Haute école d'ingénierie et d'architecture Fribourg
Hochschule für Technik und Architektur Freiburg

Hes·so

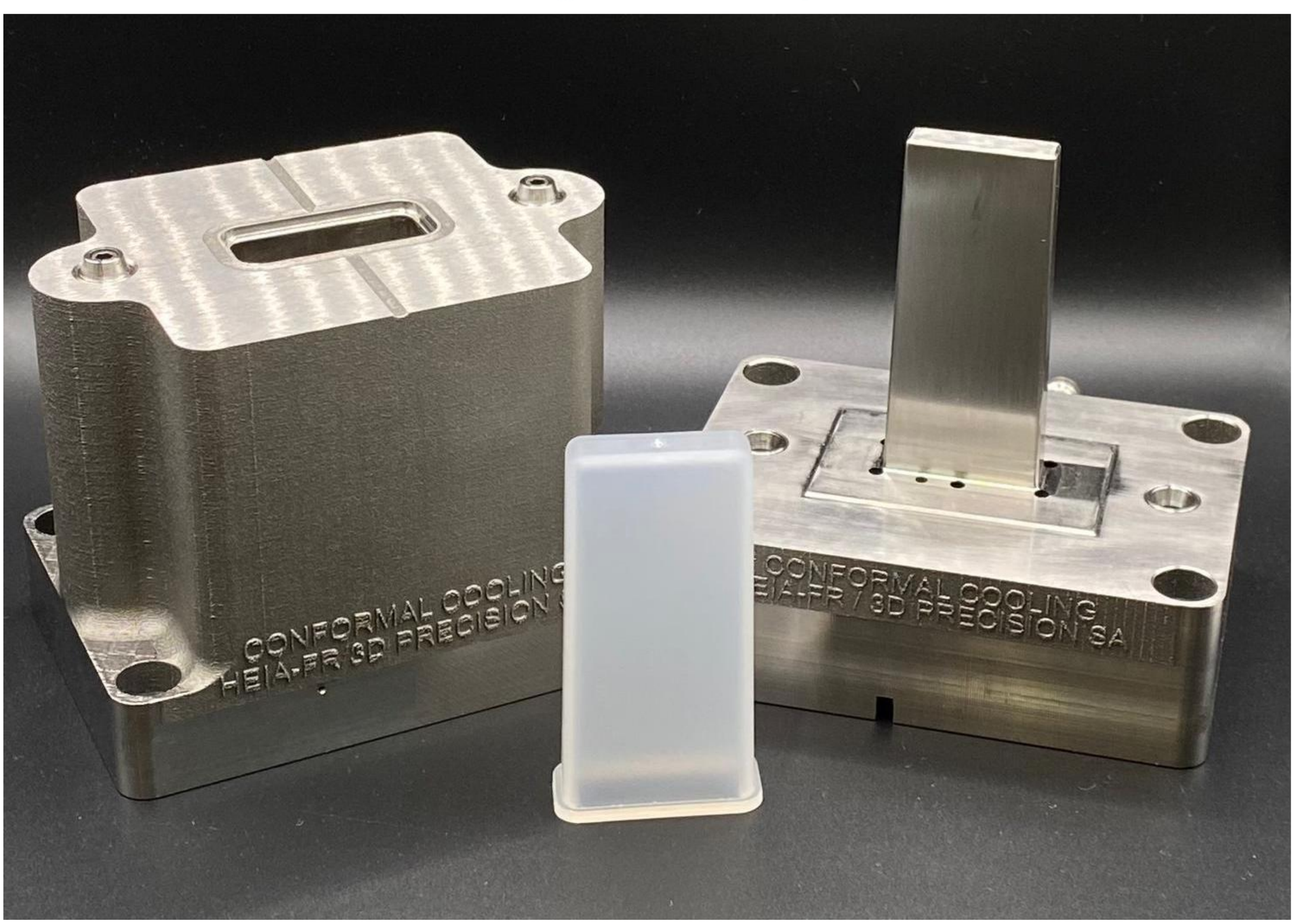
Student:

Baillod Tomas

Projet de Bachelor 2025

MECHANICAL ENGINEERING DEPARTMENT

Integration of conformal cooling in a plastic injection mold made by additive manufacturing (selective laser melting or SLM).



Conformal cooling involves using regulation channels with complex geometries to improve the thermal management of a mold. The creation of these circuits requires the use of technologies such as selective laser melting. As part of this project, the objective was to evaluate the extent to which the thermal performance of an injection mold can be improved with conformal channels compared to conventional channels. A demonstrator was designed and the corresponding mold was machined to carry out tests.

