

EQUIPMENT USED IN BASE JUMPING

WARNING:

This document summarizes the main characteristics of the gear used in BASE jumping. It MUST NOT be used as a reference document. As equipment rapidly and constantly evolves, the information provided may not be accurate and some specific options are not detailed here. It is recommended to check with the manufacturers for more information.

List of manufacturers :

Acrobat Base (Russia): container manufacturer, dealer for Atair Canopies

<http://acrobatbase.ru/>

Adrenalin Base (France): container manufacturer, dealer for Atair Canopies

<http://www.adrenalinbase.com/>

Apex Base (California, USA): container and canopy manufacturer,

<https://www.apexbase.com/>

Asylum Design (California, USA) container manufacturer, canopy dealer for Apex Base and Consolidated Rigging

<http://www.asylumbase.com/>

Atair Canopies (Slovenia): canopy manufacturer

<http://www.basetroll.com/>

Bad Seed Base (Nevada , USA): container and canopy manufacturer

<http://badseedbase.com/>

Blacksheep Rigging (Colorado, USA) : container manufacturer

<https://www.facebook.com/blacksheeprigging>

Consolidated Rigging (Kansas, USA): canopy manufacturer

<http://www.crmajo.com/>

Fly Your Body (France): container manufacturer, dealer for Apex Base and Consolidated Rigging

<http://flyyourbody.com/fr/>

GLH Systems (New Zealand): container anufacturer, canopy dealer for Atair and Apex

<http://glhsystems.biz/>

Morpheus Technologies (Florida, USA): container manufacturer, canopy dealer for Atair

Canopies

<http://www.baserigs.com/>

Nitro Rigging (Florida, USA) : container and canopy manufacturer

<http://nitrorigging.com/>

Sky Wide Systems (Ukraine) : container manufacturer

<http://sws.aero/en/>

Squirrel : container manufacturer

<http://squirrel.ws/>

Ulster County C&C (New-York, USA) : container and canopy manufacturer

<http://www.thebaser.com>

Canopies - Material

Fabrics:

All BASE jumping specific canopies are made of F-111 type nylon ripstop fabric.

"Ripstop" is a fabric made by a weaving method which creates a grid of stronger fibers. This gives a thin and light fabric, while keeping good structural strength. The grid reinforcement prevents tear propagation (hence the name "rip-stop").

The used fiber is made of nylon - referred as PA 6.6 HT (high tenacity polyamide 6.6)

"F-111" refers to the permeability characteristics of the fabric. Without going into details, it is necessary to keep a little bit of porosity to ensure proper opening and a safe and progressive behavior of the canopy to stall (but at the expense of a little of the glide)

The **ZP** or **ZeroPorosity** fabric is an analogue to the F-111 but is different as the coating makes it completely airtight. It is mainly used in skydiving where focus is put on the longevity of equipment and its performance (glide) at the expense of the quality of openings.

Aging equipment & F-111 openings:

F-111 is a slightly porous fabric when it is new - but its porosity increases with repeated mechanical stress. Throughout the life of a canopy, the porosity increases, causing a decrease in glide ratio and flair power. The most critical part of the upper surface is on the first third of the canopy. Using ZP fabric on this section avoids excessive degradation of the flight characteristics of canopy, even if the rest of the surface sees its porosity increase.

Common Name & manufacturers references:

F-111 or *0-3cfm* : classic fabric with a slight porosity which makes it a material of choice for BASE canopies (an area in which the quality and reliability of the opening trump longevity or glide.)

PN9: A lighter version of F-111 manufactured by Porcher Industries. The porosity is the same but the yarn and the nylon coating are finer.

“Ultralight” fabrics have the advantage of reducing the weight and volume of material. However, packing is a little more difficult for some, as the fabric is slipperier, and doesn’t hold its shape as well. Moreover, the light fabrics are more fragile. Reference examples exist which have aged almost as well as F-111, but care must be taken to avoid subjecting the canopy to abrasion.

PN1. New F-111 fabric from Porcher Industries

PN4: New ZP fabric from Porcher Industries

PN10: *Light* ZP version

There are several references for each type of fabric, due to the skydiving industry having seen changes in treatments, dyes, and coatings for more efficient and more sustainable products, and also to meet new industry standards to cut pollution from solvents.

