AIREX BALTEK
EXCELLENCE IN CORE SOLUTIONS

3A Composites Core Materials

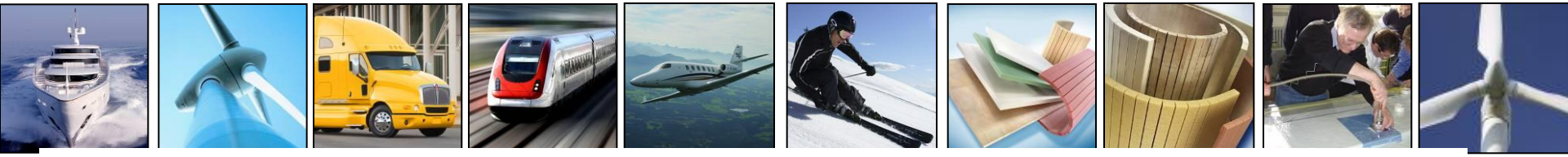
3A COMPOSITES

AIREX® BALTEK®

EXCELLENCE IN CORE SOLUTIONS

3A COMPOSITES Core Materials

Global footprint in high growth economies



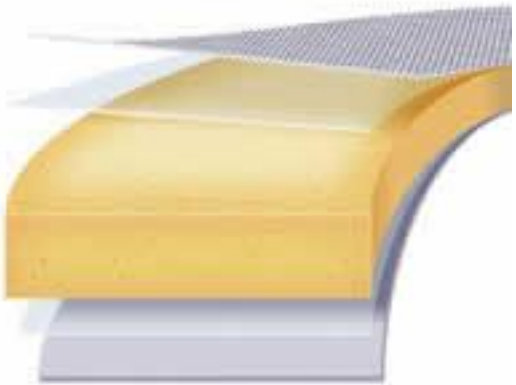
▲ Core Materials: Administrative Office / Sales Office

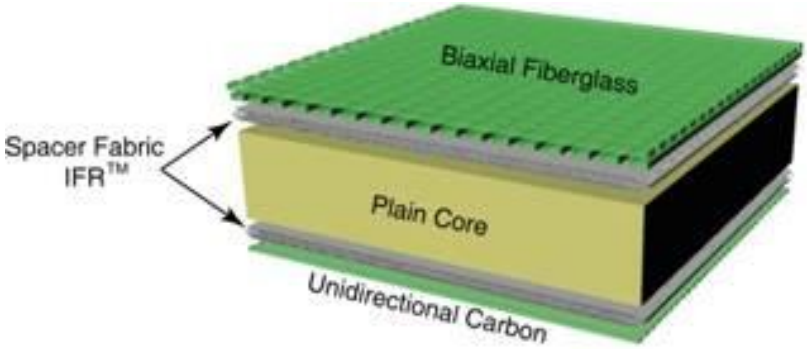
▲ Core Materials: Production Plant

Definições:

- *Compósitos*: Combinação de diferentes materiais para alcançar uma estrutura com comportamento otimizado, tipicamente resultado da associação de um (ou mais) material de reforço (ex: fibra de vidro) com a matriz (ex: resina).

- *Sandwich*: Material composto por camadas: núcleo e faces externas, com elevadas resistências mecânicas, rigidez e baixo peso no núcleo – estrutura heterogênea.

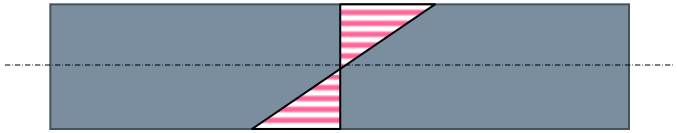




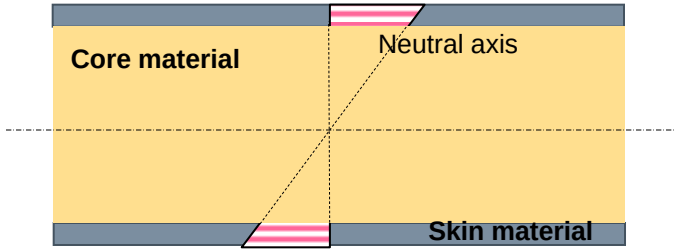
Princípio da estrutura Sandwich

- Melhor eficiência nas propriedades mecânicas da estrutura:
- As tensões superficiais não são propagadas para a estrutura toda
- Quanto maior a espessura, maior a distância do centro do eixo, maior rigidez e resistência de toda a viga

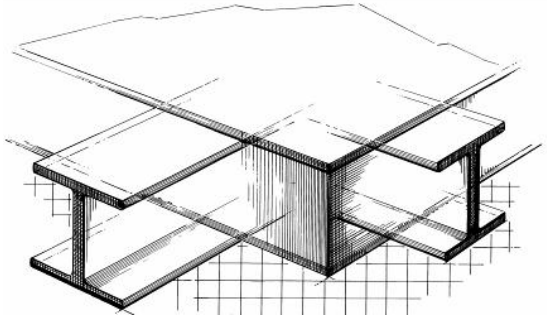
Flexural stresses in single skin (monolithic)



