of a proper sleeving needle, one can be constructed from steel guitar string. The guitar string just has to be at least twice as long as the sleeving to be threaded onto the line.

The length of sleeving used depends on the thickness of the line. As a rule, 12 inches is about as short as one can comfortably get away with. But 14 or 15 inches is a better length to use. By the time the ends have been singed, the sleeving has been folded over into a loop, and the knots have been tied one will have a loop that is only about 4 inches long. And using a 15 inch length allows adjustment of the line length if the line set lengths have to be aligned.

Take the sleeving, singe it at both ends with a lighter or lighted match. Thread the sleeving needle through the sleeving. Then trap the line in the hairpin bend of the sleeving needle and pull the line through the sleeving. Remove the needle and pull the line back through the sleeving until the end of the line is aligned with the end of the sleeving. The line can be secured with a overhand knot near the this end, but singeing the sleeving and line at the end so that it melts together can also work (Figure 38). Then fold the sleeving into a loop and make two overhand knots in the line/sleeving near the ends of the sleeving to secure the loop.

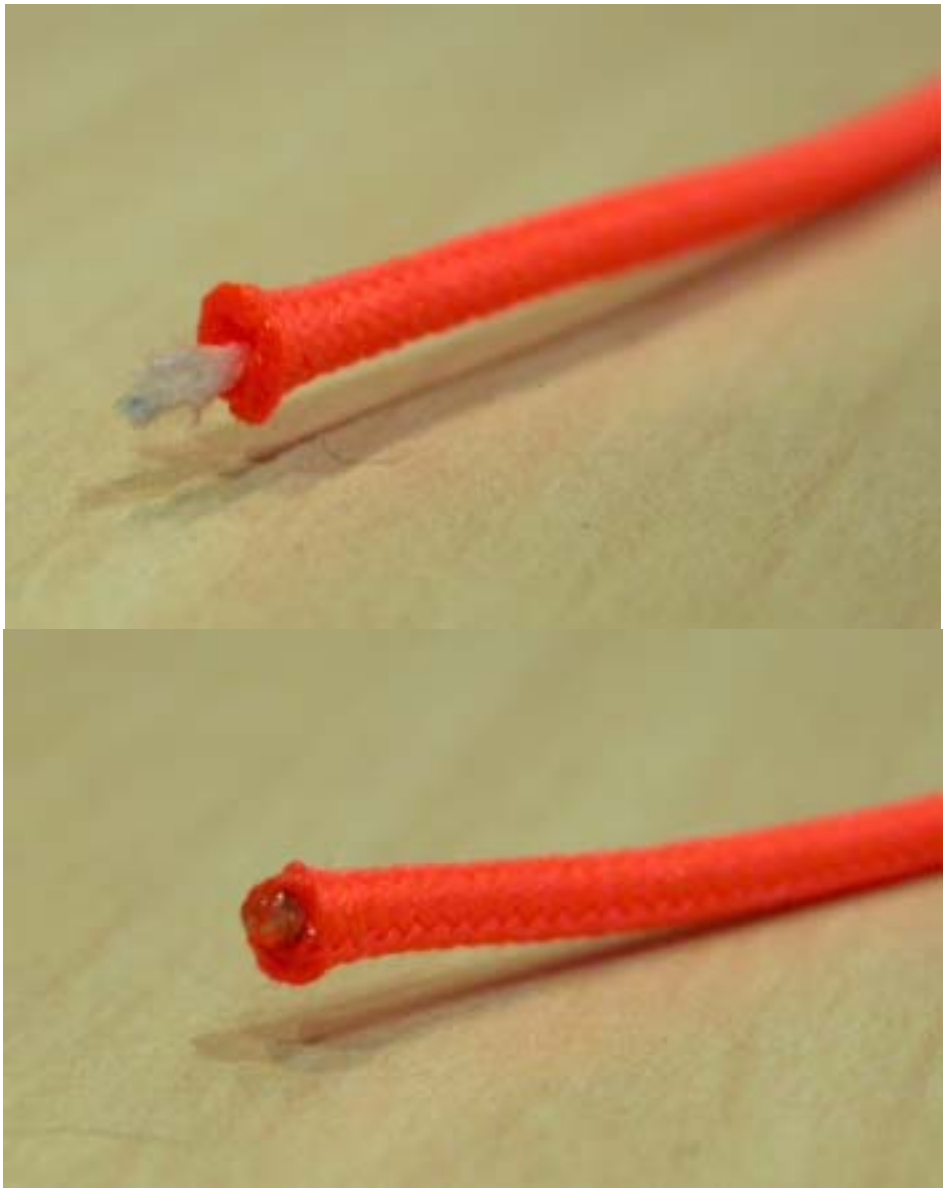

Figure 38 Melting line end and sleeving together
Top view shows ends of flying line and sleeving before melting the two together with a match or cigarette lighter. Bottom view shows the line end melted to the sleeving.

10.5 Loops without sleeving

Loops can also be made without sleeving. For very lightweight thin lines, which sleeving would not hold to well, this can be the only solution. To suppress fraying, it is worthwhile singing the ends of the lines with a lighter or match. For thin lines the length folded back to form the loop can be just six inches. The loop is made in a similar manner as for sleeved lines, with two overhand knots.

With very thin lines, it can be very difficult to undo the larks head used to secure the line to a bridle or handle. To help in undoing the knot, it is worthwhile putting an overhand knot into the loop near its tip. This makes a "handle" that can be pulled to release the larks head knot. The exact location of the overhand knot can be moved to fine trim the effective length of the line, although once made, tweezers will usually be require to loosen the knot.

11 Repair information

This chapter is a miscellany of information on various features of kites and how to maintain and repair them. After covering knots (section 11.1), leading edge connectors (section 11.2), nocks (section 11.3), stoppers (section 11.4), sails (section 11.5), sail tensioning (section 11.6), spars (section 11.7), preventative maintenance (section 11.8) and weights (section 11.9), the last section (11.10) gives a list of preventative and maintenance issues to consider with a newly acquired dual line sport kite.

11.1 Knots

Knots can be divided into the following types:

- Stopper knots – Knots used in a line as something to grip, or at the end of a line to stop fraying.
- Bends – Knots used to tie two lengths of line together.
- Binds or binding knots – Used to bind wrap or clamp other articles.
- Hitches – Used to attach a line to another article by tying around it.
- Loop knots – Used to create loops.

Several websites about knots can be found in chapter 14. There are also many books available.[32]

Some information on knots that are used in kites is given below.

11.1.1 Stopper knots

A stopper is a knot tied at the end of a line. The most common stopper is the overhand knot. However in some bridle lines this can work down the line and come off. The figure of eight is a variation on the overhand, which is more secure and also slightly larger. Figure 39 shows both these knots. Making the figure of eight differs from the overhand in that; after the loop has been formed the line is taken around to the other side of loop before passing through it.

[32] Gordon Perry "Knots" 2002, ISBN: 978-1-84013-493-3 is particularly recommended. The publisher of this book may be any one or all of: Quantum Publishing Ltd, Oceana Books, and Grange Books PLC.

Figure 39 Overhand and figure of eight stoppers
The overhand is shown in blue and the figure of eight is shown in red. On the left side the knots are shown before tightening, and they are shown tightened on the right.

11.1.2 Hitches

The larks head knot is used to connect flying lines to kites. A tutorial on this can be found at www.closeencounterskites.co.uk/tutorials.html . It is also used in some bridles to connect the outhaul/uphaul line to the inhaul. The knot is moved along the outhaul/uphaul line to change the angle of the kite to the wind.

The prussac or prusik knot is another knot that allows adjustment of a bridle. Figure 41 gives an example of its appearance and use.

11.2 Leading edge connectors

APA leading edge connectors come in the following sizes:

Size	Fits	
	Lower size	Upper size
A	.2100” / 5.33mm	.2200” / 5.59mm
B	.2300” / 5.84mm	.2400” / 6.01mm
Ca	G-Force upper leading edge	
C	.2540” / 6.45mm	.2650” / 6.73mm
Db	G-Force lower leading edge	
D	.2850” / 7.23mm	.3150” / 8.0mm
E	.1960” / 5.00mm	

Table 5 APA leading edge connector sizes

11.3 Nocks

A nock is usually glued onto the end of the spar. However this can make it difficult to save the nock if the spar is damaged or to change the nock if the nock itself is damaged. Therefore the author prefers to use PVC electrical tape to fix nocks to the end of spars. If the nock fits too loosely over the spar end, the spar end can be thickened by wrapping electrical tape around it. After the nock is fitted over the spar end, the nock can be secured by wrapping tape around spar and nock 2 or 3 times.

If the nock has to be removed, just unwrap the tape and pull off the nock.

11.4 Stoppers

A stopper[33] is for stopping a fitting such as an elbow from sliding along a spar. Commercial kites use as stoppers: C clips - C shaped plastic that clip around the spar, end caps with the ends cut off and split so that they can be glued around the spar, or heat-shrink tubing. All these are quick to fit. But often the sail pockets/sleeves are too tight to allow C clips to slide through, and stoppers made from end caps often come off, usually as a result of their edges catching against fabric when a spar is threaded through the sail sleeve. Heat shrink requires the correct size of heat shrink tubing and either a heat gun or care when applying heat with a match.

In contrast a stopper made from PVC electrical tape can easily slide through a sleeve, and requires less skill than heat-shrink tubing. To make a stopper, simply wrap the electrical tape around the spar enough times to build up the required diameter. What is the required diameter? – I usually measure this from the stopper on the spar that I am replacing, or if replacing one of those end cap adapted stoppers that has fallen off, wrap around enough tape to make up the thickness of the end cap's walls.

11.5 Sails

11.5.1 Sail fabrics

Sail fabrics can be made from a host of different fabrics, including plastic sheet and paper. For longevity, those used on sport and stunt kites are usually based on ripstop nylon or polyester weave, and are often derived from the sail boat industry. Hence spinnaker nylon, which was originally developed for the spinnakers of yachts. “Ripstop” refers to the weave not being uniform, but having denser regions in its waft and weft, giving a rectangular or more often square pattern appearance. These denser regions are to stop tears from growing.

Unprotected, nylon will absorb water, which makes it less rigid and allows it to stretch. The absorption can be dramatically reduced by the finishing coating(s) applied to the fabric. Polyester does not absorb moisture, and is often associated with “crisper” fabrics. However the stretch of the fabric is also affected by how it has been heat and pressure treated after weaving, as well as by any coating that has been applied.

Coatings are applied to give better windproofing, water repellance and/or UV resistance. Icarex is the trade name for a polyester weave that has a polycarbonate finish. Hence PC-31, where 31 relates to the weight in grams per square metre. Ventex is a polyester fabric from Toray.

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[33] Also called a “stop”.

Chikara is a nylon fabric. Carrington is a nylon fabric that is well known for being stretchy.

The best nylon sailed kites are often designed to take account of the stretch, and fly best when the sail has been flown for some hours and stretched towards its final shape. With stiffer (usually polyester and/or mylar) sails the kite can be designed to maintain the same sail shape from new, although inevitably there are some changes to a sail's qualities, which can affect for good or bad the flying performance of the kite. For example, Prism Quantum Pros can fly better in lower winds once their sails have been softened a little through flying. In contrast Prism Hypnotists tend to fly worse once the sails get old.

