

INSIDER

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Back into the Future – DORNIER and Carbon Fibres

A time journey through the new Dornier Museum in Friedrichshafen

From Vision to Reality

From CLS comes A1 and P1

Tradition meets Technology

Finest wool from Johnstons of Elgin, Scotland

Dear readers, dear friends of
Lindauer DORNIER GmbH,

LiDO celebrates its 60th birthday this year. Founded by my father, Peter Dornier, as the first industrial activity of the Dornier works following the 2nd World War, it has in the meantime established a good name for itself throughout the world with its equipment for the textile and plastics industry. We are extremely happy and proud to have been shown such great trust and confidence by so many for such a long time. From this we feel an obligation and are motivated to continue our search for new solutions and new products, whilst making our production methods better and more efficient.

We contrast durable high quality products, whose useful lives of 20 to 30 years are by no means a rarity, with our fast-moving lives today. Unsparring in terms of innovation, our investment in research and development in the last 10 years has amounted to some 200 million Euros. New buildings and more efficient production lines, and, particularly, our highly qualified workforce, create the conditions for a thoroughly optimistic view of the future. As one of the few in our sector, we are proud to exclusively pro-

duce "Made in Germany", and it is characteristic of our company that it seeks its success first of all through technical progress.

New and interesting developments in the field of textile technology plus a new generation of weaving machines stand ready for you in our technology center in Lindau. The Dornier Museum, opened only last year in Friedrichshafen – a mere 20 km away – enables you to make an inspiring journey in time through 100 years of pioneering spirit and innovative lightweight construction. Here you will be able to see the chronological development from the first all-metal aeroplane in 1916 through to the first mass-produced aircraft with carbon fibre components in 1973, alongside many other pioneering innovations.

Come and visit us – we look forward to welcoming you at beautiful Lake Constance!

Yours faithfully

Peter D. Dornier



The Dornier Museum in Friedrichshafen, opened in 2009

SRF Ltd., India, relies on technology
"Made in Germany"

Global Player in Precision Films and Technical Textiles

SRF is – like DORNIER – a business professionally led by the founding family. Both companies originate from a long tradition, building its strength on different products in different industries.

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SRF Ltd., India, relies on technology “Made in Germany”

GLOBAL PLAYER IN PRECISION FILMS AND TECHNICAL TEXTILES

SRF is – like DORNIER – a business professionally led by the founding family. Both companies originate from a long tradition, building its strength with different products in different industries.



Take-up unit of a DORNIER film stretching machine at the SRF factory in Indore

Group history

SRF Ltd. traces its origin to the lineage of the famous Lala Shri Ram, who not only ranked among one of the country’s leading business visionaries of all times, but is also the founder of the reputed Shri Ram Group of companies. The Group’s existence spans more than a century, starting way back in 1889 when its parent company Delhi Cloth Mill, now known as DCM Group, was founded. In the ensuing period, the DCM Group expanded its business interests into a very diverse product portfolio comprising sugar, automobiles, finance, fertilizers, fine chemicals, rayon, tire cord and textiles etc. Respected as an ethical company, the group is known for its contribution to art, culture and education. In particular, the group is also known for establishing some of the most famous academic institutes of the country such as “The Lady Shri Ram College”.

Company profile

SRF was originally established in 1970, under the name of “Shri Ram Fibres”, by its parent company DCM to manufacture mainly nylon tire cords. Over the years the company diversified and eventually the name “Shri Ram Fibres” was changed to SRF in 1990. Today, its business portfolio covers technical textiles, chemicals, packaging films and engineering plastics. In technical terms SRF could be described as a multi-business entity engaged in the manufacture of chemical based industrial intermediates. However, common language tells that SRF is in the business of making people’s daily lives both safer and more comfortable with its products.

Headquartered in Gurgaon, India, the 550 million \$ company, with a global workforce of around 4,000, has operations in three other countries, United Arab Emirates, Thailand and South Africa. SRF is the market leader in most of its businesses sectors

in India and also enjoys global leadership in others.

The company prides itself to be equipped with state-of-the-art R&D facilities, for process innovations and product development. It was the first tire cord company outside Japan to win the prestigious “Deming Award”, for adopting TQM as a management strategy. SRF remains committed to creating a culture of excellence through personnel development and an employee friendly approach. Through its social wing, the SRF Foundation, the company strives to make meaningful contributions to its community on a sustainable basis.

Technical textiles

Building on its dominant position in the domestic market, SRF also enjoys a significant presence in the global market for all three product lines within its “Technical Textile Business”. This business unit manufactures nylon tire cord, conveyor



DORNIER tire cord weaving plant of SRF

belting and coated fabrics. The tire cord is used worldwide as reinforcement for all kinds of tires, ranging from the humble bicycle to the heavy commercial trucks and even aeroplanes. Coated and laminated fabrics have found their end use in products such as awnings, tarpaulins and canopies for boats, trucks and car covers. Other end uses include fabrics to cover cricket pitches, tennis courts and sports fields as well as fabrics for so called “shamianas”, tents used for wedding parties. SRF is the second largest manufacturer of conveyor belting and nylon-6 tire cord fabrics in the world.

In 1987, SRF purchased their first DORNIER weaving machines for the production of conveyor belting and have continued to add more and more machines over the years. The first investment in DORNIER tire cord weaving machines



Candies wrapped with metallised film from SRF

was done in 2005. Now a great number of DORNIER weaving machines are in operation at SRF with plans for further expansion in the years to come.

Packaging films

The packaging films business of SRF manufactures Bi-axially Oriented Polyethylene Terephthalate (BOPET) or Polyester (PET) Film, which is predominantly used in flexible packaging applications for the conservation and protection of a wide range of products.

In 2009, the packaging film business doubled its capacity by adding a new DORNIER film stretching plant. With an output of 3.9 tons per hour the new plant produces packaging film of 8 to 50 microns. To run the production line requires around 25 people per shift including maintenance and support.

So whether it is the widely-used shampoo sachet or a bar of soap made by some of India’s largest FMCG (fast moving consumer goods) companies it is likely that the film brand of SRF “PETLAR” with its properties of excellent printability, strength and aroma retention are at work. The focus of the business is to always move up the value chain of packaging films. To this end, SRF also produces metallised and holographic films for highly sophisticated applications in addition to plain and chemically treated polyester films.

