COMPOSITE AEROSPACE STRUCTURES: CHALLENGES AND OPPORTUNITIES

Edson da Silva Barbosa
Francisco Kioshi Arakaki
José Maria Fernandes Marlet
Silvio Luiz Francisco Osório
Embraer S.A.

November / 2014

Content

1- Introduction to advanced composites

2- Evolution of composite materials

3- Composite evolution at Embraer

4- Evolution on rudder's conception

5- Final considerations

This information is property of Embraer and cannot be used or reproduced without written permission.

Content

1- Introduction to advanced composites

2- Evolution of composite materials

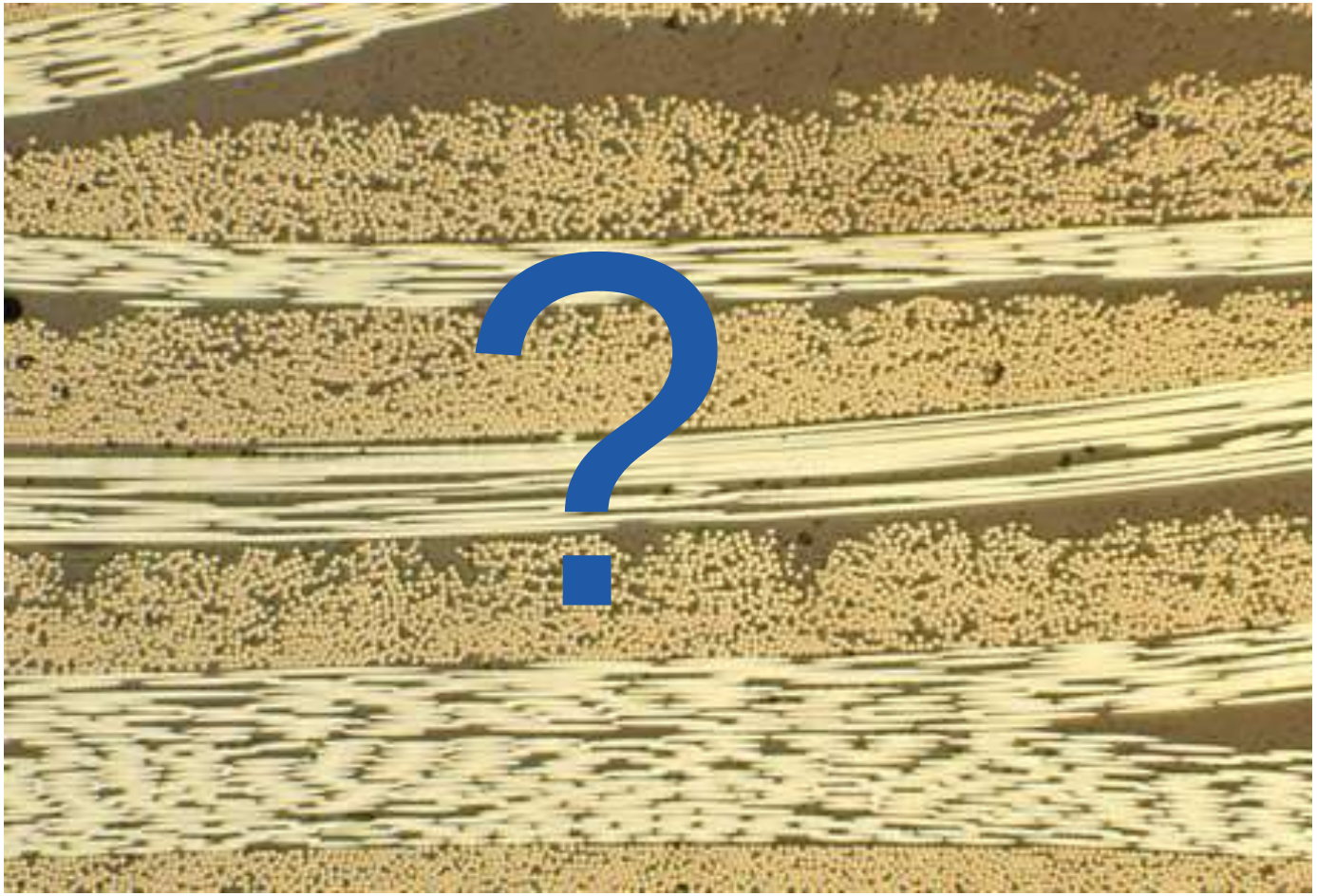
3- Composite evolution at Embraer

4- Evolution on rudder's conception

5- Final considerations

This information is property of Embraer and cannot be used or reproduced without written permission.

