

# JETLINER CABINS: EVOLUTION & INNOVATION

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E-BOOK APP

CHAPTER 15

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## GREEN ADVANCES: SUPERIOR INTERIORS

THE 'GREEN' SCENE ■ BRIGHT 'GREEN' IDEAS ■ ECO-DECO IN THE AIR ■  
'GREEN' CABIN COMPLETIONS ■ 'GREEN' HORIZONS

CLIMATE ACTION, FLIGHT SHAMING, TRAINS-OVER-PLANES LAWS, AND SUSTAINABILITY. WHILE ACTIVISTS AND POLITICIANS FOCUS ON CO<sub>2</sub> EMISSIONS, THEY MAY BE MISSING THE BIGGER PICTURE.

FOR DECADES THE AVIATION SECTOR HAS BEEN WORKING SYSTEMATICALLY TO REDUCE ITS IMPACT ON THE PLANET. THE LONG-RUNNING DEVELOPMENT OF SUSTAINABLE FUELS AND CORSIA (THE CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION), ADOPTED BY THE INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO), A UNITED NATIONS SPECIALIZED AGENCY, ARE AMONG THE MAIN PILLARS FOR GREENER SKIES.

TO REDUCE JET-FUEL BURN AND THE CONSEQUENT CARBON EMISSIONS, AIRCRAFT INTERIORS DESIGNERS AND AIRLINE BRAND MANAGERS HAVE EMPLOYED MULTIPLE STRATEGIES TO CONTROL AND REMOVE ONBOARD WEIGHT AND WASTE. THIS CHAPTER OF *JETLINER CABINS: Evolution & Innovation* EXAMINES TECHNICAL TRIUMPHS AND EXCEPTIONAL ACHIEVEMENTS ACROSS THE PRODUCT SPECTRUM: AIR TRAVELLERS CAN REST ASSURED THAT THEIR CARBON FOOTPRINTS ARE IN VERY GOOD HANDS.

Approximately 10,000 words; 100 illustrations; 80 website links.



## THE 'GREEN' SCENE

With news reports full of dramatic descriptions of future aero engines powered by hydrogen or solar cells, blended bio-fuels or blooming algae, airline passengers might well be wondering whether there are similarly inspiring plans for the 'greening' of aircraft cabins.

Analysts estimate that the purchase of jet fuel can amount to around 35 per cent of an airline's annual expenditure. Climate-change warnings have sparked a call to action to reduce carbon emissions in all business sectors. During summer 2008, when oil prices spiked towards the unprecedented level of US\$140 per barrel and the concurrent global economic downturn crippled the industry, airlines worldwide scrambled to establish new ways of reining in their jet-fuel costs.

At the major airlines, 'eco-czars', environmental experts, waste-control directors, emissions specialists, fuel gurus and 'green teams' were given direct management authorization to develop strategies to reduce weight on aircraft, improve fuel burn and cut carbon-dioxide (CO<sub>2</sub>) levels. Topics such as ecology and sustainability, carbon-emissions-trading compliance, renewability, ease of maintenance and reducing landfill now appear regularly on airline planning agendas – along with the short-term urgent need to focus on individual weight-saving initiatives to provide immediate jet-fuel savings (some early initiatives are described in the Being Thrifty section of Chapter 13/Upgrades: Refurbishing Aloft).

In 2009, the industry agreed key targets to ensure that aviation plays its part to meet its environmental obligations: 1.5 per cent annual fuel efficiency improvement to 2020; capping net emissions through carbon-neutral growth from 2020; and a 50 per cent cut in net emissions by 2050, compared to 2005.

Statistics issued by the United Nations (UN) show that the agriculture, industry and transport sectors each produce approximately 14 per cent of human-induced global carbon emissions. Within the transport category, airlines account for around 2 per cent of global carbon emissions (reportedly, about the same level as for the Internet and less than half the amount produced by cruise ships).

Figures published by the International Air Transport Association (IATA) show that aviation has a stellar track record for improving its environmental performance: over the past 40 years, aircraft have become 70 per cent more fuel efficient. Describing the newer aircraft (shown in the New Generation section of Chapter 16/Ways Ahead), IATA notes that the Airbus A380 and the Boeing B787 Dreamliner make use of lightweight aluminium and carbon-fibre-reinforced plastics (CFRP). These aircraft are advertised as consuming, on average, less than 3 litres per 100 passenger kilometres (or 62 passenger miles per US gallon), a fuel usage on a par with small-size automobiles – although aircraft travel far longer distances and much faster.

In 2020, at its 76th Annual General meeting, IATA called on governments to support Sustainable Aviation Fuel (SAF) development programs. Airlines see SAF as a 'preferred solution' for long-term sustainability. Over its lifecycle, SAF reduces airline CO<sub>2</sub> emissions by up to 80%. SAF has already powered more than 300,000 flights. SAF requires no engine modifications and can be blended with jet kerosene as supplies increase. Even better, SAF itself is sustainable as it is largely produced from waste materials, including pre-used cooking oil and non-food crops, and may include other sources like municipal waste and off-gasses.

And IATA's carbon exchange (ACE) bundles several different, calculated carbon offsets to help airlines buy carbon credits for 'green' projects such as forestry, habitat preservation and renewable energy – all certified by third-party regulators as being CORSIA-compliant under ICAO regulations.

Aircraft interiors, too, are going through a period of 'green' evolution, and airlines in all parts of the world have announced the implementation of ingenious 'green' cabin initiatives. While the challenges might seem less exciting technically than the ones confronted in an airframe-production hangar or an engine test house, this Chapter will show that 'green' advances in jetliner cabins are of vital importance to the future of the industry.

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International Air Transport Association (IATA)



International Civil Aviation Organization (ICAO)



United Nations

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## BRIGHT ‘GREEN’ IDEAS

Airline passengers are accustomed to seeing in-flight-magazine articles lauding the use of recycled paper, natural fabrics, biodegradable plastics, organic replenishable resources and vegetable-based inks for items such as menu cards, cocktail napkins, beverage cups, motion-sickness bags and amenity kits (Note: The Picture Gallery attached to [Chapter 6/Dining à la Jet Set](#) displays a large collection of menu cards, and the Picture Gallery attached to [Chapter 7/Real-Feel Customer Touchpoints](#) displays amenity kits dating back to the 1970s.) There has also been the development of personal carbon-emissions offset programmes. This concept was originally pioneered by British Airways as part of its sustainability philosophy, and a great number of airlines are now running similar CO<sub>2</sub> offset campaigns. During their flights, passengers are offered the facility to calculate the quantity of their own personal CO<sub>2</sub> emissions, and to make voluntary financial contributions to selected environmental compensation ventures such as wind farms, energy-saving machinery, forestation renewal and nature conservation.

Over the years, airlines have implemented a range of hands-on ‘green’ upgrades. Here are some pioneering published announcements:

- developing and installing a new economy-class seat that is 40 per cent lighter than its conventional seat (Air France). On the short-haul domestic routes served by Airbus A319, A320 and A321 aircraft, this advance represents a reduction of 11,464,037.60 pounds (or 5,200 metric tonnes) of CO<sub>2</sub> per year;
- eliminating paper ticket jackets (Alaska Airlines and Horizon Air). The saving of approximately 10 million ticket jackets is the equivalent of approximately 850 pulp trees per year;
- operating cashless cabins (American Airlines). For onboard purchases (food, alcoholic beverages and headsets for in-flight entertainment), passengers use credit and debit cards – eliminating the need to search for small bills and change. Flight attendants use state-of-the-art handheld devices to rapidly swipe the cards;
- collecting passenger ticket stubs (ANA). Used stubs from airports in Japan are recycled to make toilet paper;
- sorting buttons (British Airways). When cabin-attendant uniforms are outworn, outgrown, outmoded or otherwise unwanted, the airline-identity buttons are carefully snipped off and sorted for reuse in the future. The discarded clothing is compacted and shredded, and then used to fill items such as sofas, mattresses and sleeping bags – for which the airline receives nominal payments based on market value;
- recycling in-flight soft-drink cans (Delta Air Lines). Every month, from the onboard food-and-beverage service, a million cans (an amazing figure, but this is one of the world’s largest airlines) are sent for recycling and future reuse instead of, as in the past, being consigned to landfills;
- using plastic bottles (Japan Airlines). Flight attendants now serve wine from lightweight plastic bottles that are approximately one-seventh the weight of classic glass bottles. The airline has also reduced the weight of its onboard cutlery and porcelain crockery;
- substituting meal-service trays (KLM). Inside its meal-service and galley trolleys, the airline now uses lighter-weight plastic trays instead of metal ones that are heavier;
- phasing out paper tickets (LanChile). Ninety-five per cent of the airline’s customers use electronic tickets;
- introducing a new era in economy-class seating (Qantas). On the Airbus A380, in conjunction with Recaro, the airline installed the first aircraft seat to feature lightweight carbon-fibre-reinforced components within its outer surfaces;
- changing onboard oxygen containers (Thomas Cook Airlines). The new composite-material oxygen cylinders weigh approximately half that of the old steel assemblies;
- offering newly designed snack boxes printed on 100-per-cent recycled fibre (United Airlines). The boxes contain a range of organic edibles designed to boost energy, such as mixed-berry yogurts, fruit smoothies, fresh salads, juices and vitamin water; and



- reducing jet-fuel burn while aircraft are parked at passenger-boarding gates (US Airways). By operating ground power units (GPUs) instead of using the aircraft's auxiliary power unit (APU), the airline can save 50 to 60 gallons (or 189-227 litres) of jet fuel per aircraft per hour.