It is expected that Indian and Asian markets are yet to realise their full potential, as a result of increases in population and

spending power, along with changing demographics and changing lifestyles. Mr. Chatrath of SRF states: “We think that demand for polyester film will see robust growth in Asian economies, especially in India and China. As for Europe and the USA around 2% growth is expected annually with an increasing demand for speciality products”.

The final applications of the PET film produced on the DORNIER line are primarily packaging applications for food such as confectionery. Other applications are personal care products and detergents, cosmetics as well as some electronics applications such as capacitor films. Some important customers’ brands are Unilever, Lux, Surf, Dove, Head & Shoulders and Pantene. The PET film portfolio of SRF is more focussed towards international customers and into smaller sized packages. 50% of the sales are exported.

Close connection to DORNIER

In the past, SRF had only seen DORNIER as a very well-known leading global manufacturer of weaving machines. However, the company had been delivering film stretching machines since 1960 to companies such as Agfa-Gevaert, ICI, Kodak, Celanese and Fuji as well as Toray and Teijin and had become a global technological leader in this business sector also. SRF approached DORNIER in 2002 for the first time for an upgrade of an existing TDO (transverse direction orientation) line at their Kashipur plant. Just one year later, as a result of this successful upgrade, DORNIER received another order for the supply of a complete polyester film production plant, which was commissioned successfully in 2004.

SRF states about the DORNIER film stretching plant: “The machine is sturdy. However, we faced some problems in the beginning, but all the issues were settled swiftly with the support of the DORNIER team”. After the positive experience with the first machines, it was clear to SRF that they should maintain their partnership with DORNIER. Especially appreciated are qualities like customer orientation, an easy approach, the professional and ethical behaviour of the people, and, of course, the first class technology.

Total quality management

SRF manages its business through effective implementation of Total Quality Management (TQM) in an integrated

manner combining principles, methods, systems and tools. SRF built its entire organisation on this foundation and this has contributed significantly to its success.

The company's TQM activities are built on a three-pronged strategy:

- Enhancement of customer satisfaction
- Continual improvement in every business activity
- Involvement of everyone in the organisation.

SRF prides itself on its staff participation activities, which involves nearly every employee in the organisation in improvement activities such as Kaizen and Quality Control (QC) Circles. Significant improvement in cost structures, continual reduction in waste, sustained increase in cost competitiveness and an enviable record for maintaining high standards of safety, health and environment in its work premises are some of the results of TQM practices in SRF.



Textile tire cord – the stabilising component of every tire
© Oerlikon Saurer

More importantly, the company has developed a TQM based management model, which can be successfully replicated while setting up and managing a new plant or business.

Growth and expansion

Pursuing its goal to achieve global market leadership by 2020, SRF has embarked on a long and challenging journey of growth and expansion for all its businesses through both organic and inorganic routes.

Over the last four years the company has made investments of around Rs. 1,250 crore (about € 200 Million) mainly in augmenting and upgrading production facilities in different businesses. Apart from the Polyester Industrial Yarn plant, the

Laminated Fabrics plant and the second line of BOPET Film, the company also saw the commissioning of dipping facilities for tire cord fabrics with a capacity of 11,500 tons per annum.

With the commissioning of the polyester industrial yarn plant SRF has become the pioneer in this sector in India. This will enable the company to enter two new areas – tire cord fabric for radial tires and the reinforcement cords for V-Belts. This project also offers SRF the capability to manufacture High Modulus Low Shrinkage (HMLS) polyester yarn and an assortment of high tenacity and low shrinkage yarns for various industrial applications. Thus SRF has become one of the few companies in Asia, offering multiple complimentary technical textile reinforcement products. In fact, it is now a one stop shop for reinforcement fabric to the tire companies in India since it will be able to cover the full spectrum of tire cords from nylon-6 to polyester.

The successful commissioning of the laminated fabrics project has enabled SRF to complement its fabrics product portfolio. The laminated fabrics are largely used for applications such as flexible banners, signage etc. The project also helps to reduce the company's technical textiles business reliance on tire cord fabrics.

Other ongoing projects within the company include expansion of the coated fabrics division and development of a Chemical Complex at Dahej in Gujarat.

Family business

“Our Companies are very similar. Like DORNIER we are a business professionally led by a founding family. SRF is a value-driven organisation where respect and care for individuals, trust, creativity, innovation and equal opportunity, without any discrimination, are the main principles. That's the backbone of the People System. We value high standards of integrity and ethics, and also encourage (non-monetary) contributions to society by employees. Our values can be seen in action through our people's policies which are practised day in and day out”, says Mr. Chatrath.

Building on its heritage, the company strives to ensure the utmost transparency in company affairs by appointing well qualified, reputed professionals from diverse fields as independent members of the board. These professionals form the majority of the Board.

Based on totally different business areas in independent markets and with the constant aim of improving their products and processes, SRF is well positioned for the future in order to keep, and even strengthen, their dominant role in both domestic and international markets.



Family day at SRF – an event regularly taking place in all company locations

ON THE TRAIL OF THE SILK ROAD

What, according to the legendary Chinese empress Xiling Shi around 5,000 years ago was revealed when a silkworm cocoon fell into her tea, is still today one of the most desirable materials for elegant clothing, shimmering robes and flattering fabrics – silk.



Sébastien Perrin and Peter D. Dornier (from right) in the weaving shop of Perrin & Fils, Le Grands-Lemps

Along the silk road to Lyon

Along the silk road in the Middle Ages luxurious silk fabrics reached the strategically well located city of Lyon, where, in the trading of this expensive material, it was dispatched throughout flamboyant France and even as far as the royal palace. On the grounds of the palace's high level of expenditure on the desirable silk, Louis XI decided in 1466 to produce silk himself in France for the future. In this way Lyon was honoured with the silk trade monopoly in 1536 as the "Silk Capital" of France.

Near Lyon in Le Grand-Lemps, France's greatest silk weaver masters, like no other, the production of precious woven silk fabrics with the aid of the most modern technology. The Perrin & Fils company, partly owned by the Hermès Group, has recently celebrated its 80 years of existence, looking back on a long-standing, successful company and family history.

