HYBRID BRAKE PEDAL

FINAL EVENT

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Toolpresse
HYBRID BRAKE PEDAL

Company in the automotive industry, specialized in cold metal stamping, welding and machining. Factories in Portugal and Morocco.

Company with extensive experience in design, manufacture and testing of cutting and stamping tools; manufacturing, assembly and testing of special devices.

Company in the industrial sector with over 20 years of experience, dedicated to the manufacture of parts and metallic precision assemblies.
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PRODUCTION PROCESS

WIRE WELDING

STAMPING

RESISTENCE WELDING
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CORE PRODUCTS

Brake pedal

Brake and clutch pedal
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BRAKE PEDAL

An assembly of generally steels components system, which moves a piston in the master cylinder; brake fluid then applies great force to the brake pads or shoes.
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PEDALS EVOLUTION

Clutch Pedal

OLD PEDAL

Component: Yoke
Material: Steel

Component: Body Pedal
Material: Steel

ACTUAL PEDAL

Component: Yoke
Material: Composite

Component: Body Pedal
Material: Composite
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PEDALS EVOLUTION

Brake Pedal

OLD PEDAL

Component: Yoke
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ACTUAL PEDAL

Component: Yoke
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BRAKE PEDAL

Why current brake pedals are not made of composite?

Almost all the requirements that the pedals have to meet are related to maximum admissible deformation when subjected to various efforts.

The elastic and plastic deformation of the body pedal component when subjected to efforts (bending and traction) defined in the requirements, does not comply with the specified values.
TOOLPRESSE PROPOSAL

Develop a new process of making brake pedals that combines composite materials and metal joined by EMJ, in order to provide a consistent alternative to the current state of knowledge of realization of these components.
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MAIN OBJECTIVES

- Reduce the risk of serious lower limb injuries the driver in a frontal collision
  The use of composite materials in the production of this components allows to define a non-aggressive geometry, without sharp edges, which greatly reduces the risk of serious injury in case of frontal collision and simultaneously ensuring compliance with legal requirements and international statutory.

- Reduce the weight of the brake pedal assembly
  Due to the low specific weight of composite materials, the final weight of the component is less than the weight of existing components made entirely of metal

- Reduce the cost and the time of the production process
  Due to the smaller number of operations and components it’s possible to reduce the cost and production time
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DESIGN STRATEGY

How to achieve the objectives set for the deformation?
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**DESIGN STRATEGY**

If we consider a part with the length similar of length of a pedal, completely done in composite.

PA 6.6 GF30 Retangular sample 50x20x300

100Kg

2,24 mm elastic deformation allowed

PA 6.6 GF30 Retangular sample 50x20x100

100Kg

0,03mm elastic deformation allowed
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■ DESIGN STRATEGY

How to achieve the objectives set for the maximum deformation?

If we divide the component in some parts and unit them, the sum of the each individual deformation is less than the deformation of the component with the equivalent length of the sum of the parts.
DESIGN STRATEGY

So the design strategy is divide the body pedal in three parts and join them.
### PRODUT DEVELOPMENT

In partnership with the consortium members, the process was developed to ensure the join of the components using EMJ.

<table>
<thead>
<tr>
<th>Test series</th>
<th>Description</th>
<th>Aim</th>
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</table>
| Preliminary Experiment Samples | 1 | Connection of an aluminium rectangular tube with a rectangular composite part through a single groove at each side. | • To verify the feasibility to join rectangular shapes with the process EMF  
• To verify the absence of cracks. |
| 2 | Connection of an aluminium rectangular tube with two rectangular composite parts through a single groove at each end. | • To Verify compliance with the requirements |
| 3 | Connection of an aluminium rectangular tube with two rectangular composite parts through a circumferential groove. | • To verify compliance with the requirements |
| Final Brake pedal components | 4 | Connection of a metal rectangular tube with composite brake pedal components. | • To verify compliance with the requirements |
PRODUCTION DEVELOPMENT

Test series 1: Connection of an aluminium rectangular tube with a rectangular composite part through a single groove at each side

Composite part:
- Material: PA6.6 GF30
- 4 geometrical different versions

Metal rectangular tube:
- Aluminium 6082
- Thickness: 1.50 mm
PRODUT DEVELOPMENT

**Test series 1:** Connection of an aluminium rectangular tube with a rectangular composite part through a single groove at each side

**Results**

- The connection of a metallic rectangular tube with a rectangular composite part is feasible.
- No cracks were identified.
PRODUT DEVELOPMENT

Test series 2: Connection of an aluminium rectangular tube with two rectangular composite parts through a single groove at each end.

Based on test series 1:

Test method: Bending test at test bench.

Composite part:
- Material: PA6.6 GF30

Metal rectangular tube:
- Aluminium 6082
- Thickness: 1,50 mm
PRODUT DEVELOPMENT

Test series 2: Connection of an aluminium rectangular tube with two rectangular composite parts through a single groove at each end.

Based on test series 1:

Test method: Bending test at test bench

Composite part:
- Material: PA6.6 GF30

Metal rectangular tube:
- Aluminium 6082
- Thickness: 1,50 mm
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- PRODUT DEVELOPMENT

- Test series 2: Connection of an aluminium rectangular tube with two rectangular composite parts through a single groove at each end.
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- **PRODUT DEVELOPMENT**

  - **Sample test vrs 3:** Connection of an aluminium rectangular tube with two rectangular composite parts through a circumferential groove.
  - Test method: Bending test at test bench
  - Composite material:
    - PA6.6 GF30
  - Metal rectangular tube:
    - Aluminium 6082
    - Thickness: 1,50 mm
PRODUT DEVELOPMENT

In the serial samples tests we achieve the product specification to comply with the deformation
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PRODUT DEVELOPMENT

Product design

Hybrid brake pedal
Pad component
Hub component
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PRODUCT DEVELOPMENT

Product design

Hybrid brake pedal

Hub component

Pad component
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- PROCESS DESIGN

Actual Process

PROCESS DESIGN

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- PROCESS DESIGN

Proposal Process
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MAIN RESULTS

- Reduce the risk of serious lower limb injuries the driver in a frontal collision.
  The hybrid brake pedal don’t have a sharp hedges.

- Reduce the weight of the brake pedal assembly
  Actually we reduce about 17% of weight, and it’s possible reduce up to 40%

- Reduce the cost and the time of the production process
  The proposal production process reduces two operations
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NEXT STEPS

- Proceed with the stress tests.
- Start the fatigue tests.
- Divulgation and presentation the product at fairs.
Thanks for your attention