These 'green' innovations, and other similar approaches described later in this Chapter, will, cumulatively, help to curtail the overall level of aviation emissions in the coming years, and there is a good chance that favourably impressed airline passengers could, in turn, become 'eco-messengers' in their home communities. After all, according to an old Scottish proverb, 'Mony a mickle maks a muckle' (Many micro-things make a macro-thing).

## 'GREEN' TEAMS FLY INTO ACTION

The key to the future health of airline fleet renewal lies in being able to develop, certify and implement a continuing cycle of full-scale 'green' cabin-upgrade programmes that will guarantee jet-fuel savings, reduced operating costs and fewer carbon emissions in the long term. At Continental Airlines, the subject was studied in great detail.

'It is essential to focus on aircraft-interior weight-saving programmes that are commodity based because the potential long-term payoff for the airline can be enormous,' said Vern Alg, who, for 20 years, led the interior engineering team at Continental and participated as a member of the customer group advising on the development of cabin treatments for the Boeing B787 Dreamliner. But how does an airline get started on a 'green' cabin-upgrade programme?

Vern Alg explained: 'At Continental we sat down in a group. We said, "Let's examine the high-quantity and like commodities: How can we better specify materials? And how can we better dispose of materials?" One of our main target areas was the aircraft seat. Using our "green" criteria, we worked on the seat structure – the frame, cushions and covers – to achieve performance improvements. Similarly, we developed our aircraft carpet. We wanted to make it more lightweight, recyclable and longer lasting. We knew that if we could reduce weight by a fraction in each commodity unit, the total could add up to a major saving for Continental in fuel-cost dollars.'

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Diehl Aerospace

Above: Spot and reading lights.  
Below: Sidewall and ceiling lights.

Asked about other major areas of study, Vern Alg described a less-visible programme: 'We examined the amount of water placed in our aircraft tanks. Were we buying fuel to carry more water than we actually needed? Traditionally, airlines have used the "fill to overflow" approach, but is this really the best measurement for onboard water provisioning? As with our precise catering counts for uplift of food and beverage, shouldn't we try to carry just the right amount of water for the number of passengers on board a particular flight? At Continental, the far-reaching Eco-Skies Policy covered a great number of "green" programmes, including the recycling of in-flight plastic, paper and cans; electronic ticketing; reducing fuel burn while aircraft are waiting at the passenger departure gate; and the use of plastic instead of heavier materials such as glass and metal for onboard catering.'

## ECO-DECO IN THE AIR

Across the industry, there has been a surge in new 'green' products for aircraft interiors, both for line-fit during the production process and for subsequent retrofit programmes. Airline passengers are now seeing an accrual of 'green' benefits. Here are some key examples:

### CABIN LIGHTING

#### Light-Emitting Diodes (LED)

One of the most important 'green' developments in cabin design has been the increased use of LED technology inside the aircraft: this provides reduced weight and power consumption, greatly improved performance, and approximately five to 10 times the life-cycle of the old-style white-light incandescent or fluorescent lighting systems. Experts advise that the best time to install LED systems is during the construction of the aircraft, and both the Airbus A380 and Boeing B787 Dreamliner make extensive use of the new technology for general illumination throughout the cabin and to display an evocative range of dynamic and nuanced lighting effects. LED systems, such as the ones developed by Diehl Aerospace, can be used for individual passenger reading lights, for interior 'wash' lighting and to create special effects. Customer-survey reports indicate that LED mood-lighting programmes can help passengers feel more relaxed during the flight and more refreshed on arrival at their destination – and this can help them overcome a sense of jet lag. (The implementation of Broadway-inspired, theatrical cabin illumination was pioneered by Virgin Atlantic; details are provided in [Chapter 5/Sky Lights](#), in the sections entitled Mood Swing and Mood-Lighting Programmes. More examples are displayed in the [Cabin Lighting Picture Gallery](#) attached to [Chapter 5/Sky Lights](#).)



Diehl Aerospace



Diehl Aerospace



## CABIN FLOORS

### Carpet

Airlines buy miles of carpet each year and, traditionally, the throw-away rate is extremely high because of the soiling that is typical near doorways, galleys and lavatories. New stain-proofed nylon carpets, as marketed by Mohawk Aviation Carpet, can last approximately six times longer than wool aircraft carpet, resulting in fewer new resources being utilized and less carpet consigned to landfills (FAA safety-certification standards relating to aviation-grade carpets are described in [Chapter 11/Magic Carpet](#)).

Mohawk emphasizes that the proper placement of the carpet's direction during installation, that is, the warp-weft and forward-aft layout, can greatly help reduce wear-and-tear replacements, thereby providing cost savings for the airlines. The company has developed 'green' cleaning processes for aircraft carpet that are non-moisture-based and capable of being implemented on board the aircraft. The dry extraction of dirt and debris can extend the carpet life-cycle and eliminate the need for gallons of cleaning solution, thereby reducing the risk of corrosion.

For years, Mohawk has converted recycled water bottles into carpet fibre, and its recycling programmes route reconstituted aviation carpet to domestic and commercial applications.



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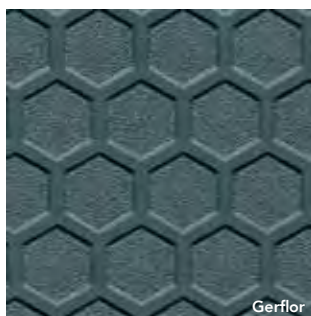
#### Modular Floor Covering

Environmentally friendly carpet tiles have been installed on Southwest Airlines Boeing B737 aircraft (as shown opposite). This new treatment for cabin floors was developed by Boeing and the industrial design company TEAGUE, in conjunction with the carpet manufacturer Interface. The individual square tiles, available in wool and nylon, are easy to install and replace. The product portfolio offers cut- and loop-pile options, with an enormous range of detailed surface patterns, a variety of textures and a kaleidoscopic palette of colours.

#### Non-Textile Floor Coverings

Installed in doorways, lavatories, galleys and other working areas where personal safety is of paramount importance, non-textile floor coverings (NTF) are specially treated to provide a non-slippery, anti-skid surface (as shown in [Chapter 9/Look Smart: Keep Clean](#)).

Batiflex, a product developed by Gerflor Transport Flooring, is advertised as the lightest weight in its category. 'This enables airlines to lower their fuel consumption and reduce transport pollution emitted by the aircraft,' says Juliette de la Feronniere, the company's Aviation Market Manager. 'Our PVC (polyvinyl chloride)-based products are recyclable, whereas silicone-based products are not recyclable. Some of our NTF floor coverings have been designed to create the look of carpet-type floor coverings: these can be used as a substitute for traditional wool or nylon carpeting, providing considerably increased durability – and thus significantly reducing throw-away rates. We manufacture only environmentally sustainable products and we assess the life-cycles of all our aircraft floor coverings – to reduce the ecological impact. We strive for very low water and energy consumption during the manufacturing stages; 95 per cent of our post-manufacturing wastes are recycled, and we utilize packaging made out of recycled material.' When the Gerflor PVC products are recycled, they are routed to subsequent domestic applications.





**This page:** Individual square tiles, available in wool and nylon, are easy to install and replace.

#### CABIN WINDOWS

The basic design of pull-down/push-up window shades has remained unchanged for decades (Readers will find several pictures in the earlier Chapters of this book), but the traditional sliding panel with its projecting handle can be susceptible to fingerprints, soiling and damage. It is frequently necessary to install replacement panels at short notice and this work can be costly and time-consuming.

Innovative technologies are now being developed and implemented. For example, on the Boeing B787 Dreamliner, the windows are operated using a new, weight-saving electrochromic process (as described in [Chapter 16/Ways Ahead](#)).

#### Power-Electric Window Shades

By contrast, electronically operated 'power shades', as developed by Aerospace Technologies Group, provide a completely different approach: in each window there are two ultra-thin shades fitted into a slim cassette that is mounted on a removable frame. The inner shade is made of a pleated translucent fabric that blocks about a third of exterior light. The outer shade blocks out all light. Change-out of the frame container takes only a few seconds – a pop-out/pop-in arrangement.

Electric-powered window shades can now be operated at the touch of a button by individual passengers or controlled centrally by flight attendants, depending on operational requirements.



Aerospace Technologies Group

**This page:** Electronically operated 'power shades', as developed by Aerospace Technologies Group, feature two ultra-thin shades fitted into a slim cassette that is mounted on a removable frame.



Aerospace Technologies Group



Aerospace Technologies Group



### 'Smart' Windows

As developed by Research Frontiers Inc., SPD (suspended particle device) high-tech window shades use a thin film that can be adjusted from fully clear to blocking more than 99.5 per cent of incoming light, and to any level of tint in between (this kind of transition was an 'if only' product prediction mentioned at the end of [Chapter 5/Sky Lights](#) when the first edition of *Jetliner Cabins* was published in 2003). As provided for corporate jets, super-yachts and luxury automobiles, with a simple dial, switch or photo sensor, passengers can instantly and precisely control the amount of light, glare and heat coming into the aircraft cabin.

'This is a patented film technology: the light-absorbing, microscopic particles align and randomize to act as a "light valve",' says Joseph Harary, the President and CEO at Research Frontiers Inc. 'This is not an electromechanical shade, and there are no moving parts. SPD-Smart windows can also block out 99.9 per cent of harmful UV radiation and this will help to prevent damage to textiles and furniture in the aircraft cabin. Protecting these items reduces the need to replace them, and this helps preserve valuable resources.'