1- Introduction to advanced composites



http://www.metallographic.com/Technical/Metallography-Intro.html

This information is property of Embraer and cannot be used or reproduced without written consent.

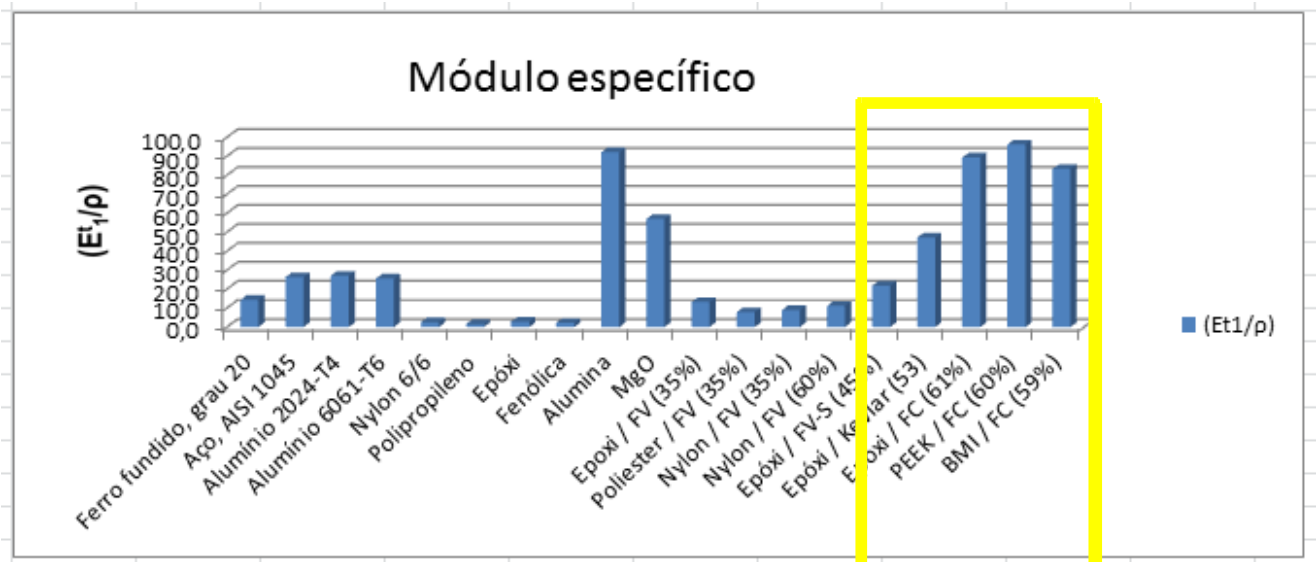
1- Introduction to advanced composites

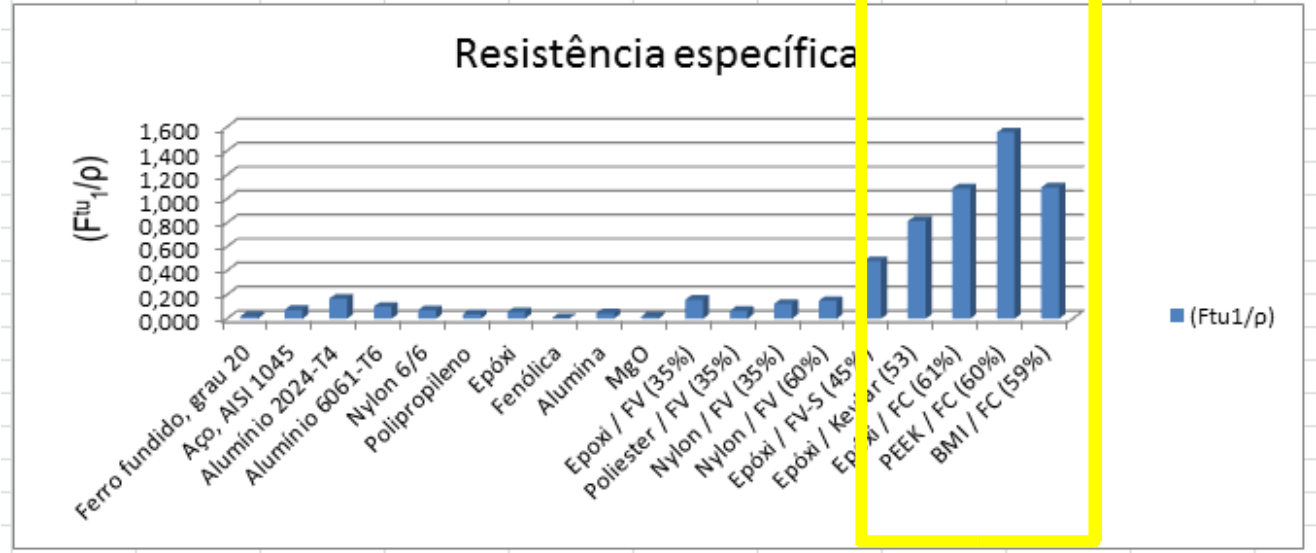
		Densidade	Tração		Módulo específico	Resistência específica	Máxima T de serviço
		ρ	E^t_1	F^{tu}_1			
		(g/cm^3)	(GPa)	(GPa)	(E^t_1/ρ)	(F^{tu}_1/ρ)	(ºC)
Metais	Ferro fundido, grau 20	7,0	100	0,14	14,3	0,020	230-300
	Aço, AISI 1045	7,8	205	0,57	26,3	0,073	500-650
	Alumínio 2024-T4	2,7	73	0,45	27,0	0,167	150-250
	Alumínio 6061-T6	2,7	69	0,27	25,6	0,100	150-250
Plásticos	Nylon 6/6	1,15	2,9	0,082	2,52	0,071	75-100
	Polipropileno	0,90	1,4	0,033	1,56	0,037	50-80
	Epóxi	1,25	3,5	0,069	2,80	0,055	80-215
	Fenólica	1,35	3	0,006	2,22	0,004	70-120
