

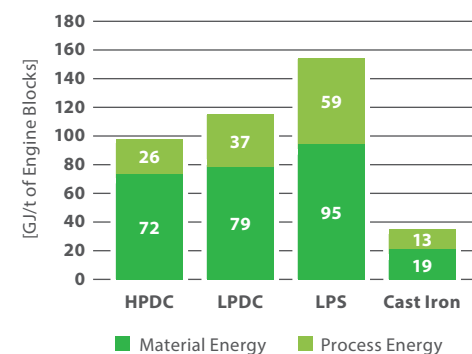
## OUR MOTIVATION — IS YOUR ADVANTAGE!

The process: Light-weight concepts are our passion. In cooperation with our customers, we develop high-tech products for the production of engine blocks, customized and adjusted to individual and increasingly complex requirements. In doing so, we still always take into account an optimal cost-benefit-ratio. Our innovative ecoCasting process excels by means of several outstanding criteria, from the idea to the product ready for assembly:

### ENVIRONMENT

- » 100% steel scrap (no pig iron)
- » 100% recycling material available worldwide
- » Lowest energy consumption in comparison to all other casting processes (see diagram)

Summary of process energy burden per metric tonne of good castings for different casting processes in the study



### INVEST NOW IN THE FUTURE!

Ensure your corporate success through cost efficiency and sustainability with Fritz Winter's cast iron light-weight concepts—from the development to the series. We've been so convinced by our completely new and innovative production process that we invested more than 50 million euros in the implementation of this process. An investment that was worthwhile!

### OUR MOTIVATION:

As supplier and partner for the international automotive, commercial vehicle and hydraulic industry, we have been aware from the beginning that the design and the implementation of innovative light-weight concepts require new technologies and unique pouring processes. We found a particular motivation in realizing the high standards we set for ourselves: to create high-precision high-tech products and to integrate all customer-specific requirements.



### ALUMINIUM WAS YESTERDAY

AVL is our strong partner for engine development in the area of innovative lightweight design. We have succeeded in optimizing the lightweight potential of cast iron materials for crankcases. The result: newly engineered cast iron components with a lightweight design that will replace common aluminum cylinder blocks.



### 30% LIGHTER THAN A GREY CAST IRON CYLINDER BLOCK

Our product is 30% lighter than a conventional grey cast iron cylinder block. Not only does this save resources, it also sustainably supports our customers in achieving their environmental targets.



### OUR RAW MATERIALS ARE 100% RECYCLABLE

Our raw materials consist of recycling material, which means that our products are 100% recyclable. Thus, we protect the environment and consume less energy than is required for the conventional cast iron process or in comparison to aluminum production.



### AT LEAST 28% LOWER COST THAN ALUMINUM

At least 28% cost savings in comparison to an aluminum cylinder block represent considerable cost efficiency—with a standardized but flexible process and with guaranteed outstanding quality.



