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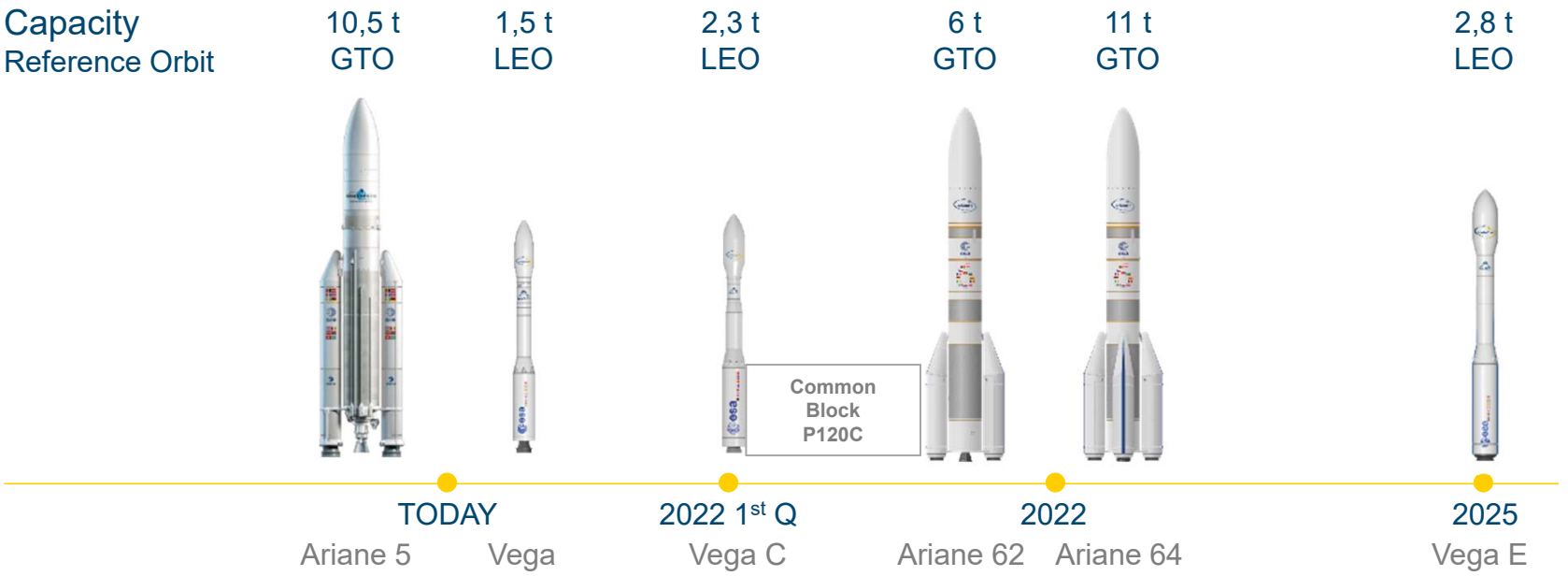
LAUNCHER SYSTEMS
THERMAL PROTECTIONS

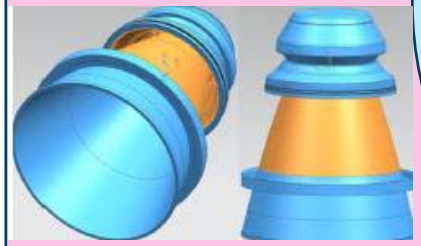
May 31st , 2021

THE EUROPEAN FLEET

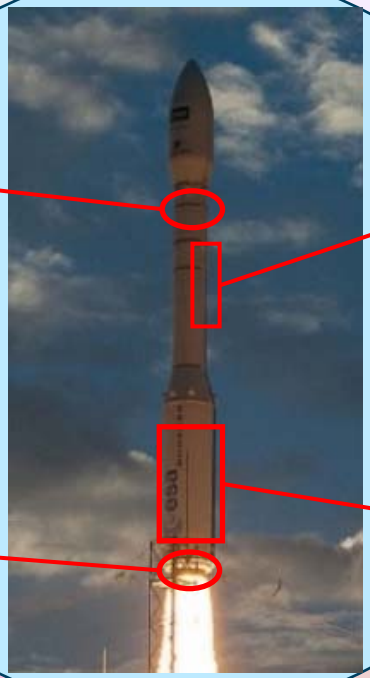


LAUNCHER THERMAL PROTECTION APPLICATIONS

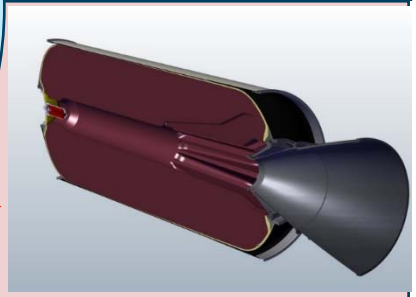
MLI requires flexibility
and insulation



Nozzles request geometrical stability
under very high heat fluxes



To be painted in order to
assure electrical continuity



Internal thermal protection provides interface
between propellant grain and structural case