The roots of a traditional company

Eugène, the eldest son of weaver Alexandre Perrin, and formerly an employee of famous Lyon silk producer Bianchini-Férier, founded his own silk weaving company "Les Tissages Perrin" in 1929 during the most severe economic crisis of the last century. Since then, the art of silk together with the successful company, has been transferred from generation to generation, from father to son. The

ceremonial handing over of the baton to the fifth generation, represented by Jean-Laurent, Jean-Hugues and Sébastien was effected in a festive setting during the anniversary celebrations on the 80th year of existence of the company on June 12, 2009.

Utilizing 60% of the French imports, Perrin & Fils is the biggest consumer of raw silk and silk yarns in the whole of France, occupying top place in its own country in the production of woven silk fabrics.

With 168 employees, the finest silk, cashmere or blended and elastic yarn fabrics – primarily for French fashion brands – are produced on 42 DORNIER dobby and Jacquard rapier weaving machines. Only 15% of the fabric is exported, with neighbouring European countries being the main customers with 76% of the total.

The exclusive end-products range from accessories, such as scarves, neckties and handkerchiefs via lingerie and swimming fashion through to women's outerwear.

Luxury – made in France

The ultimate goal for every employee is the achievement of the best possible quality. Even 10% of employees are exclusively responsible for quality control at the various production stages. Every centimetre of finished fabric is checked with extraordinary care. The "making-up" of the products is a great art in itself. Supremely "fairy-fingered" seamstresses



Dyed silk cocoons

with great expertise are busy in dressing, pressing and packaging the finished garments and accessories. Everything is hand-crafted in a routine of thousand-fold repeated operations. The making-up department especially specialises in the tailor-made production of elaborate details like flower petals, trimmings or bows, and also the manual sewing of handkerchiefs, scarves and the confection of neckties.

The circumspectly operated teamwork throughout the whole value creation chain, which incidentally takes place exclusively in France, finally produces a perfectly superior product which makes Perrin a figurehead for the French and also the international silk industry.

The company's success is based not least on a perfect harmony of values between respect for the past and tradition together with the skill and far-sightedness of constantly promoting innovation and creativity in order to persist successfully in the future.

In 2007, Perrin & Fils was honoured with the "Entreprise du patrimoine vivant" (living company heritage) award for its special technical know-how in silk handicraft. This distinction is awarded to selected French firms which are masters of special skilled handicraft, or have special know-how in industrial manufacturing.

„Quality creates value“

In order to produce the utmost quality, Perrin has always placed high value on a well-equipped, modern weaving mill with reliable weaving machines. The teamwork between the two family companies Perrin and DORNIER has endured for over 30 years. In that time, the machine park has

been constantly maintained at a modern level, and consists today exclusively of DORNIER rapier weaving machines.

The production is dedicated on the one hand to delicate, single-color woven silk fabrics in satin weaves which are subsequently printed and finished.

On the other hand, elastic and, to some extent even bi-elastic, colored Jacquard fabrics, for which the DORNIER rapier weaving machine is the optimum tool, are a speciality. A secure, spring-back-free grip on the weft end is guaranteed by its open-shed weft insertion and the secure interlac-



The modern weaving plant with DORNIER dobby and Jacquard weaving machines

ing of the weft end in the fabric selvedge before the right-hand rapier head opens. These highly elastic fabrics, particularly for further processing into swimwear and underwear, are woven with up to 50% contraction.

The fine, low-tear-strength silk and cashmere yarns are carefully inserted thanks

to the gentle weft tension cycle and the contact-free path of the rapier rod through the open shed. The finest products using high numbers of threads up to 210 ends/cm are produced on dobby and Jacquard weaving machines with a large number of shafts and hooks respectively. Yarns down to 13 to 15 denier (15 dtex) are standard, which can be inserted with high efficiency and excellent fabric quality.

Creation to customer requirements

The Perrin company places extreme value on innovation in addition to first-class product quality. A team of internal and external designers is constantly designing new collections in the women's outerwear and accessories fields and also in the underwear and swimwear sectors. The "Première Vision" in Paris is one of the most important exhibitions for Perrin & Fils for presenting those innovations directly to the customer. All in all, approximately 200 new creations are designed per year, following basic in-house market trend observations on one hand, and special customer requirements on the other. Based on its flexibility and creativity and against the background of the constantly growing popularity of French luxury goods all over the world, Perrin & Fils views the coming years with confidence.

A time journey through the new Dornier Museum in Friedrichshafen

BACK INTO THE FUTURE – DORNIER AND CARBON FIBRES

From the first large all-metal aluminium aircraft to the first serial built speedbrake made from carbon fibre reinforced plastics (CFRP) – 60 years after its replacement, Dornier, as the pioneer of metal aircraft construction, brings woven fabric back into the structure of a mass-produced aircraft.



The Dornier/Dassault "Alpha Jet" – the first European mass-produced aeroplane with carbon fibre-reinforced plastic components

© Austrian Armed Forces

The first flight – in 1973 – of the Dornier/Dassault "Alpha Jet", a light twin-jet combat and trainer aeroplane for the German air force and the French "Armée de l'Air", created a milestone for the material technology used in modern aircraft construction and for Lindauer DORNIER GmbH.

The design of the "Alpha Jet", developed under German/French collaboration, provides, for the first time, the use of textile-reinforced plastics (Carbon Fibre Reinforced Plastics) for components of the primary structure of a mass-produced (approx. 500 units) sonic-speed aircraft. The components involved in this instance are the so-called "speedbrakes" or air brakes, designed to decelerate the aircraft in a dive or on landing.

For our company, Lindauer DORNIER GmbH, then still part of the large Dornier

Group with headquarters in Friedrichshafen and Munich, this presented a thrilling technical challenge. The weaving of carbon fibres was virtually unknown in those days. Consequently, every textile and processing technology parameter had to be newly worked out from scratch in collaboration with the Brochier glass weaving company, our French partner, and the Ciba Composite Division (today HEXCEL Corp./HUNTSMAN Advanced Materials) as a producer of fibre and matrix material along with the prepreps (resinated woven mats).