... and in a sandwich



I-beam analogy in steel constructions

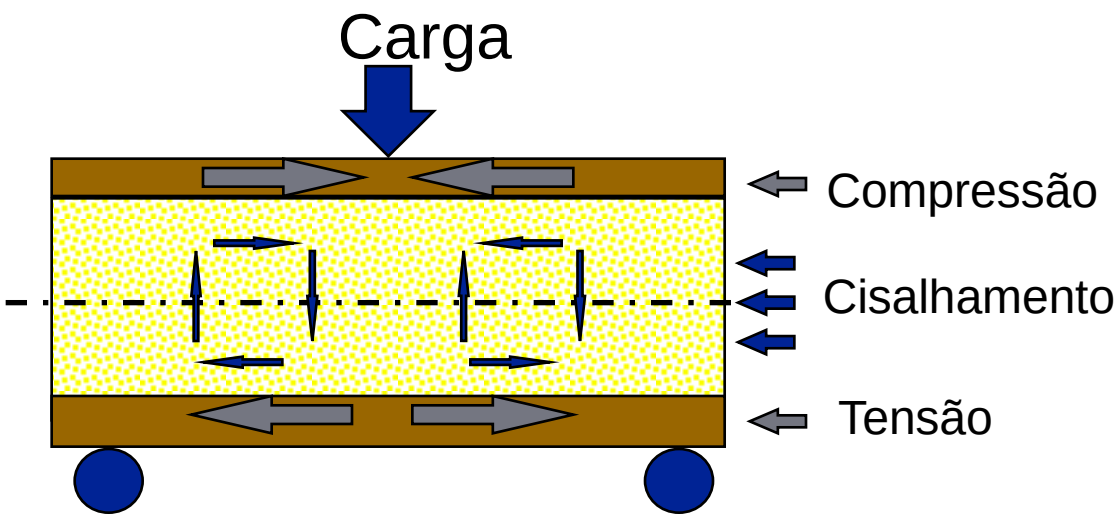


➡ O material “duro“ é locallizado nas camadas externas

Propriedades de Estruturas Sandwich

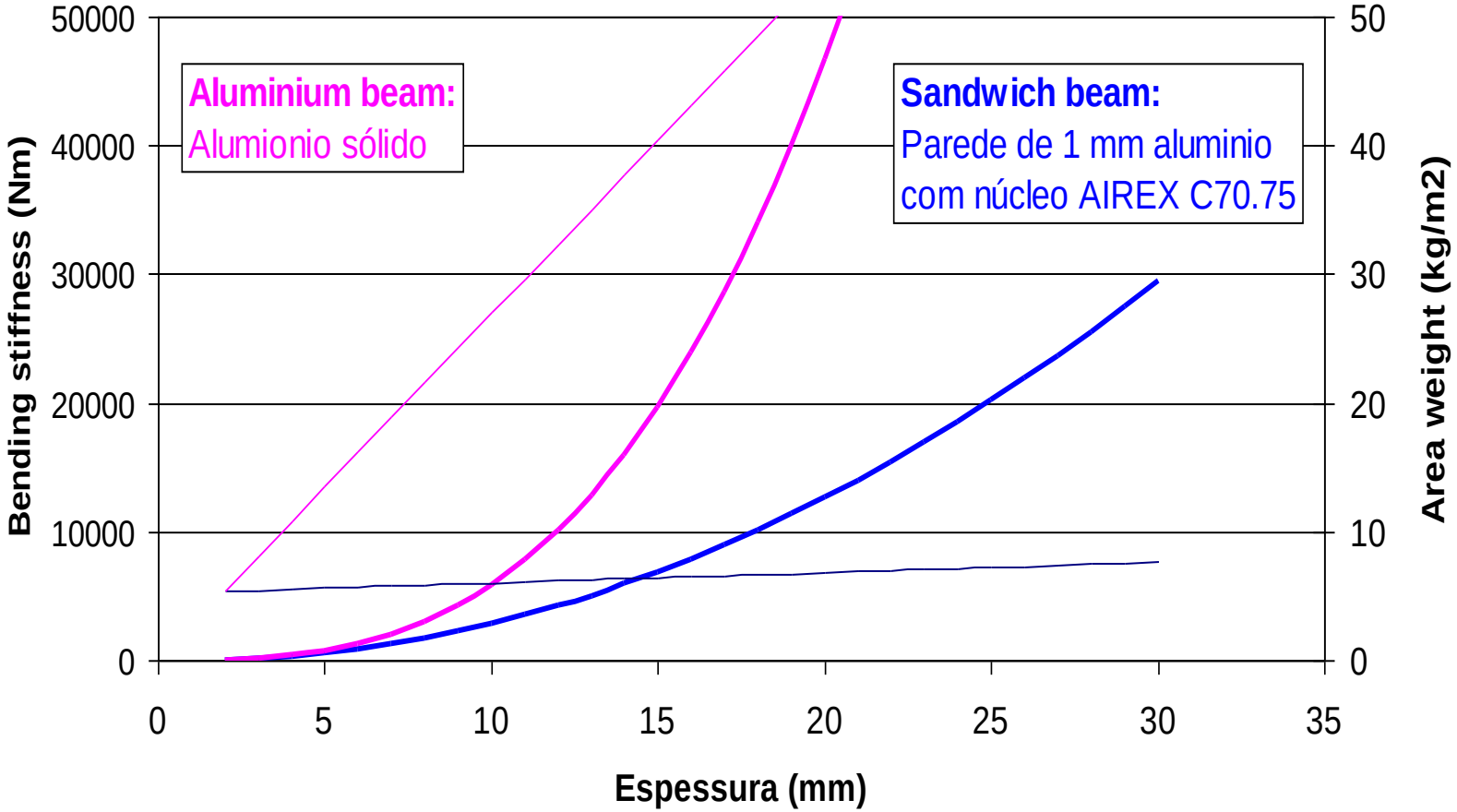
- Elevada relação rigidez x peso
- Resistências químicas
- Isolação térmica e acústica
- Boa superfície de acabamento
- Tolerância e resistência a impactos
- Constante performance das propriedades mecânicas independente do tamanho da peça

Esforços em uma estrutura Sandwich



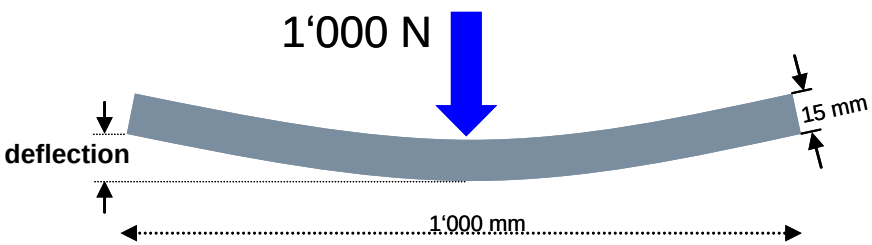
- As paredes sofrem os esforços, como os momentos e forças de tensão ou compressão.
- O núcleo sofre as forças transversais, como a tensão de cisalhamento.

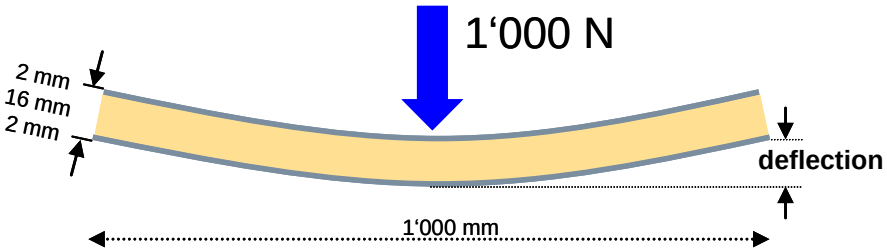
Exemplo - Resistência à flexão



Comparativo entre estrutura rígida X estrutura sandwich

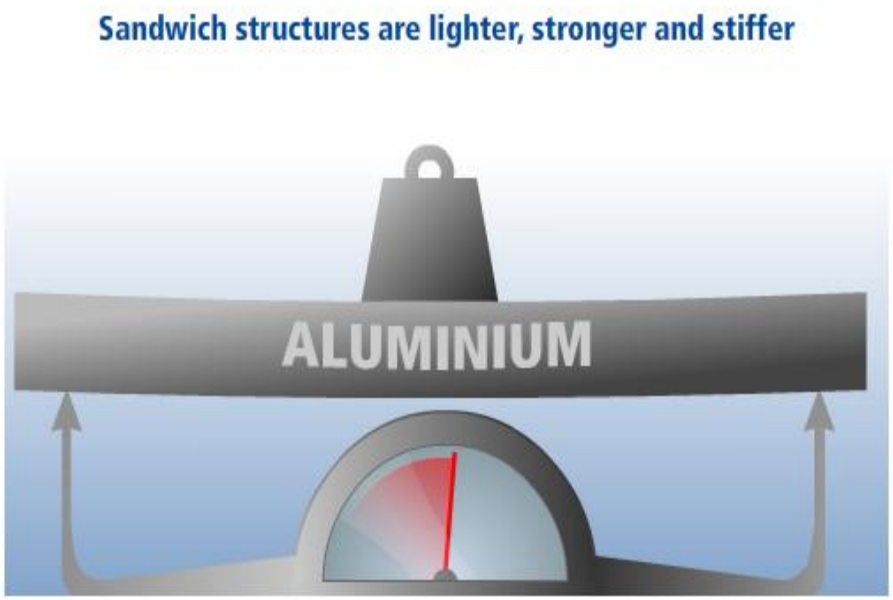
Weight reduction at identical strength and stiffness