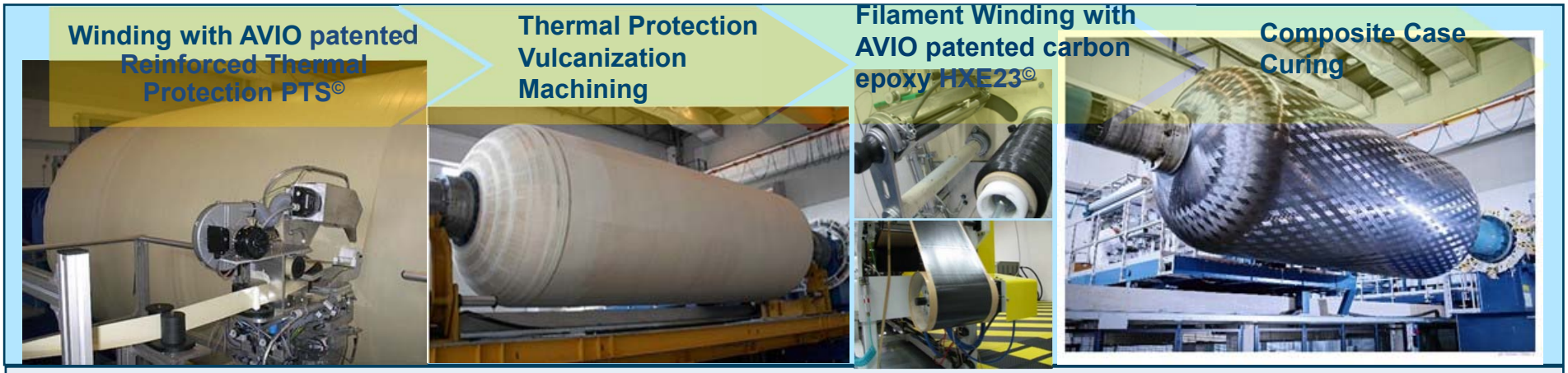
Main functions

- Thermal insulation capabilities
- Geometrical stability at high T

Constraint functions

- Minimization of weight
- Provide geometrical and functional interface with other SRM components

INTERNAL THERMAL PROTECTIONS APPLICATION



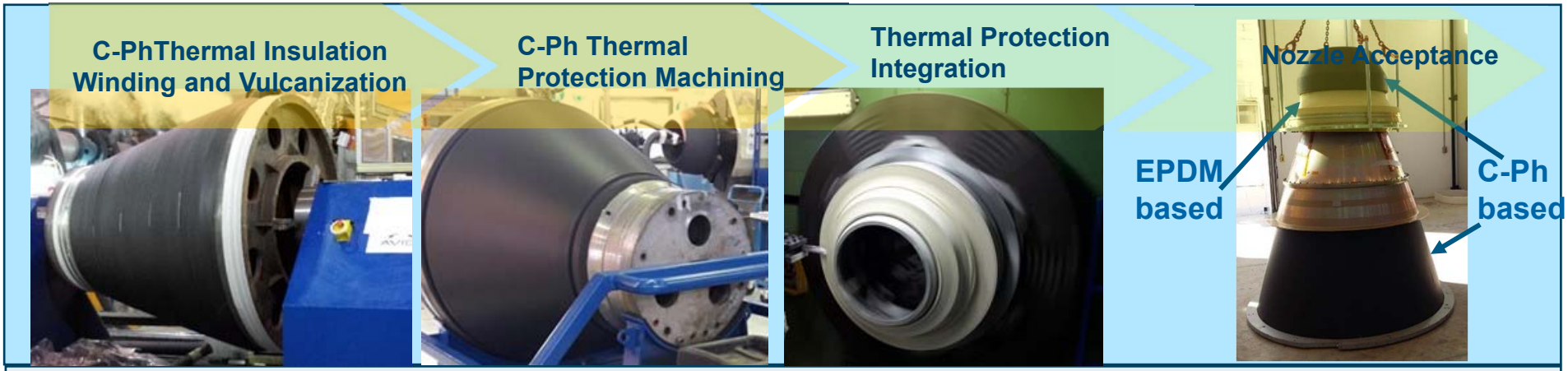
Materials	Formulation	Applications
EC59A	Reinforced EPDM with Kevlar fibers	IRIS, EBM, MAGE
EG2	Reinforced EPDM with Kevlar fibers	Booster Ariane 5
EG8	Reinforced EPDM with Kevlar fibers and silicon	Booster Ariane 4 Motori sep.Ariane 4 Zefiro
RS3	Reinforced EPDM with ceramic fibers	Small nozzles components
EG1LDB3	Reinforced EPDM with Kevlar fibers Hollow glass microspheres	Vega Zefiro P80
EG11	Reinforced EPDM with silicon	Ari 5 Acc. Mot.

