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Conception, Production de Fils et Câbles Deltex
Design and Manufacturing Deltex Wire & Cable

"Donner chaque jour
le meilleur de nous-mêmes;
pour être fier de nos produits..."

TECHNICAL INFORMATION
FOR THE USE OF DELTEX CABLES
IN THE ADVENTURE PARK SECTOR

The information held in this document is intended for **professionals** who have a good knowledge and experience of adventure parks. All the technical information, mainly about Deltex cables compared to steel cables and caving ropes also used in the installation of zip lines, is given in this brochure in order to help builders and controllers.

Each installation, activities or zip lines, must be based on common sens and security. The priority of the installations must be people's safety.

This document was published the 14th of May 2012.
It is likely that it will be completed in next editions.

WARNING

Cables used in a horizontal position, or close to horizontal (slope from 3 to 10%) sustain efforts of tension different than **hoisting cables** used in a vertical position.

A cable with a breaking point of 9 Tons can be used to lift a load of 1T500 safety factor 6.
A cable with a breaking point of 9 Tons can absolutely not bear a load of 1T500 Tons in a horizontal position.

See tables on the opposite page.

For zip line application, rigorously observe the rule of:

1 person per cable

Our advise is to put a small sign at the departure of each zip line indicating what is displayed above.

Wear and tear and replacement of Deltex cables

Concerning UV radiation, Deltex cables have a life span superior to 20 years.
They can be used in an interval of temperature from -40° à +70°C.
The mechanical life span is superior to 50 years.

Deltex cables' wear and tear happens due to: the carabiner's rubbing, the pulleys side plates' rubbing and at the place where the pulley is positionned.

Deltex cables must be replaced when, in its weaker part, its diametre has diminished of 2mm.

Cable for belay wire Ø15: change at 13 mm

Cable for zip line Ø19 : change at 17 mm

Cable for zip line Ø23 : change at 21 mm

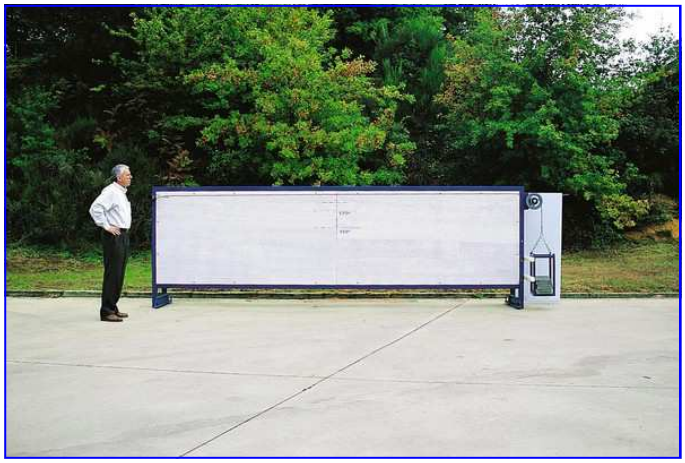
Example : Cable for belay wire Ø15 square wire.
Controls of measures are only made at the departure and the arrival of the cable.

The cable must be replaced if a wire is cut and out from its position.

1mm = 0.039 inches
1 kg = 2.20 lbs = 0.15 stone
1 Ton = 1 000 kg

Weight supported by a cable exerts different tension according to the angle of the cable

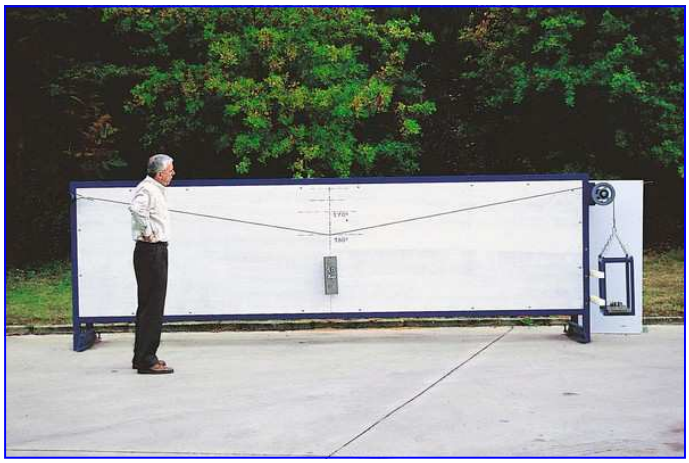
At **175°** the weight carried by the cable exerts tension 12.7 times superior to the weight .