Managing the light and heat entering an aircraft, both in the air and on the ground, has historically been a challenge. 'The SPD-Smart system is made with weight-saving polycarbonate,' explains Joseph Harary. 'It helps optimize cabin-light levels and cooling requirements by adjusting light in response to environmental conditions, passenger preference and operator requirements. Cabin heat buildup is minimized when aircraft are on the ground because the windows revert to their darkest state without using any power. Thus, less jet fuel is consumed when in flight, and less cooling energy is consumed when the aircraft is on the ground. These advanced light-control techniques will help airlines to improve operating efficiency, protect scarce resources and enhance the flying experience for airline passengers.'



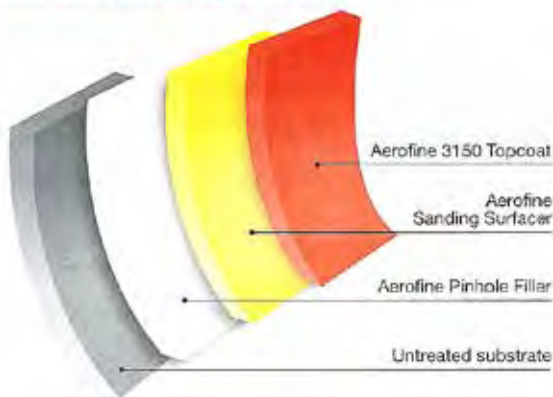
## CABIN SURFACES

### Clever Coatings

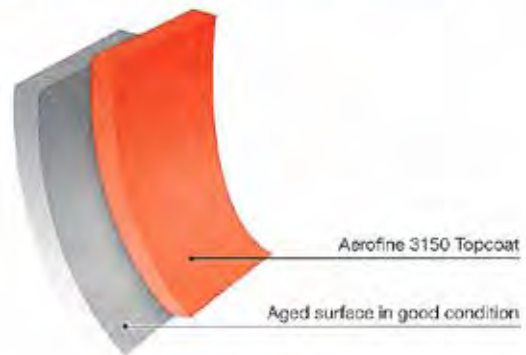
Home decorators always hope that house paint will dry quickly with minimum bad odour and then provide long-term hardness and easy-wipe cleanability. In aviation, the overall aims are similar to those in the domestic arena. But aviation paint technology is far more complicated because of stringent regulations that cover all stages of the process: for example, after hours of being parked in a chilly, dry (or hot, sticky) area, an aircraft could take off and climb to an altitude where the temperature could be -50 degrees Fahrenheit (-45.6 degrees Celsius) and then return to an airport amid belting rainstorms with temperatures in the relatively 'normal' range.

As developed by AkzoNobel (whose mission statement is: 'Tomorrow's Answers Today'), based in Amsterdam, the Netherlands, and one of the leaders on the Dow Jones Sustainability Indexes, the Aerofine waterborne paint system meets industry regulations and reduces unpleasant odours. Consisting of acrylic and polyurethane resins, and resistant against dents, scratches and stains, these cabin coatings can provide multicoloured and textured effects: matte, semi-gloss, shiny gloss, wet-look, clear-look and other combinations. Cleaning and surface repairs can be handled on board the aircraft within a short timeframe; and individual colours can be sprayed through stencil shapes to create random or repeat patterns.

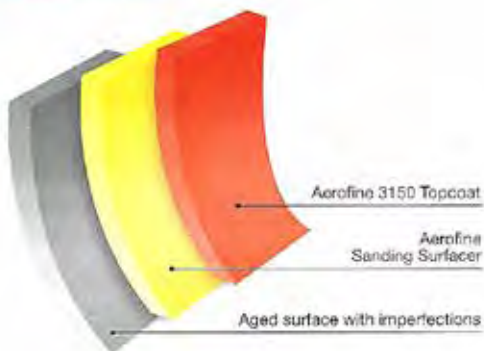
#### Paint system for untreated surfaces with imperfections:



#### Paint system for operator customization:



#### Paint system for aged surfaces with imperfections:



#### Features of the Aerofine range

- Low solvent, waterborne coating system
- Meets stringent FST regulations FAR 25.853, JAR 25.853 (OSU 65/65)
- Supports your sustainability commitment
- Quick drying with low odor
- Excellent hardness
- Easy to clean
- Mix2Win instant color availability

AkzoNobel



**Left:** An airbag is contained within the belt, alongside the buckle.



## PASSENGER SEATS

### Seat Belts

Every seat position has to have one to comply with safety regulations, and the design was unchanged for decades! AmSafe, a globally renowned provider of aviation-safety restraint products, has developed a streamlined version of its traditional seat belt. Suitable for retrofit programs using existing attachment points, the new option is 25 per cent lighter in weight and features an ergonomic clam-shell buckle design.

For those aircraft seats that require airbags to meet safety certification requirements, AmSafe offers an inflatable bag stored in the 'lap' portion of the seat belt (as shown above). Compared with the company's predecessor design, the new option provides a 30 per cent saving in weight and a 40 per cent increase in service life. This product features built-in onboard wireless diagnostics that can be used either manually or through integrated wireless systems.

### Seat Covers (*Factory-made Composition Leather*)

Leather connotes the ultimate cachet of sophistication and luxury (as described in [Chapter 12/The Leather Forecast](#), and in the Air Flair section of the [Concorde Unique Case Study](#) attached to [Chapter 4/Aero Identity](#)).

In the apparel industry, composition leather has been used extensively over many years for small accessory items such as shoes, gloves, purses, bags, briefcases and document portfolios, and for high-fashion garments such as jackets, waistcoats, skirts, trousers, hats and coats.

In recent years, aviation-grade machinery-made products, such as E-Leather, have been developed, certified for use and implemented by a number of leading airlines. The 'E' stands for 'Engineered', but it could also stand for 'Eco-friendly' or 'Environmental'.





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When natural leather hides are used to make aircraft seat covers, there is a wastage rate of approximately 40 per cent – the result of unevenness and variability from unpredictable blemishes, bald patches and the unusable sections at the hides' extreme outer edges.

At a launch event during a major US aviation conference in 2010, the company presenter explained that E-Leather offers all the advantages associated with traditional leather hides. Constructed using recycled leather fibre from tannery waste and a textile core, E-Leather aircraft seat covers weigh about half as much as those made from natural hides; this weight saving greatly reduces airline fuel burn and, consequently, represents major potential operating-cost savings.

When E-leather is used to make an aircraft seat cover – typically requiring approximately 3 square yards/metres of material – the wastage rate is only about 5 to 10 per cent, and this represents a significant saving on landfill. E-Leather is available in all colours, it is scuff-proof and can be wiped clean on the aircraft – eliminating the need for a chemical-based off-the-aircraft cleaning cycle and associated re-treatments. Colour consistency, thickness, tear strength, graining patterns and fire resistance are all 'engineered-in', to comply with mandated safety standards and customer requirements. The company emphasizes that seat covers made with this composite product will not sag or bag; hence, the new-installation appearance can be maintained without difficulty.

The E-Leather manufacturing process uses water power, 95 per cent of which is subsequently recycled, with zero emissions into the air. This product is now used for seat covers by several dozen airlines, short-haul and long-haul.





### Non-Woven Synthetics

Non-woven, microfibre composition fabrics have become very popular – not just for residential upholstery applications and airport lounges, but also for seat covers and headrest panels in aircraft cabins (FAA safety-certification requirements relating to the replacement of coverings are discussed in the section titled Flammability and Structural Certification in [Chapter 13/Upgrades: Refurbishing Aloft](#)).

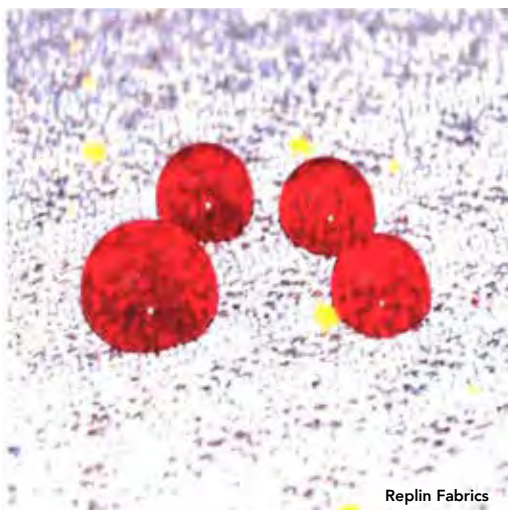
Manufactured in a dazzling array of colours, these stain-resistant, machine-washable, spot-cleanable fabrics are sufficiently pliable to be used to cover ‘difficult’ surfaces inside the aircraft. Examples include curved seat surrounds, indented shell and pod constructions, and contoured dado and sidewall panels.

Artificial suede, like that produced by Tapis Corporation (an organization that has served the commercial and VIP aviation sectors for more than 35 years), can be embossed, debossed, embroidered, laser-etched, ‘pearlized’ or otherwise customized to meet individual client requirements – it is advertised as being made of 100-per-cent high-purity recycled polyester, which reduces its carbon footprint. (A description of a pioneering wear-test analysis conducted by Tapis Corporation is provided in the New Textile Technology section of [Chapter 10/Durability](#).)

And the company’s latest artificial leather, infused with silver ion anti-microbial technology, is also classed as environmentally friendly because it does not contain plasticizers, heavy metals or stabilizers and it is 100-per-cent free of volatile organic compounds (VOCs) and formaldehyde.