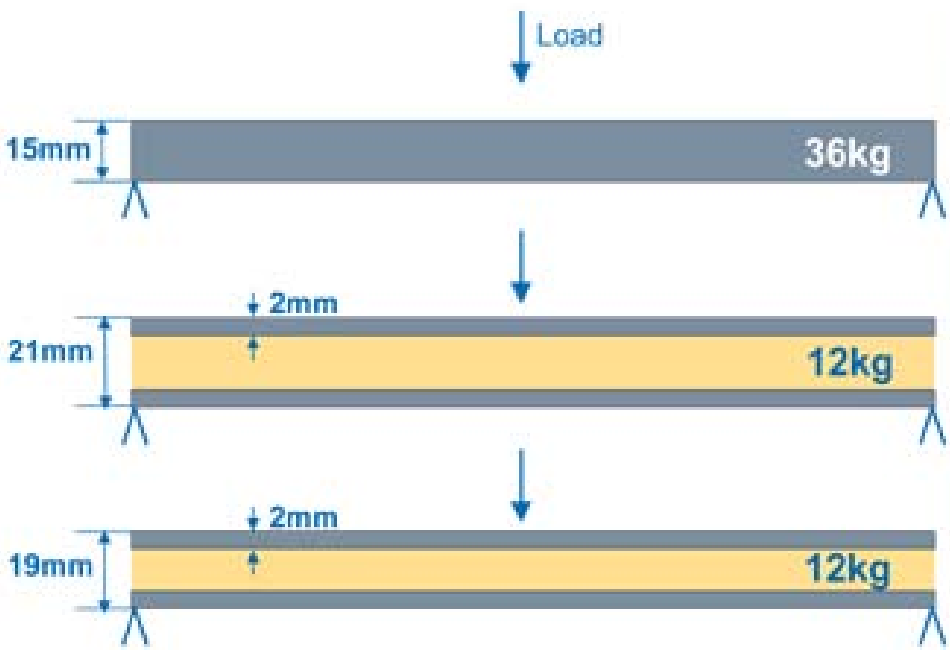
Failure load	1 (3‘030 N)	1 (2‘860 N)
Stiffness (deflection)	1 (46.3 mm)	1 (41.6 mm)
Weight	3 (7.1 kg)	1 (2.1 kg)

Comparativo entre estrutura rígida X estrutura sandwich



Comparativo entre estrutura rígida X estrutura sandwich

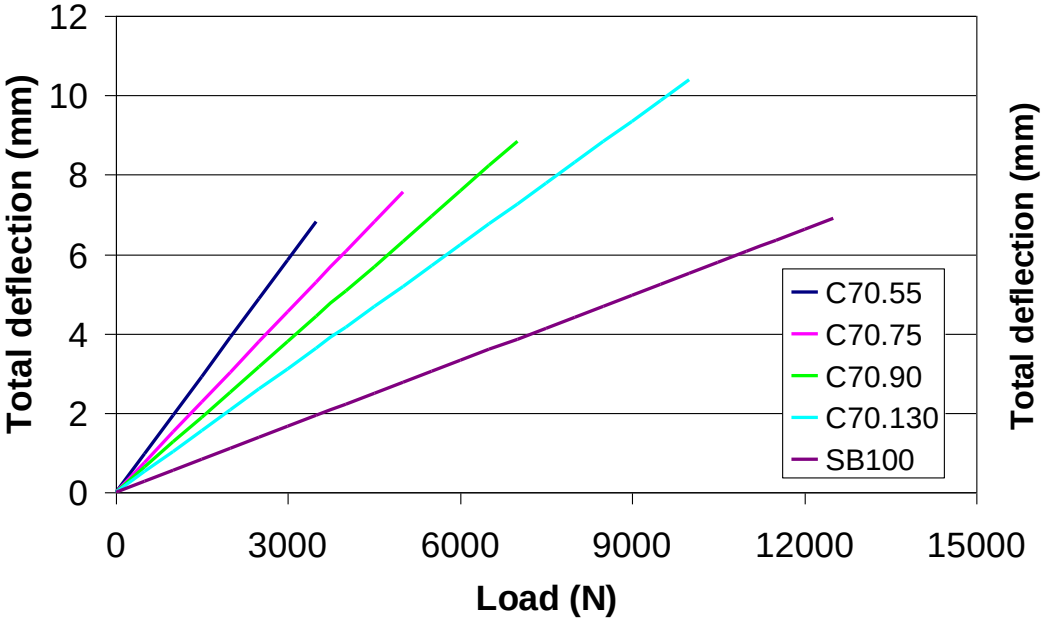
Sandwich structures are lighter, stronger and stiffer



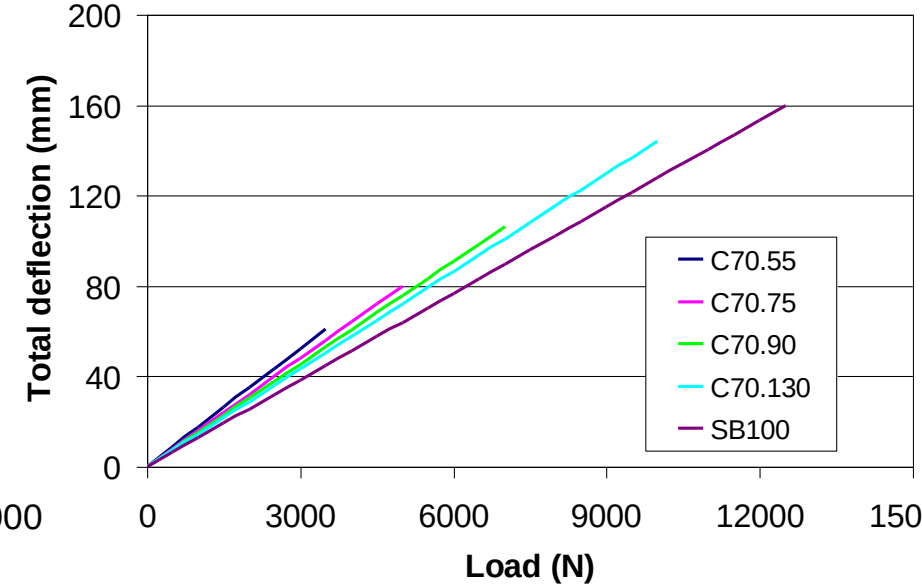
Weight	Deflection @ 1350N	max. Load
36kg	100mm	7500N
12.3kg	78mm	7500N
12kg	100mm	6800N

Influência da rigidez à cisalhamento na flexão de uma viga

Comprimento 300 mm



Comprimento 1000 mm



Espessura da face do Sandwich 1 mm alumínio, 20 mm de núcleo, apoio simples e carga central

Influência das propriedades do núcleo nas propriedades do Sandwich

Propriedades do núcleo	→	**Efeito no sandwich**
Resistência ao cisalhamento	→	Resistência à ruptura
Rigidez	→	Resistência à flexão
Resistência à compressão	→	Tolerância a danos
Formato da célula	→	Isolação térmica e acústica Fácil processamento Absorção de resinas

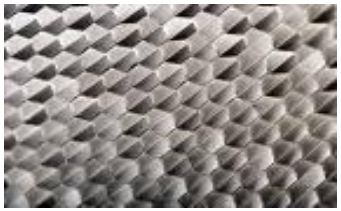
Alguns tipos de materiais de núcleo (core materials)

- Espumas poliméricas – Airex®

(PVC, PET, Uretano)