Above, the cable is stretched to **180°** by a load.

In the photo above, the 10 kg weight lifts a weight of 127 kg and brings the cable to **175°.**

The **10 kg** weight lifts a counterweight of **58 kg** and finds equilibrium at **170°**.



At **160°** the counterweight is only **27 kg**.

At **170°** the weight exerts tension on the cable and anchorages
5.8 times the weight.

At **160°** the weight supported by the cable creates a load of
2.7 times the weight.

Stretched between two fixed points:

An angle of **175°** corresponds to a supplementary elongation of **+0.1%**.
An angle of **170°** corresponds to a supplementary elongation of **+0.4%**.
An angle of **160°** adds a supplementary elongation of **+1.5%**
to the initial length at initial tension.

The elongation capacity of the cable allows it to take a position at an angle at which the cable can withstand the additional strain without approaching its breaking point.

The elastic memory of the cable allows it to return to its initial position.
This eliminates the need for interventions to retighten the cable after occasional strains due to large temperature differences or a temporary overload.

1 kg = 2.20 lbs = 0.15 stone

INSTALLATION OF DELTEX CABLES

Fixing Deltex cables is like fixing steel cables.

It is advisable, however, to take into account the fact that Deltex cables' resistance to compression is lower than steel cables' and that breaking elongation is more important.

Breaking elongation steel cable	4 %
Breaking elongation Deltex cable	12 %

Deltex cables' tension, at the installation, is between 0.2 % and 2 % depending on the wanted aim.

A Deltex cable Ø19 mm reaches its breaking point under a tension of 10 Tons. It is advisable to take into account the fixing system which generates a loss of resistance going from 5% to 55% , depending on the system fixed.
CE cables clamps induce a loss of 40% of the breaking point.

A tension of 1% of the length corresponds to a tension of 1 Ton.

Deltex cables have **a permanent elastic memory.**

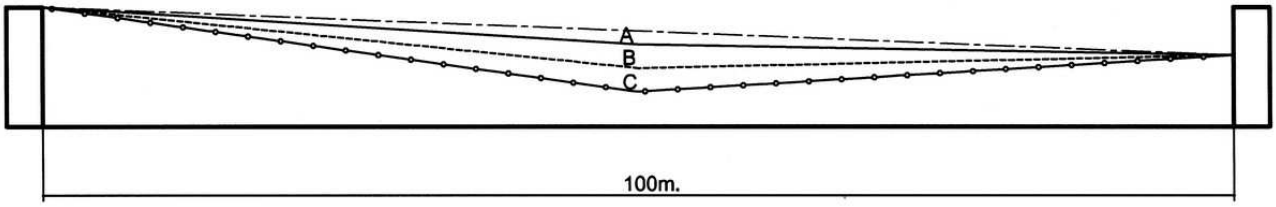
Initially stretched at 1.5% of its length, Deltex cables loose about 0.3% of their tension in the 2 weeks that follow the installation, they then remain stretched at 1.2% permanently for years, with variation of tension due exclusively to variation in temperatures.

Changes in temperature have **opposite influences** on steel cables and on Deltex cables.

	Steel cable	**Deltex cable**
Temperatures increase	Tension decreases	Tension increases
Temperatures decrease	Tension increases	Tension decreases

1 metre = 3.28 ft
1 cm = 0.39 inches
1 kg = 2.20 lbs = 0.15 stone
1 Ton = 1 000 kg
1 daN = 1kgF

SAG OF A DELTEX CABLE
On a 4% slope



Deltex cable ∅ 19, length 100 metres stretched at 300 daN

A– Cable's sag compared to the axis departure arrival:	1.10 metre
B– Cable's additionnal sag with a person of 60 kg:	2.10 metres
C– Additional sag with a person of 125 kg:	1.16 metre

Global sag for a weight of 125 kg compared to the theorical axis departure arrival: 4.36 metres

Deltex cable ∅ 19, length 100 metres stretched at 600 daN

A- Cable's sag compared to the axis departure arrival:	0.66 metre
B- Cable's additionnal sag with a person of 60 kg:	1.90 metre
C- Additional sag with a person of 125 kg:	1.08 metre

Global sag for a weight of 125 kg compared to the theorical axis departure arrival: 3.64 metres

