PARAFIL®

The Ultimate Synthetic Rope

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PARAFIL® ropes consist of a core of closely packed, high strength aramid or polyester fibres, lying parallel to each other, encased in a protective polymeric sheath.

This structure is combined with a specially designed termination technique.

The combination of these two technologies produces ropes of immense strength, capable of meeting the requirements of even the most complex application.

No other system matches its performance and PARAFIL® ropes are today used throughout the world in Catenary Support Systems, Urban Transport Systems and in Marine and Structural applications.

Its benefits, when compared to alternatives, include a high strength-to-weight ratio, excellent chemical resistance, high UV resistance, excellent fatigue characteristics and safety over a wide temperature range.

The method of manufacture produces a rope with a unique blend of physical and chemical characteristics.

A choice of combinations of strength, core fibre and sheath are available to meet the requirements of a wide variety of applications.

PARAFIL® FEATURES

- High tensile strength
- High strength to weight ratio
- Low weight
- Excellent tension-tension fatigue resistance
- Good insulating properties
- Resistant to UV degradation
- Virtually maintenance-free
- Unaffected by water, sea-water, ice and other extreme environmental conditions

PARAFIL® TYPES

There are three standard types of PARAFIL® available based on the type of fibre used for the core.

However, each of these is available with a choice of polymeric sheaths to suit varying applications.

These include a specially formulated polyethylene, which is suitable for most applications, an EVA copolymer that is more flexible and stress-crack resistant, and a polyester elastomer that offers higher resistance to heat and abrasion.

A flame retardant, cross linked polymer sheath is also available.

Yarn Type	Sheath Materials and Types			
	Polyethylene	Polyethylene	Polyester	Flame Retardant
	(LDPE)	Copolymer (EVA)	Elastomer (Hytrel)	Cross linked Polymer
High tenacity polyester	Type A	Type A (C)	Type A (H)	Type A (X)
Standard modulus Aramid	Type F	Type F (C)	Type F (H)	Type F (X)
High modulus Aramid	Type G	Type G (C)	Type G (H)	Type G (X)

PARAFIL® IN ACTION

INSULATING GUYS, CATENARIES AND SUPPORT SYSTEMS

The first applications for Parafil® ropes were in the antennae and electrical industries where they are used as insulating guys, catenaries and support systems where tensile and excellent insulating properties combined with resistance to UV radiation ensure a long and virtually maintenance-free life.

The use of Parafil® in these areas has now been extended across the world. In each instance tailor-made Parafil® ropes and specially designed terminations are produced to meet each customer's specific needs – no system is too complex for Parafil®.

These pictures are provided courtesy of ASCS Canadian Signal Corp and Thales Canada, Systems Division.

ROOF SUPPORT SYSTEMS

The physical and chemical characteristics of Parafil® also make it an ideal choice for roof support systems.

MARINE APPLICATIONS

Parafil® ropes have been used in marine applications including buoy moorings, ship and yacht rigging, guard rails and tow ropes etc, for over 20 years. Its tensile properties, low weight, freedom from corrosion and excellent tension-tension fatigue resistance make it the ideal choice.

The polyethylene sheath is unaffected by sea water and does not attract marine debris. When used in ship's rigging Parafil® is unaffected by sunlight and sea water and the smooth outer case ensures minimum build-up and easy release of ice.

URBAN TRANSPORT SYSTEMS

A natural evolution from the antennae and electrical, Parafil® ropes have been selected to support tram and trolley bus overhead conductors.

In terms of linear metres used, urban transport systems now represents one of the fastest growing markets for Parafil®.

PRE-STRESSING TENDONS

Parafil® has also proved it value in the construction industry where it has been used to repair concrete structures, including a large cooling tower that was repaired using 30 circumferential tendons of Type G Parafil® rope.

The high strength-to-weight ratio, excellent chemical, high UV and fatigue characteristics and safety over a wide temperature range make Parafil® an excellent choice for use as external, unbounded pre-stressing tendons in concrete beams.

STRUCTURAL APPLICATIONS

The high strength-to-weight ratio together with high modulus, low extension and good tension-to-tension fatigue life make Parafil® an attractive material for many structural applications.

It was used in a 'fully synthetic', cable-stay bridge spanning the River Tay at the Aberfeldy golf course in Scotland and has also been selected for a revolutionary tank bridge developed by BAE Systems Land Systems (Bridging) Limited.