Cerâmicas	Alumina	3,8	350	0,17	92,1	0,045	1425-1540
	MgO	3,6	205	0,06	56,9	0,017	900-1000
Compósitos com fibras picadas	Epoxi / FV (35%)	1,90	25	0,30	13,16	0,158	80-200
	Poliester / FV (35%)	2,00	15,7	0,13	7,85	0,065	80-125
	Nylon / FV (35%)	1,62	14,5	0,20	8,95	0,123	75-110
	Nylon / FV (60%)	1,95	21,8	0,29	11,18	0,149	75-110
Compósitos com reforços unidirecionais	Epóxi / FV-S (45%)	1,81	39,5	0,87	21,8	0,48	80-215
	Epóxi / FC (61%)	1,59	142,0	1,73	89,3	1,09	80-215
	Epóxi / Kevlar (53)	1,35	63,6	1,10	47,1	0,81	80-215
	PEEK / FC (60%)	1,55	149,0	2,41	96,1	1,55	120-250
	BMI / FC (59%)	1,56	130,0	1,71	83,3	1,10	230-320

Ref.: Mazumdar e MIL-HDBK-17 vol. 2

This information is property of Embraer and cannot be used or reproduced without written consent.

1- Introduction to advanced composites





This information is property of Embraer and cannot be used or reproduced without written consent.