PROFESSORS:

Bürgisser Bruno

CLIENT:

3D Precision SA
Rue Emile Boéchat 34
2800 Delémont

3D PRECISION SA

SUSTAINABLE DEVELOPMENT GOALS:

8 TRAVAIL DÉCENT ET CROISSANCE ÉCONOMIQUE
9 INDUSTRIE, INNOVATION ET INFRASTRUCTURE
12 CONSOMMATION ET PRODUCTION RESPONSABLES

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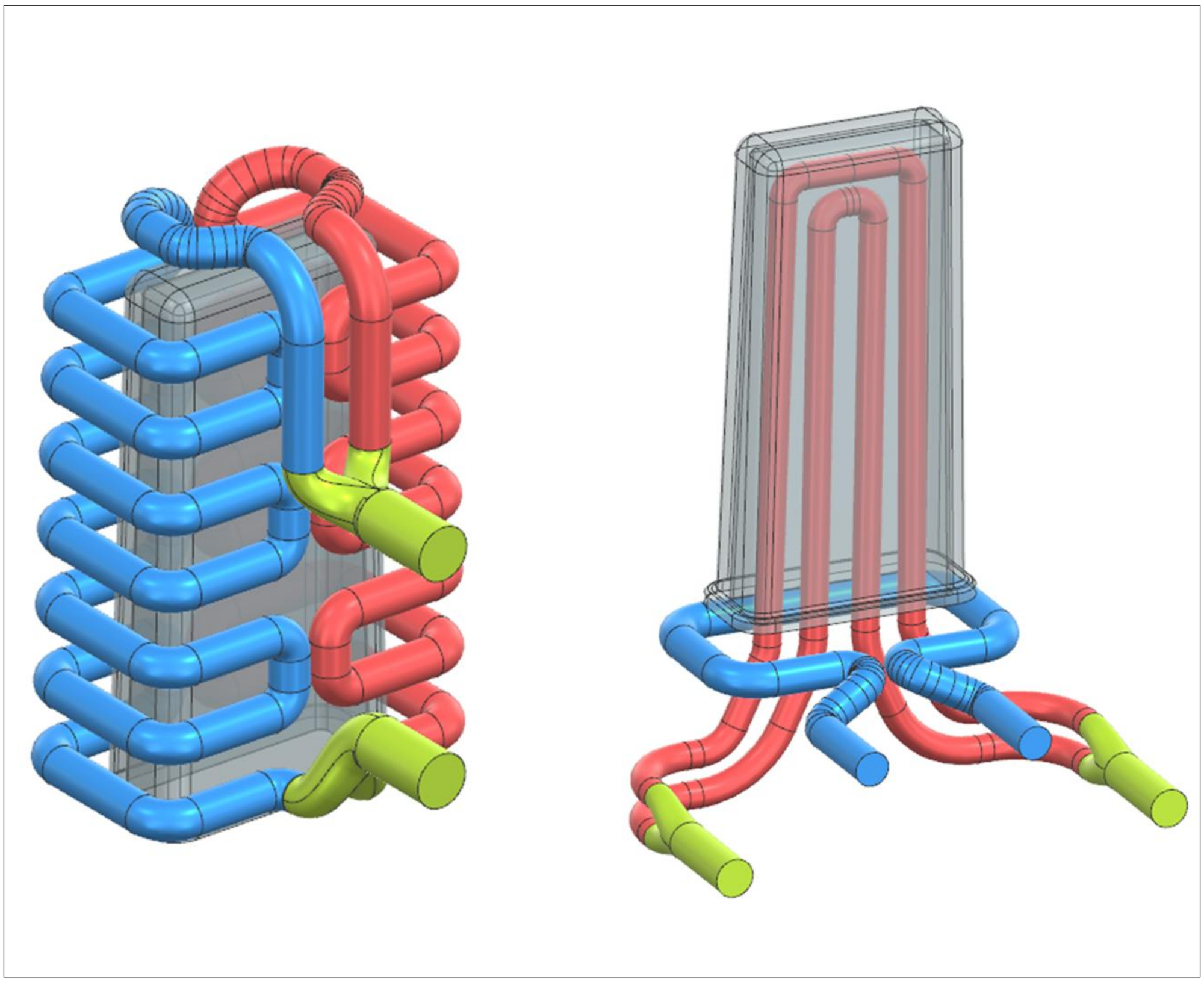
MECHANICAL ENGINEERING DEPARTMENT

Channel geometries

The traditional methods used to create cooling channels greatly limit their geometries. In the industry, circuits are mainly created by drilling the cavities and adding plugs. The channels are therefore made up of a succession of straight drillings.