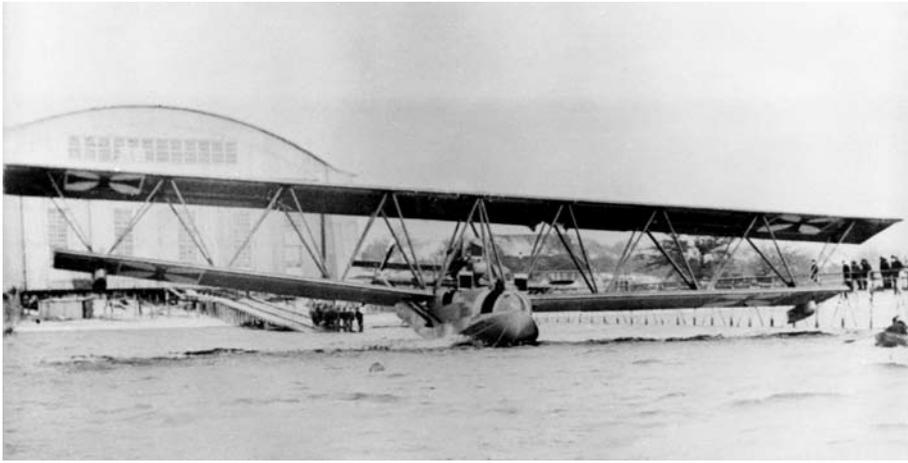
In the course of this project, the fact that Lindauer DORNIER GmbH had, at the beginning of the 1950s, restarted the first industrial activity of the Dornier Works in Lindau following the war, proved to be extremely useful. Just in 1970, with the production of the first "positively controlled rapier weaving machine", the Lindau

branch had introduced to the market the most flexible – and best suited for technical fabrics – weaving machine to date.

Very fragile carbon fibres could now therefore be transformed into high quality carbon fibre reinforcing woven fabrics in close cooperation with French weavers who had already successfully processed zero-twist glass filament yarns for the first time at high speed on the DORNIER rapier weaving machine.

A look back on 1915

In the initial years of the First World War an aircraft of gigantic proportions for those days comes into being at Friedrichshafen, on Lake Constance. Built in the then new material aluminium ("duralumin"), the Rs I designed by young constructor Claude Dornier is, with a 45 metre wingspan and a 10 tons take-off weight, the biggest and heaviest



The Rs I – the first large aeroplane made from aluminium

© EADS/Dornier GmbH

engine-powered aeroplane in the world, and the first to be entirely produced in metal.

From the textile fabric to aluminium

Count Ferdinand von Zeppelin, Dornier's employer, at that time is producing huge rigid airships for the German Navy in his hangar in Manzell. These huge colossi – over 200 m long – with hydrogen-filled envelopes still made of fabric, are equipped with load-bearing inner frames, already produced in "duralumin".

At that point Dornier already has five eventful years of work behind him in the service of the Count: This includes journeys to Paris in order to visit Gustave Eiffel and to study aerodynamics in the wind-tunnel there, along with riveting technology and its application to aluminium construction. Innumerable hours of calculation and testing follow to optimise the lightweight aluminium structures which ensure stability within the interior of the mighty Zeppelins. Intensive discussions take place with the Count and his colleagues in his design office as to whether the airship, with its expensive logistics and vulnerability, promises in any way to be a suitable and successful aircraft.

Zeppelin however is undogmatic and fair. He recognises young Dornier's potential and the one of "heavier-than-air" aircraft, which quickly proves to be an indispensable and reliable means of observation and reconnaissance not least for the artillery in the big battles of the World War.

When Dornier asks him if he might develop such an aircraft, which would be just as suitable as the Zeppelin for attacking London docks, he agrees. The "Do" department set up for that purpose in the Zeppelin Group devotes itself full-stretch to its new task.

Here, as a design principle, Dornier, from the start, refuses to use the classic wood, fabric and piano wire construction applied by reputed aircraft manufacturers Blériot, Fokker or de Havilland for the production of combat and reconnaissance aircraft coming into use in the war at that time. Wood, as a "natural composite fibre material" and coated woven cotton fabric, i.e. textiles, appears to him to be too "unpredictable", too "light" and not efficient enough for the job of carrying a 1,000 kg "payload" to London.

Instead, he goes all out for aluminium, whose discovery and large-scale production had only taken place in the previous 60 years, and at that time is a much more expensive and notably heavier material in comparison with wood, fabric and wire.

He also decides to build a seaplane – a so-called "flying boat" in preference to a land-based aircraft, and with a hull like a ship, with ribs and metal planking. But as aluminium can not yet be welded like steel, the individual components have to be riveted together.

The Rs I is completed and ready for its first flight in the late autumn of 1915, but a

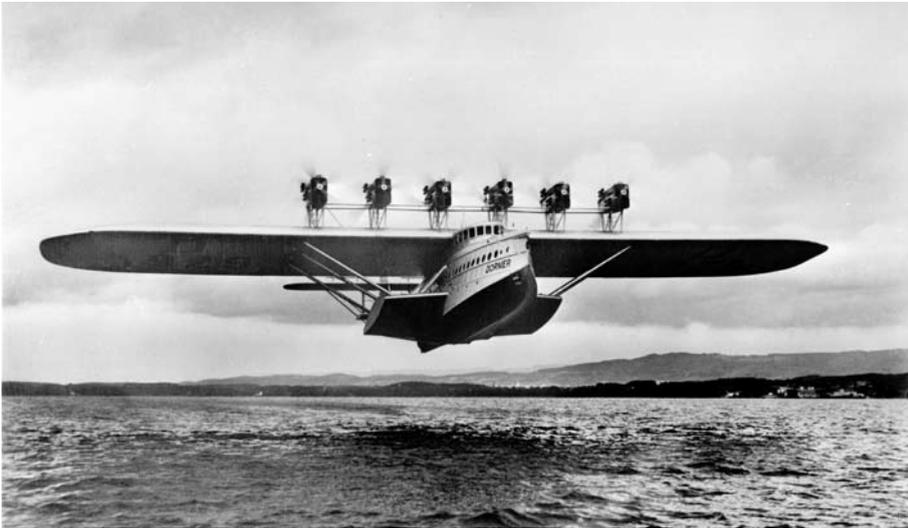
severe winter storm just before Christmas completely destroys the flying boat moored to a buoy on Lake Constance near Manzell. Dornier's dream of a large metal aircraft lies in ruins.

