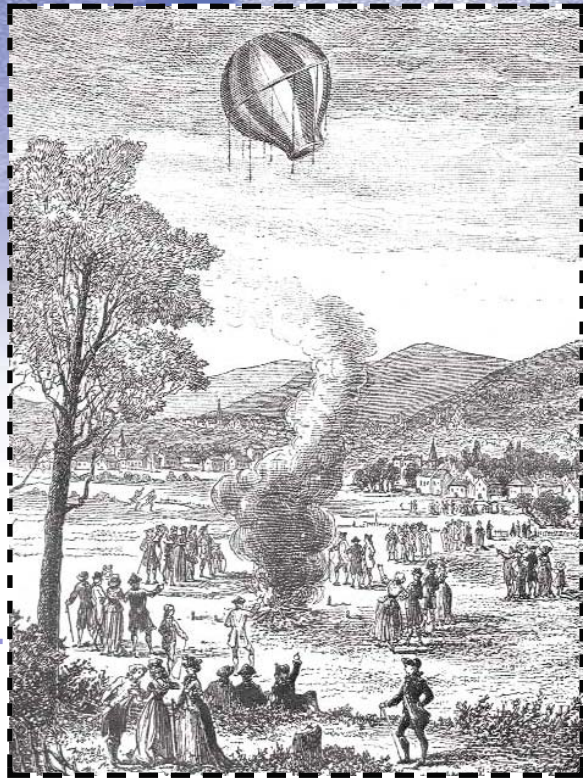


Nearly
Everything
You Need To
Know About
Hot-Air Balloon Fabric



**CAMERON
BALLOONS**



As the Montgolfier brothers proved in 1783, the principle of hot-air balloon flight is very simple. You just invert a very large sack and fill it with hot air.

Their heat was produced by a bonfire on the ground and after being released the sack lifted into the atmosphere, where it quickly cooled and returned to earth.

Being paper manufacturers the brothers naturally made their early sacks out of paper the first examples of the promotional balloon! Later they employed silk, but insulated it from the heat which was now generated by an on-board brazier with a layer of paper.

Today the principle hasn't changed, but the brazier has been replaced by powerful burners that consume liquid petroleum gas, while fabrics made from synthetic fibres have superseded silk and paper (though a tenuous connection remains the sack that contains the hot air is known as an envelope).

Nylon 6.6 is the synthetic fabric chosen by the world's leading manufacturers of hot-air balloons from which to cut the colourful panels that are sewn together to form their envelopes. Polyester is an alternative, but INVISTA (formerly DuPont Textiles and Interiors) - who can offer an unbiased opinion on the subject as they manufacture both fibres - are of the view that nylon is superior to polyester for use as the covering fabric in hot-air balloons. According to Susannah Rayfield of INVISTA, Nylon 6.6 is preferred in many industrial applications due to its

Buying finished fabric from a reputable source, which has experience and expertise in producing materials for use in this demanding industry, ensures the quality and durability of the finished balloon envelope

NYLON vs. POLYESTER

The unbiased technical argument why nylon is better

INVISTA, (previously DuPont Textiles and Interiors), one of the world's largest integrated fibre, resin and intermediates company. INVISTA manufactures, and is proud of, both its nylon and polyester products. So why does Susannah Rayfield, the company's European sales and marketing manager, say that where hot-air balloons are concerned there are clear technical reasons INVISTA Nylon 6.6 is the market leader for yarns which can be used in fabrics for this specialist end-use?

Polyester is heavier than nylon. Polyester is 21% denser than nylon 6.6. Susannah says this means that the diameter of a polyester fibre with the same decitex and filament count as nylon would be smaller. Consequently, to achieve an identical cover factor (tightness of weave to keep porosity to a minimum), a 1m² piece of polyester

would contain a greater number of thinner (but same weight) threads than the same sized piece of nylon fabric, making the polyester piece heavier than its nylon counterpart. And unnecessary weight is obviously to be avoided when building a lighter-than-air craft.

More coating means less porosity. The lower density of nylon 6.6 means that fabrics manufactured from it can have higher levels of coating and still be of an acceptable weight. Extra coating can significantly improve the life and performance of a fabric says Rayfield.