Spinnaker weight (oz)	Finished fabric weight		
	Smoz	oz/yd^2	grams/m^2
0.4	0.66 – 0.75	0.83 – 0.95	28.70 – 31.12
0.5	0.82 – 0.90	1.03 – 1.13	35.12 – 38.55
0.75	0.960 – 1.075	1.21 – 1.35	41.12 – 46.04
1	1.176 – 1.795	1.48 – 2.26	50.33 – 76.89

Table 6 Sail fabric weights

[34]Spinnaker sail fabrics are often referred to by a generic weight, such as 0.4oz, 0.5oz, 0.75oz and 1oz. These weights originally referred to the weight of the sail fabric before coating and finishing. Nowadays these figures are often used to describe bands of finished cloth weights, which are quoted in sail makers' ounces (smoz). Sail makers' ounces are the weight in a sailmakers' yard (smyd) of material, which is one yard (36 inches) long by 28.5 inches wide. The significance of 28.5 inches is that at one time the widest standard looms for sailcloth manufacture produced fabric of that width. Consequently one has the equivalences listed in the table. The conversion factors are: 1 smoz = 1.2632 oz/yd^2 = 42.829 g/m^2.

Mylar is a polyester film (stretched polyethylene terephthalate (PET)) that is transparent or translucent. When used in kite sails, it is usually reinforced with threads running along and across it. As it has very little stretch, panels of it are often used to help shape the sail.

11.5.2 Sail repairs

Small holes can be repaired by putting some sticky tape ("sellotape" or similar) across the back of the fabric and then running across the hole with superglue. When the superglue is set the sticky tape is removed.

Polyester thread is often recommended for sewing as it does not shrink or rot when the kite gets wet.

[34] Much of the information in this paragraph and the table is taken from Guy Reynolds: "Know your smoz from your oz/yds and your oz/yds from your g/ms", Brighton Kite Flyers Aerodyne magazine, July 2009.

11.6 Sail tensioning

Sail tensioning is done in a variety of ways. Some manufacturers favour bungee line or rubber bands. The main disadvantage of using bungee line is that the knots in this are relatively large and the kite lines often get caught against them.

Others use a line attached to the sail that during kite assembly is passed over the nock and back down to the sail a few times, and then tied off around the spar. However this arrangement often comes undone because the knots used to tie off the line easily work loose. Applying wax to the line can improve the knots' stability, but is not a perfect solution. Putting a long end cap over the nock traps the line and keeps the assembly from detensioning. However often suitably sized long end caps are very difficult to find.

11.6.1 HQ split nock method

A few manufacturers, notably Tim Benson, use HQ split nocks, which allow one end of a tensioning line to be permanently attached by passing it through a hole in the nock and secured with a knot that lies in a recess in the nock. The line is passed though the sail attachment, and has a knot that can be trapped in a specially shaped notch in the nock. To tension the sail, the knot is fitted in the notch, and the remainder of the line is tucked under the tensioned parts of itself. This method is very neat and applies a pre-set load. Its only disadvantage is that the special HQ split nocks are often difficult to purchase.[35]

11.6.2 Loop and knot method of pre-set sail tensioning

One of the best ways of providing wingtip tensioning to the sails of most kites is to construct a loop of bridle line with a knot along the loops' length. The loop is tucked through the sail attachment (which is normally either a fabric loop at the end of the sail, or a hole in the sail). The end of the loop is then put into the notch in the nock. For most commonly used nocks, the knot is also put into the notch in the nock. For this to be possible, the knot must be small enough, which sets the maximum size of bridle line used for the loop. For nocks that are a smaller diameter than the spars that they terminate, the knot part of the loop is still threaded through the nock's notch, but the knot is allowed to go to one side of the notch. In either case the remainder of the loop past the knot is tucked away into tunnel in the leading edge.

The pre-set sail tension is determined by the distance between the end of the loop and the knot. The tension can be increased by moving the knot nearer the end of the loop.

11.7 Spars

Spars are the rods that for the skeleton of the kite. At one time they were made from wood or bamboo. Nowadays fibreglass is popular for the cheaper kites, and carbon fibre for the more expensive. In addition there are a few spars that have fibreglass cores within a carbon fibre tube. For similar sizes of spars, fibreglass tends to be heavier and more flexible than carbon fibre.

Carbon spars can be rolled or extruded. Rolled are rolled up from a sheet of material, and have some asymmetry to their cross-section. Extruded can be axially symmetric.

[35] The writer knows of only one supplier that has a large range of sizes: www.volango.com .

The next paragraphs make some comments on carbon fibre spars in general and on several manufacturers. An exception is Skyshark, which gets a separate entry: section 11.7.1.

Aerostuff tapered spars come from Japan. They are available in Gold (for vented or standard), Silver (for standard or UL), Blue (for UL) and Zen (for SUL) grades. In addition there are "S" types of some of the spars. The S types are softer and more flexible, intended for use in kites under 2.3m wide.

Aerostuff spars use push fit internal ferrules. The spars are so tightly toleranced that the ferrules really are a push fit, and require no glue. When Aerostuff is used for the lower spreaders, then the spars butt up to each other, similar to the practice with spars using internal ferrules in leading edges. Therefore special rubber centre tees are used to enable the spars to butt. The rubber grabs hold of the spars. It can be difficult to push the spars through the rubber – this can be overcome by first working the centre tee with the hands, to soften and warm it up.

Avia carbon fibre spars are denoted in imperial dimensions.

Name	Overall diameter	Interior diameter
Avia 196	5.0	3.0
Avia 210	5.3	3.2
Avia 220	5.5	3.4

Table 7 Avia carbon fibre spar dimensions

4mm Exel carbon fibre is 3.8mm overall diameter, 2.3mm internal diameter.

More information on Avia spars can be found at www.aviasport.net .

Information about Structil rods and tubes can be found (in French) at www.structil.biz.

A table (in German) of the weights and weights per metre of various manufactures' spars (the weights of and standoffs and some fittings) can be found at http://ralf.naujoks24.de/bauteile-weight.pdf .

A comparative list of the stiffness of different spars can be found at www.vipersportkites.com/spar_charts/spar_charts.htm . There is also a list at http://www.nic.fi/~sos/spars/spars98.htm . Retailer Into The Wind has a list spar weights and stiffness at http://www.intothewind.com/charts/schart_comparison.html , which they use for replacing no-longer made spars with modern equivalents. There is also a table of spar: weight, weight per metre and stiffness at: http://users.techline.com/lord/techdata.html .

New Tech kites have a list of the spars in their kites at: http://www.newtechkites.com/untitled/NTK%20Spec%20Sheet.xls . Retailer Into The Wind keeps data on kite spars they have measured at http://www.intothewind.com/spar_charts.html .

11.7.1 Skyshark spars

Skyshark has a long history of making spars, and for this reason this section is devoted to them.

In the years before 2009, Skyshark's range of plane gauge (i.e. untapered) tubular spars were denoted by P, hence P90, P100, P200, P300 and P400, with the higher

numbers denoting heavier and more rigid spars, which was achieved by thicker tube walls. All the P series spars fitted onto the same 6.1mm diameter internal ferrules (or 6mm ferrules if that is all that is available), which they shared with the tapered PT series.

In around 2009, the carbon in the P100 spars was modified to a higher modulus, giving it the same strength and rigidity as the older P200 spars, which it replaced.

In around 2009, the PnX series of spars were gradually introduced. These were around ½ gram heavier than their equivalent P series, and also about 15-20% more rigid.

Skyshark P200 has 7.15-7.25mm exterior diameter and 6.1mm internal diameter.

Skyshark II PT tapered tubes are made on the same mandrels, which means that all the inside diameters are the same: .244inches. They can all take the same .2400 or 6mm ferrule. Earlier 2PTs were made on a mandrel with .2300 diameter.

Early 2PT and 3PT 32.5" long tubes had a built up area between 10" and 12.75" from the large end to reinforce the tube where the lower connectors are fitted. The early 2PT 32.5" tube weighed about 8 grams. The later tubes had this reinforcement removed as it led to a weak point at the end of the reinforcement.

The weight and external dimensions of Skyshark tubes in the years up to around 2009 are shown in the table below.

Length	tube	Weight (grams)	External diameter (mm)
32.5 inches (82.6cm)	2PT	9	6.20 to 7.24 (5.35 to 7.25)
`` ``	3PT	12 to 12.5	5.59 to 7.50
`` ``	5PT	16	5.94 to 7.92
`` ``	7PT	20	5.97 to 8.34
`` ``	90	10.5	6.99
`` ``	100	13.0	7.11
`` ``	200	14.5	7.21
`` ``	300	17.0	7.42
`` ``	400	18.5	7.57
`` ``	2P	9.0	
`` ``	8P	28.0	
`` ``	Nitro Standard	15.0	
`` ``	Nitro Strong	17.5	
40.0 inches (101.6cm)	2PT	10.5	5.21 to 7.37
`` ``	3PT	15.0	5.28 to 7.82

`` ``	5PT	18.5	5.46 to 7.87
`` ``	7PT	24.0	5.84 to 8.13

Table 8 Skyshark tube weights in years up to 2009
The Black diamond 3PT, 5PT and 7PT spars weigh the same as the standard spars of those types. Nominal figures shown without brackets. Actual measurements shown in brackets.

Length	tube	Weight (grams)	External diameter (mm)
32.5 inches (82.6cm)	P1X	13	7.21
`` ``	P2X	15	7.34
`` ``	P3X	17	7.47

Table 9 Skyshark PX series tubes
These tubes were introduced in 2009.

Because Skyshark PT spars are tapered, their centre of gravity is moved slightly away from their middle to the wide end of the spar. For the 5PT spar the centre of gravity is about 1 inch from its middle, and for the 3PT spar the distance is perhaps a quarter inch greater.

Standard Skyshark spars, and many other wrapped spars are bound together by wrapped cellophane around them while the resin is setting. This leaves ridges in the surface that are reputed to abrade bridle lines during tricks while the kite is on its back. In order to reduce this abrasion, the Black Diamond range of spars was introduced. These had the ridges machined away and lacquer applied.

11.7.2 Removing old internal ferrules

Internal ferrules that have been glued in place using cyanoacrylate adhesive (superglue), can often be removed by dipping the end of the spar in boiling hot water for up to 2 minutes. The boiling water will not damage the carbon tube or the ferrule, but often loosens the glue sufficiently for the ferrule to be removed by pulling it out with pliers. If this fails, the ferrule can be drilled out. Start with a drill substantially narrower than the ferrule, and drill through the central axis of the ferrule. Then use bigger drills, building up to a little smaller diameter than the ferrule, taking care to avoid drilling into the surface of the tube. Before the ferrule diameter is reached, the ferrule will loose its integrity and be able to be removed from the interior of the spar.

11.7.3 Installing new internal ferrules

Epoxy adhesive is the most reliable for holding internal ferrules permanently in place. However cyanoacrylate adhesive (superglue) is usually used in kite manufacture as it is very quick setting.

Before gluing the ferrule in place, it is very useful mark how far it is to be inserted into the tube by wrapping some masking tape (sometimes called painter's tape) around the part of the ferrule that will be protruding with one edge denoting where the ferrule will be at the end of the tube. This will allow the ferrule to be correctly positioned while the glue is setting. Where cyanoacrylate is used, this step is essential, as there is only one chance to position the ferrule correctly before the glue

sets, and the masking tape will act as a buffer stop against the end of the tube to ensure correct positioning.

If using cyanoacrylate, use some fine sandpaper to rough up slightly the part of the ferrule is to be inserted. Then put in the tube and around the ferrule, and while inserting the ferrule, turning it will help evenly distribute the glue.

Remove the tape after gluing.

11.7.4 Making internal ferrules a tighter fit

Sometimes internal ferrules fit so loosely into the female spar that there is wear due to the ferrule rubbing against the spar interior during flight. Besides making a sloppy join, the wear can weaken the spar so much that there is a sudden breakage during flight.