PLEASE VISIT **WWW.LINEARCOMPOSITES.COM** FOR OUR EXTENSIVE LIBRARY OF CASE STUDIES

PARAFIL® SERVICE

PARAFIL® Ropes are manufactured by Linear Composites, an acknowledged world leader in this field.

The company has unparalleled experience in developing and refining applications for PARAFIL® in association with customers and distributors.

Linear Composites specialists work closely with customers and designers to ensure that the ideal PARAFIL® solution is provided for each application.

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PARAFIL® ROPE
Physical Properties

Technical Note PF1, Issue 3

1. PARAFIL® Types

PARAFIL® ropes consist of a closely packed core of high strength synthetic fibres lying parallel to each other, and encased in a tough and durable polymeric sheath.

The parallel fibre structure ensures that PARAFIL® ropes have high strength and modulus characteristics coupled with an excellent tension-tension fatigue performance and low creep.

There are three standard types of PARAFIL® based on the kind of fibre used. Each has a choice of three different polymeric sheaths. A flame retardant variety is also available. The product range is shown in Table 1.

Table 1 ~ PARAFIL® Types

Yarn Type	Sheath materials and Types			
	Polyethylene (LDPE)	Polyethylene Copolymer (EVA)	Polyester Elastomer (Hytrel)	Flame Retardant Cross linked Polymer
High Tenacity polyester	Type A	Type A (C)	Type A (H)	Type A (X)
Standard Modulus Aramid	Type F	Type F (C)	Type F (H)	Type F (X)
High Modulus Aramid	Type G	Type G (C)	Type G (H)	Type G (X)

The specially formulated polyethylene sheath is most commonly used and is perfectly satisfactory for most purposes, but the polyethylene-EVA copolymer sheath is more flexible. Higher resistance to heat and abrasion can be obtained from the polyester elastomer.

The standard ranges of PARAFIL® ropes are shown in table 2 and 3, other sizes are available as requested.

Table 2 ~ Basic Characteristics of Types A and A(C) PARAFIL® Ropes

Nominal Breaking Load (NBL) (Tonnes)	Nominal Diameter (mm)	Nominal Diameter of Fibre Core (mm)	CSA of Fibre in the Core (mm^2)	Approximate Weight in Air (kg/100m)	Estimated Weight * in Seawater (Core Flooded) (kg / 100m)
0.3	4	3.0	5.19	1.2	-
0.5	7	3.7	7.97	3.7	0.05
1	8.5	5.3	15.94	5.4	0.2
2	11	7.5	31.88	9.4	0.5
3.5	13.5	10	55.8	14.5	2.1
5	17	12	79.7	22	2.1
7.5	20	15	119.6	30	4.6
10	22	17	159.4	37	5.0
15	27.5	22	239.1	56	7.5
20	31	24	318.8	73	9.3
30	36	29	478.2	99	13.4
50	47	39	797	165	25
60	53	42	956	215	32
100	64	56	1594	310	77
200	90	77	3188	622	143
250	99	86	3985	763	153

TABLE 3 ~ Basic Characteristics of Type F and F(C), G and G(C), PARAFIL® Ropes

(Note Type G ropes have a higher elastic modulus than Type F ropes)

Nominal Breaking Load (NBL) (Tonnes)	Nominal Diameter (mm)	Nominal Diameter of Fibre Core (mm)	CSA of Fibre in the Core (mm^2)	Approximate Weight in Air (kg/100m)	Estimated Weight * in Seawater (Core Flooded) (kg/100m)
0.75	4	3	4.8	1.2	-
1.5	7	4	7.64	3.7	0.13
3	8.5	5.4	15.28	5.4	0.34
4.5	9.5	6.6	22.92	6.9	0.6
6	11	7.6	30.55	9.1	0.8
10.5	13.5	10	53.47	14.9	2.6
15	17	12.5	76.38	21.5	3.7
22.5	20	15	114.6	30	5.8
30	22	17	152.8	37	7.2
45	27.5	21.5	229.2	60	7.5
60	31	24	305.5	72	8.2
90	36	29	458.3	100	16
150	47	39	763.8	170	29

Note since PARAFIL® ropes consist of a closely packed core of cylindrical filaments there is always an air space amounting to 25-30% of the cross sectional area of the core. If the ropes are sealed to prevent the penetration of water then they will float. If the ropes are allowed to become completely saturated they will have this weight in sea water.