But he does not give up. He persuades Zeppelin to give him and his team another chance, and, within only a year, an equally large but somewhat more conventionally created giant aeroplane is already floating on Lake Constance – the Rs II. But this time it not only floats – it flies – and so the era of the large metal aeroplane – continuing to this day – begins in Germany in 1916 (the equally brilliant German designer Hugo Junkers had also been successful a few months earlier with his J1 project, a lightweight all-metal single-seater fighter). The giant Dornier Do X flying boat, with over a 50 tons take-off weight and 170 passengers at a record flight over Lake Constance in 1929, forms the transient high-spot of this development and finally silences the last doubters of this concept. America's subsequent world leading aircraft industry, with its reputed designers Douglas and Boeing, will only put its first large all-metal aeroplanes on the market in the 1930s.

The aluminium construction philosophy discovered by that time was constantly further developed and has proven to be the impressive and only possible way to manufacture heavyweight engine-powered aeroplanes right up to this day. Only in glider manufacture could metal construction – too heavy and too expensive for that purpose – never gain acceptance. Here, for decades, development followed the increasingly stylised wood and fabric construction, however the emergence of glass fibre-reinforced plastics very quickly replaced the older wood/fabric combinations in the



Woven carbon fabric – produced on a DORNIER rapier weaving machine



The Do X – public attraction during its global flight in 1929

© EADS/Dornier GmbH

1960s. From around 1975, carbon fibres, produced for the first time in the 1950s by the British textile group “Courtaulds” and the “Royal Aircraft Establishment”, became available in the relevant quality for civil applications, and were immediately tested and subsequently used in glider construction.

Carbon fibres in use for the first time

The carbon fibre era also began for the Dornier company at the start of the 1970s. Their entry into satellite construction led to a very close examination of this almost unknown and extremely expensive material at that time. Here, the material properties which suddenly became available opened a whole new era of functionality and suitability which were not achievable with metals (extremely lightweight construction with high-modulus fibres, thermal stability via tailoring fibre orientation etc). Carbon fibre compounds are well-established and indispensable in space flight today.

The hazardous business of designing and producing an important component out of this material for use in the primary structure of a mass-produced aeroplane, was then undertaken for the first time in the “Alpha Jet” project.

The technique of calculating, producing and testing such components had to be worked out, practically from scratch, by Dornier itself, similar to aluminium 60 years before.

Concerning the production of the necessary textile reinforcement of the plastic, reference was made to the vast experience gained by weaving customers of the Lindau branch works – Lindauer DORNIER GmbH (LiDO).

The pioneering “positive rapier weaving

machine” newly developed by LiDO at that time, also benefits directly from the carbon fibre know-how gathered by Dornier in Friedrichshafen.

In subsequent years, highly stressed components of that machine, such as rapier rods and laminated springs, which operate at frequencies up to 10 hertz, i.e. 10 times per second – for more than 100 million times one after the other – are developed from this material and very successfully employed. Among



Off-shore wind power unit with GFRP/CFRP material

other things, this also contributes in doubling system performance from 300 to today’s 600 picks per minute.

The high technical level of carbon fibre composite material processing know-how also led to the emergence of several start-up firms, founded by former Dornier employees in Friedrichshafen and its neighbourhoods, after the Dornier Group’s disintegration as a consequence of being taken over by Daimler-Benz. The world’s largest carbon fibre producer, Japanese company TORAY, has only recently acquired a minority shareholding in one of those – the ACE company. A particularly noteworthy event in view of the great importance of CFRP materials in the bodywork field for future electrically driven vehicles.

The most interesting potential of this new technology, in addition to the already standard use of carbon fibres in military equipment and their growing importance in civil aviation (Boeing 787, A380, A350) as well as in large wind power units is to be found both in this and the civil engineering field.

Just as the 19th century became known as the century of steel, and the 20th century represents the era of light metals and “first generation” plastics, our 21st century may well be decisively marked and remembered for these high-tech plastics “of the second generation”. Modern engineering science can make an important contribution to the urgent task of today and the future – the reduction of CO₂ emissions by way of intelligent lightweight construction using these carbon fibre composite materials.

The course of this unique development can be followed in the very appealing and well laid out **Dornier Museum**, opened in 2009, directly alongside the airport in Friedrichshafen. Those interested in the return of textile technology into modern material technology will find here – with well-informed guidance – diverse examples and inspiration for further thought and discussions.

For further information about the museum please go to: www.dorniermuseum.de

Finest wool from Johnstons of Elgin, Scotland

TRADITION MEETS TECHNOLOGY

Scottish weaving mills have enjoyed an excellent reputation for quality through many centuries. Johnstons of Elgin has continuously invested in the most modern DORNIER technology in order to meet the ever increasing demands of modern markets, and to continue to play in the top quality league.



Johnstons of Elgin can look back on 200 years of successful activity

Long history

The company was founded by young Alexander Johnston in 1797. Linen, flax, tobacco and oats were Johnstons' most important trade goods. The linen business was replaced by wool in 1801, and just a few years after – by 1810 – the company was already established as a market leader in the wool sector.

Today, Johnstons is the sole, vertical, operational textile company in Great Britain, carrying out by every production stage from the raw fibre through to the finished clothing, in both woven and knitted fabrics, in the highest quality wool. Production is carried out in the weaving mill in Elgin and also in the knitting mill in Hawick.

From the 1840s the so-called “Estate Tweeds” cause a great sensation, and Johnstons, seeing a good business opportunity, also entered the market. Patterns similar to Scottish tartans identify the proximity to families living particularly in the neighbourhood of the mill. It was the fashion for both the Lairds and their followers to wear garments with the same pattern, in a similar way to the clans which are still to-

day distinguished by their tartans, and are identified by the different patterns.

These were originally very heavy cloths produced from Scottish wool in order to withstand the wind and the weather in the Highlands. Around the turn of the century however the fabrics were becoming ever lighter in weight, finding increasing entry into general clothing. Many of the luxurious cashmere fabrics in the collection today can trace their origin back to this tradition. Johnstons also offers a special service for landowners and customers in addition to the approximately 30 designs produced: They can have their own designs woven from a delivery quantity of 2 x 60 metres.