If a ferrule is too a loose fit into the female spar, it is very rarely a fault of the ferrule, as these are generally made to very accurate diameters. It is more likely to be due to poor tolerance in the manufacture of the spar. Despite this, because it is easier to wrap material around the exterior of a ferrule than it is around the interior of a spar, many people recommend wrapping the ferrule to increase its diameter. While this gives a good fit for the current female spar, it is likely that a replacement female spar will have a different internal diameter and therefore that the modified ferrule will not fit in it correctly. So instead of packing out the ferrule diameter, below is a description of a method to decrease the diameter of the female spar.

N.B. the technique described below carries the risk that the spare ferrule being used to ensure the correct diameter could get permanently glued into the female spar. To avoid this, frequent movement of the ferrule is necessary.

For the technique I use epoxy glue as the packing material. Others use cyanoacrylate (CA) glue as a packing material as it spreads well, thinly and dries quickly. However CA seems to wear away much faster than epoxy. For best results, the method requires a fairly free running but quick setting epoxy such as "Devcon 5 minute".

Place a little glur around the interior of the spar. A thinned matchstick, very small screwdriver, or a dentist’s tool is good for this. Then using a spare ferrule that has been waxed, oiled or pre-greased in the hope that it will stop the epoxy sticking to it, insert the ferrule into the spar for a distance further than the leading edge ferrule will go. This will spread glue along the interior, possibly leaving a dollop further down the spar than the leading ferrule goes. Keep turning the spare ferrule to prevent it sticking in the spar. Try removing it every 3-4 minutes, cleaning it and reinserting it. When the glue has definitely set, withdraw the ferrule, do a check that it reinserts OK, and then take it out and leave the glue to harden. You should now have a much better fitting ferrule. If you don't, add more glue and repeat above procedure.

11.8 Preventative maintenance

11.8.1 Protecting the nose from internal damage

Jim Barber of Team Cutting Edge recommends wrapping electrical tape around the top of upper leading edge spars, to prevent them from eventually making a hole in the nose pocket. The tape is wound around a couple of times, with the tape overlapping slightly beyond the spar end. The overlap is then tucked over into the interior of the spar. The finished job is said to be longer lasting than using flexible plastic end-caps.

11.9 Weights

Home made weights can be made from copper pipes. Microbore central heating pipes have the right diameters to go around spars such as Skyshark. Their statistics are:

Nominal diameter (= external diameter)	Wall thickness	Approximate internal diameter	Weight per 10cm length
8mm	0.7mm	6.6mm	13.33
10mm	0.7mm	8.6mm	19.05

Table 10 Properties of copper piping suitable for weights

11.10 Suggestions for checking over a new dual line stunt kite

By "new kite", I mean a kite that is new to you. It may be a kite that is straight from the factory, or it might be a kite that you have acquired second hand, and are unsure of its condition. Unfortunately many factory built stunt kites may have minor defects that can grow and result in a mid-air breakage. Also there are simple measures that can be taken to reduce wear and tear. The following checklist contains a number of suggestions for checking over the kite and improving its condition.

1) Strip down the frame.

2) Check the security of leading edge ferrules. Are they loose in the upper leading edge? If they look loose or as if they are soon to come loose, take them out and re-glue as described in section 11.7.3.

3) Check the fit of the leading edge ferrule. Are they a loose or tight fit into the lower leading edge? If they are a loose fit, then improve the fit as described in section 11.7.4.

4) If the top of a leading edge or the top of the spine has no end cap to prevent it from cutting into the nose, tape them it up as described in section 11.8.1.

5) Check the stoppers on the leading edges. If any are coming loose, re-glue. If any have come loose re-glue using the stopper on the opposite side leading edge as the guide for the correct position.

6) Examine the lower spreader ferrule secureness into the male lower spreader and fit into the female lower spreader. If either are a problem, fix as described for the leading edges in steps 2 and 3.

7) Check how the lower spreader(s) and spine fit through the centre tee. If they are a loose fit, consider either wrapping them with tape or heat shrink tubing to improve the fit and protect against them being damaged, or fitting a new centre tee that is a better fit.

8) If working on a QPro, wrap electrical tape around the inhauls of the bridle, where they enter aluminium centre tee. - This prevents wear at that spot. - We have to periodically replace the electrical tape (rather than replacing the bridle inhauls).

9) If working on a QPro - add a few drops of a thread locker (such as Loctite) to the weight system's threads, so that the weights are less likely to come loose in flight.

10) Reassemble kite.

11) Check the pigtails of the bridle. If the (overhand) knots look like coming loose, retie both sides with a figure of 8 knot.

12) Check that the prussac knots hold. If they don't, even after giving some good yanks on the pigtail lines to tighten them, then apply shoe polish, rub in, leave to dry, and retest prussac knots.

13) If the bridle has factory marks, sew some bright thread into and around the outer sheath of the bridle at those marks. – This saves having to worry about where the factory marks might be when they become almost invisible after a couple of flights.

12 Books

Ron Moulton and Pat Lloyd "**Kites – A practical handbook**" 1st edition published by Argus books in 1992, 2nd edition published by Nexus Special Interests in 1997. Also published by Special Interest Model Books in 2004, with ISBN 1-85486-143-3. – A 256 page book, and is in many ways a standard reference. However it has not been substantially updated since the 2nd edition in 1997, and should be read in with that in mind. This is a shame as the book's appendices cover: international flying organisations, kite museums, the kite festival calander, other kite books, and kite periodicals. As it stands, these appendices are an interesting historical record from the 1990s peak in interest in kiting. As the authors are British, many of its pictures are from the UK kiting scene

Chapters subjects include: kite making, flying lines, kite painting, kite aerial photography, parachuting teddy bears etc., rokkaku fighting kites, steerable (dual and quad-line) kites, kite design plans, the law and kite flying, and fun in kites (interesting designs and cockpit simulators).

David Pelham "**The Penguin Book of Kites**" Penguin books, 1976. – A 228 page book, with chapters on history, construction and flying, and many kite patterns.

Servaas van der Horst and Nop Velthuizen "**Stunt kites to make and fly**" Uitgeverij Thoth, 1997, ISBN 90 6868 052 8 – This book was translated into English from Dutch, and first appeared in 1992. It covers the state of the art as it was then, from the perspective of a Dutch stunt kite flying team, and so is very useful historically as well as explaining the basics of the subject.

Bill Taylor and Kim Taylor "**Flying the Rev – And how to do it**" 1996. It is downloadable at. http://www.gwtwforum.com/pdf/revbook.pdf .

Bill Taylor and Kim Taylor "**Put the Wind In Your Hands – Getting started flying a two line stunt kite**"Taylor's, 1997 – This is very good introduction to the basics of stunt kite flying, up to the level of snap-stalls. It is downloadable at http://www.gwtwforum.com/pdf/dualbook.pdf .

Harold Slit "**Indoor = No Wind = More Fun**". – This book is on two line indoor kite flying and describes some of the kites, how to learn indoor flying, and many manoeuvres and tricks. The book was originally written in Dutch (42 pages, 2005). It has been updated and translated into English (46 pages, 2010). The two editions are freely available for non-commercial use and are downloadable as pdfs from http://www.flyingkites.nl/indoor.htm.

"**1995 Prism Guide**" A 77 page guide. While the first 7 pages are on the Prism kites of the time, the remaining 70 pages are on kite flying, covering stunting up to the Lazy Susan. This is downloadable at http://www.gwtwforum.com/pdf/1995_prism_guide.pdf .

Mark Cottrell "**Swept Wing Stunt Kites**", 1990. Depending how on how you count pages, this is a 43 or 48 page book, which describes what was known about delta based stunt kites in 1990. The author was a designer and kite maker. The book is downloadable at www.iannewham.com/images/swept_wing_stunt_kites.pdf .

13 Videos

This chapter lists some of the commercially available videos. In addition there are many free to view videos available from sites such as www.youtube.com and www.vimeo.com .

"**The way to fly**" Prism video published in 1996. Gives a good overview of the basics, covering setting up the kite and reading the field, turns and landings, up to punch turns and tip stands.

"**The advanced way to fly**" Prism video published in 1996. Covers recoveries, light wind flying, axels, back flips and lazy susans.

"Flexifoil Stranger" Also known as "Stranger". This video was released in 1994, and came with the Flexifoil Stranger kite. The video is now available to view on YouTube in two parts.

"**Freestyle pilot**" Prism. DVD, approximately 50 minutes long. 36 tricks sections plus short tricks showcase. Includes "flight guide" paper manual to take onto field.

"**Dodd Gross Flight School** DVD" Dodd Gross issued several versions of his Flight School video tutorials. The Flight School DVD dates from 2002, and has both Dodd's Flight School Basic Training (34 minutes[36]) and his Flight School Advanced Training (44 minutes) on a single disk. The disk also contains "Flying with Dodd" (25 minutes) and "New Tech Kites in flight" (6 minutes). In all, this video is the most comprehensive of the ones reviewed here.

"**Trick or treat**" Souldeep Films 2006. DVD. Has Benson kite fliers (Tim Benson, Andy Wardley etc.), showing off Deep Space and Gemini kites in a variety of South East and South West England locations. Has 43 minutes tricks film and a 36 minute long set of tutorials covering 16 tricks.

"**Tricky flickery**" Flexifoil 1996. Approximately 26 minutes VHS video. Uses Flexifoil's Psycho, Stranger and Matrix kites. Carl Robertshaw, Paul Latham, Andy Preston and their friends are demonstrating. Tricky flickery is now available on YouTube in three parts.

"**Trick show**" VHS video made by Prism in 1997. Includes light wind flying demonstrations with the Prism Vapor SUL Eclipse and 3D.

[36] The estimates for the run time of the parts of the video are taken from information on the cover of the DVD box. The actual run times are very difficult to determine due to the complexity of the track structure on the DVD.

14 Web sites

This chapter contains a non-exhaustive list of websites on kites and kite related matters. Some of the links are no longer valid, but are kept as records of the resources that have existed.

//classykite.org Collections of photographs of Prism kites. Also has an independent forum.

//flickr.com/groups/fracturedaxel/ Photo section for Fractured Axel forum members.

//flickr.com/groups/gwtw/ Photo section for Gone with the Wind forum members.

//fourwindsdesigns.com Web site of Reggie Yaplee of Seattle, who makes NOS and Nebula kites.

//kitecouple.com Website of married couple Paul and Natalie. Contains descriptions of their kites and also of reknowned fliers that they know.

//nosediversstuntkiteforum21516.yuki.com

//nosediversstuntkiteforum21516.yuki.com/topic/445 Where Mark Clements explains the story of the development of Jest Of Eve kites.

www.aerostarsportkites.com Website of the manufacturers of Aerostar sport kites, who use the trade-marked "Shape Shifter"™ arrangement for standoffs, which enable the shape of the sail to be adjusted between low wind and high wind settings.

www.airbornkites.co.uk No longer functioning website of Air Born kites, which traded from a shop in Brighton and later from a shop at Bluewater from 1991 to January 2009.

www.airdynamics.co.uk Custom sport and Chinese kite makers: P.O.Box 22, Hereford, HR4 8UW, UK

www.aviasport.net Website for Avia Sport, who do Avia spars and kite fittings.

www.basingstokekitefestival.org.uk

www.bfk.com Clicking on the Kitestore archives link from this page gives access to catalogues from 1996, 1997 and 1998.

www.bilboquet.com France based kite seller.

www.blueskylark.org/zoo/ Home of the virtual kite zoo, which is Philip Le Riche's attempt to create a comprehensive set of web pages on kites with compact quick to download pictures. The web pages are also available in French.

www.chicokites.com Website of what was Gone With the Wind Kites, which has combined with Chico Kites.

www.chill-out.net German kite and bike retailer. Home of http://prismshop.chill-out.org - "Prism Parts Shop Europe".

www.climaxlines.co.uk - Website of the Climax lines company.

www.closeencounterskites.co.uk - Website of the Close Encounters kites team, which is centred around Allan and Marilyn Pothecary, past multiple UK pairs champions. Contains reviews, news items etc..

www.cuttingedgekites.com - The website of the Cutting Edge Kite Shop, sponsors of Team Cutting Edge.

www.drachenkiste.de - The website of Wolfgang Siebert, who manufactures a range of handmade kites.

www.drachenshop.de - The website of Pegasus, a German shop with English pages. Stocks many hard to obtain fabrics and spars.

www.drageportal.dk A very good kiting website, full of videos and tips. Unfortunately it is all in Danish! Exceptions are www.drageportal.dk/Video/Tutorial/Default.aspx containing tutorials from various sources and www.drageportal.dk/Video/Study/Default.aspx containing Martin Madson's studies.