The use of additive manufacturing allows more freedom. The sections can be of different shapes or of variable section. The main advantage is being able to follow the geometry of the molding cavity as closely as possible.



Overview of the cooling channels: On the left, external channels and on the right, internal channels.

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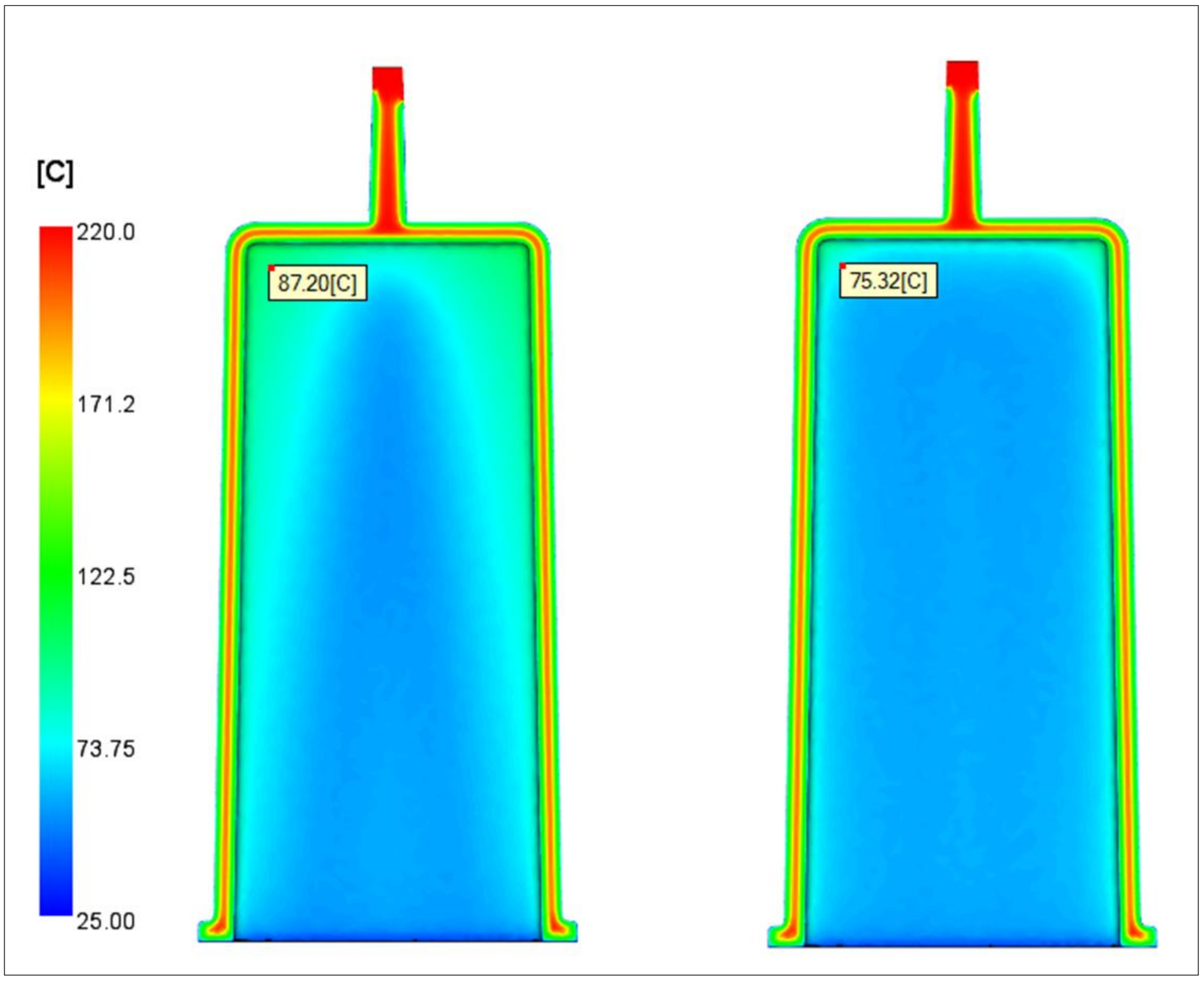
MECHANICAL ENGINEERING DEPARTMENT

Rheological simulations

Different rheological simulations were carried out to evaluate the performance of a conventional solution, with straight channels, and a solution with conformal channels. The thermal properties of the tooling were integrated into the different calculations.