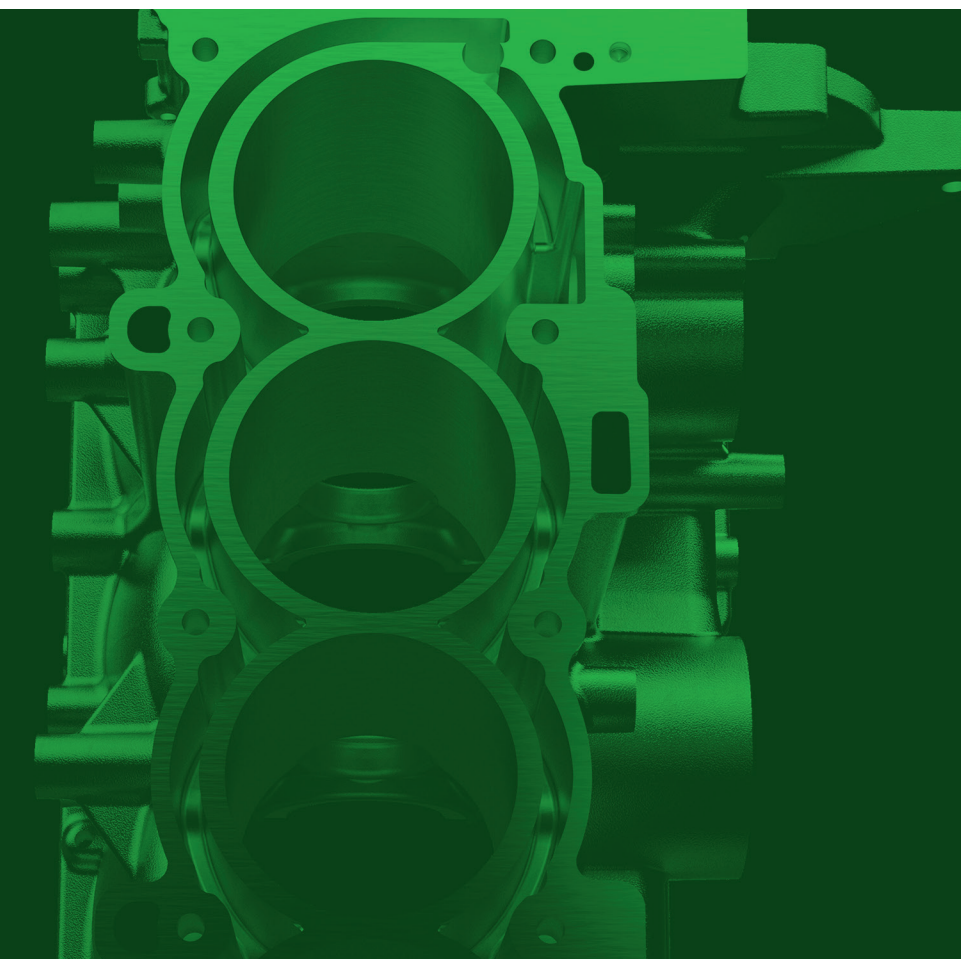
### COMPLETE ENGINE ONLY 1.5% HEAVIER

There is only a minimal difference in weight (1.5%) in comparison to the same engine equipped with an aluminum cylinder block (HPDC). However, the production of one metric ton of grey cast iron requires only one fifth of the energy consumption required for aluminum production.



### 2.5MM WALL THICKNESS WITH A TOLERANCE OF ONLY +/- 0.5MM

The cylinder block is the biggest and heaviest component of a combustion engine. Our unique technology ensures highest precision and achieves to reduce the wall thickness to just 2.5mm, and this with a tolerance of only +/-0.5mm.



## I AM THE FUTURE

Developed in accordance with economy and ecology, our green foundry offers trend-setting solutions in grey cast iron.

## IRON FOUNDRY 2.0 WE THINK GREEN

Reducing the weight of components will contribute towards a decrease in CO<sup>2</sup> emissions and minimisation of fuel consumption. AVL and Fritz Winter have conducted a research project that focuses on the potential of lightweight design concepts for cast iron.

Our Design to Material Process provides a stress-resistant product that is made of materials that exactly meet operational demands while always taking into consideration the sustainability aspects of ecological, commercial and technical parameters.

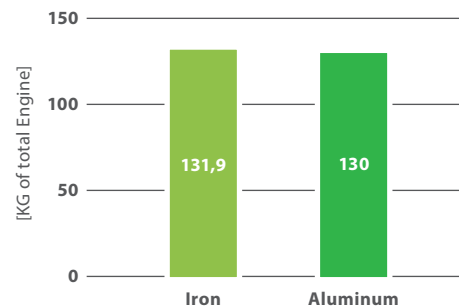
### THE FOCUS IS ALWAYS ON CUSTOMER-SPECIFIC REQUIREMENTS.

- » Sustainable reduction of vehicle consumption
- » Saving of resources
- » Use of cost potentials
- » Worldwide availability

### THE ESSENCE OF ALL OUR ACTIVITIES

- » Our motivation: to be the innovation leader
- » Our benchmark: a 1.6L 4-cylinder gasoline engine, manufactured in the aluminum high-pressure die casting process (HPDC)
- » Result: a reference engine setting standards in the comparison of the complete engines made of aluminum and grey cast iron
- » A product with a weight difference of only 1.5% (1.94 kg / in comparison to the base engine)
- » Cost advantage: at least 28% in comparison to HPDC aluminum
- » Reduction of ovalization of the cylinder bores
- » No green sand mold

Weight total engine comparison, cast iron to aluminum crank case



» We have revolutionized the iron foundry and set new benchmark standards in the foundry industry with our innovative ecoCasting production technology. «

### NEW STANDARDS IN THE QUALITY

- » Considerable cost reduction in comparison to aluminum and grey cast iron cylinder blocks
- » Modular production concept
- » Standardized but flexible processes
- » High process reliability
- » Reduction of tolerances
- » Most ecologically friendly pouring procedure worldwide
- » Globally applicable

### MORE THAN A LIGHTWEIGHT

- » Innovative compact design
- » Shorter engine length
- » Competitive alternative to aluminum crank cases
- » Low resource consumption
- » Minimized general casting tolerance (+/- 0.8 mm)
- » Minimized wall thickness tolerance (+/- 0.5 mm)

Short head screwing bosses (decoupled from cylinder bore for reduced cylinder distortion)

Top deck flange

Modified front cover flange

Modified thermostat housing

Optimized stress level (Stress level below 140Mpa)

Precast oil channel

Single main bearing caps

Reduced tolerances

Open deck (with reduced cylinder wall for improved heat transfer)

BlowBy channel

Reduced water jacket length (for weight reduction)

Bypass opening (water jacket for fast warm-up)

Reduced gearbox flange

2.5 mm wall thickness

Deep skirt design

WEIGHT AND COST REDUCTION

CO<sup>2</sup> REDUCTION