Deltex cable ∅ 19, length 100 metres stretched at 900 daN

A- Cable's sag compared to the axis departure arrival:	0.40 metre
B- Cable's additionnal sag with a person of 60 kg:	1.64 metre
C- Additional sag with a person of 125 kg:	1.00 metre

Global sag for a weight of 125 kg compared to the theorical axis departure arrival: 3.04 metres

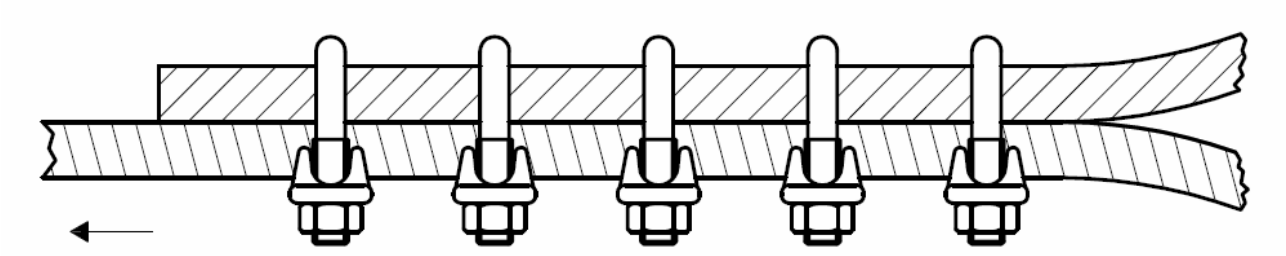
Increase of tension due to a person's weigth

Initial tension	Total tension with a person of 60 kg	Total tension with a person of 125 kg
600 daN	802 daN	1030 daN
900 daN	1020 daN	1180 daN

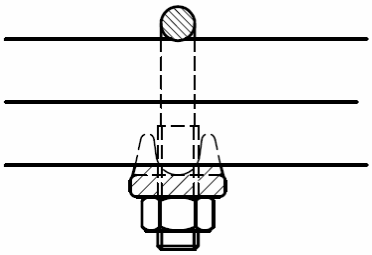
The sags and tensions indicated on this page are not the results of calculation.
They have been measured in real conditions with a Dynafor (tension measurer) for the tension and a measuring rule for the sags.

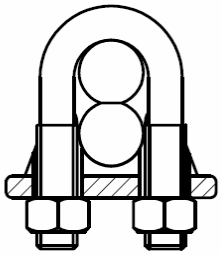
1 metre = 3.28 ft
1 kg = 2.20 lbs = 0.15 stone
1 daN = 1kgF

FIXATION FOR TRADITIONNAL CABLE CLAMPS:



We advise a minimum of :
4 CE cable clamp for the Ø15
4 CE cable clamp for the Ø19





Torque procedure for CE clamp

Câble Deltex 8 mm	**20 Nm**
Câble Deltex 11 mm	**30 Nm**
Câble Deltex 15 mm	**40 Nm**
Câble Deltex 19 mm	**60 Nm**

Torque procedure for DIN cable clamp

Cable clamp	Type of cable	Torque procedure	Number of cable clamp
8	**Ø 8 ●**	**9**	**3**
10	**Ø 11 ●**	**16**	**3**
12	**Ø 11 ●**	**20**	**3**
16	**Ø 15 ■**	**50**	**4**
19	**Ø 19 ■**	**100**	**4**

Cable Ø19 mm with thimble and 5 cable clamps
Breaking at 7T

Torque procedure for Deltex'cable clamps

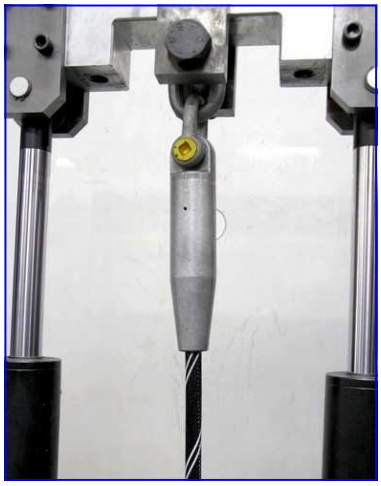
Type SCD15	**50 Nm**
Type SCD19	**75 Nm**

The fixing system with cable clamps generates a loss of resistance of 40% on Deltex cables.
Deltex' cable clamp generates a loss of 35% of the breaking strength.