The conformal channels proved to be more efficient. They allow more regular and more homogeneous regulation. This effect directly impacts the warpage of the injected part. In this case, the simulations indicated an improvement of nearly 40% for an equal cycle time.



Numerical simulation of the heat distribution on the part for the two cooling concepts.

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MECHANICAL ENGINEERING DEPARTMENT

Experimentation

Injection tests were carried out and warpage measurements were taken on the samples produced.

The lowest warpage value observed on the conventional samples is approximately 40% higher than the lowest value of the samples produced with the conformal tools. The parts produced with the conformal mold are 30% faster to manufacture. This reduces the cycle time and lowers the cost price.

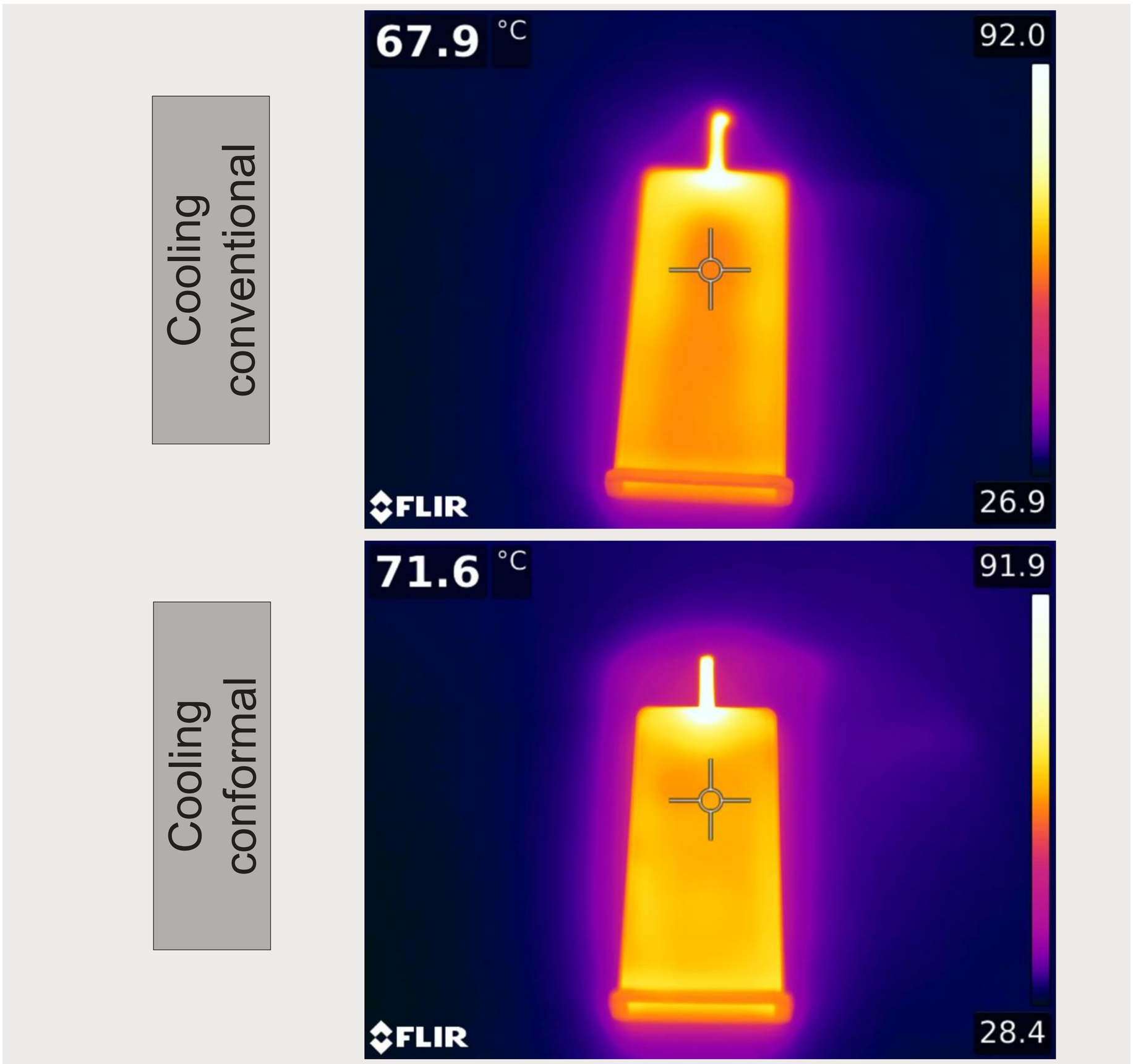

Image taken with a thermal camera illustrating the heat distribution on the part for the two cooling concepts.

