



## Facts

### Challenge

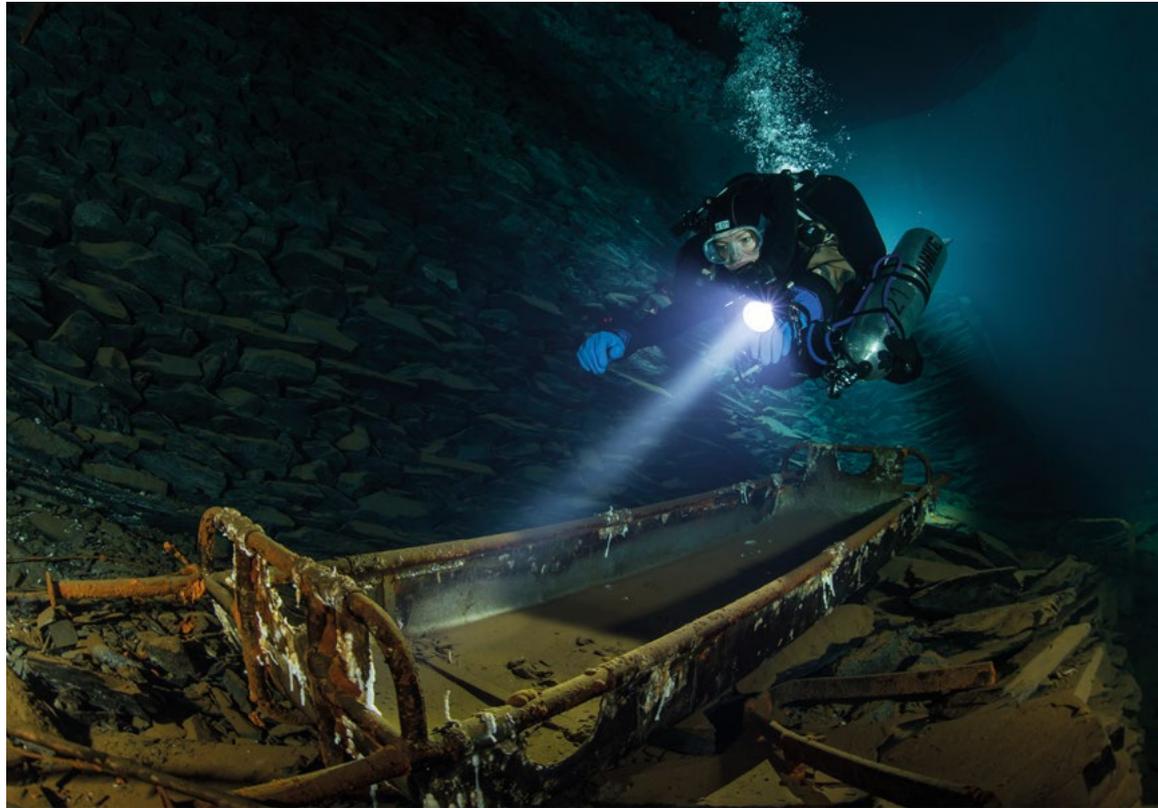
The development of a robust dive light with a bayonet connection from PA 2200 with functional integration.

### Solution

Additive manufacture of a particularly stable and at the same time lighter weight plastic connector with greater functional integration using the FORMIGA P110.

### Results

- Optimized: functional integration reduced the number of individual components
- Stable: waterproof plastic PA 2200 withstands extreme stresses at great dive depths
- Weight reduction: metal components were replaced with plastics
- Flexible: economical production even with small batch sizes



*Reliable and precise: the dive light Thor Rev 2.0 is used by special units of the police and military in Europe.  
(source: Björn Dorstewitz)*

Bright Minds, Bright Lights—with  
Industrial 3D Printing



# Innovative manufacturing technology for the perfect dive light

## Short profile

Canto Ing. GmbH is an engineering company from Lüdenscheid in Germany. It offers its customers services from its construction and development offices, as well as the manufacture of parts from its own model and prototype construction and mold making. In addition, the firm also carries out custom series production.

Thor offshore engineering GmbH was founded by Tom Bub, who, in addition to being a Managing Director at Canto Ing. GmbH and a lawyer, is also a technical diver. The firm was founded to develop the Thor Rev 2.0 as a marketable product, but also with the broader aim of developing maritime underwater technology in professional diving.

## Further information

[www.canto-web.de](http://www.canto-web.de)

[www.thor-engineering.com](http://www.thor-engineering.com)

We often say that someone is in their element when they act with confidence in a familiar environment. In water, most people are certainly not in their element, which is why, beneath the surface, it is so important to have flawless equipment. In the ocean's depths three things are in short supply: air, heat, and light. It is the provision of the last of these that has been the focus of attention for the team at Canto Ing. GmbH. It has designed and developed the Thor Rev 2.0, a particularly high quality, high performance dive light. EOS and its additive manufacturing technology made a significant contribution to the project.

## Challenge

The Thor underwater light was designed for technical and professional divers, including those working in the services, for use at depths of up to 200 meters. To provide this target group with a serious and reliable product, there were a number of challenges that first needed to be overcome. The first of these was the need for a construction that was highly stable. Of equal importance was achieving a beam that was bright and variable with an extremely small spot and a uniform corona. The body of the dive light also needed to be non-reflective. Finally, it was critical that both weight and size be kept to a minimum.