The fixing system with classical cable clamps allows the installation of cables for zip lines up to a length of 400 metres while keeping the safety factor. Above 400 metres, it is necessary to use the connecting system type RI 21L which allows to obtain more than 90% of the cable's breaking strength.

1mm = 0.039 inches
1 metre = 3.28 ft
1 kg = 2.20 lbs = 0.15 stone

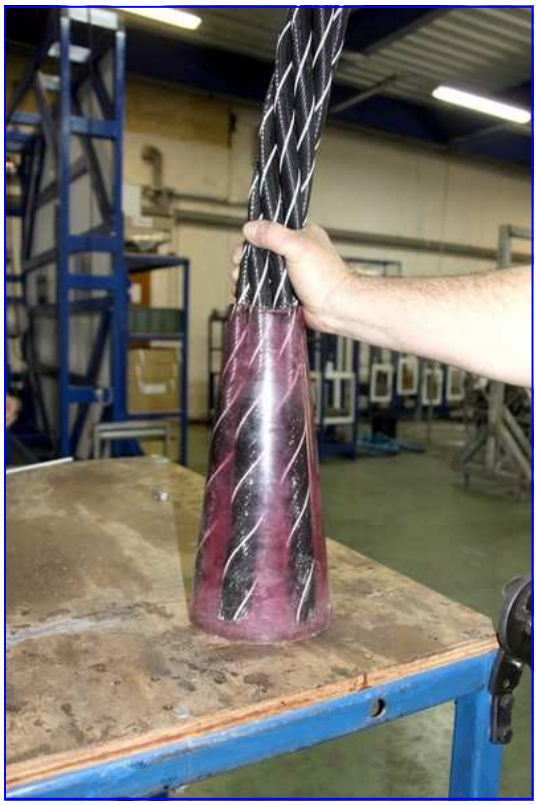
CONES AND RESIN CONNECTORS



Cable Ø19 with connector RI 21L
Breaking of the cable at 12T500

Cable Ø27 with connector RFI 30
Breaking of the cable at 23T

The picture at the top shows the RI 25 with the cable Ø23
The picture above shows the RFI 30 with the cable Ø27



The connectors type RI 21L and RI 25 are in aluminium and mainly used in the following sector: towing of construction vehicle.

The wires inside the cone are caught in a polyester resin which allows to obtain 90% of the breaking strength of the cable's wires.

The RFI 30 is mainly used in the maritime sector and offers a very high resistance.

The picture on the left shows the inside of a cable's connector with a breaking strength of 120 Tons.
The connecting system with resin enables Deltex company to achieve cables with connexion with a breaking strength of 400 Tons.
Page 7 and 8 show the results of tests made by Bureau Veritas on a cable Ø20 with a connexion cone and resin.

1 kg = 2.20 lbs = 0.15 stone
1 Ton = 1 000 kg

MARINE DIVISION

Certificate number: 3037BDX09.32

The continuation sheet(s) form(s) part of the certificate.

www.veristar.com

INSPECTION CERTIFICATE type 3.2
according to European Standard EN 10204:2004

Manufacturer : DELTEX (SARLAT - FRA)

Product description : **DELTEX Polyester monofilament cable**
Quantity : 2 pcs

Particulars of products as declared by the applicant:

Breaking strength test on : DELTEX Polyester monofilament cable diameter 20 mm
: with aluminium sockets type R20
Test required by : DELTEX

TEST RESULTS
This certificate is not valid without manufacturer's documents attached which contain details of production method, heat treatment data, chemical analysis, mechanical properties and non destructive testings or any additional results.

Identification on attachments : NA
Number of pages attached : 0

The inspection as detailed in page 2 of this certificate has been carried out by BUREAU VERITAS within the scope of the General Conditions of Marine Division. The last visit has been carried out on : **16 Mar 2009.**

Markings for identification of products : /

The undersigned manufacturer declares that the products identified above have been manufactured, tested and examined in conformity with the requirements of the purchaser's order. BUREAU VERITAS attests that the tests and examinations carried out by the manufacturer on the products identified above have been found satisfactory against the requirements of the purchaser's order.

FOR THE MANUFACTURER
Name : DELTEX

Place : SARLAT

FOR BUREAU VERITAS
Name : Raphael Garnier
Date : 12 Jun 2009
Office : BV BORDEAUX

BUREAU VERITAS SURVEYORS AT PARIS 1828 BORDEAUX INTERNATIONAL REGISTER

Continuation sheet of Certificate N°: 3037BDX09.32

The continuation sheet(s) form(s) part of the certificate.

