

Composite materials applied on gas turbine's inlet system

10th International Gas Turbine Conference
– Gas turbines in a carbon-neutral society

Bartłomiej Armański
Pierenzo Morriello
Pierluigi Tozzi

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Oilfield Services

Lower cost per barrel over the life of field



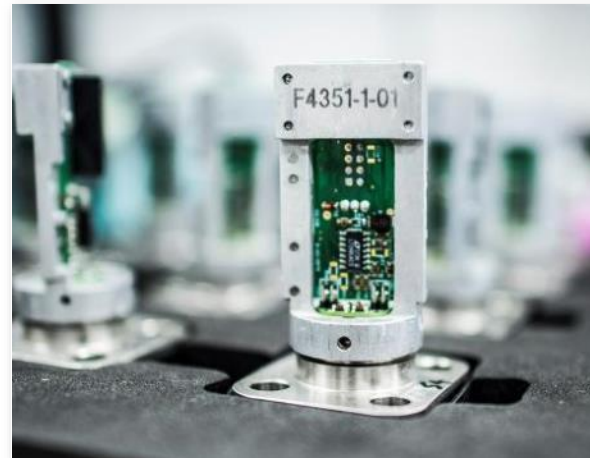
Oilfield Equipment

Ultra-reliable technologies for the harshest environments



Turbomachinery & Process Solutions

Industry-leading availability and reliability

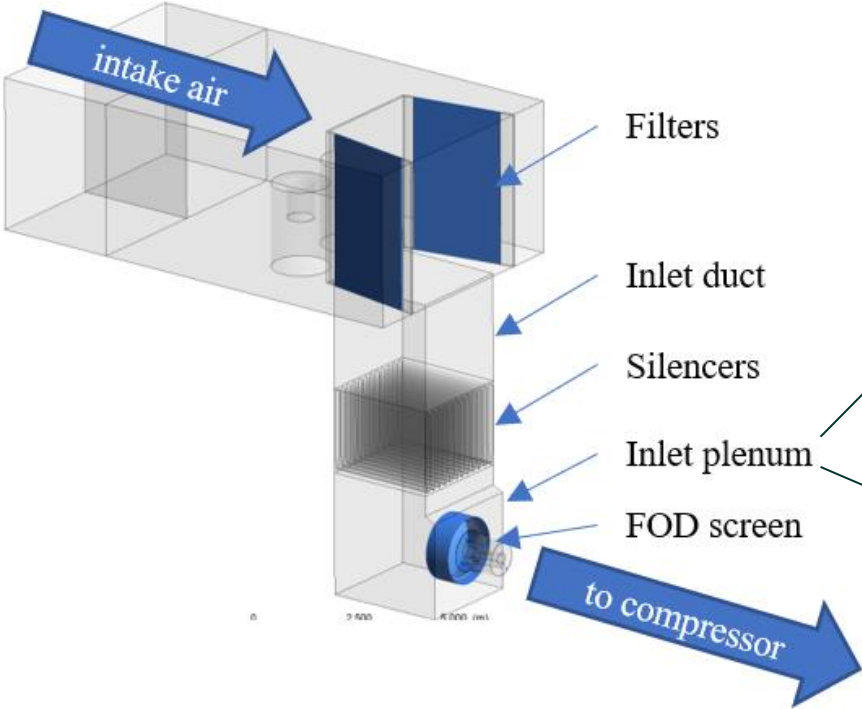