There has been an announcement that www.drageportal.dk will cease to be available after 1st August 2010, and that for Danish flyers, www.Drageflveren.DK will be available instead.

www.eolo.com - Website of Eolo-Sport Industrias, S.A, a Spanish manufacturer, also known as Eolo Gayla..

http://en.eolo.com/kite-tutorials - English language portal into part of the Eolo website that shows stunt kite tutorials created by Club de Cometas Dama de Elche. Several of the tutorials are available in different languages, with all the tutorials available in Spanish.

www.extremekites.com.au - Website of Extreme kites, an Austrialian retail company. Contains a forum that is the defacto Australian kite forum.

www.flexifoil.com Web-site of the Flexifoil company, who nowadays specialise in soft parafoils.

www.fracturedaxel.co.uk A shop containing a selection of high class sports kites, and also a forum, which includes famous people from the UK stunt kite competition scene. Also hosts the wiki described below.

www.fracturedaxel.co.uk/wiki/ A fairly large stunt trick wiki.

www.geospectra.net/kite/knots/knots.htm#short "Knots and Hitches for Kite Flyers", by James S Aber.

www.gokites.co.uk A dealer with an on-line shop and attending many North British kite festivals.

www.gwtwforum.com The big USA based kite forum. This was relaunched at its present web address in 2009.

www.horvath.ch The web site of a maker specialising in very light wind single line kites.

www.iannewham.com Ian Newham's website. This includes information on bridles, knots and kite making.

www.idemployee.id.tue.nl/p.j.f.peters/kites/index.html A Dutch site containing a huge database of trick definitions.

www.invento-hq.com Website of HQ kites.

www.jestofevekites.com Website of Jest Of Eve kites, a business run by English stunt kite maker: Mark Clements.

www.joboleisure.co.uk Website for the resurrected "Mullins Kites", a shop based in Old Amersham, Buckinghamshire, UK, which reopened in summer 2009, after a seven year absence.

www.khite.org . Home of some radical stunt kite fliers under the name of kHiTe. The site is mainly 2004 and before, and includes several reviews.

www.kiteconnection.com USA retailer.

www.kiteconnection.com Website of Kite Connection, a retailer, that also includes a forum. At http://www.kiteconnection.com/cgi-bin/ubb/ultimatebb.cgi?ubb=get topic;f=38;t=000001;p there is Mark Reed's story of why Prism kites are made in China, posted on 4th March 2003.

www.kitefactory.com.au Australian custom kite manufacturer and retailer. Not to be confused with a Chinese manufacturer called "kitefactory".

www.kitehost.net/giskc/PDFs/TPTrickDefinitions%20-%20v1.0.pdf Trick definitions.

www.kitepedia.es Do you read Spanish? If so this site on many aspects of kites may be for you.

www.kiteplans.org A huge archive of kite plans. Main site is available in English and Spanish, with some of the plans in other languages.

www.kitepower.com.au . Australian retailer, specialising in Prism kites among others.

www.kiterelateddesign.com Web site of Carl Robertshaw's company, who supply custom made fabric installations as well as kites, flying straps, wah pads and nappy brakes.

www.kites4u.co.uk UK retailer, an excellent source of Climax line and accessories.

www.kitetheory.blotspot.com Walt's blog on the theory of how to design 2 line sports kites for precision and for various sorts of tricking. As of August 2009, this website was advertised for sale, with Walt's material no longer being shown.

www.kone.org "Kites Over New England" USA.

www.lerc.nasa.gov/WWW/K-12/airplane/shortk.html A way into NASA's information on kites and how they fly. The site also has links to a single line kite simulation program.

www.levelonekites.com Website of Level 1 kites, in German.

www.longbottom.org.uk Website of Carl Longbottom.

www.midwestkitescom Website of "Midwest kites".

www.monkey-boy.com/REVisions/ - Website for Revolution kite material. Includes pointers to training articles.

www.nkg.org.uk The Northern Kite Group – A club in the North of England, covering Yorkshire and Lancashire, and as far west as Liverpool and the Wirral.

www.notakiteclub.com As the name implies, this is the website of a group of people who are not a kite club. They are a group of kite flyers who are based around County Waterford, Ireland.

www.ozfeathers.com.au/kaos/index.htm Home page of "Kaos", Kevin Sanders's kite making business, based in Australia.

www.pathangpanache.co.uk Website started in November 2007, for a UK trader specialising in Indian fighter kites.

www.prismkites.com Prism kites website, containing facilities for ordering spare parts, and access to the Prism kites forum.

www.realknots.com/knots/index.htm A website all about knots.

http://www.reeddesign.co.uk/kites.htm The part of Roy Reed's website that is on kites. This includes www.reeddesign.co.uk/kites/index.html , which describes the figures used in older STACK (Sport, Team and Competitive Kiting) competitions , and www.reeddesign.co.uk/iskcb/index.html , which describes the newer sets of IRBC competition figures, that are the international standard now.

www.robertbrasingtonkites.com Australian kite maker, specialising in unusual artistic single line designs.

www.r-sky.com R-Sky are based in Portiragues, France.

www.revkites.com Web site for Revolution kites, in Poway, California.

www.seek2know.org.uk/kites/PJKites/PJKite.html The web page that these kite notes can be downloaded from.

www.seka.org.uk South East Kiting Association, which has details of local kite flying locations.

www.skyburner.com/skyshark/ss-products.html Overview of SkyShark spars.

www.skybums.freeserve.co.uk Sky Bums are Paul and Helen Morgan, kite makers based in Shropshire, UK.

www.skyhighaction.co.uk - The website of a small Watford UK based trader, who sells Elliot kites amongst others.

www.skysportdesign.com Website of Lam Hoac, maker of Sea Devils and other custom kites.

www.snapstall.de German website holding lots of kiting videos.

www.solentkiteflyers.co.uk The Solent kite flyers association. Contains examples of how accidents happen.

www.sportkitedesign.se Website for Sportkitedesign, in Sweden, makers of the Seven dual line sport kite.

http://sportkiteflyer.spaces.live.com/ the blog website of Randy Greenway, who has many superb video tutorials.

www.stackuk.org Website of the UK branch of STACK.. At the time of writing in summer 2007, the website was very sparse, but had a large number of links.

www.teamiquad.com - The website of the "Team IQuad" Revolution kites display team.

www.tenerifeleisure.co.uk/mobius/map/map-regions.htm - A collection of kite related material by region across the UK.

www.thehighwaymen.co.uk - English shop stocking spars and some sail materials.

www.thekitesociety.org.uk The Kite Society of Great Britain.

www.tollesburysc.co.uk/Knots/Knots_gallery.htm A website with animations of how knots are formed.

www.tradewind.kites.demon.co.uk - Tradewind used to have a shop in Reading, but now trade from home at 66 Fitzroy Crescent, Woodley, Reading, RG5 4EX, phone: 0118 916 8393. Their site describes local places to fly, and has a good web-page on wind speeds.

www.trickspartyusa.com The website holding the rules and guidelines of tricks parties in the USA. Also has a video library describing tricks and the way tricks parties score them. http://www.trickspartyusa.com/videos.shtml

www.kites.tug.com A website containing a large amount of material covering old rec.kites postings, kites and and articles.

www.videolan.org/vlc/ The home website for downloading the free VLC media player. This player is truly excellent for viewing downloaded kite videos, especially as it has x0.12, x0.25, x0.33, x0.5, and x0.67 slow play speeds, which are excellent for viewing videos to figure out what a flyer's hands are doing during tricking. For example, use it to view Mama74's trick studies.

www.vientosur.org Columbian website, written in Portuguese(?). Among many other things, has pictures of extraordinary custom 4 line kites.

www.vipersportkites.com Web site of a company whose kites are named after Viper the cat.

www.vliegerwereld.nl/magazine/index.html - A very good magazine, which unfortunately is in Dutch.

www.volango.com German supplier of kites, spare parts and materials.

http://www.windpowersports.com/guides/stunt-kite.html Part of the website of WindPower Sports, a shop in Las Vegas. This is a guide to assembling and flying two line delta sport kites.

www.woolmer.co.uk Web site of a supplier of Avia spars.

www.youtube.com/user/classickitemovies - Repository for copies of the old "Tricky Flickery" and "Flexifoil Stranger" videos.

www.youtube.com/user/kamikazeDavid - Repository of some "Tricks Party USA™ " trick judging videos from the USA, and for AudioRob's video tutorials.

www.youtube.com/user/dualline - Repository of some classic Prism kites related videos, such as various versions of the Qpro.

www.zerowind.org Website of Daniel Flinkmann. As the name suggests, this is mostly about indoor kiting. Daniel was a co-developer of the Sweety and ITrix.

15 Wind speeds

Information on current and forecast wind speeds can often be found on the internet. For example www.xcweather.co.uk gives local windspeeds for the UK and several other West European countries.[37] Windmapper.com gives local wind speeds in the USA.

A table of conversions between wind speeds measured on the Beaufort scale and in various imperial and metric units is given below.

Beaufort	kph	mph	knots	m/s	
1	2-5	1-3	1-2.5	1-2.5	Light air
2	6-11	4-7	3.5-6	3-6	Light breeze
3	12-19	8-12	7-10.5	6.5-10	Gentle breeze
4	20-29	13-18	11-15.5	10.5-15.5	Moderate breeze
5	30-39	19-24	16.5-21	16-21	Fresh breeze
6	40-50	25-31	21.5-27	21-26.5	Strong breeze
7	51-59	32-37	28-32	27-31.5	Moderate gale
8	60-75	38-47	33-41	32-40	Storm

Table 11 Wind speeds and the Beaufort scale

To convert from miles/hour to kilometres/hour multiply by 1.60934. To convert from kilometres/hour to metres/second multiply by 8/15 or 0.277778. To convert from miles/hour to knots multiply by 33/38 or 0.86842 . To convert from miles/hour to metres/second multiply by 0.44704.

A squall is a short period of wind that is higher than the prevailing wind speed. To officially qualify as a squall, the wind speed should be higher than 25mph and at least 18mph higher than the prevailing wind for a period of at least 1 minute.[38]

[37] The countries are chosen by clicking on the appropriate flags in the top left corner of the main page.

[38] Definition of a squall given in "The Weather Program" BBC News channel, Sunday 30th August 2009.

16 Check lists

Here are some check lists to act as memory aids for what to take to various events.

16.1 Kite festivals

The following is lists of things that are often very useful to take to a kite festival.

- Binoculars
- Broken pieces – just in case someone is selling the right sort of spares.
- Car park pass (if pre-issued to you as a kite flyer)
- Vernier callipers – to measure the diameters of spares.
- If taking a camera, a skylight or UV (ultraviolet) filter can be very worthwhile.
- Kite anchors
- Membership cards for kite clubs
- Sun glasses and sun cream

16.2 Indoor flying

Here is a check list for what to take to an indoor flying gathering.