SCOPE OF INTERVENTION

DELTEX Polyester monofilament cable diameter 20 mm

Breaking strength tests performed on bench N°2 of DELTEX company
Actual breaking load checked with loadcell Tractel N°0608/029E : calibration certificate N° Z0812606 dated 05/05/2008

1. Test sample length 60 cm with 2 aluminium sockets type R20 fitted with resin
Achieved Breaking strength result : **12970 Kg**

2. Test sample length 60 cm with 2 aluminium sockets type R20 fitted with resin
Achieved Breaking strength result : **14010 Kg**

MARINE DIVISION

Certificate number: 3041BDX12/2

The continuation sheet(s) form(s) part of the certificate.

www.veristar.com

INSPECTION CERTIFICATE type 3.2
according to European Standard EN 10204:2004

Manufacturer : DELTEX (SARLAT - FRA)

Product description : **Serre-câble SCD-15**
Quantity : 3 pcs

Particulars of products as declared by the applicant:

Type of product : Serre-câble SCD-15
Declared as intended for : Parc de loisir en forêt

TEST RESULTS

This certificate is not valid without manufacturer's documents attached which contain details of production method, heat treatment data, chemical analysis, mechanical properties and non destructive testings or any additional results.

Identification on attachments : /
Number of pages attached : 0

The inspection as detailed in page 2 of this certificate has been carried out by BUREAU VERITAS within the scope of the General Conditions of Marine Division. The last visit has been carried out on : **02 Mar 2012.**

Markings for identification of products : /

The undersigned manufacturer declares that the products identified above have been manufactured, tested and examined in conformity with the requirements of the purchaser's order. BUREAU VERITAS attests that the tests and examinations carried out by the manufacturer on the products identified above have been found satisfactory against the requirements of the purchaser's order.

FOR THE MANUFACTURER

Name : DELTEX

Place : SARLAT

FOR BUREAU VERITAS

Name : Raphael Garnier
Date : 08 Mar 2012
Office : BV BORDEAUX

BUREAU VERITAS SURVEYORS AT PARIS 1828 BORDEAUX INTERNATIONAL REGISTER

SCOPE OF INTERVENTION

1. Serre-câble type SCD-15 avec 4 vis M12 pour serrées à 50 Nm pour retenir un câble DELTEX diamètre 15 mm monté en boucle avec une cosse tubulaire inox de diamètre 16 mm sur le serre-câble
Essai de traction sur banc étalonné BT 120 1199 avec Dynafor capacité 12,5T N° 95 1240
Résultat: glissement du câble à 4300 Kg

2. Serre-câble type SCD-15 avec 4 vis M12 pour serrées à 50 Nm pour retenir un câble DELTEX diamètre 15 mm monté en boucle avec une cosse tubulaire inox de diamètre 16 mm sur le serre-câble
Essai de traction sur banc étalonné BT 120 1199 avec Dynafor capacité 12,5T N° 95 1240
Résultat: glissement du câble à 4895 Kg

3. Serre-câble type SCD-15 avec 4 vis M12 pour serrées à 50 Nm pour retenir un câble DELTEX diamètre 15 mm monté en boucle avec une cosse tubulaire inox de diamètre 16 mm sur le serre-câble
Essai de traction sur banc étalonné BT 120 1199 avec Dynafor capacité 12,5T N° 95 1240
Résultat: rupture du câble à 4700 Kg

ADVICE FOR THE INSTALLATION OF ZIP LINES

Zip line length from 20 to 60 metres
Slope 3%

Stretch the cable on the arrival side.
The cable is stretched enough when the cable at the arrival is between 0 and 1%.
Use a level length 50 cm.

Advised type of cable:

Ø 19 length from 150 to 250 metres, slope of 5%, arrival 0%
Ø 19 length from 250 to 400 metres, slope of 6%, arrival between 0 and -1%
Ø 19 length from 400 to 600 metres, slope of 7%, arrival between 0% and -1%
Ø 19 length from 600 to 800 metres, slope of 8% arrival between 0 and -1%
Ø 23 length from 1000 to 1500 metres, slope of 9%, arrival -1%
Ø 27 length superior to 1500 metres

For the installation of a zip line, a cable Ø18 mm or Ø19 mm will usually be stretched between 300 daN and 600 daN.