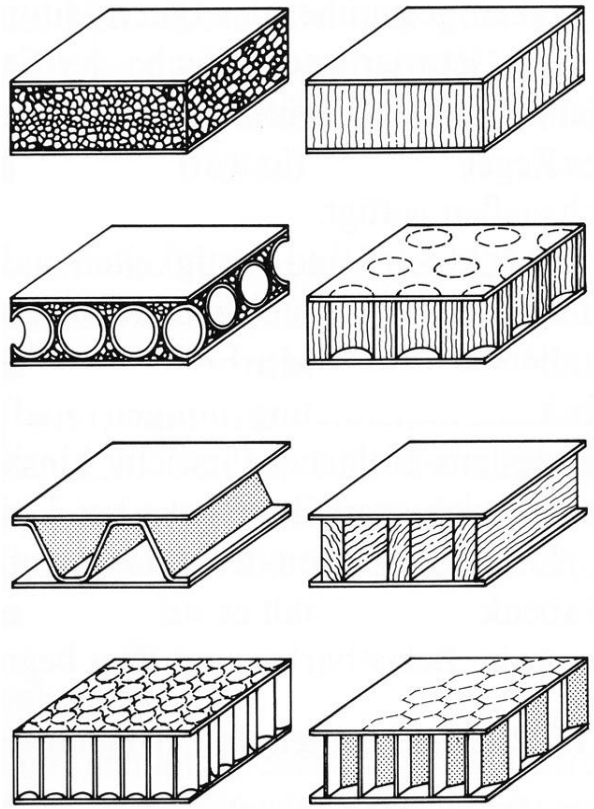
- Madeira – Baltek® (balsa)

- Colméia (Honeycomb)



Tipos de Sandwich

- Núcleo de espuma
- Espuma com bolhas
- Folha corrugada
- Núcleo tubular



- Núcleo de balsa
- Núcleo de balsa com tubos
- Balsa com tarugos verticais
- Núcleo tipo colméia

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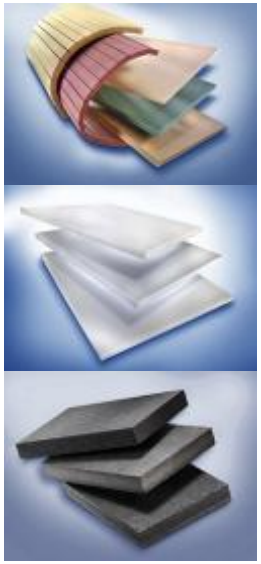
The widest selection of core materials

Structural foam core materials

- AIREX® R63 – Damage Tolerant Foam
- AIREX C70 – Universally Structural Foam
- AIREX C71 – Elevated Temperature Structural Foam
- AIREX R82 – High Performance Foam
- AIREX T90 – Fire Resistant Easy Processing Structural Foam
- AIREX T92 – Easy Processing Structural Foam
- AIREX C51 – Industrial Processing Foam
- AIREX PX – Fibre-Reinforced Structural Foam



Structural balsa core materials

- BALTEK® SB – Structural End-Grain Balsa

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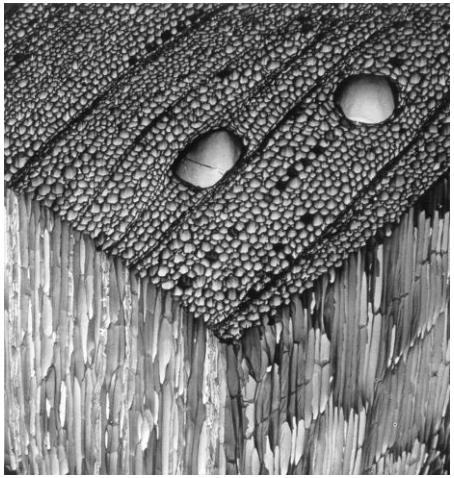
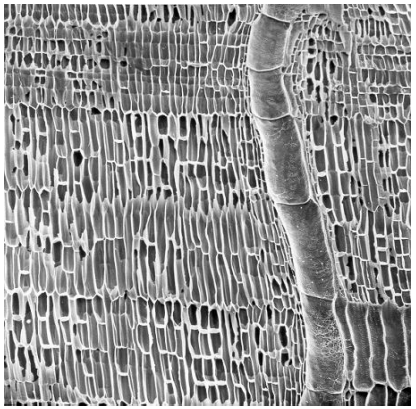
Estrutura da madeira Balsa

- Madeira Balsa é composta por fibras (celulose) e resina (lenhina);
- 92% do volume total é ar – estrutura de células fechadas;
- A baixa densidade e o tipo de estrutura celular são os itens que proporcionam à balsa excepcionais propriedades mecânicas.
- Balsa é um tipo de Honeycomb natural!





Características Principais

- Relação entre resistências mecânicas versus peso elevada
- Relação entre rigidez versus peso extremamente alta.
- Não propaga chama.
- Compatível com todos os tipos de resinas e adesivos
- Ampla faixa de temperatura de trabalho (-212°C até +163°C).
- Excelente resistência à fadiga.
- Bom isolante térmico e acústico.
- Alta resistência ao impacto.
- Madeira de reflorestamento.

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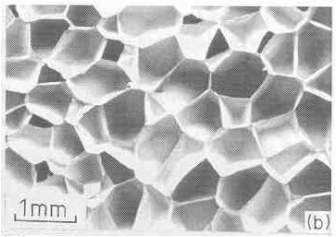
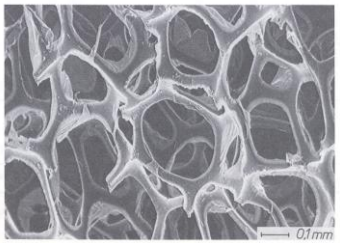
Tipos de espuma:

- Célula fechada

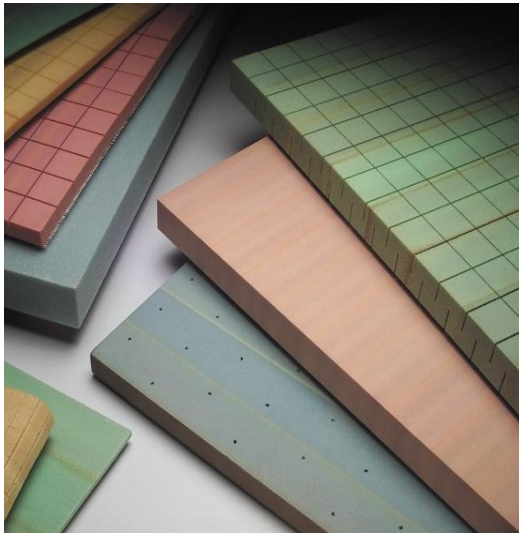


- Célula aberta



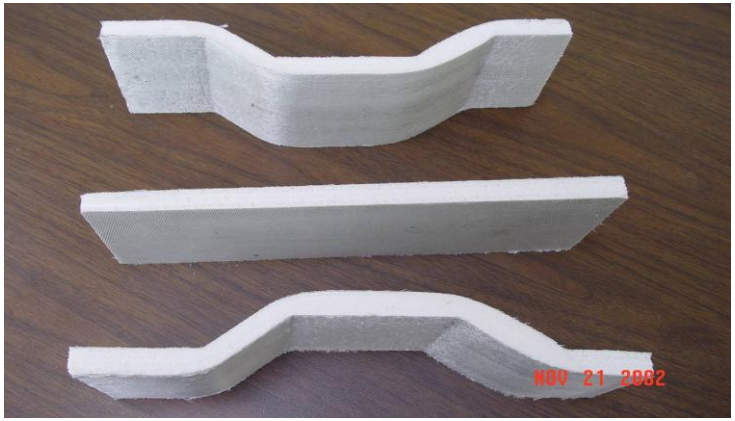
AIREX® C70 – Espuma de PVC

- Características Principais:
  - Elevada relação de rigidez x peso
  - Elevada relação de resistências mecânicas x peso
  - Boa resistência ao impacto
  - Baixa absorção de resina
  - Alta resistência à fadiga
  - Não propaga chama (auto – extinguível)
  - Bom isolante térmico e acústico
  - Boa resistência ao estireno



AIREX® T90 – Espuma de PET (polietileno-tereftalato)

- Características Principais:
  - Compatível com as principais resinas.
  - Propriedades FST elevadas (FAR25. 853; NF16. 101; DIN5510).
  - Classificação aeronáutica M1 F1
  - Excelente resistência à fadiga e deformação.
  - Estável em operações em ambientes até 100°C
  - Excelente resistência química.
  - Termoformável.
  - Reciclável.