2. Tensile Properties

The load-extension curves are shown in Figure 1 and were obtained after pre-tensioning to 60% Nominal Breaking Load and then relaxing for 1 hour, using a PARAFIL® termination fitted to each end of the test length.

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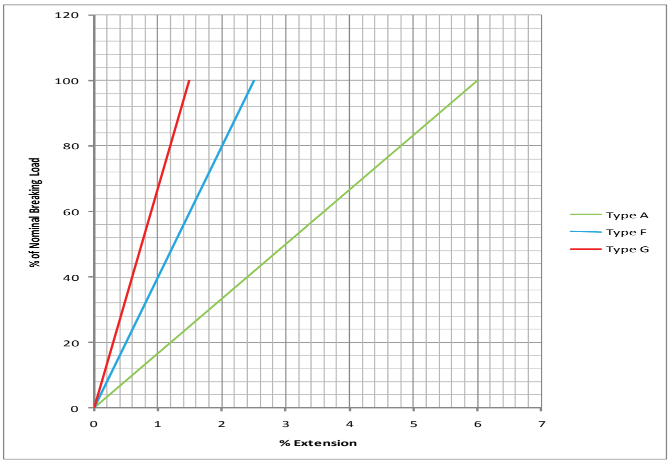
Figure 1 ~ Load Extension Curves for Type A, F and G PARAFIL®



More Detailed Load Extension curves are available from Linear Composites Ltd

The tensile properties given in Table 4 are based on the cross sectional area of fibre in the core.

The tensile properties are determined solely by the type and quantity of fibre used in the core and are independent of the sheath type.

TABLE 4 ~ Tensile Strength and Elastic Modulus of PARAFIL® Ropes

PARAFIL® Rope	Tensile Strength at NBL kNmm^{-2}	Elastic Modulus (Young's) kNmm^{-2}
Type A	0.6	9.8
Type F	1.9	77.7
Type G	1.9	125.6

Note: All Type A PARAFIL® ropes have the same core and therefore the same tensile properties. This is also true for the F and G series of PARAFIL®.

3. Effect of Temperature

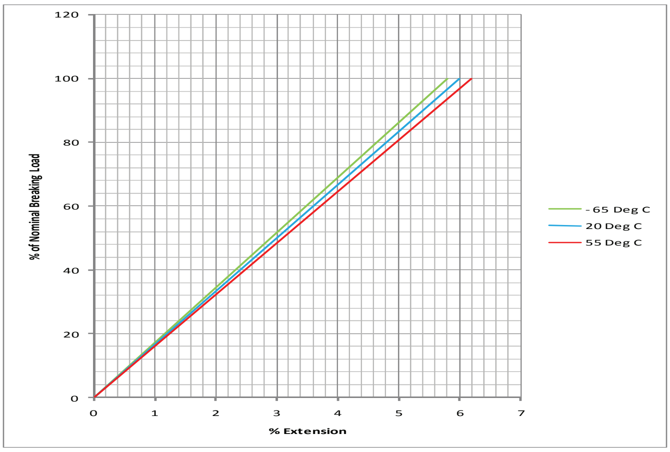
Polyester fibres melt at about 260° C. Aramid fibres do not melt but decompose at around 460° C. It is important to differentiate between 1) the effect of exposing the fibre to high temperatures and testing at that temperature, and 2) the effect of exposing to high temperatures for periods of time but testing at normal temperatures.

PARAFIL® based on aramid fibres has been tested at temperatures between –40° C and +80° C and has shown to have no detectable change in properties. Moreover aramid fibres exposed to a temperature of 150° C for long periods of time show no detectable change in residual strength when tested at normal temperatures. Aramid fibres show a strength loss of only 5% after 20 hours exposure at 200° C when tested at normal temperatures.

The Breaking Load of PARAFIL® based on Polyester has been found to be virtually unaffected when tested at temperatures between –65° C and +55° C but there are small changes in extension, as shown in Figure 2. Polyester fibres are not affected by long exposures at temperatures up to about 80°-100° C, but if tested at these temperatures they will show a small reduction in strength.

If PARAFIL® ropes are to be used at temperatures above 80° C for long periods of time it is recommended that a polyester elastomer sheath be used.

Figure 2 ~ Load Extension Curves for Type A PARAFIL® at Various Temperatures



4. Fire Resistance

Type A and A(C) and A(H) PARAFIL® will burn if exposed to a flame. However the sheathing materials can be made flame retardant if required (see separate Technical Note). Aramid fibres do not burn but decompose at around 460° C. As with Type A PARAFIL® a flame retardant sheath can be supplied.