Tapis Corporation



Replin Fabrics



Replin Fabrics

**Top:** With Replin Fabrics Protection system.  
**Above:** Without Replin Fabrics Protection system.

## HIGH-TECH TEXTILES

Regularly assaulted by fingerprints and footprints, greasy marks, scuffs, streaks and soiling, aircraft wall coverings suffer incessantly; traditionally, these areas were very difficult to handle on short gate-turnarounds. However, new-style textiles, for example, as developed by Replin, and currently flying on several leading airlines, have built-in stain protection. Although they resemble traditional textured fabrics, these new lightweight wall coverings can adhere easily to flat and curved surfaces, and they provide significant levels of acoustic insulation. Best of all, they can be quickly wiped clean.

Replin counts over 60 years' experience as a supplier to the airline industry. When coffee and orange juice are tipped over Replin fabrics, instead of spreading to form unsightly marks, the liquids roll into bead shapes – which can be removed by blotting with a tissue, cloth or sponge (as shown left).

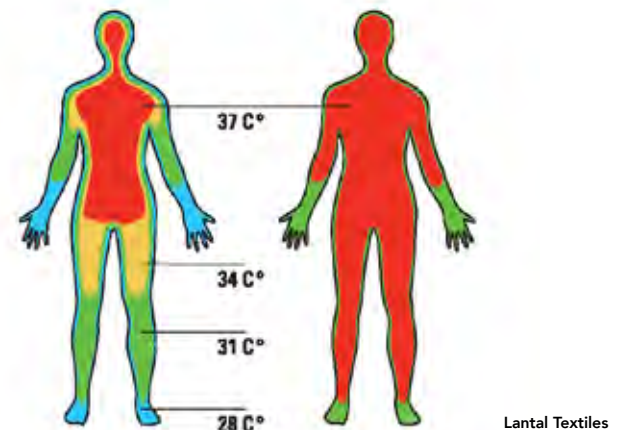
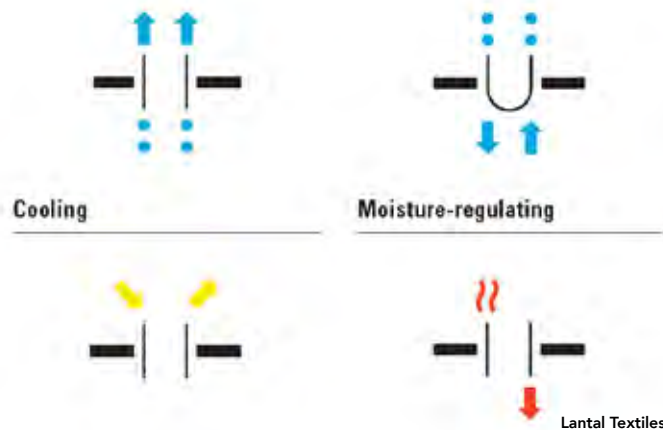
Many airlines clean their seat covers once a month, and this could cost up to approximately US\$40 to US\$50 per seat per year, depending on frequency cycles. Replin advertises that its stain-protected fabrics can reduce the requirement for cleaning by approximately 80 per cent, and this represents major savings for airlines. Additional benefits include reduced down time for aircraft and increased life of the seat covers. The Replin stain-protection process is colourless, odourless and invisible on the surface of the fabric; it is also compatible with dry-cleaning.

## Health-Conscious Fabrics

As a result of recent innovative developments, woven and blended seat-cover fabrics are becoming lighter-weight, more robust, more breathable, warmer to the touch and capable of 'wicking' away moisture, that is, staying drier longer. For example, Climatex aircraft seat-cover fabric, as supplied by famed transportation specialist Lantal Textiles, consists of renewable resources such as virgin wool and beech-wood cellulose, and the production process is environmentally safe. Climatex provides temperature-stabilized passenger comfort: changes in body temperature are continuously balanced; moisture and perspiration are absorbed, buffered and released. This fully biodegradable fabric is flying on a number of major international airlines including Air France, Air Mauritius, El Al, Emirates, Philippine Airlines, South African Airways and Thai Airways International. (Lantal was originally established by the Baumann family in 1886, manufacturing linen cheesecloth for the Emmental dairy farming community: Specialist comments from Lantal executives are included in [Chapter 12/The Leather Forecast](#) and [Chapter 14/Flying Colours](#).)



Lantal Textiles



“WOVEN AND BLENDED SEAT-COVER FABRICS ARE BECOMING LIGHTER-WEIGHT, MORE ROBUST, MORE BREATHABLE, WARMER TO THE TOUCH AND CAPABLE OF ‘WICKING’ AWAY MOISTURE”



**Top:** Climatex provides temperature-stabilized passenger comfort: changes in body temperature are continuously balanced.

**Left and Below:** Lantal's pneumatic comfort system lets passengers use a manual control panel to contour the anatomically configured air chambers in their seat.

### SOOTHING SEATING AND SLEEPING SURFACES

While airline passengers come in all shapes, sizes and moods, aircraft seats, in all classes of service, have always been uniformly and relentlessly consistent. It is not unusual to see air travellers' cabin bags festooned with inflatable neck-wrap collars, memory-foam pillows and cooling gel pads. These therapeutic products have excellent pedigrees associated with pressure-sore prevention. In future years, however, passengers are likely to find significant improvements in aircraft seat-comfort standards. Here are some examples:

#### Air-Filled Cushions

Passengers can use a manual control panel to contour the anatomically configured air chambers to adjust the cushions according to their own preferences throughout the flight, for example, a firmer surface when sitting upright or softer while stretching out or sleeping.

Pneumatic comfort systems can save about half the weight of traditional upholstered cushions, and there is less flammable material in case of fire. Pioneered by Lantal (as mentioned previously), introduced into service by Swiss International Air Lines, and subsequently by Austrian Airlines, Brussels Airlines and Lufthansa, these adaptive air-filled cushions are protected with specialized eco-efficient textiles (whereas old-style foam-filled inserts are usually non-biodegradable).

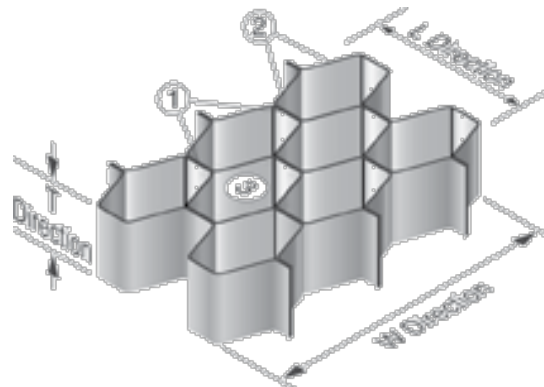


"FUSION-BONDED  
HONEYCOMB  
TECHNOLOGY  
IS MAKING  
SIGNIFICANT  
PROGRESS IN  
THE AEROSPACE  
SECTOR"

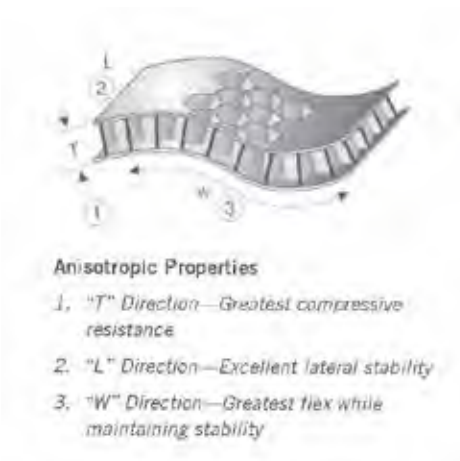
#### Honeycomb Support

As developed by Supracor (whose mission statement is: 'Technology You Can Get Comfortable With'), fusion-bonded honeycomb technology is making significant progress in the aerospace sector. The company's Stimulite sleep surfaces, as used for crew rest mattresses on Boeing B747-8 and B787 Dreamliner aircraft, can contour and self-adjust to any shape. When airline passengers sit on Stimulite cushions, perforations in the cell walls allow air to circulate and moisture to evaporate, thus creating a healthy microclimate for long-range flights. With passenger movement, the cushion cells can flex and provide a massaging effect, enhancing blood flow and the sense of personal well-being.

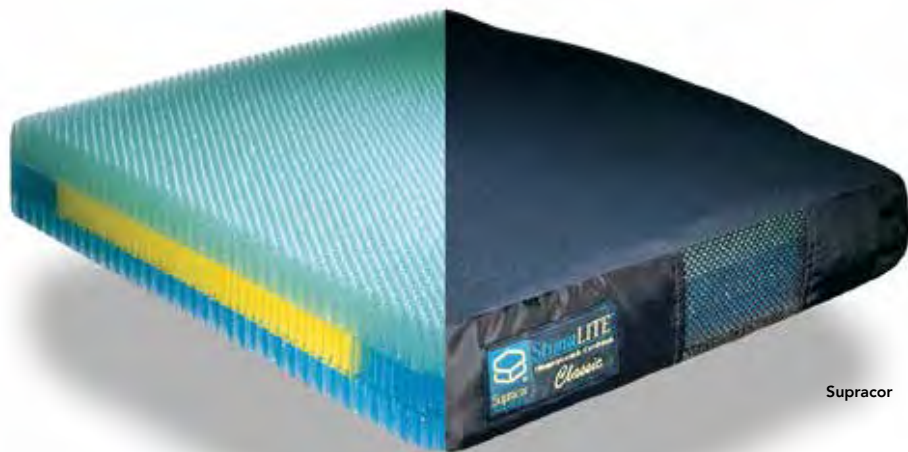
Lightweight and shock-absorbing, Stimulite has multiple degrees of resistance in its length, width and thickness. The cellular matrix is over 90 per cent open space and provides uniform weight distribution and support, with just a fraction of the profile measurement of traditional foam-type cushions. Advertised as being made from polyether thermoplastic urethane, and with a history of use for military ejection-seat cushions, bullet-proof vests, wheelchair applications, sports accoutrements and fun-fair equipment, Stimulite products are washable, non-toxic, highly durable and completely recyclable.