Nylon is stronger than polyester. In terms of strength-to-weight ratio, nylon 6.6 beats polyester. This means that envelopes made from nylon 6.6 can be lighter without any compromise on strength, or if equivalent in weight to a polyester balloon can be almost 30% stronger.

Which yarn has the better abrasion and tear properties? Says Susannah Rayfield: Nylon 6.6

is preferentially used in carpets, contract and automotive upholstery and in military and outdoor sports equipment due to having superior abrasion resistance to polyester. She added that weight-for-weight nylon 6.6 is also more resistant to tearing than a polyester fabric of the same construction. This is due to its higher extension at break, because nylon is inherently more elastic and so absorbs energy better than polyester.

What about ultra-violet stability? Ultra violet light degrades most fabrics, but, says Susannah: "although polyester has better UV protection properties than standard Nylon 6.6, INVISTA adds chemical components during the manufacture of the special Nylon 6.6 polymer used in the production of fabric for Cameron which increase the fibre's level of UV stability to the extent that it has better UV protection than polyester. In a like-for-like weathering test under the Florida sunshine INVISTA's high tenacity Nylon 6.6 outperformed polyester in terms of retained strength by a factor of five!

Tell me about hydrolysis. Hydrolysis is the chemical attraction and retention of water. Both Nylon 6.6 and polyester are classed as hydrophobic fibres, which means their ability to absorb moisture is low. Little as it may be, nylon does absorb more moisture than polyester, and moisture can encourage the growth of micro-organisms. But it's not a problem to Cameron fabric, which is coated with a specially modified urethane not just to reduce porosity but also to stop hydrolysis and fight the formation of moulds.

The information given above in italics is taken either directly or in paraphrase from a presentation made by Susannah Rayfield on Friday, 14 January, 2005. For further information please contact Cameron Balloons in Bristol, UK, or Susannah Rayfield at INVISTA in Gloucester, UK.

than polyester for the manufacture of hot-air balloons

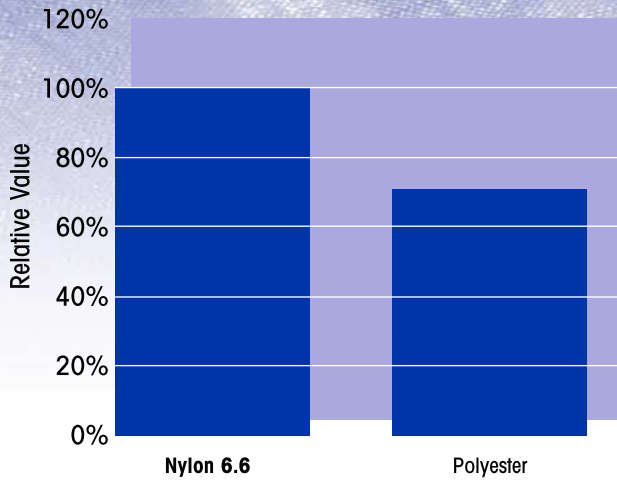


INVISTA™

**CAMERON
BALLOONS**

Data and images courtesy of Invista™ and Cameron Balloons Ltd., UK

Comparison of tensile strength



Nylon 6.6 is preferred in many industrial applications due to its superior strength to weight ratio, abrasion and tear resistance and energy absorption characteristics.

superior strength to weight ratio, abrasion and tear resistance and energy absorption characteristics. If you'd like to read the full argument, please turn to page five and six of this leaflet.

Of course, there is ordinary nylon fabric and then there is Cameron nylon fabric. Its exclusive.

For starters, the yarn from which it is manufactured is INVISTA Nylon 6.6. The polymer INVISTA uses to make this specific Nylon 6.6 yarn has been specially modified to meet the demanding requirements of aeronautical textiles and incorporates an additive that acts as an absorber of ultra violet light energy and so protects the yarn from degradation.

Cameron fabric is also brighter and offers better resistance to yellowing, so whites stay

whiter and colours retain their intensity for longer.