- Indoor court shoes or trainers – many indoor flying sessions take place in sports halls, where it is important to avoid scratching the floor surface.
- Short lines – some indoor facilities may be so narrow that flying is better with even shorter lines than those recommended for the kite. So take line lengths down to 3 and 4 metres.
- Kites – As these are fragile indoor kites, it is a good idea to transport them in strong cardboard or plastic tubes. It is very annoying to arrive at an event and discover the kite was damaged in transit.

17 Postscript

This chapter has been written both for readers who are trying to learn kite flying, and for anyone who wants to take on, build on and/or rewrite the notes. Here those who are trying to learn kite flying will read about how much they can trust these notes, about how much faith the author puts in them. And those who are thinking of improving the notes, can find what the author personally thinks of his efforts so far, and where the strengths and weaknesses are.

The postcript has been divided into 3 sections. Section 17.1 covers the aims of writing a public version of these notes, and gives a personal opinion on how well the aims have been achieved. The problems highlighted in section 17.1 on teaching and learning tricks leads onto a fuller discussion of trick flying learning styles in section 17.2. Lastly, section 17.3 makes some recommendations for taking these notes forward.

17.1 What the author thinks of his notes

When I was adapting and enlarging the notes for public consumption, I had in mind 5 aims:

1) That the notes provide a comprehensive resource of information on terminology in one place.

2) That the notes provide information on a wide range of (mostly trick) kites that a beginner would want.

3) That the notes contain a list of useful book and website references.

4) That there is information on maintaining and repairing kites.

5) That the notes help to learn trick flying.

I think that the first three aims have been mostly achieved. Through the glossary a huge range of terminology is covered, many in more detail than can be found in the major resources such as Fractured Axel's tricky wiki www.fracturedaxel.co.uk/wiki/ or Peter Peters' website www.idemployee.id.tue.nl/p.j.f.peters/kites/index.html. Indeed while not covering exactly the same material as Peter Peters' website, I like to think of these notes as an update on Peter Peters' material, which while excellent, has had only limited updates since the mid 1990s. In addition chapter 3 provides a limited survey of mostly 2 line trick kites up to 2010. There are places on the web which also have databases of kites, but in comparison to chapter 3, they either cover earlier periods of kites, or don't cover such a large number.[39]

Of course much of this information and more is available somewhere in the major on-line forums (see chapter 14), but one does have spend lots of time wading through them to search out specific information. In addition many flyers have created their own websites. I think that I have gathered together a fairly full list of (mainly English language) kite related websites in chapter 14. The list of books is rather sparser, consisting only of some of the kite books that I have read. There must be significant room for expanding chapter 12.

[39] It is worth mentioning the Review section of the Fractured Axel forum. – This probably has the most extensive set of reviews of kites in the English speaking world, and is potentially an excellent resource if you are prepared to search through it.

Regarding the fourth aim on covering kite maintenance and repair, the text covers most of the tasks that I have personally had to do over the last 4 years, and so from the point of view of using it myself, I am fairly satisfied with its contents. However I feel sure that others encounter different problems and therefore could contribute more material. In addition it feels to me that there are insufficient diagrams and pictures in these chapters for helping others who are not already familiar with the technologies.

This lack of diagrams and pictures is also regretted in the glossary chapter (addressing aim 1) and kite types chapter (addressing aim 2). Unfortunately pictures and drawings do take a lot of time to photograph and to edit, and because of copyright restrictions and privacy I have not been able to just take the ones I would have liked from other peoples work. – In short, you will often be able to find just the set of pictures that would have illustrated some terminology or repair technique of the web, but because I did not have copyright permission to use them, I would have to have created from scratch my own set of illustrations.

The fifth aim is the one that I have had the most difficulty with, and don't feel that I have succeeded. I should emphasise that while other parts of the notes may have been taken from other sources, everything in chapters 4 to 9 is based on personal experience, trial and error. There is little or nothing in those chapters that hasn't been experimented with and thought about. Unfortunately this has usually not been sufficient. One of three things has often happened.

1) I learn a trick and can do it reliably, but I find it impossible to teach the trick to others. Their attempts fail in ways that I cannot duplicate, and for reasons that I cannot identify.

2) I learn a trick so that I can do it repeatedly, and think that I know what is happening. But when I return to this trick some weeks or months later I can't do the trick at all. Eventually I discover that there was a crucial feature that I was originally doing naturally, but was not doing when I revisited the trick following my own instructions.

3) Someone sees me failing to fly a simple trick or a certain kite successfully, and concludes from that that I cannot fly any more advanced tricks.

The classic example of 1) is the axel. This was just about the first trick I learned, and was a relatively pain free experience. But consequently I have not found out the ways the trick can fail and so am unable to give good advice on how to identify and correct common mistakes.

A good example of 2) is the 540. I learnt and relearnt this trick at least 3 times. The first time I got the timing right for the flare and the pull, but failed to realise that it was also important to: start throwing one hand forward before the other, tilt the kite so that the wingtips floated over the lines, and pull for the rotation when the wing edge being pulled is facing towards the flyer. I was doing all these things naturally at the start, and as I tried to get my arm movements closer to those shown and described in videos, tried to get flatter rotations, and more precisely timed pulls, repeatedly found that I could no longer complete 540s. That is why there is so much information in section 5.6.2 on what can go wrong and how to correct it.

Recently I had great difficulty in doing backflips[40] and currently have difficulty getting the pull from a flare into a fade. So there must be something lacking in the instructions in sections 5.7 and 5.11 that have served me well in the past.[41] Regarding fades, a few weeks ago, I could get a kite to go from a flare to a fade position, but could not catch or hold the fade. I found out what I was doing wrong in catching the fade, and have added the observation to section 5.11. But now I can't even get the kite to go from the flare to the fade!

Because of things such as the above, the onlooker might conclude from the tricks that I am having trouble doing and therefore am practicing the most, that it is inevitable that I cannot most other tricks, even those that require quite different inputs. But, to take a recent example, if the onlooker had kept watching, he would have seen in the same sessions where the backflip was failing, there were also multiple rungs of half axel cascades and cometes! - That inconsistency is a problem that often dogs my flying.

The reason why I have not written up notes on Taz machines and cometes in chapter 5 is that while I can regularly do them, or in the case of a comet: variations of them (currently it seems never the same type twice), I know that I cannot do these tricks on all the popular modern trick kites. There is some feature and/or piece of knowledge missing that prevents me from doing them, and therefore any advice I would give would be fundamentally flawed. These last thoughts are enlarged on in the next section on learning styles.

17.2 Learning styles

When my partner and I first started investigating trick flying, the advice that most local flyers consistently gave us was to practice lots. Just what we should practice was not defined. They appeared to associate gaining flying proficiency solely with spending lots of time in the air. I.e. Skill level is proportional to air time.

Imagine this idea were applied in other spheres of life. Teaching at school would be a waste of time, school teachers only acting as gate keepers, equipment suppliers and policemen. – Providing there was suitable equipment, and the pupils were prevented from being distracted, the children would teach themselves.[42] Car driving instructors' only roles would be to: a) stop the pupil doing something really dangerous while they were teaching themselves vehicle control and b) let the pupil know when there skills were sufficient for attempting the driving test. A student of any field would have to

[40] This was remedied by discovering the significance of the arm swing that is now described in section 5.7.

[41] In the case of backflips, the situation was improved by the discovery of the arm swinging movements, that have now been added to the section 5.7.

[42] At one time in the UK, there were alterative school science syllabuses, run by the Nuffield Foundation. In contrast to the conventional taught facts lessons, Nuffield promoted learning by doing lots of practical work and experiments. Pupils graduating from these courses were widely reputed to have more interest in science and a greater appreciation of their subjects. The penalty was that Nuffield students did not cover so much material in each class. The Nuffield courses died out when successive governments promulgated a national curriculum that required a specific amount of information to be learnt and examined.

retrace the self-learning steps of the pioneers of that field. For instance aircraft apprentices would learn by reinventing the first aircraft and early flights.[43]

-OK. There is a fair amount of truth in that view. It is reinforced by much loved and often quoted articles such as Matthew McGee's "Conceptual Kiting"[44] and Timothy Gallwey's "The Inner Game of Tennis"[45], which emphasise experience and internal mental states over taught technique. If you are finding it difficult to get your body to do what you think it should be doing and have not already studied these writings, I can thoroughly recommend them. You might also find benefit from attending classes in some of the Eastern arts of body control such as Tai Chi, Chi Kung and/or Yoga.

But going a little further into all the above examples, one finds that consciously teaching and learning technique is not excluded, but is there right at the beginning.[46] The real significance of practice is probably what Malcolm Gladwell explains in "Outliers"[47]. One of Gladwell's examples are classical musicians, where he explains that all professional musicians need a certain level of competence to reach music school. But beyond that, at the point at which they know the technique, it is the number of hours they practice that determines whether they stay at the level of school music teachers, become professional orchestra players, with 10,000 hours of practice necessary to become a famous soloist. Gladwell explains same applies to other walks of life, such as the Beatles in pop music, and Bill Gates, Steve Jobs and Bill Joy in computers.

So in order to benefit from practice, teaching/learning technique is necessary. But what are the techniques that should be practiced? There are many DVDs and on-line videos showing tricks. But usually the instructions supplied are not sufficient to do trick solely by following the instructions and/or copying what is shown on the video. This seems to apply even when the videos are very good indeed, such as those done

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[43] See the short stories: "Found at Pharisee" and "School for perfection" in Richard Bach "A Gift of Wings" Dell Publishing Inc, 1974, ISBN 0-440-1457-6.

[44] This can be found in "The Stickies" section of the Prism kite flyers forum at http://prismkites.com/cgi-bin/yabb2/YaBB.pl .

[45] W.Timothy Gallwey "The Inner Game of Tennis" Jonathan Cape Ltd, 1974. ISBN 0 224 01178 2. Timothy Gallwey also co-wrote with Bob Kriegel a book called "Inner Skiing". An update of the techniques described in that book can be found in Peter Lightfoot "Skiing is only a game" Fernhurst Books, 1985, ISBN 0 906754 20 8.

[46] Last month I experienced a example of this. While researching for this chapter, in "The Inner Game of Tennis" I came across Gallwey's description of how to rotate the wrist (around the axis of the forearm) to get a more powerful tennis smash. While I don't play tennis that much, I have played 100s of hours of badminton, and my smash in that sport required lots of arm movement. The next time I stepped out on court I tried Gallwey's wrist movement and all of a sudden my badminton smash became more powerful with less effort. I had not learnt that movement before, even when I had attended badminton classes. Those classes had described the smash as a throwing of the racquet movement, which they probably thought included the wrist action, but because I had never thrown a ball by rotating my wrist around the axis of the forearm, it did not occur to me that such a wrist action was part of the smash. – By the way, should you try this yourself, Gallwey also explains the angle that the racquet is twisted in the hand grip during the smash. If you don't get this last detail right, but rotated the wrist, you would be hitting the ball with the edge of the racket. – The details are everything!

[47] Malcolm Gladwell "Outliers – The Story of Success" Penguin, 2009. In particular, see chapter 2 "The 10,000 hour rule".

by Martin Madsen (aka mama74), where in his more recent studies and tutorials, he shows the hand and arm movements as the kite is being tricked. It is a bit like watching a good magician, who can repeat a trick in front of you time and time again, even at slow speed, and still one cannot see how the trick works.[48]

- I am not saying that it never happens that one can follow the instructions and the trick works first time. I am saying that often when this has happened to me, then later on when I try to repeat the trick, it fails, even though I think I am doing the same things as originally taught. Usually for me it turns out that there were some crucial details that I must have been doing naturally at first, but as I followed the instructions better the crucial details were being left out and the trick failed.

What I am arguing for are comprehensive sets of instructions, so that one knows what to do, and also can spot what is going wrong when it is going wrong, and know how to correct that.