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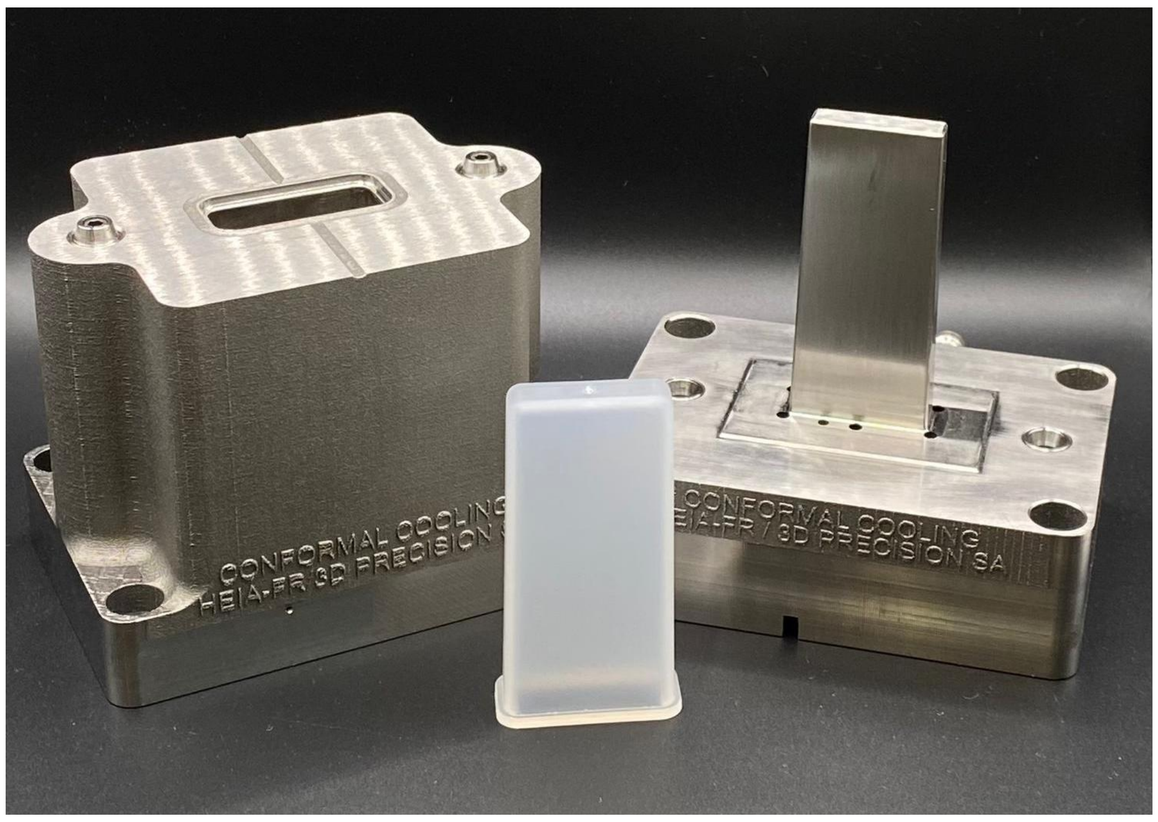

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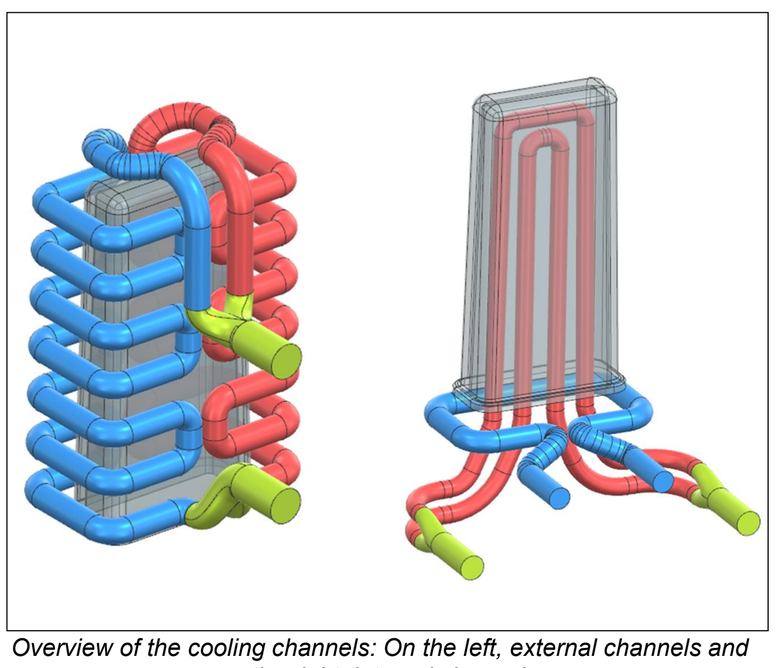