Big names

Johnstons has been regarded as a pioneer in cashmere and vicuña wool in Scotland since as long ago as 1851. Fine Scottish woollen fabrics were becoming increasingly popular in the 1920s. Large reputed fashion houses like Coco Chanel and Jean Patou processed the finest cashmere into pullovers and costumes. The big clothing brands in Western Europe, the USA and Japan, with names

like Hermès, Chanel and Burberry along with Bogner and Brioni, are numbered among Johnstons' customers today. At the same time, the own brand “Johnstons”, which can be purchased in the company's own retail shops, on-line and from catalogue, is becoming ever more popular in this respect.

The management

Managing Director James B.H. Dracup has now been with the company for nine years, but has already worked in the textile industry for over 30 years. He is supported by Sinclair Patterson as manufacturing director, and Thomas Stewart as weaving manager. He feels at home in this company with its long history. “Johnstons is an outstanding employer. The family owned company, with 600 employees, is led in accordance with traditional principles but with a modern management style. The fact that Johnstons is a family company makes us independent of financial problems. The company is led by a professional management team, not by accountants”.

The well-trained personnel are especially important in today's hard-fought marketplace. Johnstons has a good mix of young and experienced employees. “We place great value on staff training. We see that as an important basic principle of a family company – one could also say under corporate responsibility”.

The weaving mill

The weaving machines are regularly replaced in order to keep production up to date. At the beginning of 2009, Johnstons again replaced some older machines by 20 new DORNIER rapier weaving machines. Today therefore, weaving is carried out on 20 new and 4 older DORNIER weaving machines of which 18 are equipped with dobby and 6 are Jacquard. Johnstons has been a loyal customer of DORNIER since 1973. And why DORNIER precisely? Sinclair Patterson: “Over the years we have bought numerous weaving machines from DORNIER – all rapier machines. For us these weaving machines are the

most versatile with regards to weft insertion, product change and they are well engineered. The good customer service is not to be underestimated. When there is a production problem we are attended to immediately, and the problem is solved as quickly as possible. DORNIER is simply exemplary here. A good relationship with suppliers is of outstanding importance to us in order to give our own customers satisfaction in return". Thomas Stewart makes particular mention of quick style change, which is the most important characteristic of a modern weaving machine. "The 20 new DORNIER rapier weaving machines give us even more flexibility both in terms of pattern lengths and in industrial production. We always have to be faster, as our customers are always requesting shorter delivery times. Thanks to this investment we are constantly improving our quality and efficiency.



Johnstons of Elgin excels in all production stages from the raw fibre to finished clothing

I can say that we are already 10 percent faster than before". "The return on investment", according to James Dracup, "will certainly become apparent in a very short time". Johnstons consumes approximately 500 tons of the finest wool per year. The weaving mill produces around 450 piece lengths of 65 to 70 metres every week, but production is not just for in-house making-up: Some 80,000 m of woven fabric is resold each year, plus 2.5 million garments as accessories, such as knitted scarves and gloves.

Creativity and trends

A fashion company stands and falls by the creativity of its collection. 20 people work in Johnstons' design department. In earlier times, according to James Dracup, Johnstons were a "Scottish firm with Scottish products". Today many famous labels are supplied. "Our objective is not the production of large quantities, we want to generate added value for customers and ourselves and, to that end, we must manufacture tailor-made products in order

to differentiate ourselves from the competition. The speed at which we can attend to demand trends is of outstanding importance".

Product origin, the right working conditions and the social environment are also becoming of ever greater importance for him. These factors have a say in the success of today. "Made in Scotland is very important for us. We must not leave production to others, it must remain here. We must overcome the difficulties and challenges here, and that will also be rewarded by our customers. With our organisation we are in a position to produce new products continuously. The situation is not an easy one, but we are very optimistic".

Markets

This Scottish company exports about 60% of its production, with 40% staying in Great Britain. "The largest export markets today are Japan, the USA and Western Europe, and the export proportion should rise further in the future. Huge expansion possibilities are certainly in view: South America and India in particular are in our sights as new sales markets."

The future

And how has market and customer behavior changed in the last five years? Design and innovation are the most important. In the past, business could be done with few products, and in all price ranges in fact from low to high. Today Johnstons operates exclusively in the high price segment, offers even more fashion products, and is becoming increasingly faster. Whereas a company like Johnstons still had a fixed product range with two main seasons in earlier times, there are a number of collections and lighter weight all-year-round products in the range today. In contrast to times gone by, many more 100% cashmere products are sold today. Extra-fine merino products are top sellers in the range. There is complete agreement at Johnstons that the markets will continue to change. Even in the wool industry there are new markets – and not only for the winter season.

The successful lighter weight products are living proof of that. Johnstons maintains sales offices in Tokyo, Düsseldorf, New York City, London, Elgin and Hawick. Successful too are the retail shops in Elgin, with the weaving shop and the new Courtyard Shop and Heritage Centre – a veritable furnishing house – and also the new

shop in St. Andrews, world famous with golfers. These shops alone generate around 4.5 million pounds in turnover.

New sales channels, like on-line ordering, will continue to increase. Despite that, the traditional retail business will not decline, and customer service is still to be improved further.

Royal riding breeches

Johnstons is regarded as market leader in this sector. This is also honoured time and again by politicians and the country. Johnstons received the "Queen's Award" in 1978. In 1982, Margaret Thatcher, the prime minister at the time, visited Elgin, and in 2008 HRH Prince Charles paid a visit, and opened the new Courtyard Shop and Heritage Centre. Prince Charles even had a cloth made expressly in the pattern of his favourite hunting breeches.

Last year Johnstons was awarded the "Scottish Textile Brand of the Year" award.

"Every year 50 to 60 percent of new products are introduced to the market, and that interval has to become ever faster" says James B.H. Dracup. "The period from the idea to the finished product is now four weeks. Only the best is good enough. Speed is everything, so we must maintain the tempo. The new DORNIER rapier weaving machines are supporting us in these efforts with their flexibility, and we will continue to hold on to our successful position in the market in this way".