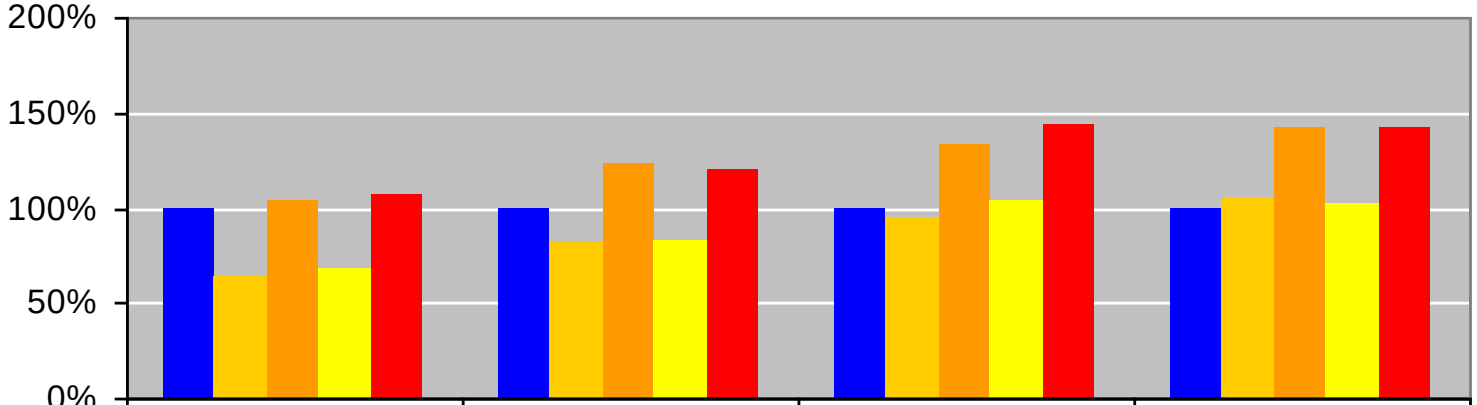
AIREX® T90 – Fire Resistance

Excelente comportamento resistente à propagação de chama, emissão de fumaça e gases tóxicos.

NF F 16 101	DIN 5510
AIREX® T90 é qualificado em **M1** Inflamabilidade (measure with chips) **F1** densidade da fumaça **F1** gás tóxico	**AIREX® T90** é qualificado em **S4** Inflamabilidade **SR2** densidade da fumaça **ST2** gotejamento

Mechanical properties of AIREX® T92.100 vs. C70 / C71

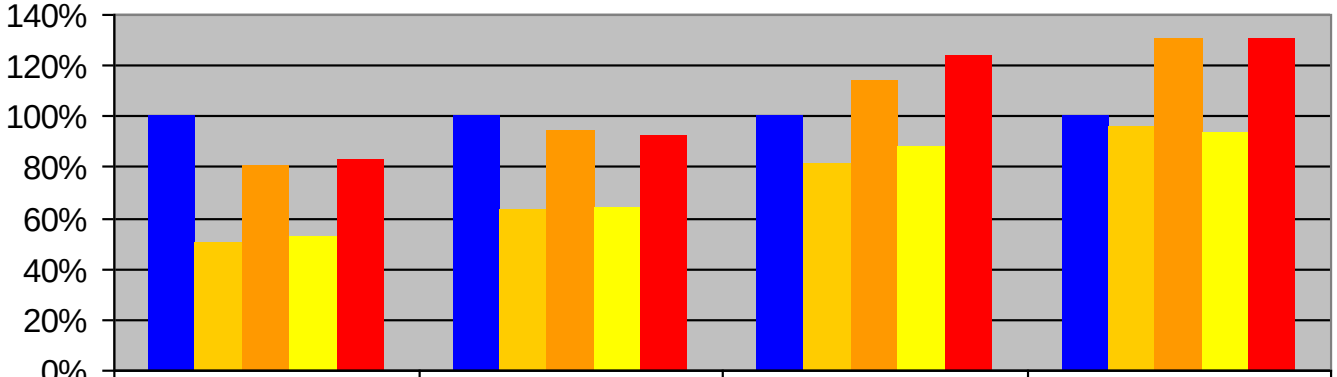
Relative Mechanical Properties (T92.100 = 100%)



	Compr. Strength	Compr. Modulus	Shear Strength	Shear Modulus
T92.100	100%	100%	100%	100%
C70.55	64%	81%	94%	105%
C70.75	104%	122%	133%	143%
C71.55	68%	82%	103%	102%
C71.75	107%	120%	144%	143%

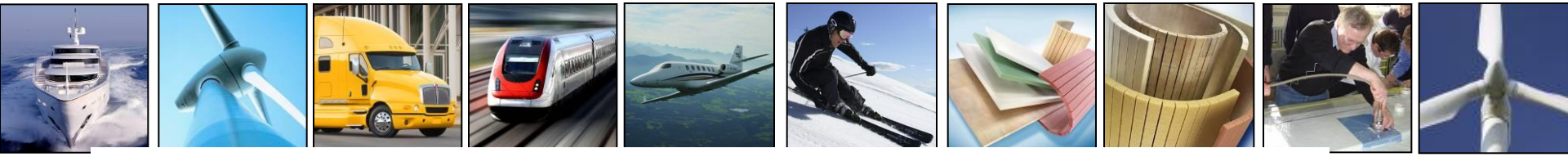
Mechanical properties of AIREX® T92.110 vs. C70 / C71

Relative Mechanical Properties (T92.110 = 100%)