This page: Supracor's Stimulite products are made from polyether thermoplastic urethane, and have a history of use for military ejection-seat cushions, bullet-proof vests and wheelchair applications.



Supracor



Supracor

"ULTRA-LIGHTWEIGHT FOOT-NETS HAVE GREATLY HELPED TO IMPROVE COMFORT LEVELS FOR ECONOMY-CLASS PASSENGERS ON LONG FLIGHTS"

#### Netted Foot Rests

Ultra-lightweight foot-nets have greatly helped to improve comfort levels for economy-class passengers on long flights. Instead of the old-style, heavy projecting foot-rest bars, passengers can use eco-chic nets attached under the seat row in front of them to rest their feet and ankles, and stop themselves from sliding forward while sleeping. Jet Airways, Qantas and other major airlines have implemented this ingenious accessory.

**Below:** In addition to 'hammock-style' foot-nets, Jet Airways provides 'cradle-type' headrest cushions.



Jet Airways



## GALLEYS

For decades, to the average passenger, aircraft galleys did not seem to change greatly in the way they looked or functioned. However, new technology is on the move! 'Temperature Accumulators', as developed by B&W Engineering of Germany (as shown opposite), will add a significant 'green' element. This problem-solving product features drawer-size containers that combine the performance of ovens and chillers, without needing power-supply connections to the galley or the cabin, and without producing any waste. Food and beverages can be kept at temperatures ranging from 4 up to 230 degrees Fahrenheit (-15.6 to 110 degrees Celsius) – a boon for overworked flight attendants.

And those heavy, muscle-wrenching galley trolleys ('dinosaurs' of the business) are rapidly becoming an endangered species and will ultimately be doomed to extinction (another boon for flight attendants). Weighing in at less than 22 pounds (10 kilograms), the winner of the 2010 Crystal Cabin Award in 'The Greener Cabin' category was the Norduyn Quantum Trolley, developed by Norduyn of Canada, in conjunction with LSG Sky Chefs of Germany. This new-style trolley is scratch-proof, dent-proof and energy-efficient, with all screw inserts molded into the structure. The insulation properties to keep contents at cool temperatures require less energy than on standard aluminium trolleys. Imbedded radio-frequency identity (RFID) chips ensure that each unit can always be easily traced. Constructed from a single body shell, this unit has 45 per cent fewer parts than traditional catering carts. Labels can be removed from the exterior surface without leaving residue. (An example of a traditional galley trolley suffering from long-term sticky-label problems is displayed in [Chapter 9/Look Smart: Keep Clean.](#))

Theoretically, a Boeing B747 aircraft fully loaded with the eco-friendly Norduyn Quantum Trolleys would be carrying 1,135 pounds (514 kilograms) less weight, total, over the course of a year: this could amount to approximately US\$100,000 per year in jet-fuel savings and a reduction of around 639,340 pounds (290 tons) of carbon emissions. The LSG company alone operates no fewer than 66,000 trolleys in its network.

## quantum Technical Features

High impact & heat resistant thermo-plastic top

Precision-machined core with all screw inserts integrated

Carbon-reinforced single body shell  
Excellent to absorb shocks

Ergonomic design all-around, no sharp edges

Lighter weight quiet roll casters

Integrated retractable handle and work table

Label area easy to clean without sticky residue

Two security devices for lock and seal

Injected polymer runners ensure ideal gliding of drawers

Lightweight door is easy to close shut

New low-maintenance braking mechanism with optional rear brake set at rear of half size

Norduyn



"THOSE HEAVY, MUSCLE-WRENCHING GALLEY TROLLEYS ('DINOSAURS' OF THE BUSINESS) ARE RAPIDLY BECOMING AN ENDANGERED SPECIES AND WILL ULTIMATELY BE DOOMED TO EXTINCTION"

## DISPOSABLE TABLEWARE

A person's hands are holding a black rectangular tray. On the tray, there is a white cloth with a wooden spoon resting on it. Next to the cloth is a small glass, a white cup, and a small container. The background is a solid orange color. The text "PriestmanGoode" is visible in the bottom right corner.



Shenling



Shenling



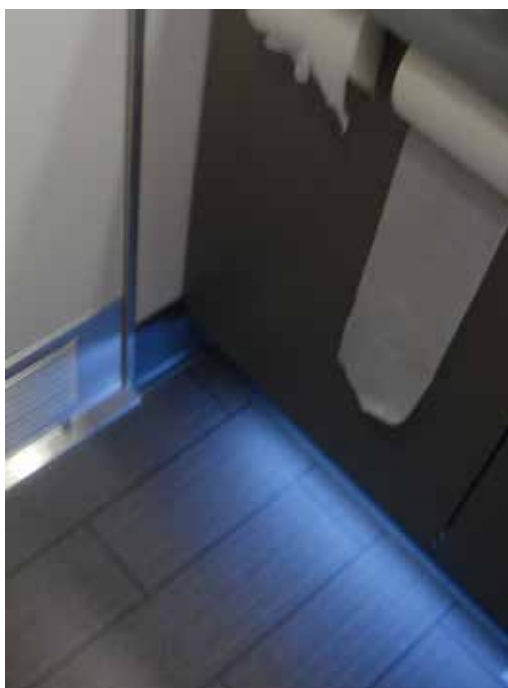


**Above:** Proximity-sensor faucets manufactured by Jamco can improve hygiene in aircraft lavatories.



Details of Covid-19 disinfection and cabin-hygiene programmes are provided in the Case Studies entitled: [2021 Flying Healthy](#) and [2020 Cabin Health Alerts](#), attached to [Chapter 9/Look Smart: Keep Clean](#).

**Below:** Stone- or wood-look floor coverings can be cleaned rapidly to high hygienic standards.



## LAVATORIES

At long last, there is a concentrated focus on how to modernize the traditional aircraft-lavatory environment. A timed flow of water in hand-basins will automatically ensure that valuable supplies are not wasted, and along with hotel-style flattering lighting, large mirrors and trace fragrances, airlines are implementing important hygiene upgrades. There are proximity-sensor faucets, such as those manufactured by Jamco. There are also anti-microbial counter surfaces, no-touch garbage disposal units, urinals for men, more conveniently placed flush-control buttons, wheelchair-access doorways, helpful grab handles, easy-reach grip cut-outs, and stone- or wood-look floor coverings that can be cleaned rapidly to high hygienic standards. And perhaps in aircraft lavatories of the future, manufacturers might find ways to install mini-hurricane-force air-flow vents capable of drying hands in 12 seconds – similar to the remarkable Dyson Airblade Tap product invention.

Aircraft lavatories need to have special floor treatments (as described in [Chapter 9/Look Smart: Keep Clean](#)). The major safety requirements are to provide anti-skid surfaces and to minimize the possibility of moisture becoming trapped underneath the floor covering, which could lead to the serious risk of corrosion. Working in conjunction with Schneller, a global leader in the field of engineered decorative laminates and non-textile flooring, Delta Air Lines developed PanGuard Flooring, a hybrid product that combines non-textile flooring with the floor pan itself. In addition to eliminating the possibility of trapped moisture between the non-textile flooring and the floor pan, the PanGuard product has reduced the weight of each lavatory by at least 2.2 pounds (1 kilogram).

This integrated 'one-step' solution can significantly reduce supply-chain delays and installation costs, and, based on the success of initial installations, Delta Air Lines has announced plans to install the new product across its entire fleet of more than 700 aircraft.

On long-haul flights, many passengers use the aircraft lavatories to change their clothes. By installing changing rooms for use by those passengers who are simply donning sleeping suits or getting dressed for arrival at their destination airports, the overall number of visits to lavatories can be significantly reduced – and the work of cleaning crews during the turnaround process can be streamlined accordingly.

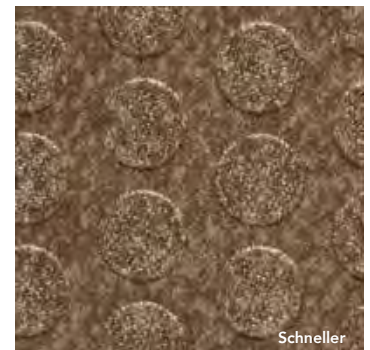
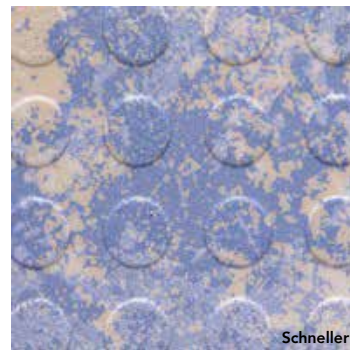
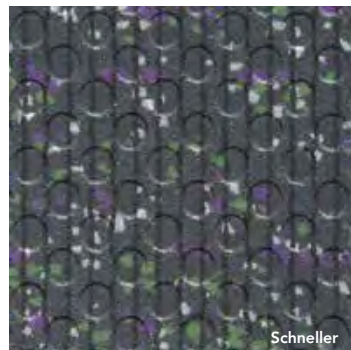
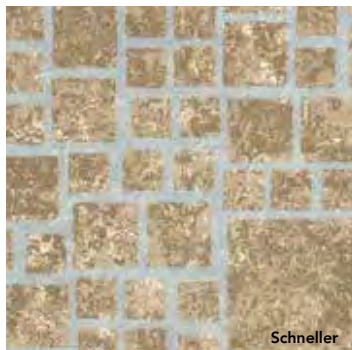
"AT LONG LAST, THERE IS A CONCENTRATED FOCUS ON HOW TO MODERNIZE THE TRADITIONAL AIRCRAFT-LAVATORY ENVIRONMENT"



"IN ADDITION TO ELIMINATING THE POSSIBILITY OF TRAPPED MOISTURE BETWEEN THE NON-TEXTILE FLOORING AND THE FLOOR PAN, THE PANGUARD PRODUCT HAS REDUCED THE WEIGHT OF EACH LAVATORY BY AT LEAST 2.2 POUNDS (1 KILOGRAM)"

**This page:** Hotel- and restaurant-style decorative treatments: airline passengers greatly welcome these aesthetic improvements after decades of traditional dark-grey floor coverings in aircraft lavatories.