The traditional Estate Tweeds are produced exclusively on DORNIER rapier weaving machines today

From CLS comes A1 and P1

FROM VISION TO REALITY

The highlight of ITMA 2007 in Munich is now in practical use. With the forward-looking, patented drive and control concept, over 300 DORNIER weaving machines with FT control have been in daily use in a variety of applications, since its introduction into the market during the 2009 customer days.



Modern weaving plant in Turkey with DORNIER A1 air-jet weaving machines for denim

Into the future with pioneering spirit

What distinguishes a pioneer? When something does not exist or does not seem to be possible, the pioneer has to invent it. This has been the case since the very beginning of the company DORNIER. Whether it is Claude Dornier and his concept of using an aluminium shell construction for aircraft production in 1918, or with Peter Dornier in textile machinery engineering, with the introduction of positive weft transfer on the rapier weaving machine in 1967 and CAN-Bus-based weaving machine control in 1989. The goal in all developments was – and still remains – to be able to offer maximum customer benefit with the best available technology.

Fast-Ethernet-Technology

With the introduction of the new Fast-Ethernet-Technology control into the series-produced machine in 2009, this pioneering electronics concept was used on weaving machines for the first time. FT technology originates in aircraft construction, and is currently the most modern data transfer communication structure available. It makes possible the reliable transfer of large quantities of data in real time. Consequently there is always something of “the flying dream” present in every DORNIER weaving machine. What is described in aeronautics as “fly by wire”, i.e. that functions are controlled via electric cables to servomotors or electromechanical actuators

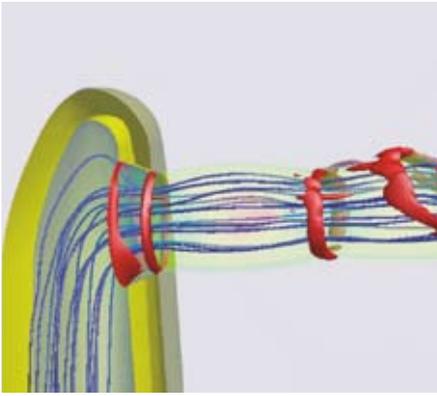
is in this case “weave by wire”. The machine monitors itself, thereby ensuring maximum process reliability.

DORNIER ErgoWeave®

Communication between man and machine is effected via an intuitively operable 15 inch touch screen panel. Vivid graphic function cycle displays facilitate operative handling. Whether for the comprehensive input of values for start-mark correction, or for setting the most important parameters for standard products: The values are completely reproducible and the setting is achieved with only a few operational steps. As on a domestic PC,



The intuitively operable DORNIER ErgoWeave® touch screen panel



The single-hole relay nozzle with bore conicity

pattern or product data is transferred via USB stick or, alternatively, by Ethernet Interface if the weaving machine is linked to a bidirectional operating data system. DORNIER ErgoWeave® offers the weaver various useful functions, such as the production of statistical evaluations over the entire weaving process or the recording and elimination of stoppage causes via a system diagnosis tool.

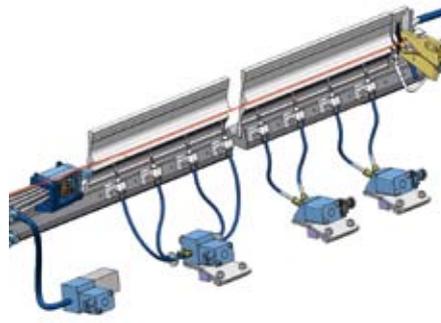
DORNIER system family

In the modular construction of the DORNIER system family, comprising air-jet and rapier weaving machines, the important elements of FT control also provide significant benefits. Approximately 95% of electronic and 65% of the mechanical sub-assembly components are of identical construction. This simplifies the maintenance and operation of the machine types in weaving mills which utilise both DORNIER rapier and air-jet weaving machines. Textile production obtains optimum flexibility and productivity for current market requirements in this way.

A1 air-jet weaving machine

The new control architecture also has an effect on the “hardware”, i.e. on the machine structure. This is clearly recognizable on the A1 air-jet weaving machine with the patented DORNIER ServoControl®-2, by the total redesign of the new, compact throttle block as well as the new tube layout for up to 8 main and tandem nozzles. Even with running speeds of more than 1,000 rpm, this layout prevents the compressed air tubes from getting into contact with each other which, if they do, can result in leakages and premature failure. In addition, this provides a clearer view and, in case of a filling break, a trouble-free access to the weft ends. The integrated pressure regulation plus semi-automatic filling threading also greatly improves operator handling.

Other important improvements are also to be found in the throttle block and the relay nozzles. The throttle block can be easily repositioned to the required fabric width with only one tool. If necessary, the width adjustment can also be made symmetrically. The flow-optimised DORNIER single hole relay nozzle is maintenance-free and uncomplicated. The special conical bore of the nozzle ensures that an air stream which impinges on the tip of the weft yarn



Reduced air consumption by way of 2 nozzles per valve

at supersonic speed does not destroy it, but carries it through the shed in the most efficient way. With these features machine downtimes are further reduced and fabric quality is improved.

Process reliability and new valve technology

The patented DORNIER PIC® system (Permanent Insertion Control) recognises imprecise operation in the case of every magnetic valve involved in weft insertion. Considerable reductions in air consumption are also achieved with the new valve technology due to their ultra short switching times.

Another optimisation provides the option of using only two relay nozzles per valve, reducing the dead volume in the air lines and therefore air consumption. These improvements are decisive success factors of the new technology in practice.

TandemPlus and the PWC clamp

An important enlargement of the weft yarn range of air-jet weaving machines is effected through the combination of the TandemPlus main nozzle and the PWC weft clamp which is positioned at the main nozzle outlet. Here, the weft end is held by means of a mechanical clamp instead of by air. For the first time, this enables core, elastane, fancy along with low-twist yarns, to be processed gently and efficiently for clothing and home textile applications on air-jet weaving machines.

P1 rapier weaving machine

The P1 combines intelligent solutions which, in their totality, ensure optimised resource usage, and allow extremely flexible machine operation. Diverse component groups and their functions have undergone decisive feature changes – beginning with the drive, through filling insertion to rapid and reliable product reproducibility with the possibility of retrieving statistic evaluations. Weaving personnel workload is reduced by shorter set-up times and increased maintenance-friendliness, with a resultant increase in productivity.