The tension depends, of course, on the cable's length and on the slope. The cable's own weigth generates a relatively important tension when the length overtakes 300 metres.

On a length of 60 metres a low slope of 2% requires a higher tension than a slope of 4%.

For the installation of a small bridge (2 cables on which planks are fixed by cable clamps), the cables can be initially stretched between 0.3 and 1.5%, depending on the desire to have a flexible bridge or a relatively rigid and more stable bridge.

On an activity, small bridge, etc… the initial tension realised by the builder must not overtake 20% of the cable's breaking point.
In general, 10% of the breaking point is enough.

For a length of 10 metres : maximum tension 20 cm
advised tension 5 to 15 cm
For a length of 50 metres: maximum tension 1 metre
advised tension 30 to 70 cm

1 metre = 3.28 ft
1 cm = 0.39 inches
1mm = 0.039 inches
1 daN = 1kgF

ZIP LINE OF A VERY LONG LENGTH

Rate resistance / weight per metre of a cable

A zip line's maximum length is limited by the cable's own weight.

The steel wires, used in the construction of cables, provide a breaking strength of 1960 N/mm², for a weight of 7.8 grammes per metre.

The Deltex wires, used in the construction of Deltex cables, provide a breaking strength of 650 N/mm², for a weight of 1.4 gramme per metre.

This gives a rate of:

Steel wire : 25 daN per gramme/metre
Deltex wire : 46 daN per gramme/metre

Steel wire : Ø 19 mm: Breaking strength 25 Tons weight 1.450 kg/metre
Deltex wire : Ø 27 mm: Breaking strength 26T500 weight 0.750 kg/metre

Rate resistance / weight per metre of the cables:

Steel wire : Ø 19 mm: 17 daN per gramme metre
Deltex wire: Ø 27 mm: 35 daN per gramme metre

For a zip line of a length of 2000 metres:

A steel cable Ø 19 weights 2900 kg.
A Deltex cable Ø 27 weights 1500 kg.

For an equal slope, Deltex cables require twice less tension than steel cable.

1mm = 0.039 inches
1 metre = 3.28 ft
1 gramme = 0.035 ounces
1 kg = 2.20 lbs = 0.15 stone
1 Ton = 1 000 kg
1 N = 0.1kgF

BREAKING AND WEAR AND TEAR TESTS DUE TO RUBBING

Breaking test of the pulley model P68

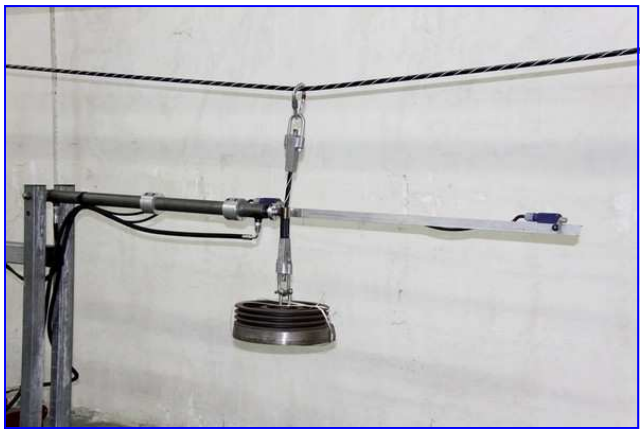
Breaking of the carabiner

Breaking test of the pulley model P61

Breaking of the bottom of the pulley at 1980 KgF

Breaking test of the handles

Breaking at 3T570

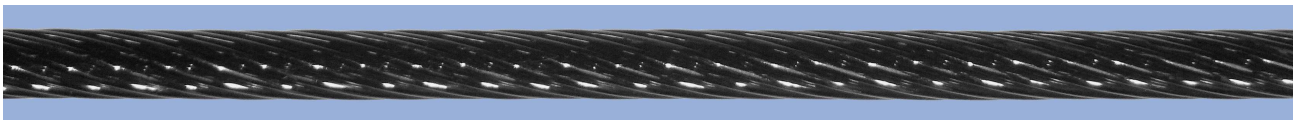


Wear and tear test by rubbing a carabiner on a belay wire's cable Ø 15 square wire