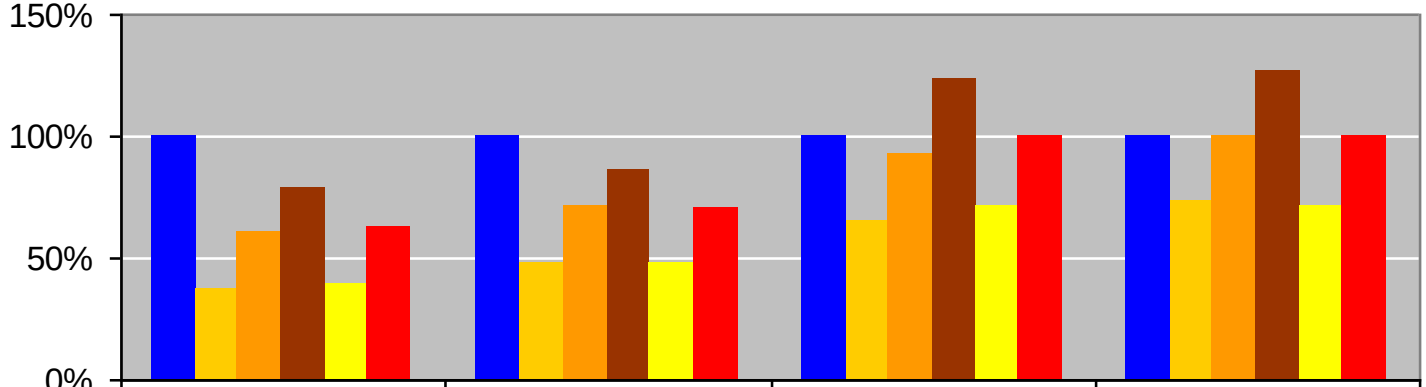


	Compr. Strength	Compr. Modulus	Shear Strength	Shear Modulus
T92.110	100%	100%	100%	100%
C70.55	50%	63%	81%	96%
C70.75	81%	95%	114%	130%
C71.55	53%	64%	89%	93%
C71.75	83%	93%	124%	130%

Mechanical properties of AIREX® T92.130 vs. C70 / C71



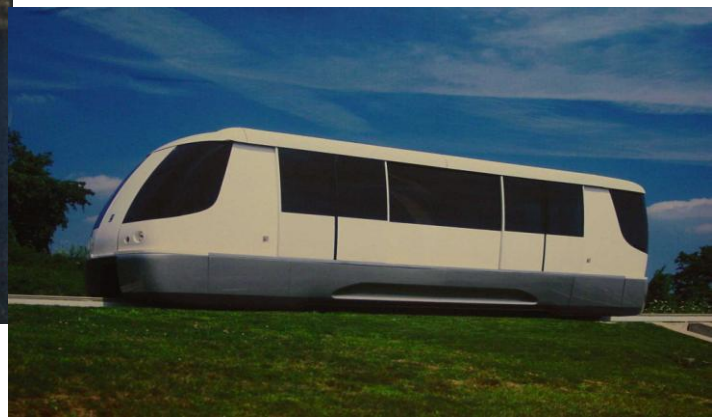
Relative Mechanical Properties (T92.130 = 100%)



	Compr. Strength	Compr. Modulus	Shear Strength	Shear Modulus
T92.130	100%	100%	100%	100%
C70.55	38%	48%	65%	73%
C70.75	60%	72%	92%	100%
C70.90	79%	86%	123%	127%
C71.55	40%	48%	72%	72%
C71.75	63%	70%	100%	100%

Mercados

- Náutico
- Geradores Eólicos
- Transportes
- Aéreo
- Industrial



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Náutico

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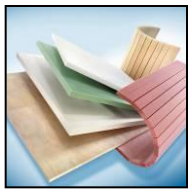

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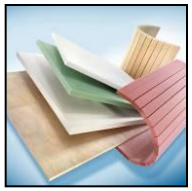
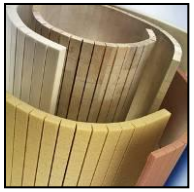

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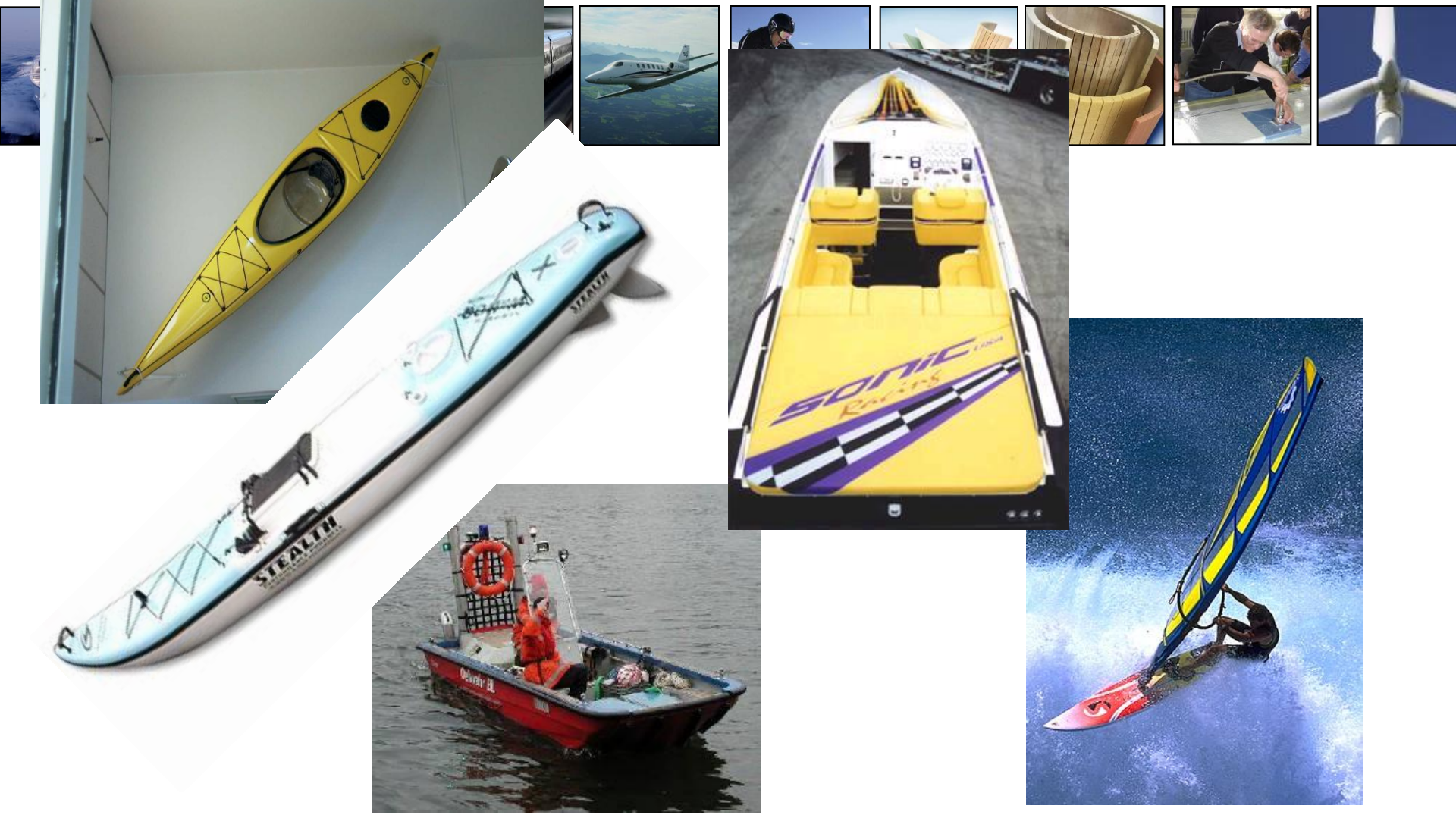
Barcos, lanchas, veleiros, botes e material esportivo