5. Resistance to Environmental Effects

5.1 Corrosion Resistance

The ability of a rope to resist deterioration over long and continuous exposure to the environment is of prime importance. With this in mind PARAFIL® ropes have been evolved from materials which not only possess a high degree of mechanical toughness but which are extremely inert chemically. For example the core and sheath components used in PARAFIL® have outstanding resistance to the corrosive action of salt water, most inorganic salts and acids and many organic solvents. An example of this was shown when an examination of Type A ropes recovered from the sea water moorings after 10 years showed that the ropes were clean and in good condition. Tensile testing of both the rope and individual core fibres revealed no significant decrease in strength.

Resistance to marine biological attack is extremely high and the smooth sheath inhibits build up of marine growth.

5.2 Resistance to Sunlight

The black polyethylene and polyethylene copolymers used for the sheathing of PARAFIL® ropes are especially formulated for maximum resistance to Ultra Violet degradation. For instance, exposure of the black Polyethylene compounds to Florida sunlight for 29 years caused no significant degradation or embrittlement.

5.3 Icing

There is very poor adhesion between ice and the smooth water repellent surface of PARAFIL® ropes. This was clearly demonstrated in tests carried out in the British Aircraft Corporation climatic chamber.

Trials on fishing vessels in Icelandic waters have shown that PARAFIL® mast-stays freed themselves of ice when aided by the ships vibration transmitted through the rigging.

5.4 High Speed Loading

Type A PARAFIL® ropes have been tested under conditions of high speed loading by the National Engineering Laboratories in the UK. At a loading speed of 15.2m/sec (50ft/sec) on a 6m (20ft) long sample, breaking loads 10-15% below nominal were recorded. The energy absorbed was measured as 2000 joules (1500ft.lbf) per tonne of breaking load (note this was for a 6m length).

LONG TERM PROPERTIES

1 BACKGROUND

For some applications, particularly in structural and civil engineering, where design lives are commonly around 100 years, it is necessary to know how materials behave under load for long periods of time.

This note outlines work which has been carried out, and in some cases is still in progress.

2 CREEP

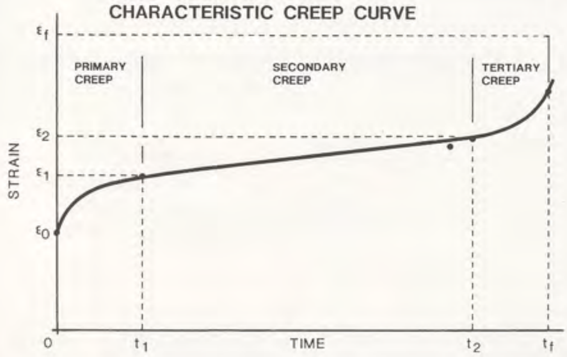
2.1 General

Creep is the continuing extension of a material under load. All materials creep to a greater or lesser extent. Modern high modulus synthetic fibres used in PARAFIL ropes have relatively low levels of creep.

For the creep and relaxation tests reported in this brochure the PARAFIL ropes were pre-tensioned to 60% of Nominal Breaking Load (NBL), and then allowed to relax for one hour, before the commencement of the tests. This procedure helps to ensure that there is no residual disorientation of the fibres caused by coiling.

The general form of the creep curve is shown in Figure 1. This curve is characteristic of many synthetic fibres.

Figure 1
CHARACTERISTIC CREEP CURVE



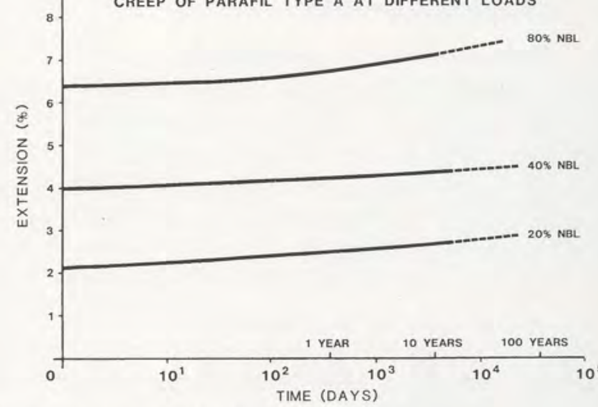
Typically the period 0-t_1 is measured in mins/hours, the period t_1-t_2 in years (assuming loads are as normally used, say 20 to 60% of Nominal Breaking Load (NBL) and the period t_2-t_f in days.