Filling insertion

Filling insertion component guidance is perfectly resolved in the case of the P1: The patented DORNIER AirGuide® guides the rapier with extreme precision through the shed, prevents capillary damage in the



The new P1 rapier weaving machine with CompactDrive and FT control

case of filament warps, and also makes it possible to weave high warp densities problem-free.

The Electronic Color Selector ECS and the electronic yarn brake with integrated filling stop motion EFC are based on modern stepping motor technology. In micro-step operation, yarn presentation in the color selector is effected with an automatic monitoring and correcting function of the yarn needle stroke. Low tear strength yarns and highly tensioned heavyweight weft yarns, such as 2,400 tex glass for example, can be processed without any problems. Different yarn needle motion profiles can be conveniently selected on the DORNIER ErgoWeave® panel. Due to the modular construction system of the presentation unit, individual modules can be added quickly and easily. A single-color machine can therefore be converted up to 16 colors at little cost.

The new drive concept

A new drive concept with three options has been developed for the A1 and P1 system families:

DirectDrive – a reliable and low-maintenance drive with no clutch-brake unit. It is optimally suited to the production of standard weaves with cam shedding motion.

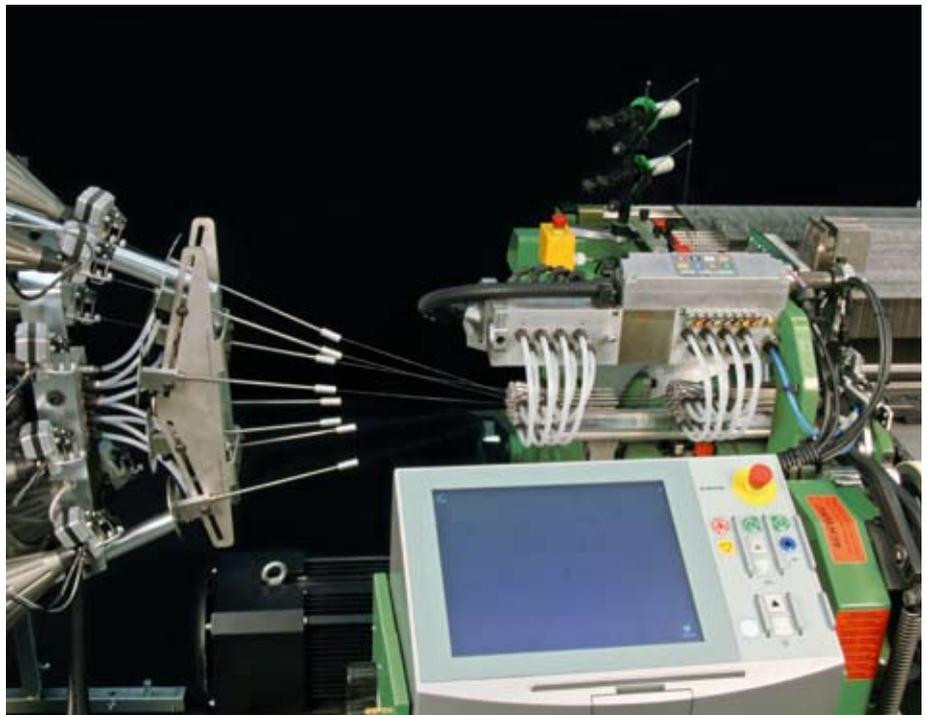
CompactDrive – a powerful motor with maximum rotational stability even with a large number of shafts or with a high hook count in Jacquard machines. The flywheel for the reliable weaving of heavier styles is integrated in the drive motor. The air-cooled motor's clutch-brake unit is easily accessible, and therefore maintenance-friendly.

DORNIER SyncroDrive® – the innovative, patented direct drive, where shedding is controlled by a separate motor.

All drive variants have integrated speed control, and are designed for high economy and precision. They are also belt-free and require very little maintenance. Depending on the application required, whether it is colorful patterned Jacquard fabrics, high-density heavyweight conveyor belt fabrics, simple plain or twill weaves at high speed, always the optimal drive can be used.

DORNIER SyncroDrive®

This intelligent drive enables very low speed variation, facilitating a so far unachievable speed potential for dobby and Jacquard weaving mills. Shed closing times are also adjustable via the DORNIER ErgoWeave® even at full speed, giving rise to new pat-



Throttle block and DORNIER ServoControl® unit of the air-jet weaving machine are disposed so as to be easily accessible and taken in at a glance

terning possibilities with improved fabric quality. Markedly smoother machine running, and consequently a smaller load on the shaft/heddle system, produces a very good fabric quality and results in a longer working life of mechanical components.

Energy efficiency and sustainability

All of Lindauer DORNIER GmbH's developments are considered from the important viewpoint of energy efficiency and sustainability. In the case of energy efficiency, it comes down to the sum of the individual components, so that, at the bottom line, a user will see appreciable savings. This is the overall aim of the FT control concept, which consists not only of the drive motor but also of the weft insertion control with the DORNIER ServoControl®-2 in combination with the PWC clamp in order to save on holding air. Experience to date

has shown that a reduction in compressed air requirement of 10 to 20% is achievable. The complete "weaving mill" system, including compressed air supply from the compressors, should be considered here. A lower compressed air requirement in volumetric and pressure terms means a smaller energy requirement and therefore reduced environmental CO₂ pollution. This is a contribution to sustainability which will, in time, be followed by others. It also includes fully responsible handling of the yarn material to be processed. For example selvedge waste can be reduced by over 50% with the new DuoColor unit for rapier weaving machines. Such solutions also make it clear that the pioneering spirit is still alive in the company DORNIER and will ensure a continuation of the successful cooperation with our customers.



The new A1 air-jet weaving machine with DORNIER SyncroDrive® and FT control

Quality creates value

DORNIER



Publisher and Copyright:

Lindauer DORNIER GmbH
88129 Lindau/Germany
Telephone +49 8382 7030
Telefax +49 8382 703386
sales.wm@lindauerdornier.com

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