See here for the Technical details:

[http://skytex.fr/uploads/files/marches/sport/08-S07% 20Gamme% 20parachuteV01.pdf](http://skytex.fr/uploads/files/marches/sport/08-S07%20Gamme%20parachuteV01.pdf)

Lines :

Type of fiber :

Nylon has been widely used in the past in skydiving but has many disadvantages (although recent methods have solved most problems). Its elasticity is at the expense of its dimensional stability. The length of the lines varies greatly during use, particularly when subjected to high stress - but also depending on the storage environment. Nylon deteriorates easily in the presence of moisture, or exposure to ultraviolet or acidic media (this results in a significant reduction in tensile strength).

Polyester or **Dacron** (*polyethylene terephthalate* or *PET* chemically) is the material most commonly used for lines designed for base jumping. Extremely resistant to mechanical stress (abrasion, impact, bending), Dacron also has good elasticity and good dimensional stability over time. This is a very well known, reliable and cheap material.

Spectra or **Dyneema** is a newer fiber. This material has a very good strength to weight ratio and is widely used in mountaineering equipment. The longevity of this fiber is exceptional. It keeps its strength well when subjected to significant repeated mechanical stresses (tension and flexion). The elasticity of the spectra is low and therefore not suitable for slider down jumps.

Spectra is sensitive to heat - Its melting temperature is low and it begins to lose strength when subjected to temperatures above 100 ° C.

Kevlar and **Technora** are extremely strong fibers of aramid family, very resistant to heat, with nearly zero elasticity. Widely used in fire protection clothing or in conjunction with resin to make light, stiff, strong, structures, it has also been used in lines and fabrics for many activities, including skydiving and paragliding.

Kevlar's weakness is its poor aging under repeated stresses, especially in flexion. Losing much of its strength fairly quickly, it must be oversized and checked regularly. Its great advantage is its excellent dimensional stability - which explains why it is still used for many paragliding wings - especially for competition wings which have a very high sensitivity to differences in lines length.

Vectran is a relatively modern fiber which performs close to Kevlar, with almost zero elasticity and good dimensional stability. However Vectran wears better than Kevlar.

Kevlar and Vectran, because of their almost nonexistent elasticity, are not usually used for BASE canopies. It would be possible to use these fibers if largely oversize to counter the loss of strength over time. That said, given the high tolerance profiles of BASE jumping canopies to differences in lines length, it does not really bring benefits compared to spectra, but would increase the forces to which the rest of the equipment is subjected (including attachment points on the canopy). If lighter, lower volume lines are desired, spectra appears to be a more appropriate choice.

The common names used are "Dacron 550" or "Spectra 725" - the number referring to the strength of the lines in pounds.

Reference : 1kg = 2.2lbs

Light gear :

Low volume canopies often use Spectra for it's low bulk and weight, due to it's low elasticity (compared with Dacron for example) canopies with Spectra lines are not suitable for slider down jumps (risks of attachment points failure).

Some manufacturers offer light canopies with Dacron 400 lines, which is lighter and less bulky than conventional Dacron lines (Dacron 525, 550 or 600).

The goal is to keep the elasticity of Dacron to be able to jump down slider, while reducing the weight and volume of material to a minimum.

Incidents (broken lines) have been reported with Dacron 400. The use of Dacron 400 in BASE jumping is subject to caution and it is imperative to be well informed before using this material. See the following discussion for more information :

<http://www.basejumper.com/cgi-bin/forum/gforum.cgi?post=2955956>

Sliders

The classic slider in BASE jumping is the big mesh slider. It provides limited reefing of openings, and is primarily used to control lines. The friction between the lines and grommets plays an important role in slowing opening speeds - some jumpers use oil-based silicon lubricants or paraffin on the lines when the slider begins to slow openings undesirably.

Changing the lines is also a solution - common sense and the general condition of the canopy are to be taken into account.

Small mesh sliders are sometimes used for terminal velocity jumps if the openings are considered too hard. Small mesh sliders generate more drag against the relative wind, and slow openings more than large mesh.

Slow sliders are sliders with two large fabric bands on the mesh. These sliders slow openings down even more than small mesh.

There are three types of sliders used in BASE jump, from the "faster" to "slower" :

- big mesh sliders
- small mesh sliders
- slow slider

Sail sliders used in skydiving are not fit for BASE jumping because they significantly increase the opening time and negatively affect heading performance.