17.3 Ways forward for these notes

As I am rejoining the ranks of full time permanent staff in June 2010, I will almost certainly have to give up developing and maintaining these notes.[49] While this seems a little sad, it also could be a good opportunity.

I think that it would be a very good thing for someone or some others to take over these notes. This would have the following advantages:

1) It could bring fresh perspectives – new observations on how tricks work and can be performed.

2) More authors give better credence. It is fairly easy to not have faith in the writings of one little known author. But if several people contribute then to the readers it is more likely that advice is likely to be genuine and correct.

My dream team for new authors would be a mixture of acknowledged experts and novice/intermediate flyers. The experts would give authority and hopefully be able to give comprehensive advice and answer all questions. Through trial and error, the novice/intermediate flyers would find the omissions in the advice. They could also spot common problems and issues that the experts do not suffer from and had probably forgotten all about.

Peter Massey
May 2010

[48] Perhaps this is why the manoeuvres are called “kite tricks” rather than “kite acrobatics”. “Acrobatics” may imply skill, but does suggest that anyone with sufficient physical fitness and technique can perform the manoeuvres. “Tricks” implies a bit of mystery and magic.

[49] It is likely that publication of material would give rise to employment contract issues. But I hope to still be practicing trick flying and will still be delighted to talk one to one with other flyers.

18 Glossary

18.1 A to B

Acid bath – A lateral roll into a back flip followed by an acid drop.

Acid drop – From a back flip, a sharp pull out so that the kite drops downwards and lands on its wing-tips. Sometimes, the same move but done high enough that the kite does not land is also called an "acid drop".

An **active bridle** is a dynamic bridle where the dynamic behaviour is achieved with the addition of extra legs to the bridle. A leg is typically a length of line running between two parts of the bridle.

Aspect ratio – Some people define this as the ratio of the width to the height. Others, notably Prism, define it as the ratio of the square of the wingspan to the surface area of the wing.

Axel – A rotation with the kite belly down, starting from a position with the nose closer to the flyer than the rest of the kite.

The axel is ascribed to Steve Thomas who claims to have invented it in 1992. It was developed from an earlier axel which is now called the 540 or flatspin. Some of the story can be found at www.kites.tug.com/Axel/steveth1.txt and http://www.kites.tug.com/Axel/kobi.txt .

In competition the axel rotation should start and end with the nose up.

Axel cascade – This term is sometimes used to describe a conventional cascade of successive half-axels.

Axel landing – A landing from an axel, which starts from the kite almost pointing sideways, with the upper wing axeled.

Axle – Often used spelling for "axel". "Axel" refers to the ice-skating spin, whereas "axle" is the spelling for the pivot of a wheel.

Back flip – A flip from normal flying position onto the kite's back. This is often done with a pop and line tension slack when the kite is at the top of the wind window.

Back spin - A rotation from a fade back to a fade. Note that half way through the backspin the kite is belly down and at this point the kite can be recovered to fly normally.

Backspin cascade – A series of reversing backspins.

Bass axel – A very early name for the backspin.

Bethell, Ray – Vancouver Canada based flyer famed for flying 3 kites simultaneously. He started flying late in life in 1980 while on holiday with his wife in Hawaii. He holds a record for flying 3 kites continuously for 12 hours 12 minutes, at Long Beach, Washington USA, on 18th August 1994. Ray says that his job as a gynaecologist helped him with his flying. Ray became suddenly deaf due to a rare virus, and lost his wife to senile dementia. See "Ray Bethell's Good Stuff" © Vancouver Film School, available at www.youtube.com/watch?v=X3rK8-39AhQ .

Bowing (dual line sport kites) – In strong winds, a dual line sport kite may bow, so that the region about the spine is further way from the flyer than normal. This distortion can result in the kite being more effective at catching the wind, which accentuates the effects of the strong wind.

Various methods have been conceived to reduce this effect. These include: using stiffer lower spreaders, bridles that give more support to the spine, and the bow limiter (described below).

Bow Limiter – A line running across the back of a dual line sport kite, between the two troughs (parts to either side of the keel that are furthest from the flyer). If the kite is bowing in strong winds, then the troughs are forced further apart. The bow limiter prevents the troughs for separating.

The bow limiter is believed to have been first introduced by Carl Robertshaw on the vented version of the Fury.

Bridle – The structure of lines between the kite and the line set.

For two line sports kites, the bridle can be 3 point, turbo or active. The 3 point bridle is the simplest. On each side of the kite, a line runs from the upper and lower leading edges and from the lower spine (often from the centre tee) to a common junction. At this point the tow point is attached.

Figure 40 Turbo bridle of a Prism Quantum Pro
Only one side is shown.

With a turbo bridle, the inhaul, upper and lower outhaul lines still run to a common junction. However the tow point is moved away from this common junction. If it is moved along the inhaul, it is a "turbo" bridle, and if it is moved onto the uphaul or outhaul, it is a "reverse turbo" bridle. Moving the tow point away from the common junction allows a little latitude in the aspect of the kite before the force of the kite line no longer pulls simultaneously on all three lines.

Because the tow points are moved closer together, a turbo bridle tends to require less input. Because of the way the kite sits in the sky, it tends to have reduced pull, and the kite speeds up in higher winds. And as the tow points are nearer to each other, in the fade the lines cross the leading edge nearer to the nose and so fades tend to be shallower.

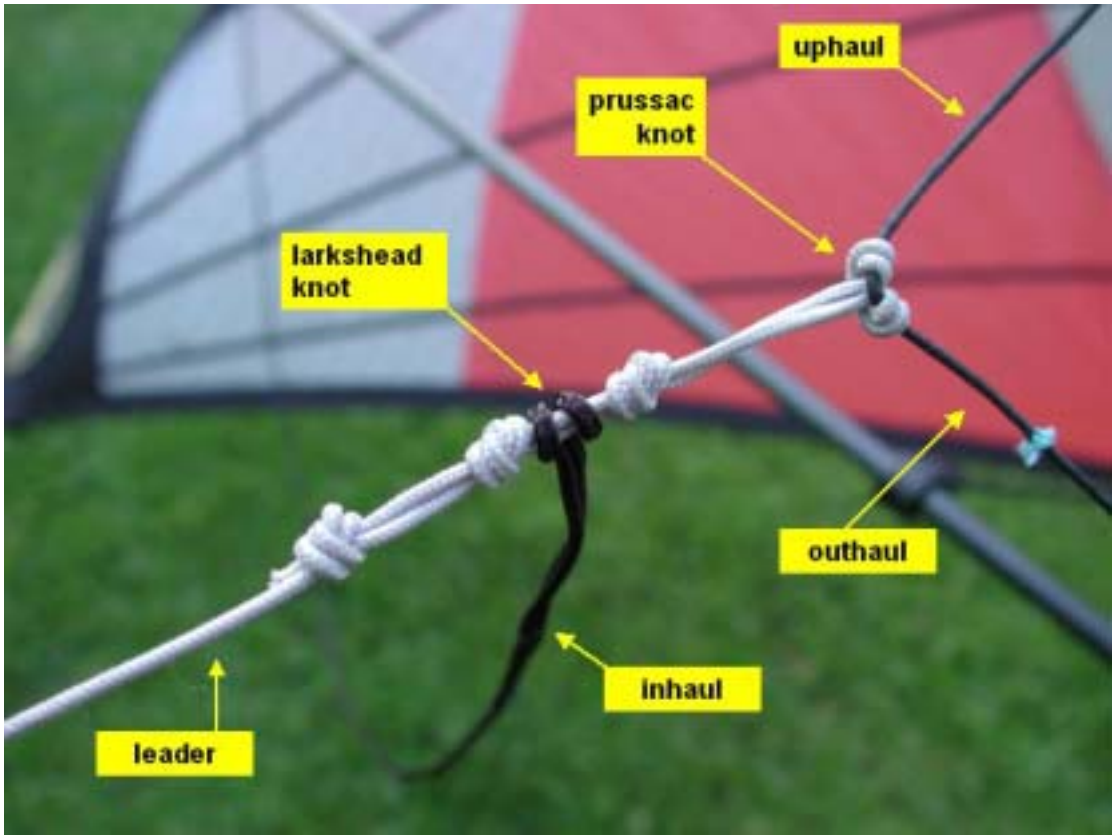

Figure 41 Tow point of turbo bridle on Prism Quantum Pro
The blue thread on the outhaul is a mark to denote a default location for the prussic knot

With the tow point moved to the lower outhaul, the reverse turbo has improved precision and tracking, and increased pull. The fade depth is increased and more arm movement is required to control and trick the kite.

Figure 42 Reverse turbo bridle with tow point on uphaul
The bridle of a Prism E2 is shown. The small black and white tags on the uphaul of this kite are to inform the flyer which way to move the prussic knot for light and high wind conditions.

With an active bridle the tow point is usually at or near the common junction between the inhaul and outhauls. However additional lines are tied between the outhauls and/or between an outhaul and the inhaul. These additional lines are called "activators" and bring the lines that they are tied between closer together. They also allow the lines that they are tied between to change direction according to the pull of the towing line and so allow latitude in the aspect of the kite before the force of the tow line no longer pulls simultaneously on the lines connected by the activator.

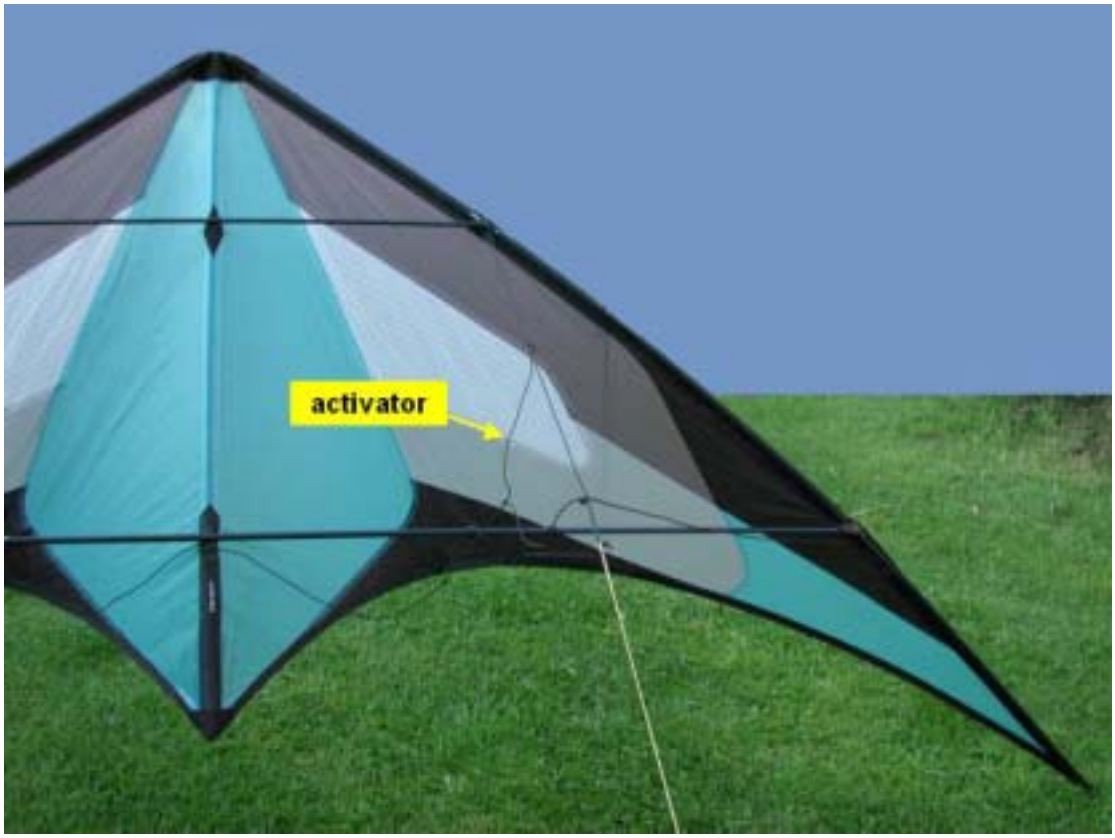

Figure 43 Semi-active bridle on a Benson Deep Space
This bridle is like a 3 point bridle, but has an activator between the uphaul and inhaul. If there were also activators between the uphaul and downhaul, and between the downhaul and inhaul, it would be a (fully) active bridle.

