Group of 2 companies:

- **CapAero**: Expansion technology and multi-material drilling
- **Meliad**: Laser surface preparation & residual stresses measurement
Fatigue life enhancement  
*cold expansion*

Expanded Bushing installation  
*Metallic and composite*

Drilling composite panels  
*Compdrill device*

Surface preparation with Laser

Residual stresses measurement
Key figures

- 2 Companies
- 15 people including 6 engineers
- 3,8 M€ 2020 Turnover
- 10% of the Turnover invested in R&T and partnership with labs
- Domestic and International business
- 2 International patents
Fatigue life enhancement with cold expansion technology
1. Hole Expansion
2. Bushing installation by expansion
3. Composite drilling device
Products

Fatigue life enhancement – Cold expansion

Metallic holes expansion
SplitSleeve – Split Mandrel

Bushing in metallic
Expanded Bushing – (EB)

Bushing in Composite
Expanded Bonded Bushing (EB²)

Composite drilling device

Drilling without delamination
CompDrill
## Products

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<th>Process</th>
<th>Metal</th>
<th>Composite</th>
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<td>Split Sleeve</td>
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<td>▪ Improved fatigue life</td>
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<tr>
<td>▪ Crack arrestor</td>
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<td>Split Mandrel</td>
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<tr>
<td><strong>Hole drilling</strong></td>
<td>CompDRILL</td>
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<td>▪ Avoid delamination</td>
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<td><strong>Bushing installation</strong></td>
<td>Expanded Bushing (<em>EB</em>)</td>
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<td>▪ Improved fatigue life</td>
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<td>▪ High Push out &amp; torque</td>
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<td>out resistance</td>
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<tr>
<td>▪ Quick installation</td>
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<td>Expanded Bonded Bushing (<em>EB²</em>)</td>
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</table>
1. Hole expansion
Split Sleeve Process

• Original license from a Boeing patent (1966)
• 100% interchangeable tooling with other coldworking suppliers

Slide the sleeve over the mandrel

Coldwork hole by drawing the mandrel back through the sleeve and hole.

Remove used sleeve and discard. The hole has been coldworked,
Split sleeve use

• Maintenance (SRM and SB)
  • MRO
  • Airlines

• Production
  • OEM
  • Supplier Tier-1 and Tier-2
Split mandrel process

• Process without sleeve (no consumable)
• For Aluminium only

Start pass-thru of hole. The hollow, split mandrel collapses.

Pass-thru is complete. Nosecap is placed flush to material. After depressing trigger, the pilot extends through center of hollow mandrel, which solidifies.

The hole diameter is expanded as the now solidified mandrel is pulled back through the material.

With no sleeve to discard, the hole has been coldworked.
Split mandrel use

Manual or automated use in production

AIRBUS
Robot for wings

SAFRAN
AEROSPACE-DEFENCE-SECURITY

BOEING
2. Bushing installation
Metallic and composite applications

Expanded bushing (EB) in metallic part

- Stainless steel bushing with anti-fretting coating
- Bronze alloy bushing

Expanded Bonded bushings (EB²) in composite parts

- Straight version
- Flanged version
Multiple and complex bushing geometry

- **Bushing inside**: 4 mm → ~120 mm
- **Bushing geometry**:
  - Straight and flanged
  - Lube grooves and holes
- **Bushing material**: bronze, titanium, steel...
- **Parent material**: aluminum, steel, titanium...
EB : Expanded Bushing process

1. Slip the pre-lubricated bushing over the mandrel
2. Insert mandrel with bushing into the structure
3. Chucks inside the puller can grab the mandrel and pull it
EB : Expanded Bushing process

Permanent metallic bushing in metallic parent material

1. Slip the pre-lubricated bushing over the mandrel

2. Insert mandrel with bushing into the structure

3. Place the puller against the structure and activate puller; bushing remains in the structure, axial movement is blocked by the nosecap

4. Ream bushing to required final diameter (optional)
EB²: Expanded Bonded Bushing process

Permanent metallic bushing in composite parent material

**STEP 1:** Micro-encapsulated adhesive precoated on the bushing

**STEP 2:** Mechanical interference breaks the micro-capsule

**STEP 3:** The polymerization is activated and bushing installed with interference
EB and EB² process benefits

Expanded bushing (EB)

- Fast and One side Operation
  *Installation in a few seconds*

- Corrosion resistance
  *Protective coating are not damaged by nitrogen*
  *No condensation and trapped water*

- High Torque / Push-out resistance
  *Greater than conventional methods, no running bushing in service*

- Installation safer and quicker
  *No cryogenic fluid & more repeatable process*

Expanded bonded bushing (EB²)

- Bushing is **bonded during manufacturing**

- Fast and one side operation
  *Installation process is similar to expanded bushing in metallic parts*

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EB and EB² performance benefits

Expanded bushing (EB)

- Improved Fatigue life (usually from x3 to x15 lifetime improvement minimum)
  Fatigue life superior to press or shrink fit installation

- Corrosion resistance
  Protective coating are not damaged by nitrogen
  No condensation and trapped water

- Multiple and complex bushing geometry

Expanded bonded bushing (EB²)

- Higher load transfer in the assembly
  Break limit is significantly improved on static tests

- Lighter assembly by assembling directly composite panels together
  Metallic assembly parts can be removed

- Reduced number of fasteners for the same mechanical performance

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Design & Calculation

- 2D and 3D Analysis
- Report provided to the customer
  - Stresses view
  - Path plot
  - Focus on specific area
- Iterations to reach customer needs
Tests in lab

- Tooling validation
- Geometrical deformation validation
  - Bushing internal diameter after expansion
  - Flange deformation (if applicable)
- Residual stresses measurement (optional)
Bushing manufacturing

- Fully sourced and manufactured in France
- Free from Exportation license and regulations
- CAPAERO certificate of conformity delivered under EN9100 norm
Use cases

Landing gears and wheels
- A400M Landing gear (Around 120 mm diameter) - Flying
- A350 and B787 Wheels - Flying
- B777 Wheel: project in progress (in production 2021 or 2022)
Use cases

Engines nacelles
- A318 Thrust reverser – Flying for 15 years

Helicopters (main rotor and tail rotors)
- T625 Helicopter, Tests in progress - with Browncoat
- Airbus Helicopter
Quality references

• EN 9100 certificate since 2018 under the scope:
  Design and manufacture of Tooling, Bushings and fatigue life enhancement Engineering for the Aerospace Industry.

• Audited and qualified by customer for flying part supply
3. Manual composite drilling
A portable feed control drill for metallic/composite material

Drilling system
- Drilling machine
- Controlled feeding
- Vacuum attachment system

Specific Cutting tool

Hydraulic feed control
Mechanical stroke control

Manual Force

- Easy to use
- Very light system
- One side access
- Economic kit
- Drill hybrid stack up material
- Better alignment
- No backup plate

Without CAPAERO drilling kit

Delamination and Wide tolerances

With CAPAERO drilling kit

Delivered in kit with cutting tools
CapAero
6 Rue Des Orfèvres
44840 LES SORINIERES
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