Opening speed is subject to many factors (other than the slider) : weight of the BASE-jumper, size of the canopy, canopy type, age of canopy, freefall velocity, position at opening, equipment (slick, tracksuit, wingsuit), etc.. There is therefore no reliable recipe to know what slider to use. Generally, base-jumpers use a large mesh slider and try slower sliders if the openings are considered too hard with large mesh slider.

Note that Apex Base offers sliders (RAS Remove-A-Slider) which can be fitted or removed without having to detach the canopy from the container. They are available in large or small mesh.

Connection to the risers

The canopy is generally connected to the risers via quick links made of stainless steel. It is recommended to use only rated steel links, with the manufacture name and weight rating stamped on the spine of the link. It is also possible to use "Soft Links" (Slinks) developed by Performance Design. They have superior resistance to quick links and are lighter, but should be checked regularly to ensure that there are no traces of fatigue. For more information on Slinks: <http://www.square1.com/manufacturers/square1/p868.asp>

canopies offered by manufacturers

Main options of BASE-jumping

Vents:

Many canopies integrate a system of "vents". Called PAC (Pressure Activated and Controlled valves) VTEC (Vent Technology) or MDV (MonoDirectional Valve), it is an unidirectional air input placed on the lower surface. This system allows a more rapid and more uniform pressurization of the canopy and better maintenance of the pressurization during steering. The "Vents" are helpful on slider down jumps and difficult landings.

Hybrid TopSkin (F-111 / ZP):

There are now some canopies with "hybrid TopSkin" - ZP fabric replacing F-111 on a small part of the canopy.

ZP fabric (Zero Porosity) is used on the upper surface at the leading edge. ZP fabric maintains its porosity over time. Using it widely extends the lifetime of the canopy and maintains good flight characteristics longer. The disadvantage is that the ZP is much slipperier and generally makes packing harder for beginners.

This option appears under different names depending on the manufacturer:

- HTS: Hybrid TopSkin
- CUS: Composite Upper Surface
- ZP Leading Edge

Multi:

This option, invented by Apex Base uses 2 or 4 anchor points of the extraction bridle on the

canopy. This, in theory, gives a cleaner canopy extraction and prevents the tail pocket from being too low during the extraction sequence :

http://www.youtube.com/watch?v=kNBZRB0_PK0

Apex BASE

Flik :

Classic Fabric

Lines Dacron 525

Options: - VTEC ("vents" on 1 to 7 cells)

- HTS

- Multi (2 or 4 anchor points)

Fox:

Classic Fabric

Lines Dacron 525

Options: - VTEC ("vents" on 1 to 7 cells)

- HTS

- Multi (2 or 4 anchor points)

Flik LV:

Classic Fabric

Lines Dacron 400

Options: - VTEC ("vents" on 1 to 7 cells)

- HTS

- Multi (2 or 4 anchor points)

The Flik LV is 8% lighter and has a 12% smaller packing volume compared to the classic Flik.

Fox LV:

Classic Fabric

Lines Dacron 400

Options: VTEC ("vents" on 1 to 7 cells)

- HTS

- Multi (2 or 4 anchor points)

The Fox LV is 8% lighter and has a 12% smaller packing volume compared to the classic Fox.

Flik Ultralite:

Light Fabric

Lines Dacron 400

Options: VTEC ("vents" on 1 to 7 cells)

- Multi (2 or 4 anchor points)

Flik The Ultralite is 20% lighter and has a 28% smaller packing volume compared to classic Flik.

Fox Ultralite:

Light Fabric

Lines Dacron 400

Options: VTEC ("vents" on 1 to 7 cells)

- Multi (2 or 4 anchor point)

The Fox Ultralite is 20% lighter and has a 28% smaller packing volume compared to classic Fox.

Fox Xs:

Light Fabric

Lines Dacron 525

Options: VTEC ("vents" on 5 cells)

- large "vents" (VTEC oversized for a faster time pressure)

- HTS (full ZP topskin possible)

The Fox Xs is specifically designed for low jumps. It is not a versatile canopy (use slider up not recommended)

H2O.

The H2O is a round canopy designed only for water jumps. It is made to be used with an Apex DPW container.