With a cross-active bridle, an activator runs between the left and right sides of the kite bridle, so transferring pulls on one side to the other. In some cases this can permit the tow point on one side to move outwards when there is no pull on the other side, thus making tricks easier, but bringing the tow points together again when the tow lines are being pulled evenly for normal flight.

Sometimes the inhaul can get caught behind the tip of the lower spine. To avoid this, a keeper line may be present, which runs between the inhaul and the top of the outhaul, and prevents the inhaul from falling down to the tip of the lower spine.

18.2 C to E

Cartwheel launch. With the kite nose-down and resting on one leading edge, the wing in the air is pulled to roll the kite across the resting leading edge and pivot into launch position.

Cascade – A series of alternating moves. By default the moves are half axels.

Cheat line – Another name for a trick line.

Coin toss – An axel from a tip stand to a tip stand, the axel being performed by tugging the wing in the air.

The coin toss was probably invented by Miguel Rodriguez at around the same time that the axel was invented by Steve Thomas. In its early days, the coin toss was also called “the coin” or “flip of the coin”.

Combination turn – A turn that involves both a push of one hand and a mostly simultaneous pull turn of the other hand. Combination turns are used for fast but still snappy turns, and combine much of the speed of pull turns with much of the precision of push turns.

Dodd Gross recommends that in a combination turn, the pull is started very slightly before the push.

Comet or **Comète** - The rotation is done with four pops. The first puts the kite from an upright position into a half axel side on position. The second with the other arm puts the kite in a nose down position. The third with the first arm puts the kite in a turtle position, and the last with the second arm puts the kite in the normal upright flying position.

The best video on the comet is probably the one made by Robert Randolph and viewable at:
www.youtube.com/watch?v=nLHJiKTQRmo&feature=player_embedded .

A very good set of descriptions and discussions of various attitudes to the comets and its forms can be found at: http://world.aerialis.no/pivot/entry.php?id=37 .

Crazy copter - A push into a shallow turtle, followed by a pop to force the nose between the lines and into a turtle, followed by a one-sided pop to rotate the kite, followed by pulling on both lines to pull the nose from between the lines and resume normal flying.

Cynique – Alternating direction lazy Susans without coming out of the turtle.

Dead launch. Launch from nose towards you belly down position. The launch is accomplished by applying one very short sharp pop, which drives the kite into the ground. As the kite bounces up again a longer even pull takes the kite into the air.

Dog staking. Running the control lines around a stake so that the pilot does not have to be windward of the kite, and can be next to the kite. Dog staking allows the pilot to see what the kite is doing from closer up. It also allows the pilot to do stunts that involve touching or holding the kite.

Dog staking is probably named after the screw into the ground type stake of that name. It is said that dog staking was first demonstrated by American: Lee Sedgewick.

Double axel – A axel that rotates twice. This can be done by flying to the edge of the wind window, tugging the upper wing and then axeling the bottom wing.

Downwind glide – A glide downwind to recover lost ground from backing up in light winds. Also called a “fly away”.

Duplex – a backspin combined with a flick flack.

Dynamic bridle – A bridle where there is a component that is designed to move under tension in normal use. In its simplest form it consists of a conventional 3 point bridle where the tow point is moved away from the junction of the three lines, so that the line holding the tow point can allow the tow point connection to move from side to side. For further information see http://wardley.org/kites/bridle/dynamic.html.

Easy over – Dual line trick. Fly across or down, pull turn sharply to point the nose upwards, and pull for an axel.

Elbow – a part that is normally used to join a spreader spar to a leading edge spar.

Elevator – A rising fade.

18.3 F to H

Fade is flying nose towards you belly upwards.

Originally, the term “fade” was used for another trick: the “edge fade”.

Figure 44 The fade
A Prism E2 held in a fade. The E2 is in “jungle” colours.

Fade-In Fade-Out – A name Andy Wardley uses for a gentle flic-flac.

Ferrule – A rod used to connect spars together, end to end. Ferrules can be external or internal. Regardless of whether the ferrule is external or internal, the spar with the ferrule glued to it is called the male, and the spar which slides onto/into the ferrule is called the female.

Five forty – A one and a half turn flat spin in a belly down position. The term 540 flatspin was coined by Andy Wardley.

Flapjack – A back flip and lazy susan that starts and ends on the ground.

Figure 45 Team Spectrum demonstrating HQ style finger straps

A **flare** is a **pancake**, which is belly down and nose away

Flashback – A 540 flatspin that moves from the edge towards the centre of the window as it is spinning.

Flic-flac – Repeated transitions between a fade and a flare. The name comes from the gymnastics term for a back handspring.

A **flip** is a turtle.

Flip launch is a flip from a belly down position to the on both wing tips launch position. It is started with one leading edge tip pointing to the flyer, and the far wing line is pulled to flip the kite over.

Fly away – Another name for the downwind glide.

A **fountain** is a cascade that goes upwards.

Fractured axel – An axel that is broken half way through by a pop that inverts the kite into a fade. Also known as "axel into fade".

Fractured axels can be done with the pop into fade done with one or two hands. To do a fractured axel with a one hand pop into fade, start an axel in the usual way. As the nose is turning completely away, pop with the other hand to the one that popped for the axel. If the nose hasn't quite reached the fully facing away point, then the pop will be pulling through the centre of gravity of the kite, and thus will be inverting the kite without imparting spin. The spin of the original axel will move the nose into a facing towards the flyer position.

French turn – A sharp turn done by pushing one arm to commence the turn, pushing the other arm to stop the turn, and then pulling both arms to pull the kite away from the turn.

Frisbee – A kite launch where the kite is thrown from the flyer in the manner of a frisbee. The kite starts belly down and with the apex toward the flyer, with the kite held by the upper spreader. If the kite is held in the flyer's right hand, then the kite is held on the far right side of the upper spreader, and over the flyer's right shoulder. The kite is launched across the body and away from the flyer, and because of the way it was held, it rotates a full circle so that the apex faces the flyer at the end of its travel. This form of frisbee is illustrated in the "Tricky Flickery" video.

An alternative method has been described by Andy Wardley. With the kite in the right hand held by the fabric of the right leading edge, the kite is launched across the body to the left, starting at eye level and finishing at shoulder level.

Fruit roll-up – is a yo-yo that is unrolled into a fade from a vertical dive. Variations include multiple wraps and unrolling directly into a backspin.

Full Monty – A spin axel, into a momentary front flip, into a back flip, into a lazy susan, followed by a recovery into flying upwards.

Genie pop – An under axel or double under axel beginning from a ground pass, and ending with the kite travelling in the opposite direction to the original ground pass.

A **ground pass** is sweeping the kite across the wind window close to the ground.

A **ground toss** is an axel that starts with both wingtips on the ground. It is achieved by giving a quick tug to the opposite wing to pop the kite just off the ground before the axel.

G-Wizz or **G-Whizz** – Starting from the kite on the ground in normal takeoff position, the kite is coin-tossed or rotated about one wing tip until the nose is facing away. Then a 540 flat-spin rotation is performed

Half axel – An axel like course reversal from a horizontal pass. The axel comes from a tug on the upper wing. A half-axel has also been called a kick turn.

Helicopter is:

1) a float across the wind window at a steady height in a stall.
2) a pinwheel.

18.4 I to L

Icarex is a ripstop polyester from Japan. It is made in P38 (heavier) and P31 (lighter) grades.

Indi – Short for "individual", as in individual competitors.

Inhaul – In the bridle, the line running from the centre tee to the outhaul. Sometimes called the inner yoke.

Inner yoke – Another name for the inhaul.

Insane – a trick in which the kite does several turns because a tip is caught in the line. This is sometimes known as a **Latham** as an attribution to Paul Latham creating it.

Insane (Right-Left) – The same as a normal insane, but as one rotation ends the opposite line is pulled to perform an insane rotation in the other direction

Inverse is a reverse in direction using a Rolling Susan

Jacob's ladder – Assuming that one is starting from a fade, then each rung of a Jacob's ladder is: starting from a fade, a lateral roll followed by a rotation into a turtle, followed by a half lazy susan followed by a rotation in to a fade.

Andy Wardley says that one of the inventors of this trick was Tim Benson, and Andy named it the Jacob's ladder as it reminded him of the toy consisting of blocks of wood tied together that can be made to appear to tumble down but never actually go anywhere. (see http://wardley.org/kites/movies/feb2004.html)

Jaws – Stall the kite down into some water, that is deep enough that the kite submerges, the nose up. Then pull the kite out of the water and back into flight.

KAP – Kite Aerial Photography – Taking photographs from a kite. Normally single line kites are used. The camera is triggered by: a second line, a wireless link, or a timer.

Keeper line – On a dual line sports kite, it is usually a line running between the top of the upper outhaul and the inhaul, which is there to prevent the inhaul falling lower and getting trapped behind the tip of the lower spine. A keeper line is sometimes called a retainer line.

Kick turn – An alternative name for a half axel.

Kite killers - Wrist straps connected to the break lines of a power kite, so that if the handles are dropped, the flier's arms pull on the break lines and bring down the kite.

Kite mate – **spar remover**. A device for moving elbows and grabbers along spars. Acts by facilitating pushing the elbow/grabber at the hole around the spar, thus relieving pressure on the spar.

Figure 46 Kite mate spar remover
The left view is of the top of the spar remover. The metal chain allows the remover to be attached to a key ring. The right view is of the underside of the spar remover, showing the grove that fits around the spar. For photograph clarity a pink kite mate is shown here, but other colours were made.

Figure 47 Using a kite mate spar remover
The fingers grip the spar, and the thumb pushes the spar remover into the elbow or other rubber connector.

Kombo – A rolling susan performed near the ground with the kite going directly into a two-point landing.

K2000 – The kite is landed so that it is resting on one of its leading edges, with the back of the kite facing the pilot and the lines coming over the trailing edge. The lower wing is pulled to begin a lazy susan, causing the kite to rise off the ground, and when the kite has rotated into the belly-up nose-away position the wingtips are pulled down into a two-point landing.

Lateral roll – A recovery from a fade into normal flying position done by rotating the kite from a fade by pulling on one line.

Lawn dart – A crash nose first into the ground.

Lazy Susan – One or more flat spins while the kite is on its back, starting from a back flip position. This is named after the lazy susan that is used to rotate food stuffs on a table, and was named this as kites at that time would often perform the rotation so flat that they looked as if they were laying down flat on a revolving stand.

A **leading edge** is an edge of the kite that is at the forward side of the kite as it passes through the wind.

Leading edge glide – Something put over a leading edge fitting (usually an elbow) to enable bridle and kite line to glide smoothly over the fitting, avoiding catching in the fitting.

Leading edge glides are generally strips that are inserted across the fitting, with the glide's edges tucked between the leading edge spar and the leading edge fabric. The strips can be made of plastic tubing, the thin parts of plastic zip ties, old plastic bottles, or in the case of the Prism QPro standard and variable vented: 2mm carbon rod. In this last case a grove is cut in the elbow to seat the rod.

In more modern kites, the need for leading edge glides has largely been eliminated through the use of covered leading edges – that is the continuation of the leading edge fabric across the fitting at the back of the kite.

