



# Composite Components in Vehicle Drivetrains

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Eaton

Institute for **ADVANCED**  
**Composites Manufacturing**  
INNOVATION

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# Eaton is a leading global power management company...



Aerospace



Buildings



Data centers



Food and beverage



Government



Healthcare



Machine building



Marine



Mining, metals and minerals



Mobile machinery and equipment



Oil and gas



Pharmaceuticals



Rail



Renewables



Residential



Utilities



Vehicles



Water/wastewater



Powering Business Worldwide



Eaton Industrial Sector  
sales \$8.9 B

Vehicle

Hydraulics

Aerospace

Eaton Electrical Sector  
sales \$13.8 B

Electrical Products

Electrical Systems & Services

## Eaton Vehicle Group



- 2013 Revenue: \$3.8 Billion USD
- 48 facilities on 6 continents
- 4 regional Innovation Centers: USA, Czech Republic, China and India
- Approximately 14,500 employees worldwide

# Eaton Vehicle Group: Customer Landscape

Global Technology

Global Network

Vehicle Group customer landscape



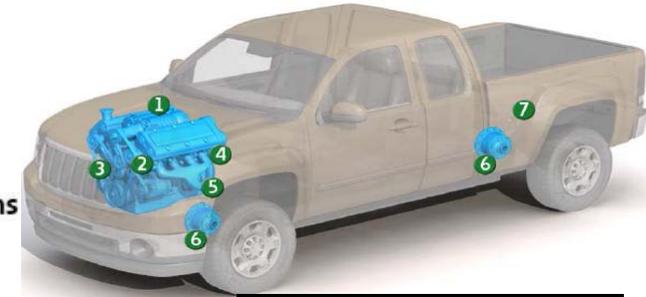
# Eaton Vehicle Group: Products

- 1 Superchargers
- 2 Valves  
Valve Actuation
- 3 Powertrain Controls
- 4 Fluid Conveyance
- 5 Torque Control
- 6 Fuel Emissions



**Crossover**

- 1 Superchargers
- 2 Valves  
Valve Actuation
- 3 Powertrain Controls
- 4 Fluid Conveyance
- 5 Light-duty Transmissions
- 6 Torque Control
- 7 Fuel Emissions



**Light Truck**

- 1 Superchargers
- 2 Valves  
Valve Actuation
- 3 Powertrain Controls
- 4 Fluid Conveyance
- 5 Fuel Emissions



**Microcar**

- 1 Valves  
Valve Actuation
- 2 Clutch
- 3 Transmissions



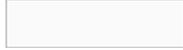
**Linehaul Truck**

# Eaton Market and Potential Composite Applications



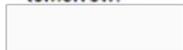
## Transmissions

Reliable and trusted manual and automated transmissions for light-, medium-, and heavy-duty vehicles.



## Superchargers

From 1-liter to 6-liter engines, passenger cars to commercial vehicles, Eaton superchargers are powering the vehicles of today and tomorrow.



## Pumps

With an expansive range of available features and design options, Eaton pumps provide both the performance and flexibility to meet the requirements of just about any application.



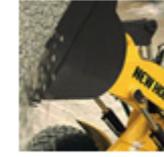
## Clutches

Medium- and heavy-duty clutches for the commercial vehicle industry. Eaton clutches are unmatched in terms of reliability, durability and performance.



## Differentials and Traction Control

From the moment your foot hits the gas, Eaton Performance differentials are at work efficiently maximizing wheel traction.



## Steering

Our team of engineers has one goal in mind: solving efficiency issues by providing the most innovative, high quality steering products at the best value.



## Fluid Conveyance

Eaton is a global supplier of high-quality air conditioning, active suspension, power steering and a wide variety of other fluid connection products.



## Plastics

Eaton specializes in the design and manufacture of high quality, functional plastic moulded components and assemblies for use in stringent automotive engineering applications.



## Aerospace

Eaton is a leading producer of Aerospace systems and components.



# Project: Lightweight Driveline Component Development

## Driveline Component Challenges

- Max Temperature
- Torque
- CTE
- Wear

## Material Property Assumptions

	Steel	Carbon Composite
Mass (g/cc)	7.85	1.48
Strength (MPa)	600	180
Modulus (GPa)	200	28
Specific Strength (MPa cc/g)	76	120
Specific Modulus (GPa cc/g)	25	20

## Current Metal Part



## Composite Part



## Benefit

**40% - 50%  
mass  
savings**

# Composite Components in Vehicle Drivetrains



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Institute for ADVANCED  
Composites Manufacturing  
INNOVATION



THE UNIVERSITY of  
TENNESSEE **UT**  
KNOXVILLE

## Potential Industrial Partners



**EATON**

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