Details of developments relating to aircraft-lavatory wheelchair-access are provided in the EXPO PORTFOLIO Case Study attached to [Chapter 8/Accessibility: Special Needs](#).





**This page:** In the Shower Spas on board the Emirates Airbus A380 aircraft, there is a timed filtering process, during which the water is purified, disinfected and recycled.

### CLEANER 'GREENER' SHOWER FILTERS

While shower compartments are not unusual on luxury corporate jets, it came as a great surprise to the flying public when Emirates announced the 'Shower Spa', the first of its kind in the world of scheduled airlines (as mentioned by Sir Maurice Flanagan, RIP, Founding CEO, Executive Vice Chairman Emirates Airline, in the [Introduction](#) to this E-Book Edition of *Jetliner Cabins: Evolution & Innovation*). Classed as a Unique Selling Point (USP) for the airline's Airbus A380 fleet, the Emirates Shower Spa has a heated floor, leather seating, and special hotel-style shower kits. It is reported that the Shower Spas are used by about 75 per cent of the airline's first-class passengers – who are advised by flight attendants to sit on the bench in the event of the aircraft encountering turbulence.





One of the prime-interest issues is the timed filtering process: the shower lasts 5 minutes, after which the designated amount of water is purified, disinfected and recycled via a special process to provide a totally clean and completely hygienic supply for the next passenger. Water-management engineers say that this process could eventually become a model for future domestic and commercial shower installations – UN demographers are predicting a global population figure of 9 billion by 2050!

Given that the powerful next-generation aircraft will be flying ever-longer stage lengths, we are certain to see far greater emphasis in the future on developing, certifying and implementing filtering systems for the hygienic reuse of various liquids inside the cabin, for example for the dish-washing process and even, possibly, to produce 'tox-free' galley and bathroom water.

## SOME 'GREEN' GRUMBLES

Of course, not all airline passengers are going to be happy all the time – particularly when their comfort levels are eroded! Given the impetus to achieve jet-fuel savings and reduce carbon emissions, aero designers might be forgiven for believing that all 'green' initiatives will elicit roars of applause from an appreciative flying public. But aerial 'eco-deco' is not a simple process, and passengers are occasionally *unenthused* about some of the developments they see in aircraft cabins, for example:

### Bungee-elastic seat-back literature pockets

These were very popular in the early days of air travel, but during the 1980s and 1990s, they were superseded by a variety of creative designs typically featuring rigid plates plus fabric flaps, gussets and pleats. Now, however, the elastic style has come back into fashion. Taut bungee pouches look streamlined and practical when holding only a newspaper, in-flight magazine, passenger safety card and motion-sickness bag, and they provide more space for passengers' knees in high-density seating configurations (samples of configuration charts are displayed at the beginning of the [Timetables/Configurations Picture Gallery](#) attached to [Chapter 4/Aero Identity](#)). For ground-service crews, the open-style construction can speed cleaning routines and greatly facilitate the detailed security-check processes that are mandatory before an aircraft can leave the departure gate. The product is almost weightless, resulting in significant jet-fuel cost savings compared with solid upholstered seat-back pockets (several pictures and descriptions are provided in [Chapter 9/Look Smart: Keep Clean](#)). But some airline passengers say they dislike the fact that small items can easily drop unnoticed onto the floor, and there is not sufficient available space for books, cameras, sweaters, mobile electronic devices and other personal accoutrements they consider to be essential for the duration of the journey.

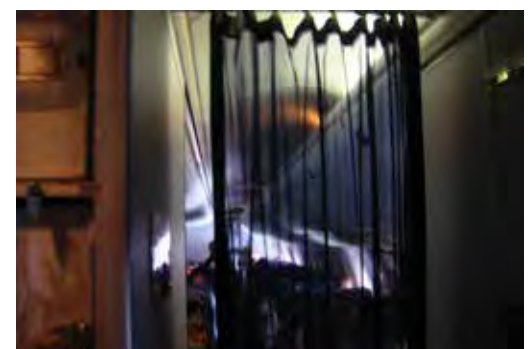
### Lightweight cabin-divider drapes

Drapes made of polyester or net-type fabric (as shown bottom right) typically fly at less than half the weight of the heavy tapestry-type materials favoured by legacy airlines in earlier decades, thus providing airlines with jet-fuel cost savings, and the modern fabrics can be steam-pleated, laundered and reused at minimal cost. After the terrorist attacks in 2001, when the US Transportation Security Administration (TSA) mandated the removal of class-divider curtains, ultra-lightweight mesh curtains were developed to provide a level of privacy for premium-class passengers, while at the same time complying with the mandate by providing visibility along the aisle of the aircraft.

For airline maintenance departments, the old-style drapes, plus the fixing hardware, extra-strong hooks and hanging rails, represented a burdensome storage commitment: the fabric could weigh up to approximately 20 ounces per square yard (5.67 grams per square metre) and required relatively expensive chemical-based dry-cleaning cycles.

Many airline passengers, however, still say they prefer thicker drapes because they are aesthetically pleasing and provide an effective level of acoustic insulation between the cabin seat rows and the lavatory/galley working areas.

**Below:** Superseded in between 1980s and 1990s by a variety of designs (typically featuring rigid plates plus fabric flaps, gussets and pleats), the elastic-style literature pocket has come back into fashion.



"IN RECENT YEARS,  
THERE HAVE BEEN  
SIGNIFICANT  
CHANGES, BOTH  
IN METHODS  
AND MATERIALS  
AND IN THE  
MANUFACTURING  
AND INSTALLATION  
PROCESSES"

## 'GREEN' CABIN COMPLETIONS

In the fitting out of aircraft passenger cabins in recent years, there have been significant changes both in methods and materials and in the manufacturing and installation processes. For example, airlines can now use electronic applications and interactive animation to visualize various cabin scenarios, instead of producing display boards, walk-around scale models or physical mock-ups, as was customary in earlier decades. (Readers might find it interesting to compare the pre-computer-days artists' renderings presented at the beginning of [Chapter 13/Upgrades: Refurbishing Aloft](#), with the accurate-to-1-millimetre computer graphics displayed at the end of the same Chapter.)

### THE VIRTUAL AND VIRTUOUS NEW WORLD OF AIRCRAFT INTERIORS!

'We use finite element modelling (FEM) to design, adjust and even test cabin layouts or cabin furniture such as seats and galleys,' explains Jeff Luedeke, Vice President, Sales and Marketing, at TIMCO Aerosystems, a division of TIMCO Aviation Services.

'Computer-based FEM allows cabin designers to do in a virtual world what once had to be done by hand. This approach saves time and offers a greater likelihood of producing solutions that will reduce waste and weight and save fuel cost. Engineers can use FEM technology to identify optimal materials and construction methods to meet a range of criteria, including environmental impact. Knowing that our airline customers are being driven to reduce the size of their carbon footprint, we include in our electronic models the calculus to produce a design that not only meets all regulatory, safety and cost-savings requirements, but one that produces a lower-weight solution than previous designs. The designer can remove a little weight here, replace it with new material there and test an innovative way of binding two structures without additional parts – all within a virtual world that combines creativity with speed and processing power.'

And what about new materials?

'Composite construction now makes great use of advanced adhesives instead of two-part binding agents or other forms of attachment,' Jeff Luedeke replies. 'Earlier wasteful and messy processes required first mixing activating material with a binding agent, applying the mixture to the parts and then using often-harmful solvents to clean up overlay and waste. Today, state-of-the-art adhesive taping is widely used in the manufacture of seats, galleys, lavatories and other interior monuments throughout the aircraft. The new taping process produces the same or an even-better outcome with minimal waste, the use of no hazardous materials and within a reduced application time.'





Asked about the related waste-management and landfill processes, Jeff Luedeke responds, 'In the past, interior panels or structural elements were often cut by hand or using small electric tools. This resulted in significant cut-away waste and lack of precision that could rob valuable space or produce added cost through a need for later retrofit. Furthermore, an entire structural element was often cut from the same heavy material to be sure there was a critical mass at key load-bearing points or bracing corners. Quite a few interior furniture items ended up being a lot heavier than they really needed to be!'

How can these problems be solved?

Jeff Luedeke says, 'We have found that computer numerical controlled (CNC) machines have changed production and assembly dramatically. They can be programmed to be highly precise and to eliminate waste. As for meeting the needs of critical-support areas and braces, the heavier metals – which are less 'green' in terms of environmental usage – can be cut to exactness, to fit just the specific areas needed. Lighter materials such as special foams can then be precise-cut using the same CNC machine technology to fit the build area. The result: far less material use and a much lighter galley or stowage bin.'