Apex Base formerly manufactured the "Rock Dragon" and "Dagger" canopies. These canopies still exist on the second-hand market but are no longer manufactured by Apex Base.

Asylum Design

Seven :

Classic Fabric

Lines Dacron 600

Options : CUS (ZP & F111)

Feather:

Light Fabric (top skin of center cell : classic fabric)

Lines Dacron 400 or Spectra 725

Options : CUS (ZP & F111-PN9)

The Feather is the light canopy from the Asylum. It has a packing volume about two sizes smaller than the Seven.

Atair Canopies

Troll DW :

Classic or Light Fabric

Lines Dacron 550 or Spectra

Options: - MDV ("vents" on 1, 3 or 5 cells)
- ZP leading edge.

Trango 3 :

Light fabric

Lines Vectran (Spectra on previous models)

Options : - ZP Leading Edge

Trango is the light canopy from Atair. Weight and pack volume are reduced by approximately 25% compared to a classic Troll DW.

OSP :

Classic or light fabric. ZP Leading Edge and MDV ("Vents") as standard.

Lines Dacron 550

OSP (Optimized Performance Slider down) is optimized for slider down jumps . However, it can be used for slider up jumps.

Bad Seed Base

Mayhem :

Classic Fabric

Lines Dacron 600

Options: - "Vents" (1 to 7 cells)
- ZP Leading edge (full ZP top surface possible)

Consolidated Rigging

Ace:

Classic fabric

Lines Dacron 600

Options: - CUS (ZP & F111)

Black Jack :

Classic Fabric

Lines Dacron 600

Options: - PAC ("Vents") as standard.
- CUS (ZP & F111)

The Black Jack is optimized for slider down jumps. However, it can be used for the slider up jumps.

Consolidated Rigging manufactured the "Mojo", the ancestor of "Ace" and "Black Jack." This canopy can still be found on second-hand market.

Nitro Rigging

Tarpus :

Classic fabric

Lines dacron 525

ZP leading edge as standard

Ulster County C&C

Base X :

Classic fabric

Lines Dacron

Options : ZP leading edge, vents (2 cells on 7)

Containers

Types of container

Manufacturers offer a wide range of rigs, ranging from versatile products to containers specially adapted to certain practices. Without going into detail, we can classify containers in three categories:

- "Classic" containers which can contain any type of canopies and are generally versatile.
- "Semi-light" containers, intermediate between the "classic" and "light", which are lighter and more aerodynamic than classic containers but can still contain standard canopies.
- "Light" containers, with flat and aerodynamic profiles. Specifically designed to contain "light" canopies, they reduce the weight of the equipment and reduce the drag generated by the rig. These are made for good trackers and wingsuiters seeking to improve their flight performance (this increase comes, in theory, from the reduction in weight and drag), and / or BASE-jumpers seeking a light rig for long walks.

"Semi-light" and "light" containers often have a top closing loop located at the bottom of the container, which gives them a flatter, and therefore more aerodynamic profile. Some "light" containers have the two closing loops at the bottom and therefore can only contain specific canopies that allow the closing loop to go through the canopy.

Closing systems

Most rigs manufactured today use a two pins system. A few bags still use a velcro closure, but it is gradually abandoned in favor of the two pins system because of an increased unvelcroting risk during terminal velocity jumps. Generally, velcro closures are considered unsuitable for slider up jumps. Such rig velcro can be used for slider down jumps.

The "Prism" container (not manufactured anymore) uses a one pin closure system. This system was abandoned in favor of two pins system, more reliable : the container remains closed if a needle accidentally pops out, the tension in the loops is better distributed. For more information on one pin closures versus two pins closure, see here :

http://www.blincmagazine.com/forum/wiki/BASE_Containers:_1_pin_or_2

Risers

Three types of risers currently exist on the market:

- direct risers: risers sewn on the container, and thus connected to the rig.
- three rings system risers : this system is designed to allow a quick release of the canopy via a simple motion. This system is useful when the canopy is stuck (tree landing for example) or when jumping near a river, with a risk of the BASE-jumper being dragged in the water by the canopy. Three rings systems must be properly installed to be reliable and should be regularly checked to prevent accidental breaking of the loops
- L-Bar risers : these risers are connected to the container via removable steel hardware. This system allows the user to detach the risers from the container in a few minutes using a screwdriver. This system does not allow a emergency release.