Energia eólica

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Energia Eólica

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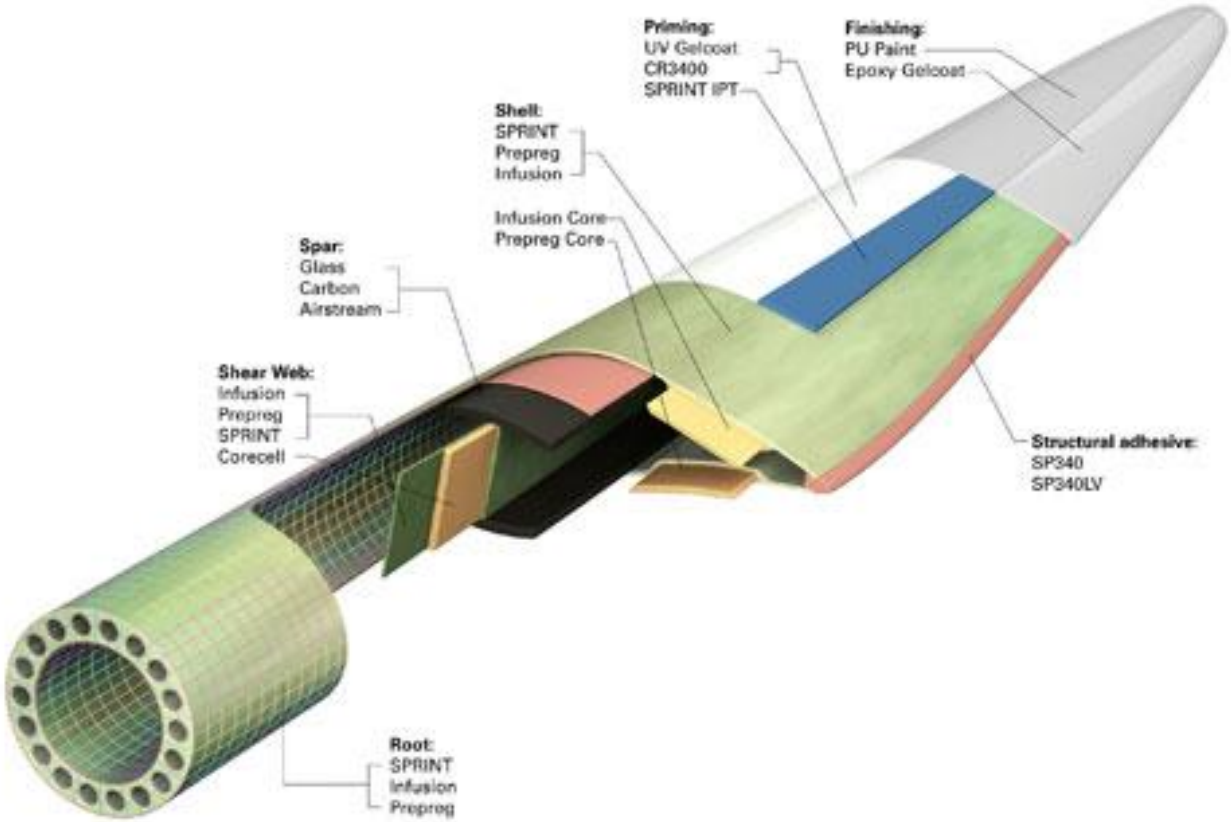


Energia Eólica – pás para turbinas

Borda de ataque da lâmina (A)

- Máxima dureza
- Baixo peso

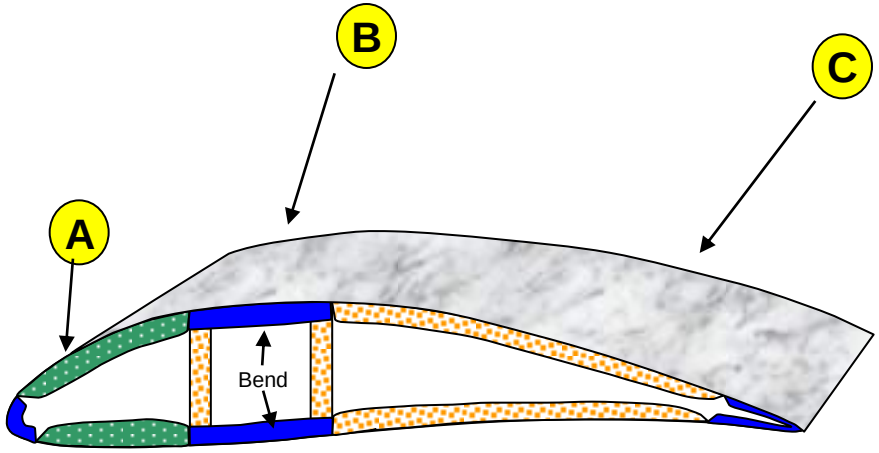
•**Rede de cisalhamento (B)**

- Sem enrugamento na face
- Sem dobra de cisalhamento na rede
- Elevado módulo de cisalhamento
- Elevado módulo de compressão
- Boa resistência a fadiga

•**Borda de araste da lâmina (C)**

- Elevada dureza
- Sem dobra na casca
- Possibilidade de baixo peso

Exemplo:



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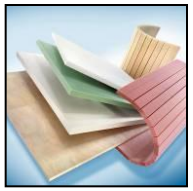
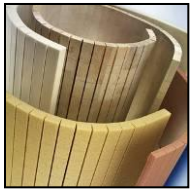
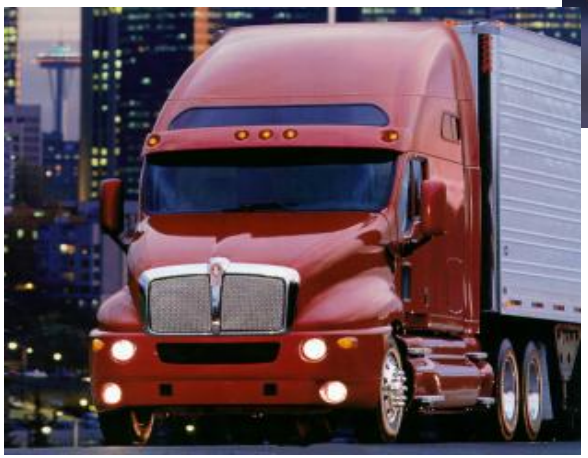
Energia Eólica

Transporte rodoviário



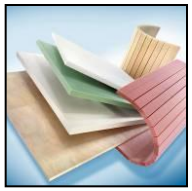
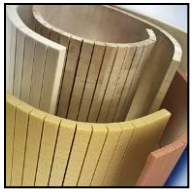
Aplicações

- **Ônibus**
- **Caminhões**
- **Vans e trailers**
- **Carros**
- **Veículos especiais**

AIREX BALTEK
EXCELLENCE IN CORE SOLUTIONS

Bus

3A COMPOSITES

Exemplo – ônibus em compósitos estrutura externa

Materiais de núcleo para aplicações inovadoras de trem

Trem de alta velocidade

Trens convencionais

Transporte urbano

Carros com cabos.

