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VOITH

Low weight, high performance
GFRP energy absorber

Advantages

+ low total weight
+ constant energy absorption behaviour
+ above average weight-specific energy absorption capacity
+ variable design and force layout
+ multi-level force layout possible
+ minimum corrosion through the use of aluminium and glasfibre reinforced plastics

Energy absorbers serve to transform the crash energy generated during an impact and thus allow the best possible protection for both passengers and rolling stock. The light-weight energy absorber designed by Voith can constitute one part of a solution meeting the current European standards EN 15227 and EN 12663.

It is characterised by a low total weight and a constant energy absorption behaviour. This results in a high energy absorption capacity and a remarkable energy to weight ratio. Furthermore, the use of aluminium and glasfibre-reinforced plastics keeps corrosion at a minimum.

Design

The light-weight energy absorber consists of a fibre composite tube functioning as crash element. Its rear end is integrated into a bearing featuring the mounting flange to the vehicle. It also serves as nozzle and as guiding element.

The front end of the absorber holds an anti-climber plate which, in case of a collision, prevents the vehicles from climbing.

For reasons of weight reduction, the bearing and the anti-climber plate are made from aluminium.

Should it be impossible to mount the absorber on the vehicle via the bearing, an adapter plate may be fitted, bridging the distance between the flange and the mounting interface of the vehicle. This also allows a refurbishment of vehicles which are already in operation.

Characteristics

A total weight of approx. 90 kg (depending on the design layout) makes the GFRP absorbers a light-weight solution compared with standard steel absorbers. Further benefits are their constant energy absorption behaviour and a high weight-specific energy absorption capacity.

Up to an offset of 80 mm, the energy absorbers remain fully functioning.

Function

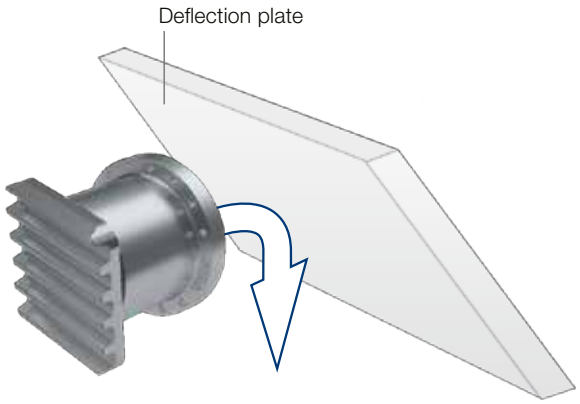
In the event of a collision, the fibre composite tube is pressed through the nozzle at the rear end. This induces a controlled collapse of the laminate.

The laminate defibrates on its way through the bearing, losing all its strength and structure. The major part of the material, however, remains attached to the absorber. The risk of formation of dangerous projectiles is thus minimised, and the material can be easily deflected downwards (figure “Deflection of laminate after an impact”), reducing the required space between flange and deflection plate to 300 mm only.

An activation of the crash tube is shown by indicators on either side of the tube.

GFRP energy absorber, flange variation

Deflection of laminate after an impact

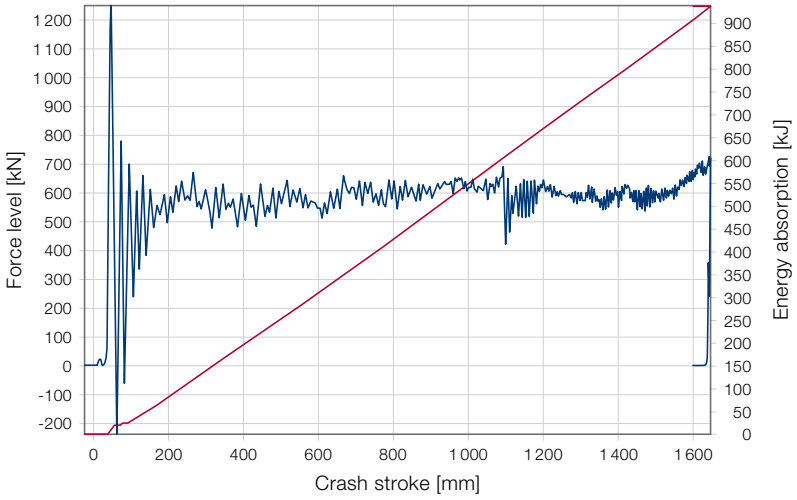


Crash test layout

- Two crash absorbers in collision
- Approx. 600 kN average force per absorber
- 80 mm offset

Dynamic test, layout

Crashtest

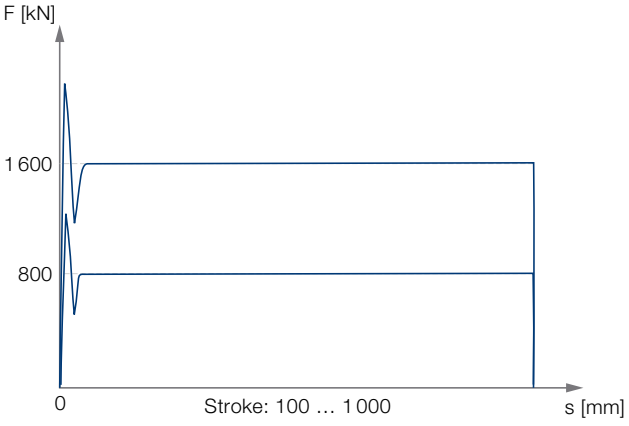


Crashtest resultat

- Total stroke: 1650 mm
- Energy absorption: approx. 1 MJ

— Force level
— Energy dissipation

Range of stroke / force layout



Technical data / layout

Crash stroke	100 – 1 000 mm
Force levels (multiple and increasing force levels possible)	600 – 1 600 kN (± 10 %)
Energy dissipation	up to 1,6 MJ
Displacement acc. to EN 15227	up to 80 mm
Operating temperature	-40 up to +60 °C
Fire protection EN 45545-2:2013	HL3; R7
Weight (nominal)	50 – 95 kg

In comparison: Standard steel absorber and light-weight GFRP absorber

	Standard steel absorber with deformation tube	Light-weight absorber with GFRP deformation tube
Energy absorption rate	4.05 kJ/kg	12.15 kJ/kg
Weight	approx. 225 kg	approx. 75 kg
Force	1 400 kN	1 400 kN
Energy absorption	910 kJ	910 kJ
Stroke length	650 mm	650 mm
Component length	1 700 mm (due to function principle)	1 300 mm (including 350 mm defibration space)

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