Control Toggles

Big Grab toggles are now standard on new equipment. Some second hand rigs are still equipped with conventional toggles, which are flatter and less easy to grab, especially right after opening, and may delay a correction maneuver.

Manufacturers also offer releasable toggles to disconnect the toggle from the control lines. Releasing the toggle allows the correction of a line-over or tension knot caused by the control lines. Releasable toggles are available as an option.

Options

Many options are offered by container manufacturers. The following list is not exhaustive, but summarizes the most common options:

- articulated harness : Stainless steel D rings are used to connect the leg straps and main lift web, making the hip junction more flexible.
- Saddlebags : these are small pockets on the leg straps used to store equipment (they can contain a stashbag)
- B12 snaps : clipable buckles on the leg straps, allowing the leg straps to be unclipped, rather than stepped-through, for donning or removing the rig.
- back protection. Flexible protection can be inserted into a back pocket of the container, allowing for integrated protection within the rig and reducing constriction generated by a separate back protector.

Containers manufactured

Velcro rigs

Apex V (Apex Base)

articulated harness, back protection

Perigee 2 (Asylum Design)

Options: articulated harness, B12 snaps

Genesis (Morpheus Technologies)

Option: articulated harness, B12 snaps.

Reactor (not manufactured anymore)

Wizard (Apex Base, not manufactured anymore)

Preserve (Bad Seed Base, not manufactured anymore)

"Classic" two pins rigs

Acrobat (Acrobat Base)

Options : articulated harness, B12 snaps, saddlebags.

Zak 2 (Adrenalin Base)

Options : articulated harness, saddlebags

Apex DP (Apex Base)

Options : articulated harness, back protection

Perigee Pro (Asylum Design)

Options : articulated harness, saddlebags

Menace (Bad Seed Base)

Options : articulated harness, B12 snaps

Talus (Blacksheep Rigging)

Options : articulated harness as standard, B12 snaps, saddlebags

The Talus also exists in a "semi-light" version.

Paragon (GLH Systems)

Options : articulated harness, B12 snaps

Paragon Lite (GLH Systems)

Options : articulated harness B12 snaps

This is a lighter version of the classic Paragon (35% less weight)

Androgen (GLH Systems)

Options : Articulated harness

Gargoyle (Morpheus Technologies)

Options : articulated harness, B12 snaps

Base R (Ulster County C&C)

Vertex (no longer in production)

Option: "Alpine" (integrated climbing harness to perform abseil)

Warlock (no longer in production)

Neo (no longer in production)

Riot (no longer in production)

"Semi-light" two pins rigs

Hybrid 2 (Adrenalin Base)

Options : articulated harness, saddlebags

Top closing loop located at the bottom of the container

Apex Summit (Apex Base)

Options: articulated harness

Top closing can be mounted to either the bottom of the container, or the top flap.

Snekor (Fly Your Body)

Options : articulated harness, saddlebags

Toggles can optionally be stowed outside of the container ("Invicibility toggles"), on the front, at shoulder level. This allows access to the toggles, and canopy maneuvering, without the need to unzip wingsuit arm zippers.

Avian (GHL Systems)

Options : articulated harness

Helium (Morpheus Technologies)

Options : Articulated harness, B12 snaps

Limbus (Nitro Rigging)

Options : articulated harness, saddlebags

Edge 2 (Sky Wide Systems)

Options : articulated harness as standard, saddlebags

"Light" two pins rigs

Hybrid LD2 (Adrenalin Base)

Options : articulated harness, saddlebags

Top closing loop located at the bottom of the container

Apex TL (Apex Base)

Options: Articulated container

Both closing loops located at the bottom of the container, but possibility to position it on the flaps.

WSX-Treme (Morpheus Technologies)

Options : articulated harness, B12 snaps

Top closing loop located at the bottom of the container.

Razor (Morpheus Technologies)

Options : articulated harness

Top closing loop located at the bottom of the container.

Stronglite (Squirrel)

Top closing can be mounted to either the bottom of the container, or the top flap.

The Stronglite is longer than most containers, giving it a flatter profile and making the pilot chute easier to grab when flying a wingsuit.

Other

Apex DPw (Apex Base)

Specifically designed to contain the H2O canopy and water jumps.

Prism (not manufactured anymore) : classic rig, one pin closure, "Alpine" option.