The period t_2-t_f for PARAFIL ropes has still to be determined since no failures have yet occurred during testing with loads in the range 20 to 80% of NBL.

2.2 Type A PARAFIL (polyester)

Fig 2. shows the creep behaviour, from 24 hours after the load has been applied, for Type A PARAFIL ropes at 20%, 40% and 80% of NBL. The creep in the first 24 hours was recorded as:
0.69% at 20% NBL
0.41% at 40% NBL

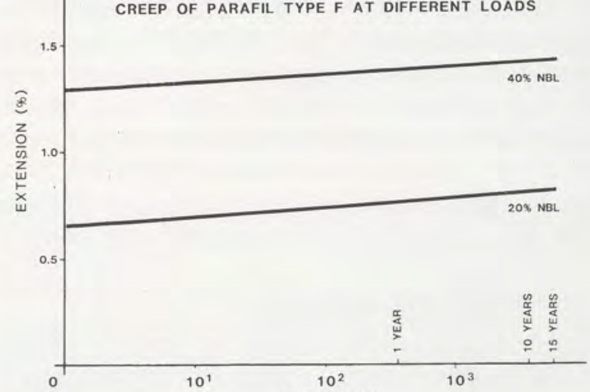
Figure 2
CREEP OF PARAFIL TYPE A AT DIFFERENT LOADS



2.3 Type F PARAFIL (Standard Modulus Aramid)

Fig.3 shows the creep behaviour of Type F PARAFIL ropes. The creep is much smaller than that of Type A PARAFIL. The creep in the first 24 hours was recorded as:
0.09% at 20% NBL
0.09% at 40% NBL

Figure 3
CREEP OF PARAFIL TYPE F AT DIFFERENT LOADS



2.4 Type G PARAFIL (High Modulus Aramid)

Measurements have shown that High Modulus Aramid fibres have a creep value of only 40% of that of Standard Modulus Aramid Fibres.

Measurements made on PARAFIL Type G have given:

$$ø_t = (0.012 \pm 0.003) \log_{10} t \text{ (Ref.1)}$$

where $ø_t$ is the creep coefficient defined as

$$ø_t = \frac{\varepsilon_c(t)}{\varepsilon_o}$$

where $\varepsilon_c(t)$ = creep strain at time t

and ε_o = initial strain

t is expressed in seconds.

Observations from stress-rupture work and creep data analysis show that Type G has a limiting creep strain, irrespective of initial stress, between 0.10 and 0.12%.

Ref. 1: "Creep behaviour of a parallel-lay aramid rope". C. J. BURGOYNE and G. B. GUIMARAES. Journal of Materials Science 27 (1992) 2473-2489.

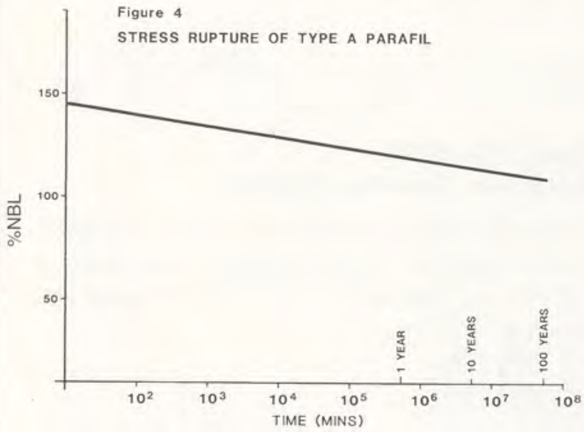
3 STRESS RUPTURE

3.1 Type A PARAFIL (polyester)

Type A PARAFIL ropes have a fibre content higher than that required to achieve the Nominal Breaking Load (NBL). With current efficient terminations, actual Breaking Loads are well in excess of the Nominal Breaking Loads. The Stress Rupture curve for Type A PARAFIL is shown in Figure 4.

Figure 4

STRESS RUPTURE OF TYPE A PARAFIL



3.2 Type G PARAFIL (High Modulus Aramid)

The Stress Rupture of Type G PARAFIL has been studied extensively at both Imperial College and Cambridge University in the UK, using 1.5, 3, and 60 tonne PARAFIL. A summary of the information to date is shown in Figure 5. This indicates that if the initial stress is restricted to less than 50% of Ultimate Tensile Strength a life of 100 years can be achieved.