Digital Solutions

Peace of mind for the world's infrastructure

Introduction

Inlet system



Starting point

- Stainless steel box
- Heavy weight
- Shape not optimized



Composite material

Fiberglass
reinforcement



Resin



Fiberglass laminate

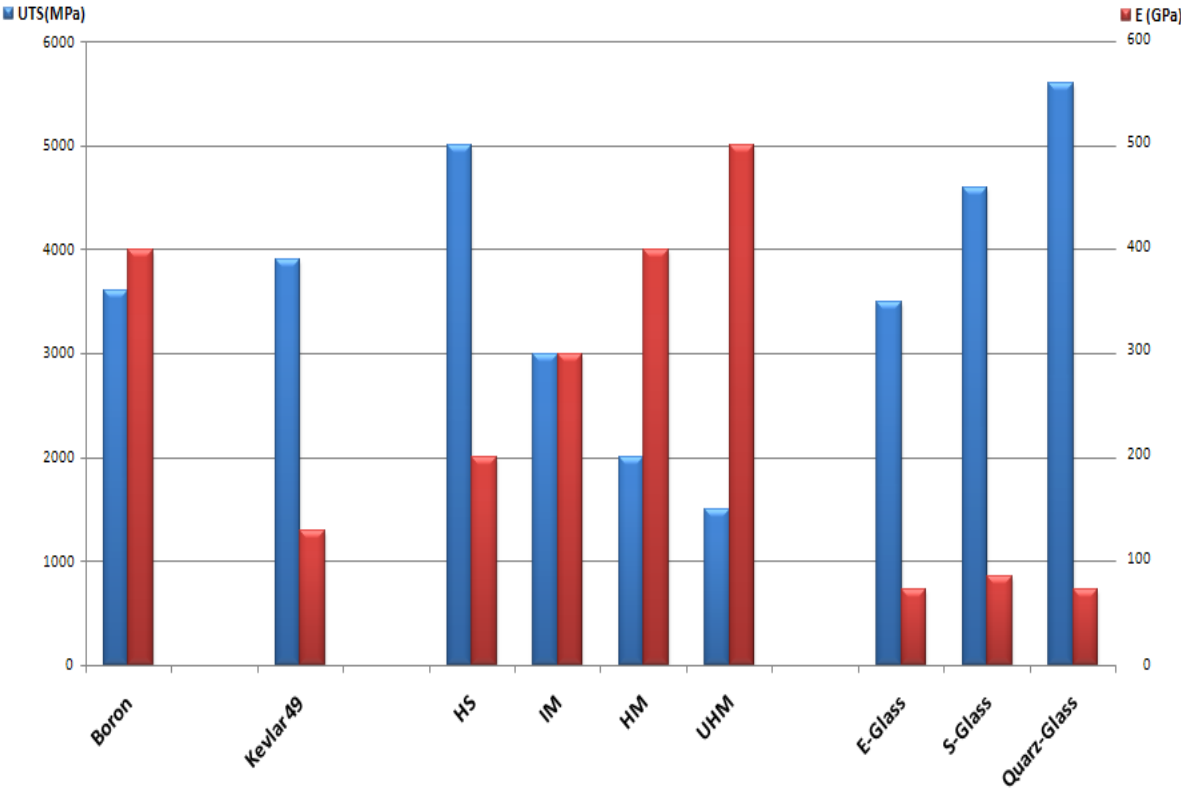


Requirements:

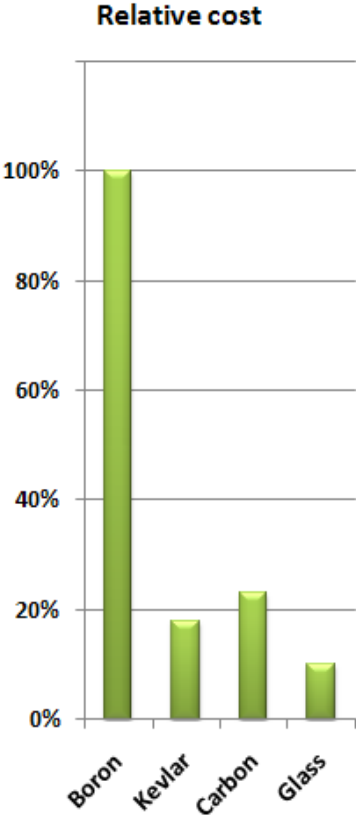
- High heat deflection temperature
- Electrically conductive surface
 - Corrosion resistance

Composite material properties

Stiffness & strength



Cost



Coatings

Gelcoats with different properties (UV protection, conductivity, etc.)