But the fabric is only half the story. Rip-stop nylon will allow some air to pass through because it is a woven fabric, and a porous hot-air balloon would be inefficient. So, manufacturers apply coatings that reduce fabric porosity. But not all coatings are the same.

Among other benefits, Camerons revolutionary aliphatic polyurethane coating delays the onset of fabric porosity. Which in simple terms means envelopes last longer and use less fuel. It also helps protect against hydrolysis and the formation of moulds that can discolour and weaken fabrics.

Now that you know why Cameron has the best balloon fabric in the world you could wonder

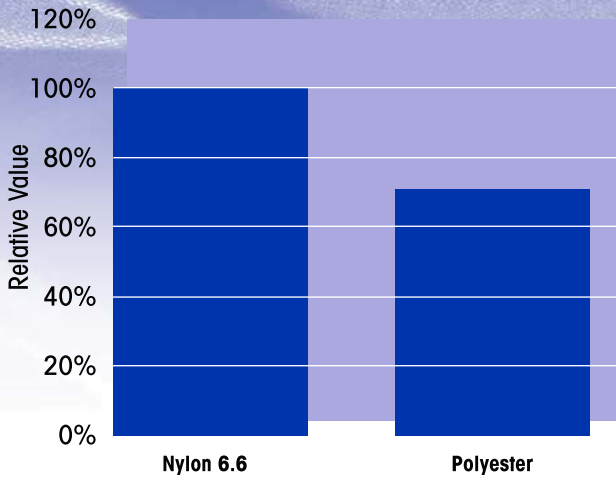
Tensile testing



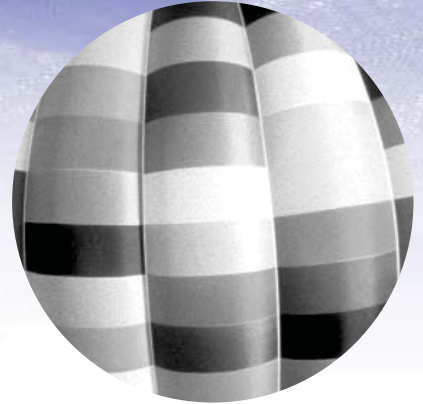
Viscosity testing of the coating mix



Comparison of extension at break



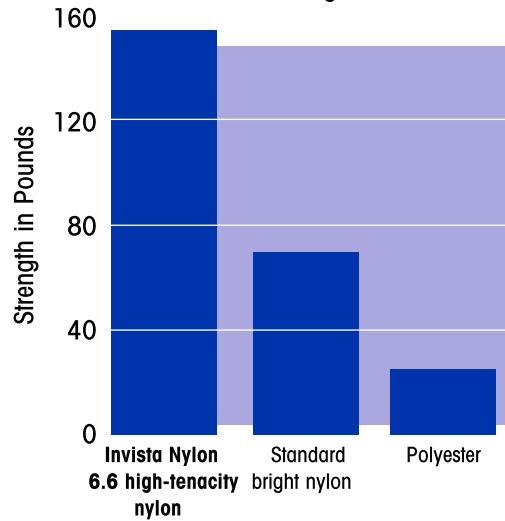
Cameron's revolutionary aliphatic polyurethane coating delays the onset of fabric porosity. Which in simple terms means envelopes last longer and use less fuel.



why we might offer to put a different material - Hyperlast - in your balloon envelope? Hyperlast has been the leading fabric for use in passenger rides envelopes for many years and is still unsurpassed. Why? Because of its incredible strength (ask for a sample and take the tear-test) and the fact that it is silicone coated on both sides. Being smoothly woven from a heavier nylon (of course) yarn it doesn't need rip-stop threads to add strength. However, you'll find genuine Hyperlast only in envelopes that carry the Cameron name.

If you haven't seen Cameron fabric, or want to take the Hyperlast tear test, we'd be happy to send samples to you. You can choose from 20 standard Cameron colours, plus black, white, silver and gold, or we can dye fabric to match your requirement for special shades.

Yellow fabric strength remaining after four months of weathering in South Florida



Porosity testing



UV testing



Crumple flex testing