4 STRESS RELAXATION

Typical Stress Relaxation curves for Type A PARAFIL over 500 hours are shown in Figure 6; the two curves relate to (a) with and (b) without a pre-tension cycle to 60% of NBL.

Figure 5

STRESS RUPTURE TEST RESULTS AND PREDICTED LIFETIMES FOR TYPE G PARAFIL

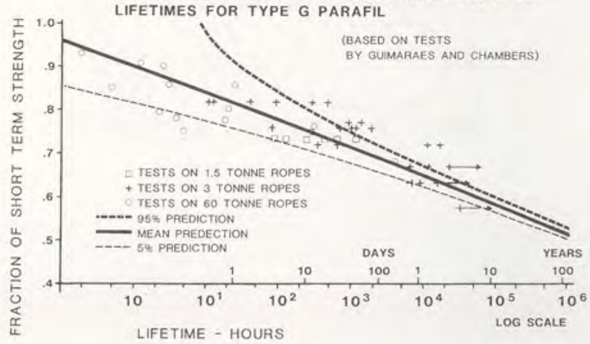
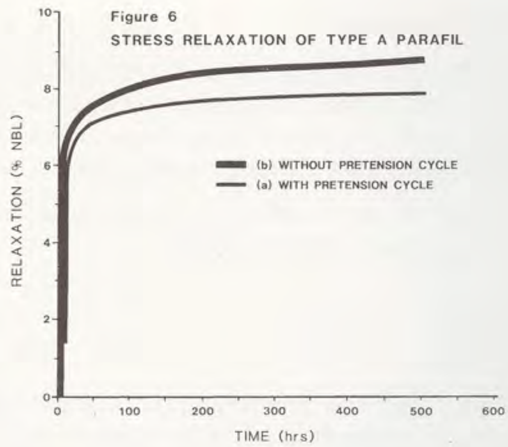


Figure 6

STRESS RELAXATION OF TYPE A PARAFIL



The actual relaxation, expressed as a percentage of NBL, from an initial stress of 40% of NBL was 7.86% for the sample given the pre-tension cycle and 8.75% for the sample given no pre-tension cycle.

Similarly the figures for Stress Relaxation for Type F PARAFIL are 6.29% and 8.82% respectively.

The higher modulus Type G PARAFIL ropes have been studied even more extensively at Imperial College. These ropes are of particular interest for pre-stressing applications (Ref: 2). Relaxation results are shown in Table 1.

TABLE 1 STRESS RELAXATION OF TYPE G PARAFIL

Initial Stress (%NBL)	Relaxation at 100 Hours (%NBL)	Relaxation at 100 years (%NBL)
30	2.9	7.0
40	3.5	7.4
50	3.8	7.8
60	4.5	8.2
70	4.5	8.6

These results conform to the relationship shown in Figure 7:

$$r = 1.82 + 0.0403 f + 0.67 \log_{10} (t-100)$$

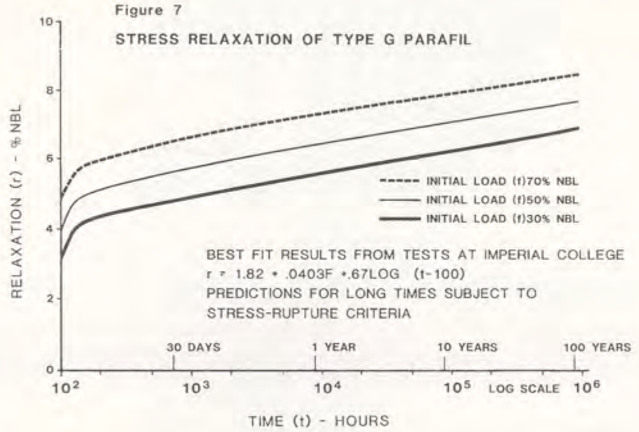
where r = stress relaxation expressed as %NBL

f = initial stress expressed as %NBL

t = time in hours

Figure 7

STRESS RELAXATION OF TYPE G PARAFIL



Note that the relaxations are expressed as percentage of Nominal Breaking Load. Relaxation figures are higher when expressed as percentage of Initial Stress:

e.g. at 60% NBL Initial Stress, the relaxation over 100 years is 8.2% NBL. This equates to a relaxation of 13.6% Initial Stress.