And customer reactions?

'We completely overhauled the TIMCO interiors-product portfolio using the innovative design techniques and new composite materials I have described, and our customers are telling us that the weight savings greatly help them to reduce jet-fuel burn. The new products have been appropriately branded the FeatherWeight™ line, and we are looking forward to continuing to lead in the development of environmentally friendly aircraft interiors in the coming years.'

**Below:** Seats from the TIMCO FeatherWeight™ line



TIMCO

"THERE IS NOW EVIDENCE AT THE PUBLIC LEVEL OF A GROWING AWARENESS OF THE BENEFICIAL IMPACT OF 'GREEN' AVIATION-PLANNING PROGRAMMES"



This page: 360-degree panoramic imaging is replacing traditional design tools.

## 'GREEN' FUTURES

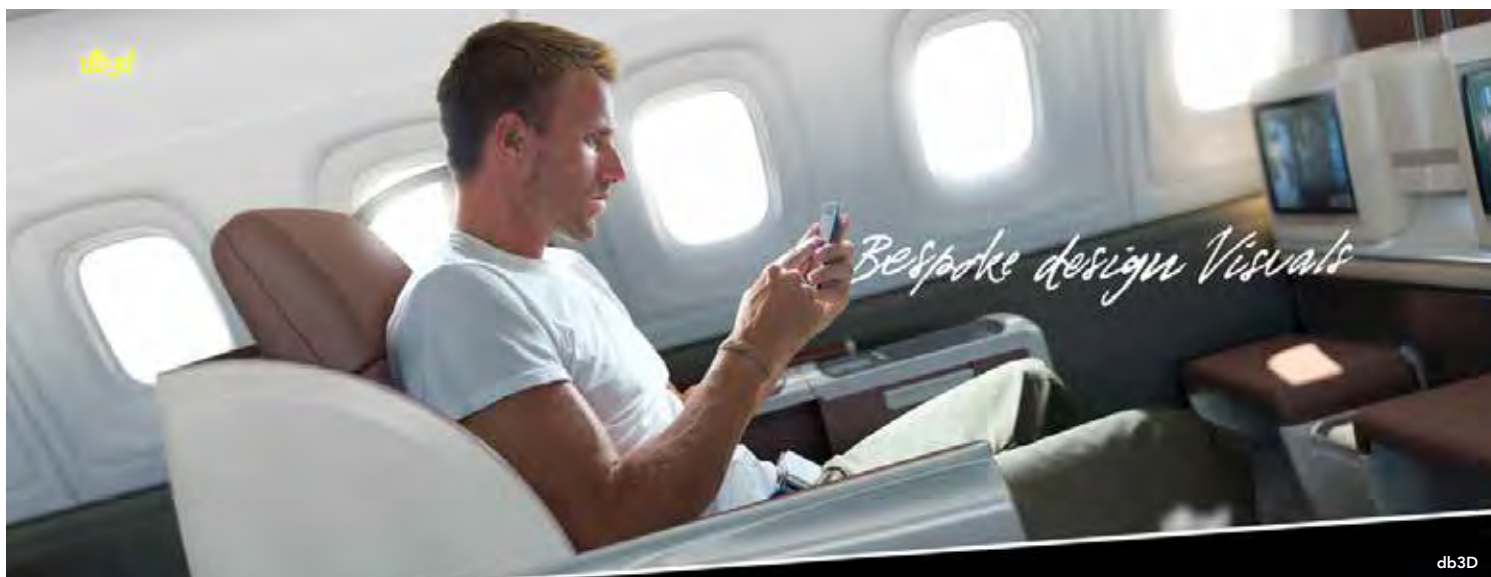
While the inspiring slogan 'Zero emissions, zero waste' still represents a far-distant goal, there is now evidence at the public level of a growing awareness of the beneficial impact of 'green' aviation-planning programmes. Here are some examples of far-reaching developments that are likely to be influential in the long term:

- 3D delights: Ambitious climbers who long to scale Mount Everest are now able to prepare for the perilous ascent in a virtual environment, thanks to 3D Reality Maps GmbH, a company offering virtual views of exciting travel destinations. Using their personal laptops, couch-potato mountaineers can confront the thrills, spills and 3D dramas of this vertiginous venture without relinquishing the comforts of hearth and home: state-of-the-art hardware and computer mapping techniques are rapidly generating addictive streams of entertainment and information, including travel itineraries, gaming, sports and other activities, packaged and marketed in ingenious ways to intrigue and amuse user groups of all ages and predilections.

For airlines that are developing 'green' cabin-planning programmes, there is an exciting new world of 360-degree panoramic imaging, photo compositions, high-definition animations and interactive content, as offered by providers such as Australia's 3DViz, OPTIS, Lantal Textiles (as mentioned previously) and Computergraphics ACA (Specialist comments from Peter Christoph Berg, Director, Computergraphics ACA, are included in [Chapter 13/Upgrades: Refurbishing Aloft](#)).

It is difficult now to recall that, in earlier decades, the cabin-design process often resembled an obstacle race: there were budget-busting renderings, unwieldy throw-away story-boards, teetering table-top mini-models and heavy-weight full-size mock-ups located in a remote hangar or downtown art studio. By contrast, today, there are miraculous software platforms to use either locally or via websites to simulate walk-through tours. 'How about...', 'Let's try...' and 'What if...' options can be assessed in real time, and airline clients can experiment with virtual changes in materials, layouts and colours. Given the speed of progress in this field, we might soon see cabin specialists working on a daily basis at their own hot desks using sci-fi movie-style helmets and goggles to design aircraft-interior dream schemes and validate detailed calculations of potential costs.

- Southwest Airlines EVOLVE: To launch its 'green plane' programme, Southwest Airlines, the original pioneer of the low-fare airline model and the largest low-fare carrier in the US, designated one Boeing B737 aircraft to serve as a flying test environment for eco-friendly products such as:





Nuts About Southwest (blog)

"IT IS DIFFICULT NOW TO RECALL THAT, IN EARLIER DECADES, THE CABIN-DESIGN PROCESS OFTEN RESEMBLED AN OBSTACLE RACE"



E-Leather



Nuts About Southwest (blog)

- canvas life-vest holders, replacing the classic metal containers and creating a weight-saving of one pound (.45 kilograms) per passenger-seat position;
- aluminium 'bump' or 'rub' strips – typically positioned on seat side panels or the walls of aisle corridors to protect surfaces that could get damaged when passengers move through the aircraft, carrying briefcases, strollers, sports equipment, etc. This metal treatment is more durable than the traditional plastic material used in the past;
- carpet pieces that are eventually 100-per-cent recyclable via a manufacturing process that is carbon neutral;
- an eco-friendly, low-profile seat that is lighter in weight and more durable than its predecessor; and
- long-life, lightweight, leather-derivative seat-cover fabrics.

This experimental 'cabin try-out' was the first of its kind in the airline world, and the design perspective was closely observed by all interested parties. After detailed technical assessments and comparison metrics, the programme, named the EVOLVE Interior, was extended across the fleet and to also cover the company's new-entry aircraft. Southwest Airlines operates more than 700 Boeing B737 aircraft and has achieved 45 straight years of profitability – recently passing its 130-million-total-annual-passenger milestone, with average passenger load factors around 85 per cent.



Southwest Airlines

**Above:** Southwest Airlines designated one Boeing B737 aircraft to serve as a flying test environment for eco-friendly products.



Aircraft Fleet  
Recycling  
Association

Above: The Aircraft Fleet Recycling Association (AFRA) works to ensure sustainable management, recycling standards and the reuse of component parts.

■ An industry group, the Aircraft Fleet Recycling Association (AFRA), co-founded by The Boeing Company, Europe Aviation, Rolls Royce and other notable organizations, is working to ensure sustainable management, recycling standards and the reuse of component parts.

■ To handle the repair of ever-larger aircraft parts made of composite materials, Lufthansa Technik, AG, expanded its workshop premises in Hamburg, Germany, to accommodate a new autoclave oven with an interior diameter of 16.4 feet (or 5 metres).

The Lufthansa Group stripped down an Airbus A340-300 to identify ways to reduce onboard weight, save on jet fuel and achieve a consequent reduction in CO<sub>2</sub> emissions. In the cockpit, the cabin and the cargo hold, all items not actually screwed down were removed for assessment and review.

■ In the academic field, at Cranfield University in the UK, an aerospace-vehicle design programme was developed to cover a range of ecological projects, including one entitled the Greenliner. The 2008 class project was to design an environmentally benign aircraft, and approximately 50 students worked in a virtual industrial environment towards realistic specifications. For each component and system, the aim was to investigate novel concepts that might lie outside the 'norm' as defined by standard industry trends.

## 787 life cycle support

Lufthansa Technik is ramping up to offer a continuously expanding suite of services for the life cycle of the Boeing 787:



Lufthansa Technik, AG



- In Canada, Bombardier provided a CRJ aircraft for a 'green' end-of-life (EOL) project at the Ecole Polytechnique de Montreal: the aim was to study the most efficient ways of eventually recycling the 25 per cent of this aircraft type that was not already recyclable. Bombardier stated the need to target better ways to build recyclable components, with the aim of applying the new technologies to its CSeries aircraft (now Airbus A220, as shown in the New-Generation section of Chapter 16/Ways Ahead).
- In Europe, automotive regulations stipulate that 95 per cent of a vehicle must be recyclable at the end of its life, while the parts that cannot be recycled and have to go to landfill incur associated fees. Might we, one day, see a similar approach in the aviation field? If so, the Bombardier CSeries (now Airbus A220) aircraft type is already well positioned. Advertised as being designed to achieve significant environmental breakthroughs compared with similar aircraft that are currently operating, the key points mentioned include: 20 per cent reduction in carbon emissions, four times less noise at airports, and 50 per cent less nitrous oxide.