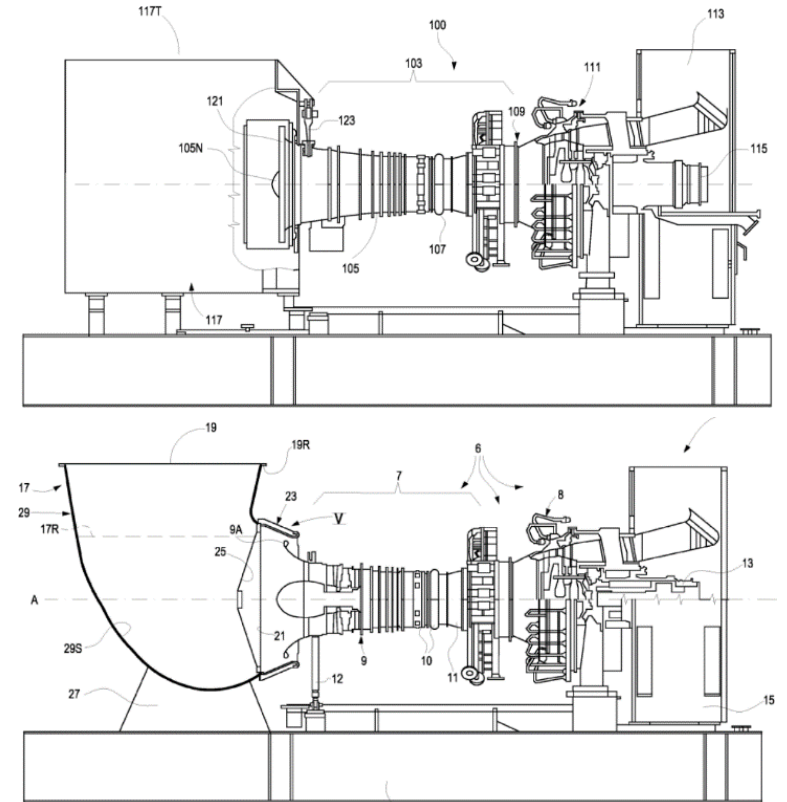
New idea and the patent

Project assumptions:

- Composite material instead of metal
- Optimize shape
- Improve gas turbine performance thanks to better air flow quality
- Reduce weight
- Reduce cost
- Reduce maintenance