Content

1- Introduction to advanced composites

2- Evolution of composite materials

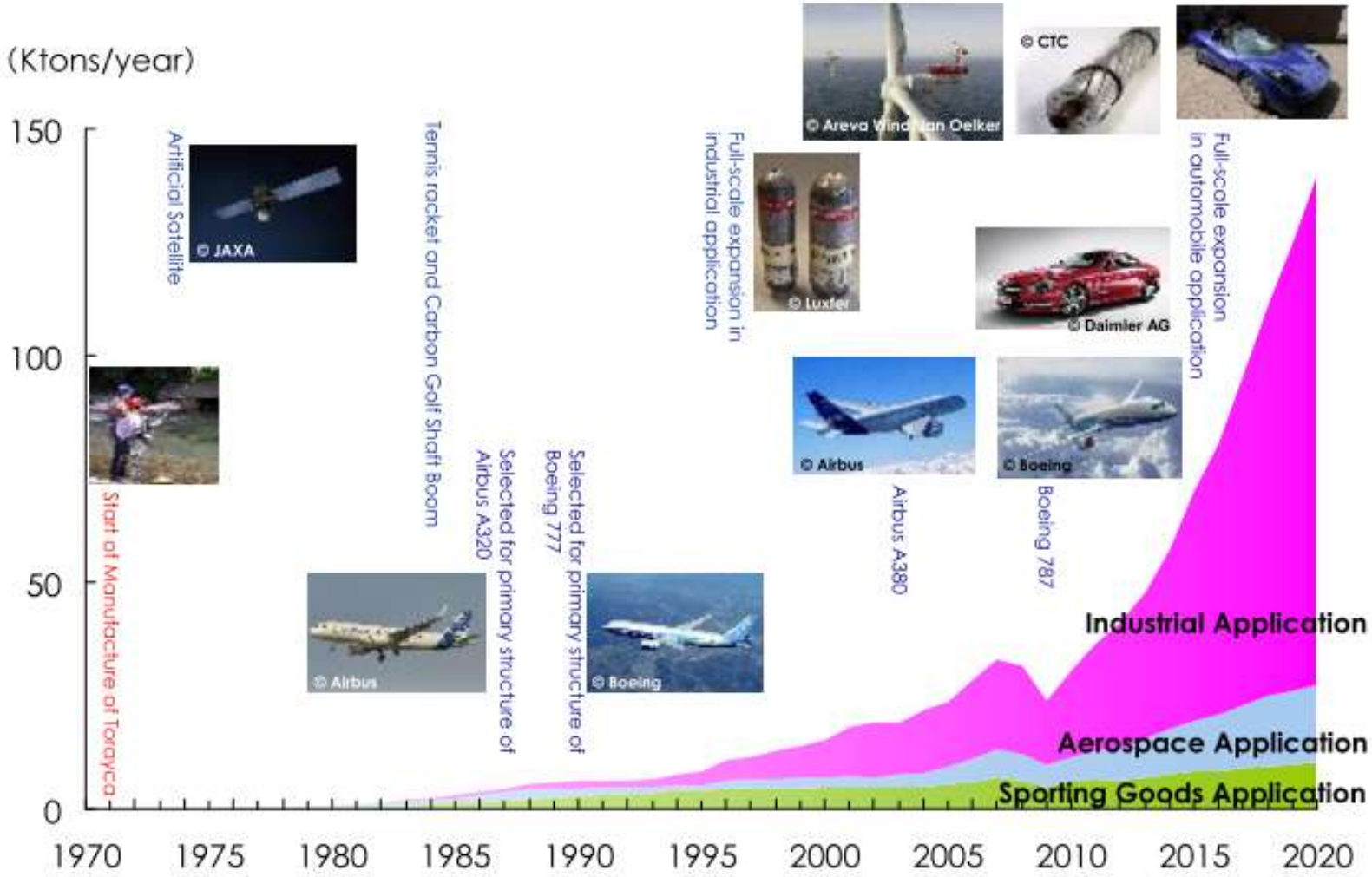
3- Composite evolution at Embraer

4- Evolution on rudder's conception

5- Final considerations

This information is property of Embraer and cannot be used or reproduced without written consent.

