MECAER | AVIATION | GROUP

ADDITIVE MANUFACTURING

CASE STUDY: MAKE OR BUY

Rome, 28/09/2017

Index

Introduction to MAG group

Mecaer Aviation Group (MAG) - headquartered in Borgomanero (Novara, Italy) - is a key Player in the Aerospace Market…

Technology and style with strong commitment in R&D activity

Strong backlog thanks to the increasing involvement in strategic and long-term international programs

Consolidated international and high quality client portfolio

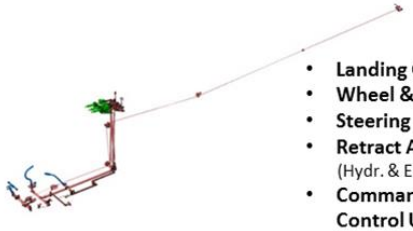
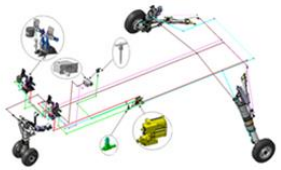
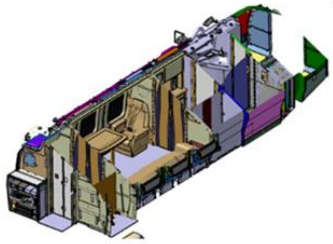
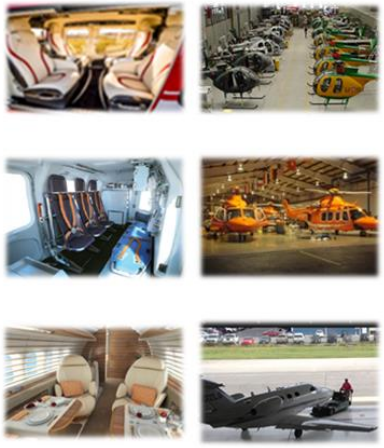
Differentiating role as system integrator

…through the design, manufacturing, certification and product support of Landing Systems, Actuation & Flight Control Systems, Cabin Comfort Systems and through Aircraft Completion and MRO & Refurbishment Services

Introduction to MAG group (cont'd)

Lines of business

MAG offers systems and equipment as a Tier 1 provider to OEMs as well as aircraft services to OEMs and End-Users

DIVISIONS	Actuation & Landing Systems	Cabin Comfort Systems	Aircraft Services
BUSINESS LINES	• Actuation & Flight Control Systems (AFCS) • Landing Systems (LS) Design & Production of Kits	• Cabin Comfort Systems (CCS) (Oil & Gas - VIP & VVIP - EMS & SAR - Utility)	• Style Design • Mission Customization & MRO • Installed Kit
PRODUCTS	 • Landing Gear • Wheel & Brake • Steering • Retract Actuator (Hydr. & EMA) • Command Lever & Control Unit (Hydr. Manifold, Electronic) • Pilot Stick and Pedal Assy • Command Chain (Mechanical Rods, Wire) • Actuator (Hydr. & EMA) • Servoactuator • Control Unit (Hydr. Manifold, Electronic) 	 • Liner and Silens • Cabin Management • Cabin Air Optimization • Lighting and Electrical • Water-Waste • Cabinet and Monument	
SITES	Borgomanero (Italy) / Laval (Quebec)	Monteprandone (Italy)	Rome (Italy) / Philadelphia Hagerstown (US)

mecaer.com-actuation AFCS | mecaer.com-landing systems LS | mecaer.com-cabin comfort systems CCS | mecaer.com-aircraft services AS

WHY POLYMERIC ADDITIVE LAYER MANUFACTURING FOR AERONAUTIC INTERIORS?

- In addition to:
  - Production time reduction
  - Complex shape not feasible with standard technologies
  - Cost saving
  - Weight saving

- Thermal compatibility with adjacent composite components
- No corrosion issues
- Ideal for electrical assemblies (Electrical equipment case)