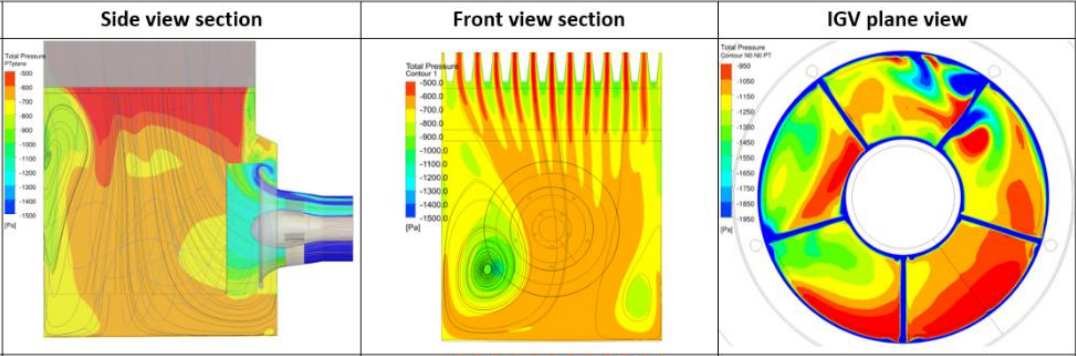


Patent

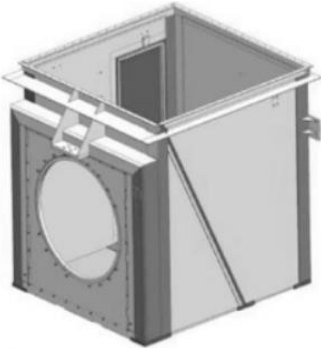
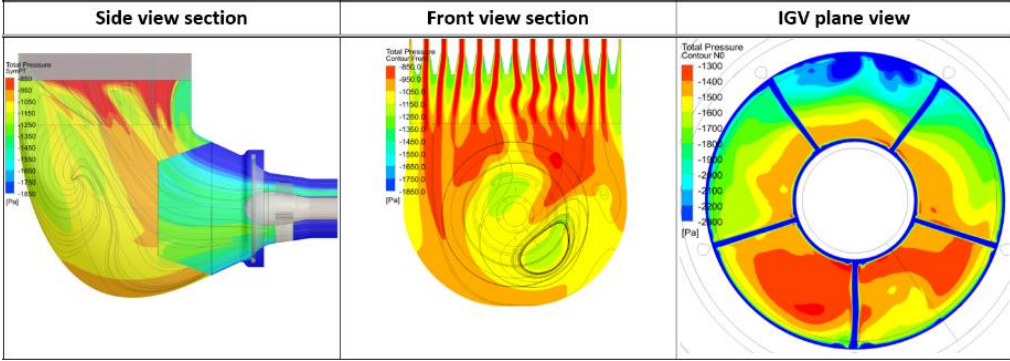


Aero design

Original shape aero performance



Optimized shape aero performance



Aero optimization