**Above:** This computer rendering shows the virtual Greenliner aircraft designed by students at Cranfield University, UK.

"WITHIN THE NEXT 20 YEARS THE COMMERCIAL AVIATION SECTOR WILL NEED ABOUT 40,000 NEW AIRCRAFT"

## 'GREEN' HORIZONS: Reducing carbon emissions

Analysts predict the need for about 40,000 new commercial aircraft over the next 20 years. If aviation environmental regulations escalate as they have in the automotive sector, and with airlines committed to reducing their carbon footprint by 50 per cent by 2050 (relative to the levels of 2005), the recyclability and fuel-efficiency metrics of the CSeries (A220) will constitute a 'green' advance of paramount importance. This achievement could eventually lead to a profound reassessment of criteria for future aircraft definition, design development and manufacture.

**This page and Opposite:**  
Images of the Bombardier CSeries  
(now Airbus A220) aircraft. A focus  
of the manufacturing programme  
was to target better ways to build  
recyclable components, in particular  
for cabin interiors.

Related information is provided  
in Chapter 16/Ways Ahead and  
additional images are displayed in the  
[Airbus A220 Picture Gallery](#).





Airbus A220



Airbus A220

In 2016, SWISS was the launch customer airline for this aircraft type (as of 2018, called Airbus A220, and formerly called Bombardier CSeries).

## COMMENTS FROM THE SPECIALISTS

**KEN DOWD**  
INDUSTRIAL DESIGN CONSULTANT,  
FORMER VICE PRESIDENT OF AVIATION,  
TEAGUE, SEATTLE

Throughout the 1980s, the airline industry focussed on a single mission of meeting or exceeding new FAA regulations on flammability. The problems were huge and the solutions were technically correct in terms of meeting the rules, but often left unintended problems for the end users. Airlines ended up with a fire-blocking upholstery layer that made seats look more like grandma's hand-sewn couch cover than finely upholstered seating. Injection molded plastics were hard to pigment, and often returned quickly to their original resin colour, sometimes even before the airplane was delivered. But as often happens with government regulations, the second or third try begins to bear fruit, and in the end, the product is not only safer, but better in every way.

At the other end of the spectrum is a grass-roots effort to make industry and the planet more at ease with each other, and apart from carbon reduction, it isn't being driven by government regulations. This lack of direct government involvement is what makes the 'green' movement so important and so special. It's the result of a genuine concern for the planet, an out-of-the-box look at 'green' and good business practices and a consumer demand for a higher level of concern for the environment. For the most part, it's driven by common sense, waste reduction and innovation. Today, we find all sorts of exciting new products that might not have happened without the first few company evangelists who inspired us.

For me, that evangel was Ray Anderson. His story of changing a petroleum-based company in a very toxic industry into a focussed 'green' machine looking for efficiency and ecology in every corner of the business was both an inspiration and a call to action. Incredibly, his story started at an age when many CEOs might want to ride success to a comfortable retirement. But Ray Anderson wanted to do more, and decided to make Interface the first enterprise in history to become truly sustainable. His

mantra was to do no harm to the environment. Today, Interface has proved that sustainability and profit are mutually compatible goals. Ray Anderson has now left us, but his legacy will live on in his products and his company. In fact, one major airline is now flying Interface carpet tiles, revolutionizing yet another industry.

Today, the aircraft industry has the opportunity to be more than just the overused term 'green'. We now have the ability and the opportunity to design 'green thinking' into the very end use of every product. We now have environmentally improved choices for recyclable carpet, lightweight fabrics and leathers, and composite technology that can be used in seats, galleys and many other areas of the cabin.

Our industry had discovered the power of design and the value of incorporating good design, technology and sustainability in an eco-friendly cabin. Our challenge now is to design for a truly sustainable experience from the ground up. This is the next big opportunity in the aerospace business. The challenge is immense, and the future is bright!

**DAVID WEINER**  
ARCHITECT, NEW YORK

Already, the transportation industry has been a leader in 'green' development, recognizing that aside from the cost savings and reduced environmental impact, there is greater worker productivity and quality of life on the user end.

Building and construction dramatically alter the environment. In the US, statistics from the Department of Energy indicate that the building sector accounts for close to half of primary energy consumption, which is more than both the transportation sector and the industrial sector. Building also produces significant amounts of carbon dioxide (CO<sub>2</sub>) emissions – even more than transportation. In response, government agencies and building owners have demanded more energy-renewable systems and ways of reducing environmental impact with 'greener' solutions. Designers and planners have begun to embrace this challenge in a number of innovative ways.

'Green' building, sometimes called 'sustainable architecture', essentially means building in a manner that is considerate towards the environment. This

consideration can range at the micro scale from building homes using efficient eco-friendly products, recycled materials, planning land use and installing monitoring devices that control mechanical systems and improve indoor air quality. It can also mean installing energy-saving systems such as geothermal and photovoltaics that can be tied into existing electric grid networks. Currently, design companies (such as Vitra) are exploring small prefabricated housing prototypes that are constructed in the controlled environment of a factory and delivered ready-made to a building site. At the urban scale, building codes are requiring new building designs to achieve higher energy-conservation performance by control of lighting systems that maximize daylight; installation of sophisticated computer-controlled heating and air conditioning systems; adding water recycling; and using materials that reduce heat loss and CO<sub>2</sub> emissions.

An important development in this pursuit has been the implementation of LEED (Leadership in Energy and Environmental Design) by the US Green Building Council, a nonprofit group based in Washington, DC. The council developed a set of building guidelines in the form of a point system to encourage building owners to reduce the overall impact of the built environment on human health and the natural environment by:

- efficiently using energy, water and other resources;
- protecting occupant health and improving employee productivity; and
- reducing waste, pollution and environmental degradation.

Increasingly, new construction is requiring compliance with LEED guidelines as owners begin to recognize the cost benefits and potential resale benefits. The LEED system has also been adopted for existing structures. Recently, the Empire State Building in New York City was renovated, achieving a gold LEED rating, making it one of the tallest LEED-certified buildings in the US.

There is no question that, moving forward, different industry sectors will start to adopt similar standards and require greater attention to life-cycle cost in pursuit of a 'greener' environment.




### LINKS TO ORGANIZATIONS MENTIONED IN THIS CHAPTER (LISTED ALPHABETICALLY)

3D Reality Maps GmbH ■ 3DViz ■ Aerospace Technologies Group ■  
 Air France ■ Air Mauritius ■ Airbus ■ Aircraft Fleet Recycling Association  
 (AFRA) ■ AkzoNobel ■ Alaska Airlines ■ All Nippon Airways (ANA)  
 ■ American Airlines ■ AmSafe ■ Austrian Airlines ■ Aviation Glass  
 ■ B/E Aerospace ■ Boeing ■ Bombardier ■ British Airways ■ Brussels Airlines  
 ■ B&W Engineering ■ Climatex ■ Computergraphics ACA GmbH  
 ■ Continental Airlines ■ Cranfield University ■ Crystal Cabin Award  
 ■ David Weiner ■ db3D ■ Delta Air Lines ■ Diehl Aerospace ■ Dow  
 Jones ■ Dyson Airblade ■ E-Leather Group ■ École Polytechnique de  
 Montréal ■ El Al Israel Airlines ■ Emirates Airline ■ Europe Aviation  
 ■ Federal Aviation Administration (FAA) ■ Gerflor Transport Flooring ■  
 Horizon Air ■ Interface ■ International Air Transport Association (IATA)  
 ■ International Civil Aviation Organization (ICAO) ■ Jamco ■ Japan  
 Airlines ■ Jet Airways ■ KLM Royal Dutch Airlines ■ LanChile ■ Lantal  
 Textiles ■ Leadership in Energy and Environmental Design (LEED) ■ LSG  
 Sky Chefs ■ Lufthansa ■ Lufthansa Group ■ Lufthansa Technik, AG ■  
 Mohawk Industries, Inc. ■ *New York Times* ■ Norduyn ■ *Nuts About  
 Southwest (blog)* ■ OPTIS ■ Philippine Airlines ■ PriestmanGoode ■  
 Qantas ■ Recaro ■ Replin Fabrics ■ Research Frontiers Inc. ■ Rolls  
 Royce ■ Schneller, Inc. ■ Shenling Environmentally Friendly Packing  
 Materials Co. ■ South African Airways ■ Southwest Airlines ■ Supracor  
 ■ Swiss International Air Lines ■ Tapis Corporation ■ TEAGUE ■ Thai  
 Airways International ■ Thomas Cook Airlines ■ TIMCO Aerosystems ■  
 United Airlines ■ United Nations (UN) ■ US Airways ■ US Department  
 of Energy ■ US Green Building Council ■ US Transportation Security  
 Administration (TSA) ■ Virgin Atlantic ■ Vitra ■ Zodiac Aerospace



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"WE DO NOT  
INHERIT THE  
EARTH FROM OUR  
ANCESTORS; WE  
BORROW IT FROM  
OUR CHILDREN."

*Chief Seattle*

*Chief of the Duwamish Indigenous  
North American Peoples  
(1780-1866)*