Technical divers operating at depths of between 100 and 200 meters don't have the time to worry about their equipment – it simply needs to function.

"In such extreme environments robustness is very important," explains Hagen Tschorn, one of the Managing Directors at Canto Ing. GmbH, from Lüdenscheid in Germany. "The construction of the light must be designed in such a way as to facilitate the exploration of deep lying wrecks or cave systems." Essentially, the fundamental challenge was clear: to develop the lightest, smallest and best performing dive light on the market.

Initially the design team was faced with a dilemma. Metals fulfil all of the necessary requirements in terms of resilience, but at an excessive cost in terms of weight. Plastics in turn, can be far lighter but can't offer the same levels of resistance as metals. An additional challenge was the cooling and replacement system for the bulbs, which house the LED light-source

and the electronic components. Although today's LED systems build up less heat than their predecessors, they still require automatic cooling systems when operating at full power – as they might be when operated at great depths when maximum light was required. In the event of a bulb failing or malfunctioning, the design needed to build-in the possibility of replacing/changing it underwater.

## Solution

Working together with the manufacturing firm Thor offshore engineering GmbH, Canto developed a dive light that was precisely oriented to these requirements. The cornerstone of the design is a black anodized aluminum housing. This central component needed to house the lighting unit and the bulb, both equally well protected and with similar degrees of flexibility. In order to achieve this, the two companies developed a unique connector system. The locking mechanism for the Thor Rev 2.0 is produced using additive manufacturing. This technology

*Dive light (left) and additively manufactured bayonet connection (right) made of impermeable and extremely durable EOS plastic material PA 2200. [source: Canto]*



facilitates the production of the internal system – which is snapped into place using springs – as a single, robust, functionally integrated component.

Canto's solution to meeting the project's strict material requirements was to use the EOS plastic PA 2200, a material that is both impermeable and extremely durable. It was the first time that this material has been used in such a context. The precise method of construction, the high production quality of the laser-sinter system FORMIGA P110 and the fundamentally robust design, all combined to make this lightweight material the ideal solution for the project. The material also matched the housing perfectly from an optical perspective.

In addition to the locking mechanism, the two companies also additively manufactured a cover for the glass body of the LEDs. "The EOS technology represents the perfect production process for our needs. Only in this way could we produce these complex components so affordably," says Hagen Tschorn, underlining another important reason for choosing this process.

Canto calculated the strengths of the bayonet fitting in advance. Parallel tests served to fine-tune

the feel and to determine the hardness of the lock and release mechanism. These refinements were important. For divers working in darkness, under stress and with gloves on, it is vital to ascertain confirmation of the locking mechanism through the sense of touch. Canto has used additive manufacturing technology, not only for the production of this series, but also in its product development. Prototypes were manufactured on the EOS system in order to further reduce the space between movable parts, and to optimize the size of components. Prototypes were also used for carrying out function and stress testing. This served, for example, to ascertain the levels of wear and tear on the locking mechanism in sand and silt.

### Results

The Thor Rev 2.0 sets a new benchmark for technical divers. Weighing just 580 grams, the light-source is extremely comfortable to handle. The functional integration resulted in a reduction of the number of individual components requiring assembly from three to just one. Furthermore, Canto was saved the expense of producing a costly injection-molding tool, which would have meant additional costs totaling up to 34,800 Euros. Despite the great scope offered

by the dive light and its lightweight structure, the quality and durability of the product meet all of the desired specifications.

The quality of the dive light has also been confirmed by the members of Cavebase, a non-commercial group of cave-divers who have already successfully used the Thor Rev 2.0 and provided key input for its development. Wilke Reints, one of the divers, commented, "I'm very happy. It's really robust and has proved extremely reliable. The locking mechanism is simple to use and gives excellent haptic feedback." The LED light-system is particularly bright and the uniform corona guarantees sight beyond the limits of the spot itself. Automatic cooling ensures the long duration of the system. Thanks to the innovative locking mechanism it is easy to change the bulb and the LEDs while underwater – a clear safety advantage.

Hagen Tschorn is also very satisfied. "EOS has shown us that they support the providers of creative solutions in their search for new fields of application. The company has enabled us to offer our end customers a complete solution: engineering and manufacture." The results of this partnership continue to shine brightly. The Thor Rev 2.0

achieves a luminosity of up to 70,000 Lux – the typical luminosity on a bright summer day is around 100,000 Lux, while on an overcast summer day it is about 20,000 Lux. With this kind of power, divers can safely negotiate the darkness of the deep – and feel truly in their element.

*„The bayonet-fitting produced using additive manufacturing is a technical highlight of the Thor Rev 2.0. We have optimized the component dimensions, the weight and the stability, as well as the functional integration – all in a single component. The reliability and precision that this has brought has led to the use of the Thor Rev 2.0 by special units of the police and military in Europe. Thanks to EOS technology, savings were made on injection-molding tool costs in the region of 34,800 Euros and assembly costs of approximately 6.80 Euros per light.“*

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