Inlet configuration	Relative swirl angle
Standard steel box plenum	1
Final shape of plenum	0,33

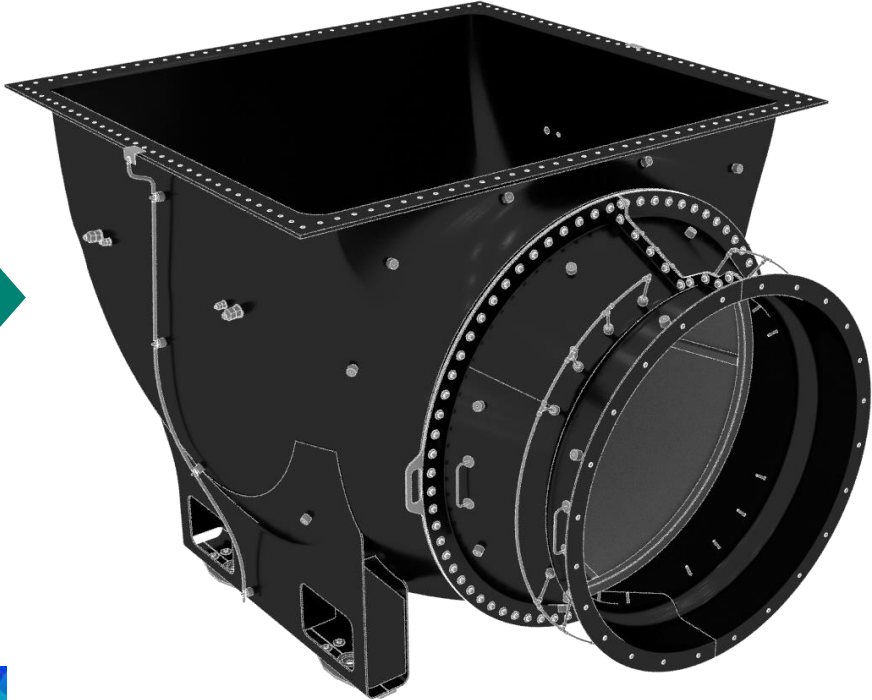
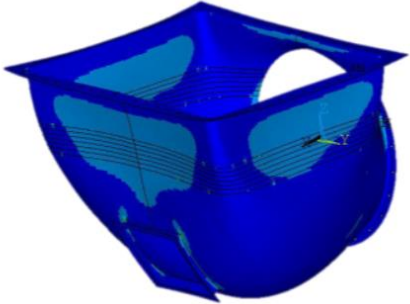
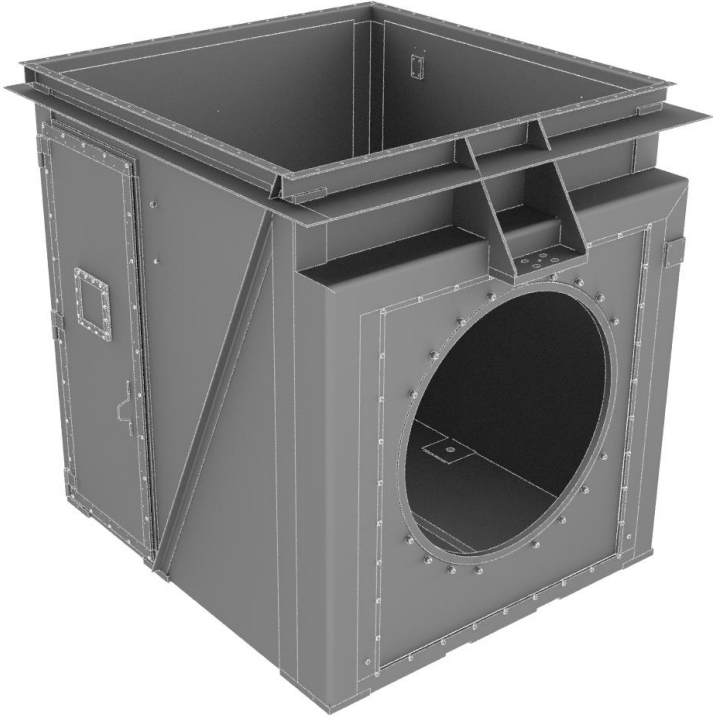
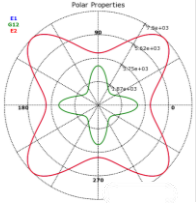