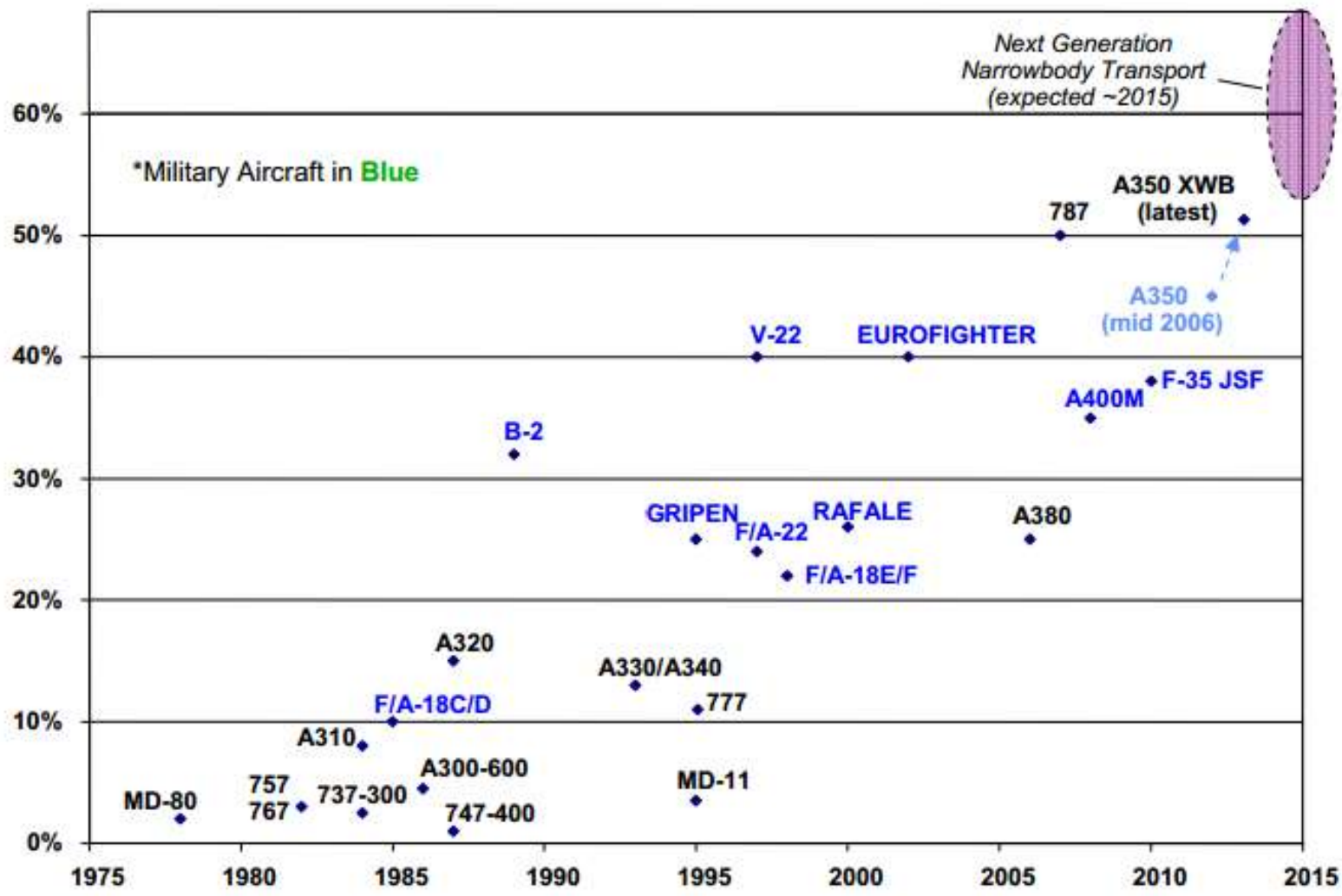
2- Evolution of composite materials



Ref.: http://www.toray.com/ir/pdf/lib/lib_a136.pdf

This information is property of Embraer and cannot be used or reproduced without written consent.

2- Evolution of composite materials



http://webfiles.wichita.edu/cedbr/WIRED_comp_ov_5_14_08.pdf

This information is property of Embraer and cannot be used or reproduced without written consent.