Although relaxations are higher than the relaxations associated with steel, the total loss of pre-stress force in a concrete beam pre-stressed with PARAFIL is very similar to that in a beam pre-stressed with steel. The losses due to relaxation of the tendon are higher but the losses due to elastic shortening of the concrete are lower because of the lower elastic modulus of PARAFIL. The amount depends on the detailed design, which will differ for structures designed with steel or PARAFIL tendons, but for most cases the two effects cancel each other out.

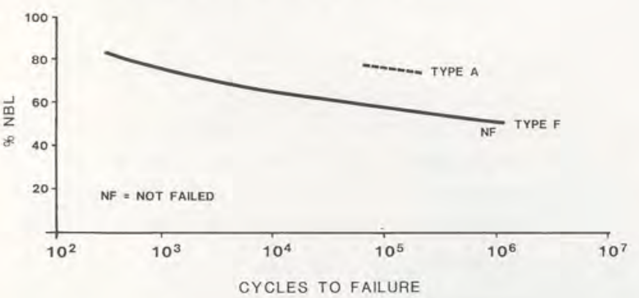
Ref.2 Chambers J.J., "Parallel Lay aramid ropes for use as tendons in pre-stressed concrete". PhD. Thesis, University of London 1986.

5 FATIGUE PERFORMANCE

In general terms the tension-tension fatigue performance of parallel-lay ropes is excellent and is superior to that of most other forms of rope construction. This is due primarily to the avoidance of fibre cross over points which cause fibre 'fretting' in twisted or braided structures.

Figure 8

TENSION-TENSION FATIGUE PERFORMANCE OF TYPE A AND TYPE F PARAFIL



The fatigue performances of Type A PARAFIL (10 tonne NBL) and Type F PARAFIL (6 tonne NBL) are shown in Figure 8. The curves were constructed by recording the number of cycles to failure in cycling from a constant lower limit corresponding to 7.5% NBL to the upper load limit depicted by the curve.

Tests on Type G PARAFIL (6 tonne NBL) have been carried out under different load amplitudes. Typical results are shown in Table 2.

TABLE 2 FATIGUE PERFORMANCE OF TYPE G PARAFIL

Mean Load (%NBL)	Load Range (%NBL)	Cycles to Failure ($x 10^6$)
30	±25	0.5
30	±15	3.4
40	±15	2.9
*40	± 5	>10

*The residual strength was measured at 6.5 tonnes.

6 ENVIRONMENTAL CONDITIONS

PARAFIL ropes consist of two components - a fibre core which determines the tensile properties, and a sheath which defines and maintains the shape of the rope and serves as a protection to the fibre core.

Most PARAFIL ropes have a polyethylene sheath. Polyethylenes are regarded as chemically inert materials and are not attacked by water, inorganic acids and alkalis, aqueous salts or other materials normally found in soils or the environment. The grades used for PARAFIL are those grades developed and used for underwater or buried telephone and electrical cables.

Natural polyethylenes used for PARAFIL are stabilised with carbon black. Tests over a 20 year period in areas of high U.V. activity on stabilised grades have shown no detectable change in properties.

PARAFIL ropes were first used as primary mast stays on Ministry of Defence installations in the United Kingdom. Erected in 1966/67 they are still in use. When examined and tested after 20 years service they were found to be unchanged.

Both polyester and aramids are durable fibres and are resistant to most chemicals. They are also highly resistant to water. The reaction of polyesters with water (hydrolysis) has been under intensive investigation over the last few years. The results show that selected polyesters will only suffer a 3% strength loss after 100 years immersion in water at 20°C. (Results published separately by Imperial College).

Tests by DuPont have shown that aramid fibres are not attacked by water at normal temperatures.

For detailed physical and chemical properties of the fibres, refer to the manufacturers technical information:
Aramid fibres - DuPont De Nemours International SA
Polyester fibres - Acordis Industrial Fibres BV
KoSa GmbH

PARAFIL® ROPE
Flame Retardant Sheath

Technical Note 5, Issue 2

Linear COMPOSITES

PARAFIL® ropes with a flame retardant polymeric sheath are designated Types A/X, F/X and G/X.

The designation 'X' indicates that the sheathing material for the particular PARAFIL® is a halogen free cross linked polyolefin.