ALM Technology on MAG projects

2011: VIP INTERIOR

Printer: STRATASYS

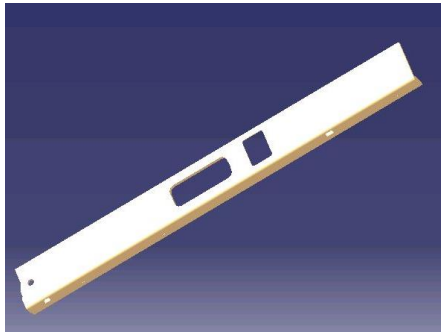
Material: ULTEM 9085

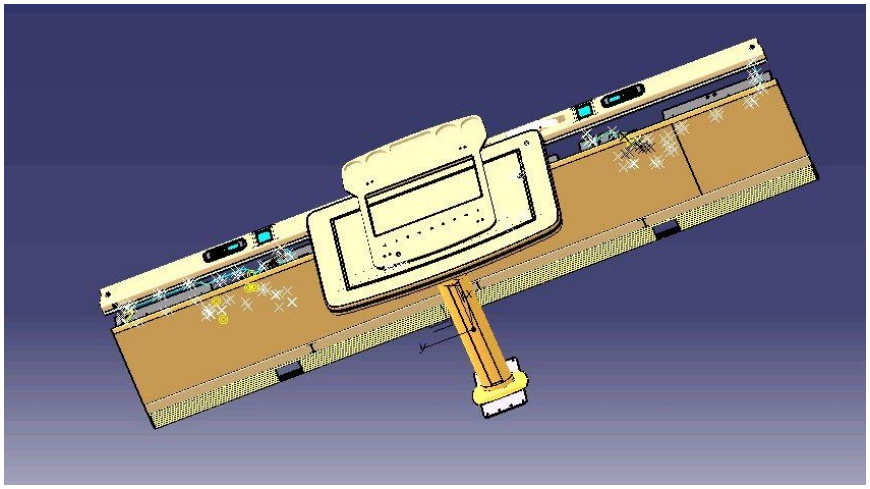
Aeronautical material compliants to FAR 25.853 (flame resistant)

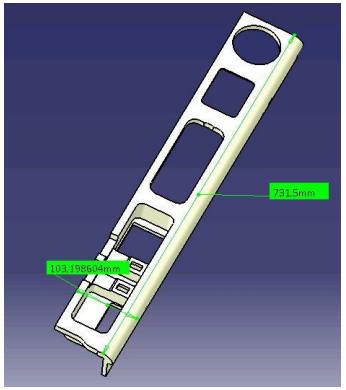
Price : 912 €

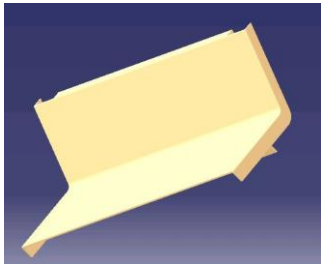
Manufacturing time: 5days

Slicing software: proprietary









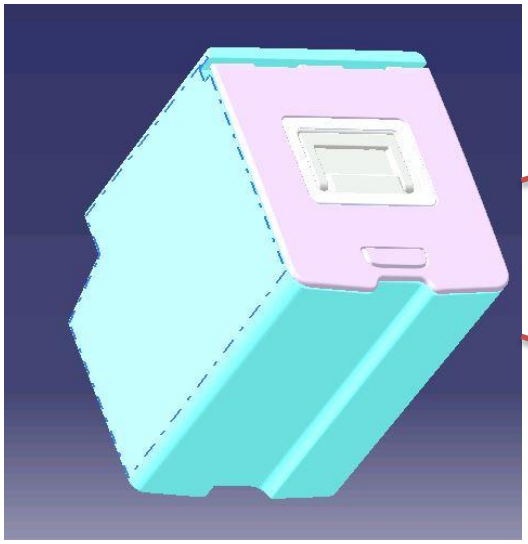
ALM Technology on MAG project (cont'd)

2013: Interior EMS

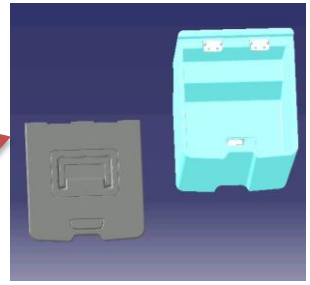
Printer STARTASYS

Material: ULTEM 9085
Aeronautical material compliants to FAR 25.853 (flame resistant)
Price : 2000 €
Manufacturing time: 10 days