Content

1- Introduction to advanced composites

2- Evolution of composite materials

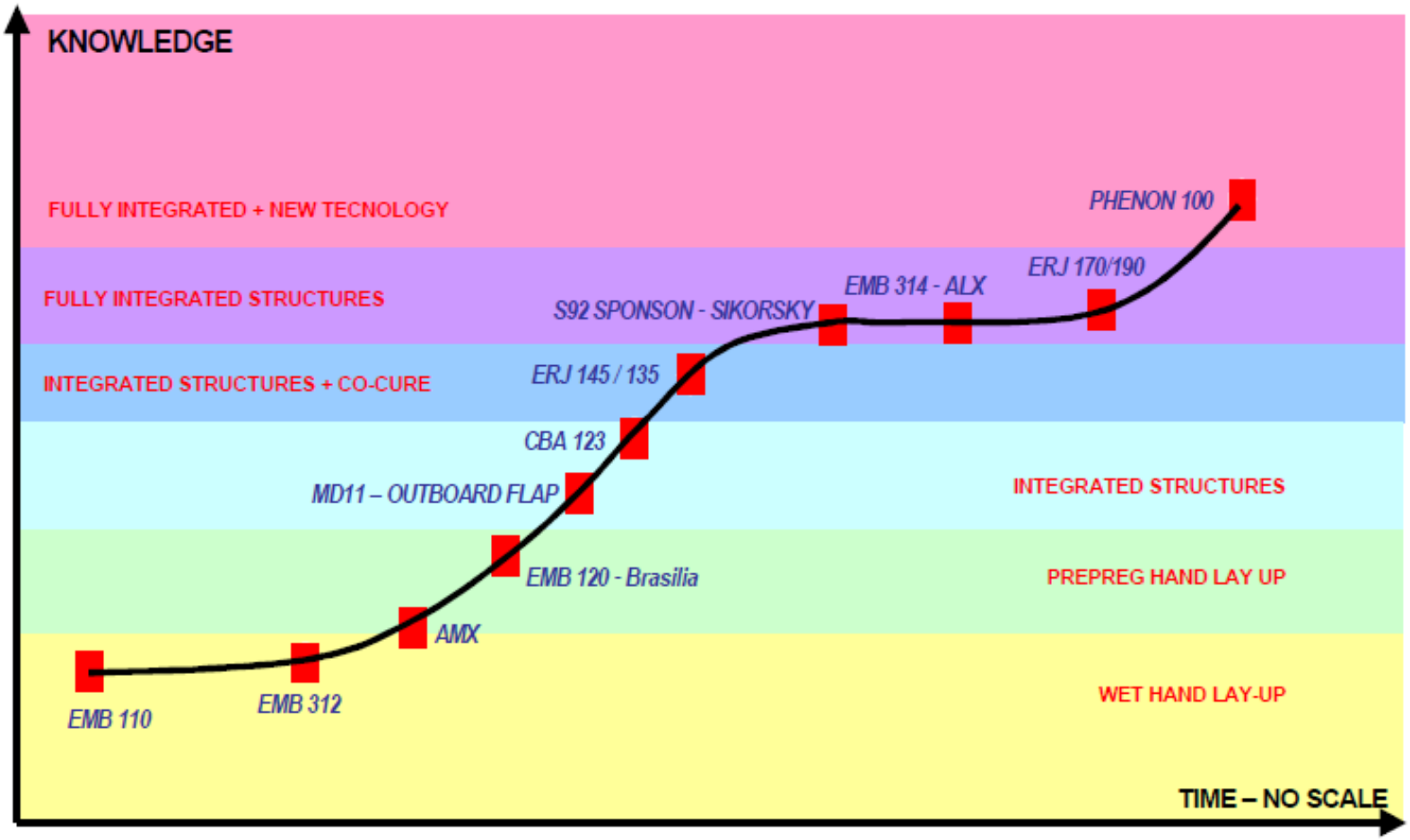
3- Composite evolution at Embraer

4- Evolution on rudder's conception

5- Final considerations

This information is property of Embraer and cannot be used or reproduced without written consent.

3- Composite evolution at Embraer



This information is property of Embraer and cannot be used or reproduced without written consent.

3- Composite evolution at Embraer

EMBRAER 170/190 Composite Rudder

LEGACY 500 Composite Empennage

Ref.: http://www.aernnova.com/user/en/popup_imagen.php?img=embraer170_3.jpg
Ref.: http://www.ainonline.com/sites/default/files/uploads/legacy500empennage.jpg

This information is property of Embraer and cannot be used or reproduced without written consent.

Content

1- Introduction to advanced composites

2- Evolution of composite materials

3- Composite evolution at Embraer

4- Evolution on rudder's conception

5- Final considerations

This information is property of Embraer and cannot be used or reproduced without written consent.

4- Evolution on rudder's conception

EMB-120 "Brasília" rudder

This information is property of Embraer and cannot be used or reproduced without written consent.

4- Evolution on rudder's conception

CBA-123 rudder

This information is property of Embraer and cannot be used or reproduced without written consent.

4- Evolution on rudder's conception

ALX-314 "Super Tucano" rudder

This information is property of Embraer and cannot be used or reproduced without written consent.

4- Evolution on rudder's conception

- components number from 100 to 33
- weight reduced from 16 kg to 12 kg (25%)

This information is property of Embraer and cannot be used or reproduced without written consent.

Content

1- Introduction to advanced composites

2- Evolution of composite materials

3- Composite evolution at Embraer

4- Evolution on rudder's conception

5- Final considerations

This information is property of Embraer and cannot be used or reproduced without written consent.

5- Final considerations

Composite aerospace structures

http://www.usp.br/imprensa/?p=18788

This information is property of Embraer and cannot be used or reproduced without written consent.

Thank you

THE INFORMATION CONTAINED HEREIN IS THE PROPERTY OF EMBRAER AND IT SHALL NOT BE COPIED NOR USED IN ANY MANNER EXCEPT AS EXPRESSLY AUTHORIZED