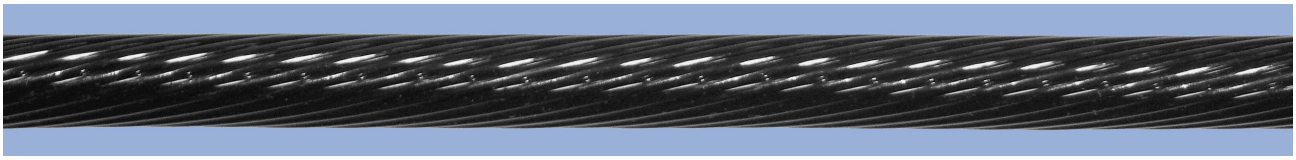
The screw jack pushes a weight of 65 Kg hanged to a carabiner, 420 passing per hour.
After 36 hours of testing, the usury is of about 1/10th of a mm.

1 kg = 2.20 lbs = 0.15 stone

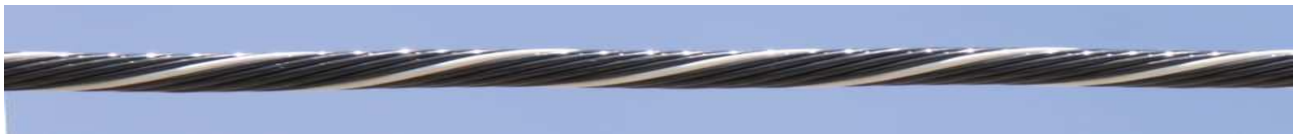
BREAKING STRENGTH



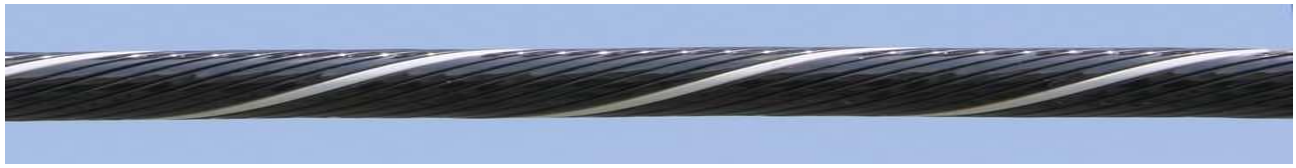
11 mm diameter cable - round wire - Breaking strength: 4 Tons
Weight per metre: 100 gr



15 mm diameter cable - round wire - Breaking strength : 7.5 Tons
Weight per metre: 180 gr



8 mm diameter cable - for CT1 connection (round wire) - Breaking strength : 2.5 Tons
With CT1 breaking strength : 1.5 Ton
Weight per metre: 60gr



15 mm diameter cable - for belay wire (square wire) - Breaking strength : 8 Tons
Weight per metre: 220gr

19 mm diameter cable - for zip lines (square wire) - Breaking strength : 12 Tons
Weight pe metre: 360 gr
With 6 cable clamps: breaking strength: 7 Tons

23 mm diameter cable - for zip lines (square wire) - Breaking strength : 19 Tons
Weight per metre: 540 gr

27 mm diameter cable - for zip lines (square wire) - Breaking strength : 26 Tons
Weight per metre: 750 gr

The use of cable clamps involves a loss of 40% of the breaking point.
The use of the cone and resin connexion allows to obtain 90% of the breaking strength of Deltex cables.

1 metre = 3.28 ft
1 gramme = 0.035 ounces
1 kg = 2.20 lbs = 0.15 stone
1 Ton = 1 000 kg

BUREAU VERITAS

Service IVS
42, Avenue des Langories BP 87
26903 VALENCE Cedex 09
☎ 04.75.78.17.60 – Fax. 04.75.42.03.18
Mobile : 06.84.81.01.13

NOTICE ABOUT THE ADEQUACY OF DELTEX CABLES FOR THE ACROBATIC COURSES

N° d'affaire : 2162189/1 Chargé d'affaire : F BALAYN	**DELTEX** **Route de Souillac** **24200 SARLAT**
Text used in reference for the adequacy : **NF EN 15567-1 Mars 2008** Parcours acrobatiques en hauteur Partie 1 : exigence de construction et sécurité.	
Encountered person : Mr CHEVRIER Stéphane	**Recipient :** Mr CHEVRIER Stéphane

NOTICE

Introduction: the standard quoted in reference is not of compulsory application. Nevertheless this standard being the only text dealing with acrobatic courses, our notice will take in reference this text.