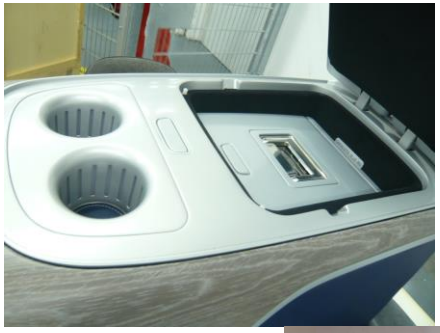
Slicing software: proprietary



Explode



Section

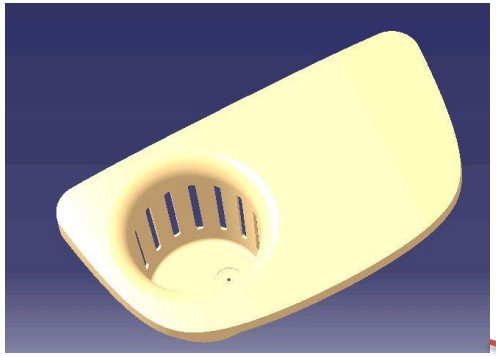


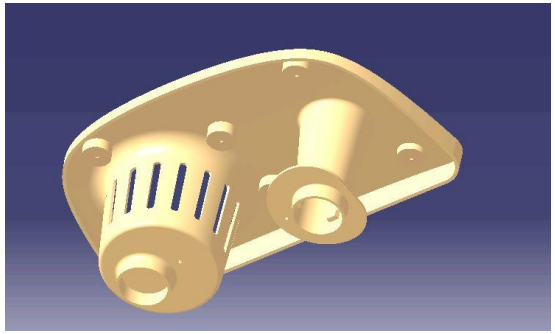
ALM Technology on MAG project (cont'd)

2015: Interior VIP EC145

Printer STARTASYS

Material: ULTEM 9085
Aeronautical material compliant to FAR 25.853 (flame resistant)
Price : 415 €
Manufacturing time: 5days





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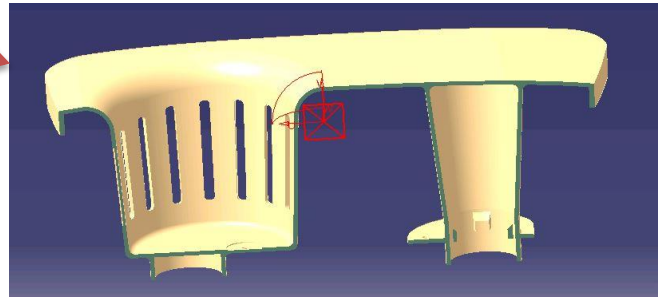
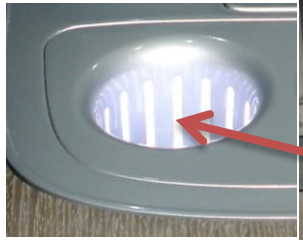




ALM Technology on MAG project (cont'd)

2015: PRINTER PURCHASE FOR PROTOTYPES

Printer: 3DGMAX

Material: ABS, PLA

Slicing software: open source

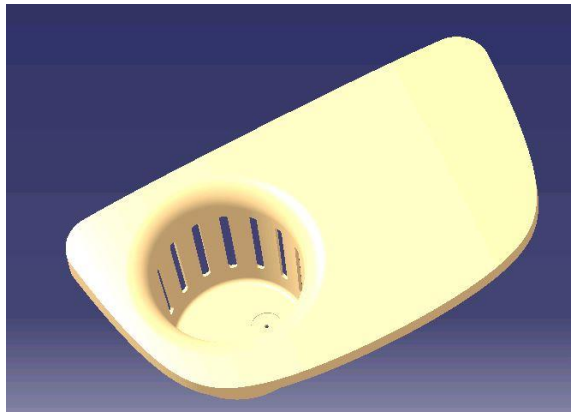
2016: PRINTER PURCHASE FOR AIRWORTHY COMPONENTS

Printer: ROBOZE

Material: PEEK, ABS

Slicing software: open source

Make or buy



Buy:
Price: 415 euro
Time: 5 days

Contra:
Rework at first installation generates a new purchase order with further cost and lead time penalty

Pro:
Low risk for ALM process issues

Make:
Cost: 200 euro
Time: 1 day

Pro:
ALM process under internal control

Contra
Optimization process after first output
Minimum time and cost addition for rework after first installation

Future Development

- MAG is working with INSTM (Università di Roma Tor Vergata) to develop a new material PEEK based to be used for:
  - aeronautic interior components with aesthetic finishing (Currently in ULTEM9085)
  - secondary structure components (Currently made of Aluminum alloy) .
- MAG will qualify the following items according to EASA requirements:

- Material (currently according to MIL-HDBK-17)
- Production process (from material preparation to printer parameter selection and operation)

OUR MISSION IS :

reddot award 2014
honourable mention

Our Mission is (cont'd)

reddot award 2014
honourable mention

CONCLUSIONS

- MAG is a pioneer in using ALM technology for airworthy parts
- Buy process
- MAG will qualify the following items according to EASA requirements:
    - Material (currently according to MIL-HDBK-17)
    - Production process (from material preparation to printer parameter selection and operation)