- Insulating elastomeric materials based on EPDM
- High temperature flame retardant additives
- Very lightweight materials

Materials shall withstand to heat fluxes induced by combustion (up to 2 MW/m^2)
The materials must guarantee:

- Adequate chemical and mechanical interface for case and propellant grain during the SRM life
- Gas sealing features during combustion time

NOZZLE THERMAL PROTECTIONS APPLICATION



Materials	Formulation	Applications
Glass-phenolic	Phenolic matrix Glass fibers	Nozzles insulators
Silica-phenolic	Phenolic matrix Silica fibers	Igniter nozzles components
Carbon-phenolic	Phenolic matrix Carbon fibers	Nozzle convergent and divergent components
Grafite	Grafite	Small nozzles throat inserts
Carbon-carbon	Carbon matrix Carbon fibers	Large nozzles throat inserts

Increasing -weight -thermal stability

Increasing- thermal insulation

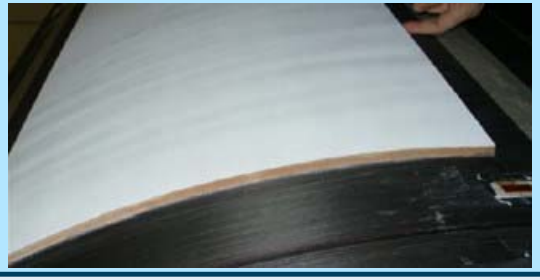
- Insulating composite materials
- High temperature degradation materials
- Lightweight materials

Materials shall withstand:

- to gas-dynamic heat fluxes induced by combustion and pressure gradient (up to 10 MW/m^2)
- to particles impingement and shear stress
- to chemically aggressive environment

EXTERNAL THERMAL PROTECTIONS APPLICATION

Thermal Protection painted tiles preparation



Thermal Protection Integration on SRM

Thermal Protection Integration On Launcher Structure

Thermal Protection finalization at launcher system

Materials	Formulation	Applications
P50	Cork bulk Phenolic resin filler	VEGA VEGA-C Ariane 6
SV2A	Siliconic bulk Glass reinforcements	

- Very insulating materials
- Medium temperature degradation components (> 300°C)
- Very lightweight materials

Materials shall withstand to aerothermal heat fluxes induced by flight speed (< 100 kW/m^2)

Materials is used to produce painted tiles bonded on the structure

MULTI LAYER INSULATION APPLICATION

Materials	Formulation	Applications
Mylar	Polyesther resin in layer form	Liquid upper stage engine Tank /Nozzle
Kapton	Poliimide resin in layer form	
Silica fabric	Insulating composite material	
Kevlar	Structural layer	Solid Rocket Motor Case/Nozzle
Nextel	Insulating/structural layer	
Insulgel	Insulating layer	

- Very insulating materials
- Medium temperature degradation components (> 250°C)
- Very lightweight materials

Materials shall withstand ground and thermo-mechanical flight environment (< 100 kW/m^2)

MLI is constituted by thin reflective foils acting as a radiation barrier
Materials are used to build up a layered insulating structure protecting Liquid and Solid Rocket Motor

Pierluigi Perugini
Head of Mechanical and Solid Propulsion Systems Engineering Department
Engineering & Product Development

T + 39 06 97285804
pierluigi.perugini@avio.com

www.avio.com

THANK YOU

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