

# HardMarque

Automotive/Additive Manufacturing



Final titanium printed piston

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Nicholas Hardman  
Director, HardMarque

**HARDMARQUE** is a digital design and manufacturing studio focused on creating “Future Factories”, additive-manufacturing facilities that focus on just-in-time production and delivery of custom, made-to-order parts ordered through the Internet. HardMarque feels that this type of innovation is imperative to the future of manufacturing in its home country of Australia. This innovation can help the country break into new markets by emerging from the constraints of traditional manufacturing.

Nicholas Hardman, Director of HardMarque is a long time CAD user who upon discovering Evolve, was immediately taken by the organic structures created in the software, as well as its ease of use. Nicholas noted,

“[Evolve] has freed me up immensely. I can truly design in 3D on the fly as opposed to being forced to design in a sketch-based fashion, which is essentially 2D.”

After using solidThinking Evolve, Nicholas also learned about the power of solidThinking Inspire for concept generation and quickly realized its great value for additive manufacturing. “Using Inspire, I can design products that are lighter and just as strong, if not stronger than their counterparts. The organic shapes created in Inspire are perfectly suited for additive manufacturing.”

## INSPIRE AND EVOLVE IN THE DESIGN PROCESS

One of HardMarque’s most recent projects for its “Future Factory” was a custom made, titanium additive manufactured automotive piston. HardMarque selected titanium for this project as it is readily available in its home country of Australia and is significantly stronger than aluminum, which is typically used in piston production.



## INDUSTRY

Automotive/Additive Manufacturing

## CHALLENGE

Reimagine the current piston design process to manufacture a piston that is not only lighter than the current versions, but also equally as strong.

## SOLUTION

A process incorporating both solidThinking Inspire and Evolve for concept development and design refinement in preparation for titanium additive manufacturing.

## RESULTS

- Concept generation in Inspire and refinement in Evolve.
- Development of new piston design that is 23.5% lighter than the original design.
- Easy export and integration with additive manufacturing equipment.
- Manufactured using titanium additive manufacturing.

For Nicholas, the design process started with an existing piston for benchmarking. He used the measurements of the piston to create an initial design space in Evolve. After the design space was created, he exported the model to Inspire for concept generation.

In the case of the titanium piston, applying accurate loading conditions was absolutely imperative to the process. "It's about getting the loads going through the piston correct," said Nicholas, "there's a force acting on the piston crown from the expanding combustion gas, and there's also lateral force acting on the sides of the piston from oil pressure against the cylinder wall." Nicholas collaborated directly with the solidThinking team, as well as a colleague in Melbourne with over fifteen years of experience in piston production to apply these loads in Inspire. Nicholas used Inspire to generate the ideal shape for the piston based on these loading scenarios.

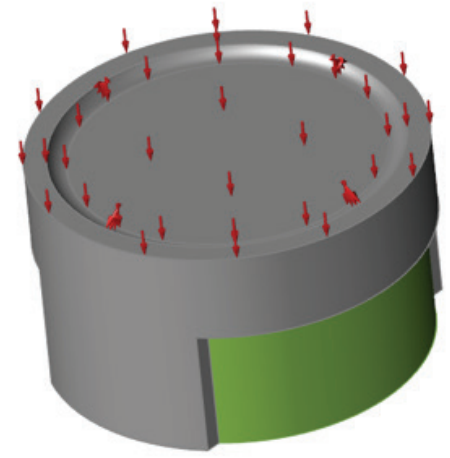
Nicholas then imported the shape created in Inspire back into Evolve where he was able to interpret the results into the final piston design, which was manufactured in titanium.

The final design weighed 289g, which was 23.5% lighter than the 378g original, yet just as strong.

Nicholas noted, "Decreasing the weight of the piston, as well as other automotive parts is extremely important. This helps to make the combustion engine much more efficient and can help to decrease fuel needs. In order to make parts lighter, you have to know where to remove material. This is where Inspire comes into play, and it works perfectly with additive manufacturing as there are many fewer constraints on the types of shapes you can manufacture."

## WHAT'S NEXT?

HarqMarque has quickly seen the benefits of solidThinking Inspire and Evolve for concept generation and development. Nicholas notes that both tools have helped him to increase the efficiency of his workflow. He is currently working on a second version of the piston that will be even lighter. The current target weight is 250g. Once this is complete, Nicholas plans to test his creations in actual engines prior to commercializing them in HarqMarque's "Future Factory."



Piston design space



Ideal piston concept generated in solidThinking Inspire



Final rendering of piston in solidThinking Evolve prior to manufacturing

## ABOUT HARDMARQUE

HardMarque looks at parts and products and wonders how they can be improved. The team tries to figure out how parts can be made better, faster, or cheaper. HardMarque focuses on additive manufacturing, material optimization, 3D CAD design, and 2D CAD drafting.

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