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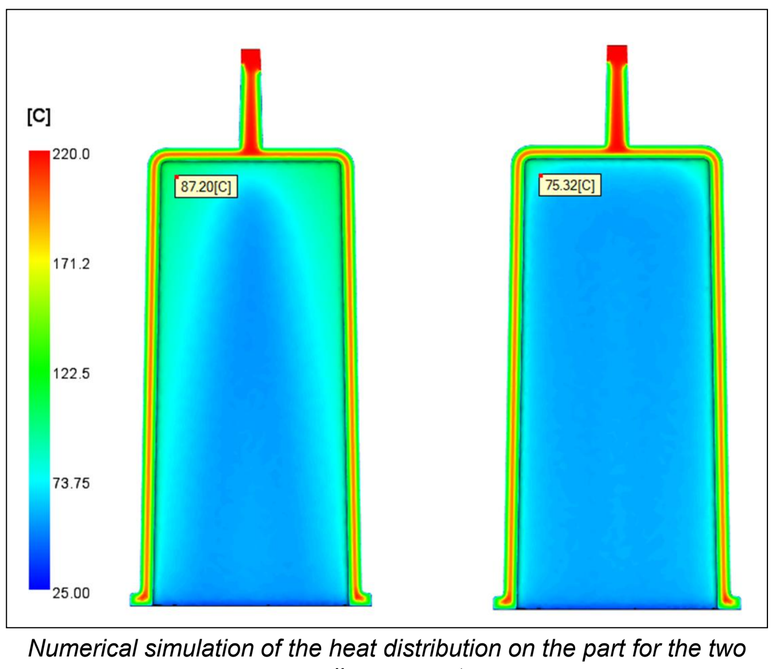

Numerical simulation of the heat distribution on the part for the two cooling concepts.

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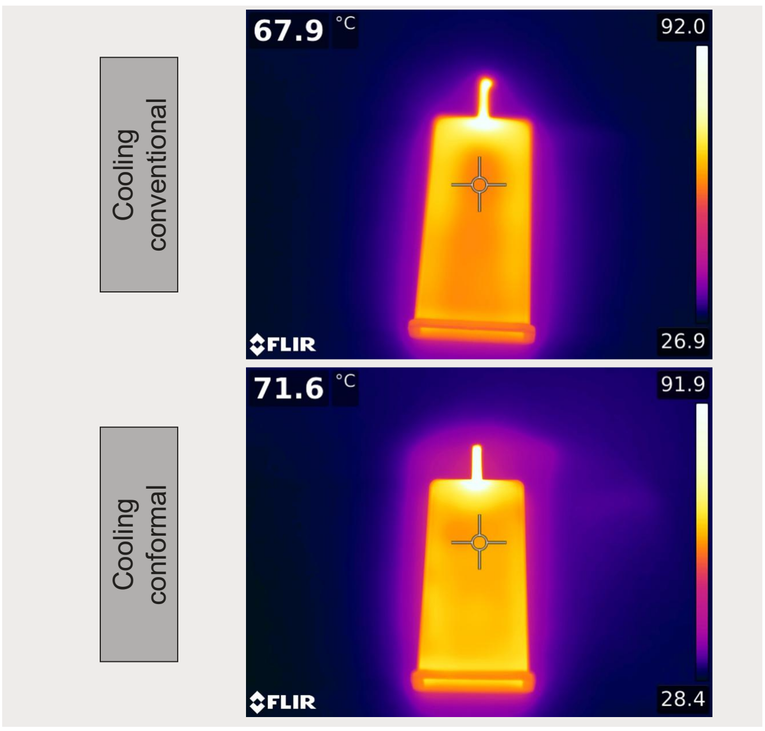

Image taken with a thermal camera illustrating the heat distribution on the part for the two cooling concepts.

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