NF EN 15567-1 :

- **Art 1 à 3** : Not applicable
- **Art 4.2.1** : « *Les matériaux doivent être adaptés à l'utilisation prévue.*

NOTE 1 Les dispositions de la présente norme relatives à certains matériaux n'impliquent pas que d'autres matériaux équivalents soient inappropriés pour la fabrication des parcours acrobatiques en hauteur. »

The standard refers essentially to steels cables, The item 4.2.1. Does not exclude the use of polyester cables.

The use of this type of cable not being usual, the manufacturer will have to provide to the users a note of detailed implementation of his products (cables, connectors, methods of fixation on supports).

- 4.2.5 Matériaux synthétiques et composites

« Si, dans le cadre de la maintenance, il est difficile de déterminer quand un matériau devient fragile, le fabricant doit indiquer le délai à l'issue duquel il convient de remplacer la pièce ou l'équipement. »

The manufacturer will have to supply to the users a note of maintenance specifying the procedure of control of cables, possible lifespan and criteria of scrap (mechanical degradation, degradation due to UV).

Art 4.3.2.5

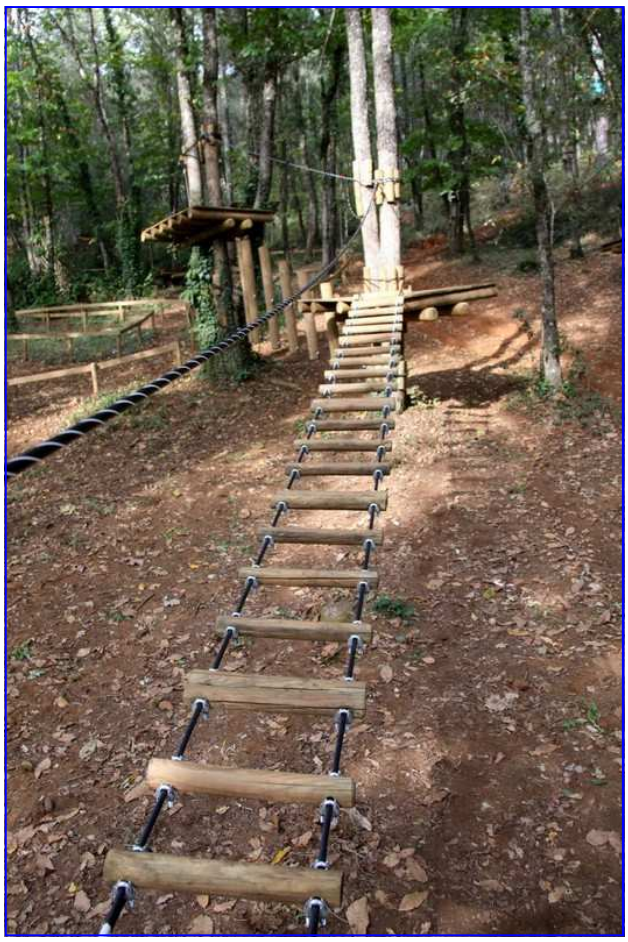
« Les installations comportant des systèmes d'auto-assurage, d'assurage continu et d'assurage assisté constitués de
câbles en acier doivent être calculées avec un coefficient de sécurité égal à 3,0 en fonction de la charge de rupture ».

The manufacturer will have to provide to the users the justifying certificates breaking loads guaranteed for his cables.

In conclusion:

subject to the respect for the observations above cable Deltex can be used in acrobatic courses.

F BALAYN



CONE AND RESIN CONNECTOR

On the picture above, you can see a cable diameter 19mm with a cone RI 21L and a shackle with a high resistance.
The cone is in marine aluminium, so it doesn't corrode, not even on the seaside. The resin is injected with a syringe on site. The process is simple to realise but must strictly follow the procedure given by Deltex.

The sheave on the left is the one available on the market today.
The sheaves manufactured by Deltex have 2 bearings. This suppresses the oscillation of the bearing and increases its life span. The diameter of the sheave is increased to 38mm, which enhances too the bearing's life span. For parks located on the seaside, Deltex provides bearing entirely in stainless steel (balls and cage), the side plates are in marine grade aluminium.

1mm = 0.039 inches

Zip line of 350 metres in Deltex diametre 19 mm.
Installation with a very low tension(650 daN) because at this point the slope is very strong (9.4%) and a higher tension leads to a very fast arrival .