Toyota - Japão

INOVIA People Mover ADtranz

- **Areas of Application:**
- **Composite Carshell, Doors and Integral Composite Floor**

People Movers

- Japan Airport
  - Composite carshell and doors
  - Otis transit systems
- Cincinnati Airport
  - Composite carshell
  - Otis transit systems

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Amtrak NEC Bombardier

3A COMPOSITES

Areas of Application:

- Cab - 1 1/2” CK 57 AL600/10®
- Skirts - 1/2” CK 57 AL600/10®
- Toilet Modules - 1/4” & 3/8” CK100
- Interior Liners - Airex® R82.80

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BART of San Francisco

3A COMPOSITES

Areas of Application:

- **Cab - A Cars: 1/2”, 3/4” and 1” CK100**
- **Floors - A&B Cars: 2” D100®**
- **Floors - C Cars: 1.25” D100®**
- **Windscreens - A,B&C Cars : 1” D100®**

Note: All floors are retrofit

San Juan, Puerto Rico Tren Urbano Siemens Transportation

Areas of Application:

Floors: .40” D100® AL600/10®

(Phenolic Composite Skins)

Cab: 1/2” & 3/4” CK 100

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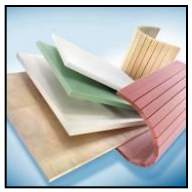
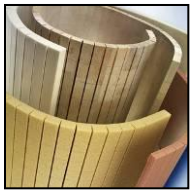
EXCELLENCE IN CORE SOLUTIONS

Other Rail Applications:

3A COMPOSITES

NORTH AMERICA:

New York / New Jersey PATH	St. Louis Car	Floors - replacement
Philadelphia SEPTA (Norristown)	ABB / Amtrak	Floors
Philadelphia SEPTA (Market-Frankfort)	ADtranz	Floors

Amtrak Surf Liner	Alstom	Interior & Toilet Modules
Boston MBTA	Kawasaki	Floors, Windscreens, & Partitions
AMTRAK Superliner	Bombardier	Composite Sleeper Modules

GM/EMD Locomotives — Toilet Modules, Cab Console, & Interior Liners

Other Rail Applications:

EUROPE:

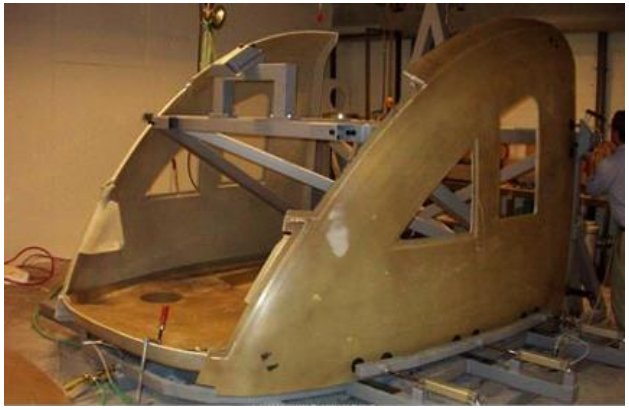
Eurotunnel	Bombardier	Floors
TGV	ANF/Alstom	Deflector & Roof
Metro of Lyon	Alstom	Floors
Norwegian State Railway, T-73 Express	ABB Offshore Tech.	Drivers Cab
Stockholm Metro, C-20	ADtranz	Drivers Cab
Transteck Pendolino	OY Joptek Ab / Transtek	Floors
Transteck Double-decker	OY Joptek Ab / Transtek	Floors & Interior Panels
Danish State Railway - Oresundstoget	Adtranz	Destination signs, Ventilation intake, Interior panels & Toilet modules.

Latest Applications – AIREX® T90

- Partition wall for “Combino” train built by Siemens Transportation
- E-glass, phenolic resin
- AIREX T90.100 core
- Meets fire requirements DIN5510 and upcoming EU fire directive

Jupiter Plast DK: T90.120

- Jupiter is a leading train part manufacturer (e.g. Pendolino)
- Uses T90 for front and roof construction
- Growing volumes up to 0.5 Mio CHF



Drivers

- FST, no PVC
- Price

Stadler Rail: T90.100

- Stadler is a leading small train and tram manufacturer
- Evaluating use of T90 for front, roof and floor construction
- Innovative Swiss production sites

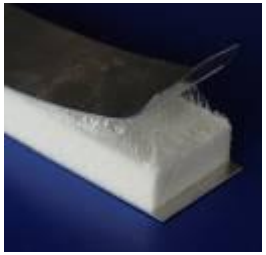
Drivers

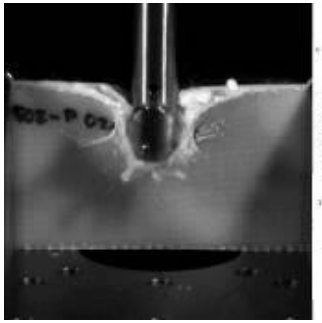
- FST
- Price

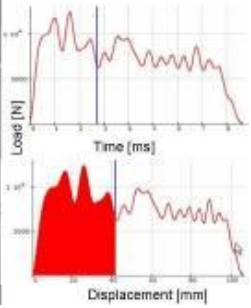
Baltek Inc.

Customized support

- Consulting: sandwich-technology & -processing
- Certification
- Material tests
  - Mechanical tests
  - Processing parameters
  - Various other tests in cooperation with external laboratories
- Research & Development in cooperation with customers and universities







AIREX BALTEK
EXCELLENCE IN CORE SOLUTIONS

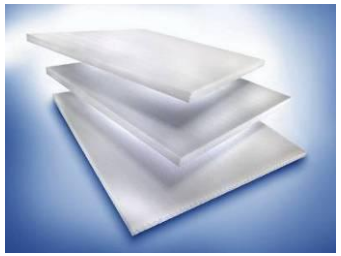
Baltek Inc.

3A COMPOSITES

Innovation & Technology

- First to develop end grain balsa core
- First to develop flexible sandwich core sheets
- First to develop sealer coating for balsa surface
- First to develop optimized configurations for resin infusion
- First to receive FSC certification for balsa plantations
- Leaders in extruded structural foam core technology
- Leaders in composite laminate and structural core testing and evaluation

FSC ©



Exemplo – piso, forro e lateriais (mono-rail)

AIREX BALTEK
EXCELLENCE IN CORE SOLUTIONS

Forro interno estrutural

3A COMPOSITES

AIREX BALTEK
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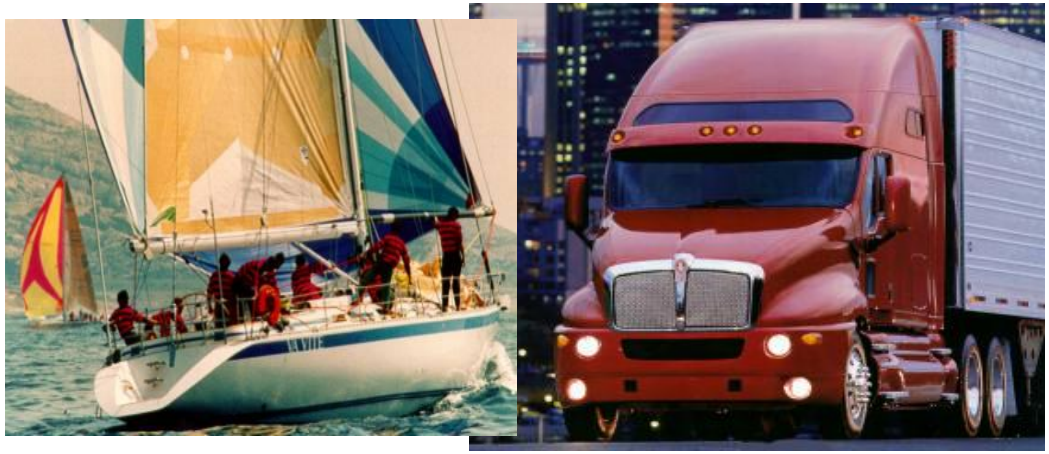
Piso para trem na Suíça

3A COMPOSITES

3A Composites – Core Materials



"Excelência em aplicações de estruturas Sandwich"

AIREX BALTEK
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3A Composites - Core Materials

3A COMPOSITES

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