Leading edge landing – A landing on a leading edge. To ensure that the landing does not break the leading edge, the kite should land with the leading edge parallel to the ground. This will spread the landing shock along the leading edge rather than concentrating it in one spot, which could break the leading edge or sometimes the lower spreader.

Leading edge launch – is a launch away from the centre of the wind window, dragging the kite on a leading edge.

A **leader line** is a line attached either between a line and a handle, or between a line and the bridal. When attached to the bridle, leader lines are used to prevent snagging on the kite and to prevent damage to the kite. They achieve this by being thicker than conventional line (often being constructed of bridle line) and so less likely to cut or catch on a small gap or notch in the kite surface. Sometimes called a tracer.

Lewis A forward roll up followed by a lazy susan while rolled up followed by an unrolling.

Lifter The kite flying with its back facing the pilot, nose facing downwards with the lines running over the trailing edge.

It is said that many German kites can do a lifter.

Lifter kite A kite used primarily for lifting other objects into the air.

Longeron A name sometimes given to any of the four name spars of a box kite.

18.5 M to R

Mega-fly – A number of fliers and/or different flying teams all flying together. As it is likely that different fliers/teams will have different kites, a mega-fly usually involves different kites being in the sky together. This raises unique problems in performing formation flying. The solution to this usually involves arranging the formation so that the faster kites fly at the front of the group.

Moebius – Dual line trick. From flying across or up, pull turn down, and when the nose is coming to face downwards pop the other wing for an axel, which because the kite is flying downwards, will be on the kite's back.

Multi-lazy is several Lazy Susan turns.

Multiple kite flying – One person flying several independently controlled kites at once. For two line kites, the maximum seems to be three kites: one connected to a bar in the left hand, one connected to a bar in the right hand, and one connected to a harness around the waist. See Figure 48. This technique is believed to have been originally developed by Ray Bethell.

Figure 48 Flying 3 kites at once
Bryan Wright flying 3 two-line kites simultaneously. Photograph adapted from an original © 2007 R.J.Davies.

For 4 line sport kites such as the Revolution, the maximum independently flyable appears to be 2. The handles of one kite are held in the left hand, and the handles of the other kite are held in the right hand.

Mutex – A combination of a flic-flac with another trick with each rung of the flic flac. Andy Wardley says that (e.g. http://wardley.org/kites/movies/feb2004.html) the original mutex was a flic-flac interspersed with a 360° flat spin done on each flare. He calls flic-flacs interspersed with back-spins on each fade, a back-spin mutex. He calls a flic-flacs interspersed with a 360° flat spin on each flare and a back-spin on each fade, a full mutex.

Nappy – A piece of cloth, usually gaze, that is used to reduce the speed of the kite. It is normally run between the flying lines, and acts by catching the wind, slowing the kite down, and by pulling on the lines to change the aspect of the kite so that its nose is more into the wind (e.g. points more towards the flyer when the kite is downwind) thus reducing pull.

A nappy can also be strung between standoffs, as shown in Figure 35.

Ninja turtle – From vertically downwards flight, a sharp 180° pull (or rather pull-pull) turn, finished by going into a turtle.

Outer yoke – Bridle line running between points on the leading edge. Another name for outhaul.

Outhaul – Bridle line running between points on the leading edge. Sometimes called the outer yoke. It is divided into upper outhaul and lower outhaul.

An **over easy** From a large loop at its bottom, or from a ground pass, release and then pull the lower wing to launch an under axel. Let this rotate and pick up the kite to continue flying in the direction before the axel pull.

Pancake – The kite lands nose away belly down.

In France, a pancake is also another term for flic-flac.

A **pinwheel** is a move where the kite rotates on its belly from near the top of the wind window. It is normally executed in light or still winds. This is sometimes (e.g. Bob Gross's "Flight School" DVD) called a helicopter.

Pogo stick – With the kite in a deep back flip, the kite touches the ground with its nose and bounces up.

It is said that the pogo stick was first done with a Benson Gemini.

A **pop** is a short sharp tug on one or two lines. Usually it is on one line.

Pop-up – A launch starting with the kite facing belly down nose away. Both lines are tugged to get the kite to pop up a few feet in the air. Then "a gentle pull on one line" pulls the nose around 180 degrees and into flying position.

A **punch turn** is a very fast push turn, where the push and recovery to original arm position is made by a punching motion.

A **push turn** is a turn started by pushing an arm away from the body towards the kite.

Q flaps – Triangular shaped flaps that are installed in pairs on the lower spreaders of dual line sport/stunt kites. Each Q flap is connected to a line that runs down to the flyer. Thus the dual line kite is converted into a four line kite. Pulling on the Q flaps can brake and reverse the kite. Sold by Skyburner.

Raise the titanic – Fly straight down into deep water, turn the kite around in the water, and then fly up and away.

Refuel – In dual line pairs flying, when one kite flies into the lines of the other kite and then keeps in contact with the lines. See Figure 49. Examples of refuels can be found in the video of Ray Bethell's multi-kite flying at http://www.youtube.com/watch?v=pe2PddwZJAI&NR=1 .

Figure 49 A refuel
The kites being flown by Team Spectrum. Photograph adapted from an original © 2007 R.J.Davies.

Retainer line – An alternative name for a keeper line.

A **reverse coin toss** is an axel from a tip stand to a tip stand, started by axeling he wing on the ground.

Reverse turtle - The kite is on its back with the nose towards the flyer, and the lines run over the trailing edge and under the kite to the flyer.

A **rising fade** is a fade where the kite rises in the air.

Roll bars are springy battons added to the rear of a sport kite to trap lines in yo-yo manoeuvres

Rolling cascade – A series of reversing half insane rotations..

Rolling up – The kite begins belly down on the ground with the nose away, and with the lines pre-wrapped around the kite. The kite is launched as for a fade launch with the nose swept up and under the kite, and the wraps will cause the kite to unroll several times

Rolling Susan (Snap Lazy). Also known as a "snap lazy". A lazy susan entered from a ground pass. The lower wing is popped while allowing slack to the upper wing. This puts the kite on its back. Then the rotation is given by a pop from the same arm

as the first pop. For competition, the exit involves flying in the same direction as the entrance to the trick.

Rotofade – An old name for a back spin.

Round the world – A team flying manoeuvre. The kites fly one after the other, around in a circle. In order to stop the lines from wrapping around each other, the flyers run in a rough circle on the ground. If the kites are travelling in a clockwise circle (as seen by the flyers), then the flyers must run in an anti-clockwise circle on the ground.

18.6 S to Z

Sideway – A French term for a side slide.

Sleeping beauty – A launch starting with the kite directly downwind on its back with nose toward the flier. Pulling one wing rotates the kite on its back 180 degrees, and then a tug on the other line scoops air under the nose and into launch position.

Slide – The kite floats sideways in a horizontal line with the nose pointing upwards.

Slot machine is an axel turn in a ground pass. To do a slot machine, optionally push, then pop the top wing, then pull the upper wing to begin the rotation. Recover to continue the ground pass.

Snap lazy – See "rolling Susan".

Solo flying – Flying with a dog stake.

Spar – a rod in the kite. See section 11.7 for more information on the types of spars that are available.

Spike – A wingtip is driven into the ground. Also know as a tip stab.

Spin axel – An axel started when the kite has been put in a spin, using a tug to the outer wing.

Spine – the spar that runs from the nose to the bottom of the central part of the kite.

A **spreader** is a rod that runs across the kite to spread the wings.

Stack – A number of kites (usually all of the same type) flying on the same lines.

Figure 50 Stacks of kites
The 5 kites in the foreground are Prism Adrenalines. In the background there is a stack of 20 diamond kites.

STACK – Sport, Team and Competitive Kiting, an organisation that organises competitions.

STACK was started in the UK in July 1988.

Stall – A trick where the kite is snapped from straight-line flight to a stop with the nose upright.

A **standoff** is a rod that pushes the sail away from the spreader.

Three sixty – flying around in a circle.

A **tip stab** is a snap stall landing that drives the kite down onto one wingtip. Sometimes known as a "spike".

A **tip stand** is the kite standing on one tip. From the two-tip standing position, a tip stand can be performed by pulling on the line nearest the closest tip. This raises the kite into the air, with the wingtip furthest from the flyer standing clear of the ground. The kite can be pulled down again by pulling on the other line, which pulls the far wing tip (the one in the air) towards the flyer, thus making the nose tip further away than the wingtip(s), reducing the lift on the raised wing and so letting that wing settle downwards. However too much pull on the line of the raised wing would make the kite face fully into the wind (i.e. line between the wingtips would be perpendicular to the wind direction), which would increase the lift and make the kite take off. So using the two lines to balance the upper wing in a tip stand is a matter of subtle pulls.

Tornado – A launch being with the kite on its back with the nose facing roughly towards the pilot, where the kite is back spinned off the ground.

Torpille – This is a tumbling trick. The kite tumbles from back to belly as it descends. It begins with a hard half axel, then a pop to knock the kite onto its belly, then another pop to put the kite on its back, and so on. See http://www.youtube.com/watch?v=T22hTedwuJM .

Tracer – Another name for leader line.

A **trailing edge** is an edge of the kite that is at the rear part of the kite as it passes through the wind.

Trick line – A line running behind the trailing edge, usually from wingtip to tail to wingtip, that is placed there either: to help in tricks, or to protect the trailing edge from the kite lines. This is also sometimes known as a "cheat line".

Turtle – From normal nose up flying position, the kite is flipped on its back. Also called the backflip.

Twist – Another name for the sleeping beauty launch.

Twizzle – A fast very tight turn that goes around several times. The expression was used in Channel 5's "The Gadget Show" on 11th May 2009 when the presenters flew the Carl Robertshaw Aerostuff Fury in their "Top 5 wind kites" item. The two twizzles that presenter Jason did upon announcement, went around twice each. The term was subsequently used heavily in discussions on the Fractured Axel forum about this broadcast.

Two-point landing – A landing where the kite lands cleanly and simulataneously on its wingtips.

Under axel – An upside down axel, done by pulling on the lower wing in a ground pass, or the outside wing when the kite is turning downwards.

In the "Flexifoil Stranger" video of 1994, Andy Preston calls what we would now call a half-axel an "under axel".

Up and over – Flying the kite overhead and onwards and downwards in a downwind glide.

Walk of shame – The flyer's walk to the kite when it has come down awkwardly to reset it for flying.

Wap-Doo-Wap – From a fade the kite is flared so that it is belly up nose towards the pilot, with the lines beneath the kite. Then the kite is spun either 360 or 540, and then yo-yoed. With 360 rotation the trick is exited nose down, and with a 540 rotation the trick is exited nose up.

Water skier – Flying a dual line kite across water so that the wing tip kicks up a plume or "rooster tail" of water.

Whisker - Another name for "stand-off": a rod that spaces a sail away from a spar.

The **wind window** is an imaginary segment of the hemisphere opposite to the wind direction, across which the kite will fly.

Yo-yo – One or more rotations of the kite such that the lines wrap around the kite.

Yo-yo line is line between the two lines that preserves the distance between the lines when in a yo-yo. It can also help prevent tip wraps.

Yo-yo multilazy – A multilazy performed while the kite is wrapped in a yo-yo.

Yo-yo stoppers – Fittings protruding from the leading edges to catch the lines when the kite is being wrapped up and to keep the lines from sliding further away from the nose. Thus the lines are kept in a location that allows the kite to be flown while wrapped up.

As a temporary measure, binder clips (found in stationary stores) can be used as yo-yo stoppers, but clipping them to the leading edges over the leading edge rods. Bulldog clips are a similar alternative, but binder clips usually have smoother handles and therefore there is less line wear.

Yo-yo takeoff – The kite starts with its wingtips on the ground. The kite is popped off the ground and pitched backward 360 so that it rolls up into a full yo-yo.

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