This compound has been formulated to have properties of flame retardancy, minimum smoke and toxic gas emission, non melting, anti-tracking and resistance to outdoor exposure. It is black in colour and is only slightly different in appearance and feel from the polymeric sheath used on PARAFIL® A, F and G.

The material has the following properties:

Flame propagation (ASTM D635)	Time of burning = 1 second Rate of burning = self extinguishing Extent of burning = 5mm
Resistance to tracking (Inclined plane track test essentially as ASTM 2303)	No permanent track established after 18 hours.

The full range of PARAFIL® Types is as follows:-

Yarn Type	Sheath materials and Types			
	Polyethylene (LDPE)	Polyethylene Copolymer (EVA)	Polyester Elastomer (Hytrel)	Flame Retardant Cross linked Polymer
High Tenacity polyester	Type A	Type A (C)	Type A (H)	Type A (X)
Standard Modulus Aramid	Type F	Type F (C)	Type F (H)	Type F (X)
High Modulus Aramid	Type G	Type G (C)	Type G (H)	Type G (X)

The tensile properties and rope diameters are unaffected by a change in the sheath material. Full details are contained in Technical Notes PF1 and PF2.

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PARAFIL® ROPE
Electrical Properties

Technical Note TN2, Issue 2

Linear COMPOSITES

The electrical properties of PARAFIL® are of importance when considering its use as a high strength insulating stay or rope in areas where it may be subject to high electrical stress. For instance when it is used in antenna systems of different types of in-line transmission work.

Specific electrical characteristics are set out in the following table:

1.0 POWER FACTOR, CAPACITANCE, PERMITIVITY

Rope diameter (mm)	Sample thickness (mm)	Frequency (MHz)	Capacitance (pF)	Permitivity	Power factor
17	2	8	1	2.89	
8.6	2	15	0.5	2.11	*0.01/0.1*
11	2	15	0.55	2.04	

Measurements made on samples under standard laboratory conditions (20°C : approx 50% RH) using a Hartshorn-Ward bridge according to BS2782 Part 2.

2.0 VOLUME RESISTIVITY

6×10^8 ohm.cm
Measurements made on samples of rope of diameter 20mm and thickness 6mm, using a micrometer electrode system and a megohmmeter at 500V dc. The rope samples were conditioned to 65% RH.

3.0 LIGHTNING RESISTANCE AND AC TESTING

3.1 Ropes of diameter 17 and 31mm were subject to a complete wetting of the outer surface. Voltage was applied at the rate of 5kV RMS/sec and flash over voltages recorded against length.

Flashover Voltage kV rms	Rope Length (mm)
123	650
245	1280
420	1890

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3.2 5 positive and 5 negative impulses of 1200kV peak were applied to dry ropes and ropes having the outer surface wet. The rope length was adjusted to give no flashover.

- Dry rope length for no flashover 2.2m
- Wet rope length for no flashover 5.8m

The wave shape of the impulses used were 1.2/50μs according to IEC definition (IEC publication 60).

In tests 3.1 and 3.2 flashover did not damage the rope.

3.3 Using a Tesla coil arrangement PARAFIL® rope has been subjected to severe high voltage of 750kV at approx 100k Hz. No damage occurred for 4 consecutive runs of 60 seconds duration on both wet and dry ropes, and only superficial damage occurred on highly polluted ropes.

4.0 RESISTANCE TO SURFACE DISCHARGE

The sheath material has a life of approx 2 hours before puncture when subjected to continuous discharge on the same area in a standard dust-fog test according to ASTM 2132. The material is non-tracking.

5.0 CORONA DISCHARGE

Ropes and terminations have been subjected to high levels of corona discharge activity for long periods, without any surface damage resulting. This still pertains even under wet conditions.

The figures and observations given above refer to tests made under laboratory conditions.

The results of electrical tests can be affected by the presence of water. With PARAFIL® water can only enter via the end fittings, if these are not water-proofed; or in the unlikely event of the sheath being damaged mechanically by mishandling so as to expose the fibre core. However, even with the presence of water in the rope, for radio applications it should present no problems unless the stay is subjected to a high electric field, which does not occur by design on most antenna and mast systems.

When PARAFIL® is used in areas where it may be subject to a high electric field it is necessary to waterproof the end fittings. Recommended procedures for this are given in Technical Note TN3.

Standard termination techniques and the physical properties of PARAFIL® are given in Technical Note TN3 and Technical Note PF1.