Mechanical design

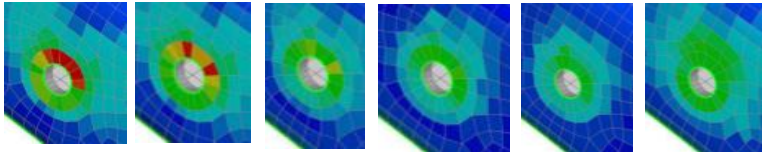
Analysis

Ansys Workbench
ACP Pre/post

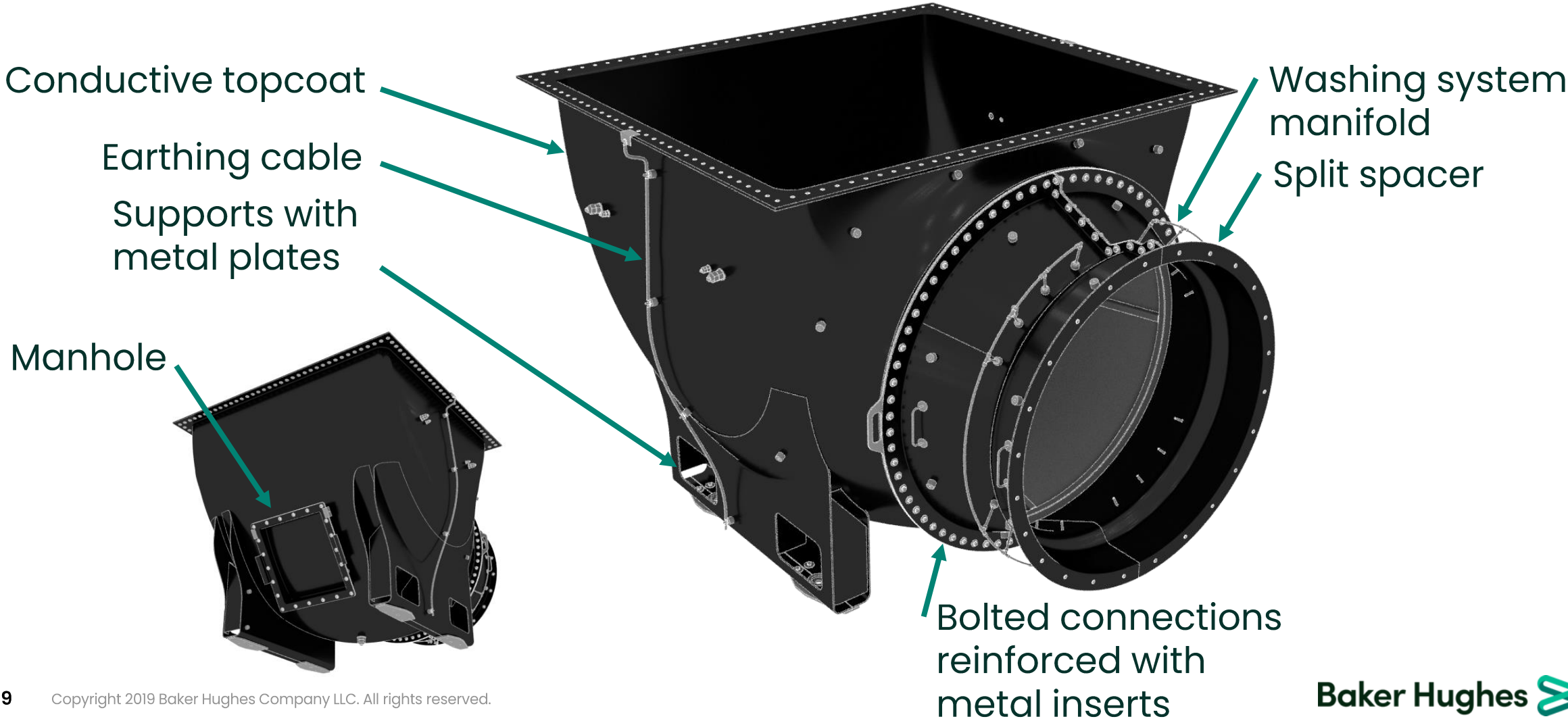
Polarity
of material
properties



Layer 1 Layer 2 Layer 3 Layer 4 Layer 5 Layer 6



Mechanical design



Manufacturing & tests

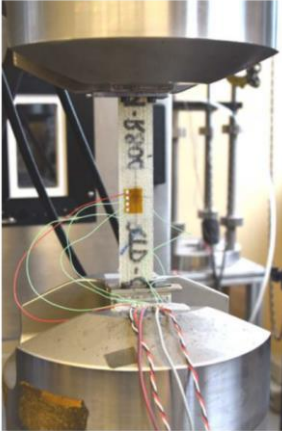
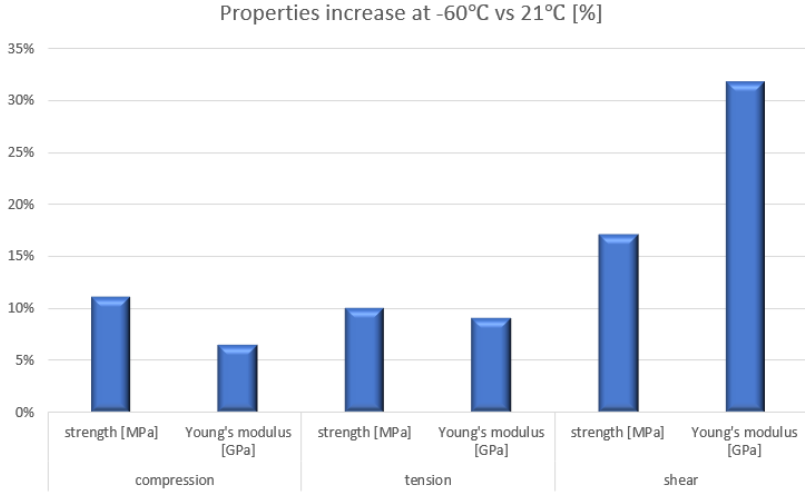
Composite part being infused



Instrumented and ready for installation

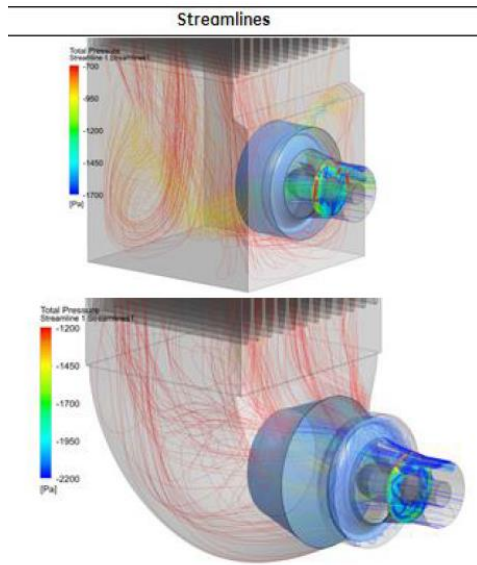


Material tests

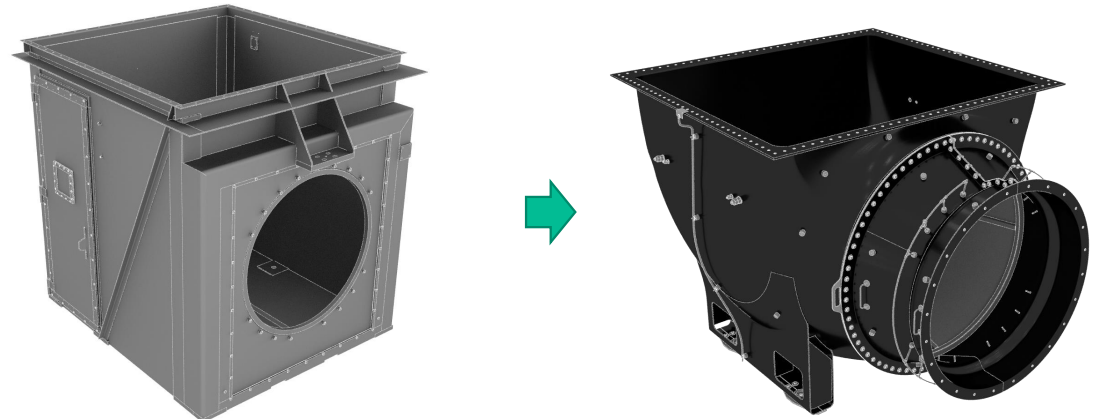


Benefits

Free form shapes possible



Mass & cost reduction



4000 kg → 700 kg

Standard price → 30% lower price

Turbine performance 0.01-0.02% ↗

Pressure loss -10% ↘

Swirl angle distortion -66% ↘

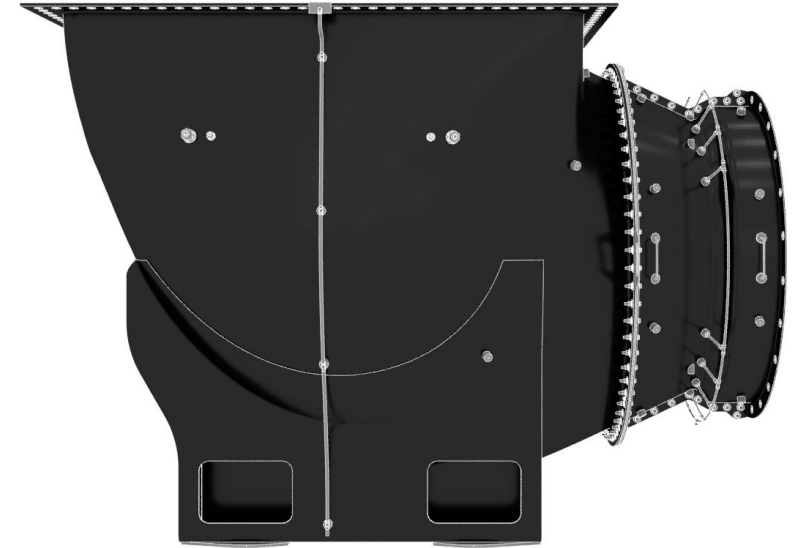
Summary

Confirmed assumptions:

- Weight reduction
- Cost reduction
- Shape optimization – improved flow parameters

Added value:

- Carbon footprint reduction
- Lead time reduction
- Handling simplification



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